Lawyer Creek and Tributaries, Idaho
Water Quality Monitoring Project 2014

Prepared by: Ken Clark, Nez Perce Tribe Water Resources Division
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Technical Results Summary
KPC-LWRC-14

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Acronyms and Abbreviations

BMPs	Best Management Practices
BOR	Bureau of Reclamation
C	Celsius
cfs	Cubic feet per second
cm	centimeter(s)
CWA	Clean Water Act
CWAL	Cold Water Aquatic Life
IDEQ	Idaho Department of Environmental Quality
DO	Dissolved Oxygen
EPA	Environmental Protection Agency
GIS	Geographical Information Systems
HUC	Hydrologic Unit Code
IDAPA	Idaho Administrative Procedure Act
mg/L	milligrams per liter
NH_3	Ammonium
NO_2+NO_3	Nitrate-Nitrite
NRCS	Natural Resources Conservation Service
OP	Ortho Phosphorus
QA/QC	Quality assurance/quality control
SCC	Soil Conservation Commission
SWCD	Soil and Water Conservation District
TDS	Total Dissolved Solids
TMDL	Total Maximum Daily Load
TP	Total Phosphorus
TSS	Total Suspended Solids
WAG	Watershed Advisory Group

Introduction

The Nez Perce Tribe (Tribe) is a federally recognized Indian Tribe with an aboriginal territory of more than 13 million acres extending from northeastern Oregon and southeastern Washington, through north-central Idaho, to southwestern Montana. The Tribe's 1855 treaty with the United States acknowledged and guaranteed a variety of retained off-reservation fishing, hunting, and gathering rights. The current Nez Perce Tribal Reservation is approximately 770,483 acres in size, and many tribal members continue to practice a subsistence-based lifestyle to this day. Clean water is valued for its cultural, spiritual, and economic uses, and the Tribe has a vested interest in protecting the quality of water both on Reservation and throughout the Clearwater, Snake, and Columbia River Basins.

The Tribe's Water Resources Division (WRD) applied for and received Treatment in a Manner Similar to a State (TAS) to implement the Clean Water Act §106 Water Quality Monitoring Program in 1990. In 1999, the WRD began collecting water quality data for Reservation waterbodies. Table 1 displays an Atlas of Tribal water resources found within the boundaries of the Reservation of 1863.

Table 1. Atlas of Tribal Water Resources

Topic	Value
Reservation Area (acres)	770,483
Reservation Population (persons)	17,959
Number of watersheds within or intersecting the reservation boundary	19
Total Miles of Rivers and Streams - *Miles of perennial streams* - *Miles of intermittent streams (does not include unnamed streams)*	1,590 *602** *85**
Number of Lakes/Reservoirs/Ponds	8
Acres of Lakes/Reservoirs/Ponds	2,883

*the remaining stream miles are unknown for perennial vs. intermittent

Water Quality Monitoring Program and Assessment Methodology

The purpose of the Nez Perce Tribal water quality monitoring and assessment program is to determine whether water quality criteria are being met and designated uses are being supported in waterbodies across the reservation.

Establishing a baseline of water quality condition for all reservation waters and periodically reassessing the water quality to look at trends are important program objectives, as is utilizing water quality data to identify waters in need of pollutant reduction projects.

Water Quality Limited Segments

The Clean Water Act (CWA) requires restoration and maintenance of the chemical, physical, and biological integrity of the nation's water (Public Law 92-500 Federal Water Pollution Control Act Amendments of 1972). Section §303(d) of the CWA establishes requirements for states and tribes to identify and prioritize waterbodies that are water quality limited (i.e., do not meet water quality standards). Lawyer Creek was listed on the state of Idaho's 1994 §303(d) list for bacteria, dissolved oxygen (DO), flow alteration, habitat alteration, ammonia, oil and grease, nutrients, sediment, and temperature.

Sampling Protocols

The WRD staff has a Quality Assurance Project Plan (QAPP) which has been reviewed and approved by the US Environmental Protection Agency (EPA). WRD staff follows methods and protocols found in the USGS *National Field Manual for the Collection of Water Quality Data* (TWRI Book 9, 1999-2004) when collecting water quality data in Reservation waters.

Approximately four liters of stream water were collected at each site, using a DH-81 depth-integrating suspended-sediment sampler. The samples were collected and transferred into a 2.5-gallon polyethylene churn splitter. The polyethylene churn splitter was rinsed with ambient water at each location prior to sample collection. The resultant composite sample was thoroughly homogenized before filling the appropriate sample containers. Water quality samples (TSS, NO_3+NO_2, NH_3, and TP) were then shipped to Boise, ID overnight to be analyzed at the Bureau of Reclamation (BOR) Pacific Northwest Regional Laboratory.

Bacteriological samples (*E. coli*) were collected directly from the thalweg into sterile sample containers. These samples were also shipped to Boise, ID overnight to be analyzed at the BOR Pacific Northwest Regional Laboratory. Most probable number (MPN) multiple tube fermentation was used to determine *E. coli* levels in the water sample.

A list of parameters, sample sizes, preservation, holding times, and analytical methods is displayed in Table 2. All sample containers were labeled with waterproof markers with the following information: station location, sample identification, date of collection, and time of collection. Samples were placed on ice and shipped to the laboratory the same day as collection. Chain-of-custody forms accompanied each sample shipment.

Table 2. Water Quality Parameters.

Parameters	Sample Size	Preservation	Holding Time	Method
Total Suspended Solids (TSS)	1 qt cubitainer	Store at 4°C	7 days	2540 D
Nitrogen Components: Nitrate+Nitrite (NO_3+NO_2) Ammonia (NH_3)	1 qt cubitainer	Cool 4°C, H_2SO_4 pH < 2	28 Days	EPA 353.2 EPA 350.1
Total Phosphorus (TP)	100 mL	Cool 4°C, H_2SO_4 pH < 2	28 Days	EPA 365.4
Ortho-phosphate (OP)	100 mL	Store at 4°C	48 Hours	EPA 365.1-PF
Escherichia coli (*E. coli)*	100 mL	Cool 4°C	30 Hours	MPN

Field Measurements

At each location, dissolved oxygen, specific conductance, pH, temperature, and turbidity were measured in the field. Calibration of all field equipment was in accordance with the manufacturer's specifications. Field measurement parameters, equipment, and calibration techniques are shown in Table 3.

Table 3. Field Measurements.

Parameters	Instrument	Calibration
Dissolved Oxygen	YSI Model 556 MPS	Ambient air calibration
Temperature	YSI Model 556 MPS	Centigrade thermometer
Specific Conductance	YSI Model 556 MPS	Specific Conductance (25°C standard)

Parameters	Instrument	Calibration
pH	YSI Model 556 MPS	Standard buffer (7,10) bracketing for linearity
Turbidity	Hach Model 2100P	Formazin Primary Standard

All field measurements were recorded in a field notebook along with pertinent observations about the site, including weather conditions, flow rates, personnel on site, and any problems observed that might affect water quality. Hourly measurements of water temperature were collected at all sites from May through October, using Onset Water Temperature Pro v2 Data Loggers.

Flow Measurements

Flow measurements were taken at each site using a Marsh McBirney Flow Mate Model 2000 flow meter. The six-tenths depth method (0.6 of the total depth from the surface of the water surface) was used. A transect line was established at each monitoring station, across the width of the stream at an angle perpendicular to the flow, for the calculation of cross-sectional area. Discharge was computed by summing the products of the partial areas (partial sections) of the flow cross-sections and the average velocities for each of those sections. Stream discharge was reported as cubic feet per second (cfs).

Quality Assurance and Quality Control (QA/QC)

The BOR Pacific Northwest Regional Laboratory utilizes methods approved and validated by the EPA. A method validation process, including precision and accuracy performance evaluations and method detection limit studies, is an element of the BOR Pacific Northwest Regional Laboratory Standard Methods. Method performance evaluations include quality control samples analyzed with a batch to ensure sample data integrity. Internal laboratory spikes and duplicates are part of the BOR Pacific Northwest Regional Laboratory's quality assurance program. Laboratory QA/QC results generated from this project can be provided upon request.

QA/QC procedures from the field-sampling portion of this project included a duplicate sample and a blank sample (one set per sampling event). The field blanks consisted of laboratory-grade deionized water, transported to the field and poured off into the appropriate sample containers. The blank sample was used to determine the integrity of the field team's handling of samples, the condition of the sample containers and deionized water supplied by the laboratory, and the accuracy of the laboratory methods. Duplicate samples were obtained by filling two sets of sample containers with homogenized composite water from the same sampling site. The duplicate and blank samples were not identified as such to laboratory personnel to ensure laboratory precision.

Data Handling

All of the field data and analytical data generated from each survey were reviewed in the WRD office by both field staff and the Water Quality Program Coordinator. These duplicate internal reviews ensure that all necessary observations, measurements, and analytical results were properly recorded. The analytical results were evaluated for completeness and accuracy. Any suspected errors were investigated and resolved, if possible. The data were then stored electronically and made available to interested entities upon request.

Lawyer Creek Monitoring Overview

In 2014, the WRD §106 staff collected water quality data from six different streams in the Lawyer Creek watershed. Monitoring sites were established at or near the mouth of each respective creek, with additional monitoring sites being established in the headwaters of the largest tributary to Lawyer Creek (Willow Creek), as well as at several additional locations on the mainstem of Lawyer Creek itself (Figure 1). The total sum of stream miles located upstream of the monitoring stations within Reservation boundaries is approximately 260 miles, or sixteen percent of the 1,590 total stream miles located within the exterior boundaries of the Reservation.

This monitoring program was initiated to evaluate water quality in the Lawyer Creek watershed. Water quality monitoring was previously conducted in the Lawyer Creek watershed by Idaho Association of Soil Conservation District (IASCD) staff in 2008. Monitoring sites that were established during the 2008 monitoring effort were revisited, when possible. Monitoring was conducted monthly from January 2014 to August 2014. Due to personnel issues, monitoring was not conducted in June or July of 2014.

This report reviews monitoring results for the following parameters at all monitoring locations:

-Total Phosphorus (TP)
-Orthophosphorus (OP)
-Bacteria (Escherichia coli)
-Nitrogen Components—NO3+NO2; NH3
-Total Suspended Sediment (TSS)
-Instantaneous Water Temperature
-Continuous Water Temperature
-Turbidity
-Dissolved Oxygen (DO)
-Percent (%) Saturation
-Specific Conductance

The Bureau of Reclamation (BOR) Pacific Northwest Regional Laboratory, in Boise Idaho, conducted all inorganic parameter testing and bacteria analysis. WRD field staff performed all other measurements.

Monitoring Site Descriptions

Water quality monitoring was previously conducted by Idaho Association of Soil Conservation District (IASCD) staff in the Lawyer Creek watershed in 2008. Monitoring sites that were established during that monitoring effort were revisited, when possible, for the sake of consistency, and in order to perform a trend analysis with the data.

1. 03901 A: Located on Lawyer Creek, near mouth (46° 13'27.49"N, 116° 1'16"W).
2. 03904 A: Located on Lawyer Creek, above confluence with Sevenmile Creek (46°12'27.85"N, 116° 4'59.31"W).
3. 03916 A: Located on Lawyer Creek, at HWY 162 crossing (46° 9'44.32"N, 116°14'23.85"W).
4. 03926 A: Located on Lawyer Creek, just upstream of HWY 95 crossing (46°11'38.67"N, 116°24'29.38"W).
5. 03936 A: Located on Lawyer Creek, just below Icicle Flats Road (46° 6'42.82"N, 116°28'48.63"W).
6. 03941 A: Located on Lawyer Creek, near headwaters (46° 3'21.95"N, 116°31'4.82"W).
7. 10201 A: Located on John Dobbs Creek, near mouth (46°12'4.36"N, 116°25'9.50"W).
8. 09303 A: Located on Willow Creek, near mouth (46° 7'41.90"N, 116°30'38.98"W).
9. 09304 A: Located on Willow Creek, near headwaters (46° 6'44.17"N, 116°32'8.60"W).
10. 05003 A: Located on Meadow Creek, east of Ferdinand (46° 8'30.18"N, 116°20'43.44"W).
11. 10301 A: Located on an unnamed perennial tributary to Lawyer Creek, near mouth (46° 7'25.89"N, 116°27'11.96"W).
12. 06901 A: Located on Sevenmile Creek, near mouth (46°12'26.91"N, 116° 4'19.65"W).

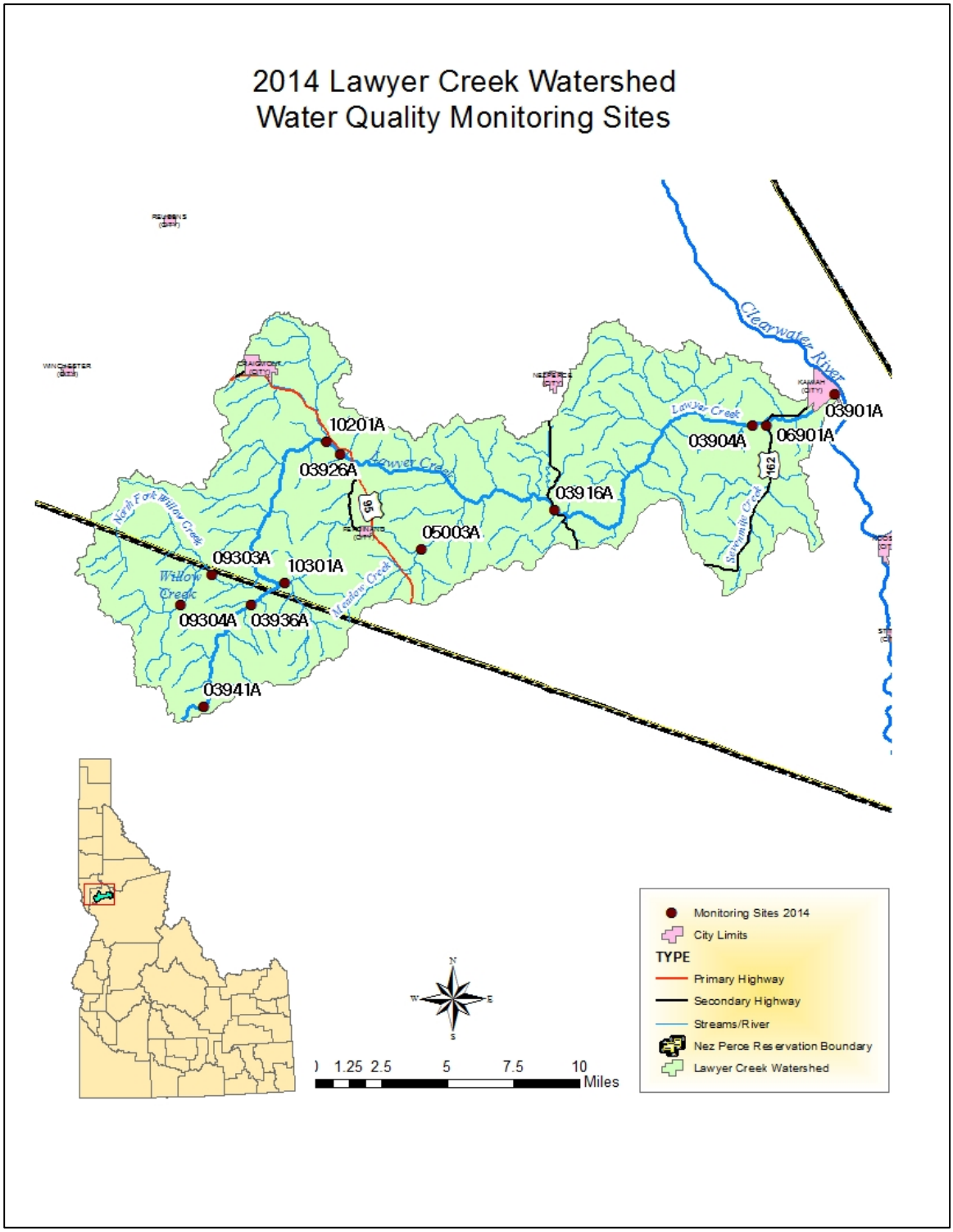

Figure 1. Lawyer Creek Monitoring Sites, 2014

Lawyer Creek Watershed Description

Lawyer Creek is a 137,000 acre watershed that ranges in elevation from 5,730 feet at the headwaters to an elevation of 1,320 feet where it enters the Clearwater River. The watershed is quite narrow, averaging 7 miles wide (north to south) along its approximately 35-mile east-to-west length. Channel density is very high, averaging 3-4 miles of stream per square mile of drainage area. Tributaries tend to be straight, steep, and enter the main channel at approximately right angles. As a result of the narrow basin shape and high stream density, most of the watershed is within 400 feet of a stream channel. Habitat has been rated as poor, but has high potential for habitat restoration (Bureau of Land Management, 2000).

The upper reaches of Lawyer Creek flow through approximately 12-miles of dryland farms, woodlots, and pasturelands grazed by livestock. The upper reaches are moderately sloped with rolling hills, although some steeper slopes are associated with Cottonwood Butte near the headwaters. The creek enters a small canyon near the Nez Perce Reservation boundary, which gets larger as it flows the 30 miles toward its confluence with the Clearwater River. The canyon walls are steeply sloped while the valley bottom ranges from moderately confined in the upper canyon to 100 to 400 feet wide in the mid and lower canyon. The prairie and plateau areas adjacent to Lawyer Creek canyon consist primarily of dryland farming operations. The Lawyer Creek drainage is in overall poor to fair condition as a result of degradation from agricultural activities, grazing, road construction, and logging.

Climate

The Lawyer Creek watershed is characterized by winter rains and rain-on-snow runoff events. The climate is sub-humid, with cool moist winters and warm dry summers. The average annual precipitation for the drainage ranges from 20 to 25 inches, with over 30 inches falling in the Cottonwood Butte area.

Fisheries

Lawyer Creek provides spawning and rearing habitat for A-run steelhead trout, which are part of the Snake River Basin Steelhead Distinct Population. Kucera and Johnson (1983) identified a potential barrier to fish passage that is located at approximately stream mile 26 in a steep gorge area. This area contains many cascading waterfalls of up to seven foot vertical drops. Bull trout use of this creek has not been documented, but Coho salmon have been found in the lower reaches of Lawyer Creek (Chandler, 2009). Other fish reported as occurring in Lawyer Creek include pikeminnow, chiselmouth, bridgelip sucker, speckled dace, and paiute sculpin (Kucera et. al.1983; Chandler, 2009). The primary limiting factors for fish production include low flows, high summer water temperatures, poor pool/ riffle ratios, lack of good quality pools, and lack of instream cover.

Table 1. General spawning and incubation periods for select salmonids found in the Clearwater River and its tributaries.

	Spawning and Incubation Periods in the Lawyer Creek Watershed											
Salmonid Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Steelhead/Rainbow Trout		✓	✓	✓	✓							
Coho Salmon										✓	✓	✓

Land Uses/Ownership

More than 90% of the watershed is privately owned and over 80% of the watershed falls within the boundaries of the Nez Perce Indian Reservation. The predominant land use in the catchment is agriculture, with about 95,000 acres in cropland, which constitutes 70% of the watershed. The major crops grown are winter wheat and spring cereal grains. Other important crops are spring peas, lentils, canola, and bluegrass. Timber harvest has primarily occurred in the headwater areas and canyon lands. Forested areas currently comprise only nine percent of the land in the watershed. Grazing occurs throughout the watershed, with the majority of rangeland grazing occurring in the canyon lands, and pastured cattle being found in the meadows located closer to the headwaters. Approximately 20,000 acres, or 15% of the watershed, is classified as rangeland.

Applicable Criterion/Standards and Analysis Techniques

The data were analyzed, and descriptive statistics such as maximum, minimum, median, and mean values for each parameter measured were determined. The number of exceedances was calculated based on the number of sampling events whose respective values exceeded water quality targets or criteria.

The Nez Perce Tribe does not have approved water quality standards, so target criteria for this water quality assessment are based upon a combination of EPA guidelines, literature review, and State of Idaho water quality standards.

All of the waterbodies in this assessment had the designated beneficial uses of:

-Salmonid Spawning (SS)
-Cold Water Aquatic Life (CWAL)
-Primary Contact Recreation (PCR) **The Tribe has designated all water bodies as Primary Contact Recreation (Resolution #NP03-136).*
-Agricultural and industrial water supply
-Wildlife habitat
-Aesthetics

Table 4 shows the first three beneficial uses on the list above, along with some associated numeric criteria used to evaluate the support status of these water bodies.

Table 4. Pollutant targets used to measure exceedances.

Parameter	Designated Use	Benchmarks/ Criteria	Citation
pH	All	pH between 6.5 and 9.5	(Idaho State Legislature, 2014)
Temperature	SS	13 ˚C or less daily maximum; 9 ˚C or less daily average	(Idaho State Legislature, 2014)
	CWAL	22 ˚C or less daily maximum; 19 ˚C or less daily average	
Dissolved Oxygen	SS	>8.0 mg/L and 90% of saturation	(US EPA, 1986)
	CWAL	>8.0 mg/L	
Total Suspended Solids	All	≤ 25 mg/L above background for short-term (e.g. <24 hours)	(DFO, 2000)
Ammonia	All	$CMC = \frac{0.275}{1+10^{7.204-pH}} + \frac{39.0}{1+10^{pH-7.204}}$	(Idaho State Legislature, 2014)
Total Phosphorus	All	0.1 mg/L	(US EPA, 1986)
NO_3+NO_2	All	0.3 mg/L	(Cline, 1973)
E. coli	PCR	406 organisms/ 100 mL instantaneous; 126 organisms/ 100 mL geometric mean	(Nez Perce Tribe, 2002)

SS: Salmonid Spawning; CWAL: Cold Water Aquatic Life; PCR: Primary Contact Recreation; NTU: nephelometric turbidity units; CMC = Acute Criterion Maximum Concentration (one hour average is not to exceed value)

Data Analysis Results

Lawyer Creek mainstem (03901A, 03904A, 03916A, 03926A, 03936A, 03941A).

The tables below present descriptive statistics for data collected from the six monitoring stations located on the main stem of Lawyer Creek.

Table 5. Descriptive statistics for Lawyer Creek at mouth (03901A), 2014.

03901A: Lawyer Creek mouth	Temp (oC)	D.O. (mg/L)	pH (H+)	E-Coli (coli/100mL)	NO_3+NO_2 (mg/L)	OP (mg/L)	TP (mg/L)	TSS (mg/L)	Flow (cfs)
Maximum	21.11	14.32	8.72	547.50	1.93	0.22	0.64	61.00	280.18
Minimum	2.18	10.12	6.90	1.00	0.02	0.06	0.09	3.00	2.27
Mean	8.19	12.51	7.99	106.56	1.08	0.11	0.19	13.71	81.58
Median	5.50	12.47	7.97	24.10	1.28	0.09	0.12	6.00	69.07
# exceedance	1.0	0.0	0.0	1.00	4.0	2.0	5.0	1.0	
% exceedance	14.3%	0.0%	0.0%	14.3%	66.7%	28.6%	71.4%	14.3%	
# sampling events	7	7	7	7	6	7	7	7	7

Table 6. Descriptive statistics for Lawyer Creek above Sevenmile Creek (03904A), 2014.

03904A: Lawyer Creek, above Sevenmile Cr.	Temp (oC)	D.O. (mg/L)	pH (H+)	E-Coli (coli/100mL)	NO_3+NO_2 (mg/L)	OP (mg/L)	TP (mg/L)	TSS (mg/L)	Flow (cfs)
Maximum	14.30	14.56	8.36	8.50	1.87	0.13	0.21	20.00	87.85
Minimum	2.03	10.49	7.55	1.00	0.07	0.05	0.08	4.00	7.72
Mean	7.19	12.31	8.06	4.45	0.91	0.09	0.12	7.80	45.80
Median	6.31	12.00	8.16	4.15	1.05	0.08	0.11	5.00	57.80
# exceedance	1.0	0.0	0.0	0.00	3.0	1.0	3.0	0.0	
% exceedance	20.0%	0.0%	0.0%	0.0%	60.0%	20.0%	60.0%	0.0%	
# sampling events	5	5	5	4	5	5	5	5	5

Table 7. Descriptive statistics for Lawyer Creek at HWY 162 crossing (03916A), 2014.

03916A: Lawyer Creek @ HWY 162	Temp (oC)	D.O. (mg/L)	pH (H+)	E-Coli (coli/100mL)	NO_3+NO_2 (mg/L)	OP (mg/L)	TP (mg/L)	TSS (mg/L)	Flow (cfs)
Maximum	20.20	14.28	8.90	248.10	1.47	0.12	0.21	10.00	140.05
Minimum	0.50	10.10	7.86	11.00	0.03	0.02	0.06	4.00	1.90
Mean	8.44	12.06	8.36	82.42	0.66	0.07	0.12	7.00	45.72
Median	6.52	12.29	8.38	35.75	0.45	0.07	0.12	7.00	29.09
# exceedance	1.0	0.0	0.0	0.00	3.0	2.0	3.0	0.0	
% exceedance	16.7%	0.0%	0.0%	0.0%	50.0%	33.3%	50.0%	0.0%	
# sampling events	6	6	6	6	6	6	6	6	6

Table 8. Descriptive statistics for Lawyer Creek at HWY 95 crossing (03926A), 2014.

03926A: Lawyer Creek near HWY 95	Temp (oC)	D.O. (mg/L)	pH (H+)	E-Coli (coli/100mL)	NO_3+NO_2 (mg/L)	OP (mg/L)	TP (mg/L)	TSS (mg/L)	Flow (cfs)
Maximum	22.00	13.03	8.78	365.40	1.15	0.14	0.18	19.00	71.50
Minimum	0.01	10.03	7.43	3.10	0.03	0.02	0.07	2.00	0.92
Mean	8.89	11.47	8.26	131.60	0.42	0.07	0.11	9.33	28.28
Median	7.43	11.37	8.35	21.85	0.24	0.06	0.09	7.50	21.58
# exceedance	1.0	0.0	0.0	0.00	3.0	1.0	3.0	0.0	
% exceedance	16.7%	0.0%	0.0%	0.0%	50.0%	16.7%	50.0%	0.0%	
# sampling events	6	6	6	6	6	6	6	6	6

Table 9. Descriptive statistics for Lawyer Creek at Icicle Flats (03936A), 2014.

03936A Lawyer Creek @ Icicle Flats	Temp (oC)	D.O. (mg/L)	pH (H+)	E-Coli (coli/100mL)	NO_3+NO_2 (mg/L)	OP (mg/L)	TP (mg/L)	TSS (mg/L)	Flow (cfs)
Maximum	17.80	12.01	7.76	240.00	0.16	0.08	0.16	16.00	16.22
Minimum	0.20	9.18	6.72	8.40	0.03	0.02	0.06	4.00	0.38
Mean	5.82	11.02	7.19	97.22	0.10	0.04	0.09	10.00	7.65
Median	4.39	11.41	7.29	34.50	0.10	0.03	0.08	9.00	4.84
# exceedance	1.0	0.0	0.0	0.00	0.0	0.0	1.0	0.0	
% exceedance	20.0%	0.0%	0.0%	0.0%	0.0%	0.0%	20.0%	0.0%	
# sampling events	5	5	5	5	3	5	5	5	5

Table 10. Descriptive statistics for Lawyer Creek near headwaters (03941A), 2014.

03941A Lawyer Creek Headwaters	Temp (oC)	D.O. (mg/L)	pH (H+)	E-Coli (coli/100mL)	NO_3+NO_2 (mg/L)	OP (mg/L)	TP (mg/L)	TSS (mg/L)	Flow (cfs)
Maximum	19.50	10.71	7.64	131.70	0.11	0.04	0.09	15.00	2.13
Minimum	5.50	7.38	6.83	7.50	0.02	0.01	0.07	9.00	0.41
Mean	12.74	9.15	7.12	54.70	0.05	0.02	0.08	11.75	1.43
Median	12.97	9.26	7.01	24.90	0.02	0.02	0.07	11.50	1.76
# exceedance	1.0	1.0	0.0	0.00	0.0	0.0	0.0	0.0	
% exceedance	25.0%	25.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	
# sampling events	4	4	4	3	3	4	4	4	3

2014 mainstem Lawyer Creek monitoring summary:

- Instantaneous temperature exceedances were documented at all sites, with most of the exceedances occurring in May, which represents the end of the salmonid spawning period (Figure 2).

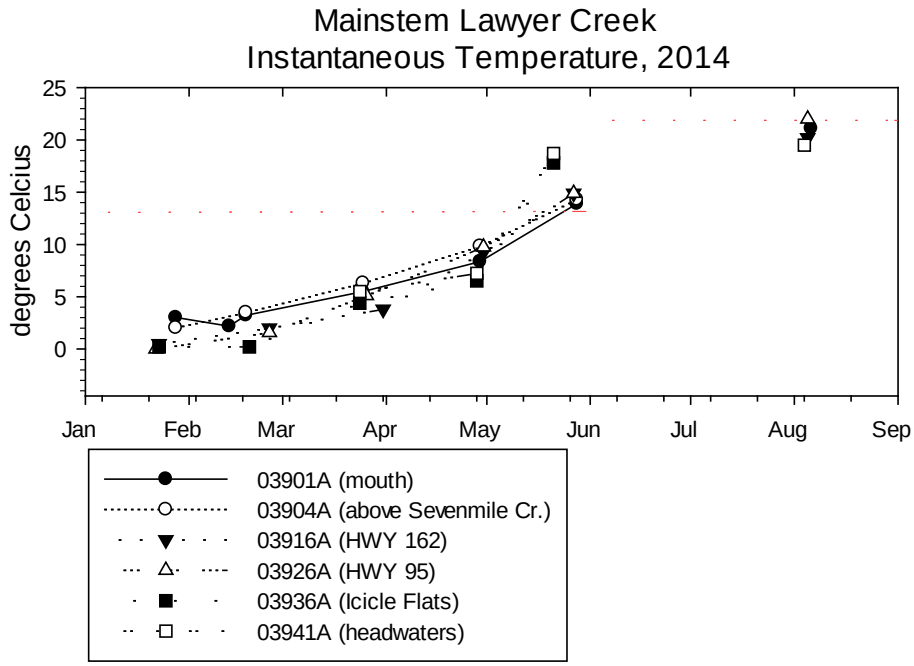

Figure 2. Mainstem Lawyer Creek instantaneous temperature, 2014. The dashed red line denotes the criterion.

Figure 3 shows the percentage of continuous temperature measurements that exceeded various target criteria for cold water aquatic life (CWAL) and salmonid spawning (SS). The monitoring stations located furthest downstream are located on the left side of the graph, while stations further upstream are located on the right side. The number of exceedances over the temperature criteria generally increased as one moves downstream. Appendix A contains graphs showing continuous temperature measurements at individual sites.

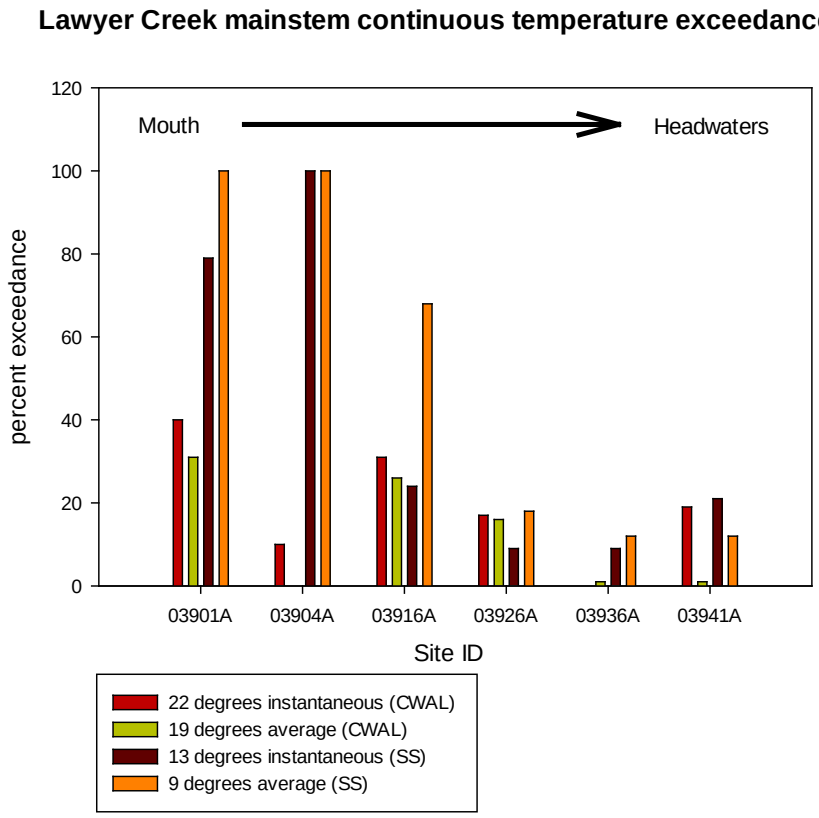

Figure 3. Percent exceedance over temperature target criteria in the mainstem of Lawyer Creek, 2014.

- DO levels only fell below the 8.0 mg/L instantaneous target criterion once, at the headwaters site (03941A). However, the productivity of aquatic macrophytes in the system indicates that there might be substantial diurnal fluctuations in dissolved oxygen concentrations, due to photosynthesis and respiration processes. Diurnal measurements will likely be a component of any future monitoring effort.
- pH levels were within an acceptable range throughout the project.
- TSS levels were generally very low, with only one exceedance occurring at the mouth of Lawyer Creek (03901A) during a high flow event on 2/13/14 that measured approximately 280 cfs. Turbidity levels were closely related to sediment levels, with a correlation coefficient of 99.68% at the mouth of Lawyer Creek (03901A).
- One exceedance of the *E. coli* instantaneous target of 406 coli/100mL occurred at the mouth of Lawyer Creek (03901A) during the same high flow event on 2/13/14. No other exceedances were documented at any site on the main stem of Lawyer Creek.
- NO_3+NO_2 levels exceeded the 0.3 mg/L target criterion at four of the six monitoring sites. No exceedances were documented at the two sites furthest

upstream (03936A; 03941A). Levels were highest during winter/ early spring and decreased as the stream got closer to base flow levels, although there was no significant correlation between discharge and nitrogen levels. It is hypothesized that rain events during late winter and early spring result in saturated hydrologic conditions that transport elevated nitrogen loads to surface waters via overland and groundwater flow. Figure 4 shows NO_3+NO_2 levels at all six monitoring sites.

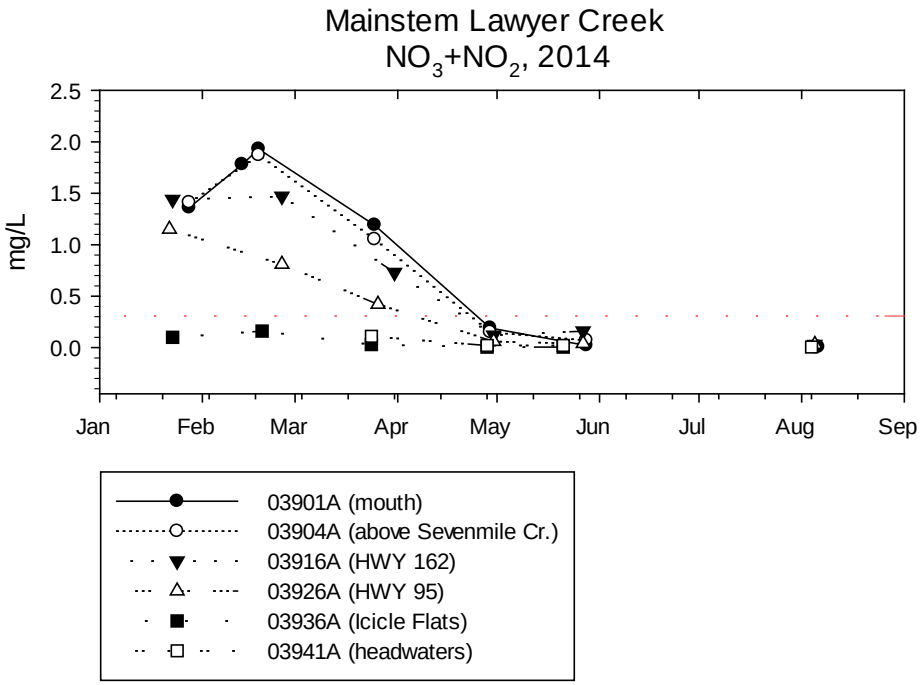

Figure 4. Mainstem Lawyer Creek NO_3+NO_2, 2014. The dashed red line denotes the 0.3 mg/L target criterion.

- Phosphorus levels exceeded the 0.1 mg/L target criterion at five of the six monitoring sites over 50% of the time. No exceedances were documented at the headwater site (03941A). Levels were highest during spring runoff and decreased as the stream got closer to base flow levels. The highest TP level was measured at the mouth of Lawyer Creek (03901A) on February 13, 2014, at 0.64 mg/L. The average OP:TP ratio for the mouth of Lawyer Creek was 70 percent, meaning that much of the phosphorus load in the system is in soluble form and readily bioavailable, likely a contributing factor to the excessive aquatic macrophyte growth that was observed at many sites. Figure 5 shows TP levels at all six monitoring sites.

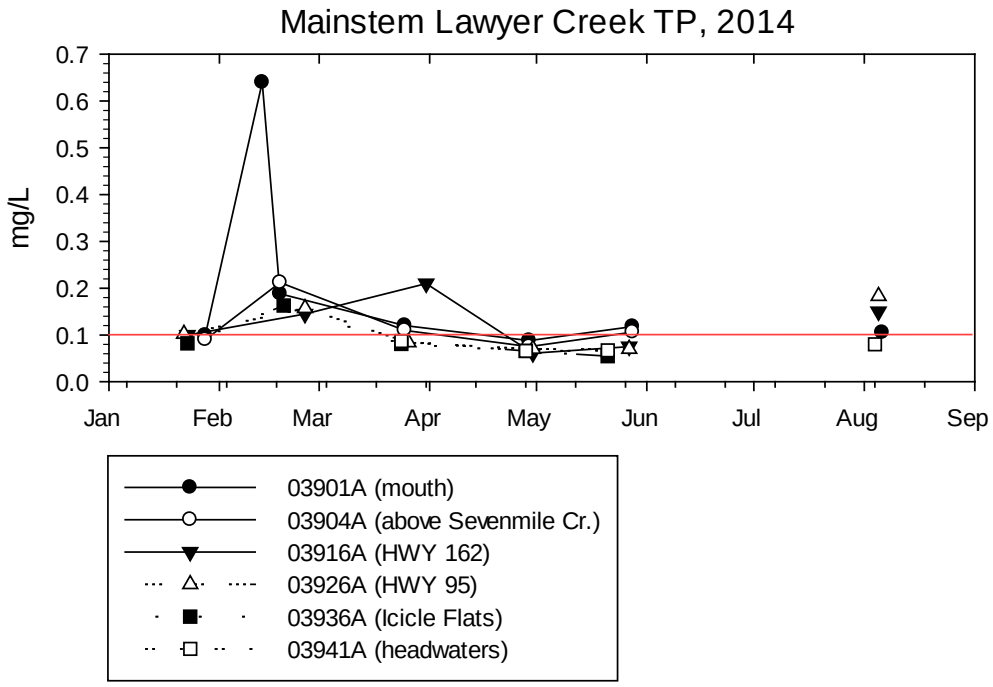

Figure 5. Mainstem Lawyer Creek TP, 2014. The dashed red line denotes the criterion.

Willow Creek (09303A, 09304A).

The tables below present descriptive statistics for data collected from the two monitoring stations located on Willow Creek.

Table 11. Descriptive statistics for Willow Creek at mouth (09303A), 2014.

09303A: Willow Creek (mouth)	Temp (oC)	D.O. (mg/L)	pH (H+)	E-Coli (coli/100mL)	NO_3+NO_2 (mg/L)	OP (mg/L)	TP (mg/L)	TSS (mg/L)	Flow (cfs)
Maximum	13.00	11.91	7.85	78.90	0.27	0.14	0.24	19.00	26.16
Minimum	0.02	10.24	6.60	12.20	0.01	0.01	0.05	8.00	1.32
Mean	3.73	11.19	7.18	37.20	0.14	0.05	0.12	12.60	13.62
Median	1.45	11.40	7.31	27.90	0.18	0.03	0.09	10.00	13.19
# exceedance	0.0	0.0	0.0	0.00	0.0	1.0	2.0	0.0	
% exceedance	0.0%	0.0%	0.0%	0.0%	0.0%	20.0%	40.0%	0.0%	
# sampling events	5	5	5	5	5	5	5	5	5

Table 12. Descriptive statistics for Willow Creek near headwaters (09304A), 2014.

09304A: Willow Creek headwaters	Temp (oC)	D.O. (mg/L)	pH (H+)	E-Coli (coli/100mL)	NO_3+NO_2 (mg/L)	OP (mg/L)	TP (mg/L)	TSS (mg/L)	Flow (cfs)
Maximum	18.40	11.98	7.59	14.80	0.01	0.03	0.10	17.00	14.55
Minimum	2.67	8.51	7.33	12.20	0.01	0.01	0.04	4.00	1.79
Mean	9.04	10.41	7.45	13.87	0.01	0.02	0.07	9.00	8.98
Median	6.05	10.75	7.43	14.60	0.01	0.02	0.05	6.00	10.60
# exceedance	1.0	0.0	0.0	0.00	0.0	0.0	1.0	0.0	
% exceedance	33.3%	0.0%	0.0%	0.0%	0.0%	0.0%	33.3%	0.0%	
# sampling events	3	3	3	3	2	3	3	3	3

2014 Willow Creek monitoring summary

- One instantaneous temperature exceedance was documented at the headwater site (09304A) on May 21, 2014, which represents the end of the salmonid spawning period. Figure 6 shows the percentage of measurements that exceeded various target criteria for cold water aquatic life (CWAL) and salmonid spawning (SS). No exceedances of the CWAL temperature criteria were observed at the headwater site (09304A) from June 1 to October 1, and less than 20% of the measurements exceeded CWAL criteria at the site nearest the mouth (09303A) during the same time period (n=102 days). Salmonid spawning criteria was exceeded 100% of the time during the spring at both sites (n= 3 days). Low water levels caused both temperature loggers to be out of the water after late September so an evaluation of fall stream temperatures was not conducted. Water in the creek during this late summer period was found mostly in isolated remnant pools. Appendix A contains graphs showing continuous temperature measurements at individual sites.

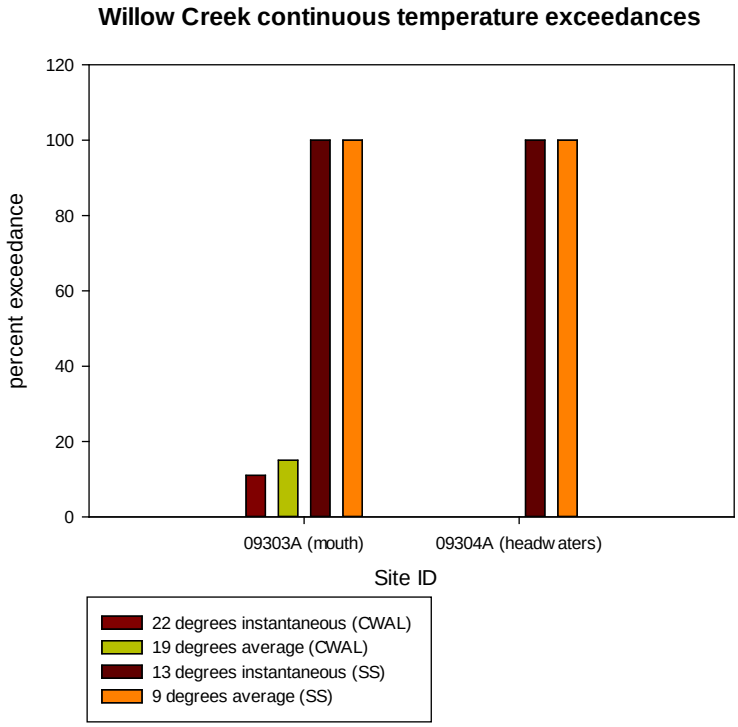

Figure 6. Percent exceedance over temperature target criteria in Willow Creek, 2014.

- DO levels were not observed to drop below the instantaneous target criterion of 8.0 mg/L at either site.
- pH levels were within an acceptable range throughout the project.
- Turbidity and TSS were generally very low at both sites.

- No exceedances of the *E. coli* instantaneous target of 406 coli/100mL were observed at either site. Livestock tend to congregate near water sources during the hot summer months, and the lack of data collection after May could have resulted in an underrepresentation of true bacterial loads. Fairly extensive grazing has been observed along Willow Creek in previous years.
- NO_3+NO_2 levels did not exceed the 0.3 mg/L target criterion at either site.
- Phosphorus levels exceeded the 0.1 mg/L target criterion 40% of the time at the mouth (09303A) and 33.3% of the time at the headwater site (09304A) (n=5 and 3, respectively). These exceedances were documented in January and February, when flows were relatively low.

Meadow Creek (05003A).

The table below contains descriptive statistics for data collected from the monitoring station located on Meadow Creek, approximately two miles east of Ferdinand, ID.

Table 13. Descriptive statistics for Meadow Creek near Ferdinand, ID (05003A), 2014.

05003A: Meadow Creek near Ferdinand	Temp (oC)	D.O. (mg/L)	pH (H+)	E-Coli (coli/100mL)	NO_3+NO_2 (mg/L)	OP (mg/L)	TP (mg/L)	TSS (mg/L)	Flow (cfs)
Maximum	21.00	13.12	8.91	613.10	5.39	0.47	2.30	1134.00	23.19
Minimum	0.04	9.03	7.44	2.00	1.69	0.13	0.14	8.00	0.33
Mean	8.33	11.40	8.34	138.23	4.32	0.21	0.50	175.43	4.75
Median	6.73	11.89	8.44	22.15	5.09	0.16	0.20	18.00	2.13
# exceedance	1.0	0.0	0.0	1.00	7.0	7.0	7.0	2.0	
% exceedance	12.5%	0.0%	0.0%	12.5%	100.0%	100.0%	100.0%	28.6%	
# sampling events	8	8	8	8	7	7	7	7	8

2014 Meadow Creek monitoring site (05003A) summary:

- One exceedance of the instantaneous temperature criteria was documented in Meadow Creek. The exceedance occurred on May 27, 2014, which falls within the salmonid spawning period. Figure 7 shows the percentage of measurements that exceeded various target criteria for cold water aquatic life (CWAL) and salmonid spawning (SS). 40% of the measurements exceeded the instantaneous temperature criteria for cold water aquatic life (CWAL) (n=122 days), and 79% of the measurements exceeded the instantaneous criteria for salmonid spawning (SS) (n= 33 days). Appendix A contains graphs showing continuous temperature measurements at individual sites.

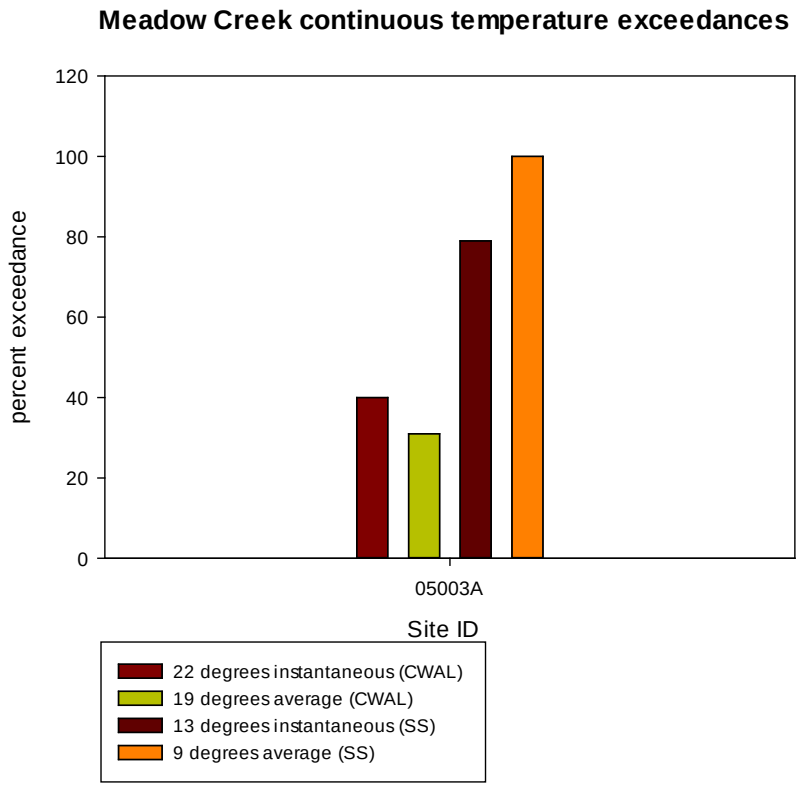

Figure 7. Percent exceedance over temperature target criteria in Meadow Creek, 2014.

- DO levels were not observed to be below the instantaneous target criterion of 8.0 mg/L at this site.
- pH levels were within an acceptable range throughout the project.
- Turbidity and TSS were generally very low, with two exceedances of the TSS targets being documented. The highest measurement occurred during a high flow event (Q = 23.19) on 2/13/14, when the TSS level was 1,134 mg/L and turbidity was measured at 932 NTU. A correlation coefficient of 94% was seen between TSS and turbidity at this site.
- One exceedance of the *E. coli* instantaneous target of 406 coli/100mL occurred during the same high flow event on 2/13/14, with a reading of 613 coli/100 mL.
- NO_3+NO_2 levels exceeded the 0.3 mg/L target criterion 100% of the time (n=7). The lowest value measured at this site was 1.69 mg/L, still over 460% higher than the target criterion. Figure 8 shows NO_3+NO_2 levels at the Meadow Creek monitoring site.

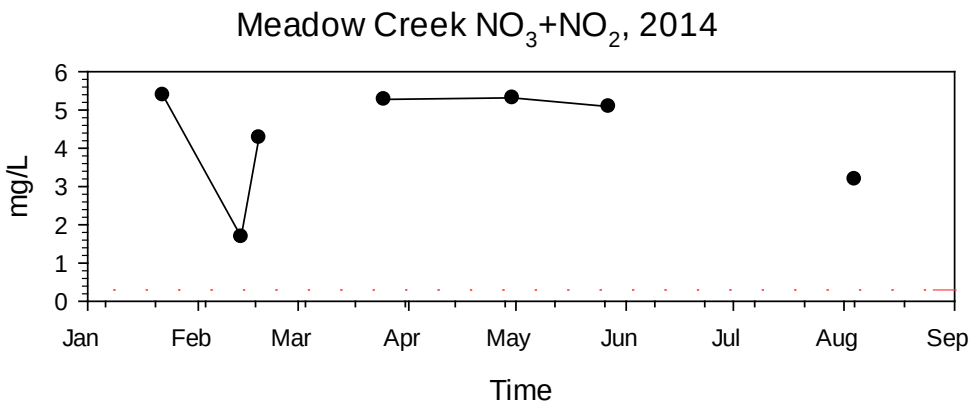

Figure 8. Meadow Creek NO3+NO2, 2014. The dashed red line denotes the 0.3 mg/L target criterion.

- Phosphorus levels exceeded the 0.1 mg/L target criterion 100% of the time. The average OP:TP ratio for Meadow Creek was 72 percent, meaning that much of the phosphorus load in the system is in soluble form and readily bioavailable. Figure 9 shows TP levels at the Meadow Creek monitoring site.

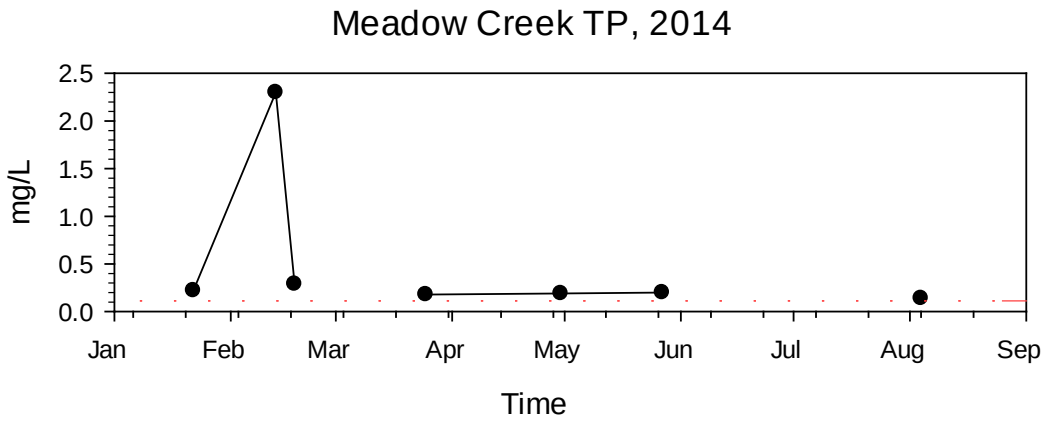

Figure 9. Meadow Creek TP, 2014. The dashed red line denotes the 0.1 mg/L target criterion.

John Dobbs Creek (10201A).

The table below contains descriptive statistics for data collected from the monitoring station located near the mouth of John Dobbs Creek. John Dobbs Creek has a drainage area of approximately 16.6 square miles and is the receiving water for the City of Craigmont's wastewater treatment facility.

Table 14. Descriptive statistics for John Dobbs Creek near mouth (10201A), 2014.

10201A John Dobbs Creek @ mouth	Temp (oC)	D.O. (mg/L)	pH (H+)	E-Coli (coli/100mL)	NO_3+NO_2 (mg/L)	OP (mg/L)	TP (mg/L)	TSS (mg/L)	Flow (cfs)
Maximum	17.60	12.88	8.95	285.10	2.80	0.26	0.46	14.00	8.66
Minimum	0.01	7.52	7.91	1.00	0.09	0.08	0.23	2.00	0.17
Mean	8.58	10.91	8.41	51.17	1.41	0.17	0.31	7.00	2.62
Median	9.07	11.06	8.43	5.75	1.55	0.17	0.30	5.50	1.50
# exceedance	1.0	1.0	0.0	0.00	4.0	5.0	6.0	0.0	
% exceedance	16.7%	16.7%	0.0%	0.0%	66.7%	83.3%	100.0%	0.0%	
# sampling events	6	6	6	6	6	6	6	6	6

2014 John Dobbs Creek monitoring site (10201A) summary:

- One exceedance of the instantaneous temperature criteria was documented in John Dobbs Creek. The exceedance occurred on May 27, 2014, which falls within the salmonid spawning period. Figure 10 shows the percentage of measurements that exceeded various target criteria for cold water aquatic life (CWAL) and salmonid spawning (SS). None of the continuous temperature measurements exceeded the instantaneous criteria for cold water aquatic life (CWAL) (n= 122 days), and 3% of the measurements exceeded the instantaneous criteria for salmonid spawning (SS); 15% of the measurements exceeded the 9° C average criterion for SS (n= 34 days). Appendix A contains graphs showing continuous temperature measurements at individual sites.

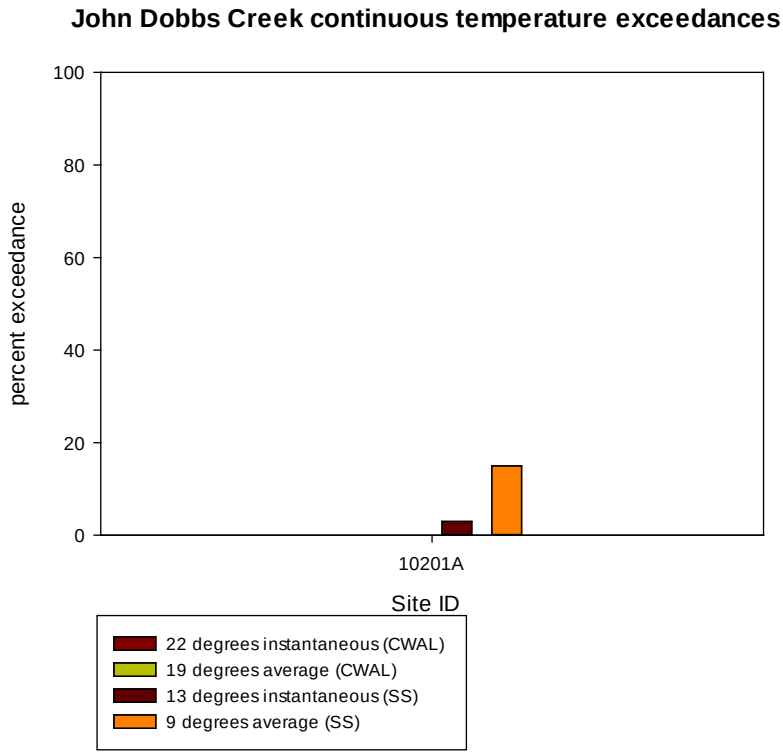

Figure 10. Percent exceedance over temperature target criteria in John Dobbs Creek, 2014.

- DO levels were not observed to be below the instantaneous target criterion of 8.0 mg/L.
- pH levels were within an acceptable range throughout the project.
- TSS levels were below the target criterion value.
- No exceedance of the *E. coli* instantaneous target was observed.
- NO_3+NO_2 levels exceeded the 0.3 mg/L target criterion approximately 67% of the time (n=6). The highest levels were measured in January and February.
- Phosphorus levels exceeded the 0.1 mg/L target criterion 100% of the time (n=6). The average OP:TP ratio for John Dobbs Creek was 60 percent, which is slightly lower than other sites in the watershed, although the majority of phosphorus in the system is still in soluble form and therefore readily bioavailable. Figure 11 shows TP levels.

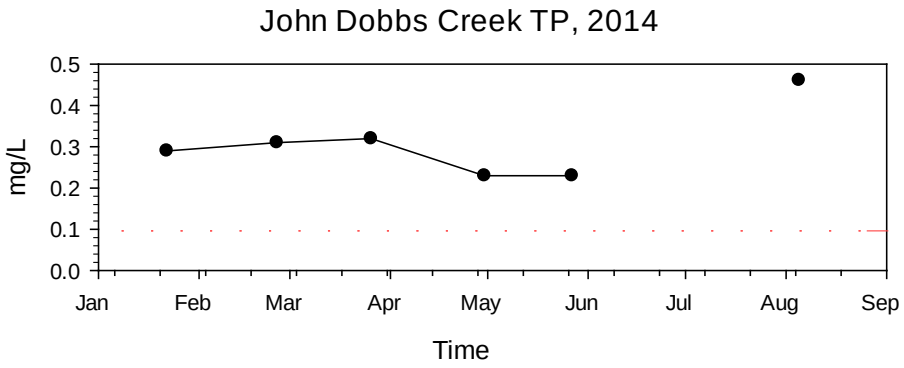

Figure 11. John Dobbs Creek TP, 2014. The dashed red line denotes the 0.1 mg/L target criterion.

Unnamed Tributary (10301A)

The table below contains descriptive statistics for data collected from the monitoring station located near the mouth of this unnamed creek that flows into Lawyer Creek, just downstream of the Icicle Flat Road crossing. This tributary has a drainage area of approximately 11 square miles and is the receiving water for the Cottonwood Job Corps Center's wastewater treatment facility.

Table 15. Descriptive statistics for Unnamed Creek just downstream of Icicle Flat Road (10301A), 2014.

10301A Unnamed tributary @ Allottment 369-A	Temp (oC)	D.O. (mg/L)	pH (H+)	E-Coli (coli/100mL)	NO_3+NO_2 (mg/L)	OP (mg/L)	TP (mg/L)	TSS (mg/L)	Flow (cfs)
Maximum	20.80	12.55	8.83	98.70	1.43	0.12	0.51	380.00	5.68
Minimum	0.16	9.53	7.23	8.60	0.18	0.06	0.12	9.00	0.62
Mean	7.31	11.23	8.03	58.14	0.72	0.08	0.25	148.40	3.38
Median	7.08	11.37	7.91	76.70	0.64	0.08	0.20	112.00	3.88
# exceedance	1.0	0.0	0.0	0.00	4.0	1.0	5.0	4.0	
% exceedance	20.0%	0.0%	0.0%	0.0%	80.0%	20.0%	100.0%	80.0%	
# sampling events	5	5	5	5	5	5	5	5	5

2014 Unnamed Creek monitoring site (10301A) summary:

- One exceedance of the instantaneous temperature criteria was documented at this location. The exceedance occurred on May 28, 2014, which falls within the salmonid spawning period. Figure 12 shows the percentage of measurements that exceeded various target criteria for cold water aquatic life (CWAL) and salmonid spawning (SS). 4% of the measurements exceeded the instantaneous criteria for cold water aquatic life (CWAL) (n=122 days), and 9% of the measurements exceeded the instantaneous criteria for salmonid spawning (SS); 56% of the measurements exceeded the 9° C average criterion for SS (n=34 days). Appendix A contains graphs showing continuous temperature measurements at individual sites.

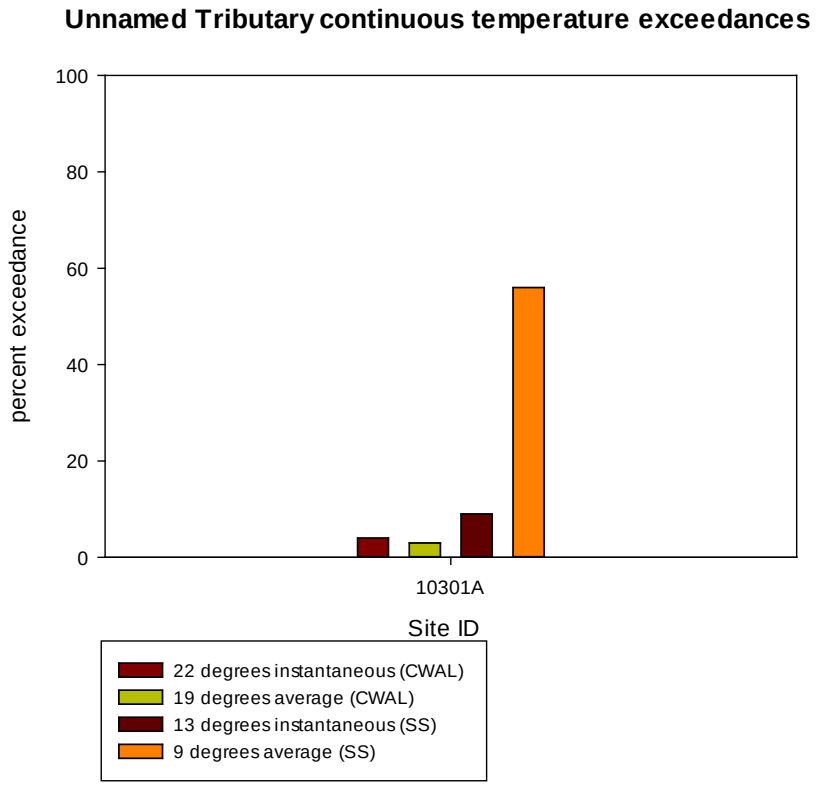

Figure 12. Percent exceedance over temperature target criteria in Unnamed Tributary, 2014.

- DO levels were not observed to be below the instantaneous target criterion of 8.0 mg/L.
- pH levels were within an acceptable range throughout the project.
- This location had the highest median turbidity and TSS levels of any site evaluated during this project. Extensive grazing occurs in this subwatershed and many of the stream banks upstream show signs of instability from heavy use. Riparian vegetation is negligible along most of this stream, until one reaches the headwaters on Cottonwood Butte. This subwatershed also has a moderately high road density of 1.9 miles of road per 1 square mile of area, and receives effluent from the Cottonwood Job Corps Center. These collective factors could be the cause of the elevated sediment levels measured at this monitoring location. TSS levels exceeded the target criterion 80% of the time (n=5) at this site.
- No exceedances of the *E. coli* instantaneous target were observed.
- NO_3+NO_2 levels exceeded the 0.3 mg/L target criterion 80% of the time (n=5). The highest levels were measured in January and February.
- Phosphorus levels exceeded the 0.1 mg/L target criterion 100% of the time (n=5). The average OP:TP ratio for this stream was 40 percent, which is considerably lower than other sites in the watershed, indicating that the majority of phosphorus in the system is associated with particulate matter and instream concentrations are highly dependent upon flow and erosional processes. A correlation coefficient of nearly 80% between TP and TSS supports this conclusion. Figure 13 illustrates how TP levels closely follow flow patterns in the creek.

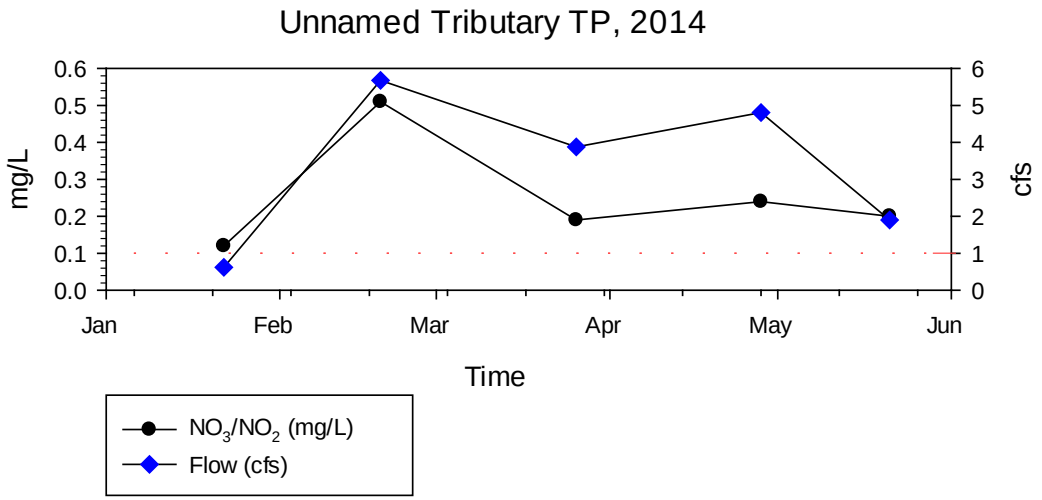

Figure 13. Unnamed Tributary to Lawyer Creek TP and flow, 2014. The dashed red line denotes the 0.1 mg/L target criterion for TP.

Sevenmile Creek (#06901A)

The table below contains descriptive statistics for data collected from the monitoring station located near the mouth of Sevenmile Creek, approximately two miles west of Kamiah, ID.

Table 16. Descriptive statistics for Sevenmile Creek at mouth (06901A), 2014.

06901A Sevenmile Creek @ mouth	Temp (oC)	D.O. (mg/L)	pH (H+)	E-Coli (coli/100mL)	NO_3+NO_2 (mg/L)	OP (mg/L)	TP (mg/L)	TSS (mg/L)	Flow (cfs)
Maximum	14.20	13.85	8.94	148.30	5.72	0.17	0.33	52.00	15.22
Minimum	2.97	10.85	7.51	2.00	0.18	0.12	0.16	2.00	0.98
Mean	7.16	12.37	8.21	44.60	1.67	0.15	0.20	12.83	5.30
Median	5.77	12.49	8.12	11.00	1.04	0.15	0.19	6.50	4.40
# exceedance	1.0	0.0	0.0	0.00	5.0	6.0	6.0	1.0	
% exceedance	16.7%	0.0%	0.0%	0.0%	83.3%	100.0%	100.0%	16.7%	
# sampling events	6	6	6	5	6	6	6	6	6

2014 Sevenmile Creek monitoring site (06901A) summary:

- One exceedance of the instantaneous temperature criteria was documented in Sevenmile Creek. The exceedance occurred on May 28, 2014, which falls within the salmonid spawning period. Figure 14 shows the percentage of measurements that exceeded various target criteria for cold water aquatic life (CWAL) and salmonid spawning (SS). 0% of the measurements exceeded the instantaneous or average criteria for cold water aquatic life (CWAL) (n= 122 days). 9% of the measurements exceeded the instantaneous criteria for salmonid spawning (SS); 100% of the measurements exceeded the 9° C average criterion for SS (n=33). Appendix A contains graphs showing continuous temperature measurements at individual sites.

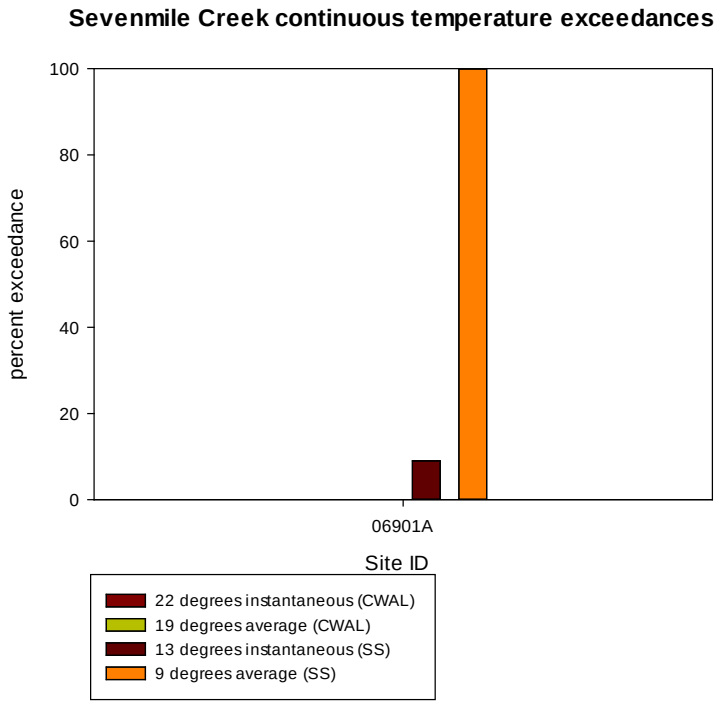

Figure 14. Percent exceedance over temperature target criteria in Sevenmile Creek, 2014.

- DO levels were not observed to be below the instantaneous target criterion of 8.0 mg/L.
- pH levels were within an acceptable range throughout the project.
- Turbidity and TSS were generally very low, with only one exceedance of the TSS target being documented, during the highest flow event (TSS=52; Q=15.22).
- No exceedances of the *E. coli* instantaneous target of 406 coli/100mL were observed.
- NO_3+NO_2 levels exceeded the 0.3 mg/L target criterion on five of the six monitoring events. Figure 15 shows NO_3+NO_2 levels.

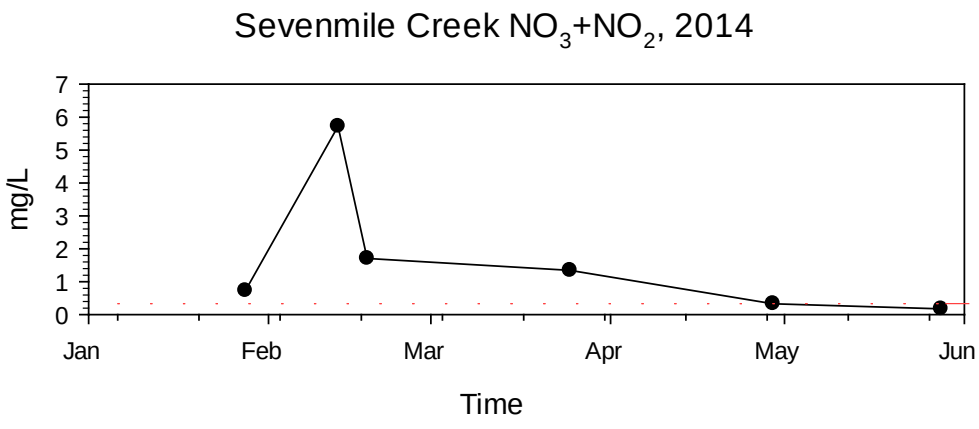

Figure 15. Sevenmile Creek NO_3+NO_2, 2014. The dashed red line denotes the 0.3 mg/L target criterion.

- Phosphorus levels exceeded the 0.1 mg/L target criterion 100% of the time. The average OP:TP ratio for Sevenmile Creek was 75 percent, meaning that much of the phosphorus load in the system is in soluble form and readily bioavailable. Figure 16 shows TP levels at all six monitoring sites.

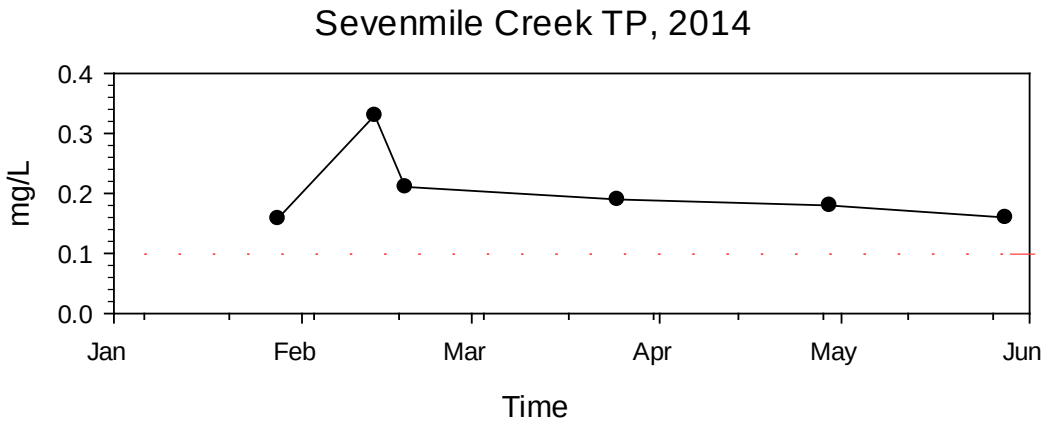

Figure 16. Sevenmile Creek TP, 2014. The dashed red line denotes the 0.1 mg/L target criterion.

Designated Beneficial Use Support Status

Designated beneficial use support status determinations have been developed based on the water quality data collected during this study. Table 17 lists the waterbodies and their designated beneficial use status. Insufficient data was collected to make a designated beneficial use support determination for Primary Contact Recreation. Additional supplemental monitoring will be conducted during the summer grazing season, in order to better characterize bacterial loads in the Lawyer Creek watershed.

Table 17. Designated beneficial use support status for assessed waterbodies.

Waterbody Name	Total Stream Miles	Designated Uses	Use Support Decision	Parameter/ Indicator
Lawyer Creek (source to mouth)	45	Primary Contact Recreation	n/a	n/a
		Cold Water Aquatic Life	Not Supporting	Temperature

Waterbody Name	Total Stream Miles	Designated Uses	Use Support Decision	Parameter/ Indicator
		Salmonid Spawning	Not Supporting	Temperature
Willow Creek	37.6	Primary Contact Recreation	n/a	n/a
		Cold Water Aquatic Life	Not Supporting	Temperature
		Salmonid Spawning	Not Supporting	Temperature
John Dobbs Creek	21	Primary Contact Recreation	n/a	n/a
		Cold Water Aquatic Life	Not Supporting	Temperature
		Salmonid Spawning	Not Supporting	Temperature
Unnamed Creek	18	Primary Contact Recreation	n/a	n/a
		Cold Water Aquatic Life	Not Supporting	Temperature
		Salmonid Spawning	Not Supporting	Temperature
Sevenmile Creek	26.0	Primary Contact Recreation	n/a	n/a
		Cold Water Aquatic Life	Not Supporting	Temperature

Waterbody Name	Total Stream Miles	Designated Uses	Use Support Decision	Parameter/ Indicator
		Salmonid Spawning	Not Supporting	Temperature
Meadow Creek	23.1	Primary Contact Recreation	n/a	n/a
		Cold Water Aquatic Life	Not Supporting	Temperature
		Salmonid Spawning	Not Supporting	Temperature

Conclusions

The monitoring program for the mainstem and tributaries of Lawyer Creek was successfully carried out as planned. Protocols were followed, QA/QC standards were met, and specific information per parameter for each subwatershed was collected.

Nutrients and excessive stream temperatures were the primary pollutants documented within the Lawyer Creek watershed during this study.

Aquatic organisms from microbes to fish are dependent on certain temperature ranges for their optimal health. Aquatic insects are sensitive to temperature and will move in a stream in order to find their optimal temperature. Temperature is also critical for fish spawning and embryo development. If stream temperatures are outside of optimal levels for prolonged periods of time, organisms become stressed and may die or be unable to reproduce. Lawyer Creek and its' tributaries have salmonid spawning as a designated beneficial use and therefore have relatively stringent temperature requirements associated with them. Every site exceeded the temperature criteria to some degree during the course of this study.

Total phosphorus loading is a persistent issue throughout the watershed. The only site without an exceedance of the 0.1 mg/L target criterion for total phosphorus was located

at the headwaters of Lawyer Creek. The high level of phosphorus is potentially contributing to excessive growth of algae and other aquatic plants that causes the depletion of dissolved oxygen when they decompose, which can result in the disappearance of intolerant aquatic insect species and fish. Even with the relatively high levels of phosphorus seen in this study, there were only two documented instances where DO levels dropped below the 8.0 mg/L target criterion. This could be attributed to the low number of samples collected during the study. Additional monitoring should be conducted to better assess diurnal fluctuations in DO levels.

NO_3+NO_2 levels are also high in most of the Lawyer Creek catchment, with the exception of the Willow Creek subwatershed, where no exceedances were documented. The data suggest that much of the nitrogen could be coming from agricultural fields and grazing allotments.

Escherichia coli (*E. coli)* is a type of fecal coliform bacteria commonly found in the intestines of animals and humans. The presence of *E. coli* in water is a strong indication of recent sewage or animal waste contamination. Bacteria levels were generally low in the watershed, but monitoring was not conducted during the summer grazing season, when livestock is often found within close proximity to water. Supplemental monitoring will be conducted to better characterize bacterial loads in the watershed and determine designated beneficial use support status for primary contact recreation.

Total suspended solids (TSS) include both sediment and organic material suspended in water. TSS can cause problems for fish by clogging gills and for aquatic plants by limiting growth because of reduced light penetration. In addition, TSS provides a medium for the accumulation and transport of other constituents such as phosphorus and bacteria. Sediment was generally low throughout the watershed, but it is believed that much of the sediment load in this watershed is transported during episodic and relatively infrequent storm events. Therefore, it is likely that the monthly monitoring results underrepresent actual sediment loads in the creeks.

Recommendations

Significant erosion is currently evident along a number of streams, and treatment should be applied to streams that are already undergoing the most severe erosion. Nutrients are a major problem in this watershed and controlling erosion would certainly help to decrease TP levels. Every stream in this watershed, including the mainstem of Lawyer Creek, is water quality limited and will benefit from strategic BMP installations.

Meadow Creek, in particular, appears to be the tributary that is contributing the highest nutrient, bacteria, and sediment load to the mainstem of Lawyer Creek, and should be prioritized for implementation of conservation/implementation measures. Fencing

cattle away from the creek, as well as stream stabilization structures and revegetation of the streambank will help to reduce sediment transport in this problem area.

The unnamed tributary near Icicle Flat Road (#10301A) also contributes a great deal of sediment, nutrients, and bacteria to Lawyer Creek. This is one of the few perennial tributaries in the watershed, and efforts should be made to improve the quality of water in the creek.

Excessive stream temperatures will be a difficult issue to overcome. Perhaps the most effective strategy would be to work toward the establishment of natural full potential canopy shade. Reducing sediment loads within critical reaches will assist in reducing stream temperatures as well, since suspended particles tend to absorb more heat.

Continued implementation of targeted stream restoration efforts to reduce sediment loads, lower temperatures, lower nutrients, and lower bacteria levels will be important. Based on stream inventory and prioritization efforts, stakeholders (NPT, NRCS, SCC, IDEQ, SWCDs, and private land owners) should fund, devise, and construct high quality stream improvements designed to promote water quality enhancement.

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Appendix A: Continuous water temperature data

Onset HOBO Water Temperature Pro v2 Data Loggers were placed at each monitoring site, after calibration in the office. The graphs show maximum and average temperatures, as well as diurnal variation. MDMT= Maximum Daily Maximum Temperature; MWMT=Maximum Weekly (7-day average) Maximum Temperature; MDAT=Maximum Daily Average Temperature; MWAT=Maximum Weekly Average Temperature.

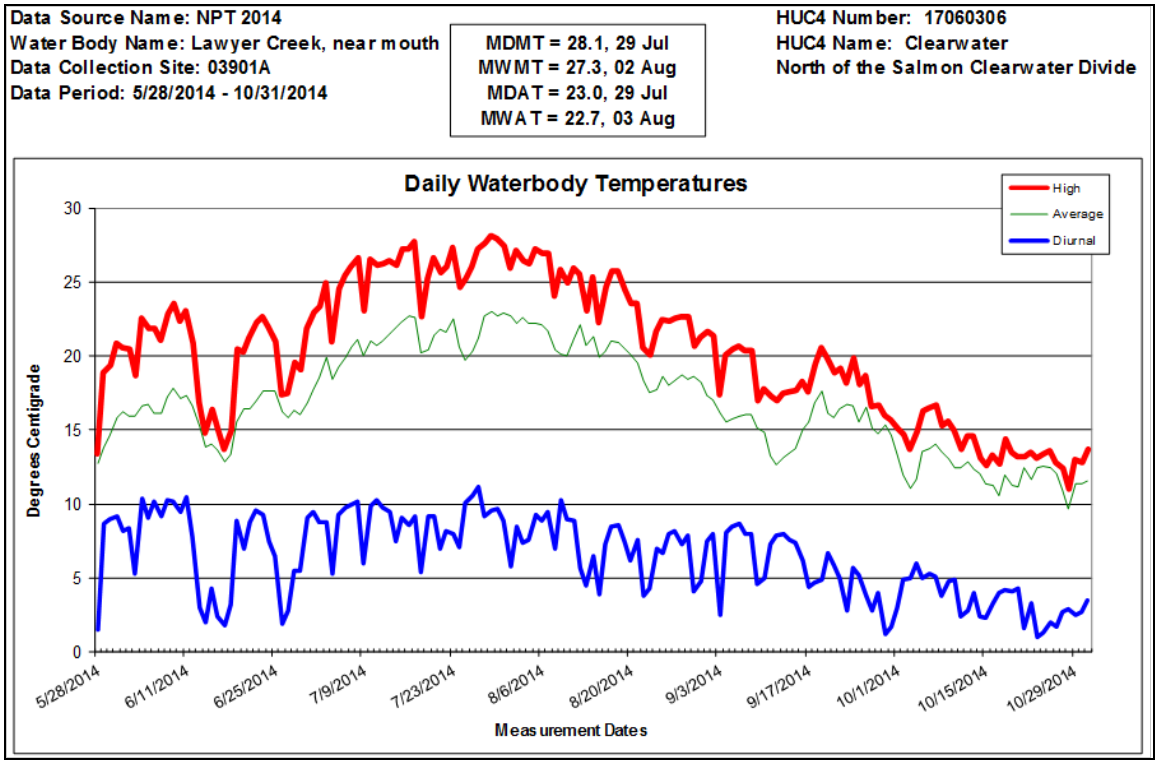

Figure 17. Continuous temperature, Lawyer Creek near mouth (03901A), 2014.

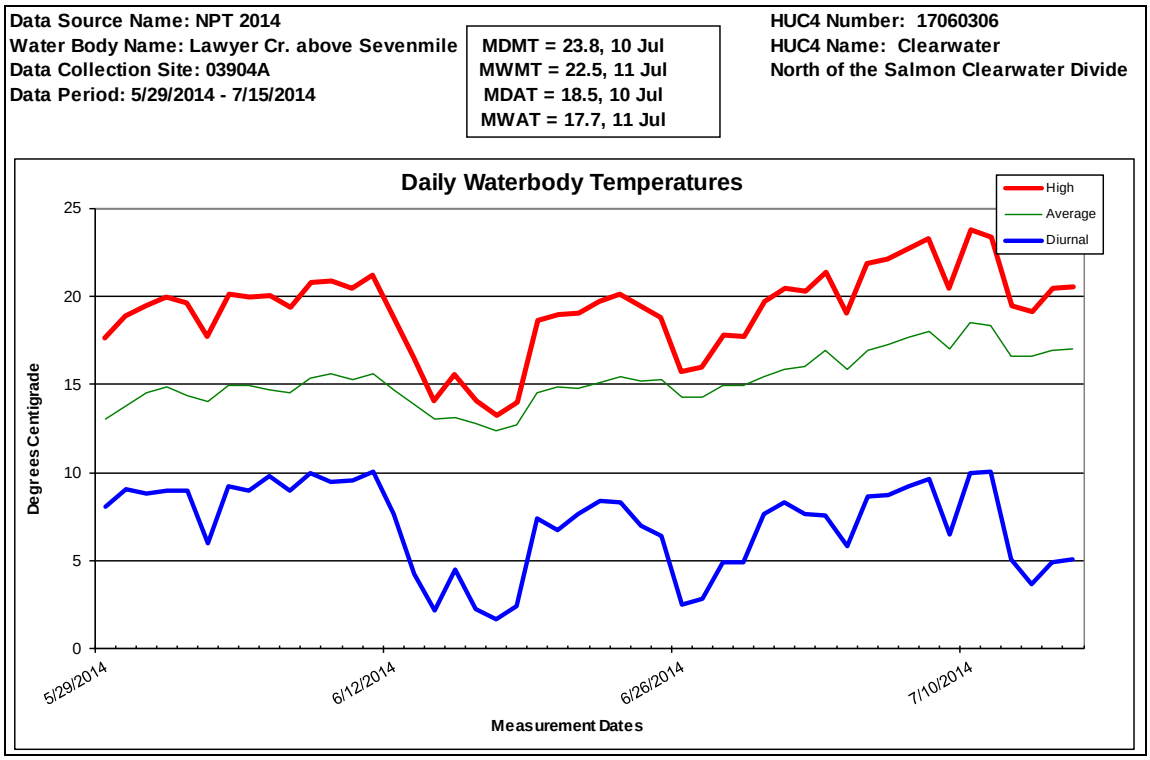

Figure 18. Continuous temperature, Lawyer Creek above Sevenmile Creek (03904A), 2014.

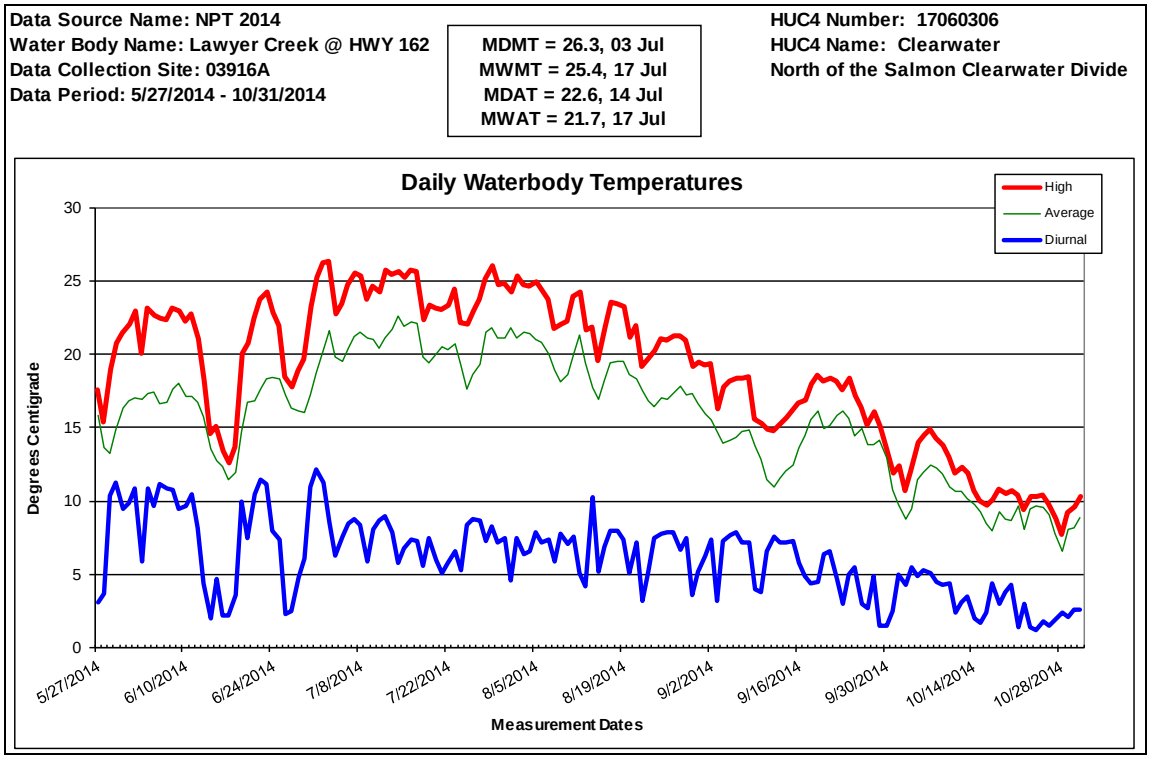

Figure 19. Continuous temperature, Lawyer Creek @ HWY 162 (03916A), 2014.

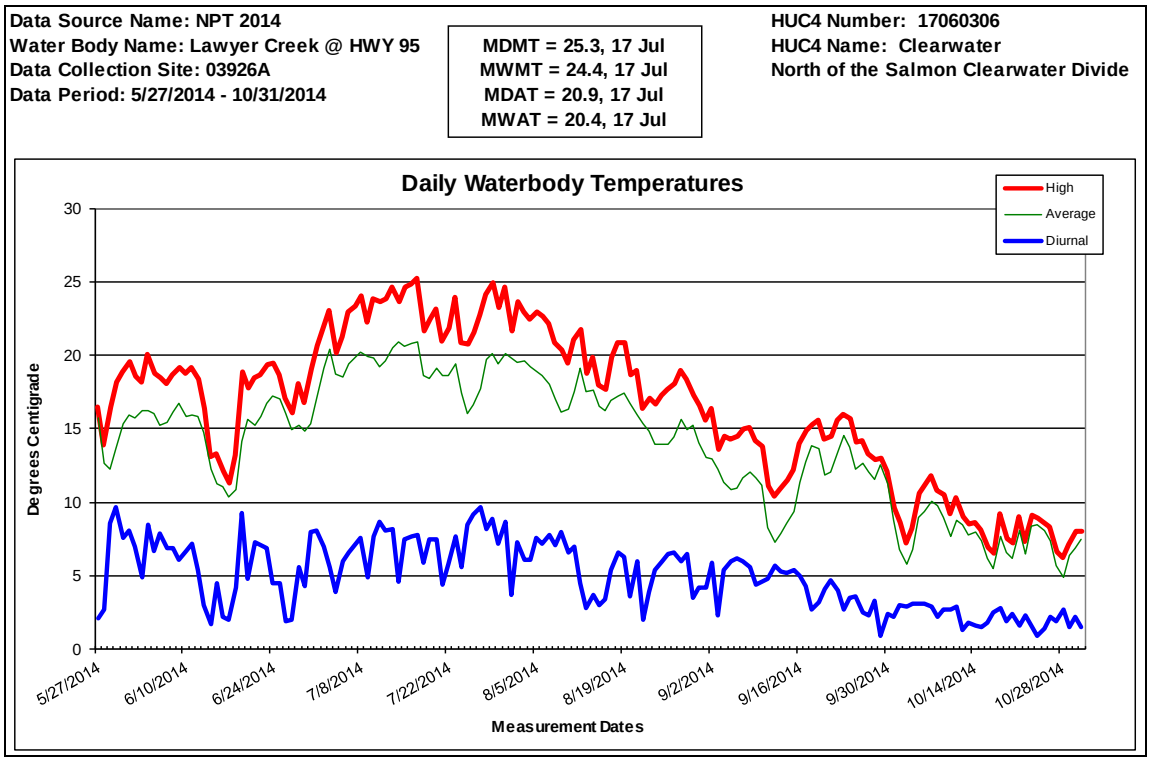

Figure 20. Continuous temperature, Lawyer Creek @ HWY 95 (03926A), 2014.

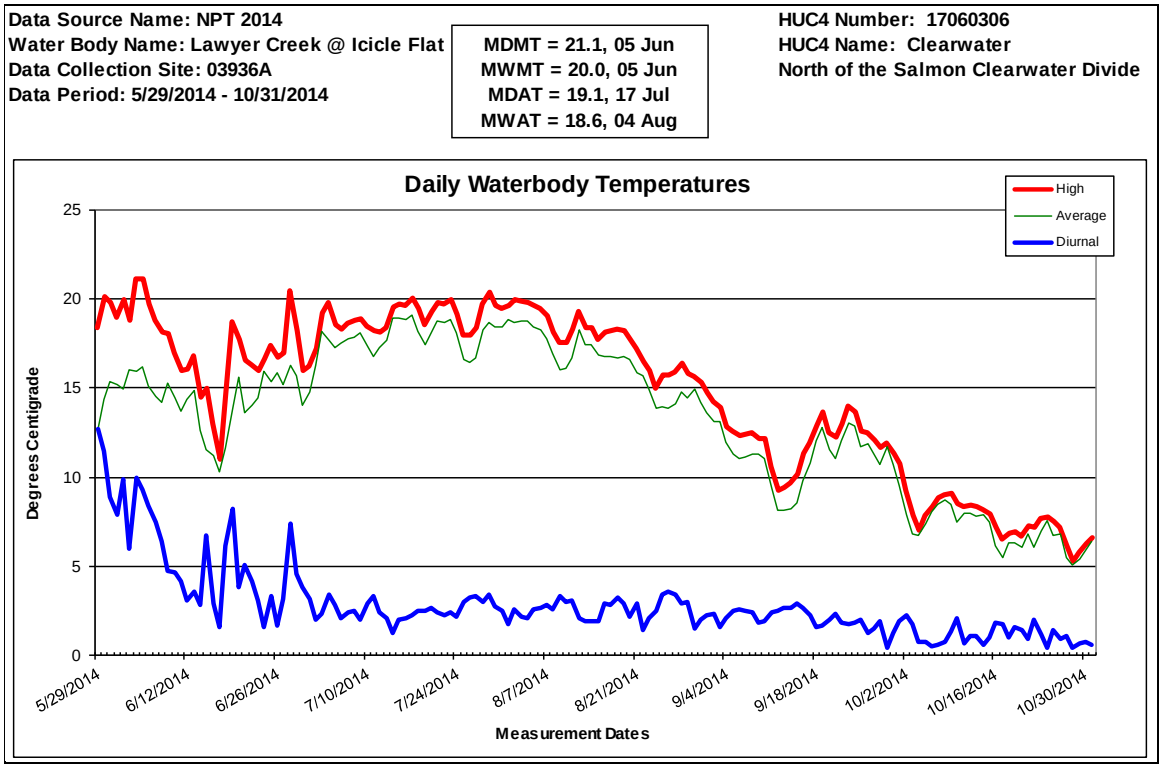

Figure 21. Continuous temperature, Lawyer Creek @ Icicle Flats Road (03936A), 2014.

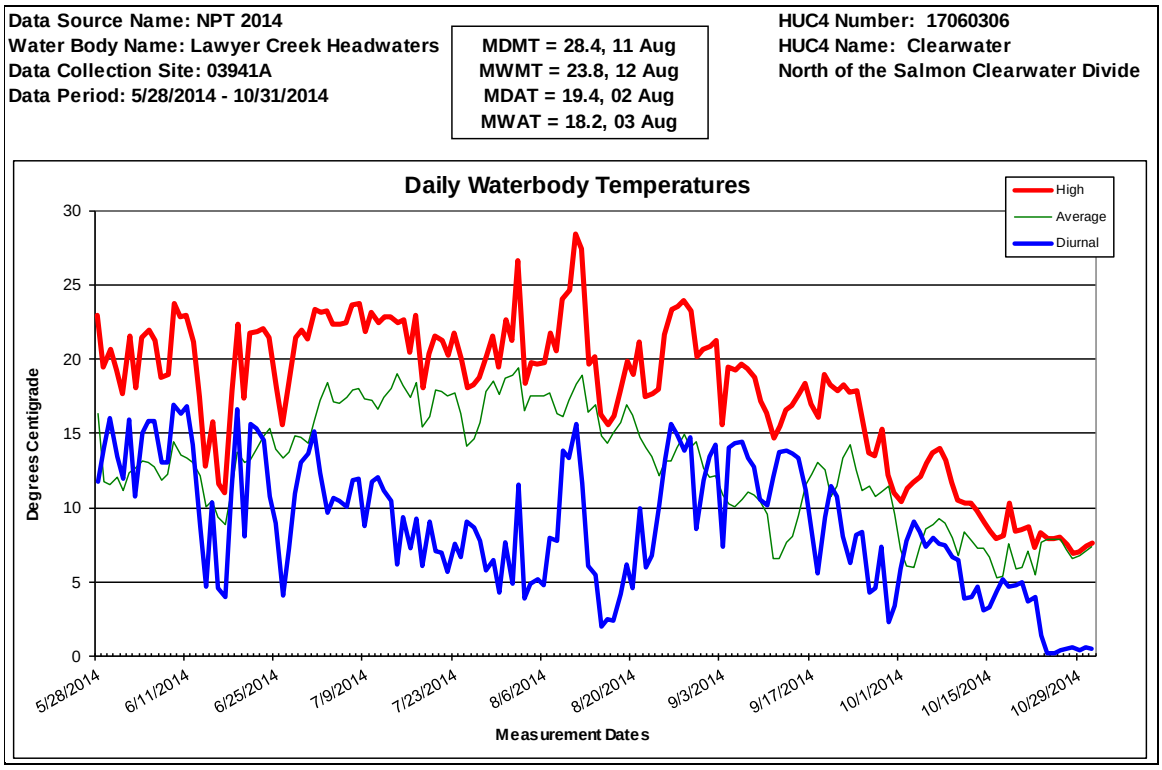

Figure 22. Continuous temperature, Lawyer Creek headwaters (03941A), 2014.

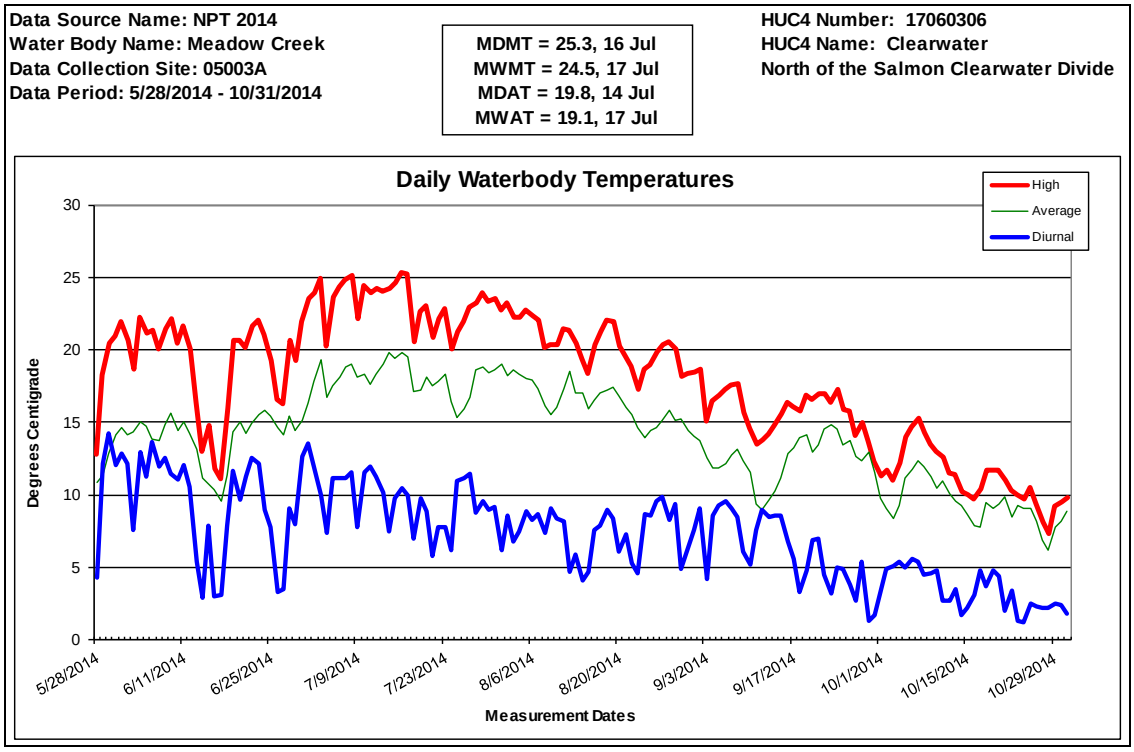

Figure 23. Continuous temperature, Meadow Creek (05003A), 2014.

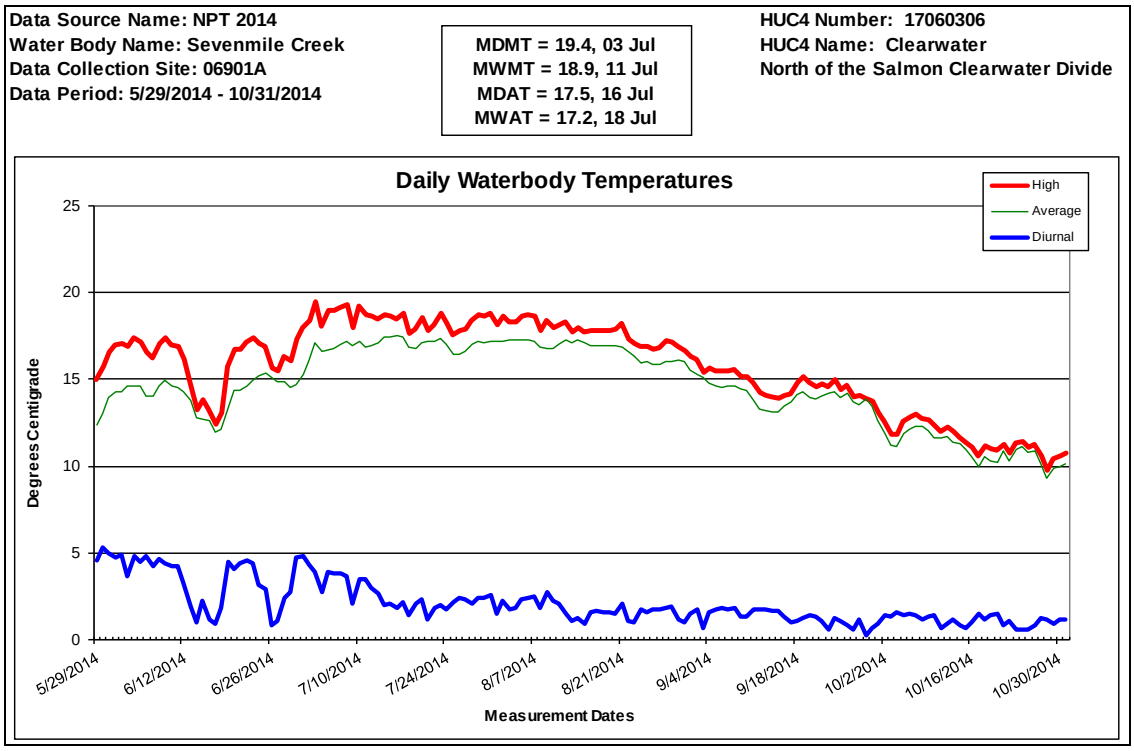

Figure 24. Continuous temperature, Sevenmile Creek (06901A), 2014.

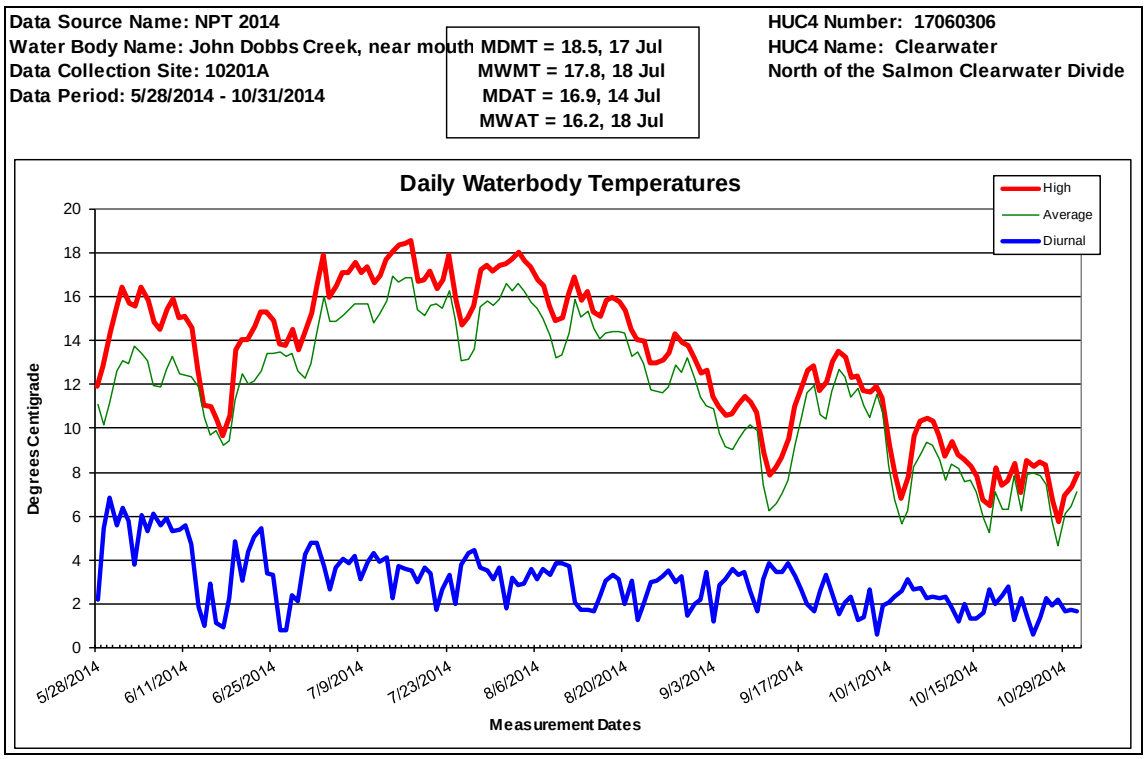

Figure 25. Continuous temperature, John Dobbs Creek (10201A), 2014.

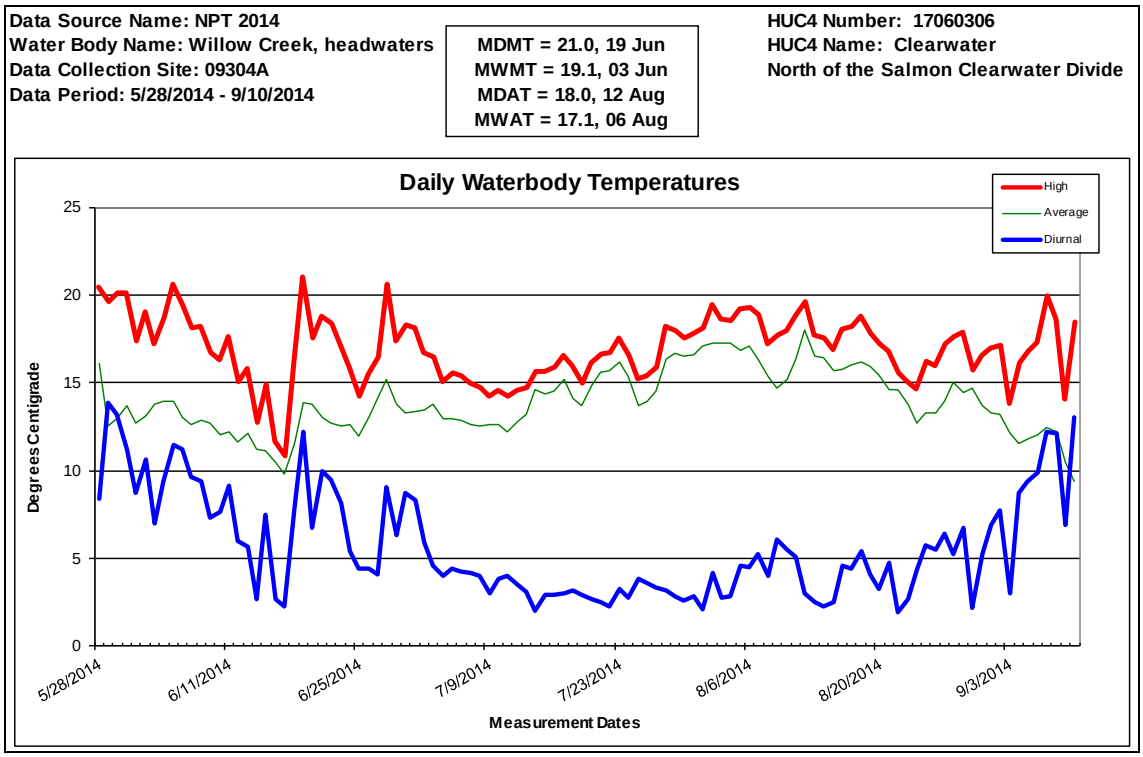

Figure 26. Continuous temperature, Willow Creek headwaters (09304A), 2014.

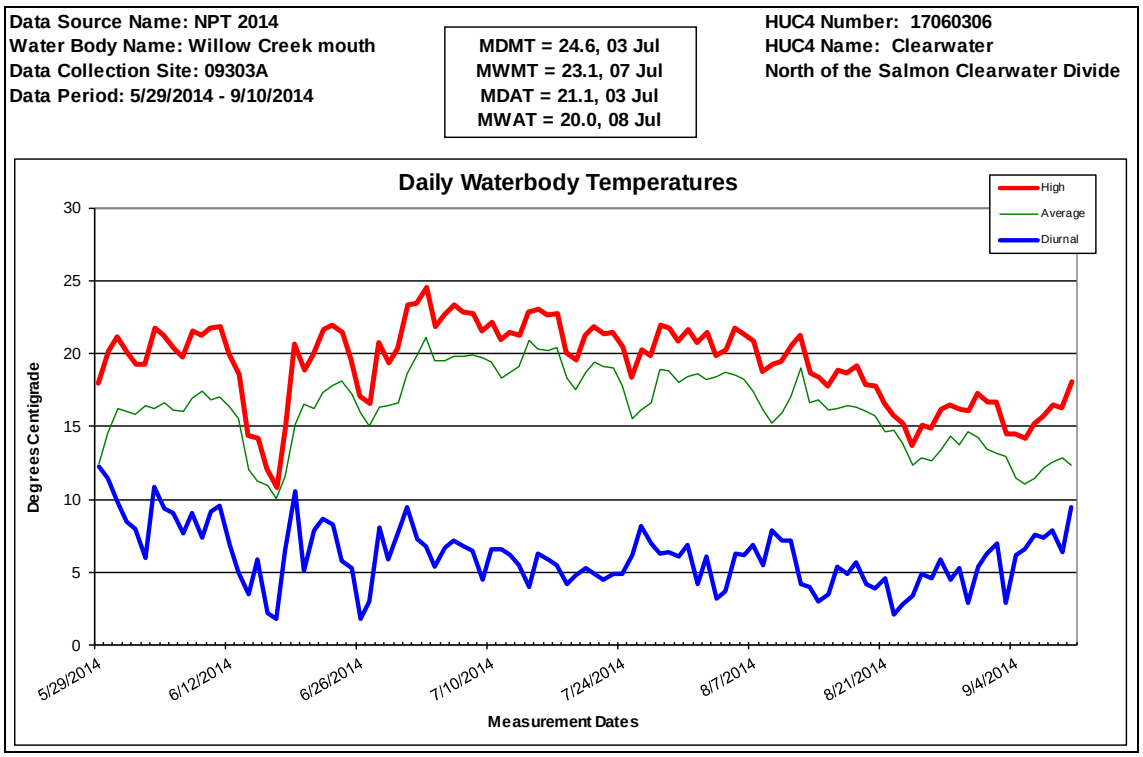

Figure 27. Continuous temperature, Willow Creek mouth (09303A), 2014.

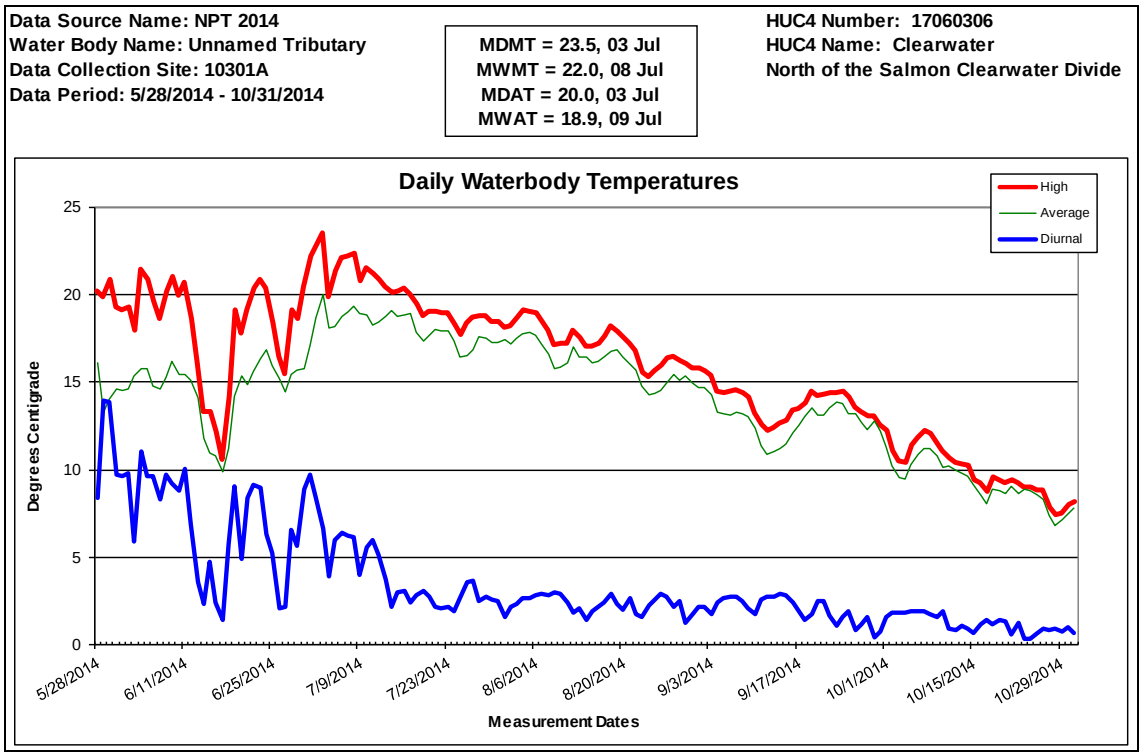

Figure 28. Continuous temperature, Unnamed Tributary (10301A), 2014.

Appendix B: Raw Data

03901A: Lawyer Creek mouth

Date	Time	Temperature, water	Specific conductance	Dissolved oxygen (DO), % Sat.	Dissolved oxygen (DO)	pH	Turbidity	Escherichia coli	NO3/NO2 mg/L	Ortho-P mg/L	T-Phos mg/L	NH3 mg/L	TSS mg/L	Velocity-discharge (cfs)
1/28/2014	11:00	3.03	269	106.9	14.32	7.93	1.8	13.2	1.36	0.088	0.099	0.02	3	13.76
2/13/2014	11:30	2.18	139	103.1	14.17	6.9	164	547.5	1.78	0.22	0.64	0.14	61	280.18
2/18/2014	10:40	3.22	195	100.0	13.36	7.29	24.7	24.1	1.93	0.13	0.188	0.03	10	93.72
3/25/2014	10:45	5.5	177	94.5	11.91	7.97	9.27	1	1.19	0.093	0.12	0.02	6	93.63
4/29/2014	10:20	8.36	175	106.6	12.47	8.46	5.48	4.1	0.19	0.056	0.088	0.02	4	69.07
5/28/2014	10:15	13.9	233	108.5	11.22	8.72	4.11	37.3	0.02	0.072	0.118	< 0.01	8	18.46
8/6/2014	10:40	21.11	325	113.9	10.12	8.67	2.33	118.7	< 0.01	0.095	0.105	< 0.01	4	2.27

03904A: Lawyer Creek @ TA 1460

Date	Time	Temperature, water	Specific conductance	Dissolved oxygen (DO), % Sat.	Dissolved oxygen (DO)	pH	Turbidity	Escherichia coli	NO3/NO2 mg/L	Ortho-P mg/L	T-Phos mg/L	NH3 mg/L	TSS mg/L	Velocity-discharge (cfs)
1/28/2014	12:45	2.03	297	105.5	14.56	8.16	4.26	3.1	1.41	0.078	0.09	0.01	4	7.72
2/18/2014	11:55	3.49	197	97.9	12.98	7.55	37.2	<1	1.87	0.129	0.212	0.04	20	64.62
3/25/2014	11:50	6.31	170	93.4	11.51	7.91	10.4	5.2	1.05	0.084	0.11	0.01	5	87.85
4/29/2014	11:30	9.84	172	106.8	12.00	8.36	5.61	1	0.15	0.05	0.075	0.02	6	57.8
5/28/2014	12:00	14.3	230	102.4	10.49	8.34	2.25	8.5	0.07	0.084	0.106	0.02	4	11

03916A: Lawyer Creek @ HWY 162														
Date	Time	Temperature, water	Specific conductance	Dissolved oxygen (DO), % Sat.	Dissolved oxygen (DO)	pH	Turbidity	Escherichia coli	NO3/NO2 mg/L	Ortho-P mg/L	T-Phos mg/L	NH3 mg/L	TSS mg/L	Velocity-discharge (cfs)
1/23/2014	13:20	0.5	289	99.1	14.28	7.86	5.13	42	1.44	0.085	0.1	0.03	4	11.53
2/25/2014	10:35	1.99	261	96.1	13.21	8.06	17.7	29.5	1.47	0.103	0.145	0.04	10	64.34
3/31/2014	10:20	3.8	140	92.8	12.23	7.87	17	24.3	0.73	0.055	0.21	0.01	8	140.05
4/30/2014	10:35	9.24	160	107.8	12.35	8.9	6.76	11	0.12	0.019	0.061	0.02	6	46.64
5/27/2014	10:30	14.9	255	106.0	10.16	8.79	4.17	248.1	0.16	0.042	0.075	0.03	10	9.83
8/5/2014	11:00	20.2	325	111.3	10.10	8.7	3.04	139.6	0.03	0.12	0.15	0.02	4	1.9

03926A: Lawyer Creek near HWY 95 (park under bridge)														
Date	Time	Temperature, water	Specific conductance	Dissolved oxygen (DO), % Sat.	Dissolved oxygen (DO)	pH	Turbidity	Escherichia coli	NO3/NO2 mg/L	Ortho-P mg/L	T-Phos mg/L	NH3 mg/L	TSS mg/L	Velocity-discharge (cfs)
1/22/2014	10:50	0.01	218	88.5	12.93	7.43	6.48	27.9	1.15	0.080	0.102	0.06	2	6.76
2/25/2014	13:05	1.58	177	93.3	13.03	7.96	27.9	365.4	0.81	0.094	0.157	0.07	19	47.35
3/26/2014	10:45	5.10	107	88.1	11.23	7.92	16.2	12	0.42	0.041	0.084	0.02	7	71.5
4/30/2014	12:35	9.76	115	101.7	11.51	8.75	13.7	3.1	0.06	0.024	0.07	0.01	14	36.06
5/27/2014	13:00	14.90	200	99.2	10.03	8.74	5.68	15.8	0.04	0.038	0.07	0.02	8	7.09
8/5/2014	12:25	22.00	305	114.4	10.06	8.78	4.58	365.4	0.03	0.144	0.183	0.02	6	0.92

03936A Lawyer Creek @ Icicle Flats

Date	Time	Temperature, water	Specific conductance	Dissolved oxygen (DO), % Sat.	Dissolved oxygen (DO)	pH	Turbidity	Escherichia coli	NO3/NO2 mg/L	Ortho-P mg/L	T-Phos mg/L	NH3 mg/L	TSS mg/L	Velocity-discharge (cfs)
1/23/2014	12:05	0.2	880	79.6	11.57	6.79	18.4	193.5	0.1	0.035	0.082	0.04	7	0.38
2/19/2014	12:25	0.2	71	82.3	12.01	6.72	20.2	34.5	0.16	0.08	0.163	0.02	14	4.84
3/24/2014	13:20	4.39	71	88.2	11.41	7.4	18.8	9.7	0.03	0.032	0.081	0.02	9	16.22
4/28/2014	12:55	6.52	69	89.0	10.92	7.29	13.5	8.4	0.01	0.023	0.066	0.02	16	14.1
5/21/2014	13:20	17.8	85	96.3	9.18	7.76	8.61	240	0.01	0.021	0.055	< 0.01	4	2.73

03941A Lawyer Creek Headwaters

Date	Time	Temperature, water	Specific conductance	Dissolved oxygen (DO), % Sat.	Dissolved oxygen (DO)	pH	Turbidity	Escherichia coli	NO3/NO2 mg/L	Ortho-P mg/L	T-Phos mg/L	NH3 mg/L	TSS mg/L	Velocity-discharge (cfs)
3/24/2014	12:25	5.5	60	84.9	10.71	6.95	23.1	24.9	0.11	0.035	0.087	0.03	9	2.13
4/28/2014	12:05	7.24	53	85.7	10.32	6.83	17.9	7.5	0.02	0.019	0.066	0.02	10	1.76
5/21/2014	12:35	18.7	60	87.8	8.19	7.06	23.6	131.7	0.02	0.021	0.067	< 0.01	15	0.41
8/4/2014	11:05	19.5	145	78.0	7.38	7.64	22.1	>2419.6	< 0.01	0.008	0.08	0.07	13	

10201A John Dobbs Creek @ mouth

Date	Time	Temperature, water	Specific conductance	Dissolved oxygen (DO), % Sat.	Dissolved oxygen (DO)	pH	Turbidity	Escherichia coli	NO3/NO2 mg/L	Ortho-P mg/L	T-Phos mg/L	NH3 mg/L	TSS mg/L	Velocity-discharge (cfs)
1/22/2014	11:45	0.01	434	88.2	12.88	7.91	4.83	2	2.23	0.26	0.29	0.25	3	1.51
2/25/2014	14:00	2.21	416	91.9	12.62	8.13	35.9	7.4	2.13	0.2	0.31	0.22	14	8.66
3/26/2014	11:40	6.3	407	91.8	11.34	8.72	4.66	5.2	2.8	0.13	0.32	0.01	2	3.38
4/30/2014	13:30	11.83	428	99.7	10.77	8.73	3.01	1	0.97	0.156	0.23	0.02	6	1.49
5/27/2014	14:10	13.5	485	99.3	10.35	8.95	2.8	6.3	0.09	0.183	0.23	0.02	5	0.5
8/5/2014	13:15	17.6	565	78.6	7.52	8.01	10.04	285.1	0.23	0.08	0.461	0.03	12	0.17

09303A: Willow Creek (mouth)

Date	Time	Temperature, water	Specific conductance	Dissolved oxygen (DO), % Sat.	Dissolved oxygen (DO)	pH	Turbidity	Escherichia coli	NO3/NO2 mg/L	Ortho-P mg/L	T-Phos mg/L	NH3 mg/L	TSS mg/L	Velocity-discharge (cfs)
1/23/2014	10:00	0.08	104	74.3	10.84	6.6	17.3	27.9	0.21	0.058	0.16	0.25	19	1.32
2/19/2014	10:30	0.02	79	78.0	11.40	6.74	26.2	21.3	0.27	0.139	0.24	0.25	16	13.19
3/24/2014	10:30	1.45	83	85.2	11.91	7.31	16.9	12.2	0.18	0.029	0.088	0.03	10	26.16
4/28/2014	10:20	4.08	77	88.6	11.55	7.39	12.4	45.7	0.05	0.018	0.068	0.02	10	23.05
5/21/2014	10:30	13	85	97.2	10.24	7.85	9.76	78.9	0.01	0.011	0.051	< 0.01	8	4.39

09304A: Willow Creek headwaters

Date	Time	Temperature, water	Specific conductance	Dissolved oxygen (DO), % Sat.	Dissolved oxygen (DO)	pH	Turbidity	Escherichia coli	NO3/NO2 mg/L	Ortho-P mg/L	T-Phos mg/L	NH3 mg/L	TSS mg/L	Velocity-discharge (cfs)
3/24/2014	11:40	2.67	62	83.5	11.98	7.33	21.2	14.6	0.01	0.029	0.104	0.02	17	14.55
4/28/2014	11:15	6.05	54	86.6	10.75	7.43	10	12.2	0.01	0.015	0.05	< 0.01	4	10.6
5/21/2014	11:35	18.4	60	90.6	8.51	7.59	7.7	14.8	0.01	0.013	0.042	< 0.01	6	1.79

05003A: Meadow Creek near Ferdinand

Date	Time	Temperature, water	Specific conductance	Dissolved oxygen (DO), % Sat.	Dissolved oxygen (DO)	pH	Turbidity	Escherichia coli	NO3/NO2 mg/L	Ortho-P mg/L	T-Phos mg/L	NH3 mg/L	TSS mg/L	Velocity-discharge (cfs)
1/22/2014	12:35	0.04	528	90.0	13.12	8.2	9.98	14.8	5.39	0.164	0.222	0.05	28	1.63
2/13/2014	14:05	1.96	201	92.5	12.79	7.44	932	613.1	1.69	0.47	2.3	0.21	1134	23.19
2/18/2014	14:10	3.65	494	89.9	11.87	8.08	12	2	4.28	0.24	0.29	0.04	18	2.36
2/25/2014	12:05	3.88	474	92.8	12.16	8.32	24.9	45						5.05
3/25/2014	13:55	9.58	530	104.6	11.90	8.91	6.17	3.1	5.28	0.13	0.18	0.01	8	2.29
4/30/2014	11:45	11.43	525	99.9	10.87	8.56	6.38	11	5.32	0.145	0.19	0.02	12	1.97
5/27/2014	12:00	15.1	565	94.1	9.47	8.55	9.27	29.5	5.09	0.155	0.2	0.02	20	1.2
8/4/2014	12:20	21	510	102.5	9.03	8.64	4.79	387.3	3.19	0.14	0.14	0.04	8	0.33

10301A Unnamed tributary @ allottment 369-A

Date	Time	Temperature, water	Specific conductance	Dissolved oxygen (DO), % Sat.	Dissolved oxygen (DO)	pH	Turbidity	Escherichia coli	NO3/NO2 mg/L	Ortho-P mg/L	T-Phos mg/L	NH3 mg/L	TSS mg/L	Velocity-discharge (cfs)
1/22/2014	13:35	0.16	250	80.5	11.70	7.85	14.8	88.6	0.91	0.078	0.12	0.06	9	0.62
2/19/2014	13:35	0.21	165	86.4	12.55	7.23	184	98.7	0.64	0.082	0.51	0.08	380	5.68
3/26/2014	12:45	8.3	168	96.7	11.37	8.34	29.8	18.1	1.43	0.06	0.19	0.02	112	3.88
4/28/2014	13:55	7.08	139	90.9	10.99	7.91	50.5	76.7	0.44	0.07	0.24	0.02	210	4.81
5/21/2014	14:10	20.8	155	106.3	9.53	8.83	21.1	8.6	0.18	0.118	0.2	< 0.01	31	1.9

06901A Sevenmile Creek @ mouth

Date	Time	Temperature, water	Specific conductance	Dissolved oxygen (DO), % Sat.	Dissolved oxygen (DO)	pH	Turbidity	Escherichia coli	NO3/NO2 mg/L	Ortho-P mg/L	T-Phos mg/L	NH3 mg/L	TSS mg/L	Velocity-discharge (cfs)
1/28/2014	13:55	2.97	207	102.9	13.85	8.21	3.53	2	0.73	0.14	0.158	< 0.01	2	0.98
2/13/2014	12:45	3.49	197	100.1	13.29	7.51	72	148.3	5.72	0.17	0.33	0.04	52	15.22
2/18/2014	13:00	4.64	187	99.8	12.86	7.81	23.5	<1	1.71	0.16	0.211	0.03	7	5.62
3/25/2014	12:45	6.89	184	92.7	11.25	8.02	13.4	5.2	1.35	0.16	0.19	0.02	2	3.66
4/29/2014	12:35	10.77	185	109.7	12.12	8.94	15.9	11	0.33	0.12	0.18	0.02	8	5.14
5/28/2014	13:15	14.2	195	105.7	10.85	8.74	9.61	56.5	0.18	0.135	0.16	0.01	6	1.17