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April 19, 2022
File No: 1301-22

District of Metchosin
4450 Happy Valley Road
Victoria, BC
V9C 3Z3

Attn: Stephanie Dunlop, Fire Chief (By E-mail: firechief@metchosinfire.ca)

Re: Proposed Fire Hall
4440 Happy Valley Road – Victoria, BC

As requested, we have completed a geotechnical investigation of the soil conditions at the referenced site. The following summarizes the results of our investigation and associated recommendations as such relates to the proposed new firehall. Our work in this regard has been carried out in accordance with, and is subject to, the previously accepted Terms of Engagement.

PROPOSED DEVELOPMENT

We understand it is proposed to construct a new firehall within the general footprint of the existing firehall, or alternatively, within the area of the adjacent administrative building attached to the west. The new building would be designed to a post disaster requirement of the BC Building Code, so foundation bearing resistance and seismic response are the two main geotechnical considerations.

No building design or concept has been completed at this time; however, we understand the new building would likely be maximum 2 to 3 storeys in height, and would have a slab on grade at rough existing site grades. We expect that the new building loads would be light to moderate in loading, with typical spread foundations.

INVESTIGATION PROCEDURE

Our desktop review involved perusal of available surficial geology mapping, aerial imagery, CRD GIS imagery, BC Water Resources Atlas, and a review of our previous involvement on site as well as projects completed nearby. We subsequently attended site on March 28 and 29, 2022, to carry out a subsurface investigation consisted of advancing eight probe holes at select locations throughout the site, using a hydraulic percussion drill owned and operated by Western Grater Ltd., to determine general depth to bedrock/refusal, to confirm seismic site class. The locations of the test holes are displayed on the attached Location Plan.

Prior to drilling, we contacted BC OneCall for utility information in the area and had our probe hole locations cleared by a private utility locating company, Western Utilities Services Ltd.

SURFACE AND SUBSURFACE CONDITIONS

The site is rectangular shaped and slopes gently to the west, with an estimated relief of about 1.8 m. The existing buildings are bounded by District of Metchosin property to the south and east, a laneway to the west, and Happy Valley Road to the north. The site is currently occupied by the existing firehall station built in 1993, and the much older fire administrative build to the west. The two buildings are attached; however, the lower slabs have an elevation change of about 1.4 m. The CRD GIS imagery notes the overall site is at approximately 49 m geodetic elevation.

According to BC Water Resources Atlas, there are multiple wells located in the general area of the site. The closest well records suggest that the water table varies seasonally between 1.5 m and 9.5 m below ground surface (bgs).

Based on our test pit investigation completed on July 15, 1993, the soil conditions on site consisted of about 1 m of surficial soil/fill material overlying a thin layer of loose to compact silty gravelly sand atop dense silty gravelly sand. The deepest test pit was 1.4 m bgs. No ground water or bedrock was encountered in any of the test pits. Geological mapping of the area indicates that soils at depth are mostly a morainal blanket (Till based soils), with localized surficial deposits of silty gravelly sand.

During our probe hole investigation, the bedrock profile was observed to generally vary substantially across the site with depth ranging from 16.5 m bgs to excess of 24.5 m bgs, reflecting the erratic nature of bedrock in the Greater Victoria Region.

Table 1: Summary of Probe Holes

Probe Hole No.	Final Depth (m)	Final depth on
PR22-01	24.5	Inferred till
PR22-02	18.5	Bedrock
PR22-03	17.5	Bedrock
PR22-04	12.2	Inferred till
PR22-05	16.5	Bedrock
PR22-06	24.5	Inferred till
PR22-07	18.3	Inferred till
PR22-08	20.7	Bedrock

*For the location of each hole, refer to the attached rock probe hole location plan.

GEOTECHNICAL ASSESSMENT AND RECOMMENDATIONS

Based on our investigation, we do not foresee any unique geotechnical issues relating to the development at this site as proposed. Conventional spread footings are anticipated to be used for new foundations.

Excavation Considerations

Typical hydraulic excavation equipment is expected to be sufficient to complete all excavation works. We expect excavations during construction will be shallow (up to 1.5 m in depth).

Given the soil conditions anticipated, we expect cutslopes will be stable at the following configurations:

- Topsoil/fill materials – 1H : 1V (Horizontal : Vertical)
- Native loose to compact silty gravelly sand – 1 H : 1V
- Native dense silty gravelly sand – 0.75H : 1V

Topsoil and fill soils should be pulled back from all excavations so as to eliminate any chance these materials might slough into the opening. Adjustments to the above may be required upon site inspection, depth of excavation during construction, any observed variations of the soil conditions, and any possible existing utilities encountered. According to WorkSafeBC guidelines, excavations deeper than 1.2 m must be inspected and approved by a qualified geotechnical professional.

Seismic Considerations

Greater Victoria is situated in a region of very high seismicity. Considerable earthquake risk exists, stemming from our proximity to the Cascadia subduction zone and numerous more local faults in southwestern BC and northwestern Washington State.

Based on soil conditions of the site it is reasonable to expect the shear wave velocity in the upper 30 m (V_s^{30}) to be between 360 m/s and 720 m/s. This corresponds to a Site Classification for Seismic Site Response of '**C**', in accordance with the current BC Building Code (2018). While a site specific seismic respond assessment may provide some benefit and cost saving in building design and construction, such is not recommended at this time as it may not produce better results than the noted Site Class "C", however, this will be assessed further once preliminary structural design is completed. The corresponding seismic hazard values/accelerations are provided on the attached 2015 National Building Code data sheet.

Settlement Considerations

Provided unsuitable soils are removed from all building/foundation and infrastructure areas, we expect that settlement at this site will be minor, if any, and of minimal significance to the structural or geotechnical design.

Foundations

All topsoil or existing fills must be removed to expose approved bearing subgrade. We expect such to consist of relatively dense silty gravelly sand and/or till based soils. For approved native subgrade or

engineering fill atop such, a bearing resistance of 250 kPa for the serviceability limit state (SLS) and 375 kPa for the ultimate limit state (ULS) may be considered for design. Higher values may be possible, but would need depth specific assessment. ULS is determined using a geotechnical resistance factor of 0.5 as per the current Canadian Foundation Engineering Manual. The bearing resistance should be confirmed at time of excavation/once footing subgrade is exposed.

We recommend minimum footing widths of 400 mm and 600 mm for strip and pad footings, respectively. For frost protection, the base of all footing should extend to a depth of at least 450 mm below adjacent finished grades. Any disturbance to the native soil below the footings by construction activities should be rectified by cleaning the disturbed area down to undisturbed native soil before placing formwork or footings.

Engineered Fill

Where design grade needs to be recovered, such as in areas of over-excavation, engineered fill will be required. Engineered fill is select granular material that has been placed and compacted to achieve sufficient density for required structural loading, etc. Site sourced gravelly sand, low in fines, or imported select granular fill such as 25 mm minis crushed rock product may be used, however, all materials must be approved by the Geotechnical Engineer of Record. The select fill is to be placed on approved subgrade, in approved lifts (i.e 300 mm for 25 mm minus) and compacted to a minimum of 95% of Standard Proctor Maximum Dry Density (SPMDD) value, or judged equivalent. The engineered fill must have a footprint that extends horizontally beyond the footings a distance equal to the thickness of the engineered fill, to provide adequate splay for foundation loads.

Slab on Grade

Use of a grade supported floor slab is considered feasible provided all undesirable/deleterious material is removed below the slab. Soil beneath the slab should consist of a sub slab levelling fill layer comprising of select free draining material, such as 19 mm crush rock, overtop of an approved free draining base soil. All sub slab fill should be compacted to at least 95% of the SPMDD value. A conventional sub slab polyethylene vapour barrier should be incorporated directly between the slab and free draining soil/fill to minimize capillary rise of moisture into the slab.

Foundation Drainage/Stormwater Disposal

Conventional perimeter foundation drainage consisting of perforated drain pipe surrounded by free draining granular material containing low fines, tied into the recommended free draining backfill material is recommended. To prevent the migration of fine-grained soil particles into the drainage system, a layer of medium weight, non-woven geotextile should be placed between the clean drain rock around the perforated pipe and the granular backfill material. The geotextile should encompass the entire drain rock/drain pipe system.

On-site stormwater disposal will be possible, with the design completed by the civil engineer. For preliminary design purposes, a hydraulic conductivity value of approximately 1.0×10^{-4} cm/sec can be

used. We do recommend that the area, and design depth, of the seepage pit be tested by in-situ soil permeability testing using a Guelph Permeameter to help with the final design.

We appreciate the opportunity to be of service to you, and hope the above is suitable for your needs at present.

Yours very truly,
Ryzuk Geotechnical
PN1002996

Patrick Ntwari, EIT
Junior Engineer

Lane Campbell, M.Eng., P.Eng.
Senior Geotechnical Engineer

PROFESSIONAL ENGINEER
PROVINCE OF BRITISH COLUMBIA
L. G. CAMPBELL
19305

Attachment - Nation Building Code Seismic Hazard Values
- Rock Probe Hole Location Plan

2015 National Building Code Seismic Hazard Calculation

INFORMATION: Eastern Canada English (613) 995-5548 français (613) 995-0600 Facsimile (613) 992-8836
Western Canada English (250) 363-6500 Facsimile (250) 363-6565

Site: 48.381N 123.535W **User File Reference:** 4440 Happy Valley - Metchosin, BC 2022-04-08 23:21 UT

Probability of exceedance per annum	0.000404	0.001	0.0021	0.01
Probability of exceedance in 50 years	2 %	5 %	10 %	40 %
Sa (0.05)	0.714	0.506	0.365	0.156
Sa (0.1)	1.103	0.788	0.565	0.239
Sa (0.2)	1.328	0.949	0.687	0.292
Sa (0.3)	1.348	0.957	0.688	0.289
Sa (0.5)	1.204	0.841	0.594	0.237
Sa (1.0)	0.724	0.471	0.312	0.113
Sa (2.0)	0.432	0.272	0.172	0.058
Sa (5.0)	0.136	0.077	0.038	0.011
Sa (10.0)	0.047	0.026	0.013	0.004
PGA (g)	0.598	0.425	0.304	0.126
PGV (m/s)	0.863	0.580	0.392	0.142

Notes: Spectral (Sa(T), where T is the period in seconds) and peak ground acceleration (PGA) values are given in units of g (9.81 m/s^2). Peak ground velocity is given in m/s. Values are for "firm ground" (NBCC2015 Site Class C, average shear wave velocity 450 m/s). NBCC2015 and CSAS6-14 values are highlighted in yellow. Three additional periods are provided - their use is discussed in the NBCC2015 Commentary. Only 2 significant figures are to be used. **These values have been interpolated from a 10-km-spaced grid of points. Depending on the gradient of the nearby points, values at this location calculated directly from the hazard program may vary. More than 95 percent of interpolated values are within 2 percent of the directly calculated values.**

References

National Building Code of Canada 2015 NRCC no. 56190; Appendix C: Table C-3, Seismic Design Data for Selected Locations in Canada

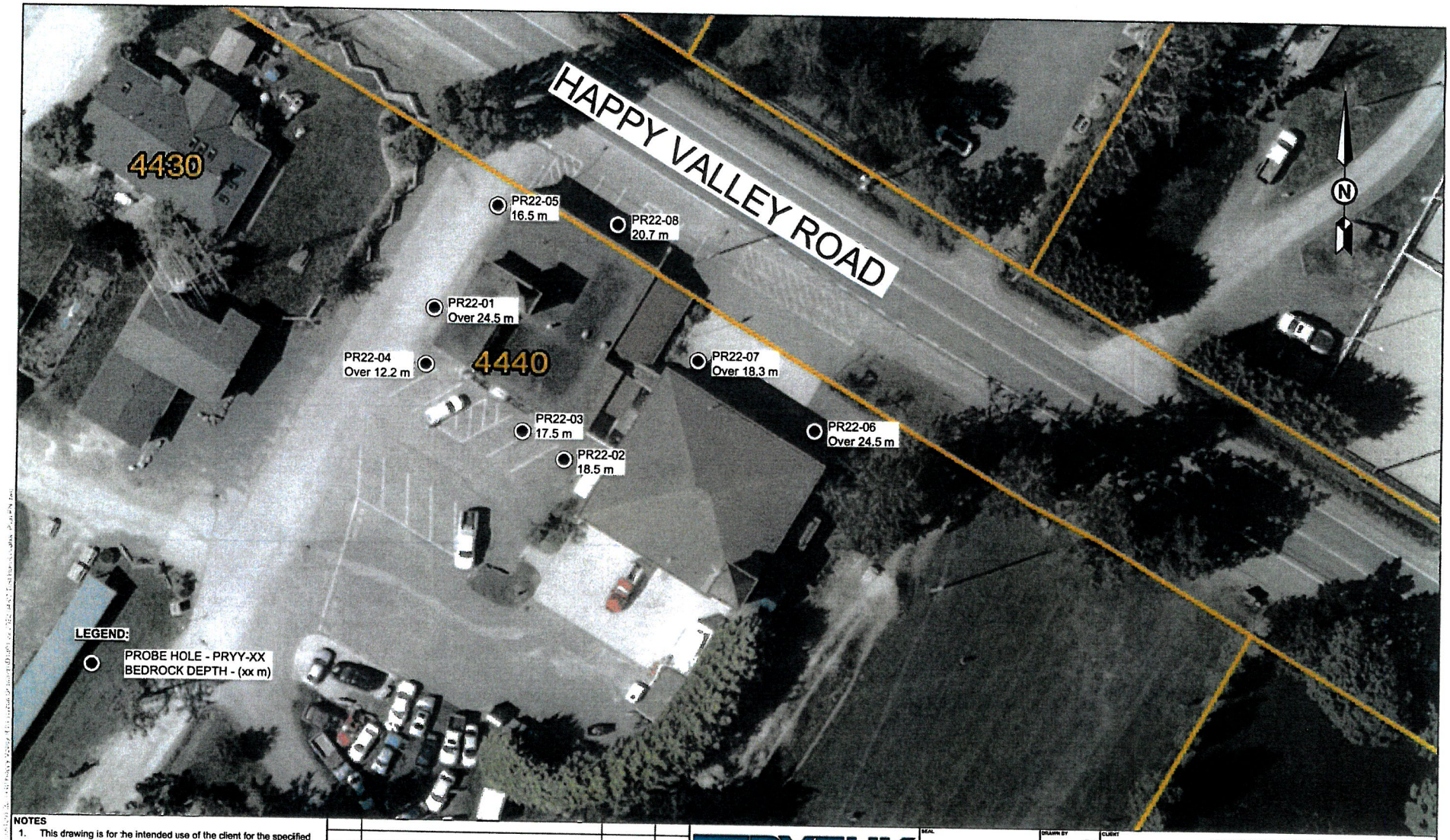
Structural Commentaries (User's Guide - NBC 2015: Part 4 of Division B)
Commentary J: Design for Seismic Effects

Geological Survey of Canada Open File 7893 Fifth Generation Seismic Hazard Model for Canada: Grid values of mean hazard to be used with the 2015 National Building Code of Canada

See the websites www.EarthquakesCanada.ca and www.nationalcodes.ca for more information

Natural Resources Canada Ressources naturelles Canada

Canada



NOTES

1. This drawing is for the intended use of the client for the specified project, and should not be used elsewhere without the express permission of the client and/or Ryzuk Geotechnical.
2. Background imagery taken from CRD atlas map® on April 7,2022.

REV.	DESCRIPTION	YY/MM/DD	BY
1	ISSUED WITH THE REPORT	22/04/19	LGC

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SEAL

DRAWN BY	PN
PROJECT MANAGER	LGC
REVIEW	LGC
SCALE	NTS
DATE	2022/04/19
CLIENT	DISTRICT OF MECHOSIN
PROJECT TITLE	PROPOSED FIRE HALL
PROJECT ADDRESS	4440 Happy Valley - Victoria, BC
DRAWING NAME	PROBE HOLE LOCATIONS PLAN
PROJECT No.	1301-22
SHEET No.	01 of 01
REVISION	00