WATERSHED REVIEW
GORDON CREEK WATERSHED
Draft March 23, 2012

Ministry Contract No: CS12NRH-011

BIOPHYSICAL AND LAND-USE CHARACTERISTICS OF THE WATERSHED

Table 1. Summary Information – Watershed Characteristics – (see Figures 1 and 2)

Size (km^2)	Dominant BEC Zones	Dominant NDT	Elevation Range (m)	Surficial Geology near the Mouth (i.e. sensitive area)	Stream Density (km/km^2)	Biggest % of watershed in same elevation band[1]	Distribution of slope gradients within the watershed (% of watershed)			
							<10% slope	10 to 30% slope	30 to 60% slope	>60% slope
36.4	ESSFmv2	NDT 2	1095-2033	Medium textured till	2.3	48.0	26.8	53.2	18.5	1.5

[1] The entire watershed is divided into 300 m elevation bands. The less elevation bands there are and the more area is represented by any given single elevation band, then the greater will likely be the effect of forest harvesting on increased peak flows due to the theoretical concept of "synchronization" (i.e. the melt from the cutblocks is synchronized as much of it comes from the same elevation), and the greater sensitivity it will have.

Table 2. Rating of "Sensitivity" of Watershed to Increased Peak Flow at the lower reaches

Rosgen Stream Channel Type	Rosgen Stream Channel Sensitivity Score	Sensitivity score relative to topography	Sensitivity score relative to lateral connectivity	Sensitivity score relative to vertical conductivity	Sensitivity score relative to climate	Sensitivity score relative to flow synchroniza-tion potential	Sensitivity score relative to NDT type	Sensit-ivity Score	Sensitivity Rating
F4- Lightly unstable/disturbed	4.3	1	1.1	1	1.1	1.07	1.03	5.72	Very High

Table 3. Rating of "Sensitivity" of Watershed to Increased Production of Fine Sediment at lower reaches

Stream Channel Type	Reach Sensitivity Score	Sensitivity score relative to topography	Sensitivity score relative to lateral connectivity	Sensitivity score relative to drainage density	Sensitivity score relative to climate	Sensitivity score relative to soils	Sensitivity Score	Sensitivity Rating
Riffle pool cobble	4	1	1.2	1	1.1	1	5.3	Very High

Table 4. Rating of "Sensitivity" of Watershed to a Loss In riparian Function.

Stream Channel Type	Reach Sensitivity Score	Sensitivity score relative to Aspect	Sensitivity score relative to climate	Overall watershed sensitivity to loss of riparian	Loss of Riparian Sensitivity Rating
F3-F6 w FP	4.5	0.9	0.9	3.65	Mod

Table 5. Peak Flow Hazard Rating, as indexed by HEDA – current scenario (i.e. no proposed harvesting considered)

Watershed area (km^2)	Total area Pine Leading (km^2)	Total area Pine Mixed (km^2)	Total area harvest (km^2)[1]	Total HEDA from Pine Beetle alone (%)	Total HEDA from logging alone (%)	Total HEDA from logging and Pine Beetle mortality (%)
36.4	9.4	5.14	0.52	17.11	1.43	18.54

[1]Note: This includes openings from VRI database, and non-overlapping openings from RESULTS and FTEN databases.

Table 5 (continued)

Total area in Agriculture (km^2)	Total area in Agriculture (% of watershed)	Total area in Proposed Harvest (km^2)	Total HEDA (%)	HEDA Hazard rating Score	HEDA Hazard Rating
0.00	0.00	0.00	18.54	1.58	Low

Table 6. Fine Sediment Hazard Rating, as indexed by the Stream Crossing Density

Watershed area (km^2)	# of x-ings	#of fish bearing X-ings[1]	#of non-fish bearing X-ings	density of x-ings (#/km^2)	Density of fish bearing X-ings (#/km^2)	Density of non-fish bearing X-ings (#/km^2)	Hazard Rating Score	Hazard Rating
36.4	13	13	0	0.4	0.4	0.00	2.06	Low

[1]Note: The information on stream crossings was provided by MoE and was generated with a GIS model, not fieldwork.

Table 7. Loss of Riparian Function Hazard Rating

Reach Number	Rosgen Stream Type	Reach Length (m)	% riparian logged (as interpreted from air photos)	Apparent stability and other comments (as viewed from air photos)
1	F4- Lightly unstable/disturbed	648	0.0	Lightly De-stabilized
2	F4- Lightly unstable/disturbed	2153	0.0	Lightly De-stabilized
3	F4- Lightly unstable/disturbed	2072	0.0	Lightly De-stabilized
4	B3- Lightly unstable	1723	0.0	Lightly De-stabilized
5	B3- Lightly unstable	1843	0.0	Lightly De-stabilized
6	B3- Lightly unstable	2054	0.0	Lightly De-stabilized
Hazard Scores:			Hazard Rating Score	Hazard Rating
			0.25	Very Low

Table 8. Risk Rankings for the Different Hazards in the watershed current scenario (i.e. no proposed harvesting considered)

Watershed Hazard Types	Sensitivity Score	Sensitivity Rating	Hazard Score	Hazard Rating	Risk Score	Risk Rating
Increased Peak Flow	5.72	Very High	1.58	Low	9.0	Mod
Increase in Production of Fine Sediment	5.28	Very High	2.06	Low	10.9	Mod
Loss of Riparian function	3.65	Mod	0.25	Very Low	0.9	Very Low

Table 9. Fisheries Sensitive Watershed Score and Rating

Name	Size (km^2)	Peak Flow Sensitivity	Sed Sensitivity Rating	Riparian Sensitivity	Fish Value[1]	FSW Score PF vs Fish	FSW Score Seds vs Fish	FSW Score Rip vs Fish	Overall FSW Score	Overall FSW Rating
Gordon Creek	36.4	Very High	Very High	Mod	High	4	4	2	10	High

[1]Note: The "Fish Values" were assessed and provided by Fisheries Biologists from the Ministry of Forest, Lands and Natural Resource Operations. This report does not describe fish values.

INTERPRETATIONS AND RECOMMENDATIONS FOR MANAGEMENT STRATEGIES FOR PROTECTION OF WATER RESOURCES IN THIS WATERSHED

Brief Watershed Description (Table 1 and Figures 1 and 2)

Gordon Creek watershed is a tributary to the Babcock Creek watershed and enters Babcock Creek just above reach # 6. The Gordon Creek watershed has a generally rolling topography with a more mountainous terrain at the back end where it flows down from Quintette and Roman Mountains (Figure 1). Elevations in this watershed range between 1095 and 2033 m, which makes it a relatively high elevation watershed. Most of this watershed spans just two 300 m elevation bands where 48% of the watershed is in the 1095 to 1395 m band and 45% of the watershed in the 1395 to 1695 band. There is not an abundance of steep slopes in this watershed as only 18% has slopes greater than 30% and only 1.5% has slopes greater than 60%. Almost all of this higher elevation watershed is located in the ESSFmv2 biogeoclimatic zone.

The mainstem of Gordon Creek is a moderate gradient confined channel that flows through entrenched canyons with limited floodplain (Figure 4). There are a few occurrences of natural failures of these steep valley walls that flow directly into Gordon Creek, which makes the channel somewhat unstable (Figures 5 and 6). There is also an abundance of flat-over-steep terrain along many of the canyon reaches (Figures 5 to 7). The surficial geology of this watershed is dominated by a mixture of fine and moderately coarse morainal tills in the lower part of the watershed and coarse colluvium rubble in the upper parts (Figure 2). Much of the lower mainstem reaches have been classified as a slightly unstable Rosgen F4 type channel (Table 7, Figures 4 to 6), with the upper reaches being classified as B3 channels. The mainstem has been well protected from riparian harvesting throughout the watershed (Table 7) and thus has a very low riparian hazard rating.

Sensitivities, Hazards and Risks in this Watershed

The overall sensitivity of the watershed to increases in peak flows has been classified as very high which is mostly a result of the very sensitive nature of the lower stream reaches, the absence of buffering lakes and the limited distribution of elevation bands (Table 2). The sensitivity to increases in fine sediments has also been classified as very high, which is due to the sensitive stream types, the abundance of flat over steep terrain and high lateral conductivity. The overall sensitivity to a loss in riparian function has been assessed as moderate because much of the watershed is located in the ESSF biogeoclimatic zone where sensitivities to temperature increases are not as significant.

None of the current risk ratings are high which is largely due to low hazard ratings for all three hazard types (Table 8). There has been very limited past forest harvesting in this watershed and almost all of the HEDA is generated by the extensive stands of pine, which are assumed to have been killed by pine beetle. It may take many years before these stands are hydrologically recovered.

When considering both the overall physical sensitivities in this watershed and the fisheries values, the Fisheries Sensitive Watershed (FSW) rating is assessed as High (Table 9).

Suggested Special Management Objectives To Protect Fish Habitat Values <u>Above and Beyond</u> What is Already Required by FPPR

1) Risks associated with an increase in peak flows
   Given that the current peak flow sensitivity for this watershed is <u>high,</u> recommendations are as follows:

   a. Maintain peak flow risks to a maximum of a <u>Low level</u>
      i. Current HEDA= <u>18.5%</u>
      ii. Max HEDA to maintain low risk = <u>15%.</u> This means that the current risk is already above the maximum recommended and thus needs to be lowered by delaying any future forest harvesting until the watershed has recovered from the impacts of the beetle infestation.
      iii. Available harvest in green timber to maintain low risk = In order to maintain a low risk, land-use related forest disturbances in this watershed would have to be curtailed for many years until the impacts of the pine beetle have recovered.
      iv. Use the peak flow risk calculator to determine the maximum suggested harvest of different combinations of healthy stands and mountain pine beetle affected stands in order to maintain the risk level below moderate.

2) Risks associated with the accelerated delivery of fine sediments
   Given that the current fine sediment sensitivity for this watershed is high, recommendations are as follows:

   a. Minimize erosion and the delivery of fine sediments at all stream crossings and keep the WQEE stream crossing rating to a maximum of a Low hazard level.

i. To complete these assessments, use the most recent WQEE protocol which can be found at the following web link: http://www.for.gov.bc.ca/ftp/hfp/external/!publish/frep/indicators/Indicators-WaterQuality-Protocol-2009.pdf

b. All flat over steep terrain that is planned for development should be assessed by a qualified professional and managed accordingly to prevent accelerated slope failures into Gordon Creek.

3) Risks associated with a loss in riparian function

Given that the current riparian sensitivity for this watershed is only moderate, no special recommendations are provided for special management objectives above and beyond what is already required by the Forest Planning and Practices Regulations (FPPR):

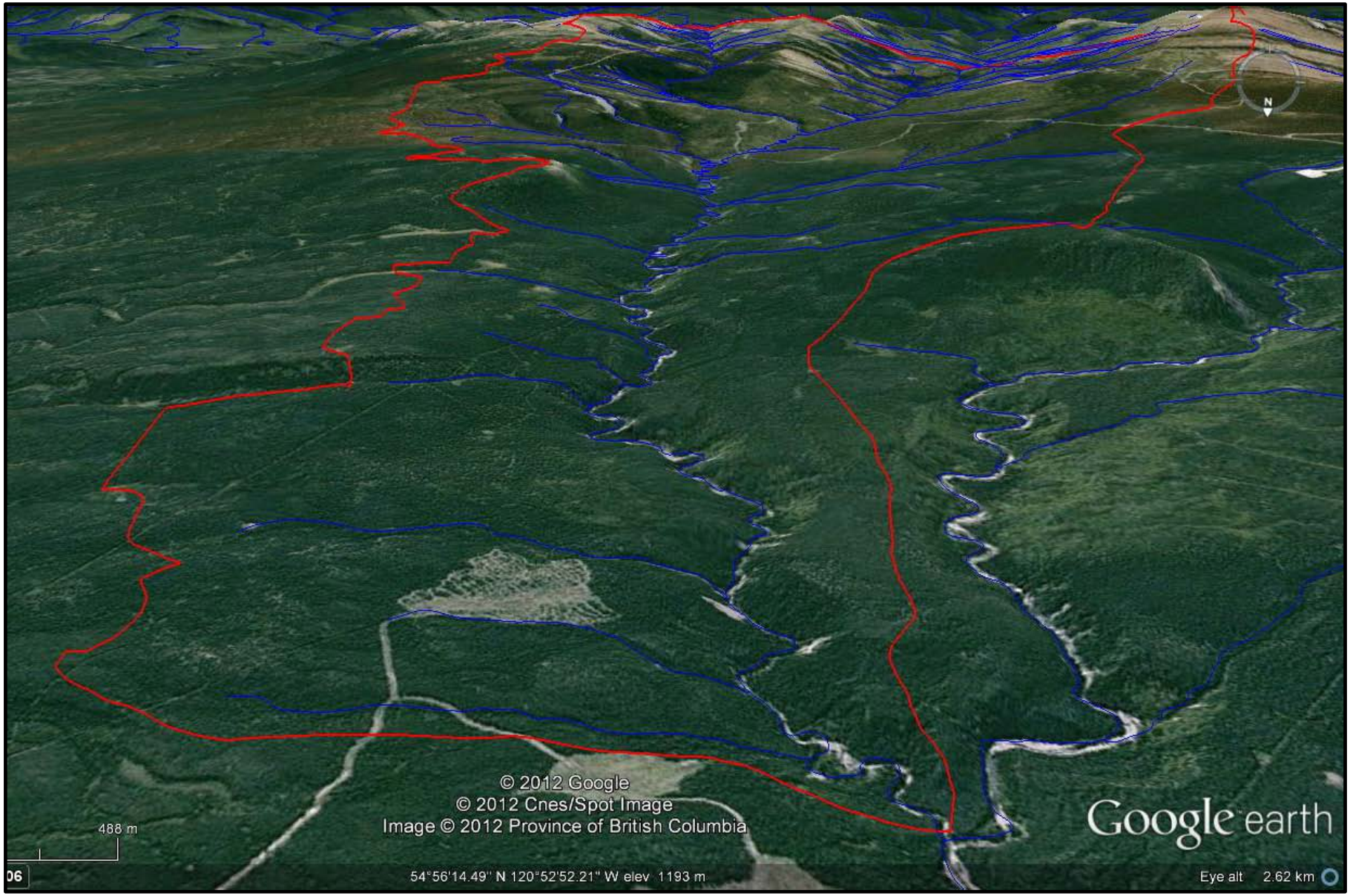

Figure 1. Google earth overview image of Gordon Creek watershed, looking upstream into the watershed.

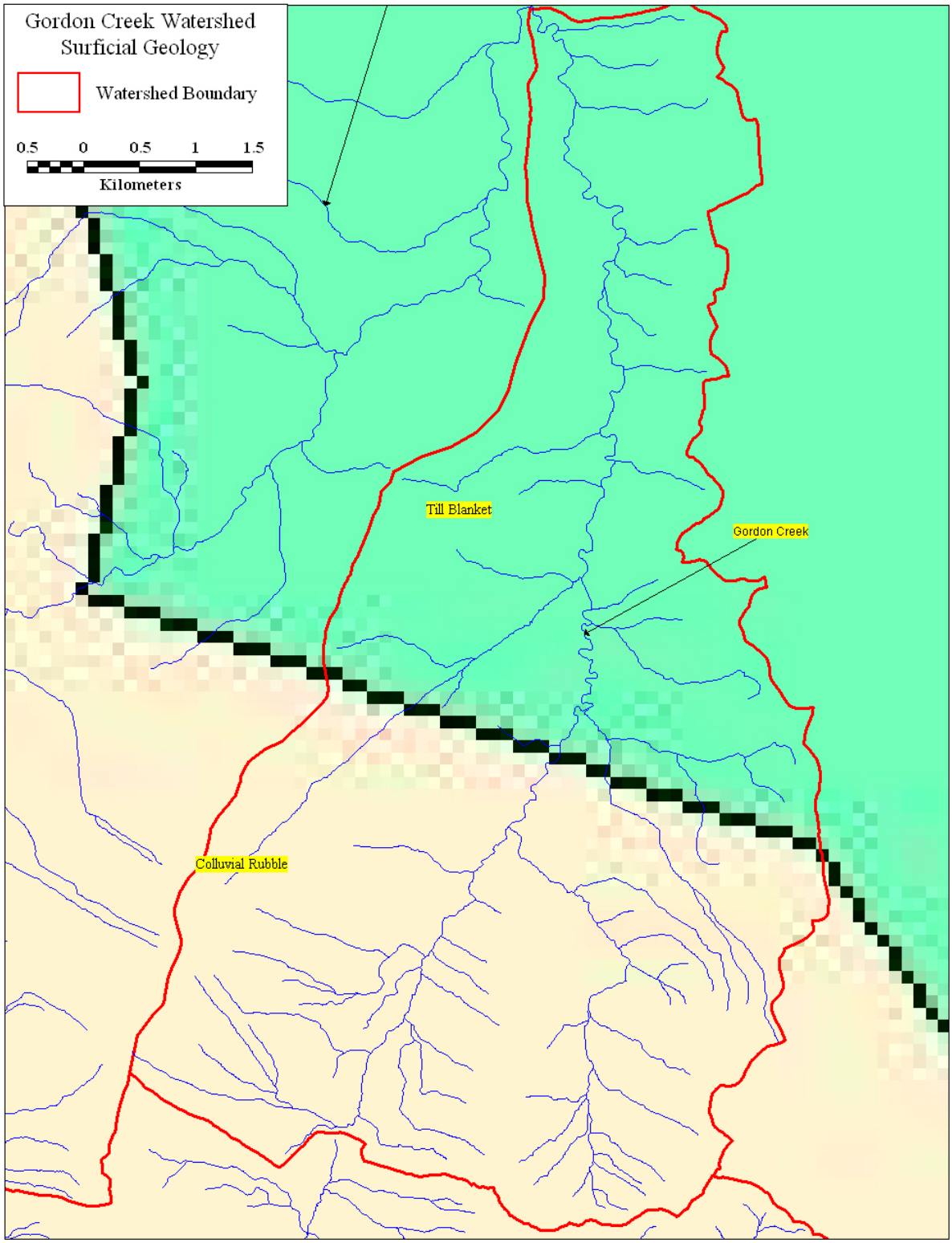

Figure 2. Distribution of dominant surficial geology types in the Gordon Creek watershed (from 1:5M BC Geological Survey Maps).

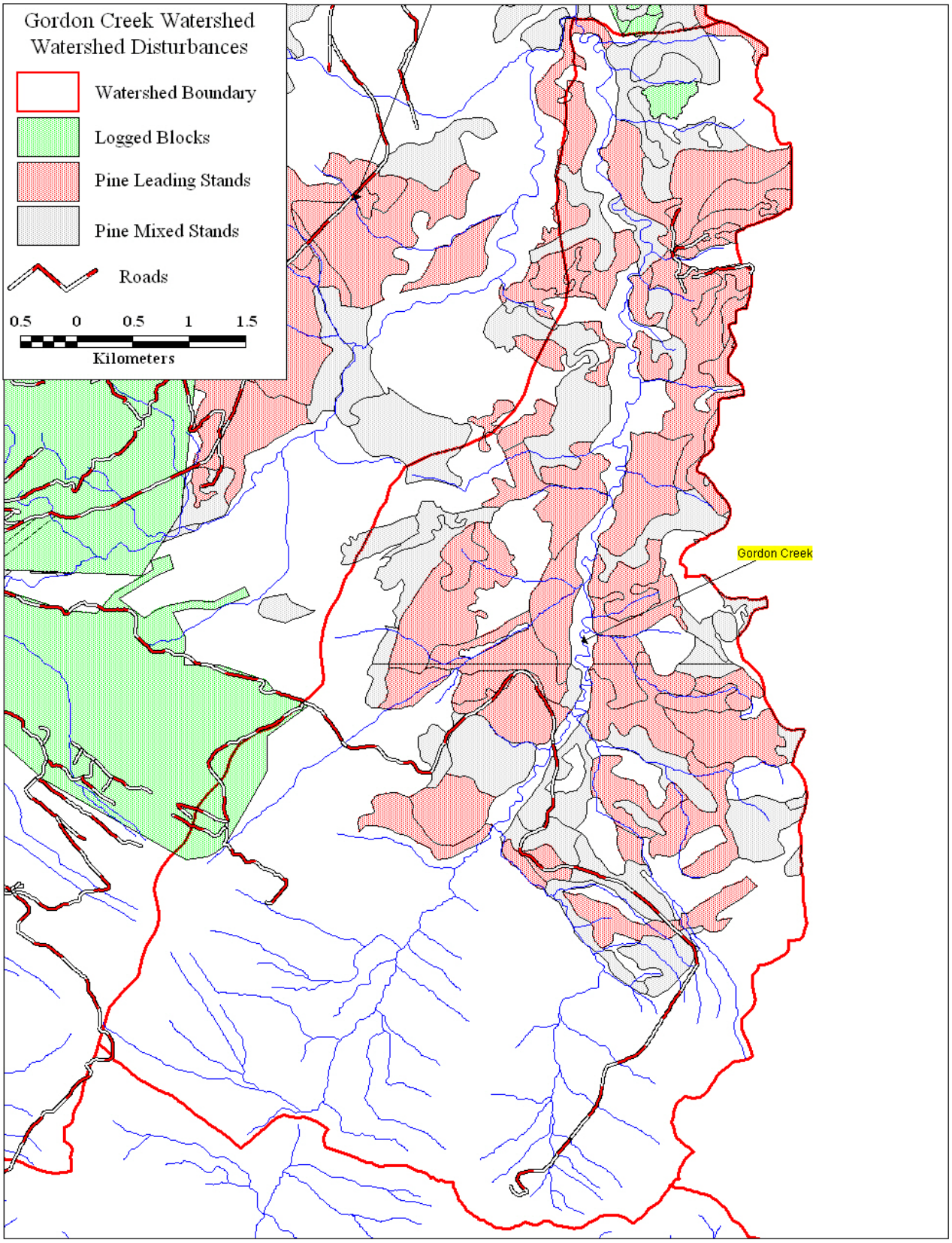

Figure 3. Land-use related and large natural disturbances in the Gordon Creek Watershed

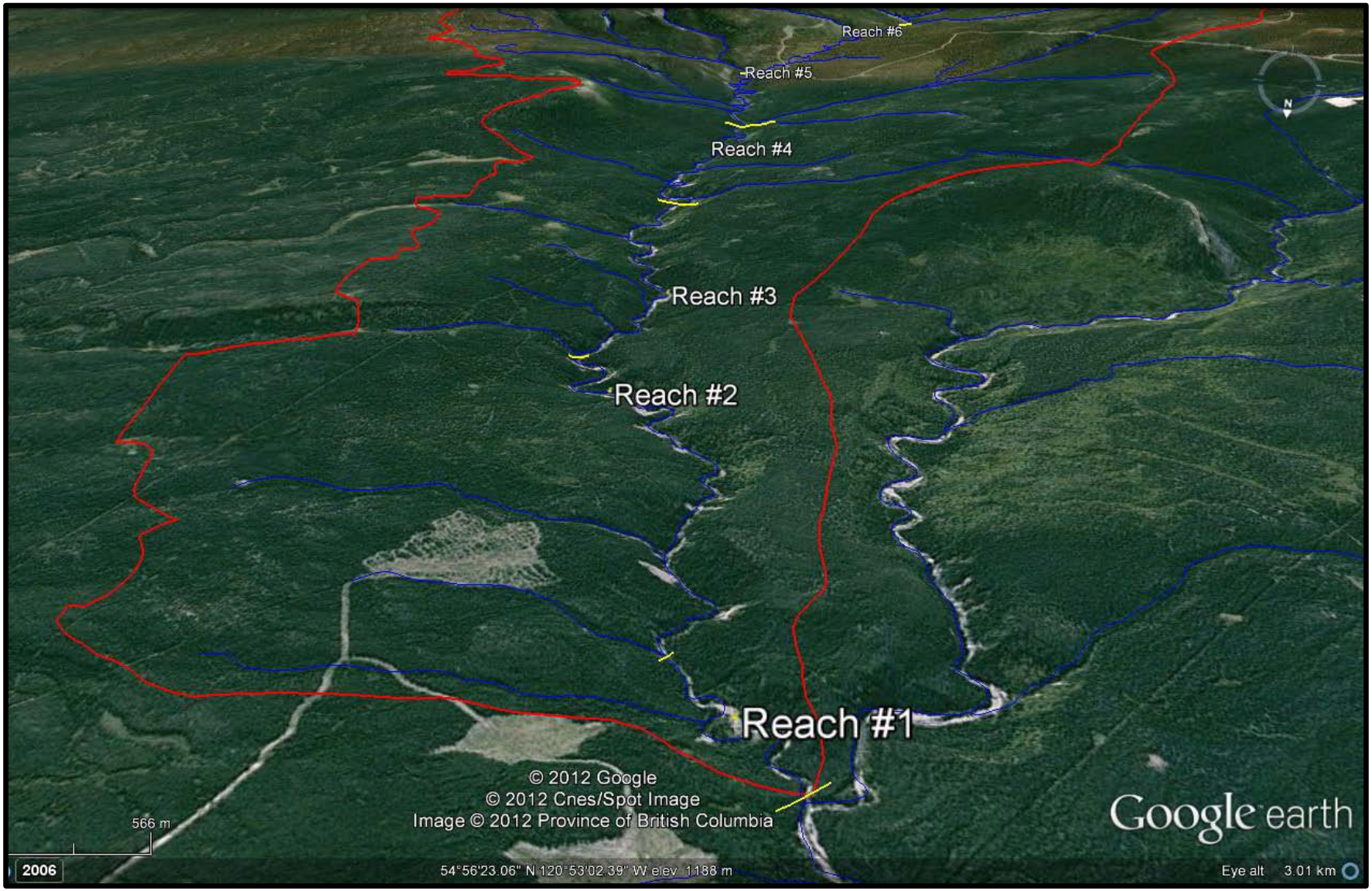

Figure 4. Identification of reaches along the mainstem of Gordon Creek watershed

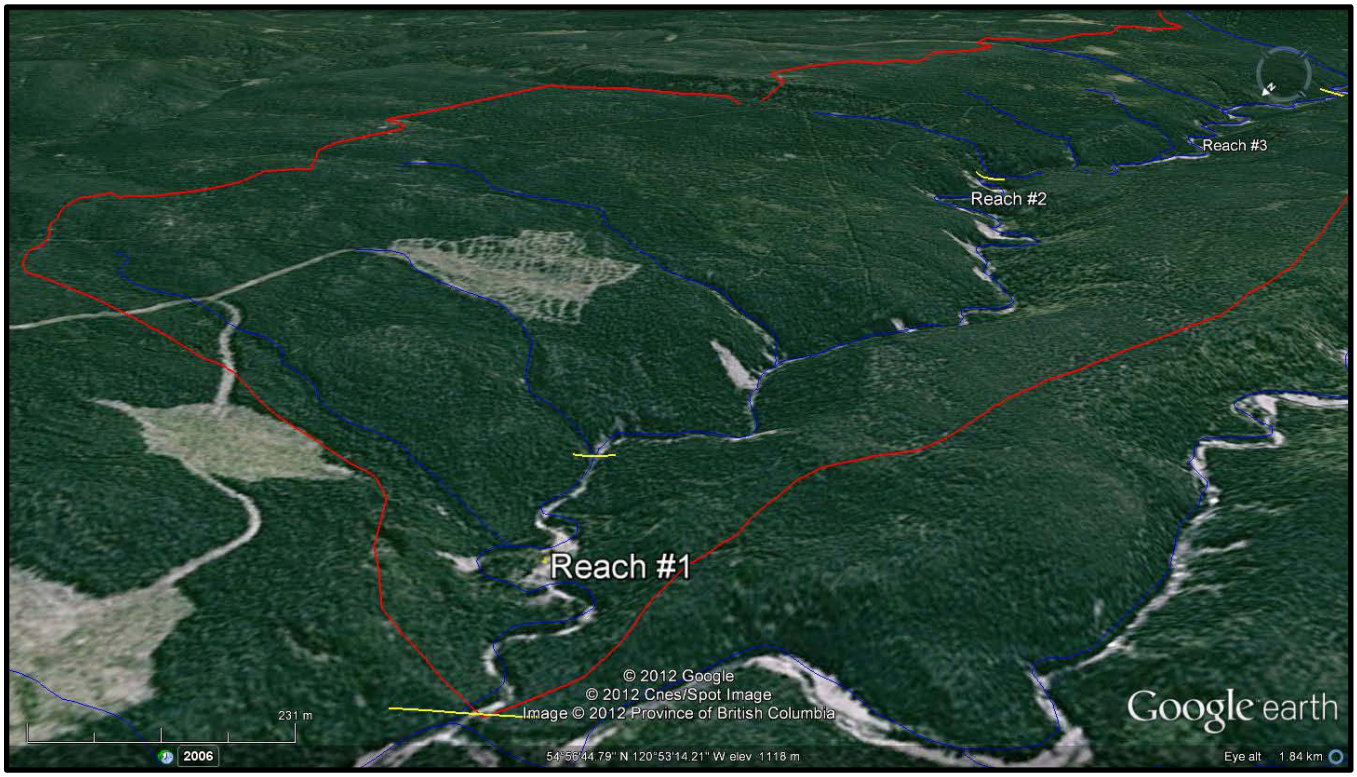

Figure 5. Google Earth image looking upstream along Reaches #1 and 2 of Gordon Creek.

Figure 6. Google Earth image looking upstream along Reaches #3 and 4 of Gordon Creek.

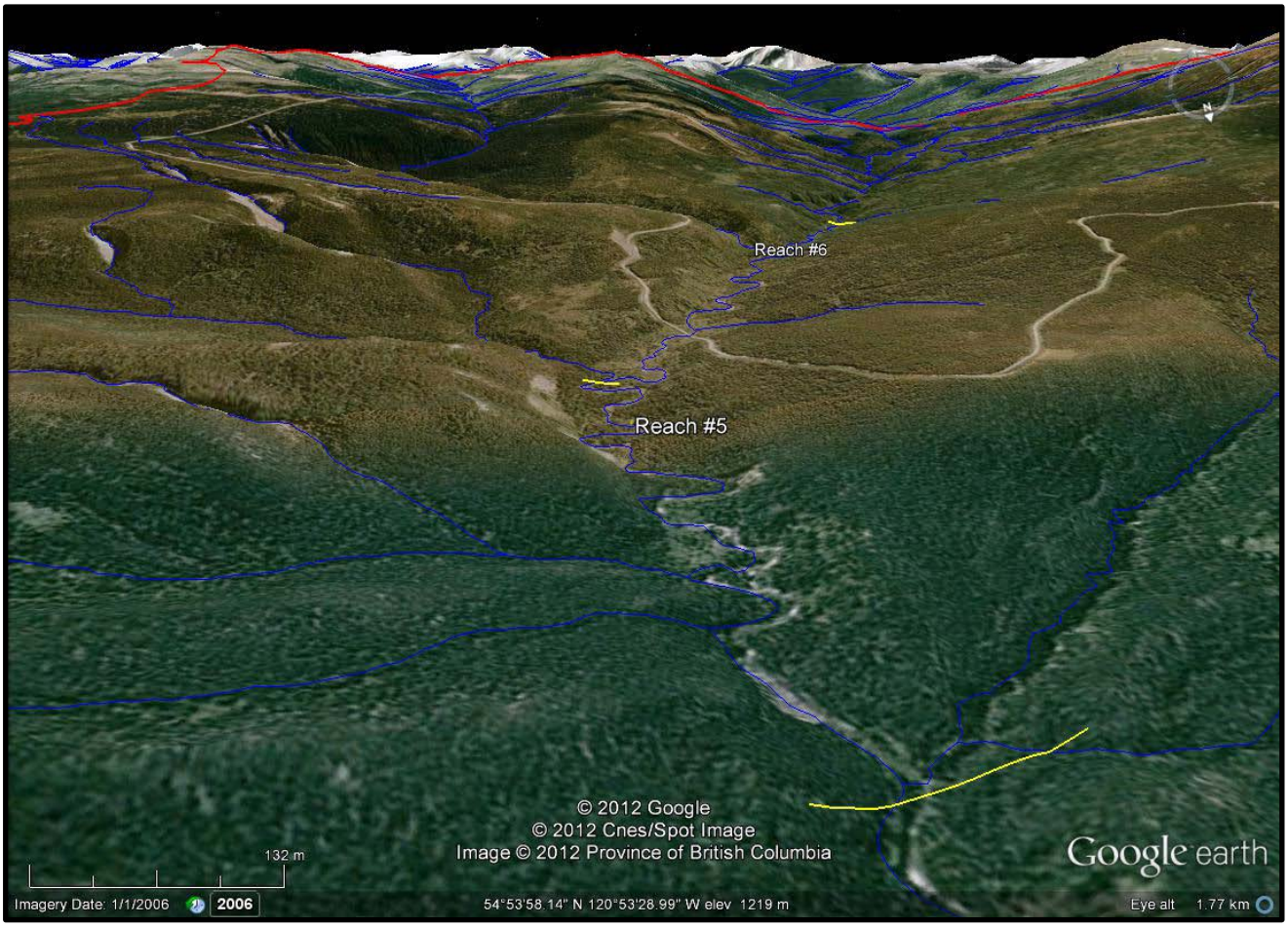

Figure 7. Google Earth image looking upstream along Reaches #5 and 6 of Gordon Creek.