Geotechnical Pavement Investigation, Moosonee Airport, ON

The Corporation of the Town of Moosonee, ON

Prepared for:
Stantec Consulting Limited

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Insert revision record

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1.0 INTRODUCTION

Stantec Consulting Limited (STANTEC) has completed an assessment of the pavements at the Moosonee Airport, Ontario, including a field coring, drilling and sampling investigation. The field investigation was carried out between April 12th and April 14th, 2015.

The purpose of the investigation was to obtain the necessary data for development of recommendations for the rehabilitation of airside pavements.

2.0 SITE DESCRIPTION

Located in northern Ontario approximately 20 km south of James Bay, the Town of Moosonee serves as a supply hub to northern communities. The Moosonee Airport is operated by the Corporation of the Town of Moosonee and has an important role in transporting people and goods to communities not serviced by roadways. The reported traffic is 25,000 annual aircraft movements.

The airside pavement infrastructure at the Moosonee Airport includes the following:

1. Runway 06-24 is the main runway and is 1,219 m (4,000 feet) long and 30.5m (100 feet) wide.

2. Runway 14-32 is the crosswind runway and is used by approximately 10 percent of aircraft traffic. It is approximately 1,160m (3,800 feet) long and 30.5m (100 feet) wide. Only the southern (32 end) 540m of Runway 14-32 is paved.

3. Taxiway A connects Runway 06-24 with the Apron. It is approximately 272m (890 feet) long and 15.2m (50 feet) wide.

4. Taxiway B connects Runway 14-32 to the Apron. It is approximately 175m (575 feet) long and 15.2m (50 feet) wide.

5. The Main Apron is approximately 210m (690 feet) by 119m (390 feet) with some incursions for buildings and a concrete parking pad.

Historical records indicate that the airport pavements were constructed with the following material:

40mm dense graded cold mix asphalt;

60mm open graded cold mix asphalt;

300mm± granular base; and

760mm± granular fill subbase.

In 2007 both runways, both taxiways and a portion of the apron were surfaced with an application of Type II micro-surfacing. Micro-surfacing consists of aggregates and a polymer modified asphalt emulsion and is applied as a thin pavement surfacing to restore and protect the asphalt surface. Type II refers to the grading requirement for the aggregates. As a general observation from the field samples, the aggregate size used in the micro-surfacing applications appears to be much smaller than the specified Type II aggregate.

3.0 PAVEMENT INVESTIGATION

In April, 2015 an investigation of the Moosonee Airport airside pavements was undertaken with the intent of evaluating the condition of the existing pavements for use in the development of rehabilitation alternatives.

3.1 FIELD PROGRAM

The locations of underground utilities were identified by the Town of Moosonee prior to commencement of drilling activities. A total of twenty (20) boreholes were then drilled at selected locations on the airside pavement as follows:

Runway 06-24	6 boreholes
Runway 14-32	4 boreholes
Taxiway A	3 boreholes
Taxiway B	3 boreholes
Main Apron	4 boreholes

At each location the full thickness of the asphalt surface was cored and the boreholes were drilled using a 100mm solid stem auger to a depth of three (3) metres. Borehole Location Plan, Drawing No. 1 in **Appendix B** indicates the locations of the boreholes. Asphalt thicknesses were measured, and underlying soil strata characterized. Soil samples were obtained for grain size distribution, classification and moisture content determination.

The site conditions are summarized in Borehole Records in **Appendix C** of this report.

3.2 LABORATORY TESTING

Samples were returned to a Stantec laboratory for detailed evaluation and classification in general accordance with, ASTM D 2487, *Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)*.

Gradation analysis and moisture content tests were conducted on representative samples of the soils obtained from the investigation. Several of the asphalt cores were heated and broken down for gradation analysis (without extracting the asphalt cement). Gradation analysis results are provided in **Appendix D.** Moisture content results are included on the Borehole Records.

4.0 SUMMARY OF PAVEMENT DISTRESSES

The following sections provide descriptions and a short discussion of the observed surface distresses.

4.1 SURFACE RAVELING IN MICRO-SURFACED PAVEMENTS

Pavement surface raveling is characterized by loss of pavement materials from the surface downward resulting in a pock marked appearance, and when severe, can lead to large potholes. The majority of the raveling encountered at the Moosonee Airport involves the separation of the bonded micro-surfacing with substrate asphalt attached. Surface raveling was also observed on the portion of the Main Apron that was not micro-surfaced.

There are several isolated high-severity pavement raveling areas within the micro-surfacing mostly on Runway 06-24 but also evident on Taxiway A. A typical example from Runway 06-24 is shown in **Figure 1**.

Figure 1 Surface Raveling in Location with Micro-surfacing

Description

The micro-surfacing layer, as well as the surface of the underlying dense graded cold mix asphalt, has debonded from the pavement. The exposed remaining asphalt layers are generally very soft (can easily be dug by hand) and the asphalt cement has visibly stripped from most of the exposed aggregates.

It is important to note the poor quality of the exposed asphalt pavement at the raveled areas on Runway 06-24. The condition is best illustrated by the photo in **Figure 2**.

Figure 2 Soft Asphalt in Raveled Areas on Runway 06-24

Description

In many of the areas where the micro-surfacing has raveled from the pavement surface, the underlying dense-graded cold mix asphalt is very soft and can be removed by hand.

4.2 SURFACE RAVELING IN PAVEMENTS WITHOUT MICRO-SURFACING

As noted above, a portion of the Main Apron did not receive an application of micro-surfacing in 2007 and high-severity surface raveling was observed over most of the surface (a portion of the surface was snow covered at the time of the investigation. **Figure 3** provides a photo of the raveled surface where micro-surfacing was not applied.

Figure 3 Surface Raveling in Location without Micro-surfacing

Description

High severity surface raveling in an area without micro-surfacing. The exposed surface is extremely raveled and the asphalt cement has stripped from the surface of the exposed asphalt pavement. The condition differs from raveling at micro-surfaced locations in that the underlying asphalt pavement is sound.

4.3 RAVELING WITHIN THE MICRO-SURFACING

The block cracking pattern over most of the surface of the micro-surfacing can also be described as medium to high severity raveling. An example is shown in **Figure 4**.

Figure 4 Raveling of the Micro-surfacing

Description

The block shaped cracking pattern in the micro-surface is the result of different temperature coefficients between the micro-surfacing and underlying dense-graded cold mix asphalt; this is typically more evident with sand seals or coal tar applications. As noted, it did appear that a fine aggregate was used to produce the micro-surfacing.

4.4 TRANSVERSE CRACKING

There are six high severity transverse cracks on Runway 06-24, two on Runway 14-32 and one on Taxiway B. **Figure 5** is a typical example from Runway 06-24.

Figure 5 Transverse Cracking on Runway 06-24

Description

Six high-severity transverse cracks were observed at various locations on Runway 06-24. Transverse cracks are the result of low temperature shrinkage in the asphalt pavement.

5.0 ASPHALT AND GRANULAR THICKNESS AND CONDITION

In this report, the airside pavements have been divided into six (6) separate sections as follows: Runway 06-24, Runway 14-32, Taxiway A, Taxiway B, the Main Apron with micro-surfacing (front of terminal building, approximately one-third of the total area) and the Main Apron without micro-surfacing (the remainder of the apron).

The pavement structure and properties of the layers encountered are provided in the following sections.

5.1 RUNWAY 06-24

The asphalt and granular base thicknesses at each of the six borehole locations on Runway 06-24 are summarized in **Table 5-1**.

Table 5-5-1 Runway 06-24

Borehole No.	Location (06 pavement end is 1+000)	Thickness (mm)	
		Asphalt	Granular Base
BH01	1+092, 4.5m right of centreline	114	242
BH02	1+368, 5.0m left of centreline	127	279
BH03	1+576, 3.0m left of centreline	114	496
BH04	1+920, 4.0m right of centreline	114	419
BH05	2+075, 3.5m left of centreline	102	406
BH06	2+178, 10.0m left of centreline	102	355
Average Thicknesses		**112 mm**	**366 mm**

Runway 06-24 has an average asphalt concrete thickness of 112mm (range of 102m to 127mm) and the granular base thickness averaged 366mm (range of 242mm to 496mm). At the test locations the asphalt pavement consisted of three layers: a thin (<10mm) layer of micro-surfacing, a well-graded surface course approximately 50 mm thick and an open-graded base course approximately 60 mm thick. Generally, slight to moderate asphalt stripping was observed in the surface course asphalt and severe asphalt stripping was evident in the base course asphalt.

A photograph of an asphalt core from BH06 on Runway 06-24 is presented in **Figure 6** which illustrates significant deterioration in the asphalt.

Figure 6 Asphalt Core from Runway 06-24

Description

Asphalt core from BH06 showing significant deterioration in both the dense graded surface and open graded base courses. While some of the cores from Runway 16-24 were intact, deterioration in the base course asphalt was evident at all locations.

5.2 RUNWAY 14-32

The asphalt and granular base thicknesses for each of the four borehole locations on Runway 14-32 are summarized in **Table 5-2**.

Table 5-2 Runway 14-32

Borehole No.	Location (intersection with 06-24 is 3+000)	Thickness (mm)	
		Asphalt	Granular Base
BH07	3+100, 3.0m right of centreline	114	343
BH08	3+200, 2.5m left of centerline	108	400
BH09	3+400, 3.5m left of centerline	95	388
BH10	3+496, 2.8m right of centreline	102	406
Average		**105 mm**	**384 mm**

Runway 14-32 has an average asphalt concrete thickness of 105mm (range from 95mm to 114mm) and an average granular base thickness of 384mm (range from 343mm to 406mm). The asphalt was present in two layers; a thin (approximately 10mm) surficial layer of micro-surfacing and layer of dense graded asphalt concrete (approximately 95mm thick). It was noted that the open graded base asphalt course was not evident in Runway 14-32. A photograph the asphalt core from BH08 on Runway 14-32 is provided in **Figure 7** below.

Figure 7 Asphalt Core from Runway 14-32

Description	
Asphalt core from BH08 on Runway 14-32. Core indicated dense graded asphalt mix in good condition. The visible aggregate particles are broken from testing) and are not indicative of asphalt stripping.	

In general, the existing asphalt surface on Runway 14-32 is in good condition.

5.3 TAXIWAY A

The asphalt and granular base thicknesses for each of the three borehole locations on Taxiway A are summarized in **Table 5-3**.

Table 5-3 Taxiway A

Borehole No.	Location (intersection with Runway 14-34 is 4+000)	Thickness (mm)	
		Asphalt	Granular Base
BH11	4+082, 1.5m right of centerline	127	330
BH12	4+137, 1.0m right of centerline	127	381
BH13	4+322, 2.5m left of centreline	140	368
Average		**131 mm**	**360 mm**

Taxiway Alpha has an average asphalt concrete thickness of 131mm (range from 127mm to 140mm) and an average granular base thickness of 360mm (range from 330mm to 381mm). The asphalt was present in three layers; a thin (approximately 10mm) topping of micro-surfacing, a dense graded asphalt course approximately 60 mm thick and an open graded base course asphalt layer approximately 70 mm thick. A photograph of the asphalt core from BH11 on Taxiway A is provided in **Figure 8** below; it is typical of the cores from Taxiway A.

Figure 8 Asphalt Core from Taxiway A

Description

Asphalt core from BH11 from Taxiway A showing the micro-surfacing, the dense graded surface course asphalt and the open graded base course asphalt. There is significant asphalt stripping in the open graded asphalt layer.

While the open graded asphalt mix on Taxiway A is undergoing severe asphalt stripping, it has not yet deteriorated to the soft condition observed at the Runway 06-24 locations.

5.4 TAXIWAY B

The asphalt and granular base thicknesses for each of the three borehole locations on Taxiway B are summarized in **Table 5-4**.

Table 5-4 Taxiway B

Borehole No.	Location (intersection with Runway 06-24 is 5+000)	Thickness (mm)	
		Asphalt	Granular Base
BH14	5+045, 2.0m right of centreline	140	419
BH15	5+090, 5.0m right of centreline	133	477
BH16	5+150, 6.0m left of centreline	108	451
Average		**127 mm**	**449 mm**

Taxiway B has an average asphalt concrete thickness of 127mm (range from 108mm to 140mm) and an average granular thickness of 449mm (range from 419mm to 477mm). The asphalt was present in three layers; a thin topping (approximately 10mm) of micro-surfacing and two layers of dense graded asphalt mix, approximately 50mm and 70mm thick respectfully. There was no open graded asphalt mix present on Taxiway B. A photograph of the asphalt core from BH14 on Taxiway B is presented in **Figure 9** below.

Figure 9 Asphalt Core from Taxiway B

Description

Asphalt core BH14 from Taxiway B showing the micro-surfacing and two layers of dense graded asphalt concrete. There is some slight asphalt stripping evident in the asphalt mixes, mostly in the fine aggregates.

5.5 MAIN APRON WITH MICRO-SURFACING

The asphalt and granular base thicknesses for each of the two borehole locations on the portion of the Main Apron without micro-surfacing are summarized in **Table 5-5**.

Table 5-5 Main Apron with Micro-Surfacing

Borehole No.	Location	Thickness (mm)	
		Asphalt	Granular Base
BH17	Southern third of the Main Apron	133	527
BH18	Southern third of the Main Apron	127	381
Average		**130 mm**	**454 mm**

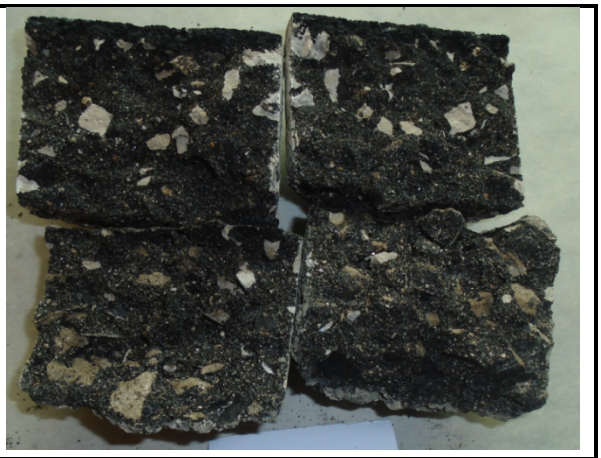
The portion of the main apron that is topped with mirco-surfacing has an average asphalt concrete thickness of 130mm (range of 127mm to 133mm) and an average granular thickness of 454mm (range of 381mm to 527mm). The asphalt was present in three layers; a thin (5 – 10mm) topping of micro-surfacing and two dense graded asphalt lifts of approximately 50mm and 70mm thickness.

A photograph of the asphalt core from BH17 from the Main Apron is presented in **Figure 10** below.

Figure 10 Asphalt Core from the Main Apron with Micro-surfacing

Description

Asphalt core from BH17 from the portion of the Main Apron with micro-surfacing show the micro-surfacing and two layers of dense graded asphalt concrete. There is some slight to moderate asphalt stripping evident in the asphalt mixes, mostly in the fine aggregates.



5.6 MAIN APRON WITHOUT MICRO-SURFACING

The asphalt and granular base thicknesses for each of the two borehole locations on the portion of the Main Apron without micro-surfacing are summarized in **Table 5-6**.

Table 5-6 Asphalt Cores from the Main Apron without Micro-surfacing

Borehole No.	Location	Thickness (mm)	
		Asphalt	Granular Base
19	Northern two-thirds of the Main Apron	114	419
20	Northern two-thirds of the Main Apron	76	153
Average		**95 mm**	**286 mm**

The portion of the main apron without mirco-surfacing has an average asphalt concrete thickness of 95mm (range of 76mm to 114mm) and an average granular thickness of 286mm (range of 153mm to 419mm). The asphalt was present in two layers of dense graded asphalt lifts of approximately 50mm and 70mm thickness.

It should be noted that the total pavement thickness (asphalt and granular base combined) at the location of BH20 is significantly less than at other locations. BH20 is located in the northeast corner of the Main Apron, approximately 50m from the connection with Taxiway B.

A photograph of the asphalt core from BH17 from the Main Apron is presented in **Figure 11** below.

Figure 11 Asphalt Core from Portion of Main Apron without Micro-surfacing

Description Asphalt core from BH20 from the portion of the Main Apron without micro-surfacing show the two layers of dense graded asphalt concrete. There is some slight to moderate asphalt stripping evident in the asphalt mixes.	

6.0 DISCUSSION OF REHABILITATION OPTIONS

6.1 NATURE OF THE FAILURES

While the historical pavement records indicated that the Moosonee pavements consisted of a dense graded cold mix surface and an open graded cold mix base course, the open graded mix was only encountered on Runway 06-24 and Taxiway A. Other site pavements consisted of two lifts of dense graded asphalt mix.

In general, in areas on Runway 06-24 and Taxiway A where the surficial layer of micro-surfacing has completely raveled off, the underlying dense graded surface layer has significantly deteriorated and the open graded layer has essentially disintegrated. In the areas where the micro-surfacing is essentially intact, the dense graded surface layer is sound while the open graded base layer is in poor condition. The deterioration is not load related and is occurring on the shoulders as well as in the travel portion of the runway and taxiway.

In the pavements on Runway 14-32, Taxiway B and the Main Apron (with and without micro-surfacing), some slight to moderate deterioration was noted in the asphalt layers but not near as severe as on Runway 06-24 and Taxiway A. Asphalt stripping was noted in most of the asphalt cores and severe stripping was noted in the open graded mix. As this mix is very porous, it would be more prone to asphalt stripping. One hypotheses for the ongoing asphalt stripping is that the micro-surfacing has prevented moisture from escaping from the asphalt layers and may have accelerated the stripping process.

There was a discussion with the Moosonee Airport representatives regarding frost heaving issues on the runway but the roughness issues noted are actually related to the transverse cracks. There are nine major transverse cracks that are contributing to pavement roughness, six on Runway 06-24, two in Runway 14-32 and one on Taxiway B. The historical information provided indicates that these were repaired prior to the placement of the micro-surfacing in 2007 but the repairs seem to have consisted of sealing the cracks.

6.2 PAVEMENT DESIGN CRITERIA

The following criteria were used in developing the recommendations for pavement rehabilitation at the Moosonee Airport:

1. The asphalt stripping and transverse cracking which have been identified as the principal causes of the ongoing deterioration needs to be addressed in the rehabilitation.

2. The rehabilitated pavement structure must provide the required strength. Moosonee Airport reports approximately 25,000 aircraft movements annually and the HS748 has been identified as the design aircraft. The HS748 has a nominal Aircraft Load Rating (ALR) of 5.4. In the structural analysis, the granular fill, which was present at the borehole

locations, has been designated as the subgrade in the design. As the granular fill materials range from sand to silty sand, a subgrade bearing strength (S) of 75kN is recommended for the use in the structural analysis.

3. While the existing layer of Granular Fill (referred to as Granular Fill Subbase in the historical information) does not meet the PWGSC requirements presented in ASG-19 for frost protection material, it does seem to be preventing differential frost movements in the pavement structures. Therefore, improving frost protection is not included in developing the pavement design.

4. While typical airport pavement design procedures are intended to provide a 15 to 20 year design life, due to the isolation of Moosonee and the lack of repair materials and equipment, the rehabilitation recommendations for the Moosonee pavements take into consideration ways of reducing repair requirements until the end of the service life. In essence, this involves recommending thicker than minimum asphalt layers.

It is recommended that the new surfacing material for the airside pavements be dense graded hot mix asphalt, not cold mix as previously used.

The following sections provide a discussion of several pavement rehabilitation alternatives.

6.2.1 Asphalt Overlay

An asphalt overlay is the most common pavement rehabilitation approach. It involves placing a layer of new asphalt concrete over the existing airside pavements, with or without cold milling for grade control/adjustments. Prior to placing the overlay, necessary repairs to the existing pavement can be carried out. For Moosonee, the repairs would include treating the ongoing transverse cracking.

Due to the significant deterioration and ongoing asphalt stripping on Runway 06-24 and Taxiway A, an asphalt overlay is not considered as a suitable rehabilitation for these pavements. It is anticipated that the deterioration in the open graded asphalt base course will have a very significant impact on the performance of the asphalt overlay.

However, an overlay is considered to be applicable for the pavements on Runway 14-32, Taxiway B and the Main Apron. While the existing micro-surfacing is undergoing raveling (block cracking) it is otherwise in good condition. However it is suggested that all the micro-surfacing be removed by cold milling prior to placing the asphalt overlay.

The transverse cracking on Runway 14-32 and Taxiway B should be repaired by removing and replacing the full depth of the existing asphalt and 350mm of the underlying granular base. The width of the removal should be at least 1.5m on either side of the transverse cracks and saw cuts should be perpendicular to the runway.

The required PLR of 5.4 is attained without the addition of the asphalt overlay so the overlay thickness is not based on meeting the strength criteria. An asphalt overlay thickness of 70mm is recommended to reduce the maintenance requirements over the proposed 20 year design life of the pavement.

6.2.2 Full Depth Asphalt Removal

For Runway 06-24 and Taxiway A, where the asphalt overlay option is not considered to be appropriate, full depth removal and replacement of the asphalt concrete can be considered. Full depth removal and replacement of the asphalt would address the concerns with the quality of the existing open graded asphalt mix.

The transverse cracking on Runway 06-24 is much more severe than on those occurring on Runway 14-32 and Taxiway B. Therefore the recommended repair at each transvers crack location is as follows:

- Following the removal of the asphalt surface, remove the underlying granular base and granular fill to a depth of 1.0m.
- The bottom of the excavation should be 4.0m wide and perpendicular to the runway.
- The side slopes should be 10H:1V to provide a frost transition taper. The excavation should be backfilled using crushed granular base material.

The new asphalt surface should consist of 120mm of new hot mix asphalt placed in two 60mm thick lifts. This is in keeping with existing thickness of cold mix asphalt but exceeds the minimum required 80mm. The intent with the recommended asphalt thickness is to reduce the maintenance requirements over the service life of the pavement.

6.2.3 Pulverizing, Mixing and Placement of New Asphalt

Another rehabilitation alternative considered for Runway 06-24 and Taxiway A is to pulverize the existing asphalt, mix with the underlying granular base and surface with new hot mix asphalt. The advantage of this approach is that it eliminates most of the waste generated by the project and allows for a reduction in the required new asphalt thickness.

For this alternative, the transverse cracks on Runway 06-24 should be repaired as noted above in Section 6.2.2 prior to pulverizing the runway. The repairs should be paved with 100mm of new hot mix asphalt prior to pulverizing to help ensure a uniform mixture is attained.

The total depth of pulverization should be 300mm. Based on the gradations from the existing granular base and the existing asphalt layers, the pulverized material should have a fines content (passing 0.075mm sieve) of between 7 and 11 percent. While the higher end of the

anticipated fines content exceeds most specifications, as a pulverized material it is expected to provide the required strength and drainage characteristics for the new paved surface.

The new asphalt surface should consist of 100mm of new hot mix asphalt placed in two 50mm thick lifts.

6.3 OTHER CONSIDERATIONS

The typical PWGSC materials specification for airports in Canada should be used to specify the materials to be using the rehabilitation of the pavements. The asphalt cement should meet the requirements for PG52-40.

7.0 CLOSURE

Use of this report is subject to the Statement of General Conditions provided in **Appendix A**. It is the responsibility of The Corporation of the Town of Moosonee, who is identified as "the Client" within the Statement of General Conditions, and its agents to review the conditions and to notify Stantec Consulting Ltd should any of these not be satisfied. The Statement of General Conditions addresses the following:

- Use of the report
- Basis of the report
- Standard of Care
- Interpretation of site conditions
- Varying or unexpected site conditions
- Planning, design, or construction

This report was prepared by Eric Theriault, P.Eng.

I trust that the information contained in this report is adequate for your present purposes. If you have questions about the contents of this report, or if I can be of further assistance, please do not hesitate to contact the undersigned at your convenience at (506) 634-2185.

Respectfully submitted,

STANTEC CONSULTING LTD.

Original to be signed by

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Appendix A STATEMENT OF GENERAL CONDITIONS

STATEMENT OF GENERAL CONDITIONS

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

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

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

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

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

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

Appendix B BOREHOLE LOCATION PLAN, DRAWING NO. 1

Stantec

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File Name: Moosonee Airport.dwg

Permit-Seal

Client/Project
CORPORATION OF THE TOWN OF MOOSONEE

GEOTECHNICAL PAVMENT INVESTIGATION, MOOSONEE AIRPORT

Title
BOREHOLE LOCATION PLAN, DRAWING NO. 1

Project No.	Scale	
163301858	AS NOTED	
Drawing No.	Sheet	Issued
01	1 of 1	

ORIGINAL SHEET - ARCH D

Appendix C BOREHOLE RECORDS

Stantec

BOREHOLE RECORD

BH01

CLIENT **CORPORATION OF THE TOWN OF MOOSONEE**

LOCATION **Moosonee Airport, Moosonee, Ontario**

DATES: BORING **2015/04/12** WATER LEVEL **NOT DETERMINED**

PROJECT No. **163301858**

BOREHOLE No. **BH01**

DATUM

DEPTH (m)	ELEVATION (m)	SOIL DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY	SAMPLES N-VALUE OR RQD
		Runway 06-24: 1+092m, 4.5m Rt of CL					mm	
0		Asphalt						
		Granular Base: SAND with silt and gravel			AU	BS1		
		Brown silty SAND						
1								
		Grey silty SAND with clay						
2		- frost to 2.2m						
3		End of Borehole						

Undrained Shear Strength - kPa

20 40 60 80

Water Content & Atterberg Limits W_P W W_L

Dynamic Penetration Test, blows/0.3m ★

Standard Penetration Test, blows/0.3m ●

10 20 30 40 50 60 70 80 90

△ Unconfined Compression Test

□ Field Vane Test ■ Remoulded

✖ Torvane

Stantec

BOREHOLE RECORD

BH02

CLIENT **CORPORATION OF THE TOWN OF MOOSONEE** PROJECT No. **163301858**

LOCATION **Moosonee Airport, Moosonee, Ontario** BOREHOLE No. **BH02**

DATES: BORING **2015/04/12** WATER LEVEL **NOT DETERMINED** DATUM

DEPTH (m)	ELEVATION (m)	SOIL DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY	SAMPLES N-VALUE OR RQD
		Runway 06-24: 1+368m, 4.25m Lt of CL					mm	
0		Asphalt						
		Granular Base: Silty SAND			AU	BS2		
		Brown SAND with gravel						
1								
		Grey sandy SILT			AU	BS3		
2		- frost to 2.4m						
3		End of Borehole						

Undrained Shear Strength - kPa

20 40 60 80

Water Content & Atterberg Limits W_P W W_L

Dynamic Penetration Test, blows/0.3m ★

Standard Penetration Test, blows/0.3m ●

10 20 30 40 50 60 70 80 90

△ Unconfined Compression Test

□ Field Vane Test ■ Remoulded

✖ Torvane

Stantec

BOREHOLE RECORD

BH03

CLIENT **CORPORATION OF THE TOWN OF MOOSONEE**

LOCATION **Moosonee Airport, Moosonee, Ontario**

DATES: BORING **2015/04/12** WATER LEVEL **NOT DETERMINED**

PROJECT No. **163301858**

BOREHOLE No. **BH03**

DATUM

DEPTH (m)	ELEVATION (m)	SOIL DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY	SAMPLES N-VALUE OR RQD
		Runway 06-24: 1+576m, 3.0m Lt of CL					mm	
0		Asphalt						
		Granular Base: Silty SAND with gravel			AU	BS1		
		Brown SAND with gravel						
1								
		Grey sandy SILT			AU	BS2		
2		- frost to 2.3m						
3		End of Borehole						

Undrained Shear Strength - kPa

20 40 60 80

Water Content & Atterberg Limits W_P W W_L

Dynamic Penetration Test, blows/0.3m ★

Standard Penetration Test, blows/0.3m ●

10 20 30 40 50 60 70 80 90

△ Unconfined Compression Test

□ Field Vane Test ■ Remoulded

✖ Torvane

BOREHOLE RECORD

BH04

CLIENT **CORPORATION OF THE TOWN OF MOOSONEE**

PROJECT No. **163301858**

LOCATION **Moosonee Airport, Moosonee, Ontario**

BOREHOLE No. **BH04**

DATES: BORING **2015/04/12**

WATER LEVEL **NOT DETERMINED**

DATUM

DEPTH (m)	ELEVATION (m)	SOIL DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY	SAMPLES N-VALUE OR RQD
		Runway 06-24: 1+920m, 4.0m Rt of CL					mm	
0		Asphalt						
		Granular Base: Silty SAND with gravel			AU	BS1		
		Brown SAND with gravel						
1								
		Grey silty SAND with clay						
2		- frost to 2.4m						
3		End of Borehole						

Undrained Shear Strength - kPa

20 40 60 80

Water Content & Atterberg Limits W_P W W_L

Dynamic Penetration Test, blows/0.3m ★

Standard Penetration Test, blows/0.3m ●

10 20 30 40 50 60 70 80 90

△ Unconfined Compression Test

□ Field Vane Test ■ Remoulded

✖ Torvane

Stantec

BOREHOLE RECORD

BH05

CLIENT **CORPORATION OF THE TOWN OF MOOSONEE**

PROJECT No. **163301858**

LOCATION **Moosonee Airport, Moosonee, Ontario**

BOREHOLE No. **BH05**

DATES: BORING **2015/04/12**

WATER LEVEL **2.7m**

DATUM

DEPTH (m)	ELEVATION (m)	SOIL DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY	SAMPLES N-VALUE OR RQD
		Runway 06-24: 2+075m, 3.5m Lt of CL					mm	
0		Asphalt						
		Granular Base: Silty GRAVEL with sand						
		Brown sandy SILT			AU	BS1		
1					AU	BS2		
		Grey silty SAND with gravel						
2		- frost to 2.5m		▽				
3		End of Borehole						

Undrained Shear Strength - kPa

20 40 60 80

Water Content & Atterberg Limits W_P W W_L

Dynamic Penetration Test, blows/0.3m ★

Standard Penetration Test, blows/0.3m ●

10 20 30 40 50 60 70 80 90

△ Unconfined Compression Test

□ Field Vane Test ■ Remoulded

✖ Torvane

Stantec

BOREHOLE RECORD

BH06

CLIENT **CORPORATION OF THE TOWN OF MOOSONEE**

LOCATION **Moosonee Airport, Moosonee, Ontario**

DATES: BORING **2015/04/12** WATER LEVEL **NOT DETERMINED**

PROJECT No. **163301858**

BOREHOLE No. **BH06**

DATUM

DEPTH (m)	ELEVATION (m)	SOIL DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY	SAMPLES N-VALUE OR RQD
		Runway 06-24: 2+178m, 10.0m Rt of CL					mm	
0		Asphalt						
		Granular Base: Silty GRAVEL with sand			AU	BS2		
		Brown SAND with gravel						
1								
2		Grey silty SAND with gravel - frost to 2.3m						
3		End of Borehole						

Undrained Shear Strength - kPa

20 40 60 80

Water Content & Atterberg Limits W_P W W_L

Dynamic Penetration Test, blows/0.3m ★

Standard Penetration Test, blows/0.3m ●

10 20 30 40 50 60 70 80 90

△ Unconfined Compression Test

□ Field Vane Test ■ Remoulded

✖ Torvane

Stantec

BOREHOLE RECORD

BH07

CLIENT **CORPORATION OF THE TOWN OF MOOSONEE**

PROJECT No. **163301858**

LOCATION **Moosonee Airport, Moosonee, Ontario**

BOREHOLE No. **BH07**

DATES: BORING **2015/04/13**

WATER LEVEL **NOT DETERMINED**

DATUM

DEPTH (m)	ELEVATION (m)	SOIL DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY	SAMPLES N-VALUE OR RQD
		Runway 14-32: 3+100m, 3.0m Rt of CL					mm	
0		Asphalt						
		Granular Base: Silty SAND with gravel			AU	BS1		
		Brown silty SAND			AU	BS2		
1								
		Grey silty SAND with gravel						
2		- frost to 2.3m						
3		End of Borehole						

Undrained Shear Strength - kPa

20 40 60 80

Water Content & Atterberg Limits W_P W W_L

Dynamic Penetration Test, blows/0.3m ★

Standard Penetration Test, blows/0.3m ●

10 20 30 40 50 60 70 80 90

△ Unconfined Compression Test

□ Field Vane Test ■ Remoulded

✖ Torvane

Stantec

BOREHOLE RECORD

BH08

CLIENT **CORPORATION OF THE TOWN OF MOOSONEE**

LOCATION **Moosonee Airport, Moosonee, Ontario**

DATES: BORING **2015/04/13** WATER LEVEL **NOT DETERMINED**

PROJECT No. **163301858**

BOREHOLE No. **BH08**

DATUM

DEPTH (m)	ELEVATION (m)	SOIL DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY	SAMPLES N-VALUE OR RQD
		Runway 14-32: 3+200m, 2.5m Lt of CL					mm	
0		Asphalt						
		Granular Base: Silty SAND with gravel						
		End of Borehole						
1								
2								
3								

Undrained Shear Strength - kPa

20 40 60 80

Water Content & Atterberg Limits W_P W W_L

Dynamic Penetration Test, blows/0.3m ★

Standard Penetration Test, blows/0.3m ●

10 20 30 40 50 60 70 80 90

△ Unconfined Compression Test

□ Field Vane Test ■ Remoulded

✖ Torvane

Stantec

BOREHOLE RECORD

BH09

CLIENT **CORPORATION OF THE TOWN OF MOOSONEE**

LOCATION **Moosonee Airport, Moosonee, Ontario**

DATES: BORING **2015/04/13** WATER LEVEL **NOT DETERMINED**

PROJECT No. **163301858**

BOREHOLE No. **BH09**

DATUM

DEPTH (m)	ELEVATION (m)	SOIL DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY	SAMPLES N-VALUE OR RQD
		Runway 14-32: 3+400m, 3.5m Lt of CL					mm	
0		Asphalt						
		Granular Base: Silty SAND with gravel			AU	BS2		
		Brown silty SAND						
1					AU	BS3		
		Grey silty SAND with clay						
2		- frost to 2.5m						
3		End of Borehole						

Undrained Shear Strength - kPa

20 40 60 80

Water Content & Atterberg Limits W_P W W_L

Dynamic Penetration Test, blows/0.3m ★

Standard Penetration Test, blows/0.3m ●

10 20 30 40 50 60 70 80 90

△ Unconfined Compression Test

□ Field Vane Test ■ Remoulded

✖ Torvane

Stantec

BOREHOLE RECORD

BH10

CLIENT **CORPORATION OF THE TOWN OF MOOSONEE**

LOCATION **Moosonee Airport, Moosonee, Ontario**

DATES: BORING **2015/04/13** WATER LEVEL **1.8m (INFERRED)**

PROJECT No. **163301858**

BOREHOLE No. **BH10**

DATUM

DEPTH (m)	ELEVATION (m)	SOIL DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY	SAMPLES N-VALUE OR RQD
		Runway 14-32: 3+496m, 2.8m Rt of CL					mm	
0		Asphalt						
		Granular Base: SAND with silt and gravel			AU	BS1		
1		Brown SAND with gravel						
2		Grey silty SAND with gravel - inferred water table - frost to 2.4m		▽				
3		End of Borehole						

Undrained Shear Strength - kPa

20 40 60 80

Water Content & Atterberg Limits W_P W W_L

Dynamic Penetration Test, blows/0.3m ★

Standard Penetration Test, blows/0.3m ●

10 20 30 40 50 60 70 80 90

△ Unconfined Compression Test

□ Field Vane Test ■ Remoulded

✖ Torvane

Stantec

BOREHOLE RECORD

BH11

CLIENT **CORPORATION OF THE TOWN OF MOOSONEE**

PROJECT No. **163301858**

LOCATION **Moosonee Airport, Moosonee, Ontario**

BOREHOLE No. **BH11**

DATES: BORING **2015/04/12**

WATER LEVEL **NOT DETERMINED**

DATUM

DEPTH (m)	ELEVATION (m)	SOIL DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY	SAMPLES N-VALUE OR RQD
		Taxiway Alpha: 4+082m, 1.5m Rt of CL					mm	
0		Asphalt						
		Granular Base: SAND with silt and gravel			AU	BS2		
		Brown SAND with gravel						
1								
		Grey SILT			AU	BS3		
2		- frost to 2.3m						
3		End of Borehole						

Undrained Shear Strength - kPa

20 40 60 80

Water Content & Atterberg Limits W_P W W_L

Dynamic Penetration Test, blows/0.3m ★

Standard Penetration Test, blows/0.3m ●

10 20 30 40 50 60 70 80 90

△ Unconfined Compression Test

□ Field Vane Test ■ Remoulded

✖ Torvane

BOREHOLE RECORD

BH12

CLIENT **CORPORATION OF THE TOWN OF MOOSONEE**

PROJECT No. **163301858**

LOCATION **Moosonee Airport, Moosonee, Ontario**

BOREHOLE No. **BH12**

DATES: BORING **2015/04/12**

WATER LEVEL **NOT DETERMINED**

DATUM

DEPTH (m)	ELEVATION (m)	SOIL DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY	SAMPLES N-VALUE OR RQD
		Taxiway Alpha: 4+137m, 1.0 m Rt of CL					mm	
0		Asphalt						
		Granular Base: SAND with silt and gravel						
		End of Borehole						
1								
2								
3								

Undrained Shear Strength - kPa

20 40 60 80

Water Content & Atterberg Limits W_P W W_L

Dynamic Penetration Test, blows/0.3m ★

Standard Penetration Test, blows/0.3m ●

10 20 30 40 50 60 70 80 90

△ Unconfined Compression Test

□ Field Vane Test ■ Remoulded

✖ Torvane

Stantec

BOREHOLE RECORD

BH13

CLIENT **CORPORATION OF THE TOWN OF MOOSONEE**

PROJECT No. **163301858**

LOCATION **Moosonee Airport, Moosonee, Ontario**

BOREHOLE No. **BH13**

DATES: BORING **2015/04/12**

WATER LEVEL **NOT DETERMINED**

DATUM

DEPTH (m)	ELEVATION (m)	SOIL DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY	SAMPLES N-VALUE OR RQD
		Taxiway Alpha: 4+322m, 2.5m Lt of CL					mm	
0		Asphalt						
		Granular Base: SAND with silt and gravel			AU	BS1		
		Brown SAND with silt			AU	BS2		
1								
		Grey silty SAND with clay						
2		- frost to 2.4m						
3		End of Borehole						

Undrained Shear Strength - kPa

20 40 60 80

Water Content & Atterberg Limits W_P W W_L

Dynamic Penetration Test, blows/0.3m ★

Standard Penetration Test, blows/0.3m ●

10 20 30 40 50 60 70 80 90

△ Unconfined Compression Test

□ Field Vane Test ■ Remoulded

✖ Torvane

BOREHOLE RECORD

BH14

CLIENT **CORPORATION OF THE TOWN OF MOOSONEE**

PROJECT No. **163301858**

LOCATION **Moosonee Airport, Moosonee, Ontario**

BOREHOLE No. **BH14**

DATES: BORING **2015/04/13**

WATER LEVEL **NOT DETERMINED**

DATUM

DEPTH (m)	ELEVATION (m)	SOIL DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY	SAMPLES N-VALUE OR RQD
		Taxiway Bravo: 5+045m, 2.0m Lt of CL					mm	
0		Asphalt						
		Granular Base: Silty SAND with gravel						
		Brown silty SAND						
1					AU	BS3		
		Grey silty SAND with clay						
2		- frost to 2.3m						
3		End of Borehole						

Undrained Shear Strength - kPa

20 40 60 80

Water Content & Atterberg Limits W_P W W_L

Dynamic Penetration Test, blows/0.3m ★

Standard Penetration Test, blows/0.3m ●

10 20 30 40 50 60 70 80 90

△ Unconfined Compression Test

□ Field Vane Test ■ Remoulded

✖ Torvane

Stantec

BOREHOLE RECORD

BH15

CLIENT **CORPORATION OF THE TOWN OF MOOSONEE**

PROJECT No. **163301858**

LOCATION **Moosonee Airport, Moosonee, Ontario**

BOREHOLE No. **BH15**

DATES: BORING **2015/04/13**

WATER LEVEL **NOT DETERMINED**

DATUM

DEPTH (m)	ELEVATION (m)	SOIL DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY	SAMPLES N-VALUE OR RQD
		Taxiway Bravo: 5+090m, 5.0m Lt of CL					mm	
0		Asphalt						
		Granular Base: Silty SAND with gravel						
		End of Borehole						
1								
2								
3								

Undrained Shear Strength - kPa

20 40 60 80

Water Content & Atterberg Limits W_P W W_L

Dynamic Penetration Test, blows/0.3m ★

Standard Penetration Test, blows/0.3m ●

10 20 30 40 50 60 70 80 90

△ Unconfined Compression Test

□ Field Vane Test ■ Remoulded

✖ Torvane

Stantec

BOREHOLE RECORD

BH16

CLIENT **CORPORATION OF THE TOWN OF MOOSONEE**

LOCATION **Moosonee Airport, Moosonee, Ontario**

DATES: BORING **2015/04/13** WATER LEVEL **NOT DETERMINED**

PROJECT No. **163301858**

BOREHOLE No. **BH16**

DATUM

DEPTH (m)	ELEVATION (m)	SOIL DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY	SAMPLES N-VALUE OR RQD
		Taxiway Bravo: 5+150m, 6.0m Rt of CL					mm	
0		Asphalt						
		Granular Base: Silty SAND with gravel						
		Brown SAND with gravel						
1								
		Grey silty SAND with clay						
2		- frost to 2.3m						
3		End of Borehole						

Undrained Shear Strength - kPa

20 40 60 80

Water Content & Atterberg Limits W_P W W_L

Dynamic Penetration Test, blows/0.3m ★

Standard Penetration Test, blows/0.3m ●

10 20 30 40 50 60 70 80 90

△ Unconfined Compression Test

□ Field Vane Test ■ Remoulded

✖ Torvane

Stantec

BOREHOLE RECORD

BH17

CLIENT **CORPORATION OF THE TOWN OF MOOSONEE** PROJECT No. **163301858**

LOCATION **Moosonee Airport, Moosonee, Ontario** BOREHOLE No. **BH17**

DATES: BORING **2015/04/14** WATER LEVEL **NOT DETERMINED** DATUM

DEPTH (m)	ELEVATION (m)	SOIL DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY	SAMPLES N-VALUE OR RQD
		Apron with Microsurfacing					mm	
0		Asphalt						
		Granular Base: SAND with silt and gravel						
		Brown silty SAND with gravel			AU	BS2		
1								
		Grey SILT with sand			AU	BS3		
2		- frost to 2.7m						
3		End of Borehole						

Undrained Shear Strength - kPa

20 40 60 80

Water Content & Atterberg Limits W_P W W_L

Dynamic Penetration Test, blows/0.3m ★

Standard Penetration Test, blows/0.3m ●

10 20 30 40 50 60 70 80 90

△ Unconfined Compression Test

□ Field Vane Test ■ Remoulded

✖ Torvane

Stantec

BOREHOLE RECORD

BH18

CLIENT **CORPORATION OF THE TOWN OF MOOSONEE**

PROJECT No. **163301858**

LOCATION **Moosonee Airport, Moosonee, Ontario**

BOREHOLE No. **BH18**

DATES: BORING **2015/04/14**

WATER LEVEL **NOT DETERMINED**

DATUM

DEPTH (m)	ELEVATION (m)	SOIL DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY	SAMPLES N-VALUE OR RQD
		Apron with Microsurfacing					mm	
0		Asphalt						
		Granular Base: GRAVEL with silt and sand			AU	BS1		
		Grey silty SAND with clay						
1								
2								
		- frost to 2.8m						
3								

Undrained Shear Strength - kPa

20 40 60 80

Water Content & Atterberg Limits W_P W W_L

Dynamic Penetration Test, blows/0.3m ★

Standard Penetration Test, blows/0.3m ●

10 20 30 40 50 60 70 80 90

△ Unconfined Compression Test

□ Field Vane Test ■ Remoulded

✖ Torvane

BOREHOLE RECORD

BH19

CLIENT **CORPORATION OF THE TOWN OF MOOSONEE**

LOCATION **Moosonee Airport, Moosonee, Ontario**

DATES: BORING **2015/04/14** WATER LEVEL **NOT DETERMINED**

PROJECT No. **163301858**

BOREHOLE No. **BH19**

DATUM

DEPTH (m)	ELEVATION (m)	SOIL DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY	SAMPLES N-VALUE OR RQD
		Apron without Microsurfacing					mm	
0		Asphalt						
		Granular Base: Silty SAND with gravel			AU	BS1		
		Brown silty SAND			AU	BS2		
1		Grey silty SAND with clay						
2		- frost to 2.3m						
3		End of Borehole						

Undrained Shear Strength - kPa

20 40 60 80

Water Content & Atterberg Limits W_P W W_L

Dynamic Penetration Test, blows/0.3m ★

Standard Penetration Test, blows/0.3m ●

10 20 30 40 50 60 70 80 90

△ Unconfined Compression Test

□ Field Vane Test ■ Remoulded

✖ Torvane

Stantec

BOREHOLE RECORD

BH20

CLIENT **CORPORATION OF THE TOWN OF MOOSONEE** PROJECT No. **163301858**

LOCATION **Moosonee Airport, Moosonee, Ontario** BOREHOLE No. **BH20**

DATES: BORING **2015/04/13** WATER LEVEL **1.3m (INFERRED)** DATUM

DEPTH (m)	ELEVATION (m)	SOIL DESCRIPTION	STRATA PLOT	WATER LEVEL	SAMPLES TYPE	SAMPLES NUMBER	SAMPLES RECOVERY	SAMPLES N-VALUE OR RQD
		Apron without Microsurfacing					mm	
0		Asphalt						
		Granular Base: SAND with silt and gravel			AU	BS2		
		Grey silty SAND			AU	BS3		
1		- inferred water table		▽				
2		- frost to 2.6m						
3		End of Borehole						

Undrained Shear Strength - kPa

20 40 60 80

Water Content & Atterberg Limits W_P W W_L

Dynamic Penetration Test, blows/0.3m ★

Standard Penetration Test, blows/0.3m ●

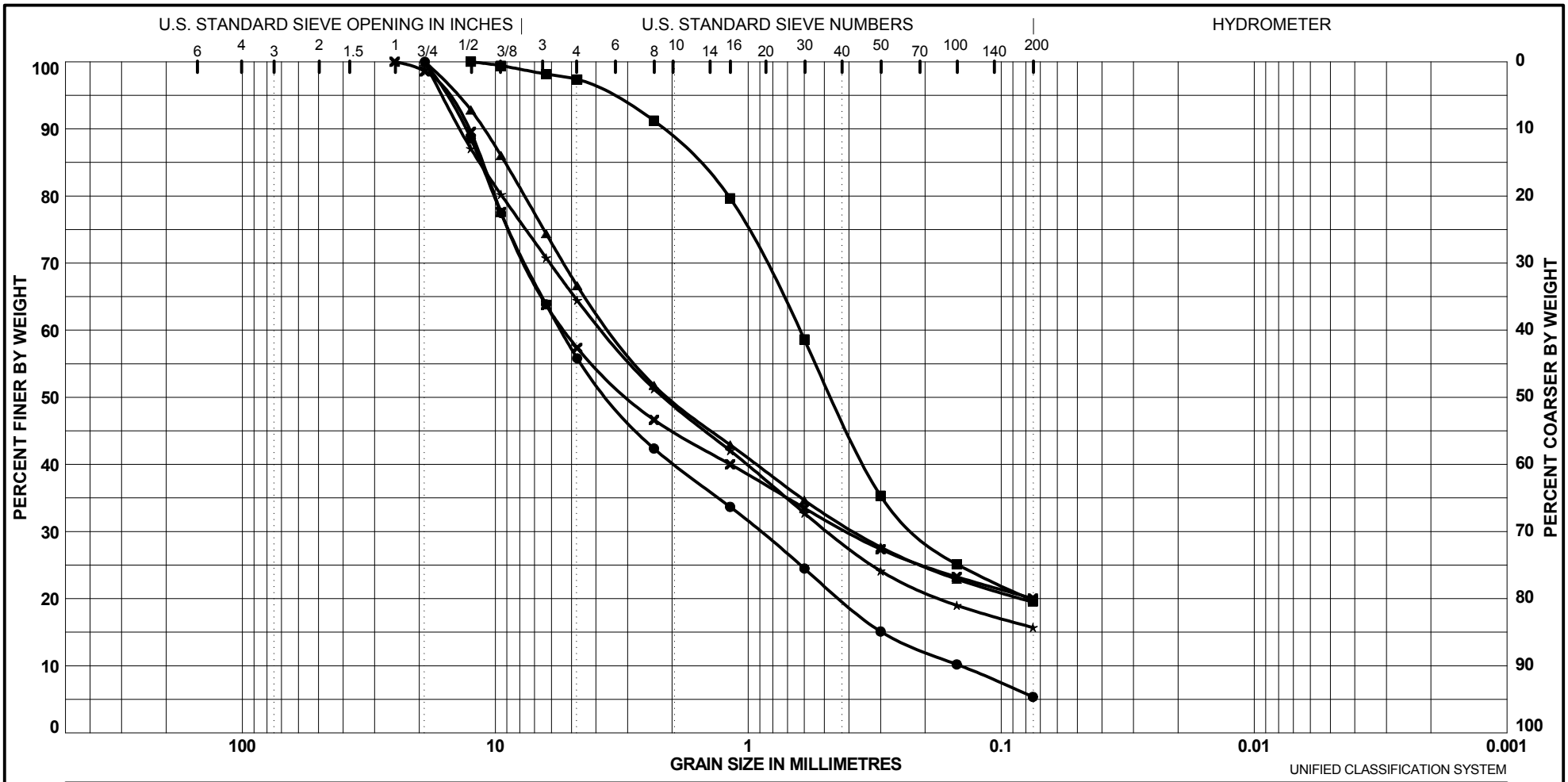
10 20 30 40 50 60 70 80 90

△ Unconfined Compression Test

□ Field Vane Test ■ Remoulded

✖ Torvane

Appendix D LABORATORY TESTING

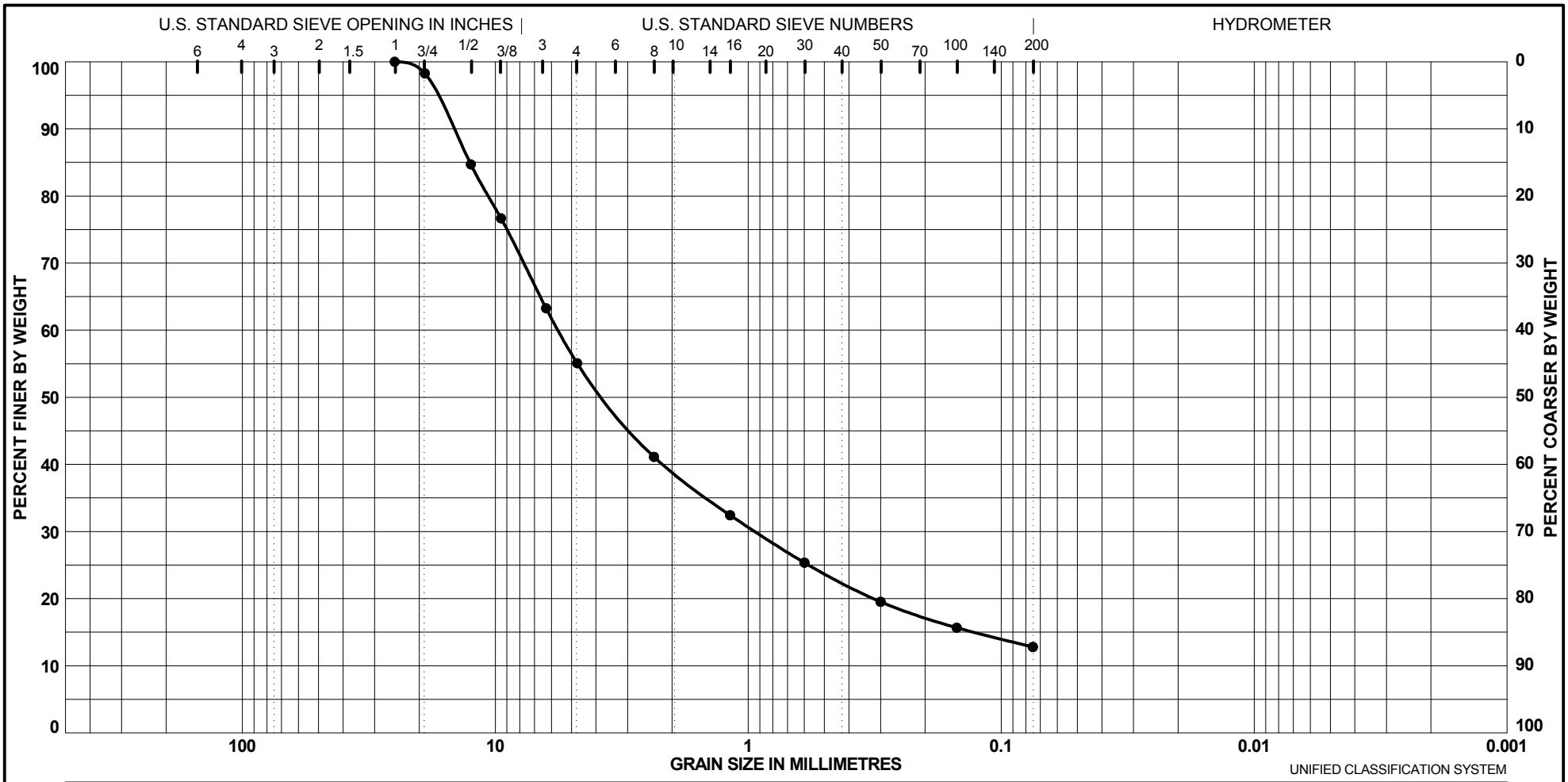


COBBLES	GRAVEL		SAND			SILT and CLAY	
	coarse	fine	coarse	medium	fine	SILT	CLAY

Source		Depth	Description	W%	W_L	W_P	I_P	%Gravel	%Sand	%Silt	%Clay
●	BH01	0.2	SAND with silt and gravel	3.2				44.2	50.4	5.4	
■	BH02	0.4	Silty SAND	10.0				2.6	77.7	19.7	
▲	BH03	0.3	Silty SAND with gravel	7.8				33.4	47.1	19.5	
★	BH04	0.2	Silty SAND with gravel	6.8				35.5	48.8	15.7	
✖	BH05	0.5	Silty GRAVEL with sand	7.1				42.6	37.4	20.0	

Stantec

Project:	**Moosonee Airport, Moosonee, Ontario**	Location:	RUNWAY 06-24
Job No.:	**163301858**	Notes:	**GRANULAR BASE**
Date:	**APRIL 11 TO 15, 2015**		**GRADATION CURVES**

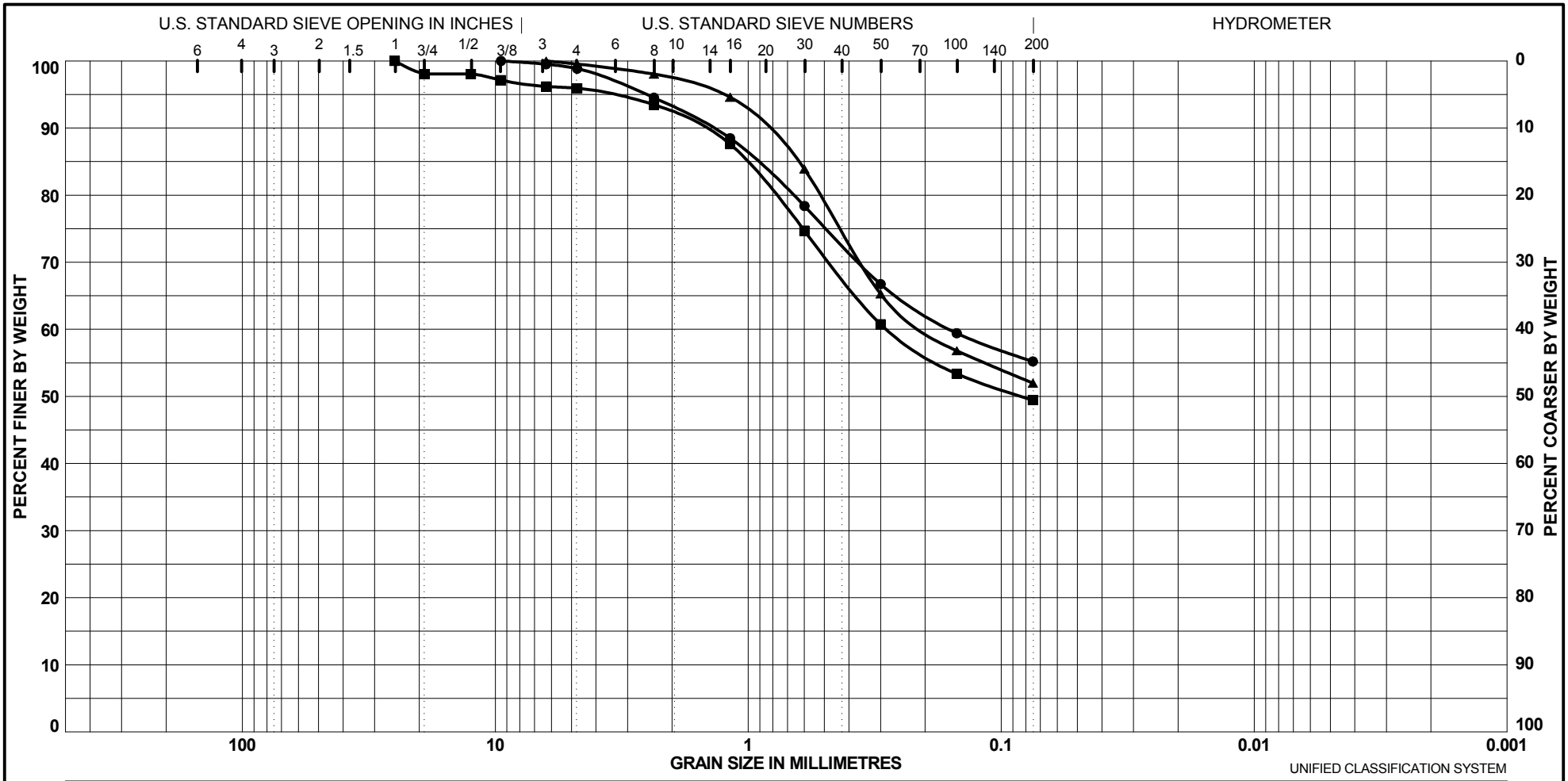


COBBLES	GRAVEL		SAND			SILT and CLAY	
	coarse	fine	coarse	medium	fine	SILT	CLAY

Source	Depth	Description	W%	W_L	W_P	I_P	%Gravel	%Sand	%Silt	%Clay
● BH06	0.3	Silty GRAVEL with sand	8.6				44.9	42.3	12.8	

Stantec

Project:	**Moosonee Airport, Moosonee, Ontario**	Location:	RUNWAY 06-24
Job No.:	**163301858**	Notes:	**GRANULAR BASE**
Date:	**APRIL 11 TO 15, 2015**		**GRADATION CURVES**

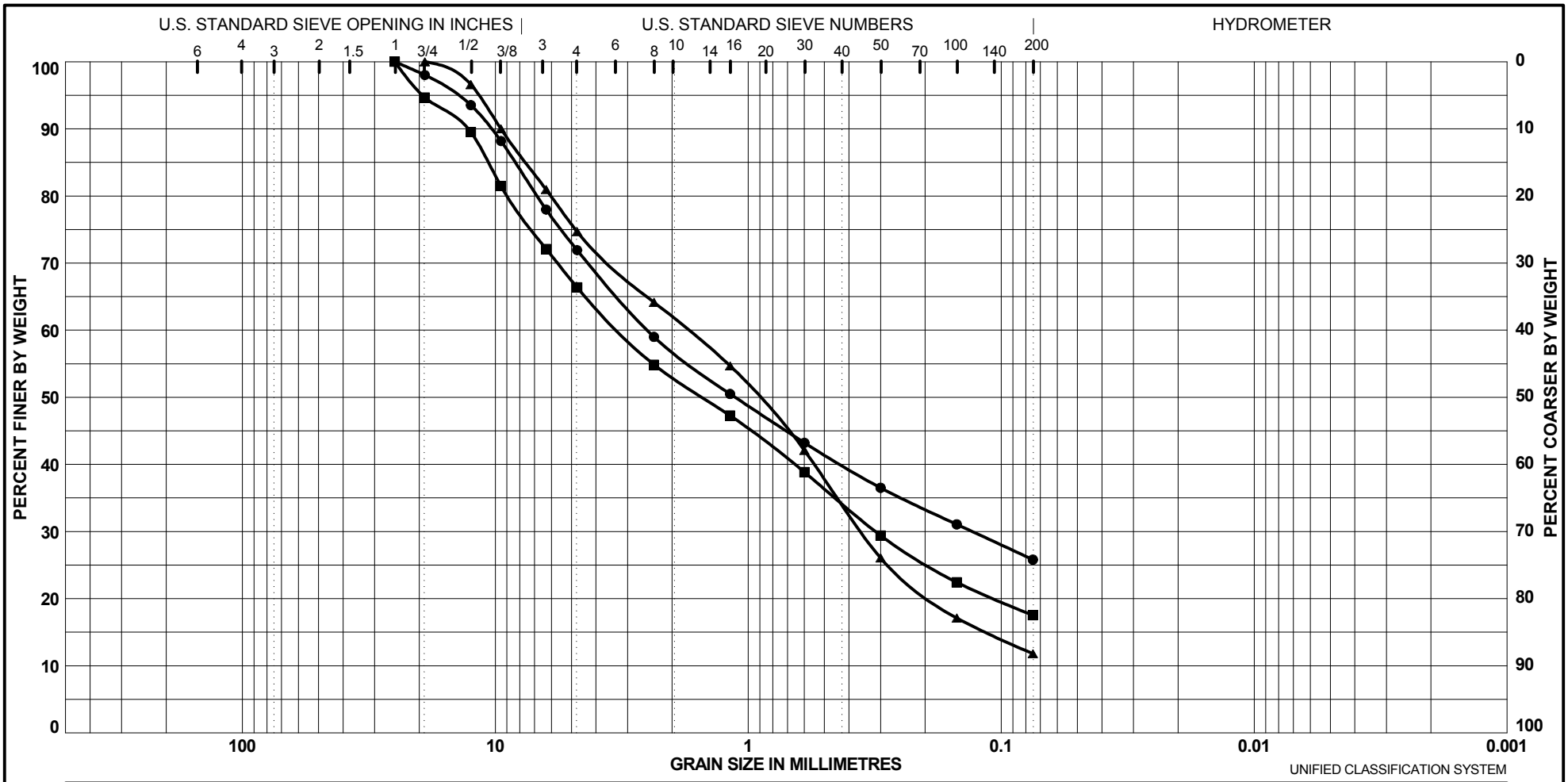


COBBLES	GRAVEL		SAND			SILT and CLAY	
	coarse	fine	coarse	medium	fine	SILT	CLAY

Source	Depth	Description	W%	W_L	W_P	I_P	%Gravel	%Sand	%Silt	%Clay
● BH02	1.5	Sandy SILT	28.7				1.2	43.6	55.2	
■ BH03	1.5	Sandy SILT	19.8				4.1	46.5	49.4	
▲ BH05	1.4	Sandy SILT	21.2				0.5	47.5	52.0	

Stantec

Project: **Moosonee Airport, Moosonee, Ontario**	Location: RUNWAY 06-24
Job No.: **163301858**	Notes: **SUBGRADE**
Date: **APRIL 11 TO 15, 2015**	**GRADATION CURVES**

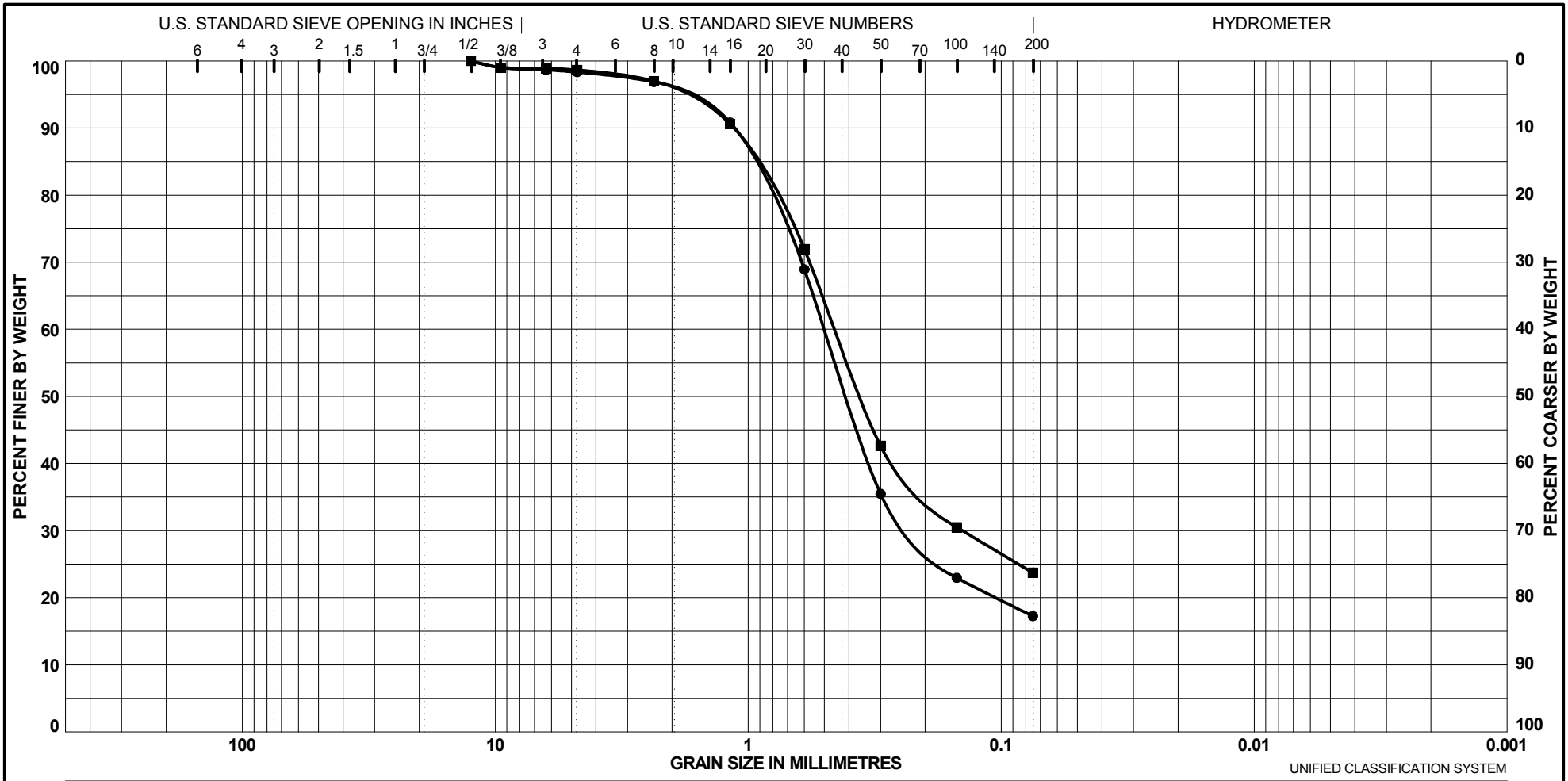


COBBLES	GRAVEL		SAND			SILT and CLAY	
	coarse	fine	coarse	medium	fine	SILT	CLAY

Source		Depth	Description	W%	W_L	W_P	I_P	%Gravel	%Sand	%Silt	%Clay
●	BH07	0.2	Silty SAND with gravel	9.5				28.1	46.1	25.8	
■	BH09	0.3	Silty SAND with gravel	5.4				33.6	48.9	17.5	
▲	BH10	0.5	SAND with silt and gravel	2.2				25.3	62.9	11.8	

Stantec

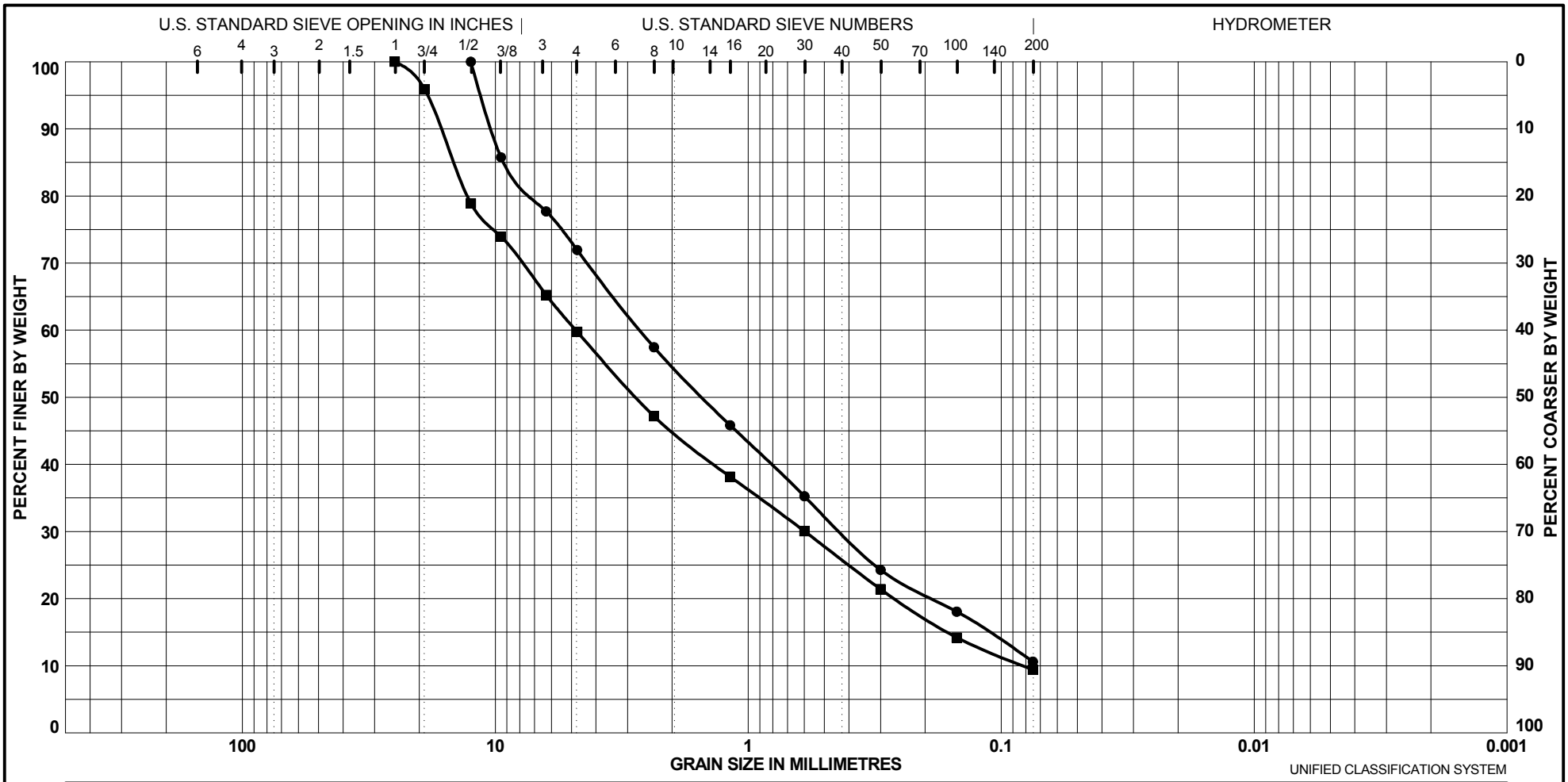
Project:	**Moosonee Airport, Moosonee, Ontario**	Location:	RUNWAY 14-32
Job No.:	**163301858**	Notes:	**GRANULAR BASE**
Date:	**APRIL 11 TO 15, 2015**		**GRADATION CURVES**



Source	Depth	Description	W%	W_L	W_P	I_P	%Gravel	%Sand	%Silt	%Clay
● BH07	0.8	Silty SAND	9.8				1.7	81.0	17.3	
■ BH09	1.6	Silty SAND	11.4				1.4	74.9	23.7	

Stantec

Project:	**Moosonee Airport, Moosonee, Ontario**	Location:	RUNWAY 14-32
Job No.:	**163301858**	Notes:	**GRANULAR FILL**
Date:	**APRIL 11 TO 15, 2015**		**GRADATION CURVES**

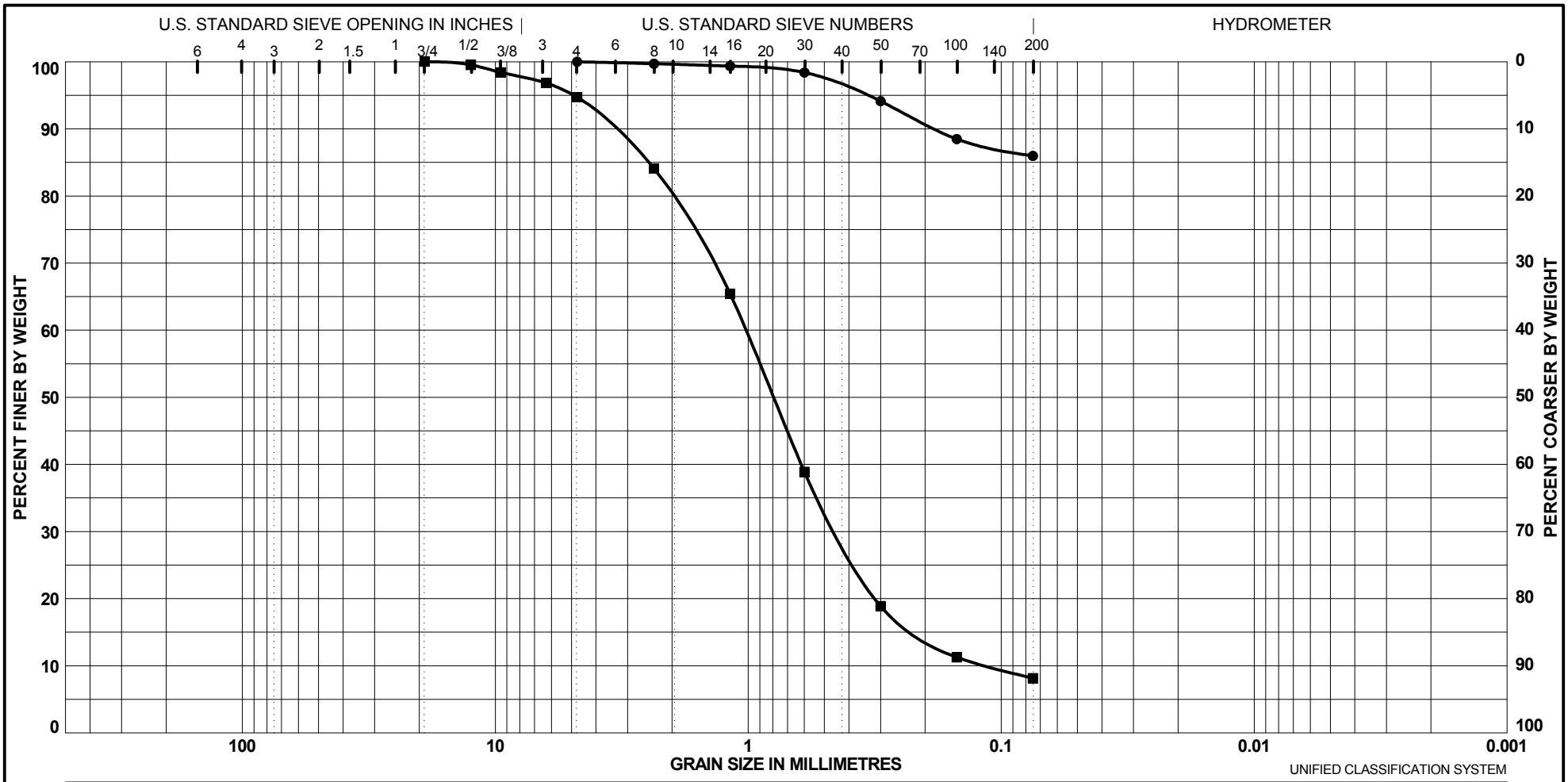


COBBLES	GRAVEL		SAND			SILT and CLAY	
	coarse	fine	coarse	medium	fine	SILT	CLAY

Source		Depth	Description	W%	W_L	W_P	I_P	%Gravel	%Sand	%Silt	%Clay
●	BH11	0.2	SAND with silt and gravel	4.2				28.0	61.4	10.6	
■	BH13	0.2	SAND with silt and gravel	3.7				40.2	50.4	9.4	

Stantec

Project:	**Moosonee Airport, Moosonee, Ontario**	Location:	TAXIWAY A
Job No.:	**163301858**	Notes:	**GRANULAR BASE**
Date:	**APRIL 11 TO 15, 2015**		**GRADATION CURVES**

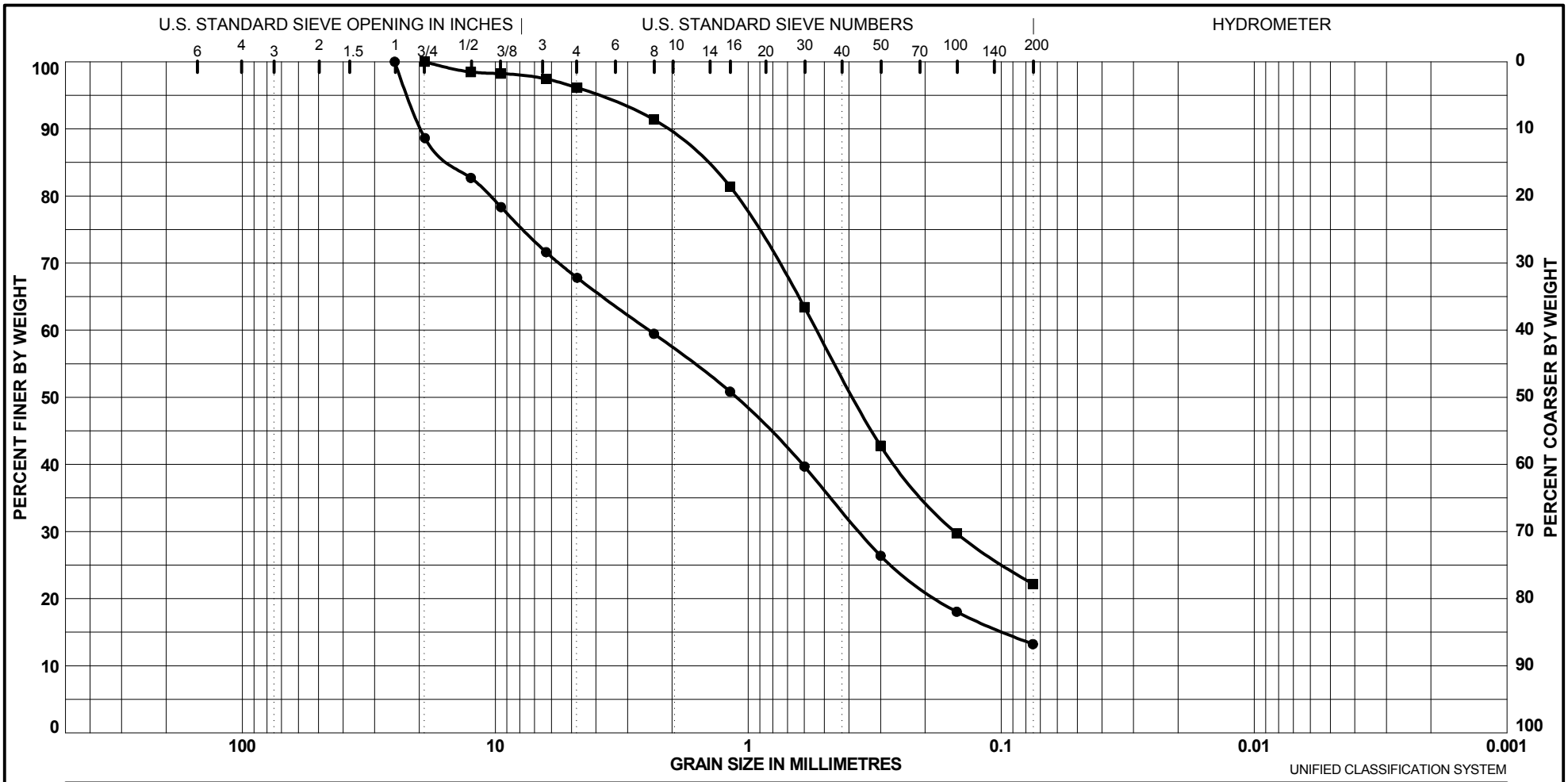


COBBLES	GRAVEL		SAND			SILT and CLAY	
	coarse	fine	coarse	medium	fine	SILT	CLAY

Source		Depth	Description	W%	W_L	W_P	I_P	%Gravel	%Sand	%Silt	%Clay
●	BH11	1.4	SILT	20.5				0.0	14.0	86.0	
■	BH13	1.2	SAND with silt	6.4				5.3	86.5	8.2	

Stantec

Project:	**Moosonee Airport, Moosonee, Ontario**	Location:	TAXIWAY A
Job No.:	**163301858**	Notes:	**GRANULAR FILL / SUBGRADE**
Date:	**APRIL 11 TO 15, 2015**		**GRADATION CURVES**



COBBLES	GRAVEL		SAND			SILT and CLAY	
	coarse	fine	coarse	medium	fine	SILT	CLAY

Source	Depth	Description	W%	W_L	W_P	I_P	%Gravel	%Sand	%Silt	%Clay
● BH14	0.3	Silty SAND with gravel	5.7				32.2	54.6	13.2	
■ BH14	1.4	Silty SAND	11.4				3.9	73.9	22.2	

Stantec

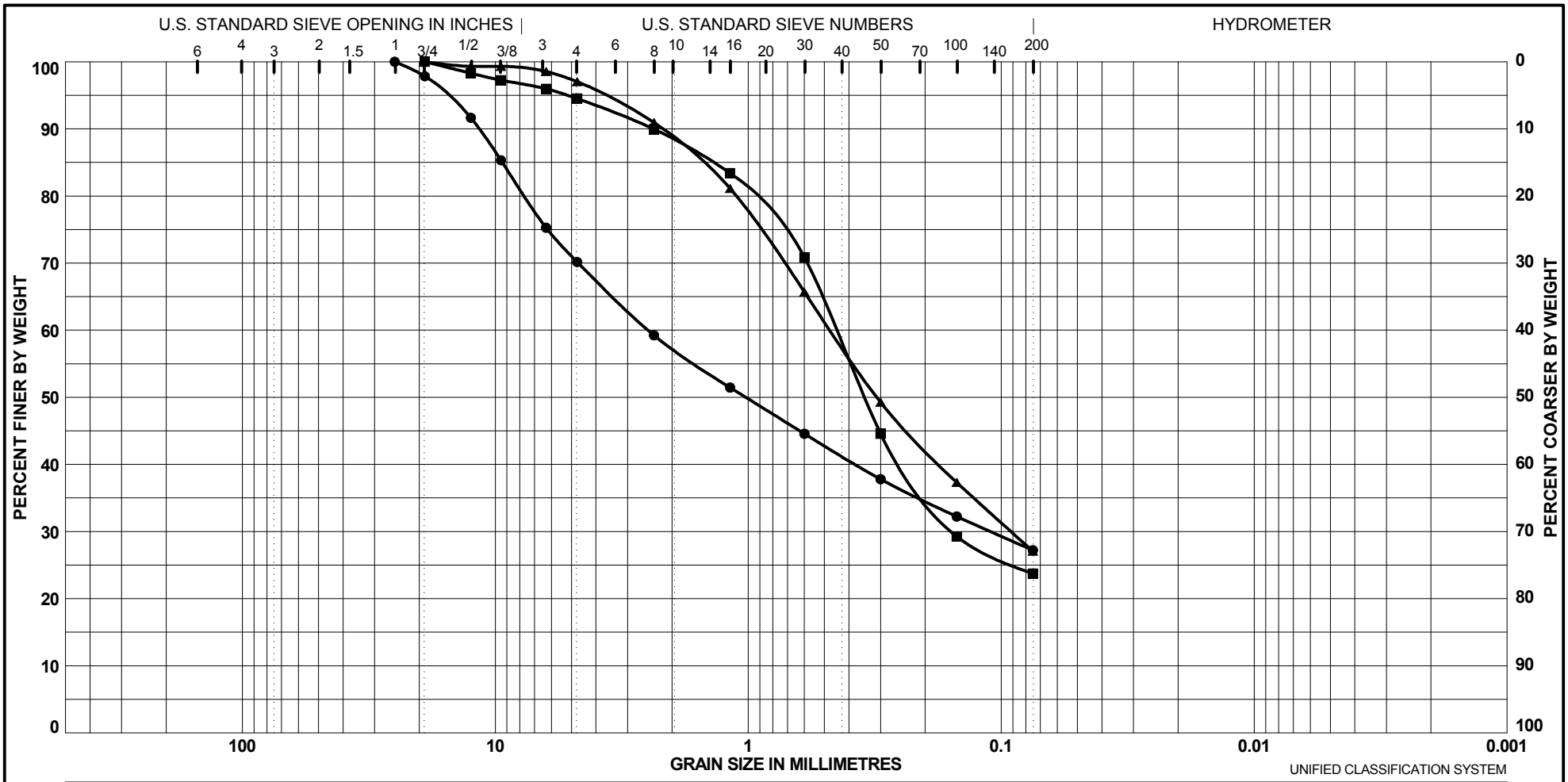
Project: **Moosonee Airport, Moosonee, Ontario**	Location: TAXIWAY B
Job No.: **163301858**	Notes: **GRANULAR BASE / GRANULAR FILL**
Date: **APRIL 11 TO 15, 2015**	**GRADATION CURVES**

COBBLES	GRAVEL		SAND			SILT and CLAY	
	coarse	fine	coarse	medium	fine	SILT	CLAY

Source		Depth	Description	W%	W_L	W_P	I_P	%Gravel	%Sand	%Silt	%Clay
●	BH18	0.5	GRAVEL with silt and sand	7.4				57.6	33.4	9.0	
■	BH19	0.4	Silty SAND with gravel	6.5				23.8	53.1	23.1	
▲	BH20	0.1	SAND with silt and gravel	8.5				29.0	59.7	11.3	

Stantec

Project:	**Moosonee Airport, Moosonee, Ontario**	Location:	APRON
Job No.:	**163301858**	Notes:	**GRANULAR BASE**
Date:	**APRIL 11 TO 15, 2015**		**GRADATION CURVES**

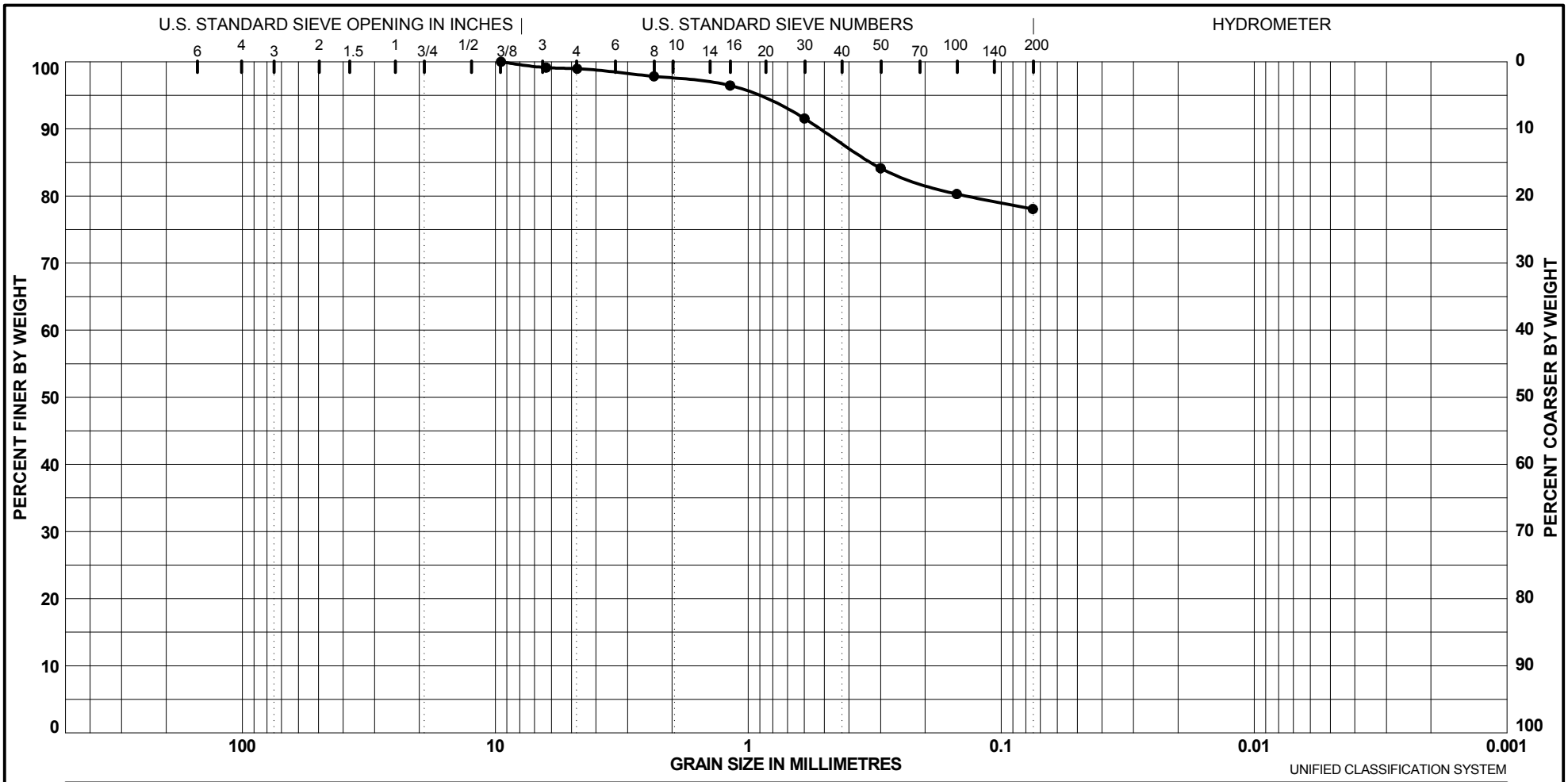


COBBLES	GRAVEL		SAND			SILT and CLAY	
	coarse	fine	coarse	medium	fine	SILT	CLAY

Source		Depth	Description	W%	W_L	W_P	I_P	%Gravel	%Sand	%Silt	%Clay
●	BH17	0.7	Silty SAND with gravel	8.3				29.8	43.0	27.2	
■	BH19	0.8	Silty SAND	9.2				5.5	70.8	23.7	
▲	BH20	0.3	Silty SAND	11.7				3.0	69.9	27.1	

Stantec

Project:	**Moosonee Airport, Moosonee, Ontario**	Location:	APRON
Job No.:	**163301858**	Notes:	**GRANULAR FILL**
Date:	**APRIL 11 TO 15, 2015**		**GRADATION CURVES**



COBBLES	GRAVEL		SAND			SILT and CLAY	
	coarse	fine	coarse	medium	fine	SILT	CLAY

Source	Depth	Description	W%	W_L	W_P	I_P	%Gravel	%Sand	%Silt	%Clay
● BH17	1.5	SILT with sand	21.6				1.0	20.9	78.1	

Stantec

Project: **Moosonee Airport, Moosonee, Ontario**	Location: APRON
Job No.: **163301858**	Notes: **SUBGRADE**
Date: **APRIL 11 TO 15, 2015**	**GRADATION CURVES**