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December 15, 2021

12999141 BC Ltd.
c/o Forest Power Sports Ltd.
#120 - 988 Great Street
Prince George BC V2N 5R7

File No. K-5786

Dear Mr. Greg Pocock:

Re: Geotechnical Review of Existing Information,
Proposed Commercial Development, 3191 Highway 16, Prince George, B.C.

We understand 12999141 BC Ltd. plans to develop 3191 Highway 16 in Prince George, B.C. Our firm carried out site investigations and prepared a geotechnical report dated August 13, 2015 for a previously proposed development on the property, our file number K-4145. A Rezoning Application is needed for the project and City of Prince George requires a letter stating that the site is still suitable for development, that the recommendations made in our August 2015 report are appropriate for use in design of this project and that we check setback requirements from a Greenbelt Zone south of the property. This letter presents the results of our review.

L&M Engineering Limited, civil engineers for the project, indicated that preliminary design drawings are not yet available but that the development will likely include a recreational vehicle dealership and self-storage facility. The buildings will be single-storey with grade-supported floor slabs and will be located within the area previously investigated.

The property is on a northeast facing slope, with about 40 m of relief, between elevations 680 and 720 m. Our investigations shows that soil conditions are variable and include glacial and post-glacial deposits, including hard gravelly clay till, silt and clay glacial lake sediments and fluvial sand and gravel from glacial meltwater. Seepage was encountered between elevations 680 and 683 m in the drill holes. Bedrock was not encountered in any of the holes.

Since the report was written parts of the site have been mined for gravel. Digital imagery available on PGMap a website maintained by City of Prince George shows that the mining operations generally involved excavation of soil from the higher, south part of the site creating an approximately 8 to 10 m high cut slope and relatively flat bench in the middle of the property. The cut slope extends down from a forested area zoned AG: Greenbelt. The slope is affected by rill erosion from surface runoff but does not show indications of seepage or deep-seated instability. Images dated 2020 show disturbed ground towards the north side of the site which may be embankment fill used to level the property. Fill placed in an uncontrolled manner, such as was likely done during mining operations, has variable gradation and compaction characteristics and is not suitable for support of building foundations, floor slabs or retaining walls.

Based on our review of the available information the site is suitable for development from a geotechnical perspective and the recommendations in our August 2015 report are appropriate. To avoid undermining the Greenbelt do not excavate within a line projecting down from its boundary at gradients steeper than described in our August 2015 report. We recommend we review project drawings prior to finalization.

Please call the writer if you have any questions or wish to discuss in more detail.

Yours truly,
GeoNorth Engineering Ltd.

W. J. LANENGA
30638

Per: W.J. Lanenga, P.Eng.

GeoNorth Engineering Ltd.
Engineers and Geoscientists B.C.
Permit to Practice No. 1001102

eDoc 616708

GEOTECHNICAL REPORT

PROPOSED HOTEL AND RESTAURANT
MARLEAU ROAD AND HIGHWAY 16
PRINCE GEORGE, B.C.

Prepared for

INSIGHT PROGRESSIVE DEVELOPMENTS INC.
PRINCE GEORGE, B.C.

Prepared by

GEONORTH ENGINEERING LTD.
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PROJECT No. K-4145

August 13, 2015

TABLE OF CONTENTS

APPENDICES

1.0 INTRODUCTION

Insight Progressive Developments Inc. (Insight) plans to construct a new hotel and restaurant approximately 150 m south of the intersection of Highway 16 and Marleau Road in Prince George, B.C. and commissioned GeoNorth Engineering Ltd. (GeoNorth) to carry out a geotechnical investigation for the project. The scope of work is outlined in our proposal dated May 22, 2015 to Mr. Loris Bedetti of Insight who authorized us to proceed with the work on June 1, 2015. A plan showing the location of the site is on Drawing 4145-A1, in Appendix A.

The proposed development is on an approximately triangular shaped property bordered by Highway 16 Frontage Road along the north property line, by Marleau Road along the east property line, by a treed area designated as greenbelt along the south property line and undeveloped land along the west. The site was recently logged and slopes down to the northeast with approximately 29 m of relief, between geodetic elevations 679 m and 708 m. A plan by L&M Engineering Limited, civil engineers for the project, shows the hotel on the west part of the site and the restaurant on the east. The footprint of the hotel will measure about 18.0 by 72.0 m and the restaurant will measure about 13.2 by 23.7 m. They will have finished floor elevations of 684.4 m and 683.3 m, respectively. Levelling the property will require cuts of up to 15 m near the southwest corner. The plan also shows about 115 m of retaining wall along the south and part of the west sides of the property and 2 horizontal to 1 vertical (2H:1V) slopes up to the property boundaries. A plan showing the proposed building layout within the property is on Drawing 4145-A2, in Appendix A.

This report presents the results of the site investigation and provides recommendations for site preparation including slope stability, design and construction of building foundations, grade-supported floor slabs, retaining walls, installation of buried services and pavement structures for parking areas and access roads. A letter dated June 19, 2015 presents the results of our assessment of slope stability conditions associated with the proposed cut, which is included in this report.

2.0 SITE INVESTIGATION AND SUBSURFACE CONDITIONS

On June 8 to 10, 2015, personnel from our office observed soil conditions in five drill holes, designated DH15-1 to 5, at the locations shown on Drawing 4145-A2. Westech Drilling Corp., on our behalf, drilled the holes to between 9.6 and 31.1 m depth using cased, air-rotary methods. We carried out Standard Penetration Tests (ASTM D1586) (SPT) at regular intervals to the bottom of the drill holes. The SPT involves driving a standard 50 mm diameter sampling tube into the bottom of the drill hole using a 62 kg weight free falling a height of 760 mm. The number of blows required to penetrate 300 mm, after an initial 150 mm seating penetration is referred to as the SPT ‘N’ value. The SPT provides information on soil density and foundation bearing capacity, and allows a soil sample to be collected.

We logged soil conditions as the drill holes were advanced by observing samples recovered from the penetration tests and from drill cuttings. Samples obtained from the SPT were retained for laboratory tests. After completion, the drill holes were backfilled with cuttings and sealed at regular intervals with bentonite plugs. A monitoring well consisting of 50 mm PVC pipe slotted in the bottom 3.0 m, was installed in DH15-1 to facilitate groundwater monitoring. Filter sand extends around and to about 0.3 m above the screen followed by a bentonite plug. Drill cuttings were used as backfill above the bentonite plug to the ground surface.

Drill hole logs describing subsurface conditions are on Plates 4145-B1 to B5, in Appendix B. They are followed by an explanation of terms and symbols used on the logs. Cross sections and summary logs showing soil and groundwater conditions are on Drawings 4145-A4 and A5, in Appendix A.

Soil conditions in the project area are variable and layered, consisting of dense, layered sand and gravel with a variable fines content, glaciofluvial or deltaic deposits, to the bottom of DH15-3, 4 and 5 and to 14.9 m depth in DH15-1 and 24.4 m depth in DH15-2, between elevations 676 and 680.5 m. Between 14.9 and 16.5 m depth, DH15-1 encountered hard, low plasticity silt with a trace amount of sand and gravel over hard, layered high plasticity clay to 18.0 m depth, then hard, low plasticity silt to the bottom of the drill hole at 18.6 m depth. Below 24.4 m depth DH15-2 encountered very stiff to hard silt and sand with a trace amount of gravel to 27.4 m depth, over hard silty sand with some gravel, a glacial till deposit, to the bottom of the drill hole at 341.1 m depth.

Seepage was encountered at 12.4 m depth, elevation 683.0 m, in DH15-1, 21.3 m depth, elevation 680.5 m in DH15-2 and 10.3 m, elevation 679.5 m in DH15-3. Bedrock was not encountered in any of the drill holes.

On June 10, 2015 groundwater in DH15-1 was recorded as 12.4 m below ground surface, elevation 683.0 m.

3.0 BACKGROUND GEOLOGICAL INFORMATION

The surficial geology of the site is complex due to the presence of both glacial and post-glacial landforms. Soil stratigraphy encountered in the drill holes and the landform features can be explained by the following possible sequence of events.

1. The region, including the site, was covered by a thick ice sheet during the climax of the Fraser Glaciation, about 15,000 years ago. Basal lodgement till was deposited beneath the glacial ice as it slowly advanced in a northeasterly direction.

2. Following a change in global climate, the glacial advance stopped and melting started at higher elevation areas. During later stages of deglaciation a large lake developed across the Prince George area at around elevation 760 m due to an ice dam that blocked drainage to the south. Melting glacial ice became partially buoyant in the large glacial lake and resulted in the deposition of various sediments from and

adjacent to the ice. The processes of deposition were complex and could have included the following:

   a. fine grained sediments, including laminated clay, silt, and fine grained sand deposited from suspension in water;
   b. ablation till deposited from glacial ice floating in the lake;
   c. deltaic sediments at the margin of the glacial lake;
   d. localized sliding of lake sediments on steeper slopes.

3. The lake level likely fluctuated due to breaches and redevelopment of the ice dam. The fluctuations resulted in alternately floating and grounding of ice which could have prevented or disrupted the accumulation of lake sediments in localized areas.

4. The lake probably drained catastrophically, resulting in very high water velocities and massive erosion of the lacustrine and till deposits.

5. The flowing water deposited sand, gravel, and cobbles in various proportions across the Prince George bowl area, with gravel and cobbles at locations of higher water velocity and sand and gravelly sand at locations of lower velocity.

The sedimentary sequences encountered in the drill holes can be explained by the ice-margin model, but the model indicates the deposition sequence will be complex and can not predict the lateral extent of specific geologic units. In general, fine grained, water deposited sediments, such as clay, silt, and fine grained sand, were deposited over basal till. The contact between the till and overlying ice-margin sediments is likely transitional and interlayered with the different sediment types. The irregular, sloping topography suggests that the site was eroded, likely prior to and during deposition of the outwash plain, resulting in variation in the extent of the till and ice-margin sediments across the site.

A previous investigation carried out to the west of the proposed development included nine drill holes that extended to between geodetic elevations 688.0 m and 698.3 m, above the proposed floor slab elevations of the hotel and restaurant. The drill holes generally encountered layered, dense silt, sand and gravel and occasionally stiff to very stiff silt. No seepage was observed.

To assess the geomorphology of the site, we reviewed bare-earth images produced from Light Detecting and Ranging (LiDAR) data, dated 2009, available on the City of Prince George website. A copy of the image is on Drawing 4145-A3, in Appendix A. There is significant development around the site that masks much of the surrounding topography. The image shows the terrain at the site is irregular and undulating, consistent with erratic erosion and deposition as the level of the glacial lake changed. Glacial lake beach deposits are visible northeast of the site at around 760 m elevation.

4.0 DISCUSSION AND RECOMMENDATIONS

Our observations of the site and of the aerial photos and LiDAR imagery indicate there are no visible signs of deep-seated instability that might affect the project area.

Soil conditions at the site are variable but dense on average and adequate for the proposed development. Excavations will generally encounter dense, layered sand and gravel with a trace to some fines which has moderate to high shear strength, low potential for settlement, moderate to high susceptibility to frost heave caused by the development of ice lenses. The layered sand and gravel has a moderate to high potential for erosion.

The main floor of the hotel and the floor level of the restaurant are proposed to be at elevations 684.4 m and 683.3 m, respectively. Seepage was encountered at 683.0 and 680.5 m near the footprint of the hotel, about 1.4 m below the proposed floor slab elevation. Cuts to bring the site to grade are therefore unlikely to encounter seepage.

The following recommendations are based on the necessary assumption that the soil and groundwater conditions encountered in the drill holes and visible in man-made exposures are representative of the 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 Slope Stability

The site will be graded to elevation 684.3 m near the southwest corner of the site and elevation 682.8 m near the northeast corner. This will result in a maximum cut of 14.5 m. Soil conditions are dense on average and have relatively high shear strength and low compressibility.

A seismic hazard calculation obtained from the National Resources Canada (NRC) website located within the project area indicates a peak horizontal ground acceleration (PGA) with a 2% probability of exceedance in 50 years is 0.68 m/sec^2 or 0.069 g. g is the acceleration due to gravity, equal to 9.8 m/sec^2.

Based on a two-dimensional stability analysis using the program Slope/W a module of Geostudio 2012 by GeoStudio International, Inc., cut slopes at 2H:1V and the soil conditions discussed above have a factor of safety against sliding of at least 1.5. A factor of safety of 1.0 occurs at failure.

During an earthquake, the slope will be subjected to horizontal loads that will tend to reduce the factor of safety against sliding. The actual loads and their effect on a slope can be difficult to calculate. We used a standard simplified, pseudo-static analysis method that conservatively applies the full horizontal acceleration of the PGA to the potential slide mass. Our analysis shows that the factor of safety under these conditions exceeds 1.0. A factor of safety of at least 1.5 under normal conditions and 1.0 under the estimated extreme seismic conditions are considered acceptable according to design standards described in the guidelines[1] produced by the Association of Professional Engineers and Geoscientists of British Columbia.

4.2 Site Preparation

Based on the results of our slope stability analysis described in Section 4.1, above, we recommend cuts in the natural dense sand and gravel be sloped no steeper than 2H:1V. Use a slope no steeper than 3H:1V for landscaped slopes that will be mowed.

Please call our office if seepage is observed in cut slopes or construction excavations. If seepage occurs on permanent cut slopes, will likely recommend construction of a rock blanket consisting of a medium weight, non-woven geotextile, followed by a layer of angular shot rock.

To enhance erosion resistance on cut slopes, seed or hydroseed the exposed slopes with an appropriate mixture of plant species and divert any sources of runoff away from the slopes.

We understand the excavated material will be hauled off site to a nearby gravel pit. No embankment fills will be constructed as part of the project.

Please call our office if soil conditions are not consistent with those reported on the drill hole logs, if seepage is observed or if signs of instability such as tension cracks, sloughing or bulges develop during excavation.

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[1] Guidelines for Legislated Landslide Assessments for Proposed Residential Development in BC. Revised May 2010. Association of Professional Engineers and Geoscientists of British Columbia.

4.3 Buried Services

We recommend using the standard City of Prince George minimum soil cover of 3.0 m over water lines and 2.4 m over sanitary and storm sewer lines, measured perpendicular to the ground surface. Use temporary side slopes for trench excavations no steeper than 1H:1V in the natural soil or use a trenching cage or shoring to reduce excavation and backfill volumes. If trenches encounter loose sand and gravel, wet silt or seepage, excavation slopes might need to be 1.5H:1V or flatter. We recommend that a geotechnical engineer review trench excavations where they are deeper than 5 m, if loose pockets of soil are encountered, if signs of instability develop, if seepage is observed, or if the undrained shear strength of soil is less than 25 kPa (can be easily penetrated several centimetres by a thumb).

Excavate the trench bottom to a width equal to the pipe diameter plus at least 500 mm on each side of the pipe to allow room for compaction equipment. For backfill around buried pipes, use Well Graded Base (WGB), defined in Table 1, below, or sand containing less than 10% fines, or other backfill materials approved by the pipe manufacturer. Place a minimum of 100 mm of granular fill below the pipes and 200 mm above. Compact the pipe bedding to at least 95% SPD at a moisture content near optimum.

For WGB, use crushed and screened material that meets the requirements of B.C. Ministry of Transportation and Infrastructure (BCMoT) Standard Specifications. The Select Granular Subbase (SGSB) can be a pit run material that meets the above gradation. Use durable aggregate that will not degrade from exposure to water, freeze-thaw cycles or handling, spreading or 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.

Use granular fill and drain rock 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	-	-
0.300	5-20	3-15	-
0.075	0-5	0-5	0-2

For trench backfill use mineral soil free of organic material and debris, with a maximum particle size of 150 mm. Where the trench excavation extends below a road or building foundation, place the trench fill in thin, uniform layers no more than 300 mm thick and compact each layer to at least 98% Standard Proctor Density (SPD) (ASTM D698) and to at least 100% SPD within 1 m of the finished ground surface and when below building foundations. Where the excavations are not located below roads or other structures sensitive to settlement, we recommend compacting the trench fill to at least 95% SPD. Add water or dry the fill as required to achieve the specified density. We recommend working with an experienced geotechnical technician to optimize placement procedures.

The maximum layer thickness for compaction will depend on several factors, including compactor type, size and energy, and the soil type and moisture content, but do not exceed a layer thickness of 300 mm. We suggest working with an experienced geotechnical technician to optimize placement procedures.

4.4 Roads and Sidewalks

The following recommended road structure designs are based on our past experience and design methods proposed by the Roads and Transportation Association of Canada (TAC) and the American Association of State Highway and Transportation Officials (AASHTO) "Guide to Design of Pavement Structures".

The design assumes that subgrade fill in utility trenches and for site grading will have similar or greater strength than the natural, dense sand and gravel or very stiff to hard silt till. Both are susceptible to frost heave and loss of strength during spring thaw. In an average year frost will penetrate about 1.8 m below areas exposed to freezing temperatures. Increasing the thickness of granular fill decreases the thickness of subgrade that will be frozen, which will help to reduce the amount of frost heave and subsequent loss of strength. Base and subbase fill meeting the gradation specifications for WGB and SGSB are considered non-frost-susceptible and do not contribute to frost heave.

The following pavement structures are not intended to protect the subgrade from freezing and developing ice lenses but are intended to have sufficient strength to allow full operation through spring thaw when the road subgrade will be in its weakest condition. We recommend the following minimum thickness for design of the road structures.

Table 2 - Recommended Pavement Structures for Design Traffic Loading

Pavement Component	Local Roads	Parking Areas
Hot Mix Asphaltic Concrete	75 mm	65 mm
Well Graded Base	150 mm	100 mm
Select Granular Subbase	600 mm	400 mm

We recommend using hot mix asphalt pavement that conforms with BCMoT Standard Specifications for Class 1, 16 mm Medium Mix Asphalt.

The potential for developing frost lenses in the subgrade can be lessened by providing good surface and subsurface drainage. We recommend the subgrade be sloped at least 2% towards ditches and the ditches be constructed at least 150 mm below the road subgrade elevation. Regular maintenance to keep ditches drained will also reduce the potential for water to infiltrate the subgrade and contribute to frost heave. If using catch basins, install drains along low spots in the subgrade surface, with pipe inverts at least 150 mm lower than the adjacent subgrade. Use 150 mm diameter, perforated SDR 35 pipe, or equivalent and surround the pipe with 150 mm of drain rock, all wrapped in a non-woven geotextile with an apparent opening size less than 0.25 mm.

To prepare the subgrade, remove all existing fill, organic soil, heavily rooted, wet and loose material in areas that will be covered by the new pavement structure and sidewalks, and beyond the edges of the pavement a horizontal distance equal to twice the depth of fill required below the pavement. Crown or shape the top of the subgrade excavation to a minimum 2% slope prior to placing any granular fill, so that water will not pond on this surface. Compact the subgrade surface with a vibratory roller compactor weighing at least 2500 kg. Excavate rutted, soft or wet areas and replace with dryer mineral soil of similar gradation to the subgrade soil, placed in thin layers and compacted to at least 100% SPD at a moisture content no more than 2% above optimum.

If fill is needed to bring subgrade areas to design elevation, use mineral soil free of organic material and debris, with a maximum particle size of 150 mm. Place the soil at no more than 2% above optimum moisture content, placed in maximum 300 mm thick layers and compacted to at least 98% SPD and 100% SPD within 1 m of the top of pavement.

Place the subbase and base fill in maximum 300 mm thick layers and compact each layer to at least 100% SPD. Add water or dry the fill as necessary to attain the specified density.

Below sidewalks, we recommend 80 mm of WGB over 300 mm of SGSB, over the prepared subgrade. Compact the top 300 mm of subgrade to at least 98% SPD and the subbase and base fills to at least 100% SPD. Use a finished surface of at least 100 mm of concrete.

4.5 Spread Footing Foundations

Design footings supported on undisturbed, natural, dense layered sand and gravel, hard silt till or hard silty clay using a factored geotechnical resistance of 300 kPa (for limit states design) and an allowable bearing capacity of 200 kPa (for serviceability conditions). We estimate that footings less than 2.5 m wide bearing on natural, dense layered sand and gravel, hard silt till or hard silty clay and subjected to the design loading will settle less than about 1 cm.

Use a minimum footing width of 400 mm for strip footings and 600 mm for square pad footings. Provide at least 300 mm of soil 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, measured from the adjacent final grade to the base of the footing.

The use of rigid insulation below the floor slab or against the inside face of perimeter foundation walls will reduce the amount of building heat available to warm the foundation bearing soil, and if used, we recommend the foundation be designed as if it is unheated. In general we recommend vertical insulation, if used, extend down the outside face of the perimeter foundation wall to improve thermal efficiency and to allow building heat to warm the foundation soil. We recommend that we review foundation insulation details prior to final design.

Protect foundations not warmed by building heat by providing 2.4 m of soil cover or as follows:

- Remove frost-susceptible soil to 2.4 m depth from surfaces exposed to freezing temperatures and replace with compacted, non-frost-susceptible structural fill, or
- Use rigid, extruded polystyrene board insulation as shown on Drawing 4145-D1 in Appendix D, or
- Use a combination of these methods.

Use slopes no steeper than 2H:1V between footings at different elevations, unless site specific analysis indicates that steeper angles are appropriate. Step strip footings that cross areas of different elevations using a maximum vertical rise of 600 mm 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.

Exterior foundation wall drainage is not required where the interior slab is grade-supported and above the outside finished grade. We recommend installing a perimeter foundation drain adjacent to basement or crawl space walls, or if there will be below-slab heating ducts or mechanical equipment.

Protect foundation soil from freezing during construction.

4.6 Grade-Supported Floor Slabs

We recommend the following procedures to reduce the potential for future slab movement and cracking:

- Remove all fill, organic soil and soft, wet, frozen or deleterious soil to expose the natural, sand and gravel, silt till or silty clay.
- Bring slab areas to grade using SGSB placed in uniform layers no thicker than 300 mm, and compact each layer to at least 100% SPD. Provide at least 300 mm of SGSB below grade-supported slab areas.
- Directly below the slab, place a minimum 100 mm thick layer of WGB and compact it to at least 100% SPD.

4.7 Lateral Earth Pressures

Design crawlspace, basement and retaining walls to withstand lateral pressures caused by soil, seismic loads, and any surcharges. Drawings 4145-D2 and D3, in Appendix D, show typical lateral earth pressures that can develop against restrained and unrestrained walls, respectively. Both cases assume that drainage protects against hydrostatic forces. Fill against the walls using granular fill that meets the gradation specifications for SGSB. Design the walls to resist lateral pressure from soil with a density of 22 kN/m^3, and using an at-rest coefficient of lateral earth pressure, K_o, of 0.38 for restrained conditions, an active coefficient of lateral earth pressure, K_a, of 0.24 for unrestrained conditions and a passive coefficient of lateral earth pressure K_p, of 4.2. Add the pressures from compaction, vehicles and other surcharge loads where they are appropriate.

Protect below-grade walls from seepage and hydrostatic pressures by installing a perimeter drainage system as shown on Drawing 4145-D4, in Appendix D. Discharge water collected in the perimeter drain to surface by gravity or through a sump and pump.

4.8 Retaining Walls

As part of the development, mechanically stabilized earth (MSE) retaining walls will be constructed along the south and part of the west sides of a proposed development. The walls will be built using concrete locking blocks with dimensions of 0.75 m wide by 0.75 m high by 1.5 m long, tied back and reinforced with geogrid, and backfilled using compacted structural fill. There will be approximately 115 m of retaining wall no more than 3.75 m in height, or 5 standard locking blocks high. The fill above the walls will be sloped up at a gradient no steeper than 2H:1V. Drawing 4145-A2 shows the locations of the proposed retaining walls.

We designed the MSE walls for this project using methods described in Report No. FHWA-NH1-00-043, dated March 2001 (published by the National Highway Institute, US Department of Transportation) and the Canadian Foundation Engineering Manual, 4th Edition. The wall design details are shown on Drawing 4145-E1. We checked the design for factors of safety against external failure (bearing capacity, sliding and overturning) and internal failure (geogrid breakage and pullout). We determined that adequate factors of safety were achieved using the geogrid length and configuration shown on Drawing 4145-E1 and based on the following construction procedures:

1. Design the elevation of the bottom of the blocks to allow at least 300 mm soil cover over the front of the blocks. Excavate behind the blocks a distance equal to the length of geogrid. Slope the back of the excavation up at no steeper than 1H:1V.

2. Below the first row of blocks, place a leveling course of WGB at least 150 mm thick and at least 300 mm beyond the front and back of the blocks. Compact this layer to at least 100% SPD. Slope the leveling surface so the blocks will be battered back about 1H:10V (10%).

3. Place a length of Tensar UX1600MSE uniaxial geogrid, or equivalent, on the prepared level surface from the front of the blocks and back 75% of the wall height

from the back of the blocks for a total length of 3.6 m for a 5 block high wall, as shown on Drawing 4145-E1. Place the geogrid with the direction of reinforcement perpendicular to the blocks. Place the sheets adjacent to each other to provide complete coverage behind the wall but do not overlap the sheets.

4. Place the first row of blocks on the levelling course and geogrid such that the long dimension of the blocks are parallel to the face of the wall.

5. Directly behind the blocks place SGSB in uniform layers no thicker than 300 mm and compact each layer to at least 98% SPD. Spread the fill starting from the block and working back to maintain tension in the geogrid. Within 1 m of the back of the blocks, use thinner layers and hand-operated vibratory compaction equipment weighing less than 225 kg (500 lb).

6. When the fill is up to the top of the first row of blocks, install the second layer of geogrid over the cruciform on the top of the block, but do not cut the geogrid to fit the cruciform. Place the second row of blocks over the geogrid, remove slack from the geogrid, then cover it with structural fill as described above.

7. Repeat this process for the remaining layers of geogrid, blocks and compacted, structural fill.

Where the height of the retaining wall changes, make the transition a full block in height to maintain continuity of the geogrid. This also applies to corners and areas where site grading affects the height of the wall. If the geogrid overlaps at corners or curves, separate the geogrid with at least 75 mm of compacted sand fill. Shape final fill slopes above the wall to be no steeper than 2H:1V.

4.9 Site Classification for Seismic Response

The 2012 British Columbia Building Code defines the "Site Classification for Seismic Site Response", Table 4.1.8.4.A, which is based on properties of the soil at the site in the top 30 m. The results of our investigation, indicate the Site Classification for Seismic Site Response is Site Class "C", "very dense soil".

4.10 Liquefaction

The drill holes encountered generally dense to very dense conditions with SPT "N" values averaging 52 and groundwater was not encountered. There is a negligible likelihood of liquefaction in dry, dense soils as encountered during our investigation.

5.0 CONSTRUCTION REVIEW

We recommend that we review the design drawings before they are finalized to check that the intent of our recommendations has been adequately communicated and applied to the design and that the level of the investigation is adequate for the project.

We also recommend, and the B.C. Building Code specifies, that an experienced engineer or his designate carry out construction review and testing of the following:

- all foundation excavations, and
- all compacted, structural fill supporting structural building components.

Prior to us being able to complete Schedule C-B of the B.C. Building 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 subgrade prior to embankment fill being placed, and 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.

6.0 CLOSURE

This report was prepared by GeoNorth Engineering Ltd. for the use of Insight Progressive Developments Inc. 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 part of the report requires clarification.

Yours truly,
GeoNorth Engineering Ltd.

PROFESSIONAL ENGINEER
PROVINCE OF BRITISH COLUMBIA
W. J. LANENGA
38338

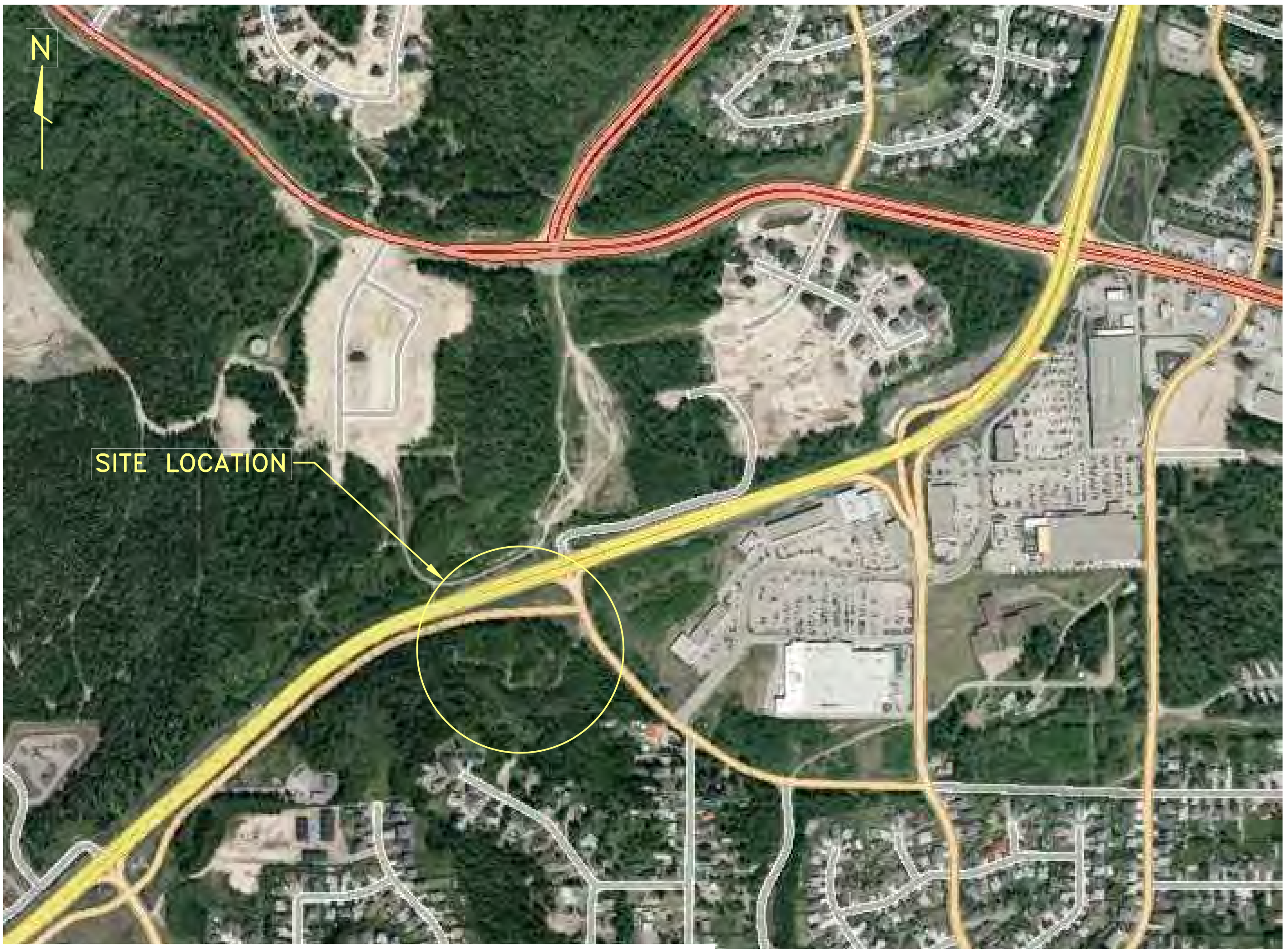
Per: W.J. Lanenga, P.Eng.

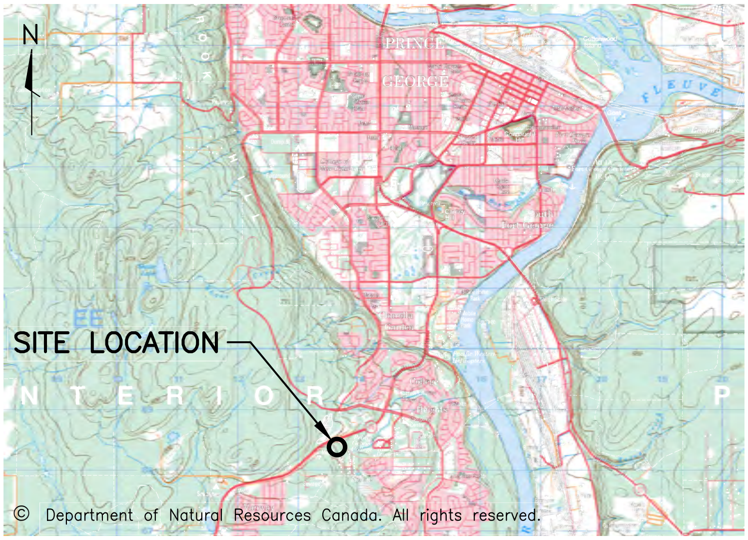
Reviewed by,
GeoNorth Engineering Ltd.

for

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

APPENDIX A





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KEY MAP

NTS Map — 93 G/15 Scale — 1:125,000

NOTE:

SITE LOCATION PLAN BASED ON DIGITAL INFORMATION FROM CITY OF PRINCE GEORGE WEBSITE. ORTHOPHOTO DATED SPRING 2014. ACCURACY CANNOT BE GUARANTEED.

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INSIGHT PROGRESSIVE DEVELOPMENTS INC.
PROPOSED HOTEL AND RESTAURANT
MARLEAU ROAD AND HIGHWAY 16, PRINCE GEORGE, B.C.
SITE LOCATION PLAN

SCALE: 1:10,000	DATE: 2015/08/13	DRAWN: LU	CHKD: —	PROJ: K-4145	DWG: 4145-A1

NOTES:

1. SITE PLAN BASED ON DIGITAL INFORMATION PROVIDED BY L&M ENGINEERING LIMITED.
2. DRILL HOLE LOCATIONS ARE APPROXIMATE.

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INSIGHT PROGRESSIVE DEVELOPMENTS INC.
PROPOSED HOTEL AND RESTAURANT
MARLEAU ROAD AND HIGHWAY 16, PRINCE GEORGE, B.C.
SITE PLAN SHOWING DRILL HOLES

SCALE: 1:500
DATE: 2015/08/13
DWN BY: LU
MAP REF: -
DWG NO. 4145-A2
APPROVED:
PROJECT NO: K-4145
REV. -

NOTES:

1. SITE PLAN BASED ON DIGITAL INFORMATION TAKEN FROM CITY OF PRINCE GEORGE WEBSITE. ACCURACY CANNOT BE GUARANTEED.

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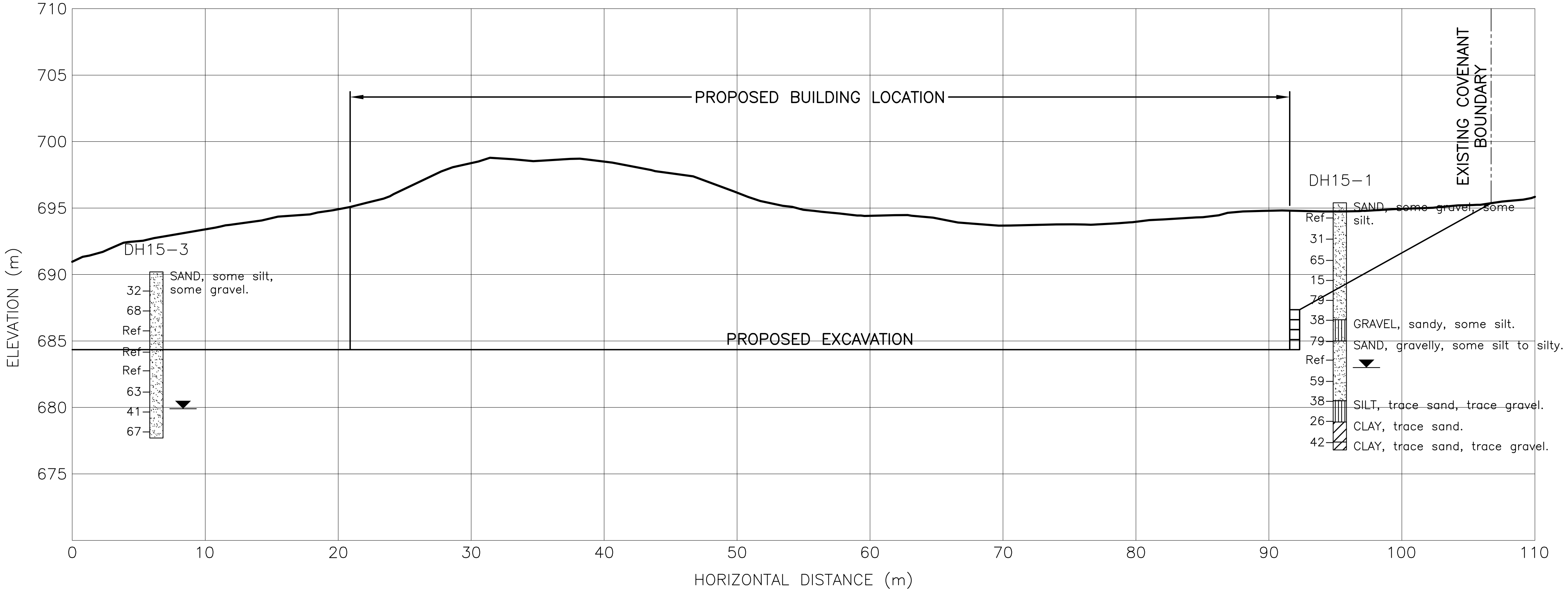
INSIGHT PROGRESSIVE DEVELOPMENTS INC.
PROPOSED HOTEL AND RESTAURANT
MARLEAU ROAD AND HIGHWAY 16, PRINCE GEORGE, B.C.
SITE PLAN SHOWING 2009 LIDAR HILLSHADE

SCALE: 1:1000
DATE: 2015/08/13
DWN BY: LU
MAP REF: –
DWG NO. 4145-A3
APPROVED:
REV. –
PROJECT NO: K-4145



Cross Section A–A

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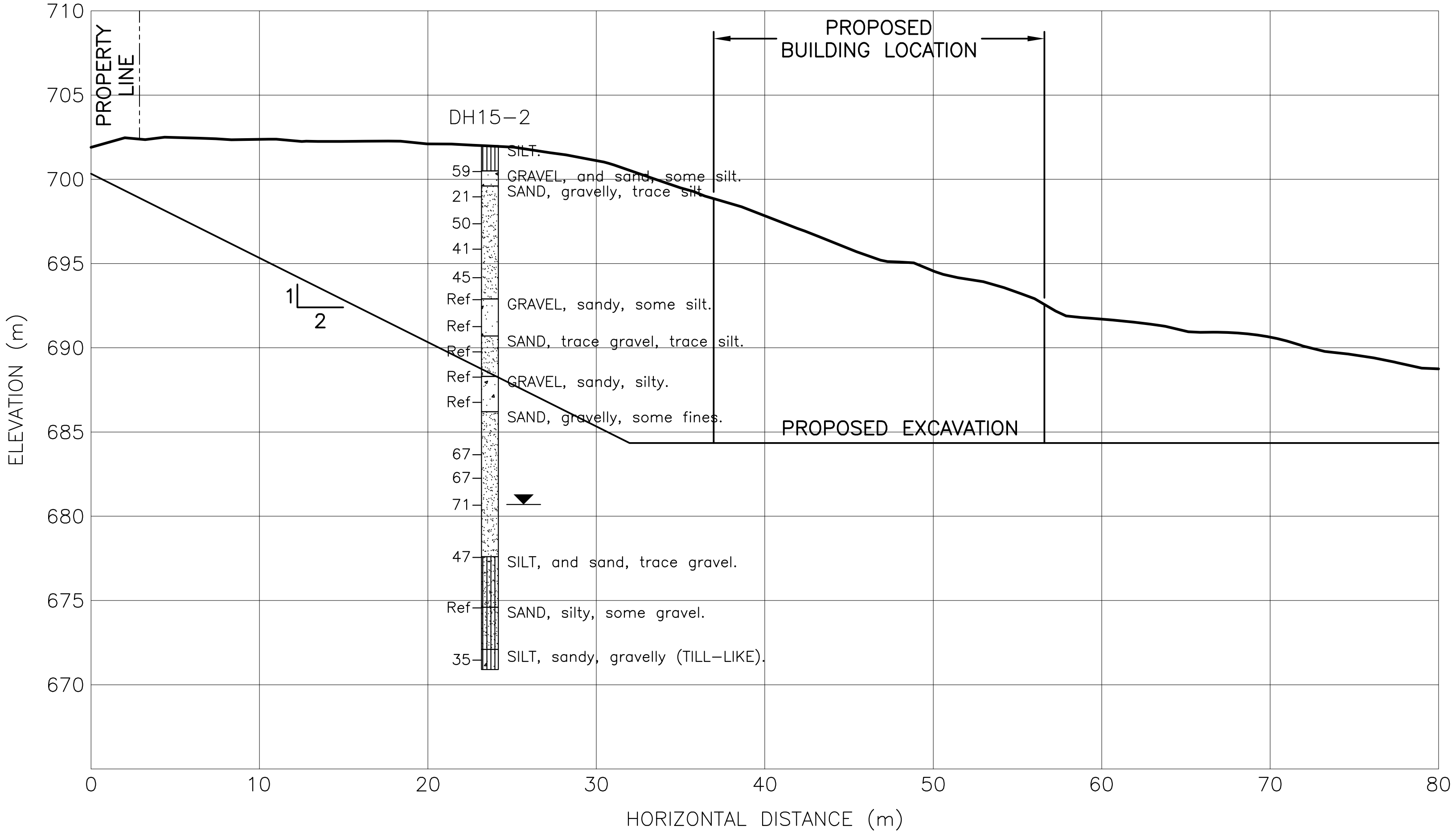
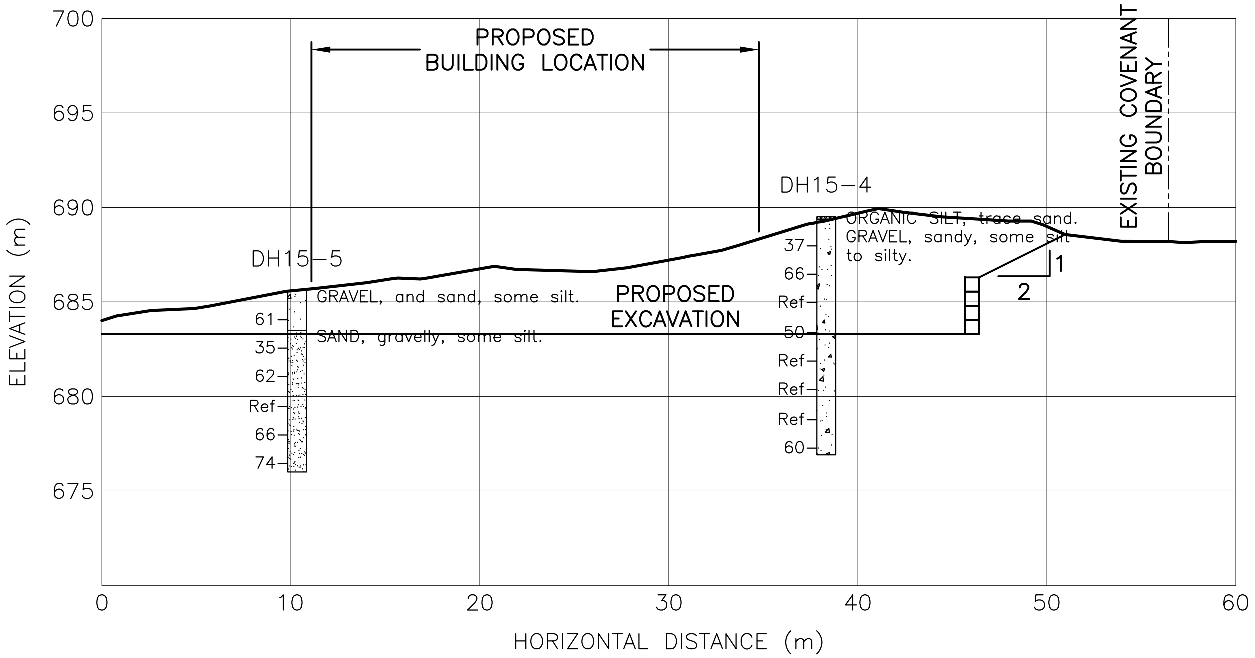
INSIGHT PROGRESSIVE DEVELOPMENTS INC.
PROPOSED HOTEL AND RESTAURANT
MARLEAU ROAD AND HIGHWAY 16, PRINCE GEORGE, B.C.
CROSS SECTIONS

APPROVED:	
PROJECT NO:	K–4145
REV.	–
SCALE:	1:400
DATE:	2015/08/13
DWN BY:	LU
MAP REF:	–
DWG NO.	4145–A4



Cross Section B–B



Cross Section C–C

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INSIGHT PROGRESSIVE DEVELOPMENTS INC.
PROPOSED HOTEL AND RESTAURANT
MARLEAU ROAD AND HIGHWAY 16, PRINCE GEORGE, B.C.
CROSS SECTIONS

APPROVED:

SCALE:	1:400
DATE:	2015/08/13
DWN BY:	LU
MAP REF:	–
DWG NO.	4145–A5
REV.	–
PROJECT NO:	K–4145

APPENDIX B

GEONORTH ENGINEERING LTD.
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DRILL HOLE LOG

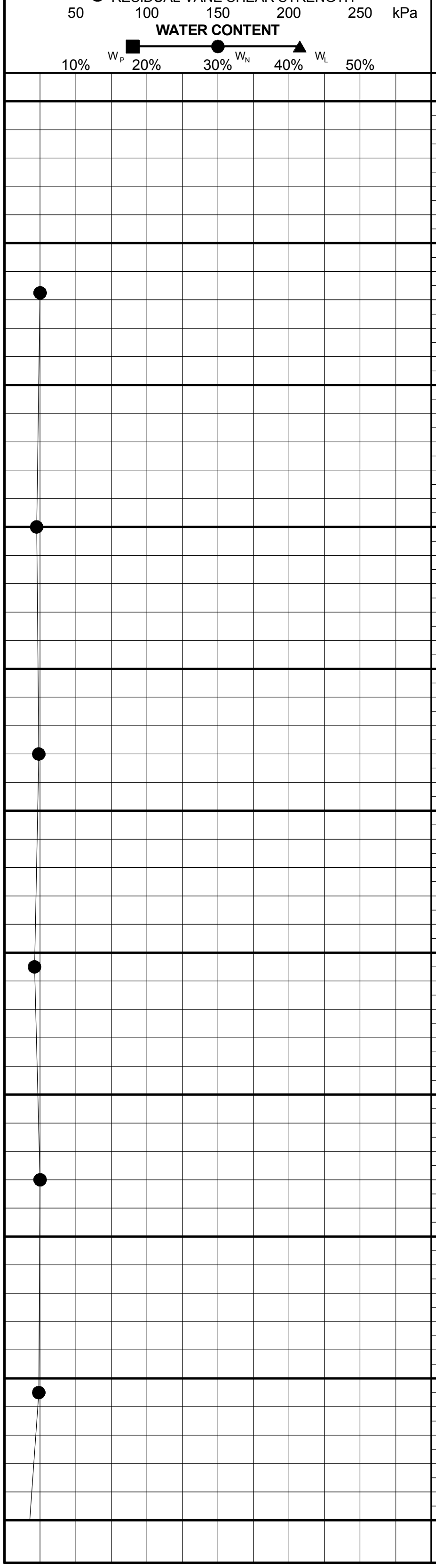
HOLE NO: **DH15-1**

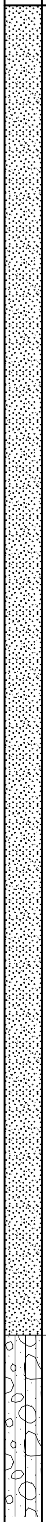
CLIENT **INSIGHT PROGRESSIVE DEVELOPMENTS INC.**

PROJECT **PROPOSED HOTEL AND RESTAURANT**
MARLEAU ROAD AND HIGHWAY 16
PRINCE GEORGE, B.C.

LOGGED: NJ
FILE NO: K-4145
DRILL: Cased Air-Rotary
DATE OF INVEST: 2015/06/08
LOCATION: 10U 513681E 5968332N
SURFACE ELEVATION (m): 695.4

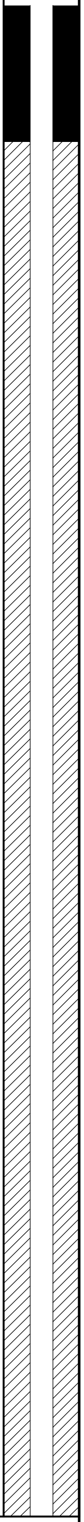
STRENGTH TEST RESULTS
◆ POCKET PENETROMETER RDG.
× NATURAL VANE SHEAR STRENGTH
⊗ RESIDUAL VANE SHEAR STRENGTH





SOIL DESCRIPTION

DEPTH (m)	SOIL DESCRIPTION	ELEV (m)	SAMPLES	SPT, BLOWS PER 152 mm	SPT 'N' / RECOVERY (mm)	COMMENTS
0	SAND, some gravel, some silt, no visible structure, very dense, brown, damp.					Water level taken on June 10, 2015 12.4 m below ground surface
				27 50	Ref / 0	
	- below 2.7 m, trace silt, trace gravel, dense.			10 15 16 20	31 / 600	
	- between 4.3 and 5.8 m, gravel, sandy, some silt, very dense.			14 32 33 36	65 / 550	- Grain Size Analysis, See Plate 4145-C1
	- below 5.8 m, compact.			9 8 7 12	15 / 290	
	- below 7.3 m, very dense.			21 38 41 37	79 / 300	
8.8	GRAVEL, sandy, some silt, no visible structure, dense, brown, moist.	686.6		12 20 18 27	38 / 450	- Grain Size Analysis, See Plate 4145-C2



(continued on next page)

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DRILL HOLE LOG

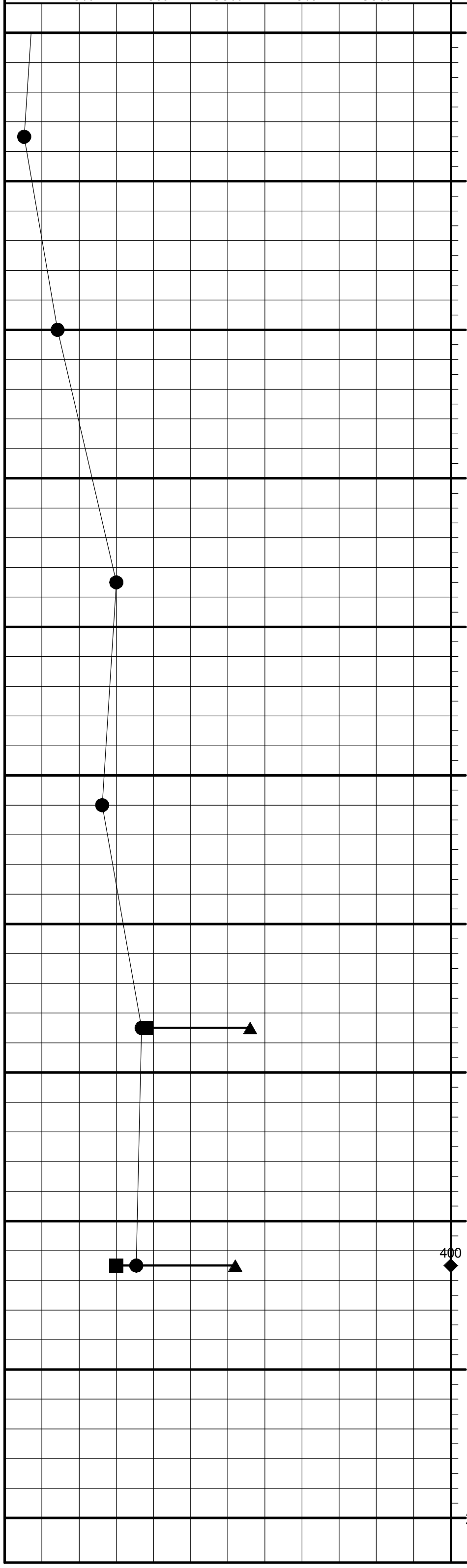
HOLE NO: **DH15-1**

CLIENT **INSIGHT PROGRESSIVE DEVELOPMENTS INC.**

PROJECT **PROPOSED HOTEL AND RESTAURANT**
MARLEAU ROAD AND HIGHWAY 16
PRINCE GEORGE, B.C.

LOGGED: NJ
FILE NO: K-4145
DRILL: Cased Air-Rotary
DATE OF INVEST: 2015/06/08
LOCATION: 10U 513681E 5968332N
SURFACE ELEVATION (m): 695.4

STRENGTH TEST RESULTS
◆ POCKET PENETROMETER RDG.
× NATURAL VANE SHEAR STRENGTH
⊗ RESIDUAL VANE SHEAR STRENGTH
50 100 150 200 250 kPa
WATER CONTENT
■ W_P ● W_N ▲ W_L
10% 20% 30% 40% 50%



SOIL DESCRIPTION

DEPTH (m)	SOIL DESCRIPTION	ELEV (m)	SPT, BLOWS PER 152 mm	SPT 'N' / RECOVERY (mm)	COMMENTS
	GRAVEL, sandy, some silt, no visible structure, dense, brown, moist. *(continued)*				
10.4	SAND, gravelly, some silt to silty, no visible structure, very dense, brown, moisture visible in siltier zones.	685.0	16 33 46 44	79 / 330	
	- below 11.9 m, and silt, damp.		33 50	Ref / 170	
	- below 13.4 m, and gravel, silty, wet. - seepage at 13.7 m.		18 29 30 17	59 / 420	
14.9	SILT, trace sand, trace gravel, layered, dense, low plasticity, grey, moist, interbedded with layers of sand.	680.5	8 13 25 31	38 / 510	
16.5	CLAY, trace sand, layered, compact, intermediate plasticity, light grey, high content of muscovite flakes, moist.	678.9	5 12 14 20	26 / 660	
	- below 18.0 m, trace gravel, hard.		23 26 16 17	42 / 490	
18.8	End of drill hole at 18.6 m. Seepage at 13.7 m.	676.6			

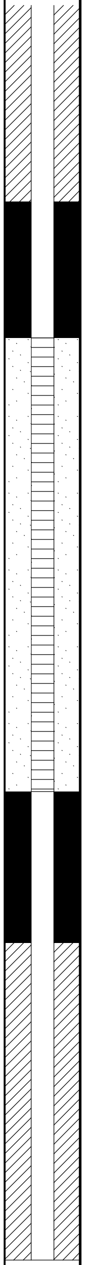


PLATE NO. **4145-B1** Pg 2 of 2

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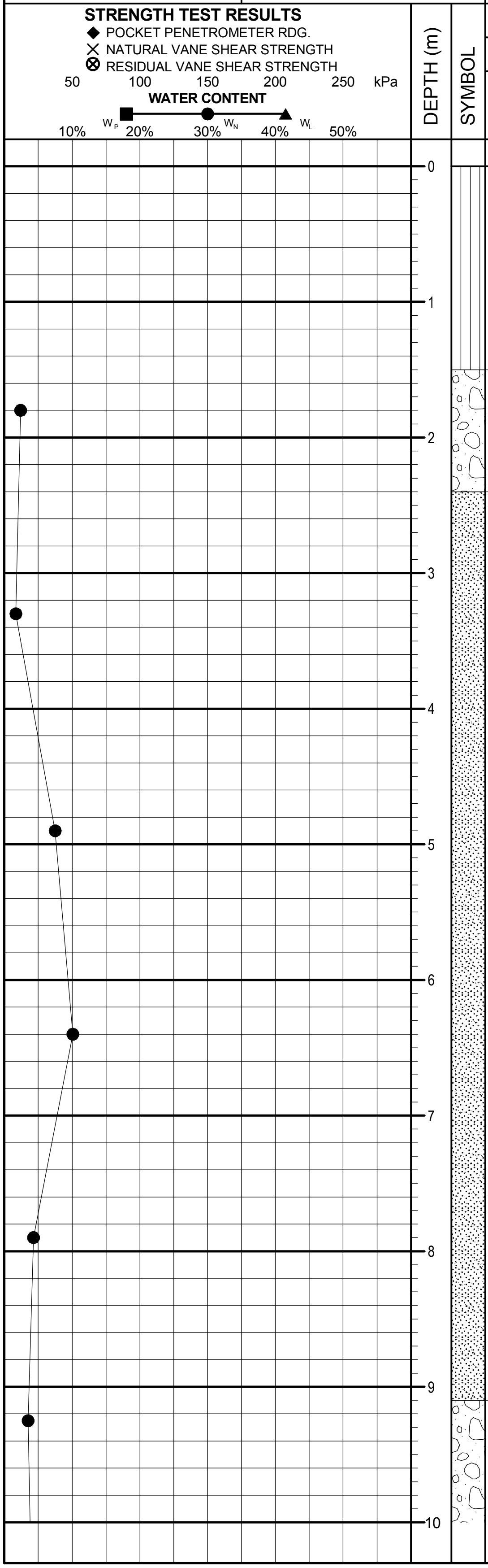
DRILL HOLE LOG

HOLE NO: **DH15-2**

CLIENT **INSIGHT PROGRESSIVE DEVELOPMENTS INC.**

PROJECT **PROPOSED HOTEL AND RESTAURANT**
MARLEAU ROAD AND HIGHWAY 16
PRINCE GEORGE, B.C.

LOGGED: NJ
FILE NO: K-4145
DRILL: Cased Air-Rotary
DATE OF INVEST: 2015/06/09
LOCATION: 10U 513659E 5968373N
SURFACE ELEVATION (m): 702.0



SOIL DESCRIPTION

DEPTH (m)	SOIL DESCRIPTION	ELEV (m)	SPT, BLOWS PER 152 mm	SPT 'N' / RECOVERY (mm)	COMMENTS
0	SILT, no visible structure, hard, low to intermediate plasticity, brown, trace organics, damp.	702.0			
1.5	GRAVEL, and sand, some silt, no visible structure, very dense, grey-brown, damp.	700.5	10 19 40 42	59 / 340	
2.4	SAND, medium grained, gravelly, trace silt, no visible structure, compact, brown, damp.	699.6			
			5 10 11 10	21 / 360	
	- below 4.6 m, very dense.		8 21 29 37	50 / 500	
	- below 5.2 m, trace gravel.				
	- below 6.1 m, some silt, dense.		9 21 20 30	41 / 680	- Grain Size Analysis, See Plate 4145-C3
	- between 7.6 and 8.2 m, coarse grained sand.		7 21 24 25	45 / 540	
9.1	GRAVEL, subangular, sandy, fine grained, some silt, no visible structure, very dense, brown, damp.	692.9	24 50	Ref / 240	

(continued on next page)

PLATE NO. **4145-B2** Pg 1 of 4

DRILL HOLE LOG

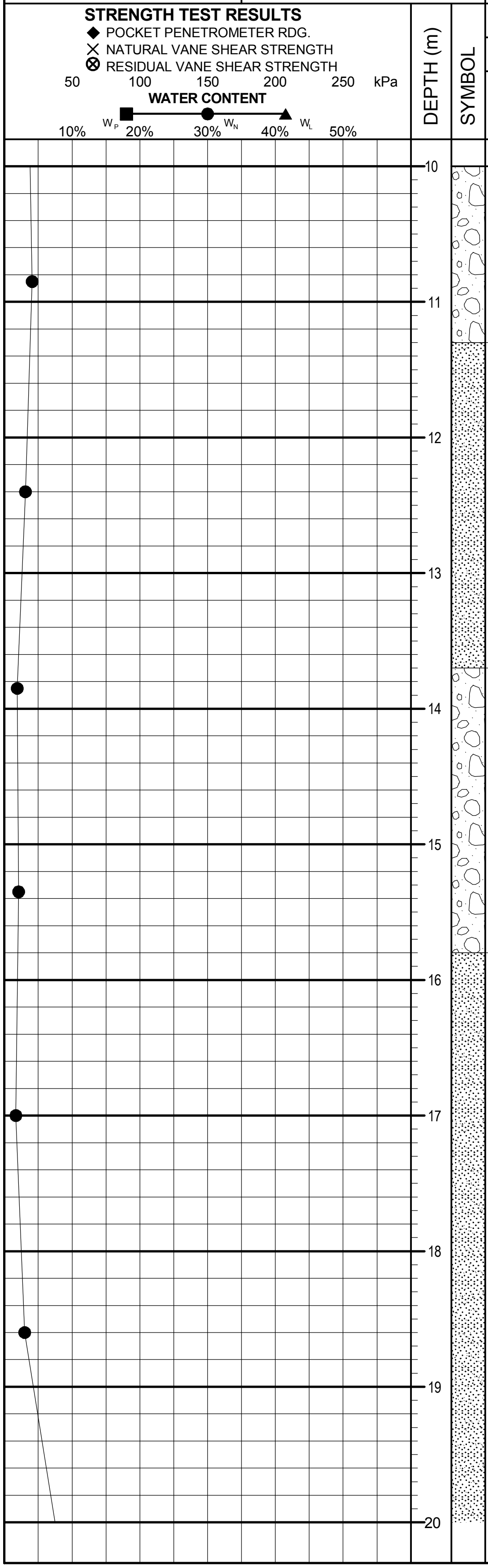
HOLE NO: **DH15-2**

CLIENT **INSIGHT PROGRESSIVE DEVELOPMENTS INC.**

PROJECT **PROPOSED HOTEL AND RESTAURANT**
MARLEAU ROAD AND HIGHWAY 16
PRINCE GEORGE, B.C.

LOGGED: NJ
FILE NO: K-4145
DRILL: Cased Air-Rotary
DATE OF INVEST: 2015/06/09
LOCATION: 10U 513659E 5968373N
SURFACE ELEVATION (m): 702.0

STRENGTH TEST RESULTS
◆ POCKET PENETROMETER RDG.
× NATURAL VANE SHEAR STRENGTH
⊗ RESIDUAL VANE SHEAR STRENGTH



SOIL DESCRIPTION

DEPTH (m)	ELEV (m)	SOIL DESCRIPTION	SPT, BLOWS PER 152 mm	SPT 'N' RECOVERY (mm)	COMMENTS
		GRAVEL, subangular, sandy, fine grained, some silt, no visible structure, very dense, brown, damp. *(continued)*			
		- below 10.7 m, silty, coarse grained sand.	32 50	Ref 250	
11.3	690.7	SAND, medium grained, trace gravel, trace silt, no visible structure, very dense, brown, damp.			
			11 28 50	Ref 550	
13.7	688.3	GRAVEL, subangular, sandy, silty, no visible structure, very dense, light brown, damp.	14 50	Ref 210	
		- below 15.2 m, and sand, trace to some silt.	21 50	Ref 230	
15.8	686.2	SAND, medium grained, gravelly, some fines, no visible structure, very dense, light brown, damp.			
		- between 16.8 and 17.4 m, gravel, sandy, trace silt.	20 29 38 50	67 380	- Grain Size Analysis, See Plate 4145-C4
		- between 18.3 and 21.3 m, trace silt, trace gravel.	35 36 31 40	67 530	

(continued on next page)

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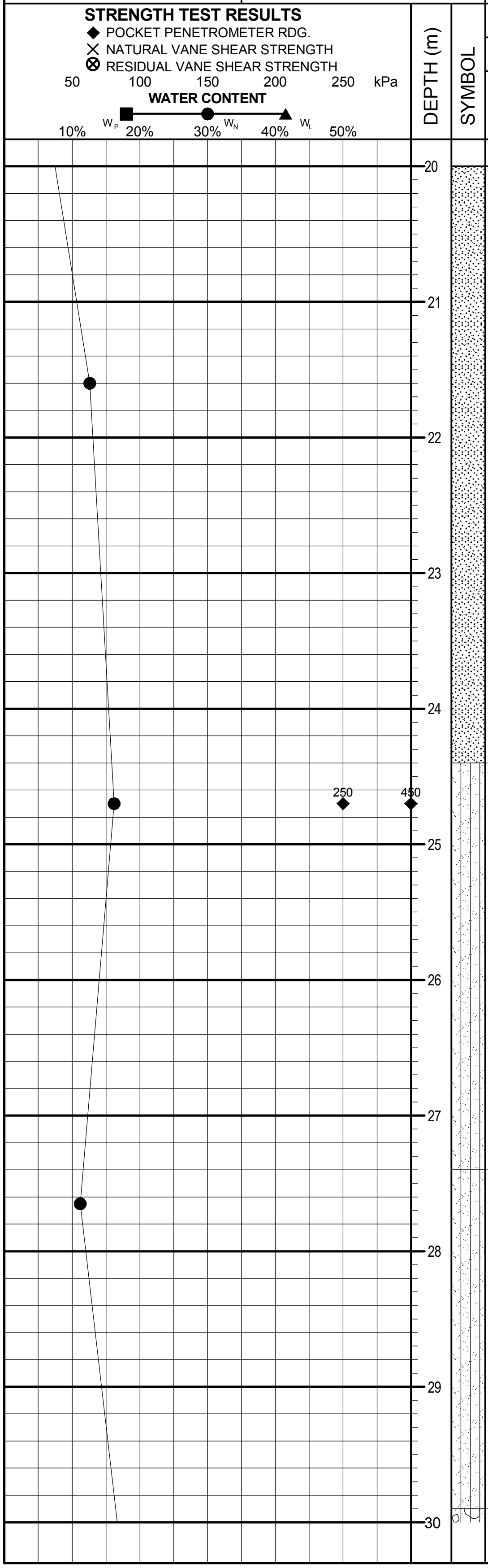
DRILL HOLE LOG

HOLE NO: **DH15-2**

CLIENT **INSIGHT PROGRESSIVE DEVELOPMENTS INC.**

PROJECT **PROPOSED HOTEL AND RESTAURANT**
MARLEAU ROAD AND HIGHWAY 16
PRINCE GEORGE, B.C.

LOGGED: NJ
FILE NO: K-4145
DRILL: Cased Air-Rotary
DATE OF INVEST: 2015/06/09
LOCATION: 10U 513659E 5968373N
SURFACE ELEVATION (m): 702.0



SOIL DESCRIPTION

DEPTH (m)	SOIL DESCRIPTION	ELEV (m)	SAMPLES	SPT, BLOWS PER 152 mm	SPT 'N' / RECOVERY (mm)	COMMENTS
	SAND, medium grained, gravelly, some fines, no visible structure, very dense, light brown, damp. *(continued)*					
	- below 21.3 m, wet. - seepage at 21.3 m.			17 43 28 37	71 / 400	
	- below 22.3 m, coarse grained sand.					
	- below 22.9 m, and silt.					
24.4	SILT, and sand, trace gravel, layered, very stiff to hard, non to low plasticity, light grey, moist, interbedded with silty sand layers. PP=450 kPa in silt layer PP=250 kPa in silty sand layer	677.6		10 23 24 24	47 / 650	
27.4	SAND, silty, some gravel, no visible structure, very dense, grey, moist.	674.6		8 35 50	Ref / 420	
29.9		672.1				

(continued on next page)

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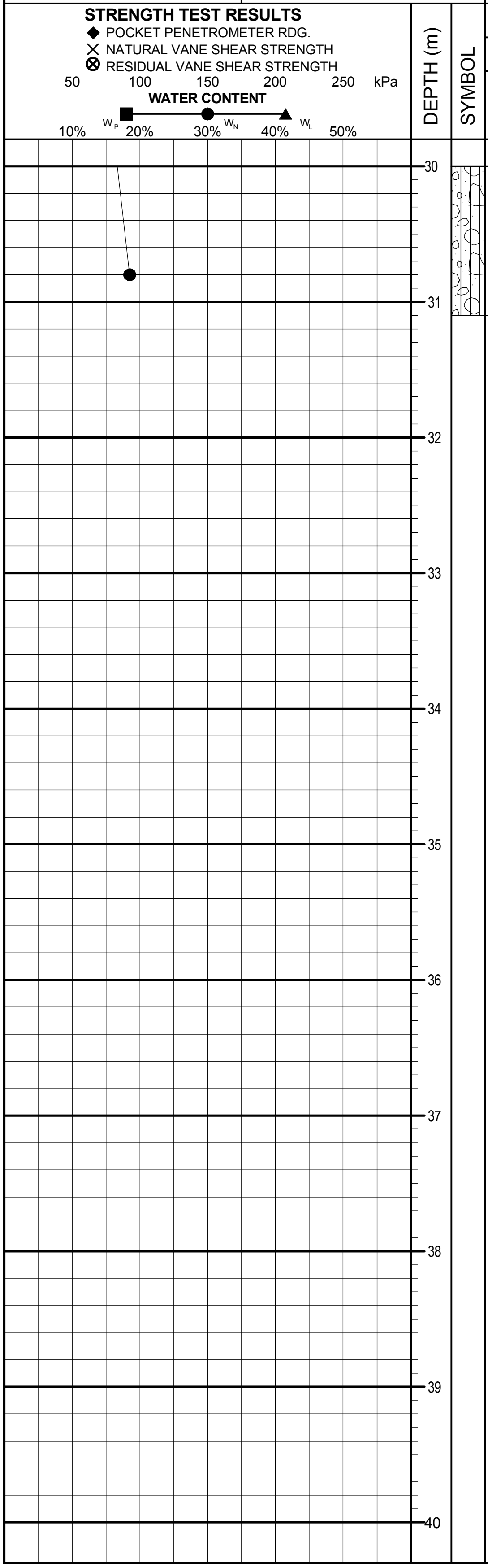
DRILL HOLE LOG

HOLE NO: **DH15-2**

CLIENT **INSIGHT PROGRESSIVE DEVELOPMENTS INC.**

PROJECT **PROPOSED HOTEL AND RESTAURANT**
MARLEAU ROAD AND HIGHWAY 16
PRINCE GEORGE, B.C.

LOGGED: NJ
FILE NO: K-4145
DRILL: Cased Air-Rotary
DATE OF INVEST: 2015/06/09
LOCATION: 10U 513659E 5968373N
SURFACE ELEVATION (m): 702.0



SOIL DESCRIPTION

DEPTH (m)	SOIL DESCRIPTION	ELEV (m)	SAMPLES	SPT, BLOWS PER 152 mm	SPT 'N' / RECOVERY (mm)	COMMENTS
	SILT, sandy, gravelly, no visible structure, dense, low plasticity, grey and brown, damp (TILL-LIKE). *(continued)*			15 16 19 24	35 590	
31.1	End of drill hole at 31.1 m. Seepage at 21.3 m.	670.9				

PLATE NO. **4145-B2** Pg 4 of 4

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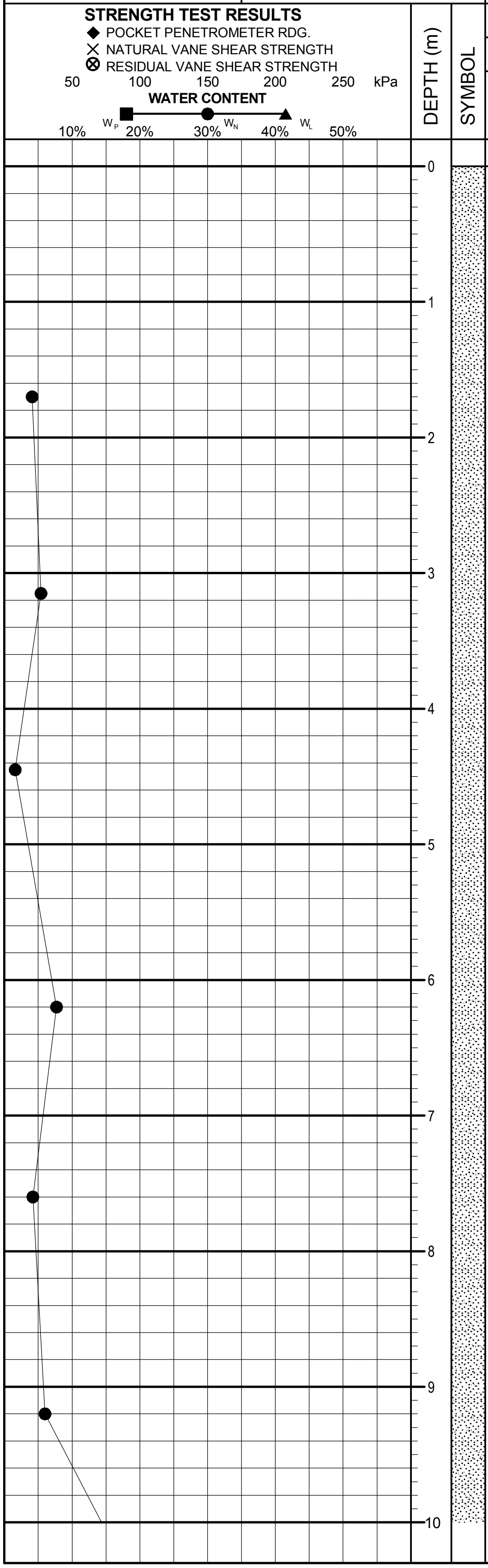
DRILL HOLE LOG

HOLE NO: **DH15-3**

CLIENT **INSIGHT PROGRESSIVE DEVELOPMENTS INC.**

PROJECT **PROPOSED HOTEL AND RESTAURANT**
MARLEAU ROAD AND HIGHWAY 16
PRINCE GEORGE, B.C.

LOGGED: NJ
FILE NO: K-4145
DRILL: Cased Air-Rotary
DATE OF INVEST: 2015/06/10
LOCATION: 10U 513693E 5968421N
SURFACE ELEVATION (m): 690.2



SOIL DESCRIPTION

DEPTH (m) ELEV (m)

SAND, coarse grained, some silt, some gravel, no visible structure, dense, brown, damp.

- between 2.1 and 4.4 m, trace gravel, trace silt, medium to fine grained sand.

- below 2.9 m, very dense.

- between 4.4 and 4.5 m, gravel, sandy, some silt, no visible structure, very dense, light brown, damp.

- below 5.9 m, silty.

- below 6.4 m, trace silt, trace gravel, coarse to medium grained sand.

(continued on next page)

SAMPLES	SPT, BLOWS PER 152 mm	SPT 'N' / RECOVERY (mm)	COMMENTS
	10 15 17 21	32 380	
	17 31 37	68 410	
	50	Ref 110	
	29 50	Ref 360	
	10 27 50	Ref 390	
	14 26 37	63 400	

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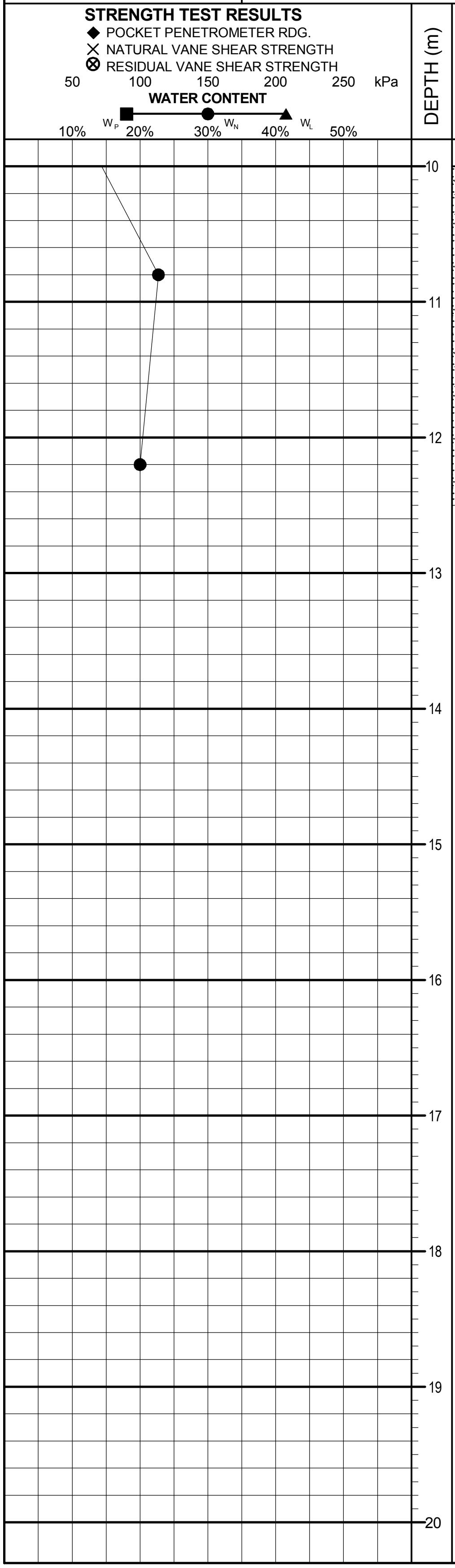
DRILL HOLE LOG

HOLE NO: **DH15-3**

CLIENT **INSIGHT PROGRESSIVE DEVELOPMENTS INC.**

PROJECT **PROPOSED HOTEL AND RESTAURANT**
MARLEAU ROAD AND HIGHWAY 16
PRINCE GEORGE, B.C.

LOGGED: NJ
FILE NO: K-4145
DRILL: Cased Air-Rotary
DATE OF INVEST: 2015/06/10
LOCATION: 10U 513693E 5968421N
SURFACE ELEVATION (m): 690.2



SOIL DESCRIPTION

DEPTH (m)	SOIL DESCRIPTION	ELEV (m)
	SAND, coarse grained, some silt, some gravel, no visible structure, dense, brown, damp. *(continued)* - seepage at 10.4 m. - wet below 10.4 m.	
12.5	End of drill hole at 12.5 m. Seepage at 10.4 m.	677.7

SAMPLES	SPT, BLOWS PER 152 mm	SPT 'N' / RECOVERY (mm)	COMMENTS
	12 18 23 29	41 / 620	
	13 21 46	67 / 610	

PLATE NO. **4145-B3** Pg 2 of 2

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DRILL HOLE LOG

HOLE NO: **DH15-4**

CLIENT **INSIGHT PROGRESSIVE DEVELOPMENTS INC.**

PROJECT **PROPOSED HOTEL AND RESTAURANT**
MARLEAU ROAD AND HIGHWAY 16
PRINCE GEORGE, B.C.

LOGGED: NJ

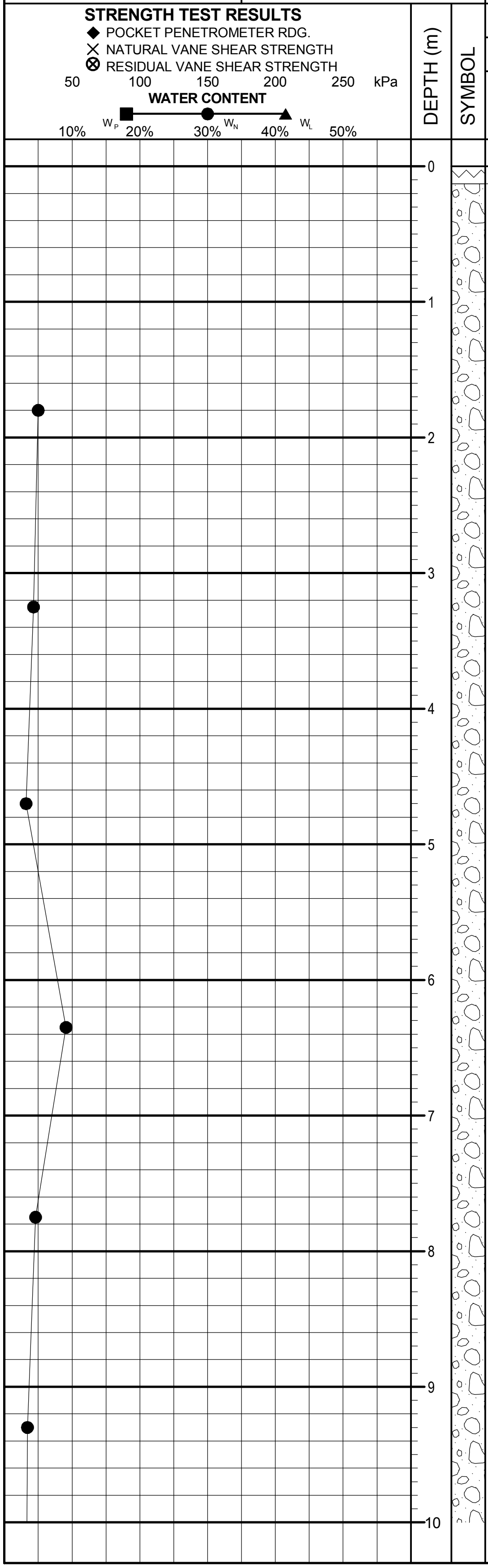
FILE NO: K-4145

DRILL: Cased Air-Rotary

DATE OF INVEST: 2015/06/10

LOCATION: 10U 513736E 5968339N

SURFACE ELEVATION (m): 689.5



SOIL DESCRIPTION

DEPTH (m) ELEV (m)

0.13 ORGANIC SILT, trace sand, pieces of bark. 689.37

GRAVEL, sandy, some silt to silty, no visible structure, dense, brown, damp, interbedded with layers of sand.

- below 3.0 m, very dense.

- below 9.1 m, trace to some silt.

(continued on next page)

SAMPLES	SPT, BLOWS PER 152 mm	SPT 'N' / RECOVERY (mm)	COMMENTS
	10 21 16 20	37 / 370	
	14 26 40	66 / 330	
	18 50	Ref / 110	
	11 21 29	50 / 400	- Grain Size Analysis, See Plate 4145-C5
	35 50	Ref / 320	
	35 50	Ref / 290	

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DRILL HOLE LOG

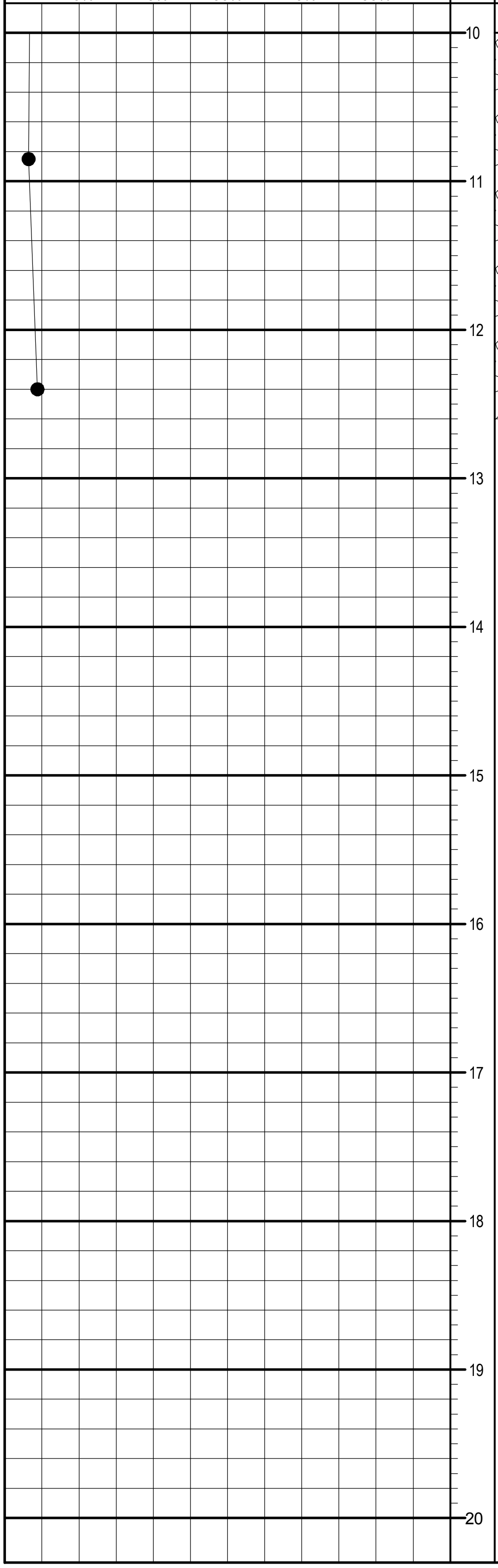
HOLE NO: **DH15-4**

CLIENT **INSIGHT PROGRESSIVE DEVELOPMENTS INC.**

PROJECT **PROPOSED HOTEL AND RESTAURANT**
MARLEAU ROAD AND HIGHWAY 16
PRINCE GEORGE, B.C.

LOGGED: NJ
FILE NO: K-4145
DRILL: Cased Air-Rotary
DATE OF INVEST: 2015/06/10
LOCATION: 10U 513736E 5968339N
SURFACE ELEVATION (m): 689.5

STRENGTH TEST RESULTS
◆ POCKET PENETROMETER RDG.
✕ NATURAL VANE SHEAR STRENGTH
⊗ RESIDUAL VANE SHEAR STRENGTH
50 100 150 200 250 kPa
WATER CONTENT
W_P ■ ● W_N ▲ W_L
10% 20% 30% 40% 50%



SOIL DESCRIPTION

DEPTH (m)	SOIL DESCRIPTION	ELEV (m)	SPT, BLOWS PER 152 mm	SPT 'N' / RECOVERY (mm)	COMMENTS
10	GRAVEL, sandy, some silt to silty, no visible structure, dense, brown, damp, interbedded with layers of sand. *(continued)*				
	- below 10.7 m, and sand.		35 50	Ref 250	
			22 34 26	60 250	
12.6	End of drill hole at 12.6 m.	676.9			

PLATE NO. **4145-B4** Pg 2 of 2

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Tel. 250-564-4304 Fax 250-564-9323

DRILL HOLE LOG

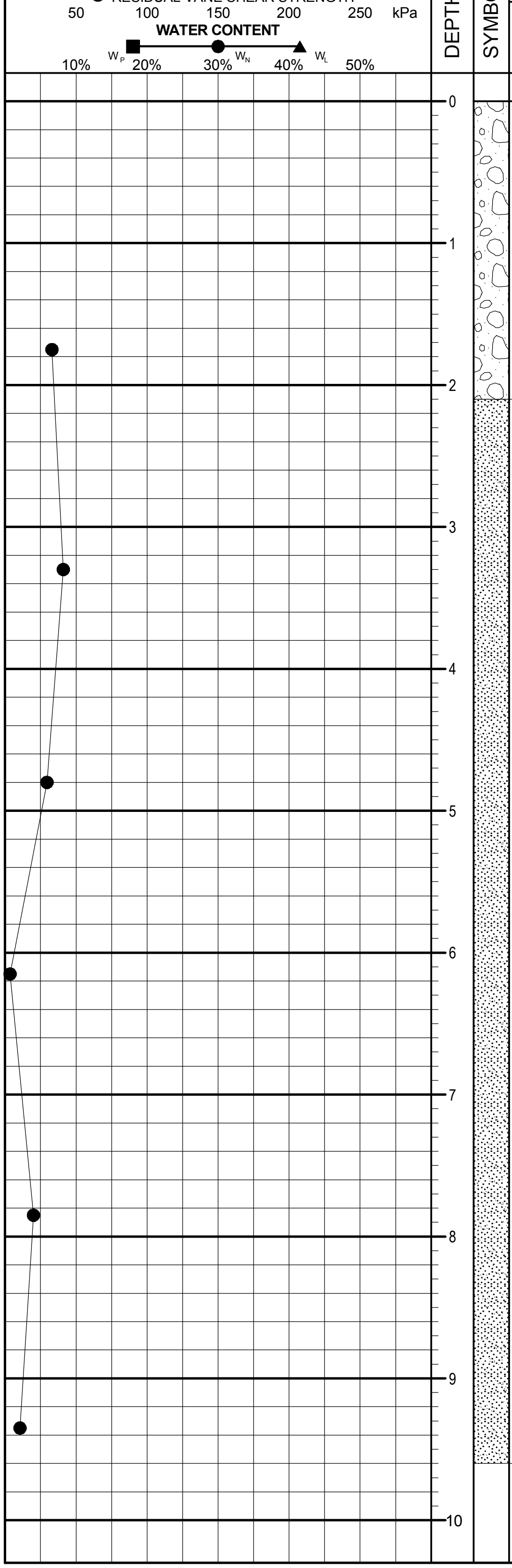
HOLE NO: **DH15-5**

CLIENT **INSIGHT PROGRESSIVE DEVELOPMENTS INC.**

PROJECT **PROPOSED HOTEL AND RESTAURANT**
MARLEAU ROAD AND HIGHWAY 16
PRINCE GEORGE, B.C.

LOGGED: NJ
FILE NO: K-4145
DRILL: Cased Air-Rotary
DATE OF INVEST: 2015/06/10
LOCATION: 10U 513741E 5968367N
SURFACE ELEVATION (m): 685.6

STRENGTH TEST RESULTS
◆ POCKET PENETROMETER RDG.
✕ NATURAL VANE SHEAR STRENGTH
⊗ RESIDUAL VANE SHEAR STRENGTH



SOIL DESCRIPTION

DEPTH (m)	SOIL DESCRIPTION	ELEV (m)	SAMPLES	SPT, BLOWS PER 152 mm	SPT 'N' / RECOVERY (mm)	COMMENTS
	GRAVEL, and sand, some silt, very dense, brown, damp.					
				13 31 30	61 300	
2.1		683.5				
	SAND, gravelly, some silt, layered, very dense, brown, moist.					
				11 16 19 38	35 500	
				17 31 31	62 420	
	- below 6.1 m, damp.			50	Ref 10	
	- between 7.0 and 7.6 m, sand layer, trace silt.					
				14 35 31	66 320	
	- between 8.2 and 9.1 m, gravel, sandy, trace silt.					
	- below 9.1 m, and gravel.			9 34 40	74 300	
9.6		676.0				
	End of drill hole at 9.6 m.					

PLATE NO. **4145-B5** Pg 1 of 1

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

SOIL DESCRIPTION

Soil is classified in accordance with the International Society of Soil Mechanics and Foundation Engineering (ISSMFE) system as described in the 1992 Canadian Foundation Engineering Manual (CFEM) 3rd Edition. 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 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:

Description 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 macrostructure and microstructure are described.

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 and odour of soil is described, especially where it may indicate organic inclusions or give evidence of 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.

SOIL SAMPLES

Graphic symbols indicate the depth and condition of soil samples:

☒ Disturbed ◪ Undisturbed

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

FIELD TESTS

Standard Penetration Test (SPT) (ASTM D1586)

The 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 D424)
△	Atterberg Liquid Limit, w_L (ASTM D423)
MA	Mechanical grain size (sieve) analysis or hydrometer test, or both (ASTM D422)
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 often included are additional test results, drilling progress, monitoring equipment installation details and other relevant information.

ISSMFE SOIL CLASSIFICATION SYSTEM

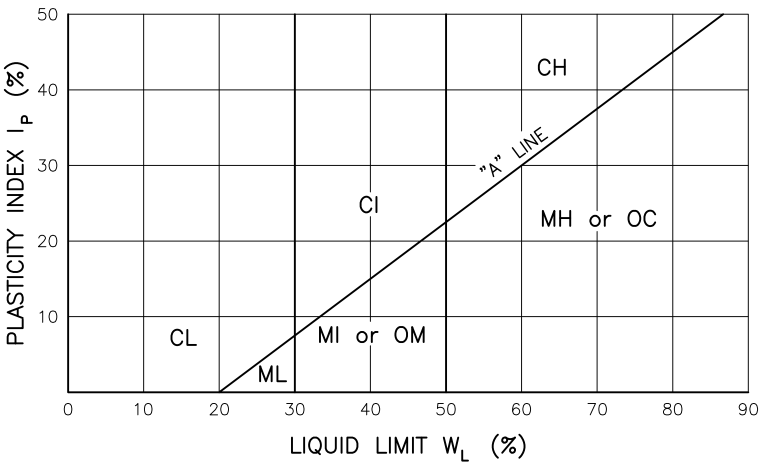
MAJOR DIVISION			GROUP SYMBOL	GRAPHIC SYMBOL	TYPICAL DESCRIPTION	LABORATORY CLASSIFICATION CRITERIA
COARSE-GRAINED SOIL	**GRAVEL** 2.0 – 60.0 mm DIAMETER	CLEAN GRAVEL	GW	░	WELL-GRADED GRAVEL AND SANDY GRAVEL MIXTURES WITH LESS THAN 5% FINES.	$C_u = \frac{D_{60}}{D_{10}} > 6,\ C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}} = 1$ to 3
			GP	░	POORLY-GRADED GRAVEL AND SANDY GRAVEL 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 0.06 – 2.0 mm DIAMETER	CLEAN SAND	SW	░	WELL-GRADED SAND AND GRAVELLY SAND MIXTURES WITH LESS THAN 5% FINES.	$C_u = \frac{D_{60}}{D_{10}} > 6,\ C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}} = 1$ 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		OC	▥	ORGANIC CLAY	
			OM	▨	ORGANIC SILT	
HIGHLY ORGANIC SOIL			Pt	≋	PEAT AND OTHER HIGHLY ORGANIC SOIL	HIGH ORGANIC CONTENT AND FIBROUS TEXTURE.

GRAIN SIZE

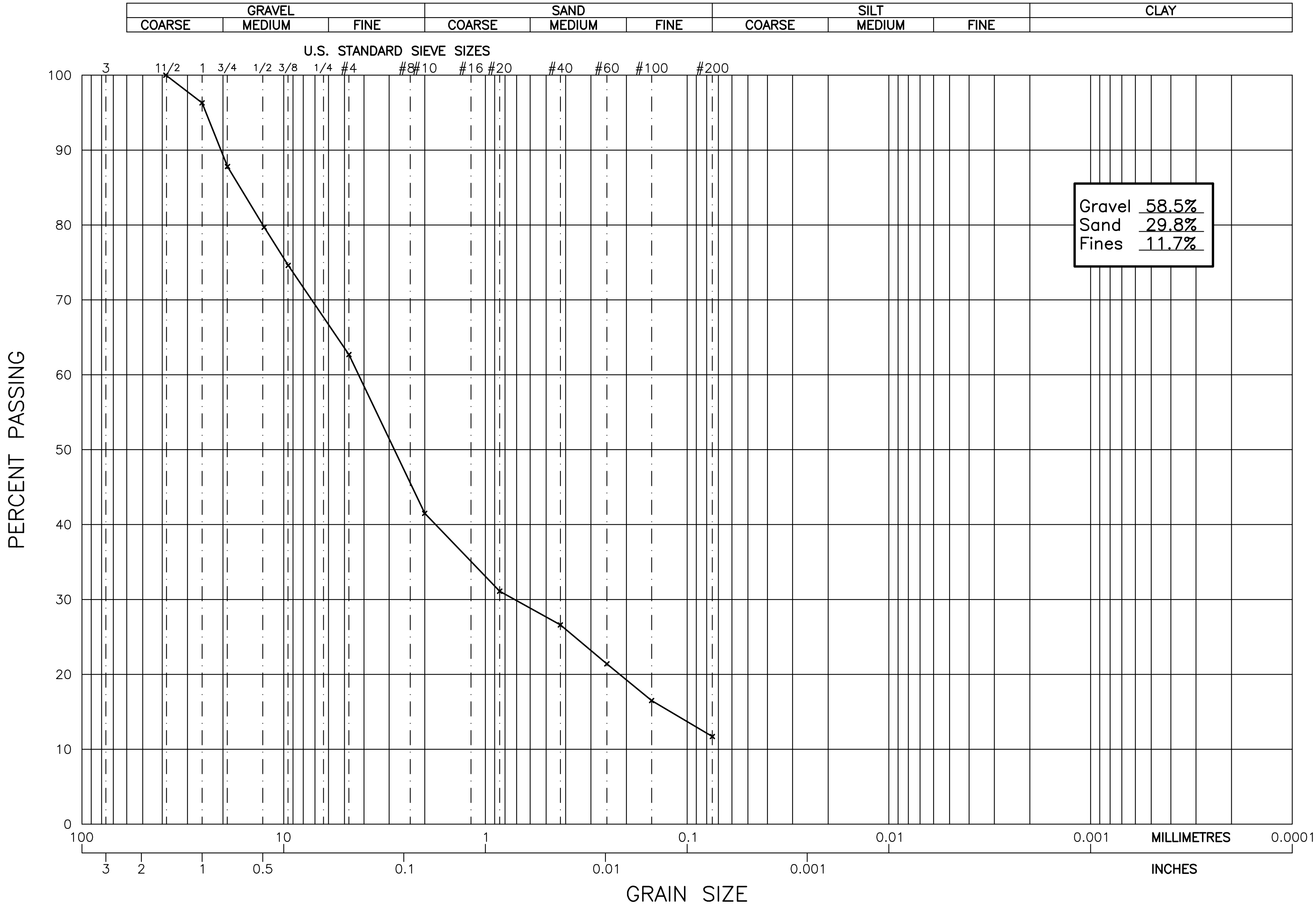
Coarse-grained soil and silt is identified on the basis of grain size diameter as follows:

SILT:	Fine	0.002 – 0.006 mm
	Medium	0.006 – 0.020 mm
	Coarse	0.020 – 0.060 mm
SAND:	Fine	0.06 – 0.20 mm
	Medium	0.20 – 0.60 mm
	Coarse	0.60 – 2.00 mm
GRAVEL:	Fine	2.0 – 6.0 mm
	Medium	6.0 – 20.0 mm
	Coarse	20.0 – 60.0 mm
COBBLES:		60.0 – 200 mm
BOULDERS:		> 200 mm

PLASTICITY CHART



APPENDIX C



Gravel 58.5%
Sand 29.8%
Fines 11.7%

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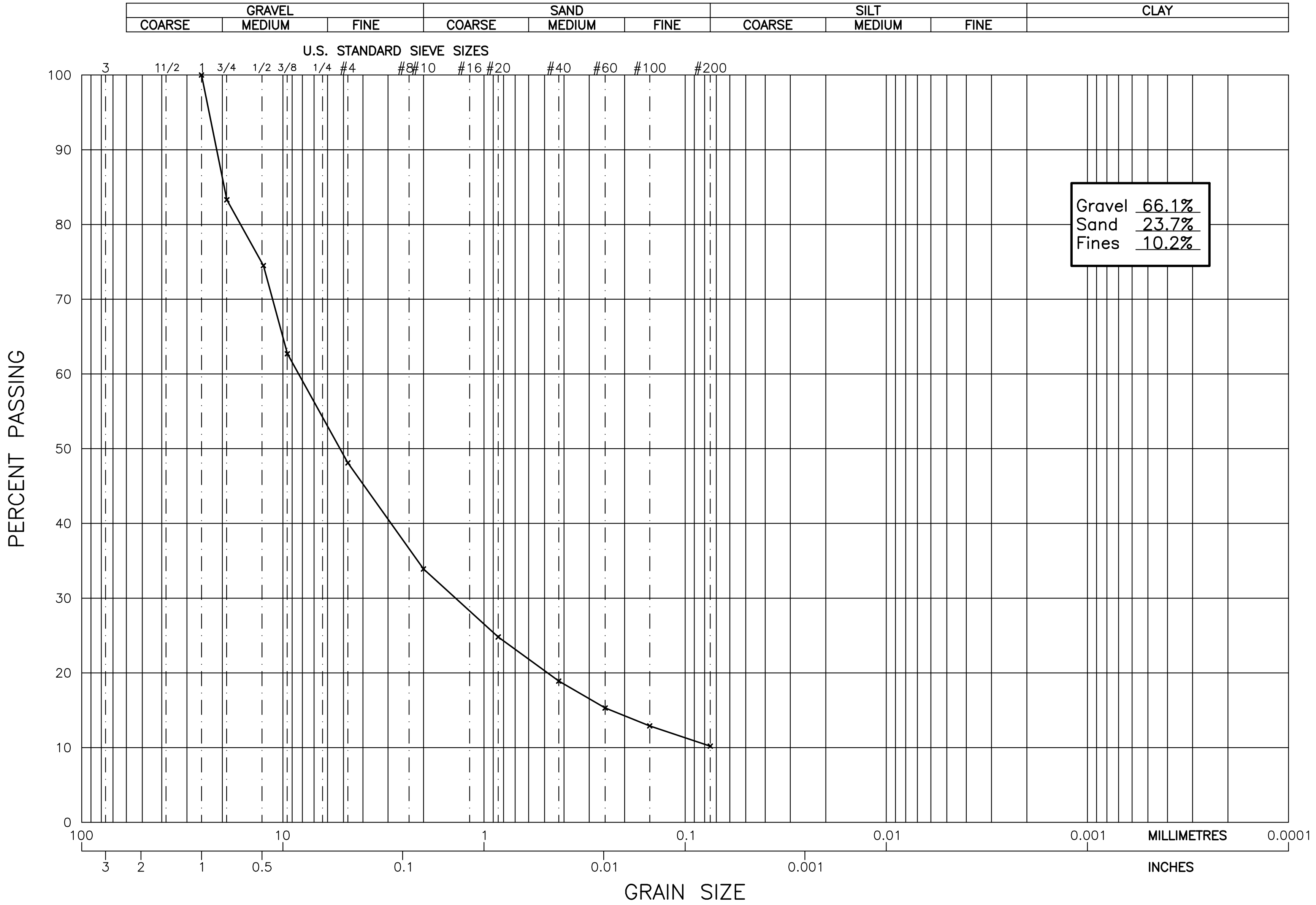
INSIGHT PROGRESSIVE DEVELOPMENTS INC.
PROPOSED HOTEL AND RESTAURANT
MARLEAU ROAD AND HIGHWAY 16, PRINCE GEORGE, B.C.
GRAIN SIZE ANALYSIS OF DH15-1, 4.3-4.9 m DEPTH

PROJECT NO.
K-4145

PLATE NO.
4145-C1



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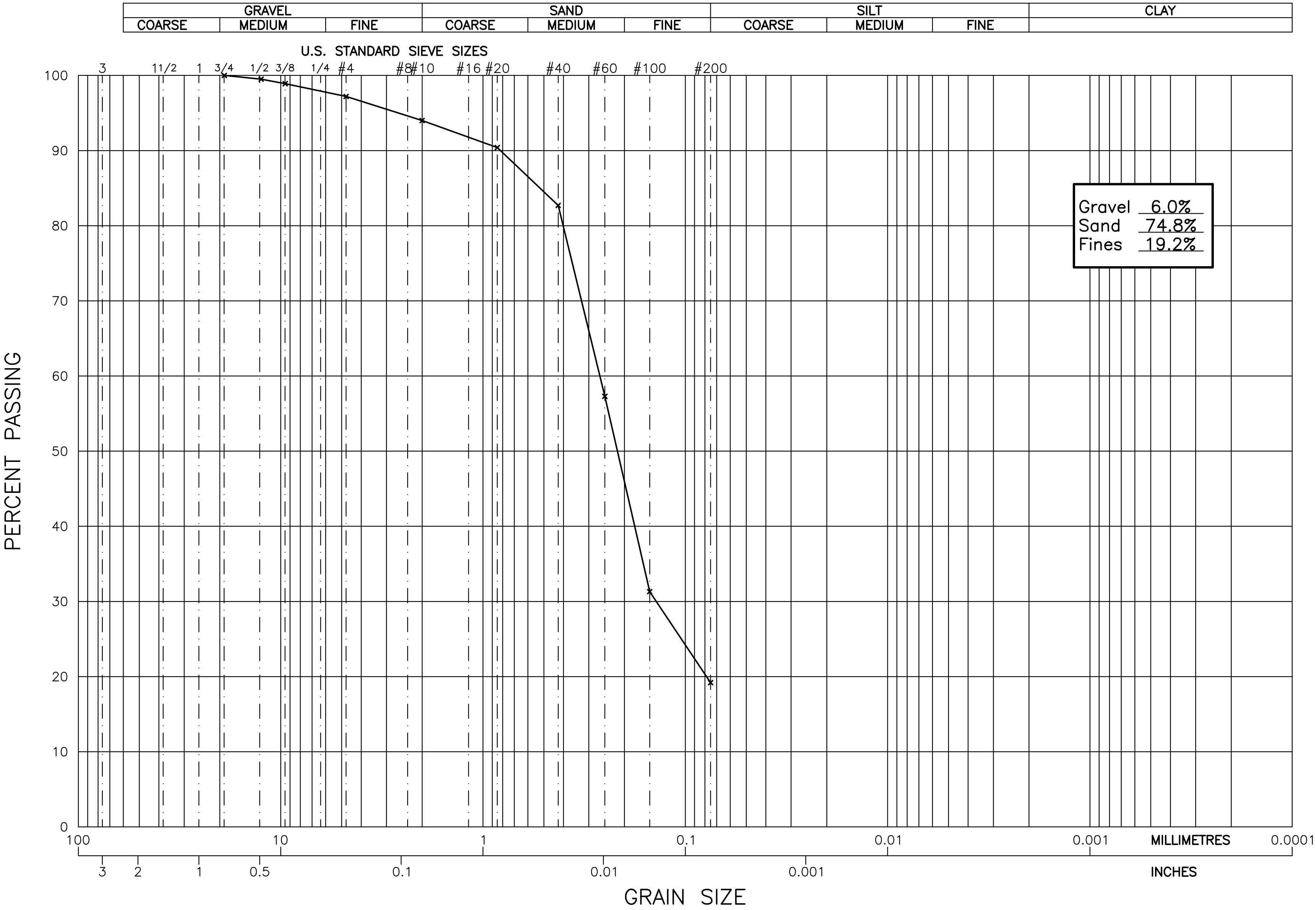
GRAIN SIZE ANALYSIS OF DH15-1, 8.8-9.4 m DEPTH

PROJECT NO.
K-4145

PLATE NO.
4145-C2



Gravel 6.0%
Sand 74.8%
Fines 19.2%

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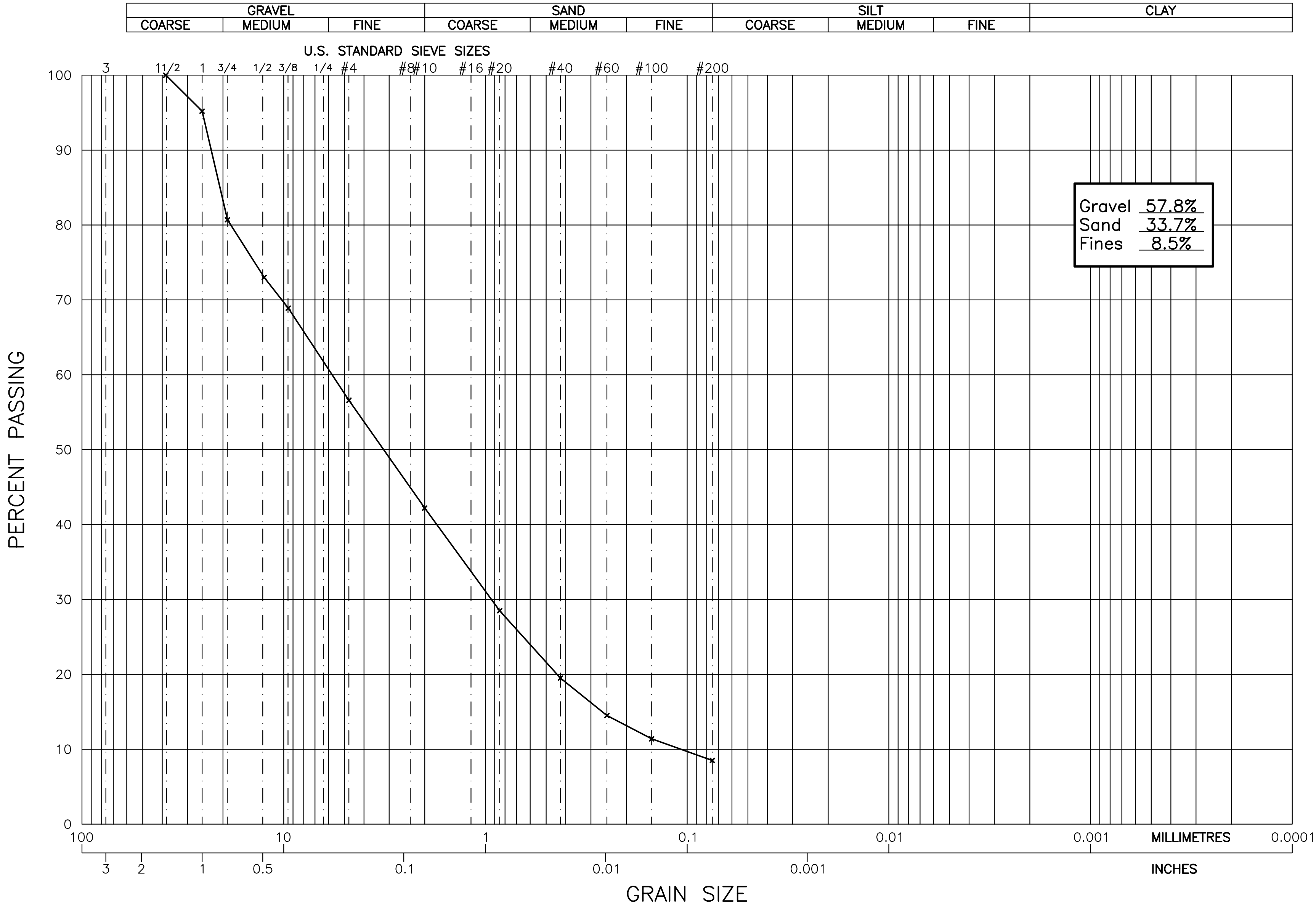
GRAIN SIZE ANALYSIS OF DH15-2, 6.1-6.7 m DEPTH

PROJECT NO.
K-4145

PLATE NO.
4145-C3



Gravel 57.8%
Sand 33.7%
Fines 8.5%

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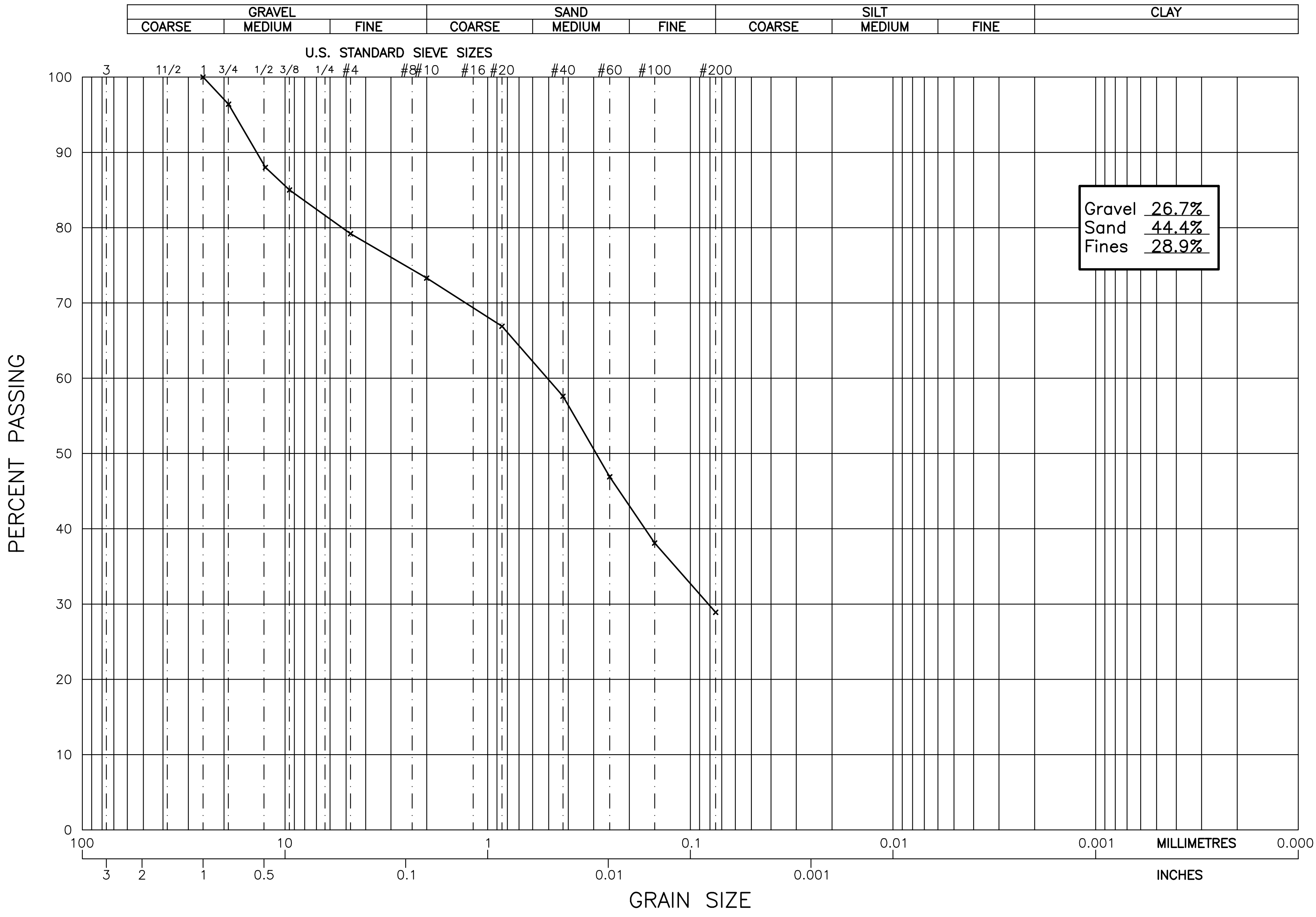
GRAIN SIZE ANALYSIS OF DH15-2, 16.8-17.4 m DEPTH

PROJECT NO.
K-4145

PLATE NO.
4145-C4



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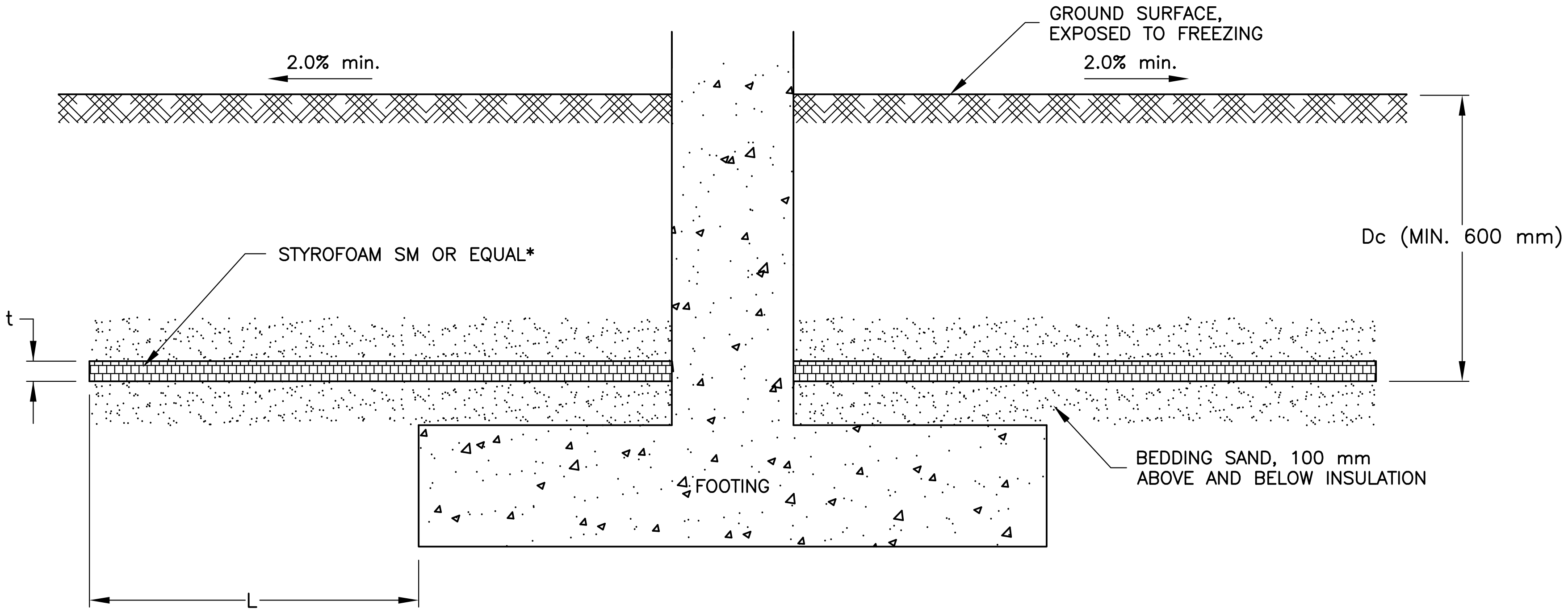
GRAIN SIZE ANALYSIS OF DH15-4, 6.1-6.6 m DEPTH

PROJECT NO.	K-4145
PLATE NO.	4145-C5

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.

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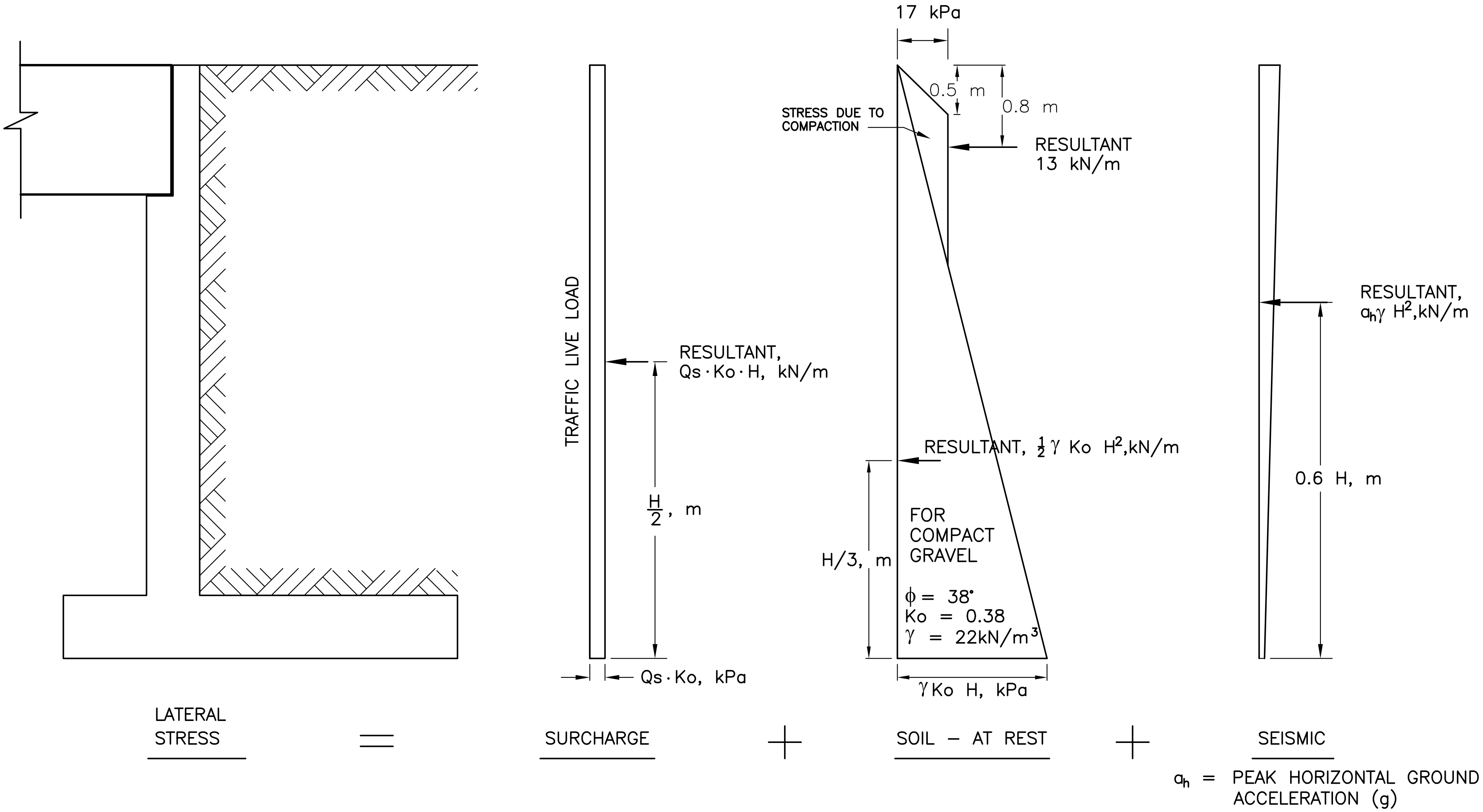
PROPOSED HOTEL AND RESTAURANT
MARLEAU ROAD AND HIGHWAY 16, PRINCE GEORGE, B.C.
TYPICAL INSULATED FOUNDATION DETAIL

SCALE: N.T.S.	DATE: 2015/08/13
PROJECT NO: K-4145	DRAWING NO. 4145-D1



Qs, kPa (From 2012 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

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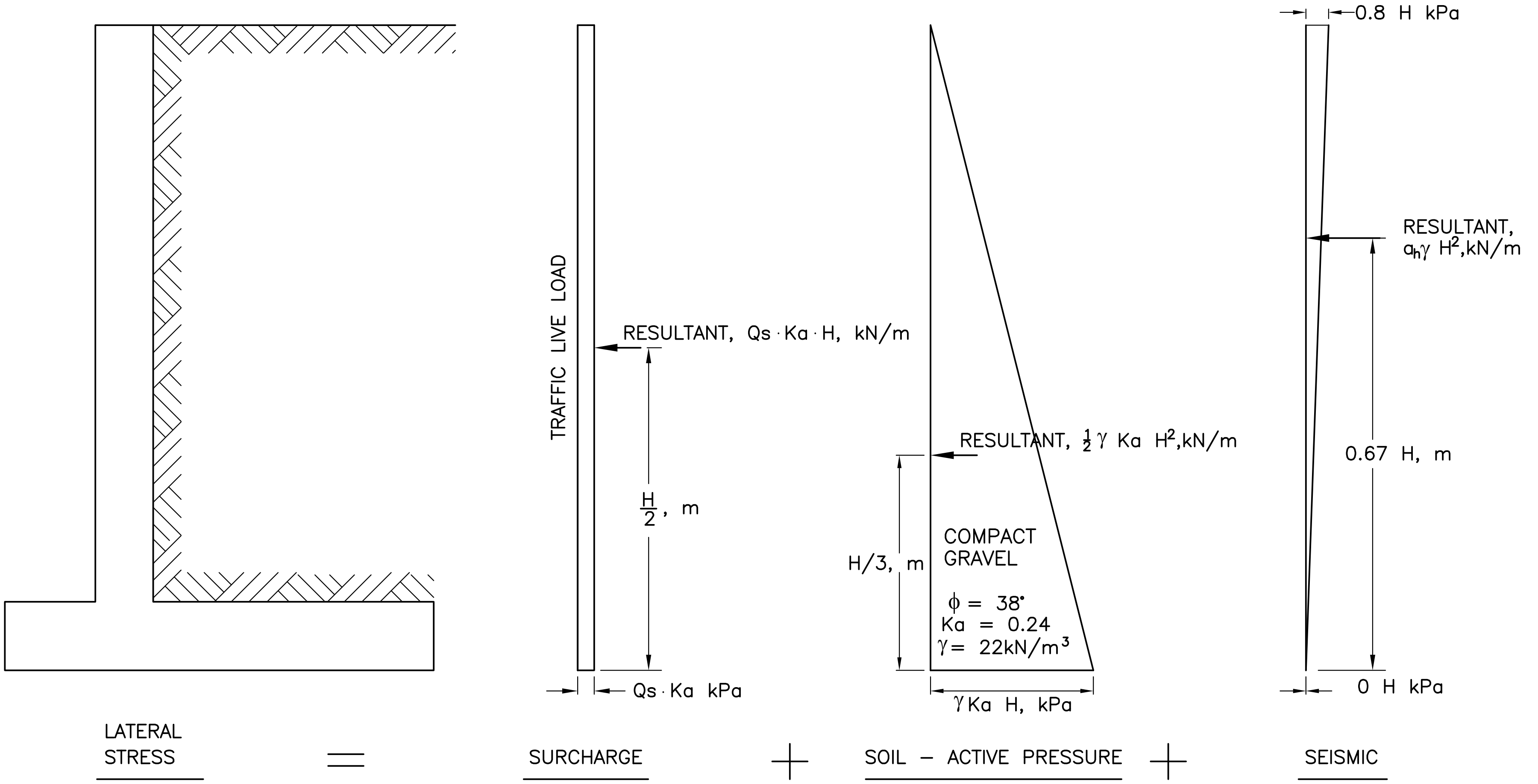
INSIGHT PROGRESSIVE DEVELOPMENTS INC.
PROPOSED HOTEL AND RESTAURANT
MARLEAU ROAD AND HIGHWAY 16, PRINCE GEORGE, B.C.
TYPICAL LATERAL EARTH PRESSURES, RESTRAINED WALL

SCALE: N.T.S.
DATE: 2015/08/13
PROJECT NO: K–4145
DRAWING NO. 4145–D2



a_h = PEAK HORIZONTAL GROUND ACCELERATION (g)

Qs, kPa (From 2012 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 UNRESTRAINED
COMPACTION TO MAXIMUM 95% STANDARD PROCTOR DENSITY

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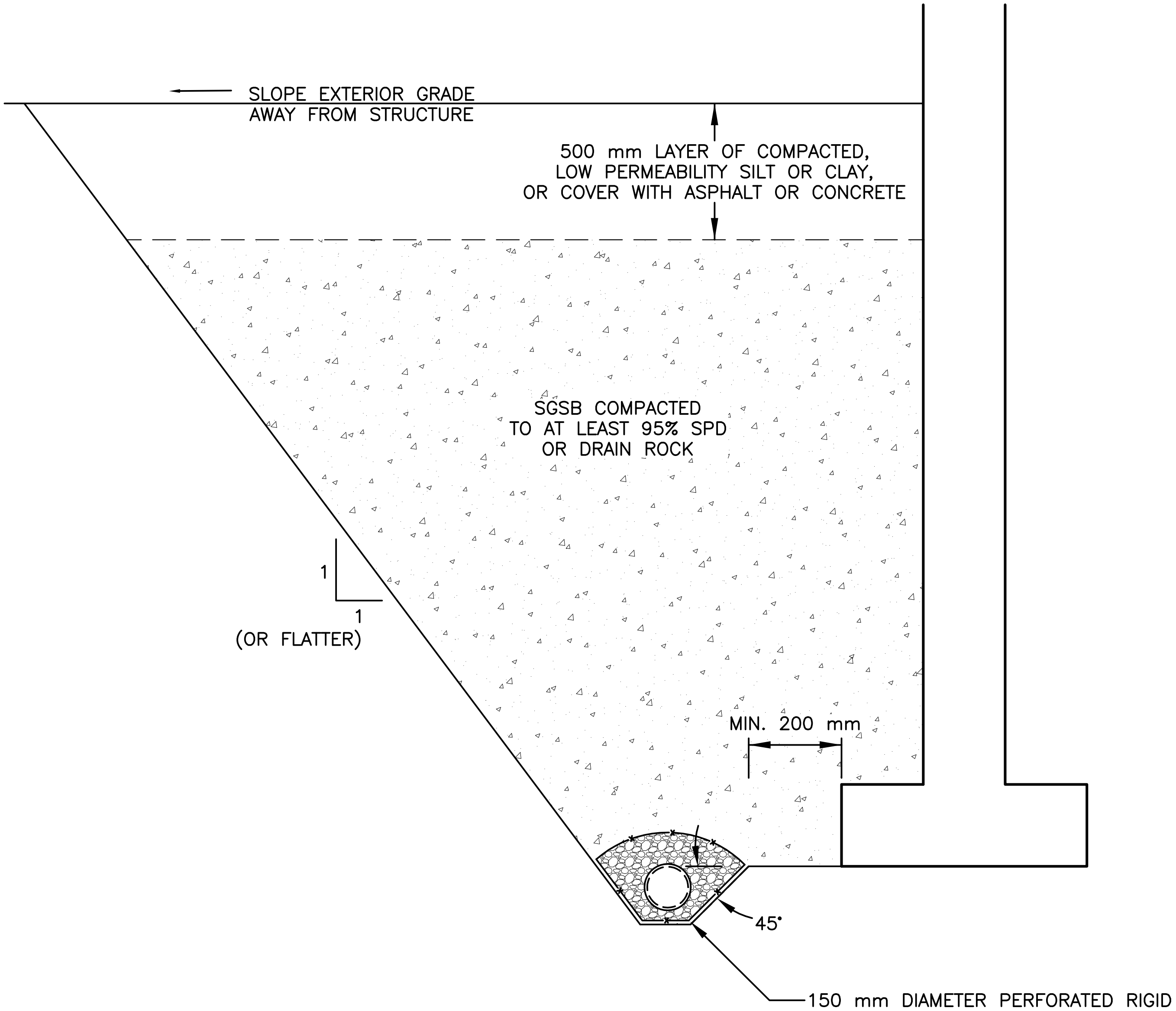
INSIGHT PROGRESSIVE DEVELOPMENTS INC.
PROPOSED HOTEL AND RESTAURANT
MARLEAU ROAD AND HIGHWAY 16, PRINCE GEORGE, B.C.
TYPICAL LATERAL EARTH PRESSURES, UNRESTRAINED WALL

SCALE: N.T.S.
DATE: 2015/08/13
PROJECT NO: K–4145
DRAWING NO. 4145–D3



150 mm DIAMETER PERFORATED RIGID PVC PIPE SLOPED AT MINIMUM 0.25% GRADIENT, COVERED WITH AT LEAST 100 mm OF PEA GRAVEL OR DRAIN ROCK, WRAPPED IN NON-WOVEN GEOTEXTILE WITH MINIMUM PUNCTURE STRENGTH OF 1.2 kN AND APPARENT OPENING SIZE OF 0.15 TO 0.25 mm. DO NOT UNDERMINE FOOTING.

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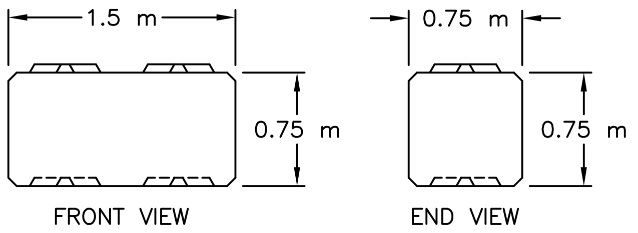
INSIGHT PROGRESSIVE DEVELOPMENTS INC.
PROPOSED HOTEL AND RESTAURANT
MARLEAU ROAD AND HIGHWAY 16, PRINCE GEORGE, B.C.
TYPICAL PERIMETER DRAIN DETAIL

SCALE: N.T.S.	DATE: 2015/08/13	DRAWN: LU	CHKD: –	PROJ: K-4145	DWG: 4145-D4

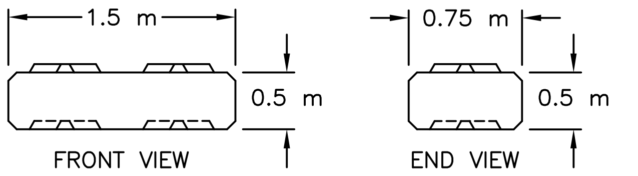
APPENDIX E

NOTES:

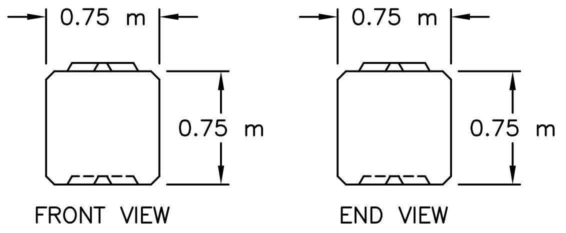
1. COMPACT GRANULAR FILL BELOW THE LOCK BLOCKS TO AT LEAST 100% STANDARD PROCTOR DENSITY (SPD) (ASTM D698) IN LIFTS NO GREATER THAN 300 mm. USE GRANULAR FILL THAT MEETS GRADATION SPECIFICATIONS FOR WELL GRADED BASE.
2. USE SELECT GRANULAR SUBBASE FOR FILL BEHIND THE WALL. PLACE THE FILL IN UNIFORM LAYERS NO MORE THAN 300 mm THICK AND COMPACT EACH LAYER TO AT LEAST 98% SPD. WITHIN 1 m OF THE BACK OF THE BLOCKS, USE HAND OPERATED, VIBRATORY EQUIPMENT WEIGHING LESS THAN 450 kg (1000 lbs). WITHIN 500 mm, USE THINNER LAYERS AND LIGHT COMPACTION EQUIPMENT WEIGHING LESS THAN 225 kg (500 lbs). OPERATE COMPACTORS PARALLEL TO THE WALL.



STANDARD BLOCK DIMENSIONS



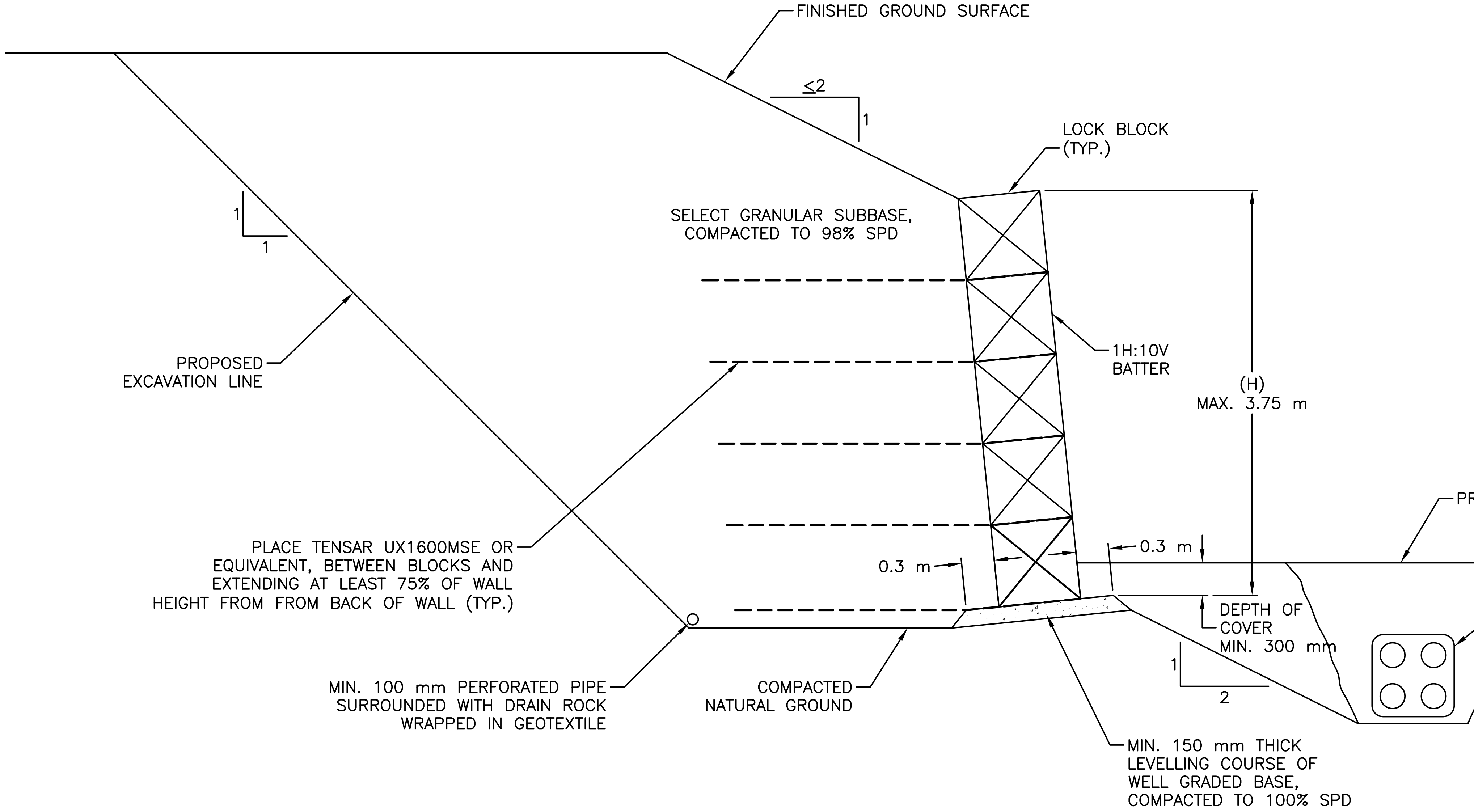
HALF BLOCK DIMENSIONS



HALF BLOCK DIMENSIONS

LOCKING BLOCK DETAILS

Scale 1:50



CROSS SECTION

Scale 1:50

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INSIGHT PROGRESSIVE DEVELOPMENTS INC.
PROPOSED HOTEL AND RESTAURANT
MARLEAU ROAD AND HIGHWAY 16, PRINCE GEORGE, B.C.
CONCEPTUAL CROSS SECTION

APPROVED:

SCALE:	As Shown
DATE:	2015/08/13
DWN BY:	LU
MAP REF:	–
DWG NO.	4145-E1
REV.	–
PROJECT NO:	K-4145