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Project No.: WG1-1406

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## GEOTECHNICAL ASSESSMENT

**Proposed Retail & Commercial Development at  
52964 Yale Road, Rosedale, B.C.**

**Submitted By: Rajinder Bains, M.Eng. P.Eng.**  
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## 1.0 INTRODUCTION

Western Geotechnical Consultants Ltd. (WesternGeo) has completed this *Geotechnical Assessment* for a proposed Retail & Commercial Development at Rosedale, B.C. The purpose of this assessment is to provide a professional opinion pertaining to the feasibility of the proposed development and to provide comments and geotechnical recommendations for the following:

- Depth to competent subgrade for the proposed building;
- Allowable soil bearing pressures for proposed building;
- Subgrade preparation for proposed building;
- Excavation and backfilling;
- Compaction requirements for structural backfill;
- Comments regarding groundwater conditions;
- Recommendations for pavement structure design; and
- Geotechnical hazard assessment of the proposed development.

The scope of work performed for this assessment included the following tasks:

1. A reconnaissance level site investigation to observe the current conditions at the site, including observations of site topography, surficial soil, vegetation, surface water, and drainage conditions;
2. A desktop review of relevant available background information including published geologic maps and related subsurface information, hazard Analysis in the adjoining areas and available survey information
3. Evaluation and geotechnical engineering analysis of the collected data;
4. Preparation of this summary geotechnical report to present the findings, recommendations, design parameters, and conclusions for the geotechnical aspects of the project;
5. Depth to competent subgrade for the proposed building foundations;
6. Allowable soil bearing capacity for building foundations; and
7. Hazard assessment of the subject site in accordance with the Fraser Valley Regional District (FVRD)- Popkum Bridal Falls Landslide Hazard Part of Electoral Area D.

Attachments to this report include a soil logs and test pit location plan. Environmental considerations are outside the scope of this report. This report may be used by the Fraser Valley Regional District for development and building planning purposes.

## 2.0 PROJECT AND SITE DESCRIPTION

The subject property is located at the civic address of 52964 Yale Road, Rosedale, B.C. The property is roughly rectangular in shape, runs approximately 70 m (N-S) by approximately 50 m (E-W). It is bounded by gas station/commercial lot to the south, Lane way to the east, Yale Road to the north and HWY 9 to the west. The site was empty and cover with bush and grass. Based on site Topographical plan, the site general flat at west portion with approximate elevation 42m, and the grades drops from 48 to 42m at east portion from eastside towards to west.

The site conceptual layout plan and Topographical plan was provided by JY Architecture Inc. WesternGeo understand that the proposed development will be one (1) story multi-unit commercial buildings with pavement parking and driveway. Any change may require additional investigation and/or revision of the geotechnical report/recommendations.

## 3.0 FIELD WORK & METHODOLOGY

A member of WesternGeo's technical staff visited the site on October 25, 2018 and conducted a reconnaissance level site investigation. The site reconnaissance included a visual investigation where features such as topography, vegetation, and surface water features were observed and recorded.

Following the reconnaissance review, a subsurface soil investigation consisting of seven (7) test pits using a track-mounted excavator was completed. WesternGeo's staff visually logged and classified the soil excavated from each test pit. Representative soil samples were obtained for further classification and testing in the laboratory. The subject site was traversed by foot in accessible areas and any features of engineering geological significance were recorded.

A desktop study of relevant available information was conducted following the site investigation. This study included the review of resources such as geologic maps and landslide Hazards studies. This information was used to assist in determining site specific geotechnical parameters needed for geohazard risk analysis and to determine construction recommendations including requirements for site preparation, foundation design, and drainage.

This report was prepared to summarize the results of the site investigation, desktop study, and subsequent engineering analysis. The intent of this report is to provide the key stakeholders with information regarding the condition of the subject site from a geotechnical perspective.

## 4.0 SOIL AND GROUNDWATER CONDITIONS

Published geological mapping by J. E. Armstrong (1977) of the Geological Survey of Canada shown on Map 1487A, Surficial Geology Chilliwack West of Sixth Meridian British Columbia includes the site area. The map indicates that most of the site and vicinity is underlain by slope deposits (SAo) consisting of fan and landslide gravel and sand and rubble up to 10 meters thick overlying Fraser River sediments. The

mapped landslide deposits extend about 3.5 kilometers north out on to the valley floor from the mountains. This is consistent to the soil conditions observed during WesternGeo’s site investigation.

The surficial deposits at the subject site include alluvial fan with colluvium sand, gravel, and rubble, which overly the Fraser river sediment. The alluvium fan is deposited by debris flow of unconsolidated sediments over 6000 years ago after a major landslide at the end of the last glaciation period of the Fraser river valley area. The landslide or rock slide that deposited the colluvium material may be associated with the Cheam slide that occurred over 6000 years as previously discussed.

Weathering, erosion and other depositional processes over the years may account for the surficial fine silt at the subject area. The bedrock at the subject area consists of Chilliwack group limestone. However, the higher steep mountain areas consist of meta-sedimentary rocks with few visible outcrops at the lower mountain slopes.

The following describes the specific soil conditions interpreted from the test pits and our local knowledge and experience in the area. Interpretation of soil conditions between test pits is based on an assumed continuity of the subsurface conditions. The soil conditions described are generalized and are based on the available information in the test pits. Variation in soil stratigraphy can occur between test pits and in the areas not investigated. The soil logs should only be referenced for soil and groundwater conditions at the specific location of each test pits.

Based on the test pit results and the general information presented in the geological maps, the stratigraphy in order of increasing depth of occurrence is summarized as follows:

**Table 1: General Soil Conditions (TP18 - 01 to TP18 - 07)**

Approximate Depth	Soil Unit
0.0 m to 0.1m	TOP SOIL: silt, rootlets, organic, soft, dark brown, moist.
0.3m to depths explored (TP18-01,02,03,04&07)	SAND: and gravel(land slide), some silt, rock rubble(angular, sharp edge), dense, brown, moist
0.3 to 1.0m	SAND: and gravel(land slide), some silt, rock rubble(angular, sharp edge), dense, brown, moist
1.0 to 2.0m	SAND: and silt, compact, dark brown, moist
2.0 to 3.0m (TP18-05)	GRAVEL: some sand, dense, brown, dry to moist
0.3 to 1.0m	SAND: and gravel(land slide), some silt, rock rubble(angular, sharp edge), dense, brown, moist
1.0 to 1.6m	SAND: and silt, compact, mottled colour, moist
1.6 to 3.0m (TP18-06)	GRAVEL: some sand, dense, brown, dry to moist

Groundwater seepage was not encountered during investigation. Seasonal fluctuations in the groundwater table are expected. It is anticipated that a localized and perched groundwater level may develop near the existing ground surface after/during periods of intense rainfall and/or rapid snowmelt.

## 5.0 DISCUSSION AND RECOMMENDATIONS

The results of the subsurface explorations indicate that the proposed Retail & Commercial development is feasible. The sand and gravel (Land Slide, rock rubble) will provide a competent subgrade for the construction of the proposed future building structure.

Based on the Schedule D5 (Development Permit Map) related to Fraser Valley Regional District(FVRD), Official Community Plan (OCP) for Popkum Bridal Fall Bylaw No.0200, the proposed site is in the zone of DPA 5-D (West Popkum Commercial Development Permit Area).

Also based on the Schedule D2 (Boundary and Area Designation Plan Map) related to FVRD, OCP Bylaw #0200, the site is in the area of Highway Tourist Recreation Commercial Area (HTRC). As per schedule D4 map, proposed development site is away from the Floodplain and Environmentally sensitive areas.

### 5.1 Seismicity

According to the B.C. Building Code (BCBC 2018), the Site Classification for this property is 'C' – Very dense soil and soft rock. The National Building Code (NBCC 2015) Seismic Hazard Calculation for the coordinates 49.1849 North and 121.7637 West gives a Peak Ground Acceleration (PGA) of 0.220 g for a return period equivalent to 2 percent in 50 years. The design Spectral Accelerations for this seismic event are given in Table 2 below.

**Table 2: Seismic spectral coefficients from NBCC (2015)**

Sa(0.2)	Sa(0.5)	Sa(1.0)	Sa(2.0)	Sa(5.0)	Sa(10.0)	PGA	PGV
0.488	0.404	0.254	0.161	0.059	0.020	0.220	0.317

Based on B.C. Building Code (BCBC 2018) Table 4.1.8.4. –H & I, the value of F(PGA) and F(PGV) were interpolated as 1.0 and 1.0, respectively. The site has no liquefaction potential due to the observed soil consistency.

### 5.2 Geohazard Assessment

#### 5.2.1 Methodology

WesternGeo conducted a review of available and pertinent documents on the subject site in addition to site reconnaissance and assessment of pertinent data from the desktop study. Documents reviewed include past geotechnical, previous hazard assessment report and the geologic hazard map. Geotechnical Hazard Study Popkum-Bridal Falls, Fraser valley Regional District (FVRD) and official Community Plan related to electoral area "D", Bylaw No.0200 were reviewed.

The site reconnaissance consists of systematic identification of any potential hazard through observation and inspection of geological features at the site. The hazards are characterized in descriptive terms as suggested by Cave (1993).

### 5.2.2 Previous Studies

- **Slope Stability**

The study identified an old landslide termed “Cheam Slide” that occurred over 6000 years back. The Cheam Slide originated southeast of the study area, which is outside the subject site, and its debris covered the Fraser River lowland. Referenced work by Nauman (1990) that a future major slide could occur in that region was counteracted by the work of Thurber Consultants (1991) in which no critical failure surface or discontinuity was found.

Further assessment by Hardy BBT Limited (1991) found no evidence of major future slope instability at the area, and concluded that rock falls or small slides from the Cheam Mountain Cliffs and the Cheam Slide pose no hazard at the subject site, thus, of low risk.

### 5.2.3 Landslide Assessment

The existing natural slope of the Cheam Mountain is well vegetated and there is evidence of instability from site inspection. The nearest steep section of the Cheam Mountain with a slope of 100% is approximately 3km from the proposed development. Besides, there is adequate building setback from the base of the mountain in the unlikely event of slope instability.

Thus, WesternGeo concurs with previous assessments that the probability of massive failure of the Cheam Mountain slope is very low (i.e., less than 1:10000), thus, it does not pose any hazard to the proposed development.

### 5.2.4 Flood and Erosion Assessment

The subject site is not within a flood and environmental hazard zone as delineated in the Schedule D4 (attached) by the FVRD, OCP for Popkum Bridal Falls Part of Electoral Area “D”, Bylaw No 200.

The site is periodically subjected to flooding during the rainy season, but the flooding may be due to ground water rather than surface water. Surface water runoff seeps into the rock rubble at the base of the mountains to the south and then apparently flows north as ground water through the inclined layer of buried rock rubble that extends under the site. During severe storms, the water may rise above the ground surface and pond at the site’s low areas, because the water is confined laterally by Gray road which is elevated at the site’s east boundary.

To minimize the risk of flood water damage, the engineered fill to be constructed at the site should be extended well above the existing natural grade, and storm drain measures should be devised to intercept and divert ponding water to locations east of Gray Road.

### 5.2.5 Snow Avalanche and Debris flow

The subject site is more than 3 km from the top of the Cheam Mountain crest, and the distance between the crest and site is well vegetated with mature trees and shrubs. Besides, there is no historical evidence of any major freshet at the subject area.

Therefore, the release of any accumulated snow or ice from the mountain top would have no impact on the subject site because of the resistance offered by the vegetation, and the large buffer zone between the mountain top and the subject site.

Flow of saturated unconsolidated sediment or debris flow from the mountain side will have low impact on the proposed development, which is approximately 2 km from the base of the mountain. Thus, avalanche and debris flow from the mountain top are of no concern at the subject site.

### 5.2.6 Liquefaction Assessment

The subject area is located within an area of moderate seismicity with a peak ground acceleration of 0.22g for a 2% probability of exceedance in 50 years. The major risks posed by seismic activities are landslide and soil liquefaction. As discussed earlier, previous studies have shown that the last major slide occurred over 6000 years ago and the likelihood of any major slide in the future is low.

Based on the observation from the testpit exploration program, no water seepage was observed in any of the testpit TP18-01 to TP18-07, the water table is considered deep enough to impact the soil aggregates at subject site. Since unsaturated soil aggregates cannot liquefy, and the non-liquefiable crust is enough buffers to mitigate the effect of any deep seated liquefaction. Thus, liquefaction hazard is of very low concern at the subject site.

In assessing hazards associated with the subject site, this geotechnical report has used the 1993 paper *Hazard Acceptability Thresholds for Development Approvals by Local Government* by Dr. Peter W. Cave (Cave Report), acknowledged throughout British Columbia as a defining document in hazard assessment. The Cave Report details eight distinct geotechnical hazards that may pose a risk to a site. The eight hazards have been summarized in Table 3. A site is rarely subject to all eight hazards; however, depending on location and the site-specific profile characterization, a property may be at risk from any combination of the hazards listed below.

**Table 3: Relevant Geotechnical Hazards**

<b>Hazard</b>	<b>Definition</b>
Inundation by Flood Waters	Characterized by an unusually large volume of water flowing in a channel, a portion of which may flow overbank. Floods are associated with other hazards such as channel erosion and avulsion.
Mountain Stream Erosion and Avulsion	Characterized by the lateral migration of a stream channel (erosion) and/or the abandonment of the channel course to occupy a different position on the alluvial fan (avulsion). This type of hazard may be associated with large flow events.
Debris Flows and Debris Torrents	A rapid, channelized, fluid transport of water saturated debris. A debris flow path can be divided into an initiation zone, a transport and erosion zone, and a deposition zone. Transport often initiates within steep gullies and is conveyed downslope at high velocity which can damage forests and human development.
Debris Floods	A large flood event associated with an unusually high amount of sediment movement consisting of coarse bed load material and organic material such as trees and logs.
Landslides, Small-Scale, Localized	The sudden and rapid or gradual and incremental downslope movement of soil, rock, and other weathered materials.
Snow Avalanche	The sudden and rapid downslope movement of snow and ice. Avalanches develop large amounts of kinetic energy, damaging anything in its path.
Rock Fall	The detachment of individual rock fragments from a steep slope and their gravitational downslope transport.
Landslides, Massive, Catastrophic	The sudden and rapid movement of unusually large amounts of soil, rock and other weathered materials.

During the site walkover, WesternGeo did not see signs of surface erosional features that pertains to susceptibility to hazard as a result of *Erosion and Avulsion, Debris Flow and Torrents, Debris Floods, Snow Avalanche, or Rock Fall*.

### 5.2.7 Risk Analysis

The Cave Report describes the appropriate regulatory responses and approval conditions to development applications for sites that may be susceptible to geohazards. The regulatory response for a specific site is based on the applicable geohazards, the expected return period of these hazards and the scope of the proposed development. The Approval Rating is quantified in a response range from 1 to 5, with corresponding conditions of approval provided below in Table 4.

**Table 4: Hazard-related Responses to Development Approval Applications**

Approval Rating	Approval Response
1	Approval without conditions relating to hazards.
2	Approval, without siting conditions or protective works conditions, but with a covenant including “save harmless” conditions.
3	Approval, but with siting requirements to avoid the hazard, or with requirements for protective works to mitigate the hazard.
4	Approval as (3) above, but with a covenant including “save harmless” conditions as well as siting conditions, protective works or both.
5	Not approvable.

The subject site was analyzed according to the criteria for *New Building*. Estimates of the annual return frequencies of potential geohazards and the appropriate approval responses to these probabilistic estimations are listed in Table 5.

**Table 5: Estimated Annual Return Frequency for Geotechnical Hazards**

Hazard	Return Frequency	Approval Rating
Inundation by Flood Waters	n/a	1
Mountain Stream Erosion/Avulsion	n/a	1
Debris Flows and Debris Torrents	n/a	1
Debris Floods	n/a	1
Landslides, Small-Scale, Localized	n/a	1
Snow Avalanche	n/a	1
Rock Fall	n/a	1
Landslides, Massive, Catastrophic	n/a	1

It is important to note that accurately defining annual return frequencies and probabilities of occurrence in terms of qualitative values is extremely complex. In accordance with standard geotechnical principles and practices, the estimation of these values is based on the observed site conditions, engineering judgment and all the information available to WesternGeo at the time the report was written. The estimated probabilities of occurrences are based on the estimated annual return frequencies described in the Cave Report.

Based on this assessment, no hazards associated with landslides, flooding and erosion, avalanche and debris flow, and soil liquefaction were identified. WesternGeo considered that the geotechnical hazard associated with the subject site is very low. Therefore, the development described in this report to be safe for the use intended.

### 5.3 Subgrade Preparation

Proposed development be stripped and cleared of topsoil, organics, loose soils and other deleterious material, in order to expose an inorganic subgrade consisting of stiff silt or dense to very dense sand and gravel or rock rubble.

Stripping of unsuitable materials should be undertaken with a tracked excavator equipped with a clean-out bucket. The excavator should progressively retreat from the stripped area to avoid disturbance to the exposed subgrade.

- Site preparation should be undertaken during extended periods of dry weather.
- All loose or deleterious material should be stripped to expose the load bearing surfaces, to a distance beyond the building footprint equal to at least the depth of the excavation. Recommended maximum cut slopes should be 1.5 H to 1 V (Horizontal: Vertical).
- If any excavated area will remain open during extended period of time, rainfall protection measures are recommended. Polyethylene Sheeting should be used to cover all cut faces and slopes. Temporary berms and channels shall be constructed to divert water away from excavations.
- A bedding layer of 100 mm (minimum thickness) of 19 mm clear crush gravel, or approved equivalent, should be placed directly on the excavated surface.
- All water-softened or disturbed soils should be removed and replaced with compacted clean cohesionless well-graded structural fill, or as directed by the Geotechnical Engineer.

### 5.4 Foundations

The proposed building(s) should be supported on shallow or spread footings founded on the dense stiff silt or dense to very dense sand and gravel or rock rubble layer, or on well-compacted structural fill (within any over-excavated areas). Geotechnical recommendations for footings are provided below:

It is recommended that design bearing pressures up to 100 kPa (approximately 2,000 psf) be used for sizing the footings under Serviceability Limit States (SLS) design, where they are directly supported on the sand and gravel or rock rubble layer. This design value can be increased by a factor of 1.5 under Ultimate Limit States (ULS) conditions.

Minimum spread footing dimensions of 0.6 metres (2.0 feet) and minimum strip footing widths of 0.9 metres (3 feet) are recommended. It is recommended that foundations be placed at least 0.45 metres (18 inches) below final exterior grades for frost protection and confinement. Foundations should step at no more than 1.0 vertical to 2.0 horizontal.

The total settlement of footings, under serviceability loading conditions, designed in accordance with the above recommendation should be less than one inch. Differential settlement would be expected to be less than 25 millimetres over a span of 10 metres (an inch over a span of 30 feet) or 0.002 radians angular distortion. This corresponds to a deflection ratio of 1 in 500.

It is suggested that the footing areas be protected with an approximately 2 inch thick layer of clear crushed gravel.

Foundation subgrades should be protected from freezing. In addition, groundwater and rainwater runoff should be directed to temporary sumps, and footing subgrades should be kept free of standing water. Footing concrete should not be poured on frozen ground.

The engineered fill materials placed in support of footings should be compacted in thin lifts to at least 100% of the maximum dry density as determined in accordance with ASTM D698 (*Standard Proctor*), within 2% of its "optimum" moisture content for compaction.

The Geotechnical Engineer of Record should be provided with an opportunity to review the exposed subgrade prior to footing construction or concrete pouring.

## 5.5 Pavement Sections

The subgrade preparation for the road works may be done as mentioned in Section 5.3 above. After stripping the topsoil, the sand/sand & gravel should be compacted and approved by the geotechnical engineer before placing subgrade fill above. The finished subgrade should be and proof rolled to the satisfaction of the geotechnical engineer before placing the subbase layer. The onsite soils are considered competent for the road widening and new section. Based on the Fraser Valley Regional District (Rose Dale) Subdivision and Control Bylaw and soil conditions encountered, the following minimum pavement section is recommended for internal subdivision roads to meet the minimum requirements.

- 75mm Asphalt Pavement
- 150 mm Crushed Granular Base
- 350 mm Select Granular Subbase
- Undisturbed approved subgrade

The base and sub-base should meet the requirements given in Master Municipal Specifications Sections 02233 and 02234. In accordance with the Master Municipal Specifications, the compaction of granular base and sub-base materials should be to a minimum of 95% Modified Proctor maximum dry density (ASTM D-1557). Silt subgrade soils should be excavated neat and should not be compacted. Any disturbed or water softened subgrade soils should be cleaned out just prior to placing structural fill or the subbase layer.

## 5.6 Excavation

Where excavation is required and exceeds a depth of 1.2m, WorkSafe B.C. guidelines for stable excavations should be followed to ensure a safe working area. For planning purposes, temporary cut

slopes deeper than 1.2 m, may be cut with side slopes of 1H:1V according to WorkSafe BC regulations unless specific on site recommendations are provided by the geotechnical engineer. Should seepage be encountered during excavation, the slopes should be flattened.

The Geotechnical Engineer should also be notified in advance in order to review the excavation to verify its stability and safety of workers entering the excavation and/or provide shoring details.

### 5.7 Slab-on-grade

Floors formed as concrete slab-on-grade construction should be underlain with a minimum 100 mm-thick layer of 19 mm clear crushed gravel, or alternatively clean cohesionless well-graded granular fill (with less than 5 percent passing the 0.075 mm sieve), compacted to a minimum of 95% of Standard Proctor maximum dry density (ASTM D-698). A moisture barrier, such as 7.5 mil polyethylene sheeting should be installed underneath the slab to minimize potential for slab dampness. A thin layer of sand can be placed underneath the poly to avoid puncture due to gravels.

### 5.8 Structural Fill

Structural fill is defined as fill placed beneath any load bearing area. Imported structural fill should consist of inorganic, clean cohesionless (less than 8 percent passing the 0.075 mm sieve), well-graded granular material.

Structural fill should extend beyond the edge of the footing and paved areas by a distance equal to, or greater than the depth of structural fill below these structural elements. Structural fill should be placed in maximum 0.3 m lifts. Table 6 summarizes the compaction recommendations for structural fill for various structural components.

**Table 6: Compaction Requirements for Structural Fill**

Structural Component	Minimum Compaction
Beneath building envelope, slab-on-grade, and basement wall backfill (non-structural loading)	95% SPMDD*
Beneath pavements and footings (structural loading)	100% SPMDD*

\*Standard Proctor maximum dry density

Laboratory Proctor and field density testing should be conducted to confirm that the standards are met. Prior to importing to the site, sources of structural fill should be reviewed by the geotechnical engineer for approval.

## 5.9 Perimeter Drainage

Footing drains are recommended, should be consisted of 150mm (6 inch) perforated drain pipe surrounded on the top and sides by at least 150mm (6 inches) of nominal 19mm (3/4 inch) drain rock or clear crushed gravel wrapped in filter fabric. A minimum 300mm (1foot) wide zone of free-draining backfill should be placed against foundation walls above the drain rock.

## 5.10 Utility Trench

Bedding material for utility trenches should have Type 1 gradation, in accordance with Master Municipal Construction Document (MMCD) specifications and should be placed and compacted in lifts to provide a minimum of 95% Modified Proctor maximum dry density (ASTM D-1557) around the pipe, including underneath its haunches. Hand-tamping equipment should not directly contact the pipe and should not be allowed to compact above the pipe until the full 300 mm bedding zone has been placed above it.

Imported trench backfill should consist of pit-run gravel or approved equivalent fill material that follows MMCD guidelines and should be placed only within the zone of trench backfill, above the pipe bedding zone. Trench backfill should be compacted to a minimum of 95% Modified Proctor maximum dry density.

## 6.0 CONSTRUCTION REVIEW

WesternGeo should be notified during the construction stage in order to facilitate and complete necessary field reviews. As a minimum, the following field reviews are necessary at the following stages:

- Field subgrade review for the proposed house during site stripping,
- Confirmation of subsoil bearing capacity for the proposed development, and
- Compaction testing of structural fill.

Upon request, WesternGeo can issue Schedule B for geotechnical aspects of the Building Permit Application for the individual buildings constructed for this project. To ensure commitment to field reviews, WesternGeo must be notified when the work commences, to conduct the necessary field reviews during construction. WesternGeo cannot assume responsibility or liability for the adequacy of its recommendations when they are used in the field without WesternGeo being retained to review and approve the actual soil conditions during construction.

## 7.0 LIMITATIONS

The recommendations in this report are provided on the assumption that the contractor will be suitably qualified and experienced. In the event of report revisions, additional funds may be required. The subsurface conditions may vary between testpits and with time. The interpretation of subsurface conditions provided is an opinion and not a certification. Stratigraphic variations in ground conditions

are expected due to its historic nature. As such, all explorations involve an inherent risk that some conditions will not be detected.

Environmental considerations are outside the scope of this geotechnical report. Our recommendations do not constitute a design of any proposed structural element. Incorporation of our recommendations into the design does not constitute us as designers. The designers of such elements must consider the appropriateness of our recommendations.

Samples obtained from site will be retained in our laboratory for 60 days. Should no instructions be received to the contrary, these samples will then be discarded. This report has been made in accordance with the generally accepted soil and foundation engineering practices.

No other warranty, expressed or implied, is made. If the project does not start within 2 years of the report date, the report may become invalid and further review may be required. This report has been prepared for the exclusive use of the client, Rose Dale the Fraser Valley Regional District, and their “Approved Users” for specific application to the development mentioned in the report. WesternGeo and its employees accept no responsibility to another party for loss or liability incurred as a result of use of this report. Any use of this report for purposes other than the intended, should be approved in writing by WesternGeo. Contractors should rely upon their own explorations for costing purposes.

The above referenced report “the Report” may be relied upon by the as if the Report was directly issued to the Fraser Valley Regional District, subject to the following conditions:

- The Fraser Valley Regional District will only use the Report for the specific project that is the recipient and subject of the Report.
- To the extent required by law and subject to the Freedom of Information and Protection of Privacy Act, R.S.B.C., 1996, c. 165, as amended, the Fraser Valley Regional District agrees not to disclose or distribute the Report furnished hereunder to any third party unless the Fraser Valley Regional District on the first page of the Report places a prominent statement that “THIS REPORT MAY NOT BE RELIED UPON WITHOUT THE EXPRESS WRITTEN CONSENT OF THE AUTHOR OF THE REPORT”.



## 8.0 CLOSURE

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

Best Regards,

**Western Geotechnical Consultants Ltd.**

Prepared By:

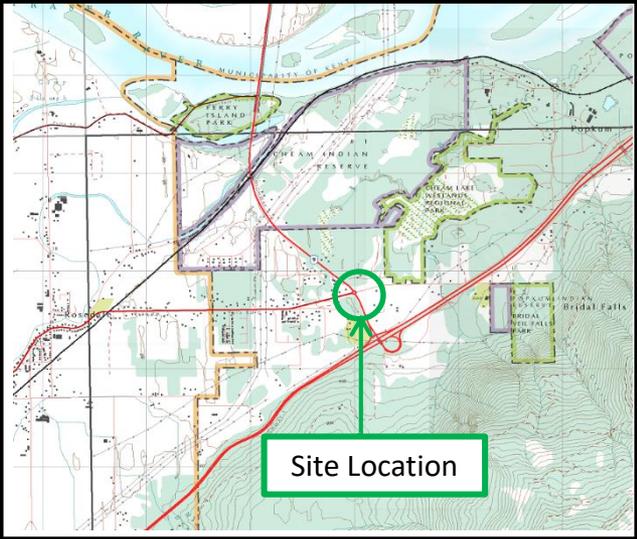
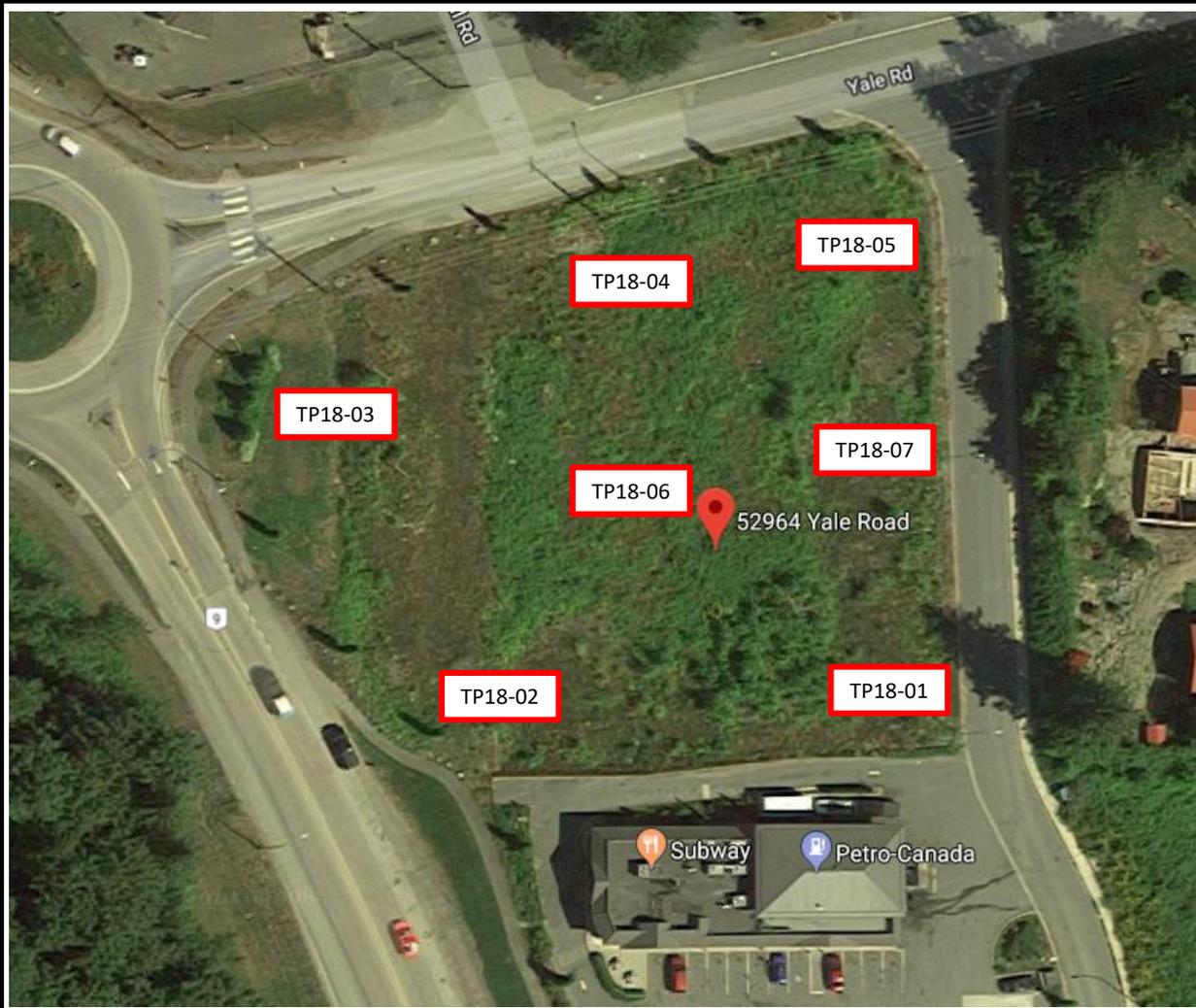
Yaodong Yu, B.A.Sc., E.I.T.  
Geotechnical Engineer in Training

Reviewed By:

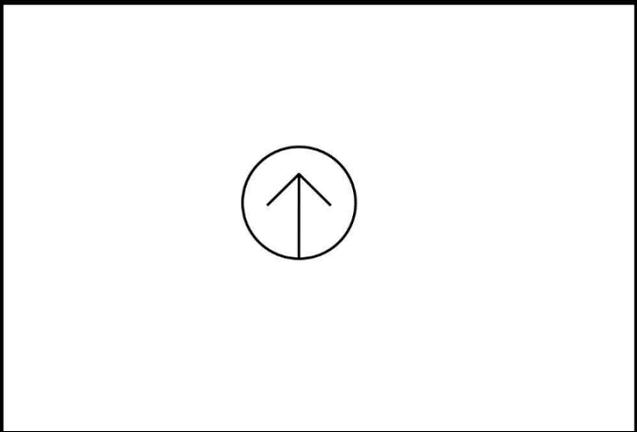
Rajinder Bains, P.Eng., M.Eng.  
Geotechnical Engineer



**Attachments:**    **Test Pit Location Plan**  
                          **Soil Logs**  
                          **Maps Schedule D2, D4 and D5**



Source: GeoBC Ministry of Forests, Lands and Natural Resource Operations



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Client: Rhee Ga Holdings

Proposed 1 Storey Retail & Commercial Development  
Test Pit Location Plan  
52964 Yale Road, Rosedale, B.C.

Project Number: WG1-1406  
Number: Figure 1  
Drawing Date: 11/06/2018

Drawn By: Yaodong Yu  
Reviewed By: Rajinder Bains  
Scale: NTS

Legend:

TP18-01 Test Pit Location (approximate)

# SOIL LOG

TP18-01

CLIENT Rhee Ga Holdings PROJECT No WG1-1406  
 PROJECT Retail & Commercial Development DATUM \_\_\_\_\_ NORTHING ---  
 LOCATION 52964 Yale Road, Rosedale, B.C. ELEVATION \_\_\_\_\_ EASTING ---  
 DATE TESTED October 25, 2018 METHOD Test Pit

DEPTH (m)	CLASSIFICATION	SOIL SYMBOL	MATERIAL DESCRIPTION	SAMPLE TYPE	ELEVATION	DCPT (N)	MOISTURE CONTENT & ATTERBERG LIMITS				POCKET ▲ PENTROMETER (kPa)				DEPTH (ft)
							WP	W	WL		100	175	250	325	
0.0			TOP SOIL: silt, organic, rootlets, soft, dark brown, moist SAND: and gravel (land slide), some silt, rock rubble (angular, sharp edge), dense, brown, moist				20	40	60	80					0
0.5															
1.0															
1.5															
2.0		gp	@1.8m, change to mottled colour, sandy gravel												
2.5			@2.4m, change to brown colour												
3.0															
3.5			NO water seepage observed End of hole at 3.3 m.												
4.0															

SOIL LOG WG1-1406 2018.10.25 SOIL LOG REVISION 00 YY RB.GPJ TESTING PURPOSE - MI.GDT 11/16/18

Sample Type: GS- Grab Sample SPT- Standard Penetration Test  
 ST- Shelby Tube PT- Piston Tube VT- Shear Vane Test

LOGGED BY:  
 Raj B.



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# SOIL LOG

**TP18-02**

**CLIENT** Rhee Ga Holdings **PROJECT No** WG1-1406  
**PROJECT** Retail & Commercial Development **DATUM** \_\_\_\_\_ **NORTHING** \_\_\_\_\_  
**LOCATION** 52964 Yale Road, Rosedale, B.C. **ELEVATION** \_\_\_\_\_ **EASTING** \_\_\_\_\_  
**DATE TESTED** October 25, 2018 **METHOD** Test Pit

DEPTH (m)	CLASSIFICATION	SOIL SYMBOL	MATERIAL DESCRIPTION	SAMPLE TYPE	ELEVATION	DCPT (N)	MOISTURE CONTENT & ATTERBERG LIMITS	POCKET ▲ PENTROMETER (kPa) 100 175 250 325  □ DCPT N VALUE 20 40 60 80	DEPTH (ft)
0.0			TOP SOIL: silt, organic, rootlets, soft, dark brown, moist SAND: and gravel (land slide), some silt, rock rubble (angular, sharp edge), dense, brown, moist				WP 20 40 60 80 W 40 60 80 WL 20 40 60 80	20 40 60 80	0
0.5									
1.0									
1.5		GP							
2.0									
2.5									
3.0			Excavation refusal @2.7m due to big size rock, NO water seepage observed End of hole at 2.7 m.						
3.5									
4.0									

SOIL LOG WG1-1406 2018.10.25 SOIL LOG REVISION 00 YY RB.GPJ TESTING PURPOSE - MI.GDT 11/16/18

Sample Type: GS- Grab Sample SPT- Standard Penetration Test  
 ST- Shelby Tube PT- Piston Tube VT- Shear Vane Test

**LOGGED BY:**  
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# SOIL LOG

## TP18-03

**CLIENT** Rhee Ga Holdings **PROJECT No** WG1-1406  
**PROJECT** Retail & Commercial Development **DATUM** \_\_\_\_\_ **NORTHING** ---  
**LOCATION** 52964 Yale Road, Rosedale, B.C. **ELEVATION** \_\_\_\_\_ **EASTING** ---  
**DATE TESTED** October 25, 2018 **METHOD** Test Pit

DEPTH (m)	CLASSIFICATION	SOIL SYMBOL	MATERIAL DESCRIPTION	SAMPLE TYPE	ELEVATION	DCPT (N)	MOISTURE CONTENT & ATTERBERG LIMITS		POCKET ▲ PENTROMETER (kPa)				DEPTH (ft)		
							WP	W	WL	100	175	250		325	
0.0			TOP SOIL: silt, organic, rootlets, soft, dark brown, moist SAND: and gravel (land slide), some silt, rock rubble (angular, sharp edge), dense, brown, moist				20	40	60	80	20	40	60	80	0
0.5															
1.0															
1.5															
2.0		gp	@1.8m, change to mottled colour, sandy gravel												
2.5			@2.4m, change to brown colour												
3.0															
3.5			NO water seepage observed End of hole at 3.3 m.												
4.0															

SOIL LOG WG1-1406 2018.10.25 SOIL LOG REVISION 00 YY RB.GPJ TESTING PURPOSE - MI.GDT 11/16/18

Sample Type: GS- Grab Sample SPT- Standard Penetration Test  
 ST- Shelby Tube PT- Piston Tube VT- Shear Vane Test

**LOGGED BY:**  
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# SOIL LOG

TP18-04

CLIENT Rhee Ga Holdings PROJECT No WG1-1406  
 PROJECT Retail & Commercial Development DATUM \_\_\_\_\_ NORTHING ---  
 LOCATION 52964 Yale Road, Rosedale, B.C. ELEVATION \_\_\_\_\_ EASTING ---  
 DATE TESTED October 25, 2018 METHOD Test Pit

DEPTH (m)	CLASSIFICATION	SOIL SYMBOL	MATERIAL DESCRIPTION	SAMPLE TYPE	ELEVATION	DCPT (N)	MOISTURE CONTENT & ATTERBERG LIMITS		POCKET ▲ PENTROMETER (kPa)				DEPTH (ft)
							WP	W	WL	100	175	250	
0.0			TOP SOIL: silt, organic, rootlets, soft, dark brown, moist SAND: and gravel (land slide), some silt, rock rubble (angular, sharp edge), dense, brown, moist										0
0.5													
1.0													
1.5													
2.0		gp	@1.8m, change to mottled colour, sandy gravel										
2.5			@2.4m, change to brown colour										
3.0													
3.5			NO water seepage observed End of hole at 3.3 m.										
4.0													

SOIL LOG WG1-1406 2018.10.25 SOIL LOG REVISION 00 YY RB.GPJ TESTING PURPOSE - MI.GDT 11/16/18

Sample Type: GS- Grab Sample SPT- Standard Penetration Test  
 ST- Shelby Tube PT- Piston Tube VT- Shear Vane Test

LOGGED BY:  
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# SOIL LOG

## TP18-05

**CLIENT** Rhee Ga Holdings **PROJECT No** WG1-1406  
**PROJECT** Retail & Commercial Development **DATUM** \_\_\_\_\_ **NORTHING** \_\_\_\_\_  
**LOCATION** 52964 Yale Road, Rosedale, B.C. **ELEVATION** \_\_\_\_\_ **EASTING** \_\_\_\_\_  
**DATE TESTED** October 25, 2018 **METHOD** Test Pit

DEPTH (m)	CLASSIFICATION	SOIL SYMBOL	MATERIAL DESCRIPTION	SAMPLE TYPE	ELEVATION	DCPT (N)	MOISTURE CONTENT & ATTERBERG LIMITS	POCKET ▲ PENTROMETER (kPa) 100 175 250 325  □ DCPT N VALUE 20 40 60 80	DEPTH (ft)
0.0			TOP SOIL: silt, organic, rootlets, soft, dark brown, moist				WP      W      WL 20    40    60    80	20    40    60    80	0
0.5	GP		SAND: and gravel (land slide), some silt, rock rubble (angular, sharp edge), dense, brown, moist						
1.0			SAND: and silt, compact, dark brown, moist						
1.5	SM								
2.0			GRAVEL: some sand, dense, brown, dry to moist						
2.5	GP								
3.0			No water seepage observed. End of hole at 3.0 m.						
3.5									
4.0									

SOIL LOG WG1-1406 2018.10.25 SOIL LOG REVISION 00 YY RB.GPJ TESTING PURPOSE - MI.GDT 11/16/18

Sample Type: GS- Grab Sample    SPT- Standard Penetration Test  
 ST- Shelby Tube    PT- Piston Tube    VT- Shear Vane Test

**LOGGED BY:**  
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# SOIL LOG

**TP18-06**

**CLIENT** Rhee Ga Holdings **PROJECT No** WG1-1406  
**PROJECT** Retail & Commercial Development **DATUM** \_\_\_\_\_ **NORTHING** ---  
**LOCATION** 52964 Yale Road, Rosedale, B.C. **ELEVATION** \_\_\_\_\_ **EASTING** ---  
**DATE TESTED** October 25, 2018 **METHOD** Test Pit

DEPTH (m)	CLASSIFICATION	SOIL SYMBOL	MATERIAL DESCRIPTION	SAMPLE TYPE	ELEVATION	DCPT (N)	MOISTURE CONTENT & ATTERBERG LIMITS	POCKET ▲ PENTROMETER (kPa) 100 175 250 325  □ DCPT N VALUE 20 40 60 80	DEPTH (ft)
0.0			TOP SOIL: silt, organic, rootlets, soft, dark brown, moist				WP    W    WL 20    40    60    80	20    40    60    80	0
0.5	GP		SAND: and gravel (land slide), some silt, rock rubble (angular, sharp edge), dense, brown, moist						
1.0	SM		SAND: and silt, compact, mottled colour, moist						
1.5			GRAVEL: some sand, dense, brown, dry to moist						5
2.0	GP								
2.5									
3.0			No water seepage observed. End of hole at 3.0 m.						10
3.5									
4.0									

SOIL LOG WG1-1406 2018.10.25 SOIL LOG REVISION 00 YY RB.GPJ TESTING PURPOSE - MI.GDT 11/16/18

Sample Type: GS- Grab Sample    SPT- Standard Penetration Test  
 ST- Shelby Tube    PT- Piston Tube    VT- Shear Vane Test

**LOGGED BY:**  
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# SOIL LOG

**TP18-07**

**CLIENT** Rhee Ga Holdings **PROJECT No** WG1-1406  
**PROJECT** Retail & Commercial Development **DATUM** \_\_\_\_\_ **NORTHING** ---  
**LOCATION** 52964 Yale Road, Rosedale, B.C. **ELEVATION** \_\_\_\_\_ **EASTING** ---  
**DATE TESTED** October 25, 2018 **METHOD** Test Pit

DEPTH (m)	CLASSIFICATION	SOIL SYMBOL	MATERIAL DESCRIPTION	SAMPLE TYPE	ELEVATION	DCPT (N)	MOISTURE CONTENT & ATTERBERG LIMITS	POCKET ▲ PENTROMETER (kPa) 100 175 250 325  □ DCPT N VALUE 20 40 60 80	DEPTH (ft)
0.0		GP	SAND: and gravel (land slide), some silt, rock rubble (angular, sharp edge), dense, brown, moist				WP    W    WL 20    40    60    80	20    40    60    80	0
-0.5									
-1.0									
-1.5									5
-2.0			No water seepage observed. End of hole at 1.8 m.						
-2.5									
-3.0									10
-3.5									
-4.0									

SOIL LOG WG1-1406 2018.10.25 SOIL LOG REVISION 00 YY RB.GPJ TESTING PURPOSE - MI.GDT 11/16/18

Sample Type: GS- Grab Sample    SPT- Standard Penetration Test  
 ST- Shelby Tube    PT- Piston Tube    VT- Shear Vane Test

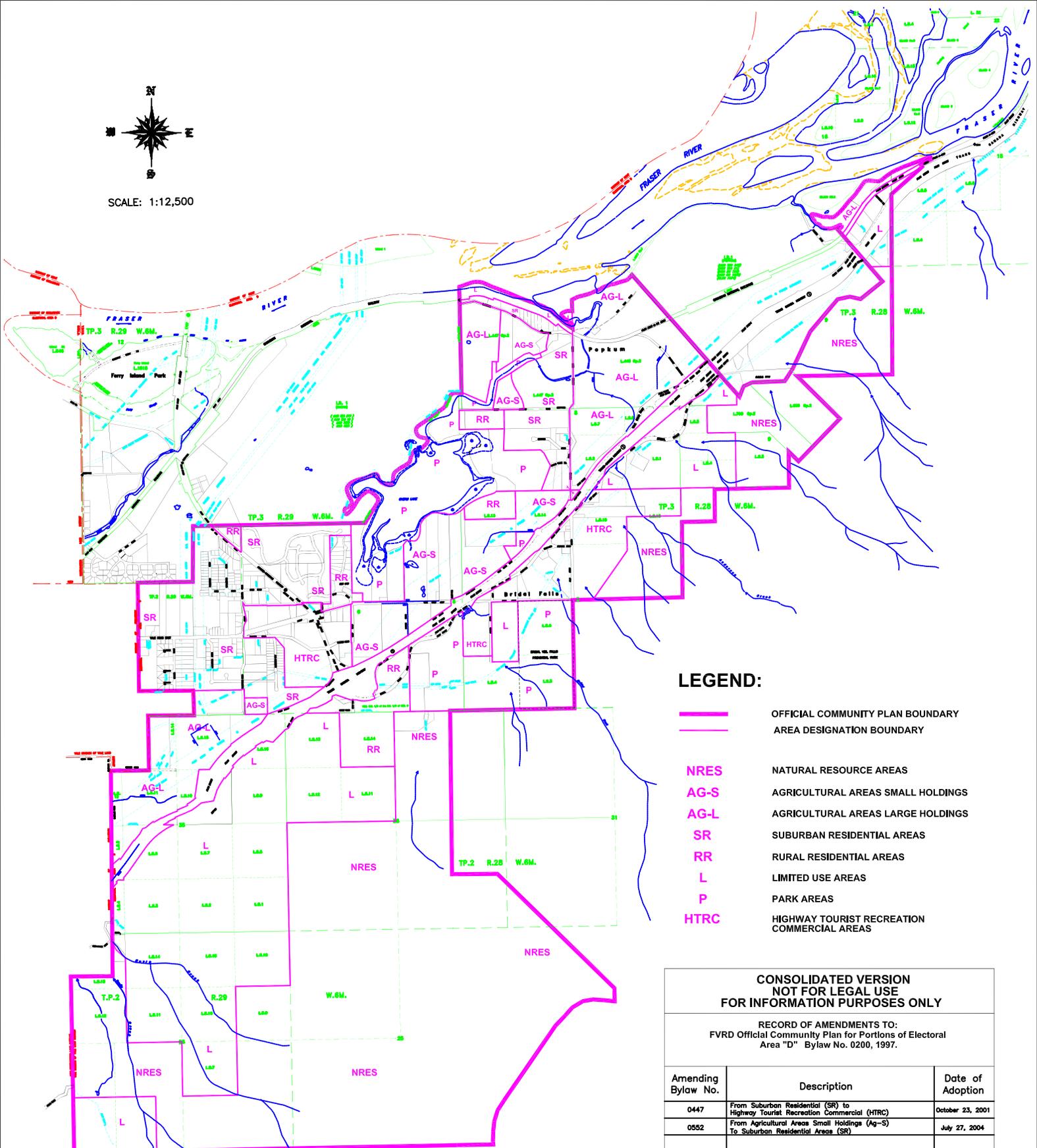
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SCALE: 1:12,500



**LEGEND:**

- OFFICIAL COMMUNITY PLAN BOUNDARY
- AREA DESIGNATION BOUNDARY
- NRES** NATURAL RESOURCE AREAS
- AG-S** AGRICULTURAL AREAS SMALL HOLDINGS
- AG-L** AGRICULTURAL AREAS LARGE HOLDINGS
- SR** SUBURBAN RESIDENTIAL AREAS
- RR** RURAL RESIDENTIAL AREAS
- L** LIMITED USE AREAS
- P** PARK AREAS
- HTRC** HIGHWAY TOURIST RECREATION COMMERCIAL AREAS

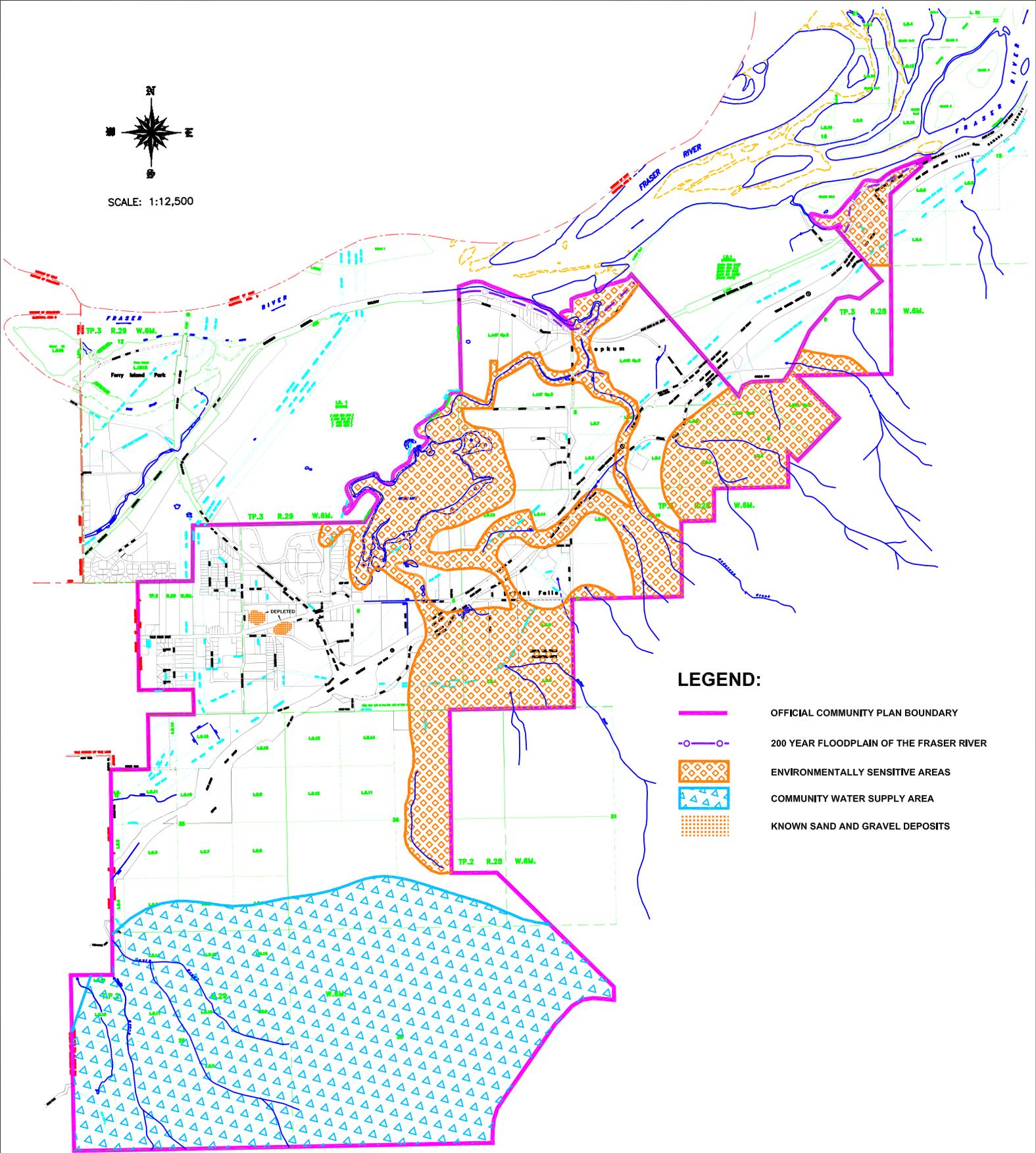
<b>CONSOLIDATED VERSION NOT FOR LEGAL USE FOR INFORMATION PURPOSES ONLY</b>		
RECORD OF AMENDMENTS TO: FVRD Official Community Plan for Portions of Electoral Area "D" Bylaw No. 0200, 1997.		
Amending Bylaw No.	Description	Date of Adoption
0447	From Suburban Residential (SR) to Highway Tourist Recreation Commercial (HTRC)	October 23, 2001
0552	From Agricultural Areas Small Holdings (Ag-S) To Suburban Residential Areas (SR)	July 27, 2004

**FRASER VALLEY REGIONAL DISTRICT  
OFFICIAL COMMUNITY PLAN FOR POPKUM BRIDAL FALLS  
PART OF ELECTORAL AREA "D", BYLAW No.0200**

**SCHEDULE D2: BOUNDARY AND AREA DESIGNATION PLAN MAP**



SCALE: 1:12,500



**LEGEND:**

-  OFFICIAL COMMUNITY PLAN BOUNDARY
-  200 YEAR FLOODPLAIN OF THE FRASER RIVER
-  ENVIRONMENTALLY SENSITIVE AREAS
-  COMMUNITY WATER SUPPLY AREA
-  KNOWN SAND AND GRAVEL DEPOSITS

**FRASER VALLEY REGIONAL DISTRICT  
OFFICIAL COMMUNITY PLAN FOR POPKUM BRIDAL FALLS  
PART OF ELECTORAL AREA "D", BYLAW No.0200**

THIS MAP COMPRISES PART OF SCHEDULE D4 TO THE OFFICIAL COMMUNITY PLAN FOR POPKUM BRIDAL FALLS AREA, PART OF ELECTORAL AREA "D" REFERRED TO IN THE FRASER VALLEY REGIONAL DISTRICT BYLAW No.0200, 1997.

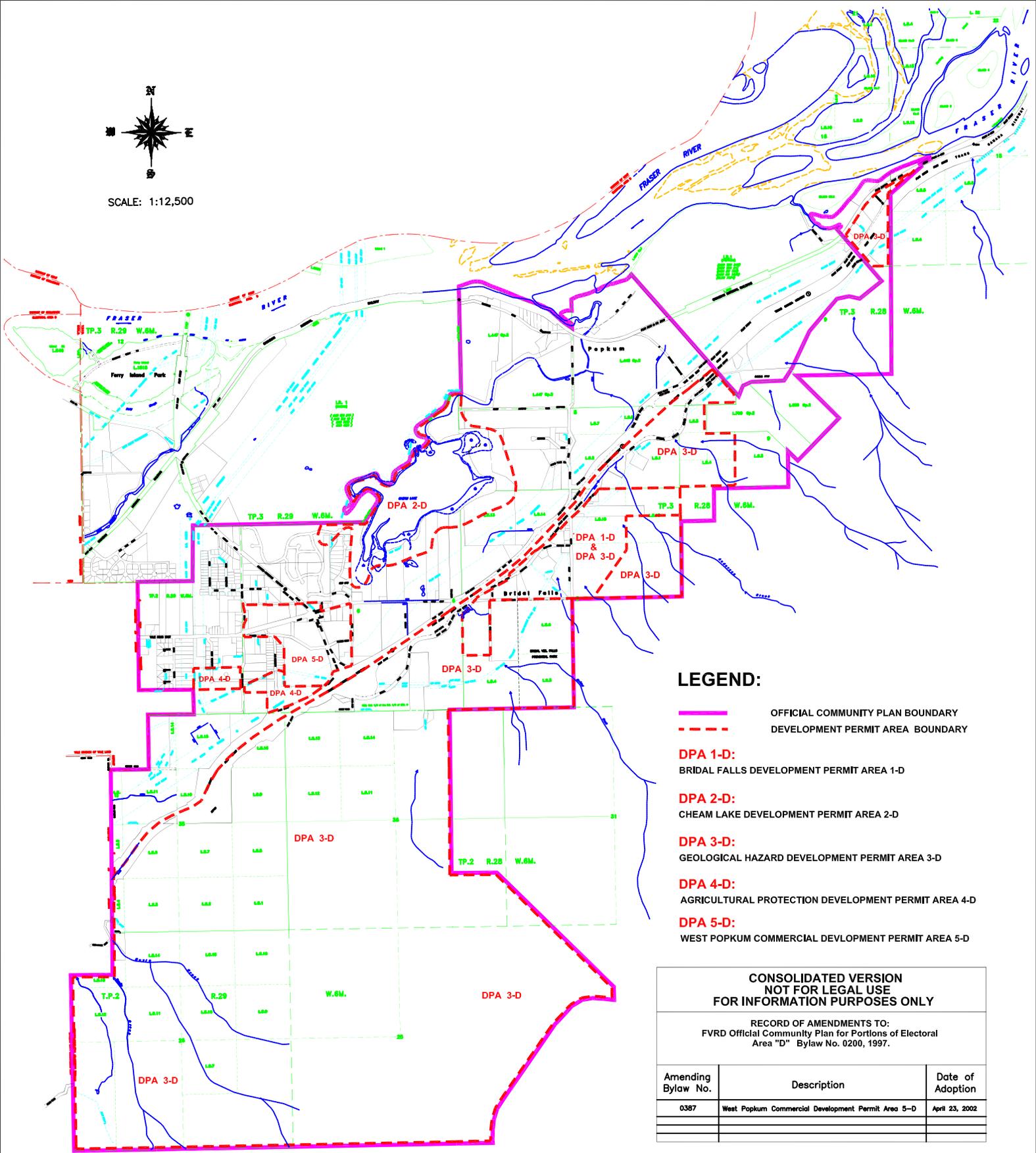
RECONSIDERED AND ADOPTED THIS 28th DAY OF APRIL, 1998.

**SCHEDULE D4: FLOODPLAIN AND ENVIRONMENTAL FEATURES MAP**

CHAIRMAN \_\_\_\_\_ SECRETARY \_\_\_\_\_



SCALE: 1:12,500



**LEGEND:**

- OFFICIAL COMMUNITY PLAN BOUNDARY
- - - - - DEVELOPMENT PERMIT AREA BOUNDARY
- DPA 1-D:**  
BRIDAL FALLS DEVELOPMENT PERMIT AREA 1-D
- DPA 2-D:**  
CHEAM LAKE DEVELOPMENT PERMIT AREA 2-D
- DPA 3-D:**  
GEOLOGICAL HAZARD DEVELOPMENT PERMIT AREA 3-D
- DPA 4-D:**  
AGRICULTURAL PROTECTION DEVELOPMENT PERMIT AREA 4-D
- DPA 5-D:**  
WEST POPKUM COMMERCIAL DEVELOPMENT PERMIT AREA 5-D

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FOR INFORMATION PURPOSES ONLY**

RECORD OF AMENDMENTS TO:  
FVRD Official Community Plan for Portions of Electoral  
Area "D" Bylaw No. 0200, 1997.

Amending Bylaw No.	Description	Date of Adoption
0387	West Popkum Commercial Development Permit Area 5-D	April 23, 2002

**FRASER VALLEY REGIONAL DISTRICT  
OFFICIAL COMMUNITY PLAN FOR POPKUM BRIDAL FALLS  
PART OF ELECTORAL AREA "D", BYLAW No.0200**

**SCHEDULE D5: DEVELOPMENT PERMIT AREA MAP**

THIS MAP COMPRISES PART OF SCHEDULE D5 TO THE OFFICIAL COMMUNITY PLAN FOR POPKUM BRIDAL FALLS AREA, PART OF ELECTORAL AREA "D" REFERRED TO IN THE FRASER VALLEY REGIONAL DISTRICT BYLAW No.0200, 1997.

RECONSIDERED AND ADOPTED THIS 28th DAY OF APRIL, 1998.