August 7, 2018

Porcupine Wood Products Ltd.
Box 850
Salmo, BC
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Attn. Bill Kestell

RE: TERRAIN STABILITY ASSESSMENT
LAIRD CREEK, CP 410, BLOCK 1 and SPURS 1, 2 AND 3

INTRODUCTION

At the request of Mr. Bill Kestell, RPF of Porcupine Wood Products Ltd. (PWP), Perdue Geotechnical Services Ltd. (PGS) conducted a geotechnical assessment for the proposed forest development within the Laird Creek operating area, Cutting Permit (CP) 410, Block 1 and the associated access roads, Spurs 1, 2 and 3. The assessment was completed by Mr. Chris Perdue, P.Geo., Eng.L., of PGS on August 1, 2018. In addition, a series of cursory field reviews were conducted in April and May 2018.

The purpose of the assessment was to review the terrain throughout the proposed development and provide recommendations to minimize the potential for landslide initiation following timber harvesting and road construction within or above potentially hazardous terrain.

SITE LOCATION

The proposed CP 410 development area is located along the southwestern side of Laird Creek, approximately 26 km northeast of Nelson, BC (see Figure 1). The study area is located in the Kokanee Range of the Selkirk Mountains within the Columbia Mountain System and is centered on UTM coordinates 499936E / 5497770N. The area is found on NTS map sheet 82F.065 in the Selkirk Forest District.

BACKGROUND INFORMATION

Terrain Stability Mapping and Previous Reporting

Detailed terrain stability mapping for the proposed development area was provided by PWP. Terrain Survey Intensity Level (TSIL) B mapping was completed by Kutenai Nature Investigations Ltd. and summarized in a report entitled *"Terrain and Soil Inventory, West Arm Demonstration Forest (WADF)"*, April 1997. The terrain hazard polygons are shown on Figure 2.

Bedrock Geology

Geological mapping of the study area, as illustrated by the Geological Survey of Canada (GSC) Map 1090A Nelson, west half (H.W. Little, 1960), GSC Open File 1195 Nelson, west half (1971) and GSC Map 1864A Kootenay Lake (J.E. Ressor, 1996) shows that the proposed development is underlain by coarse-grained, igneous bedrock of the Nelson batholith across mid to upper valley slopes and finer-grained

meta-sedimentary and sedimentary bedrock of the Milford Group (argillite, phyllite and limestone) across lower valley slopes. Field observations identified igneous bedrock underlying the proposed development.

Biogeoclimatic Mapping

According to biogeoclimatic mapping completed for the area (Nelson 82F map sheet), the proposed CP 410 development is situated within the Dry Warm Interior Cedar-Hemlock biogeoclimatic subzone (ICHdw). The area is considered to be within a moist climate region.

Resource Values

The following resources are considered potential elements at risk associated with the proposed development:

- Private land and residences are situated downslope of the proposed development;
- According to the on-line database provided by the iMapBC website, several licensed Points of Diversion (PODs) for domestic and irrigation use exist on Laird Creek, downstream of the proposed development;
- Laird Creek is directly connected to the West Arm of Kootenay Lake and is considered high value fish habitat.

PROPOSED HARVEST AREA

A field assessment was completed for the proposed harvest area discussed herein on foot within the proposed harvest boundaries and adjacent slopes. A vehicle traverse along the existing roads was completed, as well as a brief assessment of previously harvested cut blocks to assess the impact to the terrain following timber harvesting and road construction within the immediate vicinity.

A discussion following the individual block observations details the likelihood of a specific hazardous landslide initiating as a result of the proposed timber harvesting. A hazardous landslide is considered the *landslide of significance*, which is the smallest landslide that could adversely affect an element at risk. The likelihood of a landslide occurring is rated qualitatively as Very Low, Low, Moderate, High and Very High with respect to the proposed harvesting technique for the block. The ratings are based primarily on the presence or absence of existing slope instability related to timber harvesting, hydrologic conditions and the professional judgment and experience of the author.

A partial risk analysis will be completed only for blocks encompassing terrain rated as having a Moderate to Very High residual likelihood of landslide initiation as a result of the proposed development, or where the development is expected to adversely affect the stability of the adjacent terrain. *Appendix A* defines the ratings used herein and details the methodology used to complete a partial risk analysis.

Block 1

Block 1 is an irregular-shaped harvest area situated across the lower extent of a broad, topographic shoulder separating Laird Creek from the West Arm of Kootenay Lake valley. The block encompasses the mid to lower valley slopes and is not bound by any distinct features. Primary access will be provided by the Redfish Creek FSR, a limited network of existing, un-named access roads recently upgraded by Kalesnikoff Lumber Company (identified as R21395-01 and R21395-08) and the proposed Spur 1, Spur 2 and Spur 3 alignments.

According to previous terrain mapping, the upper (western) majority of the block is encompassed by Terrain Stability Class (TSC) I, II and III terrain, while the lower (eastern) edge and lower slopes directly coupled with Laird Creek are rated TSC V. At the request of PWP, the geotechnical assessment was completed for the entire block. It is understood the proposed block will be harvested as a clear cut with reserves, while utilizing both ground-based and cable-based harvesting equipment. A site plan of Block 1 is shown in Figure 3.

Block 1 is characterized by slightly irregular terrain with an overall concave slope configuration. Slopes throughout the lower, approximate half of the block (downslope of the proposed Spur 1 alignment) typically measure 30% or less, while the upper remaining area generally range from 40% to 60%. Limited, steeper slopes (up to 70%) were encountered in the northwestern corner in association with near-to-surface bedrock.

Surficial soils observed along existing cut bank exposures within close proximity to the proposed development, tree churns and shallow text pits are variable throughout the block. Shallow accumulations of well-drained sandy rubbly colluvium and similar-textured residual soils derived from the underlying igneous bedrock weathering in-situ were identified throughout the upper (northwestern) approximate half of Block 1. Soils across the lower remainder of the block consist of well to moderately well-drained mantled deposits of sandy silt till and discontinuous, overlying deposits of glaciofluvial silty sand and gravel.

Block 1 encompasses the broad, topographic shoulder separating Laird Creek from the West Arm of Kootenay Lake valley. As a result, upslope catchment area above the proposed harvest area is limited and site conditions are considered predominantly dry. Seasonally moist site conditions were identified within the southern area of the block, along with light groundwater emergence and seasonal surface watercourses.

Downslope Terrain

The lower (eastern) harvest boundary extends along a distinct, convex slope break, north of Falling Corner (FC) 49. The downslope terrain is generally steeper than in-block observations with slopes ranging from 50% to more than 100%. Surficial soils predominantly consist of well-drained, shallow accumulations of silty sandy rubbly colluvium and lesser, mantled deposits of clayey sandy silt till. The till deposits were more dense and finer-grained than till deposits identified further upslope, within the proposed harvest area. The lowermost slopes, immediately above and adjacent to Laird Creek, are predominantly bedrock-controlled, as evidenced by frequent exposures of igneous bedrock.

Generally, site conditions below Block 1 are considered dry. Several gullies and draws bisect the lower slopes that are inferred to be the result of historic mass wasting in response to Laird Creek eroding its incised gully and over-steepening the steep sidewall slopes. Earlier field observations in April and May 2018 identified seasonally moist site conditions below the block, approximately between FCs 47 and 48. Light seepage emergence was observed approximately 40 m to 60 m below the slope break. In addition, two small tension cracks were identified below the slope break, to the northeast and south of FC 47. Limited wind-throw activity was encountered within and downslope of the proposed harvest area with no resulting slope instability.

Harvest Boundary Amendment

The topographically-defined catchment area (within Block 1) upslope of the abovementioned seasonal groundwater emergences and existing tension cracking was originally proposed to be harvested with a

relatively small Wildlife Tree Retention Area (WTRA) established across the upper, northwestern harvest boundary. The original Equivalent Clearcut Area (ECA) above the lower slopes exhibiting signs of gradual slope instability is expected to increase seasonal groundwater levels and increase the likelihood of a rapid mass wasting event (i.e. a landslide). As a result, recommendations were forwarded to PWP to increase the WTRA to encompass the catchment area above the potentially unstable, lower slopes (below the convex slope break). Figure 3 illustrates the increased WTRA, which reduced the net area to be harvested from 30.1 hectares (originally) to 23.1 hectares (present).

Geotechnical Assessment

Provided the following recommendations in the subsequent section (below) are followed, the likelihood of landslide initiation as a result of the proposed timber harvesting of Block 1 is rated as Low. The following factors were considered in determining the hazard rating:

- Hillslope hydrology appears to be predominantly governed by the underlying, highly-fractured igneous bedrock and subject to surface influences beyond the topographically-defined upslope catchment area above the block;
- The steep, lower slopes (below the proposed area to be harvested) are predominantly bedrock-controlled and bisected by a series of draws and gullies with limited evidence of seasonal surface flow. The proposed timber harvesting is not expected to significantly increase the ECA above the lower slopes and adversely affect hillslope hydrology and slope instability;
- Road construction practices and drainage control measures along access routes within the proposed harvest area (including seasonal surface drainage control measures during periods of non-operational use) will have the greatest influence on surface/sub-surface watercourses and slope stability. Provided all natural watercourses are appropriately managed and maintained, the proposed timber harvesting is not expected to have a significant adverse effect on hillslope hydrology or slope stability.

Timber Harvesting Recommendations

The following general recommendations are intended to reduce the potential adverse effects of timber harvesting and road construction:

- Ground skidding across natural drainage paths and surface watercourses should be avoided. If this cannot be avoided, harvesting should be conducted during the drier months of the year, on a compressed snowpack, or effort made to ensure timber is skidded butt-first to minimize potential ground disturbance within such drainage features;
- Timber harvesting should not be completed during excessively wet conditions, such as during the freshet and/or prolonged, heavy periods of rainfall;
- A post-harvest inspection should be completed to ensue all natural drainage patterns have been maintained. Logging debris should be removed from the wetted perimeter of all watercourses and subtle drainage features to ensure an accumulation of coarse woody debris or site degradation from logging operations does not result in a drainage diversion. These measures include ensuring the drainage network (i.e. culverts and ditch lines) along permanent roads remain functional, as intended.
- Temporary access trails may be built using debris-supported fill slopes (where required) to reduce cut bank excavation and the potential for groundwater interception. Drainage control measures

should be implemented to ensure all natural drainage paths are maintained. All trails must be fully rehabilitated upon completion of the proposed timber harvesting. If harvesting is to be conducted during winter months, trails must be seasonally deactivated prior to the freshet by out-sloping where practical and installing cross ditches to maintain natural drainage patterns.

PROPOSED ACCESS ROADS

A field assessment was completed with a foot traverse along the proposed alignments discussed herein. Observations along the subject route have been referenced to the existing hub stationing previously established in the field. The following is a general description of the terrain along each of the proposed routes and their corresponding sections. The Geotechnical Recommendations Summary tables attached to this report include site-specific descriptions of the terrain conditions for each road and its corresponding sections.

Spur 1

The proposed Spur 1 alignment extends off an existing, un-named road (identified as R21395-08) and continues for approximately 1,115 m to provide access across the central region of Block 1. It is understood the proposed road will be built to a permanent standard.

According to previous terrain mapping, the entire road length is encompassed by TSC I and II terrain. At the request of PWP, a geotechnical assessment was completed for the entire length of the road. A site plan of Spur 1 is shown in Figure 3.

The initial, approximate 600 m (up to Hub 22) extends across gently-sloping, undulating terrain. Sidehill gradients measure less than 20%. Surficial soils consist of well-drained, mantled deposits of glaciofluvial (possibly alluvial) deposits of silty sand and gravel. Scattered, partially-buried surface boulders are present along the initial road section. The final 515 m (up to Hub 40) crosses slightly steeper, more uniform terrain, across slopes ranging from 30% to 45%. Soils consist of well-drained, shallow accumulations of sandy rubbly surface colluvium atop mantled deposits of glaciofluvial silty sand and gravel. Soil depth (depth to bedrock) along the entire road length is estimated to be less than 1.5 m of the undisturbed ground surface.

Site conditions along the proposed route are expected to be predominantly dry and subject to seasonal, hydrologic variations. Earlier field observations in April and May 2018 identified seasonal, surface watercourses along the initial, approximate half of the road length.

No evidence of slope instability was identified along the proposed alignment or the immediate adjacent terrain during the field review.

Spur 2

The proposed Spur 2 alignment diverges below the proposed Spur 1 route at Hub 18 and descends adversely for approximately 275 m to provide access within the central region of Block 1. It is understood the proposed road will be built to a temporary standard.

According to previous terrain mapping, the entire road length is encompassed by TSC I terrain. At the request of PWP, a geotechnical assessment was completed for the entire length of the road. A site plan of Spur 2 is shown in Figure 3.

The entire length (up to Hub 11) crosses slightly irregular, gentle to moderate-sloping terrain (25% to 40% slopes). Soils consist of well-drained, mantled deposits of glaciofluvial silty sand and gravel and lesser, overlying accumulations of sandy rubbly colluvium. Depth to bedrock is estimated to be less than 1.5 m of the undisturbed ground surface.

Site conditions along the road are considered dry with no indication of any seasonal, surface watercourses or groundwater emergences encountered.

No evidence of slope instability was identified along the proposed alignment or the immediate adjacent terrain during the field review.

Spur 3

The proposed Spur 3 alignment extends off an existing, un-named road (identified as R21395-01) and continues for approximately 505 m to provide access within the lower, southeastern area of Block 1. It is understood the proposed road will be built to a temporary standard.

According to previous terrain mapping, the entire road length is encompassed by TSC II terrain. At the request of PWP, a geotechnical assessment was completed for the entire length of the road. A site plan of Spur 3 is shown in Figure 3.

The entire length of the road (up to Hub 22) crosses slightly irregular, gentle to moderate-sloping terrain (20% to 40% slopes). Limited, steeper slopes (up to 65%) were identified within the confines of an incised gully between Hubs 15 and 17. Soils consist of moderately well-drained, mantled deposits of sandy silt till with a trace of clay. Depth to bedrock is expected to be nearly 2 m of the undisturbed ground surface.

Site conditions along Spur 3 are considered seasonally moist. Earlier field observations in April and May 2018 identified strong cut bank emergence along the end section of the existing, un-named road and is expected along the proposed route. Seasonal surface flow was also observed along an S6 creek gully at Hub 16 within the confines of an incised gully between Hubs 15 and 17. Additional, seasonal surface flow was encountered along a swale, 7 m southwest of Hub 22 (referenced as Hub 22-7m).

No evidence of slope instability was identified along the proposed alignment or the immediate adjacent terrain during the field review.

Geotechnical Assessment

The following discussion details the likelihood of a specific hazardous landslide initiating as a result of the proposed road construction. A hazardous landslide is considered the *landslide of significance*, which is the smallest landslide that could adversely affect one (or more) of the previously identified elements at risk. The likelihood of a landslide occurring is rated qualitatively as Very Low, Low, Moderate, High and Very High with respect to conventional (side cast) road construction techniques. The ratings are based primarily on the professional judgment and experience of the author, as well as hill slope geometry.

The ratings are identified in the attached Geotechnical Recommendations Summary (GRS) tables for each road and its corresponding section. A partial risk analysis will be completed only for road sections

with a Moderate to Very High residual likelihood of landslide initiation, or where the proposed development is expected to adversely affect the stability of the adjacent (downslope) terrain. *Appendix A* defines the ratings used herein and details the methodology used to complete a partial risk analysis. The assessment has determined that all of the roads discussed herein are situated across terrain rated as Very Low to Low, and may be built using conventional, side cast construction techniques. No construction limitations are recommended outside of standard road construction practices for permanent and temporary resource roads.

Road Construction Recommendations

Detailed road construction recommendations and prescribed culvert locations for the proposed roads are summarized in the attached GRS tables.

Permanent Road Construction (Spur 1)

Permanent roads should be built using clean, native soils. Overburden Material (OM) thickness, or depth to bedrock, is estimated in the GRS tables. The maximum recommended cut slope for Overburden Material (soil) is 100% (1H:1V). Reduced cut slope angles (70% to 80%) are recommended where excessive groundwater emergence is encountered during construction or expected to occur seasonally. The recommended cut slope for competent (solid) bedrock is 400% (¼:1).

Fill slopes of 70% are typically recommended for road sections utilizing clean mineral soil, while slightly oversteepened (80%) fill slopes are recommended wherever surficial materials are expected to consist of well-drained, rubbly colluvium and/or mixed rock. Bedrock and large rock fragments are expected to be encountered during construction.

Temporary Road Construction (Spur 2 and Spur 3)

Temporary road construction may utilize oversteepened fill slopes consisting of mixed soil, rock and coarse woody debris to reduce cut bank excavation and fill slope volumes. In addition, the running surface of the road should be in-sloped to further reduce fill slope volumes and eliminate ditch line requirements.

Road sections built in this manner must be deactivated concurrently with the completion of timber harvesting and must be fully rehabilitated within 2 years of being constructed unless subsequently reviewed by a geotechnical professional to assess the stability of the road prism for longer term use.

Drainage Control Measures

Appropriately-sized cross drain culverts should be installed at all prominent surface watercourses to maintain the natural drainage patterns along the proposed roads, as itemized in the GRS tables. Additional culverts and/or appropriate drainage control measures may be required where previously unidentified seasonal streams and/or groundwater emergence zones are encountered during construction.

Residual Hazard

Based on the nature of the terrain crossed by the proposed alignments discussed in this report and the anticipated soil conditions (i.e. genesis and drainage characteristics), the construction methods

recommended above are expected to result in a Low (or better) residual hazard of landslide initiation both during and after construction. Road construction practices should be completed in accordance with Chapter 6 of the (former) Ministry of Forests and Range, *Engineering Manual* (Anonymous, 2006). If soil conditions significantly differ during construction, a subsequent field assessment should be completed by a geotechnical professional to provide appropriate construction parameters.

Provided adequate cross drains are installed to maintain natural drainage patterns, the proposed road construction is not expected to have a significant adverse effect on the stability of the terrain within or below the proposed road prism.

CLOSURE

This report has been prepared for the exclusive use of Porcupine Wood Products Ltd. and their authorized representatives. The methods used herein are in accordance with generally accepted geological and geotechnical principles and practice. Site conditions are based on surface observations, shallow test pits and exposed soils. Deep, sub-surface exploration techniques were not used unless otherwise noted. Recipients of this report should be aware that sub-surface variability is inherent, as a function of natural geomorphic processes.

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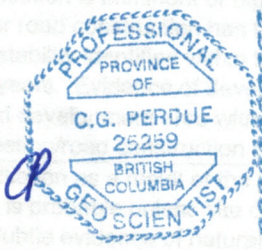
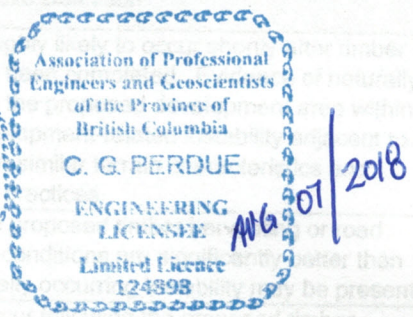
PERDUE GEOTECHNICAL SERVICES LTD.





Christopher G. Perdue, P.Geo., Eng.L.
Engineering Geologist

Attachments: Appendix A - Partial Risk Analysis
Geotechnical Recommendations Summary Tables (3 pages)
Figure 1 - Location Map (1:250,000 scale)
Figure 2 - CP 410, Development Overview Map (1:10,000 scale)
Figure 3 - CP 410, Block 1 and Spurs 1, 2 and 3 Site Plan Map (1:5,000 scale)

recommended above are expected to result in a Low (or better) residual hazard of landslide initiation both during and after construction. Road construction practices should be completed in accordance with Chapter 6 of the (former) Ministry of Forests and Range, *Engineering Manual* (Anonymous, 2006). If soil conditions significantly differ during construction, a subsequent field assessment should be completed by a geotechnical professional to provide appropriate construction parameters.

Provided adequate cross drains are installed to maintain natural drainage patterns, the proposed road construction is not expected to have a significant adverse effect on the stability of the terrain within or below the proposed road prism.

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PERDUE GEOTECHNICAL SERVICES LTD.

ORIGINAL SIGNED

Christopher G. Perdue, P.Geo., Eng.L.
Engineering Geologist

Attachments: Appendix A – Partial Risk Analysis
Geotechnical Recommendations Summary Tables (3 pages)
Figure 1 – Location Map (1:250,000 scale)
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APPENDIX A

Partial Risk Analysis

Partial Risk, P(HA), is defined as the product of the probability of a specific hazardous landslide occurring and the probability of that landslide reaching or adversely affecting the site occupied by a specific element. Partial risk is mathematically expressed as:

$$P(HA) = P(H) \times P(S:H) \times P(T:S)$$

P(H) is the probability (or likelihood) of occurrence of a specific hazardous landslide. P(S:H) is the spatial probability relating the potential of a landslide to reach or adversely affect the site occupied by a considered element. P(T:S) is the temporal probability of a mobile element to be at the affected site at the time the event occurs. Static elements, such as a bridge, road or a building for example, have a quantitative (numerical) value of 1 because it is certain that the element will be at the affected site when the event occurs. Under these circumstances and unless otherwise noted, the partial risk equation can be simplified and expressed as:

$$P(HA) = P(H) \times P(S:H)$$

The components of the partial risk analysis will be expressed qualitatively. Table 1 defines the likelihoods of a landslide occurring as a result of the proposed timber harvesting methods.

Table 1 - Landslide Occurrence

Likelihood of Occurrence, P(H)	Qualitative Definition
Very High	Landslide initiation is imminent or highly likely to occur shortly after timber harvesting or road construction has been completed. Evidence of naturally occurring instability identified within the proposed development area within the past 15 years. Evidence of development-related instability adjacent to the proposed development area with similar terrain characteristics and timber harvesting/road construction practices.
High	Landslide initiation as a result of the proposed timber harvesting or road construction is probable unless site conditions are significantly better than assumed. Subtle evidence of naturally occurring instability may be present.
Moderate	Landslide initiation is not likely to occur following the proposed timber harvesting or road construction, but considered possible if one or more the assumed site conditions are significantly altered as a result of the proposed development.
Low	Landslide initiation following timber harvesting or road construction is considered unlikely, although is possible under exceptional circumstances (i.e. an extreme or anomalous hydrological event).
Very Low	Remote possibility of a landslide initiating as a result of the proposed timber harvesting or road construction.

Table 2 provides the qualitative definition of the potential spatial effect of a specific hazardous landslide to reach or otherwise affect a site occupied by an element.

Table 2 - Spatial Effect

Potential Effect, P(S:H)	Qualitative Definition
High	Landslide will reach or directly affect the considered element at risk (eg. private or public infrastructure, high-value fish habitat or consumptive water source).
Moderate	Landslide will marginally affect the considered element. Possible termination within 200 m of the site. Secondary transport of sediment and/or small woody debris may affect the element.
Low	Landslide is unlikely to reach or affect the considered element. The terrain above the site is capable of intercepting or dissipating slide debris and the potential secondary affects.

Table 3 is an example of a linear partial risk matrix that illustrates the relationship between the potential landslide occurrence and its estimated spatial effect to an element.

Table 3 - Partial Risk Matrix

Partial Risk, P(HA)		Spatial Effect, P(S:H)		
		High	**Moderate**	**Low**
Landslide Occurrence, P(H)	**Very High**	Very High	Very High	High
	High	Very High	High	Moderate
	Moderate	High	Moderate	Low
	Low	Moderate	Low	Very Low
	Very Low	Low	Very Low	Very Low

For the purposes of this report, partial risk does not include the vulnerability of the element(s) at risk, and therefore, is not considered a completed estimate of risk. Partial risk is usually the preferred analysis method when insufficient information is known about the vulnerability of the element(s). The vulnerability of certain elements is best provided by professionals with a specific knowledge of the element(s) at risk.

Forest Resource Managers with a greater knowledge of the vulnerability of an element can determine the specific risk of an element by multiplying the assigned vulnerability rating with the partial risk value.

References

BC Ministry of Forests (2002). Forest Road Engineering Guidebook. Forest Practices Code of British Columbia. BC Ministry of Forests, Victoria, BC.

Wise, M.P., G.D. Moore and D.F. VanDine (2004). Landslide Risk Case Studies in Forest Development Planning and Operations. BC Ministry of Forests, Research Branch, Victoria, BC. Land Management Handbook No. 56.

Geotechnical Recommendations Summary Table

Section: Balfour Face (CP 410) Spur 1 (Block 1)
Section Length: 1.114 km (total length)

Prepared for: Porcupine Wood Products Ltd.
Field Review Date: August 1, 2018

Stn from (m)	to Stn (m) (At)	Terrain Classification	Depth to Bedrock (m)	Side hill Slope (%)	Initial Hazard Rating [1] / Drainage Classification	Comments	Cut / Fill Slope (%)	Recommendations	Residual Hazard [2]
Hub 01	Hub 22	zsdF^{G}w	up to 1.5	< 20	V. Low / w	Proposed alignment extends off existing, un-named road; mantled, glaciofluvial outwash deposit; scattered, partially-buried surface boulders; irregular, undulating terrain Seasonal watercourses identified along initial road section	90 / 70	Push-fill road construction	V. Low
	Hub 06					Topographic hollow (dry); low point on grade		Install 450mm culvert	
	Hub 13					Poorly-confined, seasonal stream		Install 450mm culvert	
	Hub 17					Broad swale; seasonal flow expected		Install 450mm culvert	
	Hub 18					Junction with Spur 2			
Hub 22	Hub 40	zsxCvb zsdF^{G}w	up to 1.5	30 - 45	Low / w	Surface colluvium atop coarse, non-cohesive glaciofluvial soil; uniform slopes; dry site conditions	100 / 70	Balanced bench construction	Low
	Hub 22					Subtle, dry swale upslope of seasonal flow identified within lower area of Block 1		Install 450mm culvert	
	Hub 24					Subtle, dry swale upslope of seasonal flow identified within lower area of Block 1		Install 450mm culvert	
	Hub 31					Dry, open slope		Install 450mm culvert	
	Hub 38					Dry, open slope		Install 450mm culvert	
	Hub 40					End of traverse			

1 Initial hazard rating is based on site conditions capable of supporting conventional side cast (balanced bench) road construction practices.
2 Probability of specific hazardous landslide occurring as a result of the recommended construction measures. Refer to Appendix A for definitions.

Geotechnical Recommendations Summary Table

Section: Balfour Face (CP 410) Spur 2 (Block 1)
Section Length: 0.278 km (total length)

Prepared for: Porcupine Wood Products Ltd.
Field Review Date: August 1, 2018

Stn from (m)	to Stn (m) (At)	Terrain Classification	Depth to Bedrock (m)	Side hill Slope (%)	Initial Hazard Rating [1] / Drainage Classification	Comments	Cut / Fill Slope (%)	Recommendations	Residual Hazard [2]
Hub 01	Hub 11	zsdF^{G}w	up to 1.5	25 - 40	Low / w	Proposed temporary alignment diverges off proposed Spur 1 at Hub 18; mantled, glaciofluvial outwash deposit; scattered, partially-buried surface boulders; irregular, undulating terrain	90 / 80	Temporary road construction Utilize oversteepened, debris-supported fill slopes Deactivate concurrently with completion of timber harvesting (prior to onset of winter) and fully rehabilitate within two years of construction	Low
	Hub 08					Downslope of Spur 1 culverts; upslope of seasonal flow identified within lower area of Block 1		Install 450mm culvert	
	Hub 11					End of traverse			

1 Initial hazard rating is based on site conditions capable of supporting conventional side cast (balanced bench) road construction practices.
2 Probability of specific hazardous landslide occurring as a result of the recommended construction measures. Refer to Appendix A for definitions.

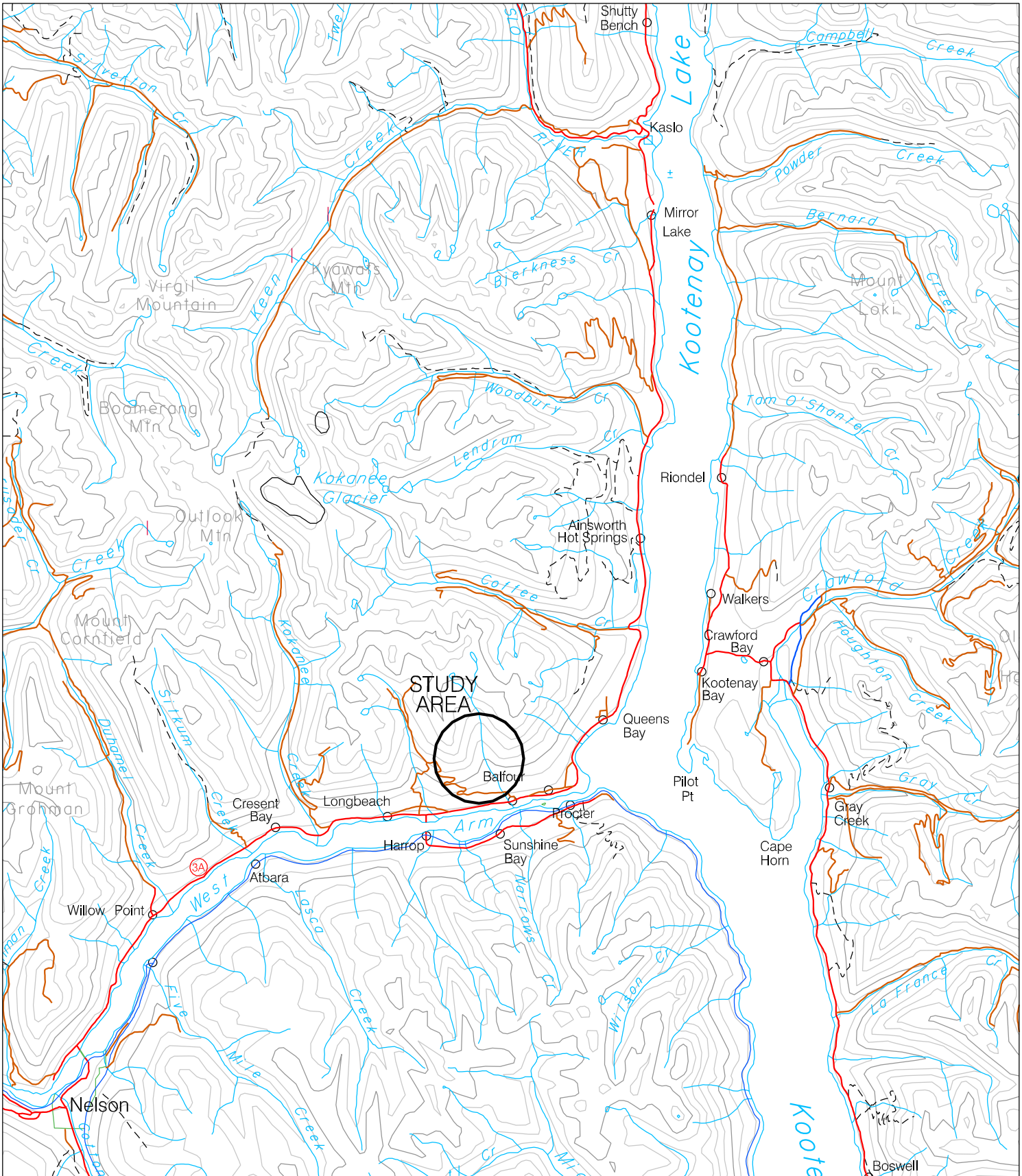
Geotechnical Recommendations Summary Table

Section: Balfour Face (CP 410) Spur 3 (Block 1)
Section Length: 0.504 km (total length)

Prepared for: Porcupine Wood Products Ltd.
Field Review Date: August 1, 2018

Stn from (m)	to Stn (m) (At)	Terrain Classification	Depth to Bedrock (m)	Side hill Slope (%)	Initial Hazard Rating [1] / Drainage Classification	Comments	Cut / Fill Slope (%)	Recommendations	Residual Hazard [2]
Hub 01	Hub 22	(c)szdMw	up to 2.0	20 - 40	Low / mw	Proposed temporary alignment diverges off existing, un-named road; mantled, fine-textured till soils (trace of clay) High seasonal groundwater levels observed along existing road section and expected along proposed route	80 / 80	Temporary road construction Utilize oversteepened, debris-supported fill slopes; reduce cut slope angle to 80%; in-slope road surface; maximum 4.5m width Deactivate concurrently with completion of timber harvesting (prior to onset of winter) and fully rehabilitate within two years of construction	Low
	Hub 03					Broad, shallow draw; no sign of seasonal surface flow		Install 450mm culvert	
	Hub 05					Dry swale		Install 450mm culvert	
	Hub 12					Northeast boundary of recently harvested cut block (2018)			
Hub 15	Hub 17					Incised, seasonal creek gully SW sidewall 65% slopes. 6m deep NE sidewall 65% slopes, 8m deep 30% channel gradient (dry)		Install 600mm culvert at Hub 16	
	Hub 22-7m					Seasonal surface flow observed during freshet; subtle swale		Install 450mm culvert	
	Hub 22					End of traverse			

1 Initial hazard rating is based on site conditions capable of supporting conventional side cast (balanced bench) road construction practices.
2 Probability of specific hazardous landslide occurring as a result of the recommended construction measures. Refer to Appendix A for definitions.



PORCUPINE WOOD PRODUCTS LTD.

LOCATION MAP

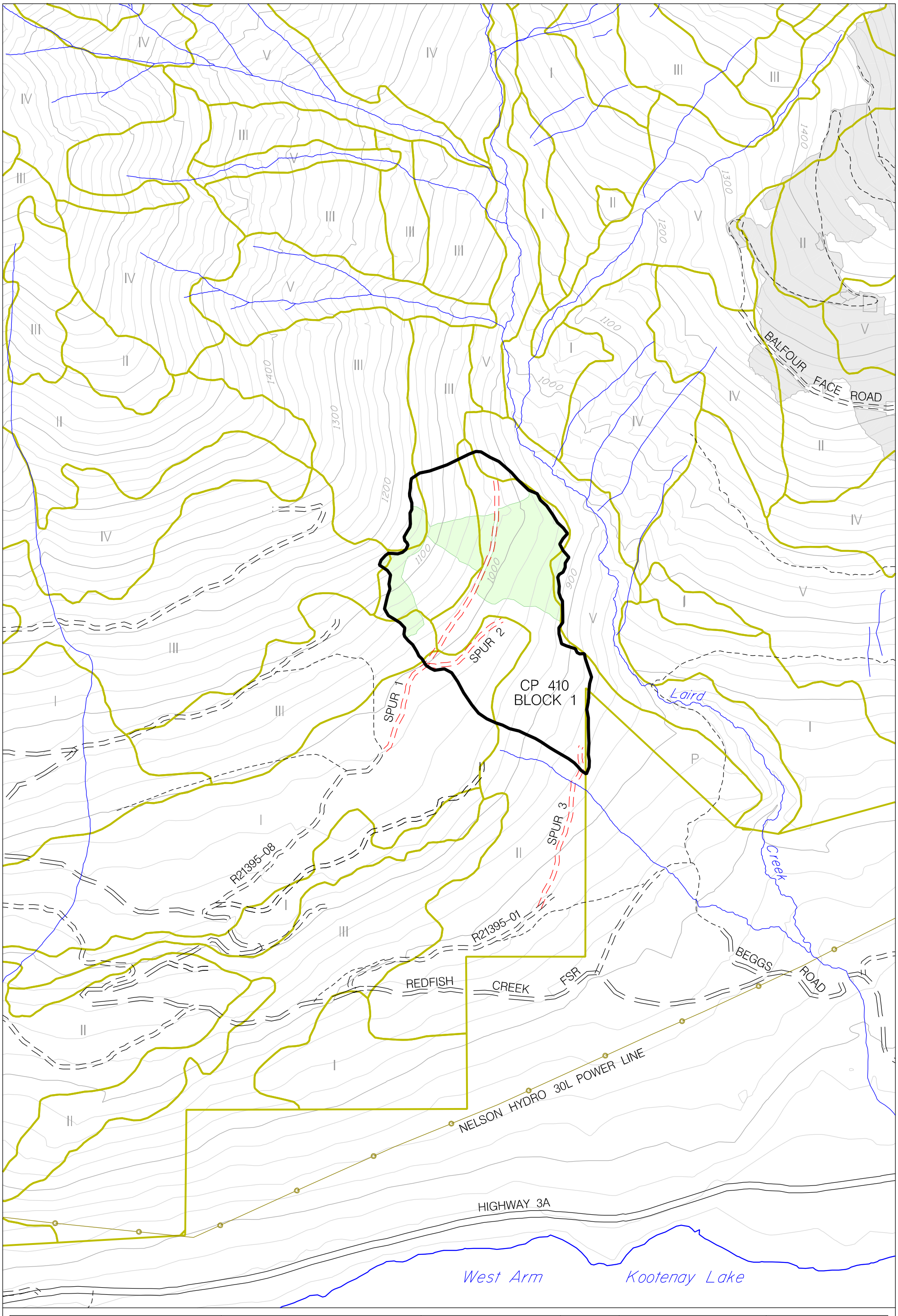
N

Scale: 1:250,000
Date: AUG. 2018
Drawn by: CP

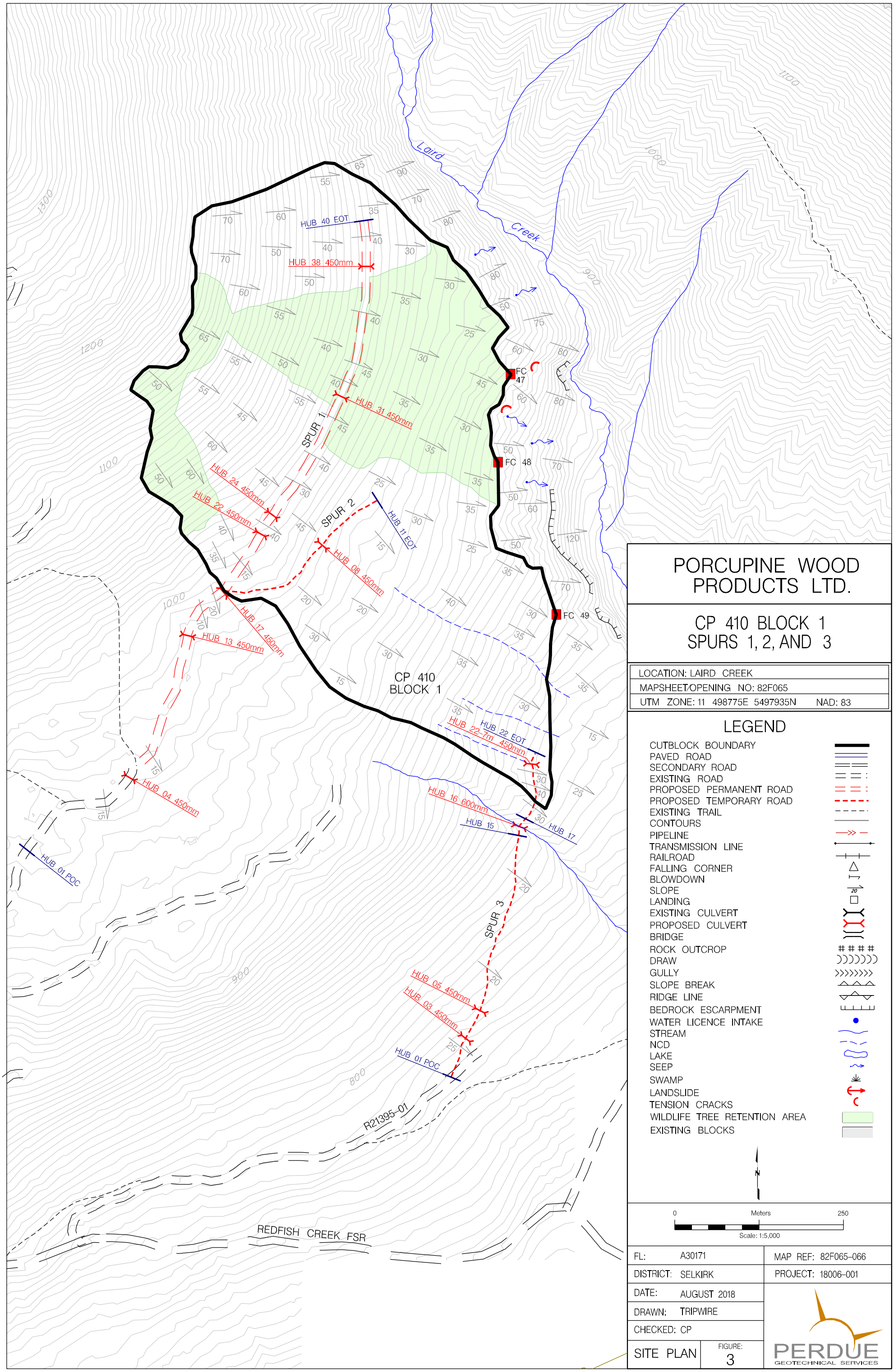
Adapted from: 82/F Nelson

Figure 1

PERDUE
GEOTECHNICAL SERVICES



PORCUPINE WOOD PRODUCTS LTD.	Mapsheet: 82F065	CP: 410	N	OVERVIEW MAP	PERDUE GEOTECHNICAL SERVICES
	Chart Area: Laird Creek	Scale: 1:10,000			
	UTM: 498775E 5497935N	Figure: 2			



PORCUPINE WOOD PRODUCTS LTD.

CP 410 BLOCK 1 SPURS 1, 2, AND 3

LOCATION: LAIRD CREEK
MAPSHEET/OPENING NO: 82F065
UTM ZONE: 11 498775E 5497935N NAD: 83

LEGEND

- CUTBLOCK BOUNDARY
- PAVED ROAD
- SECONDARY ROAD
- EXISTING ROAD
- PROPOSED PERMANENT ROAD
- PROPOSED TEMPORARY ROAD
- EXISTING TRAIL
- CONTOURS
- PIPELINE
- TRANSMISSION LINE
- RAILROAD
- FALLING CORNER
- BLOWDOWN
- SLOPE
- LANDING
- EXISTING CULVERT
- PROPOSED CULVERT
- BRIDGE
- ROCK OUTCROP
- DRAW
- GULLY
- SLOPE BREAK
- RIDGE LINE
- BEDROCK ESCARPMENT
- WATER LICENCE INTAKE
- STREAM
- NCD
- LAKE
- SEEP
- SWAMP
- LANDSLIDE
- TENSION CRACKS
- WILDLIFE TREE RETENTION AREA
- EXISTING BLOCKS

N

0 Meters 250

Scale: 1:5,000

FL: A30171	MAP REF: 82F065-066
DISTRICT: SELKIRK	PROJECT: 18006-001
DATE: AUGUST 2018	
DRAWN: TRIPWIRE	
CHECKED: CP	
SITE PLAN	FIGURE: 3

PERDUE GEOTECHNICAL SERVICES