WATERSHED REVIEW
FOXY CREEK WATERSHED

BIOPHYSICAL CHARACTERISTICS OF WATERSHED

Table 1. Summary Information – Watershed Characteristics – (see Figure 1)

Size (km^2)	Dominant BEC Zones	Dominant NDT	Elevation Range (m)	Dominant Surficial Geology	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
96.1	SBS	NDT3	791 - 1588	Coarse textured till on rolling terrain	1.89	53	59.7	37.8	2.5	0

[1] The entire watershed is divided into 300 m elevation bands of harvestable forest land-base. 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. Dominant soil textures in the watershed

Surficial Geology	Total area of surficial material in watershed (km^2)	Percent in watershed	Sensitivity to disturbance (mostly roads, trails and crossings)
Very Fine Textured Lacustrine	0	0.0	Very High Sensitivity
Fine textured fluvial	0	0.0	Very High Sensitivity
Fine textured till	0	0.0	High Sensitivity
Medium textured till	10.9	11.3	Moderate Sensitivity
Coarse textured till on rolling terrain	89.11	92.7	Low Sensitivity
Coarse textured fluvial	2	2.1	Moderate Sensitivity
Colluvial	0	0.0	Low Sensitivity
Organic	0	0.0	Very High Sensitivity
Bedrock	0	0.0	Very Low Sensitivity
Eolian	0	0.0	Very High Sensitivity
Marine (including glaciomarine)	0	0.0	Very High Sensitivity

Table 3. Rating of "Sensitivity" of Watershed to Increased Peak Flow at the lower reaches

Rosgen Stream Channel Score	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
C4 - Unstable/disturbed	5	0.75	1.05	1	1.1	1	1	4.33	High

Table 4. Rating of "Sensitivity" of Watershed to Increased Production of Fine Sediment at lower reaches

Most sensitive fish species in watershed[1]	Species Sensitivity Score	Sensitivity score relative to topography	Sensitivity score relative to lateral connectivity	Sensitivity score relative to climate	Sensitivity Score	Sensitivity Rating
Chinook Salmon	4.4	0.75	1.1	1.1	3.993	High

[1]Note: See Figure 2 for general distribution of fish species in this watershed.

Table 5. Rating of "Sensitivity" of Watershed to a Loss In riparian Function.

Most sensitive fish species in watershed	Species Sensitivity Score	Sensitivity score relative to loss of LWD	Sensitivity score relative to Aspect	Sensitivity score relative to climate	Overall watershed sensitivity to loss of riparian	Loss of Riparian Sensitivity Rating
Chinook Salmon	4.4	1.25	0.85	1.1	5.14	Very High

Table 6. Peak Flow Hazard Rating, as indexed by HEDA

Watershed area (km^2)	Total area Pine Leading (km^2)	Total area Pine Mixed (km^2)	Total area harvest (km^2)	Total HEDA from Pine Beetle alone (%)	Total HEDA from logging alone (%)	Total HEDA from logging and Pine Beetle mortality (%)
96.1	16.98	13.81	22.06	13.15	14.11	27.25

Table 6 (continued)

Total area in Agriculture (km^2)	Total area in Agriculture (% of watershed)	Total area in Other Openings[1] (km^2)	Total HEDA with Logging, O and G & Agriculture (%)	HEDA Hazard rating Score (includes Logging, O and G and Agriculture)	HEDA Hazard Rating
0.42	0.44	5.01	32.90	3.00	Mod

[1]Note: This includes Oil and Gas and mining openings

Table 7. 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
96.1	74	68	6	0.8	0.7	0.1	2.97	Mod

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

Table 8. Loss of Riparian Function Hazard Rating (See Figures 3 to 6))

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	C4 - Unstable/disturbed	217	0.0	Quite Unstable
2	C4 - Unstable/disturbed	260	0.0	Moderately De-stabilized
3	C4- Lightly unstable/disturbed	820	0.0	Lightly De-stabilized
4	E4-Stable	834	0.0	Very Stable
5	B4-Stable	620	0.0	Very Stable
Hazard Scores:			Hazard Rating Score	Hazard Rating
			0.75	Very Low

Table 9. Risk Rankings for the Different Hazards in the watershed

Watershed Hazard Types	Sensitivity Score	Sensitivity Rating	Hazard Score	Hazard Rating	Risk Score	Risk Rating
Increased Peak Flow	4.33	High	3.00	Mod	13.0	Mod
Increase in Production of Fine Sediment	3.99	High	2.97	Mod	11.9	Mod
Reduction in Riparian Function	5.14	Very High	0.75	Very Low	3.9	Low

RECOMMENDATIONS FOR LAND-BASED INVESTMENT ACTIVITIES IN PRIORITY WATERSHEDS

1. Prior to the allocation of permits for treatment activities, the Foxy Creek watershed management plan should be reviewed and carefully considered in order to determine how any LBI planned activities may affect peak flow risk in the Foxy Creek watershed.
2. The allocation of permits for treatment activities in the Foxy Creek watershed should be planned in collaboration with all major licences that operate in the watershed so that the total disturbance does not exceed the peak flow risk threshold set by government for this priority watershed.
3. Maintain long term recruitment of large woody debris (LWD), shade and bank stability by retaining at least 90% of the riparian area. This riparian area refers to the management area measured from the closest streambank to a distance 15m upslope from the streambank on:
    i. S4 streams that are 0.5m or greater in stream channel width, or
    ii. S6 streams that are 0.5m or greater in stream channel width that flow directly into a fish stream.
4. Develop and implement effective erosion and sediment control plans for all stream crossings that are your responsibility, whether you are building them, using them or just maintaining them. The effectiveness of the erosion and sediment control at the stream crossing should be measured using the Water Quality Effectiveness Evaluation methodology developed by the Government of BC[1]
5. Prior to the initiation of any treatment activities, identify the presence of any 'flat-over steep" topography and manage appropriately where needed (Figure 2). These topographic features can be prone to slope instability when forest cover is removed and localized drainage is not well planned.
6. Consider under-planting as a reforestation treatment as this minimizes the detrimental effects on peak flow risk, compared to completely knocking down the stand.
7. In order to optimize hydrological recovery, planting of all treated sites should be done with the best growing stock that is appropriate for the site. The selection of appropriate species and planting densities should be done by a qualified professional based on a site specific assessment.
8. Not all of the dead pine stands in the watershed should be targeted for knock down treatments. Some should be left for natural regeneration and biodiversity thus creating a more diverse forest in the future with more age classes, i.e. the presence of dead pine stands in the watershed is not an ecological disaster.

[1] http://www.for.gov.bc.ca/ftp/hfp/external/!publish/frep/indicators/Indicators-WaterQuality-Protocol-2009.pdf

Table 10. Table of comments and observations

Comment #1	Reach 1 and 2 appear to have jumped their banks and probably flow down an old road. I suspect that there has been some old riparian removal along the reaches of lower Foxy Creek and into lower Maxam Creek. VRI calls it NCBr, which means that it is natural brush, rather than riparian logging.
Comment #2	Only rainbow trout in the upper watershed. The main sensitive fish values are in the lower three reaches. These reaches should be protected from further degradation caused by possible increases in peak flows. According to DFO, this system has not seen coho or sockeye since 1985.
Comment #3	The water quality outflow from Equity Silver Mine at the top of the watershed may have significant influence on fish habitat throughout the lower sensitive reaches.
Comment #4	Much of the mainstem flows through a deeply incised canyon that appears to have fairly stable walls and no significant terrain stability management issues. However this topography can be sensitive to forest harvesting (i.e. flat-over-steep topography) (Figure 2).
Comment #5	There is a potential flat over steep problem along the canyon, but there is no evidence of land-use related failures in this terrain type (Figure 2).
Comment #6	It appears that some old riparian logging has occurred along the smaller streams (Figure 7).

INTERPRETATIONS AND RECOMMENDATIONS FOR MANAGEMENT STRATEGIES FOR PROTECTION OF FISH RESOURCES WITHIN THIS CANDIDATE FISHERIES SENSITIVE WATERSHED

This watershed has a high sensitivity to increased peak flows a high sensitivity to increases in fine sediment and a very high sensitivity to loss of riparian functions. However, the watershed has a high risk rating only for the sediment hazard and a moderate and low risk ranking for the peak flow and riparian hazards, respectively.

As suggested above, the dominant land-use risk in this watershed is associated with the development, use and maintenance of the road network. Although the soils in this area are relatively coarse and thus less erodible, the stream crossing density is quite high in this watershed, generating a risk ranking for this variable of High (Table 9). Effective erosion and sediment control practice at road crossings should be primary watershed management objective in this watershed. To this end the following objective should be implemented:

a) Manage fine sediment production at all active road crossings on fish streams, and direct tributaries to fish streams, such that the risk level is kept below a moderate rating. The FREP Water Quality Effectiveness Evaluation (WQEE) protocol[2] provides an approved, standardized and repeatable methodology to provide an estimate of the order of magnitude of the sediment contribution by the presence of the stream crossing, road and road right-of-way.

The risk associated with increased peak flows is currently at a moderate level (Table 9). Given that one of the main objectives of a fisheries sensitive watershed is to protect fish and fish habitat, I recommend the peak flow risk be maintained below a moderate level. This means that further stand treatment and forest harvesting activities in this watershed will have to minimized and possibly curtailed until hydrological recovery has occurred on the newer cut-blocks if a low peak flow risk is desired.

There appears to have been some riparian logging along the smaller headwater tributaries which may be inhabited by rainbow trout (Figure 7). If this watershed is designated as a Fisheries Sensitive Watershed, the riparian area along the small streams should be protected as follows:

1) Maintain long term recruitment of large woody debris (LWD), shade and bank stability to the stream channel by retaining at least 90% of the riparian area in a state undisturbed by primary forest activities.

Riparian Area – For the purposes of the riparian protection recommended above, riparian area refers to the management area measured from the closest streambank to a distance 15 m upslope from the streambank on:

iii. S4 streams that are 0.5 m or greater in stream channel width, or
iv. S6 streams that are 0.5 m or greater in stream channel width that flow directly into a fish stream.

[2] http://www.for.gov.bc.ca/ftp/hfp/external/!publish/frep/indicators/Indicators-WaterQuality-Protocol-2009.pdf

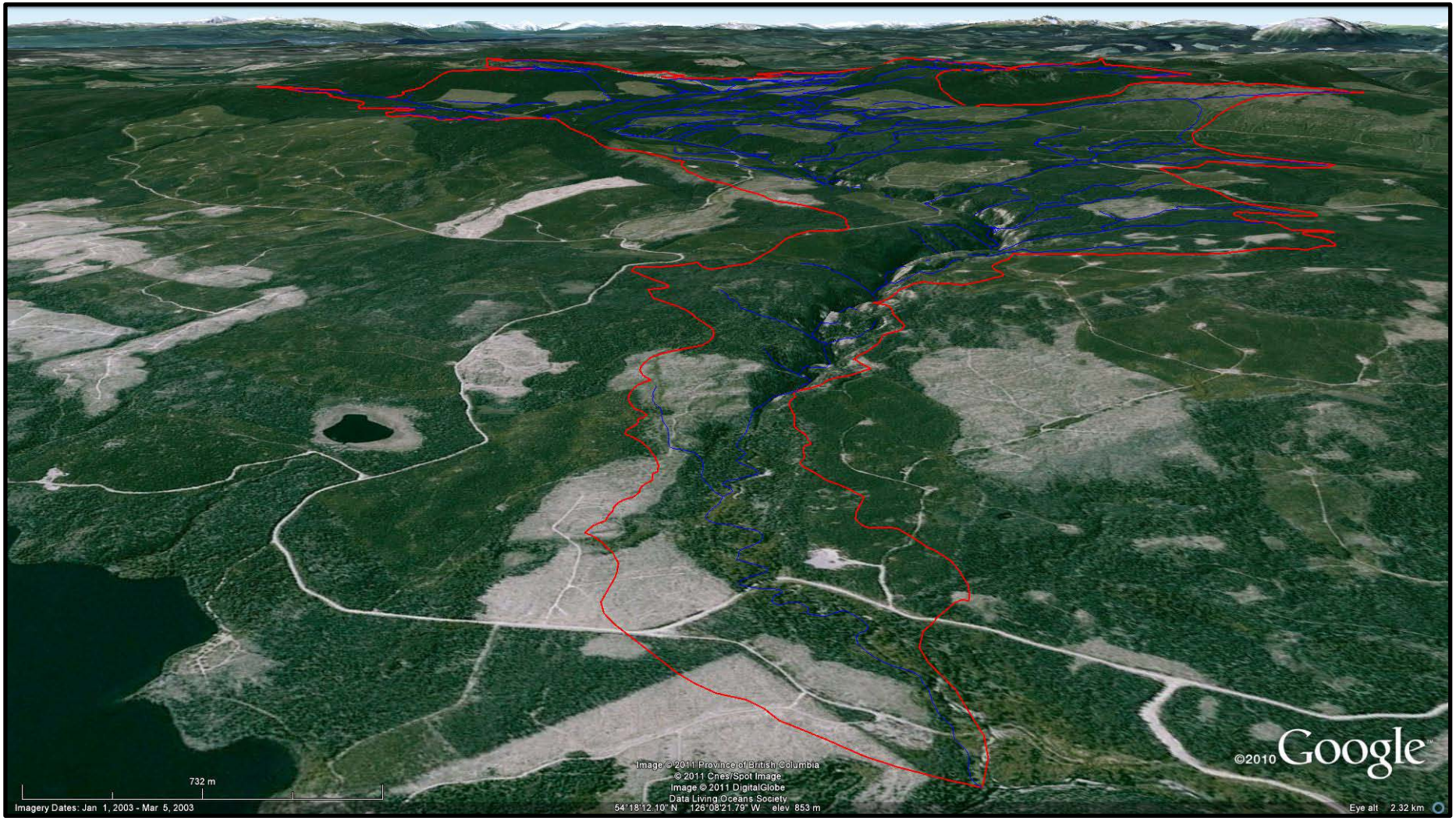

Figure 1. Overview image of Foxy Creek watershed, looking upstream into the watershed.

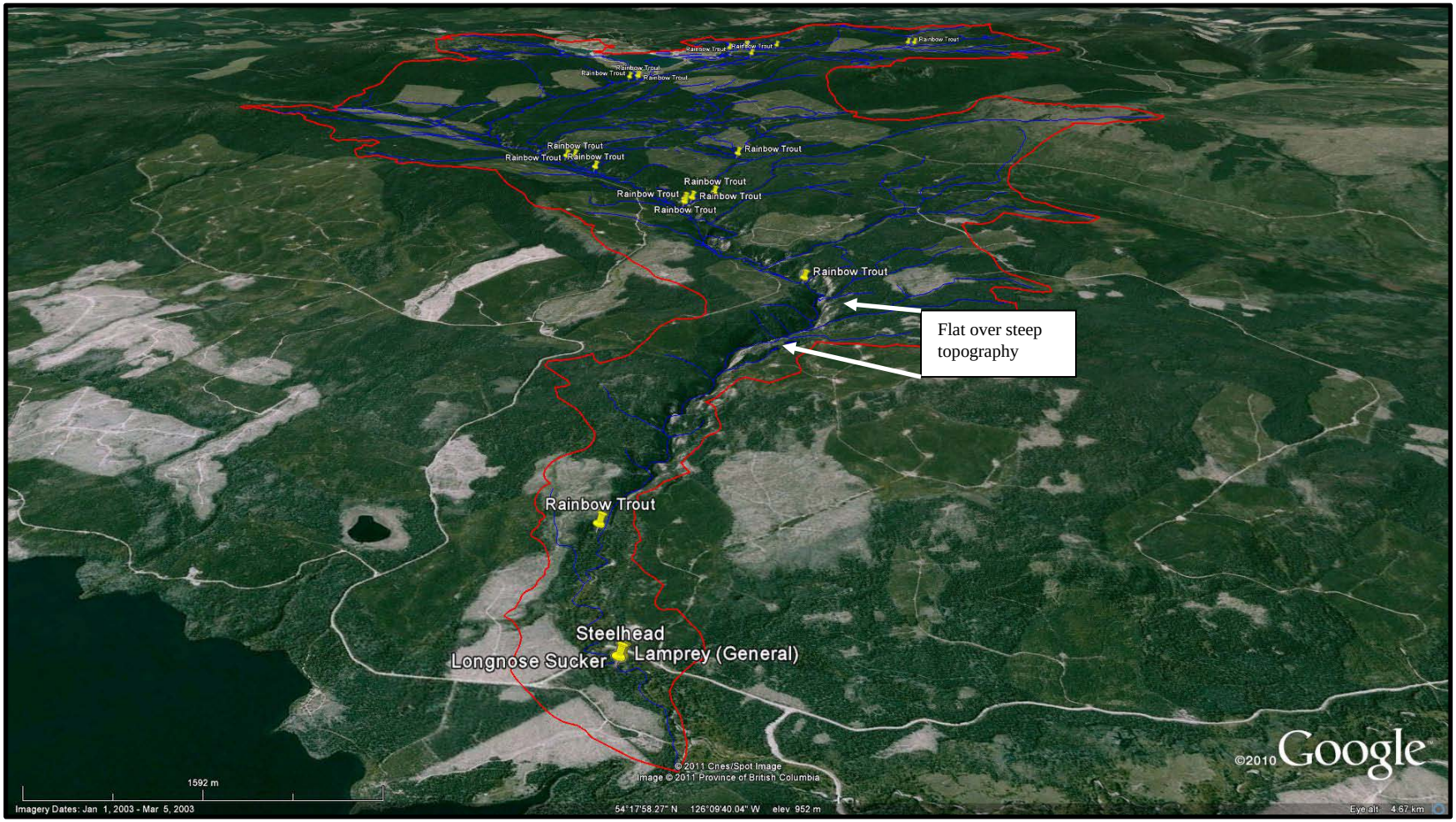

Figure 2. General distribution of fish species in the Foxy Creek watershed.

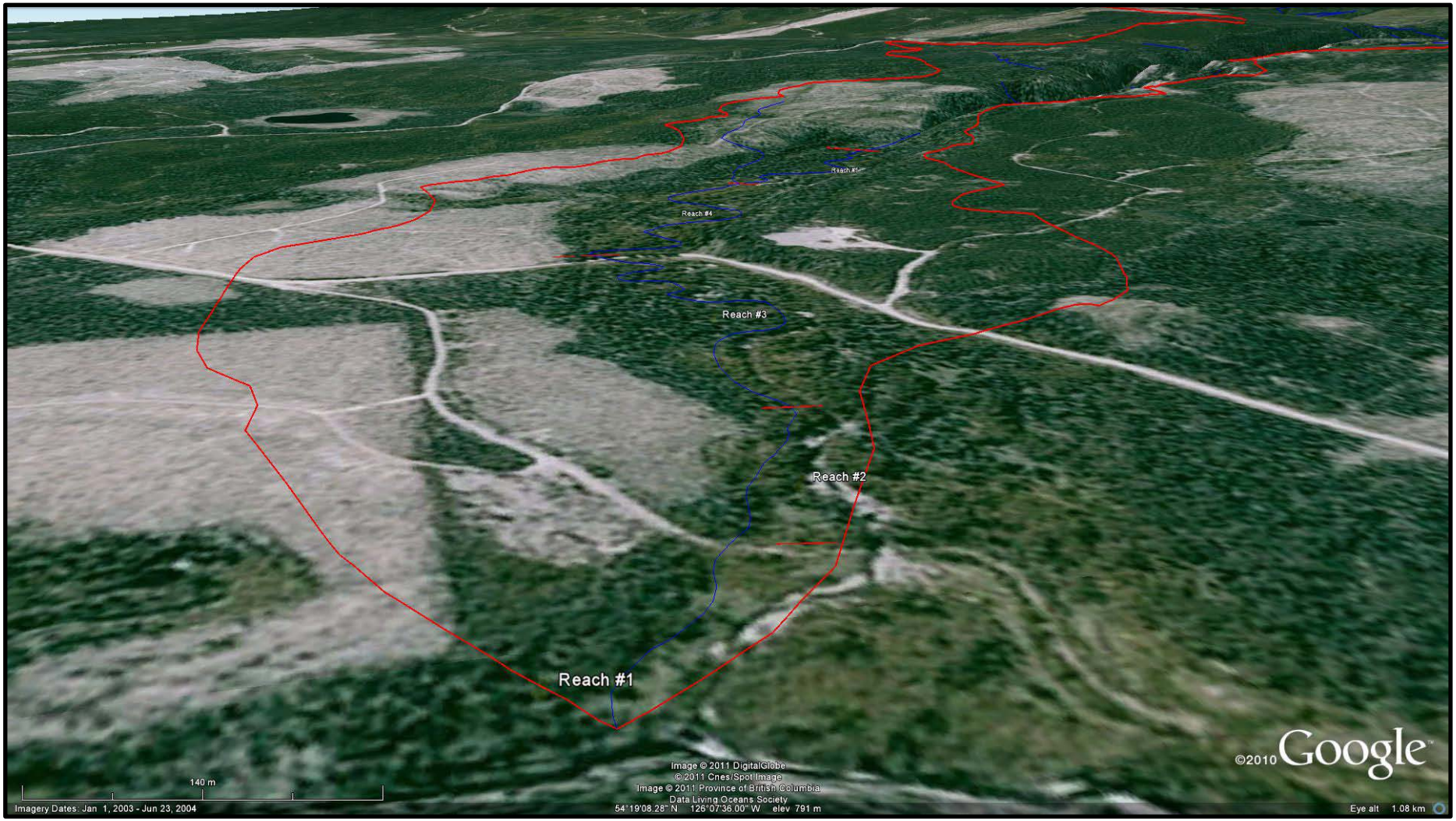

Figure 3. Google Earth image of lower three reaches of Foxy Creek.

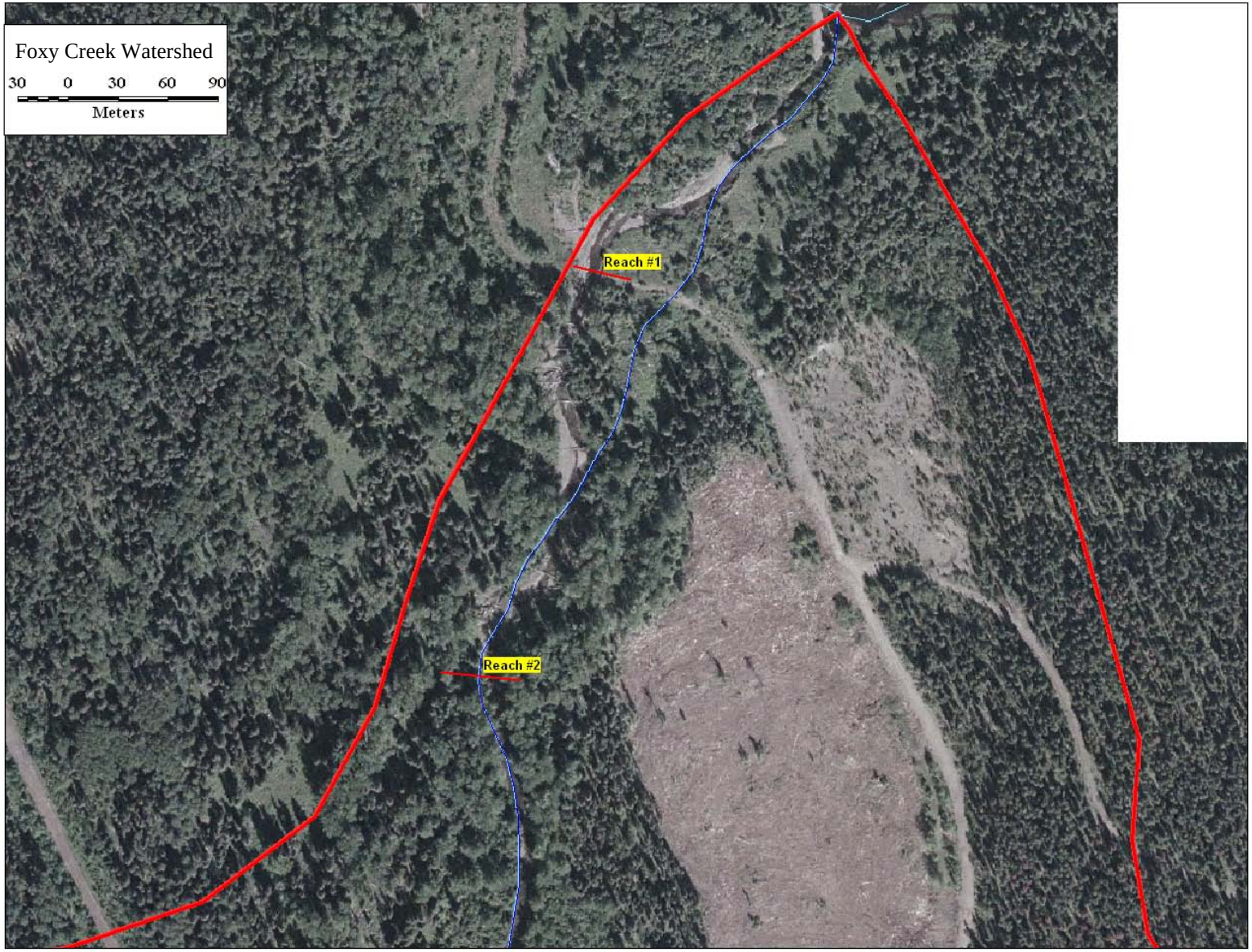

Figure 4. Vertical ortho-photo of Reach #1 and Reach #2 of Foxy Creek.

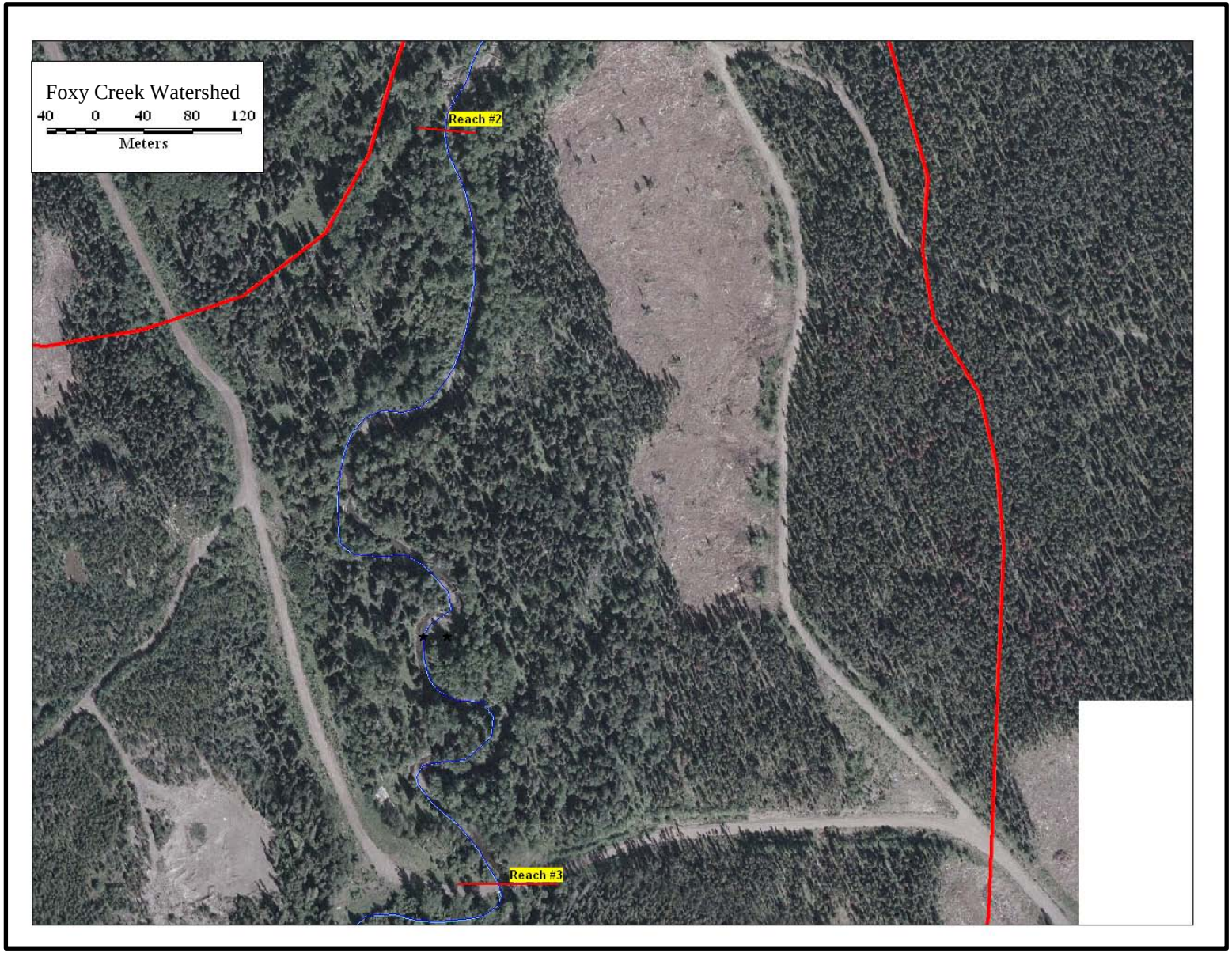

Figure 5. Vertical ortho-photo of Reach #2 of Foxy Creek.

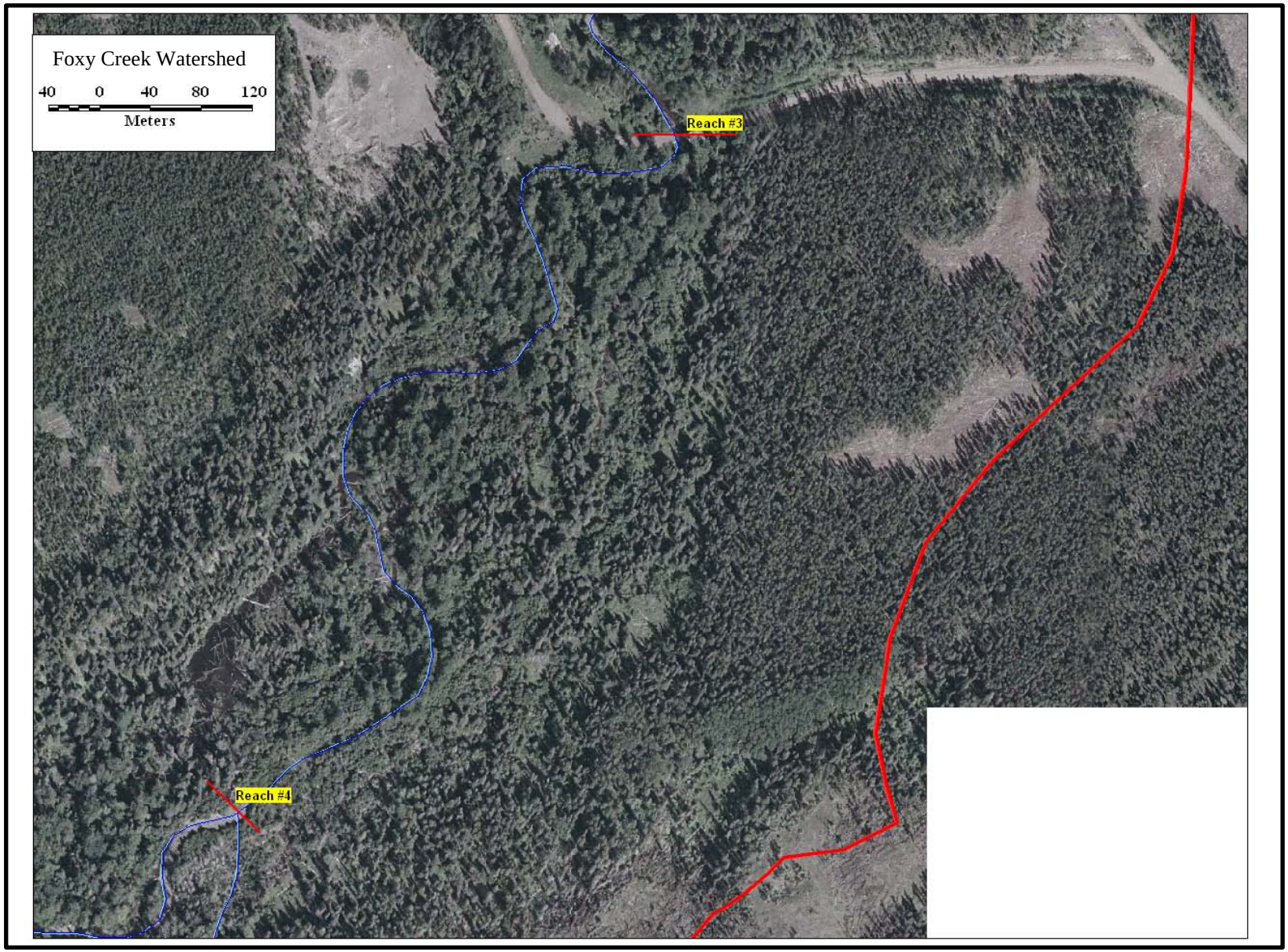

Figure 6. Vertical ortho-photo of Reach #4 of Foxy Creek

Figure 7. Forest harvesting along some of the small streams in the upper watershed.