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Data Summary Report

Little Spokane River Dissolved Oxygen and pH Total Maximum Daily Load Study

and

Little Spokane River Fish Hatchery Water Quality Monitoring for Nutrients

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Little Spokane River
Dissolved Oxygen and pH
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Little Spokane River Fish Hatchery
Water Quality Monitoring
for Nutrients

by

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Abstract

This report summarizes field and laboratory water quality data and flow data collected by the Washington State Department of Ecology (Ecology) and the Spokane County Conservation District during 2010 for the Little Spokane River Dissolved Oxygen/pH TMDL study. This report also summarizes data collected by Ecology during 2009 for the Little Spokane Fish Hatchery water quality monitoring study. A final report will be published in the near future. A quality control and quality assurance analysis of the data is included.

Field data include pH, conductivity, dissolved oxygen, water and air temperature, dew point, and flow. Laboratory data include ash-free dry weight, alkalinity, ammonia-nitrogen, biochemical oxygen demand, chloride, chlorophyll a, dissolved organic carbon, nitrite-nitrate nitrogen, orthophosphate, total non-volatile suspended solids, total organic carbon, total phosphorus, total persulfate nitrogen, and total suspended solids.

Introduction

The Little Spokane River and its tributaries have low dissolved oxygen (DO) concentrations and high pH that may not protect fish and other aquatic life. Dragoon Creek, a tributary to the Little Spokane River, has been the subject of Total Maximum Daily Load (TMDL) evaluations for ammonia nitrogen, chlorine, and total phosphorus (Joy, 1981 and Jones 1993). Phosphorus loads from the Little Spokane watershed have also been evaluated to assess seasonal impacts for the Spokane River/Lake Spokane Dissolved Oxygen TMDL (Moore and Ross, 2010). However, the causes of low DO and high pH in the Little Spokane River have not been assessed because data were lacking.

This report describes data collected from TMDL investigations in 2009 and 2010 that will fill the data gaps necessary to complete the pH and DO TMDLs in the Little Spokane watershed. Data collection included synoptic surveys during the summer low-flow season in 2010, as well as continuous temperature monitoring at selected locations. Additional nutrient data were collected from four sites during 2009 at the Little Spokane Fish Hatchery operated by the Washington Department of Fish and Wildlife.

Study Area

The Little Spokane River consists of a West Branch and East Branch that converge upstream of Milan. The river then continues down to Lake Spokane. The focus of the TMDL was the Little Spokane River mainstem from below Eloika Lake on the West Branch and Chain Lake on the East Branch, through the area between Milan and Dartford, to the mouth where it enters Lake Spokane (Figure 1).

The study area lies entirely within the Spokane Valley Outwash Plain Ecoregion. The primary land uses are forestland, agricultural, and residential.

Several 303(d) listings in the upper West and East Branches were not assessed (Table 1). Evaluation of the water quality of lakes and wetlands upstream of the affected reaches would have required more resources than are available at this time. A specialized set of studies is necessary to adequately address sources of DO and pH criteria violations other than those naturally caused by the presence of these upstream physical features.

Major tributaries in the Little Spokane River watershed also have DO and pH 303(d) listings. To address the listings, additional data were collected during the critical low-flow season from the lower free-flowing reaches of Dragoon, Deadman, and Little Deep Creeks.

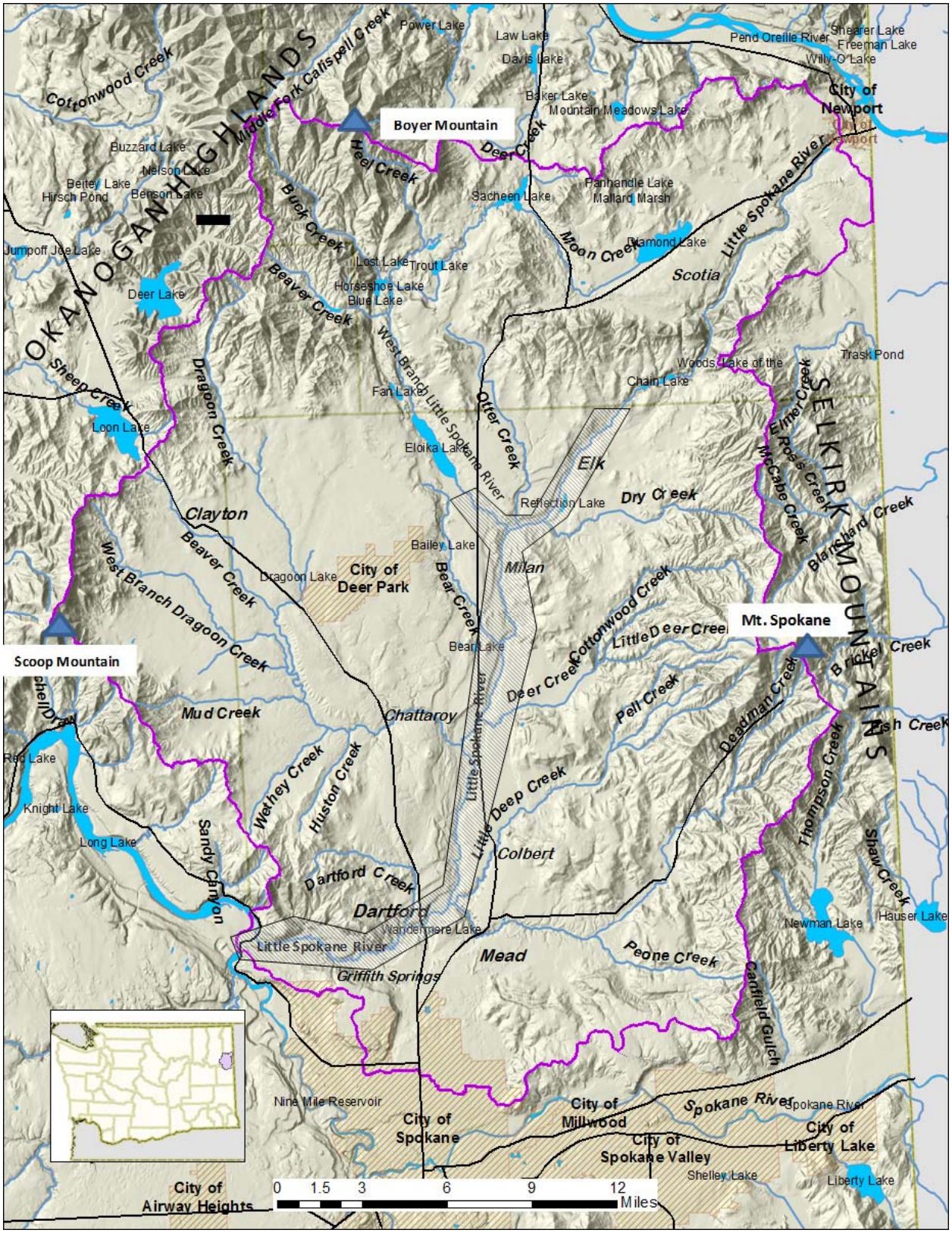

Figure 1. Study area (hatched area) for the Little Spokane River Dissolved Oxygen and pH TMDL study.

Table 1. Study area waterbodies on the 2008 303(d) list for parameters.

Waterbody	Parameter	Medium	Listing ID	Township	Range	Section
Little Spokane River	DO	Water	42597	26N	42E	05
	DO	**Water**	**47875***	30N	45E	08
	pH	Water	50434	27N	43E	33
	pH	Water	50436	29N	43E	35
Dartford Creek	pH	Water	50416	26N	43E	06
Deadman Creek	DO	Water	41981	26N	43E	01
	pH	**Water**	**50410**	26N	43E	01
	pH	**Water**	**50411**	27N	44E	33
	pH	Water	11388	27N	43E	33
Little Deep Creek	pH	Water	50401	27N	43E	33
Peone Creek	**DO**	**Water**	**47055**	26N	44E	08
Dragoon Creek	DO	Water	47094	29N	42E	34
	pH	Water	50397	28N	43E	33
Unnamed Spring at Kaiser	**DO**	**Water**	**42359**	26N	43E	03
Dry Creek	pH	Water	50373	29N	44E	30
West Branch Little Spokane	pH	Water	50379	29N	43E	15
	DO	Water	47073	29N	43E	15
	DO	**Water**	**47862**	30N	43E	32
	DO	**Water**	**47863**	31N	43E	34
Beaver Creek	**DO**	**Water**	**47869**	30N	43E	18
Buck Creek	**DO**	**Water**	**47872**	30N	43E	06
Moon Creek	**DO**	**Water**	**47861**	30N	44E	08

* Bold indicates waterbody listing IDs not addressed in this TMDL study.

Water Quality Standards and Beneficial Uses

Dissolved oxygen

Aquatic organisms are very sensitive to reductions in the level of DO in the water. The health of fish and other aquatic species depends on maintaining an adequate supply of oxygen dissolved in the water. Oxygen levels affect growth rates, swimming ability, susceptibility to disease, and the relative ability to endure other environmental stressors and pollutants. While direct mortality due to inadequate oxygen can occur, Washington State designed the criteria to maintain conditions that support healthy populations of fish and other aquatic life.

Oxygen levels can fluctuate over the day and night in response to changes in climatic conditions as well as the respiratory requirements of aquatic plants and algae. Since the health of aquatic species is tied predominantly to the pattern of daily minimum oxygen concentrations, the criterion is based on the lowest 1-day minimum oxygen concentrations that occur in a waterbody.

In the Washington State water quality standards, freshwater aquatic life use categories are described using key species (salmonid versus warm-water species) and life-stage conditions (spawning versus rearing). Minimum concentrations of DO are used as criteria to protect different categories of aquatic communities, some of which are specified for individual rivers, lakes, and streams.

The Little Spokane River watershed has not been designated for protection of any special population of fish. However, since the Little Spokane River is a tributary to Lake Spokane which has a core summer salmonid habitat designation, it must comply with the criteria of the lake [WAC 173-201A-600(1)(a)(iii)]. The DO criterion for core summer salmon protection criteria states [WAC 173-201A-200(1)(d)]:

> *The one-day minimum dissolved oxygen concentration shall not fall below 9.5 mg/L more than once every ten years on average. When DO is lower than the criterion (or are within 0.2 mg/L of the criterion) due to natural conditions, then cumulative human-caused activities will not decrease the dissolved oxygen more than 0.2 mg/L.*

The criterion above is used to maintain conditions where a waterbody is naturally capable of providing full support for its designated aquatic life uses. The standards recognize, however, that not all waters are naturally capable of staying above the fully protective DO criteria. When a waterbody is naturally lower in oxygen than the criteria, the state provides an additional allowance for further depression of oxygen conditions due to human activities. In this case, the combined effects of all human activities must not cause more than a 0.2 mg/l decrease below that naturally lower (inferior) oxygen condition.

The DO criterion may be quite restrictive for the Little Spokane River, especially during summer low-flows in July and August. Data are necessary to define or estimate DO conditions in the Little Spokane River that would seasonally occur without impacts from anthropogenic sources. For example, naturally low DO concentrations in groundwater are known to affect specific reaches of the watershed. Also, temperature and barometric pressure conditions can result in

DO concentrations at 100% saturation that are below 9.5 mg/L. However, the role of nutrients and eutrophication in creating DO concentrations out of compliance during critical summer conditions is likely occurring in open reaches of the mainstem and tributaries as well.

While the numeric criteria generally apply throughout a waterbody, the criteria are not intended to apply to discretely anomalous areas such as in shallow stagnant eddy pools where natural features unrelated to human influences are the cause of not meeting the criteria. For this reason, the standards direct that one take measurements from well-mixed portions of rivers and streams.

pH

The pH of natural waters is a measure of acid-base equilibrium achieved by the various dissolved compounds, salts, and gases. pH is an important factor in the chemical and biological systems of natural waters. pH both directly and indirectly affects the ability of waters to have healthy populations of fish and other aquatic species. Changes in pH affect the degree of dissociation of weak acids or bases. This effect is important because the toxicity of many compounds is affected by the degree of dissociation.

Some compounds, such as cyanide, increase in toxicity at lower pH; others, such as ammonia, increase in toxicity at higher pH. While there is no definite pH range within which aquatic life is unharmed and outside which it is damaged, there is a gradual deterioration as the pH values are further removed from the normal range. However, at the extremes of pH, lethal conditions can develop. For example, extremely low pH values (<5.0) may liberate sufficient carbon dioxide from bicarbonate in the water to be directly lethal to fish.

The state established pH criteria in the Washington State water quality standards primarily to protect aquatic life. The criteria also serve to protect waters as a source for domestic water supply. Water supplies with either extreme pH or those that experience significant changes of pH – even within otherwise acceptable ranges – are more difficult and costly to treat for domestic water purposes. pH also directly affects the longevity of water collection and treatment systems, and low pH waters may cause compounds of human health concern to be released from the metal pipes of the distribution system.

In the state's water quality standards, two pH criteria are established to protect six different categories of aquatic communities. Since the Little Spokane River watershed has not been designated with a special category but does need to comply with core summer salmonid protection, the pH criterion is [WAC 173-201A-200(1)(g)]:

> *pH must be kept within the range of 6.5 to 8.5, with a human-caused variation within the above range of less than 0.2 units.*

The criteria above are used to maintain conditions where a waterbody is naturally capable of providing full support for its designated aquatic life uses. The standards recognize, however, that not all waters are naturally capable of staying within the fully protective pH criteria. When a waterbody is naturally lower or higher than the criteria, this natural pH level becomes the local criteria. However, the state does not provide an additional allowance for further changes due to human activities. Only when the pH is within the criteria range can the combined effects of all human activities cause not more than a 0.2 units change.

Study Design and Methods

The primary project goals are to:

1. Provide a best estimate of the pollutant loading contributing to the DO and pH violations of Washington State water quality standards in the Little Spokane River and some of its tributaries.
2. Propose wasteload and load allocations throughout the watershed that will allow water quality standards to be met.

A secondary goal is to evaluate how any phosphorus and nitrogen allocations within the Little Spokane River meet the Lake Spokane DO TMDL phosphorus load allocations established for the Little Spokane River.

Ecology staff collected data in accordance with the requirements of the *Little Spokane River Watershed Dissolved Oxygen and pH Total Maximum Daily Load Study Water Quality Study Design: Quality Assurance Project Plan* (Joy and Tarbutton, 2010) and the *Little Spokane River Fish Hatchery Water Quality Monitoring for Nutrients: Quality Assurance Project Plan* (Ross, 2008).

The following standard operating procedures (SOPs) were followed as appropriate:

- EAP011 Instantaneous Measurement of Temperature in Water.
- EAP013 Determining Global Positioning System Coordinates.
- EAP015 Grab sampling – Fresh Water.
- EAP023 Winkler Determination of Dissolved Oxygen.
- EAP024 Estimating Streamflow.
- EAP031 Measurement of pH in Freshwater.
- EAP032 Measurement of Conductivity in Freshwater.
- EAP033 Hydrolab® DataSonde and MiniSonde Multiprobes.
- EAP035 Measurement of Dissolved Oxygen in Surface Water.
- EAP071 Minimizing spread of invasive species in areas of moderate concern.
- EPA rapid bioassessment periphyton protocols (Stevenson and Bahls, 2007).

Methods for collecting laboratory parameters, flow measurements and field parameters are described in Ecology's field measurements and sampling protocols manual (Ecology, 1993). In addition, data from the U.S. Geological Survey (USGS) and the Spokane County Conservation District (SCCD) streamflow gages were obtained for use in the project.

Synoptic surveys were conducted on July 26-30, 2010 and August 23-27, 2010. Continuous temperature data were collected June through September, 2010. Additional continuous temperature data were collected by SCCD March through September, 2010. Nutrient and field data were collected at four sites at Little Spokane Fish Hatchery twice monthly between February and September 2009. Sampling locations are displayed in Figures 2 and 3, and described in Appendix A, Tables A-1 and A-2. Table 2 summarizes field and laboratory methods used during the course of this study.

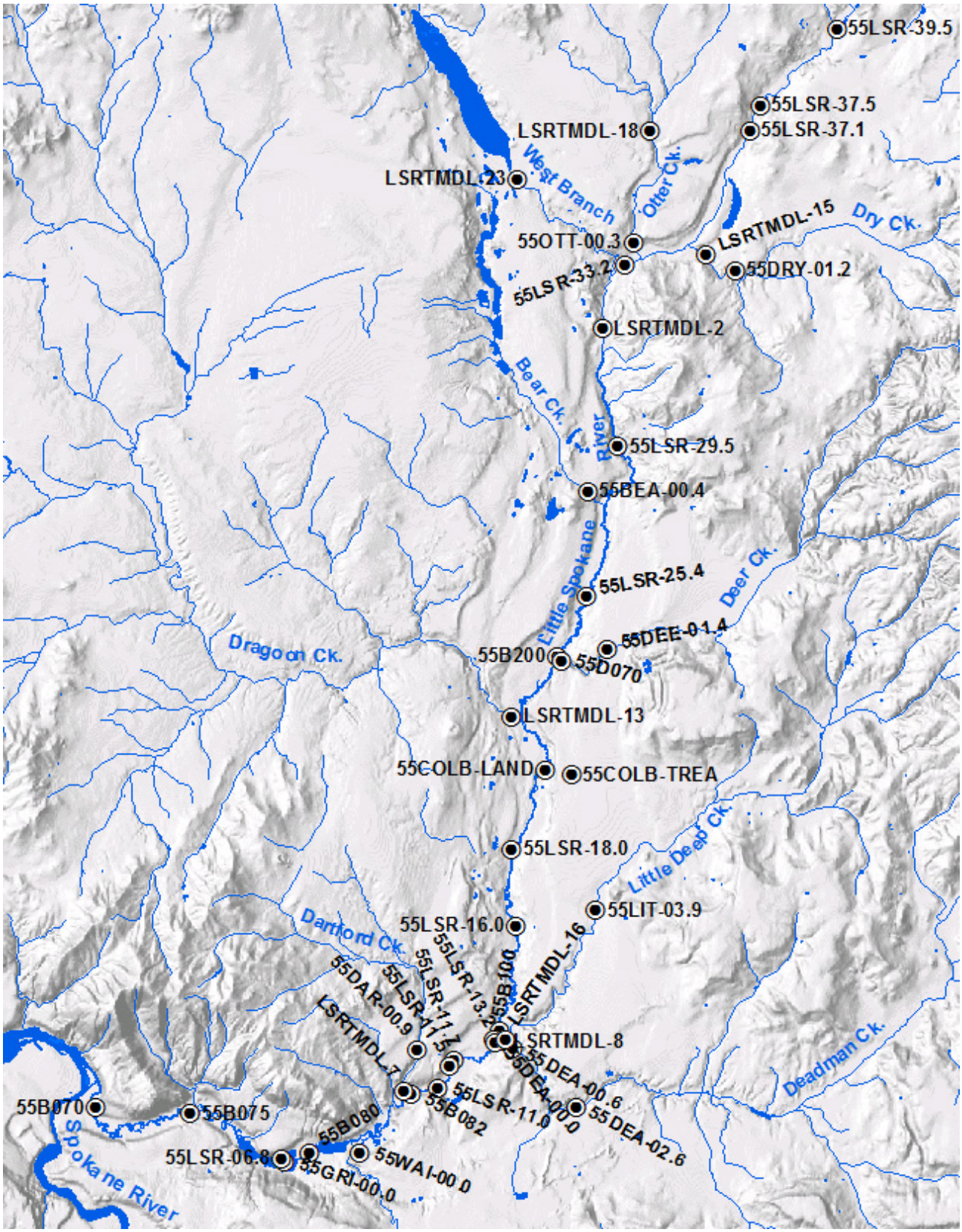

Figure 2. TMDL sampling sites in the Little Spokane watershed used during 2010.

Figure 3. Sampling sites at the Little Spokane Fish Hatchery used during 2009.

Table 2. Field and laboratory methods.

Parameter	Method	Expected Range of Values	Reporting Limits / Resolution
Chloride	EPA 300.0	0.3 – 100 mg/L	0.1 mg/L
Total Suspended Solids; TNVSS	SM 2540D	1 – 10,000 mg/L	1 mg/L
Alkalinity	SM 2320B	20 – 200 mg/L as $CaCO_3$	5 mg/L
Ammonia	SM 4500-NH_3H	<0.01 – 30 mg/L	0.01 mg/L
Dissolved Organic Carbon	EPA 415.1	<1 – 20 mg/L	1 mg/L
Nitrate/Nitrite	4500-NO_3 I	<0.01 – 30 mg/L	0.01 mg/L
Total Persulfate Nitrogen	SM 4500-NB	0.5 – 50 mg/L	0.025 mg/L
Orthophosphate	SM 4500-P G	0.01 – 5.0 mg/L	0.003 mg/L
Total Phosphorous	SM 4500-P F	0.01 – 10 mg/L	0.005 mg/L
Total Organic Carbon	EPA 415.1	<1 – 20 mg/L	1 mg/L
Biochemical Oxygen Demand	EPA 405.1	<1 – 14 mg/L	2 mg/L
Chlorophyll-a	SM 10300	1 – 1000 mg/m^2	0.1 µg/L
Ash-free Dry Weight	SM 10300	1 – 1000 mg/m^2	1 mg/L
Water Temperature	EAP033	1-30 ^oC	0.01^oC
Specific Conductivity	EAP033	50-500 uS/cm	0.1 uS/cm
pH	EAP033	6-9 su	0.05 su
Dissolved Oxygen	EAP033	1-12 mg/L	0.01 mg/L
Flow	EAP024	<0.1-10 ft/sec	0.01 ft/sec

EPA: Approved U.S. Environmental Protection Agency (EPA) analytical method
SM: Standard Methods (APHA, 2005)
EAP: Ecology Environmental Assessment Program (EAP) standard operating procedure
TNVSS: Total Non-Volatile Suspended Solids

Data Quality

Sample Data Quality

Ecology took replicate field samples for laboratory parameter analyses. Field replicates are two samples collected from the same location at the same time. Ecology collects field replicates to check the precision of the entire process of sampling and analysis. The percentage of replicates taken per parameter can be seen in Tables 4 and 7. Both the frequency of field replicates and precision of the replicated samples met criteria with the exception of Hydrolab-collected data (pH, conductivity, temperature, and DO) during the 2009 Little Spokane Fish Hatchery study and flow measurements during the 2010 Little Spokane River TMDL study. Those replicates taken were within criteria (Tables 4-5 and 7-8).

Ecology's Manchester Environmental Laboratory standard operating procedure (SOP) calls for duplicating a minimum of 5% of all samples (1/20 samples or 1/analytical batch). That goal was exceeded for all parameters. Duplicate precision was met for all parameters (Tables 3 and 6). Manchester Environmental Laboratory assesses bias for certain parameters through the use of matrix spikes (Tables 3 and 6). Bias targets were met for all parameters except for nitrite-nitrate nitrogen during the 2010 Little Spokane River TMDL study. Nitrate-nitrite bias was -9%, meaning the values may slightly underestimate sample concentrations. This is presumed to be the result of matrix interference during the laboratory analysis.

Ecology submitted field blanks for analysis with each synoptic survey during 2010 and nine times during 2009. In addition, Manchester Laboratory routinely ran lab blanks along with each analytical batch. All field and lab blanks throughout both years resulted in non-detects.

Hydrolab Data Quality

Ecology calibrated all field monitoring equipment according to manufacturer's specifications and pre-calibrated and post-checked Hydrolab® meters with certified standards.

Conductivity and pH accuracy were ensured through calibration post-checks. All conductivity and pH post-checks were within criteria except for continuous conductivity measurements taken by the Hydrolab deployed at LSRTMDL-7 (Dartford Creek at Hazard Road) during the July 26-30, 2010 synoptic survey. These data were qualified as estimates. During the August 23-27, 2010 synoptic survey, continuous conductivity data from LSRTMDL-15 (Dry Creek at Milan-Elk Road) and LSRTMDL-8 (Deadman Creek below Little Deep Creek) were qualified as estimates due to partial probe malfunction.

DO accuracy was insured through comparison with Winkler titration results. At least three Winkler samples were taken with each Hydrolab used for deployment or spot measurements. All DO data were corrected based on Winkler results. Corrected DO data are of high quality and do not need qualification, with the following exceptions:

- During the July 26-30, 2010 synoptic survey, continuous data from LSRTMDL-7 (Dartford Creek at Hazard Road) and 55LSR-11.0 (Little Spokane River at Dartford USGS Gage) were qualified as estimates due to poor correlation with Winkler data. Continuous data from 55D070 (Deer Creek at Hwy 2) were rejected due to extreme calibration shift.
- During the August 23-27, 2010 synoptic survey, continuous data from LSRTMDL-7 (Dartford Creek at Hazard Road) taken before 5:00 am on August 26, 2010 were rejected due to extreme calibration shift. Data taken after that time are acceptable.

Continuous Temperature Data Quality

Ecology continuous air and water temperature dataloggers were subjected to two-point calibration checks before and after deployment using cold and warm water baths. Relative humidity dataloggers were checked against each other for consistency. All Ecology temperature and humidity dataloggers were found to be operating within criteria.

SCCD continuous water temperature dataloggers were not calibration checked using water baths; however, point temperature measurements were taken in the field to compare to logger readings. These checks showed the majority of SCCD dataloggers to be more than 0.2°C away from the actual value. Logger error values ranged from ±0.07°C to ±2.85°C. The manufacturer specifications for the SCCD dataloggers are ±0.53°C with 0.1°C drift per year, and the loggers are approximately ten years old (Noll, personal communication). Therefore it would be reasonable to expect approximately ±1.5°C error. Loggers with errors greater than ±1.5°C were located at 55LSR-37.5 (Little Spokane River at Elk Park) and 55LSR-29.5 (Little Spokane River above Bear Creek). Continuous temperature data from SCCD loggers will be used with caution, accounting for data error.

Table 3. Lab precision and bias results for the 2010 Little Spokane River TMDL study.

Parameter	Number Samples	Number Replicates	% replicated	Target Precision	Average %RSD[1]		Target Bias	Average Bias
					< 5x DL	>= 5x DL		
Ash-Free Dry Weight	8	3	38%	<20% RSD	--	5.0%	N/A	
Alkalinity	122	10	8%	<20% RSD	--	0.7%	N/A	
Ammonia-Nitrogen	122	9	7%	<20% RSD	2.5%	1.7%	±5%	-2%
Biochemical Oxygen Demand 5-day	16	6[2]	38%	<20% RSD	--	--	N/A	
Chloride	122	9	7%	<20% RSD	--	0.8%	N/A	+1%
Chlorophyll a	8	2	25%	<20% RSD	--	14.8%	N/A	
Nitrite-Nitrate Nitrogen	122	10	8%	<10% RSD	--	0.3%	±5%	-9%
Orthophosphate	122	12	10%	<20% RSD	2.0%	1.6%	±5%	-1%
Total Non-volatile Suspended Solids	61	9	15%	<20% RSD	18.2%	7.9%	N/A	
Total and Dissolved Organic Carbon[3]	122	9	7%	<20% RSD	2.2%	3.3%	±10%	+1%
Total Phosphorus	122	13	11%	<20% RSD	1.8%	1.5%	±5%	-4%
Total Persulfate Nitrogen	122	15	12%	<20% RSD	--	1.4%	±10%	0%
Total Suspended Solids	61	8	13%	<20% RSD	0.0%	5.4%	N/A	

[1]Results at the detection limit were excluded from consideration.
[2]All but one Biochemical Oxygen Demand 5-day test replicates were non-detects. The remaining duplicate had a result of 13 mg/L, while the original sample was a non-detect.
[3]Total Organic Carbon and Dissolved Organic Carbon are the same laboratory analysis. The only difference is field filtration. Therefore precision and bias checks were only performed by the laboratory on Total Organic Carbon samples, but the results apply to both parameters.

Table 4. Total precision (field + lab) results for the 2010 Little Spokane River TMDL study.

Parameter	Number Samples	Number Replicates	% replicated	Target Precision	Average %RSD[1]	
					< 5x DL	>= 5x DL
Ash-Free Dry Weight	8	2	25%	<20% RSD	--	6.2%
Alkalinity	122	24	20%	<20% RSD	--	0.6%
Ammonia-Nitrogen	122	24	20%	<20% RSD	6.3%	8.8%
Biochemical Oxygen Demand 5-day	16	8[2]	50%	<20% RSD	--	--
Chloride	122	24	20%	<20% RSD	--	2.0%
Chlorophyll a	8	2	25%	<20% RSD	--	9.7%
Dissolved Organic Carbon	122	24	20%	<20% RSD	4.2%	--
Nitrite-Nitrate Nitrogen	122	24	20%	<10% RSD	5.7%	5.5%
Orthophosphate	122	24	20%	<20% RSD	6.7%	2.2%
Total Non-volatile Suspended Solids	61	12	20%	<20% RSD	16.3%	7.4%
Total Organic Carbon	122	24	20%	<20% RSD	5.2%	--
Total Phosphorus	122	24	20%	<20% RSD	4.7%	4.0%
Total Persulfate Nitrogen	122	24	20%	<20% RSD	--	14.8%
Total Suspended Solids	61	12	20%	<20% RSD	10.8%	5.4%

[1]Results at the detection limit were excluded from consideration.
[2]All Biochemical Oxygen Demand 5-day test replicates were non-detects.

Table 5. Field measurement precision results for the 2010 Little Spokane River TMDL study.

Parameter	Number Measurements	Number Replicates	% replicated	Target Precision	Average %RSD
Flow	86	3	3%	--	2.5%
Temperature	57	14	25%	±0.1°C[1]	±0.02°C
Conductivity	57	14	25%	<0.5% RSD	0.1%
Dissolved Oxygen	57	14	25%	<5% RSD	0.1%
pH	57	14	25%	±0.20 S.U.[1]	±0.01 S.U.

[1]Precision for Temperature and pH is given in the unit of measurement, rather than %RSD.

Table 6. Lab precision and bias results for the 2009 Little Spokane Fish Hatchery study.

Parameter	Number Samples	Number Replicates	% replicated	Target Precision	Average %RSD[1]		Target Bias	Average Bias
					< 5x RL	>= 5x RL		
Alkalinity	15	15	100%	<20% RSD	0.9%	0.7%	±20%	--[2]
Ammonia-Nitrogen	64	17	27%	<20% RSD	3.1%	1.8%	±20%	-3%
Biochemical Oxygen Demand 5-day	32	8[3]	25%	<20% RSD	0.0%	--	N/A	--
Chloride	15	15	100%	<20% RSD	0.3%	3.6%	±20%	-1%
Nitrite-Nitrate Nitrogen	64	20	31%	<20% RSD	8.8%	0.5%	±20%	-9%
Orthophosphate	64	16	25%	<20% RSD	2.4%	1.0%	±20%	-4%
Total and Dissolved Organic Carbon[4]	15	14	93%	<20% RSD	2.4%	0.7%	±20%	-2%
Total Phosphorus	64	17	27%	<20% RSD	5.9%	3.4%	±20%	+2%
Total Persulfate Nitrogen	64	19	30%	<20% RSD	--	1.1%	±20%	-6%
Total Suspended Solids	15	30	200%[5]	<20% RSD	17.7%	5.7%	N/A	--

[1]Results at the detection limit were excluded from consideration.
[2]A target bias of 20% RSD was established for alkalinity; however, the laboratory does not perform matrix spikes for this parameter.
[3]All but one Biochemical Oxygen Demand 5-day test replicates were non-detects. The remaining duplicate had the same result as the original sample, resulting in a 0% RSD.
[4]Total Organic Carbon and Dissolved Organic Carbon are the same laboratory analysis. The only difference is field filtration. Therefore precision and bias checks were only performed by the laboratory on Total Organic Carbon samples, but the results apply to both parameters.
[5]Laboratory replicates used to check a batch of samples can come from samples in a different project. This is why the number of TSS samples replicated exceeds the actual number of samples taken during the study.

Table 7. Total precision (field + lab) results for the 2009 Little Spokane Fish Hatchery study.

Parameter	Number Samples	Number Replicates	% replicated	Target Precision	Average %RSD[1]	
					< 5x RL	>= 5x RL
Alkalinity	15	4	27%	<20% RSD	--	0.7%
Ammonia-Nitrogen	64	16	25%	<20% RSD	4.4%	6.4%
Biochemical Oxygen Demand 5-day	32	8[2]	25%	<20% RSD	--	--
Chloride	15	4	27%	<20% RSD	--	1.4%
Dissolved Organic Carbon	15	4[3]	27%	<20% RSD	--	--
Nitrite-Nitrate Nitrogen	64	16	25%	<20% RSD	--	13.6%
Orthophosphate	64	16	25%	<20% RSD	3.3%	1.3%
Total Organic Carbon	15	4[3]	27%	<20% RSD	--	--
Total Phosphorus	64	16	25%	<20% RSD	15.0%	--
Total Persulfate Nitrogen	64	16	25%	<20% RSD	--	17.5%
Total Suspended Solids	15	4[3]	27%	<20% RSD	--	--

[1]Results at the detection limit were excluded from consideration.
[2]All but one Biochemical Oxygen Demand 5-day test replicates were non-detects. The remaining duplicate had the same result as the original sample, resulting in a 0% RSD.
[3]All Dissolved Organic Carbon, Total Organic Carbon, and Total Suspended Solids field replicates were non-detects.

Table 8. Field measurement precision results for the 2009 Little Spokane Fish Hatchery study.

Parameter	Number Measurements	Number Replicates	% replicated	Target Precision	Average %RSD
Flow	57	11	19%	<20% RSD	2.0%
Temperature	64	1	2%	±0.1°C[1]	±0.02°C
Conductivity	64	1	2%	<5% RSD	0.2%
Dissolved Oxygen	64	1	2%	<10% RSD	0.1%
pH	64	1	2%	±0.20 S.U.[1]	0 S.U.

[1]Precision for Temperature and pH is given in the unit of measurement, rather than %RSD.

Results

All data collected during the Little Spokane River DO-pH TMDL study and the Little Spokane Fish Hatchery Water Quality Monitoring for Nutrients study are arranged by site and date and presented in the following appendices:

- Appendix A describes sample locations.
- Appendix B lists laboratory data provided by Ecology's Manchester Laboratory.
- Appendix C lists field measurement results.
- Appendix D presents plots of continuous pH, temperature, conductivity, and DO collected from deployment of Hydrolab Datasonde® and Minisonde® multiprobes.
- Appendix E presents plots of continuous temperature and dew point data collected using Onset Hobo® dataloggers.
- Appendix F presents, for reference, selected flow data from 2010 provided by USGS gaging stations.
- Appendix G summarizes case narratives provided by Manchester Laboratory.

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Appendices

Appendix A. Sample Locations

Table A-1. Sampling locations used during the 2010 Little Spokane River DO-pH TMDL study.

Location ID	Location Description	Nutrients	Field Measurements	Periphyton	Continuous Hydrolab	Continuous Temp	Latitude	Longitude
LSRTMDL-23	West Branch Little Spokane R. below Eloika Lk.	X	X			SCCD	48.0071	-117.3627
55LSR-39.5	Little Spokane R. at Frideger Rd.	X	X		X	X	48.0407	-117.2437
55LSR-37.5[1]	Little Spokane R. at Elk Park					SCCD	48.0226	-117.2730
55LSR-37.1	Little Spokane R. at Elk-to-Hwy Rd. in Elk	X	X				48.0166	-117.2770
55DRY-01.2	Dry Ck. at N. Dunn Rd.	X	X				47.9823	-117.2846
LSRTMDL-15	Dry Ck. at Milan-Elk Rd.	X	X		X		47.9865	-117.2951
LSRTMDL-18	Otter Ck. at Elk-to-Hwy Rd.	X	X				48.0174	-117.3133
55OTT-00.3	Otter Ck. at Valley Rd.	X	X		X		47.9903	-117.3212
55LSR-33.2	Little Spokane R. at E. Eloika Rd.	X	X	X			47.9849	-117.3247
LSRTMDL-2	Little Spokane R. at Deer Park-Milan Rd.	X	X		X	SCCD	47.9695	-117.3339
55LSR-29.5[1]	Little Spokane R. above Bear Ck.					SCCD	47.9404	-117.3299
55BEA-00.4	Bear Ck. at Milan Rd.	X	X				47.9297	-117.3416
55LSR-25.4	Little Spokane R. at Riverway Rd.	X	X	X			47.9040	-117.3435
55B200	Little Spokane R. at Chattaroy	X	X		X	SCCD	47.8894	-117.3553
55DEE-01.4	Deer Ck. at N. Elk-Chattaroy Rd.	X	X				47.8908	-117.3366
55D070	Deer Ck. at Hwy. 2	X	X		X		47.8883	-117.3536
LSRTMDL-13	Dragoon Ck. at Crescent Rd.	X	X		X	X	47.8751	-117.3728
55COLB-TREA	Colbert Landfill (treated water exiting facility)	X					47.8603	-117.3516
55COLB-LAND	Colbert Landfill (treated water at outfall)		X				47.8618	-117.3609
55LSR-18.0	Little Spokane R. at Little Spokane Dr. in Buckeye	X	X	X			47.8426	-117.3746
55LSR-16.0	Little Spokane R. at E. Colbert Rd.	X	X			SCCD[2]	47.8239	-117.3741
55B100	Little Spokane R. at N. Little Spokane Dr.	X	X		X		47.7983	-117.3817
55LSR-13.2	Little Spokane R. above Deadman Ck.					X	47.7960	-117.3837
55DEA-02.6	Deadman Ck. at private owner below Market St.	X	X				47.7788	-117.3548
55DEA-00.6	Deadman Ck. at Shady Slope Rd.					X	47.7937	-117.3771
LSRTMDL-8	Deadman Ck. below Little Deep Ck.	X	X		X		47.7956	-117.3808
55DEA-00.0	Deadman Ck. at mouth					X	47.7955	-117.3833
55LIT-03.9	Little Deep Ck. at Colbert Rd.	X	X				47.8267	-117.3448
LSRTMDL-16	Little Deep Ck. above Deadman Ck.	X	X		X		47.7960	-117.3797
55LSR-11.7	Little Spokane R. at Pine River Park (road bridge)					X	47.7913	-117.3984
55LSR-11.5	Little Spokane R. at Pine River Park (in park)			X			47.7900	-117.4002
55LSR-11.0	Little Spokane R. at Dartford USGS gage				X		47.7847	-117.4049
55B082	Little Spokane R. at N. Dartford Dr.	X	X				47.7836	-117.4144
55DAR-00.9	Dartford Ck. along N. Dartford Dr.	X	X				47.7945	-117.4117
LSRTMDL-7	Dartford Ck. at Hazard Rd.	X	X		X		47.7844	-117.4173
55WAI-00.0	Waikiki Springs at Spokane Country Club	X	X				47.7696	-117.4341
55B080	Little Spokane R. at W. Waikiki Rd.	X	X				47.7700	-117.4525
55GRI-00.0	Griffith Spring combined discharge to river	X	X				47.7682	-117.4616
55LSR-06.8	Little Spokane R. below Griffith Spring					X	47.7688	-117.4625
55B075	Little Spokane R. at Rutter Pkwy.	X	X				47.7809	-117.4952
55B070	Little Spokane R. at Hwy 291	X	X		X		47.7832	-117.5297

[1]SCCD data only, sites not in EIM.
[2]At 55LSR-16.0, SCCD collected water temp data and Ecology collected air and dew point data.

Table A-2. Sampling locations used during the 2009 Little Spokane Fish Hatchery study.

Location ID	Location Description	Latitude	Longitude
55GRI-00.5	Griffith Spring above LS Fish Hatchery	47.7654	-117.4591
55GSFH-00.4	Broodstock Outfall	47.7665	-117.4585
55GSFH-00.3	Main Outfall	47.7666	-117.4599
55GRI-00.0	Combined Discharge	47.7682	-117.4616

Appendix B. Laboratory Data

Table B-1. Abbreviations and units of measurement used in this appendix.

Abbreviation	Parameter	Unit of Measurement
AFDW	Ash-Free Dry Weight (Volatile Organic Matter)	mg/L
Alk	Alkalinity, Total as $CaCO_3$	mg/L
NH_3	Ammonia Nitrogen	mg/L
BOD5	Biochemical Oxygen Demand 5-day	mg/L
Cl	Chloride	mg/L
Chl a	Chlorophyll a	ug/L
DOC	Dissolved Organic Carbon	mg/L
NO_2-NO_3	Nitrite-Nitrate Nitrogen	mg/L
OP	Orthophosphate	mg/L
Peri (AFDW)	Periphyton Biomass (as Ash-Free Dry Weight)	mg/m^2
Peri (Chl a)	Periphyton Biomass (as Chlorophyll a)	mg/m^2
TNVSS	Total Non-volatile Suspended Solids	mg/L
TSS	Total Organic Carbon	mg/L
TP	Total Phosphorus	mg/L
TPN	Total Persulfate Nitrogen	mg/L
TSS	Total Suspended Solids	mg/L

Table B-2. Data qualifiers used in this appendix.

Qualifier	Meaning
U	The analyte was not detected at or above the reported result.
J	The analyte was positively identified. The associated numerical result is an estimate.
UJ	The analyte was not detected at or above the reported estimated result.

Table B-3. Laboratory water quality results from the 2010 Little Spokane River DO-pH TMDL study.

Location ID	Date	Time	Alk	NH3	BOD5	Cl	DOC	NO2-NO3	OP	TNVSS	TOC	TPN	TP	TSS
LSRTMDL-23	7/27/2010	8:20	42.5	0.03		2.22	5.6	0.01 U	0.0069	1 U	6.4	0.454	0.0243	2
LSRTMDL-23	7/27/2010	13:30	41.8	0.027		2.19	5.8	0.01 U	0.0065		6.3	0.462	0.0248	
LSRTMDL-23	8/24/2010	9:05	43.9	0.01 U		2.7	6.5	0.017	0.0041	2 U	7.4	0.514	0.0281	5
LSRTMDL-23	8/24/2010	13:20	42.8	0.016		2.78	6.5	0.015	0.0047		7.7	0.51	0.0243	
55LSR-39.5	7/27/2010	9:10	107	0.01 U		2.91	1.8	0.011	0.0073	1 U	2.1	0.156	0.0131	2
55LSR-39.5	7/27/2010	14:10	106	0.01 U		2.9	1.9	0.013	0.0068		2	0.151	0.0113	
55LSR-39.5	7/27/2010	14:10	106	0.01 U		2.8	1.9	0.012	0.0068		2.3	0.169	0.0131	
55LSR-39.5	8/24/2010	9:40	108	0.01 U		3.07	1.4	0.01 U	0.004	1 U	1.7	0.14	0.0085	1
55LSR-39.5	8/24/2010	14:00	107	0.01 U		3.02	1.5	0.01 U	0.004		1.8	0.149	0.0082	
55LSR-39.5	8/24/2010	14:00	108	0.01 U		3.07	1.5	0.01 U	0.0041		1.9	0.128	0.0089	
55LSR-37.1	7/27/2010	10:00	99.5	0.01 U		2.8	1.6	0.167	0.008	1 U	1.7	0.272	0.0112	2
55LSR-37.1	7/27/2010	14:30	96.9	0.01 U		2.76	1.8	0.141	0.0081		1.9	0.287	0.0124	
55LSR-37.1	8/24/2010	10:26	103	0.01 U		2.88	1.2	0.165	0.0055	1 U	1.6	0.273	0.0086	1 U
55LSR-37.1	8/24/2010	14:45	100	0.01 U		2.94	1.1	0.15	0.0058		1.6	0.269	0.0094	
55DRY-01.2	7/27/2010	10:20	108	0.01 U		2.55	1	1.06	0.0179	1 U	1	1.15	0.0243	1
55DRY-01.2	7/27/2010	10:20	108	0.01 U		2.63	1.1	1.06	0.0176	1 U	1.1	1.12	0.0259	1
55DRY-01.2	7/27/2010	14:50	108	0.01 U		2.7	1	1.08	0.0179		1	1.12	0.0263	
55DRY-01.2	8/24/2010	10:50	112	0.01 U		2.66	1 U	1.15	0.0151	3 J	1 U	1.25	0.0146	4 J
55DRY-01.2	8/24/2010	10:50	111	0.01 U		2.67	1 U	1.17	0.0125	3 J	1 U	1.23	0.0151	4 J
55DRY-01.2	8/24/2010	15:00	112	0.01 U		2.72	1 U	1.15	0.0123		1 U	1.2	0.014	
LSRTMDL-15	7/27/2010	11:20	109	0.01 U		2.52	1.7	0.969	0.0225	4	1.5	1.07	0.0301	5
LSRTMDL-15	7/27/2010	15:15	110	0.01 U		2.6	1.4	0.997	0.0229		1.5	1.08	0.027	
LSRTMDL-15	8/24/2010	11:20	113	0.01 U		2.64	1 U	1.08	0.0183	2 J	1 U	1.16	0.0206	3 J
LSRTMDL-15	8/24/2010	15:35	114	0.01 U		2.7	1 U	1.09	0.0186		1 U	1.17	0.0198	
LSRTMDL-18	7/27/2010	12:00	120	0.01 U		4.32	1.7	1.45	0.0456	4	1.3	1.61	0.0506	5
LSRTMDL-18	7/27/2010	15:42	119	0.01 U		4.53	1.8	1.53	0.0477		1.6	1.66	0.0503	
LSRTMDL-18	8/24/2010	12:00	87.2	0.01 U		9.84	1.5	0.819	0.0287	1 U	1.6	0.98	0.0383	2
LSRTMDL-18	8/24/2010	16:10	86.9	0.024		10	1.7	0.857	0.0288		2	1.35	0.0429	
55OTT-00.3	7/27/2010	12:45	82.6	0.01 U		4.36	1 U	1.65	0.0224	1	1 U	1.64	0.0224	2
55OTT-00.3	7/27/2010	16:10	82.5	0.01 U		4.4	1.1	1.69	0.0214		1.1	1.64	0.0223	
55OTT-00.3	8/24/2010	12:40	78.9	0.01 U		5.64	1 U	1.45	0.0202	1 U	1 U	1.62	0.0238	2 J
55OTT-00.3	8/24/2010	16:45	79.5	0.01 U		5.88	1 U	1.58	0.021		1 U	1.52	0.0226	
55LSR-33.2	7/27/2010	10:20	98.7	0.01 U		2.9	1.3	0.379	0.0127	4	1.6	0.47	0.0179	5
55LSR-33.2	7/27/2010	13:50	98.3	0.01 U		2.93	1.3	0.366	0.012		1.6	0.478	0.0172	
55LSR-33.2	8/24/2010	9:45	102	0.01 U		3.39	1 UJ	0.385	0.0086	1 U	1.5	0.465	0.0136	2 J
55LSR-33.2	8/24/2010	14:40	145	0.01 U		3.46	1.1	0.372	0.009		1.5	0.48	0.0111	

Location ID	Date	Time	Alk	NH3	BOD5	Cl	DOC	NO2-NO3	OP	TNVSS	TOC	TPN	TP	TSS
LSRTMDL-2	7/27/2010	11:00	80.8	0.01 U		2.7	2.7	0.266	0.013	1	3	0.466	0.0203	2
LSRTMDL-2	7/27/2010	14:30	80.3	0.01 U	2 U	2.77	2.5	0.255	0.0126		2.8	0.45	0.0209	
LSRTMDL-2	7/27/2010	14:30	80.1	0.01 U	2 U	2.66	2.5	0.252	0.0112		2.7	0.448	0.0203	
LSRTMDL-2	8/24/2010	10:25	90.6	0.01 U		3.28	1.9	0.285	0.0072	1 U	2.4	0.45	0.013	1
LSRTMDL-2	8/24/2010	15:15	89.7	0.01 U	2 U	3.26	1.8	0.275	0.0074		2.5	0.435	0.0153	
LSRTMDL-2	8/24/2010	15:15	89.4	0.01 U	13	3.23	1.9	0.277	0.0077		2.3	0.426	0.0159	
55BEA-00.4	7/27/2010	11:45	150	0.01 U		4.8	2.5	1.13	0.0297	9	2.7	1.36	0.0496	15
55BEA-00.4	7/27/2010	11:45	150	0.01 U		4.59	2.5	1.12	0.0302	8	2.8	1.36	0.0564	15
55BEA-00.4	7/27/2010	15:00	144	0.01 U		4.22	2.5	0.976	0.0286		2.8	1.18	0.0505	
55BEA-00.4	8/24/2010	11:25	157	0.01 U		4.09	3	0.652	0.0159	5	3.1	0.848	0.0351	9
55BEA-00.4	8/24/2010	11:25	157	0.01 U		4.05	3.1	0.656	0.0156	5	3.4	0.89	0.0369	10
55BEA-00.4	8/24/2010	15:45	157	0.01 U		3.91	2.9	0.679	0.0159		3.4	0.894	0.0328	
55LSR-25.4	7/27/2010	12:35	84.2	0.01 U		2.91	2.4	0.24	0.0097	2	2.8	0.452	0.0184	3
55LSR-25.4	7/27/2010	15:40	83.9	0.01 U		2.87	2.5	0.248	0.0101		2.8	0.431	0.0196	
55LSR-25.4	8/24/2010	12:05	96.9	0.013		3.44	1.6	0.27	0.0073	1 U	2.3	0.425	0.0124	1
55LSR-25.4	8/24/2010	16:15	96.2	0.01 U		3.46	1.9	0.26	0.0077		2.2	0.442	0.0125	
55B200	7/28/2010	9:10	87.4	0.01 U		2.95	2.4	0.287	0.0094	1	2.6	0.465	0.0174	2
55B200	7/28/2010	13:25	86	0.01 U		2.97	2.2	0.282	0.0097		2.7	0.453	0.0192	
55B200	8/25/2010	10:10	96.6	0.01 U		3.56	1.8	0.269	0.0066	1 U	2.1	0.389	0.0091	1
55B200	8/25/2010	12:30	96.2	0.01 U		3.48	1.7	0.26	0.007		2.3	0.414	0.0099	
55DEE-01.4	7/28/2010	10:20	36.4	0.01 U		1.59	2.9	0.241	0.058	1	3.2	0.359	0.0648	2
55DEE-01.4	7/28/2010	12:15	36.2	0.01 U		1.58	2.9	0.236	0.0566		3.1	0.319	0.0644	
55DEE-01.4	8/25/2010	8:50	50.7	0.01 U		2.39	2.5	0.277	0.0538	1 U	2.9	0.401	0.0585	1
55DEE-01.4	8/25/2010	11:30	48.4	0.011		2.42	2.5	0.252	0.0547		2.8	0.365	0.0606	
55D070	7/28/2010	11:10	39.7	0.01 U		1.76	2.8	0.32	0.0528	2	3	0.438	0.0605	3
55D070	7/28/2010	11:10	40	0.01 U		1.81	2.8	0.313	0.0531	2	3	0.419	0.0588	3
55D070	7/28/2010	13:00	39.5	0.01 U		1.76	2.8	0.298	0.0532		3	0.387	0.062	
55D070	8/25/2010	9:20	58.1	0.033		2.83	1.8	0.531	0.0448	1 U	2.1	0.648	0.0471	1
55D070	8/25/2010	9:20	58.3	0.01 U		2.79	1.8	0.528	0.0458	1	2.2	0.632	0.0478	2
55D070	8/25/2010	11:55	56.5	0.01 U		2.75	2	0.468	0.0451		2.3	0.573	0.0472	
LSRTMDL-13	7/28/2010	11:40	144	0.01 U		5.88	1.9	2.68	0.0384	9	2.1	3.52	0.0532	11
LSRTMDL-13	7/28/2010	14:15	144	0.01 U	2 U	5.93	1.9	2.73	0.0387		2.2	3.93	0.0479	
LSRTMDL-13	7/28/2010	14:15	144	0.01 U	2 U	5.98	2	2.83	0.0381		2.2	2.8	0.0486	
LSRTMDL-13	8/25/2010	10:35	152	0.01 U		6.29	1.5	2.9	0.0326	1 U	2	3.05	0.0346	2
LSRTMDL-13	8/25/2010	12:45	149	0.01 U	2 U	6.27	1.5	3.09	0.0321		1.8	3.18	0.0359	
LSRTMDL-13	8/25/2010	12:45	150	0.01 U	2 U	6.22	1.6	3.38	0.0328		1.8	3.03	0.0358	
55COLB-TREA	7/28/2010	8:35	243	0.01 UJ		7.66	1 U	4.97	0.0244	1 U	1 U	5.25	0.0221	1 U

Location ID	Date	Time	Alk	NH3	BOD5	Cl	DOC	NO2-NO3	OP	TNVSS	TOC	TPN	TP	TSS
55COLB-TREA	7/28/2010	12:50	223	0.01 U	2 U	7.22	1 U	4.52	0.0252		1 U	4.51	0.0231	
55COLB-TREA	8/25/2010	8:35	231	0.01 U		7	1 U	4.67	0.0251	1 U	1 U	4.47	0.0215	1 U
55COLB-TREA	8/25/2010	12:27	229	0.01 U	2 U	6.82	1 U	4.77	0.0247		1 U	4.61	0.0217	
55LSR-18.0	7/28/2010	9:30	108	0.012		3.7	2.2	0.904	0.0166	2	2.3	1.03	0.0272	2
55LSR-18.0	7/28/2010	9:30	107	0.013		3.72	2.4	0.909	0.0162	2 U	2.6	1.07	0.0269	2
55LSR-18.0	7/28/2010	13:35	106	0.01		3.79	2.1	0.888	0.0169		2.3	1.01	0.0262	
55LSR-18.0	8/25/2010	9:25	118	0.01 U		4.42	1.4	0.997	0.0143	1	1.8	1.16	0.0168	2
55LSR-18.0	8/25/2010	9:25	118	0.01 U		4.15	1.4	0.998	0.0142	1 U	1.7	1.18	0.0184	2
55LSR-18.0	8/25/2010	13:30	118	0.01 U		4.31	1.4	0.987	0.0146		1.7	1.12	0.0162	
55LSR-16.0	7/28/2010	11:00	108	0.014		4.03	2.4	0.911	0.0168	2	2.4	1.06	0.0259	2
55LSR-16.0	7/28/2010	14:35	107	0.01		3.83	2.2	0.887	0.0173		2.3	1.01	0.0255	
55LSR-16.0	7/28/2010	14:35	107	0.011		3.74	2.4	0.901	0.0173		2.3	1.05	0.0301	
55LSR-16.0	8/25/2010	10:40	118	0.01 U		4.21	1.5	0.977	0.0138	1 U	1.8	1.15	0.0176	1
55LSR-16.0	8/25/2010	14:05	119	0.01 U		4.18	1.5	0.971	0.0139		2	1.13	0.0167	
55LSR-16.0	8/25/2010	14:05	118	0.01 U		4.21	1.4	0.976	0.0135		1.8	1.05	0.0174	
55B100	7/28/2010	12:10	107	0.013		3.86	2.5	0.858	0.0166	1	2.4	1.03	0.0257	2
55B100	7/28/2010	15:25	106	0.012	2 U	3.93	2.5	0.855	0.0171		2.4	1.02	0.0261	
55B100	8/25/2010	11:53	119	0.01 U		4.35	1.4	0.956	0.0134	1 U	1.8	1.11	0.0176	1
55B100	8/25/2010	13:30	119	0.01 U	2 U	4.32	1.5	0.947	0.0136		1.8	1.1	0.0156	
55DEA-02.6	7/29/2010	8:25	47.8	0.01 U		4.55	2.9	0.149	0.0754	3	3.2	0.354	0.171	4
55DEA-02.6	7/29/2010	12:20	47.1	0.01 U		4.25	3.2	0.148	0.0808		3.3	0.354	0.173	
55DEA-02.6	8/26/2010	8:25	53	0.01 U		5.62	2.1	0.266	0.046	2 U	2.6	0.437	0.0806	2 U
55DEA-02.6	8/26/2010	11:45	52.5	0.01 U		5.65	2.4	0.266	0.0463		2.5	0.395	0.0822	
LSRTMDL-8	7/29/2010	10:48	117	0.01 U		6.76	2.4	0.576	0.0531	2	2	0.697	0.0948	3
LSRTMDL-8	7/29/2010	14:25	115	0.01 U	2 U	6.72	2.4	0.563	0.0531		2.3	0.685	0.0956	
LSRTMDL-8	7/29/2010	14:25	115	0.01 U	2 U	6.73	2.1	0.559	0.0531		2.2	0.674	0.0907	
LSRTMDL-8	8/26/2010	10:05	153	0.01 U		8.9	1	0.862	0.0286	1 U	1.1	0.968	0.0379	1
LSRTMDL-8	8/26/2010	13:00	155	0.01 U	2 U	8.9	1.1	0.849	0.0287		1.2	0.928	0.0392	
LSRTMDL-8	8/26/2010	13:00	156	0.01 U	2 U	9.14	1	0.85	0.0288		1.1	0.928	0.0368	
55LIT-03.9	7/29/2010	9:33	46.4	0.01 U		2.74	4.9	0.01 U	0.104	3	4.7	0.179	0.159	4
55LIT-03.9	7/29/2010	13:02	46	0.01 U		1.2	5.1	0.01 U	0.108		4.7	0.216	0.168	
LSRTMDL-16	7/29/2010	10:17	151	0.01 U		8.33	2.5	0.559	0.0557	1 U	2.5	0.679	0.0703	2
LSRTMDL-16	7/29/2010	13:50	152	0.01 U		8.31	2.6	0.545	0.0554		2.6	0.657	0.0692	
LSRTMDL-16	8/26/2010	9:40	218	0.01 U		12	1 U	0.931	0.026	1 U	1 U	0.984	0.0284	1 U
LSRTMDL-16	8/26/2010	12:30	217	0.01 U		11.9	1.1	0.912	0.0251		1.3	1.01	0.0278	
55B082	7/29/2010	11:30	112	0.011		4.7	2.4	0.842	0.0236	2	2.3	0.997	0.0324	3
55B082	7/29/2010	11:30	110	0.012		4.73	2.4	0.834	0.0214	2 U	2.4	1.02	0.0292	3

Location ID	Date	Time	Alk	NH3	BOD5	Cl	DOC	NO2-NO3	OP	TNVSS	TOC	TPN	TP	TSS
55B082	7/29/2010	15:00	110	0.011		5.54	2.3	0.842	0.0223		2.2	1.01	0.0353	
55B082	8/26/2010	10:30	124	0.01 U		5.23	1.4	0.942	0.0125	1 U	1.6	1.02	0.0186	2
55B082	8/26/2010	10:30	124	0.01 U		5.27	1.3	0.936	0.0124	1 U	1.7	1.06	0.0181	2
55B082	8/26/2010	13:25	123	0.01 U		5.22	1.4	0.927	0.0126		1.7	1.16	0.0195	
55DAR-00.9	7/29/2010	8:10	217	0.01 U		14.8	1 U	9.53	0.0373	4	1 U	8.69	0.0364	6
55DAR-00.9	7/29/2010	12:35	218	0.01 U		15	1 U	8.81	0.0378		1 U	8.72	0.0352	
55DAR-00.9	8/26/2010	8:15	220	0.01 U		15	1 U	8.66	0.0357	5 J	1 U	7.23	0.0365	6 J
55DAR-00.9	8/26/2010	13:45	220	0.01 U		14.9	1 U	8.75	0.035		1 U	8.45	0.0373	
LSRTMDL-7	7/29/2010	8:50	217	0.01 U		15	1 U	9.46	0.0388	7 J	1 U	8.53	0.0396	8 J
LSRTMDL-7	7/29/2010	13:07	219	0.01 U		15	1 U	8.75	0.0414		1 U	8.75	0.0393	
LSRTMDL-7	8/26/2010	8:45	220	0.01 U		15.1	1.1	8.53	0.0364	4 J	1 U	8.05	0.0374	5 J
LSRTMDL-7	8/26/2010	14:10	220	0.01 U		14.9	1 U	8.55	0.036		1 U	8.68	0.0361	
55WAI-00.0	7/27/2010	8:30	143	0.01 U		6.71	1 U	1.51	0.0066	1 U	1 U	1.43	0.005 U	1 U
55WAI-00.0	7/27/2010	17:00	141	0.01 U		6.66	1 U	1.45	0.0051		1 U	1.46	0.0057	
55WAI-00.0	8/24/2010	8:30	143	0.01 U		7.17	1 U	1.49	0.0041	1 U	1 U	1.41	0.005 U	1 U
55WAI-00.0	8/24/2010	13:25	101	0.01 U		7.1	1 U	1.54	0.004		1 U	1.56	0.005 U	
55B080	7/29/2010	11:10	119	0.01 U		4.77	1 U	1.11	0.0142	2	1	1.14	0.0156	3
55B080	7/29/2010	15:00	120	0.01 U		4.8	1 U	1.09	0.0139		1 U	1.15	0.0158	
55B080	7/29/2010	15:00	120	0.01 U		4.7	1 U	1.08	0.0151		1	1.16	0.0153	
55B080	8/26/2010	10:40	124	0.01 U		5.08	1 U	1.13	0.0091	1	1 U	1.23	0.0115	2
55B080	8/26/2010	13:40	126	0.01 U		5.14	1 U	1.13	0.0093		1 U	1.3	0.0118	
55B080	8/26/2010	13:40	125	0.01 U		5.29	1 U	1.13	0.0093		1 U	1.17	0.0101	
55GRI-00.0	7/29/2010	9:50	146	0.042		8.42	1 U	1.86	0.0193	1 U	1 U	1.63	0.0171	1 U
55GRI-00.0	7/29/2010	9:50	149	0.045		8.04	1 U	1.64	0.0177	1 U	1 U	1.64	0.0176	1 U
55GRI-00.0	7/29/2010	13:50	145	0.049	2 U	8.3	1 U	1.63	0.0167		1 U	1.67	0.016	
55GRI-00.0	8/26/2010	9:38	149	0.075		8.33	1 U	1.58	0.0395	2	1.2	1.7	0.188	7
55GRI-00.0	8/26/2010	9:38	150	0.085		8.27	1 U	1.69	0.0411	3	1.4	1.75	0.186	8
55GRI-00.0	8/26/2010	12:40	148	0.06	2 U	8.15	1.1	1.6	0.0514		1 U	1.62	0.0869	
55B075	7/29/2010	11:30	123	0.01 U		4.99	1 U	1.12	0.0129	2	1 U	1.2	0.0149	3
55B075	7/29/2010	15:20	122	0.01 U		5.01	1 U	1.11	0.0141		1 U	1.17	0.0154	
55B075	8/26/2010	11:00	126	0.01 U		5.35	1 U	1.15	0.0095	2	1 U	1.25	0.0129	2
55B075	8/26/2010	14:02	127	0.01 U		5.27	1 U	1.15	0.0099		1 U	1.29	0.0116	
55B070	7/29/2010	11:50	123	0.01 U		4.97	1 U	1.1	0.0156	2	1 U	1.17	0.0158	2
55B070	7/29/2010	15:54	124	0.01 U	2 U	5.1	1 U	1.11	0.0133		1 U	1.03	0.0152	
55B070	8/26/2010	11:24	128	0.01 U		5.3	1 U	1.12	0.009	1	1 U	1.18	0.0122	2
55B070	8/26/2010	14:25	127	0.01 U	2 U	5.22	1 U	1.14	0.0091		1 U	1.12	0.0111	

Table B-4. Periphyton results from the 2010 Little Spokane River DO-pH TMDL study.

Location ID	Date	Time	AFDW[1]	Chl a[1]		Peri (AFDW)	Peri (Chl a)	
55LSR-33.2	7/26/2010	10:15	320	2060		18400	118	
55LSR-33.2	8/23/2010	10:55	265	445		15200	25.6	
55LSR-25.4	7/26/2010	10:50	386	1620		26600	112	
55LSR-25.4	8/23/2010	11:35	400	483		17500	21	
55LSR-18.0	7/26/2010	11:30	107	344		6720	24.7	
55LSR-18.0	7/26/2010	11:30	96.7	356		8050	25.9	
55LSR-18.0	8/23/2010	12:15	128	73.8	J	9550	5.51	J
55LSR-11.5	7/26/2010	12:25	83.3	604		6220	45.1	
55LSR-11.5	8/23/2010	12:50	72.9	101		4830	6.69	
55LSR-11.5	8/23/2010	12:50	69.9	151		4290	9.26	

[1]Ash-Free Dry Weight and Chlorophyll a results in mg/L and ug/L are not very meaningful in of themselves, as they only represent the total amount of periphyton collected by the field crew. The areal periphyton biomass calculations (Peri) account for the surface area from which the periphyton was collected.

Table B-5. Laboratory results from the 2009 Little Spokane Fish Hatchery study.

Location ID	Date	Time	Alk	NH3	BOD5	Cl	DOC	NO2-NO3	OP	TOC	TPN	TP	TSS
55GRI-00.5	2/9/2009	13:25	163	0.01 UJ	4 J	9.66	1 U	1.99	0.0079	1 U	3.39	0.0068	1 U
55GRI-00.5	2/9/2009	13:25	163	0.01 UJ	4 J	9.74	1 U	1.98	0.0071	1 U	1.98	0.0074	1 U
55GRI-00.5	2/23/2009	13:10		0.01 U				2.28	0.0068		2.27	0.0073	
55GRI-00.5	3/11/2009	12:44	152	0.01 U	2 U	7.19	1 U	1.79	0.0076	1 U	1.76	0.0082	1 U
55GRI-00.5	3/24/2009	9:57	143	0.01 U		7.19	1 U	2.11	0.0067	1 U	1.91	0.007	1 U
55GRI-00.5	4/6/2009	12:50	146	0.01 U	2 U	7.47	1 U	2.34	0.0072	1 U	2.62	0.0078	1 U
55GRI-00.5	4/6/2009	12:50	148	0.01 U	2 U	7.74	1 U	2.23	0.0073	1 U	1.81	0.0069	1 U
55GRI-00.5	4/20/2009	12:20	146	0.01 U		7.75	1 U	2.52	0.0115	1 U	2.44	0.009	1 U
55GRI-00.5	5/4/2009	13:20	148	0.01 U	2 U	7.74	1 U	1.3	0.0074	1 U	2.35	0.006	1 U
55GRI-00.5	5/18/2009	13:05	147	0.01 U		7.61	1 U	2.05	0.0085	1 U	2.17	0.007	1 U
55GRI-00.5	6/1/2009	13:00	147	0.01 U	2 U	7.58	1 U	2.27	0.0075	1 U	1.9	0.008	1 U
55GRI-00.5	6/15/2009	13:10	147	0.01 U		6.48	1 U	2.19	0.0084	1 U	1.84	0.0076	1 U
55GRI-00.5	6/15/2009	13:10	146	0.01 U		6.51	1 U	1.75	0.0082	1 U	1.77	0.0082	1 U
55GRI-00.5	7/6/2009	13:17	152	0.01 U	2 U	8.87	1 U	1.82	0.009	1 U	1.74	0.0086	1 U
55GRI-00.5	7/13/2009	12:40	146	0.01 U		7.92	1 U	1.85	0.0099	1 U	2.42	0.0067	1 U
55GRI-00.5	8/3/2009	13:42	152	0.01 U	4 U	8.72	1 U	1.98	0.0068	1 U	1.77	0.0074	1 U
55GRI-00.5	8/17/2009	10:53	155	0.01 U		9.01	1 U	1.88	0.0076	1 U	1.81	0.0072	1 U
55GRI-00.5	9/8/2009	11:40	153	0.01 U	2 UJ	9.03	1 U	1.84	0.0073	1 U	1.91	0.0095	1 U
55GRI-00.5	9/22/2009	11:25	154	0.01 U		9.23	1 U	1.71	0.007	1 U	1.76	0.008	1 U
55GRI-00.5	9/22/2009	11:25	156	0.01 U		9.38	1 U	1.84	0.0074	1 U	1.83	0.0069	1 U
55GSFH-00.4	2/9/2009	14:03		0.028	4 J			1.77	0.0143		3.15	0.0151	
55GSFH-00.4	2/23/2009	14:11		0.016				2.25	0.0099		1.84	0.0113	
55GSFH-00.4	2/23/2009	14:11		0.013				1.71	0.0107		1.71	0.0124	
55GSFH-00.4	3/11/2009	13:45		0.047	2 U			1.86	0.0156		1.79	0.0146	
55GSFH-00.4	3/24/2009	10:30		0.045				2.13	0.0128		2.48	0.0165	
55GSFH-00.4	3/24/2009	10:30		0.045				1.74	0.0127		1.79	0.0194	
55GSFH-00.4	4/6/2009	14:25		0.053	2 U			2.37	0.0125		2.45	0.0193	
55GSFH-00.4	4/20/2009	13:22		0.049				2.66	0.0168		2.38	0.021	
55GSFH-00.4	4/20/2009	13:22		0.051				1.92	0.0165		1.86	0.0153	
55GSFH-00.4	5/4/2009	14:25		0.065	2 U			2.29	0.013		2.5	0.017	

Location ID	Date	Time	Alk	NH3	BOD5	Cl	DOC	NO2-NO3	OP	TOC	TPN	TP	TSS
55GSFH-00.4	5/18/2009	14:05		0.028				2.54	0.0119		2.13	0.0118	
55GSFH-00.4	6/1/2009	13:57		0.018	2 U			2.43	0.0092		2.09	0.0162	
55GSFH-00.4	6/1/2009	13:57		0.02	2 U			1.78	0.0089		1.78	0.019	
55GSFH-00.4	6/15/2009	14:39		0.03				2.25	0.013		2.09	0.0276	
55GSFH-00.4	7/6/2009	13:30		0.038	2 U			1.74	0.0133		1.77	0.0159	
55GSFH-00.4	7/13/2009	13:27		0.033				2.03	0.0142		2.56	0.0125	
55GSFH-00.4	7/13/2009	13:27		0.031				1.71	0.0137		2.66	0.0204	
55GSFH-00.4	8/3/2009	13:55		0.029	4 U			1.92	0.0091		1.74	0.0107	
55GSFH-00.4	8/17/2009	11:45		0.026				1.77	0.0095		1.8	0.0123	
55GSFH-00.4	8/17/2009	11:45		0.027				1.72	0.0096		1.8	0.0108	
55GSFH-00.4	9/8/2009	12:43		0.062	2 UJ			2.07	0.0183		1.86	0.0242	
55GSFH-00.4	9/22/2009	12:40		0.068				1.85	0.0201		1.86	0.0257	
55GSFH-00.3	2/9/2009	14:33		0.086	4 J			1.97	0.0094		2.21	0.0138	
55GSFH-00.3	2/23/2009	14:35		0.065				1.75	0.0094		1.77	0.0126	
55GSFH-00.3	3/11/2009	14:10		0.079	2 U			1.99	0.0118		1.8	0.0221	
55GSFH-00.3	3/11/2009	14:10		0.085	2 U			1.72	0.0125		1.78	0.0192	
55GSFH-00.3	3/24/2009	10:40		0.042				2.19	0.0118		2.7	0.0178	
55GSFH-00.3	4/6/2009	14:55		0.081	2 U			2.42	0.0132		2.26	0.0187	
55GSFH-00.3	4/20/2009	13:45		0.11				2.41	0.0175		2.41	0.0211	
55GSFH-00.3	5/4/2009	14:47		0.104	2 U			2.2	0.0115		2.58	0.0161	
55GSFH-00.3	5/4/2009	14:47		0.104	2 U			1.75	0.0112		1.98	0.0146	
55GSFH-00.3	5/18/2009	14:40		0.148				2.34	0.0154		2.53	0.0187	
55GSFH-00.3	6/1/2009	14:33		0.068	9			2.26	0.0095		2.08	0.0172	
55GSFH-00.3	6/15/2009	15:02		0.04				1.74	0.0083		1.81	0.0131	
55GSFH-00.3	7/6/2009	13:55		0.065	2 U			2.03	0.0107		1.82	0.0113	
55GSFH-00.3	7/6/2009	13:55		0.063	2 U			1.75	0.0104		1.84	0.0104	
55GSFH-00.3	7/13/2009	13:57		0.056				1.88	0.0115		2.58	0.01	
55GSFH-00.3	8/3/2009	14:25		0.061	4 U			1.9	0.0078		1.82	0.0125	
55GSFH-00.3	8/3/2009	14:25		0.075	4 U			1.73	0.008		1.82	0.0114	
55GSFH-00.3	8/17/2009	12:10		0.056				1.8	0.0088		1.86	0.0103	
55GSFH-00.3	9/8/2009	13:13		0.103	2 UJ			1.75	0.0092		1.9	0.0187	
55GSFH-00.3	9/22/2009	13:00		0.138				1.73	0.0105		1.96	0.0275	
55GRI-00.0	2/9/2009	15:05		0.022	4 J			1.68	0.013		1.84	0.0252	
55GRI-00.0	2/23/2009	14:55		0.037				1.87	0.0136		1.66	0.0284	
55GRI-00.0	3/11/2009	14:43		0.042	2 U			1.95	0.0156		1.67	0.0256	
55GRI-00.0	3/24/2009	11:00		0.017				2.25	0.0127		2.32	0.0201	
55GRI-00.0	4/6/2009	15:17		0.022	2 U			2.17	0.0119		2.28	0.0176	
55GRI-00.0	4/20/2009	14:12		0.034				2.26	0.0149		2.04	0.0189	
55GRI-00.0	5/4/2009	15:13		0.028	2 U			1.97	0.0095		2.09	0.0128	
55GRI-00.0	5/18/2009	15:10		0.046				1.8	0.0113		1.57	0.0152	
55GRI-00.0	5/18/2009	15:10		0.048				1.56	0.0118		1.58	0.0141	
55GRI-00.0	6/1/2009	14:52		0.025	2 U			2.05	0.0117		1.87	0.0193	
55GRI-00.0	6/15/2009	15:30		0.041				2.17	0.0121		1.86	0.0215	
55GRI-00.0	7/6/2009	14:30		0.027	2 U			1.57	0.0122		1.62	0.0133	
55GRI-00.0	7/13/2009	14:18		0.031				1.8	0.0142		2.42	0.0144	
55GRI-00.0	8/3/2009	15:20		0.039	4 U			1.66	0.0116		1.62	0.0142	
55GRI-00.0	8/17/2009	12:25		0.021				1.63	0.013		1.74	0.0158	
55GRI-00.0	9/8/2009	13:40		0.053	2 UJ			1.76	0.0141		1.73	0.0198	
55GRI-00.0	9/8/2009	13:40		0.053	2 UJ			1.63	0.0149		1.71	0.0207	
55GRI-00.0	9/22/2009	13:25		0.055				1.64	0.0168		1.74	0.0207	

Appendix C. Field Measurements

Table C-1. Abbreviations and units of measurement used in this appendix.

Abbreviation	Parameter	Unit of Measurement
Temp	Stream Temperature	°C
Cond	Specific Conductivity	uS/cm
pH	pH	S.U.
DO	Dissolved Oxygen (Hydrolab® probe)[1]	mg/L
Wink	Dissolved Oxygen (Winkler titration)	mg/L
Flow	Streamflow	cfs
Dep	Average Depth	ft
Vel	Average Velocity	ft/s
WW	Wetted Width	ft

[1]All DO data taken using Hydrolab® probes are corrected using Winkler titration data.

Table C-2. Field water quality measurements taken during the 2010 Little Spokane River TMDL study.

Location ID	Date	Time	Temp	Cond	pH	DO	Wink
LSRTMDL-23	7/27/2010	8:20	22.72	94.2	8.69	6.22	6.30
LSRTMDL-23	7/27/2010	13:30	24.60	94.8	8.71	7.23	
LSRTMDL-23	8/24/2010	9:05	16.11	107.3	7.54	6.74	6.61
LSRTMDL-23	8/24/2010	13:20	19.38	107.5	8.08	8.21	
55LSR-39.5	7/27/2010	9:30	21.65	221	7.59	6.35	6.38
55LSR-39.5	7/27/2010	14:10	23.61	220	8.04	8.82	8.99
55LSR-39.5	7/27/2010	14:15	23.61	220	8.04	8.83	
55LSR-39.5	8/24/2010	9:40	17.72	246	7.90	7.84	8.00
55LSR-39.5	8/24/2010	14:00	20.46	242	8.44	10.33	10.31
55LSR-39.5	8/24/2010	14:25	20.48	242	8.44	10.32	
55LSR-37.1	7/27/2010	10:00	19.97	209	8.03	9.01	
55LSR-37.1	7/27/2010	14:30	21.85	275	8.38	9.10	
55LSR-37.1	8/24/2010	10:26	15.06	232	8.18	9.42	
55LSR-37.1	8/24/2010	14:45	18.91	228	8.60	10.39	
55DRY-01.2	7/27/2010	10:20	10.60	229	7.42	8.43	
55DRY-01.2	7/27/2010	14:50	11.32	231	7.46	8.28	
55DRY-01.2	8/24/2010	10:50	8.87	260	7.63	8.91	
55DRY-01.2	8/24/2010	10:55	8.88	260	7.63	8.91	
55DRY-01.2	8/24/2010	15:00	11.07	259	7.67	9.05	
LSRTMDL-15	7/27/2010	11:20	11.87	231	7.98	9.65	9.69
LSRTMDL-15	7/27/2010	15:15	12.47	231	8.04	9.41	9.89
LSRTMDL-15	8/24/2010	11:20	9.88	262	8.19	10.30	10.40
LSRTMDL-15	8/24/2010	15:35	11.04	262	8.17	10.19	9.97
LSRTMDL-18	7/27/2010	12:00	11.70	264	7.71	7.75	
LSRTMDL-18	7/27/2010	12:10	11.70	264	7.71	7.73	
LSRTMDL-18	7/27/2010	15:42	12.69	263	7.75	7.75	
LSRTMDL-18	8/24/2010	12:00	10.89	232	7.85	9.13	
LSRTMDL-18	8/24/2010	16:10	13.30	240	7.85	8.33	
55OTT-00.3	7/27/2010	12:45	12.36	196	7.99	9.56	9.65
55OTT-00.3	7/27/2010	16:10	12.26	196	7.96	9.68	9.62
55OTT-00.3	8/24/2010	12:40	11.69	210	8.12	10.15	9.98
55OTT-00.3	8/24/2010	16:45	12.10	210	8.08	10.00	9.79

Location ID	Date	Time	Temp	Cond	pH	DO	Wink
55LSR-33.2	7/27/2010	10:20	18.33	211	8.16	8.64	
55LSR-33.2	7/27/2010	13:50	19.19	208	8.35	8.99	
55LSR-33.2	8/24/2010	9:45	13.71	217	8.09	9.32	
55LSR-33.2	8/24/2010	14:40	16.30	217	8.34	9.91	
LSRTMDL-2	7/27/2010	11:00	20.24	172	8.40	9.00	9.00
LSRTMDL-2	7/27/2010	14:30	20.91	172	8.58	9.21	9.20
LSRTMDL-2	8/24/2010	10:25	14.64	194	8.37	10.42	10.70
LSRTMDL-2	8/24/2010	15:15	17.30	194	8.68	11.22	11.03
LSRTMDL-2	8/24/2010	15:15	17.37	194	8.74	11.24	
55BEA-00.4	7/27/2010	11:45	17.53	315	8.28	8.39	
55BEA-00.4	7/27/2010	15:00	18.54	304	8.30	8.19	
55BEA-00.4	8/24/2010	11:25	13.71	326	8.26	9.44	
55BEA-00.4	8/24/2010	11:25	13.72	326	8.29	9.44	
55BEA-00.4	8/24/2010	15:45	15.09	328	8.21	9.00	
55LSR-25.4	7/27/2010	12:35	21.55	181	8.42	9.24	
55LSR-25.4	7/27/2010	15:40	21.42	180	8.72	10.01	
55LSR-25.4	8/24/2010	12:05	16.81	209	8.26	9.76	
55LSR-25.4	8/24/2010	16:15	18.73	207	8.62	11.07	
55B200	7/28/2010	9:10	19.13	187	7.97	7.66	
55B200	7/28/2010	13:25	21.39	184	8.52	10.47	
55B200	8/25/2010	10:10	15.73	210	8.30	8.96	
55B200	8/25/2010	12:30	16.56	210	8.51	10.30	
55DEE-01.4	7/28/2010	10:20	15.70	82.1	7.98	9.70	
55DEE-01.4	7/28/2010	12:15	17.16	82.2	8.13	9.71	
55DEE-01.4	8/25/2010	8:50	11.87	113	7.94	9.70	
55DEE-01.4	8/25/2010	11:30	13.68	110.3	8.19	10.22	
55D070	7/28/2010	11:10	15.88	90.0	8.00	9.34	
55D070	7/28/2010	13:00	17.55	89.5	8.06	9.01	
55D070	8/25/2010	9:20	10.70	134.5	8.03	10.10	10.1
55D070	8/25/2010	9:20	10.75	134.3	8.02	10.10	
55D070	8/25/2010	11:55	12.65	131.3	8.14	9.75	
LSRTMDL-13	7/28/2010	11:40	17.77	331	8.53	9.36	
LSRTMDL-13	7/28/2010	14:15	20.14	330	8.65	8.90	8.90
LSRTMDL-13	8/25/2010	10:35	13.28	352	8.45	9.84	
LSRTMDL-13	8/25/2010	12:45	15.29	349	8.56	9.51	9.4
LSRTMDL-13	8/25/2010	12:45	15.32	349	8.55	9.49	
55COLB-LAND	7/28/2010	8:55	11.25	525	8.14	10.27	
55COLB-LAND	7/28/2010	13:08	11.48	485	8.18	9.97	
55COLB-LAND	8/25/2010	8:35	10.94	545	8.27	10.22	
55COLB-LAND	8/25/2010	12:27	11.36	538	8.36	10.10	
55LSR-18.0	7/28/2010	9:30	17.48	235	7.85	8.04	
55LSR-18.0	7/28/2010	9:35	17.50	235	7.86	8.11	
55LSR-18.0	7/28/2010	13:35	20.02	238	8.25	9.17	
55LSR-18.0	8/25/2010	9:25	14.06	281	8.12	9.21	
55LSR-18.0	8/25/2010	9:40	14.06	281	8.12	9.21	
55LSR-18.0	8/25/2010	13:30	16.41	282	8.41	9.85	
55LSR-16.0	7/28/2010	11:00	18.09	240	7.94	8.76	
55LSR-16.0	7/28/2010	14:35	20.28	237	8.32	9.68	
55LSR-16.0	7/28/2010	14:40	20.30	237	8.32	9.67	
55LSR-16.0	8/25/2010	10:40	14.86	282	8.23	9.63	
55LSR-16.0	8/25/2010	14:05	16.41	282	8.48	10.10	
55LSR-16.0	8/25/2010	14:20	16.43	282	8.49	10.10	
55B100	7/28/2010	12:10	19.26	236	8.08	9.44	9.51

Location ID	Date	Time	Temp	Cond	pH	DO	Wink
55B100	7/28/2010	15:25	20.98	236	8.43	9.88	
55B100	8/25/2010	11:53	15.66	283	8.32	10.14	10.10
55B100	8/25/2010	13:30	16.71	263	8.49	10.63	10.7
55DEA-02.6	7/29/2010	8:25	19.02	112	7.43	7.94	
55DEA-02.6	7/29/2010	12:20	20.76	109	7.69	8.29	
55DEA-02.6	8/26/2010	8:25	13.46	141	7.74	9.20	
55DEA-02.6	8/26/2010	11:45	14.94	141.6	8.11	9.83	
LSRTMDL-8	7/29/2010	10:48	16.53	264	8.11	8.96	8.7
LSRTMDL-8	7/29/2010	14:25	18.95	261	8.20	8.61	8.6
LSRTMDL-8	8/26/2010	10:05	11.60	372	8.34	10.06	10.13
LSRTMDL-8	8/26/2010	13:00	13.41	372	8.45	9.94	10.01
55LIT-03.9	7/29/2010	9:33	19.95	96.8	7.21	7.76	
55LIT-03.9	7/29/2010	13:02	22.89	97.0	7.55	8.69	
55LIT-03.9	8/26/2010	9:05					
LSRTMDL-16	7/29/2010	10:17	15.98	329	8.14	8.93	8.9
LSRTMDL-16	7/29/2010	13:50	17.60	329	8.24	8.55	8.6
LSRTMDL-16	8/26/2010	9:40	11.03	503	8.43	10.25	10.39
LSRTMDL-16	8/26/2010	12:30	12.50	501	8.51	10.23	10.30
55B082	7/29/2010	11:30	20.31	246	8.15	8.76	8.4
55B082	7/29/2010	15:00	22.01	246	8.38	9.08	8.8
55B082	8/26/2010	10:30	15.66	296	8.37	9.40	9.46
55B082	8/26/2010	13:25	16.65	294	8.52	9.68	9.71
55DAR-00.9	7/29/2010	8:10	12.32	527	8.28	10.92	
55DAR-00.9	7/29/2010	12:35	13.45	527	8.40	10.76	
55DAR-00.9	8/26/2010	8:15	10.72	550	8.31	10.01	
55DAR-00.9	8/26/2010	13:45	12.26	589	8.45	9.79	
55DAR-00.9	8/26/2010	13:50	12.27	589	8.46	9.80	
LSRTMDL-7	7/29/2010	8:50	13.11	524	8.39	10.79	10.8
LSRTMDL-7	7/29/2010	13:07	14.35	523	8.52	10.46	10.7
LSRTMDL-7	8/26/2010	8:45	10.95	546	8.41	10.02	10.01
LSRTMDL-7	8/26/2010	14:10	12.80	582	8.59	9.61	9.70
55WAI-00.0	7/27/2010	8:30	11.26	320	8.00	9.29	
55WAI-00.0	7/27/2010	17:00	11.06	320	8.04	9.28	
55WAI-00.0	8/24/2010	8:30	10.35	335	8.10	9.87	
55WAI-00.0	8/24/2010	13:25	12.76	335	8.17	9.55	
55B080	7/29/2010	11:10	15.47	265	8.35	8.52	
55B080	7/29/2010	15:00	16.96	265	8.30	9.11	
55B080	8/26/2010	10:40	10.91	287	8.29	8.12	
55B080	8/26/2010	13:40	13.76	287	8.39	8.44	
55B080	8/26/2010	13:40	13.78	287	8.39	8.44	
55GRI-00.0	7/29/2010	9:50	11.91	330	8.12	11.12	
55GRI-00.0	7/29/2010	13:50	13.60	329	8.35	12.97	
55GRI-00.0	8/26/2010	9:38	11.34	347	8.15	9.83	
55GRI-00.0	8/26/2010	9:38	11.36	347	8.14	9.86	
55GRI-00.0	8/26/2010	12:40	12.84	336	8.33	10.51	
55B075	7/29/2010	11:30	15.62	273	8.31	9.11	
55B075	7/29/2010	15:20	17.49	271	8.52	10.43	
55B075	8/26/2010	11:00	12.88	292	8.29	8.76	
55B075	8/26/2010	14:02	14.18	291	8.40	9.27	
55B070	7/29/2010	11:50	15.61	272	8.29	9.23	9.2
55B070	7/29/2010	15:54	17.50	273	8.45	10.62	10.4
55B070	8/26/2010	11:24	12.88	291	8.36	9.13	9.12
55B070	8/26/2010	14:25	13.95	291	8.41	9.75	9.71

Table C-3. Flow measurements taken during the 2010 Little Spokane River TMDL study.

Location ID	Date	Time	Flow	Dep	Vel	WW
55LSR-39.5	7/27/2010	9:10	33	1.40	0.95	24.8
55LSR-39.5	7/27/2010	15:55	33	1.42	0.95	24.5
55LSR-39.5	8/24/2010	9:40	30	1.53	0.85	23.1
55LSR-39.5	8/24/2010	13:47	28	1.47	0.81	23.6
55DRY-01.2	7/27/2010	10:30	1.8	0.13	3.10	4.4
55DRY-01.2	7/27/2010	10:46	1.8	0.13	3.06	4.4
55DRY-01.2	7/27/2010	14:45	1.8	0.13	2.91	4.6
55DRY-01.2	8/24/2010	10:53	1.5	0.44	0.70	4.8
55DRY-01.2	8/24/2010	15:00	1.5	0.49	0.45	6.7
LSRTMDL-15	7/27/2010	11:20	1.7	0.47	0.58	6.2
LSRTMDL-15	7/27/2010	15:10	1.8	0.44	0.68	6.0
LSRTMDL-15	8/24/2010	11:22	2.5	0.42	0.97	6.1
LSRTMDL-15	8/24/2010	13:28	1.4	0.25	0.86	6.6
LSRTMDL-18	7/27/2010	12:00	0.73	0.31	0.40	6.0
LSRTMDL-18	7/27/2010	15:38	0.79	0.27	0.45	6.5
LSRTMDL-18	8/24/2010	12:05	1.3	0.35	0.44	8.3
LSRTMDL-18	8/24/2010	16:08	1.5	0.41	0.47	7.8
55OTT-00.3	7/27/2010	12:42	5.9	0.41	1.75	8.2
55OTT-00.3	7/27/2010	16:03	5.4	0.42	1.73	7.4
55OTT-00.3	8/24/2010	12:34	5.2	0.40	1.64	7.9
55OTT-00.3	8/24/2010	16:42	5.4	0.43	1.72	7.3
55LSR-33.2	7/27/2010	10:05	53	1.04	1.65	30.7
55LSR-33.2	7/27/2010	13:45	53	1.02	1.66	31.2
55LSR-33.2	8/24/2010	9:45	46	0.97	1.54	30.7
55LSR-33.2	8/24/2010	14:42	46	0.94	1.61	30.4
LSRTMDL-2	8/24/2010	10:35	53	2.00	0.88	30.0
55BEA-00.4	7/27/2010	11:51	1.1	0.14	0.71	11.0
55BEA-00.4	7/27/2010	15:01	1.0	0.14	0.66	10.8
55BEA-00.4	8/24/2010	11:30	1.3	0.14	0.85	10.7
55BEA-00.4	8/24/2010	15:45	1.3	0.14	0.88	10.6
55LSR-25.4	7/27/2010	12:38	78	2.04	0.84	45.2
55LSR-25.4	7/27/2010	15:36	79	2.02	0.86	45.5
55LSR-25.4	8/24/2010	12:05	60	1.92	0.75	41.7
55LSR-25.4	8/24/2010	16:18	58	2.02	0.65	44.3
55B200	7/28/2010	9:13	83	1.36	2.07	29.4
55B200	7/28/2010	13:20	84	1.05	2.43	32.9
55DEE-01.4	7/28/2010	10:20	3.7	0.21	1.70	10.6
55DEE-01.4	7/28/2010	12:18	3.7	0.20	1.74	10.9
55DEE-01.4	8/25/2010	9:00	0.69	0.08	1.10	8.3
55DEE-01.4	8/25/2010	11:35	0.78	0.09	1.09	8.1
55D070	7/28/2010	11:05	3.1	0.37	1.10	7.6
55D070	7/28/2010	12:55	2.9	0.41	0.96	7.4
55D070	8/25/2010	9:30	0.78	0.24	0.51	6.4
55D070	8/25/2010	11:57	0.69	0.25	0.42	6.5
55COLB-TREA[1]	7/28/2010	8:35	1.4			
55COLB-TREA[1]	7/28/2010	12:50	1.4			
55COLB-TREA[1]	8/25/2010	8:35	1.0			
55COLB-TREA[1]	8/25/2010	12:27	1.0			
55LSR-18.0	7/28/2010	9:17	111	1.73	1.35	47.3
55LSR-18.0	7/28/2010	9:55	112	1.74	1.36	47.3
55LSR-18.0	7/28/2010	13:25	109	1.71	1.35	47.3

Location ID	Date	Time	Flow	Dep	Vel	WW
55LSR-18.0	8/25/2010	9:24	90	1.60	1.19	47.6
55LSR-18.0	8/25/2010	9:52	86	1.58	1.14	47.6
55LSR-18.0	8/25/2010	13:20	89	1.63	1.15	47.5
55LSR-16.0	7/28/2010	10:48	113	1.36	1.58	52.5
55LSR-16.0	7/28/2010	14:12	110	1.37	1.53	52.7
55LSR-16.0	8/25/2010	10:42	87	1.16	1.43	52.5
55LSR-16.0	8/25/2010	14:00	93	1.21	1.47	52.5
55B100	7/28/2010	11:42	122	1.08	2.23	50.9
55B100	7/28/2010	15:00	118	1.08	2.15	51.0
55B100	8/25/2010	11:29	104	0.87	2.32	51.2
55B100	8/25/2010	13:40	94	0.83	2.20	51.7
55DEA-02.6	7/29/2010	8:11	7.2	0.50	0.77	18.5
55DEA-02.6	7/29/2010	12:23	7.2	0.49	0.80	18.2
55DEA-02.6	8/26/2010	8:22	2.7	0.47	0.38	15.3
55DEA-02.6	8/26/2010	11:42	2.4	0.38	0.39	16.1
55LIT-03.9	7/29/2010	9:35	1.3	0.48	0.39	6.9
55LIT-03.9	7/29/2010	13:03	1.4	0.47	0.43	7.0
55LIT-03.9	8/26/2010	9:05	0	0	0	0
LSRTMDL-16	7/29/2010	10:20	1.8	0.60	0.31	9.8
LSRTMDL-16	7/29/2010	13:53	1.5	0.61	0.25	9.7
LSRTMDL-16	8/26/2010	9:30	1.1	0.60	0.20	9.2
LSRTMDL-16	8/26/2010	12:29	1.2	0.72	0.19	9.0
55DAR-00.9	7/29/2010	8:15	3.5	0.32	1.59	6.9
55DAR-00.9	7/29/2010	12:38	2.9	0.27	1.57	6.9
55DAR-00.9	8/26/2010	8:18	3	0.27	1.68	6.5
55DAR-00.9	8/26/2010	13:40	2.6	0.24	1.78	6.2
LSRTMDL-7	7/29/2010	8:58	3.2	0.62	1.14	4.5
LSRTMDL-7	7/29/2010	13:15	2.9	0.60	1.19	4.1
LSRTMDL-7	8/26/2010	8:50	2.9	0.71	0.99	4.1
LSRTMDL-7	8/26/2010	14:24	2.6	0.59	0.90	4.9
55WAI-00.0	7/27/2010	8:50	1.9	0.35	0.84	6.5
55WAI-00.0	7/27/2010	17:00	1.9	0.32	0.94	6.4
55WAI-00.0	8/24/2010	8:35	2.1	0.32	1.36	4.9
55WAI-00.0	8/24/2010	13:25	3	0.35	1.33	6.4
55GRI-00.0	7/29/2010	9:58	21	1.18	0.63	28.1
55GRI-00.0	7/29/2010	13:58	21	1.19	0.63	27.8
55GRI-00.0	8/26/2010	9:49	19	1.53	0.53	23.6
55GRI-00.0	8/26/2010	12:46	18	1.70	0.46	23.1

[1]Flow data from Colbert Landfill are measured by the facility and are not Ecology measurements.

Table C-4. Field water quality measurements taken during the 2009 Little Spokane Fish Hatchery study.

Location ID	Date	Time	Temp	Cond	pH	DO	Wink
55GRI-00.5	2/9/2009	13:25	10.76	377	8.12	8.12	8.09
55GRI-00.5	2/23/2009	14:00	10.90	347	8.13	7.39	7.38
55GRI-00.5	3/11/2009	12:44	10.97	345	7.77	7.56	7.59
55GRI-00.5	3/24/2009	9:57	10.90	347	8.05	7.50	7.5
55GRI-00.5	4/6/2009	12:50	11.06	350	8.03	7.85	7.85
55GRI-00.5	4/20/2009	12:20	11.12	354	7.99	7.84	7.8
55GRI-00.5	5/4/2009	13:20	10.99	347	7.98	7.30	7.3
55GRI-00.5	5/18/2009	13:05	11.10	357	7.78	7.68	7.7
55GRI-00.5	6/1/2009	13:00	11.10	356	7.73	7.58	7.65
55GRI-00.5	6/15/2009	13:10	11.08	356	7.77	7.60	7.6
55GRI-00.5	7/6/2009	13:17	11.09	359	7.75	7.68	7.7
55GRI-00.5	7/13/2009	12:40	10.90	326	7.85	7.17	7.18
55GRI-00.5	8/3/2009	13:42	11.23	349	7.66	7.69	7.6
55GRI-00.5	8/17/2009	10:53	10.96	348	7.68	7.52	7.5
55GRI-00.5	9/8/2009	11:40	11.03	355	7.68	7.40	7.4
55GRI-00.5	9/22/2009	11:25	11.08	353	7.69	7.32	7.32
55GRI-00.5	9/22/2009	11:54	11.10	354	7.69	7.33	
55GSFH-00.3	2/9/2009	14:33	10.43	337	8.13	9.00	
55GSFH-00.3	2/23/2009	14:40	10.74	337	8.18	9.65	
55GSFH-00.3	3/11/2009	14:10	11.05	334	8.00	9.72	
55GSFH-00.3	3/24/2009	10:40	10.70	340	8.12	9.72	
55GSFH-00.3	4/6/2009	14:55	12.09	338	8.07	9.38	
55GSFH-00.3	4/20/2009	13:45	12.30	339	8.08	9.40	
55GSFH-00.3	5/4/2009	14:47	11.77	336	7.99	9.45	
55GSFH-00.3	5/18/2009	14:40	12.25	343	7.86	9.05	
55GSFH-00.3	6/1/2009	14:33	12.20	340	7.94	9.46	
55GSFH-00.3	6/15/2009	15:02	12.31	340	7.98	9.34	
55GSFH-00.3	7/6/2009	13:55	12.50	341	7.91	9.39	9.40
55GSFH-00.3	7/13/2009	13:57	11.22	338	7.93	9.40	
55GSFH-00.3	8/3/2009	14:25	12.78	341	7.79	9.29	
55GSFH-00.3	8/17/2009	12:10	12.09	344	7.80	9.39	
55GSFH-00.3	9/8/2009	13:13	11.89	346	7.20	9.30	
55GSFH-00.3	9/22/2009	13:00	11.85	343	7.71	9.18	
55GSFH-00.4	2/9/2009	14:03	10.22	336	8.31	9.38	9.4
55GSFH-00.4	2/23/2009	14:20	10.80	334	8.28	9.66	9.69
55GSFH-00.4	3/11/2009	13:45	11.04	333	8.00	9.69	9.64
55GSFH-00.4	3/24/2009	10:30	10.79	338	8.12	9.52	9.5
55GSFH-00.4	4/6/2009	14:25	11.71	337	8.08	9.22	9.22
55GSFH-00.4	4/20/2009	13:22	11.79	338	8.07	9.34	9.4
55GSFH-00.4	5/4/2009	14:25	11.45	338	8.02	9.53	
55GSFH-00.4	5/18/2009	14:05	11.93	341	8	9.43	9.4
55GSFH-00.4	6/1/2009	13:57	11.90	339	7.89	9.53	9.4
55GSFH-00.4	6/15/2009	14:39	11.77	338	7.93	9.20	9.2
55GSFH-00.4	7/6/2009	13:30	11.89	341	7.89	9.40	
55GSFH-00.4	7/13/2009	13:27	11.09	340	7.88	9.34	9.31
55GSFH-00.4	8/3/2009	13:55	12.07	339	7.74	9.34	9.5
55GSFH-00.4	8/17/2009	11:45	11.67	344	7.77	9.41	9.45
55GSFH-00.4	9/8/2009	12:43	11.50	346	7.76	9.11	9.1
55GSFH-00.4	9/22/2009	12:40	11.56	342	7.73	9.05	9.05
55GRI-00.0	2/9/2009	15:05	9.67	331	8.26	9.42	9.42

Location ID	Date	Time	Temp	Cond	pH	DO	Wink
55GRI-00.0	2/23/2009	15:22	10.61	327	8.35	10.21	10.2
55GRI-00.0	3/11/2009	14:43	10.62	325	8.22	10.97	11.0
55GRI-00.0	3/24/2009	11:00	10.24	333	8.14	9.78	9.8
55GRI-00.0	4/6/2009	15:17	13.10	325	8.63	13.70	13.7
55GRI-00.0	4/20/2009	14:12	13.18	328	8.51	12.72	12.7
55GRI-00.0	5/4/2009	15:13	12.69	328	8.64	13.89	13.89
55GRI-00.0	5/18/2009	15:10	14.28	328	8.53	13.17	13.18
55GRI-00.0	6/1/2009	14:52	14.40	328	8.4	11.84	11.9
55GRI-00.0	6/15/2009	15:30	13.88	330	8.35	11.02	11.02
55GRI-00.0	7/6/2009	14:30	15.14	329	8.44	12.28	12.25
55GRI-00.0	7/13/2009	14:18	11.72	329	8.13	9.82	9.85
55GRI-00.0	8/3/2009	15:20	15.44	324	8.31	11.57	11.5
55GRI-00.0	8/17/2009	12:25	13.77	332	8.32	11.87	11.85
55GRI-00.0	9/8/2009	13:40	12.90	336	8.22	11.35	11.35
55GRI-00.0	9/22/2009	13:25	12.65	333	8.1	11.25	11.25

Table C-5. Flow measurements taken during the 2009 Little Spokane Fish Hatchery study.

Location ID	Date	Time	Flow	Dep	Vel	WW
55GRI-00.5	2/23/2009	13:10	12	1.51	0.47	17.7
55GRI-00.5	3/11/2009	12:58	12	1.52	0.49	17.7
55GRI-00.5	3/24/2009	9:25	13	1.34	0.52	17.6
55GRI-00.5	4/6/2009	13:07	13	1.30	0.53	17.6
55GRI-00.5	4/6/2009	13:41	13	1.33	0.52	17.6
55GRI-00.5	4/20/2009	12:27	13	1.43	0.59	17.6
55GRI-00.5	5/4/2009	13:30	13	1.48	0.54	17.6
55GRI-00.5	5/18/2009	13:12	13	1.47	0.54	17.7
55GRI-00.5	6/1/2009	13:00	12	1.45	0.51	17.6
55GRI-00.5	6/15/2009	13:10	13	1.57	0.51	17.5
55GRI-00.5	6/15/2009	13:56	13	1.55	0.52	17.5
55GRI-00.5	7/6/2009	12:57	13	1.16	0.58	17.3
55GRI-00.5	7/13/2009	12:40	13	1.42	0.58	17.3
55GRI-00.5	8/3/2009	13:07	15	1.53	0.62	17.1
55GRI-00.5	8/17/2009	11:01	12	1.50	0.48	17.1
55GRI-00.5	9/8/2009	11:50	13	1.39	0.58	17.6
55GRI-00.5	9/22/2009	11:28	12	1.36	0.55	17.4
55GRI-00.5	9/22/2009	12:01	12	1.39	0.55	17.4
55GSFH-00.4	2/9/2009	14:03	2.5	0.52	2.15	2.00
55GSFH-00.4	2/23/2009	14:11	2.4	0.47	2.23	2.00
55GSFH-00.4	3/11/2009	13:54	2.4	0.52	2.16	1.90
55GSFH-00.4	3/24/2009	10:16	2.4	0.50	2.20	1.90
55GSFH-00.4	3/24/2009	10:20	2.6	0.51	2.32	1.90
55GSFH-00.4	4/6/2009	14:34	2.7	0.49	2.45	2.00
55GSFH-00.4	4/20/2009	13:22	2.7	0.48	2.56	1.95
55GSFH-00.4	4/20/2009	13:27	2.7	0.51	2.44	1.95
55GSFH-00.4	5/4/2009	14:25	2.7	0.50	2.49	1.90
55GSFH-00.4	5/18/2009	14:09	2.7	0.52	2.41	1.90
55GSFH-00.4	5/18/2009	14:17	2.6	0.51	2.39	1.90
55GSFH-00.4	6/1/2009	13:57	2.8	0.52	2.53	1.90
55GSFH-00.4	6/1/2009	14:03	2.9	0.52	2.55	1.90
55GSFH-00.4	6/15/2009	14:42	2.2	0.51	1.94	2.00

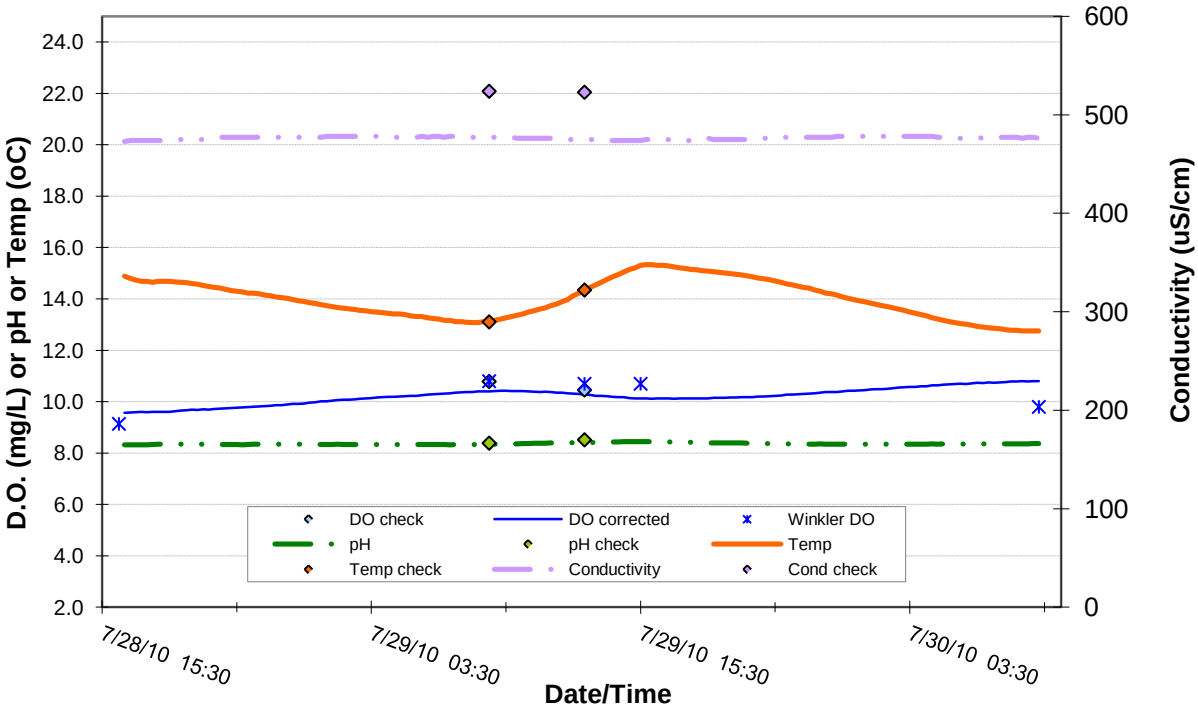
Location ID	Date	Time	Flow	Dep	Vel	WW
55GSFH-00.4	7/6/2009	13:32	3.2	0.53	2.85	1.90
55GSFH-00.4	7/13/2009	13:27	3.2	0.51	2.84	1.95
55GSFH-00.4	7/13/2009	13:33	3.1	0.51	2.74	1.95
55GSFH-00.4	8/3/2009	14:03	3.3	0.53	2.78	1.95
55GSFH-00.4	8/17/2009	11:51	3.1	0.53	2.54	1.95
55GSFH-00.4	9/8/2009	12:52	2.9	0.50	2.44	1.95
55GSFH-00.4	9/22/2009	12:45	3.1	0.52	2.74	1.90
55GSFH-00.3[1]	2/9/2009	14:33	5.3			
55GSFH-00.3[1]	2/23/2009	14:35	6.6			
55GSFH-00.3[1]	3/11/2009	14:15	7.2			
55GSFH-00.3[1]	3/11/2009	14:20	7.0			
55GSFH-00.3[1]	3/24/2009	10:40	7.5			
55GSFH-00.3[1]	4/6/2009	14:57	7.1			
55GSFH-00.3[1]	4/20/2009	13:45	8.1			
55GSFH-00.3[1]	5/4/2009	14:47	8.2			
55GSFH-00.3[1]	5/4/2009	14:50	8.2			
55GSFH-00.3[1]	5/18/2009	14:40	7.3			
55GSFH-00.3[1]	6/1/2009	14:33	9.8			
55GSFH-00.3[1]	6/15/2009	15:02	7.4			
55GSFH-00.3[1]	7/6/2009	13:55	7.6			
55GSFH-00.3[1]	7/13/2009	13:57	7.7			
55GSFH-00.3[1]	8/3/2009	14:25	5.9			
55GSFH-00.3[1]	8/17/2009	12:10	5.5			
55GSFH-00.3[1]	9/8/2009	13:13	7.0			
55GSFH-00.3[1]	9/22/2009	13:05	6.5			
55GRI-00.0	2/9/2009	15:05	20	0.90	0.31	64.9
55GRI-00.0	2/23/2009	14:55	21	0.93	0.31	66.4
55GRI-00.0	3/11/2009	14:43	20	1.30	0.22	66.2
55GRI-00.0	6/15/2009	15:30	17	0.87	0.20	91.7
55GRI-00.0	7/6/2009	14:33	21	0.76	0.41	61.8
55GRI-00.0	7/13/2009	14:18	22	0.77	0.42	62.0
55GRI-00.0	8/3/2009	14:56	25	0.63	0.59	61.7
55GRI-00.0	8/17/2009	12:31	19	0.66	0.43	62.5
55GRI-00.0	9/8/2009	13:57	21	0.66	0.45	62.0
55GRI-00.0	9/8/2009	14:21	20	0.65	0.46	62.0
55GRI-00.0	9/22/2009	13:25	21	0.72	0.45	59.5

[1]Flow measurements at 55GSFH-00.3 were taken using the culvert flow method.

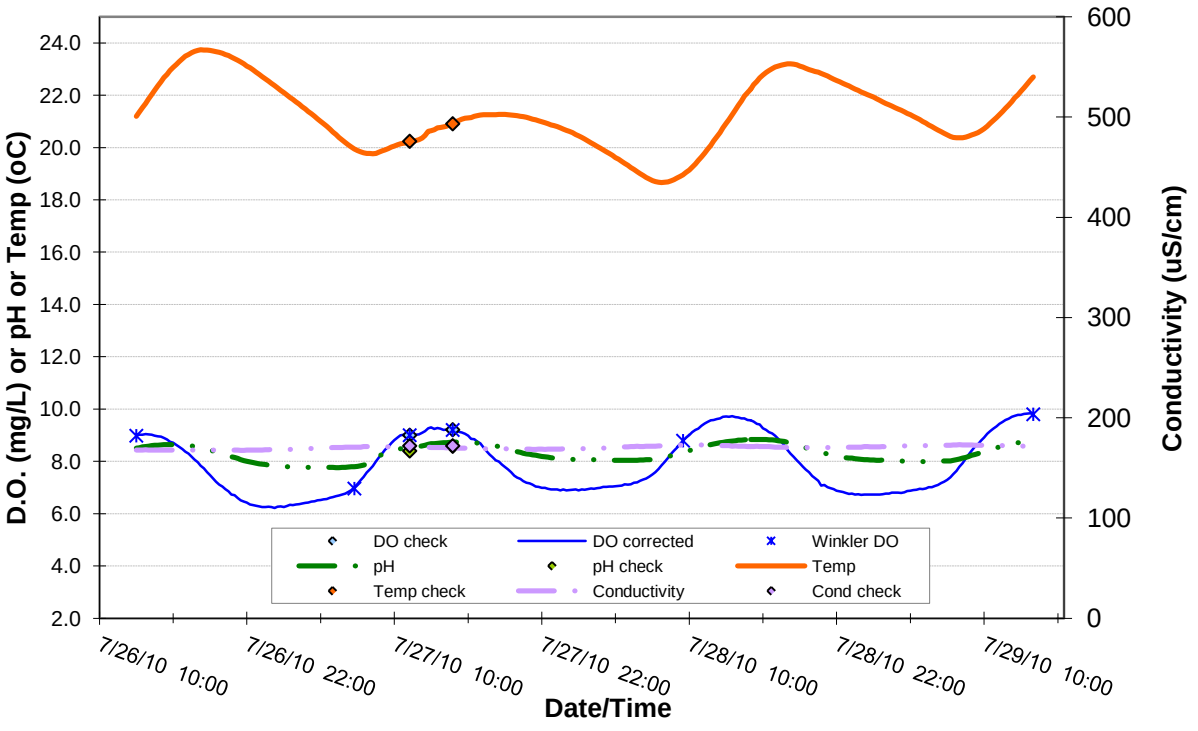
Appendix D. Continuous Hydrolab Data Plots

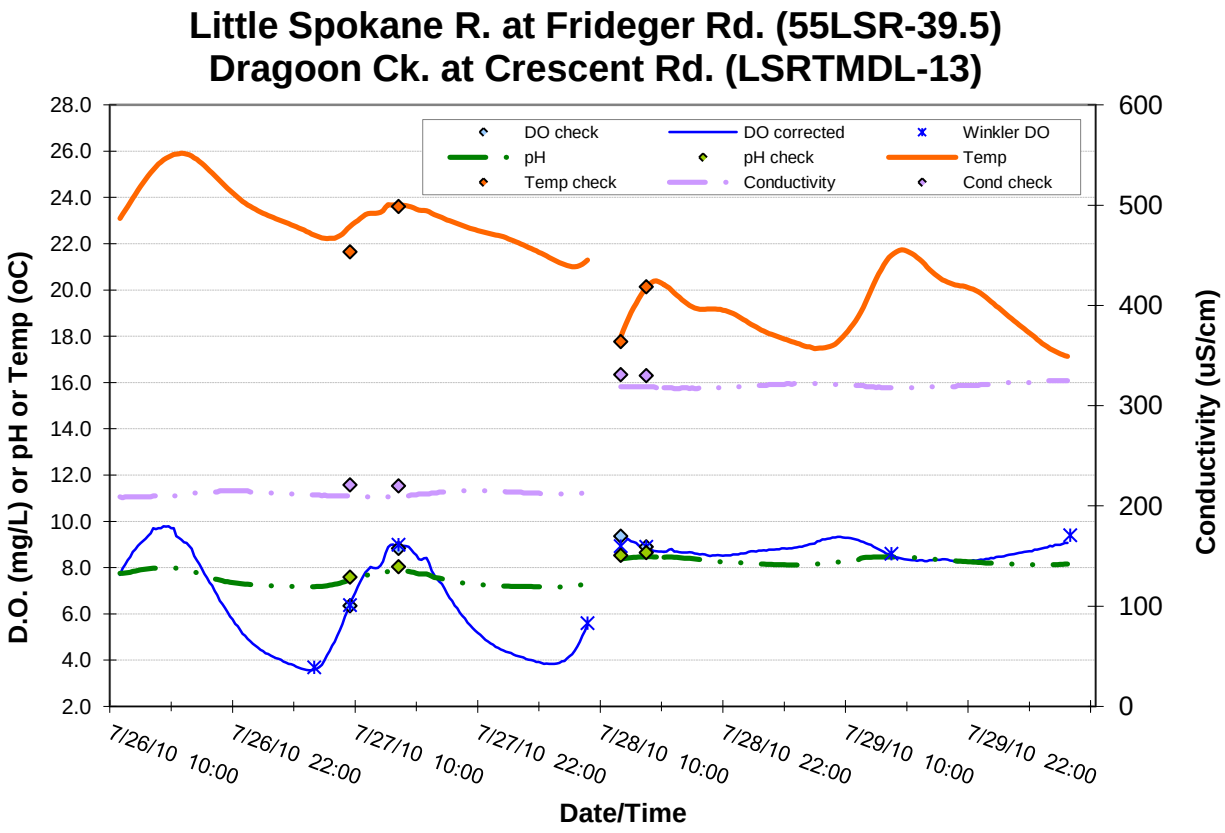
Dartford Creek at Hazard Rd. (LSRTMDL-7)

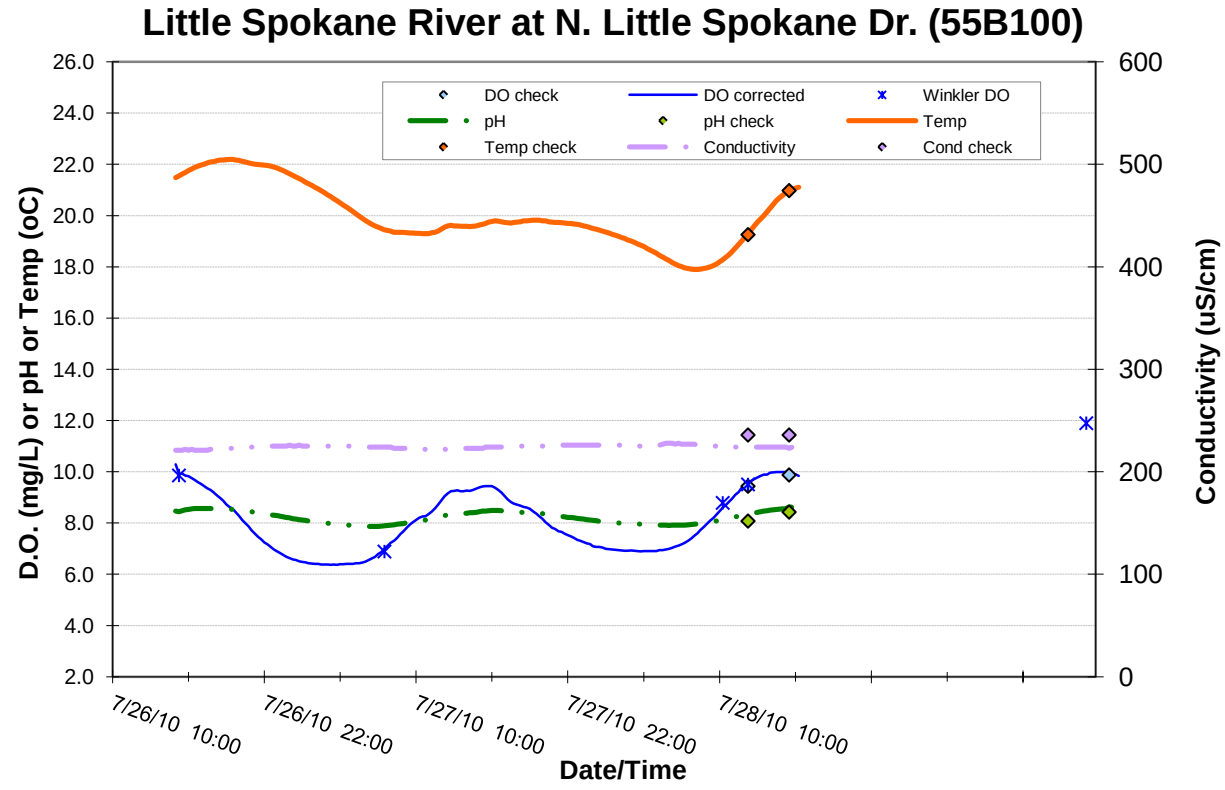
DO and **Conductivity** data are qualified as estimates**.**

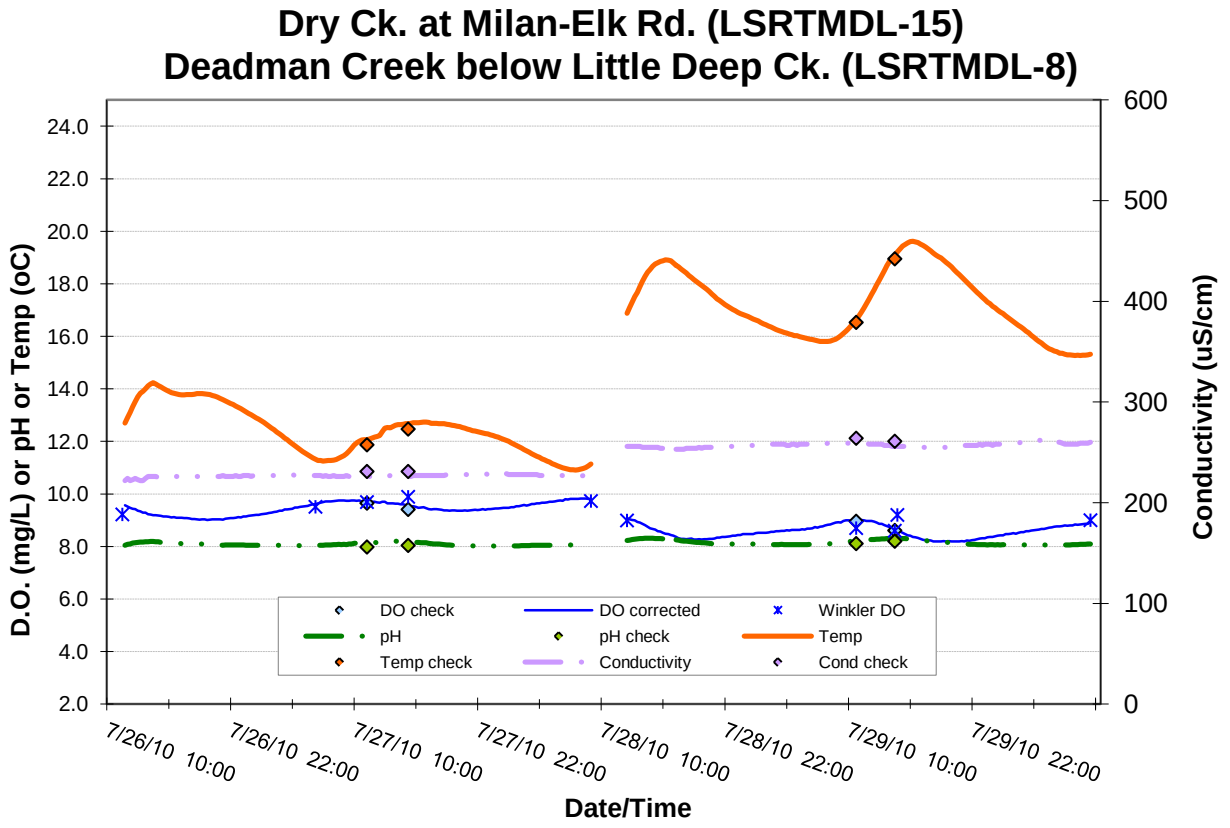


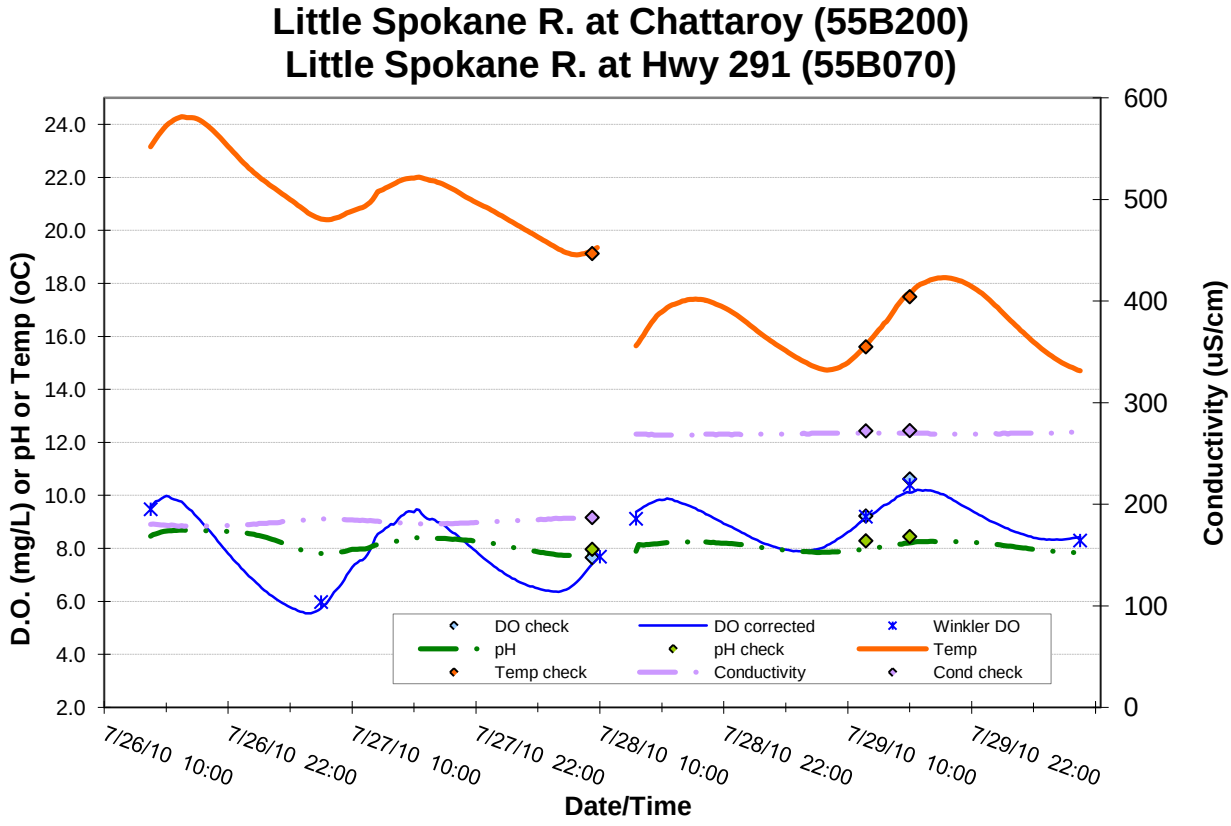
Little Spokane R. at Deer Park-Milan Rd. (LSRTMDL-2)



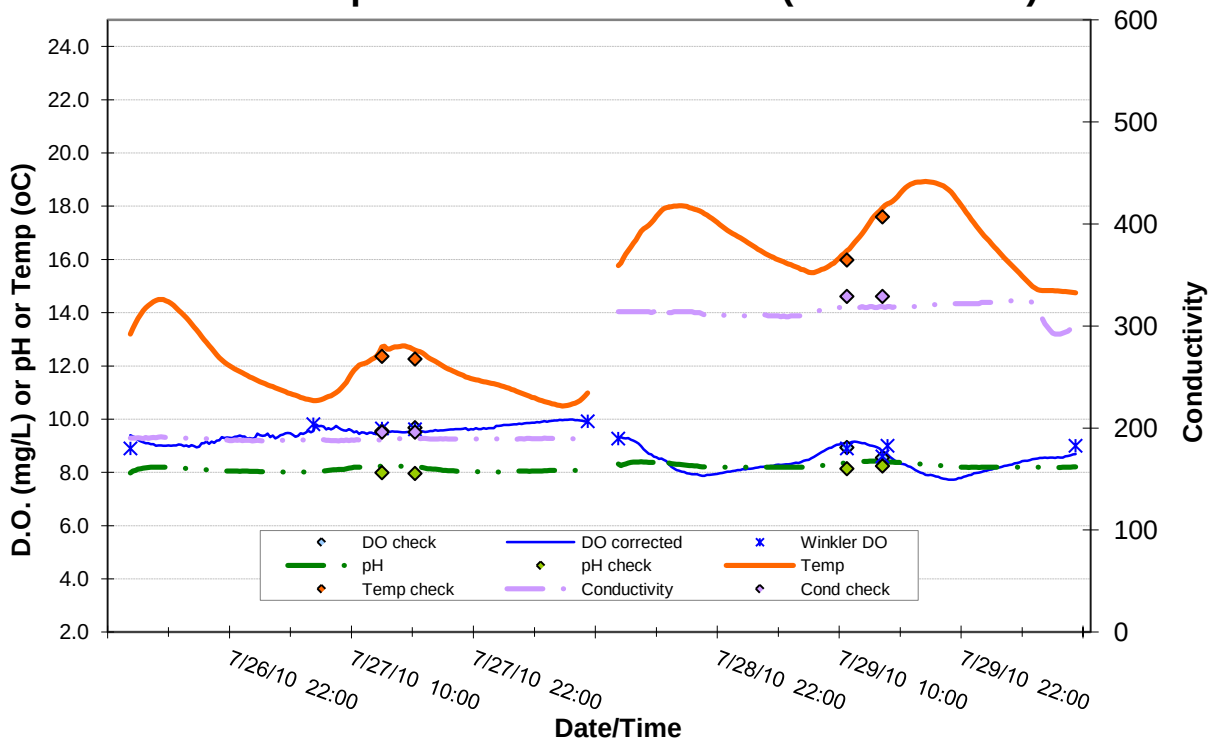

Little Spokane R. at Frideger Rd. (55LSR-39.5)
Dragoon Ck. at Crescent Rd. (LSRTMDL-13)
DO check
DO corrected
Winkler DO
pH
pH check
Temp
Temp check
Conductivity
Cond check
D.O. (mg/L) or pH or Temp (oC)
Conductivity (uS/cm)
28.0
26.0
24.0
22.0
20.0
18.0
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
600
500
400
300
200
100
0
7/26/10 10:00
7/26/10 22:00
7/27/10 10:00
7/27/10 22:00
7/28/10 10:00
7/28/10 22:00
7/29/10 10:00
7/29/10 22:00
Date/Time


Little Spokane River at N. Little Spokane Dr. (55B100)
DO check
DO corrected
Winkler DO
pH
pH check
Temp
Temp check
Conductivity
Cond check
D.O. (mg/L) or pH or Temp (oC)
Conductivity (uS/cm)
26.0
24.0
22.0
20.0
18.0
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
600
500
400
300
200
100
0
7/26/10 10:00
7/26/10 22:00
7/27/10 10:00
7/27/10 22:00
7/28/10 10:00
Date/Time


Dry Ck. at Milan-Elk Rd. (LSRTMDL-15)
Deadman Creek below Little Deep Ck. (LSRTMDL-8)
D.O. (mg/L) or pH or Temp (oC)
Conductivity (uS/cm)
Date/Time
DO check
DO corrected
Winkler DO
pH
pH check
Temp
Temp check
Conductivity
Cond check


Little Spokane R. at Chattaroy (55B200)
Little Spokane R. at Hwy 291 (55B070)
D.O. (mg/L) or pH or Temp (oC)
Conductivity (uS/cm)
Date/Time
DO check
DO corrected
Winkler DO
pH
pH check
Temp
Temp check
Conductivity
Cond check

Otter Ck. at Valley Rd. (55OTT-00.3)
Little Deep Ck. abv. Deadman Ck. (LSRTMDL-16)

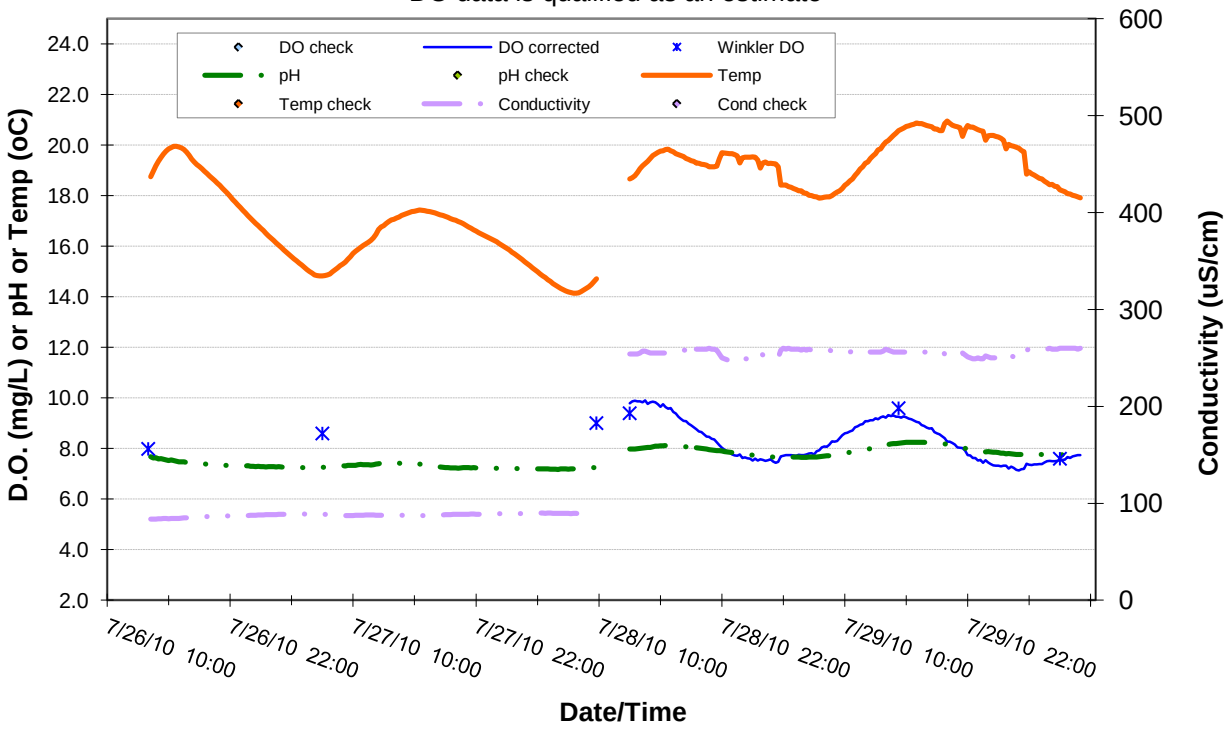


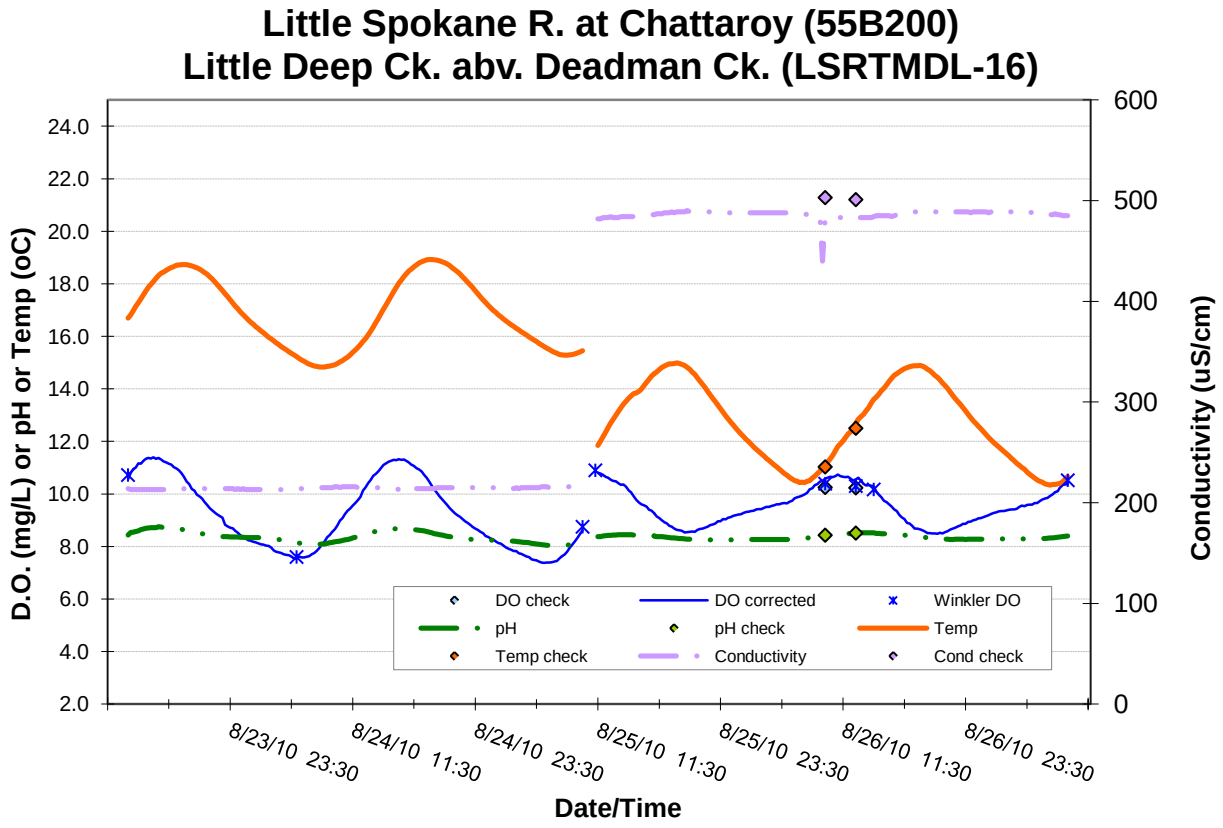
Deer Ck. at Hwy 2 (55D070)

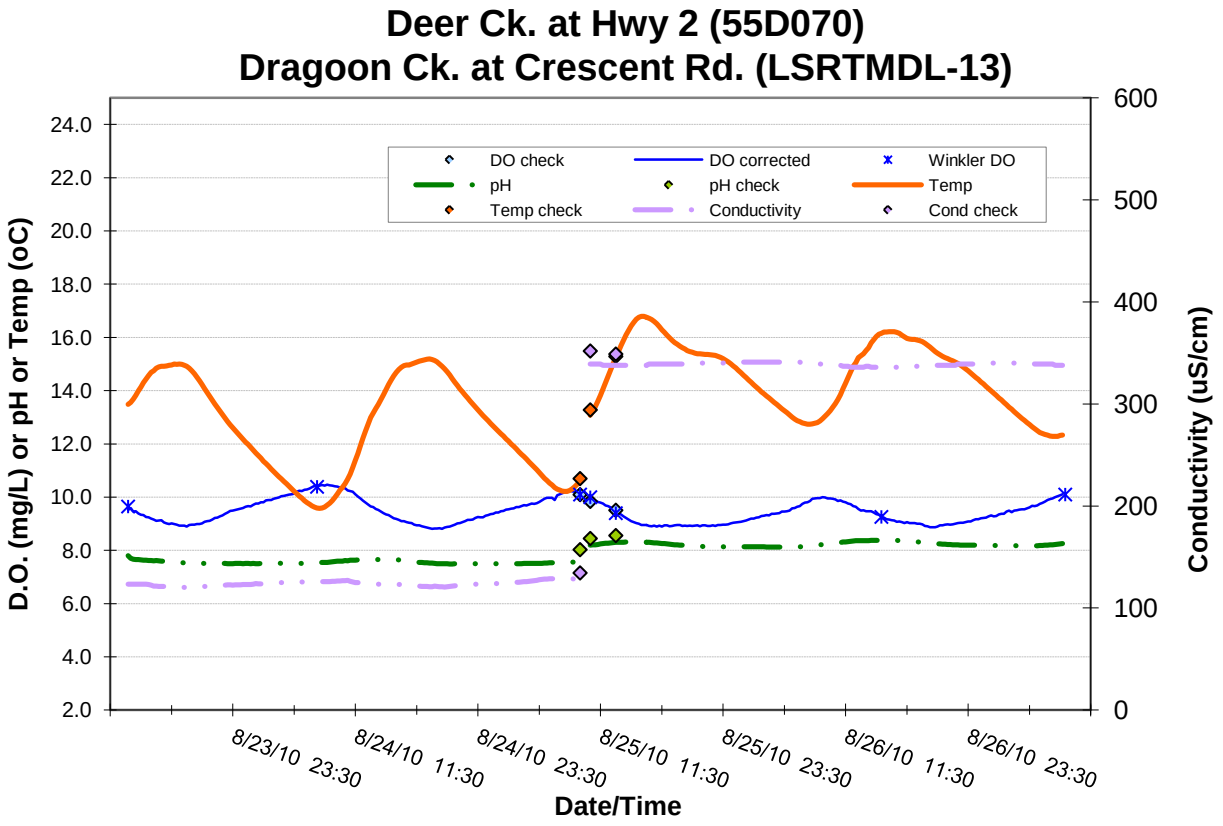
DO data is rejected

Little Spokane R. at Dartford USGS gage (55LSR-11.0)

DO data is qualified as an estimate

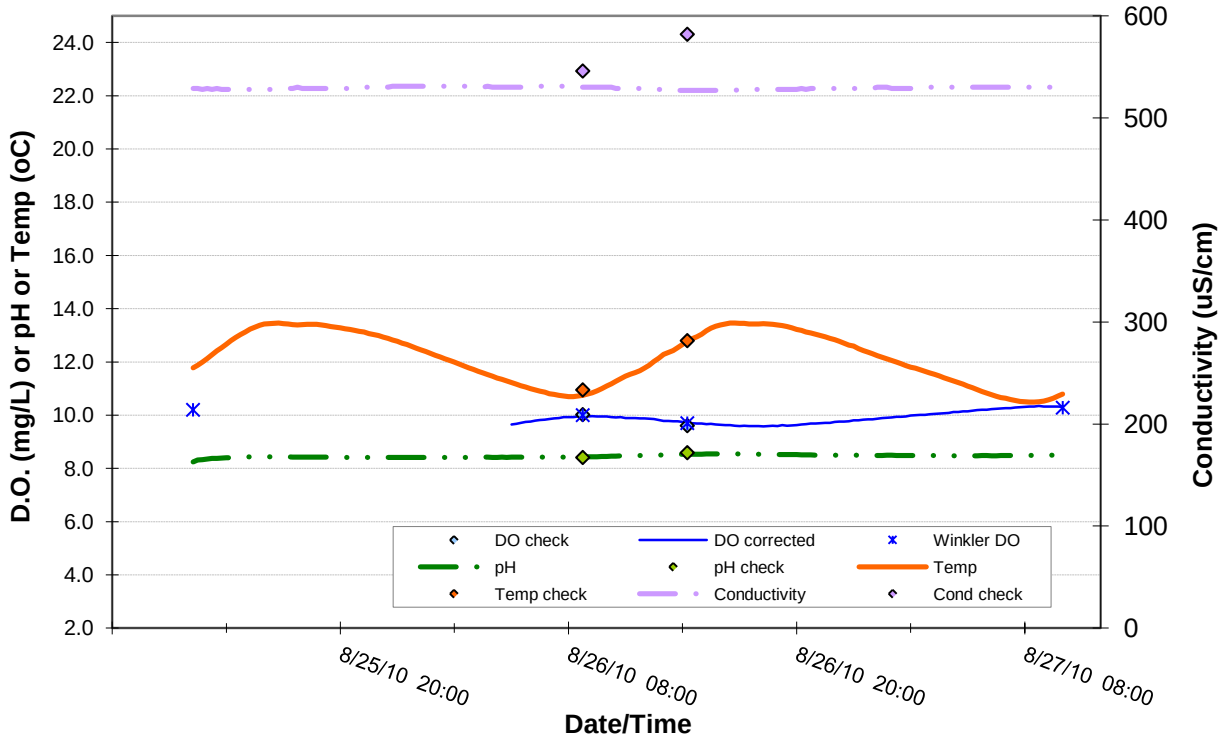



Little Spokane R. at Chattaroy (55B200)
Little Deep Ck. abv. Deadman Ck. (LSRTMDL-16)
D.O. (mg/L) or pH or Temp (oC)
Conductivity (uS/cm)
Date/Time
DO check
DO corrected
Winkler DO
pH
pH check
Temp
Temp check
Conductivity
Cond check
8/23/10 23:30
8/24/10 11:30
8/24/10 23:30
8/25/10 11:30
8/25/10 23:30
8/26/10 11:30
8/26/10 23:30

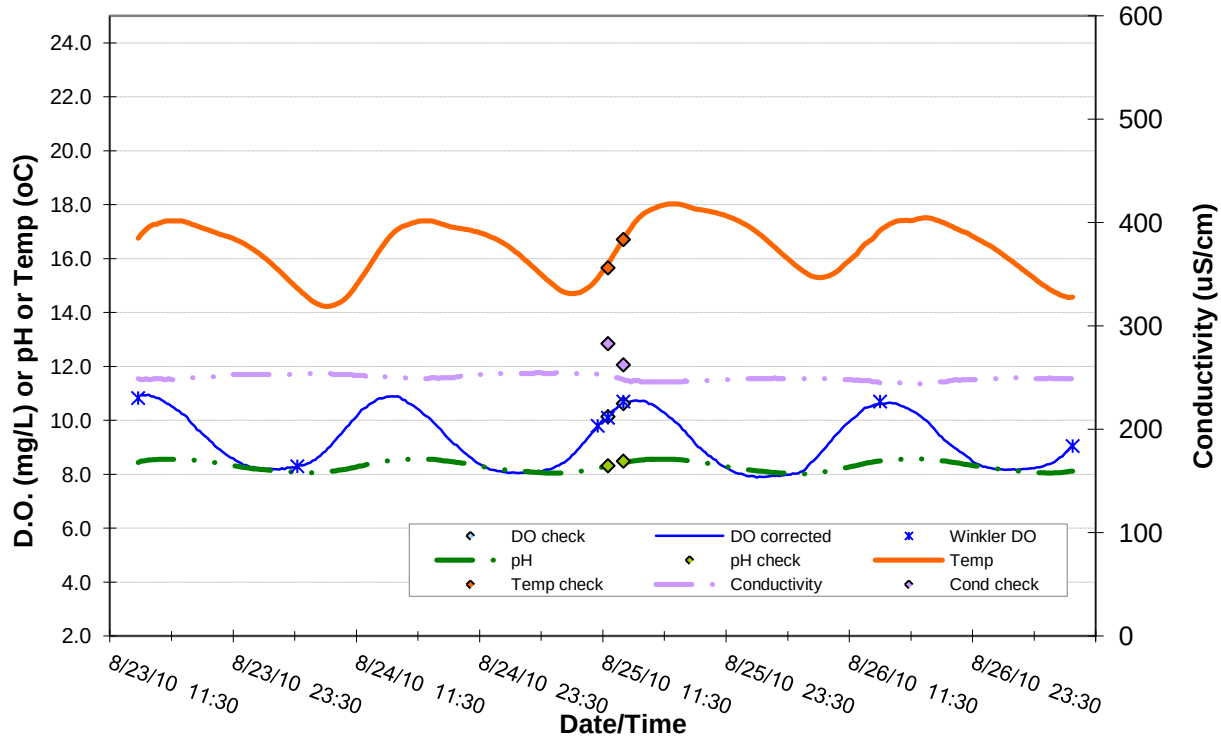

Deer Ck. at Hwy 2 (55D070)
Dragoon Ck. at Crescent Rd. (LSRTMDL-13)
D.O. (mg/L) or pH or Temp (oC)
Conductivity (uS/cm)
Date/Time
DO check
DO corrected
Winkler DO
pH
pH check
Temp
Temp check
Conductivity
Cond check
8/23/10 23:30
8/24/10 11:30
8/24/10 23:30
8/25/10 11:30
8/25/10 23:30
8/26/10 11:30
8/26/10 23:30

Dartford Creek at Hazard Rd. (LSRTMDL-7)

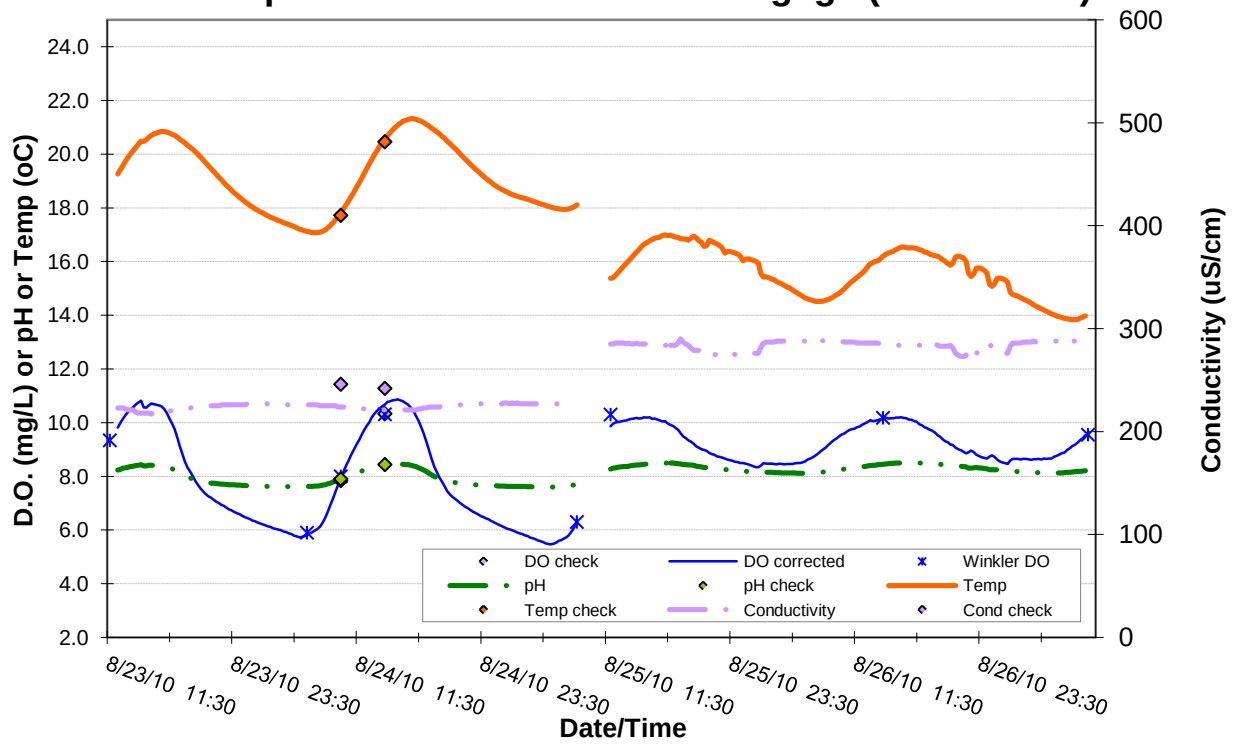
DO data prior to 8/26/10 5:00 are rejected.



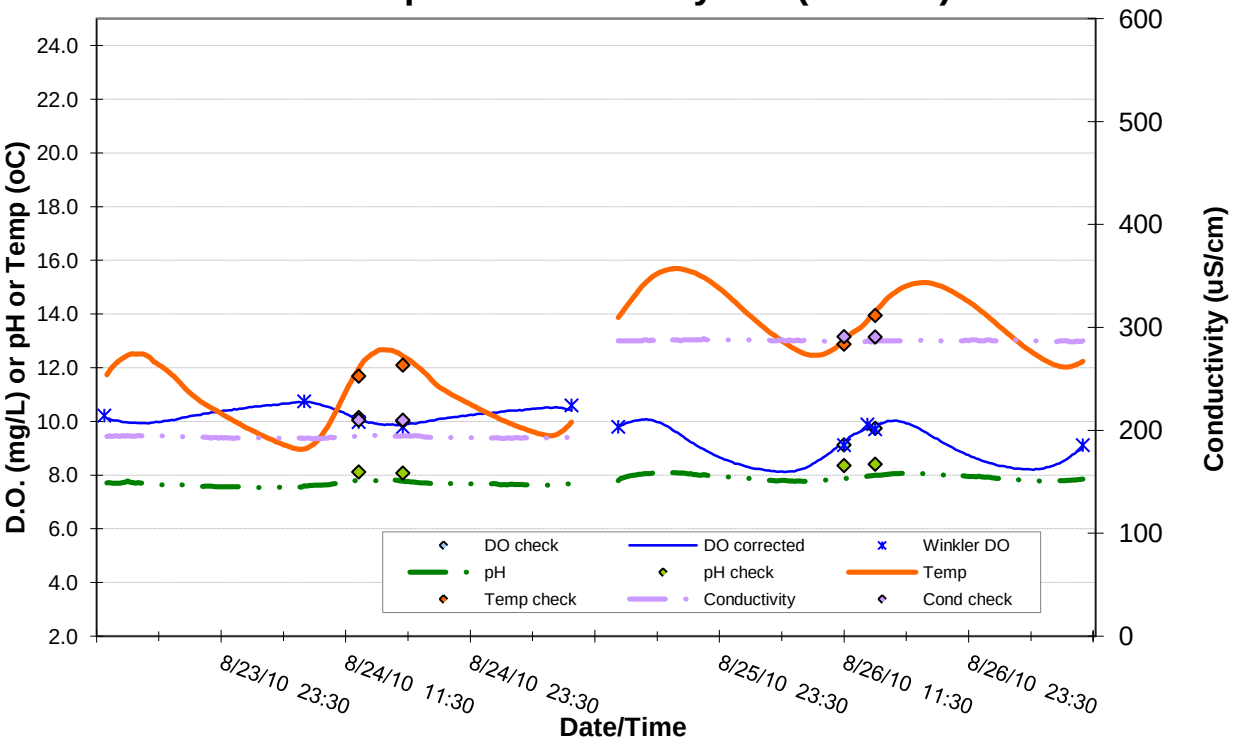
Little Spokane River at N. Little Spokane Dr. (55B100)



Little Spokane R. at Frideger Rd. (55LSR-39.5)
Little Spokane R. at Dartford USGS gage (55LSR-11.0)

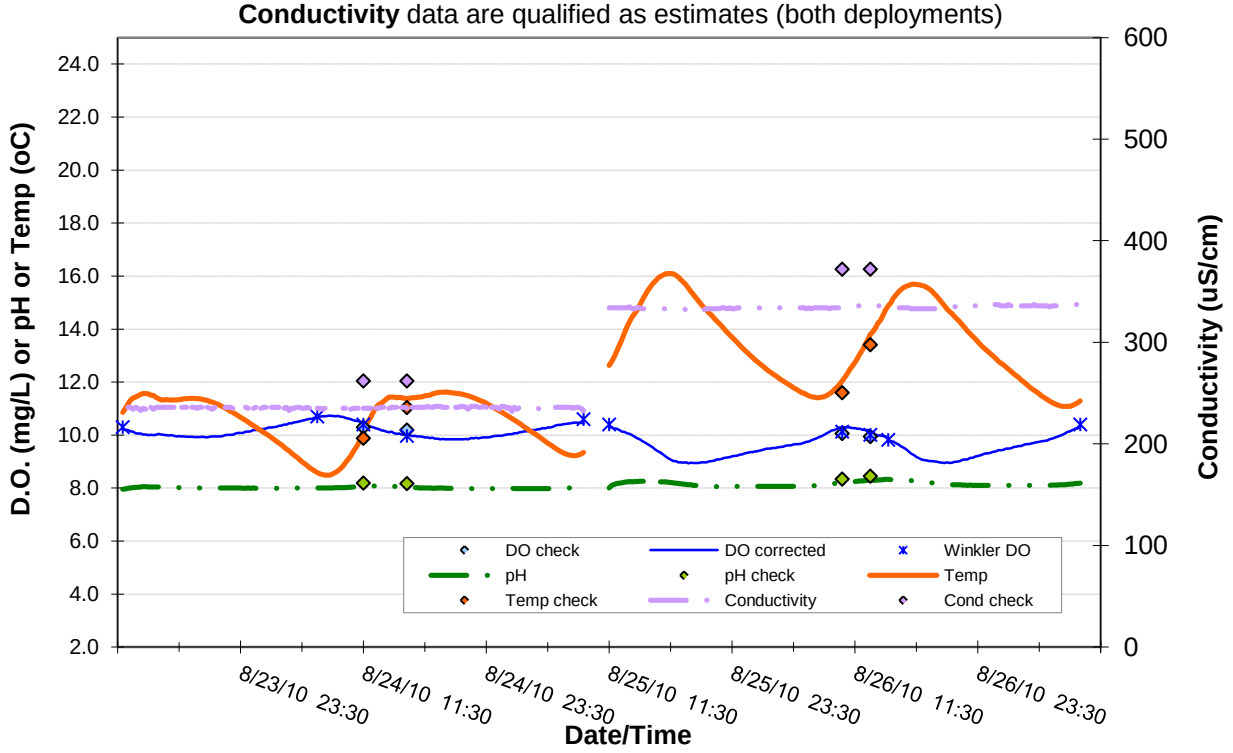


Otter Ck. at Valley Rd. (55OTT-00.3)
Little Spokane R. at Hwy 291 (55B070)

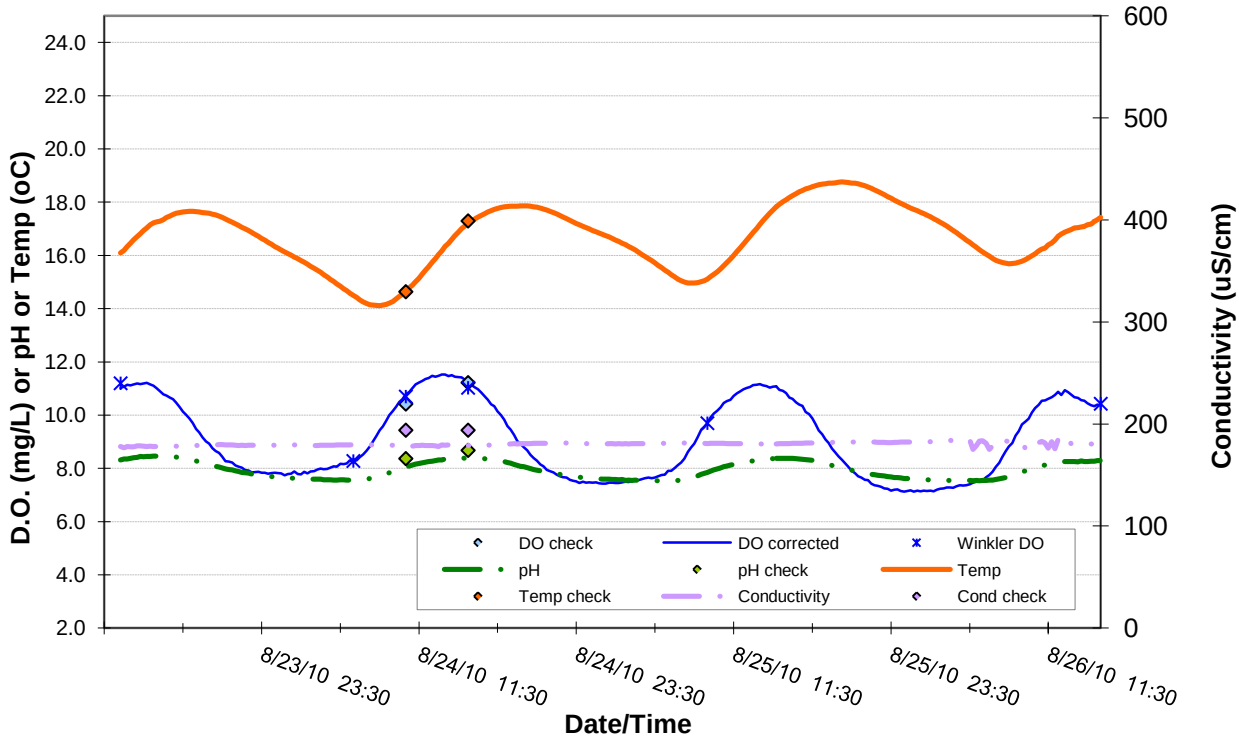


Dry Ck. at Milan-Elk Rd. (LSRTMDL-15)
Deadman Creek below Little Deep Ck. (LSRTMDL-8)

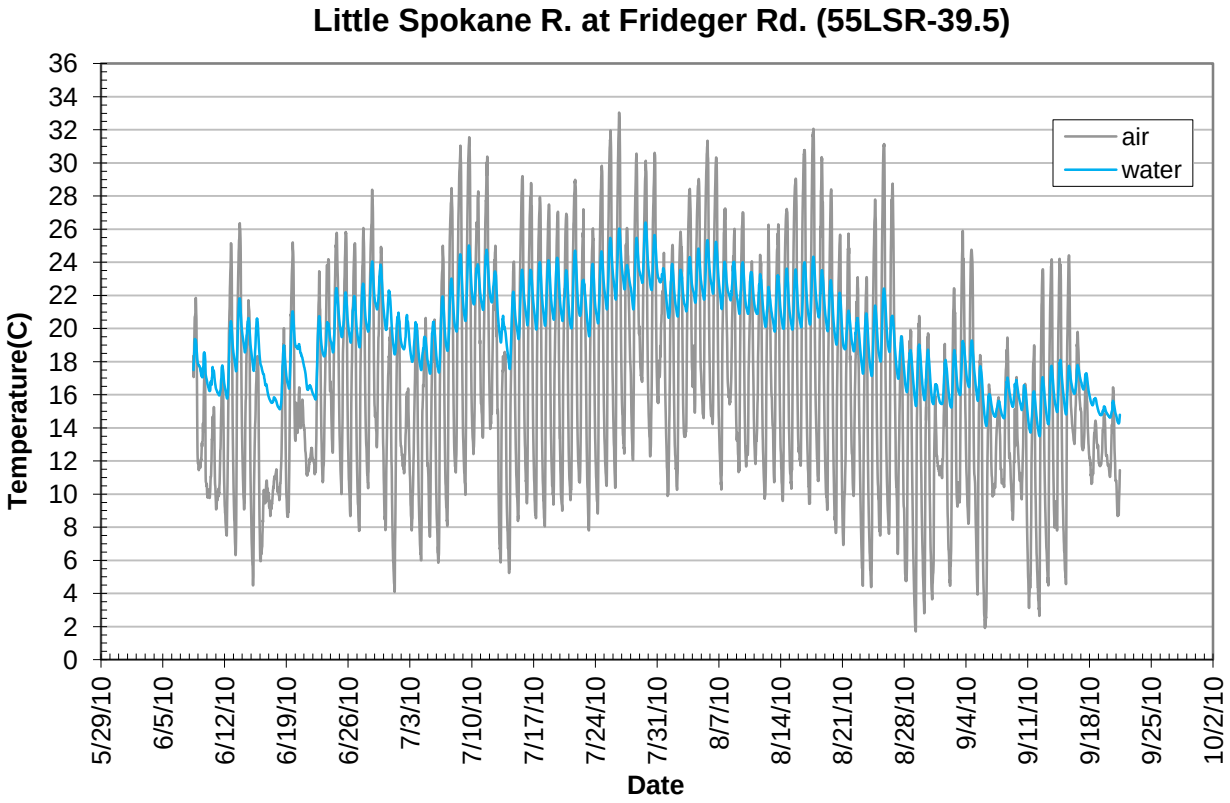
Conductivity data are qualified as estimates (both deployments)

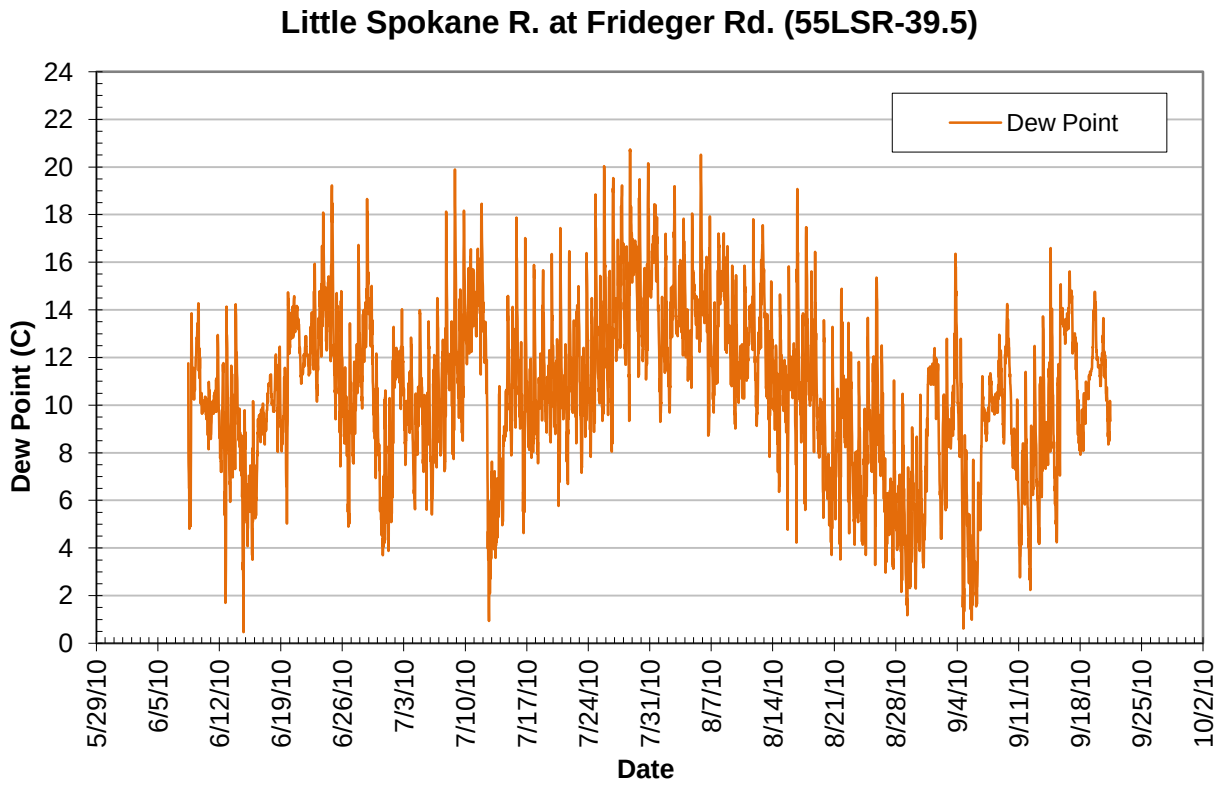


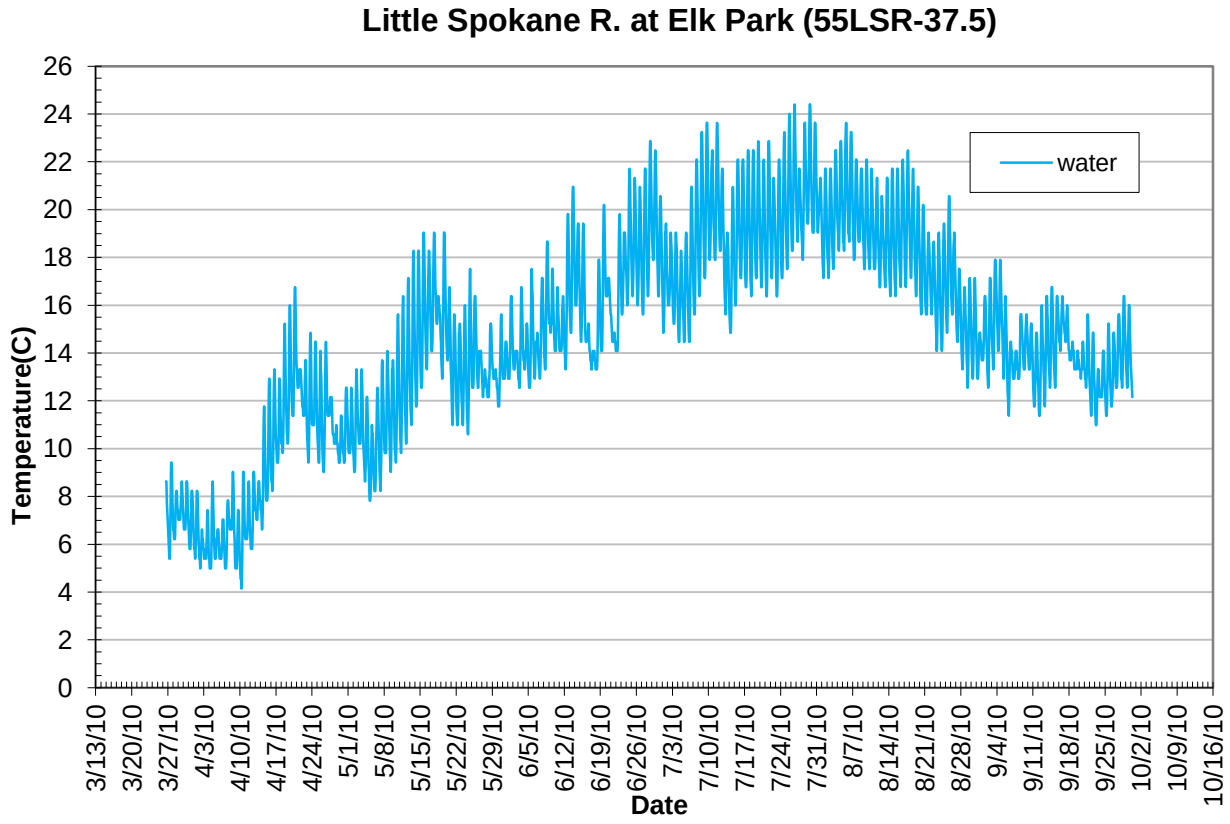
Little Spokane R. at Deer Park-Milan Rd. (LSRTMDL-2)



Appendix E. Continuous Temperature and Dew Point Plots






Little Spokane R. at Elk Park (55LSR-37.5)
Temperature(C)
Date
water
0
2
4
6
8
10
12
14
16
18
20
22
24
26
3/13/10
3/20/10
3/27/10
4/3/10
4/10/10
4/17/10
4/24/10
5/1/10
5/8/10
5/15/10
5/22/10
5/29/10
6/5/10
6/12/10
6/19/10
6/26/10
7/3/10
7/10/10
7/17/10
7/24/10
7/31/10
8/7/10
8/14/10
8/21/10
8/28/10
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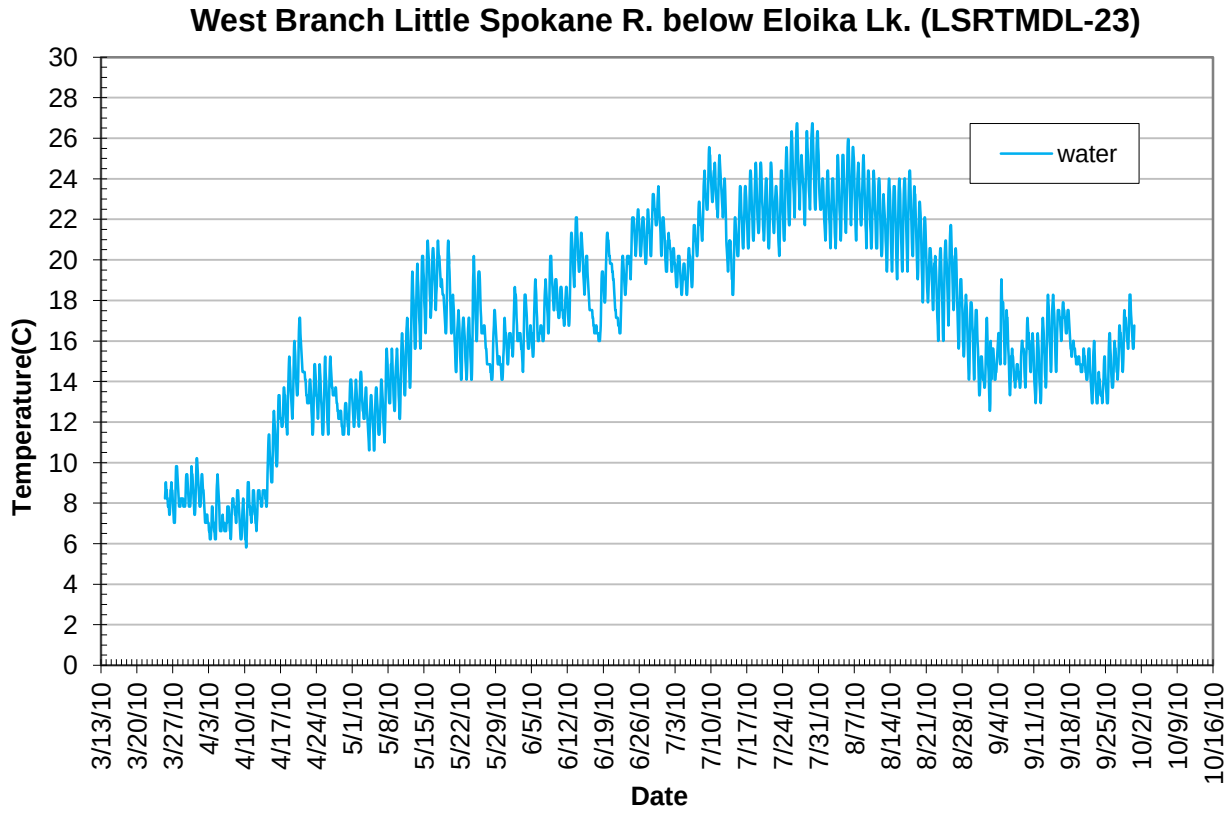
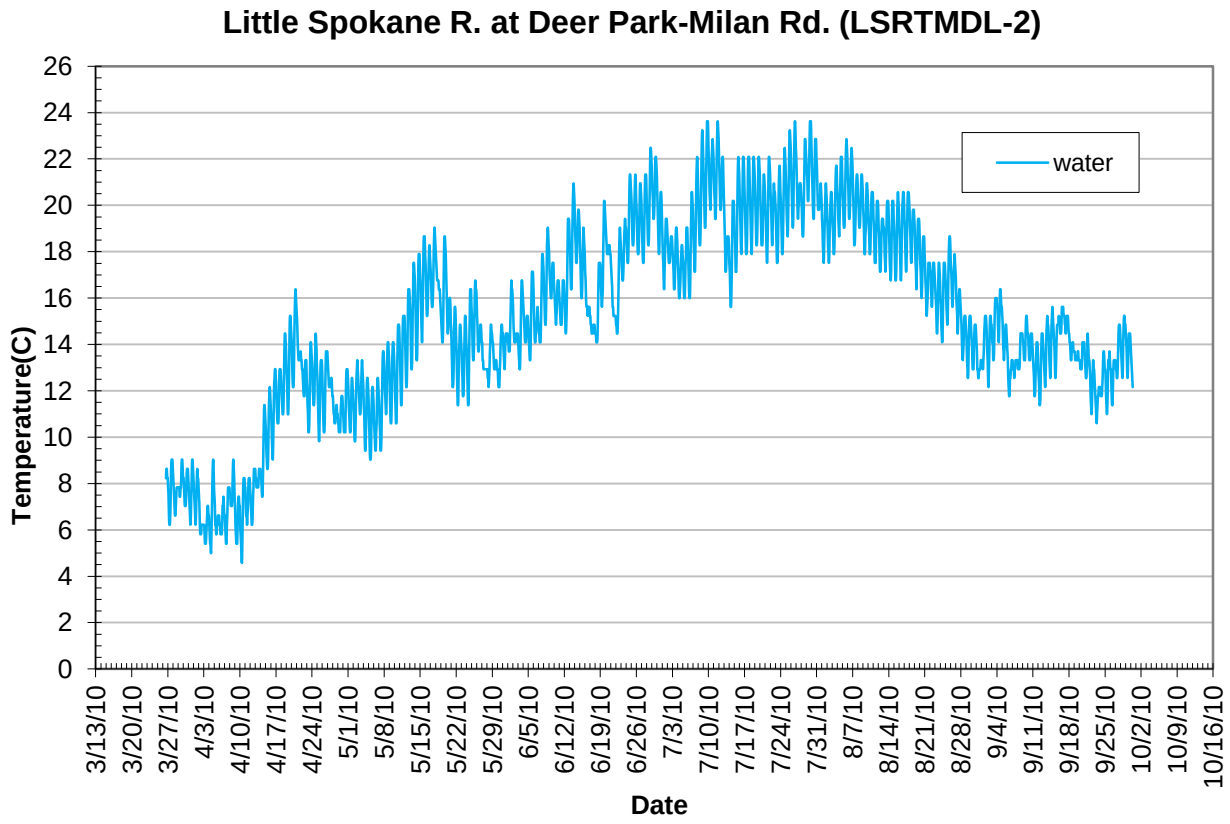
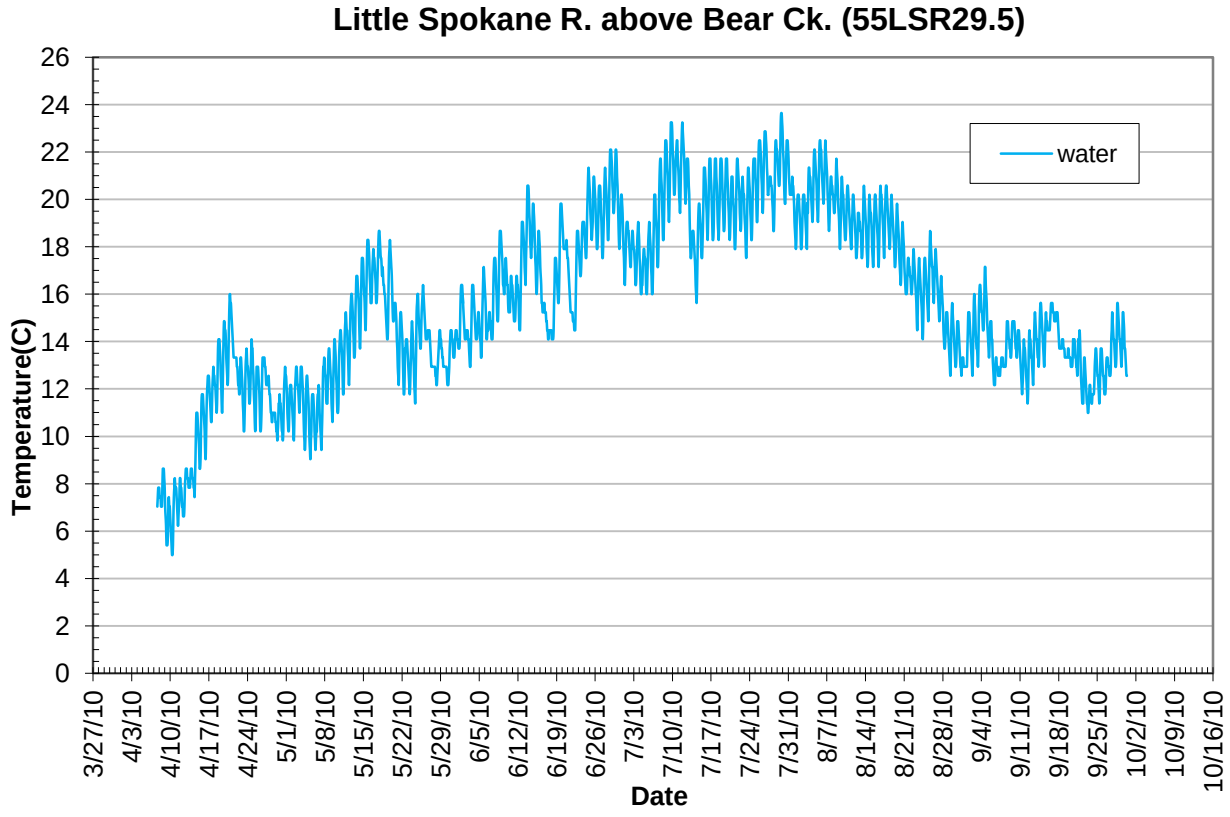
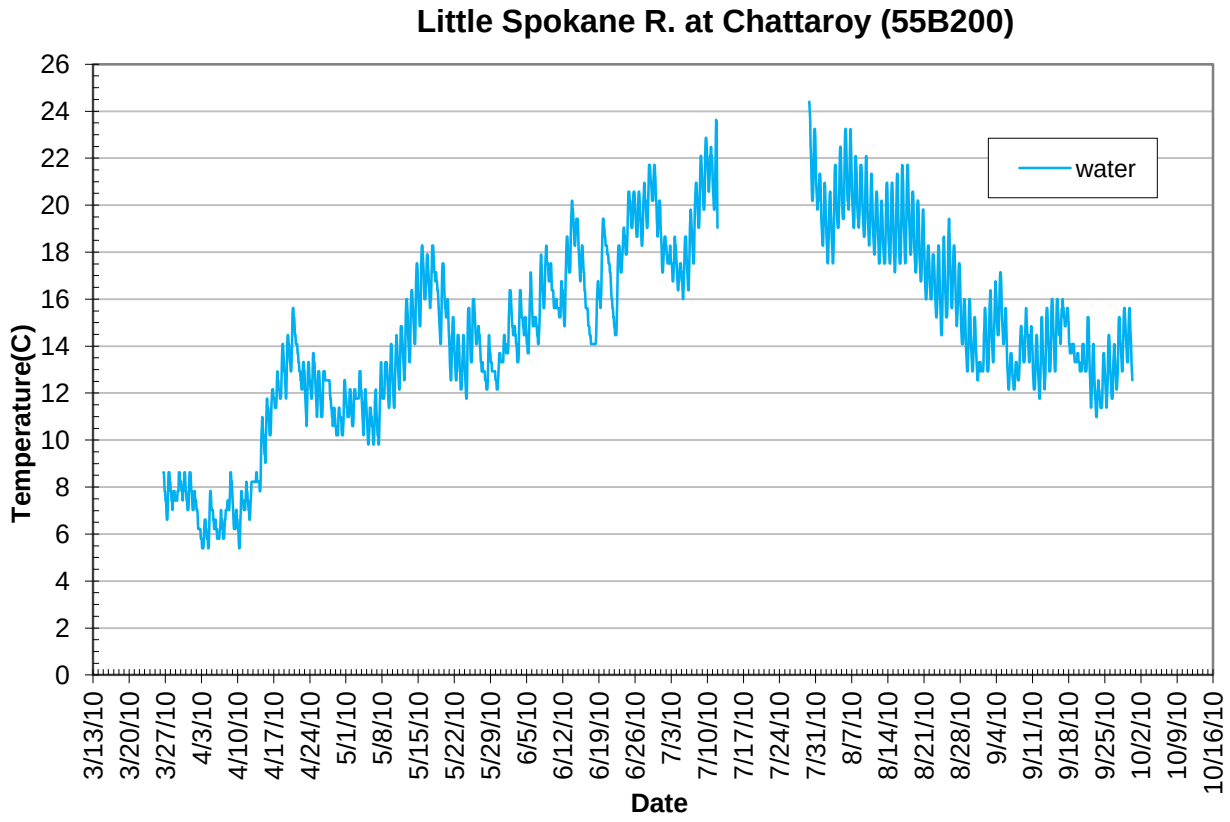
9/18/10
9/25/10
10/2/10
10/9/10
10/16/10


West Branch Little Spokane R. below Eloika Lk. (LSRTMDL-23)
Temperature(C)
Date
water
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
3/13/10
3/20/10
3/27/10
4/3/10
4/10/10
4/17/10
4/24/10
5/1/10
5/8/10
5/15/10
5/22/10
5/29/10
6/5/10
6/12/10
6/19/10
6/26/10
7/3/10
7/10/10
7/17/10
7/24/10
7/31/10
8/7/10
8/14/10
8/21/10
8/28/10
9/4/10
9/11/10
9/18/10
9/25/10
10/2/10
10/9/10
10/16/10


Little Spokane R. at Deer Park-Milan Rd. (LSRTMDL-2)
Temperature(C)
0
2
4
6
8
10
12
14
16
18
20
22
24
26
3/13/10
3/20/10
3/27/10
4/3/10
4/10/10
4/17/10
4/24/10
5/1/10
5/8/10
5/15/10
5/22/10
5/29/10
6/5/10
6/12/10
6/19/10
6/26/10
7/3/10
7/10/10
7/17/10
7/24/10
7/31/10
8/7/10
8/14/10
8/21/10
8/28/10
9/4/10
9/11/10
9/18/10
9/25/10
10/2/10
10/9/10
10/16/10
Date
water


Little Spokane R. above Bear Ck. (55LSR29.5)
Temperature(C)
0
2
4
6
8
10
12
14
16
18
20
22
24
26
3/27/10
4/3/10
4/10/10
4/17/10
4/24/10
5/1/10
5/8/10
5/15/10
5/22/10
5/29/10
6/5/10
6/12/10
6/19/10
6/26/10
7/3/10
7/10/10
7/17/10
7/24/10
7/31/10
8/7/10
8/14/10
8/21/10
8/28/10
9/4/10
9/11/10
9/18/10
9/25/10
10/2/10
10/9/10
10/16/10
Date
water


Little Spokane R. at Chattaroy (55B200)
Temperature(C)
Date
water
0
2
4
6
8
10
12
14
16
18
20
22
24
26
3/13/10
3/20/10
3/27/10
4/3/10
4/10/10
4/17/10
4/24/10
5/1/10
5/8/10
5/15/10
5/22/10
5/29/10
6/5/10
6/12/10
6/19/10
6/26/10
7/3/10
7/10/10
7/17/10
7/24/10
7/31/10
8/7/10
8/14/10
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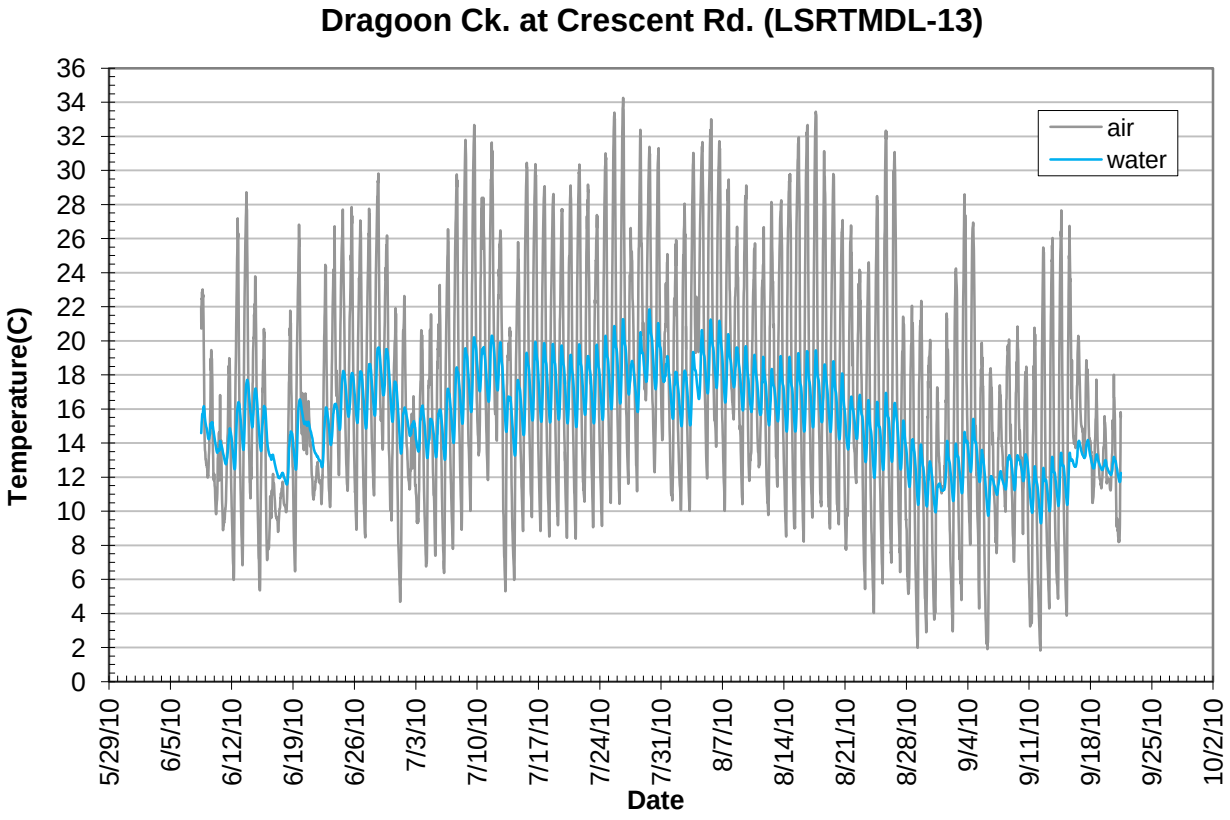
9/25/10
10/2/10
10/9/10
10/16/10


Dragoon Ck. at Crescent Rd. (LSRTMDL-13)
Temperature(C)
Date
air
water
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
5/29/10
6/5/10
6/12/10
6/19/10
6/26/10
7/3/10
7/10/10
7/17/10
7/24/10
7/31/10
8/7/10
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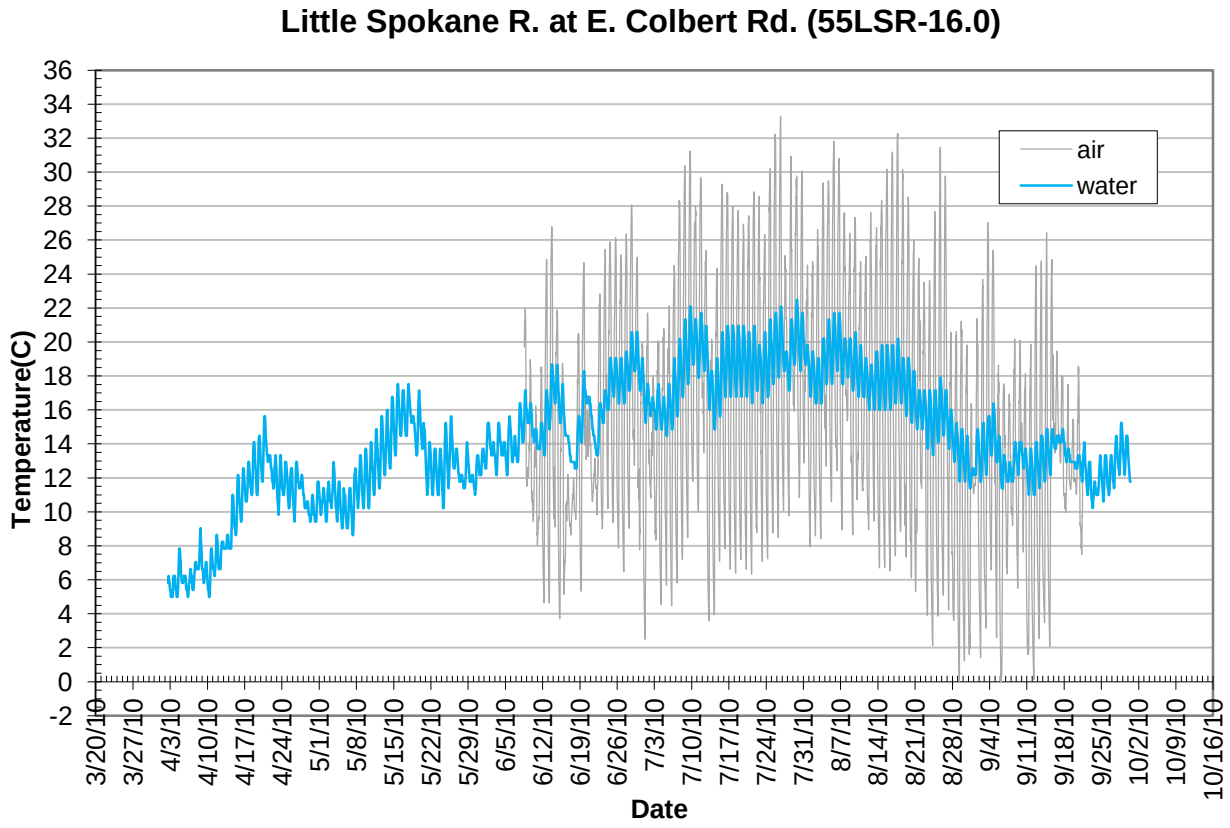
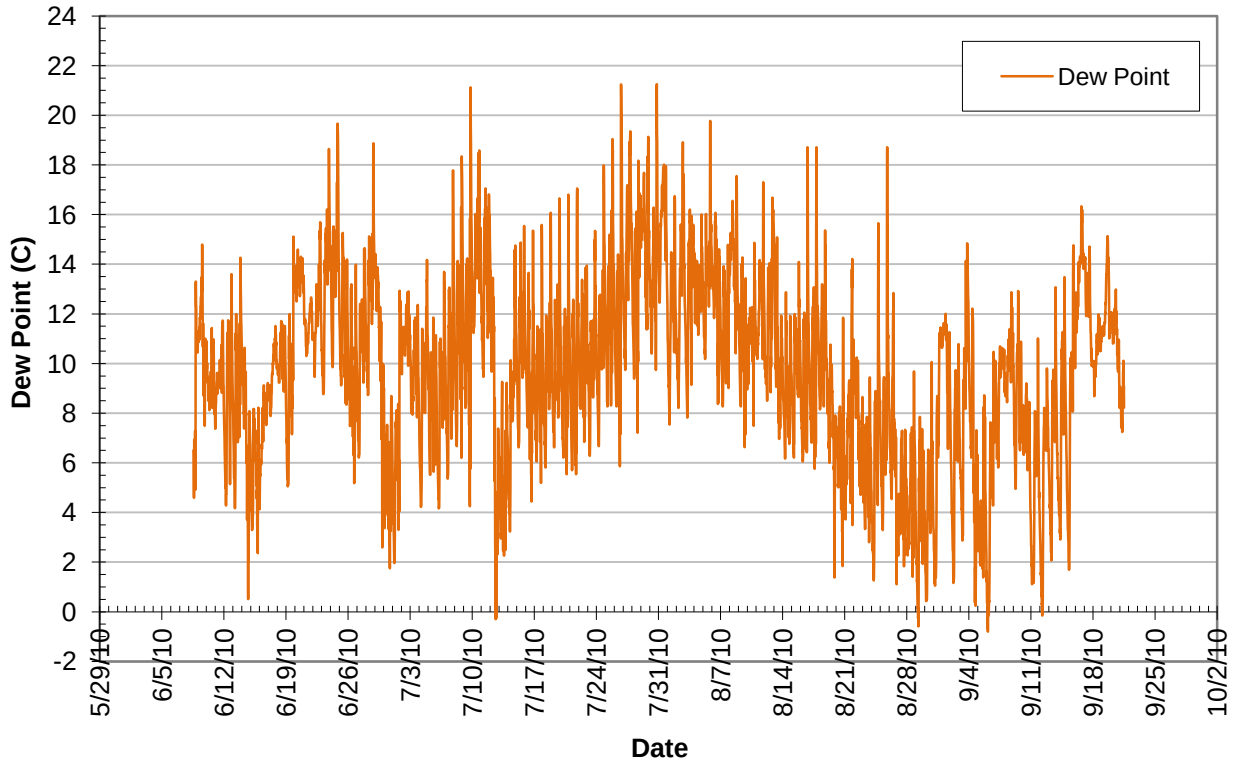
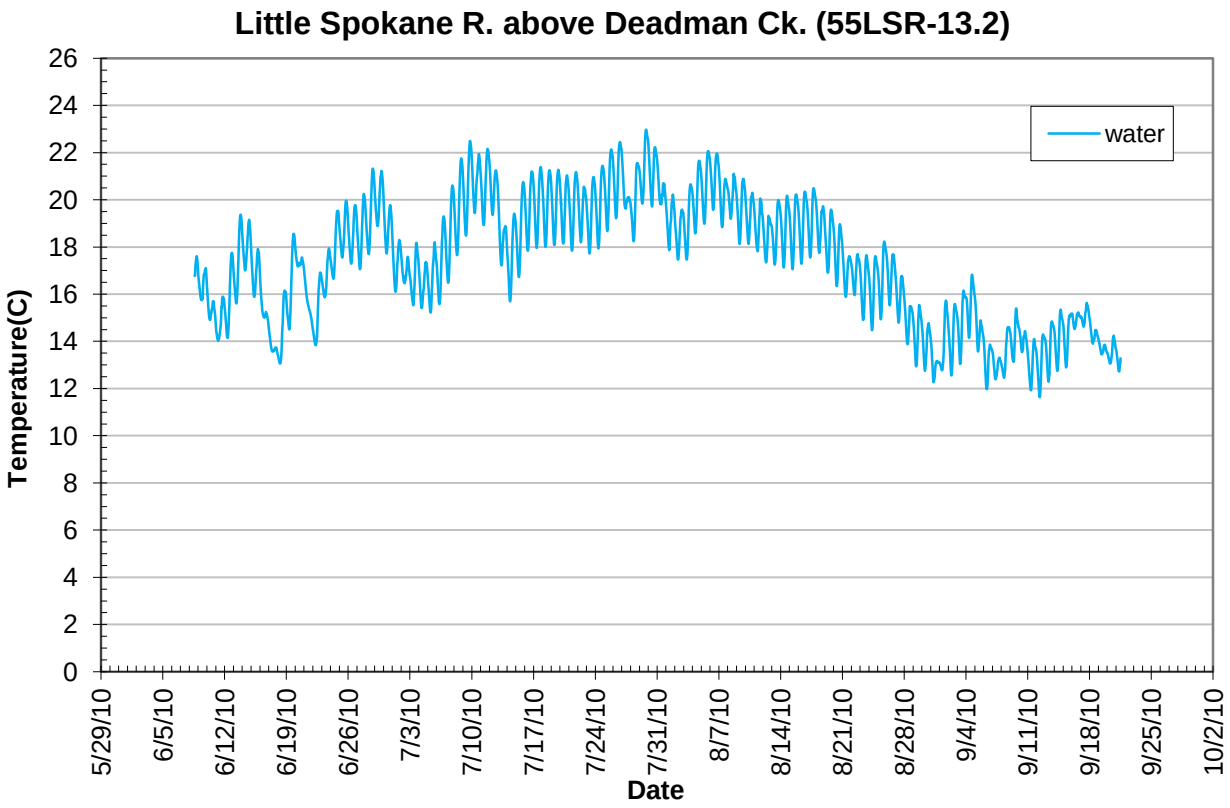
9/11/10
9/18/10
9/25/10
10/2/10


Little Spokane R. at E. Colbert Rd. (55LSR-16.0)
Temperature(C)
36
34
32
30
28
26
24
22
20
18
16
14
12
10
8
6
4
2
0
-2
air
water
3/20/10
3/27/10
4/3/10
4/10/10
4/17/10
4/24/10
5/1/10
5/8/10
5/15/10
5/22/10
5/29/10
6/5/10
6/12/10
6/19/10
6/26/10
7/3/10
7/10/10
7/17/10
7/24/10
7/31/10
8/7/10
8/14/10
8/21/10
8/28/10
9/4/10
9/11/10
9/18/10
9/25/10
10/2/10
10/9/10
10/16/10
Date


Little Spokane River at E. Colbert Rd. (55LSR-16.0)
Dew Point (C)
24
22
20
18
16
14
12
10
8
6
4
2
0
-2
Dew Point
5/29/10
6/5/10
6/12/10
6/19/10
6/26/10
7/3/10
7/10/10
7/17/10
7/24/10
7/31/10
8/7/10
8/14/10
8/21/10
8/28/10
9/4/10
9/11/10
9/18/10
9/25/10
10/2/10
Date


Little Spokane R. above Deadman Ck. (55LSR-13.2)
Temperature(C)
Date
water
0
2
4
6
8
10
12
14
16
18
20
22
24
26
5/29/10
6/5/10
6/12/10
6/19/10
6/26/10
7/3/10
7/10/10
7/17/10
7/24/10
7/31/10
8/7/10
8/14/10
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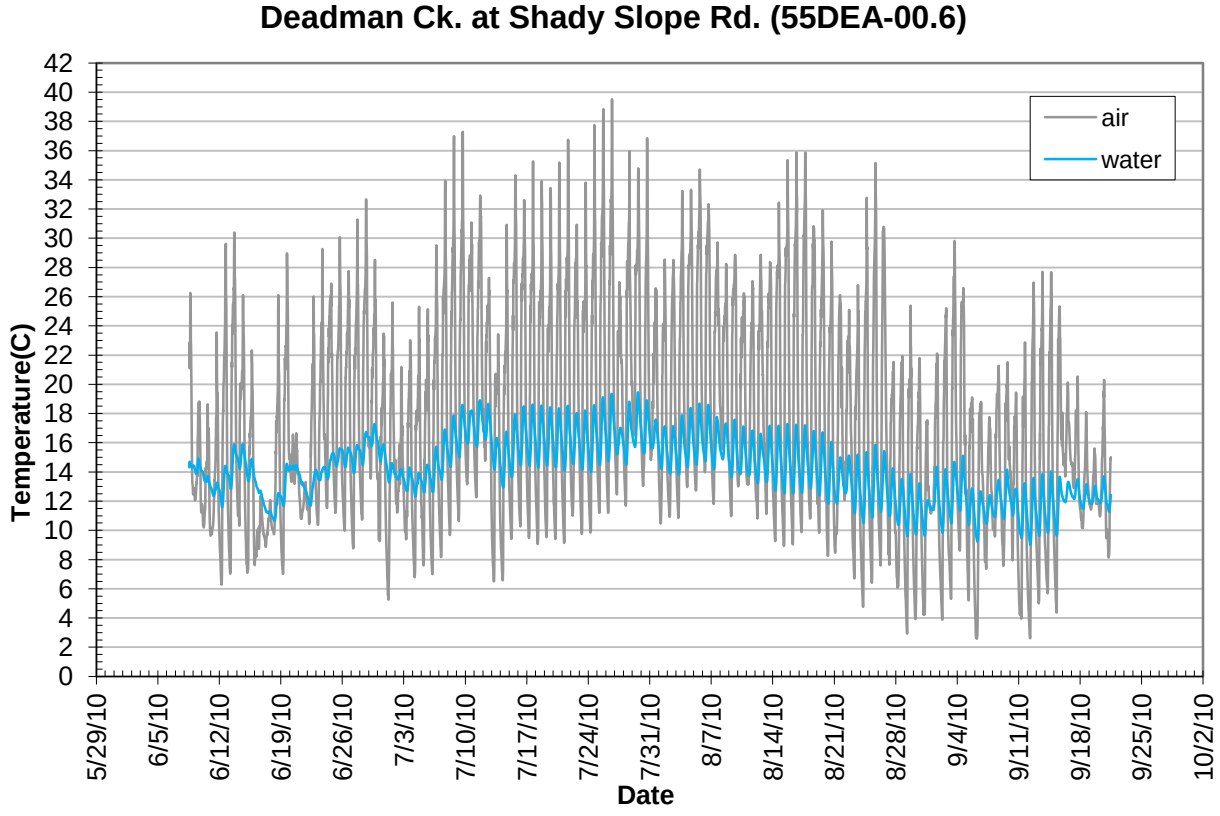
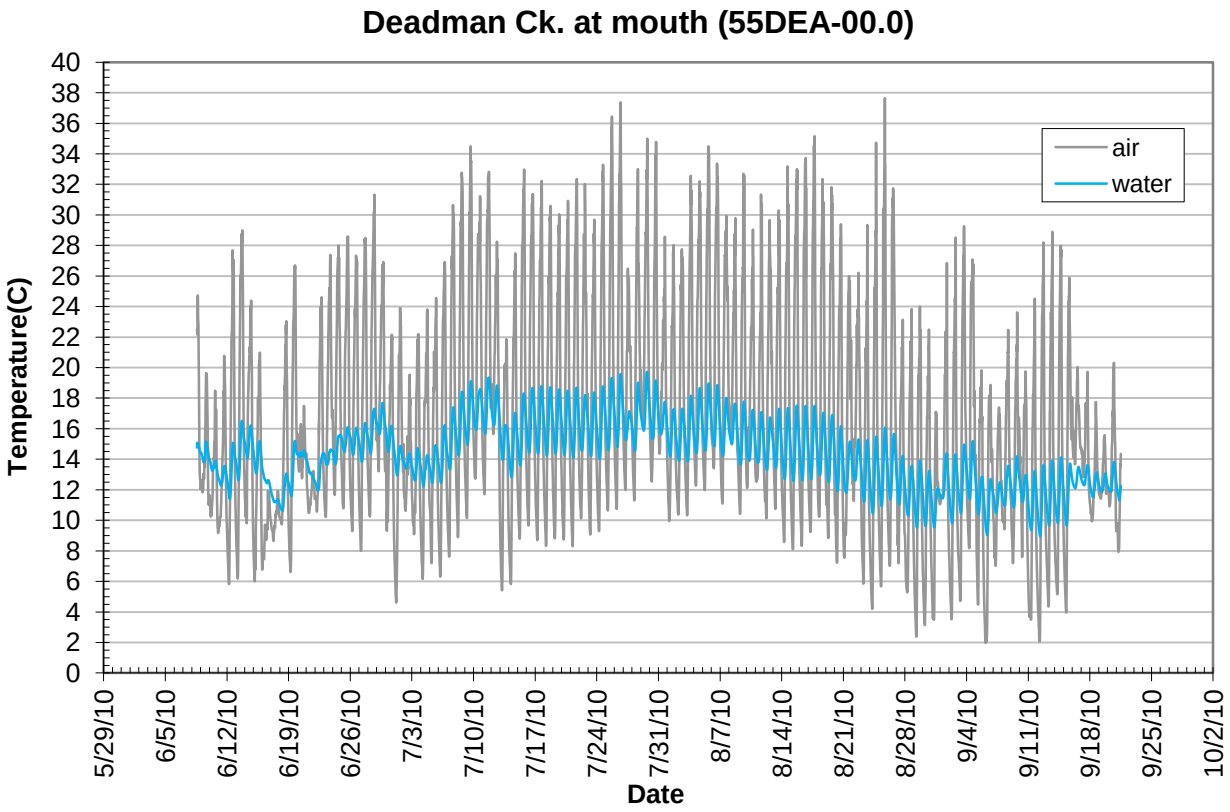
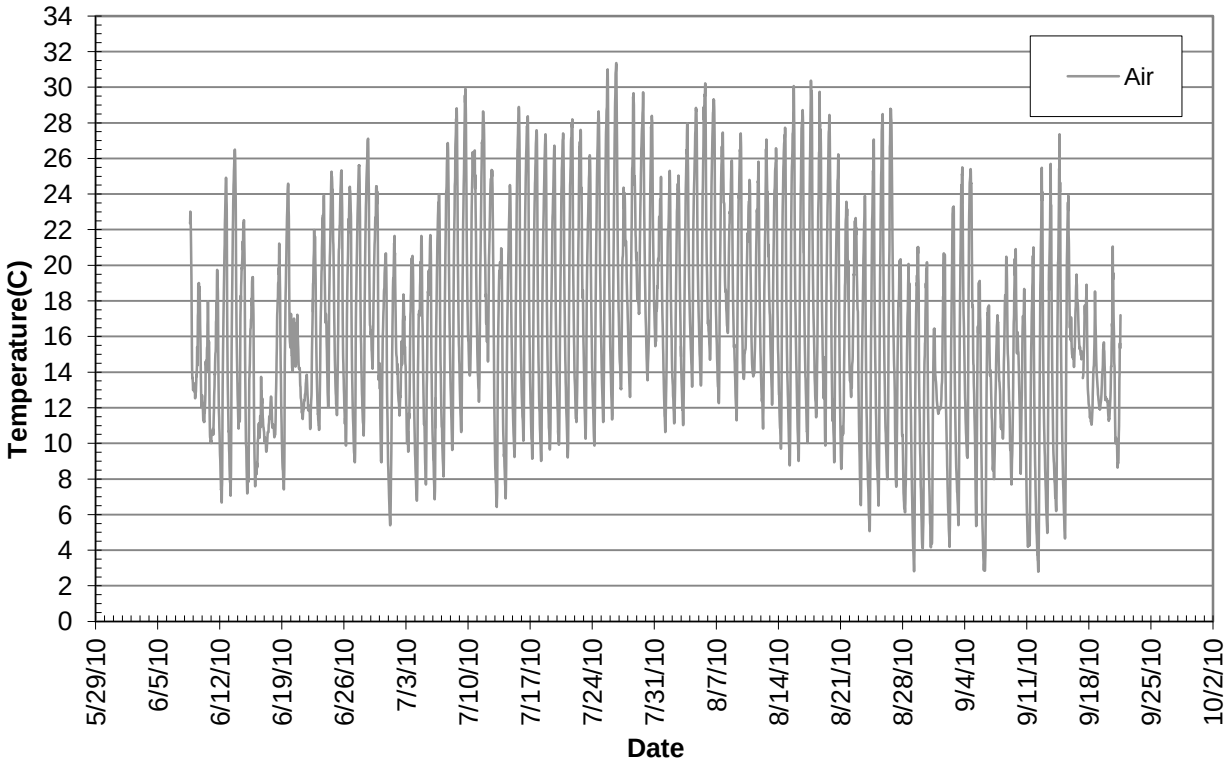
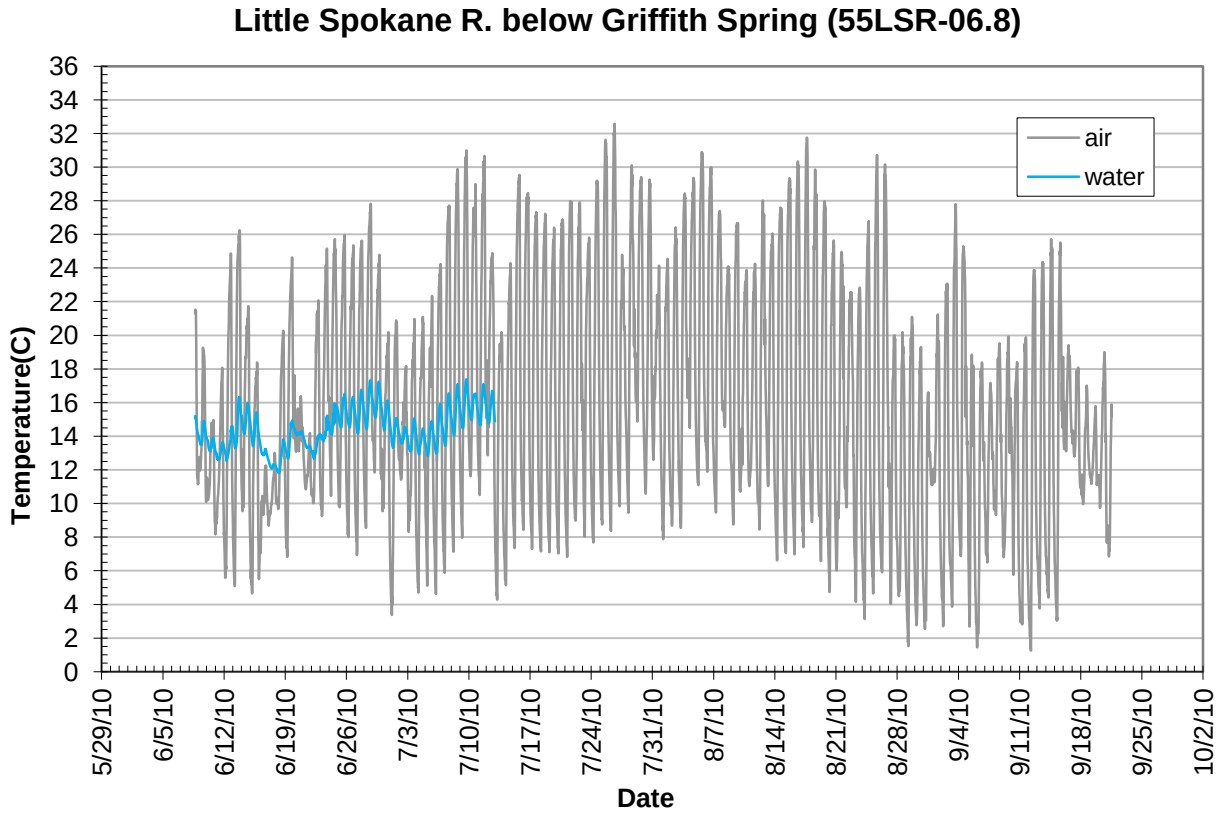
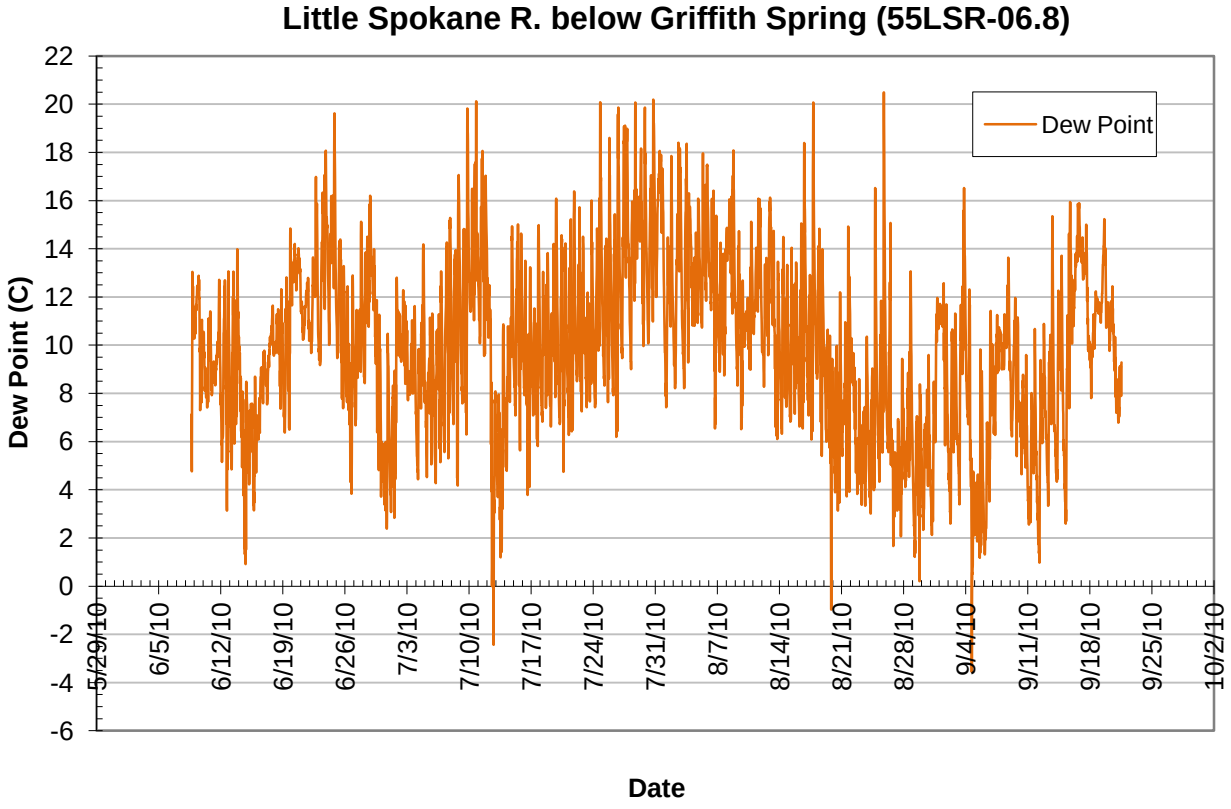
8/28/10
9/4/10
9/11/10
9/18/10
9/25/10
10/2/10


Deadman Ck. at Shady Slope Rd. (55DEA-00.6)
Temperature(C)
Date
air
water
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
42
5/29/10
6/5/10
6/12/10
6/19/10
6/26/10
7/3/10
7/10/10
7/17/10
7/24/10
7/31/10
8/7/10
8/14/10
8/21/10
8/28/10
9/4/10
9/11/10
9/18/10
9/25/10
10/2/10


Deadman Ck. at mouth (55DEA-00.0)
Temperature(C)
Date
air
water
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
5/29/10
6/5/10
6/12/10
6/19/10
6/26/10
7/3/10
7/10/10
7/17/10
7/24/10
7/31/10
8/7/10
8/14/10
8/21/10
8/28/10
9/4/10
9/11/10
9/18/10
9/25/10
10/2/10


Little Spokane R. at Pine River Park (road bridge) (55LSR-11.7)
Temperature(C)
Date
Air
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
5/29/10
6/5/10
6/12/10
6/19/10
6/26/10
7/3/10
7/10/10
7/17/10
7/24/10
7/31/10
8/7/10
8/14/10
8/21/10
8/28/10
9/4/10
9/11/10
9/18/10
9/25/10
10/2/10


Little Spokane R. below Griffith Spring (55LSR-06.8)
Temperature(C)
36
34
32
30
28
26
24
22
20
18
16
14
12
10
8
6
4
2
0
air
water
5/29/10
6/5/10
6/12/10
6/19/10
6/26/10
7/3/10
7/10/10
7/17/10
7/24/10
7/31/10
8/7/10
8/14/10
8/21/10
8/28/10
9/4/10
9/11/10
9/18/10
9/25/10
10/2/10
Date


Little Spokane R. below Griffith Spring (55LSR-06.8)
Dew Point (C)
22
20
18
16
14
12
10
8
6
4
2
0
-2
-4
-6
Dew Point
5/29/10
6/5/10
6/12/10
6/19/10
6/26/10
7/3/10
7/10/10
7/17/10
7/24/10
7/31/10
8/7/10
8/14/10
8/21/10
8/28/10
9/4/10
9/11/10
9/18/10
9/25/10
10/2/10
Date

Appendix F. Selected USGS Gaging Station Flow Data

Table F-1. Selected streamflow data from USGS gaging stations.

Date	USGS Gaging Station		
	Little Spokane R. at Elk, WA (USGS 12427000)	Little Spokane R. at Dartford, WA (USGS 12431000)	Little Spokane R. near Dartford, WA (USGS 12431500)
	Equivalent Location ID		
	55LSR-37.1	55LSR-11.0	55B075
	Daily Average Streamflow (cfs)		
7/26/2010	35	143	412
7/27/2010	35	142	409
7/28/2010	35	140	407
7/29/2010	34	138	405
7/30/2010	36	134	400
8/23/2010	34	109	368
8/24/2010	34	108	367
8/25/2010	35	108	367
8/26/2010	35	108	367
8/27/2010	34	108	367

Note: This data was not collected as part of either of the projects being summarized in this report. It is provided for reference and is available at http://water.usgs.gov.

Appendix G. Laboratory Case Narrative Summaries

Little Spokane River DO-pH TMDL study (2010)

July Synoptic (Work Order #1007063)

Sample 1007063-72 for TSS and TNVSS analyses contained fast settling sand. The results were qualified as estimates.

Samples where the OP is greater than the associated TP, the DOC is greater than the TOC, and the NO2NO3 + NH3 is greater than the associated TPN with concentrations less than 5 times the reporting limit were not evaluated.

The ammonia concentration in sample 1007063-50 may have been biased low due to matrix interference. The result was qualified as an estimate.

August Synoptic (Work Order #1008057)

Samples 1008057-11, 1008057-12, 1008057-14, 1008057-23, 1008057-32, 1008057-71, and 1008057-72 for TSS and TNVSS analyses contained fast settling sand. The results were qualified as estimates.

The sample bottle for DOC 1008057-23 was received empty. An aliquot of the TOC sample was filtered and analyzed. The result has been qualified as an estimate.

Samples where the OP is greater than the associated TP, the DOC is greater than the TOC, and the NO2NO3 + NH3 is greater than the associated TPN with concentrations less than 5 times the reporting limit or where the relative percent difference was <20% were not evaluated.

The ammonia concentration in sample 1008057-50 may have been biased low due to matrix interference. The result was qualified as an estimate.

Little Spokane River Fish Hatchery study (2009)

Feb 9, 2009 (Work Order #0901062)

The results for samples 0901062-01 and 0901062-05 for ammonia analysis were qualified as estimates. The samples contained matrix interference that may have interfered with the analysis.

Feb 23, 2009 (Work Order #0902049)

The result for sample 0902049-01 for ammonia analysis may have been biased low due to matrix interference.

Mar 11, 2009 (Work Order #0903038)

The result for sample 0903038-01 for ammonia analysis may have been biased low due to matrix interference.

Mar 24, 2009 (Work Order #0903042)

The result for sample 0903042-01 for ammonia analysis may have been biased low due to matrix interference.

Apr 6, 2009 (Work Order #0904029)

The results for samples 0904029-01, 0904029-05, and 0904029-05 duplicate for ammonia may have been biased low due to matrix interference.

Apr 20, 2009 (Work Order #0904030)

No issues

May 4, 2009 (Work Order #0905020)

The result for sample 0905020-01 for ammonia analysis may have been biased low due to matrix interference.

May 18, 2009 (Work Order #0905023)

The result for sample 0905023-01 for ammonia analysis may have been biased low due to matrix interference.

Jun 1, 2009 (Work Order #0906048)

The result for sample 0906048-01 for ammonia analysis may have been biased low due to matrix interference.

Jun 15, 2009 (Work Order #0906061)

No issues

Jul 6, 2009 (Work Order #0907036)

The result for sample 0907036-01 for ammonia analysis may have been biased low due to matrix interference.

Jul 13, 2009 (Work Order #0907050)

The result for sample 0907050-01 for ammonia analysis may have been biased low due to matrix interference.

Aug 3, 2009 (Work Order #0908041)

The result for sample 0908041-01 for ammonia analysis may have been biased low due to matrix interference.

Aug 17, 2009 (Work Order #0908042)

No issues

Sep 8, 2009 (Work Order #0909028)

The samples for BOD analysis were analyzed out of hold time. The results were qualified as estimates.

Sep 22, 2009 (Work Order #0909031)

The result for sample 0909031-05 for ammonia analysis may have been biased low due to matrix interference.

Appendix H. Glossary, Acronyms, and Abbreviations

Glossary

Conductivity: A measure of water's ability to conduct an electrical current. Conductivity is related to the concentration and charge of dissolved ions in water.

Dissolved oxygen (DO): A measure of the amount of oxygen dissolved in water.

Parameter: Water quality constituent being measured (analyte). A physical, chemical, or biological property whose values determine environmental characteristics or behavior.

pH: A measure of the acidity or alkalinity of water. A low pH value (0 to 7) indicates that an acidic condition is present, while a high pH (7 to 14) indicates a basic or alkaline condition. A pH of 7 is considered to be neutral. Since the pH scale is logarithmic, a water sample with a pH of 8 is ten times more basic than one with a pH of 7.

Total Maximum Daily Load (TMDL): Water cleanup plan. A distribution of a substance in a waterbody designed to protect it from not meeting (exceeding) water quality standards. A TMDL is equal to the sum of all of the following: (1) individual wasteload allocations for point sources, (2) the load allocations for nonpoint sources, (3) the contribution of natural sources, and (4) a Margin of Safety to allow for uncertainty in the wasteload determination. A reserve for future growth is also generally provided.

Watershed: A drainage area or basin in which all land and water areas drain or flow toward a central collector such as a stream, river, or lake at a lower elevation.

303(d) list: Section 303(d) of the federal Clean Water Act requires Washington State to periodically prepare a list of all surface waters in the state for which beneficial uses of the water – such as for drinking, recreation, aquatic habitat, and industrial use – are impaired by pollutants. These are water quality-limited estuaries, lakes, and streams that fall short of state surface water quality standards and are not expected to improve within the next two years.

Acronyms and Abbreviations

AFDW	Ash-Free Dry Weight
Alk	Alkalinity
BOD5	Biochemical Oxygen Demand (5-day)
Chl a	Chlorophyll a
Cl	Chloride
DO	(See Glossary above)
DOC	Dissolved Organic Carbon
Ecology	Washington State Department of Ecology
EIM	Environmental Information Management database
EPA	U.S. Environmental Protection Agency
NH_3	Ammonia Nitrogen

NO_2-NO_3	Nitrite-Nitrate Nitrogen
OP	Orthophosphate
Peri	Periphyton Biomass
RSD	Relative Standard Deviation
SCCD	Spokane County Conservation District
SOP	Standard Operating Procedures
TMDL	(See Glossary above)
TNVSS	Total Non-Volatile Suspended Solids
TP	Total Phosphorus
TPN	Total Persulfate Nitrogen
TSS	Total Suspended Solids
USGS	U.S. Geological Survey
Vel	Velocity
WAC	Washington Administrative Code

Units of Measurement

°C	degrees centigrade
cfs	cubic feet per second
ft/s	feet per second
mg/L	milligrams per liter (parts per million)
mg/m^2	milligrams per square meter of streambed
s.u.	standard units
uS/cm	microsiemens per centimeter, a unit of conductivity