Okanogan River Basin (US Portion) Reach Assessment

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REPORT

1. Background

Since 2006, collaborations between Summit Environmental Consultants Inc. (Summit) and the Confederated Tribes of the Colville Reservation (CCT) were initiated to collect and evaluate fish habitat data within the Okanogan River Basin, for the strategic development of fish habitat protection and rehabilitation initiatives. These efforts have been funded by Bonneville Power Administration through the Okanogan Basin Monitoring and Evaluation Program (OBMEP) and the Okanogan Sub-basin Habitat Improvement Program (OSHIP).

Over the past six years fish habitat data has been routinely collected by OBMEP at 91 sites throughout the Okanogan Basin. The resulting OBMEP database is comprised of thousands of data points pertaining to various fish habitat features collected throughout the basin. These data points and collected data have been used to generate information and results in this report pertaining to limiting factors throughout the Okanogan Basin that affect salmonid spawning, rearing and migrating.

2. Introduction

CCT and Summit have been working together to analyze the collected data to develop a reach assessment for the United States portion of the Okanogan River Basin. The result of this reach assessment will guide users to areas in need of fish habitat protection and habitat rehabilitation. The objectives for this phase of the project were to

- Delineate reaches in the basin by the biophysical fish behavior characteristics (spawning, rearing or migrating).
- Identify the habitat indicators applicable to the Okanogan River Basin to classify each stream reach;
- Determine classification criteria for each indicator to differentiate between Properly Functioning (PF), At Risk (AR), or Not Properly Functioning (NPF);
- Evaluate the data in terms of the above classifications;
- Develop methods for prioritizing stream reaches for protection or rehabilitation; and
- Provide recommendations for the strategic management of fish habitat protection and rehabilitation initiatives in the Okanogan River Basin.

Through the interaction and participation of CCT staff, Summit developed iterative data analysis and mapping routines for each selected indicator.

This report presents the methods, results and recommendations that have resulted from the above process.

3. Habitat Indicator Methods

Below is the explanation of how habitat indicators and classifications were defined; how the basin was assessed; and how existing data was incorporated.

A. Indicator Selections

The selection of the habitat indicators began with an in-depth collaborative review of the indicators and classification criteria used for the Upper Columbia River Basin Salmon Habitat Restoration Reach Assessments developed by agencies doing habitat work in the Upper Columbia Basin in collaboration with the Upper Columbia Salmon Recovery Board (UCSRB)[1]. Each indicator in these reports was discussed to determine if it should be adopted, adapted or not included in the Okanogan River Basin reach assessment. In cases where the indicators were adapted it was because different criteria were better suited to the Okanogan Basin, or the data required was not available for the Okanogan River Basin. A matrix of the indicators considered and the justification for the decision made is seen in Table 1.

For a complete list of the OBMEP selected indicators, and the criteria used to determine the classification groups of each, see Table 2.

B. Species-Specific Indicators

Fish focused on in this study were grouped into two types: (1) summer steelhead (spring spawners), and (2) summer Chinook and sockeye (fall spawners). Because the temperature and streamflow requirements of these two types differ, the indicator classification criteria for each were also different. Therefore, the “Temperature” and “Bedscour & Streamflow” indicators have been separated for each fish type. It should also be noted that summer steelhead utilizes both the mainstem and tributaries, whereas summer Chinook and sockeye only utilize the mainstem.

Details pertaining to how the indicators and classification criteria have been applied are detailed in the indicator-specific methodologies (Section 4).

C. Reach Allocation

As previously mentioned, there are 91 data collection sites within the Okanogan basin. However, the basin is subdivided into 110 individual stream reaches. Therefore there are several reaches that do not physically contain any data collection sites. For the majority of indicators, data collected was only used to represent the conditions at the reach where the actual sampling site is located.

[1] http://uc.ekosystem.us/

The exceptions to this were the “Temperature” and “Stream Flow” indicators. For these, if a sampling location was not located in the reach, data was allocated from sampling locations in the neighboring reaches. Details pertaining to how representative reaches were selected are detailed in the indicator-specific methodologies (Section 5).

D. Direct and Inferred Reach Classifications

The classification criteria for each indicator were applied on a reach-by-reach basis. For the majority of the indicators, classification criteria were dependant on data collected directly from the stream or streamside area.

The exceptions to this were the “Road Density” and “Landuse” indicators. For these, the upland areas surrounding each reach were classified. The classification most prevalent in the upland areas was adopted as the reach classification.

The resulting classifications for each of the indicators are summarized (by reach name) in Table 3. Maps 1-7 are overview maps that identify the name and location of the reaches analyzed in this study.

TABLE 1. COMPARISON OF PATHWAYS AND INDICATORS IN THE UPPER COLUMBIA REPORTS WITH THE OKANOGAN BASIN PROJECT

PATHWAY			UPPER COLUMBIA VALUES [1]			Comparison Notes	CCT metric?
		Tributary-scale/ Reach-scale	Adequate Condition	At Risk	Unacceptable		
Water Quality[1]	Temp	Tributary-scale	Bull trout: incubation (2-5C), rearing (4-10), spawning (1-9) Salmon & Steelhead: spawning (June-Sept 15C) (Sept-May 12C), rearing (15C), migration (15C), adult holding (15C) Or 7-DADMax performance standards (WDOE): Salmon spawning (13C), Core summer salmonid habitat (16C), Salmonid spawning, rearing and migration (17.5C), salmonid rearing & migration only (17.5C)	MWMT in reach during the following life history stages: Incubation (<2 or 6C), rearing (<4 or 13-15), spawning (<4 or 10C). Temperatures in areas used by adults during the local spawning migration sometimes exceed 15C. Or 7-DADMax performance standards exceeded by </= 15%	MWMT in reach during the following life history stages: Incubation (<1 or >6C), rearing (>15), spawning (<4 or >10C). Temperatures in areas used by adults during the local spawning migration regularly exceed 15C. Or 7-DADMax performance standards exceeded by > 15%	CCT methods include a trend analysis of temperatures during specific period of records.	Yes
	Turbidity	Tributary-scale	performance standard: acute (<70 NTU), chronic (<50NTU). For streams that naturally exceed these standards: turbidity should not exceed natural baseline levels at the 95% CL. <15% exceedance. Or Turbidity shall not exceed: 5 NTU over background when the background is 50 NTU or less; or a 10% incr in turb when the bckgrd turb is > 50 NTU	15-50% exceedance	>50% exceedance	CCT does not collect enough turbidity data to analyse this metric.	No
	Chemical contamination/ Nutrients	Tributary-scale	low levels of chem contam from landuse sources, no excessive nutrients, no CWA 303d designated reaches or WSDOE standards - 173-201A-200	moderate levels of chem contam from landuse sources, some excess nutrients, one CWA 303d designated reach	high levels of chem contam from landuse sources, high levels of excess nutrients, more than one CWA 303d designated reach	CCT does not collect enough water chemistry data to analyse this metric.	No
Habitat Access (combined with Off Channel Habitats and the Floodplain Connectivity)	Physical Barriers	Reach-scale	no manmade barriers present in the mainstem that prevent upstream or downstream migration at some flows that are biologically significant.	manmade barriers present in the mainstem that prevent upstream or downstream migration at some flows that are biologically significant	manmade barriers present in the mainstem that prevent upstream or downstream migration at multiple or all flows	CCT methods combine physical barriers, off-channel habitats and floodplain connectivity.	Yes
	Floodplain Connectivity	Reach-scale	Floodplain areas are frequently hydrological linked to main channel; overbank flows occur and maintain wetland functions, riparian vegetation and succession	Reduced linkage of wetland, floodplains and riparian areas to main channel; overbank flows are reduced relative to historic frequency, as evidenced by moderate degradation of wetland function, riparian vegetation/succession.	Severe reduction in hydrologic connectivity between off-channel, wetland, floodplain and riparian areas; wetland extent drastically reduced and riparian vegetation/succession altered significantly.		
	Off-channel Habitat	Reach-scale	Reach has many ponds, oxbows, backwaters, and other off-channel areas with cover, and side channels are low energy areas. No manmade barriers present along the mainstem that prevent access to off-channel areas.	Reach has some ponds, oxbows, backwaters, and other off-channel areas with cover, and side channels are generally high energy areas. Manmade barriers present that prevent access to off-channel habitat at some flows that are biologically significant.	Reach has few or no ponds, oxbows, backwaters, and other off-channel areas. Manmade barriers present that prevent access to off-channel habitat at multiple or all flows.		
Channel Condition and Dynamics	Substrate & Embeddedness	Reach-scale	Gravels or small cobbles make-up >50% of the bed materials in spawning areas. Reach embeddedness in rearing areas <20%. <12% fines (<0.85 mm) in spawning gravel or </= 12% surface fines of </= 6mm.	Gravels or small cobbles make-up 30-50% of the bed materials in spawning areas. Reach embeddedness in rearing areas 20-30%. 12-17% fines (<0.85 mm) in spawning gravel or 12-20% surface fines of </= 6mm	Gravels or small cobbles make-up <30% of the bed materials in spawning areas. Reach embeddedness in rearing areas >30%. >17% fines (<0.85 mm) in spawning gravel or >20% surface fines of </= 6mm	CCT methods evaluate substrate and embeddedness separately for spawning and rearing areas.	Yes
Watershed Condition	Large Woody Debris[3]	Reach-scale	>20 pieces/mile >12" diameter >35 ft length; and adequate sources of woody debris available for both long- and short-term recruitment.	currently levels are being maintained at minimum levels desired for "adequate", but potential sources for long-term woody debris recruitment is lacking to maintain these minimum values.	current levels are not at those desired values for "adequate" and potential source of woody debris for short- and/or long-term recruitment are lacking.	CCT methods use LWD sizes based on the data that is available.	Yes
	Pool Frequency & Quality	Reach-scale	Pool frequency: Channel width # pools/mile 0-5 ft 39 5-10 ft 60 10-15 ft 48 15-20 ft 39 20-30 ft 23 30-35 ft 18 35-40 ft 10 40-65 ft 10 40-65 ft 9 65-100 ft 4 Pools have good cover and cool water and only minor reduction of pool volume by fine sediment Each reach has many large pools > 1m deep with good fish cover.	Pool frequency is similar to values in "functioning adequately", but pools have inadequate cover/temperature, and/or there has been a moderate reduction of pool volume by fine sediment Reaches have few large pools (>1m) present with good fish cover.	Pool frequency is considerably lower than values for "functioning adequately", also cover/temperature is inadequate, and there has been a major reduction of pool volume by fine sediment Reaches have no deep pools (>1m) with good fish cover	CCT methods are based on the specific watershed characteristics.	Yes
	Width to Depth Ratios					CCT methods include Width to Depth Ratios.	Yes
	Bank Stability/Channel Migration	Reach-scale	Channel is migrating at or near natural rates	Limited amount of channel migration is occurring at a faster/slower rate relative to natural rates, but significant change in channel width or planform is not detectable; LWD is still being recruited.	Little or no channel migration occurring because of human actions preventing reworking of the floodplain and LWD recruitment; or channel migration is occurring at an accelerated rate such that channel width has at least doubled, possibly resulting in a channel planform change, and sediment supply has noticeably increased from bank erosion.	CCT methods based on percentage of bare ground.	Yes
	Vertical Channel Stability	Reach-scale	No measurable trend of aggradation or incision and no visible change in channel planform.	Measurable trend of aggradation or incision that has the potential to but not yet caused disconnection of the floodplain or a visible change in channel planform (e.g., single thread to braided)	Enough incision that the floodplain and off-channel habitat areas have been disconnected; or, enough aggradation that a visible change in channel planform has occurred (e.g., single thread to braided)	CCT does not have the data to analyze this metric.	No
	Effective Drainage Network & Watershed Road Density	Tributary-scale	zero or minimum increases in active channel length correlated with human caused disturbance And Road density <1 miles/miles2.	low to mod. Incr. in active channel length correlated with human cause disturbances. And Road density 1-2.4 mi/mi2	> than mod. Increase in active channel length correlated with human caused disturbances and road density >2.4 mi/mi2	CCT methods based on road density analyses.	Yes
General Indicators/ Riparian Vegetation	Disturbance (30 m buffer zone)	Tributary-scale	Env. disturb. is short lived; predictable hydrograph, high quality habitat and watershed complexity providing refuge and rearing space for all life stages or multiple life-history forms. Natural processes are stable.	Scour events, debris torrents, or catastrophic fires are localized events that occur in several minor parts of the watershed. Resiliency of habitat to recover from env. Dist. Is moderate.	Frequent flood or drought producing highly variable and unpredictable flows, scour events, debris torrents or high probability of catastrophic fir exists throughout a major part of the watershed. The channel is simplified, providing little hydraulic complexity in the form of pools or side channels. Natural processes are unstable.	CCT does not have the data to analyze this metric.	No
	Disturbance (human)	Reach-scale	>80% mature trees (medium-large) in the riparian buffer zone (defined as a 30 m belt along each bank) that are available for recruitment by the river via channel migration; <20% disturbance in the floodplain (e.g., agriculture, residential, roads, etc.); <2 mi/mi2 road density in the floodplain	50-80% mature trees (med-lg) in the riparian buffer zone (defined as a 30 m belt along each bank) that are available for recruitment by the river via channel migration; 20-50% disturbance in the floodplain (e.g., agriculture, residential, roads, etc.); 2-3 mi/mi2 road density in the floodplain	<50% mature trees (med-lg) in the riparian buffer zone (defined as a 30 m belt along each bank) that are available for recruitment by the river via channel migration; >50% disturbance in the floodplain (e.g., agriculture, residential, roads, etc.); >3 mi/mi2 road density in the floodplain	CCT methods include analyses of these characteristics in other metrics (canopy cover, landuse/disturbance).	Yes
	Streamflow	Tributary-scale	magnitude, timing, duration and frequency of peak flows within a watershed are not altered relative to natural conditions of an undisturbed watershed of similar size, geology and geography.	some evidence of altered magnitude, timing duration and/or frequency of peak flows relative to natural conditions of an undisturbed watershed of similar size, geology and geography.	pronounced changes in magnitude, timing, duration, and/or frequent of peak flows relative to natural conditions of an undisturbed watershed of similar size, geology and geography.	CCT methods based on flow during specific period of records.	Yes
	Structure	Reach-scale	>80% spp composition, seral stage, and structural complexity are consistent with potential native community	50-80% spp composition, seral stage, and structural complexity are consistent with potential native community	<50% spp composition, seral stage, and structural complexity are consistent with potential native community	CCT methods based on large tree data.	Yes
	Canopy Cover (10 m zone)	Reach-scale	trees and shrubs within one site potential tree height distance have >80% canopy cover that provides thermal shading to the river.	Trees and shrubs within one site potential tree height distance have 50-80% canopy cover that provides thermal shading to the river.	trees and shrubs within one site potential tree height distance have <50% canopy cove that provides thermal shading to the river.	CCT methods based on shading (densiometer) data.	Yes

1 Upper Columbia River Basin Salmon Habitat Restoration Reach Assessments (http://uc.ekosystem.us/)

Table 2. Matrix of Pathways and Indicators for the Okanogan Basin Habitat Improvement Projects.

PATHWAY	INDICATOR			CRITERIA: PROPERLY FUNCTIONING	CRITERIA: AT RISK	CRITERIA: NOT PROPERLY FUNCTIONING	MAP NUMBER
Water Quality[1] (for Summer Steelhead)	Temp	Spawning and Incubation Criteria: 18 degrees (LC50 for summer Steelhead); April 1 – June 30	daily average (screened data for anomalies - see rules)	< 17 deg throughout period of record	If one or more days exceeds 17 deg, but the # of days violating this criteria are decreasing (# of days you violate criteria over the period, each year just during the period)	If one or more days exceeds 17 deg, **and** the # of days violating this criteria are increasing or more than half the days are in exceedance for any year (# of days you violate criteria over the period, each year just during the period)	1a
		Rearing Criteria 20 degrees; (Water is stressful for coldwater salmonids and defines lasting distributions); Year round	daily average (screened data for anomalies - see rules)	< 19 deg all year	If one or more days exceeds 19 deg, but the # of days violating this criteria are decreasing (# of days annually you violate criteria)	If one or more days exceeds 19 deg, **and** the # of days violating this criteria are decreasing or more than half the days are in exceedance for any year (# of days annually you violate criteria)	
		Migration Criteria: 24 degrees (maximum adult migration) 21 degrees(migration restrictions begin); October 1 – May 31	daily average (screened data for anomalies - see rules)	< 21 deg throughout period of record	If one or more days exceeds 21 deg, but the # of days violating this criteria are decreasing (# of days you violate criteria over the period, each year just during the period)	If one or more days exceeds 21 deg, **and** the # of days violating this criteria are decreasing or more than half the days are in exceedance for any year (# of days you violate criteria over the period, each year just during the period)	
Water Quality[1] (for Summer Chinook and Sockeye)	Temp (mainstem only, not including data in the tributaries)	Spawning and Incubation Criteria: 18 degrees (LC50 for summer Steelhead); October 1 – March 30	daily average (screened data for anomalies - see rules)	< 17 deg throughout period of record	If one or more days exceeds 17 deg, but the # of days violating this criteria are decreasing (# of days you violate criteria over the period, each year just during the period)	If one or more days exceeds 17 deg, **and** the # of days violating this criteria are increasing or more than half the days are in exceedance for any year (# of days you violate criteria over the period, each year just during the period)	1b
		Rearing Criteria 20 degrees; (Water is stressful for coldwater salmonids and defines lasting distributions); March 1 – August 31	daily average (screened data for anomalies - see rules)	< 19 deg throughout period of record	If one or more days exceeds 19 deg, but the # of days violating this criteria are decreasing (# of days annually you violate criteria)	If one or more days exceeds 19 deg, **and** the # of days violating this criteria are decreasing or more than half the days are in exceedance for any year (# of days annually you violate criteria)	
		Migration Criteria: 24 degrees (maximum adult migration) 21 degrees (migration restrictions begin); July 1 – October 1	daily average (screened data for anomalies - see rules)	< 21 deg throughout period of record	If one or more days exceeds 21 deg, but the # of days violating this criteria are decreasing (# of days you violate criteria over the period, each year just during the period)	If one or more days exceeds 21 deg, **and** the # of days violating this criteria are decreasing or more than half the days are in exceedance for any year (# of days you violate criteria over the period, each year just during the period)	
Habitat Access	Physical Barriers, Off Channel Habitats, Flood Plain Connectivity	Visual Interpretation of point data and orthos, then interpolation to the reaches (If all points are PF – reach is PF; If all AR – reach is AR; If nothing – NPF; If any NPF – NPF)		Off Channel areas are frequently hydrologically linked to main channel Allows upstream and down stream passage at all flows (Complete access to all areas with no obstructions) Connected to Main flow at all times. Off Channel areas are frequently hydrologically linked to main channel.	Does not allow upstream and downstream passage at base flows. Connected to main flow during high water only. Reduced linkage of off channel areas to main channel.	Does not allow upstream and downstream passage. Not connected to Main flow. Severely Reduced linkage of off channel areas to main channel.	2a 2b
Channel Condition and Dynamics	Dominant Substrate	Dominant Substrate	Spawning	fine gravel to small cobble	large cobble (and any other samples not fitting into the other categories)	fines to fine gravel, boulder to bedrock	3
			Rearing	small cobble to boulder	fine gravel to coarse gravel (and any other samples not fitting into the other categories)	bedrock, fines and sand	
			Migrating	All			
	Embeddedness	Embeddedness	Spawning Rearing	<25%	25-50%	>50%	4
			Migrating	All			
Watershed Condition	Large Woody Debris			• Main stem ≥41 pieces/mi (>1 meter ln) • Tributaries ≥250 pieces/mi (>1 meter ln)	• Main stem 20-41 pieces/mi (>1 meter ln) • Tributaries 69-250 pieces/mi (>1 meter ln)	• Main stem ≤20 pieces/mi (>1 meter ln) • Tributaries ≤69 pieces/mi (>1 meter ln)	5
	Pool Quantity and Quality			• Mainstem pools and riffles present • Tributaries >200 pools per mile	• Mainstem only pool habitat is present • Tributaries 75-200 pools per mile	• Mainstem no water • Tributaries <75 pools/mile	6
	Width to Depth Ratios	bankfull height + thalweg depth and dividing by bankfull width		• Mainstem Okanogan River (U.S. ≤25) • Similkameen ≤20 • Tributaries ≤8	• Mainstem Okanogan River (U.S. 25-35) • Similkameen 20-30 • Tributaries 8-10	• Mainstem Okanogan River (U.S. ≥35) • Similkameen ≥30 • Tributaries ≥10	7
	Bank Stability/Channel Migration			Proportion of groundcover as bare (<10%)	Proportion of groundcover as bare (10-40%)	Proportion of groundcover as bare (>40%)	8
	Road Density	Interpolation to the reaches to represent the majority of the surrounding area.		*<1 mi/mi², some valley bottom roads*	*1-2 mi/mi², some valley bottom roads*	*>2 mi/mi², many valley bottom roads*	9
General Indicators/Riparian Vegetation	Landuse/ disturbance	Interpolation to the reaches to represent the majority of the surrounding area.		Continuous tracts of agriculture, forest land or open space (>75%)	Some continuous tracts of agriculture, forest land or open space (50-75%) along with some residential (<50%)	Little continuous tracts of agriculture , forest land or open space (<50%) along with lots of residential (>50%)	10
	Bedscour & Streamflow	Steelhead (March 26th to July 4th). Mainstem - spawning reaches only. Tributaries included.		• Mainstem & Similk < 10 days > 5000 CFS, or all < 5000 CFS • Mainstem below Zosel to confluence with Similk < 10 days > 1500 CFS, or all < 1500 CFS	• Mainstem 10-30 days > 5000 CFS • Mainstem below Zosel 10-30 days > 1500 CFS	• Mainstem >30 days > 5000 CFS • Mainstem below Zosel > 30 days > 1500 CFS	11a
				• Tributaries if flow is always >1	• Tributaries if there are some days < 1 CFS but no 0 days	• Tributaries >1 day with no flow	
		Chinook incubation (October 2nd to February 28th). Mainstem - spawning reaches only. Tributaries not included.		• Mainstem & Similk < 10 days > 5000 CFS, or all < 5000 CFS • Mainstem below Zosel to confluence with Similk < 10 days > 1500 CFS, or all < 1500 CFS	• Mainstem 10-30 days > 5000 CFS • Mainstem below Zosel 10-30 days > 1500 CFS	• Mainstem >30 days > 5000 CFS • Mainstem below Zosel > 30 days > 1500 CFS	11b
	Structure	Trees (large and small)		Proportion of trees is >40%	Proportion of trees is 10-40%	Proportion of trees is <10%	12a
		Shrubs (understory and groundcover)		Proportion of shrubs is >40%	Proportion of shrubs is 10-40%	Proportion of shrubs is <10%	12b
	Canopy Cover			some shading ≥ 70% (i.e., avg densiometer ≥11.9)	Not much shading 50-70% (i.e., avg densiometer 8.5-11.9)	≤50% shading (i.e., avg densiometer ≤8.5)	13

Table 3. Indicator Classification Summary

REACH	Highest Biol. Value	FLOW - STHD	FLOW - CHIN	TEMP - STHD	TEMP - CHIN	OFF CHAN HAB	SUBSTRATE	EMBEDDEDNESS	LWD	BANK STABILITY	ROAD DENSITY	LANDUSE	WTD	BARE	TREES	SHRUBS	CANOPY
Tributaries																	
Aeneas Creek0.00 to 0.25	Rearing		Tributary	PF	Tributary	NPF					NPF	PF					
Antoine Creek0.00 to 0.80	Rearing	NPF	Tributary	NPF	Tributary	NPF	AR	NPF	NPF	NPF	NPF	PF	PF	AR	NPF	NPF	PF
Antoine Creek0.80 to 12.0	Rearing	NPF	Tributary	NPF	Tributary	NPF	NPF	NPF	NPF	NPF	NPF	PF	PF	PF	NPF	NPF	AR
Bonaparte Creek0.00 to 0.95	Rearing	AR	Tributary	NPF	Tributary	NPF	NPF	NPF	NPF	AR	NPF	AR	PF	PF	NPF	NPF	PF
Chilliwist Creek0.00 to 0.10	Rearing		Tributary	PF	Tributary	NPF					NPF	AR					
Loup Loup Creek0.00 to 1.00	Rearing		Tributary	NPF	Tributary	NPF	NPF	NPF	AR	AR	NPF	AR	NPF	NPF	NPF	NPF	NPF
Ninemile Creek0.00 to 1.05	Rearing	AR	Tributary	PF	Tributary	NPF	NPF	NPF	NPF	AR	AR	PF	PF	PF	NPF	AR	PF
Ninemile Creek1.05 to 1.90	Rearing	AR	Tributary	PF	Tributary	NPF					AR	PF					
Ninemile Creek1.90 to 4.10	Rearing	AR	Tributary	PF	Tributary	NPF					AR	PF					
Ninemile Creek4.10 to 6.10	Rearing	AR	Tributary	PF	Tributary	NPF	PF	NPF	NPF		AR	PF	PF	PF	NPF	NPF	PF
Omak Creek0.00 to 0.90	Rearing	PF	Tributary	AR	Tributary	NPF	AR	NPF	NPF	NPF	NPF	NPF	NPF	PF	NPF	NPF	PF
Omak Creek0.90 to 3.70	Rearing	PF	Tributary	NPF	Tributary	NPF	NPF	NPF	NPF	NPF	NPF	PF	NPF	PF	NPF	AR	PF
Omak Creek3.70 to 5.05	Rearing	PF	Tributary		Tributary	NPF	NPF	NPF	NPF	NPF	NPF	PF	AR	PF	NPF	NPF	NPF
Omak Creek5.05 to 5.40	Rearing	PF	Tributary	AR	Tributary	NPF	NPF	NPF	PF	NPF	NPF	PF	PF	PF	NPF	AR	
Omak Creek5.40 to 5.65	Rearing	PF	Tributary	AR	Tributary	NPF					NPF	PF					NPF
Omak Creek5.65 to 6.30	Rearing	PF	Tributary	AR	Tributary	NPF	PF	NPF	PF	AR	NPF	PF	AR	PF	NPF	NPF	
Omak Creek6.30 to 7.55	Rearing	PF	Tributary	NPF	Tributary	NPF	PF	NPF	NPF		NPF	PF	NPF	PF	NPF	AR	AR
Omak Creek7.55 to 10.15	Rearing	PF	Tributary	AR	Tributary	NPF	PF	NPF	AR	NPF	NPF	PF	AR	PF	AR	NPF	AR
Omak Creek10.15 to 16.15	Rearing	PF	Tributary	AR	Tributary	NPF	NPF	NPF	NPF	NPF	NPF	PF	NPF	PF	NPF	AR	PF
Omak Creek16.15 to 17.70	Rearing	PF	Tributary	AR	Tributary	NPF					NPF	PF					
Salmon Creek0.00 to 1.85	Rearing		Tributary		Tributary	NPF	PF	AR	NPF		AR	AR	NPF	NPF	NPF	NPF	NPF
Salmon Creek1.85 to 2.45	Rearing		Tributary		Tributary	NPF	PF	AR	NPF	NPF	AR	PF	AR	PF	AR	AR	AR
Salmon Creek2.45 to 2.85	Rearing		Tributary		Tributary	NPF					AR	PF					
Salmon Creek2.85 to 3.60	Rearing		Tributary		Tributary	NPF					AR	PF					
Salmon Creek3.60 to 4.25	Rearing		Tributary		Tributary	NPF					AR	PF					
Salmon Creek4.25 to 4.65	Rearing		Tributary	PF	Tributary	NPF	NPF	NPF	PF	AR	AR	PF	AR	PF	NPF	NPF	PF
Salmon Creek4.65 to 5.15	Rearing		Tributary	PF	Tributary	NPF	NPF	NPF	AR	NPF	AR	PF	NPF	PF	NPF	NPF	
Salmon Creek5.15 to 14.65	Rearing		Tributary	AR	Tributary	NPF	PF	NPF	NPF	NPF	AR	PF	NPF	PF	NPF	NPF	AR
Salmon Creek14.65 to 16.95	Rearing		Tributary	AR	Tributary	NPF	PF	NPF	NPF	AR	AR	PF	NPF	PF	NPF	NPF	PF
Salmon Creek16.95 to 17.50	Rearing		Tributary	PF	Tributary	NPF	NPF	NPF	NPF	AR	AR	PF	PF	PF	NPF	NPF	
Salmon Creek17.50 to 17.51	Rearing		Tributary	PF	Tributary	NPF					AR	PF					
Salmon Creek17.51 to 17.55	Rearing		Tributary	PF	Tributary	NPF					AR	PF					
Stapaloop Creek0.00 to 0.28	Rearing		Tributary	PF	Tributary	NPF					NPF	PF					
Stapaloop Creek0.28 to 3.08	Rearing		Tributary	PF	Tributary	NPF	AR	NPF	NPF		NPF	PF	AR	PF	NPF	AR	PF
Tonasket Creek0.00 to 0.90	Rearing	NPF	Tributary	AR	Tributary	NPF	PF	NPF	NPF	AR	NPF	PF	PF	PF	NPF	NPF	AR
Tonasket Creek0.90 to 1.95	Rearing	NPF	Tributary	NPF	Tributary	NPF	NPF	NPF	NPF	AR	NPF	PF	PF	PF	NPF	NPF	AR
Tunk Creek0.00 to 0.70	Rearing	PF	Tributary	AR	Tributary	NPF	NPF	NPF	AR		AR	PF	AR	PF	NPF	NPF	AR
Wanacut Creek0.00 to 0.60	Rearing		Tributary	AR	Tributary	NPF					NPF	AR					
Wanacut Creek0.60 to 1.20	Rearing		Tributary	AR	Tributary	NPF	NPF	NPF	AR		NPF	AR	PF	PF	NPF	AR	PF
Wild Horse Spring Creek0.00 to 0.75	Rearing		Tributary		Tributary	NPF	PF	NPF	NPF	AR	NPF	PF	PF	PF	NPF	NPF	NPF
Mainstem																	
Okanogan River0.0 to 4.40	Migrate	Migrate	Migrate	PF	NPF	AR	PF			AR	NPF	PF					
Okanogan River4.40 to 14.40	Migrate	Migrate	Migrate	PF	NPF	AR	PF	PF	NPF	PF	NPF	PF	NPF	PF	NPF	NPF	NPF
Okanogan River14.40 to 15.10	Migrate	Migrate	Migrate	AR	NPF	NPF	PF	PF	PF	PF	NPF	AR	AR	PF	NPF	AR	NPF
Okanogan River15.10 to 15.80	Migrate	Migrate	Migrate	PF	NPF	NPF	PF			AR	NPF	AR					
Okanogan River15.80 to 16.60	Migrate	Migrate	Migrate	PF	NPF	AR	PF	PF	AR	PF	NPF	PF	AR	PF	NPF	NPF	NPF
Okanogan River16.60 to 16.80	Spawn	NPF	AR	NPF	NPF	NPF				AR	NPF	AR					
Okanogan River16.80 to 16.95	Migrate	Migrate	Migrate	PF	NPF	NPF	PF			AR	NPF	AR					
Okanogan River16.95 to 21.70	Migrate	Migrate	Migrate	PF	NPF	NPF	PF	PF	NPF	PF	NPF	AR	AR	PF	NPF	NPF	NPF
Okanogan River21.70 to 23.40	Spawn	NPF	AR	NPF	NPF	NPF	PF	NPF	PF	PF	NPF	AR	AR	PF	NPF	AR	NPF
Okanogan River23.40 to 24.30	Migrate	Migrate	Migrate	PF	NPF	NPF	PF	PF	NPF	AR	NPF	AR	NPF	PF	NPF	AR	NPF
Okanogan River24.30 to 24.95	Migrate	Migrate	Migrate	PF	NPF	NPF	PF			AR	NPF	PF					
Okanogan River24.95 to 25.65	Migrate	Migrate	Migrate	PF	NPF	NPF	PF	PF	NPF	PF	NPF	NPF	PF	PF	AR	NPF	
Okanogan River25.65 to 26.00	Migrate	Migrate	Migrate	PF	NPF	NPF	PF	PF	NPF	PF	NPF	NPF	PF	PF	AR	NPF	NPF
Okanogan River26.00 to 28.70	Migrate	Migrate	Migrate	PF	NPF	AR	PF	PF	AR	PF	NPF	AR	AR	PF	NPF	AR	NPF
Okanogan River28.70 to 29.10a	Spawn	NPF	AR	NPF	NPF	NPF				PF	NPF	AR		PF	NPF	AR	
Okanogan River28.70 to 29.10b	Spawn	NPF	AR	NPF	NPF	NPF	NPF	NPF	NPF	PF	NPF	AR	PF	PF	NPF	AR	NPF
Okanogan River29.10 to 29.30	Migrate	Migrate	Migrate	PF	NPF	NPF	PF			AR	NPF	AR					
Okanogan River29.30 to 29.95	Migrate	Migrate	Migrate	PF	NPF	AR	PF	PF	PF	PF	NPF	AR	AR	PF	NPF	NPF	NPF
Okanogan River29.95 to 30.50	Migrate	Migrate	Migrate	PF	NPF	NPF	PF			AR	NPF	NPF					
Okanogan River30.50 to 30.80	Spawn	NPF	AR	NPF	NPF	NPF				AR	NPF	NPF					
Okanogan River30.80 to 30.80	Migrate	Migrate	Migrate	PF	NPF	NPF	PF	PF	NPF	PF	NPF	AR	AR	PF	NPF	AR	NPF
Okanogan River31.80 to 32.00	Spawn	NPF	AR	NPF	NPF	NPF				AR	NPF	AR					
Okanogan River32.00 to 34.05	Migrate	Migrate	Migrate	PF	NPF	NPF	PF	PF	NPF	PF	NPF	AR	NPF	PF	NPF	NPF	NPF
Okanogan River34.05 to 34.15	Migrate	Migrate	Migrate	PF	NPF	NPF	PF			AR	NPF	AR					
Okanogan River34.15 to 35.00	Migrate	Migrate	Migrate	PF	NPF	AR	PF			AR	NPF	AR					
Okanogan River35.00 to 35.60	Spawn	NPF	AR	AR	PF	NPF	AR	PF	NPF	AR	NPF	AR	NPF	PF	NPF	NPF	
Okanogan River35.60 to 37.65	Migrate	Migrate	Migrate	PF	NPF	NPF	PF	PF	NPF	PF	NPF	PF	NPF	PF	NPF	AR	NPF
Okanogan River37.65 to 37.80	Spawn	NPF	AR	AR	PF	NPF				AR	NPF	PF					
Okanogan River37.80 to 39.30	Migrate	Migrate	Migrate	PF	NPF	NPF	PF	PF	NPF	PF	NPF	PF	NPF	PF	NPF	PF	NPF
Okanogan River39.30 to 39.50	Migrate	Migrate	Migrate	PF	NPF	NPF	PF	PF	NPF	PF	NPF	PF	NPF	PF	NPF	AR	
Okanogan River39.50 to 44.30	Migrate	Migrate	Migrate	PF	NPF	AR	PF	PF	NPF	PF	NPF	AR	NPF	PF	NPF	AR	NPF
Okanogan River44.30 to 45.010	Spawn	NPF	AR	AR	PF	NPF	PF	PF	NPF	AR	NPF	PF	NPF	PF	NPF	NPF	
Okanogan River45.00 to 47.60	Migrate	Migrate	Migrate	PF	NPF	NPF	PF	PF	PF	PF	NPF	PF	NPF	PF	NPF	NPF	NPF
Okanogan River47.60 to 48.20	Migrate	Migrate	Migrate	PF	NPF	NPF	PF			AR	NPF	PF					
Okanogan River48.20 to 48.90	Migrate	Migrate	Migrate	PF	NPF	NPF	PF	PF	AR	PF	NPF	PF	PF	AR	NPF	NPF	NPF
Okanogan River48.90 to 49.90	Migrate	Migrate	Migrate	PF	NPF	NPF	PF			AR	NPF	PF					
Okanogan River49.90 to 50.40	Spawn	NPF	AR	AR	PF	NPF	PF	NPF	PF	PF	NPF	PF	NPF	PF	NPF	NPF	
Okanogan River50.40 to 52.15	Migrate	Migrate	Migrate	PF	NPF	NPF	PF	PF	NPF	PF	NPF	PF	AR	PF	NPF	NPF	NPF
Okanogan River52.15 to 52.70	Spawn	NPF	AR	AR	PF	NPF				AR	NPF	PF					
Okanogan River52.70 to 52.90	Migrate	Migrate	Migrate	PF	NPF	NPF	PF			AR	NPF	PF					
Okanogan River52.90 to 53.25	Migrate	Migrate	Migrate	PF	NPF	NPF	PF			AR	NPF	PF					
Okanogan River53.25 to 54.65	Migrate	Migrate	Migrate	PF	NPF	NPF	PF	PF	NPF	PF	NPF	PF	PF	PF	NPF	AR	NPF
Okanogan River54.65 to 56.70	Spawn	NPF	AR	AR	PF	NPF	AR	AR	NPF	PF	NPF	AR	PF	AR	NPF	PF	NPF
Okanogan River56.70 to 57.30	Spawn	NPF	AR	AR	PF	NPF	AR	PF	PF	PF	NPF	NPF	AR	PF	NPF	NPF	NPF
Okanogan River57.30 to 61.20	Migrate	Migrate	Migrate	PF	NPF	AR	PF	PF	NPF	PF	NPF	PF	AR	PF	NPF	AR	NPF
Okanogan River61.20 to 62.20	Migrate	Migrate	Migrate	PF	NPF	NPF	PF	PF	AR	PF	NPF	PF	AR	PF	NPF	AR	NPF
Okanogan River62.20 to 63.60	Migrate	Migrate	Migrate	PF	NPF	NPF	PF	PF	AR	PF	NPF	PF	NPF	PF	NPF	NPF	NPF
Okanogan River63.60 to 70.00	Migrate	Migrate	Migrate	PF	NPF	NPF	PF	PF	NPF	AR	NPF	PF	PF	PF	NPF	NPF	NPF
Okanogan River70.00 to 70.30	Migrate	Migrate	Migrate	PF	NPF	NPF	PF	PF	PF	PF	NPF	PF	PF	PF	NPF	NPF	
Okanogan River70.30 to 71.15	Migrate	Migrate	Migrate	PF	NPF	NPF	PF	PF	NPF	PF	NPF	PF	AR	PF	NPF	NPF	
Okanogan River71.15 to 71.55	Spawn	NPF	AR	AR	PF	NPF	PF	NPF	AR	PF	NPF	AR	NPF	PF	NPF	NPF	NPF
Okanogan River71.55 to 74.05	Migrate	Migrate	Migrate	PF	NPF	NPF	PF	PF	NPF	PF	NPF	PF	NPF	PF	NPF	NPF	NPF
Okanogan River74.05 to 74.85	Migrate	Migrate	Migrate	AR	NPF	NPF	PF			AR	NPF	AR					
Okanogan River74.85 to 76.40	Spawn	NPF	NPF	NPF	AR	NPF	PF	NPF	NPF	PF	NPF	PF	PF	PF	NPF	NPF	NPF
Okanogan River76.40 to 76.60	Migrate	Migrate	Migrate	AR	NPF	NPF	PF	PF	NPF	PF	NPF	PF	AR	PF	NPF	NPF	
Okanogan River76.60 to 77.55	Spawn	NPF	NPF	NPF	AR	AR	PF	NPF	PF	PF	NPF	AR	AR	PF	NPF	NPF	NPF
Okanogan River77.55 to 77.80	Migrate	Migrate	Migrate	AR	NPF	NPF	PF			AR	NPF	NPF					
Okanogan River77.80 to 78.95	Migrate	Migrate	Migrate	AR	NPF	AR	PF			AR	AR	NPF					
Okanogan RiverCrossChannel	Migrate			AR	NPF	NPF	PF	PF	NPF	PF	NPF	PF	PF	PF	NPF	NPF	NPF
Similkameen River00.00 to 3.70	Spawn	NPF	PF	NPF	AR	NPF	NPF	NPF	PF	PF	AR	PF	NPF	AR	NPF	NPF	NPF
Similkameen River3.7 to 3.8	Spawn		Migrate	PF	AR	NPF	PF		AR	AR	AR	PF	NPF	PF	NPF	NPF	
Similkameen River3.80 to 4.00	Spawn	NPF	PF	NPF	AR	AR				AR	AR	PF					
Similkameen River4.00 to 4.50	Spawn	NPF	PF	NPF	AR	AR	PF	AR	NPF	PF	AR	PF	AR	AR	NPF	NPF	
Similkameen River4.50 to 5.00	Migrate	Migrate	Migrate	PF	AR	NPF	PF	PF	AR	PF	AR	AR	NPF	PF	NPF	AR	NPF
Similkameen River5.00 to 5.65	Spawn	NPF	PF	NPF	AR	NPF				AR	AR	PF					
Similkameen River5.65 to 6.60	Spawn	NPF	PF	NPF	AR	AR				AR	AR	PF					
Similkameen River6.60 to 6.95	Spawn	NPF	PF	NPF	AR	NPF				AR	AR	PF					
Similkameen River6.95 to 7.20	Spawn	NPF	PF	NPF	AR	NPF	NPF	NPF	NPF	PF	AR	PF	PF	NPF	NPF	NPF	NPF
Similkameen River7.20 to 7.75	Migrate	Migrate	Migrate		AR	NPF	PF	PF	NPF	PF	AR	PF	AR	NPF	NPF	NPF	
Similkameen River7.75 to 8.60	Migrate	Migrate	Migrate		AR	NPF	PF	PF	NPF	PF	AR	PF	AR	NPF	NPF	NPF	NPF

N
W
E
S

Map Number 1

Map Number 2

Map Number 3

Map Number 4

Map Number 5

Map Number 6

Oroville
Tonasket
Riverside
Omak
Okanogan
Conconully
Brewster

Ninemile Crk.
SIMILKAMEEN R.
Tonasket Crk.
WildHorse Spring Crk.
Antoine Crk.
Bonaparte Crk.
Aeneas Crk.
OKANOGAN RIVER
Tunk Crk.
Salmon Crk.
Wanacut Crk.
Omak Crk.
Omak Crk.
Sinlahekin Crk.
Loup Loup Crk.
Chilliwist Crk.
COLUMBIA RIVER

0 2 4 Kilometers

Miles
0 1.25 2.5

Wide River or Lake
River or Stream
Road
U.S.A. Canada Border

DATE: March 2012
DRAWN BY: DA

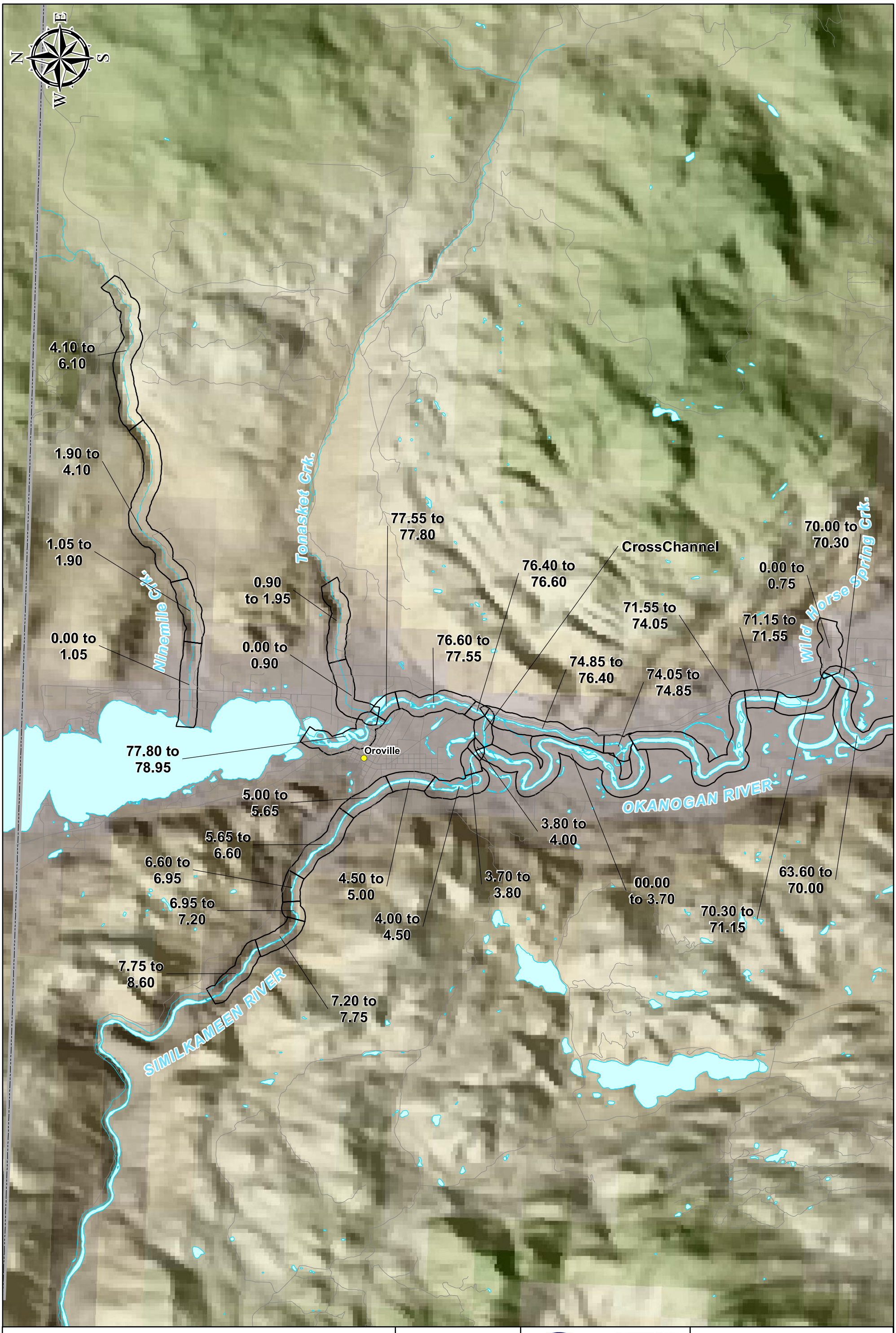
PREPARED FOR: OBMEP

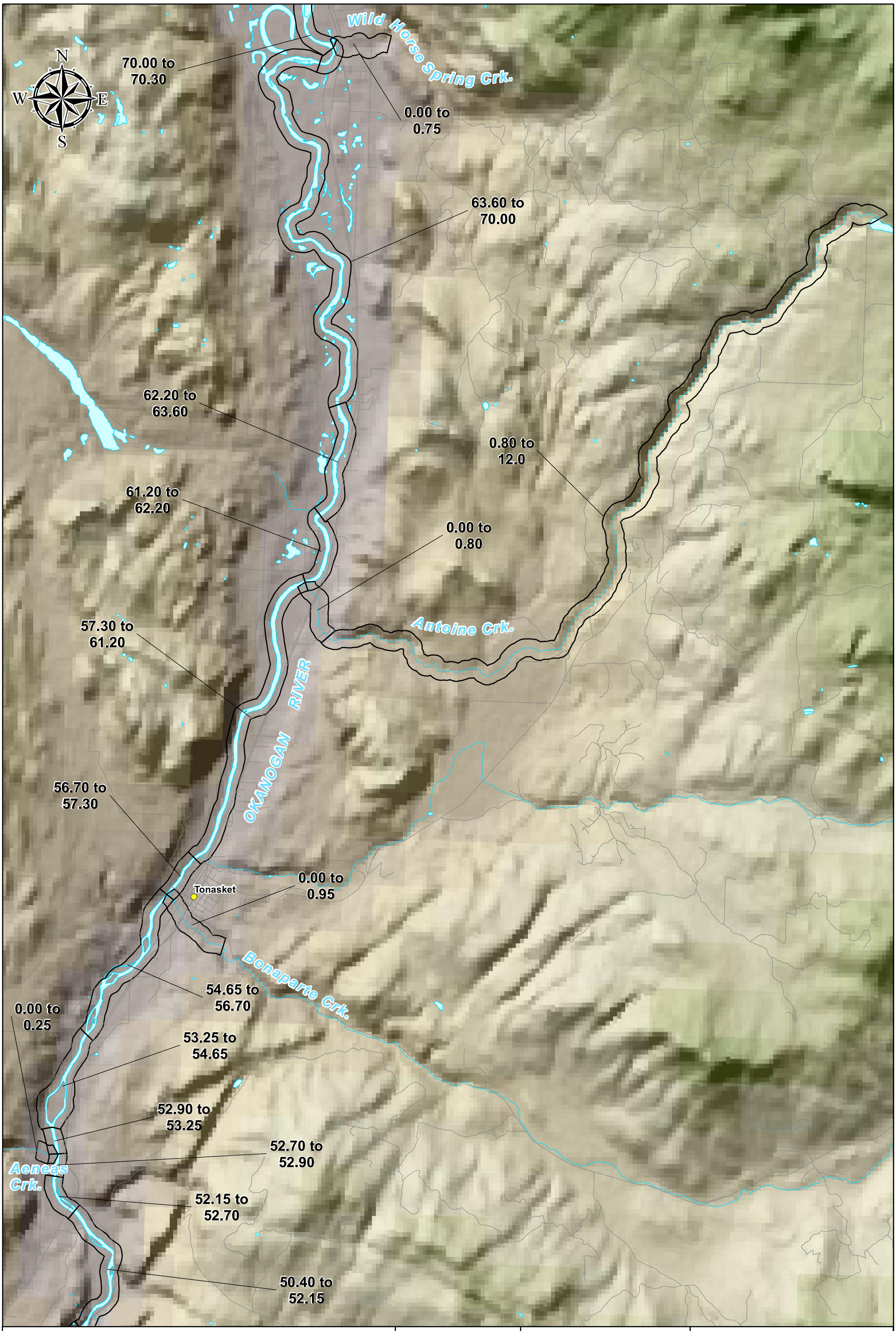
OBMEP Reach Names

FILE: Reachnames.mxd

Data Source(s):
Elevation - SRTM; Hydrology, Roads - CCT, 2007

OVERVIEW


N
E
S
W
4.10 to 6.10
1.90 to 4.10
1.05 to 1.90
0.00 to 1.05
0.90 to 1.95
0.00 to 0.90
77.55 to 77.80
76.60 to 77.55
76.40 to 76.60
74.85 to 76.40
74.05 to 74.85
71.55 to 74.05
71.15 to 71.55
70.30 to 70.00
0.00 to 0.75
77.80 to 78.95
5.00 to 5.65
5.65 to 6.60
6.60 to 6.95
6.95 to 7.20
7.75 to 8.60
7.20 to 7.75
4.50 to 5.00
4.00 to 4.50
3.80 to 4.00
3.70 to 3.80
00.00 to 3.70
70.30 to 71.15
63.60 to 70.00
CrossChannel
Oroville
Ninemile Crk.
Tonasket Crk.
Wild Horse Spring Crk.
OKANOGAN RIVER
SIMILKAMEEN RIVER
0
2
4
Kilometers
0
1.25
2.5
Miles
Wide River or Lake
River or Stream
Road
U.S.A. Canada Border
DATE: March 2012
DRAWN BY: DA
PREPARED FOR: OBMEP
OBMEP Reach Names
FILE: Reachnames.mxd
Data Source(s): Elevation - SRTM; Hydrology, Roads - CCT, 2007
Map 1 of 6


N
W
E
S
70.00 to
70.30
Wild Horse Spring Crk.
0.00 to
0.75
63.60 to
70.00
62.20 to
63.60
0.80 to
12.0
61.20 to
62.20
0.00 to
0.80
57.30 to
61.20
Antoine Crk.
OKANOGAN RIVER
56.70 to
57.30
Tonasket
0.00 to
0.95
Bonaparte Crk.
54.65 to
56.70
0.00 to
0.25
53.25 to
54.65
52.90 to
53.25
52.70 to
52.90
Aeneas
Crk.
52.15 to
52.70
50.40 to
52.15
0
2
4
Kilometers
Miles
0
1.25
2.5
Wide River or Lake
River or Stream
Road
U.S.A. Canada Border
DATE: March 2012
DRAWN BY: DA
PREPARED FOR:
OBMEP
OBMEP Reach Names
FILE: Reachnames.mxd
Data Source(s):
Elevation - SRTM; Hydrology, Roads - CCT, 2007
Map 2 of 6

N
W
E
S

49.90 to 50.40

48.90 to 49.90

48.20 to 48.90

47.60 to 48.20

45.00 to 47.60

44.30 to 45.010

0.00 to 0.70

39.50 to 44.30

39.30 to 39.50

35.00 to 35.60

37.65 to 37.80

37.80 to 39.30

35.60 to 37.65

0.00 to 0.60

0.60 to 1.20

30.80 to 30.80

31.80 to 32.00

32.00 to 34.05

30.50 to 30.80

34.15 to 35.00

29.95 to 30.50

34.05 to 34.15

29.30 to 29.95

0.00 to 0.90

OKANOGAN RIVER

Tunk Crk.

Wanacut Crk.

Riverside

Omak

0 2 4 Kilometers

0 1.25 2.5 Miles

Wide River or Lake

River or Stream

Road

U.S.A. Canada Border

DATE: March 2012

DRAWN BY: DA

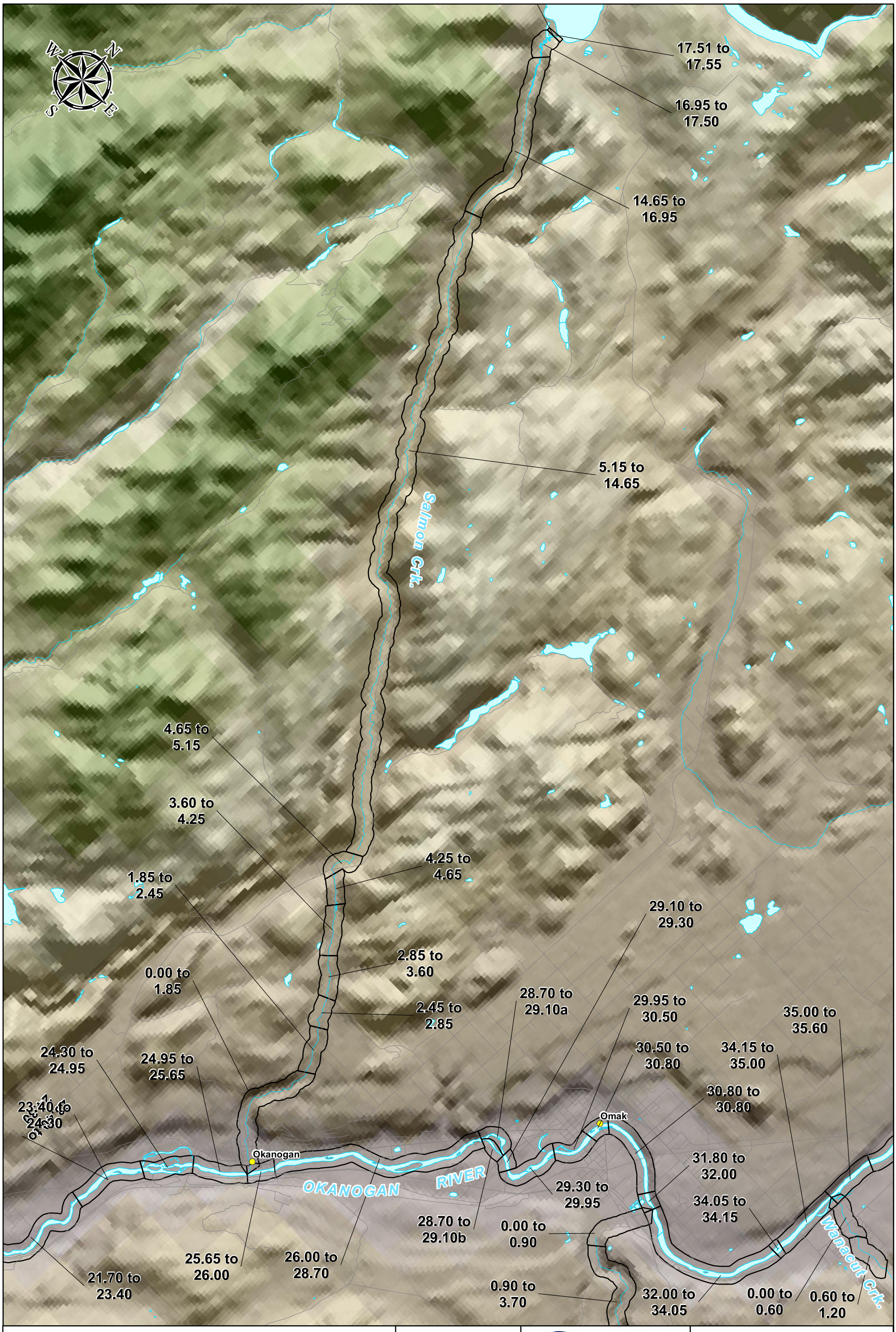
PREPARED FOR: OBMEP

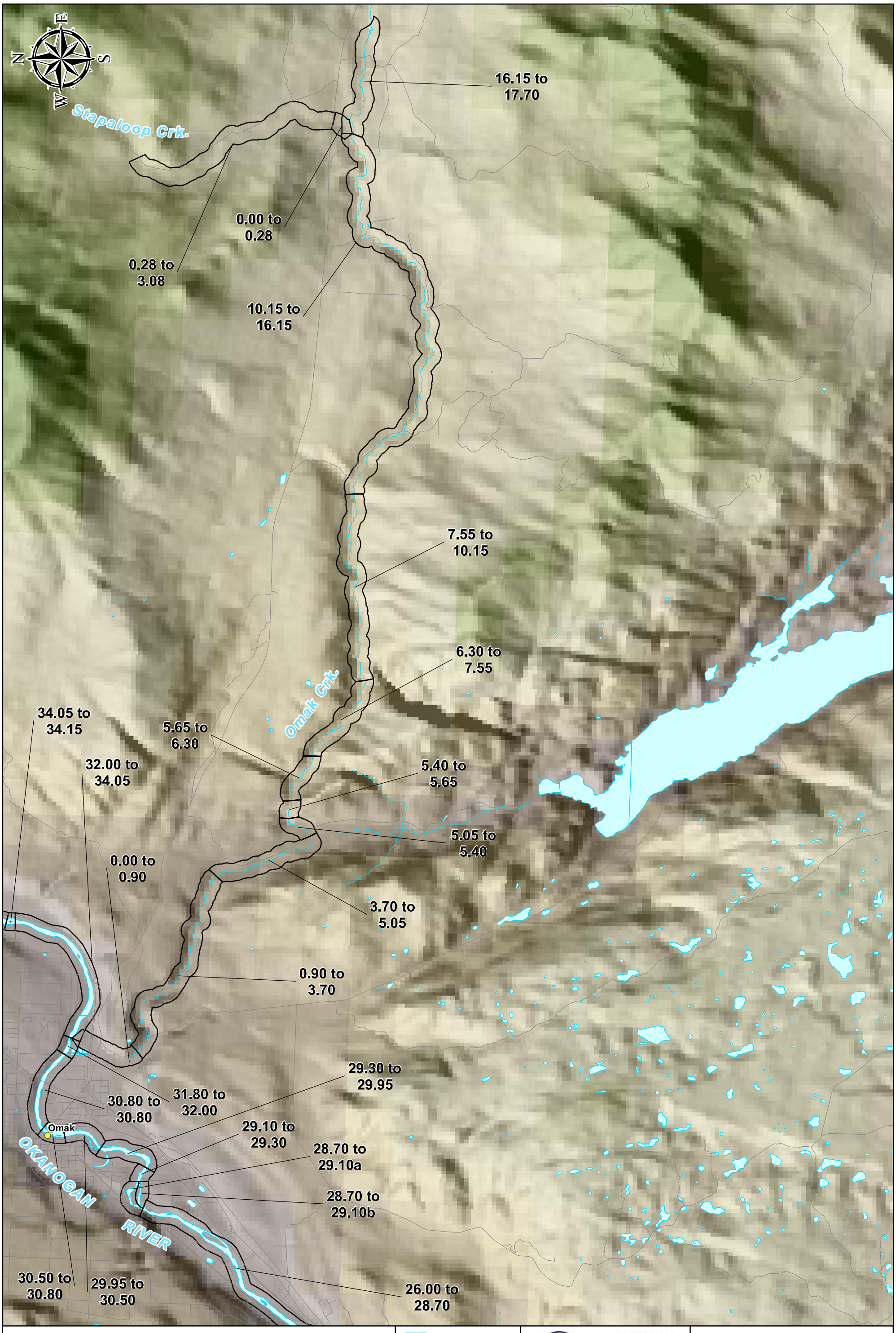
OBMEP Reach Names

FILE: Reachnames.mxd

Data Source(s): Elevation - SRTM; Hydrology, Roads - CCT, 2007

Map 3 of 6


17.51 to 17.55
16.95 to 17.50
14.65 to 16.95
5.15 to 14.65
Salmon Crk.
4.65 to 5.15
3.60 to 4.25
4.25 to 4.65
1.85 to 2.45
29.10 to 29.30
2.85 to 3.60
0.00 to 1.85
28.70 to 29.10a
29.95 to 30.50
35.00 to 35.60
2.45 to 2.85
30.50 to 30.80
34.15 to 35.00
24.30 to 24.95
24.95 to 25.65
30.80 to 30.80
23.40 to 24.30
Omak
Okanogan
31.80 to 32.00
OKANOGAN RIVER
29.30 to 29.95
34.05 to 34.15
28.70 to 29.10b
0.00 to 0.90
Wanacut Crk.
25.65 to 26.00
26.00 to 28.70
21.70 to 23.40
0.90 to 3.70
32.00 to 34.05
0.00 to 0.60
0.60 to 1.20
0 2 4 Kilometers
0 1.25 2.5 Miles
Wide River or Lake
River or Stream
Road
U.S.A. Canada Border
BONNEVILLE POWER ADMINISTRATION
OBMEP Reach Names
DATE: March 2012
DRAWN BY: DA
PREPARED FOR: OBMEP
FILE: Reachnames.mxd
Data Source(s): Elevation - SRTM; Hydrology, Roads - CCT, 2007
Map 4 of 6


N
E
S
W
Stapaloop Crk.
16.15 to 17.70
0.00 to 0.28
0.28 to 3.08
10.15 to 16.15
7.55 to 10.15
6.30 to 7.55
Omak Crk.
34.05 to 34.15
5.65 to 6.30
32.00 to 34.05
5.40 to 5.65
5.05 to 5.40
0.00 to 0.90
3.70 to 5.05
0.90 to 3.70
29.30 to 29.95
31.80 to 32.00
30.80 to 30.80
Omak
29.10 to 29.30
28.70 to 29.10a
28.70 to 29.10b
OKANOGAN RIVER
30.50 to 30.80
29.95 to 30.50
26.00 to 28.70
0 2 4 Kilometers
0 1.25 2.5 Miles
Wide River or Lake
River or Stream
Road
U.S.A. Canada Border
DATE: March 2012
DRAWN BY: DA
PREPARED FOR: OBMEP
OBMEP Reach Names
FILE: Reachnames.mxd
Data Source(s): Elevation - SRTM; Hydrology, Roads - CCT, 2007
Map 5 of 6

N
W
E
S

Loup Loup Crk.

21.70 to 23.40

0.00 to 1.00

15.80 to 16.60

16.95 to 21.70

15.10 to 15.80

0.00 to 0.10

16.80 to 16.95

16.60 to 16.80

14.40 to 15.10

4.40 to 14.40

OKANOGAN RIVER

0.0 to 4.40

COLUMBIA RIVER

Brewster

0 2 4 Kilometers

0 1.25 2.5 Miles

Wide River or Lake
River or Stream
Road
U.S.A. Canada Border

OBMEP Reach Names

DATE: March 2012
DRAWN BY: DA
PREPARED FOR: OBMEP
FILE: Reachnames.mxd
Data Source(s): Elevation - SRTM; Hydrology, Roads - CCT, 2007

Map 6 of 6

4. Indicator-Specific Methods and Results

This section describes the indicator-specific analysis methods and assumptions therein. The resulting spatial analysis maps for each indicator are also presented.

A. Temperature Maps - #1a and #1b

As detailed in Section 3-c, temperature data for reaches that did not contain sampling locations was inferred from the temperature data in neighboring reaches.

Reach Allocation

The rules for allocating data to reaches were as follows:

For Tributaries:

- Use all OBMEP panel sites within a reach.
- Use all OBMEP annual sites within a reach.
- If no annual or panel site is present within a reach, use nearest annual or panel site downstream of the reach. If no site is available downstream, use nearest site upstream.
- If there is an upstream and downstream site equidistant from a reach with no site, use both sites' data.
- For Ninemile creek temperature, use USGS-12438900 (Ninemile Creek).

For the Mainstem:

- Use USGS-12447200 temperature near Loup Loup Creek for all downstream reaches and upstream to Omak Creek.
- Use USGS 12445000 temperature at Janis for downstream reaches to Omak Creek and upstream reaches to the Similkameen/Okanogan confluence.
- Use USGS 12439500 temperature near Zosel Dam for reaches in the Okanogan upstream of the Similkameen/Okanogan confluence.
- Use the DOE 49B070 temperature on the Similkameen for reaches upstream of the Similkameen/Okanogan confluence.
- For the crosschannel between the Okanogan and Similkameen, use USGS 12439500 (this is a migrating reach so this data correlates best with the analysis timeframe).

Anomaly Screening

During quality assurance testing of the temperature data, several data anomalies were identified and the cause researched. Examples of reasons for these anomalies included: loggers collecting air instead of water temperatures, malfunctioning loggers, and incorrect set up of loggers. Therefore, Summit and CCT staff completed extensive research to develop an anomaly screen to audit the data and exclude suspected anomalies.

The anomaly screen (in order of implementation) was:

1. All temperatures below zero, will be changed to equal zero;
2. Exclude the first and last days of each data series;
3. When there is an hourly increment > 5 degrees C, exclude data records from that measurement until temperature recovers at least 3 degrees C; and
4. If there are any remaining results > 30 degrees, data for the entire day will be excluded.

Indicator Analyses

As detailed in Section 3-b, temperature specific classification criteria differ for the different fish types analyzed. Therefore the analysis for the "Temperature" Indicators for each fish type has been separated for each fish type.

- For steelhead, the tributaries and the mainstem were considered, using the highest biological value rating for each reach (spawning, rearing or migrating).
- For summer Chinook and sockeyes only the mainstem reaches were included.
- Classification criteria was applied accordingly (i.e., temperature threshold and sensitive period) to determine if the reach was PF, AR, or NPF for each fish type (Maps 1a and 1b).

For further details, see Table 2.

B. Habitat Access - #2a and #2b

Maps 2a and 2b show the potential habitat rating of specific off-channel locations. Map 2a shows locations where potential off-channel habitat could be created based on a combination of airphoto and field knowledge interpretation. These sites have not been ground truthed for their biological benefit. Map 2b shows the classification of the reaches.

For further details, see Table 2.

C. Substrate - #3 and Embeddedness - #4

For the "Substrate" and "Embeddedness" indicators, the analyses considers the classification of the reaches for spawning, migrating and rearing, with migrating always classified as "properly functioning". The classification criteria were applied to each data collection site, and the classification most prevalent in the reach was adopted as the reaches classification.

D. Large Woody Debris - #5

The LWD piece-per-mile values described in the classification criteria were determined as follows:

1. calculated the average numbers of LWD occurrences (>1m and >2m) each year;
2. determined the multi-year average; and
3. divided it by the reach length.

For further details, see Table 2.

E. Pool Quantity and Quality - #6

The pools-per-mile described in the classification criteria were determined as follows:

1. Habitat type classified as "glide", "beaver pond", or "primary pool" in a reach were summed for each year
2. The average numbers of these pools in a reach for each year were calculated;
3. The multi-year average was determined and divided by the reach length.

For further details, see Table 2.

F. Width to Depth - #7

The width-to-depth ratios were calculated using the following formula:

WTD = “bankfull height” + “thalweg depth” / “bankfull width”.

If side channels were present, the ratio for side and main channels were calculated separately, then averaged for each site.

For further details, see Table 2.

G. Bank Stability/Channel Migration - #8

The classification criteria were applied to each data collection site, and the classification most prevalent in the reach was adopted as the reaches classification.

For further details, see Table 2.

H. Road Density - #9

The road data used for this analysis was a combination of HUC (Hydrologic Unit Code) 12 road data (Sourced), and a road layer Summit compiled from a variety of other sourced data. As described in Section 3-d, the reach classifications were allocated from the most prevalent upland classification.

For further details, see Table 2.

I. Landuse/disturbance - #10

As described in Section 3-d, each reach classification was inferred from the most prevalent upland classification. Upland data was collected from sourced property data and aerial photographs.

For further details, see Table 2.

J. Bedscour & Stream flow - #11a & #11b

As detailed in Section 3-b, streamflow specific classification criteria differed for the two fish types analyzed. Therefore, the “Bedscour and Streamflow” Indicator has been separated for each fish type.

Flow allocation for individual reaches

The rules for which neighboring stations were selected were as follows:

For Tributaries:

- If there is an upstream and downstream site equidistant from a reach with no site, use both sites’ data.
- For Ninemile creek, use USGS-12438900 (Ninemile Creek).

For Mainstem:

- Use USGS 12445200 discharge for all downstream reaches and upstream to Omak Creek.
- Use USGS 12445000 discharge for downstream reaches to Omak Creek and upstream reaches to the Similkameen/Okanogan confluence.
- Use USGS 12439500 discharge for reaches in the Okanogan upstream of the Similkameen/Okanogan confluence.

- Use the DOE 49B070 discharge on the Similkameen for reaches upstream of the Similkameen/Okanogan confluence.
- For the crosschannel between the Okanogan and Similkameen, use USGS 12439500. This is a migrating reach so this data correlates best with the analysis timeframe.

Indicator Analyses

As detailed in Section 3-b, streamflow specific classification criteria differ for the different fish types analyzed. Therefore Bedscour & Streamflow" for each fish type has been separated for each fish type.

The calculations were conducted twice, once for steelhead and once for summer Chinook and sockeye

- For steelhead, the tributaries and the mainstem were considered, using the highest biological value rating for each reach (spawning, rearing or migrating).
- For summer Chinook and sockeyes only the mainstem reaches were included.
- Classification criteria was applied accordingly (i.e., streamflow threshold and sensitive period) to determine if the reach was PF, AR, or NPF for each fish type (Maps 11a and 11b).

For further detail, see Table 2.

K. Structure - #12a (Trees) & #12b (Shrubs)

Classification criteria were applied to each data collection site, and the classification most prevalent in the reach was adopted as the reach classification.

For further details, see Table 2.

L. Canopy Cover - #13

Average canopy cover readings (taken with a densitometer), were compared to the classification criteria for each reach.

For further details, see Table 2.

N
W
E
S

SIMILKAMEEN RIVER
Ninemile Crk.
Tonasket Crk.
Oroville
WildHorse Spring Crk.
Antoine Crk.
Tonasket
Bonaparte Crk.
Aeneas Crk.
OKANOGAN RIVER
Tunk Crk.
Conconully
Riverside
Salmon Crk.
Wanacut Crk.
Omak
Omak Crk.
Scapeloop Crk.
Okanogan
Loup Loup Crk.
Chilliwist Crk.
Brewster
COLUMBIA RIVER

		PROPERLY FUNCTIONING	AT RISK	NOT PROPERLY FUNCTIONING
Spaw ning and Incubation Criteria: 18 degrees (LC50 for summer Steelhead); April 1 – June 30	daily average (screened data for anomalies - see rules)	< 17 deg throughout period of record	If one or more days exceeds 17 deg, but the # of days violating this criteria are decreasing (# of days you violate criteria over the period, each year just during the period)	If one or more days exceeds 17 deg, **and** the # of days violating this criteria are increasing or more than half the days are in exceedance for any year (# of days you violate criteria over the period, each year just during the period)
Rearing Criteria 20 degrees; (Water is stressful for coldw ater salmonids and defines lasting distributions); Year round	daily average (screened data for anomalies - see rules)	< 19 deg all year	If one or more days exceeds 19 deg, but the # of days violating this criteria are decreasing (# of days annually you violate criteria)	If one or more days exceeds 19 deg, **and** the # of days violating this criteria are increasing or more than half the days are in exceedance for any year (# of days annually you violate criteria)
Migration Criteria: 24 degrees (maximum adult migration) 21 degrees(migration restrictions begin); October 1 – May 31	daily average (screened data for anomalies - see rules)	< 21 deg throughout period of record	If one or more days exceeds 21 deg, but the # of days violating this criteria are decreasing (# of days you violate criteria over the period, each year just during the period)	If one or more days exceeds 21 deg, **and** the # of days violating this criteria are increasing or more than half the days are in exceedance for any year (# of days you violate criteria over the period, each year just during the period)

Reach Query Results
- Properly Functioning (PF)
- At Risk (AR)
- Not Properly Functioning (NPF)
- No Data

Reach Break
Road
U.S.A. Canada Border
Wide River or Lake
River or Stream

0 8 km
0 5 mi

DATE: December 2011
DRAWN BY: DA
PREPARED FOR: OBMEP

Summer Steelhead Temperature Indicator Analysis

FILE: Temperature All Year.mxd
Data Source(s): Elevation - SRTM; Hydrology, Roads - CCT, 2007

Map 1a All Years

N
W
E
S

SIMILKAMEEN RIVER
Ninemile Crk.
Tonasket Crk.
Oroville
WildHorse Spring Crk.
Antoine Crk.
Tonasket
Bonaparte Crk.
Aeneas Crk.
OKANOGAN RIVER
Tunk Crk.
Conconully
Riverside
Salmon Crk.
Wanacut Crk.
Omak
Omak Crk.
Stapleloop Crk.
Okanogan
Loup Loup Crk.
Chilliwist Crk.
Brewster
COLUMBIA RIVER

			PROPERLY FUNCTIONING	AT RISK	NOT PROPERLY FUNCTIONING
Temp (mainstem only, not including data in the tributaries)	Spawning and Incubation Criteria: 18 degrees (LC50 for summer Steelhead); October 1 – March 30	daily average (screened data for anomalies - see rules)	< 17 deg throughout period of record	If one or more days exceeds 17 deg, but the # of days violating this criteria are decreasing (# of days you violate criteria over the period, each year just during the period)	If one or more days exceeds 17 deg, **and** the # of days violating this criteria are increasing or more than half the days are in exceedance for any year (# of days you violate criteria over the period, each year just during the period)
	Rearing Criteria 20 degrees; (Water is stressful for coldwater salmonids and defines lasting distributions); March 1 – August 31	daily average (screened data for anomalies - see rules)	< 19 deg throughout period of record	If one or more days exceeds 19 deg, but the # of days violating this criteria are decreasing (# of days annually you violate criteria)	If one or more days exceeds 19 deg, **and** the # of days violating this criteria are decreasing or more than half the days are in exceedance for any year (# of days annually you violate criteria)
	Migration Criteria: 24 degrees (maximum adult migration) 21 degrees (migration restrictions begin); July 1 – October 1	daily average (screened data for anomalies - see rules)	< 21 deg throughout period of record	If one or more days exceeds 21 deg, but the # of days violating this criteria are decreasing (# of days you violate criteria over the period, each year just during the period)	If one or more days exceeds 21 deg, **and** the # of days violating this criteria are decreasing or more than half the days are in exceedance for any year (# of days you violate criteria over the period, each year just during the period)

Reach Query Results
- Properly Functioning (PF)
- At Risk (AR)
- Not Properly Functioning (NPF)

Reach Break
Road
U.S.A. Canada Border
Wide River or Lake
River or Stream

0 8 km
0 5 mi

DATE: December 2011
DRAWN BY: DA
PREPARED FOR: OBMEP

Summer Chinook & Sockeye Temperature Indicator Analysis

FILE: Temperature All Year.mxd
Data Source(s): Elevation - SRTM; Hydrology, Roads - CCT, 2007

Map 1B All Years

N
W E
S

SIMILKAMEEN RIVER
Ninemile Crk.
Tonasket Crk.
Wildhorse Spring Crk.
Antoine Crk.
Bonaparte Crk.
Aeneas Crk.
OKANOGAN RIVER
Tunk Crk.
Salmon Crk.
Wanacut Crk.
Omak Crk.
Stapaloop Crk.
Loup Loup Crk.
Chilliwist Crk.
COLUMBIA RIVER

	PROPERLY FUNCTIONING	AT RISK	NOT PROPERLY FUNCTIONING
Visual Interpretation of point data and orthos	Off Channel areas are frequently hydrologically linked to main channel Allows upstream and down stream passage at all flows (Complete access to all areas with no obstructions) Connected to Main flow at all times. Off Channel areas are frequently hydrologically linked to main channel.	Does not allow upstream and downstream passage at base flows. Connected to main flow during high water only. Reduced linkage of off channel areas to main channel.	Does not allow upstream and downstream passage. Not connected to Main flow. Severely Reduced linkage of off channel areas to main channel.

Potential Habitat Rating

- Properly Functioning (PF)
- At Risk (AR)
- Not Properly Functioning (NPF)

- Reach Break
- Road
- U.S.A. Canada Border
- Wide River or Lake
- River or Stream

0 5 mi
0 8 km

Potential Off Channel Habitat Locations

FILE: Off channel Habitat.mxd

DATE: December 2011

DRAWN BY: DA

PREPARED FOR: OBMEP

Data Source(s): Elevation - SRTM; Hydrology, Roads - CCT, 2007

Map 2a All Years

N
W E
S

SIMILKAMEEN RIVER
Ninemile Crk.
Tonasket Crk.
Wildhorse Spring Crk.
Antoine Crk.
Bonaparte Crk.
Aeneas Crk.
OKANOGAN RIVER
Tunk Crk.
Salmon Crk.
Wanacut Crk.
Omak Crk.
Stapaloop Crk.
Loup Loup Crk.
Chilliwist Crk.
COLUMBIA RIVER

	PROPERLY FUNCTIONING	AT RISK	NOT PROPERLY FUNCTIONING
Visual Interpretation of point data and orthos	Off Channel areas are frequently hydrologically linked to main channel Allows upstream and down stream passage at all flows (Complete access to all areas with no obstructions) Connected to Main flow at all times. Off Channel areas are frequently hydrologically linked to main channel.	Does not allow upstream and downstream passage at base flows. Connected to main flow during high water only. Reduced linkage of off channel areas to main channel.	Does not allow upstream and downstream passage. Not connected to Main flow. Severely Reduced linkage of off channel areas to main channel.

Potential Habitat Rating

- Properly Functioning (PF)
- At Risk (AR)
- Not Properly Functioning (NPF)

- Reach Break
- Road
- U.S.A. Canada Border
- Wide River or Lake
- River or Stream

0 5 mi

0 8 km

DATE: December 2011

DRAWN BY: DA

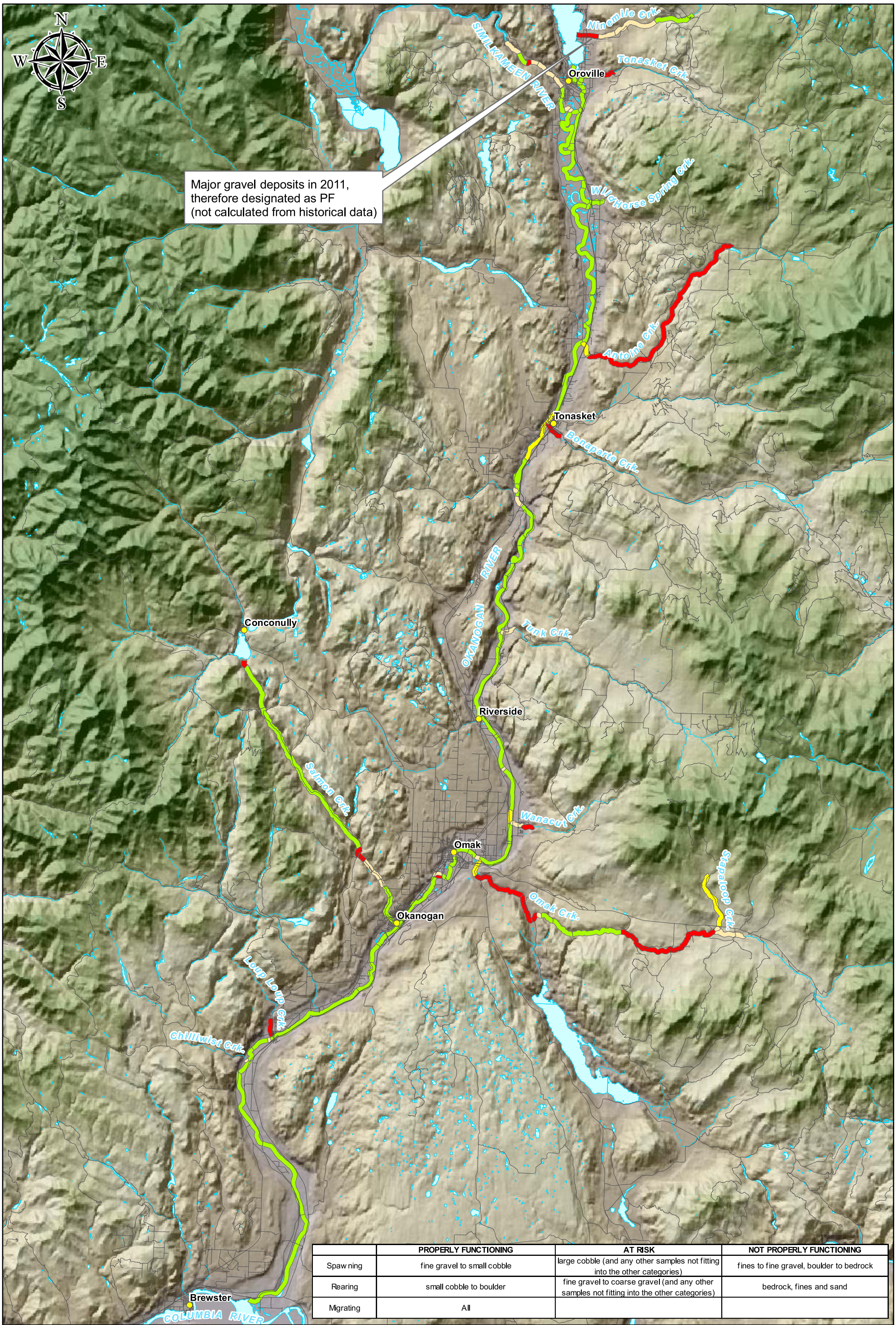
PREPARED FOR: OBMEP

Potential Off Channel Habitat Analysis

FILE: Off channel Habitat.mxd

Data Source(s): Elevation - SRTM; Hydrology, Roads - CCT, 2007

Map 2b All Years



	PROPERLY FUNCTIONING	AT RISK	NOT PROPERLY FUNCTIONING
Spawning	fine gravel to small cobble	large cobble (and any other samples not fitting into the other categories)	fines to fine gravel, boulder to bedrock
Rearing	small cobble to boulder	fine gravel to coarse gravel (and any other samples not fitting into the other categories)	bedrock, fines and sand
Migrating	All		

Reach Query Results
- No Data
- Properly Functioning (PF)
- At Risk (AR)
- Not Properly Functioning (NPF)

Reach Break
Road
U.S.A. Canada Border
Wide River or Lake
River or Stream

0 5 mi
0 8 km

DATE: December 2011
DRAWN BY: DA
PREPARED FOR: OBMEP

Dominant Substrate Indicator Analysis

FILE: Substrate.mxd

Data Source(s): Elevation - SRTM; Hydrology, Roads - CCT, 2007

Map 3 All Years

N
W
E
S

SIMILKAMEEN RIVER
Ninemile Crk.
Tonasket Crk.
Oroville
Wildhorse Spring Crk.
Antoine Crk.
Tonasket
Bonaparte Crk.
Aeneas Crk.
OKANOGAN RIVER
Tunk Crk.
Conconully
Riverside
Salmon Crk.
Wanacut Crk.
Omak
Omak Crk.
Steepleloop Crk.
Okanogan
Loup Loup Crk.
Chilliwist Crk.
Brewster
COLUMBIA RIVER

	PROPERLY FUNCTIONING	AT RISK	NOT PROPERLY FUNCTIONING
Spawning	<25%	25-50%	>50%
Rearing			
Migrating	All		

Reach Query Results
- No Data
- Properly Functioning (PF)
- At Risk (AR)
- Not Properly Functioning (NPF)

Reach Break
Road
U.S.A. Canada Border
Wide River or Lake
River or Stream

0 5 mi
0 8 km

DATE: December 2011
DRAWN BY: DA

PREPARED FOR: OBMEP

Embeddedness Indicator Analysis

FILE: Embed.mxd

Data Source(s): Elevation - SRTM; Hydrology, Roads - CCT, 2007

Map 4 All Years

N
W
E
S

SIMILKAMEEN RIVER
Ninemile Crk.
Tonasket Crk.
Oroville
Wildhorse Spring Crk.
Antoine Crk.
Tonasket
Bonaparte Crk.
Aeneas Crk.
OKANOGAN RIVER
Tunk Crk.
Conconully
Riverside
Salmon Crk.
Wanacut Crk.
Omak
Omak Crk.
Sarapoolop Crk.
Okanogan
Loup Loup Crk.
Chilliwist Crk.
Brewster
COLUMBIA RIVER

PROPERLY FUNCTIONING	AT RISK	NOT PROPERLY FUNCTIONING
• Main stem ≥41 pieces/mi (>1 meter In) • Tributaries ≥250 pieces/mi (>1 meter In)	• Main stem 20-41 pieces/mi (>1 meter In) • Tributaries 69-250 pieces/mi (>1 meter In)	• Main stem ≤20 pieces/mi (>1 meter In) • Tributaries ≤69 pieces/mi (>1 meter In)

Reach Query Results
- No Data
- Properly Functioning (PF)
- At Risk (AR)
- Not Properly Functioning (NPF)

Reach Break
Road
U.S.A. Canada Border
Wide River or Lake
River or Stream

0 5 mi
0 8 km

LWD Indicator Analysis

DATE: December 2011
DRAWN BY: DA
PREPARED FOR: OBMEP
FILE: LWD Iteration 6 2011.mxd
Data Source(s): Elevation - SRTM; Hydrology, Roads - CCT, 2007

Map 5 All Years

N
W E
S

SIMILKAMEEN RIVER
Ninemile Crk.
Tonasket Crk.
Oroville
Wildhorse Spring Crk.
Antoine Crk.
Tonasket
Bonaparte Crk.
Aeneas Crk.
OKANOGAN RIVER
Tunk Crk.
Conconully
Riverside
Salmon Crk.
Wanacut Crk.
Omak
Omak Crk.
Sepaloop Crk.
Okanogan
Loup Loup Crk.
Chilliwist Crk.
Brewster
COLUMBIA RIVER

PROPERLY FUNCTIONING	AT RISK	NOT PROPERLY FUNCTIONING
• Mainstem pools and riffles present • Tributaries >200 pools per mile	• Mainstem only pool habitat is present • Tributaries 75-200 pools per mile	• Mainstem no w ater • Tributaries <75 pools/mile

Reach Query Results
- No Data
- Properly Functioning (PF)
- At Risk (AR)
- Not Properly Functioning (NPF)

Reach Break
Road
U.S.A. Canada Border
Wide River or Lake
River or Stream

0 5 mi
0 8 km

DATE: December 2011
DRAWN BY: DA
PREPARED FOR: OBMEP

Pool Quantity and Quality Indicator Analysis

FILE: PQQ.mxd

Data Source(s):
Elevation - SRTM; Hydrology, Roads - CCT, 2007

Map 6
All Years

N
W E
S

Ninemile Crk.
SIMILKAMEEN RIVER
Tonasket Crk.
Oroville
Wildhorse Spring Crk.
Antoine Crk.
Tonasket
Bonaparte Crk.
Aeneas Crk.
OKANOGAN RIVER
Tunk Crk.
Conconully
Riverside
Salmon Crk.
Wanacut Crk.
Omak
Omak Crk.
Sepadoop Crk.
Okanogan
Loup Loup Crk.
Chilliwist Crk.
Brewster
COLUMBIA RIVER

	PROPERLY FUNCTIONING	AT RISK	NOT PROPERLY FUNCTIONING
bankfull height + thalw eg depth and dividing by bankfull w idth	• Mainstem Okanogan River (U.S. ≤25) • Similkameen ≤20 • Tributaries ≤8	• Mainstem Okanogan River (U.S. 25-35) • Similkameen 20-30 • Tributaries 8-10	• Mainstem Okanogan River (U.S. ≥35) • Similkameen ≥30 • Tributaries ≥10

Reach Query Results
- No Data
- Properly Functioning (PF)
- At Risk (AR)
- Not Properly Functioning (NPF)

- Reach Break
- Road
- U.S.A. Canada Border
- Wide River or Lake
- River or Stream

0 5 mi
0 8 km

DATE: December 2011
DRAWN BY: DA
PREPARED FOR: OBMEP

Width to Depth Ratio Indicator Analysis

FILE: WTD.mxd

Data Source(s):
Elevation - SRTM; Hydrology, Roads - CCT, 2007

Map 7
All Years

N
W
E
S

SIMILKAMEEN RIVER
Ninemile Crk.
Tonasket Crk.
Oroville
Wildhorse Spring Crk.
Antoine Crk.
Tonasket
Bonaparte Crk.
Aeneas Crk.
OKANOGAN RIVER
Tunk Crk.
Conconully
Riverside
Salmon Crk.
Wanacut Crk.
Omak
Omak Crk.
Sinlahekin Crk.
Okanogan
Loup Loup Crk.
Chilliwist Crk.
Brewster
COLUMBIA RIVER

PROPERLY FUNCTIONING	AT RISK	NOT PROPERLY FUNCTIONING
Proportion of groundcover as bare (<10%)	Proportion of groundcover as bare (10-40%)	Proportion of groundcover as bare (>40%)

Reach Query Results
- No Data
- Properly Functioning (PF)
- At Risk (AR)
- Not Properly Functioning (NPF)

Reach Break
Road
U.S.A. Canada Border
Wide River or Lake
River or Stream

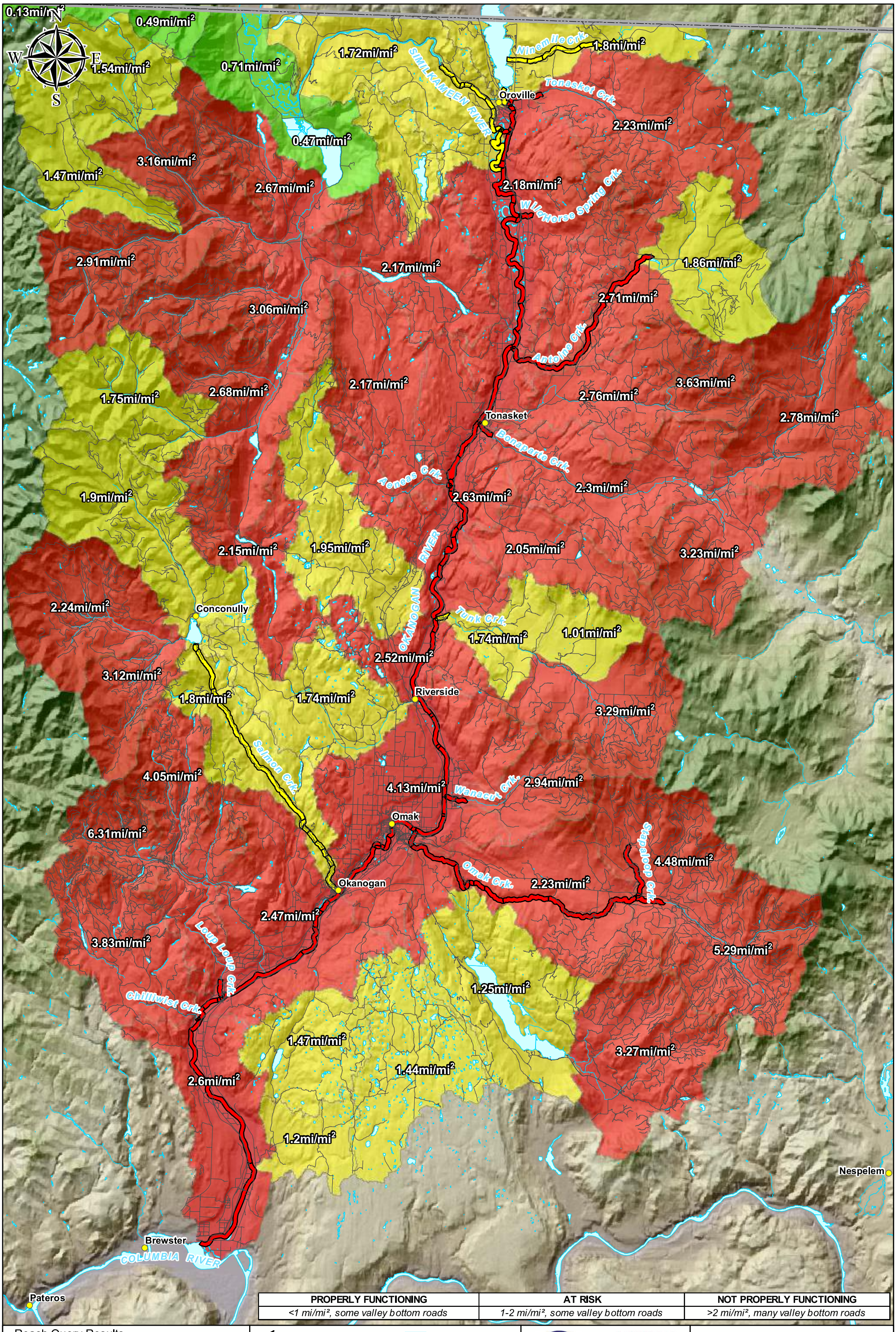
0 5 mi
0 8 km

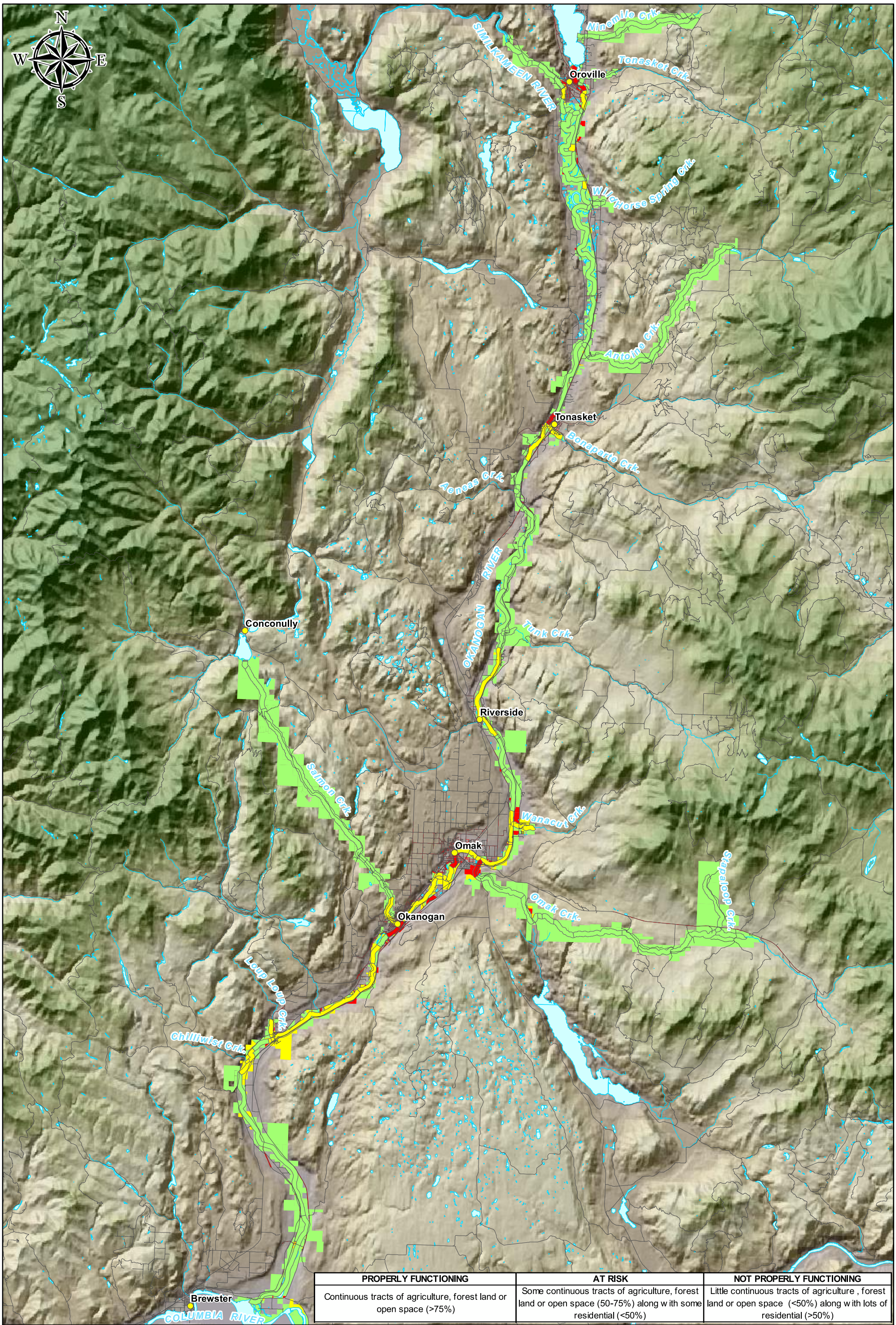
DATE: December 2011
DRAWN BY: DA
PREPARED FOR: OBMEP

Bank Stability Indicator Analysis

FILE: Bank Stab.mxd
Data Source(s): Elevation - SRTM; Hydrology, Roads - CCT, 2007

Map 8
All Years


N
W
E
S
0.13mi/mi²
0.49mi/mi²
1.54mi/mi²
0.71mi/mi²
1.72mi/mi²
SIMILKAMEEN RIVER
Nine mile Crk.
1.8mi/mi²
Tonasket Crk.
Oroville
2.23mi/mi²
0.47mi/mi²
3.16mi/mi²
1.47mi/mi²
2.67mi/mi²
2.18mi/mi²
WildHorse Spring Crk.
2.91mi/mi²
2.17mi/mi²
1.86mi/mi²
2.71mi/mi²
3.06mi/mi²
Antoine Crk.
1.75mi/mi²
2.68mi/mi²
2.17mi/mi²
3.63mi/mi²
2.76mi/mi²
Tonasket
2.78mi/mi²
Bonaparte Crk.
Aeneas Crk.
2.3mi/mi²
2.63mi/mi²
1.9mi/mi²
2.15mi/mi²
1.95mi/mi²
OKANOGAN RIVER
2.05mi/mi²
3.23mi/mi²
2.24mi/mi²
Conconully
Tunk Crk.
1.74mi/mi²
1.01mi/mi²
2.52mi/mi²
3.12mi/mi²
1.8mi/mi²
1.74mi/mi²
Riverside
3.29mi/mi²
Salmon Crk.
4.05mi/mi²
4.13mi/mi²
Wanacut Crk.
2.94mi/mi²
Omak
6.31mi/mi²
Omak Crk.
Stapaloop Crk.
4.48mi/mi²
Okanogan
2.23mi/mi²
2.47mi/mi²
Loup Loup Crk.
3.83mi/mi²
5.29mi/mi²
Chilliwist Crk.
1.25mi/mi²
1.47mi/mi²
3.27mi/mi²
1.44mi/mi²
2.6mi/mi²
1.2mi/mi²
Nespelem
Brewster
COLUMBIA RIVER
Pateros
PROPERLY FUNCTIONING
<1 mi/mi², some valley bottom roads
AT RISK
1-2 mi/mi², some valley bottom roads
NOT PROPERLY FUNCTIONING
>2 mi/mi², many valley bottom roads
Reach Query Results
No Data
Properly Functioning (PF)
At Risk (AR)
Not Properly Functioning (NPF)
Reach Break
Road
U.S.A. Canada Border
Wide River or Lake
River or Stream
0 5 mi
0 8 km
DATE: December 2011
DRAWN BY: DA
PREPARED FOR: OBMEP
Road Density Indicator Analysis
FILE: Bank Stab.mxd
Data Source(s): Elevation - SRTM; Hydrology, Roads - CCT, 2007
Map 9



PROPERLY FUNCTIONING	AT RISK	NOT PROPERLY FUNCTIONING
Continuous tracts of agriculture, forest land or open space (>75%)	Some continuous tracts of agriculture, forest land or open space (50-75%) along w ith some residential (<50%)	Little continuous tracts of agriculture , forest land or open space (<50%) along w ith lots of residential (>50%)

Reach Query Results
- Properly Functioning (PF)
- At Risk (AR)
- Not Properly Functioning (NPF)

Road
U.S.A. Canada Border
Wide River or Lake
River or Stream

0 5 mi
0 8 km

DATE: December 2011
DRAWN BY: DA
PREPARED FOR: OBMEP

Landuse Along the River

FILE: Landuse.mxd
Data Source(s): Elevation - SRTM; Hydrology, Roads - CCT, 2007

Map 10

N
W E
S

SIMILKAMEEN RIVER
Ninemile Crk.
Tonasket Crk.
Oroville
Wild Horse Spring Crk.
Antoine Crk.
Tonasket
Bonaparte Crk.
Aeneas Crk.
OKANOGAN RIVER
Tunk Crk.
Conconully
Riverside
Salmon Crk.
Wanacut Crk.
Omak
Omak Crk.
Sinlahekin Crk.
Okanogan
Loup Loup Crk.
Chiliwist Crk.
Brewster
COLUMBIA RIVER

	PROPERLY FUNCTIONING	AT RISK	NOT PROPERLY FUNCTIONING
Steelhead (March 26th to July 4th). Mainstem - spawning reaches only. Tributaries included.	• Mainstem & Similk < 10 days > 5000 CFS, or all < 5000 CFS • Mainstem below Zosel to confluence with Similk < 10 days > 1500 CFS, or all < 1500 CFS	• Mainstem 10-30 days > 5000 CFS • Mainstem below Zosel 10-30 days > 1500 CFS	• Mainstem >30 days > 5000 CFS • Mainstem below Zosel > 30 days > 1500 CFS
	• Tributaries if flow is always >1	• Tributaries if there are some days < 1 CFS but no 0 days	• Tributaries >1 day with no flow

Reach Query Results
- No Data
- Properly Functioning (PF)
- At Risk (AR)
- Not Properly Functioning (NPF)

Reach Type
- Mainstem Migrate Reaches

- Reach Break
- Road
- U.S.A. Canada Border
- Wide River or Lake
- River or Stream

0 5 mi
0 8 km

Streamflow (bed scour) Indicator Analysis: Steelhead

DATE: December 2011
DRAWN BY: DA
PREPARED FOR: OBMEP
FILE: Flow - Steelhead.mxd
Data Source(s): Elevation - SRTM; Hydrology, Roads - CCT, 2007

Map 11a
Water Year 1929-2009

N
W E
S

SIMILKAMEEN RIVER
Ninemile Crk.
Tonasket Crk.
Oroville
Wild Horse Spring Crk.
Antoine Crk.
Tonasket
Bonaparte Crk.
Aeneas Crk.
OKANOGAN RIVER
Tunk Crk.
Conconully
Riverside
Salmon Crk.
Wanacut Crk.
Omak
Omak Crk.
Sarapaloop Crk.
Okanogan
Loup Loup Crk.
Chiliwist Crk.
Brewster
COLUMBIA RIVER

	PROPERLY FUNCTIONING	AT RISK	NOT PROPERLY FUNCTIONING
Chinook incubation (October 2nd to February 28th). Mainstem- spawning reaches only. Tributaries not included.	• Mainstem & Similk < 10 days > 5000 CFS, or all < 5000 CFS • Mainstem below Zosel to confluence with Similk < 10 days > 1500 CFS, or all < 1500 CFS	• Mainstem 10-30 days > 5000 CFS • Mainstem below Zosel 10-30 days > 1500 CFS	• Mainstem >30 days > 5000 CFS • Mainstem below Zosel > 30 days > 1500 CFS

Reach Query Results
- Properly Functioning (PF)
- At Risk (AR)
- Not Properly Functioning (NPF)

Reach Type
- Mainstem Migrate Reaches
- Tributaries

- Reach Break
- Road
- U.S.A. Canada Border
- Wide River or Lake
- River or Stream

0 5 mi
0 8 km

Streamflow (bed scour) Indicator Analysis: Chinook

DATE: December 2011
DRAWN BY: DA
PREPARED FOR: OBMEP
FILE: Flow - Chinook.mxd
Data Source(s): Elevation - SRTM; Hydrology, Roads - CCT, 2007

Map 11b
Water Year 1929-2009

N
W E
S

SIMILKAMEEN RIVER
Ninemile Crk.
Tonasket Crk.
Oroville
Wild Horse Spring Crk.
Antoine Crk.
Tonasket
Bonaparte Crk.
Aeneas Crk.
OKANOGAN RIVER
Tunk Crk.
Conconully
Riverside
Salmon Crk.
Wanacut Crk.
Omak
Omak Crk.
Sarpaloop Crk.
Okanogan
Loup Loup Crk.
Chilliwist Crk.
Brewster
COLUMBIA RIVER

PROPERLY FUNCTIONING	AT RISK	NOT PROPERLY FUNCTIONING
Proportion of trees is >40%	Proportion of trees is 10-40%	Proportion of trees is <10%

Reach Query Results
- No Data
- Properly Functioning (PF)
- At Risk (AR)
- Not Properly Functioning (NPF)

Reach Break
Road
U.S.A. Canada Border
Wide River or Lake
River or Stream

0 5 mi
0 8 km

DATE: December 2011
DRAWN BY: DA
PREPARED FOR: OBMEP

Tree Structure Indicator Analysis

FILE: Structure.mxd
Data Source(s): Elevation - SRTM; Hydrology, Roads - CCT, 2007

Map 12a
All Years

N
W E
S

SIMILKAMEEN RIVER
Nine mile Crk.
Tonasket Crk.
Oroville
Wild Horse Spring Crk.
Antoine Crk.
Tonasket
Bonaparte Crk.
Aeneas Crk.
OKANOGAN RIVER
Tunk Crk.
Conconully
Riverside
Salmon Crk.
Wanacut Crk.
Omak
Omak Crk.
Sarapaloop Crk.
Okanogan
Loup Loup Crk.
Chilliwist Crk.
Brewster
COLUMBIA RIVER

PROPERLY FUNCTIONING	AT RISK	NOT PROPERLY FUNCTIONING
Proportion of shrubs is >40%	Proportion of shrubs is 10-40%	Proportion of shrubs is <10%

Reach Query Results
- No Data
- Properly Functioning (PF)
- At Risk (AR)
- Not Properly Functioning (NPF)

Reach Break
Road
U.S.A. Canada Border
Wide River or Lake
River or Stream

0 5 mi
0 8 km

DATE: December 2011
DRAWN BY: DA
PREPARED FOR: OBMEP

Shrub Structure Indicator Analysis

FILE: Structure.mxd
Data Source(s): Elevation - SRTM; Hydrology, Roads - CCT, 2007

Map 12b
All Years

N
W E
S

SIMILKAMEEN RIVER
Ninemile Crk.
Tonasket Crk.
Oroville
WildHorse Spring Crk.
Antoine Crk.
Tonasket
Bonaparte Crk.
Aeneas Crk.
OKANOGAN RIVER
Tunk Crk.
Conconully
Riverside
Salmon Crk.
Wanacut Crk.
Omak
Omak Crk.
Staplo Crk.
Okanogan
Loup Loup Crk.
Chilliwist Crk.
Brewster
COLUMBIA RIVER

PROPERLY FUNCTIONING	AT RISK	NOT PROPERLY FUNCTIONING
some shading ≥ 70% (i.e., avg densiometer ≥11.9)	Not much shading 50-70% (i.e., avg densiometer 8.5-11.9)	≤50% shading (i.e., avg densiometer ≤8.5)

Reach Query Results
- Properly Functioning (PF)
- At Risk (AR)
- Not Properly Functioning (NPF)
- No Data

Reach Break
Road
U.S.A. Canada Border
Wide River or Lake
River or Stream

0 5 mi
0 8 km

DATE: December 2011
DRAWN BY: DA
PREPARED FOR: OBMEP

Canopy Cover Indicator Analysis

FILE: Canopy Cover.mxd
Data Source(s): Elevation - SRTM; Hydrology, Roads - CCT, 2007

Map 13
All Years

6. Prioritization Methods

A. Protection versus Rehabilitation

A ranking system was needed to determine which reaches should be protected, or rehabilitated and in what order. The first key decision was that the priority would be based on protection over rehabilitation. To prioritize for rehabilitation, the ranking can be applied in reverse order.

Because the indicators: "Bedscour & Streamflow" and "Temperature" are survival indicators for fish, these indicators were determined as the most important. The twelve remaining indicators were determined to be of a lesser "value" than the survival indicators, and each indicator was ranked based on its' perceived contribution to salmonid survival and reproduction. The ranking of these indicators was done separately for tributary and mainstem habitats.

Note that as described in 3-b, the "Temperature" and "Bedscour & Streamflow" requirements differ between the different fish types, therefore the below analysis was completed separately for each fish type. As only steelhead are found in the tributaries, the steelhead ranking values were directly applied to the tributary reaches. However, for the mainstem reaches, an average of the two ranking values was applied.

The following general ranking rules from highest to lowest, were then applied to the reaches in the order they are presented:

Rule #	Flow		Temperature (combination of)*		Other Indicators
1	PF	+	PF, Migrate reaches, AR, No Data, NPF	+	sum of other indicators PF
2	AR	+	PF, Migrate reaches, AR, No Data, NPF	+	sum of other indicators PF
3	No Data	+	PF, Migrate reaches, AR, No Data, NPF	+	sum of other indicators PF
4	NPF	+	PF, Migrate reaches, AR, No Data, NPF	+	sum of other indicators PF

*application of each temperature option was considered a separate rule

Within each rule, a higher ranking indicated a higher priority. However, the rankings among rules was hierarchal (e.g., The lowest ranked reach in Rule #1 is a higher priority than the highest ranked reach in Rule #2).

The results of the above rule-set resulted in a number of "ties" among the reaches. To further delineate the reach rankings, a tie-breaking rule set was developed (See next Section).

B. Rehabilitation tie-breaking rule set

In order to further delineate the reach rankings, Summit and CCT developed an "ease of restoration weight" for each indicator. The "Ease of restoration weight" were determined by considering each indicator in terms of:

1. Timeliness,
2. Ease to implement, and
3. Strength of biological effect,

As detailed in Section 3-b, habitat requirements and basin distributions differ among the two fish types. In order to reflect this, the weighting of tributary and mainstem reaches were determined differently. Mainstem reaches incorporated the worst-case scenario data for either "steelhead" or "summer Chinook and sockeye"; whereas as tributary reaches were solely based on "steelhead" data.

For each indicator where the reach was designated as AR or NPF, the weight value was summed to get a total weighting sum for each reach. For example, Aeneas Creek0.00 to 0.25 reach has AR or NPF for the off channel habitat and road density indicators, therefore 1 + 13 equals a total weighting sum of 14. The weighting was as follows:

Indicator	Tributaries	Mainstem
FLOW	9	11
TEMP	6	13
OFF CHAN HAB	1	1
SUBSTRATE	2	5
EMBEDDEDNESS	10	3
LWD	3	6
POOLS	8	8
ROAD DENSITY	13	14
LANDUSE	14	10
WTD	11	7
BANK STABILITY	7	2
TREES	5	4
SHRUBS	12	9
CANOPY	4	12

To obtain the final prioritization, the list of reaches was sorted by the following ranks:
1. Original Conservation ranking, then
2. "Ease of Restoration" weighting sum, then
3. Highest Biological Value (Spawning, then Rearing, then Migrating),

The final ranking for the mainstem reaches is provided in Table 4 (for protection) and reverse-ranking in Table 5 (for rehabilitation),. Table 6 and 7 show the ranking for the tributaries.

7. Results

Map #14 is a map showing the top 10 priorities for protection and rehabilitation, in the mainstem and in the tributaries.

In the Mainstem, several upper Similkameen River reaches were identified as the top priority for protection, in addition to several braided portions of the middle Okanogan River. The Similkameen River reaches are migrating habitat with relatively simple restoration opportunities (off channel habitat opportunities, require LWD enhancement and tree/shrub planting). Two of the Okanogan River reaches have spawning habitat and require enhanced flow, off-channel opportunities, tree/ shrub planting, and other rehabilitation opportunities.

In the tributaries, Omak Creek was the highest priority for protection (with eight reaches representing the top ten priority list). Ninemile Creek and Tunk Creek were also identified as high priority for protection. In these creeks the restoration opportunities include off-channel habitat, bank stability and tree/shrub planting.

For rehabilitation, the upper portions of the Okanogan River and Tonasket Creek, Wild Horse Spring Creek, Antoine Creek, Bonaparte Creek, Wanacut Creek, Loup Loup Creek, and Chilliwist Creek were identified as priority. Similarly were a few intermittent sections of the lower Okanogan River.

For the complete details, see Tables 4 through 7, and Map #14.

Table 4. Reach Prioritization Ranking for the Mainstem with Protection as the Priority.

REACH	Count PF	CHINOOK RANKING	STHD RANKING	CHINOOK RANKING %LE (/28)	STHD RANKING %LE (/43)	AVG RANKING	RESTORATION SUM	Highest Biol. Value	FINAL RANKING (protection - rehabilitation)
Similkameen River7.75 to 8.60	4	14	11	50%	26%	38%	68	Migrate	1
Similkameen River4.50 to 5.00	4	14	11	50%	26%	38%	76	Migrate	2
Similkameen River3.7 to 3.8	3	15	12	54%	28%	41%	62	Spawn	3
Similkameen River7.20 to 7.75	4	14	16	50%	37%	44%	56	Migrate	4
Okanogan River49.90 to 50.40	5	9	26	32%	60%	46%	49	Spawn	5
Okanogan River44.30 to 45.010	4	10	27	36%	63%	49%	60	Spawn	6
Okanogan River56.70 to 57.30	4	10	27	36%	63%	49%	73	Spawn	7
Okanogan River70.00 to 70.30	7	22	9	79%	21%	50%	41	Migrate	8
Okanogan River54.65 to 56.70	3	11	28	39%	65%	52%	68	Spawn	9
Okanogan River71.15 to 71.55	3	11	28	39%	65%	52%	77	Spawn	10
Okanogan River37.80 to 39.30	6	23	10	82%	23%	53%	57	Migrate	11
Okanogan River53.25 to 54.65	6	23	10	82%	23%	53%	59	Migrate	12
Okanogan River45.00 to 47.60	6	23	10	82%	23%	53%	60	Migrate	13
Okanogan River39.30 to 39.50	5	24	10	86%	23%	54%	54	Migrate	14
Okanogan River70.30 to 71.15	5	24	10	86%	23%	54%	54	Migrate	14
Okanogan River48.20 to 48.90	5	24	10	86%	23%	54%	61	Migrate	15
Okanogan River35.60 to 37.65	5	24	10	86%	23%	54%	66	Migrate	16
Okanogan River71.55 to 74.05	5	24	10	86%	23%	54%	66	Migrate	16
Okanogan River50.40 to 52.15	5	24	10	86%	23%	54%	66	Migrate	16
Okanogan River57.30 to 61.20	5	24	10	86%	23%	54%	66	Migrate	16
Okanogan River61.20 to 62.20	5	24	10	86%	23%	54%	66	Migrate	16
Okanogan River62.20 to 63.60	5	24	10	86%	23%	54%	66	Migrate	16
Okanogan River63.60 to 70.00	5	24	10	86%	23%	54%	67	Migrate	17
Okanogan River35.00 to 35.60	2	12	29	43%	67%	55%	75	Spawn	18
Similkameen River4.00 to 4.50	3	7	37	25%	86%	56%	70	Spawn	19
Similkameen River6.95 to 7.20	3	7	37	25%	86%	56%	80	Spawn	20
Similkameen River00.00 to 3.70	3	7	37	25%	86%	56%	81	Spawn	21
Okanogan River39.50 to 44.30	4	25	11	89%	26%	57%	76	Migrate	22
Okanogan River32.00 to 34.05	4	25	11	89%	26%	57%	76	Migrate	22
Okanogan River52.15 to 52.70	1	13	30	46%	70%	58%	34	Spawn	23
Okanogan River37.65 to 37.80	1	13	30	46%	70%	58%	34	Spawn	23
Similkameen River3.80 to 4.00	1	8	38	29%	88%	58%	47	Spawn	24
Similkameen River6.60 to 6.95	1	8	38	29%	88%	58%	47	Spawn	24
Similkameen River5.00 to 5.65	1	8	38	29%	88%	58%	47	Spawn	24
Similkameen River5.65 to 6.60	1	8	38	29%	88%	58%	47	Spawn	24
Okanogan River24.95 to 25.65	5	24	15	86%	35%	60%	57	Migrate	25
Okanogan River15.80 to 16.60	5	24	15	86%	35%	60%	66	Migrate	26
Okanogan River4.40 to 14.40	5	24	15	86%	35%	60%	66	Migrate	26
Okanogan River25.65 to 26.00	5	24	15	86%	35%	60%	69	Migrate	27
Okanogan River29.30 to 29.95	5	24	15	86%	35%	60%	70	Migrate	28
Okanogan River16.95 to 21.70	4	25	16	89%	37%	63%	76	Migrate	29
Okanogan River26.00 to 28.70	4	25	16	89%	37%	63%	76	Migrate	29
Okanogan River30.80 to 30.80	4	25	16	89%	37%	63%	76	Migrate	29
Okanogan River47.60 to 48.20	2	27	13	96%	30%	63%	36	Migrate	30
Okanogan River52.90 to 53.25	2	27	13	96%	30%	63%	36	Migrate	30
Okanogan River48.90 to 49.90	2	27	13	96%	30%	63%	36	Migrate	30
Okanogan River52.70 to 52.90	2	27	13	96%	30%	63%	36	Migrate	30
Okanogan RiverCrossChannel	6	23	21	82%	49%	65%	59	Migrate	31
Okanogan River23.40 to 24.30	3	26	17	93%	40%	66%	84	Migrate	32
Okanogan River34.15 to 35.00	1	28	14	100%	33%	66%	46	Migrate	33
Okanogan River34.05 to 34.15	1	28	14	100%	33%	66%	46	Migrate	33
Okanogan River76.40 to 76.60	5	24	22	86%	51%	68%	54	Migrate	34
Okanogan River24.30 to 24.95	2	27	18	96%	42%	69%	36	Migrate	35
Okanogan River0.0 to 4.40	2	27	18	96%	42%	69%	36	Migrate	35
Okanogan River74.85 to 76.40	5	16	35	57%	81%	69%	73	Spawn	36
Okanogan River16.80 to 16.95	1	28	19	100%	44%	72%	46	Migrate	37
Okanogan River15.10 to 15.80	1	28	19	100%	44%	72%	46	Migrate	37
Okanogan River29.10 to 29.30	1	28	19	100%	44%	72%	46	Migrate	37
Okanogan River29.95 to 30.50	1	28	19	100%	44%	72%	46	Migrate	37
Okanogan River76.60 to 77.55	4	17	36	61%	84%	72%	84	Spawn	38
Okanogan River14.40 to 15.10	5	24	26	86%	60%	73%	70	Migrate	39
Okanogan River21.70 to 23.40	4	18	40	64%	93%	79%	84	Spawn	40
Okanogan River74.05 to 74.85	1	28	25	100%	58%	79%	46	Migrate	41
Okanogan River77.55 to 77.80	1	28	25	100%	58%	79%	46	Migrate	41
Okanogan River77.80 to 78.95	1	28	25	100%	58%	79%	46	Migrate	41
Okanogan River28.70 to 29.10b	3	19	41	68%	95%	82%	88	Spawn	42
Okanogan River31.80 to 32.00	0	21	39	75%	91%	83%	57	Spawn	43
Okanogan River28.70 to 29.10a	2	20	42	71%	98%	85%	62	Spawn	44
Okanogan River16.60 to 16.80	0	21	43	75%	100%	88%	57	Spawn	45
Okanogan River30.50 to 30.80	0	21	43	75%	100%	88%	57	Spawn	45

Table 5. Reach Prioritization Ranking for the Mainstem with Rehabilitation as the Priority.

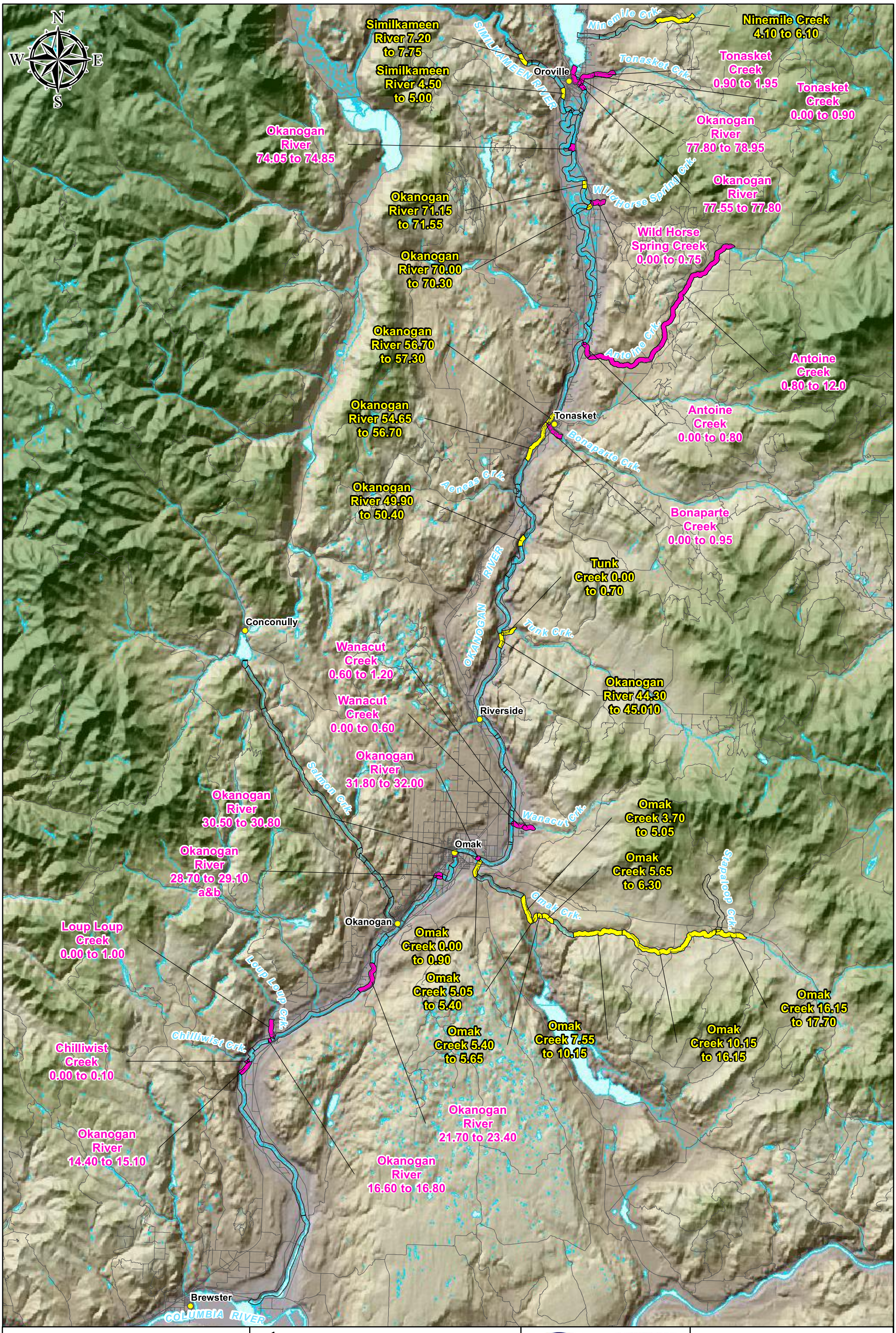
REACH	Count PF	CHINOOK RANKING	STHD RANKING	CHINOOK RANKING %LE (/28)	STHD RANKING %LE (/43)	AVG RANKING	RESTORATION SUM	Highest Biol. Value	FINAL RANKING (protection - rehabilitation)
Okanogan River16.60 to 16.80	0	21	43	75%	100%	88%	57	Spawn	45
Okanogan River30.50 to 30.80	0	21	43	75%	100%	88%	57	Spawn	45
Okanogan River28.70 to 29.10a	2	20	42	71%	98%	85%	62	Spawn	44
Okanogan River31.80 to 32.00	0	21	39	75%	91%	83%	57	Spawn	43
Okanogan River28.70 to 29.10b	3	19	41	68%	95%	82%	88	Spawn	42
Okanogan River74.05 to 74.85	1	28	25	100%	58%	79%	46	Migrate	41
Okanogan River77.55 to 77.80	1	28	25	100%	58%	79%	46	Migrate	41
Okanogan River77.80 to 78.95	1	28	25	100%	58%	79%	46	Migrate	41
Okanogan River21.70 to 23.40	4	18	40	64%	93%	79%	84	Spawn	40
Okanogan River14.40 to 15.10	5	24	26	86%	60%	73%	70	Migrate	39
Okanogan River76.60 to 77.55	4	17	36	61%	84%	72%	84	Spawn	38
Okanogan River16.80 to 16.95	1	28	19	100%	44%	72%	46	Migrate	37
Okanogan River15.10 to 15.80	1	28	19	100%	44%	72%	46	Migrate	37
Okanogan River29.10 to 29.30	1	28	19	100%	44%	72%	46	Migrate	37
Okanogan River29.95 to 30.50	1	28	19	100%	44%	72%	46	Migrate	37
Okanogan River74.85 to 76.40	5	16	35	57%	81%	69%	73	Spawn	36
Okanogan River24.30 to 24.95	2	27	18	96%	42%	69%	36	Migrate	35
Okanogan River0.0 to 4.40	2	27	18	96%	42%	69%	36	Migrate	35
Okanogan River76.40 to 76.60	5	24	22	86%	51%	68%	54	Migrate	34
Okanogan River34.15 to 35.00	1	28	14	100%	33%	66%	46	Migrate	33
Okanogan River34.05 to 34.15	1	28	14	100%	33%	66%	46	Migrate	33
Okanogan River23.40 to 24.30	3	26	17	93%	40%	66%	84	Migrate	32
Okanogan RiverCrossChannel	6	23	21	82%	49%	65%	59	Migrate	31
Okanogan River47.60 to 48.20	2	27	13	96%	30%	63%	36	Migrate	30
Okanogan River52.90 to 53.25	2	27	13	96%	30%	63%	36	Migrate	30
Okanogan River48.90 to 49.90	2	27	13	96%	30%	63%	36	Migrate	30
Okanogan River52.70 to 52.90	2	27	13	96%	30%	63%	36	Migrate	30
Okanogan River16.95 to 21.70	4	25	16	89%	37%	63%	76	Migrate	29
Okanogan River26.00 to 28.70	4	25	16	89%	37%	63%	76	Migrate	29
Okanogan River30.80 to 30.80	4	25	16	89%	37%	63%	76	Migrate	29
Okanogan River29.30 to 29.95	5	24	15	86%	35%	60%	70	Migrate	28
Okanogan River25.65 to 26.00	5	24	15	86%	35%	60%	69	Migrate	27
Okanogan River15.80 to 16.60	5	24	15	86%	35%	60%	66	Migrate	26
Okanogan River4.40 to 14.40	5	24	15	86%	35%	60%	66	Migrate	26
Okanogan River24.95 to 25.65	5	24	15	86%	35%	60%	57	Migrate	25
Similkameen River3.80 to 4.00	1	8	38	29%	88%	58%	47	Spawn	24
Similkameen River6.60 to 6.95	1	8	38	29%	88%	58%	47	Spawn	24
Similkameen River5.00 to 5.65	1	8	38	29%	88%	58%	47	Spawn	24
Similkameen River5.65 to 6.60	1	8	38	29%	88%	58%	47	Spawn	24
Okanogan River52.15 to 52.70	1	13	30	46%	70%	58%	34	Spawn	23
Okanogan River37.65 to 37.80	1	13	30	46%	70%	58%	34	Spawn	23
Okanogan River39.50 to 44.30	4	25	11	89%	26%	57%	76	Migrate	22
Okanogan River32.00 to 34.05	4	25	11	89%	26%	57%	76	Migrate	22
Similkameen River00.00 to 3.70	3	7	37	25%	86%	56%	81	Spawn	21
Similkameen River6.95 to 7.20	3	7	37	25%	86%	56%	80	Spawn	20
Similkameen River4.00 to 4.50	3	7	37	25%	86%	56%	70	Spawn	19
Okanogan River35.00 to 35.60	2	12	29	43%	67%	55%	75	Spawn	18
Okanogan River63.60 to 70.00	5	24	10	86%	23%	54%	67	Migrate	17
Okanogan River35.60 to 37.65	5	24	10	86%	23%	54%	66	Migrate	16
Okanogan River71.55 to 74.05	5	24	10	86%	23%	54%	66	Migrate	16
Okanogan River50.40 to 52.15	5	24	10	86%	23%	54%	66	Migrate	16
Okanogan River57.30 to 61.20	5	24	10	86%	23%	54%	66	Migrate	16
Okanogan River61.20 to 62.20	5	24	10	86%	23%	54%	66	Migrate	16
Okanogan River62.20 to 63.60	5	24	10	86%	23%	54%	66	Migrate	16
Okanogan River48.20 to 48.90	5	24	10	86%	23%	54%	61	Migrate	15
Okanogan River39.30 to 39.50	5	24	10	86%	23%	54%	54	Migrate	14
Okanogan River70.30 to 71.15	5	24	10	86%	23%	54%	54	Migrate	14
Okanogan River45.00 to 47.60	6	23	10	82%	23%	53%	60	Migrate	13
Okanogan River53.25 to 54.65	6	23	10	82%	23%	53%	59	Migrate	12
Okanogan River37.80 to 39.30	6	23	10	82%	23%	53%	57	Migrate	11
Okanogan River71.15 to 71.55	3	11	28	39%	65%	52%	77	Spawn	10
Okanogan River54.65 to 56.70	3	11	28	39%	65%	52%	68	Spawn	9
Okanogan River70.00 to 70.30	7	22	9	79%	21%	50%	41	Migrate	8
Okanogan River56.70 to 57.30	4	10	27	36%	63%	49%	73	Spawn	7
Okanogan River44.30 to 45.010	4	10	27	36%	63%	49%	60	Spawn	6
Okanogan River49.90 to 50.40	5	9	26	32%	60%	46%	49	Spawn	5
Similkameen River7.20 to 7.75	4	14	16	50%	37%	44%	56	Migrate	4
Similkameen River3.7 to 3.8	3	15	12	54%	28%	41%	62	Spawn	3
Similkameen River4.50 to 5.00	4	14	11	50%	26%	38%	76	Migrate	2
Similkameen River7.75 to 8.60	4	14	11	50%	26%	38%	68	Migrate	1

Table 6. Reach Prioritization Ranking for the Tributaries with Protection as the Priority.

REACH	Count PF	STHD RANKING	RESTORATION SUM	Highest Biol. Value	FINAL RANKING (protection - rehabilitation)
Tributaries					
Omak Creek5.05 to 5.40	4	1	57	Rearing	1
Omak Creek5.65 to 6.30	4	1	66	Rearing	2
Omak Creek10.15 to 16.15	3	2	71	Rearing	3
Omak Creek7.55 to 10.15	3	2	73	Rearing	4
Tunk Creek0.00 to 0.70	2	3	67	Rearing	5
Omak Creek0.00 to 0.90	2	3	85	Rearing	6
Omak Creek16.15 to 17.70	1	4	20	Rearing	7
Omak Creek5.40 to 5.65	1	4	24	Rearing	8
Omak Creek3.70 to 5.05	2	5	69	Rearing	9
Ninemile Creek4.10 to 6.10	5	6	53	Rearing	10
Ninemile Creek0.00 to 1.05	4	7	63	Rearing	11
Ninemile Creek1.05 to 1.90	1	8	23	Rearing	12
Ninemile Creek1.90 to 4.10	1	8	23	Rearing	12
Salmon Creek4.25 to 4.65	4	16	62	Rearing	13
Salmon Creek16.95 to 17.50	3	17	54	Rearing	14
Stapaloop Creek0.28 to 3.08	3	17	57	Rearing	15
Salmon Creek4.65 to 5.15	2	18	65	Rearing	16
Aeneas Creek0.00 to 0.25	1	19	14	Rearing	17
Salmon Creek17.50 to 17.51	1	19	14	Rearing	17
Salmon Creek17.51 to 17.55	1	19	14	Rearing	17
Stapaloop Creek0.00 to 0.28	1	19	14	Rearing	17
Chilliwist Creek0.00 to 0.10	0	20	28	Rearing	18
Wild Horse Spring Creek0.00 to 0.75	4	23	56	Rearing	19
Salmon Creek1.85 to 2.45	3	24	67	Rearing	20
Salmon Creek2.45 to 2.85	1	25	14	Rearing	21
Salmon Creek2.85 to 3.60	1	25	14	Rearing	21
Salmon Creek3.60 to 4.25	1	25	14	Rearing	21
Salmon Creek0.00 to 1.85	1	25	80	Rearing	22
Salmon Creek14.65 to 16.95	4	27	69	Rearing	23
Wanacut Creek0.60 to 1.20	3	28	66	Rearing	24
Salmon Creek5.15 to 14.65	3	28	73	Rearing	25
Wanacut Creek0.00 to 0.60	0	31	34	Rearing	26
Tonasket Creek0.00 to 0.90	4	32	71	Rearing	27
Omak Creek6.30 to 7.55	3	33	65	Rearing	28
Omak Creek0.90 to 3.70	3	33	71	Rearing	29
Bonaparte Creek0.00 to 0.95	3	34	83	Rearing	30
Loup Loup Creek0.00 to 1.00	0	39	96	Rearing	31
Antoine Creek0.80 to 12.0	3	41	73	Rearing	32
Tonasket Creek0.90 to 1.95	3	41	73	Rearing	32
Antoine Creek0.00 to 0.80	3	41	76	Rearing	33

Table 7. Reach Prioritization Ranking for the Tributaries with Rehabilitation as the Priority.

REACH	Count PF	STHD RANKING	RESTORATION SUM	Highest Biol. Value	FINAL RANKING (protection - rehabilitation)
Tributaries					
Antoine Creek0.00 to 0.80	3	**41**	**76**	Rearing	33
Antoine Creek0.80 to 12.0	3	**41**	**73**	Rearing	32
Tonasket Creek0.90 to 1.95	3	**41**	**73**	Rearing	32
Loup Loup Creek0.00 to 1.00	0	**39**	**96**	Rearing	31
Bonaparte Creek0.00 to 0.95	3	**34**	**83**	Rearing	30
Omak Creek0.90 to 3.70	3	**33**	**71**	Rearing	29
Omak Creek6.30 to 7.55	3	**33**	**65**	Rearing	28
Tonasket Creek0.00 to 0.90	4	**32**	**71**	Rearing	27
Wanacut Creek0.00 to 0.60	0	**31**	**34**	Rearing	26
Salmon Creek5.15 to 14.65	3	**28**	**73**	Rearing	25
Wanacut Creek0.60 to 1.20	3	**28**	**66**	Rearing	24
Salmon Creek14.65 to 16.95	4	**27**	**69**	Rearing	23
Salmon Creek0.00 to 1.85	1	**25**	**80**	Rearing	22
Salmon Creek2.45 to 2.85	1	**25**	**14**	Rearing	21
Salmon Creek2.85 to 3.60	1	**25**	**14**	Rearing	21
Salmon Creek3.60 to 4.25	1	**25**	**14**	Rearing	21
Salmon Creek1.85 to 2.45	3	**24**	**67**	Rearing	20
Wild Horse Spring Creek0.00 to 0.75	4	**23**	**56**	Rearing	19
Chilliwist Creek0.00 to 0.10	0	**20**	**28**	Rearing	18
Aeneas Creek0.00 to 0.25	1	**19**	**14**	Rearing	17
Salmon Creek17.50 to 17.51	1	**19**	**14**	Rearing	17
Salmon Creek17.51 to 17.55	1	**19**	**14**	Rearing	17
Stapaloop Creek0.00 to 0.28	1	**19**	**14**	Rearing	17
Salmon Creek4.65 to 5.15	2	**18**	**65**	Rearing	16
Stapaloop Creek0.28 to 3.08	3	**17**	**57**	Rearing	15
Salmon Creek16.95 to 17.50	3	**17**	**54**	Rearing	14
Salmon Creek4.25 to 4.65	4	**16**	**62**	Rearing	13
Ninemile Creek1.05 to 1.90	1	**8**	**23**	Rearing	12
Ninemile Creek1.90 to 4.10	1	**8**	**23**	Rearing	12
Ninemile Creek0.00 to 1.05	4	**7**	**63**	Rearing	11
Ninemile Creek4.10 to 6.10	5	**6**	**53**	Rearing	10
Omak Creek3.70 to 5.05	2	**5**	**69**	Rearing	9
Omak Creek5.40 to 5.65	1	**4**	**24**	Rearing	8
Omak Creek16.15 to 17.70	1	**4**	**20**	Rearing	7
Omak Creek0.00 to 0.90	2	**3**	**85**	Rearing	6
Tunk Creek0.00 to 0.70	2	**3**	**67**	Rearing	5
Omak Creek7.55 to 10.15	3	**2**	**73**	Rearing	4
Omak Creek10.15 to 16.15	3	**2**	**71**	Rearing	3
Omak Creek5.65 to 6.30	4	**1**	**66**	Rearing	2
Omak Creek5.05 to 5.40	4	**1**	**57**	Rearing	1



Top Priority Reaches for:

Rehabilitation

Protection

Reach Break

Road

U.S.A. Canada Border

Wide River or Lake

River or Stream

0 5 mi

0 8 km

DATE: May 2012

DRAWN BY: DA

PREPARED FOR: OBMEP

Top Priority Reaches

FILE: Top Priority Reaches.mxd

Data Source(s): Elevation - SRTM; Hydrology, Roads - CCT, 2007

Map 14

8. Recommendations

This chapter provides a bulleted summary of the action item recommendations, determined from this reach assessment, by tributary or mainstem channel, based on the ranking system discussed previously. The recommendations provided here are not prioritized, and are based upon the current technical understanding of the Okanogan River Basin. The indicator analysis and the final rankings, sorted by tributary/mainstem channel are summarized in Table 8 and Map #14.

Protection of good quality spawning, rearing and migrating habitat in the Okanogan River mainstem and tributaries is the priority for survival of salmonid and recovery of listed salmonid stocks. The next priority would be habitat projects that address each primary indicator.

A. Similkameen River Mainstem Action Items

For the mainstem analysis, the four highest priority reaches for fish habitat protection are Similkameen River 7.75 to 8.6, 4.5 to 5.00, 3.7 to 3.8 and 7.2 to 7.75 (shown on Map #14). The key action items to be addressed in the mainstem Similkameen River are:

- Off channel habitat
- Large woody debris
- Width to depth
- Trees, shrubs, canopy

B. Okanogan River Mainstem Action Items

The top six highest priority reaches in the Okanogan River mainstem are 49.90 to 50.40, 44.30 to 45.010, 56.70 to 57.30, 70.00 to 70.30, 54.65 to 56.70 and 71.15 to 71.55, (Map #14). Key action items to be addressed in the mainstem Okanogan River are:

- Flow in the five spawning reaches
- Off channel habitat
- Road density
- Trees, shrubs, canopy

C. Omak Creek Action Items

Of the tributary analyses, Omak Creek contains eight of the top ten reaches for protection. Key action items to be addressed in this tributary are:

- Off channel habitat
- Embeddedness
- Bank stability
- Road density
- Trees, shrubs, canopy

D. Tunk Creek Action Items

Tunk Creek was identified as the #5 priority for protection. Key action items to be addressed in this tributary are:

- Off channel habitat
- Substrate
- Embeddedness
- Trees, shrubs, canopy

E. Ninemile Creek Action Items

Ninemile Creek was identified as containing the next priority reaches for protection. Key action items to be addressed in this tributary are:

- Off channel habitat
- Embeddedness
- Large woody debris
- Trees, shrubs

F. Salmon Creek Action Items

Following Ninemile Creek, Salmon Creek was identified as containing the next priority reaches for protection. Key action items to be addressed in this tributary are:

- Off channel habitat
- Substrate
- Embeddedness
- Large woody debris
- Bank stability
- Width to depth
- Trees, shrubs

G. Stapaloop Creek Action Items

Stapaloop Creek was identified as priority 15 and 16 (out of 33 reaches). Key action items to be addressed in this tributary are:

- Off channel habitat
- Embeddedness
- Large woody debris
- Road density
- Trees

H. Aeneas Creek Action Items

Aeneas Creek was identified as priority 17 (tied with Stapaloop). Key action items to be addressed in this tributary are:

- Off channel habitat
- Road density

I. Chilliwist Creek Action Items

Chilliwist Creek was identified as priority 18. Key action items to be addressed in this tributary are:

- Off channel habitat
- Road density

J. Wild Horse Spring Creek Action Items

Wild Horse Spring Creek was identified as priority 19. Key action items to be addressed in this tributary are:

- Off channel habitat
- Embeddedness
- Large woody debris
- Road density
- Trees, shrubs, canopy

K. Wanacut Creek Action Items

Wanacut Creek was identified as priority 24 and 26. Key action items to be addressed in this tributary are:

- Off channel habitat
- Substrate
- Embeddedness
- Road density
- Trees

L. Tonasket Creek Action Items

Tonasket Creek was identified as priority 27 and 32 (out of 33 reaches). Key action items to be addressed in this tributary are:

- Flow
- Temperature
- Off channel habitat
- Substrate
- Embeddedness
- Large woody debris
- Road density
- Trees, shrubs

M. Bonaparte Creek Action Items

Bonaparte Creek was identified as priority 30. Key action items to be addressed in this tributary are:

- Temperature
- Off channel habitat
- Substrate
- Embeddedness
- Large woody debris
- Road density
- Trees, shrubs

N. Loup Loup Creek Action Items

Loup Loup Creek was identified as priority 31. Key action items to be addressed in this tributary are:

- Temperature
- Off channel habitat
- Substrate
- Embeddedness
- Road density
- Width to depth
- Bare ground, trees, shrubs, canopy

O. Antoine Creek Action Items

Antoine Creek was identified as priority 32 and 33. Key action items to be addressed in this tributary are:

- Flow
- Temperature
- Off channel habitat
- Substrate
- Embeddedness
- Large woody debris
- Bank stability
- Road density
- Trees, shrubs

Table 6. Ranking Results

REACH	FINAL RANKING (Tables 4 & 5)	Highest Biol. Value	FLOW - STHD	FLOW - CHIN	TEMP - STHD	TEMP - CHIN	OFF CHAN HAB	SUBSTRATE	EMBEDDEDNESS	LWD	BANK STABILITY	ROAD DENSITY	LANDUSE	WTD	BARE	TREES	SHRUBS	CANOPY
Tributaries																		
Omak Creek																		
Omak Creek5.05 to 5.40	1	Rearing	PF	Tributary	AR	Tributary	NPF	NPF	NPF	PF	NPF	NPF	PF	PF	PF	NPF	AR	
Omak Creek5.65 to 6.30	2	Rearing	PF	Tributary	AR	Tributary	NPF	PF	NPF	PF	AR	NPF	PF	AR	PF	NPF	NPF	
Omak Creek10.15 to 16.15	3	Rearing	PF	Tributary	AR	Tributary	NPF	NPF	NPF	NPF	NPF	NPF	PF	NPF	PF	NPF	AR	PF
Omak Creek7.55 to 10.15	4	Rearing	PF	Tributary	AR	Tributary	NPF	PF	NPF	AR	NPF	NPF	PF	AR	PF	AR	NPF	AR
Omak Creek0.00 to 0.90	6	Rearing	PF	Tributary	AR	Tributary	NPF	AR	NPF	NPF	NPF	NPF	NPF	NPF	PF	NPF	NPF	PF
Omak Creek16.15 to 17.70	7	Rearing	PF	Tributary	AR	Tributary	NPF					NPF	PF					
Omak Creek5.40 to 5.65	8	Rearing	PF	Tributary	AR	Tributary	NPF					NPF	PF					NPF
Omak Creek3.70 to 5.05	9	Rearing	PF	Tributary		Tributary	NPF	NPF	NPF	NPF	NPF	NPF	PF	AR	PF	NPF	NPF	NPF
Omak Creek6.30 to 7.55	28	Rearing	PF	Tributary	NPF	Tributary	NPF	PF	NPF	NPF		NPF	PF	NPF	PF	NPF	AR	AR
Omak Creek0.90 to 3.70	29	Rearing	PF	Tributary	NPF	Tributary	NPF	NPF	NPF	NPF	NPF	NPF	PF	NPF	PF	NPF	AR	PF
Tunk Creek																		
Tunk Creek0.00 to 0.70	5	Rearing	PF	Tributary	AR	Tributary	NPF	NPF	NPF	AR		AR	PF	AR	PF	NPF	NPF	AR
Ninemile Creek																		
Ninemile Creek4.10 to 6.10	10	Rearing	AR	Tributary	PF	Tributary	NPF	PF	NPF	NPF		AR	PF	PF	PF	NPF	NPF	PF
Ninemile Creek0.00 to 1.05	11	Rearing	AR	Tributary	PF	Tributary	NPF	NPF	NPF	NPF	AR	AR	PF	PF	PF	NPF	AR	PF
Ninemile Creek1.05 to 1.90	12	Rearing	AR	Tributary	PF	Tributary	NPF					AR	PF					
Ninemile Creek1.90 to 4.10	12	Rearing	AR	Tributary	PF	Tributary	NPF					AR	PF					
Salmon Creek																		
Salmon Creek4.25 to 4.65	13	Rearing		Tributary	PF	Tributary	NPF	NPF	NPF	PF	AR	AR	PF	AR	PF	NPF	NPF	PF
Salmon Creek16.95 to 17.50	14	Rearing		Tributary	PF	Tributary	NPF	NPF	NPF	NPF	AR	AR	PF	PF	PF	NPF	NPF	
Salmon Creek4.65 to 5.15	16	Rearing		Tributary	PF	Tributary	NPF	NPF	NPF	AR	NPF	AR	PF	NPF	PF	NPF	NPF	
Salmon Creek17.50 to 17.51	17	Rearing		Tributary	PF	Tributary	NPF					AR	PF					
Salmon Creek17.51 to 17.55	17	Rearing		Tributary	PF	Tributary	NPF					AR	PF					
Salmon Creek1.85 to 2.45	20	Rearing		Tributary		Tributary	NPF	PF	AR	NPF	NPF	AR	PF	AR	PF	AR	AR	AR
Salmon Creek2.45 to 2.85	21	Rearing		Tributary		Tributary	NPF					AR	PF					
Salmon Creek2.85 to 3.60	21	Rearing		Tributary		Tributary	NPF					AR	PF					
Salmon Creek3.60 to 4.25	21	Rearing		Tributary		Tributary	NPF					AR	PF					
Salmon Creek0.00 to 1.85	22	Rearing		Tributary		Tributary	NPF	PF	AR	NPF		AR	AR	NPF	NPF	NPF	NPF	NPF
Salmon Creek14.65 to 16.95	23	Rearing		Tributary	AR	Tributary	NPF	PF	NPF	NPF	AR	AR	PF	NPF	PF	NPF	NPF	PF
Salmon Creek5.15 to 14.65	25	Rearing		Tributary	AR	Tributary	NPF	PF	NPF	NPF	NPF	AR	PF	NPF	PF	NPF	NPF	AR
Stapaloop Creek																		
Stapaloop Creek0.28 to 3.08	15	Rearing		Tributary	PF	Tributary	NPF	AR	NPF	NPF		NPF	PF	AR	PF	NPF	AR	PF
Stapaloop Creek0.00 to 0.28	17	Rearing		Tributary	PF	Tributary	NPF					NPF	PF					
Aeneas Creek																		
Aeneas Creek0.00 to 0.25	17	Rearing		Tributary	PF	Tributary	NPF					NPF	PF					

REACH	FINAL RANKING (Tables 4 & 5)	Highest Biol. Value	FLOW - STHD	FLOW - CHIN	TEMP - STHD	TEMP - CHIN	OFF CHAN HAB	SUBSTRATE	EMBEDDEDNESS	LWD	BANK STABILITY	ROAD DENSITY	LANDUSE	WTD	BARE	TREES	SHRUBS	CANOPY
Chilliwist Creek																		
Chilliwist Creek0.00 to 0.10	18	Rearing		Tributary	PF	Tributary	NPF					NPF	AR					
Wild Horse Spring Creek																		
Wild Horse Spring Creek0.00 to 0.75	19	Rearing		Tributary		Tributary	NPF	PF	NPF	NPF	AR	NPF	PF	PF	PF	NPF	NPF	NPF
Wanacut Creek																		
Wanacut Creek0.60 to 1.20	24	Rearing		Tributary	AR	Tributary	NPF	NPF	NPF	AR		NPF	AR	PF	PF	NPF	AR	PF
Wanacut Creek0.00 to 0.60	26	Rearing		Tributary	AR	Tributary	NPF					NPF	AR					
Tonasket Creek																		
Tonasket Creek0.00 to 0.90	27	Rearing	NPF	Tributary	AR	Tributary	NPF	PF	NPF	NPF	AR	NPF	PF	PF	PF	NPF	NPF	AR
Tonasket Creek0.90 to 1.95	32	Rearing	NPF	Tributary	NPF	Tributary	NPF	NPF	NPF	NPF	AR	NPF	PF	PF	PF	NPF	NPF	AR
Bonaparte Creek																		
Bonaparte Creek0.00 to 0.95	30	Rearing	AR	Tributary	NPF	Tributary	NPF	NPF	NPF	NPF	AR	NPF	AR	PF	PF	NPF	NPF	PF
Loup Loup Creek																		
Loup Loup Creek0.00 to 1.00	31	Rearing		Tributary	NPF	Tributary	NPF	NPF	NPF	AR	AR	NPF	AR	NPF	NPF	NPF	NPF	NPF
Antoine Creek																		
Antoine Creek0.80 to 12.0	32	Rearing	NPF	Tributary	NPF	Tributary	NPF	NPF	NPF	NPF	NPF	NPF	PF	PF	PF	NPF	NPF	AR
Antoine Creek0.00 to 0.80	33	Rearing	NPF	Tributary	NPF	Tributary	NPF	AR	NPF	NPF	NPF	NPF	PF	PF	AR	NPF	NPF	PF
Mainstem - Similkameen River																		
Similkameen River7.75 to 8.60	1	Migrate	Migrate	Migrate		AR	NPF	PF	PF	NPF	PF	AR	PF	AR	NPF	NPF	NPF	NPF
Similkameen River4.50 to 5.00	2	Migrate	Migrate	Migrate	PF	AR	NPF	PF	PF	AR	PF	AR	AR	NPF	PF	NPF	AR	NPF
Similkameen River3.7 to 3.8	3	Spawn		Migrate	PF	AR	NPF	PF		AR	AR	AR	PF	NPF	PF	NPF	NPF	
Similkameen River7.20 to 7.75	4	Migrate	Migrate	Migrate		AR	NPF	PF	PF	NPF	PF	AR	PF	AR	NPF	NPF	NPF	
Similkameen River4.00 to 4.50	19	Spawn	NPF	PF	NPF	AR	AR	PF	AR	NPF	PF	AR	PF	AR	AR	NPF	NPF	
Similkameen River6.95 to 7.20	20	Spawn	NPF	PF	NPF	AR	NPF	NPF	NPF	NPF	PF	AR	PF	PF	NPF	NPF	NPF	NPF
Similkameen River00.00 to 3.70	21	Spawn	NPF	PF	NPF	AR	NPF	NPF	NPF	PF	PF	AR	PF	NPF	AR	NPF	NPF	NPF
Similkameen River3.80 to 4.00	24	Spawn	NPF	PF	NPF	AR	AR				AR	AR	PF					
Similkameen River5.00 to 5.65	24	Spawn	NPF	PF	NPF	AR	NPF				AR	AR	PF					
Similkameen River5.65 to 6.60	24	Spawn	NPF	PF	NPF	AR	AR				AR	AR	PF					
Similkameen River6.60 to 6.95	24	Spawn	NPF	PF	NPF	AR	NPF				AR	AR	PF					

REACH	FINAL RANKING (Tables 4 & 5)	Highest Biol. Value	FLOW - STHD	FLOW - CHIN	TEMP - STHD	TEMP - CHIN	OFF CHAN HAB	SUBSTRATE	EMBEDDEDNESS	LWD	BANK STABILITY	ROAD DENSITY	LANDUSE	WTD	BARE	TREES	SHRUBS	CANOPY
Mainstem - Okanogan River																		
Okanogan River49.90 to 50.40	5	Spawn	NPF	AR	AR	PF	NPF	PF	NPF	PF	PF	NPF	PF	NPF	PF	NPF	NPF	
Okanogan River44.30 to 45.010	6	Spawn	NPF	AR	AR	PF	NPF	PF	PF	NPF	AR	NPF	PF	NPF	PF	NPF	NPF	
Okanogan River56.70 to 57.30	7	Spawn	NPF	AR	AR	PF	NPF	AR	PF	PF	PF	NPF	NPF	AR	PF	NPF	NPF	NPF
Okanogan River70.00 to 70.30	8	Migrate	Migrate	Migrate	PF	NPF	NPF	PF	PF	PF	PF	NPF	PF	PF	PF	NPF	NPF	
Okanogan River54.65 to 56.70	9	Spawn	NPF	AR	AR	PF	NPF	AR	AR	NPF	PF	NPF	AR	PF	AR	NPF	PF	NPF
Okanogan River71.15 to 71.55	10	Spawn	NPF	AR	AR	PF	NPF	PF	NPF	AR	PF	NPF	AR	NPF	PF	NPF	NPF	NPF
Okanogan River37.80 to 39.30	11	Migrate	Migrate	Migrate	PF	NPF	NPF	PF	PF	NPF	PF	NPF	PF	NPF	PF	NPF	PF	NPF
Okanogan River53.25 to 54.65	12	Migrate	Migrate	Migrate	PF	NPF	NPF	PF	PF	NPF	PF	NPF	PF	PF	PF	NPF	AR	NPF
Okanogan River45.00 to 47.60	13	Migrate	Migrate	Migrate	PF	NPF	NPF	PF	PF	PF	PF	NPF	PF	NPF	PF	NPF	NPF	NPF
Okanogan River39.30 to 39.50	14	Migrate	Migrate	Migrate	PF	NPF	NPF	PF	PF	NPF	PF	NPF	PF	NPF	PF	NPF	AR	
Okanogan River70.30 to 71.15	14	Migrate	Migrate	Migrate	PF	NPF	NPF	PF	PF	NPF	PF	NPF	PF	AR	PF	NPF	NPF	
Okanogan River48.20 to 48.90	15	Migrate	Migrate	Migrate	PF	NPF	NPF	PF	PF	AR	PF	NPF	PF	PF	AR	NPF	NPF	NPF
Okanogan River35.60 to 37.65	16	Migrate	Migrate	Migrate	PF	NPF	NPF	PF	PF	NPF	PF	NPF	PF	NPF	PF	NPF	AR	NPF
Okanogan River71.55 to 74.05	16	Migrate	Migrate	Migrate	PF	NPF	NPF	PF	PF	NPF	PF	NPF	PF	NPF	PF	NPF	NPF	NPF
Okanogan River50.40 to 52.15	16	Migrate	Migrate	Migrate	PF	NPF	NPF	PF	PF	NPF	PF	NPF	PF	AR	PF	NPF	NPF	NPF
Okanogan River57.30 to 61.20	16	Migrate	Migrate	Migrate	PF	NPF	AR	PF	PF	NPF	PF	NPF	PF	AR	PF	NPF	AR	NPF
Okanogan River61.20 to 62.20	16	Migrate	Migrate	Migrate	PF	NPF	NPF	PF	PF	AR	PF	NPF	PF	AR	PF	NPF	AR	NPF
Okanogan River62.20 to 63.60	16	Migrate	Migrate	Migrate	PF	NPF	NPF	PF	PF	AR	PF	NPF	PF	NPF	PF	NPF	NPF	NPF
Okanogan River63.60 to 70.00	17	Migrate	Migrate	Migrate	PF	NPF	NPF	PF	PF	NPF	AR	NPF	PF	PF	PF	NPF	NPF	NPF
Okanogan River35.00 to 35.60	18	Spawn	NPF	AR	AR	PF	NPF	AR	PF	NPF	AR	NPF	AR	NPF	PF	NPF	NPF	
Okanogan River39.50 to 44.30	22	Migrate	Migrate	Migrate	PF	NPF	AR	PF	PF	NPF	PF	NPF	AR	NPF	PF	NPF	AR	NPF
Okanogan River32.00 to 34.05	22	Migrate	Migrate	Migrate	PF	NPF	NPF	PF	PF	NPF	PF	NPF	AR	NPF	PF	NPF	NPF	NPF
Okanogan River52.15 to 52.70	23	Spawn	NPF	AR	AR	PF	NPF				AR	NPF	PF					
Okanogan River37.65 to 37.80	23	Spawn	NPF	AR	AR	PF	NPF				AR	NPF	PF					
Okanogan River24.95 to 25.65	25	Migrate	Migrate	Migrate	PF	NPF	NPF	PF	PF	NPF	PF	NPF	NPF	PF	PF	AR	NPF	
Okanogan River15.80 to 16.60	26	Migrate	Migrate	Migrate	PF	NPF	AR	PF	PF	AR	PF	NPF	PF	AR	PF	NPF	NPF	NPF
Okanogan River4.40 to 14.40	26	Migrate	Migrate	Migrate	PF	NPF	AR	PF	PF	NPF	PF	NPF	PF	NPF	PF	NPF	NPF	NPF
Okanogan River25.65 to 26.00	27	Migrate	Migrate	Migrate	PF	NPF	NPF	PF	PF	NPF	PF	NPF	NPF	PF	PF	AR	NPF	NPF
Okanogan River29.30 to 29.95	28	Migrate	Migrate	Migrate	PF	NPF	AR	PF	PF	PF	PF	NPF	AR	AR	PF	NPF	NPF	NPF
Okanogan River16.95 to 21.70	29	Migrate	Migrate	Migrate	PF	NPF	NPF	PF	PF	NPF	PF	NPF	AR	AR	PF	NPF	NPF	NPF
Okanogan River26.00 to 28.70	29	Migrate	Migrate	Migrate	PF	NPF	AR	PF	PF	AR	PF	NPF	AR	AR	PF	NPF	AR	NPF
Okanogan River30.80 to 30.80	29	Migrate	Migrate	Migrate	PF	NPF	NPF	PF	PF	NPF	PF	NPF	AR	AR	PF	NPF	AR	NPF
Okanogan River47.60 to 48.20	30	Migrate	Migrate	Migrate	PF	NPF	NPF	PF			AR	NPF	PF					
Okanogan River52.90 to 53.25	30	Migrate	Migrate	Migrate	PF	NPF	NPF	PF			AR	NPF	PF					
Okanogan River48.90 to 49.90	30	Migrate	Migrate	Migrate	PF	NPF	NPF	PF			AR	NPF	PF					
Okanogan River52.70 to 52.90	30	Migrate	Migrate	Migrate	PF	NPF	NPF	PF			AR	NPF	PF					
Okanogan RiverCrossChannel	31	Migrate			AR	NPF	NPF	PF	PF	NPF	PF	NPF	PF	PF	PF	NPF	NPF	NPF
Okanogan River23.40 to 24.30	32	Migrate	Migrate	Migrate	PF	NPF	NPF	PF	PF	NPF	AR	NPF	AR	NPF	PF	NPF	AR	NPF
Okanogan River34.15 to 35.00	33	Migrate	Migrate	Migrate	PF	NPF	AR	PF			AR	NPF	AR					

REACH	FINAL RANKING (Tables 4 & 5)	Highest Biol. Value	FLOW - STHD	FLOW - CHIN	TEMP - STHD	TEMP - CHIN	OFF CHAN HAB	SUBSTRATE	EMBEDDEDNESS	LWD	BANK STABILITY	ROAD DENSITY	LANDUSE	WTD	BARE	TREES	SHRUBS	CANOPY
Okanogan River34.05 to 34.15	33	Migrate	Migrate	Migrate	PF	NPF	NPF	PF			AR	NPF	AR					
Okanogan River76.40 to 76.60	34	Migrate	Migrate	Migrate	AR	NPF	NPF	PF	PF	NPF	PF	NPF	PF	AR	PF	NPF	NPF	
Okanogan River24.30 to 24.95	35	Migrate	Migrate	Migrate	PF	NPF	NPF	PF			AR	NPF	PF					
Okanogan River0.0 to 4.40	35	Migrate	Migrate	Migrate	PF	NPF	AR	PF			AR	NPF	PF					
Okanogan River74.85 to 76.40	36	Spawn	NPF	NPF	NPF	AR	NPF	PF	NPF	NPF	PF	NPF	PF	PF	PF	NPF	NPF	NPF
Okanogan River16.80 to 16.95	37	Migrate	Migrate	Migrate	PF	NPF	NPF	PF			AR	NPF	AR					
Okanogan River15.10 to 15.80	37	Migrate	Migrate	Migrate	PF	NPF	NPF	PF			AR	NPF	AR					
Okanogan River29.10 to 29.30	37	Migrate	Migrate	Migrate	PF	NPF	NPF	PF			AR	NPF	AR					
Okanogan River29.95 to 30.50	37	Migrate	Migrate	Migrate	PF	NPF	NPF	PF			AR	NPF	NPF					
Okanogan River76.60 to 77.55	38	Spawn	NPF	NPF	NPF	AR	AR	PF	NPF	PF	PF	NPF	AR	AR	PF	NPF	NPF	NPF
Okanogan River14.40 to 15.10	39	Migrate	Migrate	Migrate	AR	NPF	NPF	PF	PF	PF	PF	NPF	AR	AR	PF	NPF	AR	NPF
Okanogan River21.70 to 23.40	40	Spawn	NPF	AR	NPF	NPF	NPF	PF	NPF	PF	PF	NPF	AR	AR	PF	NPF	AR	NPF
Okanogan River74.05 to 74.85	41	Migrate	Migrate	Migrate	AR	NPF	NPF	PF			AR	NPF	AR					
Okanogan River77.55 to 77.80	41	Migrate	Migrate	Migrate	AR	NPF	NPF	PF			AR	NPF	NPF					
Okanogan River77.80 to 78.95	41	Migrate	Migrate	Migrate	AR	NPF	AR	PF			AR	AR	NPF					
Okanogan River28.70 to 29.10b	42	Spawn	NPF	AR	NPF	NPF	NPF	NPF	NPF	NPF	PF	NPF	AR	PF	PF	NPF	AR	NPF
Okanogan River31.80 to 32.00	43	Spawn	NPF	AR	NPF	NPF	NPF				AR	NPF	AR					
Okanogan River28.70 to 29.10a	44	Spawn	NPF	AR	NPF	NPF	NPF				PF	NPF	AR		PF	NPF	AR	
Okanogan River16.60 to 16.80	45	Spawn	NPF	AR	NPF	NPF	NPF				AR	NPF	AR					
Okanogan River30.50 to 30.80	45	Spawn	NPF	AR	NPF	NPF	NPF				AR	NPF	NPF					