Terrain-Stability Analysis

of the

Mt. Currie - D'Arcy Corridor
in Southwestern British Columbia

A report completed for the

Squamish-Lillooet Regional District
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by

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- Summary -

1. This study has established where various types of natural hazardous events might occur in the Mt. Currie - D'Arcy corridor and how these events might affect present settlements and future development plans.

2. The terrain[1] analysis and hazard assessment should allow more refined land use decisions to be made. This should minimize the risk and impact of natural hazardous events while at the same time identifying areas of relative safety where proposed developments could be allowed to proceed.

3. The area is underlain by 200 million year old (Triassic-aged) metamorphic rock and 70 million year old (Cretaceous-aged) granitic rock that has been formed by the subduction of the Juan de Fuca plate under North America. Uplift, mountain building, weathering and erosion are significant by-products of this activity and explain why hazardous events periodically occur.

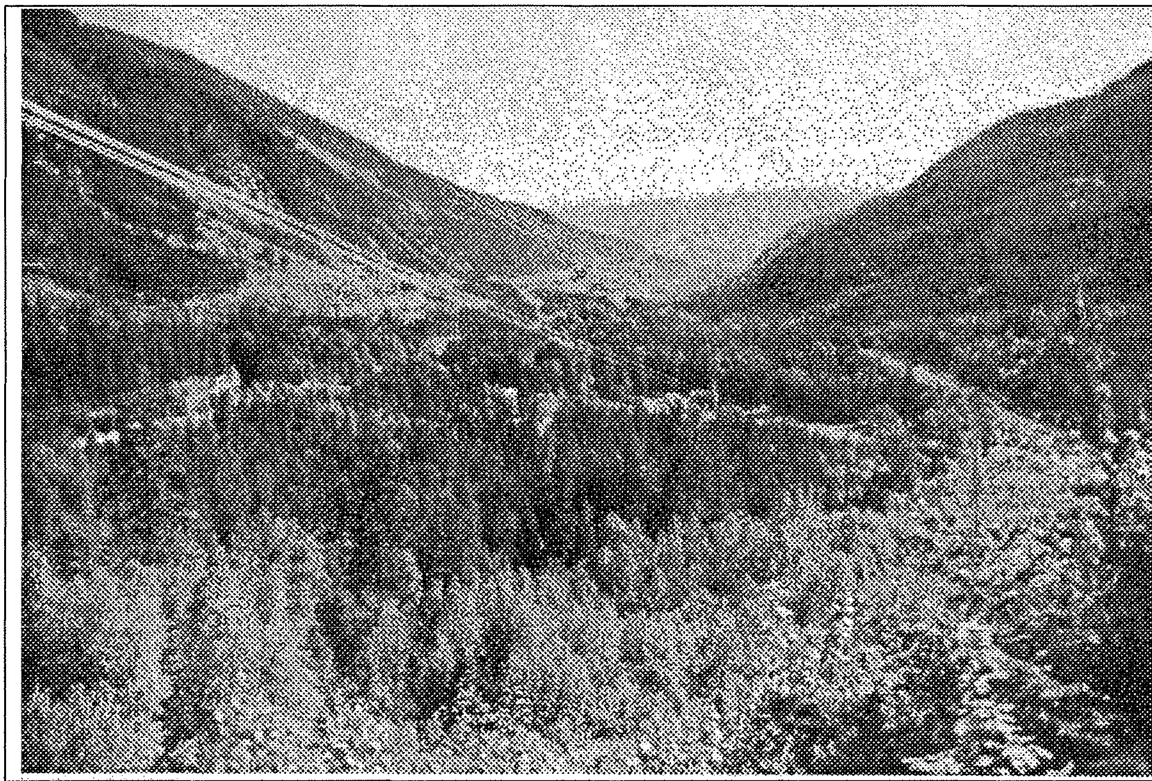

Fig. 1: General view of the Mt. Currie - D'Arcy corridor, looking southwest.

4. The corridor is located in a mountainous region that has been extensively modified by glaciers. These carved out many of the features that are seen and also left a variety of deposits of unconsolidated material which are a major factor in determining the stability of the terrain.

1 a short glossary that defines many of the technical terms is appended to this report.

5. The corridor is located in an area of generally moderate precipitation in a temperate marine climate zone. However, rainfall duration and intensity can be high and may produce major flooding, sediment transport, landslides and stream avulsions. In fall, rain-on-snow or freeze-thaw events are common and may add to the considerable runoff or produce rockfall.

6. The upper elevations of the corridor are areas of considerable snowfall that may cause snow avalanche activity and large spring runoffs.

7. The major terrain units that are present in the Mt. Currie - D'Arcy corridor are (from highest to lowest elevation):
   - steep bedrock
   - colluvial and glacial till veneers over bedrock
   - upper elevation glacial deposits (lateral moraines and kame terraces).
   - colluvial and glacial till blankets.
   - lower valley glacial deposits (glaciolacustrine and glaciofluvial deposits).
   - alluvial and debris fan deposits.
   - fluvial deposits

8. A number of natural hazards may occur in this area. These include debris flows, debris slides, rockfall, rockslides, rock avalanches, stream flooding, stream avulsions, lake outburst floods, landslide-induced lake floods, and snow avalanches. These events have left a number of geomorphic features, most notably, the many talus, alluvial and debris fans that spread out over much of the lower valley.

9. Many of the alluvial fans and other products of mass wastage activity were formed by events of the geologic past- they were made at a time when glacial meltwater and sediment were abundant and mass wastage processes were at their most active. Today, much of this activity has diminished and a number of areas that may have been unacceptably hazardous in the past are now places of relative safety.

9. To complete this study, the following methodology was used:

   - the entire corridor was flown by helicopter and a complete set of oblique photographs (35 mm slides) was assembled.

   - 1:15 000 vertical air photographs were obtained and used with the oblique photographs to complete a terrain analysis of the valley floor and adjacent side hills. 840 terrain polygons were identified during the course of this work.

   - numerous ground traverses and additional aerial inspections were completed to check and refine the terrain analysis.

   - the susceptibility of the terrain polygons to various natural hazards was assessed and used to provide a three tiered hazard rating for each polygon:

     green for areas where there is little or no risk of hazardous events (judged to be safe for habitation and development in the context of this study),

     yellow for areas where there is some risk posed by hazardous events but where a more detailed assessment by a building inspector and/or professional engineer should be able to delineate acceptable sites for a proposed development or prescribe measures that would mitigate the hazard. Examples of yellow areas are floodplains and areas near snow avalanche runout zone.

red for areas where there is a high risk of future hazardous events occurring and where it is unlikely that protective works will be able to mitigate the hazard, or where detailed engineering will be needed to establish areas of safety or conditions of use.

10. To provide additional information on potential hazards, especially for yellow areas, a table listing the hazard polygons, hazard classification, a more detailed description of the terrain conditions, and recommendations for guiding the decision making process is appended to this report. This should help a building inspector decide whether he/she can assess a site and determine the conditions under which a development could proceed, or whether additional more detailed professional advice will be needed. It should also help prospective developers determine whether a site is reasonably safe or what may be required to help ensure that it meets acceptable standards of safety.

    It must be stressed that these hazard ratings should be considered guidelines and that some judgment will always be required when evaluations are made. For example, small areas in green zones may still have rockfall hazard. Similarly, it is likely that areas of safety could be identified within red zones. It should also be noted that, although yellow areas may be acceptably safe if certain protective measures are built or conditions of limited use are adhered to, this study has not tried to define the exact nature of such mitigative measures; in some cases, this may require additional study. Finally, it must be recognized that there is always some risk in living in mountainous country and people who reside in the study area must be prepared to accept such risks.

11. The general principles of risk assessment used by the Fraser-Cheam Regional District were applied to this situation. These principles consider the following hazardous events, their return frequencies, and the scale of development to determine whether an area is acceptable or not for development or habitation. Note that this is an abridged version of the Fraser-Cheam zoning scheme that highlights new building approval; the complete document is appended to this report.

Hazardous Event	Acceptable risk range (depends on the scale of development- from minor repairs to development of a new community).	Maximum acceptable risk for new building approval (but may require protective works, conditional use or a restrictive covenant).	Maximum acceptable risk for unconditional new building approval.
Flooding	1:40 to <1:200	1:40	1:200
Debris Flood	1:50 to <1:10000	1:50	1:500
Stream Avulsion	1:10 to <1:500	1:100	1:500
Debris flow	1:50 to <1:10000	1:200	1:10000
Landslip	1:50 to <1:10000	1:50	1:10000
Snow avalanche	1:30 to <1:10000	1:30	1:10000
Rockfall	1:100 to 1:10000	1:500	1:1000
Major landslide	1:500 to 1:10000	1:1000	1:1000

12. A number of additional hazards not included in the Fraser-Cheam model were considered in this study. These include the risk of lake outburst floods and landslide-induced lake waves.

13. The 17 attached air photos present the terrain analysis and hazard assessment that was completed. The overlays to the original photographs are the penultimate product that show the polygon number, boundary, and hazard classification for all terrain polygons identified in the study. Hazard zones outlined in the 16 large aerial photographs are based on the information contained in the original photographs; in case of dispute, the original photographs should be consulted.

14. This study has identified a number of administrative issues that will need to be addressed. These include the following:

    - how to deal with present landowners and residents who are located in red or yellow (restricted) areas.
    - how to deal with new development proposals in red or yellow areas.
    - how to deal with property owners who have interests in approved subdivisions or who have been issued building permits and now find themselves in areas deemed to be less than acceptably safe.
    - how to deal with situations involving poorly or undefined risks (snow avalanche, catastrophic landslides, lake wave inundation), especially where no clearly defined or accepted standards exist.
    - how to deal with the transfer of risk problem in situations where protective works are contemplated.
    - whether to allow restrictive covenants to become part of the approvals process.
    - how to deal with situations where there is a disagreement among experts about the degree of hazard and therefore the safety of a development.
    - how to deal with property value fluctuations that may occur as a result of the information contained in this report.
    - how to deal with the inherent lack of precision of a report of this nature (dealing with an inexact science) and the need to be able to make future revisions as new data and techniques allow more precise hazard determinations to be made.
    - how to legally define hazard zoning boundaries that are based on an analysis of 1:15000 scale air photographs and that have not been established on the ground by a legal survey.

An Understanding:

The conclusions of this report are based on the currently available data and may need to be modified if additional information becomes available. It must be stressed that terrain analysis, hazard assessment and the evaluation of slope hazards is an inexact science and that any development in mountainous terrain is subject to some degree of geologic or hydrologic hazard risk. This means that the absolute safety or stability of any proposed development cannot be guaranteed, and that users of this report must accept a certain degree of risk if they carry out such development plans. It must also be noted that the zoning boundaries given in this report were defined on the basis of a stereoscopic examination of air photos having an average scale of 1:15000 and have not been established in the field by a legal survey. This means that the precision of a given line is limited by the ability of the analysis to define a given terrain boundary and by the accuracy of the line that could be drawn on a stereo photograph. If questions remain, additional specialist advice or a second opinion should be obtained.

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1.0 Introduction

This report describes and analyzes the terrain and slope and hydrologic hazards present in the Mt. Currie - D'Arcy area in order to allow the safety of present inhabited areas and future development proposals to be assessed.

The study area is located in a major valley that connects the towns of Mt. Currie and D'Arcy (see Figure 2 below).

2.0 Objectives and Methodology

The objectives of the study were to:

- identify as many of the terrain units (polygons) as possible that make up the valley area in this corridor.
- define the characteristics of each terrain unit (terrain analysis).
- evaluate the stability of the terrain in each polygon (stability assessment).
- assess the geologic and hydrologic risk that inhabited areas or proposed new developments in a given polygon would be subject to.

To complete these objectives, the following methodology was used:

- a set of 1990 vertical aerial photographs with an average scale of 1:15 000 were obtained and used to complete a terrain analysis of the study area. A total of 840 terrain polygons were delineated and described during this process.

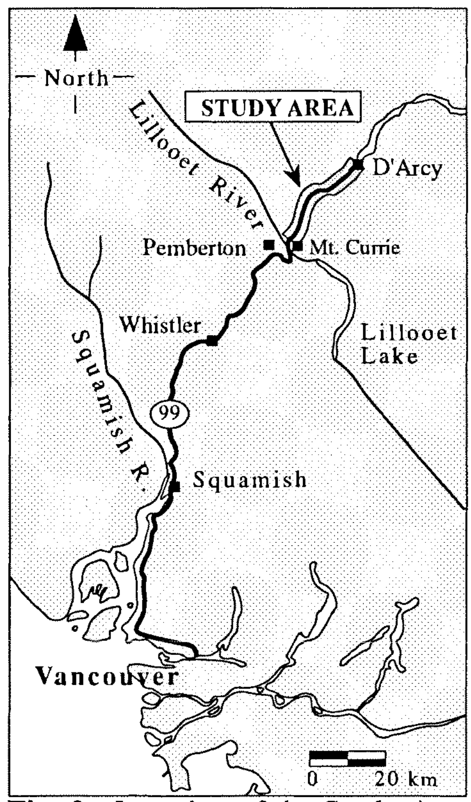


Fig. 2: Location of the Study Area.

- 12 days were spent completing major traverses of key areas of the corridor. In addition, a total of about six days were spent on shorter traverses and check visits. During this work, slope angle measurements were obtained, observations recorded, and the terrain analysis was refined. A total of about 175 of the 840 terrain polygons (21%) in the area were checked on the ground. It should be noted that a much greater percentage of the polygons in the valley bottom were ground checked and that many of the polygons that were not checked are those located in more rugged areas peripheral to the main valley.

- the entire area was flown and assessed from the air. A total of about three hours of flying was done in support of this portion of the project.
- for future reference, colour slides and videos of much of the area were taken during both the ground traverses and the aerial reconnaissance.
- in order to finalize the terrain analysis and complete the stability and impact assessment, the aerial photographs were re-analyzed and assessed in conjunction with the information gathered during the ground traverses and from the videos and photographs.
- some of the terrain polygon information from the original air photographs was transferred to orthophoto maps that had previously been produced by B.C. Hydro. This should allow terrain information to be matched to property lines.
- some of the available technical literature applicable to this area was read and, in combination with the terrain information, was used to prepare this report.

3.0 Physiography

The study area is located within the Coast Mountains of British Columbia in a forested corridor that connects the coastal and interior valleys.

The Mt. Currie - D'Arcy corridor is about 35 km long and encompasses about 100 square kilometres of land. Elevations in the area range from about 200 to 2750 metres above sea level. Although the valley floor is generally flat, adjacent slopes are quite steep, especially where the U-shaped valley profile is at its most precipitous.

4.0 Regional Geology

The Mt. Currie - D'Arcy corridor is located in an area of complex regional geology, about 400 km inland from the western margin of the North American plate. Numerous older terranes make up this area which was then intruded by the Coast plutonic complex (Gabrielse, 1991). The corridor consists of two major rock types: metamorphic rock (mainly phyllite) belonging to the upper Triassic age (200 million year old) Hurley Formation to the north and the Cretaceous-aged (70 million year old) granitic rock of the Mt. Rohr formation, part of the Coast Plutonic complex, to the south.

Since the Mt. Currie - D'Arcy area is located in an active mountain belt, only about 400 km east of the Juan de Fuca - North American plate boundary off the west coast of Vancouver Island, it has been uplifted, folded, and faulted. This activity is on-going and results in periodic earthquakes as mountain building continues. Uplift exposes the rock to the forces of weathering and erosion which then allows landslides and other mass wastage events to occur.

Regional faulting is mainly oriented in a northwesterly and northeasterly direction; this activity has strongly fractured all rock in the Mt. Currie -D'Arcy area and is a major contributing factor to mass wastage events. The presence of broken rock, steep slopes, and large elevation differences make this corridor particularly susceptible to such events. Most of this activity consists of rockfall from steep valley slopes and debris flows that come down the mountain gullies. Occasionally, however, large rock avalanches have plunged to the valley floor.

5.0 Glacial History

Glaciers in the Mt. Currie - D'Arcy area reached their maximum extent about 14 000 years ago and disappeared from the lower valleys about 10 000 years ago (Clague et al, 1980).

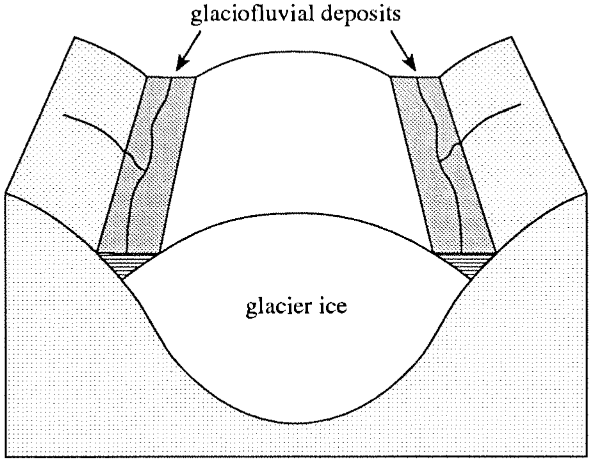


Fig. 3 (a): Formation of glaciofluvial deposits on both sides of a valley glacier.

The glacial activity formed much of the present topography and deposited a considerable amount of sediment that may now become involved in landslides and floods.

Deglaciation was not always a continuous, steady process. Occasionally, melting would temporarily slow down or stop and sediment would then be deposited and accumulate on the margins of the mountain glaciers that filled valleys like the Mt. Currie - D'Arcy corridor.

When the ice disappeared, these deposits (kame terraces or lateral moraines) were left perched at higher elevations on the steep valley slopes. If these deposits are weakened, they may become a source of landslide activity.

Other glacial material was left on valley bottoms as the glaciers receded upslope. These deposits may also be unstable, particularly where they have been incised by later stream activity that has formed steep, v-shaped channels.

Occasionally, the valleys were blocked by ice or sediment and temporary lakes formed and were filled with sediment. One such glaciolacustrine deposit is found at about the 200 metre level in the lower Birkenhead area.

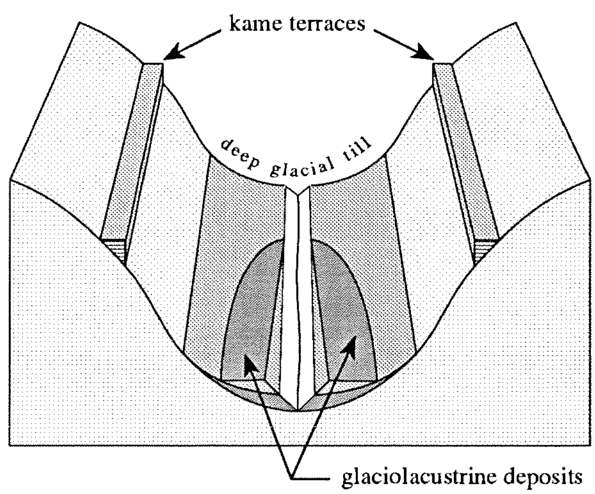
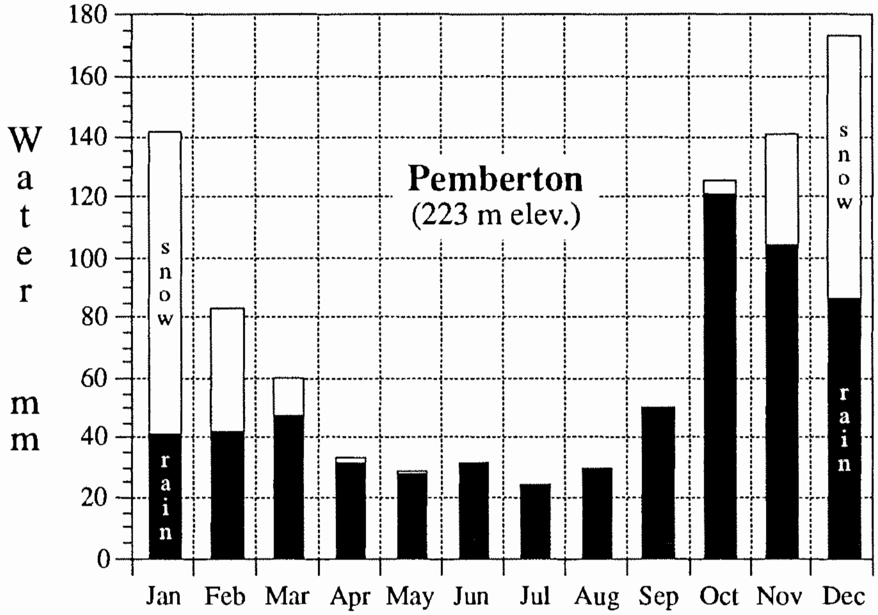


Fig. 3 (b): Deposits left after deglaciation.

6.0 Weather

The best long term weather records for the Mt. Currie - D'Arcy area were recorded at nearby Pemberton, where about 50 years of readings were taken between 1917 and 1967. Average rain and snowfall at Pemberton and Shalath is shown in the graph below and can be used to determine general precipitation patterns.



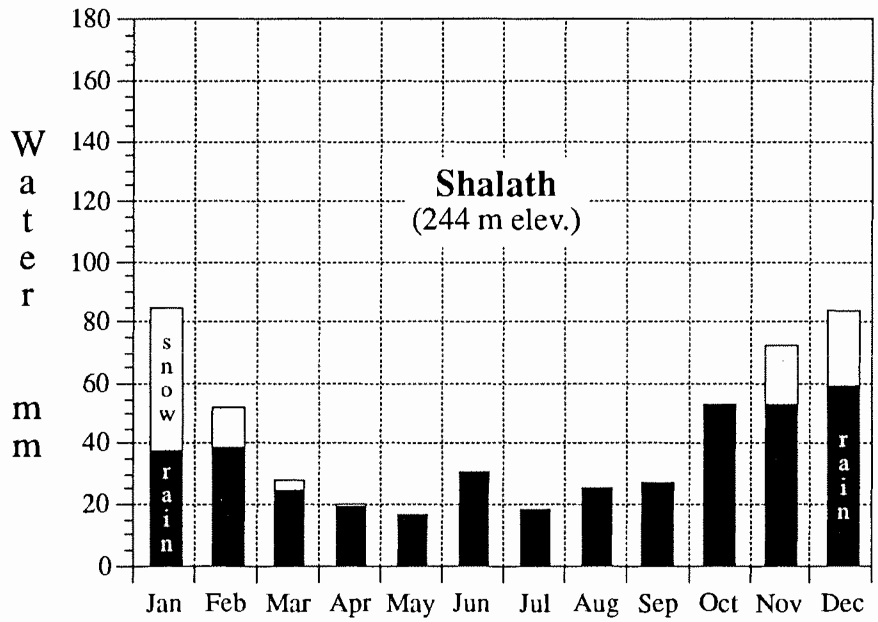


Fig. 4. Monthly average rain and snowfall at recording stations located in Pemberton and Shalath (respectively, 5 km west and 50 km northeast of the study area).

The data indicates that the weather becomes drier in the eastern portion of the study area and that the heaviest rainfalls typically occur in October and November. This would then be the most likely time for flooding and weather-dependent mass wastage events (such as rockfalls) to occur. Late October or November, when a combination of heavy rain that melts early winter snow (a so-called rain on snow event) probably creates the greatest runoffs, is likely the worst time period for such events.

It is also worth comparing some of the precipitation data from Pemberton and Shalath with that recorded at Tofino on the west coast of Vancouver Island (see Fig. 6 below).

	Tofino (26 years of records)	**Pemberton** (50 years of records)	**Shalath** (27 years of records)
mean annual precipitation:	3288 mm	990 mm	520 mm
max 24 hour precipitation:	174 mm	76 mm	55 mm
mean October precipitation:	392 mm	142 mm	55 mm
mean November precipitation:	432 mm	172 mm	49 mm
mean December precipitation:	479 mm	153 mm	38 mm

Note: Pemberton data was obtained from the 1951-80 Climate Normals; the rest from the 1961-90 Climate Normals.

Fig. 5: Precipitation data relevant to the Mt. Currie - D'Arcy area.

At Pemberton, the yearly average precipitation is only about 30% of that on the West Coast of Vancouver Island, one of the wettest areas in B.C. Also, the area is much less likely to be affected by high intensity rainfalls- the greatest 24 hour precipitation recorded at Pemberton was only 76 mm, about 44% of the maximum rainfall recorded on the Coast.

Snowfall is common from December until March and would accumulate in the mountains during this period of time. This means that wet snow avalanches, capable of running down to the valley floor, are most likely to occur in April when a combination of a deep snowpack and spring thaw is most likely to precipitate such events.

Snow survey data from Tenquille Lake (27 km west) and McGillivray Pass (23 km north) indicate that the snowpack reaches its maximum depth by April 1, which also suggests that large avalanches are most likely to occur in April.

The data also indicates that there is less snow east of Pemberton, and that the total snowpack is relatively shallow (approximately 200 cm in the mountains above Gates Lake located near the center of the study area). This suggests that winter dry snow avalanches are probably much less of a threat to the lower valley than wet snow avalanches. The latter occur during spring thaw (March to April), are very dense and wet and can run down slopes of less than 20°.

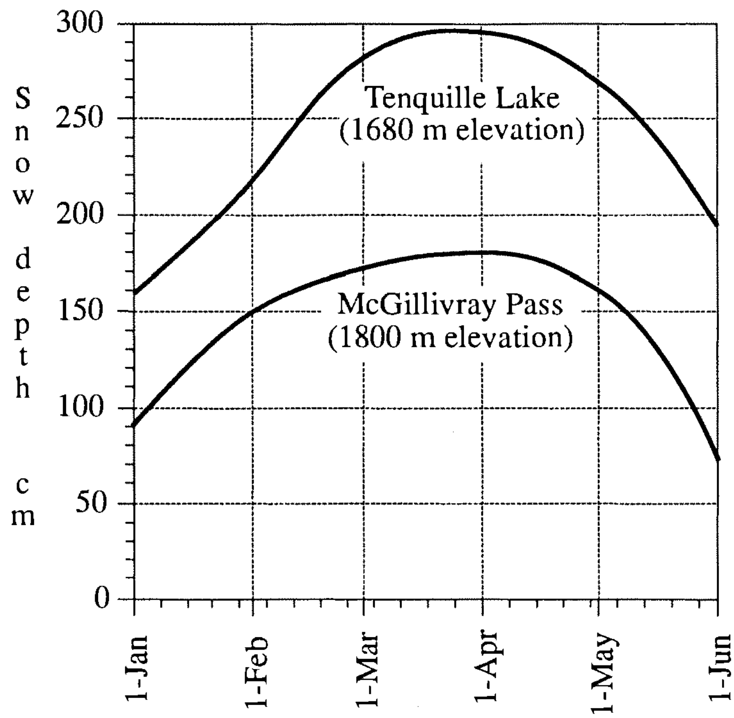


Fig. 6. Average snowpack depths at snow survey stations in the Mt. Currie - D'Arcy area.

7.0 Terrain Descriptions

Besides bedrock, four major terrain types are present in the study area. These are described below and are shown on Figure 14 (appended). For ease of reading, a more descriptive nomenclature is used throughout; however, the standard terrain classification symbols are also included.

7.1 Colluvial veneers and blankets over bedrock (dCb and dCv)

These are deposits of loose debris that are products of local weathering and erosion. The veneers are found mainly on the steep, upper slopes in the Mt. Currie - D'Arcy area. On lower slopes, the colluvial material accumulates to form talus deposits on concave slopes that sweep into the valley bottom, or debris fans at the base of gullies. Usually, the lower slope colluvial material is in contact with, or overlies, valley deposits of glacial till, glaciofluvial or glaciolacustrine deposits (see below).

7.2 High elevation glacial deposits (lateral moraines, kame terraces) (Mvb or $F^{G}t$)

These are relatively minor deposits of gravel and clay-rich glacial material that form discontinuous, elongate bands that stretch across the upper slopes in the Mt. Currie - D'Arcy area. They formed when glacial retreat temporarily stalled, allowing material to be deposited between the ice and the adjacent mountain slope. Where present, these deposits are often unstable, especially if they are located on steeper portions of the U-shaped valley profile.

7.3 Glacial till blankets (gMb)

These deposits were left by glaciers that filled the Mt. Currie - D'Arcy corridor. They form several metre thick blankets of material, mainly in the flat lower reaches of the valley and on the immediately adjacent sidehills. Glacial tills are composed of an unsorted mass of subrounded to subangular boulders of mixed lithology, all contained in a well-consolidated, clay-rich matrix. In flatter areas these deposits are usually stable but along creek channels, particularly where erosion has left steep gullied banks, the till may become saturated with water and fail during high rainfall events.

Till blankets inevitably weather. The weathered section, recognized by its brown, oxidized appearance, is usually more permeable than the underlying basal till and so is able to carry considerably more groundwater. Shear failures, such as debris slides, then occur during high rainfall events at the interface between the weathered and unweathered till.

7.4 Lower valley glaciolacustrine and glaciofluvial deposits ($sL^{G}t$ and $gF^{G}t$):

Glaciolacustrine and glaciofluvial deposits form discontinuous terraces on both sides of the Mt. Currie - D'Arcy corridor. They are most conspicuous along the highway near Mt. Currie and in the D'Arcy area. Occasionally, slides have occurred in these deposits, especially in areas where the microhydrology has been disrupted by roads or similar activity.

Failures in glaciofluvial deposits often occur when ground water becomes perched above thin, clay-rich impermeable seams within the layered sequence of these deposits, adds weight to the soil mass, reduces the internal shear strength of the soil, and so causes masses of this material to fail as debris slides, flows or rotational slides (these are discussed in more detail below).

7.5 Alluvial and debris fan deposits (gFf-R):

These are delta-shaped deposits of debris that form at places where the gradient of a stream coming out of a side valley abruptly changes as it enters a main valley.

The channel of the side creek on the fan periodically changes as it becomes choked with debris. The stream then changes course, or avulses, and deposits material over a new sector of the fan. Over time, this process forms a broad fan-like land form.

If sediment is carried to the fan in debris flows (see below) or similar violent events, the term *debris fan* is used instead of alluvial fan.

Houses on active fans may be at risk if a stream avulses and forms a new channel.

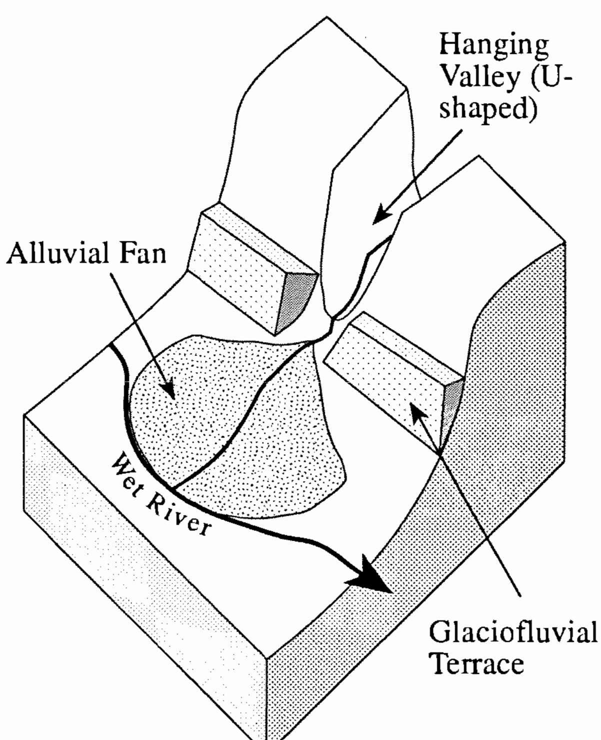


Fig. 7: Alluvial fans and other features.

8.0 Hazardous events that may affect the Mt. Currie - D'Arcy area

The sections below describe the more common mass wastage events that may occur in this area. Although it is not possible to precisely define all potential sites where a given event might occur, polygons with a -R (rapid mass movement), -F (slow mass movement), -V (gullying) or -A (snow avalanching) are sites where the given geological process might occur. This information is summarized in more detail on the terrain and hazard classification photos.

8.1 Previously recognized slope hazards in the vicinity of D'Arcy.

A number of significant slope hazards and landslides have been recognized in the study area. The most prolific areas for such slides have been the major volcanic centres located west of the Lillooet River valley (Mt. Garibaldi, Mt. Cayley and Mt. Meager). Since there are no such unstable volcanic complexes in the D'Arcy area, potential landslides from such sources are excluded from further consideration. Some of the larger remaining known events and potential slope hazards are briefly described below; innumerable smaller failures are also present.

Name	Location	Estimated Size	Comment	Reference
Mystery Creek rock avalanche	5 km SW of Pemberton along Highway 99	40 million cubic metres	Post glacial. Fell about 700 metres vertically and traveled about 3 km across the Green River valley.	Evans (1992)
Green River Crossing rock avalanche.	8 km SW of Pemberton.	Several million cubic metres.	Post glacial. This slide fell about 750 m but only traveled 500 m beyond the toe of the slope.	none
Spetch rock avalanche	9 km NE of Pemberton	Several million cubic metres.	Post glacial. Fell over 1000 metres and crossed the Birkenhead River valley.	none
Mt. Currie toppling failure	On the north face of Mt. Currie, 7 km SE of Pemberton.	Several million cubic metres.	A major potential failure that would spread rock debris over the Green River valley near the Pemberton airport.	Evans (1987)
Gates Peak rock avalanche	South of Gates Lake near the middle of the study area.	15 million cubic metres.	A major rock avalanche that probably occurred during deglaciation (about 10,000 years ago).	Baumann (1992; private report).
Anderson Lake rockfall	On the south side of Anderson Lake, about 18 km NE of D'Arcy.	Several million cubic metres have been deposited by a series of small rock falls.	An unusually active area of rockfall in granitic rock that has built a large, steep talus cone into Anderson Lake.	none

Fig. 8: Previously recognized rock avalanches in the Pemberton - D'Arcy area.

These failures have all occurred in faulted rock where relief and overall slope steepness is very great. The failures appear to be related to major regional structures and occur where these faults cut through fractured rock in areas of high relief.

Where faulting and fracturing has broken up the rock, conditions that would cause small, continuous failures (similar to those at Anderson Lake), rather than large, catastrophic ones exist. Nevertheless, the presence of numerous large landslides in this part of British Columbia indicates that large rock avalanches are always a possibility in this region of high mountains, rugged topography, and complex structural geology.

8.2 Debris flows (polygons with a -R, -V or -F as an indicated geological process).

These are failures that involve a rapidly moving mass of poorly sorted, water-saturated debris that may include boulders and angular rock fragments, as well as soil and organic material (logs, etc.) (VanDine, 1985).

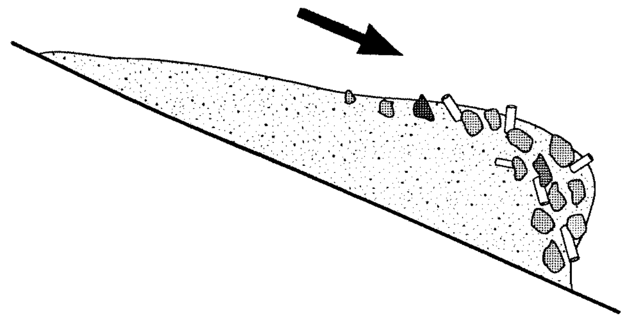


Fig. 9: Debris flow

Rapidly moving, water charged debris flows that contain more than 50% sand, silt and clay, are sometimes called *mudflows;* and debris flows that involve water-charged, predominantly coarser inorganic and organic material flowing rapidly down a steep, confined, pre-existing channel are sometimes called *channelized debris flows* or *debris torrents.*

VanDine (1985) lists a number of features that are likely to make a drainage susceptible to debris torrents. These include a small drainage area (0.4 to 7.0 square kilometres), steep (>15°) slopes in areas of debris accumulation, slopes of greater than 10° for continued transport of material, and climatic conditions that bring high intensity rainfalls.

A number of the side creeks that feed into the main Mt. Currie - D'Arcy valley have a sufficiently high gradient, sources of debris, and small watershed areas and are therefore susceptible to channelized debris flow activity during periods of heavy rain; these are identified on the terrain classification map with a -R, -V or -F symbol.

8.3 Debris Slides (polygons with a -R, or -V as an indicated geological process).

These are rapid failures of unconsolidated sediment on steep hillsides. Debris slides are often a source of material for debris flows if they deposit material into a creek. Small debris slides are possible on any loose, steep slope, especially during heavy rains. They are a particular problem in steep areas which have a thin soil cover, especially if these deposits are saturated with water.

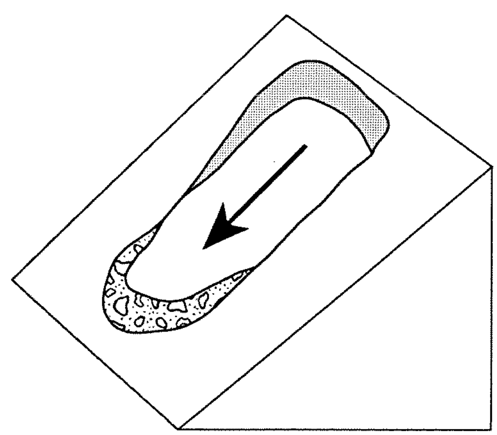


Fig. 10: Debris Slide

In the present study area, soil veneers are mainly found at higher elevations; however, steep banks of glacial material in the lower valleys may also be source areas for debris slide activity. In the latter case, the banks are often cut by small side creeks or saturated with seepage water, both of which tend to destabilize this material.

8.4 Rockfalls and Rockslides (polygons with a -R as an indicated geological process. Areas where the terrain is classified as Rs (steep rock) would also be prone to such failures).

Detachment and rapid tumbling of blocks from steep bedrock.

Most steep slopes in the study area are susceptible to rockfall or rockslide activity. Such areas are usually recognized by the presence of talus slopes or angular boulders. Since rockfall can occur on any steep slope, especially during earthquake loading; many of the valley sidewalls in the Mt. Currie - D'Arcy area are subject to rockfall hazard.

To determine where rockfall under cliffs might be a problem, the methodology proposed by Evans and Hungr (1993) is recommended. This involves defining a rockfall shadow zone that runs from the top of a given talus slope to a point 27.5° out from the base of the slope. Areas within this shadow zone are deemed to have an unacceptable risk of future rockfall hazard.

8.5 Rock Avalanches (polygons with a -R as an indicated geological process).

A streaming mass of blocky debris which results from bedrock failures in solid rock; the dry rock mass tends to travel far beyond the foot of the failed slope. These are the classic "landslides" recognized by lay people, and include such well-known examples as the Hope Slide, near Hope, B.C. and the Frank Slide, near Frank, Alberta.

Four major areas of potential rock avalanche activity were noted in the study area. The first is west of the Spetch railway crossing (in the vicinity of polygon 147). Here, the presence of angular slide debris and major tension cracking in a rocky area high above the valley indicates that future activity is likely. A second region of potential rock avalanche activity is located in a steep gullied area southeast of the Poole Creek subdivision (in the vicinity of polygon 293). A third major potential source of rock avalanche activity is the Gates Peak area (polygon 407)- a slide in this area could enter Gates Lake and cause major wave activity. The fourth area of concern is an unnamed ridge 1.5 km northeast of Birkenhead Peak (in the vicinity of polygon 593). Here, a number of linears suggest that there may be a deep seated instability that could be the source of a larger failure.

8.6 Topples and Slumps (polygons with a -R as an indicated geological process).

Topples involve a forward rotation of a rock unit or units about some pivot point; slumps are rotational slides, usually involving spoon-shaped masses of surficial material, that move along curved rupture surfaces and leave concentric surface cracks, scarps, hummocks and other features.

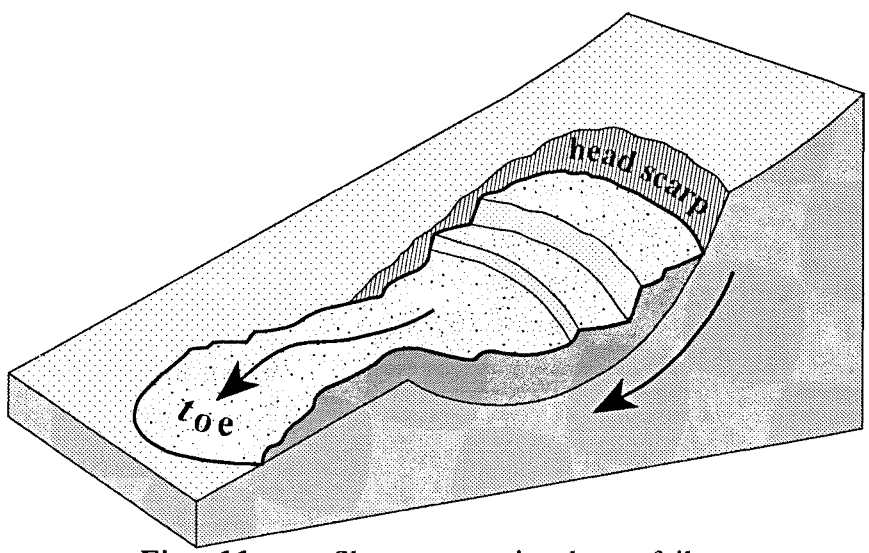


Fig. 11: Slump or rotational-type failure.

A number of small, arcuate slump failures are present along steep glaciofluvial and glaciolacustrine deposits located in the Mt. Currie - D'Arcy corridor.

These glacial deposits often form terraces along the sides of rivers or creeks and are often saturated with hillslope water coming from the slopes above. Rotational failures in these deposits appear to be caused by one of two mechanisms:

- water that comes through more permeable overlying material, flows along the contact between the glaciolacustrine and the more permeable overlying material, and then pours out of the bank, causing it to fail as a debris flow or slide.
- water that enters the unconsolidated material through innumerable cracks, reduces the shear strength of this clay-rich material, and produces a slump or earth flow.

8.7 Stream Flooding

There is only limited water flow information available for the Gates River from a gauging station near D'Arcy (about 7 km downstream) that was maintained from August, 1965 until August, 1968. The maximum recorded discharge was 54 m^3/s (June 22, 1967) from a watershed area of 77.8 km^2. Considering the size of this basin, a 1975 regional peak flow analysis by the B.C. Ministry of Environment suggests that 200 year peak flows of approximately 160 m^3/s could be expected on the Gates River at the gauging station.

About six kilometres upstream from Anderson Lake, the Gates River has been artificially constricted by a combination of fill used to build the railroad and the main highway. In the past, this constriction has restricted water flow, causing upstream ponding. Silt deposits and eyewitness accounts suggest that such events have never previously caused more than a few decimetres of water to pond on the properties upstream. The channel in this area should be widened and any potential impediments to the flow (such as old bridges, logjams, etc.) should be removed.

The Birkenhead River is the other major watercourse in the corridor. Twenty three years of records (between about 1945 and 1971) are available for this drainage and indicate a maximum flow of 362 m^3/s (June 27, 1968) from a watershed area of 596 km^2. In this watershed, a Gumbel extreme value flow analysis suggests that peak annual flows average about 127 m^3/s and that flows of about 700 m^3/s could be expected during 200 year floods.

8.8 Lake Outburst Floods

A sudden flood caused by the release of impounded water behind a temporary dam, such as a mound of landslide debris, or debris left by a stream bank collapse.

Lake outburst floods may occur where debris slides or rock avalanches carry material into a creek or river, especially in narrow side valleys. Any incised creek could be the site of such activity; numerous such places are found in the study area.

8.9 Stream Avulsions (a concern in polygons that have active fans (identified with an "f" in the surface expression portion of the terrain description))

An abrupt change in the course of a stream that may occur during a flood or other event. Avulsions are often a secondary effect of debris flows or slides that block an existing channel, and are a common occurrence in creeks with high sediment loads. Numerous side creeks in the study area have active debris fans where stream avulsions are possible- this is a major problem in this corridor. Road building or other development on such fans must take into account that changes in stream location could occur.

On a number of the large fans, it was found that erosional processes are dominant over depositional ones and that the contributor streams on these fans have carved incised channels into them. In such cases (for example, the Spruce Creek Fan) it was possible to conclude that much of the fan surface is now stable and that the events that formed the fan are no longer as active as they have been in the past.

8.10 Snow Avalanches (polygons with a -A as an indicated geological process):

Sudden releases of snow caused by heavy accumulations of new snow, or conditions that weaken the existing snowpack and cause it to move downhill.

A number of avalanche slidepaths exist in the Mt. Currie - D'Arcy area, most notably at Gates Lake and Mars Crossing. It should be recognized that any snow-covered slope steeper than about 25° (or even less) can slide and should be approached with caution during winter. It is particularly important that smaller slidepaths, which may go unnoticed but which can pose a significant hazard to houses, personnel and equipment, be identified and dealt with in any planning process.

Cutting trees in timbered areas below snow avalanche slidepaths may permanently enlarge runout zones and allow debris to be carried farther downhill. It may also cause permanent loss of tree growing sites and increase the risk to facilities (such as power lines) and personnel.

Snow avalanche slidepaths are identified on the terrain classification map with a -A symbol.

9.0 Forest Hydrology

In this section, the general forest hydrology present in the Mt. Currie - D'Arcy area is discussed. These comments are meant to help the reader appreciate how water flow influences the stability of the terrain in this area and how this information relates to the terrain and hazard classification maps.

9.1 Runoff in areas of bedrock and shallow colluvium

In rocky areas in the Mt. Currie - D'Arcy area, surface runoff is very rapid and often concentrated in steep, rocky channels. Runoff from such areas may carry considerable water and loose material during periods of intense rainfall.

On open slopes, problems may occur when water runs off the bedrock into areas where blankets of unconsolidated but relatively porous colluvial material are present (fine grained scree aprons, for example). Since soil permeability is high, groundwater flow can be quite high and failures occur when the soil particles become mobilized during intense rainstorms. Along roads, piping failures are common. In logged areas, debris slides may occur once tree root strength is lost and the protective forest canopy is removed.

9.2 Runoff in areas of glaciofluvial deposits

Further down most slopes, glaciofluvial deposits are common. Although usually less permeable, these deposits are often quite deep and can therefore carry a considerable amount of water. Clearcut failures are less common but poorly designed roads that concentrate water flow will produce debris flows and rotational failures. If roads are not maintained or adequately deactivated in such areas, failures may occur long after harvesting has finished and water conveyances are no longer functional. As noted earlier, excess water becomes perched above more impermeable layers, causing the pore water pressure to rise and the shear strength of the material to be reduced. This then initiates failures.

Upper elevation glaciofluvial deposits (kame terraces) are not as deep, are usually located on steeper slopes and consist of more clay-rich material. As such, high water flows from slopes above can easily destabilize these deposits and initiate failures. Once a slide starts, it can quickly build up speed and rapidly overwhelm slopes below.

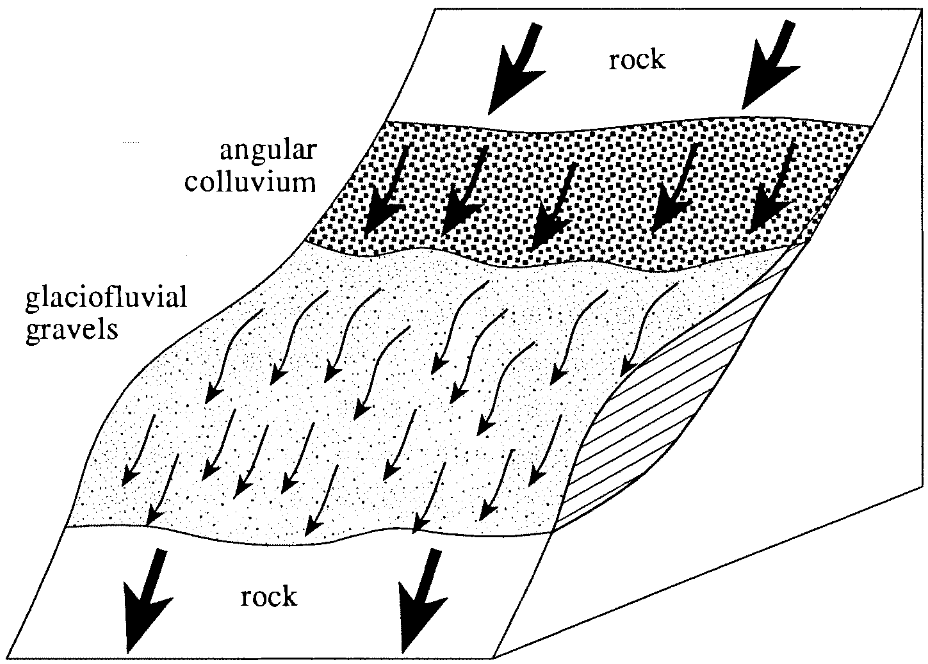


Fig. 11: Surface runoff on typical slopes in the Mt. Currie - D'Arcy area. The larger arrows represent more rapid and concentrated flows.

9.3 Runoff in areas of glaciolacustrine or glaciofluvial deposits

Glaciolacustrine or glaciofluvial deposits, such as are present in parts of the lower Birkenhead River, may be unstable if water becomes trapped above impermeable layers within a stratigraphic sequence or runs over an impermeable surface layer. Where these deposits are located in the lowest part of the valley, all hillslope water passes through or over them, making them particularly vulnerable to failures. However, they may also become unstable if they are saturated by water that enters the soil mass through cracks or other areas of broken ground.

9.4 Runoff in glacial till deposits:

Glacial till veneers behave like bedrock slopes and shed water very quickly. However, the upper, weathered portions of these deposits tend to be more permeable and can quickly become saturated with water during heavy rainstorms. If this happens, a shear failure may occur between the weathered material and the more consolidated basal till underneath. Since trees on these deposits tend to be shallow-rooted, and therefore blow over during strong winds, soil disturbance may be high and the terrain may become even more vulnerable to slope failures, soil transport, and stream siltation.

10.0 Conclusions

The terrain and hazard classification information on the air photographs and in the detailed descriptions of polygons (Appendix 4) summarizes the slope conditions that are present in the study area and should make it possible to assess the risk and impact of natural hazardous events. This should allow more precise planning to be carried out and reduce the risk of future natural hazardous events becoming disasters. It should also allow more zoning decisions to be made by local authorities and finally allow prospective land developers to determine the safety of a given site and provide them with some indication of what would be required to help make a site acceptably safe.

The location of the Mt. Currie - D'Arcy area in rugged coastal mountains close to a plate boundary has provided the geologic and geographic setting that explains why this area is susceptible to mass wastage and flooding events. Past glaciation has contributed to this instability by providing both the glacial landforms and deposits that are often involved in these events.

The Mt. Currie - D'Arcy area is located in an area of only moderate rainfall and so slope failures would not be as common as in Coastal areas.

The major terrain units that are present in the Mt. Currie - D'Arcy area include:

- areas of steep bedrock, mainly consisting of granitic and metamorphic rock.
- colluvial veneers, mainly found on steep upper slopes, and deeper blankets of colluvial and alluvial or debris fan deposits in mid-slope areas.
- high elevation lateral moraines and kame terraces.
- glacial till blankets that are common in the lower, less rugged areas of the area.
- lower elevation glaciofluvial and glaciolacustrine deposits.
- alluvial and debris fan deposits.
- fluvial deposits.

Hazardous events that may occur in this area include debris flows, debris slides, rockslides and rockfalls, rock avalanches, topples and slumps, stream flooding, lake outburst floods, landslide-induced flood waves on lakes, stream avulsions and snow avalanches.

Numerous creeks that enter the main corridor are source areas for debris flow or flood events. Debris slides are likely to occur in steep areas where colluvial or weathered glacial till veneers are present or where steep banks of unconsolidated material are present along creek channels. Rockfall and rockslide hazard could occur in any steep, rocky areas, particularly where regional faulting has weakened the rock. Topples and slumps are most likely to occur in the steep deposits of glaciolacustrine material found along several of the major rivers and creeks in the area.

There are several major rock avalanche deposits in the study area and four areas where future rock avalanches may occur. These sites are located near the Spetch Creek crossing, near Poole Creek, at Gates Lake, and northeast of Birkenhead Peak.

Numerous avalanche slidepaths are present in the Mt. Currie - D'Arcy area. The slidepaths are a threat to anyone present in these areas during periods of instability and may also be permanently enlarged if too much of the surrounding forest cover is removed by development, tree harvesting, road building or other activities.

Stream flow data indicates that the Mt. Currie - D'Arcy has an average annual peak flow of about 52 m^3/s and is likely to have flood flows of about 153 m^3/s at a 200 year return frequency. Based on potential rainfall intensities and basin areas, theoretical peak water flows could be as high as 268 m^3/s. If a temporary blockage of the channel occurred, it is possible that even higher water flows could be generated. The Birkenhead River has annual peak flows of about 126 m^3/s and theoretical 200 year peak water flows of about 700 m^3/s.

11.0 Recommendations

The following recommendations are made:

1. Terrain areas classified as having a green hazard rating should be subjected to the normal inspections and approvals process. Such sites should still be reviewed by the building inspector as required under Section 734 of the Municipal Act to ensure that there are no site-specific or unusual problems.

2. Terrain areas classified as having a yellow hazard rating should be checked in the detailed polygon descriptions to determine whether the building inspector alone or the building inspector in consultation with a professional engineer should determine a course of action. It must be stressed that Section 734 of the Municipal Act already gives building inspectors the authority to decide whether a given site is acceptably safe or not. This study is meant to help the inspector make this assessment more often and therefore reduce the instances where additional expert advice is required. It should also allow a more uniform application of standards to be applied to the building permit approvals process.

3. Where it has been stated in the detailed polygon descriptions that the building inspector can assess all sites, only minor hazards appear to exist or hazards are of low risk. This means that the building inspector should be guided by the normal responsibilities and procedures as defined in Section 734 of the Municipal Act. In such cases, the building inspector should be able to decide whether a building permit can be issued even though a geotechnical evaluation may still be required for some unusual sites.

   Where it has been stated that professional help may be required, some hazardous areas may exist or the hazards may be more severe. This means that, although the building inspector should still be able to decide in many cases whether a building permit can be issued, a conservative attitude should prevail and professional advice should be sought for all sites that appear to have any problems.

   Where it has been stated that professional help is required, there is a high risk of hazardous events occurring or natural hazards would be dangerous and site specific advice will be required. This may not preclude all development but may require very specific site restrictions, protective works, or conditions of limited use.

4. Terrain areas classified as having a red hazard rating should require full agency review and a major, site specific engineering analysis that considers all possible hazards and establishes the conditions under which any proposed development, if any, is allowed.

5. Harvesting of timber in steep areas rated as having a red hazard classification should only be done if a detailed full coverage terrain analysis and hazard assessment is completed.

6. Forested areas near recognized avalanche slidepaths should be treated with caution since any activities, such as road building, powerline construction, or timber harvesting may permanently enlarge avalanche slidepaths and allow more debris to be carried into nearby streams.

7. A number of administrative decisions will need to be made as a result of this study. The following issues should be addressed:

    - how to deal with present landowners and residents who are located in red or yellow (restricted) areas.
    - how to deal with new development proposals in red or yellow areas.
    - how to deal with property owners who have interests in approved subdivisions or who have been issued building permits and now find themselves in areas deemed to be less than acceptably safe.
    - how to deal with situations involving poorly or undefined risks (snow avalanche, catastrophic landslides, wave inundation), especially where no clearly defined standards exist.
    - how to deal with the transfer of risk problem in situations where protective works are contemplated.
    - whether to allow restrictive covenants to become part of the approvals process.
    - how to deal with situations where there is a disagreement among experts about the degree of hazard and therefore the safety of a development.
    - how to deal with property value fluctuations that may occur as a result of this study.
    - how to deal with the inherent lack of precision of a report of this nature (dealing with an inexact science) and the need to be able to make future revisions as new data and techniques allow more precise hazard determinations to be made.
    - how to legally define hazard zoning boundaries that are based on an analysis of 1:15000 scale air photographs and that have not been established on the ground by a legal survey.

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Appendix 1

Explanation of Terrain Unit Symbols, Hazard Classification and Risk Assessment Guidelines used in this Study

The terrain unit symbols describe the texture and material that make up a given terrain unit, the surface expression of the terrain, and the geological process that formed it or that may modify it. A typical terrain description for a gravel-rich, glaciofluvial terrace with some active avalanche activity looks as follows:

$$gF^{G}t - A^{A}$$

The following table describes what each part of this terrain description means. Note that the position numbers refer to each of the letters in the description (see below). Not all symbols typically used are included below; see Howes and Kenk (1988) for a more complete description of all possible symbols.

Typical Terrain Unit:	**g**	**F**	^{G}	**t**	**-**	**A**	^{A}
	↑	↑	↑	↑	↑	↑	↑
Position number:	1	2	3	4	5	6	7

Position number and characteristic	Letters Used	Simplified Description
1 **Texture** (may have up to 3 lower case letters).	a b s $ c g	angular blocks greater than 256 mm in size. rounded and subrounded boulders greater than 256 mm in size. sand sized particles. silt sized particles. clay-sized particles. gravel-sized particles (mix of boulders, cobbles and pebbles).
2 **Material** (One upper case letter but may have a qualifying superscript).	C F F^{G} L M R V	Colluvium: material derived from weathering & erosion of rock. Fluvial: material transported and deposited by s. Glaciofluvial: fluvial material deposited in association with glaciers (Note: the second letter is a qualifier; see below). Lacustrine: sediment deposited in lakes. Morainal: material deposited directly by ice. Rock: exposed bedrock. Volcanic material. Usually refers to loose, pyroclastic material.
3 **Material qualifying descriptor** (one super-scripted upper case letter).	G	Glacial: fluvial or lacustrine material deposited in association with glacial ice.

4 **Surface expression** (may have up to 3 lower case letters).	a b c f h j k s t v	moderate slope: >15° but <26°. blanket: mantle of loose material more than one metre thick. cone: loose material that forms a cone that is >15° steep. fan: a smooth segment of a cone that is <15° steep. hummocky: undulating terrain. gentle slope: >3° but <15° moderately steep slope: >26° but <35° steep slope: >35° slope angle. terrace: step-like topography. veneer: a mantle of loose material less than one metre thick.
5 Separator (up to three or even more symbols may be used).	– = / // -	upper unit overlies the lower one two units in approximately equal abundance. preceding unit is more extensive than the following one. preceding unit is much more extensive than the following one. dash: separates terrain description from description of geologic processes.
6 **Geological process** (may have up to 3 upper case letters).	A B F R V	Avalanches: rapid downhill movement of snow and ice. Braiding: braided channel, high sediment load. Slow mass movement: soil creep or similar slow movement of unconsolidated material Rapid mass movement: rockfalls or similar rapid mass movement. Gully erosion: formation of v-shaped gullies.
7 **Geological process qualifying descriptor** (one super-scripted upper case letter).	A,I	Active or Inactive: refers to current state of activity of geological processes.

Hazard Classification Used in This Study

The hazard classification for a designated terrain polygon is a qualitative assessment based on a number of factors including, most importantly, the terrain characteristics and hydrologic conditions. The final hazard classification is based on the professional judgment and experience of the person who is evaluating the terrain. The professional evaluation may be based on an analysis of air photos and maps, an aerial reconnaissance, ground traverses, an assessment of previous slides in the area, weather factors, and measurements of rock, soil or hydrologic characteristics.

Normally, the hazard classification system is used in the forest industry to assess the stability of terrain with respect to timber harvesting activities. This may not always provide a total picture of the stability; for example, some slopes may have very large potential slope failures that would not be affected one way or the other by the removal of trees. Such a slope might then be given a somewhat lower hazard classification, despite the presence of a major slope instability.

In this study, the hazard classification system was modified to indicate the overall susceptibility of a given terrain polygon to mass wastage events, rather than just potential hazard related to logging activity. It was also designed to be of specific help in allowing the safety of proposed developments in this portion of the Regional District to be assessed.

Class	Description
Green	Areas where no significant slope hazards were found to be present, other than those low risk events always present in any mountainous terrain subject to earthquakes. Small areas of suspect terrain may still exist within such zones.
Yellow	Areas where there is some risk posed by hazardous events but where more detailed work should be able to prescribe measures that would mitigate the hazard (areas on floodplains, near avalanche runout zones, etc).
Red	Areas where there is an unacceptable risk of future hazardous events and where it is unlikely that protective works will be able to mitigate the hazard, or where much more work will be needed to establish areas of safety.

Risk Assessment

The general principles of risk assessment used by the Fraser-Cheam Regional District were used in this study. These principles evaluate the threat posed by a number of hazardous events, provide acceptable/not acceptable return frequency thresholds for these events, and then give guidelines for determining whether a proposed development should be approved or not. The final recommendation is based on the risk involved and the scale of the proposed development. Note that this is an abridged version of the Fraser-Cheam zoning scheme and highlights that portion of the guidelines that deal with new building approvals. For detailed reference, the complete document is appended to this report.

Hazardous Event	Acceptable risk range (depends on the scale of development- from minor repairs to development of a new community).	Maximum acceptable risk for new building approval (but may require protective works, conditional use or a restrictive covenant).	Maximum acceptable risk for unconditional new building approval.
Flooding	1:40 to <1:200	1:40	1:200
Debris Flood	1:50 to <1:10000	1:50	1:500
Stream Avulsion	1:10 to <1:500	1:100	1:500
Debris flow	1:50 to <1:10000	1:200	1:10000
Landslip	1:50 to <1:10000	1:50	1:10000
Snow avalanche	1:30 to <1:10000	1:30	1:10000
Rockfall	1:100 to 1:10000	1:500	1:1000
Major landslide	1:500 to 1:10000	1:1000	1:1000

Appendix 2

Glossary of Terms Used

accreted	to become attached to. Usually refers to masses of crustal material that become attached to existing continents.
colluvium	loose fragments of material derived from the weathering and erosion of local rock.
deglaciation:	the process by which glaciers melt and an ice age comes to an end.
glacial till:	unconsolidated deposits of glacially-derived sediment. Consists of an unsorted mass of clay to boulder sized, subrounded fragments, usually set in a clay-rich matrix.
glaciofluvial:	deposits formed by activity associated with glaciers, particularly when the ice melts and glaciers retreat. These deposits are usually layered and consist of gravel, sand, and silt that has been sorted into graded units.
glaciolacustrine	similar to glaciofluvial deposits, except formed in ice-dammed lakes.
granitic rock:	rock formed when molten magma cools slowly deep underground and solidifies to form a rock with large crystals. To be visible on the earth's surface, weathering and erosion must remove the overlying rock material and expose the granitic rock.
kame terrace:	sediment formed when material is deposited on the margins of a valley glacier by creeks that carry rock debris down from adjacent side hills. When the glacier melts, these deposits form terraces that cling to the sides of the glacially-carved valley. These are similar to glaciofluvial deposits.
mass movement or mass wastage.	an activity, such as a landslide, debris flow, etc., that causes material to move down a slope because of the force of gravity. Movement can be either slow (e.g., soil creep; or catastrophic, e.g., landslides).
moraine, morainal	sediment deposited directly by glacier ice. This usually consists of unsorted, poorly graded, subangular to subrounded material containing clay to boulder size fragments.
piping	a type of slope failure that occurs when water becomes concentrated in a small portion of an unconsolidated deposit and the water flow causes an elongated cavity to form as loose sediment is removed.
plutonic rock; plutonic complex	granitic rock. Rock that slowly crystallizes from a molten magma located deep in the Earth's crust. Uplift and weathering and erosion of overlying rock most occur before this material is exposed on the earth's surface.
sediment:	the loose deposits of rock fragments formed when a rock mass is broken up by weathering and erosion.

talus; talus cone	a steeply sloping deposit of large, angular rock fragments, usually found at the base of a slope or below cliffs. Talus cones form where angular rock debris is channeled down a gully and comes to rest where the slope becomes more gentle.
terrain	ground which has a common origin and usually consists of similar material.
terrane	A segment of the earth's crust. The term usually refers to blocks of crustal material that have moved like islands across an ocean and became attached to an existing continent.
unconsolidated material:	deposits of loose sediment that have been deposited by volcanic activity, glaciers, s or some other similar process.

Appendix 3:

Fraser-Cheam
Hazard Acceptability Thresholds

page 23

BRITISH COLUMBIA GEOLOGIC HAZARDS WORKSHOP
FEBRUARY 20 & 21, 1991

HAZARD ACCEPTABILITY THRESHOLDS FOR DEVELOPMENT APPROVALS BY LOCAL GOVERNMENT.

(Revised November 1993)

A Paper by:

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HAZARD ACCEPTABILITY THRESHOLDS FOR DEVELOPMENT APPROVALS BY LOCAL GOVERNMENT.

Amendments to the Municipal Act in 1985 empowered and required local governments to address the question of geotechnical hazards in their development policies and permits. The wording of the legislation at the policy level speaks of "...designating areas ... restricting the use of land ...[and] the protection of development from hazardous conditions ..." (Section 945). The Act states that development permits for new developments may "...specify areas of land that ... must remain free of development..." (Section 976) and that "... where the geotechnical engineer ... determines that the land may not be used safely for the use intended, the building inspector shall refuse to issue the building permit." (Section 734). Basing their decisions on policies and designations in the community plan and on reports from geotechnical engineers, therefore, it is the building inspector in the case of new construction and the approving officer in the case of new subdivisions who must ultimately determine what is acceptable or "how safe is safe enough".

The methodology employed by Fraser-Cheam Regional District to implement these provisions of the Municipal Act has been reported elsewhere.[1] The procedure involves, first, the identification of potential hazards through overview, secondary and site-specific geotechnical studies which provide a characterization of each hazard in descriptive terms and in terms of its probability of occurrence. Risk estimation, or exposure to hazard, is the second step in the procedure and this is simplified somewhat by the fact that it is the risk to the aggregate community over a period of time which is important for decision-making rather than the (much lower) risk to any given individual. As well as a quantitative aspect, however, risk has a "qualitative" component which reflects the type of hazard. The occurrence of some hazards, for example, will normally provide adequate time to alert the population, thereby limiting the risk only to property damage rather than personal injury also, whereas other types of hazard will exhibit few preliminary signs to forewarn of danger. Again some hazards are associated with so-called "voluntary" risks whereas others expose people involuntarily.[2] Both these qualitative and the quantitative aspects of risk are important in assessing acceptability.

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[1] Cave, P.W., Sloan, H. and Gerath, R.F.: "Slope Hazard Evaluations in Southwest British Columbia", in Procs. Canadian Geotechnical Conference, Tome I, Univ. Laval, 1990.

[2] These issues are well catalogued in: Pack, R. & Morgan, G.: "Evaluation and Acceptance of Risk in Geotechnical Engineering", in Procs. Vancouver Geotechnical Society, May 27, 1988

Once the engineer has characterized the hazard and quantified its occurrence and its related risks, its acceptability to the regulatory authority will involve an evaluation of:-

a) the type of risk,
b) the type of development, and
c) any possible remedial or protective measures.

These factors are analyzed in the eight matrices shown as Figures 3-10 which are used in Fraser-Cheam to secure consistency in the development approvals process. These matrices all take the same form which is illustrated in the stylized "Hazard Acceptability for Development" Chart shown as Figure 1 below. This illustrates how developments which involve greater increases in land use density and those exposed to greater risks are less likely to be approvable. Each of the matrices Figures 3-10 relates to a different type of geotechnical hazard specified in the Act and the content of each cell reflects a judgement as to whether the risk is acceptable. In fact, this question of acceptability is not a simple black and white issue and the figures show that there are at least five levels of acceptability implied by the regulatory responses ranging from outright refusal to unconditional acceptance (see Figure 2).

THE GEOTECHNICAL HAZARDS

The following descriptions of geotechnical hazards focus upon those characteristics which most affect whether or not the risk of exposure is acceptable. The distinctions, therefore, are based on the effects of the hazards rather than upon strict geotechnical classifications.

1. INUNDATION BY FLOOD WATERS.

Of those named in the Act, this is the hazard which threatens the greatest amount of development in Fraser-Cheam. In some areas, particularly along certain reaches of the Fraser, it is also the most benign of the hazards because it is predictable, because rates of flow are relatively slow and because depth and duration of flooding are moderate. Bank-full conditions are also less frequent on the Fraser than on the more volatile mountain tributaries. In other areas, the hazard is much greater. Those portions of the flood-plain known as "primary" flood areas, roughly equivalent to the flood channel itself, are to be avoided completely.

2. MOUNTAIN STREAM EROSION AND AVULSION.

The Chilliwack River, the Coquihalla River, and Silverhope Creek are notoriously volatile wild tributaries to the Fraser on which settlements have been established. Others,

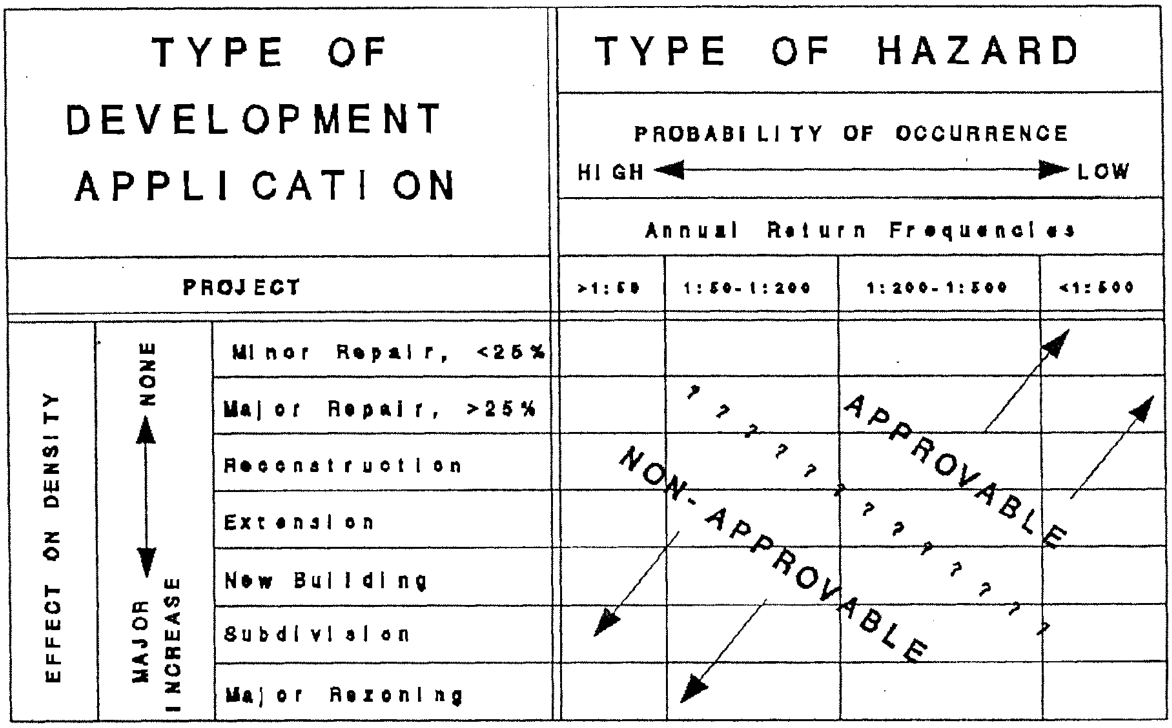

Figure 1. Hazard Acceptability for Development

such as Yale, Frosst, and Hallecks Creeks are less well known but also have settlements built on the alluvial fans at their mouths.

All these are mountain streams with steep gradients and in flood they are extremely dangerous. They have enormous concentrated energy and erosion of the banks can occur rapidly where the channel is cut in alluvium, and there is constant danger of avulsion at high water in the flood-plain areas and on the depositional fan. Their speed of attack is such that they must be regarded as potentially life-threatening.

3. <u>DEBRIS FLOWS AND DEBRIS TORRENTS.</u>

The threat from debris flows and torrents is virtually ubiquitous in Fraser-Cheam associated, as it is, with steep, unstable first- and second-order drainages which can become choked with debris from erosion and vegetation. Fortunately the effects of these hazards are localised in that they do not extend far into the flatter reaches of the drainages but they have great destructive power and may occur without warning.

4. DEBRIS FLOODS.

The lower reaches of these first- and second-order drainages, at the point where the debris torrent spreads out and releases its energy, are typically subject to debris flows which grade into debris floods. The former still carry sufficient energy and destructive power to be capable of causing serious damage to buildings and even to people under certain conditions, while the latter is a depositional hazard which will cause property damage and nuisance.

5. LANDSLIDES, SMALL-SCALE, LOCALISED.

The potential de-stabilization of steep slopes is a constant concern whenever development takes place on unconsolidated material. In fact, depending upon the physical and chemical properties of the soil and the amount and distribution of water, quite shallow slopes may be subject to landslip. The event may be sudden and rapid, or gradual and incremental, but the danger signs of future movement are usually evident before the event. In Fraser-Cheam, slopes susceptible to localized failure are not uncommon and they pose a constant threat to those living below.

6. SNOW AVALANCHE.

For the most part, snow avalanche tracks do not reach down to the settled areas of Fraser-Cheam and these hazards tend to be of far greater importance to the maintenance of transportation routes than they are to the development approval process. At Hemlock Valley ski resort, however, snow avalanches do pose a constraint to subdivision and construction. In the avalanche run-out zones, in their lowermost reaches where most of the energy has already been spent, it is possible to engineer structures to withstand the lateral thrust of moving snow. For the most part, however, the hazard is one entirely to be avoided.

7. ROCK FALL.

Rock fall hazard results from the dislocation of rock fragments or small blocks from a slope, usually because of mechanical weathering (freeze-thaw). For the sake of evaluating risk acceptability, rock fall can be taken to include the various forms of rolling rock hazard. It is distinguished, perhaps rather arbitrarily, from massive landslide hazard on the basis of its much more frequent occurrence and its very much more localized effect. There is usually evidence on the ground at the toe of a slope to indicate the extent of land potentially affected by rock fall. Geotechnical studies can define a "rock fall shadow area" susceptible to the hazard and planning regulations can ensure that development avoids it.

8. LANDSLIDES, MASSIVE, CATASTROPHIC.

Fraser-Cheam Region is the site of a number of ancient and some recent massive landslides. The best known is the Hope Slide which moved approximately 47 mill.cu.m of material in 1965. Others have been studied in the Fraser Valley at Lake-of-the-Woods, Mount Cheam, and Katz. Of the surficial hazards, they are the least common, the least predictable and by far the most destructive.

THE TYPES OF DEVELOPMENT.

In the face of these hazards, seven types of development application are distinguished in order to evaluate their acceptability. They are ranked in order of increasing intensity of land use, from a minor building repair to a major rezoning, reflecting corresponding increases in exposure to risk. The following brief description is written, for the sake of simplicity, from the residential perspective only.

1. MINOR REPAIR.

In a policy sense, an application for a building permit to repair an existing building is one of the most difficult types to evaluate. The Municipal Act itself distinguishes such applications by exempting the applicant from the requirement to hire a geotechnical engineer to prove the site safe (Sec. 734.(2.1)). It does not, however, exempt the building inspector from the duty to refuse the permit if he already possesses a report which identifies the site as hazardous.(Sec. 734.3).

Apparently, the intent of the Act in this respect is similar to its provisions respecting "non-conformity" of land use which essentially permit the non-conformity to continue for the life-span of the business or the life-span of the building, whichever is the shorter. By discouraging permits for repairs in areas of known hazard, the Act is discouraging the extension of the life-span of those buildings which would not have been approvable under modern regulations.

In reality, of course, the analogy with non-conformity only provides a perspective from which to view the general issue of buildings sited in unsafe areas. It does not provide all the answers to individual applicants who may have lived in their houses for many years and who want simply to repair a leaky roof or to install a safer fireplace. Blanket refusal of all such applications because of off-site hazards would be draconian indeed, particularly for those repairs which are really only stop-gap measures and which do not materially extend the life of the building. Therefore, at Fraser-Cheam a Board policy has been struck to the effect that if the nature of the hazard is not life-threatening, and if the cost of the repair is not greater than 25% of the value of the building before repair, and if the owner will register a covenant against the title guaranteeing to effect protective measures against the hazard in future before any further construction is undertaken, then a permit will be available.[3]

2. MAJOR REPAIR.

A major repair is defined as one the cost of which exceeds 25% of the assessed value of the structure before repair. It is seen as having the effect of extending the life-span of the building and therefore of increasing the exposure to the hazard in the long term. For this reason permits are not generally available in the face of significant risk from geotechnical hazard until remedial or protective work is undertaken. However, if the cumulative probability of occurrence throughout the extended life-span of the building is small, as it may be in the case of some low frequency events, then this type of permit may be issued in Fraser-Cheam.

3. RECONSTRUCTION.

In one sense, reconstruction is just a more complete form of "major repair" but it differs in two important respects. First, it provides the opportunity to relocate the building to a safer site on the parcel and thereby to lessen the risk. Secondly, it is the type of permit which fire insurance policies typically require to be available to validate the policy. Outright refusal, therefore, could render the site value of a residential parcel virtually worthless. Thus the significance of the availability of reconstruction permits far outweighs the numbers actually ever applied for or issued and these permits are usually a central concern at any public hearings dealing with hazard land management policies. In general, the larger the parcel the easier it is to meet protective siting restrictions and the more likely is a reconstruction permit to be issued.

4. EXTENSION.

Whereas reconstruction may simply amount to replacement and may not increase the density of use, an application to increase the size of a building does imply an increased density of use and therefore a greater annual risk. Moreover while reconstruction may facilitate relocation, extension does not. Thus, a permit to extend a building in a hazardous area is often more difficult to secure than is a permit to reconstruct.

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[3] It should be noted that some types of repair costing less than $2000 do not require a permit under local bylaws.

5. NEW BUILDING.

The right to construct a new home on an existing vacant lot is the issue most frequently discussed in the context of the new legislation on hazards. It is, in a sense, the "acid test".

Denial of such a permit, in most instances, is tantamount to rendering the lot unsaleable at anything like its former value and almost inevitably this leads to threats of legal action both against those who now deny the permit and against those who previously approved the subdivision. It also leads, just as inevitably, to claims that the owner should somehow be compensated by the government for the difference between the market value of the lot and the value which it could command were the hazard not present. Such reactions are natural and understandable responses to perceived financial loss. It is rarely appreciated, however, that the act of identifying the hazard neither creates nor materially alters the level of risk; it merely raises awareness. Equally, the act of refusing the permit does not cause the loss of value. It is the knowledge that the property is unsafe to live on which is the specific detriment to market value; the refusal of the permit is the consequence. Indeed to grant approval to construct an unsaleable building would be more likely to compound than to mitigate the financial losses of the land owner.

Fortunately, the number of occasions on which permits cannot be issued for vacant lots is very few. Recent subdivisions will not have been approved unless they contain a building site which complies with the new provisions of the Municipal Act and the Land Title Act. It is the older subdivisions which may have problems. Indeed, the very physical and site difficulties which have kept these older lots vacant in the past generally prove now to be the very reasons why the permit is refused under Section 734. From this perspective, again, the refusal causes no real loss of value now; instead, it serves only to confirm how unrealistic were the owner's former expectations of value. Less common is the possibility, whenever the time interval is long between subdivision approval and building permit application, that the state of geotechnical knowledge will have advanced and will have identified a hazard on a lot formerly certified as safe.

6. SUBDIVISION.

The regulations which subdivision approving officers must administer respecting geotechnical hazards are embedded in the Land Title Act (Sec. 86(1)(c)(v) and Sec. 82). They are charged with the duty of ensuring that all new lots registered are suited "...to the use intended..." (Sec. 82) and that they comply with all local government bylaws, thereby invoking the planning and building regulations discussed above. In addition, Section 82 requires the approving officer specifically to take into account whether "the land is subject, or could reasonably be expected to be subject, to flooding, erosion, land slip, or avalanche."

Together, these regulations ensure that adequate detailed site planning is undertaken and that each new lot is safe to develop. They are not intended, however, to dictate the basic patterns of density at which new development will occur. The designation of density, the principal regulatory determinant of land value, is supposed to be done through zoning based upon community plan policies. Then the subdivision approval process, which is administrative rather than political in nature, can concern itself with issues of site planning and layout. If the overall planning and approval system is operating properly therefore, the approving officer's impact on land value should not be great.

Nevertheless, the level of hazard acceptable for a new subdivision will tend to be less than for other types of permit application for two reasons. First, these lots are new and should comply fully with modern safety standards in the same way that new buildings have to comply with the Building Code even if their building sites are less than ideal. Secondly, the subdivision will increase density of use of land and the exposure to the hazard.

Some low degree of hazard, however, is generally acceptable even in new subdivisions for two reasons. One reason is that subdivisions are typically in the nature of infill or extension of existing development and this established development may already be subject to the same hazard. Also, the zoning and community plan density designations can be taken by the approving officer as a general indication that elected authorities have deemed that level of risk to be acceptable.

7. MAJOR REZONING and COMMUNITY PLAN AMENDMENT.

The distinction between development which is in the nature of infilling or extension and development which involves creating new communities, new patterns of growth on new areas of land is one which is reflected in the distinction between subdivision applications and applications for major rezonings and amendments to the community plan.

The community plan amendment raises the question as to whether, in the long term, the community should grow in one direction, or on one type of land, or another. It confronts the issue of whether any degree of exposure to the hazard is necessary or unavoidable. In the case of these far-reaching policy decisions, which could seriously impact the community for hundreds of years to come, the level of acceptable risk should be very small indeed. Areas which are known to be hazardous should simply be avoided unless there are simple mitigative measures or no viable alternatives.

REMEDIAL AND PROTECTIVE MEASURES.

Where the risk is considered unacceptably high, some action is necessary to mitigate the hazard or to reduce exposure before approval can be given. These actions fall naturally into two classes discussed below, viz. (i) avoidance (i.e. exposure reduction) and (ii) protection (i.e. hazard reduction). Note that both purport only to reduce the hazard, or to change the probabilities. A third action, the granting of "waivers" to "save-harmless" the approving agency is an attempt to transfer liability for the hazard and this will also be discussed briefly.

Avoidance Measures:

Reduction of exposure to risk by simple avoidance is obviously the most desirable mitigative measure. Examples embodied in regulation include elevation of construction above a "flood construction level", set-back requirements from streams to avoid the hazard of erosion and the primary flood area, and set-backs from the toe of a slope to avoid a rock-fall hazard or from a watercourse to avoid a debris torrent hazard. More complex techniques, such as slope stability monitoring devices coupled with warning and evacuation programs, have only rarely been employed in Fraser-Cheam for institutional reasons but they do seem to offer promise in the future for those hazards which are may affect communities already established.

At the policy level, simple avoidance is the preferred technique for official plans and zoning bylaws. Land can be designated for uses which minimize exposure to the hazard such as daytime summer tourist commercial uses in areas which are exposed to winter debris flow hazards, or industrial storage uses in areas which may have low probability rockfall hazard. From a technical perspective, it is worth noting that the Municipal Act encourages the use of the Development Permit regulations to implement such risk avoidance policies even to the point of allowing the permit to over-ride the use and density variations in the zoning bylaw.

Protective Measures:

Protective measures are more visible and generally more popular than regulated avoidance but they are less secure in their results and they usually involve a commitment to maintenance which is more difficult to achieve. In Fraser-Cheam the most common examples are rip-rap protection of river banks to prevent erosion and raised re-enforced foundations to protect against debris floods. Others include various types of protective berms and dykes designed to protect the immediate area against flooding, debris floods, rolling rock etc. and various forms of traps, grizzlies and debris basins designed to protect downstream areas from similar hazards.

Transference of Liability:

One of the most common arguments relating to development applications in hazardous areas is whether approval can be granted in return for some form of waiver of the right to sue the regulatory authority in the event that damage or death occurs. This is usually coupled with some form of indemnity to protect the regulatory authority against suits launched by others. Such waivers are known as "save-harmless" covenants and, if linked to land use restrictions, can be registered as legal incumbrances against the title of the property pursuant to Section 215 of the Land Title Act.

It should be noted that these covenants are in the nature of private agreements between the landowner and the government. Thus third parties, such as visitors to the property, will be exposed involuntarily to the hazard while not being party to the agreement. Their statutory rights to protection cannot really be transferred by these agreements.

Nevertheless, these covenants do serve a valuable function as an instrument on title, in informing prospective purchasers of known hazards. They may also have value, in some cases, as an attempt to recognize and assign the residual liability after all reasonable remedial and protective measures have been undertaken. They do not, however, provide an alternative to implementation of the requirements of the Municipal Act and the Land Title Act by elected officials, planners, building inspectors and approving officers. The duties of each are rather clearly spelled out in the statutes, and no private agreements or covenants can over-ride these obligations.

THE ACCEPTABILITY OF RISK IN FRASER-CHEAM

Figure 2 lists the range of regulatory responses to development applications. These are the numbers in the individual cells in fig.3-10. In practice, this spectrum from unconditional approval to outright refusal is far more complex and subtle than this list implies because each individual case confronts different specific hazards and presents different mitigative opportunities.

There are few generally accepted yardsticks which can provide help in calibrating regulatory approvals charts like those in Figs.3-10 below. One such yardstick derives from the Provincially sponsored flood-proofing program which provides financial support for protective measures and regulatory control over many forms of development. The design event for this program has a return frequency of once-in-200-years. Floods greater than this are regarded as too costly to protect against, too unlikely, or both; lesser floods are seen as too frequent and costly to be acceptable.

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Figure 2. Hazard-Related Responses to Development Approval Applications.

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.

A second yardstick can be inferred from Provincial policy on subdivision approval in hazardous areas where advice is given to geotechnical engineers "...to think in terms of a 10% probability [of occurrence] in 50 years..." (i.e. 1:500 annually). This appears to be an appropriate standard for infill or extension subdivision or for rezoning.

A third guideline derives from the B.C. Supreme Court decision of Berger, J. in 1973 which found a site exposed to a very low probability of landslide occurrence (1:10,000) to be unsuitable for development.[4] In this case, the development would have formed the nucleus of a new community while the suspected hazard was a type of massive and destructive landslide. Thus it provides a solid precedent for broad community planning policy. A 1:10,000 probability is assigned to an event the occurrence of which, though apparently possible at any time, has not taken place within the last 10,000 years (i.e. not since the climatic change at the end of the last glacial episode). In this sense, the 1:10,000 standard has absolute significance in that such hazards have not occurred under existing climatic conditions. It may be the best practical definition of "safe".

Apart from these few guidelines, the other entries on the regulatory approvals charts (Figures 3-10) are all relative and subjectively determined. They are derived, as inevitably they must be, from experience in adjudicating numerous individual applications and from the constant search for consistency and for that elusive threshold of acceptability. Once compiled the charts are deceptively simple in their appearance.

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[4] Berger, T.B.: "Reasons for the judgement of the Honourable Mr. Justice Berger on the matter of the Land Registry Act - and an application for approval of a proposed subdivision by Cleveland Holdings Ltd." Report, Supreme Court of British Columbia, 1973.

However, it must be emphasized that what is classified here, for example, simply as a "type 4" approval (see Figure 2) in fact includes a wide variety of conditions both on the ground and in the covenant.

Nevertheless, together these charts comprise a public policy statement on development safety standards. As such, they are dynamic and will change as societal standards change and as scientific knowledge improves.

CONCLUSION

The principal value of a set of formalised approvals charts like those presented here is to facilitate consistent application of safety regulations and to permit comparison. Undoubtedly, these standards could be enforced with even more conviction, and with more certainty of fairness, if they had been debated more generally and if a provincial consensus had already been achieved. For the future, and after that consensus is achieved, it is even possible to envisage a regulatory scheme analogous to the Building Code which already specifies standards for such hazards as earthquake, wind, snowloads, weak soils and fire-spread. There is no intrinsic reason why geotechnical hazards should not be included in the Code in the long term.

Figure 3.

Inundation[1] by Flood Waters from Fraser River & Tributaries[2]			
	1:40	1:40-1:200	<1:200
Minor Repair (<25%)	2	1	1
Major Repair (>25%)	4	3	1
Reconstruction	4	3	1
Extension	4	3	1
New Building	4	3	1
Subdivision (infill/extend)	5	4	1
Rezoning (for new community)	5	5	1

[1]Flooding Hazard involves both inundation and erosion/avulsion. Hazard acceptability thresholds must therefore involve assessment of both types of hazards at a given site.
[2]Revised 7/21/92.

Figure 4.

Debris Flood				
	1:50	1:50-1:200	1:200-1:500	1:500-1:10,000
Minor Repair (<25%)	2	2	1	1
Major Repair (>25%)	4	4	1	1
Reconstruction	4	4	3	1
Extension	4	4	3	1
New Building	4	4	3	1
Subdivision (infill/extend)	5	5	4	2
Rezoning (for new community)	5	5	5	3

Figure 5.

Mountain Stream Erosion or Avulsion[1]					
	1:10	1:10-1:100	1:100-1:200	1:200-1:500	<1:500
Minor Repair (<25%)	5	2	1	1	1
Major Repair (>25%)	5	4	2	1	1
Reconstruction	5	5	2	2	1
Extension	5	5	2	2	1
New Building	5	5	4	2	1
Subdivision (infill/extend)	5	5	5	4	1
Rezoning (for new community)	5	5	5	5	1

[1] Revised 7/21/92.

Figure 6.

Debris Flow/Debris Torrent					
	1:50	1:50-1:200	1:200-1:500	1:500-1:10,000	<1:10,000
Minor Repair (<25%)	5	2	2	1	1
Major Repair (>25%)	5	4	2	1	1
Reconstruction	5	5	4	3	1
Extension	5	5	4	2	1
New Building	5	5	4	3	1
Subdivision (infill/extend)	5	5	5	4	1
Rezoning (for new community)	5	5	5	5	1

Figure 7.

Small-Scale Localised Landslip					
	1:50	1:50- 1:200	1:200- 1:500	1:500- 1:10,000	<1:10,000
Minor Repair (<25%)	5	2	2	1	1
Major Repair (>25%)	5	4	4	1	1
Reconstruction	5	4	4	3	1
Extension	5	4	4	3	1
New Building	5	4	4	3	1
Subdivision (infill/extend)	5	5	5	4	1
Rezoning (for new community)	5	5	5	5	1

Figure 8.

Snow Avalanche					
	1:30	1:30- 1:100	1:100- 1:500	1:500- 1:10,000	<1:10,000
Minor Repair (<25%)	5	4	4	4	1
Major Repair (>25%)	5	4	4	4	1
Reconstruction	5	4	4	4	1
Extension	5	4	4	4	1
New Building	5	4	4	4	1
Subdivision (infill/extend)	5	5	5	4	1
Rezoning (for new community)	5	5	5	5	1

Figure 9.

Rockfall Small-Scale Detachment					
	1:100	1:100- 1:500	1:500- 1:1,000	1:1,000- 1:10,000	<1:10,000
Minor Repair (<25%)	5	2	1	1	1
Major Repair (>25%)	5	4	2	1	1
Reconstruction	5	4	2	1	1
Extension	5	5	4	1	1
New Building	5	5	4	1	1
Subdivision (infill/extend)	5	5	5	4	1
Rezoning (for new community)	5	5	5	5	1

Figure 10.

Major Catastrophic Landslide					
	1:200	1:200- 1:500	1:500- 1:1,000	1:1,000- 1:10,000	<1:10,000
Minor Repair (<25%)	5	2	1	1	1
Major Repair (>25%)	5	5	2	1	1
Reconstruction	5	5	5	1	1
Extension	5	5	5	1	1
New Building	5	5	5	1	1
Subdivision (infill/extend)	5	5	5	5	1
Rezoning (for new community)	5	5	5	5	5

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Figure 11.

Chilliwack River Valley Erosion or Avulsion			
Setback:	Setback within the "Erosion setback line"[1]	Setback between "100 year erosion limit line" and "Erosion setback line"[1]	Setback greater than "100 year erosion limit" line[1]
Minor Repair (<25%)	2[2]	2[3]	1
Major Repair (>25%)	4[4]	2[3]	1
Reconstruction	4[4]	2[3]	1
Extension	4[4]	2[3]	1
New Building	4[6]	2[3]	1
Subdivision (infill/extend)	5	4[5]	1
Rezoning (for new community)	5	4[6]	1

Table Revised Oct.27/93.

[1] The terms "erosion setback line" and "100 year erosion limit line" are explained and defined in the Official Settlement Plan, and in the HayCo reports on river hazard management in the Chilliwack River Valley.

[2] Where the threat of river avulsion or erosion is deemed to be immediate and extreme a building permit may not be available until approved bank protection is provided.

[3] A save harmless covenant to acknowledge potential future erosion hazard is implied in this approval.

[4] Where the property cannot be protected by on-site works, a building permit may not be available until the community protection scheme outlined in the Hazard Management Plan has been implemented.

[5] Approved Bank Protection may mean on-site protection on an individual lot, or where it is not possible to protect the property with on-site works, it may mean installation of works recommended in the community protection scheme outlined in the Hazard Management Plan which are administered by a local Service Area.

[6] Same as 5 above.

Appendix 4:

Mt. Currie - D'Arcy
Detailed polygon descriptions

Mt. Currie to D'Arcy
Detailed Polygon Descriptions

Photo No.	Poly No.	Terrain	Haz	Comment
1	**1**	Cvb/Ra – R	Y	Minor rockfall hazard. Some steep slopes. Building inspector should be able to assess all sites.
1	**2**	Cbak – R	Y	Minor rockfall hazard. Some steep slopes. Building inspector should be able to assess all sites.
1	**3**	Cv/Rha	Y	Moderate rockfall hazard. Numerous steep slopes. Building inspector should be able to assess most sites but some will require professional help.
1	**4**	F^G/Rh	Y	Minor rockfall hazard. Some steep slopes. Building inspector should be able to assess all sites.
1	**5**	F^Gb	G	Only minor concerns regarding slope hazards. Building inspector should be able to assess all sites.
1	**6**	Fp	R	Birkenhead River floodplain. Major inundation and strong currents possible. Professional help needed.
1	**7**	$\frac{F^G bj}{Mb}$	G	Only minor concerns regarding slope hazards. Building inspector should be able to assess all sites.
1	**8**	$\frac{Cvb}{Rr}$ – R	Y	Minor rockfall hazard. Some steep slopes. Building inspector should be able to assess all sites.
1	**9**	$\frac{Cvba}{F^G b}$	R	Minor rockfall hazard. Some steep slopes. River bank may have more significant problems. Building inspector should be able to assess most sites but professional help may be needed in areas of steep slopes and along the river.
1	**10**	$\frac{F^G b/Cva}{Mb}$	G	Only minor concerns regarding slope hazards. Building inspector should be able to assess all sites.
16	**11**	F^Gbp	Y	Gates River floodplain. Flood proofing may be required. Building inspector should be able to assess most sites but some professional help may be needed.
1	**12**	F^Gbt	Y	Minor rockfall hazard. Some steep slopes that drop on to the Birkenhead River floodplain. Building inspector should be able to assess all sites.
1	**13**	F^Gba	G	Only minor concerns regarding slope hazards. Building inspector should be able to assess all sites.

Photo No.	**Poly No.**	Terrain	Haz	Comment
1	**14**	$\frac{\mathrm{Cvb}}{\mathrm{F^{G}bt}}$	G	Minor natural hazards. Building inspector should be able to assess all sites.
1	**15**	Cvb – R^{A}	R	Rockfall and rock slide hazard. Professional help will most likely be required.
1	**16**	Rk/Cvb – R	Y	Minor rockfall hazard and some steep slopes. Building inspector should be able to assess most sites but some professional help may be needed.
1	**17**	Cv/Rh	Y	Minor rockfall hazard and some steep slopes. Building inspector should be able to assess most sites.
1	**18**	Cvb/Ra – R	Y	Minor rockfall hazard and some steep slopes. Building inspector should be able to assess most sites.
1	**19**	Cvb/Rh	G	Only minor concerns regarding slope hazards. Building inspector should be able to assess all sites.
1	**20**	Rh	Y	Minor rockfall hazard and some steep slopes. Building inspector should be able to assess most sites.
1	**21**	F^{G}/Mbh / /Rh	G	Only minor concerns regarding slope hazards. Building inspector should be able to assess all sites.
1	**22**	Rh	Y	Minor rockfall hazard and some steep slopes. Building inspector should be able to assess most sites.
1	**23**	Rsh/Cvb – R^{A}	R	Minor rockfall hazard and some steep slopes. Building inspector should be able to assess most sites but some professional help may be needed.
1	**24**	F^{G}bt	G	Gravel pit. Some artificially steep slopes may be hazardous. Building inspector should be able to assess most sites but some areas close to the highway may require professional help.
1	**25**	Rr/Cv – R	Y	Some steep slopes, minor rockfall and debris slide hazard, especially along the banks of the Birkenhead River. Building inspector should be able to assess most sites but some professional help may be needed.
1	**26**	Cv/Rs – R	Y	Minor rockfall hazard and some steep slopes. Building inspector should be able to assess most sites.
1	**27**	Mb	G	Only minor concerns regarding slope hazards. Building inspector should be able to assess all sites.

Photo No.	Poly No.	Terrain	Haz	Comment
1	**28**	F^G/Cb	G	Only minor concerns regarding slope hazards. Building inspector should be able to assess all sites.
1	**29**	$\frac{F^Gb}{Rh}$	G	Only minor concerns regarding slope hazards. Building inspector should be able to assess all sites.
1	**30**	Rr	G	Only minor concerns regarding slope hazards. Building inspector should be able to assess all sites.
1	**31**	Fp	Y	Birkenhead River floodplain. Moderate debris slide or debris flow hazard along the river banks. Building inspector should be able to assess most sites but some professional help may be required.
1	**32**	$F^Gk - R^A$	R	Steep gravel banks- debris slide, flow or rockfall hazard. Professional advice required.
1	**33**	$F^Gb//Cv$	G	Minor rockfall and debris slide hazard. Some parts border unstable slopes above the Birkenhead River. Building inspector should be able to assess most sites but some professional help may be required.
1	**34**	$\frac{Cvb}{F^Gb}$	G	Only minor concerns regarding slope hazards. Building inspector should be able to assess all sites.
1	**35**	F^Gba/Cv	G	Only minor concerns regarding slope hazards. Building inspector should be able to assess all sites.
1	**36**	$F^Gb/Mb - V$	Y	Minor debris slide and debris flow hazard. Building inspector should be able to assess most sites.
1	**37**	F^G/Mb	G	Only minor concerns regarding slope hazards. Building inspector should be able to assess all sites.
1	**38**	$\frac{Cvb}{Mb/F^G}$	G	Only minor concerns regarding slope hazards. Building inspector should be able to assess all sites.
1	**39**	$\frac{Cv}{Rh}$	Y	Minor rockfall hazard. Building inspector should be able to assess most sites but some professional help may be required.
1	**40**	$\frac{Cv}{Rh}$	Y	Minor rockfall hazard. Building inspector should be able to assess most sites but some professional help may be required.

Photo No.	**Poly No.**	Terrain	Haz	Comment
1	**41**	F^Gbt	R	Steep slopes along the Birkenhead River. Minor debris slide and debris flow hazard. Building inspector should be able to assess most sites although some professional help may be required.
1	**42**	F^Gb-F	R	Steep slopes along the Birkenhead River. Minor debris slide and debris flow hazard. Building inspector should be able to assess some sites but some professional help may be required, especially along the Birkenhead River.
1	**43**	$\frac{\text{Cvb}}{\text{F}^G\text{b}}$-F	R	Steep slopes along the Birkenhead River. Minor debris slide and debris flow hazard. Building inspector should be able to assess most sites although some professional help may be required.
1	**44**	F^Gbj	G	Only minor concerns regarding slope hazards. Building inspector should be able to assess all sites.
1	**45**	F^Gk – F^I	Y	Some steep slopes and rockfall hazard. Building inspector should be able to assess all sites.
1	**46**	Cvbj – R	R	Stream and debris flooding hazards and minor debris slide hazards along the creek. Building inspector should be able to assess most sites but some may require professional help.
1	**47**	$\frac{\text{F}^G\text{v/Mv}}{\text{Rhj}}$	G	Only minor concerns regarding slope hazards. Building inspector should be able to assess all sites.
1	**48**	$\frac{\text{Cv/Mv}}{\text{Rh}}$	G	Only minor concerns regarding slope hazards. Building inspector should be able to assess all sites.
1	**49**	$\frac{\text{Cbf}}{\text{F}^G}$	G	Only minor concerns regarding slope hazards although there is some minor flooding potential on the alluvial fan. Building inspector should be able to assess all sites.

Photo No.	Poly No.	Terrain	Haz	Comment
2	**50**	$\frac{Cvb}{Mb} - R^{I}$	Y	Minor rockfall hazard. Building inspector should be able to assess all sites.
2	**51**	$\frac{Cbf}{F^{G}}$	Y	Some debris slide and debris flow hazards especially along the banks of the Birkenhead River. Building inspector should be able to assess most sites although some professional advice may be required.
2	**52**	$\frac{Cvb}{F^{G}} - V$	Y	Minor debris slide and rockfall hazard. Building inspector should be able to assess most sites but some professional advice may be required.
2	**53**	$\frac{F^{G}ht}{Mb}$	G	Only minor concerns regarding slope hazards. Building inspector should be able to assess all sites.
2	**54**	$\frac{F^{G}t}{Mb}$	G	Only minor concerns regarding slope hazards. Building inspector should be able to assess all sites.
2	**55**	$\frac{Cb}{F^{G}} - F$	Y	Some debris slide and debris flow hazards especially along the banks of the Birkenhead River. Building inspector should be able to assess most sites although some professional advice may be required.
2	**56**	$\frac{Cva}{F^{G}b}$	Y	Minor rockfall and debris slide hazard. Some steep slopes. Building inspector should be able to assess most sites.
2	**57**	gFp	R	Birkenhead River floodplain and bank deposits. Steep slopes and rockfall hazard. Building inspector should be able to assess many sites but some professional advice may be required.
2	**58**	$\frac{Cb}{F^{G}} - F$	Y	Birkenhead River floodplain and bank deposits. Building inspector should be able to assess most sites although some professional advice may be required.
2	**59**	$\frac{F^{G}j}{Mb}$	Y	Birkenhead River floodplain and bank deposits. Building inspector should be able to assess most sites although some professional advice may be required.
2	**60**	$\frac{Cb}{F^{G}} - F$	Y	Birkenhead River floodplain and bank deposits. Building inspector should be able to assess most sites although some professional advice may be required.
2	**61**	$F^{A}j - M$	R	Birkenhead River floodplain and bank deposits. Building inspector should be able to assess most sites although some professional advice may be required.

Photo No.	Poly No.	Terrain	Haz	Comment
2	**62**	Cbf – R^I	G	Only minor concerns regarding slope hazards. Building inspector should be able to assess all sites.
2	**63**	F^Aj	R	Active channel of Owl Creek. Major flooding and debris flood potential, especially if the upstream channel was temporarily blocked. Professional advice will be needed.
2	**64**	Cbf – R	Y	Old channel of Owl Creek. Flooding and debris flood hazard. Building inspector should be able to assess some sites but professional help will likely be required.
2	**65**	$\frac{Cv/F^Gvj}{Mb}$	G	Only minor concerns regarding slope hazards. Building inspector should be able to assess all sites.
2	**66**	Cvb/Rak – R	Y	Minor debris slide and rockfall hazard. Building inspector should be able to assess most sites.
2	**67**	Cvba – V	Y	Some rockfall and rock slide hazard. Professional help will likely be required.
2	**68**	arCbk – R	R	High rockfall and rock slide hazard. Professional help will be required but development will probably not be possible.
2	**69**	Cba – R^I	Y	Some rockfall, debris flow and debris flood hazards. Some areas can be assessed by the building inspector but additional professional help will likely be needed.
2	**70**	Cvba – R	Y	Debris flood, debris flow and rockfall hazard. Professional help required.
2	**71**	Rrj/Cvb	R	Rockfall hazard and steep slopes. Building inspector may be able to assess some sites but most will require professional advice.
2	**72**	Rs//Cv – R	R	Rockfall, rock slide and debris avalanche hazard. Professional advice required.
2	**73**	Ra/Cbt	R	Rockfall hazard and steep slopes. Building inspector may be able to assess some sites but most will require professional advice.
2	**74**	xCbvk – R	R	Rockfall hazard and steep slopes. Building inspector may be able to assess some sites but most will require professional advice.

Photo No.	**Poly No.**	Terrain	Haz	Comment
2	**75**	Cab	Y	Minor rockfall and debris slide hazard. Building inspector should be able to assess most sites although some professional advice may be required.
2	**76**	$\frac{\text{Cv/Mv}}{\text{Ra}}$	Y	Steep slopes, rockfall and debris slide hazard. Building inspector may be able to assess some sites but most will require professional advice.
2	**77**	$\frac{\text{Cv/Mv}}{\text{Ra}}$	Y	Building inspector may be able to assess some sites but most will require professional advice.
2	**78**	$\frac{\text{Cvb/Mv}}{\text{Ra}}$	G	Some steep slopes but only minor concerns regarding slope hazards. Building inspector should be able to assess most sites.
2	**79**	A	G	Gravel pit. Some localized hazards. Building inspector should be able to assess most sites.
2	**80**	$\frac{\text{F}^{\text{G}}\text{bj}}{\text{Mb}}$	G	Minor slope hazards adjacent to Birkenhead River. Building inspector should be able to assess most sites.
2	**81**	A	G	Set-back distance from gravel pit slope crest should be determined by a professional otherwise the building inspector should be able to assess most sites.
2	**82**	Cvb/Rk	Y	Rockfall runout concerns and blasting of steep slopes may induce rock avalanches. Professional advice may be required
2	**83**	xCvb//Rk – R	R	Steep cliffs and active talus slopes pose rockfall and rock avalanche problems. Professional input required.
2	**84**	Rrs/Cvb – ARV	R	Fractured rock, steep cliffs and gullies; unsuitable for most development.
2	**85**	arCbc – R	R	Active rock fall/avalanche deposition zone. Unsuitable for most development. Professional advice required.
2	**86**	$\frac{\text{Cbf}}{\text{Rh}} - \text{R}^{\text{I}}$	Y	Rockfall is a concern only near the top of the polygon. Building inspector should be able to assess most sites.
2	**87**	$\frac{\text{Cvb/Mv}}{\text{Rh}}$	G	Rockfall runout is a concern near top of polygon. Building inspector should be able to assess most sites.

Photo No.	**Poly No.**	Terrain	Haz	Comment
2	**88**	xCbvk/R – R	R	Steep slopes of fractured rock. Evidence of active talus slopes and indicators of significant rockfall and avalanche hazards. Professional advice required.
2	**89**	Cvb/Ra	Y	Rockfall runout area. Building inspector may be able to assess some sites but professional advice is most likely required.
2	**839**	$\frac{Cvb}{Rj}$	Y	Slope stability and potential rock avalanche runout zone. Professional advice most likely required.

Photo No.	Poly No.	Terrain	Haz	Comment
3	**90**	Cbk – $R^{I}V$	Y	Professional should apply set-back from gully. Building inspector should be able to assess most sites.
3	**91**	arCvb/Rk – R	R	Steep unstable fractured rock and active talus slopes pose rockfall and avalanche danger. Professional advice required.
3	**92**	Rs/Cv – R	R	Steep fractured cliffs. Professional advice required.
3	**93**	$\frac{\text{Cbc}}{\text{Ra}}$ – R	Y	Rockfall runout concerns. Traces of large rock will require a run-out analysis. May require professional advice.
3	**94**	Cbc – R^{I}	Y	Rockfall runout concerns near polygon boundaries. Building inspector should be able to assess most sites.
3	**95**	Fp	Y	Lots adjacent to the Gates River should have a safe set-back distance determined by a professional. Building inspector should be able to assess most sites.
3	**96**	Fbp	Y	Lots adjacent to the Gates River and steep slopes should have a safe set-back distance determined by a professional. Building inspector should be able to assess most sites.
3	**97**	Cvk – RV	R	Steep bedrock gully poses rock failure problems. Professional advice required.
3	**98**	Cvb / /Rj – R	R	Rock runout zone for multiple gullies. Professional advice required.
3	**99**	Rhja / /Cvb – R	VR	Talus slopes below indicate unstable rock in this polygon. Professional advice required.
3	**100**	Rks/Cvbt – RV	R	Steep unstable rock faces provide potential for rockfall and avalanches. Professional advice required.
3	**101**	Rhjr / /Cv	Y	Numerous linears should be investigated. Professional advice required.
3	**102**	Rr	Y	Steep unstable slopes and talus deposits warrant a slope investigation by a professional. Some sites the building inspector can assess.
3	**103**	Cb	Y	Rockfall runout analysis may be required near talus slope however the building inspector should be able to assess most sites.

Photo No.	**Poly No.**	Terrain	Haz	Comment
3	**104**	Caj – R^I	R	Activity of old rock avalanche source area should be determined by a professional.
3	**105**	$\frac{Cvb}{Ra}$ – R^I	R	Inactive slide paths with shallow groundwater flow warrant professional advice.
3	**106**	Cvb/Rj	Y	Steep cliffs pose rockfall hazards otherwise the building inspector should be able to assess most sites.
3	**107**	rCvbk – R	R	Steep cliffs provide source material for rockfall within the gully. Professional advice required.
3	**108**	$\frac{Cvb}{Rj}$ – R	R	Old runout zone for a rock avalanche. Professional advice required.
3	**109**	$\frac{Cvb}{Ra}$ – R	R	Active talus slopes. Unsuitable for most development.
3	**110**	$\frac{Cvf}{Rh}$ – R	R	Professional advice is required to determine the active and in-active portions of this colluvial fan.
3	**111**	Rk/Cv – R	R	Steep fractured cliff sections. Unsuitable for most development due to rockfall hazard.
3	**112**	Cvb / /Rh – R	R	Rockfall runout may be needed on east side and a major rock avalanche run-out analysis is needed for the west side. Professional advice required.
3	**113**	$\frac{Cbj}{F^Gb}$ – R^I	R	Rock avalanche runout analysis from the west side is required by a professional due to the previous deposit.
3	**114**	F^Aj – M	R	Active channel of the Birkenhead River. Professional advice required.
3	**115**	Cvb / /Rh	Y	Rockfall runout analysis needed below cliffs otherwise the building inspector should be able to assess most sites.
3	**116**	Cvh/Ra – R	R	Steep slopes and talus deposits warrant further investigation by a professional.
3	**117**	Cvk / /R – R^I	Y	Rockfall runout analysis may be needed below cliffs otherwise the building inspector should be able to assess most sites.
3	**118**	Cvb/Rk – R	R	Steep slopes and active talus may require a rock fall runout analysis by a professional.
3	**119**	xCbk – R	R	Active rockfall hazard. No development.

Photo No.	**Poly No.**	Terrain	Haz	Comment
3	**120**	Rs/xCvb – R	R	Steep unstable rock and rockfall hazard. Professional advice required.
3	**121**	$\frac{Cvb}{Rk} - R$	R	Steep slopes with active talus warrant professional advice.
3	**122**	Cbc – R	R	High potential rock avalanche runout hazard from polygons above. No development.
3	**123**	xCab – R	R	High potential rock avalanche runout hazard from polygons. No development.
3	**124**	$cgF^{A}p - I$	R	Active floodplain of Birkenhead River. No development.
3	**125**	$\frac{Cbf}{F^{G}} - R^{I}$	R	Professional advice required to determine if rock avalanche will run-up from other side of the valley and reach this area.
3	**126**	Cb / /Rj – R	R	Professional advice required to determine if rock avalanche will run-up from other side of the valley and reach this area.
3	**127**	$\frac{Cbj}{F^{G}b}/Rh - R$	Y	Minor rockfall and creek avulsions. Building inspector should be able to assess most sites.
3	**128**	Ra/Cvb – RV	R	Active gullies, rockfall and steep slopes. Professional advice required.
3	**129**	Cbf – R	Y	Possibly an old debris fan with some hazards. Building inspector should be able to assess some sites but professional advice is likely required.
3	**130**	xCab – R	R	Steep cliffs and active talus slopes. Professional advice required.
3	**131**	Cvb/Rk	R	Unstable steep cliffs, some areas may be hit by snow avalanche. Professional advice may be required.
3	**132**	Cbc/Rs – RV	R	Slope stability and rockfall hazards. Professional advice required.
3	**133**	$\frac{Cv}{Rk} - AR^{I}$	R	Active snow avalanche path / old rock avalanche deposit with shallow groundwater flow. Unsuitable for most development.
3	**134**	xCvb / /Ra – R	R	Unstable slopes and active talus. No development.

Photo No.	**Poly No.**	Terrain	Haz	Comment
3	**135**	Rs / /Cv – R	R	Steep unstable cliffs with rockfall hazard. Professional advice required.
3	**136**	xCvbk – RV	R	Rock fall / rock avalanche runout zone. No development.
3	**137**	$\frac{\text{xCvb}}{\text{Rk}}$ – AR	R	Rockfall / snow avalanche runout zone. Professional advice required.
3	**138**	$\frac{\text{xCvb}}{\text{Rk}}$ – ARV	R	Active gullies and snow avalanche paths. Professional advice required.
3	**139**	$\frac{\text{Cb}}{\text{Ra}} - \text{R}^{\text{I}}$	Y	Rockfall runout analysis may be needed near steep slopes. Building inspector should be able to assess some sites at the bottom of this polygon.
3	**140**	$\frac{\text{Cbj}}{\text{F}^{\text{G}}}\text{R}^{\text{I}}$	Y	Set back from Birkenhead River required by a professional. Building inspector should be able to assess most sites.
3	**141**	$\text{sF}^{\text{A}}\text{j}$	R	Active Birkenhead River channel. Professional advice required.
3	**142**	$\frac{\text{Cbc}}{\text{F}}$	Y	Flooding and rockfall runout concerns. Professional advice required.
3	**143**	rCbk – R	R	Steep active talus slopes. No development.
3	**144**	$\text{Cvbj}//\text{R} - \text{R}^{\text{I}}$	Y	Rock avalanche / rockfall runout analysis may be needed. Professional advice required.
3	**145**	arCbR – R	R	Active talus slope. No development.
3	**146**	Rk / /Cvb – R	R	Steep, fractured rock slopes with high rockfall hazard. Professional advice required.
3	**147**	arCbc – R	R	Rock avalanche path. No development.
3	**148**	Cbc – R	R	Rock avalanche runout zone. No development.
3	**149**	$\frac{\text{Cvb}}{\text{Rk}} - \text{R}^{\text{I}}$	Y	Steep, fractured slopes with high rockfall hazard. Professional advice required.
3	**150**	Rs / /Cv – R	R	Unstable, fractured cliffs, and stability problems. Professional advice required.
3	**151**	Rk / /Cv	Y	Slope stability and rockfall hazards. Professional advice may be required.

Photo No.	Poly No.	Terrain	Haz	Comment
3	**152**	Rs/Cb – R	R	Unstable cliffs and talus slopes. Professional advice required.
3	**153**	Fp	R	Flooding and rockfall runout concerns. Professional advice required.
3	**154**	Fbp	Y	Flooding concerns. Professional advice required.
3	**155**	Cbk – V	Y	Minor stream avulsion concerns. Building inspector should be able to assess some sites.
3	**156**	C^{I}bk – V	R	Slope stability concerns near gully headwall. Professional advice required.
3	**157**	Cvba/Rk – RV	R	Rockfall and gully headwall stability concerns. Professional advice required.
3	**158**	Fp	Y	Flooding concerns. Professional advice required.
3	**159**	$\frac{\text{Cvbj}}{\text{Rh}} - R^{I}$	G	Building inspector should be able to assess most sites however if tension cracks near the top of any slope are identified, professional advice will be required.
3	**160**	$\frac{\text{Cbj}}{F^{G}} - R^{I}$	G	Building inspector should be able to assess most sites.
3	**161**	Cab – R	Y	Rockfall runout analysis and slope stability concerns. Professional advice required.
3	**162**	Rk/Cv – R	R	Unstable cliffs. Professional advice required.
3	**163**	Cvb/Ra – R	R	Areas contain active talus slopes. Slope stability concerns warrant professional advice.
3	**164**	Cvb/Rt – V	G	Minor stream avulsions and rockfall concerns. Building inspector should be able to assess most sites.
3	**165**	Cvb/Ra – R	Y	Slope stability and rockfall concerns warrant professional advice.
3	**166**	$\frac{C^{I}\text{b}}{\text{Ra}}$	Y	Up-slope rock avalanche potential should be determined by a professional. Otherwise the building inspector should be able to assess most sites.
3	**167**	Rksr/Cv – R	R	Steep unstable rock mass. Rock avalanche source area. No development.

Photo No.	**Poly No.**	Terrain	Haz	Comment
3	**168**	xCb/Rk – R	R	Unstable cliffs and active talus slopes. No development.
3	**169**	Rkr/Cb – R	R	Steep, fractured unstable slopes. Professional advice required.
3	**170**	Rksr – RV	R	Steep unstable rock mass is a rock avalanche source area. No development.
3	**171**	Rar/Cv – RV	R	Tension cracks and unstable side walls will cause slope stability problems in the future. No development.
3	**172**	Cbc – R	R	Unstable slopes and active talus deposits. No development.
3	**173**	Fp	R	Flooding and rockfall runout concerns. Professional advice required.

Photo No.	**Poly No.**	Terrain	Haz	Comment
4	**174**	$\frac{Cv/Mb}{Ra}$ – ARV	R	Snow avalanche, talus slopes and a active gully pose concerns in this polygon. No development.
4	**175**	$F^{A}j$	R	No development should occur within the side-walls of this small channel. Professional advice required.
4	**176**	$sgF^{A}p$ – B	R	Active flood plain of the Birkenhead River. Professional advice required.
4	**177**	Cb/Fp	Y	Slope stability / rockfall concerns. Professional advice needed.
4	**178**	Rs/Cv – R	R	Unstable slopes and active talus slopes. Professional advice required.
4	**179**	xCab – R	R	Active talus slopes. No development.
4	**180**	Rh/Cv	R	Steep unstable slopes. Professional advice required.
4	**181**	Rs – R	R	Unstable cliffs. Professional advice required.
4	**182**	Rk/Cvk – R	Y	Up-slope and down-slope concerns with stability. Professional advice may be required.
4	**183**	Rk/Cv – V	R	Slope stability concerns. Professional advice required.
4	**184**	Rk/Cv	R	Steep unstable slopes provide source for rockfall. Professional advice required.
4	**185**	Cb/Rhj	Y	Slope instability concerns by the gully and down-slope to the valley. The building inspector should be able to assess most sites.
4	**186**	Rj/Cv	Y	Minor slope stability problems. Building inspector should be able to assess most sites.
4	**187**	Rja/Cv	R	Unstable slopes. Professional advice required.
4	**188**	Cb/Rj – VR	Y	Slope stability concerns warrant professional advice where lots are adjacent to talus slopes otherwise the building inspector should be able to assess most sites.
4	**189**	Cab/Mb – R^{I}	Y	Building inspector should be able to assess most sites however areas near rockfall will require professional advice.

Photo No.	**Poly No.**	Terrain	Haz	Comment
4	**190**	Ra/Cv	R	Rock avalanche and rockfall source area. Professional advice may be required.
4	**191**	$\frac{\text{xCb}}{\text{Rj}}$ – R	R	Rock avalanche / rock fall runout analysis may be needed. Professional advice required.
4	**192**	$\frac{\text{Cb}}{\text{Rj}}$ – R^I	Y	Minor slope stability problems. Building inspector should be able to assess most sites.
4	**193**	Rjr/Cv	Y	Professional advice is needed for lots adjacent to the perimeter of this polygon where the slopes are steep and tension cracks are present. Building inspector should be able to assess other sites.
4	**194**	xCkb/Rk – R	R	Active talus slopes. No development.
4	**195**	Fp	Y	Rock avalanche runout and flooding concerns. Professional advice required.
4	**196**	F^Gbj/Cv	Y	Minor stability and rockfall concerns. Building inspector should be able to assess most lower elevation sites.
4	**197**	Cvb/Rk – R	R	Cliff sections and active talus slopes. Professional advice required.
4	**198**	Rk / /Cv – R	R	Steep unstable slopes provide source rock for avalanches and falls. Professional advice required.
4	**199**	$\frac{\text{Cvba}}{\text{Mb}}$ – R^I	Y	This polygon borders a snow avalanche path and active talus slopes. Professional advice is required.
4	**200**	Cba – AV	R	Unstable source rock for snow avalanches and rockfalls. No development.
4	**201**	Rh/Cv – R	R	Unstable rock avalanche source rock. No development.
4	**202**	Cvb / /Ra – R	R	Unstable rock avalanche source rock and active talus slopes. No development.
4	**203**	rCba – R	R	Active talus slopes. No development.
4	**204**	Rakr/Cv – R	R	Unstable rock avalanche source rock with visible linears. No development.
4	**205**	rCb / /Rk – R	R	Active talus slope. No development.

Photo No.	**Poly No.**	Terrain	Haz	Comment
4	**206**	Rs/Cv – R	R	Steep unstable slopes with linears. Professional advice required.
4	**207**	Rjr/Cv – V	Y	Unstable slopes with linears. Professional advice required.
4	**208**	$\frac{\text{Cvb}}{\text{Rh}} - \text{R}^{\text{I}}$	Y	Professional advice required adjacent to talus and steep slopes otherwise the building inspector should be able to assess most sites.
4	**209**	$\text{F}^{\text{A}}\text{j}$	R	Active creek channel. Professional advice required.
4	**210**	$\frac{\text{Cb/Mbj}}{\text{Rh}}$	Y	Areas near rockfall require professional advice. Building inspector should be able to assess most sites.
4	**211**	Cbj//Rh – RV	Y	Professional advice required to assess debris flow potential from the gullies and consequential stream avulsion.
4	**212**	$\frac{\text{Cvb}}{\text{Rj}} - \text{R}^{\text{I}}$	Y	Sites adjacent to creek and near steep rockfall prone slopes require professional advice. Building inspector should be able to assess most sites.
4	**213**	$\frac{\text{Cb/Mb}}{\text{Rhj}}$	G	Sites adjacent to cliffs require professional advice. The building inspector should be able to assess most sites.
4	**214**	xCbk/Rks – RV	R	Rockfall and debris slide hazards. Professional advice required.
4	**215**	Fp	Y	Flooding concerns. Professional advice required.
4	**216**	Cbc – R	R	Active talus cone. No development.
4	**217**	Rk/Cvb – R	R	Unstable rock mass will provide potential for rock avalanches and rockfall. No development.
4	**218**	$\frac{\text{arCb}}{\text{Rj}} - \text{R}$	R	Unstable rock mass will provide potential for rock avalanches and rockfall. No development.
4	**219**	arCb – R	R	Active talus slope and debris present. No development.
4	**220**	Rar/Cv – RV	R	Unstable rock mass will provide potential for rock avalanches and rockfall. No development.
4	**221**	Rak/Cv – R	R	Steep unstable rock mass. No development.

Photo No.	Poly No.	Terrain	Haz	Comment
4	**222**	Rja/Cv – R	R	Some areas could be prone to rock avalanche. Professional advice required.
4	**223**	Cvbj – R^I	Y	Stream avulsion concerns. Building inspector should be able to assess most sites.
4	**224**	Cvb/Rt – R	Y	Areas adjacent to rockfall will require professional advice. Building inspector should be able to assess other sites.
4	**225**	Cvb/Ŕa – R	Y	Slope stability / rockfall problems will require professional advice.
4	**226**	Rksr/Cv – RV	R	Steep unstable rock mass with linears. No development.
4	**227**	rCba – R	R	Slope stability / rockfall concerns. Professional advice required.
4	**228**	Cbj – R^I	Y	Sites near rockfall and creek require professional advice. Building inspector should be able to assess other sites.
4	**229**	Cvba/Rt – R	Y	Slope stability / rockfall concerns require professional advice.
4	**230**	Rh/Cvb – RV	Y	Slope stability / rockfall concerns near cliff edge require professional advice. Building inspector should be able to assess other sites.
4	**231**	Cab – RV	Y	Stream avulsion and debris flood concerns near creek. Professional advice required in this area. Debris flow possible in upper reaches. Note: polygon was previously red.
4	**232**	$\frac{Cbf}{F^G}$ – R	Y	Stream avulsion and debris flood concerns. Professional advice required.
4	**233**	$\frac{F^Aj}{Cbf}$ – R	R	Active channel of Spetch Cr., stream avulsions and debris flood potential. Professional advice required.
4	**234**	$\frac{Cbf}{F^G}$ – R	Y	Stream avulsion and debris flood concerns. Professional advice required.
4	**235**	F^Aj	R	Active creek channel. Professional advice required.
4	**236**	Rks/Cvbj – ARV	R	Unstable slopes leading to a gully. Professional advice required.

Photo No.	Poly No.	Terrain	Haz	Comment
5	**237**	Cvb / /Ra – R	R	Steep slopes and active talus. No development.
5	**238**	Cvba / /Rk – R	R	Stream avulsion and rockfall concerns may warrant professional advice.
5	**239**	Cbfj – R^I	Y	Some stream avulsion potential near creek and Birkenhead River. Building inspector should be able to assess most sites.
5	**240**	$\frac{Cvb/Mb}{Rh} - R^I$	Y	Rockfall concerns may warrant a runout analysis by a professional. Building inspector should be able to assess some sites.
5	**241**	xCba/Rs – R	R	Steep cliffs and active talus slopes. Professional advice required.
5	**242**	$\frac{Mb/Cv}{Rh}$	G	Building inspector should be able to assess most sites.
5	**243**	Cv/Rhj – R^I	G	Professional advice needed near steep slopes otherwise building inspector should be able to assess most sites.
5	**244**	Cvbj	G	Areas near rockfall require professional advice. Building inspector should be able assess other sites.
5	**245**	$\frac{Cbf}{F^G} - R^I$	G	Minor rockfall runout concerns for sites adjacent to steep slopes. Building inspector should be able to assess most sites.
5	**246**	sgF^Ap – B	R	Active Birkenhead River flood plain. Professional advice required.
5	**247**	Cbf – R^I	Y	Professional advice required near stream avulsions. Building inspector should be able to assess other sites.
5	**248**	$\frac{Cbc}{Ra} - R$	R	Debris flow and stream avulsion potential. Professional advice required.
5	**249**	Rks / /Cv – ARV	R	Rock and snow avalanche source area; debris flow transport zone. No development.
5	**250**	Ra/Cv – R	R	Steep unstable slopes with some talus. Professional advice required.
5	**251**	Rak/Cv – RV	R	Gullies with steep unstable side-walls and debris flow potential. Professional advice required.

Photo No.	**Poly No.**	Terrain	Haz	Comment
5	**252**	$\frac{\text{Cbc}}{\text{Ra}} - \text{R}$	Y	Stream avulsion and debris flow potential. Professional advice required.
5	**253**	Fbp	Y	Flood proofing and stream avulsion concerns. Professional advice required.
5	**254**	Cva – V	Y	Rapid mass movement concerns within the gully. Professional advice required.
5	**255**	Cvba – R	R	Steep unstable slope with talus underneath. Professional advice required.
5	**256**	Cvj/Ra – R	Y	Professional advice required near rockfall area otherwise the building inspector should be able to assess most sites.
5	**257**	xCvb / /Ra – R	R	Unstable slopes and talus warrant the need for professional advice.
5	**258**	Cvba/Mvb	G	Building inspector should be able to assess most sites. Sites adjacent to gullies will require professional advice.
5	**259**	Cva – V	Y	Unstable gully side-walls and debris flow concerns. Professional advice required.
5	**260**	Cv/Ra – RV	R	Steep gully side-walls could be unstable and fractured. Professional advice is required.
5	**261**	$\text{Cv/Rhj} - \text{R}^{\text{I}}$	G	Minor rockfall concerns. Building inspector should be able to assess most sites.
5	**262**	$\frac{\text{Cv/Mb}}{\text{Raj}} - \text{R}^{\text{I}}$	G	Building inspector should be able to assess most sites.
5	**263**	xCb/Ra – R	R	Unstable cliffs and active talus slopes. Professional advice required.
5	**264**	xCvb/Rt – R	R	Rock avalanche and rockfall concerns. Professional advice required.
5	**265**	xCvba – R	Y	Steep unstable rock and talus. Professional advice required.
5	**266**	$\frac{\text{F}^{\text{G}}\text{v/Cv}}{\text{Rj}}$	G	Building inspector should be able to assess most sites.
5	**267**	Ra/Cvb – R	R	Steep slopes with some evidence of instability. Professional advice may be required.

Photo No.	**Poly No.**	Terrain	Haz	Comment
5	**268**	Rakr / /Cv – R	R	Steep slopes with some evidence of instability. Professional advice required.
5	**269**	Rar/Cv – R	Y	Slope stability needs to be investigated further, multiple linears cross this polygon. Professional advice required.
5	**270**	Cvba/Rks – R	R	Fractured slopes and talus present. Professional advice required.
5	**271**	Cvb / /Rah – R	R	Slope stability and stream avulsion concerns. Professional advice may be required.
5	**272**	$\frac{Cv}{Rs}$	R	Unstable cliff section. Professional advice required.
5	**273**	Rhj/Cv – R^1	G	Slope stability concerns near cliff edge. Building inspector should be able to assess most sites.
5	**274**	xCvba/Rks – R	R	Steep unstable slopes and talus. Professional advice required.
5	**275**	Rks/Cv – RV	Y	Slope stability / rockfall concerns. Professional advice may be required.
5	**276**	$\frac{Cv/Mb}{Rj}$ – R^IV	Y	Stream avulsions and minor rockfall concerns. Professional advice may be required. Building inspector should be able to assess some sites.
5	**277**	Cv/Raj – R^IV	Y	Some unstable gully side-walls and stream avulsion potential. Professional advice required.
5	**278**	$\frac{xCb}{Ra}$ – R	R	Slope stability concerns and active talus deposits. Professional advice required.
5	**279**	Cv/Rhs – R	R	Slope stability concerns and active talus deposits. Professional advice required.
5	**280**	Cvb / /Rhj – R^I	G	Building inspector should be able to assess most sites.

Photo No.	**Poly No.**	Terrain	Haz	Comment
6	**281**	Rk/Cv – RV	R	Steep unstable gully side-walls. No development.
6	**282**	Cv/Ra – R	R	Slope stability concerns. Professional advice required.
6	**283**	arCvb / /Ra – R	R	Recent rock avalanche site. No development.
6	**284**	Rk/Cvb – R	R	Steep unstable rock and recent talus. No development.
6	**285**	Fp	Y	Flooding and rock avalanche runout concerns. Professional advice required.
6	**286**	$sgF^{A}p$ – B	R	Birkenhead River flood plain. Professional advice required.
6	**287**	Fp	Y	Flooding concerns. Professional advice required.
6	**288**	Cvb/Ra – R	R	Steep unstable rock and talus. Professional advice required.
6	**289**	$\frac{Cv}{Rhj} - R^{I}$	Y	Some sites adjacent to steep slopes have linears and require professional advice. Building inspector should be able to assess other sites.
6	**290**	arCb / /Rk – R	R	Recent rock avalanche deposit. No development.
6	**291**	Cvb/Ra – R	R	Unstable slopes and active talus deposits. Professional advice required.
6	**292**	$\frac{Cv}{Rj} - R^{I}$	Y	Sites near steep slopes and rockfall areas require a professional assessment. Otherwise the building inspector should be able to assess other sites.
6	**293**	Rksr / /Cv – ARV	R	Source area for rock / snow avalanches and debris flows. No development.
6	**294**	xCvb/Rk – R	R	Unstable slopes and active talus deposits. Professional advice required.
6	**295**	$\frac{xCbv}{Rk} - R^{A}$	R	Some unstable slopes and active talus deposits. Professional advice required.
6	**296**	$\frac{Cvb}{Ra} - R$	R	Slope stability concerns. Professional advice required.
6	**297**	$\frac{Cvb}{Ra} - R^{I}V$	Y	Rock avalanche runout analysis may be needed. Professional advice required.

Photo No.	Poly No.	Terrain	Haz	Comment
6	**298**	xCvb/Rt – R	R	Unstable cliffs and talus slopes. Professional advice required.
6	**299**	Cv/Ra	Y	Minor slope stability and stream avulsion problems. Professional advice may be needed.
6	**300**	Fp	Y	Flooding potential west of the railway tracks needs to be looked at by a professional. Building inspector should be able to assess most sites.
6	**301**	Cv/Rk – R	R	Rock avalanche potential. Professional advice required.
6	**302**	Rk/Cv – R	R	Rock avalanche potential. Professional advice required.
6	**303**	$\frac{Cv}{Ra}$ – R	R	Potentially unstable rock mass. Professional advice may be needed.
6	**304**	Rsk/Cv – R	R	Steep unstable slopes. Professional advice required.
6	**305**	Cv/Ra – R	R	Slope stability and rock avalanche runout analysis may be needed. Professional advice required near steep slopes otherwise the building inspector should be able to assess most sites.
6	**306**	Cvb/Rk – R	R	Active talus and steep unstable slopes. Professional advice required.
6	**307**	$\frac{Cvb}{Ra} - R^{1}$	Y	Slope stability and minor flooding concerns. Professional advice may be needed; building inspector should be able to assess some sites.
6	**308**	$\frac{Cvb}{Rht} - R^{I}$	Y	Sites adjacent to rockfall or steep slopes require professional advice otherwise the building inspector should be able to assess most sites.
6	**309**	Cv/Rs – R	R	Steep slopes leading to Birkenhead River. Professional advice required.
6	**310**	$F^{A}j$	R	Narrow active channel of the Birkenhead River. Professional advice required.
6	**311**	Fbp	Y	Flooding and minor rockfall concerns. Professional advice required.

Photo No.	**Poly No.**	Terrain	Haz	Comment
6	**312**	$\frac{Cv}{Rk} - R^{I}$	G	Minor rockfall concerns. Building inspector should be able to assess most sites.
6	**313**	$\frac{Cb}{Rbj} - R^{I}$	Y	Flooding and slope stability concerns require professional advice. Building inspector should be able to assess some sites.
6	**314**	$gCbfk - R^{A}A^{A}$	R	Rock and snow avalanche, debris flow and stream avulsion potential. Professional advice required.
6	**315**	Cbc – AR	R	Stream avulsion and debris flow snow avalanche deposition area. Professional advice required.
6	**316**	$\frac{Cvb}{Ra} - RA$	R	Unstable rock mass and slope stability concerns. Professional advice required.
6	**317**	Cvb/Rks – ARV	R	Cliffs, rock avalanche and debris flow source area. No development.
6	**318**	Cv/Rk – RV	R	Steep unstable slopes. No development.
6	**319**	$\frac{Cvb}{Ra} - R^{I}$	Y	Steep unstable slopes. Professional advice required.
6	**320**	$\frac{Cb}{Ra} - R$	Y	Unstable slopes and active talus. Professional advice required.
6	**321**	$\frac{Cb}{Rk} - R$	Y	Slope stability and rockfall concerns. Professional advice required.
6	**322**	$\frac{Cvb}{Ra} - R$	R	Active talus slopes. Professional advice required.
6	**323**	$sgCbf - R^{A}$	R	Rock avalanche / debris flow runout analysis needed. Professional advice required.
6	**324**	$sgCb/F^{G}$	Y	Minor flooding and up-slope stream avulsion potential. Building inspector should be able to assess some sites.
6	**325**	$F^{A}p$	R	Active channel of Poole Creek. Flooding concerns require professional advice.
6	**326**	$\frac{Cbf}{Rj} - R^{I}$	G	Building inspector should be able to assess most sites.
6	**327**	$\frac{Cvb/Mb}{Ra}$	Y	Minor rockfall and stream avulsion concerns. Building inspector should be able to assess most sites.

Photo No.	**Poly No.**	Terrain	Haz	Comment
6	**328**	Cv/Rs – R	R	Steep unstable cliffs and active talus slopes. Professional advice required.
6	**329**	$\frac{\text{Mb//Cv}}{\text{Rrj}}$	G	Minor slope stability concerns near steep slopes. Building inspector should be able to assess most sites.
6	**330**	$\frac{\text{Mvb/Cv}}{\text{Rh}}$	G	Minor rockfall and flooding concerns. Building inspector should be able to assess most sites.
6	**331**	Fbp	Y	Flooding concerns. Professional advice required.
6	**332**	sgCbf – R	R	Rock avalanche and debris flow runout concerns. Professional advice required.
6	**333**	Cbf – R^A	R	Rock avalanche and debris flow runout concerns and minor slope instabilities. Professional advice required.
6	**334**	$\frac{\text{Cv/Mb}}{\text{Ra}}$	Y	Slope stability and runout concerns. Professional advice required.
6	**335**	Cvb/Mb – A	R	Unstable slopes and potential snow avalanche runout path. Professional advice required.
6	**336**	Cvb/Rs – RV	R	Highly unstable gully and gully side-walls. No development.
6	**337**	$\frac{\text{Cvb/Mvb}}{\text{Ra}}$ – RV	R	Unstable slopes and active talus. Professional advice required.

Photo No.	**Poly No.**	Terrain	Haz	Comment
7	**338**	xCbr – R	R	Potential rock avalanche runout zone. Professional advice required.
7	**339**	Rs / /Cv – R	R	Unstable cliffs and slopes. No development.
7	**340**	Rk/Cv – R	R	Fractured and unstable slopes with some talus. Professional advice required.
7	**341**	Cbc – AR	R	Stream avulsions and rockfall runout concerns. Professional advice required.
7	**342**	$\frac{Cv/Mv}{Rh}$	G	Minor slope stability and rockfall concerns. Building inspector should be able to assess most sites.
7	**343**	Cv/Ra – V	Y	Sites adjacent to steep slopes and areas of rockfall require professional advice otherwise the building inspector should be able to assess most sites.
7	**344**	$\frac{Cv/F^{G}b}{Rhj} - R^{1}$	G	Sites adjacent to steep slopes and areas of rockfall require professional advice otherwise the building inspector should be able to assess most sites.
7	**345**	$\frac{Fp//Ov}{L^{G}v}$	Y	Flooding concerns. Professional advice required.
7	**346**	$\frac{Cv}{Rk}$	R	Steep unstable slopes. No development.
7	**347**	$\frac{Cv}{Rj} - R^{I}$	Y	Slopes stability concerns and up-slope hazards warrant the need for professional advice.
7	**348**	xCvba – R	R	Active rockfall area. No development.
7	**349**	Cv / /Ra – R	R	Active rockfall area with unstable source. Professional advice required.
7	**350**	$\frac{Cv}{Rj} - R^{I}$	Y	Potentially unstable rock-mass may fail. Professional advice required near steep slopes otherwise the building inspector should be able to assess most sites.
7	**351**	xCv/Ra – R	R	Steep unstable slopes with active talus. Professional advice required.
7	**352**	$\frac{Cvb}{Rht} - R$	Y	Rockfall runout concerns near steep slopes. Building inspector should be able to assess other sites.
7	**353**	xCvb/Rha – R	R	Unstable slopes with active talus. Professional advice required.

Photo No.	Poly No.	Terrain	Haz	Comment
7	**354**	Cvb / /Ra – R	R	Slope stability and rockfall concerns. Professional advice required.
7	**355**	F^A	Y	Active channel. Professional advice required for sites adjacent to Poole Creek.
7	**356**	$\frac{gFf}{gF^Gb} - R^I$	Y	Potential debris flow transport / deposition zone. Professional advice required.
7	**357**	$\frac{F^Gbj/Mb}{Rj}$	G	Sites adjacent to steep slopes and rockfall will require professional advice otherwise the building inspector should be able to assess most sites.
7	**358**	Cv/F^Gb	G	Sites near steep slopes may require professional advice. Building inspector should be able to assess most sites.
7	**359**	$\frac{Cv/F^Gb}{Rhj}$	Y	Sites near steep slopes may require professional advice. Building inspector should be able to assess most sites.
7	**360**	Cv/Ra – R	R	Rock avalanche and rockfall runout concerns. Professional advice required.

7	**361**	Cvb / /Ra – R	R	Unstable rock and active rockfall. No development.
7	**362**	Ra/Cv – RV	R	Unstable rock bordering gully. Professional advice required.
7	**363**	xCbk – R	R	Active talus slopes. No development.
7	**364**	Cvb/Rk – R	R	Unstable rock mass with talus slopes. No development.
7	**365**	Cvba – R	R	Active talus slopes. No development.
7	**366**	Rk/Cv – RV	R	Steep unstable slopes provide source material for rockfall and rock avalanches. Professional advice required.
7	**367**	Cvba – R	R	Active talus slopes. No development.
7	**368**	$Cbc - R^I$	R	Old debris deposition zone from gully. Professional advice required.
7	**369**	$\frac{Cv}{Ra}$	R	Rock avalanche and rockfall runout concerns. Professional advice required.
7	**370**	Cbc – AR	R	Old rock avalanche deposition zone. Professional advice required.

Photo No.	Poly No.	Terrain	Haz	Comment
7	**371**	Cbc – R	R	Old rock avalanche deposition zone. Professional advice required.
7	**372**	Cvba – R^{I}	Y	Rock avalanche and rockfall runout concerns. Professional advice required.
7	**373**	$\frac{F^{A}j}{Cb}$	R	Active Poole Creek channel. Professional advice required.
7	**374**	gFbfj – R	Y	Potential debris flow transport / deposition zone. Professional advice required.
7	**375**	Rhd / /Cv	Y	Rockfall and flooding concerns warrant professional advice. Building inspector should be able to assess other sites.
7	**376**	$\frac{Mb/Cv}{Rh}$	G	Minor rockfall runout concerns. Building inspector should be able to assess most sites.
7	**377**	Rs/Cv – RA	R	Unstable cliffs and active talus slopes. No development.
7	**378**	$\frac{Cvbc}{Rk}$ – RA	R	Active talus slopes. No development.
7	**379**	Cv/Rk – R	R	Unstable rock mass and active talus slopes. No development.
7	**380**	Rk/Cv – R	R	Unstable rock mass. No development.
7	**381**	Cv/Ra – R	R	Unstable slopes with rock avalanche potential. No development.
14	**382**	Cvbf/F^{G}b/Lv	G	~~Note: same as 380.~~ Polygon now placed into airphoto #14. *This should be a green, no hazard polygon. / FW B[illegible] Jan 09, 2001*
7	**383**	Rk / /Cv – ARV	R	Steep unstable gully side-walls. No development.
7	**384**	Rks/Cv – R	R	Steep unstable rock mass with talus. No development.
7	**385**	Cva – R	R	Rock avalanche / rock fall runout zone. No development.
7	**386**	Cv/Rk – ARV	R	Unstable gully side-walls. No development.
7	**387**	xCbk – R	R	Active talus slope. No development.
7	**388**	Cv/Rak – R	R	Steep unstable slopes. Professional advice required.

Photo No.	**Poly No.**	Terrain	Haz	Comment
7	**389**	Rak/Cv – RV	R	Steep unstable slopes and cliffs. Professional advice required.
7	**390**	Cv/Rk – ARV	R	Unstable slopes and active talus deposits. No development.
7	**391**	Rk / /Cv – A	R	Steep unstable rock mass subject to snow avalanches. No development.
7	**392**	Cv/Rk – A	R	Steep unstable slopes and debris chutes. No development.
7	**393**	Cv/Rk – A	R	Unstable slopes subject to snow avalanches. No development.
7	**394**	Cv/Rk – A	R	Unstable slopes subject to snow avalanches. No development.
7	**395**	Rk/Cv – R	R	Steep unstable slopes with talus. No development.
7	**396**	Cv/Rk – R	R	Active talus slopes. No development.
7	**397**	Rk/Cv – ARV	R	Steep unstable slopes. No development.
7	**398**	sgFf – R^I	G	Minor stream avulsions. Building inspector should be able to assess most sites.

Photo No.	Poly No.	Terrain	Haz	Comment
8	**399**	Cv/Rj	Y	Potentially unstable rock mass. Professional advice required near steep slopes. Building inspector should be able to assess some sites.
8	**400**	Cv/Rj	Y	Unstable rock and potential rock avalanche runout zone. Professional advice required.
8	**401**	xCvb/Rks – R	R	Unstable cliffs and active talus slopes. No development.
8	**402**	Cv/Rk – RV	R	Unstable gully head-wall and side-walls. Professional advice required.
8	**403**	Cv/Rk – V	Y	Slope stability concerns. Professional advice required.
8	**404**	Cv/Rk – RV	R	Unstable gully head-wall and side-walls. No development.
8	**405**	Cv/Rk – V	Y	Slope stability concerns. Professional advice required.
8	**406**	Cv/Rak	Y	Slope stability and stream avulsion concerns require professional advice. Building inspector should be able to assess some lower elevation sites.
8	**407**	Cvb/Rak – ARV	R	Unstable gully capable of moving rock avalanches, debris flows and snow avalanches. No development.
8	**408**	Cv/Rak – V	Y	Slope and gully side-wall stability concerns. Professional advice required.
8	**409**	Cv/Rak – ARV	R	Unstable gully capable of moving rock avalanches, debris flows and snow avalanches. No development.
8	**410**	Cv/Ra – V	Y	Slope and gully side-wall stability concerns. Professional advice required.
8	**411**	Cv/Ra – A	R	Snow avalanche slide path. No development.
8	**412**	xCvb/Raj – R	R	Rock avalanche and rockfall runout zone. Professional advice required.
8	**413**	Cbc – AR	R	Potential debris flow and snow avalanche deposition zone. Professional advice required.
8	**414**	Cv/Rj – A	R	Snow avalanche runout zone. Professional advice required.

Photo No.	**Poly No.**	Terrain	Haz	Comment
8	**415**	$\frac{\text{Cvb}}{\text{Ra}}$	R	Slope stability and close proximity of snow avalanche gully warrant professional advice.
8	**416**	$\frac{\text{Cv}}{\text{Ra}}$	Y	Slope stability and close proximity of snow avalanche gully may warrant professional advice. Building inspector should be able to assess some sites.
8	**417**	$\frac{\text{Cv}}{\text{Rj}}$	Y	Slope stability and stream avulsion concerns. Professional advice may be required. Building inspector should be able to assess some sites.
8	**418**	Cvj – V	R	Slope stability and stream avulsion concerns. Professional advice required.
8	**419**	Cvbc – R	R	Old debris fan deposition zone. Professional advice required.
8	**420**	$\frac{\text{xCvb}}{\text{Ra}} - \text{R}$	R	Debris fan deposition zone. Professional advice required.
8	**421**	$\frac{\text{Cv}}{\text{Raj}}$	Y	Steep unstable slopes. Professional advice required.
8	**422**	$\frac{\text{Cv}}{\text{Rj}} - \text{V}$	R	Up-slope stability and stream avulsions. Professional advice may be needed. Building inspector should be able to assess some lower elevation sites.
8	**423**	Cv / /Rhj	Y	Slope stability, rockfall and rock avalanche runout concerns. Professional advice required.
8	**424**	$\frac{\text{Cv}}{\text{Rj}}$	Y	Minor slope stability concerns. Building inspector should be able to assess most sites.
8	**425**	$\frac{\text{xCv}}{\text{Ra}} - \text{R}$	R	Unstable slopes and active talus. Professional advice required.
8	**426**	$\text{F}^{\text{A}} - \text{RV}$	R	Unstable gully side-walls and active channel of Place Creek. Professional advice required.
8	**427**	$\frac{\text{xCvb}}{\text{Rhj}} - \text{RV}$	R	Slope stability concerns and active talus slopes. Professional advice required.
8	**428**	$\frac{\text{Cvb}}{\text{Rj}} - \text{V}$	Y	Stream avulsions and minor slope stability concerns. Professional advice may be needed. Building inspector should be able to assess some lower elevation sites.

Photo No.	Poly No.	Terrain	Haz	Comment
8	**429**	$\frac{Cbf/Mv}{L^Gp} - R^I$	G	Sites adjacent to steep, unstable slopes may require professional advice. Building inspector should be able to assess most sites.
8	**430**	Cv/Ra	G	Minor slope stability concerns. Building inspector should be able to assess most sites.
8	**431**	$\frac{Cv/Mv}{Rh}$	Y	Sites adjacent to steep slopes have rock avalanche and rockfall concerns that require professional advice otherwise the building inspector should be able to assess most sites.
8	**432**	$\frac{Cv/Lv}{Mb} - W$	G	Landslide induce flood wave may impact this area. Wave height analysis should be carried out for all sites bordering Gates Lake. Professional advice required for those lots. Building inspector should be able to assess other lots.
8	**433**	$\frac{Cv/Mv}{Raj}$	G	Landslide induce flood wave may impact this area. Wave height analysis should be carried out for all sites bordering Gates Lake. Professional advice required for those lots. Building inspector should be able to assess other lots.
8	**434**	$\frac{Cv}{Rj}$	Y	Landslide induce flood wave may impact this area. Wave height analysis should be carried out for all sites bordering Gates Lake. Professional advice required for those lots. Building inspector should be able to assess other lots.
8	**435**	$\frac{Cvb}{Rhj}$	Y	Slope stability concerns warrant professional advice. Building inspector should be able to assess lower elevation sites.
8	**436**	Cbf – R	R	Potential rock avalanche and debris flow deposition zone. Professional advice required.
8	**437**	Cbf – AR	R	Potential rock avalanche and debris flow deposition zone. Professional advice required.
8	**438**	$Cva - V^I$	Y	Minor slope stability concerns and landslide induce flood waves may impact this area. Wave height analysis should be carried out for all sites bordering Gates Lake. Potential rock avalanche runout zone. Professional advice required for those lots.
8	**439**	$\frac{Cv/Mb}{Rhj}$	Y	Potential rock avalanche runout zone. Professional advice required.
8	**440**	$\frac{Cv/Mv}{Rhj} - A$	R	Potential rock / snow avalanche and / or debris flow runout zone. Professional advice required.

Photo No.	**Poly No.**	Terrain	Haz	Comment
8	**441**	$\frac{\text{Cv}}{\text{Rj}}$	Y	Potential snow and rock avalanche runout zone. Professional advice required.
8	**442**	$\frac{\text{xCvb}}{\text{Raj}} - \text{R}$	Y	Sites adjacent to steep slopes and rockfall require professional advice. Building inspector should be able to assess most sites.
8	**443**	$\frac{\text{Cvb/Mb}}{\text{Ra}}$	Y	Slope stability and stream avulsion concerns require professional advice. Building inspector should be able assess some sites.
8	**444**	Cvb/Rak – R	Y	Unstable slopes and rockfall runout concerns. Professional advice required.
8	**445**	$\frac{\text{Cv/Mb}}{\text{Raj}}$	Y	Minor slope stability, stream avulsion and rock avalanche runout concerns. Professional advice required.
8	**446**	Cv/Rhj	Y	Minor slope stability, stream avulsion and rock avalanche runout concerns. Professional advice required.
8	**447**	Cv/Ra	G	Rockfall and wave height problems require professional advice. Building inspector should be able to assess most sites.
8	**448**	$\frac{\text{Cv/Mv}}{\text{Rhj}}$	G	Gates Peak rock avalanche runout concerns. Professional advice required. Otherwise building inspector should be able to assess most sites.
8	**449**	$\text{C}^{\text{I}}\text{b}$	G	Landslide induce flood wave may impact this area. Wave height analysis should be carried out for all sites bordering Gates Lake. Professional advice required for those lots. Building inspector should be able to assess other lots.
8	**450**	$\text{F}^{\text{A}}\text{p}$	R	Active channel of the Gates River. Professional advice required near the sides of the river.
8	**451**	$\frac{\text{Mv/Cv}}{\text{Rj}}$	Y	Minor stream avulsions and rockfall runout concerns. Building inspector should be able to assess most sites.
8	**452**	$\frac{\text{Cv/Mv}}{\text{Rj}}$	Y	Gates Peak rock avalanche runout concerns. Professional advice required. Otherwise building inspector should be able to assess most sites.
8	**453**	xCvj/Ra – R	R	Unstable slopes and active rock avalanche / rockfall concerns. No development.

Photo No.	**Poly No.**	Terrain	Haz	Comment
8	**840**	Ov/Cv over Mb	Y	Swampy area that may be susceptible to a landslide induced flood wave. Professional advice required for sites adjacent to the lake. Other sites may be assessed by the building inspector.
8	**841**	Cvb/Rk	Y	Steep slopes with rockfall hazards. In addition, sites adjacent to the lake may be susceptible to a landslide induced flood wave. Professional advice required.

Photo No.	**Poly No.**	Terrain	Haz	Comment
9	**454**	$gbFf - R^{I}$	Y	Stream avulsions and debris flow runout potential. Professional advice required.
9	**455**	Cvb/Rj	G	Minor slope stability concerns. Building inspector should be able to assess most sites.
9	**456**	$F^{G}bf/Cbf$	G	Minor rockfall runout concerns. Building inspector should be able to assess most sites.
9	**457**	xCb//Rk – R	R	Rockfall concerns from talus slopes. No development.
9	**458**	$\frac{Cvbc}{Rh} - R^{I}$	Y	Potential rock fall / slide runout zone. Professional advice required.
9	**459**	Cvk – RA	R	Active snow avalanche and debris fan. No development.
9	**460**	Cvbs/Rs – R	R	Steep unstable slopes and rockfall concerns. Professional advice required.
9	**461**	$Cbf/F^{G}b$	Y	Snow avalanche runout and landslide induced flood wave height require professional advice. Otherwise building inspector should be able to assess most sites.
9	**462**	Cbf	G	Landslide induced flood wave height concerns require professional advice. Otherwise building inspector should be able to assess most sites.
9	**463**	$gF^{G}b/Cb$	G	Landslide induced flood wave height concerns require professional advice. Otherwise building inspector should be able to assess most sites.
9	**464**	$gF^{G}/F/Cvb$	G	Building inspector should be able to assess most sites.
9	**465**	$Fp/F^{G}b$	Y	Stream avulsions pose flooding concerns. Professional advice required.
9	**466**	$gFf - R^{A}$	Y	Stream avulsions pose debris flooding concerns. Professional advice required.
9	**467**	Rh/Cv	G	Building inspector should be able to assess most sites.
9	**468**	$gF^{G}b/Cv//Rh$	G	Minor flooding concerns. Building inspector should be able to assess most sites.
9	**469**	$F^{G}b/Cb$	G	Minor slope stability problems. Building inspector should be able to assess most sites.
9	**470**	$F^{G}ba$	Y	Steep unstable slopes will require professional advice.

Photo No.	**Poly No.**	Terrain	Haz	Comment
9	**471**	F^Gbf/Cb	G	Minor slope stability problems. Building inspector should be able to assess most sites.
9	**472**	Cbf – R	Y	Potential debris flow transport / deposition zone. Professional advice required.
9	**473**	Cbf – RA	R	Stream avulsion, debris flow and snow avalanche concerns. Professional advice required.
9	**474**	Cv/Ra – A	R	Stream avulsions and slope stability concerns. Professional advice required.
9	**475**	Cbc – AR	R	Snow avalanche and stream avulsions. Professional advice required.
9	**476**	Rak/Cv	Y	Potentially unstable rock mass and close proximity of snow avalanche slide path warrant professional advice.
9	**477**	Rs/Cv – R	R	Steep unstable slopes. No development.
9	**478**	Cv/Rs – R	R	Steep unstable slopes and rockfall. No development.
9	**479**	Cv/Rs – AR	R	Unstable slopes subject to snow avalanches. No development.
9	**480**	Rs / /Cv – R	R	Unstable cliffs and steep slopes. No development.
9	**481**	Cvb/Rak – R	Y	Unstable slopes with rockfall. Professional advice required.
9	**482**	$\frac{\text{Cv}}{\text{Rak}}$	Y	Unstable slopes and close proximity to snow avalanche paths warrant professional advice.
9	**483**	$\frac{\text{Cv}}{\text{Raj}}$ – A	R	Active snow avalanche path. No development.
9	**484**	Cv/Rk	Y	Unstable slopes and close proximity to snow avalanche paths warrant professional advice.
9	**485**	Cv/Rak – ARV	R	Unstable slopes proned to snow avalanches. No development.
9	**486**	$\frac{\text{Cv}}{\text{Ra}}$	Y	Unstable slopes and close proximity to snow avalanche paths warrant professional advice.

Photo No.	Poly No.	Terrain	Haz	Comment
9	**487**	Rks//Cv – AR	R	Unstable slopes proned to snow avalanches. No development.
9	**488**	$\frac{\text{Cv}}{\text{Rak}}$	Y	Steep unstable slopes and close proximity to snow avalanche paths warrant professional advice.
9	**489**	Rk//Cv – AR	R	Unstable slopes have rockfall, stream avulsion, rock avalanche and snow avalanche problems. Professional advice required.
9	**490**	Rak/Cv – ARV	R	Unstable slopes have rockfall, stream avulsion, rock avalanche and snow avalanche problems. No development.
9	**491**	Rk/Cv – ARV	R	Steep unstable slopes proned to snow avalanches. No development.
9	**492**	Cv/Rk – R	R	Unstable slopes, rockfall and close proximity to snow avalanche slide paths warrant professional advice.
9	**493**	Rak/Cv – A	R	Steep unstable slopes subject to snow / rock avalanches, rockfall and possibly debris flows. No development.
9	**494**	Cbc/Rk – A	R	Unstable slopes and debris fan subjected to snow avalanches. Professional advice required.
9	**495**	Cv/Rk – R	R	Unstable slopes subject to rock fall and / or avalanches. No development.
9	**496**	$\frac{\text{Cv}}{\text{Ra}}$	Y	Steep slopes and close proximity to snow avalanche paths warrant professional advice.
9	**497**	Cbf – AR	R	Snow avalanche and debris flow runout concerns. Professional advice required.
9	**498**	Cb/F^{G}b – R^{I}	Y	Old debris fan. Professional advice required.
9	**499**	$\frac{\text{Cv/Mv}}{\text{Rh}}$	G	Building inspector should be able to assess most sites.
9	**500**	$\frac{\text{Cvb}}{\text{Rk}}$	Y	Rockfall and rock avalanche runout warrant professional advice.
9	**501**	Cvb//Rk – R	R	Unstable slopes and rockfall. Professional advice required.
9	**502**	Rk/Cv – R	R	Unstable cliffs and rockfall. No development.

Photo No.	Poly No.	Terrain	Haz	Comment
9	**503**	Rk/Cv – R	R	Unstable cliffs and rockfall. No development.
9	**504**	Cv/Rs – V	R	Unstable gully side-walls. No development.
9	**505**	Rs / /Cv – R	R	Unstable cliffs and rockfall. No development.
9	**506**	Rks/Cvb – AR	R	Steep unstable slopes subject to rockfall and snow avalanches. No development.
9	**507**	Rks/Cv – ARV	R	Steep unstable slopes subject to rockfall and snow avalanches. No development.
9	**508**	Rks/Cv – AR	R	Steep unstable slopes subject to rockfall and snow avalanches. No development.

Photo No.	**Poly No.**	Terrain	Haz	Comment
10	**509**	$\frac{Cvb/Mb}{Ra}$	Y	Stream avulsions and slope stability concerns warrant professional advice. Building inspector should be able to assess some lower elevation sites.
10	**510**	Ra/Cv – R	R	Unstable slopes and rockfall. Professional advice required.
10	**511**	Ra/xCv – R	R	Unstable slopes and rockfall / slide. Professional advice required.
10	**512**	$\frac{Cvb}{Rak}$ – RV	R	Unstable slopes and debris potential need to be investigated in this gully. Professional advice required.
10	**513**	$\frac{Cv}{Ra}$ – V	Y	Minor slope stability concerns. Building inspector should be able to assess most sites.
10	**514**	$\frac{Mb/Cv}{Rj}$	Y	Minor slope stability and stream avulsions. Building inspector should be able to assess most sites.
10	**515**	$\frac{Cvb}{Raj}$	G	Building inspector should be able to assess most sites.
10	**516**	Cv/Rk – R	R	Steep slopes with rockfall. Professional advice required.
10	**517**	$\frac{Mb/Cv}{Rja}$	Y	Stream avulsions and rock avalanche / rockfall runout concerns require professional advice. Building inspector should be able to assess some lower elevation sites.
10	**518**	$\frac{Cvb/Mb}{Ra}$	Y	Minor slope stability concerns. Building inspector should be able to assess most sites.
10	**519**	Cv/Ra – R	R	Steep and potentially unstable slopes require professional advice. Building inspector should be able to assess some sites.
10	**520**	Cbf – R	R	Active portion of the Eight Mile Creek fan. Professional advice required.
10	**521**	Mb/F^{G}b	G	Minor flooding concerns. Building inspector should be able to assess most sites.
10	**522**	gFg – R^{A}	Y	Stream avulsion and debris flooding concerns. Professional advice required.
10	**523**	$\frac{Cv/Mh}{Ra}$	Y	Potentially unstable slopes. Professional advice required.
10	**524**	Rk/Cv – R	R	Steep unstable slopes. No development.

Photo No.	**Poly No.**	Terrain	Haz	Comment
10	**525**	xCvb/Rh – R	R	Unstable slopes, rock avalanche and rockfall runout concerns. Professional advice required.
10	**526**	Rk / /W – R	R	Potentially unstable rock mass. Professional advice required.
10	**527**	Cvb/Raj	Y	Stream avulsion and slope stability concerns will require professional advice. Building inspector should be able to assess some sites.
10	**528**	$\frac{\text{Cvb}}{\text{Rj}}$ – RV	R	Steep unstable gully side-walls. Professional advice required.
10	**529**	$\frac{\text{xCvb}}{\text{Ra}}$ – R	R	Steep slopes with rock avalanche potential. Professional advice required.
10	**530**	$\frac{\text{Cb}}{\text{Rj}}$	Y	Slope stability and rock avalanche runout concerns. Professional advice required.
10	**531**	$\frac{\text{Cv/Mb}}{\text{Ra}}$ – V	Y	Slope stability concerns. Professional advice required.
10	**532**	xCbak – R	R	Steep unstable slopes subject to rock avalanches. Professional advice required.
10	**533**	Cv/Rj/Mv	Y	Slope stability concerns will require professional advice. Building inspector should be able to assess some sites away from steep slopes.
10	**534**	Cbf – R	R	Stream avulsions and debris flood potential. Professional advice required.
10	**535**	$\frac{\text{Fp}}{\text{Mb}}$	G	Minor rockfall runout and flooding concerns. Building inspector should be able to assess most sites.
10	**536**	Cv/Mb	Y	Potential slope instability. Some professional advice may be needed; building inspector should be able to assess most lower elevation sites.
10	**537**	Cv/Rk – ARV	R	Unstable slopes subject to debris flows, stream avulsions and rock avalanches. No development.
10	**538**	Rk / /Cv – R	R	Steep unstable slopes. No development.
10	**539**	Cbc – RV	R	Debris flood and stream avulsion potential. Professional advice required.

Photo No.	Poly No.	Terrain	Haz	Comment
10	**540**	Cbc / /Rh – R^I	Y	Stream avulsion, debris flood and rockfall concerns near steep slopes. Professional advice required.
10	**541**	Cbc – RV	R	Stream avulsion and debris flood potential. Professional advice required.
10	**542**	Cbc / /Rh – R^I	Y	Stream avulsion, debris flood, and minor rockfall concerns near steep slopes. Professional advice required.
10	**543**	Cbf – R^I	G	Minor flooding concerns adjacent to creek. Building inspector should be able to assess most sites.
10	**544**	$\frac{Cvb}{Rj}$ – R^I	Y	Potentially unstable slopes and rock avalanche runout concerns will require professional advice. Building inspector should be able to assess some lower elevation sites.
10	**545**	$\frac{Mb/Cv}{Rh}$	G	Minor flooding and rockfall concerns. Building inspector should be able to assess most sites.
10	**546**	Mb/Cv	G	Minor flooding concerns. Building inspector should be able to assess most sites.
10	**547**	Cbf – R^I	G	Minor up-slope stability concerns. Building inspector should be able to assess most sites.
10	**548**	Rs/Cv – R	R	Steep potentially unstable slopes. No development.
10	**549**	Rak / /Cv – RVAR	R	Steep potentially unstable slopes. No development.
10	**550**	Rk/Cv – R	R	Steep potentially unstable slopes. No development.
10	**551**	Cv/Rk – AR	R	Steep unstable slopes with rockfall. No development.
10	**552**	Cv/Rks – ARV	R	Unstable gully side-wall subject to snow and rock avalanches. No development.
10	**553**	Rk / /xCv – AR	R	Steep unstable slopes with rockfall. No development.
10	**554**	Cv/Rks – ARV	R	Unstable gully side-wall subject to snow and rock avalanches. No development.
10	**555**	Rk / /Cv – R	R	Steep unstable slopes with rockfall. Professional advice required.

Photo No.	**Poly No.**	Terrain	Haz	Comment
10	**556**	Rk/Cv – RV	R	Steep and potentially unstable slopes. No development.
10	**557**	Rk/Cv – RV	R	Slope stability, stream avulsion and close proximity to snow avalanche slide path warrant professional advice.
10	**558**	Rk/xCvb – R	R	Steep unstable slopes with rockfall. No development.

Photo No.	**Poly No.**	Terrain	Haz	Comment
11	**559**	$\frac{\text{Cvb}}{\text{Rak}}$ – AV	R	Slope stability, stream avulsion and snow avalanche concerns. Professional advice required.
11	**560**	$\frac{\text{Cvb}}{\text{Rak}}$ – AV	Y	Rock avalanche / rockfall runout concerns. Professional advice required.
11	**561**	xCba – R	R	Active talus deposits. No development.
11	**562**	Cv/Rks – RV	R	Steep unstable slopes with rockfall. Professional advice required.
11	**563**	$\frac{\text{Cv}}{\text{Rt}}$	Y	Slope stability concerns and linears found on airphotos. If tension cracks are found near steep slopes then professional advice is required. Otherwise, the building inspector should be able to assess most sites.
11	**564**	$\frac{\text{xCvb}}{\text{Ra}}$ – RV	R	Unstable gully and slopes. Professional advice required.
11	**565**	$\frac{\text{Cv}}{\text{Ra}}$	Y	Steep potentially unstable slopes. Professional advice required.
11	**566**	$\frac{\text{Cv}}{\text{Ra}}$ – RV	Y	Steep potentially unstable slopes with some rockfall. Professional advice required.
11	**567**	$\frac{\text{Cvb}}{\text{Ra}}$	Y	Steep potentially unstable slopes with some rockfall. Professional advice required.
11	**568**	$\frac{\text{Cv}}{\text{Rk}}$	R	Steep potentially unstable slopes. Professional advice required.
11	**569**	$\frac{\text{xCvb}}{\text{Ra}}$ – R	R	Active talus slopes. Professional advice required.
11	**570**	$\frac{\text{Cv}}{\text{Rt}}$ – R	Y	Steep slopes with potential for failure. Professional advice required.
11	**571**	Cbf – R^{I}	Y	Stream avulsion, debris flood and rock avalanche runout concerns. Professional advice required.
11	**572**	Fp	Y	Flooding concerns. Professional advice required except for scattered higher areas of lower concern.
11	**573**	$\frac{\text{Cvb}}{\text{Ra}}$	Y	Slope stability and rockfall / avalanche runout concerns. Professional advice required.
11	**574**	$\frac{\text{Cvb}}{\text{Rb}}$	G	Building inspector should be able to assess most sites.

Photo No.	**Poly No.**	Terrain	Haz	Comment
11	**575**	Fp/Ov	Y	Flood concerns. Professional advice required.

Photo No.	**Poly No.**	Terrain	Haz	Comment
12	**576**	Rak/Cv	Y	Steep unstable slopes. Professional advice required.
12	**577**	Cv / /Ra	Y	Steep and potentially unstable slopes require professional advice. Building inspector should be able to assess lower elevation sites without hazards.
12	**578**	Cba – R	R	Potential debris flow / flood problems. Professional advice required.
12	**579**	Cbf – R^{I}	Y	Old debris fan has potential snow avalanche and debris flow hazards. Professional advice required.
12	**580**	$F^{G}b$	G	Minor up-slope hazards. Building inspector should be able to assess most sites.
12	**581**	$\frac{Cb}{Rk}$	G	Minor flooding concerns. Building inspector should be able to assess most sites.
12	**582**	Cvbj – R^{I}	R	Potential rock avalanche / rockfall runout zone. Professional advice required.
12	**583**	Cvb/Rk	R	Steep potentially unstable slopes. Professional advice required.
12	**584**	xCvb / /Rs – R	R	Active talus slopes. No development.
12	**585**	Rks / /Cv – R	R	Steep unstable slopes. No development.
12	**586**	Rks/Cvb – R	R	Unstable slopes with potential rockfall hazard. Professional advice required.
12	**587**	$\frac{Cv}{Rhj}$	R	Rockfall / rock slide runout concerns. Professional advice required.
12	**588**	Cb/F^{G}b	Y	Potential snow avalanche runout zone. Professional advice required.
12	**589**	Cbc – R^{I}	R	Stream avulsion and snow avalanche concerns. Professional advice required.
12	**590**	Cv/Ra – RV	Y	Unstable slopes with potential debris flow hazard. Professional advice required.
12	**591**	Cv – RA	R	Unstable gullies with snow avalanche and debris flow potential. Professional advice required.

Photo No.	**Poly No.**	Terrain	Haz	Comment
12	**592**	Rkr/Cv – ARV	Y	Steep slopes subject to snow avalanche and rockfall. Professional advice required.
12	**593**	Cv/Rk – RV	R	Steep unstable slopes. No development.
12	**594**	$\frac{Cb}{Ra}$ – ARV	R	Snow avalanche path possibly capable of moving debris flows and / or rock avalanches. Professional advice required.
12	**595**	$\frac{Cvb}{Rar}$ – V	Y	Steep slopes and close proximity of snow avalanche slide paths warrant professional advice.
12	**596**	$\frac{Cvb}{Ra}$ – ARV	R	Unstable gully side-walls, snow avalanche and debris flow potential. Professional advice required.
12	**597**	$\frac{Cv}{Rak}$	R	Steep unstable slopes with rockfall. Professional advice required.
12	**598**	$\frac{Cvb}{Rak}$ – ARV	R	Unstable gully side-walls, snow avalanche and debris flow potential. No development.
12	**599**	Cv/Rak – AR	R	Steep unstable slopes with rockfall / rock avalanche potential. Professional advice required.
12	**600**	$\frac{Cvb}{Ra}$	Y	Potentially unstable slopes. Professional advice required.
12	**601**	Cvb/Rks – R	R	Steep unstable slopes with rockfall. No development.
12	**602**	$\frac{Cb}{Rj}$ – R^I	Y	Potential rock avalanche runout zone. Professional advice required.

Photo No.	**Poly No.**	Terrain	Haz	Comment
13	**603**	Cvbk	Y	Steep potentially unstable slopes. Professional advice required.
13	**604**	Rs/Cb	Y	Slope stability concerns. Professional advice required near steep slopes.
13	**605**	Rhk	Y	Minor slope stability problems. Building inspector should be able to assess most sites.
13	**606**	xCb/Rs	Y	Unstable slopes with rockfall. Professional advice required.
13	**607**	$\frac{Cvb}{Mvb}/Rk$	Y	Potentially unstable slopes. Professional advice required for those sites and the building inspector should be able to assess some of the lower elevation sites within this polygon.
13	**608**	$\frac{Cv}{Mv}/Rhk$	Y	Sites near steep slopes will require professional advice otherwise the building inspector should be able to assess most sites.
13	**609**	xCbf	Y	Potential rock avalanche source. Professional advice required.
13	**610**	xCb – R	R	Active talus slope. No development.
13	**611**	$\frac{Cv}{Rj}$	Y	Old slide debris. Professional advice required.
13	**612**	Rs/Cb	Y	Steep and potentially unstable slopes. Professional advice required.
13	**613**	Rhs	Y	Steep and potentially unstable slopes. Professional advice required.
13	**614**	xCba – R	R	Active talus slopes. Professional advice required.
13	**615**	Cf/Rk – R	R	Steep unstable slopes with talus. Professional advice required.
13	**616**	$\frac{Cbf}{Rh}$	Y	Potential rockfall / avalanche runout zone. Professional advice required; building inspector should be able to assess some of the lower elevation sites.
13	**617**	Cb/Rhk	R	Steep and potentially unstable slopes. Professional advice required.
13	**618**	$\frac{Cv}{Mb}/Rs$	Y	Some potential for rock avalanche runout. Professional advice required.

Photo No.	Poly No.	Terrain	Haz	Comment
13	**619**	xCf – R	R	Steep and potentially unstable slopes with talus. Professional advice required.
13	**620**	Rs/Cv – R	R	Potential rock avalanche source. Professional advice required.
13	**621**	xbCf – R	R	Recent rock avalanche. No development.
13	**622**	Rk/Cvb	R	Potential rock avalanche source rock. Professional advice required.
13	**623**	xCb/Rs	R	Steep unstable slope. Professional advice required.
13	**624**	Rs/Cv – R	R	Steep and potentially unstable slopes. No development.
13	**625**	arCvb – R	R	Active talus slopes. No development.
13	**626**	$\frac{\text{Cvs}}{\text{Rs}}$	Y	Steep and potentially unstable slopes. Professional advice required.
13	**627**	Cvb/Rs	Y	Steep and potentially unstable slopes. Professional advice required.
13	**628**	xCb/Rs	R	Steep unstable slopes with talus. Professional advice required.
13	**629**	Cbf/Rs	Y	Minor rock avalanche runout concerns. Professional advice required.
13	**630**	Rkh	Y	Potentially unstable, steep slopes. Professional advice required.
13	**631**	Rsh	R	Steep and potentially unstable slopes. Professional advice required.
13	**632**	xCbf – R	R	Active talus slopes and potential rockfall runout. Professional advice required.
13	**633**	sFp//Cvb	Y	Flooding concerns. Professional advice required.
13	**634**	F^{A}p – M	R	Active channel of the Gates River. Flooding hazard will require professional advice.
13	**635**	Cvb/Raj	R	Steep unstable slopes with rockfall hazard. Professional advice required.

Photo No.	Poly No.	Terrain	Haz	Comment
13	**636**	xCbf / /F^{G}b	R	Steep unstable slopes with rockfall hazard. Professional advice required.
13	**637**	Mb/Cb	R	Steep unstable slopes with rockfall hazard. Professional advice required.
13	**638**	Cvb/Mb/Rk	R	Steep unstable slopes with rockfall hazard. Professional advice required.
13	**639**	Mb/Cvb	G	Minor slope stability problems. Building inspector should be able to assess most sites.
13	**640**	$\frac{\text{xCvb}}{\text{Mb}}$	R	Rockfall / rock avalanche runout concerns on this steep slope. Professional advice required.
13	**641**	xCbf – R	R	Active talus slopes. No development.
13	**642**	Rs/Cv	R	Unstable cliffs. No development.
13	**643**	xCf – R	R	Active talus slopes. No development.
13	**644**	xCbf	R	Steep unstable slopes. No development.
13	**645**	$\frac{\text{Cv}}{\text{Mb}}$/$F^{G}$t	Y	Up and down slope stability concerns. Professional advice required.
13	**646**	Cv/Ra	R	Potential rock avalanche / rockfall runout. Professional advice required.
13	**647**	Rk / /Cv	R	Steep and potentially unstable slopes. Professional advice required.
13	**648**	xCvb / /Rks – R	R	Recent failures and rockfall. No development.
13	**649**	Rks / /Cv – R	R	Steep unstable slopes. No development.
13	**650**	Cvba – V	R	Stability of this gully needs to be assessed. Professional advice required.
13	**651**	$\frac{\text{Cv}}{\text{Ra}}$	Y	Steep and potentially unstable slopes. Professional advice required.
13	**652**	$\frac{\text{Cv}}{\text{Mb}}$	Y	Up and down slope stability concerns. Professional advice required.

Photo No.	**Poly No.**	Terrain	Haz	Comment
13	**653**	$\frac{Cvb}{Ra} - R^{I}$	Y	Up and down slope stability concerns. Professional advice required.
13	**654**	Cvb/Rs – R	R	Unstable cliffs. No development.
13	**655**	$\frac{Cvb}{Mvb} // F^{G}$	Y	Some rock fall / rock slide stability concerns. Professional advice required for most sites; building inspector should be able to assess some sites.
13	**656**	Cvb/Rs – R	R	Steep slopes with rockfall. Professional advice required.
13	**657**	Rs / /Cv – R	R	Steep unstable slopes. No development.
13	**658**	xCbf – R	R	Recent rockfall and steep slopes. No development.
13	**659**	Rs/Cv – RV	R	Steep unstable slope. No development.
13	**660**	Rs/Cv	R	Steep unstable slope. Professional advice required.
13	**661**	xCbf – R	R	Steep unstable slope with rockfall. No development.
13	**662**	Rks/Cv – RV	R	Steep unstable slope with rockfall. No development.
13	**663**	Rk / /Cv	R	Steep unstable slope. No development.
13	**664**	Cv/Rk – R	R	Steep unstable slope with rockfall. Professional advice required.
13	**665**	$\frac{Cvb}{Ra}$	Y	Steep potentially unstable slope. Professional advice required.
13	**666**	$\frac{Cvj}{Mb}$	Y	Potentially unstable lower slope. Professional advice required.

Photo No.	**Poly No.**	Terrain	Haz	Comment
14	**667**	$\frac{Cv/Mv}{Rk} - AV$	R	Slope stability, stream avulsion, and snow avalanche concerns. Professional advice required.
14	**668**	$\frac{Cvb}{Rk} - ARV$	R	Unstable slopes and gullies, snow avalanche potential. Professional advice required.
14	**669**	$\frac{Cv}{Rrk} - R$	R	Unstable gullies and slopes with rockfall. Professional advice required.
14	**670**	$\frac{Cv}{Rk} - ARV$	R	Unstable slopes with recent rockfall; snow avalanche potential. Professional advice required.
14	**671**	$\frac{Cvb}{Rak} - AV$	R	Unstable gullies, snow avalanche potential and stream avulsion are potential problems. Professional advice required.
14	**672**	$\frac{Cvb}{Rks} - ARV$	R	Unstable gully slopes with rockfall problems. No development.
14	**673**	$\frac{Cvb}{Rak} - V$	R	Potentially unstable gully side-walls. Professional advice required.
14	**674**	$\frac{Cvb}{Rak} - RV$	R	Steep and potentially unstable gully side-walls. Professional advice required.
14	**675**	$\frac{Cvb/Mv}{Ra} - V$	Y	Stream avulsion and slope stability concerns. Professional advice may be needed. Building inspector should be able to assess some of the sites.
14	**676**	Rs/Cv – RV	R	Steep unstable gully side-walls. Professional advice required.
14	**677**	$\frac{Cvb}{Rak} - RV$	R	Potentially unstable gully side-walls. Professional advice required.
14	**678**	$\frac{Cvb}{Ra} - V$	Y	Slope stability and stream avulsion concerns. Professional advice may be needed. Building inspector should be able to assess some of the sites.
14	**679**	$\frac{Cvb}{Ra}$	Y	Slope stability concerns. Professional advice required.
14	**680**	Cbf – R	R	Old debris fan with stream avulsion problems. Professional advice required.

Photo No.	Poly No.	Terrain	Haz	Comment
14	**681**	Cbf – R	R	Old debris fan with potential debris flow and stream avulsion problems. Professional advice required.
14	**682**	$\frac{Cvb/Mv}{Ra}$ – A	R	Slope stability and potential snow avalanche problems. Professional advice required.
14	**683**	$\frac{Cv}{Rrk}$ – RV	R	Unstable gully side-walls. Professional advice required.
14	**684**	Cvbf – R	R	Stream avulsion and slope stability concerns. Professional advice required.
14	**685**	Cbf – R^I	Y	Old debris fan with stream avulsion concerns. Professional advice required.
14	**686**	$\frac{Cvb}{Ra}$ – V	Y	Unstable gully side-walls. Professional advice required.
14	**687**	Cbf – R^I	Y	Old debris fan with potential stream avulsion and potential debris flood problems. Low risk but professional advice will be required.
14	**688**	Cv/Rh	G	Building inspector should be able to assess most sites.
14	**689**	$\frac{Cv/Mv}{Raj}$ – V	Y	Minor stability problems. Building inspector should be able to assess most sites.
14	**690**	$\frac{Mb/Cv}{Rhj}$	G	Building inspector should be able to assess all sites.
14	**691**	Cbf – R^I	Y	Flooding on the west side of the railway tracks and stream avulsion on the east side. Professional advice required.
14	**692**	Cbf – R^I	Y	Stream avulsion and minor debris flood potential. Professional advice required.
14	**693**	gFf – R	R	Stream avulsion and debris flood potential. Low risk but professional advice required.
14	**694**	$\frac{Cvb}{Raj}$	Y	Minor slope stability concerns. Professional advice may be needed but the building inspector should be able to assess most sites.
14	**695**	$\frac{Cvb}{Ra}$ – V	Y	Steep and potentially unstable gully side-walls. Professional advice required for most of the gully. Building inspector should be able to assess some sites.

Photo No.	Poly No.	Terrain	Haz	Comment
14	**696**	$\frac{Mb/Cv}{Rj}$	G	Minor slope stability and stream avulsion concerns. Building inspector should be able to assess most sites.
14	**697**	gFbj	Y	Slope stability and minor debris flooding potential. Some professional advice may be required; building inspector should be able to assess some sites.
14	**698**	$gF^{A}b - RV$	R	Spruce Creek stream avulsion and debris flooding concerns. Professional advice required.
14	**699**	$F^{G}bk - F^{A}$	Y	Steep potentially unstable slope. Professional advice required.
14	**700**	$gFb - R^{I}$	R	Stream avulsion and debris flooding concerns. Professional advice may be required.
14	**701**	$\frac{Cvb}{Ra} - RV$	Y	Slope stability concerns. Professional advice required.
14	**702**	$Cbf - R^{I}$	Y	Old debris fan with potential stream avulsion and debris flood hazards. Professional advice required.
14	**703**	$gbF^{A}f - R$	R	Spruce Creek stream avulsion and debris flooding potential. Professional advice required.
14	**704**	$gFbf - R^{I}$	Y	Flooding and debris flooding concerns. Flood proofing will be required in addition to professional advice.
14	**705**	$F^{A}p$	R	Gates River channel with debris flooding potential. Professional advice required.
14	**706**	$\frac{Cv}{Ra}$	G	Some steep slopes. Building inspector should be able to assess most sites.
14	**707**	$\frac{Mb/Cv}{Rj}$	G	Building inspector should be able to assess most sites.
14	**708**	$\frac{Cvb/Mv}{Rha} - V$	Y	Professional advice will be required near steep slopes otherwise the building inspector should be able to assess most sites.
14	**709**	$\frac{Cvb}{Rha}$	Y	Professional advice will be required near steep slopes otherwise the building inspector should be able to assess most sites.
14	**710**	$\frac{Mb/Cv}{Rj}$	G	Minor slope stability and stream avulsion concerns. Building inspector should be able to assess most sites.

Photo No.	**Poly No.**	Terrain	Haz	Comment
14	**711**	$\frac{\text{Cvb/Mv}}{\text{Rha}} - \text{V}$	G	Building inspector should be able to assess most sites.
14	**712**	Cvb/Rh – R	Y	Professional advice will be required near steep slopes or for sites adjacent to rockfall. Other sites may be assessed by the building inspector.
14	**713**	$\frac{\text{Cv/Mv}}{\text{Rh}}$	G	Building inspector should be able to assess most sites.
14	**714**	Cb/Rs – V	Y	Minor slope stability and stream avulsion concerns. Building inspector should be able to assess most sites.
14	**715**	gFbj	R	Sites adjacent to Gates River will require professional advice. Sites above the lower road and highway may be assessed by the building inspector.
14	**716**	gFbf – R^{I}	Y	Stream avulsion and debris flooding potential from Spruce Creek. Professional advice required.
14	**717**	gbFf – R^{I}	G	Building inspector should be able to assess most sites.
14	**718**	$gF^{G}b$	G	Building inspector should be able to assess most sites.
14	**719**	$gF^{G}bh$	G	Building inspector should be able to assess most sites.
14	**720**	Cva/Mb//Rh – V	G	Minor stream avulsion potential. Building inspector should be able to assess most sites.
14	**721**	$\frac{\text{Mb/Cv}}{\text{Rj}}$	G	Minor stream avulsion potential. Building inspector should be able to assess most sites.
14	**722**	$\frac{\text{Cb/Mb}}{\text{Rj}}$	G	Minor stream avulsion potential. Building inspector should be able to assess most sites.

Photo No.	Poly No.	Terrain	Haz	Comment
15	**723**	$\frac{Mv/Cv}{Rhj}$	G	Building inspector should be able to assess most sites.
15	**724**	$\frac{Cvf}{F^{G}b} - R^{I}$	G	Sites near steep slopes may require professional advice. Building inspector should be able to assess most sites.
15	**725**	$sgF^{G} - ba$	G	Sites near steep slopes may require professional advice. Building inspector should be able to assess most sites. OK.
15	**726**	Fbp	G	Building inspector should be able to assess most sites. OK.
15	**727**	Cbf – RV	Y	Stream avulsion, debris flood from Blackwater Creek and slope stability concerns. Professional advice required.
15	**728**	$sgF^{G}bt$	G	Building inspector should be able to assess most sites.
15	**729**	Fbp	Y	Flooding potential by the Gates River should be looked into. Professional advice recommended.
15	**730**	$\frac{Cvb/Mv}{Rha}$	Y	Minor slope stability concerns. Building inspector should be able to assess most sites.
15	**731**	$\frac{F^{G}b/Mb}{Rj}$	G	Sites adjacent to steep slopes may require professional advice. Building inspector should be able to assess most sites.
15	**732**	Cbj	R	Debris flooding potential. Professional advice required.
15	**733**	$F^{G}bk$	Y	Steep potentially unstable slopes. Professional advice required.
15	**734**	$\frac{Fbf}{Cbf} - R^{I}$	G	Minor stream avulsions. Building inspector should be able to assess most sites.
15	**735**	$\frac{Cv/Mv}{Rja}$	G	Building inspector should be able to assess most sites.
15	**736**	$\frac{Cv/Mv}{Rj}$	R	Potentially unstable slopes. Professional advice required.
15	**737**	$\frac{Mv/Cv}{Rj}$	G	Minor slope stability and stream avulsion concerns. Building inspector should be able to assess most sites.
15	**738**	Cv/Mba	G	Minor slope stability concerns. Building inspector should be able to assess most sites.
15	**739**	$\frac{Mv/Cv}{Rh}$	G	Building inspector should be able to assess most sites.

Photo No.	**Poly No.**	Terrain	Haz	Comment
15	**740**	$\frac{Mb/Cv}{Ra}$	G	Minor stream avulsion concerns. Building inspector should be able to assess most sites.
15	**741**	$sF^{G}ba$	G	Sites near steep gully side-walls will require professional advice. Building inspector should be able to assess most sites.
15	**742**	$\frac{F^{G}b}{Rj}$	G	Sites near steep gully side-walls will require professional advice. Building inspector should be able to assess most sites.
15	**743**	$\frac{Cv/Mv}{Ra}$	Y	Minor stability concerns. Building inspector should be able to assess most sites.
15	**744**	$\frac{Cvb/Mv}{Ra}$	Y	Sites near steep gully side-walls will require professional advice. Building inspector should be able to assess most sites.
15	**745**	$\frac{Mb/Cv}{Rj}$	G	Building inspector should be able to assess most sites.
15	**746**	$\frac{Cv}{Ra}$	Y	Stream avulsion concerns. Professional advice required.
15	**747**	$\frac{Cv}{Ra} - V$	G	Minor stability concerns. Building inspector should be able to assess most sites.
15	**748**	$\frac{Cv}{Ra} - V$	G	Minor stability concerns. Building inspector should be able to assess most sites.
15	**749**	$\frac{Cv/Mv}{Ra} - V$	G	Minor stability concerns. Building inspector should be able to assess most sites.
15	**750**	$F^{A}j - R$	R	Active channel of Haylmore Creek. Debris flooding concerns. Professional advice required.
15	**751**	Rks/Cv – RV	R	Steep unstable slopes. Professional advice required.
15	**752**	$\frac{Mv/Cv}{Ra}$	G	Building inspector should be able to assess most sites.
15	**753**	$\frac{Fbf}{Cbf} - R^{I}$	G	Building inspector should be able to assess most sites.
15	**838**	gA	R	Slope stability concerns. No development on or near the slopes.

Photo No.	Poly No.	Terrain	Haz	Comment
16	**11**	$F^{G}bp$	Y	Gates River floodplain. Flood proofing may be required. Building inspector should be able to assess most sites but professional help may be needed.
16	**754**	$\frac{Cvb/Mv}{Rj}$	G	Sites near steep slopes and rockfall will require professional advice. Building inspector should be able to assess most sites.
16	**755**	$\frac{Mvb/Cv}{Rj}$	G	Building inspector should be able to assess most sites.
16	**756**	$\frac{Cvba}{Mb} - V$	Y	Potential slope stability problems near the gullies warrant professional advice.
16	**757**	Cvb/Mba – V	R	Steep potentially unstable gully side-walls. Professional advice required.
16	**758**	$\frac{Cv/F^{G}v}{Mbj} - V$	G	Minor slope stability and stream avulsion concerns. Building inspector should be able to assess most sites.
16	**759**	$\frac{Cvbf}{F^{G}b}$	G	Minor stream avulsion concerns. Building inspector should be able to assess most sites.
16	**760**	$\frac{Cvj}{Mb} - V$	G	Minor slope stability concerns. Building inspector should be able to assess most sites.
16	**761**	$F^{G}bj/Mb$	G	Minor slope stability concerns. Building inspector should be able to assess most sites.
16	**762**	$\frac{Op/Cv}{Mb}$	G	Sites near the lake shore may require a landslide induced flood wave analysis. Otherwise the building inspector should be able to assess most sites.
16	**763**	$\frac{Fp}{Mb}$	Y	Sites near the lake shore may require a landslide induced flood wave analysis. Flooding potential by the Gates River will also require professional advice.
16	**764**	$F^{G}bpj$	Y	Sites near the lake shore may require a landslide induced flood wave analysis. Flooding potential by the Gates River will also require professional advice.
16	**765**	$\frac{Cv/Fp}{Mb}$	G	Sites near the lake shore may require a landslide induced flood wave analysis. Building inspector should be able to assess most sites.
16	**766**	Cvbj – V	G	Minor slope stability concerns within the gully. Building inspector should be able to assess most sites.

Photo No.	**Poly No.**	Terrain	Haz	Comment
16	**767**	Mbh/Cv	G	Minor slope stability concerns. Building inspector should be able to assess most sites.
16	**768**	$\frac{\text{Cv}}{\text{Mbj}}$	G	Sites near the lake shore may require a landslide induced flood wave analysis. Building inspector should be able to assess most sites.
16	**769**	$\frac{\text{F}^{\text{G}}\text{b}}{\text{Mbj}}$	G	Sites near the lake shore may require a landslide induced flood wave analysis. Building inspector should be able to assess most sites.
16	**770**	Cvbj – V	Y	Steep and potentially unstable gully side-walls. Professional advice required.
16	**771**	$\frac{\text{F}^{\text{G}}\text{b/Mb}}{\text{Ra}}$ – V	G	Minor slope stability concerns. Building inspector should be able to assess most sites.
16	**772**	$\frac{\text{Cva}}{\text{Mb}}$ – V	Y	Slope and gully side-wall stability concerns. Professional advice required.
16	**773**	F^{A}j/Cv – V	R	Gully side-wall stability concerns. Professional advice required.
16	**774**	$\frac{\text{Mvb/Cv}}{\text{Ra}}$	G	Minor slope stability and stream avulsion problems. Building inspector should be able to assess most sites.
16	**775**	$\frac{\text{F}^{\text{G}}\text{b/Cv}}{\text{Mbj}}$	G	Sites near the lake shore may require a landslide induced flood wave analysis. Building inspector should be able to assess most sites.
16	**776**	Fv/Cv – V	Y	Steep and potentially unstable gully side-walls. Professional advice required.
16	**777**	$\frac{\text{Mv/Cv}}{\text{Rhj}}$	G	Sites near the lake shore may require a landslide induced flood wave analysis. Building inspector should be able to assess most sites.
16	**778**	Cvb/Ra – R^{I}	Y	Minor rockfall concerns. Building inspector should be able to assess most sites; some professional advice may be needed.
16	**779**	Rks/Cv – R	R	Some unstable slopes with rockfall potential. Building inspector should be able to assess most sites; some professional advice may be required.
16	**780**	Cvb – V	R	Steep and potentially unstable gully side-walls. Professional advice required.

Photo No.	Poly No.	Terrain	Haz	Comment
16	**781**	$\frac{Cvb/Mv}{Rh}$	G	Sites adjacent to steep slopes may require professional advice. Building inspector should be able to assess most sites.
16	**782**	$\frac{Cvb}{Rk} - R^{I}$	Y	Potential rock avalanche runout zone. Professional advice required.
16	**783**	$\frac{Cv/Mv}{Rhj}$	Y	Sites adjacent to steep slopes may require professional advice. Building inspector should be able to assess most sites.
16	**784**	Rs//Cvb – R	R	Steep unstable slopes with recent rockfall. Professional advice required.
16	**785**	$\frac{Cvb}{Rak} - RV$	R	Up-slope stability concerns. Professional advice required.
16	**786**	$\frac{Mv/Cvb}{Ra}$	G	Sites near the lake shore may require a landslide induced flood wave analysis. Minor stream avulsion concerns. Building inspector should be able to assess most sites.
16	**787**	Rka/Cv – R	R	Steep unstable rock. Professional advice required.
16	**788**	$F^{A}j$	R	Active channel of the Gates River. High flooding potential will require professional advice.

Photo No.	Poly No.	Terrain	Haz	Comment
17	**789**	Cbc – AR	R	Old debris fan with slope stability and stream avulsion problems. Professional advice required.
17	**790**	Rsk/Cv – R	R	Steep unstable slopes with rockfall. Professional advice required.
17	**791**	$\frac{\text{Cvb}}{\text{Rja}}$ – V	Y	Slope stability and stream avulsion concerns. Professional advice required for most sites. Building inspector should be able to assess some sites.
17	**792**	$\frac{\text{Mb/Cv}}{\text{Rj}}$	G	Sites near steep slopes may require professional advice. Building inspector should be able to assess most sites.
17	**793**	$\frac{\text{Cvb/Mb}}{\text{Rj}}$	G	Minor slope stability and stream avulsion concerns. Building inspector should be able to assess most sites.
17	**794**	$\frac{\text{Cvb}}{\text{Rj}}$	G	Minor slope stability concerns. Building inspector should be able to assess most sites.
17	**795**	$\frac{\text{Cvb}}{\text{Ra}}$	Y	Some slope stability concerns. Building inspector should be able to assess most sites.
17	**796**	$\frac{\text{Cv}}{\text{Rhak}}$	Y	Sites near steep slopes may require professional advice. Building inspector should be able to assess most sites.
17	**797**	$\frac{\text{Cv}}{\text{Rs}}$	R	Steep and potentially unstable slopes. Professional advice required.
17	**798**	$\frac{\text{Cvb}}{\text{Ra}}$	Y	Steep and potentially unstable slopes. Professional advice required for most sites. Building inspector should be able to assess some sites.
17	**799**	Rk/Cv – R	R	Steep unstable slopes with some rockfall. Professional advice required.
17	**800**	$\frac{\text{Cb}}{\text{Ra}}$ – R	R	Minor slope stability concerns. Professional advice may be required.
17	**801**	$\frac{\text{Cvb}}{\text{Rak}}$	Y	Sites near steep slopes and / or rockfall will require professional advice. Building inspector should be able to assess some sites.
17	**802**	$\frac{\text{Mb/Cv}}{\text{Ra}}$	G	Minor stream avulsion concerns. Building inspector should be able to assess most sites.
17	**803**	$\frac{\text{Mvb/Cv}}{\text{Rt}}$	G	Building inspector should be able to assess most sites.

Photo No.	**Poly No.**	Terrain	Haz	Comment
17	**804**	$\frac{Cv}{Rk}$	Y	Steep potentially unstable slopes. Professional advice may be required.
17	**805**	$\frac{Mvb/Cv}{Rt}$	G	Building inspector should be able to assess most sites.
17	**806**	$\frac{Cv}{Rkh}$	Y	Steep slopes. Professional advice may be required. Building inspector should be able to assess some of the sites.
17	**807**	$Cbf - R^I$	G	Inactive fluvial fan of D'Arcy Creek. Building inspector should be able to assess most sites.
17	**808**	Fbf – RV	Y	Debris flooding and stream avulsion concerns with D'Arcy Creek. Professional advice required.
17	**809**	$Fbf - R^I$	G	Minor stream avulsion concerns. Building inspector should be able to assess most sites.
17	**810**	$\frac{Cvb}{Ra} - V$	Y	Gully side-walls and steep slopes will require professional advice. Building inspector should be able to assess some sites.
17	**811**	Cvba – V	Y	Potentially unstable gully side-walls. Professional advice may be required.
17	**812**	$\frac{Cv}{Mbt}$	G	Sites near steep slopes may require professional advice. Building inspector should be able to assess most sites.
17	**813**	$\frac{Cvb}{Ra}$	G	Building inspector should be able to assess most sites.
17	**814**	Cvb / /Rk – V	Y	Potentially unstable gully. Professional advice required for gully side-walls. Building inspector should be able to assess some sites.
17	**815**	$\frac{Cv}{Rh}$	G	Building inspector should be able to assess most sites.
17	**816**	Cvb/Rk – V	Y	Potentially unstable gully. Professional advice required for gully side-walls. Building inspector should be able to assess some sites.
17	**817**	Cv/Mba – V	Y	Sites near steep slopes may require professional advice. Building inspector should be able to assess most sites.
17	**818**	Cbja	G	Some steep slopes. Building inspector should be able to assess most sites.

Photo No.	**Poly No.**	Terrain	Haz	Comment
17	**819**	Cbf – R^{I}	G	Sites adjacent to polygons 823, 824, 825 have potential rockfall problems and sites adjacent to Anderson Lake may be susceptible to a landslide induced flood wave. Professional advice required for those sites otherwise the building inspector should be able to assess most sites.
17	**820**	Cvba – V	Y	Potentially unstable gully. Professional advice required near gully side-walls. Building inspector may be able to assess some sites.
17	**821**	$\frac{\text{Cvb}}{\text{Rak}}$ – VR	R	Unstable gully side-walls. Professional advice required.
17	**822**	$\frac{\text{Cb}}{\text{Ra}}$	Y	Potential rock avalanche / rockfall runout zone. Professional advice required.
17	**823**	$\frac{\text{Cv}}{\text{Rk}}$	R	Steep and potentially unstable slopes. Professional advice required.
17	**824**	Cvb/Rk – R	R	Rockfall and potential rock avalanche problems in addition to the possibility of a landslide induced flood wave. Professional advice required.
17	**825**	Rs/Cvk – R	R	Steep slopes with rockfall hazards and potential rock avalanche hazards. Professional advice required.
17	**826**	Rks/Cv – R	R	Steep and unstable slopes. Professional advice required.
17	**827**	$\frac{\text{xCvb}}{\text{Rk}}$ – R	R	Active talus slopes. No development.
17	**828**	Rs//Cv – R	R	Unstable cliffs. No development.
17	**829**	$\frac{\text{Cv/Mv}}{\text{Ra}}$	Y	Sites adjacent to steep slopes will require professional advice. Building inspector should be able to assess most of the other sites.
17	**830**	Rsk/Cv – RV	R	Unstable cliffs and steep slopes. Professional advice required.
17	**831**	xCvbk – R	R	Active talus slopes. Professional advice required.
17	**832**	Cvb/Rak – RV	R	Slope stability and landslide induced flood wave height concerns. Professional advice required.

Photo No.	**Poly No.**	Terrain	Haz	Comment
17	**833**	$\frac{Cvb}{Ra} - R$	R	Active talus slopes and landslide induced flood wave height concerns. Professional advice required.
17	**834**	$Cvb/Ra - R^{I}$	Y	Slope stability, rock avalanche and rockfall concerns. Professional advice required.
17	**835**	Cvb/Rks – RV	R	Steep and potentially unstable gully side-walls. Professional advice required.
17	**836**	Rs/Cvba – RV	R	Steep and potentially unstable slopes. Professional advice required.
17	**837**	$\frac{Mv/Cv}{Rj}$	Y	Slope stability concerns; especially near polygon 836. Professional advice required in this area. Building inspector should be able to assess some sites.
-				**Polygons previously shown.**
15	**838**	gA	R	Slope stability concerns. No development on or near the slopes.
2	**839**	$\frac{Cvb}{Rj}$	Y	Slope stability and potential rock avalanche runout zone. Professional advice required.
8	**840**	$\frac{Ov/Cv}{Mb}$	Y	Swampy area that may be susceptible to a landslide induced flood wave. Professional advice required for sites adjacent to the lake. Other sites may be assessed by the building inspector.
8	**841**	Cvb/Rk	Y	Steep slopes with rockfall hazards. In addition, sites adjacent to the lake may be susceptible to a landslide induced flood wave. Professional advice required.