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November 29, 2023
File No. 6234-49

WSP CANADA INC.
Suite 1200, 10909 Jasper Avenue NW
Edmonton, Alberta
T5J 3L9

ATTENTION: Larissa McClure, P. Eng., Senior Project Manager

Dear Madame:

Re: Geotechnical Investigation – Second Submission
Proposed Goodridge Corners Phase 3
Part of SE 12 – 54 – 25 – W4M
185 Avenue & 132 Street NW
Edmonton, Alberta

Please find enclosed our report with respect to the above noted investigation. In brief, this report presents the general soil conditions and geotechnical recommendations for the design and construction of the proposed development.

Thank you for the privilege of providing this service to your organization. We will be pleased to meet with you to review the contents of this report at your convenience.

Yours truly,
Hoggan Engineering & Testing (1980) Ltd.

Scott MacFarlane

Scott MacFarlane, P. Eng.

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REPORT NO: 6234-49

GEOTECHNICAL INVESTIGATION – SECOND SUBMISSION
PROPOSED GOODRIDGE CORNERS PHASE 3
PART OF SE 12 – 54 – 25 – W4M
185 AVENUE & 132 STREET NW
EDMONTON, ALBERTA

NOVEMBER 2023

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PROPOSED GOODRIDGE CORNERS PHASE 3
PART OF SE 12 – 54 – 25 – W4M
185 AVENUE & 132 STREET NW
EDMONTON, ALBERTA

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GEOTECHNICAL INVESTIGATION

PROJECT: Proposed Goodridge Corners Phase 3

LOCATION: Part of SE 12 – 54 – 25 – W4M
185 Avenue & 132 Street NW
Edmonton, Alberta

CLIENT: WSP CANADA INC.
Suite 1200, 10909 Jasper Avenue NW
Edmonton, Alberta
T5J 3L9

ATTENTION: Larissa McClure, P. Eng., Senior Project Manager

1.0 INTRODUCTION

This report presents the results of a geotechnical investigation and analysis made for the proposed residential subdivision in Edmonton, Alberta. The project is understood to consist of a residential subdivision with fully serviced lots for single-family houses with basements. Preliminary subdivision layout drawings were provided to our firm for review by WSP Canada Inc. prior to drilling. It is assumed the maximum depths of underground utilities will be approximately 7.5 metres. The objective of the investigation was to determine the subsoil data for use in the geotechnical planning and design aspects of the subject subdivision. It should be noted that all environmental and previous land use issues are beyond the scope of this report.

Authorization to proceed and permission to enter the site was received from Larissa McClure, P. Eng. (WSP Canada Inc.) on behalf of the land owner.

2.0 SITE DESCRIPTION & BACKGROUND RESEARCH

The site is of the proposed development is located north and east of 185 Avenue & 132 Street NW, in Edmonton, Alberta. The site is is approximately 8 acres in size, located within a portion of Part of SE 12 – 54 – 25 – W4M.

Limited Aerial Photography Review

Aerial photography taken between 2004 and 2022, covering the subject site and surrounding areas, were found online via Google Earth. The images were compared and reviewed for any signs of disturbances within the site.

In 2004, the subject site was noted to be at the intersection of two parcels. The north parcel appeared to be open crop, while the south parcel featured isolated patches or rows of trees present. The property line appeared to be fenced and featured significant tree cover. A farm yard was present east of the subject site.

In 2008, no significant changes to the subject site were noted. The rows of trees were more pronounced and increased farmyard equipment/storage structures were present throughout the south parcel.

In 2011, a significant area of the north parcel featured new rows of trees. The south parcel still featured significant rows of trees, however it was noted the farmstead and other structures were removed. Grading activities and a temporary parking lot on the now existing RCMP building was visible.

In 2014, the majority of the RCMP lot appeared to be graded. The subject site appeared to be generally undisturbed, with the exception of the south east corner, which appeared to be stripped.

In 2015, a low lying area within the subject site was visible and appeared to contain free standing water. The temporary parking lot visible in 2011 has disappeared and appears to be in the process of being graded in October 2015.

In 2018, a significant amount of grading and construction activity is visible onsite. The east and south limit of the subject site appeared to be stripped with a haul road traversing the site. The rows of trees are still present onsite and appear undisturbed from adjacent grading activities.

In 2022, the site appears to be consistent with the current state.

Current Site Conditions

At the time of the investigation, the majority of the site featured vegetation (regrowth). The north west portion of the site featured an existing tree farm, where access was restricted to between the existing rows of trees. The north east portion of the site appeared to be previously stripped. A low lying wetland was present in the south east portion of the subject site.

In general, the site terrain was considered generally level and featured wild vegetation. Access to the site was gained via an approach off the existing 132 Street NW turn-around. Travel onsite was possible for normal-wheeled vehicles in open level areas.

Geotechnical Report Review

The following geotechnical investigations were completed previously onsite and permission to utilize the reports and soils information were provided by the owner.

- *Geotechnical Investigation, Proposed Goodridge Corner Subdivision, Stage 1 and Deep Sanitary Sewer, 127 Street & Anthony Henday Drive, Edmonton, Alberta, May 2015, Prepared By J.R. Paine & Associates Ltd., JRP File No. 1229-417.*
- *Preliminary Geotechnical Investigation, Neighbourhood Study, Rural NW Neighbourhood, Between 142 Street NW, City Limit and Future Anthony Henday Drive, Edmonton, Alberta, October 2008, Prepared By J.R. Paine & Associates Ltd., JRP File #2418-1441.*

Two (2) testholes in the above noted reports were located within or near the subject site. The approximate locations of relevant testholes can be found in the site plan attached in the Appendix. The soil logs of all relevant testholes are also included in the current investigation.

Coal Mine Atlas Review

As noted in the above report, the Alberta Coal Mine Atlas produced by the Energy Resources Conservation Board was reviewed, and no records of coal mining activity were found within the study lot or in the immediate vicinity of the study lot. Coal mining related issues were not investigated further.

3.0 FIELD INVESTIGATION

The subsurface soil sampling for this project was undertaken on August 2 and 8, 2023, utilizing a truck mounted drill rig owned and operated by SPT Drilling Ltd. A total of two (2) testholes were drilled to depths of approximately 10.4 metres below existing ground surface (BGS). The testhole layout was chosen by our firm based the proposed subdivision layout provided by the client, coverage of previous testholes, and cleared of underground utilities.

The testhole locations and elevations were surveyed by our firm using a Trimble GPS unit. The approximate locations of all testholes can be found on the attached site plan in the Appendix.

All testholes were advanced with 150 millimetre diameter solid stem augers in 1.5 metre increments. A continuous visual description, including the soil types, depths, moisture, transitions, and other pertinent observations, were recorded on site. Soil samples were collected at 750 millimetre interval for laboratory testing. Standard Penetration Tests (SPT) complete with split spoon sampling were conducted at regular 1.5 metre intervals.

Following the drilling operation, 25 mm diameter slotted PVC piezometric standpipes were installed in each testhole to measure watertable levels. The testholes were backfilled with cuttings and sealed with bentonite near the surface to help prevent surface water infiltration.

4.0 LABORATORY TESTING

Soil samples retrieved from augers were bagged and returned to the laboratory for further testing. All samples were tested for moisture content. Representative clay samples were also tested to determine the liquid and plastic Atterberg limits, as well as soluble soil sulphate concentrations. Two bulk samples were also tested for CBR. Shelby tube samples obtained at various depths were tested for dry density and unconfined compressive strength. The results of all laboratory testing and field observations are provided on the attached soil logs.

5.0 GEOLOGY & SOIL CONDITIONS

According to the Quaternary Geology of Central Alberta conducted by I. Shetsen, the local surficial geology of the site is classified as a lacustrine deposit of Pleistocene and Holocene age. The fine sediment was described in the legend as silt and clay with a flat to gently undulating surface. The general bedrock geology in the region was identified as the Horseshoe Canyon Formation of late Cretaceous age. The Horseshoe Canyon Formation generally comprised of grey feldspathic clayey sandstone and bentonitic mudstone, with scattered coal and bentonite beds of various thickness.

Detailed description of the soils encountered can be found in the attached soil logs in the Appendix. In general, the soil profile encountered consisted of topsoil or vegetation at the surface, followed by layers of native clay underlain by clay till. Soil transitions were gradual, as such soil boundaries in the soil logs were best estimations only.

Topsoil

Topsoil/Organic clay soil was encountered at the surface of Testhole 2023-01. In general, the topsoil/organic clay encountered was considered moist, very stiff, black and was measured to a depth of approximately 450 millemetres BGS. It is emphasized that the topsoil depths were known only at the testhole locations, and may vary away from the testholes.

Native Clay

Below the topsoil within Testhole 2023-01 and at the surface of Testhole 2023-02, native lacustrine clay deposits were encountered. In general, the upper clay material encountered was considered silty, high plastic, moist, brown/grey, and contained a trace of oxides. SPT "N" values between 6 and 17 blows per 300 millimetres of penetration was recorded, indicating a variable consistency.

Below a depth of 2.3 and 1.4 metres in Testholes 2023-01 and 2023-02, respectively, the clay soil transitioned into very silty clay. The clay soil was considered, very moist, medium plastic, firm to stiff and contained odd high plastic clay seams. This seam was noted to be sensitive below a depth of approximately 3.0-5.0 metres BGS.

Native Clay Till

Clay till was encountered below a depth of approximately 9.1 and 8.5 metres BGS in Testholes 2023-01 and 2023-02, respectively. In general, the clay till material encountered was considered medium plastic, moist, brown, and contained a trace of coal, oxide, and gravel. SPT "N" values between 29 and 58 blows per 300 millimetres of penetration was recorded, indicating a hard consistency.

Testhole Conditions At Completion

At the completion of drilling, immediate groundwater seepage was measured within all testholes. Slough accumulation was also measured in Testhole 2023-01. The observed results are summarized below.

Testhole #	Accumulation Free Water and Slough Following Drilling (Above Hole Bottom)
2023-02	4.6 m of water and 3.6 slough
2023-03	3.7 m of water and slough
2014-02	7.6 m of water
08-2	0.5 m of water

6.0 GROUNDWATER CONDITIONS

The groundwater table within the study area was generally moderate to low. Several sets of readings were taken, with the results tabled below.

Groundwater Table Readings JRP File # 2418-1441, Report dated October 31, 2008 (Metres Below Ground Surface)				
Testhole #	**Testhole Elevation (m)**	**Depth to Watertable (m)**		**Watertable Elevation (m)**
		1st Reading Sept. 2/2008	**2nd Reading Sept. 16/2008**	
08-2	693.62	8.02 m (13 day)	7.96 (29 day)	685.66

Groundwater Table Readings JRP File # 1229-417, Report dated March 20, 2015 (Metres Below Ground Surface)					
Testhole #	**Testhole Elevation (m)**	**Depth to Watertable (m)**			**Watertable Elevation (m)**
		1st Reading Nov. 7/2014	**2nd Reading Nov. 18/2014**	**3rd Reading Jan. 13/2015**	
2014-02	687.282	6.58 m (10 day)	7.51 (21 day)	7.25 (77 day)	680.03

Groundwater Table Readings Current Hoggan Report Proposed Goodridge Corners Phase 3 Part of SE 12 – 54 – 25 – W4M 185 Avenue & 132 Street NW (Metres Below Ground Surface)					
Testhole #	**Testhole Ground Elevation (m)**	**Depth to Watertable**			**Watertable Elevation (m)**
		1st Reading Aug. 8, 2023	**2nd Reading Aug. 23, 2023**	**3rd Reading Sept. 5, 2023**	
2023-01	690.75	5.22 (6 day)	5.04 (21 day)	5.08 (34 day)	685.67
2023-02	689.97	N/A	3.89 (15 day)	3.78 (28 day)	686.19

It should be noted that watertable levels may fluctuate on a seasonal or yearly basis with the highest readings obtained in the spring or after periods of heavy rainfall. The above current 2023 readings should be near the seasonal average levels.

7.0 RECOMMENDATIONS

7.1 Site Grading

1. Topsoil and all other organic soil are considered unsuitable to support footing foundations, basement slab-on-grade, and roads. At the time of stripping, any former local depressions and channels should be identified where additional stripping and cuts may be required.

All organic soil at the ground surface should be completely stripped away, stockpiled, and reused for landscaping purposes only.

It should be noted that Testhole 2023-01 was located in an area noted to be previously stripped. The existing vegetation should be completely stripped away from site. Any existing fill found during construction should be reviewed by our firm to verify suitability. Material removed that is relatively free of organic soil can be reused as grading fill material. Field judgment will be required to determine the suitability to reuse any existing fill material.

2. The soils encountered near the surface in most cases were relatively stiff and should be adequate to support construction traffic. Conventional clearing and stripping should be suitable for most parts of the sites. Soft native clay soil was encountered in TH2023-02 between a depth of approximately 2-5 metres BGS. Therefore, a hoe and trucks may be required to excavate over firm areas and within local depressions including the existing wetland area in the south east corner of the site.
3. The measured watertable levels were measured at 5.1 and 3.8 metres BGS in Testholes 2023-01 and 2023-02, respectively. Therefore, no groundwater issue is expected during the stripping operation for shallow cuts. However, stripping within local depressions may encounter surface water accumulations.
4. Engineered fill may be considered in areas where low elevations necessitate deep fill zones. This option should be reviewed by our firm to evaluate site conditions and borrow material sources prior to implementation. Fill deeper than 4.0 metres should be reviewed by our firm to address potential settlement prior to construction. Settlement monitoring is recommended for fill deeper than 4.0 metres.

   Engineered fill is soil that is placed in a controlled manner under the full-time inspection of a qualified soil technician. The fill is placed and compacted to a minimum 98 percent of its Standard Proctor Density (SPD) near its optimum moisture content, in maximum 150 millimetre lifts. All topsoil and non-engineered fill must first be stripped from the engineered fill area. Engineered fill placement requires full-time monitoring and extensive testing by the geotechnical consultant during construction. However, proper placement of engineered fill will negate the need for pile foundations in deep lot fill areas, and possibly reduce the foundation costs to the builders and developer.

Engineered fill placement requires the support of strong underlying soil and may not be feasible over soft to firm, very moist to wet, underlying soils. Soft native clay soil was encountered in TH2023-02 between a depth of approximately 2-5 metres BGS. Compacting the first lift of fill material over these firm underlying soils to the engineered fill standard may be impossible. Where a minimum fill depth condition is met, construction of a clay pad approximately of 300 to 500 millimetres in thickness will be required to obtain an adequate working platform. This pad should be compacted to a minimum of 98 percent of SPD where possible. The normal engineered fill lift thickness and compaction criteria mentioned above should be applied to successive lifts. To employ this method, a minimum of 1.0 metre of engineered fill must be placed on top of the clay pad. If this condition is not met, the fill would not be considered to have met engineered fill standards.

In addition, engineered fill requires fill depth differentials across the building footprint of less than 1.5 metres. This may be a limiting factor in sloping existing ground. In some cases, removal of native material may allow for the minimum fill depth or the maximum fill differential conditions to be met. However, this may not always be the most economical solution.

5. The upper clay was high plastic and exhibited high swelling and shrinkage potential. The risk of swelling and shrinkage to structures placed upon high plastic clay must be accepted by all parties. Since high plastic clay is already present near the surface throughout the site, placing additional high plastic clay fill will not further increase the swelling and shrinkage potential if placed above optimum moisture content. It is emphasized that any native high plastic clay or high plastic clay fill at slab subgrade level within commercial or multi-family lots will unlikely be acceptable for slab support due to high swelling and shrinkage potential.

   Any high plastic clay fill must be placed at slightly above optimum moisture content, to minimize possible swelling and shrinkage concerns. It is important that changes in moisture content be avoided both during and after construction to limit the risk of soil swelling and shrinkage. Proper site grading is also imperative.

6. The near surface site clays are of low to moderate frost susceptibility, with the susceptibility becoming higher in the very silty clays encountered with depth throughout

the site. A high watertable within approximately 3.0 meters of the road surface is required for significant frost heaving to occur. The closer the watertable is to the surface, the higher is the frost heave potential. The standpipes for all of the testholes at this project have stabilized near or below this level, and the potential for frost heave will be low to moderate. It is recommended that the design grade be set as high as possible. No significant cuts are recommended.

7.2 Residential Housing

1. The inorganic native soils encountered throughout this site are considered satisfactory for supporting single family dwellings utilizing standard concrete footing foundation and slab-on-grade from the strength and settlement viewpoints. Soft native clay soil was encountered in TH2023-02 between a depth of approximately 2-5 metres BGS. Excavation into firm soils should be inspected by qualified geotechnical personnel. The bearing capacity of soft to firm soils may fall below the minimum 75 kilopascals required for applying the Section 9 of the National Building Code – Alberta Edition. In such cases, wider footings will be required.

   Engineered fill as described in Item 7.1.4 would also be considered suitable for supporting single family dwellings with standard concrete footing foundation and slab-on-grade from the strength and settlement viewpoints. Topsoil encountered in all testholes is not considered suitable for footing or slab-on-grade support and should be removed from all building pockets.

2. The upper native clay encountered near the surface was high plastic and exhibited a high shrinkage and swelling potential with changes in moisture content. The following factors should be considered when utilizing a footing foundation where high plastic clay is present at footing grade.

   a. As with all high plastic clays, some minor amounts of long-term foundation and slab movement may occur, especially during extreme wet and dry weather periods. It is emphasized that the potential of soil movement from shrinkage and swelling of high plastic clays cannot be eliminated and the building owner must accept the risk of foundation movement when utilizing a footing foundation.

b. Recommendations provided in Items 7 to 11 are also imperative to help mitigate or reduce, but not eliminate, the swelling and shrinkage potential of the high plastic clay.
c. If movement cannot be tolerated, pile foundation is one option. More recommendations on pile foundation are provided in Items 13 to 15.

3. The recorded watertable levels were variable, but were more than 3.0 m below the existing grade. Assuming the design lot grades will be at or above the existing grade, typical footing foundation excavation of 1.5 m to 2.5 m should not intercept the watertable in most parts of the site. Design grade should be kept high where the watertable is closest to the existing grade to avoid basement excavation intercepting the watertable.
4. The native clay encountered near the surface throughout the site were high plastic and were considered slightly susceptible to frost. The lower very silty clay soils were medium plastic and were considered moderately susceptible to frost. To help prevent frost heave issues, diligence with recommendations provided in Items 5 and 6 is emphasized. Insulation may also be considered to keep bearing soil from freezing. Our firm should be consulted if insulation will be used.
5. All houses will require at least 1.5 metres of earthen cover to prevent potential frost heave problems, and to minimize movements associated with seasonal variations in moisture content. The amount of cover should be increased to 2.0 metres for exterior isolated footings or for footings of non-continuously heated structures.
6. During winter construction, it is essential that all interior fill and load bearing materials remain frost free. Recommended winter construction practices, with respect to hoarding and heating of the forms and the fresh concrete, should be followed. In order to minimize the potential frost heave problems, the interior of the building must be heated as soon as the walls have been poured. The period in which the excavation is left open due to freezing conditions should be as short as possible. If doubts remain as to the suitability of the foundation during construction, the builder should consult a qualified geotechnical engineer.
7. No loose, disturbed, or slough material should remain in the open excavation floor. Excavations should be performed by machinery operating remotely from the bearing

surface. The footing excavation surface should be made smooth and level so that water cannot accumulate in low spots. The bottom of interior spread footing elevations should be designed and constructed to match the slab subgrade, so that groundwater will not accumulate around the lower footing. Cleaning by hand is advised if the equipment fails to produce a smooth surface.

8. Care should be taken during construction and structure design life to prevent excessive changes in moisture content of the soil under the footings. Footing excavations should be protected from rain, snow and influx of groundwater.

   The time span between the start of excavation to installation of basement footings, walls, peripheral weeping tile and backfilling operations should be minimized in order to prevent any problems developing within the excavation due to ingressing of groundwater or surface waters or desiccation of the subsoil.

9. At a minimum, peripheral weeping tile lines are recommended along the footing to handle seasonal groundwater fluctuation, and also help reduce the swelling and shrinkage potential of the soil. All lines should be placed at or slightly below bottom of the footing, level with no bumps or sags to ensure positive drainage, and connected to an approved system. Minimum 150 millimetres of clean tile rock drainage filter, wrapped in geotextile, are also recommended around the weeping tile line. The sump and outlet piping must be water tight, with no holes below the float level. Additional recommendations on upgraded foundation drainage measures for footings near the watertable can be found in Item 7.6.2.

   Good long-term subsurface drainage is also imperative to help reduce swelling. Sumps should be connected to both weeping tiles and granular base under the slab to maximize drainage.

10. Clay is the preferred backfill material around the basement walls. This serves to reduce water penetration into the backfill, and subsequently into the weeping tile system. The native clays encountered throughout the site would be suitable for this purpose.

    All backfill against foundation walls should be inorganic material and should be moderately compacted with care taken not to over compact the fill and generate excessive lateral pressure. The backfill should be placed in lifts not great than 150 millimetres after compaction. It is recommended that floor joists be placed prior to backfilling in order to minimize any detrimental effects on the foundation walls caused by soil compaction.

Water dispersed on the property from the roof leaders should not be allowed to accumulate against the foundation walls. To ensure positive drainage, the soil surface of all lots should be made sloping away from all buildings. This will require a positive lot grading of at least five percent away from the foundation walls for a minimum of 1.2 metres. In cases where the lot drainage runs from the back of the lot to the front, runoff should be kept 1.2 metres away from the buildings.

As a long-term maintenance measure, loosely compacted backfill around the foundation can settle with time and may require re-grading to ensure that all surface water is directly away from the foundation. Also to help prevent moisture changes to soil near the buildings, lawn should not be over watered and trees should not be planted near footing foundations and slabs.

11. Final lot grading is not known at this time. If general lot grading will produce areas of fill extending in depth below that of the footing elevation, it is strongly recommended that qualified geotechnical personnel inspect the house excavations. Generally, it is not recommended that footings be constructed on non-engineered fill. In such cases, the following alternatives are commonly recommended:
    - Removal of the fill down to native soil and backfill with fillcrete or a compacted granular material. A normal footing foundation may then be founded on the cured fillcrete or compacted gravel. However, foundation drainage must be modified to drain the bottom of gravel and ensure positive flow within the weeping tile towards the sump in all locations.
    - Utilize a pile foundation.

12. In the case of pile foundations, some installation problems may be encountered. Immediate groundwater seepage was observed in both Testholes 2023-01 and 2023-02. The need for casing cannot be ruled out and should be on site during pile installation to control groundwater seepage in any pile hole when necessary. At a minimum, pile concrete should be on-site during the pile drilling to allow for quick concrete placement. The factored soil skin friction resistance for pile design should be determined on a lot by lot basis.

13. All piles should be adequately reinforced. Concrete for all piles should be adequately vibrated.
14. To compensate the possible swelling of the subsoil beneath the pile caps and the effects of frost action, void form or other means to allow soil expansion are recommended beneath the grade beams pile caps, basement foundation walls, and structural slabs.
15. The native inorganic clay encountered near the surface in all testholes are considered suitable for slab-on-grade support from the strength and settlement viewpoints. Engineered fill as specified in Item 7.1.4 would also be adequate to provide slab-on-grade support from the strength and settlement viewpoints.

    The high swelling potential of the native clay should be addressed. When using a slab-on-grade, all interior walls supported by the slab must have design and finishing details which allow for movement. Joints between interior slab-supported walls and exterior foundation supported walls must be flexible. A 75 mm gap is recommended for the top of slab-supported walls to allow for swelling.
16. A minimum 150 millimetre layer of clean granular material of maximum 25 millimetre grain size should be placed immediately below the slab-on-grade. This material should be uniformly compacted to a minimum 100 percent of the corresponding SPD at or slightly above the optimum moisture content to provide slab support.

    To help provide under slab drainage, washed rock (maximum 25 millimetres in size with less than 10 percent passing 4 millimetre sieve) can be used as slab base material. However, a non-woven geotextile separator (Nilex 4551 or similar) should be placed between washed rock and soil subgrade.
17. A non-deteriorating vapour retarder should be placed beneath the concrete floor to prevent desiccation of the subgrade material.
18. Edmonton is located within an area that has been identified by the national research council to have high levels of relative Radon hazard. Radon is a tasteless, odorless, colorless gas potentially emitted by the site subsoil and is a health concern. As per Section 9.1.3.4 of the National Building Code – 2019 Alberta Edition Volume 2, rough-in for Radon extraction system is required for new residential houses. One method of Radon extraction system may include a clean granular material, having less than 10 percent passing through the 4 millimetre sieve, at least 100 millimetres thick below the

slab. In addition, this Radon extraction system may also include an air tight vapor seal between the washed rock and bottom of slab. The washed rock slab base and vapor retarder recommended in Items 16 and 17 respectively may be incorporated into such Radon extraction system as well.

7.3 Underground Utilities

1. The native clay and clay till encountered within the testholes were considered satisfactory for the installation of underground utilities with open cut trenches. Any organic soil excavated from the trenches should be separated and should not be reused as backfill.
2. Immediate groundwater seepage was observed in Testholes 2023-01 and 2023-02, while the watertable levels were measured at 5.1 and 3.3 metres BGS in Testholes 2023-01 and 2023-02, respectively. Therefore, some groundwater seepage should be expected in deep trenches and construction delay should be anticipated.

   Groundwater seepage from the lower clay till is expected to be slow to moderate. Temporary dewatering measures may be required during utility installation in at least some areas. In-trench pumping during installation should be sufficient to maintain trench working conditions. More recommendations on groundwater issues can be found in Section 7.6.
3. Standard trenching cutback slope of 1H:1V is expected to be adequate for the native clay and clay till encountered in the testholes. Trenching within the soft, very silty clay soils may require shallower cutback slope of 2H:1V in order to remain stable. If any excavation encounters bedrock, our firm should be notified and more recommendations can be provided upon inspection. The optimum cutback slope for utility trenches should be determined in the field during construction. Exact stable slope values cannot be pinpointed without detailed and extensive analysis. For this reason, this information should be used as a guideline only. Part 32 of the Occupational Health and Safety Regulation should be strictly followed, except were superseded by this report.

   To reach the maximum trench depth of 7 metres, benching the slope maybe be required to remain stable. The bench depth and width will depend on the soil conditions encountered and size of the machine, and should be determined on site during construction.

All slopes should be monitored regularly for signs of cracking or movement, especially after periods of rainfall. Remediation should be performed immediately wherever such signs are observed. Opening relatively long portions of utility trench over an extended period of time is not recommended.

4. Temporary surcharge loads, such as spill piles, should not be allowed within 3.0 metres of an unsupported excavation face, while mobile vehicles should be kept back at least 1.0 metre.
5. To reduce pipe loading, trench widths should be minimized but be compatible with safe construction operations. The trench width must be wide enough to accommodate pipe bedding and compaction equipment.
6. Where unsupported excavation is not feasible or where trenches are to remain open for an extended period of time, temporary shoring or retaining structures can be utilized to support the excavation. Pressure distribution will depend on shoring type. The shoring design should be carried out in cooperation with our firm once construction details have been finalized.
7. For thrust block design only, the estimated factored bearing capacities of the soil encountered at various depths in each testhole are summarized below:

Thrust Block Bearing Capacity vs. Soil Depth			
Factored Bearing Capacity	0 kPa	50 kPa	minimum 72 kPa
Testhole #	Soil Depth (m)		
2023-01	0 - 0.45	n/a	0.45 - 10.4
2023-02	n/a	n/a	0 - 10.4
2014 - 2 (1229-417)	n/a	2.1 - 6.7	0 - 2.1 & 6.7 - 14.9
08-2 (2418-1441)	0 - 0.1	n/a	0.1 - 8.8

The upper native clay and sand encountered in the testholes should meet the minimum factored bearing capacity of 72 kPa specified by EPCOR. However, some of the lower very silty clay encountered in Testhole 2014-02 (JRP Report #1229-41) was relatively soft, where the factored bearing capacity would fall to 50 kPa.

Engineered fill to be placed during the construction will also meet the minimum factored bearing capacity of 72 kilopascals specified by EPCOR. However, thrust blocks should not be founded on any non-engineered fill or organic soil.

It is emphasized that soil conditions may vary away from the testhole locations. Where variable soil condition is encountered during construction, thrust block excavation should be inspected accordingly to confirm the bearing capacity prior to placement of concrete.

8. Pipe bedding and trench backfill procedures should adhere to the City of Edmonton Construction Specifications. The backfill material immediately beneath and above the pipe should be an approved bedding sand material where conditions allow. This material should be hand placed and hand tamped, with care taken to fill the underside of the pipe, and compacted to a minimum 95 percent of the SPD.

   If groundwater seepage or saturated conditions are encountered in trenches, washed rock completely wrapped in geotextile separator are recommended for pipe bedding. The washed rock and geotextile configuration should be determined in the field during construction. The need for this configuration is estimated to be low for this site, although cannot be ruled out.

9. Trench backfill procedures should adhere to the City of Edmonton Construction Specifications. All trench backfill above bedding material should be suitable uniform inorganic soil, placed and compacted in maximum compacted lift thickness of 300 millimetres. No organic or frozen soil should be used as trench backfill. The following chart summarizes the trench backfill compaction requirements found in the City of Edmonton Construction Specifications for trenches under existing or proposed road, alley, walk, street or similar structure and within a distance from such structure equal to trench depth.

Table 5: Trench Backfill Compaction Requirement Options

Backfill Zone	Standard Criteria	One Point Criteria
Within 1.5 m below subgrade	minimum 98% SPD	minimum 100% OPPD
More than 1.5 below subgrade	minimum 95% SPD	minimum 97% OPPD
SPD = corresponding Standard Proctor Density		
OPPD = corresponding One-Point Proctor Density (with maximum moisture criteria)		

   Based on our experience in neighbourhoods throughout Edmonton, the one-point criteria should be applicable for this site. Uniform backfill is required by City of Edmonton specifications and is also recommended by our firm.

10. The following table compares the native moisture content of the materials encountered at the time of investigations, with different moisture content criteria for trench backfill at this site. It should be noted that moisture contents varied significantly within the site. More Atterberg Limit testing will be required at the time of construction to confirm these results.

Trench Backfill Maximum Moisture Content Criteria											
Testhole Number	Sample Depth m	Liquid Limit %	Plastic Limit %	Field Moisture Content %	Plasticity Index (PI) %	Maximum Moisture Content Criteria					
						Uniform Backfill		Conventional Backfill		PL+8 Criteria	
						PL+PI/2	+/- Criteria	PL+PI/3	+/- Criteria	PL+8	+/- Criteria
2023-01	1.5	57.6	19.7	28.9	37.9	38.7	-9.8	32.3	-3.4	27.7	1.2
2023-01	4.5	51.7	21.3	38.9	30.4	36.5	2.4	31.4	7.5	29.3	9.6
2023-02	6.1	33.6	22.5	34.8	11.1	28.1	6.8	26.2	8.6	30.5	4.3
2023-02	9.8	34.2	13.3	18.7	20.9	23.8	-5.1	20.3	-1.6	21.3	-2.6
2014-02	4.6	46.9	20.8	44.6	26.1	33.9	10.8	29.5	15.1	28.8	15.8
08-2	8.2	62.3	23.7	29.8	38.6	43.0	-13.2	36.6	-6.8	31.7	-1.9

Notes:
- City specifications state that when the plasticity index criteria for maximum moisture content exceeds 8 percent over the plastic limit, the plastic limit plus 8 percent shall govern.
- All values of under the criteria are percentages.
- Chart shows only the moisture content of samples tested for Atterberg Limits. See testhole logs for all moisture content data

* denotes unsuitable backfill material within 1.5 m below road subgrade

The moisture contents of the native clay and clay till encountered were typically slightly abover to well above the plastic limit. Therefore, moderate to extensive drying will be required to meet compaction specifications.

It is suggested that a maximum moisture content of 5.0 percent above the plastic limit be set for the top 1.5 metres of the trench, in order to improve conditions for the construction of surface utilities. This will require increased drying but can reduce subgrade preparation cost. Weather conditions should be considered during trench backfill operations.

11. It should be noted that the ultimate performance of the trench backfill is directly related to the consistency and uniformity of the backfill compaction, as well as the underground contractor's construction procedures. In order to achieve this uniformity, the lift thickness and compaction criteria should be strictly enforced.

7.4 Surface Utilities

1. The native clays encountered throughout this site are considered generally fair for the construction of roads, curbs, and sidewalks. All existing organic soil and other deleterious materials should be removed prior to construction of roads, sidewalks and other surface utilities.

One concern for surface utility construction at this site is the elevated moisture content of the lower clays. If the very moist to wet lower native clays excavated are allowed to be placed in the upper portion of the trench, the road subgrade will be soft and inadequate to support normal pavement structures. Extra subgrade work would then be required in order to construct an adequate working platform for the pavement structure placement and long term support. It is emphasized that the degree of material separation and trench backfill drying during underground utility installation will affect the soil conditions for road and sidewalk construction, with increased drying improving the soil conditions. The key to the development success will be in ensuring that suitable soils are in place below subgrade elevation to adequately bridge the lower wet clays found in most of the testholes. This can be accomplished during the site grading and trenching operations by extensive drying, thorough mixing, or material substitution.

2. The upper native clay encountered was high plastic and was considered slightly frost susceptible. The lower native clay encountered was typically very silty with a medium plastiticty and was considered slightly frost susceptible. The closer the watertable is to the surface, the higher is the frost heave potential. The measured watertable levels were more than 3.0 m below the existing grade. Overall, frost heave concern at this site is considered low, but cannot be ruled out.

3. The upper native clay encountered was high plastic and had a high swelling and shrinkage potential. The lower native clay encountered was medium plastic and had a moderate swelling and shrinkage potential. As recommended previously, the moisture content of any high plastic backfill within the top 1.5 m below the subgrade should be kept at slightly above the optimum level to minimize the swelling potential. Recommendations in Items 4 to 6 will also help reduce the swelling potential of the clay subgrade.

4. Cement stabilization is the recommended minimum subgrade preparation method for this site. Past experience has shown that cement stabilization is effective in reducing the swelling potential of high plastic clays. Application rates would best be determined in the field during construction. The addition of 10 kg/m^2 of cement mixed to 150 mm depth of subgrade, and re-compacted to a minimum 100% of SPD at optimum moisture content, is estimated for this site.

   The subgrade should be proof rolled prior to stabilization to determine the exact cement content needed. Observations during underground construction would also help determine the subgrade treatment required. If soft native soil or rain softened material is present, increased cement stabilization (25 kg/m^2 to 30 kg/m^2 of cement to 300 mm in depth of subgrade) may be applicable. Replacement of the wet and soft soil with drier clay material to obtain a more stable and stronger subgrade would also be an option.

The subgrade should be proof rolled after final compaction. Any areas showing visible deflections should be inspected and repaired. If cement stabilization fails to produce an adequate subgrade, upgraded pavement structures with an additional gravel base may be required.

5. Care must be taken not to allow any excess moisture into these soils during construction. It is recommended that all areas beyond the back of curb/sidewalk be landscaped as soon as possible to avoid water permeating into the subgrade from free standing puddles.

   It is also important that subgrade soils not be allowed to dry excessively when exposed. As recommended in Item 3, the moisture contents of high plastic clay subgrade should be kept slightly over optimum to help reduce swelling potential. Weather conditions should be considered during construction.

6. Surface water will often collect within the granular base, causing subgrade softening and pavement damage. Therefore, it is recommended that wick drains be installed in the gravel road base at the curb bottom locations. The wick drains must be properly attached to the catch basins. A minimum cross slope of 2.0% on the subgrade surface should be constructed and maintained to ensure proper drainage of water away from the road structure.

7. Two (2) bulk samples were sampled during drilling from Testholes 2023-01 (0.8 to 2.3 m BGS) and 2023-02 (5.3 to 7.6 m BGS). The bulk samples were re-compacted to near 100% SPD and underwent California Bearing Ration (CBR) testing. The test results showed soaked CBR's of 4.7% and 4.8% were achieved. Cement stabilization recommended in Item 4 should produce a suitable subgrade that will meet an estimated subgrade modulus of 30 MPa (approximately equivalent to CBR of 3.0%). Based on the traffic loading values specified in City's Standard, a reliability of 85%, a design life of 20 years, and applying the pavement design method from AASHTO Guide For Design Of Pavement Structures 1993, the following pavement structures are recommended.

Recommended Staged Roadway Structures						
	Traffic Loading	Alley middle (2.0x10^4 ESALs)	Alley edge (2.0x10^4 ESALs)	Local Residential (3.6x10^4 ESALs)	Minor Collector (1.8x10^5 ESALs)	Major Collector (3.6x10^5 ESALs)
Stage 1	Asphaltic Concrete	75 mm		65 mm (10mm-LT)	75 mm (10mm-LT)	75 mm (10mm-HT)
	Crushed Gravel	225 mm	300 mm	200 mm	250 mm	325 mm
Stage 2	Asphaltic Concrete	n/a		35 mm (10mm-LT)	35 mm (10mm-LT)	35 mm (10mm-HT)
Note:	10mm-LT = City of Edmonton Asphaltic Concrete Mix Type 10 mm - Low Traffic 10mm-HT = City of Edmonton Asphaltic Concrete Mix Type 10 mm - High Traffic Crushed Gravel = City of Edmonton Aggregate Designation 3 Class 20, 25, 40, or 63 All granular base material should be compacted to 100% of the Standard Proctor Density in maximum 150 mm lifts.					

No traffic loading data was provided to our firm at this time. The stated Equivalent Single Axle Load (ESAL) values for different roadway designations were obtained from City of Edmonton guidelines. Our firm should be advised when updated traffic loading information becomes available and the pavement design should be modified accordingly.

7.5 Groundwater & Drainage Issues

1. The current watertable levels were measured at 5.1 and 3.8 metres BGS in Testholes 2023-01 and 2023-02, respectively. House footing elevation designs should consider the groundwater level. As previously noted, the design site grade should be raised to help reduce or eliminate high watertable areas. If groundwater seepage is encountered during basement excavation, temporary dewatering recommended in Item 4 may be feasible in summer time. However, if groundwater seepage becomes frozen in winter time, dewatering may not be feasible. Footings and slabs must not be constructed on free water/ice.
2. Where house basements and footing foundations are near the watertable, upgraded foundation drainage to include a washed rock slab base, interior and exterior weeping tile, and dimpled membrane around the exterior foundation wall is recommended. A schematic drawing depicting the recommended drainage measures is attached. Frequent pump operations should also be expected. If footings are more than 1.0 metre above the high

seasonal watertable, standard house drainage measure should be sufficient. The need for upgraded foundation drainage should be determined on a lot by lot basis.

3. In addition to proper lot grading recommended in Items 7.2.10, the following alternatives may also be considered in order to ensure no flow paths for water from the roof leaders occur adjacent to the foundation walls:
   a. A concrete splash pad, placed beneath the downspouts, a minimum of 1.2 metres long and firmly anchored to the house foundation can be used.
   b. A permanent downspout extension could be used to carry water away from the foundation wall. This is the recommended option where high plastic clay is present at the footing elevation.
4. Immediate groundwater seepage was observed both Testhole 2023-01 and 2023-02. Groundwater seepage and saturated soil conditions should be expected in trenches below the watertable. The amount of groundwater seepage encountered will depend on the excavation depth below the watertable and the soil stratum encountered. Moderate dewatering effort may be required and construction delays should be expected in trenches.

   Temporary to continuous dewatering consisting of in-trench sumps and pumping should be sufficient to handle moderate groundwater seepage in the clay soils. Any water pumped out of the trench should be discharged in approved area as far away as possible. The water should not be discharged near the excavation to prevent recirculation back into the excavation.

   The amount of groundwater seepage encountered will depend on the excavation depth below the watertable and the soil stratum encountered. Trench specific pump tests may be conducted onsite to help determine the amount of seepage from the water bearing layers, if desired.
5. Subgrade softening below surface utilities is a concern in higher watertable areas. If the grading design cannot be raised in high watertable areas, the following options to help lower the watertable should be considered.
   a. One option to lower the watertable is to hydraulically connecting the storm sewer bedding materials to the manholes, or leaving the rubber gaskets off the joints of the storm sewers during construction, allowing groundwater to seep into the storm

sewer. When employing this method, it is important to wrap the joints in filter cloth to prevent silting. This method only applies where the storm sewer line is well below the watertable. If the depth of the storm sewer is shallow, there is a risk of storm water leaking into the ground, and causing the watertable to rise and softening the ground.

b. Another option to lower the watertable can be made by using perforated sub-drains to collect groundwater below the road area, usually consisting of perforated pipe and manhole inlets. The exact configuration and need for the sub-drains should be determined during construction.

7.6 Cement

Tests on selected soil samples indicated a very severe concentration of water soluble soil sulphate is present in the native deposits. The following alternatives are advised to address the sulphate content:

1. Underground Concrete Pipe

Concrete used for all underground pipes must be constructed of C.S.A. Type HS, sulphate resistant hydraulic cement.

2. Curbs and Sidewalks

All concrete for surface improvements such as sidewalks and curbs may be constructed using CSA Type GU, normal Portland cement.

3. Foundation Construction

Based on C.S.A. Standards A23.1-19, class of exposure S-3 should be applied to the design requirements for concrete in contact with the soil and susceptible to sulphate degradation. The class S-1 exposure requires Type HS, sulphate resistant hydraulic cement with a minimum 56 day concrete strength of 35 MPa, as well as other requirements as given in the noted C.S.A. guideline. However, individual locations may show higher or lower concentrations of soluble soil sulphate, and thus additional soil testing on a lot specific basis may prove valuable.

All concrete subject to freeze thaw must be air entrained with 5 to 7 percent air. Other exposure conditions and structural requirements should be considered when choosing a minimum strength for the concrete. Concrete should conform to CSA Standards A23.1-19 and A23.2-19.

8.0 CLOSURE

This report has been prepared for the exclusive and confidential use of WSP Canada Inc., City of Edmonton, and their authorized agents. Use of this report is limited to the subject residential subdivision development only. The recommendations given are based on the subsurface soil conditions encountered during test boring, current construction techniques and generally accepted engineering practices. No other warranty, expressed or implied, is made. Due to geological randomness of many soils formations, no interpolation of soil conditions between or away from the testholes has been made or implied. Soil conditions are known only at the test boring location. Should other soils be encountered during construction or other information pertinent becomes available, the undersigned should be contacted as the recommendations may be altered or modified.

We trust this information is satisfactory. If you have any questions or comments, please contact our office.

Yours truly,

HOGGAN ENGINEERING & TESTING (1980) LTD.

PROFESSIONAL ENGINEER ALBERTA
SCOTT G. MACFARLANE
ID# 89667 2023-11-30

PERMIT TO PRACTICE
HOGGAN ENGINEERING & TESTING (1980) LTD.
RM SIGNATURE: Rick Evans
RM APEGA ID #: 49679
DATE: November 30 2023
PERMIT NUMBER: P003691
The Association of Professional Engineers and Geoscientists of Alberta (APEGA)

Scott MacFarlane, P.Eng.
APEGA Member #89667
Reviewed by: Rick Evans, P.Eng., President
H:\DATA 2023\6234 WSP Canada Inc\6234-49 Prop Goodridge Corners Ph 3\hr2008wsp2.docx

A P P E N D I X

HOGGAN ENGINEERING & TESTING (1980) LTD.

Approximate Testhole Locations
Goodridge Corners Phase 3
Part of SE 12 - 54 - 25 - W4M
Part of 18523 - 127 Street
Edmonton, Alberta

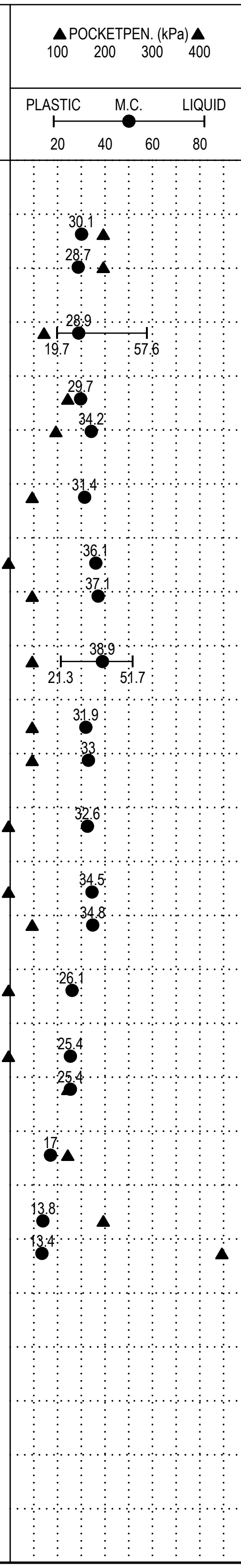
SCALE 1:2500	DATE: September 29, 2023
FILE #: 6234 - 49	DRAWN BY: Andrew R. Klein

PROJECT: Proposed Goodridge Corner Phase 3		PROJECT NO: 6234-49	BOREHOLE NO: **TH2023-01**
CLIENT: WSP Canada Inc.	DRILL METHOD: Solid Stem Auger		ELEVATION: 690.75 m
OWNER:	LOCATION: N 5946204.26, E 297788.62		

SAMPLE TYPE: SHELBY TUBE, CORE SAMPLE, SPT SAMPLE, GRAB SAMPLE, NO RECOVERY

BACKFILL TYPE: BENTONITE, PEA GRAVEL, SLOUGH, GROUT, DRILL CUTTINGS, SAND

Depth (m)	MODIFIED USCS	SOIL DESCRIPTION	SPT (N)	OTHER DATA
0 – 460 mm	OR	**TOPSOIL/ORGANIC CLAY** : moist, very stiff, black.		
460 mm – 2.3 m	CI	**CLAY** : silty to very silty, very stiff, moist, high plastic, brown/grey.	9	P.L. = 19.7 L.L. = 57.6 M.C. = 28.9
2.3 m – 7.3 m	CI-CH	**CLAY** : very silty, very moist, medium to high plastic, firm to stiff, brown, trace oxides. At 4.6 m: very moist. At 5.8 m: slightly sensitive. At 6.1m: moderate sensitive.	6, 6, 7, 7	P.L. = 21.3 L.L. = 51.7 M.C. = 38.9 **Soluble Sulphates:** Very Severe
7.3 m – 9.1 m	CI	**CLAY** : very silty, very sandy, very moist, soft, medium plastic, brown/grey. Below 7.6m: free water on augers.	17	
9.1 m – 10.4 m	CI	**CLAY TILL** : silty, sandy, moist, stiff to very stiff, medium plastic, brown, trace coal and gravel. At 9.8 m: very sandy seam.	58	



Water Level: Well 1: 5.08

Slotted Piezometer: Well 1: 685.67

Elevation (m): 690, 689, 688, 687, 686, 685, 684, 683, 682, 681, 680, 679, 678

END OF TESTHOLE @ 10.4 m. 4.6 m of water and 3.7 m of slough on completion of testhole.
Well 1: Slotted standpipe installed to 10.36 m.

6 day waterlevel reading: 5.22 m bgs.
21 day waterlevel reading: 5.04 m bgs.
34 day waterlevel reading: 5.08 m bgs.

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Fax: (780) 489-0800

LOGGED BY: A. Klein	COMPLETION DEPTH: 10.36 m
REVIEWED BY: R Evans	COMPLETION DATE: 8/2/23
Fig. No: 2	Page 1 of 1

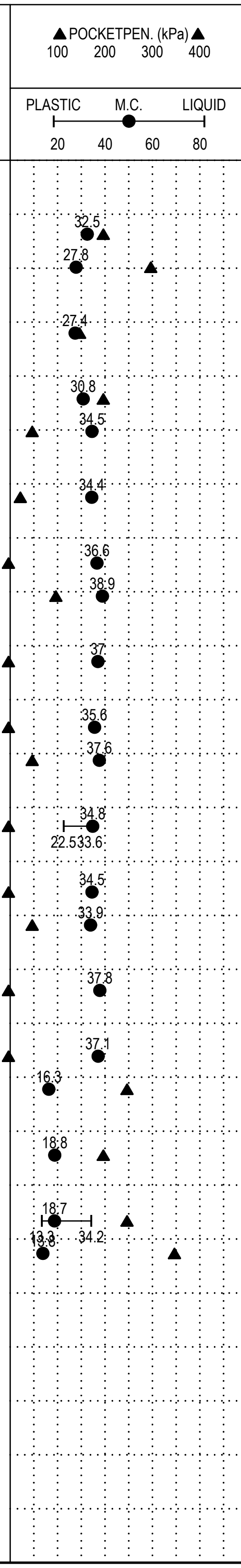
PROJECT: Proposed Goodridge Corner Phase 3		PROJECT NO: 6234-49	BOREHOLE NO: **TH2023-02**
CLIENT: WSP Canada Inc.	DRILL METHOD: Solid Stem Auger		ELEVATION: 689.97 m
OWNER:	LOCATION: N 5946287.19, E 29954.64		

SAMPLE TYPE	▨ SHELBY TUBE	◪ CORE SAMPLE	☒ SPT SAMPLE	■ GRAB SAMPLE	▥ NO RECOVERY
BACKFILL TYPE	■ BENTONITE	⁘ PEA GRAVEL	▥ SLOUGH	⁙ GROUT	▨ DRILL CUTTINGS / ⁙ SAND

Depth (m) Water Level	MODIFIED USCS	SOIL DESCRIPTION	SPT (N)	OTHER DATA
0 – 1.4 m	CH	**CLAY** : silty, moist, very stiff, high plastic, grey, trace vegetation/roots near surface.	8	
1.4 – 8.5 m	CI	**CLAY** : very silty, very moist, medium plastic, firm to stiff, brown, odd high plastic clay seams, trace oxides. Below 3.1 metres: very moist to wet, sensitive, brown/grey. Below 4.9 metres: dark brownish grey. At 7.6 metres: sandier.	5 5 6 6	P.L. = 22.5 L.L. = 33.6 M.C. = 34.8
8.5 – 10.4 m	CI	**CLAY TILL** : silty, sandy, moist, stiff to very stiff, medium plastic, brown, trace coal and gravel.	29 47	P.L. = 13.3 L.L. = 34.2 M.C. = 18.7 **Soluble Sulphates:** Moderate

Well 1: 3.78

Well 1: 686.19



END OF TESTHOLE @ 10.4 m. 4.6 m of water and no slough on completion of testhole.
Well 1: Slotted standpipe installed to 10.36 m.

15 day waterlevel reading: 3.89 m bgs.
28 day waterlevel reading: 3.78 m bgs.

JRP 6234-49.GPJ JRPV3_0.GDT 10/12/23

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LOGGED BY: S. MacFarlane	COMPLETION DEPTH: 10.36 m
REVIEWED BY: R Evans	COMPLETION DATE: 8/8/23
Fig. No: 3	Page 1 of 1

PROJECT: Rural NW Neighborhood		PROJECT NO: 2418 - 1441	BOREHOLE NO: **08 - 2**
CLIENT: Stantec Consulting Ltd	DRILL METHOD: Solid Stem Auger		ELEVATION: 693.62 m
OWNER: City of Edmonton	LOCATION: As per site plan		

SAMPLE TYPE: SHELBY TUBE; CORE SAMPLE; SPT SAMPLE; GRAB SAMPLE; NO RECOVERY

BACKFILL TYPE: BENTONITE; PEA GRAVEL; SLOUGH; GROUT; DRILL CUTTINGS; SAND

Depth (m) Water Level	SOIL SYMBOL	USC	SOIL DESCRIPTION	SAMPLE TYPE	SPT (N)	▲ POCKETPEN. (kPa) ▲ 100 200 300 400 / PLASTIC M.C. LIQUID 20 40 60 80	OTHER DATA	SLOTTED PIEZOMETER	Elevation (m)
0		OR	**TOPSOIL** 100 mm						
		CH	**CLAY**: silty, marginal, high plastic, damp to moist, hard, dark bronw 610 mm			20.9			693
1			**CLAY**: silty, medium plastic, moist to very moist, firm, brown, trace oxide			22.6	Insufficient Shelby Tube Sample		
2						31.6			692
					9	32.1, 28.7			691
3						32.2			
			Below 3.4 m - sandy, slightly friable			26.3			690
4		CI			16	20.6			
5						27.6			689
					15	19.1, 21.2			688
6						26.1			
7					7	32.3, 32.2			687
	7.96		7.3 m **CLAY TILL**: sandy, silty, high plastic, moist to very moist, stiff to very stiff, grey, trace coal, oxide and gravel At 7.6 m - wet sand seam, some coal			15.8		685.66	686
8		CH	At 8.2 m - some sand, high plastic, moist, very stiff, greenish grey, trace bentonite, bedrock like			29.8 (23.7 – 62.3)	P.L. = 23.7 L.L. = 62.3 M.C. = 29.8 **Soluble Sulphates:** Severe		
					61	14.6			685
9			**END OF TESTHOLE @ 8.8 m.** 0.5 m of water and no slough on completion of testhole. Slotted standpipe installed to 8.84 m. 13 day waterlevel reading: 8.02 m bgs. 29 day waterlevel reading: 7.96 m bgs.						684
10									

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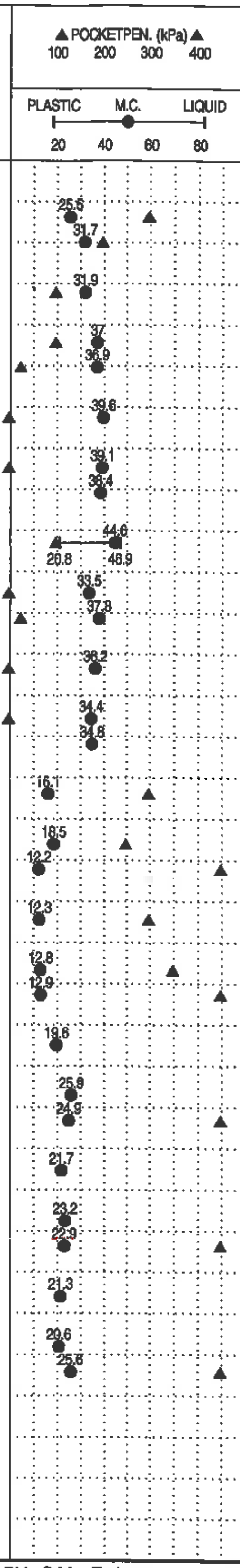
LOGGED BY: J Tsoi	COMPLETION DEPTH: 8.84 m
REVIEWED BY: R Evans	COMPLETION DATE: 22/8/08

PROJECT: Geotechnical Investigation - Prop. Goodridge Corner Subdivision Stg 1	PROJECT NO: 1229-417	BOREHOLE NO: **TH2014-02**
CLIENT: Al-Terra Engineering Ltd.	DRILL METHOD: Solid Stem Auger	ELEVATION: 687.282 m
OWNER:	LOCATION: As per site plan	

SAMPLE TYPE: SHELBY TUBE | CORE SAMPLE | SPT SAMPLE | GRAB SAMPLE | NO RECOVERY

Depth (m) / Water Level	USC	SOIL DESCRIPTION	SPT (N)	OTHER DATA
0	CI	**CLAY :** very silty, moist, very stiff, medium plastic, brown/grey, trace oxides, odd high plastic clay seams.		
1			8	
1.5		Below 1.5 metres: softer, very moist in seams.		
2.5			4	
3.1		Below 3.1 metres: very moist, very soft, trace sensitive.		
4			3	
4.6		At 4.6 meres: firm, medium to high plastic clay seam.		P.L. = 20.8 L.L. = 46.9 M.C. = 44.6 **Soluble Sulphates:** Negligible
5.3		At 5.3 metres: grey, very silty, very soft, moderately sensitive.	3	
7.2 m	CI	**CLAY TILL :** silty, sandy, to very sandy, moist, low to medium plastic, stiff to very stiff, grey, trace coal, oxides, gravel, sand seams.	9	
7.51		At 7.6 metres: water brought up with augers.		
8.5			32	
10.0		Below 10.0 metres: hard.	30	
11.5			40	
13	CH		42	
14.5			53	
14.9		**END OF TESTHOLE @ 14.9 m.** 7.6 m of water and no slough on completion of testhole. 10 day waterlevel reading: 6.58 m bgs. 21 day waterlevel reading: 7.51 m bgs.		



Elevation (m): 687, 686, 685, 684, 683, 682, 681, 680 (6.97), 679, 678, 677, 676, 675, 674, 673, 672, 671

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LOGGED BY: S MacFarlane	COMPLETION DEPTH: 14.94 m
REVIEWED BY: R Evans	COMPLETION DATE: 28/10/14
Fig. No: 5	Page 1 of 1

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CONSULTING AND TESTING ENGINEERS

EDMONTON - GRANDE PRAIRIE -PEACE RIVER

ASTM 1883 - CBR of Laboratory Compacted Soils

Client: WSP Canada Inc.

Project: Proposed Goodridge Corners Phase 3

Location: Part of SE 12-54-25 W4M

185 Avenue & 132 Street NW, Edmonton, AB

Sample: TH2023-01 Depth: 0.8 - 2.3 m

File No.: 6234-49

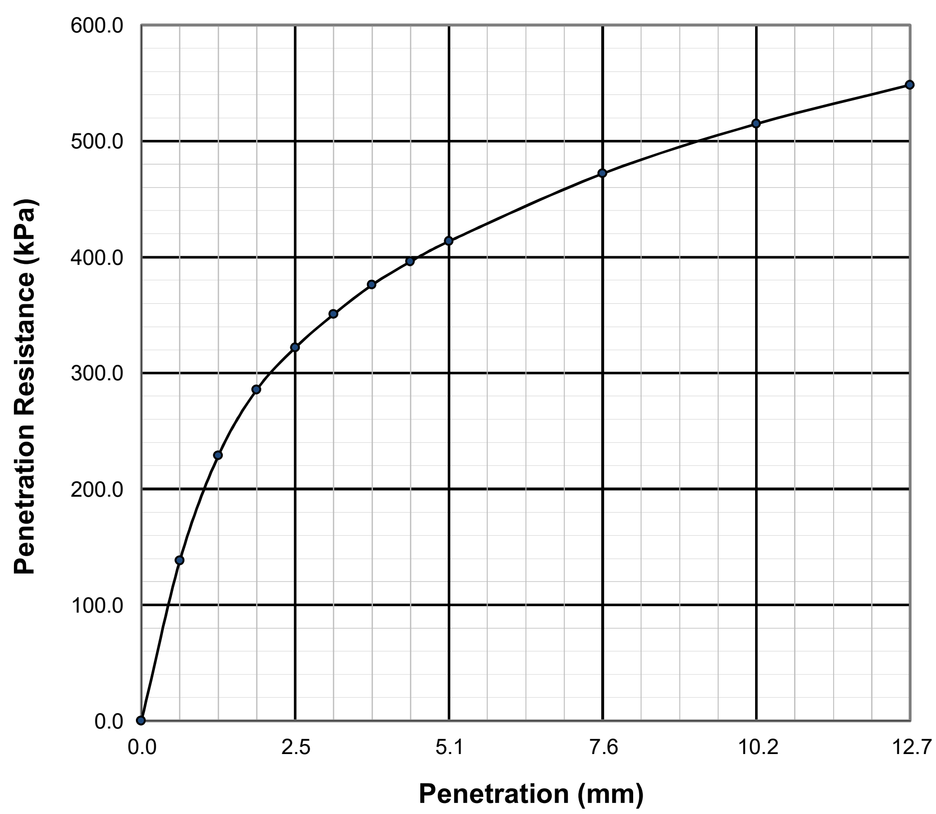
Test Date: August 14, 2023

Tested By: C.R.

Compaction Method: ASTM D698

Soaked: X Unsoaked:

Penetration (mm)	Resistance (kPa)
0.0	0.0
0.6	138.4
1.3	228.8
1.9	285.6
2.5	**321.7**
3.2	350.6
3.8	375.9
4.4	396.1
5.1	**413.6**
7.6	472.0
10.2	514.8
12.7	548.4



CBR at 2.5mm (0.1 in.) Penetration: **4.7**

CBR at 5.1mm (0.2 in.) Penetration: 4.0

Corrected CBR at 2.54mm (0.1 in.) Penetration:

Dry Unit Wt. Before Soak (kg/m^3): 1536

Moisture Content Before Soak (%): 24.7

Water Content After Soak - Top 25mm (%): 28.8

Swell (%): 1.5

Sample Description:

Standard Proctor Density (kg/m^3): 1530

Optimum Moisture Content: 23.6

Compaction (%) 100.4

Retained on 19.0mm Sieve (%):

Comments:

Reviewed By:

HOGGAN ENGINEERING & TESTING (1980) LTD.

CONSULTING AND TESTING ENGINEERS

EDMONTON - GRANDE PRAIRIE -PEACE RIVER

ASTM 1883 - CBR of Laboratory Compacted Soils

Client: WSP Canada Inc.

File No.: 6234-49

Project: Proposed Goodridge Corners Phase 3

Test Date: August 25, 2023

Location: Part of SE 12-54-25 W4M

185 Avenue & 132 Street NW, Edmonton, AB

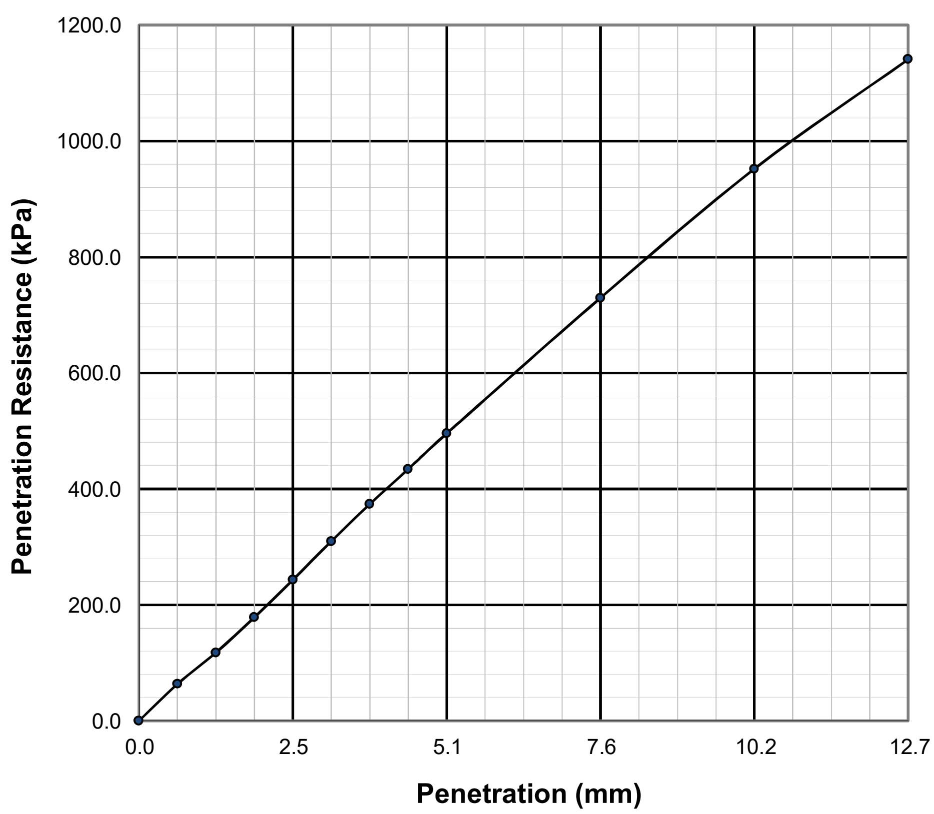
Tested By: C.R.

Compaction Method: ASTM D698

Sample: 2023-02 Depth: 5.3 - 7.6 m

Soaked: X Unsoaked:

Penetration (mm)	Resistance (kPa)
0.0	0.0
0.6	63.5
1.3	117.7
1.9	178.7
2.5	**243.2**
3.2	309.8
3.8	373.9
4.4	434.3
5.1	**495.7**
7.6	729.6
10.2	952.2
12.7	1141.2



CBR at 2.5mm (0.1 in.) Penetration: 3.5

CBR at 5.1mm (0.2 in.) Penetration: **4.8**

Sample Description:

Corrected CBR at 2.54mm (0.1 in.) Penetration:

Dry Unit Wt. Before Soak (kg/m^3): 1638

Standard Proctor Density (kg/m^3): 1605

Moisture Content Before Soak (%): 19.5

Optimum Moisture Content: 18.5

Water Content After Soak - Top 25mm (%): 22.5

Compaction (%) 102.1

Swell (%): 0.1

Retained on 19.0mm Sieve (%):

Comments: Trial 1 of 2

Reviewed By:

Photo 1: Drilling Testhole 2023-01 – Photo Looking East (August 2, 2023)