Geotechnical, Environmental and Materials Engineering

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GEOTECHNICAL INVESTIGATION

PROPOSED NURSERY GOLF COURSE RV DEVELOPMENT
PORTION OF SW 7-41-26-W4M
LACOMBE COUNTY, ALBERTA

PREPARED FOR

WSP CANADA INC.

RED DEER, ALBERTA

PREPARED BY

PARKLAND GEOTECHNICAL CONSULTING LTD.

RED DEER, ALBERTA

PROJECT NO. RD5911

MARCH 2016

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1.0 INTRODUCTION

1.1 GENERAL

The Nursery Golf and Country Club Inc. (NGCC) is proposing new RV site in Lacombe County, Alberta. Parkland Geotechnical Consulting Ltd. (ParklandGEO) was commissioned by WSP Canada Inc. (WSP) to conduct a geotechnical assessment and provide preliminary suitability of private sewage system for the site. The scope was outlined in the ParklandGEO proposal dated November 2, 2016 (File # PRO5425). Authorization to proceed with this assessment was given by Mr. Craig Suchy of WSP acting on behalf of NGCC. The site location is shown on Figure 1.

1.2 SCOPE OF WORK

This assessment was based on a review of existing publically available site investigation information and recent site investigation. This report summarizes results of historical field and laboratory testing programs for the site and presents geotechnical recommendations for the proposed development. Geotechnical recommendations are provided with respect to design and installation of underground services, suitable shallow foundations, roadway subgrades and flexible pavement design for light residential and collector roads.

2.0 SITE AND PROJECT DESCRIPTION

The proposed RV site is located south of the NGCC's golf course, approximately 3 km north of City of Lacombe, Alberta. The legal address of the site is LSD 4-41-26-W4M in Lacombe County, Alberta. Access to the site is from the east of Range Road 270. The surface coverage and site development is shown on the 2010 Aerial Photograph (Figure 3). The site was surrounded by the agricultural lands and residential acreage.

The property has a gentle rolling topography. The overall relief at the site was about 2.5 m between boreholes with elevations that range from 851.3 m to 853.6 m. The high areas were at the west of the development sloping down to the east. The development area was covered with snow during the drilling. Southeast corner portion of the development was tree covered.

NGCC is proposing to develop the 5.16 acres into RV sites and a proposed pumphouse. The design details for the pumphouse was not available when this report was prepared. It is understood that the sewage from the RV site will be treated at existing treatment field located southeast of the site. A site plan illustrating the proposed RV sites layout is provided on Figure 2. The RV sites will be accessed by gravel road and will be constructed as part of this development.

3.0 FIELD AND LABORATORY PROGRAMS

On December 5, 2015, five boreholes were drilled at the site. All boreholes were drilled to depths between 6 and 6.5 m below grade. The following sampling and testing procedures were followed during the field program:

1. Prior to mobilizing the drilling rig, ParklandGEO personnel completed an Alberta One Call to verify the drill site was clear of underground utilities.

2. The boreholes were drilled using a truck mounted power auger drilling rig with 150 mm diameter solid stem augers. The drill rig was owned and operated by Darkhorse Drilling of Lacombe, Alberta.

3. Drilling operations were monitored by members of ParklandGEO's geotechnical staff. The soil encountered was visually examined during drilling and logged according to the Modified Unified Soil Classification System.

4. Soil samples were collected from auger cuttings at 1.0 m intervals in order to determine the soil/moisture profile and from other selected depths for other testing. Disturbed soil samples were also obtained from Standard Penetrations Tests (SPTs), which were performed at selected depth intervals.

5. At the completion of drilling, a 25 mm hand-slotted PVC standpipes was installed in all boreholes and backfilled with auger cuttings. Excess auger cuttings were spread at the respective borehole locations. Groundwater levels and depths where seepage zones were encountered were noted during drilling. Groundwater measurements were recorded on December 16, 2016, about 11 days after drilling.

6. All soil samples were returned to ParklandGEO's Red Deer laboratories for possible further testing. The results of all laboratory testing are shown on the borehole logs in Appendix A. The laboratory program consisted of moisture contents, Atterberg Limits, sieve and hydrometer particle size analysis and water soluble sulphates.

7. The location of the boreholes were surveyed and provided by WSP. Locations were referenced to UTM coordinate and elevations referenced to a geodetic datum. Elevations are provided in the boreholes logs in Appendix A.

4.0 SUBSURFACE CONDITIONS

The general soil profile at the site consisted of topsoil overlaying firm clay. Bedrock was not encountered during this investigation. Detailed descriptions of the soil conditions encountered at the borehole locations are provided in the logs in Appendix A. Individual soil test results and definitions of the terminology and symbols used on the borehole logs are provided on the explanation sheets in Appendix A. The following is a brief description of the typical soil types encountered.

4.1 TOPSOIL

A layer of topsoil was encountered at the surface in all boreholes. The topsoil at this site ranged from 200 to 450 mm thick at the borehole locations. Thicker depths of topsoil may be encountered between borehole sites. This moderately organic, black and moist topsoil layer was considered to be weak and compressible under load.

4.2 SAND

A 1 m thick layer of sand was encountered below the topsoil in Borehole 2. The sand extended to a depth of 1.2 m below grade. The sand was fine grained and compact in relative density. The moisture content of the sand was 10 percent. The estimated California Bearing Ratio (CBR) in soaked condition for the sand is between 4.0 and 6.0.

4.3 CLAY

Clay was encountered below the topsoil in Boreholes 1, 3, 4 and 5; and below the sand in Borehole 2. The clay extended to depths beyond drilled depth of 6.5 m below grade. The clay contained some silt, little sand with occasional inclusion of rust staining and coal. The clay was low to medium plastic and firm; with a Standard Penetration Test (SPT) “N” value between 4 and 9 blows. The moisture content of the clay ranged from 21 to 41 percent with an average of 37.1 percent. The estimated CBR in soaked condition for the clay is between 2.5 and 3.0.

4.4 SOIL TEST AND CHEMISTRY RESULTS

Soil samples were taken at a depth of 2.0 m in selected boreholes for water soluble concentration testing. The concentration is expressed as percent of the dry mass of soil. The concentration of water soluble sulphate ranged from 0.04 to 0.11 percent which indicates a "moderate potential for sulphate attach on buried concrete in direct contact with soil.

The following table provides a summary of laboratory classification testing undertaken for this investigation.

TABLE 1
LABORATORY CLASSIFICATION TEST SUMMARY

BH#	Depth (m)	Grain Size Distribution (%)				Plasticity (%)			Soil Classification
		Gravel	Sand	Silt	Clay	PL	LL	PI	
1	1.5	0.0	3.8	17.4	78.8	---	---	---	Lean Clay (Cl)
2	3.0	0.0	7.8	24.3	67.9	20	44	24	Lean Clay (Cl)
4	0.6	0.0	54.0	24.0	22.0	17	29	12	Clayey Sand (SC)

5.0 GROUNDWATER LEVELS

Groundwater seepage was observed in all boreholes during drilling. The groundwater levels measured on December 16, 2016, are summarized in the following table.

TABLE 2
GROUNDWATER MEASUREMENTS

Borehole	Ground Elevation (m)	Upon Completion		
		Groundwater Level (mbg)	Groundwater Level (mbg)	Groundwater Elevation (m)
1	852.86	Wet	4.00	848.86
2	853.60	Wet	5.86	847.74
3	851.64	Wet	3.81	847.83
4	852.40	Wet	4.75	847.65
5	851.25	Wet	4.26	846.99

The relatively shallow groundwater condition is considered to be typical for this area. Groundwater levels are expected to be dependent on infiltration for recharge. Groundwater elevations are expected to fluctuate on a seasonal basis and will be highest after periods of heavy or prolonged precipitation and snow-melt. The volumes of groundwater encountered will be dependent on seasonal conditions and the permeability of the soils within the profile.

6.0 DISCUSSION AND RECOMMENDATIONS

6.1 GEOTECHNICAL EVALUATION

The development will include three RV sites, a pumphouse and a gravel access road. The subsurface conditions at this site are considered to be suitable for proposed development. Bearing pressures for shallow foundations on native soil or properly engineered fill will be suitable for lightly pumphouse and residence. The predominant native silty clay is considered to be very sensitive to disturbance; particularly during periods of seasonal high groundwater including perched groundwater conditions. Site preparation measures will be significantly impacted by wet weather. The surficial clay subgrade is considered to be moderately to highly frost susceptible if given access to free water or groundwater within the zone of seasonal frost (estimated to an average depth of 2.5 m). However, the depth to the local water table for much of this site is relatively deep and will reduce potential heave in these frost susceptible soils.

6.2 SITE PREPARATION

It is anticipated that only minor cuts or fills (i.e. less than 1.0 m) are proposed for the development area. It is recommended that all vegetation and topsoil be stripped from areas to be pre-graded or developed for RV parking pad, roadway or building pad areas. Topsoil could be stockpiled for future use at the site. Ideally, fill used to bring the site up to grade should be: selected sand, well graded coarse gravel, or low to medium plastic inorganic clay. The surficial sand is considered to be a suitable fill material, however, moisture conditioning may be required prior to use in order to achieve specified densities.

The engineered fill placed during site grading should be compacted to at least 95 percent of SPMDD. Uniformity of compaction is most important. The lift thicknesses should be governed by the ability of the selected compaction equipment to uniformly achieve the recommended density. Maximum lift thicknesses of 200 mm for granular fill and 150 mm for clay fill are recommended. Granular fill is best compacted with large smooth drum vibratory rollers while clay fill is best compacted with large vibratory "padfoot" or "sheepsfoot" rollers. In areas which require higher compaction, it is recommended that granular fill be placed at moisture contents 0 to 2 percent below the OMC and that clay fill be placed at moisture contents about 0 to 2 percent above the OMC. This will help reduce compactive effort and potential risk of subgrade disturbance needed to achieve maximum density.

Special consideration must be given to deep fill areas at the proposed building sites. The engineered fill placed below structures should be uniformly compacted to at least 98 percent of SPMDD at moisture content within 2 percent of OMC for fills up to 1.0 m deep. For deeper fill, the compaction standards should be increased to 100 percent of SPMDD. If these density levels cannot be achieved using common fill during site grading, the footing bearing surfaces should be subcut and underlain with select granular fills compacted to at least 99 percent. The depth of subcut should be determined at the time of construction and will depend on factors

such as: age of fill, initial compaction, depth of fill, water table, footing configuration and loads. To reduce settlement potential and the compactive efforts to achieve maximum density, it is recommended that granular fill be placed at moisture contents 0 to 2 percent below the OMC. Full time density testing during placement and compaction and post construction settlement monitoring are strongly recommended for fill depths exceeding 1.5 in proposed building area footprints

6.3 BUILDING CODE REQUIREMENTS

In accordance with the 2014 version of the Alberta Building Code (ABC), the use of Limit States Design (LSD) is required for the design of buildings and their structural components including foundations. The limit states of LSD design are classified into two groups; the Ultimate Limit States (ULS) and the Serviceability Limit States (SLS). The ULS design requirements in the ABC reference the Structural Commentaries in the User Guide of the National Building Code of Canada (NBCC).

6.3.1 Ultimate Limit States (ULS)

The Ultimate Limit States (ULS) case is primarily concerned with safety and the levels of load and resistance at the point of collapse or structural failure. The geotechnical value for this case is the ultimate resistance. For foundation design this ultimate resistance value is reduced using a Geotechnical Resistance Factor (GRF) which is based on the reliability index of the geotechnical data used to determine the ultimate resistance for the foundation loading case. The GRF value for footings is 0.5 as per NBCC Users Guide - Structural Commentaries (Part 4 of Division B) - Commentary K –Foundations.

6.3.2 Serviceability Limit States (SLS)

The SLS occurs when the foundation loads cause movements or vibrations that are greater than the structure can tolerate before the intended use of the structure is restricted or hindered. The SLS case is addressed by determining the maximum available resistance to keep the foundation deformation within tolerable limits under service loads (i.e. settlement, lateral deflection, etc.). Typically, the foundation loads, configurations and serviceability tolerances have to be known to properly determine geotechnical SLS resistance values. In some foundation cases, such as small footings, basic assumptions can be used to provide preliminary SLS resistance values under specific stated conditions, assuming the tolerable limit of total settlement is less than 25 mm.

6.3.3 Seismic Classification

The Alberta Building Code requires buildings to be designed to resist a minimum earthquake force. The formula for obtaining minimum earthquake force is dependent of several factors including Foundation Factor (F) which should be determined using a Site Class of D for this site (Table 4.1.8.4.A). The native subgrade soil is extensive firm clay to a depth up to 6.5 m below grade. Based on a published document, till was encountered overlying sand and gravel underlain by bedrock at depth of about 44 m below grade.

6.4 PUMPHOUSE FOOTINGS

The design details for the pumphouse was not available. The site soil conditions are considered to be suited for conventional strip and spread footings bearing on the undisturbed native clay. Footings founded on native competent soil within 3.0 m of grade may be designed for the ULS and SLS cases using the bearing resistance values given in Table 3.

TABLE 3
BEARING RESISTANCE FOR FOOTINGS

Footing Type	Depth (m)	ULS (kPa)		SLS (kPa)
		Ultimate	Factored	
Strip	< 2.5	200	100	70
Spread	< 2.5	250	125	90

The “factored” ULS resistance given above has been calculated by multiplying the ultimate bearing capacity values by a geotechnical resistance factor of 0.5, in accordance with the building code as summarized in Section 6.3. The serviceability bearing resistance value is given above are based on limiting the settlement to less than 25 mm and are applicable to footings with a maximum dimension of 1.2 m wide or 1.5 x 1.5 m^2. If very strict settlement tolerances are required or if larger footings are proposed, the footing sizes and settlement potential should be reviewed. Preparation of the bearing surfaces should be monitored by a qualified geotechnical engineer prior to placement of footings to verify that design criteria are met. Given the expected non uniform and soft bearing conditions, it may be prudent to found footings on a gravel mat to help spread foundation loads to the subgrade.

The following additional recommendations are submitted for footing design and construction:

1. Footings should bear on native soil free from loosened material. Excavation of the footing trenches should be undertaken in a manner to minimize disturbance to the bearing surface. The use of backhoe or grade-all equipment is strongly recommended over loader or dozer equipment.

2. For protection against frost action in continuously heated structures; at least 1.5 m of ground cover should be provided for exterior footings, and 0.5 m of ground cover for interior footings (provided the footing is not on fill or buried organics). If perimeter insulation is used, it should be placed exterior to the footing wall. Isolated footings and exterior footings in unheated structures will require 2.5 m of ground cover. Styrofoam insulation may be used to prevent frost penetration where adequate depths of ground cover cannot be economically provided.

3. Footings and foundation walls should be reinforced to span localized soft spots. If the footing is dropped for the frost wall, it should stepped down in 0.6 m steps.

4. The footing trenches should be protected against surface water run-off through the use of conventional sumps and ditches, if required. Footing bases should not be allowed to dry out excessively during construction.

5. Foundation soils must not be allowed to freeze at any time prior to, during, or after construction.

6. Preparation of the bearing surfaces should be monitored by a qualified geotechnical engineer prior to placement of footings to verify that design criteria are met.

6.5 GRADE SUPPORTED SLABS

Grade supported floor slabs, supported by the clay or engineered fill prepared as described in Section 6.2 are expected to perform well at this site. For floor slab design, a modulus of subgrade reaction (K_s) of 25,000 kN/m^3 is applicable for slabs placed on at least 150 mm of gravel base on the subgrade. The following recommendations are provided for grade supported floor slabs in building which will be continuously heated:

1. Lightly loaded (less than 10 kPa) grade supported concrete slabs should be underlain with 150 mm of well graded, free draining, crushed gravel compacted to 98 percent of SPMDD.

2. Slabs should be provided with construction joints or saw cuts in accordance with local practice. The concrete slab should be reinforced with steel bars and dimensioned in accordance with the structural engineer's requirements. The reinforcing bars can be carried through the construction joints. As a minimum, it is recommended that floor slabs should be reinforced with 10 mm bars at 600 mm spacing in both directions or by an equivalent wire mesh.

3. Slabs should be constructed independently of all walls, columns and grade beams. Slab on grade floors can be tied into the grade beam with dowels at doorways to allow access should the slab heave. Alternatively, the slab can also be tied to the grade beam if a construction joint is placed parallel to the wall at a distance of about 2.0 m.

4. Non-load bearing partitions should be designed to accommodate slight vertical movements (approximately 25 mm). Service connections should be flexible enough to allow for small differential movements.

5. Piping and electrical conduit connections should be laid out to permit some flexibility, as vertical movement of such equipment as water meters, furnaces and electrical equipment may cause distress in the pipes. The provision is particularly importance where there are short pipe runs between mechanical equipment and points where piping passes through the walls. Heating ducts beneath the floor should be insulated with at least 50 mm of rigid insulation to prevent drying of subgrade soils.

6.6 CONCRETE

Water soluble sulphate concentrations from the samples tested indicated a moderate potential for chemical attack of subsurface concrete. Therefore, high sulphate-resistance (Type HS) hydraulic cement is recommended for use in all subsurface concrete in contact with native soil at the site in accordance with CSA Standard CAN3-A23.1-M14. The recommended minimum 56 day compressive strength is 32 MPa with a water cement ratio of 0.45. Air entrainment is recommended for all concrete exposed to freezing and thawing to further enhance durability. Calcium chloride or any admixture formulation containing chloride should not be used in the subsurface concrete. Calcium salts used as accelerating admixture should be avoided, since they may increase the severity of sulphate attack.

6.7 SERVICE TRENCH INSTALLATION

6.7.1 Service Trench Excavation

Excavations will be required for foundations and underground utility installations. All excavation work must comply with the requirements of the Alberta Occupational Health and Safety Act (OHS Act, 2002), OHS Regulation (2003) and OHS Code (2009). The OHS Code contains the technical requirements that support the Act and Regulation. Excavation side slopes are not expected to be able to stand near vertical for extended periods of time. For all excavations deeper than 1.5 m in the native clay, side slopes should be cut back to 1H:1V. If space does not permit the slopes to be cut back, some form of temporary shoring must be installed to protect workers in the trench.

The degree of stability of excavated trench walls directly decreases with time and therefore, construction should be directed at minimizing the length of time service trenches are left open. Significant groundwater seepage is not expected at this site. However, during seasonal conditions where perched water is encountered after precipitation or snow melt, seepage may be encountered. If groundwater is encountered, base heave and/or boiling of the trench bottom could occur where a significant differential hydrostatic head exists at the bottom of the excavation and soils are not cohesive. Dewatering and other pressure relief measures are available to minimize problems with the stability of the trench bottom.

Surface grading should be undertaken so that surface water is not allowed to pond adjacent to service trenches. Surcharge loads, including excavation spoil, should be kept back from the crest of the excavation a minimum distance equal to the excavation depth. Monitoring and maintenance of the slopes should be carried out on a regular basis.

Installation of underground services and utilities require an observational approach to be adopted, which should combine past local experience, contractor's experience, and geotechnical input. It would be desirable for the selected excavation contractor to be experienced in similar conditions and/or, alternatively, to excavate test pits in advance of construction to familiarize field personnel with subsurface conditions. Quality workmanship is essential.

6.7.2 Pipe Bedding

Ideally, granular pipe bedding should be relatively well graded sand or sand gravel mixture which can be readily compacted around the pipe to achieve a high frictional strength. Bedding soils must have an appropriate gradation so that migration of natural soils into the granular system is minimized. Uniform or gap-graded sands and gravels should not be used as bedding materials unless adequate provision is made to surround such soils with a filter fabric or graded granular filter compatible with the existing subsoils. Select native materials such as fine sand may be proposed for bedding. However, the use of these materials may require a higher level of compaction in order to satisfy the pipe manufacturer's requirements for adequate pipe support. Native materials consisting of high plastic clay or wet, silty clay that cannot be adequately compacted should not be used for pipe bedding. If granular bedding material is proposed, the following gradation specifications are recommended.

TABLE 4
GRADATION SPECIFICATIONS - GRANULAR BEDDING MATERIAL

Sieve Size (mm)	Percent Passing By Weight		
	Native Sand	Clean Sand	Drain Rock
50	-	-	100
40	-	-	95 - 100
20	-	-	5 -10
10	-	100	0 - 5
5	100	90 -100	0 - 5
2.5	-	80 - 95	-
1.25	66 - 100	55 - 85	-
0.63	52 - 100	30 - 65	-
0.315	35 - 78	10 - 35	-
0.160	18 - 43	2 - 10	-
0.080	2 - 12	0 - 8	-

Minor deflections of the trench bedding are expected. Underground utility pipes should be of a type which will maintain watertight joints (i.e. rubber gasket) after minor shifting has occurred. Bedding requirements are a function of the class of pipe and trench configuration, as well as site specific geotechnical considerations.

In the event of significant groundwater seepage or wet base conditions, additional pipe foundation measures may be required. Typically these measures include placement of a working mat of free draining gravel and filter cloth after lowering of the water table and removal of disturbed soils. This layer of gravel is intended to be a safe working base and the thickness required will be based on keeping groundwater below the working surface. The function of the geotextile in pipe bedding applications is to act as a separation barrier between the coarse bedding materials and the native fine grained soils, therefore it needs to be strong enough to withstand construction activity.

6.7.3 Trench Backfill

It is assumed that trench backfill will consist of excavated sand or silty clay materials. The native sand is considered to be suitable for backfill, but may require removal adjustment of the natural moisture content to achieve proper compaction. Soil used for trench backfill should be free of frozen material, organics, and any other undesirable debris. To minimize fill settlement under self-weight, it is not recommended to allow the use of excavated soil for fill where the water content exceeds the OMC of the soil by more than 5 percent. If excavated soils are excessively wet, the material should be dried or blended with dry soil prior to use.

Trench backfill in building areas should conform with the recommendations given under the site preparation discussion. In other developed areas, trench backfill should be placed in maximum 150 mm thick lifts compacted to 95 percent of the SPMDD to within 1.5 m of the finished ground surface and to a minimum 98 percent of the SPMDD from 1.5 m below ground surface to grade. The lift thicknesses should be governed by the ability of the selected compaction equipment to uniformly achieve the recommended density. It is recommended to use lifts with a maximum compacted thickness of 150 mm for clay soils.

Some settlement of the compacted backfill in trenches under self-weight is expected to occur. The magnitude and rate of settlement would be dependent on the backfill soil type, the moisture condition of the backfill at the time of placement, the depth of the service trench, drainage conditions and the initial density achieved during compaction. For the compaction recommendations given above it is expected that total settlement in the order of 0.5 to 1.0 percent of the trench depth will occur. For properly moisture conditioned sand backfill the majority of the settlement is expected to occur with 2 to 4 months of backfill. Silty soils will take slightly longer to consolidate. Density monitoring of backfill placement is recommended to encourage better attention to quality workmanship in placement. Fill materials with variable moisture contents recompacted as trench backfill will not provide uniform roadway subgrades for the support of pavement sections. To minimize the effects of potential settlements on completed roadway surfaces, it is recommended that staged asphalt pavement construction be

adopted and that placement of final asphalt concrete surfacing materials be delayed as long as possible, subsequent to completion of trench backfilling.

6.8 GRAVELLED PAVEMENT

It is understood gravel surfaced lanes will be reconstructed. Expected traffic will include light vehicles and RV truck.

TABLE 5
PROPOSED GRAVEL PAVEMENT SECTIONS FOR LANES

Pavement Sections	Gravel Lanes
Design Traffic (ESAL's)	5×10^2
20 mm Crushed Base Gravel	250 mm

The recommended levels of compaction for the granular materials should be a minimum of 98 percent of SPMDD. The gravel specifications in the preceding section may be used. If subbase gravel with a large maximum aggregate size is proposed the thickness of the subbase layer should be at least twice the diameter of the largest particle size. It is recommended to provide surface drainage with cross slope crowns of at least 2 percent on regularly maintained gravel lane surfaces. Allowing water to pond on gravel surfaces will lead to infiltration which could result in subgrade weakening and the associated higher maintenance costs.

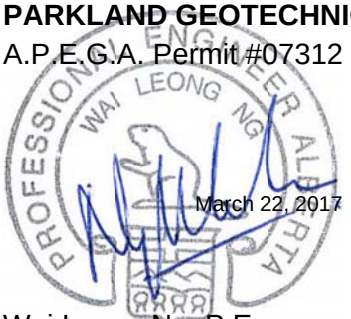
6.9 INSPECTION

It is recommended that on-site inspection and testing be performed to verify that actual site conditions are consistent with assumed conditions which meet or exceed design criteria. Based on the Alberta Building Code, adequate levels of inspection include: testing of engineered fill, review of all completed bearing surfaces for footings and full time inspection during construction of deep foundations.

7.0 CLOSURE

This report is based on the findings at the 5 boreholes at the site. If new information or different subsoil/groundwater conditions are encountered, this office must be notified and recommendations submitted herein will be reviewed and revised as required. This report has been prepared for the exclusive use of **WSP Canada Inc.** and their approved agents for the specified application to the proposed Nursery Golf Course RV Development within portion of SW 7-41-26-W4M in Lacombe County, Alberta. This report has been prepared in accordance with generally accepted soil and foundation engineering practices. No other warranty, expressed or implied, is made. The limitations of this report are specified in the General Terms and Conditions section and should be considered part of this report.

Respectfully submitted,
PARKLAND GEOTECHNICAL CONSULTING LTD.
A.P.E.G.A. Permit #07312



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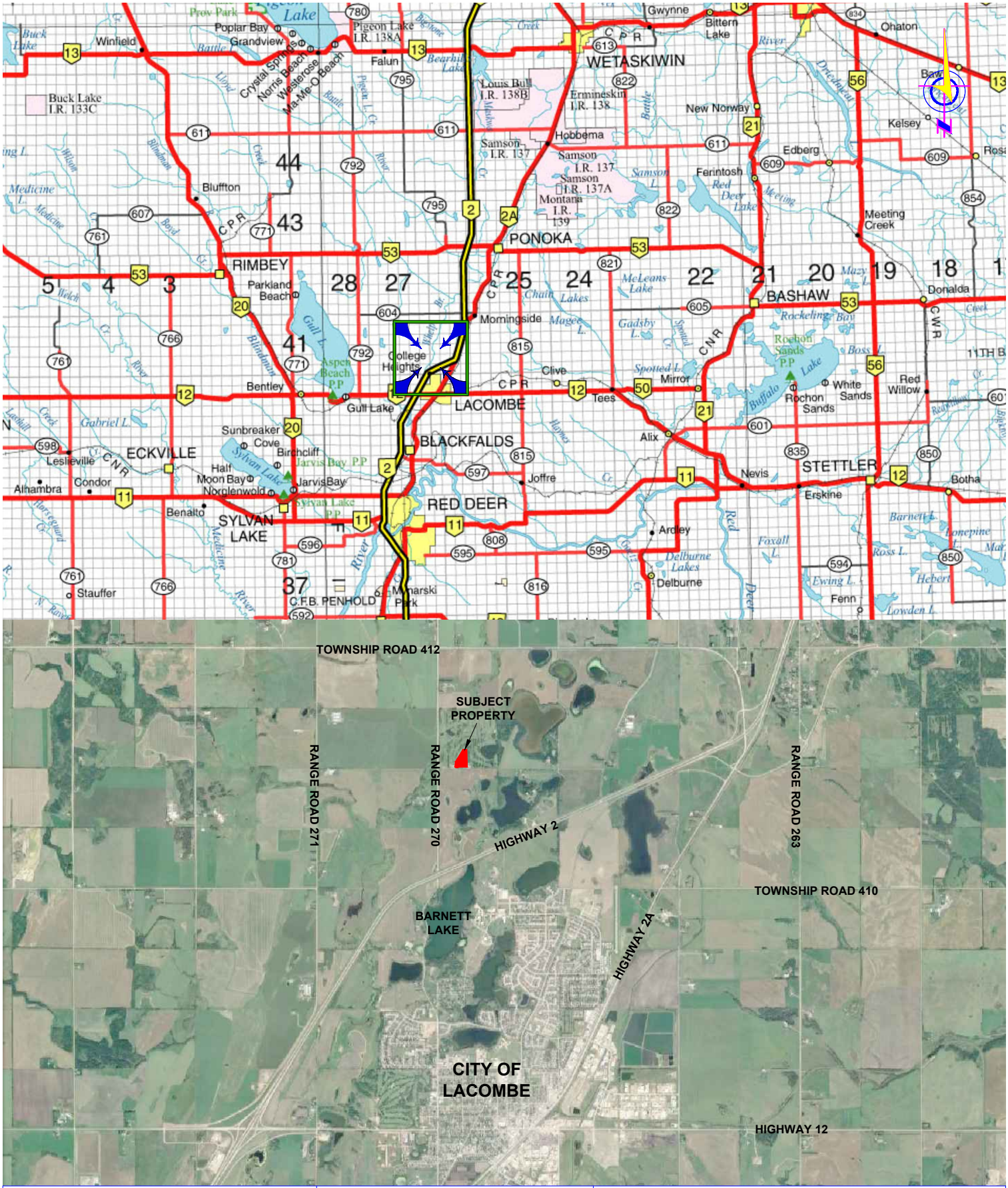
Mark Brotherton, P. Eng.

FIGURES



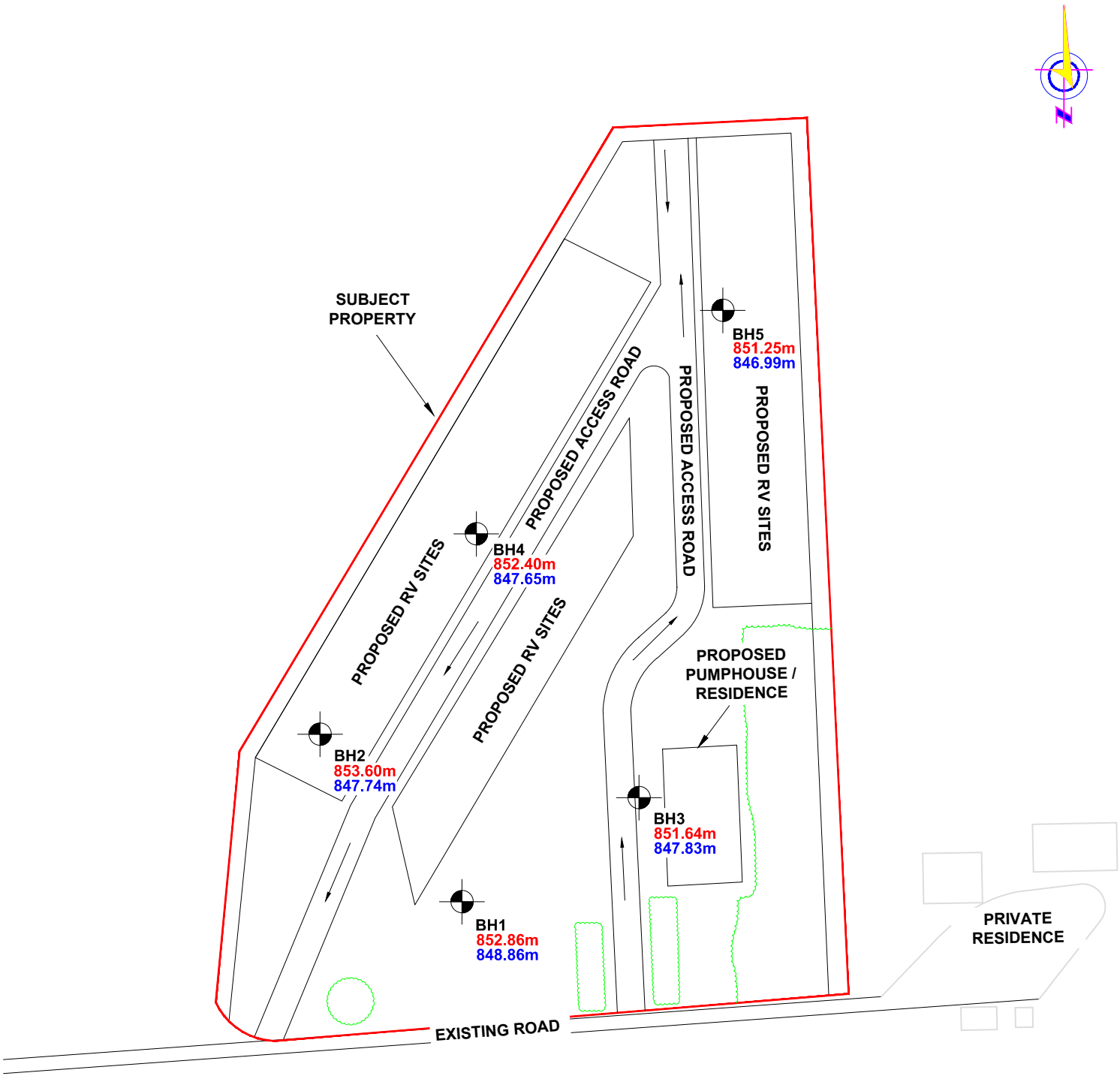
CLIENT:

KEY PLAN

PROPOSED NURSERY GOLF COURSE RV DEVELOPMENT
PORTION OF SW 7-41-26 W4M, LACOMBE COUNTY, AB

DRAWN:	CHK'D.:	REV #:	DATE:
NC	NN	0	MARCH 2017

SCALE:	JOB NO.	DRAWING NO.
NTS	RD5911	FIGURE 1



TREELINE

ALL BOREHOLE LOCATIONS ARE APPROXIMATE.

852.86m SURFACE ELEVATION

848.86m GROUNDWATER ELEVATION (DECEMBER 16, 2016)

SCALE (metres)

-30 -15 0 15 30 60

ParklandGEO

CLIENT: WSP

SITE PLAN

PROPOSED NURSERY GOLF COURSE RV DEVELOPMENT
PORTION OF SW 7-41-26 W4M, LACOMBE COUNTY, AB

DRAWN:	CHK'D.:	REV #:	DATE:
NC	NN	0	MARCH 2017

SCALE:	JOB NO.	DRAWING NO.
1:1250	RD5911	FIGURE 2

NOTE: AERIAL PHOTOGRAPH OBTAINED FROM GOOGLE EARTH, DATED AUGUST 22, 2015.

ALL BOREHOLE LOCATIONS ARE APPROXIMATE.

SCALE (metres)

-30 -15 0 15 30 60

ParklandGEO

CLIENT: WSP

AERIAL PLAN

PROPOSED NURSERY GOLF COURSE RV DEVELOPMENT
PORTION OF SW 7-41-26 W4M, LACOMBE COUNTY, AB

DRAWN:	CHK'D.:	REV #:	DATE:
NC	NN	0	MARCH 2017

SCALE:	JOB NO.	DRAWING NO.
1:1250	RD5911	FIGURE 3

PHOTOGRAPH 1: SHOWS SUBJECT PROPERTY, FACING NORTHEAST

PHOTOGRAPH 2: SHOWS SUBJECT PROPERTY, FACING EAST

PHOTOGRAPH 3: SHOWS SUBJECT PROPERTY, FACING SOUTHEAST

PHOTOGRAPH 4: SHOWS BH2, FACING SOUTH

ParklandGEO	CLIENT: WSP	**SITE PHOTOGRAPHS**	
		PROPOSED NURSERY GOLF COURSE RV DEVELOPMENT PORTION OF SW 7-41-26 W4M, LACOMBE COUNTY, AB	
		DRAWN: NC / CHK'D.: NN / REV #: 0	DATE: MARCH 2017
		SCALE: NTS / JOB NO. RD5911	DRAWING NO. FIGURE 4

APPENDIX A

Borehole Logs (5)
Soil Test Results
Explanation Sheets

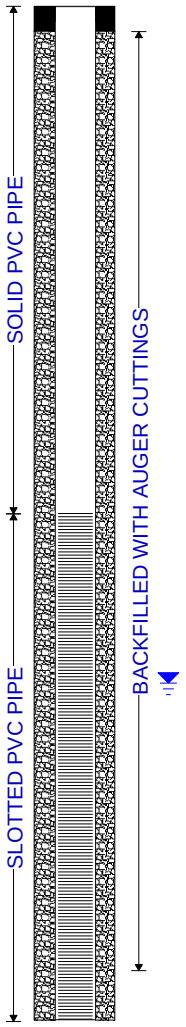
BOREHOLE NO.: 01

CLIENT: WSP Canada Inc.
SITE: Nursery Golf Course RV Development
NOTES:

PROJECT NO.: RD5911
BH LOCATION:

SUBSURFACE PROFILE

Depth (m)	Description	Symbol	Moisture (Wp |-----X-----| Wl) 25 50 75	Type	Sample No	SPT (N)	Comments	Well Completion Details	Elevation (m)
0	GROUND SURFACE								852.86
	Topsoil Organic, black, moist.								852.40
1	***Clay*** Some sand, some silt, firm, low plastic, brown, moist to wet. - Trace sand at 1.4 m.		21	G	1G1				
2			40		1D1	7	**Grain Size Analysis:** Sand - 3.8% Silt - 17.4% Clay - 78.8%		
				G	1G2				
3			35						
				G	1G3				
4	- Wet at 3.8 m.		40						
	- Silty, grey at 4.9 m.				1D2	6			
5			41						
6	End of hole at 6.0 m. Sloughed to 5.7 m upon completion. 25 mm PVC standpipe installed. Backfilled with auger cuttings. Wet upon completion. Water at 4.00 mbg on December 16, 2016.		40						846.86
7									
8									



LOGGED BY: BL
CONTRACTOR: Dark Horse Drilling Ltd.
RIG/METHOD: Geoprobe 7822DT/ Solid Stem
DATE: December 5, 2016
CALIBRATION:

GROUND ELEVATION: 852.86 m
NORTHING: 5820980.522
EASTING: 313855.731

BOREHOLE NO.: 02

CLIENT: WSP Canada Inc.
SITE: Nursery Golf Course RV Development
NOTES:

PROJECT NO.: RD5911
BH LOCATION:

SUBSURFACE PROFILE

Depth (m)	Description	Symbol	Moisture (Wp |-----X-----| Wl) 25 50 75	Type	Sample No	SPT (N)	Comments	Well Completion Details	Elevation (m)
0	GROUND SURFACE								853.60
	Topsoil Organic, black, moist.								853.40
	Sand Some silt, trace clay, trace gravel, compact, fine grained, brown and white, moist.		10	G	2G1				
1									852.40
	Clay Some silt, trace to little sand, firm to stiff, low to medium plastic, brown with dark streaks, moist.		35	G	2G2		SO_4 = 0.05%		
2									
	- Firm (softer drilling), wet at 2.8 m.		39		2D1	7	**Grain Size Analysis:** Sand - 7.8% Silt - 24.3% Clay - 67.9%		
3									
			37						
4									
			38						
5				G	2G3				
	- Grey at 5.7 m.		39						
6					2D2	7			
	End of hole at 6.5 m. Sloughed to 4.9 m upon completion. 25 mm PVC standpipe installed. Backfilled with auger cuttings. Wet upon completion. Water at 5.86 mbg on December 16, 2016.								847.10
7									
8									

Well Completion Details: SOLID PVC PIPE; BACKFILLED WITH AUGER CUTTINGS; SLOTTED PVC PIPE; SLOUGH

LOGGED BY: BL
CONTRACTOR: Dark Horse Drilling Ltd.
RIG/METHOD: Geoprobe 7822DT/ Solid Stem
DATE: December 5, 2016
CALIBRATION:

GROUND ELEVATION: 853.60 m
NORTHING: 5821018.854
EASTING: 313825.796

BOREHOLE NO.: 03

CLIENT: WSP Canada Inc.
SITE: Nursery Golf Course RV Development
NOTES:

PROJECT NO.: RD5911
BH LOCATION:

SUBSURFACE PROFILE

Depth (m)	Description	Symbol	Moisture (Wp |-----X-----| Wl) 25 50 75	Type	Sample No	SPT (N)	Comments	Well Completion Details	Elevation (m)
	GROUND SURFACE								851.64
0	***Topsoil*** Organic, black, moist.								851.44
	Clay Some silt, little sand, firm to stiff, low to medium plastic, brown with dark streaks, moist to wet.		33	G	3G1				
1	- Trace sand at 1.3 m.								
			38				SO_4 = 0.04%		
2									
			36						
3					3D1	5			
			40						
4									
	- Grey at 4.8 m.								
			38	G	3G2				
5									
			40						
6					3D2	5			
	End of hole at 6.5 m. Sloughed to 5.6 m upon completion. 25 mm PVC standpipe installed. Backfilled with auger cuttings. Wet upon completion. Water at 3.81 mbg on December 16, 2016.								845.14
7									
8									

SOLID PVC PIPE
BACKFILLED WITH AUGER CUTTINGS
SLOTTED PVC PIPE
SLOUGH

LOGGED BY: BL
CONTRACTOR: Dark Horse Drilling Ltd.
RIG/METHOD: Geoprobe 7822DT/ Solid Stem
DATE: December 5, 2016
CALIBRATION:

GROUND ELEVATION: 851.64 m
NORTHING: 5821002.295
EASTING: 313895.222

BOREHOLE NO.: 04

CLIENT: WSP Canada Inc.
SITE: Nursery Golf Course RV Development
NOTES:

PROJECT NO.: RD5911
BH LOCATION:

SUBSURFACE PROFILE

Depth (m)	Description	Symbol	Moisture (Wp |-----X-----| Wl) 25 50 75	Type	Sample No	SPT (N)	Comments	Well Completion Details	Elevation (m)
0	GROUND SURFACE								852.40
	Topsoil Organic, black, moist.								852.20
1	***Clay*** Some silt, some sand, firm, low to medium plastic, brown with dark streaks, moist to wet.		36	G	4G1		**Grain Size Analysis:** Sand - 54.0% Silt - 24.1% Clay - 22.0%		
	- Trace sand at 1.2 m.								
2			35		4D1	9	SO_4 = 0.05%		
	- Silty, occasional rust from 2.5 to 3.0 m.								
3			39						
4			41	G	4G2				
5			38		4D2	4			
	- Grey, trace gravel at 5.6 m.								
6	End of hole at 6.0 m. 25 mm PVC standpipe installed. Backfilled with auger cuttings. Wet upon completion. Water at 4.75 mbg on December 16, 2016.		33						846.40
7									
8									

Well Completion Details: SOLID PVC PIPE; BACKFILLED WITH AUGER CUTTINGS; SLOTTED PVC PIPE

LOGGED BY: BL
CONTRACTOR: Dark Horse Drilling Ltd.
RIG/METHOD: Geoprobe 7822DT/ Solid Stem
DATE: December 5, 2016
CALIBRATION:

GROUND ELEVATION: 852.40 m
NORTHING: 5821062.228
EASTING: 313862.438

BOREHOLE NO.: 05

CLIENT: WSP Canada Inc.
SITE: Nursery Golf Course RV Development
NOTES:

PROJECT NO.: RD5911
BH LOCATION:

SUBSURFACE PROFILE

Depth (m)	Description	Symbol	Moisture (Wp |-----X-----| Wl) 25 50 75	Type	Sample No	SPT (N)	Comments	Well Completion Details	Elevation (m)
	GROUND SURFACE								851.25
0	***Topsoil*** Organic, black, moist.								851.00
	Clay Some silt, trace sand, firm, low to medium plastic, brown with dark streaks, moist to wet.		36						
1									
			37				SO_4 = 0.11%		
2	- Rust staining from 2.2 to 2.5 m.			G	5G1				
	- Silt from 2.8 to 3.8 m.		38						
3					5D1	7			
			38						
4	- Grey at 4.4 m.			G	5G2				
			40						
5									
			37						
6					5D2	5			
	End of hole at 6.5 m. Sloughed to 6.1 m upon completion. 25 mm PVC standpipe installed. Backfilled with auger cuttings. Wet upon completion. Water at 4.26 mbg on December 16, 2016.								844.75
7									
8									

Well Completion Details: SOLID PVC PIPE; BACKFILLED WITH AUGER CUTTINGS; SLOTTED PVC PIPE

LOGGED BY: BL
CONTRACTOR: Dark Horse Drilling Ltd.
RIG/METHOD: Geoprobe 7822DT/ Solid Stem
DATE: December 5, 2016
CALIBRATION:

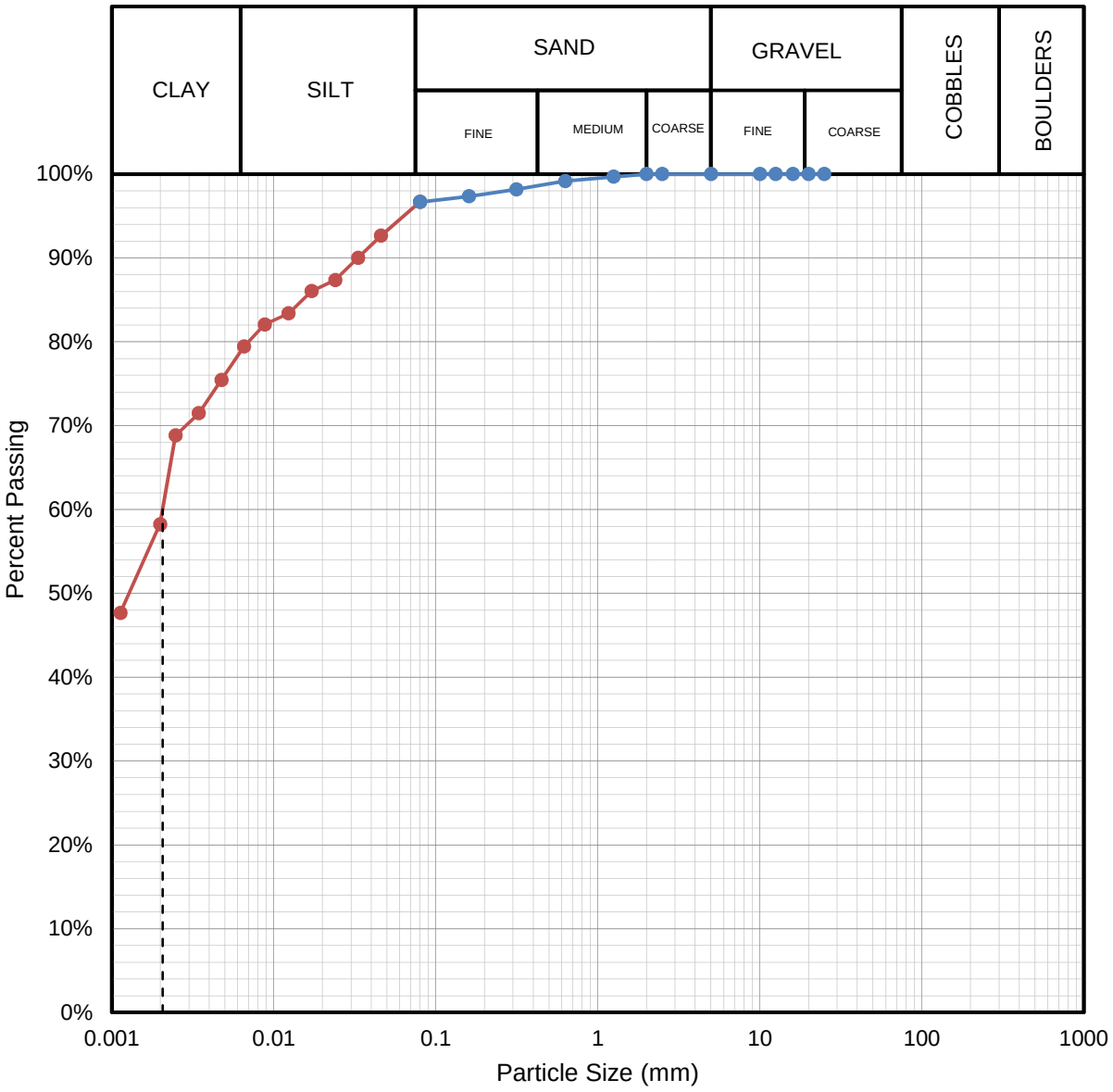
GROUND ELEVATION: 851.25 m
NORTHING: 5821108.762
EASTING: 313918.498

PARTICLE-SIZE ANALYSIS

ASTM D422

PROJECT: Proposed Nursery Golf Course RV Development
PROJECT#: RD5911
CLIENT: WSP Canada Inc.
SOIL DESCRIPTION: clay, little silt, trace sand

SAMPLE DATE: December 5, 2016
TEST DATE: December 22, 2016
SAMPLE ID: 1D1
DEPTH: 1.5m



SUMMARY OF RESULTS		
	Gravel	0.0%
	Sand	3.8%
	Silt	17.4%
	Clay	78.8%

GRAIN SIZE		
	D_{10}	---
	D_{30}	---
	D_{60}	0.0021 mm

COEFFICIENTS		
	Coefficient of Uniformity, C_U	---
	Coefficient of Curvature, C_C	---

TECH: AB
CHECKED: NN

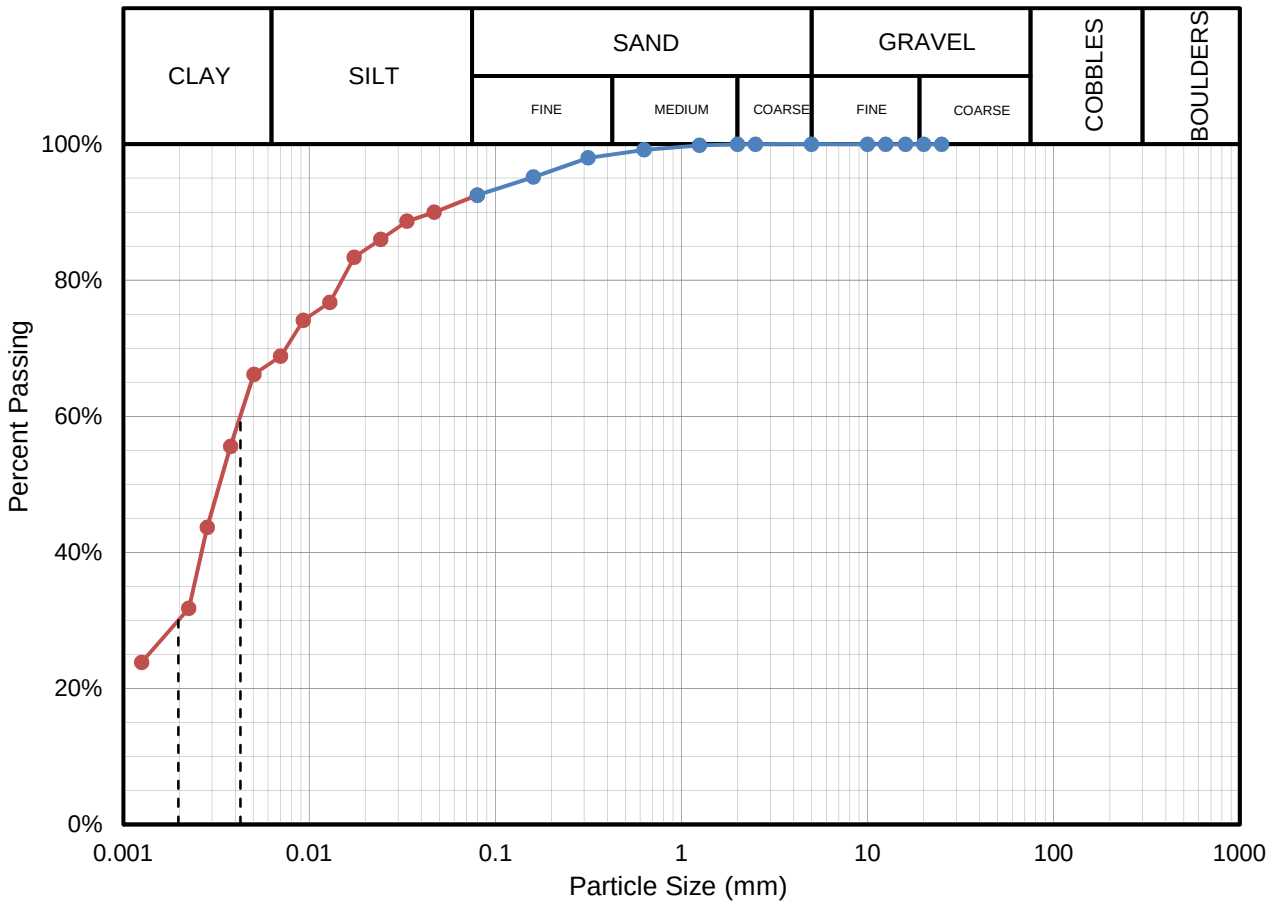
V14.1 U20160225
P:\RD5900-RD5949\RD5911 - Proposed Nursery Golf Course RV Development GEO\Labs\Hydrometer 1D1.xlsx

PARTICLE-SIZE ANALYSIS, LIQUID LIMIT, PLASTIC LIMIT, AND PLASTICITY

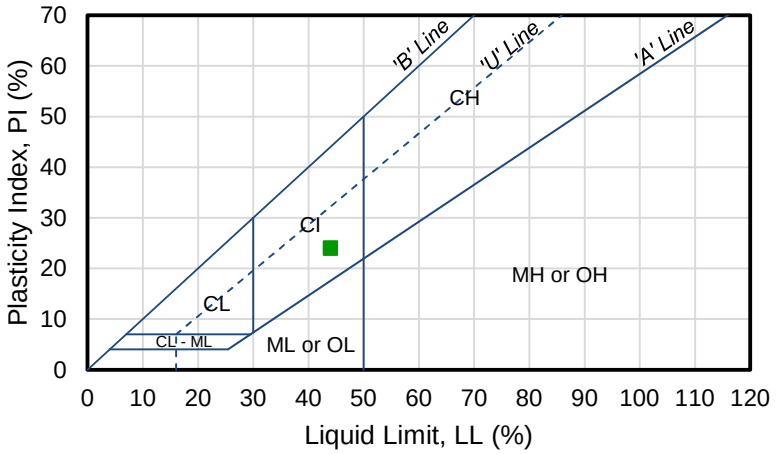
ASTM D422 & ASTM D4318

PROJECT: Proposed Nursery Golf Course RV Development
PROJECT#: RD5911
CLIENT: WSP Canada Inc.
SOIL DESCRIPTION: clay, some silt, trace sand

SAMPLE DATE: December 5, 2016
TEST DATE: December 22, 2016
SAMPLE ID: 2D1
DEPTH: 3.0m



PARTICLE-SIZE ANALYSIS	Gravel	0.0%
	Sand	7.8%
	Silt	24.3%
	Clay	67.9%
	D_{10}	---
	D_{30}	0.0020 mm
	D_{60}	0.0043 mm
	C_U	---
	C_C	---
LIMITS	PL	20
	LL	44
	PI	24



Modified Unified Soil Classification	Group Symbol
Lean clay	CI

TECH: AB
CHECKED: NN

LIQUID LIMIT, PLASTIC LIMIT, AND PLASTICITY

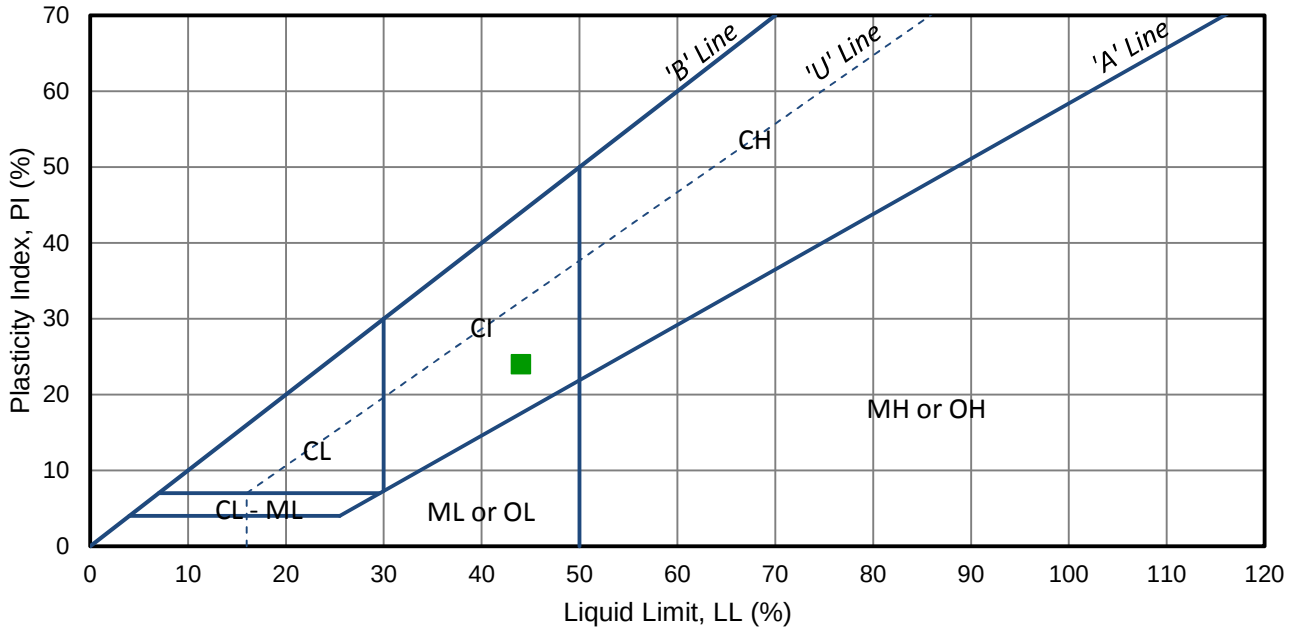
ASTM D4318 - Method A: Multi-Point

PROJECT: Proposed Nursery Golf Course RV Development
PROJECT#: RD5911
CLIENT: WSP Canada Inc.
SOIL DESCRIPTION: clay, some silt, trace sand

SAMPLE DATE: December 5, 2016
TEST DATE: December 22, 2016
SAMPLE ID: 2D1
DEPTH: 3.0m

PROCEDURE USED: Wet Preparation - Method A: Mult-Point

	AS RECEIVED	PLASTIC LIMIT				LIQUID LIMIT	
		1	2	3	4	1	2
Number of blows, N						22	22
Container Number		1	2	3		1	2
Tare Container, M_C (g)		6.303	6.294	6.360		16.273	16.098
Wet Sample + Tare, M_{CMS} (g)		8.956	8.938	8.568		25.840	24.475
Dry Sample + Tare, M_{CDS} (g)		8.428	8.417	8.373		22.917	21.888
Dry Sample, M_S (g)		2.125	2.123	2.013		6.644	5.790
Water, M_W (g)		0.528	0.521	0.195		2.923	2.587
Moisture Content, w (%)		24.8	24.5	9.7		44.0	44.7
One point liquid limit for given trial, $LL^n = w^n \cdot (N/25)^{0.121}$ (%)						43.3	44.0



Plastic Limit, PL or w_P (%)	20
Liquid Limit, LL or w_L (%)	44
Plasticity Index, PI (%)	24
Modified USCS Classification	CI

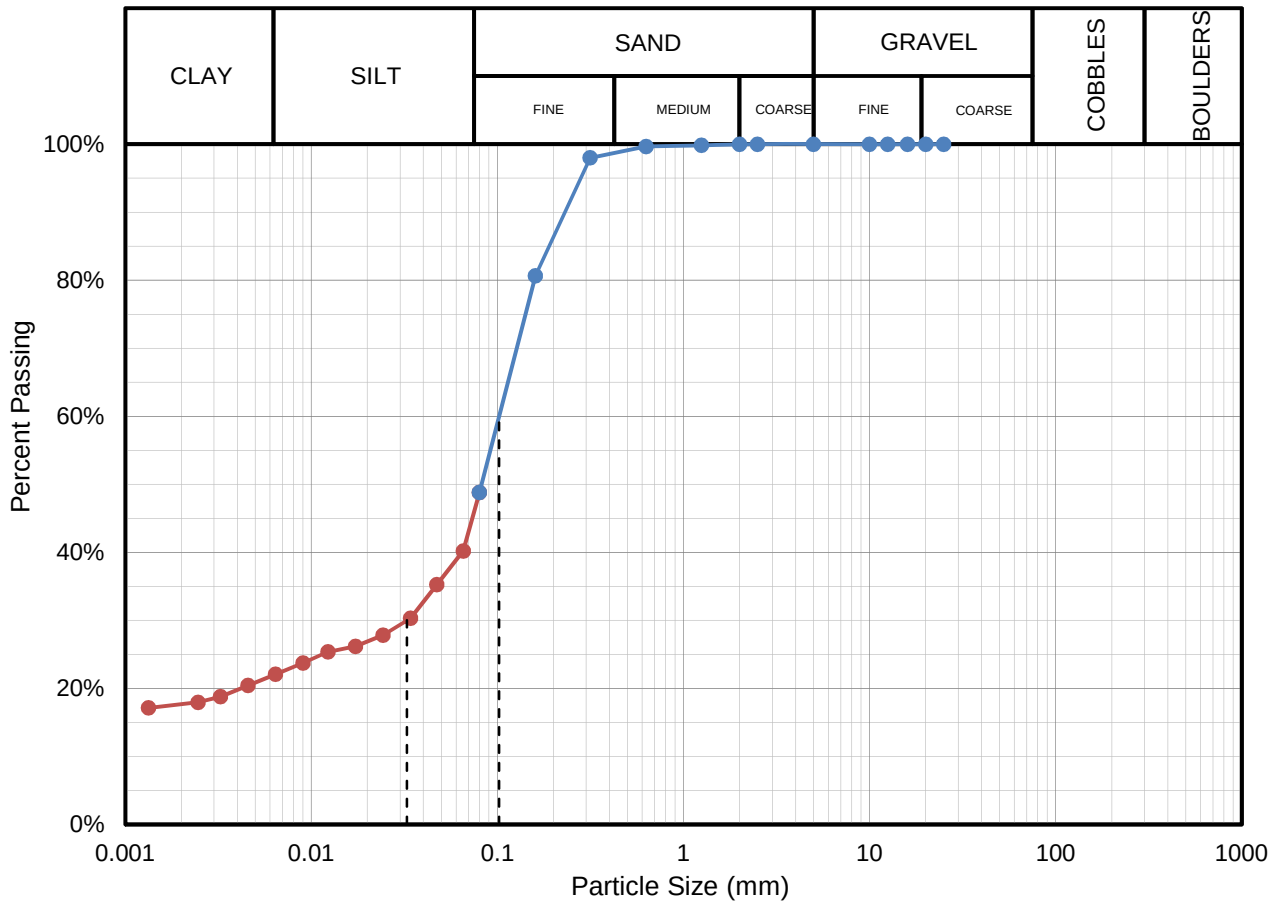
TECH: AB
CHECKED: NN

PARTICLE-SIZE ANALYSIS, LIQUID LIMIT, PLASTIC LIMIT, AND PLASTICITY

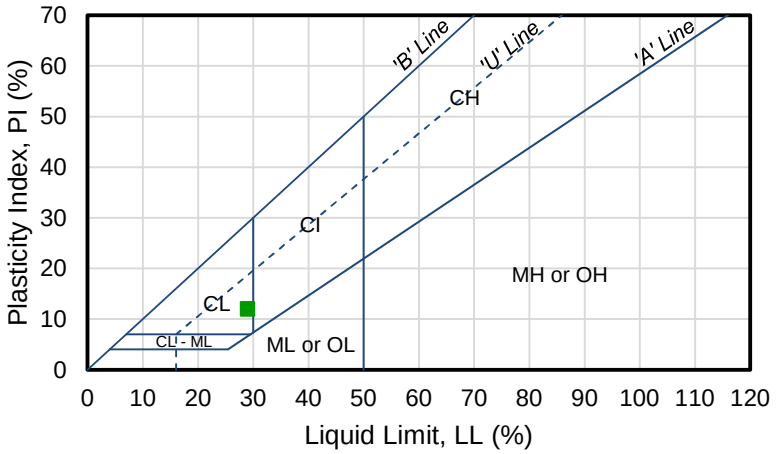
ASTM D422 & ASTM D4318

PROJECT: Proposed Nursery Golf Course RV Development
PROJECT#: RD5911
CLIENT: WSP Canada Inc.
SOIL DESCRIPTION: sand, some silt, some clay

SAMPLE DATE: December 5, 2016
TEST DATE: December 22, 2016
SAMPLE ID: 4G1
DEPTH: 0.6m



PARTICLE-SIZE ANALYSIS	Gravel	0.0%
	Sand	54.0%
	Silt	24.1%
	Clay	22.0%
	D_{10}	---
	D_{30}	0.0326 mm
	D_{60}	0.1020 mm
	C_U	---
	C_C	---
LIMITS	PL	17
	LL	29
	PI	12



Modified Unified Soil Classification	Group Symbol
Clayey sand	SC

TECH: AB
CHECKED: NN

LIQUID LIMIT, PLASTIC LIMIT, AND PLASTICITY

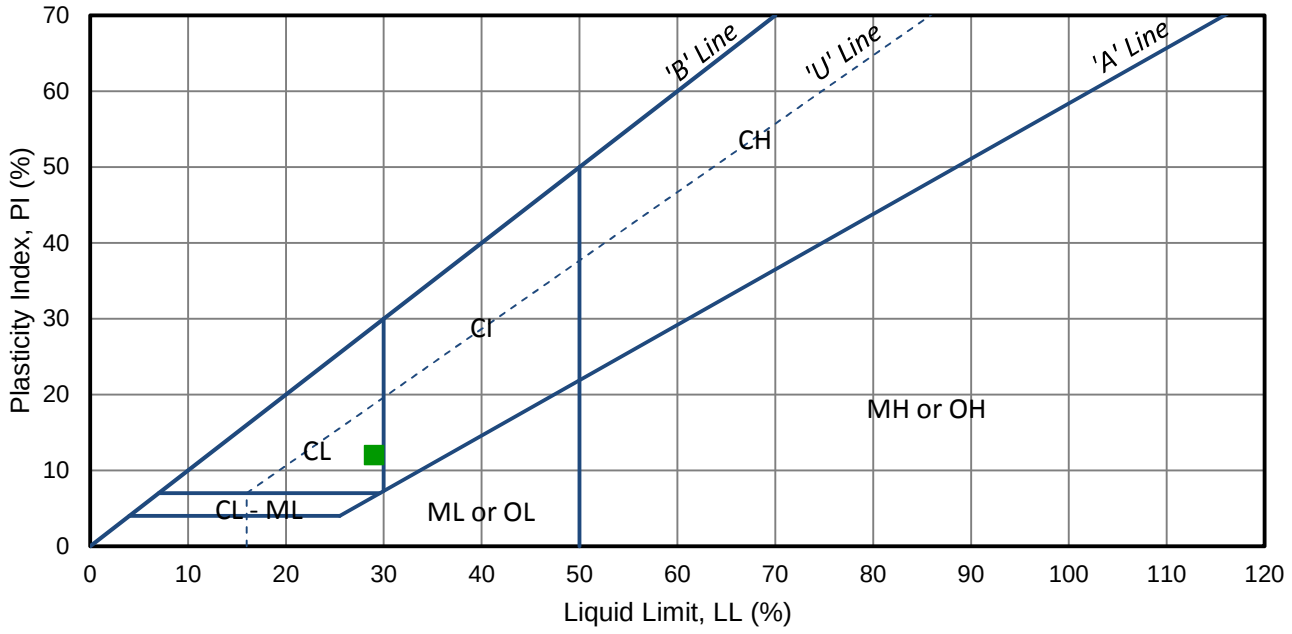
ASTM D4318 - Method A: Multi-Point

PROJECT: Proposed Nursery Golf Course RV Development
PROJECT#: RD5911
CLIENT: WSP Canada Inc.
SOIL DESCRIPTION: sand, some silt, some clay

SAMPLE DATE: December 5, 2016
TEST DATE: December 22, 2016
SAMPLE ID: 4G1
DEPTH: 0.6m

PROCEDURE USED: Wet Preparation - Method A: Mult-Point

	AS RECEIVED	PLASTIC LIMIT				LIQUID LIMIT	
		1	2	3	4	1	2
Number of blows, N						24	24
Container Number		1	2	3		1	2
Tare Container, M_C (g)		6.297	6.339	6.297		16.021	16.030
Wet Sample + Tare, M_{CMS} (g)		8.929	8.946	8.931		26.330	26.385
Dry Sample + Tare, M_{CDS} (g)		8.540	8.567	8.550		24.035	24.076
Dry Sample, M_S (g)		2.243	2.228	2.253		8.014	8.046
Water, M_W (g)		0.389	0.379	0.381		2.295	2.309
Moisture Content, w (%)		17.3	17.0	16.9		28.6	28.7
One point liquid limit for given trial, $LL^n = w^n \cdot (N/25)^{0.121}$ (%)						28.5	28.6



Plastic Limit, PL or w_P (%)	17
Liquid Limit, LL or w_L (%)	29
Plasticity Index, PI (%)	12
Modified USCS Classification	SC

TECH: AB
CHECKED: NN

Project: Proposed Nursery Golf Course RV Development
Subject: Geotechnical Testing - Soil Sulphate Test Results
Project #: RD5911 **Date:** December 21, 2016

Soil Sulphate Test Results

Laboratory: Parkland Geotechnical

Sample #: MC2-2 Borehole: 2 Depth: 2.0m Result (% Sulphate): 0.05	Sample #: Borehole: Depth: Result (% Sulphate):
Sample #: MC3-2 Borehole: 3 Depth: 2.0m Result (% Sulphate): 0.04	Sample #: Borehole: Depth: Result (% Sulphate):
Sample #: MC4-2 Borehole: 4 Depth: 2.0m Result (% Sulphate): 0.05	Sample #: Borehole: Depth: Result (% Sulphate):
Sample #: MC5-2 Borehole: 5 Depth: 2.0m Result (% Sulphate): 0.11	Sample #: Borehole: Depth: Result (% Sulphate):
Sample #: Borehole: Depth: Result (% Sulphate):	Sample #: Borehole: Depth: Result (% Sulphate):

Comments:

REQUIREMENTS FOR CONCRETE SUBJECTED TO SULPHATE ATTACK (CAN/CSA-A231-M09)

EXPOSURE CLASSIFICATION	DEGREE OF EXPOSURE	WATER-SOLUBLE SULPHATE(SO4) IN SOIL SAMPLE, %	SULPHATE(SO4) IN GROUND WATER SAMPLES, mg/L	MINIMUM SPECIFIED 56-DAY COMPRESSIVE STRENGTH, MPa	MAXIMUM WATER/CEMENTING MATERIALS RATIO	PORTLAND CEMENT TO BE USED
S-1	Very Severe	over 2.0	over 10,000	35	0.4	HS
S-2	Severe	0.20 to 2.0	1 500 to 10 000	32	0.45	HS
S-3	Moderate	0.10 to 0.20	150 to 1 500	30	0.5	MS or HS

Tech: AB **Chkd:** NN

THE PARKLANDGEO CONSULTING GROUP
EXPLANATION OF TERMS AND SYMBOLS

The terms and symbols used on the borehole logs to summarize the results of the field investigation and subsequent laboratory testing are described on the following two pages.

The borehole logs are a graphical representation summarizing the soil profile as determined during site specific field investigation. The materials, boundaries, and conditions have been established only at the borehole location at the time of drilling. The soil conditions shown on the borehole logs are not necessarily representative of the subsurface conditions elsewhere across the site. The transitions in soil profile usually have gradual rather than distinct unit boundaries as shown on the borehole logs.

1. PRINCIPAL SOIL TYPE – The major soil type by weight of material or by behaviour.

Material	Grain Size
Boulders	Larger than 300 mm
Cobbles	75 mm to 300 mm
Coarse Gravel	19 mm to 75 mm
Fine Gravel	5 mm to 19 mm
Coarse Sand	2 mm to 5 mm
Medium Sand	0.425 mm to 2 mm
Fine Sand	0.075 mm to 0.425 mm
Silt & Clay	Smaller than 0.075 mm

2. DESCRIPTION OF MINOR SOIL TYPE – Minor soil types are identified by weight of minor component.

Percent	Descriptor
35 to 50	and
20 to 35	some
10 to 20	little
1 to 10	trace

3. RELATIVE STRENGTH OF COARSE GRAINED SOIL – The following terms are used relative to Standard Penetration Test (SPT), ASTM D1586, N value for blows per 300 mm.

Description	N Value
Very Loose	Less than 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very Dense	Over 50

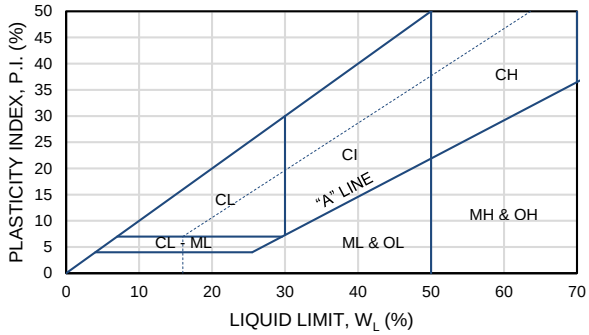
4. CONSISTENCY OF FINE GRAINED SOILS – The following terms are used relative to undrained shear strength and Standard Penetration Test (SPT), ASTM D1586, N value for blows per 300 mm. It is noted that this correlation needs to be used with caution as the correlation is only very approximate.

Description	Undrained Shear Strength, C_u (kPa)	N Value
Very Soft	Less than 12	Less than 2
Soft	12 to 25	2 to 4
Firm	25 to 50	4 to 8
Stiff	50 to 100	8 to 15
Very Stiff	100 to 150	15 to 30
Hard	Over 150	Over 30

THE PARKLANDGEO CONSULTING GROUP
EXPLANATION OF TERMS AND SYMBOLS

MODIFIED UNIFIED CLASSIFICATION SYSTEM FOR SOILS

MAJOR DIVISION			GROUP SYMBOL	GRAPH SYMBOL	TYPICAL DESCRIPTION	LABORATORY CLASSIFICATION CRITERIA	
COARSE GRAINED SOILS (MORE THAN HALF BY WEIGHT LARGER THAN NO. 200 SIEVE)	GRAVELS MORE THAN HALF COARSE GRAINS LARGER THAN NO. 4 SIEVE	CLEAN GRAVELS (LITTLE OR NO FINES)	GW		WELL GRADED GRAVELS, GRAVEL-SAND MIXTURE, LITTLE OR NO FINES	$C_U = \frac{D_{60}}{D_{10}} > Cc = \frac{(D_{30})^2}{D_{10} \times D_{60}} = 1 \text{ to } 3$	
			GP		POORLY GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES	NOT MEETING ABOVE REQUIREMENTS	
		DIRTY GRAVELS (WITH SOME FINES)	GM		SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES	CONTENT OF FINES EXCEEDS 12%	ATTERBERG LIMITS BELOW "A" LINE OR P.I. LESS THAN 4
			GC		CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES		ATTERBERG LIMITS ABOVE "A" LINE OR P.I. LESS THAN 7
	SANDS MORE THAN HALF FINE GRAINS SMALLER THAN NO. 4 SIEVE	CLEAN SANDS (LITTLE OR NO FINES)	SW		WELL GRADED SANDS, GRAVELLY SANDS WITH LITTLE OR NO FINES	$C_U = \frac{D_{60}}{D_{10}} > Cc = \frac{(D_{30})^2}{D_{10} \times D_{60}} = 1 \text{ to } 3$	
			SP		POORLY GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES	NOT MEETING ABOVE REQUIREMENTS	
		DIRTY SANDS (WITH SOME FINES)	SM		SILTY SANDS, SAND-SILT MIXTURES	CONTENT OF FINES EXCEEDS 12%	ATTERBERG LIMITS BELOW "A" LINE OR P.I. LESS THAN 4
			SC		CLAYEY SANDS, SAND-CLAY MIXTURES		ATTERBERG LIMITS ABOVE "A" LINE OR P.I. LESS THAN 7
FINE-GRAINED SOILS (MORE THAN HALF BY WEIGHT PASSES NO. 200 SIEVE)	SILTS BELOW "A" LINE NEGLIGIBLE ORGANIC CONTENT	$W_L < 50\%$	ML		INORGANIC SILTS & VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY	CLASSIFICATION IS BASED UPON PLASTICITY CHART (SEE BELOW)	
		$W_L > 50\%$	MH		INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS, FINE SANDY OR SILTY SOILS		
	CLAYS ABOVE "A" LINE NEGLIGIBLE ORGANIC CONTENT	$W_L < 30\%$	CL		INORGANIC CLAYS OF LOW PLASTICITY, GRAVELLY, SANDY, OR SILTY SOILS		
		$30\% < W_L < 50\%$	CI		INORGANIC CLAYS OF MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS		
		$W_L > 50\%$	CH		INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS		
	ORGANIC SILTS & CLAYS BELOW "A" LINE	$W_L < 50\%$	OL		ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW AND MEDIUM PLASTICITY		
		$W_L > 50\%$	OH		ORGANIC CLAYS OF HIGH PLASTICITY, ORGANIC SILTS		
HIGHLY ORGANIC SOILS			Pt		PEAT AND OTHER HIGHLY ORGANIC SOILS	STRONG COLOR OR ODOR, AND OFTEN FIBROUS TEXTURE	



NOTES ON SOIL CLASSIFICATION AND DESCRIPTION:

1. Soil are classified and described according to their engineering properties and behaviour.
2. Boundary classification for soil with characteristics of two groups are given combined group symbols (e.g. GW-GC is a well graded gravel sand mixture with clay binder between 5 and 12%).
3. Soil classification is in accordance with the Unified Soil Classification System (ASTM D2487) with the exception that an inorganic clay of medium plasticity (CI) is recognized.
4. The use of modifying adjectives may be employed to define the estimated percentage range by eight of minor components.

LIMITATION

General Terms and Conditions

The use of this attached report is subject to the following general terms and conditions.

1. STANDARD OF CARE - In the performance of professional services, ParklandGEO used the degree of care and skill ordinarily exercised under similar circumstances by reputable members of its profession practicing in the same or similar localities. No other warranty expressed or implied is made in any manner.

2. INTERPRETATION OF THE REPORT - The CLIENT recognizes that subsurface conditions will vary from those encountered at the location where borings, surveys, or explorations are made and that the data, interpretations and recommendation of ParklandGEO are based solely on the information available to him. Classification and identification of soils, rocks, geological units, contaminated materials and contaminant quantities will be based on commonly accepted practices in geotechnical or environmental consulting practice in this area. ParklandGEO will not be responsible for the interpretation by others of the information developed.

3. SITE INFORMATION - The CLIENT has agreed to provide all information with respect to the past, present and proposed conditions and use of the Site, whether specifically requested or not. The CLIENT acknowledged that in order for ParklandGEO to properly advise and assist the CLIENT, ParklandGEO has relied on full disclosure by the CLIENT of all matters pertinent to the Site investigation.

4. COMPLETE REPORT - The Report is of a summary nature and is not intended to stand alone without reference to the instructions given to ParklandGEO by the CLIENT, communications between ParklandGEO and the CLIENT, and to any other reports, writings or documents prepared by ParklandGEO for the CLIENT relative to the specific Site, all of which constitute the Report. The word "Report" shall refer to any and all of the documents referred to herein. In order to properly understand the suggestions, recommendations and opinions expressed by ParklandGEO, reference must be made to the whole of the Report. ParklandGEO cannot be responsible for use of any part or portions of the report without reference to the whole report. The CLIENT has agreed that "This report has been prepared for the exclusive use of the named CLIENT. Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. ParklandGEO accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report."

   The CLIENT has agreed that in the event that any such report is released to a third party, the above disclaimer shall not be obliterated or altered in any manner. The CLIENT further agrees that all such reports shall be used solely for the purposes of the CLIENT and shall not be released or used by others without the prior written permission of ParklandGEO.

5. LIMITATIONS ON SCOPE OF INVESTIGATION AND WARRANTY DISCLAIMER
   There is no warranty, expressed or implied, by ParklandGEO that:
   a) the investigation uncovered all potential geo-hazards, contaminants or environmental liabilities on the Site; or
   b) the Site is entirely free of all geo-hazards or contaminants as a result of any investigation or cleanup work undertaken on the Site, since it is not possible, even with exhaustive sampling, testing and analysis, to document all potential geo-hazards or contaminants on the Site.

   The CLIENT acknowledged that:
   a) the investigation findings are based solely on the information generated as a result of the specific scope of the investigation authorized by the CLIENT;
   b) unless specifically stated in the agreed Scope of Work, the investigation will not, nor is it intended to assess or detect potential contaminants or environmental liabilities on the Site;
   c) any assessment regarding geological conditions on the Site is based on the interpretation of conditions determined at specific sampling locations and depths and that conditions may vary between sampling locations, hence there can be no assurance that undetected geological conditions, including soils or groundwater are not located on the Site;
   d) any assessment is also dependent on and limited by the accuracy of the analytical data generated by the sample analyses;
   e) any assessment is also limited by the scientific possibility of determining the presence of unsuitable geological conditions for which scientific analyses have been conducted; and
   f) the laboratory testing program and analytical parameters selected are limited to those outlined in the CLIENT's authorized scope of investigation; and
   g) there are risks associated with the discovery of hazardous materials in and upon the lands and premises which may inadvertently discovered as part of the investigation. The CLIENT acknowledges that it may have a responsibility in law to inform the owner of any affected property of the existence or suspected existence of hazardous materials and in some cases the discovery of hazardous conditions and materials will require that certain regulatory bodies be informed. The CLIENT further acknowledges that any such discovery may result in the fair market value of the lands and premises and of any other lands and premises adjacent thereto to be adversely affected in a material respect.

6. COST ESTIMATES - Estimates of remediation or construction costs can only be based on the specific information generated and the technical limitations of the investigation authorized by the CLIENT. Accordingly, estimated costs for construction or remediation are based on the known site conditions, which can vary as new information is discovered during construction. As some construction activities are an iterative exercise, ParklandGEO shall therefore not be liable for the accuracy of any estimates of remediation or construction costs provided.

7. LIMITATION OF LIABILITY - The CLIENT has agreed that to the fullest extent permitted by the law ParklandGEO's total liability to CLIENT for any and all injuries, claims, losses, expenses or damages whatsoever arising out of or in anyway relating to the Project is contractually limited, as outlined in ParklandGEO's standard Consulting Services Agreement. Further, the CLIENT has agreed that to the fullest extent permitted by law ParklandGEO is not liable to the CLIENT for any special, indirect or consequential damages whatsoever, regardless of cause.

8. INDEMNIFICATION - To the fullest extent permitted by law, the CLIENT has agreed to defend, indemnify and hold ParklandGEO, its directors, officers, employees, agents and subcontractors, harmless from and against any and all claims, defence costs, including legal fees on a full indemnity basis, damages, and other liabilities arising out of or in any way related to ParklandGEO's work, reports or recommendations.