REPORT OF
GEOTECHNICAL INVESTIGATION FOR
LEXINGTON STATE HARBOR

LEXINGTON TOWNSHIP
SANILAC COUNTY
MICHIGAN

AUGUST 30, 2024

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License No.
6201311998

8/30/24

Edgewater Resources, LLC
518 Broad Street, Suite 200
St. Joseph, Michigan 49085

Project No. 2024.1415

SOILS &
STRUCTURES

August 30, 2024

Edgewater Resources, LLC
518 Broad Street, Suite 200
St. Joseph, Michigan 49085

Attention: Ms. Suzanne Fromson

Regarding: Lexington State Harbor
Geotechnical Report
Lexington Township, Sanilac County, Michigan
Project No. 2024.1415

Dear Ms. Fromson:

Soils & Structures is pleased to present this geotechnical investigation report for the Lexington State Harbor project located in Lexington Township, Sanilac County, Michigan.

The investigation included nine (9) test borings drilled to depths ranging from 5.0 to 33.0 feet. The test borings were conducted in accordance with ASTM D 1586 procedures.

The report, test boring location plan, and test boring logs are enclosed. The report provides recommendations for site preparation, foundations, fill, floors, and pavement.

We appreciate the opportunity to provide engineering services to Edgewater Resources, LLC. If you have any questions regarding this report, please contact our office.

Sincerely,
Soils & Structures, Inc.

Vincent O. Oderah, P.E.
VOO/vo

Reviewed by:

Michael J. Partenio, P.E.

Ann Arbor • Muskegon • Traverse City • Upper Peninsula
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Location of Soil Investigation

The soil investigation was conducted at Lexington State Harbor located at 7411 Huron Avenue in Section 30 of Lexington Sanilac County, Michigan. The parcel numbers for the site are 152-300-000-001-00, 152-300-000-032-00, and 152-300-000-035-00.

Purpose of Investigation

The purpose of this investigation is to provide geotechnical engineering recommendations for the proposed park improvements.

Design Information

The project consists of various improvements to the Lexington State Harbor and Tierney Park. The improvements will include a new boardwalk, restroom building, pavilions, amphitheater, pavements, stormwater bioswales, and other recreational improvements. The buildings are anticipated to be single-story, wood-framed or masonry buildings with slab on grade floors. Pavement for the project will include new parking lots and pathways.

The boardwalk is anticipated to be subjected primarily to pedestrian traffic. The maximum axial load is anticipated to be less than 15.0 kips per pier. The maximum column loads for restroom and pavilion buildings are anticipated to be less than 50.0 kips. The maximum wall load is anticipated to be less than 3.0 kips per linear foot. Allowable settlements of 0.6 inches for total settlement and 0.4 inches for differential settlement are assumed. If the actual loads are significantly greater than the anticipated loads listed in this report, then Soils & Structures should be contacted so that the recommendations included in this report may be reviewed and revised if necessary.

The floor elevations of the buildings have not been determined at the time of this report. Excavation and backfill will be required to achieve the desired grade in the construction areas. Groundwater controls and dewatering will probably not be necessary to construct foundations and utilities.

An equivalent single axle load (ESAL) of 250,000 was assumed for the design of the preliminary pavement sections. Pavement for this project is assumed to be subjected to automobile and occasional truck traffic including food trucks and boat trailers. A service life of twenty years was assumed for the pavement subgrade recommendations. The subgrade is assumed to be prepared as recommended in this report. The final pavement design should be based on site-specific traffic conditions.

Tests Performed

The investigation included nine (9) test borings drilled to depths ranging from 5.0 to 33.0 feet. The test borings are designated as Test Boring One (TB-01) through Test Boring Nine (TB-09). Test Boring Six and Test Boring Nine were terminated at shallower depths than originally planned due to auger refusal on competent strata. The locations were determined by Edgewater Resources, LLC. Soils & Structures reviewed the locations for accessibility and revised as necessary. The test borings were conducted in accordance with ASTM D 1586 procedures. The ASTM D 1586 standard describes the procedure for sampling and testing soil using the Standard Penetration Test. An automatic hammer was used to obtain the soil samples.

The surface elevations at the test boring locations and additional points of reference were obtained with a Global Navigation Satellite System (GNSS) Receiver. The receiver was connected to the local MDOT CORS base station. Through this system, vertical measurements are obtained and referenced to the North American Vertical Datum (NAVD88). Horizontal measurements are also obtained at the test boring locations, which are referenced to the Michigan State Plane Coordinate System. Both the vertical and horizontal measurements typically have an accuracy of approximately 0.5 inches. The measured test boring locations and surface elevations are represented in Table 1.

Table 1: Measured Test Boring and Points of Reference Locations and Surface Elevations

Test Boring / Location	Elevation (feet)	Northing (feet)	Easting (feet)	Surface Cover
Test Boring One	586.1	650426.7	13613405.1	Topsoil
Test Boring Two	609.9	650342.6	13613033.0	Gravel
Test Boring Three	584.4	650310.5	13613176.7	Asphalt
Test Boring Four	585.3	650246.2	13613376.9	Topsoil
Test Boring Five	587.5	650171.7	13613191.4	Topsoil
Test Boring Six	582.7	650202.2	13613551.2	Topsoil
Test Boring Seven	586.0	650026.7	13613279.1	Asphalt
Test Boring Eight	585.4	649938.6	13613391.7	Asphalt
Test Boring Nine	583.4	649866.8	13613601.1	Asphalt
Base Setup	837.5	707173.4	13574538.6	-

Soil samples were classified according to the Unified Soil Classification System. This method is a standardized system for classifying soil according to its engineering properties. Please refer to the appendix of this report for the Unified Classification System Chart. The classification is shown in the "Material Description" column of the test boring logs.

The soil strength and the allowable soil bearing value were evaluated using the "N" value. The "N" value is the number of blows required to drive a soil sampler one foot with a standard 140-pound drop hammer. The sampler is driven a distance of 18.0 inches. The number of blows for each 6.0-inch increment is recorded. The sum of the second and third intervals is the "N" value. The number of blows for each 6.0-inch interval is shown on the test boring logs under the column labeled "Penetration." The "N" value for each sample is shown in the adjacent column.

Laboratory testing consisted of natural moisture content (ASTM D 2216), particle size (sieve) analysis (ASTM D 6913), and unconfined compression (ASTM D 2166). The tests were performed in accordance with the ASTM standards listed above. The tests were performed on representative soil samples. The moisture content documents the presence of groundwater in a soil sample. The sieve analysis determines the particle distribution which is used to classify the soil and estimate its properties. The unconfined compression testing aids in determining the properties of cohesive soils.

The U.S. Geological Survey Topographic map and the Quaternary Geology map of Michigan were reviewed. These maps provide general geological information about the region. Publicly available well logs were reviewed to determine the depth of bedrock.

Description of Soil

The general soil profile consists of a layer of sand which extends to depths of 14.0 to 15.0 feet overlying a layer of clay with a pocket of silt which extends to a depth of at least 33.0 feet. The clay and sand layers are lacustrine deposits. Lacustrine deposits are deposits found near lakes formed by glacial activity and typically form layered strata.

Topsoil is present at the surface in the area of Test Boring One and Test Boring Four through Test Boring Six. The topsoil thickness ranges from 4.0 to 7.0 inches. Pavement consisting of 4.0 inches of asphalt is present in the areas of Test Boring Three and Test Boring Seven through Test Boring Nine. In the areas of Test Borings Seven and Eight, the asphalt overlies a 4.0 to 6.0-inch layer of gravelly sand base.

The sand layer consists of brown and gray, fine to medium sand with varying amounts of gravel and extends to depths of 14.0 to 15.0 feet. The "N" values of the sand layer range from 12 to over 50, indicating the sand is in a compact to extremely compact state. The majority of the sand layer is in a very compact state. The "N" values generally correspond to an internal friction angle between 32 and 38 degrees.

Pockets of brown, fine to medium, clayey sand are present above a depth of 4.0 feet in the areas of Test Borings One and Five. The "N" values of the clayey sand pockets range from 4 to 5, indicating that the sand is in a loose to slightly compact state. The "N" values correspond to an internal friction angle of 27 degrees.

A pocket of gray sandy silt underlies the sand layer in the area of Test Boring Four and extends to a depth of over 20.0 feet. The "N" values of the silt pocket range from 35 to over 50, indicating the silt is in a very stiff to extremely stiff state. The internal friction angle of the silt is between 20 and 25 degrees.

The clay layer consists of gray sandy clay with varying amounts of silt and extends to a depth of at least 33.0 feet. The "N" values of the clay layer range from 35 to over 50, indicating the clay is in a very stiff to extremely stiff state. The undrained shear strength of the clay layer is approximately 5,360 pounds per square foot, indicating the clay is in an extremely stiff state.

Bedrock is present below a depth of approximately 140.0 feet. The bedrock consists of sandy shale formed during the Late Devonian Period. The bedrock is part of the Bedford Shale Formation.

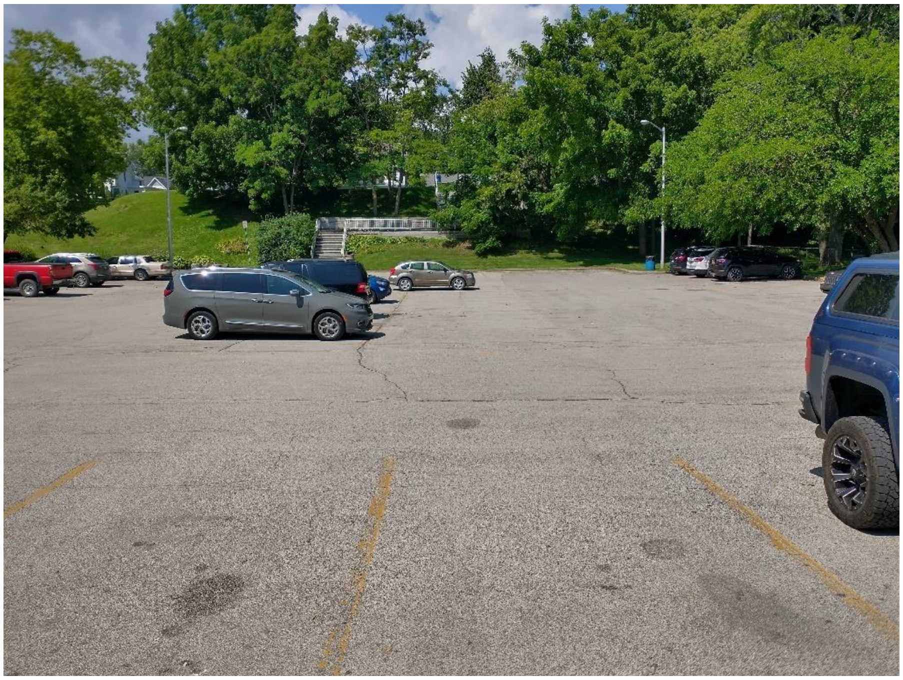
Description of Groundwater Conditions

The water table is present at depths of 5.0 to 7.0 feet. These depths correspond to elevations ranging from 582.5 to 577.7 feet. The static water elevation will be approximately equal to the water elevation of Lake Huron which was approximately 579.0 feet at the time of the investigation. Long-term groundwater monitoring was not performed as part of this investigation.

Description of Site

The site is located at Lexington State Harbor on the western shore of Lake Huron in Lexington Township, Sanilac County, Michigan. The site is bordered to the north and west by residential properties. The south side of the site is bordered by Huron Avenue and the east side is bordered by Lake Huron and the marina. The surface elevation of the site ranges from 582.7 to 609.9 feet. Photographs #1 through #3 show the site at the time of the investigation.

Photograph #1: Northeastern portion of the site. View is to the northeast. (Project No. 2024.1415, Lexington State Harbor, Lexington Township, Sanilac County, Michigan, July 2024)



Photograph #2: Eastern portion of the site and view of existing parking lot. View is to the south. (Project No. 2024.1415, Lexington State Harbor, Lexington Township, Sanilac County, Michigan, July 2024)

Recommendations

Site & Subgrade Preparation

Trees and vegetation in the construction area should be cleared and removed as part of subgrade preparation. The topsoil should be removed to the extent that all soil with an organic content of 3.0 percent or greater is removed. Soil containing roots should be removed to the extent that the root content by volume is 5.0 percent or less. All roots over 0.5 inches in diameter should be removed. The average amount of topsoil anticipated to be removed is 5.0 inches.

The construction areas should be excavated to achieve the desired subgrade elevation as necessary. Excavated sand may be retained for use as fill. Fill should be placed in accordance with the recommendations in the “Fill” section of this report. The fill should be compacted to 95.0 percent of its maximum density to its full depth. In-situ sand should be compacted to 95.0 percent of its maximum density prior to placement of fill. Sand not meeting this requirement should be recompacted.

Soil brought to the site for fill should be clean sand meeting MDOT Class II specifications. Fill should be placed in accordance with the “Fill” section of this report. The fill should be compacted to 95.0 percent of its maximum density, as determined by the modified proctor method per the ASTM D 1557 standard. The soil which will be used for fill should be kept free of topsoil and other organic materials. Compaction tests are recommended to check the compaction of the new fill.

The pavement subgrade, subbase, and aggregate base should be proof-rolled prior to construction. The proof roll should consist of single, overlapping passes. Areas that experience yielding during the proof roll should be recompacted. Areas that continue to experience yielding following recompaction may require undercutting or the placement of a geogrid to stabilize the subgrade.

Boardwalk Foundations Discussion

A new boardwalk will be constructed in the areas of Test Boring Six and Test Boring Nine. Helical piers are recommended to support the boardwalk. Alternatively, pipe or timber piles may be utilized to support the boardwalk. Pipe or timber pile capacities may be evaluated using the soil properties presented in Table 2. Soil & Structures should be consulted for additional recommendations for pipe or timber piles if desired. A bathymetric and topographical survey is recommended prior to the design of boardwalk foundations. Recommendations for helical piers are provided in the section below.

Table 2: Soil Properties for the Pile Axial and Lateral Capacity Analysis

Soil Layer	Depth (ft)	ϕ' (degrees)	Undrained strength (pcf)	Soil Unit Weight (pcf)
Very Compact Sand	0.0 – 14.0	35	-	125
Extremely Stiff Clay	14.0 – 33.0	0	5,360	130

Helical Piers

Helical piers are recommended to support the proposed boardwalk. Helical piers are round or square steel shafts with one or more steel helices. The steel helices are bearing plates welded to the central shaft in locations determined by the pier manufacturer. The helical piers are drilled into the subsurface and shaft extensions are added until a suitable bearing stratum has been reached. The torque required to install the piers is continuously monitoring by the installation equipment.

Helical piers should extend to sufficient depths required to mobilize bearing capacity. The pier lengths should be determined in the field and will vary depending on the specific soil conditions in the area of each helical pier. The anticipated embedment depth for the helical piers is 10.0 to 15.0 feet below the lakebed. However, the final embedment depth of the helical pier installed on the seaward side should take into consideration the height required above the water level, the water level, and sediment depth, and should extend a minimum of twice the exposed height. The exposed height is defined by the water column plus the length of the pier above the water level.

The estimated helical pier length is intended to represent the length required to mobilize soil bearing capacity. The helical piers should be extended until the required installation torque is achieved and maintained over the length of the lead section within the bearing strata. The relationship between installation torque and pile capacity is based on empirical factors provided by the pier manufacturer. If the installation torque required to advance the helical pier reaches the mechanical torque rating of the pier before the anticipated depth is achieved or if refusal conditions are encountered, then the installation should be terminated and Soils & Structures should be contacted before the pier is accepted.

A three-helix lead section is recommended. Table 3 provides the estimated ultimate axial and uplift capacities for different lead sections based on the soil conditions. Safety factors of 2.0 and 3.0 are recommended to determine the allowable axial and uplift capacities, respectively, based on the allowable stress design (ASD) methodology. The final capacity of the helical piers will be based on the shaft diameter and thickness which should be determined by a licensed structural engineer.

Table 3: Estimated Ultimate Axial Capacities for Helical Piers

Helices Diameter (in)	Ultimate Axial Capacity (kips)	Ultimate Uplift Capacity (kips)
8/10/12	49.0	24.0
10/12/14	72.0	33.0

A minimum recommended pier spacing is 3.0 feet on center. An efficiency factor of 1.0 is recommended for piers spaced at 3.0 times the largest helix diameter. Piers spaced closer than the recommended minimum should use efficiency factors of 0.95, 0.85, and 0.80 for pier groups of two, three, and four respectively. The recommended design tolerance for the pier placement is 3.0 inches.

The unbraced length of the helical piers will depend on the exposed height of the pier, water depth, and sediment depth. The unbraced length refers to soil conditions providing minimal lateral support or piers extending thorough air or water which may allow for bending or buckling of the piers under sufficient loading. In general, helical piers are assumed to be braced in sections containing helices and in soil with an "N" value of 5 or greater. The exact unbraced length should be determined following a topographical and bathymetric survey.

Helices should be single-edged with the smallest diameter on the bottom. The helical piers should be installed by a contractor certified by the pier manufacturer. All manufacturer guidelines should be observed including bolting the top cap to the pier shaft. The helical pier contractor should submit the pier installation equipment calibration charts prior to mobilization.

Restroom & Pavilion/Amphitheater Foundations Discussion

The restroom and pavilion/Amphitheater buildings will be constructed in the area of Test Boring Four. Recommendations for the building foundation are provided in the sections below.

Spread Foundations

Spread foundations are recommended to support the buildings provided the subgrade is prepared as discussed in this section as well as the "Site & Subgrade Preparation" and "Fill" sections of this report including compaction. The foundations will be supported on the in-situ soil or compacted fill following site preparation.

Fill in the building areas should be compacted to 95.0 percent of the soil's maximum density to its full depth. In-situ sand should be compacted to 95.0 percent of the sand's maximum density at footing grade using a vibratory compactor or a hoe-pack. Compaction tests should be performed in the foundation subgrade to verify these levels of compaction. Soils not exceeding the minimum density should be recompacted.

Foundations may be designed using an allowable soil bearing value of 3,500 pounds per square foot for isolated column footings and 3,000 pounds per square foot wall foundations provided the recommendations for subgrade preparation in the previous section are followed including compaction. A minimum width of 16.0 inches is recommended for new foundations. The allowable bearing values may be increased by 25.0 percent when considering transient loads such as earthquakes and wind.

Drilled Pier Foundations

Drilled concrete piers may be used to support the pavilion and amphitheater. A minimum pier diameter of 12.0 inches is recommended. The piers should bear on the very sand below a depth of 3.5 feet. Piers may be extended to greater depths for the purposes of meeting overturning and uplift requirements as determined by the structural engineer. Piers bearing at or below a depth of 3.5 feet will achieve an allowable end bearing pressure of 3,500 pounds per square foot.

The drilled pier shaft should be straight, dry, and free of loose or caved materials. Concrete should be placed as soon as possible after drilling. The “Dry Temporary Casing Construction Method” detailed in subsection 718.03.B.3 of the 2020 MDOT Standard Specifications for Construction is anticipated due to the presence of sand which is susceptible to caving.

The concrete should have a minimum 28-day compressive strength of 4,000 pounds per square inch. The mix design should be submitted by the contractor for approval prior to mobilization. Steel reinforcing, if required, should be designed by a licensed structural engineer.

General Foundation Recommendations

The recommended minimum cover over the bottom of exterior foundations is 42 inches for protection against frost heave. Foundations should not be constructed on frozen soil. During cold weather construction, the foundation subgrade and foundations should be protected from freezing with insulated blankets until backfill is placed over both sides of the foundation. Foundations that are damaged by frost heave should be replaced.

The site classification for seismic design is “D” based on ASCE-7 Table 20.3-1 and the Michigan Building Code. The final seismic parameters including the seismic design category of the structure should be verified by the structural engineer on record.

Settlement

The maximum settlement of the buildings and boardwalk is anticipated to be less than 0.4 inches, provided the recommendations in this report are observed. Differential settlement will be approximately one half of the maximum value. These levels of settlement are within the recommended acceptable limits of 0.6 inches of total settlement and 0.4 inches of differential settlement.

Floors

A slab on grade is recommended for the floors. A modulus of subgrade reaction of 150 pounds per cubic inch is recommended for the design of slabs on grade. A base of 6.0 inches of clean sand is recommended under the floors. The sand should meet MDOT Class II specifications. Fill under floors should be compacted as specified in the “Fill” section of this report. The in-situ sand is suitable for use as a base material.

Lateral Earth Pressure

Foundation walls with different soil levels on either side should be designed as retaining walls. Sand should be used as backfill behind retaining and foundation walls. The sand should meet MDOT Class II specifications. The walls should be designed using a soil density of 120 pounds per cubic foot, a coefficient of active earth pressure of 0.33 for level sand backfill and a coefficient of at-rest earth pressure of 0.45 for level sand backfill. The effects of any surcharge or sloping backfill should also be included in the design. Coefficients of passive earth pressure of 1.0 and 3.0 may be used for the in-situ clay and sand, respectively.

Excavations

The in-situ soils are a mixture of OSHA type "B" and "C" soils. Excavations that will be entered by personnel should be based on OSHA requirements for type "C" soil. Based on OSHA requirements, a maximum allowable side slope of 34 degrees (1.5 H:1V) is recommended for excavations 4.0 to 20.0 feet deep. Excavations less than 4.0 feet deep may have vertical side slopes. Excavations adjacent to structures or property lines may require temporary shoring.

Fill

Fill, including the aggregate layers under pavement, should be compacted to a density of 95.0 percent of its maximum density to its full depth. The maximum density should be determined in accordance with the ASTM D 1557 standard. A maximum thickness per layer of 6.0 inches is recommended for compaction. The lift thickness may be increased to 12.0 inches for granular fill if a vibratory roller or hoe-pack is used for compaction. Compaction tests are recommended to confirm that the fill is compacted to the required density.

Soil brought to the site for structural fill should be sand meeting MDOT Class II requirements or ASTM requirements for an SP or SW which are the designations for clean sand. Excavated sand may be used as fill. If the amount of fill required to establish the final grade exceeds the amount of material available on site, additional material will have to be imported.

Fill should not be placed over frozen ground, snow, or ice. Soil which contains frozen material should not be used as fill. During winter construction, removal of frozen ground may be necessary prior to placing fill.

Groundwater Management

Groundwater controls and dewatering will probably not be necessary for the construction of foundations and utilities. If excavations encounter groundwater, the excavation bottom may be stabilized by placing a 6.0 to 8.0 inch layer of porous aggregate over the bottom of the excavation. The aggregate will stabilize the bottom of the excavation.

The infiltration rate of the in-situ sand is anticipated to be suitable for internal drainage of stormwater. Stormwater will only infiltrate to the elevation of the water table which corresponds to the elevation of Lake Huron.

Underdrains below pavement are not required but may increase the pavement lifespan. Pavement areas should be properly drained to minimize the effects of frost heaving and the loss of subgrade due to water infiltration. The parking areas should be sloped towards low points with catch basins or curb inlets.

Hot Mix Asphalt (HMA) Pavement

The recommended preliminary HMA pavement sections listed in Table 4 were developed based on the discussions and assumptions included in this report and the design procedures outlined in the "AASHTO Guide for Design of Pavement Structures." The subgrade should be prepared as described in the "Site & Pavement Subgrade Preparation" and "Fill" sections of this report. The recommended pavement section materials listed in Table 4 refer to and should comply with the standard material designations included in applicable MDOT specifications and guidelines including the 2020 MDOT "Standard Specifications for Construction." The final pavement design should be based on site specific traffic loading.

The following recommendations assume that maintenance repairs such as joint sealing, patching, and overlays are regularly performed throughout the lifespan of the pavement and that proper drainage has been established throughout the site. Proper drainage includes the installation of stormwater controls, underdrains, and establishing positive drainage in the subgrade and pavement layers.

Table 4: Recommended Pavement Sections

Pavement Cross Section Materials	Standard Duty		Heavy Duty	
	Material	Thickness (in)	Material	Thickness (in)
HMA Wearing Course	4EML	2.0	4EML	2.5
HMA Base Course	4EML	2.0	4EML	2.5
Aggregate Base	21AA Limestone	8.0	21AA Limestone	10.0
Sand Subbase	Class II	12.0	Class II	12.0

The recommended asphaltic binder is PG 64-28. Tier 1 recycled asphalt (RAP) specifications may be used in combination with the PG 64-28 binder for the wearing course. Tier 2 RAP specifications may be used for the base course. A softer binder may be necessary to achieve desired performance characteristics when utilizing Tier 2 RAP contents, per the MDOT Special Provision for Recycled Asphalt Pavement. The compacted asphalt should be between 94.0 and 97.0 percent of the Theoretical Maximum Density, as determined via the Superpave "Rice" Method. The target void content should be 3.5 percent for both the base and wearing course. A tack or "bond coat" of SS-1h emulsion shall be applied between the base and wearing course layers at a rate of 0.1 gallons per square yard.

The paving contractor should submit the proposed mix design to the owner for review and approval prior to placement. The HMA pavement should be placed in at least two lifts. The pavement section should be constructed in accordance with MDOT guidelines and specifications as well as applicable state and local requirements.

Paved areas that display poor workmanship, which may include segregation, “cold screed scrapes”, wearing courses not flush with curbs or rims, roller marks, shoving, smearing, or tearing of the mat, flushing, or excessive cold joints should be repaired or replaced by the contractor immediately.

Pavement subgrade, subbase, and aggregate base should be proof rolled prior to aggregate base and pavement placement. The proof rolls should be conducted in accordance with the recommendations in the “Site & Subgrade Preparation” section of this report. The in-situ sand is suitable for use as a subbase material.

The pavement section should be constructed in accordance with MDOT guidelines and specifications as well as applicable state and local requirements. Support conditions and compaction should be assessed during construction in accordance with the “Quality Control and Testing” section of this report. This assessment should occur prior to the installation of individual pavement layers.

Portland Cement Concrete (PCC) Pavement

The subgrade should be prepared in accordance with the “Site & Subgrade Preparation” and “Fill” sections of this report. A modulus of subgrade reaction of 150 pounds per cubic inch is recommended for the design of concrete pavement provided the recommendations in this report are observed. The paving contractor should submit the proposed mix design to the owner for review and approval prior to concrete placement.

A base of 12.0 inches of clean sand or aggregate that meets MDOT Class II or 21AA specifications respectively is recommended under the slab on grade concrete pavement. The in-situ soil is suitable for use as a base. The minimum base thickness may be reduced to 6.0 inches for sidewalk slabs. A minimum slab on grade concrete pavement thickness of 4.0 to 6.0 inches is recommended for standard and heavy-duty concrete pavement. In the areas of dumpster pads, a minimum pavement thickness of 8.0 inches is recommended. The pavement and reinforcement, if required, should be designed based on site-specific loading conditions. The recommended minimum concrete pavement thickness is 4.0 inches for sidewalks surrounded by greenbelt and 5.0 inches for revealed-face slabs.

Quality Control Testing

Compaction tests as per ASTM D 6938 are recommended to confirm that fill in the construction areas is compacted to the specified density. While fill is being placed, compaction tests should be performed at the rate of one test per 400 cubic yards of fill and throughout the depth of the fill with a minimum of five tests at each 1.0-foot elevation interval. Full-time inspection is recommended while sand and fill are compacted in the building areas. Compaction tests should be performed under foundations at the rate of one test per column foundation. The recommended testing frequency in the floor and pavement subgrade is one test per 2500 square feet. Tests should also be performed in the backfill over foundations and utilities. The maximum density should be determined in accordance with ASTM D 1557 or ASTM D 4253 procedures.

Full time inspection of the helical pier installation is recommended. For each helical pier, the following information should be recorded; surface elevation, depth drilled, tip elevation, cutoff elevation, pier length, drilling time, and measured installation torque. The torque measured at the time of installation should be used to verify the pier capacity at the embedment depth. A pile load test may be omitted provided full time inspection and torque monitoring are conducted.

Unless otherwise specified in the design documents or project plans, the following testing procedures and frequencies should be observed for HMA and slab on grade concrete. Both asphalt and concrete quality testing should adhere to the 2020 MDOT Standards for Construction.

Asphalt temperatures during placement should be at least 275 degrees Fahrenheit; material that arrives at temperatures below 250 degrees Fahrenheit shall be rejected. Asphalt density testing should be performed with a nuclear density gauge at a minimum rate of one test per 500 square feet of pavement. At least five total verification cores in each course are recommended to assess relative compaction, calibrate the nuclear density gauge, and evaluate thickness. A minimum of two loose mix samples per mix per day should be taken at the plant and delivered to the quality-assurance firm’s laboratory for vacuum extraction-gradations. The asphalt contractor should provide a minimum of two (2) theoretical maximum density verifications per day.

Concrete testing should be performed by a certified concrete technician (MCA Michigan Level I or II). One set of concrete tests should be performed for every fifty (50) cubic yards of concrete placed. Concrete should be sampled in accordance with ASTM C172. A set of concrete tests should consist of a concrete slump, air content, and concrete temperature. Slump testing should be performed in accordance with ASTM C143. Air content testing should be performed in accordance with ASTM C231. Concrete temperature testing should be performed in accordance with ASTM C1064. Air temperature should also be recorded at the time of testing. A set of test cylinders should be molded at the time of testing. A minimum of two (2) test cylinders should be molded per cylinder set for 28-day compressive strength testing. Test cylinders should be prepared in accordance with ASTM C31 and tested in accordance with ASTM C39.

A smooth 0.5-to-0.75-inch diameter rod should be used in conjunction with compaction tests to probe for loose areas under foundations, in fill, and under floors. A dynamic cone should not be substituted for compaction tests for evaluating fill. Testing should be performed by technicians supervised by a registered geotechnical engineer.

General Conditions & Reliance

The report was prepared in accordance with generally accepted practices of the geotechnical engineering profession. The scope of work consisted of performing nine (9) test borings and providing soil related recommendations for the design and construction of the proposed park improvements. The scope of work did not include an environmental study or wetland determination.

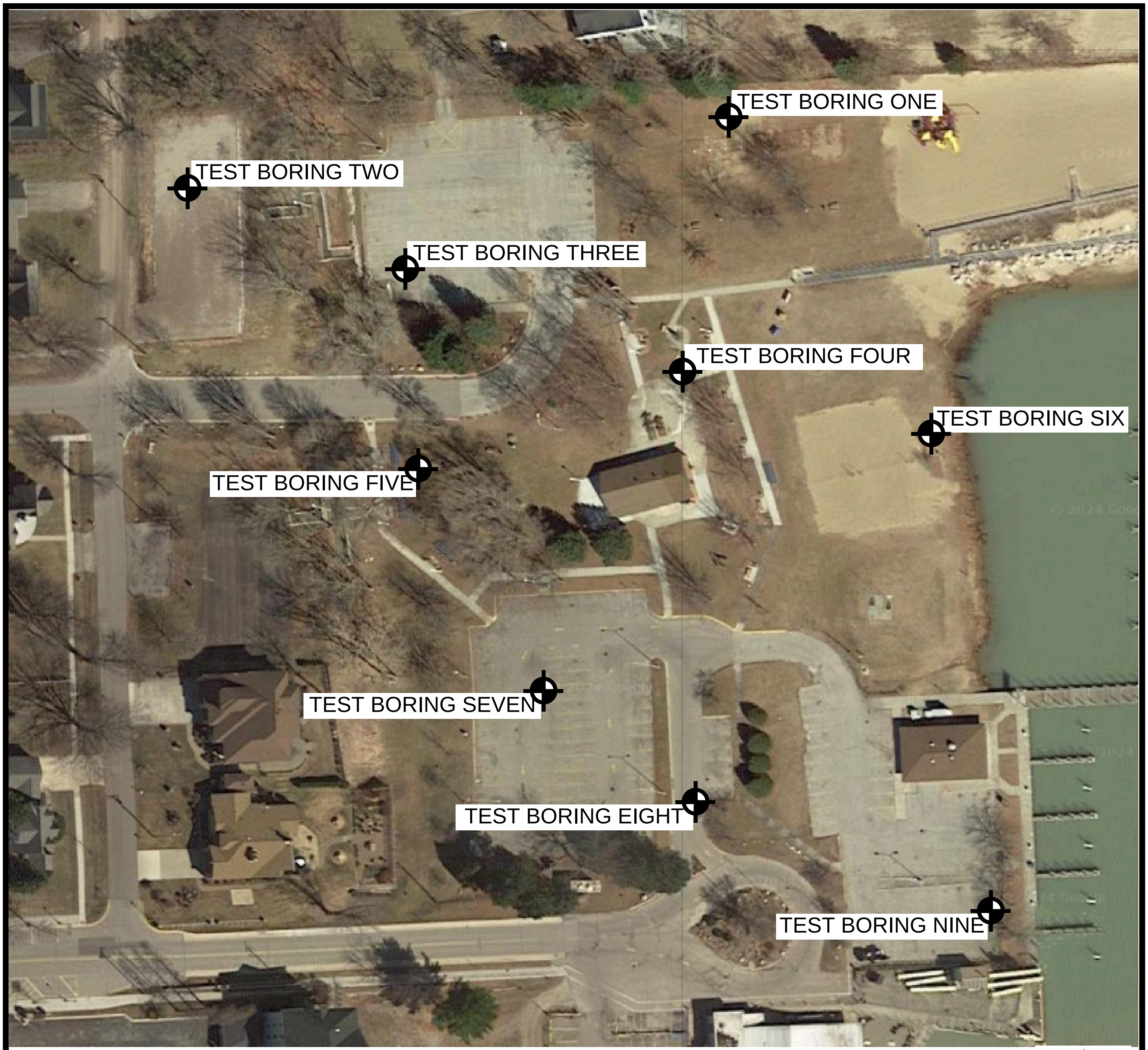
The report and the associated test borings were prepared specifically for the previously described project and site. Soils & Structures should be consulted if a significant change in the scope of the project is made.

The test borings represent point information and may not have encountered all of the soil types and materials present on this site. This report does not constitute a guarantee of the soil or groundwater conditions or that the test borings are an exact representation of the soil or groundwater conditions at all points on this site.

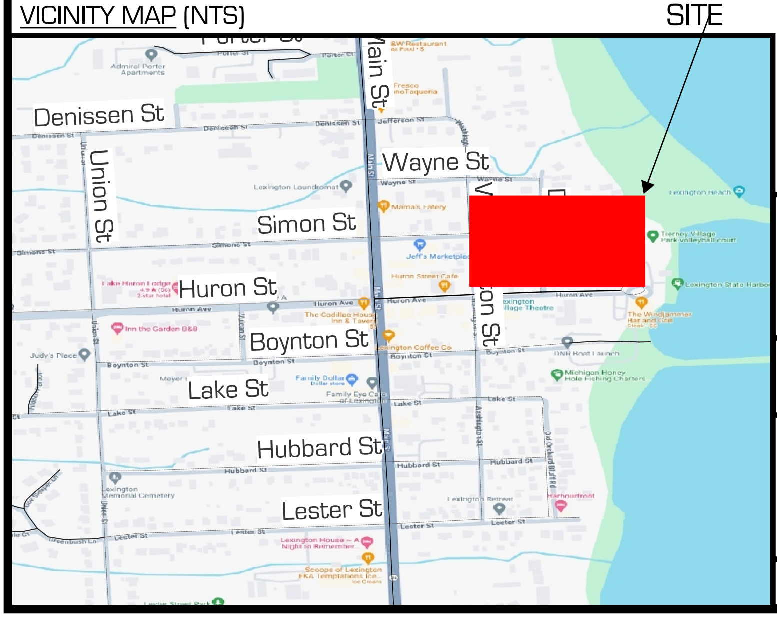
The descriptions and recommendations contained in this report are based on an interpretation of the test borings and laboratory tests. The test borings should not be used independently of the report. If soil conditions are encountered which are significantly different from the test borings, Soils & Structures should be consulted for additional recommendations.

The report and test borings may be relied upon by Edgewater Resources, LLC. for the design, construction, permitting, and financing associated with the construction of the Lexington State Harbor project located in Lexington Township, Sanilac County, Michigan. The use of the report and test borings by third parties not associated with this project or for other sites has not been agreed upon by Soils & Structures. Soils & Structures does not recommend or consent to third party use or reliance of the report or test borings unless allowed to review the proposed use of these materials. Unless obtained in writing, consent to third-party use should not be assumed. Third parties using the report or test boring logs do so at their own risk and are offered no guarantee or promise of indemnity.

Appendix



VICINITY MAP (NTS)



TEST BORING LOCATION PLAN

NTS

Note: The background of the test boring plan is a portion of an aerial photograph from Google Earth.

Lexington State Harbor
7411 Huron Avenue

Lexington Township, Ottawa County, Michigan

Soils & Structures, Inc.
6480 Grand Haven Road
Muskegon, Michigan 49441

JOB NO.: 2024.1415

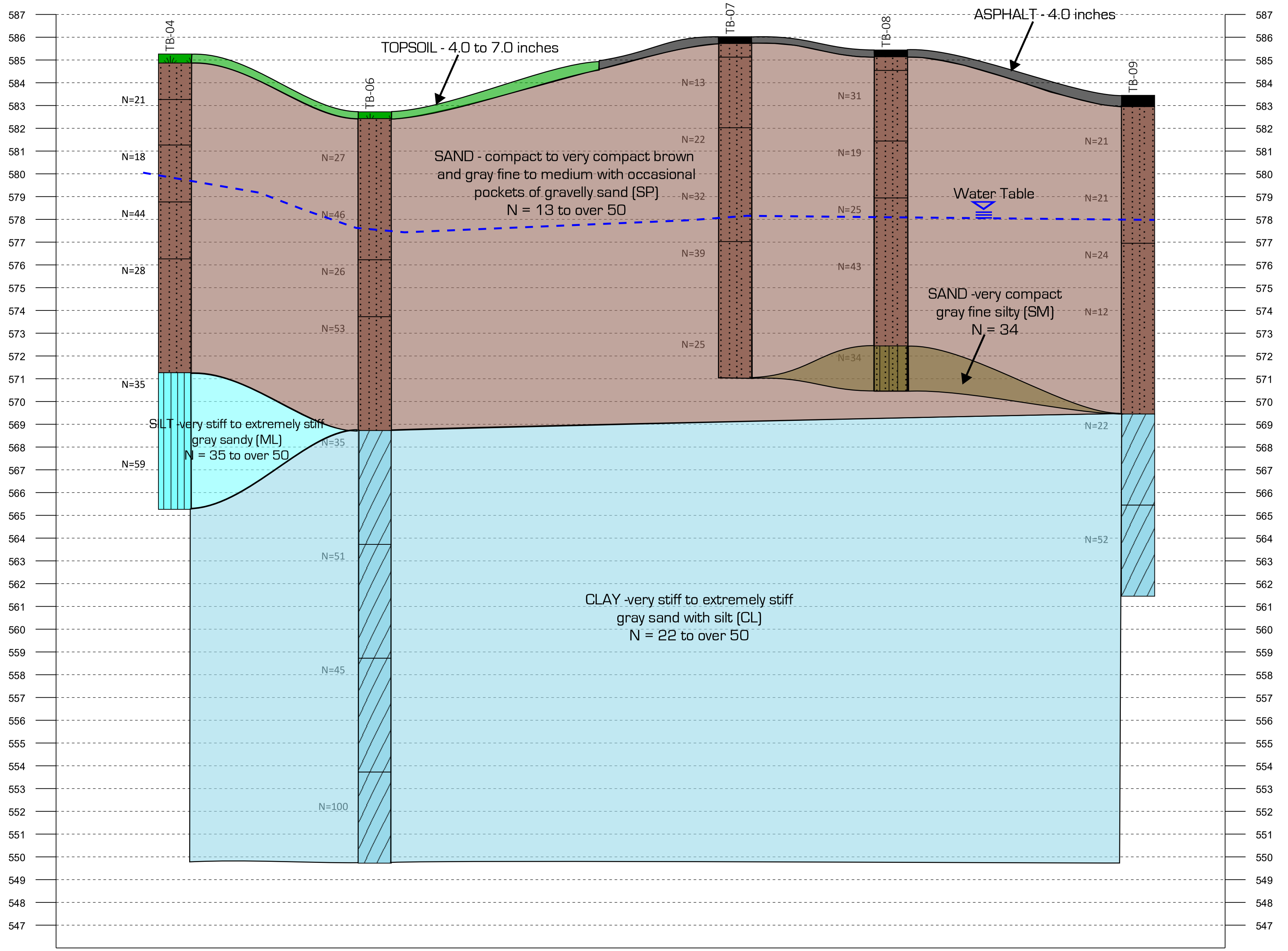
DATE: 08-15-2024

Project Id: 2024.1415
Project Title: Lexington State Harbor
Location: Lexington, Michigan
Client: Edgewater Resources, LLC

Title: Section line 1
Vertical Scale: 1:74
Horizontal Scale: 1:1509
Engineer: Vincent Oderah, P.E.

GENERAL SOIL PROFILE

NOTE: The water table is at depths of 5.0 to 10.0 feet.



Legend Key

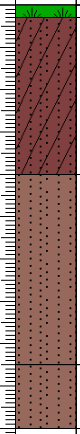
- ■ Asphalt
- ▨ Poorly Graded SAND
- 🟩 Topsoil
- ▥ SILTY SAND
- ▥ SILT
- ▨ Lean CLAY

SOILS & STRUCTURES

Borehole ID: TB-01

Sheet 1 of 1

Project Name: Lexington State Harbor
Project Number: 2024.1415
Project Location: Lexington, Michigan
Logged By: H Spangler **Reviewed By:** K Martella
Client: Edgewater Resources, LLC
Survey Datum: NAD 1983 StatePlane Michigan South **Hole Depth:** 10.00
Date Started: Aug 05 2024 **Completed:** Aug 05 2024
Northing: 650426.7 **Easting:** 13613405.1 **Elevation:** 586.06
Drilling Method: 3-1/4" Hollow Stem Auger
Frost Depth
Equipment: Diedrich D-25
Ground Water Levels
Hammer Type: Automatic Hammer
▽ At Time of Drilling 7.00' on Aug 05 2024
▼
Notes:



Depth	Graphic	Material Description	Sample Type	Number	Recovery % RQD	Blow Counts	N-Value	Pocket Pen (tsf)	Shear Strength (tsf)	Moisture Content (%)	Atterberg Limits Liquid Limit	Plastic Limit	Plasticity Index	USCS
		TOPSOIL - brown sandy (4.0")												
1		SAND - slightly compact brown fine to medium clayey												
2														SC
3				SPT-A	80	3-2-3	5			3.8				
4		SAND - very compact brown fine to medium												
5				SPT-B	87	6-14-17	31							
6														SP
7		▽												
8				SPT-C	87	9-10-16	26							
9		SAND - very compact brown fine to medium gravelly		SPT-D	87	7-14-22	36			12.1				SP
10														
11														
12														
13														
14														
15														
16														
17														
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19														
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28														
29														
30														

SOILS &
STRUCTURES

Borehole ID: TB-02

Sheet 1 of 1

Project Name: Lexington State Harbor
Project Number: 2024.1415
Project Location: Lexington, Michigan
Logged By: H Spangler **Reviewed By:** K Martella
Client: Edgewater Resources, LLC
Survey Datum: NAD 1983 StatePlane Michigan South **Hole Depth:** 5.00
Date Started: Aug 05 2024 **Completed:** Aug 05 2024
Northing: 650342.6 **Easting:** 13613033.0 **Elevation:** 609.94
Drilling Method: 3-1/4" Hollow Stem Auger
Frost Depth
Equipment: Diedrich D-25
Ground Water Levels
Hammer Type: Automatic Hammer
▽
Notes:
▼ End of Drilling Aug 05 2024 - Water Not Encountered

Depth	Graphic	Material Description	Sample Type	Number	Recovery % RQD	Blow Counts	N-Value	Pocket Pen (tsf)	Shear Strength (tsf)	Moisture Content (%)	Atterberg Limits Liquid Limit	Atterberg Limits Plastic Limit	Atterberg Limits Plasticity Index	USCS
		GRAVEL - gray fine to medium sandy (10.0")												GP
1		SAND - dark brown fine to medium gravelly with a trace of clay												SP
2														
3		CLAY - firm brown sandy	⧗	SPT-A	87	2-3-3	6			14.2				CL
4		CLAY - stiff brown with sand and a trace of silt	⧗	SPT-B	87	4-5-7	12		2.68	13.4				CL
5														
6														
7														
8														
9														
10														
11														
12														
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SOILS & STRUCTURES

Borehole ID: TB-03

Sheet 1 of 1

Project Name: Lexington State Harbor
Project Number: 2024.1415
Project Location: Lexington, Michigan
Logged By: H Spangler **Reviewed By:** K Martella
Client: Edgewater Resources, LLC
Survey Datum: NAD 1983 StatePlane Michigan South **Hole Depth:** 5.00
Date Started: Aug 05 2024 **Completed:** Aug 05 2024
Northing: 650310.5 **Easting:** 13613176.7 **Elevation:** 584.38
Drilling Method: 3-1/4" Hollow Stem Auger
Frost Depth
Equipment: Diedrich D-25
Ground Water Levels
Hammer Type: Automatic Hammer
▽
Notes:
▼ End of Drilling Aug 05 2024 - Water Not Encountered

Depth	Graphic	Material Description	Sample Type	Number	Recovery % RQD	Blow Counts	N-Value	Pocket Pen (tsf)	Shear Strength (tsf)	Moisture Content (%)	Atterberg Limits			USCS
											Liquid Limit	Plastic Limit	Plasticity Index	
		ASPHALT - (4.0")												
1		SAND - very compact brown fine to coarse												
2														SP
3				SPT-A	87	9-15-16	31			8.7				
4		SAND - very compact brown fine to medium with a trace of gravel		SPT-B	87	13-13-18	31			15.1				SP
5														
6														
7														
8														
9														
10														
11														
12														
13														
14														
15														
16														
17														
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29														
30														

SOILS & STRUCTURES

Borehole ID: TB-04

Sheet 1 of 1

Project Name: Lexington State Harbor
Project Number: 2024.1415
Project Location: Lexington, Michigan
Logged By: H Spangler **Reviewed By:** K Martella
Client: Edgewater Resources, LLC
Survey Datum: NAD 1983 StatePlane Michigan South **Hole Depth:** 20.00
Date Started: Aug 06 2024 **Completed:** Aug 06 2024
Northing: 650246.2 **Easting:** 13613376.9 **Elevation:** 585.26
Drilling Method: 3-1/4" Hollow Stem Auger
Frost Depth
Equipment: Diedrich D-25
Ground Water Levels
Hammer Type: Automatic Hammer
▽ At Time of Drilling 5.00' on Aug 06 2024
▼
Notes:

Depth	Graphic	Material Description	Sample Type	Number	Recovery % RQD	Blow Counts	N-Value	Pocket Pen (tsf)	Shear Strength (tsf)	Moisture Content (%)	Atterberg Limits Liquid Limit	Atterberg Limits Plastic Limit	Atterberg Limits Plasticity Index	USCS
1	🟩 🟫	TOPSOIL - brown sandy with a trace of clay (5.0")												SP
2	🟫	SAND - brown fine to medium with a trace of clay												
3	🟫	SAND - compact brown fine	⧗	SPT-A	87	7-9-12	21			3.1				SP
4	🟫	SAND - compact brown fine to medium												
5	🟫	▽	⧗	SPT-B	87	5-9-9	18			8.6				SP
6	🟫													
7	🟫	SAND - very compact brown fine to medium gravelly with a trace of clay												
8	🟫		⧗	SPT-C	87	9-20-24	44							SP
9	🟫	SAND - very compact brown fine												
10	🟫		⧗	SPT-D	87	8-11-17	28			22.2				
11	🟫													SP
12	🟫													
13	🟫													
14	🟫	SILT - very stiff to extremely stiff gray sandy												
15	🟦		⧗	SPT-E	87	18-18-17	35							
16	🟦													
17	🟦													ML
18	🟦													
19	🟦		⧗	SPT-F	87	13-27-32	59			10.7				
20														
21														
22														
23														
24														
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27														
28														
29														
30														

SOILS & STRUCTURES

Borehole ID: TB-05

Sheet 1 of 1

Project Name: Lexington State Harbor
Project Number: 2024.1415
Project Location: Lexington, Michigan
Logged By: H Spangler **Reviewed By:** K Martella
Client: Edgewater Resources, LLC
Survey Datum: NAD 1983 StatePlane Michigan South **Hole Depth:** 5.00
Date Started: Aug 05 2024 **Completed:** Aug 05 2024
Northing: 650171.7 **Easting:** 13613191.4 **Elevation:** 587.46
Drilling Method: 3-1/4" Hollow Stem Auger
Frost Depth
Equipment: Diedrich D-25
Ground Water Levels
Hammer Type: Automatic Hammer
▽ At Time of Drilling 5.00' on Aug 05 2024
▼
Notes:

Depth	Graphic	Material Description	Sample Type	Number	Recovery % RQD	Blow Counts	N-Value	Pocket Pen (tsf)	Shear Strength (tsf)	Moisture Content (%)	Atterberg Limits Liquid Limit	Atterberg Limits Plastic Limit	Atterberg Limits Plasticity Index	USCS
1		TOPSOIL - dark brown sandy with a trace of clay (7.0")												
2		SAND - loose brown fine to medium clayey												SC
3			⧗	SPT-A	80	2-2-2	4			13.7				
4		SAND - compact brown fine to medium with a trace of gravel	⧗	SPT-B	87	7-9-8	17			13.7				SP
5	▽													
6														
7														
8														
9														
10														
11														
12														
13														
14														
15														
16														
17														
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28														
29														
30														

SOILS & STRUCTURES

Borehole ID: TB-06

Sheet 1 of 2

Project Name: Lexington State Harbor
Project Number: 2024.1415
Project Location: Lexington, Michigan
Logged By: H Spangler **Reviewed By:** K Martella
Client: Edgewater Resources, LLC
Survey Datum: NAD 1983 StatePlane Michigan South **Hole Depth:** 33.00
Date Started: Aug 06 2024 **Completed:** Aug 06 2024
Northing: 650202.2 **Easting:** 13613551.2 **Elevation:** 582.72
Drilling Method: 3-1/4" Hollow Stem Auger
Frost Depth
Equipment: Diedrich D-25
Ground Water Levels
Hammer Type: Automatic Hammer
▽ At Time of Drilling 5.00' on Aug 06 2024
▼
Notes:

Depth	Graphic	Material Description	Sample Type	Number	Recovery % RQD	Blow Counts	N-Value	Pocket Pen (tsf)	Shear Strength (tsf)	Moisture Content (%)	Atterberg Limits: Liquid Limit	Atterberg Limits: Plastic Limit	Atterberg Limits: Plasticity Index	USCS
		TOPSOIL - brown sandy (4.0")												
1		SAND - very compact brown fine to medium												
2														
3			⧗	SPT-A	87	8-9-18	27							SP
4														
5	▽		⧗	SPT-B	87	11-19-27	46			11.1				
6														
7		SAND - very compact gray fine												
8			⧗	SPT-C	87	1-10-16	26			24.9				SP
9		SAND - extremely compact gray fine to medium with a trace of silt and gravel												
10			⧗	SPT-D	87	12-24-29	53							
11														SP
12														
13														
14		CLAY - very stiff gray sandy												
15			⧗	SPT-E	53	13-16-19	35			13.8				
16														CL
17														
18														
19		CLAY - extremely stiff gray sandy with a trace of silt												
20			⧗	SPT-F	150	19-50/0...	50/4"							
21														CL
22														
23														
24		CLAY - very stiff gray sandy												
25			⧗	SPT-G	80	16-17-28	45			11.8				
26														CL
27														
28														
29		CLAY - extremely stiff gray with silt sand and a trace of gravel												
30														

SOILS &
STRUCTURES

Borehole ID: TB-06

Sheet 2 of 2

Project Name: Lexington State Harbor
Project Number: 2024.1415
Project Location: Lexington, Michigan
Logged By: H Spangler
Reviewed By: K Martella
Client: Edgewater Resources, LLC
Survey Datum: NAD 1983 StatePlane Michigan South
Hole Depth: 33.00
Date Started: Aug 06 2024
Completed: Aug 06 2024
Northing: 650202.2
Easting: 13613551.2
Elevation: 582.72
Drilling Method: 3-1/4" Hollow Stem Auger
Frost Depth
Equipment: Diedrich D-25
Ground Water Levels
Hammer Type: Automatic Hammer
▽ At Time of Drilling 5.00' on Aug 06 2024
Notes:
▼

Depth	Graphic	Material Description	Sample Type	Number	Recovery % RQD	Blow Counts	N-Value	Pocket Pen (tsf)	Shear Strength (tsf)	Moisture Content (%)	Atterberg Limits			USCS
											Liquid Limit	Plastic Limit	Plasticity Index	
31	▨	CLAY - extremely stiff gray with silt sand and a trace of gravel	⧗	SPT-H	152	50/0.33'	50/4"							CL
32														
33														
34														
35														
36														
37														
38														
39														
40														
41														
42														
43														
44														
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55														
56														
57														
58														
59														
60														

Borehole ID: TB-07

Sheet 1 of 1

Project Name: Lexington State Harbor
Project Number: 2024.1415
Project Location: Lexington, Michigan
Logged By: H Spangler **Reviewed By:** K Martella
Client: Edgewater Resources, LLC
Survey Datum: NAD 1983 StatePlane Michigan South **Hole Depth:** 15.00
Date Started: Aug 05 2024 **Completed:** Aug 05 2024
Northing: 650026.7 **Easting:** 13613279.1 **Elevation:** 586.02
Drilling Method: 3-1/4" Hollow Stem Auger
Frost Depth
Equipment: Diedrich D-25
Ground Water Levels
Hammer Type: Automatic Hammer
▽ At Time of Drilling 7.00' on Aug 05 2024
▼
Notes:

Depth	Graphic	Material Description	Sample Type	Number	Recovery % RQD	Blow Counts	N-Value	Pocket Pen (tsf)	Shear Strength (tsf)	Moisture Content (%)	Atterberg Limits Liquid Limit	Atterberg Limits Plastic Limit	Atterberg Limits Plasticity Index	USCS
		ASPHALT - (4.0")												
1		SAND - dark brown fine to medium gravelly (6.0")												SP
2														SP
3		SAND - compact brown fine	⧗	SPT-A	87	3-5-8	13							
4														
5		SAND - very compact brown fine to medium	⧗	SPT-B	87	4-9-13	22			13.9				
6														
7	▽													SP
8			⧗	SPT-C	0	14-17-15	32							
9														
10		SAND - very compact brown fine to medium gravelly	⧗	SPT-D	100	12-16-23	39			16.5				
11														
12														SP
13														
14			⧗	SPT-E	0	8-9-16	25							
15														
16														
17														
18														
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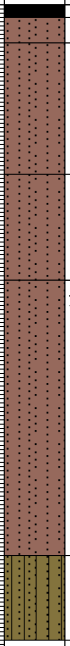
30														

SOILS & STRUCTURES

Borehole ID: TB-08

Sheet 1 of 1

Project Name: Lexington State Harbor
Project Number: 2024.1415
Project Location: Lexington, Michigan
Logged By: H Spangler **Reviewed By:** K Martella
Client: Edgewater Resources, LLC
Survey Datum: NAD 1983 StatePlane Michigan South **Hole Depth:** 15.00
Date Started: Aug 05 2024 **Completed:** Aug 05 2024
Northing: 649938.6 **Easting:** 13613391.7 **Elevation:** 585.44
Drilling Method: 3-1/4" Hollow Stem Auger
Frost Depth
Equipment: Diedrich D-25
Ground Water Levels
Hammer Type: Automatic Hammer
▽ At Time of Drilling 7.00' on Aug 05 2024
Notes:
▼



Depth	Graphic	Material Description	Sample Type	Number	Recovery % RQD	Blow Counts	N-Value	Pocket Pen (tsf)	Shear Strength (tsf)	Moisture Content (%)	Atterberg Limits			USCS
											Liquid Limit	Plastic Limit	Plasticity Index	
		ASPHALT - (4.0")												
1		SAND - gray fine to medium gravelly (4.0")												SP
2		SAND - very compact brown fine to medium												SP
3			⧗	SPT-A	80	10-17-14	31			3.2				
4		SAND - compact brown fine to coarse with lenses of clay												
5			⧗	SPT-B	87	8-8-11	19							SP
6														
7		▽ SAND - very compact gray fine												
8			⧗	SPT-C	87	9-11-14	25			25.1				
9														
10			⧗	SPT-D	87	8-13-30	43			19.5				SP
11														
12														
13		SAND - very compact gray fine silty												
14			⧗	SPT-E	87	13-15-19	34							SM
15														
16														
17														
18														
19														
20														
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29														
30														

SOILS & STRUCTURES

Borehole ID: TB-09

Sheet 1 of 1

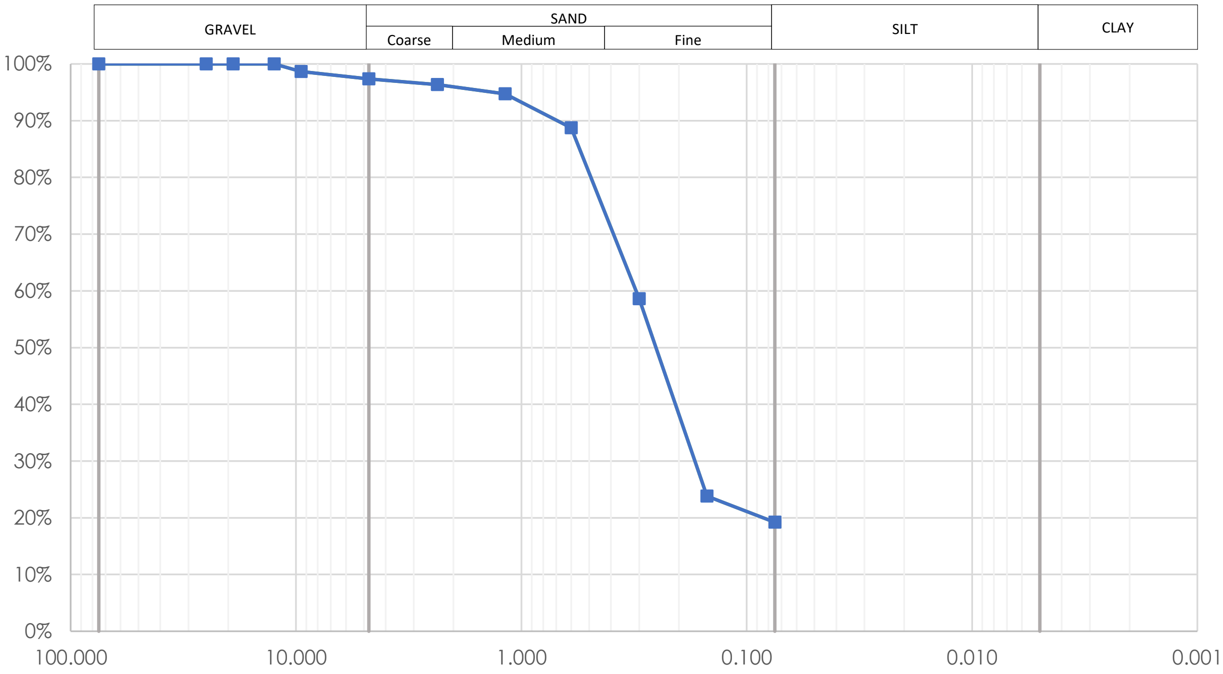
Project Name: Lexington State Harbor
Project Number: 2024.1415
Project Location: Lexington, Michigan
Logged By: H Spangler **Reviewed By:** K Martella
Client: Edgewater Resources, LLC
Survey Datum: NAD 1983 StatePlane Michigan South **Hole Depth:** 22.00
Date Started: Aug 05 2024 **Completed:** Aug 05 2024
Northing: 649866.8 **Easting:** 13613601.1 **Elevation:** 583.45
Drilling Method: 3-1/4" Hollow Stem Auger
Frost Depth
Equipment: Diedrich D-25
Ground Water Levels
Hammer Type: Automatic Hammer
▽ At Time of Drilling 5.00' on Aug 05 2024
Notes:
▼

Depth	Graphic	Material Description	Sample Type	Number	Recovery % RQD	Blow Counts	N-Value	Pocket Pen (tsf)	Shear Strength (tsf)	Moisture Content (%)	Atterberg Limits Liquid Limit	Plastic Limit	Plasticity Index	USCS
		ASPHALT - (6.0")												
1		SAND - very compact brown fine to medium												
2														
3			⧗	SPT-A	87	7-10-11	21			14.4				SP
4														
5		▽	⧗	SPT-B	87	4-9-12	21							
6														
7		SAND - compact gray fine to medium gravelly												
8			⧗	SPT-C	87	13-15-9	24			15.1				
9														
10			⧗	SPT-D	47	9-8-4	12							SP
11														
12														
13														
14		CLAY - very stiff gray sandy with a trace of gravel												
15			⧗	SPT-E	80	5-6-16	22							
16														CL
17														
18		CLAY - extremely stiff gray with silt and sand												
19														
20			⧗	SPT-F	125	38-50/0...	50/4"			9.9				CL
21														
22														
23														
24														
25														
26														
27														
28														
29														
30														

Particle Size Distribution Report

Project Name	Lexington State Harbor
Project Number	2024.1415
Client	Edgewater Resources, LLC
Date	8/19/2024

Sample Location TB-01 Sample ID A Depth (ft) 2.0



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0%	0.0%	2.6%	1.5%	24.7%	52.0%	0.0%	0.0%
D85	**D60**	**D50**	**D30**	**D15**	**D10**	**Loss By Wash**	
0.5627	0.3138	0.2629	0.1766	0.0586	0.0391	19.2%	

Particle Size	
Sieve	**% Passing**
3 in.	100%
1 in.	100%
3/4 in.	100%
1/2 in.	100%
3/8 in.	99%
No. 4	97%
No. 8	96%
No. 16	95%
No. 30	89%
No. 50	59%
No. 100	24%
No. 200	19.2%

Hydrometer	
Particle Size (mm)	**% Passing**

Material Description

Fine to Medium Clayey SAND (SC)

Remarks

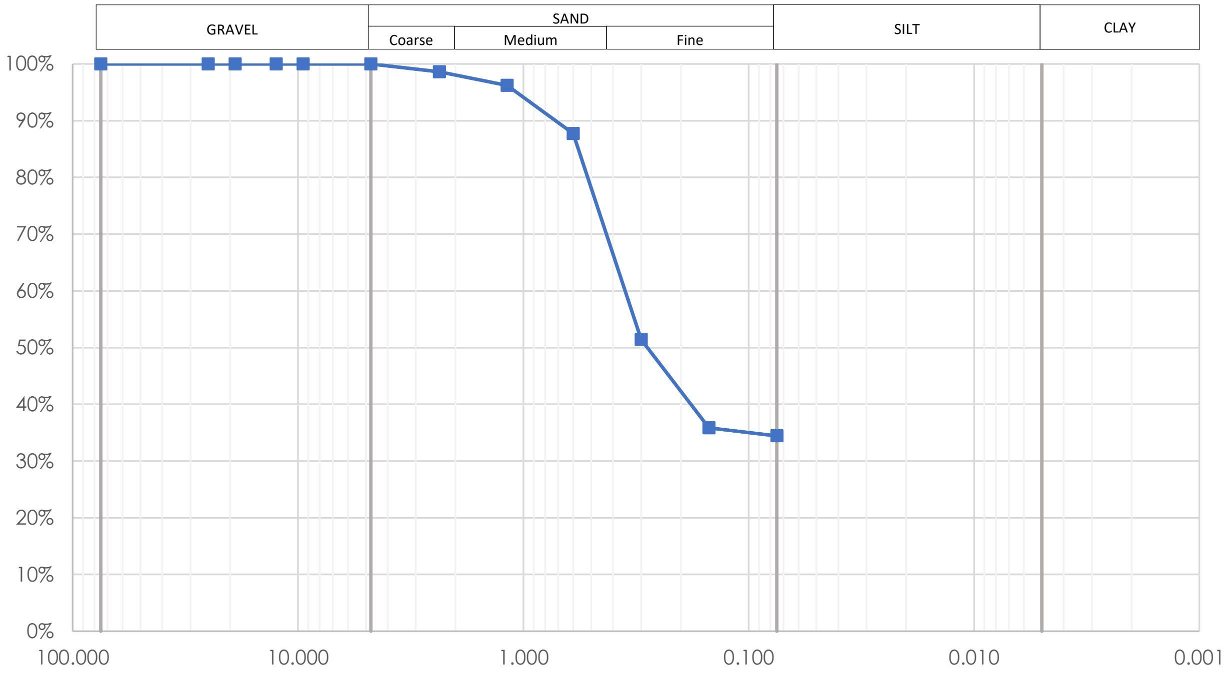
Technician
bfritz

Checked

Approved
mvanweelden

Particle Size Distribution Report

Project Name	Lexington State Harbor				
Project Number	2024.1415				
Client	Edgewater Resources, LLC				
Date	8/19/2024				
Sample Location	TB-05	Sample ID	A	Depth (ft)	2.0



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0%	0.0%	0.0%	2.1%	31.3%	32.1%	0.0%	0.0%
D85	**D60**	**D50**	**D30**	**D15**	**D10**	**Loss By Wash**	
0.5774	0.3709	0.2864	0.0653	0.0327	0.0218	34.4%	

Particle Size	
Sieve	**% Passing**
3 in.	100%
1 in.	100%
3/4 in.	100%
1/2 in.	100%
3/8 in.	100%
No. 4	100%
No. 8	99%
No. 16	96%
No. 30	88%
No. 50	51%
No. 100	36%
No. 200	34.4%

Hydrometer	
Particle Size (mm)	**% Passing**

Material Description

Fine to Medium Clayey SAND (SC)

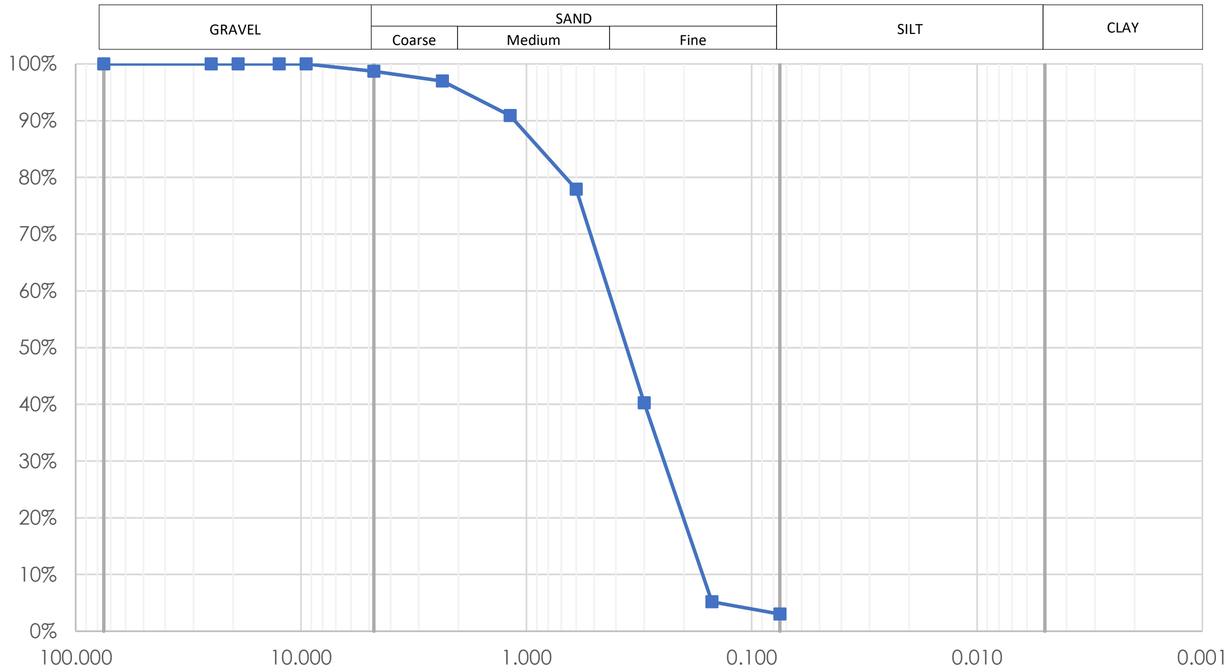
Remarks

Technician	Checked	Approved
bfritz		mvanweelden

SOILS & STRUCTURES

Particle Size Distribution Report

Project Name	Lexington State Harbor				
Project Number	2024.1415				
Client	Edgewater Resources, LLC				
Date	8/19/2024				
Sample Location	TB-07	Sample ID	B	Depth (ft)	4.5



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0%	0.0%	1.3%	3.6%	39.2%	52.9%	0.0%	0.0%
D85	D60	D50	D30	D15	D10	Loss By Wash	
0.9161	0.4572	0.3776	0.2561	0.1919	0.1706	3.0%	

Particle Size

Sieve	% Passing
3 in.	100%
1 in.	100%
3/4 in.	100%
1/2 in.	100%
3/8 in.	100%
No. 4	99%
No. 8	97%
No. 16	91%
No. 30	78%
No. 50	40%
No. 100	5%
No. 200	3.0%

Hydrometer

Particle Size (mm)	% Passing

Material Description

Fine to Medium SAND (SP)

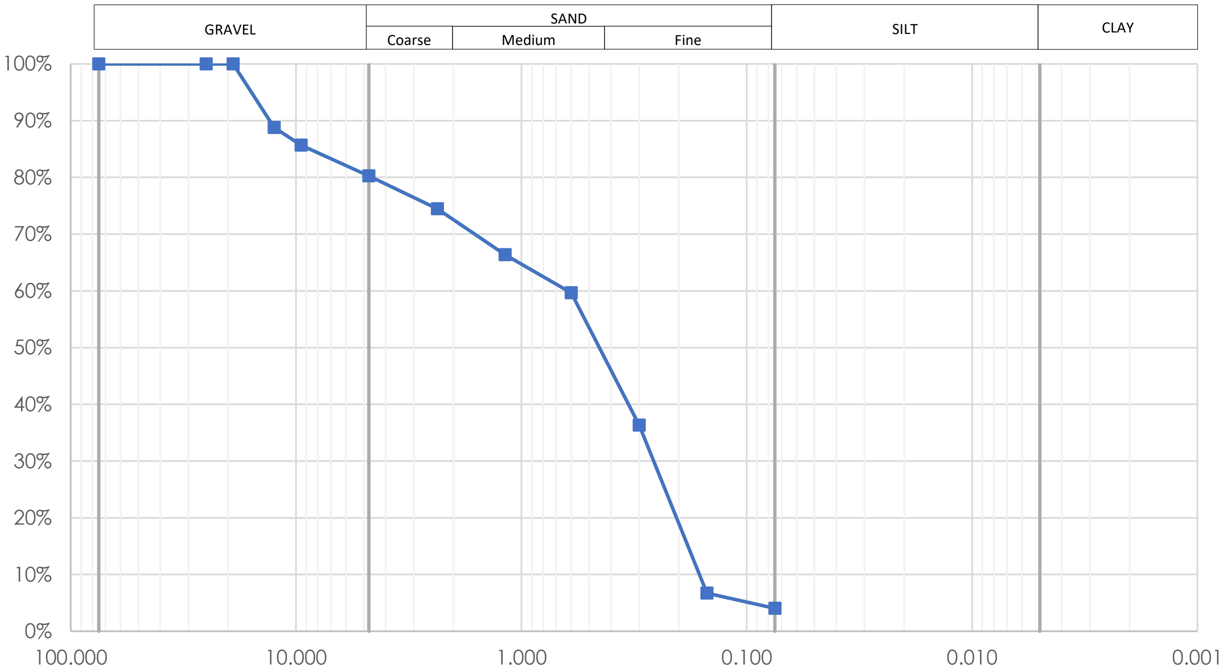
Remarks

Technician	Checked	Approved
bfritz		mvanweelden

Particle Size Distribution Report

Project Name	Lexington State Harbor
Project Number	2024.1415
Client	Edgewater Resources, LLC
Date	8/19/2024

Sample Location TB-09 Sample ID C Depth (ft) 7.0



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0%	0.0%	19.7%	8.3%	25.9%	42.0%	0.0%	0.0%
D85	**D60**	**D50**	**D30**	**D15**	**D10**	**Loss By Wash**	
8.9260	0.6309	0.4760	0.2680	0.1919	0.1666	4.0%	

Particle Size	
Sieve	**% Passing**
3 in.	100%
1 in.	100%
3/4 in.	100%
1/2 in.	89%
3/8 in.	86%
No. 4	80%
No. 8	74%
No. 16	66%
No. 30	60%
No. 50	36%
No. 100	7%
No. 200	4.0%

Hydrometer	
Particle Size (mm)	**% Passing**

Material Description

Fine to Medium Gravelly SAND (SP)

Remarks

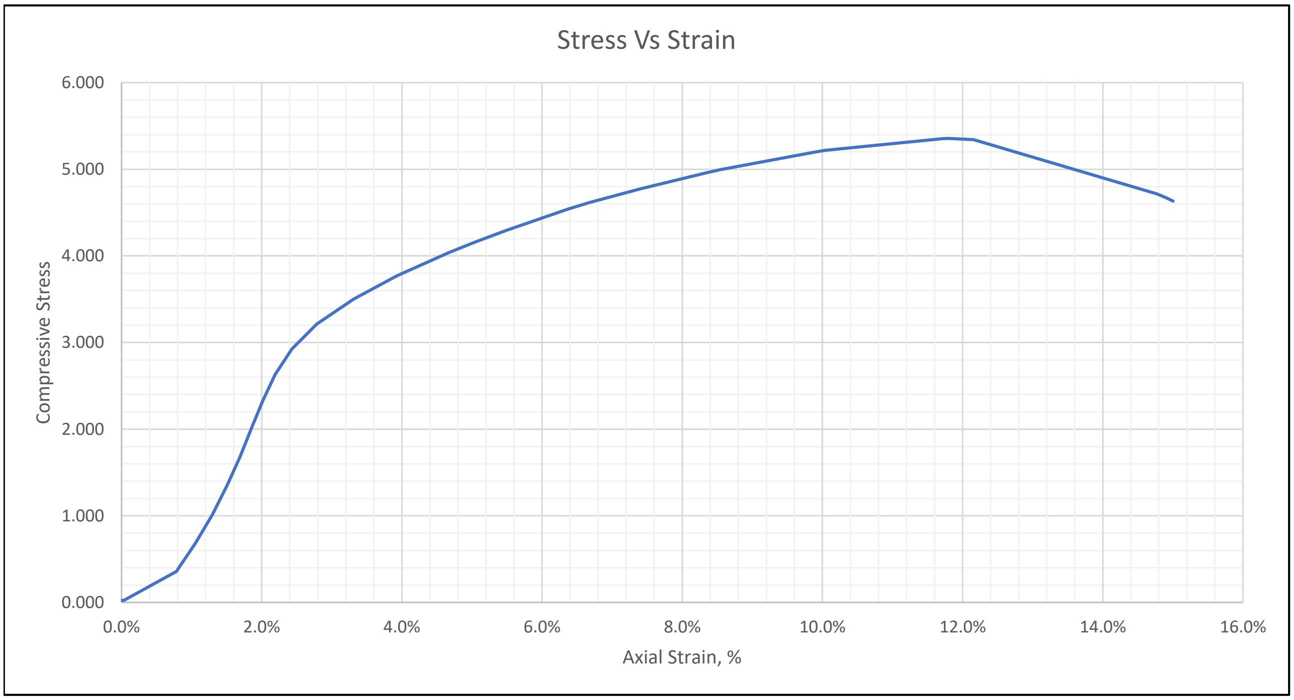
Technician
bfritz

Checked

Approved
mvanweelden

Unconfined Compressive Strength
ASTM D2166

Project Name	Lexington State Harbor				
Project Number	2024.1415				
Date	8/19/2024				
Client	Edgewater Resources, LLC				
Sample Location	TB-02	Sample ID	B	Depth (ft)	3.5



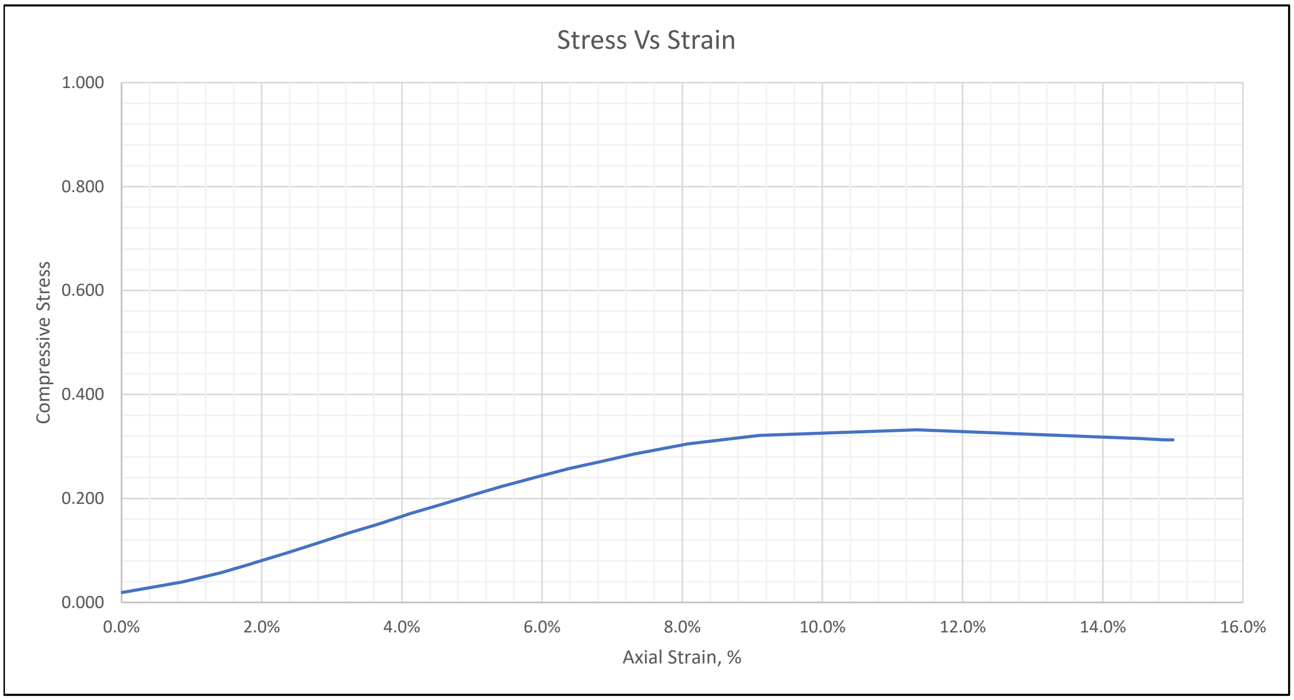
Sample ID	B
Unconfined Strength (tsf)	5.356
Undrained Shear Strength (tsf)	2.678
Failure Strain (%)	11.8%
Strain Rate, (in/min)	0.055
Moisture Content	13.4%
Wet Density (pcf)	138.0
Dry Density (pcf)	121.8
Void Ratio	0.3735
Saturation (%)	95.9%
Specimen Diameter (in)	1.40
Specimen Height (in)	3.02
Height/Diameter Ratio	2.16

Remarks

Technician	Checked	Approved
kmartella		mvanweelden

Unconfined Compressive Strength
ASTM D2166

Project Name	Lexington State Harbor				
Project Number	2024.1415				
Date	8/19/2024				
Client	Edgewater Resources, LLC				
Sample Location	TB-06	Sample ID	G	Depth (ft)	24.5



Sample ID	G
Unconfined Strength (tsf)	0.332
Undrained Shear Strength (tsf)	0.166
Failure Strain (%)	11.3%
Strain Rate, (in/min)	0.055
Moisture Content	11.8%
Wet Density (pcf)	138.5
Dry Density (pcf)	123.8
Void Ratio	0.3504
Saturation (%)	90.5%
Specimen Diameter (in)	1.58
Specimen Height (in)	2.78
Height/Diameter Ratio	1.76

Remarks

Technician	Checked	Approved
kmartella		mvanweelden

SOILS & STRUCTURES

Determination of Water Content (Moisture) of Soil and Rock by Mass

(ASTM D2216)

Project Name Lexington State Harbor
Project Number 2024.1415
Client Edgewater Resources, LLC
Date 8/19/2024

Sample Location		TB-01	TB-02	TB-04	TB-05	TB-03
Sample ID		A	A	A	A	A
Depth	ft	2.0	2.0	2.0	2.0	2.0
Sample Type		SPT	SPT	SPT	SPT	SPT
Mass of Container	g	392.60	19.60	21.17	301.50	19.63
Mass of Wet Soil and Container	g	706.70	85.40	85.37	542.00	85.64
Accepted Dry mass + container	g	695.10	77.20	83.46	513.00	80.34
Water Content	%	3.8	14.2	3.1	13.7	8.7
Remarks						

Sample Location		TB-08	TB-09	TB-03	TB-05	TB-02
Sample ID		A	A	B	B	B
Depth	ft	2.0	2.0	3.5	3.5	3.5
Sample Type		SPT	SPT	SPT	SPT	SPT
Mass of Container	g	21.32	19.56	19.65	19.79	61.38
Mass of Wet Soil and Container	g	85.62	85.73	85.28	85.49	229.81
Accepted Dry mass + container	g	83.62	77.40	76.66	77.58	209.96
Water Content	%	3.2	14.4	15.1	13.7	13.4
Remarks						

Sample Location		TB-04	TB-06	TB-07	TB-06	TB-09
Sample ID		B	B	B	C	C
Depth	ft	4.5	4.5	4.5	7.0	7.0
Sample Type		SPT	SPT	SPT	SPT	SPT
Mass of Container	g	19.70	19.79	382.50	20.79	302.50
Mass of Wet Soil and Container	g	85.55	85.78	645.10	85.34	559.60
Accepted Dry mass + container	g	80.32	79.20	613.10	72.48	525.80
Water Content	%	8.6	11.1	13.9	24.9	15.1
Remarks						

Technician
Checked
Approved
mvanweelden

SOILS & STRUCTURES

Determination of Water Content (Moisture) of Soil and Rock by Mass

(ASTM D2216)

Project Name	Lexington State Harbor
Project Number	2024.1415
Client	Edgewater Resources, LLC
Date	8/19/2024

Sample Location		TB-08	TB-01	TB-04	TB-07	TB-08
Sample ID		C	D	D	D	D
Depth	ft	7.0	8.5	9.5	9.5	9.5
Sample Type		SPT	SPT	SPT	SPT	SPT
Mass of Container	g	19.67	21.14	19.41	19.71	19.51
Mass of Wet Soil and Container	g	85.85	85.28	85.84	85.68	85.95
Accepted Dry mass + container	g	72.58	78.38	73.76	76.36	75.10
Water Content	%	25.1	12.1	22.2	16.5	19.5
Remarks						

Sample Location		TB-06	TB-04	TB-09	TB-06	
Sample ID		E	F	F	G	
Depth	ft	14.5	18.0	19.5	24.5	
Sample Type		SPT	SPT	SPT	SPT	
Mass of Container	g	21.06	19.73	19.65	62.08	
Mass of Wet Soil and Container	g	85.99	85.46	85.29	260.24	
Accepted Dry mass + container	g	78.14	79.10	79.36	239.27	
Water Content	%	13.8	10.7	9.9	11.8	
Remarks						

Sample Location						
Sample ID						
Depth	ft					
Sample Type						
Mass of Container	g					
Mass of Wet Soil and Container	g					
Accepted Dry mass + container	g					
Water Content	%					
Remarks						

Technician	Checked	Approved mvanweelden

General Information for Method of Field Investigation

The soil investigation was performed in accordance with the American Society of Testing and Materials method ASTM D 1586, which is the "Standard Test Method for Standard Penetration Test (SPT) and Split-Barrel Sampling of Soils". Samples of compressible clays or organic soils are obtained in accordance with ASTM D 1587, which is the "Standard Practice for Thin-Walled Tube Sampling of Soils for Geotechnical Purposes." Rock may be cored in conjunction with the above methods as specified in ASTM D 2113 which is the "Standard Practice for Rock Core Drilling and Sampling of Rock for Site Investigation."

Field Testing

Standard Penetration Tests (SPT) in accordance with ASTM D 1586 were generally performed at depths of 2.0', 4.5', 7.0', 9.5' and 5.0' intervals thereafter.

Laboratory Testing

Samples obtained from the Standard Penetration Test, ASTM D 1586 or thin walled tube method, ASTM D 1587, were tested in the laboratory for the moisture content and density and/or particle size, where applicable. When soils sampled possessed sufficient cohesive properties, it was tested for its compressive strength in the unconfined state.

Natural Percent Moisture content (N.P.M.) of the soil is the percentage by weight of water contained in the soil sample compared to the dry weight of the solids of which the soil is composed. The NPM of select samples is determined in accordance with ASTM D 2216.

Natural Density (N.D.) of soil as reported on the appended boring logs is the natural wet density of the soils expressed in pounds per cubic foot.

The unconfined compressive strength of cohesive soils is determined in the laboratory on "undisturbed" select samples in accordance with ASTM D 2166. This test determines the maximum load required at a specified rate to deform the cohesive soil specimen length twenty (20%) percent. The primary purpose of the unconfined compression test is to obtain approximate quantitative values of the compressive strength of soils possessing sufficient coherence to permit testing in the unconfined state. The shear strength of the cohesive soil can be calculated from the results of the unconfined compressive strength test.

Color

When the color of the soils is uniform throughout, the color recorded will be such as brown, gray, and black and may be modified by adjectives such as light and dark. If the soils predominant color is shaded by secondary color, the secondary color precedes the primary color, such as gray-brown, or yellow-brown. If two major and distinct colors are swirled throughout the soil, the colors will be modified by the term mottled; such as mottled brown and gray.

Water Observations

Depth of water recorded in the test boring is measured from the ground surface to the water surface. Initial depth indicates water level during boring, completing depth indicates water level immediately after boring, and depth after "X" number of hours indicates water level after allowing the groundwater rise or fall over a period of time. Water observations in pervious soils are considered reliable groundwater levels for accurate groundwater measurements at the time the test borings were performed unless records are made over several days' time. Factors such as weather, soils porosity, etc., will cause the groundwater level to fluctuate for both pervious and impervious soils.

Sample Type

If not otherwise indicated, the sample is a split-barrel liner sample ASTM D 1586.

“S.T.’ – Shelby tube sample, ASTM D 1587

“A” – disturbed augered sample

“C” – rock core sampled ASTM D 2113

N.P.M. – Natural Percent Moisture of in-situ soils sample

N.D. – Natural Density of in-situ soils sample in pcf.

S.S. – Shear Strength of cohesive soils samples as determined by the Unconfined Compression tests in ksf.

Classification Data – Laboratory data to assist in classification of soils and classification of soils characteristics; i.e., plastic limit or liquid limit

Test Boring Logs

Particle Size	**Visual**
Boulders	Larger than 12” (300 mm)
Cobbles	12” to 3” (300 to 75 mm)
Gravel - Coarse	3” to ¾ “ (75 to 19 mm)
Gravel – Fine	19.0 to 4.75 mm
Sand- Coarse	4.75 to 2.0 mm
Sand - Medium	2.0 to 0.425 mm
Sand - Fine	0.425 to 0.075 mm
Silt	0.075 to 0.002 mm
Clay	0.002 mm and smaller

Soils Components

Major Component	**Minor Component**
Gravel	Trace (1 - 10%)
Sand	Some (11 - 35%)
Silt/Clay	And (36 - 50%)

Condition of Soil Relative to Compactness

Granular Material	**“N” Value**
Loose	0 - 4
Slightly Compact	5 - 7
Compact	8 - 20
Very Compact	21 - 50
Extremely Compact	51 and above

Cohesive Material	**“N” Value**
Soft	0 - 4
Firm	5 - 7
Stiff	8 - 20
Very Stiff	21 - 50
Extremely Stiff	51 and above

“N” values in clay soils are not to be used as a measure of shear strength. However, they may be used as a general indication of strength.

Unified Soil Classification System Chart

Major Divisions			Letter Symbol	Typical Descriptions
Coarse Grained Soils More than 50% of material is larger than No. 200 sieve size	Gravel – Gravelly Soils more than 50% of coarse fraction retained on No. 4 sieve	Clean gravels (little or no fines)	GW	Well-Graded gravels, gravel-sand mixtures, little or no fines
			GP	Poorly-Graded gravels, gravel-sand mixtures, little or no fines
		Gravel with Fines (appreciable amount of fines)	GM	Silty gravels, gravel-sand-silt mixtures
			GC	Clayey gravels, gravel-sand-clay mixtures
	Sand and Sandy Soils More than 50% of coarse fraction passing No. 4 sieve	Clean Sand (little or no fines)	SW	Well-Graded sands, gravelly sands, little or no fines
			SP	Poorly-Graded sands, gravelly sands, little or no fines
		Sand with Fines (appreciable amount of fines)	SM	Silty sands, sand-silt mixtures
			SC	Clayey sands, sand-clay mixtures
Fine Grained Soils More than 50% of material is smaller than No. 200 sieve size	Silts and Clays Liquid limit less than 50		ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity
			CL	Inorganic clays or low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
			OL	Organic silts and organic silty clays or low plasticity
	Silts and Clays Liquid limit greater than 50		MH	Inorganic silts, micaceous or diatomaceous fine sand or silty soils
			CH	Inorganic clays of high plasticity, fat clays
			OH	Organic clays or medium to high plasticity, organic silts
	Highly organic soils		PT	Peat, humus, swamp soils with high organic contents

For Laboratory Classification of Fine Grained Soil
Plasticity Chart