ABLE GEOTECHNICAL LTD.

July 20, 2023
File: 1788

Jugraj Bains

Re: Geotechnical Site Assessment
Proposed Single Family Dwelling and Farm Building
Lot 39 McNeil Road, Pitt Meadows, BC

1.0 INTRODUCTION

This report presents the results of a geotechnical site assessment conducted by Able Geotechnical Ltd. for the proposed single family dwelling and barn at the above referenced project site. The purpose of the assessment was to evaluate the site soil conditions in order to provide geotechnical recommendations in relation to the following.

- Preload recommendations.
- Stripping depth to competent subgrade.
- Subgrade preparation for building foundations.
- Allowable soil bearing pressures for building foundations.
- Compaction requirements for structural fill and other related geotechnical design parameters.

Environmental considerations are outside the scope of this geotechnical report.

2.0 SITE DESCRIPTION AND PROPOSED DEVELOPMENT

The property is bounded by McNeil Road to the south and similar acreage farms on other three sides. The property is a farm, rectangular in shape and measures approximately 100 m (EW) by 400 m (NS). The site was vacant at the time of site investigation.

It is understood that a new dwelling and barn will be constructed at the site. Topographic plan indicates that the existing site elevations are in the order of 1.0 m. The dwelling would be situated over an elevated pad (approximately 1 m thick), constructed of structural fill, so as to bring the slab-on-grade to minimum flood construction level (FCL) of 2.45 m. However, the barn's pad would be raised only 0.5 m above the existing farm elevation and it does not have to meet FCL. Heavy live surcharge slab loads (material stockpiles, pallets, etc.) are not anticipated for the farm building.

3.0 SUBSURFACE INVESTIGATION (TEST PIT)

The subsurface exploration consisted of two testpits (TP1 and TP2) excavated up to 2.6 m depth below the existing site grade. The testpit locations are shown in the attached Testpit Location Plan. A track-mounted excavator was utilized to conduct the testpit program. An engineer from Able supervised the field work, located the testpits, classified the soils encountered in the testpits and sent representative soil samples to the laboratory for moisture content determination. Site conditions and features of geological significance were also recorded. The testpits were backfilled with excavated soil upon completion of the investigation and compacted with the bucket.

4.0 SOIL AND GROUNDWATER CONDITIONS

Geological map (GeoMap Vancouver – Robert J.W. Turner and John J. Clauge) indicates that the site is located within a formation of Modern Age sediments. The subsurface conditions encountered were generally consistent with the published geological information. The soil conditions were generally consistent in the testpits. The following soil conditions were encountered in the order of increasing depth:

- **Silt**. Surficial layer of native silt was encountered in both testpits to approximately 2 m depth. The silt was non-plastic, stiff near the surface and becomes firm below approximately 0.6 m and moist. The unconfined shear strength (Su) was in the order of 70 kPa. Underlain by;
- **Silty Sand**. The silt was underlain by native deposit of silty sand. This deposit was loose to compact. the sand was fine grained, moist to wet and light grey. The testpits terminated at 2.6 and 2.0 m depth and based on our past experience in this area, loose to firm soils are expected to continue to a significant depth.

Refer to attached Soil Logs for detailed soil description. The soil conditions as described above are generalized and are based on the testpit information. Minor variations in the soil stratigraphy should be expected.

Groundwater: No groundwater seepage encountered in the testpits. Based on the testpit information, since deep digging it not required, groundwater seepage is not expected. However the static ground water is expected within few meters of the surface.

5.0 DISCUSSION AND RECOMMENDATIONS

5.1 General

The results of the site exploration indicate that the site is underlain by compressible silty soils. The soils are normally consolidated under its existing loading conditions. This means that any increase in site loading, through grade raise over existing grade, or by building loads, will induce consolidation in clay, resulting in settlements at surface. Such settlement may be large and would occur over slowly over a long period of time. Since the building pad will be elevated by approximately 1.4 m above the adjacent grade, the permanent raise of grade will impose significant loading on the underlying compressible soils. Therefore, for the dwelling, ground improvement in terms of preloading will be required to offset the future settlement. The surficial organics should be stripped under the proposed dwelling and the underlying firm to stiff silt should be preloaded. However, the barn preload is not required. The following sections of the report provide our recommendations in further detail.

5.2 Subgrade Preparation

The building footprint and 2 m beyond should be stripped and cleared of organics and unsuitable soils to expose an in-organic native subgrade consisting of native silt. Estimated stripping depth 0.2 m. The native soils are highly sensitive to moisture accumulation and construction activity. Consequently, measures must be adopted to avoid subgrade disturbance. Conduct the site preparation during extended dry weather. If work is carried during rainy weather, over-excavation is expected. No construction activity directly over the native soils.

Prepared subgrades must be sloped to drain water away from the stripped areas. The septic may be located outside the preload over the native soils.

5.3 Preload

The purpose of preloading is to pre-compress the underlying soft clays. The stripped areas should be backfilled with structural fill, in lifts, approved for compaction by Geotechnical Engineer. This structural fill platform which supports the building is defined as **pad** in this report. The temporary fill placed as weight above the footing level is defined as **preload**. The following recommendations for the structural fill pad and preload are provided:

1. PAD: The building pad should be constructed in lifts, to elevation (EL) 2.6 m. Every lift should be compacted with a heavy ride on compactor. The compaction of the pad should be reviewed and approved by the Geotechnical Engineer, during compaction. Lift thickness of pad varies with type of soil, moisture, roller size, and will be specified during construction. The pad should be topped with the preload as recommended below.
2. MOISTURE: The pad material should be sandy material in damp (not moist or wet). However, there is no moisture restriction for the preload material.
3. PRELOAD: The preload be completed to EL 4.0 m. It may consist of any mineral fill. After completion of the preloading time, the preload will be removed. The height of preload and the required duration (for targeted rate of settlement) are related. The higher the preload, lesser will be its duration, and vice versa. The preload duration depends upon the thickness of the structural pad, permeability of the underling clay, building load, and cannot be accurately determined in advance. It is estimated that the preload duration will be 6 months +/- 3 months. However, the actual preload duration will be decided based on the settlement rate of the preload, which will be determined by settlement gauge readings obtained from the gauges installed in the preload. Also note that the preload material is taken off-site after completion, however the pad would stay.
4. SLOW PLACEMENT: Soft soils under this site have low shear strength and may fail if filling is carried out too quickly and too high. Therefore, the pad and preload, each should be placed in stages, each stage NOT MORE THAN 1m. A construction pause of approximately 20 days between the stages would be required. WRITTEN APPROVAL OF GEOTECHNICAL ENGINEER MUST BE TAKEN BEFORE THE NEXT STAGE FILLING MAY COMMENCE. Therefore the Geotechnical Engineer should be notified during the fill placement. The pause duration depends on the site conditions, and therefore can be determined on-site.
5. SIDE SLOPES: The preload top should extend at least 1 m beyond the building envelope. The side slope of the fill are generally sloped to 2H:1V (Horizontal:Vertical). To save space, lock blocks may be used. Survey stakes should be installed before starting the excavation/filling so that the preload location be accurate. Hay should be placed over the slopes and preload to minimise the erosion during the rainy months.
6. SETTLEMENT GAUGES: In order to determine the settlement rate of the preload, settlement gauges should be installed. These should be placed on the native clay after stripping the peat. The settlement gauges consist of 50 mm diameter metal pipe risers attached to plywood base plates (0.6m by 0.6m by 50 mm). The pipe should extend approximately 1 m above the finished preload. The full height of the pipe should be installed at the first time, and later extension is NOT acceptable, as this disturbs the survey.

7. SETTLEMENT SURVEY: Able will survey the initial elevation of the settlement gauges on the installation day. Settlement gauge elevations should be determined bi-weekly for 1 month and then monthly until primary consolidation is determined to be complete. The gauge settlement data will be be reviewed by Able to determine the time of completion of preload.
8. PRELOAD LOCATION SURVEY: An as-built survey of the preload's top of bank should be carried out by a BC Land Surveyor to; a) establish building envelope. The dwelling must sit inside preload top b) confirm that the preload height meets the recommended elevations c) to establish building envelope shape. The survey should tie the preload location relative to the property lines and will be helpful to lay the building for the form-work.

5.4 Foundations

The proposed single family dwelling and barn may be supported on spread and strip footings on the approved structural fill pad. Footings founded on approved subgrade may be designed for a gross serviceability bearing resistance of 75 kPa. A factored Ultimate Bearing Resistance of 150 kPa may be taken for design. *All footing subgrades must be reviewed and approved by the geotechnical engineer to confirm the bearing pressure, before covering with gravel/structural fill.* A Site Class "E" may be used for the seismic design.

Footings constructed as recommended above are expected to experience a total settlement of 30 mm and differential settlement of 20 mm over a 10 m span under static loading conditions. Minimum footing widths should be 0.45 m for strip footings and 0.9 m for pad footings, in accordance with the requirements of the 2018 British Columbia Building Code. Footings should have a minimum embedment of 0.45 m for frost protection and confinement. The footings are expected to undergo a differential settlement of 35 mm under static conditions.

Farm Buildings be designed in accordance with the National Farm Building Code of Canada 1995 (NFBCC 1995). The subject farm building is considered to be a low human occupancy (occupant load not more than one person per 40 m^2. Structures classified as of low human occupancy are not required to be designed for current NBCC design earthquake (Section 2.2.4.1 NFBCC 1995). As such, farm buildings may experience severe structural distress and or collapse in the design seismic event. This includes structural damage caused by earthquake settlements and soil liquefaction.

5.5 Slab-on-Grade

The fill under the concrete floor slabs-on-grade should be river sand or clear crushed gravel. A moisture barrier consisting of 0.15 mm polyethylene sheeting should be installed under the slab to minimize potential for slab dampness. All tears in the polyethylene sheeting should be repaired with red polyethylene tape. The compaction of the slab-on-grade fill must be approved by the geotechnical engineer prior to installation of polyethylene sheet.

5.6 Foundation Drainage System

Typically at grade structures do not require perimeter drainage system, provided the slab is at least 200 mm above the exterior grade and the finished surface is drained away from the building. The building will be constructed on an elevated pad whereas the surrounding native

farm grade elevation is significantly lower than the pad. The proposed building will likely to meet the above requirements. The exterior grades would be sloping away for positive drainage. The roof water will be released on splash pads and it will drain to the lower landscaped areas and the farm. It is understood that the footing will be placed on compacted and approved subgrade, and therefore structural integrity of foundation and bearing capacity will not be affected by deleting the perimeter drainage system. Based on the above, it is our opinion that the perimeter drainage system for the proposed building may be deleted.

5.7 Structural fill

Structural fill is defined as fill placed beneath any load bearing area. Imported structural fill should consist of well-graded, 75 mm minus pit run sand and gravel or other granular material approved by the Geotechnical Engineer. It should be non-organic and clean (less than 8% fines passing 0.075 mm sieve by weight). Structural fill should be placed in maximum 0.3 m lifts. In building envelope, it should be compacted to at least 95% of Modified Proctor maximum dry density or to the satisfaction of geotechnical engineer. Field density testing should be conducted to confirm that the compaction is adequate.

5.8 Geotechnical Reviews

Recommendations presented herein are based on interpretation of the information collected during the site investigation. During construction, the Geotechnical Engineer must complete field reviews to assess the actual soil conditions to confirm the assumptions used from site investigation. Where conditions differ significantly from those assumed, the above recommendations may need revision. The field reviews are not carried out for the benefit of Contractors, therefore do not affect the Contractor's obligation to perform under his/her contract. It will be the Contractor's responsibility to advise Able (minimum 24 in advance) that a field review is required. It is also critical that Contractor should view this report in advance of work. The following work sequence and minimum reviews are recommended.

Able cannot assume responsibility or liability for the adequacy of its recommendations when they are used in the field without Able being retained to review and approve the recommendations during construction.

6.0 CLOSURE AND LIMITATIONS

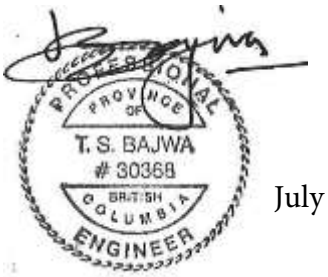
The subsurface conditions may vary in the area not explored. The interpretation of subsurface conditions provided is an opinion and not a certification. Stratigraphic variations in ground conditions are expected due to its historic nature. As such, all explorations involve an inherent uncertainty that some conditions will not be detected, as expected. Environmental considerations are outside the scope of this geotechnical report. Samples obtained from site will be retained in our laboratory for 60 days. Should no instructions be received to the contrary, these samples will then be discarded. This report has been made in accordance with the generally accepted soil and foundation engineering practices. No other warranty, expressed or implied, is made. If the project does not start with 2 years of the report date, the report may become invalid and further review may be required. This report has been prepared for the exclusive use of Jugraj Bains, City of Pitt Meadows and their "Approved Users" for specific application to the development mentioned in the report. Able and its employees accept no responsibility to another party for loss or liability incurred as a result of use of this report.

Any use of this report for purposes other than the intended, should be approved in writing by Able. Contractors should rely upon their own explorations for costing purposes. Electronic media is susceptible to unauthorized modification/alteration, and the Client should not rely on electronic versions of report/documents. All documents should be obtained in original from Able. The recommendations in this report are provided on the assumption that the contractor will be suitably qualified and experienced.

We appreciate the opportunity to be of service to you. If you have any questions regarding the contents of this report, or if we can be of further assistance to you on this project, please call the undersigned.

Yours truly,

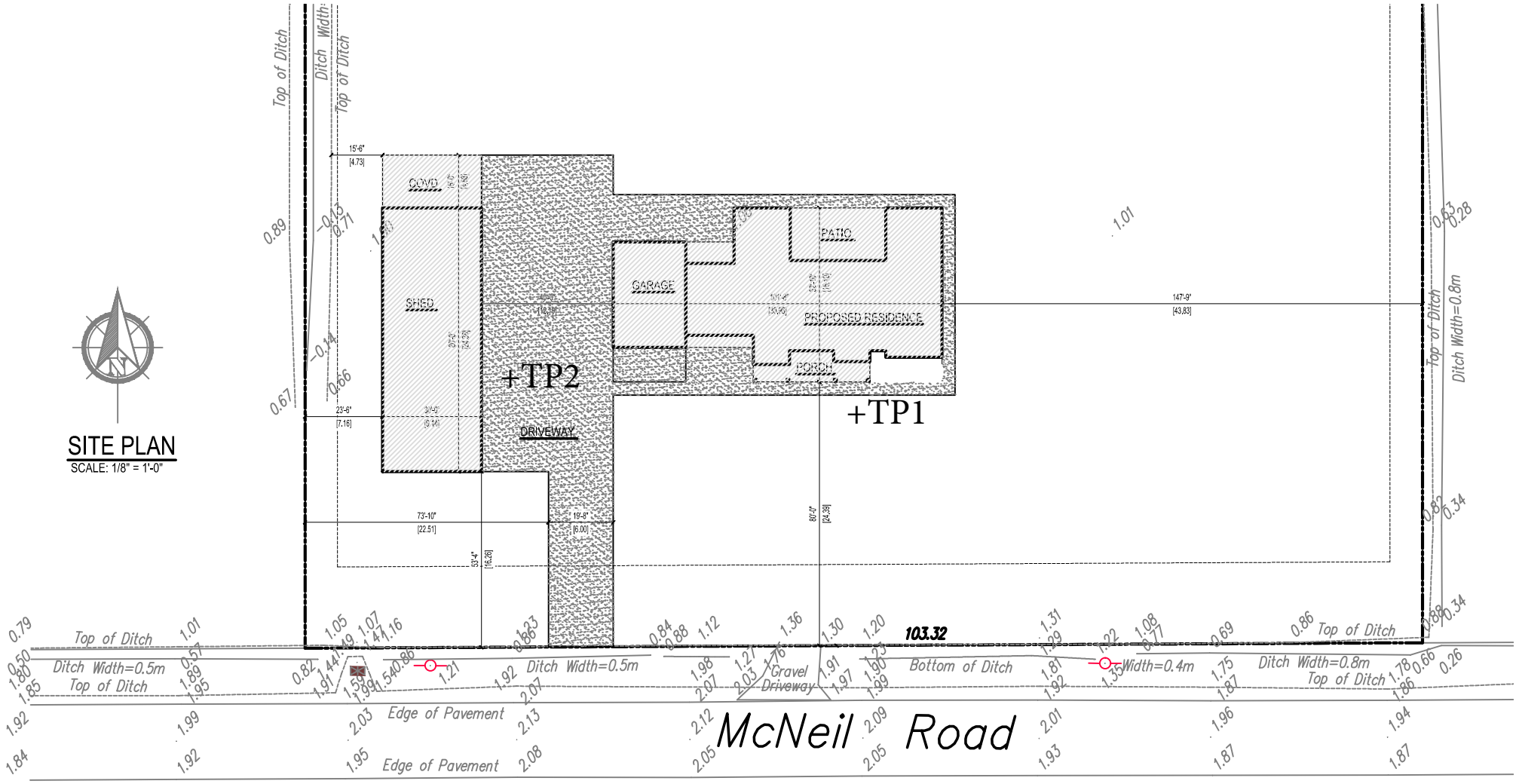
Able Geotechnical Ltd. (Permit To Practice# 1003426)



July 20, 2023

Tegbir S. Bajwa, P. Eng.
Geotechnical Engineer

Enclosures: Testpit Location Plan, Soil Logs



Testpit Location Plan

SOIL LOGS

Project: Proposed Farm Building and Dwelling **Machine Type**: Tracked Excavator
Site: Lot 39 McNeil Road, Pitt Meadows **Date Logged**: July 15, 2023

TP 1

DEPTH (m)	SOIL CONDITIONS	Moisture (%)
0.0 – 2.1 m	**Grass and rootmat, underlain by;** **Silt** Native, stiff, non-plastic, grey brown, moist Su 70 kPa Below 0.6 m becomes firm, grey brown, moist	At 0.5m w=15% At 1m w=28%
2.1 – 2.6 m	**Silty Sand** Fine grained sand, light grey, compact, wet	At 2.2 w=35%
2.6 m	Bottom of testpit No seepage encountered Testpit stayed open	

TP 2

DEPTH (m)	SOIL CONDITIONS	Moisture (%)
0.0 – 1.9 m	**Grass and rootmat, underlain by;** **Silt** Native, stiff, non-plastic, grey brown, moist Below 0.6 m becomes firm, grey brown, moist	
1.9 – 2.2 m	**Silty Sand** Fine grained sand, light grey, compact, wet	
2.2 m	Bottom of testpit No seepage encountered Testpit stayed open	

Su: Undrained Shear Strength