Okanagan Basin Monitoring and Evaluation Program (OBMEP)
2011 Annual Report for Sites in Canada

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TABLE OF CONTENTS

LIST OF TABLES AND FIGURES

GLOSSARY OF OKANAGAN PLACE NAMES

N'syilx'cin Place Name	Common Name
nx̌ʷəntkʷitkʷ	Columbia River
snpinˀyaʔtkʷ	Ellis Creek
akskʷəkʷant	Inkaneep Creek
nˤaylintən	McIntyre Dam
sx̌wəx̌wnikw	Okanagan Falls
Kɬusxənitkʷ	Okanagan Lake
q̓awsitkʷ	Okanagan River
nʕaləm'xnitkʷ	Oliver
suwiẃs	Osoyoos Lake
snpintktn	Penticton
akɬxʷminaʔ	Shingle Creek
q'awst'ik'ʷt	Skaha Lake
snʕax̌əlqaxʷiyaʔ	Vaseux Creek
np'əxɬpiw'	Vaseux Lake

1.0 INTRODUCTION

1.1 Project Background

The Okanagan Basin Monitoring and Evaluation Program (OBMEP) is a 20-year monitoring program of anadromous salmonids habitat and abundance within the ḳawsitkʷ (Okanagan[1] River)[2] sub-basin of the Upper nx̌ʷəntkʷitkʷ (Columbia River)[3]. Initiated in 2004 by the Colville Confederated Tribes Fish and Wildlife Department (CCTFWD), the program began collaborating with the Okanagan Nation Alliance Fisheries Department (ONAFD) in 2005 due to the trans-boundary nature of the sub-basin (Walsh and Long 2006a; Benson *et al*. 2007).

The OBMEP procedures and methodology are adapted from the *Monitoring Strategy for the Upper Columbia Basin* (Hillman 2004). Monitoring status and trends of anadromous salmonids and their habitat involves:

1. documenting present conditions of habitat characteristics, water quality, species presence and abundance; and
2. quantifying changes to these conditions over time.

Status and trend data will:

1. help identify issues that require further experimental research to understand cause and effect relationships; and
2. aid in effectively monitoring management actions performed in or around streams of interest (i.e., a stream restoration project resulting in a change of abundance or quality of habitat for juvenile salmonid populations).

Thus, OBMEP strives to guide restoration and adaptive management strategies within the study area (Figure 1) with the collection of long-term data.

[1] Okanagan equals Okanogan in Washington State

[2] Commonly referred to as Okanagan River but for the remainder of this report referred to as ḳawsitkʷ

[3] Commonly referred to as Columbia River but for the remainder of this report referred to as nx̌ʷəntkʷitkʷ

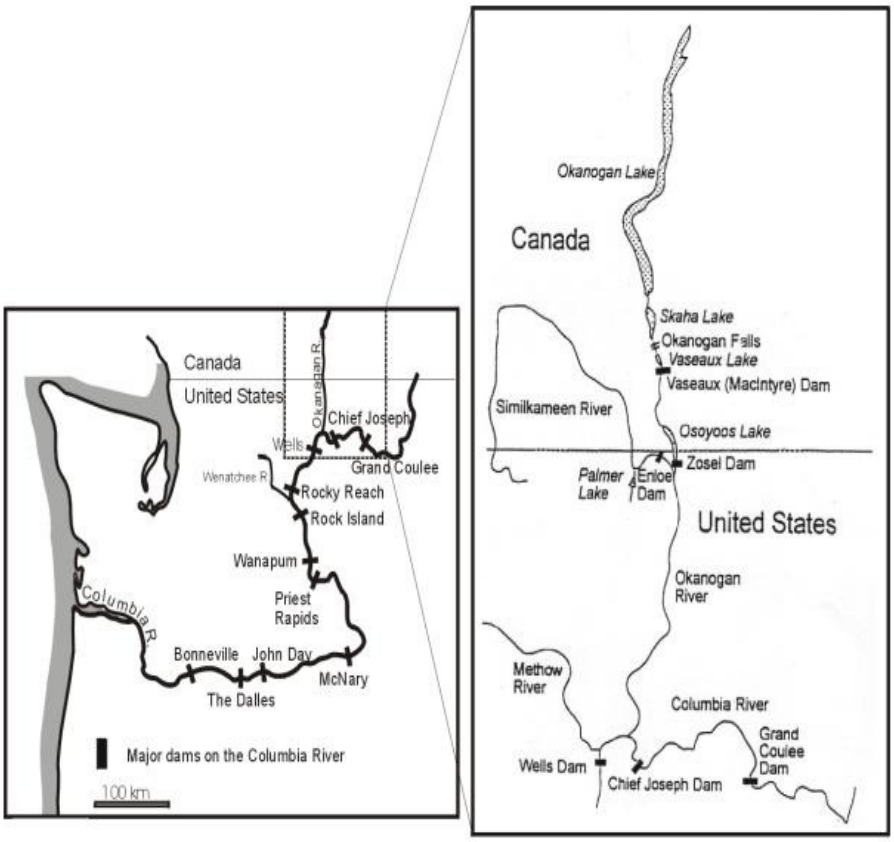

Figure 1: Core study area for the Okanagan Basin Monitoring and Evaluation Program in Canada.

Structured barriers are major constraints to present salmonid migrations in the Okanagan sub-basin. Dams exist at the outlets of all Canadian-bound Okanagan mainstem lakes (Figure 1) specifically, suwiẇs (Osoyoos Lake)[4], np'əxɬpiw' (Vaseux Lake)[5], q'awst'ik'ʷt (Skaha Lake)[6], and Kɬusxənitkʷ (Okanagan Lake)[7]. As of 2009 (late September), nˁaylintən (McIntyre Dam)[8], which is the outlet dam at np'əxɬpiw's, was refitted so that it is no longer a fish migration barrier for ntitiyx (Chinook Salmon) (*Oncorhynchus tshawytscha*), Sockeye Salmon (*O. nerka*) and Steelhead Trout (*O. mykiss*).

Outlet dams upstream from nˁaylintən are the q'awst'ik'ʷt outlet dam (at sx̌wəx̌wnikw (Okanagan Falls)[9]) and the Kɬusxənitkʷ outlet dam, both of which are the barriers for these salmon species. It

[4] Commonly referred to as Osoyoos Lake but for the remainder of this report referred to as suwiẇs

[5] Commonly referred to as Vaseux Lake but for the remainder of this report referred to as np'əxɬpiw'

[6] Commonly referred to as Skaha Lake but for the remainder of this report referred to as q'awst'ik'ʷt

[7] Commonly referred to as Okanagan Lake but for the remainder of this report referred to as Kɬusxənitkʷ

[8] Commonly referred to as McIntyre Dam but for the remainder of this report referred to as nˁaylintən

[9] Commonly referred to as Okanagan Falls but for the remainder of this report referred to as sx̌wəx̌wnikw

is the general thought that anadromous salmonids have previously occupied the entire q̓awsitkʷ headwater system (Ernst and Vedan 2000).

Re-introduction of Sockeye fry into the q'awst'ik'ʷt[10] system presently extends the range of anadromous salmonids to just below the Kɬusxənitkʷ outlet dam in snpintktn (Penticton)[11] (British Columbia). Consequently, under the OBMEP mandate, the study area in Canada extends from the Kɬusxənitkʷ outlet dam south to the United States border (Figure. 1).

1.2 Study objectives

The OBMEP program in Canada requires a total of 48 sites[12] to be surveyed over a 20-year study period. The 48 sites are divided into six panels each consisting of eight sites. One constant panel is surveyed annually along with one of the remaining five panels surveyed in a five year rotation (initiated with Panel 1, in 2005). Status and trend data collected, thus far, primarily include physical habitat characteristics, biological conditions, and water quality components.

The primary objectives for the Canadian OBMEP program in 2011 were to:

- observe on-going water discharge at four permanent hydrometric stations: three stations in q̓awsitkʷ mainstem and one station in aksk^{w}ək^{w}ant (Inkaneep Creek)[13];
- monitor on-going water temperature at the eight Annual Panel and eight Panel 2 sites (following standard field protocols);
- survey the physical habitat at the eight Annual Panel and eight Panel 2 sites (following standard field protocols);
- collect invertebrates samples at the eight Annual Panel and eight Panel 2 sites (following standard field protocols);
- survey the existing juvenile and adult fish production at the eight Annual Panel and eight Panel 2 sites (following standard field protocols) and;
- re-establish the Panel 3 sites at the end of 2011 OBMEP program in Canada.

[10] Each year, beginning in 2004 to present, between 400,000 and 1,700,000 hatchery-reared Sockeye fry have been released into Skaha Lake (Wright et al. 2011).

[11] Commonly referred to as Penticton but for the remainder of this report referred to as snpintktn

[12] As defined in Section 2.1.

[13] Commonly referred to as Inkaneep Creek but for the remainder of this report referred to as aksk^{w}ək^{w}ant

2.0 METHODS

2.1 Site selection

The monitoring of fish and their habitats for status and trends involves both temporal and spatial replication and probabilistic sampling of stream reaches (Hillman 2004). Study sites in Canada were selected from a total of 600 possible sites randomly generated from the Environmental Protection Agency's (EPA) Environmental Monitoring and Assessment Program (EMAP). EMAP is a statistically based and spatially explicit site-selection process developed for aquatic systems. For the purpose of the OBMEP study, sites refer to the EMAP sites and consist of q̓awsitkʷ sub-basin reaches of either stream or river.

Prior to selecting the OBMEP sites, barriers to anadromous fish migration were documented to determine current range (Walsh and Long 2006b). The 48 Canadian Okanagan EMAP sites were selected above and below fish migration barriers based on accessibility with preference toward sites downstream of barriers (Appendix 1). Reaches upstream of barriers were included as they are a source of water, nutrients, and substrate.

Prior to data collection, the sites were verified in the field to ensure they were practical and feasible to survey. If the sites could not be surveyed for these reasons, they could be replaced with sites not yet surveyed from an extra panel designated for this purpose.

The OBMEP sites in the Canadian q̓awsitkʷ sub-basin are presented in Figure 2 and Appendix 1. The sites are grouped into one annual panel and five rotating panels. Each panel includes eight sites. An additional panel of alternate (extra) sites is included if any of the Panels 1 to 5 cannot be surveyed. The schedule of panel surveys to be performed over the 20-year OBMEP program is detailed in Appendix 2. For the 2011 study period a total of 16 sites were evaluated from the annual panel and Panel 2 as displayed in Table 1. The sites for the 2011 study period include four q̓awsitkʷ mainstem sites and twelve tributary sites.

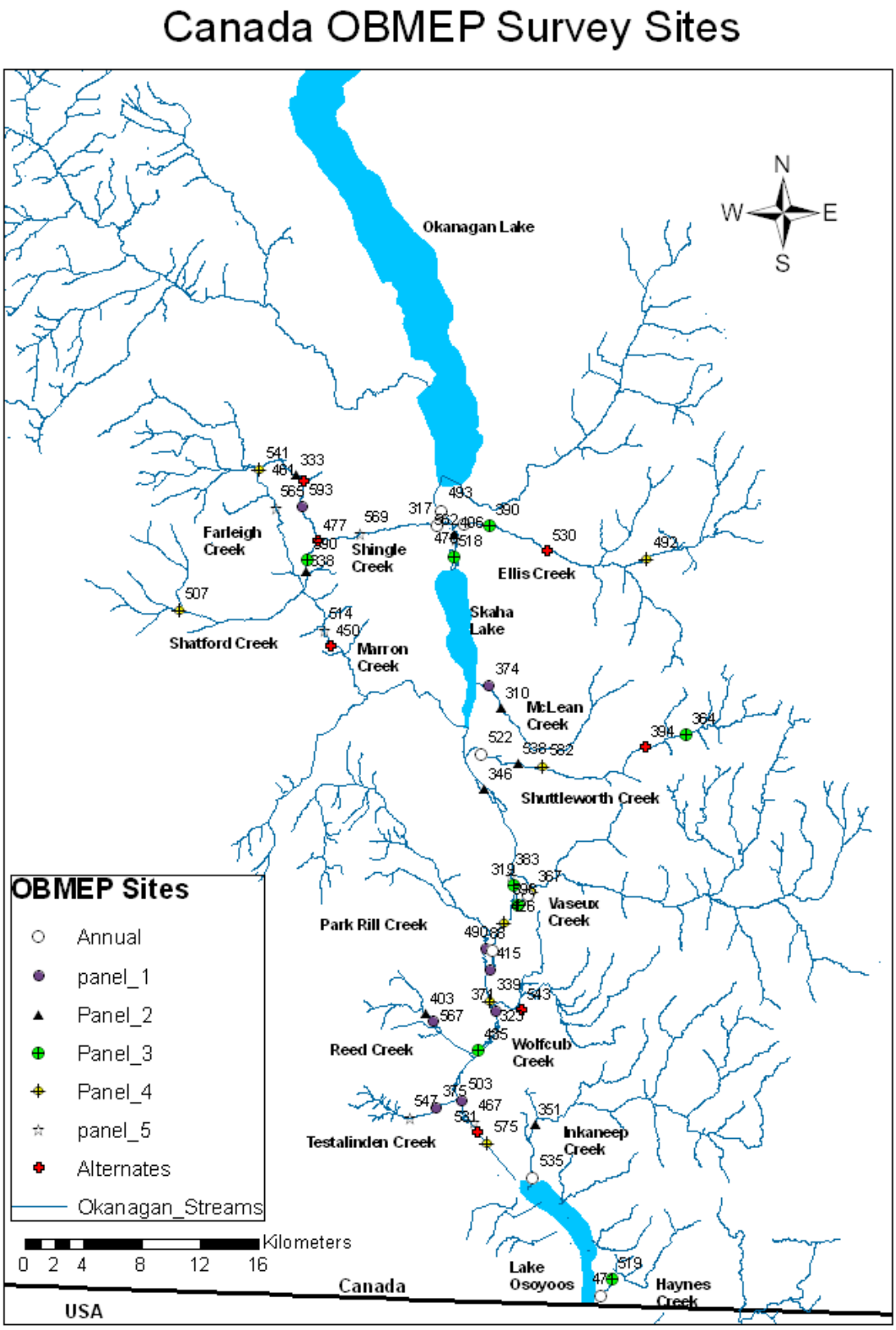

Figure 2: EMAP sites for the OBMEP program in the Canadian q̓awsitkʷ sub-basin.

Table 1: EMAP sites for the OBMEP study in the Canadian ḳawsitkʷ sub-basin surveyed in 2011. Panel 2 of the rotating panels will be surveyed once every five years, commencing in 2006.

Annual Panel Sites:

Stream	Site No.
ḳawsitkʷ	**490**
ḳawsitkʷ	**493**
aksk^{w}ək^{w}ant	**535**
snʃaxʷəlqaxʷiyaʔ (VaseuxCreek)[14]	**177**
Shuttleworth	**522**
akɬxʷminaʔ (Shingle Creek)[15]	**317**
snpinˀyaʔtkʷ (Ellis Creek)[16]	**470**
McLean*	**374**

*replaced Haynes Creek 471 in 2007

Panel 2 Sites 2011:

Stream	Site No.
ḳawsitkʷ	**562**
Upper akɬxʷminaʔ	**333**
Shatford	**338**
ḳawsitkʷ	**346**
Reed	**403**
aksk^{w}ək^{w}ant	**351**
Shuttleworth	**538**
McLean	**310**

2.2. Field protocol

With the implementation of scientifically rigorous protocols, randomly selected reaches located on a stream or river can be used to measure changes over time in the status and trends of habitat, water quality, and biota (Arterburn *et al*. 2006).

The CCTFWD developed two field-sampling protocol manuals employed throughout the ḳawsitkʷ sub-basin (based on Hillman 2004). One is for the collection of physical habitat data (Arterburn *et al*. 2006) and the other for the collection of biological data (Arterburn *et al*. 2005). A brief description of the protocols is included below.

In general, the OBMEP survey consists of documenting the study site, establishing transects within the site, and collecting both physical habitat and biological data related to anadromous salmonids. Surveys of the sites are generally conducted from June to September.

Dividing the stream reach into transects creates defined increments for measuring habitat characteristics and changes (Arterburn *et al*. 2006). Initially, a study site is located with GPS coordinates provided for all the EMAP sites – supplied by the CCTFWD. Once the site is located, a rebar marker is placed to designate the center point of the site. The total length (or reach) of a site is determined based on an average of five bankfull width measurements (refer to Appendix 3)

[14] Commonly referred to as Vaseux Creek but for the remainder of this report referred to as snʃaxʷəlqaxʷiyaʔ

[15] Commonly referred to as Shingle Creek but for the remainder of this report referred to as akɬxʷminaʔ

[16] Commonly referred to as Ellis Creek but for the remainder of this report referred to as snpinˀyaʔtkʷ

around the center point of the site, and then multiplied by twenty. The reach of the site is then divided into ten equally spaced transects, flagged and consecutively labeled with letters 'A' through 'K' (with 'A' beginning at the downstream of the center point 'F' and 'K' ending upstream) (Figure 3). These ten transects are again divided in half to create mid-transect points. The mid-transect point is that point exactly halfway from transect line A to transect line B, for example, and would be flagged and labeled as 'A1'. Rebar placed at transects 'A' and 'K' also delineate the site as permanent markers.

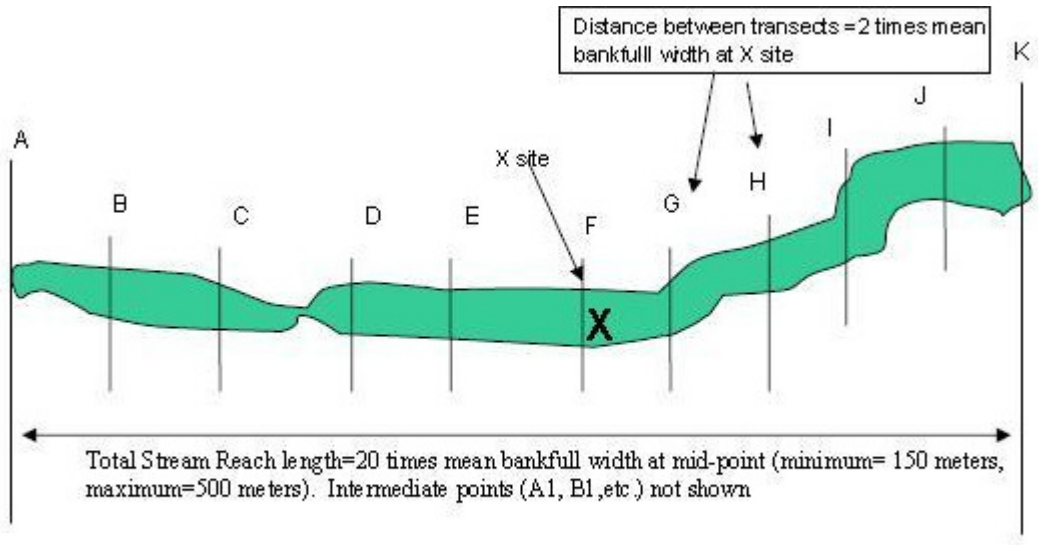

Figure 3: A typical EMAP habitat sampling site layout (from Arterburn et al. 2006).

Consistency in site location and data collection is important to the goals of the OBMEP study. Site documentation was recorded to assist in the accurate location of sites throughout the study period. GPS location of the center, upper- and lower-most transects[17], photo-documentation, and written description of the site (i.e., landmarks) are all contained in the site documentation.

2.2.1 Physical habitat surveys

Alternating crews of three (one constant, all well versed in OBMEP methodology) collected and recorded the physical habitat data in 2011. Physical habitat measurements included stream depth characteristics, habitat type, substrate characteristics, riparian vegetation, and human influences. These measurements were collected along transects, mid-transects, and finer habitat increments. In addition, environmental conditions during the habitat survey were recorded. The physical habitat measurements, their units, and a short description are summarized in Appendix 3.

[17] Electronic data entry allowed for the collection of GPS locations of all transects (and mid-transects as explained in section 2.3).

In streams too deep and deemed to be non-wadeable, a zodiac equipped with a small outboard engine (or a two-person kayak) was used to obtain in-stream depth information. A stadia rod was used to acquire the thalweg and cross-section depths.

2.2.2 Water quality, quantity, and temperature sampling

Water quantity (or discharge) data for 2011 were obtained from the Water Survey of Canada (WSC) real-time hydrometric stations (http://www.ec.gc.ca/rhc-wsc/). Measurements include water velocity, water levels, discharge, and temperature from various stations operating within the OBMEP study area. Active WSC stations of interest are located on the ḳawsitkʷ at snpintktn, sx̌wəx̌wnikw, and nʕaləm'xnitkʷ (Oliver)[18] and on the mouth of aksk^{w}ək^{w}ant (the latter has involved financial assistance from OBMEP). The WSC tributary stations on snʕax̌əlqax^{w}iyaʔ and Shuttleworth Creek have been discontinued.

Water quality data was collected on several occasions between October 2010 and November 2011 at Panel sites 1, 3, 4 and 5. Data was collected using a Hanna Instruments HI 9828 Multiparameter Probe and a LaMotte 2020 Turbidimeter. Parameters measured included pH, dissolved oxygen (DO), turbidity, conductivity, salinity, and Oxygen Reduction Potential.

Temperature data were collected using HOBO® Water Temp Pro v2 data loggers (Onset Computer Corporation) temperature loggers. One temperature data logger was set for each of the 2011 OBMEP sites. The loggers were housed in aluminum piping (to protect from damage), secured to a land base anchor (tree stump, shrub bases, fence posts, etc), and placed within an active channel representative of the site. The installation date and a site description (i.e., transect and bank) were recorded. Loggers were retrieved after 8 to 14 weeks and the temperature data downloaded. Temperature data for the 2010-2011 water-year were first collected from November 2010 to January 2011 followed then by February to October 2011. Data-recording intervals were set for every hour on the hour. Daily temperatures were averaged per site and plotted over time with sites from similar locations[19].

2.2.3 Snorkel surveys

Snorkeling was conducted to identify, enumerate, and classify salmonids and non-salmonids into length categories. Snorkel surveys were performed within weeks of the physical habitat surveys. Data were recorded per transect (A to K) and included start and end times, species (for salmonids),

[18] Commonly referred to as Oliver but for the remainder of this report referred to as nʕaləm'xnitkʷ

[19] Comparisons between site temperature data were made within 3 regions: ḳawsitkʷ main stem, northern tributaries (located between the Kɬusxənitkʷ outlet dam and sx̌wəx̌wnikw), and southern tributaries (located between sx̌wəx̌wnikw and the U.S. border).

family or species where possible (for non-salmonids), number of fish (for each species or family), and length category (<100 mm, 100-300 mm, or >300 mm) (Table 2). The underwater visual distance, average wetted width, stream temperature and environmental conditions (at the time of the survey) were also recorded.

The number of crew members for snorkeling mainstem sites (and stream sites with wider wetted widths) was dependent upon the visual distance under the water. A crew of five conducted the snorkel surveys on the five q̓awsitkʷ (mainstem) sites in 2011. Crew members spaced in intervals (determined by the underwater visual distance) snorkeled downstream (from Transect K) in a straight line across the wetted width of the site. Snorkel surveys in shallower streams generally required only two or three crew members who usually began downstream (at Transect A) and finished at the upstream end of the site. In streams too shallow to snorkel, crew members walked side by side and observed fish with the aid of polarized glasses and/ or snorkel masks for deeper pools. In 2011, two of the sites were not completely surveyed because they were almost completely dry. Both Shuttleworth 522 and Upper akɬxʷminaʔ 333 sites only had one isolated pool with no flow.

Table 2: Description of the biological measurements collected during the 2011 snorkel surveys.

Measurement	General Description	Methods	Units
Fish species	Salmonids and non-salmonids are identified to species where possible	snorkel survey	species or family
Number of fish	The number of fish, of each species and family, are counted	snorkel survey	number
Length category	Counted fish are measured and classified into one of three fish length groups (<100mm, 100-300mm, or >300mm)	snorkel survey	millimeters

2.2.4 Benthic Macroinvertebrate Collection

Benthic macroinvertebrates were collected from 15 of the 16 sites as an indicator for biological integrity and stream health. The site Upper akɬxʷminaʔ 333 was too dry to sample. In each of the wadeable streams and rivers, an area that best represented a riffle habitat within a reach was selected for sampling. After choosing the ideal spot, a 1ft x 1ft sampling area was chosen. Downstream of this area, a D-shaped kicknet was placed with open end facing upstream. The streambed in the 1ft x 1ft above the net was vigorously fanned. All rocks and or woody debris were rubbed in front of the net so all specimens floated into the net. After washing the organisms into the cup at the end of the net, the sides of the net were checked thoroughly for any organisms clinging to the sides.

The samples were then brought back to the ONAFD lab for separating. Each sample was poured into a tub, and then divided in quarters. All of the specimens were separated from the sample and placed in a container filled with 95% ethanol to be shipped to a separate laboratory (EcoAnalysts Inc.) for analysis.

2.3 Data collection and processing

Field data were recorded using both electronic data entry and data sheets. Most physical habitat data were collected with an electronic Trimble® GeoExplorer® Series GeoXM pocket PC. Snorkel data were primarily collected using OBMEP data field sheets or conventional field books (where necessary). Temperature data were collected using HOBO® Water Temp Pro v2 data loggers (Onset Computer Corporation) and devices with a Panasonic CF-30 TOUGHBOOK laptop.

The Trimble® device uses TerraSync™ Version 2.50 software to collect and record GPS positions. GPS coordinates were recorded with the Trimble® during the site documentation and physical habitat survey. Collection templates for the habitat survey were programmed into the Trimble® unit by the CCTFWD (containing the same information as the data field sheets).

The electronic Trimble® data were transferred and processed using GPS Pathfinder® Office 3.1 software. The GPS data collected by GPS receivers in the Trimble® unit were subject to errors (satellite clock errors, orbit errors, and atmospheric noise) and adjusted using differential correction. Snorkel field data were transferred from field notes to an OBMEP snorkel data sheet with Microsoft Excel. The temperature loggers' data were launched and read out using HOBOware® Pro Version 2.x software (Onset Computer Corporation).

All Canadian OBMEP field data from the ONAFD are forwarded to Summit Environmental Consulting where it is quality assured and quality controlled through a Microsoft Access database program to be returned to both ONAFD and CCTFWD for further analysis. Direct access to the OBMEP database is still in progress.

3.0 RESULTS

This is the seventh year of a proposed 20-year monitoring program of anadromous salmonid habitat and abundance within the Okanagan sub-basin of the Upper Columbia. The methods used in this study will be repeated annually for the purpose of comparing results.

3.1 Physical habitat surveys

Physical habitat data were collected for all 16 OBMEP sites in 2011. The data has been categorized into habitat type, substrate characteristics, riparian vegetation, and human influence characteristics. All habitat data collected in 2011 is summarized in the following tables and appendices. Table 3 presents the site physical habitat parameters; Table 4 presents the substrate characteristics; Table 5 presents the physical habitat types; Table 6 and Appendix 4 present the riparian vegetation attributes, and Table 7 and Appendix 5 present the human influence characteristics.

Table 3: Physical habitat parameters for eight annual EMAP sites and eight Panel 1 sites sampled in the ɑawsitkʷ Basin in 2011.

	PARAMETER								
EMAP Sites	**Bankfull Width (m)**	**Pool/Riffle Ratio**	**Canopy Cover Reach Average (%)**	**Canopy Cover Bank Average (%)**	**% Embedded**	**Small Sediment (%)**	**Bankfull Width/ Depth**	**Small LWD >10 cm and >1m in length (#)**	**Large LWD >10 cm and >2m in length (#)**
Vaseux Creek 177	20.66	0.18	0.04	0.06	24.76	25.88	19.50	99	91
McLean 310	4.06	0.04	0.42	0.50	35.91	68.18	5.07	119	116
Shingle Creek 317	7.07	NA	0.15	0.32	23.11	84.55	8.65	10	20
Shingle Upper 333	6.99	NA	0.12	0.27	39.25	9.09	6.76	131	126
Shatford 338	7.44	NA	0.26	0.41	27.68	86.36	10.26	39	40
Okanagan River 346	32.70	NA	0.00	0.00	59.39	90.91	13.25	2	9
Inkaneep 351	5.72	1.38	0.15	0.36	29.98	16.16	3.84	6	13
McLean Creek 374	4.85	0.06	0.14	0.18	49.39	55.45	5.53	66	97
Reed 403	4.26	0.02	0.67	0.68	31.86	63.64	7.09	104	152
Ellis Creek 470	8.14	NA	0.39	0.68	30.07	11.36	14.51	42	20
Okanagan River 490	33.25	NA	0.19	0.54	32.84	77.14	21.37	185	130
Okanagan River 493	28.73	NA	0.00	0.00	16.14	0.00	16.96	1	3
Shuttleworth Creek 522	8.67	0.09	0.33	0.64	35.14	23.23	14.67	0	0
Inkaneep Creek 535	9.13	0.32	0.38	0.59	47.52	71.82	6.37	51	76
Shuttleworth 538	17.11	0.02	0.17	0.41	39.52	10.61	22.04	87	118
Okanagan River 562	28.82	105.00	0.00	0.00	14.39	91.82	11.61	0	3

NA – not applicable (either no pools or no riffles recorded at the site)

Table 3: Physical habitat parameters for eight annual EMAP sites and eight Panel 1 sites sampled in the ɑawsitkʷ Basin in 2011 (continued).

	PARAMETER									
EMAP Sites	Thalweg Depth (m)	Gradient (%)	Wetted Width (m)	Bankfull Height (m)	Entrenchment Ratio (Bankfull width/flood prone width)	Entrenchment (E,ME,SE)	Flood Prone Width (m)	Bankfull Depth (m)	Flood Prone Depth (m)	Wetted Width/ Thalweg Depth
Vaseux Creek 177	0.25	2.71	7.06	0.82	0.51	ME	40.34	1.06	2.12	28.29
McLean 310	0.16	2.92	2.21	0.65	0.95	E	4.26	0.80	1.60	13.52
Shingle Creek 317	0.27	1.41	3.97	0.55	0.95	E	7.41	0.82	1.64	14.85
Shingle Upper 333	0.00	n/m	0.00	1.03	0.95	E	7.32	1.03	2.07	NA
Shatford 338	0.16	2.10	4.00	0.57	0.43	ME	17.14	0.72	1.45	25.32
Okanagan River 346	2.03	0.09	31.36	0.49	0.95	E	34.26	2.47	4.94	15.41
Inkaneep 351	0.21	2.89	2.89	1.27	0.95	E	6.00	1.49	2.98	13.78
McLean Creek 374	0.37	1.11	2.59	0.53	0.93	E	5.24	0.88	1.75	6.90
Reed 403	0.20	1.15	2.09	0.39	0.95	E	4.46	0.60	1.20	10.54
Ellis Creek 470	0.20	2.61	5.54	0.37	0.95	E	8.53	0.56	1.12	27.54
Okanagan River 490	0.89	0.37	24.46	0.68	0.63	ME	52.49	1.56	3.11	27.48
Okanagan River 493	0.96	0.06	25.95	0.75	0.95	E	30.10	1.69	3.39	26.95
Shuttleworth Creek 522	0.13	2.82	3.19	0.48	0.95	E	9.09	0.59	1.18	24.26
Inkaneep Creek 535	0.19	2.21	3.67	1.24	0.95	E	9.56	1.43	2.87	18.83
Shuttleworth 538	0.20	4.38	4.40	0.58	0.53	ME	32.10	0.78	1.55	21.65
Okanagan River 562	1.68	0.03	26.64	0.82	0.90	E	31.90	2.48	4.96	15.90

n/m – not measured

NA= Not Applicable, E=Entrenched, ME=Moderately Entrenched, SE=Slightly Entrenched

Table 4: Substrate characteristics for eight annual EMAP sites and eight Panel 1 sites sampled in the q̓awsitkʷ Basin in 2011.

	PARAMETER (%)											
EMAP Sites	Bedrock Smooth (RS)	Bedrock Rough (RR)	Boulder (BL)	Large Cobble (LCB)	Small Cobble (SCB)	Coarse Gravel (GC)	Fine Gravel (GF)	Sand (SA)	Silt/Clay/ Muck (FN)	Hardpan (HP)	Wood (WD)	Other (OT)
Vaseux Creek 177	0	0	18	24	25	17	5	8	1	0	2	2
McLean 310	0	5	9	10	14	18	7	6	15	0	6	10
Shingle Creek 317	0	0	4	8	23	13	6	3	9	25	6	3
Shingle Upper 333	0	0	1	12	24	21	7	16	11	0	3	3
Shatford 338	0	0	0	29	22	18	3	10	10	0	3	6
Okanagan River 346	0	0	0	0	0	1	2	51	11	0	0	33
Inkaneep 351	0	0	23	29	22	10	3	2	8	0	2	2
McLean Creek 374	0	0	0	0	5	13	15	39	3	0	5	20
Reed 403	0	0	0	1	7	2	24	9	10	0	10	36
Ellis Creek 470	0	0	5	15	42	16	5	1	0	13	0	2
Okanagan River 490	0	0	5	1	17	49	4	9	6	0	3	6
Okanagan River 493	0	0	9	13	41	30	1	1	0	0	0	5
Shuttleworth Creek 522	0	0	2	20	29	18	0	17	0	0	6	7
Inkaneep Creek 535	0	0	3	15	18	14	5	20	16	0	8	1
Shuttleworth 538	0	0	11	23	26	20	0	16	0	0	1	1
Okanagan River 562	0	0	2	7	15	57	3	5	2	0	1	7

Table 5: Physical habitat types for eight annual EMAP sites and eight Panel 1 sites sampled in the ɋawsitkʷ Basin in 2011.

	PARAMETER												
EMAP Sites	Primary Pool (%)	Beaver Pool (%)	Pool Tail out (%)	Glide (%)	Large Cobble Riffle (%)	Small Cobble Riffle (%)	Rapids (%)	Side Channel (Y/N)	Back-water (Y/N)	Total Pools (%)	Total Riffles (%)	Cascade/ Falls (%)	Mid-channel Bar width Average (m)
Vaseux Creek 177	14.12	0.00	0.59	0.00	77.06	0.00	0.00	Y	N	14.12	77.65	0.00	0.72
McLean 310	3.64	0.00	0.91	0.00	0.00	86.36	0.00	N	N	3.64	87.27	0.00	0.00
Shingle Creek 317	0.00	0.00	0.00	0.00	0.91	90.00	0.00	N	N	0.00	90.91	0.00	0.00
Shingle Upper 333	0.00	0.00	0.00	0.00	0.00	90.91	0.00	N	Y	0.00	90.91	0.00	0.00
Shatford 338	0.00	0.00	0.00	0.00	0.00	90.91	0.00	Y	N	0.00	90.91	0.00	0.00
Okanagan River 346	0.00	0.00	0.00	90.91	0.00	0.00	0.00	Y	N	90.91	0.00	0.00	0.00
Inkaneep 351	52.73	0.00	0.91	0.00	37.27	0.00	0.00	Y	N	52.73	38.18	0.00	0.00
McLean Creek 374	5.45	0.00	0.91	0.00	0.00	84.55	0.00	N	N	5.45	85.45	0.00	0.00
Reed 403	1.82	0.00	0.00	0.00	0.91	74.55	0.00	Y	Y	1.82	89.09	13.64	0.05
Ellis Creek 470	0.00	0.00	0.00	0.00	0.91	90.00	0.00	N	N	0.00	90.91	0.00	0.00
Okanagan River 490	0.00	0.00	0.00	0.00	19.29	74.29	0.71	Y	Y	0.00	94.29	0.00	1.39
Okanagan River 493	0.00	0.00	0.00	90.91	0.00	0.00	0.00	N	N	90.91	0.00	0.00	0.00
Shuttleworth Creek 522	0.00	0.00	0.91	0.00	0.00	82.73	0.00	N	N	7.27	83.64	0.00	0.00
Inkaneep Creek 535	21.82	0.00	0.91	0.00	0.00	68.18	0.00	N	Y	21.82	69.09	0.00	0.00
Shuttleworth 538	1.82	0.00	0.00	0.00	63.64	25.45	0.00	N	N	1.82	89.09	0.00	0.97
Okanagan River 562	0.00	0.00	0.00	95.45	0.91	0.00	0.00	N	N	95.45	0.91	0.00	0.00

Table 6: Riparian vegetation attributes for eight annual EMAP sites and eight Panel 1 sites sampled in the q̓awsitkʷ Basin in 2011.

	PARAMETER (%)									
EMAP Sites	Overstory Deciduous	Over-story Big trees	Over-story Small trees	Understory Deciduous	Under-story Woody shrubs/ saplings	Under-story Non-woody	Ground cover Woody shrubs/ saplings	Ground cover Non-woody	Ground cover Barren dirt/duff	Ground cover LWD
Vaseux Creek 177	18	24	32	56	97	68	82	15	100	88
McLean 310	41	82	55	86	100	100	95	18	82	95
Shingle Creek 317	59	95	73	77	100	95	100	50	100	86
Shingle Upper 333	68	64	14	91	100	86	100	45	91	95
Shatford 338	77	50	77	95	95	100	95	23	100	82
Okanagan River 346	18	18	9	50	36	100	18	91	100	18
Inkaneep 351	9	91	55	91	100	100	100	14	100	100
McLean Creek 374	25	23	32	95	100	100	95	100	68	100
Reed 403	68	64	41	100	100	59	100	27	100	100
Ellis Creek 470	86	86	64	91	100	91	100	5	100	86
Okanagan River 490	91	85	85	85	100	100	100	100	52	85
Okanagan River 493	32	27	18	100	45	100	27	100	82	36
Shuttleworth Creek 522	59	64	77	77	100	100	100	73	95	95
Inkaneep Creek 535	91	86	73	100	100	95	100	5	100	100
Shuttleworth 538	41	55	77	73	100	95	100	23	100	100
Okanagan River 562	0	0	0	100	27	100	32	100	100	5

Table 7: Human influence for eight annual EMAP sites and eight Panel 1 sites sampled in the ɋawsitkʷ Basin in 2011.

	Not Present (%)											
EMAP Sites	Wall/ Dike/ Revetment /Riprap /Dam	Buildings	River access site	Pavement/ Road/ Railroad	Pipes (inlet/ outlet)	Garbage pile	Cleared lot/ Lawn	Orchard/Row Crops	Pasture/ Range/ Hay Field	Logging Operations	Mining Activity	Diversion
Vaseux Creek 177	53	97	100	56	100	100	100	100	100	100	100	100
McLean 310	100	100	95	64	77	77	100	100	91	100	100	100
Shingle Creek 317	45	55	82	36	95	41	86	100	100	100	100	100
Shingle Upper 333	100	100	91	100	100	95	100	100	100	100	100	100
Shatford 338	100	100	82	100	95	95	100	100	50	100	100	100
Okanagan River 346	0	64	23	5	77	59	91	100	73	95	100	95
Inkaneep 351	100	100	91	91	100	95	100	100	100	100	100	100
McLean Creek 374	100	100	100	100	91	91	100	100	100	100	100	100
Reed 403	100	95	95	55	68	55	100	100	100	100	100	86
Ellis Creek 470	0	0	68	18	91	0	64	100	100	100	100	100
Okanagan River 490	95	73	78	50	86	95	86	67	100	100	100	86
Okanagan River 493	0	77	95	0	82	9	55	100	100	100	100	100
Shuttleworth Creek 522	100	68	100	32	100	77	91	100	18	100	100	100
Inkaneep Creek 535	86	100	86	77	100	91	100	100	55	100	100	100
Shuttleworth 538	100	100	100	59	95	86	100	100	100	100	100	100
Okanagan River 562	0	91	100	0	77	0	100	100	64	100	100	100

3.2 Water Quantity and Quality

3.2.1 Water quantity: discharge

The mean monthly discharges (m^3/s) for four hydrometric stations are summarized in Figure 4. The longest data set is from 1915 to 2011 for OK River at OK Falls. Peak discharges typically occur from May to July.

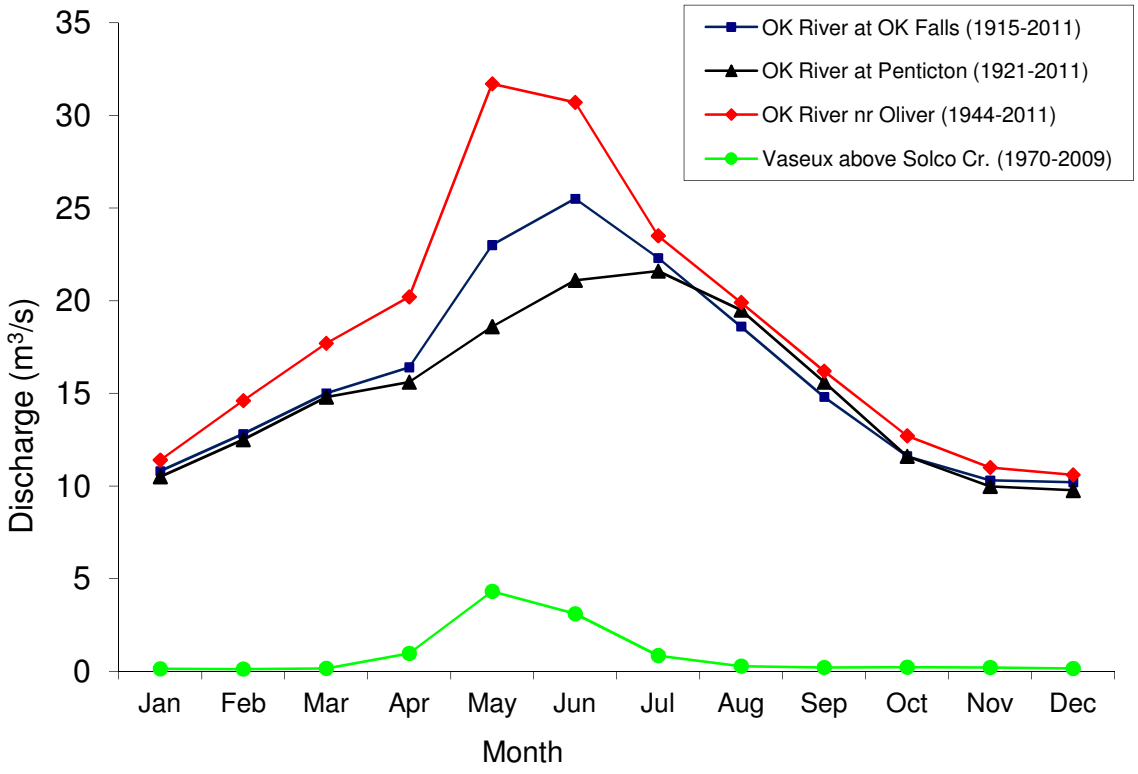

Figure 4: Historic mean monthly discharges (m^3/s) from four real-time hydrometric stations in the ɋawsitkʷ sub-basin (WSC 2012).

Mean daily discharge rates for the ɋawsitkʷ mainstem are depicted in Figures 5 to 7 for the 2011 water year. Data presented are provisional and not endorsed by Environment Canada until further quality control and assurance protocols have been conducted. Discharges depicted are not the natural hydrograph as discharge is controlled at the Kɬusxənitkʷ outlet dam in snpintktn, the ɋawst'ik'ʷt outlet dam in sx̌wəx̌wnikw, and nˁaylintən at the outlet of np'əxɬpiw's (Symonds 2000).

The mean daily discharge rate of the hydrometric station located at the mouth of aksk^{w}ək^{w}ant is depicted in Figure 8 for the 2011 water year (November 2010 to November 2011).

Figure 5: Mean daily discharge (m^3/s) in the ʔawsitkʷ at snpintktn (08NM050) during the 2011 water year (WSC).

Figure 6: Mean daily discharge (m^3/s) in the ʔawsitkʷ at sx̌wəx̌wnikw (Okanagan Falls) (08NM002) during the 2011 water year (WSC 2012).

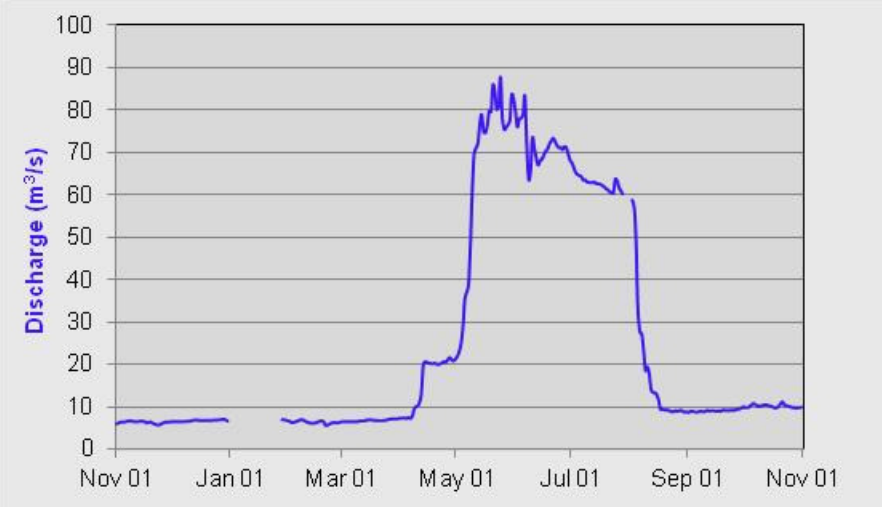

Figure 7: Mean daily discharge (m^3/s) in the ʤawsitkʷ at nʕaləm'xnitkʷ (08NM085) during the 2011 water year (WSC 2012).

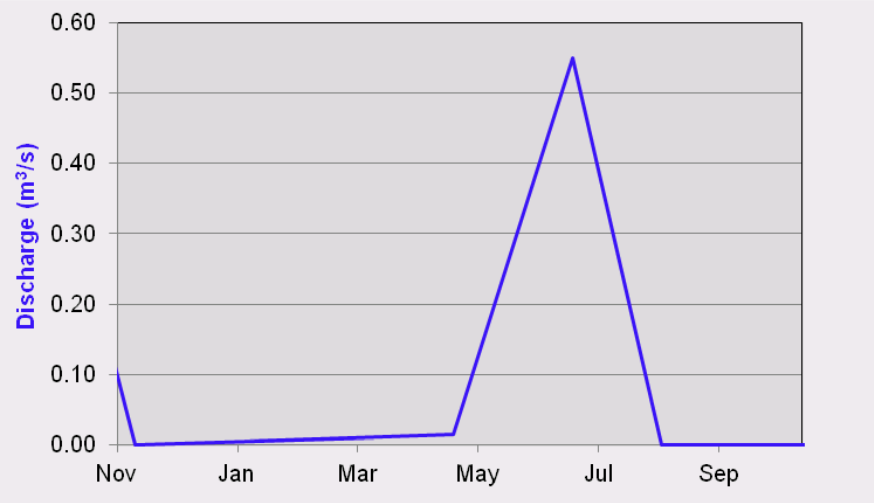

Figure 8: Mean daily discharge (m^3/s) at the mouth of Shuttleworth Creek (08NM149) during the 2011 water year (WSC 2012).

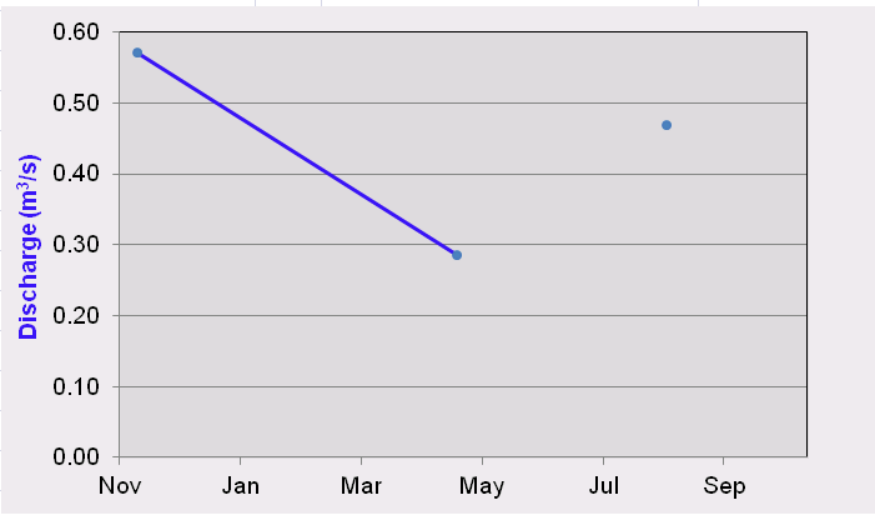

Figure 9: Mean daily discharge (m^3/s) at the mouth of snʕaxəlqaxʷiyaʔ (08NM246) during the 2010 water year (WSC 2012).

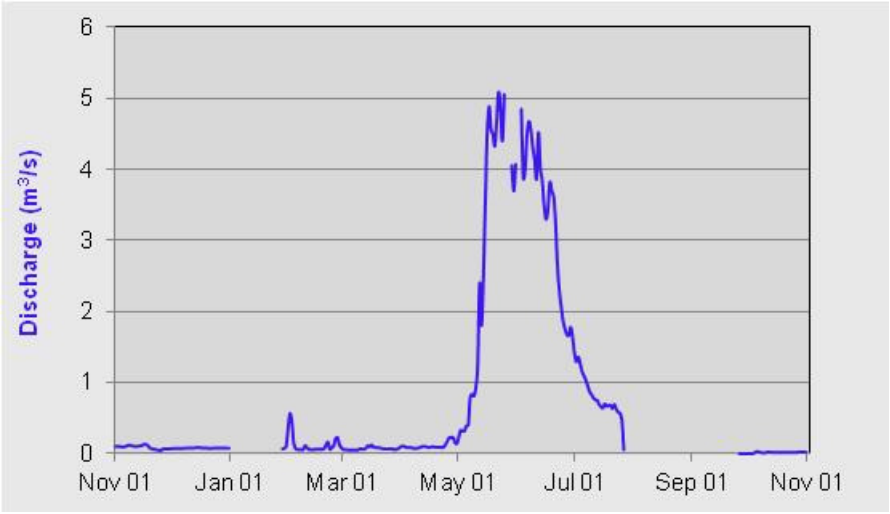

Figure 10: Mean daily discharge (m^3/s) at the mouth of aksk^{w}ək^{w}ant (08NM200) during the 2011 water year (WSC 2012).

3.2.2 Water quality: temperatures

Water temperature loggers were deployed at all sites for this study year late in 2010. Downloads occurred in the spring and fall of 2011 (and or as necessary) to capture the 2010-2011 water year (Figures 11-16).

Figure 11: Mean daily river temperatures for the northern ɋawsitkʷ mainstem sites for the 2011 water year.

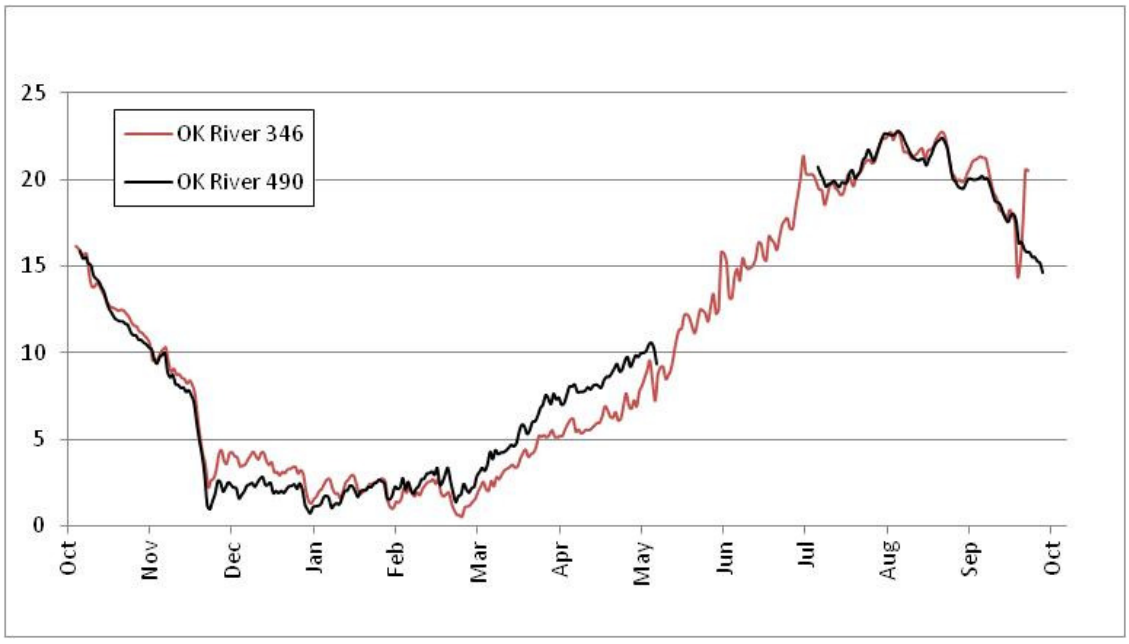

Figure 12: Mean daily river temperatures for the southern ɋawsitkʷ mainstem sites for the 2011 water year.

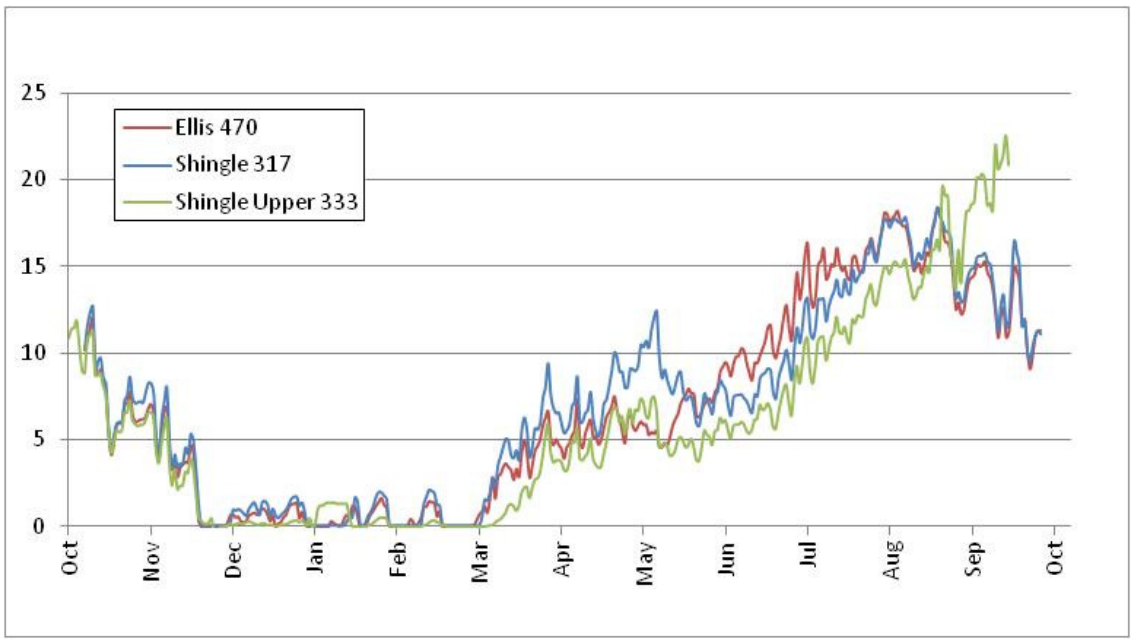

Figure 13: Mean daily stream temperatures for snpin'ya?tkʷ 470, akɬxʷmina? 317, and Upper akɬxʷmina? 333 sites for the 2011 water year.

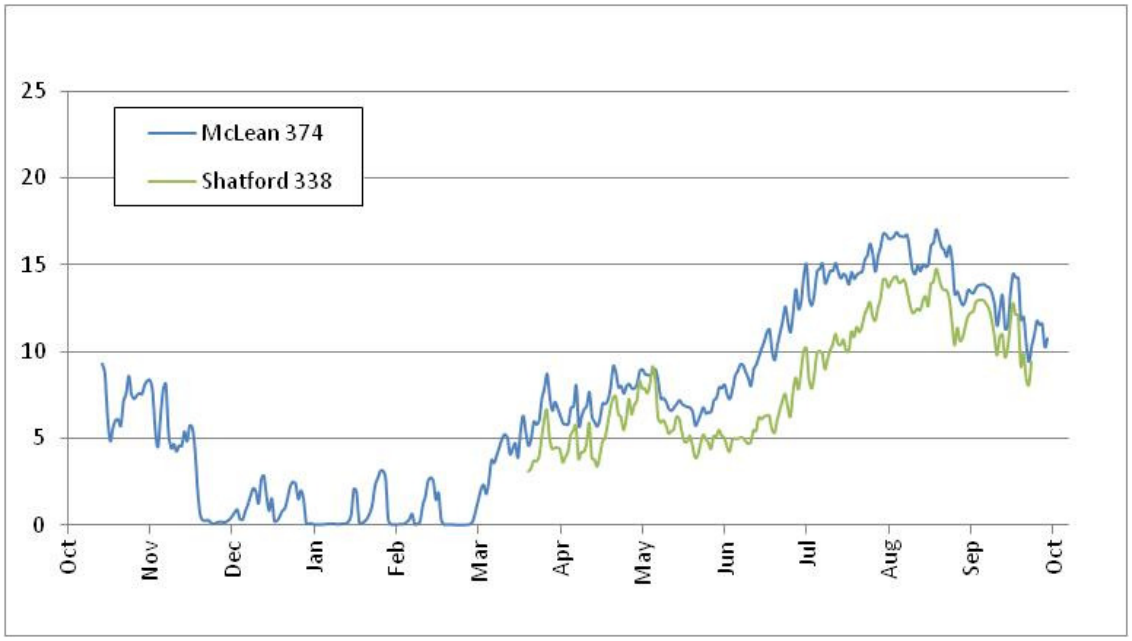

Figure 14. Mean daily stream temperatures for McLean 371 and Shatford 338 sites for the 2011 water year.

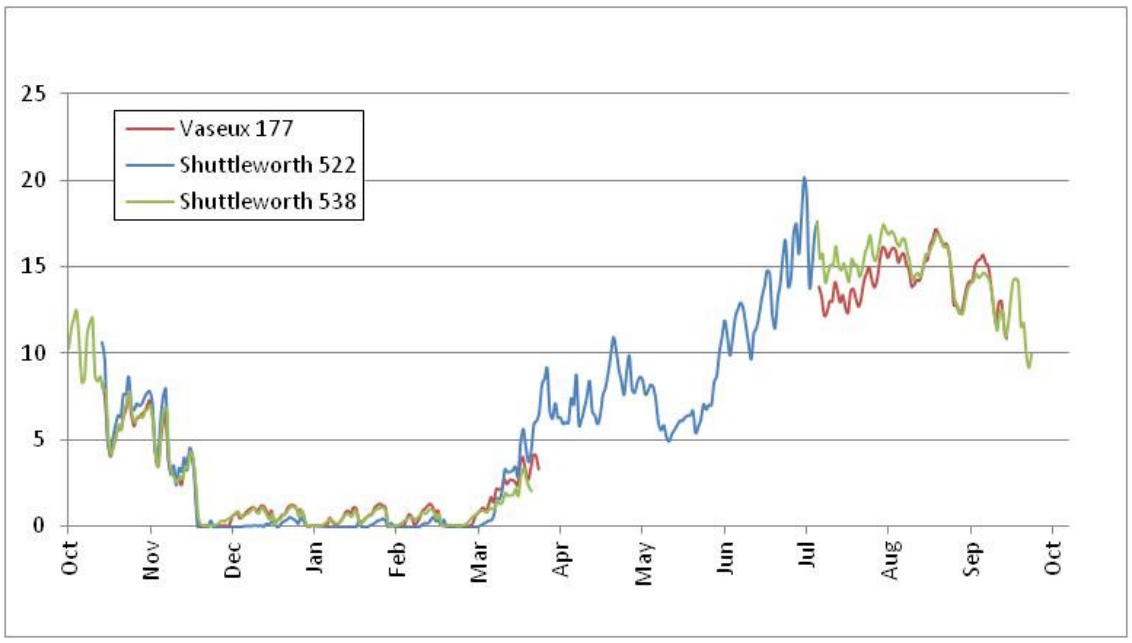

Figure 15: Mean daily stream temperatures for snʕaxəlqaxʷiyaʔ 177 and Shuttleworth 522 and 538 sites for the 2011 water year.

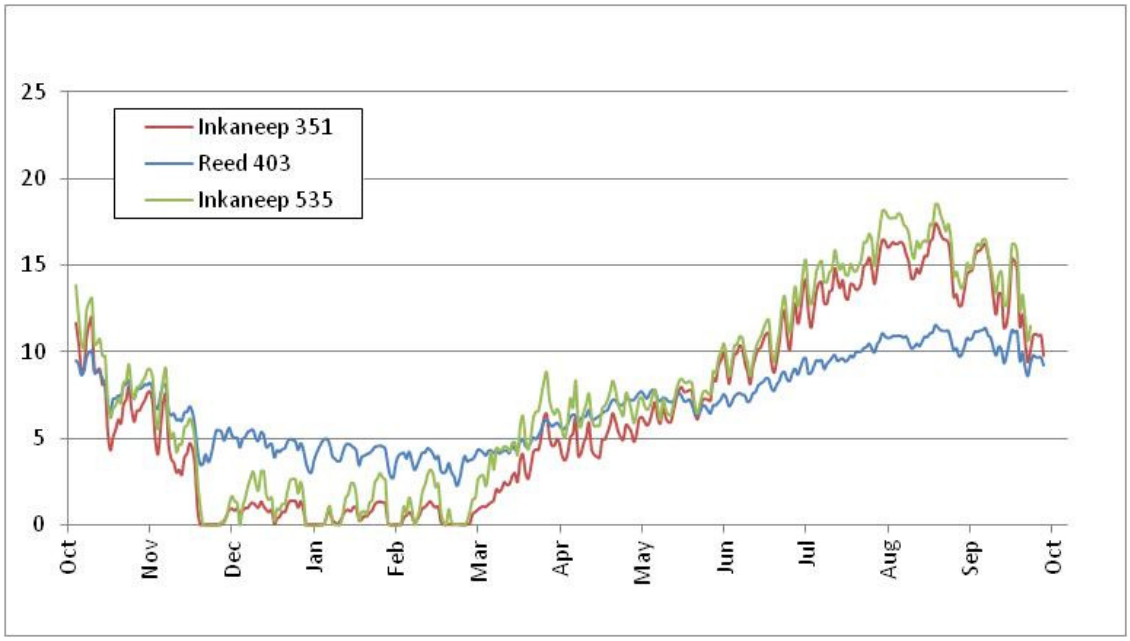

Figure 16: Mean daily stream temperatures for Reed 403 and akskʷəkʷant 351 and 535 sites for the 2011 water year.

Brett (1952) determined that the preferred temperature of ntitiyx (Chinook Salmon) fingerlings ranges from 12.2°C to 13.9°C, with an upper lethal temperature for ntitiyx (Chinook Salmon) fry at 25°C. The upper lethal temperature for Rainbow Trout fingerlings was 24°C after being acclimated down to 11°C in laboratory studies (Black 1953).

In mid-August, mean daily temperatures for all the mainstem river sites approached 23°C, with maximum daily temperatures reaching 23.2°C for q'awsitkʷ 562, 23.3°C for 493, 22.8°C for 346, and 22.8°C for 490.

According to Scott and Crossman (1973), Kokanee generally spawn from September to October when temperatures drop from 10.5°C to 5.0°C and Sockeye spawn from July to December when temperatures drop from 7°C to 3°C. In 2011, peak spawning in the q'awsitkʷ was October 16th for Sockeye (Benson and Audy 2012) and October 21st for Kokanee (ONA, unpublished data). Mean temperatures in the q'awsitkʷ[20] for these dates were 12.9°C and 12.5°C, respectively.

3.2.3 Water quality: chemistry

Water chemistry data was collected at Panel sites 1, 3, 4 and 5 between October 2010 and November 2011. Issues with the pH and DO probe, as well as dry or frozen conditions prevented the collection of samples on some occasions. Results for pH, DO, conductivity and salinity are provided in Figures 17-24.

McKean and Nagpal (1991) noted that pH values >9.0 are likely harmful to salmonids and perch during long-term exposure. pH values in exceeding 9.0 were encountered in several streams (McLean, q'awsitkʷ, Reed, snʕaxəlqaxʷiyaʔ, Wolfcub, Shuttleworth, akɬxʷminaʔ, Testalinden).

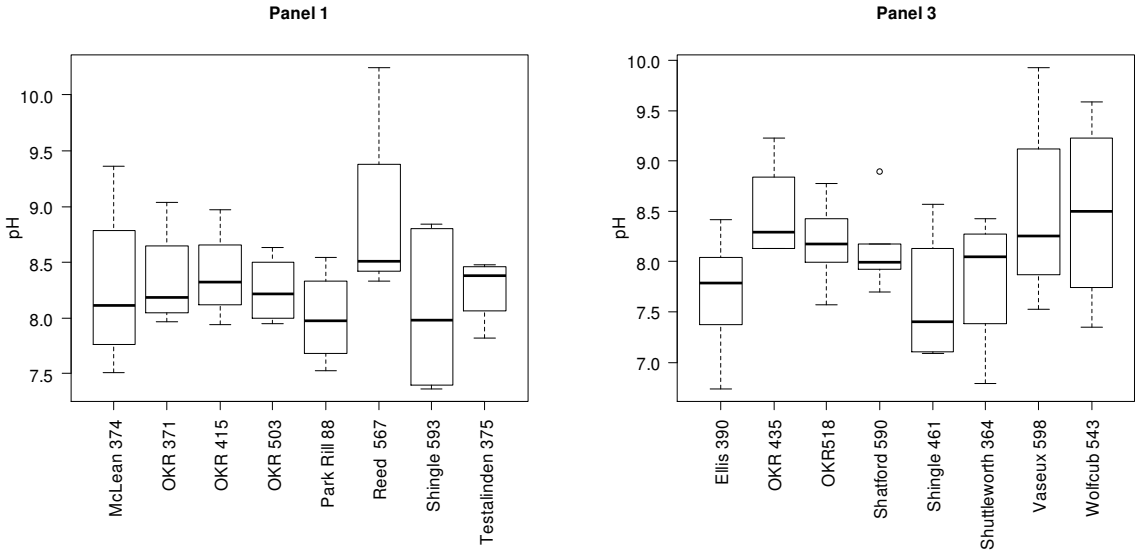

Figure 17: pH results for Panel 1 and Panel 3 sites.

[20] Averaged for the q̓awsitkʷ OBMEP sites.

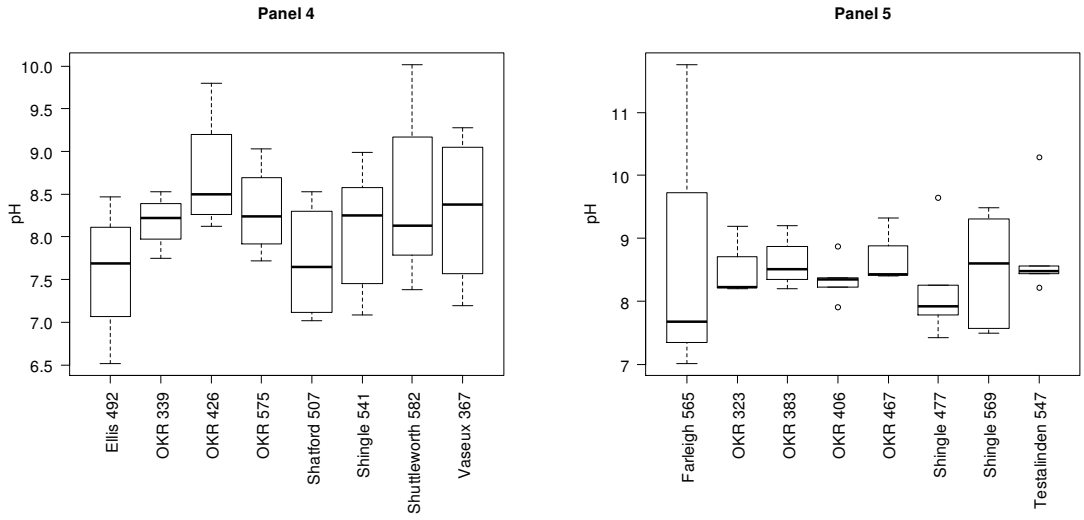

Figure 18: pH results for Panel 4 and Panel 5 sites.

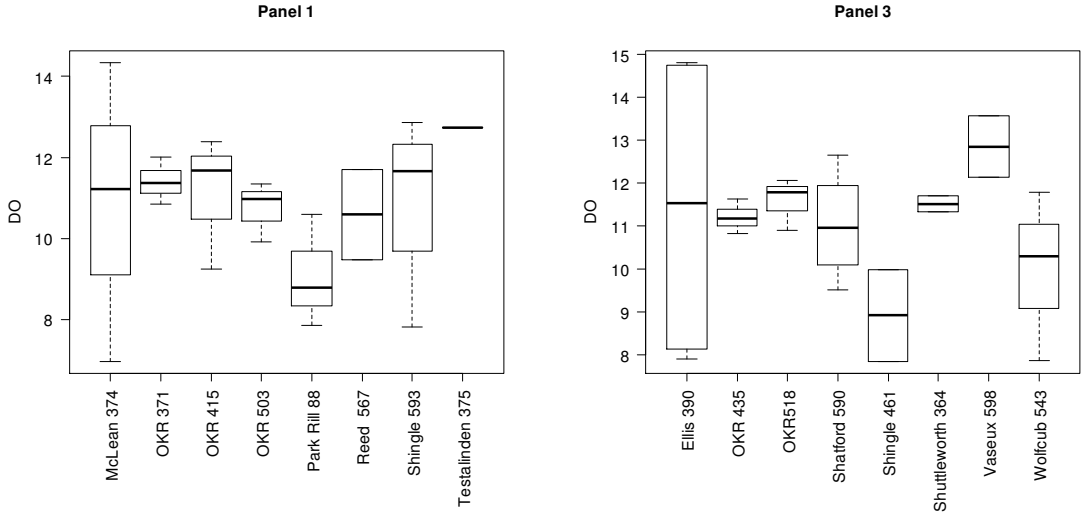

Figure 19: DO results for Panel 1 and Panel 3 sites

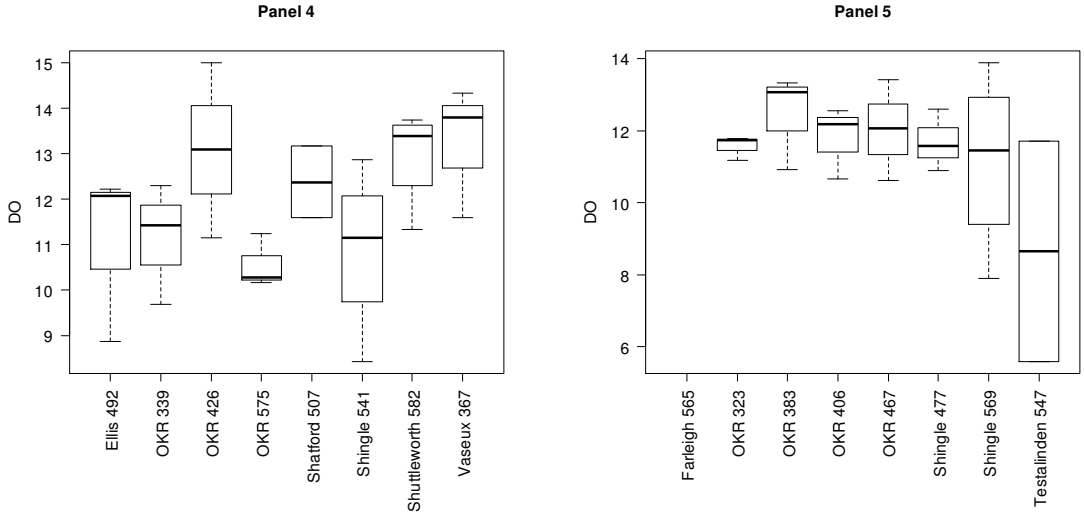

Figure 20: DO results for Panel 4 and Panel 5 sites

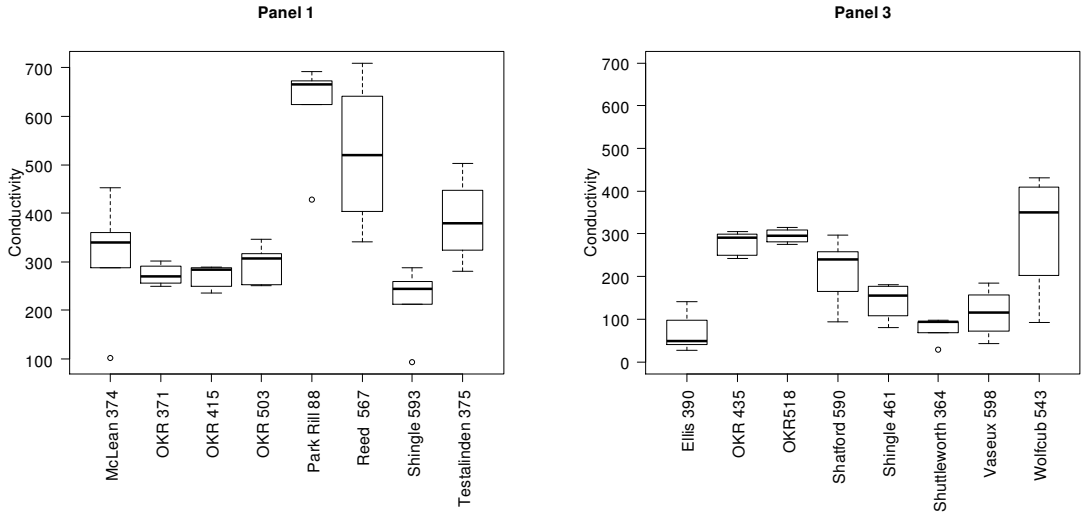

Figure 21: Conductivity results for Panel 1 and Panel 3 sites

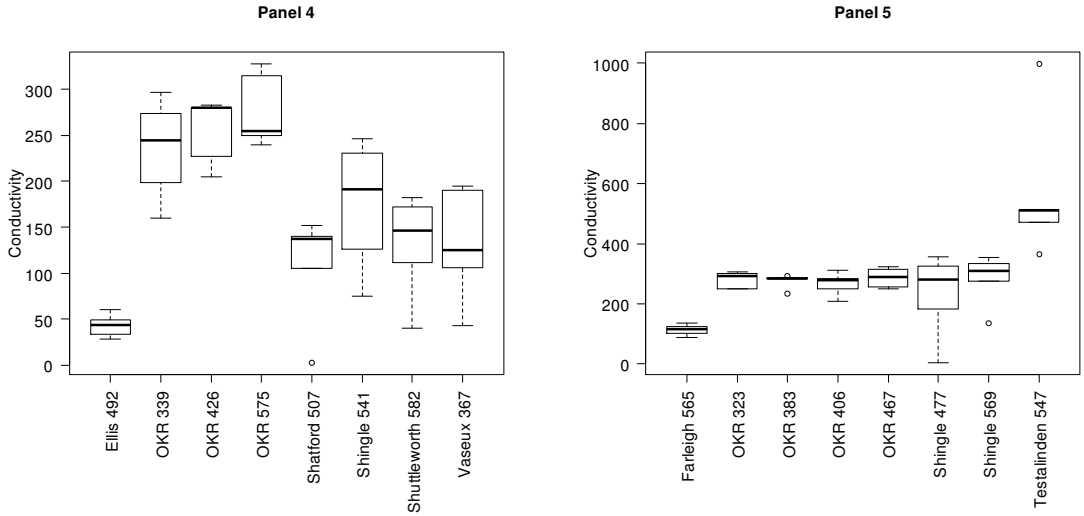

Figure 22: Conductivity results for Panel 4 and Panel 5 sites

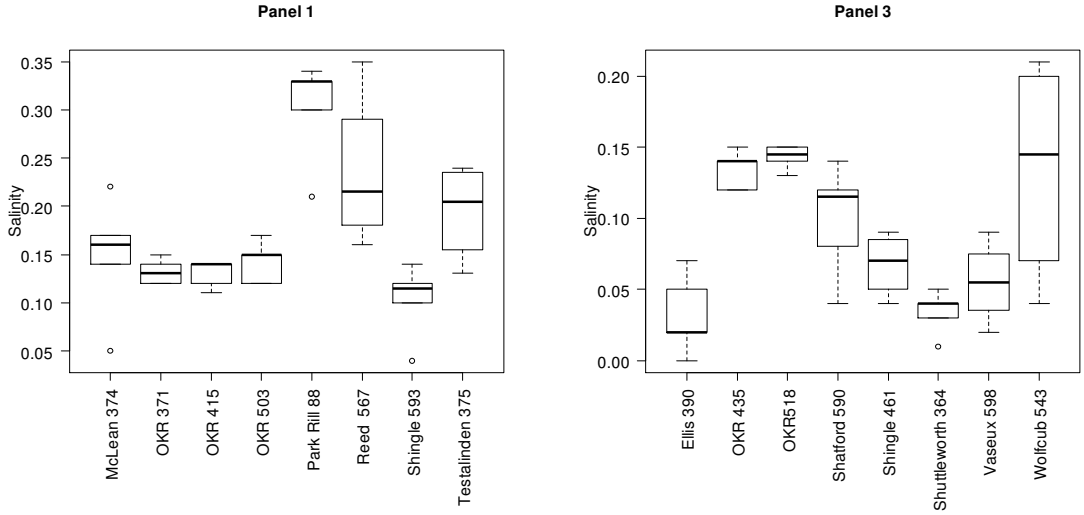

Figure 23: Salinity results for Panel 1 and Panel 3 sites

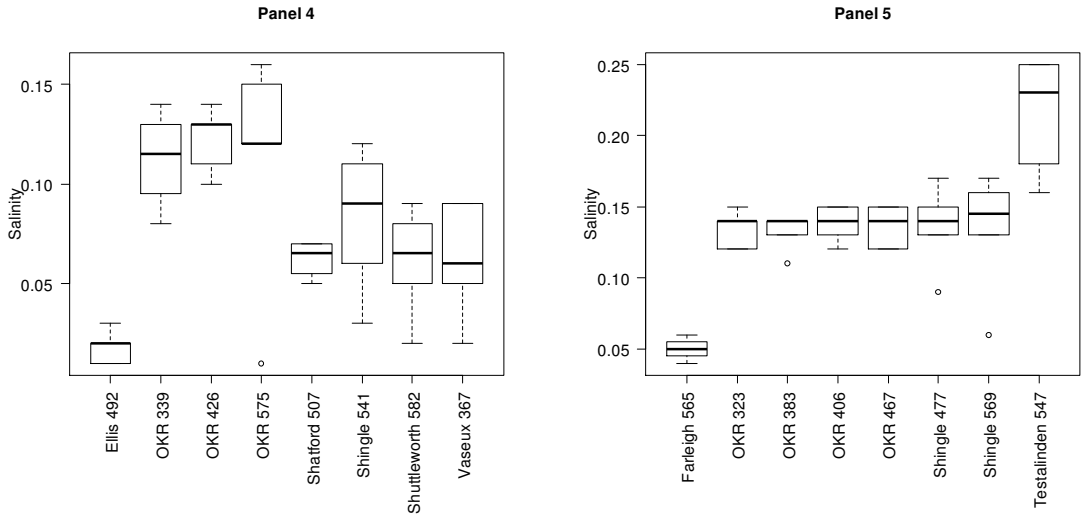

Figure 24: Salinity results for Panel 4 and Panel 5 sites

3.3 Biological surveys

Snorkel surveys were conducted in September 2011 to document the presence and abundance of juvenile and adult salmonids as well as non-salmonids. Most of the mainstem surveys were conducted on September 28th, 2011, with five snorkelers. All of the tributary surveys were conducted in September, with two snorkelers.

Salmonid species present included Rainbow Trout/Steelhead (*Oncorhynchus mykiss)*, Kokanee and Sockeye Salmon (*O. nerka*)*,* Mountain Whitefish (*Prosopium williamsoni*) and Brook Trout (*Salvelinus fontinalis*). Non-salmonid families present included bass (Centrarchidae), minnows (Cyprinidae), sculpins (Cottidae), and suckers (Catostomidae). Snorkel survey results are summarized in Appendices 9 and 10.

The benthic macroinvertebrates collection took place from late October to November 2011 with a crew of two persons. The invertebrate sample taken from each site was sent to CCT for laboratory analysis. Results from the analysis are included in Appendix 11.

4.0 DISCUSSION AND RECOMMENDATIONS

The 2011 OBMEP objectives were effectively completed for this year's anadromous salmonid physical habitat and biological study in the Canadian q̓awsitkʷ sub-basin. A detailed discussion of changes in physical habitat parameters and trends from 2005 to 2011 is currently not applicable because only seven years of data have been collected. Comparisons will be warranted after several years of sampling are completed. Ideally, long-term monitoring will incorporate different water year types and thus capture the natural variation of the system.

Recommendations for future years include:

- Continue providing land owners with information sheets detailing the study and survey schedule.
- Test the Trimble® GPS unit and its software prior to and during the OBMEP study.
- Check and download temperature data loggers pre- and post-freshet.
- Continue the present methodology for snorkel surveys in streams too shallow to snorkel.
- Continue on-going communications with the CCTFWD and Summit Environmental Consulting Ltd.
- Find a better way to get the gradient.

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APPENDICES

Appendix 1. Summary of the OBMEP sites in the Canadian portion of the Okanagan sub-basin

Annual Panel	Panel 1 (2005)	Panel 2 (2006)	Panel 3 (2007)
Okanagan River **490**	Okanagan River 371	Okanagan River 562	Okanagan River 435
Okanagan River **493**	Okanagan River 503	Shingle Upper 333	Shatford 590
Inkaneep **535**	Okanagan River415	Shatford 338	Shingle 461 (xtra p)
Vaseux **177**	Testalinden 375	Okanagan River 346	Haynes 471
Shuttleworth **522**	Reed 567	Reed 403	Ellis 390
Shingle **317**	Wolfcub 543	Inkaneep 351	Okanagan River 518
Ellis **470**	Park rill 88	Shuttleworth 538	Shuttleworth 364
McLean **374**[a]	Shingle 593	McLean 310	Vaseux 598

Panel 4 (2008)	Panel 5 (2009)	Extra Panel
Okanagan River **339**	Shingle 569	Okanagan River 319
Okanagan River **575**	Okanagan River 383	Shatford 338
Shatford **507**	Okanagan River 323	Shingle 477
Shuttleworth **582**	Testalinden 547	Okanagan River 531
Vaseux **367**	Okanagan River 467	Ellis 530
Ellis **492**	Shingle 477[b]	Shuttleworth 394
Shingle **541**	Okanagan River 406	Haynes 519
Okanagan River **426**	Farleigh creek 565	Marron Creek 450

[a]prior to 2007 Haynes 471 was an annual site, replaced later by McLean 374
[b]Shingle 477, in Panel 5, is actually within the Shatford tributary

Appendix 2. Monitoring schedule for the 20-year OBMEP project.

Panel	Year									
	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Annual	x	x	x	x	x	x	x	x	x	x
Panel 1	x					x				
Panel 2		x					x			
Panel 3			x					x		
Panel 4				x					x	
Panel 5					x					x

Panel	Year									
	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Annual	x	x	x	x	x	x	x	x	x	x
Panel 1	x					x				
Panel 2		x					x			
Panel 3			x					x		
Panel 4				x					x	
Panel 5					x					x

Note: X' denotes a physical and biological survey will be performed.

Appendix 3. OBMEP physical habitat measurements collected and recorded in the field.

Measurement	General Description	Equipment	Units
Thalweg depth	Deepest depth of a channel cross-section	stadia rod	meters
Entrenchment ratio	Entrenched, moderately entrenched, or slightly entrenched	n/a	no units
Wetted width	Width of water surface measured perpendicular to the direction of flow at a specific discharge*	stadia rod or laser ranging instrument	meters
Bankfull width	Channel width between the tops of the most pronounced banks on either side of a stream reach*	stadia rod or laser ranging instrument	meters
Bankfull heights	Vertical distance from the water surface at the wetted edge to the point of maximum flow elevation occurring on a 1.5 year cycle	stadia rod and a level	meters
Sediment	Unconsolidated, loose deposits with diameter <16 mm i.e. fine gravel, sand, silt, clay or muck	n/a	presence or absence
Habitat types	Glide, primary pool, dry, falls, small cobble riffle, large cobble riffle, pool tailout, beaver pond, rapid, or cascade	n/a	habitat type code
Mid channel bar	Width of mid channel bar if present	stadia rod or laser ranging instrument	meters
Substrate	Classify particle by its median diameter i.e. coarse gravel, boulder, bedrock. Estimate embeddedness as the average % that substrate are surrounded by fine sediments	n/a	substrate size class and embeddedness (%)
Large Woody Debris	Dead trees with diameter >0.1 m in the active channel or spanning the channel	n/a	no. of pieces of each length category (>1 m or >2 m)
Human influence	Pipes, buildings, dikes, pasture, river access site, pavement, garbage piles, cleared lots, orchards, logging or mining operations, diversion structures	n/a	presence or absence, proximity to channel
Canopy cover	Measure riparian vegetation structure in mid-channel, and facing the left and right bank	concave spherical densitometer	number of grid intersection points
Riparian vegetation	Dominant vegetation type and aerial coverage for: canopy layer, understory, and ground cover layer	n/a	vegetation type, % aerial coverage
Side channel	LWD, Thalweg, and substrate	stadia rod	units for each described above
Backwaters	Quiescent off-channel aquatic habitats i.e. sloughs, alcoves, backwater ponds, or oxbows	n/a	presence or absence
Gradients	Gradients between the transects and mid-transects (i.e. A to A1, J1 to K) collected while standing in the thalweg of the stream	Laser Technology, Inc Impulse 200™ laser ranging instrument	percentage

Note: Units are measured to the nearest 0.01m where applicable.

*Armantrout, N.B., Compiler. 1998. Glossary of Aquatic Habitat Inventory Terminology. American Fisheries Society, Bethesda, Maryland.

Appendix 4. Summary of riparian vegetation from sites surveyed in 2011 (averaged for each site).

	Present (%)									
EMAP Site Name & Number	Canopy Cover Reach (%)	Canopy Cover Bank (%)	Overstory Deciduous	Understory Deciduous	Overstory Coniferous	Understory Coniferous	Overstory Mixed	Understory Mixed	Overstory None	Understory None
Vaseux Creek 177	4	6	18	56	24	12	0	29	59	3
McLean 310	42	50	41	86	18	0	32	14	9	0
Shingle Creek 317	15	32	59	77	0	0	36	23	5	0
Shingle Upper 333	12	27	68	91	0	5	0	5	32	0
Shatford 338	26	41	77	95	0	0	0	0	23	5
Okanagan River 346	0	0	18	50	0	0	5	0	77	50
Inkaneep 351	15	36	9	91	5	0	77	9	9	0
McLean Creek 374	14	18	25	95	0	0	10	5	65	0
Reed 403	67	68	68	100	0	0	5	0	27	0
Ellis Creek 470	39	68	86	91	0	0	9	9	5	0
Okanagan River 490	19	54	91	85	0	0	0	15	9	0
Okanagan River 493	0	0	32	100	0	0	0	0	68	0
Shuttleworth Creek 522	33	64	59	77	0	5	32	18	9	0
Inkaneep Creek 535	38	59	91	100	5	0	0	0	5	0
Shuttleworth 538	17	41	41	73	23	0	27	27	9	0
Okanagan River 562	0	0	0	100	0	0	0	0	100	0

Appendix 4. Summary of riparian vegetation from sites surveyed in 2011 (averaged for each site) continued.

	Present (%)														
	Average Canopy Big Trees > 0.3 m DBH*					Average Canopy Small Trees <0.3 m DBH*					Average Understory Woody Shrubs/Saplings				
EMAP Site Name & Number	0%	<10%	10-40%	40-75%	>75%	0%	<10%	10-40%	40-75%	>75%	0%	<10%	10-40%	40-75%	>75%
Vaseux Creek 177	76	12	12	0	0	68	29	3	0	0	3	32	50	15	0
McLean 310	18	55	27	0	0	45	50	5	0	0	0	18	73	9	0
Shingle Creek 317	5	55	41	0	0	27	64	9	0	0	0	50	32	18	0
Shingle Upper 333	36	45	14	5	0	86	14	0	0	0	0	32	41	27	0
Shatford 338	50	32	14	5	0	23	27	50	0	0	5	23	41	27	5
Okanagan River 346	82	18	0	0	0	91	9	0	0	0	64	32	5	0	0
Inkaneep 351	9	18	68	5	0	45	50	5	0	0	0	9	64	27	0
McLean Creek 374	77	23	0	0	0	68	27	5	0	0	0	55	36	9	0
Reed 403	36	55	9	0	0	59	23	18	0	0	0	0	59	41	0
Ellis Creek 470	14	41	45	0	0	36	55	9	0	0	0	41	41	18	0
Okanagan River 490	15	48	30	7	0	15	23	31	31	0	0	58	35	8	0
Okanagan River 493	73	23	5	0	0	82	14	5	0	0	55	36	5	5	0
Shuttleworth Creek 522	36	36	27	0	0	23	27	50	0	0	0	27	50	23	0
Inkaneep Creek 535	14	45	41	0	0	27	59	14	0	0	0	14	68	18	0
Shuttleworth 538	45	45	9	0	0	23	36	32	9	0	0	45	41	14	0
Okanagan River 562	100	0	0	0	0	100	0	0	0	0	73	14	9	5	0

* DBH = diameter at breast height

Appendix 4. Summary of riparian vegetation from sites surveyed in 2011 (averaged for each site) continued.

	Present (%)														
	Average Understory Non-Woody Herbs/Grasses/Forbs					Average Ground Cover Woody Shrubs/Saplings					Average Ground Cover Non-Woody Herbs/Grasses/Forbs				
EMAP Site name & Number	0%	<10%	10-40%	40-75%	>75%	0%	<10%	10-40%	40-75%	>75%	0%	<10%	10-40%	40-75%	>75%
Vaseux Creek 177	32	29	32	6	0	18	74	9	0	0	85	15	0	0	0
McLean 310	0	36	27	32	5	5	64	23	9	0	82	18	0	0	0
Shingle Creek 317	5	50	32	14	0	0	55	45	0	0	50	50	0	0	0
Shingle Upper 333	14	32	32	23	0	0	59	36	5	0	55	32	14	0	0
Shatford 338	0	14	64	18	5	5	73	18	5	0	77	23	0	0	0
Okanagan River 346	0	9	64	27	0	82	9	9	0	0	9	9	45	36	0
Inkaneep 351	0	86	9	5	0	0	41	55	5	0	86	9	5	0	0
McLean Creek 374	0	9	41	36	14	5	59	27	9	0	0	27	23	45	5
Reed 403	41	55	5	0	0	0	14	73	14	0	73	27	0	0	0
Ellis Creek 470	9	73	14	5	0	0	82	18	0	0	95	5	0	0	0
Okanagan River 490	0	22	44	33	0	0	50	35	15	0	0	38	50	13	0
Okanagan River 493	0	0	23	50	27	73	27	0	0	0	0	32	55	14	0
Shuttleworth Creek 522	0	50	45	5	0	0	27	45	27	0	27	64	9	0	0
Inkaneep Creek 535	5	50	27	18	0	0	68	32	0	0	95	5	0	0	0
Shuttleworth 538	5	68	9	18	0	0	77	23	0	0	77	23	0	0	0
Okanagan River 562	0	0	23	50	27	68	14	18	0	0	0	82	18	0	0

Appendix 4. Summary of riparian vegetation from sites surveyed in 2011 (averaged for each site) continued.

	Present (%)									
	Average Ground Cover Barren Dirt/Duff					Average Ground Cover LWD				
EMAP Site Name & Number	0%	<10%	10-40%	40-75%	>75%	0%	<10%	10-40%	40-75%	>75%
Vaseux Creek 177	0	15	29	41	15	12	53	35	0	0
McLean 310	18	50	18	14	0	5	45	27	23	0
Shingle Creek 317	0	14	59	27	0	14	55	32	0	0
Shingle Upper 333	9	59	18	14	0	5	55	36	5	0
Shatford 338	0	50	32	14	5	18	50	27	5	0
Okanagan River 346	0	41	45	14	0	82	14	5	0	0
Inkaneep 351	0	36	45	14	5	0	64	36	0	0
McLean Creek 374	32	64	5	0	0	0	68	27	5	0
Reed 403	0	9	41	50	0	0	18	64	18	0
Ellis Creek 470	0	5	45	50	0	14	82	5	0	0
Okanagan River 490	48	26	13	13	0	15	85	0	0	0
Okanagan River 493	18	77	5	0	0	64	36	0	0	0
Shuttleworth Creek 522	5	59	18	18	0	5	50	36	9	0
Inkaneep Creek 535	0	50	36	9	5	0	55	41	5	0
Shuttleworth 538	0	32	14	50	5	0	64	36	0	0
Okanagan River 562	0	68	27	5	0	95	0	5	0	0

Appendix 5. Summary of human influence characteristics collected from sites surveyed in 2011 (averaged for each site).

	Average Wall/Dike/Revetment/Riprap/Dam (%)				Average Buildings (%)				Average River access sites (%)			
EMAP Site Name & Number	Bank	<10m	10-30m	None	Bank	<10m	10-30m	None	Bank	<10m	10-30m	None
Vaseux Creek 177	18	3	26	53	0	0	3	97	0	0	0	100
McLean 310	0	0	0	100	0	0	0	100	0	0	5	95
Shingle Creek 317	55	0	0	45	0	9	36	55	18	0	0	82
Shingle Upper 333	0	0	0	100	0	0	0	100	9	0	0	91
Shatford 338	0	0	0	100	0	0	0	100	18	0	0	82
Okanagan River 346	100	0	0	0	0	9	27	64	73	5	0	23
Inkaneep 351	0	0	0	100	0	0	0	100	9	0	0	91
McLean Creek 374	0	0	0	100	0	0	0	100	0	0	0	100
Reed 403	0	0	0	100	5	0	0	95	5	0	0	95
Ellis Creek 470	100	0	0	0	0	5	95	0	32	0	0	68
Okanagan River 490	5	0	0	95	9	0	18	73	22	0	0	78
Okanagan River 493	100	0	0	0	0	0	23	77	5	0	0	95
Shuttleworth Creek 522	0	0	0	100	0	5	27	68	0	0	0	100
Inkaneep Creek 535	14	0	0	86	0	0	0	100	9	5	0	86
Shuttleworth 538	0	0	0	100	0	0	0	100	0	0	0	100
Okanagan River 562	100	0	0	0	0	0	9	91	0	0	0	100

Appendix 5. Summary of human influence characteristics collected from sites surveyed in 2011 (averaged for each site) continued.

	Average pavement/Road/railroad (%)				Average Pipes (inlet/outlet) (%)				Average Garbage Piles (%)			
EMAP Site name & Number	Bank	<10m	10-30m	None	Bank	<10m	10-30m	None	Bank	<10m	10-30m	None
Vaseux Creek 177	0	18	26	56	0	0	0	100	0	0	0	100
McLean 310	0	0	36	64	0	0	23	77	14	5	5	77
Shingle Creek 317	0	14	50	36	5	0	0	95	59	0	0	41
Shingle Upper 333	0	0	0	100	0	0	0	100	5	0	0	95
Shatford 338	0	0	0	100	5	0	0	95	5	0	0	95
Okanagan River 346	55	32	9	5	23	0	0	77	32	9	0	59
Inkaneep 351	0	9	0	91	0	0	0	100	5	0	0	95
McLean Creek 374	0	0	0	100	9	0	0	91	9	0	0	91
Reed 403	0	32	14	55	27	5	0	68	45	0	0	55
Ellis Creek 470	0	82	0	18	9	0	0	91	100	0	0	0
Okanagan River 490	0	41	9	50	14	0	0	86	5	0	0	95
Okanagan River 493	0	0	100	0	18	0	0	82	27	64	0	9
Shuttleworth Creek 522	0	50	18	32	0	0	0	100	23	0	0	77
Inkaneep Creek 535	0	9	14	77	0	0	0	100	5	0	5	91
Shuttleworth 538	0	9	32	59	5	0	0	95	14	0	0	86
Okanagan River 562	0	5	95	0	23	0	0	77	27	73	0	0

Appendix 5. Summary of human influence characteristics collected from sites surveyed in 2011 (averaged for each site) continued.

	Average Cleared lot/lawn (%)				Average Orchard/Row Crops (%)				Average pasture/range/Hay Field (%)			
EMAP Site Name & Number	Bank	<10m	10-30m	None	Bank	<10m	10-30m	None	Bank	<10m	10-30m	None
Vaseux Creek 177	0	0	0	100	0	0	0	100	0	0	0	100
McLean 310	0	0	0	100	0	0	0	100	9	0	0	91
Shingle Creek 317	0	0	14	86	0	0	0	100	0	0	0	100
Shingle Upper 333	0	0	0	100	0	0	0	100	0	0	0	100
Shatford 338	0	0	0	100	0	0	0	100	0	9	41	50
Okanagan River 346	0	9	0	91	0	0	0	100	0	27	0	73
Inkaneep 351	0	0	0	100	0	0	0	100	0	0	0	100
McLean Creek 374	0	0	0	100	0	0	0	100	0	0	0	100
Reed 403	0	0	0	100	0	0	0	100	0	0	0	100
Ellis Creek 470	0	23	14	64	0	0	0	100	0	0	0	100
Okanagan River 490	9	5	0	86	0	0	33	67	0	0	0	100
Okanagan River 493	0	0	45	55	0	0	0	100	0	0	0	100
Shuttleworth Creek 522	0	5	5	91	0	0	0	100	0	14	68	18
Inkaneep Creek 535	0	0	0	100	0	0	0	100	0	0	45	55
Shuttleworth 538	0	0	0	100	0	0	0	100	0	0	0	100
Okanagan River 562	0	0	0	100	0	0	0	100	0	0	36	64

Appendix 5. Summary of human influence characteristics collected from sites surveyed in 2011 (averaged for each site) continued.

	Average Logging Operations (%)				Average Mining Activities (%)				Average Diversions (%)			
EMAP Site Name & Number	Bank	<10m	10-30m	None	Bank	<10m	10-30m	None	Bank	<10m	10-30m	None
Vaseux Creek 177	0	0	0	100	0	0	0	100	0	0	0	100
McLean 310	0	0	0	100	0	0	0	100	0	0	0	100
Shingle Creek 317	0	0	0	100	0	0	0	100	0	0	0	100
Shingle Upper 333	0	0	0	100	0	0	0	100	0	0	0	100
Shatford 338	0	0	0	100	0	0	0	100	0	0	0	100
Okanagan River 346	0	5	0	95	0	0	0	100	5	0	0	95
Inkaneep 351	0	0	0	100	0	0	0	100	0	0	0	100
McLean Creek 374	0	0	0	100	0	0	0	100	0	0	0	100
Reed 403	0	0	0	100	0	0	0	100	9	5	0	86
Ellis Creek 470	0	0	0	100	0	0	0	100	0	0	0	100
Okanagan River 490	0	0	0	100	0	0	0	100	14	0	0	86
Okanagan River 493	0	0	0	100	0	0	0	100	0	0	0	100
Shuttleworth Creek 522	0	0	0	100	0	0	0	100	0	0	0	100
Inkaneep Creek 535	0	0	0	100	0	0	0	100	0	0	0	100
Shuttleworth 538	0	0	0	100	0	0	0	100	0	0	0	100
Okanagan River 562	0	0	0	100	0	0	0	100	0	0	0	100

Appendix 9. Summary of snorkel survey data for salmonids collected in 2011.

	Site Name and Salmonid Fish Abundance 2011															
Size Class	Okanagan 490	Okanagan 493	McLean 374*	Inkaneep 535	Vaseux 177	Shuttle-worth 522	Shingle 317	Ellis 470	McLean 310	Shingle Upper 333	Shatford 338	Okanagan River 346	Inkaneep 351	Shuttleworth 538	Okanagan River 562	Reed 403
Salmonids	46	3	140	102	229	1	5	0	40	3	24	2	13	59	6	
<100 mm	0	0	38	55	135	0	3	0	0	3	16	0	0	29	3	
100 - 300 mm	2	2	101	47	92	1	2	0	36	0	8	0	13	30	2	
>300 mm	44	1	1	0	2	0	0	0	4	0	0	2	0	0	1	
Rainbow/Steelhead																
<100 mm			38	46	135		3			3	16			29		
100 – 300 mm	2	1	101	38	92	1	2		36		8		7	30	1	
>300 mm	1		1		2				4						1	
Brook Trout																
<100 mm				9												
100 – 300 mm				9									6			
>300 mm																
Sockeye																
<100 mm																
100 – 300 mm																
>300 mm	13											2				
Kokanee																
<100 mm															3	
100 – 300 mm		1													1	
>300 mm		1														
Whitefish																
<100 mm																
100 – 300 mm																
>300 mm	30															

*Reed not surveyed

Total Salmonids	673

Appendix 10. Summary of snorkel survey data for non-salmonids collected in 2011.

	Site Name and Non-Salmonid Fish Abundance 2011															
Size Class	Okanagan 490	Okanagan 493	McLean 374*	Inkaneep 535	Vaseux 177	Shuttle-worth 522	Shingle 317	Ellis 470	McLean 310	Shingle Upper 333	Shatford 338	Okanagan River 346	Inkaneep 351	Shuttle-worth 538	Okanagan River 562	Reed 403
Non-Salmonids	30	29	0	21	0	10	139	19	4	0	0	114	0	8	101	
<100 mm	9	4	0	1	0	0	137	19	2	0	0	0	0	6	61	
100 – 300 mm	2	5	0	20	0	10	2	0	2	0	0	2	0	2	1	
>300 mm	19	20	0	0	0	0	0	0	0	0	0	112	0	0	39	
Bass																
<100 mm	9	3													61	
100 – 300 mm	2											2				
>300 mm												2				
Suckers																
<100 mm																
100 – 300 mm																
>300 mm		19										102			34	
Carp*																
<100 mm																
100 – 300 mm																
>300 mm	19	1										3			3	
Dace*																
<100 mm							136	19						6		
100 – 300 mm						10	2		2					2	1	
>300 mm																
Minnows*																
<100 mm		1														
100 – 300 mm		5														
>300 mm												5			2	
Sculpins																
<100 mm				1												
100 – 300 mm																
>300 mm																
Unidentified/Other																
<100 mm							1		2							
100 – 300 mm				20												
>300 mm																

*Carp, Dace, Minnow and Peamouth all part of the larger Minnow Family Cyprinidae

Total Non - Salmonids	475

Appendix 11. Summary of invertebrate data collected in 2011.

	PARAMETER							
EMAP Sites	**Total # of taxa**	**Number of Plecoptera (stonefly) taxa**	**Number of Ephemeroptera (mayfly) taxa**	**Number of Trichoptera (caddisfly) taxa**	**Number of intolerant taxa**	**Number of clinger taxa**	**B-IBI score[1]**	**Stream Condition**
Vaseux Creek 177	15	3	7	3	10	10	21	Good
McLean 310	14	2	4	3	6	9	15	Fair
Shingle Creek 317	20	1	7	4	8	12	21	Good
Shingle Upper 333	-	-	-	-	-	-	-	-
Shatford 338	19	5	7	1	8	11	23	Excellent
Okanagan River 346	4	0	1	1	0	0	5	Very Poor
Inkaneep 351	16	2	8	3	8	12	21	Good
McLean Creek 374	15	2	3	4	5	8	17	Fair
Reed 403	5	2	1	1	2	4	9	Poor
Ellis Creek 470	11	1	3	3	4	7	15	Fair
Okanagan River 490	9	0	4	1	1	6	11	Poor
Okanagan River 493	9	0	1	3	0	4	5	Very Poor
Shuttleworth Creek 522	4	0	1	0	1	1	7	Very Poor
Inkaneep Creek 535	17	5	5	4	8	13	23	Excellent
Shuttleworth 538	3	0	2	1	2	2	9	Poor
Okanagan River 562	4	0	1	0	0	0	5	Very Poor

Note: Upper Shingle 333 was not measured because it was dry

1 Based on Jensen (2006)