

Slocan River Rainbow Trout Habitat Assessment
and
Side Channel Analysis: 2012

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1.0 Introduction

Over the last several years, numerous rainbow trout (*Oncorhynchus mykiss*) habitat enhancement projects have been undertaken with the likelihood of more projects being developed in the future. Most projects to dates have been assessed on the site-specific merits and not viewed in the overall context of the Slocan River. In order to make sound judgments on a specific projects value, it must be assessed in view of habitat values throughout the river and indentify sites with the greatest potential return of rainbow trout productivity. This will ensure that the greatest economic and environmental value is achieved through future potential habitat enhancement projects.

While social values and technical issues are a critical component to the decision-making matrix for project selection, this project focuses on the environmental aspects of the river, identifying sites where the greatest trout production can be achieved by assessing all of the trout habitat in the Slocan River. A special emphasis will be placed on side channels, as they have been determined to be of the highest habitat value on the river (Corbett, 2011) where the greatest inroads can be made for ecosystem restoration and rainbow trout production.

To this end, current (2011) aerial photography was captured and used to assess rainbow trout habitat throughout the river, stratifying river habitats into habitat types and developing an associated database connecting each habitat polygon with relevant biological and physical data pertaining to rainbow trout utilization.

This project was funded through a partnership with Columbia Basin Trust, Columbia Power Corporation and the Slocan River Streamkeepers.

2.0 Methods

An aerial flight was conducted on July 12th, 2011 to capture 10 cm raster digital ortho photos of the Slocan River and the lower portions of the Little Slocan River. The timing was such that high water would be dropping (receding hydrograph) so that the side channels would be bank full but that water would be clearing so water depths could be determined in both the side channels and mainstem habitats.

The digital photos were then merged into a single seamless image and then broken up into tiles or map sheets. Figure 1 shows the extent of the photography and the subsequent tiles used for interpretation.

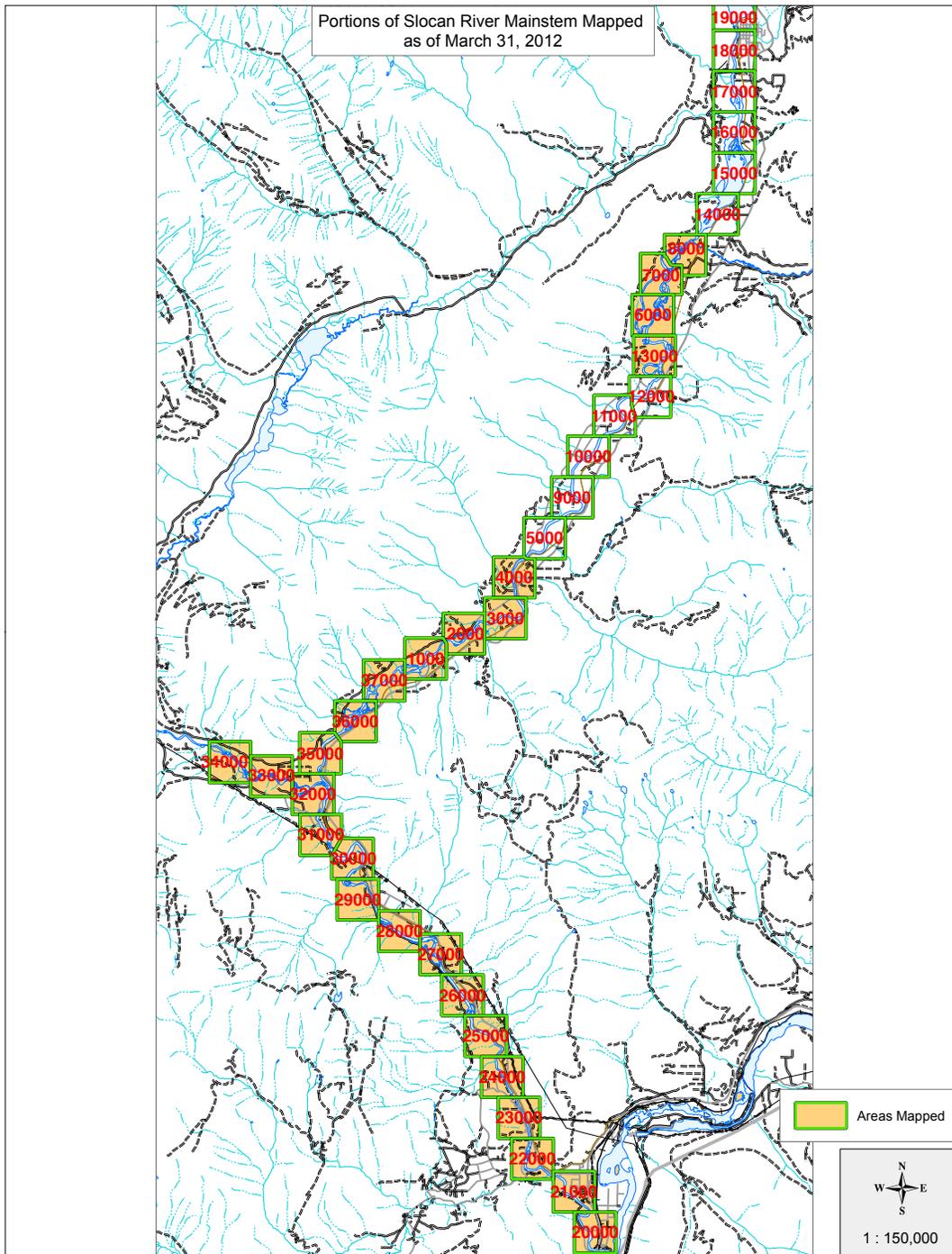


Figure 1. The Slocan River study site and the associated tiles used for the Slocan River Rainbow Trout Habitat Assessment.

River habitats were typed into 8 primary categories based on water depth (shallow, moderately shallow, moderate and deep) and velocity (riffle, glide) with 2 additional categories for non-river habitat types (swamp, flooded plains). Secondary descriptors were employed to further describe primary categories where applicable (over story vegetation, log jams, rip wrap). A tertiary category was also included to

signify fish bearing (adult rainbow trout) habitats as determined through over a decade of snorkel surveys to monitor the fish populations of the Slokan over time. Table 1 below describes the habitat attributes for each category.

Table 1. Habitat attributes, mapping symbols and descriptions employed on the Slokan River Habitat Assessment (2012)

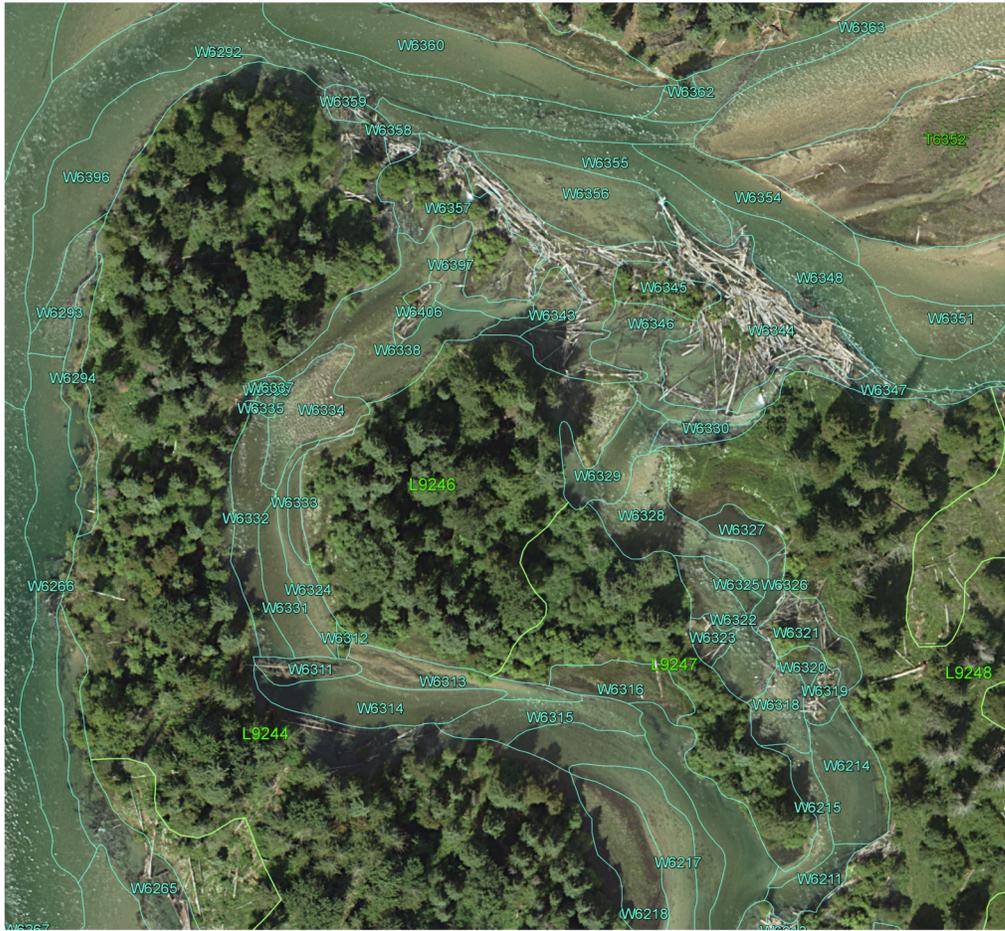
Category	Level	Symbol	Description
Glide Shallow	1	GS	Slow moving water, usually dry by summer's end
Glide Moderately Shallow	1	GMS	Slow moving water, usually dry by fall's end
Glide Moderate	1	GM	Slow moving water, low to moderate water by summer's end
Glide Deep	1	GD	Slow moving water, deepest of the glides
Riffle Shallow	1	RS	Fast moving water, gravel bar by summer's end
Riffle Moderately Shallow	1	RMS	Fast moving water, gravel bar by fall's end
Riffle Moderate	1	RM	Fast moving water, low to moderate depth at summer's end
Riffle Deep	1	RD	Fast moving water, deepest of the riffles
Swamp	1	S	Permanent wetlands
Flood Plain	1	F	Flooded temporarily in spring
Over Story Vegetation	2	O	Provides over story vegetative cover for fish
Log Jam (LOD)	2	L	Provides woody cover for fish
Rip Wrap	2	R	Man made habitat
Fish Bearing	3	Y	Adult rainbow trout present during snorkel surveys

The primary categories of depth are relative terms. River depth can be gauged from the photos based on colour and value with dark green being the deepest and then gradually moving towards a light tan (brown) colour being the most shallow.

Riffles have a disturbed water surface created by waves that reflect the light and are discernable by having a bright texture on the surface. Riffle areas are dominated by a coarse river bottom, ranging from pebbles to boulders, depending on water velocity. Rainbow trout are most often observed in moderate to deep riffle habitats.

Glides are areas of slower water with an undisturbed surface. The river bottom will be dominated by finer sediments and are areas of deposition. Rainbow trout are rarely observed in glide habitats on the Slokan River.

Every habitat polygon will be assigned a primary habitat category. Secondary and tertiary categories will only be applied where applicable. An example of the habitat typing and the associated database created for each tile can be seen in Figure 2 below.



POLY	ATTR1	ATTR2	FISH	AREA_HA
L9244	TERRESTRIAL			1.964
L9246	TERRESTRIAL			0.433
L9247	TERRESTRIAL			0.213
L9248	TERRESTRIAL			0.741
T6352	TERRESTRIAL			0.237
W6211	GM		Y	0.019
W6214	GMS			0.046
W6215	RS			0.019
W6217	RS			0.050
W6218	GMS			0.071
W6265	GMS	L		0.089
W6266	GM			0.119
W6293	RM	L		0.025
W6294	GMS			0.032
W6311	GS	L		0.014
W6312	GS	L		0.002
W6313	GS			0.032
W6314	GMS			0.050
W6315	RS			0.036
W6316	F			0.030
W6318	RS			0.023
W6319	GM	L		0.010
W6320	GM			0.007
W6321	GM	L		0.028
W6322	RMS			0.037
W6323	GMS	L		0.009
W6324	GS			0.020
W6325	GMS			0.008
W6326	GM	L	Y	0.008

POLY	ATTR1	ATTR2	FISH	AREA_HA
W6327	GM			0.014
W6328	RMS			0.054
W6329	GM		Y	0.033
W6330	GMS	O		0.011
W6331	GMS			0.027
W6332	RMS			0.043
W6333	GS	L		0.008
W6334	RS			0.044
W6335	RMS	L		0.002
W6336	RMS			0.001
W6337	RMS	L		0.003
W6338	GMS			0.081
W6343	GS			0.016
W6344	GS	L		0.200
W6345	S			0.024
W6346	GS			0.050
W6347	RS		Y	0.018
W6348	RM		Y	0.200
W6351	RS			0.036
W6354	GMS			0.048
W6355	RMS		Y	0.064
W6356	GS		Y	0.063
W6357	S			0.077
W6358	GM	L		0.009
W6359				0.007
W6360	GM			0.121
W6362	RM	L		0.002
W6363	RM			0.102
W6396				0.091

Figure 2. An example of the polygon habitat typing with the associated database

With the completion of the habitat assessment, a side channel analysis was completed. A side channel is defined as having a vegetated island separating it from the main stem of the river. A non-vegetated island (e.g. gravel bar, flood plain etc.) would not be categorized as a side channel due to its ephemeral or dynamic nature and would be considered a braided section of the river. All side channels were given a unique identification tag and classed as either functioning or non-functioning. A functioning side channel is considered to have sufficient water flow during all seasons, providing spawning habitat in the spring, high water refugia for trout during peak flows and summer and fall habitat for adult rainbow trout. All pools or potential pools were then identified to quantify trout habitat availability for each side channel as a measure of their potential restoration value.

3.0 Results

In total, 28 photo tiles were completed, including 3 that covered the lower reach of the Little Slovan River. Side channel analysis was conducted for all photo tiles covering the Slovan River with the exception of the 2 reaches that are dominated by glide habitat and have little potential for rainbow trout habitat restoration.

A total of 35 channels and sub-channels have been identified, 24 which are considered to be non-functional with restoration potential (see Table 2 below). Within these side channels, 81 pools were identified as having potential to support trout if restoration efforts were undertaken to restore historic water levels or discharge. Based on previous trout population assessments of functioning side channel conducted in 2010 (Corbett, 2011), an estimate of 3.2 trout per pool ($n=3$) was calculated. Using these estimates the 81 pools identified in the non-functioning side channels could potentially provide habitat for 243 rainbow trout using a conservative estimate of 3 fish per pool. It must be emphasized that these estimates are very conservative in nature and do not include the potential increase in production beyond the efforts of returning side channels back to their historic level of ecological function through an increase in water discharge. Further restoration efforts, using in-stream structures to increase the number of pools in the restored side channel, would increase the trout production accordingly.

Table 2. A list of all side channels identified during the channel analysis on the Slokan River. Trout estimates are given for only the non-functioning side channels as a measure of potential productivity. Fish estimates were obtained based on a prediction of producing 3 trout per pool based on evidence from fish counts in functioning side channels on the Slokan River.

Side Channel	Function	Location	Tile	Pools	Fish
1-1	N	Lemon	8000	3	9
1-2	N	Lemon	8000	7	21
1-3	N	Lemon	8000	2	6
2-1	Y	Larsen	7000	6	
2-2	N	Larsen	7000	21	63
2-3	N	Larsen	7000	1	3
2-4	N	Nixon	6000	5	15
3-1	Y	Larsen	7000	9	
3-2	Y	Nixon	6000	4	
3-3	N	Nixon	6000	5	15
4-1	N	Cross	13000	2	6
5-1	N	Cross	13000	2	6
6-1	N	Roger	3000	3	9
7-1	N	Cougar	2000	1	3
7-2	N	Cougar	2000	1	3
8-1	N	Cougar	2000	1	3
8-2	Y	Cougar	2000	9	
8-3	N	Cougar	2000	1	3
8-4	Y	Cougar	2000	5	
9-1	N	Ehlers	1000	1	3
10-1	N	Ehlers	1000	2	6
10-2	N	Ehlers	1000	5	15
11-1	Y	Zalewski	37000	2	
12-1	N	Zalewski	37000	4	12
13-1	N	Zalewski	37000	2	6
14-1	Y	Lumberyard	36000	3	
15-1	Y	Lumberyard	36000	7	
16-1	N	Lumberyard	36000	3	9
17-1	N	Lumberyard	36000	3	9
18-1	N	Passmore	30000	2	6
19-1	N	SP2	29000	1	3
20-1	Y	SP2	29000	5	
21-1	Y	SP Back	28000	18	
22-1	Y	Cookie Jar	27000	7	
23-1	N	Mail Box	26000	3	9

The non-functioning side channels were then ranked according to potential fish production with a secondary ranking based on relative technical feasibility (access, site sensitivity etc) and ranked as Low (L), Medium (M) or High (H) (see Table 3). A social ranking must also be considered but is beyond the scope of this project and will require public consultation and adjacent landowners.

Table 3. Ranking of potential side channel restoration projects on the Slocan River

Biological Ranking	Technical Ranking	Side Channel	Tile Name	Tile No.	Pools	Fish
1		2-2	Larsen	7000	21	63
2		1-2	Lemon	8000	7	21
3 (t)		2-4	Nixon	6000	5	15
3 (t)		3-3	Nixon	6000	5	15
3 (t)		10-2	Ehlers	1000	5	15
6		12-1	Zalewski	37000	4	12
7 (t)		1-1	Lemon	8000	3	9
7 (t)		6-1	Roger	3000	3	9
7 (t)		16-1	Lumberyard	36000	3	9
7 (t)		17-1	Lumberyard	36000	3	9
7 (t)		23-1	Mail Box	26000	3	9
12 (t)		1-3	Lemon	8000	2	6
12 (t)		4-1	Cross	13000	2	6
12 (t)		5-1	Cross	13000	2	6
12 (t)		10-1	Ehlers	1000	2	6
12 (t)		13-1	Zalewski	37000	2	6
12 (t)		18-1	Passmore	30000	2	6
18 (t)		2-3	Larsen	7000	1	3
18 (t)		7-1	Cougar	2000	1	3
18 (t)		7-2	Cougar	2000	1	3
18 (t)		8-1	Cougar	2000	1	3
18 (t)		8-3	Cougar	2000	1	3
18 (t)		9-1	Ehlers	1000	1	3
18 (t)		19-1	SP2	29000	1	3

4.0 Restoration Prescriptions

The development of site-specific detailed prescriptions is beyond the scope of this project and should consider the Sensitive Ecosystem Mapping project that is in progress. Rather a general description of the recommended prescriptions will be given, with steps required to meet restoration objectives.

Once a site has been chosen based on a decision-making matrix involving the consideration of biological, technical and social values a longitudinal stream bottom profile should be obtained (see example below). This will facilitate determining the size and depth of the side channel opening or intake at the head of the stream based on the objectives of the restoration project. The objective for these projects is to ensure sufficient stream flows during spawning season and during periods of low water in the fall, providing adequate pool depths to support rainbow trout. The

intake therefore must be deep enough that during these periods sufficient water flows from the mainstem will enter into the channel.

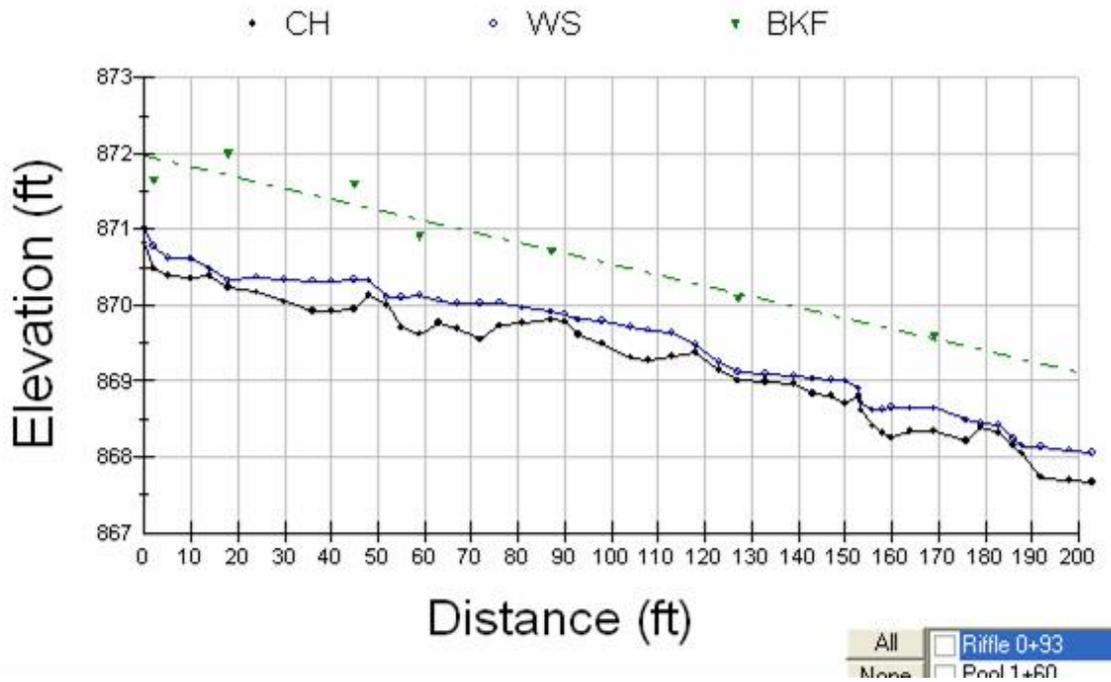


Figure 3. An example of a longitudinal stream profile created by RIVERmorph stream restoration software.

The current restriction at the head of the side channel must therefore be opened to a specific depth in order to create the desired downstream effects. All of the restrictions on the Slocan are from a build up of rock substrate, mostly gravel and cobbles. In some instances, this build up was created in conjunction with a logjam and therefore, there may be instances when the log jam will have to be partially removed. Log material should remain on site for future restoration considerations.

Once the desired depth of the riffle crest at the intake has been determined the intake will be excavated out and the intake reinforced with sufficiently large boulders to ensure that erosion does not occur during peak flows and that the desired riffle crest depth is maintained over time. Once work has been completed, appropriate riparian restoration efforts should be undertaken to restore ecological function of the work site.

Once water levels have been established and the stream morphology has had an opportunity to respond to increase water flows, other restoration opportunities may be realized. Creating additional pools through the use of in-stream structures will increase the biological productivity of the side channel. Installing perforated pipe (infiltration galleries) into the stream bed will encourage an increase in cold ground water discharge benefiting both water volume and temperatures during periods of low water (Minor, 2006).

5.0 References

Corbett, P.J. (2011). Slocan River preliminary side channel assessment: 2010. Un Pub Rpt, Columbia Basin Trust, Cranbrook, B.C.

Minor, Tom (2006). Huwer Ground Water Complex. Un Pub Rpt. Whitevalley Community Resource Centre, B.C.