

Appendix A.

Temperature Monitoring Results, Pend Oreille River, June – October 2004

Abstract

Temperature was monitored in the Pend Oreille River with data logging thermistors, thermometer, and a profiling multiparameter instrument from June through October 2004 at several locations in the mainstem river and selected tributaries. The collected data will support the development of the total maximum daily load of temperature in the Pend Oreille River. Data show temperature changes over time at these sites and allow comparisons to data collected by other organizations.

Introduction

The Pend Oreille River is part of the Pend Oreille/Clark Fork Watershed, which drains the Rocky Mountains in Western Montana and Northern Idaho. The Clark Fork empties into Lake Pend Oreille, and the Pend Oreille River begins at the outlet of the lake. The river enters Washington near the city of Newport and flows northward towards the international border with Canada (Figure 1). Downstream of Newport, the river passes through the reservation of the Kalispel Tribe of Indians. A short reach of the river flows through Canada to its confluence with the Columbia River just upstream of the international border.

The Washington State Department of Ecology (Ecology), Idaho Department of Environmental Quality (IDEQ), the Kalispel Tribe of Indians, and the U.S. Environmental Protection Agency (EPA) are jointly determining the Total Maximum Daily Load (TMDL) of temperature in the mainstem Pend Oreille River from its outlet at Lake Pend Oreille to the Canadian border. Ecology has listed the Pend Oreille River as impaired for temperature on its 1996 and 1998 303(d) water quality assessment lists, and has proposed Category 5 303(d) listings (“polluted waters that require a TMDL”) for the Pend Oreille River on its 2002/2004 water quality assessment. The Pend Oreille River is listed for temperature on the state of Idaho’s 1998 303(d) list of impaired waters, and IDEQ has recently received funding to begin a study of temperature in this reach.

Recently Ecology, IDEQ, the Kalispel Tribe, and EPA concurred with a plan to the joint issuance of this TMDL (EPA, 2005). Under this agreement, Ecology is the lead for TMDL development in waters of Washington and for TMDL technical analysis of waters in the Kalispel reservation, while Idaho is the lead for its waters. Ecology and Idaho will issue the TMDL for

their waters and submit the TMDL to EPA for approval, and EPA will issue the TMDL for waters of the Kalispel Indian Reservation.

The Washington State Water Quality Standards, set forth in Chapter 173-201A of the Washington Administrative Code, include designated beneficial uses, waterbody classifications, and numeric and narrative water quality criteria for surface waters of the state. A revised version of the standards was adopted in 2003 and is currently awaiting approval by U.S. EPA. For temperature, the 1997 standards still apply under a TMDL.

Under the old standards (1997 version), the Pend Oreille River is classified as “Class A” waters, and a special condition is defined for temperature:

Pend Oreille River from Canadian border (river mile 16.0) to Idaho border (river mile 87.7). Special condition - temperature shall not exceed 20.0°C due to human activities. When natural conditions exceed 20.0°C, no temperature increase will be allowed which will raise the receiving water temperature by greater than 0.3°C; nor shall such temperature increases, at any time, exceed $t=34/(T+9)$.

Under the new standards, the mainstem Pend Oreille River is protected for “non-core salmon and trout.” The new standards contain a special condition for temperature:

Temperature shall not exceed a 1-day maximum (1-DMax) of 20.0°C due to human activities. When natural conditions exceed a 1-DMax of 20.0°C, no temperature increase will be allowed which will raise the receiving water temperature by greater than 0.3°C; nor shall such temperature increases, at any time, exceed $t=34/(T+9)$. (“T” represents the background temperature as measured at a point, or points, unaffected by the discharge and representative of the highest ambient water temperature in the vicinity of the discharge.)

The temperature special conditions for the Pend Oreille River are identical in both versions of the standards.

The Kalispel Tribe has adopted water quality standards, which U.S. EPA approved on June 24, 2004. The Pend Oreille River is designated to meet the use of adult salmonid migration. The criteria for salmonid migration are a seven day average of daily maximum temperatures (7-DADMax) of 18°C and 1-DMax of 20.5°C. For all designated uses, if natural conditions are above criteria then human influences can raise water temperatures by no more than 0.3°C.

Washington is required under federal case law to meet the Kalispel Tribal standards. This TMDL is being developed jointly with EPA and the Kalispel Tribe, and the TMDL analysis will address the most stringent provisions of either standard.

Ecology developed a Quality Assurance Project Plan (QAPP) for temperature TMDL technical development in the waters of Washington and the Kalispel Tribe (Ecology, 2004a). The QAPP provides a detailed description of the TMDL, including historical and on-going monitoring

studies and programs. Ecology conducted monitoring in 2004 to meet the QAPP objectives, which included:

- Developing a data set for enhancement of the temperature model for the Box Canyon Reservoir;
- Collecting data for comparison to monitoring by the Army Corps of Engineers, Pend Oreille Public Utility District, the City of Seattle, the Kalispel Tribe, the U.S. Forest Service, and the Pend Oreille Conservation District.
- Evaluating temperatures in potential biologically important areas.

The methods and results of Ecology's monitoring are described below.

Methods

The methods used for the temperature surveys followed the Quality Assurance Project Plan (Ecology, 2004a), with the changes and exceptions noted below. Figure 1 shows the TMDL study area, including Pend Oreille River dams and Ecology's temperature monitoring locations for this study. Table 1 lists the monitoring locations used in the study, with information about the dates surveyed and the location and fate of thermistors.

Surveys were conducted on June 22-25, July 27-29, August 18-20, September 21-23, and October 19-20, 2004. Daily average river flows prior to, during, and following the surveys are shown in Figure 2 for the U.S. Geological Survey (USGS) Box Canyon gage. Surveys captured conditions beginning with the declining leg of the early summer hydrograph, two surveys during mid-summer low flow, and two surveys during higher fall flows. Flows in the summer of 2004 were very low, with minimum flows below the 7Q10 low flow of 12,300 cubic feet per second (cfs).

The TidbiT[®] thermistors in general performed well. All were calibrated consistent with the protocols described in the QAPP before being deployed. Seven were deployed near the bottom of the river on a cable attached to a buoy and pier block. Five buoy deployments were removed from the river and the thermistors lost (except for one which was returned after the season).

Six thermistors were installed inside ten-foot long PVC casings attached to wooden pilings. Piling deployments performed very well. The PVC casings were lowered in July (because of falling water levels), resulting in a few that were just under water in the fall, but still accessible. Of all thermistors recovered, one month of data from one thermistor was not recovered for unknown reasons.

Thermistors at two tributary sites and two mainstem sites (Box Canyon Dam and Newport – Kelly Island) were attached to cables from the bank, and one tributary thermistor was attached directly to a post in the stream:

- The Kelly Island cable site was used with permission of Pend Oreille Public Utility District who had installed the cables for total dissolved gas monitoring.
- At Box Canyon Dam the thermistor was attached to a cable on the draft tube deck between two powerhouses, one turbine down from the Seattle City Light deployment. This site had problems with the cable winding up and the meter coming out of the water. During a later survey this problem was fixed by attaching a large fishing weight.
- The Sullivan Creek site was located in swift water adjacent to the Seattle City Light monitoring location under the highway bridge at the USGS flow gage.
- The Calispell Creek site was just upstream of the pump site in a bed of weeds. Pumps run intermittently at this site, resulting in stagnant conditions between pump cycles and rapid drawdown and currents while pumping occurred.
- At LeClerc Creek the meter was attached to a steel post that held a stream gage.

During the June survey a thermistor on a cable was used for temperature profiles. For the rest of the surveys a Hydrolab[®] multiparameter meter was used for profile measurements. Meters performed well, except for some occasional problems with the dissolved oxygen circulator. A number of depth-profiles were collected at the TidbiT[®] sites, midchannel near the TidbiT[®] sites, and at the mouths of selected creeks. No flow measurements were taken during surveys.

Data quality procedures from the QAPP were followed as described, except that the final thermistor check after monitoring was conducted in May 2005. For the pre- and post-monitoring checks, the TidbiT[®] thermistors were soaked in two water baths, one bath around 16 degC and another near 0 degC, measuring temperatures every one minute. The thermistor data were compared to a NIST certified thermometer and the average difference of 10 measurements was calculated. Thermistors passed the accuracy check if the average difference was within the thermistors' specified accuracy range.

The data quality procedures used for the Hydrolab[®] meters are described in Ecology (2004b).

Results

Data Quality

The analyses of monitoring data quality are shown in Tables 2 through 4. The root mean square error (RMSE) of measurements that meets Measurement Quality Objectives is shown in bold, while RMSEs that exceed the MQOs are shaded.

Table 2 shows the results of paired measurements between a TidbiT[®] and a profile thermistor reading. Although the pooled results from all sites was slightly above the MQOs ("All pairs"), all mainstem monitoring sites met the MQO of 0.2 °C, indicating a large, well-mixed river with a slow rate of thermal response. The Sullivan Creek site also met the MQO. The Calispell and LeClerc Creek sites were outside the MQO, probably as a result a more dynamic temperature

regime and more spatial variability (especially at Calispell Creek) which made the monitoring of identical conditions difficult. Tributary site monitoring data is usable, but higher variability will be taken into account. Tributary sites will be used for paired data comparisons with other monitoring data at those locations when such data become available.

Table 3 shows the comparison of profile averages from near the Tidbit[®] thermistor and midchannel. Overall, both profiles varied by less than 0.2 °C, indicating again that the river is well-mixed. A difference slightly above 0.2 °C was observed at the site near Cusick, suggesting that data from that site might vary slightly from midchannel conditions.

Table 4 presents the calibration check results (both pre- and post-survey) for the Hydrolab[®] meter. Temperature and pH showed consistently acceptable results. Conductivity and DO showed some slight deviation from the calibration standards. Conductivity readings appear to be accurate at ±5% of the measurement values. DO readings in August and September fall well within the MQO of ±5% saturation or ±0.5 mg/L, while readings in July and October may be less accurate but appear to still fall within a range of ±10% saturation or ±1.0 mg/L.

The results of the post-monitoring thermistor accuracy check show that all Tidbit[®] thermistors except one met the MQO of ±0.2 °C. The average differences between the reference thermometer and thermistor #598748, used at Box Canyon Dam, were -0.237 °C for the ice bath and -0.288 °C for the warm bath (the thermistor was consistently reading low). The pre-season accuracy check for this thermistor was good with the results of 0.09 °C for the ice bath and -0.132 °C for the warm bath, so the thermistor was meeting the MQO at the beginning of the study. Also, the field check during the final survey was only 0.01 °C different, and the post-monitoring check was close to the MQO and was measured months after the survey. Therefore, the data from this thermistor appears acceptable for use, but should be used with caution with the post-monitoring measured differences taken into account.

Field Data

Figures 3 through 17 show the results of the Tidbit[®] monitoring, along with the spot field measurements from the profiles. Overall, the time series show similar patterns over the season which likely reflect meteorological and flow conditions. Mainstem sites are very similar, while tributaries show greater variability and characteristics unique to each site. Calispell Creek had the warmest temperatures, peaking near 26 °C, while LeClerc Creek was the coolest, with temperatures rarely exceeding 16 °C. Peak temperatures occurred in the second half of August, followed by an overall cooling trend as the season progressed.

Data gaps reflect the date of installation (July for some sites), lost equipment, or missing data:

- The August data for the mainstem site near Cusick (Figure 8) was not recorded for reasons unknown.
- Data during June at Lost Creek (Figure 14) showed indications that the meter was removed from the river for several weeks and then replaced. These data were deleted.

- Data at Box Canyon (Figure 16) indicated that tailrace water elevations dropped during the night, so that the meter was exposed to cool night temperatures and then was back in the water during the day. Data were screened and blocks of data reflecting air temperatures were deleted. Therefore, some of the data reflect daily maximums but not minimums.

Figure 18 shows the trend in maximum temperatures measured from the TidbiT[®] thermistors from upstream to downstream. For each site, the warmest daily maximum is shown, along with the date it occurred. Maximum temperatures were all above 23 °C, and above 24 °C downstream of Dalkena. The highest seven day average daily maximum was measured near Ione at 24.7 °C. The highest temperature measured in the mainstem was 25.0 °C above Skookum Creek on August 18.

Depth-profile data are reported in Table 5, and temperature profiles are shown in Figure 19. As described above, profiles showed the river to be consistently well-mixed. Only isolated dissolved oxygen readings fell below the water quality criterion of 8 mg/L, and the only readings significantly below 8 mg/L were in off-channel areas near the mouths of Calispell and Tahoma Creeks. All pH readings were above 7.0, and all pH readings from the mainstem were above 8.0 (readings between 7 and 8 were found at the creek mouths). Readings above the water quality criterion of 8.5 were widespread in the mainstem, especially in August. The Pend Oreille River is listed on Ecology's 303(d) list for pH, and past studies have attributed high pH to productivity from the river's milfoil beds (Golder Associates, 2004). Conductivity readings were between 130 and 150 uS/cm in the mainstem, while a few readings below 100 were found at the creek mouths.

Conclusions and Recommendations

Continuous temperature data were successfully collected from eleven mainstem Pend Oreille River sites and three tributary sites. Data are of good quality, although higher variability was indicated for certain data at certain times which must be taken into account. Monitoring results met the project objective of characterizing temperatures for model development.

Project logistics went well except for buoy deployments – five out of seven deployments were removed and one appeared to be removed and put back. Future projects should avoid this method, and should focus on piling and cable deployments. Cable deployments that hang loose in a high energy environment need adequate weight attached to avoid self-winding.

Temperatures were consistent with previous studies, with maximum temperatures that exceeded 24 °C over much of the river in late August. Temperatures exceeded the numeric water quality criterion of 20 °C in the mainstem during most of July and August. High pH levels in excess of the water quality criterion of 8.5 were also observed, mostly during the August survey.

The Pend Oreille River is consistently well mixed. Small areas of unmixed waters were found in the vicinity of creek mouths. Conditions are similar throughout the mainstem sites, although some variations in temperature can be observed from upstream to downstream. Tributaries showed greater variability in temperature both at each site and between sites.

References

Ecology, 2004a. Quality Assurance Project Plan, Pend Oreille River Temperature Total Maximum Daily Load Technical Study. Publication No. 04-03-109. Washington State Department of Ecology, Environmental Assessment Program, Olympia, WA.
<http://www.ecy.wa.gov/biblio/0403109.html>

Ecology, 2004b. Quality Assurance Project Plan, Pend Oreille River Total Dissolved Gas Total Maximum Daily Load Study. Publication No. 04-03-107. Washington State Department of Ecology, Environmental Assessment Program, Olympia, WA.
<http://www.ecy.wa.gov/biblio/0403107.html>

EPA, 2005. "Interstate – EPA Tribal TMDL for the Pend Oreille River", Joint agency Memorandum, U.S. Environmental Protection Agency, March, 24, 2005, Portland OR.

Golder Associates, 2004. Pend Oreille (WRIA 62) Watershed Planning Phase II, Level 2 Assessment. Draft Report to the Pend Oreille Watershed Planning Unit and Pend Oreille Conservation District. Golder Associates, Inc., Coeur d'Alene, ID and Redmond, WA.

Tables

Table 1. Description of Monitoring Sites

EIM ¹ ID	RM ²	Location ³	Start Date	End Date	Thermistor No.	Thermistor Depth	Comments
1010	87.5	POR near Newport (Kelly Island)	27-Jun-04	20-Oct-04	598735	near bottom	
1020	84.5	POR above Marshall Creek	24-Jun-04	20-Oct-04	728520	near bottom	
1030		POR at Marshall Creek mouth	20-Aug-04	20-Aug-04	-		
1040	81.6	POR above Indian Island	24-Jun-04	7-Aug-04	728518	near bottom	tidbit and buoy removed and later returned
1050		POR at Indian Creek mouth	20-Aug-04	20-Aug-04	-		
1060	77.7	POR near Dalkena	24-Jun-04	20-Oct-04	728524	3m	
1070	74.7	POR above Skookum Creek	24-Jun-04	20-Oct-04	728530	3m	
1080	70.3	POR near Cusick	23-Jun-04	19-Oct-04	728531	3m	August data lost
2080		Calispell Creek above pumps	28-Jul-04	19-Oct-04	598747	bottom	
1090		POR at Calispell Creek mouth	19-Aug-04	19-Aug-04	-		
1110	67.2	POR above Tacoma Creek	24-Jun-04	19-Aug-04	728523 598754	near bottom	lost tidbit and buoy
1120		POR at Tacoma Creek mouth	19-Aug-04	19-Aug-04	-		
1125		POR near River Bend	24-Jun-04	22-Sep-04	466857	near bottom	lost tidbit and buoy
1130		POR above Mill Creek	24-Jun-04	22-Sep-04	728533	near bottom	lost tidbit and buoy
1135		POR at Mill Creek mouth	22-Jun-04	18-Aug-04	-		
1140	56.8	POR above LeClerc Creek	22-Jun-04	19-Oct-04	728541	3m	
1150		POR at LeClerc Creek mouth	18-Aug-04	18-Aug-04	-		
2140		LeClerc Creek near stream gage	29-Jul-04	19-Oct-04	598744	bottom	
1160	54.3	POR above Blueslide	24-Jun-04	19-Oct-04	728522	3m	
1170		POR at Ruby Creek Mouth	18-Aug-04	18-Aug-04	-		
1180	49.5	POR above Lost Creek	24-Jun-04	19-Oct-04	728540	near bottom	
1185		POR near Tiger	25-Jun-04	22-Sep-04	466860	near bottom	lost tidbit and buoy
1190	38.3	POR near Ione	25-Jun-04	19-Oct-04	598738	3m	
1220	34.4	POR at Box Canyon Dam – tailrace	29-Jul-04	19-Oct-04	598748	variable	
2220		Sullivan Creek- near USGS gage	29-Jul-04	19-Oct-04	560547	bottom	

¹ Environmental Information Management system (Department of Ecology environmental database)

² River mile

³ POR = Pend Oreille River

Table 2. Data quality assessment of temperature measurements: Paired comparison of thermistor and spot profile data points

Location	Date	Time	Temperature (deg C)				
			Spot Reading	Thermistor	Resid ¹	Avg Resid ¹	RMSE ²
Pend Oreille River (POR) above Newport - Kelly Island/State Line	27-Jul-04	14:50	22.53	22.54	-0.01		
	20-Aug-04	9:20	23.37	23.38	-0.01		
	23-Sep-04	9:52	15.71	15.76	-0.05		
	20-Oct-04	9:40	12.79	12.80	-0.01	-0.02	0.03
POR above Marshall Creek	27-Jul-04	15:50	22.91	22.94	-0.03		
	20-Aug-04	10:15	23.12	23.28	-0.16		
	23-Sep-04	10:30	15.73	15.94	-0.21		
	20-Oct-04	10:35	12.79	12.97	-0.18	-0.15	0.16
POR above Indian Island	27-Jul-04	17:45	23.11	23.2	-0.09	-0.09	0.09
POR near Dalkena	27-Jul-04	16:45	22.84	23.02	-0.18		
	20-Aug-04	11:15	23.21	23.36	-0.15		
	23-Sep-04	12:30	15.80	15.85	-0.05		
	20-Oct-04	11:20	12.81	12.87	-0.06	-0.11	0.12
POR above Skookum Creek	28-Jul-04	10:30	22.46	22.62	0.01		
	19-Aug-04	9:03	22.84	22.96	-0.12		
	21-Sep-04	17:20	16.05	16.27	-0.22		
	20-Oct-04	11:41	12.76	12.97	-0.21	-0.14	0.16
POR near Cusick	7/28/2004	11:30	22.59	22.69	-0.10		
	8/19/2004	10:51	23.01	23.19	-0.18		
	9/21/2004	16:40	16.01	16.06	-0.05		
	10/19/2004	17:08	13.11	13.24	-0.13	-0.12	0.12
Calispell Creek above pumps	7/28/2004	14:30	23.7	23.4	0.30		
	9/22/2004	8:50	12.1	12.77	-0.67		
	10/19/2004	16:18	10.8	9.5	1.30	0.31	0.86
POR above Tacoma Creek	28-Jul-04	12:35	22.96	23.11	-0.15		
	19-Aug-04	10:05	23.16	23.28	-0.12		
	21-Sep-04	15:55	15.95	15.97	-0.02	-0.10	0.11
POR above LeClerc Creek	28-Jul-04	16:55	23.25	23.30	-0.05		
	18-Aug-04	11:15	23.65	23.82	-0.17		
	22-Sep-04	11:05	15.53	15.63	-0.10		
	19-Oct-04	15:00	12.81	12.99	-0.18	-0.13	0.14
LeClerc Creek near stream gage	29-Jul-04	14:55	15.5	15.99	-0.49		
	22-Sep-04	17:49	9.8	9.93	-0.13		
	19-Oct-04	8:45	7.4	7.16	0.24	-0.13	0.32
POR above Blueslide	28-Jul-04	17:32	23.24	23.38	-0.14		
	18-Aug-04	12:15	23.71	23.89	-0.18		
	22-Sep-04	11:30	15.46	15.56	-0.10		
	19-Oct-04	14:15	12.80	12.89	-0.09	-0.13	0.13
POR above Lost Creek	28-Jul-04	18:20	23.27	23.47	-0.20		
	18-Aug-04	13:45	23.90	23.98	-0.08		
	22-Sep-04	12:15	15.60	15.83	-0.23		
	19-Oct-04	13:25	12.80	13.03	-0.23	-0.18	0.20
POR near Ione	29-Jul-04	18:20	23.12	23.21	-0.09		
	18-Aug-04	17:20	23.97	24.07	-0.10		
	22-Sep-04	14:30	15.57	15.70	-0.13		
	19-Oct-04	11:30	13.03	13.19	-0.16	-0.12	0.12
POR at Box Canyon Dam – tailrace	19-Oct-04	10:05	13.05	13.04	0.01	0.01	0.01
Sullivan Creek - near USGS gage	22-Sep-04	16:47	11.6	11.69	-0.09		
	19-Oct-04	10:35	11.9	12.00	-0.10	-0.09	0.10
¹ Avg Resid = Average residual					All pairs:	-0.09	0.26
² RMSE = Root mean square error					Mainstem sites only:		0.13

Table 3. Data quality assessment of temperature measurements: Paired comparison of spot profile average values at thermistor and midchannel

Location ¹	Date	Time	Temperature (deg C)			
			@thermistor	Midchannel	Resid ²	RMSE ³
POR above Marshall Creek	20-Aug-04	10:25	23.12	23.16	-0.04	0.04
POR near Dalkena	20-Aug-04	11:41	23.26	23.25	0.01	0.01
POR above Skookum Creek	19-Aug-04	9:35	22.83	23.02	-0.19	0.19
POR near Cusick	19-Aug-04	11:13	23.02	23.25	-0.23	0.23
POR above Tacoma Creek	19-Aug-04	10:10	23.17	23.20	-0.03	0.03
POR above LeClerc Creek	18-Aug-04	11:25	23.61	23.68	-0.07	0.07
POR above Blueslide	24-Jun-04	16:10	18.10	18.2	-0.10	0.10
	18-Aug-04	12:40	23.73	23.75	-0.02	0.02
POR above Lost Creek	18-Aug-04	14:00	23.92	23.98	-0.06	0.06
All pairs:					-0.08	0.11

¹ POR = Pend Oreille River; ² Resid = Residual; ³ RMSE = Root mean square error

Table 4. Data quality assessment of field monitoring: Multi-parameter meter calibration checks.

Laboratory Calibration Check - tap water						
Date	Parameter	Meter	Liquid thermometer	Difference		Comment
				Meter-thermometer	Target ¹	
8/17/2004	Temperature	23.87	24.0	0.1	0.2	
9/21/2004		22.87	23.0	0.1	0.2	
10/18/2004		21.60	21.7	0.1	0.2	
10/21/2004		14.94	14.9	0.0	0.2	
Laboratory Calibration Check – standards						
Date	Parameter	Meter	Standard	Difference		Comment
				Meter-Std	Target ¹	
8/17/2004	Specific Conductance	103.7	103.4	0.3	5	Recalibrated after check
9/21/2004		102.3	103.4	1.1	5	
10/18/2004		108.9	103.4	5.5	5	
10/21/2004		103.1	103.3	0.2	5	
8/17/2004	Dissolved Oxygen Percent Saturation	92.9%	100.0%	7.1%	5%	Recalibrated after check
9/21/2004		101.0%	100.0%	1.0%	5%	
10/18/2004		99.9%	100.0%	0.1%	5%	
10/21/2004		108.7%	100.0%	8.7%	5%	
8/17/2004	pH	6.97	7.01	0.04	0.5	Recalibrated after check
8/17/2004		9.87	10.04	0.17	0.5	Recalibrated after check
9/21/2004	pH	7.02	7.01	0.01	0.5	
9/21/2004		10.05	10.04	0.01	0.5	
10/18/2004	pH	6.98	7.02	0.04	0.5	
10/18/2004		9.98	10.05	0.07	0.5	
10/21/2004	pH	7.01	7.00	0.01	0.5	
10/21/2004		10.01	10.03	0.02	0.5	

¹ Measurement Quality Objectives from Ecology (2004a)

Table 5. Results of Depth-Profile Measurements.

Site	Site ID	Date	Time	Depth (m)	Temp. (deg C)	DO (mg/L)	DO % Sat	pH (s.u.)	SP. Cond. (uS/cm)	Comments
POR near Newport (Kelly Island)	1010	27-Jul-04	14:50	0.1	22.55	8.82	101.4	8.42	143.3	
				1.0	22.55					
				2.0	22.55					
				3.0	22.55					
				4.0	22.54					
				5.0	22.55					
				6.0	22.53					
POR near Newport (Kelly Island)	1010	20-Aug-04	9:20	0.1	23.30	8.37	105.2	8.55	157.3	
				1.0	23.32	8.29	104.2	8.55	156.7	
				2.0	23.33	8.40	105.6	8.53	157.3	
				3.0	23.33	8.36	105.1	8.53	156.7	
				4.0	23.32	8.27	104.0	8.52	157.1	
				5.0	23.33	8.30	104.3	8.51	156.9	
				6.1	23.33	8.24	103.7	8.50	156.8	
				7.0	23.34	8.27	104.0	8.50	157.2	
				8.0	23.33	8.28	104.1	8.50	157.0	
9.0	23.34	8.31	104.5	8.48	157.3					
9.6	23.37	8.27	104.0	8.49	157.0					
POR near Newport (Kelly Island)	1010	23-Sep-04	9:52	0.1	15.70	9.12	98.4	8.34	156.1	
				1.0	15.70	8.95	96.6	8.31	157.0	
				2.0	15.70	8.95	96.6	8.30	156.8	
				3.0	15.71	8.88	95.8	8.31	156.7	
				4.0	15.71	8.87	95.6	8.30	156.8	
				5.0	15.70	8.88	95.7	8.29	156.7	
				6.1	15.70	8.88	95.8	8.29	156.7	
				7.1	15.70	8.91	96.2	8.29	156.6	
8.0	15.71	8.88	95.8	8.29	156.4					
POR near Newport (Kelly Island)	1010	20-Oct-04	9:25	0.1	12.79	9.36	94.7	8.23	145.0	
				1.0	12.79	9.27	93.9	8.21	144.5	
				2.0	12.79	9.29	94.1	8.21	144.6	
				3.0	12.79	9.17	92.8	8.21	144.2	
				4.0	12.80	9.18	93.0	8.21	144.7	
				5.0	12.79	9.19	93.0	8.20	144.7	
				6.0	12.79	9.18	92.5	8.20	144.4	

Table 5, continued. Results of Profile Measurements.

Site	Site ID	Date	Time	Depth (m)	Temp (deg C)	DO (mg/L)	DO % Sat	pH (s.u.)	SPCond (uS/cm)	Comments
POR above Marshall Creek	1020	24-Jun-04	13:40	0.1	17.6					
				1.0	17.6					
				2.0	17.6					
				3.0	17.6					
				4.0	17.6					
				5.0	17.6					
POR above Marshall Creek	1020	27-Jul-04	15:50	0.1	22.94					
				1.0	22.92					
				2.0	22.91					
				3.0	22.91					
				3.5	22.91	9.28	107.3	8.53	143.4	
POR above Marshall Creek	1020	20-Aug-04	10:15	0.1	23.12	8.36	104.7	8.46	158.4	
				1.0	23.12	8.29	103.8	8.45	158.4	
				2.0	23.11	8.17	102.3	8.44	158.3	
				3.0	23.11	8.12	101.7	8.45	158.6	
				4.0	23.12	8.15	102.1	8.44	157.9	
				5.0	23.12	8.10	101.4	8.44	158.3	
POR above Marshall Creek	1020	20-Aug-04	10:25	0.1	23.18	8.16	102.3	8.48	158.2	midchannel
				1.0	23.16	8.11	101.7	8.47	158.3	
				2.0	23.16	8.10	101.6	8.47	158.1	
				3.0	23.15	8.12	101.8	8.47	158.1	
				4.0	23.16	8.11	101.7	8.46	158.1	
POR above Marshall Creek	1020	23-Sep-04	10:50	0.1	15.73	9.12	98.4	8.33	155.9	midchannel
				1.0	15.74	9.04	98.2	8.33	156.1	
				2.0	15.73	9.06	97.9	8.31	156.2	
				3.0	15.73	9.00	97.2	8.32	156.2	
				4.0	15.73	9.03	97.5	8.31	156.3	
				4.4	15.73	8.91	96.2	8.32	156.1	
POR above Marshall Creek	1020	20-Oct-04	10:35	0.1	12.78	9.41	95.3	8.19	147.1	midchannel
				1.1	12.79	9.29	94.0	8.18	147.0	
				2.1	12.79	9.26	93.7	8.18	147.0	
				3.1	12.79	9.17	92.8	8.17	146.5	
				4.0	12.79	9.23	93.4	8.24	147.0	

Definitions of abbreviations: POR = Pend Oreille River; m = meters; Temp = temperature; deg C = degree Centigrade; DO = dissolved oxygen; mg/L = milligrams per liter; %sat = percent of saturation; s.u. = standard units; SPCond = specific conductance

Table 5, continued. Results of Profile Measurements.

Site	Site ID	Date	Time	Depth (m)	Temp (deg C)	DO (mg/L)	DO %Sat	pH (s.u.)	SPCond (uS/cm)	Comments
POR at Marshall Creek mouth	1030	20-Aug-04	12:33	0.1	16.48	9.34	103.2	8.31	138.6	
POR at Marshall Creek mouth	1030	20-Aug-04	12:33	0.2	13.55	10.12	104.0	8.17	131.5	
POR above Indian Island	1040	24-Jun-04	12:40	0.1	17.5					
				0.5	17.4					
				1.0	17.4					
				1.5	17.4					
				2.0	17.4					
				2.5	17.4					
				3.0	17.4					
				3.5	17.4					
POR above Indian Island	1040	27-Jul-04	17:45	0.1	23.11					
				1.0	23.11					
				2.0	23.11					
				3.0	23.11					
				4.0	23.11					
				4.4	23.11	9.24	107.4	8.54	143.4	
POR above Indian Island	1040	20-Aug-04	10:52	0.1	23.14	8.75	109.6	8.50	158.5	
				1.0	23.13	8.42	105.4	8.50	157.5	
				2.0	23.13	8.36	104.7	8.49	158.9	
				3.0	23.12	8.28	103.7	8.49	158.7	
				4.0	23.13	8.25	103.3	8.49	158.0	
				4.8	23.12	8.30	103.9	8.54	158.6	
POR above Indian Island	1040	23-Sep-04	11:30	0.1	15.79	9.12	98.6	8.34	155.7	
				1.1	15.78	9.06	97.9	8.33	155.7	
				2.0	15.77	9.02	97.5	8.33	155.7	
				3.0	15.78	9.06	97.9	8.32	155.3	
				4.0	15.77	9.03	97.5	8.31	155.4	
				4.8	15.77	8.89	96.1	8.32	155.8	
POR at Indian Creek mouth	1050	20-Aug-04	12:00	0.1	15.52	10.71	114.8	8.18	128.3	
				0.4	13.77	10.14	104.9	7.72	96.6	
POR near Indian Island		27-Jul-04	18:03	0.1		10.37	121.1	8.79	141.3	in milfoil bed

Table 5, continued. Results of Profile Measurements.

Site	Site ID	Date	Time	Depth (m)	Temp (deg C)	DO (mg/L)	DO %Sat	pH (s.u.)	SPCond (uS/cm)	Comments
POR near Dalkena	1060	24-Jun-04	11:40	0.1	17.2					
				1.0	17.2					
				2.0	17.2					
				3.0	17.1					
				4.0	17.1					
				5.0	17.1					
				6.0	17.1					
				7.0	17.1					
				8.0	17.2					
				9.0	17.2					
POR near Dalkena	1060	27-Jul-04	16:45	0.1	22.88					
				1.0	22.87					
				2.0	22.84					
				3.0	22.84					
				4.0	22.84					
				5.0	22.83					
				5.5	22.84	9.08	8.51	143.6		
POR near Dalkena	1060	20-Aug-04	11:15	0.1	23.44	8.33	105.0	8.52	157.9	
				1.0	23.24	8.14	102.2	8.50	157.9	
				2.1	23.24	8.15	102.3	8.49	158.0	
				3.0	23.21	8.12	101.9	8.49	157.7	
				4.0	23.21	8.13	102.0	8.49	158.0	
				5.0	23.22	8.11	101.8	8.49	158.5	
				5.8	23.23	8.11	101.8	8.48	157.7	
POR near Dalkena	1060	20-Aug-04	11:41	0.1	23.42	8.05	101.3	8.48	158.6	midchannel
				1.0	23.30	7.99	100.4	8.48	158.2	midchannel
				2.0	23.25	8.07	101.3	8.48	158.7	midchannel
				3.0	23.21	8.06	100.6	8.47	158.1	midchannel
				4.0	23.20	7.98	100.1	8.47	158.2	midchannel
				4.9	23.20	8.02	100.6	8.47	158.4	midchannel
				6.0	23.20	8.00	100.4	8.48	158.5	midchannel

Table 5, continued. Results of Profile Measurements.

Site	Site ID	Date	Time	Depth (m)	Temp (deg C)	DO (mg/L)	DO % Sat	pH (s.u.)	SPCond (uS/cm)	Comments
POR near Dalkena	1060	23-Sep-04	12:30	0.2	15.81	8.90	96.2	8.30	155.8	
				1.1	15.81	8.95	96.8	8.29	155.9	
				2.0	15.80	8.90	96.2	8.30	155.7	
				3.0	15.80	8.86	95.8	8.29	156.1	
				4.0	15.80	8.85	95.6	8.28	156.1	
				5.0	15.80	8.86	95.8	8.28	156.1	
				6.0	15.80	8.87	95.5	8.27	155.7	
				7.0	15.80	8.81	95.3	8.28	155.8	
POR near Dalkena	1060	20-Oct-04	11:20	0.1	12.79	9.20	93.2	8.16	147.0	
				1.0	12.81	9.22	93.3	8.15	148.3	
				2.1	12.81	9.25	93.6	8.13	146.0	
				3.1	12.81	9.15	93.6	8.12	146.6	
				4.1	12.81	9.17	92.9	8.12	145.1	
				5.0	12.81	9.14	92.6	8.12	145.7	
				6.0	12.81	9.12	92.3	8.13	146.0	
POR above Skookum Creek	1070	24-Jun-04	11:00	0.1	17.7					
				1.0	17.6					
				2.0	17.5					
				3.0	17.6					
				4.0	17.5					
				5.0	17.5					
				6.0	17.5					
				7.0	17.5					
				8.0	17.5					
9.0	17.5									
POR above Skookum Creek	1070	28-Jul-04	10:30	0.1	23.01					
				1.0	22.81					
				2.0	22.54					
				3.0	22.46					
				3.5	22.41	8.92	102.2	8.61	141.3	

Table 5, continued. Results of Profile Measurements.

Site	Site ID	Date	Time	Depth (m)	Temp (deg C)	DO (mg/L)	DO % Sat	pH (s.u.)	SPCond (uS/cm)	Comments
POR above Skookum Creek	1070	19-Aug-04	9:03	0.1	22.81	7.56	94.2	8.42	155.5	
				1.1	22.84			8.42	156.0	
				2.0	22.83			8.41	155.9	
				3.0	22.84			8.39	155.6	
				4.0	22.84			8.41	155.6	
				4.3	22.84			8.40	155.5	
POR above Skookum Creek	1070	19-Aug-04	9:35	0.1	23.02	8.14	101.8	8.53	157.0	midchannel
				1.1	23.03			8.53	157.3	
				2.1	23.02			8.49	156.6	
				3.0	23.02			8.51	156.5	
				4.0	23.03			8.50	156.9	
POR above Skookum Creek	1070	21-Sep-04	17:20	0.1	16.06	10.56	114.8	8.67	151.5	
				1.1	16.03	10.21	110.9	8.65	151.8	
				2.1	16.05	10.30	112.0	8.66	152.0	
				3.0	16.05	10.05	109.2	8.64	152.0	
				4.0	16.04	10.10	109.8	8.63	152.0	
				4.8	16.04	10.03	109.0	8.63	152.2	
POR above Skookum Creek	1070	20-Oct-04	11:41	0.1	12.79	9.55	96.7	8.27	145.7	
				1.1	12.79	9.46	95.7	8.27	145.8	
				2.1	12.76	9.43	95.4	8.24	145.7	
				3.0	12.76	9.45	95.6	8.22	145.9	
				4.0	12.76	9.35	94.6	8.23	145.0	
POR near Cusick	1080	23-Jun-04	13:30	0.1	17.7					
				1.0	18.0					
				2.0	17.9					
				3.0	17.6					
				4.0	17.5					
				5.0	17.5					
				6.0	17.5					
				7.0	17.6					
				8.0	17.7					
				9.0	17.5					
10.0	17.5									

Table 5, continued. Results of Profile Measurements.

Site	Site ID	Date	Time	Depth (m)	Temp (deg C)	DO (mg/L)	DO %Sat	pH (s.u.)	SPCond (uS/cm)	Comments
POR near Cusick	1080	28-Jul-04	11:30	0.1	22.76					
				1.0	22.74					
				2.0	22.67					
				3.0	22.59					
				4.0	22.58					
				4.4	22.58	8.88	102.3	8.57	143.0	
POR near Cusick	1080	19-Aug-04	10:51	0.1	23.10	8.15	102.1	8.50	156.7	
				1.1	23.02	8.03	100.3	8.47	155.9	
				2.1	23.01	7.90	99.2	8.47	155.9	
				3.0	23.01	7.93	99.1	8.46	156.5	
				3.9	22.99	7.89	98.6	8.46	156.3	
				4.4	23.00	7.89	98.3	8.44	156.7	
POR near Cusick	1080	19-Aug-04	11:13	0.1	23.28	8.46	106.3	8.57	157.4	midchannel
				1.1	23.25	8.54	107.2	8.56	157.6	
				2.0	23.25	8.73	109.6	8.56	157.2	
				3.0	23.25	8.65	108.5	8.55	156.9	
				4.0	23.24	8.74	109.7	8.54	157.9	
				5.0	23.25	8.82	110.0	8.54	158.0	
				6.0	23.25	8.28	103.9	8.53	158.3	
POR near Cusick	1080	21-Sep-04	16:40	0.1	16.01	9.76	106.0	8.50	151.6	
				1.1	16.01	9.55	103.7	8.49	151.8	
				2.1	16.01	9.55	103.7	8.48	152.0	
				3.1	16.01	9.41	102.1	8.48	152.2	
				4.1	16.01	9.45	102.6	8.48	152.2	
				5.0	16.01	9.42	102.3	8.47	152.0	
				5.7	16.01	9.41	102.2	8.47	152.3	
POR near Cusick	1080	19-Oct-04	17:08	0.1	13.10	9.82	100.1	8.35	144.0	
				1.0	13.11	9.71	99.0	8.35	144.3	
				2.1	13.11	9.65	98.4	8.35	144.4	
				3.0	13.11	9.64	98.3	8.34	144.5	
				4.0	13.12	9.54	97.3	8.34	144.3	
				5.0	13.12	9.57	97.6	8.33	144.3	

Table 5, continued. Results of Profile Measurements.

Site	Site ID	Date	Time	Depth (m)	Temp (deg C)	DO (mg/L)	DO %Sat	pH (s.u.)	SPCond (uS/cm)	Comments
POR at Calispell Creek mouth	1090	19-Aug-04	11:30	0.1	24.41	6.56	84.2	7.24	76.6	outside levy
				1.0	23.56	6.39	80.6	7.15	74.9	
				2.1	23.28	6.22	78.2	7.10	75.1	
				2.6	23.18	5.96	74.7	7.07	74.8	
Calispell Creek above pumps	2080	28-Jul-04	14:30	0.1	23.70					
Calispell Creek above pumps	2080	22-Sep-04	8:50	0.1	12.10					
Calispell Creek above pumps	2080	19-Oct-04	16:18	0.1	10.80					
POR above Tacoma Creek	1110	24-Jun-04	20:45	0.1	17.7					
				1.0	17.7					
				2.0	17.7					
				3.0	17.7					
				4.0	17.7					
				5.0	17.7					
				7.1	17.7					
POR above Tacoma Creek	1110	28-Jul-04	12:35	0.1	23.02					
				1.0	22.98					
				2.0	22.97					
				3.0	22.97					
				4.0	22.96					
				4.5	22.96	9.14	105.5	8.56	143.4	
POR above Tacoma Creek	1110	19-Aug-04	10:05	0.1	23.18	8.45	106.2	8.57	156.3	
				1.1	23.17	8.59	107.6	8.54	156.5	
				2.0	23.17	8.58	107.6	8.54	157.5	
				3.0	23.16	8.47	106.1	8.53	156.9	
				4.0	23.16	8.48	106.4	8.52	157.5	
				4.9	23.16	8.38	105.0	8.54	156.9	
POR above Tacoma Creek	1110	19-Aug-04	10:10	0.1	23.21	8.66	108.7	8.56	157.8	midchannel
				1.1	23.20	8.54	107.2	8.55	157.6	
				2.1	23.20	8.47	106.7	8.55	157.2	
				3.0	23.20	8.45	105.7	8.54	157.2	
				4.0	23.19	8.42	105.6	8.54	157.3	
				5.0	23.19	8.41	105.5	8.53	157.6	

Table 5, continued. Results of Profile Measurements.

Site	Site ID	Date	Time	Depth (m)	Temp (deg C)	DO (mg/L)	DO %Sat	pH (s.u.)	SPCond (uS/cm)	Comments
POR above Tacoma Creek	1110	21-Sep-04	15:55	0.1	15.94	9.26	100.5	8.36	152.6	
				1.0	15.96	9.15	99.5	8.36	153.0	
				2.0	15.95	9.17	99.5	8.33	152.8	
				3.0	15.95	9.15	99.3	8.32	153.0	
				4.3	15.95	9.06	98.2	8.32	152.8	
				5.4	15.95	9.05	98.4	8.32	153.1	
POR above Tacoma Creek	1110	19-Oct-04	17:52	0.1	13.10	9.54	97.4	8.25	144.9	buoy and tidbit lost
				1.0	13.10	9.43	96.4	8.24	144.9	
				2.0	13.10	9.37	95.5	8.23	144.9	
				3.1	13.10	9.42	96.0	8.23	145.0	
				4.0	13.10	9.35	95.4	8.23	145.0	
POR at Tacoma Creek mouth	1120	19-Aug-04	10:30	0.1	22.15	8.77	108.0	8.17	50.0	
				1.0	21.93	8.50	104.1	7.97	50.1	
				2.0	21.66	6.33	77.1	7.11	54.0	
				2.4	21.18	4.57	55.1	6.85	62.7	
POR near River Bend	1125	24-Jun-04	18:33	0.1	18.2					buoy and tidbit lost
				1.0	18.2					
				2.0	18.2					
				3.0	18.2					
				4.0	18.2					
				5.0	18.2					
				6.0	18.2					
				7.0	18.2					
8.0	18.2									
POR near River Bend	1125	18-Aug-04	10:16	0.1	23.63	8.64	109.4	8.62	154.8	
				1.1	23.61	8.69	109.7	8.61	154.9	
				2.0	23.59	8.74	110.4	8.61	154.4	
				3.0	23.59	8.74	110.4	8.60	155.0	
				4.0	23.58	8.74	110.4	8.59	155.1	
				5.0	23.58	8.70	109.9	8.59	155.1	
				6.0	23.58	8.68	109.9	8.59	155.1	

Table 5, continued. Results of Profile Measurements.

Site	Site ID	Date	Time	Depth (m)	Temp (deg C)	DO (mg/L)	DO %Sat	pH (s.u.)	SPCond (uS/cm)	Comments
POR near River Bend	1125	22-Sep-04	10:15	0.1	15.71	9.57	102.9	8.49	154.1	buoy and tidbit lost
				1.1	15.64	9.50	102.4	8.45	154.2	
				2.1	15.65	9.50	102.3	8.45	154.6	
				3.1	15.64	9.40	101.2	8.45	153.8	
				4.0	15.62	9.38	101.0	8.43	154.2	
				5.0	15.63	9.32	100.4	8.44	153.8	
				6.0	15.62	9.34	100.6	8.42	154.2	
POR above Mill Creek	1130	22-Jun-04	15:00	1.0	17.50					
				2.0	17.50					
				3.0	17.50					
				4.0	17.40					
				5.0	17.40					
				6.0	17.40					
				7.0	17.30					
8.0	17.30									
POR above Mill Creek	1130	22-Jun-04	15:25	1.0	17.40					midchannel
				2.0	17.30					
				3.0	17.40					
				4.0	17.30					
				5.0	17.30					
				6.0	17.20					
				7.0	17.20					
				8.0	17.20					
				9.0	17.20					
10.0	17.20									

Table 5, continued. Results of Profile Measurements.

Site	Site ID	Date	Time	Depth (m)	Temp (deg C)	DO (mg/L)	DO % Sat	pH (s.u.)	SPCond (uS/cm)	Comments
POR above Mill Creek	1130	24-Jun-04	18:04	1.0	18.2					
				2.0	18.2					
				3.0	18.2					
				4.0	18.2					
				5.0	18.2					
				6.0	18.2					
				7.0	18.2					
				8.0	18.2					
				9.0	18.2					
POR above Mill Creek	1130	18-Aug-04	10:40	0.1	23.67	8.65	109.4	8.60	155.1	buoy and tidbit lost
				1.0	23.66	8.72	110.2	8.60	154.8	
				2.0	23.64	8.76	110.5	8.58	155.2	
				3.0	23.64	8.82	111.6	8.58	155.7	
				4.0	23.64	8.88	112.4	8.59	155.4	
				5.0	23.64	8.95	113.4	8.57	155.2	
				6.0	23.64	8.96	113.3	8.57	155.2	
				6.9	23.64	8.59	108.8	8.56	155.3	
POR above Mill Creek	1130	22-Sep-04	10:40	0.1	15.62	9.36	100.8	8.38	154.3	
				1.1	15.62	9.26	99.7	8.37	154.2	
				2.1	15.62	9.20	99.1	8.37	154.1	
				3.1	15.62	9.23	99.4	8.36	154.3	
				4.1	15.61	9.22	99.3	8.35	154.1	
				5.0	15.61	9.14	98.4	8.36	154.6	
				6.0	15.61	9.09	97.9	8.35	154.2	
				7.0	15.61	9.13	98.3	8.35	154.2	
				8.0	15.61	9.21	99.2	8.34	154.5	
8.6	15.61	9.32	100.3	8.37	154.3					
POR at Mill Creek mouth	1135	22-Jun-04	16:00	4.5	13.5					
POR at Mill Creek mouth	1135	18-Aug-04	10:55	0.1	23.14	8.70	109.0	8.57	151.5	
				0.2	17.60	8.90	101.0	8.12	93.20	

Table 5, continued. Results of Profile Measurements.

Site	Site ID	Date	Time	Depth (m)	Temp (deg C)	DO (mg/L)	DO %Sat	pH (s.u.)	SPCond (uS/cm)	Comments
POR above LeClerc Creek	1140	22-Jun-04	16:05	1.0	17.4					
				2.0	17.5					
				3.0	17.4					
				4.0	17.4					
				5.0	17.4					
				6.0	17.4					
				7.0	17.5					
				8.0	17.5					
				9.0	17.5					
				10.0	17.5					
POR above LeClerc Creek	1140	28-Jul-04	16:55	0.1	23.96					
				1.0	23.30					
				2.0	23.27					
				3.0	23.25					
				4.0	23.20					
				4.5	23.00	8.60	99.0	8.48	142.7	
POR above LeClerc Creek	1140	18-Aug-04	11:15	0.1	23.63	9.04	114.4	8.61	156.8	
				1.0	23.65	8.84	111.8	8.60	157.1	
				2.0	23.65	8.78	111.1	8.59	156.9	
				3.0	23.65	8.73	110.4	8.59	157.2	
				4.0	23.65	8.70	110.1	8.58	157.1	
				5.0	23.45	8.52	107.2	8.55	156.7	
POR above LeClerc Creek	1140	18-Aug-04	11:25	0.1	23.68	8.78	111.2	8.62	157.4	midchannel
				1.0	23.68	8.75	110.7	8.62	157.0	
				2.0	23.68	8.76	110.8	8.62	157.2	
				3.0	23.68	8.75	110.8	8.62	157.2	
				4.0	23.68	8.77	111.0	8.61	157.2	
				5.0	23.67	8.73	110.4	8.61	157.4	
				6.0	23.67	8.72	110.4	8.60	157.5	
				6.9	23.68	8.75	110.7	8.60	157.3	
				7.6	23.67	8.84	111.8	8.64	157.1	

Table 5, continued. Results of Profile Measurements.

Site	Site ID	Date	Time	Depth (m)	Temp (deg C)	DO (mg/L)	DO % Sat	pH (s.u.)	SPCond (uS/cm)	Comments
POR above LeClerc Creek	1140	22-Sep-04	11:05	0.1	15.51	9.41	101.1	8.39	153.4	
				1.1	15.53	9.29	99.8	8.39	153.2	
				2.1	15.52	9.17	98.6	8.38	153.3	
				3.1	15.53	9.15	98.3	8.38	153.0	
				4.1	15.54	9.11	98.0	8.37	153.8	
				5.0	15.54	9.11	98.0	8.37	153.2	
				5.3	15.55	8.83	95.0	8.30	154.2	
POR above LeClerc Creek	1140	19-Oct-04	15:00	0.1	12.81	9.52	96.4	8.20	144.5	
				1.0	12.82	9.37	94.9	8.20	144.6	
				2.1	12.81	9.32	94.4	8.19	144.7	
				3.0	12.81	9.32	94.4	8.19	144.6	
				4.0	12.81	9.29	94.1	8.18	144.3	
				5.0	12.80	9.28	93.9	8.19	144.6	
				6.0	12.81	9.29	94.0	8.18	144.8	
POR at LeClerc Creek mouth	1150	18-Aug-04	11:38	0.1	16.54	10.22	110.6	8.28	159.6	
				0.3	16.60	8.61	94.9	8.33	158.6	
LeClerc Creek near stream gage	2140	29-Jul-04	14:55	0.1	15.5					
LeClerc Creek near stream gage	2140	22-Sep-04	17:49	0.1	9.8					
LeClerc Creek near stream gage	2140	19-Oct-04	8:45	0.1	7.4					
POR above Blueslide	1160	24-Jun-04	16:00	0.1	18.2					midchannel
				1.0	18.2					
				2.0	18.1					
				3.0	18.1					
				4.0	18.1					
				5.0	18.1					
				6.0	18.1					

Table 5, continued. Results of Profile Measurements.

Site	Site ID	Date	Time	Depth (m)	Temp (deg C)	DO (mg/L)	DO %Sat	pH (s.u.)	SPCond (uS/cm)	Comments
POR above Blueslide	1160	24-Jun-04	16:10	0.1	18.2					
				1.0	18.2					
				2.0	18.2					
				3.0	18.2					
				4.0	18.2					
				5.0	18.2					
				6.0	18.2					
				7.0	18.2					
				8.0	18.2					
				9.0	18.2					
POR above Blueslide	1160	28-Jul-04	17:32	0.1	23.47					
				0.1	23.38					
				1.0	23.37					
				2.0	23.27					
				3.0	23.24					
				4.0	23.23					
				5.0	23.24					
				6.0	23.23					
				7.0	23.23	9.50	105.9	8.64	142.4	
POR above Blueslide	1160	18-Aug-04	12:15	0.1	23.76	9.05	114.8	8.63	156.1	
				1.0	23.76	8.94	113.1	8.62	156.5	
				2.0	23.77	8.83	111.9	8.62	156.3	
				3.0	23.71	8.80	111.5	8.61	156.7	
				4.0	23.72	8.73	110.5	8.62	156.6	
				5.0	23.70	8.73	110.6	8.61	156.6	
				6.0	23.70	8.72	110.3	8.61	156.7	
				7.0	23.70	8.74	110.6	8.61	156.8	
				7.4	23.70	8.72	110.4	8.61	156.6	

Table 5, continued. Results of Profile Measurements.

Site	Site ID	Date	Time	Depth (m)	Temp (deg C)	DO (mg/L)	DO %Sat	pH (s.u.)	SPCond (uS/cm)	Comments
POR above Blueslide	1160	18-Aug-04	12:40	0.1	23.81	8.61	109.2	8.62	156.5	midchannel
				1.0	23.82	8.68	109.9	8.61	156.3	
				2.0	23.75	8.65	109.6	8.61	156.3	
				3.0	23.73	8.64	109.4	8.61	156.5	
				4.0	23.73	8.68	109.9	8.60	156.6	
				4.9	23.72	8.61	109.4	8.59	156.4	
				5.9	23.72	8.67	109.8	8.59	156.3	
				7.0	23.71	8.66	109.7	8.58	156.6	
				8.0	23.72	8.67	109.9	8.58	156.2	
POR above Blueslide	1160	22-Sep-04	11:45	0.1	15.39	9.28	99.5	8.39	153.0	
				1.1	15.46	9.23	98.9	8.38	153.0	
				2.1	15.46	9.21	98.9	8.37	153.2	
				3.0	15.46	9.17	98.5	8.37	152.8	
				4.0	15.47	9.20	98.7	8.37	153.0	
				5.0	15.47	9.15	98.2	8.36	153.0	
				6.0	15.47	9.17	98.4	8.36	152.8	
				7.0	15.47	9.15	98.3	8.35	152.9	
				7.7	15.47	9.17	98.4	8.35	153.0	
POR above Blueslide	1160	19-Oct-04	14:15	0.1	12.79	9.44	96.0	8.21	144.1	
				1.0	12.80	9.32	94.4	8.22	144.4	
				1.9	12.80	9.39	95.1	8.21	144.4	
				3.0	12.80	9.32	94.4	8.21	144.4	
				4.0	12.80	9.33	94.5	8.21	144.4	
				5.0	12.79	9.41	95.3	8.22	143.9	
				6.0	12.79	9.34	94.6	8.22	144.9	
				7.0	12.79	9.37	94.8	8.22	144.1	
				POR at Ruby Creek Mouth	1170	18-Aug-04	12:59	0.1	22.30	
0.9	18.51	9.13	104.5					8.27	110.6	

Table 5, continued. Results of Profile Measurements.

Site	Site ID	Date	Time	Depth (m)	Temp (deg C)	DO (mg/L)	DO %Sat	pH (s.u.)	SPCond (uS/cm)	Comments
POR above Lost Creek	1180	22-Jun-04	17:00	0.1	17.4					midchannel
				1.0	17.3					
				2.0	17.3					
				3.0	17.3					
				4.0	17.2					
				5.0	17.2					
				6.0	17.2					
				7.0	17.2					
				8.0	17.2					
				9.0	17.2					
POR above Lost Creek	1180	22-Jun-04	17:30	0.1	17.3					right bank
				1.0	17.3					
				2.0	17.3					
				3.0	17.3					
				4.0	17.3					
				5.0	17.3					
				6.0	17.3					
				7.0	17.3					
				8.0	17.3					
				9.0	17.2					
POR above Lost Creek	1180	24-Jun-04	17:12	1.0	18.1					
				2.0	18.1					
				3.0	18.1					
				4.0	18.1					
				5.0	18.1					
				6.0	18.1					
				7.0	18.1					
				8.0	18.1					

Table 5, continued. Results of Profile Measurements.

Site	Site ID	Date	Time	Depth (m)	Temp (deg C)	DO (mg/L)	DO %Sat	pH (s.u.)	SPCond (uS/cm)	Comments
POR above Lost Creek	1180	28-Jul-04	18:20	0.1	23.49					
				1.0	23.35					
				2.0	23.33					
				3.0	23.27					
				4.0	23.27					
				5.0	23.28					
				6.0	23.27					
				7.0	23.27					
				7.3	23.27	9.00	104.6	8.40	142.6	
POR above Lost Creek	1180	18-Aug-04	13:45	0.1	23.95	8.51	109.0	8.61	155.5	circulator problem
				1.0	23.93	8.47	107.7	8.61	155.7	
				2.0	23.91	8.24	104.8	8.61	156.0	
				3.0	23.93	8.05	102.4	8.60	156.1	
				4.0	23.90	8.31	105.6	8.60	156.2	
				5.0	23.91	8.06	102.2	8.60	156.0	
				6.0	23.90	8.57	108.8	8.57	155.6	
POR above Lost Creek	1180	18-Aug-04	14:00	0.1	24.10	8.59	109.4	8.60	150.9	midchannel
				1.0	23.97	8.26	105.6	8.61	156.7	
				2.0	24.00	8.24	104.4	8.61	156.6	
				3.0	23.98	8.23	105.2	8.61	156.4	
				4.0	23.98	8.19	104.1	8.61	156.4	
				5.0	23.98	8.16	104.8	8.61	156.4	
				6.0	23.98	8.22	105.1	8.61	156.2	
				7.0	23.93	8.27	105.1	8.60	156.3	
				7.7	23.94	8.40	106.9	8.62	156.7	
POR above Lost Creek	1180	22-Sep-04	12:15	0.1	15.61	9.39	101.1	8.34	152.9	
				1.1	15.60	9.34	100.5	8.35	153.2	
				2.1	15.60	9.36	100.7	8.36	152.9	
				3.1	15.60	9.29	100.0	8.37	152.8	
				4.1	15.60	9.24	99.5	8.37	152.9	
				5.0	15.60	9.25	99.3	8.36	152.9	
				6.1	15.60	9.13	98.3	8.37	152.9	
				7.0	15.60	9.16	98.6	8.36	152.8	
				8.0	15.60	9.19	99.0	8.36	153.0	

Table 5, continued. Results of Profile Measurements.

Site	Site ID	Date	Time	Depth (m)	Temp (deg C)	DO (mg/L)	DO %Sat	pH (s.u.)	SPCond (uS/cm)	Comments
POR above Lost Creek	1180	19-Oct-04	13:25	0.1	12.80	9.64	97.6	8.18	143.9	
				1.0	12.80	9.51	96.2	8.20	144.0	
				2.0	12.80	9.50	96.2	8.20	144.1	
				3.0	12.80	9.43	95.5	8.19	144.5	
				4.0	12.80	9.44	95.6	8.18	144.1	
				5.0	12.80	9.40	95.2	8.18	144.0	
				6.0	12.80	9.38	95.0	8.17	144.1	
				7.1	12.80	9.37	95.0	8.18	144.2	
POR near Tiger	1185	25-Jun-04	10:22	0.1	18.2					alternate location
				1.0	18.2					
				2.0	18.2					
				3.0	18.2					
				4.0	18.2					
				5.0	18.2					
				6.0	18.2					
				7.0	18.2					
8.0	18.2									
POR near Tiger	1185	25-Jun-04	10:35	0.1	18.2					
				1.0	18.3					
				2.0	18.2					
				3.0	18.2					
				4.0	18.2					
				5.0	18.2					
				6.0	18.2					
				7.0	18.2					
				8.0	18.2					
				9.0	18.2					

Table 5, continued. Results of Profile Measurements.

Site	Site ID	Date	Time	Depth (m)	Temp (deg C)	DO (mg/L)	DO %Sat	pH (s.u.)	SPCond (uS/cm)	Comments
POR near Tiger	1185	22-Sep-04	15:10	0.1	15.65	9.62	103.6	8.41	151.9	buoy and tidbit lost
				1.1	15.66	9.52	102.6	8.40	152.4	
				2.1	15.66	9.49	102.5	8.40	152.8	
				3.0	15.66	9.48	102.2	8.41	152.3	
				4.0	15.66	9.45	101.8	8.40	152.3	
				5.0	15.66	9.40	101.3	8.40	152.1	
				6.0	15.66	9.40	101.3	8.39	151.7	
				7.0	15.66	9.39	101.2	8.40	152.0	
				8.0	15.66	9.38	101.2	8.38	152.1	
				9.0	15.65	9.38	101.1	8.38	152.0	
POR near Ione	1190	25-Jun-04	11:25	0.1	18.3					
				1.0	18.2					
				2.0	18.2					
				3.0	18.2					
				4.0	18.2					
				5.0	18.2					
				6.0	18.2					
				7.0	18.2					
				8.0	18.2					
				9.0	18.2					
POR near Ione	1190	29-Jul-04	11:20	0.1	23.34					
				1.0	23.29					
				2.0	23.21					
				3.0	23.12					
				4.0	23.09					
				5.0	23.08					
				6.0	23.06					
				7.0	23.07					
				8.0	23.06					
				9.0	23.05					
				10.0	23.05					
				11.0	23.05					
				12.0	23.05					
12.2	23.05	8.46	97.5	8.56	143.3					

Table 5, continued. Results of Profile Measurements.

Site	Site ID	Date	Time	Depth (m)	Temp (deg C)	DO (mg/L)	DO % Sat	pH (s.u.)	SPCond (uS/cm)	Comments
POR near Ione	1190	18-Aug-04	17:20	0.1	24.04	8.45	107.6	8.61	155.0	circulator problem
				1.1	23.98	8.31	105.7	8.59	155.2	
				2.0	24.00	8.40	106.9	8.58	155.2	
				3.0	23.97	8.28	105.7	8.58	155.6	
				4.0	23.96	8.07	102.7	8.56	155.6	
				5.0	23.96	8.13	103.6	8.57	154.9	
				6.0	23.95	8.09	103.6	8.55	155.1	
				7.0	23.95	8.10	103.1	8.54	155.6	
				8.0	23.94	8.09	103.0	8.54	155.0	
				9.0	23.93	8.00	102.4	8.54	155.6	
				10.0	23.93	8.01	101.7	8.53	156.0	
				11.0	23.93	8.14	103.7	8.55	155.7	
				12.0	23.93	8.18	103.3	8.53	155.8	
				12.5	23.93			8.52	156.2	
POR near Ione	1190	22-Sep-04	14:30	0.1	15.57	9.64	103.7	8.46	149.5	
				1.0	15.57	9.56	102.9	8.43	149.9	
				2.1	15.58	9.48	102.0	8.42	149.9	
				3.0	15.57	9.47	101.9	8.43	150.3	
				4.0	15.57	9.42	101.3	8.42	150.0	
				5.0	15.56	9.42	101.3	8.41	150.0	
				6.0	15.56	9.42	101.3	8.41	150.2	
				7.0	15.56	9.44	101.5	8.40	150.0	
				8.0	15.56	9.37	100.7	8.39	150.0	
				9.0	15.55	9.40	100.8	8.39	149.9	
				10.0	15.55	9.35	100.6	8.38	150.3	
				11.0	15.55	9.35	100.6	8.38	150.0	
				12.0	15.55	9.33	100.3	8.38	150.3	
				12.7	15.54	9.33	100.3	8.38	150.4	

Table 5, continued. Results of Profile Measurements.

Site	Site ID	Date	Time	Depth (m)	Temp (deg C)	DO (mg/L)	DO %Sat	pH (s.u.)	SPCond (uS/cm)	Comments
POR near Ione	1190	19-Oct-04	11:30	0.1	13.06	9.30	94.6	8.11	143.4	
				1.0	13.05	9.17	93.4	8.10	143.4	
				2.0	13.02	9.09	92.5	8.11	143.4	
				3.1	13.03	9.17	93.3	8.09	143.3	
				4.1	13.03	9.17	93.3	8.08	143.4	
				5.1	13.02	9.14	93.0	8.09	143.4	
				6.1	13.04	9.06	92.2	8.08	143.3	
				7.0	13.03	9.13	92.9	8.08	143.6	
				8.0	13.02	9.12	92.8	8.08	143.6	
				9.0	13.02	9.07	92.3	8.07	143.3	
POR at Box Canyon Dam - tailrace	1220	19-Oct-04	10:05	0.1	13.05	9.07	92.4	8.11	143.3	circulator problem (0.1 - 2.0 m)
				2.0	13.05	8.95	91.1	8.08	143.5	
				4.1	13.05	9.01	91.9	8.09	143.2	
				6.1	13.05	9.01	91.7	8.06	143.8	
Sullivan Creek- near USGS gage	2220	22-Sep-04	16:47	0.1	11.6					
Sullivan Creek- near USGS gage	2220	19-Oct-04	10:35	0.1	11.9					

Figures

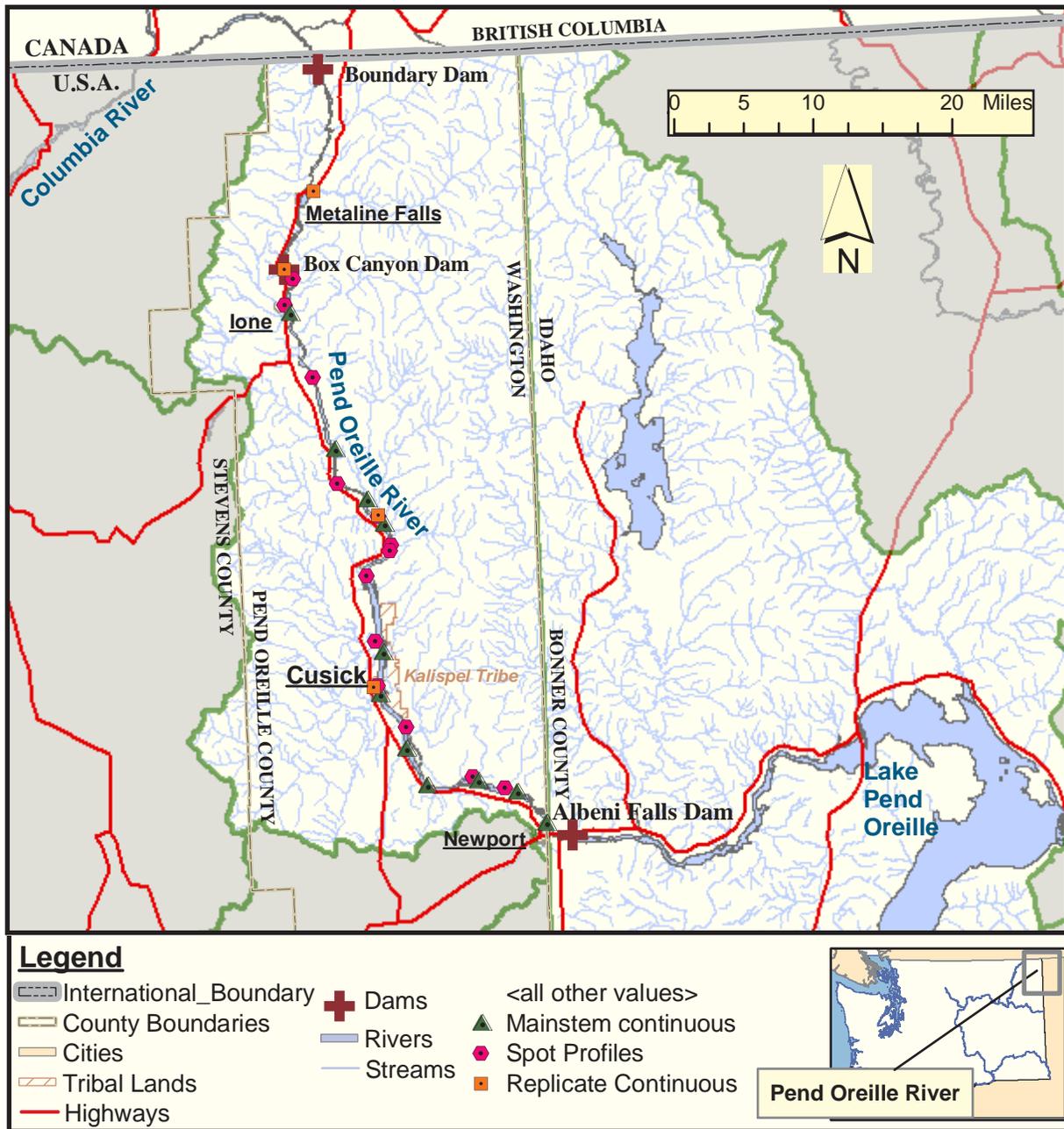


Figure 1. Pend Oreille River Temperature TMDL Study Area (Washington), as well as upstream (Idaho) and downstream (British Columbia) neighboring areas

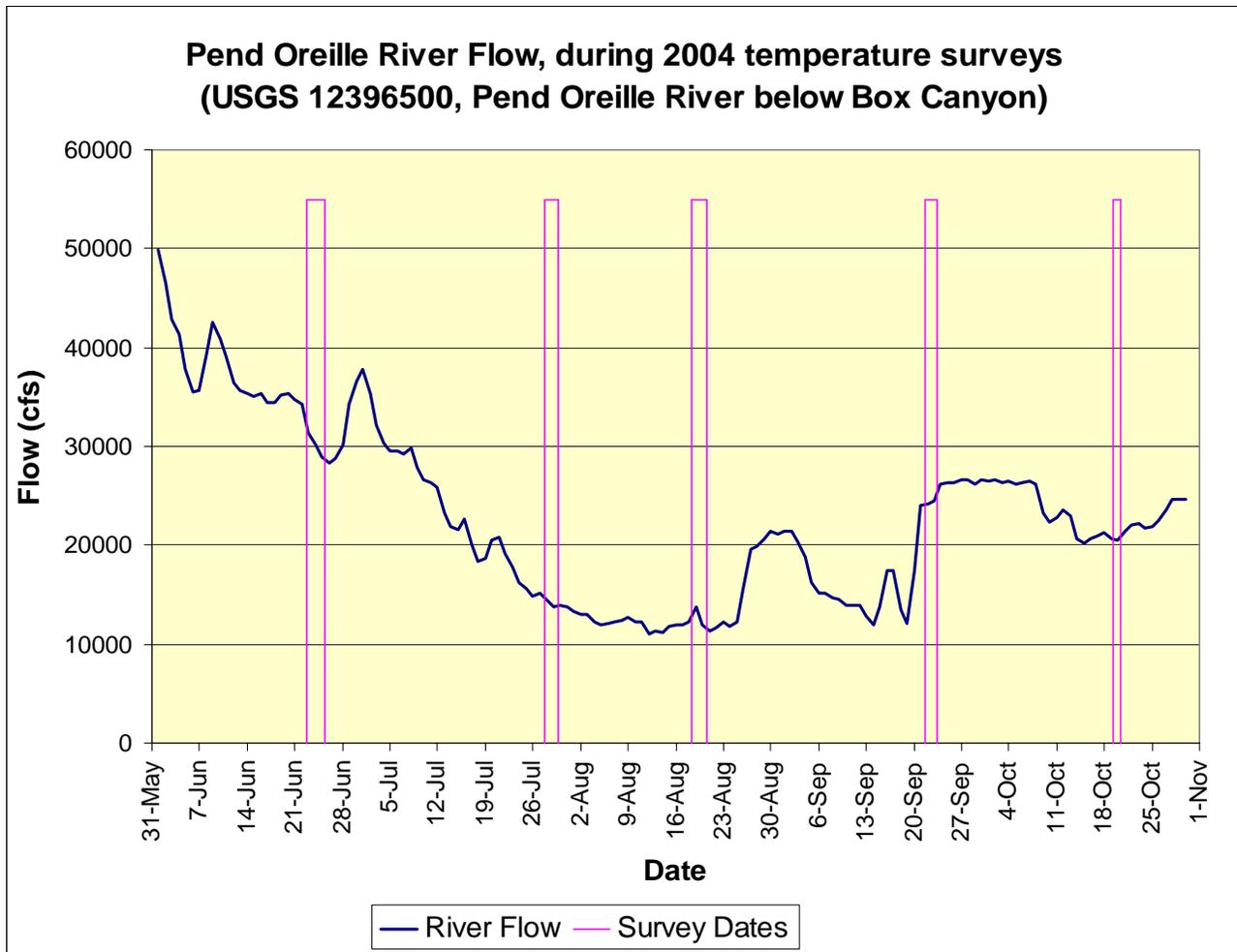


Figure 2. Pend Oreille River Flows During Monitoring Period

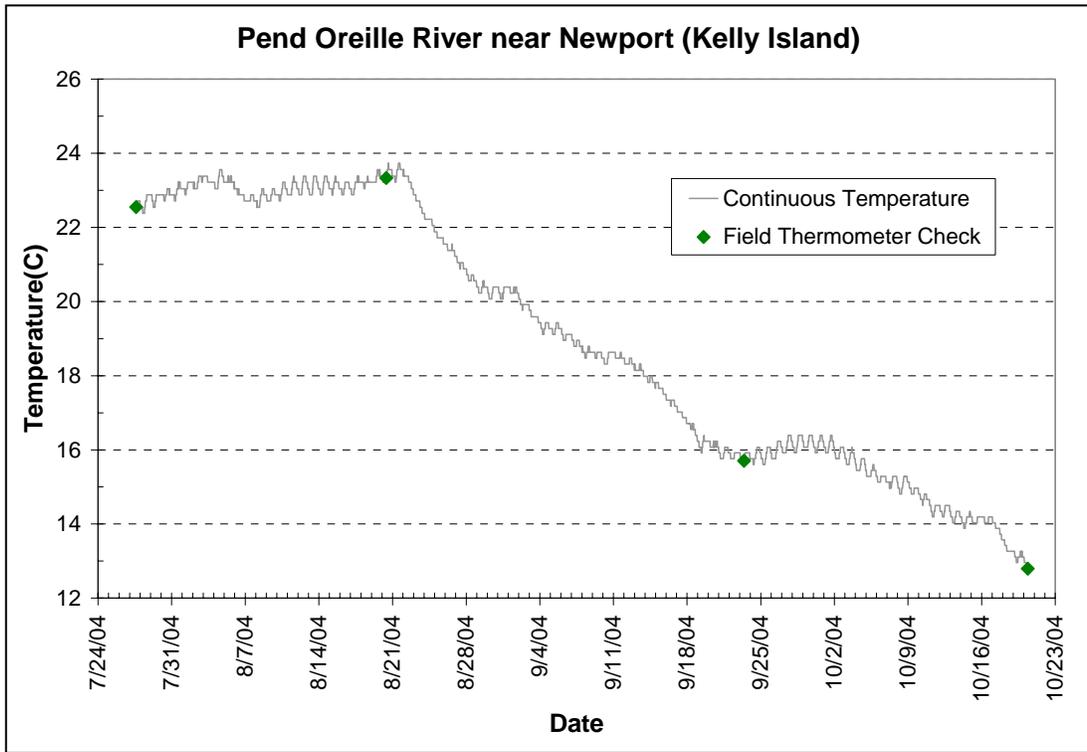


Figure 3. Temperature Measurements: Pend Oreille River near Newport (Kelly Island)

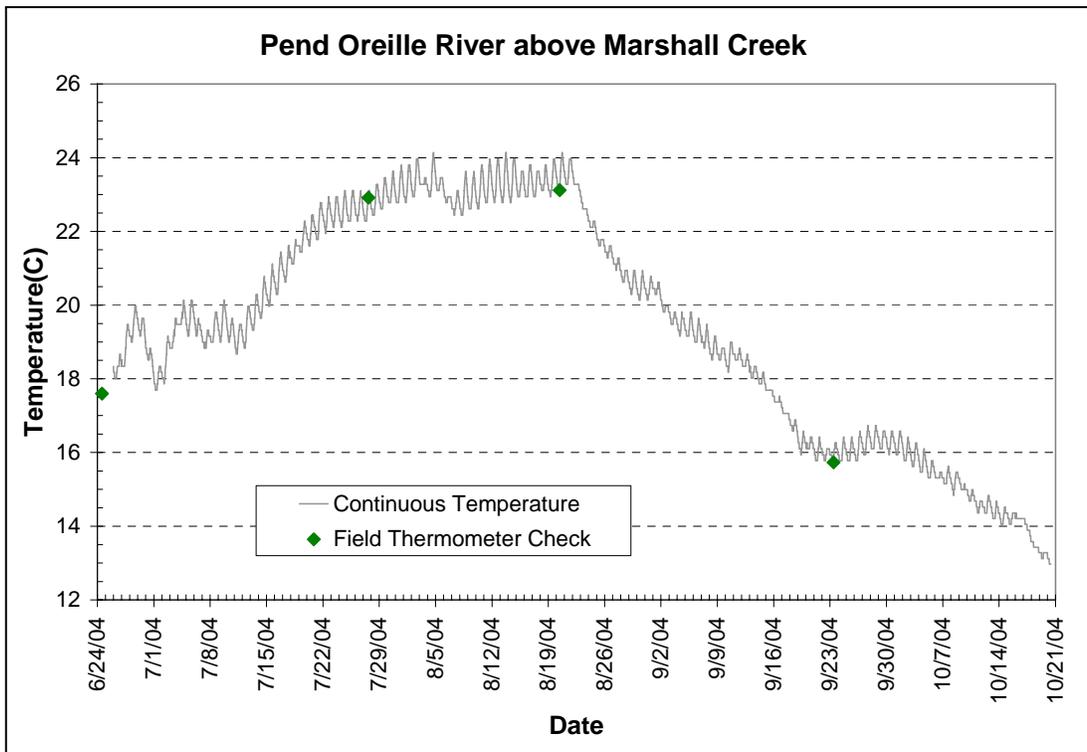


Figure 4. Temperature Measurements: Pend Oreille River above Marshall Creek

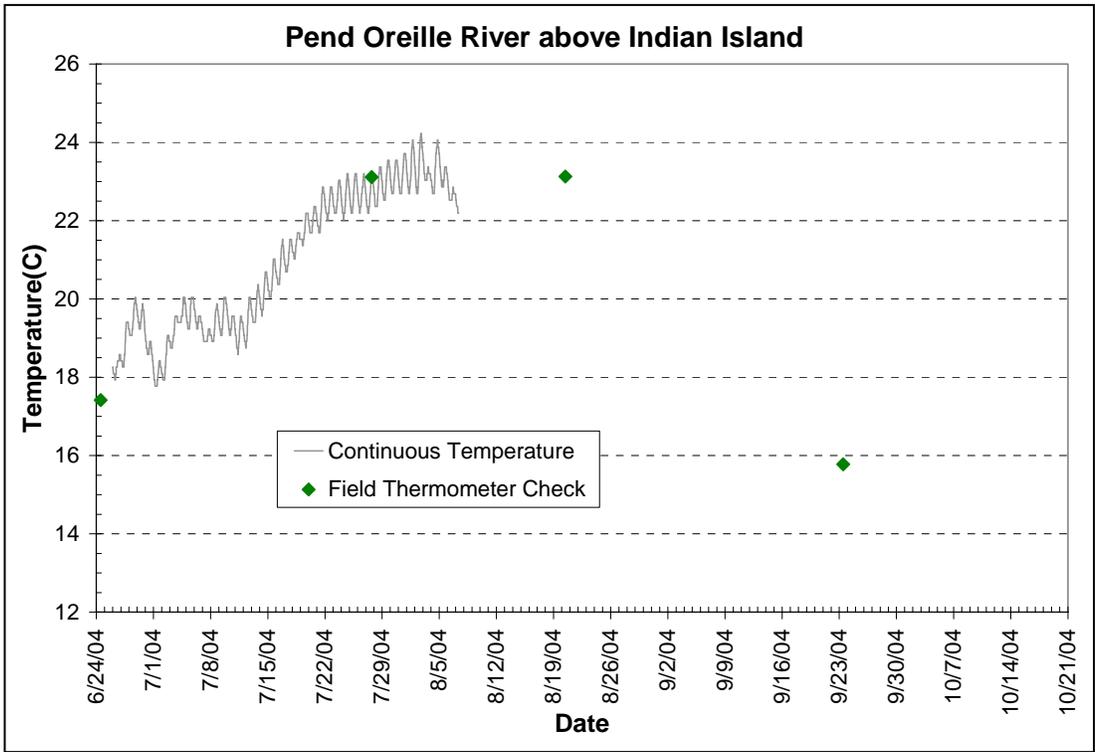


Figure 5. Temperature Measurements: Pend Oreille River above Indian Island

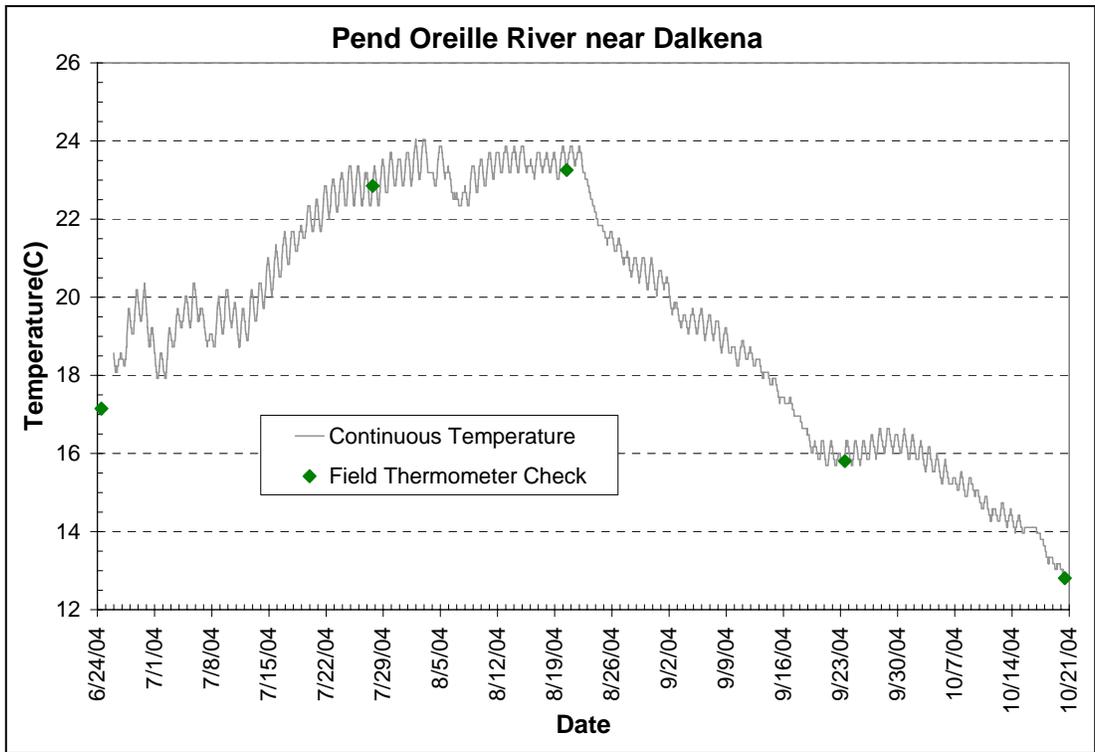


Figure 6. Temperature Measurements: Pend Oreille River near Dalkena

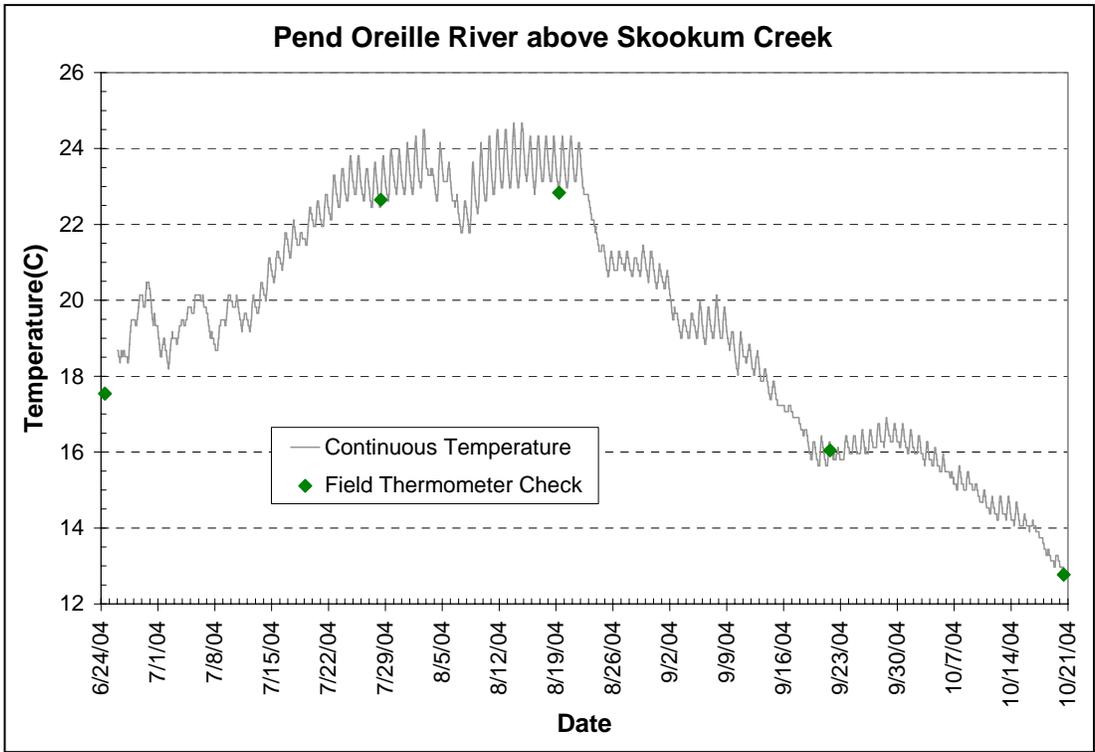


Figure 7. Temperature Measurements: Pend Oreille River above Skookum Creek

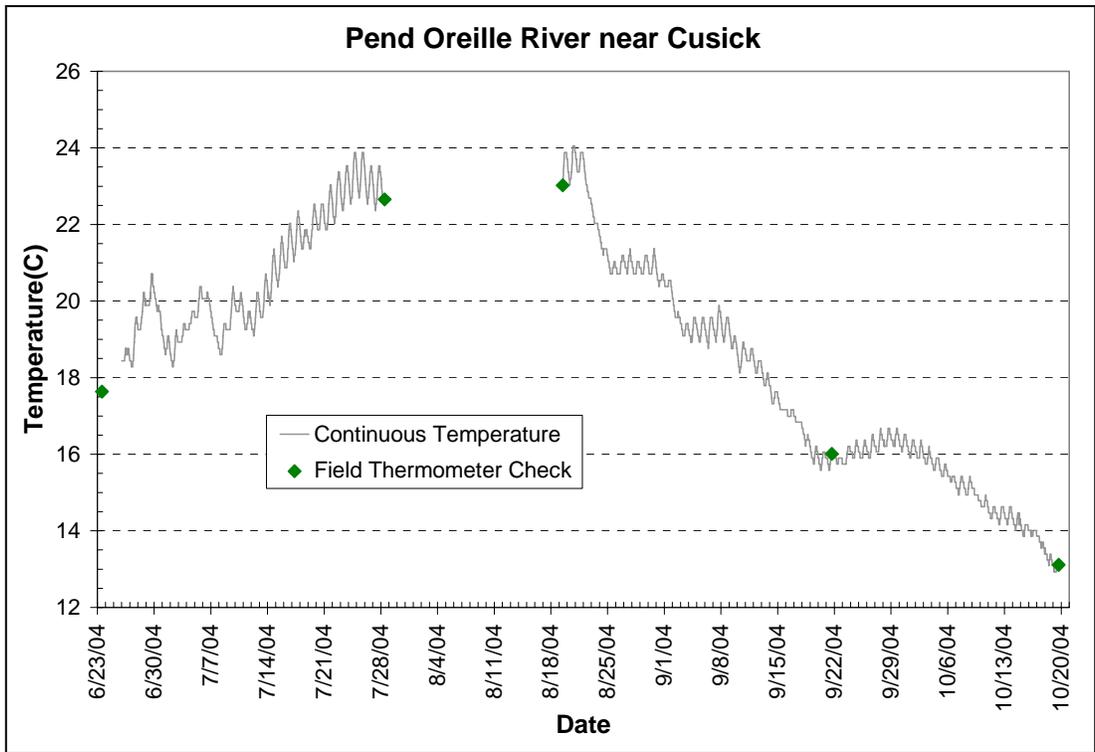


Figure 8. Temperature Measurements: Pend Oreille River near Cusick

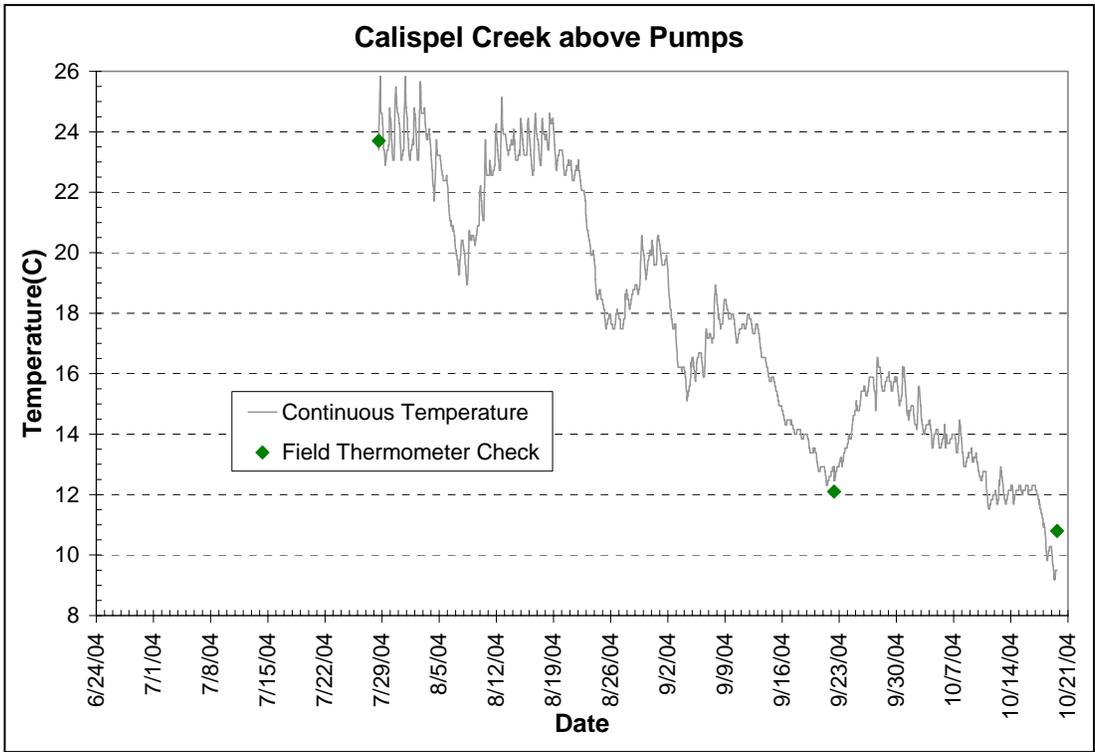


Figure 9. Temperature Measurements: Calispel Creek above Pumps

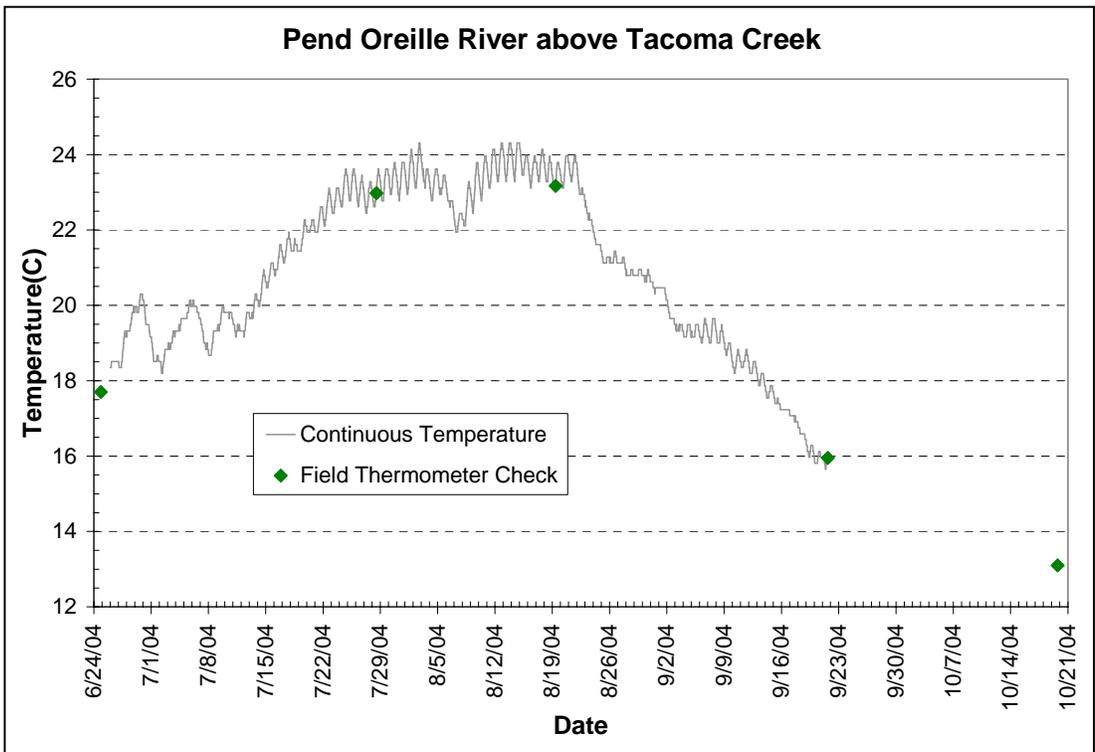


Figure 10. Temperature Measurements: Pend Oreille River above Tacoma Creek

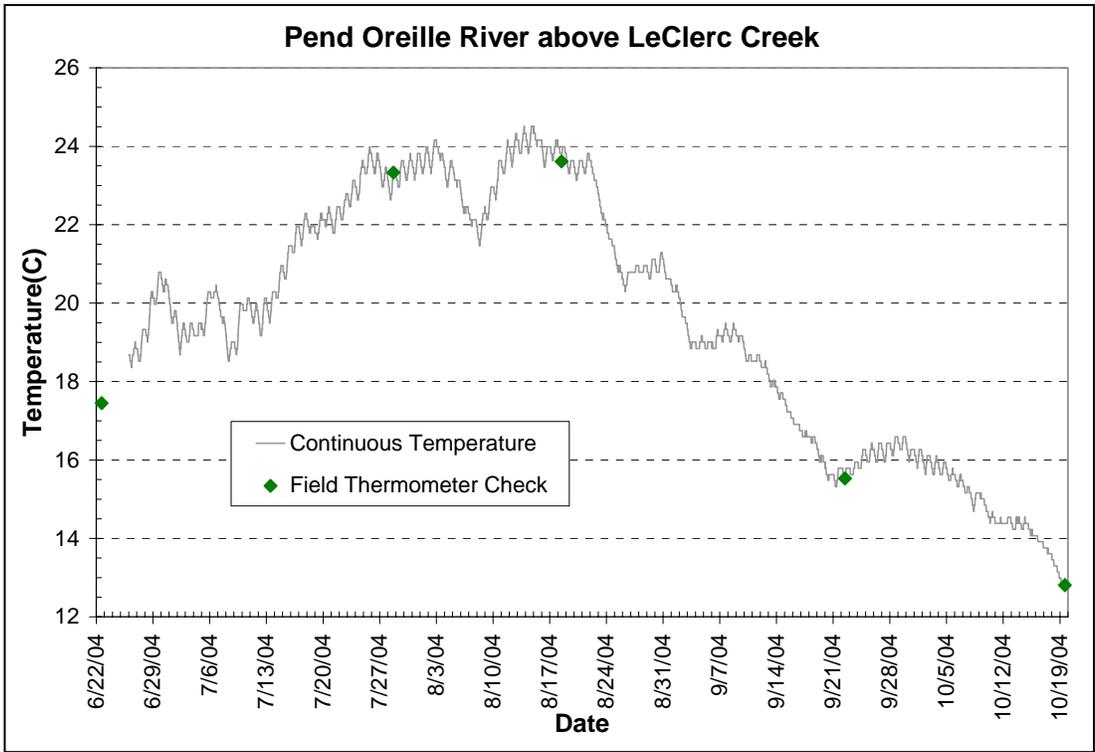


Figure 11. Temperature Measurements: Pend Oreille River above LeClerc Creek

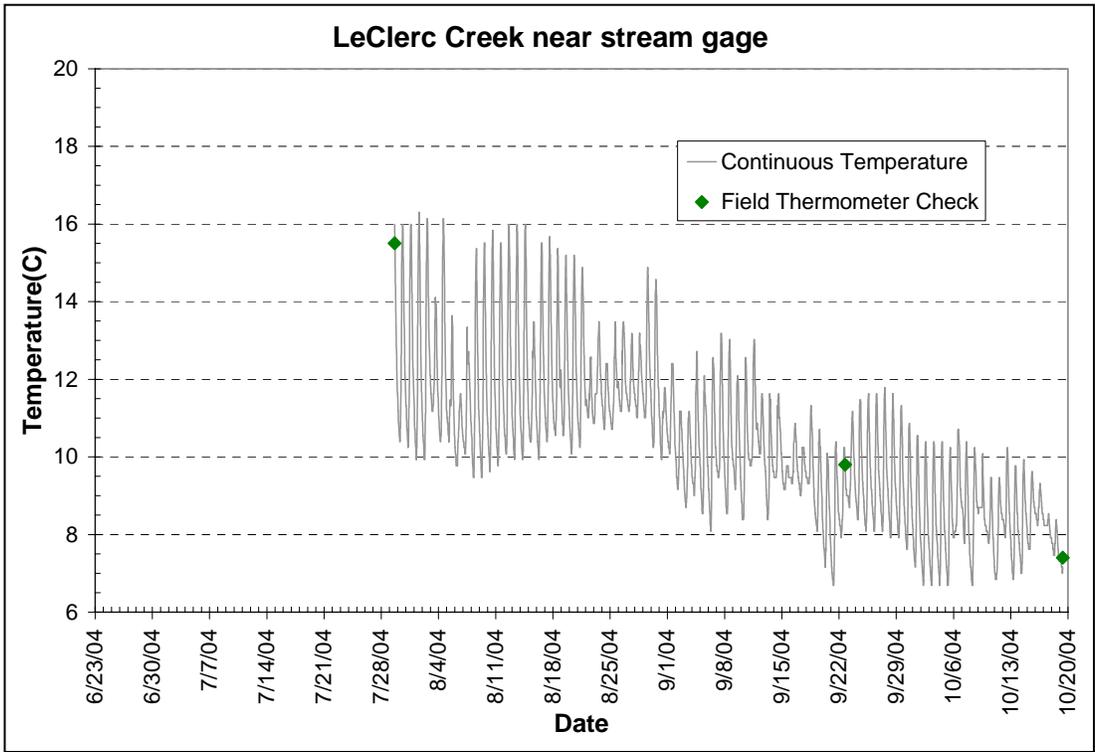


Figure 12. Temperature Measurements: LeClerc Creek near stream gage

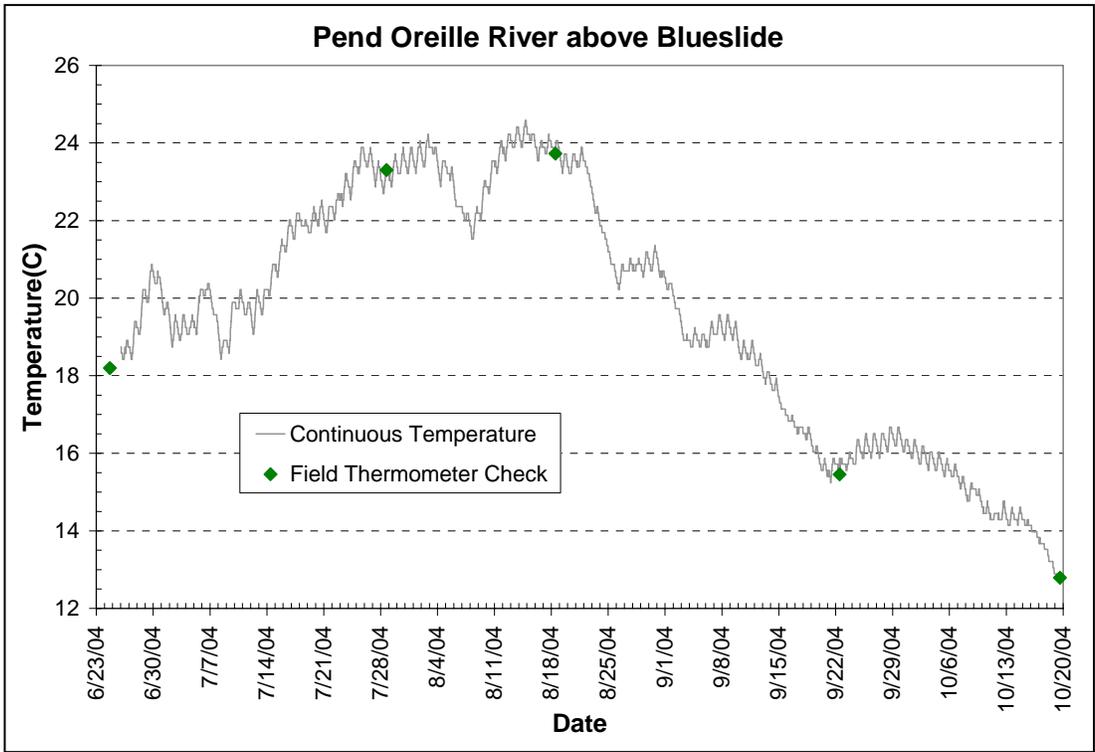


Figure 13. Temperature Measurements: Pend Oreille River above Blueslide

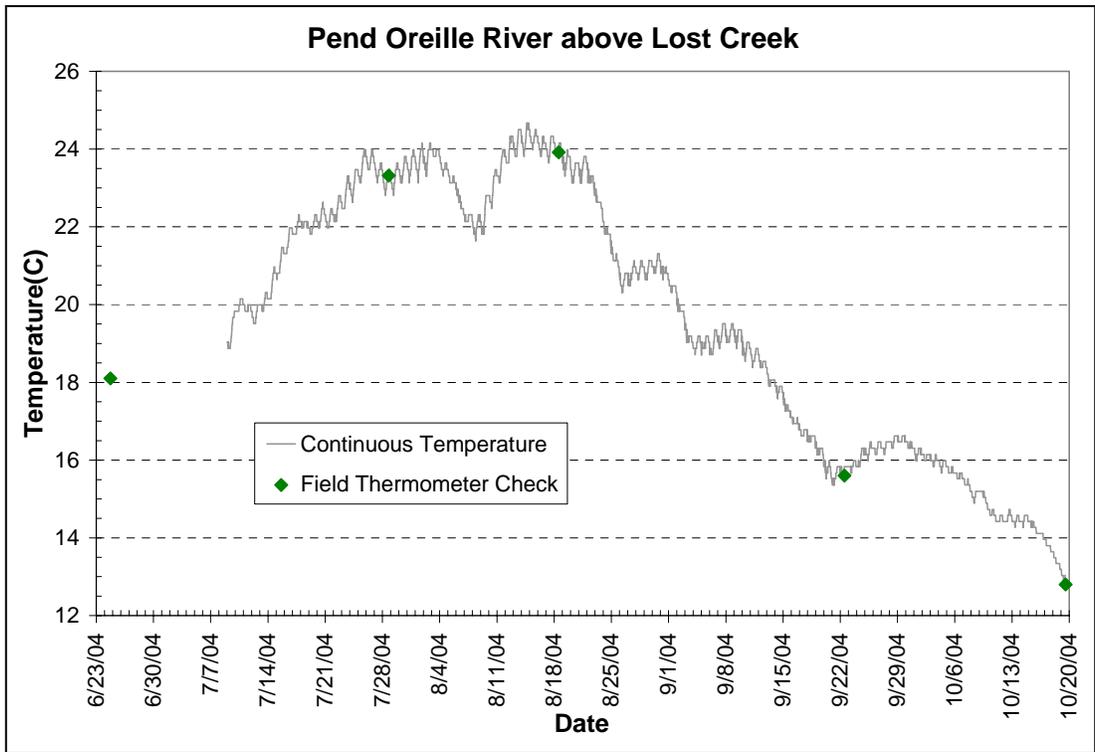


Figure 14. Temperature Measurements: Pend Oreille River above Lost Creek

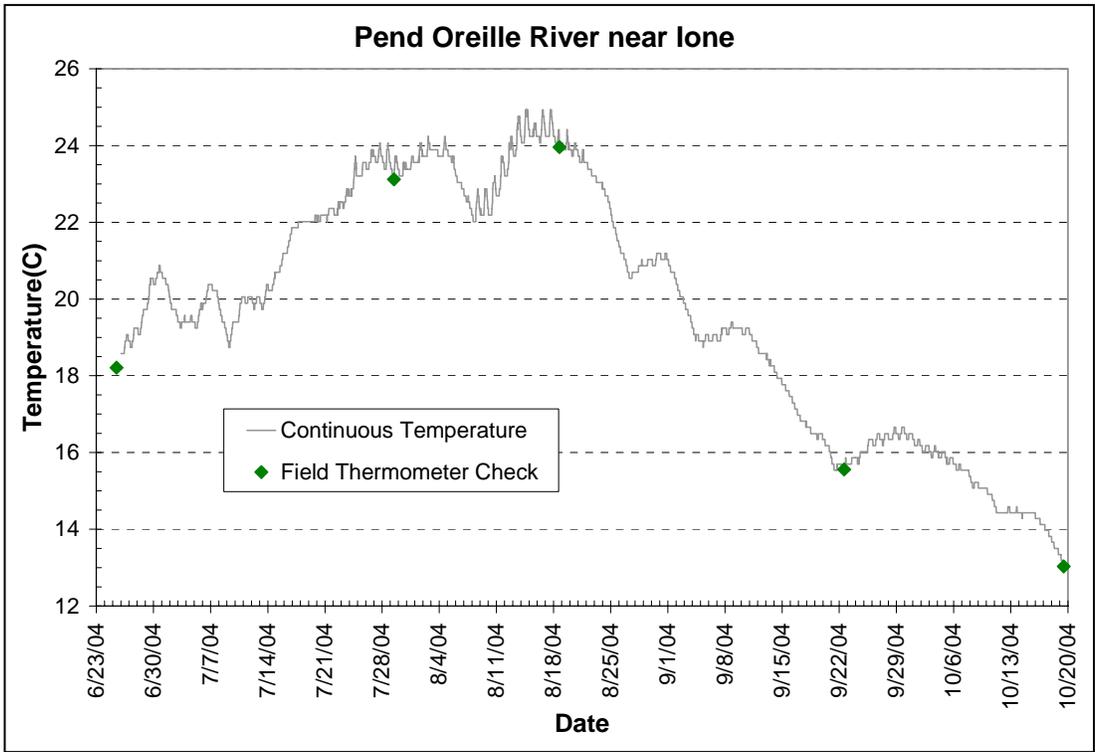


Figure 15. Temperature Measurements: Pend Oreille River near Ione

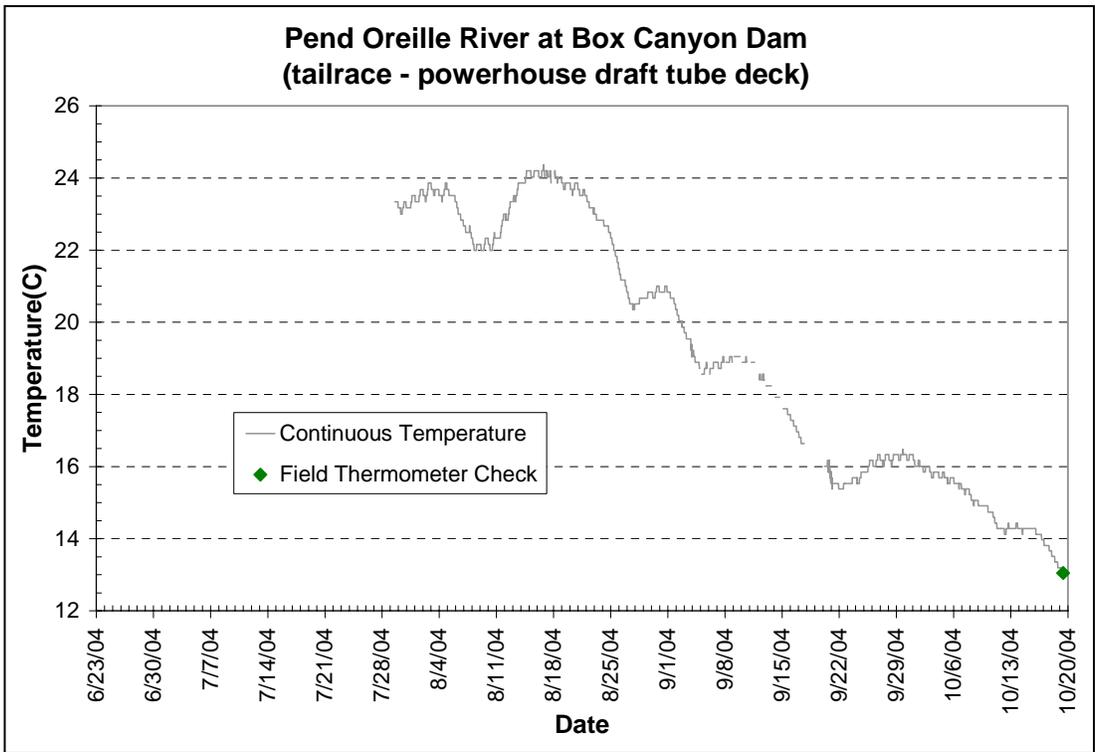


Figure 16. Temperature Measurements: Pend Oreille River at Box Canyon Dam tailrace

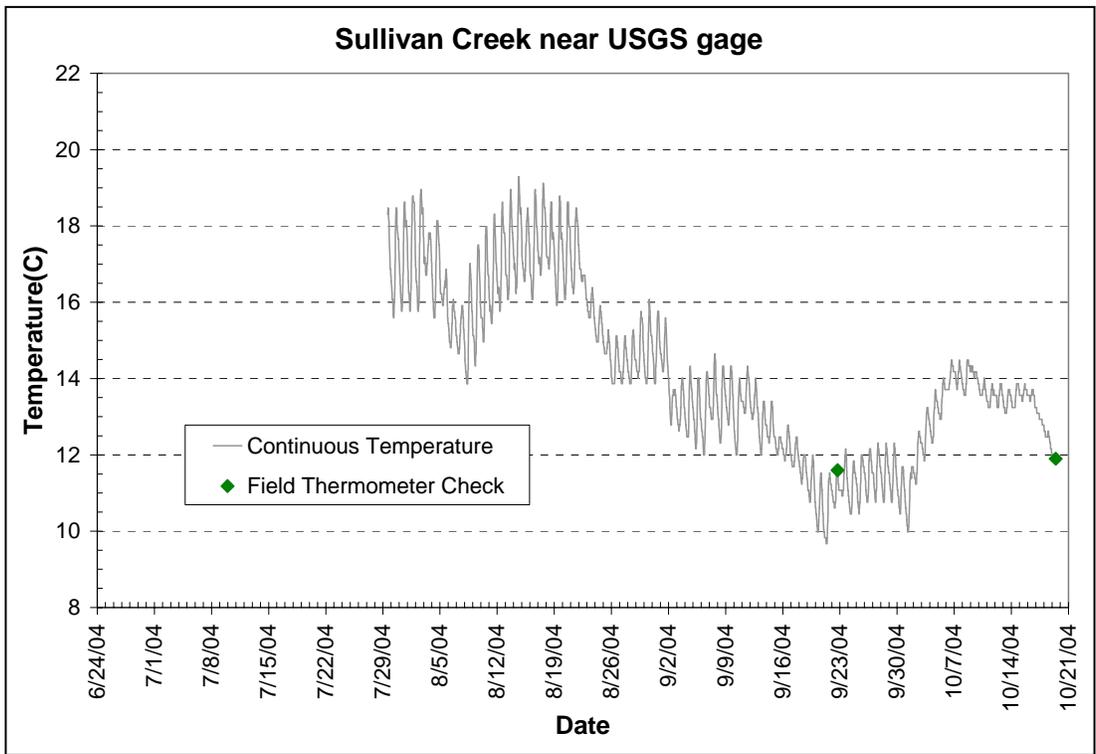


Figure 17. Temperature Measurements: Sullivan Creek near USGS gage

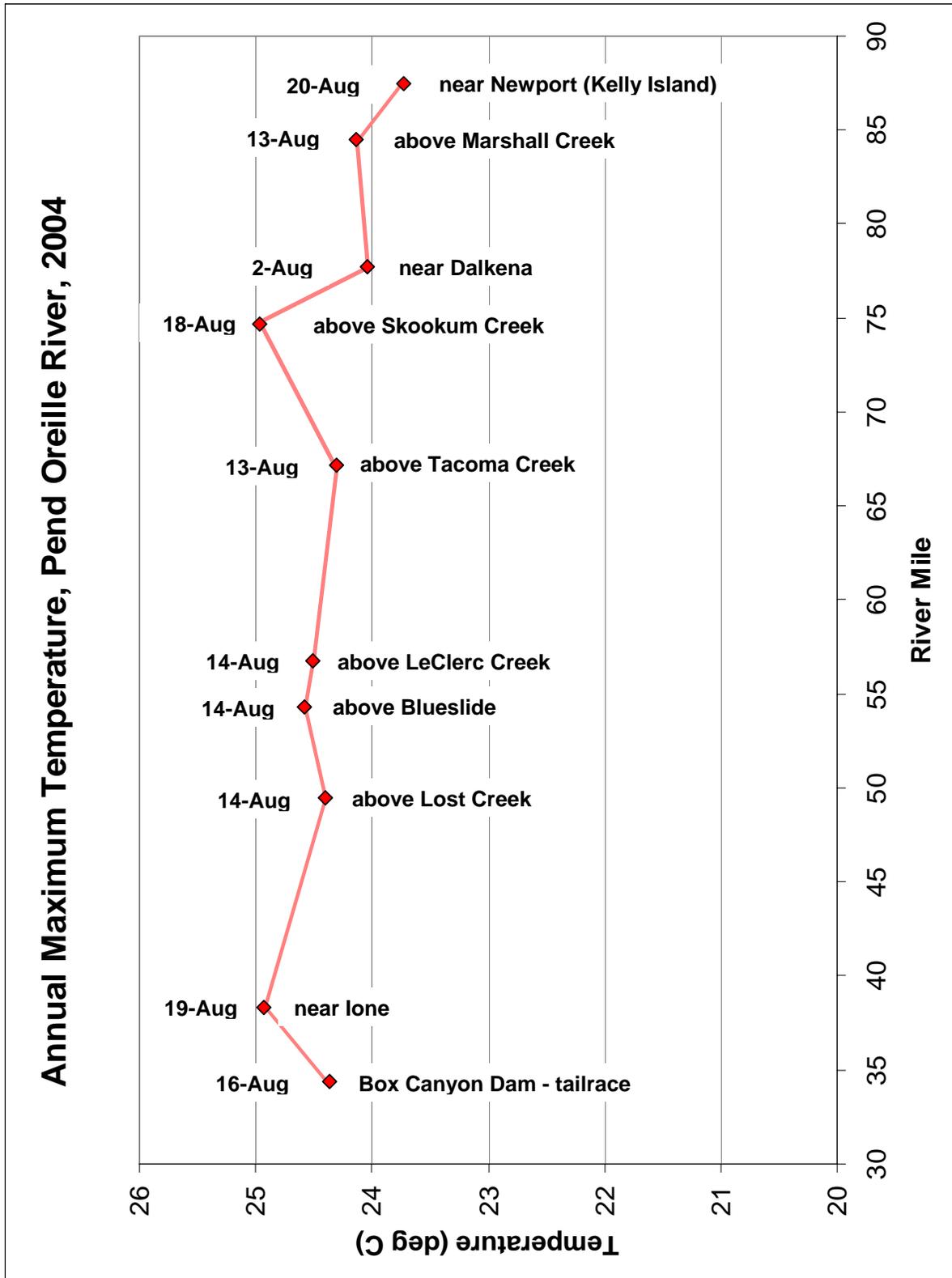


Figure 18. Maximum Pend Oreille River Temperatures from 2004 survey

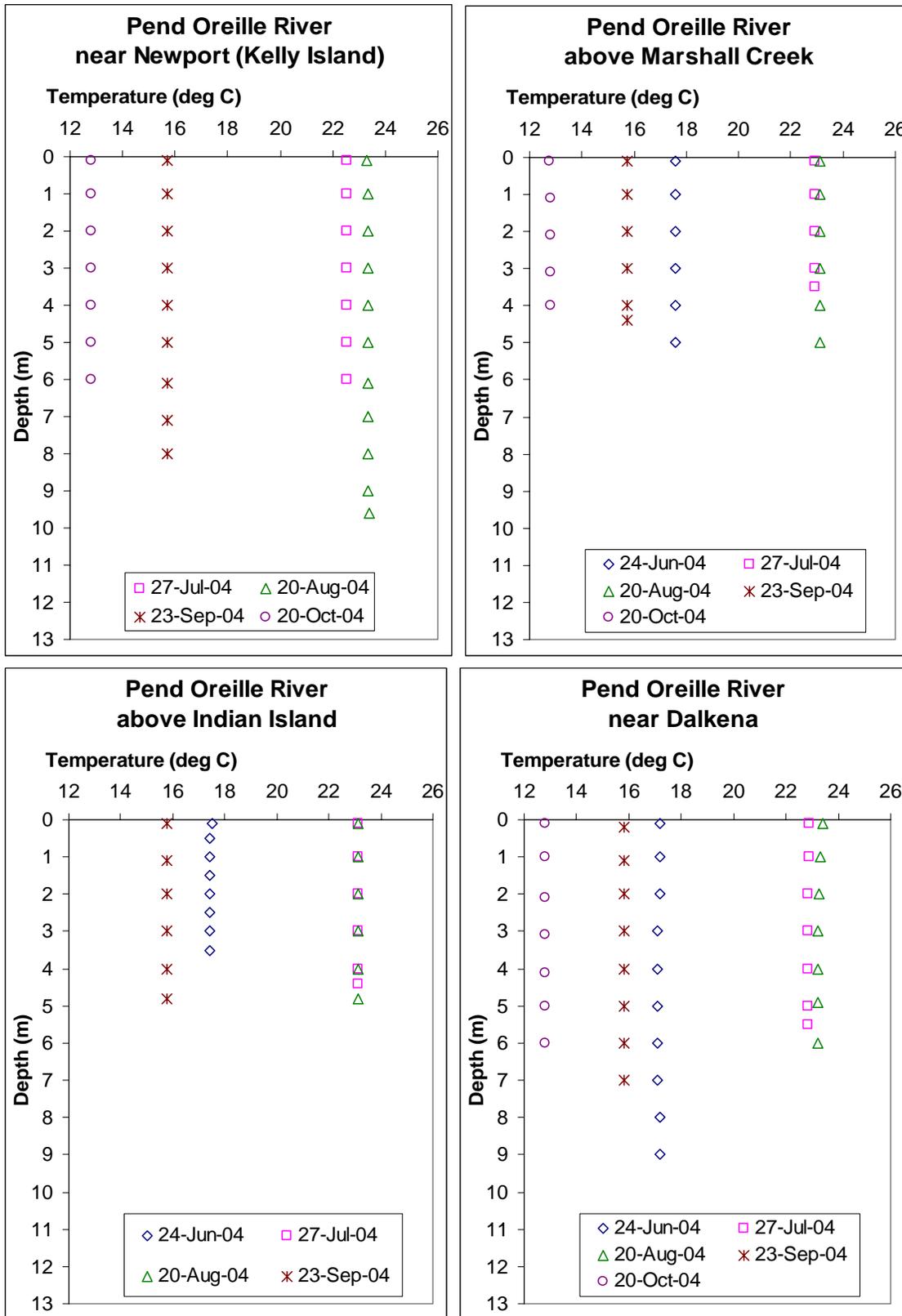


Figure 19. Pend Oreille River Temperature Profiles.

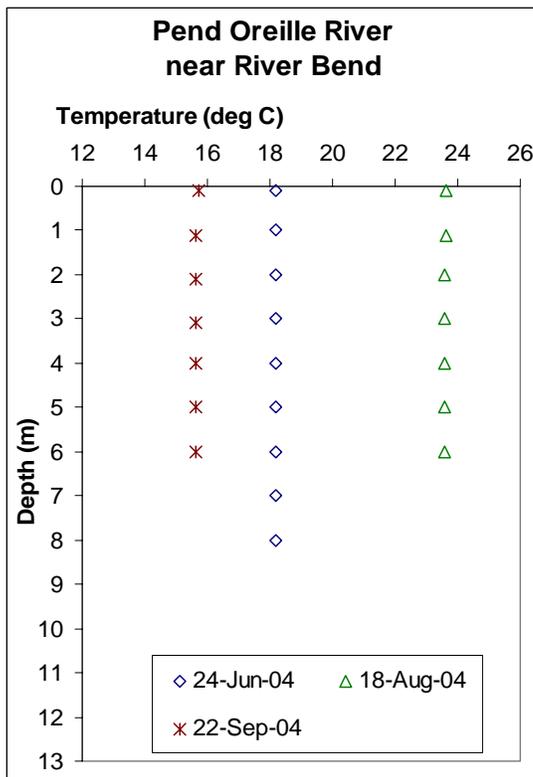
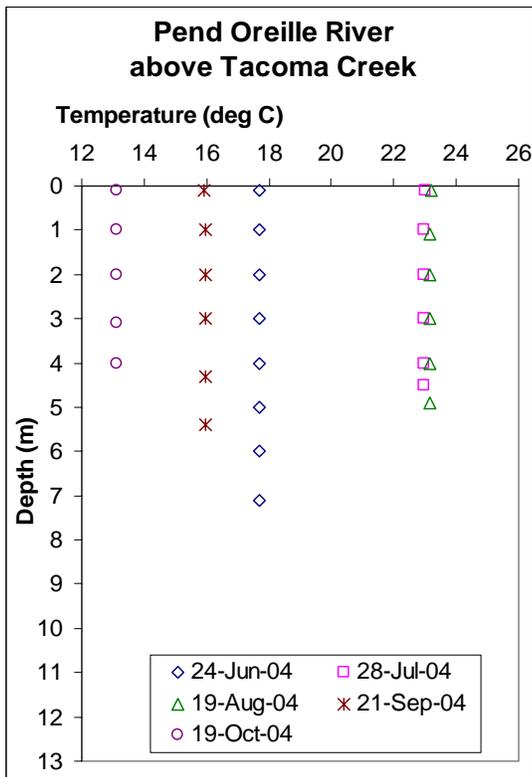
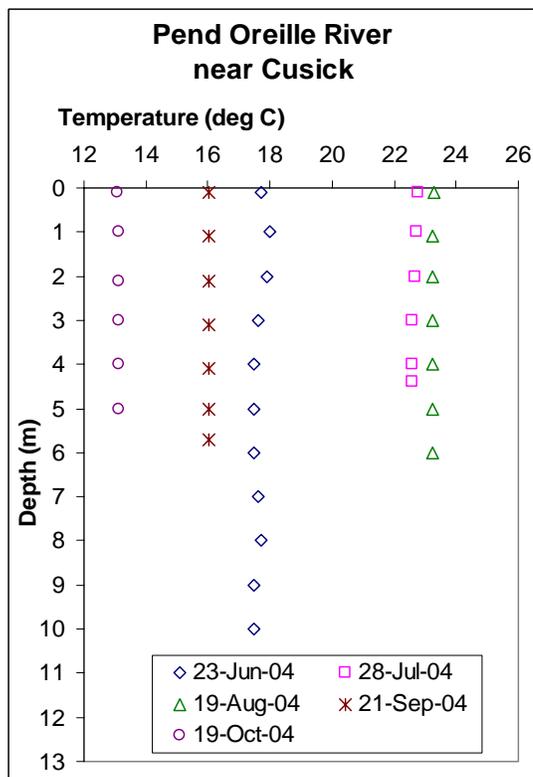
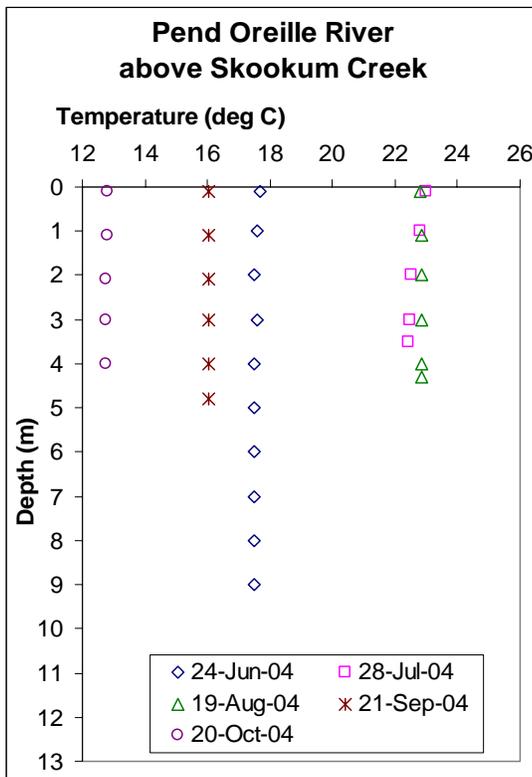


Figure 19. Pend Oreille River Temperature Profiles, continued.

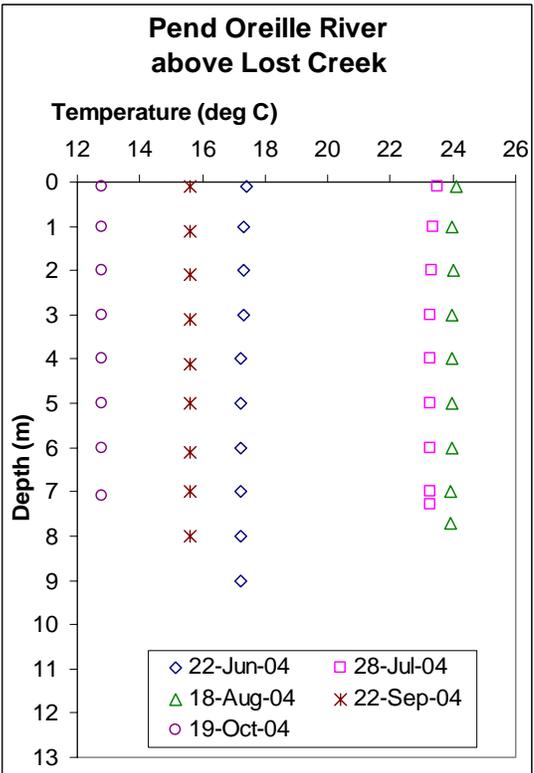
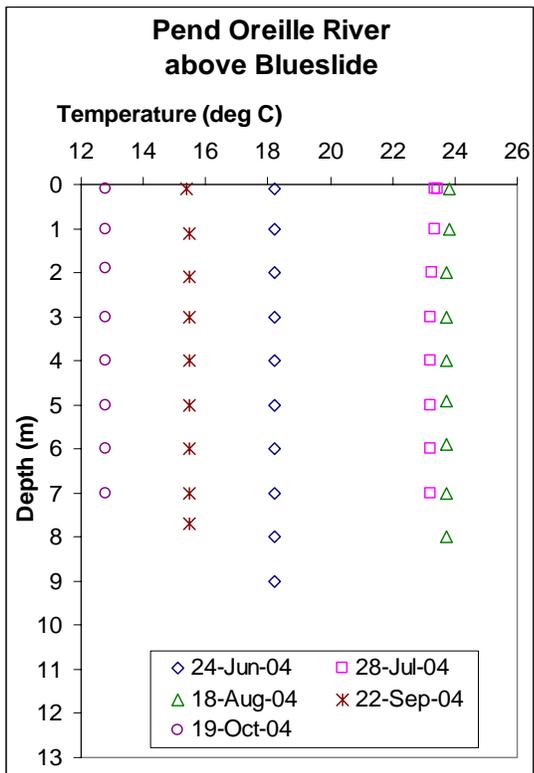
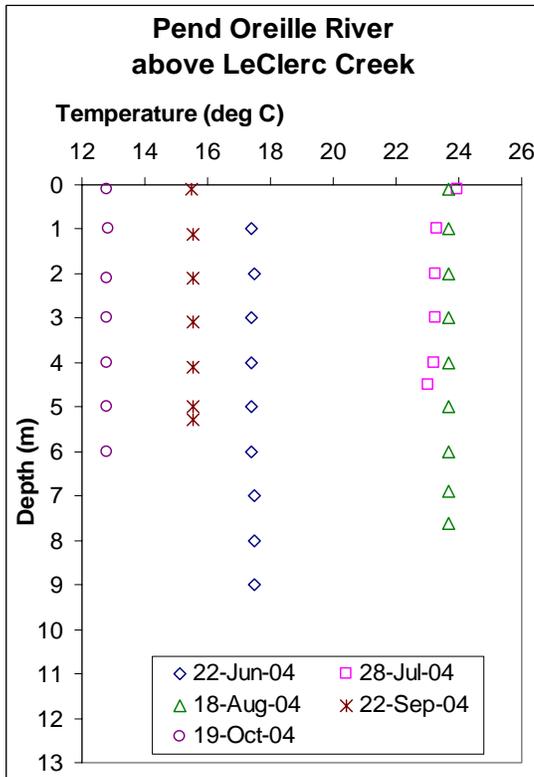
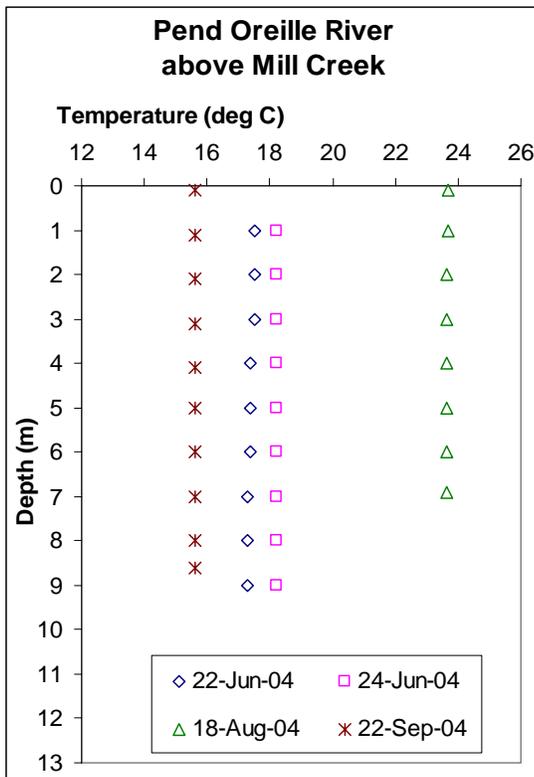


Figure 19. Pend Oreille River Temperature Profiles, continued.

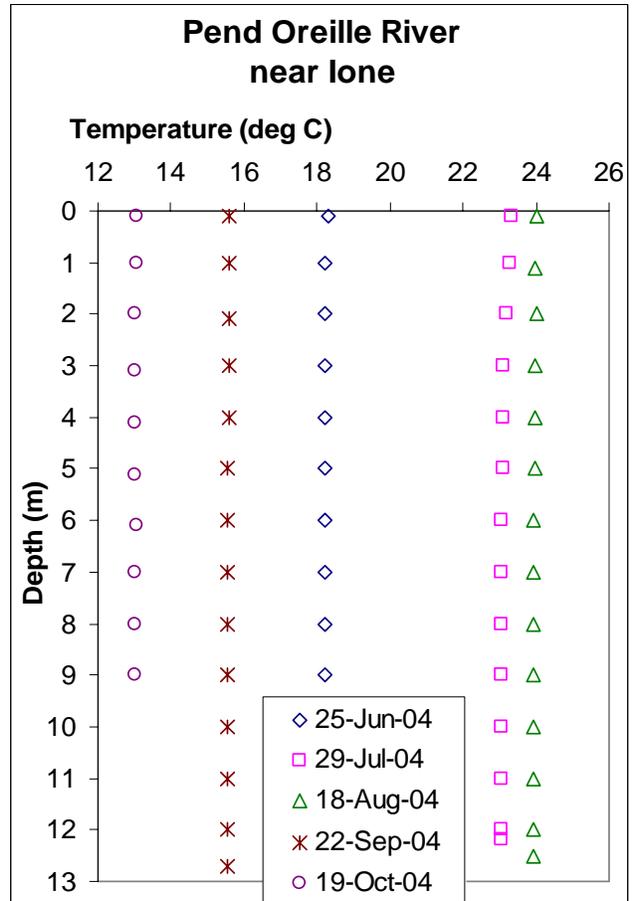
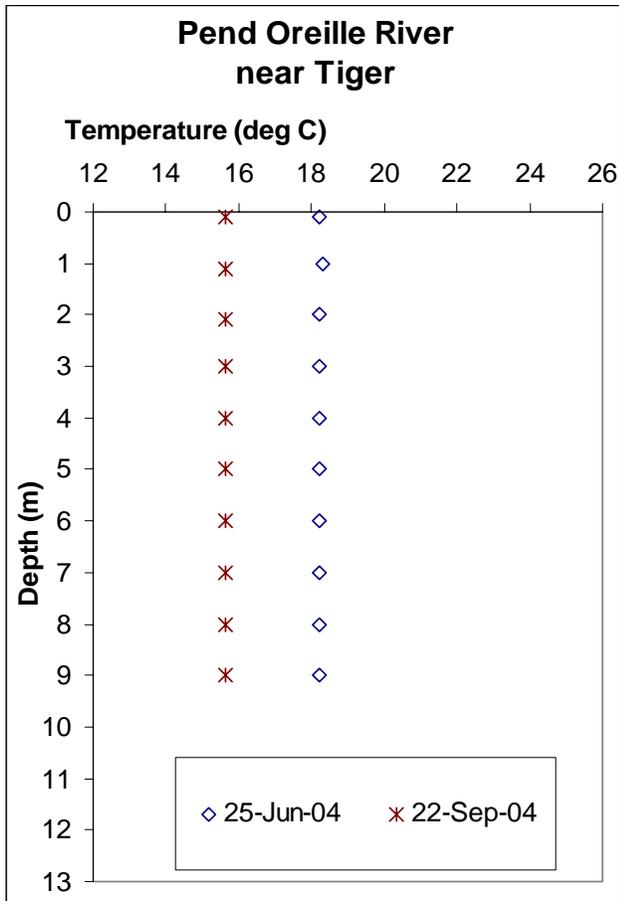


Figure 19. Pend Oreille River Temperature Profiles, continued.