Forest Practices Board

# Laird Creek Landslide

*Complaint Investigation 111006*

**FPB/IRC/186**

February 2013

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# Board Commentary

This investigation looked at a landslide into Laird Creek that caused damage to the water supply of about 100 homes. The slide was caused by a combination of factors, including logging by the BC Timber Sales program that occurred in the area prior to 2007.

The legal framework for forestry in BC permits forest licensees to exercise discretion in their forestry practices as long as they achieve the required results. In order to do this—and to protect public interest on Crown land—licensees rely on qualified professionals to plan and oversee their practices and on strong government enforcement.

However, the law also recognizes that timber development can create risks to other values, such as water, and that sound forestry practices can reduce but not eliminate this. Should a situation occur whereby a forest licensee causes an unintended impact on a resource value, the forest licensee may be deemed not to have contravened the law if it can demonstrate to the government that it exercised due diligence (i.e. demonstrates that he or she exercised due care to avoid contravening legislation).

The Board investigation found that BCTS's operational and technical practices were sound. Overall the Board finds that BCTS acted in a responsible manner after the slide event, though there was no legislated requirement for it to do so. BCTS conducted appropriate assessments; implemented the recommendations; stabilized the road and slide path; helped water users get their systems running; and, ensured water users had access to potable water.

Since the landslide occurred, BCTS has developed a terrain stability model that sets out standards for professionals involved with terrain stability to adhere to. The model includes a decision matrix tool to assist professionals in customizing the evaluation of key risk aspects that may be associated with the development area beyond those provided by a standard terrain stability assessment (TSA).

It is the Board's view that there are opportunities to improve operational and technical processes, which may reduce the risk of a landslide event in similar situations. In areas where there are significant resource values at risk, licensees should:

1. Involve specialists at the operational level early enough in development planning to ensure road and cut block planning and layout work is informed by adequate assessments.
2. Have one specialist undertake a comprehensive integration of multiple assessments to establish overall risk before deciding if development should proceed and what strategies to incorporate into operational activities.
3. Prior to development, undertake a systematic, transparent and well documented decision-making process that shows appropriate consideration of the potential impacts of harvesting, silviculture systems and roads on the risks to public and third party interests before proceeding.

4. When conducting an assessment following an event such as a landslide, endeavour to conduct the assessment in a manner that will avoid any perception of bias.

It may also be useful to review the forest sector guidelines[i] for professionals, produced by the Joint Practices Board of the ABCFP and APEGBC, which speak to similar issues. In particular, the guidance on communication among professionals and specialists in the forest sector crossings guideline is also relevant to this type of situation.

In a system based on discretion, professional reliance and strong enforcement, there needs to be a high level of transparency—not only must the public interest be kept, it must be seen to be kept. The Board encourages the government and professionals to ensure this occurs.

Also, the Board is concerned that even with sound technical practices, risks taken by one resource user can harm another, something the Board has identified in previous reports and that may occur more often as multiple resource use increases on BC's Crown land.

This case brings to light broader issues regarding public policy and decision making, including potential gaps in regulation that go well beyond this specific instance, and the Board will examine those concerns separately, drawing on the results of this and other recent audits and investigations.

# Executive Summary

In May 2011, there was a landslide into Laird Creek, which flows into Kootenay Lake. The slide was caused by a combination of factors, including historical logging.

Between 2004 and 2007, BC Timber Sales (BCTS) in the Kootenay Lake Business Area developed an area above Balfour, on slopes draining into Laird Creek, an inherently unstable watershed that provides domestic water to over 100 homes.

In 2004, the Board investigated a complaint about the development above Balfour and found that the licensee's development planning adequately addressed slope stability issues in the area.

In October 2011, the Board received another complaint, this time about a landslide that affected waterworks in the area by plugging water intakes and introducing suspended sediment to water systems. The Board was asked to examine three aspects of the incident: whether danger to the water supply was adequately addressed; whether a lack of due diligence or flaws in regulation contributed; and, what could be done differently to prevent a recurrence.

The Board found that BCTS understood water licensees' concerns and tried to address potential impacts of forestry activities on water quality in its operational planning and development.

BCTS:

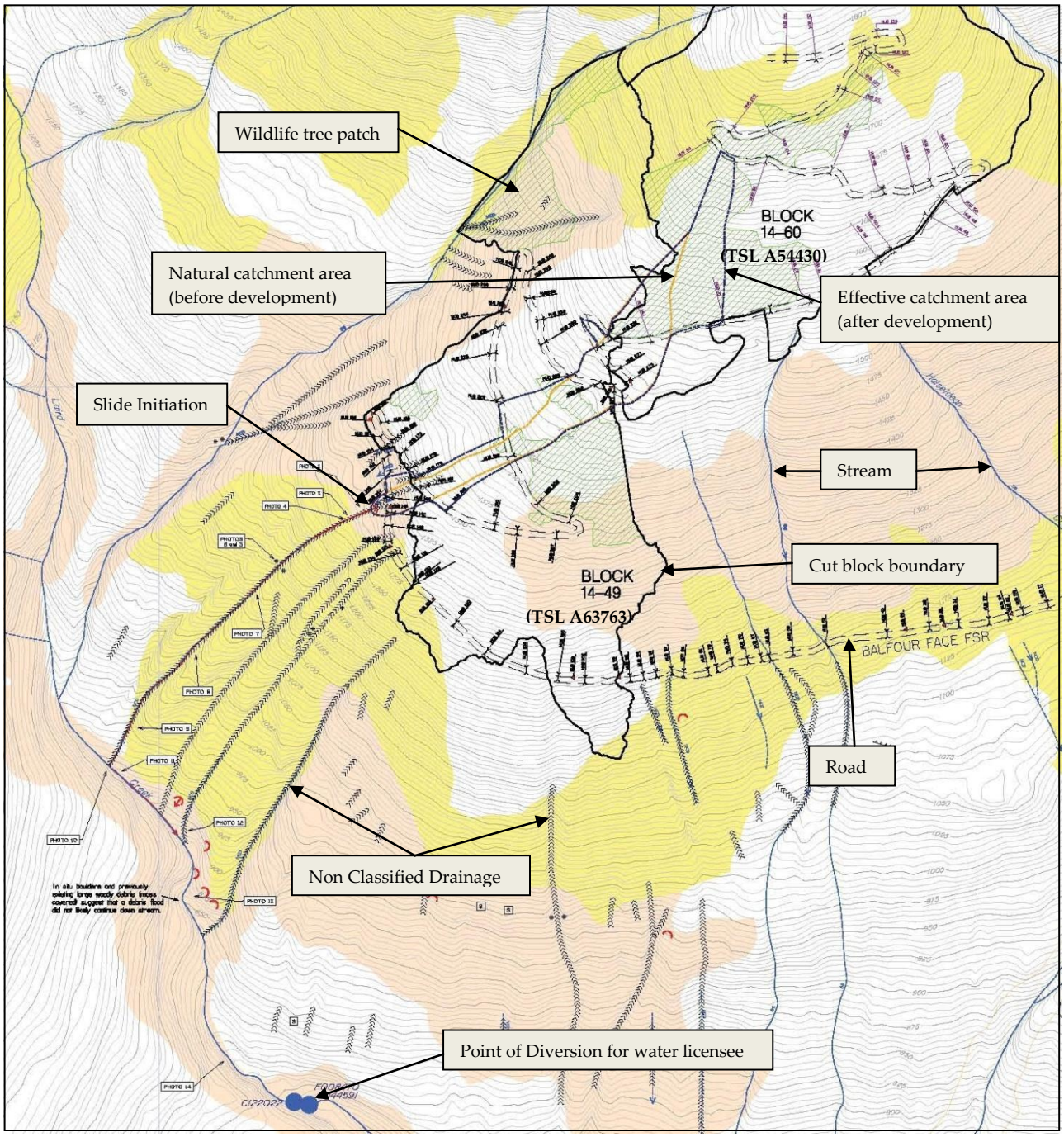
- Coordinated the layout and used qualified professionals with expertise in terrain stability, road engineering and hydrology to conduct assessments.
- Prepared a drainage plan and made recommendations on how to carry out operations.
- Assessed the risk associated with development and determined when and how development would proceed.
- Closely monitored road construction.
- Maintained natural drainage patterns.
- Minimized soil compaction and disturbance during harvesting.
- Maintained and inspected the road following harvesting activities.

It appears that BCTS used a regular road maintenance program to deal with landslide risk, and no indicators of the pending slide were detected.

In July 2011, an assessment was completed that indicated that the landslide resulted from a combination of weather conditions and forestry related activities. It made recommendations to mitigate the risk of another landslide, which BCTS implemented. BCTS further helped water users affected by the landslide by providing them with potable water and assistance in cleaning out their intakes.

In the Board's view, BCTS took the operational measures reasonably expected to address potential impacts of unstable terrain, high road densities and harvesting activities on water quality. It followed the advice of forest professionals and other specialists in conducting assessments and implementing suitable operational practices.

## OVERVIEW OF BALFOUR FACE DEVELOPMENT



# Introduction

## The Complaint

BC Timber Sales (BCTS) in the Kootenay Lake Business Area developed an area above Balfour on slopes draining into Laird Creek. Road construction was completed in September 2005 and logging was completed in September 2007. However, a landslide that initiated in TSL A63763 in May 2011 reached Laird Creek and negatively affected licensed waterworks in the area.

The Forest Practices Board (the Board) received a complaint in October 2011, requesting a Board investigation to determine how BCTS' development process failed to protect water values and the public interest. In particular, the complainant requested the Board determine whether:

- the dangers associated with unstable terrain, high road densities and high levels of harvest were adequately addressed;
- there was a lack of due diligence or flaws in the regulatory regime that contributed to the landslide; and
- there is anything that can be done differently in the future to minimize the likelihood of something like this happening again.


*Arrows point to same feature.*

## Background

Laird Creek flows into the West Arm of Kootenay Lake near Balfour, about 33 kilometres east of Nelson. Government has issued 84 water licenses on it, with 63 for domestic use serving over 100 residences, but has not classified the area as a community watershed.

The area has a history of natural disturbance events. Terrain mapping completed in 1997 identifies 23 historic landslides, and natural flood events disrupted domestic water supplies in 1948, 1956, 1972 and 1999. As well, Laird Creek also experiences elevated levels of turbidity for two to six weeks during annual spring freshet.

BCTS proposed development on an area above Balfour (called the 'Balfour face') and laid out two cutblocks in 2003 and 2004 to salvage dead and dying lodgepole pine. The lower cutblock was located on 'gentle over steep' terrain.[1]


[1] Gentle over steep is where there is gentler ground above steep, unstable or potentially unstable terrain.

In its 2004 planning, BCTS used specialists[2] with expertise in terrain stability, engineering and hydrology to conduct three assessments for the proposed cutblock, TSL A63763:[3] a hydrological assessment[ii] for the development area, a terrain stability assessment (TSA) for the cutblock, and a TSA for the roads.[iii] The assessments were completed after the cutblock and roads were laid out and recommendations to reduce the risk of the proposed development on the water resource were provided.

The assessments were reviewed in 2004 by a research geomorphologist and research hydrologist working for the forests ministry (now the Ministry of Forests, Lands and Natural Resource Operations—MFLNRO) in the Kootenay Boundary Forest Region (formerly the Southern Interior Forest Region). The review identified several concerns, including the overall road density in the cutblock.

BCTS reviewed the assessments and deleted approximately 20 hectares along the northwest boundary of TSL A63763 to avoid unstable terrain; however road locations were not changed.

BCTS held meetings with user groups and specialists from government and the private sector to share information and to review the proposed development. In October 2004, a group of concerned citizens, the Laird Creek Water Users, filed a complaint[4] with the Board about the proposed development on the Balfour face. The Board investigated and found that the development planning adequately addressed slope stability issues. However, the investigation process did result in BCTS completing a drainage plan[iv] in July 2005 for the road accessing TSL A63763.

*Cable harvest portion of TSL A63763.*

Roads were constructed in 2004 and 2005 and followed the road design and drainage plan. Harvesting of the lower block, TSL A63763, occurred between November 2005 and July 2006 and the upper block, TSL A54430, was harvested between May and September 2007. Road maintenance included installation of waterbars, annual clearing of the ditches and drainage structures and formal and informal road inspections.

Despite these precautions, a landslide occurred on May 11, 2011, and caused a debris flow that deposited approximately 2000 cubic metres of debris into Laird Creek. The landslide started on

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[2] For the purpose of this report, unless otherwise stated, specialist refers to those individuals with expertise in fields other than forestry and includes professional agrologists, engineers and goescientists.

[3] TSL A63763 is also referred to as Block 14-49 in some assessments.

[4] http://www.fpb.gov.bc.ca/publications.aspx?id=3026&terms=laird

unstable terrain[5] in standing timber on a non-classified drainage[6] (NCD) below the lowest road traversing cutblock TSL A63763. It travelled approximately 850 metres to Laird Creek. The total area of the slide is estimated to be half a hectare. Material and debris moved down the Laird Creek channel for approximately 600 metres, at which point the debris and disturbance associated with the slide dissipated. However, the increased turbidity and sedimentation associated with the slide plugged water intakes and introduced sediment to water supplies of licensed waterworks, which were a further 250 metres downstream. BCTS immediately took remedial measures by delivering potable water to water users and assisting with cleaning of intakes.

On May 12, 2011, BCTS brought specialists on-site to assess the slide. The assessment[v] was completed by the same consulting company[7] that conducted the road TSA and drainage plan. It identified the cause and contributing factors and provided recommendations to reduce the likelihood of a similar event in the future. Factors that contributed to the slide included:

- Increased effective drainage area of the NCD caused by the interception of subsurface flows by road cuts.
- Six stacked roads intercepting subsurface water and concentrating it into culverts.
- Slope gradients.
- Presence of clay in higher than typical amounts below the head scarp.
- Concentration of water to the head scarp.
- Near record snow pack.
- High snow melt rates caused by warm daytime temperatures and harvest openings.

BCTS implemented recommendations from the post-slide assessment: it regularly measured stream turbidity; reviewed the entire road system while snow was receding from the area and during snow free conditions; implemented enhanced seasonal deactivation measures; rehabilitated a portion of the Laird Creek Forest Service Road; and, completed a biological engineering assessment of the slide.

The Compliance and Enforcement (C&E) division of the MFLNRO opened a file on the slide but it has not yet determined if an investigation is warranted.

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[5] Unstable terrain includes unstable and potentially unstable terrain. Unstable terrain is areas where natural landslide scars are present and there is a high likelihood of landslide initiation following timber harvesting or road construction. Potentially unstable terrain is areas with a moderate likelihood of landslide initiation following timber harvesting or road construction. See http://www.for.gov.bc.ca/TASB/LEGSREGS/FPC/FPCGUIDE/terrain/index.htm

[6] A discontinuous seasonal stream. A watercourse must have a continuous channel bed of at least 100 metres, with observable scour or alluvial deposits.

[7] The geotechnical engineer that completed the road TSA and drainage plan was not involved with the post slide assessment. Another geotechnical engineer working for the same company completed the assessment, which was peer reviewed by an independent professional engineer.

# Discussion

The damage to the water quality in Laird Creek was a direct result of the landslide. The *Forest Planning and Practices Regulation* (FPPR) requires that a licensee (BCTS in this case) must ensure that the primary forest activity[8] does not:

- cause a landslide that has a material adverse effect on water quality (Section 37);
- cause material that is harmful to human health to be deposited in, or transported to, water that is diverted for human consumption by a licensed waterworks (Section 59); or,
- damage a licensed waterworks (Section 60).

Ensuring that forest practices do not cause a landslide requires some form of proactive management to minimize that likelihood. Therefore the Board's investigation considered BCTS's planning and implementation processes. Specifically, the Board looked at:

1. How BCTS addressed unstable terrain, high road densities and harvesting when developing the Balfour face.
2. Whether BCTS addressed the recommendations in the professional reports.
3. Whether there are opportunities for improvement.

## How BCTS addressed unstable terrain, high road densities and harvesting when developing the Balfour face

***Planning Overview***

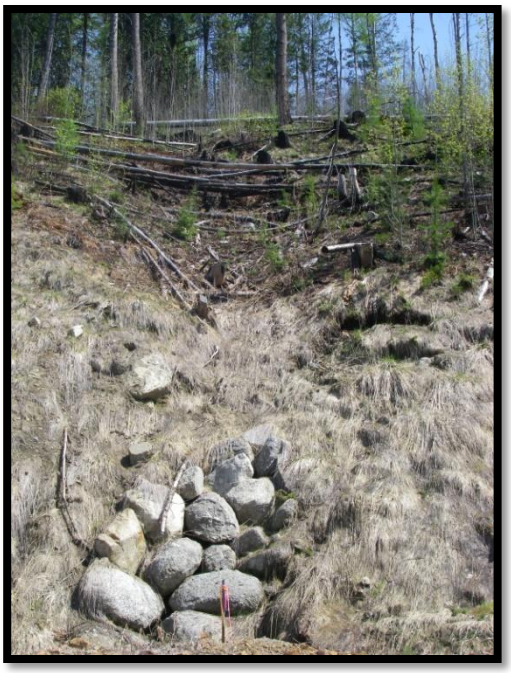
Laird Creek is within the West Arm Demonstration Forest (WADF), which covers 13 500 hectares on the north shore of Kootenay Lake. WADF was established in 1992 with the intent to manage the land base in a way that protects identified resource values. In 2000 the WADF working committee prepared a strategic plan for managing the demonstration forest. The WADF strategic plan recognizes water as the highest priority resource in the area; however, the plan is a guidance document only and is not enforceable.

Safe drinking water is a critically important resource to the people of British Columbia. Managing the quality of water used for domestic consumption is a shared responsibility between government, water licensees and tenure holders working within the watershed.

Licensees use forest professionals to plan, advise and carry out complex tasks to achieve the interests of their employers and the public. Forest professionals in turn rely on specialists to conduct assessments of proposed development and to provide recommendations on operational activities.

[8] Primary forest activity means one or more of (a) timber harvesting; (b) silviculture activities; (c) road construction, maintenance and deactivation.

The development of the Balfour face targeted mountain pine beetle infested stands. BCTS developed a 37.5 hectare cutblock, consisting of harvest area and roads, on the gentle over steep terrain above Laird Creek using a number of in-block switchbacks to facilitate harvesting. However, this type of development is highly susceptible to landslides[vi] and so BCTS needed to consider the impacts of forest cover removal and road location on both the hydrological process and landslide risk.



*NCD above road: armoured culvert and grass seeded for erosion control.*

BCTS completed layout using forestry field staff but hired specialists to assess proposed roads and cutblock locations after layout was complete. These assessments identified risks and made recommendations on how to carry out activities to minimize those risks.

Also, when the drainage plan was prepared, BCTS mapped the drainage boundaries of the major sub-drainages along the Balfour face. None of the approximately 20 small NCD[9] drainage boundaries within, or affected by, activities on TSL A63763 were mapped prior to development.

One of the main purposes of establishing drainage boundaries is to conduct quantitative hydrological analysis, such as watershed assessments or equivalent clearcut area[10] calculations, which are seldom done on small streams and less often on NCDs. Most often, small streams and NCDs are better addressed through detailed field assessments because impacts are usually site specific at this scale (e.g., erosion sites, potential impacts to springs).[vii]

The road system used in the Balfour face development is commonly used for steep mountainous areas. BCTS indicated that there were no other practicable options for the road location and in this instance it allowed roads to minimize the crossing of unstable terrain.

During road construction, natural drainage patterns were maintained but changes in drainage area and the removal of forest cover[11] changed the amount of surface water introduced into the natural drainages.[12] A change in drainage area occurs with most development, especially with regard to small streams or NCDs, and is primarily due to road construction intercepting subsurface water from one drainage area, moving it down a ditch line and introducing it to another drainage area. The post-slide assessment found that the development had increased the

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[9] Based on review of the map accompanying the Drainage Plan (2005).

[10] Equivalent clearcut area (ECA) is the area that has been harvested, cleared or burned, with consideration given to the silvicultural system, regeneration growth, and location within the watershed.

[11] Forest cover removal affects snow accumulation, and the timing and rate of snow melt. In general, reduction in forest cover results in annual water yield increasing and advancement in the timing of peak flows.

[12] Natural drainage refers to stream channels and well defined NCDs.

drainage area above the slide initiation point from 6 hectares to 10 hectares. The majority of this drainage area expansion occurred above the upper road in a wildlife tree patch.

The site plan (SP) for the cutblock noted that the integrity of the water supply used for domestic consumption would be maintained through a partial retention harvesting system, placement of reserve zones and careful diligence during road construction activities. The SP committed to retaining approximately 25 to 50 stems per hectare on-site following harvesting.[13] A review of the block in 2012 found that many of the retained stems were dead as a result of BCTS broadcast burning[14] the block following harvesting.

***Assessments***

BCTS addressed the overall impact of the development on landslide risk, and the potential impact on water quality, by having three specialists complete detailed assessments. Professional foresters and BCTS staff used the assessments to guide them when making decisions about how best to manage the landbase in order to minimize potential impacts to water quality and other resource values.

A 1997 terrain and soil inventory[viii] was used by the specialists in preparing the road, cut block and hydrological assessments to guide where and when more detailed on-site TSAs should be carried out. Terrain and soil inventories are conducted primarily from air photos with a limited amount of field verification. Because these inventories are not as detailed or accurate as TSAs, it is common for a TSA to be used to redefine the terrain and soil inventory polygons,[ix] which was done in some cases. Forest management decisions are based on the more detailed TSAs, rather than on the more general information provided by terrain mapping.

Fieldwork for the assessments occurred between June 20 and July 10, 2004 and the reports were published between July 30 and October 26, 2004. The three specialists used by BCTS worked independently. When using this approach, it is important that there be good communication between all parties and a comprehensive integration of multiple assessments, since some environmental impacts may result from the combination of individually minor effects of multiple factors over time. As a result, the findings of one assessment may affect the hazard risk and recommendations of other assessments.

BCTS encouraged the specialists to communicate with each other by reading each other's reports (drafts or final version) and to discuss any questions they may have prior to finalizing their own individual reports. However, though BCTS considered the assessments prior to finalizing development, there was no formal, overarching review of the multiple assessments by a specialist.

The hydrologic assessment identified a concern about the potential of the road to accumulate surface and subsurface water and redirect it such that it could destabilize downslope gullies.

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[13] The SP indicated an objective of retaining 10 $m^2$ basal area per hectare which converts to 50 stems per hectare of stems 50 centimetres in diameter and 35 stems per hectare of stems 60 centimetres in diameter.

[14] A controlled burn, where the fire is intentionally ignited and allowed to proceed over a designated area within well-defined boundaries, for the reduction of fuel hazard after logging or for site preparation before planting. Also called slash burning."(Ministry of Forests and Range Glossary of Forestry Terms in British Columbia March 2008).

The assessment recommended maintaining natural drainage patterns and avoiding concentration of flows.

BCTS approached the maintenance of natural drainage by using a professional engineer to complete a drainage plan and to implement the assessment's recommendations. The drainage plan identified drainage patterns and prescribed culvert size and locations.

All road systems concentrate water to some degree by intercepting subsurface water and moving it down a ditch line. BCTS tried to minimize concentrated flows by installing cross drain culverts to dissipate water away from the ditch line. How far water should be carried in a ditch before being diverted through a cross drain depends on a number of factors including water volume and velocity, soil types, hill-slope aspect, elevation, vegetation, rainfall intensity, the incidence of rain-on-snow events, and down-slope conditions.[x] In this instance, a geotechnical engineer prepared a road design prescribing the location and size of all drainage structures, and approved any variances to the design.

Following harvesting, BCTS installed waterbars on the road surface at locations prescribed by a geotechnical engineer to redirect water flowing on the road surface into ditch lines or onto fill slopes.

BCTS implemented the assessment recommendations, followed the drainage plan and installed waterbars after harvesting to address the cumulative impacts of roads and harvesting on landslide potential.

***Risk Ratings***

The underlying goal when making forest management decisions is to assess and manage risk against expected benefits—it is one of the most challenging aspects of forest management. Since risk management is directed at uncertainty related to future events, and outcomes it can be minimized but not eliminated, therefore the assessments must accurately describe risk to enable BCTS staff to evaluate proposed development.

**Table 1 Example of Risk Rating Matrix**

| | | Landslide Consequence | | |
|---|---|---|---|---|
| | | High | Moderate | Low |
| **Landslide Hazard** | V High | **VH** | **VH** | **H** |
| | High | **VH** | **H** | **M** |
| | Moderate | **H** | **M** | **L** |
| | Low | **M** | **L** | **VL - L** |

However, risk assessment is subjective and involves the process of determining hazard (the likelihood of the landslide occurring) and consequence (the impact of the landslide on a specific resource value, in this case water quality) (Table 1). The assessments completed on the Balfour face used three different, but accepted, risk rating methodologies[xi] when determining hazard, consequence and risk rating.

Specialists are familiar with the properties that affect the hazard but also recognize that it is difficult to assess hazard precisely, since they cannot see all the ground conditions; subtle drainage boundaries are hard to identify (especially NCDs); and, surface indicators do not always reveal subsurface conditions. All three specialists rated the hazard as low if recommendations were followed (Table 2).

| Table 2 Hazard, Consequence and Risk Rating for Three Different Assessments | | | |
|---|---|---|---|
| **Assessment** | **Hazard** | **Consequence** | **Risk** |
| Roads | Low | Low – Moderate | V. Low - Low |
| Block (if recommendations followed)* | Low | Moderate | Moderate |
| Block (if recommendations **not** followed) | Moderate - High | High - Very High | Very High |
| Hydrological | Low | High | Moderate |

*The Board believes that the recommendations in the block report were followed.

Also, though consequence was determined by the specialists, it is BCTS that is familiar with the resource values; history; expectations of other resource users; and, impacts should an event occur. In the case of the Balfour face development the consequence rating established by the specialists resulted in three different consequence ratings ranging from low to high. BCTS recognized that it should be establishing the consequence rating and in 2010 it formalized the process of determining and documenting a consequence rating by developing the terrain stability assessment decision and documentation tool for the Kootenay Business Area. This tool requires that a BCTS coordinating professional establish a consequence rating for resource values that may be at risk from proposed forest development. Water used for domestic consumption defaults to a high consequence.

Nevertheless, risk rating is an assessment of both hazard and consequence, so when either hazard or consequence changes, the risk rating may also change and if risk increases, measures to reduce the likelihood of an event happening may become more stringent. In this case, the risk rating established by the three assessments ranged from very low to moderate if recommendations were followed. Whether a different risk rating would have affected the recommendations in the assessments is uncertain.

BCTS staff reviewed the reports and, coupled with its own experience and local knowledge, plus an evaluation of the benefits and risks associated with the proposed development, determined that the risk was acceptable. In doing so, BCTS increased the risk to water users who ultimately had to bear the consequence of this decision. BCTS then established operational constraints to mitigate the increased risk.

***Findings***

- BCTS was diligent when planning the Balfour face. Appropriate assessments were conducted to address the unstable terrain, high road densities and harvesting.
- Specialists communicated primarily by exchanging reports and BCTS reviewed the reports prior to proceeding with development. However, there was no formal integration of all the assessment by a specialist which may have been helpful to integrate multiple impacts from a variety of factors.
- The road system used in this development is common on steep mountainous terrain and in this instance it allowed the road to minimize the crossing of unstable terrain.
- Water users bear the negative consequence of the decision to proceed with the development but were not involved with the decision to accept the risk.

## Did BCTS address the recommendations in the professional reports?

The investigation reviewed the assessment recommendations and the operational activities. Recommendations to mitigate the risk of landslide were included in the assessment and included:

- modification to cut block boundary
- harvesting strategies
- road supervision and inspections;
- road construction including methods and drainage for permanent and temporary roads
- road deactivation

BCTS implemented almost all assessment recommendations. However, BCTS did not implement one road TSA recommendation that a geotechnical specialist assess the stability of the road prism and drainage control after five years. Instead, BCTS chose to conduct ongoing monitoring and inspections of the Balfour Face Forest Service Road, primarily after freshet and rain events. BCTS agreed to consult with geotechnical professionals if stability or drainage problems became evident.

***Findings***

- The assessment recommendations were adequately implemented.

## Are there Opportunities for Improvement?

On a broader scale, the situation at Liard Creek has brought forward some important concerns about multiple resource use on the land base, and presented opportunities to examine and improve procedural processes in order to reduce the risk of landslides when developing similar terrain.

**Example 1**: While BCTS coordinated the layout and brought in specialists to conduct assessments and make recommendations after the layout was complete, there could be value to having a specialist involved prior to layout. This would allow BCTS—or any given licensee—to identify sensitive areas and address them more effectively during layout instead of afterward.

**Example 2**: While BCTS accepted expert advice from specialists and forest professionals before building roads or harvesting, it relied on consultants exchanging reports as a way to address overall impacts on landslide risk. This does not equate to effective communication and using more than one consultant increases the chance for miscommunication. BCTS informally considered the multiple assessments prior to finalizing the layout; however, it may have been more efficient and a better result may have been achieved if just one consultant had conducted the TSAs for both roads and block, or one specialist had conducted a formal overview assessment of the entire development.

**Example 3**: While BCTS followed the recommendations in the assessments, they still had a responsibility to review the reports; determine if the level of risk associated with the proposed development was acceptable; and, decide what recommendations would be implemented to minimize risk. Under current legislation, there is no definitive decision matrix to determine if development should or should not proceed based on the risk rating; consequently, BCTS and all

licensees working in areas where resource values at risk are high should incorporate a systematic, transparent and well documented decision-making process into their planning that clearly demonstrates appropriate consideration of benefits and risks before decision-making proceeds.

**Example 4**: While BCTS immediately addressed the landslide by bringing in a terrain stability specialist to assess the situation the day after it occurred, the landslide assessment was completed by the same consulting company (though not the same individual) who completed the road TSA and drainage plan. Granted, the assessment was further reviewed by an independent third party—but by not using an independent third party to complete the assessment in the first place, BCTS risked a perception of bias. Licensees are granted significant power under FRPA, and are entitled to select how and who will conduct such assessments. However, in highly contentious areas, avoiding perception of bias is important if public trust is to be established and maintained.

# Conclusions

The *Forest and Range Practices Act* (FRPA) relies on the integrity and experience of forest professionals to manage the province's forest resource by prescribing sound forest practices that address both statutory requirements and non-statutory expectations. BCTS in the Kootenay Lake Business Area was fully aware of the complainants' concerns and it is the Board's view that BCTS was diligent in its planning with regard to addressing potential impacts of unstable terrain, high road densities and harvesting activities on water quality. BCTS used forest professionals and other specialists to conduct assessments and make recommendations about operational practices, implemented the recommendations, and closely monitored the road following harvesting. However, there are opportunities to improve planning and assessment processes in high risk situations to reduce the risk of a landslide occurring.

## Endnotes

[i] *Guidelines for Professional Services in the Forest Sector – Crossings*, September 2008, and *Guidelines for Professional Services in the Forest Sector – Terrain Stability August 2010,* APEGBC & ABCFP

[ii] Henderson, G. and Toews, D. 2004. *Hydrologic Assessment of the Laird Creek Study Area*. Henderson Environmental Consulting Limited.

[iii] Sitkum Consulting Ltd. 2004. *Terrain Stability Assessment & Soil Erosion Field Assessment Balfour-Laird Forest Service Road Extension*.

[iv] Sitkum Consulting Ltd. 2005. *Drainage Plan Balfour Face FSR, Laird Creek Extension.*

[v] Sitkum Consulting Ltd. 2011. *Laird Creek Landslide Assessment Event Geotechnical Assessment*.

[vi] Jordan, P. 2001 *Regional incidence of landslides In Proc. Watershed Assessment in the Southern Interior of British Columbia*. D.A.A. Toews and S. Chatwin (editors). B.C. Min. For., Res. Br., Victoria, B.C. Work. Pap 57/2001, pp. 237 – 247.

[vii] BC Ministry of Forests 2001 *Watershed assessment procedure guidebook 2nd ed., Version 2.1*. For. Prac. Br., Min. For., Victoria, B.C. Forest Practices Code of British Columbia Guidebook.

[viii] Utzig, G. 1997. *Terrain and soil inventory West Arm Demonstration Forest*. Unpublished maps and report prepared for the Ministry BC Ministry of Forest, Nelson, BC by Kutenai Natural Investigations Ltd., Nelson, BC

[ix] Jordans, P. 2012. *Personal Communication, Research Geomorphologist, Ministry of Forests, Lands and Natural Resource Operations, Selkirk District*.

[x] Engineering Manual, 2009. Ministry of Forests, Lands and Natural Resource Operations. http://www.for.gov.bc.ca/hth/engineering/documents/publications_guidebooks/manuals_standards/Eng-Manual.pdf

[xi] Road assessment - Forest Road Engineering Guidebook (2002), Cut block assessment - Landslide Risk Case Studies and Forest Development Planning (2004), and Hydrology assessment - Managing Risk Within a Statutory Framework (1999).


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