Floodplain and Landslide Report – Committee of the Whole – June 18, 2020

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File No. 6410-01

Introduction

As a result of recent flooding and landslide activity, staff have brought forward this report for Board discussion. This report outlines the history, risks, current CRD regulations, available regulatory tools, and future considerations regarding landslide and flooding hazards in relation to land development within the CRD.

Landslide Hazards

Landslide hazards can be broken down into four broad categories: soil creep, land slump, debris flow, and rockfall hazard (Figure 1). These landslide categories can again be broken down further (Figure 2). There are many combinations of events that can happen in one area. Thus, often, a complex slide emerges, made up of many different types of land movement.

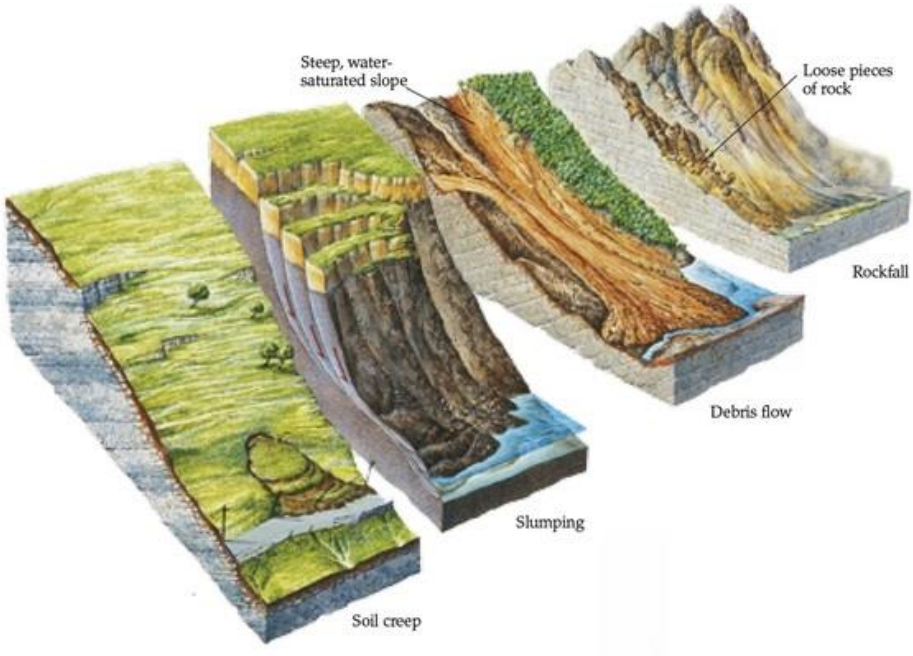

Figure 1 – Landslide Categories (**Source:** https://monstrouslandslides.weebly.com/types-of-landslides.html)

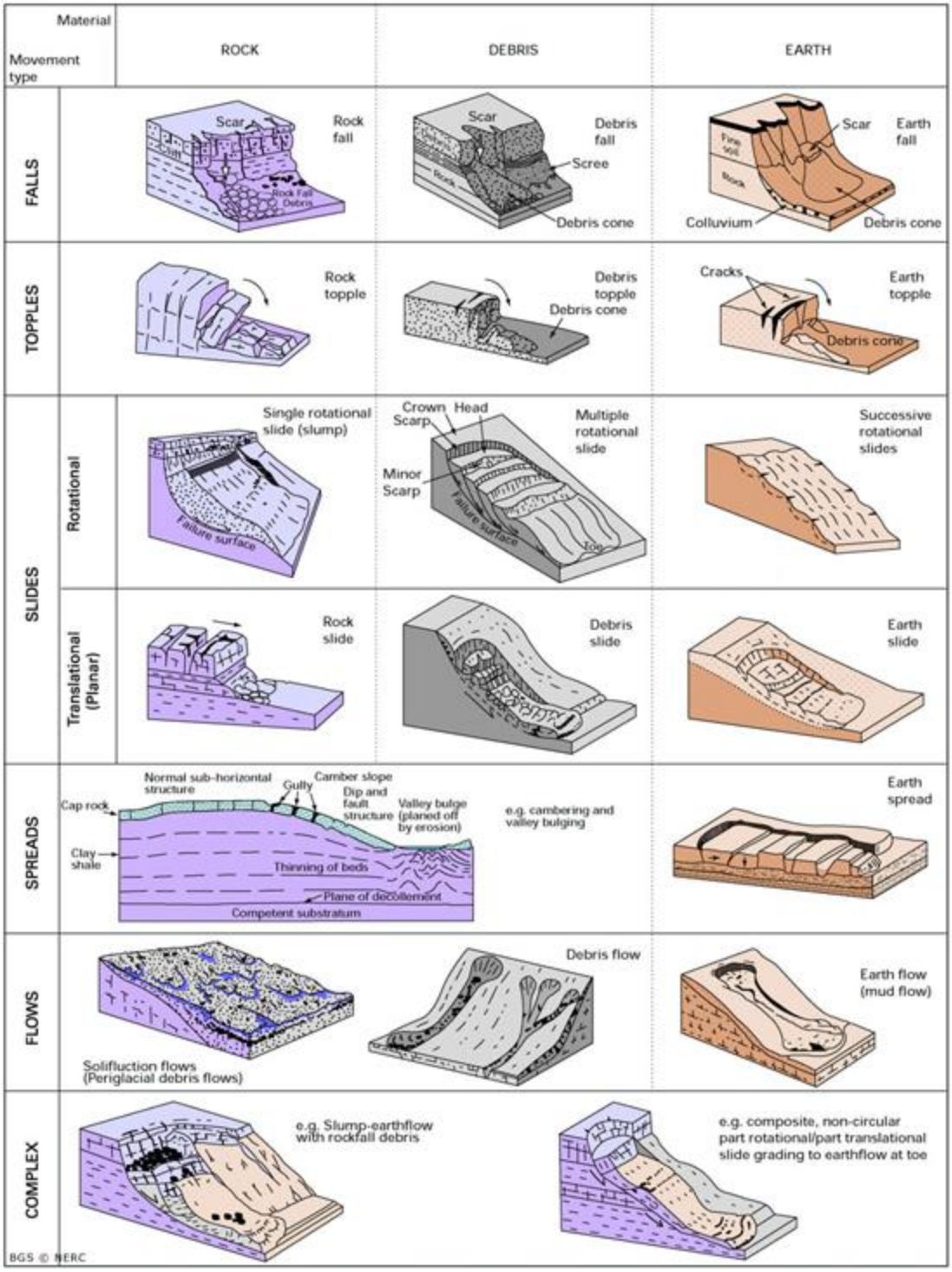

Figure 2 – Further Landslide Categories (USGS Fact Sheet 2004-3072, July 2004, https://pubs.usgs.gov/fs/2004/3072/fs-2004-3072.html)

One of the challenges with landslides is that they may remain relatively stable for long periods of time, and movement may start and stop over a period of years or decades. This often allows vegetation such as trees and shrubs to regrow over slide areas, hiding the slide risks to the average citizen.

There are many different engineering methodologies that can be used to mitigate landslide risks. Methodologies are very site specific and are based on detailed assessments. This assessment work often contains detailed air photo analysis, site visits and observations, LiDAR surveys, shallow pit and deep drilling soils sampling, including laboratory testing of soils. Mitigation methods are often costly and include buttressing, dewatering slopes, and constructing retaining walls. As with any natural disaster, no methodology can reduce the risk to zero. The safest solution to risk reduction is to avoid the hazard as much as possible by directing development, construction, and human activities away from hazardous areas.

Due to a combination of the complexity, activity, private property ownership, and intensity of development, the areas of landslide hazard in the CRD of greatest note surround (and include) the cities of Williams Lake and Quesnel. The landslide hazard areas are shown and discussed briefly in the September 12, 2019 Committee of the Whole report (attached).

Figure 3 – Head and toe of rotational landslide often creates bump on roads – Hwy 97 @ Cottonwood River. A similar bump commonly appears at toe of Hodgson Rd slide on Hwy 20 in Williams Lake. (Source – Quesnel Observer & MyCaribooNow.com)

Quesnel Fringe Area Landslides

The Quesnel Fringe Area has a history of numerous active landslides, mainly in the areas of the escarpments and slopes surrounding the confluence of the Quesnel and Fraser Rivers. This includes areas such as Red Bluff, Quesnel Canyon, West Fraser, West Quesnel, and Bouchie Lake.

The 2009 AMEC Report is the most recent area-wide report, commissioned as part of the Quesnel Fringe Area OCP update. The report is based on a desktop study and classifies slide areas in the Quesnel area as active or steep slope. Steep slopes and active areas can overlap.

The areas of known landslide activity in the Quesnel area have recorded annual movement in the range of 300 mm to 900 mm (11.8 in. to 35.4 in.) horizontally and 100 mm to 250 mm (3.9 in. to 9.8 in.) vertically, although larger movements (up to 4.9 m.; 16 ft. in one instance) have been observed. Major areas include the Knickerbocker/Wells Rd/Old Dump Site landslide complex, the West Quesnel complex,

and the West Fraser Road slide. These areas are actively monitored, a project primarily led by FortisBC. Semi-annual update meetings are held regarding these active areas with participants from utility providers (FortisBC, BC Hydro, MOTI) and the City of Quesnel and CRD staff. It has been observed that movement generally increases during or after wetter seasons and years.

During the 2020 spring freshet, landslide activity has increased in the Quesnel area. Known areas of increased activity include the Red Bluff slide complex, the Baker Creek slide complex, and the Knickerbocker/Wells Rd/Old Dump Site complex. For the CRD's emergency operations centre, this resulted in a number of evacuation orders and alerts in the area.

Previous Quesnel Landslide Reports

In approximately the 1980's the Ministry of Transportation and Infrastructure (at that time likely named Department of Highways) commissioned a report on the slide areas within the Quesnel and surrounding area. The report was used by the Ministry of Transportation and Infrastructure when considering subdivision approvals. Our records indicate that CRD staff began relying upon this mapping in the late 1990's when issuing building permits. If properties were within the identified hazard areas, geotechnical reports were required prior to issuance of a building permit. This process was formalized into bylaw with the adoption of the current Quesnel Fringe Area Zoning Bylaw No. 3504 in April 2000.

Upon update of the 2012 Quesnel Fringe Area Official Community Plan, Development Permit requirements were implemented, and the Sensitive/Hazardous designations removed from the zoning bylaw as it was more comprehensively regulated in the new OCP.

Williams Lake Fringe Area Landslides

In the lead up to the Williams Lake Fringe Area OCP, the CRD partnered with the City of Williams Lake in 2006 to commission Golder and Associates to develop a geotechnical study of the area, identifying areas of landslide related risks. Land within the plan area was assessed in a similar methodology to the 2009 AMEC report, relying primarily on air photo interpretation, with some field confirmations. Detailed and intrusive (i.e. digging or drilling) investigations were not part of this study. The 2006 Golder and Associates report broke down the risk areas as Moderate – Ancient Landslide areas, High Risk – Active Landslides, steep slopes, rolling rock hazards, and detailed assessment of the Williams Lake River Valley escarpments. Major slide areas include the Westridge/Hodgson Road slide, South Lakeside slides, and Russet Bluff slides. Ancient landslide features were also identified in the Chimney Valley area.

As with the Quesnel area, FortisBC has been leading ongoing monitoring of the main Williams Lake slide areas, including Hodgson Road, Westridge, and Dog Creek areas.

Other Known Slide Areas

There are two other slide areas that the CRD is aware of, where geotechnical reporting has been conducted, in the Soda Creek Road area and Marguerite Ferry area of Hwy 97. These areas are not within OCP areas and as such are not designated for Hazardous Area Development Permit requirements.

CRD staff rely upon Section 56 of the *Community Charter* to require site-specific geotechnical assessments prior to issuing Building Permits in the area (see discussion on regulatory tools for further information).

Existing Landslide Regulations

Within the CRD, landslide risk is primarily dealt with through Development Permit areas, identified in Official Community Plans. The areas are identified based on the existing studies described above. In areas outside OCPs, staff would rely on the Building Inspector's ability to note signs of active land movement (keeping in mind building inspectors are not land stability experts). In areas outside building inspection, there is no current practice in identifying or requiring geotechnical assessments prior to construction or use of land.

Flood Hazards

Like landslides, flooding can be broken down into different types (see Figure 4). The common flooding types experienced in the Cariboo are listed below:

River (fluvial) flooding: rapid thaw or heavy rain causes rivers to overtop their normal banks and inundates their floodplain.

Surface Water (pluvial) flooding: heavy rain or high water levels overwhelm drainage systems, preventing water from draining away. In the Cariboo this is usually the result of culverts reaching capacity, backing up water, and the road through which it must pass begins to act as a dam.

Groundwater flooding: water table in permeable rocks and soils rises and enters basements and cellars. In the Cariboo this is usually experienced with high water levels on lakefront (and occasionally riverfront) properties.

Flash flooding: intense rainfall causes waters to rise quickly and flow at high speed for a short period of time.

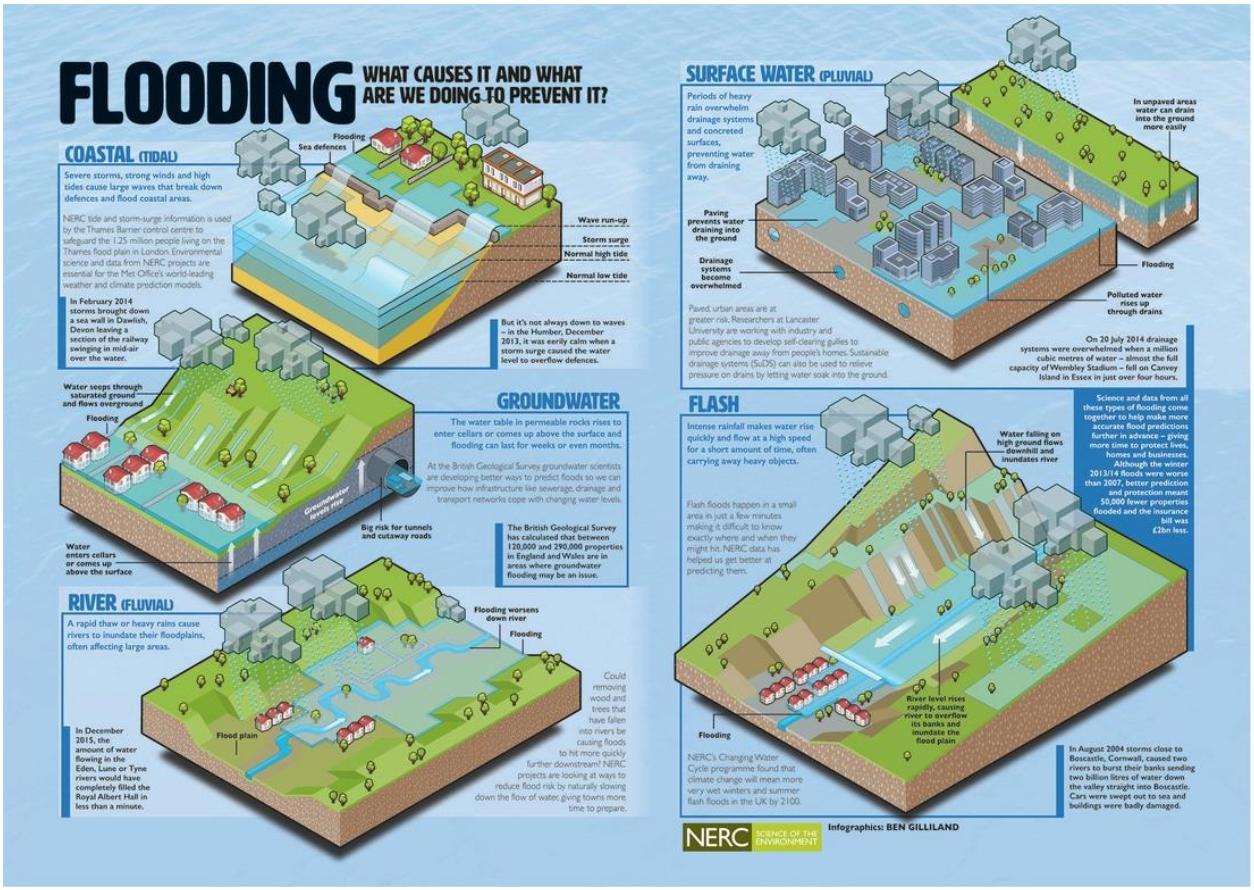

Figure 4 – Flooding Types (Ben Gilliland – Natural Environment Resource Council https://www.bengilliland.com/the-blog/beware-the-flood)

Also associated with high water or rain events are debris floods and debris torrents:

Debris Torrent: Debris torrents most often occur where landslide debris gets funnelled into a gulley and creates a highly hazardous, high velocity flow of rocks, boulders, mud and other debris which can cause significant damage downstream.

Debris Flood: A debris flood is similar to a debris torrent, but with lower velocities and usually where high water levels scour debris from a channel, rather than triggered by a landslide. This is possibly what caused the damage to a property on Pigeon Road in 150 Mile House during the 2020 spring freshet.

Flood levels are often referred to in "return periods" i.e. a 100-year return period. This is a probability statement and refers to any given year having a 1 in 100 (or 1%) chance of seeing a flood level of a specific height. For example, a 1 in 100 year flood can occur in any year or even two years in a row (a 1% chance of occurring each year).

Recent Flooding Events Examples

Below are some examples of types of flooding experienced during the 2020 freshet.

Figure 5 – River (fluvial) flooding of San Jose river floodplain. CN Rail line cutting through flooded area. (Photo Credit – CRD)

Figure 6 – Water flow exceeding culvert capacity, backing up water and causing flooding. (Photo Credit – CRD)

Figure 7 – During and after images of debris flood in 150 Mile House area. Gravel deposits of approximately 4-12 ft. across property. (Photo Credit – CRD)

Existing Flood Reports in CRD

Limited floodplain mapping has been conducted in the CRD. In the mid 1990's the provincial government conducted floodplain mapping for Williams Lake, and the Fraser and Quesnel Rivers in the vicinity of the Quesnel area only.

The CRD in partnership with Fraser Basin Council and TNRD, received Federal grant funding in 2019 to conduct base level flood mapping for portions of the Thompson River watershed. Only a relatively small portion of the Cariboo is within the Thompson River watershed (Bridge Creek watershed, into Canim and Mahood Lakes). The final reporting for this project was received at the end of April 2020 and is being reviewed by staff. This is an intermediate level of flood risk identification, more detailed than a screening level, but less detailed than full flood hazard assessment.

Existing Flood Regulations

Currently, flood protection regulations are addressed through the Zoning and Rural Land Use Bylaws. Setbacks are generally 7.6 m horizontal distance from the natural boundary of a lake, and 1.5 m. elevation above the natural boundary. On lakes over 15 km in length, a higher 3.0 m elevation is required. Watercourse (i.e. creek) setbacks are 30 m. and 3.0 m. elevation. Where the elevation (height) from a watercourse can be increased to 6.0 m., the horizontal setback can be reduced to 15 m.

As detailed flood mapping for all lakes, watercourses, and waterbodies within the CRD would be incredibly onerous and costly, the above setbacks were established as a "catch all" best practice to set reasonably conservative setbacks in alignment with provincial best practices. Detailed flood mapping has not been conducted and as a result there is some risk in knowing whether or not these setbacks are adequate for all conceivable flood events. The Zoning and Rural Land Use Bylaws further allow for site specific assessments by a qualified professional to determine the actual 200-year flood elevation for a specific site. This option is usually quite costly and is rarely pursued by residents/developers.

Available Land Use Protection Tools (for both Landslides & Flooding)

It is important for local governments to consider the protection of its residents and land users from hazardous conditions. There are a number of legislative tools available for local governments to enable these protections described below.

Development Permits

Division 7 of Part 14 of the *Local Government Act* provides for local government to identify Development Permit Areas for various types of development, one of them being the protection of development from natural hazards (this can include flooding, landslide, wildfire, and others). The local government must identify the areas and situations where Development Permits are required, and the requirements that must be met prior to issuance of the Development Permit.

Development Permit Areas and Guidelines are most commonly outlined and identified in Official Community Plans, however, local governments can specify Development Permit requirements within Zoning Bylaws (and Rural Land Use Bylaws, where they still exist, such as within the CRD). Currently, the CRD relies upon Development Permit areas for landslide hazard areas within the Quesnel Fringe Area OCP, Williams Lake Fringe Area OCP, 150 Mile House Area OCP, and South Cariboo Area OCP. The CRD does not presently utilize Development Permit areas for flood protection, but relies upon setbacks prescribed in the Zoning and Rural Land Use Bylaws.

The authority to issue Hazardous Area Development Permits is often delegated from the local government Board to staff. It is good practice as these permits are technical in nature and rely on the recommendations of qualified professionals (rather than Form & Character Development Permits, which are largely aesthetics-based and somewhat subjective in nature).

Details regarding the natural hazard risk are not always obvious to property owners or potential property owners when identified as a Development Permit area. As practice in the Cariboo (and elsewhere in BC) realtors tend to focus on property zoning information when dealing with property. It is not always known by realtors and property owners to check the OCP for information regarding potential

property hazards and additional permit requirements. The CRD has made ongoing efforts to inform property owners of these areas with informational handouts, and by posting the areas on large maps in the sub-offices.

When a geotechnical assessment is completed for a property, as part of the Development Permit process, only a notice of the existence of a Development Permit is registered on the property title. It is up to the property owner or potential purchaser to inquire with Regional District staff as to the particular details of the permit (the same notice is placed on title whether it is a hazardous area DP, another DP, or a DVP). This again is a section on the property title that is not always checked by realtors or even conveyancers in some cases when a property changes hands.

Zoning/Rural Land Use Bylaw – Water Setbacks

Section 479 of the *Local Government Act* allows for the specification of different setbacks for different locations and types of development. Through this authority, the CRD specifies setbacks from watercourses and waterbodies (discussed earlier in this report). Water setbacks specified in a zoning bylaw can be varied through a normal development variance permit process, which requires Board consideration. By varying such setbacks, the CRD takes on an element of risk (see Corporate Risk section below for further discussion). The practice of specifying flood protection setbacks in a zoning bylaw is generally an older practice and if the intent of the jurisdiction is to protect development from flooding, then it is better to utilize floodplain bylaw provisions (discussed below).

Floodplain Bylaws

Floodplain bylaws can be established under Section 524 of the *Local Government Act*. This is similar to specifying water setbacks in a zoning or rural land use bylaw, however, has specific requirements and implementation procedures outlined in the *Local Government Act*. It specifies a procedure to waive or amend the requirements, based on receipt and consideration of a professional report. It also allows the local government to rely upon Provincial guidelines when considering waiving or amending floodplain bylaw requirements. Provincial guidance recommends that floodplain bylaws are utilized rather than setback provisions specified through zoning/rural land use bylaws.

Section 56 Community Charter & Site-Specific Professional Reports

In areas subject to local government building bylaw regulations (i.e. Building Inspection Areas within the CRD), the Building Inspector can require a professional report if they consider the land is subject to or likely subject to flooding, mud flows, debris flows, debris torrents, erosion, land slip, rockfalls, subsidence, or avalanche. The report must determine that the land may be safely used for the use intended, and must be registered as a restrictive covenant on title.

This is a good tool which allows for the Building Inspector to ensure that construction is safe in areas where there may be concern. The challenge with this tool is it relies on the discretion and knowledge of the Building Inspector to identify potentially complex geotechnical or flooding risks (not what a building

inspector is specialized in). Further, the Building Inspector is generally not on site to observe warning signs of instability until footings are framed, which is well into the development phase of a site. This tool is best utilized as a sort of last resort catch in situations where the Regional District either has pre-existing knowledge of hazard areas (such as Soda Creek Road area) which aren't identified as Development Permit areas, or in areas where no known hazard exists until the inspector is on site. This tool cannot be utilized in areas where there is no Building Inspection service.

Section 219 Restrictive Covenants

Section 219 Restrictive Covenants are utilized as part of different processes in regulating development in areas subject to landslide or flooding risk.

At subdivision stage, the Provincial Subdivision Approving Officer (PAO) can require restrictive covenants in landslide hazard areas, which specify that a detailed geotechnical assessment is required prior to construction of a structure. They can also specify areas safe for construction and specific construction measures that may be required at time of construction.

Often at subdivision stage, the Provincial Subdivision Approving Officer requires setbacks from watercourses and/or water bodies. They often add the CRD as an additional signatory to the covenant. Issues have risen in the past where the PAO specifies setbacks that are less than those required in CRD Bylaws.

If a professional report is required by the Building Inspector under their authority of Section 56 of the *Community Charter* (discussed in previous section), a restrictive covenant containing the details and requirements of the professional report is registered on title of the property. The strongest benefit of a Section 219 covenant is that it clearly shows on a property title and the related documents are easily accessible to the public through realtors, land surveyors, property lawyers, and the BC Land Titles and Survey Authority website.

Future Considerations & Discussion

A number of topics for Board consideration and discussion are briefly introduced below.

Increased Frequency and Intensity of Hazardous Events

The CRD should be aware of and prepared for more frequent, more intense, and larger natural hazard events as a result of climate change. This trend is already being observed over the past ten years. Landslide and flooding events are further compounded by wildfires, as soils are less able to absorb moisture in these areas, and higher snowpack accumulates due to a reduction in tree cover.

Further events witnessed on an increasingly frequent basis:

- Melting over frozen land (beginning of 2019 freshet event; can also occur during warm spells in mid-winter)

- Greater intensity and frequency of cloudburst storms (such as 2018 Chilcotin event)
- Prolonged dry seasons with greater risks of wildfire, extending later into the year (Oct/Nov)

Inadequate Infrastructure

Due to increasing intensity and frequency of rain events, culverts are often found to be undersized for managing water for such events. What was found during the Spring 2020 freshet, is that as culverts back up water, the road often acts as a dam and backs up water, impacting residents. The extent of the road network and number of culverts throughout the CRD significantly exasperates this challenge. Although technically possible, it would be very challenging to accurately calculate the flow capacity of each culvert in the region and determine if it is adequately sized based on the upland drainage area.

Review Existing Reports/Known Areas of Risk

The existing geotechnical reports in the Quesnel and Williams Lake areas were based primarily on air photo interpretation and are subject to some variability in accuracy. In more recent years, LiDAR has become a common tool in providing much greater detail and accuracy in landslide risk assessments. LiDAR is a form of imaging that is commonly flown with an airplane and is able to provide an accurate and detailed representation of the ground without vegetation (see Figure 8 as example). LiDAR imaging can provide better detail around determining locations of unknown landslides as well as better accuracy in determining the boundaries of hazardous areas.

There would be substantial cost for comprehensive LiDAR mapping throughout the region and partnering with provincial agencies (such as MOTI) who may already have LiDAR data in some areas, along with applications for Provincial and Federal funding would be required to move forward with such projects.

The Board may wish to consider moving towards conducting a broad study to prioritize identification of flood and landslide hazards across the Regional District. Further detailed assessments would then be required based on the prioritization that results from an initial overview study.

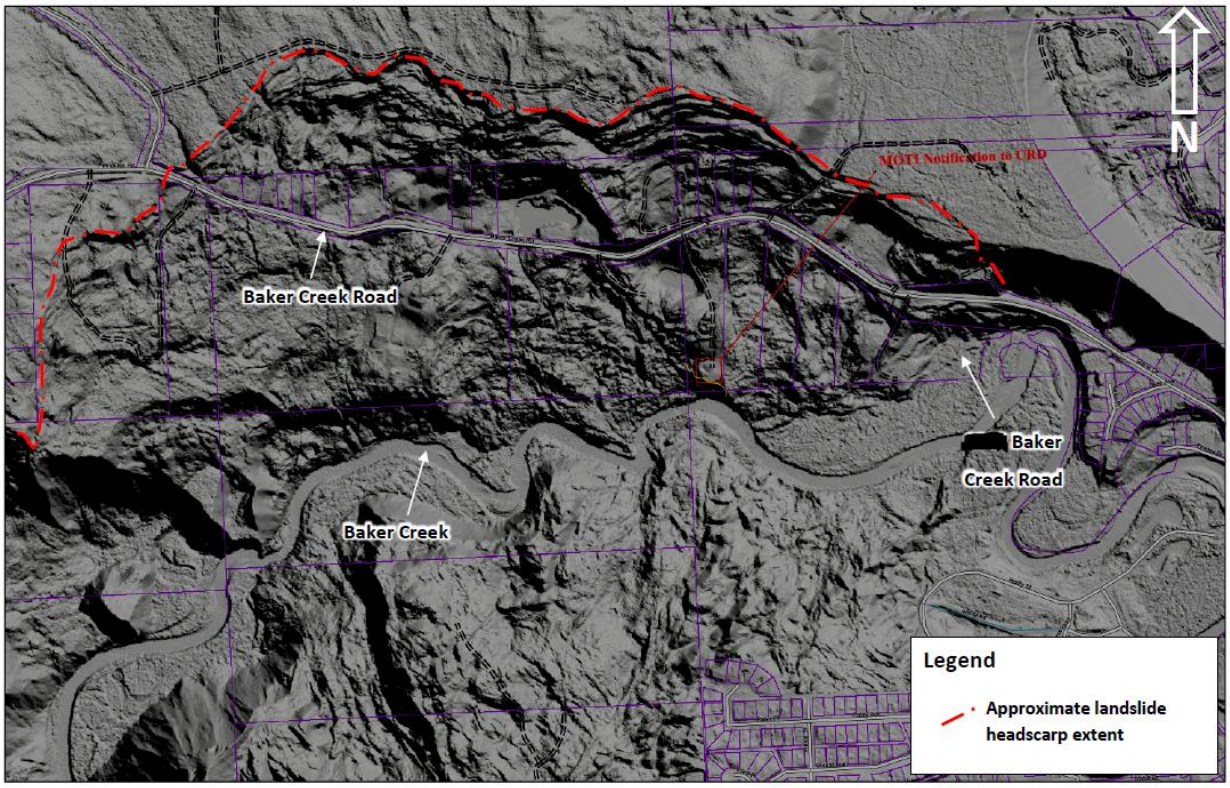

Figure 8 – LiDAR example of Baker Creek Slide complex.

BC Emergency Program Act

Provincial revitalization of the Emergency Program Act (EPA) may have impacts on long range planning and development approvals for local governments in areas subject to natural hazards. In the provincial discussion paper, reference was made to ensuring/increasing local government responsibility to identify areas of risk, as well as increase mitigation requirements for development in known hazardous areas. Staff will be monitoring these developments closely, both for potential impacts on emergency operations and preparedness, but also on long range planning and development approvals.

Corporate Risk

There is an element of corporate risk of lawsuit when there is a reliance upon third party professional reporting (i.e. engineering reports) when issuing permits to construct in potentially hazardous areas. Third party reports must be carefully reviewed to ensure they adequately assess the risk on a particular property. The quality of reports received from third party professionals can vary considerably which challenges staff in ensuring that sound decisions are made. Although the risk of poor geotechnical or flood assessment reporting initially falls on the professional writing the report, if a disaster occurs, the professional's liability insurance usually only goes so far, and a risk extends to the local government in ensuring there was a duty of care to confirm that the report was adequate to make a reasoned decision.

When issuing variances to flood elevations, even when a save harmless covenant is signed, the local government still takes on some risk, whether through a duty of care argument or through general long term impacts should the development ever be impacted by future events (i.e. flooding, landslide, etc.).

The CRD has an obligation under the *Freedom of Information and Protection of Privacy Act* (FOIPPA) to inform landowners where information is received by the CRD of a known risk on properties. This process was completed for the Soda Creek Landslide, the recent landslide events during the 2020 freshet event, and is underway for the Marguerite slide area.

Conclusion

It is prudent to take a high level, long term approach when considering development in areas subject to natural hazards within the Regional District. Reliance upon third party reporting does not necessarily absolve a local government from liability. Further, by allowing development in potentially risky areas, it compounds the effects on overall community well-being during and after a natural disaster. An ongoing, concerted effort should be made to direct development outside areas of risk, rather than focusing on finding mitigative measures and ways to approve construction within areas of risk. By directing development outside areas of risk, the overall impact on communities will be reduced during extreme weather events and natural hazards.

Recommendations

Pursue further federal funding to prioritize areas for further assessment (conduct flood/geotechnical hazard at the screening level across the RD to prioritize areas for more detailed study). Preliminary priorities recommended based on previous events and building inspection includes: Nazko area, Quesnel River, Horsefly River, Quesnel Fringe area, Bridge Creek, Green Lake, Watch Lake, Horse Lake.