Interior Watershed Assessment Update

Woodjam Creek Watershed

1.0 WATERSHED DESCRIPTIVE INFORMATION

Table 1.1 Summary information – Biophysical

Size (km^2)	BEC Zones	Elevation Range (m)	H_{60} Elevation (m)	Stream Density km/km^2	Distribution of slope gradients within the watershed (% of watershed)			
					<10% slope	10 to 30% slope	30 to 60% slope	>60%slope
92.66	SBSdw1/ mc1 SPBSmk ESSFwk1	831 – 1563	1114	1.63	69.40	29.14	1.38	0.08

Table 1.2. Characteristics of main stream reaches – (assessment is based on a combination of air-photo interpretations, TRIM maps, helicopter over-flight and various reports).

Reach ID	Minimum Elevation (m)	Maximum Elevation (m)	Reach Length (m)	Reach Gradient (%)	Stream Stability Assessment
Main-R1	839.3	840.001	1021	0.1%	RPg Unstable and eroding
Main-R2	840.001	862.632	2045	1.1%	RPg Localized instability
Main-R3	862.632	899.995	2239	1.7%	RPg Minor instability
Main-R4	899.995	959.992	2939	2.0%	RPg – Localized instability
Main-R5	959.992	1038.85	3247	2.4%	Stable –RPg
Main-R6	1038.85	1079.52	1950	2.1%	Stable –RPg
Main-R7	1079.52	1171.23	3510	2.6%	Stable –RPg
Main-R8	1171.23	1239.7	2154	3.2%	Stable –RPg
Main-R9	1239.7	1359.53	4716	2.5%	Stable –RPg

RPg = Riffle-Pool gravel morphology

2.0 WATERSHED HARVESTING, ROADS AND LAND-USE HISTORY

Table 2.1. Woodjam Creek Watershed

Private	Total harvest 2002 (%)	Current ECA (%)	Planned Harvest (%)	Current ECA below H60 (%)	Current ECA Above H60 (%)	Peak Flow Index		Road Density Active (km/km^2)		Stream Crossing density active (#/km^2)		Road Density De-active (km/km^2)	
						Current (2002) (%)	End of FDP (2007)(%)	Current (2002)	End of FDP (2007)	Current (2002)	End of FDP (2007)	Current (2002)	End of FDP (2007)
1.60%	18.86	17.37	10.32	9.0	8.4	21.5	34.8	0.42	0.54	0.29	0.41	0.68	0.81

3.0 SUMMARY OF EXTENT OF RIPARIAN REMOVAL (agriculture and forestry)

Table 3.1. Woodjam Creek Watershed

Watershed name	Length (km) of riparian removal on small tributaries (<5m in width)	Length (km) of riparian removal on large tributaries (>5m)	% Riparian removal of all tributaries	Length (km) of riparian removal on mainstem	% Riparian removal of mainstem	Total length of all tributaries (from Trim) (km)	Total length of mainstem (km)
Woodjam	24.43	0.00	**16.16**	4.08	**30.86**	151.14	13.22

4.0 SUMMARY OF LARGE SEDIMENT SOURCES

Table 4.1. Woodjam Creek Watershed

Watershed Name	Large natural sediment sources		Large natural sediment sources directly connected to a stream		Large land-use related sediment sources		Large land-use related sediment sources directly connected to a stream		Large sediment sources	
	number	density (#/km^2)	number	density (#/km^2)	number	density (#/km^2)	number	density (#/km^2)	number	density (#/km^2)
Woodjam	2	0.022	2	0.022	13	0.141	13	0.141	15	0.162

5.0 SUMMARY OF LAND-USE ACTIVITIES ON UNSTABLE TERRAIN

Table5.1. Woodjam Creek Watershed

Watershed	Length of road on unstable terrain (km)		Area of cut blocks on unstable terrain (km^2)		Road density on unstable terrain (km/km^2)	Source of information for stability assessment
	Active	Proposed	Harvested	Proposed		
Woodjam	0	0	0	0	0.0000	slope>60%

6.0 SUMMARY OF ROAD RELATED SOURCES OF SURFACE EROSION

Table 6.1 Woodjam Watershed - summary of stream crossing sediment source survey –			
Number of crossings surveyed	Estimated total # of crossings (TRIM maps)	Percentage surveyed	Watershed Size (km^2)
16	53	30.2	92.5

Table 6.2 Summary of Water Quality Concern Ratings (WQCR) – Woodjam Watershed							
No Concern		**Low**		**Medium**		**High**	
Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage
3	18.7	10	62.5	1	6.3	2	12.5

Stream Width Class	Table 6.3 Summary of Water Quality Concern Ratings by Stream Size - Woodjam Watershed								# of streams surveyed per class
	None		Low		Medium		High		
	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	
1	0	0.0	0	0.0	0	0.0	0	0.0	0
2	1	100.0	0	0.0	0	0.0	0	0.0	1
3	1	33.3	2	66.7	0	0.0	0	0.0	3
4	1	14.3	4	57.2	1	14.3	1	14.3	7
5	0	0.0	4	80.0	0	0.0	1	20.0	5

Table 6.4 ESC Summary - Woodjam	
WQCR	"Equivalent" number of stream crossings
No Concern	0.0
Low	9.9
Moderate	2.3
High	6.6
Total	18.9

Table 6.5 Surface erosion hazard – Woodjam Watershed	
Equivalent stream crossing density (xings/km^2)	Surface Erosion Hazard
0.20	Moderate

7.0 SUMMARY OF MAINSTEM CHANNEL CONDITIONS

Table 7.1. Extent of channel disturbance

Reach ID	Reach Length (m)	Reach Gradient (%)	Length disturbed (m)	% of channel disturbed	Level of channel disturbance	Probable cause of disturbance
Main-R1	1021	0.1%	303	30	Severe	Agriculture
Main-R2	2045	1.1%	122	271	Low	Agriculture
Main-R3	2239	1.7%	92	4	Low	Agriculture
Main-R4	2939	2.0%	407	14	Low	Agriculture
Main-R5	3247	2.4%	0	0	Undisturbed	-
Main-R6	1950	2.1%	0	0	Undisturbed	-
Main-R7	3510	2.6%	0	0	Undisturbed	-
Main-R8	2154	3.2%	0	0	Undisturbed	-
Main-R9	4716	2.5%	0	0	Undisturbed	-

8.0 SUMMARY OF FISHERIES RESOURCES IN THE WATERSHED

Table 8.1 Documented fish species presence

Category	Common Name	Latin Name	Species Code	Reference
Anadromous salmonid	Chinook Salmon	*Oncorhynchus tshawytscha*	CH	Fish Wizard[1]
	Coho Salmon	*Oncorhynchus kisutch*	CO	Fish Wizard[1]
Freshwater game species	Rainbow Trout	*Oncorhynchus mykiss*	RB	Fish Wizard[1]
Non-game species	Dace (general)	*Rhinichthys* spp.	DC	Fish Wizard[1]
N/A	Unidentified Species	N/A	N/A	Fish Wizard[1]

[1]Fish Wizard available at http://pisces.env.gov.bc.ca

9.0 SUMMARY OF HAZARDS FOR THE WOODJAM WATERSHED

Table 9.1 Watershed assessment hazards

Watershed	Hazard Ratings[2]						Generalized Channel Disturbance[1]
	Increases in peak-flows (Current/ Proposed)	Reduction in riparian functions	Large logging related sediment sources	Road related sediment sources (field work)	Accelerated surface erosion from GIS (Current/ proposed)	Accelerated mass wasting	
Woodjam	VL/M	VH	VL	M	M/H	VL	4

[1] Note: Generalized channel disturbance codes: 1 = no disturbance identified, 2 = localized channel disturbance, 3 = minor localized land-use related disturbance, 4 = moderate land-use related channel disturbance, 5 = extensive land-use related channel disturbance.
[2] Note: Hazard ratings: VL=very low, L=low, M=moderate, H=high, VH=very high

10.0 INTERPRETATIONS

10.1 Peakflow Hazards

The current Peak Flow Index (PFI) is 21% (**Very Low** hazard) and will increase to 35% (**Moderate** hazard) by the end of the Forest Development Plan. The lower reaches of the Woodjam have low to severe instability (Table 7.1). Like the Moffat watershed, the extent of development in this watershed is progressing towards a hazard level that is significant enough that it should be considered in the land-use development plans. Possible management strategies are presented in Section 11 of this report.

10.2 Hazards Associated with a loss in Riparian Functions

As for the Moffat watershed, the riparian hazard for the Woodjam is **Very High.** This has been caused by the removal of the riparian forest in the lower reaches and agricultural activities along the streambank (Photograph #1121). This loss of riparian function has probably had a negative effect on the fisheries resource within this watershed.

10.3 Hazards Associated with Large Sediment Sources

There are no large, directly connected, sediment sources (e.g. landslides) that can be attributed directly to forest harvesting activities in the Woodjam watershed. Consequently, the hazard is **Very Low** (Table 9.1). However, there are some localized large sources of sediment associated with the agricultural activities in the lower reaches, mostly accelerated erosion of streambanks (Photograph #1127). The extent of this problem is not as large as in the Moffat watershed, but it does occur in several places.

The accelerated bank erosion can theoretically have a significant negative impact on fish habitat.

10.4 Hazards Associated with Roads Related Surface Erosion

Of the 16 crossings surveyed, 13 (81%) had none or low surface erosion concerns (Table 6.2). All of the problems identified (i.e. medium and high concerns) were located on small streams (less than 1.5 m in width) (Table 6.3). Based on our field sampling, the calculated "equivalent stream crossing density" was computed as 0.20 crossings/km^2. This includes all active and de-activated stream crossings. This number has generated a **Moderate** hazard value (Table 6.5).

We concentrated our survey on logging roads located in the middle and upper parts of the watershed. The lower watershed has many old roads that are used for agricultural purposes and are accessed through private land. Because we did not sample the lower part of the watershed and the watershed is relatively small, our sample size is quite small (i.e. 16 crossings or 30%). Similar to the Moffat watershed, we found that many of the streams identified on TRIM maps do not exist in the field. Consequently, the total number of stream crossings in this watershed is probably substantially less than 53 (calculated using TRIM maps).

10.5 Hazards Associated with Accelerated Mass Wasting (from logging on steep slopes).

There is no steep slope logging in this watershed. Consequently, there is no hazard associated with this IWAP indicator.

10.6 Watershed Cumulative Effects and Channel Stability

The situation in the Woodjam watershed is very similar to that of the Moffat watershed. The main potential cumulative effect is associated with the extent of harvest and the channel instability caused by the removal of the riparian forest along the lower reaches (although the problems are not as extensive as for the Moffat).

Water related land management decisions in the Woodjam watershed should focus on controlling the effects of forest removal on peak flows and riparian management in the lower reaches (see Section 11 of this report).

11.0 RECOMMENDATIONS

11.1) Recommendations for the Forest Development Plan (landscape level)

The peak flow hazard will reach a Moderate level by the end of the Forest Development Plan for the Woodjam watershed. Because of the instability in the lower reaches, these increased flows could be detrimental to water quality and fish habitat near the mouth of the Woodjam, a similar situation to the Moffat watershed. Please see Section 11.1 of the Moffat report for a discussion of extent of harvest threshold values.

The peak flow index is currently 21% (Very Low) and will increase to 35% (low end of Moderate). Consequently, the extent of harvest is slowly becoming an issue and must be considered in the forest development planning process. Specific recommendations are provided in the next section.

11.2) Recommendations for Site Specific Activities (site level)

Since the situation in the Woodjam watershed is very similar to that of the Moffat watershed (i.e. moderate peak flow hazard, extensive riparian removal, unstable lower reaches), I have provided very similar recommendations.

The management of the Woodjam watershed to address peak flow concerns should include:

1. Continued effective de-activation of roads in an effort to maintain natural drainage patterns. Long ditch lines and direct delivery of intercepted water to streams increases the speed at which water is delivered to streams and thus can contribute to increased peak flows.

2. Based on the concept of variable source area, I recommend that future cutblocks not be located near streams, or that the width of buffer strips or riparian retention zones be increased. Cutblocks that do not have streams in them or are located away from streams have less of an impact on increased peak flows, than those located close to streams. This recommendation should target the S6, S4 and S3 streams more specifically because the FPC requirements are less on those streams. This raises the question: how large an increase in stream buffer is recommended? Rather than giving a specific number, you should use soil, plant and terrain indicators that identify the true riparian area (i.e. terrestrial zones that are influenced by the presence of the stream or water body). In most cases it is relatively easy in the field to delineate the true riparian area from the upper terrestrial areas. Because the Woodjam watersheds have been identified as Moderate risk for peak flows and unstable channels, it would be a good watershed management strategy to avoid harvesting within the true riparian areas around S5, S4 and S3 type streams.

3. Leave 20-30% canopy cover in partial retention over the block area. This will decrease the impact on increased snow accumulation and melt rates compared to complete clearcut. The rational for this recommendation is provided in Section 11.2 of the Moffat report (bullet number 3).

4. Blocks that are NSR should be dealt with aggressively so that the ECA can be lowered.

5. For upland areas (away from streams), small blocks should be amalgamated into larger blocks with 20% retention. This will reduce the length of active roads.

6. For higher elevation blocks (ESSF) retain understory (broken-up by skid trails). A significant amount of understory can have a positive effect on the mitigation of peak flow increases. A significant amount of "tall" understory can have a positive effect on the mitigation of peak flow increases if it is distributed throughout the cut-block. I recognize that by itself, this mitigative measure may only have a limited value. However, it could contribute to positive cumulative effects when implemented with other associated measure.

7. Use "frozen-in" winter roads with no ditch lines wherever possible. This will limit the negative effects of disturbing the natural drainage pattern.

8. Similar to the Moffat watershed, the Woodjam Creek watershed will be developing an "ECA" concern at the end of this development plan (albeit that this concern is a theoretical one). Although setting an absolute ECA threshold value is a difficult technical, political and economic endeavor, I believe that it would be prudent management to maintain the peak flow index in the moderate risk category. This assumes that items 1 to 7 above are included in the management regime of the Woodjam Creek watershed.

The management of surface erosion should include:

1. Implement or fix erosion and sediment control practices on those stream crossings that were identified as a moderate or high erosion concern (3 crossing). All of these crossings are on small streams (class 4 or 5 width class) and fixing them is usually a relatively simple process (i.e. grass seed, or temporary sediment control).

2. During regular road maintenance activities, assess those crossings that were not included in our stream crossing survey. If there are any problems or concerns deal with them promptly and record the activities. The value of the "equivalent stream crossing density" can be lowered as the number of moderate and high concerns are lowered and the associated hazard lowered also.

3. Maintain effective Erosion and Sediment Control plans for the Woodjam watershed. This would include: a) Development of a plan with precise objectives and standards

and clear operating procedures, b) clearly define the types of erosion and sediment control practices that need to be implemented, c) regular maintenance of any ESC structure that has been installed, d) regular field monitoring to evaluate the effectiveness of the plan.

The management of loss of riparian function should include:

1. The only way to reduce the riparian hazard is to continue working with the agricultural land owners so that appropriate vegetation is re-planted and channel sections stabilized where possible (site specific prescriptions are required).

APPENDIX 1 – Database of disturbed riparian areas

Woodjam - inventory of riparian harvest

ID	Channel Width	Stream Type	One or 2 sided	Length of RL km	Landuse
WooJmRL-001	4	2	1	1.0269	1
WooJmRL-005	3	1	2	0.8669	2
WooJmRL-003	3	1	2	0.6989	2
WooJmRL-002	3	1	2	1.1267	2
WooJmRL-004	4	2	2	0.3585	2
WooJmRL-031	4	2	2	0.9685	2
WooJmRL-030	4	2	2	0.9356	2
WooJmRL-029	4	2	2	0.4792	1
WooJmRL-027	4	3	2	0.4414	1
WooJmRL-028	4	3	2	0.2335	1
WooJmRL-033	4	3	2	0.3774	2
WooJmRL-036	4	3	2	0.1611	2
WooJmRL-037	4	2	2	0.2673	1
WooJmRl-022	4	2	2	0.5734	1
WooJmRL-020	4	2	3	0.3377	1
WooJmRL-021	4	2	2	0.2042	1
WooJmRL-016	4	3	2	0.342	1
WooJmRL-015	4	3	2	0.178	1
WooJmRL-014	4	3	2	0.1754	1
WooJmRL-007	4	3	2	0.3942	1
WooJmRL-006	4	3	2	3.4636	1
WooJmRL-009	4	3	2	0.6287	1
WooJmRL-010	4	3	2	0.2472	1
WooJmRL-011	4	3	2	0.7449	1
WooJmRL-012	4	3	2	0.5343	2
WooJmRL-008	4	3	2	0.6787	1
WooJmRL-013	4	3	2	0.838	1
WooJmRL-017	4	2	2	0.573	1
WooJmRL-018	4	3	1	0.3329	1
WooJmRL-019	4	3	2	0.1937	1
WooJmRL-026	4	3	2	0.2395	1
WooJmRL-025	4	3	2	0.6844	1
WooJmRL-023	4	3	2	0.3911	1
WooJmRL-024	4	2	2	0.1442	2
WooJmRL-034	4	3	2	0.4059	1

ID	Channel Width	Stream Type	One or 2 sided	Length of RL km	Landuse
WooJmRL-032	4	3	2	0.2949	1
WooJmRL-035	4	3	2	0.0862	1
WooJmRL-038	4	2	2	0.1392	1
WooJmRL-039	3	1	2	1.3945	1
WooJmRL-040	4	2	2	0.5648	1
WooJmRL-041	4	2	2	0.5186	1
WooJmRL-042	3	2	2	0.6003	1
WooJmRL-043	4	3	2	0.9433	1
WooJmRL-044	4	2	2	0.1589	1

APPENDIX 2 – Database of large sediment sources

Woodjam survey of large sediment sources

ID	Type	Cause	Deliverability	Degree of Reveg	Activity Level
Wo-01	3	4	1	1	2
Wo-02	3	4	1	2	2
Wo-03	7	10	1	1	3
Wo-04	7	10	1	1	3
Wo-05	7	10	1	1	3
Wo-06	7	10	1	1	3
Wo-07	7	10	1	1	3
Wo-08	7	10	1	1	3
Wo-09	7	10	1	1	3
Wo-10	7	10	1	1	3
Wo-11	7	10	1	1	3
Wo-12	7	10	1	1	3
Wo-13	7	10	1	1	3
Wo-14	7	10	1	1	3
Wo-15	7	10	1	1	3

APPENDIX 3 – Database of stream crossing survey (surface erosion)

Woodjan Stream Crossing Survey (SCQI) for surface erosion

Sub Basin	Crossing ID	UTM Easting	UTM Northing	Structure type	Size of Culvert	Crossing Erosion Score	WQCR	Stream width Class	Stream gradient Class
Woodjam	W01	615250	5789865	5	600	0.4	Low	5	3
Woodjam	W02	614500	5789111	5	800	1.0	High	4	3
Woodjam	W03	614302	5788904	5	600	0.2	Low	5	2
Woodjam	W04	614008	5788221	5	800	0.0	None	4	2
Woodjam	W05	615462	5788069	s. pt.		0.0	s.pt		0
Woodjam	W06	613665	5787858	1	NA	0.0	None	2	1
Woodjam	W07	612619	5787655	1	800	0.4	Low	5	2
Woodjam	H01	619224	5790348	s. pt.		0.0	s.pt		0
Woodjam	H02	618965	5790518	5	900	0.4	Low	4	4
Woodjam	H03	617437	5790138	5	600	0.9	High	5	3
Woodjam	H04	617460	5790143	5	600	0.4	Low	5	3
Woodjam	H05	617106	5789981	1	NA	0.3	Low	4	3
Woodjam	H06	616227	5789826	5	800	0.5	Med	4	5
Woodjam	H07	616127	5789819	5	800	0.3	Low	4	6
Woodjam	H08	613186	5787569	5x2	500	0.4	Low	4	1
Woodjam	W10	615445	5783796	1		0.1	Low	3	1
Woodjam	W09	615660	5782537	1		0.2	Low	3	2
Woodjam	W08	614930	5783580	8		0.0	None	3	2

APPENDIX 4 – Inventory of disturbed channel reaches

Woodjam - inventory of disturbed channel reaches

ID	Length_m	Instability level	Source	Reach
Wood-01	65.18	Mod	2	1
Wood-02	145.7	Mod	2	1
Wood-03	91.68	Mod	2	1
Wood-05	406.44	Low	2	4
Wood-04a	40.13	Low	2	3
Wood-04	121.93	Low	2	2

APPENDIX 5 – Selected photographs

Photograph # 1121: Riparian agriculture Reach #2

Photograph # 1127: Localized instability –Reach #3

Photograph # 1129: Instability associated with old road

Photograph #: 1137: Natural bank instability – Reach #3.

APPENDIX 5 – Selected photographs

Photograph # 1143: De-activated crossing W08

Photograph # 1146: Bridge xing in upper Woodjam

Photograph # 1505: Bridge over Woodjam, SCQI score=0

Photograph # 211-7: Crossing "H5" SCQI score = 0