

**MINISTRY OF FORESTS: POST-WILDFIRE NATURAL HAZARD RISK ANALYSIS –
RECONNAISSANCE REPORT**

NOTE: The results given on this form are reconnaissance in nature and are intended to be a warning of potential hazards and risks. It is not a detailed risk analysis and further work may alter the conclusions. Please read the appendix of this report for important limitations. Contact the author for more information.

FIRE NUMBER: N72263	FIRE YEAR: 2022	DATE OF REPORT: October 31, 2022	
AUTHOR: Sarah Crookshanks, P.Geo., Ministry of Forests			
REPORT PREPARED FOR: Southeast Fire Centre, District Manager			
FIRE SIZE, LOCATION, AND LAND OWNERSHIP: 660 ha on Crown land 12 km northeast of Nelson.			
VALUES AT RISK:			
<ol style="list-style-type: none"> 1. Private residences on the Duhamel Creek fan 2. Domestic surface water quality on Duhamel Creek 3. Highway 3A and secondary public roads 			
WATERSHEDS AFFECTED	TOTAL AREA	AREA BURNED	BURN SEVERITY (% of watershed area)
<i>Duhamel Creek</i>	5706 ha	443 ha (8%)	2% H, 4% M
<i>Lemon Creek</i>	20222 ha	18 ha (0.3%)	
SUMMARY OF POST-FIRE HAZARD AND RISK			
<p>1. Hazard = $P(H)$, the probability of occurrence of a hazardous event</p> <p>2. Probability of spatial impact, $P(S:H)$, the probability of a hazard reaching or affecting an element at risk</p> <p>3. Partial Risk, the probability of a hazard occurring and affecting an element at risk = $P(H) \times P(S:H)$</p> <p>4: Location with the highest risk rating given; at other locations the risk may be lower</p>			
<i>Debris flood or flood impacting private residences, highway, or secondary roads</i>			
Hazard $P(H)^1$ = low Probability of spatial impact $P(S:H)^2$ = moderate Partial Risk ^{3,4} = low			
<p>Duhamel Creek is prone to both floods and debris floods, and numerous historical reports have assessed the hazard and risk to development and infrastructure on the fan (e.g. NHC/Thurber, 1990 and BGC, 2020). The Monument Creek fire burned 8% of the Duhamel Creek watershed; therefore, the incremental hazard of flooding on Duhamel Creek due to this fire is low. The assessment of the cumulative hazard of forest development and historical wildfires within the Duhamel Creek watershed is beyond the scope of this report.</p> <p>Another mechanism that may generate downstream hazard is when a debris flow from a steep tributary transitions to a debris flood in the main channel. Within the fire perimeter, a debris flow is most likely to be generated in the northernmost tributary, where the headwaters were severely burned and the channel gradient is steep (> 40%; Figure 4); however, this tributary drains into Six Mile Lakes; therefore, downstream impacts would be limited to minor turbidity. Further south, there are several other tributaries that may also be prone to debris flows, though burn severity within their watersheds is lower and limited to the lower slopes. Furthermore, the channel reach from Six Mile Lakes to 600 m downstream of the fire boundary has a low gradient (~ 3.5%, see Figure 3); therefore, it is improbable that a debris flow generated within the fire area would transition to a debris flood within the main Duhamel Creek channel.</p>			

Water quality impacts to surface domestic water users

Hazard P(H)¹ = moderate Probability of spatial impact P(S:H)² = high Partial Risk^{3,4} = high

It is possible that domestic water users on Duhamel Creek will experience water quality impacts due to increased fire-related sediment load in Duhamel Creek. Sedimentation is expected to be episodic, occurring during spring freshet and in response to significant rainstorms. Sediment may be generated by overland flow eroding and transporting sediment and ash into a creek. Alternatively, it is possible that a landslide may introduce a significant volume of sediment into the creek channel. A landslide may be in the form of a debris flow (hazard discussed above), or a failure of the Duhamel Face (Heights) Road that switchbacks up the southern end of the fire. This road has experienced multiple failures over the past years, one of which has reportedly introduced sediment into Duhamel Creek. Evidence of potential instability was observed at one location. The burned area may increase the likelihood of landslides originating from this road.

FURTHER ACTIONS

- I recommend that local government forward this report to affected landowners.
- I recommend full deactivation of the Duhamel Face (Heights) Road as soon as practical. Until full deactivation is undertaken, diligent road inspection and maintenance are critical to help reduce the likelihood of additional landslides that may impact Duhamel Creek.

COMMENTS

The Monument Creek fire began on September 4, 2022 and burned mostly within the Duhamel Creek watershed northeast of Nelson. The fire continued to produce smoke into late October, though limited growth was observed after mid-September. An aerial overview of the fire was completed on September 26 and a site visit was undertaken on October 14. Lidar data was obtained from the LidarBC Data Portal and used in this analysis.

Burn severity mapping was produced for this fire in late September by regional geomatics staff using Sentinel-2 satellite imagery. The satellite-derived burn severity generally corresponds with the visual determination of vegetation burn severity from aerial photos for the north half of the fire. The south half of the fire encompasses cutblocks dating from 2009 to 2012 as well as several clearings that are assumed to be wildfires. These forest openings appear to have resulted in the satellite burn severity mapping process over-estimating the true burn severity. During the site visit, several of the cutblocks were traversed and burn severity plots were completed. These field observations in combination with the aerial photographs were used to reclassify the burn severity within the openings (in general, high burn severity within an opening was downgraded to moderate, and moderate downgraded to low).

Further analysis of post-wildfire natural hazards for this fire is not recommended.

SIGNATURE, SEAL, FIRM PRACTICE #

Original signed and sealed.

ATTACHMENTS

See attached map, photos and Appendix

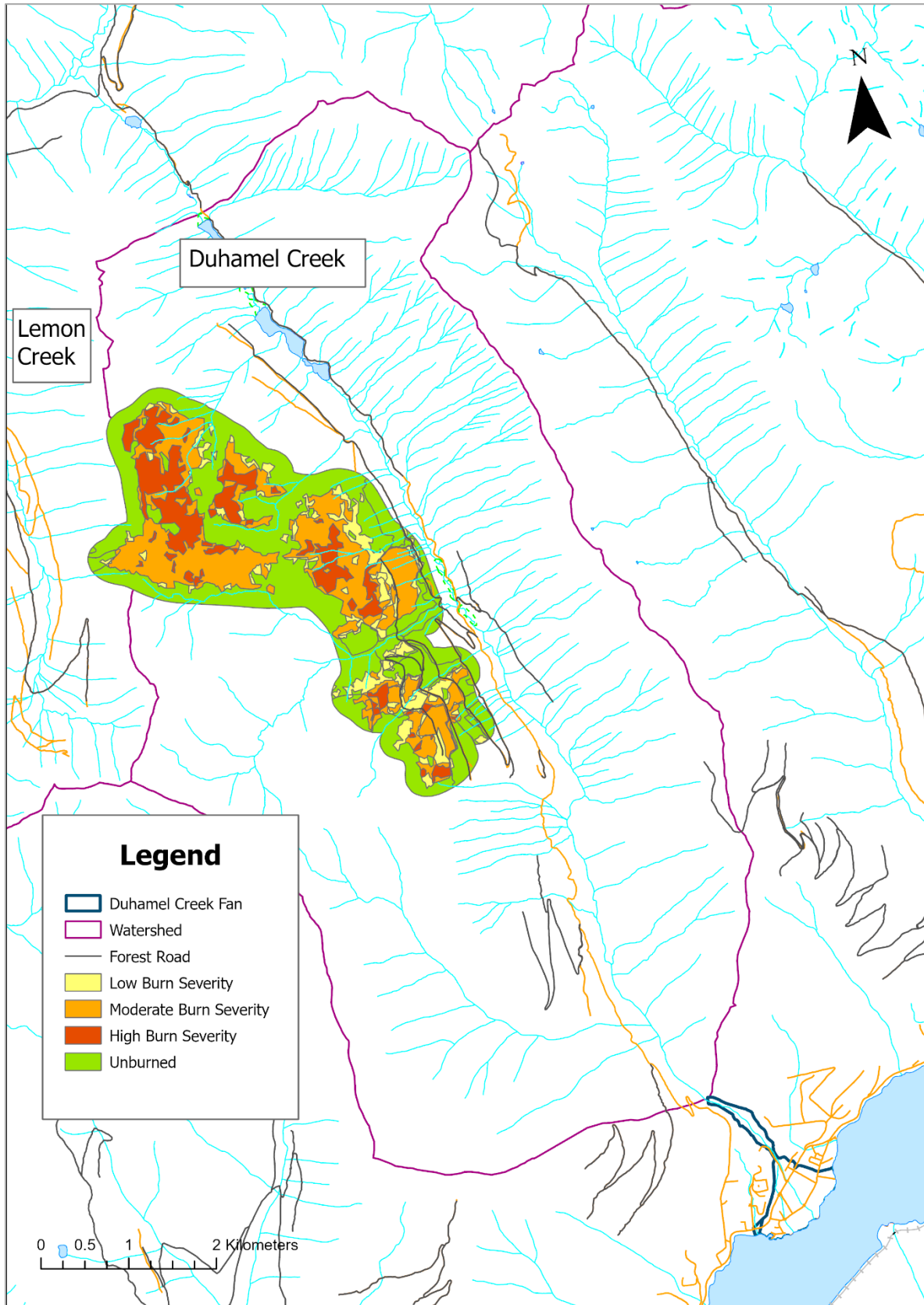


Figure 1 Burn severity map of the Monument Creek fire showing estimated classes derived from Sentinel-2 imagery (prefire: 2022-08-17, post-fire: 2022-09-21).



Figure 2 Overview of the Monument Creek fire viewed from the east.



Figure 3 Downstream view of Duhamel Creek from the southern boundary of the fire.



Figure 4 Overview of the northern end of the Monument Creek fire, showing the steep debris-flow prone watershed with high burn severity in the headwater area.



Figure 5 Overview of the southern end of the Monument Creek fire, showing the Duhamel Face (Heights) road and evidence of historical landslides.

Appendix to PWNHRA Reconnaissance Reports

Scope of reconnaissance reports

Reconnaissance reports are primarily intended to identify whether post-wildfire hazards are likely to occur and need detailed investigation to protect identified elements at risk. Identified elements at risk are generally limited to public safety and infrastructure. Reconnaissance reports may also be used to assess safety conditions for wildfire fighters. In some cases, the FLNRORD District Manager may request assessments for non-standard elements at risk or for other reasons.

Definitions of hazard and risk

Wildfire may produce conditions conducive to a suite of hazards. Debris flows, debris floods, and floods are often the most important hazards, but other types of landslide hazards including rockfall, debris slides and earthflows can also occur in response to wildfire. Wildfire can also cause snow avalanches and may affect water quality, cause erosion and result in sedimentation. Terrain, watershed, and channel conditions that produce post-wildfire hazards may also produce similar hazards in unburned conditions; these hazards may be mentioned, but are not evaluated in this report.

P(H), P(S:H) and partial risk are presented for each identified elements at risk. Multiple types of channel hazards (debris flows, debris floods, floods) may affect an element at risk. These hazards are ranked by severity, with debris flow as the most damaging and destructive and flood as the least damaging and dangerous, and ratings are given for the highest rating hazard that may affect an element at risk. For example, where a channel has the potential for a debris flow and an element at risk may be affected, the lower ranking debris flood and flood hazards are not rated, since discharge and velocity are likely to be less than for a debris flow. These processes may cause erosion or sedimentation that affects the element at risk. Hazards that are unlikely to affect an identified element at risk are not discussed.

Table A1 is a matrix which combines the hazard likelihood with the spatial impact likelihood to determine partial risk.

Table A1. Post-wildfire risk matrix partial risk matrix.

Hazard likelihood (Table A1)	Spatial impact likelihood (Table A2)		
	H	M	L
H	VH	H	M
M	H	M	L
L	M	L	VL

Report Standards

FLNRORD Land Management Handbook 69 is the primary standard followed in this report. LMH 69 describes the process to complete a detailed report. This reconnaissance report uses the framework of LMH 69 but does not follow it where detailed assessment procedures are described.

[Land Management Handbook 69 Post Wildfire Natural Hazards Risk Analysis in British Columbia 2015](https://www.for.gov.bc.ca/hfd/pubs/Docs/Lmh/Lmh69.htm)
<https://www.for.gov.bc.ca/hfd/pubs/Docs/Lmh/Lmh69.htm>

Additional guidance is provided in the FLNRORD SOG for PWNHRA and the 2014 FLNRO Landslide Risk Management Procedure.

Other professional guidance standards that may be used for the preparation of reconnaissance reports are listed below. These guidelines have similar report content to this reconnaissance assessment, but are for different purposes, have different levels of appropriate effort, and do not recognize the potential emergency nature of this reconnaissance assessment. These guidelines include:

EGBC Guidelines for TSA in the Forest Sector 2010
<https://www.egbc.ca/getmedia/684901d7-779e-41dc-8225-05b024beae4f/APEGBC-Guidelines-for-Terrain-Stability-Assessments.pdf.aspx>

EGBC Guidelines for Legislated Landslide Assessments 2010
<https://www.egbc.ca/getmedia/5d8f3362-7ba7-4cf4-a5b6-e8252b2ed76c/APEGBC-Guidelines-for-Legislated-Landslide-Assessments.pdf.aspx>

Legislated Flood Assessments in a Changing Climate in BC 2018
<https://www.egbc.ca/getmedia/f5c2d7e9-26ad-4cb3-b528-940b3aaa9069/Legislated-Flood-Assessments-in-BC.pdf>

Watershed Assessment and management of hydrologic and geomorphic risk in the Forest Sector
<https://www.egbc.ca/app/Practice-Resources/Individual-Practice/Guidelines-Advisories/Document/01525AMW2ATQA5BSODHJAKBAGZDYTRL6FJ/Watershed%20Assessment%20and%20Management%20of%20Hydrologic%20and%20Geomorphic%20Risk%20in%20the%20Forest%20Sect>

Other standards may also apply, depending on the professional qualifications of the writer.

Statement of Limitations

Reconnaissance PWNH assessments are typically done in constrained timelines where personnel, resources, data collection, and analysis methods are limited. Post-wildfire hydrogeomorphic hazards in BC are not well understood and therefore hazard and risk assessments are estimates only. While probabilities ranges are given in Tables A1 and A2, the state of the science in BC does not allow for precise assessments, particularly near the borders of classes. Numeric probabilities ranges do not imply precision.

Identification of elements at risk relies on BC government data layers, satellite imagery, and perhaps an overview flight. BCWS and the FLNRORD district office may provide additional information. No further confirmation of elements at risk was conducted.

Comments, conclusions and suggestions contained in this reconnaissance assessment reflect my experience and judgement in light of the information available to me at the time that this report was prepared and are considered appropriate for the reconnaissance nature of the review. The review has been carried out in accordance with generally accepted professional practices. This assessment and its contents are intended for the sole use of post-wildfire hazard management by provincial agencies, First Nation governments and local governments. I do not accept any responsibility for the accuracy of any of the data, the interpretation, or the conclusions contained or referenced in the report when the report is used or relied on for any other purpose than specified. Any such unauthorized use of this report is at the sole risk of the user.

References

BGC Engineering Inc. 2020. *RDCK Floodplain and Steep Creek Study: Duhamel Creek*. Prepared for Regional District of Central Kootenay.

Northwest Hydraulic Consultants Ltd. And Thurber Consultants Ltd. 1990. *Alluvial Fan Hazard Assessment: Regional District of Central Kootenay Electoral Area "E" & "F"*. Prepared for Regional District of Central Kootenay.