GREAT LAKES FISHERY & ECOSYSTEM RESTORATION (GLFER)

FT. SHERIDAN RAVINE & COSTAL RESTORATION

APPENDIX D – GEOTECHNICAL ANALYSIS

U.S. Army Corps of Engineers, Chicago District
Geotechnical & Survey Section

January 21, 2014

GEOTECHNICAL APPENDIX

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GEOTECHNICAL APPENDIX

INTRODUCTION

1. The Great Lakes Fishery & Ecosystem Restoration (GLFER) was authorized in Section 506 of the Water Resources Development Act of 2000. The purpose is to restore fishery, ecosystem, and beneficial uses of the Great Lakes in cooperation with non-Federal interests. This specific project is located along the Lake Michigan coastline, east of Sheridan Rd within the city limits of Lake Forest, Ft. Sheridan, and Highland Park, Illinois.

2. The proposed project will restore five ravines along the lakeside bluffs to a more natural state by modifying the path of urban runoff, as well as, removing several dilapidated concrete and sheet pile structures that inhibit natural flow and restoring the natural channel. Several breakwaters will be added to promote fish habitat and a portion of the dunes will be repaired with sand and gravel. Additionally, this project will remove invasive plant species and replant the area with native species.

3. The bluff slopes vary but are around 45 degrees. There is considerable local variability in slope, and many segments of the bluff slope have been graded or terraced for erosion control along private lakeshore property as well as public lakeshore. The ravines are cut into the morainal upland and originate as much as one mile inland from the shore. The ravines typically have intermittent streams that discharge to Lake Michigan.

Project Background

4. The Lake Michigan coastal systems were once some of the most diverse ecosystems in Lake County, Illinois. When European settlers reached this area, the ecosystem started to degrade first from logging and then after the establishment of Ft. Sheridan in 1887. Extensive watershed development has increased the flow along the ravines, causing erosion and the continued degradation of quality habitat. Numerous stormwater pipes also outlet into these ravines, causing the steepness of the banks to decline as the ravine continues to widen to handle the increased flow. Some ravines have bulky manmade structures to reduce the geomorphology, but these are also degrading and have lost their effectiveness.

5. This study was conducted to ascertain the feasibility of restoring the ravines, bluffs, and littoral areas by altering the hydrology, eliminating invasive plant species, planting native vegetation, and stabilizing ravine slopes. The existing manmade structures would be modified/ removed to increase the quality of habitat. Stormwater pipes would be rerouted away from the ravines to reduce the water flow and the risk of further ravine erosion. Once these measures are implemented, then invasive plant species can be replaced with native vegetation.

6. The selected ravines to perform work include Hutchinson, McCormick/Janes, Schenck, Bartlett, and Scott. VanHorne and MacArthur ravines were not chosen.

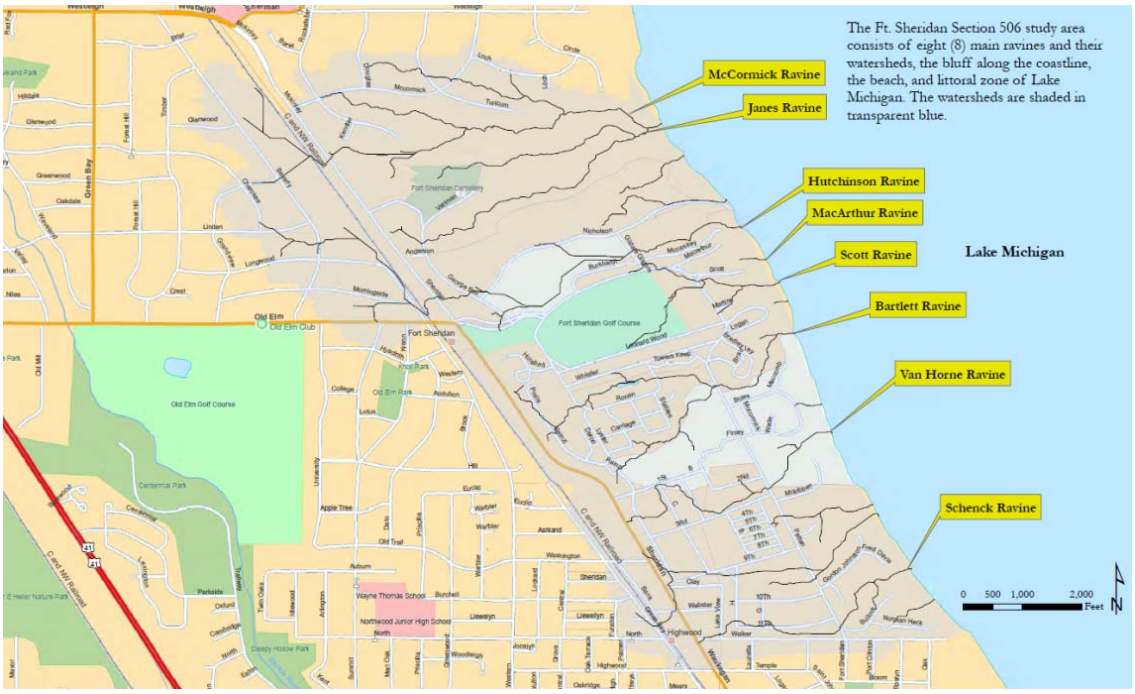


Figure 1. Location of Project Site

GEOLOGY

7. Silurian Age Bedrock – The underlying regional bedrock is Silurian-age dolomite, most likely of the Niagaran Series (Willman 1971). This rock resulted from marine deposition when all of northeastern Illinois and much of the neighboring Great Lakes region was the floor of a tropical sea from about 440 to 410 million years ago. As shown on the soil thickness map in Attachment 5, the bedrock is about 50 to 100 feet below the surface along the coast. Farther inland, the overburden becomes 100 to 200, then 200 to 300 feet thick. This project does not anticipate encountering bedrock.

8. Wadsworth Till Member – The dominant material in the Illinois coastal zone is a compact, gray, silty and clayey till of the Wadsworth Till Member. The till may contain discontinuous layers of sand and gravel mixed with sand. This till, which is ubiquitous across the coastal zone, was deposited by glacial ice during the most recent (Wisconsinan) glacial episode. The till is exposed along the coastal bluffs, as well as the material first encountered beneath most of the soils in the area. It also occurs beneath the beach sand and it occurs on the lake bottom either beneath the shore sand or exposed where sand cover is absent. The cohesion of the till has contributed to the near-vertical bluffs along parts of the bluff coast.

9. Highland Park Moraine – Along the coast between North Chicago and Winnetka, the lakeshore and the Zion City and Highland Park Moraines dead-end into Lake Michigan. These end moraines formed about 14,000 years ago just prior to glacial ice permanently receding into the Lake Michigan basin. These are thus the youngest end moraines in Illinois. The Highland Park Moraine encompasses the entire study area. Long-term wave erosion along this morainal unit has resulted in bluffs that form the highest and steepest landscape along the Illinois coast. Maximum bluff heights of about 90-feet occur along the southern Highland Park lakeshore.

SOILS

10. As shown in Attachment 5, the soil types within the project area consist of mostly Ozaukee silt loam, with about 90% of the land attributed to this type. The remaining 10% of the surface soils consist of Blount silt loam, Ashkum silty clay loam, beach sand, Orthents, and landfills.

11. Ozaukee silt loam – These soils are typically found on ground moraines, in this case the Highland Park moraine. Slopes on the plateaus range from 2 to 6% and in the ravines from 20 to 35%. These soils formed in thin loess or other silty material and in the underlying loamy dense till. These soils are moderately well drained and the potential for surface runoff ranges from medium to very high with a slow permeability. These soils have a perched seasonal high water table at a depth of 1.5 to 3.5-feet for 1 month or more per year in 6 or more out of 10 years. Native vegetation is mixed hardwood forest of northern red oak, American basswood, white ash, and sugar maple. These soils almost exclusively make up the area between the railroad tracks and the beach.

12. Beach Sands – Beach sediments along the Illinois coast consist of mixed sand, sandy gravel, and gravel and vary in width from around 40 to 150 feet. The primary source for beach sediments is erosion of the coastal bluffs. These areas are generally not stable enough to support vegetation as they are continually reworked during storms and high water.

13. Orthents – Of the few non-Ozaukee type soils near the lake, one area about 16.4 acres was depicted as Orthents, clayey, undulating. This area appears to be a ravine from the naval base that had been recently eroded, leaving the less permeable clayey tills soils as the surface materials. They are often referred to as "skeletal soils" or, in the FAO soil classification, as Lithosols.

14. Ashkum Silty Clay Loam – There are a few areas near the train tracks that classify as Ashkum silty clay loam, although it is likely that these soils have been replaced/modified due to residential construction. These soils are typically found on nearly level and gently sloping till plains of Wisconsinan Age in colluvial positions on the low lying topography and along upland swales. The soils formed in colluvial sediments consisting of eroded sediments from till and loess or shallow lacustrine materials less than 40-inches thick and in the underlying silty clay loam till. These soils are poorly drained and the potential for surface runoff is low. Permeability is moderately slow. Saturated hydraulic conductivity is moderately high. Where drained, an intermittent apparent seasonal high water table is 0.5 foot above the surface to 1.0 foot below the surface at some time between January and May in normal years. Native vegetation is marsh grasses and sedges.

15. Blount Silt Loam – Like Ashkum soils, these soils were also identified away from the coast near the train tracks and likely have been removed/modified due to construction. These soils formed on the till plains of Wisconsinan Age glacial material. These soils are somewhat poorly drained and the potential for surface runoff is low to medium. Permeability is slow. An intermittent perched seasonal high water table is at a depth of 0.5 to 2.0 feet in most years. Native vegetation is hardwood forest.

16. Landfills – One area about 1500 feet west of the shoreline and 4.2 acres was identified as Landfill. These are classified as highly modified areas where industrial or commercial wastes are buried, likely from the former naval base. Soil characteristics are unpredictable and are limited for restoring native plant communities. Residential structures now occupy this area.

LOCAL GEOLOGY

17. Two separate soil investigations were completed within the Ft. Sheridan project area. One was completed by AECOM and the other by CTL, both in 2010. Both subsurface investigation soil boring locations are shown in Attachment 1, but the actual reports are in Attachment 2 (AECOM) and 3 (CTL).

18. The investigation completed by AECOM was requested by USACE for this project to perform soil borings near seven major ravine mouths, generally on the Beach Sands. Soil Borings SB-01, 02, 03, 05, 06A and 07 were completed using the General 550, a light dolly-mounted small gasoline powered rig. SB-04 was completed using the Mobile B-61, a truck-mounted drill rig and SB-06 was completed via hand auguring. All were scheduled to extend to a depth of 20 feet each, but several encountered cobbles and boulders that prevented full depth to be attained. In general, the soil borings encountered a layer of fine to coarse grained sand and gravel (silty at some locations) typically ranging from about 2 to 7 feet in thickness. The shallow sands were loose to medium dense, while the deeper sands and gravels were medium dense to dense. Limestone riprap was present within the sand and visible on the surface in a few of the borings. These materials were underlain by stiff to very stiff gray silty clay (till). Additional soil boring information can be found in the AECOM report in Attachment 2.

19. The investigation completed by CTL was requested by Clauss Brothers, Inc. for their "Openlands Lakeshore Preserve" Project, which provides recommendations for the construction of three parking lots, a pathway/bike trail, overlook areas and a pedestrian bridge over Schenk Ravine. A total of 16 soil borings were taken using a truck mounted drill rig, with all but B-16 drilled to about 7-½ feet below grade. All of these were completed within the Ozaukee soil type. B-16 was drilled to about 50 feet below grade at the location of the proposed bridge. B-1, B-14, and B-15 were each completed at a different proposed parking lot. B-2 through B-13 were completed along the proposed pathway/bike trail and overlook areas. These measures are separate from this study. In general, the soil borings encountered medium stiff to hard silty clay with few exceptions. In Borings B-4 thru B-10 and B-13 thru B-15, varying amounts of fill and possible fill were encountered varying from about ½-foot to around 5-½ feet thick, consisting mostly of similar native clay materials and varying amounts of sand. Additional soil boring information, along with recommended design parameters for the proposed structures, can be found in the CTL report in Attachment 3.

20. These subsurface investigations did not include any borings within the lake to determine the local properties of the submerged soils for the breakwaters. Offshore borings would yield marginally useful information, compared to the cost to complete them. There are some existing borings that were completed for projects offshore along the Chicago Shoreline, about 20 to 30 miles south of Ft. Sheridan; CB-2-3-94, CB-3-2-94, CB-3-3-94, CB-3-4-94, CB-3-5-94, and CB-4-1-94. These borings were completed between 200 and 400 ft from the existing shore, although the historic shoreline location has changed throughout Chicago's history. In general, these borings encountered a layer of sand less than 5 ft thick underlain by about 20 ft of soft to medium stiff clay. Beneath the soft clay, stiff to hard clay, dense sand, and hard silts were present. These borings can be found in Attachment 4.

RECOMMENDATIONS

21. The below table includes various measures that were considered for the proposed plan. Each measure is then discussed with respect to geotechnical issues which may arise. This list may include measures that have since been dropped for various reasons.

Habitat Zone/Alt.	**Measures**	**Description**
Ravines		
Bartlett (BR-A)	Not Selected	
Hutchinson (HR-A)	HRC	Remove unnatural flow with detentiona basin & pipe
	HRE	Remove invasive plant species
	HRF	Reestablish native plant species
McCormick/Janes (MJR-B)	MJRB	Repairs and naturalizes the mouth of the ravines
	MJRC	Repairs and naturalizes the mouth of the ravines

	MJRD	Remove invasive plant species
	MJRE	Reestablish native plant species
Schenck (ShR-A)	SRC	Remove unnatural flow with ravine floor pipe
	SRD	Repair channel at mouth with riffles
	SRE	Remedy failed storm sewer pipe at ravine mouth
	SRK	Repair channel with riffles
	SRL	Remove invasive plant species
	SRM	Reestablish native plant species
Scott (ScR-A)	SRE	Remove unnatural flow with ravine floor pipe
	SRH	Restore connectivity to Lake Michigan
	SRP	Remove invasive plant species
	SRQ	Reestablish native plant species
Van Horne	Not Selected	
MacArthur	Not Selected	
Lacustrine		
MJL-A	DC	McCormick breakwater for fish & dune habitat
	DA	Remove invasive plant species
	DB	Reestablish native plant species
MJL-B	DD	Hutchinson breakwater for fish & dune habitat
	DA	Remove invasive plant species
	DB	Reestablish native plant species
BL-B	DP	Bartlett breakwater for fish, dune & bluff habitat
	DJ	Dune restoration via placing stone and sand
	DI	Dune restoration via placing stone and sand
	DA	Remove invasive plant species
	DB	Reestablish native plant species
SL-A	DF	Schenck breakwater for fish & dune habitat
	DA	Remove invasive plant species
	DB	Reestablish native plant species
Bluff		
BLF	BD	Repair outfall on bluff near Barlett Ravine mouth
	BE	General gully repairs
	SRI	Repair gully on bluff south of Schenck Ravine
	SRJ	Repair eroding bluff face south of Schenck Ravine
	BRF	Redirect existing storm sewer that is causing erosion
	BA	Remove invasive plant species
	BB	Reestablish native plant species

Figure 2. Table of Proposed Measures

22. HRC – This measure would remove the stormwater pipe that empties into Hutchinson Ravine and replace it with a 6-ft deep detention basin to reduce the flow through the ravine. There are no soil borings in this location, but based on the other borings completed in the similar Ozaukee soils, it is anticipated that this area will encounter similar stiff clays. This

would be ideal for a detention basin, as clays are relatively easy to work with and have a low permeability.

23. MJRB – This measure would remove the failed structure located at the confluence of McCormick and Janes Ravine and replace it with a 30'x45' plunge pool sloped at 2H: 1V and about 3 feet deep. The pipe in McCormick Ravine would be removed and multiple riffles installed in both ravines to reduce the energy of the flowing water. In order to handle the riffle lengths, the ravine slopes must be cut back to an acceptable slope grade, per geotechnical recommendations. The closest boring to these ravines is AECOM's SB-01, which is about 600 ft south of the ravine mouth. Additional field investigations will be necessary to determine a final grading plan.

24. MJRC – This measure would stabilize the mouth of McCormick/Janes Ravine using tree trunks, root wads, and boulders to prevent it from collapsing and blocking the connectivity between the ravine and lake. Once a formal plan is selected, it should be analyzed by a geotechnical engineer. It is recommended that the existing bluff be modified as little as possible to reduce the chances of a slope failure.

25. SRC – This measure would reduce the flow through Schenck Ravine by installing a 1,400-foot bypass pipe in the ravine, then burying it with about 2 feet of fill consisting of stone and alluvial material. Manholes would be installed at any change in direction, supported about 4 feet below grade. This depth will protect them from frost heave. Additionally, another pipe from an existing detention pond will be linked to this new pipe bypass via directional drill. The third portion of this measure includes repairing a curb to direct flow to a lift station instead of into the ravine. Prior to placing the pipe and manholes, the ground should be properly compacted to prevent any future settlement. Any unsuitable materials encountered during installation such as organics, soft, etc. should be removed and replaced. CTL B-4 and B-16 were completed along this ravine and both encountered only very stiff to hard clay. AECOM SB-07 was completed at the mouth of this ravine and encountered about 3 feet of sand, underlain by stiff to hard clay. The clay encountered in these borings would be suitable for manhole and pipe support. The sand should be protected from erosion at the pipe outlet with cobbles underlain by bedding stone. The directionally drilled pipe is likely to encounter stiff to hard clays, as well. Directional drilling works best in uniform soils without large stones, which are the conditions found in the native soils on this site.

26. SRD – This measure includes installing 23 stone grade control structures about 3 ft wide each, near the Schenck Ravine mouth to prevent further head-cutting and minimize flow velocities. The elevation drop between each structure would be about 1 foot and would be placed at 8-ft spacing. These structures will likely be constructed on clay materials, which would support the small concrete structures. Bedding stone should be placed prior to placing the control structures to create a solid base less susceptible to undermining. Riprap/cobble should be placed around each structure to prevent erosion. Nearby borings are mentioned in measure SRC.

27. SRE – This measure would replace an existing stormwater drain that drains to the Schenck Ravine mouth with another pipe to reduce erosion. The new pipe would be

directionally drilled to exit into the structure depicted in SRC. As stated in SRC, directional drilling is feasible on this site due to the anticipated uniform stiff to hard clays.

28. SRK – This measure would install riffles along Schenck Ravine to reduce the water velocity. Riffles can be installed with little to no risk of geotechnical issues, as long as the cobbles are properly sized and will not migrate downstream during high flow events.

29. SRE – This measure would install a plunge pool at the head of Scotts Ravine to catch stormwater from existing sewer lines. This plunge pool would be connected to a new 850-ft pipe, buried under about 2 feet of stone and 1 foot of alluvial material to redirect stormwater away from the ravine. Nine manholes would be installed along the pipe in order for it to follow the natural shape of the ravine. At the outfall, a stone apron would be installed to prevent scouring. Additionally, several riffles would be added to prevent erosion downstream of the pipe outlet. While no soil borings were completed in Scotts Ravine, it is assumed that stiff to hard clays will be present which would be able to support the proposed structures. The clayey less permeable soils would also be appropriate for a plunge pool.

30. SRH – This measure would remove the existing check dam at the mouth of Scotts Ravine and replace it with riffles. This will increase the connectivity between the ravine and lake. The riffle cobbles should be appropriately sized so they will not migrate downstream.

31. DC, DD, DF, DP – These measures include constructing near-shore breakwaters to remedy shoreline and bluff recession adjacent to McCormick, Hutchinson, Schenck, and Bartlett Ravines, respectively. They will also provide protected fish habitat along the lakefront. These proposed breakwaters will be constructed out of large armor stone blocks placed about 135 to 150 feet offshore. The crest widths would be about 11 feet. No soil borings were completed in the lake, but it is assumed that similar sand underlain by clay is present. Attachment 6 includes a complete stability and settlement analysis for an assumed conservative cross section. Based on this cross section, the anticipated settlement is less than ½-ft and slopes of 2H: 1V are acceptable for the breakwaters. Refer to Attachment 6 for more information.

32. DI, DJ – These measures are to stabilize the beach dune by adding stone along the toe of the bluff, then covering the stone with beach fill for plantings. This should be acceptable.

33. BD – This measure is to plug an obsolete stormwater outlet from emptying into Bartlett Ravine. The outlet is obsolete because the neighborhood it previously serviced has been razed. No geotechnical issues are anticipated from this measure.

34. BE – This measure would apply minor cuts and fills of small gullies and rills on bluff faces in order to plant native species. Once a final plan is developed, it should be reviewed by a geotechnical engineer so the cuts/fills do not negatively affect the slope stability.

35. SRI – This measure is to replace an outfall eroding bluff face to the south of the Schenck Ravine mouth. The existing outfall structure would be replaced with an outfall structure located farther down the slope. The pipe is anticipated to be directionally drilled, which is acceptable in the stiff to hard clays encountered in CTL borings B-16 and B-3, which are located near this proposed work.

36. SRJ – This measure is also to repair the eroding bluff face to the south of Schenck Ravine mouth. The existing detention feature's volume would be increased by removing the inlet structure. Several cobble check dams would also be installed to allow the water to flow through them at a slower pace to prevent erosion. These cobble check dams should be placed on about 1 foot of bedding stone to provide an even base and prevent undercutting.

37. BRF – This measure redirects existing storm sewer discharge away from Bartlett Ravine. It involves placing a curb to prevent street runoff from freely entering the ravine and adding additional stormwater trenches to direct the flow. The existing access road will be reworked to force drainage along a newly riprapped side of the road, directing stormwater into a plunge pool. CTL Boring B-10, as well as, AECOM Boring SB-04 are near this measure. SB-04 was completed near the end of the access road and encountered about 7-½ ft of fill presumably placed in order to construct the road. The fill was placed on about 2-½ ft of sand, underlain by typical clay for this site. Boring B-10 also encountered about 3 feet of fill underlain by the typical hard silty clay. The final location of the pool should be far enough away from the shoreline that sand would not be encountered in the subsurface. The trenches and riprapped slope would be appropriate to construct on the clay materials encountered, although the riprapped slope should be examined by a geotechnical engineer once a design is provided.

38. The remaining measures include removing invasive plant species and reestablishing native plant species. These measures are designated HRE, HRF, MJRD, MJRE, SRL, SRM, SRP, SRQ, DA, DB, BA and BB. While performing these measures, it is important to maintain erosion protection such as straw, geotextile, etc. while the native species establish themselves. Without erosion protection or healthy plant roots, the soil can wash out during rain storms.

SUMMARY

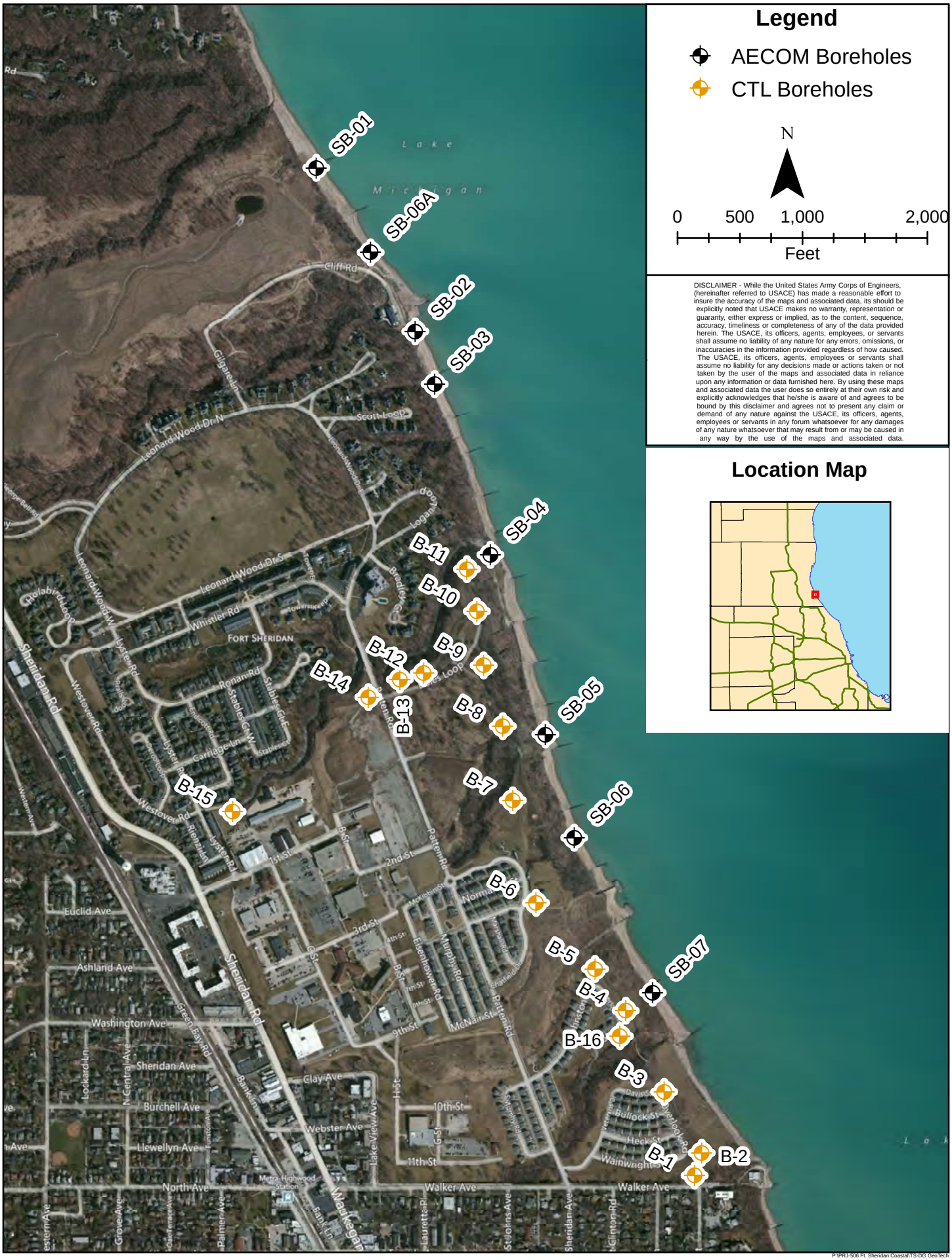
39. The measures proposed above are appropriate for the site subsurface conditions, but all should be reviewed by a geotechnical engineer once a final plan is developed. The site subsurface conditions are essentially homogenous medium stiff to hard clay; ideal for construction detention ponds, directional drilling, and for supporting structures. There could be localized pockets of unsuitable materials, however, and these areas should be mitigated accordingly during construction. Once the locations of the measures are finalized, a geotechnical engineer should complete a field visit to determine if any additional issues could arise. Measures should generally avoid work done on the slopes or work that cuts into the slopes, as the slopes are steep and any disturbance could cause instability. Any work that steepens the existing slope would likely require countermeasures.

APPENDIX D – GEOTECHNICAL ANALYSIS

Attachment 1: Ft. Sheridan Soil Boring Map

FT. SHERIDAN SOIL BORING LOCATIONS

U.S. Army Corps of Engineers
Chicago District



Legend

AECOM Boreholes

CTL Boreholes

N

0 500 1,000 2,000

Feet

DISCLAIMER - While the United States Army Corps of Engineers, (hereinafter referred to USACE) has made a reasonable effort to insure the accuracy of the maps and associated data, its should be explicitly noted that USACE makes no warranty, representation or guaranty, either express or implied, as to the content, sequence, accuracy, timeliness or completeness of any of the data provided herein. The USACE, its officers, agents, employees, or servants shall assume no liability of any nature for any errors, omissions, or inaccuracies in the information provided regardless of how caused. The USACE, its officers, agents, employees or servants shall assume no liability for any decisions made or actions taken or not taken by the user of the maps and associated data in reliance upon any information or data furnished here. By using these maps and associated data the user does so entirely at their own risk and explicitly acknowledges that he/she is aware of and agrees to be bound by this disclaimer and agrees not to present any claim or demand of any nature against the USACE, its officers, agents, employees or servants in any forum whatsoever for any damages of any nature whatsoever that may result from or may be caused in any way by the use of the maps and associated data.

Location Map

P:\PRJ-506 Ft. Sheridan Coastal\TS-DG GeoTech

APPENDIX D – GEOTECHNICAL ANALYSIS

Attachment 2: AECOM Subsurface Investigation Report

Submitted to:
U.S. Army Corps of Engineers
Chicago, IL

Submitted by:
AECOM
Vernon Hills, IL
60163812
October 2010

Subsurface Investigation Report

Fort Sheridan Coastal Habitat Restoration
U.S. Army Corps of Engineers
Delivery Order No. CX 0013
Contract No. W911XK-09-D-0015

AECOM
750 Corporate Woods Parkway
Vernon Hills, Illinois 60061
T 847 279 2500 F 847 279 2510

October 29, 2010

Mr. Bill Rochford
U.S. Army Corps of Engineers
Geotechnical & Structural Engineering Branch
Chicago District
111 N Canal St # 600
Chicago, IL 60606

RE: Fort Sheridan Costal Habitat Restoration
Subsurface Investigation
AECOM Job Number 60163812

Dear Mr. Rochford,

AECOM has completed the Subsurface Investigation for the Fort Sheridan Costal Habitat Restoration project and is pleased to submit a report of our findings.

This report includes a summary of the field activities, the investigation completed to evaluate the soil and groundwater conditions at the site and laboratory test results.

If you have any questions, or would like to further discuss the report or the project, please contact us.

Respectfully,
AECOM

Joshua M. Bickett, EIT
Assistant Project Engineer

Jamie S. Matus, C.P.G.
Vice President

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General Notes

Soil Classification System

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Boring Log Procedures

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Figure 1 Boring Location Plan

1.0 Authorization and Purpose of Investigation

1. In September of 2010 the United States Army Corps of Engineers (USACE) Chicago District contracted with AECOM to complete a geotechnical investigation of subsurface conditions (subsurface investigation) for the Fort Sheridan Costal Habitat Restoration in the cities of Lake Forest and Highland Park, Illinois. The work was authorized on September 13, 2010 under contract W911XK-09-D-0015 delivery order CX 0013 purchase requisition number W81G66006894.

2. The objective of the project is to stabilize shoreline natural communities and restore historical native plant communities to Lake Michigan lakeshore at Fort Sheridan Forest Preserve and adjacent openlands holdings. The main stability concerns occur at the mouths of ravines that cut through the natural bluffs along the beach. The purpose of the subsurface investigation performed by AECOM was to identify the stratigraphy and soil properties of the areas where the aforementioned stability concerns are located. The information obtained through the subsurface investigation will be used by others to analyze the stability of the ravine mouths.

3. The subsurface investigation boreholes were drilled as close as possible to plan locations. Some locations were adjusted in the field due to observed site conditions. As-drilled locations are shown on the attached Figure 1: Boring Location Plan.

2.0 Project Location

4. The Fort Sheridan Costal Habitat Restoration Project is along about 1½ miles of Lake Michigan coastline, covering approximately 100 acres of beaches and bluffs. The area is east of McKinley Road, south of E Westleigh Road, and north of Walker Road in the cities of Lake Forest and Highland Park, Illinois. Specifically the subsurface investigation was completed at seven major ravine mouths on the site. Currently, the ravine mouths have man-made sheet pile structures that are to be removed as part of the project.

3.0 Scope of Work

5. The AECOM services were completed in general accordance with the Fort Sheridan Costal Habitat Restoration; Scope of Work (USACE Delivery Order No. CX 0013 Contract No. W911XK-09-D-0015). The Scope of Work included, but was not limited to, the following tasks:
   - Preparing a Quality Control Plan (QCP) and Accident Prevention Plan (APP).
   - Coordinating utility clearance and site access with USACE representatives.
   - Coordinate with USACE to avoid endangered plants in the vicinity of the boring locations.
   - Establishing soil boring locations (horizontally and vertically) as specified by USACE.
   - Mobilizing drilling equipment and personnel to complete seven soil borings to depths of approximately 20-feet below the existing sediment surface.
   - Split spoon sampling of overburden material at a maximum of 2½ foot intervals at each boring in general accordance with ASTM standards and collection of a representative soil sample(s) for that interval.
   - Observing soil conditions while drilling and sampling and prepare field logs documenting drilling methods, Standard Penetration Test (SPT) results, soil condition observations, and other pertinent geotechnical-related observations.
   - Performing laboratory analysis on samples selected jointly by AECOM and the USACE.
   - Preparing this geotechnical engineering report summarizing the field investigation, soil conditions, boring location plan, and final boring logs.

4.0 Subsurface Investigation

4.1 Drilling Activities

6. A total of seven (7) soil borings were completed by an AECOM drill crew. Multiple drilling rigs and methods were used to perform the borings in locations required by USACE. The rigs included a General 550 and a Mobile B-61. The General 550 is a light dolly-trailer mounted, small gasoline engine powered rig equipped with 140-lb Safety Hammer (30 inch fall) and cathead (Appendix C: Photo 1) that was utilized for drilling borings SB-01, SB-02, SB-03, SB-05, SB-06A and SB-07. The Mobile B-61 is a truck mounted drill rig equipped with an automatic hydraulic hammer that was utilized for drilling SB-04. Hand augering was performed at boring SB-06 and it should be noted that split spoon samples were obtained using an 89-lb hammer with 12 inch fall. The actual locations drilled were adjusted from USACE proposed locations based on access and observed site conditions. A map of the boring locations is shown on the attached Figure 1: Boring Location Plan.

7. The borings were generally advanced using continuous flight auger with the exception of boring B-4 where 3¼ inch hollow stem auger was used to advance the borehole. Due to site conditions, AECOM used a portable General 550 to advance the majority of the soil borings. As a result, it was not feasible to mix cement-bentonite grout for tremie placement in each borehole. In lieu of cement bentonite grout, the majority of the soil borings were backfilled with bentonite chips. The near surface of each borehole was then backfilled with beach sand. At some boring locations, collapsing saturated sand prevented placement of bentonite chips to the bottom of each boring.

8. Boreholes were advanced to plan depth where possible. At some locations, namely SB-03, SB-06 and SB-06A, borings were terminated prior to reaching plan depth. Specifically, borings SB-03 and SB-06A were terminated due to auger refusal on boulder sized (approximately 3 feet and larger in diameter) limestone riprap and armor stones (Appendix C: Photo 2), and SB-06 was terminated at a practical depth for hand augering. Mildly successful alternative locations were attempted on the site at boring locations where obstructions were encountered.

9. Representative soil samples were obtained using split-spoon sampling techniques in general accordance with American Society of Testing and Materials (ASTM) Standard D-1586 where possible. Soil samples were collected from each split-spoon sample obtained and transported back to AECOM's soils laboratory for further observation and testing. A copy of the AECOM Standard Boring Log Procedures is also included in Appendix A. The results of field observations are shown on the final boring logs that are included in Appendix B. General information describing each borehole is provided in Table 1: As-drilled Borehole Data.

10. An AECOM field engineer was present during the drilling activities to prepare field logs documenting drilling methods, soil sampling, soil conditions, water depth measurements, and other pertinent geotechnical-related observations. Copies of the field logs are provided in Appendix B. It is important to note that the information included on the field logs is based on the initial interpretations of the soil conditions and soil types by the AECOM field engineer. Two (2) selected photos documenting the drilling activities are included in Appendix C.

Table 1: As-drilled Borehole Data

Project: Fort Sheridan Costal Habitat Restoration				Drilling Firm: AECOM		
Boring	US State Plane 83, Illinois East 1201 Zone		Top of Hole Elevation (ft)	Hole Depth (ft)	Date Drilled	Borehole Backfill Material
	Northing	Easting				
SB-01	2025310.309	1126058.867	581.2	20	9/22/10	Bentonite
SB-02	2024001.053	1126851.598	580.5	15	9/17/10	Bentonite
SB-03	2023578.395	1127005.918	580.4	1.5	9/17/10	Bentonite
SB-04	2022213.518	1127452.516	587.9	22	9/22/10	Bentonite
SB-05	2020775.177	1127892.923	583.0	20	9/21/10	Bentonite
SB-06	2019949.602	1128124.045	581.6	5	9/22/10	Bentonite
SB-06A	2024632.215	1126494.219	580.1	1.5	9/22/10	Bentonite
SB-07	2018709.448	1128752.006	582.2	19.5	9/21/10	Bentonite

4.2 Laboratory Testing

11. Laboratory samples were classified according to Unified Soil Classification System (USCS) and tested to determine natural water content, index properties (cohesive samples) and grain size distribution (granular samples). Calibrated penetrometer strength testing was performed on cohesive samples. Table 2: Laboratory Testing Program outlines the laboratory tests that were completed and their corresponding ASTM designation:

Table 2: Laboratory Testing Program

Test Name	ASTM Designation	Proposed Number of Tests	Actual Number of Tests
Visual Classification	D 2487	56	46
Moisture Content	D 2216	56	46
Gradation Analysis	D 422	5	5
Atterberg Limits	D 4318	2	2
Calibrated Penetrometer	N/A	14	26

12. Deviations from the anticipated number of tests outlined in the Scope of Work were made by AECOM due to the soil conditions encountered during drilling.

13. The unconfined compressive strength of selected cohesive samples is estimated using the calibrated penetrometer. In conjunction with the laboratory testing program, all of the samples were classified in the field with AECOM Soil Classification System. These descriptions and estimated group symbols are in general conformance with the USCS classification system. The USCS serves as the basis for the AECOM Soil Classification System. AECOM/USCS soil descriptions and group symbols are included on the soil boring logs.

14. A brief explanation of the classification of soil samples is included in the Appendix A. The laboratory test results are included in Appendix B and the data is briefly summarized on Table 3: Laboratory Testing Summary.

Table 3: Laboratory Testing Summary

Soil Stratum	Ave. N-value	Ave. Qp (tsf)	Ave. w_o%	Ave. P200 %	Ave. LL	Ave. PL
Beach Sand and Boulders	10	-	11	2	-	-
Sands and Gravels	29	-	11	6	-	-
Silty Clay	29	2.95	18	-	29	13

4.3 Elevation and Location Survey

15. The location of each boring was determined using existing NGS primary benchmarks. The level of accuracy for borehole locations were established at +/-0.1 feet vertically and at +/-1.0 foot horizontally. Borehole locations were determined using GPS survey equipment and were checked into two NGS benchmarks. The horizontal coordinate system referenced is Illinois State Plane based on the North American Datum 1983 (NAD83). Elevations are referenced to North American Vertical Datum 1988 (NAVD88). The as-drilled boring locations are shown on the attached Boring Location Plan. A summary of the survey results is provided above in Table 1: As-drilled Borehole Data.

5.0 Subsurface Conditions

5.1 Soil Stratigraphy

16. Prior to subsurface investigation it was known that the existing surficial site conditions along Fort Sheridan area consisted of sandy beaches with low vegetation dispersed along the beach and boulder sized riprap (approximately 3 feet and larger in diameter) along the base of the bluff. Ravines exist on the bluff with man-made sheet pile structures across them to prevent erosion.

17. The general subsurface soil profile encountered at the site consists of a layer fine to coarse-grained sand and gravel (silty at some locations) typically ranging from approximately 2 to 7 feet in thickness underlain by a stiff to very stiff gray silty clay stratum (till). In general, the sand and gravel stratum is loose to medium dense near the surface (beach sand) and is medium dense to dense at depth (sands and gravels). Boulder sized limestone riprap is visible at the ground surface and was encountered within the first two (2) feet below the ground surface. Based on the observations during drilling, boulders can be completely buried beneath sand and not visible from the ground surface. While boulders were encountered at or near the ground surface during drilling, their depth may vary across the project site. More detailed descriptions of the soil conditions encountered at each boring are provided on the individual boring logs in Appendix B. The overall boring depths ranged from 1½ to 22 feet below the ground surface.

5.2 Groundwater

18. Groundwater was encountered in each borehole during the drilling process with the exception of one very shallow hole, boring SB-06A. Due to the close proximity to Lake Michigan, the long term groundwater can be assumed to be at or near the lake level. This assumption is confirmed with observations during the drilling operations. The approximate groundwater elevation can be taken at elevation 580 feet (NAVD88) for design purposes.

6.0 General Qualifications

19. The information presented in this report is based on data obtained from soil borings and laboratory testing completed. Variations can occur between borings; the nature and extent of which may not become evident until after construction. If variations are encountered, it may be necessary reevaluate the information contained in this report with respect to the design and construction.

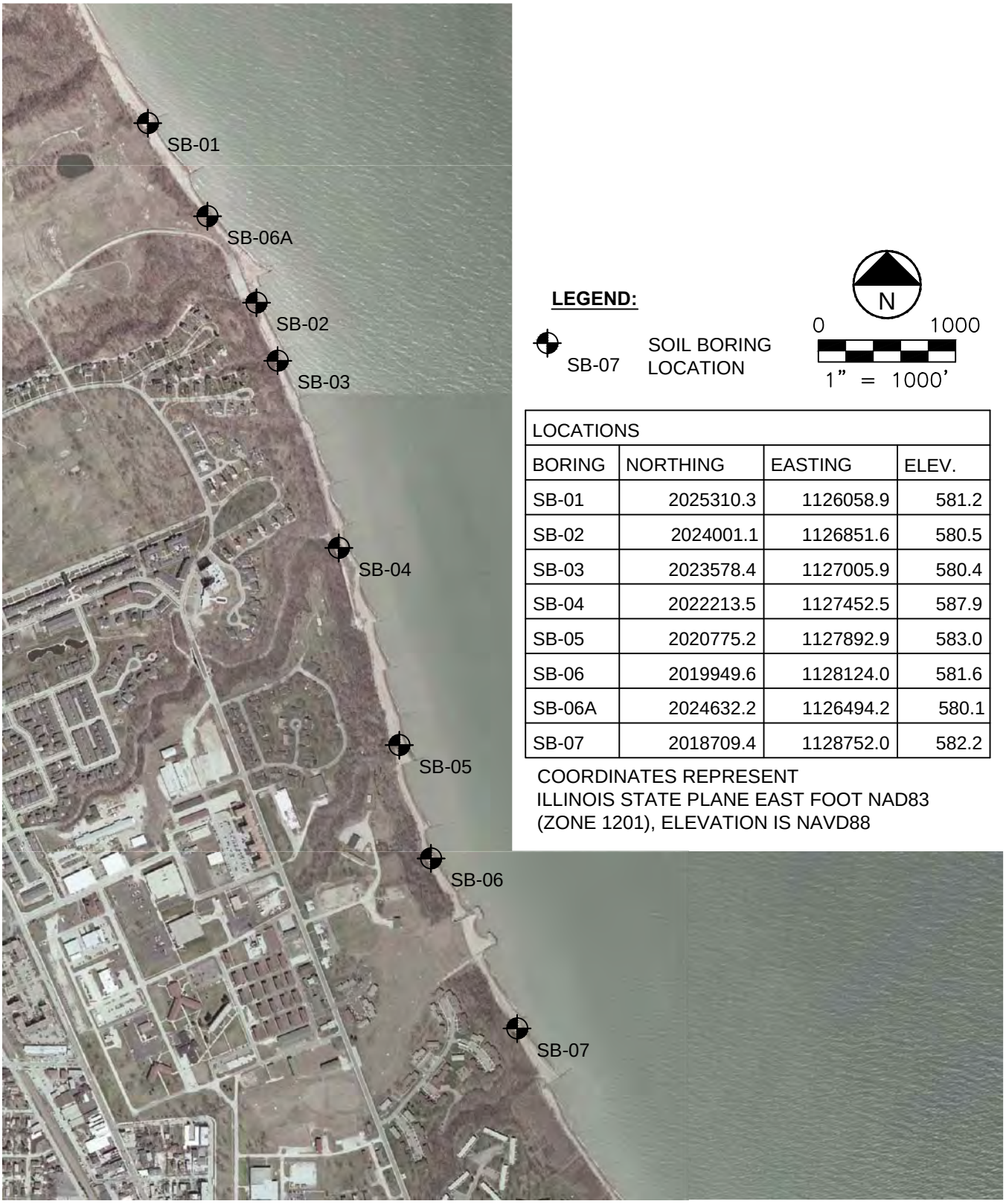
20. Water level readings have been made in the borings at the time and under the conditions stated on the boring logs. This data has been reviewed and an interpretation made in the text of this report. However, it must be noted that the period of observation was relatively short, and that seasonal and annual fluctuations in the level of the groundwater will likely occur.

21. This report has been prepared in accordance with generally accepted soil and foundation engineering practices to aid in the evaluation of this property, and to assist in the design of this project. No other warranty, expressed or implied, is made. The scope of this report is limited to the specific project and location described herein, and our description of the project represents our understanding of the significant aspects relevant to soil characteristics. In the event any changes in the design or location of the structures as outlined in this report are planned, we should be informed so the changes can be reviewed, and the conclusions of this report modified as required.

22. As a check, we recommend that AECOM be authorized to review project plans and specifications to confirm that the recommendations of this report have been interpreted in accordance with our intent. Without this review, AECOM will not be responsible for misinterpretation of our data, our analyses, and/or our recommendations or how these are incorporated into the final design.

Figure 1

Boring Location Plan



LEGEND:

SB-07 SOIL BORING LOCATION

N

0 1000

1" = 1000'

LOCATIONS			
BORING	NORTHING	EASTING	ELEV.
SB-01	2025310.3	1126058.9	581.2
SB-02	2024001.1	1126851.6	580.5
SB-03	2023578.4	1127005.9	580.4
SB-04	2022213.5	1127452.5	587.9
SB-05	2020775.2	1127892.9	583.0
SB-06	2019949.6	1128124.0	581.6
SB-06A	2024632.2	1126494.2	580.1
SB-07	2018709.4	1128752.0	582.2

COORDINATES REPRESENT
ILLINOIS STATE PLANE EAST FOOT NAD83
(ZONE 1201), ELEVATION IS NAVD88

AECOM

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SOIL BORING LOCATION PLAN
USACE - CHICAGO DISTRICT
FORT SHERIDAN COASTAL
HABITAT RESTORATION
FT SHERIDAN, IL.

Drawn :	DJD	10/22/2010
Checked:	JMB	10/27/2010
Approved:	RE	10/27/2010
PROJECT NUMBER	60163812	
FIGURE NUMBER	FIGURE 1	

X:\PROJECTS\60163812\000_CAD\001_DRAWINGS\SHEETS\G60163812_SBLD-1.dwg; 10/29/2010 8:55:54 AM; DEARMAN, DANIEL; STS.stb

Appendix A

General Notes

Soil Classification System

Field and Laboratory Procedures

Boring Log Procedures

AECOM General Notes

Drilling and Sampling Symbols:

SS : Split Spoon - 1-3/8" I.D. 2" O.D. (Unless otherwise noted)	HS : Hollow Stem Auger
ST : Shelby Tube-2" O.D. (Unless otherwise noted)	WS : Wash Sample
PA : Power Auger	FT : Fish Tail
DB : Diamond Bit-NX, BX, AX	RB : Rock Bit
AS : Auger Sample	BS : Bulk Sample
JS : Jar Sample	PM : Pressuremeter Test
VS : Vane Shear	GS : Giddings Sampler
OS : Osterberg Sampler	

Standard "N" Penetration: Blows per foot of a 140 pound hammer falling 30 inches on a 2 inch O.D. split spoon sampler, except where otherwise noted.

Water Level Measurement Symbols:

WL : Water Level	WCI : Wet Cave In
WS : While Sampling	DCI : Dry Cave In
WD : While Drilling	BCR : Before Casing Removal
AB : After Boring	ACR : After Casing Removal

Water levels indicated on the boring logs are the levels measured in the boring at the time indicated. In pervious soils, the indicated elevations are considered reliable groundwater levels. In impervious soils, the accurate determination of groundwater elevations may not be possible, even after several days of observations; additional evidence of groundwater elevations must be sought.

Gradation Description and Terminology:

Coarse grained or granular soils have more than 50% of their dry weight retained on a #200 sieve; they are described as boulders, cobbles, gravel or sand. Fine grained soils have less than 50% of their dry weight retained on a #200 sieve; they are described as clay or clayey silt if they are cohesive and silt if they are non-cohesive. In addition to gradation, granular soils are defined on the basis of their relative in-place density and fine grained soils on the basis of their strength or consistency and their plasticity.

Major Component of Sample	Size Range	Description of Other Components Present in Sample	Percent Dry Weight
Boulders	Over 8 in. (200 mm)	Trace	1-9
Cobbles	8 inches to 3 inches (200 mm to 75 mm)	Little	10-19
Gravel	3 inches to #4 sieve (75 mm to 4.76 mm)	Some	20-34
Sand	#4 to #200 sieve (4.76 mm to 0.074 mm)	And	35-50
Silt	Passing #200 sieve (0.074 mm to 0.005 mm)		
Clay	Smaller than 0.005 mm		

Consistency of Cohesive Soils:

Unconfined Compressive Strength, Qu, tsf	Consistency
<0.25	Very Soft
0.25 - 0.49	Soft
0.50 - 0.99	Medium (firm)
1.00 - 1.99	Stiff
2.00 - 3.99	Very Stiff
4.00 - 8.00	Hard
>8.00	Very Hard

Relative Density of Granular Soils:

N-Blows per foot	Relative Density
0 - 3	Very Loose
4 - 9	Loose
10 - 29	Medium Dense
30 - 49	Dense
50 - 80	Very Dense
>80	Extremely Dense

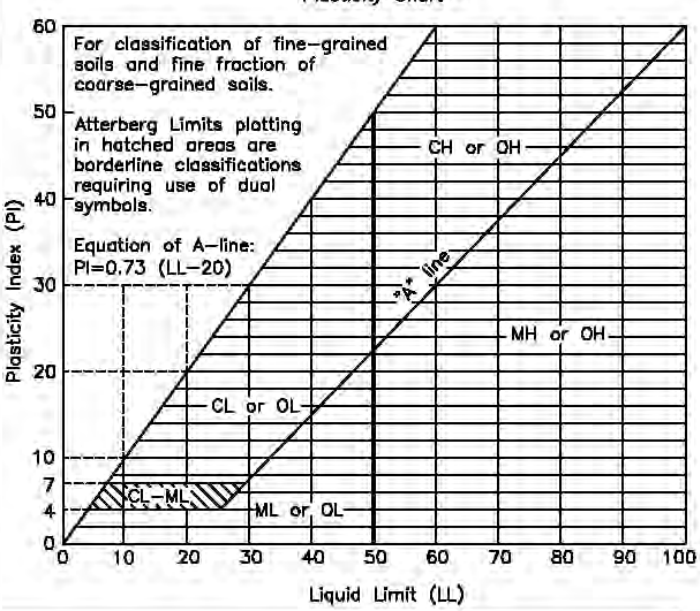
AECOM Soil Classification System [1]

Major Divisions		Group Symbols	Typical Names	Laboratory Classification Criteria	
Coarse-grained soils (More than half of material is *larger* than No. 200 sieve size) — Gravel (More than half of coarse fraction is larger than No. 4 sieve size)	Clean gravel (Little or no fines)	GW	Well-graded, gravel, gravel-sand mixtures, little or no fines	$C_u = \frac{D_{60}}{D_{10}}$ greater than 4; $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 & 3	
		GP	Poorly graded gravel, gravel-sand mixtures, little or no fines	Not meeting all gradation requirements for GW	
	Gravel with fines (Appreciable amount of fines)	GM	Silty gravel, gravel-sand-silt mixtures	Atterberg limits below "A" line or PI less than 4	Above "A" line with PI between 4 and 7 are ***borderline*** cases requiring use of dual symbols
		GC	Clayey gravel, gravel-sand-clay mixtures	Atterberg limits above "A" line or PI greater than 7	
Sand (More than half of coarse fraction is smaller than No. 4 sieve size)	Clean sand (Little or no fines)	SW	Well-graded sand, gravelly sand, little or no fines	$C_u = \frac{D_{60}}{D_{10}}$ greater than 6; $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 & 3	
		SP	Poorly graded sand, gravelly sand, little or no fines	Not meeting all gradation requirements for SW	
	Sand with fines (Appreciable amount of fines)	SM	Silty sand, sand-silt mixtures	Atterberg limits below "A" line or PI less than 4	Limits plotting in hatched zone with PI between 4 and 7 are ***borderline*** cases requiring use of dual symbols
		SC	Clayey sand, sand-clay mixtures	Atterberg limits above "A" line or PI greater than 7	
Fine-grained soils (More than half of material is *smaller* than No. 200 sieve size) — Silt and clay (Liquid limit less than 50)		ML	Inorganic silt and very fine sand, rock flour, silty or clayey fine sand or clayey silt with slight plasticity		
		CL	Inorganic clay of low to medium plasticity, gravelly clay, sandy clay, silty clay, lean clay		
		OL	Organic silt and organic silty clay of low plasticity		
Silt and clay (Liquid limit greater than 50)		MH	Inorganic silt, micaceous or diatomaceous fine sandy or silty soils, elastic silt		
		CH	Inorganic clay of high plasticity, fat clay		
		OH	Organic clay of medium to high plasticity, organic silt		
Highly organic soils		PT	Peat and other highly organic soil		

Determine percentages of sand and gravel from grain-size curve. Depending on percentage of fines (fraction smaller than No. 200 sieve size), coarse-grained soils are classified as follows:

Less than 5 percent . . . . . GW, GP, SW, SP
More than 12 percent . . . . . GM, GC, SM, SC
5 to 12 percent . . . . . Borderline cases *requiring* dual symbols [3]

Plasticity Chart [2]



1. See AECOM General Notes for component gradation terminology, consistency of cohesive soils and relative density of granular soils.
2. Reference: Unified Soil Classification Systems
3. Borderline classifications, used for soils possessing characteristics of two groups, are designated by combinations of group symbols. For example: GW-GC, well-graded gravel-sand mixture with clay binder.

AECOM Field and Laboratory Procedures

Subsurface Exploration Procedures

Hand-Auger Drilling (HA)

In this procedure, a sampling device is driven into the soil by repeated blows of a sledge hammer or a drop hammer. When the sampler is driven to the desired sample depth, the soil sample is retrieved. The hole is then advanced by manually turning the hand auger until the next sampling depth increment is reached. The hand auger drilling between sampling intervals also helps to clean and enlarge the borehole in preparation for obtaining the next sample.

Power Auger Drilling (PA)

In this type of drilling procedure, continuous flight augers are used to advance the boreholes. They are turned and hydraulically advanced by a truck, trailer or track-mounted unit as site accessibility dictates. In auger drilling, casing and drilling mud are not required to maintain open boreholes.

Hollow Stem Auger Drilling (HS)

In this drilling procedure, continuous flight augers having open stems are used to advance the boreholes. The open stem allows the sampling tool to be used without removing the augers from the borehole. Hollow stem augers thus provide support to the sides of the borehole during the sampling operations.

Rotary Drilling (RB)

In employing rotary drilling methods, various cutting bits are used to advance the boreholes. In this process, surface casing and/or drilling fluids are used to maintain open boreholes.

Diamond Core Drilling (DB)

Diamond core drilling is used to sample cemented formations. In this procedure, a double tube (or triple tube) core barrel with a diamond bit cuts an annular space around a cylindrical prism of the material sampled. The sample is retrieved by a catcher just above the bit. Samples recovered by this procedure are placed in sturdy containers in sequential order.

AECOM Field and Laboratory Procedures

Field Sampling Procedures

Auger Sampling (AS)

In this procedure, soil samples are collected from cuttings off of the auger flights as they are removed from the ground. Such samples provide a general indication of subsurface conditions; however, they do not provide undisturbed samples, nor do they provide samples from discrete depths.

Split-Barrel Sampling (SS) - (ASTM Standard D-1586-99)

In the split-barrel sampling procedure, a 2-inch O.D. split barrel sampler is driven into the soil a distance of 18 inches by means of a 140-pound hammer falling 30 inches. The value of the Standard Penetration Resistance is obtained by counting the number of blows of the hammer over the final 12 inches of driving. This value provides a qualitative indication of the in-place relative density of cohesionless soils. The indication is qualitative only, however, since many factors can significantly affect the Standard Penetration Resistance Value, and direct correlation of results obtained by drill crews using different rigs, drilling procedures, and hammer-rod-spoon assemblies should not be made. A portion of the recovered sample is placed in a sample jar and returned to the laboratory for further analysis and testing.

Shelby Tube Sampling Procedure (ST) - ASTM Standard D-1587-94

In the Shelby tube sampling procedure, a thin-walled steel seamless tube with a sharp cutting edge is pushed hydraulically into the soil and a relatively undisturbed sample is obtained. This procedure is generally employed in cohesive soils. The tubes are identified, sealed and carefully handled in the field to avoid excessive disturbance and are returned to the laboratory for extrusion and further analysis and testing.

Giddings Sampler (GS)

This type of sampling device consists of 5-foot sections of thin-wall tubing which are capable of retrieving continuous columns of soil in 5-foot maximum increments. Because of a continuous slot in the sampling tubes, the sampler allows field determination of stratification boundaries and containerization of soil samples from any sampling depth within the 5-foot interval.

AECOM Laboratory Procedures

Water Content (Wc)

The water content of a soil is the ratio of the weight of water in a given soil mass to the weight of the dry soil. Water content is generally expressed as a percentage.

Hand Penetrometer (Qp)

In the hand penetrometer test, the unconfined compressive strength of a soil is determined, to a maximum value of 4.5 tons per square foot (tsf) or 7.0 tsf depending on the testing device utilized, by measuring the resistance of the soil sample to penetration by a small, spring-calibrated cylinder. The hand penetrometer test has been carefully correlated with unconfined compressive strength tests, and thereby provides a useful and a relatively simple testing procedure in which soil strength can be quickly and easily estimated.

Unconfined Compression Tests (Qu)

In the unconfined compression strength test, an undisturbed prism of soil is loaded axially until failure or until 20% strain has been reached, whichever occurs first.

Dry Density (γd)

The dry density is a measure of the amount of solids in a unit volume of soil. Use of this value is often made when measuring the degree of compaction of a soil.

Classification of Samples

In conjunction with the sample testing program, all soil samples are examined in our laboratory and visually classified on the basis of their texture and plasticity in accordance with the AECOM Soil Classification System which is described on a separate sheet. The soil descriptions on the boring logs are derived from this system as well as the component gradation terminology, consistency of cohesive soils and relative density of granular soils as described on a separate sheet entitled "AECOM General Notes". The estimated group symbols included in parentheses following the soil descriptions on the boring logs are in general conformance with the Unified Soil Classification System (USCS) which serves as the basis of the AECOM Soil Classification System.

AECOM Standard Boring Log Procedures

In the process of obtaining and testing samples and preparing this report, standard procedures are followed regarding field logs, laboratory data sheets and samples.

Field logs are prepared during performance of the drilling and sampling operations and are intended to essentially portray field occurrences, sampling locations and procedures.

Samples obtained in the field are frequently subjected to additional testing and reclassification in the laboratory by experienced geotechnical engineers, and as such, differences between the field logs and the final logs may exist. The engineer preparing the report reviews the field logs, laboratory test data and classifications, and using judgment and experience in interpreting this data, may make further changes. It is common practice in the geotechnical engineering profession not to include field logs and laboratory data sheets in engineering reports, because they do not represent the engineer's final opinions as to appropriate descriptions for conditions encountered in the exploration and testing work. Results of laboratory tests are generally shown on the boring logs or are described in the text of the report, as appropriate.

Samples taken in the field, some of which are later subjected to laboratory tests, are retained in our laboratory for sixty days and are then discarded unless special disposition is requested by our client. Samples retained over a long period of time, even in sealed jars, are subject to moisture loss which changes the apparent strength of cohesive soil, generally increasing the strength from what was originally encountered in the field. Since they are then no longer representative of the moisture conditions initially encountered, observers of these samples should recognize this factor.

Appendix B

Boring Log Procedures

Field Logs

Laboratory Testing Results

HOLE NO. SB-01

DRILLING LOG

DIVISION	Great Lakes - Chicago Dist.
INSTALLATION	AECOM
SHEET	1 OF 1 SHEETS
1. PROJECT	Ft Sheridan Coastal Habitat Restoration
JOB NUMBER	60163812
2. LOCATION (Coordinates or Station)	Ft. Sheridan, IL N 2025310.309 E 1126058.867
3. DRILLING AGENCY	AECOM
4. HOLE NO. (As shown on drawing title and file number)	SB-01
5. NAME OF DRILLER	McCarthy
6. DIRECTION OF HOLE	[X] VERTICAL [ ] INCLINED _____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN	-
8. DEPTH DRILLED INTO ROCK	0
9. TOTAL DEPTH OF HOLE	20.0 ft
10. SIZE AND TYPE OF BIT	PA
11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	NAVD88
12. MANUFACTURER'S DESIGNATION OF DRILL	General 550
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	8 — DISTURBED 8 — UNDISTURBED 0
14. TOTAL NUMBER CORE BOXES	0
15. ELEVATION GROUND WATER	579.7 ft
16. DATE HOLE	STARTED 9/21/2010 — COMPLETED 9/22/2010
17. ELEVATION TOP OF HOLE	581.2 ft
18. TOTAL CORE RECOVERY FOR BORING	65 %
19. SIGNATURE OF INSPECTOR	Joshua M. Bickett

ELEVATION (ft) a	DEPTH (ft) b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth weathering, etc., if significant) g
579.2	2.0		Fine to coarse sand, trace gravel - brownish gray - loose to medium dense - moist (SP)	0.0 ft	1 0.0-2.0'	3-5-5-7, N=10, w=1.7%
577.2	4.0		Coarse sand and gravel - brown - medium dense - saturated (SP-GP)	0.9 ft	2 2.5-4.0'	10-12-16, N=28, w=10.2%
574.2	7.0		Fine to coarse sand, trace gravel - brown - medium dense - saturated (SP-GP)	1.2 ft	3 5.0-6.5'	13-15-20, N=35, w=19.1%, 10.5% Gravel, 83.1% Sand, 6.4% Fines
			Silty clay, trace sand, gravel and shale pebbles - gray - stiff to very stiff (CL)	1.3 ft	4 7.5-9.0'	11-10-11, N=21, w=18.3%, Qp=2.5 tsf
				1.0 ft	5 10.0-11.5'	10-10-10, N=20, w=16.1%, Qp=3.25 tsf, LL=29, PL=13
				1.3 ft	6 12.5-14.0'	12-15-21, N=36, w=18.4%, Qp=3.25 tsf
				1.3 ft	7 15.0-16.5'	13-16-20, N=36, w=17.7%, Qp=3.50 tsf
561.2	20.0		End of Boring Boring backfilled with bentonite chips upon completion 140 lb Safety Hammer, 30" fall, 2" OD split spoon	1.5 ft	8 18.0-20.0'	15-20-20-23, N = 40, w=18.5%, Qp=4.00 tsf

DRILLING LOG

DIVISION	Great Lakes - Chicago Dist.
INSTALLATION	AECOM
SHEET	1 OF 1 SHEETS
1. PROJECT	Ft Sheridan Coastal Habitat Restoration
JOB NUMBER	60163812
2. LOCATION (Coordinates or Station)	Ft. Sheridan, IL N 2024001.053 E 1126851.598
3. DRILLING AGENCY	AECOM
4. HOLE NO. (As shown on drawing title and file number)	SB-02
5. NAME OF DRILLER	McCarthy
6. DIRECTION OF HOLE	[X] VERTICAL [ ] INCLINED _____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN	-
8. DEPTH DRILLED INTO ROCK	0
9. TOTAL DEPTH OF HOLE	15.0 ft
10. SIZE AND TYPE OF BIT	PA
11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	NAVD88
12. MANUFACTURER'S DESIGNATION OF DRILL	General 550
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	6 — DISTURBED 6 — UNDISTURBED 0
14. TOTAL NUMBER CORE BOXES	0
15. ELEVATION GROUND WATER	579.5 ft
16. DATE HOLE	STARTED 9/17/2010 — COMPLETED 9/17/2010
17. ELEVATION TOP OF HOLE	580.5 ft
18. TOTAL CORE RECOVERY FOR BORING	61 %
19. SIGNATURE OF INSPECTOR	Joshua M. Bickett

ELEVATION (ft) a	DEPTH (ft) b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth weathering, etc., if significant) g
			Fine to coarse sand, trace gravel - brown - very loose to loose - saturated (SP)			
578.5	2.0		Becomes medium to coarse grained below 1.5'	1.0 ft	1 0.0-2.0'	1-2-3-4, N=5, w=13.8%, 1.4% Gravel, 98.0% Sand, 0.6% Fines
			Medium to coarse sand, trace to little gravel - brownish gray - medium dense to dense - saturated (SP-GP)	1.4 ft	2 2.5-4.0'	13-19-19, N=38, w=9.2%
575.5	5.0				2A 4.0-4.5'	
			Clayey silt - gray - medium dense to dense - saturated (ML)	1.0 ft	3 5.0-7.0'	7-17-15-23, N=32, w=17.7%, Qp=4.50 tsf
573.0	7.5					
			Silty clay, trace sand, gravel and shale - gray - stiff to very stiff (CL)	0.8 ft	4 7.5-9.5'	7-15-18-29, N=33, w=15.1%, Qp=4.00 tsf
				1.2 ft	5 10.0-11.5'	6-7-9, N=16, w=21.1%, Qp=2.25 tsf
565.5	15.0			1.6 ft	6 12.5-14.5'	7-9-10-11, N=19, w=20.6%, Qp=2.75 tsf
			End of Boring Boring backfilled with bentonite chips upon completion 140 lb Safety Hammer, 30" fall, 2" OD split spoon			

DRILLING LOG

DIVISION	Great Lakes - Chicago Dist.
INSTALLATION	AECOM
SHEET	1 OF 1 SHEETS
1. PROJECT	Ft Sheridan Coastal Habitat Restoration
JOB NUMBER	60163812
2. LOCATION (Coordinates or Station)	Ft. Sheridan, IL N 2023578.395 E 1127005.918
3. DRILLING AGENCY	AECOM
4. HOLE NO. (As shown on drawing title and file number)	SB-03
5. NAME OF DRILLER	McCarthy
6. DIRECTION OF HOLE	[X] VERTICAL [ ] INCLINED _____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN	-
8. DEPTH DRILLED INTO ROCK	0
9. TOTAL DEPTH OF HOLE	1.5 ft
10. SIZE AND TYPE OF BIT	PA
11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	NAVD88
12. MANUFACTURER'S DESIGNATION OF DRILL	General 550
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	1 — DISTURBED 1 — UNDISTURBED 0
14. TOTAL NUMBER CORE BOXES	0
15. ELEVATION GROUND WATER	580.1 ft
16. DATE HOLE	STARTED 9/17/2010 — COMPLETED 9/17/2010
17. ELEVATION TOP OF HOLE	580.4 ft
18. TOTAL CORE RECOVERY FOR BORING	67 %
19. SIGNATURE OF INSPECTOR	Joshua M. Bickett

ELEVATION (ft) a	DEPTH (ft) b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth weathering, etc., if significant) g
578.9	1.5		Silty fine sand, trace gravel - brown - medium dense - saturated (SM) Obstructed at 1.5' by boulder (riprap limestone) End of Boring Boring backfilled with bentonite chips upon completion 140 lb Safety Hammer, 30" fall, 2" OD split spoon	1.0 ft	1 0.0-1.5'	5-7-10, N=17, w=11.7%

DRILLING LOG

DIVISION	Great Lakes - Chicago Dist.
INSTALLATION	AECOM
SHEET	1 OF 1 SHEETS
1. PROJECT	Ft Sheridan Coastal Habitat Restoration
JOB NUMBER	60163812
2. LOCATION (Coordinates or Station)	Ft. Sheridan, IL N 2022213.518 E 1127452.516
3. DRILLING AGENCY	AECOM
4. HOLE NO. (As shown on drawing title and file number)	SB-04
5. NAME OF DRILLER	McCarthy
6. DIRECTION OF HOLE	[X] VERTICAL [ ] INCLINED _____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN	-
8. DEPTH DRILLED INTO ROCK	0
9. TOTAL DEPTH OF HOLE	22.0 ft
10. SIZE AND TYPE OF BIT	HSA
11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	NAVD88
12. MANUFACTURER'S DESIGNATION OF DRILL	Mobile B-61
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	9 — DISTURBED 9 — UNDISTURBED 0
14. TOTAL NUMBER CORE BOXES	0
15. ELEVATION GROUND WATER	578.4 ft
16. DATE HOLE	STARTED 9/22/2010 — COMPLETED 9/22/2010
17. ELEVATION TOP OF HOLE	587.9 ft
18. TOTAL CORE RECOVERY FOR BORING	83 %
19. SIGNATURE OF INSPECTOR	Joshua M. Bickett

ELEVATION (ft) a	DEPTH (ft) b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth weathering, etc., if significant) g
585.4	2.5		Fill: Silty clay, mixed with sand and gravel - dark brown - stiff	1.3 ft	1 0.0-2.0'	6-6-8-8, N=14, w=7.7%
582.9	5.0		Fill: Sandy silt, trace clay - brown - medium dense - moist	1.2 ft	2 2.5-4.0'	8-9-11, N=20, w=10.1%
580.4	7.5		Fill: Sand mixed with clay - brown - medium dense - moist	1.5 ft	3 5.0-7.0'	6-6-7-14, N=13, w=15.1%, Qp=2.50 tsf
577.9	10.0		Fine to medium sand, trace gravel - brown - medium dense - saturated (SP)	1.7 ft	4 7.5-9.5'	7-9-9-4, N=18, w=18.8%, 18.1% Gravel, 76.6% Sand, 5.3% Fines
			Silty clay, trace sand, gravel and shale pebbles - gray - stiff to very stiff (CL)	1.7 ft	5 10.0-12.0'	7-8-8-10, N=16, w=18.9%, Qp=4.25 tsf
				1.2 ft	6 12.5-14.0'	10-12-16, N=28, w=16.1%, Qp=6.25 tsf
				1.5 ft	7 15.0-16.5'	8-8-10, N=18, w=18.8%, Qp=3.75 tsf
				1.5 ft	8 17.5-19.0'	9-10-12, N=22, w=18.8%, Qp=3.25 tsf
565.9	22.0			1.7 ft	9 20.0-22.0'	10-10-12-14, N=22, w=19.7%, Qp=3.25 tsf
			End of Boring Boring backfilled with bentonite chips upon completion 140 lb Automatic Hammer, 30" fall, 2" OD split spoon			

DRILLING LOG

DIVISION	Great Lakes - Chicago Dist.
INSTALLATION	AECOM
SHEET	1 OF 1 SHEETS
1. PROJECT	Ft Sheridan Coastal Habitat Restoration
JOB NUMBER	60163812
2. LOCATION (Coordinates or Station)	Ft. Sheridan, IL N 2020775.177 E 1127892.923
3. DRILLING AGENCY	AECOM
4. HOLE NO. (As shown on drawing title and file number)	SB-05
5. NAME OF DRILLER	McCarthy
6. DIRECTION OF HOLE	[X] VERTICAL [ ] INCLINED _____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN	-
8. DEPTH DRILLED INTO ROCK	0
9. TOTAL DEPTH OF HOLE	20.0 ft
10. SIZE AND TYPE OF BIT	PA
11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	NAVD88
12. MANUFACTURER'S DESIGNATION OF DRILL	General 550
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	8 — DISTURBED 8 — UNDISTURBED 0
14. TOTAL NUMBER CORE BOXES	0
15. ELEVATION GROUND WATER	580.5 ft
16. DATE HOLE	STARTED 9/20/2010 — COMPLETED 9/21/2010
17. ELEVATION TOP OF HOLE	583.0 ft
18. TOTAL CORE RECOVERY FOR BORING	74 %
19. SIGNATURE OF INSPECTOR	Joshua M. Bickett

ELEVATION (ft) a	DEPTH (ft) b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth weathering, etc., if significant) g
580.5	2.5		Fine to medium sand, trace gravel - brownish gray - loose - moist (SP)	1.2 ft	1 0.0-2.0'	3-3-3-3, N=6, w=5.3%
575.5	7.5		Fine to medium sand, trace gravel - brownish gray - loose to medium dense - saturated (SP)	1.1 ft	2 2.5-4.5'	4-3-5-7, N=8, w=19.0%, 3.1% Gravel, 93.7% Sand, 3.2% Fines
				1.2 ft	3 5.0-6.5'	13-16-17, N=33, w=20.9%
573.0	10.0		Silty clay, trace sand, gravel and shale pebbles - gray - very stiff (CL)	1.1 ft	4 7.5-9.0'	11-13-17, N=30, w=19.0%, Qp=2.75 tsf
570.5	12.5		Silty sand, trace gravel - gray - medium dense - saturated (SM)	1.5 ft	5 10.0-11.5'	13-13-17, N=30, w=20.1%
563.0	20.0		Silty clay, trace sand, gravel and shale pebbles - gray - stiff to hard (CL)	1.2 ft	6 12.5-14.0'	9-13-16, N=29, w=20.4%, Qp=2.25 tsf
				1.2 ft	7 15.0-16.5'	10-12-16, N=28, w=20.2%, Qp=2.00 tsf
				1.5 ft	8 18.0-20.0'	16-18-37-40, N=55, w=12.6%, Qp=3.75 tsf
			End of Boring Boring backfilled with bentonite chips upon completion 140 lb Safety Hammer, 30" fall, 2" OD split spoon			

DRILLING LOG

DIVISION	Great Lakes - Chicago Dist.
INSTALLATION	AECOM
SHEET	1 OF 1 SHEETS
1. PROJECT	Ft Sheridan Coastal Habitat Restoration
JOB NUMBER	60163812
2. LOCATION (Coordinates or Station)	Ft. Sheridan, IL N 2019949.602 E 1128124.045
3. DRILLING AGENCY	AECOM
4. HOLE NO. (As shown on drawing title and file number)	SB-06
5. NAME OF DRILLER	McCarthy
6. DIRECTION OF HOLE	[X] VERTICAL [ ] INCLINED _____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN	-
8. DEPTH DRILLED INTO ROCK	0
9. TOTAL DEPTH OF HOLE	5.0 ft
10. SIZE AND TYPE OF BIT	HA
11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	NAVD88
12. MANUFACTURER'S DESIGNATION OF DRILL	Hand Auger
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	3 — DISTURBED 3 — UNDISTURBED 0
14. TOTAL NUMBER CORE BOXES	0
15. ELEVATION GROUND WATER	580.1 ft
16. DATE HOLE	STARTED 9/22/2010 — COMPLETED 9/22/2010
17. ELEVATION TOP OF HOLE	581.6 ft
18. TOTAL CORE RECOVERY FOR BORING	70 %
19. SIGNATURE OF INSPECTOR	Joshua M. Bickett

ELEVATION (ft) a	DEPTH (ft) b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth weathering, etc., if significant) g
580.1	1.5		Fine to medium sand, trace gravel - brownish gray - medium dense - moist (SP)	1.0 ft	1 0.0-1.5'	10-15-22, N=37, w=3.3%
			Fine to coarse gravel with sand - brown - dense to very dense - saturated (GP-SP)	1.2 ft	2 1.5-3.0'	30-40-45, N=85, w=8.2%
576.6	5.0			1.3 ft	3 3.0-5.0'	30-38-40-50, N=78, w=8.9%

End of Boring
Boring backfilled with bentonite chips upon completion

89 lb Donut Hammer, 12" fall, 2" OD split spoon

Note: N-value shown corresponds to number of blows required to drive split spoon sampler 1 foot after the initial 6 inch increment with 89 lb hammer

DRILLING LOG

DIVISION	Great Lakes - Chicago Dist.
INSTALLATION	AECOM
SHEET	1 OF 1 SHEETS
1. PROJECT	Ft Sheridan Coastal Habitat Restoration
JOB NUMBER	60163812
2. LOCATION (Coordinates or Station)	Ft. Sheridan, IL N 2024632.215 E 1126494.219
3. DRILLING AGENCY	AECOM
4. HOLE NO. (As shown on drawing title and file number)	SB-06A
5. NAME OF DRILLER	McCarthy
6. DIRECTION OF HOLE	[X] VERTICAL [ ] INCLINED _____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN	-
8. DEPTH DRILLED INTO ROCK	0
9. TOTAL DEPTH OF HOLE	1.5 ft
10. SIZE AND TYPE OF BIT	PA
11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	NAVD88
12. MANUFACTURER'S DESIGNATION OF DRILL	General 550
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	1 — DISTURBED 1 — UNDISTURBED 0
14. TOTAL NUMBER CORE BOXES	0
15. ELEVATION GROUND WATER	NE ft
16. DATE HOLE	STARTED 9/22/2010 — COMPLETED 9/22/2010
17. ELEVATION TOP OF HOLE	580.1 ft
18. TOTAL CORE RECOVERY FOR BORING	45 %
19. SIGNATURE OF INSPECTOR	Joshua M. Bickett

ELEVATION (ft) a	DEPTH (ft) b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth weathering, etc., if significant) g
578.6	1.5		Fine to medium sand, trace gravel - brownish gray - medium dnese - moist (SP) Obstructed at 1.5 ft by boulder (riprap limestone) End of Boring Boring backfilled with bentonite chips upon completion	0.7 ft	1 0.0-1.5'	4-9-15, N=24, w=6.4%

HOLE NO. SB-07

DRILLING LOG

DIVISION	Great Lakes - Chicago Dist.
INSTALLATION	AECOM
SHEET	1 OF 1 SHEETS
1. PROJECT	Ft Sheridan Coastal Habitat Restoration
JOB NUMBER	60163812
2. LOCATION (Coordinates or Station)	Ft. Sheridan, IL N 2018709.448 E 1128752.006
3. DRILLING AGENCY	AECOM
4. HOLE NO. (As shown on drawing title and file number)	SB-07
5. NAME OF DRILLER	McCarthy
6. DIRECTION OF HOLE	[X] VERTICAL [ ] INCLINED _____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN	-
8. DEPTH DRILLED INTO ROCK	0
9. TOTAL DEPTH OF HOLE	19.5 ft
10. SIZE AND TYPE OF BIT	PA
11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	NAVD88
12. MANUFACTURER'S DESIGNATION OF DRILL	General 550
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	8 — DISTURBED 8 — UNDISTURBED 0
14. TOTAL NUMBER CORE BOXES	0
15. ELEVATION GROUND WATER	579.7 ft
16. DATE HOLE	STARTED 9/21/2010 — COMPLETED 9/21/2010
17. ELEVATION TOP OF HOLE	582.2 ft
18. TOTAL CORE RECOVERY FOR BORING	76 %
19. SIGNATURE OF INSPECTOR	Joshua M. Bickett

ELEVATION (ft) a	DEPTH (ft) b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth weathering, etc., if significant) g
578.9	3.3		Fine to coarse sand, trace gravel - brown - medium dense - saturated (SP)	1.0 ft	1 0.0-2.0'	3-8-9-9, N=17, w=9.3%
			Silty clay, trace sand, gravel and shale pebbles - gray - stiff to hard (CL)	0.7 ft	2 2.5-3.75'	4-5-9-9, N=14, w=17.7%, 45.5% Gravel, 52.5% Sand, 2.0% Fines
				1.0 ft	2A 3.25-4.5'	w=20.6%, Qp=1.50 tsf
				1.5 ft	3 5.0-7.0'	5-8-12-12, N=20, w=22.2%, Qp=1.25 tsf
				0.6 ft	4 7.5-9.5'	8-11-12-14, N=23, w=21.4%, Qp=0.50 tsf
				1.2 ft	5 10.0-11.5'	14-16-16, N=32, w=17.6%, Qp=3.25 tsf
				1.4 ft	6 12.5-14.0'	11-17-24, N=41, w=17.1%, Qp=3.25 tsf
				1.5 ft	7 15.0-16.5'	20-16-25, N=43, w=18.0%, Qp=1.25 tsf, LL=29, PL=13
562.7	19.5			1.7 ft	8 18.0-19.5'	18-20-20, N=40, w=17.3%, Qp=1.75 tsf
			End of Boring Boring backfilled with bentonite chips upon completion 140 lb Safety Hammer, 30" fall, 2" OD split spoon			

approx elev. 580.

AECOM

FIELD BORING LOG

{ End of Boring
{ 140 lb Hammer, 30" Fall, 2" OD split spoon

TECHNICIAN _____
DRILLER Billy
HELPER Chris
RIG MFG/MODEL Geoprobe

SURFACE ELEV. _____
BORING STARTED 9-21-10
BORING COMPLETED 9-22-10
STATION _____
OFFSET _____

140 LB. HAMMER TYPE:
- [ ] DONUT
- [x] SAFETY
- [ ] AUTOMATIC

CASING USED _____ SIZE _____

WATER LEVEL OBSERVATIONS
WL: 1.5 WS OR WD
WL: _____ BCR _____ ACR
WL: _____ AB _____ HR. AB
WL: _____ 24 HR. AB

JOB NO. 60163812 BORING NO. 8-1 CLIENT FT. SHERIDAN Coastal Habitat Restoration WEATHER _____
USACE Chicago Dist.

SAMPLE NO.	DEPTH OR ELEVATION FROM	TO	SAMPLE METHOD	PENETRATION RECORD SPLIT SPOON BLOWS 6"	6"	6"	6"	R LENGTH RECOVERED IN FEET	QP PENETROMETER TEST IN TSF	HNU PHOTO-IONIZATION DETECTION	STRATA CHANGE	SAMPLE DESCRIPTION
1	0	2.0	DS	3	5	5	7	1'				F-C Sand & Gravel
	0	2.5	PA									
2	2.5	4.0	SS	10	12	14		11"				Sat Sand & Gravel M-C
												CONTINUED ON
												PG. 2

ABBREVIATIONS

FT	FISH TAIL
WO	WASH OUT
ST	SHELBY TUBE
SS	SPLIT SPOON
DB	DIAMOND BIT
PA	POWER AUGER
HSA	HOLLOW STEM AUGER
HA	HAND AUGER
RB	ROCK BIT
WS	WHILE SAMPLING
WD	WHILE DRILLING
BCR	BEFORE CASING REMOVAL
ACR	AFTER CASING REMOVAL
AB	AFTER BORING

DRILL CREW CHECKLIST
TOPSOIL THICKNESS _____
FILL THICKNESS _____

CAVE-IN LEVEL:
WHILE DRILLING AND SAMPLING _____
AFTER BORING COMPLETION _____

WATER LOSS:
AT _____ TO _____
PERCENT LOSS
AT _____ TO _____
PERCENT LOSS _____

BOULDERS OR OBSTRUCTIONS:
AT _____ TO _____
AT _____ TO _____

ARTESIAN PRESSURE:
DEPTH _____
HEIGHT OF SOIL RISE IN CASING _____
PIEZOMETER PVC OR SS
DIAMETER _____ IN.
SCREEN DEPTH _____ FT. TO _____ FT
RISER PIPE _____ FT. TO _____ FT

AECOM

FIELD BORING LOG

vol 2

TECHNICIAN _____
DRILLER Billy
HELPER Chris
RIG MFG/MODEL General

SURFACE ELEV. _____
BORING STARTED 9/21/10
BORING COMPLETED 9/22/10
STATION _____
OFFSET _____

140 LB. HAMMER TYPE:
- ☐ DONUT
- ☑ SAFETY
- ☐ AUTOMATIC

CASING USED _____ SIZE _____

WATER LEVEL OBSERVATIONS
WL: _____ WS OR WD
WL: _____ BCR _____ ACR
WL: 1.5 AB _____ HR. AB
WL: _____ 24 HR. AB

JOB NO. _____ BORING NO. 1 CLIENT USACOE WEATHER _____

SAMPLE NO.	DEPTH OR ELEVATION FROM	TO	SAMPLE METHOD	PENETRATION RECORD SPLIT SPOON BLOWS 6"	6"	6"	6"	R LENGTH RECOVERED IN FEET	QP PENETROMETER TEST IN TSF	HNU PHOTO-IONIZATION DETECTION	STRATA CHANGE	SAMPLE DESCRIPTION
3	5.0	6.5	SS	13	15	20		14"				F/c Sand
	5.0	7.5	PA								7.0	
4	7.5	9.0	SS	11	10	11		16"	2.5			Grey Silty clay
	7.5	10.0	PA									
5	10.0	11.5	SS	10	10	10		12"	2.5			Same
	10.0	12.5	PA									
6	12.5	14.0	SS	12	15	21		16"	2.5			Same
	12.5	15.0	PA									
7	15.0	16.5	SS	13	16	20		15"	2.75			Same
	15.0	17.0	PA									
8	17.0	20	SS	15	20	26	23	18"	4.25			Same
											EOB	Backfilled

ABBREVIATIONS

FT	FISH TAIL
WO	WASH OUT
ST	SHELBY TUBE
SS	SPLIT SPOON
DB	DIAMOND BIT
PA	POWER AUGER
HSA	HOLLOW STEM AUGER
HA	HAND AUGER
RB	ROCK BIT
WS	WHILE SAMPLING
WD	WHILE DRILLING
BCR	BEFORE CASING REMOVAL
ACR	AFTER CASING REMOVAL
AB	AFTER BORING

DRILL CREW CHECKLIST
TOPSOIL THICKNESS _____
FILL THICKNESS _____

CAVE-IN LEVEL:
WHILE DRILLING AND SAMPLING _____
AFTER BORING COMPLETION _____

WATER LOSS:
AT _____ TO _____
PERCENT LOSS
AT _____ TO _____
PERCENT LOSS _____

BOULDERS OR OBSTRUCTIONS:
AT _____ TO _____
AT _____ TO _____

ARTESIAN PRESSURE:
DEPTH _____
HEIGHT OF SOIL RISE IN CASING _____
PIEZOMETER PVC OR SS
DIAMETER _____ IN.
SCREEN DEPTH _____ FT. TO _____ FT
RISER PIPE _____ FT. TO _____ FT

SAKA

AECOM

FIELD BORING LOG

TECHNICIAN _____
DRILLER Dan & Billy
HELPER _____
RIG MFG/MODEL General

SURFACE ELEV. _____
BORING STARTED Sept 17, 2010
BORING COMPLETED Sept 17, 2010
STATION _____
OFFSET _____

140 LB. HAMMER TYPE:
☐ DONUT
☑ SAFETY
☐ AUTOMATIC
CASING USED ✓ SIZE ✓

WATER LEVEL OBSERVATIONS
WL: 1' WS OR WD
WL: _____ BCR _____ ACR
WL: _____ AB _____ HR. AB
WL: _____ 24 HR. AB

JOB NO. _____ BORING NO. B-2 CLIENT Ft Sheridan WEATHER _____

SAMPLE NO.	DEPTH OR ELEVATION FROM	TO	SAMPLE METHOD	PENETRATION RECORD SPLIT SPOON BLOWS 6"	6"	6"	6"	R LENGTH RECOVERED IN FEET	QP PENETROMETER TEST IN TSF	HNU PHOTO-IONIZATION DETECTION	STRATA CHANGE	SAMPLE DESCRIPTION
1	0'	2'	SS	1	2	3	4	12"				- Silty fine sand - brown -
												wet to saturated
												- became medium to coarse
	2	2.5'	PA									grained below 1.5'
2	2.5'	4'	SS	13	19	19		17"				-medium to coarse sand
2A	4'	5'	PA									- limestone gravel at tip
3	5'	7'	SS	7	17	15	23	1'				- gray clayey silt - saturated
	7'	7.5'	PA									
4	7.5	9.5'	SS	7	15	18	29	9"	3.0			silty clay - gray - trace
	7.5	10.0	PA									sand and shale - very stiff
5	10.0	11.5	SS	6	7	9		14"	1.5			Gray Silty Clay Tr sand gr
	10.0	12.5	PA									
6	12.5	14.5	SS	7	9	10	11	19"	2.25			SAME
	12.5	15.0	PA									

ABBREVIATIONS

FT	FISH TAIL
WO	WASH OUT
ST	SHELBY TUBE
SS	SPLIT SPOON
DB	DIAMOND BIT
PA	POWER AUGER
HSA	HOLLOW STEM AUGER
HA	HAND AUGER
RB	ROCK BIT
WS	WHILE SAMPLING
WD	WHILE DRILLING
BCR	BEFORE CASING REMOVAL
ACR	AFTER CASING REMOVAL
AB	AFTER BORING

DRILL CREW CHECKLIST
TOPSOIL THICKNESS _____
FILL THICKNESS _____

CAVE-IN LEVEL:
WHILE DRILLING AND SAMPLING _____
AFTER BORING COMPLETION _____

WATER LOSS:
AT _____ TO _____
PERCENT LOSS
AT _____ TO _____
PERCENT LOSS _____

BOULDERS OR OBSTRUCTIONS:
AT _____ TO _____
AT _____ TO _____

ARTESIAN PRESSURE:
DEPTH _____
HEIGHT OF SOIL RISE IN CASING _____
PIEZOMETER PVC OR SS
DIAMETER _____ IN.
SCREEN DEPTH _____ FT. TO _____ FT
RISER PIPE _____ FT. TO _____ FT

EGD

AECOM

FIELD BORING LOG

TECHNICIAN _____
DRILLER Dan & Billy
HELPER _____
RIG MFG/MODEL General

SURFACE ELEV. _____
BORING STARTED Sept 17, 2010
BORING COMPLETED Sept 17, 2010
STATION _____
OFFSET _____

140 LB. HAMMER TYPE:
☐ DONUT
☒ SAFETY
☐ AUTOMATIC
CASING USED _____ SIZE _____

WATER LEVEL OBSERVATIONS
WL: 3'' WS OR (WD)
WL: _____ BCR _____ ACR
WL: _____ AB _____ HR. AB
WL: _____ 24 HR. AB

JOB NO. _____ BORING NO. B-3 CLIENT FT. SHERIDAN WEATHER _____

SAMPLE NO.	DEPTH OR ELEVATION FROM	TO	SAMPLE METHOD	PENETRATION RECORD SPLIT SPOON BLOWS 6"	6"	6"	6"	R LENGTH RECOVERED IN FEET	QP PENETROMETER TEST IN TSF	HNU PHOTO-IONIZATION DETECTION	STRATA CHANGE	SAMPLE DESCRIPTION
1.	0	1.5	SS	5	7	10						Sand + gravel, Silty - brown -
												Saturated (SM - GP)
	1.5	-										obstructed at 1.5 ft by
												the rip-rap limestone block

ABBREVIATIONS

FT	FISH TAIL
WO	WASH OUT
ST	SHELBY TUBE
SS	SPLIT SPOON
DB	DIAMOND BIT
PA	POWER AUGER
HSA	HOLLOW STEM AUGER
HA	HAND AUGER
RB	ROCK BIT
WS	WHILE SAMPLING
WD	WHILE DRILLING
BCR	BEFORE CASING REMOVAL
ACR	AFTER CASING REMOVAL
AB	AFTER BORING

DRILL CREW CHECKLIST
TOPSOIL THICKNESS _____
FILL THICKNESS _____

CAVE-IN LEVEL:
WHILE DRILLING AND SAMPLING _____
AFTER BORING COMPLETION _____

WATER LOSS:
AT _____ TO _____
PERCENT LOSS
AT _____ TO _____
PERCENT LOSS _____

BOULDERS OR OBSTRUCTIONS:
AT _____ TO _____
AT _____ TO _____

ARTESIAN PRESSURE:
DEPTH _____
HEIGHT OF SOIL RISE IN CASING _____
PIEZOMETER PVC OR SS
DIAMETER _____ IN.
SCREEN DEPTH _____ FT. TO _____ FT
RISER PIPE _____ FT. TO _____ FT

AECOM

FIELD BORING LOG

1 of 8

TECHNICIAN _____
DRILLER Billy
HELPER Chaw
RIG MFG/MODEL 61

SURFACE ELEV. _____
BORING STARTED 9/22/10
BORING COMPLETED 9/22/10
STATION _____
OFFSET _____

140 LB. HAMMER TYPE:
☐ DONUT
☐ SAFETY
☑ AUTOMATIC
CASING USED _____ SIZE _____

WATER LEVEL OBSERVATIONS
WL: 9.5 WS OR WD
WL: _____ BCR _____ ACR
WL: _____ AB _____ HR. AB
WL: _____ 24 HR. AB

JOB NO. _____ BORING NO. 4 CLIENT US ACE WEATHER _____

SAMPLE NO.	DEPTH OR ELEVATION FROM	TO	SAMPLE METHOD	PENETRATION RECORD SPLIT SPOON BLOWS 6"	6"	6"	6"	R LENGTH RECOVERED IN FEET	QP PENETROMETER TEST IN TSF	HNU PHOTO-IONIZATION DETECTION	STRATA CHANGE	SAMPLE DESCRIPTION
1	0	2.0	SS	6	6	8	8	16"				Clayfill w/ gr. @ top
	0	2.5	HSA									
2	2.5	4.0	SS	8	9	11		14"				Sandyfill w/ silt
	2.5	5.0	HSA									
3	5.0	7.0	SS	6	6	7	14	18"				Sandyfill w/ + clayfill
	5.0	7.5	HSA									
4	7.5	9.5	SS	7	9	9	8	20"			7.5	F/c Sand & gr.
	7.5	10.0	HSA									
5	10.0	12.0	SS	7	8	8	10	20"	4.0		10.0	Grey Silty clay
	10.0	12.5	HSA									
6	12.5	14.0	SS	10	12	16		14"	4.5+			Sand
	12.5	15.0	HSA									
7	15.0	16.5	SS	8	8	10		18"	3.0			Sand
	15.0	17.5	HSA									
8	17.5	19.0	SS	9	10	12		18"	3.0			Sand
	17.5	20.0	HSA									
9	20.0	22.0	SS	10	10	12	14	20"	3.5			Sand

ABBREVIATIONS

FT	FISH TAIL
WO	WASH OUT
ST	SHELBY TUBE
SS	SPLIT SPOON
DB	DIAMOND BIT
PA	POWER AUGER
HSA	HOLLOW STEM AUGER
HA	HAND AUGER
RB	ROCK BIT
WS	WHILE SAMPLING
WD	WHILE DRILLING
BCR	BEFORE CASING REMOVAL
ACR	AFTER CASING REMOVAL
AB	AFTER BORING

DRILL CREW CHECKLIST
TOPSOIL THICKNESS ____
FILL THICKNESS 7.5

CAVE-IN LEVEL:
WHILE DRILLING AND SAMPLING _____
AFTER BORING COMPLETION _____

WATER LOSS:
AT _____ TO _____
PERCENT LOSS
AT _____ TO _____
PERCENT LOSS _____

BOULDERS OR OBSTRUCTIONS:
AT _____ TO _____
AT _____ TO _____

ARTESIAN PRESSURE:
DEPTH _____
HEIGHT OF SOIL RISE IN CASING _____
PIEZOMETER PVC OR SS
DIAMETER _____ IN.
SCREEN DEPTH _____ FT. TO _____ FT
RISER PIPE _____ FT. TO _____ FT

1 of 1

AECOM

FIELD BORING LOG

TECHNICIAN _____
DRILLER Billy
HELPER Chris
RIG MFG/MODEL General

SURFACE ELEV. _____
BORING STARTED 9/20/10
BORING COMPLETED 9/21/10
STATION _____
OFFSET _____

140 LB. HAMMER TYPE:
- [ ] DONUT
- [x] SAFETY
- [ ] AUTOMATIC

CASING USED _____ SIZE _____

WATER LEVEL OBSERVATIONS
WL: 2.5 WS OR WD
WL: _____ BCR _____ ACR
WL: 2.5 AB _____ HR. AB
WL: _____ 24 HR. AB

JOB NO. _____ BORING NO. B-5 CLIENT U.S.A.C.E WEATHER _____

SAMPLE NO.	DEPTH OR ELEVATION FROM	TO	SAMPLE METHOD	PENETRATION RECORD SPLIT SPOON BLOWS 6"	6"	6"	6"	R LENGTH RECOVERED IN FEET	QP PENETROMETER TEST IN TSF	HNU PHOTO-IONIZATION DETECTION	STRATA CHANGE	SAMPLE DESCRIPTION
												UNSURE ON SAMPLE INTEGRITY POSSIBLE CAVE IN OF SAMPLE #5
1	0	2.0	SS	3	3	3	3	14"				F.C Sand & Gravel
	0	2.5	PA									
2	2.5	4.5	SS	4	3	5	7	13"				F.C Sand & Grey Silt
	2.5	5.0	PA									
3	5.0	6.5	SS	13	16	17		14"				Sand
	5.0	7.5	PA									
4	7.5	9.0	SS	11	13	17		13"	3.5		7.5	Grey Silty Clay and Sand [illegible]
	7.5	10.0	PA									
5	10.0	11.5	SS	13	13	17		18"			10.0	[illegible]
	10.0	12.5										
6	12.5	14.0	SS	9	13	16		14"	2.0		2.0	Grey Silty Clay
	12.5	14.0	PA									
7	15.0	16.5	SS	10	12	14		14"	2.0			Sand
	15.0	18.0	PA									
8	18.0	20.0	SS	16	18	37	40	18"	4.5+		18.0	Sand

ABBREVIATIONS

FT	FISH TAIL
WO	WASH OUT
ST	SHELBY TUBE
SS	SPLIT SPOON
DB	DIAMOND BIT
PA	POWER AUGER
HSA	HOLLOW STEM AUGER
HA	HAND AUGER
RB	ROCK BIT
WS	WHILE SAMPLING
WD	WHILE DRILLING
BCR	BEFORE CASING REMOVAL
ACR	AFTER CASING REMOVAL
AB	AFTER BORING

DRILL CREW CHECKLIST
TOPSOIL THICKNESS _____
FILL THICKNESS _____

CAVE-IN LEVEL:
WHILE DRILLING AND SAMPLING _____
AFTER BORING COMPLETION _____

WATER LOSS:
AT _____ TO _____
PERCENT LOSS
AT _____ TO _____
PERCENT LOSS _____

BOULDERS OR OBSTRUCTIONS:
AT _____ TO _____
AT _____ TO _____

ARTESIAN PRESSURE:
DEPTH _____
HEIGHT OF SOIL RISE IN CASING _____
PIEZOMETER PVC OR SS
DIAMETER _____ IN.
SCREEN DEPTH _____ FT. TO _____ FT
RISER PIPE _____ FT. TO _____ FT

EOB Backfilled

AECOM

FIELD BORING LOG

1 of

TECHNICIAN _____
DRILLER Billy
HELPER Chris
RIG MFG/MODEL HA

SURFACE ELEV. _____
BORING STARTED 9/22/10
BORING COMPLETED 9/22/10
STATION _____
OFFSET _____

~~140~~ 29 LB. HAMMER TYPE:
☑ DONUT
☐ SAFETY
☐ AUTOMATIC
CASING USED _____ SIZE _____

WATER LEVEL OBSERVATIONS
WL: 1.5 (WS) OR WD
WL: _____ BCR _____ ACR
WL: _____ AB _____ HR. AB
WL: _____ 24 HR. AB

JOB NO. _____ BORING NO. 16 CLIENT US ACE WEATHER _____

SAMPLE NO.	DEPTH OR ELEVATION FROM	TO	SAMPLE METHOD	PENETRATION RECORD SPLIT SPOON BLOWS 6"	6"	6"	6"	R LENGTH RECOVERED IN FEET	QP PENETROMETER TEST IN TSF	HNU PHOTO-IONIZATION DETECTION	STRATA CHANGE	SAMPLE DESCRIPTION
1	0	1.5	SS	10	15	22		12"				F/c Sand
	0	1.5	HA									
2	1.5	3.0	SS	30	40	45		14"				F/c Sand w/ lg gr.
	1.5	3.0	HA									
3	3.0	5.0	SS	30	38	40	50	16"				Same
												EOB Backfilled

ABBREVIATIONS

FT	FISH TAIL
WO	WASH OUT
ST	SHELBY TUBE
SS	SPLIT SPOON
DB	DIAMOND BIT
PA	POWER AUGER
HSA	HOLLOW STEM AUGER
HA	HAND AUGER
RB	ROCK BIT
WS	WHILE SAMPLING
WD	WHILE DRILLING
BCR	BEFORE CASING REMOVAL
ACR	AFTER CASING REMOVAL
AB	AFTER BORING

DRILL CREW CHECKLIST
TOPSOIL THICKNESS _____
FILL THICKNESS _____

CAVE-IN LEVEL:
WHILE DRILLING AND SAMPLING _____
AFTER BORING COMPLETION _____

WATER LOSS:
AT _____ TO _____
PERCENT LOSS
AT _____ TO _____
PERCENT LOSS _____

BOULDERS OR OBSTRUCTIONS:
AT _____ TO _____
AT _____ TO _____

ARTESIAN PRESSURE:
DEPTH _____
HEIGHT OF SOIL RISE IN CASING _____
PIEZOMETER PVC OR SS
DIAMETER _____ IN.
SCREEN DEPTH _____ FT. TO _____ FT
RISER PIPE _____ FT. TO _____ FT

FIELD BORING LOG

AECOM

TECHNICIAN Nick [illegible]
DRILLER Billy McCarthy
HELPER Curtis Franks
RIG MFG/MODEL ATV

SURFACE ELEV.
BORING STARTED 9/22/10
BORING COMPLETED 9/22/10
STATION
OFFSET

140 LB. HAMMER TYPE:
☐ DONUT
☒ SAFETY
☐ AUTOMATIC
CASING USED N SIZE

WATER LEVEL OBSERVATIONS
WL: WS OR WD
WL: BCR ACR
WL: AB HR. AB
WL: 24 HR. AB

JOB NO. Sheridan
BORING NO. B-6A ALTERNATE
CLIENT
WEATHER Windy 65°

SAMPLE NO.	DEPTH OR ELEVATION FROM	TO	SAMPLE METHOD	PENETRATION RECORD SPLIT SPOON BLOWS 6"	6"	6"	6"	R LENGTH RECOVERED IN FEET	QP PENETROMETER TEST IN TSF	HNU PHOTO-IONIZATION DETECTION	STRATA CHANGE	SAMPLE DESCRIPTION
1	0.0	1.5	SS	4	9	15		8"				Coarse sand [illegible]
	1.0	4.3	PA									[illegible]
												[illegible]
												[illegible]
												[illegible]

ABBREVIATIONS

FT	FISH TAIL
WO	WASH OUT
ST	SHELBY TUBE
SS	SPLIT SPOON
DB	DIAMOND BIT
PA	POWER AUGER
HSA	HOLLOW STEM AUGER
HA	HAND AUGER
RB	ROCK BIT
WS	WHILE SAMPLING
WD	WHILE DRILLING
BCR	BEFORE CASING REMOVAL
ACR	AFTER CASING REMOVAL
AB	AFTER BORING

DRILL CREW CHECKLIST
TOPSOIL THICKNESS
FILL THICKNESS

CAVE-IN LEVEL:
WHILE DRILLING AND SAMPLING
AFTER BORING COMPLETION

WATER LOSS:
AT TO
PERCENT LOSS
AT TO
PERCENT LOSS

BOULDERS OR OBSTRUCTIONS:
AT TO
AT TO

ARTESIAN PRESSURE:
DEPTH
HEIGHT OF SOIL RISE IN CASING
PIEZOMETER PVC OR SS
DIAMETER IN.
SCREEN DEPTH FT. TO FT
RISER PIPE FT. TO FT

AECOM

FIELD BORING LOG

TECHNICIAN _____
DRILLER Billy
HELPER Chris
RIG MFG/MODEL General

SURFACE ELEV. _____
BORING STARTED 9/21/10
BORING COMPLETED 9/21/10
STATION _____
OFFSET _____

140 LB. HAMMER TYPE:
☐ DONUT
☑ SAFETY
☐ AUTOMATIC
CASING USED _____ SIZE _____

WATER LEVEL OBSERVATIONS
WL: 2.5 WS OR WD
WL: ' BCR _____ ACR
WL: 2.5 AB _____ HR. AB
WL: _____ 24 HR. AB

JOB NO. _____ BORING NO. B-7 CLIENT FT. SHERIDAN WEATHER _____

SAMPLE NO.	DEPTH OR ELEVATION FROM	TO	SAMPLE METHOD	PENETRATION RECORD SPLIT SPOON BLOWS 6"	6"	6"	6"	R LENGTH RECOVERED IN FEET	QP PENETROMETER TEST IN TSF	HNU PHOTO-IONIZATION DETECTION	STRATA CHANGE	SAMPLE DESCRIPTION
1	0	2.0	SS	3	8	9	7	12"				Sat Sand & Gravel F.C
	0	2.5	PA									
2	2.5	3.25	SS	4	5	9	9	8"				Sand
2-A	3.25	4.5	SS				A	12"	2.5		3.25	Gray Silty Clay
	2.5	5.0	PA									
3	5.0	7.0	SS	5	8	12	12	18"	2.5			Gray Silty Clay Sand & Gravel F.C
	5.0	7.5	PA									
4	7.5	9.5	SS	8	11	12	14	7"				Same Sample Disturbed by Cobbles
	7.5	10.0	PA									
5	10.0	11.5	SS	14	14	14		14"	4.0			Same
	10.0	12.5	PA									
6	12.5	14.0	SS	11	17	24		17"	4.0			Same
	12.5	15.0	PA									Same
7	15.0	16.5		20	18	25		18"	2.75			Same
	15.5	18.0	PA									
	18.0	19.5	SS	18	20	20	24	20"	3.0			Same

ABBREVIATIONS

FT	FISH TAIL
WO	WASH OUT
ST	SHELBY TUBE
SS	SPLIT SPOON
DB	DIAMOND BIT
PA	POWER AUGER
HSA	HOLLOW STEM AUGER
HA	HAND AUGER
RB	ROCK BIT
WS	WHILE SAMPLING
WD	WHILE DRILLING
BCR	BEFORE CASING REMOVAL
ACR	AFTER CASING REMOVAL
AB	AFTER BORING

DRILL CREW CHECKLIST
TOPSOIL THICKNESS _____
FILL THICKNESS _____

CAVE-IN LEVEL:
WHILE DRILLING AND SAMPLING _____
AFTER BORING COMPLETION _____

WATER LOSS:
AT _____ TO _____
PERCENT LOSS
AT _____ TO _____
PERCENT LOSS _____

BOULDERS OR OBSTRUCTIONS:
AT _____ TO _____
AT _____ TO _____

ARTESIAN PRESSURE:
DEPTH _____
HEIGHT OF SOIL RISE IN CASING _____
PIEZOMETER PVC OR SS
DIAMETER _____ IN.
SCREEN DEPTH _____ FT. TO _____ FT
RISER PIPE _____ FT. TO _____ FT

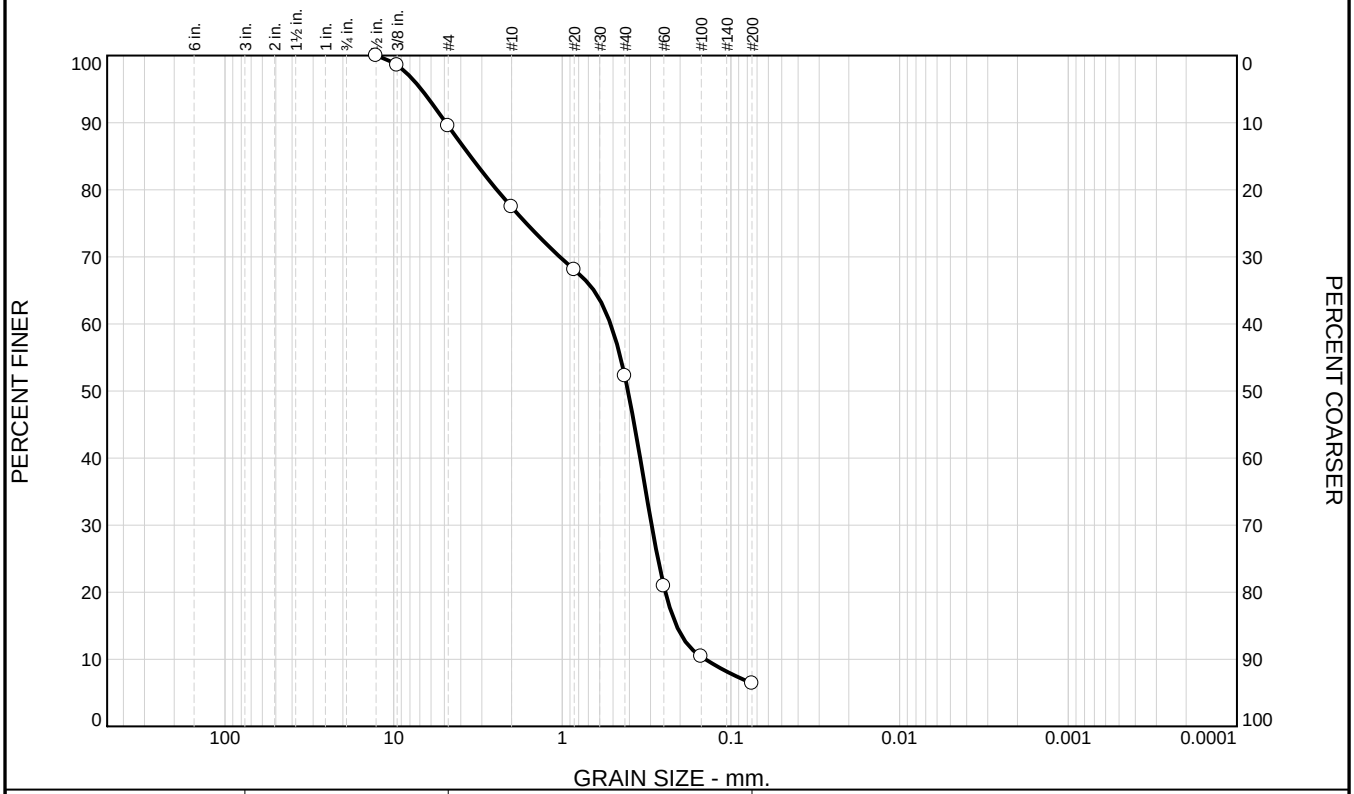
E.O.B. Back Filled.

SUMMARY OF LABORATORY TESTS

Project No.: 60163812 **Project:** USACE - Fort Sheridan **Client** : US Army Corps of Engineers

Boring No.	Sample No.	Depth (ft.)	Description	USCS	Nat. WC%	Qp (tsf)	LL	PL	PI	% Gravel	% Sand	% Fines (silt and clay)
Boring 1												
	1	0.0-2.0	F-C SAND TRACE CLAY TRACE SILT TRACE F GRAVEL - GRAY	SP	1.7							
	2	2.5-4.0	F GRAVEL LITTLE F-C SAND TRACE SILT - GRAY	GP	10.2							
	3	5.0-6.5	F-C SAND LITTLE F GRAVEL TRACE FINES - GRAY	SP-SM	19.1					10.5	83.1	6.4
	4	7.5-9.0	SILTY CLAY TRACE F-C SAND TRACE F GRAVEL - GRAY	CL	18.3	2.50						
	5	10.0-11.5	SILTY CLAY TRACE F-C SAND TRACE F GRAVEL - GRAY	CL	16.1	3.25	29	13	16			
	6	12.5-14.5	SILTY CLAY TRACE F-C SAND TRACE F GRAVEL - GRAY	CL	18.4	3.25						
	7	15.0-16.5	SILTY CLAY TRACE F-C SAND TRACE F GRAVEL - GRAY	CL	17.7	3.50						
	8	18.0-20.0	SILTY CLAY TRACE F-C SAND TRACE F GRAVEL - GRAY	CL	18.5	4.00						
Boring 2												
	1	0.0'-2.0'	F-C SAND TRACE F GRAVEL - GRAY	SP	13.8					1.4	98.0	0.6
	2	2.5-4.0	F-C GRAVEL LITTLE F-C SAND TRACE SILT - GRAY	GP	9.2							
	3	5.0-7.0	SILTY CLAY TRACE F-C SAND TRACE F GRAVEL - GRAY	CL	17.7	4.50						
	4	7.5-9.5	SILTY CLAY TRACE F-C SAND TRACE F GRAVEL - GRAY	CL	15.1	4.00						
	5	10.0-11.5	SILTY CLAY TRACE F-C SAND TRACE F GRAVEL - GRAY	CL	21.1	2.25						
	6	12.5-14.5	SILTY CLAY TRACE F-C SAND TRACE F GRAVEL - GRAY	CL	20.6	2.75						
Boring 3												
	1	0.0-1.5	F-C GRAVEL LITTLE F-C SAND TRACE SILT - GRAY	GP	11.7							
Boring 4												
	1	0.0-2.0	F-C SAND TRACE CLAY TRACE F GRAVEL TRACE TOPSOIL - GRAY TO DK GRAY	SP	7.7							
	2	2.5-4.0	SILT TRACE CLAY TRACE F-C SAND TRACE F GRAVEL - BROWN	ML	10.1							
	3	5.0-7.0	SILTY CLAY TRACE F-C SAND TRACE F GRAVEL - GRAY	CL	15.1	2.50						
	4	7.5'-9.5'	F-C SAND LITTLE F-C GRAVEL TRACE FINES - GRAY	SP-SM	18.8					18.1	76.6	5.3
	5	10.0-12.0	SILTY CLAY TRACE F-C SAND TRACE F GRAVEL - GRAY	CL	18.9	4.25						
	6	12.5-14.0	SILTY CLAY TRACE F-C SAND TRACE F GRAVEL - GRAY	CL	16.1	6.25						
	7	15.0-16.5	SILTY CLAY TRACE F-C SAND TRACE F GRAVEL - GRAY	CL	18.8	3.75						
	8	17.5-19.0	SILTY CLAY TRACE F-C SAND TRACE F GRAVEL - GRAY	CL	18.8	3.25						
	9	20.0-22.0	SILTY CLAY TRACE F-C SAND TRACE F GRAVEL - GRAY	CL	19.7	3.25						
	4	73.5-9.5	F-C SAND TRACE SILT TRACE F GRAVEL - GRAY	SP	18.8							
Boring 5												
	1	0.0-2.0	F-C SAND TRACE SILT TRACE F GRAVEL - GRAY	SP	5.3							
	2	2.5'-4.5'	F-C SAND TRACE F GRAVEL TRACE FINES - GRAY	SP	19.0					3.1	93.7	3.2
	3	5.0-6.5	F-C SAND TRACE SILT TRACE F GRAVEL - GRAY	SP	20.9							
	4	7.5-9.0	SILTY CLAY TRACE F-C SAND TRACE F GRAVEL - GRAY	CL	19.0	2.75						
	5	10.0-11.5	F-C SAND LITTLE SILT TRACE F GRAVEL - GRAY	SP-SM	20.1							
	6	12.5-11.0	SILTY CLAY TRACE F-C SAND TRACE F GRAVEL - GRAY	CL	20.4	2.25						
	7	15.0-16.5	SILTY CLAY TRACE F-C SAND TRACE F GRAVEL - GRAY	CL	20.2	2.00						
	8	18.0-20.0	SILTY CLAY TRACE F-C SAND TRACE F GRAVEL - GRAY	CL	12.6	3.75						
Boring 6												
	1	0.0-1.5	F-C SAND TRACE SILT TRACE F GRAVEL - GRAY	SP	3.3							
	2	1.5-3.0	F-C GRAVEL LITTLE F-C SAND TRACE SILT - GRAY	GP	8.2							
	3	3.0-5.0	SANDY F-C GRAVEL TRACE SILT - GRAY	GP	8.9							
Boring 6A												
	1	0.0-1.5	F-C SAND LITTLE F-C GRAVEL - GRAY	SP	6.4							
Boring 7												
	1	0.0-2.0	F-C SAND LITTLE F-C GRAVEL TRACE SILT - GRAY	SP	9.3							
	2	2.5'-3.25'	F-C SAND AND F-C GRAVEL TRACE FINES - GRAY	SP	17.7					45.5	52.5	2.0
	2A	3.25-4.0	SILTY CLAY TRACE F-C SAND TRACE F GRAVEL - GRAY	CL	20.6	1.50						
	3	5.0-7.0	SILTY CLAY TRACE F-C SAND TRACE F GRAVEL - GRAY	CL	22.2	1.25						
	4	7.5-9.5	SILTY CLAY TRACE F-C SAND TRACE F GRAVEL - GRAY	CL	21.4	0.50						
	5	10.0-11.5	SILTY CLAY TRACE F-C SAND TRACE F GRAVEL - GRAY	CL	17.6	3.25						
	6	12.5-14.5	SILTY CLAY TRACE F-C SAND TRACE F GRAVEL - GRAY	CL	17.1	3.25						
	7	15.0-16.5	SILTY CLAY TRACE F-C SAND TRACE F GRAVEL - GRAY	CL	18.0	1.25	29	13	16			
	8	18.0-19.5	SILTY CLAY TRACE F-C SAND TRACE F GRAVEL - GRAY	CL	17.3	1.75						

Partical Size Analysis of Soils ASTM D 422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	10.5	12.1	25.2	45.8	6.4	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.50	100.0		
.375	98.5		
#4	89.5		
#10	77.4		
#20	68.1		
#40	52.2		
#60	20.9		
#100	10.4		
#200	6.4		

* (no specification provided)

Material Description

F-C SAND LITTLE F GRAVEL TRACE FINES - GRAY

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 4.9030 D_{85}= 3.5065 D_{60}= 0.5171
D_{50}= 0.4073 D_{30}= 0.2955 D_{15}= 0.2102
D_{10}= 0.1418 C_u= 3.65 C_c= 1.19

Classification

USCS= SP-SM AASHTO=

Remarks

F.M.=2.56

Source of Sample: Boring 1 **Depth:** 5.0-6.5
Sample Number: 3 **Date:** 10/4/2010

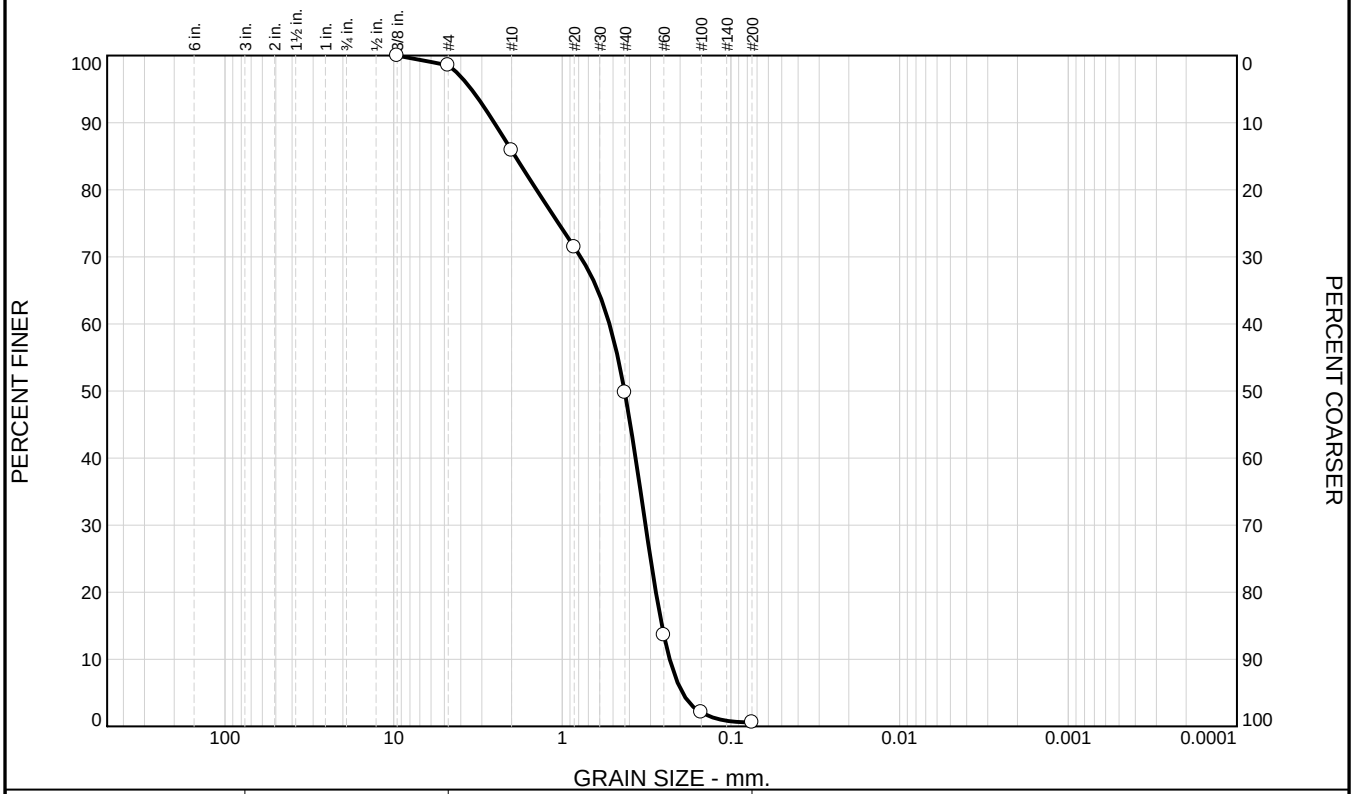
AECOM

Client: US Army Corps of Engineers
Project: USACE - Fort Sheridan

Project No: 60163812

Tested By: EMR **Checked By:** WPQ

Partical Size Analysis of Soils ASTM D 422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	1.4	12.7	36.1	49.2	0.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.375	100.0		
#4	98.6		
#10	85.9		
#20	71.4		
#40	49.8		
#60	13.6		
#100	2.1		
#200	0.6		

* (no specification provided)

Material Description

F-C SAND TRACE F GRAVEL - GRAY

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 2.5307 D_{85}= 1.9024 D_{60}= 0.5252
D_{50}= 0.4266 D_{30}= 0.3212 D_{15}= 0.2566
D_{10}= 0.2307 C_u= 2.28 C_c= 0.85

Classification

USCS= SP AASHTO=

Remarks

F.M.=2.44

Source of Sample: Boring 2 **Depth:** 0.0'-2.0'
Sample Number: 1 **Date:** 10/4/2010

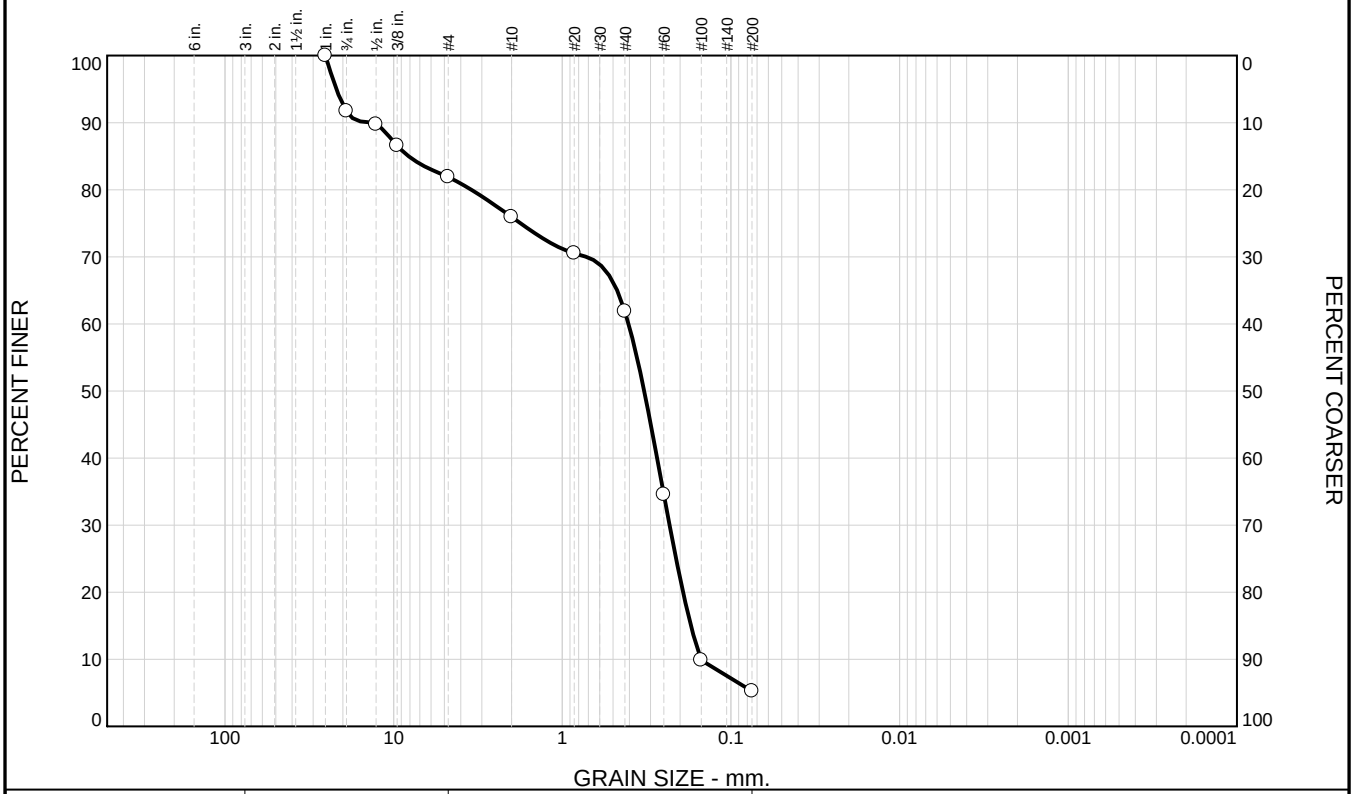
AECOM

Client: US Army Corps of Engineers
Project: USACE - Fort Sheridan

Project No: 60163812

Tested By: EMR **Checked By:** WPQ

Partical Size Analysis of Soils ASTM D 422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	8.3	9.8	5.9	14.1	56.6	5.3	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.0	100.0		
.75	91.7		
.50	89.7		
.375	86.6		
#4	81.9		
#10	76.0		
#20	70.5		
#40	61.9		
#60	34.6		
#100	9.8		
#200	5.3		

* (no specification provided)

Material Description

F-C SAND LITTLE F-C GRAVEL TRACE FINES - GRAY

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 13.5652 D_{85}= 8.1578 D_{60}= 0.4040
D_{50}= 0.3270 D_{30}= 0.2311 D_{15}= 0.1726
D_{10}= 0.1507 C_u= 2.68 C_c= 0.88

Classification

USCS= SP-SM AASHTO=

Remarks

F.M.=2.67

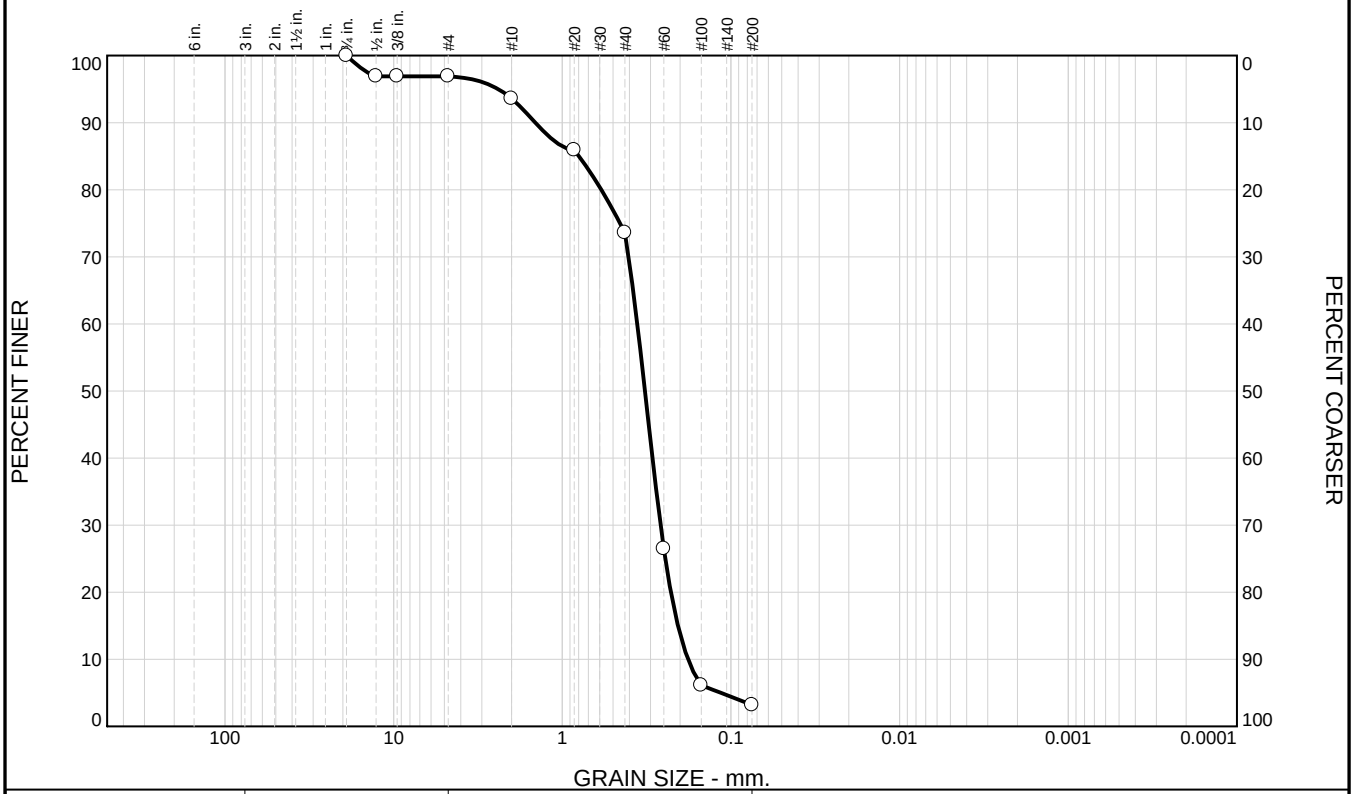
Source of Sample: Boring 4 **Depth:** 7.5'-9.5'
Sample Number: 4 **Date:** 10/4/2010

AECOM

Client: US Army Corps of Engineers
Project: USACE - Fort Sheridan
Project No: 60163812

Tested By: EMR **Checked By:** WPQ

Partical Size Analysis of Soils ASTM D 422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	3.1	3.3	20.0	70.4	3.2	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.75	100.0		
.50	96.9		
.375	96.9		
#4	96.9		
#10	93.6		
#20	85.9		
#40	73.6		
#60	26.5		
#100	6.1		
#200	3.2		

* (no specification provided)

Material Description

F-C SAND TRACE F GRAVEL TRACE FINES - GRAY

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 1.4441 D_{85}= 0.7970 D_{60}= 0.3592
D_{50}= 0.3236 D_{30}= 0.2614 D_{15}= 0.2061
D_{10}= 0.1796 C_u= 2.00 C_c= 1.06

Classification

USCS= SP AASHTO=

Remarks

F.M.=1.94

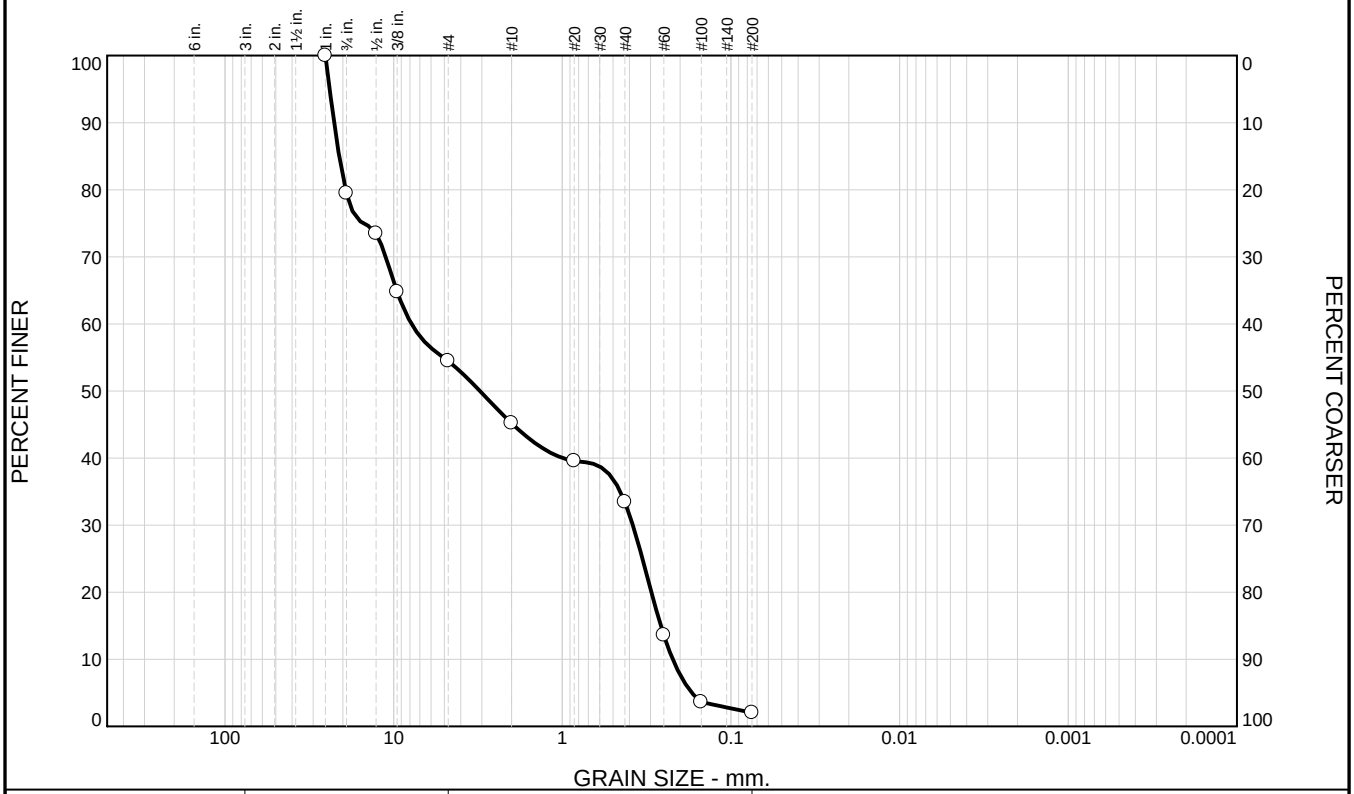
Source of Sample: Boring 5 **Depth:** 2.5'-4.5'
Sample Number: 2 **Date:** 10/4/2010

AECOM

Client: US Army Corps of Engineers
Project: USACE - Fort Sheridan
Project No: 60163812

Tested By: EMR **Checked By:** WPQ

Partical Size Analysis of Soils ASTM D 422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	20.5	25.0	9.3	11.8	31.4	2.0	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.0	100.0		
.75	79.5		
.50	73.5		
.375	64.8		
#4	54.5		
#10	45.2		
#20	39.6		
#40	33.4		
#60	13.6		
#100	3.6		
#200	2.0		

* (no specification provided)

Material Description

F-C SAND AND F-C GRAVEL TRACE FINES - GRAY

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 22.5145 D_{85}= 21.0233 D_{60}= 7.8402
D_{50}= 3.0776 D_{30}= 0.3815 D_{15}= 0.2605
D_{10}= 0.2214 C_u= 35.41 C_c= 0.08

Classification

USCS= SP AASHTO=

Remarks

F.M.=4.51

Source of Sample: Boring 7 **Depth:** 2.5'-3.25'
Sample Number: 2 **Date:** 10/4/2010

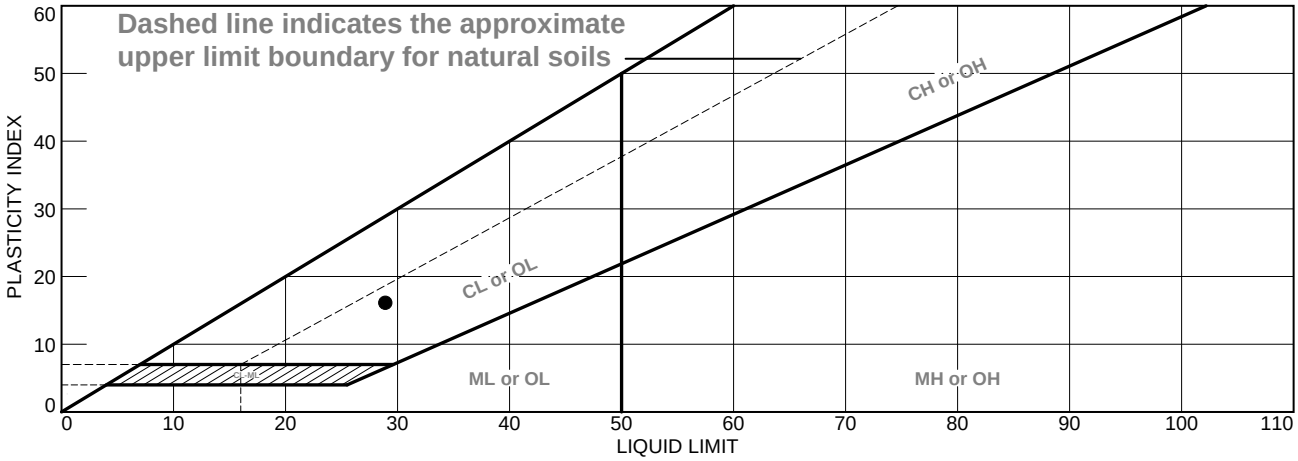
AECOM

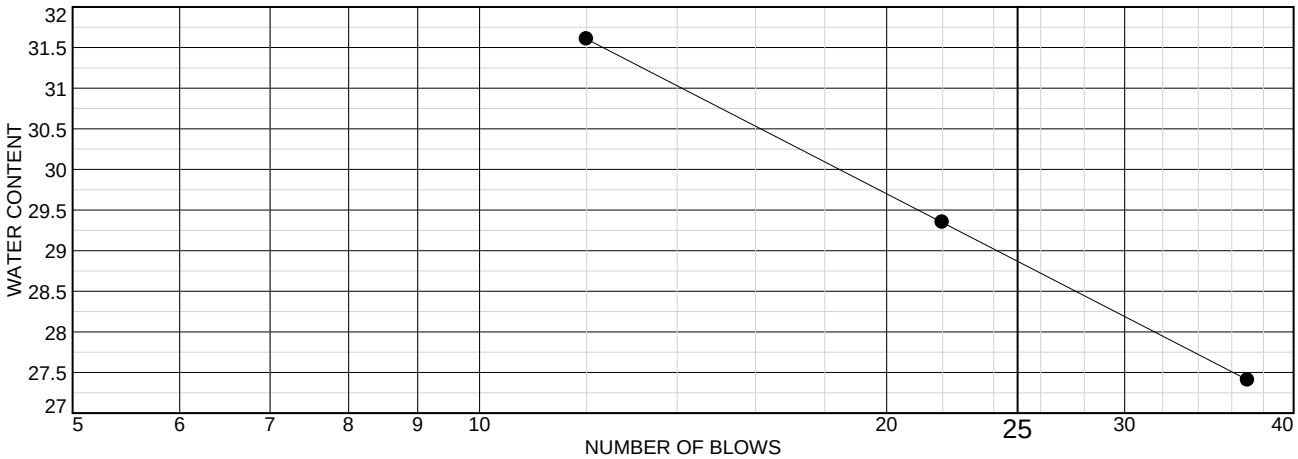
Client: US Army Corps of Engineers
Project: USACE - Fort Sheridan

Project No: 60163812

Tested By: EMR **Checked By:** WPQ

LIQUID AND PLASTIC LIMITS ASTM D 4318





	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	SILTY CLAY TRACE F-C SAND TRACE F GRAVEL - GRAY	29	13	16			CL

Project No. 60163812 **Client:** US Army Corps of Engineers

Project: USACE - Fort Sheridan

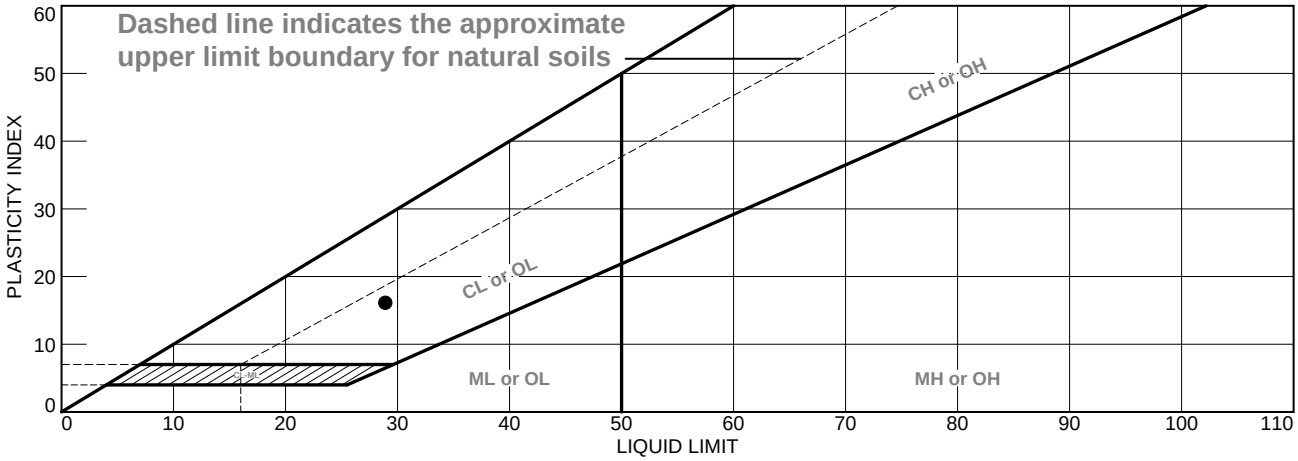
●**Source of Sample:** Boring 1 **Depth:** 10.0-11.5 **Sample Number:** 5

Remarks:

AECOM

Tested By: DS **Checked By:** WPQ

LIQUID AND PLASTIC LIMITS ASTM D 4318



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	SILTY CLAY TRACE F-C SAND TRACE F GRAVEL - GRAY	29	13	16			CL

Project No. 60163812 **Client:** US Army Corps of Engineers

Project: USACE - Fort Sheridan

●**Source of Sample:** Boring 7 **Depth:** 15.0-16.5 **Sample Number:** 7

Remarks:

AECOM

Tested By: DS **Checked By:** WPQ

Appendix C

Drilling Photos

Photo 1 – General 550 Drill Rig

Photo 2 – Typical Buried Boulder

APPENDIX D – GEOTECHNICAL ANALYSIS

Attachment 3: CTL Geotechnical Engineering Report

Geotechnical Engineering Report

Proposed "Openlands Lakeshore Preserve" Project
Highland Park/Fort Sheridan, Illinois.

Chicago Testing Laboratory, Inc.
Project No. 10EG204
05/06/2010

Prepared for:

Mr. James A. Stevenson
Clauss Brothers, Inc.
360 West Schaumburg Road
Streamwood, Illinois 60107

Prepared by:

Founded1912

Chicago Testing Laboratory, Inc.
Warrenville, Illinois

Chicago Testing Laboratory, Inc.
30W114 Butterfield Road, Warrenville, IL 60555 p 630.393.CTL1 f 630.393.CTL7
18000 South Williams Street, Thornton, IL 60476 p 708.877.1801 f 708.877.6926
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P.O. Box 3395, Joliet, IL 60434 p 815.385.8351 f 815.385.8456
www.chicagotestinglab.com
info@chicagotestinglab.com
Founded 1912
Testing • Inspection • Training • Consulting • Research • Geotechnical

May 7, 2010

Mr. James A. Stevenson
Clauss Brothers, Inc.
360 West Schaumburg Road
Streamwood, Illinois 60107

Re: Report of Subsurface Exploration and Engineering Services
Proposed "Openlands Lakeshore Preserve" project
Highland Park/Fort Sheridan, Illinois.
CTL Project No. 10EG204

Dear Mr. Stevenson:

This report presents the results of geotechnical subsurface exploration, lab testing and engineering analysis conducted for the above referenced project in Highland Park and Fort Sheridan, Illinois. This exploration was performed in accordance with our Proposal No. EG10029 dated March 4, 2010, and your subsequent authorization.

INTRODUCTION

General

The recommendations submitted herein are based on the available soil information and preliminary design details outlined in this report. Any revision in the plans for the proposed structures from those enumerated in this report should be brought to the attention of the Geotechnical Engineer so that he may determine if changes in the recommendations are required. If deviations from the noted subsurface conditions are encountered during construction, they should also be brought to the attention of the Geotechnical Engineer.

Purpose and Scope of Work

The purpose of this exploration was to evaluate the subsurface conditions at the site and to formulate conclusions and recommendations pertaining to the influence of those conditions upon the proposed construction of three (3) parking lots, a pathway or bike trail, overlook areas and a pedestrian bridge over the Schenck Ravine. The scope of work included subsurface exploration by soil

borings, engineering analysis of the pertinent geotechnical data, and preparation of this report. Samples obtained during this exploration will be retained in our facility for a period of 90 days, after which time they will be discarded unless other arrangements are made.

SITE LOCATION & PROJECT DESCRIPTION

General

The proposed 26 acre property site located along the Lake Michigan and Bartlett Ravine bluffs is located in Highland Park and Fort Sheridan, Illinois. The explored area, mostly covered with grass was relatively flat with the exception of the area of boring B-15, which was covered with old asphalt pavement. The project starts with a parking lot located north of the intersection of Walker Avenue and Oak Street in Highland Park. The pathway system starts from the parking lot and moves along the Lake Michigan bluff over the Schenck and Van Horn Ravines to the Bartlett Ravine. The pathway then moves west along the Bartlett Ravine and ends at the second parking lot located west of Patton Road in Highland Park. The third parking lot was located in Fort Sheridan east of Lyster Road. Site and Boring Location Plan is included in Appendix A.

FIELD EXPLORATION

General

The soil and groundwater conditions were investigated by drilling and sampling of the subsurface materials at the site. Boreholes were extended to a depth of 7 ½ feet below the existing ground surface (bgs) at each location with the exception of deeper boring B-16, which was drilled to a depth of 50 feet for the bridge at Schenck Ravine. The drilling and sampling methods used are described herein.

Scope

A total of sixteen soil borings, identified as B-1 through B-16 were drilled during the present subsurface exploration. The boring locations were selected and marked in the field by Clauss Brothers representatives. The approximate locations of the borings are illustrated in the Site and Boring Location Plan included in the Appendix A.

Soil Drilling & Sampling Procedures

The borings were drilled with a conventional truck mounted drill rig equipped with a rotary head. Continuous Flight augers (CFA) were used to advance the boreholes. Soils were sampled at 2½ foot intervals through the borings termination depths.

At sampling elevations, advancement of the borehole was stopped and representative soil samples were obtained with a sampling device known as a split-spoon or split-barrel sampler. The sampler was attached to the drill rods and lowered into the borehole. The advancement of the sampler into the soil was conducted in general accordance with the Standard Penetration Test (SPT) (ASTM D1586). The sampling spoon was advanced, by driving, using a drop hammer. The number of blows required driving the sampler 12 inches with a hammer weighing 140 lbs and dropping over a distance of 30 inches is known as the standard penetration resistance (N).

The results of the standard penetration tests indicate the relative density of granular soils and comparative consistency of cohesive soils, and thereby provide a basis for estimating the relative strength and compressibility of the soil profile components. The results of standard penetration tests can be found on the log of borings included in the Appendix B.

Field Logs

The results of Standard Penetration Testing (SPT) and field descriptions of the soils encountered, approximate measurements of strata thicknesses, groundwater observations, as well as other pertinent remarks were recorded on the field logs. The field logs were maintained by the drilling crew. The soil samples and field logs were submitted for lab testing upon completion of the field exploration.

Water Level Measurements

Groundwater level measurements were made in the soil borings during and immediately following the drilling operations. Groundwater information is indicated on the log of borings, located in the Appendix B. In relatively pervious soils, such as sandy soils, the indicated elevations are considered reliable short-term groundwater levels. In relatively impervious soils, the accurate determination of the groundwater elevation may not be possible, even after several days of observation. Additionally, seasonal variations, temperature, recent rainfall conditions, permeability of the soil and other factors can influence the groundwater level.

LABORATORY TESTING

General

Upon completion of the field exploration, the soil samples and field logs were brought to our laboratory for further testing. The sampled soils were tested by our laboratory staff. Detailed soil descriptions were prepared by a Geotechnical Engineer. Estimations of grain sizes and physical properties of the sampled soils

were used to prepare soil descriptions based on the Visual/Manual Classification System (ASTM D2488).

Scope

The laboratory testing program included supplementary visual description, and water content determinations (Wc) on all relatively cohesive samples. In addition, reasonably intact samples of fine-grain cohesive soils were subjected to unconfined compressive strength testing using a calibrated hand-held penetrometer. Consideration must be given to the manner in which the values of the unconfined compressive strengths (Qp) were obtained. It should be noted that ASTM D2166 Split-spoon sampling techniques provide a representative, though somewhat disturbed, soil sample. The values presented must be considered approximate unconfined compressive strength values. In order to provide USDA Soil Classification, Hydrometer (ASTM T422) and Atterberg Limits (ASTM D4318) tests were performed on select representative soil samples.

The results of the standard penetration tests (N), water content tests (Wc), unconfined compressive strength estimates (Qp) and other specialized test along with the visual descriptions are presented on the log of Borings included in the Appendix B and C of this report.

SUBSURFACE CONDITIONS

General

The stratification of the soils, as presented on the Boring Logs, was prepared using the field logs. Variations in the subsurface conditions may occur between the boring locations and lines of demarcation represent the approximate vertical boundaries between the soil types, but the transition may be more gradual. The subsurface conditions described are representative of those conditions encountered at each specific boring location or other point of exploration.

Subsurface Soils Description

Proposed Parking Lots: Borings B-1, B-14, were drilled at the proposed Parking lots in Highland Park and boring B-15 was drilled at the proposed parking lot in Fort Sheridan. Approximately 2 inches of black Clayey Topsoil was encountered at the surface of boring B-1, which was followed by brown with grey streaks Silty Clay through the boring termination depth of 7 ½ feet below the existing grade (bgs). Approximately 8 inches of Topsoil, over 6 inches of black Silty Clay (FILL) was noted at the surface of boring B-14. Below Topsoil and Clayey Fill, brown Silty Clay was encountered through the boring termination depth of 7 ½ feet bgs. Boring B-15 was drilled for the proposed parking lot in Fort Sheridan. Approximately 3 ¾ inch of existing asphalt pavement was noted at the surface, which was followed by Fill material comprising of brown to grey and dark grey

Silty Clay to a depth of 4.5 feet bgs. Following the Clayey Fill, Very Stiff brown and grey Silty Clay was found through the boring termination depth of 7 ½ feet bgs. The Very Stiff to Hard consistency of Clay was shown by Qp values ranging from 2.0 tsf to greater than 4.5 tsf. The natural moisture in Silty Clay/Clay Loam ranged from 15% to 23%.

Proposed Pathway and Overlook Structures: Borings B-2 through B-13 were drilled to evaluate the subsurface soils for the proposed pathway/bike trail and overlook structures. In general, approximately 2 to 6 inches of dark brown to black Clayey Topsoil and/or Fill was noted at the surface with the exception of the area of Boring B-13. In Boring B-13, 12 inches of black Clayey Topsoil was noted at the surface which was followed by 14 inches of black Sand, Cinders and Gravel Fill. Underlying the surficial Topsoil and Fill, Stiff to Very Stiff and Hard brown to brown and grey Silty Clay and Silty Clay Loam was encountered through the borings termination depth of 7 ½ feet bgs. Inter-bedded in Silty Clay a stratum of brown Clayey Silt was noted 3 ½ feet to 6 feet depth in Boring B-5. The Stiff to Hard consistency of Clay was shown by Qp values ranging from 1.5 tsf to greater than 4.0 tsf. The natural moisture in Silty Clay/Clay Loam and Loam ranged from 12% to 26%.

Proposed Pedestrian Bridge: Boring B-16 was drilled at the location of North Abutment. Stiff brown Silty Clay was noted from surface to a depth of 2.5 feet bgs. Below 2 ½ feet depth, Very Stiff to Hard brown and gray Silty Clay was encountered to a depth of 13 feet bgs, which was followed by Very Stiff to Hard grey Silty Clay Loam through the boring termination depth of 50 feet. The Stiff to Hard consistency of Clay was shown by Qp values ranging from 1.25 tsf to greater than 4.0 tsf. The natural moisture in Silty Clay and Silty Clay Loam ranged from 14% to 22%.

Groundwater Observations

Groundwater level observations were made by the drilling personnel. With the exception of Borings B-5 and B-16, groundwater was not encountered during the present subsurface exploration. In Boring B-5, groundwater was noted in silt layer at a depth of 4 feet while drilling. In deeper boring B-16, groundwater was encountered at a depth of 23.5 feet during drilling. It should be noted that groundwater levels are subject to seasonal and long term variations in response to climate conditions and man made influences.

DISCUSSIONS AND RECOMMENDATIONS

Project Description

The planned project consist of the construction of three (3) parking lots, asphalt pavement pathway/bike trail, overlooks areas and a pedestrian bridge over Schenck Ravine along the Lake Michigan shore bluffs in Highland Park and Fort Sheridan, Illinois.

Site Preparation:

Prior to any construction, the proposed parking lots, pathway and overlook areas should be carefully observed and stripped to remove surface vegetation, topsoil and/or any other unsuitable surface materials such as asphalt (Boring B-15).

Upon removing the Topsoil and/or any other unsuitable surface materials, the subgrade soil is expected to be stiff to Very stiff and Hard brown Silty Clay for most of the construction areas. However, relatively low bearing medium stiff Clay was noted below the Topsoil in the area of boring B-11 and black Sand, Cinders and gravel fill was encountered below the Topsoil in the area of boring B-13. The areas in the vicinity of these borings should be carefully observed and any low bearing and/or unsuitable materials encountered during the construction should be undercut and replaced with an engineered fill.

It is recommended that upon removing the surfical vegetation/topsoil and grading the site, the entire parking lots, pathway and overlook areas should be proof-rolled using a tandem wheeled dump truck. Proof rolling should be observed by a geotechnical engineer to delineate any softer/unstable areas or areas requiring additional undercutting. The over-excavated or undercut areas should then be backfilled with an engineered fill.

Pavement Section for Parking lots:

Based on our observation of the on-site soil the typical section which should be constructed in the car parking lots in 1-inch of asphaltic surface course and 2-inches of asphaltic bonder over 10 inches of compacted crushed stone. These typical thicknesses assume that the soil subgrade is stable and any fill placed for grading is compacted to a minimum of 95 percent of the maximum dry density as determined by Modified proctor test, ASTM D1557.

Pavement Section for Pathways:

Initially a porous asphalt pavement was proposed. However, due to the presence of impermeable Clay, conventional hot mix asphalt is being considered for the pathways. Project specifications regarding the thickness of asphalt pavement and crushed stone base should be followed. In general, upon following the recommendations provided in the “Site Preparation” section of this report, the clayey subgrade soil should be considered suitable to support the asphalt pavement.

A clay subgrade, in general is considered a poor subgrade for pavements if it becomes wet. The site grading and drainage should be designed to prevent accumulation of rain water. If pavements are not constructed immediately after grading, the subgrade should be shaped to prevent water ponding. Minor ponding, of even short duration, can cause softening of a soil subgrade to a

significant depth. If there is a substantial lapse of time between grading and paving, or if the subgrade is disturbed by construction activities, the subgrade should be proof-rolled with a loaded, tandem-wheeled dump truck. Unstable areas observed during construction or proof-rolling should be removed and replaced with soil or crushed stone. A stone base course is recommended below the asphalt pavement.

Foundation Design for overlook structures:

It is anticipated that footings will be required for the five (5) overlook structures. The loadings of these structures are not known to us at this time. However, as per Mr. Jim Stevenson these structures will be of light load. Borings B-2, B-5, B-6, B-7, B-8 and B-11 were drilled close to the vicinity of proposed overlook structures. For a shallow based foundation system the bearing materials below a frost depth of 3.5 feet would mostly consist of stiff to very stiff Clay which is considered suitable to support the footings. Recommended Net allowable bearing pressure for the soil at each overlook structure is presented in the following table.

Overlook Structure No.	Corresponding Boring No.	Net Allowable Bearing Pressure (psf)
Structure No.1	B-2	2,500
Structure No.2	B-5	3,500
Structure No.3	B-6	2,500
Structure No.4	B-7 & B-8	4,000
Structure No.5	B-11	4,000

The footing subgrade at each location should be carefully observed and tested by a Geotechnical Engineer or experienced Soils Technician. The subgrade soil should be evaluated using a hand auger probe to at least 2 to 3 feet below the bottom of proposed footings. The settlement of footings, designed in accordance with our recommendations is anticipated to be in the range of 1 inch or less, with the maximum differential settlement expected to be half of the total settlement.

Foundation Subgrade Evaluation and Construction:

Care should be exercised as not to disturb the clayey bearing materials, encountered at the bottom of footing excavation. The bearing soils should be carefully evaluated after foundation excavation, and any soft, or otherwise unsuitable material if encountered should be undercut down to competent soil. The required excavation to remove unstable or low bearing materials if encountered should be carried out covering a zone within a 1 horizontal to 1 vertical plane extended downward and outward from the outer limits of the proposed footings. The over excavated areas should then be replaced with a compacted load bearing engineered fill.

All footing excavations should be protected from freezing conditions and maintained free of ponded water before concrete placement. The footings should be cast as soon as possible after excavation is prepared, and backfilled after the concrete has attained its strength.

Engineered Fill:

Engineered fill should be comprised of well-graded, crushed limestone, free of organic or other objectionable materials, with a maximum particle size of 1½ inch, grading down to fines but not having more than 10 percent of particles finer than the No. 200 sieve, such an IDOT CA-6 size crushed stone. Engineered fill should be placed in essentially horizontal lifts not exceeding 9 inches in loose thickness. Each lift should be compacted to at least 95 percent of the maximum dry density as determined in the laboratory by the "Modified Proctor" compaction test, ASTM D1557.

Proposed Pedestrian Bridge:

A 5 ton timber pile supported pedestrian bridge is proposed over the Schenck Ravine. As per the data provided by Mr. Jim Stevenson, the bridge will be supported on 9" butt pilings with 3 pilings per bents. The bridge will be 12 feet wide, 230 feet long and 43 feet high. Boring B-16 was drilled at the location of North Abutment. Very Stiff to Hard brown to gray Silty Clay/Silty Clay Loam was noted from ground surface through the boring termination depth of 50 feet at this location. Very Stiff to Hard Clay is considered suitable material to support the proposed bridge abutment. Allowable pile capacity in kips for various pile lengths is shown in the following table. The pile capacity was calculated using a procedure developed by FHWA (FHWA-HI-97-013) with a factor safety value of 3.0.

Estimated Pile Length (ft)	Allowable Pile Capacity (Kips)
7.5	21
10	32
12.5	45
15.0	59
17.5	79
20	100

CONSTRUCTION CONSIDERATIONS

OSHA regulations regarding soil excavation should be followed and is the responsibility of the contractor. Excavations exceeding a depth of 5 feet will need to be appropriately sloped or benched. Groundwater is not considered a significant concern during construction.

Construction Observation

It is recommended that full time construction observation be provided during earthworks construction by a Geotechnical Engineering firm which is familiar with the subsurface conditions and design criteria. Since the intent of the design recommendations is best understood by CTL, it is imperative to involve CTL in the construction process. The construction observation services which could be provided at an additional cost should include the observation and documentation of all phases of construction, evaluation of bearing materials, subgrade preparation, proof-rolling, placement and compaction of engineered fill and density tests on asphalt pavement. CTL will be pleased to provide these services, if requested.

CLOSURE

The conclusions and recommendations presented in this report are based upon the assumption that the subsurface conditions do not deviate appreciably from those disclosed by the soil borings, and are also based upon the premise of competent field engineering, monitoring and testing during construction.

The professional services provided in connection with this project were performed in a manner consistent with the level of care and skill ordinarily exercised by an engineering firm. The opinions and conclusions presented in this report are based upon visual observations, limited testing and engineering judgement. No other representation, warranty, or guarantee is intended.

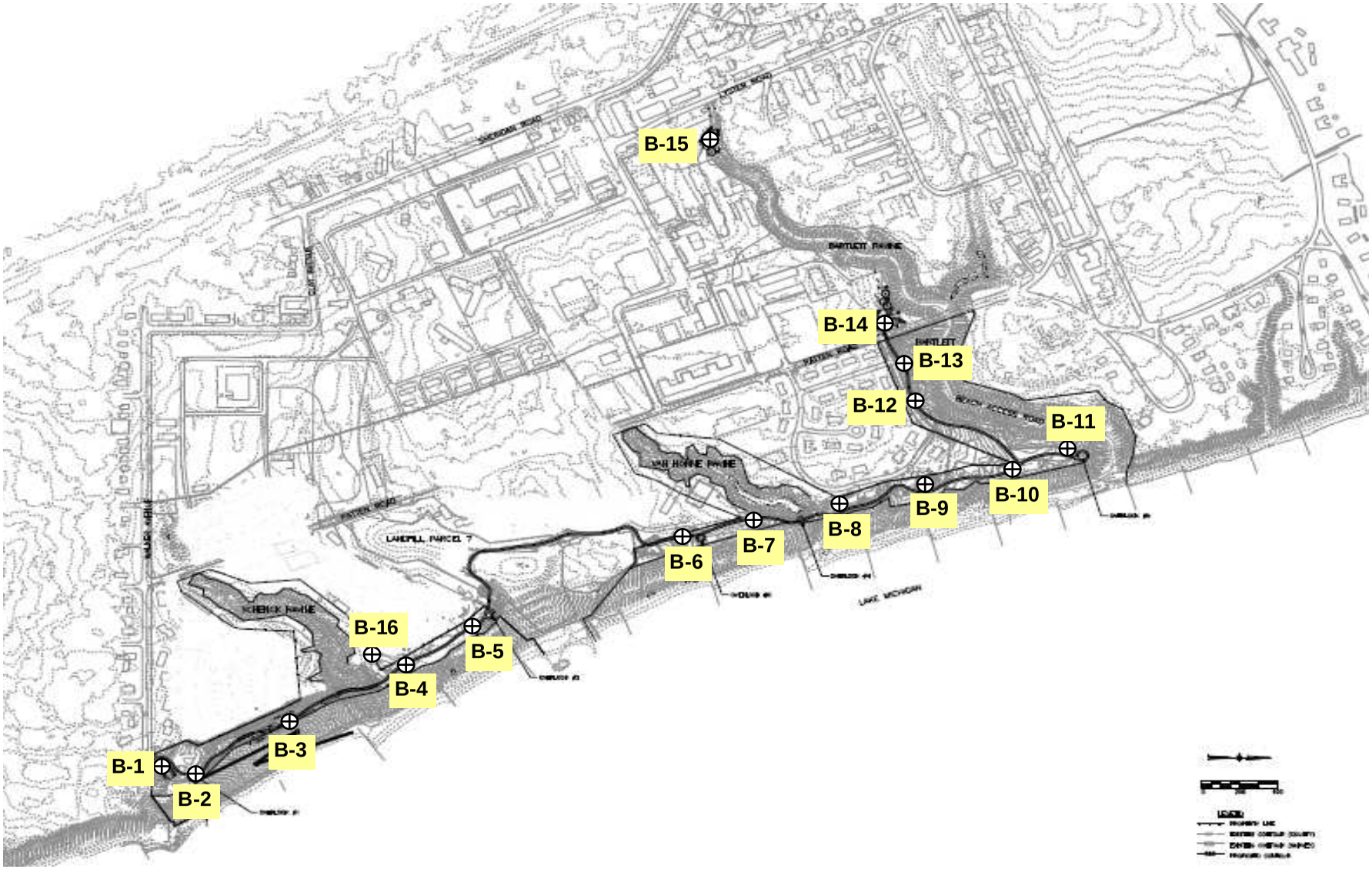
We appreciate the opportunity to be of service to you. If you have any questions regarding this report or if we may be of additional service, please do not hesitate to call our office.

Sincerely,
CHICAGO TESTING LABORATORY, INC.

Tahir Munawar
Geotechnical Engineer

Christopher Chan, P.E.
Senior Geotechnical Engineer

Appendix - A
Site and Boring Location Plan



CHICAGO TESTING LABORATORY, INC.	**SITE AND BORING LOCATION PLAN**	**EXHIBIT:** A	**DRAFTER:** TM	**PROJECT NO.** 10EG204
	Openlands Lakeshore Preserve **Highland park/Fort Sheridan, IL.**	**LEGEND:** ⊕ Approximate Boring Location	**ENGINEER:** CC	**SCALE:** NTS
			REVISION:	**DATE:** 5/6/2010

Appendix - B

Log of Borings
(Borings B-1 through B-16)

Project: Lake Shore Preserve
Project Location: Highland Park, IL
Project Number: 10EG204

Chicago Testing Laboratory, Inc.

Log of Boring B-1

Sheet 1 of 1

Date(s) Drilled	April 20, 2010	Logged By	S.E.	Checked By	Tahir Munawar
Drilling Method	Continuous Flight Auger	Drill Bit Size/Type	3-1/4 inch soil bit	Total Depth of Borehole	7.5 feet bgs
Drill Rig Type	CME 45	Drilling Contractor	i. e. xploration, llc	Approximate Surface Elevation	
Groundwater Level and Date Measured	Not Encountered ATD	Sampling Method(s)	SPT	Hammer Data	140 lb, 30 in drop, auto trip
Borehole Backfill	Cuttings	Location	See Boring Location Plan		

Elevation, feet	Depth, feet	Sample Type	Sample Number	N-Value (blows per foot)	Recovery (inches)	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Qp (tsf)	LL, %	PI, %	REMARKS AND OTHER TESTS
	0						2" Black Clayey Topsoil					
							Brown with streaks of grey Silty CLAY, trace gravel					
			SS-1	9	18			21	3.25	48	18	
			SS-2	14	18			16	4.0			
	5		SS-3	20	18			15	4.5+			
							Bottom of Boring at 7.5 feet bgs					
	10											
	15											
	20											
	25											

Figure B-1

P:\ElkGrove\Geo (200 Series)\2010 Soils Reports\10EG204 Lakeshore Preserve Project\Boring Logs.bgs [Boring Log - 3 Lab Modified.tpl]

Project: Lake Shore Preserve
Project Location: Highland Park, IL
Project Number: 10EG204

Chicago Testing Laboratory, Inc.

Log of Boring B-2

Sheet 1 of 1

Date(s) Drilled	April 20, 2010	Logged By	S.E.	Checked By	Tahir Munawar
Drilling Method	Continuous Flight Auger	Drill Bit Size/Type	3-1/4 inch soil bit	Total Depth of Borehole	7.5 feet bgs
Drill Rig Type	CME 45	Drilling Contractor	i. e. xploration, llc	Approximate Surface Elevation	
Groundwater Level and Date Measured	Not Encountered ATD	Sampling Method(s)	SPT	Hammer Data	140 lb, 30 in drop, auto trip
Borehole Backfill	Cuttings	Location	See Boring Location Plan		

Elevation, feet	Depth, feet	Sample Type	Sample Number	N-Value (blows per foot)	Recovery (inches)	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Qp (tsf)	LL, %	PI, %	REMARKS AND OTHER TESTS
	0						3" Black Clayey Topsoil					
			SS-1	7	16		Brown Silty CLAY, very stiff, trace gravel	17	3.0			
			SS-2	14	18		Brown and grey Silty CLAY, trace to little gravel	19	1.5			
	5		SS-3	16	18		Brown Silty Clay LOAM, trace fine gravel, hard	15	4.5+			
							Bottom of Boring at 7.5 feet bgs					
	10											
	15											
	20											
	25											

Figure B-2

P:\ElkGrove\Geo (200 Series)\2010 Soils Reports\10EG204 Lakeshore Preserve Project\Boring Logs.bgs [Boring Log - 3 Lab Modified.tpl]

Project: Lake Shore Preserve
Project Location: Highland Park, IL
Project Number: 10EG204

Chicago Testing Laboratory, Inc.

Log of Boring B-3

Sheet 1 of 1

Date(s) Drilled	April 20, 2010	Logged By	S.E.	Checked By	Tahir Munawar
Drilling Method	Continuous Flight Auger	Drill Bit Size/Type	3-1/4 inch soil bit	Total Depth of Borehole	7.5 feet bgs
Drill Rig Type	CME 45	Drilling Contractor	i. e. xploration, llc	Approximate Surface Elevation	
Groundwater Level and Date Measured	Not Encountered ATD	Sampling Method(s)	SPT	Hammer Data	140 lb, 30 in drop, auto trip
Borehole Backfill	Cuttings	Location	See Boring Location Plan		

Elevation, feet	Depth, feet	Sample Type	Sample Number	N-Value (blows per foot)	Recovery (inches)	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Qp (tsf)	LL, %	PI, %	REMARKS AND OTHER TESTS
	0						3" Dark Brown Silty Clayey Topsoil					
			SS-1	7	18		Brown with streaks of grey Silty CLAY, very stiff to medium stiff, trace fine gravel	17	3.25			
			SS-2	5	14			20	0.75			
	5						Grey Silty Clay LOAM, trace gravel, very stiff					
			SS-3	13	18			15	2.5			
							Bottom of Boring at 7.5 feet bgs					
	10											
	15											
	20											
	25											

Figure B-3

P:\ElkGrove\Geo (200 Series)\2010 Soils Reports\10EG204 Lakeshore Preserve Project\Boring Logs.bgs [Boring Log - 3 Lab Modified.tpl]

Project: Lake Shore Preserve
Project Location: Highland Park, IL
Project Number: 10EG204

Chicago Testing Laboratory, Inc.

Log of Boring B-4

Sheet 1 of 1

Date(s) Drilled	April 20, 2010	Logged By	S.E.	Checked By	Tahir Munawar
Drilling Method	Continuous Flight Auger	Drill Bit Size/Type	3-1/4 inch soil bit	Total Depth of Borehole	7.5 feet bgs
Drill Rig Type	CME 45	Drilling Contractor	i. e. xploration, llc	Approximate Surface Elevation	
Groundwater Level and Date Measured	Not Encountered ATD	Sampling Method(s)	SPT	Hammer Data	140 lb, 30 in drop, auto trip
Borehole Backfill	Cuttings	Location	See Boring Location Plan		

Elevation, feet	Depth, feet	Sample Type	Sample Number	N-Value (blows per foot)	Recovery (inches)	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Qp (tsf)	LL, %	PI, %	REMARKS AND OTHER TESTS
	0						2" Black Clayey Topsoil over 6" Brown Silty CLAY, FILL					
			SS-1	9	16		Brown and grey Clay LOAM, very stiff, trace fine gravel	20	2.75	27	14	
			SS-2	14	18		Brown Silty Clay LOAM, trace gravel, hard	15	4.5+			
	5		SS-3	12	18			17	4.5+			
							Bottom of Boring at 7.5 feet bgs					
	10											
	15											
	20											
	25											

Figure B-4

P:\ElkGrove\Geo (200 Series)\2010 Soils Reports\10EG204 Lakeshore Preserve Project\Boring Logs.bgs [Boring Log - 3 Lab Modified.tpl]

Project: Lake Shore Preserve Project Location: Highland Park, IL Project Number: 10EG204	Chicago Testing Laboratory, Inc.	**Log of Boring B-5** Sheet 1 of 1

Date(s) Drilled	April 20, 2010	Logged By	S.E.	Checked By	Tahir Munawar
Drilling Method	Continuous Flight Auger	Drill Bit Size/Type	3-1/4 inch soil bit	Total Depth of Borehole	7.5 feet bgs
Drill Rig Type	CME 45	Drilling Contractor	i. e. xploration, llc	Approximate Surface Elevation	
Groundwater Level and Date Measured	4 feet ATD	Sampling Method(s)	SPT	Hammer Data	140 lb, 30 in drop, auto trip
Borehole Backfill	Cuttings	Location	See Boring Location Plan		

Elevation, feet	Depth, feet	Sample Type	Sample Number	N-Value (blows per foot)	Recovery (inches)	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Qp (tsf)	LL, %	PI, %	REMARKS AND OTHER TESTS
	0						5" Dark Brown to Black Clayey Topsoil (possible FILL)					
			SS-1	15	18		Brown (with streaks of white) Silty CLAY, hard	15	4.5+			
			SS-2	10	18		Brown Clayey SILT, damp, very stiff (ATD)	18	2.25			
	5											
			SS-3	20	18		Brown Silty Clay LOAM, trace fine gravel	16	4.0			
							Bottom of Boring at 7.5 feet bgs					
	10											
	15											
	20											
	25											

Figure B-5

P:\ElkGrove\Geo (200 Series)\2010 Soils Reports\10EG204 Lakeshore Preserve Project\Boring Logs.bgs [Boring Log - 3 Lab Modified.tpl]

Project: Lake Shore Preserve **Project Location: Highland Park, IL** **Project Number: 10EG204**	Chicago Testing Laboratory, Inc.	**Log of Boring B-6** Sheet 1 of 1

Date(s) Drilled	April 20, 2010	Logged By	S.E.	Checked By	Tahir Munawar
Drilling Method	Continuous Flight Auger	Drill Bit Size/Type	3-1/4 inch soil bit	Total Depth of Borehole	7.5 feet bgs
Drill Rig Type	CME 45	Drilling Contractor	i. e. xploration, llc	Approximate Surface Elevation	
Groundwater Level and Date Measured	Not Encountered ATD	Sampling Method(s)	SPT	Hammer Data	140 lb, 30 in drop, auto trip
Borehole Backfill	Cuttings	Location	See Boring Location Plan		

Elevation, feet	Depth, feet	Sample Type	Sample Number	N-Value (blows per foot)	Recovery (inches)	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Qp (tsf)	LL, %	PI, %	REMARKS AND OTHER TESTS
	0						Brown Clay LOAM, stiff (possible FILL)					No Topsoil observed
			SS-1	5	16			17	1.25			
			SS-2	9	18		Brown and grey Silty CLAY, trace gravel, very stiff	22	1.25			
	5		SS-3	9	18			12	2.75			
							Bottom of Boring at 7.5 feet bgs					
	10											
	15											
	20											
	25											

Figure B-6

P:\ElkGrove\Geo (200 Series)\2010 Soils Reports\10EG204 Lakeshore Preserve Project\Boring Logs.bgs [Boring Log - 3 Lab Modified.tpl]

Project: Lake Shore Preserve
Project Location: Highland Park, IL
Project Number: 10EG204

Chicago Testing Laboratory, Inc.

Log of Boring B-7

Sheet 1 of 1

Date(s) Drilled	April 20, 2010	Logged By	S.E.	Checked By	Tahir Munawar
Drilling Method	Continuous Flight Auger	Drill Bit Size/Type	3-1/4 inch soil bit	Total Depth of Borehole	7.5 feet bgs
Drill Rig Type	CME 45	Drilling Contractor	i. e. xploration, llc	Approximate Surface Elevation	
Groundwater Level and Date Measured	Not Encountered ATD	Sampling Method(s)	SPT	Hammer Data	140 lb, 30 in drop, auto trip
Borehole Backfill	Cuttings	Location	See Boring Location Plan		

Elevation, feet	Depth, feet	Sample Type	Sample Number	N-Value (blows per foot)	Recovery (inches)	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Qp (tsf)	LL, %	PI, %	REMARKS AND OTHER TESTS
	0						Brown to dark brown and black Silty CLAY, stiff, FILL					
			SS-1	9	18		Brown to dark brown Silty Clay LOAM, very stiff	26	1.25			
							Brown with streaks of grey Silty CLAY, trace gravel					
			SS-2	13	18			19	3.75			
	5											
			SS-3	21	18			15	4.5+			
							Bottom of Boring at 7.5 feet bgs					
	10											
	15											
	20											
	25											

Figure B-7

P:\ElkGrove\Geo (200 Series)\2010 Soils Reports\10EG204 Lakeshore Preserve Project\Boring Logs.bgs [Boring Log - 3 Lab Modified.tpl]

Project: Lake Shore Preserve
Project Location: Highland Park, IL
Project Number: 10EG204

Chicago Testing Laboratory, Inc.

Log of Boring B-8

Sheet 1 of 1

Date(s) Drilled	April 21, 2010	Logged By	S.E.	Checked By	Tahir Munawar
Drilling Method	Continuous Flight Auger	Drill Bit Size/Type	3-1/4 inch soil bit	Total Depth of Borehole	7.5 feet bgs
Drill Rig Type	CME 45	Drilling Contractor	i. e. xploration, llc	Approximate Surface Elevation	
Groundwater Level and Date Measured	Not Encountered ATD	Sampling Method(s)	SPT	Hammer Data	140 lb, 30 in drop, auto trip
Borehole Backfill	Cuttings	Location	See Boring Location Plan		

Elevation, feet	Depth, feet	Sample Type	Sample Number	N-Value (blows per foot)	Recovery (inches)	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Qp (tsf)	LL, %	PI, %	REMARKS AND OTHER TESTS
	0						9" Dark Brown Silty CLAY mixed with Pea Gravel, FILL					
			SS-1	9	18		Brown Clay LOAM, hard, trace gravel, FILL	16	4.5+			
			SS-2	11	18		Grey to Dark Grey Silty and Sandy CLAY, trace black cinders and brick fragments, hard, FILL	17	4.5+			
	5		SS-3	10	18		Brown with grey Silty CLAY, trace gravel, hard	18	4.5+			
							Bottom of Boring at 7.5 feet bgs					
	10											
	15											
	20											
	25											

Figure B-8

P:\ElkGrove\Geo (200 Series)\2010 Soils Reports\10EG204 Lakeshore Preserve Project\Boring Logs.bgs [Boring Log - 3 Lab Modified.tpl]

Project: Lake Shore Preserve
Project Location: Highland Park, IL
Project Number: 10EG204

Chicago Testing Laboratory, Inc.

Log of Boring B-9

Sheet 1 of 1

Date(s) Drilled	April 21, 2010	Logged By	S.E.	Checked By	Tahir Munawar
Drilling Method	Continuous Flight Auger	Drill Bit Size/Type	3-1/4 inch soil bit	Total Depth of Borehole	7.5 feet bgs
Drill Rig Type	CME 45	Drilling Contractor	i. e. xploration, llc	Approximate Surface Elevation	
Groundwater Level and Date Measured	Not Encountered ATD	Sampling Method(s)	SPT	Hammer Data	140 lb, 30 in drop, auto trip
Borehole Backfill	Cuttings	Location	See Boring Location Plan		

Elevation, feet	Depth, feet	Sample Type	Sample Number	N-Value (blows per foot)	Recovery (inches)	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Qp (tsf)	LL, %	PI, %	REMARKS AND OTHER TESTS
	0						6" Dark Brown Silty CLAY mixed with Pea Gravel, FILL					
			SS-1	6	18		Brown Silty CLAY, very stiff, trace fine gravel, FILL	17	3.5			
			SS-2	7	18		Brown to dark brown with traces of black Silty CLAY, trace fine sand, stiff	29	1.5			
	5		SS-3	20	18		Brown and grey Silty Clay LOAM, trace gravel, hard	15	4.25			
							Bottom of Boring at 7.5 feet bgs					
	10											
	15											
	20											
	25											

Figure B-9

P:\ElkGrove\Geo (200 Series)\2010 Soils Reports\10EG204 Lakeshore Preserve Project\Boring Logs.bgs [Boring Log - 3 Lab Modified.tpl]

Project: Lake Shore Preserve
Project Location: Highland Park, IL
Project Number: 10EG204

Chicago Testing Laboratory, Inc.

Log of Boring B-10

Sheet 1 of 1

Date(s) Drilled	April 21, 2010	Logged By	S.E.	Checked By	Tahir Munawar
Drilling Method	Continuous Flight Auger	Drill Bit Size/Type	3-1/4 inch soil bit	Total Depth of Borehole	7.5 feet bgs
Drill Rig Type	CME 45	Drilling Contractor	i. e. xploration, llc	Approximate Surface Elevation	
Groundwater Level and Date Measured	Not Encountered ATD	Sampling Method(s)	SPT	Hammer Data	140 lb, 30 in drop, auto trip
Borehole Backfill	Cuttings	Location	See Boring Location Plan		

Elevation, feet	Depth, feet	Sample Type	Sample Number	N-Value (blows per foot)	Recovery (inches)	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Qp (tsf)	LL, %	PI, %	REMARKS AND OTHER TESTS
	0						6" Black Silty CLAY Topsoil, FILL					
			SS-1	10	16		Brown to dark brown LOAM, trace gravel, hard, FILL	17	4.5+	28	15	
			SS-2	6	18		Brown Silty CLAY, hard, trace gravel	17	4.5+			
	5		SS-3	12	18			15	4.5+			
							Bottom of Boring at 7.5 feet bgs					
	10											
	15											
	20											
	25											

Figure B-10

P:\ElkGrove\Geo (200 Series)\2010 Soils Reports\10EG204 Lakeshore Preserve Project\Boring Logs.bgs [Boring Log - 3 Lab Modified.tpl]

Project: Lake Shore Preserve **Project Location: Highland Park, IL** **Project Number: 10EG204**	Chicago Testing Laboratory, Inc.	**Log of Boring B-11** Sheet 1 of 1

Date(s) Drilled	April 21, 2010	Logged By	S.E.	Checked By	Tahir Munawar
Drilling Method	Continuous Flight Auger	Drill Bit Size/Type	3-1/4 inch soil bit	Total Depth of Borehole	7.5 feet bgs
Drill Rig Type	CME 45	Drilling Contractor	i. e. xploration, llc	Approximate Surface Elevation	
Groundwater Level and Date Measured	Not Encountered ATD	Sampling Method(s)	SPT	Hammer Data	140 lb, 30 in drop, auto trip
Borehole Backfill	Cuttings	Location	See Boring Location Plan		

Elevation, feet	Depth, feet	Sample Type	Sample Number	N-Value (blows per foot)	Recovery (inches)	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Qp (tsf)	LL, %	PI, %	REMARKS AND OTHER TESTS
	0						5" Dark Brown Silty CLAY Topsoil					
							Brown Sandy Clay LOAM, medium stiff to stiff					
			SS-1	4	18			22	0.75			
							Brown Silty CLAY, very stiff to hard, trace fine gravel					
			SS-2	7	18			18	3.0			
	5											
			SS-3	10	18			16	4.5+			
							Bottom of Boring at 7.5 feet bgs					
	10											
	15											
	20											
	25											

Figure B-11

P:\ElkGrove\Geo (200 Series)\2010 Soils Reports\10EG204 Lakeshore Preserve Project\Boring Logs.bgs [Boring Log - 3 Lab Modified.tpl]

Project: Lake Shore Preserve
Project Location: Highland Park, IL
Project Number: 10EG204

Chicago Testing Laboratory, Inc.

Log of Boring B-12

Sheet 1 of 1

Date(s) Drilled	April 21, 2010	Logged By	S.E.	Checked By	Tahir Munawar
Drilling Method	Continuous Flight Auger	Drill Bit Size/Type	3-1/4 inch soil bit	Total Depth of Borehole	7.5 feet bgs
Drill Rig Type	CME 45	Drilling Contractor	i. e. xploration, llc	Approximate Surface Elevation	
Groundwater Level and Date Measured	Not Encountered ATD	Sampling Method(s)	SPT	Hammer Data	140 lb, 30 in drop, auto trip
Borehole Backfill	Cuttings	Location	See Boring Location Plan		

Elevation, feet	Depth, feet	Sample Type	Sample Number	N-Value (blows per foot)	Recovery (inches)	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Qp (tsf)	LL, %	PI, %	REMARKS AND OTHER TESTS
	0						6" Black Silty CLAY Topsoil					
							Brown with streaks of grey Silty CLAY, very stiff to hard, trace fine gravel					
			SS-1	8	18			23	2.0			
			SS-2	13	16			15	4.5+			
	5											
			SS-3	21	18			15	4.5+			
							Bottom of Boring at 7.5 feet bgs					
	10											
	15											
	20											
	25											

Figure B-12

P:\ElkGrove\Geo (200 Series)\2010 Soils Reports\10EG204 Lakeshore Preserve Project\Boring Logs.bgs [Boring Log - 3 Lab Modified.tpl]

Project: Lake Shore Preserve Project Location: Highland Park, IL Project Number: 10EG204	Chicago Testing Laboratory, Inc.

Log of Boring B-13

Sheet 1 of 1

Date(s) Drilled	April 21, 2010	Logged By	S.E.	Checked By	Tahir Munawar
Drilling Method	Continuous Flight Auger	Drill Bit Size/Type	3-1/4 inch soil bit	Total Depth of Borehole	7.5 feet bgs
Drill Rig Type	CME 45	Drilling Contractor	i. e. xploration, llc	Approximate Surface Elevation	
Groundwater Level and Date Measured	Not Encountered ATD	Sampling Method(s)	SPT	Hammer Data	140 lb, 30 in drop, auto trip
Borehole Backfill	Cuttings	Location	See Boring Location Plan		

Elevation, feet	Depth, feet	Sample Type	Sample Number	N-Value (blows per foot)	Recovery (inches)	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Qp (tsf)	LL, %	PI, %	REMARKS AND OTHER TESTS
	0						12" Black Silty CLAY Topsoil, FILL					
			SS-1	11	18		Black SAND, Cinders and GRAVEL, FILL	27				
			SS-2	15	18		Brown with streaks of grey Silty CLAY, very stiff to hard, trace gravel	17	3.75			
	5		SS-3	20	18			16	4.5+			
							Bottom of Boring at 7.5 feet bgs					
	10											
	15											
	20											
	25											

Figure B-13

P:\ElkGrove\Geo (200 Series)\2010 Soils Reports\10EG204 Lakeshore Preserve Project\Boring Logs.bgs [Boring Log - 3 Lab Modified.tpl]

Project: Lake Shore Preserve
Project Location: Highland Park, IL
Project Number: 10EG204

Chicago Testing Laboratory, Inc.

Log of Boring B-14

Sheet 1 of 1

Date(s) Drilled	April 21, 2010	Logged By	S.E.	Checked By	Tahir Munawar
Drilling Method	Continuous Flight Auger	Drill Bit Size/Type	3-1/4 inch soil bit	Total Depth of Borehole	7.5 feet bgs
Drill Rig Type	CME 45	Drilling Contractor	i. e. xploration, llc	Approximate Surface Elevation	
Groundwater Level and Date Measured	Not Encountered ATD	Sampling Method(s)	SPT	Hammer Data	140 lb, 30 in drop, auto trip
Borehole Backfill	Cuttings	Location	See Boring Location Plan		

Elevation, feet	Depth, feet	Sample Type	Sample Number	N-Value (blows per foot)	Recovery (inches)	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Qp (tsf)	LL, %	PI, %	REMARKS AND OTHER TESTS
	0						8" Black Silty CLAY Topsoil, FILL					
							Black Silty CLAY mixed with gravel, FILL					
			SS-1	9	18		Brown Silty CLAY, very stiff, trace sand, trace gravel	20	3.5			
			SS-2	16	18		Brown with streaks of grey Silty CLAY, hard	16	4.5+			
	5		SS-3	20	18			16	4.5+			
							Bottom of Boring at 7.5 feet bgs					
	10											
	15											
	20											
	25											

Figure B-14

P:\ElkGrove\Geo (200 Series)\2010 Soils Reports\10EG204 Lakeshore Preserve Project\Boring Logs.bgs [Boring Log - 3 Lab Modified.tpl]

Project: Lake Shore Preserve
Project Location: Highland Park, IL
Project Number: 10EG204

Chicago Testing Laboratory, Inc.

Log of Boring B-15

Sheet 1 of 1

Date(s) Drilled	April 21, 2010	Logged By	S.E.	Checked By	Tahir Munawar
Drilling Method	Continuous Flight Auger	Drill Bit Size/Type	3-1/4 inch soil bit	Total Depth of Borehole	7.5 feet bgs
Drill Rig Type	CME 45	Drilling Contractor	i. e. xploration, llc	Approximate Surface Elevation	
Groundwater Level and Date Measured	Not Encountered ATD	Sampling Method(s)	SPT	Hammer Data	140 lb, 30 in drop, auto trip
Borehole Backfill	Cuttings	Location	See Boring Location Plan		

Elevation, feet	Depth, feet	Sample Type	Sample Number	N-Value (blows per foot)	Recovery (inches)	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Qp (tsf)	LL, %	PI, %	REMARKS AND OTHER TESTS
	0						3-3/4" Asphalt					
							Grey Crushed Stone mixed with some CLAY, FILL					
			SS-1	9	0		Brown Silty CLAY, Stiff, FILL	19				No recovery in sampler, auger sample.
							Grey to dark grey Silty CLAY, very stiff, FILL					
			SS-2	8	18			23	2.0			
	5						Brown and grey Silty CLAY, trace gravel, very stiff	17	2.75			
			SS-3	9	18			22	2.0			
							Bottom of Boring at 7.5 feet bgs					
	10											
	15											
	20											
	25											

Figure B-15

P:\ElkGrove\Geo (200 Series)\2010 Soils Reports\10EG204 Lakeshore Preserve Project\Boring Logs.bgs [Boring Log - 3 Lab Modified.lpl]

Project: Lake Shore Preserve
Project Location: Highland Park, IL
Project Number: 10EG204

Chicago Testing Laboratory, Inc.

Log of Boring B-16

Sheet 1 of 2

Date(s) Drilled	April 21, 2010	Logged By	S.E.	Checked By	Tahir Munawar
Drilling Method	Continuous Flight Auger	Drill Bit Size/Type	3-1/4 inch soil bit	Total Depth of Borehole	50 feet bgs
Drill Rig Type	CME 45	Drilling Contractor	i. e. xploration, llc	Approximate Surface Elevation	
Groundwater Level and Date Measured	23.5 feet ATD	Sampling Method(s)	SPT	Hammer Data	140 lb, 30 in drop, auto trip
Borehole Backfill	Cuttings	Location	See Boring Location Plan		

Elevation, feet	Depth, feet	Sample Type	Sample Number	N-Value (blows per foot)	Recovery (inches)	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Qp (tsf)	LL, %	PI, %	REMARKS AND OTHER TESTS
	0						Brown Silty CLAY, stiff					No Topsoil observed
			SS-1	5	16			22	1.25			
							Brown and Grey Silty CLAY, trace sand, trace fine gravel, very stiff to hard					
			SS-2	8	18			15	4.5+			
	5											
			SS-3	15	18			16	4.5+			
			SS-4	19	18			15	4.5+			
	10											
			SS-5	25	18			16	4.5+			
							Grey Silty Clay LOAM, trace gravel, trace shale, very stiff to hard					
			SS-6	14	18			15	3.5			
	15											
			SS-7	13	18			15	3.0			
			SS-8	15	18			15	3.75	31	14	
	20											
			SS-9	11	18			15	3.5			
							(ATD)					
			SS-10	15	14			15	3.25			
	25											

Figure B-16

P:\ElkGrove\Geo (200 Series)\2010 Soils Reports\10EG204 Lakeshore Preserve Project\Boring Logs.bgs [Boring Log - 3 Lab Modified.tpl]

Project: Lake Shore Preserve
Project Location: Highland Park, IL
Project Number: 10EG204

Chicago Testing Laboratory, Inc.

Log of Boring B-16

Elevation, feet	Depth, feet	Sample Type	Sample Number	N-Value (blows per foot)	Recovery (inches)	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Qp (tsf)	LL, %	PI, %	REMARKS AND OTHER TESTS
	25						Grey Silty Clay LOAM, trace gravel, trace shale, very stiff to hard (cont.)					
			SS-11	19	14			14	3.5			
			SS-12	18	18			15	2.5			
	30											
			SS-13	20	18			14	4.0			
	35											
			SS-14	15	18			15	3.5			
	40											
			SS-15	18	18			16	2.0			
	45											
			SS-16	25	18			14	4.5+			
	50						Bottom of Boring at 50 feet bgs					

Figure B-16

P:\ElkGrove\Geo (200 Series)\2010 Soils Reports\10EG204 Lakeshore Preserve Project\Boring Logs.bgs [Boring Log - 3 Lab Modified.tpl]

Project: Lake Shore Preserve
Project Location: Highland Park, IL
Project Number: 10EG204

Chicago Testing Laboratory, Inc.

Key to Log of Boring

Elevation, feet	Depth, feet	Sample Type	Sample Number	N-Value (blows per foot)	Recovery (inches)	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Qp (tsf)	LL, %	PI, %	REMARKS AND OTHER TESTS
1	2	3	4	5	6	7	8	9	10	11	12	13

COLUMN DESCRIPTIONS

1 **Elevation, feet:** Elevation (MSL, feet)

2 **Depth, feet:** Depth in feet below the ground surface.

3 **Sample Type:** Type of soil sample collected.

4 **Sample Number:** Sample identification number.

5 **N-Value (blows per foot):** Number of blows to advance driven sampler one foot (or distance shown) beyond seating interval using the indicated hammer.

6 **Recovery (inches):** Length of representative soil sample recovered in sampler

7 **Graphic Log:** Graphic depiction of material encountered.

8 **MATERIAL DESCRIPTION:** Description of material encountered. May include consistency, moisture, color and other descriptive text.

9 **Water Content, %:** Water content of the soil sample, expressed as percentage of dry weight of sample.

10 **Qp (tsf):** Pocket penetrometer value (tsf)

11 **LL, %:** Liquid Limit, expressed as a water content

12 **PI, %:** Plasticity Index, expressed as a water content

13 **REMARKS AND OTHER TESTS:** Comments and observations regarding drilling or sampling made by driller or field personnel.

FIELD AND LABORATORY TEST ABBREVIATIONS

bgs: Below Ground Surface
SPT: Standard Penetration Test (in general accordance with ASTM D1586)
LL-PL(PL): Liquid Limit- Plastic Limit (Plasticity Index) (in general accordance with ASTM D 4318)
Color: Color(s) are generally representative of samples in moist condition.
Qp: Relative strength measured with a pocket penetrometer on reasonably intact samples of cohesive materials

RIMAC: Unconfined Compressive Strength estimate as determined by the Rimac spring tester as modified by IDOT (Reference IDOT Geotechnical Manual)
Qu: Unconfined Compressive Strength as determined by AASHTO T 208/ASTM D 2166

TYPICAL MATERIAL GRAPHIC SYMBOLS

- Well graded GRAVEL (GW)
- Well graded GRAVEL with Clay (GW-GC)
- Well graded SAND (SW)
- Well graded SAND with Clay (SW-SC)
- Lean CLAY, CLAY w/SAND, SANDY CLAY (CL)
- Lean-Fat CLAY, CLAY w/SAND, SANDY CLAY (CL-CH)
- SILTY CLAY (CL-ML)
- Clayey SAND to Sandy CLAY (SC-CL)
- Silty to Clayey SAND (SM-SC)

TYPICAL SAMPLER GRAPHIC SYMBOLS

- 2-inch-OD unlined split spoon (SPT)
- Shelby Tube (Thin-walled, fixed head)
- Grab Sample

OTHER GRAPHIC SYMBOLS

- Water level (at time of drilling, ATD)
- Water level (after waiting a given time)
- Minor change in material properties within a stratum
- Inferred or gradational contact between strata
- Queried contact between strata

GENERAL NOTES

1. Material descriptions were prepared based, in part, upon the USDA Textural Classification Chart. Descriptions are interpretive by nature and therefore somewhat subjective based upon the experience of the personnel making the observations. Descriptions of the same sample may vary slightly from person to person. Field descriptions and samples obtained are reviewed by experienced geotechnical engineers or geologists in the laboratory prior to incorporation into a formal report. Descriptions are also influenced by the results of lab testing. Questions regarding material descriptions are welcomed.
2. Changes in lithology (or layering), as shown on the log are influenced by factors such as texture, relative density, strength, color, plasticity and moisture condition. Other factors may also influence the presentation as well. Changes are often inferred or estimated based upon the judgement of experienced personnel. Changes may be gradual or gradational.
3. The final boring log is representative of a thorough effort to communicate accurately the observations made by the field and lab personnel.
4. Test data and observations apply only to the specific boring location at the time the boring was completed. They may not be representative of subsurface conditions at other locations.

P:\ElkGrove\Geo (200 Series)\2010 Soils Reports\10EG204 Lakeshore Preserve Project\Boring Logs.bgs [Boring Log - 3 Lab Modified.tpl]

Appendix - C

Reports of Combined Sieve &Hydrometer Analysis

Chicago Testing Laboratory, Inc.
30W114 Butterfield Road, Warrenville, IL 60555 p 630.393.CTL1 f 630.393.CTL7
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3866 West Dayton Street, Unit A, McHenry, IL 60050 p 815.385.8351 f 815.385.8456
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LAB REPORT

ID #	1004037 (1&2)
CTL PROJECT #	10EG204

PROJECT NAME Lake Shore Preserve CLIENT Clauss Brothers, Inc.
LOCATION Highland Park, IL MATERIAL Soil

Report of Combined Sieve and Hydrometer Analysis

Date: 5/6/2010 Sample Type: Split Spoon
Boring: B-1 Sample #: SS-1 Depth: 1-2.5 ft. bgs
Total Sample Weight (g): 316.3

	Sieve Size:	Cum. Weight Retained	% Retained	% Passing	Total Passing (%)	Diameter (mm)
+ #10 sieve portion	1"	0.00	0.0	100.0	100.0	25.0000
	3/4"	0.00	0.0	100.0	100.0	19.0000
	1/2"	0.00	0.0	100.0	100.0	12.5000
	3/8"	0.00	0.0	100.0	100.0	9.5000
	No. 4	0.30	0.1	99.9	99.9	4.7500
	No. 10	1.50	0.5	99.5	99.5	2.0000
	No. 20	0.40	0.8	99.2	98.7	0.8500
- #10 sieve portion	No. 40	1.00	2.0	98.0	97.5	0.4200
	No. 100	3.70	7.5	92.5	92.0	0.1500
	No. 200	6.00	12.2	87.8	87.4	0.0750

Sample Weight at Start of Hydrometer (g): 49.20 Temperature: 24 °C
Blank Hydrometer Reading: 4.5
Specific Gravity: 2.70 est.

	Elapse Time (min.)	Uncorrected Hydrometer Reading	Corrected Hydrometer Reading	% Passing	Total Passing (%)	Diameter (mm)
Hydrometer Portion	1	46.0	42.5	85.4	85.0	0.0379
	2	45.0	41.5	83.4	83.0	0.0271
	5	42.0	38.5	77.4	77.0	0.0176
	15	38.0	34.5	69.3	69.0	0.0105
	30	35.0	31.5	63.3	63.0	0.0076
	60	32.0	28.5	57.3	57.0	0.0055
	120	29.5	26.0	52.3	52.0	0.0040
	250	26.0	23.0	46.2	46.0	0.0028
	1440	23.0	19.5	39.2	39.0	0.0012

Liquid Limit: 48 **Plastic Limit:** 18 **Plasticity Index:** 30

% Gravel : 1 **% Sand :** 13 **% Silt :** 43 **% Clay :** 43

USDA Textural Soil Classification: **silty clay**

Delivered By: DKS Tested By: DKS/DP Reviewed By: DKS
Date Received: 4/22/10 Date Complete: 5/5/10 Date: 5/6/10

Chicago Testing Laboratory, Inc.
30W114 Butterfield Road, Warrenville, IL 60555 p 630.393.CTL1 f 630.393.CTL7
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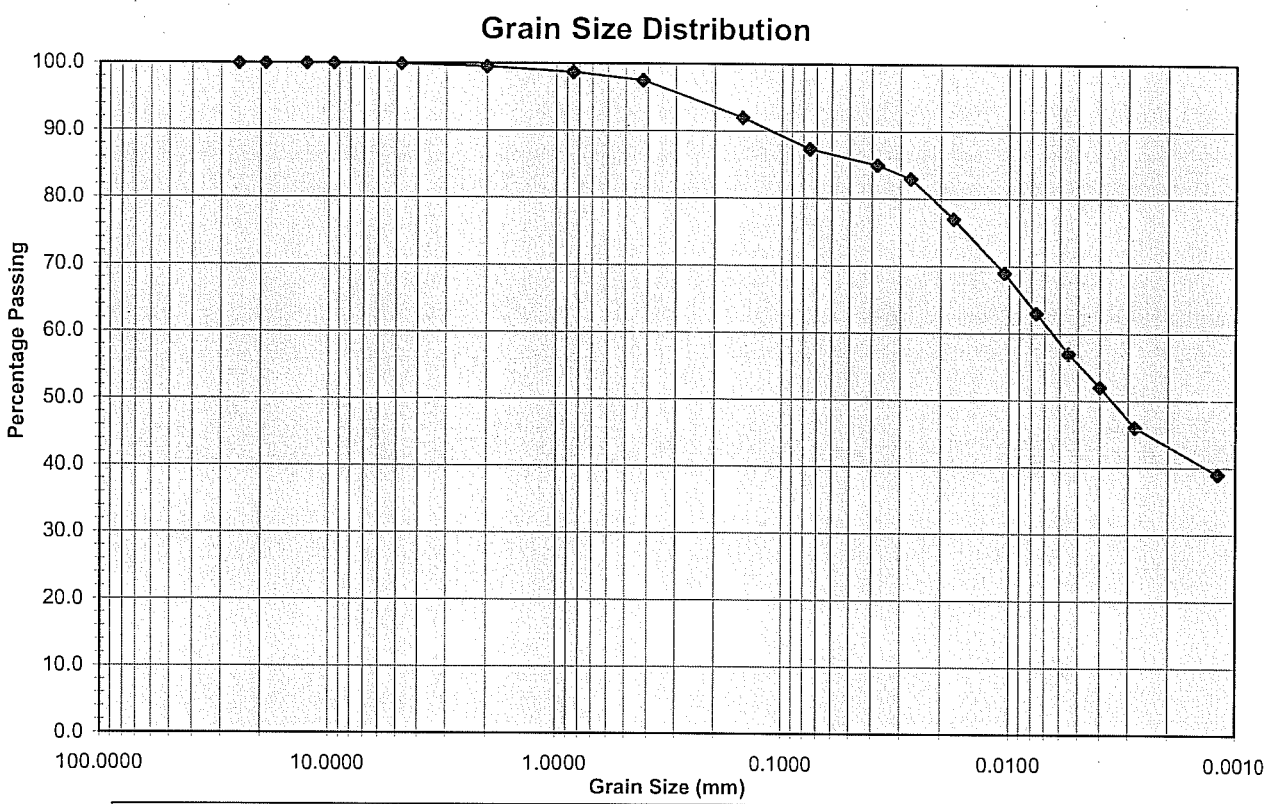
LAB REPORT

ID #	1004037 (1&2)
CTL PROJECT #	10EG204

PROJECT NAME Lake Shore Preserve CLIENT Clauss Brothers, Inc.
LOCATION Highland Park, IL MATERIAL Soil

Report of Combined Sieve and Hydrometer Analysis

Date: 5/6/2010 Sample Type: Split Spoon
Boring: B-1 Sample #: SS-1 Depth: 1-2.5 ft. bgs



Gravel	Sand	Silt	Clay
.			.

Liquid Limit: 48 **Plastic Limit:** 18 **Plasticity Index:** 30 **Group Index:** _____

% Gravel : 1 **% Sand :** 13 **% Silt :** 43 **% Clay :** 43

USDA Textural Soil Classification: **silty clay**

Delivered By: DKS Tested By: DKS/DP Reviewed By: DKS
Date Received: 4/22/10 Date Complete: 5/5/10 Date: 5/6/10

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LAB REPORT

ID #	1004037 (13&14)
CTL PROJECT #	10EG204

PROJECT NAME Lake Shore Preserve CLIENT Clauss Brothers, Inc.
LOCATION Highland Park, IL MATERIAL Soil

Report of Combined Sieve and Hydrometer Analysis

Date: 5/6/2010 Sample Type: Split Spoon
Boring: B-4 Sample #: SS-1 Depth: 1-2.5 ft. bgs
Total Sample Weight (g): 320.2

	Sieve Size:	Cum. Weight Retained	% Retained	% Passing	Total Passing (%)	Diameter (mm)
+ #10 sieve portion	1"	0.00	0.0	100.0	100.0	25.0000
	3/4"	0.00	0.0	100.0	100.0	19.0000
	1/2"	5.60	1.7	98.3	98.3	12.5000
	3/8"	5.60	1.7	98.3	98.3	9.5000
	No. 4	12.60	3.9	96.1	96.1	4.7500
	No. 10	19.80	6.2	93.8	93.8	2.0000
	No. 20	1.50	3.0	97.0	91.0	0.8500
- #10 sieve portion	No. 40	3.90	7.7	92.3	86.6	0.4200
	No. 100	13.00	25.7	74.3	69.7	0.1500
	No. 200	17.60	34.8	65.2	61.2	0.0750

Sample Weight at Start of Hydrometer (g): 50.60
Temperature: 24 °C
Blank Hydrometer Reading: 4.5
Specific Gravity: 2.70 est.

	Elapse Time (min.)	Uncorrected Hydrometer Reading	Corrected Hydrometer Reading	% Passing	Total Passing (%)	Diameter (mm)
Hydrometer Portion	1	34.5	31.0	60.6	56.8	0.0418
	2	32.0	28.5	55.7	52.3	0.0301
	5	29.5	26.0	50.8	47.7	0.0194
	15	25.5	22.0	43.0	40.3	0.0115
	30	23.0	19.5	38.1	35.8	0.0083
	60	20.0	16.5	32.2	30.3	0.0060
	120	18.0	14.5	28.3	26.6	0.0043
	250	16.0	12.5	24.4	22.9	0.0030
	1440	14.0	10.5	20.5	19.3	0.0013

Liquid Limit: 27 **Plastic Limit:** 14 **Plasticity Index:** 13

% Gravel : 6 **% Sand :** 36 **% Silt :** 37 **% Clay :** 21

USDA Textural Soil Classification: **clay loam**

Delivered By: DKS Tested By: DKS/DP Reviewed By: DKS
Date Received: 4/22/10 Date Complete: 5/5/10 Date: 5/6/10

Chicago Testing Laboratory, Inc.
30W114 Butterfield Road, Warrenville, IL 60555 p 630.393.CTL1 f 630.393.CTL7
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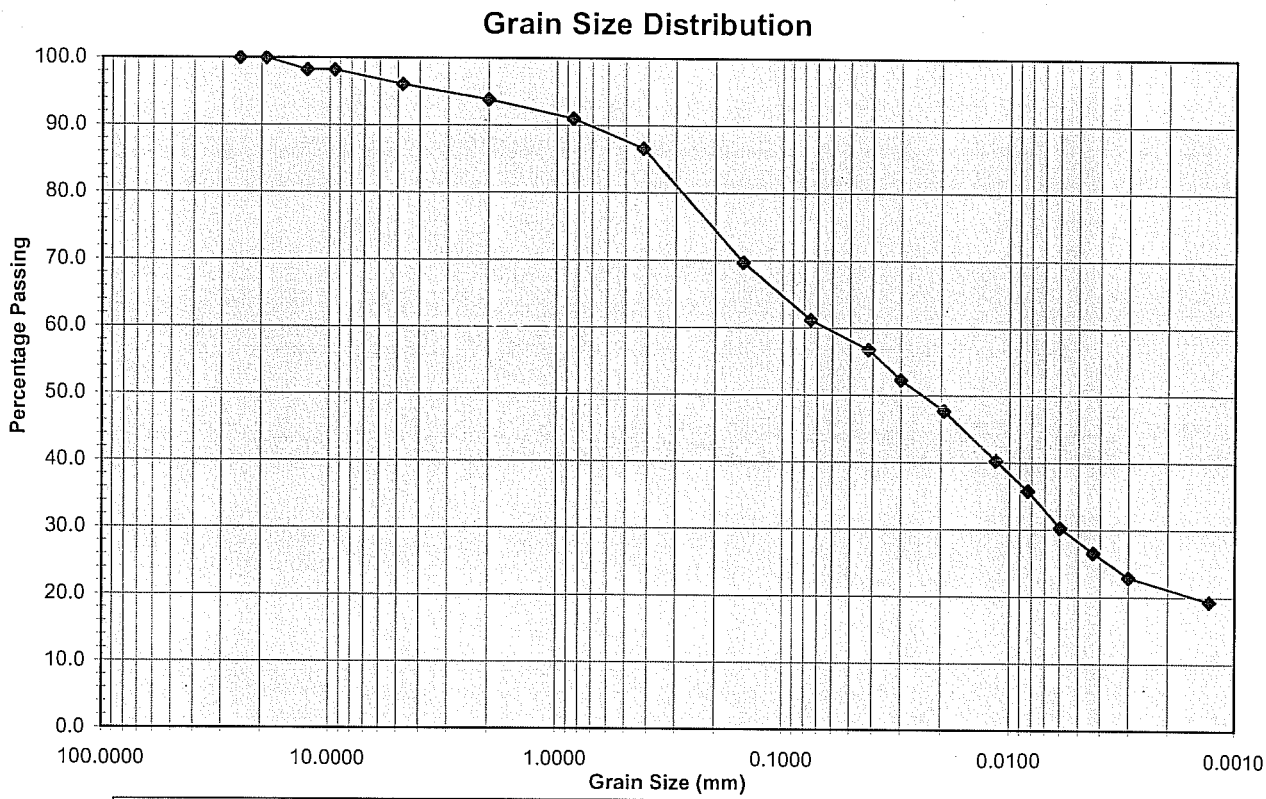
LAB REPORT

ID #	1004037 (13&14)
CTL PROJECT #	10EG204

PROJECT NAME Lake Shore Preserve CLIENT Clauss Brothers, Inc.
LOCATION Highland Park, IL MATERIAL Soil

Report of Combined Sieve and Hydrometer Analysis

Date: 5/6/2010 Sample Type: Split Spoon
Boring: B-4 Sample #: SS-1 Depth: 1-2.5 ft. bgs



Gravel	Sand	Silt	Clay

Liquid Limit: 27 **Plastic Limit:** 14 **Plasticity Index:** 13 **Group Index:** _____

% Gravel : 6 **% Sand :** 36 **% Silt :** 37 **% Clay :** 21

USDA Textural Soil Classification: **clay loam**

Delivered By: DKS Tested By: DKS/DP Reviewed By: DKS
Date Received: 4/22/10 Date Complete: 5/5/10 Date: 5/6/10

Chicago Testing Laboratory, Inc.
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3966 West Dayton Street, Unit A, McHenry, IL 60050 p 815.385.8361 f 815.385.8456
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LAB REPORT

ID #	1004037 (37&38)
CTL PROJECT #	10EG204

PROJECT NAME Lake Shore Preserve CLIENT Clauss Brothers, Inc.
LOCATION Highland Park, IL MATERIAL Soil

Report of Combined Sieve and Hydrometer Analysis

Date: 5/6/2010 Sample Type: Split Spoon
Boring: B-10 Sample #: SS-1 Depth: 1-2.5 ft. bgs
Total Sample Weight (g): 295.1

	Sieve Size:	Cum. Weight Retained	% Retained	% Passing	Total Passing (%)	Diameter (mm)
+ #10 sieve portion	1"	0.00	0.0	100.0	100.0	25.0000
	3/4"	10.20	3.5	96.5	96.5	19.0000
	1/2"	19.50	6.6	93.4	93.4	12.5000
	3/8"	23.70	8.0	92.0	92.0	9.5000
	No. 4	34.20	11.6	88.4	88.4	4.7500
	No. 10	45.60	15.5	84.5	84.5	2.0000
- #10 sieve portion	No. 20	3.30	6.5	93.5	79.0	0.8500
	No. 40	6.50	12.9	87.1	73.6	0.4200
	No. 100	12.20	24.2	75.8	64.1	0.1500
	No. 200	17.90	35.5	64.5	54.5	0.0750

Sample Weight at Start of Hydrometer (g): 50.40
Temperature: 24 °C
Blank Hydrometer Reading: 4.5
Specific Gravity: 2.70 est.

	Elapse Time (min.)	Uncorrected Hydrometer Reading	Corrected Hydrometer Reading	% Passing	Total Passing (%)	Diameter (mm)
Hydrometer Portion	1	32.0	28.5	55.9	47.3	0.0426
	2	31.5	28.0	54.9	46.4	0.0302
	5	27.0	23.5	46.1	39.0	0.0198
	15	24.0	20.5	40.2	34.0	0.0116
	30	21.0	17.5	34.3	29.0	0.0084
	60	18.0	14.5	28.5	24.1	0.0060
	120	16.0	12.5	24.5	20.7	0.0043
	250	13.5	10.0	19.6	16.6	0.0030
	1440	11.5	8.0	15.7	13.3	0.0013

Liquid Limit: 28 **Plastic Limit:** 15 **Plasticity Index:** 13

% Gravel : 15 **% Sand :** 37 **% Silt :** 33 **% Clay :** 15

USDA Textural Soil Classification: **loam**

Delivered By: DKS
Date Received: 4/22/10
Tested By: DKS/DP
Date Complete: 5/5/10
Reviewed By: DKS
Date: 5/6/10

Chicago Testing Laboratory, Inc.
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3966 West Dayton Street, Unit A, McHenry, IL 60050 p 815.385.8351 f 815.385.8456
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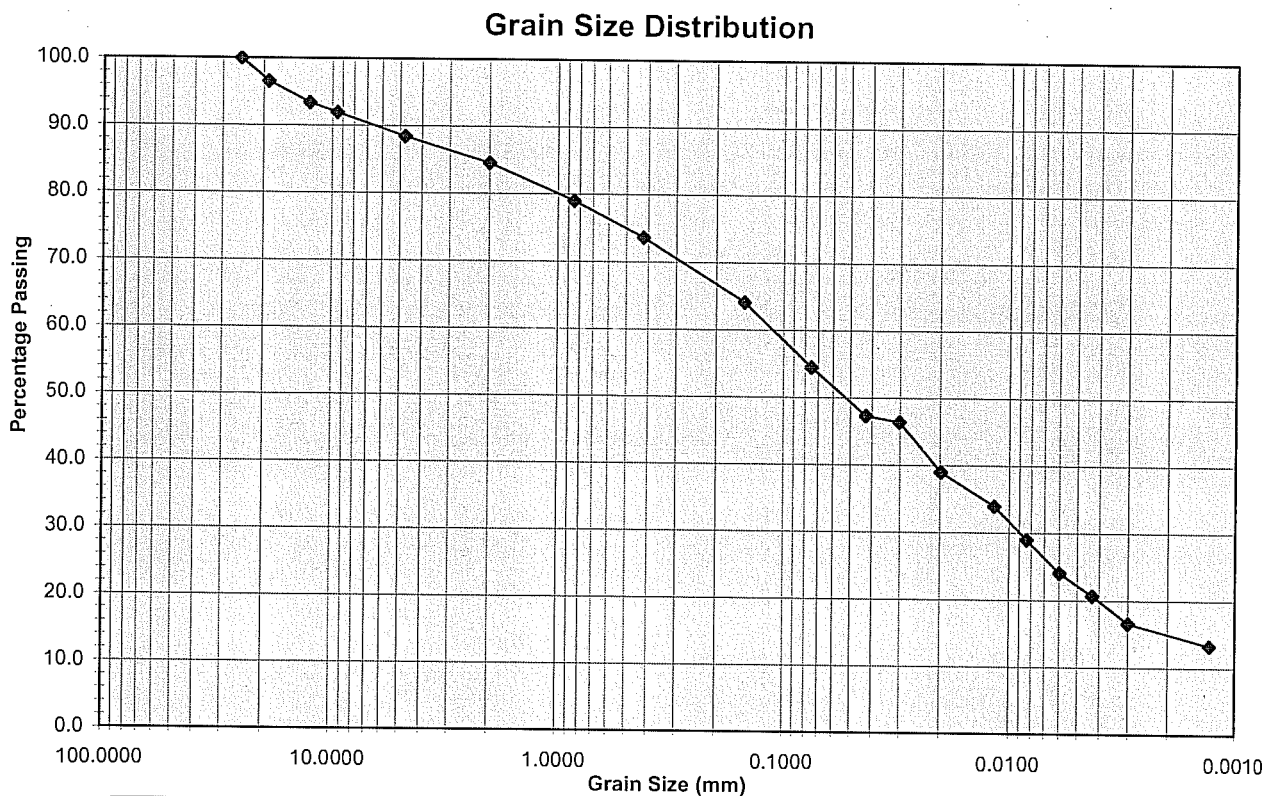
LAB REPORT

ID #	1004037 (37&38)
CTL PROJECT #	10EG204

PROJECT NAME Lake Shore Preserve CLIENT Clauss Brothers, Inc.
LOCATION Highland Park, IL MATERIAL Soil

Report of Combined Sieve and Hydrometer Analysis

Date: 5/6/2010 Sample Type: Split Spoon
Boring: B-10 Sample #: SS-1 Depth: 1-2.5 ft. bgs



Gravel	Sand	Silt	Clay

Liquid Limit: 28 **Plastic Limit:** 15 **Plasticity Index:** 13 **Group Index:**

% Gravel : 15 **% Sand :** 37 **% Silt :** 33 **% Clay :** 15

USDA Textural Soil Classification: loam

Delivered By: DKS Tested By: DKS/DP Reviewed By: DKS
Date Received: 4/22/10 Date Complete: 5/5/10 Date: 5/6/10

Chicago Testing Laboratory, Inc.
30W114 Butterfield Road, Warrenville, IL 60555 p 630.393.CTL1 f 630.393.CTL7
16900 South Williams Street, Thornton, IL 60476 p 708.877.1801 f 708.877.6926
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LAB REPORT

ID #	1004037 (69)
CTL PROJECT #	10EG204

PROJECT NAME Lake Shore Preserve CLIENT Clauss Brothers, Inc.
LOCATION Highland Park, IL MATERIAL Soil

Report of Combined Sieve and Hydrometer Analysis

Date: 5/6/2010 Sample Type: Split Spoon
Boring: B-16 Sample #: SS-8 Depth: 18.5-20 ft. bgs
Total Sample Weight (g): 180.1

	Sieve Size:	Cum. Weight Retained	% Retained	% Passing	Total Passing (%)	Diameter (mm)
+ #10 sieve portion	1"	0.00	0.0	100.0	100.0	25.0000
	3/4"	0.00	0.0	100.0	100.0	19.0000
	1/2"	0.00	0.0	100.0	100.0	12.5000
	3/8"	0.00	0.0	100.0	100.0	9.5000
	No. 4	1.20	0.7	99.3	99.3	4.7500
	No. 10	4.10	2.3	97.7	97.7	2.0000
	No. 20	0.70	1.4	98.6	96.4	0.8500
- #10 sieve portion	No. 40	1.20	2.4	97.6	95.4	0.4200
	No. 100	2.70	5.4	94.6	92.5	0.1500
	No. 200	5.10	10.2	89.8	87.8	0.0750

Sample Weight at Start of Hydrometer (g): 50.10 Temperature: 24 °C
Blank Hydrometer Reading: 4.5
Specific Gravity: 2.70 est.

	Elapse Time (min.)	Uncorrected Hydrometer Reading	Corrected Hydrometer Reading	% Passing	Total Passing (%)	Diameter (mm)
Hydrometer Portion	1	47.0	43.5	85.9	83.9	0.0376
	2	44.0	40.5	79.9	78.1	0.0273
	5	33.0	35.5	70.1	68.5	0.0180
	15	34.0	30.5	60.2	58.8	0.0108
	30	30.5	27.0	53.3	52.1	0.0079
	60	27.5	24.0	47.4	46.3	0.0057
	120	24.0	20.5	40.5	39.5	0.0041
	250	22.0	18.5	36.5	35.7	0.0029
	1440	18.5	15.0	29.6	28.9	0.0012

Liquid Limit: 31 **Plastic Limit:** 14 **Plasticity Index:** 17

% Gravel : 2 **% Sand :** 12 **% Silt :** 53 **% Clay :** 33

USDA Textural Soil Classification: **silty clay loam**

Delivered By: DKS
Date Received: 4/22/10

Tested By: DKS/DP
Date Complete: 5/5/10

Reviewed By: DKS
Date: 5/6/10

Chicago Testing Laboratory, Inc.
30W114 Butterfield Road, Warrenville, IL 60555 p 630.393.CTL1 f 630.393.CTL7
16000 South Williams Street, Thornton, IL 60476 p 708.877.1801 f 708.877.6926
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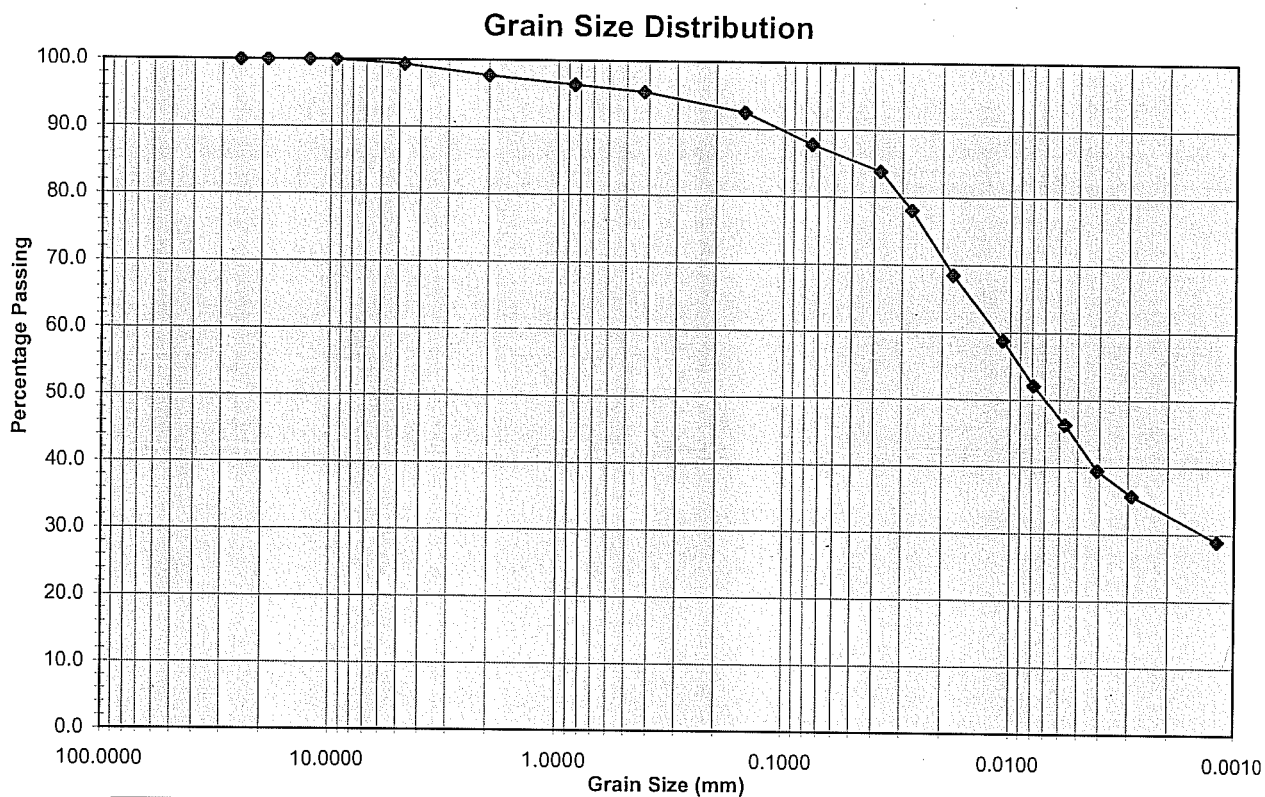
LAB REPORT

ID #	1004037 (69)
CTL PROJECT #	10EG204

PROJECT NAME Lake Shore Preserve CLIENT Clauss Brothers, Inc.
LOCATION Highland Park, IL MATERIAL Soil

Report of Combined Sieve and Hydrometer Analysis

Date: 5/6/2010 Sample Type: Split Spoon
Boring: B-16 Sample #: SS-8 Depth: 18.5-20 ft. bgs



Gravel	Sand	Silt	Clay

Liquid Limit: 31 **Plastic Limit:** 14 **Plasticity Index:** 17 **Group Index:** _____

% Gravel : 2 **% Sand :** 12 **% Silt :** 53 **% Clay :** 33

USDA Textural Soil Classification: **silty clay loam**

Delivered By: DKS Tested By: DKS/DP Reviewed By: DKS
Date Received: 4/22/10 Date Complete: 5/5/10 Date: 5/6/10

APPENDIX D – GEOTECHNICAL ANALYSIS

Attachment 4: Offshore Soil Borings

Hole No. CB-2-3-94

DRILLING LOG	DIVISION NORTH CENTRAL	INSTALLATION CHICAGO DISTRICT	SHEET 1 OF 2 SHEETS

1. PROJECT CHICAGO SHORELINE EROSION - REACH 2	10. SIZE AND TYPE OF BIT 3-7/8" DRAG BIT
2. LOCATION (Coordinates or Station) 688576 E 1927627 N (feet)	11. DATUM FOR ELEVATION SHOWN (TBM or MSL) LOW WATER DATUM (LWD)
3. DRILLING AGENCY FUGRO-McCLELLAND	12. MANUFACTURER'S DESIGNATION OF DRILL FAILING 250 (TRUCK-MOUNTED)
4. HOLE NO. (As shown on drawing title and file number) CB-2-3-94	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 10; UNDISTURBED 2
5. NAME OF DRILLER DAVID FENDLEY	14. TOTAL NUMBER CORE BOXES N/A
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED ____ DEG. FROM VERT.	15. ELEVATION GROUND WATER 2.5 LWD (LAKE LEVEL)
7. THICKNESS OF OVERBURDEN 29 FT	16. DATE HOLE: STARTED 22 MAY 94; COMPLETED 22 MAY 94
8. DEPTH DRILLED INTO ROCK 0 FT	17. ELEVATION TOP OF HOLE -12.5 LWD (15' WATER DEPTH)
9. TOTAL DEPTH OF HOLE 29 FT	18. TOTAL CORE RECOVERY FOR BORING N/A %
	19. SIGNATURE OF INSPECTOR David D. Hyman

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
-12.5' LWD	1, 2, 3, 4		(SM) SAND, Brown, Fine, Silty -with abundant gravel w = 22% @ 2.7' (4.0')	3/18	1, NS	Std. Penetration Test Blows NS = No Sample Set casing to 2.5' below lakebed 5, 8, 4
					NS	
				2/18	2, NS	3, 6, 3
-16.5' LWD	4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19		(CL) CLAY, Gray, Firm to Stiff -with gravel, sand pockets, and claystone fragments w = 26% @ 5.3'		NS	Driller notes clay at 4'
				4/18	3, NS	Casing reset to 7.5' below lakebed due to caving of gravel into hole. 3, 4, 6
					NS	
			-with silt pockets 7.5' - 9' w = 25% @ 9'	18/18	4	1, 3, 3
					NS	
			-silty at 11' w = 23% @ 11.2'	14/18	5, NS	2, 6, 6
					NS	
			Q = 0.6 ksf (cp = 16 psi), 0.4 ksf (cp = 25 psi), 0.3 ksf (cp = 32 psi) @ 14' DD = 106 pcf, w = 22% @ 14' Tor = 1.1 ksf @ 14.3' PP = 1.0 ksf, 1.0 ksf @ 14.3' w = 16% @ 14.3'	22/24	6, 6A, NS	3" ø Thin-Walled Tube Sample PUSH
					NS	
			w = 19% @ 16.3'	15/18	7, NS	2, 3, 3
					NS	ABBREVIATIONS w = Water Content DD = Dry Density
			w = 20% @ 18.7'	14/18	8, NS	PL = Plastic Limit LL = Liquid Limit G_s = Specific Gravity Q = Unconsolidated-Undrained cp = Confining Pressure 4, 5, 7
-32.5' LWD					NS	Unc = Unconfined Compression Tor = Torvane PP = Pocket Penetrometer

ENG FORM 1836 PREVIOUS EDITIONS

PLATE B-2g

Hole No. CB-2-3-94

DRILLING LOG	DIVISION NORTH CENTRAL	INSTALLATION CHICAGO DISTRICT	SHEET 2 OF 2 SHEETS

1. PROJECT CHICAGO SHORELINE EROSION – REACH 2	10. SIZE AND TYPE OF BIT 3-7/8" DRAG BIT
2. LOCATION (Coordinates or Station) 688576 E 1927627 N (feet)	11. DATUM FOR ELEVATION SHOWN (TBM or MSL) LOW WATER DATUM (LWD)
3. DRILLING AGENCY FUGRO-McCLELLAND	12. MANUFACTURER'S DESIGNATION OF DRILL FAILING 250 (TRUCK-MOUNTED)
4. HOLE NO. (As shown on drawing title and file number) CB-2-3-94	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 10; UNDISTURBED 2
5. NAME OF DRILLER DAVID FENDLEY	14. TOTAL NUMBER CORE BOXES N/A
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED ____ DEG. FROM VERT.	15. ELEVATION GROUND WATER 2.5 LWD (LAKE LEVEL)
7. THICKNESS OF OVERBURDEN 29 FT	16. DATE HOLE: STARTED 22 MAY 94; COMPLETED 22 MAY 94
8. DEPTH DRILLED INTO ROCK 0 FT	17. ELEVATION TOP OF HOLE –12.5 LWD (15' WATER DEPTH)
9. TOTAL DEPTH OF HOLE 29 FT	18. TOTAL CORE RECOVERY FOR BORING N/A %
	19. SIGNATURE OF INSPECTOR Craig D. Hyde

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
-32.5' LWD			(CL) CLAY, Gray, Firm to Stiff	17/18	9	Std. Penetration Test Blows NS = No Sample; Driller reamed hole to 20'. Problems with gravel caving into hole. 4, 6, 10
	21		–with gravel, sand pockets, and claystone fragments		NS	
			–with a few shell fragments 20' – 21.5'		NS	Add 5' casing–total 12.5' below lakebed.
	22		w = 21% @ 21.4'			
	23			24/24	10	3" ø Thin-Walled Tube Sample PUSH
	24		Q = 1.5 ksf (cp = 24 psi) DD = 108 pcf, w = 25% @ 24.1'		10A	
			w = 24% 24.5'		NS	
	25		Tor = 1.2 ksf @ 24.5' PP = 1.5 ksf, 1.4 ksf @ 24.5'	18/18	11	4, 5, 4
	26		w = 28%, LL = 38%, PL = 18% @ 26.5' (27.0')		NS	Driller notes sand at 27'
-39.5' LWD	27		(SM) SAND, Dark Gray, Fine, Silty			
	28		–200 = 24% @ 28.5' (29.0')	12/18	12	9, 11
					NS	12
-41.5' LWD	29		Completion Depth = 29.0 ft			
	30					

ABBREVIATIONS

w = Water Content
DD = Dry Density
PL = Plastic Limit
LL = Liquid Limit
G_s = Specific Gravity
Q = Unconsolidated–Undrained
cp = Confining Pressure
Unc = Unconfined Compression
Tor = Torvane
PP = Pocket Penetrometer

PLATE B-2h

Hole No. CB-3-2-94

DRILLING LOG	DIVISION NORTH CENTRAL	INSTALLATION CHICAGO DISTRICT	SHEET 1 OF 1 SHEETS

1. PROJECT CHICAGO SHORELINE EROSION - REACH 3	10. SIZE AND TYPE OF BIT 3-7/8" DRAG BIT
2. LOCATION (Coordinates or Station) 698306 E 1895049 N (feet)	11. DATUM FOR ELEVATION SHOWN (TBM or MSL) LOW WATER DATUM (LWD)
3. DRILLING AGENCY FUGRO-McCLELLAND	12. MANUFACTURER'S DESIGNATION OF DRILL FAILING 250 (TRUCK-MOUNTED)
4. HOLE NO. (As shown on drawing title and file number) CB-3-2-94	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 5; UNDISTURBED 3
5. NAME OF DRILLER DAVID FENDLEY	14. TOTAL NUMBER CORE BOXES N/A
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED ____ DEG. FROM VERT.	15. ELEVATION GROUND WATER 2.4 LWD (LAKE LEVEL)
7. THICKNESS OF OVERBURDEN 19.5 FT	16. DATE HOLE: STARTED 21 MAY 94; COMPLETED 21 MAY 94
8. DEPTH DRILLED INTO ROCK 0 FT	17. ELEVATION TOP OF HOLE -21.1 LWD (23.5' WATER DEPTH)
9. TOTAL DEPTH OF HOLE 19.5 FT	18. TOTAL CORE RECOVERY FOR BORING N/A %
	19. SIGNATURE OF INSPECTOR

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
-21.1' LWD			(CL) CLAY, Gray, Soft to Firm -with a few gravel and coarse sand -shell hash and gravel to 0.3'	24/24	1	Std. Penetration Test Blows NS = No Sample WOP = Weight of Pipe WOH = Weight of Hammer PUSH
	1		Q = 0.3 ksf (cp = 11 psi), DD = 87 pcf @ 1.6' w = 36% @ 1.6' w = 34% @ 2'		1A	
	2				NS	
	3			0/18	NS	-Sample not recovered due to gravel borehole WOH 1-12"
	4				NS	
	5			18/18	3	1-18"
	6		w = 34% @ 6.5'			
	7				NS	
	8		-with silt pockets at 8'	16/18	4	WOH 1-12"
	9		w = 37% @ 8.8'		NS	
					NS	
	10			24/24	5	3" ø thin-walled tube sample PUSH
	11				5A	
	12				NS	
	13		Tor = 0.5 ksf @ 12' PP = 0.5 ksf, 0.4 ksf @ 12' w = 20% @ 12'	12/18	6	WOH 1-12"
	14				NS	
					NS	ABBREVIATIONS
	15		-with a few claystone fragments below 15'	18/18	7	WOH w = Water Content DD = Dry Density PL = Plastic Limit LL = Liquid Limit 1-12"
	16		w = 25% @ 16.5'			
	17				NS	G_s = Specific Gravity Q = Unconsolidated-Undrained cp = Confining Pressure
	18		Q = 0.4 ksf (cp = 24 psi), DD = 101 pcf @ 19.1' w = 27% @ 19.1' Tor = 0.7 ksf @ 19.5' PP = 0.5 ksf, 0.6 ksf @ 19.5'	24/24	8	Unc = Unconfined Compression Tor = Torvane PP = Pocket Penetrometer PUSH
	19		w = 26% @ 19.5' (19.5')		8A	
-40.6' LWD			COMPLETION DEPTH = 19.5'			

PLATE B-2c

Hole No. CB-3-3-94

DRILLING LOG	DIVISION NORTH CENTRAL	INSTALLATION CHICAGO DISTRICT	SHEET 1 OF 1 SHEETS

1. PROJECT CHICAGO SHORELINE EROSION – REACH 3	10. SIZE AND TYPE OF BIT 3-7/8" DRAG BIT
2. LOCATION (Coordinates or Station) 698347 E 1894173 N (feet)	11. DATUM FOR ELEVATION SHOWN (TBM or MSL) LOW WATER DATUM (LWD)
3. DRILLING AGENCY FUGRO-McCLELLAND	12. MANUFACTURER'S DESIGNATION OF DRILL FAILING 250 (TRUCK-MOUNTED)
4. HOLE NO. (As shown on drawing title and file number) CB-3-3-94	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 6; UNDISTURBED 2
5. NAME OF DRILLER DAVID FENDLEY	14. TOTAL NUMBER CORE BOXES N/A
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED ____ DEG. FROM VERT.	15. ELEVATION GROUND WATER 2.6 LWD (LAKE LEVEL)
7. THICKNESS OF OVERBURDEN 19.0 FT	16. DATE HOLE: STARTED 21 MAY 94; COMPLETED 21 MAY 94
8. DEPTH DRILLED INTO ROCK 0 FT	17. ELEVATION TOP OF HOLE –20.9 LWD (23.5' WATER DEPTH)
9. TOTAL DEPTH OF HOLE 19.0 FT	18. TOTAL CORE RECOVERY FOR BORING N/A %
	19. SIGNATURE OF INSPECTOR [signature]

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
–20.9' LWD			(CL) CLAY, Gray, Fine, Soft to Firm –with a few gravel, coarse sand, and claystone fragments –fine brown sand to 0.2' w = 37% @ 1.1'	13/18	1	Std. Penetration Test Blows NS = No Sample WOP = Weight of Pipe WOH = Weight of Hammer 4 / 2 / 1
	1				NS	
	2				NS	
	3			18/18	2	1 / 1 / 1
	4		w = 32% @ 4'		NS	
	5			24/24	3	3" ø thin-walled tube sample PUSH
	6		Q = 0.3 ksf (cp = 14 psi), DD = 87 pcf @ 6.6' w = 39% @ 6.6'		3A	
	7		Tor = 0.4 ksf @ 7' PP = 0.5 ksf, 0.3 ksf @ 7' w = 16% @ 7' –with many gravel at 7'		NS	
	8		w = 33%, LL = 45%, PL = 19% @ 8.6'	13/18	4	WOH / 1 / 1
	9				NS	ABBREVIATIONS
	10			18/18	5	w = Water Content DD = Dry Density PL = Plastic Limit LL = Liquid Limit Weight of pipe
	11		–with silt seams at 11' w = 23% @ 11.5'		NS	G_s = Specific Gravity Q = Unconsolidated-Undrained cp = Confining Pressure
	12			18/18	6	Unc = Unconfined Compression Tor = Torvane PP = Pocket Penetrometer WOP / 1–12"
	13		–with gravel seam at 13.5'			
	14		w = 21%, G_s = 2.69@ 14'		NS	
	15			24/24	7	3" ø thin-walled tube sample PUSH
	16				7A	
	17		Tor = 0.6 ksf @ 17' PP = 0.5 ksf, 0.5 ksf @ 17' w = 25% @ 17'		NS	
	18			18/18	8	3 / 4 / 5
	19		w = 27% @ 19' (19.0')		NS	
–39.9' LWD			COMPLETION DEPTH = 19.0 FT			

ENG FORM 1836

PROJECT	HOLE NO.
CHICAGO SHORELINE EROSION	CB-3-3-94
CHICAGO SHORELINE EROSION	CB-3-3-94

PLATE B-2d

Hole No. CB-3-4-94

DRILLING LOG	DIVISION NORTH CENTRAL	INSTALLATION CHICAGO DISTRICT	SHEET 1 OF 1 SHEETS

1. PROJECT CHICAGO SHORELINE EROSION – REACH 3	10. SIZE AND TYPE OF BIT 3-7/8" DRAG BIT
2. LOCATION (Coordinates or Station) 698367 E 1893268 N (feet)	11. DATUM FOR ELEVATION SHOWN (TBM or MSL) LOW WATER DATUM (LWD)
3. DRILLING AGENCY FUGRO-McCLELLAND	12. MANUFACTURER'S DESIGNATION OF DRILL FAILING 250 (TRUCK-MOUNTED)
4. HOLE NO. (As shown on drawing title and file number) CB-3-4-94	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 6; UNDISTURBED 2
5. NAME OF DRILLER DAVID FENDLEY	14. TOTAL NUMBER CORE BOXES N/A
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED ____ DEG. FROM VERT.	15. ELEVATION GROUND WATER 2.4 LWD (LAKE LEVEL)
7. THICKNESS OF OVERBURDEN 17.0 FT	16. DATE HOLE: STARTED 21 MAY 94; COMPLETED 21 MAY 94
8. DEPTH DRILLED INTO ROCK 0 FT	17. ELEVATION TOP OF HOLE -22.6 LWD (25' WATER DEPTH)
9. TOTAL DEPTH OF HOLE 17.0 FT	18. TOTAL CORE RECOVERY FOR BORING N/A %
	19. SIGNATURE OF INSPECTOR [signature]

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
-22.6' LWD			(CL) CLAY, Gray, Soft to Firm -with a few gravel and coarse sand -with silt seams and pockets to 6' w = 35% @ 1.5'	18/18	1	Std. Penetration Test Blows NS = No Sample WOP = Weight of Pipe WOH = Weight of Hammer 1 2 2
	1					
	2				NS	
	3		-with a few small shell fragments at 3' w = 30%, LL = 37%, PL = 20%, -200 = 89% @ 4'	18/18	2	1 1 1
	4				NS	
	5		w = 28% @ 6'	18/18	3	1 2
	6		w = 25% @ 6.5'		4	4
	7		-firm to stiff 7.5'-9'		NS	
	8			21/24	5	3" ø Thin-Walled Tube Sample PUSH
	9		Q = 1.2 ksf (cp = 17 psi), DD = 96 pcf, w = 30% @ 8.9' Tor = 0.9 ksf @ 9.2' PP = 0.8 ksf, 0.6 ksf @ 9.2' w = 29% @ 9.2'		5A NS	
	10				NS	
	11		w = 32% @ 11.5'	18/18	6	2 4 4
	12				NS	
	13			24/24	7	3" ø Thin-Walled Tube Sample PUSH
	14		Q = 0.5 ksf (cp = 21 psi), 0.7 ksf (cp = 32 psi), 0.8 ksf (cp = 42 psi) @ 14.2' DD = 93 pcf @ 14.2' Tor = 0.7 ksf @ 14.5' PP = 0.6 ksf, 0.5 ksf @ 14.5' w = 31% @ 14.5'		7A	
	15				NS	ABBREVIATIONS
	16		w = 33% @ 16.7'	14/18	8	1 3 3
	17		(17.0')		NS	w = Water Content DD = Dry Density PL = Plastic Limit LL = Liquid Limit
-39.6' LWD	18		COMPLETION DEPTH = 17 FT			G_s = Specific Gravity Q = Unconsolidated-Undrained cp = Confining Pressure Unc = Unconfined Compression Tor = Torvane PP = Pocket Penetrometer
	19					

PLATE B-2e

Hole No. CB-3-5-94

DRILLING LOG

DIVISION	NORTH CENTRAL
INSTALLATION	CHICAGO DISTRICT
SHEET	1 OF 2 SHEETS
1. PROJECT	CHICAGO SHORELINE EROSION – REACH 3
2. LOCATION (Coordinates or Station)	698397 E 1892415 N (feet)
3. DRILLING AGENCY	FUGRO–McCLELLAND
4. HOLE NO. (As shown on drawing title and file number)	CB-3-5-94
5. NAME OF DRILLER	DAVID FENDLEY
6. DIRECTION OF HOLE	☒ VERTICAL ☐ INCLINED ____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN	21.5 FT
8. DEPTH DRILLED INTO ROCK	0 FT
9. TOTAL DEPTH OF HOLE	21.5 FT
10. SIZE AND TYPE OF BIT	3-7/8" DRAG BIT
11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	LOW WATER DATUM (LWD)
12. MANUFACTURER'S DESIGNATION OF DRILL	FAILING 250 (TRUCK-MOUNTED)
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED 8; UNDISTURBED 2
14. TOTAL NUMBER CORE BOXES	N/A
15. ELEVATION GROUND WATER	2.6 LWD (LAKE LEVEL)
16. DATE HOLE	STARTED 21 MAY 94; COMPLETED 21 MAY 94
17. ELEVATION TOP OF HOLE	–17.9 LWD (20.5' WATER DEPTH)
18. TOTAL CORE RECOVERY FOR BORING	N/A %
19. SIGNATURE OF INSPECTOR	Craig D. Hyde

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
–17.9' LWD			(SM) SAND, Gray, Fine, Silty –with a few gravel and shell fragments –200 = 36% @ 1'	12/18	1	Std. Penetration Test Blows NS = No Sample 1 3 5
	1				NS	
	2				NS	–set casing to 1.5 ft below lakebed
			w = 25% @ 3' (3.0')		2	1
–20.9' LWD	3		(CL) CLAY, Gray, Soft to Firm –with a few gravel and coarse sand w = 33%, LL = 43%, PL = 18% @ 3.8'	15/18	3	1 2
	4				NS	
	5				NS	
	6		w = 34% @ 6.5'	18/18	4	1 2 3
	7				NS	
	8			24/24	5	3" ø Thin-Walled Tube Sample PUSH
	9		Q = 0.4 ksf (cp = 15 psi), DD = 90 pcf, w = 35% @ 9.1' Tor = 0.8 ksf @ 9.5' PP = 0.8 ksf, 0.6 ksf @ 9.5' w = 33% @ 9.5'		5A	
	10				NS	
	11		–with shale seams at 11' w = 17% @ 11.3"	16/18	6	–Lost circulation at 10'. Add 5' casing (total depth 6.5' below lakebed) 4 3 4
					NS	
	12				NS	
	13			24/24	7	3" ø Thin-Walled Tube Sample PUSH
	14		–with many gravel at 14'		7A	
			Tor = 0.8 ksf @ 14.5' PP = 0.8 ksf @ 14.5' w = 14% @ 14.5'		NS	ABBREVIATIONS
	15			13/18	8	1
	16		w = 28% @ 16.1'		NS	w = Water Content DD = Dry Density PL = Plastic Limit LL = Liquid Limit 2 3
	17				NS	G_s = Specific Gravity Q = Unconsolidated–Undrained cp = Confining Pressure
	18			18/18	9	Unc = Unconfined Compression Tor = Torvane PP = Pocket Penetrometer 1 2 4
	19		w = 26% @ 19'			
–37.9' LWD					NS	

ENG FORM 1836

PROJECT CHICAGO SHORELINE EROSION

HOLE NO. CB-3-5-94

CHICAGO SHORELINE EROSION CB-3-5-94

PLATE B-2f

Hole No. CB-3-5-94

DRILLING LOG	DIVISION NORTH CENTRAL	INSTALLATION CHICAGO DISTRICT	SHEET 2 OF 2 SHEETS

1. PROJECT CHICAGO SHORELINE EROSION – REACH 3	10. SIZE AND TYPE OF BIT 3-7/8" DRAG BIT
2. LOCATION (Coordinates or Station) 698397 E 1892415 N (feet)	11. DATUM FOR ELEVATION SHOWN (TBM or MSL) LOW WATER DATUM (LWD)
3. DRILLING AGENCY FUGRO-McCLELLAND	12. MANUFACTURER'S DESIGNATION OF DRILL FAILING 250 (TRUCK-MOUNTED)
4. HOLE NO. (As shown on drawing title and file number) CB-3-5-94	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 8; UNDISTURBED 2
5. NAME OF DRILLER DAVID FENDLEY	14. TOTAL NUMBER CORE BOXES N/A
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED ____ DEG. FROM VERT.	15. ELEVATION GROUND WATER 2.6 LWD (LAKE LEVEL)
7. THICKNESS OF OVERBURDEN 21.5 FT	16. DATE HOLE: STARTED 21 MAY 94; COMPLETED 21 MAY 94
8. DEPTH DRILLED INTO ROCK 0 FT	17. ELEVATION TOP OF HOLE -17.9 LWD (20.5' WATER DEPTH)
9. TOTAL DEPTH OF HOLE 21.5 FT	18. TOTAL CORE RECOVERY FOR BORING N/A %
	19. SIGNATURE OF INSPECTOR [signature]

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
-37.9' LWD	21		(CL) CLAY, Gray, Soft to Firm –with a few gravel and coarse sand w. = 21% @ 21.5' (21.5')	18/18	10	2 4 4
-39.4' LWD	22 23 24 25		COMPLETION DEPTH = 21.5'			

PLATE B-2g

Hole No. CB-4-1-94

DRILLING LOG	DIVISION NORTH CENTRAL	INSTALLATION CHICAGO DISTRICT	SHEET 1 OF 2 SHEETS

1. PROJECT CHICAGO SHORELINE EROSION – REACH 4	10. SIZE AND TYPE OF BIT 3-7/8" DRAG BIT
2. LOCATION (Coordinates or Station) 697726 E 1886419 N (feet)	11. DATUM FOR ELEVATION SHOWN (TBM or MSL) LOW WATER DATUM (LWD)
3. DRILLING AGENCY FUGRO-McCLELLAND	12. MANUFACTURER'S DESIGNATION OF DRILL FAILING 250 (TRUCK-MOUNTED)
4. HOLE NO. (As shown on drawing title and file number) CB-4-1-94	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 13; UNDISTURBED 0
5. NAME OF DRILLER DAVID FENDLEY	14. TOTAL NUMBER CORE BOXES N/A
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED ____ DEG. FROM VERT.	15. ELEVATION GROUND WATER 2.5 LWD (LAKE LEVEL)
7. THICKNESS OF OVERBURDEN 27.0 FT	16. DATE HOLE: STARTED 20 MAY 94; COMPLETED 20 MAY 94
8. DEPTH DRILLED INTO ROCK 0 FT	17. ELEVATION TOP OF HOLE -20.0 LWD (22.5' WATER DEPTH)
9. TOTAL DEPTH OF HOLE 27.0 FT	18. TOTAL CORE RECOVERY FOR BORING N/A %
	19. SIGNATURE OF INSPECTOR [signature]

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
-20.0' LWD	1		(SM) SAND, Gray, Fine, Silty -with small shell fragments and silt seams w = 25% @ 1.3'	15/18	1	Std. Penetration Test Blows 3 5 7 NS = No Sample
					NS	
	2				NS	
	3			18/18	2	3 1 1
	4		w = 24% @ 4'			
			(4.5')		NS	
-24.5' LWD	5		(ML) SILT, Dark Gray, Loose, Clayey (PROBABLE SPOIL MATERIAL) -with a few gravel and sand pockets and seams	18/18	3	-material appears spangy weight of pipe
	6		w = 61%, LL = 50%, PL = 34% @ 6.5'			
	7				NS	
	8			18/18	4	weight of pipe
	9		w = 54% @ 9' -200 = 76% @9'		NS	
	10			18/18	5	weight of pipe
	11		w = 58%, LL = 50%, PL = 36% @ 11.5' -with clay pockets below 12'			
	12				NS	
	13			18/18	6	weight of pipe
	14		w = 57% @ 14'		NS	
	15			18/18	7	ABBREVIATIONS w = Water Content DD = Dry Density PL = Plastic Limit weight of pipe
	16		w = 44%, LL = 43%, PL = 29% @ 16.5'			
	17				NS	LL = Liquid Limit G_s = Specific Gravity Q = Unconsolidated-Undrained cp = Confining Pressure Unc = Unconfined Compression
	18			18/18	8	Tor = Torvane PP = Pocket Penetrometer weight of pipe
	19					
-40.0' LWD			w = 46% @ 19.5'		NS	

PLATE B-2a

Hole No. CB-4-1-94

DRILLING LOG	DIVISION NORTH CENTRAL	INSTALLATION CHICAGO DISTRICT	SHEET 2 OF 2 SHEETS

1. PROJECT CHICAGO SHORELINE EROSION – REACH 4	10. SIZE AND TYPE OF BIT 3-7/8" DRAG BIT
2. LOCATION (Coordinates or Station) 697726 E 1886419 N (feet)	11. DATUM FOR ELEVATION SHOWN (TBM or MSL) LOW WATER DATUM (LWD)
3. DRILLING AGENCY FUGRO–McCLELLAND	12. MANUFACTURER'S DESIGNATION OF DRILL FAILING 250 (TRUCK-MOUNTED)
4. HOLE NO. (As shown on drawing title and file number) CB-4-1-94	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 13; UNDISTURBED 0
5. NAME OF DRILLER DAVID FENDLEY	14. TOTAL NUMBER CORE BOXES N/A
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED ____ DEG. FROM VERT.	15. ELEVATION GROUND WATER 2.5 LWD (LAKE LEVEL)
7. THICKNESS OF OVERBURDEN 27.0 FT	16. DATE HOLE: STARTED 20 MAY 94; COMPLETED 20 MAY 94
8. DEPTH DRILLED INTO ROCK 0 FT	17. ELEVATION TOP OF HOLE –20.0 LWD (22.5' WATER DEPTH)
9. TOTAL DEPTH OF HOLE 27.0 FT	18. TOTAL CORE RECOVERY FOR BORING N/A %
	19. SIGNATURE OF INSPECTOR [signature]

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
-40.0' LWD			(ML) SILT, Dark Gray, Loose, Clayey (PROBABLE SPOIL MATERIAL)		NS	Std. Penetration Test Blows
	21		-clay layer, 20.5' – 21'	10/18	9	NS = No Sample; weight
			-slag debris, 21' – 21.3'		10	of
			w = 40%, LL = 38%, PL = 19% @ 21'		NS	pipe
	22		w = 48% @ 21.3' (22.5')		NS	
-42.5' LWD	23		(SM) SAND, Gray, Fine, Silty -with a few shell fragments and shelly seams	13/18	11	Natural Material; 4
	24		-200 = 16% @ 24'			3
			w = 25% @ 24.1'		NS	2
	25				NS	
	26		w = 24% @ 26' (26.0')	18/18	12	5
-46.0' LWD			(CL) CLAY, Gray, Stiff -with gravel and sand pockets		13	7
	27		w = 23%, LL = 35%, PL = 17% @ 27' (27.0')			9
-47.0' LWD			Completion Depth = 27.0 ft			
	28					
	10					
	11					
	12					
	13					
	14					

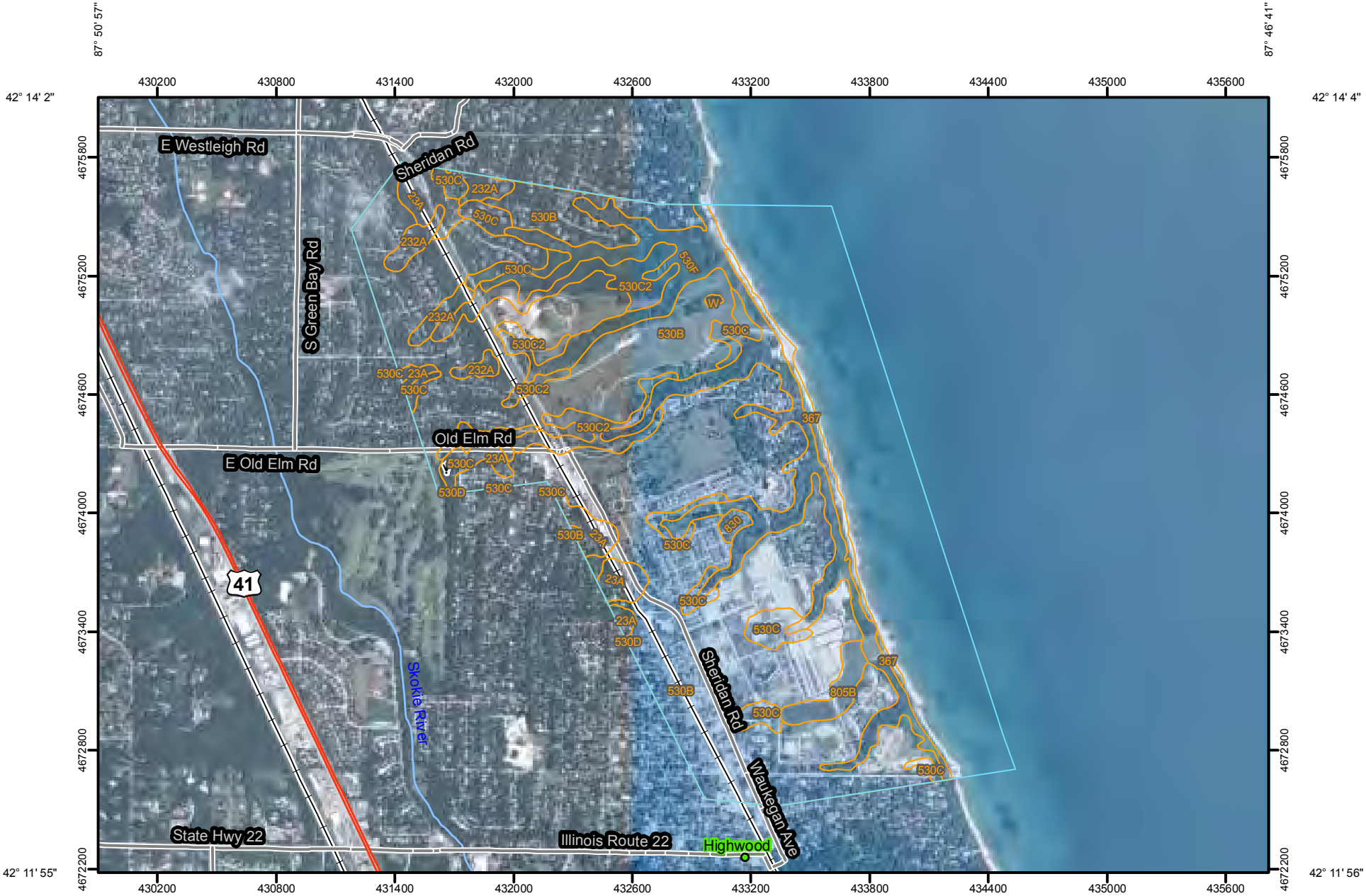
ABBREVIATIONS

w = Water Content
DD = Dry Density
PL = Plastic Limit
LL = Liquid Limit
G_s = Specific Gravity
Q = Unconsolidated-Undrained
cp = Confining Pressure
Unc = Unconfined Compression
Tor = Torvane
PP = Pocket Penetrometer

PLATE B-2b

APPENDIX D – GEOTECHNICAL ANALYSIS

Attachment 5: NRCS, Soil Type, & Soil Thickness Maps



Map Scale: 1:28,100 if printed on A size (8.5" x 11") sheet.

N

Meters: 0, 350, 700, 1,400, 2,100

Feet: 0, 1,500, 3,000, 6,000, 9,000

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Map Units

Special Point Features

Blowout

Borrow Pit

Clay Spot

Closed Depression

Gravel Pit

Gravelly Spot

Landfill

Lava Flow

Marsh or swamp

Mine or Quarry

Miscellaneous Water

Perennial Water

Rock Outcrop

Saline Spot

Sandy Spot

Severely Eroded Spot

Sinkhole

Slide or Slip

Sodic Spot

Spoil Area

Stony Spot

Very Stony Spot

Wet Spot

Other

Special Line Features

Gully

Short Steep Slope

Other

Political Features

Cities

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

MAP INFORMATION

Map Scale: 1:28,100 if printed on A size (8.5" × 11") sheet.

The soil surveys that comprise your AOI were mapped at 1:12,000.

Please rely on the bar scale on each map sheet for accurate map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 16N NAD83

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Lake County, Illinois
Survey Area Data: Version 6, Jan 20, 2012

Date(s) aerial images were photographed: 7/7/2007

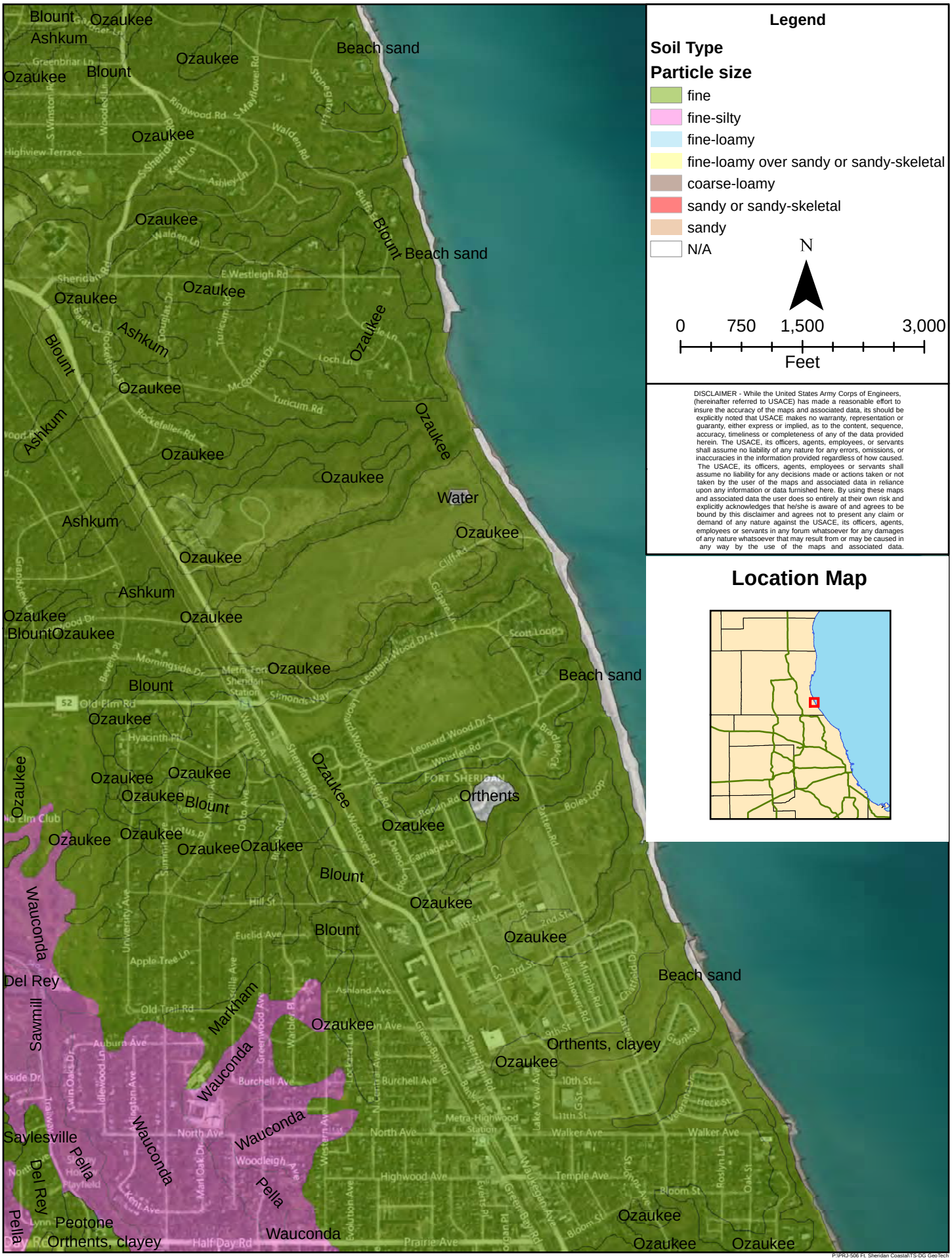
The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Lake County, Illinois (IL097)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
23A	Blount silt loam, 0 to 2 percent slopes	52.5	3.3%
232A	Ashkum silty clay loam, 0 to 2 percent slopes	28.0	1.8%
367	Beach sand	19.3	1.2%
530B	Ozaukee silt loam, 2 to 4 percent slopes	811.8	51.6%
530C	Ozaukee silt loam, 4 to 6 percent slopes	69.8	4.4%
530C2	Ozaukee silt loam, 4 to 6 percent slopes, eroded	66.0	4.2%
530D	Ozaukee silt loam, 6 to 12 percent slopes	0.5	0.0%
530F	Ozaukee silt loam, 20 to 30 percent slopes	176.7	11.2%
805B	Orthents, clayey, undulating	16.4	1.0%
830	Landfills	4.2	0.3%
W	Water	1.1	0.1%
Subtotals for Soil Survey Area		**1,246.2**	**79.2%**
Totals for Area of Interest		**1,572.9**	**100.0%**

FT. SHERIDAN SOIL TYPE

U.S. Army Corps of Engineers
Chicago District


Legend
Soil Type
Particle size
fine
fine-silty
fine-loamy
fine-loamy over sandy or sandy-skeletal
coarse-loamy
sandy or sandy-skeletal
sandy
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0 750 1,500 3,000
Feet
Location Map
Blount
Ozaukee
Ashkum
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Water
Orthents
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Wauconda
Del Rey
Sawmill
Markham
Saylesville
Pella
Peotone
Ft. Sheridan
Metra-Fort Sheridan Station
Metra-Highwood Station
Highwood
Highland Park
Lake Forest
Lake Bluff
Lake Villa
Lake Zurich
Lake Barrington
Lake Cook Rd
Lake Shore Dr
Lake View Ave
Lakewood Ave
Lakeshore Dr
Lakeside Dr
Lakeside Ln
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Lakeshore Trail
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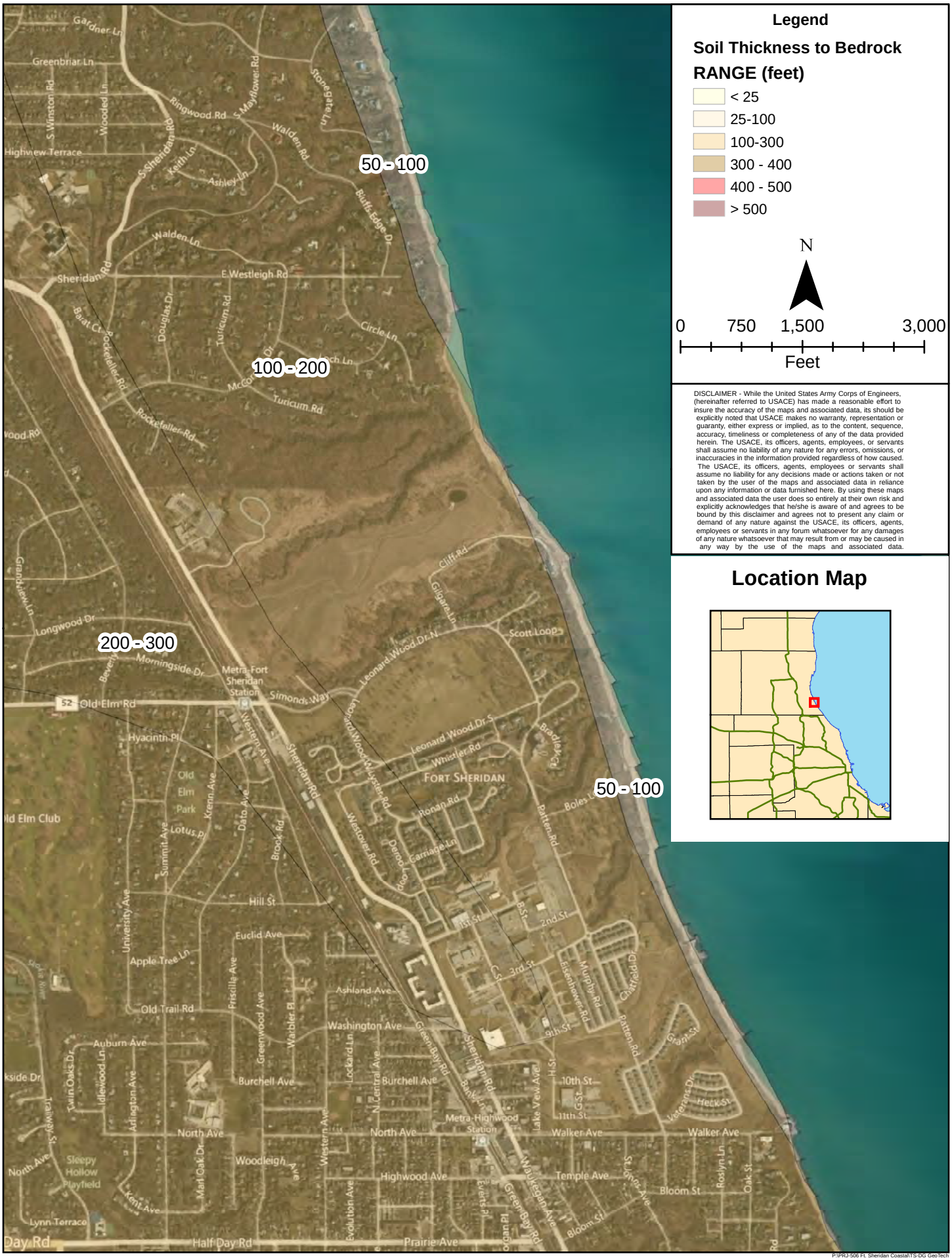
FT. SHERIDAN SOIL THICKNESS

U.S. Army Corps of Engineers
Chicago District



Legend

Soil Thickness to Bedrock RANGE (feet)

- < 25
- 25-100
- 100-300
- 300 - 400
- 400 - 500
- > 500

N

0 750 1,500 3,000

Feet

DISCLAIMER - While the United States Army Corps of Engineers, (hereinafter referred to USACE) has made a reasonable effort to insure the accuracy of the maps and associated data, its should be explicitly noted that USACE makes no warranty, representation or guaranty, either express or implied, as to the content, sequence, accuracy, timeliness or completeness of any of the data provided herein. The USACE, its officers, agents, employees, or servants shall assume no liability of any nature for any errors, omissions, or inaccuracies in the information provided regardless of how caused. The USACE, its officers, agents, employees or servants shall assume no liability for any decisions made or actions taken or not taken by the user of the maps and associated data in reliance upon any information or data furnished here. By using these maps and associated data the user does so entirely at their own risk and explicitly acknowledges that he/she is aware of and agrees to be bound by this disclaimer and agrees not to present any claim or demand of any nature against the USACE, its officers, agents, employees or servants in any forum whatsoever for any damages of any nature whatsoever that may result from or may be caused in any way by the use of the maps and associated data.

Location Map

P:\PRJ-506 Ft. Sheridan Coastal\TS-DG GeoTech

APPENDIX D – GEOTECHNICAL ANALYSIS

Attachment 6: Breakwater Stability & Settlement Calculations

Soil Parameters

1. For the Ft. Sheridan 506 Feasibility Study, no soil borings were completed offshore for the proposed breakwaters. The cost to perform subsurface investigations offshore would have been expensive and funding is limited for this project. Additionally, the proposed structure is constructed of loose stones and is designed to settle, so precise knowledge of the site is not warranted. Therefore to complete the below analysis, assumptions of the subsurface were made using the soil borings completed on the beach, as well as, borings completed offshore in other areas away from the site.

2. To analyze the slope stability and settlement, conservative values for the lake bed subsurface were borrowed from the Chicago Shoreline – Montrose to Irving Park Project. These are shown in the table below. The values for A, B, and C stone are assumed.

Soil Type	Unit Weight (pcf)	End of Construction		Long Term	
		Cohesion (psf)	Friction Angle (φ)	Cohesion (psf)	Friction Angle (φ)
Sand	125	0	29	0	29
Soft Clay	130	550	0	0	30
Medium Stiff Clay	133	1090	0	0	29
A Stone	135	0	40	0	40
B & C Stone	135	0	38	0	38

Figure 1. Soil parameters used in stability analyses

3. The subsurface cross section was also assumed based on other soil borings completed offshore along Lake Michigan. These borings were completed about 20 to 30 miles south of Ft. Sheridan, along the coast of the City of Chicago and are included in Attachment 4. These borings typically encountered a thin layer of sand underlain by a thick layer of soft clay. Beneath the soft clay, a mix of medium stiff to hard clays and silts were present. To simplify the analysis, the soils beneath the soft clay were considered homogenous medium stiff clay. This is also a very conservative estimate, as the clay is likely more stiff. The assumed subsurface profile is shown in the proposed cross section below.

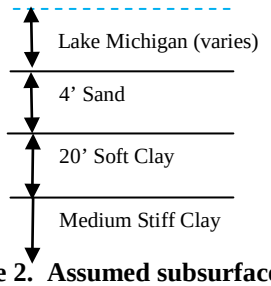


Figure 2. Assumed subsurface profile

4. The lake bottom was surveyed around 572.5 ft, IGLD85 at 150 ft from shore. The current lake level is around 577 IGLD85. However, the lake is currently lower than average and can fluctuate by about 6 ft. A graph of the lake level over the past 100 years is shown below. This graph is provided by NOAA data at Calumet Harbor, IL; about 40 miles south of Ft. Sheridan. http://tidesandcurrents.noaa.gov/geo.shtml?location=9087044.

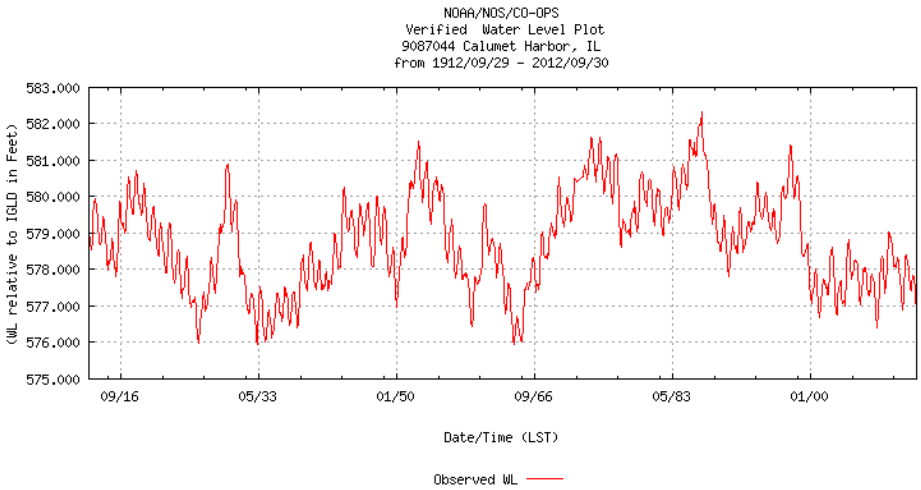


Figure 3. Graph of lake levels

5. Based on the Hydrologic Appendix A, the height of the breakwater should be higher than the high water level shown above. Therefore, a crest elevation of 588 ft IGLD 1985 was chosen. The cross section was also determined in the Hydrologic Appendix. It has a crest width of 11 ft and slopes at 2H: 1V. The cross section is shown below.

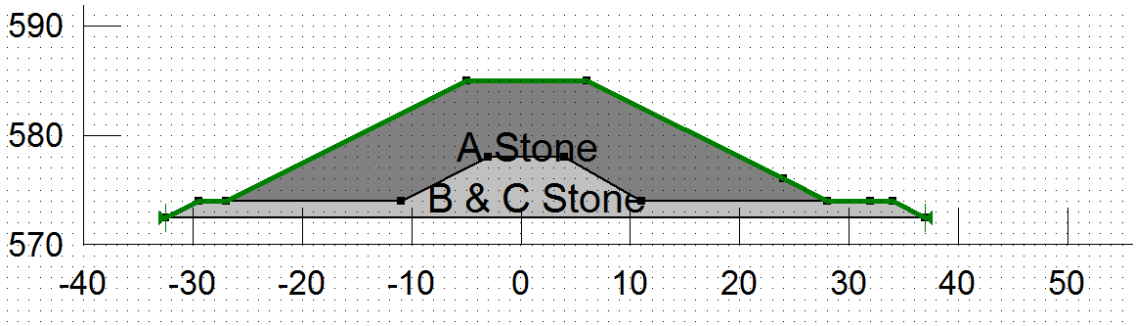


Figure 4. Proposed breakwater cross section

Settlement

6. To determine the settlement, the conservative subsurface cross section was used with the same parameters that were used for the Chicago Shoreline – Montrose to Irving Park analysis. The cross section was simplified to a trapezoid with the dimensions depicted in the figure below. It uses the current water level, as discussed above.

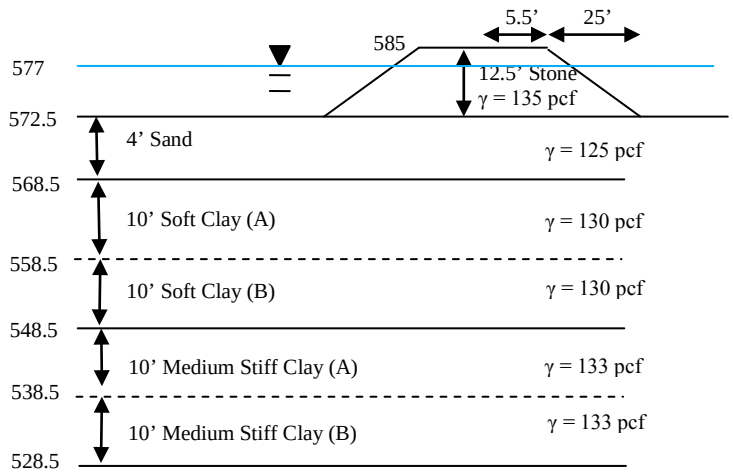


Figure 5. Settlement calculation cross section

7. Material properties for the existing soils are shown in the table below. The clay parameters were determined through laboratory testing by AECOM on soils at the Chicago Shoreline – Montrose to Irving Park project. The sand parameters were developed based on EM 1110-1-1904, Table 3-7.

Soil Type	γ_{sat} (pcf)	e_o	σ'_c (pcf)	C_c	C_s
Sand	125	1	N/A	0.02	
CL soft	130	0.704	2600	0.16	0.04
CL medium stiff	133	0.435	*	0.073	0.013

*Assumed overconsolidated

Figure 6. Soil consolidation properties from Chicago Shoreline

8. The Boussinesq chart for an embankment load of infinite length was used to find the influence factors under vertical stress. The influence factors were doubled for the calculations since the chart was for only half of the embankment.

CL soft (A) layer Sample Calculation:

H_e = height of embankment from Figure 5 = 12.5 feet
a = slope length from Figure 5 = 25 feet
b = half crest width from Figure 5 = 5.5 feet
D_{top} = depth to top of layer from Figure 5 = 4 feet
D_{bottom} = depth to bottom of layer from Figure 5 = 14 feet
γ_{rubble} = unit weight of rubble mound = 135 pcf
γ_{sand} = unit weight of sand = 125 pcf
γ_{CL} = unit weight of CL soft (A) = 130 pcf

e_o = initial void ratio of CL soft (A) = 0.704
σ'_c = Preconsolidation pressure of CL soft (A) = 2600 psf
Cc = compression index = 0.16
Cs = swell index = 0.04
H_w = height of water from lake bottom = 4.5 ft
γ_{water} = unit weight of water = 62.4 pcf

H_o = height of soil layer = $D_{bottom} - D_{top}$ = 14 - 4 = 10 ft
z = depth to midpoint = $H_o/2 + D_{top}$ = 10/2 + 4 = 9 ft
a/z = ratio of slope versus depth to midpoint = 25/9 = 2.78
b/z = ratio of crest versus depth to midpoint = 5.5/9 = 0.61
I = Boussinesq Influence Value = from chart = 0.46
σ'_v = new load of embankment = $H * \gamma_{rubble} - H_w * \gamma_{rwater}$ = 12.5*135 – 4.5*62.4 = 1406.7 psf
$\Delta\sigma'_v$ = effective new load = $2 * I * \sigma'_v$ = 2*0.46*1406.7 = 1294.2 psf
σ'_{vo} = initial load on soil = $\gamma_{water}*H_w + (\gamma_{sand} - \gamma_{water})* D_{top} + (\gamma_{CL} - \gamma_{water}) * (z - D_{top})$ = 62.4*4.5 + (125-62.4)*4 + (130 – 62.4)*(9-4) = 869.2 psf
$\sigma'_{vo} + \Delta\sigma'_v$ = 869.2 + 1294.2 = 2163.4, which is less than σ'_c = 2600. Therefore, CL soft is overconsolidated and so settlement calc uses…

$$S_p = C_s \frac{H_o}{1+e_o} \log \frac{\sigma_{vo}' + \Delta\sigma'_v}{\sigma'_{vo}} = 0.04 \frac{10}{1+0.704} \log \frac{869.2+1294.2}{869.2} = 0.093\,ft$$

9. A summary of the consolidation settlement is shown in the table below:

Soil Layer	**z (ft)**	**a/z**	**b/z**	**I**	**Δσ'v (psf)**	**σ'vo (psf)**	**S (ft)**
Sand	2	12.5	2.75	0.50	1406.7	406.0	0.026
CL soft (A)	9	2.78	0.61	0.46	1294.2	869.2	0.093
CL soft (B)	19	1.32	0.29	0.37	1041.0	1545.2	0.053
CL med stiff (A)	29	0.86	0.19	0.30	844.0	2236.2	0.013
CL med stiff (B)	39	0.64	0.14	0.24	675.2	2942.2	0.008
						Total (ft)	**0.193**

Figure 7. Consolidation Calculation Table

10. As shown above, the calculated settlement for a hypothetical conservative subsurface cross section is less than ¼ ft. Since the actual subsurface profile is likely made of stiffer clays, the actual settlement will not likely exceed this amount. Therefore, an overbuild height of about ¼ ft would be appropriate to account for settlement.

Stability

11. An evaluation of the end of construction and long term stability were completed for the breakwater. A rapid drawdown case was not completed since the breakwater is in the lake, and the stones drain quickly. The minimum recommended factors of safety for the conditions of end of construction and long term are 1.3 and 1.5, respectively based on EM 1110-2-1902, Table 3-1.

12. The soil properties used in the stability analyses below are the same that were used in the Chicago Shoreline – Montrose to Irving project. Both use armor stone and a smaller underlayer bedding stone in the new structure cross section. The Ft. Sheridan offshore subsurface is assumed to be a conservative profile with the same properties as soils encountered at Chicago Shoreline.

13. The end of construction case uses the proposed 2H: 1V slopes and the current water level discussed in paragraph 4. The failure plane with the lowest factor of safety is shown below and has a factor of safety of 1.583, which is greater than the minimum recommended 1.3 for end of construction.

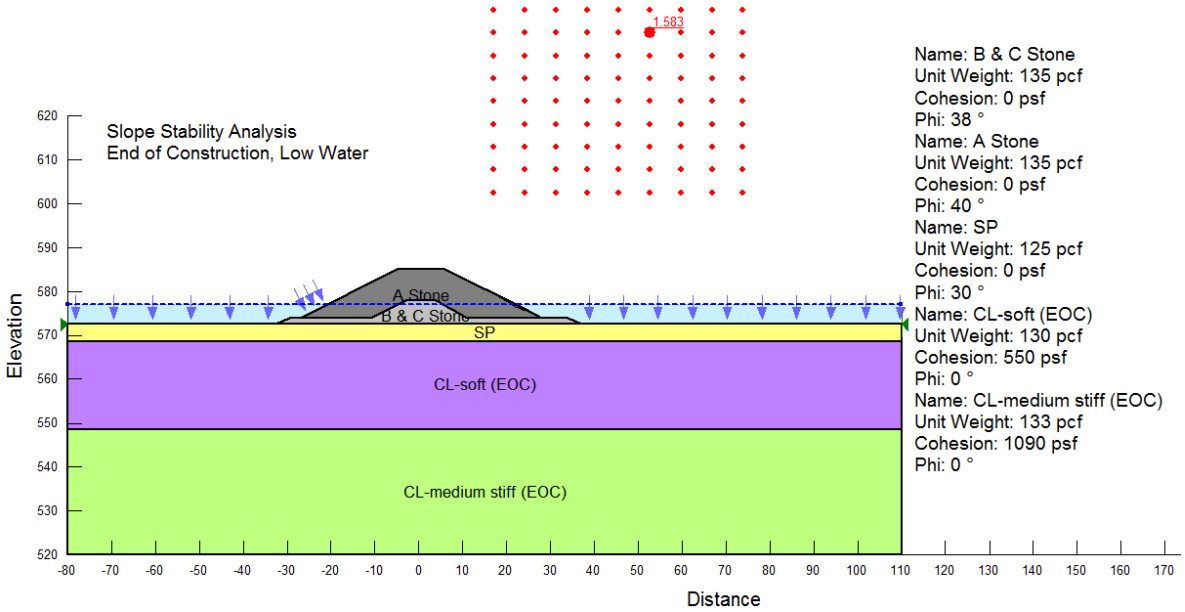


Figure 8. End of Construction Stability, FS = 1.583

14. This failure plane is near the surface and does not take into account the fact that the average stone size diameter is about 3.4 ft. Therefore, a failure plane would have to be at least this thick in order to affect the actual breakwater. This failure plane is shown below which results in a factor of safety of 1.711.

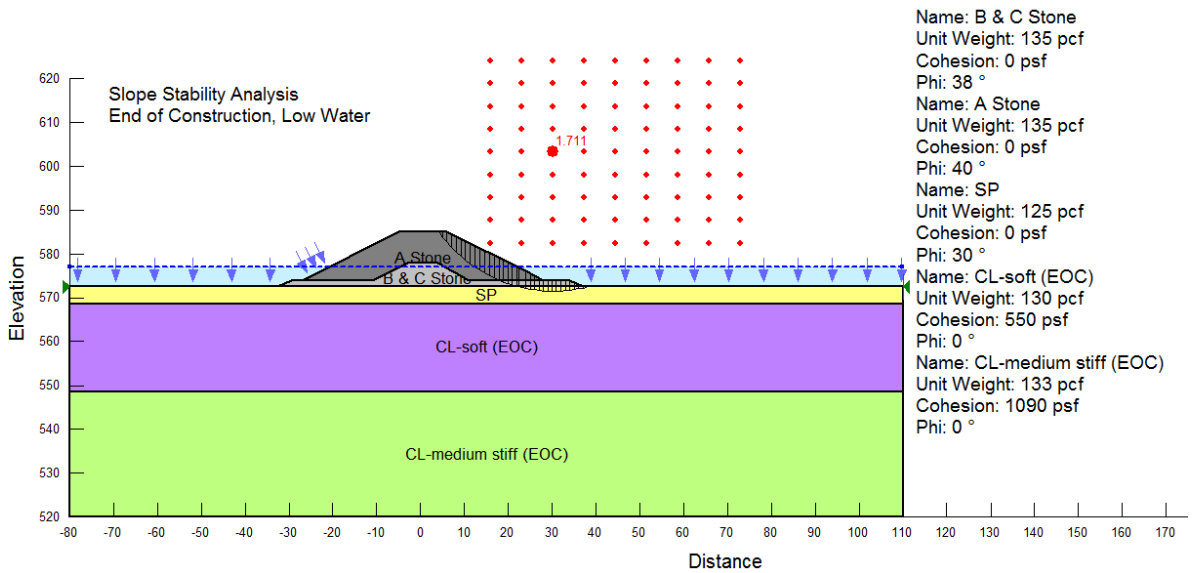


Figure 9. End of Construction Stability, FS = 1.711

15. Running the same cross section with the long term conditions produces a factor of safety of 1.579. This is greater than the recommended 1.5. The analysis is shown below.

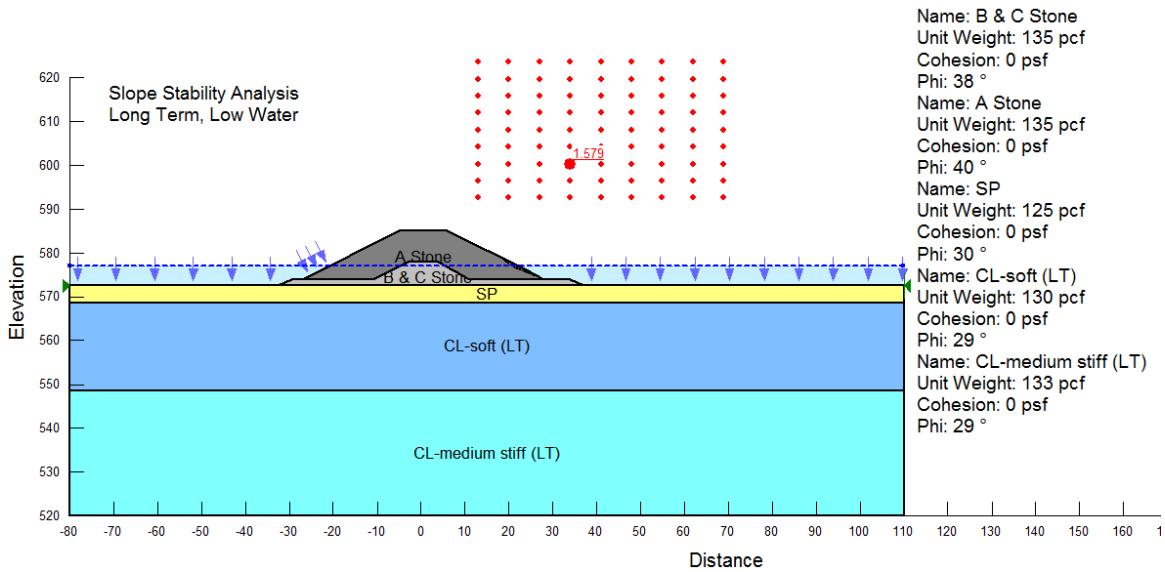


Figure 10. Long Term Stability, Low Water FS = 1.579

16. Again ignoring the surface failure planes, the resulting factor of safety of 1.703 is shown below.

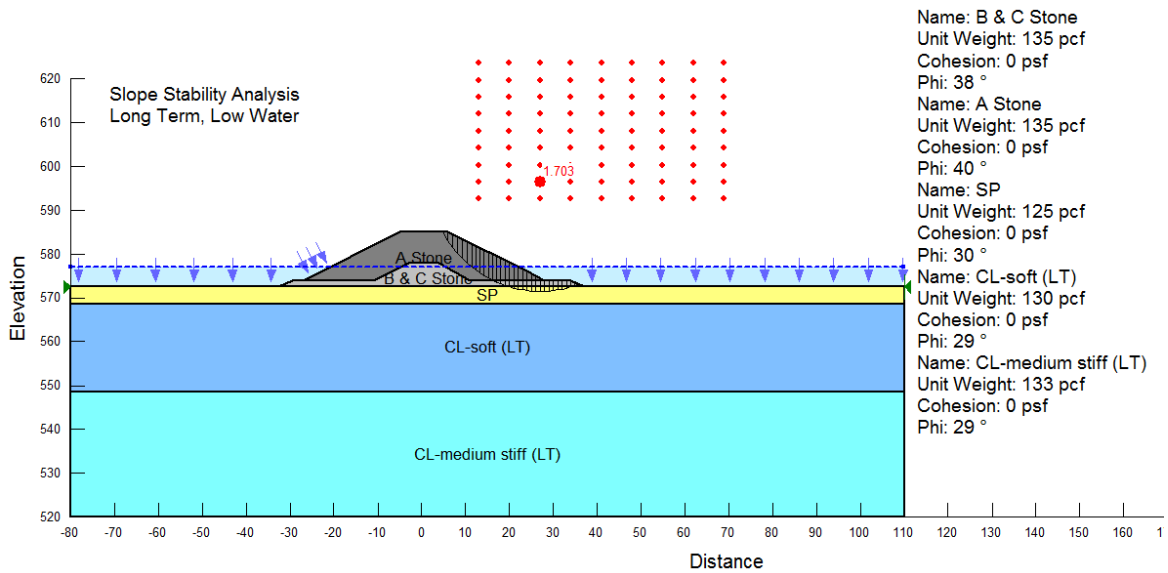


Figure 11. Long Term Stability, Low Water FS = 1.703

17. Currently, the lake level is historically low, so another analysis was completed to determine the stability when the water is high using long term conditions. The high level was determined by the graph in Figure 3, when the lake went above 582 IGLD in the 1980's. The water level was assumed at 583 IGLD in the below analysis. This results in a factor of safety of 1.574 as shown below. This is greater than the recommended 1.5.

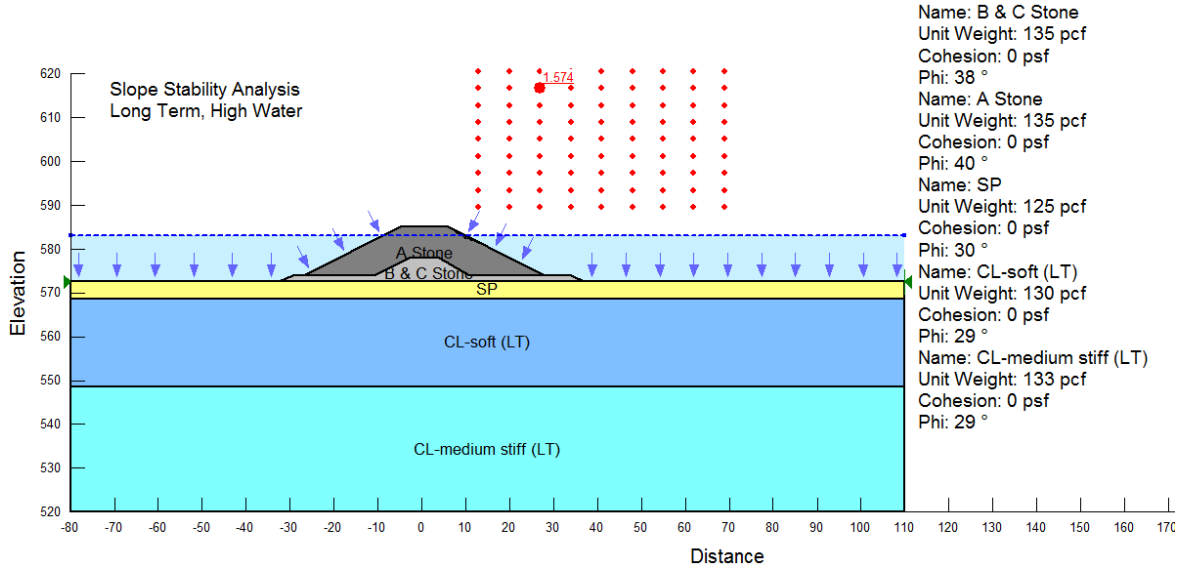


Figure 12. Long Term Stability, High Water FS = 1.574

18. Again ignoring the surface failure planes, the resulting factor of safety of 1.908 is shown below.

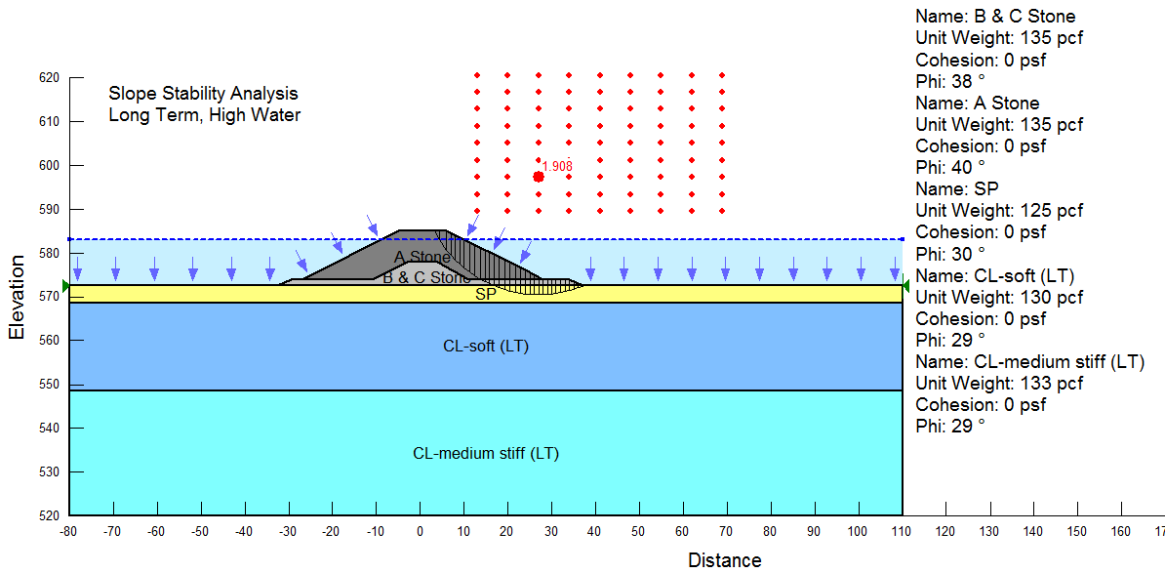


Figure 13. Long Term Stability, High Water FS = 1.908

Conclusion

19. Based on the above stability and settlement analyses, the proposed breakwater in the Hydrologic Appendix is suitable to construct. There was no subsurface analysis completed at the site, but based on the conservative properties used in the analysis, it is acceptable to construct with a 2H: 1V slope. The structure should anticipate less than ½-foot of settlement. This settlement would not damage the integrity of the structure, since it is constructed out of loose stones. Any changes from the cross section analyzed above should be reviewed by the geotechnical engineer.