WATERSHED REVIEW
OBJECTIVE 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
36.6	SBS	NDT3	791 - 1637	Coarse textured till on rolling terrain	2.08	72	44.5	35.4	19.3	0.8

[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	0.5	1.4	Very High Sensitivity
Fine textured till	0	0.0	High Sensitivity
Medium textured till	6.1	16.7	Moderate Sensitivity
Coarse textured till on rolling terrain	30	82.0	Low Sensitivity
Coarse textured fluvial	0	0.0	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
C5-Stable	3.5	0.75	1.1	0.95	1.1	1.05	1	3.17	Mod

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
Dolly Varden	5	0.75	1.2	1.1	4.95	Very High

[1]Note: See Figure 2 for 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
Dolly Varden	5	1.25	0.9	1.1	6.19	Extreme

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 (%)
36.6	2.51	1.87	8.72	4.96	19.92	24.88

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
0.00	0.00	0.00	24.88	2.50	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
36.6	19	16	3	0.5	0.4	0.1	1.98	Low

[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 7)

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	C5- Stable	690	0.0	Stable
2	C4- Stable	510	0.0	Stable
3	E5-Stable	1710	0.0	Stable
4	E5-Stable	590	0.0	Stable
5	E4-Stable	1100	0.0	Very Stable
Upper small streams	A4 - Unstable	300 to 500 m	100%	Destabilized[1]
Hazard Scores:			Hazard Rating Score	Hazard Rating
			3.75	High[1]

[1]Note: The high hazard rating is mostly as a result of the riparian logging along the upper smaller streams (Figures 9 to 11).

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	3.17	Mod	2.75	Mod	8.7	Mod
Increase in Production of Fine Sediment	4.95	Very High	1.98	Low	9.8	Mod
Reduction in Riparian Function	6.19	Extreme	3.75	High	23.2	Very High

RECOMMENDATIONS FOR LAND-BASED INVESTMENT ACTIVITIES IN PRIORITY WATERSHEDS

1. Prior to the allocation of permits for treatment activities, the Objective 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 Objective Creek watershed.
2. The allocation of permits for treatment activities in the Objective 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 6). 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 in 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	There are Dolly Varden high into the upper reaches. This means that the riparian areas of these small streams need to be well protected (Figure 8).
Comment #2	The ortho and Google satellite images provide excellent views of channel destabilization likely caused by riparian removal along the small streams, located on steeper ground (Figures 9 to 11).
Comment #3	The main FSW management recommendation in this watershed is the provision of extra protection of the riparian areas along the small streams that flow down Tableland Mountain (Figure 12).
Comment #4	The roads and the HEDA are not a serious concern in this watershed at this time although management of these two hazards needs to be considered into the future.

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

This watershed has a moderate sensitivity to increased peak flows and very high sensitivities to increases in fine sediment and extreme sensitivity to loss of riparian functions. However, the watershed has a high risk rating only for the riparian hazard. Thus, this is the process where the FSW recommendations for special land management activities should focus its efforts on. However, recommendations are also provided to protect the watershed for peak flow and fine sediment risks.

The FSW objectives for Objective Creek should focus on providing effective riparian protection to the small streams flowing down the north side of Tableland Mountain to maintain channel integrity and riparian function (Figure 12). This objective could be achieved by implementing the following practice along all S4 and S6 streams flowing down the north side of Tableland Mountain:

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.

<u>Riparian Area</u> – For the purposes of riparian protection objective below, riparian area refers to the management area measured from the closest streambank to a distance 15m 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.

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.

The current fine sediment risk rating is moderate, thus it is recommended that a WQEE survey[2] be completed in the Objective Creek watershed in order to identify individual stream crossings that may have erosion and sediment control problems and to develop site-specific prescriptions to address any such problems.

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

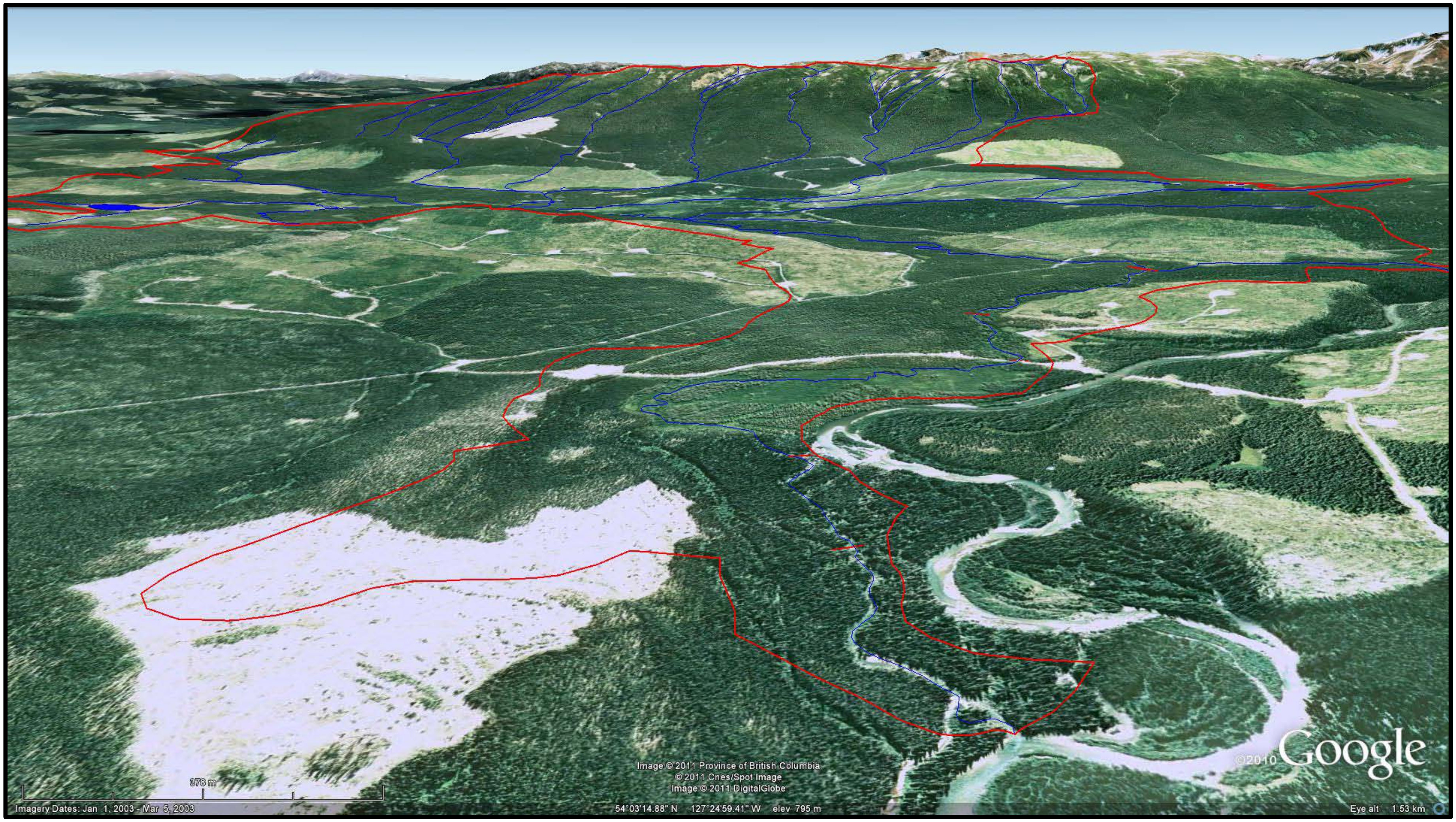

Figure 1. Google Earth overview image of Objective Creek watershed, looking upstream into the watershed.

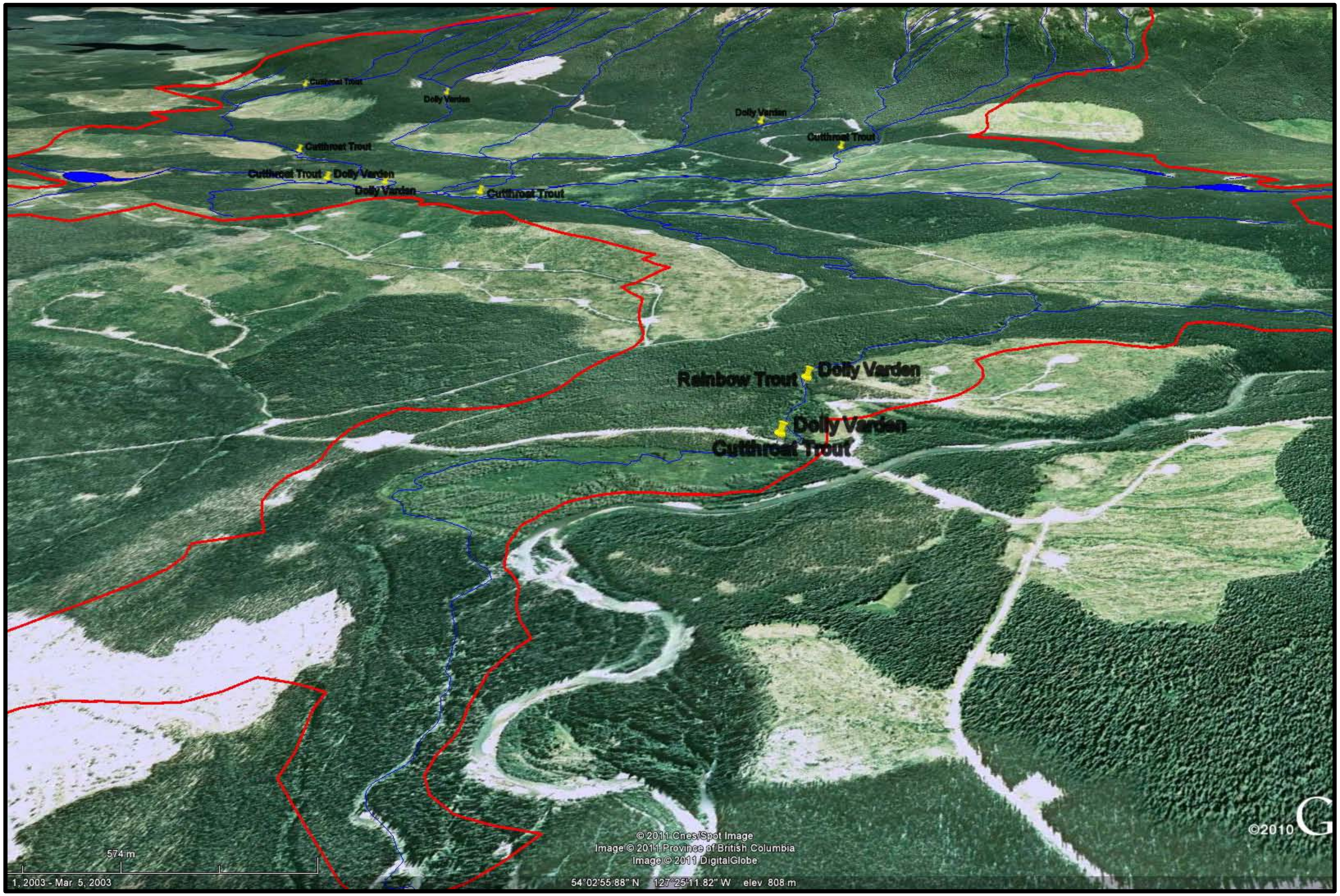

Figure 2. Known fish distribution in the Objective Creek watershed (Google Earth image).

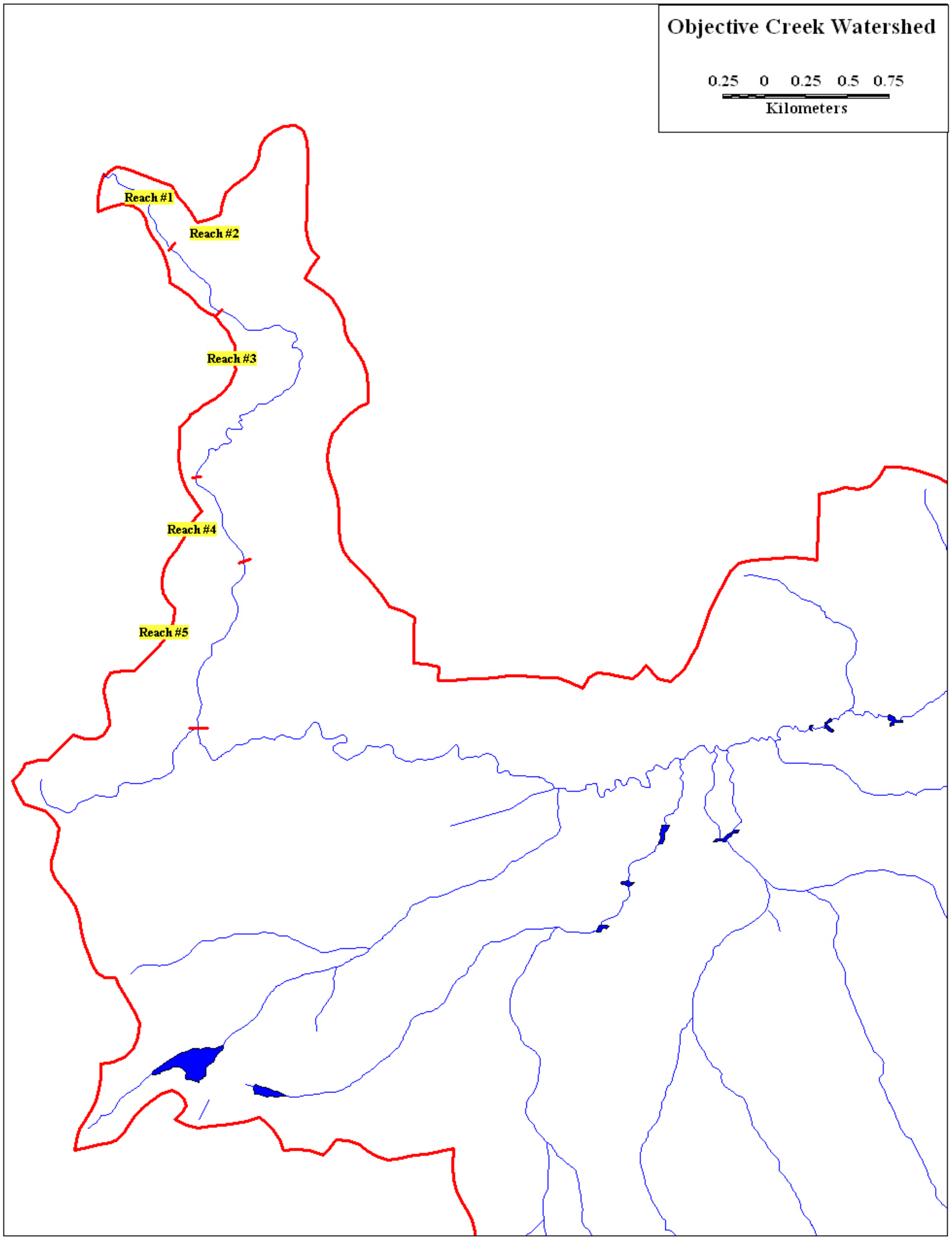

Figure 3. Location of lower reaches in Objective Creek watershed.

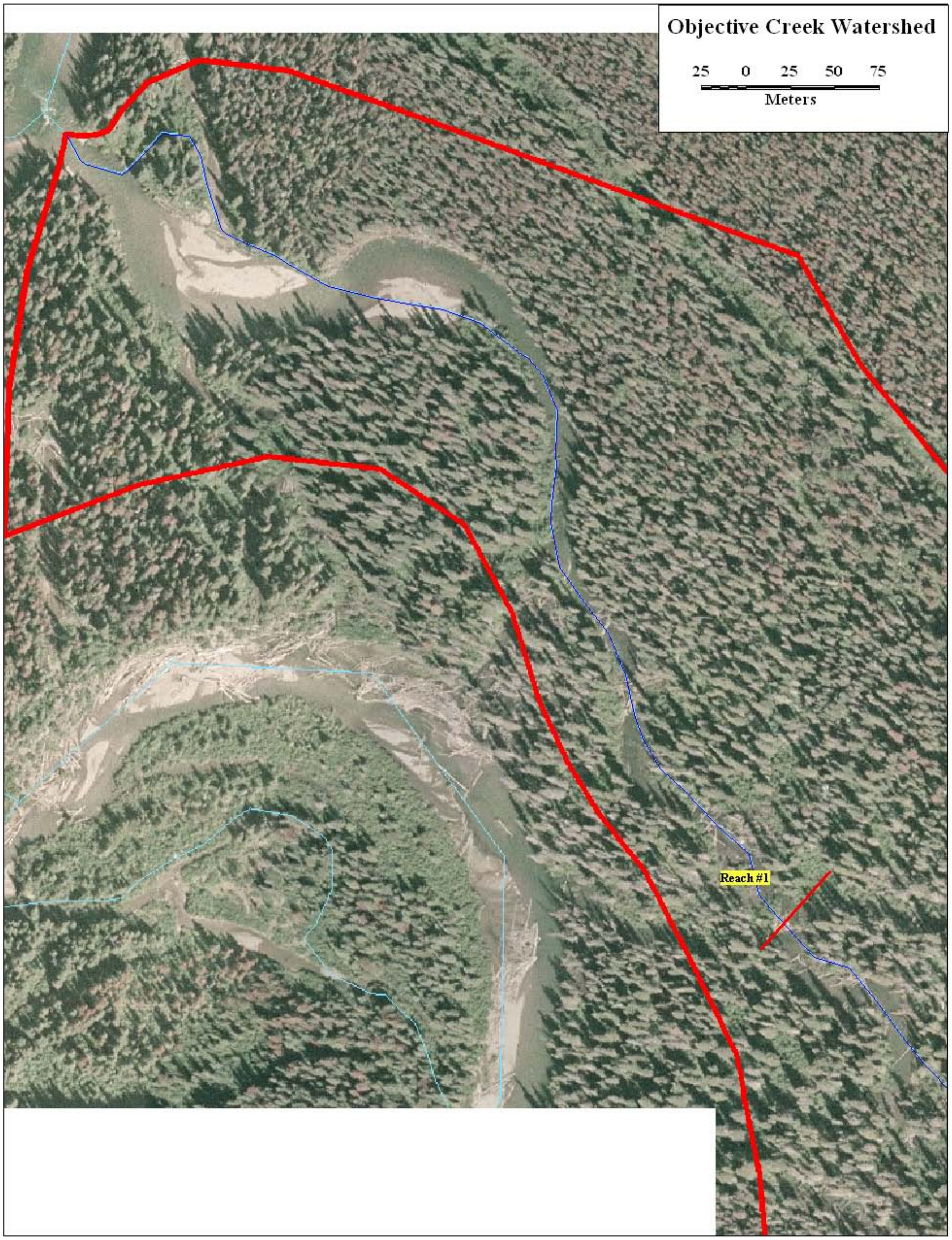

Figure 4. Ortho-photo showing lowest reach of the Objective Creek mainstem.

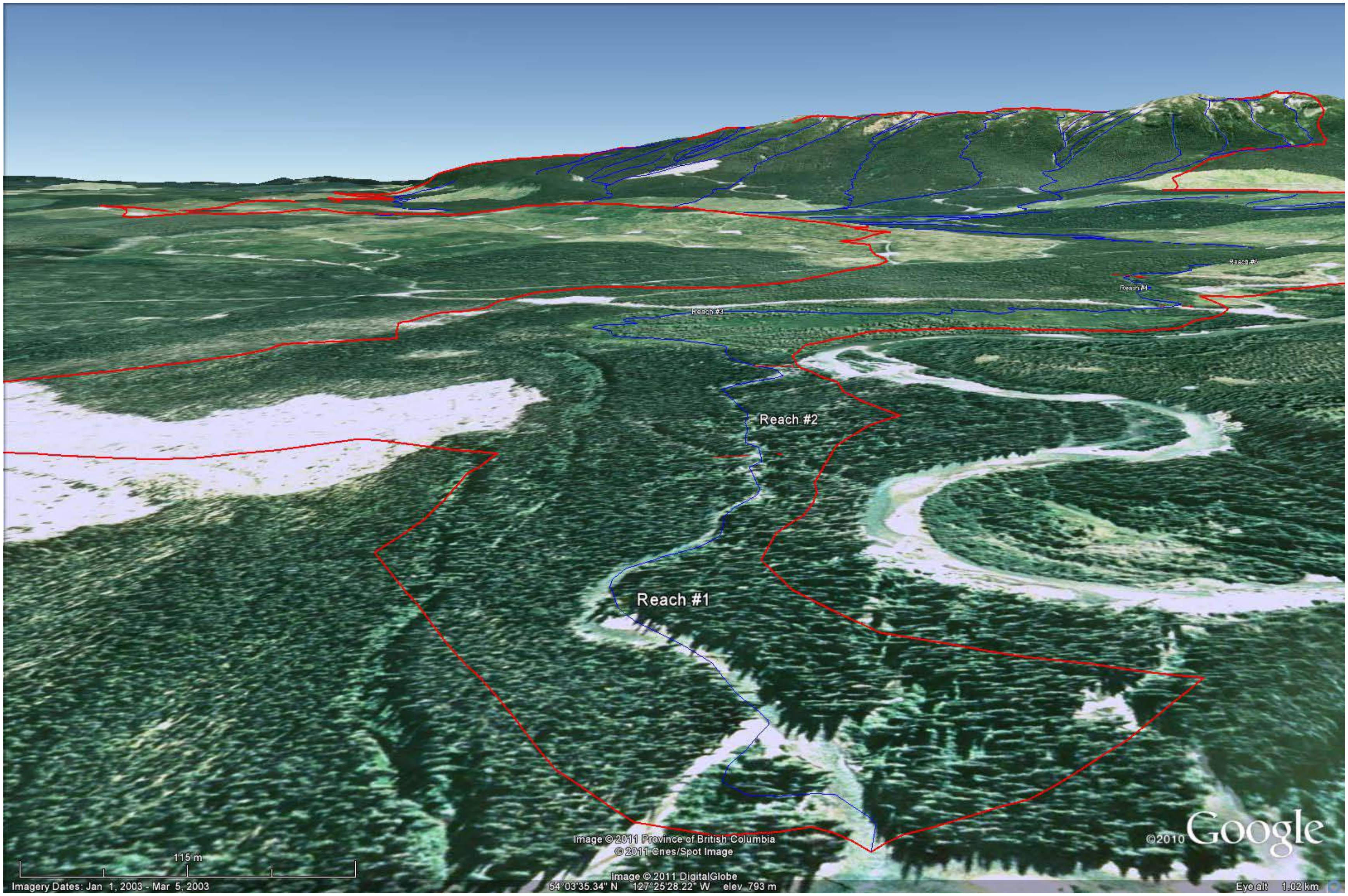

Figure 5. Google Earth image of Reach #1 and #2, looking upstream into the watershed

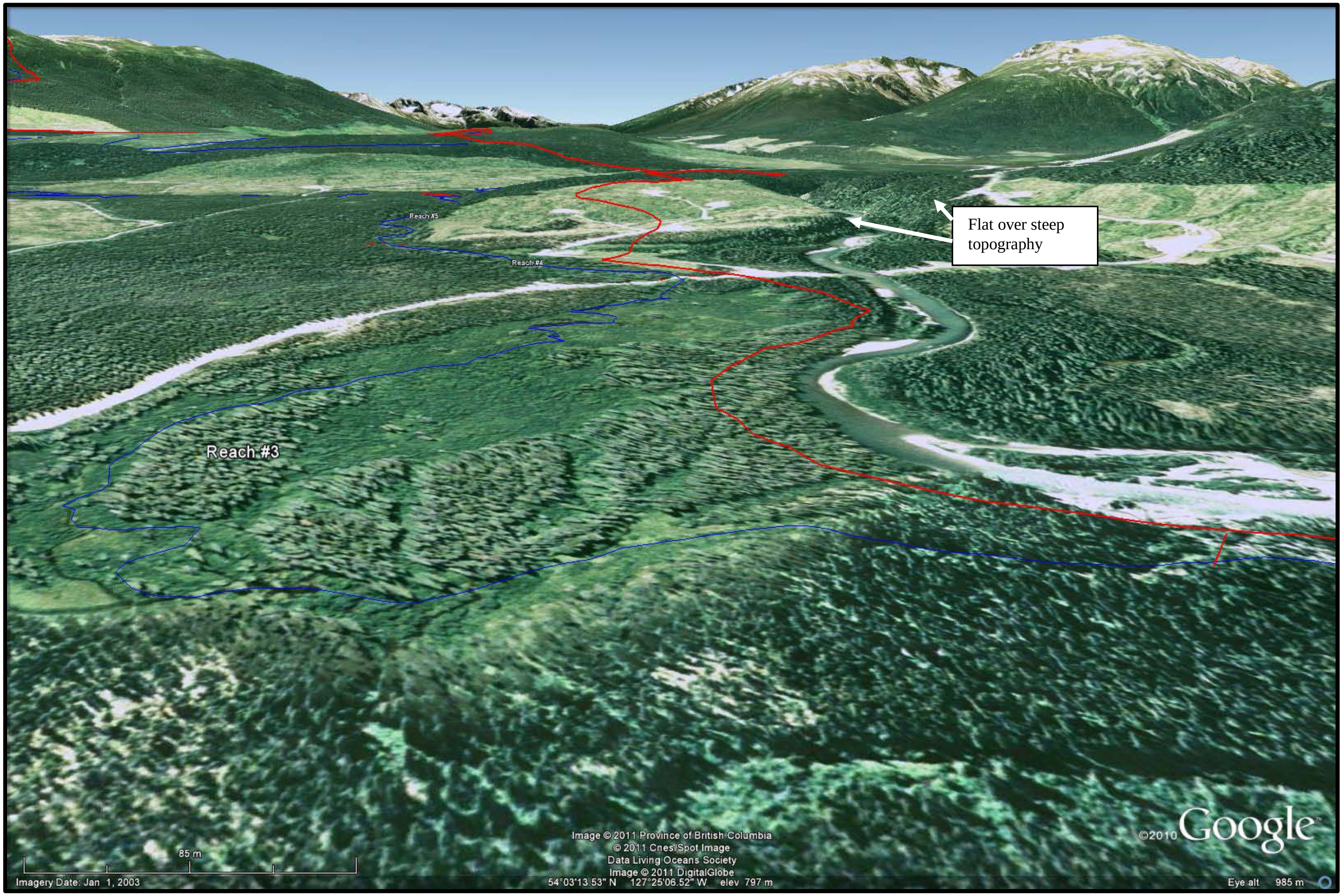

Figure 6. Google Earth image of Reach #3 (on left of image), looking upstream into the watershed.

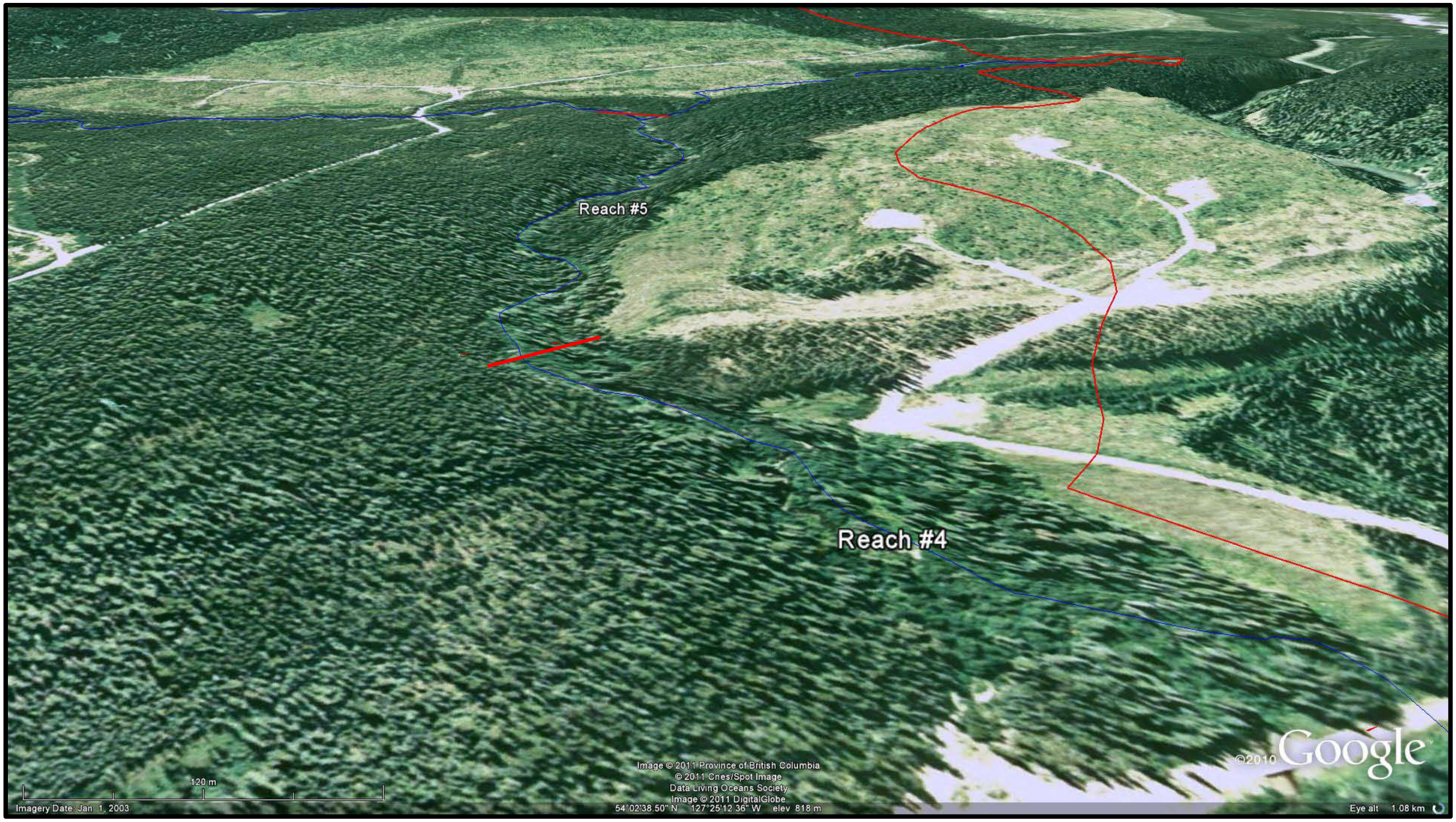

Figure 7. Google Earth image of Reach #4 and #5, looking upstream into the watershed.

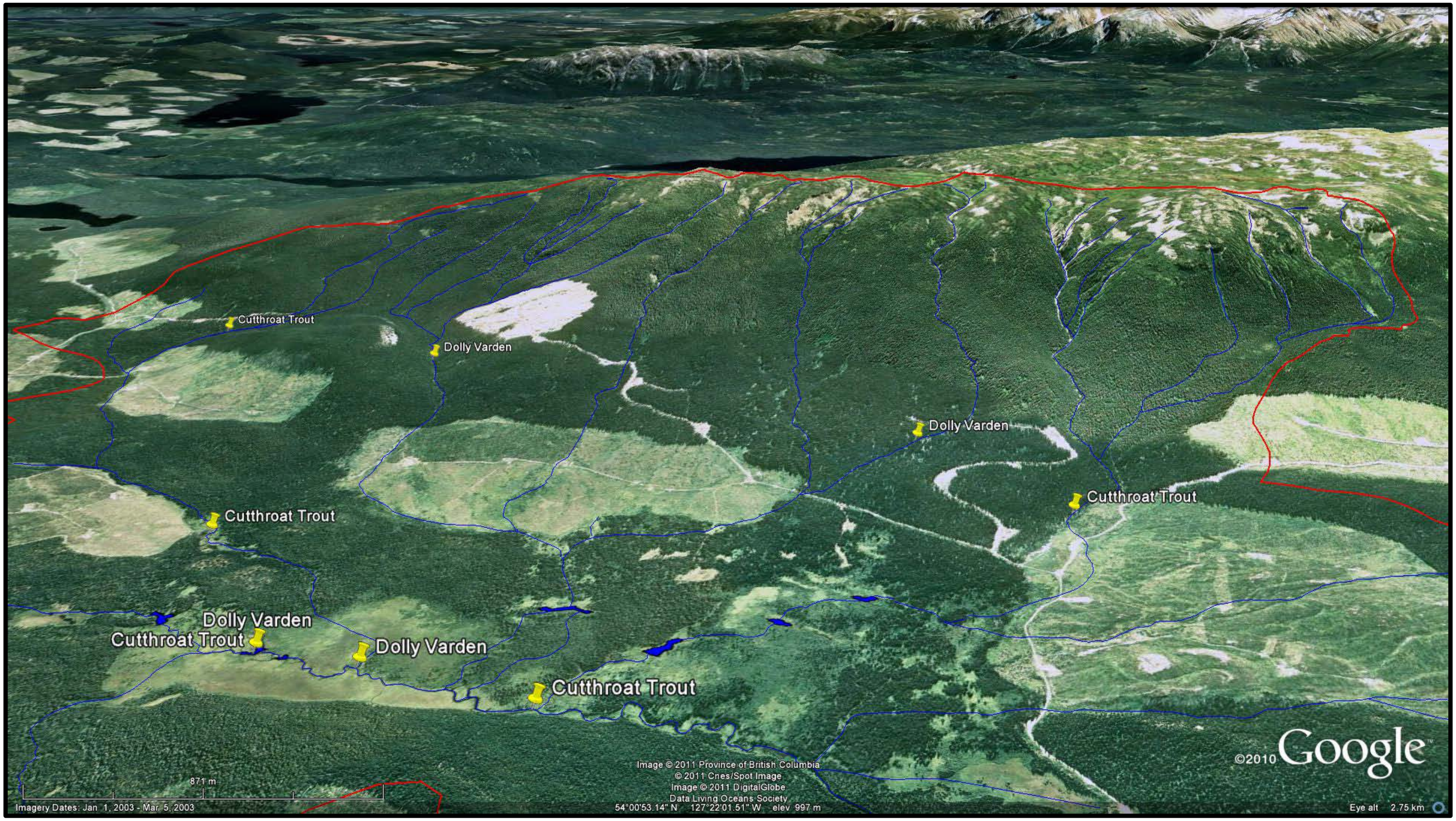

Figure 8. Distribution of fish species in the upper watershed of Objective Creek.

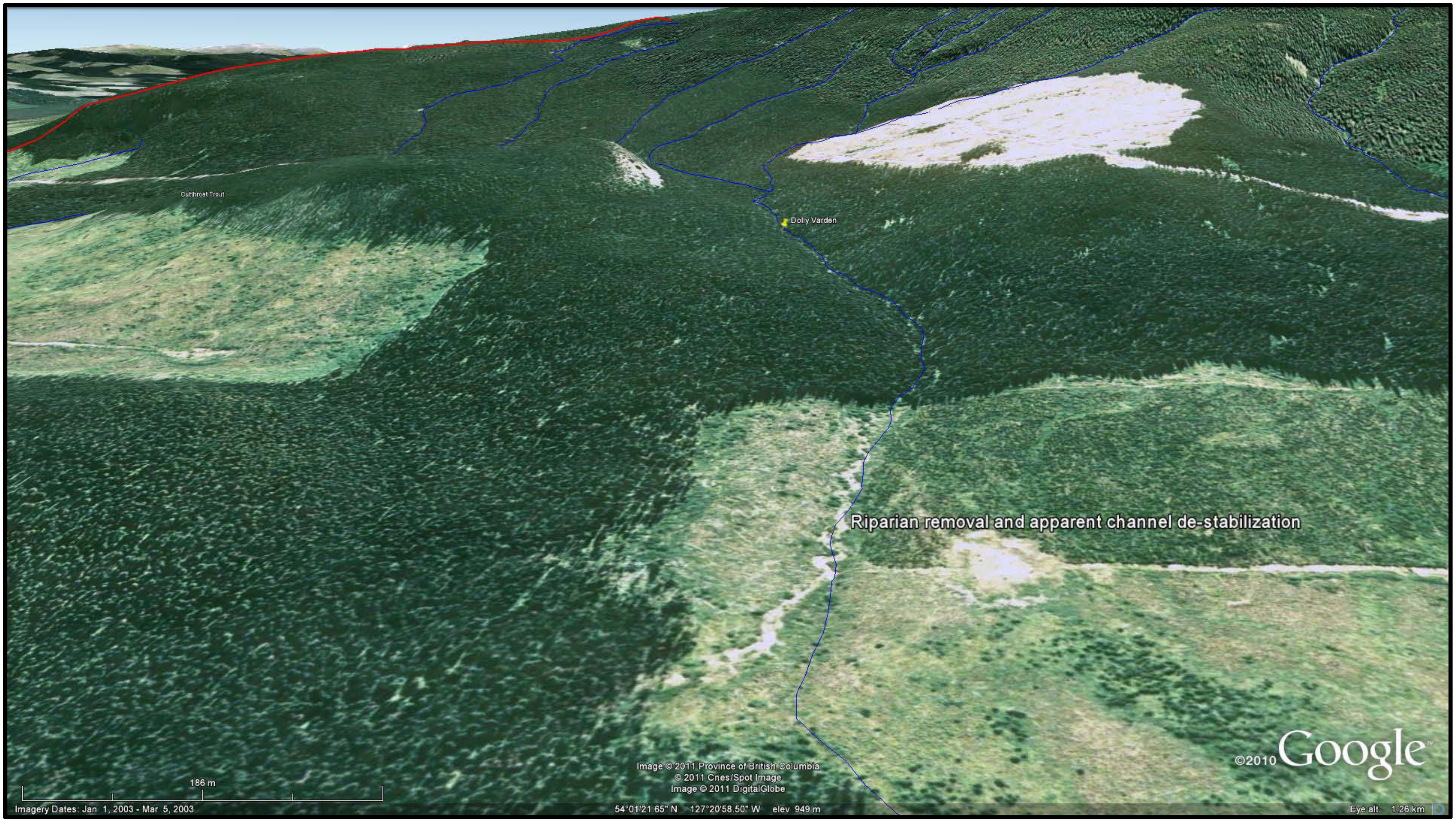

Figure 9. Channel destabilization and avulsion, mostly likely caused by riparian removal along a small steep channel (Google Earth image).

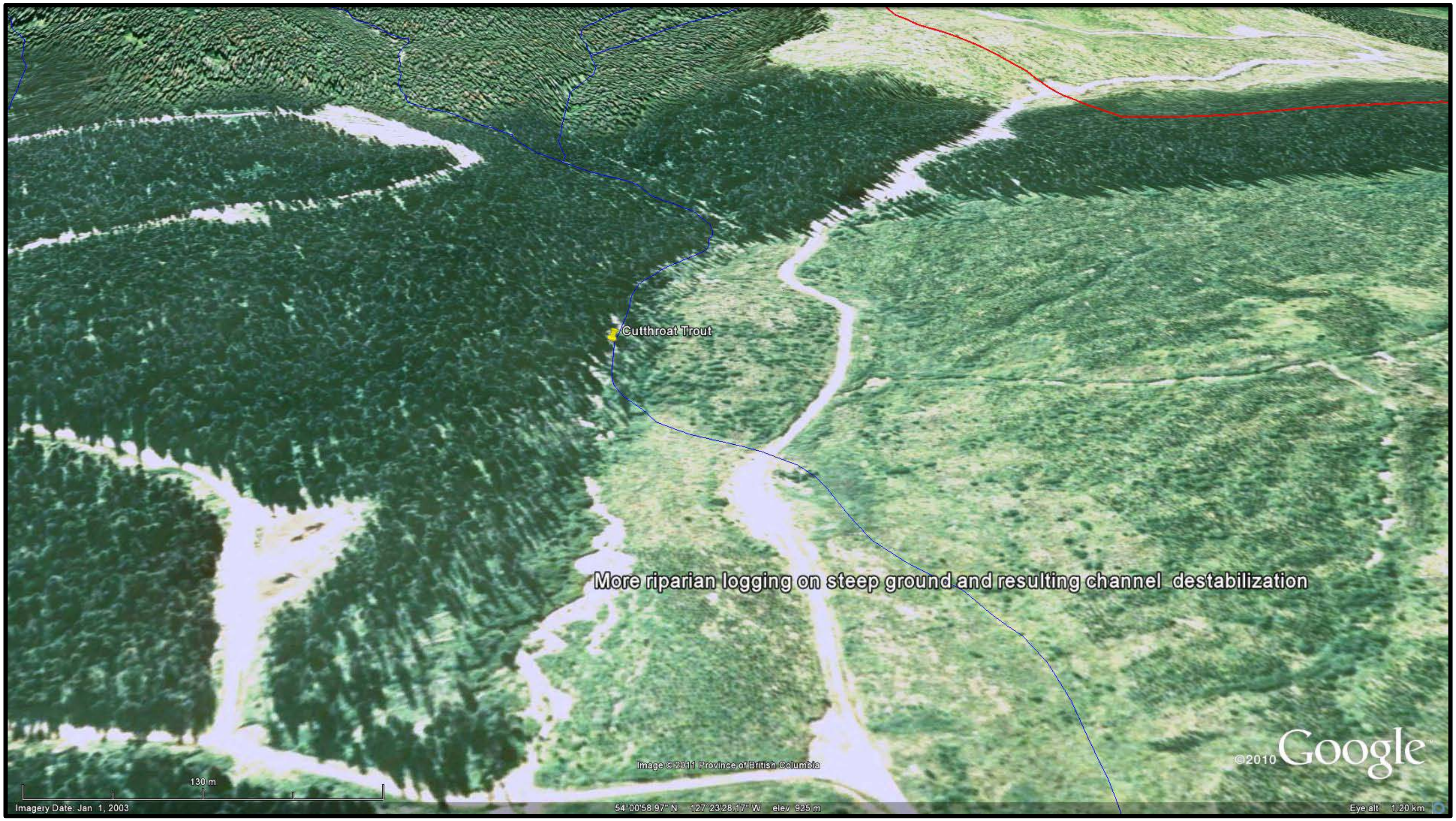

Figure 10. Another example of channel destabilization as a probable result of logging the riparian area along small streams (Google Earth image).

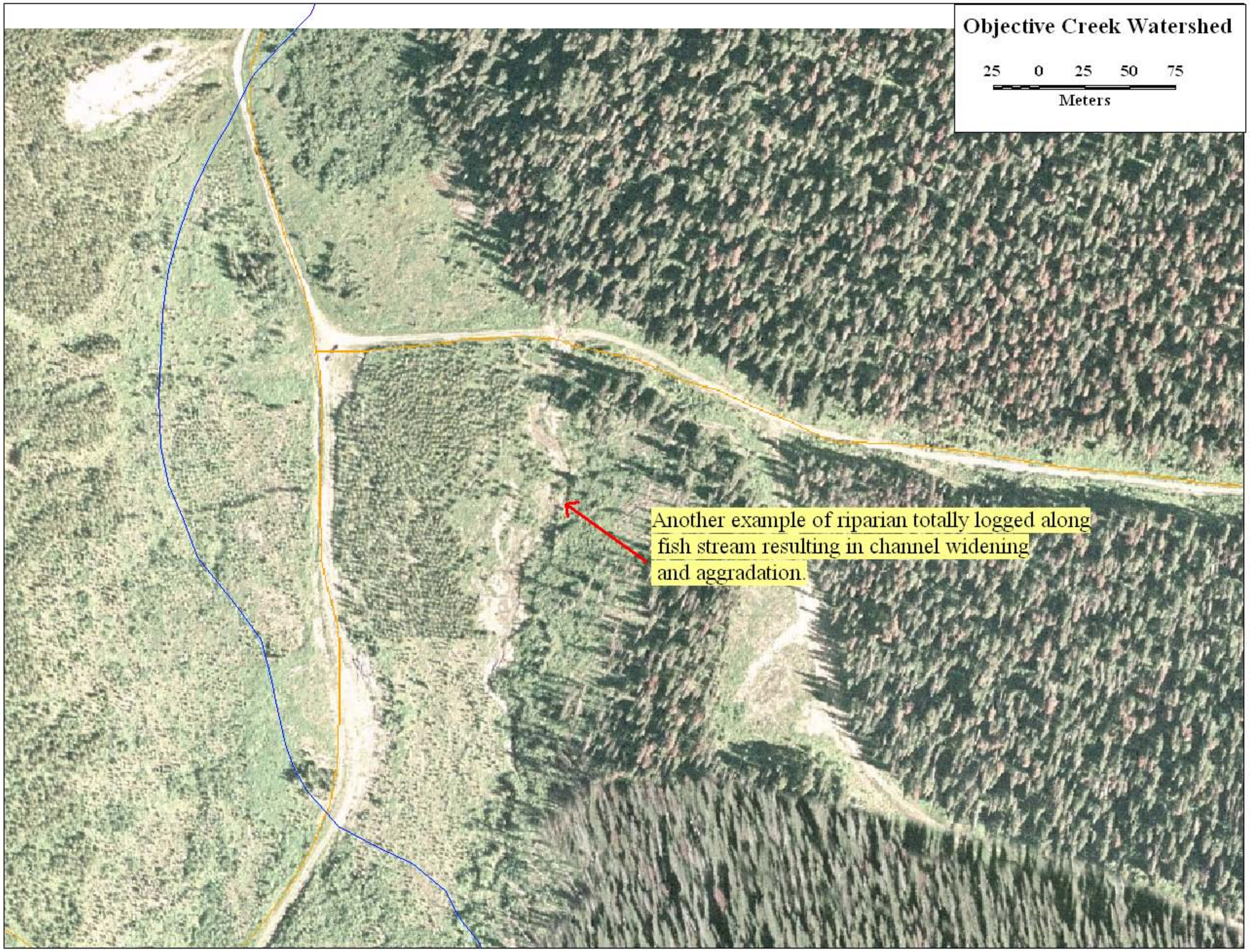

Figure11. Orthophoto image of same channel reach as in Figure 8, where riparian logging has most likely contributed to channel avulsion and destabilization.

Figure 12. General location of planned cutblocks and with it comes the potential for further riparian logging along these small streams.