January 24, 2022

Project No. K-5655

GEOTECHNICAL REPORT

PROPOSED DAYCARE
420 WEBSTER AVENUE, QUESNEL, B.C.

CITY OF QUESNEL

GEONORTH ENGINEERING LTD

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1.0 INTRODUCTION

The City of Quesnel plans to build a new daycare at 420 Webster Avenue in Quesnel, B.C. and commissioned GeoNorth Engineering Ltd. (GeoNorth) to carry out a geotechnical site investigation and provide geotechnical recommendations for the project. The work was authorized under City of Quesnel Purchase Order Number 181846, based on the scope of work outlined in our proposal dated July 6, 2021.

The proposed building location is currently used as a public park and playground, and encompasses an area of about 0.24 hectares (0.6 acres). The site location is shown on Drawing 5655-A1, in Appendix A. We understand the proposed building will be supported on conventional spread footing foundations and that the east corner of the building will have a basement for use as a mechanical/electrical/storage room. The remaining areas of the building will have grade-supported floor slabs.

The purpose of the investigation was to identify existing soil and groundwater conditions. This report presents the results of our site investigation, and provides geotechnical recommendations for ground preparation and design and construction of spread footing foundations for support of the building and for grade-supported concrete slabs.

2.0 BACKGROUND

The surficial geology of the area is described by Geological Survey of Canada in Bulletin 196 by Tipper (1971), with Map 1290A "Surficial Geology, Quesnel, British Columbia". During the last glacial period, which ended about 10,000 years before present, the Fraser and Quesnel River valleys were partly filled with glacial till, consisting of material deposited from glacial ice, followed by deposits of silt and clay from glacial lake sediments. As the glacial ice that blocked the major valleys melted, the water that accumulated in the glacial lakes drained and cut into the till and glacial lake sediments, and in some places eroded the underlying, much older clay and

bedrock deposits. Map 1290A shows that this part of Quesnel is within a large glacial meltwater or outwash channel. Outwash channel deposits typically consist of layered, compact to dense sand and sandy gravel.

Geological Survey of Canada, in Paper 92-11, 1993, indicates the project area is underlain by Pliocene to upper Oligocene Epoch (2.5 to 34 million years old) sedimentary rock of the Australian Creek Formation. This deposit is composed mainly of weakly consolidated mudstone with lesser amounts of conglomerate, sandstone and coal or lignite.

The City of Quesnel has carried out detailed geotechnical work in many areas of West Quesnel to determine potential landslide hazards. The results of geotechnical investigations by others have concluded that parts of West Quesnel are underlain by a large, ancient landslide that covers an area west and north of the proposed building site. The City of Quesnel has published a drawing showing areas of potential landslide hazard, designated the West Quesnel Land Stability Area, under their Building Bylaw No. 1550, 2003. The study shows the area of potential landslide hazard is approximately 140 m southeast of the study area.

A flood plain map dated September 1992 by Northwest Hydraulics Consultants Ltd., prepared for Environment Canada, shows the Fraser River 200 year return period flood construction level is at about geodetic elevation 472.5 m. Data available on the City of Quesnel website shows the proposed building site is at about elevation 475.5 m and is 250 m northwest of the 200 year return period flood plain.

3.0 SITE INVESTIGATION AND SUBSURFACE CONDITIONS

On July 14, 2021, GeoNorth personnel observed soil and groundwater conditions in three test pits designated TP21-01 to 03, excavated to between 3.0 and 3.6 m depth using a Cat 305.5E2CR excavator. The locations of the test pits were measured by using a tape, referenced to the northwest corner fencepost, and are shown on Drawing 5655-A1.

We logged soil and groundwater conditions as the test pits were being excavated and obtained representative samples for laboratory moisture content and classification testing. In our laboratory, we carried out natural moisture content tests (ASTM D2216) on all samples, and Atterberg limits (ASTM D4318) and grain size analysis (ASTM C177 and C136) tests on selected samples. Test pit logs describing subsurface conditions are on Plates 5655-B1 to B3, in Appendix B, and are followed by an explanation of terms and symbols used on the logs. The results of laboratory moisture content and Atterberg limits tests are shown on the logs, and the results of grain size analysis tests are on Plates 5655-C1 to C3, in Appendix C.

TP21-01, located southeast of the proposed building, encountered silt fill to 0.45 depth, over natural, layered sand with a trace amount of fines and gravel to 1.1 m depth, over layered, loose to compact silt and sand to 1.5 m depth, over layered sand and gravel with a trace amount of fines to 2.1 m depth, over compact, sandy gravel with a trace amount of fines to 2.7 m depth, over layered, loose silt and sand to the bottom of the hole at 3.0 m depth.

TP21-02 and 03, located at the northwest end of the proposed building, encountered fill with variable gradation to 0.4 and 0.5 m depth, respectively, over natural, layered, stiff, clayey silt of intermediate plasticity to 0.7 and 1.0 m depth, respectively, over layered, loose to compact silt and sand to the bottom of the test pits at 3.0 and 3.6 m depth, respectively.

The depth of fill could vary across the property and may be deeper than encountered in the test pits. Neither seepage nor bedrock were observed in the test pits.

The results of two Atterberg limits tests, used to define soil plasticity, indicate the silt has a plastic limit of 22 and 26%, and a liquid limit of 37 and 38%. The Atterberg plastic limit defines the moisture content at which soil behaviour changes from semi-solid to plastic, and the liquid limit defines the moisture content at which soil behaviour changes from plastic to that of a viscous liquid. Laboratory tests show that the natural moisture content of the silty clay varies between 19.8% and 30.1%, indicating it will behave as semi-solid to plastic material.

4.0 DISCUSSION AND RECOMMENDATIONS

The layered silt, sand and gravel that underlie the site suggest a complex depositional environment with flood plain, over bank and backwater channel deposits that developed as the Fraser River cut into the valley bottom sediments and meandered across the valley bottom. Flooded, abandoned, meander loops, with layers of fine-grained silt and silty sand were left as the water receded. Stagnant, swampy water can develop thin layers of organic debris between layers of silt and sand.

The silt and sand has low shear strength, moderate to high susceptibility to settlement and high susceptibility to the development of ice lenses that cause frost heave. The sand and gravel has moderate shear strength and low potential for settlement. We did not see layers of compressible organic deposits such as peat or organic silt within the sediments observed in the test pits.

Site grading fills, due to their wide extent, will also cause a stress increase to considerable depth, into the more compressible silt deposits. Please call our office for additional recommendations if the site grade will be raised by more than about 1.2 m.

The test pits did not encounter groundwater seepage; groundwater levels are likely controlled by the level of Fraser River and will be slightly higher due to groundwater flow from the adjacent slopes to the valley bottom. During an extreme flood event, the groundwater level could rise to slightly above the 200 year return period flood level, but the lack of groundwater encountered in the test pits suggests it is unlikely to rise above the level of a conventional 2.4 m basement. Regardless, and as noted below, we recommend protecting the basement against a buildup of groundwater pressure by installing a perimeter foundation drainage system.

The following recommendations are based on the necessary assumption that soil encountered in the test pits is representative of soil conditions elsewhere on the site. Please contact our office for additional recommendations if conditions encountered during construction differ in any way from those described in this report.

4.1 Spread Footing Foundations

To prepare ground conditions for the proposed building foundations, remove all organic soil, any existing fill, and wet, soft or disturbed soil to expose the natural, layered sand and gravel, sandy gravel, or the layered silt and sand, and to at least 300 mm below the proposed foundations. Have the excavation reviewed by an experienced geotechnical engineer or a Building Official. If the base of the excavation is wet and sensitive to disturbance, excavate an additional 300 mm deep and 300 mm on each side of the footing, cover the base and sides of the excavation with a medium-weight nonwoven geotextile that has a burst strength (ASTM D6241) of at least 1400 N, then place a layer of drain rock at least 300 mm thick. Install a temporary sump and pump within the drain rock, as needed, to keep the excavation dry. Overlap adjacent sheets by at least 500 mm. Compact the drain rock with several passes of a vibratory plate compactor weighing up to 450 kg.

Bring the foundation areas to grade using clean granular soil that meets the gradation specifications for Select Granular Subbase (SGSB), defined in Table 1, Section 4.2. Place fill in uniform layers no thicker than 300 mm and compact each layer to at least 100% Standard Proctor Density (SPD) (ASTM D698). Place the fill out beyond the edges of the footings a horizontal distance equal to the depth of fill under the footing to allow for a 1 horizontal to 1 vertical (1H:1V) load distribution below the footings, through structural fill onto the natural sand and gravel, sandy gravel or silt and sand.

Design spread footings supported on a layer of compacted granular fill placed on the natural soil conditions, as described above, using a factored bearing resistance of 150 kPa for limit states design and an allowable bearing pressure of 100 kPa for serviceability conditions. Use a minimum footing width of 450 mm for strip footings and 600 mm for square pad footings.

We estimate that a 1 m square pad footing subjected to the design allowable bearing pressure, and bearing on the soils noted above, will settle less than 2 cm. The total differential settlement between adjacent footings could be 75% of the total estimated settlement. We can carry out additional settlement analysis at your request.

Provide at least 300 mm of cover over heated interior footings for confinement, measured from the top of the slab to the base of the footing, and at least 1.2 m of cover over heated perimeter footings for confinement and to protect against frost heave.

Frost can penetrate to at least 2.4 m depth during a colder than average winter. We recommend that unheated footings, such as for canopies or signs, or unheated areas of the building, be protected against frost heave by providing 2.4 m of soil cover. Alternatives to using soil cover for frost protection are to provide non-frost-susceptible fill below the footing to 2.4 m below finished grade, or to protect the bearing soil from freezing using rigid board insulation, or a combination of these methods. Granular fill that meets the gradation specifications for SGSB and Well Graded Base (WGB) contains less than 5% fines and is considered non-frost-susceptible. A typical detail for using rigid board insulation for frost protection of an isolated, unheated pad footing is on Drawing 5655-D1, in Appendix D.

Place vertical insulation, if it is used, against the outside face of the foundation wall to allow building heat to warm the foundation. If it is placed against the inside face, do not extend vertical insulation more than 600 mm below the slab elevation, or provide additional soil cover over the footing as though it was unheated. Similarly, if horizontal insulation is required below grade-supported floor slabs, provide sufficient frost protection as if the footing was unheated. A typical detail for using rigid board insulation for frost protection of unheated, perimeter spread footing foundations is on Drawing 5655-D2, in Appendix D.

Protect foundation soil and footings from freezing during construction until building heat can be applied.

Use a maximum slope of 2H:1V between footings at different elevations, unless site specific analysis indicates that steeper angles are appropriate. Similarly, step strip footings that cross areas of different elevations using a maximum vertical rise of 0.6 m between horizontal steps. Construct the steps at an overall slope no steeper than 2H:1V.

If buried utilities are installed parallel to building foundations, place the footings or the utility so that the utility is above a line drawn down at a slope of 2H:1V from the edge of the footing. This will avoid transferring foundation load to the utility, as well as the potential for foundations to be undermined if future repairs are required.

Excavations for installation of buried services below or that are within a 1H:1V line extending down from the outside edge of building foundations will reduce foundation support, which can cause building settlement. We recommend buried services be installed prior to construction of building foundations. If buried services can not be installed prior to foundation construction, either install a length of steel casing at the desired service location below the foundation, or construct the building foundations below the utility and install a sleeve through the foundation wall at the service location. Backfill around buried utilities that are within a 1H:1V line extending down from the building foundations using placement and compaction procedures as described in this section, or use concrete with a compressive strength of at least 20 MPa.

4.2 Grade-Supported Concrete Floor Slabs

We recommend removing all organic soil, any existing fill, and wet, soft or disturbed soil to expose the natural, compact, layered sand and gravel, sandy gravel or the natural silt and sand, and to at least 400 mm below the underside of the slab. Bring the slab area to grade following the procedures described in Section 4.1, above. Directly below the slab, place at least 100 mm of WGB compacted to at least 100% SPD or use drain rock if required for radon gas rough-in. Gradation specifications for WGB and drain rock are defined in Table 1, below.

Use granular fill that meets the following specifications:

Table 1 - Specified Gradation for Granular Fill

Sieve Size (mm)	Percentage Passing		
	Well Graded Base	Select Granular Subbase	Drain Rock
100	-	100	-
75	-	95-100	-
40	-	-	100
25	100	-	-
19	80-100	35-100	0-100
9.5	50-85	-	-
4.75	35-70	15-60	0-10
2.36	25-50	-	0-5
1.18	15-35	-	-
0.3	5-20	3-15	-
0.075	0-5	0-5	0-2

For WGB, use crushed and screened material that meets the requirements of B.C. Ministry of Transportation and Infrastructure Standard Specifications. The SGSB can be a pit run material, provided it meets the gradation specifications defined in Table 1. Use durable aggregate that will not degrade from exposure to water, freeze-thaw cycles or handling, spreading and compacting. It must not contain organic materials or an excess of flat or elongate stones. Do not place fill that is frozen and do not place fill on frozen ground.

4.3 Seismic Site Classification

The 2018 British Columbia Building Code defines the "Site Classification for Seismic Site Response" based on soil properties to 30 m depth. A drill hole from an investigation at a nearby property encountered layered silt and sand to 3.0 m depth, over layered gravel and sand to 26.8 m

depth, over silt of intermediate to high plasticity to the bottom of the hole at about 31.3 m depth. Based on Standard Penetration Test (SPT) 'N' values from that investigation, the Site Classification for Seismic Site Response is no worse than Site Class "D", "Stiff soil" ($15 \le N_{60} \le 50$ and $50\ kPa \le S_u \le 100\ kPa$), as defined in Table 4.1.8.4.A. We recommend a drill hole to 30 m depth at the proposed building location if this parameter is critical to the building design.

4.4 Lateral Earth Pressure

Design basement foundation walls to withstand lateral pressures caused by soil, seismic and surcharge loads. Drawing 5655-D3, in Appendix D, shows typical lateral earth pressures that can develop against a restrained wall. It assumes the wall is unyielding and that drainage protects against hydrostatic forces. The at-rest (K_o) and seismic loads will apply for all restrained walls.

Use granular fill that meets the gradation specifications for SGSB against foundation walls. For this soil type, use an at-rest coefficient of lateral earth pressure, K_o, of 0.38 and a soil density of 22 kN/m^3. Add the pressures from compaction and vehicle loading where they are appropriate.

The compaction stress is based on a 900 mm wide, double-drum, vibratory walk-behind roller that has a total compactive force (dead plus live load) of 76 kN (17,000 lb). The stress is based on the assumption that the fill is placed in 300 mm thick layers and that the compactor is kept at least 300 mm away from the wall. The use of larger compaction equipment, thinner lifts, or less distance to the back of the walls will increase the lateral earth pressures from that shown.

4.5 Perimeter Foundation Drainage

Protect basement foundation walls from seepage and a buildup of hydrostatic pressures by installing a perimeter drainage system. Drawing 5655-D4, in Appendix D, shows a typical perimeter drain installation. Set the invert of the perimeter drain at least 200 mm below finished floor elevation and install it at a minimum 0.5% gradient. Discharge the perimeter drainage

system into a slump equipped with an automatic pump or by gravity to the storm sewer system. Do not connect rainwater leaders to the perimeter drainage system. Equip the discharge line of the perimeter drainage system with a one-way (back-up prevention) valve at a location that is accessible for maintenance.

4.6 Pavement Structure

Parking lot traffic will mostly be from passenger vehicles but will also include infrequent single and tandem axle garbage and delivery trucks at legal highway loads. Pavement structures will likely be located over existing buried utilities located within the site. Below asphalt surfaced areas, depending on performance expectations, it may be appropriate to only partially excavate the existing fill. In our experience, the cost to excavate the existing fill and replace it with compacted granular fill is likely to be more than the cost to repair the asphalt surface if and when it settles.

The following pavement structure assumes that maintenance of the asphalt surface is preferred, rather than full excavation and replacement of existing fill, and does not protect the structure from frost heave. The potential for developing frost lenses in the subgrade, which can cause frost heave, can be lessened by providing good surface and subsurface drainage and using a thick pavement structure.

We recommend the following minimum thicknesses for design of the pavement structures:

- 75 mm of 16 mm Medium Mix Asphaltic Concrete, over
- 150 mm of WGB, over
- 450 mm SGSB, over
- Prepared subgrade.

Use asphalt that conforms to B.C. Ministry of Transportation and Infrastructure Standard Specification 502 for Class 1, 16 mm medium mix asphaltic pavement.

Regular maintenance including crack, pothole and rut repairs are needed to extend the life of the pavement structure. Well drained pavement and subgrade surfaces will also help maintain the shear strength of the granular pavement structure and reduce softening of the subgrade. To remove water that infiltrates the parking surfaces, shape or slope the subgrade surface with a cross fall of at least 2% across the parking areas. Drain the subgrade into open ditches or to subdrains where curbs and manholes are used. Construct subdrains by installing at least 6 m length of 100 mm diameter perforated pipe, such as SDR 35 or BOSS 1000, or equivalent, wrapped in a nonwoven geotextile, along and slightly below the invert in the subgrade surface. Discharge the perforated pipe into manholes or catch basins.

To prepare the subgrade, excavate to the design subgrade elevation using equipment operating from areas to be cut or on a thick layer of granular fill. Excavate heavily rooted soil, organic silt and peat exposed at the subgrade surface. If general borrow is required to bring road and parking subgrade areas to design elevation, use mineral soil free of organic material and debris. Place the soil in maximum 300 mm thick layers and compact each layer to at least 98% SPD. Please call our office for additional recommendations if the subgrade is too soft to allow compaction.

Shape the subgrade as noted above. If silt is exposed at the subgrade surface, cover that part of the subgrade with a medium-weight nonwoven geotextile followed by a biaxial geogrid such as Tensar BX1100, or equivalent. Overlap adjacent sheets as recommended by the manufacturer. Place subbase and base granular fill in maximum 300 mm thick layers and compact each layer to at least 100% SPD. Add water or dry the fill as required to achieve the specified density. We recommend working closely with experienced geotechnical technician to develop appropriate placement methods to avoid softening the relatively weak subgrade soil.

At garbage bins or where heavy trucks are expected to park, we recommend 150 mm of Portland Cement concrete pavement in place of asphalt. Concrete made with Portland Cement is more durable than asphalt and better able to resist deflection from wheel-loads applied by heavy vehicles.

For sidewalks and concrete pads, we recommend at least 100 mm of WGB, over 500 mm of SGSB, over a nonwoven geotextile, over the sloped or crowned subgrade. We recommend constructing the subgrade below sidewalks and concrete pads to match that of the adjacent road to reduce differential frost heave. To avoid sidewalk and approach slabs at building entrances from lifting due to frost heave, we recommend either placing the SGSB on 50 mm rigid board insulation, such as Styrofoam Highload 40 or equivalent, extending 1.2 m from the wall and 1.2 m laterally on each side of the doorway, or replacing the soil to at least 1.8 m depth and 1.8 m from the building. Compact the subbase and base fills as described above.

5.0 CONSTRUCTION REVIEW

We recommend, and the British Columbia Building Code specifies, that an experienced engineer or his designate carry out construction review and testing of the following:

1. all foundation excavations, and
2. all compacted, structural fill below buildings and grade-supported floor slabs.

Prior to us being able to complete Schedule C-B of the Code, which is a form titled "Assurance of Professional Field Review and Compliance", we will need to carry out the necessary field reviews. The Schedule C-B form is often required by Building Inspection Officials prior to an Occupancy Permit being issued.

The foundation excavation review will include checks that soil conditions are as expected and that the base is free of water or sloughed or loosened soil. If soil conditions are different than expected, we can provide recommendations for remedial measures, as required.

We recommend that an experienced geotechnical technician review the placement and compaction of all structural fill, starting with the first layer, to confirm that the fill materials and soil density meet the project specifications.

7.0 CLOSURE

This report was prepared by GeoNorth Engineering Ltd. for the use of the City of Quesnel and their consultants. The material in it reflects GeoNorth Engineering's judgement in light of the information available to us at the time of preparation. Any use which Third Parties make of this report, or any reliance on decisions to be made based on it, are the responsibility of such Third Parties. GeoNorth Engineering Ltd. accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

Please contact the writers if any parts of this report need to be clarified or described in more detail.

Yours truly,
GeoNorth Engineering Ltd.

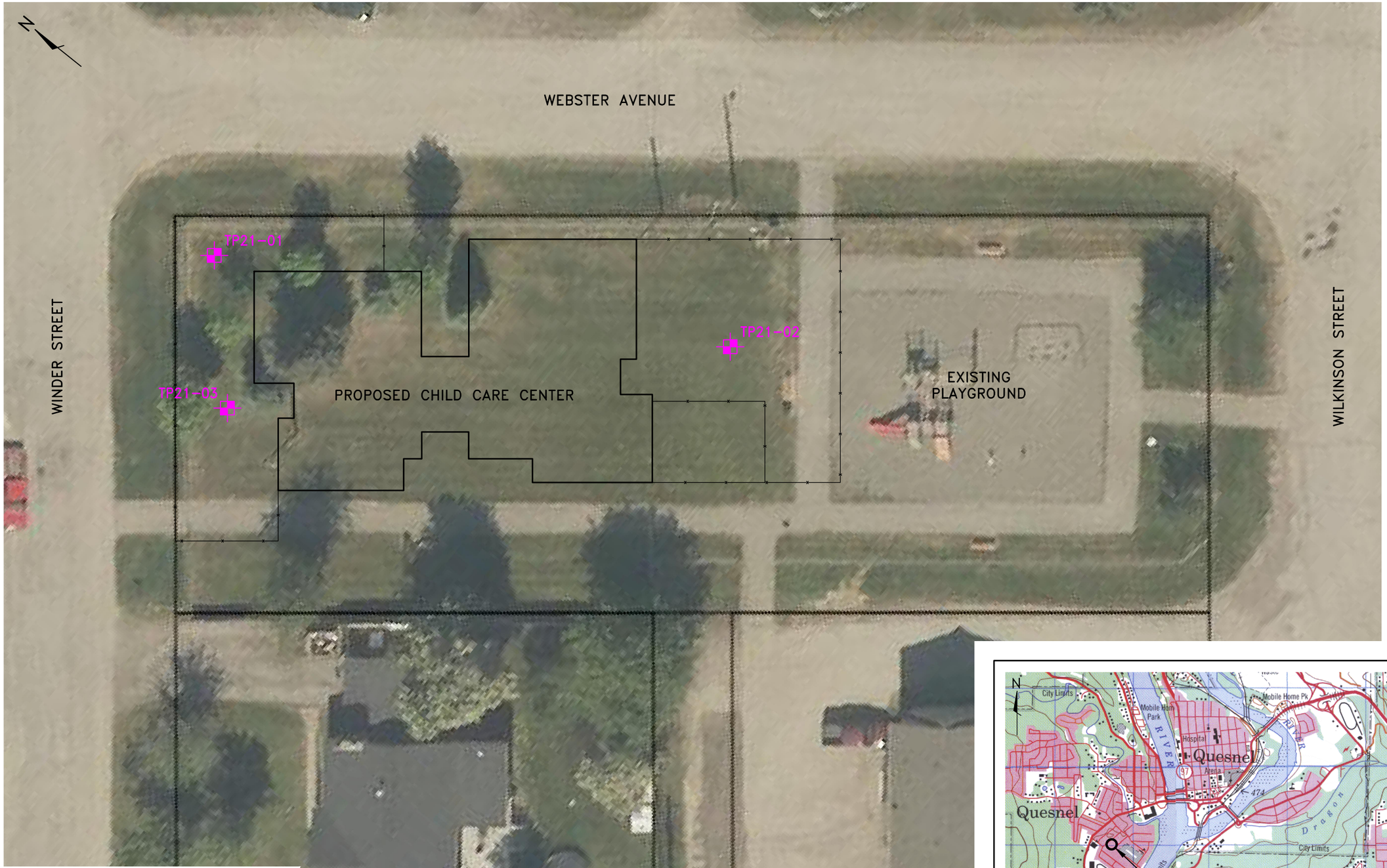
Per: D.B. Betemps, EIT

Reviewed by,
GeoNorth Engineering Ltd.

PROFESSIONAL ENGINEER
PROVINCE OF BRITISH COLUMBIA
D. J. McDOUGALL
14614

Per: D.J. McDougall, M.Eng., P.Eng.

APPENDIX A



NOTES:

1. SITE PLAN BASED ON DIGITAL INFORMATION FROM CITY OF QUESNEL WEBSITE. ORTHOPHOTO DATED 2018. ACCURACY CANNOT BE GUARANTEED.
2. TEST PIT LOCATIONS ARE APPROXIMATE.

Scale – 1:300

0 2 4 6 8 10

KEY MAP

NTS Map – 93 B/15&16 Scale – 1:50,000

Note: Drawing is included for information purposes only and is to be interpreted with the corresponding Geotechnical Report.

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CITY OF QUESNEL
PROPOSED DAYCARE AT 420 WEBSTER AVENUE, QUESNEL, B.C.
SITE PLAN SHOWING TEST PIT LOCATIONS

APPROVED:

SCALE: 1:300
DATE: 2022/01/24
DRAWN BY: LU
REVIEWED BY: DJM
DRAWING NO: 5655-A1
REVISION: –
PROJECT NO: K-5655

A P P E N D I X B

GEONORTH ENGINEERING LTD
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TEST PIT LOG

HOLE NO: TP21-01

CLIENT: CITY OF QUESNEL

PROJECT: PROPOSED DAYCARE AT 420 WEBSTER AVENUE QUESNEL, B.C.

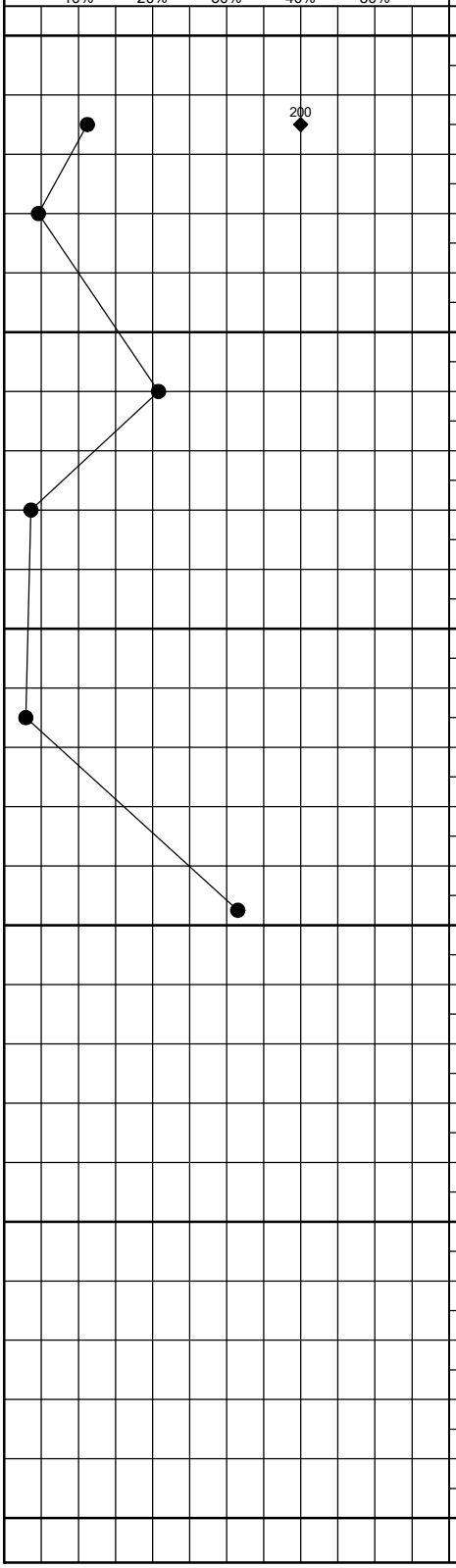
LOGGED: DB | FILE NO: K-5655 | EXCAVATOR: CAT 305.5E2CR | DATE OF INVEST: 2021/07/14

LOCATION: 10U 532739E 5869072N

SURFACE ELEVATION (m): N/A

STRENGTH TEST RESULTS
◆ POCKET PENETROMETER RDG.
50 100 150 200 250 kPa

WATER CONTENT
10% W_P 20% 30% W_N 40% W_L 50%



DEPTH (m) | SYMBOL | SAMPLES

SOIL DESCRIPTION

DEPTH (m)	ELEV (m)	SOIL DESCRIPTION	SAMPLES	COMMENTS
0.1		TOPSOIL, grass on top.		
0.45		SILT, some sand, trace gravel, no visible structure, very stiff, low plasticity, light brown, Wn<Wp (FILL).		
1.1		SAND, trace fines, trace gravel, layered, loose to compact, greyish brown, damp.		
1.5		SILT, and sand, some clay, layered, loose to compact, light brown, mottled orange, damp.		- Grain Size Analysis, See Plate 5655-C1
2.1		SAND, and gravel, trace fines, layered, compact, greyish brown, damp.		- Grain Size Analysis, See Plate 5655-C2
2.7		GRAVEL, sandy, trace fines, compact, greyish brown, damp.		
3.0		SILT, and sand, layered, loose, light brown, mottled orange, moist.		
		End of test pit at 3.0 m. No seepage observed. Test pit walls did not slough.		

PLATE NO. 5655 - B1

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TEST PIT LOG

HOLE NO: TP21-02

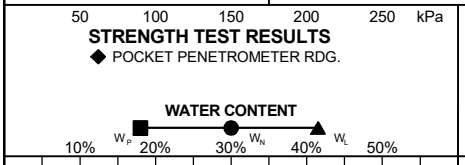
CLIENT: CITY OF QUESNEL

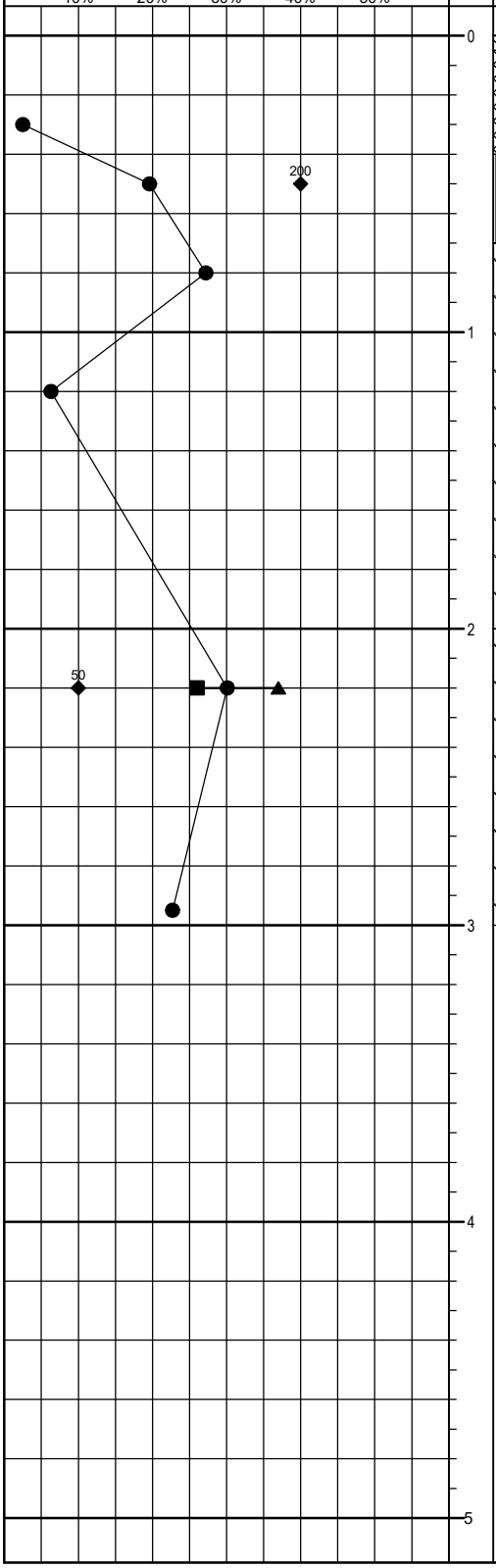
PROJECT: PROPOSED DAYCARE AT 420 WEBSTER AVENUE QUESNEL, B.C.

LOGGED: DB | FILE NO: K-5655 | EXCAVATOR: CAT 305.5E2CR | DATE OF INVEST: 2021/07/14

LOCATION: 10U 532760E 5869034N

SURFACE ELEVATION (m): N/A





DEPTH (m) | SYMBOL | SOIL DESCRIPTION | SAMPLES | COMMENTS

DEPTH (m)	ELEV (m)	SOIL DESCRIPTION	SAMPLES	COMMENTS
0.05		TOPSOIL, grass on top.		
0.4		GRAVEL, sandy, trace to some fines, no visible structure, compact, brown, damp (FILL).		
0.7		SILT, clayey, some sand, trace gravel, layered, intermediate plasticity, stiff, light brown, Wn<Wp.		
2.0		SAND, and silt, layered, loose to compact, light brown, damp. - below 1.1 m, trace fines.	- Grain Size Analysis, See Plate 5655-C3	
3.0		SILT, and sand, some clay, layered, intermediate plasticity, firm, light brown, mottled orange, damp. - below 2.8 m, non plastic.		
		End of test pit at 3.0 m. No seepage observed. Test pit walls did not slough.		

PLATE NO. 5655 - B2

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TEST PIT LOG

HOLE NO: TP21-03

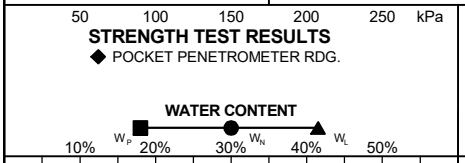
CLIENT: CITY OF QUESNEL

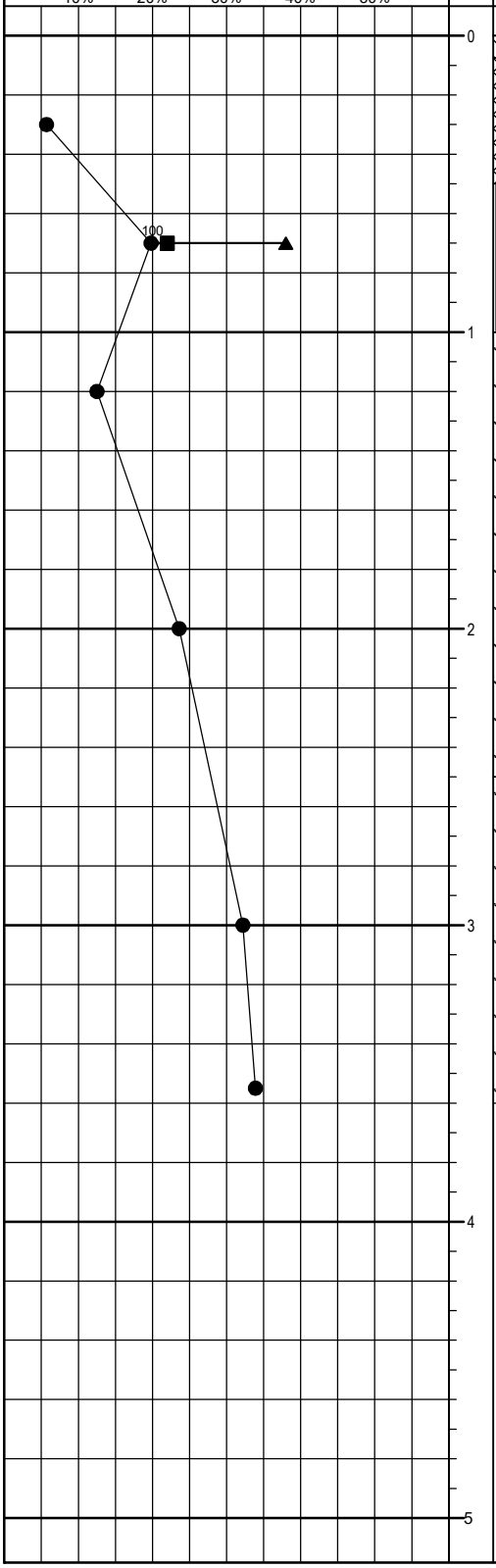
PROJECT: PROPOSED DAYCARE AT 420 WEBSTER AVENUE QUESNEL, B.C.

LOGGED: DB | FILE NO: K-5655 | EXCAVATOR: CAT 305.5E2CR | DATE OF INVEST: 2021/07/14

LOCATION: 10U 532729E 5869062N

SURFACE ELEVATION (m): N/A





DEPTH (m) | SYMBOL | SAMPLES

SOIL DESCRIPTION

DEPTH (m)	ELEV (m)	
0.08		TOPSOIL, grass on top.
0.5		SILT, sandy, trace gravel, layered, stiff, low plasticity, light brown, mottled orange, Wn<Wp (FILL).
1.0		SILT, clayey, some sand, layered, stiff, intermediate plasticity, light brown, mottled orange, Wn<Wp.
2.5		SAND, and silt, some clay, layered, loose to compact, light brown, mottled orange, damp.
3.6		SILT, sandy, some clay, layered, soft, brown, mottled orange, Wn>Wp.
		End of test pit at 3.6 m. No seepage observed. Test pit walls did not slough.

COMMENTS

PLATE NO. 5655 - B3

EXPLANATION OF TERMS AND SYMBOLS USED ON DRILL HOLE & TEST PIT LOGS

SOIL DESCRIPTION

Soil is classified based on the Unified Soil Classification System (ASTM D2487), with reference to the Canadian Foundation Engineering Manual 4th Edition (2006). Descriptions for each soil type encountered are divided by contact lines at interface depths. Each description has a corresponding graphic symbol which relates to soil type.

Major Soil Division
The major soil division is the main fraction of soil and constitutes at least 35% by weight. Soil is classified as GRAVEL, SAND, CLAY, SILT or ORGANIC according to the criteria on page 3.

Interpretation
Where applicable, a bracketed term such as (FILL) or (TILL) is included to describe soil genesis.

Grain Size and Shape
Grain size descriptions for soil follow the criteria on page 3
The shape of coarse and oversized particles is described as:

angular – sharp corners
subangular – slightly rounded corners
subrounded – no angular corners
rounded – smooth rounded surface
platy – flat, plate shaped

Soil Composition
The following terms are used to describe the percentage of soil components by weight based on laboratory sieve analyses or field estimates.

Descriptive Term		Percentage Passing
"and"	and sand, and gravel, etc.	>35%
"___y"	clayey, sandy, etc.	20 to 35%
"some"	some silt, some gravel, etc.	10 to 20%
"trace"	trace of sand, trace of silt, etc.	0 to 10%

The amount of cobbles and boulders, in increasing proportion, are described as:
isolated < occasional < frequent < numerous.

Compactness and Consistency
The following terms are used to describe the compactness, or relative density, of cohesionless soil based on the Standard Penetration Test (SPT) or field estimates:

Descriptive Term	SPT 'N' Value
very loose	0 to 4
loose	4 to 10
compact	10 to 30
dense	30 to 50
very dense	over 50

The following terms are used to describe the consistency of fine grained soils based on unconfined compressive strength as determined by field or laboratory tests, or estimates:

Descriptive Term	Unconfined Compressive Strength (kPa)
very soft	<25
soft	25 to 50
firm	50 to 100
stiff	100 to 200
very stiff	200 to 400
hard	>400

Structure
Soil structure can include layering, fissures, imbrication, etc.

Plasticity
Plasticity of fine grained soil is estimated or determined from Atterberg Limit tests based on the plasticity chart on page 3.

EXPLANATION OF TERMS AND SYMBOLS USED ON DRILL HOLE & TEST PIT LOGS

SOIL DESCRIPTION (cont'd)

Colour and Odour

Colour is referenced to a standard colour code, as noted at the time of the investigation. Odour, if noted, may indicate organic inclusions or soil contamination.

Inclusions

The quantity of inclusions is described using the same relative–amount terms used for cobbles and boulders, noted above.

Water Content

Soil moisture, in increasing amount, is subjectively described as:

dry < damp < moist < wet < saturated < excess water,

or in relation to the plastic limit for fine grained soils.

SOIL SAMPLES

Graphic symbols indicate the depth and condition of soil samples:

 Disturbed

 Undisturbed

Undisturbed samples may be taken with Shelby tubes, from blocks or by coring. All other types of samples are disturbed.

FIELD TESTS

Standard Penetration Test (SPT) (ASTM D1586)

SPT results are reported as the 'N' value at the appropriate depth. The N value denotes the number of blows of a 63.5 kg hammer, freely dropping 760 mm, required to drive a 50.8 mm diameter split–spoon sampler from 150 mm to 460 mm into the bottom of a drill hole.

Dynamic Penetration Test (DPT)

Dynamic penetration test results are shown graphically. The number of blows required to drive a 50.8 mm diameter cone 305 mm is shown opposite the depth. The method of driving the cone is the same as for the SPT test described above.

Field Vane Test (FVT) (ASTM D2573–72)

Undrained shear strength of cohesive soil is measured using a 100 mm long by 50 mm diameter vane. Test results for peak and residual strengths are graphically reported at the appropriate depths using the following symbols:

 Peak Shear Strength

Residual Shear Strength

Pocket Penetrometer and Torvane Tests

The pocket penetrometer and torvane provide an indication of a soil's unconfined compressive strength and undrained shear strength, respectively. Pocket penetrometer results are shown graphically using ◊ symbols. Torvane results are reported using the same symbols used for the field vane test.

LABORATORY TESTS

The following symbols are used to denote laboratory test results:

○	Natural water content, w_N (ASTM D2216)
□	Atterberg Plastic Limit, w_P (ASTM D4318)
△	Atterberg Liquid Limit, w_L (ASTM D4318)
MA	Mechanical grain size (sieve) analysis or hydrometer test, or both (ASTM C117 and C136)
qu	Unconfined compressive strength test on an undisturbed sample (ASTM D2166)
SO_4	Test for concentration of water–soluble sulphates
γ	Unit weight of soil or rock
γ_d	Dry unit weight of soil or rock

COMMENTS

Groundwater conditions are indicated using the following symbols:

groundwater table

seepage

Comments can often include additional test results, drilling progress, monitoring equipment installation details and other relevant information.

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SOIL CLASSIFICATION DESCRIPTION

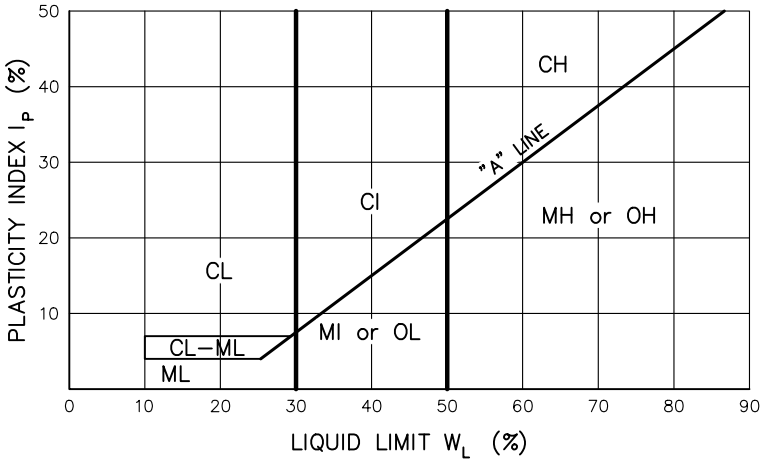
MAJOR DIVISION			GROUP SYMBOL	GROUP SYMBOL	TYPICAL DESCRIPTION	LABORATORY CLASSIFICATION CRITERIA
COARSE-GRAINED SOIL	GRAVEL 4.75 – 75.0 mm DIAMETER	CLEAN GRAVEL	GW		WELL-GRADED GRAVEL AND SANDY GRAVEL MIXTURES WITH LESS THAN 5% FINES.	$C_u = \frac{D_{60}}{D_{10}} > 6,\ C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}} = 1 \text{ to } 3$
			GP		POORLY-GRADED GRAVEL AND SANDY GRAVE MIXTURES WITH LESS THAN 5% FINES.	NOT MEETING ABOVE REQUIREMENTS.
		DIRTY GRAVEL	GM		SILTY GRAVEL AND SILT-SAND-GRAVEL MIXTURES WITH MORE THAN 15% FINES.	ATTERBERG LIMITS BELOW "A" LINE.
			GC		CLAYEY GRAVEL AND CLAY-SAND-GRAVEL MIXTURES WITH MORE THAN 15% FINES.	ATTERBERG LIMITS ABOVE "A" LINE.
	SAND 0.075 – 4.75 mm DIAMETER	CLEAN SAND	SW		WELL-GRADED SAND AND GRAVELLY SAND MIXTURES WITH LESS THAN 5% FINES.	$C_u = \frac{D_{60}}{D_{10}} > 6,\ C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}} = 1 \text{ to } 3$
			SP		POORLY-GRADED SAND AND GRAVELLY SAND MIXTURES WITH LESS THAN 5% FINES.	NOT MEETING ABOVE REQUIREMENTS.
		DIRTY SAND	SM		SILTY SAND AND SILT-GRAVEL-SAND MIXTURES WITH MORE THAN 15% FINES.	ATTERBERG LIMITS BELOW "A" LINE.
			SC		CLAYEY SAND AND CLAY-GRAVEL-SAND MIXTURES WITH MORE THAN 15% FINES.	ATTERBERG LIMITS ABOVE "A" LINE.
FINE-GRAINED SOIL	SILT BELOW "A" LINE ON PLASTICITY CHART NEGLIGIBLE ORGANIC CONTENT		ML		INORGANIC SILT, VERY FINE SAND, ROCK FLOUR, AND SANDY SILT OF LOW PLASTICITY.	SEE PLASTICITY CHART BELOW
			MI		INORGANIC SILT OF INTERMEDIATE PLASTICITY.	
			MH		INORGANIC SILT AND MICACEOUS OR DIATOMACEOUS SOIL OF HIGH PLASTICITY.	
	CLAY ABOVE "A" LINE ON PLASTICITY CHART NEGLIGIBLE ORGANIC CONTENT		CL		INORGANIC CLAY OF LOW PLASTICITY, GRAVELLY, SANDY OR SILTY CLAY, 'LEAN' CLAY.	
			CI		INORGANIC CLAY OF INTERMEDIATE PLASTICITY, SILTY CLAY.	
			CH		INORGANIC CLAY OF HIGH PLASTICITY, 'FAT' CLAY.	
	ORGANIC SILT & CLAY BELOW "A" LINE ON PLASTICITY CHART		OL		ORGANIC SILT OR CLAY OF LOW PLASTICITY.	
			OH		ORGANIC SILT OR CLAY OF HIGH PLASTICITY.	
HIGHLY ORGANIC SOIL			Pt		PEAT AND OTHER HIGHLY ORGANIC SOIL.	HIGH ORGANIC CONTENT AND FIBROUS TEXTURE.

GRAIN SIZE

Coarse-grained soil and silt is identified on the basis of grain size diameter as follows:

SILT & CLAY:		< 0.075 mm
SAND:	Fine	0.075 – 0.425 mm
	Medium	0.425 – 2.00 mm
	Coarse	2.00 – 4.75 mm
GRAVEL:	Fine	4.75 – 19.0 mm
	Coarse	19.0 – 75.0 mm
COBBLES:		75.0 – 300 mm
BOULDERS:		> 300 mm

PLASTICITY CHART



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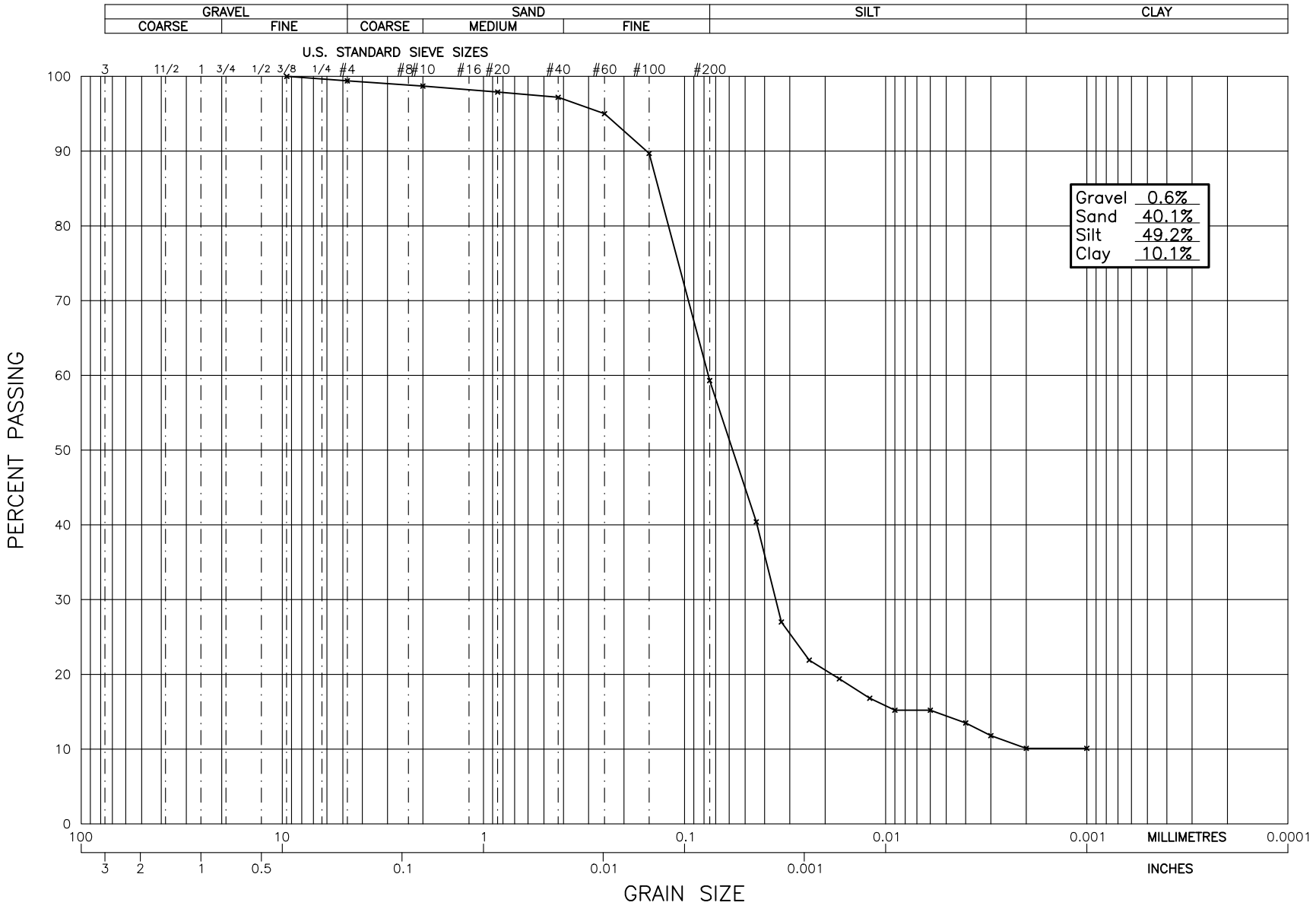
APPENDIX C



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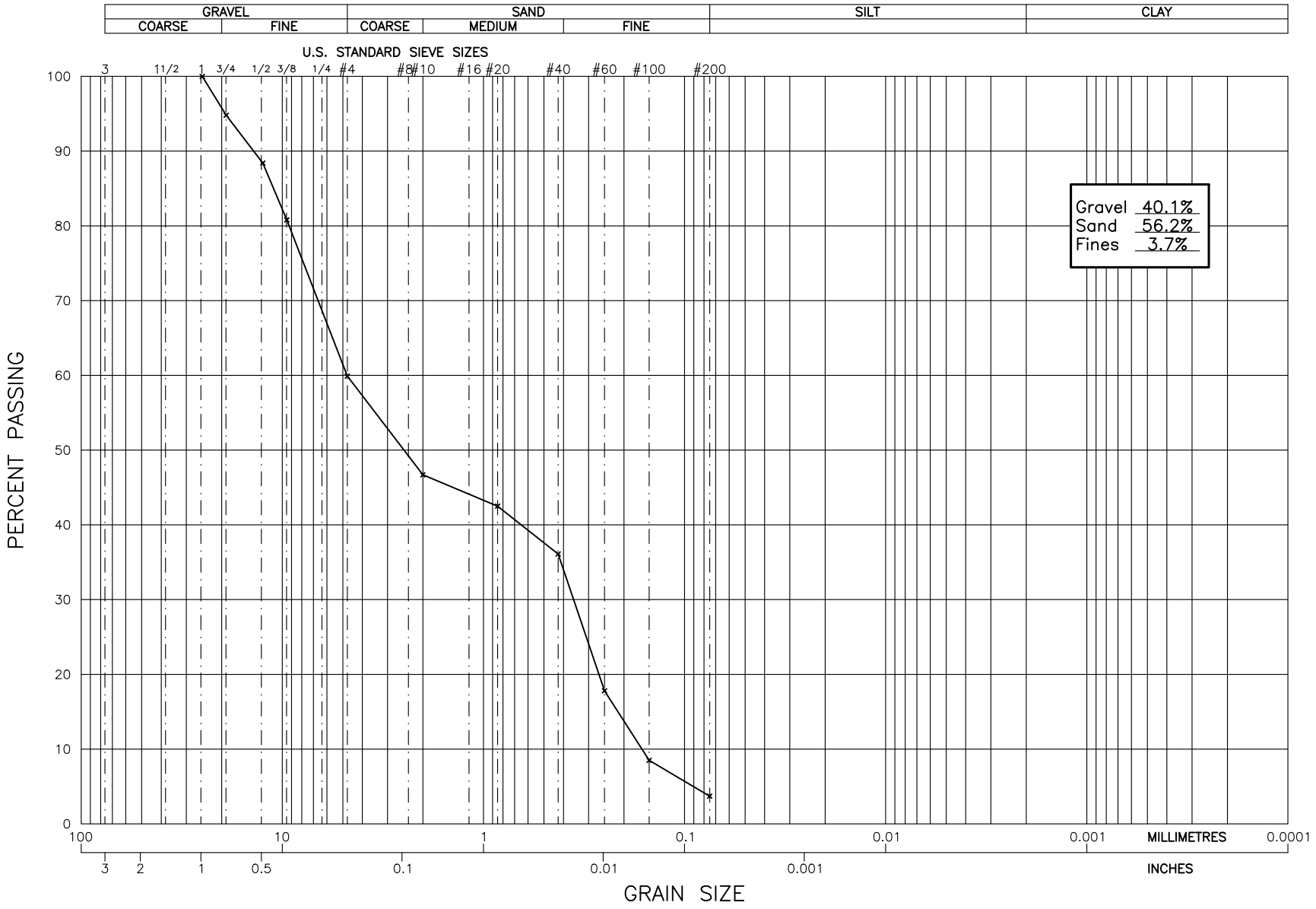
CITY OF QUESNEL
PROPOSED DAYCARE AT
420 WEBSTER AVENUE, QUESNEL, B.C.
GRAIN SIZE ANALYSIS OF TP21-01, 1.2 m DEPTH

PROJECT NO.
K-5655

PLATE NO.
5655-C1



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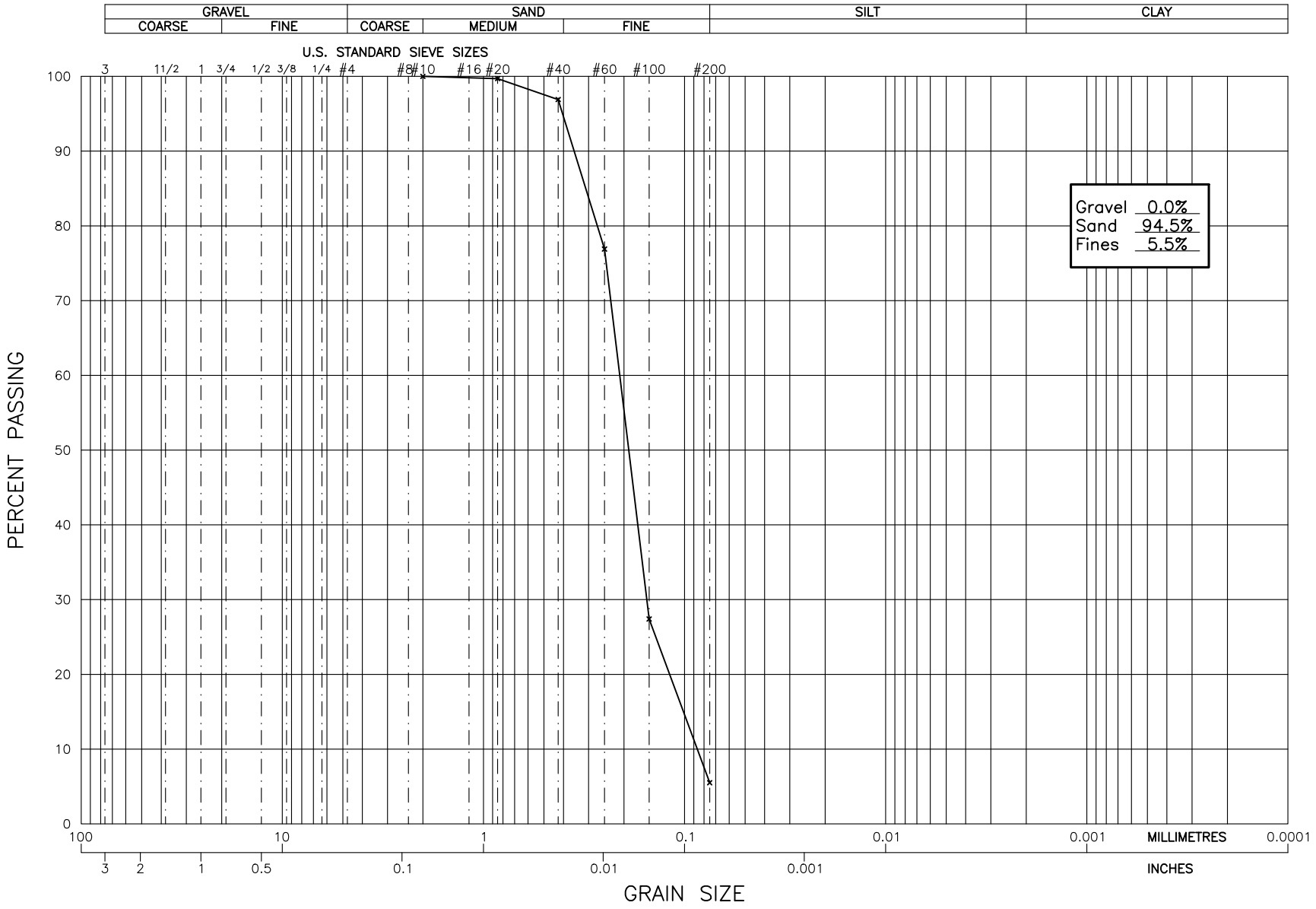
GRAIN SIZE ANALYSIS OF TP21-01, 1.6 m DEPTH

PROJECT NO.
K-5655

PLATE NO.
5655-C2



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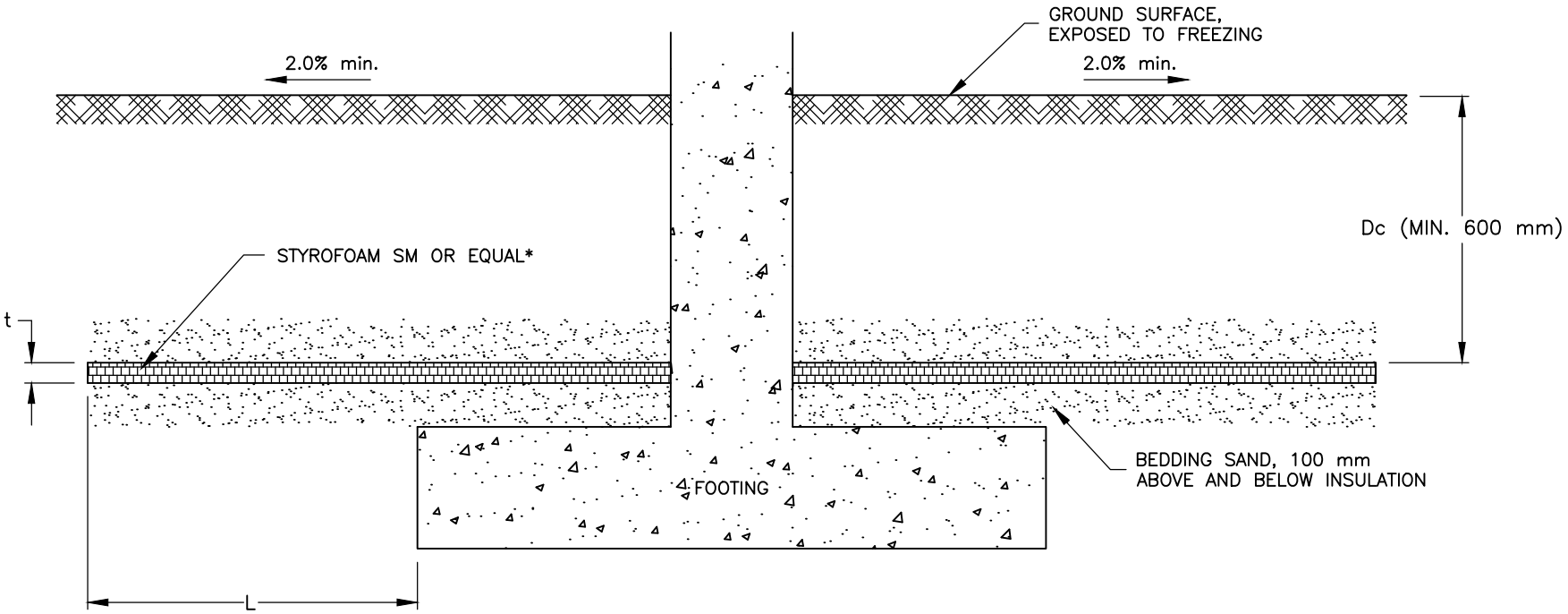
GRAIN SIZE ANALYSIS OF TP21-02, 1.2 m DEPTH

PROJECT NO.
K-5655

PLATE NO.
5655-C3

APPENDIX D



EXTEND INSULATION PAST EDGE OF FOOTING
BY DISTANCE: L = 2.4 m − Dc ON UNHEATED SIDE

if D_c = 600 mm; t = 100 mm

if D_c = 900 mm; t = 75 mm

if D_c = 1.2 m; t = 65 mm

if D_c = 1.5 m; t = 50 mm

* USE STYROFOAM SM, OR EQUIVALENT IN AREAS OF NO TRAFFIC. USE STYROFOAM HL 60, OR EQUIVALENT UNDER AREAS SUBJECTED TO VEHICLE TRAFFIC.

Note: Drawing is included for information purposes only and is to be interpreted with the corresponding Geotechnical Report.

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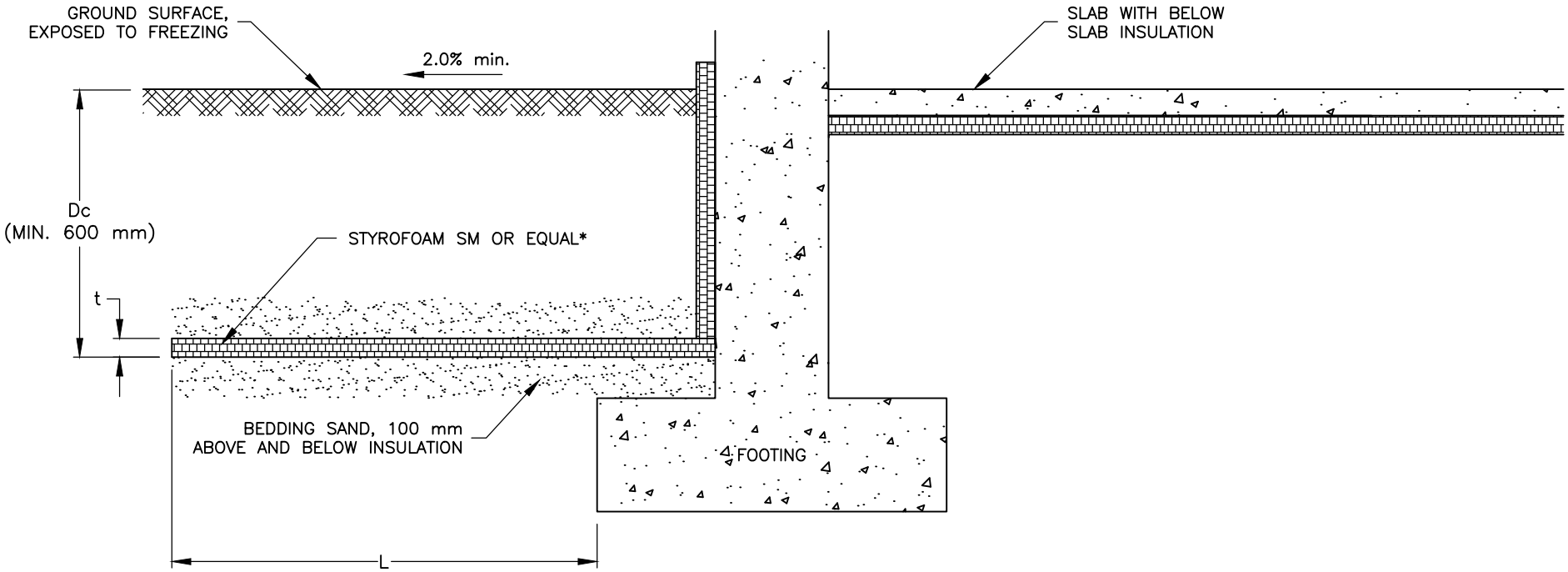
CITY OF QUESNEL
PROPOSED DAYCARE AT
420 WEBSTER AVENUE, QUESNEL, B.C.
TYPICAL INSULATION DETAIL FOR UNHEATED FOOTING

SCALE: N.T.S.	DATE: 2022/01/24
DRAWN BY: LU	REVIEWED BY: DJM
PROJECT NO: K-5655	DWG NO: 5655-D1



EXTEND INSULATION PAST EDGE OF FOOTING
BY DISTANCE: L = 2.4 m − Dc ON UNHEATED SIDE

if D_c = 600 mm; t = 100 mm

if D_c = 900 mm; t = 75 mm

if D_c = 1.2 m; t = 65 mm

if D = 1.5 m; t = 50 mm

* USE STYROFOAM SM, OR EQUIVALENT IN AREAS OF NO TRAFFIC. USE STYROFOAM HL 60, OR EQUIVALENT UNDER AREAS SUBJECTED TO VEHICLE TRAFFIC.

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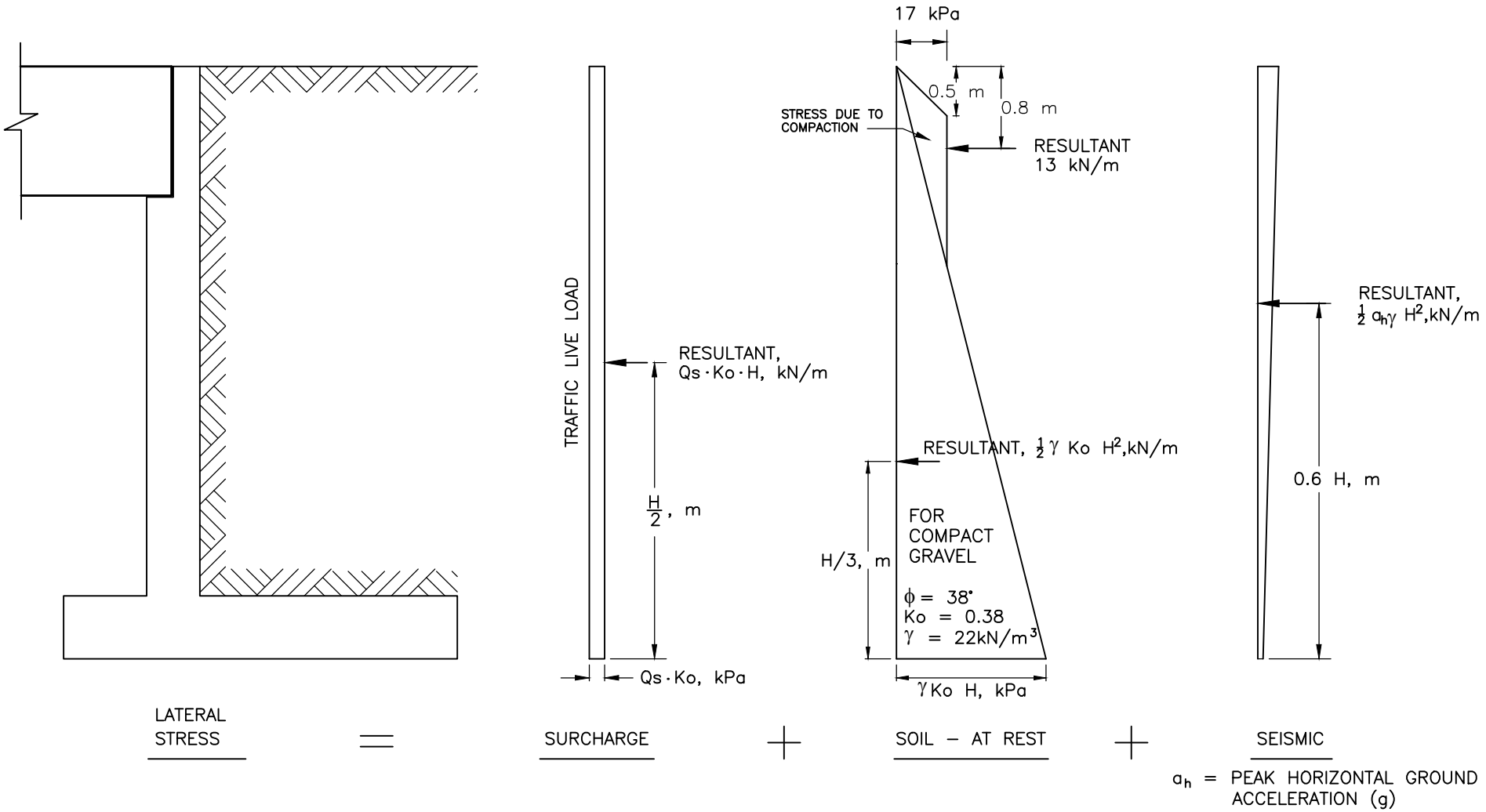
CITY OF QUESNEL
PROPOSED DAYCARE AT
420 WEBSTER AVENUE, QUESNEL, B.C.
INSULATION DETAIL FOR FOOTING ADJACENT TO INSULATED SLAB

SCALE: N.T.S.	DATE: 2022/01/24
DRAWN BY: LU	REVIEWED BY: DJM
PROJECT NO: K-5655	DWG NO: 5655-D2



a_h = PEAK HORIZONTAL GROUND ACCELERATION (g)

Qs, kPa (From 2018 BC Building Code)

Passenger cars <4000 kg GVW	2.4
Unloaded buses and light trucks <9000 kg GVW	6.0
Loaded buses and trucks >9000 kg GVW	12.0

DESIGN ASSUMPTIONS

FULLY DRAINED CONDITIONS
HORIZONTAL FREE–DRAINING GRANULAR BACKFILL
NO WALL FRICTION, WALL RESTRAINED

Note: Drawing is included for information purposes only and is to be interpreted with the corresponding Geotechnical Report.

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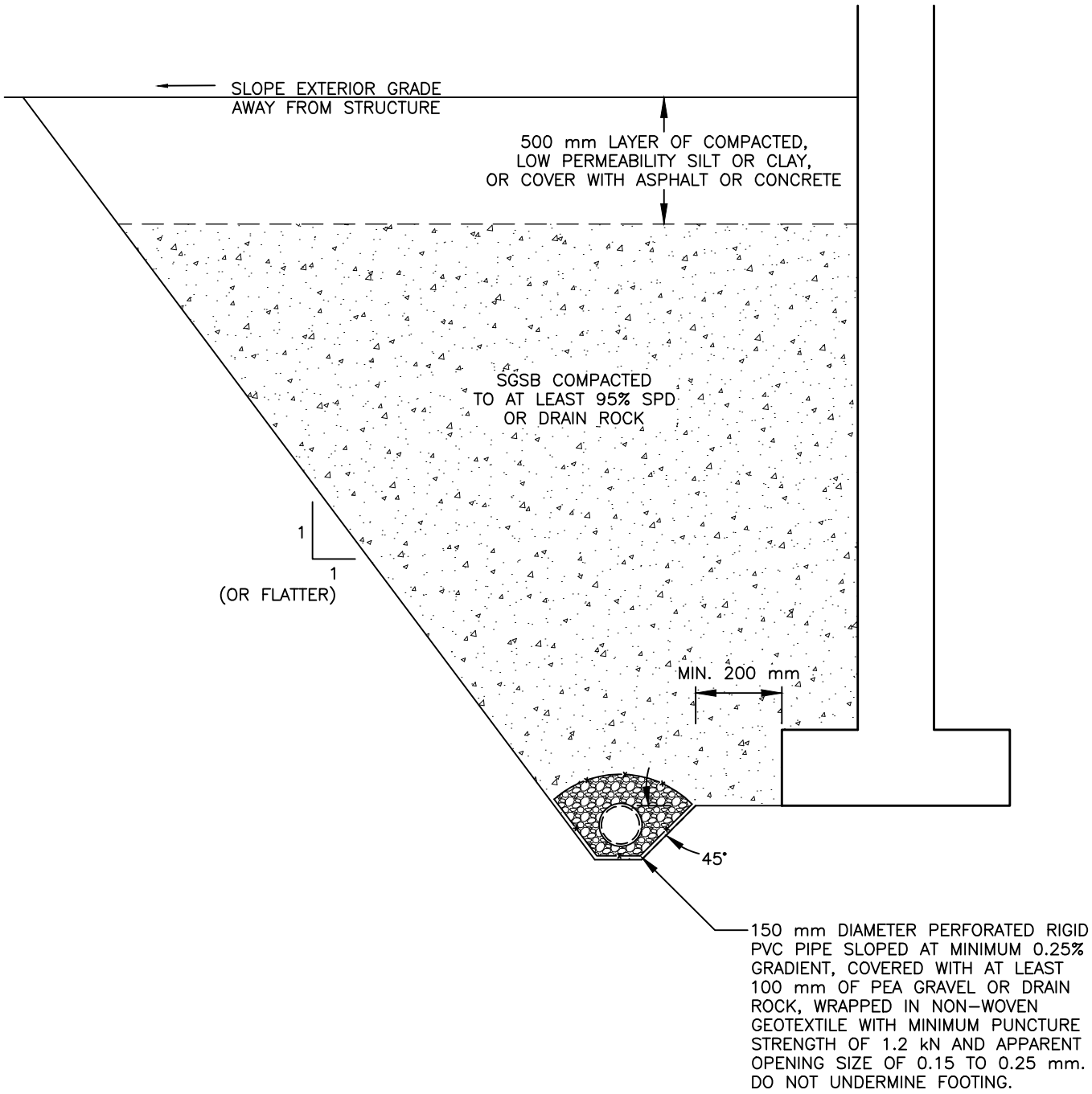
CITY OF QUESNEL
PROPOSED DAYCARE AT
420 WEBSTER AVENUE, QUESNEL, B.C.
TYPICAL LATERAL EARTH PRESSURES

SCALE:	N.T.S.	DATE:	2022/01/24
DRAWN BY:	LU	REVIEWED BY:	DJM
PROJECT NO:	K–5655	DWG NO:	5655–D3



Note: Drawing is included for information purposes only and is to be interpreted with the corresponding Geotechnical Report.

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CITY OF QUESNEL
PROPOSED DAYCARE AT
420 WEBSTER AVENUE, QUESNEL, B.C.
TYPICAL PERIMETER DRAIN DETAIL

SCALE: N.T.S.	DATE: 2022/01/24	DRAWN: LU	REVIEWED: DJM	PROJ: K-5655	DWG: 5655-D4