Municipal Roads Geotechnical Borehole Investigation

Amherst Island Wind Energy Project
Amherst Island, Ontario

Prepared for:
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Project No.: 133560104

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1.0 INTRODUCTION

At the request of Pennecon Heavy Civil Ltd. (PHCL), Stantec Consulting Ltd. (Stantec) was commissioned to carry out a geotechnical investigation of the municipal roads on Amherst Island.

The purpose of the investigation was to confirm the existing conditions (presence, thickness and condition of asphalt and/or granular materials and soil type/condition of the underlying subgrade) and subsequently assess the use of the existing municipal roads as 'heavy haul routes' during construction of the planned project.

This report provides a summary and overview of the conditions encountered in the boreholes advanced for the investigation and the results of the laboratory testing completed on samples of the granular materials and sub-grade soils collected. This report also includes an assessment of the anticipated construction traffic on the island and an assessment of the heavy haul traffic that the municipal roads can support in the present condition.

Use of this report is subject to the Statement of General Conditions provided in **Appendix A**.

2.0 AREA OF INVESTIGATION

Given the current proposed layout of the project and the intended locations of the wind turbines, the following municipal roads were investigated:

- Front Road
- Stella 40 Foot Road
- 2nd Concession Road
- 3rd Concession Road
- South Shore Road
- Lower 40 Foot Road
- Dump Road

For reference, the portion of Front Road in the immediate area of the town core and the initial portion of Stella 40 Foot Road from Front Road to 2nd Concession were not included in the scope of the investigation.

3.0 FIELD INVESTIGATION PROGRAM

3.1 PRE-INVESTIGATION MEASURES

The locations of the boreholes were established with a general view to obtaining information along the length of the municipal roads of interest. The specific locations of the boreholes were constrained by the locations of residences and development and availability of access for the drilling equipment.

Prior to commencing the drilling investigation, Stantec contacted Ontario One-Call to identify and confirm the potential presence of buried utilities and services in proximity to the borehole locations. Staff from Stantec accompanied the utility locate contractor during the execution of the utility locates program.

Algonquin Power forwarded letters of notification to local residents requesting that any knowledge of existing infrastructure (buried water mains or electrical cables) near the proposed borehole locations be provided. In consideration of the responses to this inquiry, the locations of several boreholes were adjusted to reflect the potential presence of private buried utilities or services that were not identified through the public utility locates program.

Algonquin Power coordinated obtaining the necessary Excavation Permits and a Temporary Road Closure Permit (specific to Dump Road) with Loyalist Township.

3.2 BOREHOLE LOCATIONS AND NUMBERS

The number of boreholes was established to provide general coverage of the municipal roads of interest (reference the list provided in a previous section of this report) with consideration for the general characterization of the roads based on earlier visual observations. Several boreholes were included for specific design purposes (e.g. possible road widening and locations of existing culverts).

The following table provides a summary of the type of roads (or general purpose) and number of boreholes included in the investigation program.

Table 1 - Summary of Boreholes

Road Type	Number of Boreholes
Paved Roads	4
Gravel Roads	2
Poor Quality Roads	19
Proposed Road Widening	6
Existing Culverts	2
Proposed O/M Building	1

The road boreholes were advanced on the travelled surface of the road with due consideration for avoiding traffic disruption and consideration for appropriate traffic control and safety.

The boreholes at the locations of the two culverts were deleted from the program in lieu of hand-dug test pits to confirm the thickness of cover over the existing culverts.

The borehole for the O/M Building was included in the current municipal road investigation program for efficiency in execution. The borehole was advanced on the edge of the travelled surface of the road.

The boreholes were advanced to relatively shallow depth, consistent with penetrating the full depth of the asphalt and/or granular road structure and terminating in the underlying native soils/sub-grade. Sampling was conducted in accordance with the Standard Penetration Test as described in ASTM D1586. Samples were obtained on a continuous basis in all of the boreholes.

The locations of the boreholes are illustrated on the drawing in **Appendix B.**

3.3 DRILL EQUIPMENT

The boreholes were advanced with a truck mounted drill rig supplied and operated by Terex Drilling Solutions based in Concord, Ontario.

3.4 TRAFFIC CONTROL

Traffic control services were provided by On Track Safety Limited, based in Thornhill, Ontario, specialists in traffic management and control.

Traffic control was provided in accordance with the latest version of "Ontario Traffic Manual Book 7 Temporary Conditions" (OTM Book 7).

Based on the rural nature of the municipal roads on the island and the prevailing light traffic volume, Typical Layout Figure TL-19 was adopted for the traffic control program. This Layout Type applies to low volume roads, very short duration work.

The exception to the traffic control plan described in the preceding paragraph was Dump Road. Given the extremely narrow width of this road, the Township required a temporary closure from 2nd Concession Road to the north while maintaining access from Front Road to the south.

3.5 DRILLING PROGRAM

The field drilling program was completed in accordance with the following:

- The boreholes were advanced using solid stem augers.
- Standard Penetration Testing (SPTs) was conducted on a continuous basis in each borehole.
- Soil samples were collected from the split tubes advanced for the SPTs.
- The soil samples were placed in moisture-proof containers for storage and transport.
- The presence of groundwater seepage and/or free groundwater in the open borehole was recorded (where applicable).

Coring of the underlying bedrock (known to exist at shallow depth based on the results of previous investigation drilling and test pitting on the island) was not intended or required as a component of the investigation proposed herein. In several boreholes, augering and/or sampling was terminated on presumed bedrock.

The installation of groundwater monitoring stand-pipes or monitoring wells was not included as a component of the investigation.

The boreholes were backfilled with a low-permeability mixture of the auger spoils and granular bentonite, meeting the intent of MOE Regulation 903.

A "cold-asphalt" plug was placed at the ground surface of the boreholes advanced through existing asphaltic pavements.

Consistent with the Township's request, the drilling program included consideration for barreling, testing and disposing of excess soils generated while drilling at an approved (off-island) location. However, given the limited depth of the boreholes and the volume of the samples retained for geotechnical characterization and testing, excess soils were not generated.

As a component of Stantec's Standard Operating Procedures, if during the investigation potential environmental contamination was potentially identified (e.g. via olfactory or visual observation), Stantec would report the conditions observed to Algonquin Power for discussion and further action as may be warranted.

3.6 GEOTECHNICAL LABORATORY TESTING PROGRAM

The geotechnical laboratory testing program was to include the following:

- Grain size distribution tests - Representative samples of the granular surfacing.
- Grain size distribution tests – Representative samples of the underlying native sub-grade soils.
- Atterberg Limits tests - Representative samples of the underlying native sub-grade soils.
- Moisture Content Tests – Representative samples of granular surfacing and the underlying native sub-grade soils.
- Unit Weight tests – Limited number of representative samples of the underlying native sub-grade soils.
- Moisture-Density Relations & California Bearing Ratio Tests – Two (2) representative samples of the underlying native sub-grade soils.

4.0 HEALTH & SAFETY

Stantec's Safe Work Practices (SWPs) are documents designed around specific tasks and are intended to help identify hazards and applicable controls necessary to reduce our employees' exposure to health and safety risks. The following SWPs apply to all drilling field investigation activities undertaken by Stantec.

Risk Management Strategy (RMS) 1 – Prepared in advance of commencement of work.

Risk Management Strategy (RMS) 2 – Prepared in the field at the time of the work.

Safe Work Practice (SWP (416) – Supervision of Contracted Drilling Activities.

The RMS1 document was prepared at commencement of the project. The document included a description of the work, recognition of applicable hazards, an assessment of the hazards,

applicable and appropriate Personal Protective Equipment (PPE), and H&S contacts, documentation, and controls.

The RMS2 (Fit for Duty) is an extension of the RMS1 and was completed by the field staff on mobilization to the Island to conduct the geotechnical investigation. The RMS2 includes a field evaluation of conditions with a view to identifying potential hazards (or changed conditions) that were not identified at the time of the RMS1. It also provides for an opportunity to discuss all potential hazards and concerns with the sub-contractors present and engaged in the work, and finally includes a requirement that the field staff acknowledge they are physically capable of carrying out the required tasks.

Stantec's SWP 416 includes a comprehensive description of the responsibilities, potential hazards, and controls associated with executing field drilling activities.

Field staff (both Stantec and the drilling sub-contractor) were required to have the following personal protective equipment (PPE):

- Hearing protection;
- Eye protection;
- Head protection;
- High-visibility vests; and,
- CSA approved work boots (with a 6" steel shank and a defined heel).

5.0 FACTUAL RESULTS OF THE INVESTIGATION

5.1 REFERENCE STANDARDS

The soils encountered in the boreholes were classified in accordance with the Unified Soil Classification System (USCS). Stantec adopts minor modifications to the USCS Standard consistent with the methods of the Ontario Ministry of Transportation (MTO) including the removal of the descriptions "lean" and "fat" with reference to clay soils, and including a "Medium" category with respect to plasticity.

5.2 SUBSURFACE CONDITIONS

5.2.1 Overview

The subsurface conditions encountered in the boreholes are provided in the table in **Appendix C**. The results of the geotechnical laboratory testing program are included in **Appendix D**.

In general, the subsurface stratigraphy encountered in the boreholes consisted of asphalt (on select roads), granular fill materials (travel surface or as base/sub-base under the asphalt pavement), and native sub-grade soils. Inferred bedrock was encountered in several boreholes based on the content of the split tube samples and/or on the progress or resistance/refusal to augering and/or sampling.

5.2.2 Asphalt Pavement

Front Road East was asphalt paved. The thickness of the asphalt in the two boreholes advanced on this road was approximately 1" (25 mm).

A portion of Front Road West (extending west from the intersection with Stella 40 Foot Road) was also asphalt paved. The two boreholes advanced along this portion of the road encountered two layers of asphalt; a surface layer that was approximately 1" (25 mm thick) and a second underlying layer (below a granular layer) that was also approximately 1" (25 mm) thick.

A portion of Stella 40 Foot Road (from the intersection with 2nd Concession Road and extending south) was also asphalt paved. The two boreholes advanced along this portion of the road encountered asphalt that was 1.5" (37.5 mm) and 2" (50 mm) thick.

5.2.3 Granular Materials

The granular material underlying the asphalt on Front Road East was 6" (150 mm) and 9" (225 mm) thick.

The granular material underlying the surface course of asphalt on Front Road West was 3" (75 mm) and 4" (100 mm). The granular material underlying the buried asphalt layer was 4" (100 mm) and 5" (125 mm) thick.

The granular material underlying the asphalt on Stella 40 Foot Road was 13" (330 mm) and 5 ½" (140 mm).

The thickness of the existing granular surfacing encountered in the boreholes varied considerably. The following table provides a summary of the range in thicknesses recorded for the boreholes advanced on the respective roads (locations where asphalt was present are discussed in the preceding paragraphs and not included in the table).

Table 2 - Summary of the Granular Surface Thickness

Road	Number of Boreholes	Granular Surface Thickness (Inches/mm)
Front Road East	3	7.5/190 – 10/250
Lower 40 Foot Road	3	7.5/190 – 8/200
South Shore Road	4	4/100 – 10/250
Stella 40 Foot Road	1	7/190
2nd Concession Road	7	6/150 – 8/200
3rd Concession Road	6	7/180 – 12/300
Dump Road	2	No Granular Surface

For additional reference, the hand-dug test pit at the location of the existing culvert on Stella 40 Foot Road encountered 10" (250 mm) of granular cover and the hand-dug test pit at the location of the existing culvert on Marshall 40 Foot Road encountered 7" (180 mm) of granular cover.

The existing granular surfacing consists of well-graded sand and gravel with a varying fines content.

Moisture content tests were conducted on 17 samples of the granular surfacing material. The tests yielded results in a narrow range, from 2.1% to 3.9%.

A total of 17 grain size analysis tests were conducted on samples of the granular surfacing. The tests yielded a fines content (combined percentage of silt and clay size particles) ranging from 9% to 24% and the average of the samples tested was 18.5%. For reference, this percentage of fines exceeds the maximum fines percentage for OPSS Granular A base material (e.g. 8%).

The results of the grain size analysis tests are shown on the grain size analysis tests curves in Figures 1 to 4 in **Appendix E**.

5.2.4 Subgrade

The subgrade encountered underlying the asphalt and granular materials consisted of sandy clay, clay with sand, and silty clayey sand.

For reference, the hand-dug test pit at the location of the existing culvert on Stella 40 Foot Road encountered 5" (130 mm) of topsoil and fill material underlying the granular material noted in the preceding section; combined the granular material and fill material provided 15" (380 mm) of cover over the top of the culvert. The hand-dug test pit at the location of the existing culvert on Marshall 40 Foot Road encountered 2" (50 mm) of topsoil and fill material underlying the granular material noted in the preceding section; combined the granular material and fill material provided 9" (230 mm) of cover over the top of the culvert.

Moisture content tests were conducted on seven samples of the native subgrade soils. The results were typically in two ranges; a lower range with two results of 6.5% and 7.5% and a higher range of 16.6% to 30%. The lower range is representative of the samples described as silty clayey sand soil and the higher range is representative of the samples described as sandy clay and clay with sand.

The results of grain size analysis tests completed on seven samples of the native subgrade soils are shown on Figures 5 and 6 in **Appendix D**.

The results of Atterberg Limits tests completed on the seven samples are illustrated on the Plasticity Chart included as Figure 7 in **Appendix D**.

The test results indicate that these soils contain varying proportions of sand, silt, and clay, with very limited gravel (e.g. typically 5% or less). The varying percentage of sand, silt and clay size particles also reflect the varying plasticity index test results; the soils range from low to high plasticity.

As indicated above and in accordance with the Unified Soil Classification System, the soil samples tested can be characterized as sandy clay (CL), clay with sand (CH) and silty clayey sand (SC-SM).

Four samples of the native subgrade were submitted for unit weight tests. The tests yielded unit weights of 18.8 kN/m^3, 17.6 kN/m^3, 21.0 kN/m^3 and 19.2 kN/m^3.

A single sample of the silty clayey sand (SC-SM) was selected for California Bearing Ratio (CBR) testing. The result yielded a CBR of 4.99 (unsoaked) for a penetration of 2.5 mm and a CBR of 5.39 (soaked) for a penetration of 2.5 mm.

A single sample of the clay with sand (CH) was selected for CBR testing. The result yielded a CBR of 1.30 (unsoaked) for a penetration of 2.5 mm and a CBR of 1.67 (soaked) for a penetration of 2.5 mm.

5.2.5 Bedrock

The inferred depth to bedrock is indicated on the borehole summary table in **Appendix C**. The depth is indicated as "inferred" given that coring of the rock was not included as a component of the investigation. The contact surface with the bedrock was inferred based on refusal of the augers and/or sampler.

As indicated, the majority of the boreholes encountered the inferred surface of the bedrock at depths ranging from 0.33 m to 3.51 m. Several boreholes were terminated at depths of 3.66 m below grade without encountering the inferred contact with the underlying bedrock.

5.2.6 Groundwater

Free groundwater was not observed in any of the open boreholes at the time of drilling.

6.0 MUNICIPAL ROAD ASSESSMENT

6.1 ASSESSMENT METHODOLOGY

Two methods were used to assess the suitability of the existing and proposed roads to handle the anticipated heavy haul traffic.

For the majority of the roads, the 1993 AASHTO Guide of Design of Pavement Structure methodology for aggregate-surface roads was used. This approach considers two failure mechanisms as follows:

- Loss of Pavement Serviceability Index (PSI) which indicates a general decline in the road surface. For the assessment completed, an allowable decrease in serviceability of 2.0 was set as the maximum allowable.
- Surface wheel path rutting which allows for a specific depth of ruts. For the assessment completed, a rut depth of 50 mm was permitted.

For the new road required from the new island dock to 2nd Concession Road and for Dump Road, the assessment was undertaken using a geotextile methodology by DuPont Typar titled Designing Aggregate Bases.

6.2 EXISTING CONDITIONS

6.2.1 Road Granular

As discussed above in Section 5.0, the existing roadway granular surfacing consists of a well-graded sand and gravel with a percentage of silt/clay (e.g. fines) that exceeds the tolerance for typical granular base materials.

As a result of the high silt/clay content, the existing granular surfacing is prone to softening and rutting in wet conditions and the surface can become muddy. Under the heavy haul traffic anticipated, this condition will be compounded.

6.2.2 Subgrade

As discussed above in Section 5.0, the predominant subgrade type underlying the existing roadways (and encountered in the majority of the boreholes advanced on the island to date) consists of sandy clay, clay with sand, and silty clayey sand. For convenience, these soil strata are referred to in subsequent sections as sandy clay.

The soil types described above are generally characterized as providing poor to very poor support, impervious drainage, and a high frost potential in the context of subgrade for roads.

In consideration of the soil types described, the results of the drilling investigation, and the results of the geotechnical laboratory testing program, a subgrade modulus of 28 MPa was selected for use in this assessment.

6.2.3 Drainage

Most of the municipal roads on the island do not have adequate drainage.

The lack of drainage will result in deterioration of the existing roads under the heavy haul traffic.

6.3 FORECASTED CONSTRUCTION TRAFFIC

The loading and truck configuration for each turbine component including the transformers were reviewed, and the Equivalent Single Axle Loadings (ESALs) for construction deliveries, including concrete and aggregates, were estimated.

The total traffic loadings were estimated and the traffic was subsequently proportioned based on the number of turbine sites accessed via the specific municipal road being assessed.

6.4 ROAD DESCRIPTION & TRAFFIC ASSESSMENT

6.4.1 Front Road

It is understood that the portion of Front Road from the new island dock to the access road for Turbine S30 will be used for the transport of turbine components for four Turbines (S13, S18, S26 and S30). It is not intended for use by other heavy vehicle loads.

The road has an asphalt surface on approximately 25% of the length, a chip seal surface on approximately 50% of the length and a gravel surface on approximately 25% of the length (this last may in fact have been a former chip seal surface that has deteriorated to the current state).

Comments regarding this road are as follows:

- Construction traffic was estimated to be 1,000 ESALs;

- The existing structure is 150 mm granular material with the asphalt chip seal over sandy clay subgrade; and,
- The assessment indicated that the existing road structure is suitable for 1,000 ESALs.

Based on the results of the assessment no improvements are anticipated to be required for this road.

6.4.2 Stella 40 Foot Road

The initial portion of 2nd Concession Road (from the intended access to the layover area over to Stella 40 Foot Road) and Stella 40 Foot Road from 2nd Concession Road to the access entrance road to Turbine S37 was reviewed. Comments are as follows:

- Construction traffic was estimated to be 25,500 ESALs;
- The existing structure has:
  - 40 mm to 50 mm of asphalt for approximately 60% of the road length (The asphalt is severely distressed, likely due to the lack of roadside drainage);
  - 200 mm granular over sandy clay subgrade for approximately 40% of the road length; and,
- The assessment indicated that the existing road structure is suitable for 2,000 ESALs based on the rutting criteria.
- Based on the results of the assessment, maintenance will be required in accordance with Section 6.4.7.

6.4.3 2nd Concession Road

The portion of 2nd Concession Road from the intended access to the layover area extending east to the access entrance road to Turbine S01 was reviewed. Comments are as follows:

- The maximum construction traffic at the east end of the road was estimated to be 15,300 ESALs. The volume of construction traffic will decrease towards the west as vehicles leave the road to access the various turbine sites;
- The existing structure consists of 150 mm granular material over the sandy clay subgrade; and,
- The assessment indicated that the existing road structure is suitable for less than 1,000 ESALs based on the rutting criteria.
- Based on the results of the assessment, maintenance will be required in accordance with Section 6.4.7.

6.4.4 3rd Concession Road

The section of 3rd Concession Road from Stella 40 Foot Road to the construction access to Turbine S11 was reviewed. Comments are as follows:

- Construction traffic was estimated to be 5,100 ESALs;
- The existing structure consists of 180 mm granular material over sandy clay subgrade; and,
- The assessment indicated that the existing road structure is suitable for 1,000 ESALs based on the rutting criteria.

- Based on the results of the assessment, maintenance will be required in accordance with Section 6.4.7.

6.4.5 South Shore Road

This section of South Shore Road extends from the access road to Turbine S02 to the access road to Turbine S33. Comments regarding this section are as follows:

- Construction traffic was estimated to be 15,300 ESALs;
- The existing structure consists of 150 mm granular material over sandy clay subgrade; and,
- The assessment indicated that the existing road structure is suitable for less than 2,500 ESALs based on the PSI and rutting criteria.
- Based on the results of the assessment, maintenance will be required in accordance with Section 6.4.7.

6.4.6 Lower 40 Foot Road

This section of road includes the portion of South Shore Road from the access to Turbine S33 to the corner with Lower 40 Foot Road, the entire length of Lower 40 Foot Road, and the portion of Front Road from the corner with Lower 40 Foot Road to the access to Turbine S30 on Front Road. Comments regarding this section are as follows:

- Construction traffic was estimated to be 5,100 ESALs;
- The existing pavement is 200mm granular over sandy clay subgrade; and,
- The assessment indicated that the existing road structure is suitable for less than 1,300 ESALs based on the rutting criteria.
- Based on the results of the assessment, maintenance will be required in accordance with Section 6.4.7.

6.4.7 Existing Roads Summary Commentary

As indicated in the preceding section, the municipal roads (exclusive of the portion of Front Road as assessed) in the present condition will not support the anticipated heavy construction traffic. Based on the results of the assessment, improvement involving capping the existing roads with additional granular material would be the recommended approach. However, it is understood that public feedback from the local community has indicated that road capping is not preferred. It is therefore understood that continual monitoring, maintenance, repairs and upgrades, will be undertaken as necessary throughout the construction period to maintain the roads in a suitable condition for the support of the heavy construction traffic.

It is noted that heavy loads hauled when the roads are frozen will have little impact on the road condition; heavy loads hauled in the spring thaw period will have a significant impact on the road condition; and, heavy loads hauled in the summer and fall period (when dryer conditions are presumed to prevail) will deteriorate the road surface with cumulative passes.

6.5 NEW CONSTRUCTION

6.5.1 Dump Road

Based on visual observations and the conditions encountered in the boreholes, Dump Road does not have an existing granular structure or travel surface, although minor gravel was present at the intersection with 2nd Concession Road. There may also have been placement of granular material at low spots in the roadway or where standing water accumulated, though these areas were most certainly localized.

The assessment of Dump Road considered construction extending from 2nd Concession to the location of Turbine S31. Comments regarding this road are as follows:

- Construction traffic was estimated to be 1,000 ESAL;
- The existing roadway has no granular surface of any significance; and,
- The subgrade consists of sandy clay.

In the absence of an existing road structure, this road is not considered suitable to support heavy construction traffic. It is therefore recommended that Dump Road be upgraded as follows:

- Compact and proof-roll the exposed subgrade/road surface;
- Place Terrafix Combigrid 30/30 or approved equivalent; and,
- Place and compact 300 mm of OPSS Granular B Type II.

6.5.2 Temporary Turning Alignments at Existing Intersections

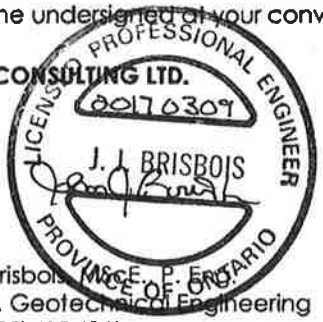
It is understood that there are several locations on the municipal roads where temporary turning alignments will be required to permit turning for 'longer' delivery vehicles.

Construction of these turning alignments can be relatively simple and straight-forward. Any existing vegetation and organics (including topsoil) should be stripped and stockpiled for reinstatement on completion of the construction of the overall project. The turning alignments can be constructed by placing OPSS Granular B Type II or OPSS Granular A material to the design grades. The granular material should be placed in 200 mm thick loose lifts and each lift uniformly compacted to achieve 100% of the material's Standard proctor Maximum Dry Density.

7.0 CLOSURE

We trust that this is satisfactory for your present purposes. If you have any questions, please contact the undersigned at your convenience.

STANTEC CONSULTING LTD.



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APPENDICES

Appendix A

A.1 STATEMENT OF GENERAL CONDITIONS

STATEMENT OF GENERAL CONDITIONS

USE OF THIS REPORT: This report has been prepared for the sole benefit of the Client or its agent and may not be used by any third party without the express written consent of Stantec Consulting Ltd. and the Client. Any use which a third party makes of this report is the responsibility of such third party.

BASIS OF THE REPORT: The information, opinions, and/or recommendations made in this report are in accordance with Stantec Consulting Ltd.'s present understanding of the site specific project as described by the Client. The applicability of these is restricted to the site conditions encountered at the time of the investigation or study. If the proposed site specific project differs or is modified from what is described in this report or if the site conditions are altered, this report is no longer valid unless Stantec Consulting Ltd. is requested by the Client to review and revise the report to reflect the differing or modified project specifics and/or the altered site conditions.

STANDARD OF CARE: Preparation of this report, and all associated work, was carried out in accordance with the normally accepted standard of care in the state or province of execution for the specific professional service provided to the Client. No other warranty is made.

INTERPRETATION OF SITE CONDITIONS: Soil, rock, or other material descriptions, and statements regarding their condition, made in this report are based on site conditions encountered by Stantec Consulting Ltd. at the time of the work and at the specific testing and/or sampling locations. Classifications and statements of condition have been made in accordance with normally accepted practices which are judgmental in nature; no specific description should be considered exact, but rather reflective of the anticipated material behavior. Extrapolation of in situ conditions can only be made to some limited extent beyond the sampling or test points. The extent depends on variability of the soil, rock and groundwater conditions as influenced by geological processes, construction activity, and site use.

VARYING OR UNEXPECTED CONDITIONS: Should any site or subsurface conditions be encountered that are different from those described in this report or encountered at the test locations, Stantec Consulting Ltd. must be notified immediately to assess if the varying or unexpected conditions are substantial and if reassessments of the report conclusions or recommendations are required. Stantec Consulting Ltd. will not be responsible to any party for damages incurred as a result of failing to notify Stantec Consulting Ltd. that differing site or sub-surface conditions are present upon becoming aware of such conditions.

PLANNING, DESIGN, OR CONSTRUCTION: Development or design plans and specifications should be reviewed by Stantec Consulting Ltd., sufficiently ahead of initiating the next project stage (property acquisition, tender, construction, etc), to confirm that this report completely addresses the elaborated project specifics and that the contents of this report have been properly interpreted. Specialty quality assurance services (field observations and testing) during construction are a necessary part of the evaluation of sub-subsurface conditions and site preparation works. Site work relating to the recommendations included in this report should only be carried out in the presence of a qualified geotechnical engineer; Stantec Consulting Ltd. cannot be responsible for site work carried out without being present.

Appendix B

B.1 BOREHOLE LOCATION PLAN

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Revised: 2017-02-02 By: pworsell

Stantec

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Notes

Legend

- ## WTG Number

Proposed Borehole Locations

- Paved Roads (4) [BH16-01, BH16-03 - BH16-05]
- Gravel Roads (2) [BH16-06 & BH16-07]
- Poorer Quality Roads (19) [BH16-08 & BH16-10 – BH16-27]
- Randomly Selected Locations at Required Road Widenings (6) [BH16-28 – BH16-32 & BH16-34]
- Existing Culverts (2) [BH16-35 & BH16-36] (Conducted as hand-dug test pits)
- Proposed O/M Building (1) [BH16-38]

* BH16-02, BH16-09, BH16-33 and BH16-37 were deleted from the investigation program and are not shown on this plan.

Revision	By	Appd.	YY.MM.DD.

Issued	By	Appd.	YY.MM.DD.

File Name: | Dwn. | Chkd. | Dsgn. | YY.MM.DD.

Permit-Seal

Client/Project

Windlectric Inc.
AMHERST ISLAND WIND PROJECT
75MW WIND FARM
Amherst Island, Loyalist Township, Ontario

Title
BOREHOLE LOCATION PLAN
MUNICIPAL ROADS INVESTIGATION PROGRAM

Project No.	Scale	Revision
133560104	1:50,000 (0 500 1,000 m)	
Drawing No.	Sheet	
1	1 of 1	A

Appendix C

C.1 BOREHOLE SUMMARY

Borehole	Inferred Depth to Bedrock (m)	Stratigraphy Description	Depth Interval (m)	Granular Thickness (inches/mm)	Moisture Condition	Colour	Remarks
Front Road West							
16-30	1.67	Asphalt	0 - 0.025	1"/25mm	-	black	
		SAND and GRAVEL	0.025 - 0.1	3"/75mm	moist	grey	
		Asphalt	0.1 - 0.125	1"/25mm	-	black	
		SAND and GRAVEL	0.125 - 0.225	4"/100mm	moist	grey	
		Sandy CLAY (CL), trace gravel	0.225 - 1.67		moist	brown	
16-01	1.37	Asphalt	0 - 0.025	1"/25mm	-	black	
		SAND and GRAVEL	0.025 - 0.1	3"/75mm	3.9	grey	
		Asphalt	0.1 - 0.125	1"/25mm	-	black	
		SAND and GRAVEL	0.125 - 0.25	5"/125mm	moist	grey	
		Sandy CLAY (CL), trace gravel	0.25 - 1.37		16.6	brown	wet at approximately 0.91 m
Front Road East							
16-04	1.37	Asphalt	0. - 0.025	1"/25mm		black	
		SAND and GRAVEL	0.025 - 0.175	6"/150mm	dry	grey	geotextile at 0.1 m
		Sandy CLAY (CL), trace gravel	0.175 - 1.37		moist	brown	increasing sand with depth
16-05	0.76	Asphalt	0 - 0.025	1"/25mm		black	
		Silty SAND with gravel	0.025 - 0.25	9"/225mm	moist	grey	geotextile at 0.1 m
		Sandy CLAY (CL), trace gravel	0.25 - 0.75		moist	brown	
16-06	0.81	Silty SAND with gravel	0 - 0.19	7.5"/190mm	dry	grey	
		Silty, Clayey SAND (SC-SM), trace gravel	0.19 - 0.81		moist	brown	

Borehole	Inferred Depth to Bedrock (m)	Stratigraphy Description	Depth Interval (m)	Granular Thickness (inches/mm)	Moisture Condition	Colour	Remarks
16-08	1.62	Silty SAND with gravel	0 - 0.25	10"/250mm	dry	grey	
		Silty, Clayey SAND (SC-SM), trace gravel	0.25 - 0.76		moist	brown	
			0.76 - 1.62		moist	light brown	
16-10	1.73	Silty SAND with gravel	0 - 0.2	8"/200mm	moist	grey	
		Silty, Clayey SAND (SC-SM), trace gravel	0.2 - 1.73		dry	light brown	increasing silt with depth
Lower 40 Foot Road							
16-17	0.76	Silty SAND with gravel	0 - 0.2	8"/200mm	dry	grey-brown	
		Clayey SAND (SC), trace gravel	0.2 - 0.76		moist to dry	brown	
16-18	0.91	Silty SAND with gravel	0 - 0.19	7.5"/190mm	dry	grey	
		Clayey SAND (SC), trace gravel	0.19 - 0.91		moist	brown to grey	
16-19	1.52	Silty SAND with gravel	0 - 0.2	8"/200mm	dry	grey	
		Clayey SAND (SC), trace gravel	0.2 - 1.52		moist	brown	decreasing gravel content with depth
South Shore Road							
16-34	0.33	SAND and GRAVEL	0 - 0.29	9.5"/240mm	dry	grey	
		Weathered rock fragments	0.29 - 0.33		dry	grey	
16-20	0.61	Silty SAND with gravel	0 - 0.15	6"/150mm	dry	grey	
		CLAY (CH) with sand, tace gravel	0.15 - 0.61		slightly moist to moist	brown	
16-21	1.21	Silty SAND with gravel	0 - 0.25	10"/250mm	dry	grey	
		CLAY (CH) with sand, tace gravel	0.25 - 1.21		moist to wet	brown	increasing moisture content with depth

Borehole	Inferred Depth to Bedrock (m)	Stratigraphy Description	Depth Interval (m)	Granular Thickness (inches/mm)	Moisture Condition	Colour	Remarks
16-22	0.61	SAND and GRAVEL	0 - 0.1	4"/100mm	dry		
		CLAY (CL) with sand, trace gravel	0.1 - 0.61		dry to moist	grey-brown	rock fragments at bottom of sample
Stella 40 Foot Road							
16-38	1.4	Asphalt	0 - 0.04	1.5"/38mm		black	
		SAND and GRAVEL	0.04 - 0.37	13"/330mm	moist to dry	grey	
		CLAY (CL) with sand, trace gravel	0.37 - 1.4		moist	grey-brown	
16-03	2.13	Asphalt	0 - 0.05	2"/50mm		black	
		SAND and GRAVEL	0.05 - 0.14	5.5"/140mm	moist to dry	grey	
		CLAY (CL) with sand, trace gravel	0.14 - 2.13		moist	grey-brown	decreasing gravel with depth/ increased moisture at bottom of hole
16-07	3.48	Silty SAND with gravel	0 - 0.18	7"/180mm	dry	grey	
		CLAY (CH) with sand, trace gravel	0.18 - 2.41		moist	brown	
		Sandy CLAY (CL), trace gravel	2.41 - 3.05		moist to wet	brown	150 mm thick sand seam at 2.41 m
		CLAY (CH) with sand, trace gravel	3.05 - 3.48		moist	brown	
2nd Concession Road							
16-11	Terminated at 3.66 m Bedrock not encountered	SAND and GRAVEL	0 - 0.15	6"/150mm	dry	grey	
		Sandy CLAY (CL), trace gravel	0.15 - 0.76		dry to moist	brown	
		Clayey SAND (SC), trace gravel	0.76 - 3.66		moist to wet	brown	increasing moisture with depth

Borehole	Inferred Depth to Bedrock (m)	Stratigraphy Description	Depth Interval (m)	Granular Thickness (inches/mm)	Moisture Condition	Colour	Remarks
16-31	2.6	Silty SAND with gravel	0 - 0.18	7"/180mm	dry	grey	
		Sandy CLAY (CL), trace gravel	0.18 - 2.43		moist	brown	
		Clayey SAND (SC), trace gravel	2.43 - 2.60		moist to wet	brown	
16-12	3.05	Silty SAND with gravel	0 - 0.15	6"/150mm	dry	grey	
		Sandy CLAY (CL), trace gravel	0.15 - 1.78		moist	brown	
		Clayey SAND (SC), trace gravel	1.78 - 3.05		moist	brown to grey	auger grinding at 2.29 m and at 2.74 m (corresponds to rock in spoon)
16-23	1.01	SAND and GRAVEL	0 - 0.19	7.5"/190mm	dry	grey	
		Sandy CLAY (CL), trace gravel	0.19 - 1.01		dry to mosit	brown	
16-24	1.22	Silty SAND with gravel	0 - 0.18	7"/180mm	dry	grey	
		Sandy CLAY (CL), trace gravel	0.81 - 0.91		moist	brown to black	
			0.91 - 1.22		moist to wet	light brown to grey	
16-25	1.4	Silty SAND with gravel	0 - 0.20	8"/200mm	dry	grey	
		Silty, Clayey SAND (SC-SM), trace gravel	0.20 - 0.56		moist	brown	
		Sandy CLAY (CL), trace gravel	0.56 - 1.40		moist	brown	

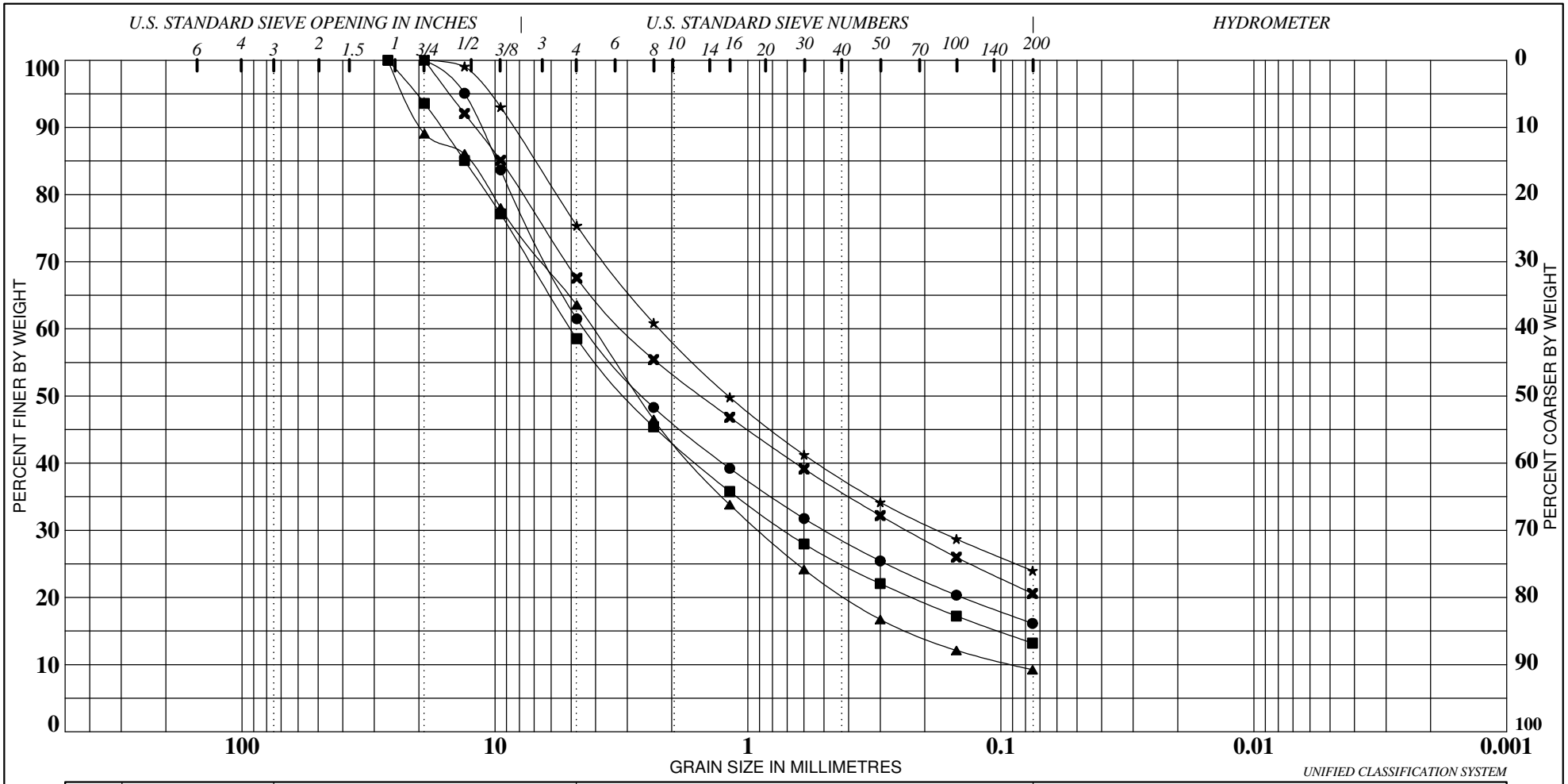
Borehole	Inferred Depth to Bedrock (m)	Stratigraphy Description	Depth Interval (m)	Granular Thickness (inches/mm)	Moisture Condition	Colour	Remarks
16-28	2.6	Silty SAND with gravel	0 - 0.20	8"/200mm	dry	grey	
		Sandy CLAY (CL), trace gravel	0.20 - 2.29		moist to wet	brown	increasing sand with depth/wet layer at 1.07 m to 1.37/100 mm gravel seam at 1.52 m
		Silty, Clayey SAND (SC-SM), trace gravel	2.29 - 2.6		dry to moist	brown	
3rd Concession Road							
16-32	Terminated at 3.66 Inferred bedrock not encountered	SAND and GRAVEL	0 - 0.27	10.5"/270mm	dry to mosit	grey	
		CLAY (CH) with sand, trace gravel	0.27 - 2.33		moist	brown	
		Silty, Clayey SAND (SC-SM), trace gravel	2.33 - 3.66		moist	brown	
16-13	Terminated at 3.66 Inferred bedrock not encountered	Silty SAND with gravel	0 - 0.25	10"/250mm	dry	grey	
		Silty, Clayey SAND (SC-SM), trace gravel	0.25 - 0.76		moist to dry	grey-brown	
		CLAY (CH) with sand, trace gravel	0.76 - 1.93		moist	brown	
		Silty, Clayey SAND (SC-SM), trace gravel	1.93 - 2.90		moist	grey	auger grinding at 2.43 m; minimal sample recovery
		Clayey SAND (SC), trace gravel	2.90 - 3.05		wet	grey	
		Silty, Clayey SAND (SC-SM), trace gravel	3.05 - 3.66		dry	grey-brown	possible bedrock fragment at base of final sample

Borehole	Inferred Depth to Bedrock (m)	Stratigraphy Description	Depth Interval (m)	Granular Thickness (inches/mm)	Moisture Condition	Colour	Remarks
16-14	3.35 (inferred from spoon refusal)	Silty SAND with gravel	0 - 0.28	11"/280mm	dry	grey	
		CLAY (CL) with sand, trace gravel	0.28 - 2.29		moist to wet	brown (grey)	increasing moisture with depth/grey at approximately 2.13 m
		Sand w/ some gravel, trace to some silt	2.29 - 3.35		dry to slightly moist	brown to grey	
16-15	3.51 (inferred from spoon refusal)	SAND and GRAVEL	0 - 0.25	10"/250mm	moist to dry	grey	
		CLAY (CL) with sand, trace gravel	0.25 - 2.29		moist to wet	brown to grey	25 mm gravel seam at approximately 1.83 m/wet layer from 1.52 m to 1.82 m
		Clayey SAND (SC), trace gravel	2.29 - 3.51		dry to slightly moist	grey	
16-16	Terminated at 3.66 inferred bedrock not encountered	Silty SAND with gravel	0 - 0.30	12"/300mm	dry	grey	
		Silty, Clayey SAND (SC-SM), trace gravel	0.30 - 0.76		dry	brown	
		CLAY (CL) with sand, trace gravel	0.76 - 3.66		moist to wet	brown to grey	50 mm - 75 mm sand seam at approximately 1.83 m/grey below approximately 2.74 m

Borehole	Inferred Depth to Bedrock (m)	Stratigraphy Description	Depth Interval (m)	Granular Thickness (inches/mm)	Moisture Condition	Colour	Remarks
16-29	3.35 (inferred from spoon refusal)	Silty SAND with gravel	0 - 0.18	7"/180mm	moist to dry	grey	
		CLAY (CL) with sand, trace gravel	0.18 - 2.90		moist	grey to brown	possible fill to 0.76 m auger grinding at approximately 1.22 m decreasing clay content with depth grey below approximately 2.74 m
		Silty, Clayey SAND (SC-SM), trace gravel	2.90 - 3.35		dry to slightly moist	grey	possible weathered bedrock at bottom of final sample
Dump Road							
16-26	0.91	Sandy CLAY (CL), trace gravel	0 - 0.91		moist to dry	brown	larger gravel content below 0.76 m decreasing moisture with depth
16-27	0.76	Silty SAND with gravel	0 - 0.15	6"/150mm	dry to moist	grey	
		Sandy CLAY (CL), trace gravel	0.15 - 0.76		moist	brown	some bedrock fragments at bottom of final sample
Existing Culverts							
16-35 (Stella 40 Foot Rd)	unknown	Sand and Gravel (granular), some silt and organics	0 - 0.25	10"/250mm	dry to moist	grey-brown	At road edge - some organic inclusions
		Topsoil and native silty sandy clay	0.25 - 0.38		moist	brown	0.38 m to top of culvert
16-36 (Marshall 40 Foot Rd)	unknown	Sand and Gravel (granular), some silt and organics	0 - 0.18	7"/180mm	dry to moist	grey-brown	At road edge - some organic inclusions
		Topsoil and native silty sandy clay	0.18 - 0.23		moist	brown	0.23 m to top of culvert

Appendix D

D.1 GEOTECHNICAL LABORATORY TESTING RESULTS



UNIFIED CLASSIFICATION SYSTEM

BLDs	COBBLES	GRAVEL		SAND			SILT & CLAY	
		coarse	fine	coarse	medium	fine	SILT	CLAY

Sample		Depth (m)	Description	W%	W_L	W_P	I_P	%Gravel	%Sand	%Silt	%Clay
●	BH16-01	0.2	SAND and GRAVEL	4				39	45	16	
■	BH16-03	0.3	SAND and GRAVEL	4				41	46	13	
▲	BH16-04	0.3	SAND and GRAVEL	3				36	55	9	
★	BH16-06	0.3	SILTY SAND with GRAVEL	3				25	51	24	
✖	BH16-07	0.3	SILTY SAND with GRAVEL	3				32	47	21	

Stantec

Project: Amherst Island Wind Farm

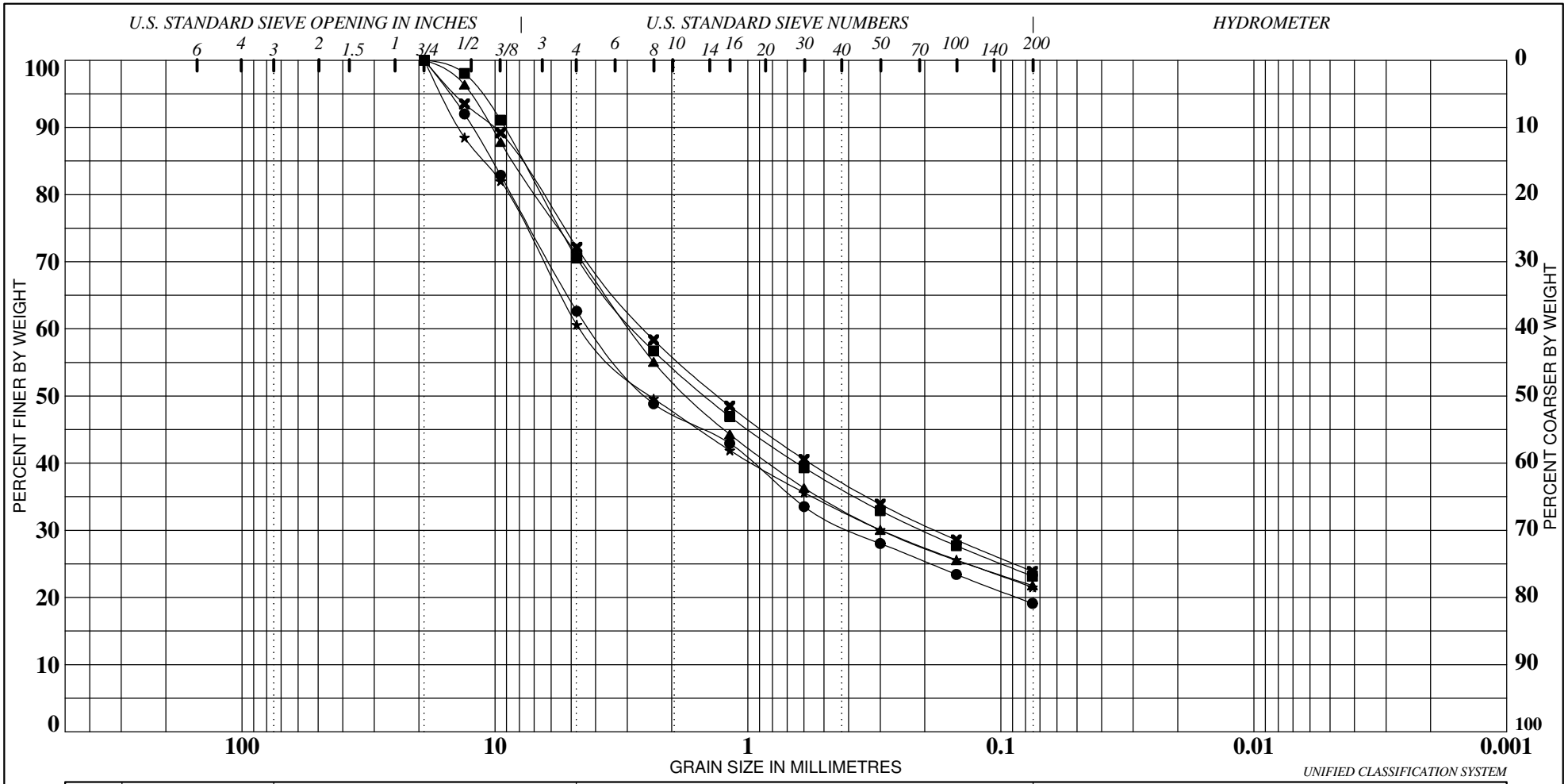
Location: Amherst Island

Project No.: 133560104

GRADATION CURVE (ASTM D422)

Figure: 1

Remarks:



UNIFIED CLASSIFICATION SYSTEM

BLDs	COBBLES	GRAVEL		SAND			SILT & CLAY	
		coarse	fine	coarse	medium	fine	SILT	CLAY

Sample	Depth (m)	Description	W%	W_L	W_P	I_P	%Gravel	%Sand	%Silt	%Clay
● BH16-08	0.3	SILTY SAND with GRAVEL	3				37	44	19	
■ BH16-10	0.3	SILTY SAND with GRAVEL	3				29	48	23	
▲ BH16-12	0.3	SILTY SAND with GRAVEL	3				29	49	22	
★ BH16-13	0.3	SILTY SAND with GRAVEL	3				39	39	22	
✖ BH16-16	0.3	SILTY SAND with GRAVEL	3				28	48	24	

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Project: Amherst Island Wind Farm

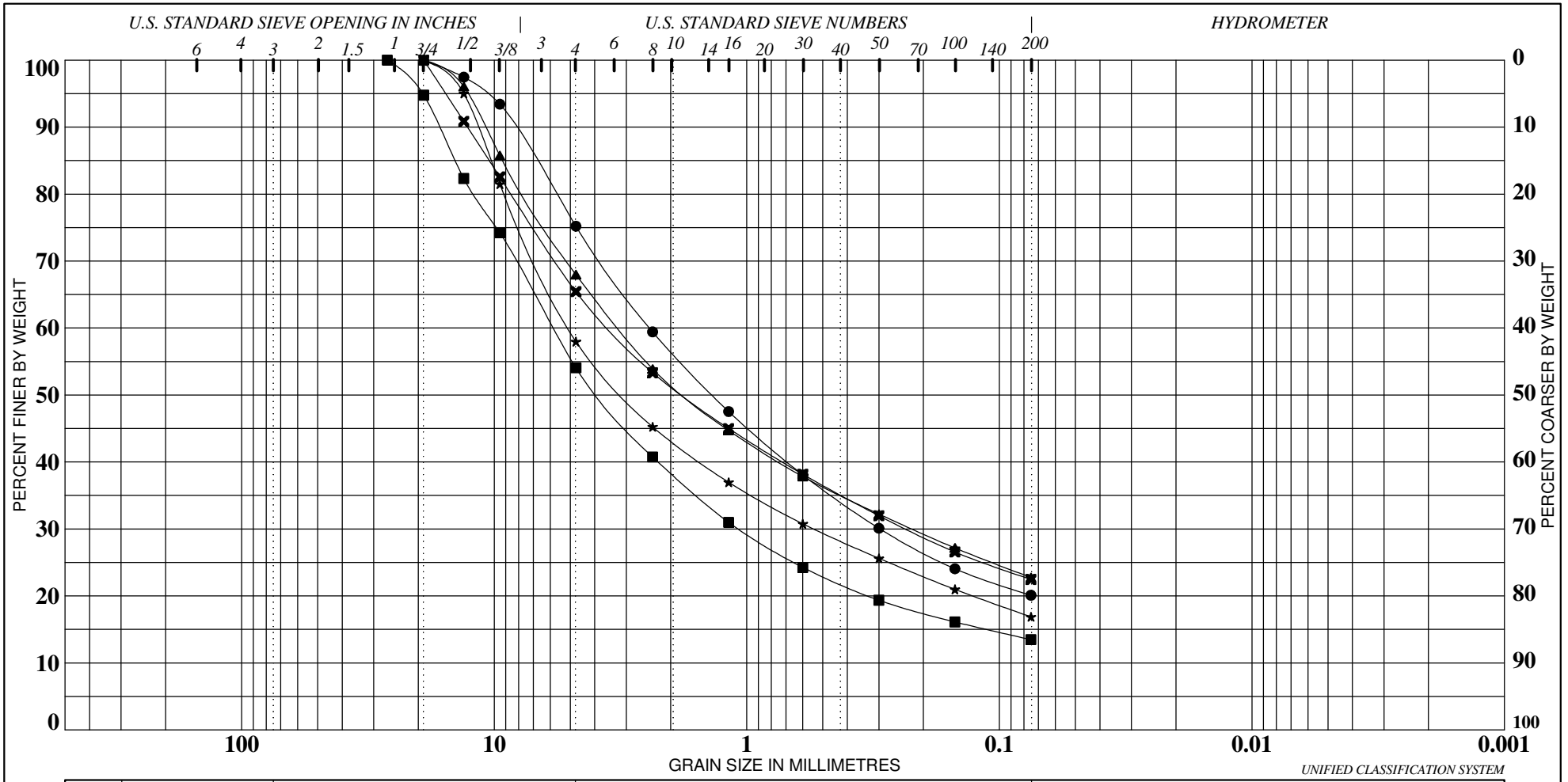
Location: Amherst Island

Project No.: 133560104

GRADATION CURVE (ASTM D422)

Figure: 2

Remarks:



UNIFIED CLASSIFICATION SYSTEM

BLDs	COBBLES	GRAVEL		SAND			SILT & CLAY	
		coarse	fine	coarse	medium	fine	SILT	CLAY

Sample	Depth (m)	Description	W%	W_L	W_P	I_P	%Gravel	%Sand	%Silt	%Clay
● BH16-19	0.3	SILTY SAND with GRAVEL	3				25	55	20	
■ BH16-21	0.3	SILTY SAND with GRAVEL	2				46	41	13	
▲ BH16-22	0.3	SAND and GRAVEL	3				32	45	23	
★ BH16-27	0.3	SILTY SAND with GRAVEL	3				42	41	17	
✖ BH16-28	0.3	SILTY SAND with GRAVEL	3				35	43	22	

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Project: Amherst Island Wind Farm

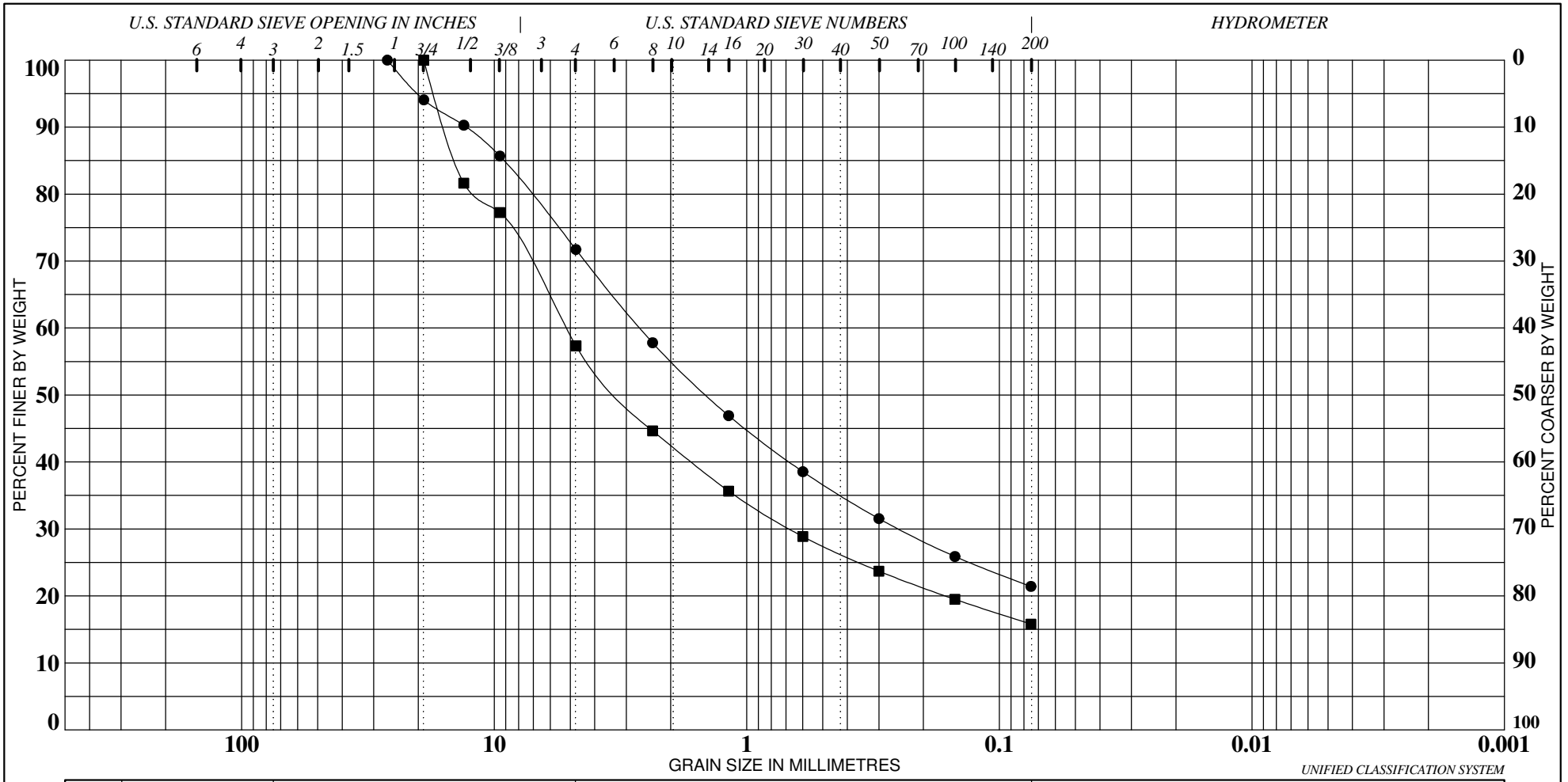
Location: Amherst Island

Project No.: 133560104

GRADATION CURVE (ASTM D422)

Figure: 3

Remarks:



UNIFIED CLASSIFICATION SYSTEM

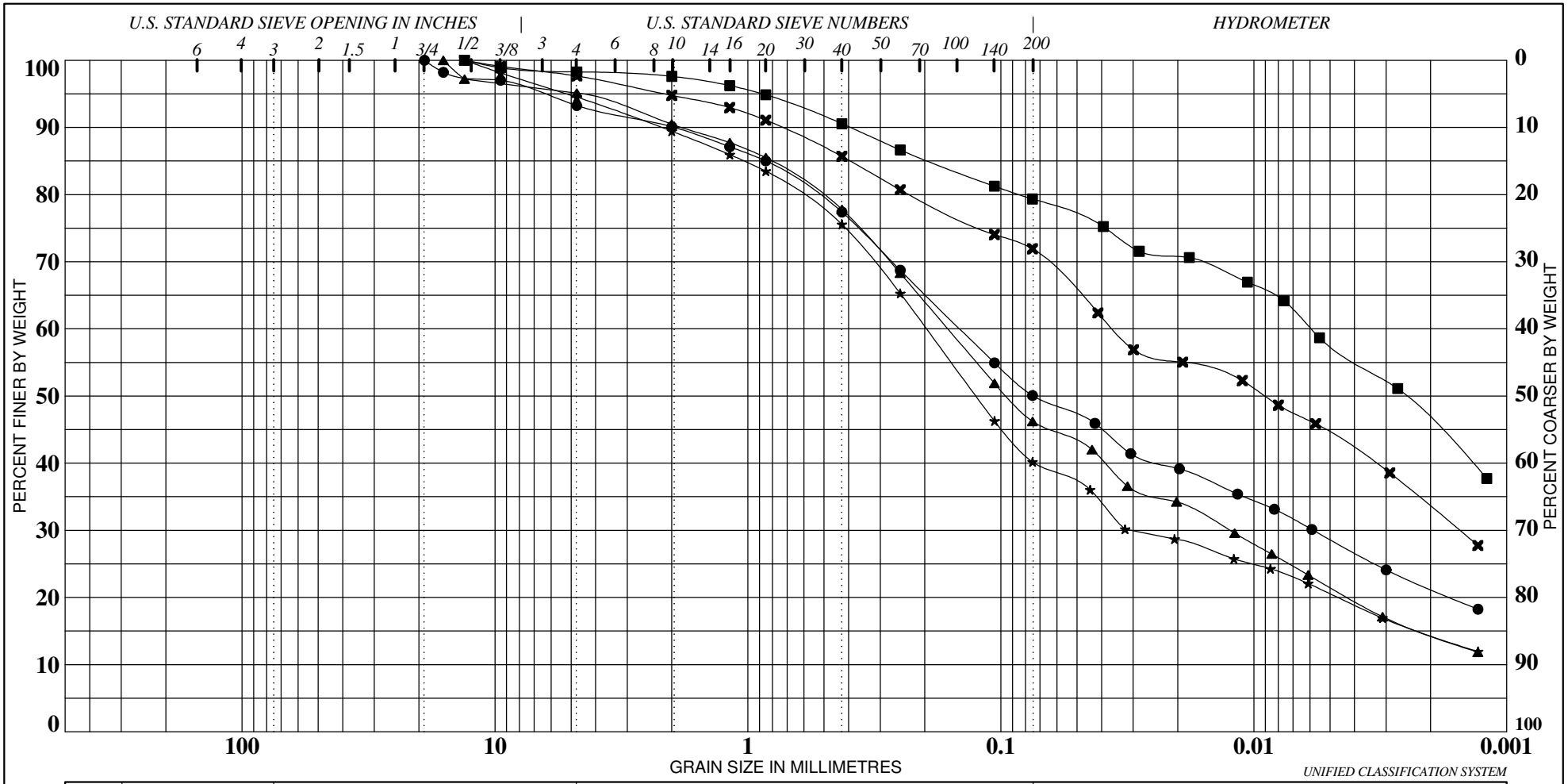
BLDs	COBBLES	GRAVEL		SAND			SILT & CLAY	
		coarse	fine	coarse	medium	fine	SILT	CLAY

Sample	Depth (m)	Description	W%	W_L	W_P	I_P	%Gravel	%Sand	%Silt	%Clay
● BH16-31	0.3	SILTY SAND with GRAVEL	3				28	51	21	
■ BH16-38	0.3	SAND with GRAVEL	4				43	41	16	

Stantec

Project: Amherst Island Wind Farm
Location: Amherst Island
Project No.: 133560104

GRADATION CURVE (ASTM D422)
Figure: 4
Remarks:



BLDs	COBBLES	GRAVEL		SAND			SILT & CLAY	
		coarse	fine	coarse	medium	fine	SILT	CLAY

Sample		Depth (m)	Description	W%	W_L	W_P	I_P	%Gravel	%Sand	%Silt	%Clay
●	BH16-01	0.3	SANDY CLAY (CL)	17	28	17	11	7	43	29	21
■	BH16-07	1.1	CLAY with SAND (CH)	30	53	27	26	2	19	33	46
▲	BH16-08	1.1	SILTY, CLAYEY SAND (SC-SM)	8	18	13	5	5	49	32	14
★	BH16-10	1.1	SILTY, CLAYEY SAND (SC-SM)	7	15	11	4	5	55	26	14
✖	BH16-16	1.1	CLAY with SAND (CH)	29	55	29	26	2	26	38	34

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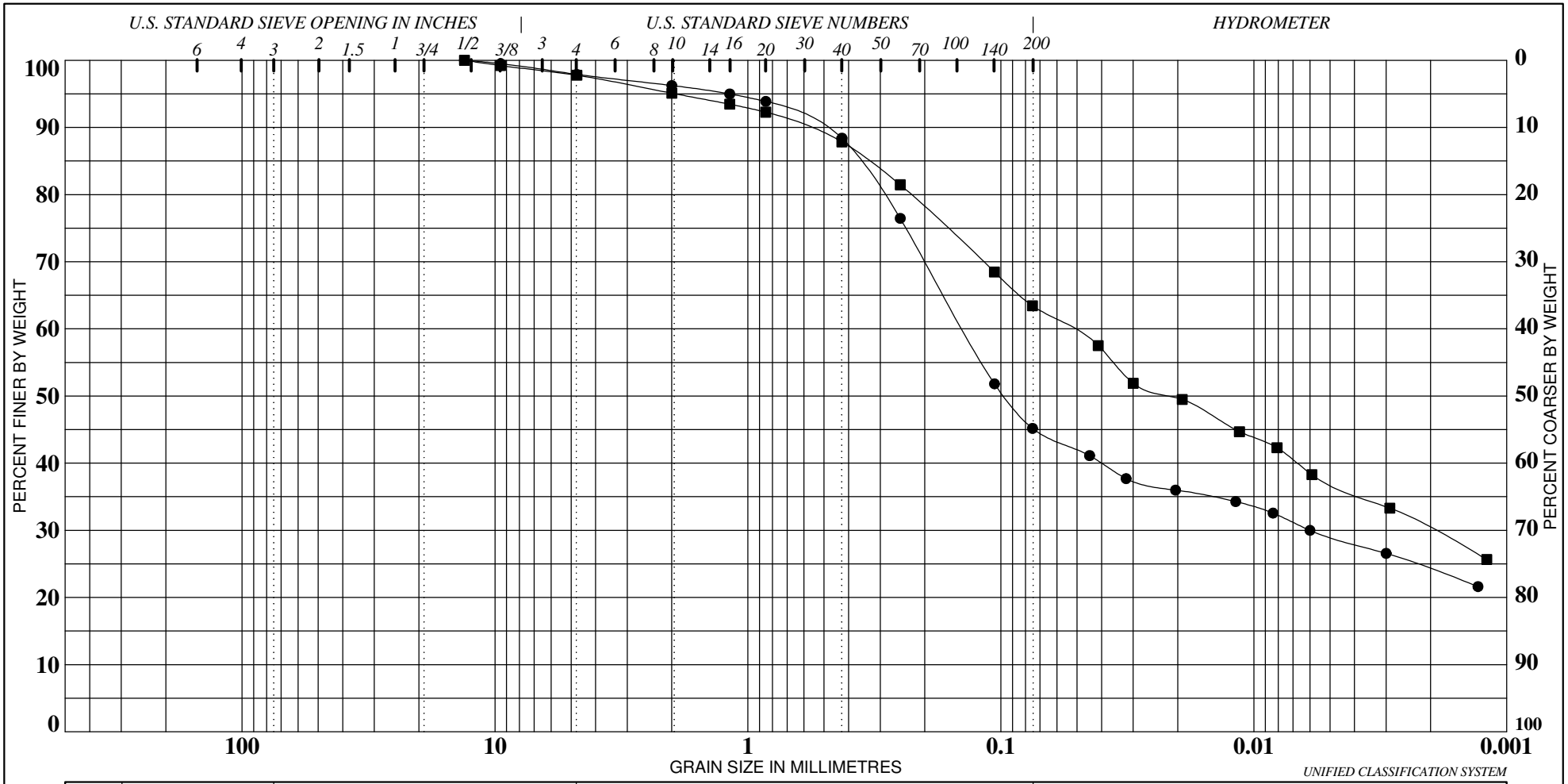
Location: Amherst Island

Project No.: 133560104

GRADATION CURVE (ASTM D422)

Figure: 5

Remarks:



BLDs	COBBLES	GRAVEL		SAND			SILT & CLAY	
		coarse	fine	coarse	medium	fine	SILT	CLAY

Sample	Depth (m)	Description	W%	W_L	W_P	I_P	%Gravel	%Sand	%Silt	%Clay
● BH16-21	1.0	CLAYEY SAND (SC)	22	24	15	9	2	53	21	24
■ BH16-28	1.1	SANDY CLAY (CL)	21	37	16	21	2	35	33	30

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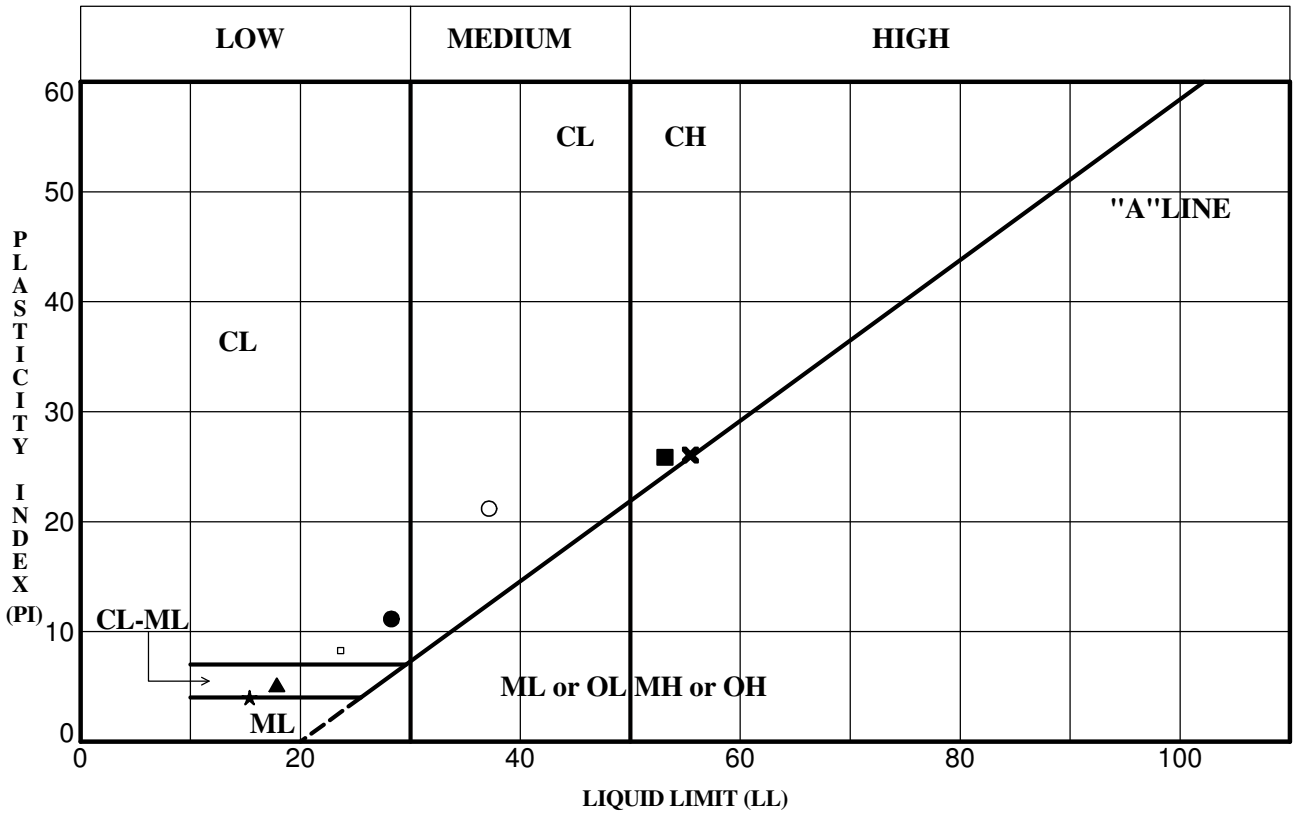
Location: Amherst Island
Project No.: 133560104

GRADATION CURVE (ASTM D422)
Figure: 6
Remarks:

PLASTICITY CHART



	Specimen	Depth (m)	LL	PL	PI	Fines	W%	Classification
●	BH16-01	0.3	28	17	11	50	17	SANDY CLAY (CL)
■	BH16-07	1.1	53	27	26	79	30	CLAY with SAND (CH)
▲	BH16-08	1.1	18	13	5	46	8	SILTY, CLAYEY SAND (SC-SM)
★	BH16-10	1.1	15	11	4	40	7	SILTY, CLAYEY SAND (SC-SM)
✖	BH16-16	1.1	55	29	26	72	29	CLAY with SAND (CH)
▫	BH16-21	1.0	24	15	9	45	22	CLAYEY SAND (SC)
○	BH16-28	1.1	37	16	21	63	21	SANDY CLAY (CL)

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Project: Amherst Island Wind Farm

Location: Amherst Island

Project No.: 133560104

ATTERBERG LIMITS
(ASTM D4318)

Figure: 7

Remarks:

STN13-ATTERBERG 133560104.GPJ MM.GDT 2/1/17