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**Newfoundland and Labrador Hydro
Lower Churchill Project
Pre-Feed Engineering Services**

**AC1060 - Field Investigation & Construction
Requirements**

**230 kV Transmission Line
Muskrat Falls to Gull Island**

FINAL



**Document No:
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Newfoundland & Labrador Hydro

LOWER CHURCHILL PROJECT

TECHNICAL REPORT

AC1060 – Field Investigation & Construction Requirements 230 kV Transmission Line Muskrat Falls to Gull Island

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February 2008

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EXECUTIVE SUMMARY

This report presents findings with respect to the location, number of camps, marshalling yards, access routes, and tote roads associated with the proposed construction of a 230 kV transmission line from Muskrat Falls to Gull Island, approximately 66 km. Also presented are the results of a geotechnical investigation program along the route which included test pit excavation, anchor pull out tests, hand augering and bog probes.

Line Routing

The 230 kV line from Muskrat Falls to Gull Island is assumed to parallel (approximately 85 m to the south) the existing 138 kV line running between Happy Valley-Goose Bay and Churchill Falls. As a result of other investigative work for the Lower Churchill Project, the converter station and switchyard were relocated from the south side of Churchill River to the north side. The variant study for Muskrat Falls recommends a stand-alone switchyard at Muskrat Falls. These changes will result in some minor adjustments for the transmission line routing which are reflected on the report drawings.

Access Roads and Tote Roads

Throughout the proposed route of the 230 kV transmission line there is excellent access from the Trans Labrador Highway. In a number of instances the proposed 230 kV line will cross the highway. The line is also adjacent to the existing 138 kV wood pole transmission line running between Churchill Falls and Happy Valley-Goose Bay.

Tote roads or access trails from the Trans Labrador Highway, suitable for the proposed transmission line, were established as part of the construction of the existing 138 kV transmission line. The number of access trails, with one addition at Edward's Brook, is adequate to construct the new 230 kV line. It is anticipated that heavier equipment will be used to construct the new 230 kV line versus the equipment used for construction of the existing 138 kV line. The decision as to the extent of upgrading/improvement required along the existing access routes should be left to the transmission line contractor(s) as part of the competitive bidding process. The best season for transmission line construction is winter when the ground is sufficiently hard to allow movement of heavy equipment, resulting in less environmental disturbance.

Camps

During construction of the Muskrat Falls Hydroelectric Development, it is assumed that a main camp will be operational at the Muskrat Falls site. Space can be made available in that camp to accommodate transmission line construction personnel, depending on the schedule for constructing the transmission line. In the event space is not available, provision should be made in the main camp to add bunkhouse type trailers for transmission line personnel and have them share the remaining facilities (kitchen, diner, recreational, first aid station, communications etc.) with the main camp.

Marshalling Yards

The most likely scenario for delivery of materials and equipment would be by marine transport to Happy Valley-Goose Bay and then by road to Muskrat Falls. An area of approximately 1.5 hectares would be required to marshall materials. It is proposed that the marshalling yard be part of the laydown area for construction of the main project.

Based on the assumption that the owner will procure materials, it is recommended that the owner provide a fully prepared marshalling yard, where materials can be received, sorted and checked, prior to being turned over to the contractor at the start of construction.

Geotechnical

The geotechnical program included:

- Air photo interpretation combined with base map preparation and fieldwork preparation;
- Two (2) site reconnaissance trips; The first to assess the general outline of the route and the second to examine the ground in some of the remote areas;
- Site Investigations; A total of sixteen (16) test pits, six (6) hand auger holes, several hundred bog probes and two (2) anchor pull out tests were used to inventory the soil and rock conditions along the route;
- Laboratory testing; Index testing was performed on representative samples from along the route;

The transmission line route follows the Churchill River lowlands which comprise a mixed terrain of mostly glaciofluvial sand with some sand and gravel in the lower elevations. At higher elevations minor rock outcrops and some glacial till with boulders are encountered. Occasionally marine sediments in the form of silt/clay exist in areas where the overlying fluvial material has been eroded away. Rare bedrock outcrops consisted of a hard granite gneiss with some shear zones.

The Allowable Bearing Capacities in the various types of material encountered based on empirical values and test data are:

- Glaciofluvial sand and the sand and gravel deposits – 250 kPa;
- Glacial till – 300 kPa;
- Marine sediments – 50 kPa;
- Submerged high quality fill in bogs or other wet areas – 100 kPa.

The unit weight for properly compacted soils ranged from 16 kN/m³ for the sand to over 22 kN/m³ for the glacial till.

The rock tested had excellent holding strength at one (1) test location, however, at another location, deliberately placed in a shear zone, the anchor head would not hold.

Several quarries and borrow pits exist along the proposed route and are accessible from the nearby Trans Labrador Highway. The locations are indicated on the report drawings. Sufficient high quality soil and rock fill materials are available over the entire length of the line.

1 INTRODUCTION

1.1 TERMS OF REFERENCE

The Scope of Work covered by this report was outlined in Work Task Order (WTO) AC1060 titled Field Investigation and Construction Requirements - 230kV Transmission Line – Muskrat Falls to Gull Island.

In brief, the work included the following:

- Assess the requirements for camps, marshalling yards, access routes and tote roads necessary for the construction of the double circuit 230 kV transmission line from Muskrat Falls to Gull Island;
- Recommend locations for camps, marshalling yards, and typical layout drawings for each;
- Conduct a field investigation program to confirm the geotechnical conditions along the transmission line route and in the area of the proposed supporting infrastructure;
- From the field investigation, establish the availability of construction materials along the route;
- Present the data collected in an ArcGIS compatible format covering the entire line route, associated access routes and other related areas.

1.2 PREVIOUS STUDIES

Information and data for this report were obtained from a review of the 1999 Feasibility Study on Development of EHV Transmission Lines in Labrador¹ and from site visits carried out during the periods July 24 to July 26, 2007 and September 18 to September 21, 2007. Hydro's TL 240 fording location maps provided valuable information for assessing constructability issues.

¹ Feasibility Study on Development of EHV Transmission Lines in Labrador, RSW-EDM, February 1999.

1.3 CONTENT OF THE REPORT

The report presents the findings with respect to the location and number of camps, marshalling yards, access routes, and tote roads required. Also presented are the results of the geotechnical field investigation program which included test pit excavation, anchor pull out tests, hand augering and bog probes.

2 LINE ROUTING

2.1 GENERAL

A comprehensive feasibility study on the development of EHV Transmission Lines in Labrador for the Lower Churchill Project (Gull Island and Muskrat Falls) was completed in February 1999¹. The report included a proposed routing of the 230 kV line between Muskrat Falls and Gull Island. Hydro has subsequently decided the 230 kV line routing would parallel (approximately 85 m to the south) the existing 138 kV line running between Happy Valley-Goose Bay and Churchill Falls. See Drawing #'s 722850-AC1060-43DD-0001 to 0005.

2.2 LINE ROUTING ADJUSTMENT

Originally the converter station and switchyard for the Gull Island Project were located on the south side of the Churchill River. As a result of other investigative work for the Lower Churchill Project, the converter station and switchyard were relocated from the south side of Churchill River to the north side. The 230 kV line will now be slightly shorter by about four (4) km. The change in converter station location also results in a change in the routing across the Churchill River for the HVDC line to the Island. It is recommended that when the exact location of the major structures on the HVDC line for the river crossing is better established, a geotechnical investigation should be undertaken for the tower structure foundations.

It is anticipated that, as a result of other investigative work ongoing on the variants for the Muskrat Falls Project, the switchyard will probably be relocated from the powerhouse to a stand-alone switchyard. The drawings show a relocated switchyard near the powerhouse which results in only a minor adjustment for the transmission line routing.

¹ Ibid.

3 ACCESS ROUTES AND TOTE ROADS

3.1 ACCESS ROADS

Access to the proposed 230 kV transmission line is excellent, as it is adjacent to the Trans Labrador Highway throughout its length. In a number of instances, the proposed 230 kV line will cross the highway. It is also adjacent to the existing 138 kV wood pole transmission line running between Churchill Falls and Happy Valley-Goose Bay.

Tote roads or access tracks from the Trans Labrador Highway to the proposed transmission line were established as part of the original construction of the existing 138 kV transmission line. The location of these access points together with information on fording locations were identified on Hydro's fording location maps. A site reconnaissance was used to look at the access points to determine their adequacy to construct the new 230 kV transmission line.

The maps were relatively accurate with the exception of the access near stream crossing number 15. The existing access is slightly to the east and crosses a wet area. It was agreed that the location shown on the map is the preferred location and, since it is a new access, it will have to be established by the contractor. Also, an additional existing access near Edward's Brook was identified and has been added to the maps.

Between Muskrat Falls and the Gull Island converter station, a total of seven (7) stream/river crossings were identified on the fording location maps as "no fording" locations. Four (4) of these crossings are the major rivers; namely, Lower Brook, Upper Brook, Edward's Brook and Penas River. Access points exist on either side of these river crossings so bridges will not be required at these crossings in order to construct the transmission line. The three (3) remaining locations are subject to the crossing requirements of the regulatory agency, should they be required.

It is anticipated that heavier equipment will be used to construct the new 230 kV line versus the equipment used for construction of the existing 138 kV line. The existing

access points will be upgraded, extended, or improved to handle the heavier traffic. The decision as to the extent of upgrading/improvement should be left to the transmission line contractor as part of the competitive bidding process. The contract specification should describe and define the environmental guidelines and restrictions the contractor has to follow. The contractor should choose the type and size of equipment he wants to use to construct the line. The best season for transmission line construction is winter when the ground is sufficiently hard to allow movement of heavy equipment, resulting in less environmental disturbance.

4 CAMPS AND MARSHALLING YARDS

4.1 CAMP(S)

4.1.1 General

During the construction of the Muskrat Falls hydroelectric powerstation, it is assumed that a main camp will be operational at Muskrat Falls and space may be available to accommodate transmission line construction personnel, depending on the transmission line construction schedule. Since the actual construction time for the line is relatively short (approximately six (6) months), it could be scheduled during a period when construction activity on the main plant is at its ebb towards the end of the project. There also exists the possibility that camp space may be available at Gull Island depending on the completion schedule for the Gull Island powerstation.

4.1.2 Number of Camps

Since the preferred routing of the proposed 230 kV transmission line is parallel and adjacent to the existing 138 kV wood pole transmission line between Goose Bay and Churchill Falls, as well as to the all weather Trans Labrador Highway, and since the total line length is only 60 kms, a one-camp set-up will be all that is required. The preferred camp location would be at Muskrat Falls. One at Gull Island would also be acceptable.

Another option would be to construct a temporary camp along the Trans Labrador Highway remote from the Muskrat Falls or Gull Island sites. Such a site was not investigated as part of this work; however, a suitable location should not be an issue as there is at least one site where the contractor engaged to upgrade the Trans Labrador Highway had a temporary construction camp. This option has merit should the owner decide the transmission line contractor will provide his own temporary camp.

4.1.3 Camp Layout

It is assumed that either one or both of the Gull Island or Muskrat Falls camp sites erected for the construction of the powerstations will be operational during the time of

construction of the transmission line. Should lodging space for transmission line construction personnel not be available, the most economical and logical solution would be to add bunkhouse trailers only to the main camp and have transmission line personnel share the remaining facilities (kitchen, diner, recreational, first aid station, communications, etc) with the main camp.

The number of construction workers is based on the construction schedule. For a typical 230 kV transmission line in the terrain conditions existing along the route, an overall construction period of approximately six (6) calendar months plus clean-up time appears reasonable, allowing three (3) months for each of the three (3) overlapping major operations of foundation, tower assembly and erection, and conductor installation.

Based on the above, bunkhouse trailers to accommodate approximately 150 workers would be required. Drawing # 722850-AC1060-43DD-0007 shows a typical layout for bunkhouse type trailers.

The scenario presented assumes the camp facilities will be supplied by the owner. For the construction of this particular transmission line, this is probably the most economic approach as only sleeping accommodations have to be added to the main camp.

4.1.4 Water, Sewer, and Waste Disposal

As it is recommended that accommodations be part of the main construction camp for the project, separate water and sewer services will not be required. Likewise, waste disposal procedures would be part of the operational requirements for the main camp.

4.2 MARSHALLING YARDS

4.2.1 Logistics

Both the Gull Island and Muskrat Falls extremities of the line are situated along the all-weather Trans Labrador Highway linking Baie Comeau, Quebec to Happy Valley-Goose Bay, Labrador, hence all transmission line materials and equipment could be

transported by road from points west. One advantage of delivery by road would be just in time delivery which would reduce the requirement for marshalling areas.

The most likely scenario is that materials and equipment would be shipped via marine transport to Goose Bay and then by road to Muskrat Falls. Though it is generally more economical transporting by this method, it is limited to the period that the shipping channels are open, roughly between mid June and late November. Since the construction schedule is only approximately six (6) months, this lends itself to a mid summer or early fall delivery schedule with a one-winter construction period.

Construction of the transmission line during the winter may be the more desirable option, not only from the environmental disturbance point of view but also as stated in the 1999 Feasibility Study on page 131¹ “According to recent Hydro-Quebec statistics the production rate for certain equipment in winter is about 20% higher than in other seasons”.

4.2.2 Yard Location

The proposed location for the marshalling yard is in the vicinity of coordinates N 5,904,100, E 648,226 and is located on Drawing # 722850-AC1060-43DD-0002. The site was selected based on the following:

- The gateway to the project is Goose Bay which is reached by road via the Trans Labrador Highway, by air via major carriers, and by sea. Goose Bay is 30 km by road from the Muskrat Falls site.
- Delivery of material, equipment, and supplies to the marshalling yard can be via a combination of land, air, or sea depending on delivery schedules.
- The marshalling yard is part of the lay down area for construction of the main project.

¹ Ibid.

Based on a review of material requirements presented in the 1999 Feasibility Study¹, an area of approximately 1.5 hectares would be required to marshal materials. Drawing # 722850-AC1060-43DD-0006 shows a typical layout of the proposed marshalling area.

4.2.3 Preparation of the Site

It is recommended that Hydro provide a fully prepared, levelled and fenced site to the transmission line contractor especially given that the marshalling area should be part of the main lay down area for the project. The delivery schedule for Hydro supplied permanent line materials (i.e., foundation and tower steel, anchor rods, conductor insulators and accessories, etc.) will dictate whether Hydro or the transmission line contractor will undertake the receiving, sorting, checking and storage of this material prior to the construction start-up.

It is assumed that procurement will be done by the Hydro, hence, it is preferable that Hydro receives, sorts, and checks all material at the marshalling yard and hands all materials over to the contractor prior to construction start-up.

¹ Ibid.

5 GEOTECHNICAL

5.1 GENERAL

The drawings in Appendix A show the specific test locations discussed in this report.

5.2 INVESTIGATION PROCEDURES

The geotechnical program was divided into several tasks:

5.2.1 Task 1 - Air Photo Interpretation/Base Map Prep/Fieldwork Prep

A series of stereo pairs, black and white air photos and colour air photo mosaics were provided by Hydro. These were examined to obtain remote sensing data on the landforms and surficial geology of the route. Hydro also provided route maps that were prepared for the environmental studies. These maps contained the approved stream crossings and locations of access trails, which aided in the planning of the work. During the study it was discovered that surficial geology and geomorphology mapping was being prepared by one of the environmental consultants, Jacques Whitford Ltd. Instead of producing a separate surficial geology map, it was decided to provide field information to Jacques Whitford so they could ground truth the air photo interpretation.

Published reports (see bibliography) of the area on surficial and bedrock geology were reviewed.

When the review of surficial and bedrock geology was completed, plans were finalized for the field investigation program. The intrusive program, that was identified in the original WTO Execution Plan, was modified. A reduction was made in intrusive investigations and more emphasis was placed on areas where varying conditions were expected, such as the area west of Lower Brook, where the line is located on a hillside.

5.2.2 Task 2 - Reconnaissance

Two (2) reconnaissance trips were made by helicopter. The first trip was on July 25, 2007, to become familiar with the route and any problems with access for testing. The second trip was on September 9, 2007, to examine the topographic features and soil conditions in remote locations. The route maps supplied by Hydro were used during this process to record the surficial geology of the route. Soil/rock conditions, in areas that represented a change in the surficial geology, were examined more closely.

5.2.3 Task 3 - Permits

Hydro had in place permitted access trails and fording sites. Intrusive investigations were limited to those areas where permits were in place and in areas away from streams and water bodies where permits were not required.

5.2.4 Task 4 - Ground Truthing and Geotechnical Investigations

The fieldwork for this investigation was performed between July 25 and September 28, 2007, using helicopter support. Mechanical excavators were used for test pit excavation. Hand auger probing and bog probing were performed by project personnel.

Areas of interest were examined on the ground and intrusive investigations were performed. Representative samples of the materials encountered were obtained and sent to the site laboratory for index testing. In total sixteen (16) test pits were excavated, six (6) hand auger holes were drilled, ten (10) areas of bog were probed and two (2) anchor pull out tests were performed. Eleven (11) samples were also obtained from existing borrow pits or road cuts near the transmission line for moisture density relationship and gradation testing.

Test Pits

Sixteen (16) test pits were excavated in representative areas that provided coverage of the anticipated soil conditions for the 66 km long route. The test pit results are included in Appendix B. The results of the two (2) test pits excavated for the Muskrat

Falls campsite are also included in the Appendix as they are representative of soil conditions for the transmission line in that area.

Hand Auger Holes

In areas where long mobilizations for heavy equipment were required and where the reconnaissance indicated suitable soil, six (6) hand auger holes were drilled to refusal or to a maximum reach of the apparatus at about three (3) m. The hand auger results are included in Appendix C.

Bog Probes

Although bog probing was not specifically identified in the WTO preparation, nine (9) areas containing bog were identified during the reconnaissance trips that were close to the route and were probed to aid the designers in making decisions on the final routing. Some of the areas had more than one small bog and each bog is reported individually. The probe results are included in Appendix D.

Anchor Pull Out Tests

Two (2) anchor pull out tests were performed along the area of the rocky ridge just west of Lower Brook. This area is the only one along the route where bedrock is expected. The rock bolts were installed in bedrock (granite gneiss). The rock bolts were stressed to determine the ultimate holding capacity of the anchor rod only.

25 mm diameter utility pole rock bolt anchors, with cable eyes removed and the ends threaded, were used for testing.

The anchors were installed approximately 1.8 m into bedrock in 45 mm diameter drill holes. The anchor shells were 50 mm long and ribbed. The shell was anchored by torquing with a 0.6 m long pipe wrench to refusal. No grout was used as the holding resistance of the anchor in the rock was required.

The testing equipment was calibrated in imperial units and the results were reported in the same units. The anchor was then loaded to two (2) tons (short). Every two (2) minutes a load of two (2) tons was added until either the anchor failed or the jack had

reached its maximum capacity of 18 tonnes. The test results are included in Appendix E.

Moisture Density

All samples collected during the field investigation were tested for gradation. Selected samples from existing borrow pits or road cuts that were representative of the various materials encountered were tested for Standard Proctor Dry Density. All testing was in conformance with applicable ASTM standards. Moisture content results are included in Appendix F.

5.2.5 Task 5 - Reporting

All of the material reviewed, field test results and interpretations are assembled in this technical report.

5.3 SURFICIAL GEOLOGY

The site is located on the Churchill River Lowlands. These lowlands are restricted to the river valley in a band some three (3) to eight (8) km wide. The former glacially scoured valley has been filled with a combination of glacial till at the bedrock surface which has been overlain by fine-grained estuarine marine sediments (sand/clay) and then by fluvial sand. There are sporadic areas where the lower sediments and bedrock rise through the overlying sands. All of these sediments have been incised by the modern day Churchill River and its tributaries. At the intersection of the tributaries with the Churchill River, sand and gravel has been deposited. Most of the larger rivers in the area are running over a bed of cobbles and boulders.

The upper sides of the Churchill River Valley are covered with generally thin deposits of glacial till. Bedrock is exposed on some steeper hillsides and riverbeds.

Bogs have developed in low-lying flat areas where the marine sediment, some other low permeability soil, or bedrock is located near the ground surface.

5.4 BEDROCK GEOLOGY

The 66 km long transmission line traverses a Precambrian age geology dominated by crystalline metamorphic rocks composed of granite gneiss with some dark mafic material and numerous pegmatite stringers. Bedrock is at or near the surface on the proposed transmission line route at two (2) locations; both sides of Muskrat Falls and just west of Lower Brook.

5.5 INVESTIGATION RESULTS

Upon completion of the Air Photo Interpretation (API) and terrain analysis, calculations were made for the type of soil, bog, and rock expected along the route in the upper 4 m. This calculation was further upgraded upon completion of the fieldwork for the project. The percentages of the various types may be summarized as follows:

• Bog lands	4%
• Bare rock or rock concealed under thin organic soil	3%
• Areas of thin glacially produced soil	17%
• Areas of thick glacially produced soils	9%
• Fluvial sand/sand dunes	55%
• Fluvial sand and gravel	9%
• Estuarine marine sediments	3%

The percentages of the various types were determined, based on visual observations, test pit excavation and information from the report “Surficial Geology and Geomorphology, Proposed TL240 Line” and are rounded to the nearest one.

5.6 GEOTECHNICAL DESIGN PARAMETERS

By far, the most common landform throughout the route is fluvial sand. This soil, in all cases observed and tested, is a fine to medium grained material with a trace of fines and some gravel. Some sand and gravel exists along the larger tributaries and in higher elevations at the uppermost fluvial terraces. Sand dunes are common on top of the fluvial sand.

Glacial till comprising a well graded, diamicton of sand and gravel with varying amounts of fines, cobbles and boulders was encountered near the central portion of the route.

Marine sediments (silt/clay) are evident in eroded areas and deeply incised tributaries of the Churchill River.

Minor bog lands exist throughout the area, however, the route has been carefully chosen to avoid most of it. The bog soil is not suitable for bearing or anchoring or reuse as fill.

Frost penetration in this area is expected to be 2.5 m based on data from the Canadian Foundation Engineering Manual, 3rd Edition. The susceptibility for frost action in glacial till and marine soil containing significant fines is moderate to objectionable. In clean sand and gravel, away from the water table, frost action will be slight.

The geotechnical parameters for soils expected along the route are presented in the following table:

Table 1: Summary of Geotechnical Design Parameters

Soil or Rock Type	Allowable Bearing Capacity kP_a	K_a	K_p	SG	γ kN/m^3	γ kN/m^3 submerged	ϕ S_u	Recommended Anchoring Procedure
Fluvial Sand/Dune Sand	250	0.33	3.00	NA	18	8	30°	Gravity
Fluvial Sand and Gravel	250	0.31	3.26	NA	19	9	32°	Gravity
Clay/Silt	50*	0.39	2.56	NA	NA	10	25 kPa	Gravity
Glacial Till [undisturbed]	300	0.24	4.20	NA	22	12	38°	Gravity
Submerged Fill in Bogs or Other Wet Areas	100	0.36	2.77	NA	11	9	28°	Gravity
Granite Gneiss	3000	NA	NA	2.6	25	15	45°	Rock Bolts

K_a , K_p – Rankine Assumptions; SG – Specific Gravity; γ - Unit Weight; ϕ - Friction Angle; S_u – Undrained Shear Strength (clay/silt only); NA – Not Applicable

* This bearing capacity is preliminary. Consolidation testing should be performed during the final design stage of the project to predict the settlement characteristics of this soil which would ultimately determine the bearing capacity.

5.7 CONSTRUCTION CONSIDERATIONS

5.7.1 Materials

Construction of the transmission line will require material for fill and aggregates.

Clean acceptable fill may be found over most of the proposed route in the fluvial soils and in the thin veneer of glacial till that is abundant near the centre section of the line. Proctor values obtained are included in Appendix F.

Natural aggregates that may be suitable for concrete are known to occur at the Penas River. This material is clean fluvial sand and gravel existing in the terraces at that location. However, its proximity to nearby water bodies may preclude its use as aggregate.

Two (2) concrete and crushed aggregate suppliers are located in nearby Goose Bay.

Several quarries are located on the nearby TLH that are suitable for blast rock fill.

5.7.2 Quality Specifications

The quality of construction must be assured. It is suggested that CSA A23.1-00 Concrete Materials and Methods of Construction/Methods of Test for Concrete be followed and used as a minimum standard.

If grades are such that foundations are required on fill, the fill should be a high quality, well graded material, free from organics, with low fines content and placed at optimum moisture content. Granular B as specified by the Newfoundland Department of Transportation and Works would be acceptable. An alternative to Granular B may be used providing its quality is inspected and approved by qualified personnel prior to its use. The fill should be located away from steep embankments and protected from erosion. It must be placed in lifts not exceeding 150 mm thick and on soil which has been proof rolled. The fill must be compacted to 100% of its corrected maximum dry density (ASTM D 698-78). Foundations placed on well-compacted, engineered fill may be designed based on an allowable bearing pressure of 150 kPa, provided its placement is inspected by qualified personnel.

With this allowable bearing pressure, the total settlement is expected to be less than 25 mm.

5.8 CLOSURE

This report was prepared for the exclusive use of Hydro for specific application to the project site. The field investigations and analyses were performed using generally accepted geological and engineering practices in accordance with the work plan developed and verbal requests from Hydro. No other warranty expressed or implied is made. The limitations of this report are attached in Appendix G.

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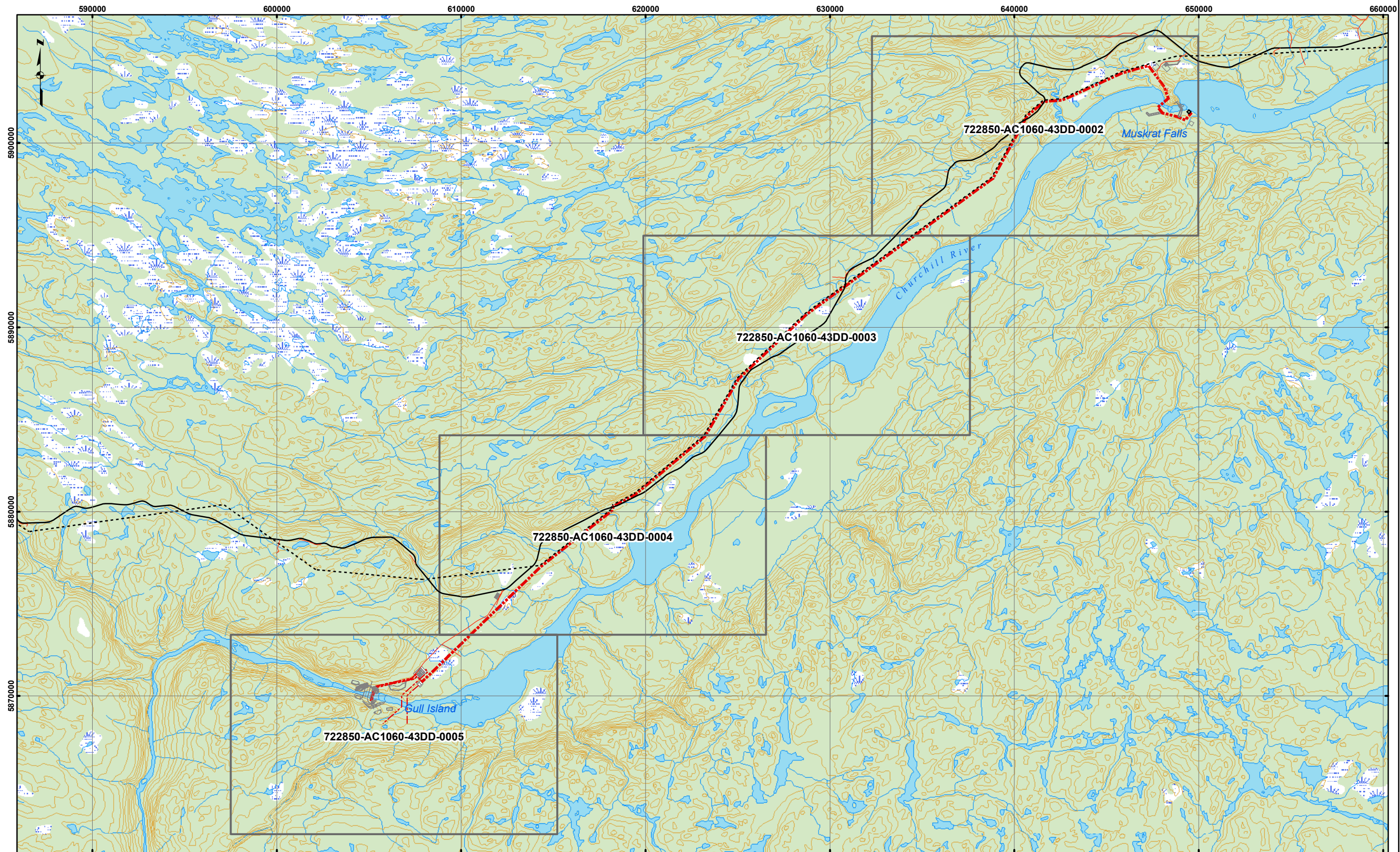
Newfoundland and Labrador Surficial Geology Map Series – 1998, Sheets 13F/7, 13F6, 13F3, 13C/14, Government of Newfoundland and Labrador, Department of Mines and Energy, Geological Survey.

Proctor and Redfern Ltd., 1980; Lower Churchill Hydroelectric Project Reservoir Preparation Study.

Canadian Foundation Engineering Manual, 3rd Edition.

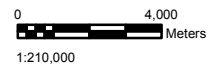
Appendix A

Drawings



LEGEND

- Existing Road
- Trans Labrador Highway
- - - - Existing Transmission Line 138kV
- - - - Proposed Transmission Line 230kV
- Index Grid



DWG NO.	TITLE	NO.	DATE	ISSUED FOR REVIEW DESCRIPTION	NG	EL	CM
					OWN	DESIGN	CHK
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TRANS	DRAWN	N. GRIFFIN
MECH	DATE	JAN 23, 2008
P&C	CHECKED	G. SMITH
TELC	APPROVED	C. MILES

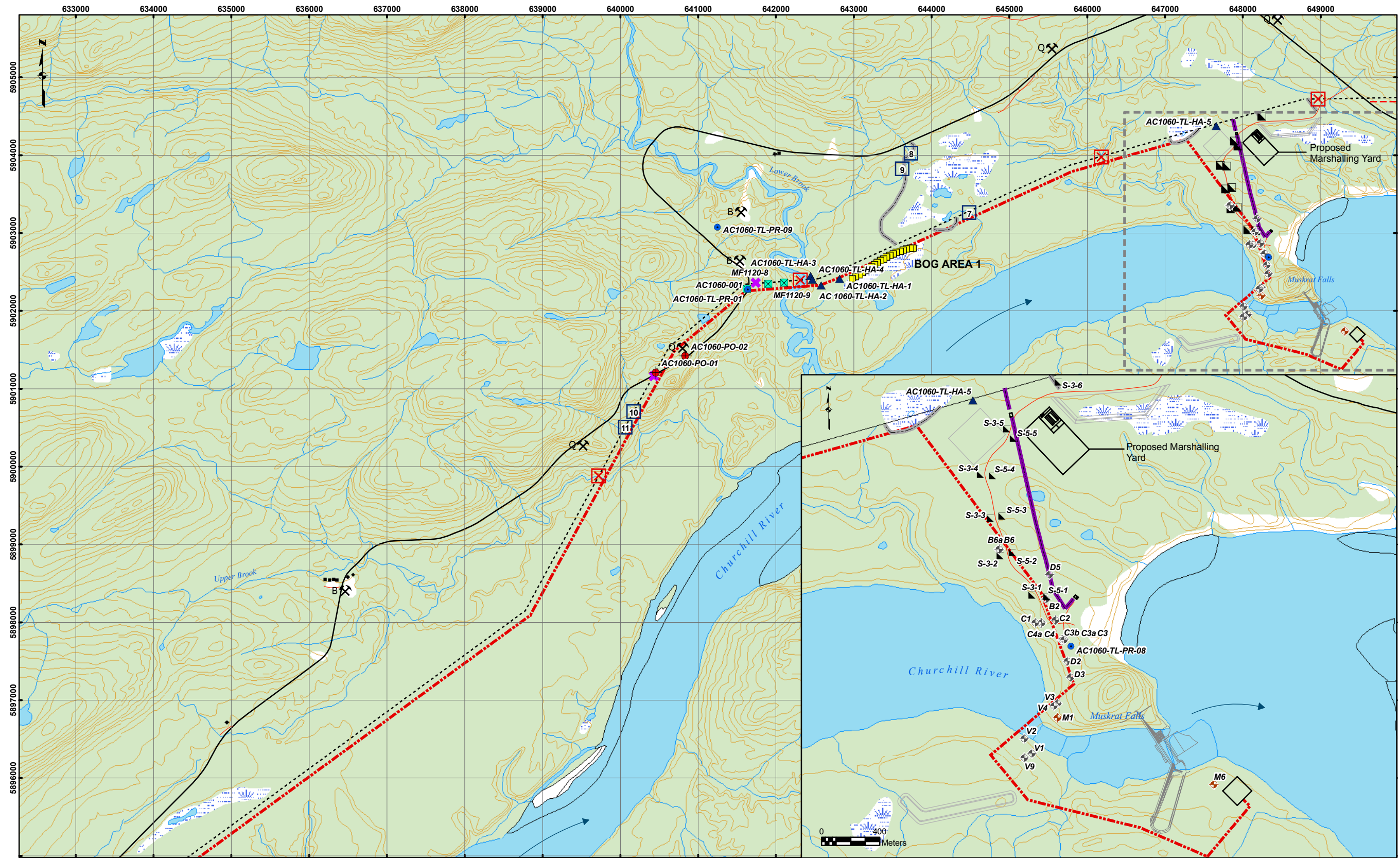
SNC-LAVALIN
BAE-Newplan

BAE-Newplan Group Limited
1133 Topsail Rd. Mt.
Pearl, NL, Canada
A1N 5G2

NEWFOUNDLAND AND LABRADOR HYDRO

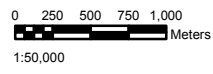
**LOWER CHURCHILL PROJECT - LOCATION PLAN INDEX MAP
MUSKRAT FALLS TO GULL ISLAND INDEX MAP**

W.O. NO.	DWG. NO. 722850-AC1060-43DD-0001	REV. 0
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LEGEND

- | | | | | | |
|-----|---------------------|---|---------------------------|---------|----------------------------------|
| B X | Existing Borrow Pit | ● | Proctor Sample | — | Distribution Line |
| Q X | Existing Quarry | ● | Pull Out Test | --- | New Road |
| ▲ | 1998 Test Pit | ⊕ | 1979 Borehole | — | Existing Road |
| ■ | Bog Probe Location | ⊕ | 1998 Borehole | — | Trans Labrador Highway |
| ⊗ | Test Pit | □ | Approved Fording Location | - - - - | Existing Transmission Line 138kV |
| ✱ | Access Point | ⊗ | No Fording | --- | Proposed Transmission Line 230kV |
| ▲ | Hand Auger | — | Access Trail | | |

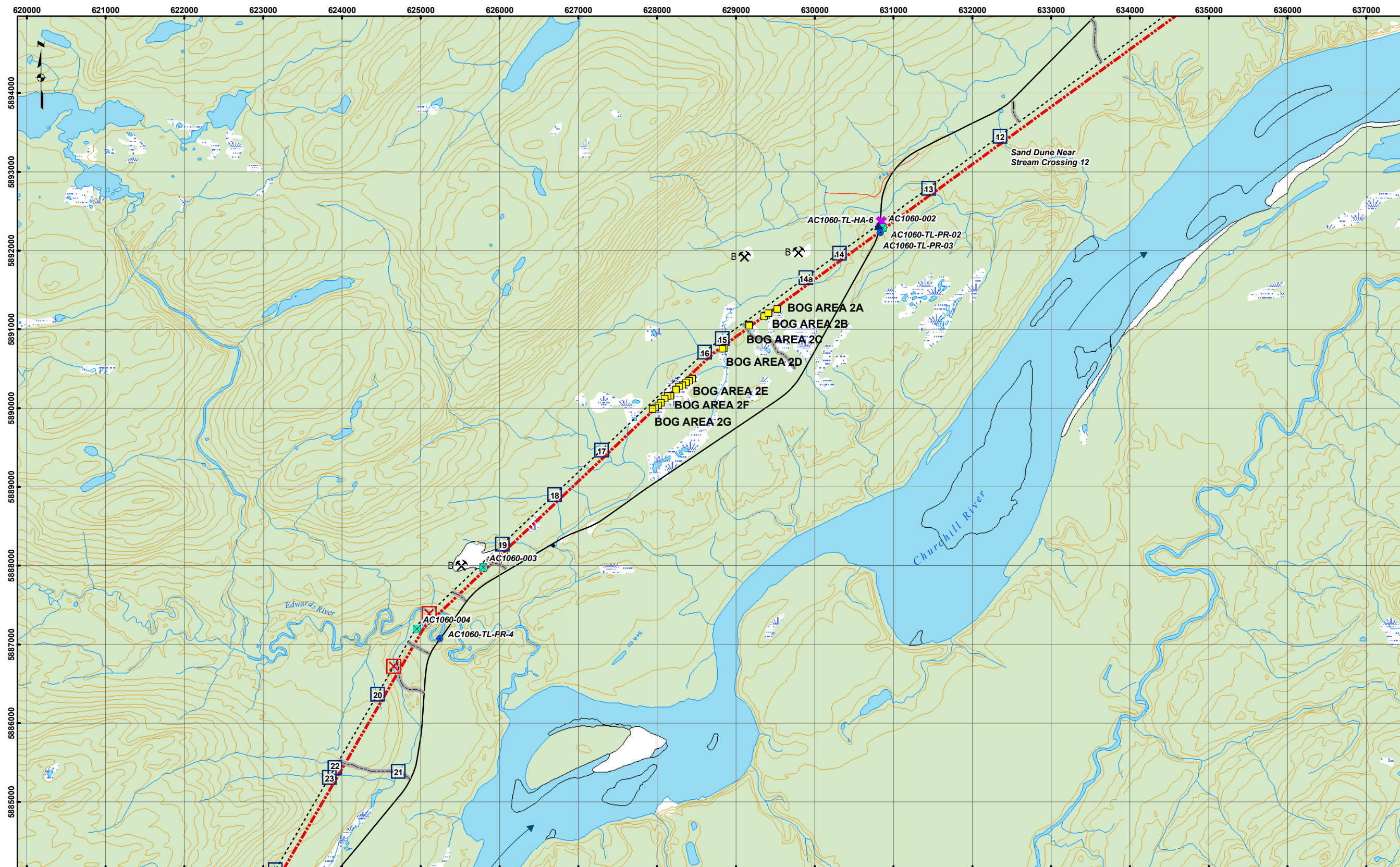


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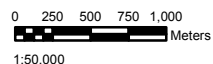
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CML.	DESIGNED:	N. GRIFFIN
TRANS.	DRAWN:	N. GRIFFIN
MECH.	DATE:	JAN 23, 2008
P&C.	CHECKED:	G. SMITH
TELE.	APPROVED:	C. MILES

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		NEWFOUNDLAND AND LABRADOR HYDRO
LOWER CHURCHILL PROJECT - LOCATION PLAN MUSKRAT FALLS TO GULL ISLAND 230KV TRANSMISSION LINE		
W.O. NO.	DWG. NO. 722850-AC1060-43DD-0002	REV. 0



LEGEND

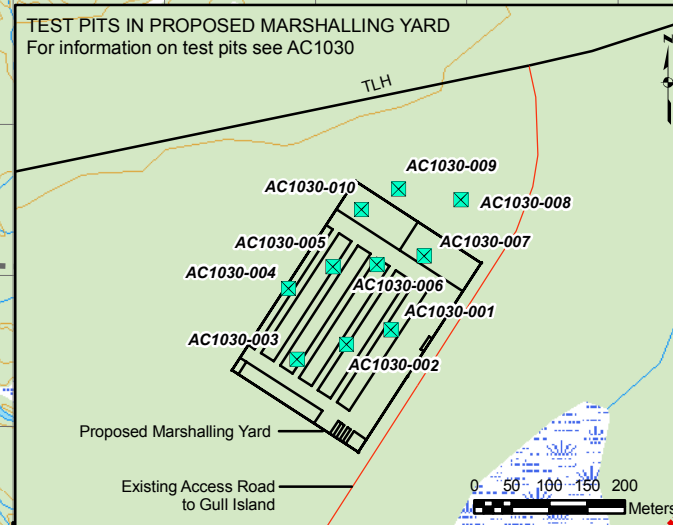
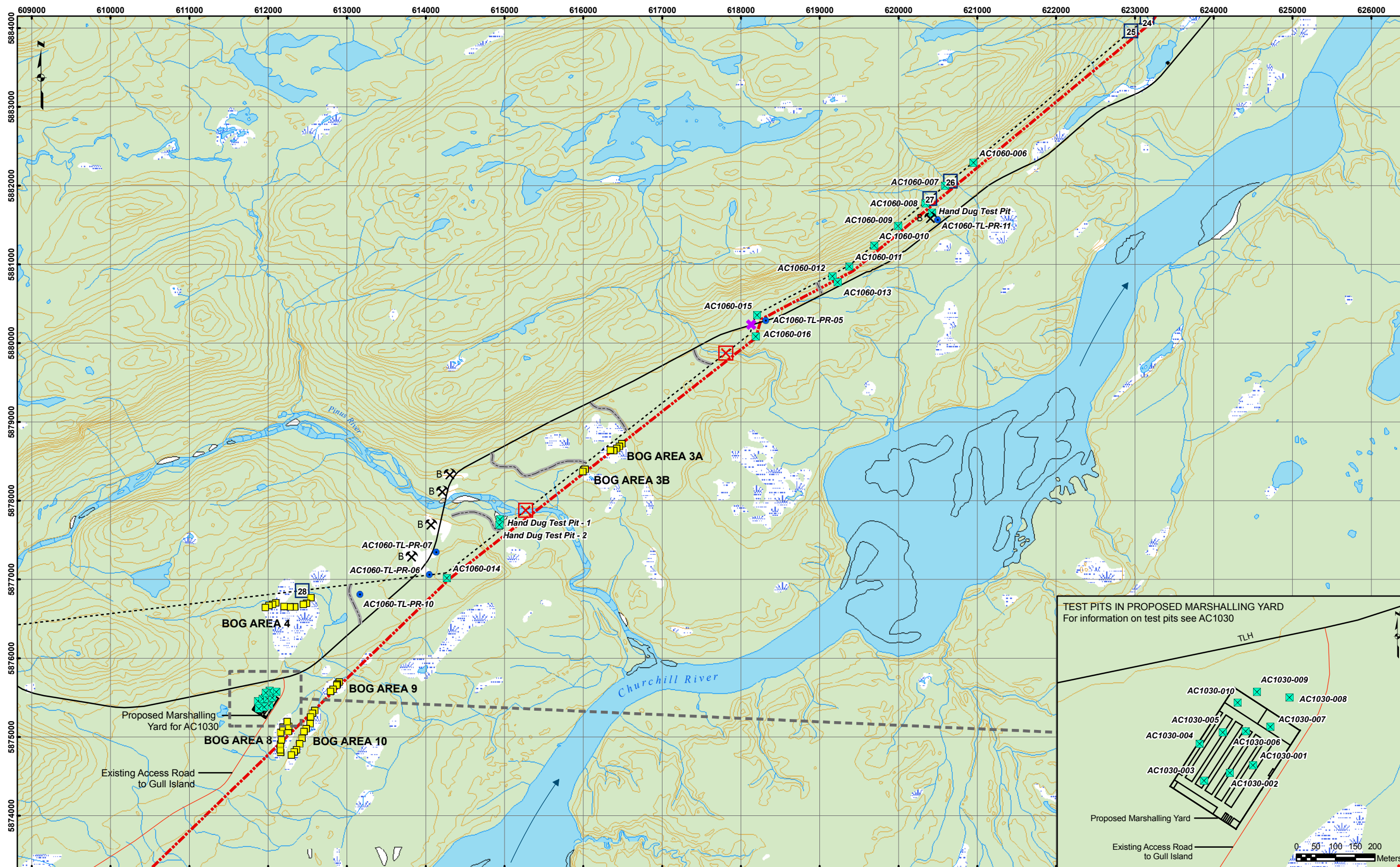
- B Existing Borrow Pit
- Q Existing Quarry
- Bog Probe Location
- Test Pit
- Access Point
- Hand Auger
- Proctor Sample
- Pull Out Test
- Approved Fording Location
- No Fording
- Access Trail
- Distribution Line
- New Road
- Existing Road
- Trans Labrador Highway
- Existing Transmission Line 138kV
- Proposed Transmission Line 230kV



DWG NO.	TITLE	NO.	DATE	ISSUED FOR REVIEW	DESCRIPTION	OWN.	DESIGN.	CHK.	APPD.

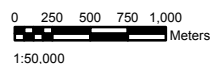
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LOWER CHURCHILL PROJECT - LOCATION PLAN MUSKRAT FALLS TO GULL ISLAND 230KV TRANSMISSION LINE		
W.O. NO.	DWG. NO. 722850-AC1060-43DD-0003	REV. 0



LEGEND

- B X Existing Borrow Pit
- Q X Existing Quarry
- Yellow square Bog Probe Location
- Green cross Test Pit
- Purple cross Access Point
- Blue triangle Hand Auger
- Blue circle Proctor Sample
- Red circle Pull Out Test
- Blue square Approved Fording Location
- Red square No Fording
- Grey line Access Trail
- Red dashed line New Road
- Orange line Existing Road
- Black line Trans Labrador Highway
- Black dashed line Existing Transmission Line 138kV
- Red dashed line Proposed Transmission Line 230kV



DWG NO.	TITLE	NO.	DATE	ISSUED FOR REVIEW	DESCRIPTION	OWN.	DESIGN.	CHK.	APPD.
	REFERENCE DRAWINGS								

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P&C.	CHECKED:	G. SMITH
TELC.	APPROVED:	C. MILES

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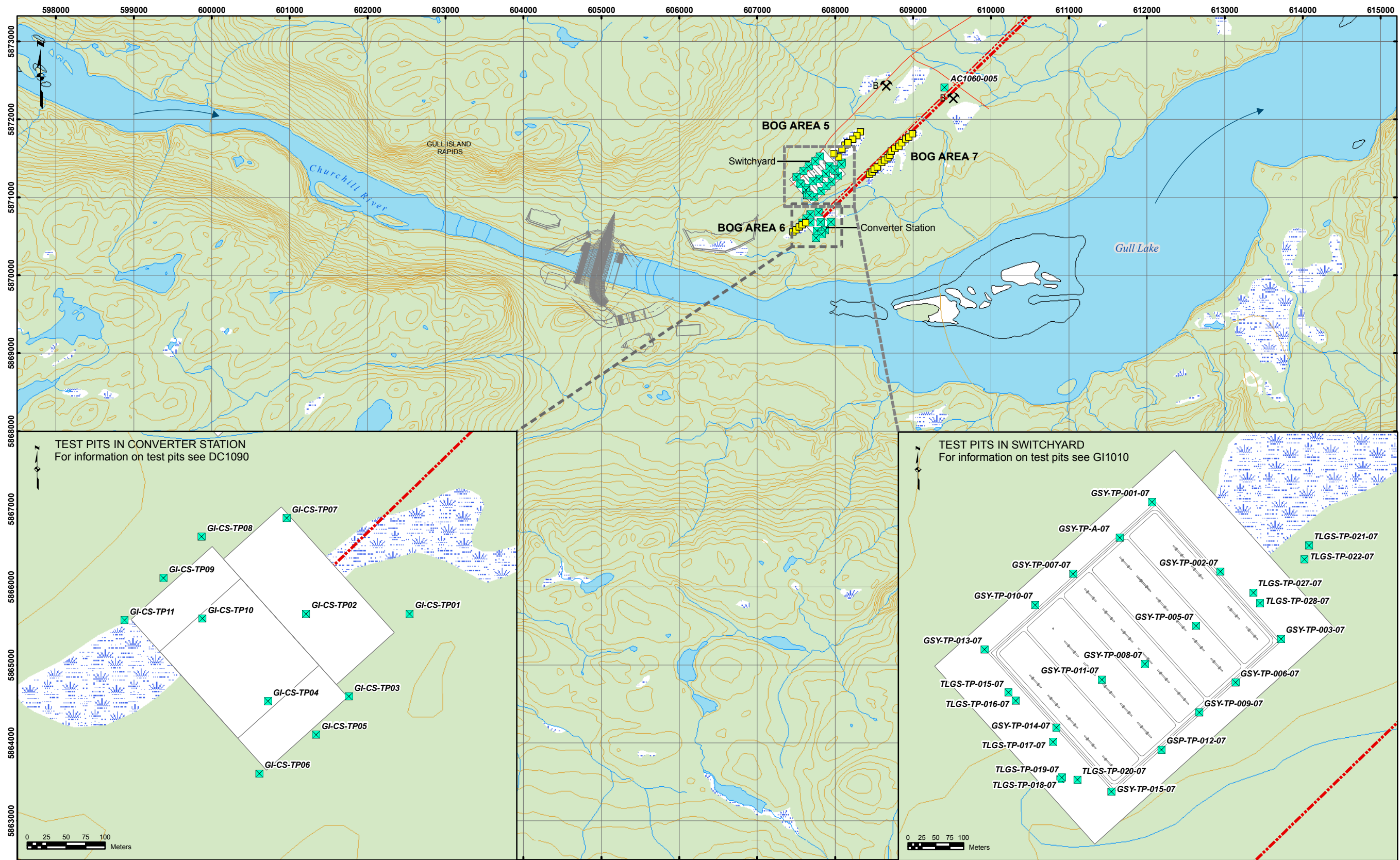
BAE-Newplan Group Limited
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A1N 5G2

HYDRO NEWFOUNDLAND AND LABRADOR HYDRO

LOWER CHURCHILL PROJECT - LOCATION PLAN
MUSKRAT FALLS TO GULL ISLAND 230KV
TRANSMISSION LINE

W.O. NO. _____ DWG. NO. 722850-AC1060-43DD-0004 REV. 0

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LEGEND

- B X Existing Borrow Pit
- Q X Existing Quarry
- Bog Probe Location
- ⊠ Test Pit
- ⊠ Access Point
- ▲ Hand Auger
- Proctor Sample
- Pull Out Test
- Approved Forging Location
- ⊠ No Forging
- Access Trail
- Distribution Line
- - - New Road
- - - Existing Road
- - - Trans Labrador Highway
- - - Existing Transmission Line 138kV
- - - Proposed Transmission Line 230kV

0 250 500 750 1,000
Meters
1:50,000

DWG NO.	TITLE	NO.	DATE	ISSUED FOR REVIEW DESCRIPTION	DWN.	DESIGN	EL.	CM.	APPD.
	REFERENCE DRAWINGS								

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TRANS.	DRAWN:	N. GRIFFIN
MECH.	DATE:	JAN 23, 2008
P&C.	CHECKED:	G. SMITH
TELC.	APPROVED:	C. MILES

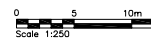
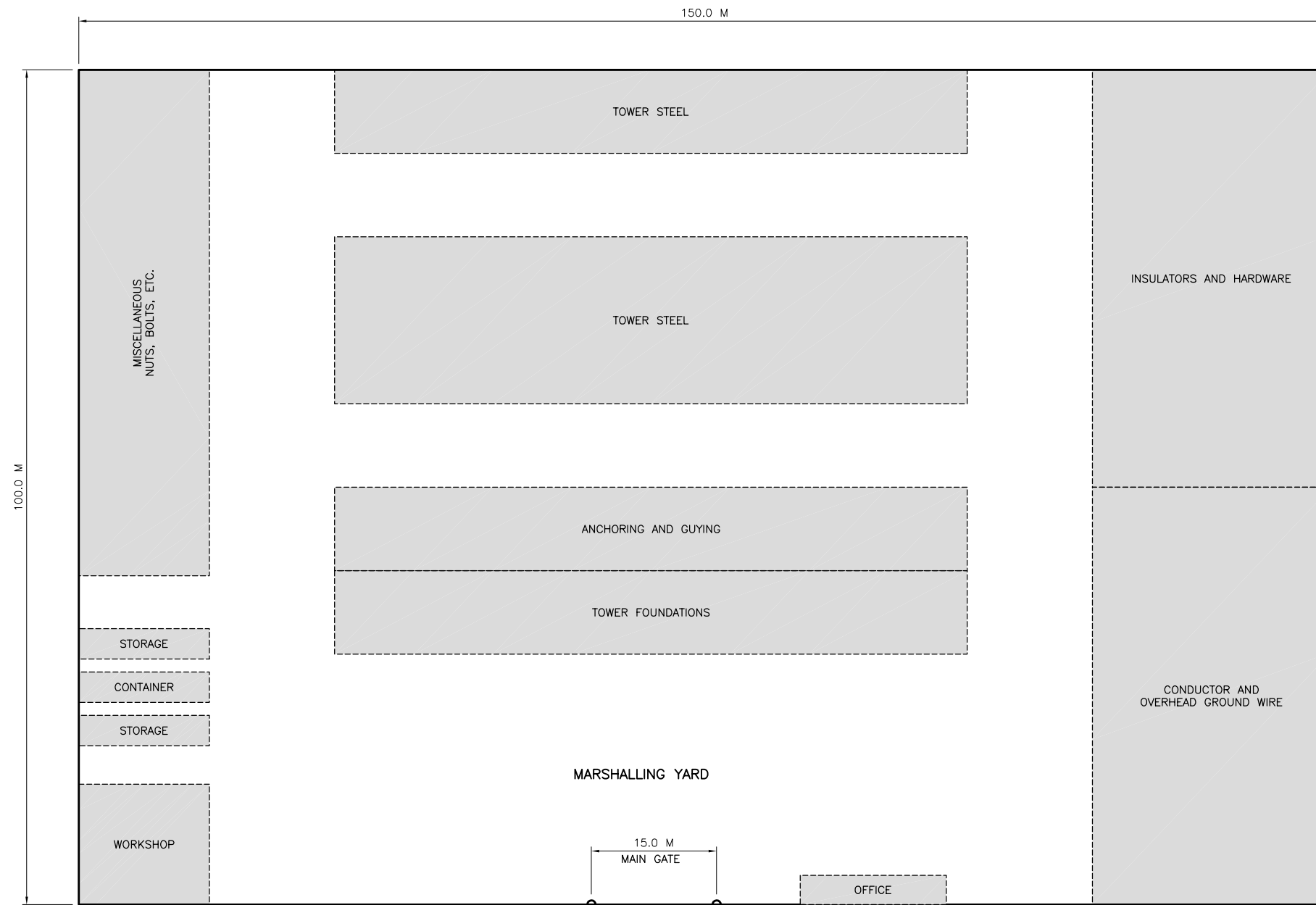
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NEWFOUNDLAND AND LABRADOR HYDRO

LOWER CHURCHILL PROJECT - LOCATION PLAN
MUSKRAT FALLS TO GULL ISLAND 230KV
TRANSMISSION LINE

W.O. NO.	DWG. NO.	REV.
	722850-AC1060-42DD-0005	0



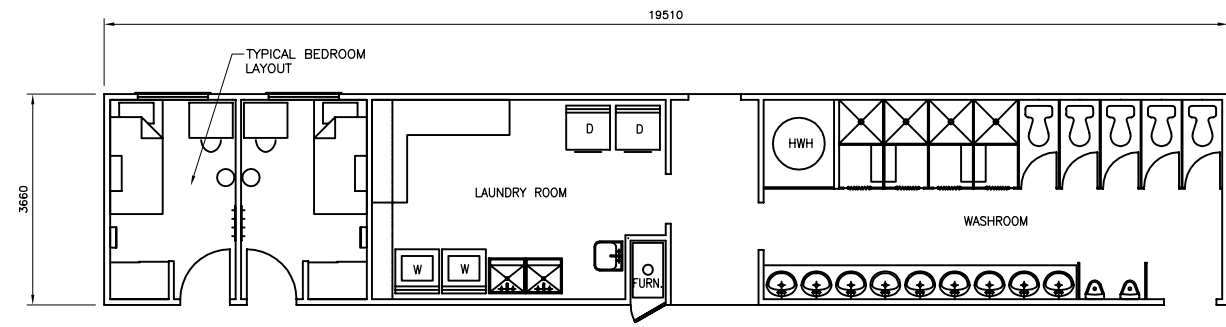
NOTES :
1. ALL DIMENSIONS ARE NOTED IN METER UNITS.

DWG. NO.	TITLE	NO.	DATE	DESCRIPTION	DWN.	DESIGN.	CHK.	APP'D
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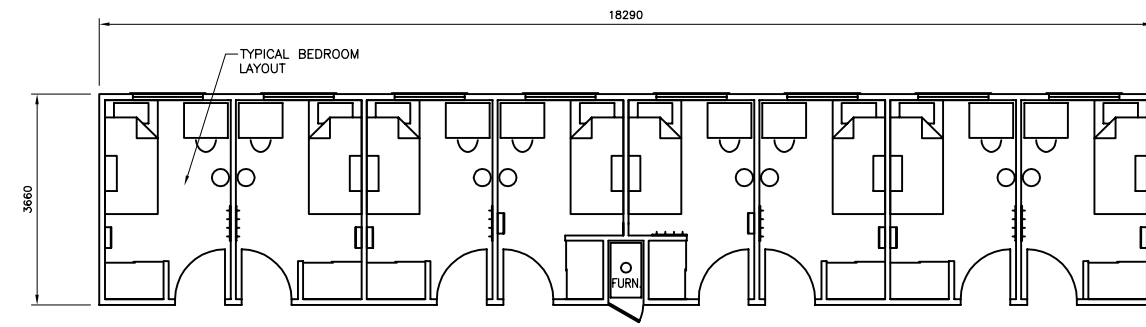
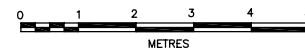
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TRANS.	DRAWN:	G.L./P.W.
MECH.	DATE:	08/02/08
P&C	CHECKED:	T.M.
TELC.	APPROVED:	B.C.

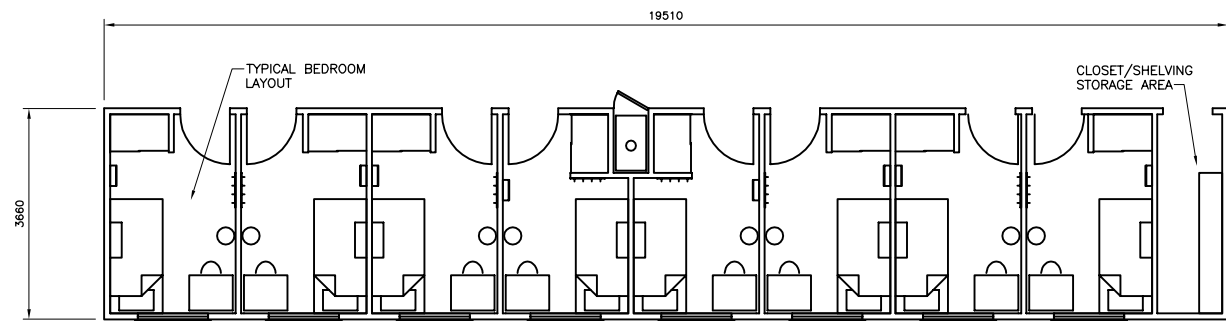
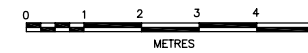
 SNC • LAVALIN 1133 Topsail Rd. Mt. Pearl, NL, Canada A1N 5G2	 BAB-Newsplan Group Limited 1133 Topsail Rd. Mt. Pearl, NL, Canada A1N 5G2	
		 NEWFOUNDLAND AND LABRADOR HYDRO
LOWER CHURCHILL PROJECT - TRANSMISSION STUDIES MUSKRAT FALLS TO GULL ISLAND 230KV TRANSMISSION LINE MARSHALLING YARD LAYOUT		
W.O. NO.	DWG. NO. 722850-AC1060-43DD-0006	REV. 0



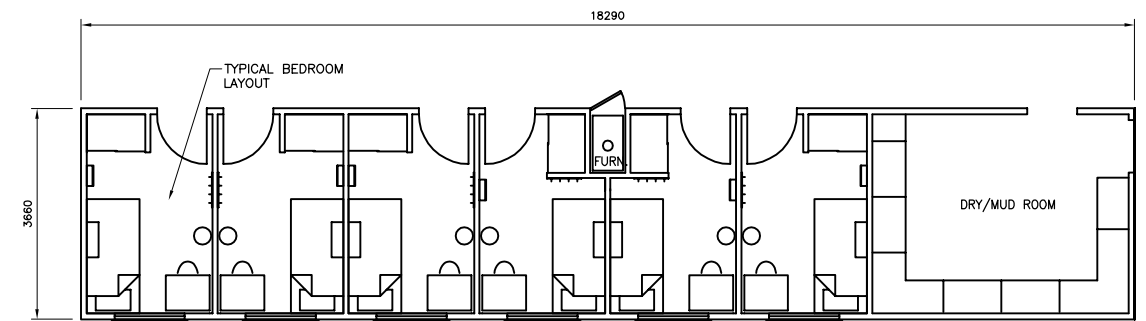
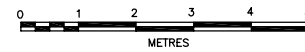
UNIT B - 2 PERSON SLEEPER/WASHROOM



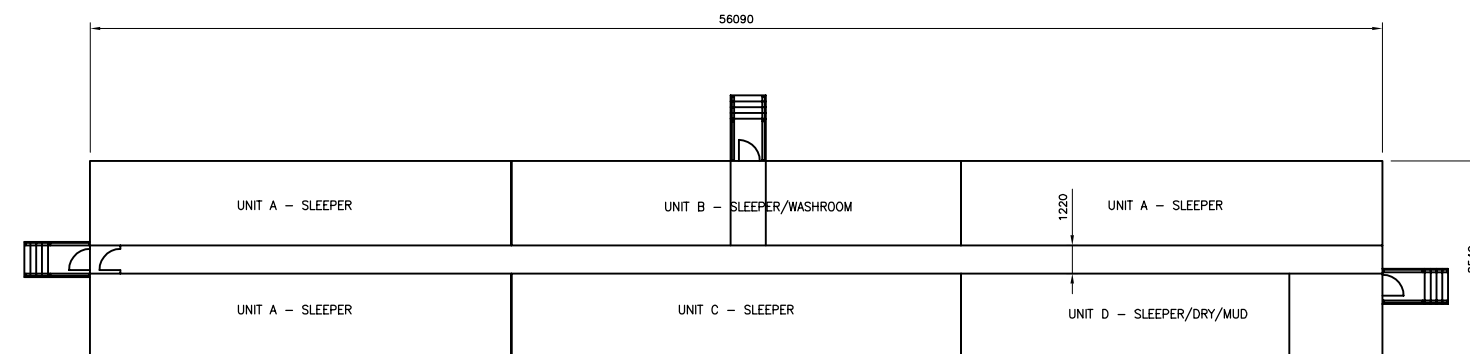
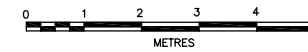
UNIT A - 8 PERSON SLEEPER



UNIT C - 8 PERSON SLEEPER



UNIT D - 6 PERSON SLEEPER/DRY/MUD



KEY PLAN
 TYPICAL 40 PERSON PER FLOOR COMPLEX (2 Floors = 80 PERSONS)
 (NOT TO SCALE)

ELECT.	SCALE:	AS NOTED
CIVIL	DESIGNED:	G.L./T.M.
TRANS.	DRAWN:	G.L./P.W.
MECH.	DATE:	08/02/08
P&C	CHECKED:	T.M.
TELC.	APPROVED:	B.C.

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HYDRO NEWFOUNDLAND AND LABRADOR HYDRO

LOWER CHURCHILL PROJECT - GULL ISLAND
 TRADES ACCOMMODATIONS COMPLEX
 DORMITORY TYPE 2

DWG. NO.	TITLE	NO.	DATE	DESCRIPTION	DWN.	DESIGN.	CHK.	APP'D
	REFERENCE DRAWINGS			REVISIONS				

W.O. NO.	DWG. NO. 722850-AC1060-43DD-0007	REV. 0
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Appendix B

Test Pit Logs & Gradation Analysis



Test Pit: AC1060 - 1					
Firm:	Newfoundland and Labrador Hydro			Date: 11-Sep-07	
Project:	Lower Churchill Project – 230 kV Transmission Line – Muskrat Falls to Gull Island				
Contract No.	AC1060	Location:	N 5902284	E 0641626	Inspector: Dave Oldford



Soil and Groundwater Conditions

Depth (m) From - To	Description	Sample ID.	Sample Depth (m)	Sample Type
0.0 – 4.0	Gravely SAND with some fines, some cobbles, damp, light grey, angular, compact.	1	2.0 – 4.0	Grab
4.0	Bedrock.	NA	NA	NA
Estimated Cobbles (%) 15		Estimated Boulders (%) 5 - 10		Estimated Max Diameter (m) 1.0
Start Time: 10:05 am		End Time: 10:30 am		Estimated Excavated Volume (m ³) 20

General Notes

Pit was vertical.
End of test pit at 4.0 m (Refusal) - probable bedrock from visual observation.
North and East coordinates obtained using Garmin Etrex legend Cx GPS.

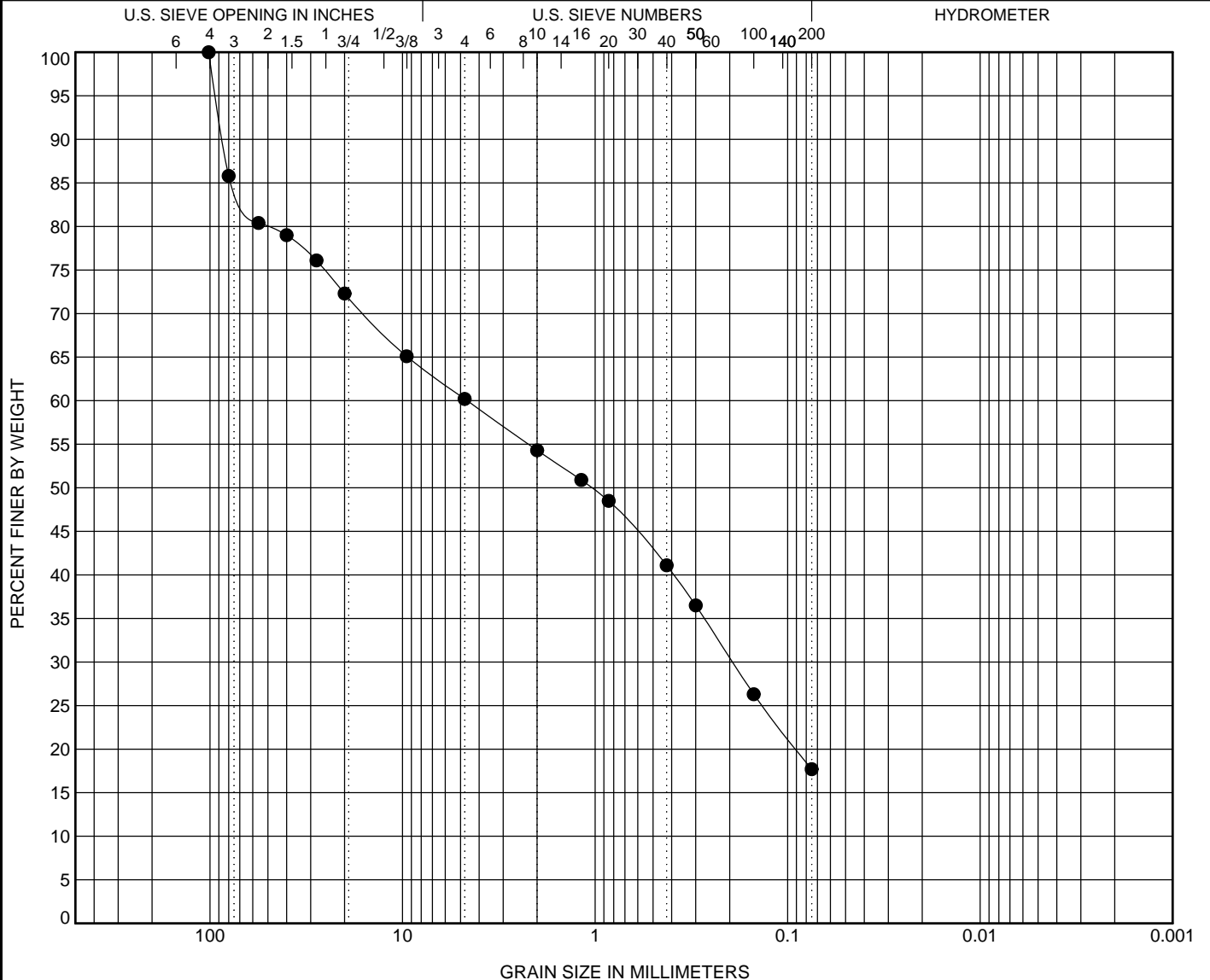


TEST PIT AC 1060-001

GRAIN SIZE DISTRIBUTION

CLIENT: Newfoundland and Labrador Hydro
 PROJECT: Lower Churchill Project

SITE: 230 kV Transmission Line - Muskrat Falls to Gull Island
 LOCATION: Transmission Line



COBBLES	GRAVEL		SAND			CLAY OR SILT
	coarse	fine	coarse	medium	fine	

Test pit no.	Sample	Depth (m)	% Gravel		% Sand			% Silt		% Clay			
● AC 1060-001	GB-1	2.00 - 4.00	24.6		42.5			17.7					
▲													
★													
◎													
80 mm	56 mm	40 mm	28 mm	20 mm	9.525 mm	4.76 mm	2 mm	0.85 mm	0.425 mm	0.3 mm	0.15 mm	0.075 mm	
● 85.8	80.4	79.0	76.1	72.3	65.1	60.2	54.3	48.5	41.1	36.5	26.3	17.7	
▲													
★													
◎													
Test pit no.	ASTM Classification				D60	D30	D10	W	LL	PL	PI	Cc	Cu
● AC 1060-001	Gravelly SAND with some Fines & Cobbles				4.6	0.2		6.7					
▲													
★													
◎													

GRAIN SIZE 2 - TEST PIT 1 TRANSMISSION LINE DATABASE AC1060_2007.GPJ GINT STD CANADA.GDT 08-1-24



Test Pit: AC1060 - 2				
Firm:	Newfoundland and Labrador Hydro			Date: 11-Sep-07
Project:	Lower Churchill Project – 230 kV Transmission Line – Muskrat Falls to Gull Island			
Contract No.	AC1060	Location:	N 5892290	E 0630859
		Inspector: Dave Oldford		



Soil and Groundwater Conditions

Depth (m) From - To	Description	Sample ID.	Sample Depth (m)	Sample Type
0.0 - 0.5	Roots and organics, previously grubbed area, brown.	NA	NA	NA
0.5 - 6.0	SILT (ML) - firm to stiff, wet, low plastic, very moist, greenish olive.	1	1.0 - 6.0	Grab
Estimated Cobbles (%) 0	Estimated Boulders (%) 0	Estimated Max Diameter (m) NA		
Start Time: 11:30 am	End Time: 12:00 pm	Estimated Excavated Volume (m ³)		40

General Notes

Test pit was dry upon completion.
Pit was vertical.
North and East coordinates obtained using Garmin Etrex Legend Cx GPS.



SNC • LAVALIN

TEST PIT AC 1060-002

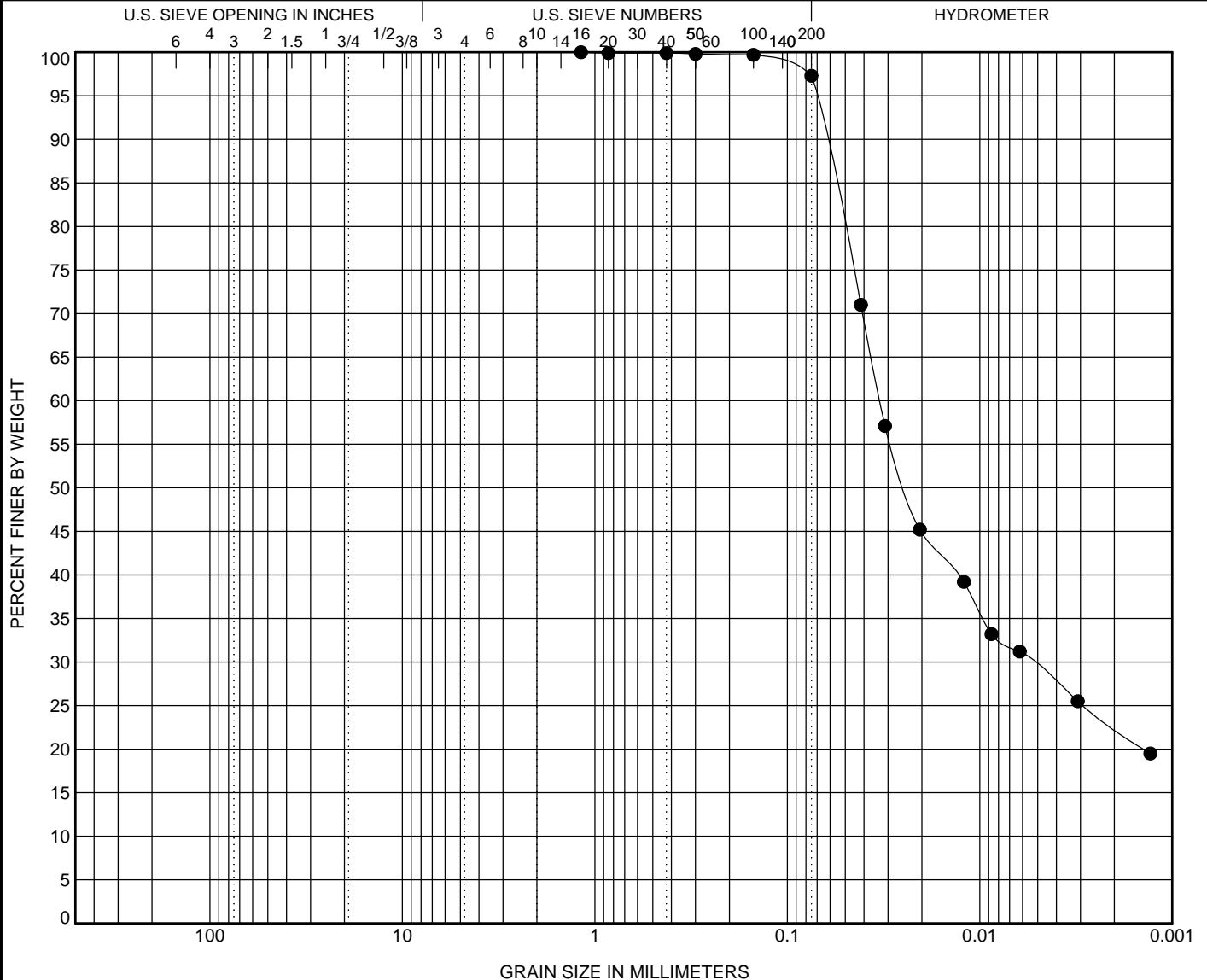
GRAIN SIZE DISTRIBUTION

CLIENT: Newfoundland and Labrador Hydro

SITE: 230 kV Transmission Line - Muskrat Falls to Gull Island

PROJECT: Lower Churchill Project

LOCATION: Transmission Line



COBBLES	GRAVEL		SAND			CLAY OR SILT
	coarse	fine	coarse	medium	fine	

Test pit no.	Sample	Depth (m)	% Gravel	% Sand	% Silt	% Clay																										
● AC 1060-002	GB-1	1.00 - 6.00	0.0	2.7	74.8	22.5																										
<table border="1"> <thead> <tr> <th>80 mm</th> <th>56 mm</th> <th>40 mm</th> <th>28 mm</th> <th>20 mm</th> <th>9.525 mm</th> <th>4.76 mm</th> <th>2 mm</th> <th>0.85 mm</th> <th>0.425 mm</th> <th>0.3 mm</th> <th>0.15 mm</th> <th>0.075 mm</th> </tr> </thead> <tbody> <tr> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>99.9</td> <td>99.9</td> <td>99.8</td> <td>99.7</td> <td>97.3</td> </tr> </tbody> </table>							80 mm	56 mm	40 mm	28 mm	20 mm	9.525 mm	4.76 mm	2 mm	0.85 mm	0.425 mm	0.3 mm	0.15 mm	0.075 mm									99.9	99.9	99.8	99.7	97.3
80 mm	56 mm	40 mm	28 mm	20 mm	9.525 mm	4.76 mm	2 mm	0.85 mm	0.425 mm	0.3 mm	0.15 mm	0.075 mm																				
								99.9	99.9	99.8	99.7	97.3																				
Test pit no.	ASTM Classification				D60	D30	D10	W	LL	PL	PI	Cc	Cu																			
● AC 1060-002	SILT(ML)				0	0		27.8	23	22	1																					

GRAIN SIZE 2 - TEST PIT TRANSMISSION LINE_DATABASE_AC1060_2007.GPJ_GINT STD CANADA.GDT 08-1-28



Test Pit: AC1060 - 3				
Firm:	Newfoundland and Labrador Hydro			Date: 11-Sep-07
Project:	Lower Churchill Project – 230 kV Transmission Line – Muskrat Falls to Gull Island			
Contract No.	AC1060	Location:	N 5887978	E 0625794
		Inspector: Dave Oldford		



Soil and Groundwater Conditions				
Depth (m) From - To	Description	Sample ID.	Sample Depth (m)	Sample Type
0.0 – 0.5	Weathered SAND – some fines, some gravel, loose to compact, poorly graded, orange to light brown, oxidized.	NA	NA	NA
0.5 - 1.0	SAND and GRAVEL - some cobbles, some fines, trace boulders, subangular, light brown, well graded, moist, compact.	NA	NA	NA
1.0 - 3.0	Silty SAND with some gravel, trace cobbles, trace boulders, subangular, light grey, moist, compact.	1	2.0 m	Grab
Estimated Cobbles (%) 10 - 15	Estimated Boulders (%) 1 - 5	Estimated Max Diameter (m) 1.5		
Start Time: 12:50 pm	End Time: 1:25 pm	Estimated Excavated Volume (m ³)		18

General Notes

Very little sloughing. Test pit was dry upon completion.

End of test pit at 3.0 m (REFUSAL) - probable boulders from excavator response.

North and East coordinates obtained using Garmin Etrex Legend Cx GPS.

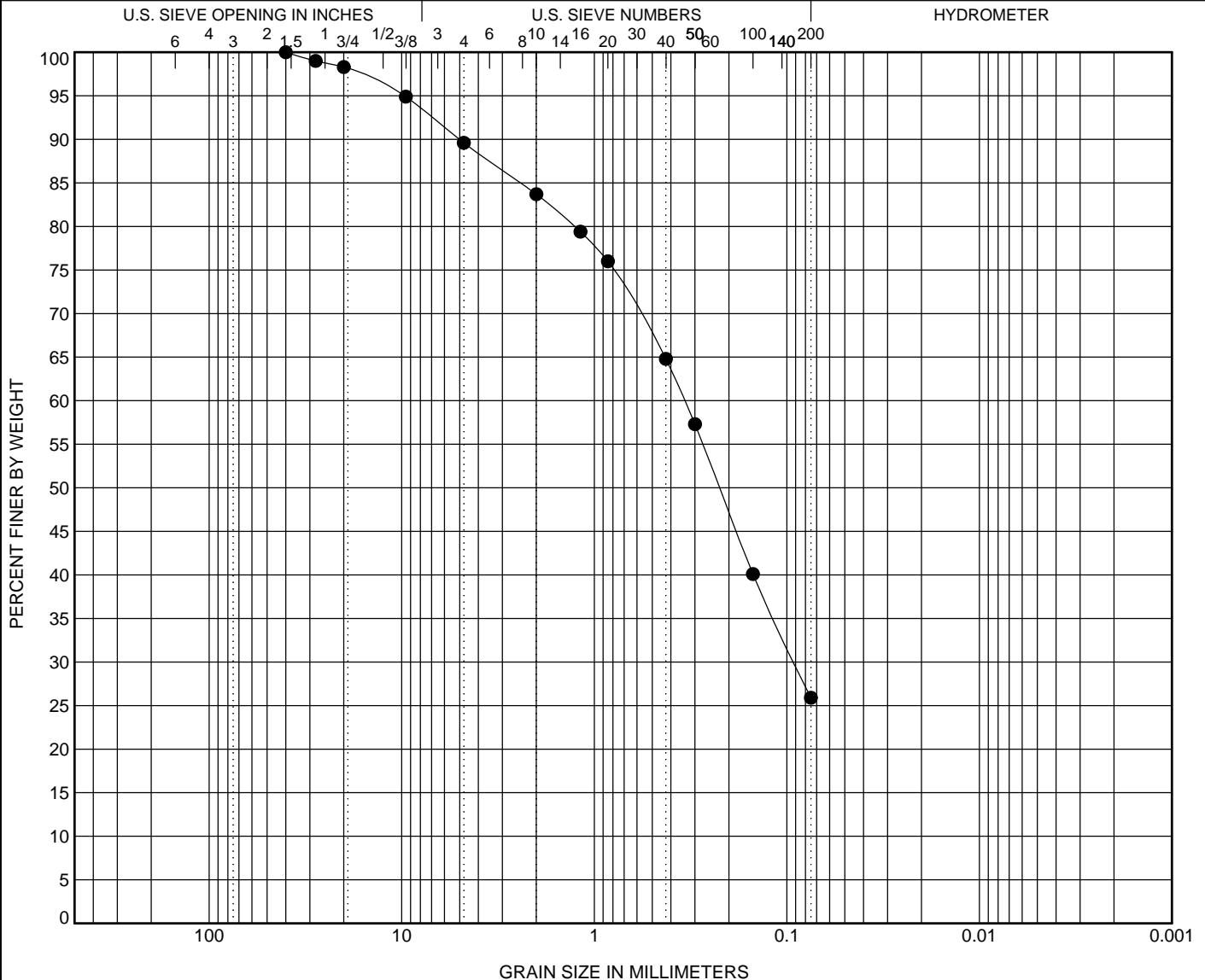


TEST PIT AC 1060-003

GRAIN SIZE DISTRIBUTION

CLIENT: Newfoundland and Labrador Hydro
 PROJECT: Lower Churchill Project

SITE: 230 kV Transmission Line - Muskrat Falls to Gull Island
 LOCATION: Transmission Line



COBBLES	GRAVEL		SAND			CLAY OR SILT
	coarse	fine	coarse	medium	fine	

Test pit no.	Sample	Depth (m)	% Gravel			% Sand			% Silt		% Clay			
● AC 1060-003	GB-1	2.00 - 2.50	10.4			63.7			25.9					
☒														
▲														
★														
◎														
80 mm	56 mm	40 mm	28 mm	20 mm	9.525 mm	4.76 mm	2 mm	0.85 mm	0.425 mm	0.3 mm	0.15 mm	0.075 mm		
●		100.0	99.0	98.3	94.9	89.6	83.7	76.0	64.8	57.3	40.1	25.9		
☒														
▲														
★														
◎														
Test pit no.	ASTM Classification					D60	D30	D10	W	LL	PL	PI	Cc	Cu
● AC 1060-003	Silty SAND with some Gravel					0.3	0.1		8.4					
☒														
▲														
★														
◎														

GRAIN SIZE 2 - TEST PIT 1 TRANSMISSION LINE DATABASE AC1060_2007.GPJ GINT STD CANADA.GDT 08-1-24



Test Pit: AC1060 - 4				
Firm:	Newfoundland and Labrador Hydro			Date: 11-Sep-07
Project:	Lower Churchill Project – 230 kV Transmission Line – Muskrat Falls to Gull Island			
Contract No.	AC1060	Location:	N 5887199	E 0624950
		Inspector: Dave Oldford		



Soil and Groundwater Conditions

Depth (m) From - To	Description	Sample ID.	Sample Depth (m)	Sample Type
0.0 - 0.1	PEAT - dark brown, organic soil, rootlets, moist, loose.	NA	NA	NA
0.1 - 0.5	Topsoil - brown with organics/tree roots and branches.	NA	NA	NA
0.5 - 4.0	SAND with some fines, trace gravel - light grey, moist, compact, water slowly seeping (trickle) into test pit at 4.0 m.	1	1.0 - 4.0	Grab
4.0 – 4.5	Marine SAND with tree stumps and wood debris.	NA	NA	NA
Estimated Cobbles (%) 0	Estimated Boulders (%) 0	Estimated Max Diameter (m) NA		
Start Time: 2:30 pm	End Time: 3:35 pm	Estimated Excavated Volume (m ³)	30	

General Notes

Moderate sloughing at 2.0 m.
 Tree stump present at bottom of test pit. Test Pit was excavated next to Upper Brook.
 North and East coordinates obtained using Garmin Etrex Legend Cx GPS.

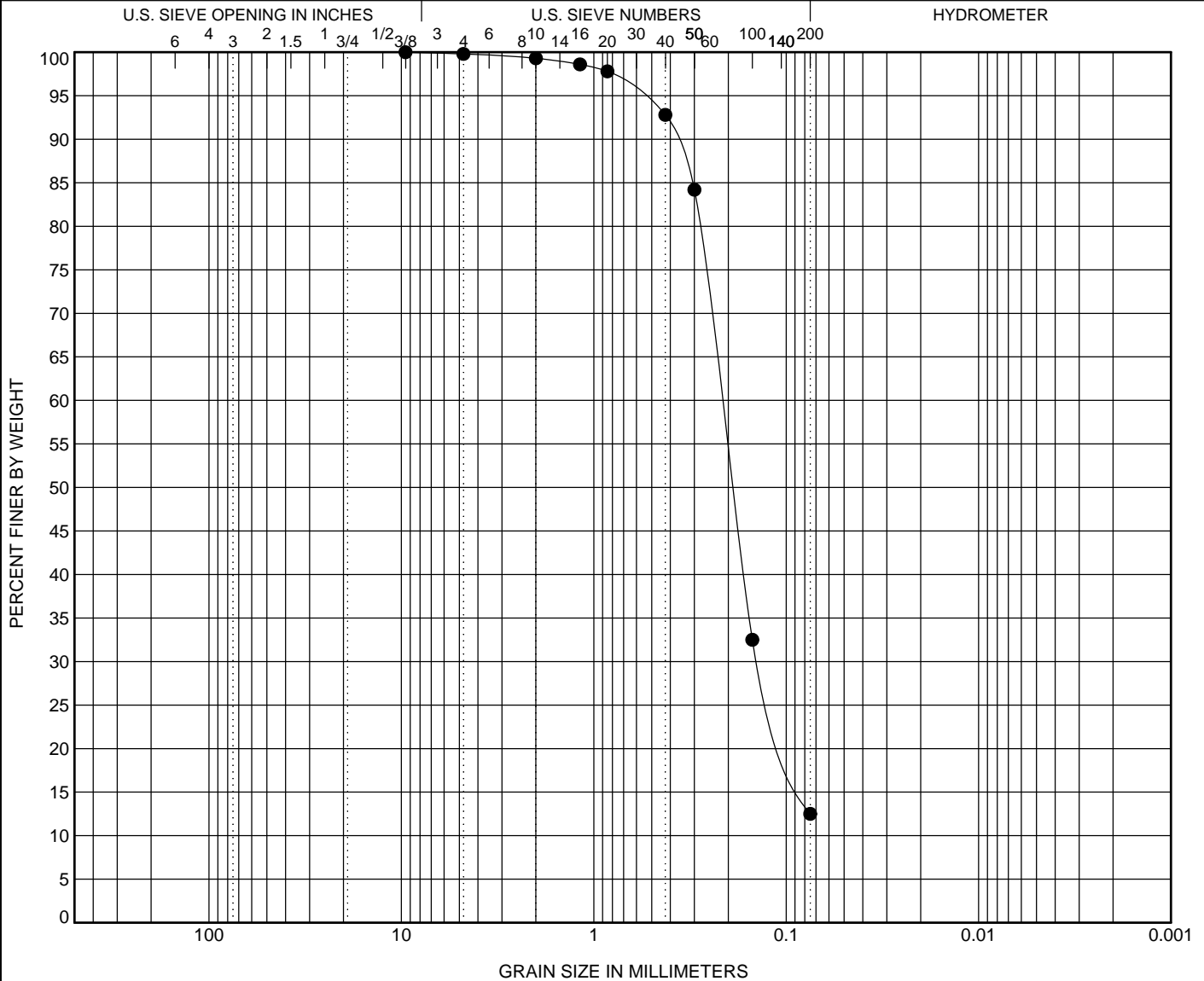


TEST PIT AC 1060-004

GRAIN SIZE DISTRIBUTION

CLIENT: Newfoundland and Labrador Hydro
 PROJECT: Lower Churchill Project

SITE: 230 kV Transmission Line - Muskrat Falls to Gull Island
 LOCATION: Transmission Line



COBBLES	GRAVEL		SAND			CLAY OR SILT
	coarse	fine	coarse	medium	fine	

Test pit no.	Sample	Depth (m)	% Gravel			% Sand			% Silt		% Clay		
● AC 1060-004	GB-1	1.00 - 4.00	0.2			87.3			12.5				
☒													
▲													
★													
◎													
80 mm	56 mm	40 mm	28 mm	20 mm	9.525 mm	4.76 mm	2 mm	0.85 mm	0.425 mm	0.3 mm	0.15 mm	0.075 mm	
●					100.0	99.8	99.3	97.8	92.8	84.2	32.5	12.5	
☒													
▲													
★													
◎													
Test pit no.	ASTM Classification				D60	D30	D10	W	LL	PL	PI	Cc	Cu
● AC 1060-004	SAND with some Fines, trace Gravel				0.2	0.1		23.6					
☒													
▲													
★													
◎													

GRAIN SIZE 2 - TEST PIT 1 TRANSMISSION LINE DATABASE AC1060_2007.GPJ GINT STD CANADA.GDT 08-1-24



Test Pit: AC1060 - 5				
Firm:	Newfoundland and Labrador Hydro			Date: 11-Sep-07
Project:	Lower Churchill Project – 230 kV Transmission Line – Muskrat Falls to Gull Island			
Contract No.	AC1060	Location:	N 5872412	E 0609404
		Inspector: Dave Oldford		



Soil and Groundwater Conditions

Depth (m) From - To	Description	Sample ID.	Sample Depth (m)	Sample Type
0.0 - 2.0	SAND - trace fines, brown, loose, moist, poorly graded.	NA	NA	NA
2.0 - 6.0	SILT (ML) -stiff, moist, grey, water entering at 2.0 m.	1	2.0 - 6.0	Grab
Estimated Cobbles (%) 0	Estimated Boulders (%) 0	Estimated Max Diameter (m) NA		
Start Time: 4:15 pm	End Time: 4:40 pm	Estimated Excavated Volume (m ³)		35

General Notes

Severe sloughing in first 2.0 m of test pit.
 North and East coordinates obtained using Garmin Etrex Legend Cx GPS.



SNC-LAVALIN

TEST PIT AC 1060-005

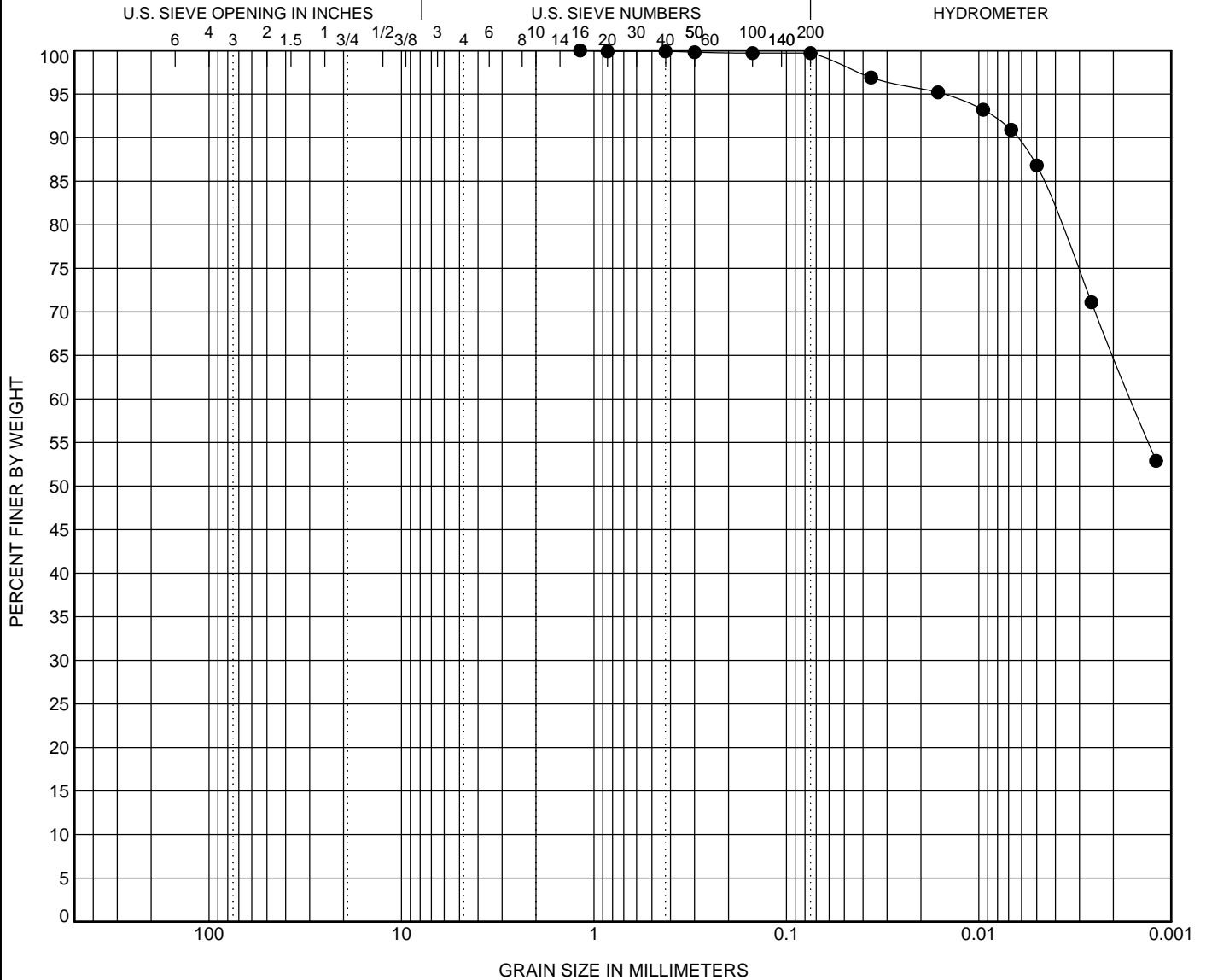
GRAIN SIZE DISTRIBUTION

CLIENT: Newfoundland and Labrador Hydro

SITE: 230 kV Transmission Line - Muskrat Falls to Gull Island

PROJECT: Lower Churchill Project

LOCATION: Transmission Line



COBBLES	GRAVEL		SAND			CLAY OR SILT
	coarse	fine	coarse	medium	fine	

Test pit no.	Sample	Depth (m)	% Gravel			% Sand			% Silt		% Clay																											
AC 1060-005	GB-1	2.00 - 6.00	0.0			0.3			34.8		64.9																											
<table border="1"> <thead> <tr> <th>80 mm</th> <th>56 mm</th> <th>40 mm</th> <th>28 mm</th> <th>20 mm</th> <th>9.525 mm</th> <th>4.76 mm</th> <th>2 mm</th> <th>0.85 mm</th> <th>0.425 mm</th> <th>0.3 mm</th> <th>0.15 mm</th> <th>0.075 mm</th> </tr> </thead> <tbody> <tr> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>99.9</td> <td>99.9</td> <td>99.8</td> <td>99.7</td> <td>99.7</td> </tr> </tbody> </table>													80 mm	56 mm	40 mm	28 mm	20 mm	9.525 mm	4.76 mm	2 mm	0.85 mm	0.425 mm	0.3 mm	0.15 mm	0.075 mm									99.9	99.9	99.8	99.7	99.7
80 mm	56 mm	40 mm	28 mm	20 mm	9.525 mm	4.76 mm	2 mm	0.85 mm	0.425 mm	0.3 mm	0.15 mm	0.075 mm																										
								99.9	99.9	99.8	99.7	99.7																										
Test pit no.	ASTM Classification					D60	D30	D10	W	LL	PL	PI	Cc	Cu																								
AC 1060-005	SILT(ML)					0			49.5	49	35	14																										

GRAIN SIZE 2 - TEST PIT 1 TRANSMISSION LINE DATABASE AC1060_2007.GPJ GINT STD CANADA.GDT 08-1-24



Test Pit: AC1060 - 6				
Firm:	Newfoundland and Labrador Hydro			Date: 12-Sep-07
Project:	Lower Churchill Project – 230 kV Transmission Line – Muskrat Falls to Gull Island			
Contract No.	AC1060	Location:	N 5882293	E 0620950
		Inspector: Dave Oldford		



Soil and Groundwater Conditions

Depth (m) From - To	Description	Sample ID.	Sample Depth (m)	Sample Type
0.0 - 0.1	PEAT, dark brown, moist, fibrous, frequent rootlets	NA	NA	NA
0.1 - 0.5	Weathered SAND, moist, frequent roots, slightly oxidized, orange to light brown.	NA	NA	NA
0.5 - 4.5	Cobbly SAND with some fines, trace gravel, trace boulders, subangular, damp, compact, grey.	1	0.5 - 4.5	Grab
Estimated Cobbles (%) 20	Estimated Boulders (%) 1 - 10	Estimated Max Diameter (m) 0.6		
Start Time: 9:37 am	End Time: 10:00 am	Estimated Excavated Volume (m ³)		20

General Notes

No sloughing. Test pit was dry upon completion.
 North and East coordinates obtained using Garmin Etrex Legend Cx GPS.

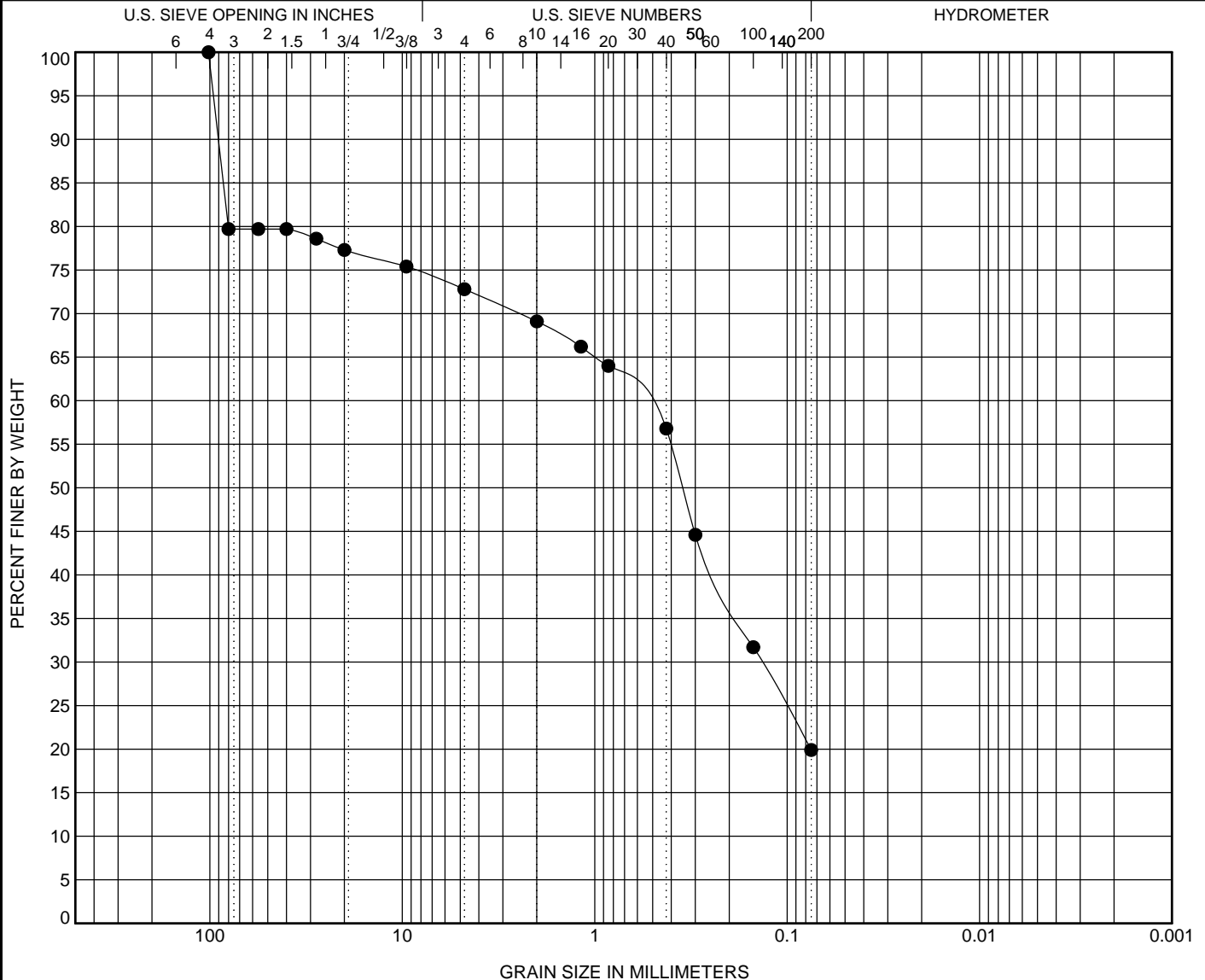


TEST PIT AC 1060-006

GRAIN SIZE DISTRIBUTION

CLIENT: Newfoundland and Labrador Hydro
 PROJECT: Lower Churchill Project

SITE: 230 kV Transmission Line - Muskrat Falls to Gull Island
 LOCATION: Transmission Line



COBBLES	GRAVEL		SAND			CLAY OR SILT
	coarse	fine	coarse	medium	fine	

Test pit no.	Sample	Depth (m)	% Gravel		% Sand			% Silt		% Clay			
● AC 1060-006	GB-1	0.50 - 4.50	6.9		52.9			19.9					
▲													
★													
◎													
80 mm	56 mm	40 mm	28 mm	20 mm	9.525 mm	4.76 mm	2 mm	0.85 mm	0.425 mm	0.3 mm	0.15 mm	0.075 mm	
● 79.7	79.7	79.7	78.6	77.3	75.4	72.8	69.1	64.0	56.8	44.6	31.7	19.9	
▲													
★													
◎													
Test pit no.	ASTM Classification				D60	D30	D10	W	LL	PL	PI	Cc	Cu
● AC 1060-006	SAND with some Fines, trace Gravel				0.6	0.1		9.3					
▲													
★													
◎													

GRAIN SIZE 2 - TEST PIT 1 TRANSMISSION LINE DATABASE AC1060_2007.GPJ GINT STD CANADA.GDT 08-1-24



Test Pit: AC1060 - 7				
Firm:	Newfoundland and Labrador Hydro			Date: 12-Sep-07
Project:	Lower Churchill Project – 230 kV Transmission Line – Muskrat Falls to Gull Island			
Contract No.	AC1060	Location:	N 5882001	E 0620589
		Inspector: Dave Oldford		



Soil and Groundwater Conditions

Depth (m) From - To	Description	Sample ID.	Sample Depth (m)	Sample Type
0.0 - 0.02	PEAT, dark brown, moist, fibrous, frequent rootlets.	NA	NA	NA
0.02 - 0.3	COBBLES - with rootlets and organic soil, some sand, some fines, some gravel, moist, loose to compact, brown.	NA	NA	NA
0.3 - 3.5	Cobbly SAND and GRAVEL with some boulders, trace fines, subangular, moist, compact, light brown.	1	2.0 – 4.0	Grab
3.5 - 4.0	SAND COBBLES and BOULDERS - subangular.	NA	NA	NA
Estimated Cobbles (%) 20		Estimated Boulders (%) 15		Estimated Max Diameter (m) 1.5
Start Time: 10:15 am		End Time: 10:45 am		Estimated Excavated Volume (m ³) 20

General Notes

End of test pit at 4.0 m (REFUSAL) - probable bedrock from excavator response.
 Moderate sloughing when boulders were moved out of hole. Test Pit was dry upon completion.
 North and East coordinates obtained using Garmin Etrex Legend Cx GPS.

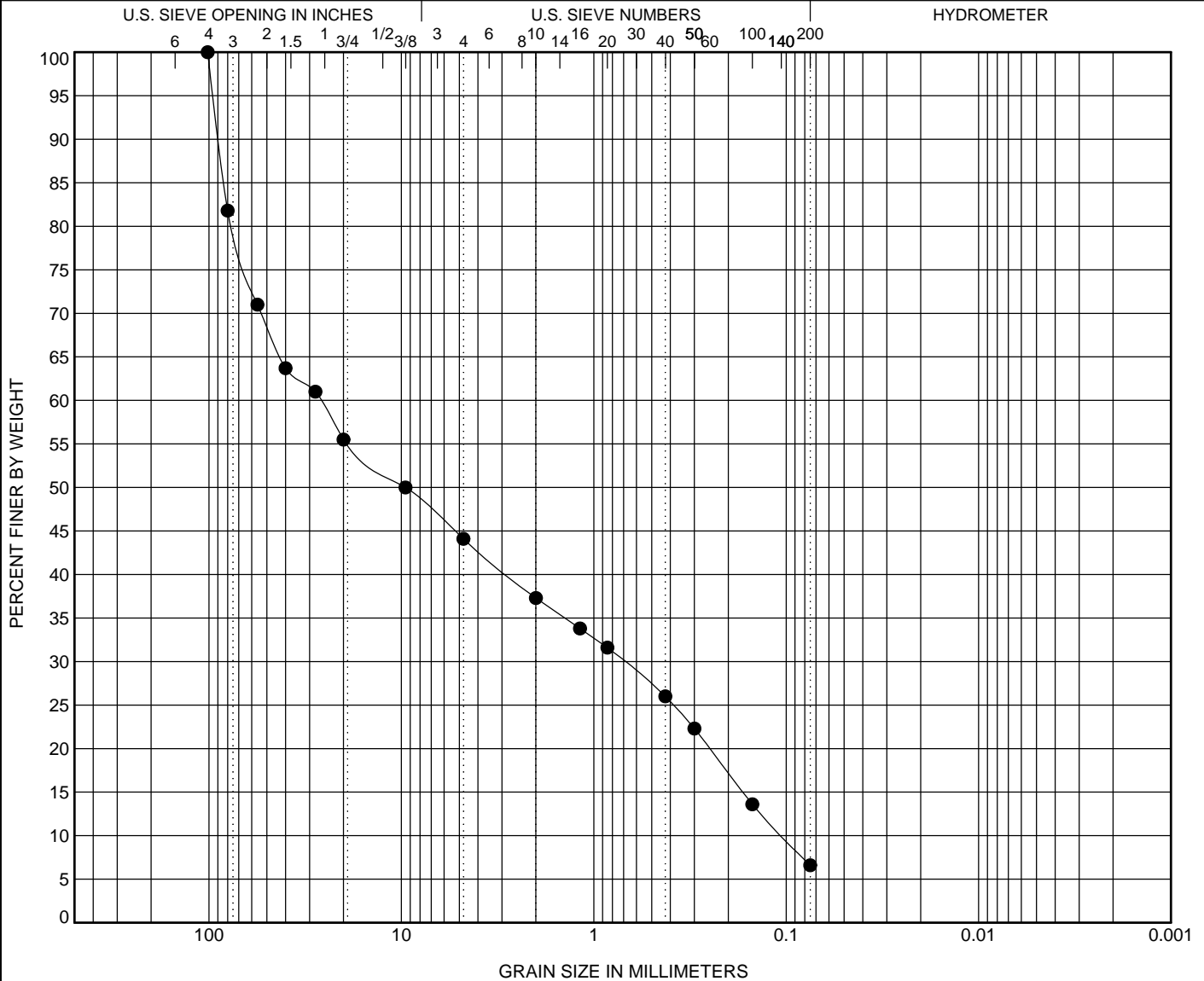


TEST PIT AC 1060-007

GRAIN SIZE DISTRIBUTION

CLIENT: Newfoundland and Labrador Hydro
 PROJECT: Lower Churchill Project

SITE: 230 kV Transmission Line - Muskrat Falls to Gull Island
 LOCATION: Transmission Line



COBBLES	GRAVEL		SAND			CLAY OR SILT
	coarse	fine	coarse	medium	fine	

Test pit no.	Sample	Depth (m)	% Gravel		% Sand			% Silt		% Clay			
● AC 1060-007	GB-1	3.80 - 4.00	35.8		37.5			6.6					
▲													
★													
◎													
80 mm	56 mm	40 mm	28 mm	20 mm	9.525 mm	4.76 mm	2 mm	0.85 mm	0.425 mm	0.3 mm	0.15 mm	0.075 mm	
● 81.8	71.0	63.7	61.0	55.5	50.0	44.1	37.3	31.6	26.0	22.3	13.6	6.6	
▲													
★													
◎													
Test pit no.	ASTM Classification				D60	D30	D10	W	LL	PL	PI	Cc	Cu
● AC 1060-007	SAND & GRAVEL with some Cobbles, tr. Fines				26.3	0.7	0.1	10.4				0.2	250.8
▲													
★													
◎													

GRAIN SIZE 2 - TEST PIT 1 TRANSMISSION LINE DATABASE AC1060_2007.GPJ GINT STD CANADA.GDT 08-1-24



Test Pit: AC1060 - 8				
Firm:	Newfoundland and Labrador Hydro			Date: 12-Sep-07
Project:	Lower Churchill Project – 230 kV Transmission Line – Muskrat Falls to Gull Island			
Contract No.	AC1060	Location:	N 5881778	E 0620343
		Inspector: Dave Oldford		



Soil and Groundwater Conditions

Depth (m) From - To	Description	Sample ID.	Sample Depth (m)	Sample Type
0.0 - 0.1	PEAT, dark brown, moist, fibrous, frequent rootlets.	NA	NA	NA
0.1 - 0.8	SAND - trace fines, trace gravel, trace cobbles, trace boulders, moist, loose to compact, well graded, light brown.	NA	NA	NA
0.8 - 4.5	Cobbly, gravelly, SAND with some fines, some boulders, subangular, compact, moist, light grey.	1	0.5 - 4.0	Grab
Estimated Cobbles (%) 20		Estimated Boulders (%) 10		Estimated Max Diameter (m) 1.0
Start Time: 10:50 am		End Time: 11:20 am		Estimated Excavated Volume (m ³) 20

General Notes

End of test pit at 4.5 m (REFUSAL) - probable bedrock from excavator response.
Minor sloughing within first meter of test pit. Test pit was dry upon completion.
North and East coordinates obtained using Garmin Etrex Legend Cx GPS.



SNC-LAVALIN

TEST PIT AC 1060-008

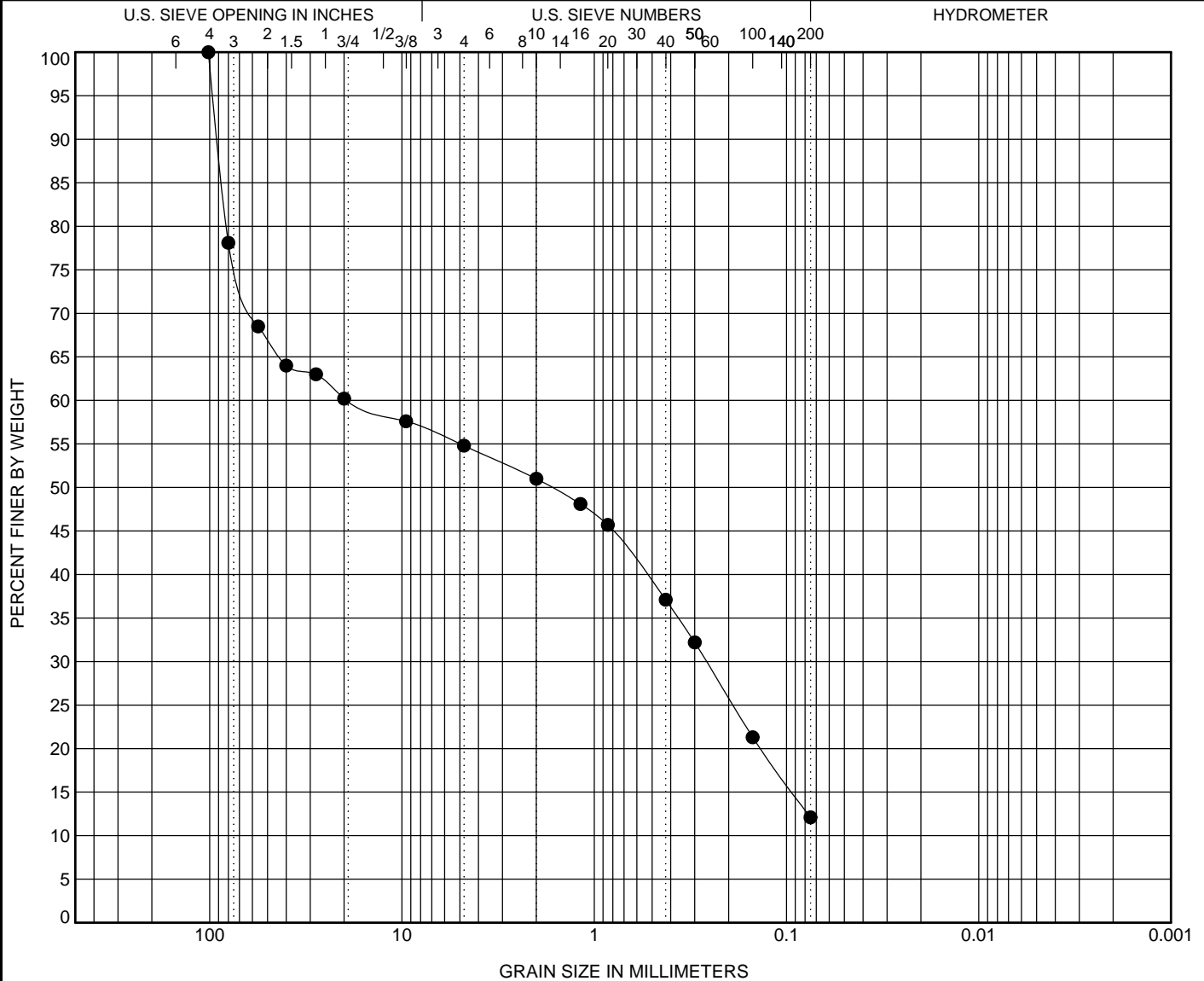
GRAIN SIZE DISTRIBUTION

CLIENT: Newfoundland and Labrador Hydro

SITE: 230 kV Transmission Line - Muskrat Falls to Gull Island

PROJECT: Lower Churchill Project

LOCATION: Transmission Line



COBBLES	GRAVEL		SAND			CLAY OR SILT
	coarse	fine	coarse	medium	fine	

Test pit no.	Sample	Depth (m)	% Gravel	% Sand	% Silt	% Clay
● AC 1060-008	GB-1	0.50 - 4.00	21.6	42.7	12.1	

80 mm	56 mm	40 mm	28 mm	20 mm	9.525 mm	4.76 mm	2 mm	0.85 mm	0.425 mm	0.3 mm	0.15 mm	0.075 mm
● 78.1	68.5	64.0	63.0	60.2	57.6	54.8	51.0	45.7	37.1	32.2	21.3	12.1

Test pit no.	ASTM Classification	D60	D30	D10	W	LL	PL	PI	Cc	Cu
● AC 1060-008	Cobbly, Gravelly, SAND with some Fines	18.9	0.3		6.9				0.1	295.1

GRAIN SIZE 2 - TEST PIT 1 TRANSMISSION LINE DATABASE AC1060_2007.GPJ GINT STD CANADA.GDT 08-1-24



Test Pit: AC1060 - 9				
Firm:	Newfoundland and Labrador Hydro			Date: 12-Sep-07
Project:	Lower Churchill Project – 230 kV Transmission Line – Muskrat Falls to Gull Island			
Contract No.	AC1060	Location:	N 5881490	E 0619994
		Inspector: Dave Oldford		



Soil and Groundwater Conditions

Depth (m) From - To	Description	Sample ID.	Sample Depth (m)	Sample Type
0.0 - 0.2	PEAT - black, moist, fibrous, frequent rootlets.	NA	NA	NA
0.2 - 1.5	SAND AND GRAVEL - trace fines, trace cobbles, trace boulders, subangular, moist, compact, light brown.	NA	NA	NA
1.5 - 5.0	Gravelly SAND with some fines, some cobbles, some boulders, subangular, moist, compact, light grey.	1	1.5 – 5.0	Grab
Estimated Cobbles (%) 15		Estimated Boulders (%) 10		Estimated Max Diameter (m) 0.8
Start Time: 11:30 am		End Time: 12:00 pm		Estimated Excavated Volume (m ³) 20

General Notes

End of test pit at 5.0 m (REFUSAL) - probable bedrock from excavator response.
 Slight sloughing above 2 m. Test pit was dry upon completion.
 North and East coordinates obtained using Garmin Etrex Legend Cx GPS.

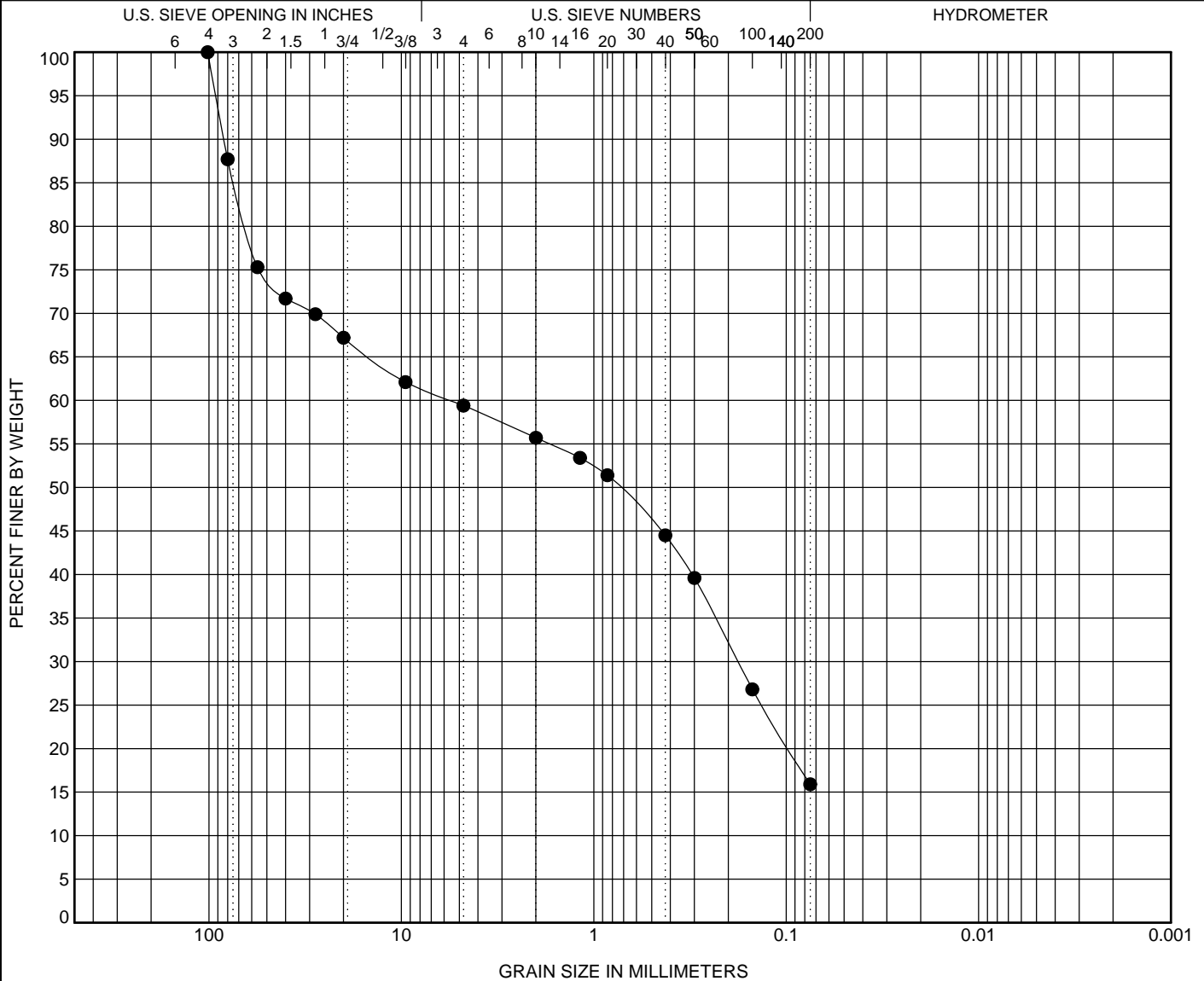


TEST PIT AC 1060-009

GRAIN SIZE DISTRIBUTION

CLIENT: Newfoundland and Labrador Hydro
 PROJECT: Lower Churchill Project

SITE: 230 kV Transmission Line - Muskrat Falls to Gull Island
 LOCATION: Transmission Line



COBBLES	GRAVEL		SAND			CLAY OR SILT
	coarse	fine	coarse	medium	fine	

Test pit no.	Sample	Depth (m)	% Gravel		% Sand			% Silt		% Clay			
● AC 1060-009	GB-1	1.50 - 5.00	26.1		43.5			15.9					
▲													
★													
◎													
80 mm	56 mm	40 mm	28 mm	20 mm	9.525 mm	4.76 mm	2 mm	0.85 mm	0.425 mm	0.3 mm	0.15 mm	0.075 mm	
● 87.7	75.3	71.7	69.9	67.2	62.1	59.4	55.7	51.4	44.5	39.6	26.8	15.9	
▲													
★													
◎													
Test pit no.	ASTM Classification				D60	D30	D10	W	LL	PL	PI	Cc	Cu
● AC 1060-009	Gravelly SAND with some Fines & Cobbles				5.6	0.2		6.5					
▲													
★													
◎													

GRAIN SIZE 2 - TEST PIT 1 TRANSMISSION LINE DATABASE AC1060_2007.GPJ GINT STD CANADA.GDT 08-1-24



Test Pit: AC1060 - 10				
Firm:	Newfoundland and Labrador Hydro			Date: 12-Sep-07
Project:	Lower Churchill Project – 230 kV Transmission Line – Muskrat Falls to Gull Island			
Contract No.	AC1060	Location:	N 5881242	E 0619694
		Inspector: Dave Oldford		



Soil and Groundwater Conditions				
Depth (m) From - To	Description	Sample ID.	Sample Depth (m)	Sample Type
0.0 - 0.1	PEAT - black, moist, fibrous, frequent rootlets.	NA	NA	NA
0.1 - 0.5	Weathered SAND - moist, frequent rootlets, slightly oxidized, orange to light brown.	NA	NA	NA
0.5 - 2.5	SAND - some fines, some gravel, trace cobbles, trace boulders, well graded, subangular, moist, compact, light brown.	NA	NA	NA
2.5 - 5.0	Silty SAND with some gravel, trace cobbles, trace boulders, subangular, moist, compact, grey.	1	2.5 - 5.0	Grab
Estimated Cobbles (%) 5 - 10		Estimated Boulders (%) 2 - 5		Estimated Max Diameter (m) 0.5
Start Time: 12:20 pm		End Time: 12:50 pm		Estimated Excavated Volume (m ³) 30

General Notes

End of test pit at 5.0 m (REFUSAL) - probable bedrock from excavator response.

Moderate sloughing within first meter of test pit.

Water slowly entering test pit at 2.5 meter mark where soil transition occurs between brown and grey.

North and East coordinates obtained using Garmin Etrex Legend Cx GPS.

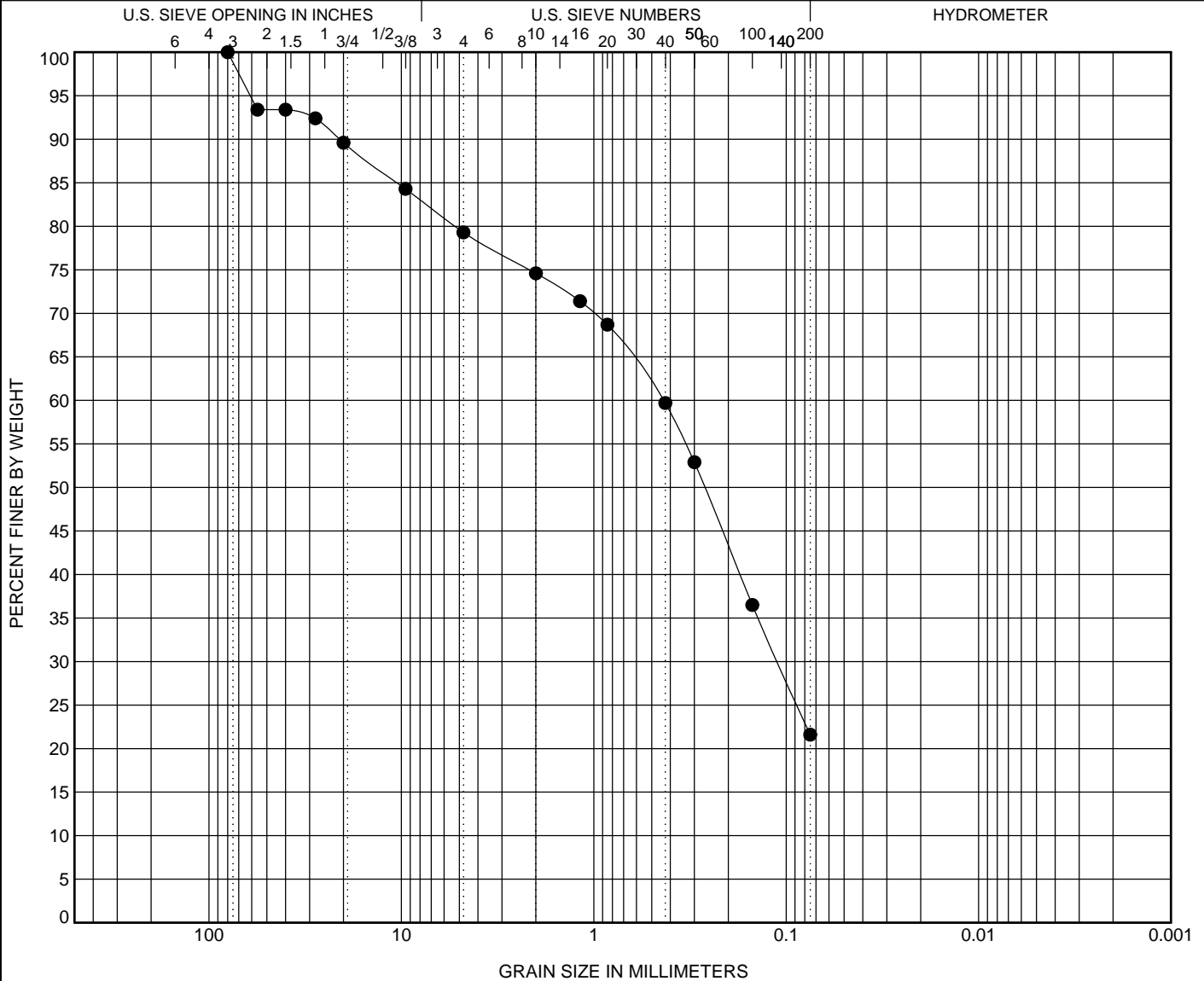


TEST PIT AC 1060-010

GRAIN SIZE DISTRIBUTION

CLIENT: Newfoundland and Labrador Hydro
 PROJECT: Lower Churchill Project

SITE: 230 kV Transmission Line - Muskrat Falls to Gull Island
 LOCATION: Transmission Line



COBBLES	GRAVEL		SAND			CLAY OR SILT
	coarse	fine	coarse	medium	fine	

Test pit no.	Sample	Depth (m)	% Gravel		% Sand			% Silt		% Clay			
● AC 1060-010	GB-1	2.50 - 5.00	19.5		57.7			21.6					
▲													
★													
◎													
80 mm	56 mm	40 mm	28 mm	20 mm	9.525 mm	4.76 mm	2 mm	0.85 mm	0.425 mm	0.3 mm	0.15 mm	0.075 mm	
● 100.0	93.4	93.4	92.4	89.6	84.3	79.3	74.6	68.7	59.7	52.9	36.5	21.6	
▲													
★													
◎													
Test pit no.	ASTM Classification				D60	D30	D10	W	LL	PL	PI	Cc	Cu
● AC 1060-010	Silty SAND with some Gravel, tr. Cobbles				0.4	0.1		9.8					
▲													
★													
◎													

GRAIN SIZE 2 - TEST PIT 1 TRANSMISSION LINE DATABASE AC1060_2007.GPJ GINT STD CANADA.GDT 08-1-24

Test Pit: AC1060 - 11					
Firm:	Newfoundland and Labrador Hydro			Date: 12-Sep-07	
Project:	Lower Churchill Project – 230 kV Transmission Line – Muskrat Falls to Gull Island				
Contract No.	AC1060	Location:	N 5880975	E 0619376	Inspector: Dave Oldford



Soil and Groundwater Conditions

Depth (m) From - To	Description	Sample ID.	Sample Depth (m)	Sample Type
0.0 - 0.03	PEAT - black, moist, fibrous, frequent rootlets.	NA	NA	NA
0.03 - 0.08	Weathered SAND – moist, trace roots, slightly oxidized, trace fines, loose, orange to light brown.	NA	NA	NA
0.08 - 0.3	SAND - moist, compact, poorly graded, trace fines, trace gravel, light grey.	NA	NA	NA
0.3 - 1.5	SAND and GRAVEL with some fines, trace cobbles, very dense, moist, olive grey.	1	0.3 - 1.5	Grab
1.5 - 1.6	SILTY SAND - fine grained cemented, very dense, poorly graded, damp, olive grey, trace cobbles.	2	1.6 - 3.5	Grab
1.6 - 3.5	SAND - trace fines, poorly graded, damp.	NA	NA	NA
3.5 - 4.5	SAND - some cobbles, trace boulders, trace gravel, trace fines, loose to compact.	NA	NA	NA
4.5 - 5.0	Sandy clayey SILT - moist, medium stiff, grey.	3	4.5 - 5.0	Grab
Estimated Cobbles (%) 5 - 10	Estimated Boulders (%) 1 to 5	Estimated Max Diameter (m) 0.5		
Start Time: 1:10 pm	End Time: 2:10 pm	Estimated Excavated Volume (m ³)		30

General Notes

Water entering test pit at a depth of 4.5 m moderate to trickle to steady flow.
Moderate sloughing in first meter of soil.
North and East coordinates obtained using Garmin Etrex Legend Cx GPS.

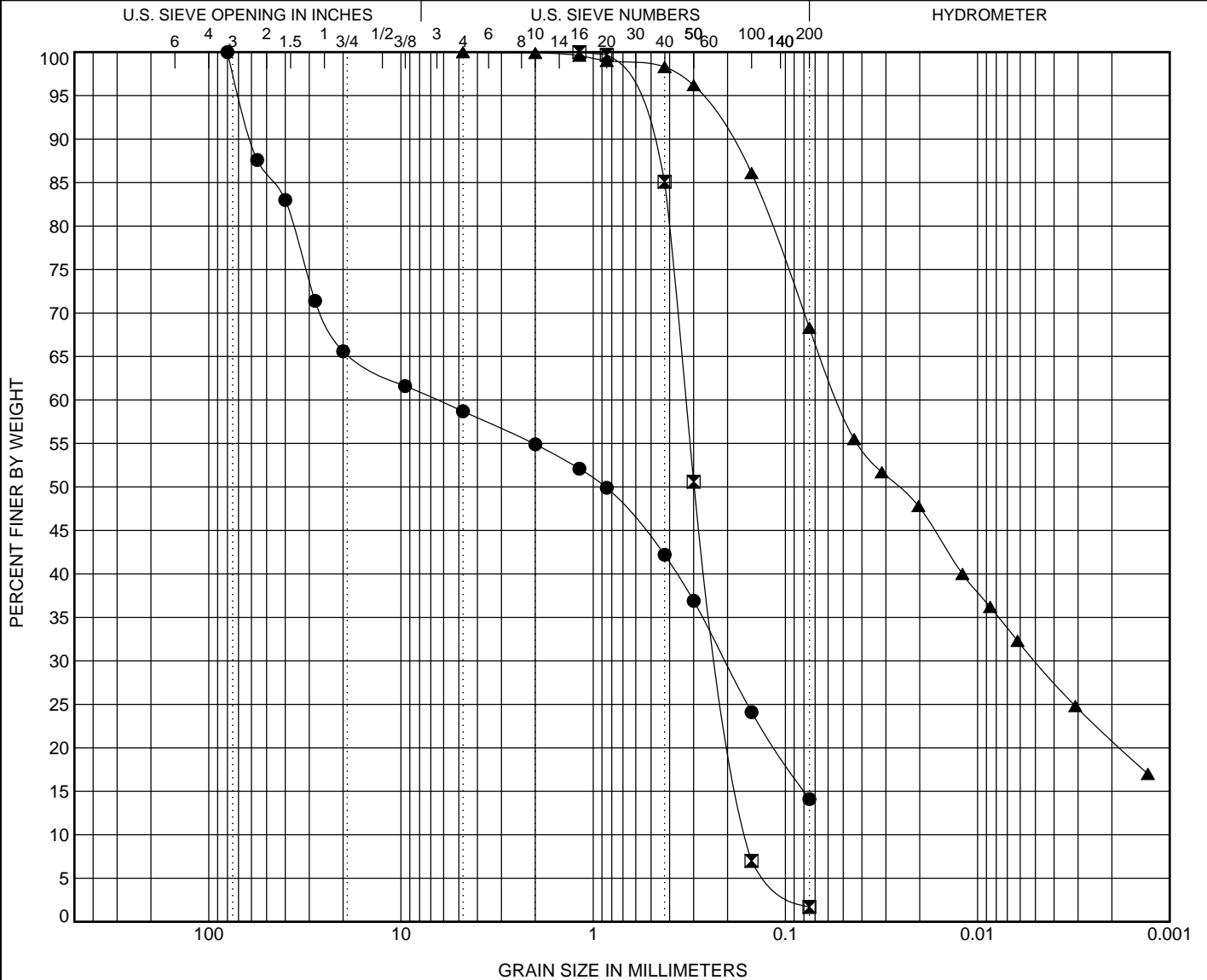


TEST PIT AC 1060-011

GRAIN SIZE DISTRIBUTION

CLIENT: Newfoundland and Labrador Hydro
 PROJECT: Lower Churchill Project

SITE: 230 kV Transmission Line - Muskrat Falls to Gull Island
 LOCATION: Transmission Line



COBBLES	GRAVEL		SAND			CLAY OR SILT
	coarse	fine	coarse	medium	fine	

Test pit no.	Sample	Depth (m)	% Gravel	% Sand	% Silt	% Clay
● AC 1060-011	GB-1	0.30 - 1.50	39.1	44.6	14.1	
■ AC 1060-011	GB-2	1.60 - 3.50	0.0	98.3	1.7	
▲ AC 1060-011	GB-3	4.50 - 5.00	0.0	31.7	47.4	20.9

	80 mm	56 mm	40 mm	28 mm	20 mm	9.525 mm	4.76 mm	2 mm	0.85 mm	0.425 mm	0.3 mm	0.15 mm	0.075 mm
●	100.0	87.6	83.0	71.4	65.6	61.6	58.7	54.9	49.9	42.2	36.9	24.1	14.1
■									99.7	85.1	50.6	7.0	1.7
▲							100.0	99.9	99.0	98.3	96.2	86.1	68.3

Test pit no.	ASTM Classification	D60	D30	D10	W	LL	PL	PI	Cc	Cu
● AC 1060-011	SAND & GRAVEL with some fines, tr. Cobbles	6.5	0.2		13.4					
■ AC 1060-011	POORLY GRADED SAND(SP)	0.3	0.2	0.2	8.7				0.9	2.1
▲ AC 1060-011	SANDY LEAN CLAY(CL)	0.1	0		21.1	25	16	9		

GRAIN SIZE 2 - TEST PIT TRANSMISSION LINE_DATABASE_AC1060_2007.GPJ GINT STD CANADA.GDT 08-1-24



Test Pit: AC1060 - 12					
Firm:	Newfoundland and Labrador Hydro			Date: 12-Sep-07	
Project:	Lower Churchill Project – 230 kV Transmission Line – Muskrat Falls to Gull Island				
Contract No.	AC1060	Location:	N 5880852	E 0619162	Inspector: Dave Oldford



Soil and Groundwater Conditions				
Depth (m) From - To	Description	Sample ID.	Sample Depth (m)	Sample Type
0.0 - 0.1	PEAT – dark brown, moist, fibrous, frequent rootlets.			
0.1 - 0.2	SAND with trace fines, damp, loose, frequent rootlets, oxidized, orange to light brown.	1	0.1- 0.2	Grab
0.2 - 4.5	SAND with trace fines, damp, loose to compact, light grey.	2	0.2 - 4.5	Grab
Estimated Cobbles (%) 0	Estimated Boulders (%) 0	Estimated Max Diameter (m) NA		
Start Time: 2:30 pm	End Time: 3:00 pm	Estimated Excavated Volume (m ³)	25	

General Notes

Slight sloughing above 3.5 m and moderate sloughing below 3.5 m. Test pit was dry upon completion.
 North and East coordinates obtained using Garmin Etrex Legend Cx GPS.

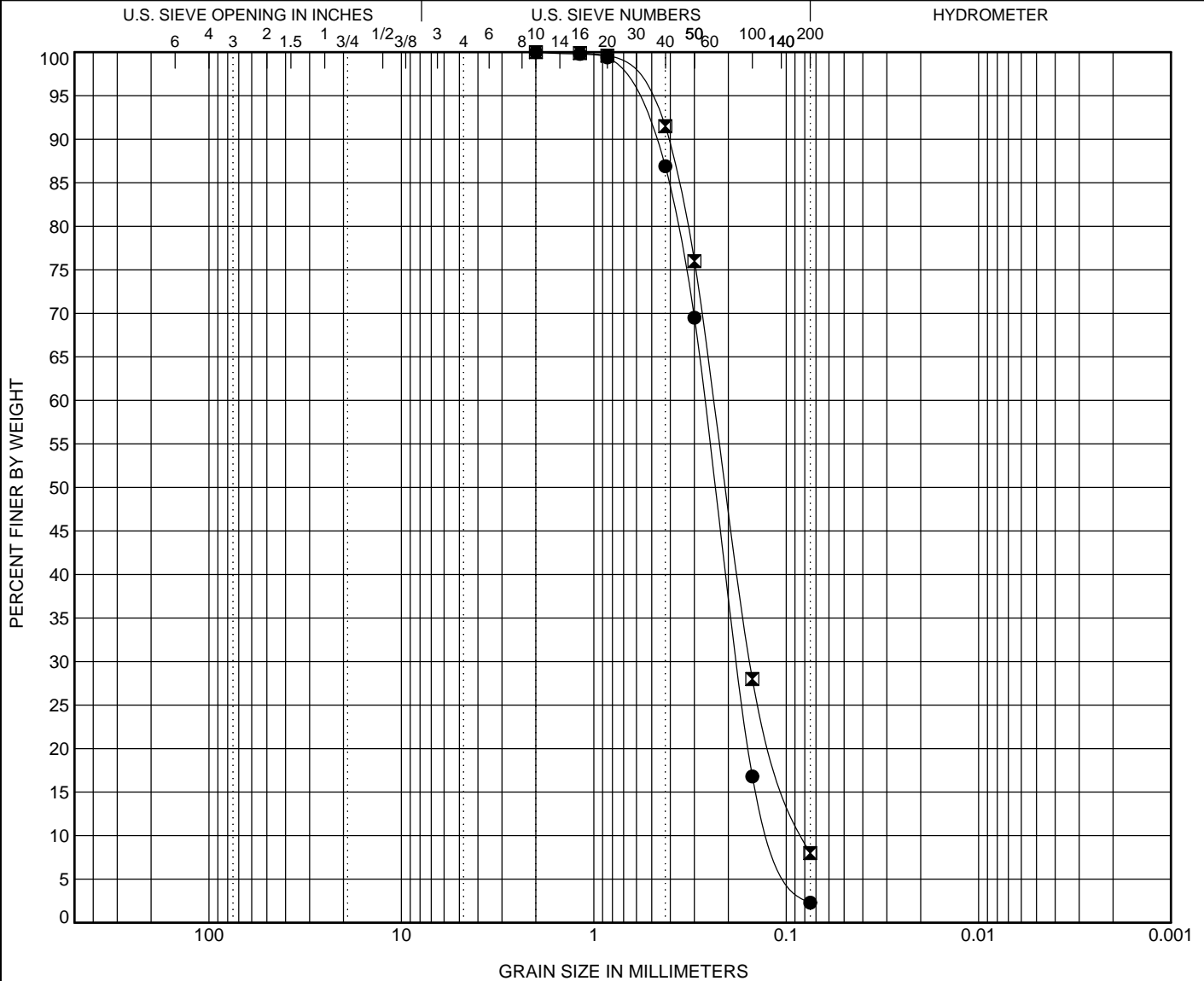


TEST PIT AC 1060-012

GRAIN SIZE DISTRIBUTION

CLIENT: Newfoundland and Labrador Hydro
 PROJECT: Lower Churchill Project

SITE: 230 kV Transmission Line - Muskrat Falls to Gull Island
 LOCATION: Transmission Line



COBBLES	GRAVEL		SAND			CLAY OR SILT
	coarse	fine	coarse	medium	fine	

Test pit no.	Sample	Depth (m)	% Gravel	% Sand	% Silt	% Clay
● AC 1060-012	GB-1	0.08 - 0.20	0.0	97.7	2.3	
☒ AC 1060-012	GB-2	0.20 - 4.50	0.0	92.0	8.0	

	80 mm	56 mm	40 mm	28 mm	20 mm	9.525 mm	4.76 mm	2 mm	0.85 mm	0.425 mm	0.3 mm	0.15 mm	0.075 mm
● AC 1060-012								100.0	99.4	86.9	69.5	16.8	2.3
☒ AC 1060-012								100.0	99.6	91.5	76.0	28.0	8.0

Test pit no.	ASTM Classification	D60	D30	D10	W	LL	PL	PI	Cc	Cu
● AC 1060-012	POORLY GRADED SAND(SP)	0.3	0.2	0.1	5.3				1.1	2.4
☒ AC 1060-012	SAND with trace Fines	0.2	0.2	0.1	6.6				1.2	3.0

GRAIN SIZE 2 - TEST PIT TRANSMISSION LINE_DATABASE_AC1060_2007.GPJ GINT STD CANADA.GDT 08-1-24



Test Pit: AC1060 - 13				
Firm:	Newfoundland and Labrador Hydro			Date: 12-Sep-07
Project:	Lower Churchill Project – 230 kV Transmission Line – Muskrat Falls to Gull Island			
Contract No.	AC1060	Location:	N 5880774	E 0619227
		Inspector: Dave Oldford		



Soil and Groundwater Conditions

Depth (m) From - To	Description	Sample ID.	Sample Depth (m)	Sample Type
0.0 - 0.1	PEAT - black, moist, fibrous, frequent rootlets.	NA	NA	NA
0.1- 0.3	Weathered SAND - trace fines, damp, poorly graded, loose, frequent rootlets, oxidized, orange to light brown.	NA	NA	NA
0.3 - 3.5	POORLY GRADED SAND (SP) - trace fines, damp, loose to compact, light brown.	1	0.3 - 3.5	Grab
Estimated Cobbles (%) 0	Estimated Boulders (%) 0	Estimated Max Diameter (m) NA		
Start Time: 3:15 pm	End Time: 3:45 pm	Estimated Excavated Volume (m ³)		25

General Notes

Severe sloughing at 3.5 m. Test pit was dry upon completion.

North and East coordinates obtained using Garmin Etrex Legend Cx GPS.

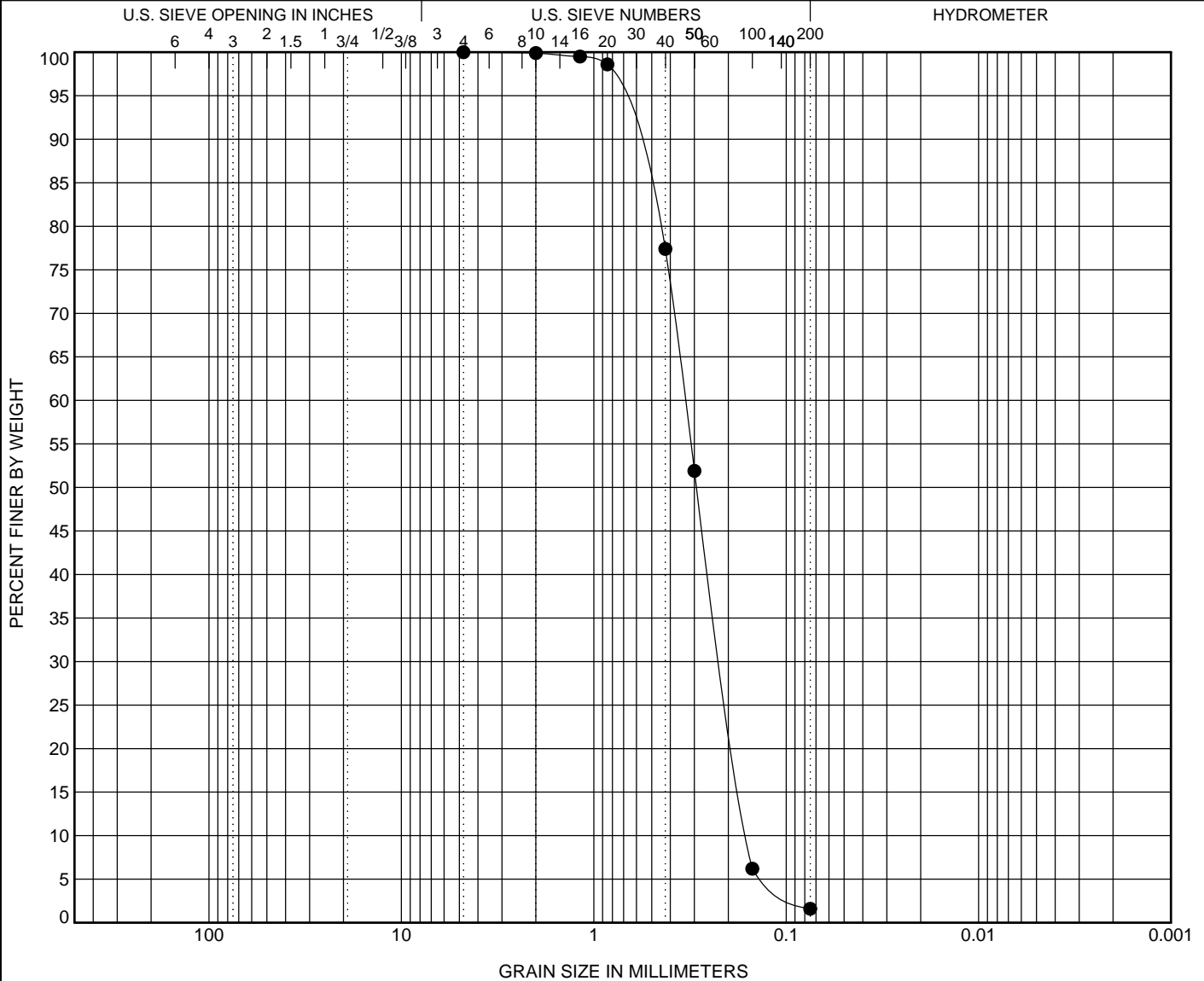


TEST PIT AC 1060-013

GRAIN SIZE DISTRIBUTION

CLIENT: Newfoundland and Labrador Hydro
 PROJECT: Lower Churchill Project

SITE: 230 kV Transmission Line - Muskrat Falls to Gull Island
 LOCATION: Transmission Line



COBBLES	GRAVEL		SAND			CLAY OR SILT
	coarse	fine	coarse	medium	fine	

Test pit no.	Sample	Depth (m)	% Gravel			% Sand			% Silt		% Clay		
● AC 1060-013	GB-1	0.30 - 3.50	0.0			98.4			77.4		1.6		
▲													
★													
◎													
80 mm	56 mm	40 mm	28 mm	20 mm	9.525 mm	4.76 mm	2 mm	0.85 mm	0.425 mm	0.3 mm	0.15 mm	0.075 mm	
●						100.0	99.9	98.6	77.4	51.9	6.2	1.6	
▲													
★													
◎													
Test pit no.	ASTM Classification				D60	D30	D10	W	LL	PL	PI	Cc	Cu
● AC 1060-013	POORLY GRADED SAND(SP)				0.3	0.2	0.2	3.1				0.9	2.1
▲													
★													
◎													

GRAIN SIZE 2 - TEST PIT 1 TRANSMISSION LINE DATABASE AC1060_2007.GPJ GINT STD CANADA.GDT 08-1-24



Test Pit: AC1060 - 14				
Firm:	Newfoundland and Labrador Hydro			Date: 14-Sep-07
Project:	Lower Churchill Project – 230 kV Transmission Line – Muskrat Falls to Gull Island			
Contract No.	AC1060	Location:	N 5877018	E 0614267
				Inspector: Dave Oldford



Soil and Groundwater Conditions

Depth (m) From - To	Description	Sample ID.	Sample Depth (m)	Sample Type
0.0 - 0.1	PEAT - black organic soil, rootlets, moist, loose.	NA	NA	NA
0.1 - 0.25	Oxidized SAND - trace fines, trace rootlets, poorly graded, loose to compact, orange to light brown.	NA	NA	NA
0.25 – 0.6	POORLY GRADED SAND (SP)- trace fines, trace gravels, loose to compact, olive grey to light grey, moist.	1	0.1 – 0.6	Grab
0.6 – 1.0	POORLY GRADED SAND (SP) trace fines, trace gravels, loose to compact, olive grey to light grey, moist.	2	0.6 – 1.0	Grab
1.0 – 4.5	POORLY GRADED SAND (SP) trace fines, trace gravels, loose to compact, olive grey to light grey, moist.	3	3.5 - 4.5	Grab
Estimated Cobbles (%) 0	Estimated Boulders (%) 0	Estimated Max Diameter (m) NA		
Start Time: 11:50 am	End Time: 1:00 pm	Estimated Excavated Volume (m ³)	35	

General Notes

Severe sloughing within test pit. Test pit was dry upon completion.

North and East coordinates obtained using Garmin Etrex Legend Cx GPS.



TEST PIT AC 1060-014

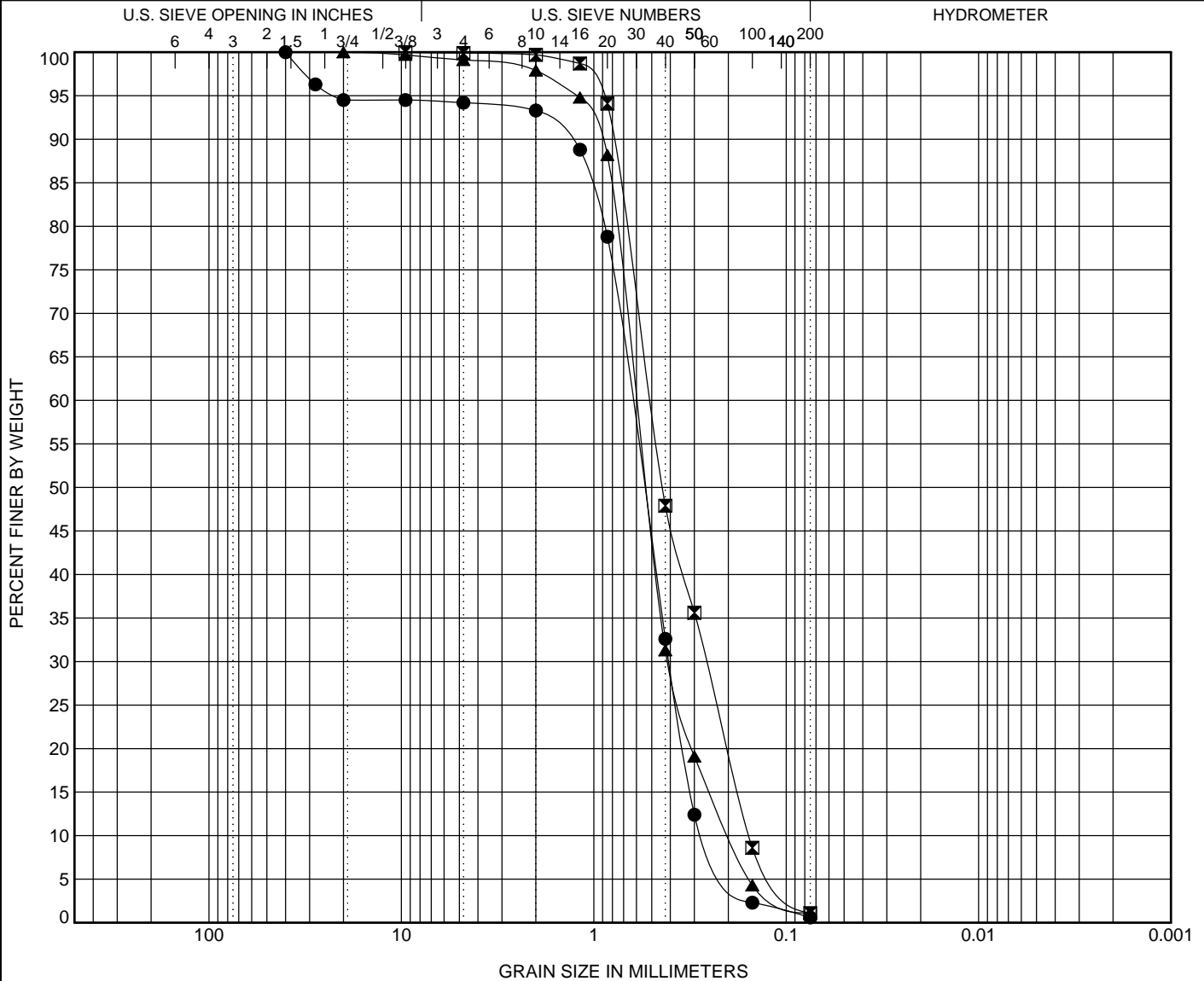
GRAIN SIZE DISTRIBUTION

CLIENT: Newfoundland and Labrador Hydro

SITE: 230 kV Transmission Line - Muskrat Falls to Gull Island

PROJECT: Lower Churchill Project

LOCATION: Transmission Line



COBBLES	GRAVEL		SAND			CLAY OR SILT
	coarse	fine	coarse	medium	fine	

Test pit no.	Sample	Depth (m)	% Gravel	% Sand	% Silt	% Clay
● AC 1060-014	GB-1	0.06 - 0.60	5.8	93.6		0.6
■ AC 1060-014	GB-2	0.60 - 1.00	0.1	98.8		1.1
▲ AC 1060-014	GB-3	3.50 - 4.50	0.9	98.0		1.1

	80 mm	56 mm	40 mm	28 mm	20 mm	9.525 mm	4.76 mm	2 mm	0.85 mm	0.425 mm	0.3 mm	0.15 mm	0.075 mm
●			100.0	96.3	94.5	94.5	94.2	93.3	78.8	32.6	12.4	2.3	0.6
■						100.0	99.9	99.7	94.1	47.9	35.6	8.6	1.1
▲					100.0	99.7	99.1	97.9	88.2	31.3	19.1	4.3	1.1

Test pit no.	ASTM Classification	D60	D30	D10	W	LL	PL	PI	Cc	Cu
● AC 1060-014	POORLY GRADED SAND(SP)	0.6	0.4	0.3	4.0				1.0	2.5
■ AC 1060-014	POORLY GRADED SAND(SP)	0.5	0.3	0.2	3.2				0.9	3.3
▲ AC 1060-014	POORLY GRADED SAND(SP)	0.6	0.4	0.2	4.5				1.4	3.1

GRAIN SIZE 2 - TEST PIT TRANSMISSION LINE_DATABASE_AC1060_2007.GPJ GINT STD CANADA.GDT 08-1-24



Test Pit: AC1060 - 15				
Firm:	Newfoundland and Labrador Hydro			Date: 14-Sep-07
Project:	Lower Churchill Project – 230 kV Transmission Line – Muskrat Falls to Gull Island			
Contract No.	AC1060	Location:	N 5880359	E 0618206
		Inspector: Dave Oldford		



Soil and Groundwater Conditions

Depth (m) From - To	Description	Sample ID.	Sample Depth (m)	Sample Type
0.0 - 0.04	PEAT - black organic soil, rootlets, moist, loose.	NA	NA	NA
0.04 - 0.3	Oxidized SAND - trace fines, trace rootlets, poorly graded, loose to compact, orange to light brown.	NA	NA	NA
0.3 - 3.5	POORLY GRADED SAND (SP) - trace fines, trace gravels, loose to compact, olive grey to light grey, moist.	1	0.3 - 3.5	Grab
Estimated Cobbles (%) 0	Estimated Boulders (%) 0	Estimated Max Diameter (m) NA		
Start Time: 1:50 pm	End Time: 2:20 pm	Estimated Excavated Volume (m ³)		30

General Notes

Severe sloughing within test pit. Test pit was dry upon completion.
 North and East coordinates obtained using Garmin Etrex Legend Cx GPS.

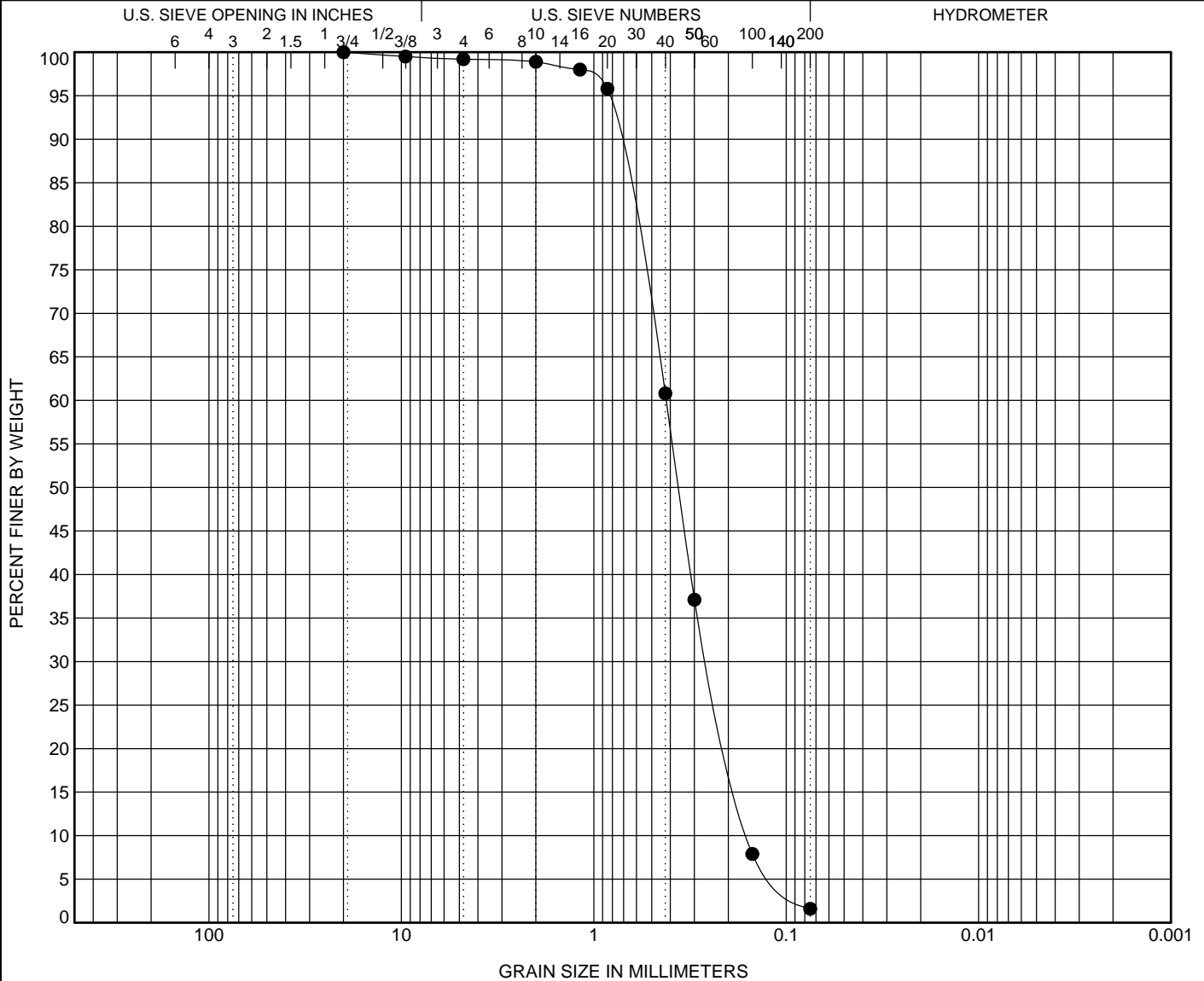


TEST PIT AC 1060-015

GRAIN SIZE DISTRIBUTION

CLIENT: Newfoundland and Labrador Hydro
 PROJECT: Lower Churchill Project

SITE: 230 kV Transmission Line - Muskrat Falls to Gull Island
 LOCATION: Transmission Line



COBBLES	GRAVEL		SAND			CLAY OR SILT
	coarse	fine	coarse	medium	fine	

Test pit no.	Sample	Depth (m)	% Gravel	% Sand	% Silt	% Clay
● AC 1060-015	GB-1	0.30 - 3.50	0.8	97.6	1.6	

80 mm	56 mm	40 mm	28 mm	20 mm	9.525 mm	4.76 mm	2 mm	0.85 mm	0.425 mm	0.3 mm	0.15 mm	0.075 mm
●				100.0	99.5	99.2	98.9	95.8	60.8	37.1	7.9	1.6

Test pit no.	ASTM Classification	D60	D30	D10	W	LL	PL	PI	Cc	Cu
● AC 1060-015	POORLY GRADED SAND(SP)	0.4	0.3	0.2	5.6				1.0	2.7

GRAIN SIZE 2 - TEST PIT 1 TRANSMISSION LINE DATABASE AC1060_2007.GPJ GINT STD CANADA.GDT 08-1-24



Test Pit: AC1060 - 16				
Firm:	Newfoundland and Labrador Hydro			Date: 14-Sep-07
Project:	Lower Churchill Project – 230 kV Transmission Line – Muskrat Falls to Gull Island			
Contract No.	AC1060	Location:	N 5880086	E 0618187
		Inspector: Dave Oldford		



Soil and Groundwater Conditions

Depth (m) From - To	Description	Sample ID.	Sample Depth (m)	Sample Type
0.0 - 0.1	PEAT - black organic soil, rootlets, moist, loose.	NA	NA	NA
0.1 - 0.3	Oxidized SAND - trace fines, trace rootlets, loose to compact, orange to light brown.	NA	NA	NA
0.3 - 3.5	POORLY GRADED SAND (SP) - trace fines, trace gravels, trace cobbles, loose to compact, olive grey to light grey, moist.	1	2.0 - 3.5	Grab
Estimated Cobbles (%) 5	Estimated Boulders (%) 0	Estimated Max Diameter (m) NA		
Start Time: 2:30 pm	End Time: 3:00 pm	Estimated Excavated Volume (m ³)		30

General Notes

Severe sloughing within test pit. Test pit was dry upon completing
 North and East coordinates obtained using Garmin Etrex Legend Cx GPS

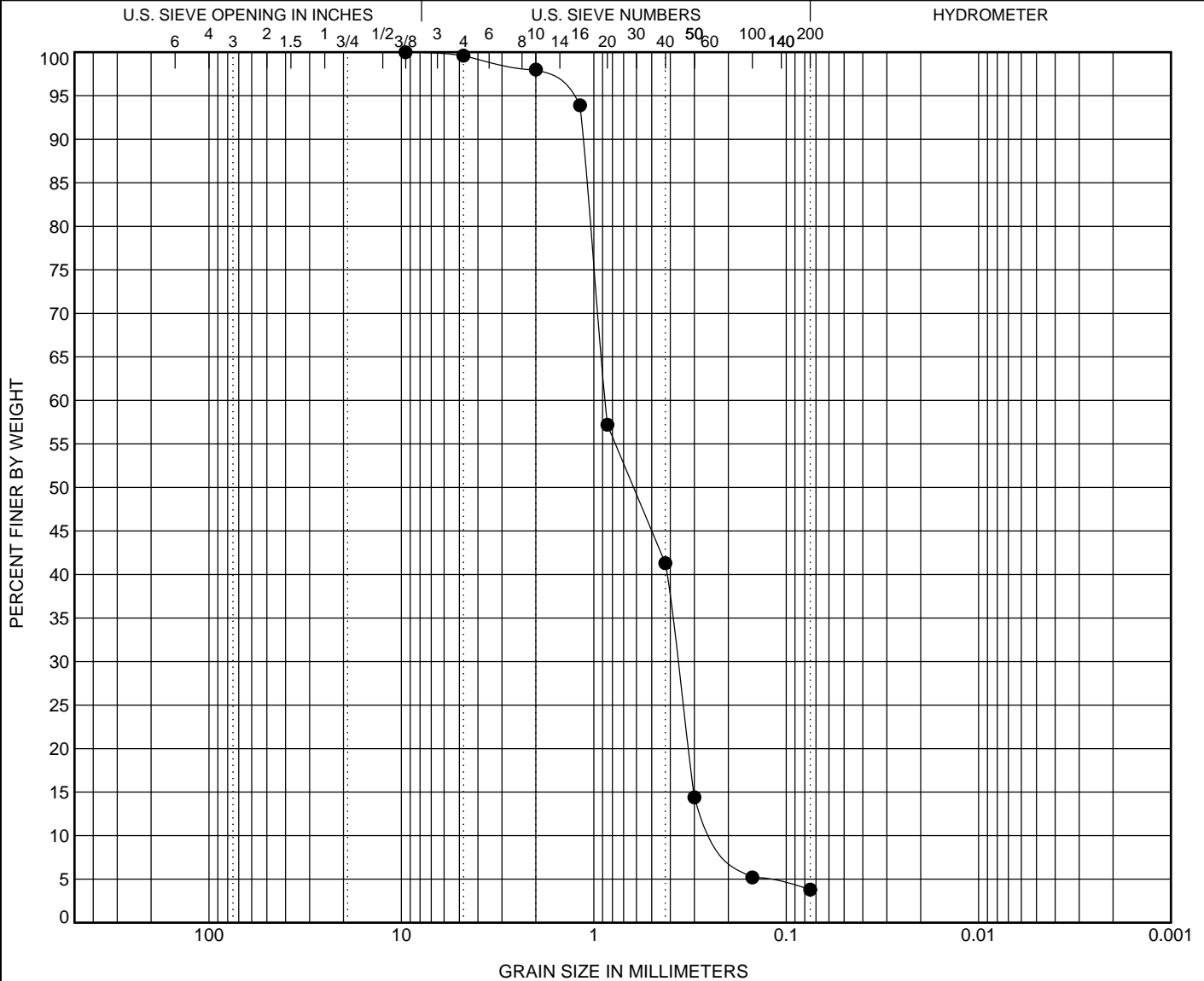


TEST PIT AC 1060-016

GRAIN SIZE DISTRIBUTION

CLIENT: Newfoundland and Labrador Hydro
 PROJECT: Lower Churchill Project

SITE: 230 kV Transmission Line - Muskrat Falls to Gull Island
 LOCATION: Transmission Line



COBBLES	GRAVEL		SAND			CLAY OR SILT
	coarse	fine	coarse	medium	fine	

Test pit no.	Sample	Depth (m)	% Gravel		% Sand		% Silt		% Clay				
● AC 1060-016	GB-1	3.00 - 3.50	0.4		95.8		3.8						
▲													
★													
◎													
80 mm	56 mm	40 mm	28 mm	20 mm	9.525 mm	4.76 mm	2 mm	0.85 mm	0.425 mm	0.3 mm	0.15 mm	0.075 mm	
●					100.0	99.6	98.0	57.2	41.3	14.4	5.2	3.8	
▲													
★													
◎													
Test pit no.	ASTM Classification				D60	D30	D10	W	LL	PL	PI	Cc	Cu
● AC 1060-016	POORLY GRADED SAND(SP)				0.9	0.4	0.2	6.4				0.7	4.0
▲													
★													
◎													

GRAIN SIZE 2 - TEST PIT 1 TRANSMISSION LINE DATABASE AC1060_2007.GPJ GINT STD CANADA.GDT 08-1-24



Test Pit: MF1120 - 8				
Firm:	Newfoundland and Labrador Hydro			Date: 11-Sep-07
Project:	Lower Churchill Project – 230 kV Transmission Line – Muskrat Falls to Gull Island			
Contract No.	MF1120	Location:	N 5902362	E 0642104
		Inspector: Dave Oldford		



Soil and Groundwater Conditions

Depth (m) From - To	Description	Sample ID.	Sample Depth (m)	Sample Type
0.0 - 0.04	PEAT - black organic soil, rootlets, moist, loose.	NA	NA	NA
0.04 - 0.1	Topsoil, rootmat with organics, loose, moist, brown.	NA	NA	NA
0.1- 4.5	Silty sandy GRAVEL with trace cobbles, trace boulders, light brown, loose, moist.	1	2.0 - 3.0	Grab
Estimated Cobbles (%) 5	Estimated Boulders (%) 2	Estimated Max Diameter (m) 0.6		
Start Time: 8:10 am	End Time: 8:50 am	Estimated Excavated Volume (m ³)		30

General Notes

Water running into test pit at 3.5 m mark. Rapid seepage.
 Moderate sloughing at 3.5 m.
 North and East coordinates obtained using Garmin Etrex Legend Cx GPS.

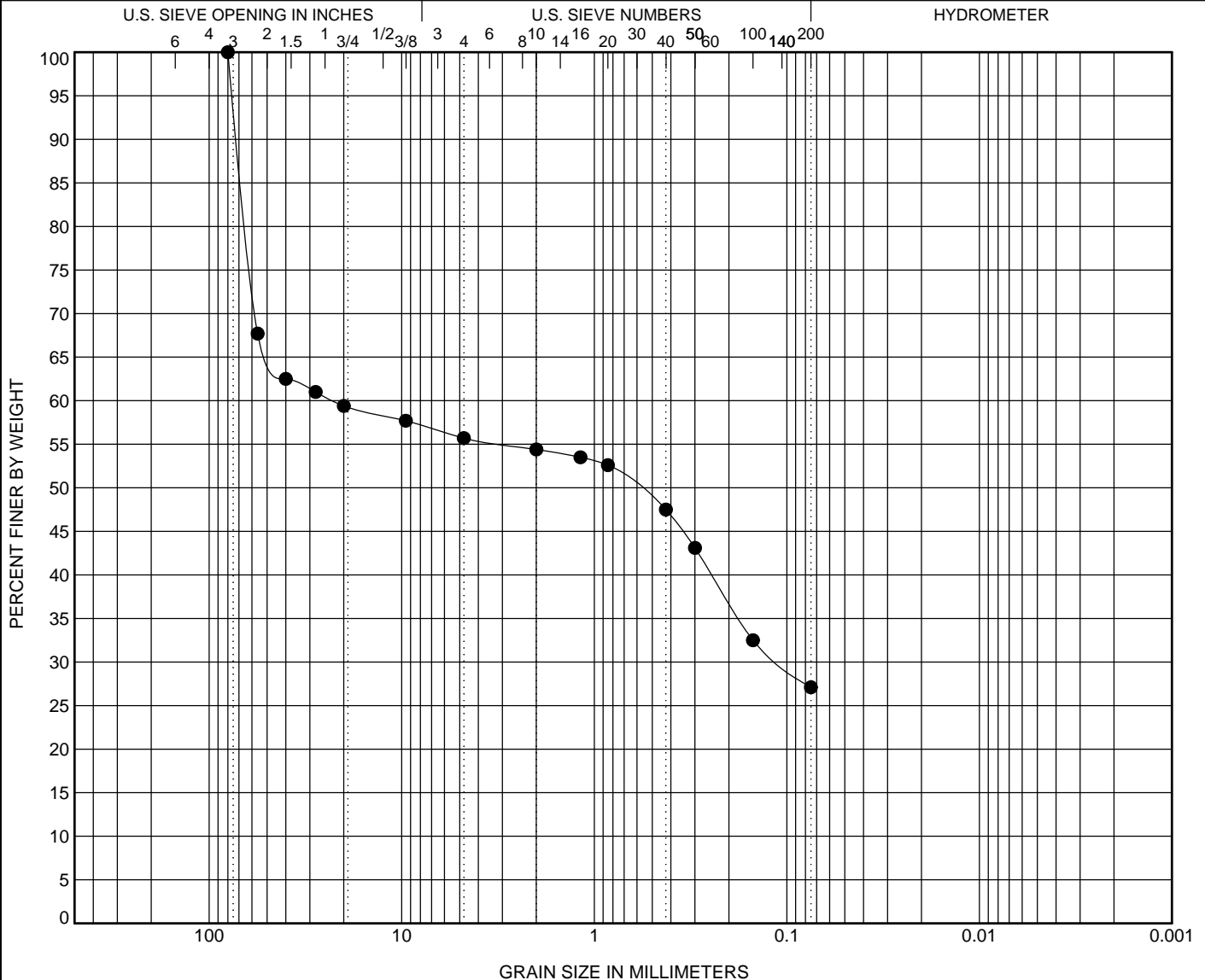


TEST PIT MF 1120-008

GRAIN SIZE DISTRIBUTION

CLIENT: Newfoundland and Labrador Hydro
 PROJECT: Lower Churchill Project

SITE: 230 kV Transmission Line - Muskrat Falls to Gull Island
 LOCATION: Lower Brook



COBBLES	GRAVEL		SAND			CLAY OR SILT
	coarse	fine	coarse	medium	fine	

Test pit no.	Sample	Depth (m)	% Gravel			% Sand			% Silt		% Clay		
MF 1120-008	GB-1	4.00 - 4.50	38.5			28.6			27.1				
80 mm	56 mm	40 mm	28 mm	20 mm	9.525 mm	4.76 mm	2 mm	0.85 mm	0.425 mm	0.3 mm	0.15 mm	0.075 mm	
100.0	67.7	62.5	61.0	59.4	57.7	55.7	54.4	52.6	47.5	43.1	32.5	27.1	
Test pit no.	ASTM Classification				D60	D30	D10	W	LL	PL	PI	Cc	Cu
MF 1120-008	Sandy Silty GRAVEL				22.7	0.1		16.2					

GRAIN SIZE 2 - TEST PIT 1 - TEST PITS MF1120_23NOV.GPJ GINT STD CANADA.GDT 08-1-25



Test Pit: MF1120 - 9				
Firm:	Newfoundland and Labrador Hydro			Date: 11-Sep-07
Project:	Lower Churchill Project – 230 kV Transmission Line – Muskrat Falls to Gull Island			
Contract No.	MF1120	Location:	N 5902349	E 0641901
		Inspector: Dave Oldford		



Soil and Groundwater Conditions

Depth (m) From - To	Description	Sample ID.	Sample Depth (m)	Sample Type
0.0 - 0.8	Topsoil, loose, moist, brown, some rootlets.	NA	NA	NA
0.8 - 2.0	SAND - some gravel, trace fines, trace cobbles, trace boulder, moist, loose, light brown, well graded.	NA	NA	NA
2.0 - 3.0	Gravely SAND with trace fines, trace cobbles, trace boulders, loose to compact, moist, grey.	1	2.0 - 3.0	Grab
3.0	Bedrock	NA	NA	NA
Estimated Cobbles (%) 2		Estimated Boulders (%) 1		Estimated Max Diameter (m) 1.0
Start Time: 9:00 am		End Time: 9:45 am		Estimated Excavated Volume (m ³) 25

General Notes

No sloughing. Test pit was dry upon completion.
 North and East coordinates obtained using Garmin Etrex Legend Cx GPS.

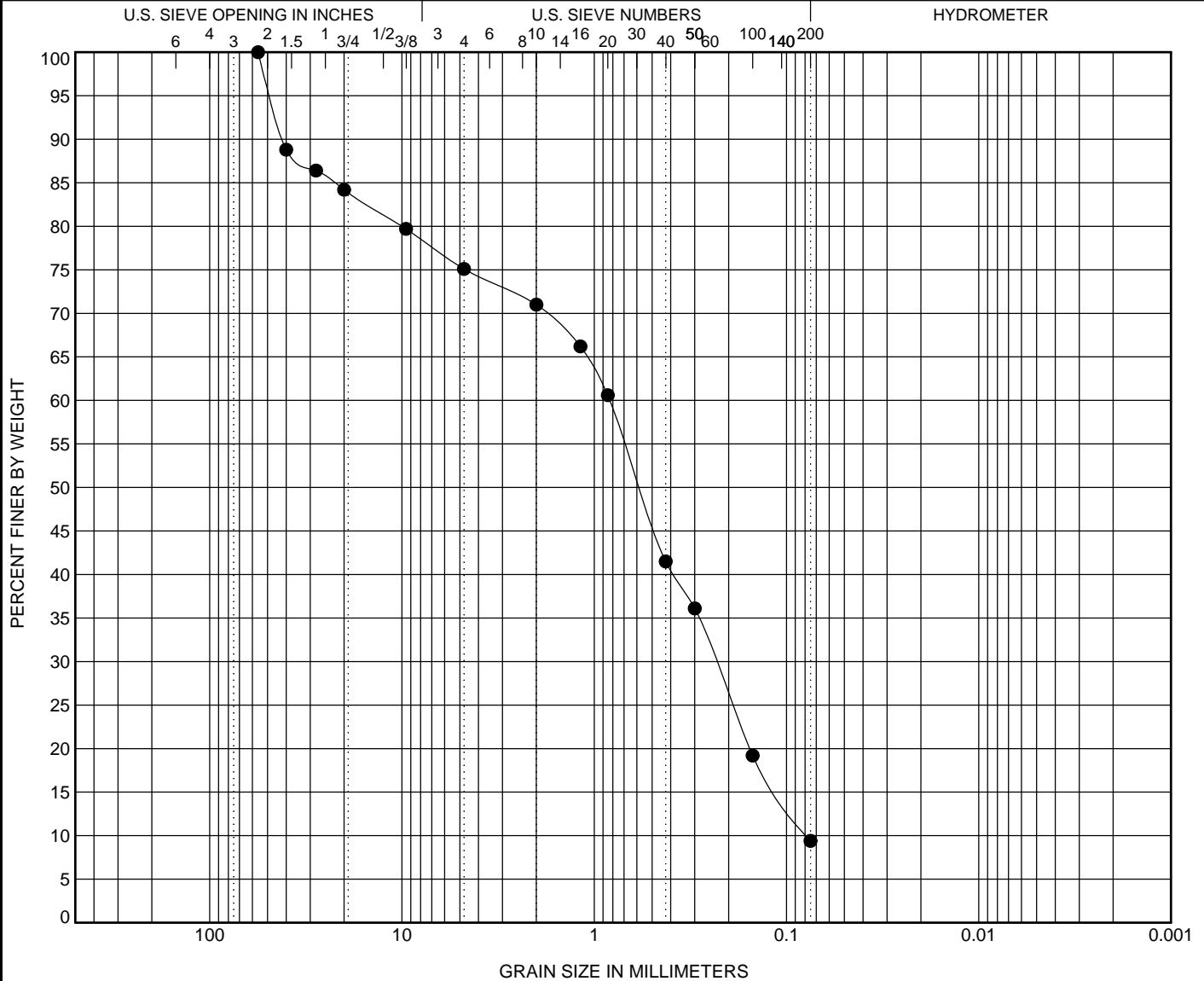


TEST PIT MF 1120-009

GRAIN SIZE DISTRIBUTION

CLIENT: Newfoundland and Labrador Hydro
 PROJECT: Lower Churchill Project

SITE: 230 kV Transmission Line - Muskrat Falls to Gull Island
 LOCATION: Lower Brook



COBBLES	GRAVEL		SAND			CLAY OR SILT
	coarse	fine	coarse	medium	fine	

Test pit no.	Sample	Depth (m)	% Gravel	% Sand	% Silt	% Clay
MF 1120-009	GB-1	2.00 - 3.00	24.9	65.7	9.4	

80 mm	56 mm	40 mm	28 mm	20 mm	9.525 mm	4.76 mm	2 mm	0.85 mm	0.425 mm	0.3 mm	0.15 mm	0.075 mm
	100.0	88.8	86.4	84.2	79.7	75.1	71.0	60.6	41.5	36.1	19.2	9.4

Test pit no.	ASTM Classification	D60	D30	D10	W	LL	PL	PI	Cc	Cu
MF 1120-009	Gravelly SAND with trace Fines	0.8	0.2	0.1	14.8				0.8	10.6

GRAIN SIZE 2 - TEST PIT 1 - TEST PITS MF1120_23NOV.GPJ GINT STD CANADA.GDT 08-1-25

Appendix C

Hand Auger Logs

HAND AUGER: AC 1060-TL-HA-1					
Firm:	Newfoundland Hydro	Project:	Lower Churchill Geotechnical Program	Date:	17 Sep 2007
Contract No.	AC 1060	Location:	N 5902414	E 0642815	Inspector: DJD

PHOTOGRAPHS



SOIL AND GROUNDWATER CONDITIONS

Depth (m)		Description	Sample No.	Sample Depth (m)	Sample Type
From	To				
0	0.01	Forest Litter & Moss			
0.01	0.25	TOPSOIL (SAND), fine grained, trace to some fines, poorly graded, loose to compact, orangish-brown, damp, trace of rootlets			
0.25	1.2	SAND, fine grained with some medium grained sizes, trace of fines, poorly graded, loose to compact, grayish-brown, damp ... compact, brown below 0.5 m ... moist below 0.7 m End of Hand Auger at 1.2 m Dry at Completion	1	0.4 – 0.5	Grab

Est Max Diameter (m)	
Start Time:	10:30 am
End Time	10:45 am
Hole Dimensions:	50 mm

General Notes	
• Hand auger located approximately 85 m south of existing 3 pole structure (Structure No. 1133), at east bank of Lower Brook crossing.	
• Location marked with recreational grade Garmin GPS (WPT 33)	



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TEST PIT AC 1060-TL-HA-1

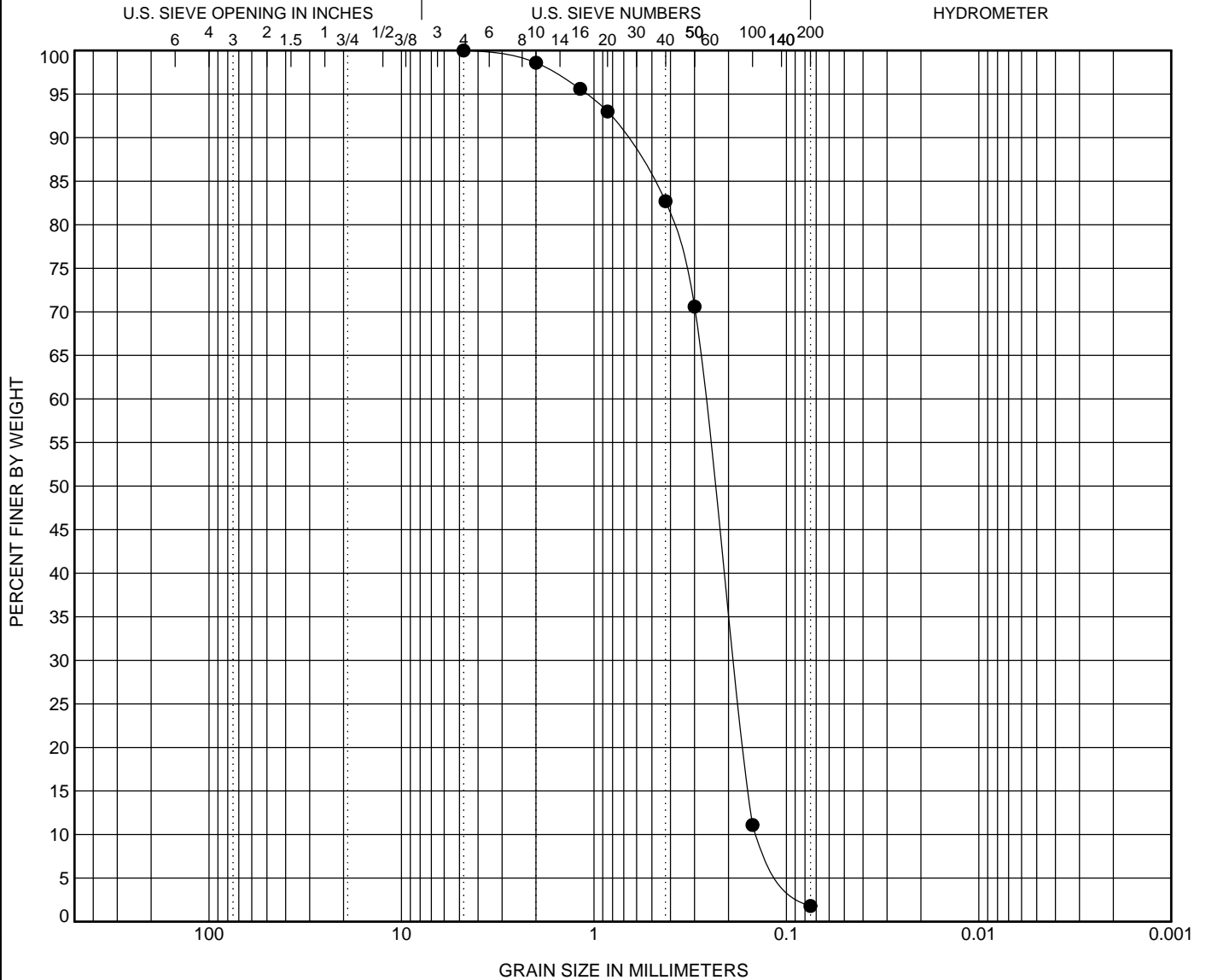
GRAIN SIZE DISTRIBUTION

CLIENT: Newfoundland and Labrador Hydro

SITE: 230 kV Transmission Line - Muskrat Falls to Gull Island

PROJECT: Lower Churchill Project

LOCATION: Transmission Line



COBBLES	GRAVEL		SAND			CLAY OR SILT
	coarse	fine	coarse	medium	fine	

Test pit no.	Sample	Depth (m)	% Gravel			% Sand			% Silt		% Clay		
● AC 1060-TL-HA-1	GB-1	0.40 - 0.50	0.0			98.2			1.8				
■													
▲													
★													
◎													
80 mm	56 mm	40 mm	28 mm	20 mm	9.525 mm	4.76 mm	2 mm	0.85 mm	0.425 mm	0.3 mm	0.15 mm	0.075 mm	
●						100.0	98.6	93.0	82.7	70.6	11.1	1.8	
■													
▲													
★													
◎													
Test pit no.	ASTM Classification				D60	D30	D10	W	LL	PL	PI	Cc	Cu
● AC 1060-TL-HA-1	POORLY GRADED SAND(SP)				0.3	0.2	0.1	6.6				1.0	1.9
■													
▲													
★													
◎													

GRAIN SIZE 2 - TEST PIT 1 TRANSMISSION LINE DATABASE AC1060_2007.GPJ GINT STD CANADA.GDT 08-1-25

HAND AUGER: AC 1060-TL-HA-2					
Firm:	Newfoundland Hydro	Project:	Lower Churchill Geotechnical Program	Date:	17 Sep 2007 & Returned 25 Sept 2007
Contract No.	AC 1060	Location:	N 5902330	E 0642580	Inspector: DJD

PHOTOGRAPHS



SOIL AND GROUNDWATER CONDITIONS

Depth (m)		Description	Sample No.	Sample Depth (m)	Sample Type
From	To				
0	0.025	Forest Litter & Moss			
0.025	0.25	TOPSOIL (SAND), fine grained, trace to some fines, poorly graded, loose to compact, orangish-brown, damp, trace of rootlets			
0.25	3.0	SAND, fine grained with trace to some medium grained sizes, trace of fines, poorly graded, loose to compact, grayish-brown, damp	1	1.0-1.2	Grab
			2		Grab
		... moist, compact below 0.5 m	3		Grab
		... very moist below 0.7 m			
		End of Hand Auger at 3.0 m			
		Dry at Completion			

Est Max Diameter (m)					
Start Time:	11:10 am 17 Sept	End Time	11:30 am 17 Sept	Hole Dimensions:	50 mm
	12:15 pm 25 Sep		1:15 pm 25 Sep		

General Notes
• Hand auger located approximately 85 m south of existing 3 pole structure (Structure No. 1137), at east bank of Lower Brook crossing.
• Location marked with recreational grade Garmin GPS (WPT 34)



TEST PIT AC 1060-TL-HA-2

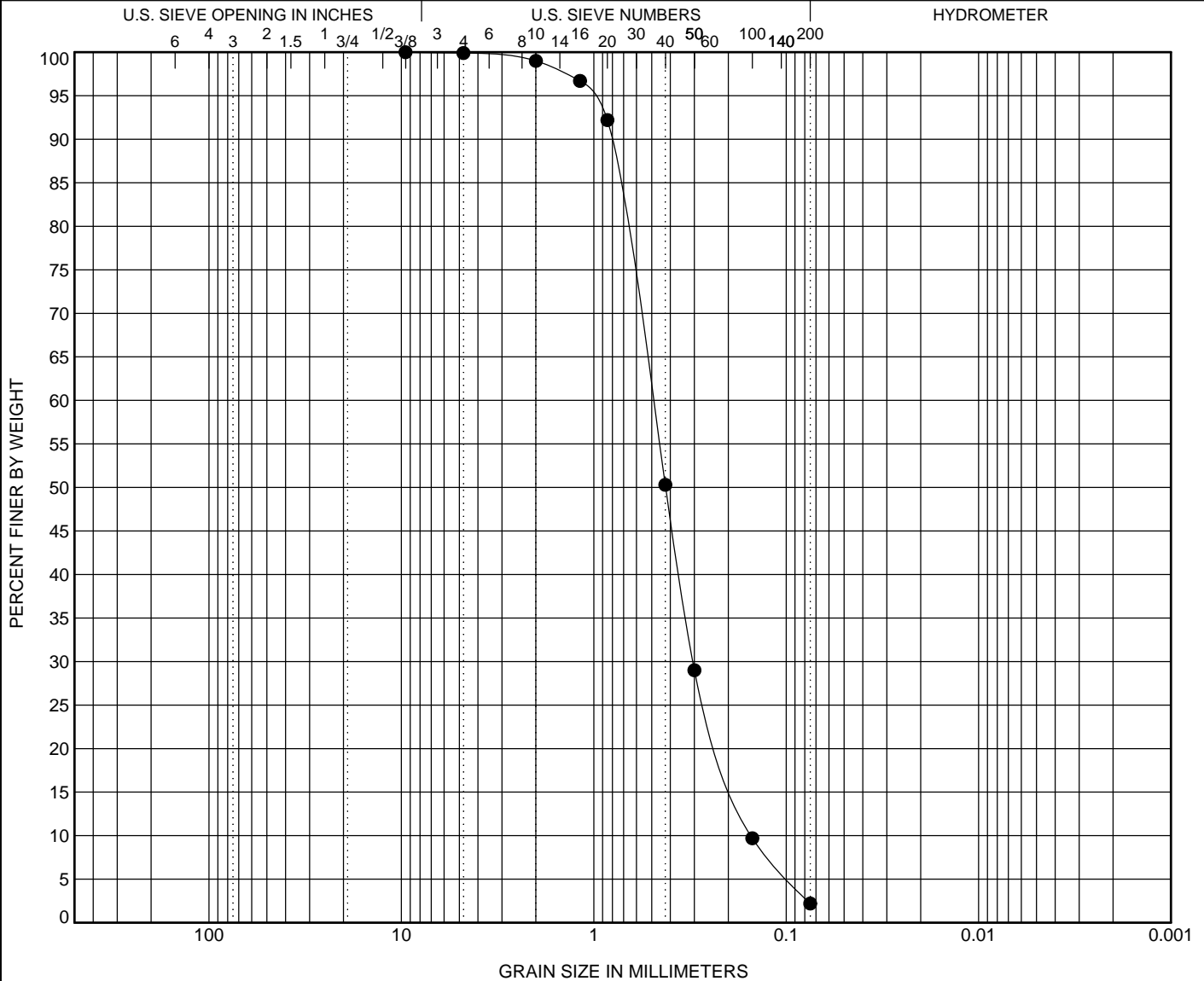
GRAIN SIZE DISTRIBUTION

CLIENT: Newfoundland and Labrador Hydro

SITE: 230 kV Transmission Line - Muskrat Falls to Gull Island

PROJECT: Lower Churchill Project

LOCATION: Transmission Line



COBBLES	GRAVEL		SAND			CLAY OR SILT
	coarse	fine	coarse	medium	fine	

Test pit no.	Sample	Depth (m)	% Gravel	% Sand	% Silt	% Clay
● AC 1060-TL-HA-2	● GB-1	1.00 - 1.20	0.1	97.7	2.2	

80 mm	56 mm	40 mm	28 mm	20 mm	9.525 mm	4.76 mm	2 mm	0.85 mm	0.425 mm	0.3 mm	0.15 mm	0.075 mm
					100.0	99.9	99.0	92.2	50.3	29.0	9.7	2.2

Test pit no.	ASTM Classification	D60	D30	D10	W	LL	PL	PI	Cc	Cu
● AC 1060-TL-HA-2	POORLY GRADED SAND(SP)	0.5	0.3	0.2	6.3				1.2	3.3

GRAIN SIZE 2 - TEST PIT 1 TRANSMISSION LINE DATABASE AC1060_2007.GPJ GINT STD CANADA.GDT 08-1-25

HAND AUGER: AC 1060-TL-HA-3					
Firm:	Newfoundland Hydro	Project:	Lower Churchill Geotechnical Program	Date:	17 Sep 2007
Contract No.	AC 1060	Location:	N 5902450 E 0642443	Inspector:	DJD

PHOTOGRAPHS



SOIL AND GROUNDWATER CONDITIONS

Depth (m)		Description	Sample No.	Sample Depth (m)	Sample Type
From	To				
0	0.01	Forest Litter			
0.01	0.45	CLAEY SILT, trace of sand with some sandy laminations, soft to firm, grayish-brown, wet, some partially decomposed organic pockets			
		... WATER AT 0.12 m			
0.25	1.2	SILTY CLAY, medium plastic, firm, grey, very moist, some sandy lenses	1	0.8-1.0	Grab
		End of Hand Auger at 1.2 m			
		Dry at Completion			

Est Max Diameter (m)					
Start Time:	11:50 am	End Time	12 :10 pm	Hole Dimensions:	50 mm

General Notes
• Hand auger located approximately ¾ down Lower Brook East Slope on a lower terrace, near base of old slide area.
• Estimate hole located approximately 15 to 20 m above Lower Brook water elevation.
• Gravel and cobbles visible at tow of slope at brook edge.
• Location marked with recreational grade Garmin GPS (WPT 35)

HAND AUGER: AC 1060-TL-HA-4					
Firm:	Newfoundland Hydro	Project:	Lower Churchill Geotechnical Program	Date:	17 Sep 2007
Contract No.	AC 1060	Location:	N 5902402	E 0642466	Inspector: DJD

PHOTOGRAPHS



SOIL AND GROUNDWATER CONDITIONS

Depth (m)		Description	Sample No.	Sample Depth (m)	Sample Type
From	To				
0	0.02	Forest Litter			
0.02	0.45	TOPSOIL (SAND), fine grained, some fines, poorly graded, loose to compact, orangish-brown, damp, trace of Rootlets and some partially decomposed organic pockets			
0.45	1.2	SAND, fine grained with trace to some medium grained sizes, trace of fines, poorly graded, loose to compact, grayish-brown, damp			
		... fine grained, trace to some fines, compact below 0.5 m			
		... some fines, grey below 0.7 m			
		End of Hand Auger at 1.2 m			
		Dry at Completion			

Est Max Diameter (m)	
Start Time:	11:50 am
End Time	12 :10 pm
Hole Dimensions:	50 mm

General Notes
• Hand auger located approximately ¼ down Lower Brook East Slope.
• Location marked with recreational grade Garmin GPS (WPT 35)



TEST PIT AC 1060-TL-HA-5

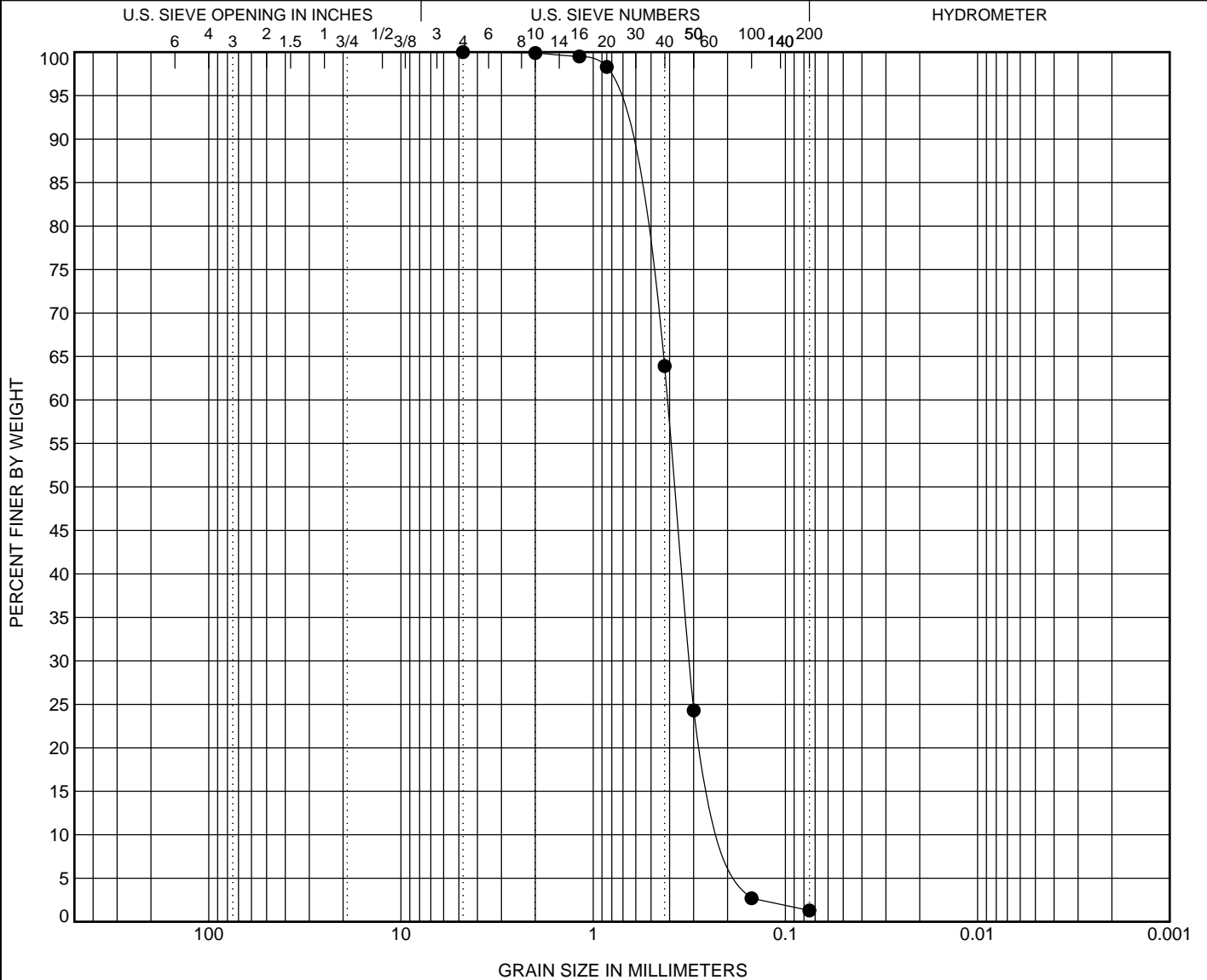
GRAIN SIZE DISTRIBUTION

CLIENT: Newfoundland and Labrador Hydro

SITE: 230 kV Transmission Line - Muskrat Falls to Gull Island

PROJECT: Lower Churchill Project

LOCATION: Transmission Line



COBBLES	GRAVEL		SAND			CLAY OR SILT
	coarse	fine	coarse	medium	fine	

Test pit no.	Sample	Depth (m)	% Gravel			% Sand			% Silt		% Clay		
● AC 1060-TL-HA-5	GB-1	1.00 - 2.00	0.0			98.7			63.9		24.3		
☒													
▲													
★													
◎													
80 mm	56 mm	40 mm	28 mm	20 mm	9.525 mm	4.76 mm	2 mm	0.85 mm	0.425 mm	0.3 mm	0.15 mm	0.075 mm	
●						100.0	99.9	98.3	63.9	24.3	2.7	1.3	
☒													
▲													
★													
◎													
Test pit no.	ASTM Classification				D60	D30	D10	W	LL	PL	PI	Cc	Cu
● AC 1060-TL-HA-5	POORLY GRADED SAND(SP)				0.4	0.3	0.2	3.8				1.3	2.2
☒													
▲													
★													
◎													

GRAIN SIZE 2 - TEST PIT 1 TRANSMISSION LINE DATABASE AC1060_2007.GPJ GINT STD CANADA.GDT 08-1-25

HAND AUGER: AC 1060-TL-HA-6					
Firm:	Newfoundland Hydro	Project:	Lower Churchill Geotechnical Program	Date:	9 Sep 2007
Contract No.	AC 1060	Location:	N 5892298	E 0630829	Inspector: David Oldford Calvin Miles Glen Smith

PHOTOGRAPHS

See Test Pit AC-1060-2

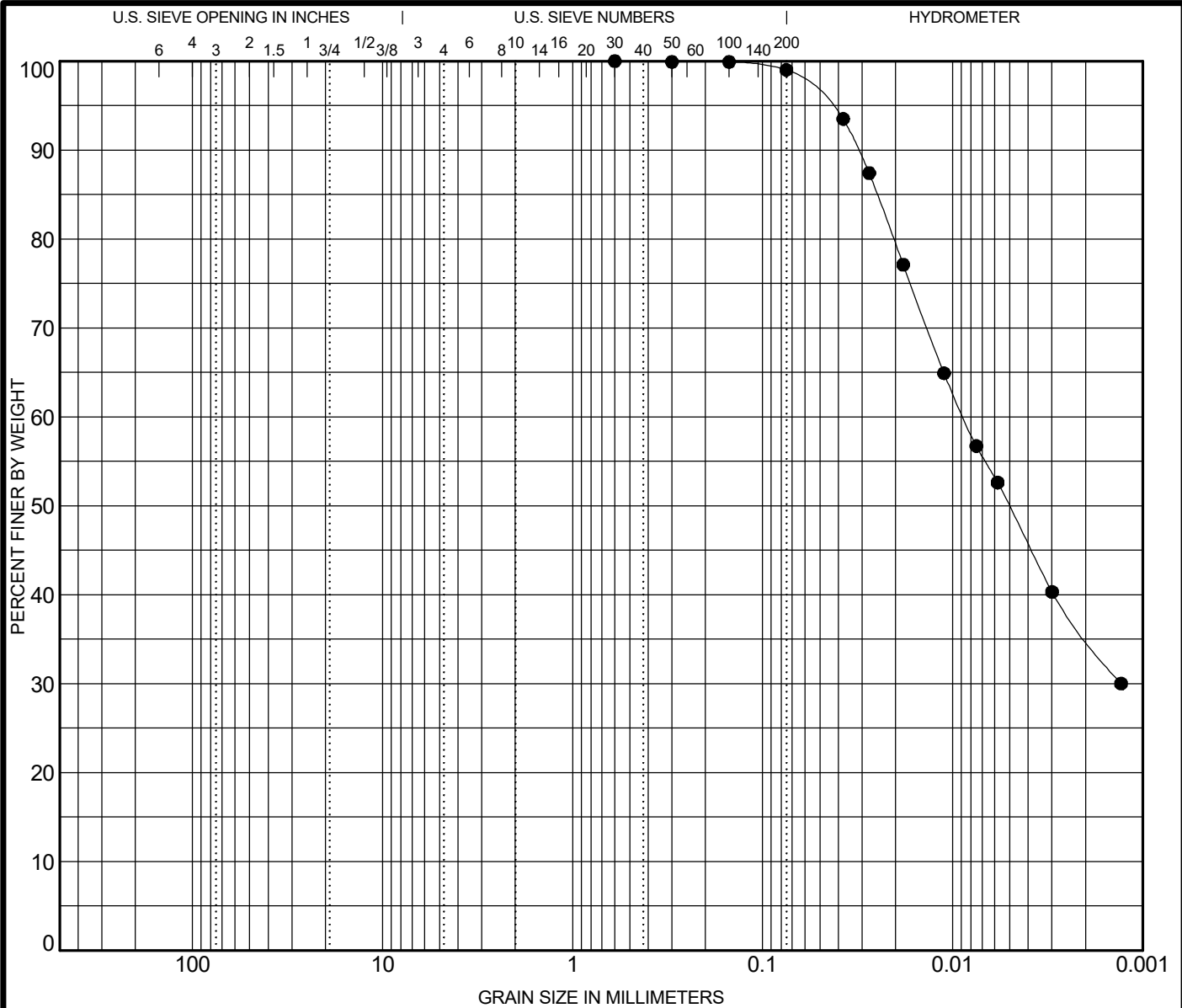
SOIL AND GROUNDWATER CONDITIONS

Depth (m)		Description	Sample No.	Sample Depth (m)	Sample Type
From	To				
0	0.5	Roots and organics previously grubbed area			
0.5	2.6	SILT – trace sand, trace of clay, slightly plastic, firm, need saturation, greenish grey			

Est Max Diameter (m)	
Start Time:	12:20 pm
End Time	12 :30 pm
Hole Dimensions:	50 mm

General Notes

<ul style="list-style-type: none"> Hand auger located on left had side of road going west where transmission line crosses road (E631000 – E630800) (N5892000 – N5892300)
<ul style="list-style-type: none"> A test pit was dug in this area with an excavator. Test pit AC – 1060 – 2 with coordinates E0630859 N5892290



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	Classification	LL	PL	PI	Cc	Cu
● TL-HA-06 1.55 m	LEAN CLAY(CL)	33	20	13		

Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● TL-HA-06 1.55 m	0.6	0.009	0.001		0.0	1.0	63.7	35.3



GRAIN SIZE DISTRIBUTION
 Project No.: TF7316548
 Client: Newfoundland and Labrador Hydro
 Project Name: AC 1060
 Location:

CAN EM GRAIN SIZE AC 1060.GPJ AMEC HALIFAX.GDT 12/11/07

Appendix D

Bog Probing Results



Bog Probing – Bog 1A				
Project:		AC1060 230kV TL Muskrat Falls to Gull Island		Tested By: Dave Oldford
Client:		Newfoundland and Labrador Hydro		Date Test: 26-Sept-07
Project No.:		722855		
Probe No.	Easting	Northing	Depth Penetrated (m)	View Looking Southeast
1	643762	5902805	1.00	
2	643729	5902807	1.20	
3	643678	5902796	1.25	
4	643636	5902781	1.75	
5	643597	5902763	1.90	
6	643547	5902753	2.06	
7	643508	5902731	2.00	
8	643465	5902714	2.17	
9	643424	5902690	1.80	
10	643384	5902665	1.70	
11	643344	5902649	1.50	
12	643303	5902623	1.25	
13	643268	5902596	1.08	
14	643230	5902563	0.80	
15	643194	5902540	1.02	
16	643155	5902519	0.95	
17	643111	5902493	1.04	
18	643073	5902466	0.65	
19	643023	5902440	0.67	
20	642984	5902411	0.60	



Bog Probing – Bog 2G				
Project:		AC1060 230kV TL Muskrat Falls to Gull Island		Tested By: Dave Oldford
Client:		Newfoundland and Labrador Hydro		Date Test: 26-Sept-07
Project No.:		722855		
Probe No.	Easting	Northing	Depth Penetrated (m)	View Looking West
18	628048	5890066	0.80	<p>West</p> <p>East</p> <p>Bog Probe Path - - - - -</p> <p>New Transmission Line - - - - -</p>
19	628014	5890033	0.90	
20	627976	5890009	0.73	
21	627941	5889989	0.93	

Bog Probing – Bog 3A				
Project:		AC1060 230kV TL Muskrat Falls to Gull Island		Tested By: Dave Oldford
Client:		Newfoundland and Labrador Hydro		Date Test: 26-Sept-07
Project No.:		722855		
Probe No.	Easting	Northing	Depth Penetrated (m)	View Looking Southwest
1	616489	5878724	1.60	<p>West</p> <p>East</p> <p>Bog Probe Path - - - - -</p> <p>New Transmission Line - - - - -</p>
2	616458	5878691	0.40	
3	616423	5878665	0.30	
4	616389	5878637	0.66	
5	616344	5878641	0.70	



Bog Probing – Bog 3B				
Project:		AC1060 230kV TL Muskrat Falls to Gull Island		Tested By: Dave Oldford
Client:		Newfoundland and Labrador Hydro		Date Test: 26-Sept-07
Project No.:		722855		
Probe No.	Easting	Northing	Depth Penetrated (m)	View Looking South
6	616024	5878398	1.55	
7	615996	5878369	1.50	
Bog Probe Path - - - - - New Transmission Line - - - - -				

Bog Probing – Bog 4A				
Project:		AC1060 230kV TL Muskrat Falls to Gull Island		Tested By: Dave Oldford
Client:		Newfoundland and Labrador Hydro		Date Test: 26-Sept-07
Project No.:		722855		
Probe No.	Easting	Northing	Depth Penetrated (m)	View Looking West
1	612543	5876767	0.43	
2	612487	5876697	0.55	
3	612448	5876684	0.40	
4	612338	5876653	0.54	
5	612278	5876651	0.90	
6	612203	5876654	0.45	
7	612098	5876702	0.80	
8	612055	5876684	0.66	
9	612009	5876669	0.95	
10	611965	5876644	0.85	
Bog Probe Path - - - - - New Transmission Line - - - - -				



Bog Probing – Bog 7A				
Project:		AC1060 230kV TL Muskrat Falls to Gull Island		Tested By: Dave Oldford
Client:		Newfoundland and Labrador Hydro		Date Test: 01-Nov-07
Project No.:		722855		
Probe No.	Easting	Northing	Depth Penetrated (m)	View Looking Northeast
1	608442	5871296	1.10	
2	608475	5871325	2.56	
3	608499	5871361	2.02	
4	608546	5871391	0.83	
5	608599	5871450	1.25	
6	608631	5871476	1.66	
7	608678	5871507	1.17	
8	608703	5871542	1.70	
9	608721	5871592	1.22	
10	608769	5871627	0.88	
11	608818	5871655	0.85	
12	608854	5871703	0.82	
13	608906	5871748	1.95	
14	608946	5871773	0.79	
15	608993	5871815	1.63	

Bog Probing – Bog 8A				
Project:		AC1060 230kV TL Muskrat Falls to Gull Island		Tested By: Dave Oldford
Client:		Newfoundland and Labrador Hydro		Date Test: 31-Oct-07
Project No.:		722855		
Probe No.	Easting	Northing	Depth Penetrated (m)	View Looking Northeast
1	612160	5874802	0.80	
2	612153	5874837	0.85	
3	612158	5874909	0.66	
4	612169	5874962	1.07	
5	612160	5875058	0.85	
6	612189	5875124	0.75	
7	612259	5875072	0.63	
8	612260	5875134	1.05	
9	612243	5875195	0.77	



Bog Probing – Bog 9A				
Project:		AC1060 230kV TL Muskrat Falls to Gull Island		Tested By: Dave Oldford
Client:		Newfoundland and Labrador Hydro		Date Test: 01-Nov-07
Project No.:		722855		
Probe No.	Easting	Northing	Depth Penetrated (m)	View Looking Southwest
1	612901	5875698	0.70	
2	612880	5875674	0.80	
3	612870	5875659	0.73	
4	612822	5875605	0.67	
5	612791	5875577	0.58	

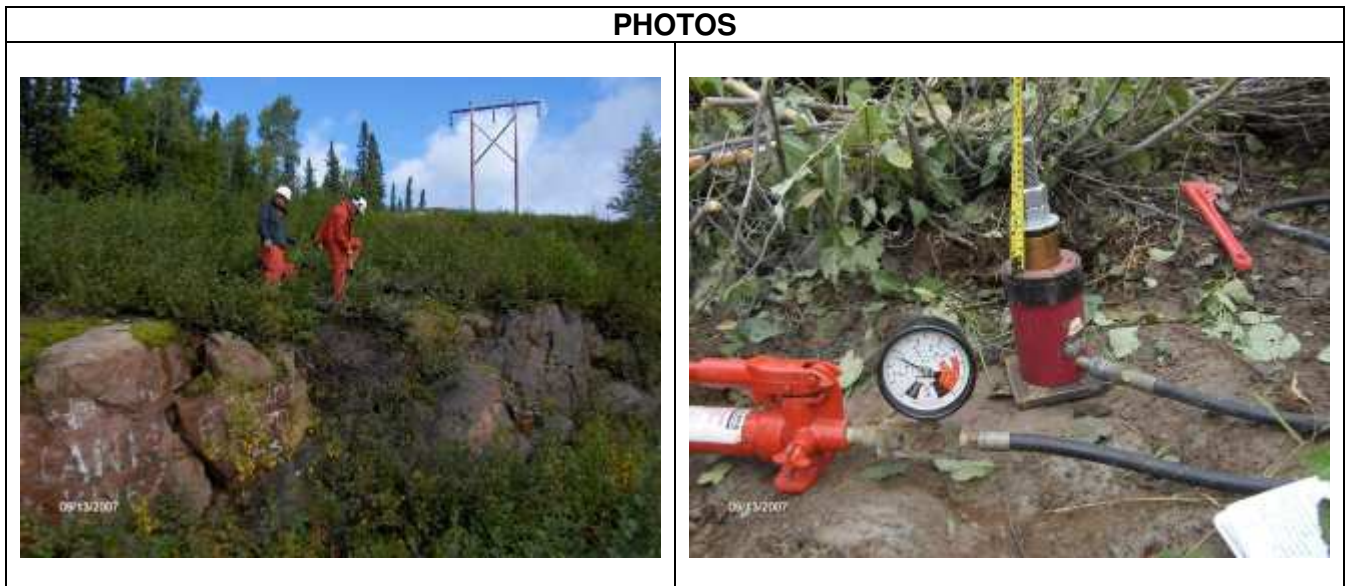
Bog Probing – Bog 10A				
Project:		AC1060 230kV TL Muskrat Falls to Gull Island		Tested By: Dave Oldford
Client:		Newfoundland and Labrador Hydro		Date Test: 01-Nov-07
Project No.:		722855		
Probe No.	Easting	Northing	Depth Penetrated (m)	View Looking Southwest
1	612591	5875337	1.20	
2	612563	5875300	1.47	
3	612537	5875251	1.41	
4	612531	5875171	1.32	
5	612484	5875104	1.20	
6	612457	5875068	1.00	
7	612432	5874985	1.06	
8	612399	5874914	0.82	
9	612359	5874837	0.93	
10	612333	5874810	0.95	
11	612294	5874770	1.16	

Appendix E

Anchor Testing Results

ANCHOR PULL OUT TEST: AC 1060-PO-1						
Firm:	Newfoundland Hydro	Project:	Lower Churchill Geotechnical Program			
Contract No.	AC 1060	Location:	N 5901209	E 0640453	Inspector:	DJD
Date	Sept 16, 2007	Start	09:30 am	Finish	11:20 am	

TEST LOCATION				
<ul style="list-style-type: none"> Location marked with Garmin recreational grade GPS (WPT No. 31) Test conducted on rock outcrop on north side of Trans Labrador Highway (TLH), where existing transmission line crosses TLH. 				
ROCK CONDITION OBSERVATIONS				
<ul style="list-style-type: none"> Rock outcrop predominated by fractured granite gneiss. Water seeping into hole at ~ 1.1 m. Very easy drilling 1.1 to 1.7 m. 				
PULL-OUT TEST RESULTS				
TIME		Applied Load (Tons)	Jack Rise (mm)	Notes
From	To			
				<ul style="list-style-type: none"> Start Test
11:05	11:06	1.5	5.0	<ul style="list-style-type: none"> Jack & rod turned slightly and settled in. ~ 5 mm rise in jack.
11:07	11:09	4.5		<ul style="list-style-type: none"> Jacked up to 4.5 tons Anchor began to slip in rock.
11:10	11:11	6.0	51.0	<ul style="list-style-type: none"> Held at 6.0 tons.
11:11	11:12	9.0		
11:12	11:14	17.0		<ul style="list-style-type: none"> Loaded up to 17 tons with three pumps of jack handle.
11:14	11:16	18.0	0.0	<ul style="list-style-type: none"> Loaded up to 18 tons (overload for jack). Held at 18 tons for two minutes. End of test.



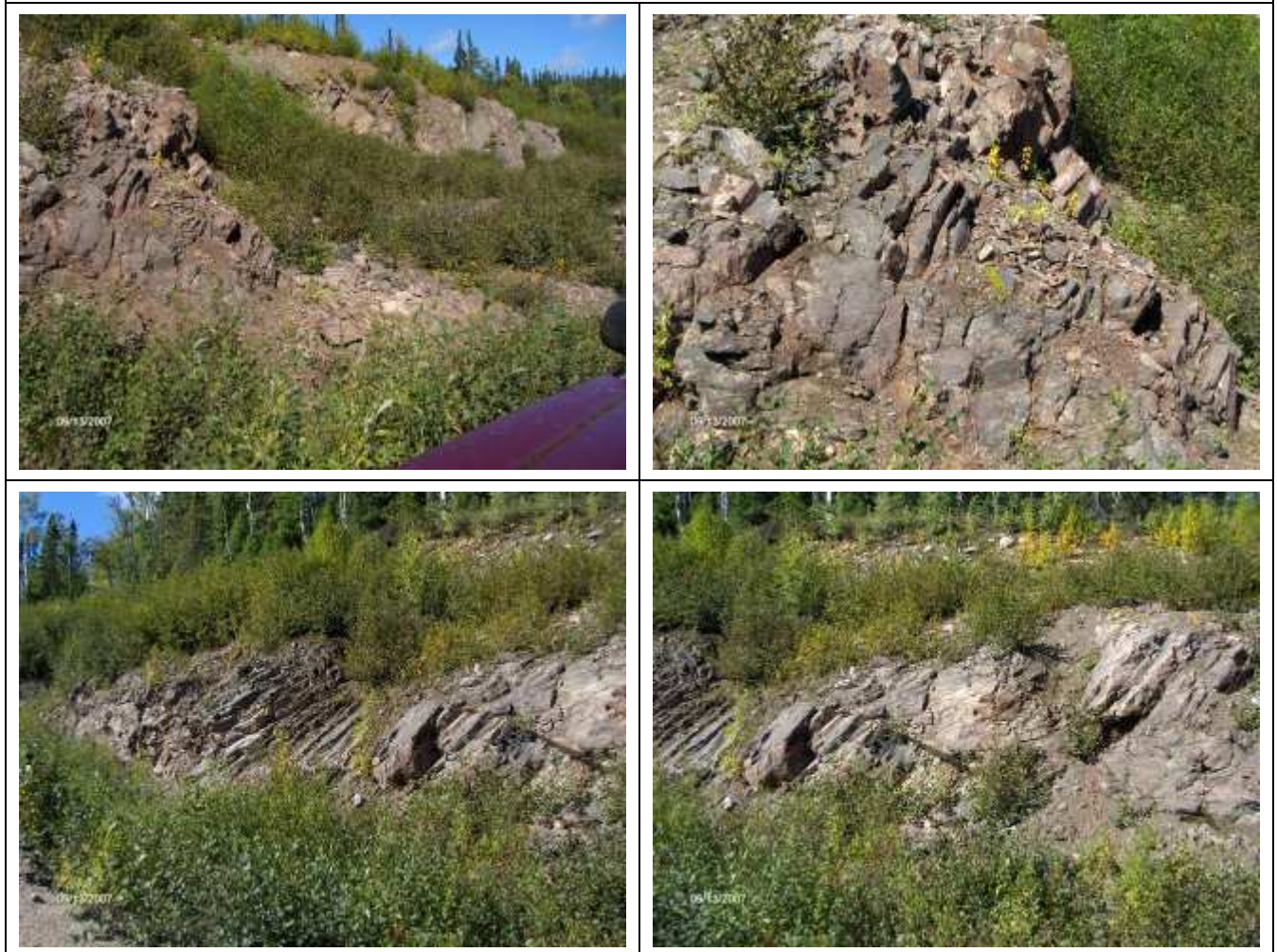
ANCHOR PULL OUT TEST: AC 1060-PO-2						
Firm:	Newfoundland Hydro	Project:	Lower Churchill Geotechnical Program			
Contract No.	AC 1060	Location:	N 5901422	E 0640832	Inspector:	DJD
Date	Sept 16, 2007	Start	11:45 am	Finish	12:45 pm	

TEST LOCATION
<ul style="list-style-type: none"> Location marked with Garmin recreational grade GPS (WPT No. 32) Test conducted on rock outcrop on north side of Trans Labrador Highway (TLH), in former quarry.

ROCK CONDITION OBSERVATIONS
<ul style="list-style-type: none"> Rock outcrop predominated by fractured granite gneiss. Easy drilling from 1.1 to 1.5 m. Very easy drilling from 1.5 to 1.7 m (rods dropping). Suspected shear zone. Slight moisture at 1.0 m, but hole staying dry at end of drilling.

PULL-OUT TEST RESULTS				
TIME		Applied Load (Tons)	Jack Rise (mm)	Notes
From	To			
				<ul style="list-style-type: none"> Lost two cones while trying to set anchor. Abandoned test.

PHOTOS



Appendix F

Moisture Density Relationship

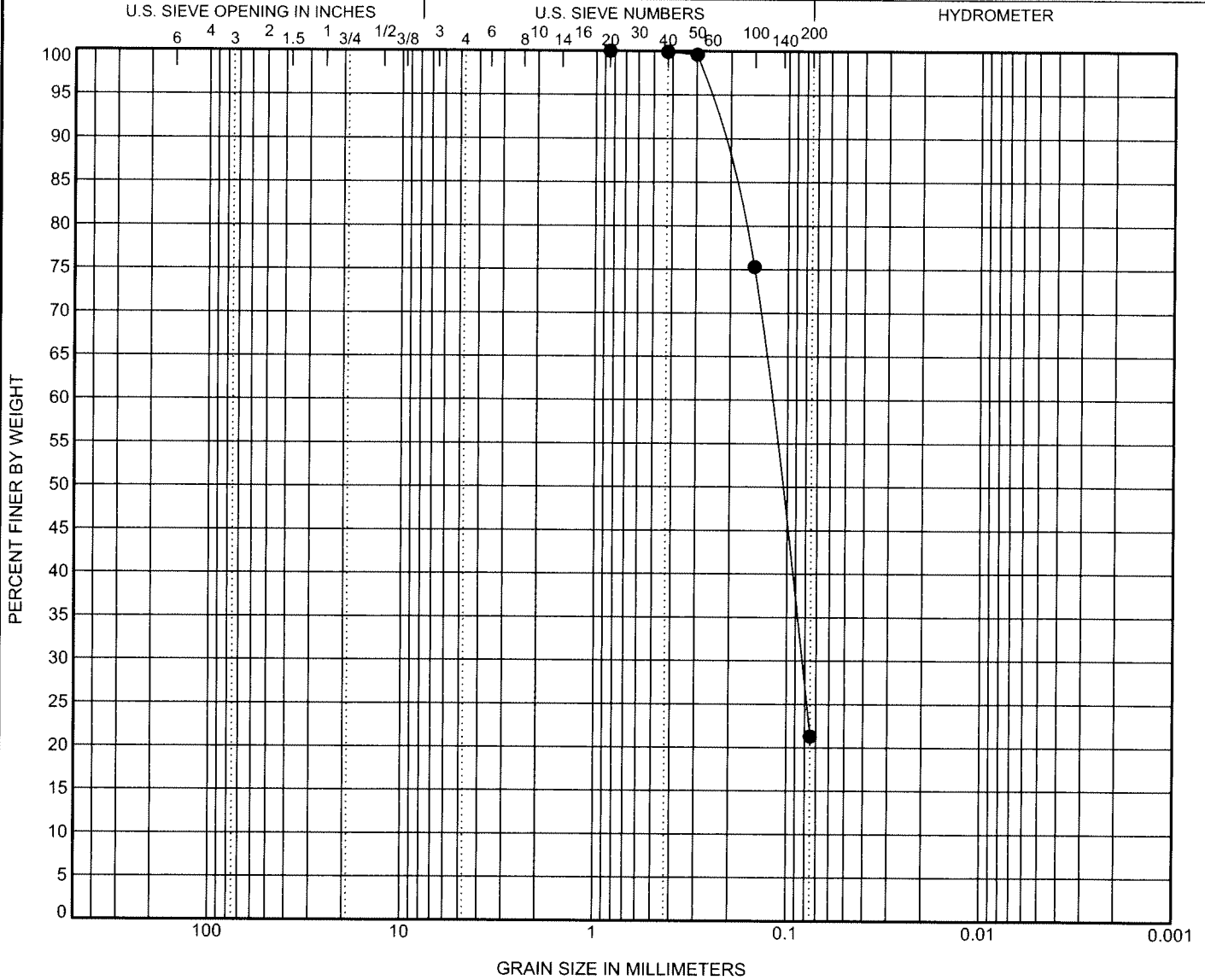


TEST PIT Hand Dug Test Pit 1

GRAIN SIZE DISTRIBUTION

CLIENT: Newfoundland and Labrador Hydro
 PROJECT: Lower Churchill Project

SITE: 230 kV Transmission Line - Muskrat Falls to Gull Island
 LOCATION: Right Bank Lower Slope Pinus



COBBLES	GRAVEL		SAND			CLAY OR SILT
	coarse	fine	coarse	medium	fine	

Test pit no.	Sample	Depth (m)	% Gravel		% Sand		% Silt		% Clay				
● Hand Dug Test Pit 1	GB-1	0.00 - 0.00	0.0		78.7				21.3				
☐													
▲													
★													
◎													
	80 mm	56 mm	40 mm	28 mm	20 mm	9.525 mm	4.76 mm	2 mm	0.85 mm	0.425 mm	0.3 mm	0.15 mm	0.075 mm
●									100.0	99.9	99.6	75.3	21.3
☐													
▲													
★													
◎													
Test pit no.	ASTM Classification		D60	D30	D10	W	LL	PL	PI	Cc	Cu		
● Hand Dug Test Pit 1	SAND with some Fines		0.1	0.1		10.6							
☐													
▲													
★													
◎													

GRAIN SIZE2 - TEST PIT 1 TRANSMISSION LINE_DATABASE AC1060_2007.GPJ GINT STD CANADA.GDT 08-1-25



TEST PIT Hand Dug Test Pit 2

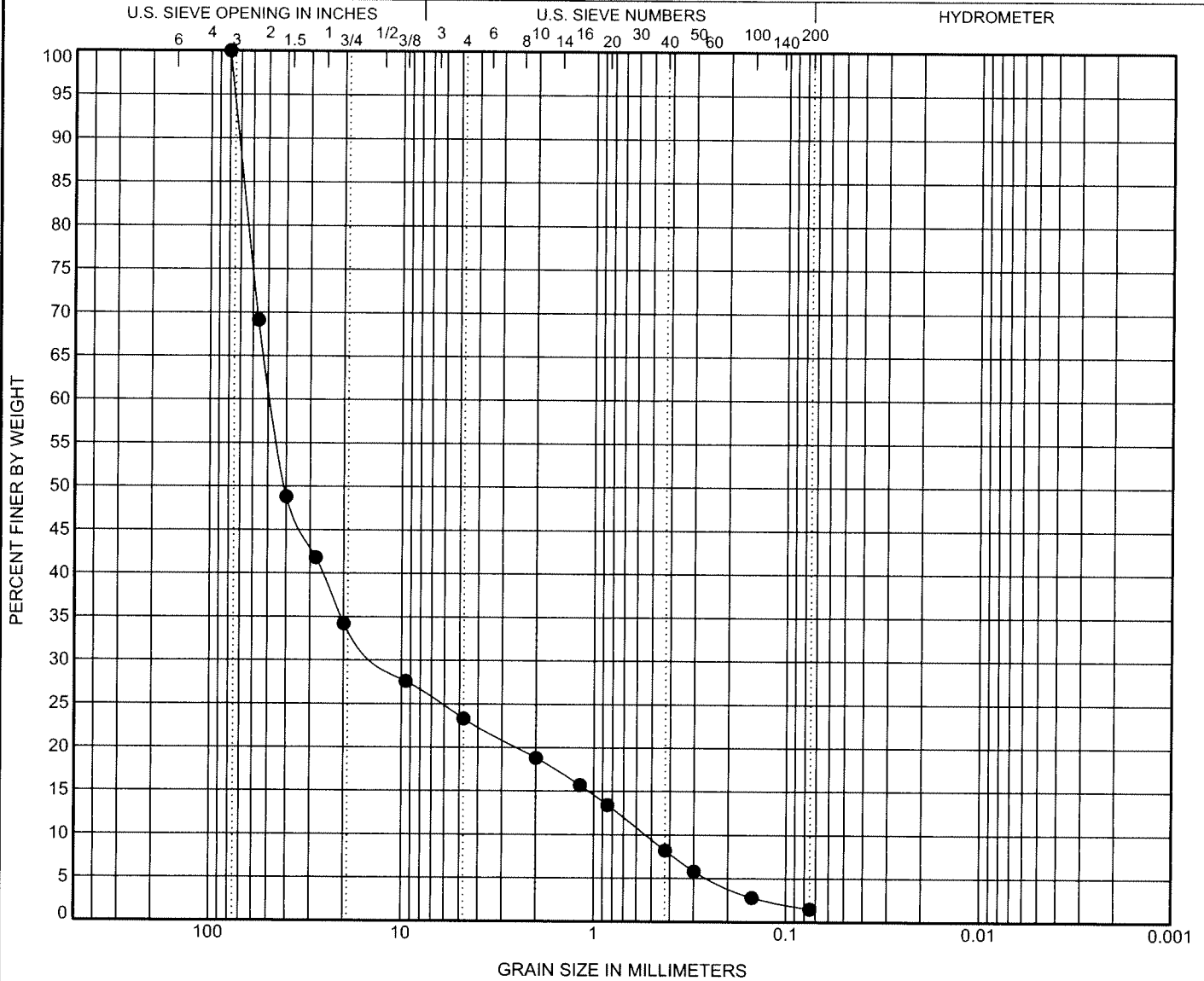
GRAIN SIZE DISTRIBUTION

CLIENT: Newfoundland and Labrador Hydro

SITE: 230 kV Transmission Line - Muskrat Falls to Gull Island

PROJECT: Lower Churchill Project

LOCATION: Right Bank Upper Slope Pinus



COBBLES	GRAVEL		SAND			CLAY OR SILT
	coarse	fine	coarse	medium	fine	

Test pit no.	Sample	Depth (m)	% Gravel		% Sand		% Silt		% Clay					
● Hand Dug Test Pit 2	GB-1	0.00 - 0.00	71.1		21.8		1.5							
□														
▲														
★														
○														
	80 mm	56 mm	40 mm	28 mm	20 mm	9.525 mm	4.76 mm	2 mm	0.85 mm	0.425 mm	0.3 mm	0.15 mm	0.075 mm	
●	100.0	69.1	48.8	41.8	34.2	27.6	23.3	18.8	13.4	8.2	5.8	2.8	1.5	
□														
▲														
★														
○														
Test pit no.	ASTM Classification					D60	D30	D10	W	LL	PL	PI	Cc	Cu
● Hand Dug Test Pit 2	POORLY GRADED GRAVEL with SAND(GP)					48.2	12.5	0.5	12.6				6.0	89.1
□														
▲														
★														
○														

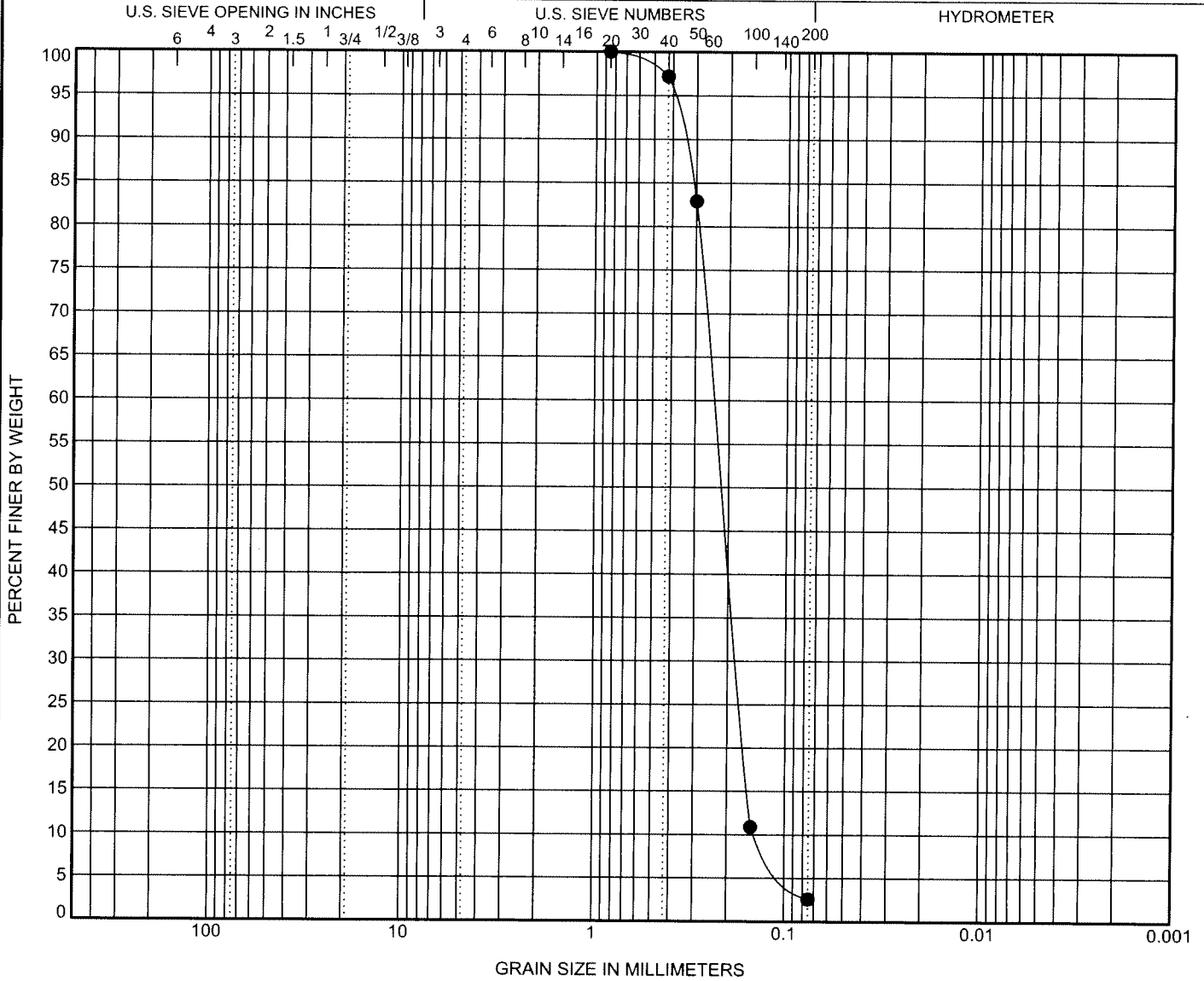
GRAIN SIZE2 - TEST PIT 1 TRANSMISSION LINE DATABASE AC1060_2007.GPJ GINT STD CANADA.GDT 08-1-25



TEST PIT Sand at Crossing 12 GRAIN SIZE DISTRIBUTION

CLIENT: Newfoundland and Labrador Hydro
PROJECT: Lower Churchill Project

SITE: 230 kV Transmission Line - Muskrat Falls to Gull Island
LOCATION: Sand Dune Near Stream Crossing 12



COBBLES	GRAVEL		SAND			CLAY OR SILT
	coarse	fine	coarse	medium	fine	

Test pit no.	Sample	Depth (m)	% Gravel		% Sand		% Silt		% Clay			
● Sand at Crossing 12	GB-1	0.00 - 0.00	0.0		97.4				2.6			
□												
▲												
★												
◎												
80 mm	56 mm	40 mm	28 mm	20 mm	9.525 mm	4.76 mm	2 mm	0.85 mm	0.425 mm	0.3 mm	0.15 mm	0.075 mm
●								100.0	97.2	82.9	10.9	2.6
□												
▲												
★												
◎												
Test pit no.	ASTM Classification		D60	D30	D10	W	LL	PL	PI	Cc	Cu	
● Sand at Crossing 12	POORLY GRADED SAND(SP)		0.2	0.2	0.1	4.3				1.0	1.7	
□												
▲												
★												
◎												

GRAIN SIZE2 - TEST PIT.1 TRANSMISSION LINE DATABASE AC1060_2007.GPJ GINT STD CANADA.GDT 08-1-25

MOISTURE DENSITY RELATIONSHIP



Lab No: 704

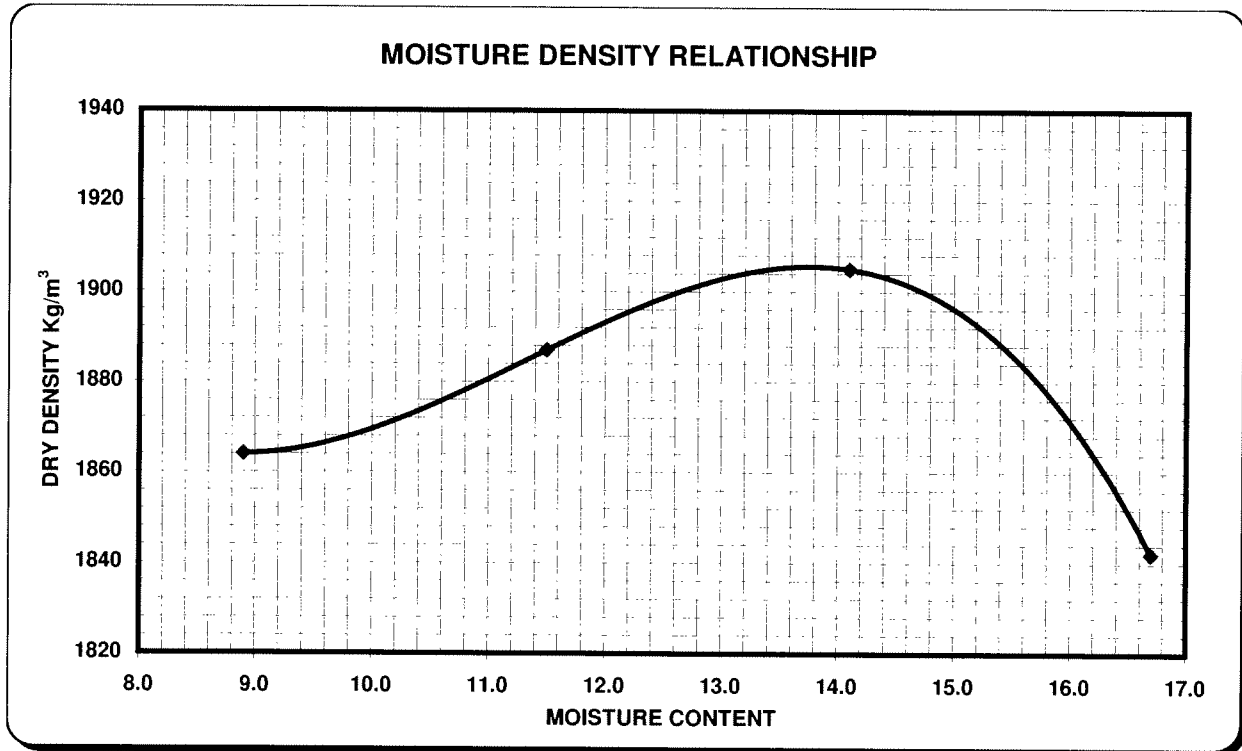
Client: Newfoundland and Labrador Hydro
 Project No: 722855
 Project: AC 1060 230 kV TL Muskrat to Gull Island
 Sample #: AC1060-TL-PR-01
 Sample Type / Source: Clayey Silt from cuts in the road embankment on TLH

Date Sampled: September 30, 2007 Sampled By Dwayne Druggett

Date Received: September 30, 2007 Preparation _____

Percent Retained:	> 19mm = 0.0%
-------------------	---------------

Compaction Std.	ASTM D698		Method	C
Moisture Content	8.9	11.5	14.1	16.7
Dry Density kg/m ³	1864	1887	1905	1842



Note : Oversized Material Correction > 19mm = 0.0%

Maximum Dry Density	1906 kg/m ³	Corrected Dry Density	1906 kg/m ³
Maximum Moisture	13.8 %	Maximum Moisture	13.8 %

Tested by, Ken Collier

Reviewed by, _____



SNC-LAVALIN

TEST PIT AC1060-TL-PR-01

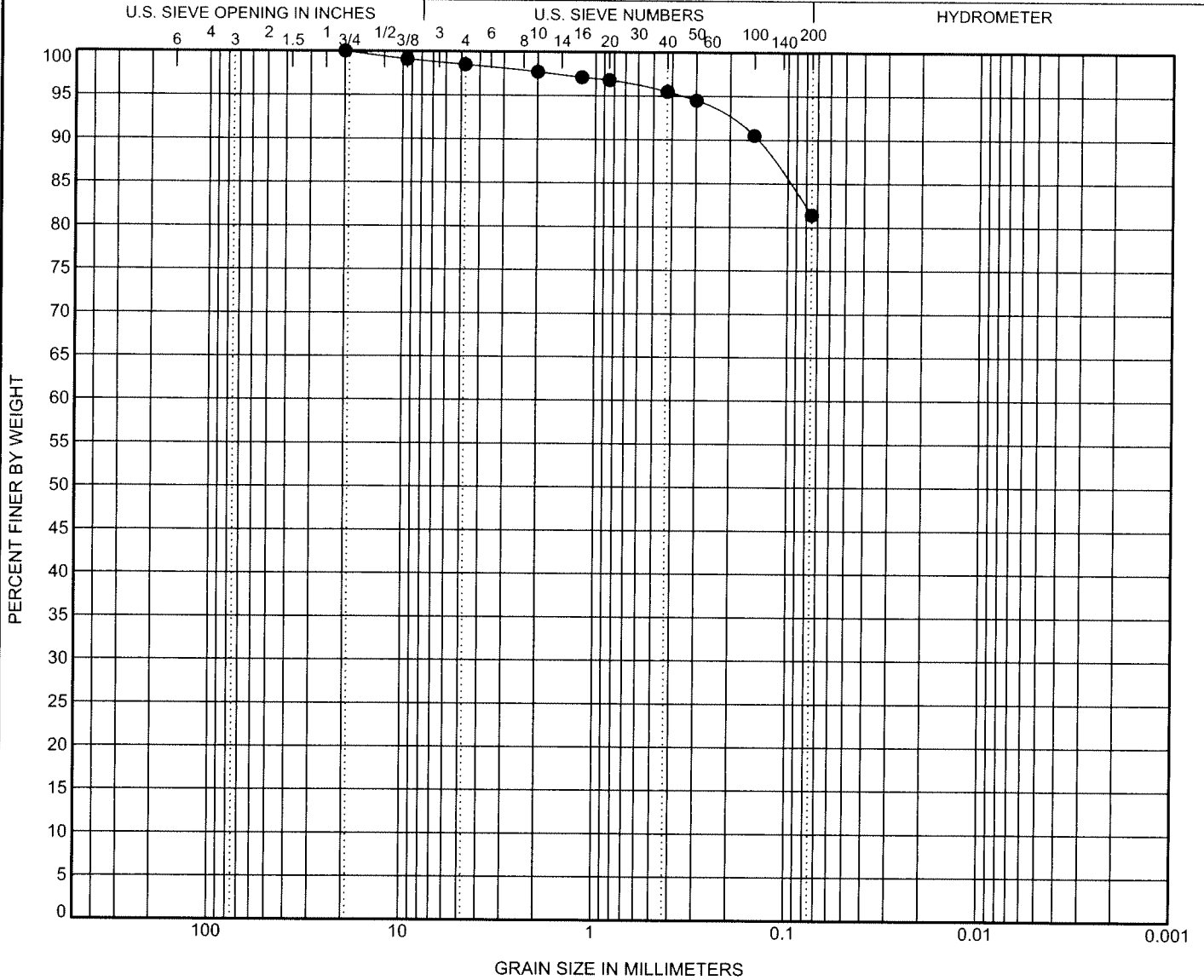
GRAIN SIZE DISTRIBUTION

CLIENT: Newfoundland and Labrador Hydro

SITE: 230 kV Transmission Line - Muskrat Falls to Gull Island

PROJECT: Lower Churchill Project

LOCATION: Transmission Line



COBBLES	GRAVEL		SAND			CLAY OR SILT
	coarse	fine	coarse	medium	fine	

Test pit no.	Sample	Depth (m)	% Gravel		% Sand		% Silt		% Clay			
● AC1060-TL-PR-01	GB-1	0.00 - 0.00	1.5		17.1				81.4			
■												
▲												
★												
◎												
80 mm	56 mm	40 mm	28 mm	20 mm	9.525 mm	4.76 mm	2 mm	0.85 mm	0.425 mm	0.3 mm	0.15 mm	0.075 mm
●				100.0	99.1	98.5	97.7	96.8	95.5	94.5	90.5	81.4
■												
▲												
★												
◎												
Test pit no.	ASTM Classification		D60	D30	D10	W	LL	PL	PI	Cc	Cu	
● AC1060-TL-PR-01	FINES with trace Sand					5.4						
■												
▲												
★												
◎												

GRAIN SIZE 2 - TEST PIT 1, TRANSMISSION LINE, DATABASE AC1060_2007.GPJ, GINT STD CANADA.GDT 08-1-25

MOISTURE DENSITY RELATIONSHIP



Lab No: 705

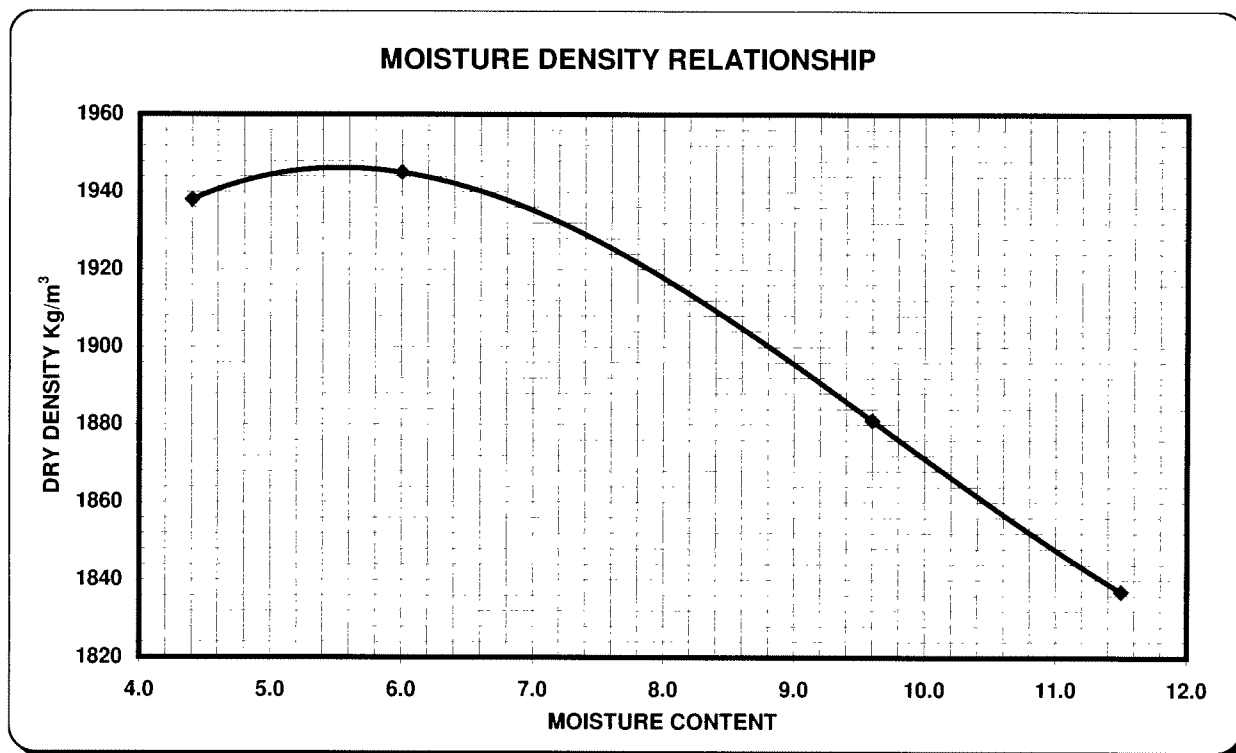
Client: Newfoundland and Labrador Hydro
 Project No: 722855
 Project: AC 1060 230 kV TL Muskrat to Gull Island
 Sample #: AC1060-TL-PR-02
 Sample Type / Source: Sand from cuts in the road embankment on TLH

Date Sampled: September 30, 2007 Sampled By Dwayne Druggett

Date Received: September 30, 2007 Preparation _____

Percent Retained:	> 19mm = 11.3%
-------------------	----------------

Compaction Std.	ASTM D698		Method	C
Moisture Content	4.4	6.0	9.6	11.5
Dry Density kg/m ³	1938	1945	1881	1837



Note : Oversized Material Correction > 19mm = 11.3%

Maximum Dry Density	1946 kg/m ³	Corrected Dry Density	1998.7 kg/m ³
Maximum Moisture	5.6 %	Maximum Moisture	5.1 %

Tested by, Ken Collier

Reviewed by, _____



SNC-LAVALIN

TEST PIT AC1060-TL-PR-02

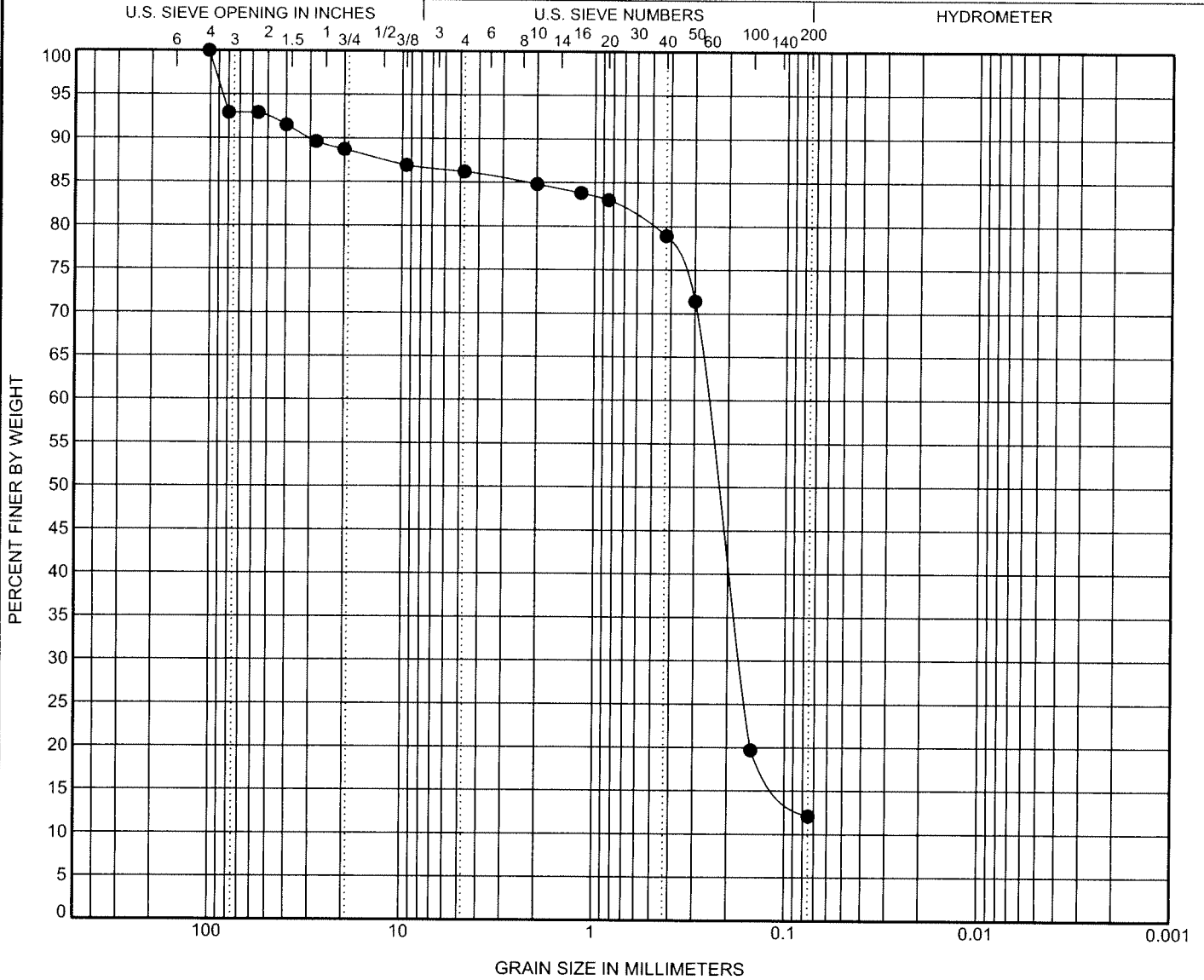
GRAIN SIZE DISTRIBUTION

CLIENT: Newfoundland and Labrador Hydro

SITE: 230 kV Transmission Line - Muskrat Falls to Gull Island

PROJECT: Lower Churchill Project

LOCATION: Transmission Line



COBBLES	GRAVEL		SAND			CLAY OR SILT
	coarse	fine	coarse	medium	fine	

Test pit no.	Sample	Depth (m)	% Gravel		% Sand		% Silt		% Clay				
● AC1060-TL-PR-02	GB-1	0.00 - 0.00	6.7		74.1		12.1						
■													
▲													
★													
◎													
	80 mm	56 mm	40 mm	28 mm	20 mm	9.525 mm	4.76 mm	2 mm	0.85 mm	0.425 mm	0.3 mm	0.15 mm	0.075 mm
●	92.9	92.9	91.5	89.6	88.7	86.9	86.2	84.8	83.0	78.9	71.4	19.7	12.1
■													
▲													
★													
◎													
Test pit no.	ASTM Classification		D60	D30	D10	W	LL	PL	PI	Cc	Cu		
● AC1060-TL-PR-02	SAND with some Fines, trace Cobbles & Gravel		0.3	0.2		11.7				1.9	4.2		
■													
▲													
★													
◎													

GRAIN SIZE 2 - TEST PIT 1, TRANSMISSION LINE, DATABASE AC1060_2007.GPJ GINT STD CANADA.GDT 08-1-25

MOISTURE DENSITY RELATIONSHIP



Lab No: 706

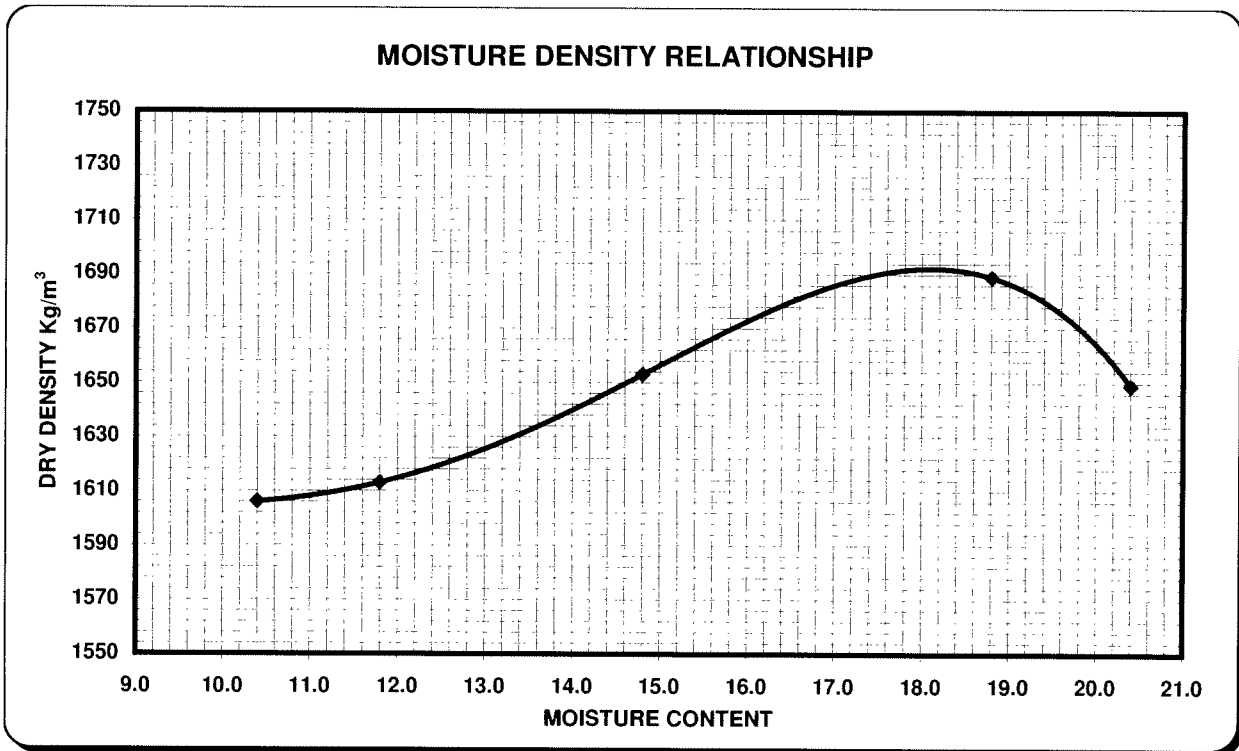
Client: Newfoundland and Labrador Hydro
 Project No: 722855
 Project: AC 1060 230 kV TL Muskrat to Gull Island
 Sample #: AC1060-TL-PR-03
 Sample Type / Source: Silty Clay from cuts in the road embankment on TLH

Date Sampled: September 30, 2007 Sampled By Dwayne Druggett

Date Received: September 30, 2007 Preparation _____

Percent Retained:	> 19mm = 0.0%
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Compaction Std.	ASTM D698		Method	C	
Moisture Content	10.4	11.8	14.8	18.8	20.4
Dry Density kg/m ³	1606	1613	1653	1689	1649



Note : Oversized Material Correction > 19mm = 0.0%
 Maximum Dry Density 1690.3 kg/m³ Corrected Dry Density 1690.3 kg/m³
 Maximum Moisture 18 % Maximum Moisture 18 %

Tested by, Ken Collier

Reviewed by, _____



SNC · LAVALIN

TEST PIT AC1060-TL-PR-03

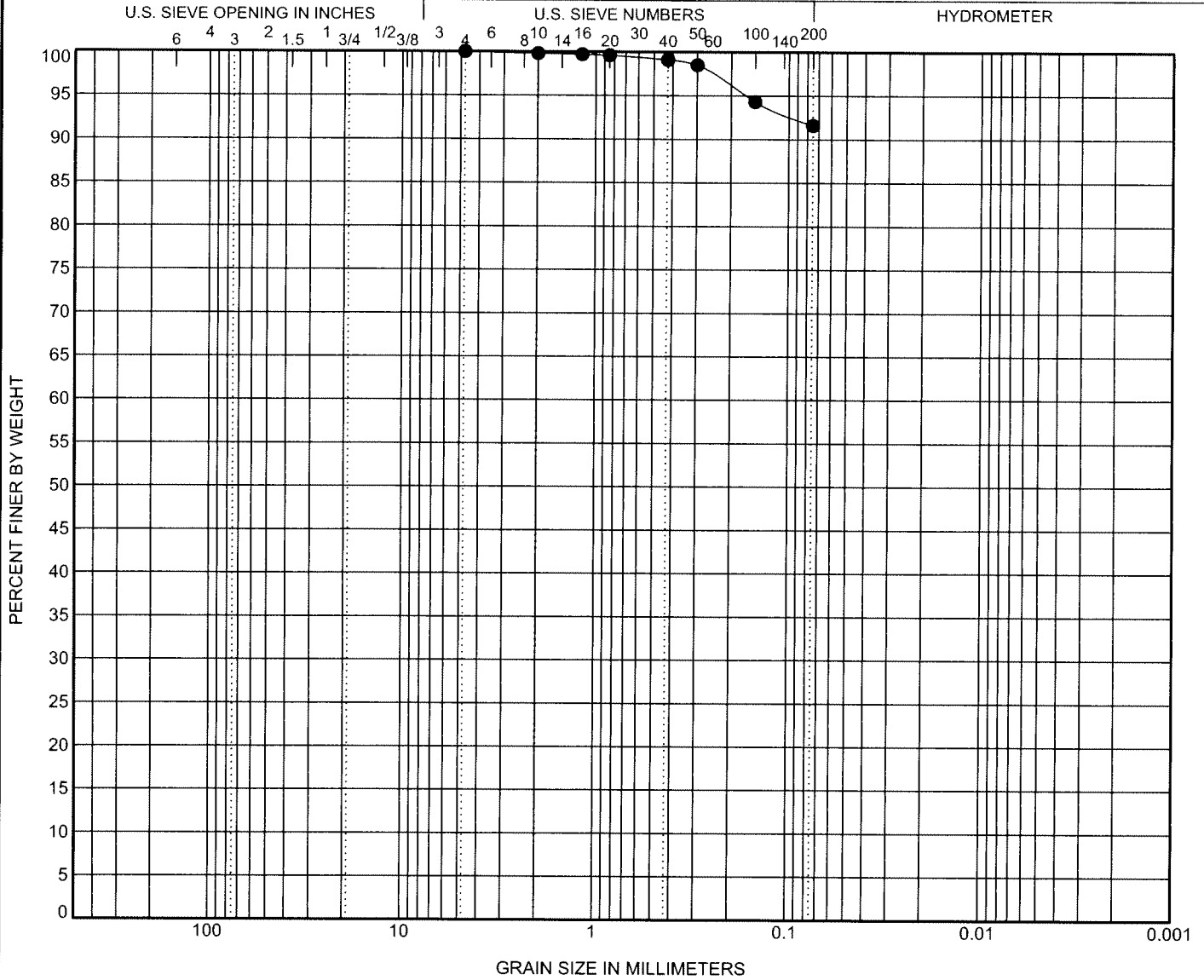
GRAIN SIZE DISTRIBUTION

CLIENT: Newfoundland and Labrador Hydro

SITE: 230 kV Transmission Line - Muskrat Falls to Gull Island

PROJECT: Lower Churchill Project

LOCATION: Transmission Line



COBBLES	GRAVEL		SAND			CLAY OR SILT
	coarse	fine	coarse	medium	fine	

Test pit no.	Sample	Depth (m)	% Gravel			% Sand			% Silt			% Clay	
● AC1060-TL-PR-03	GB-1	0.00 - 0.00	0.0			8.4			91.6				
▲													
★													
○													
80 mm	56 mm	40 mm	28 mm	20 mm	9.525 mm	4.76 mm	2 mm	0.85 mm	0.425 mm	0.3 mm	0.15 mm	0.075 mm	
●						100.0	99.8	99.6	99.1	98.5	94.3	91.6	
▲													
★													
○													
Test pit no.	ASTM Classification				D60	D30	D10	W	LL	PL	PI	Cc	Cu
● AC1060-TL-PR-03	FINES with trace Sand							2.5					
▲													
★													
○													

GRAIN SIZE 2 - TEST PIT 1, TRANSMISSION LINE, DATABASE, AC1060_2007.GPJ GINT STD CANADA.GDT 08-1-25

MOISTURE DENSITY RELATIONSHIP



Lab No: 707

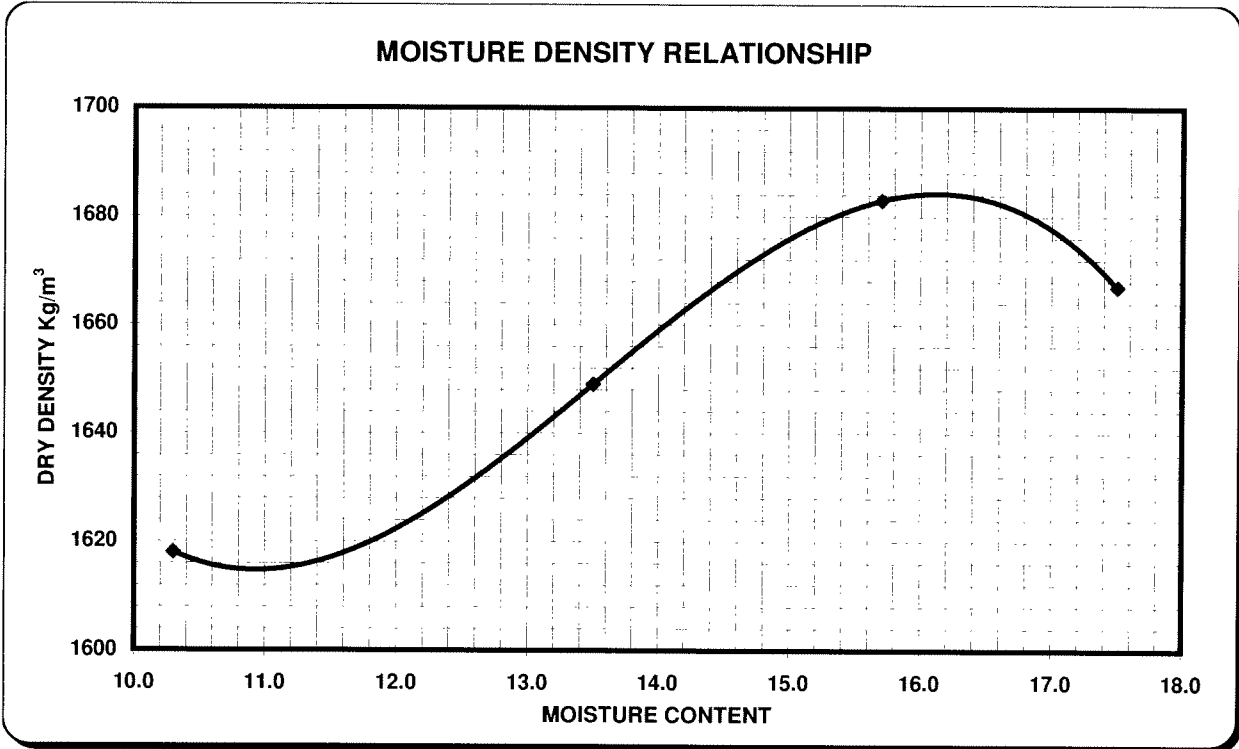
Client: Newfoundland and Labrador Hydro
 Project No: 722855
 Project: AC 1060 230 kV TL Muskrat to Gull Island
 Sample #: AC1060-TL-PR-04
 Sample Type / Source: Sand from cuts in the road embankment on TLH

Date Sampled: September 30, 2007 Sampled By Dwayne Druggett

Date Received: September 30, 2007 Preparation _____

Percent Retained:	> 19mm = 0.0%
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Compaction Std.	ASTM D698		Method	C
Moisture Content	10.3	13.5	15.7	17.5
Dry Density kg/m ³	1618	1649	1683	1667



Note : Oversized Material Correction > 19mm = 0.0%

Maximum Dry Density	1684.2 kg/m ³	Corrected Dry Density	1684.2 kg/m ³
Maximum Moisture	16.1 %	Maximum Moisture	16.1 %

Tested by, Ken Collier

Reviewed by, _____



SNC-LAVALIN

TEST PIT AC1060-TL-PR-04

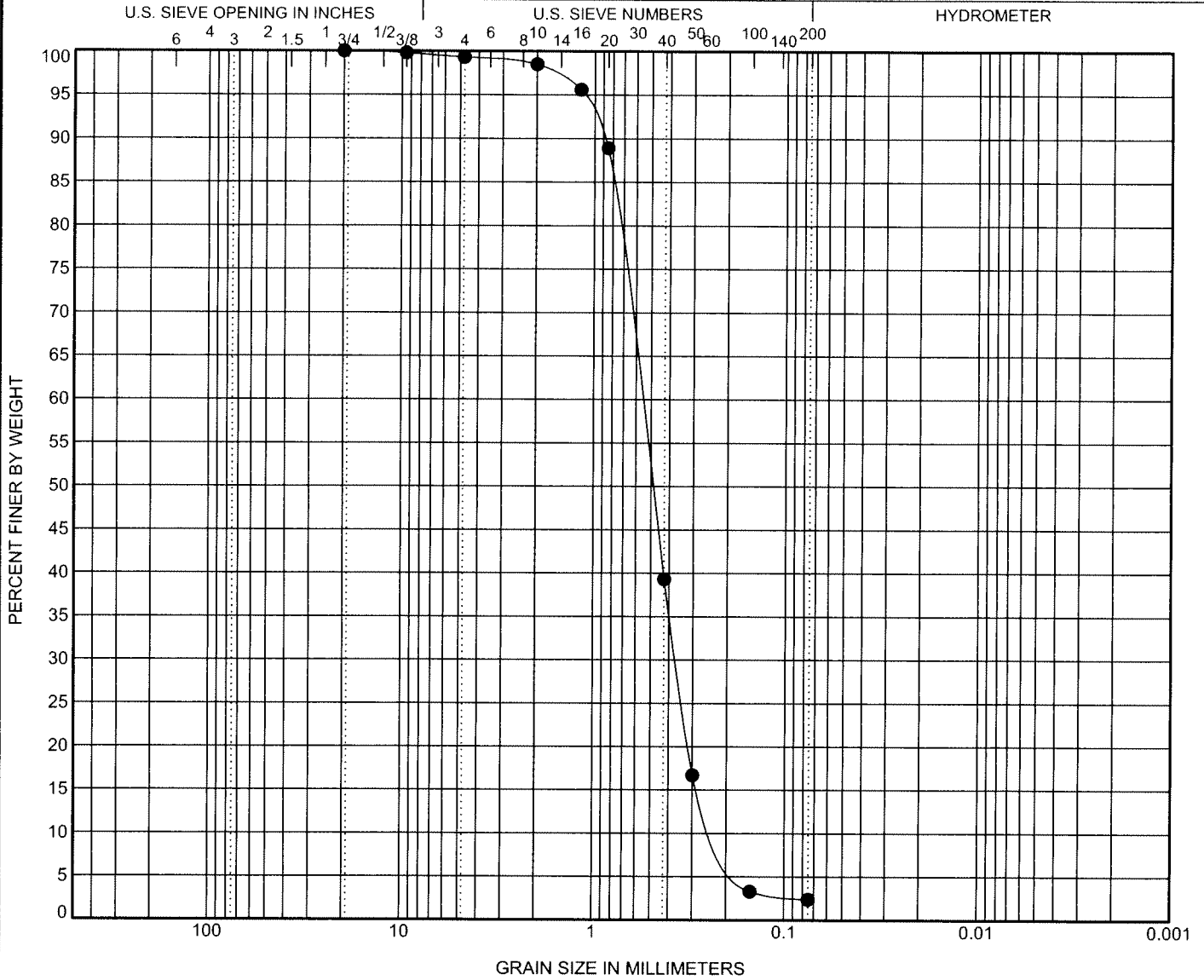
GRAIN SIZE DISTRIBUTION

CLIENT: Newfoundland and Labrador Hydro

SITE: 230 kV Transmission Line - Muskrat Falls to Gull Island

PROJECT: Lower Churchill Project

LOCATION: Transmission Line



COBBLES	GRAVEL		SAND			CLAY OR SILT
	coarse	fine	coarse	medium	fine	

Test pit no.	Sample	Depth (m)	% Gravel		% Sand		% Silt	% Clay				
● AC1060-TL-PR-04	GB-1	0.00 - 0.00	0.7		96.9		2.4					
■												
▲												
★												
◎												
80 mm	56 mm	40 mm	28 mm	20 mm	9.525 mm	4.76 mm	2 mm	0.85 mm	0.425 mm	0.3 mm	0.15 mm	0.075 mm
●				100.0	99.8	99.3	98.5	88.9	39.3	16.7	3.3	2.4
■												
▲												
★												
◎												
Test pit no.	ASTM Classification			D60	D30	D10	W	LL	PL	PI	Cc	Cu
● AC1060-TL-PR-04	POORLY GRADED SAND(SP)			0.6	0.4	0.2	4.4				1.1	2.7
■												
▲												
★												
◎												

GRAIN SIZE2 - TEST PIT 1, TRANSMISSION LINE, DATABASE, AC1060_2007.GPJ GINT STD CANADA.GDT 08-1-25

MOISTURE DENSITY RELATIONSHIP



Lab No: 708

Client: Newfoundland and Labrador Hydro
 Project No: 722855
 Project: AC 1060 230 kV TL Muskrat to Gull Island
 Sample #: AC1060-TL-PR-05
 Sample Type / Source: Sand from cuts in the road embankment on TLH

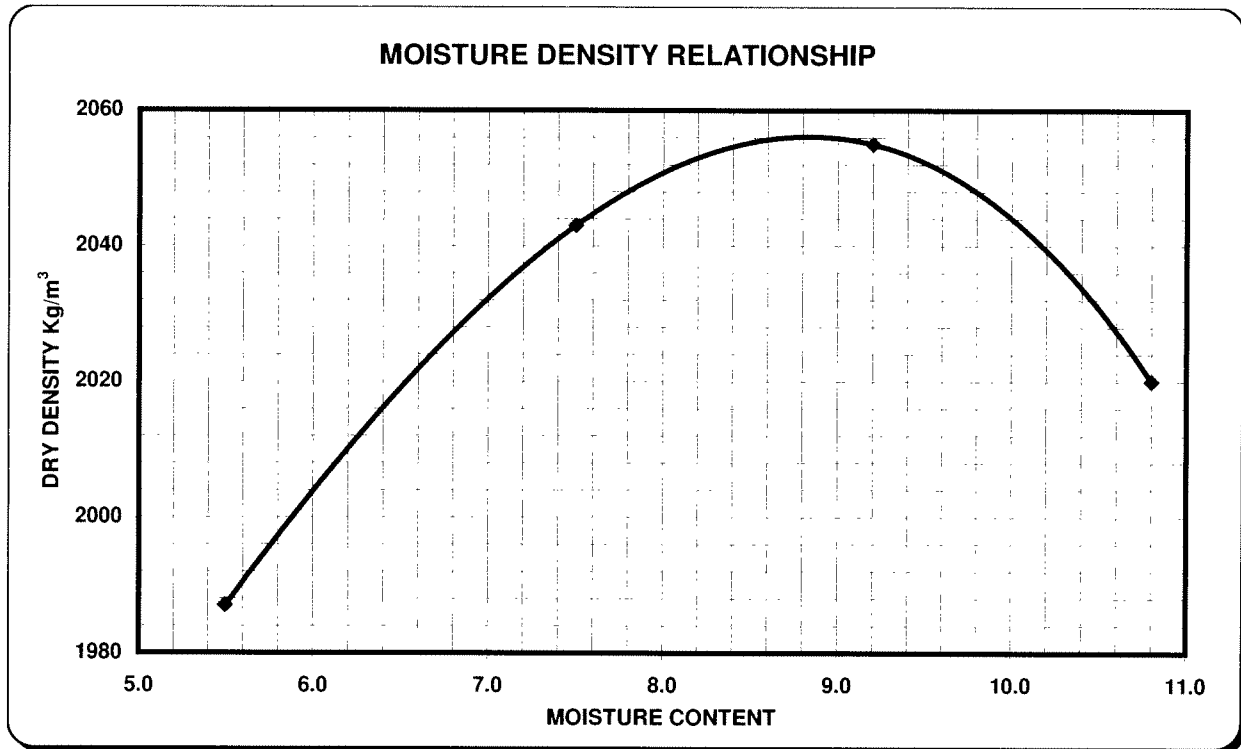
Date Sampled: September 28, 2007 Sampled By Dwayne Druggett

Date Received: September 28, 2007 Preparation _____

Percent Retained:	> 19mm = 20.4%
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Compaction Std.	ASTM D698	Method	C
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Moisture Content	5.5	7.5	9.2	10.8	
Dry Density kg/m ³	1987	2043	2055	2020	



Note : Oversized Material Correction > 19mm = 20.4%

Maximum Dry Density	2056 kg/m ³	Corrected Dry Density	2128.6 kg/m ³
Maximum Moisture	8.8 %	Maximum Moisture	7.3 %

Tested by, Ken Collier

Reviewed by, _____



SNC-LAVALIN

TEST PIT AC1060-TL-PR-05

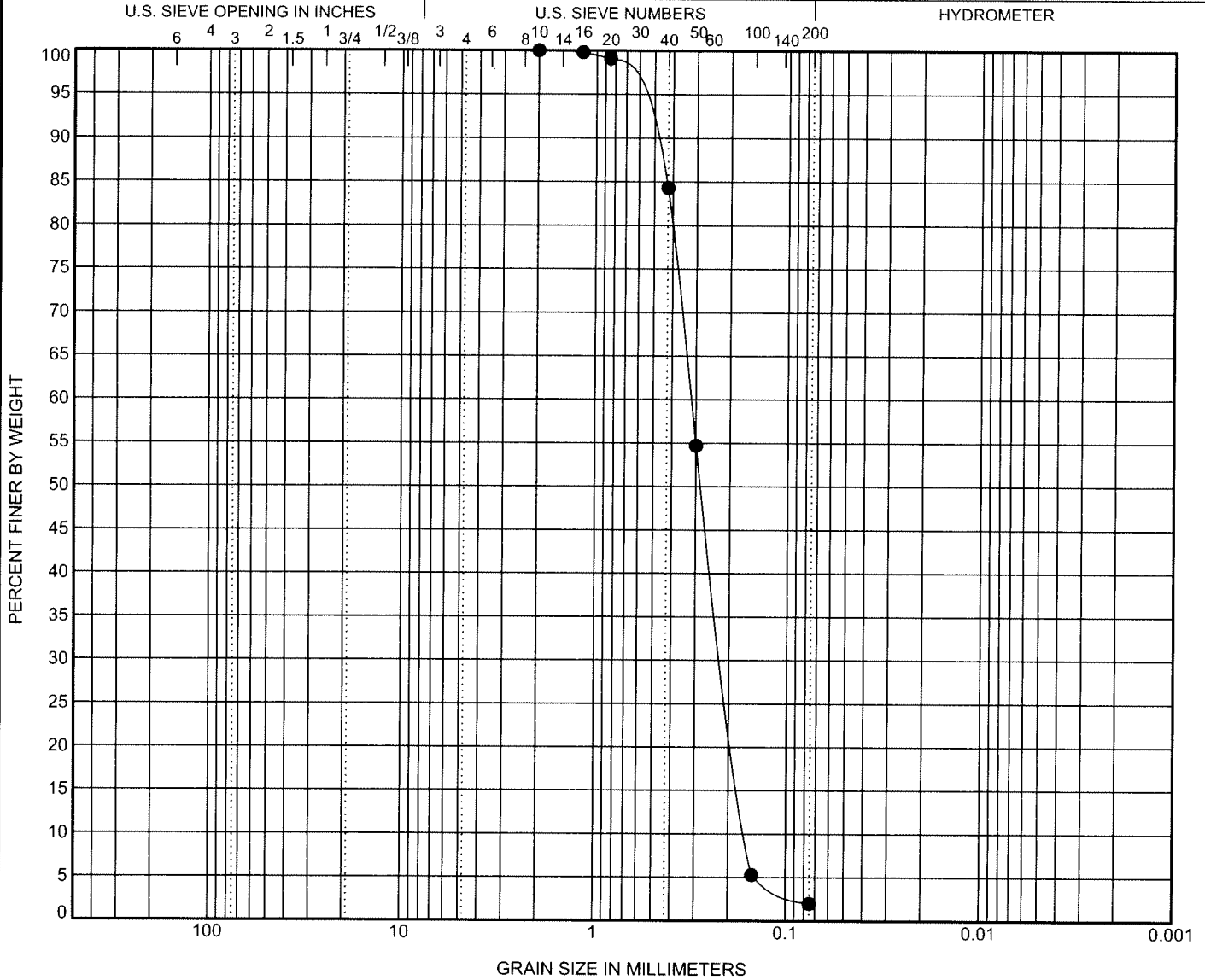
GRAIN SIZE DISTRIBUTION

CLIENT: Newfoundland and Labrador Hydro

SITE: 230 kV Transmission Line - Muskrat Falls to Gull Island

PROJECT: Lower Churchill Project

LOCATION: Transmission Line



COBBLES	GRAVEL		SAND			CLAY OR SILT
	coarse	fine	coarse	medium	fine	

Test pit no.	Sample	Depth (m)	% Gravel		% Sand		% Silt	% Clay
● AC1060-TL-PR-05	GB-1	0.00 - 0.00	0.0		98.0		2.0	
■								
▲								
★								
◎								

80 mm	56 mm	40 mm	28 mm	20 mm	9.525 mm	4.76 mm	2 mm	0.85 mm	0.425 mm	0.3 mm	0.15 mm	0.075 mm
							100.0	99.1	84.3	54.7	5.3	2.0
●												
■												
▲												
★												
◎												

Test pit no.	ASTM Classification	D60	D30	D10	W	LL	PL	PI	Cc	Cu
● AC1060-TL-PR-05	POORLY GRADED SAND(SP)	0.3	0.2	0.2	5.8				0.9	2.0
■										
▲										
★										
◎										

GRAIN SIZE2 - TEST PIT 1, TRANSMISSION LINE, DATABASE, AC1060_2007.GPJ GINT STD CANADA.GDT 08-1-25

MOISTURE DENSITY RELATIONSHIP



Lab No: 709

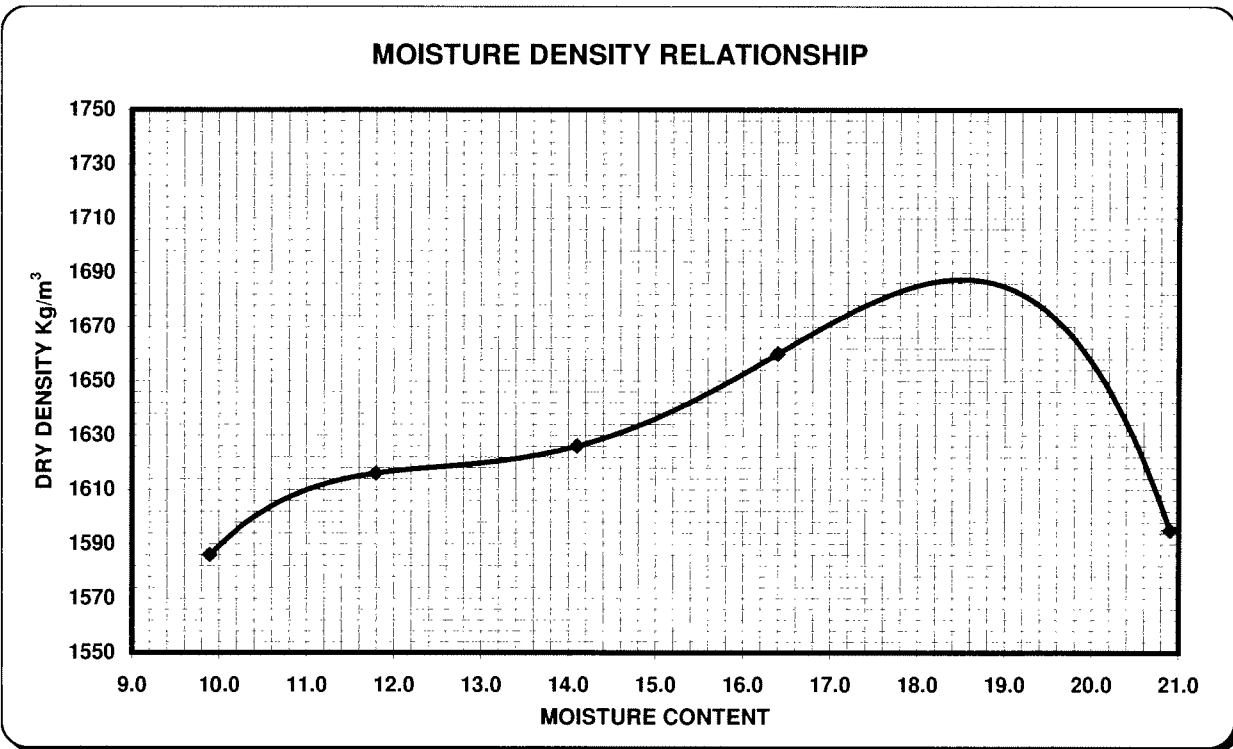
Client: Newfoundland and Labrador Hydro
 Project No: 722855
 Project: AC 1060 230 kV TL Muskrat to Gull Island
 Sample #: AC1060-TL-PR-06
 Sample Type / Source: Sand from cuts in the road embankment on TLH

Date Sampled: September 30, 2007 Sampled By Dwayne Druggett

Date Received: September 30, 2007 Preparation _____

Percent Retained:	> 19mm = 0.0%
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Compaction Std.	ASTM D698		Method	C	
Moisture Content	9.9	11.8	14.1	16.4	20.9
Dry Density kg/m ³	1586	1616	1626	1660	1595



Note : Oversized Material Correction > 19mm = 0.0%

Maximum Dry Density	1690 kg/m ³	Corrected Dry Density	1690 kg/m ³
Maximum Moisture	18.6 %	Maximum Moisture	18.6 %

Tested by, Ken Collier Reviewed by, _____



SNC-LAVALIN

TEST PIT AC1060-TL-PR-06

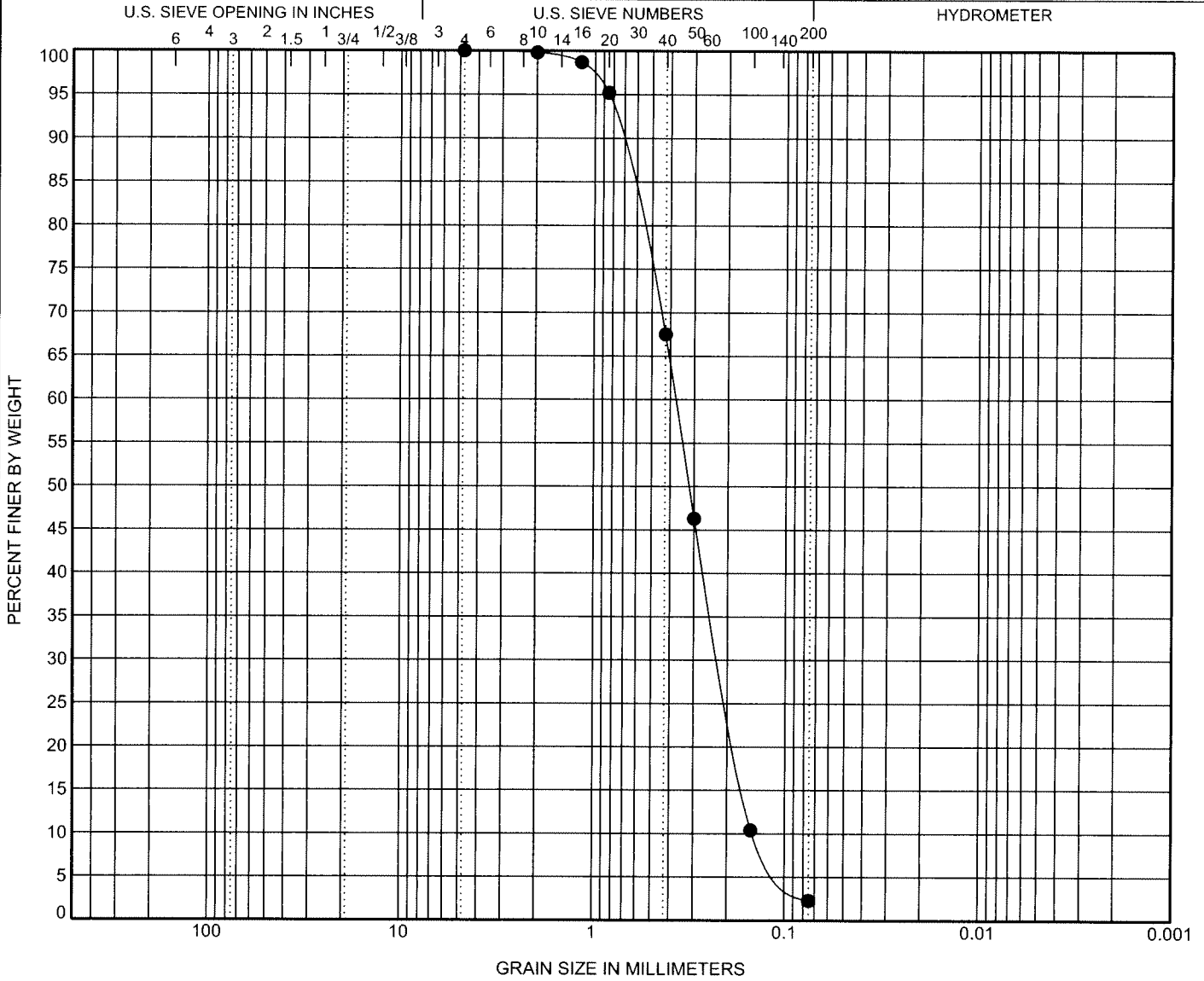
GRAIN SIZE DISTRIBUTION

CLIENT: Newfoundland and Labrador Hydro

SITE: 230 kV Transmission Line - Muskrat Falls to Gull Island

PROJECT: Lower Churchill Project

LOCATION: Transmission Line



COBBLES	GRAVEL		SAND			CLAY OR SILT
	coarse	fine	coarse	medium	fine	

Test pit no.	Sample	Depth (m)	% Gravel		% Sand				% Silt		% Clay		
● AC1060-TL-PR-06	GB-1	0.00 - 0.00	0.0	0.0	97.7	97.7	95.2	67.5	46.3	10.4	2.3		
▲													
★													
◎													
80 mm	56 mm	40 mm	28 mm	20 mm	9.525 mm	4.76 mm	2 mm	0.85 mm	0.425 mm	0.3 mm	0.15 mm	0.075 mm	
●						100.0	99.8	95.2	67.5	46.3	10.4	2.3	
▲													
★													
◎													
Test pit no.	ASTM Classification				D60	D30	D10	W	LL	PL	PI	Cc	Cu
● AC1060-TL-PR-06	POORLY GRADED SAND(SP)				0.4	0.2	0.1	7.2				0.9	2.6
▲													
★													
◎													

GRAIN SIZE2 - TEST PIT 1, TRANSMISSION LINE, DATABASE, AC1060_2007.GPJ, GINT STD CANADA.GDT 08-1-25

MOISTURE DENSITY RELATIONSHIP



Lab No: 710

Client: Newfoundland and Labrador Hydro
 Project No: 722855
 Project: AC 1060 230 kV TL Muskrat to Gull Island
 Sample #: AC1060-TL-PR-07
 Sample Type / Source: Sandy Gravel from cuts in the road embankment on TLH

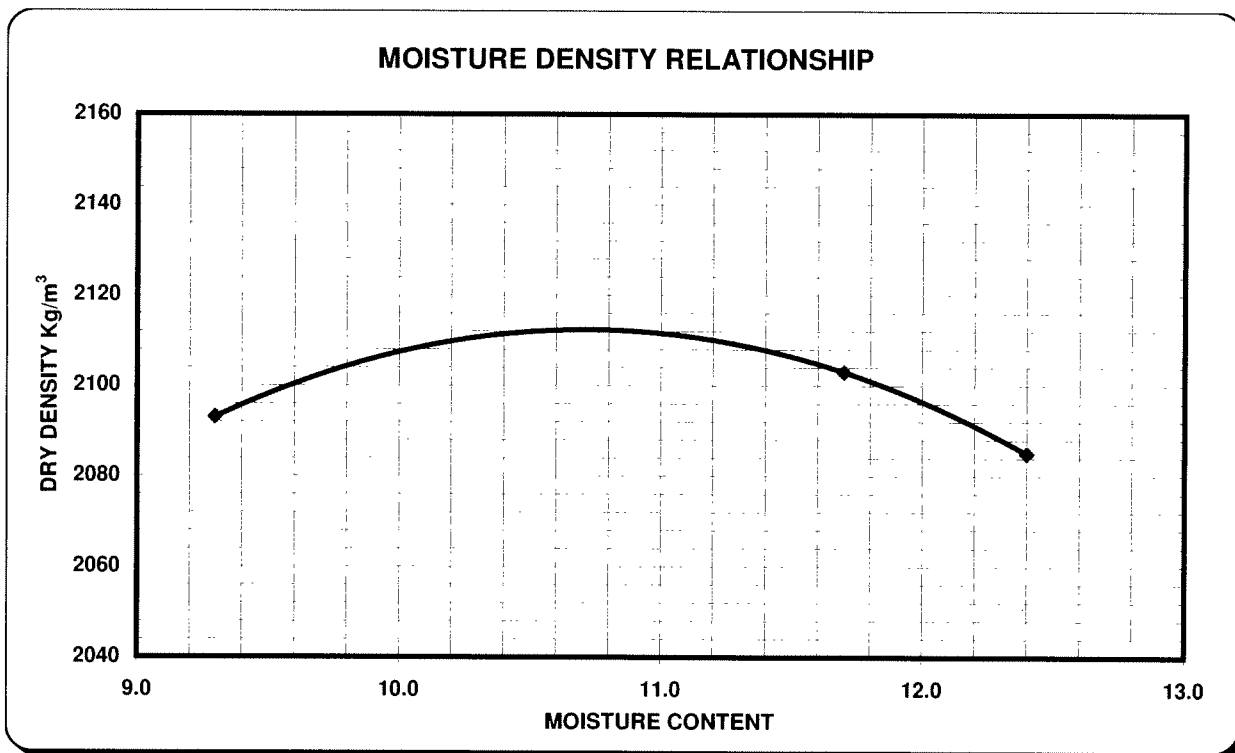
Date Sampled: September 30, 2007 Sampled By Dwayne Druggett

Date Received: September 30, 2007 Preparation _____

Percent Retained:	> 19mm = 53.5%
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Compaction Std.	ASTM D698	Method	C
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Moisture Content	9.3	11.7	12.4
Dry Density kg/m ³	2093	2103	2085



Note : Oversized Material Correction > 19mm = 53.5%

Maximum Dry Density	2114 kg/m ³	Corrected Dry Density	2273.4 kg/m ³
Maximum Moisture	10.7 %	Maximum Moisture	5.8 %

Tested by, Ken Collier

Reviewed by, _____



SNC-LAVALIN

TEST PIT AC1060-TL-PR-07

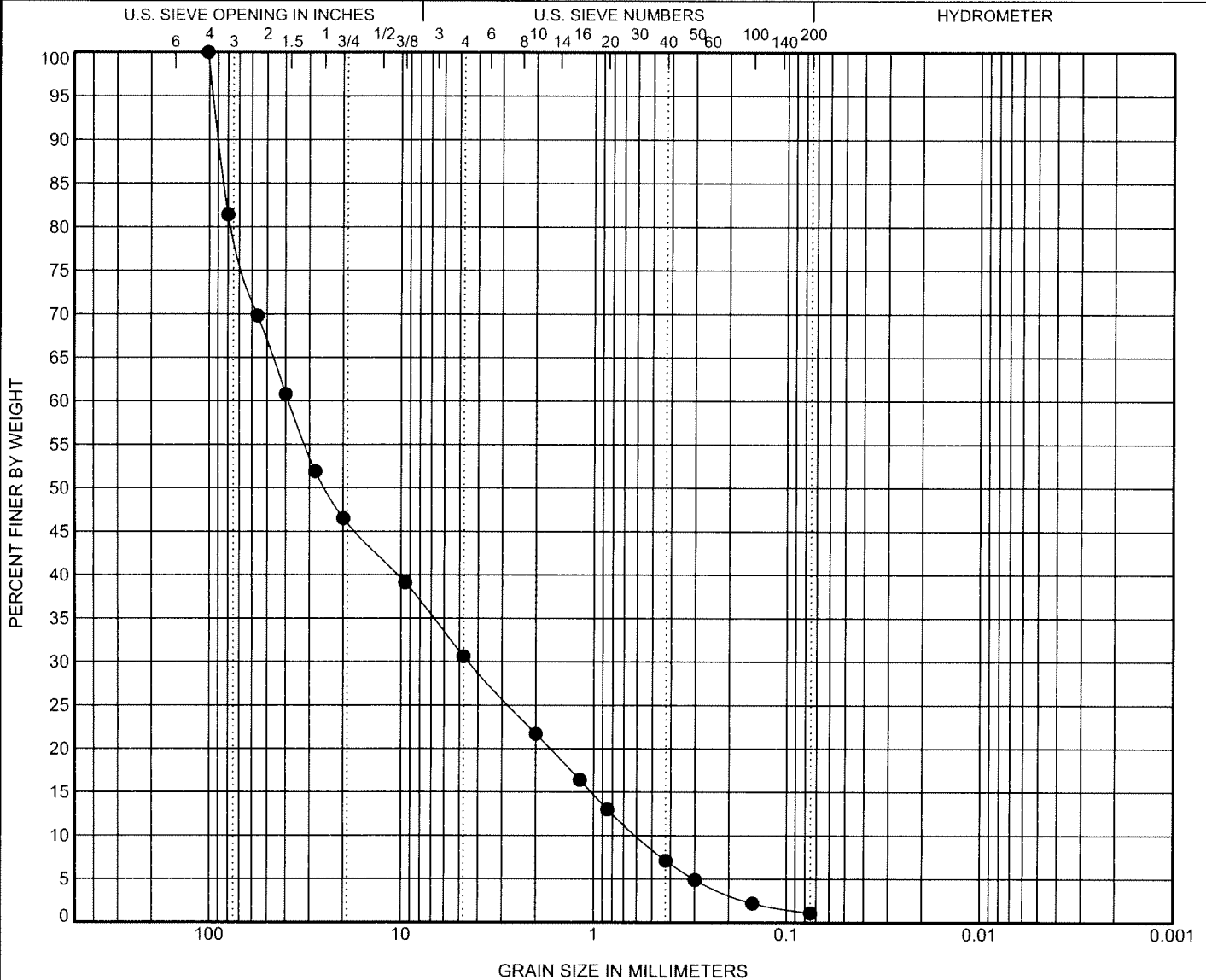
GRAIN SIZE DISTRIBUTION

CLIENT: Newfoundland and Labrador Hydro

SITE: 230 kV Transmission Line - Muskrat Falls to Gull Island

PROJECT: Lower Churchill Project

LOCATION: Transmission Line



COBBLES	GRAVEL		SAND			CLAY OR SILT
	coarse	fine	coarse	medium	fine	

Test pit no.	Sample	Depth (m)	% Gravel		% Sand		% Silt		% Clay					
● AC1060-TL-PR-07	GB-1	0.00 - 0.00	48.7	29.5			1.1							
☒														
▲														
★														
◎														
	80 mm	56 mm	40 mm	28 mm	20 mm	9.525 mm	4.76 mm	2 mm	0.85 mm	0.425 mm	0.3 mm	0.15 mm	0.075 mm	
●	81.4	69.8	60.8	51.9	46.5	39.1	30.6	21.7	13.0	7.1	4.9	2.2	1.1	
☒														
▲														
★														
◎														
Test pit no.	ASTM Classification					D60	D30	D10	W	LL	PL	PI	Cc	Cu
● AC1060-TL-PR-07	POORLY GRADED GRAVEL with SAND(GP)					38.7	4.5	0.6	4.3				0.9	64.8
☒														
▲														
★														
◎														

GRAIN SIZE2 - TEST PIT 1 - TRANSMISSION LINE DATABASE AC1060 2007.GPJ GINT STD CANADA.GDT 08-1-25

MOISTURE DENSITY RELATIONSHIP



Lab No: 711

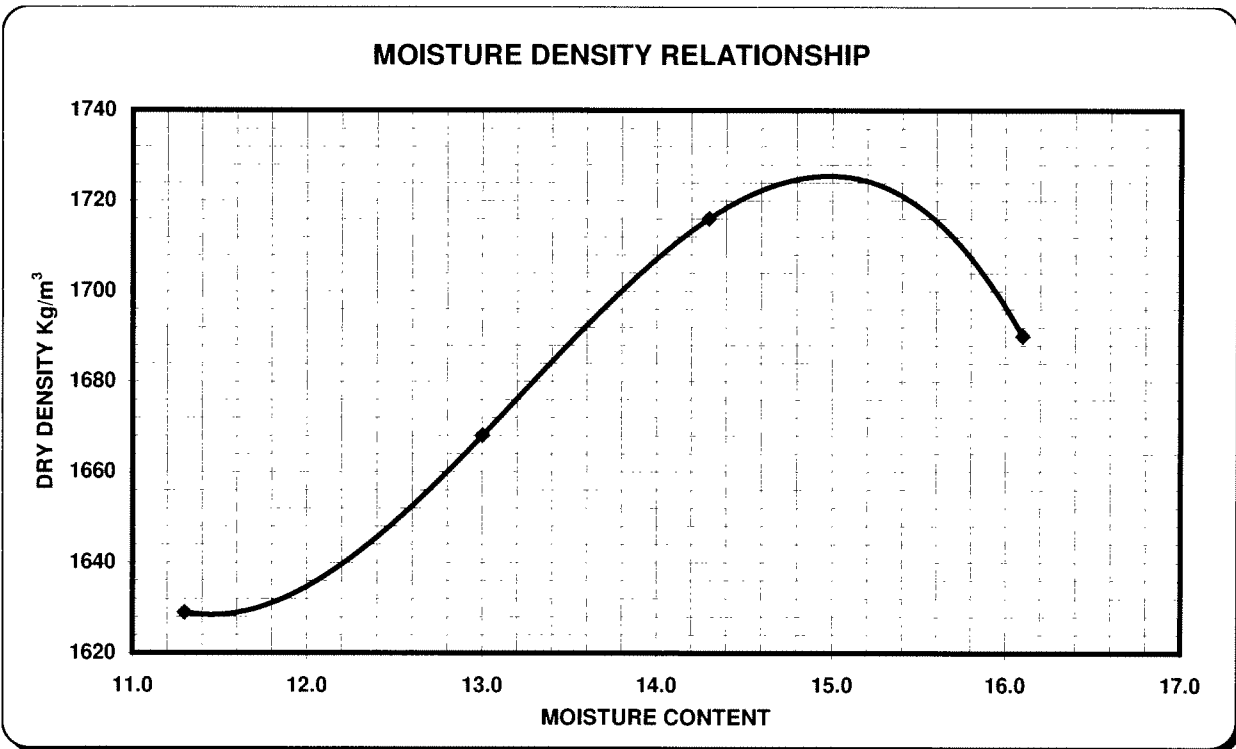
Client: Newfoundland and Labrador Hydro
 Project No: 722855
 Project: AC 1060 230 kV TL Muskrat to Gull Island
 Sample #: AC1060-TL-PR-08
 Sample Type / Source: Sand from cuts in the road embankment on TLH

Date Sampled: September 30, 2007 Sampled By Dwayne Druggett

Date Received: September 30, 2007 Preparation _____

Percent Retained:	> 19mm = 0.0%
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Compaction Std.	ASTM D698		Method	C
Moisture Content	11.3	13.0	14.3	16.1
Dry Density kg/m ³	1629	1668	1716	1690



Note : Oversized Material Correction > 19mm = 0.0%

Maximum Dry Density	1726 kg/m ³	Corrected Dry Density	1726 kg/m ³
Maximum Moisture	15 %	Maximum Moisture	15 %

Tested by, Ken Collier

Reviewed by, _____



SNC-LAVALIN

TEST PIT AC1060-TL-PR-08

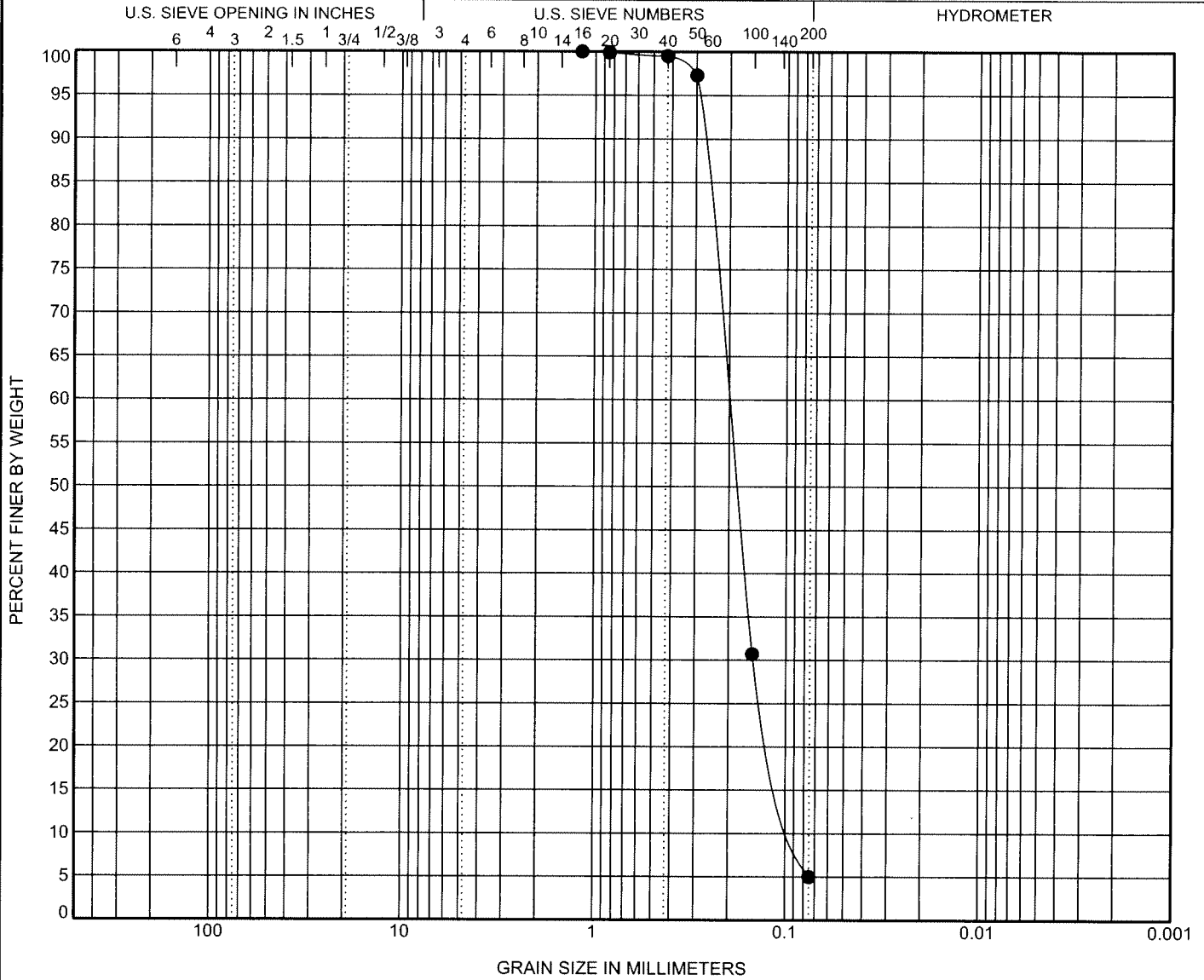
GRAIN SIZE DISTRIBUTION

CLIENT: Newfoundland and Labrador Hydro

SITE: 230 kV Transmission Line - Muskrat Falls to Gull Island

PROJECT: Lower Churchill Project

LOCATION: Transmission Line



COBBLES	GRAVEL		SAND			CLAY OR SILT
	coarse	fine	coarse	medium	fine	

Test pit no.	Sample	Depth (m)	% Gravel			% Sand			% Silt	% Clay			
● AC1060-TL-PR-08	GB-1	0.00 - 0.00	0.0			95.0			5.0				
■													
▲													
★													
◎													
80 mm	56 mm	40 mm	28 mm	20 mm	9.525 mm	4.76 mm	2 mm	0.85 mm	0.425 mm	0.3 mm	0.15 mm	0.075 mm	
●								99.9	99.5	97.3	30.7	5.0	
■													
▲													
★													
◎													
Test pit no.	ASTM Classification				D60	D30	D10	W	LL	PL	PI	Cc	Cu
● AC1060-TL-PR-08	SAND with trace Fines				0.2	0.1	0.1	7.4				1.2	2.4
■													
▲													
★													
◎													

GRAIN SIZE2 - TEST PIT 1 - TRANSMISSION LINE - DATABASE - AC1060 - 2007.GPJ GINT STD CANADA.GDT 08-1-25

MOISTURE DENSITY RELATIONSHIP



Lab No: 712

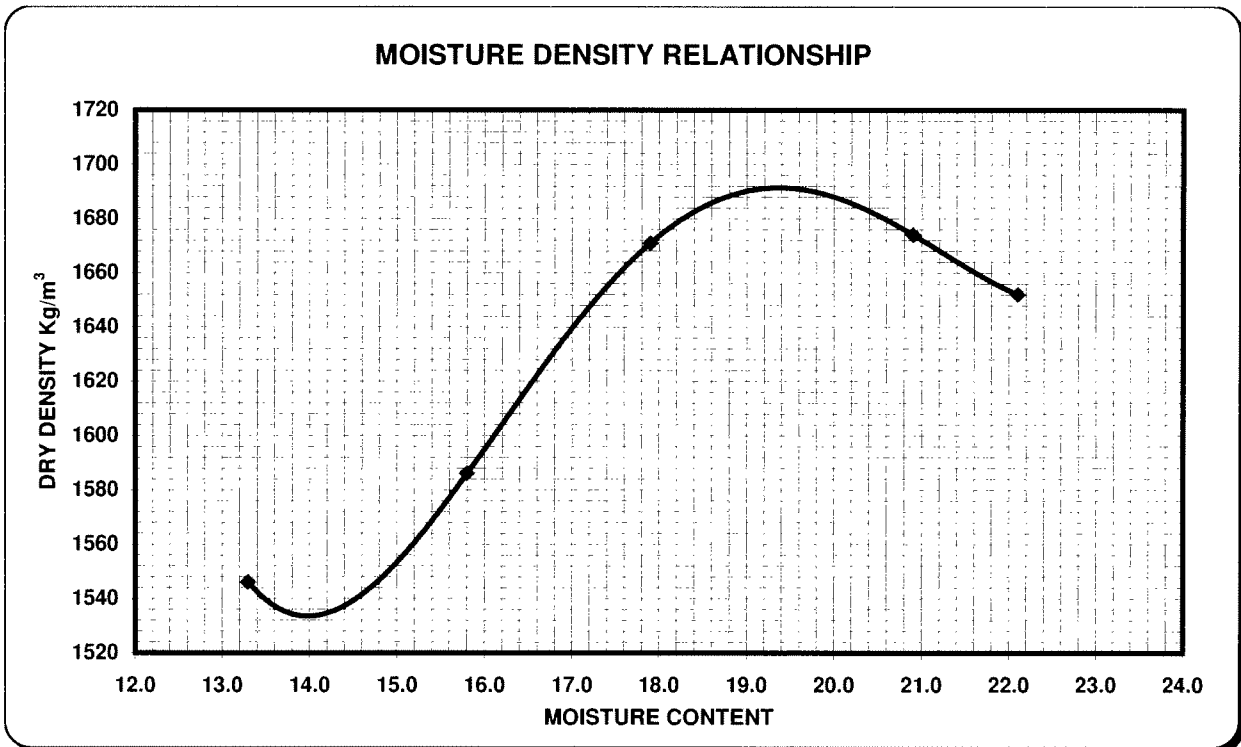
Client: Newfoundland and Labrador Hydro
 Project No: 722855
 Project: AC 1060 230 kV TL Muskrat to Gull Island
 Sample #: AC1060-TL-PR-09
 Sample Type / Source: Clayey Silt from cuts in the road embankment on TLH

Date Sampled: September 30, 2007 Sampled By Dwayne Druggett

Date Received: September 30, 2007 Preparation _____

Percent Retained:	> 19mm = 0.0%
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Compaction Std.	ASTM D698		Method	C	
Moisture Content	13.3	15.8	17.9	20.9	22.1
Dry Density kg/m ³	1546	1586	1671	1674	1652



Note : Oversized Material Correction > 19mm = 0.0%

Maximum Dry Density	1692 kg/m ³	Corrected Dry Density	1692 kg/m ³
Maximum Moisture	19.4 %	Maximum Moisture	19.4 %

Tested by, Ken Collier

Reviewed by, _____



SNC-LAVALIN

TEST PIT AC1060-TL-PR-09

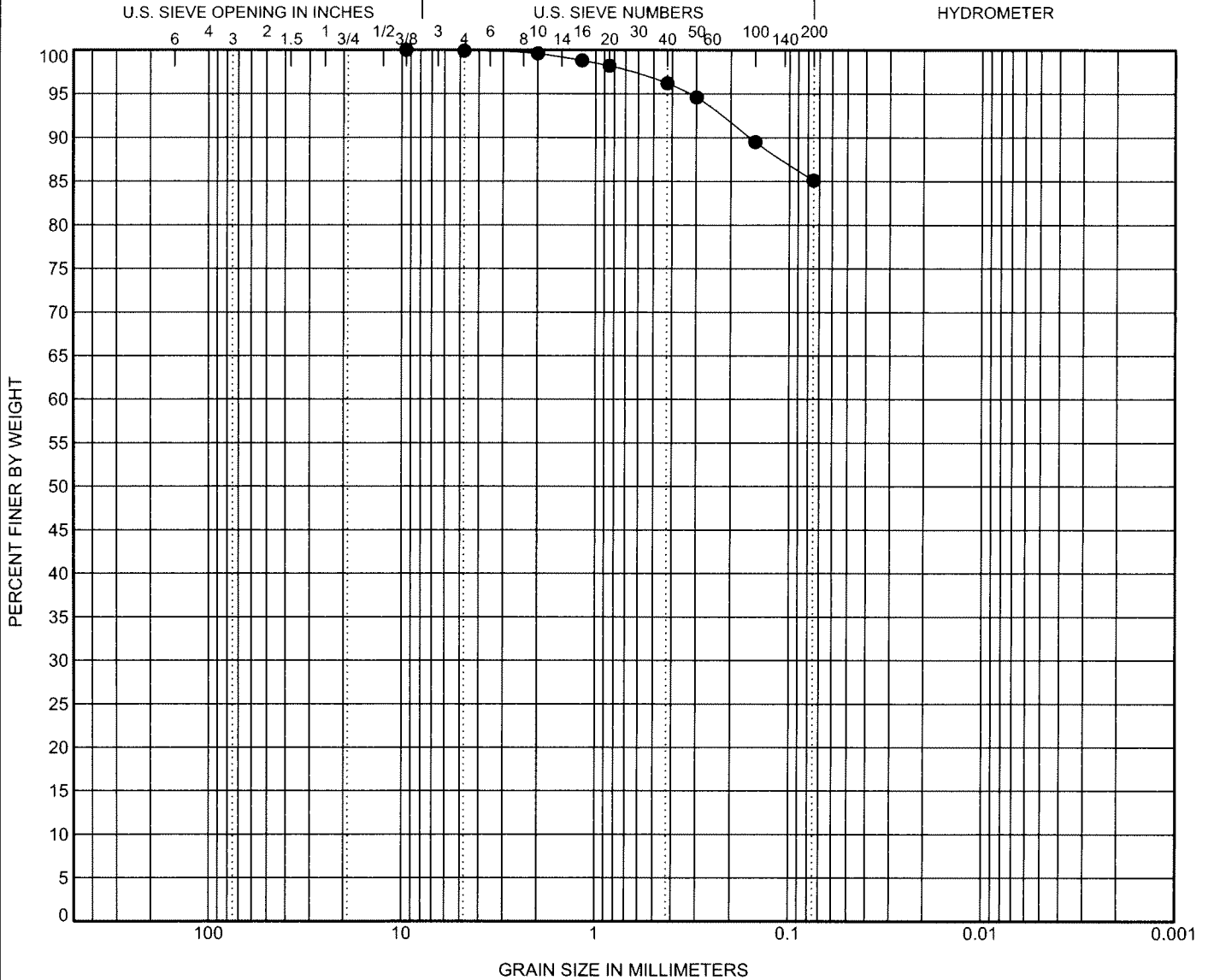
GRAIN SIZE DISTRIBUTION

CLIENT: Newfoundland and Labrador Hydro

SITE: 230 kV Transmission Line - Muskrat Falls to Gull Island

PROJECT: Lower Churchill Project

LOCATION: Transmission Line



COBBLES	GRAVEL		SAND			CLAY OR SILT
	coarse	fine	coarse	medium	fine	

Test pit no.	Sample	Depth (m)	% Gravel		% Sand		% Silt		% Clay			
● AC1060-TL-PR-09	GB-1	0.00 - 0.00	0.1		14.8				85.1			
▲												
★												
◎												
80 mm	56 mm	40 mm	28 mm	20 mm	9.525 mm	4.76 mm	2 mm	0.85 mm	0.425 mm	0.3 mm	0.15 mm	0.075 mm
●					100.0	99.9	99.6	98.2	96.2	94.6	89.5	85.1
▲												
★												
◎												

Test pit no.	ASTM Classification	D60	D30	D10	W	LL	PL	PI	Cc	Cu
● AC1060-TL-PR-09	FINES with some Sand									
▲										
★										
◎										

GRAIN SIZE2 - TEST PIT 1 TRANSMISSION LINE DATABASE AC1060_2007.GPJ GINT STD CANADA.GDT 08-1-25

MOISTURE DENSITY RELATIONSHIP



Lab No: 444

Client: Newfoundland and Labrador Hydro
 Project No: 722855
 Project: AC 1060 230 kV TL Muskrat to Gull Island
 Sample #: AC1060-TL-PR-10
 Sample Type / Source: Sand Dune Near Pina's River

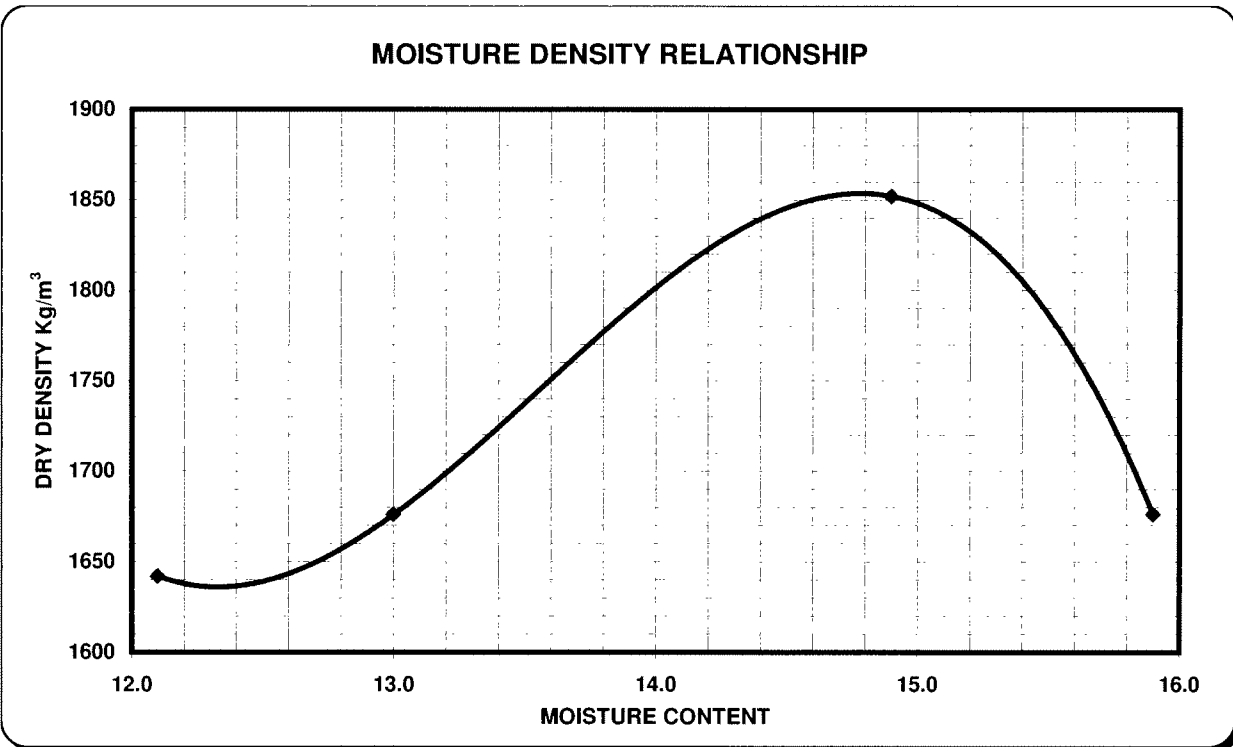
Date Sampled: September 8, 2007 Sampled By Calvin Miles

Date Received: September 8, 2007 Preparation _____

Percent Retained: > 19mm = 0%

Compaction Std. ASTM D698 Method C

Moisture Content	12.1	13.0	14.9	15.9
Dry Density kg/m ³	1642	1676	1852	1676



Note : Oversized Material Correction > 19mm = 0.0%

Maximum Dry Density	1856 kg/m ³	Corrected Dry Density	1856 kg/m ³
Maximum Moisture	14.8 %	Maximum Moisture	14.8 %

Tested by, Ken Collier

Reviewed by, _____



SNC-LAVALIN

TEST PIT AC1060-TL-PR-10

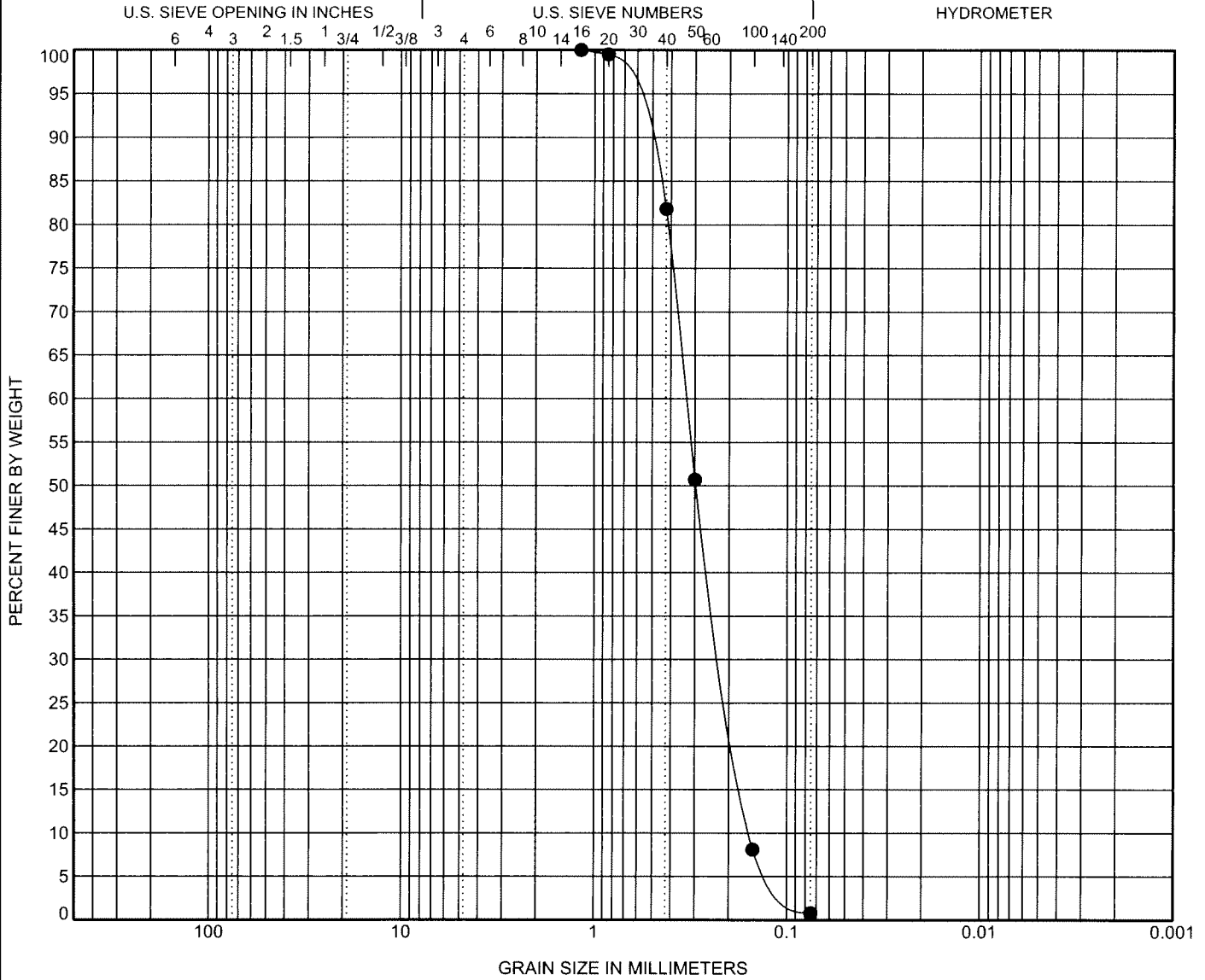
GRAIN SIZE DISTRIBUTION

CLIENT: Newfoundland and Labrador Hydro

SITE: 230 kV Transmission Line - Muskrat Falls to Gull Island

PROJECT: Lower Churchill Project

LOCATION: Sand Dune near Pinus



COBBLES	GRAVEL		SAND			CLAY OR SILT
	coarse	fine	coarse	medium	fine	

Test pit no.	Sample	Depth (m)	% Gravel		% Sand				% Silt		% Clay	
● AC1060-TL-PR-10	GB-1	0.00 - 0.00	0.0		99.2					0.8		
▲												
★												
◎												
80 mm	56 mm	40 mm	28 mm	20 mm	9.525 mm	4.76 mm	2 mm	0.85 mm	0.425 mm	0.3 mm	0.15 mm	0.075 mm
●								99.5	81.8	50.7	8.1	0.8
▲												
★												
◎												
Test pit no.	ASTM Classification		D60	D30	D10	W	LL	PL	PI	Cc	Cu	
● AC1060-TL-PR-10	POORLY GRADED SAND(SP)		0.3	0.2	0.2	3.9				0.9	2.2	
▲												
★												
◎												

GRAIN SIZE 2 - TEST PIT 1 - TRANSMISSION LINE DATABASE - AC1060_2007.GPJ - GINT STD CANADA.GDT_08-1-25

MOISTURE DENSITY RELATIONSHIP



Lab No: 445

Client: Newfoundland and Labrador Hydro
 Project No: 722855
 Project: AC 1060 230 kV TL Muskrat to Gull Island
 Sample #: AC1060-TL-PR-11
 Sample Type / Source: Glacial Till Pit East of Pina's River

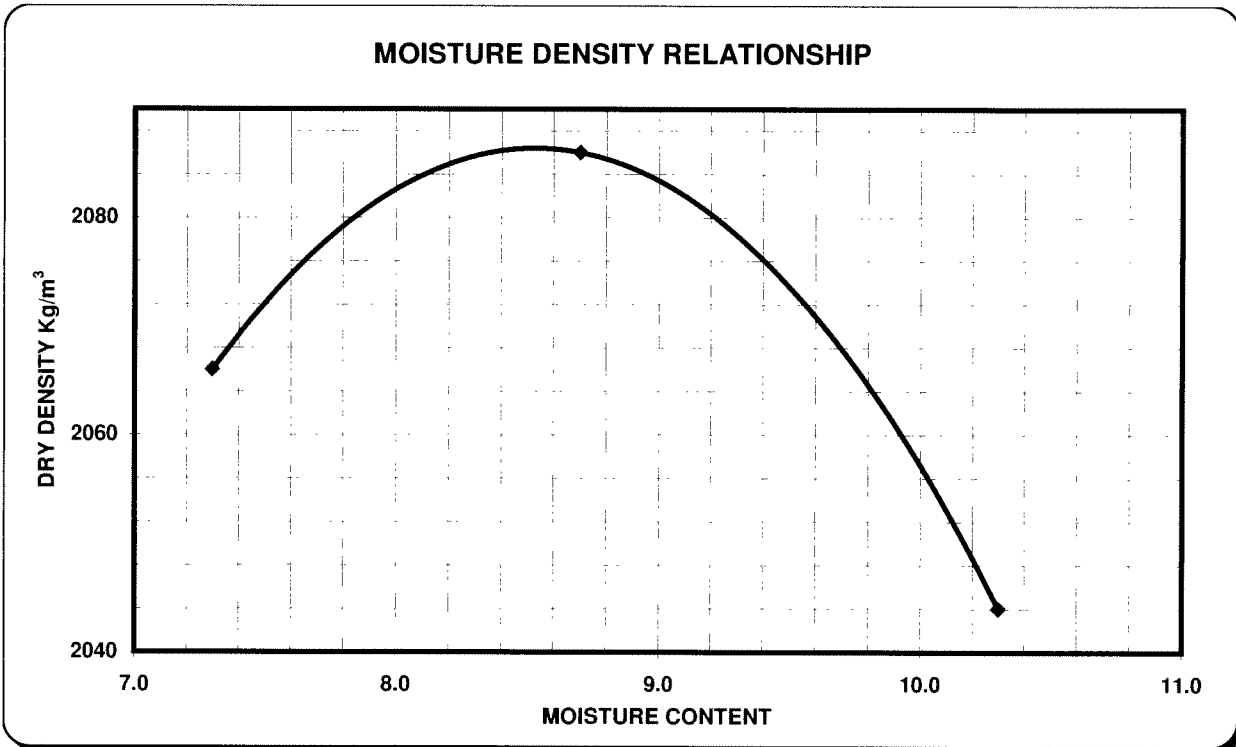
Date Sampled: August 29, 2007 Sampled By Calvin Miles

Date Received: August 29, 2007 Preparation _____

Percent Retained:	> 19mm = 10.4%
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Compaction Std.	ASTM D698	Method	C
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Moisture Content	7.3	8.7	10.3		
Dry Density kg/m ³	2066	2086	2044		



Note : Oversized Material Correction > 19mm = 10.4%

Maximum Dry Density	2129 kg/m ³	Corrected Dry Density	2158.4 kg/m ³
Maximum Moisture	8.5 %	Maximum Moisture	7.8 %

Tested by, Ken Collier

Reviewed by, _____



SNC-LAVALIN

TEST PIT AC1060-TL-PR-11

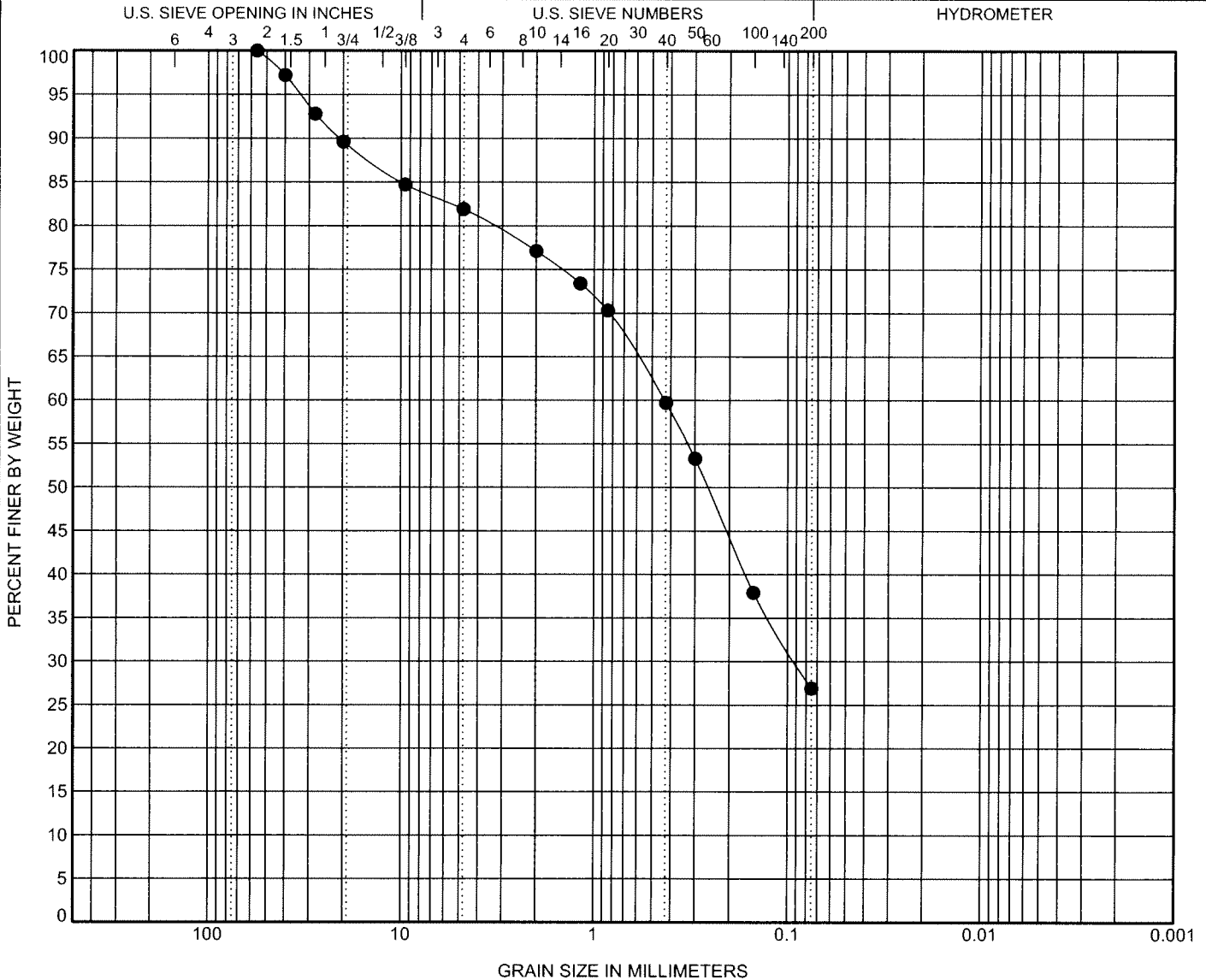
GRAIN SIZE DISTRIBUTION

CLIENT: Newfoundland and Labrador Hydro

SITE: 230 kV Transmission Line - Muskrat Falls to Gull Island

PROJECT: Lower Churchill Project

LOCATION: Till Pit East of Pinus River



COBBLES	GRAVEL		SAND			CLAY OR SILT
	coarse	fine	coarse	medium	fine	

Test pit no.	Sample	Depth (m)	% Gravel		% Sand		% Silt		% Clay			
● AC1060-TL-PR-11	GB-1	0.00 - 0.00	18.1		55.0			26.9				
▲												
★												
◎												
80 mm	56 mm	40 mm	28 mm	20 mm	9.525 mm	4.76 mm	2 mm	0.85 mm	0.425 mm	0.3 mm	0.15 mm	0.075 mm
● 100.0	97.2	92.8	89.6	84.7	81.9	77.1	70.3	59.7	53.3	37.9	26.9	
▲												
★												
◎												

Test pit no.	ASTM Classification	D60	D30	D10	W	LL	PL	PI	Cc	Cu
● AC1060-TL-PR-11	Silty SAND with some Gravel	0.4	0.1		7.2					
▲										
★										
◎										

GRAIN SIZE 2 - TEST PIT 1 - TRANSMISSION LINE DATABASE - AC1060 - 2007.GPJ GINT STD CANADA.GDT 08-1-25

Appendix G

Limitations

LIMITATIONS OF REPORT

The conclusions and recommendations given in this report are based on information determined at the test locations. The information contained herein in no way reflects on the environmental aspects of the project, unless otherwise stated. Subsurface and groundwater conditions between and beyond the test locations may differ from those encountered at the test locations, and conditions may become apparent during construction, which could not be detected or anticipated at the time of the site investigation. It is recommended practice that a geotechnical consultant be retained during construction to confirm that the subsurface conditions throughout the site do not deviate materially from those encountered at the test locations. The elevations used in this report are primarily to establish relative elevation differences between the test locations and should not be used for other purposes, such as grading, excavating, planning development, etc.

The design recommendations given in this report are applicable only to the project described in the text and then only if constructed substantially in accordance with the details stated in this report. Since all details of the design may not be known, it is recommended that the final design be verified as being consistent with the recommendations, and that the assumptions made in this analysis are valid.

Any comments made in this report on potential construction problems and possible methods are intended only for the guidance of the designer. The number of test locations may not be sufficient to determine all the factors that may affect construction methods and costs. The contractors bidding on this project or undertaking the construction should, therefore, make their own interpretation of the factual information presented and draw their own conclusions as to how the subsurface conditions may affect their work. This work has been undertaken in accordance with normally accepted geotechnical engineering practices. No other warranty is expressed or implied.

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