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Upper Yakima River Basin Water Quality Monitoring for Aquatic Life: Temperature, Dissolved Oxygen, and pH – Data Summary

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COVER PHOTO: Yakima River at the lower end of Thorp Canyon below Hwy 10 in October 2019. Photo credit: Eiko Urmos-Berry.

Upper Yakima River Basin
Water Quality Monitoring for Aquatic Life: Temperature, Dissolved Oxygen, and pH

Data Summary

by

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Environmental Assessment Program
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Olympia, Washington

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Abstract

Washington State Department of Ecology (Ecology) monitored the Upper Yakima River basin and its major tributaries from late February 2019 through November 2019 for the *Upper Yakima River Basin Water Quality Monitoring for Aquatic Life Parameters Study* (*Aquatic Life*) (Carroll, 2019).

Monitoring took place at 50 locations, including two groundwater locations. Sampling for laboratory analysis occurred every two weeks. In addition to sampling, telemetered monitoring stations and other water quality data loggers continuously collected measurements from April-November, while other sensor installations captured short-term diel measurements from other locations throughout the basin.

Laboratory data were collected for alkalinity, total organic carbon, dissolved organic carbon, ammonia, nitrite, nitrate, orthophosphate, total phosphorus, and total persulfate nitrogen. Field data were collected for pH, conductivity, dissolved oxygen, water temperature, air temperature, dew point, nitrate, light attenuation in water, and water time of travel, channel geometry, longitudinal surface water quality, and groundwater quality information.

Under a congruent study, the *Upper Yakima River Basin Suspended Sediment and Turbidity Status Monitoring Study* (*Sediment and Turbidity*) (Carroll and Urmos-Berry, 2019), data were collected for total suspended solids, total non-volatile suspended solids, turbidity, and streamflow. Results from the data collected under this study will be published in a separate report.

This report summarizes laboratory and field water quality data collected for the Aquatic Life study and includes quality assurance analysis.

Introduction

Background

Historical measurements of water temperature and dissolved oxygen (DO) at a long-term ambient monitoring station on the Yakima River near Cle Elum (Location ID 39A090) indicate potential water quality impairments for aquatic life use. Monthly monitoring at this site has shown that the Yakima River can have high water temperature and low DO levels that do not protect fish and other aquatic life that depend on cool, oxygenated water. A previous water quality project on the tributaries to the Upper Yakima River showed that the water temperature in some tributaries also do not protect fish and aquatic life (Creech and Stuart, 2014).

In 2019, Ecology conducted a Sediment and Turbidity study (Carroll and Urmos-Berry, 2019) to evaluate the effectiveness of a sediment and turbidity Total Maximum Daily Load (TMDL) established in the Upper Yakima River (Joy, 2002; Creech and Joy, 2002). At the same time, Ecology collected additional water quality parameters under its Programmatic Quality Assurance Project Plan (QAPP) for Water Quality Impairment Studies (McCarthy and Mathieu, 2017) and the project-specific Aquatic Life QAPP (Carroll, 2019).. The goal of the Aquatic Life study was to collect a complete water quality data set to assess pH, DO, and temperature in the Upper Yakima River basin and to generate an adequate data set that could be used for a future water quality model of the Upper Yakima River.

Study Area

The study area is located within Water Resource Inventory Area (WRIA) 39, the Upper Yakima River basin. It consists of the mainstem Yakima River and the mouths of its major tributaries from river mile (RM) 121.7 (Harrison Bridge, near the town of Selah) upstream to Lake Easton (Figure 1).

The Yakima River basin is located in south-central Washington State. The Yakima River flows 214.5 miles from the dam outlet of Lake Keechelus, southeasterly to its confluence with the Columbia River. The upper portion of the Yakima River Basin drains 2,139 square miles of the eastern slope of the Cascade Mountains. Below Lake Keechelus, the main tributaries to the Upper Yakima River are the Kachess, Cle Elum, and Teanaway Rivers. There are also many smaller tributaries, including Taneum, Manastash, Wilson, Naneum, and Wenas Creeks.

Land uses in the Upper Yakima River basin vary from wilderness, forestland, livestock range, and intensively irrigated agriculture to urban and suburban areas (Joy, 2002). The Upper Yakima River basin is one of the most irrigated areas in Washington. The majority of irrigated acreage drains to the tributaries of Wilson Creek, Manastash Creek, and Sorenson Creek (Anderson, 2008).

A network of supply canals, diversions, and irrigation return drains are located all within the Upper Yakima River basin but are especially concentrated in the lower Kittitas Valley. Water from the Yakima River and streams flowing through the valley is directed through the irrigation network (Creech and Joy, 2002).

The United States Department of the Interior's Bureau of Reclamation (USBR) operates the Yakima Project, which controls stream discharge volumes in the Yakima River and some of its tributaries. The USBR delivers water to meet downstream demands, such as irrigation, power production, and instream flow for fish protection. To meet these demands, the USBR releases water from three storage reservoirs from April through November in the Upper Yakima River basin: Lake Keechelus, Lake Kachess, and Lake Cle Elum.

To meet irrigation demands late in the irrigation season, the USBR uses a management strategy descriptively termed "flip-flop." In practice, flip-flop, which was conceived and initiated in 1981, consists of releasing most of the water needed by irrigation users in the Lower Yakima River valley from the Upper Yakima River reservoirs until September. During this time, releases from the lower reservoirs in the Naches River basin are minimized. In early September, the release pattern reverses, when the majority of the flow is provided from the Naches basin, and the Upper Yakima basin releases are curtailed (YSFWPB, 2004).

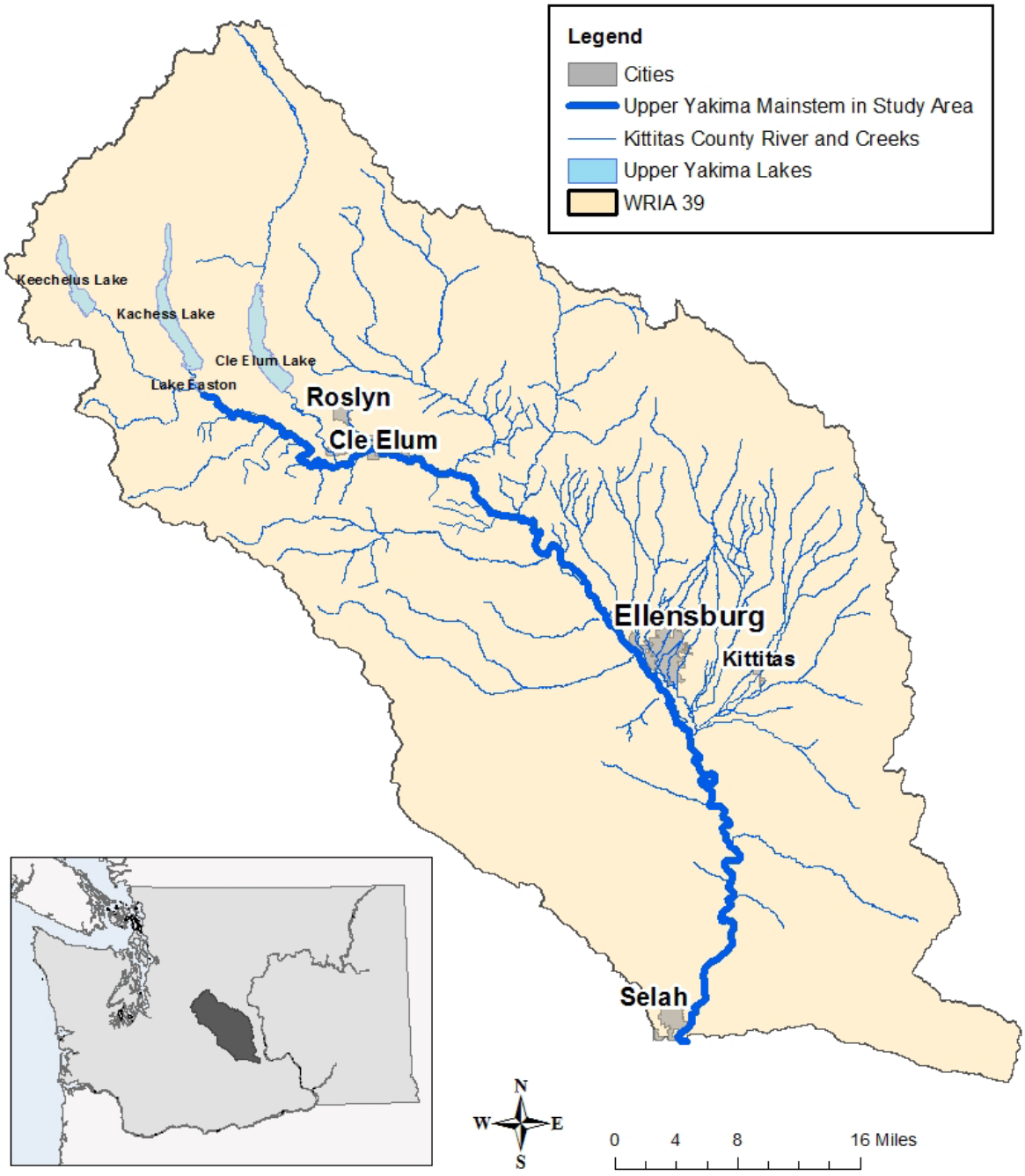

Figure 1. Study area for the Upper Yakima River Basin Water Quality Monitoring for Aquatic Life Parameters.

Project Description

Project Goals

The goal of this 2019 study was to collect a complete data set to assess water temperature, DO, pH levels, and associated conditions in the Upper Yakima River basin. Ecology collected these data in conjunction with another Ecology effectiveness monitoring study measuring total suspended solids (TSS) and turbidity from all major sources to the Yakima River (Carroll and Urmos-Berry, 2019).

Project Objectives

- Collect biweekly samples of nutrients, organic carbon, and alkalinity in the Upper Yakima River mainstem and priority tributaries.
- Monitor continuous (diel) temperature, DO, pH, and conductivity at stations in the Upper Yakima River, and its tributaries.
- Obtain streamflow data from USBR, USGS, Ecology, and other sources.
- Collect measurements of light attenuation in water, water time-of-travel, channel geometry, longitudinal surface water quality, and groundwater quality.
- Submit monitoring results into Ecology's Environmental Information Management (EIM) database, as appropriate.

Study Design and Methods

Ecology collected laboratory and field data in the Upper Yakima River basin from late February-November 2019. This data collection effort followed the Aquatic Life QAPP (Carroll, 2019) as well as Ecology's Programmatic QAPP - Water Quality Impairment Studies (McCarthy and Mathieu, 2017).

Ecology monitored 50 locations with 23 on the Yakima River mainstem, 25 on tributaries, and 2 from groundwater.

Figure 2 shows a map of the sampling locations. Table A1 in Appendix A lists the monitoring locations and the types of data that Ecology collected at each location.

Nutrients

Ecology collected water samples every 2 weeks (biweekly) at 37 locations. At stream sampling locations, Ecology collected grab samples in the thalweg in a well-mixed part of the channel. When a bridge was available, Ecology sampled from the bridge, using a weighted sampler to grab samples. At some of those bridge sites, grab samples were taken at 2-3 locations across the channel, composited in a churn splitter, and then poured into sample bottles. At the two publically owned treatment works (POTW) locations, the POTW collected 24-hour, flow-weighted composite samples from its effluent. Ecology filled sample bottles from each composited sample.

Manchester Environmental Laboratory (MEL) analyzed samples for parameters in Table 1, using the analytical methods listed. Ecology also collected DO samples, and field staff performed Winkler titrations to achieve sample results. The Winkler titration results are listed in Table B4 in Appendix B.

Table 1. Sample parameters and analytical methods

Parameter	Analytical Method
Alkalinity	SM2320B
Ammonia	SM4500NH3H
Dissolved Organic Carbon	SM5310B
Nitrate	EPA300.0
Nitrate + Nitrite	SM4500NO3I
Orthophosphate	SM4500P-G
Total Organic Carbon	SM5310B
Total Phosphorus	SM4500P-H
Total Persulfate Nitrogen	SM4500NB

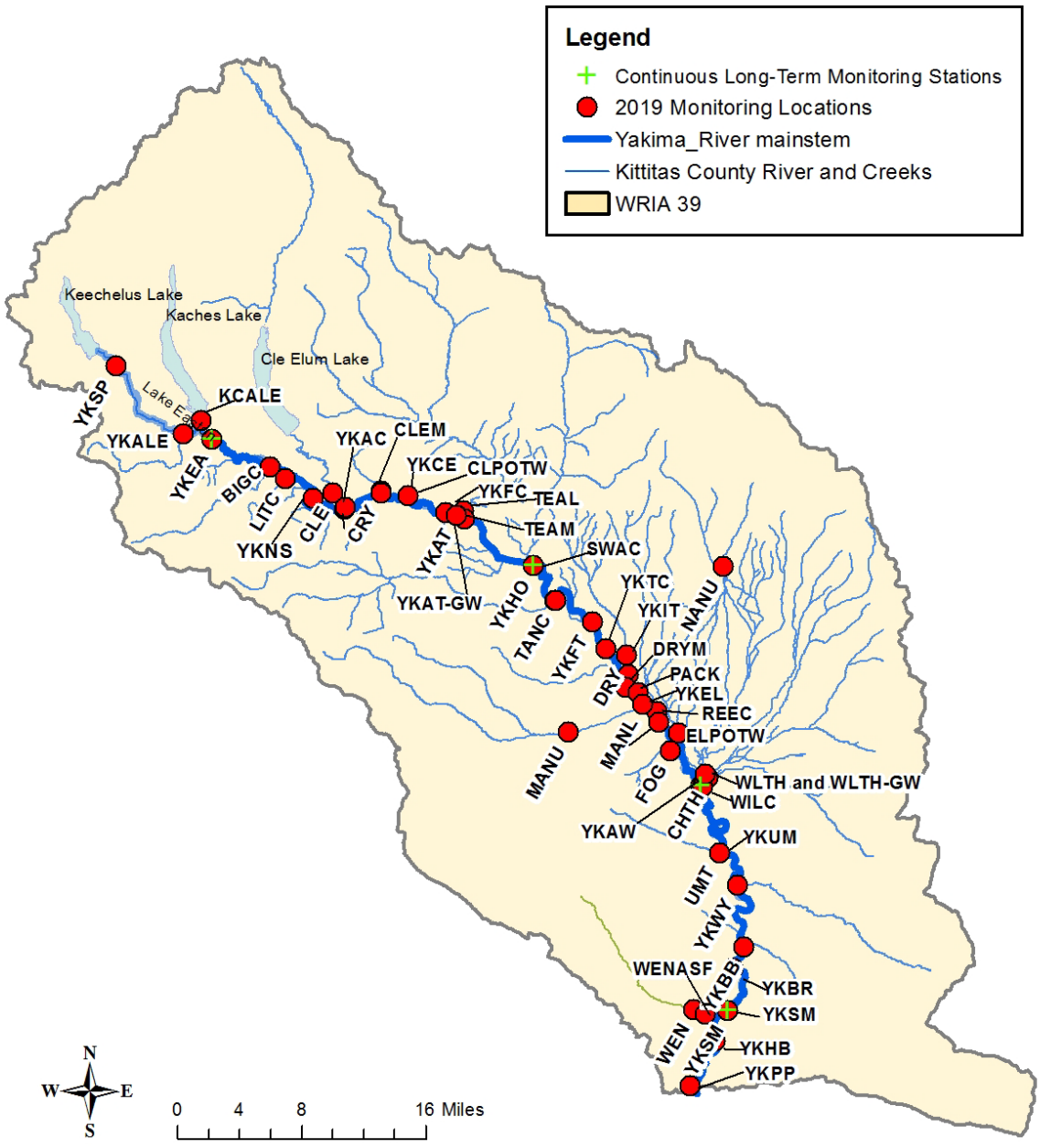

Figure 2. Map of 2019 monitoring locations for the Upper Yakima River basin Water Quality Monitoring for Aquatic Life Parameters.

Discrete Field Measurements

At 33 locations, Ecology measured pH, DO, and temperature using Hydrolab® multi-probe sondes during biweekly sampling surveys throughout the study period. These instruments were also used to perform quality control (QC) checks on other continuously deployed sondes and DO data loggers. In addition, DO samples were collected throughout each sampling day. The results from Winkler titration of those samples were used as additional QC measure for the sondes.

Continuous pH, Dissolved Oxygen, and Conductivity

At four locations, Ecology deployed Hydrolab® multi-probe sondes for continuous long-term monitoring from April through the first week of November in 2019 to record pH, DO, and conductivity. The sondes continuously logged measurements for these parameters every 15 minutes. Ecology also collected measurements every two weeks with another Hydrolab® sonde for QC checks.

At 12 other locations, Ecology deployed Hydrolab® and/or YSI® EXO multi-probe sondes for continuous short-term diel monitoring from June-October 2019 during the biweekly sampling survey to capture pH, dissolved, oxygen, and conductivity. Not all locations were monitored every sampling period. These instruments were deployed over one- to two-day intervals to capture diel patterns and logged measurements every 15 minutes. Instantaneous measurements collected during sampling surveys with another Hydrolab® sonde provided QC checks on the continuous data.

At six locations, Ecology deployed Onset® Hobo® Dissolved Oxygen data loggers from July-October 2019. The data loggers continuously logged DO measurements every 15 minutes. Ecology also collected Winkler DO samples and took DO measurements every two weeks with a Hydrolab® sonde for QC checks.

Continuous Water, Air, and Dew Point Temperature

Ecology deployed Onset® Hobo® temperature and Onset® Hobo® RH/Temp data loggers at 36 locations throughout the study area. Deployments include:

- Water: 36 locations and logged every 30 minutes.
- Air: 16 locations and logged every hour.
- Dew Point: 8 locations and logged every hour.

Groundwater

Ecology installed piezometers to monitor groundwater at two locations. Ecology collected samples, discrete sonde measurements, and water levels once a month from August-November 2019. Ecology also deployed water temperature data loggers in each piezometer, logging

measurements every 30 minutes. In conjunction with the groundwater monitoring, two additional surface water temperature data loggers were deployed and surface water sonde measurements were taken next to the piezometers.

Other

Ecology collected other types of data through special studies. The data from these special studies support the other data collected for this study. These studies are:

- Longitudinal water quality and depth profiling
- Time-of-Travel
- Light extinction

The data collected from these studies are not found in Ecology's Environmental Information Management (EIM) online database, since they do not fit the database's format. The data are available on request to Ecology.

Data Quality

Laboratory Samples

Ecology took replicate field samples for lab parameter analysis. Field replicates consisted of two samples collected from the same location and as close to the same time as possible. Ecology collected field replicates to evaluate sample precision, a measure of the variability in the results of replicate measurements due to random error. Random error is imparted by the variation in concentrations of samples from the environment as well as other introduced sources of variation (e.g., field and laboratory procedures). Manchester Environmental Lab (MEL) evaluated the analytical precision by analyzing lab duplicates. Lab duplicates consisted of two subsamples taken from the same sample container and analyzed separately.

Tables 2 and 3 present the evaluation of results for the field and lab sample precision. About 10% of lab samples and field samples were duplicated or replicated. The Programmatic QAPP (McCarthy and Mathieu, 2017) established the measurement quality objectives (MQOs) for the field and lab precision targets as referenced by the Aquatic Life QAPP (Carroll, 2019). Both the field and lab precision results met the MQO targets, except for the dissolved organic carbon field precision. Only one replicate pair for dissolved organic carbon exceeded ≥ 5 times the reporting limit, which resulted in a higher relative standard deviation (RSD) (Table 3) that exceeded the target.

MEL assessed analytical bias for samples by using lab control samples and matrix spikes. Lab control samples and matrix spikes results were within targets for all parameters (Table 2).

To check for sample contamination, Ecology submitted field blanks for analysis for each sampling run. In addition, MEL routinely ran lab blanks with each analytical batch. All blank results were below reporting limits (RLs), with the exception of one result (Table 4). One result for nitrate-nitrite had a value just above the reporting limit (Table 5).

MEL provided a case narrative for each set of sample batches. The case narratives provide information on sample condition at time of arrival to the lab and other lab quality assurance measures or issues. All samples were received within holding times and at proper temperatures without any other issues, with the exception of a few cases noted below. In addition, results were reported to the method detection limit (MDL). Results greater than the MDL, but below the RL, were qualified as estimates, indicated with a "J." A summary of the case narratives can be found in Table B3 in Appendix B.

Sample issues:

- 3/12/19-3/14/19: One TPN and one nitrate-nitrite were qualified as estimates due to matrix interference. Due to high concentrations, it was necessary for samples to be diluted and reanalyzed. The nitrate-nitrite sample was then analyzed by ion chromatography without any change in results.
- 4/23/19-4/25/19: One ammonia sample was reported as an estimate, because it may have been biased due to low matrix interference.
- 7/1/19-7/3/19: One OP sample was analyzed out of hold time due to laboratory error. The result was qualified as an estimate.
- 8/13/19-8/15/19: One OP sample was analyzed out of hold time due to laboratory error. The result was qualified as an estimate.
- 9/10/19-9/12/19: Six alkalinity samples and two dissolved alkalinity samples were analyzed out of hold time due to laboratory error. The results were qualified as estimates.
- 10/22/19/10/24/19: One OP sample contained ice upon receipt. The result was qualified as an estimate.
- 11/6/19-11/8/19: One OP sampled was received with ice in its container. The result was qualified as an estimate. 25 OP samples were received with insufficient hold time remaining or were received out of hold time and were analyzed out of hold time. The results were qualified as estimates. This was due to shipping issues. See Table B1 for comprehensive list of samples.

Table 2. Lab precision and bias results from 2019 samples.

Parameter	# of Samples	# of Duplicates	% Duplicated	Target Precision (% RPD)	RL	% RPD[1]		Lab Control Samples (% Recovery)			Matrix Spikes (% Recovery)		
						< 5X RL	≥ 5X RL	Target Range (%)	Actual Range (%)	Average (%)	Target Range (%)	Actual Range (%)	Average (%)
Alkalinity	504	41	8%	<20	5.000	1.58	0.57	80-120	84-110	93	--	--	
Ammonia	504	53	11%	<20	0.010	13.44	---	80-120	92-112	103	75-125	87-110	99
Dissolved Organic Carbon	504	58	12%	<20	1.000	2.33	0.43	80-120	91-104	99	75-125	84-109	100
Nitrate-Nitrite	459	51	11%	<20	0.010	15.80	1.10	80-120	97-106	100	75-125	89-103	98
Nitrate[2]	48	15	31%	<20	0.010	---	0.89	80-120	96-109	101	75-125	95-104	100
Orthophosphate	504	59	12%	<20	0.003	6.44	0.40	80-120	88-111	96	75-125	88-123	96
Total Organic Carbon	504	46	9%	<20	1.000	1.17	---	80-120	91-104	98	75-125	91-114	100
Total Phosphorus	504	51	10%	<20	0.005	3.82	2.03	80-120	96-109	101	75-125	93-111	101
Total Persulfate Nitrogen	504	53	11%	<20	0.025	6.82	2.84	80-120	93-113	101	75-125	83-115	99

[1] = Results at the detection limit were excluded from consideration.
[2] = Lab performed duplicates for Nitrate. Nitrate field replicates were not taken.
RPD = Relative Percent Difference
RL = Reporting Limit

Table 3. Total precision (field+lab) results from 2019 samples.

Parameter	# of Samples	# of Replicates	% Replicated	Target Precision % RSD	RL	Median % RSD[1]	
						< 5X RL	≥ e5X RL
Alkalinity	504	50	10	10	5.000	0.87	0.37
Ammonia	504	50	10	10	0.010	7.44	1.91
Dissolved Organic Carbon	504	50	10	10	1.000	3.77	12.06
Nitrate-Nitrite	459	45	10	10	0.010	6.63	0.80
Orthophosphate	504	50	10	10	0.003	3.29	0.71
Total Organic Carbon	504	50	10	10	1.000	2.45	0.54
Total Phosphorus	504	50	10	10	0.005	4.98	1.99
Total Persulfate Nitrogen	504	50	10	10	0.025	9.19	1.87

[1] = Nitrate field replicates were not taken. Field replicates were taken only for Nitrate-Nitrite that was analyzed by different method. Results at the detection limit were excluded from consideration.
RSD = Relative Standard Deviation
RL = Reporting Limit

Table 4. Field blank results from 2019 samples.

Parameter	# of Lab Blanks	# of Lab Blanks Results > RL	# of Field Blanks	# of Field Blanks Results > RL
Alkalinity	18	0	18	0
Ammonia	18	0	18	0
Dissolved Organic Carbon	18	0	18	0
Nitrate-Nitrite	18	0	18	1
Orthophosphate	18	0	18	0
Total Organic Carbon	18	0	18	0
Total Phosphorus	18	0	18	0
Total Persulfate Nitrogen	18	0	18	0

Nitrate field blanks were not taken.
RL = Reporting Limit

Table 5. Lab results for field blank results greater than the reporting limit from 2019 samples.

Parameter	Date	Time (local)	Sample ID	RL (mg/L)	Result (mg/L)
Nitrate-Nitrite	2/27/2019	13:52	1902034-34	0.010	0.012

RL = Reporting Limit

Multi-Probe Sondes

Ecology calibrated Hydrolab® MiniSonde and HL4, and YSI® EXO multi-probe sondes according to manufacturers' specifications using certified standards. In addition, the sondes were temperature checked, pre- and post-monitoring events, against a National Institute of Standards and Technology (NIST) certified thermometer to ensure that the factory temperature calibration was still acceptable. Multi-probe sondes were used to measure DO, pH, conductivity, and water temperature. Sondes were used for continuous long-term stations, short-term diel deployments, and instantaneous measurements taken during biweekly sampling runs.

Sondes were calibrated prior to each monitoring or deployment event, and the calibrations were post-checked after each event to assess calibration drift. Before removing a deployed sonde from a long-term station, Ecology compared the in-situ readings to a recently calibrated field check sonde as a quality control (QC) check. At continuous long-term stations, a newly calibrated sonde was installed every two weeks in order to prevent any issues with biofouling. For continuous short-term monitoring, Ecology used a recently calibrated sonde to field check the sonde before removal.

Ecology assessed the calibration post-checks according to the measurement quality objectives (MQOs) in Table 6 and applied the appropriate qualifiers. For continuous long-term and short-term deployed sondes, Ecology used field check measurements, calibration post-checks, and DO Winkler titration results to evaluate continuous instrument data. If indicated by the weight of evidence of these evaluations, Ecology applied a bias adjustment to the raw instrument data for pH, DO, and conductivity.

Table D1 in Appendix D and Table E1 in Appendix E lists instruments information, deployment dates, and any applied qualifiers for continuous data collected with multi-parameter sondes. Instrument adjusted data are flagged "IA" and qualified data are flagged "EST" in the EIM database.

Table 6. Multi-probe sonde MQOs.

Parameter	Accept	Qualify	Reject
pH	≤ ± 0.2 s.u.	> ± 0.2 and ≤ ± 0.8 s.u.	> ± 0.8 s.u.
Dissolved Oxygen	≤ ± 0.5 mg/L	> ± 0.5 and ≤ ± 1.0 mg/L	> ± 1.0 mg/L
Specific Conductance	≤ ± 10%	> ± 10% and ≤ ± 20%	> ± 20%
Water Temperature	≤ ± 0.2°C	> ± 0.2 and ≤ ± 0.8°C	> ± 0.8°C

Criteria expressed as a percentage of readings; for example, buffer = 100.2 uS/cm and sonde = 98.7 uS/cm; (100.2-98.7)/100.2 = 1.49% variation, which would fall into the acceptable data criteria of less than 5%.

Dissolved Oxygen Data Loggers

Onset® Hobo Dissolved Oxygen data loggers were deployed at several locations. The data loggers were pre- and post-checked using air saturated water (bubbler) readings and DO Winkler titration results from both room-temp and cool water baths. While deployed, check

measurements were made using recently calibrated field check sondes, and DO samples were collected. After deployment, Ecology assessed the post-check calibration data, field check measurements, and DO Winkler titration results to evaluate the DO continuous record. If indicated by weight of evidence of these evaluations, Ecology applied a bias adjustment to the raw instrument data. Adjusted data are flagged "IA" in EIM. Selected intervals of data were rejected due to biofouling or sensor error.

Tables F1 and F2 in Appendix F list the instrument information, deployment dates, qualifiers, and any gaps in data due to sensor fouling or logger error codes.

Temperature

Onset® Hobo Temperature data loggers were deployed in many locations throughout the study area to record water and air temperatures. The data loggers were pre- and post-checked in ice and room temperature water baths against a NIST certified thermometer. Those data loggers that did not pass the temperature pre-checks were not used. If any did not pass the post-checks, they would have been rejected. All the data loggers passed the post-checks, so temperature data was not rejected.

Air temperature results were checked for reasonable match to air temperatures at the local airport in Ellensburg or Yakima.

Continuous water temperature records were compared to air temperatures records to identify any periods when the data logger might have been de-watered. At locations where water samples were also collected, a Hydrolab® HL4 multi-probe sonde was used as a field check instrument to measure temperature. If a temperature data logger was also deployed at the sampling location, the continuous temperature records were checked against the sonde measurements. De-watered results were rejected.

Table G1 in Appendix G lists the locations, instrument information, deployment dates. Rejected results with dates and times are found in Table G2.

Onset® RH/Temp data loggers used to collect air and dew point temperatures were deployed throughout the study area. Before deployment, the data loggers were pre-checked for air temperature both at room temperature and at a lower temperature (refrigerator) to determine if the loggers were properly functioning and were used for monitoring. After deployment, the data loggers were post-checked for air temperature by placing them in an open jar in an insulated cooler at room temperature over several days and later into a refrigerator overnight. Temperature data loggers that had recently passed water temperature bath checks were also placed alongside the RH/Temp data loggers as check data loggers.

Table 7 shows the bias and root mean square error (RMSE) were calculated for comparison of the dew point temperature to the other temperature check data loggers.

Table 7. Bias/RMSE of the temperature data comparison between RH/Temp data loggers and temperature check data loggers.

Study Location ID	Serial No	Room Temp Bias (°C)	Refrigerator Bias (°C)	Room Temp RMSE (°C)	Refrigerator RMSE (°C)
YKAT	462003	0.5	0.3	0.6	0.4
DRYM	462004	-0.9	-0.6	0.9	0.6
TANC	462012	-0.3	-0.1	0.3	0.2
YKCE	538477	-0.1	-0.2	0.1	0.2
YKAW	1002563	0.0	0.0	0.1	0.1
YKSM	1002564	0.10	0.13	0.13	0.17
YKEA	1002566	0.27	0.19	0.28	0.22
YKHO	538479	Data not available			

RMSE = root mean square error RH = relative humidity

Groundwater

Ecology sampled two groundwater locations four times from August to November 2019. Following the same quality control procedures for sample precisions determination used for surface water, the precision targets (%RSD) were adequately met (Table 8). Orthophosphate results at lower levels did slightly exceed the target, but low-level sample results can have a higher relative variability than higher sample results. Only one replicate pair for orthophosphate was <5 times the reporting limit, which resulted in a higher RSD (Table 8) that exceeded the target. Ecology submitted only one set of groundwater field blank samples, and there was one detection (Tables 9 and 10). This detection might have been the result of inadequate ambient rinsing of the inline filters before collecting the blank sample, so the residual leachate on the filters had not cleared. This residual leachate might have introduced the contamination.

Table 8. Groundwater total precision (field + lab) results from 2019.

Parameter	Target Precision % RSD	RL	Median % RSD[1]	
			Samples < 5X RL	Samples ≥ 5X RL
Alkalinity	10	5.000	---	0.26
Ammonia	10	0.010	0.00	---
Dissolved Organic Carbon	10	1.000	2.80	
Nitrate-Nitrite	10	0.010	---	0.48
Orthophosphate	10	0.003	17.37	0.63
Total Phosphorus	10	0.005	2.22	---
Total Persulfate Nitrogen	10	0.025	---	2.24

[1] = Results at the detection limit were excluded from consideration.
RSD = Relative Standard Deviation
RL = Reporting Limit

Table 9. Groundwater field blank results from 2019.

Parameter	# of Field Blanks	# of Field Blank Results > RL
Alkalinity	1	0
Ammonia	1	0
Dissolved Organic Carbon	1	0
Nitrate-Nitrite	1	1
Orthophosphate	1	0
Total Phosphorus	1	0
Total Persulfate Nitrogen	1	0

RL = Reporting Limit

Table 10. Lab results for groundwater field blank results greater than the reporting limit from 2019 groundwater samples.

Parameter	Date	Time (local)	Sample ID	RL (mg/L)	Result (mg/L)
Nitrate-Nitrite	11/4/2019	12:30	1911015-45	0.010	0.150

RL = Reporting Limit

Results

Data collected during the *Upper Yakima River Basin Aquatic Life Parameters Monitoring Study* are presented in the following appendices:

- Appendix A lists monitoring locations, descriptions, and parameters collected or measured at each location.
- Appendix B lists the sample collection details, surface water laboratory results analyzed by MEL, summary of laboratory case summaries, and Winkler titration results for dissolved oxygen (DO).
- Appendix C lists discrete surface water multi-parameter sonde measurements.
- Appendix D lists continuous long-term monitoring locations with instrument information, deployment dates, and data qualifiers. It also contains charts showing the results for pH, DO, and conductivity at each location.
- Appendix E lists continuous short-term monitoring locations with instrument information, deployment dates, and data qualifiers. It also contains charts showing the results for pH, DO, and conductivity at each location
- Appendix F lists continuous DO monitoring locations with instrument information and deployment dates. It also lists any gaps in the data due to sensor fouling or logger error codes. There are charts showing the results at each location.
- Appendix G lists continuous temperature monitoring locations with instrument information and deployment dates. It also contains charts showing the results at each location.
- Appendix H lists groundwater laboratory results analyzed by MEL. It also contains discrete multi-parameter sonde measurements and continuous temperature results from two groundwater locations and two surface water locations.

All data in Appendices are available from Ecology's EIM database located at: https://apps.ecology.wa.gov/eim/search/default.aspx.

Results may be accessed by searching EIM using the User Study ID (jica0005), the Study Name (*Upper Yakima River Basin Water Quality Monitoring for Aquatic Life Parameters*), or the EIM ID for any of the locations listed in Appendix A.

Some data for this study are not available in EIM. These data types either represent non-standard parameters or are spatially oriented data types that are not compatible with the EIM database format. The data are not presented in this report but are available on request to Ecology. These are:

- Longitudinal profile data of water depth, conductivity, and nitrate levels.
- Time-of-travel study data.
- Light Extinction data.

In addition, Ecology measured other water quality parameters in 2019 under the *Upper Yakima River Basin Suspended Sediment and Turbidity Status Monitoring QAPP* (Carroll and Urmos-Berry, 2019). Ecology collected suspended sediment and turbidity samples and continuous turbidity measurements. Ecology also collected discrete flow measurements and stage data at many of the same locations mentioned in this report. Specific information for the methods, data quality assurance, and results are found in the *Upper Yakima River Basin Suspended Sediment and Organochlorine Pesticides TMDL – 2019 Status Monitoring for TSS and Turbidity TMDL Targets* (Newell et al., 2021). These additional water quality data can be found in EIM, under study ID jica0004. Flow measurements data are available on request from Ecology.

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Glossary, Acronyms, and Abbreviations

Glossary

Basin (Watershed): A drainage area 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.

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.

Diel: Of, or pertaining to, a 24-hour period.

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

Effluent: An outflowing of water from a natural body of water or from a man-made structure. For example, the treated outflow from a wastewater treatment plant.

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 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.

Surface waters of the state: Lakes, rivers, ponds, streams, inland waters, salt waters, wetlands and all other surface waters and water courses within the jurisdiction of Washington State.

Total Maximum Daily Load (TMDL): Water cleanup plan. A distribution of a substance in a waterbody designed to protect it from not meeting 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.

Acronyms and Abbreviations

Ecology	Washington State Department of Ecology
EIM	Environmental Information Management database
EPA	U.S. Environmental Protection Agency
MEL	Manchester Environmental Laboratory
NIST	National Institute of Standards and Technology
RPD	relative percent difference
RSD	relative standard deviation
SOP	standard operating procedures
TMDL	Total Maximum Daily Load (see glossary)
TSS	total suspended solids
WRIA	Water Resource Inventory Area

Units of Measurement

°C	degrees centigrade
cfs	cubic feet per second
ft	feet
mg/L	milligrams per liter (parts per million)
s.u.	standard units
µmhos/cm	micromhos per centimeter
µS/cm	microsiemens per centimeter, a unit of conductivity

Appendices

Appendix A. Monitoring Locations

Table A1. Monitoring locations with list of measurements and parameters collected at each location.

Study Location ID	Monitoring Site Name	EIM Location ID	Latitude	Longitude	WQ Samples	Sonde (discrete)	Sonde (cont)	Short-Term Sonde	Water Temp Data logger	Air Temp Data logger	RH/Dew Point Data logger	DO Data logger	Light Meter	Piezometer
YKSP	Yakima River at Stampede Pass Rd	YAK-CRYS	47.30827	-121.31470					X					
YKALE	Yakima River above Lake Easton	YKALE	47.24518	-121.22084					X					
KCALE	Kachess River above Lake Easton	KCALE	47.25843	-121.19724					X					
YKEA	Yakima River below Lake Easton	YKEA	47.24034	-121.18170	X	X	X		X	X	X			
BIGC	Big Creek	BIGC	47.21500	-121.10214	X	X			X					
LITC	Little Creek	LITC	47.20469	-121.08040	X	X								
YKNS	Yakima River @ Nelson Siding	39A090	47.18596	-121.04288	X	X		X	X	X		X		
YKAC	Yakima River above Cle Elum River confluence	YKAC	47.17610	-120.99931	X	X			X					
CLE	Cle Elum River @ Bullfrog Rd bridge	39B090	47.19111	-121.01556	X	X		X	X			X		
CLEM	Cle Elum River near mouth	CLEM	47.17783	-120.99851					X					
CRY	Crystal Creek	08-CRY	47.19305	-120.94887	X	X								
YKCE	Veolia WTP site	39A080	47.19181	-120.94889	X	X			X	X	X	X		
CLPOTW	Cle Elum POTW	FSID 8169652	47.18889	-120.91259	X	X								
YKFC	Yakima River at public fishing area below Cle Elum	YKFC	47.17361	-120.86043					X	X				
TEAL	Teanaway River @ Lambert Road	39D075	47.17490	-120.83610	X	X		X						
YKAT	Yakima River above Teanaway	YKAT	47.17087	-120.84482	X	X			X	X	X			
TEANM	Teanaway River near mouth	TEANM	47.16785	-120.83450					X	X				
YKHO	Yakima River @ Horlick	YKHO	47.12390	-120.73940	X	X	X		X	X	X		X	
SWAC	Swauk Creek at mouth	39SWA00.1	47.12401	120.73807	X	X		X	X					

Study Location ID	Monitoring Site Name	EIM Location ID	Latitude	Longitude	WQ Samples	Sonde (discrete)	Sonde (cont)	Short-Term Sonde	Water Temp Data logger	Air Temp Data logger	RH/Dew Point Data logger	DO Data logger	Light Meter	Piezometer
YKTC	Yakima River above Taneum Creek	YKTC	47.09169	-120.71083					X					
TANC	Taneum Creek at mouth	11-TAN	47.09189	-120.70926	X	X		X	X	X	X			
YKFT	Yakima River at public fishing area near Thorp	YKFT	47.07150	-120.65900					X	X				
YKIT	Yakima River above I-90 near Thorp	YKIT	47.04650	-120.64013					X					
DRY	Dry Creek @ Hwy 10	14-DRY	47.04078	-120.61147	X	X								
DRYM	Dry Creek at Mouth	DRYM	47.02198	-120.60918	X	X		X	X		X			
PACK	Packwood Canal	YAK-49	47.01057	-120.61298	X	X		X	X					
YKEL	Yakima River near Ellensburg	03-YKKO	47.00523	-120.59616	X	X		X	X	X		X		
REEC	Reecer Creek in Irene Rinehart Park	15-REE	46.98810	-120.57070	X	X		X	X					
MANU	Manastash Creek @ Manastash Road	01-MAN	46.96810	-120.69128	X	X								
MANL	Manastash Creek @ Brown Rd	YAK-46	46.99438	-120.59043	X	X		X	X					
YKUB	Yakima River at Umptanum Rd bridge	04-YKIR	46.97777	-120.56759	X[2]	X			X					
FOG	Sorenson/Fogarty @ Riverbottom Road	16-FOG	46.95113	-120.55184	X	X		X						
ELPOTW	Ellensburg POTW	FSID 12235	46.96809	-120.54022	X	X			X					
YKAW	Yakima River above Wilson Creek	YKAW	46.91855	-120.51005	X	X	X		X		X		X	
NANU	Naneum Creek @ Naneum Road	26-NN	47.12354	-120.47989	X	X								
WLTH	Wilson Creek @ Thrall Road	YAK-48	46.92631	-120.50168	X	X								
CHTH	Cherry Creek @ Thrall Road	39CHE00.2	46.92560	-120.50040	X	X								
WILC	Wilson Creek @ Hwy 821	17-WIL	46.91716	-120.50810	X	X		X	X			X		
UMT	Umtanum Creek	39UMT00.2	46.85574	-120.48502	X	X			X					
YKUM	Yakima River @ Umtanum Creek Bridge	05-YKUM	46.85568	-120.48417	X	X			X		X	X		

Study Location ID	Monitoring Site Name	EIM Location ID	Latitude	Longitude	WQ Samples	Sonde (discrete)	Sonde (cont)	Short-Term Sonde	Water Temp Data logger	Air Temp Data logger	RH/Dew Point Data logger	DO Data logger	Light Meter	Piezometer
YKWY	Yakima River near Wymer	YKWY	46.82560	-120.46040					X					
YKBB	Yakima River below Burbank Creek	YKBB	46.76760	-120.45130					X	X				
YKBR	Yakima River below Roza Reservoir Dam	YKBR	46.74707	-120.46668					X					
YKSM	Yakima River at Selah Moxee diversion	YKSM	46.70810	-120.47422	X	X	X		X	X	X		X	
WEN	Wenas Creek above mouth	WENAS-1	46.70848	-120.52027	X	X								
WENASF	Wenas Creek near WDFW fish array	WENASF	46.70467	-120.50381					X					
YKHB	Yakima River @ Harrison Bridge	39A050	46.67958	-120.49117	X	X			X	X				
YKPP	Yakima River near Playland Park (Selah Road)	YAK-PLAY	46.63781	-120.52475					X	X				
YKAT-GW	Yakima River above Teanaway-GW	YKAT-GW	47.17055	-120.84606	X	X			X					X
WLTH-GW	Wilson Creek @ Thrall Road-GW	WLTH-GW	46.92945	-120.50420	X	X			X					X

EIM = Environmental Information Management System
WQ = water quality
Sonde = Hydrolab or YSI EXO
Cont = continuous
Temp = temperature
RH = relative humidity
DO = dissolved oxygen
ORP = oxidation reduction potential

WQ samples = Sample collection for analysis of alkalinity, ammonia, dissolved organic carbon, nitrate/nitrite, orthophosphate, total organic carbon, total persulfate nitrogen, total phosphorus, and DO.
Sonde (discrete, continuous, and short-term) = Measurements collected for pH, DO, conductivity.
Stand-alone data loggers = Collected temperatures for air, water, and dew point and for DO.
Piezometers = Piezometer = Measurements collected for pH, DO, conductivity, temperature, ORP, and vertical hydraulic gradient; Samples collected for analysis of alkalinity, ammonia, nitrate/nitrite, orthophosphate, total persulfate nitrogen, and total phosphorus

Note: Water samples were collected every two weeks. Turbidity, total suspended solids, total non-volatile suspended solids, flow measurements, and continuous turbidity measurements were also collected under the *Upper Yakima River Basin Suspended Sediment and Turbidity Status Monitoring QAPP* (Carroll and Urmos-Berry, 2019). Results are in EIM under Study ID jica0004 and in the *Upper Yakima River Basin Suspended Sediment and Turbidity Status Monitoring Report.*

Appendix B. Laboratory Samples and Results – Surface Water

Table B1. Sample collection details for Upper Yakima River Basin Water Quality Monitoring for Aquatic Life.

Study Location ID	EIM Location ID	Feb 25-27	Mar 11-13	Mar 25-27	Apr 8-10	Apr 22-24	May 6-8	May 20-22	Jun 3-5	Jun 17-19	Jun 30-Jul 2	Jul 15-17	Jul 29-31	Aug 12-14	Aug 26-28	Sep 9-11	Sep 23-25	Oct 7-9	Oct 21-23	Nov 4-6
YKEA	YKEA	LB	LB	LB	LB	LB	LB	LB	LB	LB	LB	LB	LB	LB	LB	LB	LB	LB	LB	LB
YKNS	39A090	2Xc	2Xc	2Xc	2Xc	2Xc	2Xc	2Xc	2Xc	2Xc	2Xc	2Xc	2Xc	2Xc	2Xc	2Xc	2Xc	2Xc	2Xc	2Xc
YKCE	39A080	1Xc	1Xc	1Xc	1Xc	1Xc	1Xc	1Xc	1Xc	1Xc	1Xc	1Xc	1Xc	1Xc	1Xc	1Xc	1Xc	1Xc	1Xc	1Xc
YKAT	YKAT	NS	NS	NS	LB	LB	LB	LB	LB	LB	LB	LB	LB	LB	LB	LB	LB	LB	LB	LB
YKHO	YKHO	LB	LB	LB	LB	LB	LB	LB	LB	LB	LB	LB	LB	LB	LB	LB	LB	LB	LB	LB
YKEL	03-YKKO	LB	LB	2Xc	2Xc	2Xc	2Xc	2Xc	2Xc	2Xc	2Xc	2Xc	2Xc	2Xc	2Xc	2Xc	2Xc	2Xc	2Xc	2Xc
YKUB	04-YKIR	LB sonde only	LB sonde only	LB sonde only	LB sonde only	LB sonde only	LB sonde only	LB sonde only	LB sonde only	LB sonde only	LB sonde only	LB sonde only	LB sonde only	LB sonde only	LB sonde only	LB sonde only	LB sonde only	LB sonde only	LB sonde only	LB sonde only
YKAW	YKAW	LB	LB	LB	LB	LB	LB	LB	LB	LB	LB	LB	LB	LB	LB	LB	LB	LB	LB	LB
YKUM	05-YKUM	3Xc	3Xc	3Xc	3Xc	3Xc	3Xc	3Xc	3Xc	3Xc	3Xc	3Xc	3Xc	3Xc	3Xc	3Xc	3Xc	3Xc	3Xc	3Xc
YKSM	YKSM	NS	LB	LB	LB	LB	LB	LB	LB	LB	LB	LB	LB	LB	LB	LB	LB	LB	LB	LB
YKHB	39A050	2Xc	2Xc	2Xc	2Xc	2Xc	2Xc	2Xc	2Xc	2Xc	2Xc	2Xc	2Xc	2Xc	2Xc	2Xc	2Xc	2Xc	2Xc	2Xc
CLPOTW	FSID 8169652	NS	NS	NS	NS	NS	NS	NS	NS	24c	NS	24c	24c	24c	24c	24c	24c	24c	24c	NS
ELPOTW	FSID 12235	NS	NS	NS	NS	NS	NS	NS	NS	24c	NS	24c	24c	24c	24c	24c	24c	24c	24c	NS
NANU	26-NN	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	1Xc	1Xc	1Xc	1Xc	1Xc	1Xc	1Xc	1Xc
MANU	01-MAN	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	1Xc	1Xc	1Xc	1Xc	1Xc	1Xc	1Xc
BIGC	BIGC	RB	RB	RB	RB	RB	RB	RB	RB	RB	RB	RB	RB	RB	RB	RB	RB	RB	RB	RB
LITC	LITC	1Xc	ICE	1Xc	1Xc	1Xc	1Xc	1Xc	1Xc	1Xc	1Xc	1Xc	1Xc	1Xc	1Xc	1Xc	1Xc	1Xc	1Xc	1Xc
CLE	39B090	2Xc	2Xc	2Xc	2Xc	LB	LB	LB	LB	LB	LB	LB	LB	LB	LB	LB	LB	LB	LB	LB
CRY	08-CRY	LB	LB	LB	LB	LB	LB	LB	LB	LB	LB	LB	DRY	DRY	DRY	DRY	DRY	LB	LB	DRY
TEAL	39D075	2Xc	2Xc	2Xc	2Xc	1Xc	1Xc	1Xc	1Xc	1Xc	1Xc	1Xc	1Xc	1Xc	1Xc	1Xc	1Xc	1Xc	1Xc	1Xc

Study Location ID	EIM Location ID	Feb 25-27	Mar 11-13	Mar 25-27	Apr 8-10	Apr 22-24	May 6-8	May 20-22	Jun 3-5	Jun 17-19	Jun 30-Jul 2	Jul 15-17	Jul 29-31	Aug 12-14	Aug 26-28	Sep 9-11	Sep 23-25	Oct 7-9	Oct 21-23	Nov 4-6
SWAC	39SWA00.1	RB	RB	RB	RB	RB	RB	RB	RB	RB	1Xc	RB	LB	RB	1Xc	RB	1Xc	1Xc	LB	RB
TANC	11-TAN	RB	RB	RB	RB	RB	RB	RB	RB	RB	RB	RB	RB	RB	RB	RB	RB	RB	RB	RB
DRY	14-DRY	1Xc	1Xc	1Xc	1Xc	1Xc														
DRYM	DRYM						LB	LB	LB	LB	LB	LB	LB	LB	LB	LB	LB	LB	LB	LB
PACK	YAK-49	NS	NS	1Xc	1Xc	1Xc	1Xc	1Xc	1Xc	1Xc	1Xc	1Xc	1Xc	1Xc	1Xc	1Xc	1Xc	1Xc	1Xc	1Xc
MANL	YAK-46	NS	NS	1Xc	1Xc	1Xc	1Xc	1Xc	1Xc	1Xc	1Xc	1Xc	1Xc	1Xc	1Xc	1Xc	1Xc	1Xc	1Xc	1Xc
REEC	15-REE	1Xc	1Xc	1Xc	1Xc	1Xc	1Xc	1Xc	1Xc	1Xc	1Xc	1Xc	1Xc	1Xc	1Xc	1Xc	1Xc	1Xc	1Xc	1Xc
FOG	16-FOG	NS	NS	LB	LB	LB	LB	LB	LB	LB	LB	LB	LB	LB	LB	LB	LB	LB	LB	LB
WLTH	YAK-48	1Xc	1Xc	1Xc	1Xc	1Xc	1Xc	1Xc	1Xc	1Xc	1Xc	1Xc	1Xc	1Xc	1Xc	1Xc	1Xc	1Xc	1Xc	1Xc
CHTH	39CHE00.2	1Xc	1Xc	1Xc	1Xc	1Xc	1Xc	1Xc	1Xc	1Xc	1Xc	1Xc	1Xc	1Xc	1Xc	1Xc	1Xc	1Xc	1Xc	1Xc
WILC	17-WIL	LB	LB	LB	LB	LB	LB	LB	LB	LB	LB	LB	LB	LB	LB	LB	LB	LB	LB	LB
UMT	39UMT00.2	1Xc	1Xc	1Xc	1Xc	1Xc	1Xc	1Xc	1Xc	1Xc	1Xc	1Xc	1Xc	1Xc	1Xc	1Xc	1Xc	1Xc	1Xc	1Xc
WEN	WENAS-1	LB	LB	LB	LB	LB	LB	LB	LB	LB	LB	LB	LB	LB	DRY	DRY	LB	LB	LB	NS

For YKUM, only sonde measurement were taken. No samples.
1Xc = 1-point sample centered on the thalweg
2Xc = 2-point grab sample composite
3Xc = 3-point grab sample composite
24c = grab from a 24-hour composite
NS = not sampled or not sampled for Aquatic Life Parameters

ICE = not sampled (frozen)
DRY = not sampled (dry or not enough water to sample)
RB = right bank sample
LB = left bank sample
[blank] = site not visited during survey

Table B2. Laboratory results for surface water samples collected in 2019 for Upper Yakima River Basin Water Quality Monitoring for Aquatic Life.

Study Location ID	Date	Time (local)	Sample ID	Rep Y/N	Comp Y/N	Alk (mg/L)	NH3 (mg/L)	DOC (mg/L)	NO3/ NO2 (mg/L)	NO3 (mg/L)	OP (mg/L)	TOC (mg/L)	TPN (mg/L)	TP (mg/L)
BIGC	2/25/2019	13:55	1902034-03	N	N	42.6	0.01 U	0.4 J	0.01U		0.0033	0.421 J	0.033	0.01 U
BIGC	3/11/2019	12:00	1903029-03	N	N	44.3	0.01 U	0.35 J	0.01U		0.0057	0.428 J	0.025 U	0.01 U
BIGC	3/25/2019	13:30	1903030-03	N	N	37.6	0.01 U	1.30	0.01 U		0.0046	1.21	0.023 J	0.0095 J
BIGC	4/8/2019	12:50	1904024-03	N	N	34.1	0.01 U	1.17	0.01 U		0.0053	1.16	0.018 J	0.0071 J
BIGC	4/22/2019	12:45	1904025-03	N	N	31.3	0.01 U	1.00	0.003 J		0.0057	1.27	0.022 J	0.0091 J
BIGC	5/6/2019	11:45	1905021-03	N	N	32.0	0.01 U	0.81	0.01U		0.0051	0.858	0.025 U	0.0072 J
BIGC	5/20/2019	10:30	1905022-03	N	N	30.3	0.01 U	0.77	0.01U		0.0054	0.628	0.023 J	0.0085 J
BIGC	6/3/2019	12:10	1906021-03	N	N	34.4	0.01 U	0.47 J	0.01U		0.0048	0.562	0.025 U	0.01 U
BIGC	6/17/2019	12:50	1906022-03	N	N	39.4	0.01 U	0.45 J	0.01U		0.0050	0.38 J	0.032	0.0076 J
BIGC	7/1/2019	14:00	1907027-03	N	N	41.9	0.01 U	0.4 J	0.004 J		0.0047	0.654	0.019 J	0.0093 J
BIGC	7/15/2019	12:45	1907028-03	N	N	41.8	0.01 U	0.60	0.01U		0.0053	0.629	0.035	0.0069 J
BIGC	7/29/2019	13:15	1907029-03	N	N	43.9	0.01 U	0.4 J	0.006 J		0.0046	0.445 J	0.029	0.007 J
BIGC	8/12/2019	13:10	1908026-03	N	N	36.3	0.01 U	0.58	0.003 J		0.0034	0.613	0.030	0.01 U
BIGC	8/26/2019	12:30	1908027-03	N	N	35.8	0.01 U	0.53	0.004 J		0.0028 J	0.531	0.030	0.0066 J
BIGC	9/9/2019	12:00	1909025-03	N	N	36.7	0.01 U	0.57	0.004 J		0.0027 J	0.636	0.031	0.01 U
BIGC	9/23/2019	12:45	1909026-03	N	N	34.9	0.01 U	0.56	0.004 J		0.0022 J	0.567	0.021 J	0.01 U
BIGC	10/7/2019	13:45	1910017-03	N	N	35.4	0.01 U	0.64	0.01U		0.002 J	0.630	0.018 J	0.01 U
BIGC	10/22/2019	12:00	1910018-03	N	N	33.5	0.01 U	4.43	0.006 J		0.0052	5.01	0.085	0.0149
BIGC	11/4/2019	10:20	1911015-03	N	N	37.9	0.01 U	0.98	0.01U		0.0047 J	0.938	0.02 J	0.0066 J
CHTH	2/27/2019	10:00	1902034-24	N	Y	193.0	0.01 U	1.42	1.89		0.1020	1.33	1.99	0.1080
CHTH	3/13/2019	8:30	1903029-24	N	Y	194.0	0.013	2.21	1.80 J		0.1030	2.24	1.86 J	0.1060
CHTH	3/27/2019	9:30	1903030-24	N	Y	147.0	0.021	3.28	1.35		0.1130	3.74	1.59	0.1710
CHTH	4/10/2019	8:35	1904024-24	N	Y	125.0	0.013	3.39		0.943	0.0975	3.47	1.10	0.1480
CHTH	4/24/2019	9:20	1904025-24	N	Y	62.7	0.041	2.50		0.416	0.0711	2.98	0.653	0.2410

Study Location ID	Date	Time (local)	Sample ID	Rep Y/N	Comp Y/N	Alk (mg/L)	NH3 (mg/L)	DOC (mg/L)	NO3/ NO2 (mg/L)	NO3 (mg/L)	OP (mg/L)	TOC (mg/L)	TPN (mg/L)	TP (mg/L)
CHTH	5/8/2019	9:15	1905021-24	N	Y	138.0	0.440	4.20		1.72	0.3890	4.45	2.80	0.4740
CHTH	5/22/2019	9:10	1905022-24	N	Y	98.1	0.019	2.76		0.782	0.1300	2.96	0.983	0.1760
CHTH	6/5/2019	8:30	1906021-24	N	Y	110.0	0.027	2.87		0.876	0.1440	3.20	1.15	0.1890
CHTH	6/5/2019	8:50	1906021-32	Y	Y	111.0	0.021	2.78	0.8682		0.1440	3.14	1.09	0.1910
CHTH	6/19/2019	9:18	1906022-24	N	Y	92.1	0.068	2.53		0.825	0.1490	2.70	1.10	0.1970
CHTH	7/2/2019	10:38	1907027-24	N	Y	116.0	0.039 J	4.35		1.62	0.2460	4.64	2.32	0.2890
CHTH	7/17/2019	10:45	1907028-24	N	Y	140.0	0.039	4.32		1.69	0.1970	4.75	1.99	0.2410
CHTH	7/31/2019	10:20	1907029-24	N	Y	149.0	0.013	3.69	1.37	1.41	0.1940	3.83	1.63	0.2260
CHTH	8/14/2019	10:07	1908026-24	N	Y	121.0	0.01 J	3.20		0.813	0.1400	3.25	1.06	0.1880
CHTH	8/28/2019	11:15	1908027-24	N	Y	95.1	0.005 J	2.34		0.595	0.0847	2.52	0.753	0.1070
CHTH	9/11/2019	12:00	1909025-24	N	Y	120.0	0.01 J	3.33		0.956	0.1570	3.66	1.16	0.1980
CHTH	9/25/2019	10:10	1909026-24	N	Y	114.0	0.01 U	2.06		0.789	0.0880	2.08	0.860	0.1060
CHTH	10/9/2019	10:05	1910017-24	N	Y	104.0	0.01 U	1.53		0.846	0.0823	1.73	0.999	0.0980
CHTH	10/23/2019	9:37	1910018-24	N	Y	193.0	0.004 J	1.88		1.69	0.1180	2.13	1.74	0.1290
CHTH	11/6/2019	8:35	1911015-24	N	Y	197.0	0.01 U	1.53		1.72	0.111 J	1.54	1.96	0.1210
CLE	2/25/2019	10:20	1902034-01	N	Y	31.8	0.01 U	0.73	0.016		0.0015 J	0.742	0.056	0.01 U
CLE	3/11/2019	11:25	1903029-01	N	Y	31.8	0.01 U	0.83	0.018		0.0026 J	0.664	0.030	0.01 U
CLE	3/25/2019	9:38	1903030-01	N	Y	32.9	0.01 U	1.14	0.018		0.003 U	0.766	0.048	0.01 U
CLE	4/8/2019	9:15	1904024-01	N	Y	37.9	0.01 U	1.04	0.006 J		0.0031	0.886	0.035	0.01 U
CLE	4/22/2019	9:45	1904025-01	N	Y	29.6	0.01 U	0.92	0.019		0.0032	0.938	0.045	0.01 U
CLE	4/22/2019	10:07	1904025-33	Y	Y	29.4	0.01 U	0.70	0.018		0.0023 J	0.823	0.034	0.01 U
CLE	5/6/2019	9:02	1905021-01	N	Y	32.8	0.01 U	0.71	0.011		0.0024 J	0.734	0.029	0.01 U
CLE	5/20/2019	9:00	1905022-01	N	Y	30.5	0.01 U	0.88	0.007 J		0.0023 J	0.766	0.037	0.01 U
CLE	6/3/2019	9:16	1906021-01	N	Y	29.9	0.01 U	0.68	0.003 J		0.0018 J	0.717	0.025 U	0.01 U
CLE	6/17/2019	8:56	1906022-01	N	Y	24.8	0.01 U	0.93	0.01 J		0.0019 J	0.697	0.029	0.01 U
CLE	6/30/2019	8:30	1907027-01	N	Y	24.5	0.01 U	0.73	0.007 J		0.003 U	0.725	0.03	0.01 U

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CLE	7/15/2019	9:15	1907028-01	N	Y	24.0	0.01 U	0.74	0.01 U		0.0021 J	0.801	0.033	0.01 U
CLE	7/29/2019	8:54	1907029-01	N	Y	24.6	0.01 U	0.66	0.01 U		0.0018 J	0.682	0.027	0.01 U
CLE	7/29/2019	9:09	1907029-33	Y	Y	24.3	0.01 U	0.68	0.01 U		0.0018 J	0.674	0.029	0.01 U
CLE	8/12/2019	9:06	1908026-01	N	Y	25.5	0.01 U	0.73	0.01 U		0.003 UJ	0.758	0.027	0.01 U
CLE	8/26/2019	9:00	1908027-01	N	Y	27.2	0.01 U	0.73	0.003 J		0.003 U	0.782	0.037	0.01 U
CLE	9/9/2019	8:52	1909025-01	N	Y	31.9 J	0.01 U	0.78	0.004 J		0.003 U	0.757	0.030	0.01 U
CLE	9/23/2019	9:20	1909026-01	N	Y	35.0	0.01 U	0.79	0.004 J		0.003 U	0.682	0.030	0.01 U
CLE	10/7/2019	9:15	1910017-01	N	Y	35.1	0.01 U	0.90	0.007 J		0.003 U	0.658	0.034	0.01 U
CLE	10/21/2019	9:45	1910018-01	N	Y	34.2	0.01 U	0.70	0.016		0.0039	0.769	0.015 J	0.01 U
CLE	11/4/2019	9:15	1911015-01	N	Y	32.9	0.01 U	0.64	0.017		0.003 UJ	0.759	0.043	0.01 U
CLPOTW	6/17/2019	13:30	1906022-41	N	Y	90.4	0.246	5.40	0.987		3.32	7.11	1.98	3.49
CLPOTW	7/15/2019	13:00	1907028-41	N	Y	89.6	0.475	4.31	0.519		1.17	4.94	1.54	1.40
CLPOTW	7/29/2019	13:00	1907029-41	N	Y	92.1	0.441	4.11	0.368		0.81	5.15	1.40	0.92
CLPOTW	8/12/2019	13:15	1908026-41	N	Y	91.2	0.287	4.59	0.403		1.00	5.06	1.30	1.16
CLPOTW	8/26/2019	13:30	1908027-41	N	Y	92.0	0.197	4.86	0.468		3.36	5.32	1.33	3.48
CLPOTW	9/9/2019	13:00	1909025-41	N	Y	93.7	0.159	5.13	0.509		1.66	5.56	1.28	1.78
CLPOTW	9/23/2019	13:05	1909026-41	N	Y	88.9	0.161	6.14	0.781		3.83	6.70	1.65	4.16
CLPOTW	10/7/2019	13:45	1910017-41	N	Y	93.6	0.248	9.01	0.446		3.09	9.59	1.75	3.33
CLPOTW	10/21/2019	13:00	1910018-41	N	Y	84.8	0.532	7.46	0.370		1.74	7.95	1.73	1.90
CRY	2/25/2019	13:20	1902034-08	N	N	125.0	0.01 U	2.50	0.355		0.0134	2.51	0.486	0.0338
CRY	3/11/2019	13:02	1903029-08	N	N	131.0	0.01 U	2.09	0.334		0.0123	2.29	0.412	0.0179
CRY	3/25/2019	12:45	1903030-08	N	N	90.7	0.005 J	5.55	0.448		0.0375	5.64	0.617	0.0754
CRY	4/8/2019	12:40	1904024-08	N	N	98.2	0.01 U	4.15	0.302		0.0260	3.96	0.378	0.0482
CRY	4/22/2019	13:15	1904025-08	N	N	119.0	0.006 J	2.84	0.252		0.0184	3.16	0.372	0.0305
CRY	5/6/2019	11:43	1905021-08	N	N	136.0	0.009 J	2.58	0.158		0.0198	2.71	0.262	0.0272
CRY	5/20/2019	11:30	1905022-08	N	N	148.0	0.018	2.44	0.269		0.0266	2.48	0.411	0.0388

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CRY	6/3/2019	11:22	1906021-08	N	N	148.0	0.037	1.96	0.386		0.0348	2.09	0.520	0.0567
CRY	6/17/2019	10:21	1906022-08	N	N	127.0	0.051	0.94	0.870		0.0122	0.915	1.03	0.0348
CRY	6/30/2019	10:00	1907027-08	N	N	128.0	0.043	0.82	0.911		0.0089	0.884	1.05	0.0316
CRY	7/15/2019	11:11	1907028-08	N	N	135.0	0.041	0.84	0.990		0.0131	1.03	1.20	0.0353
CRY	10/7/2019	10:30	1910017-08	N	N	119.0	0.015	0.76	1.00		0.0114	0.755	1.06	0.0155
CRY	10/21/2019	12:37	1910018-08	N	N	118.0	0.032	2.41	0.184		0.0171	2.57	0.813	0.0395
DRY	2/26/2019	10:00	1902034-17	N	N	69.8	0.01 U	1.61	0.347		0.0136	1.77	0.455	0.0226
DRY	3/12/2019	9:53	1903029-17	N	N	74.3	0.01 U	1.68	0.220		0.0176	1.71	0.316	0.0176
DRY	3/26/2019	9:52	1903030-17	N	N	52.0	0.01 U	5.07	0.536		0.0350	4.67	0.811	0.0652
DRY	4/9/2019	12:10	1904024-17	N	N	63.1	0.01 U	3.79	0.083		0.0117	4.00	0.344	0.0243
DRY	4/23/2019	12:00	1904025-17	N	N	62.6	0.005 J	2.26	0.395		0.0137	2.53	0.563	0.0178
DRYM	5/7/2019	10:40	1905021-17	N	N	64.2	0.009 J	1.97	0.357		0.0115	2.10	0.488	0.0275
DRYM	5/21/2019	9:55	1905022-17	N	N	64.8	0.011	1.78	0.205		0.0098	1.94	0.322	0.0248
DRYM	6/4/2019	10:50	1906021-17	N	N	66.2	0.019	1.53	0.181		0.0154	1.83	0.311	0.0377
DRYM	6/18/2019	13:21	1906022-17	N	N	55.9	0.015	1.50	0.092		0.018	1.66	0.203	0.0431
DRYM	7/1/2019	15:05	1907027-17	N	N	63.5	0.014	1.95	0.083		0.0193	2.10	0.235	0.0377
DRYM	7/1/2019	15:15	1907027-33	Y	N	63.6	0.013	1.85	0.082		0.0193	2.03	0.238	0.0365
DRYM	7/16/2019	15:11	1907028-17	N	N	62.7	0.009 J	1.87	0.041		0.0189	1.97	0.201	0.0349
DRYM	7/30/2019	15:17	1907029-17	N	N	64.3	0.006 J	1.69	0.023		0.0212	1.99	0.176	0.0368
DRYM	8/13/2019	12:19	1908026-17	N	N	62.1	0.007 J	1.93	0.008 J		0.0205	2.03	0.156	0.0384
DRYM	8/27/2019	13:43	1908027-17	N	N	70.6	0.005 J	1.81	0.005 J		0.0186	2.17	0.172	0.0359
DRYM	9/10/2019	13:30	1909025-17	N	N	68.6	0.006 J	1.92	0.007 J		0.0199	2.14	0.153	0.0394
DRYM	9/24/2019	13:05	1909026-17	N	N	68.1	0.011	2.15	0.018		0.0204	1.94	0.167	0.0418
DRYM	10/8/2019	11:52	1910017-17	N	N	62.5	0.01 U	1.02	0.006 J		0.0122	1.16	0.099	0.0220
DRYM	10/8/2019	12:04	1910017-31	Y	N	60.8	0.01 U	1.03	0.005 J		0.0125	1.22	0.105	0.0211
DRYM	10/23/2019	11:20	1910018-17	N	N	67.3	0.008 J	1.31	0.019		0.0096	1.34	0.107	0.0173

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DRYM	11/5/2019	14:40	1911015-17	N	N	72.6	0.010	1.01	0.039		0.0068	1.13	0.132	0.0209
ELPOTW	6/17/2019	7:15	1906022-40	N	Y	86.5	0.111	5.75	13.9		1.43	7.20	14.60	1.55
ELPOTW	7/15/2019	8:00	1907028-40	N	Y	85.5	0.065	4.10	11.6		1.22	4.84	12.40	1.47
ELPOTW	7/29/2019	7:45	1907029-40	N	Y	86.3	0.080	3.86	11.7		1.30	5.12	12.50	1.41
ELPOTW	8/12/2019	8:00	1908026-40	N	Y	89.9	0.099	4.71	11.8		1.28	5.41	12.30	1.53
ELPOTW	8/26/2019	8:15	1908027-40	N	Y	94.3	0.076	5.33	10.9		1.25	6.61	11.20	1.40
ELPOTW	9/9/2019	8:00	1909025-40	N	Y	91.7	0.074	4.65	11.5		1.22	5.18	11.80	1.37
ELPOTW	9/23/2019	8:15	1909026-40	N	Y	82.8	0.095	4.57	14.8		1.53	5.03	14.90	1.70
ELPOTW	10/7/2019	8:05	1910017-40	N	Y	79.5	0.069	5.21	16.4		1.66	5.80	16.80	1.81
ELPOTW	10/21/2019	8:15	1910018-40	N	Y	83.6	0.095	5.98	15.9		1.53	6.50	15.80	1.76
FOG	3/26/2019	10:45	1903030-22	N	N	54.7	0.010	3.10	1.09		0.0668	3.35	1.30	0.1010
FOG	4/9/2019	10:05	1904024-22	N	N	58.3	0.01 U	1.83	0.673		0.0390	2.05	0.807	0.0630
FOG	4/23/2019	9:55	1904025-22	N	N	53.7	0.014	2.84	0.401		0.0424	3.08	0.568	0.0894
FOG	5/7/2019	9:45	1905021-22	N	N	63.1	0.064	1.85	1.09		0.1180	2.03	1.44	0.1670
FOG	5/21/2019	14:20	1905022-22	N	N	56.4	0.012	1.62	0.925		0.0699	1.79	1.05	0.1180
FOG	6/4/2019	10:15	1906021-22	N	N	57.8	0.008 J	1.77	0.689		0.0741	1.96	0.785	0.1130
FOG	6/18/2019	9:55	1906022-22	N	N	54.5	0.127	1.79	0.89		0.0722	1.85	1.42	0.1110
FOG	7/1/2019	10:30	1907027-22	N	N	53.6	0.044	1.56	1.05		0.0851	1.63	1.39	0.1220
FOG	7/16/2019	10:45	1907028-22	N	N	56.1	0.010	1.36	0.923		0.0696	1.58	1.14	0.0907
FOG	7/30/2019	10:15	1907029-22	N	N	59.2	0.01 U	1.26	0.874		0.0675	1.31	1.02	0.0805
FOG	7/30/2019	10:25	1907029-32	Y	N	58.7	0.005 J	1.29	0.884		0.0682	1.41	1.01	0.0797
FOG	8/13/2019	10:15	1908026-22	N	N	58.7	0.004 J	1.42	0.545		0.0673	1.56	0.669	0.0809
FOG	8/27/2019	10:45	1908027-22	N	N	57.6	0.01 U	1.69	0.604		0.0624	1.86	0.694	0.0786
FOG	9/10/2019	10:00	1909025-22	N	N	63.5	0.005 J	1.59	0.924		0.0837	1.67	1.02	0.1020
FOG	9/24/2019	8:50	1909026-22	N	N	65.7	0.01 U	1.20	0.873		0.0774	1.33	0.945	0.0915
FOG	10/8/2019	10:30	1910017-22	N	N	55.4	0.01 U	1.12	0.664		0.0466	1.14	0.76	0.0578

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FOG	10/21/2019	10:15	1910018-22	N	N	70.0	0.01 U	1.27	1.12		0.0798	1.36	1.30	0.0825
FOG	11/5/2019	8:45	1911015-22	N	N	80.0	0.01 U	1.18	1.56		0.0785 J	1.19	1.68	0.0897
LITC	2/25/2019	13:10	1902034-04	N	N	57.3	0.01 U	0.53	0.01 U		0.0024 J	0.534	0.033	0.01 U
LITC	3/25/2019	12:45	1903030-04	N	N	51.1	0.01 U	1.63	0.005 J		0.0035	1.78	0.049	0.0082 J
LITC	4/8/2019	14:00	1904024-04	N	N	47.5	0.01 U	1.75	0.009 J		0.0039	1.78	0.043	0.0063 J
LITC	4/22/2019	13:30	1904025-04	N	N	44.6	0.01 U	1.48	0.005 J		0.0041	1.62	0.041	0.0092 J
LITC	5/6/2019	12:30	1905021-04	N	N	42.5	0.01 U	1.06	0.005 J		0.0034	1.18	0.023 J	0.01 U
LITC	5/20/2019	12:15	1905022-04	N	N	41.0	0.01 U	0.88	0.003 J		0.0035	0.892	0.029	0.01 U
LITC	6/3/2019	12:45	1906021-04	N	N	43.0	0.01 U	0.78	0.01 U		0.0027 J	0.757	0.025 U	0.01 U
LITC	6/17/2019	13:35	1906022-04	N	N	33.4	0.01 U	0.63	0.003 J		0.0029 J	0.656	0.056	0.01 U
LITC	6/30/2019	12:15	1907027-04	N	N	31.5	0.01 U	0.66	0.01 U		0.002 J	0.687	0.048	0.0079 J
LITC	7/15/2019	13:35	1907028-04	N	N	30.6	0.01 U	0.62	0.01 U		0.0022 J	0.688	0.036	0.01 U
LITC	7/29/2019	14:15	1907029-04	N	N	26.8	0.01 U	0.61	0.01 U		0.002 J	0.654	0.030	0.01 U
LITC	8/12/2019	14:00	1908026-04	N	N	27.0	0.01 U	0.68	0.01 U		0.0021 J	0.732	0.037	0.01 U
LITC	8/26/2019	13:15	1908027-04	N	N	26.2	0.01 U	0.62	0.01 U		0.003 U	0.703	0.038	0.01 U
LITC	9/9/2019	13:00	1909025-04	N	N	26.6	0.01 U	0.71	0.01 U		0.003 U	0.783	0.033	0.01 U
LITC	9/23/2019	13:15	1909026-04	N	N	26.3	0.01 U	0.66	0.01 U		0.003 U	0.682	0.02 J	0.01 U
LITC	9/23/2019	13:30	1909026-31	Y	N	26.4	0.01 U	0.68	0.01 U		0.003 U	0.640	0.023 J	0.01 U
LITC	10/7/2019	14:30	1910017-04	N	N	25.8	0.01 U	0.73	0.01 U		0.003 U	0.741	0.028	0.01 U
LITC	10/22/2019	14:15	1910018-04	N	N	41.2	0.01 U	2.60	0.01 U		0.0030	2.85	0.062	0.0071 J
LITC	11/4/2019	12:35	1911015-04	N	N	31.6	0.01 U	1.15	0.01 U		0.0038 J	1.18	0.033	0.0089 J
MANL	3/26/2019	12:45	1903030-21	N	N	44.1	0.005 J	4.08	0.101		0.0359	4.12	0.241	0.0617
MANL	4/9/2019	14:30	1904024-21	N	N	43.9	0.01 U	4.50	0.067		0.0312	4.52	0.183	0.0539
MANL	4/9/2019	14:40	1904024-32	Y	N	43.9	0.01 U	4.75	0.067		0.0312	4.87	0.173	0.0519
MANL	4/23/2019	14:55	1904025-21	N	N	40.4	0.006 J	3.92	0.031		0.0246	4.66	0.139	0.0406
MANL	5/7/2019	12:30	1905021-21	N	N	39.9	0.019	3.12	0.118		0.0437	3.18	0.232	0.0604

Study Location ID	Date	Time (local)	Sample ID	Rep Y/N	Comp Y/N	Alk (mg/L)	NH3 (mg/L)	DOC (mg/L)	NO3/ NO2 (mg/L)	NO3 (mg/L)	OP (mg/L)	TOC (mg/L)	TPN (mg/L)	TP (mg/L)
MANL	5/21/2019	14:25	1905022-21	N	N	33.7	0.011	2.77	0.096		0.0182	2.42	0.186	0.0326
MANL	6/4/2019	15:36	1906021-21	N	N	33.8	0.009 J	1.67	0.072		0.0226	1.82	0.143	0.0433
MANL	6/18/2019	9:50	1906022-21	N	N	34.1	0.007 J	1.64	0.121		0.0236	1.86	0.218	0.0500
MANL	7/1/2019	10:04	1907027-21	N	N	34.4	0.051	1.47	0.166		0.0210	1.68	0.304	0.0691
MANL	7/16/2019	11:50	1907028-21	N	N	36.9	0.009 J	1.11	0.124		0.0186	1.37	0.236	0.0379
MANL	7/30/2019	13:40	1907029-21	N	N	38.0	0.006 J	1.13	0.170		0.0188	1.21	0.256	0.0398
MANL	8/13/2019	13:50	1908026-21	N	N	34.9	0.007 J	1.17	0.119		0.0187	1.29	0.197	0.0730
MANL	8/27/2019	11:54	1908027-21	N	N	35.9	0.01 U	1.52	0.083		0.0216	1.51	0.187	0.0418
MANL	9/10/2019	12:05	1909025-21	N	N	30.8	0.01 U	0.95	0.042		0.0118	1.01	0.084	0.0287
MANL	9/24/2019	11:40	1909026-21	N	N	40.5	0.01 U	1.11	0.207		0.0209	1.11	0.267	0.0411
MANL	10/8/2019	10:55	1910017-21	N	N	35.4	0.01 U	0.85	0.027		0.0091	1.01	0.078	0.0167
MANL	10/22/2019	12:40	1910018-21	N	N	57.2	0.01 U	2.23	0.067		0.0215	2.53	0.158	0.0365
MANL	11/5/2019	10:45	1911015-21	N	N	61.7	0.01 U	1.60	0.075		0.0186 J	1.70	0.140	0.0288
MANL	11/5/2019	10:50	1911015-32	Y	N	61.5	0.01 U	1.63	0.080		0.0184 J	1.65	0.159	0.0280
MANU	8/27/2019	12:35	1908027-20	N	N	47.6	0.01 U	1.19	0.004 J		0.0268	1.23	0.061	0.0367
MANU	9/10/2019	11:17	1909025-20	N	N	48.4	0.01 U	1.50	0.003 J		0.0268	1.40	0.053	0.0376
MANU	9/24/2019	10:30	1909026-20	N	N	50.8	0.01 U	1.24	0.004 J		0.0238	1.18	0.042	0.0369
MANU	10/8/2019	9:50	1910017-20	N	N	51.4	0.01 U	1.18	0.01 U		0.0218	1.24	0.050	0.0286
MANU	10/22/2019	11:40	1910018-20	N	N	46.4	0.01 U	2.94	0.005 J		0.0258	3.28	0.078	0.0516
MANU	11/5/2019	10:03	1911015-20	N	N	49.5	0.01 U	1.41	0.01 U		0.0213 J	1.48	0.042	0.0274
NANU	8/28/2019	9:27	1908027-12	N	N	46.4	0.01 U	1.35	0.006 J		0.0282	1.37	0.069	0.0386
NANU	9/11/2019	10:15	1909025-12	N	N	46.2	0.01 U	1.32	0.003 J		0.0273	1.43	0.072	0.0386
NANU	9/11/2019	10:21	1909025-32	Y	N	46.1	0.01 U	1.51	0.004 J		0.0264	1.39	0.059	0.0366
NANU	9/25/2019	12:20	1909026-12	N	N	46.5	0.01 U	1.34	0.005 J		0.0260	1.33	0.057	0.0382
NANU	10/8/2019	13:35	1910017-12	N	N	41.8	0.01 U	2.01	0.01 U		0.0239	2.14	0.078	0.0421
NANU	10/22/2019	10:25	1910018-12	N	N	41.2	0.007 J	3.20	0.005 J		0.0261	3.67	0.085	0.0677

Study Location ID	Date	Time (local)	Sample ID	Rep Y/N	Comp Y/N	Alk (mg/L)	NH3 (mg/L)	DOC (mg/L)	NO3/ NO2 (mg/L)	NO3 (mg/L)	OP (mg/L)	TOC (mg/L)	TPN (mg/L)	TP (mg/L)
NANU	11/5/2019	7:30	1911015-12	N	N	41.4	0.005 J	1.32	0.01 U		0.0202 J	1.40	0.052	0.0290
PACK	3/26/2019	14:05	1903030-19	N	N	50.3	0.025	4.69	1.44		0.0849	4.47	1.72	0.1790
PACK	4/9/2019	10:25	1904024-19	N	N	49.0	0.02	3.65	0.791		0.0537	3.68	1.01	0.1530
PACK	4/23/2019	9:20	1904025-19	N	N	59.7	0.209	3.21	0.834		0.1240	3.26	1.99	0.1590
PACK	5/7/2019	10:00	1905021-19	N	N	72.9	0.017	1.92	1.22		0.0914	2.09	1.44	0.1100
PACK	5/21/2019	13:19	1905022-19	N	N	62.3	0.005 J	1.27	0.934		0.0494	3.55	1.04	0.0655
PACK	6/4/2019	9:43	1906021-19	N	N	67.4	0.033	1.81	0.682		0.0596	2.11	0.810	0.0946
PACK	6/18/2019	12:17	1906022-19	N	N	53.0	0.025	1.89	0.873		0.0654	2.21	1.30	0.0867
PACK	6/18/2019	12:36	1906022-33	Y	N	52.7	0.025	1.92	0.868		0.0664	2.21	1.27	0.0922
PACK	7/1/2019	8:57	1907027-19	N	N	54.3	0.524	2.98	1.31		0.105 J	2.84	2.24	0.1310
PACK	7/16/2019	10:25	1907028-19	N	N	55.9	0.022	1.92	1.42		0.0793	2.24	1.67	0.0952
PACK	7/30/2019	11:45	1907029-19	N	N	74.2	0.010	2.05	0.577		0.0683	2.16	0.774	0.0856
PACK	8/13/2019	10:37	1908026-19	N	N	55.6	0.007 J	1.52	0.657		0.0669	1.68	0.766	0.0859
PACK	8/13/2019	10:44	1908026-32	Y	N	55.4	0.007 J	1.44	0.656		0.0666	1.60	0.775	0.0874
PACK	8/27/2019	10:03	1908027-19	N	N	55.4	0.014	1.84	0.582		0.0789	2.17	0.746	0.1140
PACK	9/10/2019	10:30	1909025-19	N	N	70.0	0.020	2.22	0.785		0.1030	2.44	0.966	0.1260
PACK	9/24/2019	9:57	1909026-19	N	N	53.4	0.010	1.11	0.536		0.0373	1.09	0.617	0.0565
PACK	10/8/2019	9:08	1910017-19	N	N	51.8	0.01 U	1.04	0.619		0.0304	1.20	0.722	0.0467
PACK	10/22/2019	9:40	1910018-19	N	N	86.0	0.021	1.31	1.57		0.0420	1.51	1.72	0.0620
PACK	11/5/2019	9:20	1911015-19	N	N	88.4	0.106	1.30	1.28		0.0325 J	1.46	1.63	0.1920
REEC	2/26/2019	13:35	1902034-18	N	N	104.0	0.01 U	3.02	0.557		0.0193	2.19	0.701	0.0309
REEC	3/12/2019	10:45	1903029-18	N	N	107.0	0.01 U	2.04	0.550		0.0188	1.99	0.671	0.0290
REEC	3/26/2019	11:35	1903030-18	N	N	73.3	0.009 J	5.39	0.733		0.0611	5.62	1.05	0.1000
REEC	4/9/2019	13:30	1904024-18	N	N	81.5	0.01 U	4.73	0.385		0.0301	4.80	0.679	0.0510
REEC	4/23/2019	13:30	1904025-18	N	N	60.2	0.01 U	2.56	0.154		0.0208	2.65	0.288	0.0351
REEC	5/7/2019	11:12	1905021-18	N	N	73.4	0.231	3.58	0.632		0.1460	3.84	1.39	0.1730

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REEC	5/7/2019	11:14	1905021-31	Y	N	73.3	0.222	3.51	0.631		0.1440	3.63	1.41	0.1770
REEC	5/21/2019	15:15	1905022-18	N	N	71.7	0.021	2.75	0.327		0.1020	2.92	0.556	0.1210
REEC	6/4/2019	13:59	1906021-18	N	N	72.7	0.012	4.05	0.232		0.0729	3.06	0.419	0.0934
REEC	6/18/2019	11:07	1906022-18	N	N	66.4	0.016	2.56	0.215		0.0492	2.99	0.403	0.0706
REEC	7/1/2019	12:17	1907027-18	N	N	67.1	0.027	2.76	0.462		0.0920	3.16	0.719	0.1090
REEC	7/16/2019	13:41	1907028-18	N	N	65.8	0.009 J	2.79	0.299		0.0712	3.23	0.602	0.0981
REEC	7/31/2019	12:20	1907029-18	N	N	86.3	0.013	2.76	0.277		0.0853	3.20	0.566	0.1120
REEC	8/13/2019	15:20	1908026-18	N	N	85.3	0.019	3.26	0.212		0.0847	3.29	0.482	0.1060
REEC	8/27/2019	15:00	1908027-18	N	N	74.1	0.025	2.47	0.170		0.0900	2.90	0.407	0.1140
REEC	9/10/2019	14:25	1909025-18	N	N	77.2	0.014	2.26	0.383		0.1040	2.55	0.560	0.1240
REEC	9/24/2019	14:10	1909026-18	N	N	81.6	0.008 J	1.80	0.106		0.0416	1.88	0.244	0.0611
REEC	10/8/2019	15:05	1910017-18	N	N	70.6	0.01 U	1.22	0.066		0.0253	1.48	0.171	0.0337
REEC	10/8/2019	15:09	1910017-32	Y	N	69.9	0.01 U	1.19	0.065		0.0256	1.39	0.163	0.0343
REEC	10/22/2019	13:55	1910018-18	N	N	105.0	0.010	2.62	0.113		0.0409	2.97	0.308	0.0502
REEC	11/5/2019	13:30	1911015-18	N	N	108.0	0.01 U	1.77	0.589		0.0314 J	1.95	0.733	0.0416
SWAC	2/25/2019	16:45	1902034-06	N	N	93.5	0.01 U	1.24	0.01 U		0.0085	1.38	0.069	0.0123
SWAC	3/11/2019	13:25	1903029-06	N	N	92.3	0.01 U	1.18	0.01 U		0.0128	1.31	0.046	0.0182
SWAC	3/25/2019	16:00	1903030-06	N	N	75.3	0.01 U	4.65	0.162		0.0229	4.10	0.280	0.0593
SWAC	4/8/2019	15:30	1904024-06	N	N	74.8	0.01 U	3.81	0.012		0.0167	3.74	0.103	0.0358
SWAC	4/22/2019	16:50	1904025-06	N	N	69.3	0.01 U	2.98	0.01 U		0.0153	3.32	0.091	0.0286
SWAC	5/6/2019	14:55	1905021-06	N	N	61.9	0.01 U	2.05	0.010		0.0168	2.28	0.079	0.0069 J
SWAC	5/20/2019	16:30	1905022-06	N	N	60.9	0.007 J	1.93	0.004 J		0.0176	2.00	0.080	0.0306
SWAC	6/3/2019	16:30	1906021-06	N	N	74.2	0.006 J	1.90	0.003 J		0.0202	2.05	0.086	0.032
SWAC	6/17/2019	14:19	1906022-06	N	N	79.7	0.007 J	1.88	0.003 J		0.0197	1.79	0.081	0.0298
SWAC	6/30/2019	14:15	1907027-06	N	N	81.7	0.01 U	1.64	0.006 J		0.0160	1.62	0.074	0.025
SWAC	7/15/2019	15:47	1907028-06	N	N	81.8	0.01 U	1.61	0.01 U		0.0174	1.60	0.098	0.0226

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SWAC	7/29/2019	14:45	1907029-06	N	N	85.7	0.006 J	1.64	0.004 J		0.0162	1.74	0.114	0.0233
SWAC	8/12/2019	15:21	1908026-06	N	N	88.5	0.01 U	1.66	0.01 U		0.0130	1.80	0.106	0.0185
SWAC	8/26/2019	14:10	1908027-06	N	N	90.7	0.01 U	1.77	0.003 J		0.0097	2.01	0.115	0.0159
SWAC	9/9/2019	15:19	1909025-06	N	N	90.4	0.01 U	1.95	0.01 U		0.0098	2.24	0.122	0.0164
SWAC	9/23/2019	15:05	1909026-06	N	N	88.7	0.01 U	1.61	0.01 U		0.0111	1.70	0.073	0.0193
SWAC	10/7/2019	15:16	1910017-06	N	N	92.1	0.01 U	1.48	0.01 U		0.0118	1.50	0.062	0.0138
SWAC	10/21/2019	15:20	1910018-06	N	N	85.0	0.01 U	2.41	0.01 U		0.0200	2.71	0.074	0.0216
SWAC	11/4/2019	14:35	1911015-06	N	N	82.7	0.01 U	1.65	0.01 U		0.0153	1.81	0.065	0.0200
TANC	2/26/2019	10:15	1902034-13	N	N	74.9	0.01 U	1.03	0.028		0.0076	1.10	0.066	0.0108
TANC	3/12/2019	9:30	1903029-13	N	N	77.4	0.013	0.99	0.028		0.0106	1.01	0.068	0.0116
TANC	3/26/2019	12:40	1903030-13	N	N	63.5	0.01 U	3.17	0.112		0.0166	3.28	0.221	0.0350
TANC	4/9/2019	12:45	1904024-13	N	N	61 U	0.01 U	3.99	0.011		0.0129	4.09	0.085	0.0345
TANC	4/23/2019	12:15	1904025-13	N	N	52.2	0.01 U	2.97	0.004 J		0.0108	3.38	0.065	0.0245
TANC	5/7/2019	13:20	1905021-13	N	N	57.1	0.016	2.37	0.011		0.0102	2.47	0.091	0.0201
TANC	5/21/2019	13:15	1905022-13	N	N	50.9	0.01 U	1.69	0.004 J		0.0084	1.62	0.063	0.0147
TANC	6/4/2019	12:00	1906021-13	N	N	60.3	0.01 U	1.48	0.007 J		0.0095	1.55	0.052	0.0180
TANC	6/4/2019	12:30	1906021-34	Y	N	60.7	0.01 U	1.56	0.008 J		0.0098	1.62	0.083	0.0192
TANC	6/18/2019	11:30	1906022-13	N	N	44.0	0.01 U	1.06	0.006 J		0.0052	1.05	0.065	0.0124
TANC	7/1/2019	12:00	1907027-13	N	N	38.1	0.01 U	0.93	0.01 U		0.0041	0.989	0.047	0.0129
TANC	7/16/2019	14:30	1907028-13	N	N	36.0	0.01 U	0.85	0.01 U		0.0047	0.932	0.062	0.0113
TANC	7/30/2019	13:56	1907029-13	N	N	35.4	0.01 U	1.10	0.007 J		0.0057	1.16	0.081	0.0107
TANC	8/13/2019	15:15	1908026-13	N	N	37.0	0.01 U	1.05	0.01 U		0.0060	1.12	0.066	0.0144
TANC	8/27/2019	15:00	1908027-13	N	N	25.0	0.01 U	0.90	0.004 J		0.0028 J	0.87	0.056	0.0085 J
TANC	9/10/2019	14:30	1909025-13	N	N	31.4	0.01 U	0.89	0.004 J		0.0033	0.992	0.053	0.0069 J
TANC	9/24/2019	14:10	1909026-13	N	N	28.2	0.01 U	0.84	0.003 J		0.0027 J	0.824	0.035	0.0240
TANC	10/8/2019	15:15	1910017-13	N	N	31.9	0.01 U	0.83	0.01 U		0.0018 J	0.870	0.054	0.01 U

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TANC	10/8/2019	15:30	1910017-33	Y	N	32.0	0.01 U	0.79	0.01 U		0.0021 J	0.868	0.037	0.01 U
TANC	10/21/2019	13:15	1910018-13	N	N	77.5	0.01 U	1.85	0.007 J		0.0104	2.03	0.052	0.0105
TANC	11/5/2019	10:30	1911015-13	N	N	80.0	0.01 U	1.35	0.01 U		0.0084 J	1.53	0.050	0.0128
TEAL	2/25/2019	15:30	1902034-11	N	Y	63.6	0.01 U	1.30	0.112		0.003 J	0.796	0.153	0.01 U
TEAL	3/11/2019	15:21	1903029-11	N	Y	64.0	0.01 U	0.68	0.110		0.0050	0.675	0.128	0.0067 J
TEAL	3/25/2019	15:05	1903030-11	N	Y	52.7	0.01 U	2.36	0.321		0.0092	2.59	0.365	0.0319
TEAL	4/8/2019	14:25	1904024-11	N	Y	48.0	0.01 U	1.99	0.172		0.0069	2.04	0.234	0.0183
TEAL	4/8/2019	14:45	1904024-31	Y	Y	49.6	0.01 U	2.01	0.171		0.0076	2.20	0.205	0.0164
TEAL	4/22/2019	15:00	1904025-11	N	Y	45.5	0.01 U	1.21	0.136		0.0044	1.47	0.176	0.0129
TEAL	5/6/2019	13:40	1905021-11	N	Y	44.9	0.01 U	0.98	0.085		0.0047	1.03	0.126	0.0119
TEAL	5/20/2019	13:15	1905022-11	N	Y	47.0	0.01 U	0.93	0.023		0.0035	0.852	0.067	0.0078 J
TEAL	6/3/2019	14:24	1906021-11	N	Y	49.0	0.01 U	0.83	0.011		0.003 J	0.808	0.019 J	0.008 J
TEAL	6/17/2019	13:15	1906022-11	N	Y	61.5	0.01 U	0.68	0.022		0.0041	0.718	0.073	0.008 J
TEAL	6/30/2019	12:44	1907027-11	N	Y	67.7	0.01 U	0.64	0.013		0.0031	0.697	0.060	0.0077 J
TEAL	7/15/2019	13:45	1907028-11	N	Y	73.0	0.01 U	0.80	0.013		0.0043	0.938	0.085	0.0072 J
TEAL	7/15/2019	14:00	1907028-31	Y	Y	73.6	0.014	0.75	0.013		0.0043	0.914	0.091	0.0087 J
TEAL	7/29/2019	13:14	1907029-11	N	Y	78.8	0.006 J	0.75	0.019		0.0038	0.898	0.087	0.01 U
TEAL	8/12/2019	13:00	1908026-11	N	Y	81.2	0.01 U	1.03	0.006 J		0.0030	0.921	0.063	0.01 U
TEAL	8/26/2019	12:40	1908027-11	N	Y	85.8	0.01 U	0.73	0.004 J		0.0028 J	0.914	0.059	0.01 U
TEAL	9/9/2019	13:40	1909025-11	N	Y	78.7	0.01 U	0.79	0.01 U		0.003 J	0.937	0.053	0.01 U
TEAL	9/23/2019	14:00	1909026-11	N	Y	76.7	0.01 U	0.66	0.003 J		0.003 U	0.734	0.036	0.01 U
TEAL	10/7/2019	13:10	1910017-11	N	Y	76.9	0.01 U	0.61	0.01 U		0.002 J	0.650	0.038	0.01 U
TEAL	10/21/2019	14:15	1910018-11	N	Y	61.1	0.01 U	1.18	0.037		0.0039	1.27	0.080	0.0069 J
TEAL	11/4/2019	13:05	1911015-11	N	Y	61.6	0.01 U	0.73	0.029		0.0034 J	0.712	0.060	0.01 U
UMT	2/27/2019	13:35	1902034-28	N	N	89.7	0.01 U	0.82	0.01 U		0.0572	0.881	0.041	0.0563
UMT	3/13/2019	12:45	1903029-28	N	N	91.3	0.01 U	0.89	0.01 U		0.0675	0.927	0.042	0.0577

Study Location ID	Date	Time (local)	Sample ID	Rep Y/N	Comp Y/N	Alk (mg/L)	NH3 (mg/L)	DOC (mg/L)	NO3/ NO2 (mg/L)	NO3 (mg/L)	OP (mg/L)	TOC (mg/L)	TPN (mg/L)	TP (mg/L)
UMT	3/27/2019	12:25	1903030-28	N	N	46.6	0.006 J	6.42	0.652		0.0874	6.76	0.847	0.1240
UMT	4/10/2019	11:40	1904024-28	N	N	58.0	0.01 U	5.24	0.108		0.0693	5.67	0.303	0.0743
UMT	4/24/2019	10:25	1904025-28	N	N	72.3	0.01 U	3.60	0.004 J		0.0635	3.61	0.162	0.0645
UMT	5/8/2019	11:20	1905021-28	N	N	81.2	0.005 J	3.09	0.012		0.0764	2.80	0.147	0.078
UMT	5/22/2019	10:04	1905022-28	N	N	87.4	0.01 U	2.24	0.008 J		0.0734	2.32	0.131	0.0743
UMT	6/5/2019	10:00	1906021-28	N	N	90.9	0.01 U	2.07	0.015		0.0783	2.13	0.113	0.0777
UMT	6/19/2019	12:15	1906022-28	N	N	93.3	0.01 U	1.95	0.014		0.0785	2.03	0.133	0.0814
UMT	7/2/2019	9:27	1907027-28	N	N	95.7	0.01 U	1.67	0.007 J		0.0755	1.71	0.092	0.0719
UMT	7/17/2019	8:15	1907028-28	N	N	98.1	0.01 U	1.49	0.008 J		0.0733	1.63	0.099	0.0762
UMT	7/31/2019	8:13	1907029-28	N	N	106.0	0.01 U	1.42	0.019		0.0735	1.58	0.130	0.0742
UMT	8/14/2019	8:17	1908026-28	N	N	110.0	0.01 U	1.56	0.011		0.0765	1.65	0.117	0.0754
UMT	8/28/2019	13:25	1908027-28	N	N	109.0	0.01 U	1.49	0.011		0.0739	1.57	0.120	0.0813
UMT	9/11/2019	8:35	1909025-28	N	N	110.0	0.01 U	1.39	0.003 J		0.0719	1.44	0.080	0.0777
UMT	9/25/2019	9:05	1909026-28	N	N	102.0	0.01 U	1.28	0.01 U		0.0685	1.27	0.074	0.0715
UMT	10/9/2019	8:40	1910017-28	N	N	99.0	0.005 J	1.04	0.01 U		0.0668	1.40	0.058	0.0699
UMT	10/23/2019	8:20	1910018-28	N	N	96.5	0.01 U	1.32	0.01 U		0.0711	1.54	0.063	0.0745
UMT	11/6/2019	10:15	1911015-28	N	N	96.1	0.01 U	1.09	0.01 U		0.069 J	1.12	0.057	0.0759
WEN	2/27/2019	14:25	1902034-29	N	N	143.0	0.006 J	2.23	0.169		0.0313	2.43	0.29	0.0439
WEN	3/13/2019	13:25	1903029-29	N	N	131.0	0.007 J	2.41	0.094		0.0421	2.63	0.248	0.0499
WEN	3/27/2019	13:50	1903030-31	Y	N	74.9	0.006 J	4.44	0.177		0.0683	4.82	0.407	0.0986
WEN	3/27/2019	14:00	1903030-29	N	N	75.0	0.006 J	4.36	0.175		0.0693	4.99	0.401	0.1020
WEN	4/10/2019	13:10	1904024-29	N	N	53.3	0.007 J	5.75	0.051		0.0669	5.78	0.232	0.1120
WEN	4/24/2019	13:30	1904025-29	N	N	57.8	0.011	5.79	0.024		0.0617	5.23	0.208	0.0833
WEN	4/24/2019	13:45	1904025-32	Y	N	57.5	0.007 J	4.88	0.025		0.0623	5.19	0.200	0.0849
WEN	5/8/2019	13:15	1905021-29	N	N	71.5	0.020	4.27	0.122		0.0838	4.09	0.327	0.1120
WEN	5/22/2019	13:10	1905022-29	N	N	70.5	0.011	3.62	0.103		0.0692	3.81	0.278	0.0878

Study Location ID	Date	Time (local)	Sample ID	Rep Y/N	Comp Y/N	Alk (mg/L)	NH3 (mg/L)	DOC (mg/L)	NO3/ NO2 (mg/L)	NO3 (mg/L)	OP (mg/L)	TOC (mg/L)	TPN (mg/L)	TP (mg/L)
WEN	6/5/2019	12:00	1906021-29	N	N	89.4	0.011	3.64	0.191		0.0667	3.76	0.370	0.0851
WEN	6/19/2019	13:00	1906022-29	N	N	161.0	0.017	3.80	0.068		0.0541	4.07	0.316	0.0747
WEN	7/2/2019	14:07	1907027-29	N	N	154.0	0.012	3.54	0.084		0.0561	3.66	0.182	0.0714
WEN	7/17/2019	17:00	1907028-29	N	N	141.0	0.007 J	3.45	0.024		0.0573	3.85	0.286	0.0798
WEN	7/31/2019	15:00	1907029-29	N	N	153.0	0.006 J	3.47	0.026		0.0659	3.96	0.318	0.0859
WEN	8/14/2019	13:45	1908026-29	N	N	158.0	0.007 J	3.57	0.033		0.0825	3.73	0.312	0.105
WEN	9/25/2019	15:00	1909026-29	N	N	137.0	0.005 J	3.34	0.125		0.0476	3.45	0.352	0.064
WEN	10/9/2019	15:00	1910017-29	N	N	154.0	0.01 U	3.21	0.196		0.0409	3.27	0.376	0.057
WEN	10/23/2019	15:15	1910018-29	N	N	155.0	0.007 J	3.39	0.223		0.0496	3.62	0.451	0.0644
WILC	2/27/2019	12:15	1902034-25	N	N	166.0	0.009 J	1.31	1.28		0.0732	1.45	1.41	0.0894
WILC	2/27/2019	12:20	1902034-33	Y	N	165.0	0.010	1.29	1.29		0.0726	1.42	1.41	0.0875
WILC	3/13/2019	11:15	1903029-25	N	N	163.0	0.018	1.94	1.20		0.0755	1.94	1.41	0.0865
WILC	3/27/2019	11:10	1903030-25	N	N	118.0	0.007 J	3.15	0.863		0.0717	3.50	1.02	0.1120
WILC	4/10/2019	10:15	1904024-25	N	N	99.0	0.008 J	3.28		0.569	0.0606	3.42	0.679	0.0986
WILC	4/24/2019	10:15	1904025-25	N	N	57.3	0.037	2.66		0.311	0.0570	2.99	0.501	0.1690
WILC	5/8/2019	9:20	1905021-25	N	N	108.0	0.335	3.88		1.15	0.2920	4.22	2.02	0.3640
WILC	5/22/2019	10:05	1905022-25	N	N	90.0	0.016	2.73		0.56	0.1030	2.86	0.696	0.1520
WILC	6/5/2019	9:45	1906021-25	N	N	105.0	0.019	2.94		0.763	0.1250	3.17	0.949	0.1750
WILC	6/19/2019	10:40	1906022-25	N	N	87.2	0.069	2.47		0.741	0.1310	2.77	1.05	0.1720
WILC	6/19/2019	10:50	1906022-32	Y	N	86.2	0.070	2.42	0.702		0.1310	2.67	1.07	0.1790
WILC	7/2/2019	10:00	1907027-25	N	N	107.0	0.037 J	4.53		1.45	0.2250	4.66	2.47	0.2640
WILC	7/17/2019	10:00	1907028-25	N	N	122.0	0.032	4.03		1.34	0.1590	4.54	1.64	0.2070
WILC	7/31/2019	10:30	1907029-25	N	N	122.0	0.009 J	3.24	0.965	0.964	0.1450	3.71	1.28	0.1700
WILC	8/14/2019	8:15	1908026-25	N	N	107.0	0.01 J	2.95		0.61	0.1160	3.16	0.843	0.1470
WILC	8/28/2019	10:15	1908027-25	N	N	90.6	0.006 J	2.39		0.477	0.0724	2.46	0.616	0.0975
WILC	8/28/2019	10:25	1908027-32	Y	N	90.2	0.005 J	2.25	0.460		0.0728	2.41	0.610	0.0936

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WILC	9/11/2019	10:46	1909025-25	N	N	113.0	0.007 J	3.44		0.742	0.1350	3.68	0.963	0.1680
WILC	9/11/2019	11:00	1909025-33	Y	N	112.0	0.009 J	3.46	0.737		0.1350	3.60	0.964	0.1670
WILC	9/25/2019	10:00	1909026-25	N	N	104.0	0.01 U	2.27		0.604	0.0729	2.24	0.716	0.0926
WILC	10/9/2019	10:15	1910017-25	N	N	95.9	0.01 U	1.59		0.666	0.0664	1.69	0.794	0.0790
WILC	10/23/2019	10:45	1910018-25	N	N	161.0	0.01 U	2.08		1.14	0.0848	2.27	1.25	0.0948
WILC	11/6/2019	9:07	1911015-25	N	N	164.0	0.01 U	1.61		1.13	0.0761 J	1.69	1.36	0.0894
WLTH	2/27/2019	11:30	1902034-23	N	Y	119.0	0.024	1.39	0.432		0.0304	1.72	0.593	0.0768
WLTH	3/13/2019	9:15	1903029-23	N	Y	116.0	0.011	1.96	0.391 J		0.0383	2.16	0.494 J	0.0581
WLTH	3/27/2019	8:20	1903030-23	N	Y	91.3	0.006 J	2.98	0.420		0.0328	3.33	0.560	0.0699
WLTH	3/27/2019	8:40	1903030-33	Y	Y	91.4	0.005 J	4.13	0.425		0.0317	3.40	0.614	0.0656
WLTH	4/10/2019	8:50	1904024-23	N	Y	74.4	0.005 J	3.25		0.226	0.0282	3.50	0.366	0.0654
WLTH	4/24/2019	8:45	1904025-23	N	Y	51.6	0.025	2.87		0.177	0.0405	3.25	0.366	0.1040
WLTH	5/8/2019	9:00	1905021-23	N	Y	76.8	0.229	3.62		0.55	0.1700	3.87	1.23	0.2240
WLTH	5/22/2019	8:50	1905022-23	N	Y	73.9	0.015	2.85		0.272	0.0678	2.92	0.332	0.1100
WLTH	6/5/2019	9:10	1906021-23	N	Y	91.6	0.015	2.81		0.505	0.0719	3.05	0.672	0.1100
WLTH	6/19/2019	9:40	1906022-23	N	Y	72.7	0.102	2.29		0.547	0.0833	2.53	0.926	0.1110
WLTH	7/2/2019	9:00	1907027-23	N	Y	83.7	0.331	4.42		1.1	0.1750	4.61	1.96	0.2030
WLTH	7/17/2019	9:00	1907028-23	N	Y	83.0	0.008 J	3.66		0.594	0.0863	4.14	0.877	0.1250
WLTH	7/31/2019	9:00	1907029-23	N	Y	81.0	0.005 J	3.10	0.380	0.401	0.0791	3.50	0.692	0.1050
WLTH	8/14/2019	9:15	1908026-23	N	Y	76.1	0.006 J	2.85		0.187	0.0667	3.04	0.420	0.0966
WLTH	8/28/2019	9:15	1908027-23	N	Y	77.2	0.01 U	2.31		0.143	0.0435	2.47	0.313	0.0631
WLTH	9/11/2019	8:30	1909025-23	N	Y	91.9	0.006 J	3.79		0.268	0.0801	4.03	0.510	0.1070
WLTH	9/25/2019	8:55	1909026-23	N	Y	83.9	0.01 U	2.38		0.264	0.0476	2.43	0.408	0.0699
WLTH	10/9/2019	9:15	1910017-23	N	Y	79.1	0.01 U	1.63		0.218	0.0308	1.62	0.356	0.0414
WLTH	10/23/2019	9:00	1910018-23	N	Y	113.0	0.005 J	2.39		0.333	0.0328 J	2.70	0.485	0.0463
WLTH	10/23/2019	9:15	1910018-32	Y	Y	113.0	0.006 J	2.40	0.307		0.0334	2.68	0.491	0.0435

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WLTH	11/6/2019	8:30	1911015-23	N	Y	110.0	0.01 U	1.76		0.28	0.0250	1.86	0.433	0.0407
YKAT	4/8/2019	14:35	1904024-33	N	N	33.5	0.01 U	1.21	0.009 J		0.0044	1.14	0.0400	0.0100
YKAT	4/22/2019	14:20	1904025-35	N	N	31.3	0.01 U	0.81	0.010		0.0043	0.887	0.0490	0.0083 J
YKAT	5/6/2019	13:55	1905021-35	N	N	35.4	0.006 J	1.77	0.024		0.0041	0.800	0.0500	0.0089 J
YKAT	5/20/2019	14:10	1905022-35	N	N	33.8	0.01 U	0.80	0.013		0.0037	0.685	0.055	0.0072 J
YKAT	5/20/2019	14:20	1905022-31	Y	N	34.1	0.01 U	0.64	0.018		0.0040	0.745	0.057	0.0084 J
YKAT	6/3/2019	14:45	1906021-35	N	N	31.8	0.01 U	0.80	0.018		0.0038	0.854	0.050	0.0089 J
YKAT	6/17/2019	14:05	1906022-35	N	N	26.1	0.01 U	0.67	0.004 J		0.0022 J	0.762	0.036	0.0081 J
YKAT	6/17/2019	14:15	1906022-31	Y	N	26.0	0.01 U	0.71	0.003 J		0.0021 J	0.743	0.038	0.0076 J
YKAT	6/30/2019	13:14	1907027-35	N	N	25.5	0.01 U	0.70	0.006 J		0.0017 J	0.787	0.031	0.0063 J
YKAT	7/15/2019	14:35	1907028-35	N	N	25.2	0.01 U	0.69	0.01 U		0.0027 J	0.754	0.044	0.0066 J
YKAT	7/29/2019	13:15	1907029-35	N	N	25.4	0.01 U	0.71	0.01 U		0.0019 J	0.680	0.032	0.01 U
YKAT	7/29/2019	13:20	1907029-31	Y	N	25.5	0.01 U	0.64	0.003 J		0.0025 J	0.696	0.038	0.01 U
YKAT	8/12/2019	14:45	1908026-35	N	N	25.7	0.01 U	0.67	0.01 U		0.0025 J	0.694	0.035	0.007 J
YKAT	8/26/2019	14:30	1908027-35	N	N	26.4	0.01 U	0.65	0.003 J		0.0024 J	0.731	0.045	0.0076 J
YKAT	9/9/2019	13:30	1909025-35	N	N	31.1 J	0.01 U	0.70	0.002 J		0.0040	0.746	0.045	0.007 J
YKAT	9/23/2019	14:30	1909026-35	N	N	37.0	0.01 U	0.71	0.008 J		0.0044	0.701	0.036	0.0086 J
YKAT	10/7/2019	15:30	1910017-35	N	N	34.4	0.01 U	0.69	0.01 U		0.0048	0.604	0.037	0.01 U
YKAT	10/21/2019	14:45	1910018-35	N	N	32.9	0.004 J	0.86	0.006 J		0.0048	0.882	0.048	0.0068 J
YKAT	11/4/2019	13:30	1911015-35	N	N	35.2	0.01 U	0.77	0.009 J		0.0067 J	0.639	0.036	0.0067 J
YKAW	2/26/2019	12:30	1902034-16	N	N	44.1	0.01 U	0.69	0.159		0.0096	0.767	0.206	0.0150
YKAW	2/26/2019	12:45	1902034-32	Y	N	43.3	0.01 U	0.83	0.160		0.0096	0.768	0.214	0.0156
YKAW	3/12/2019	13:15	1903029-16	N	N	44.1	0.01 U	0.72	0.142		0.0108	0.809	0.18	0.0167
YKAW	3/12/2019	13:35	1903029-31	Y	N	43.7	0.01 U	0.74	0.146		0.0105	0.802	0.183	0.0182
YKAW	3/26/2019	13:10	1903030-16	N	N	45.3	0.005 J	2.03	0.248		0.0128	2.09	0.348	0.0382
YKAW	4/9/2019	14:00	1904024-16	N	N	46.4	0.01 U	1.94	0.128		0.0102	2.20	0.172	0.0214

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YKAW	4/23/2019	13:45	1904025-16	N	N	40.9	0.01 U	2.07	0.100		0.0091	1.45	0.151	0.0188
YKAW	4/23/2019	14:00	1904025-31	Y	N	40.4	0.006 J	1.30	0.097		0.0091	1.51	0.162	0.0192
YKAW	5/7/2019	13:50	1905021-16	N	N	46.0	0.005 J	1.31	0.159		0.0157	1.44	0.243	0.0279
YKAW	5/21/2019	15:30	1905022-16	N	N	45.3	0.009 J	1.30	0.173		0.0167	1.24	0.257	0.0263
YKAW	5/21/2019	15:35	1905022-32	Y	N	45.3	0.008 J	1.07	0.173		0.0162	1.23	0.258	0.0266
YKAW	6/4/2019	16:25	1906021-16	N	N	44.8	0.005 J	1.31	0.141		0.0174	1.37	0.176	0.0313
YKAW	6/18/2019	7:55	1906022-16	N	N	32.1	0.008 J	0.83	0.088		0.0074	0.918	0.154	0.0180
YKAW	7/1/2019	8:15	1907027-32	Y	N	31.5	0.011	0.94	0.121		0.0085	0.977	0.192	0.0178
YKAW	7/1/2019	8:30	1907027-16	N	N	31.0	0.012	0.87	0.122		0.0083	0.879	0.186	0.0191
YKAW	7/16/2019	8:45	1907028-16	N	N	30.0	0.005 J	0.77	0.096		0.0085	0.864	0.172	0.0174
YKAW	7/30/2019	9:15	1907029-16	N	N	30.0	0.01 U	0.78	0.061		0.0071	0.786	0.115	0.0147
YKAW	8/13/2019	9:15	1908026-16	N	N	30.8	0.01 U	0.87	0.064		0.0074	0.827	0.112	0.0149
YKAW	8/27/2019	8:45	1908027-16	N	N	31.1	0.01 U	0.81	0.054		0.0074	0.841	0.106	0.0128
YKAW	8/27/2019	9:00	1908027-31	Y	N	31.2	0.01 U	0.76	0.053		0.0071	0.828	0.110	0.0135
YKAW	9/10/2019	9:00	1909025-16	N	N	38.9	0.01 U	1.12	0.120		0.0127	1.01	0.178	0.0188
YKAW	9/24/2019	10:45	1909026-16	N	N	43.4	0.01 U	0.87	0.197		0.0158	0.890	0.251	0.0246
YKAW	10/8/2019	9:15	1910017-16	N	N	40.7	0.01 U	0.80	0.14		0.0106	0.823	0.196	0.0165
YKAW	10/21/2019	9:00	1910018-16	N	N	44.1	0.005 J	1.04	0.116		0.0106	1.15	0.172	0.0145
YKAW	11/5/2019	14:45	1911015-16	N	N	46.4	0.01 U	0.83	0.179		0.0151	0.923	0.217	0.0211
YKAW	11/5/2019	15:00	1911015-33	Y	N	45.7	0.01 U	0.93	0.179		0.0151	0.830	0.220	0.0195
YKCE	2/25/2019	13:54	1902034-09	N	N	30.1	0.01 U	0.66	0.01 U		0.0023 J	1.10	0.043	0.01 U
YKCE	3/11/2019	13:34	1903029-09	N	N	29.7	0.01 U	0.77	0.01 U		0.0033	0.873	0.034	0.0172
YKCE	3/11/2019	14:02	1903029-32	Y	N	29.6	0.01 U	0.73	0.01 U		0.0035	0.879	0.029	0.01 U
YKCE	3/25/2019	13:30	1903030-09	N	N	31.5	0.01 U	0.94	0.008 J		0.0019 J	0.873	0.035	0.0071 J
YKCE	4/8/2019	13:10	1904024-09	N	N	32.3	0.01 U	1.08	0.01 U		0.0029 J	0.935	0.065	0.0071 J
YKCE	4/22/2019	13:40	1904025-09	N	N	29.3	0.01 U	1.00	0.003 J		0.0035	0.942	0.034	0.0074 J

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YKCE	5/6/2019	12:05	1905021-09	N	N	38.1	0.01 U	0.89	0.004 J		0.0038	1.04	0.033	0.0117
YKCE	5/20/2019	11:52	1905022-09	N	N	31.5	0.01 U	0.75	0.01 U		0.0031	0.709	0.035	0.0064 J
YKCE	6/3/2019	11:41	1906021-09	N	N	29.9	0.01 U	0.70	0.003 J		0.0026 J	0.735	0.033	0.0069 J
YKCE	6/17/2019	10:24	1906022-09	N	N	24.9	0.01 U	0.86	0.007 J		0.002 J	0.712	0.039	0.01 U
YKCE	6/30/2019	9:58	1907027-09	N	N	24.7	0.01 U	0.80	0.003 J		0.003 U	0.764	0.029	0.01 U
YKCE	7/15/2019	11:07	1907028-09	N	N	24.8	0.01 U	0.73	0.01 U		0.0024 J	0.799	0.040	0.0065 J
YKCE	7/29/2019	10:43	1907029-09	N	N	24.8	0.01 U	0.67	0.01 U		0.003 U	0.663	0.025	0.01 U
YKCE	8/12/2019	10:25	1908026-09	N	N	24.9	0.01 U	0.70	0.01 U		0.002 J	0.724	0.038	0.01 U
YKCE	8/26/2019	10:22	1908027-09	N	N	26.5	0.01 U	0.82	0.01 U		0.0021 J	0.771	0.038	0.0067 J
YKCE	9/9/2019	12:00	1909025-09	N	N	33.4 J	0.01 U	0.80	0.01 U		0.0021 J	0.739	0.044	0.01 U
YKCE	9/23/2019	12:15	1909026-09	N	N	39.8	0.01 U	0.61	0.003 J		0.0026 J	0.663	0.031	0.01 U
YKCE	10/7/2019	10:50	1910017-09	N	N	34.6	0.01 U	0.62	0.01 U		0.0021 J	0.633	0.031	0.01 U
YKCE	10/21/2019	12:59	1910018-09	N	N	34.2	0.01 U	0.95	0.004 J		0.0040	0.958	0.045	0.01 U
YKCE	11/4/2019	11:23	1911015-09	N	N	37.0	0.01 U	0.80	0.01 U		0.0034 J	0.866	0.030	0.0066 J
YKCE	11/4/2019	11:25	1911015-31	Y	N	37.2	0.01 U	0.87	0.003 J		0.0036 J	0.727	0.030	0.01 U
YKEA	2/25/2019	14:45	1902034-02	N	N	21.6	0.01 U	0.66	0.013		0.0021 J	0.709	0.053	0.01 U
YKEA	3/11/2019	11:00	1903029-02	N	N	20.9	0.01 U	1.79	0.023		0.0031	0.650	0.042	0.0067 J
YKEA	3/25/2019	11:45	1903030-02	N	N	20.9	0.01 U	0.77	0.032		0.002 J	0.776	0.055	0.01 U
YKEA	4/8/2019	11:05	1904024-02	N	N	23.0	0.01 U	0.87	0.015		0.0035	1.05	0.045	0.01 U
YKEA	4/22/2019	11:00	1904025-02	N	N	22.7	0.01 U	1.75	0.013		0.0039	0.913	0.033	0.0071 J
YKEA	5/6/2019	10:30	1905021-02	N	N	20.2	0.01 U	1.15	0.031		0.0022 J	0.782	0.056	0.01 U
YKEA	5/20/2019	10:00	1905022-02	N	N	17.8	0.01 U	0.70	0.043		0.0024 J	0.695	0.074	0.0071 J
YKEA	6/3/2019	10:35	1906021-02	N	N	16.4	0.01 U	0.83	0.029		0.003 U	0.805	0.050	0.01 U
YKEA	6/17/2019	10:25	1906022-02	N	N	15.5	0.01 U	0.64	0.017		0.0019 J	0.739	0.051	0.0065 J
YKEA	6/30/2019	11:25	1907027-02	N	N	16.7	0.01 U	0.75	0.012		0.0018 J	0.812	0.031	0.0063 J
YKEA	7/15/2019	11:35	1907028-02	N	N	17.3	0.01 U	0.74	0.006 J		0.0022 J	0.691	0.046	0.01 U

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YKEA	7/29/2019	12:10	1907029-02	N	N	17.5	0.01 U	0.60	0.005 J		0.0022 J	0.664	0.040	0.01 U
YKEA	8/12/2019	11:20	1908026-02	N	N	18.0	0.01 U	0.68	0.01 U		0.003 U	0.786	0.029	0.01 U
YKEA	8/26/2019	11:00	1908027-02	N	N	20.7	0.01 U	0.66	0.003 J		0.003 U	0.726	0.042	0.01 U
YKEA	9/9/2019	10:35	1909025-02	N	N	21.5 J	0.01 U	0.70	0.003 J		0.003 U	0.744	0.042	0.01 U
YKEA	9/23/2019	11:30	1909026-02	N	N	22.2	0.01 U	0.64	0.004 J		0.003 U	0.638	0.024 J	0.01 U
YKEA	10/7/2019	11:50	1910017-02	N	N	21.9	0.01 U	0.95	0.01 U		0.003 U	0.676	0.029	0.01 U
YKEA	10/22/2019	9:30	1910018-02	N	N	20.1	0.01 U	1.13	0.013		0.003 U	1.26	0.047	0.0065 J
YKEA	11/4/2019	9:25	1911015-02	N	N	24.9	0.01 U	0.83	0.011		0.003 UJ	0.917	0.043	0.01 U
YKEL	2/26/2019	11:10	1902034-14	N	Y	41.5	0.01 U	0.64	0.035		0.0026 J	0.778	0.057	0.0065 J
YKEL	3/12/2019	10:15	1903029-14	N	Y	41.8	0.01 U	0.65	0.029		0.0039	0.735	0.057	0.0096 J
YKEL	3/26/2019	8:36	1903030-14	N	Y	44.1	0.005 J	1.95	0.197		0.0095	2.01	0.301	0.0333
YKEL	4/9/2019	8:45	1904024-14	N	Y	44.9	0.01 U	1.95	0.097		0.0066	2.00	0.140	0.0223
YKEL	4/23/2019	8:35	1904025-14	N	Y	40.1	0.01 U	1.28	0.074		0.0064	1.42	0.133	0.0155
YKEL	5/7/2019	8:40	1905021-14	N	Y	44.7	0.005 J	1.32	0.082		0.0055	1.26	0.140	0.0179
YKEL	5/21/2019	8:33	1905022-14	N	Y	44.2	0.01 U	1.08	0.084		0.0064	1.16	0.137	0.0128
YKEL	6/4/2019	8:30	1906021-14	N	Y	42.7	0.01 U	1.03	0.102		0.0096	1.13	0.160	0.0226
YKEL	6/4/2019	8:55	1906021-31	Y	Y	42.5	0.01 U	0.97	0.091		0.0083	1.07	0.174	0.0192
YKEL	6/18/2019	8:28	1906022-14	N	Y	29.9	0.01 U	0.77	0.019		0.0032	0.836	0.066	0.0131
YKEL	7/1/2019	8:16	1907027-14	N	Y	28.9	0.012	0.83	0.044		0.0042	0.873	0.106	0.0117
YKEL	7/16/2019	9:24	1907028-14	N	Y	28.5	0.01 U	0.83	0.048		0.0053	0.933	0.123	0.0133
YKEL	7/30/2019	9:20	1907029-14	N	Y	27.8	0.01 U	0.80	0.018		0.0029 J	0.809	0.06	0.0094 J
YKEL	8/13/2019	9:36	1908026-14	N	Y	29.1	0.01 U	0.81	0.024		0.0038	0.842	0.074	0.0139
YKEL	8/27/2019	9:17	1908027-14	N	Y	28.9	0.01 U	1.24	0.017		0.0039	0.797	0.072	0.0093 J
YKEL	9/10/2019	9:30	1909025-14	N	Y	35.9	0.01 U	0.95	0.065		0.0081	1.04	0.129	0.0148
YKEL	9/24/2019	9:10	1909026-14	N	Y	39.4	0.01 U	0.91	0.094		0.0071	0.881	0.153	0.0130
YKEL	10/8/2019	8:34	1910017-14	N	Y	36.2	0.01 U	0.63	0.039		0.0035	0.691	0.093	0.0078 J

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YKEL	10/22/2019	8:45	1910018-14	N	Y	41.2	0.007 J	1.06	0.030		0.0034	1.28	0.092	0.0225
YKEL	11/5/2019	8:35	1911015-14	N	Y	43.2	0.007 J	0.84	0.038		0.003 J	0.882	0.099	0.0093 J
YKHB	2/27/2019	13:45	1902034-30	N	Y	60.2	0.01 U	0.92	0.169		0.0097	1.03	0.241	0.0161
YKHB	3/13/2019	14:53	1903029-30	N	Y	61.3	0.01 U	1.07	0.109		0.0086	1.36	0.188	0.0146
YKHB	3/27/2019	13:40	1903030-30	N	Y	52.6	0.008 J	2.25	0.275		0.0201	2.58	0.400	0.0512
YKHB	4/10/2019	12:58	1904024-30	N	Y	52.3	0.013	2.79	0.122		0.0249	2.97	0.248	0.0511
YKHB	4/24/2019	13:10	1904025-30	N	Y	44.3	0.011	1.71	0.117		0.0175	1.93	0.205	0.0480
YKHB	5/8/2019	13:08	1905021-30	N	Y	54.5	0.018	1.76	0.262		0.0358	1.92	0.424	0.0543
YKHB	5/8/2019	13:30	1905021-32	Y	Y	54.2	0.019	1.81	0.267		0.0357	2.00	0.410	0.0551
YKHB	5/22/2019	11:45	1905022-30	N	Y	59.1	0.015	1.74	0.250		0.0426	1.92	0.408	0.0590
YKHB	6/5/2019	12:35	1906021-30	N	Y	61.1	0.021	1.98	0.193		0.0383	1.97	0.340	0.0566
YKHB	6/19/2019	13:36	1906022-30	N	Y	39.5	0.008 J	1.55	0.099		0.0149	1.40	0.183	0.0302
YKHB	7/2/2019	13:10	1907027-30	N	Y	39.0	0.029	1.33	0.244		0.0273	1.58	0.043	0.0430
YKHB	7/17/2019	15:45	1907028-30	N	Y	38.5	0.010	1.13	0.165		0.0204	1.33	0.274	0.0389
YKHB	7/31/2019	14:00	1907029-30	N	Y	37.3	0.007 J	1.07	0.094		0.0164	1.16	0.201	0.0280
YKHB	8/14/2019	13:48	1908026-30	N	Y	41.8	0.005 J	1.40	0.098		0.0214	1.31	0.201	0.0349
YKHB	8/28/2019	14:08	1908027-30	N	Y	41.2	0.005 J	1.19	0.050		0.0144	1.35	0.148	0.0248
YKHB	8/28/2019	14:40	1908027-33	Y	Y	41.4	0.005 J	1.14	0.052		0.0149	1.28	0.155	0.0247
YKHB	9/11/2019	13:53	1909025-30	N	Y	55.7	0.007 J	1.59	0.113		0.0258	1.70	0.256	0.0382
YKHB	9/25/2019	14:50	1909026-30	N	Y	65.3	0.006 J	1.55	0.135		0.0252	1.57	0.273	0.0381
YKHB	10/9/2019	12:05	1910017-30	N	Y	59.2	0.01 U	1.06	0.147		0.0173	1.30	0.247	0.0262
YKHB	10/23/2019	14:05	1910018-30	N	Y	47.7	0.007 J	2.26	0.227		0.0121	2.75	0.348	0.0522
YKHB	11/6/2019	11:05	1911015-30	N	Y	66.2	0.005 J	1.04	0.185		0.0115 J	1.06	0.251	0.0193
YKHO	2/25/2019	16:05	1902034-05	N	N	36.6	0.01 U	0.71	0.009 J		0.003 J	0.708	0.060	0.01 U
YKHO	3/11/2019	13:50	1903029-05	N	N	36.5	0.005 J	0.61	0.005 J		0.0042	0.697	0.036	0.01 U
YKHO	3/25/2019	15:00	1903030-05	N	N	40.6	0.01 U	1.68	0.141		0.0058	1.80	0.189	0.0236

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YKHO	3/25/2019	15:10	1903030-32	Y	N	40.4	0.01 U	1.90	0.139		0.0053	1.70	0.186	0.0234
YKHO	4/8/2019	15:15	1904024-05	N	N	40.8	0.01 U	1.89	0.075		0.0053	1.58	0.111	0.0134
YKHO	4/22/2019	15:15	1904025-05	N	N	36.9	0.01 U	0.92	0.051		0.0043	1.21	0.087	0.0123
YKHO	5/6/2019	14:45	1905021-05	N	N	40.0	0.005 J	1.19	0.035		0.0043	0.952	0.070	0.0074 J
YKHO	5/6/2019	14:55	1905021-33	Y	N	40.3	0.01 U	0.83	0.034		0.004	0.951	0.063	0.0115
YKHO	5/20/2019	15:45	1905022-05	N	N	39.1	0.01 U	0.80	0.004 J		0.0033	0.840	0.044	0.0087 J
YKHO	6/3/2019	15:20	1906021-05	N	N	37.1	0.01 U	0.90	0.003 J		0.004	0.819	0.048	0.0088 J
YKHO	6/17/2019	14:50	1906022-05	N	N	27.4	0.005 J	0.71	0.01 U		0.0022 J	0.739	0.034	0.0088 J
YKHO	6/30/2019	13:25	1907027-31	Y	N	26.7	0.01 U	1.08	0.003 J		0.0019 J	0.807	0.035	0.0096 J
YKHO	6/30/2019	13:35	1907027-05	N	N	26.6	0.01 U	0.80	0.005 J		0.0023 J	0.748	0.041	0.0073 J
YKHO	7/15/2019	15:15	1907028-05	N	N	25.6	0.01 U	0.68	0.01 U		0.0042	0.753	0.041	0.007 J
YKHO	7/29/2019	15:26	1907029-05	N	N	25.7	0.01 U	0.67	0.003 J		0.0018 J	0.696	0.035	0.01 U
YKHO	8/12/2019	15:20	1908026-05	N	N	26.3	0.01 U	0.71	0.01 U		0.003 U	0.736	0.039	0.0083 J
YKHO	8/12/2019	15:30	1908026-33	Y	N	26.2	0.01 U	0.72	0.01 U		0.0025 J	0.734	0.044	0.0071 J
YKHO	8/26/2019	15:15	1908027-05	N	N	27.0	0.01 U	0.69	0.01 U		0.0024 J	0.725	0.034	0.0064 J
YKHO	9/9/2019	14:35	1909025-05	N	N	29.9	0.01 U	0.64	0.003 J		0.0028 J	0.734	0.040	0.01 U
YKHO	9/23/2019	15:00	1909026-05	N	N	33.4	0.01 U	0.65	0.01 U		0.003	0.649	0.035	0.0078 J
YKHO	10/7/2019	16:05	1910017-05	N	N	32.5	0.01 U	0.68	0.01 U		0.0031	0.616	0.028	0.0210
YKHO	10/21/2019	15:15	1910018-05	N	N	37.6	0.005 J	0.91	0.005 J		0.0043	0.994	0.037	0.0066 J
YKHO	10/21/2019	15:30	1910018-31	Y	N	37.7	0.01 U	0.93	0.005 J		0.0038	0.987	0.046	0.01 U
YKHO	11/4/2019	14:30	1911015-05	N	N	39.0	0.01 U	0.79	0.004 J		0.0041	0.767	0.034	0.0067 J
YKNS	2/25/2019	11:45	1902034-07	N	Y	27.6	0.01 U	0.72	0.005 J		0.0039	0.614	0.067	0.01 U
YKNS	3/11/2019	9:45	1903029-07	N	Y	26.5	0.01 U	0.59	0.01 U		0.0035	0.640	0.021 J	0.01 U
YKNS	3/25/2019	11:15	1903030-07	N	Y	27.2	0.01 U	1.14	0.014		0.003 J	0.934	0.050	0.0111
YKNS	4/8/2019	10:45	1904024-07	N	Y	27.9	0.01 U	1.00	0.010		0.0039	0.984	0.041	0.0089 J
YKNS	4/22/2019	11:00	1904025-07	N	Y	28.4	0.01 U	1.13	0.004 J		0.0051	1.03	0.038	0.0103

Study Location ID	Date	Time (local)	Sample ID	Rep Y/N	Comp Y/N	Alk (mg/L)	NH3 (mg/L)	DOC (mg/L)	NO3/ NO2 (mg/L)	NO3 (mg/L)	OP (mg/L)	TOC (mg/L)	TPN (mg/L)	TP (mg/L)
YKNS	5/6/2019	10:15	1905021-07	N	Y	29.1	0.01 U	0.94	0.01 J		0.0047	0.796	0.035	0.0085 J
YKNS	5/20/2019	10:00	1905022-07	N	Y	28.6	0.01 U	0.71	0.012		0.0043	0.759	0.061	0.0091 J
YKNS	5/20/2019	10:16	1905022-33	Y	Y	27.8	0.01 U	0.60	0.012		0.0042	0.641	0.036	0.0089 J
YKNS	6/3/2019	10:35	1906021-07	N	Y	27.2	0.004 J	0.65	0.012		0.0033	0.701	0.049	0.0083 J
YKNS	6/17/2019	9:45	1906022-07	N	Y	26.1	0.01 U	0.65	0.011		0.0031	0.694	0.067	0.0098 J
YKNS	6/30/2019	9:15	1907027-07	N	Y	27.1	0.01 U	0.58	0.007 J		0.003 J	0.683	0.050	0.0104
YKNS	7/15/2019	10:05	1907028-07	N	Y	26.3	0.01 U	0.84	0.01 U		0.0035	0.816	0.068	0.0078 J
YKNS	7/29/2019	9:56	1907029-07	N	Y	26.2	0.01 U	0.76	0.013		0.003	0.872	0.112	0.0077 J
YKNS	8/12/2019	9:45	1908026-07	N	Y	22.5	0.01 U	0.68	0.004 J		0.0033	0.740	0.035	0.0095 J
YKNS	8/26/2019	9:45	1908027-07	N	Y	22.8	0.01 U	0.75	0.003 J		0.0025 J	0.895	0.063	0.0088 J
YKNS	9/9/2019	9:24	1909025-07	N	Y	25.7 J	0.01 U	0.77	0.01 U		0.0033	0.670	0.045	0.0071 J
YKNS	9/9/2019	9:51	1909025-31	Y	Y	25.3 J	0.01 U	0.64	0.003 J		0.003 J	0.664	0.048	0.0066 J
YKNS	9/23/2019	10:00	1909026-07	N	Y	29.2	0.01 U	0.60	0.004 J		0.0036	0.652	0.038	0.0075 J
YKNS	10/7/2019	10:00	1910017-07	N	Y	27.9	0.01 U	0.61	0.01 U		0.0024 J	0.630	0.041	0.01 U
YKNS	10/21/2019	11:05	1910018-07	N	Y	27.5	0.01 U	0.92	0.008 J		0.0041	1.02	0.041	0.007 J
YKNS	11/4/2019	9:50	1911015-07	N	Y	30.9	0.01 U	0.84	0.008 J		0.0043 J	0.881	0.043	0.0077 J
YKUM	2/27/2019	14:09	1902034-27	N	Y	57.8	0.01 U	0.78	0.234		0.0135	0.916	0.281	0.0198
YKUM	3/13/2019	11:20	1903029-27	N	Y	57.7	0.01 U	1.09	0.215		0.0144	0.926	0.273	0.0187
YKUM	3/13/2019	11:40	1903029-33	Y	Y	58.5	0.01 U	1.03	0.210		0.0143	0.979	0.258	0.0196
YKUM	3/27/2019	11:00	1903030-27	N	Y	52.3	0.005 J	2.06	0.283		0.0165	2.48	0.386	0.0438
YKUM	4/10/2019	10:15	1904024-27	N	Y	50.8	0.006 J	1.98	0.148		0.0137	2.19	0.243	0.0344
YKUM	4/24/2019	12:10	1904025-27	N	Y	43.0	0.006 J	1.53	0.129		0.0156	1.75	0.212	0.0436
YKUM	5/8/2019	11:45	1905021-27	N	Y	53.6	0.025	1.71	0.284		0.0462	1.82	0.469	0.0712
YKUM	5/22/2019	10:50	1905022-27	N	Y	57.8	0.014	1.62	0.291		0.0404	1.73	0.410	0.0628
YKUM	6/5/2019	11:30	1906021-27	N	Y	58.5	0.009 J	1.54	0.238		0.0318	1.82	0.372	0.0526
YKUM	6/19/2019	11:15	1906022-27	N	Y	38.4	0.012	1.19	0.140		0.0193	1.21	0.227	0.0376

Study Location ID	Date	Time (local)	Sample ID	Rep Y/N	Comp Y/N	Alk (mg/L)	NH3 (mg/L)	DOC (mg/L)	NO3/ NO2 (mg/L)	NO3 (mg/L)	OP (mg/L)	TOC (mg/L)	TPN (mg/L)	TP (mg/L)
YKUM	7/2/2019	8:56	1907027-27	N	Y	38.6	0.041	1.24	0.264		0.0296	1.38	0.430	0.0429
YKUM	7/17/2019	8:43	1907028-27	N	Y	38.0	0.007 J	1.06	0.191		0.0184	1.24	0.299	0.0335
YKUM	7/31/2019	8:47	1907029-27	N	Y	37.1	0.006 J	1.07	0.128		0.0151	1.03	0.220	0.0261
YKUM	8/14/2019	8:30	1908026-27	N	Y	40.8	0.005 J	1.14	0.127		0.0201	1.20	0.208	0.0357
YKUM	8/28/2019	12:49	1908027-27	N	Y	41.6	0.01 U	1.20	0.093		0.0164	1.16	0.175	0.0275
YKUM	9/11/2019	8:15	1909025-27	N	Y	57.1	0.006 J	1.65	0.246		0.0335	1.57	0.367	0.0483
YKUM	9/25/2019	8:10	1909026-27	N	Y	62.7	0.01 U	1.43	0.287		0.0293	1.53	0.413	0.0391
YKUM	9/25/2019	8:35	1909026-33	Y	Y	62.9	0.004 J	1.38	0.284		0.0287	1.40	0.401	0.0452
YKUM	10/9/2019	9:00	1910017-27	N	Y	58.3	0.01 U	1.04	0.288		0.0237	1.19	0.385	0.0322
YKUM	10/23/2019	8:50	1910018-27	N	Y	45.6	0.005 J	2.07	0.236		0.0118	2.39	0.311	0.0638
YKUM	11/6/2019	9:45	1911015-27	N	Y	64.2	0.01 U	0.98	0.288		0.0187 J	0.976	0.365	0.0250

Rep = Replicate
Comp = Composite
Alk = Alkalinity
NH3 = Ammonia
DOC = Dissolved Organic Carbon
NO3/NO2 = Nitrate/Nitrite
NO3 = Nitrate
OP = Orthophosphate
TOC = Total Organic Carbon
TPN = Total Persulfate Nitrogen
TP = Total Phosphorus

J = Analyte was positively identified. The reported result is an estimate.
U = Analyte was not detected at or above the reported result.
UJ = Analyte was not detected at or above the reported estimate.

Note: NO3 samples were taken at WILC, WLTH, and CHTH on specific dates.

Table B3. Summary of Laboratory Case Narratives.

Laboratory Work Order	Date Samples were Received at MEL	Issues
1902034	2/26/19-2/28/2019	None. Results were reported to the method detection limit (MDL). Results greater than the MDL but below the reporting limit (RL) were qualified as estimates, indicated with a "J."
1903029	3/12/19-3/14/19	Results were reported to the method detection limit (MDL). Results greater than the MDL but below the reporting limit (RL) were qualified as estimates, indicated with a "J." Samples 23 and 24 for TPN and nitrate-nitrite were qualified as estimates due to matrix interference. Upon initial analyses, the concentrations of the undiluted samples exceeded the calibration ranges. The samples were diluted and reanalyzed. The diluted results did not correlate with the undiluted results, they were significantly lower. The samples were analyzed by ion chromatography for nitrate-nitrite. The results were similar to the diluted analyses. Sample 23 = WLTH, Sample 24 = CHTH
1903030	3/26/19-3/28/19	None. Results were reported to the method detection limit (MDL). Results greater than the MDL but below the reporting limit (RL) were qualified as estimates, indicated with a "J."
1904024	4/9/19-4/11/19	None. Results were reported to the method detection limit (MDL). Results greater than the MDL but below the reporting limit (RL) were qualified as estimates, indicated with a "J."
1904025	4/23/19-4/25/19	Results were reported to the method detection limit (MDL). Results greater than the MDL but below the reporting limit (RL) were qualified as estimates, indicated with a "J." The ammonia concentration in Sample 28 may have been biased low due to matrix interference. It was qualified as an estimate. Sample 28 = UMT
1905021	5/7/19-5/9/19	None. Results were reported to the method detection limit (MDL). Results greater than the MDL but below the reporting limit (RL) were qualified as estimates, indicated with a "J."
1905022	5/21/19-5/23/19	None. Results were reported to the method detection limit (MDL). Results greater than the MDL but below the reporting limit (RL) were qualified as estimates, indicated with a "J."
1906021	6/4/19-6/6/19	None. Results were reported to the method detection limit (MDL). Results greater than the MDL but below the reporting limit (RL) were qualified as estimates, indicated with a "J."
1906022	6/18/19-6/20/19	None. Results were reported to the method detection limit (MDL). Results greater than the MDL but below the reporting limit (RL) were qualified as estimates, indicated with a "J."
1907027	7/1/19-7/3/19	Results were reported to the method detection limit (MDL). Results greater than the MDL but below the reporting limit (RL) were qualified as estimates, indicated with a "J." Sample 19 for OP was analyzed out of hold time due to laboratory error. The result was qualified as an estimate. Sample 19 = PACK
1907028	7/16/19-7/18/19	None. Results were reported to the method detection limit (MDL). Results greater than the MDL but below the reporting limit (RL) were qualified as estimates, indicated with a "J."
1907029	7/30/19-8/1/19	None. Results were reported to the method detection limit (MDL). Results greater than the MDL but below the reporting limit (RL) were qualified as estimates, indicated with a "J."

Laboratory Work Order	Date Samples were Received at MEL	Issues
1908026	8/13/19-8/15/19	Results were reported to the method detection limit (MDL). Results greater than the MDL but below the reporting limit (RL) were qualified as estimates, indicated with a "J." Sample 01 for OP was analyzed out of hold time due to laboratory error. The result was qualified as an estimate. Sample 1 = CLE
1908027	8/27/19-8/29/19	None. Results were reported to the method detection limit (MDL). Results greater than the MDL but below the reporting limit (RL) were qualified as estimates, indicated with a "J."
1909025	9/10/19-9/12/19	Results were reported to the method detection limit (MDL). Results greater than the MDL but below the reporting limit (RL) were qualified as estimates, indicated with a "J." Samples 01, 02, 07, 09, 31, and 35 for alkalinity and 43 and 44 for dissolved alkalinity were analyzed out of hold time due to laboratory error. The results were qualified as estimates. See table B1 for comprehensive list of samples.
1909026	9/24/19-9/26/19	None. Results were reported to the method detection limit (MDL). Results greater than the MDL but below the reporting limit (RL) were qualified as estimates, indicated with a "J."
1910017	10/8/19-10/10/19	None. Results were reported to the method detection limit (MDL). Results greater than the MDL but below the reporting limit (RL) were qualified as estimates, indicated with a "J."
1910018	10/22/19/10/24/19	Results were reported to the method detection limit (MDL). Results greater than the MDL but below the reporting limit (RL) were qualified as estimates, indicated with a "J." The container for sample 23 for OP analysis contained ice upon receipt. The result was qualified as an estimate. Sample 23 = WLTH
1911015	11/6/19-11/8/19	Results were reported to the method detection limit (MDL). Results greater than the MDL but below the reporting limit (RL) were qualified as estimates, indicated with a "J." Sample 34 for OP analysis was received with ice in its container. The result was qualified as an estimate. Samples 01 through 04, 07, 09, 11 through 14, 18 through 22, 24, 25, 27, 28, 30 through 32, 35, and 45 through 46 for OP were received with insufficient hold time remaining or was received out of hold time and were analyzed out of hold time. The results were qualified as estimates. This was due to shipping issues. See table B1 for comprehensive list of samples.

Example: 1903029-23; 1903029 is the laboratory work order number, and -23 is the specific sample. Together, these make up the sample ID.
See Table B1 for the list of sample IDs.

None = Samples were received within hold times and at proper temperatures. No other issues were noted.

MEL = Manchester Environmental Laboratory
Alk = Alkalinity
NH3 = Ammonia
NO3/NO2 = Nitrate/Nitrite
NO3 = Nitrate
OP = Orthophosphate
TPN = Total Persulfate Nitrogen

Table B4. Location, date, and time of DO sample collection and DO Winkler titration results.

Study Location ID	Date Collected	Time Collected (local)	Dissolved Oxygen (mg/L)
YKAW	4/3/2019	12:15	11.9
YKEA	4/3/2019	15:45	11.6
YKHO	4/3/2019	13:58	12.5
YKSM	4/3/2019	10:15	12.1
CLE	4/8/2019	9:58	12.7
YKHO	4/8/2019	15:45	12.3
YKNS	4/8/2019	11:00	12.0
YKAW	4/9/2019	15:25	11.9
CHTH	4/10/2019	8:35	11.2
YKSM	4/10/2019	12:00	12.1
CLE	4/22/2019	9:45	11.9
CLE	4/22/2019	10:07	11.9
SWAC	4/22/2019	16:50	10.6
YKEA	4/22/2019	11:15	11.4
YKHO	4/22/2019	16:15	11.3
YKAW	4/23/2019	14:45	11.0
YKEL	4/23/2019	8:35	11.1
CHTH	4/24/2019	8:25	10.6
YKHB	4/24/2019	13:10	11.6
YKSM	4/24/2019	12:06	11.5
YKAW	4/30/2019	10:25	11.5
YKEA	4/30/2019	13:15	11.6
YKEA	4/30/2019	13:20	11.6
YKHO	4/30/2019	10:00	12.2
YKSM	5/1/2019	8:00	10.5
CLE	5/6/2019	9:02	11.5

Study Location ID	Date Collected	Time Collected (local)	Dissolved Oxygen (mg/L)
SWAC	5/6/2019	14:55	10.1
YKEA	5/6/2019	10:41	10.7
YKHO	5/6/2019	14:45	11.0
YKAW	5/7/2019	13:50	11.8
YKAW	5/7/2019	14:37	12.0
YKEL	5/7/2019	8:40	10.4
CHTH	5/8/2019	8:20	9.6
YKSM	5/8/2019	12:00	11.2
YKUM	5/8/2019	11:45	11.6
CLE	5/20/2019	9:00	11.4
YKEA	5/20/2019	10:30	10.3
YKHO	5/20/2019	15:35	11.0
YKAW	5/21/2019	16:15	10.6
YKEL	5/21/2019	8:33	10.3
CHTH	5/22/2019	8:23	9.7
UMT	5/22/2019	10:04	10.5
YKSM	5/22/2019	12:10	11.2
WILC	5/24/2019	7:40	9.3
YKAW	5/24/2019	7:24	9.3
YKSM	5/24/2019	6:30	8.9
CLE	6/3/2019	9:16	11.5
SWAC	6/3/2019	16:30	9.0
YKEA	6/3/2019	11:00	10.0
YKHO	6/3/2019	15:45	10.1
MANL	6/4/2019	15:55	8.8
YKAW	6/4/2019	16:50	11.6
YKEL	6/4/2019	8:53	10.2
CHTH	6/5/2019	8:20	9.5
YKSM	6/5/2019	11:15	10.4

Study Location ID	Date Collected	Time Collected (local)	Dissolved Oxygen (mg/L)
YKUM	6/5/2019	11:30	10.9
CLE	6/17/2019	8:56	10.6
CRY	6/17/2019	10:36	7.4
SWAC	6/17/2019	14:43	9.0
YKEA	6/17/2019	10:45	9.8
YKHO	6/17/2019	15:30	10.3
DRYM	6/18/2019	13:21	10.6
YKAW	6/18/2019	8:15	9.5
YKEL	6/18/2019	8:28	9.8
CHTH	6/19/2019	8:22	9.3
UMT	6/19/2019	12:15	9.1
YKSM	6/19/2019	12:15	10.8
CLE	6/30/2019	8:30	10.1
REEC	6/30/2019	9:49	6.1
SWAC	6/30/2019	14:15	9.0
YKEA	6/30/2019	11:40	9.5
YKHO	6/30/2019	14:00	10.0
DRYM	7/1/2019	15:05	9.9
YKAW	7/1/2019	9:00	9.6
YKEL	7/1/2019	8:16	9.7
CHTH	7/2/2019	10:38	8.9
YKSM	7/2/2019	13:30	10.8
YKUM	7/2/2019	8:56	9.2
CLE	7/15/2019	9:15	9.2
REEC	7/15/2019	9:20	5.7
SWAC	7/15/2019	15:47	8.9
YKEA	7/15/2019	11:52	9.3
YKHO	7/15/2019	15:40	9.3
DRYM	7/16/2019	15:11	10.0

Study Location ID	Date Collected	Time Collected (local)	Dissolved Oxygen (mg/L)
YKAW	7/16/2019	9:15	9.3
YKEL	7/16/2019	9:24	9.3
PACK	7/17/2019	13:52	11.3
UMT	7/17/2019	8:15	9.3
YKSM	7/19/2019	12:35	11.1
CLE	7/29/2019	8:54	9.0
CLE	7/29/2019	9:09	9.0
SWAC	7/29/2019	14:45	8.8
YKEA	7/29/2019	12:13	9.0
YKHO	7/29/2019	16:20	8.8
YKAW	7/30/2019	8:56	8.8
YKEL	7/30/2019	9:25	9.0
YKEL	7/30/2019	16:30	8.9
REEC	7/31/2019	12:20	6.4
UMT	7/31/2019	8:13	9.0
WILC	7/31/2019	10:30	9.4
YKSM	7/31/2019	14:10	10.3
CLE	8/12/2019	9:06	8.8
SWAC	8/12/2019	15:21	9.0
YKEA	8/12/2019	11:45	8.8
YKHO	8/12/2019	16:00	8.7
REEC	8/13/2019	15:20	6.4
YKAW	8/13/2019	9:00	8.8
YKEL	8/13/2019	9:36	8.8
NANU	8/14/2019	12:29	8.8
WILC	8/14/2019	8:15	7.8
YKSM	8/14/2019	12:45	9.9
YKUM	8/14/2019	8:42	8.4
CLE	8/26/2019	9:00	9.0

Study Location ID	Date Collected	Time Collected (local)	Dissolved Oxygen (mg/L)
SWAC	8/26/2019	14:10	9.3
YKEA	8/26/2019	11:30	9.2
YKHO	8/26/2019	15:40	9.2
YKAW	8/27/2019	9:30	9.1
YKEL	8/27/2019	9:17	9.3
YKUB	8/27/2019	15:20	9.3
NANU	8/28/2019	9:27	9.8
YKSM	8/28/2019	12:20	10.6
YKUM	8/28/2019	12:49	10.5
WILC	9/5/2019	10:00	9.0
YKNS	9/5/2019	14:00	9.0
YKUM	9/5/2019	9:25	9.1
CLE	9/9/2019	8:52	8.9
REEC	9/9/2019	8:40	5.1
SWAC	9/9/2019	15:19	9.3
YKEA	9/9/2019	10:58	9.0
YKHO	9/9/2019	15:07	9.5
PACK	9/10/2019	10:40	7.0
REEC	9/10/2019	14:25	7.8
YKAW	9/10/2019	9:25	9.6
YKEL	9/10/2019	9:30	9.2
CHTH	9/11/2019	12:00	9.6
YKSM	9/11/2019	13:45	11.7
YKUM	9/11/2019	8:15	8.8
CLE	9/23/2019	9:20	9.5
DRYM	9/23/2019	9:23	8.8
SWAC	9/23/2019	15:05	10.3
YKEA	9/23/2019	11:40	9.7
YKHO	9/23/2019	15:30	10.3

Study Location ID	Date Collected	Time Collected (local)	Dissolved Oxygen (mg/L)
REEC	9/24/2019	14:10	8.5
YKAW	9/24/2019	11:07	10.7
YKEL	9/24/2019	9:10	9.8
NANU	9/25/2019	12:20	10.1
YKSM	9/25/2019	13:10	12.5
YKUM	9/25/2019	8:10	9.3
YKUM	9/25/2019	8:35	9.4
CLE	10/7/2019	9:15	10.4
SWAC	10/7/2019	15:16	10.7
YKEA	10/7/2019	12:00	10.6
YKHO	10/7/2019	14:25	10.6
REEC	10/8/2019	15:05	9.6
YKAW	10/8/2019	9:45	10.6
YKEL	10/8/2019	8:34	10.4
PACK	10/9/2019	12:00	14.8
YKSM	10/9/2019	14:15	14.0
YKUM	10/9/2019	9:00	11.0
CLE	10/21/2019	9:45	10.7
SWAC	10/21/2019	15:20	10.9
YKAW	10/21/2019	9:30	11.0
YKHO	10/21/2019	15:45	11.4
REEC	10/22/2019	13:55	8.1
YKEA	10/22/2019	9:55	11.3
YKEL	10/22/2019	8:45	10.8
DRYM	10/23/2019	11:20	10.5
UMT	10/23/2019	8:20	10.9
WILC	10/23/2019	10:45	11.2
YKSM	10/23/2019	14:25	12.3
YKUM	10/23/2019	12:45	11.5

Study Location ID	Date Collected	Time Collected (local)	Dissolved Oxygen (mg/L)
CLE	11/4/2019	9:15	11.6
SWAC	11/4/2019	14:35	11.9
YKEA	11/4/2019	9:25	12.3
YKHO	11/4/2019	14:30	12.2
FOG	11/5/2019	8:45	10.4
REEC	11/5/2019	13:30	10.2
YKAW	11/5/2019	14:45	14.0
YKEL	11/5/2019	8:35	12.0
CHTH	11/6/2019	8:35	13.2
WLTH	11/6/2019	8:30	11.5
YKSM	11/6/2019	12:52	14.9
YKUM	11/6/2019	9:45	13.3

Appendix C. Field Measurements - Discrete

Table C1. Discrete surface water sonde measurements from 2019.

Study Location ID	Date	Time (local)	Replicate Y/N	Temp (°C)	pH (s.u.)	Conductivity (uS/cm)	Dissolved Oxygen (mg/L)
BIGC	2/25/2019	13:55	N	1.11	7.62	79.4	12.68
BIGC	3/11/2019	12:00	N	-0.03	7.41	79.0	13.41
BIGC	3/25/2019	13:30	N	4.10	7.30	69.1	11.57
BIGC	4/8/2019	12:50	N	4.55	7.48	62.9	11.86
BIGC	4/22/2019	12:45	N	5.72	7.38	56.6	11.39
BIGC	5/6/2019	11:45	N	6.37	7.12	58.4	11.49
BIGC	5/20/2019	10:30	N	6.52	7.61	54.9	11.16
BIGC	6/3/2019	12:10	N	10.15	7.61	63.5	10.33
BIGC	6/17/2019	12:50	N	14.33	7.66	74.9	9.61
BIGC	7/1/2019	14:00	N	14.85	7.50	81.0	9.05
BIGC	7/15/2019	12:45	N	13.90	7.60	79.7	9.37
BIGC	7/29/2019	13:15	N	17.08	7.61	84.1	8.86
BIGC	8/12/2019	13:10	N	17.49	7.95	72.1	8.66
BIGC	8/26/2019	12:30	N	16.40	7.63	69.0	9.10
BIGC	9/9/2019	12:00	N	16.00	8.06	71.0	9.09
BIGC	9/23/2019	12:45	N	12.95	7.68	67.9	9.62
BIGC	10/7/2019	13:45	N	9.70	7.70	66.3	10.34
BIGC	10/22/2019	12:00	N	6.87	7.59	63.0	11.49
BIGC	11/4/2019	10:20	N	3.72	7.34	70.6	12.13
CHTH	2/27/2019	10:00	N	3.74	8.01	396.9	12.72
CHTH	3/13/2019	8:30	N	4.14	7.66	400.6	11.84
CHTH	3/27/2019	9:30	N	6.17	7.92	204.0	12.16
CHTH	4/10/2019	8:35	N	6.75	7.77	260.8	10.98
CHTH	4/10/2019	8:35	Y	6.72	7.97	259.2	11.32
CHTH	4/24/2019	8:25	N	8.97	7.49	130.4	10.72
CHTH	4/24/2019	8:25	Y	8.93	7.70	131.5	11.00
CHTH	5/8/2019	8:20	N	11.61	7.80	318.0	9.73
CHTH	5/8/2019	8:20	Y	11.64	7.77	317.0	9.77
CHTH	5/8/2019	9:15	N	11.78	7.87	315.8	9.70
CHTH	5/22/2019	8:23	N	11.47	7.77	213.9	9.84
CHTH	5/22/2019	8:23	Y	11.51	7.76	213.7	9.94
CHTH	6/5/2019	8:20	N	13.16	7.80	239.0	9.50
CHTH	6/5/2019	8:20	Y	13.22	7.83	238.0	9.55
CHTH	6/19/2019	8:22	N	13.73	7.85	203.9	9.32
CHTH	6/19/2019	8:22	Y	13.77	7.76	203.0	9.42
CHTH	7/2/2019	10:38	N	15.58	7.80	270.6	9.00

Study Location ID	Date	Time (local)	Replicate Y/N	Temp (°C)	pH (s.u.)	Conductivity (uS/cm)	Dissolved Oxygen (mg/L)
CHTH	7/17/2019	10:45	N	15.82	7.86	318.7	8.97
CHTH	7/31/2019	10:20	N	15.61	7.83	319.9	9.51
CHTH	8/14/2019	10:07	N	17.43	7.87	258.1	8.85
CHTH	8/28/2019	11:15	N	16.52	7.94	200.7	9.27
CHTH	9/11/2019	12:00	N	15.30	8.04	256.4	9.83
CHTH	9/25/2019	10:10	N	12.97	7.92	239.6 EST	9.83
CHTH	10/9/2019	10:05	N	7.81	7.89	210.6	11.24
CHTH	10/23/2019	9:37	N	9.34	8.01	395.4	10.84
CHTH	11/6/2019	8:35	N	6.72	7.85	399.1	11.49
CLE	2/25/2019	10:20	N	1.97	7.30	55.1	12.49
CLE	3/11/2019	11:25	N	2.30	7.37	55.0	13.46
CLE	3/25/2019	9:38	N	3.28	7.60	58.6	12.44
CLE	4/8/2019	9:58	N	4.64	7.70	67.7	12.84
CLE	4/22/2019	9:45	N	5.87	7.24	52.7	11.94
CLE	4/22/2019	9:45	Y	5.83	7.35	53.0	11.67
CLE	4/22/2019	10:07	Y	6.02	7.20	52.8	11.75
CLE	4/22/2019	10:08	Y	5.96	7.33	53.2	11.66
CLE	5/6/2019	9:02	N	6.84	7.41	60.2	10.97
CLE	5/6/2019	9:02	Y	6.91	7.26	60.7	11.24
CLE	5/20/2019	9:00	N	8.35	7.47	56.0	10.71
CLE	5/20/2019	9:00	Y	8.42	7.35	55.4	11.03
CLE	5/20/2019	9:01	Y	8.51	7.39	57.7	11.04
CLE	6/3/2019	9:16	N	8.10	7.51	54.4	11.11
CLE	6/3/2019	9:16	Y	8.16	7.42	53.8	11.46
CLE	6/17/2019	8:56	N	9.31	7.24	43.8	10.56
CLE	6/30/2019	8:30	N	11.75	7.56	44.3	10.01
CLE	7/15/2019	9:15	N	15.28	7.31	44.0	9.13
CLE	7/29/2019	8:54	N	16.81	7.58	45.0	9.06
CLE	8/12/2019	9:06	N	18.13	7.68	48.0	8.71
CLE	8/12/2019	10:30	N	18.41	7.84	47.7	8.65
CLE	8/26/2019	9:00	N	15.86	7.57	50.9	8.92
CLE	9/9/2019	8:52	N	16.15	7.78	59.6	8.93
CLE	9/23/2019	9:20	N	13.30	7.70	67.1 EST	9.56
CLE	10/7/2019	9:15	N	9.41	7.34	63.4	10.04
CLE	10/21/2019	9:45	N	8.55	7.47	61.8	10.67
CLE	10/21/2019	9:59	Y	8.58	7.51	61.7	10.78
CLE	11/4/2019	9:15	N	6.29	7.53	59.0	11.63
CLPOTW	6/17/2019	13:30	N	10.80	7.03	375.5	6.71
CLPOTW	7/15/2019	13:00	N	9.54	7.25	333.0	7.65
CLPOTW	7/15/2019	13:15	N	17.40	6.89	335.8	4.92
CLPOTW	8/12/2019	13:15	N	10.17	7.25	355.0	7.03

Study Location ID	Date	Time (local)	Replicate Y/N	Temp (°C)	pH (s.u.)	Conductivity (uS/cm)	Dissolved Oxygen (mg/L)
CLPOTW	8/26/2019	13:30	N	12.37	6.92	352.7	6.27
CLPOTW	9/9/2019	13:00	N	13.45	7.26	541.6	6.49
CLPOTW	9/23/2019	13:05	N	11.87	7.18	371.3	7.48
CLPOTW	10/7/2019	13:45	N	10.63	7.51	411.6	7.70
CLPOTW	10/21/2019	13:00	N	9.50	7.19	307.7	6.67
CLPOTW	7/29/2019	13:00	Y		7.25	302.3	6.59
CRY	2/25/2019	13:20	N	0.76	7.75	353.7	14.14
CRY	3/11/2019	13:02	N	1.09	7.64	373.9	15.03
CRY	3/25/2019	12:45	N	5.16	7.87	204.4	11.73
CRY	4/8/2019	12:40	N	6.96	7.94	221.8	11.48
CRY	4/22/2019	13:15	N	9.65	8.29	271.3	12.21
CRY	5/6/2019	11:43	N	10.62	8.26	321.7	12.31
CRY	5/20/2019	10:30	N	10.77	7.73	363.5	10.06
CRY	6/3/2019	11:22	N	12.41	7.36	415.1	8.42
CRY	6/17/2019	10:21	N	12.54	6.91	554.5	6.34
CRY	6/30/2019	10:00	N	11.07	6.87	565.5	6.73
CRY	7/15/2019	11:11	N	12.11	6.70	601.3	6.92
CRY	10/7/2019	10:30	N	8.87	7.19	500.1	5.03
CRY	10/21/2019	12:37	N	9.20	7.13	518.0	8.53
DRY	2/26/2019	10:00	N	3.80	7.36	194.9	13.04
DRY	3/12/2019	9:53	N	3.83	7.33	196.5	13.31
DRY	3/26/2019	9:52	N	5.88	7.46	136.4	14.86
DRY	4/9/2019	12:10	N	10.03	8.33	163.4	13.37
DRY	4/23/2019	12:00	N	12.75	7.54	169.6	12.86
DRYM	5/7/2019	10:40	N	11.92	7.49	161.5	11.02
DRYM	5/21/2019	9:55	N	11.66	7.56	154.1	10.93
DRYM	6/4/2019	10:50	N	14.09	7.55	152.3	10.11
DRYM	6/18/2019	13:21	N	18.08	8.12	125.1	10.77
DRYM	7/1/2019	15:05	N	19.32	7.90	145.8	10.15
DRYM	7/16/2019	15:11	N	18.61	7.93	137.9	10.51
DRYM	8/13/2019	12:19	N	18.71	7.84	136.2	10.69
DRYM	9/10/2019	13:30	N	17.33	7.88	148.1	10.90
DRYM	9/24/2019	13:05	N	16.04	7.93	149.4 EST	11.07
DRYM	10/8/2019	11:52	N	11.86	7.66	148.5 EST	10.60
DRYM	10/8/2019	12:04	Y	11.88	7.65	126.7	10.61
DRYM	10/23/2019	11:20	N	9.82	7.59	127.0	10.46
DRYM	11/5/2019	14:40	N	8.49	7.50	137.3	11.81
ELPOTW	6/17/2019	7:15	N	10.06	7.36	448.0	8.30
ELPOTW	7/15/2019	8:00	N	17.22	7.40	408.2	7.47
ELPOTW	7/29/2019	7:45	N	11.56	7.21	407.0	8.71
ELPOTW	8/12/2019	8:00	N	17.04	7.34	407.0	8.25

Study Location ID	Date	Time (local)	Replicate Y/N	Temp (°C)	pH (s.u.)	Conductivity (uS/cm)	Dissolved Oxygen (mg/L)
ELPOTW	8/26/2019	8:15	N	9.95	7.14	408.0	7.45
ELPOTW	9/9/2019	8:00	N	11.82	7.00	450.6	7.88
ELPOTW	9/23/2019	8:15	N	15.09	7.49	455.0	8.70
ELPOTW	10/7/2019	8:05	N	12.97	7.40	435.0	8.33
ELPOTW	10/21/2019	8:15	N	12.21	7.56	438.0	8.22
FOG	3/26/2019	10:45	N	6.77	7.45	136.0	11.21
FOG	4/9/2019	10:05	N	8.14	7.59	133.2	10.03
FOG	4/23/2019	9:55	N	10.62	7.44	113.3	11.55
FOG	5/7/2019	9:45	N	11.80	7.30	147.9	10.00
FOG	5/21/2019	14:20	N	14.38	7.56	131.5	9.65
FOG	6/4/2019	10:25	N	13.85	7.56	128.5	10.10
FOG	6/18/2019	9:40	N	14.58	7.56	126.8	9.37
FOG	7/1/2019	10:30	N	14.64	7.25	127.5	9.33
FOG	7/16/2019	11:55	N	16.87	7.49	128.9	10.07
FOG	7/29/2019	8:57	N	15.85	7.25	127.0	
FOG	7/30/2019	10:15	N	16.31	7.20	132.3	9.47
FOG	7/31/2019	12:05	N	17.30	7.47	124.0	
FOG	8/13/2019	10:15	N	16.79	7.38	128.8	8.79
FOG	9/10/2019	10:00	N	15.35	7.44	143.9	8.73
FOG	9/24/2019	8:50	N	13.46	7.28	146.5	8.74
FOG	10/8/2019	10:30	N	11.40	7.33	119.5	10.13
FOG	10/21/2019	10:15	N	9.53	7.35	156.7	9.87
FOG	11/5/2019	8:45	N	5.81	7.42	175.4	10.21
LITC	2/25/2019	13:10	N	-0.05	7.79	109.6	13.25
LITC	3/25/2019	12:45	N	4.05	7.58	96.7	11.57
LITC	4/8/2019	14:00	N	4.68	7.77	89.5	11.88
LITC	4/22/2019	13:30	N	6.58	7.54	84.3	11.51
LITC	5/6/2019	12:30	N	8.29	7.52	84.2	10.90
LITC	5/20/2019	12:15	N	7.84	7.61	79.0	10.80
LITC	6/3/2019	12:45	N	11.11	7.73	86.0	10.12
LITC	6/17/2019	13:35	N	14.55	7.82	72.3	9.41
LITC	6/30/2019	12:15	N	13.78	7.71	68.6	9.24
LITC	7/15/2019	13:35	N	16.07	7.50	64.1	8.93
LITC	7/29/2019	14:15	N	18.62	7.46	58.6	8.55
LITC	8/12/2019	14:00	N	18.90	7.88	56.7	8.54
LITC	8/26/2019	13:15	N	17.94	7.35	52.8	8.77
LITC	9/9/2019	13:00	N	17.64	7.91	53.3	8.79
LITC	9/23/2019	13:15	N	14.19	7.66	52.8	9.51
LITC	10/7/2019	14:30	N	10.88	7.54	50.0	10.11
LITC	10/22/2019	14:15	N	8.30	7.65	82.9	10.89
LITC	11/4/2019	12:36	N	4.86	7.38	67.8	11.78

Study Location ID	Date	Time (local)	Replicate Y/N	Temp (°C)	pH (s.u.)	Conductivity (uS/cm)	Dissolved Oxygen (mg/L)
MANL	3/26/2019	12:45	N	4.77	7.70	85.2	12.00
MANL	4/9/2019	14:30	N	7.63	7.90	84.3	11.26
MANL	4/9/2019	14:40	Y	7.74	7.79	84.5	11.17
MANL	4/23/2019	14:55	N	10.49	7.51	77.8	10.41
MANL	5/7/2019	12:30	N	11.14	7.56	80.1	9.95
MANL	5/21/2019	14:25	N	11.15	7.52	67.6	9.86
MANL	6/4/2019	15:55	N	16.82	7.65	72.2	8.92
MANL	6/18/2019	9:50	N	15.52	7.63	73.3	9.24
MANL	7/1/2019	10:04	N	14.69	7.47	74.3	9.25
MANL	7/16/2019	11:50	N	17.03	7.48	77.3	8.89
MANL	7/30/2019	13:40	N	18.99	7.63	80.0	8.63
MANL	8/13/2019	13:50	N	20.30	7.61	73.9	8.51
MANL	8/13/2019	13:55	Y	20.30	7.61	74.1	8.45
MANL	8/27/2019	11:54	N	16.92	7.59	74.6	9.34
MANL	9/10/2019	12:05	N	16.59	7.67	63.1	9.09
MANL	9/24/2019	11:40	N	13.66	7.60	86.0	9.72
MANL	10/8/2019	10:55	N	9.42	7.69	69.8	10.59
MANL	10/22/2019	12:40	N	8.26	7.62	108.9	11.06
MANL	11/5/2019	10:45	N	2.38	7.77	113.6	12.59
MANL	11/5/2019	10:50	Y	2.40	7.46	113.6	12.78
MANU	7/30/2019	14:06	N	19.32	8.02	86.0	8.41
MANU	8/13/2019	14:23	N	19.09	8.10	90.3	8.70
MANU	8/27/2019	12:35	N	15.66	8.04	89.7	9.71
MANU	9/10/2019	13:41	N	13.41	7.90	90.3	9.94
MANU	9/24/2019	10:30	N	10.64	7.78	96.3 EST	10.28
MANU	10/8/2019	9:50	N	6.93	7.71	93.1	11.02
MANU	10/22/2019	11:40	N	5.88	7.75	85.9	11.15
MANU	11/5/2019	10:03	N	1.28	7.50	88.4	12.03
NANU	7/31/2019	11:20	N	15.00	7.77	82.0	9.31
NANU	8/14/2019	12:29	N	17.21	7.97	86.2	8.81
NANU	8/28/2019	9:27	N	11.77	7.76	84.4	9.75
NANU	9/11/2019	10:15	N	10.26	7.76	86.1	10.09
NANU	9/11/2019	10:21	Y	10.30	7.76	86.1	10.06
NANU	9/25/2019	12:20	N	10.20	7.85	88.4 EST	10.23
NANU	10/8/2019	13:35	N	7.30	7.70	77.3	10.57
NANU	10/22/2019	10:25	N	6.02	7.71	7.7	10.95
NANU	11/5/2019	7:30	N	1.23	7.36	74.2	12.70
PACK	3/26/2019	14:05	N	8.97	7.58	12.0	10.73
PACK	4/9/2019	10:25	N	7.38	7.37	105.8	11.58
PACK	4/23/2019	9:20	N	10.66	7.35	132.7	9.94
PACK	5/7/2019	10:00	N	12.56	7.48	164.2	9.98

Study Location ID	Date	Time (local)	Replicate Y/N	Temp (°C)	pH (s.u.)	Conductivity (uS/cm)	Dissolved Oxygen (mg/L)
PACK	5/21/2019	13:19	N	12.73	8.22	142.0	12.66
PACK	6/4/2019	9:53	N	13.41	7.37	149.0	9.64
PACK	6/18/2019	12:17	N	16.35	8.63	122.2	14.46
PACK	6/18/2019	12:36	Y	16.49	8.69	122.5	12.19
PACK	7/1/2019	8:57	N	14.99	7.07	135.9	12.21
PACK	7/16/2019	10:25	N	15.88	7.27	134.6	7.47
PACK	7/30/2019	11:45	N	17.17	8.01	154.3	9.84
PACK	8/13/2019	10:37	N	17.23	7.69	125.1	11.77
PACK	8/27/2019	10:03	N	16.51	7.26	125.1	12.92
PACK	9/10/2019	10:30	N	15.62	7.10	156.1	11.00
PACK	9/24/2019	9:57	N	13.18	7.78	119.7 EST	8.32
PACK	10/8/2019	9:08	N	10.30	7.45	113.0	6.82
PACK	11/5/2019	9:20	N	4.56	7.45	185.6	6.95
REEC	2/26/2019	13:35	N	2.04	8.15	217.0	14.34
REEC	3/12/2019	10:44	N	1.60	7.26	221.4	12.48
REEC	3/26/2019	11:35	N	6.77	7.71	159.7	11.68
REEC	4/9/2019	13:30	N	9.87	8.49	172.0	13.76
REEC	4/23/2019	13:30	N	12.38	8.15	127.0	11.91
REEC	5/7/2019	11:12	N	13.31	7.53	16.9	9.13
REEC	5/21/2019	15:15	N	13.39	8.00	161.7	10.63
REEC	6/4/2019	13:59	N	15.52	7.77	161.0	9.83
REEC	6/18/2019	11:07	N	16.70	7.41	160.1	7.23
REEC	7/1/2019	12:17	N	16.21	7.43	148.9	8.09
REEC	7/16/2019	13:41	N	16.98	7.33	155.0	8.04
REEC	7/31/2019	12:20	N	17.45	7.34	147.2	6.37
REEC	8/13/2019	15:20	N	18.27	7.36	185.0	6.38
REEC	8/27/2019	15:00	N	16.56	7.28	185.5	8.08
REEC	9/10/2019	14:25	N	16.54	7.42	154.7	7.48
REEC	9/24/2019	14:10	N	14.20	7.39	167.8	8.51
REEC	10/8/2019	15:05	N	11.12	7.57	170.3 EST	9.45
REEC	10/8/2019	15:09	Y	11.12	7.63	144.1	9.46
REEC	10/22/2019	13:55	N	9.49	7.62	144.2	7.91
REEC	11/5/2019	13:30	N	4.72	7.44	215.9	9.99
SWAC	2/25/2019	16:45	N	0.92	7.95	217.7	13.21
SWAC	3/11/2019	13:25	N	0.07	7.70	214.0	13.90
SWAC	3/25/2019	16:00	N	5.74	7.70	115.6	11.68
SWAC	4/8/2019	15:30	N	5.72	7.94	170.2	11.42
SWAC	4/22/2019	16:50	N	9.76	7.80	147.6	10.50
SWAC	4/22/2019	16:50	Y	9.72	7.96	148.4	10.40
SWAC	5/6/2019	14:55	N	12.02	8.09	131.4	10.09
SWAC	5/20/2019	16:26	N	11.22	8.11	130.0	9.98

Study Location ID	Date	Time (local)	Replicate Y/N	Temp (°C)	pH (s.u.)	Conductivity (uS/cm)	Dissolved Oxygen (mg/L)
SWAC	6/3/2019	16:30	N	17.75	8.24	156.5	8.96
SWAC	6/3/2019	16:30	Y	17.73	8.24	157.1	8.95
SWAC	6/17/2019	14:19	N	21.01	8.46	171.0	8.80
SWAC	6/30/2019	14:15	N	17.50	8.30	174.6	8.75
SWAC	7/15/2019	15:57	N	20.02	8.49	175.8	9.06
SWAC	7/29/2019	14:45	N	24.29	8.69	185.2	8.91
SWAC	8/12/2019	15:21	N	23.19	8.77	193.7	8.91
SWAC	8/26/2019	14:10	N	20.42	8.60	197.2	8.95
SWAC	9/9/2019	15:19	N	18.23	8.65	194.3	9.54
SWAC	9/23/2019	15:05	N	13.17	8.44	197.7 EST	9.57
SWAC	10/7/2019	15:16	N	10.81	8.33	199.3	10.38
SWAC	10/21/2019	15:20	N	8.30	8.04	188.9	10.50
SWAC	11/4/2019	14:35	N	4.69	7.75	178.3	11.07
TANC	2/26/2019	10:15	N	0.05	7.29	173.1	13.60
TANC	3/12/2019	9:30	N	-0.02	7.80	161.0	13.40
TANC	3/26/2019	12:40	N	5.43	7.65	86.2	12.20
TANC	4/9/2019	12:45	N	6.87	8.03	122.7	11.56
TANC	4/23/2019	12:15	N	8.18	7.66	97.0	10.91
TANC	5/7/2019	13:20	N	10.59	7.68	108.5	10.46
TANC	5/21/2019	13:15	N	10.46	7.81	98.2	10.24
TANC	6/4/2019	12:00	N	14.80	7.86	119.3	
TANC	6/18/2019	11:30	N	18.07	7.74	93.1	
TANC	7/1/2019	12:00	N	18.37	7.83	82.7	9.45
TANC	7/15/2019	14:30	N	19.02	7.62	80.9	8.93
TANC	7/29/2019	10:33	N	18.77	7.61	78.7	8.61
TANC	7/30/2019	13:56	N	22.73	7.65	81.0	8.76
TANC	8/13/2019	15:15	N	23.74	7.96	84.0	8.26
TANC	9/10/2019	14:30	N	18.86	7.98	66.2	8.04
TANC	9/24/2019	14:10	N	16.31	7.74	57.4	8.80
TANC	10/8/2019	15:15	N	11.20	7.66	63.0	9.30
TANC	10/21/2019	13:15	N	7.61	7.89	148.9	10.14
TANC	11/5/2019	10:30	N	3.01	7.72	145.5	9.87
TEAL	3/11/2019	15:21	N	0.66 EST	7.47 EST	119.8 EST	13.29 EST
TEAL	4/8/2019	14:25	N	5.92	7.67	92.9	11.66
TEAL	4/8/2019	14:45	Y	6.02	7.71	93.0	11.65
TEAL	4/22/2019	15:00	N	9.07	7.66	85.2	10.92
TEAL	5/6/2019	13:40	N	10.76	7.97	84.8	10.41
TEAL	5/20/2019	13:15	N	9.73	7.83	86.8	10.30
TEAL	6/3/2019	14:40	N	16.51	8.19	92.7	9.48
TEAL	6/17/2019	13:08	N	20.21	8.38	117.5	9.65
TEAL	6/30/2019	12:44	N	18.75	8.38	130.3	9.29

Study Location ID	Date	Time (local)	Replicate Y/N	Temp (°C)	pH (s.u.)	Conductivity (uS/cm)	Dissolved Oxygen (mg/L)
TEAL	7/15/2019	13:54	N	20.20	8.60	142.7	9.23
TEAL	7/29/2019	13:14	N	23.03	8.44	150.1	8.51
TEAL	8/12/2019	13:00	N	21.10	8.56	153.8	9.51
TEAL	8/26/2019	12:40	N	17.85	8.33	162.3	9.81
TEAL	9/9/2019	13:40	N	18.46	8.68	148.5	9.65
TEAL	9/23/2019	14:00	N	13.48	8.49	148 EST	10.32
TEAL	10/7/2019	13:10	N	10.06	8.24	141.9	10.45
TEAL	10/21/2019	14:15	N	7.97	8.06	112.3	11.41
TEAL	11/4/2019	13:05	N	4.74	7.70	110.7	12.34
UMT	2/27/2019	13:35	N	2.49	7.82	170.7	12.60
UMT	3/13/2019	12:45	N	3.97	7.83	173.5	12.48
UMT	3/27/2019	12:25	N	4.79	7.65	101.3	12.00
UMT	4/10/2019	11:40	N	7.43	7.70	116.5	11.05
UMT	4/24/2019	10:25	N	9.34	7.75	144.4	10.71
UMT	5/8/2019	11:20	N	12.90	8.06	164.3	9.83
UMT	5/22/2019	10:04	N	12.03	8.04	171.9	10.03
UMT	6/5/2019	10:00	N	14.39	8.10	175.6	9.51
UMT	6/19/2019	12:15	N	16.94	8.26	181.5	9.33
UMT	7/2/2019	9:27	N	14.90	8.05	183.6	9.48
UMT	7/17/2019	8:15	N	15.34	8.00	187.3	9.36
UMT	7/31/2019	8:13	N	16.15	8.04	198.3	9.17
UMT	8/14/2019	8:17	N	16.70	7.98	210.8	8.69
UMT	8/28/2019	13:23	N	19.81	8.54	211.4	10.82
UMT	9/11/2019	8:35	N	13.45	8.00	211.9	9.50
UMT	9/25/2019	9:05	N	12.79	8.03	196.3 EST	9.75
UMT	10/9/2019	8:40	N	7.94	7.95	185.5	10.83
UMT	10/23/2019	8:20	N	7.88	7.80	184.2	10.91
UMT	11/6/2019	10:15	N	4.64	7.70	179.0	12.13
WEN	2/27/2019	14:25	N	2.20	7.97	340.7	14.17
WEN	3/13/2019	13:25	N	3.68	7.96	299.4	13.94
WEN	3/27/2019	13:50	Y	7.92	8.04	168.0	12.22
WEN	3/27/2019	14:00	N	7.93	8.05	167.6	12.62
WEN	4/10/2019	13:10	N	8.23	7.65	105.4	11.12
WEN	4/24/2019	13:30	N	12.52	8.07	115.8	10.42
WEN	5/8/2019	13:15	N	16.41	7.91	145.4	9.64
WEN	5/22/2019	13:10	N	14.88	7.95	143.7	9.81
WEN	6/5/2019	12:00	N	17.50	8.19	178.8	10.02
WEN	6/19/2019	13:00	N	18.88	7.96	411.1	8.95
WEN	7/2/2019	14:07	N	21.94	7.76	372.4	8.54
WEN	7/17/2019	17:00	N	21.85	8.04	308.7	8.35
WEN	7/31/2019	15:00	N	23.36	7.98	332.2	8.34

Study Location ID	Date	Time (local)	Replicate Y/N	Temp (°C)	pH (s.u.)	Conductivity (uS/cm)	Dissolved Oxygen (mg/L)
WEN	8/14/2019	13:45	N	22.56	7.95	347.1	7.98
WEN	9/11/2019	14:30	N	18.86	7.96	404.2	9.22
WEN	9/25/2019	15:00	N	14.79	8.40	268.6	10.89
WEN	10/9/2019	15:00	N	8.28	7.88	303.2	11.03
WEN	10/23/2019	15:15	N	8.27	7.75	334.0	10.48
WEN	11/6/2019	12:00	N	3.71	7.50	340.8	11.80
WILC	2/27/2019	12:15	N	4.32	8.11	345.3	13.36
WILC	3/13/2019	11:15	N	4.24	8.02	331.7	12.90
WILC	3/27/2019	11:10	N	6.25	7.88	249.1	11.96
WILC	4/10/2019	10:15	N	6.75	7.66	199.6	11.56
WILC	4/24/2019	10:15	N	8.88	7.72	121.3	10.98
WILC	5/8/2019	9:20	N	11.91	7.69	247.1	9.69
WILC	5/22/2019	10:05	N	11.85	7.79	188.5	9.89
WILC	6/5/2019	9:45	N	13.63	7.84	226.6	9.82
WILC	6/19/2019	10:40	N	14.31	7.98	190.0	10.15
WILC	7/2/2019	10:00	N	15.47	7.68	252.3	9.10
WILC	7/29/2019	8:33	N	16.06	7.69	282.0	8.76
WILC	7/31/2019	10:30	N	16.36	7.81	264.0	8.37
WILC	8/28/2019	10:15	N	16.23	7.73	189.6	9.38
WILC	9/11/2019	10:45	N	14.85	7.94	241.3	8.72
WILC	9/25/2019	10:00	N	13.02	7.98	213.1	9.40
WILC	10/9/2019	10:15	N	7.89	7.80	196.6	9.75
WILC	10/23/2019	10:45	N	9.21	8.03	332.4	9.65
WILC	11/6/2019	9:07	N	5.88	7.76	330.5	11.21
WLTH	2/27/2019	11:30	N	3.88	7.47	250.9	12.01
WLTH	3/13/2019	9:15	N	2.67	7.29	246.6	11.88
WLTH	3/27/2019	8:20	N	5.75	7.52	195.3	10.98
WLTH	3/27/2019	8:40	Y	5.73	7.50	195.2	11.12
WLTH	4/10/2019	8:50	N	6.51	7.73	155.2	11.27
WLTH	4/24/2019	8:45	N	8.13	7.47	107.1	11.16
WLTH	5/8/2019	9:00	N	12.05	7.57	174.7	9.75
WLTH	5/22/2019	8:50	N	11.59	7.62	160.2	9.65
WLTH	6/5/2019	9:10	N	13.98	7.78	199.5	10.03
WLTH	6/19/2019	9:40	N	13.95	7.91	159.5	10.53
WLTH	7/2/2019	9:24	N	15.90	7.55	204.0	9.00
WLTH	7/17/2019	9:00	N	16.57	7.58	188.0	8.81
WLTH	7/31/2019	9:00	N	16.92	7.52	176.0	8.75
WLTH	8/14/2019	9:15	N	18.06	7.65	164.9	8.10
WLTH	8/28/2019	9:15	N	16.07	7.45	160.8	8.78
WLTH	9/9/2019	11:45	N	17.06	7.54	207.1	9.50
WLTH	9/11/2019	8:30	N	14.80	7.54	200.6	7.70

Study Location ID	Date	Time (local)	Replicate Y/N	Temp (°C)	pH (s.u.)	Conductivity (uS/cm)	Dissolved Oxygen (mg/L)
WLTH	9/25/2019	8:55	N	13.12	7.81	174.8	8.98
WLTH	10/9/2019	9:30	N	7.95	7.64	162.6	10.93
WLTH	10/23/2019	9:00	N	8.63	7.69	232.6	10.18
WLTH	11/6/2019	8:30	N	4.67	7.64	219.0	11.37
YKAT	4/8/2019	14:35	N	6.35	7.62	79.4	12.04
YKAT	4/22/2019	14:20	N	8.92	7.41	65.6	12.01
YKAT	5/6/2019	13:55	N	11.98	7.28	83.8	10.60
YKAT	5/20/2019	14:10	N	10.57	7.52	75.6	10.81
YKAT	6/3/2019	14:45	N	14.31	7.51	77.2	10.33
YKAT	6/17/2019	14:05	N	13.28	7.64	51.0	10.73
YKAT	6/30/2019	13:14	N	13.48	7.23	56.1	10.18
YKAT	7/15/2019	14:35	N	16.59	7.46	49.1	9.15
YKAT	7/29/2019	13:15	N	19.34	7.35	49.6	8.78
YKAT	8/12/2019	14:45	N	20.26	7.65	51.6	8.60
YKAT	8/26/2019	14:30	N	18.53	7.24	52.9	9.04
YKAT	9/9/2019	13:30	N	17.53	7.89	63.7	9.23
YKAT	9/9/2019	14:00	N	15.50	6.75	69.6	4.93
YKAT	9/23/2019	14:40	N	14.20	7.56	74.4	9.57
YKAT	10/7/2019	15:30	N	11.57	7.52	70.1	10.30
YKAT	10/21/2019	14:45	N	9.27	7.53	68.5	10.87
YKAT	11/4/2019	13:30	N	7.72	7.53	72.5	11.03
YKAW	2/26/2019	12:30	N	1.66	7.66	99.3	13.73
YKAW	3/12/2019	13:15	N	3.20	7.99	94.8	14.29
YKAW	3/26/2019	13:50	N	6.04	7.46	98.8	12.73
YKAW	4/9/2019	14:00	N	7.97	7.97	97.3	11.61
YKAW	4/9/2019	14:15	Y	7.98	7.78	96.9	11.82
YKAW	4/23/2019	13:45	N	9.84	7.65	81.2	11.06
YKAW	4/23/2019	15:25	N	10.18	7.55	82.1	11.65
YKAW	4/23/2019	15:25	Y	10.11	7.64	81.8	11.14
YKAW	5/7/2019	13:50	N	13.89	8.72	104.2	11.09
YKAW	5/21/2019	15:30	N	12.89	8.17	96.7	11.80
YKAW	5/21/2019	16:15	N	12.95	8.31	96.8	11.00
YKAW	6/4/2019	16:25	N	18.11	9.04	97.6	10.72
YKAW	6/18/2019	7:55	N	13.62	7.39	97.1	11.79
YKAW	7/1/2019	8:30	N	13.28	7.39	64.6	9.34
YKAW	7/16/2019	8:45	N	15.69	7.14	63.1	9.41
YKAW	7/30/2019	9:15	N	17.20	7.29	60.3	9.08
YKAW	8/13/2019	9:15	N	17.97	7.53	58.9	8.85
YKAW	8/27/2019	9:10	N	16.64	7.54	63.0	8.74
YKAW	9/10/2019	9:00	N	16.35	7.77	63.1	9.05
YKAW	9/24/2019	10:45	N	13.89	8.06	81.6	9.20

Study Location ID	Date	Time (local)	Replicate Y/N	Temp (°C)	pH (s.u.)	Conductivity (uS/cm)	Dissolved Oxygen (mg/L)
YKAW	10/8/2019	9:15	N	10.80	7.61	91.9	10.92
YKAW	10/21/2019	9:00	N	7.55	7.50	82.0	10.11
YKAW	11/5/2019	14:45	N	6.74	7.93	90.3	10.87
YKCE	3/11/2019	13:34	N	2.68 EST	7.54 EST	70.8 EST	13.23 EST
YKCE	3/11/2019	14:02	Y	3.16 EST	7.59 EST	69 EST	13.07 EST
YKCE	3/25/2019	13:30	N	4.05	7.74	74.6	12.69
YKCE	4/8/2019	13:10	N	5.68	7.66	77.3	12.25
YKCE	4/22/2019	13:40	N	8.45	7.55	69.9	11.49
YKCE	5/6/2019	12:05	N	10.15	7.78	89.7	10.86
YKCE	5/20/2019	11:52	N	9.60	7.72	89.2	10.67
YKCE	6/3/2019	12:00	N	12.24	7.75	66.5	10.35
YKCE	6/17/2019	10:48	N	11.02	7.40	48.5	10.76
YKCE	6/30/2019	10:10	N	12.60	7.41	48.0	10.42
YKCE	7/15/2019	11:25	N	15.65	7.42	47.8	9.13
YKCE	7/29/2019	10:43	N	17.42	7.57	48.4	9.06
YKCE	8/12/2019	10:25	N	18.17	7.53	51.2	8.75
YKCE	8/13/2019	12:25	N	19.42	7.87	51.8	8.63
YKCE	8/26/2019	10:22	N	16.54	7.58	52.9	8.87
YKCE	9/9/2019	12:00	N	17.40	7.85	68.6	9.20
YKCE	9/23/2019	12:15	N	13.57	7.88	82.1 EST	9.84
YKCE	10/7/2019	10:50	N	9.87	7.53	73.1	10.21
YKCE	10/21/2019	12:59	N	8.54	7.60	69.9	10.85
YKCE	11/4/2019	11:23	N	6.26	7.48	74.8	11.97
YKCE	11/4/2019	11:25	Y	6.30	7.51	74.9	11.96
YKEA	2/25/2019	14:45	N	1.32	7.82	62.2	12.96
YKEA	3/11/2019	11:00	N	1.55	6.88	56.0	12.66
YKEA	3/25/2019	11:45	N	3.08	7.00	56.7	12.56
YKEA	4/8/2019	11:05	N	5.16	7.33	57.0	11.92
YKEA	4/8/2019	11:40	Y	5.23	7.16	57.3	12.04
YKEA	4/22/2019	11:00	N	7.41	6.96	55.5	11.13
YKEA	5/6/2019	10:30	N	9.58	6.95	54.1	10.64
YKEA	5/20/2019	10:00	N	9.59	7.34	55.4	10.29
YKEA	5/20/2019	10:00	Y	9.64	7.02	52.3	10.14
YKEA	6/3/2019	10:35	N	11.92	7.09	50.8	9.97
YKEA	6/17/2019	10:25	N	13.59	7.22	47.6	9.82
YKEA	6/30/2019	11:25	N	14.23	7.37	49.3	9.70
YKEA	6/30/2019	11:40	Y	14.41	7.19	49.4	9.72
YKEA	7/15/2019	11:35	N	16.66	7.34	45.9	9.25
YKEA	7/29/2019	12:10	N	18.39	7.12	45.9	9.17
YKEA	8/12/2019	11:20	N	18.87	7.49	44.7	8.87
YKEA	8/26/2019	11:00	N	17.75	7.48	44.8	9.16

Study Location ID	Date	Time (local)	Replicate Y/N	Temp (°C)	pH (s.u.)	Conductivity (uS/cm)	Dissolved Oxygen (mg/L)
YKEA	9/9/2019	10:35	N	18.17	7.88	44.8	8.86
YKEA	9/23/2019	11:30	N	14.73	7.43	45.9	9.89
YKEA	10/7/2019	11:50	N	10.52	7.42	44.7	10.43
YKEA	10/22/2019	9:30	N	7.51	7.42	48.2	11.32
YKEA	11/4/2019	9:25	N	4.76	7.44	56.9	11.94
YKEL	2/26/2019	11:10	N	1.14	7.42	93.2	13.50
YKEL	3/12/2019	10:15	N	1.51	7.34	89.7	12.56
YKEL	3/26/2019	9:08	N	4.38	7.57	98.6	11.97
YKEL	4/9/2019	8:45	N	5.80	7.46	95.4	11.45
YKEL	4/9/2019	8:45	Y	5.81	7.68	95.9	11.82
YKEL	4/23/2019	8:35	N	7.87	7.35	81.4	11.00
YKEL	4/23/2019	8:35	Y	7.81	7.44	81.6	10.86
YKEL	5/7/2019	8:40	N	10.39	7.48	98.7	10.20
YKEL	5/7/2019	8:40	Y	10.43	7.46	96.7	10.45
YKEL	5/21/2019	8:33	N	9.90	7.44	99.1	10.34
YKEL	5/21/2019	8:33	Y	9.85	7.40	98.3	10.55
YKEL	6/4/2019	8:53	N	12.45	7.88	94.2	10.06
YKEL	6/4/2019	8:53	Y	12.55	7.45	93.0	10.16
YKEL	6/18/2019	8:28	N	12.54	7.46	65.5	9.88
YKEL	7/1/2019	8:16	N	13.20	7.35	70.4	9.78
YKEL	7/16/2019	9:24	N	15.54	7.43	66.7	9.24
YKEL	7/30/2019	9:25	N	17.00	7.47	62.8	9.01
YKEL	7/30/2019	16:30	N	19.65	7.44	61.0	8.86
YKEL	8/13/2019	9:36	N	17.73	7.58	65.2	8.93
YKEL	8/27/2019	9:17	N	16.15	7.53	68.1	9.11
YKEL	9/10/2019	9:30	N	15.79	7.53	95.4	9.27
YKEL	9/24/2019	9:10	N	13.00	7.61	90 EST	9.87
YKEL	10/8/2019	8:34	N	10.11	7.57	78.5	10.40
YKEL	11/5/2019	8:35	N	4.61	7.45	89.0	12.00
YKHB	2/27/2019	13:45	N	2.63 EST	8.75 EST	144.4 EST	15.02 EST
YKHB	3/27/2019	13:40	N	6.67	7.93	112.9	12.57
YKHB	4/10/2019	12:58	N	8.58	8.13	112.4	12.08
YKHB	4/24/2019	13:10	N	10.84	7.94	97.8	11.84
YKHO	2/25/2019	16:05	N	1.97	8.13	82.8	13.94
YKHO	3/11/2019	13:50	N	2.70	8.02	79.8	13.50
YKHO	3/25/2019	15:00	N	5.13	7.68	53.5	12.54
YKHO	4/8/2019	15:15	N	6.15	8.13	83.8	12.29
YKHO	4/22/2019	15:15	N	9.14	7.68	72.6	12.24
YKHO	5/6/2019	14:40	N	12.83	8.33	81.3	10.88
YKHO	5/6/2019	14:40	Y	12.89	8.16	82.5	10.83
YKHO	5/6/2019	14:45	Y	12.13	7.95	81.5	11.22

Study Location ID	Date	Time (local)	Replicate Y/N	Temp (°C)	pH (s.u.)	Conductivity (uS/cm)	Dissolved Oxygen (mg/L)
YKHO	5/6/2019	14:55	Y	12.31	8.13	81.5	11.09
YKHO	5/20/2019	15:45	N	12.84	8.55	98.6	11.05
YKHO	6/3/2019	15:20	N	16.41	8.30	76.8	10.46
YKHO	6/17/2019	14:50	N	14.69	8.00	53.6	10.25
YKHO	6/30/2019	13:35	N	14.08	7.78	51.7	10.59
YKHO	7/15/2019	15:15	N	17.03	7.65	49.5	10.09
YKHO	7/29/2019	15:26	N	19.68	7.72	50.1	9.37
YKHO	8/12/2019	15:20	N	20.45	7.84	52.5	8.92
YKHO	8/26/2019	15:15	N	18.91	7.75	53.6	8.65
YKHO	9/9/2019	14:30	N	18.33	8.37	61.4	9.17
YKHO	9/23/2019	15:00	N	14.41	8.30	67.6	9.42
YKHO	10/7/2019	16:05	N	12.15	8.33	63.3	10.38
YKHO	11/4/2019	14:30	N	6.60	7.92	78.0	10.84
YKNS	2/25/2019	11:45	N	1.62	7.35	68.5	12.95
YKNS	3/11/2019	9:45	N	0.31	7.07	66.0	12.53
YKNS	3/25/2019	11:15	N	3.61	7.69	65.5	12.57
YKNS	4/8/2019	11:00	N	5.08	7.15	67.8	11.82
YKNS	4/22/2019	11:00	N	7.04	7.19	62.1	11.22
YKNS	5/6/2019	10:15	N	8.05	7.28	66.4	10.63
YKNS	5/20/2019	10:00	N	8.44	7.23	63.2	10.37
YKNS	5/20/2019	10:16	Y	8.51	7.20	63.4	10.32
YKNS	6/4/2019	15:05	N	14.72	7.44	63.2	10.14
YKNS	6/17/2019	9:45	N	12.87	7.38	63.3	9.57
YKNS	6/30/2019	9:15	N	12.72	7.45	63.6	9.59
YKNS	7/15/2019	10:05	N	14.77	7.28	60.8	8.91
YKNS	7/29/2019	9:56	N	16.11	7.52	58.6	9.19
YKNS	8/12/2019	9:45	N	17.79	7.63	49.7	8.53
YKNS	8/26/2019	9:45	N	17.05	7.67	48.3	8.59
YKNS	9/9/2019	9:36	N	16.82	7.84	54.3	8.76
YKNS	9/9/2019	9:51	Y	16.95	7.79	54.2	8.84
YKNS	9/23/2019	10:00	N	13.67	7.75	62.9 EST	9.48
YKNS	10/7/2019	10:00	N	9.80	7.41	57.5	10.10
YKNS	10/21/2019	11:05	N	8.27	7.50	61.6	10.67
YKNS	11/4/2019	9:50	N	5.44	7.32	68.6	11.58
YKSM	3/27/2019	12:55	N	6.48	7.89	111.7	12.98
YKSM	4/10/2019	11:30	N	8.00	7.98	109.0	12.19
YKSM	4/24/2019	11:55	N	10.15	7.88	90.1	11.64
YKSM	5/8/2019	11:35	N	14.07	8.16	118.3	11.21
YKSM	5/22/2019	12:10	N	13.40	8.30	128.3	11.45
YKSM	6/5/2019	10:55	N	17.78	8.50	131.8	10.42
YKSM	6/19/2019	11:50	N	16.20	8.32	82.6	11.03

Study Location ID	Date	Time (local)	Replicate Y/N	Temp (°C)	pH (s.u.)	Conductivity (uS/cm)	Dissolved Oxygen (mg/L)
YKSM	7/2/2019	13:00	N	17.34	8.50	86.7	10.26
YKSM	7/17/2019	15:04	N	18.84	8.46	82.2	10.23
YKSM	7/31/2019	14:08	N	20.17	8.43	77.9	10.59
YKSM	8/14/2019	12:30	N	20.76	8.57	87.8	10.02
YKSM	8/28/2019	12:15	N	19.11	8.47	86.6	10.71
YKSM	9/11/2019	13:30	N	18.48	8.85	122.0	11.71
YKSM	9/25/2019	12:40	N	15.82	9.06	134.3	12.46
YKSM	10/9/2019	13:55	N	10.44	8.89	121.4	14.03
YKSM	10/23/2019	14:00	N	9.78	8.36	99.9	12.46
YKSM	11/6/2019	12:50	N	5.95	8.70	132.7	14.99
YKUB	2/26/2019	11:40	N	1.36	7.58	95.3	13.63
YKUB	3/12/2019	12:20	N	2.63	7.77	92.0	12.81
YKUB	3/26/2019	11:10	N	4.88	7.59	62.7	11.98
YKUB	4/9/2019	10:35	N	6.20	7.71	97.2	12.04
YKUB	4/23/2019	10:25	N	8.25	7.58	81.3	11.75
YKUB	5/7/2019	11:43	N	12.48	8.24	93.3	11.09
YKUB	5/21/2019	14:45	N	12.66	8.31	92.7	10.96
YKUB	6/4/2019	14:25	N	17.34	8.76	91.7	11.17
YKUB	6/18/2019	11:51	N	13.83	7.73	62.7	10.28
YKUB	7/1/2019	13:11	N	15.33	7.74	63.0	10.35
YKUB	7/16/2019	14:10	N	17.31	7.61	60.8	9.32
YKUB	7/29/2019	15:45	N	19.55	7.48	59.2	9.03
YKUB	8/13/2019	15:45	N	20.54	7.78	63.9	9.01
YKUB	8/27/2019	15:20	N	18.86	7.94	62.3	9.63
YKUB	9/10/2019	14:50	N	18.66	8.64	78.0	10.20
YKUB	9/24/2019	14:40	N	16.37	8.50	87.6 EST	10.37
YKUB	10/8/2019	15:30	N	11.18	8.18	75.3	11.27
YKUB	10/22/2019	14:25	N	9.89	7.73	86.5	10.73
YKUB	10/22/2019	14:30	Y	9.89	7.70	86.5	10.67
YKUB	11/5/2019	14:10	N	6.66	7.54	88.9	11.89
YKUM	2/27/2019	14:09	N	1.91	8.23	125.3	14.28
YKUM	3/13/2019	11:20	N	3.38	7.90	125.9	14.01
YKUM	3/13/2019	11:40	Y	3.60		126.3	13.95
YKUM	3/27/2019	11:00	N	5.30	7.81	110.7	12.09
YKUM	4/10/2019	10:15	N	6.72	7.64	106.1	11.34
YKUM	4/24/2019	12:10	N	8.76	7.54	86.8	11.26
YKUM	5/8/2019	11:45	N	13.20	8.44	117.3	11.49
YKUM	5/8/2019	12:20	N	13.60	8.52	117.2	11.79
YKUM	5/22/2019	10:50	N	12.11	7.97	126.5	10.64
YKUM	6/5/2019	11:30	N	15.31	8.51	127.3	11.19 IA
YKUM	6/19/2019	11:15	N	13.73	8.45	80.3	11.25 IA

Study Location ID	Date	Time (local)	Replicate Y/N	Temp (°C)	pH (s.u.)	Conductivity (uS/cm)	Dissolved Oxygen (mg/L)
YKUM	7/2/2019	8:56	N	14.87	7.57	84.2	9.32 IA
YKUM	7/17/2019	8:43	N	16.67	7.63	80.1	8.98 IA
YKUM	7/31/2019	8:47	N	17.32	7.87	76.2	8.8 IA
YKUM	8/12/2019	8:20	N	17.58	7.77	87.8	8.54 IA
YKUM	8/14/2019	8:42	N	18.79	7.74	85.9	8.49 IA
YKUM	8/28/2019	12:49	N	18.17	8.56	87.0	11.3 IA
YKUM	9/11/2019	8:15	N	15.41	7.74	123.0	8.81 IA
YKUM	9/25/2019	8:10	N	13.44	7.79	136.3 EST	9.24 IA
YKUM	9/25/2019	8:35	Y	13.41	7.81	136 EST	9.38 IA
YKUM	10/9/2019	9:00	N	8.09	7.72	119.5	10.79 IA
YKUM	10/23/2019	8:50	N	8.20	7.67	95.7	10.62 IA
YKUM	11/6/2019	9:45	N	4.66	7.89	131.5	13.06 IA

Temp = temperature
IA = Instrument adjusted
EST = Estimate

Appendix D. Continuous Long-Term Monitoring Results

Following are continuous long-term monitoring (15-minute interval) results for pH, dissolved oxygen (DO), and conductivity.

Continuous long-term monitoring data presented below are in chart format. The continuous data records are too large to include in the report. All data are available from Ecology's Environmental Information Management (EIM) online database located at https://apps.ecology.wa.gov/eim/search/default.aspx.

Table D1. Continuous long-term monitoring locations with instrument information, deployment dates, and data qualifiers.

Study Location ID	Instrument ID	Start Date/Time (PST)	End Date/Time (PST)	pH		DO		Cond	
				Data Qualifier	Bias Adjust (s.u.)	Data Qualifier	Bias Adjust (mg/L)	Data Qualifier	Bias Adjust (µS/cm)
YKEA	140600065723	4/3/2019 14:45	4/8/2019 10:00	IA	-0.16			IA	-1.30
	140600065726	4/8/2019 10:30	4/22/2019 9:45	IA	-0.13			IA	-1.30
	140600065723	4/22/2019 17:30	5/6/2019 9:15	IA	-0.08			IA	-1.30
	140600065726	5/6/2019 9:45	5/20/2019 9:00	IA	-0.10			IA	-1.30
	140600065723	5/20/2019 9:15	6/3/2019 9:30	IA	-0.06			IA	-1.30
	140600065726	6/3/2019 10:00	6/17/2019 9:15	IA	-0.13			IA	-1.30
	140600065723	6/17/2019 9:45	6/30/2019 10:15	IA	-0.09			IA	-1.30
	140600065726	6/30/2019 10:45	7/15/2019 10:30	IA	-0.08			IA	-1.30
	140600065723	7/15/2019 21:30	7/29/2019 10:45					IA	-1.30
	140600065726	7/29/2019 11:15	8/12/2019 10:15	IA	0.05			IA	-1.30
	140600065723	8/12/2019 10:45	8/26/2019 10:00					IA	-1.30
	140600065726	8/26/2019 10:30	9/9/2019 9:30	IA	0.05			IA	-1.30
	140600065723	9/9/2019 10:00	9/23/2019 10:30					IA	-1.30
	140600065726	9/23/2019 10:45	10/7/2019 15:15					IA	-1.30
	140600065723	10/7/2019 15:30	10/22/2019 8:30					IA	-1.30
	140600065726	10/22/2019 9:00	11/4/2019 9:15					IA	-1.30
YKHO	110300060492	4/3/2019 13:00	4/8/2019 14:15	IA	-0.25			IA	-1.50

Study Location ID	Instrument ID	Start Date/Time (PST)	End Date/Time (PST)	pH		DO		Cond	
				Data Qualifier	Bias Adjust (s.u.)	Data Qualifier	Bias Adjust (mg/L)	Data Qualifier	Bias Adjust (µS/cm)
	140600065725	4/8/2019 14:45	4/22/2019 14:15	IA	-0.25			IA	-1.50
	110300060492	4/22/2019 14:45	5/6/2019 14:00			IA	-0.30	IA	-1.50
	140600065725	5/6/2019 14:30	5/20/2019 14:15	IA	0.10			IA	-1.50
	110300060492	5/20/2019 14:30	6/3/2019 14:15	IA	-0.10			IA	-1.50
	140600065725	6/3/2019 14:45	6/17/2019 14:00					IA	-1.50
	110300060492	6/17/2019 14:30	6/30/2019 12:30	IA	-0.20			EST	
	140600065725	6/30/2019 13:00	7/15/2019 14:15					IA	-1.50
	110300060492	7/15/2019 14:45	7/29/2019 14:45	IA	-0.15			IA	-1.50
	140600065725	7/29/2019 15:00	8/12/2019 14:30	IA	0.05			IA	-1.50
	110300060492	8/12/2019 15:00	8/26/2019 14:15	IA	-0.10			IA	-1.50
	140600065725	8/26/2019 14:45	9/9/2019 13:45	IA	0.05			IA	-1.50
	110300060492	9/9/2019 14:15	9/23/2019 14:00	IA	-0.10			IA	-1.50
	140600065725	9/23/2019 14:45	10/7/2019 15:00					IA	-1.50
	110300060492	10/7/2019 15:30	10/21/2019 15:00					IA	-1.50
YKAW	80700046875	4/3/2019 11:15	4/23/2019 13:30	IA	-0.40			IA	-1.80
	140600065724	4/23/2019 14:00	5/7/2019 13:30	IA	0.50	IA	1.10	IA	-1.80
	80700046875	5/7/2019 13:45	5/21/2019 14:45	IA	-0.20			IA	-1.80
	140600065724	5/21/2019 15:00	6/4/2019 15:30					IA	-1.80
	80700046875	6/4/2019 16:00	6/18/2019 7:00					IA	-1.80
	140600065724	6/18/2019 7:15	7/1/2019 7:45	IA	0.10			IA	-1.80
	80700046875	7/1/2019 8:00	7/16/2019 8:00	IA	-0.15			IA	-1.80
	140600065724	7/16/2019 8:15	7/30/2019 7:30					IA	-1.80
	80700046875	7/30/2019 8:00	8/13/2019 7:45					EST	
	140600065724	8/13/2019 8:00	8/27/2019 8:00					IA	-1.80
	80700046875	8/27/2019 8:30	9/10/2019 10:00					IA	-1.80

Study Location ID	Instrument ID	Start Date/Time (PST)	End Date/Time (PST)	pH		DO		Cond	
				Data Qualifier	Bias Adjust (s.u.)	Data Qualifier	Bias Adjust (mg/L)	Data Qualifier	Bias Adjust (µS/cm)
	10600039014	9/10/2019 10:15	9/24/2019 9:45	IA	0.50			IA	-1.80
	80700046875	9/24/2019 10:00	10/8/2019 8:15	IA	-0.10			IA	-1.80
	10600039014	10/8/2019 8:45	10/21/2019 8:00	IA	0.50			IA	-1.80
	80700046875	10/21/2019 8:30	11/5/2019 14:45	IA	-0.20			IA	-1.80
YKSM	50600042726	4/3/2019 9:00	4/10/2019 10:30	IA	-0.10			IA	-2.70
	130500064702	4/10/2019 11:00	4/24/2019 10:45	IA	-0.10			IA	-2.70
	50600042726	4/24/2019 11:15	5/8/2019 10:30	IA	-0.10			IA	-2.70
	130500064702	5/8/2019 11:00	5/22/2019 11:00			IA	-0.15	IA	-2.70
	50600042726	5/22/2019 11:30	6/5/2019 10:00					IA	-2.70
	130500064702	6/5/2019 10:15	6/19/2019 11:00					IA	-2.70
	50600042726	6/19/2019 11:15	7/2/2019 12:00					IA	-2.70
	130500064702	7/2/2019 12:30	7/19/2019 11:15					IA	-2.70
	50600042726	7/19/2019 11:45	7/31/2019 12:45					IA	-2.70
	130500064702	7/31/2019 13:15	8/14/2019 11:30					IA	-2.70
	50600042726	8/14/2019 11:45	8/28/2019 11:15					IA	-2.70
	130500064702	8/28/2019 11:30	9/11/2019 12:30					IA	-2.70
	50600042726	9/11/2019 13:00	9/25/2019 11:45					IA	-2.70
	130500064702	9/25/2019 12:15	10/9/2019 13:00					IA	-2.70
	50600042726	10/9/2019 13:30	10/23/2019 13:00	IA	-0.10			IA	-2.70
	130500064702	10/23/2019 13:30	11/6/2019 13:00	IA	-0.20			IA	-2.70

IA = Instrument result adjusted; reported result meets study objectives.

EST = Data considered to be an estimate based on post-check versus reference standard.

DO = dissolved oxygen

Cond = conductivity

Table D2. Data rejected due to site maintenance, meter issues, or data not meeting study's measurement quality objectives.

Study Location ID	Instrument ID	Start Date/Time (PST)	End Date/Time (PST)	Parameter
YKSM	130500064702	5/8/2019 10:45	5/12/2019 9:30	pH
YKHO	110300060492	10/16/2019 8:15	10/19/2019 3:30	DO
YKHO	110300060492	10/16/2019 8:15	10/19/2019 3:30	Cond
YKHO	110300060492	10/7/2019 15:55	10/21/2019 15:00	pH

DO = dissolved oxygen
Cond = conductivity

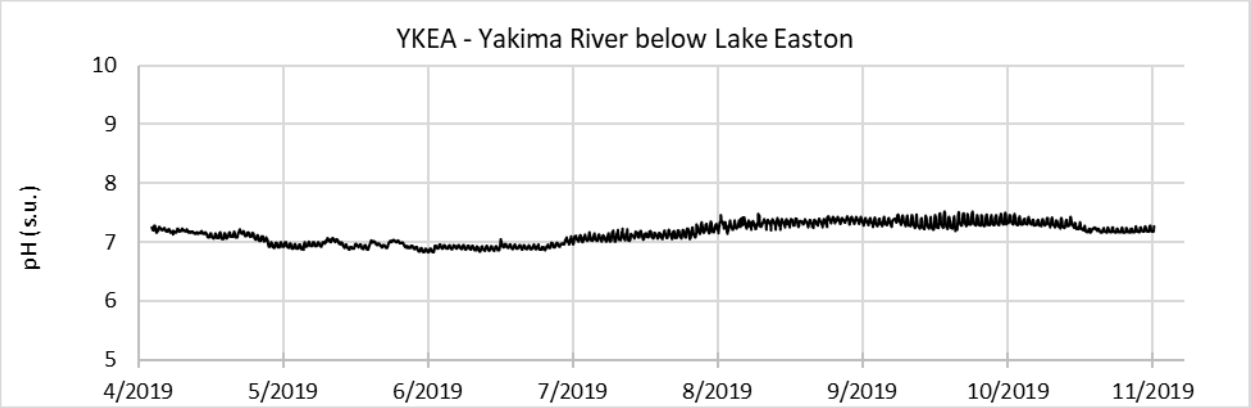

Figure D1. Continuous pH data for location YKEA from 4/3/2019 to 11/4/2019.

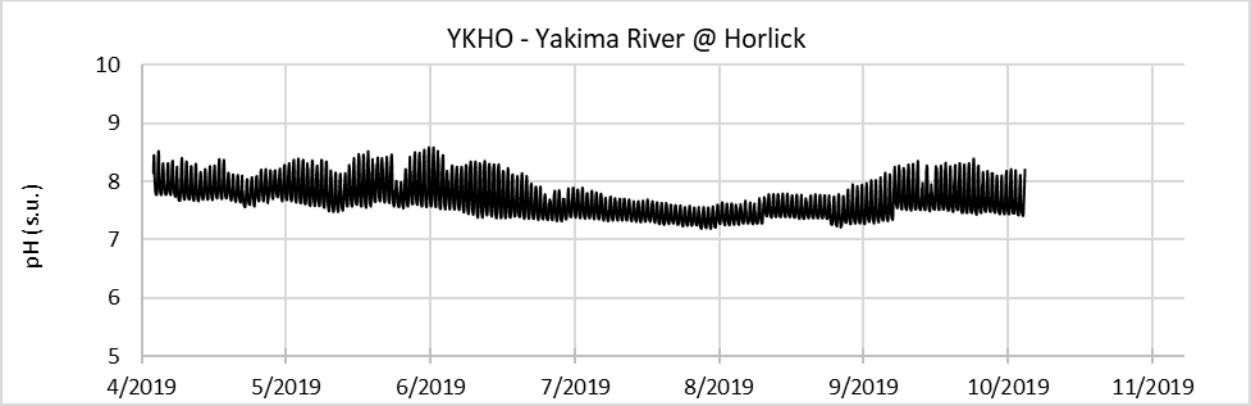

Figure D2. Continuous pH data for location YKHO from 4/3/2019 to 10/7/2019.

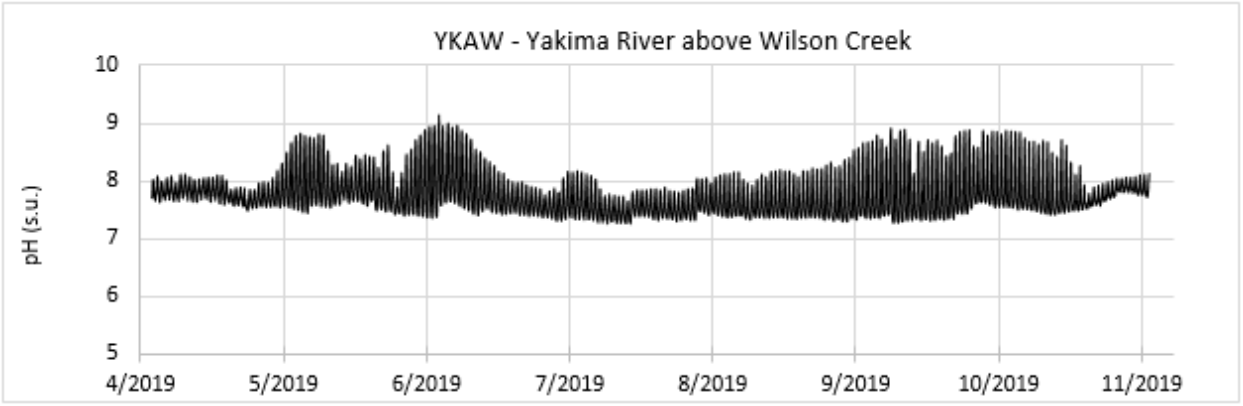

Figure D3. Continuous pH data for location YKAW from 4/3/2019 to 11/6/2019.

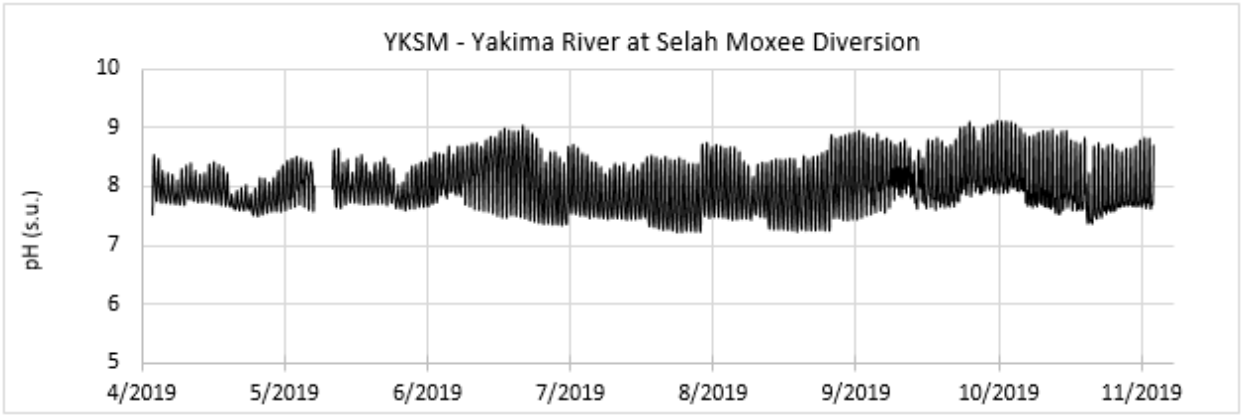

Figure D4. Continuous pH data for location YKSM from 4/3/2019 to 11/6/2019.

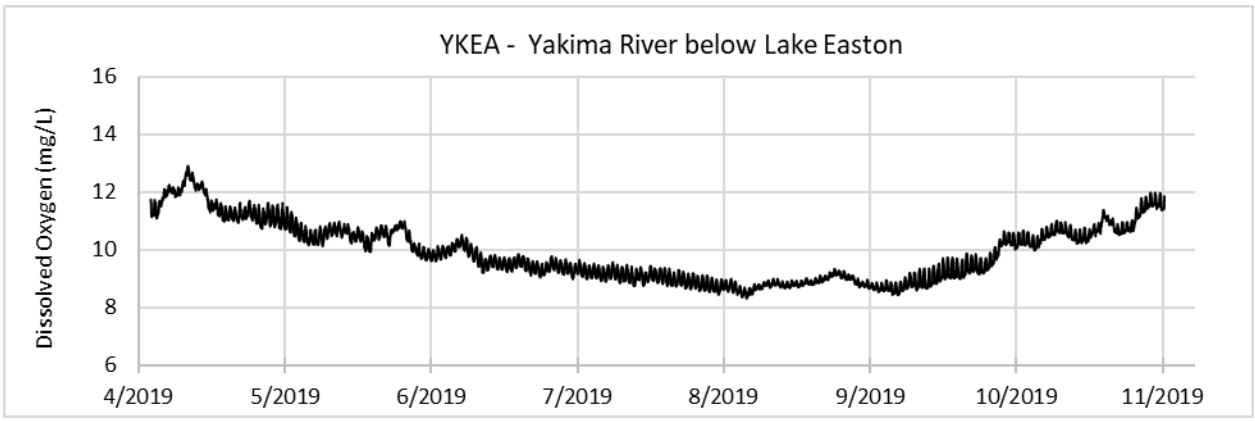

Figure D5. Continuous DO data for location YKEA from 4/3/2019 to 11/4/2019.

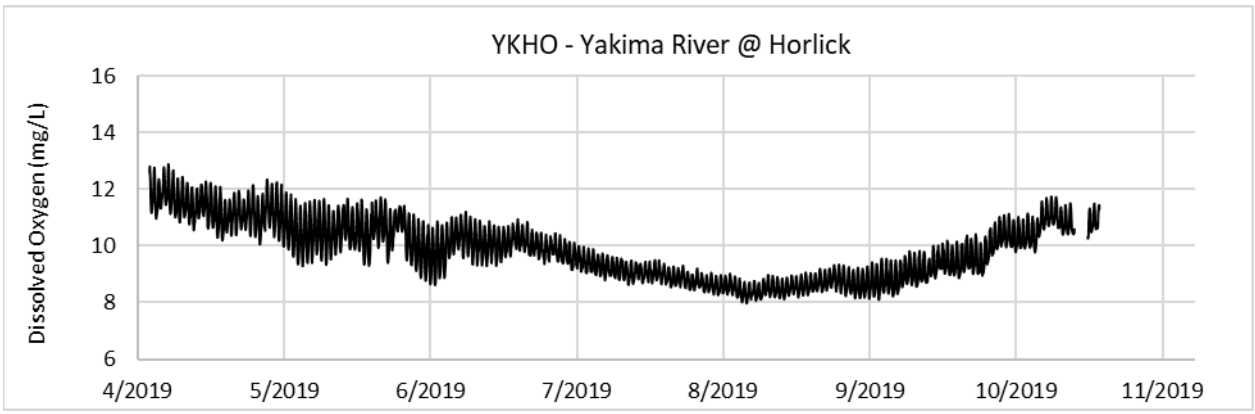

Figure D6. Continuous DO data for location YKHO from 4/3/2019 to 10/21/2019.

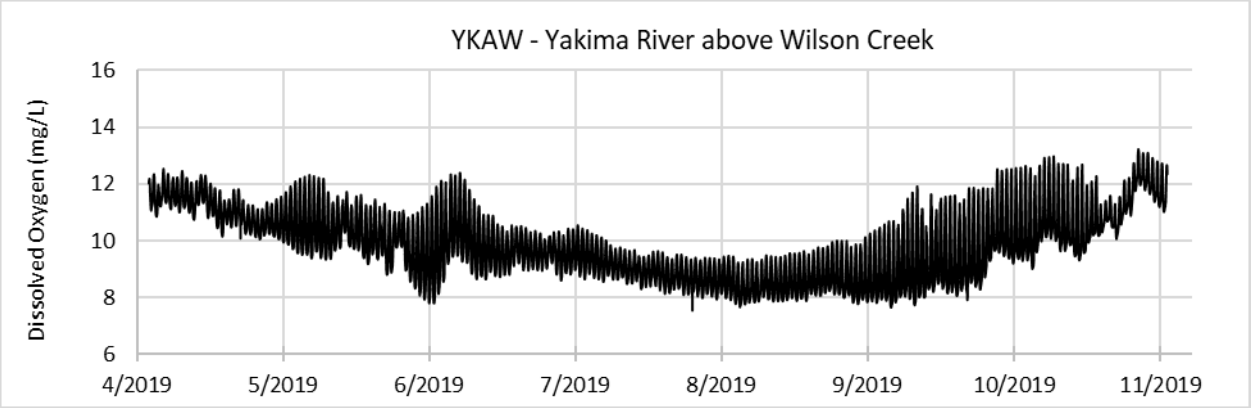

Figure D7. Continuous DO data for location YKAW from 4/3/2019 to 11/6/2019.

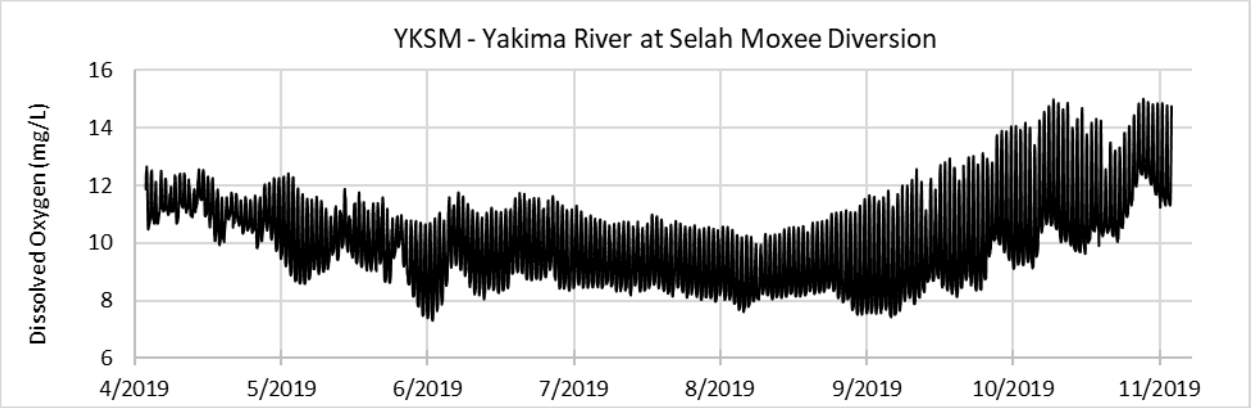

Figure D8. Continuous DO data for location YKSM from 4/3/2019 to 11/6/2019.

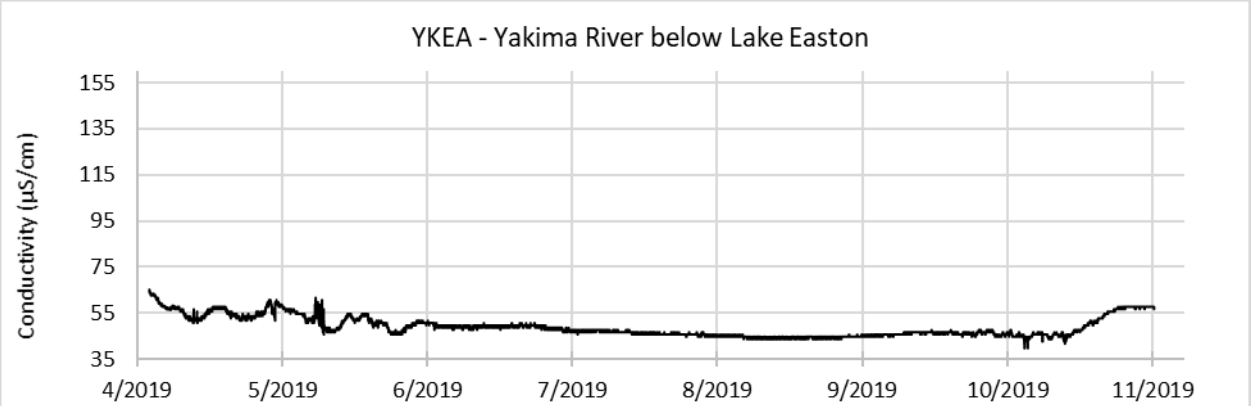

Figure D9. Continuous conductivity data for location YKEA from 4/3/2019 to 11/4/2019.

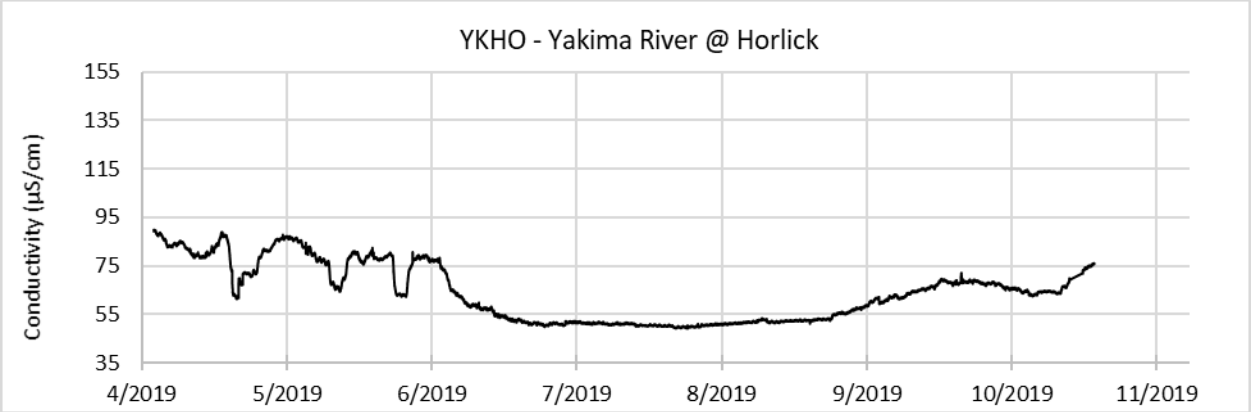

Figure D10. Continuous conductivity data for location YKHO from 4/3/2019 to 10/21/2019.

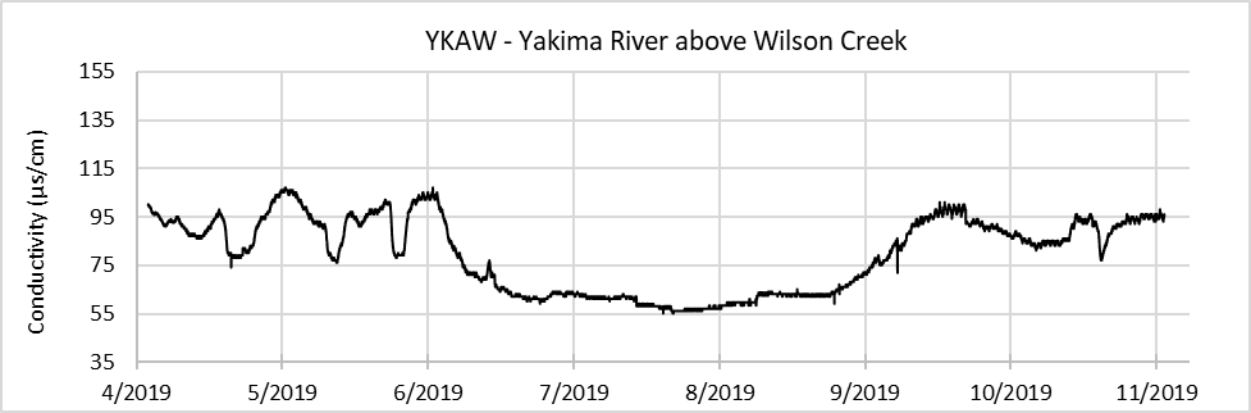

Figure D11. Continuous conductivity data for location YKAW from 4/3/2019 to 11/6/2019.

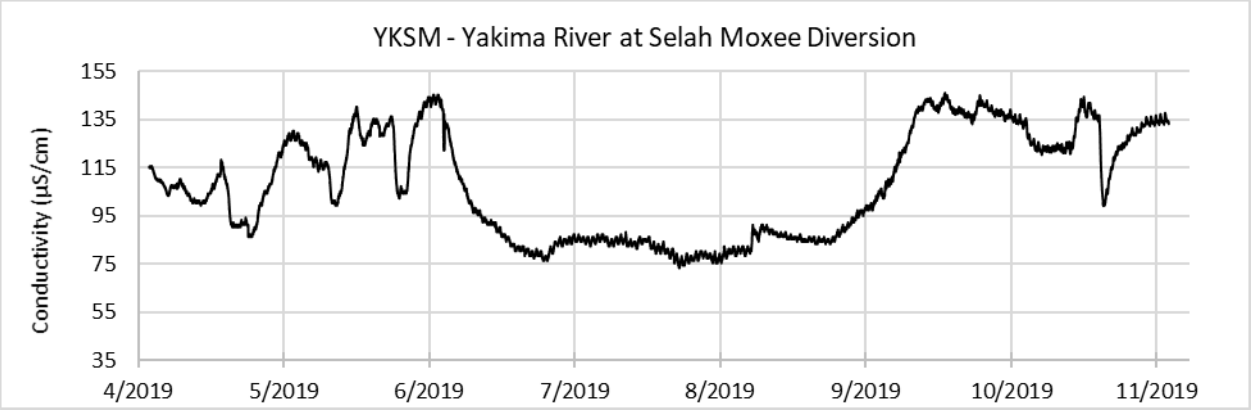

Figure D12. Continuous conductivity data for location YKSM from 4/3/2019 to 11/6/2019

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Appendix E. Short-Term Monitoring Results

Continuous short-term monitoring results for pH, dissolved oxygen, and conductivity.

Continuous short-term monitoring data presented below are in chart format. The continuous data records are too large to include in the report. All data are available from Ecology's Environmental Information Management (EIM) online database located at https://apps.ecology.wa.gov/eim/search/default.aspx.

Table E1. Continuous short-term monitoring locations with instrument information, deployment dates, and data qualifiers.

Study Location ID	Instrument ID	Start Date/Time (PST)	End Date/Time (PST)	pH		DO		Cond	
				Data Qualifier	Bias Adjust (s.u.)	Data Qualifier	Bias Adjust (mg/L)	Data Qualifier	Bias Adjust (µS/cm)
YKNS	17E103178	6/3/2019 9:45	6/4/2019 15:05			IA	-0.20	IA	-4.00
	17E103179	6/17/2019 11:30	6/18/2019 16:35	IA	0.22	IA	-0.30	IA	-4.00
CLE	130500064703	6/3/2019 10:00	6/4/2019 13:55	IA	-0.25	IA	-0.10		
	130500064703	6/17/2019 8:40	6/18/2019 14:15			IA	-0.10		
TEAL	10600039014	6/3/2019 9:15	6/4/2019 13:35	IA	0.30				
	10600039014	6/17/2019 9:00	6/18/2019 17:10						
SWAC	17E103179	6/3/2019 8:45	6/4/2019 13:10			IA	-0.20	IA	-13.00
	17E103178	6/17/2019 7:55	6/18/2019 17:30					IA	-13.00
TANC	17E103179	8/26/2019 10:05	8/27/2019 15:10					IA	-3.00
	140600065724	9/23/2019 10:11	9/25/2019 11:05					IA	-3.00
DRYM	17E103179	7/29/2019 9:32	7/30/2019 15:18					IA	-5.00
	10600039014	8/26/2019 9:30	8/27/2019 12:19	IA	0.30	IA	0.30	IA	-5.00
	130500064703	9/23/2019 9:20	9/25/2019 13:05						
YKEL	130500064703	6/4/2019 18:05	6/6/2019 8:45	IA	-0.25				
PACK	10600039014	6/6/2019 9:00	6/6/2019 9:00						
	130500064703	6/6/2019 9:00	6/6/2019 9:00						
	17E103178	6/6/2019 9:00	6/6/2019 9:00						

Study Location ID	Instrument ID	Start Date/Time (PST)	End Date/Time (PST)	pH		DO		Cond	
				Data Qualifier	Bias Adjust (s.u.)	Data Qualifier	Bias Adjust (mg/L)	Data Qualifier	Bias Adjust (µS/cm)
	17E103179	6/4/2019 17:55	6/6/2019 9:05						
	17E103178	6/18/2019 17:50	6/20/2019 8:05					IA	-6.00
	130500064716	6/30/2019 9:31	7/2/2019 11:48						
	10600039014	7/15/2019 10:13	7/17/2019 13:55						
	130500064703	8/12/2019 9:55	8/14/2019 11:06						
	17E103179	9/9/2019 9:35	9/11/2019 10:00	IA	0.26			IA	-5.00
	140600065724	10/7/2019 9:50	10/9/2019 12:00					IA	-4.00
REEC	17E103178	6/4/2019 17:35	6/6/2019 8:35						
	17E103179	6/30/2019 9:48	7/2/2019 11:20						
	17E103179	7/15/2019 9:20	7/17/2019 12:52						
	17E103178	8/12/2019 9:02	8/14/2019 9:55					IA	-10.50
	130500064716	9/9/2019 8:40	9/11/2019 9:45					IA	-8.00
	17E103179	10/7/2019 8:55	10/9/2019 11:02					IA	-7.00
MANL	130500064703	6/18/2019 18:00	6/20/2019 8:10						
	17E103178	6/30/2019 10:23	7/2/2019 11:36			IA	-0.20	IA	-10.00
	130500064703	7/15/2019 10:00	7/17/2019 13:40					EST	
	17E103178	7/29/2019 9:53	7/31/2019 12:25						
	130500064716	8/12/2019 9:45	8/14/2019 10:38	IA	0.25				
	17E103178	8/26/2019 9:05	8/27/2019 11:54						
	140600065724	9/9/2019 9:20	9/11/2019 9:30			IA	0.10		
	17E103179	9/23/2019 8:54	9/25/2019 11:40	IA	0.27	IA	-0.20	IA	-5.00
	17E103178	10/7/2019 9:35	10/9/2019 11:42			IA	-0.30		
FOG	17E103179	6/18/2019 18:15	6/20/2019 8:25	IA	0.30				
	10600039014	6/30/2019 10:08	7/2/2019 11:05						
	17E103178	7/15/2019 9:45	7/17/2019 12:52	IA	0.22			IA	-6.00
	17E103179	8/12/2019 9:25	8/14/2019 10:20	EST	0.22				

Study Location ID	Instrument ID	Start Date/Time (PST)	End Date/Time (PST)	pH		DO		Cond	
				Data Qualifier	Bias Adjust (s.u.)	Data Qualifier	Bias Adjust (mg/L)	Data Qualifier	Bias Adjust (µS/cm)
	130500064703	8/26/2019 8:45	8/27/2019 11:10						
	130500064703	9/9/2019 9:00	9/11/2019 9:15						
	130500064703	10/7/2019 9:15	10/9/2019 11:20	EST	-0.10				
WILC	10600039014	5/22/2019 9:45	5/24/2019 7:30	IA	0.25	IA	-0.30	IA	-6.50
	10600039014	6/4/2019 15:00	6/6/2019 8:15	IA	0.25				
	10600039014	6/18/2019 18:35	6/20/2019 9:05						
	130500064703	6/30/2019 8:30	7/2/2019 10:03					IA	-6.00
	130500064716	7/15/2019 8:50	7/17/2019 10:02					IA	-7.00
	10600039014	8/12/2019 8:30	8/14/2019 8:25	IA	0.22			IA	-5.00
	130500064716	8/26/2019 8:30	8/28/2019 10:30					IA	-7.00
	130500064716	9/23/2019 8:30	9/25/2019 10:02					IA	-8.00
	130500064716	10/7/2019 8:35	10/9/2019 10:00					IA	-11.00

IA = Instrument result adjusted; reported result meets study objectives.

EST = Data considered to be an estimate based on post-check versus reference standard.

DO = dissolved oxygen

Cond = conductivity

Table E2. Data rejected due to instrument fouling and/or not meeting the study's measurement quality objectives.

Study Location ID	Instrument ID	Start Date/Time (PST)	End Date/Time (PST)	Parameter
CLE	130500064703	6/17/19 8:40	6/18/19 14:15	pH
PACK	10600039014	7/15/19 10:13	7/17/19 13:55	pH
SWAC	17E103179	6/4/2019 4:30	6/4/2019 5:30	DO
MANL	130500064716	8/13/2019 6:30	8/13/2019 12:03	cond
MANL	140600065724	9/9/19 9:20	9/11/19 9:30	cond
FOG	10600039014	6/30/19 10:00	7/2/19 11:00	pH

DO = dissolved oxygen cond = conductivity

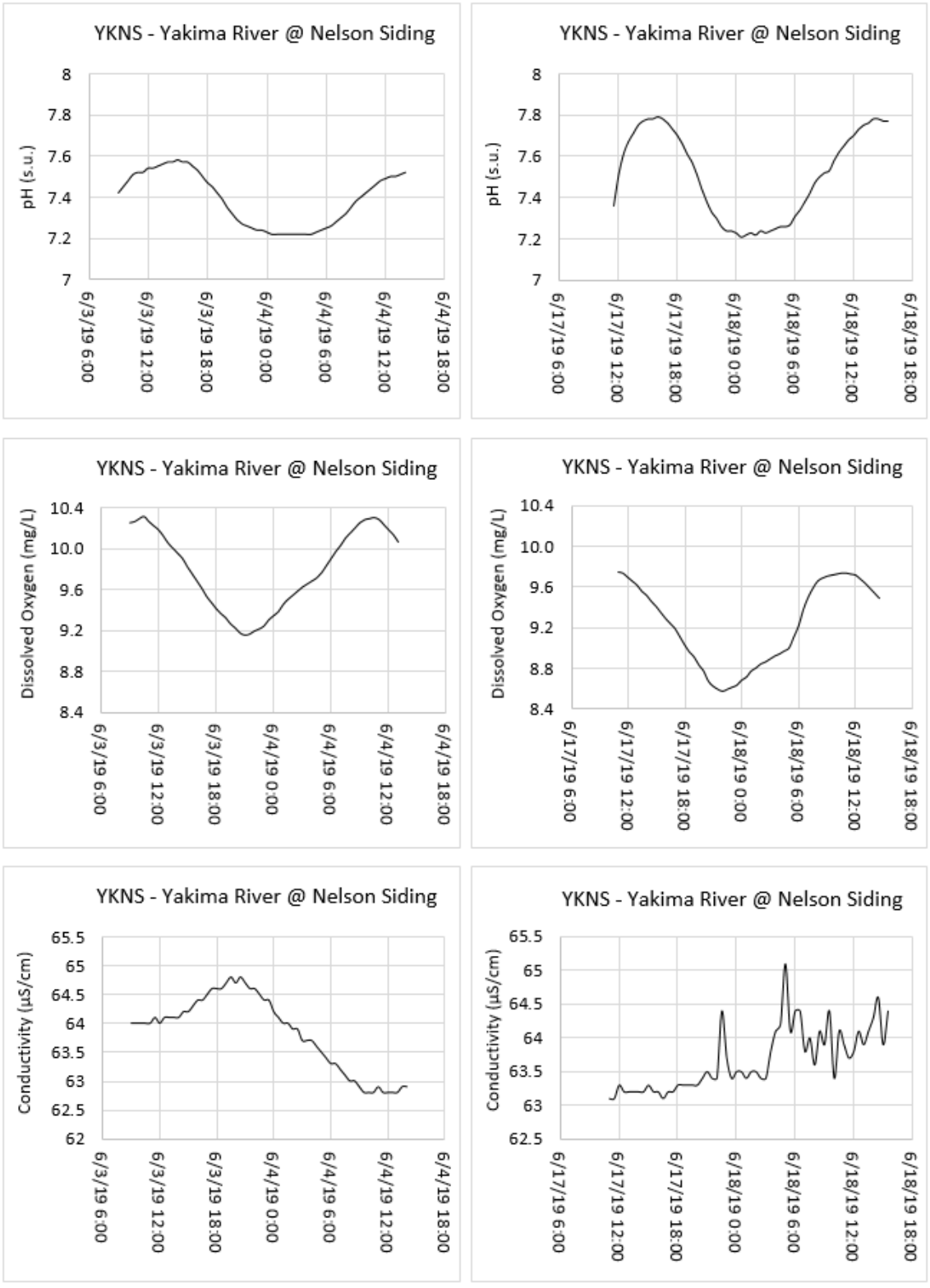


Figure E1. Continuous short-term pH, dissolved oxygen, and conductivity monitoring results for YKNS.

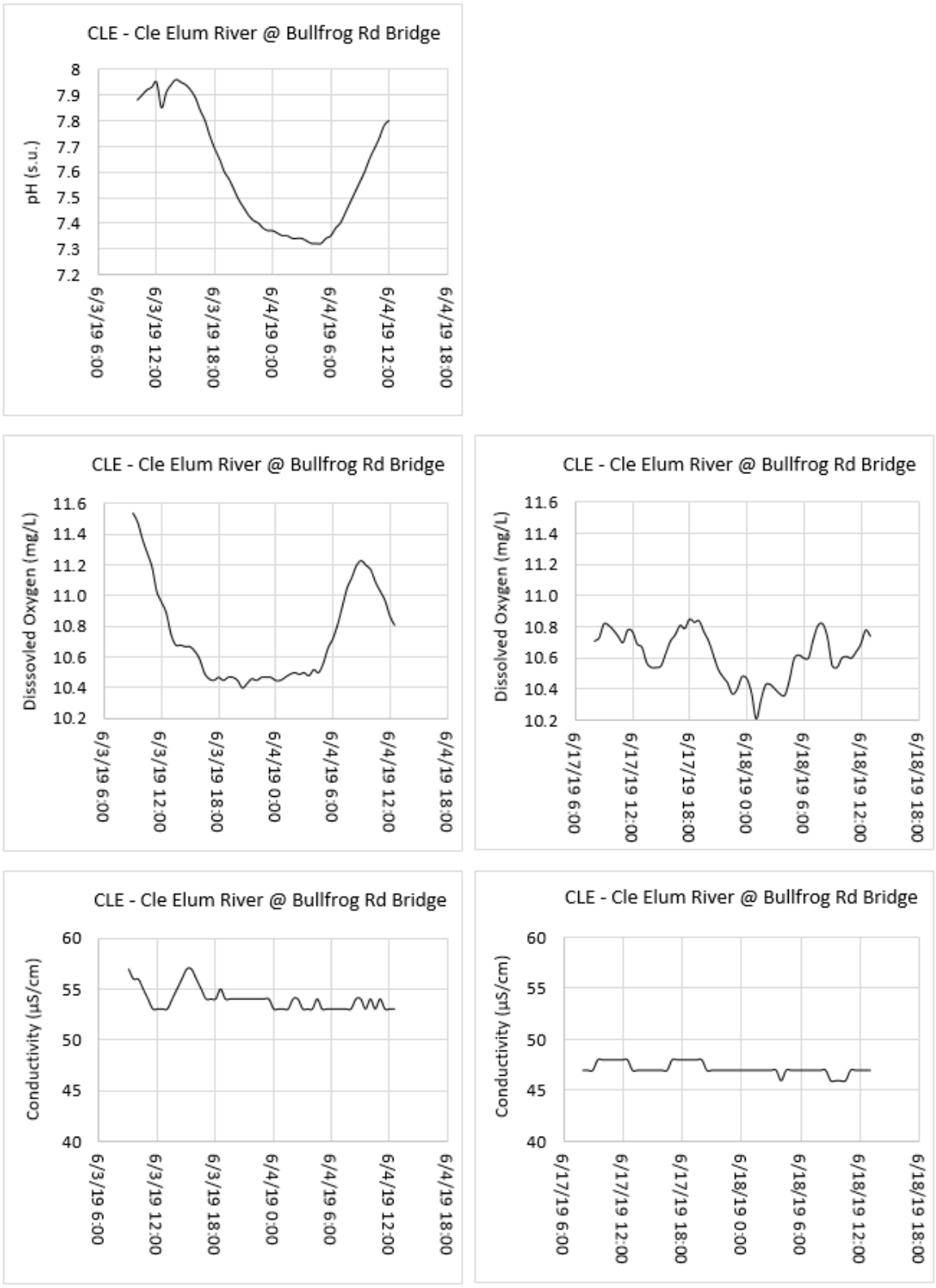


Figure E2. Continuous short-term pH, dissolved oxygen, and conductivity monitoring results for CLE.

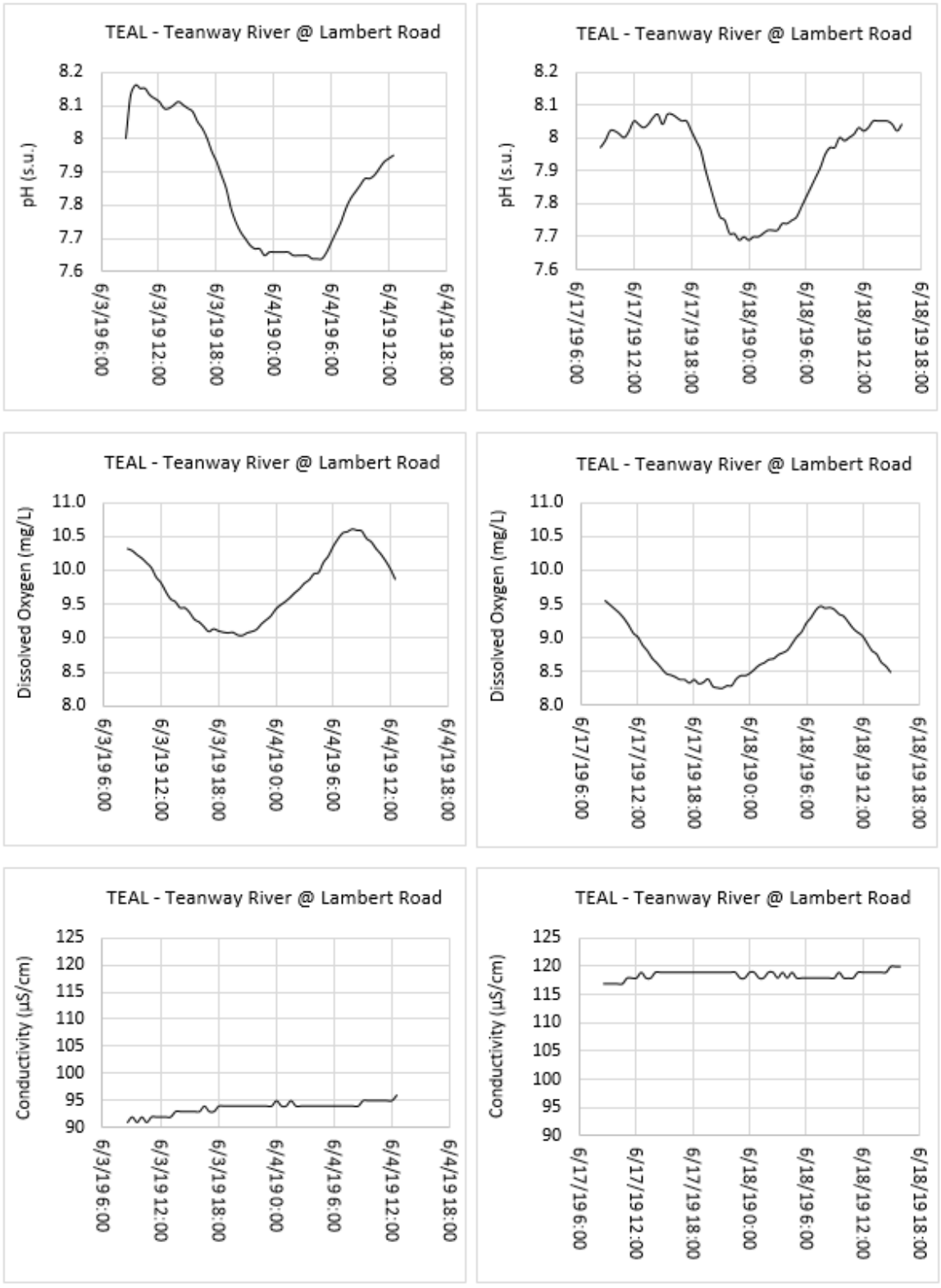


Figure E3. Continuous short-term pH, dissolved oxygen, and conductivity monitoring results for TEAL.

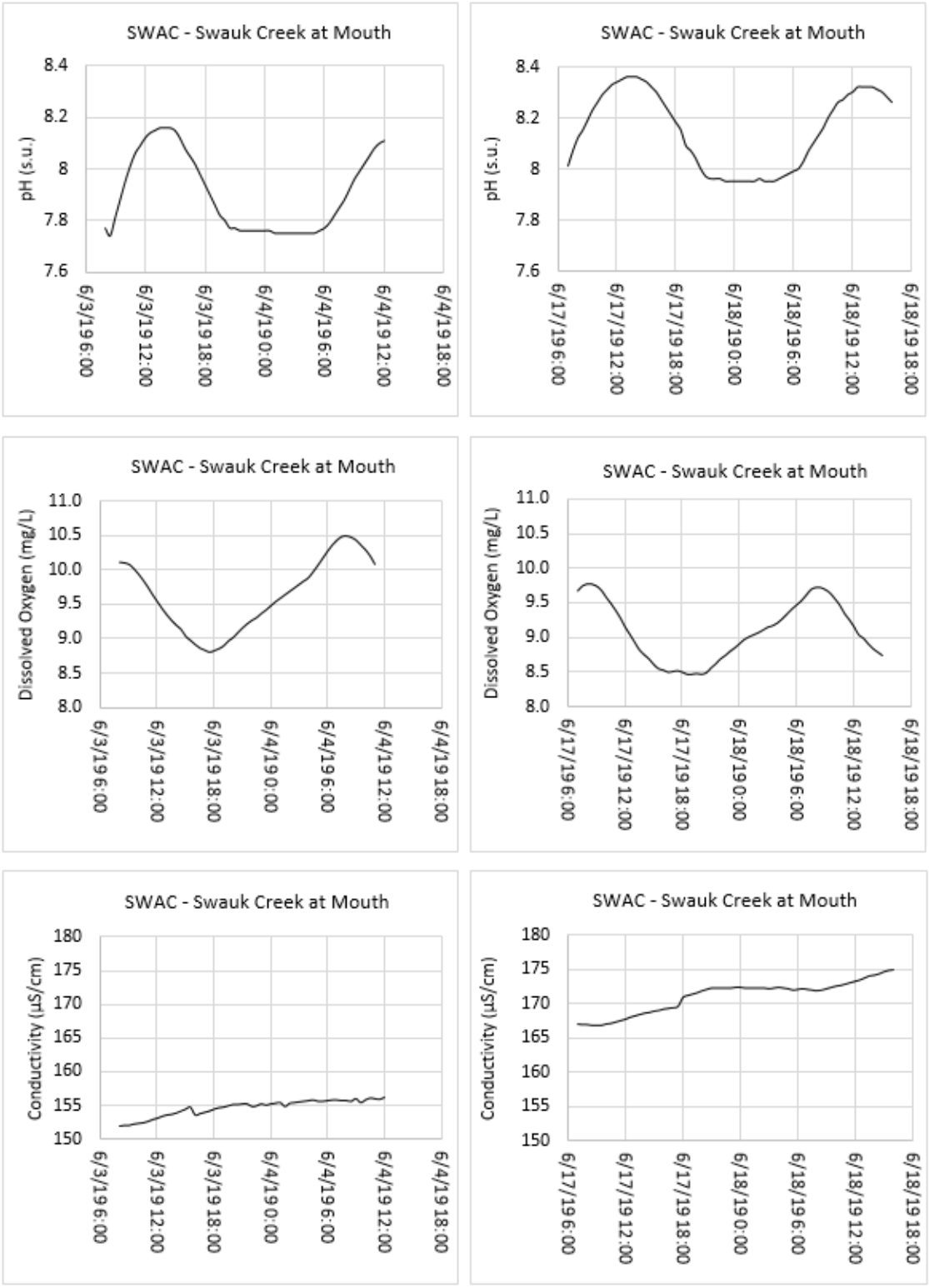


Figure E4. Continuous short-term pH, dissolved oxygen, and conductivity monitoring results for SWAC.

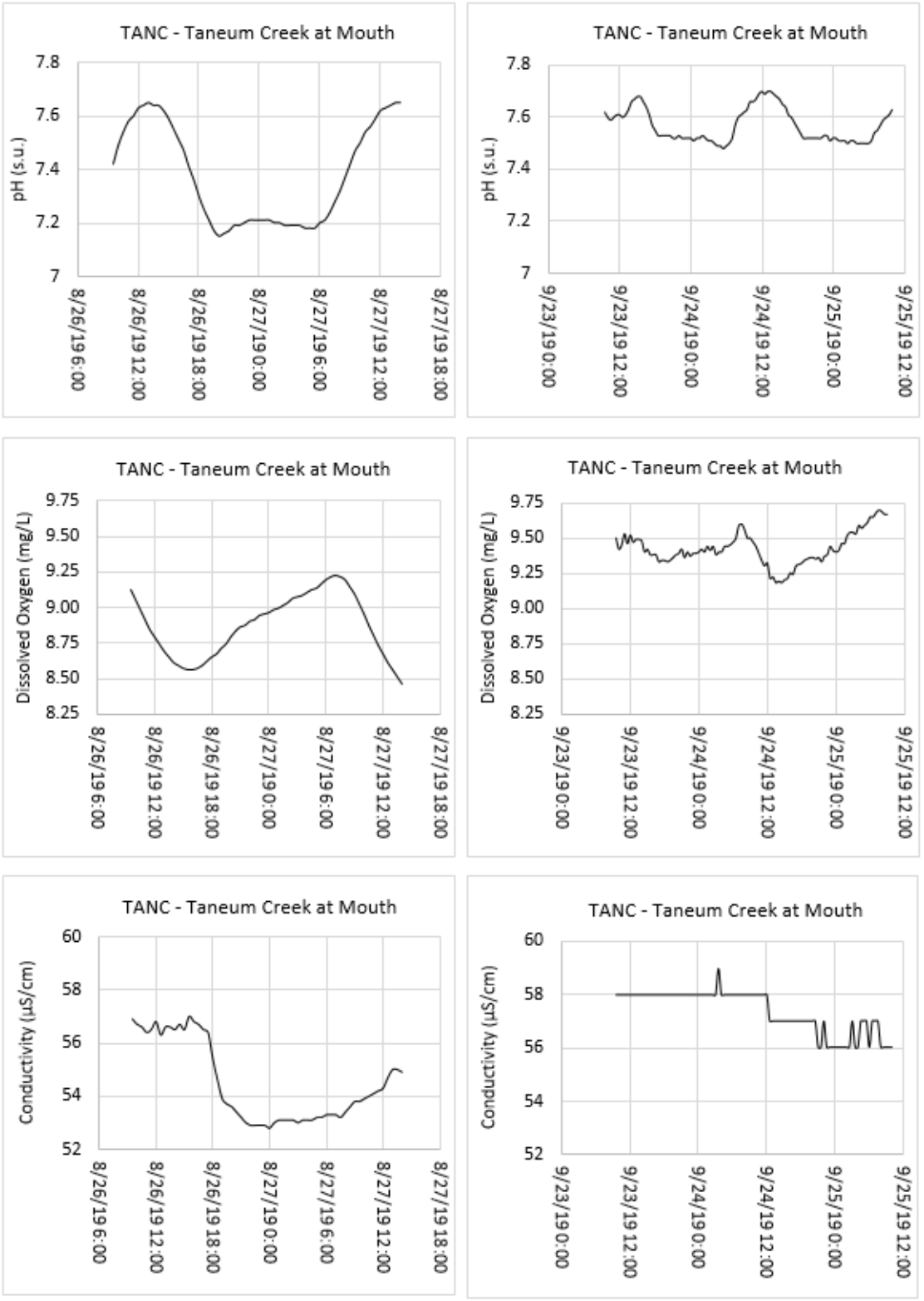


Figure E5. Continuous short-term pH, dissolved oxygen, and conductivity monitoring results for TANC.

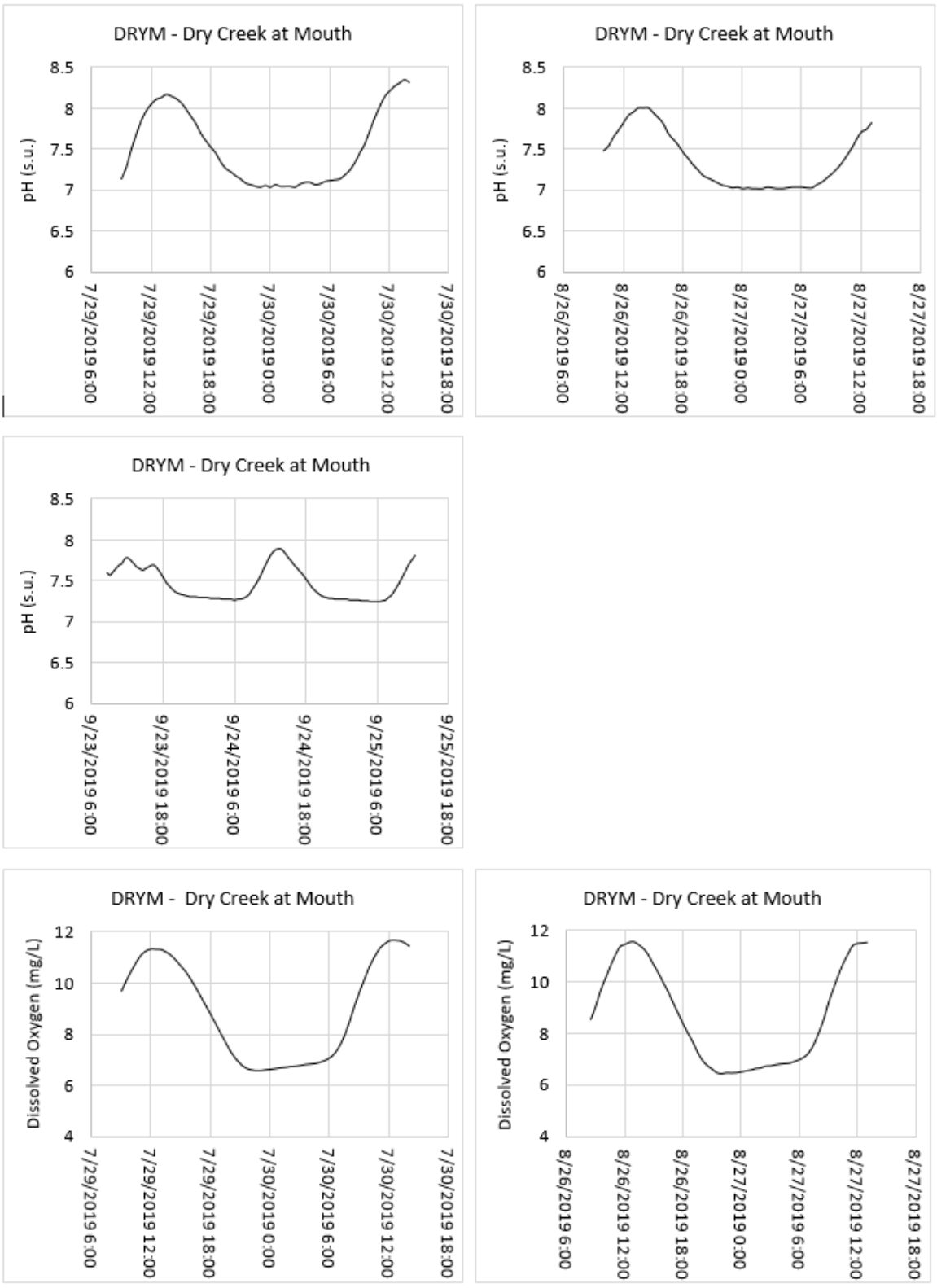


Figure E6.1. Continuous short-term pH and dissolved oxygen monitoring results for DRYM.

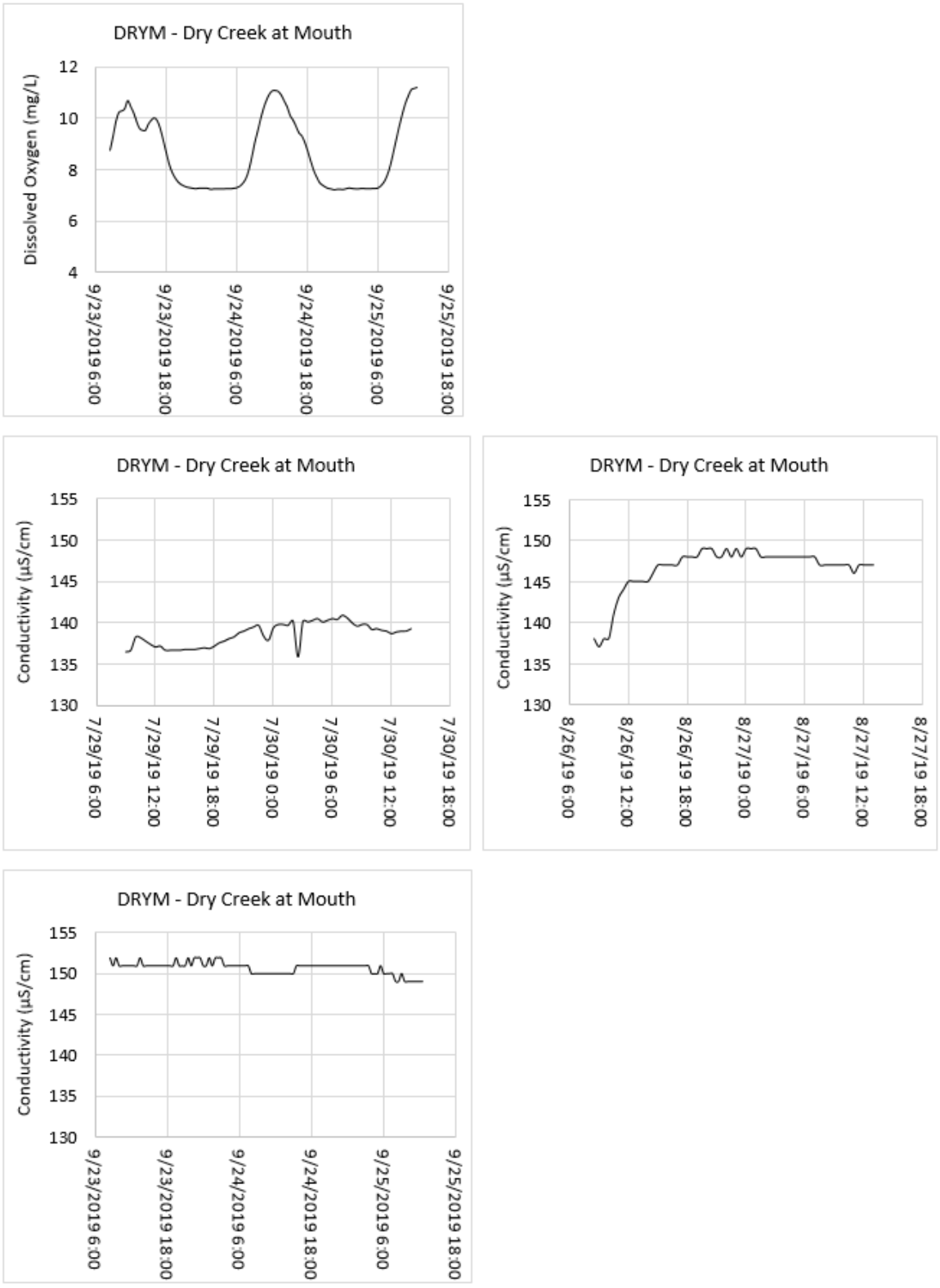
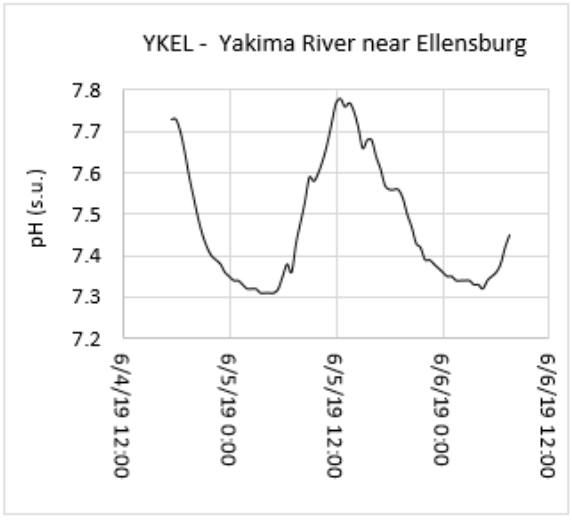
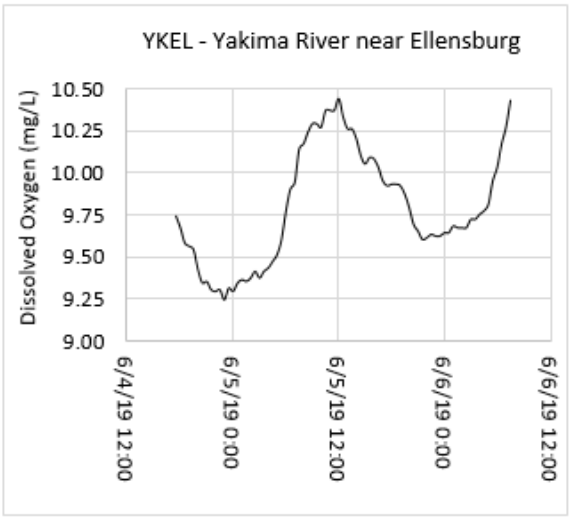


Figure E6.2. Continuous short-term dissolved oxygen (continued) and conductivity monitoring results for DRYM.





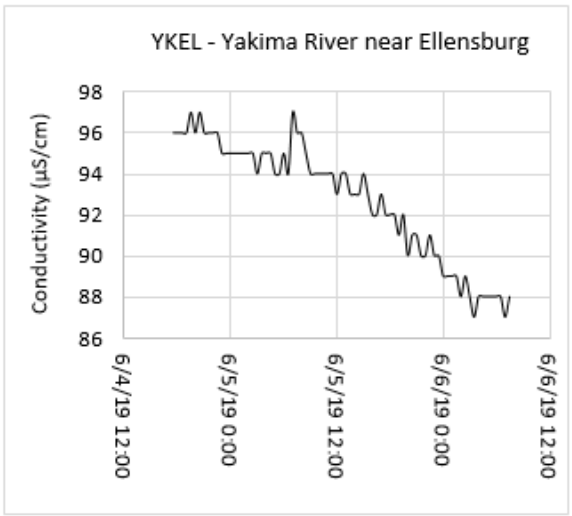


Figure E7. Continuous short-term pH, dissolved oxygen, and conductivity monitoring results for YKEL.

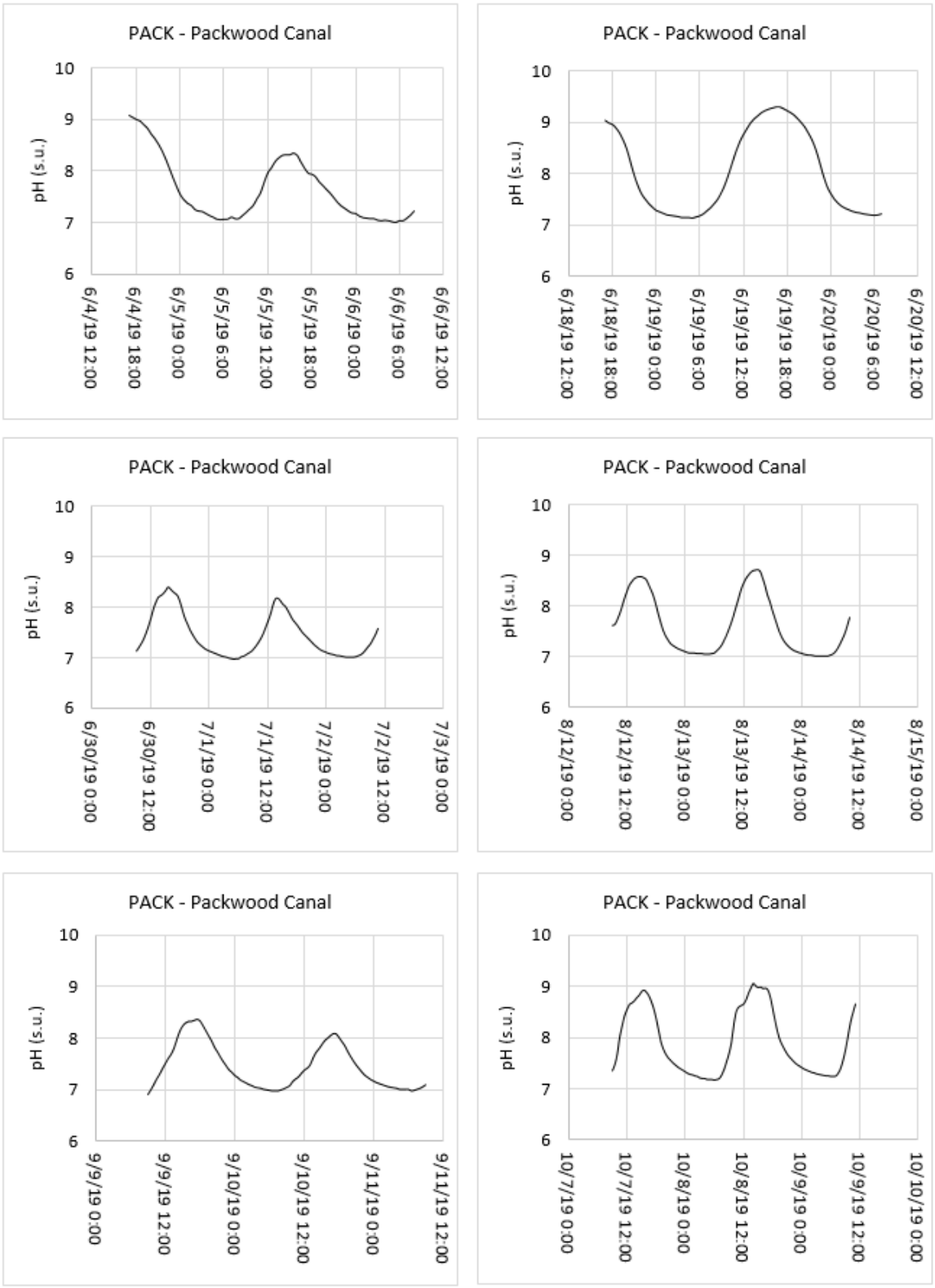


Figure E8.1. Continuous short-term pH monitoring results for PACK.

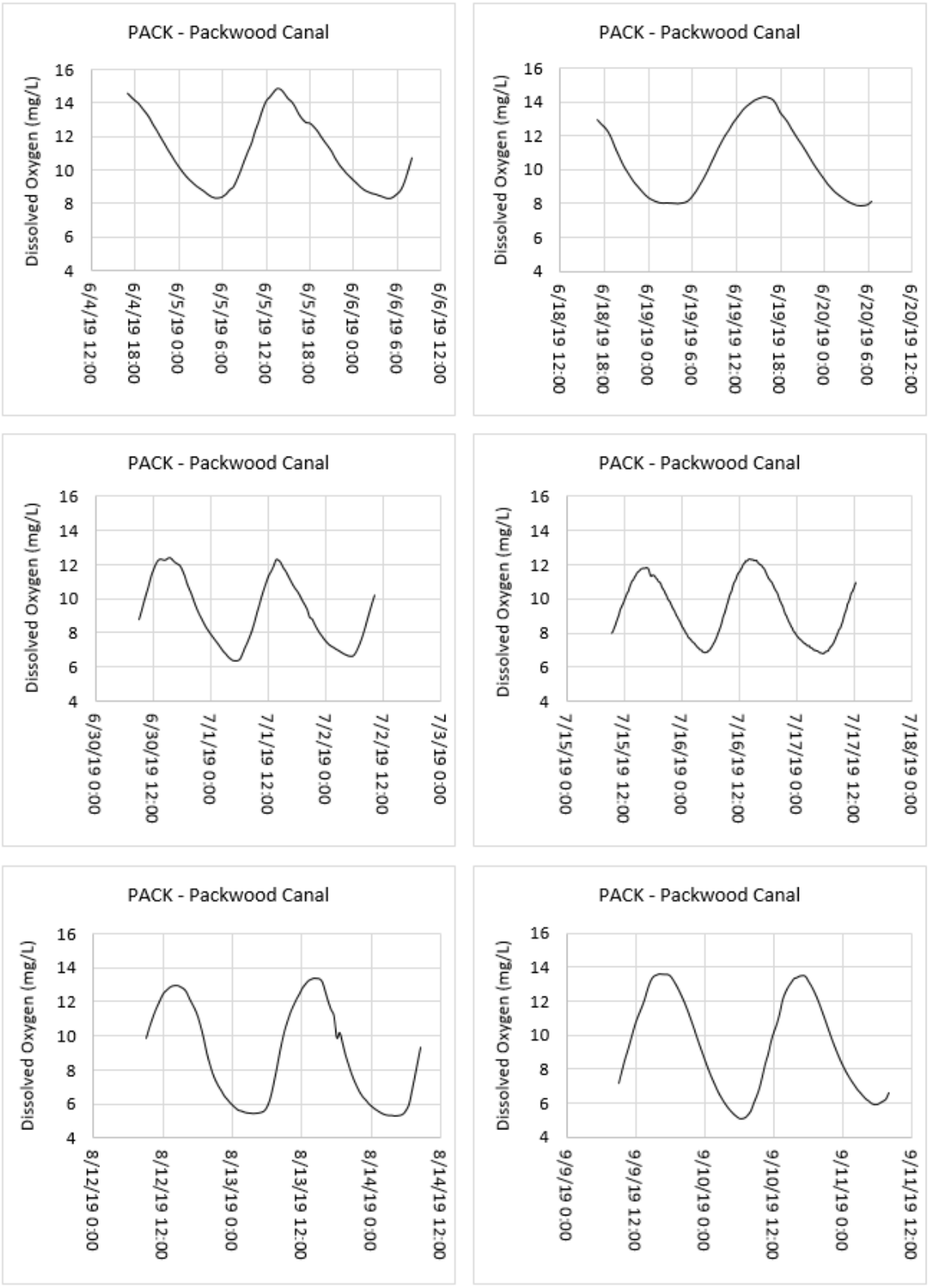


Figure E8.2. Continuous short-term dissolved oxygen monitoring results for PACK.

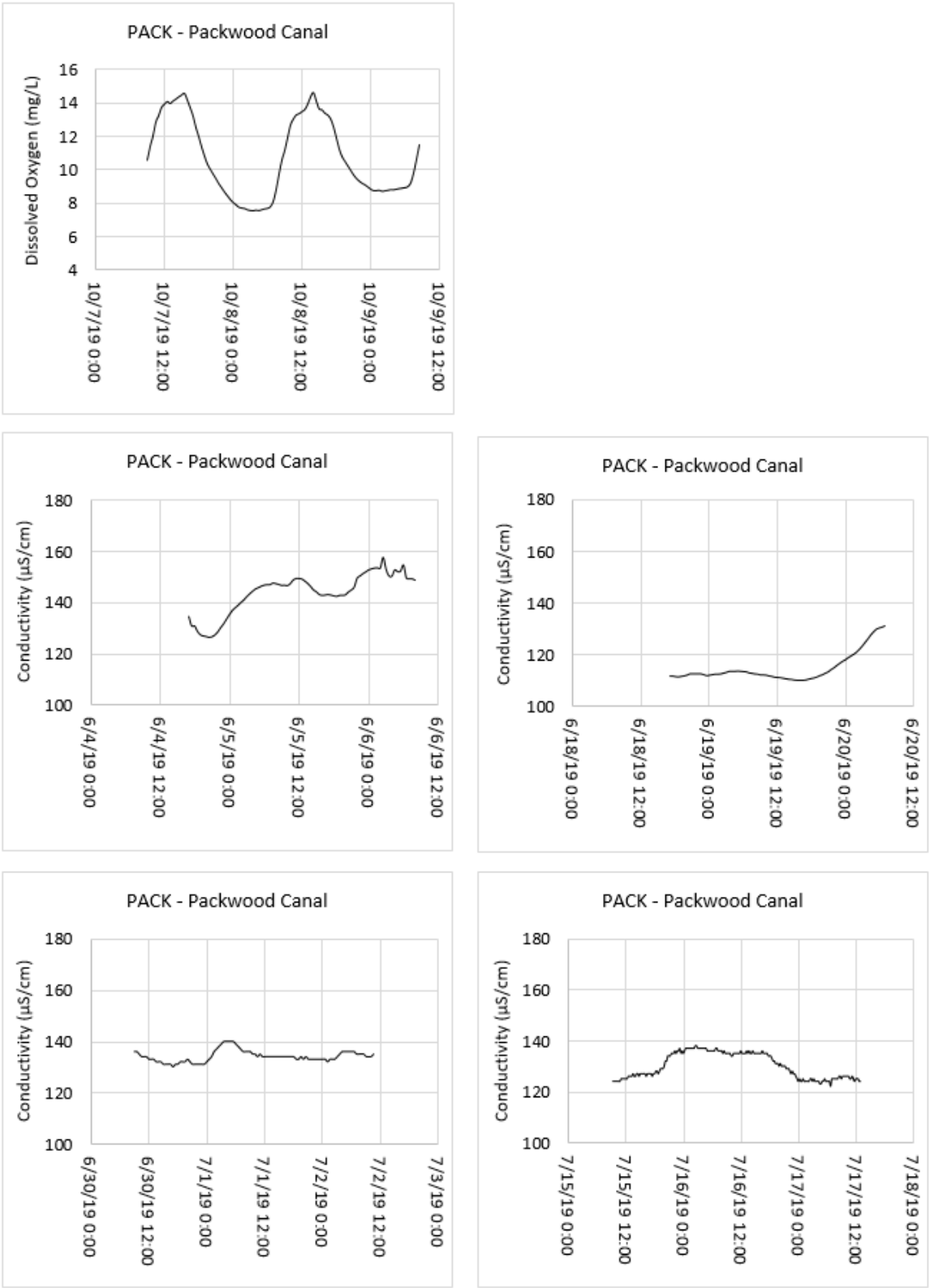


Figure E8.3. Continuous short-term dissolved oxygen (continued) and conductivity monitoring results for PACK.

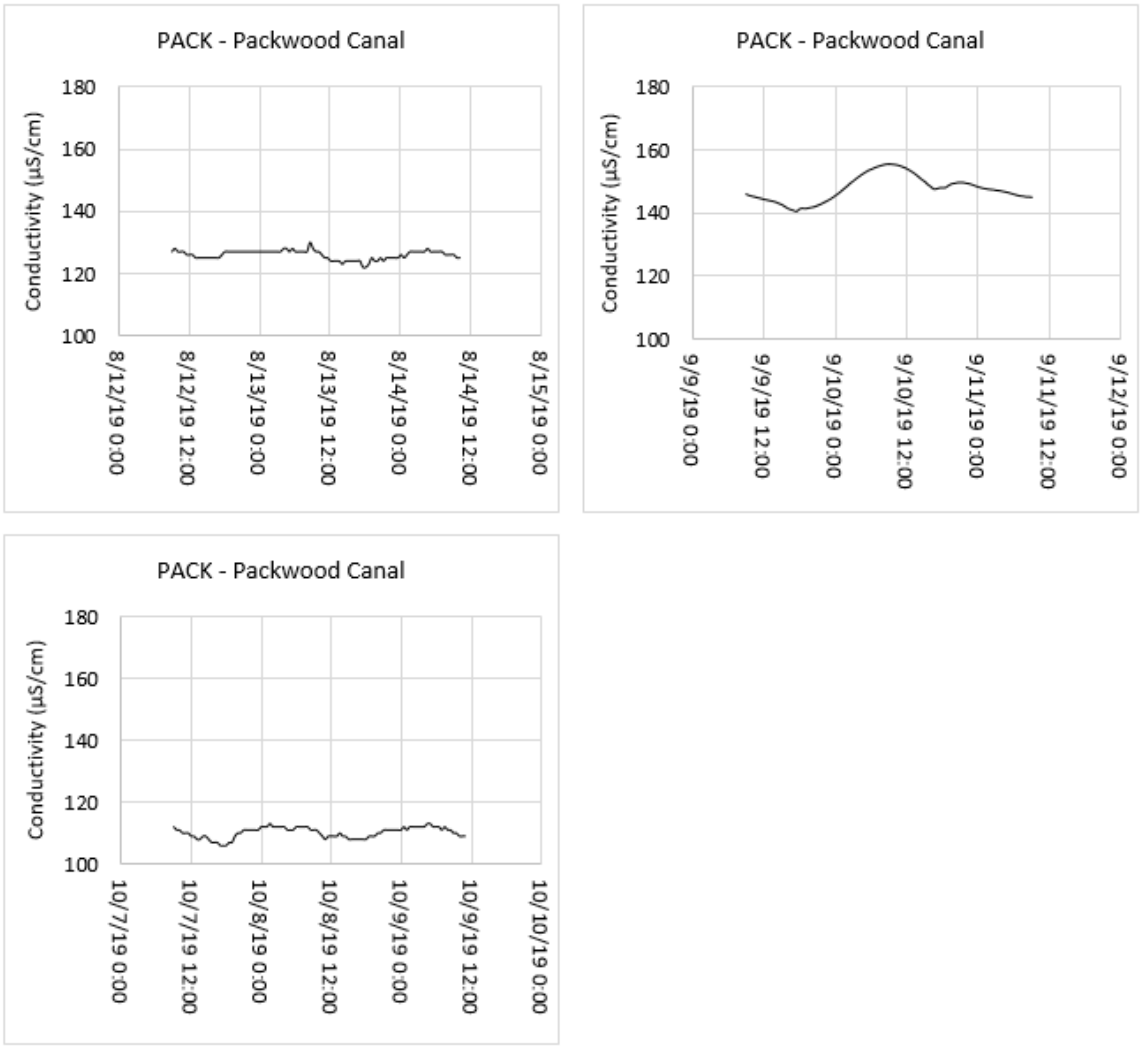


Figure E8.4. Continuous short-term conductivity (continued) monitoring results for PACK.

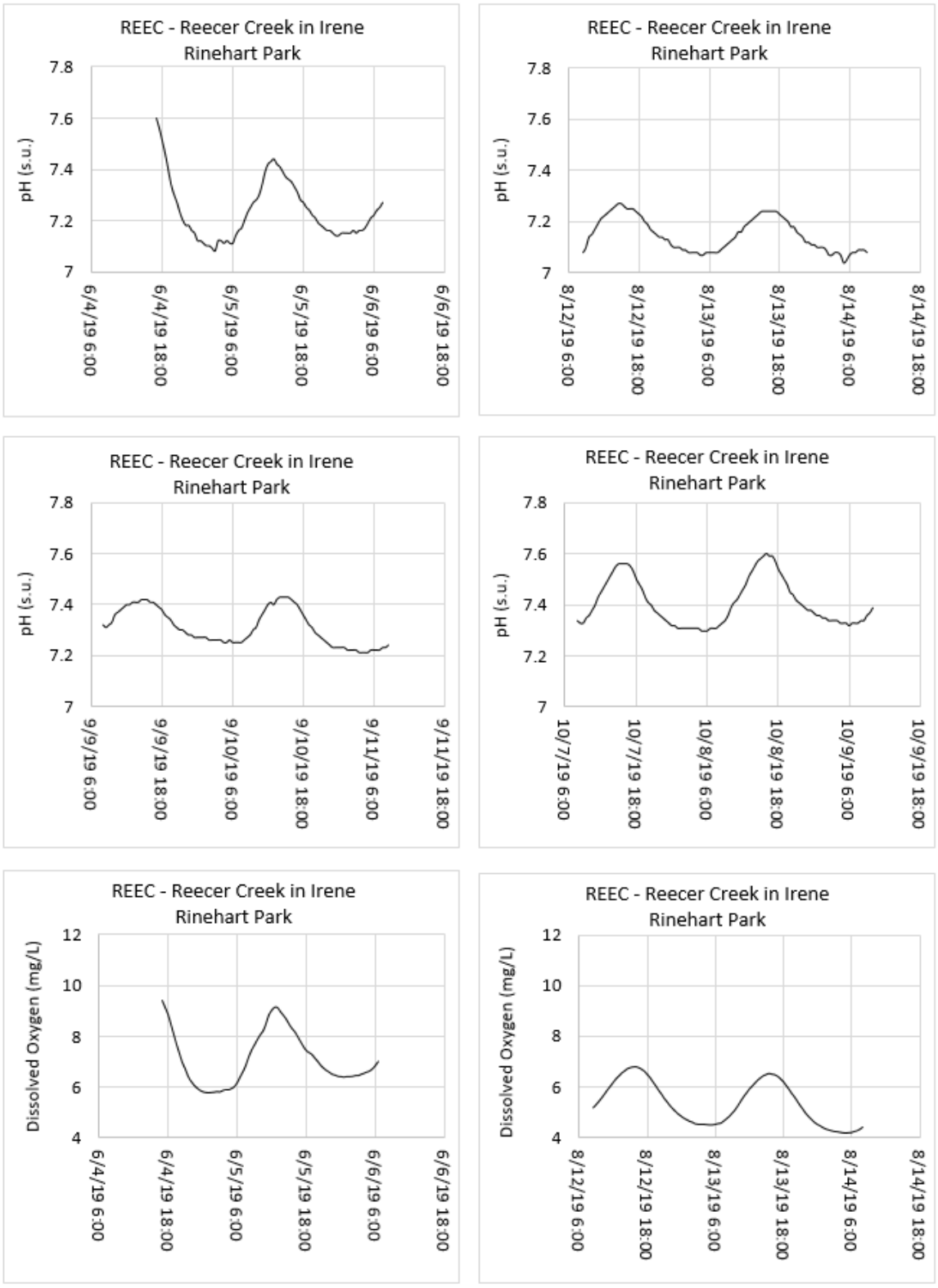


Figure E9.1. Continuous short-term pH and dissolved oxygen monitoring results for REEC.

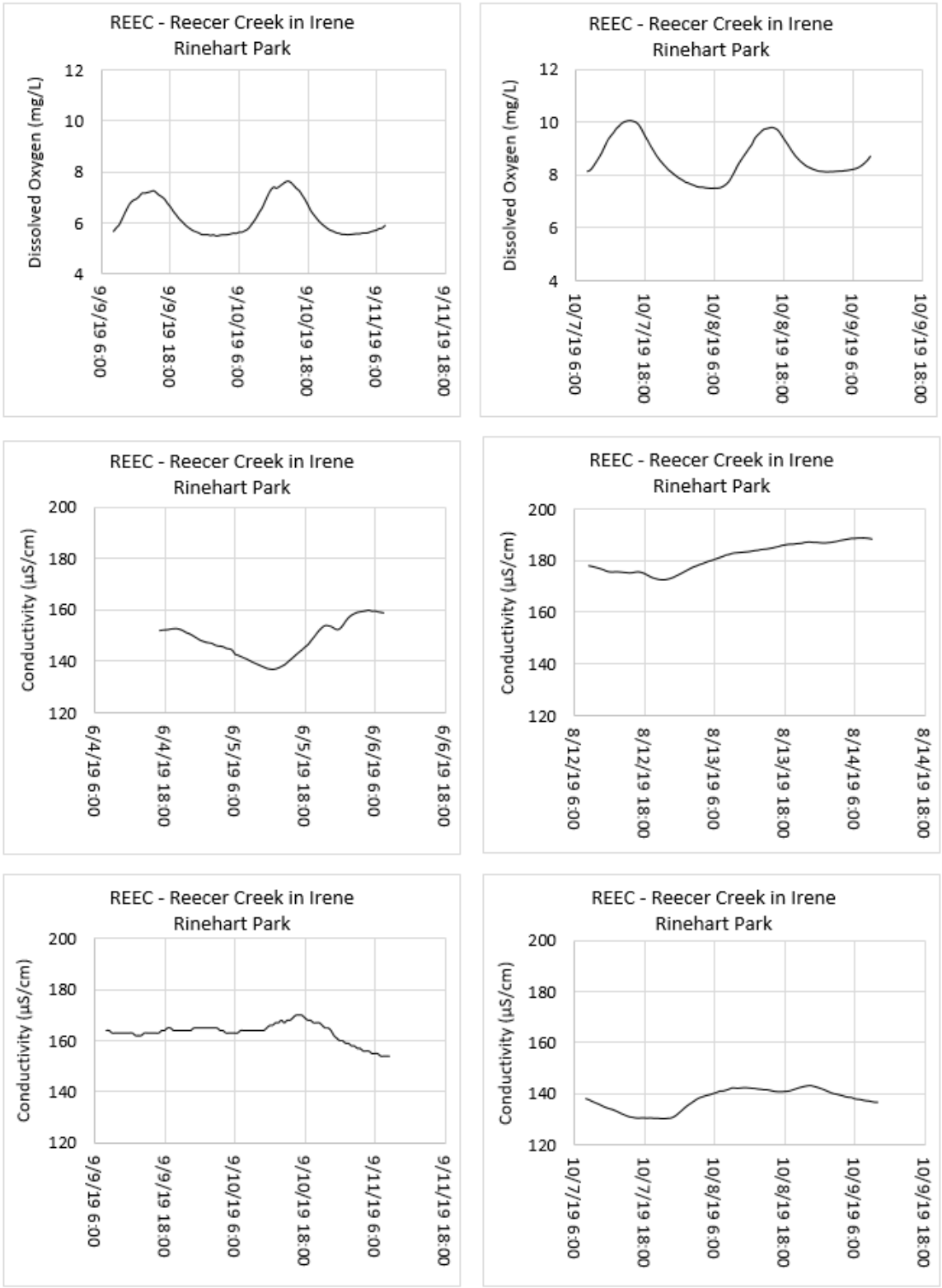


Figure E9.2. Continuous short-term dissolved oxygen (continued) and conductivity monitoring results for REEC.

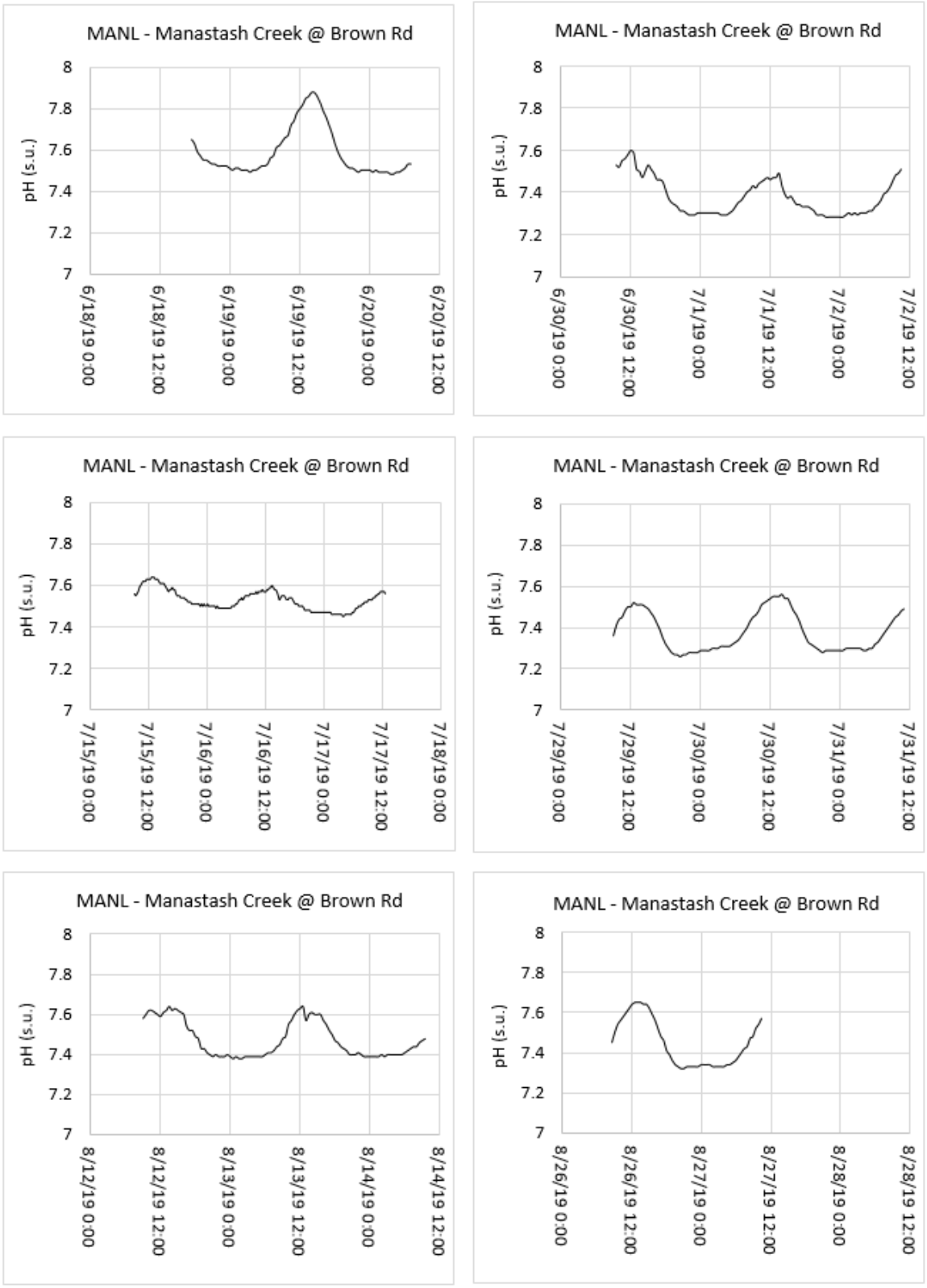


Figure E10.1. Continuous short-term pH monitoring results for MANL.

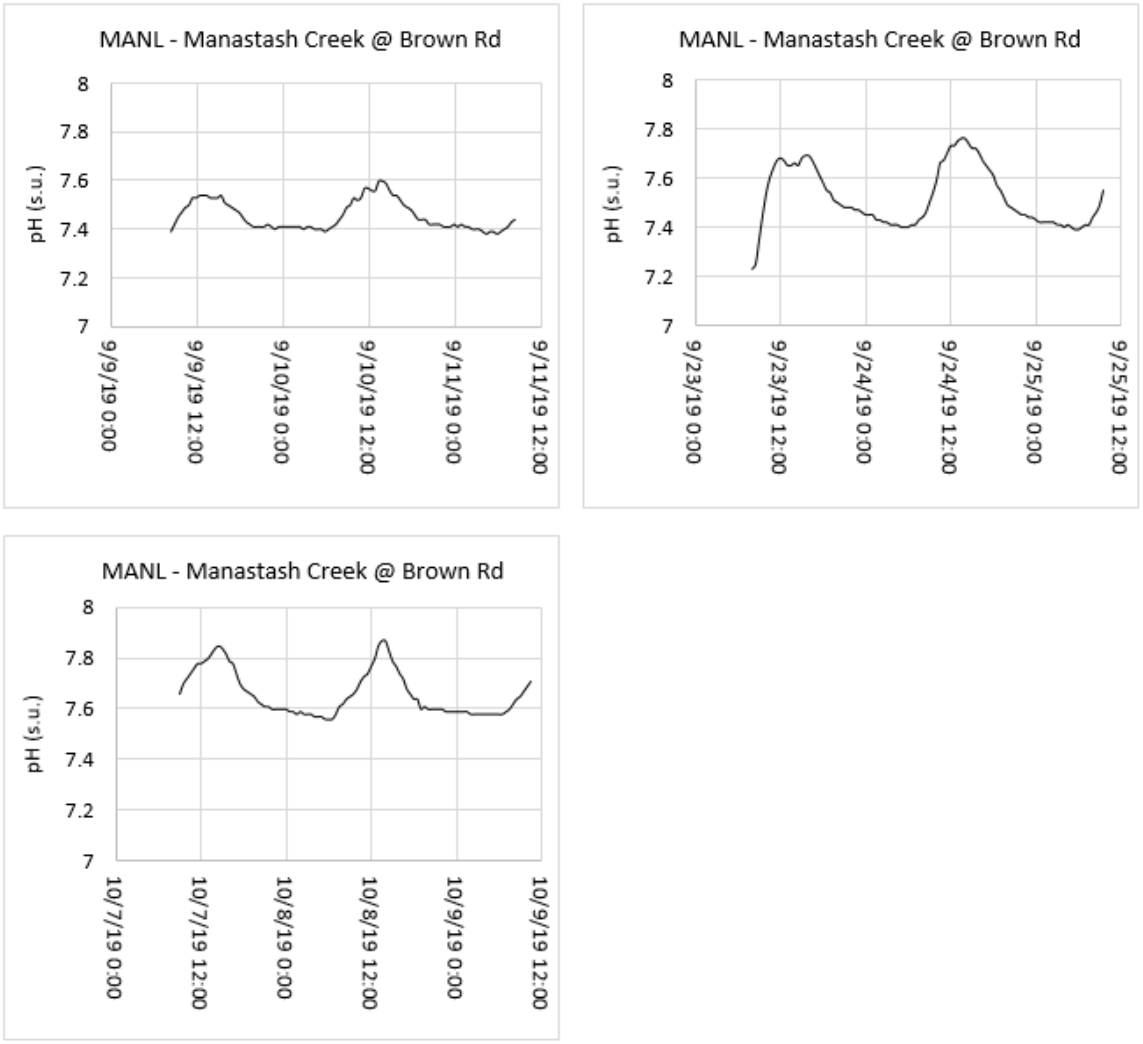


Figure E10.2. Continuous short-term pH (continued) monitoring results for MANL.

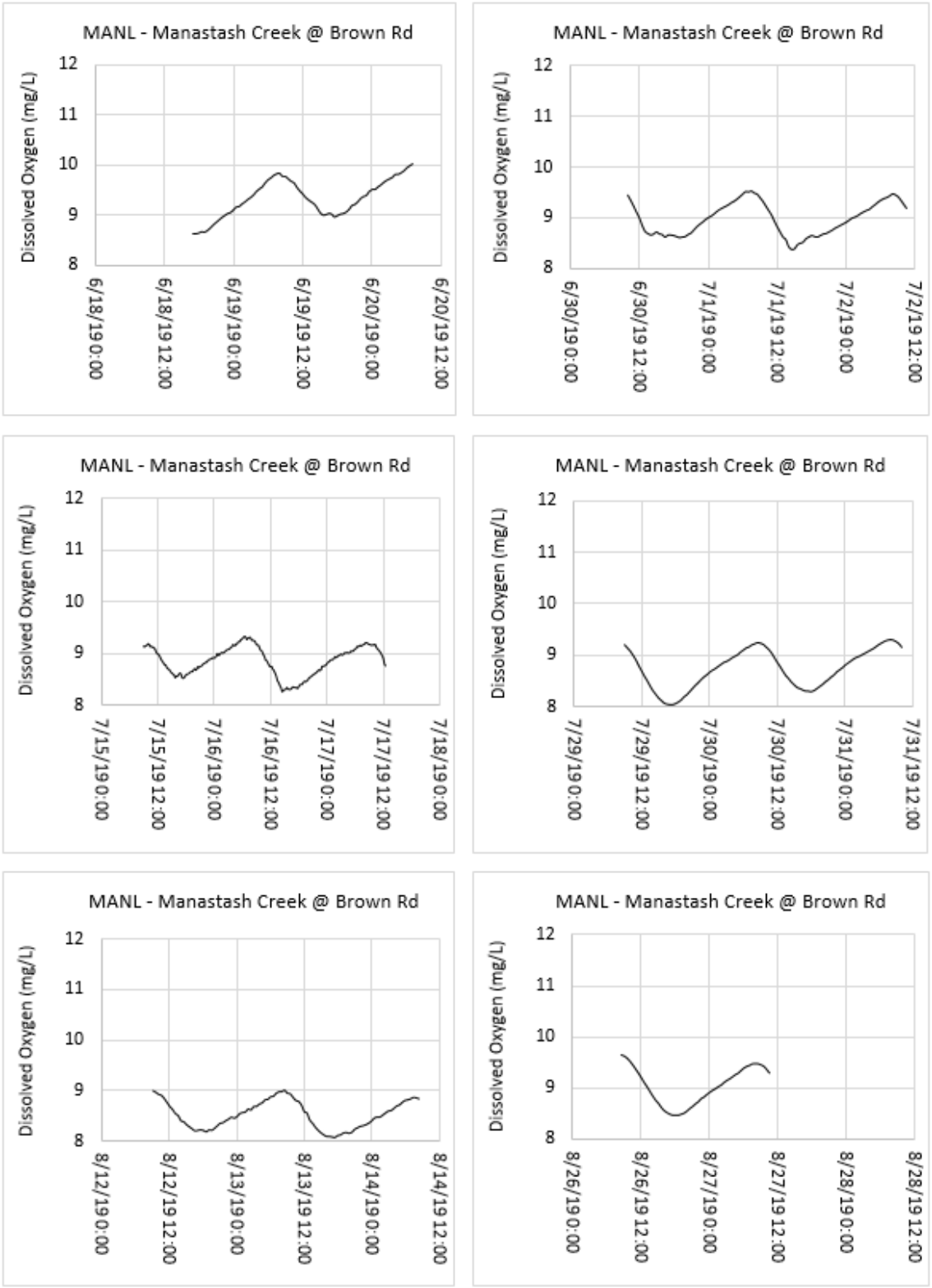


Figure E10.3. Continuous short-term dissolved oxygen monitoring results for MANL

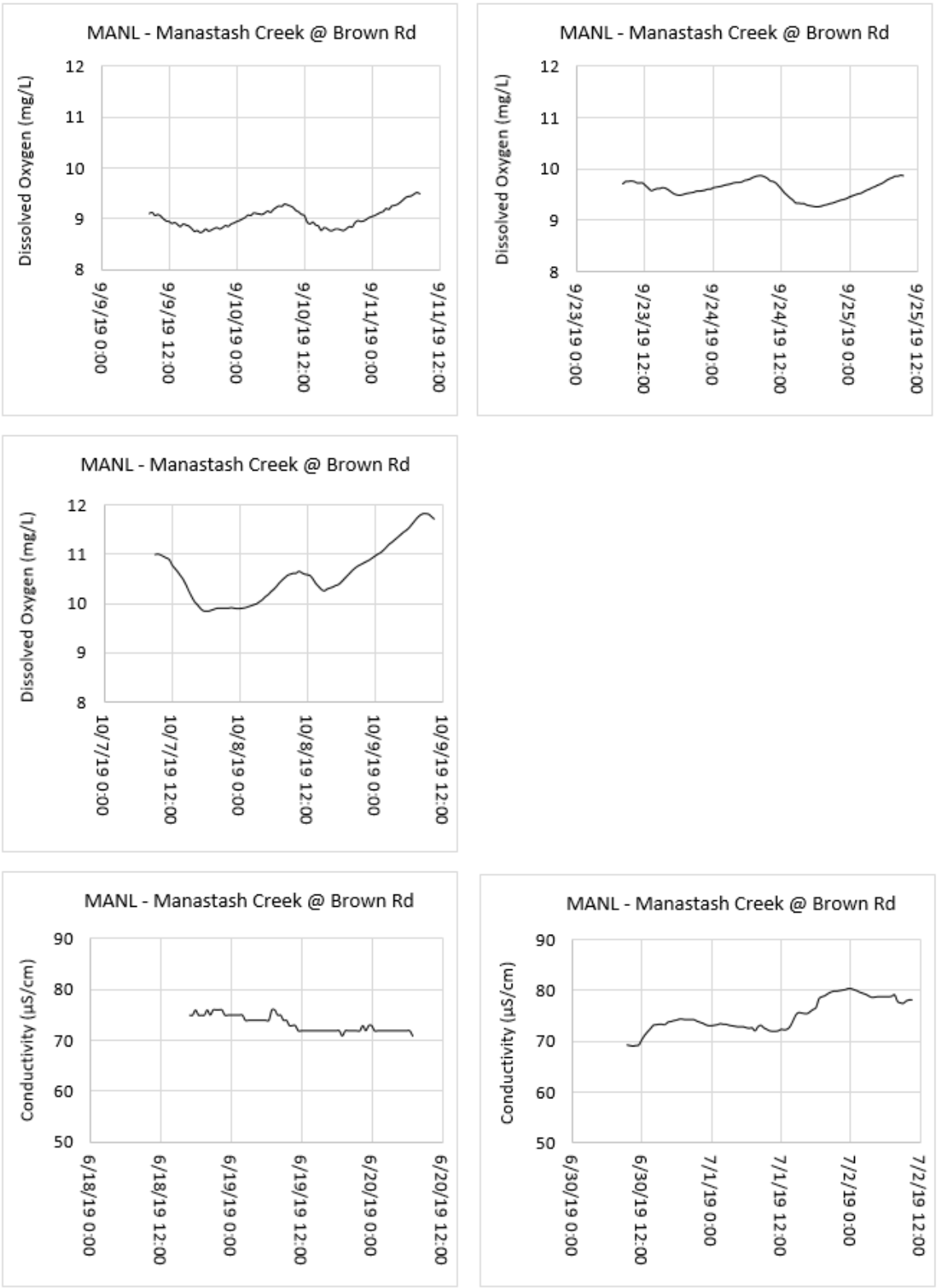


Figure E10.4. Continuous short-term dissolved oxygen (continued) and conductivity monitoring results for MANL.

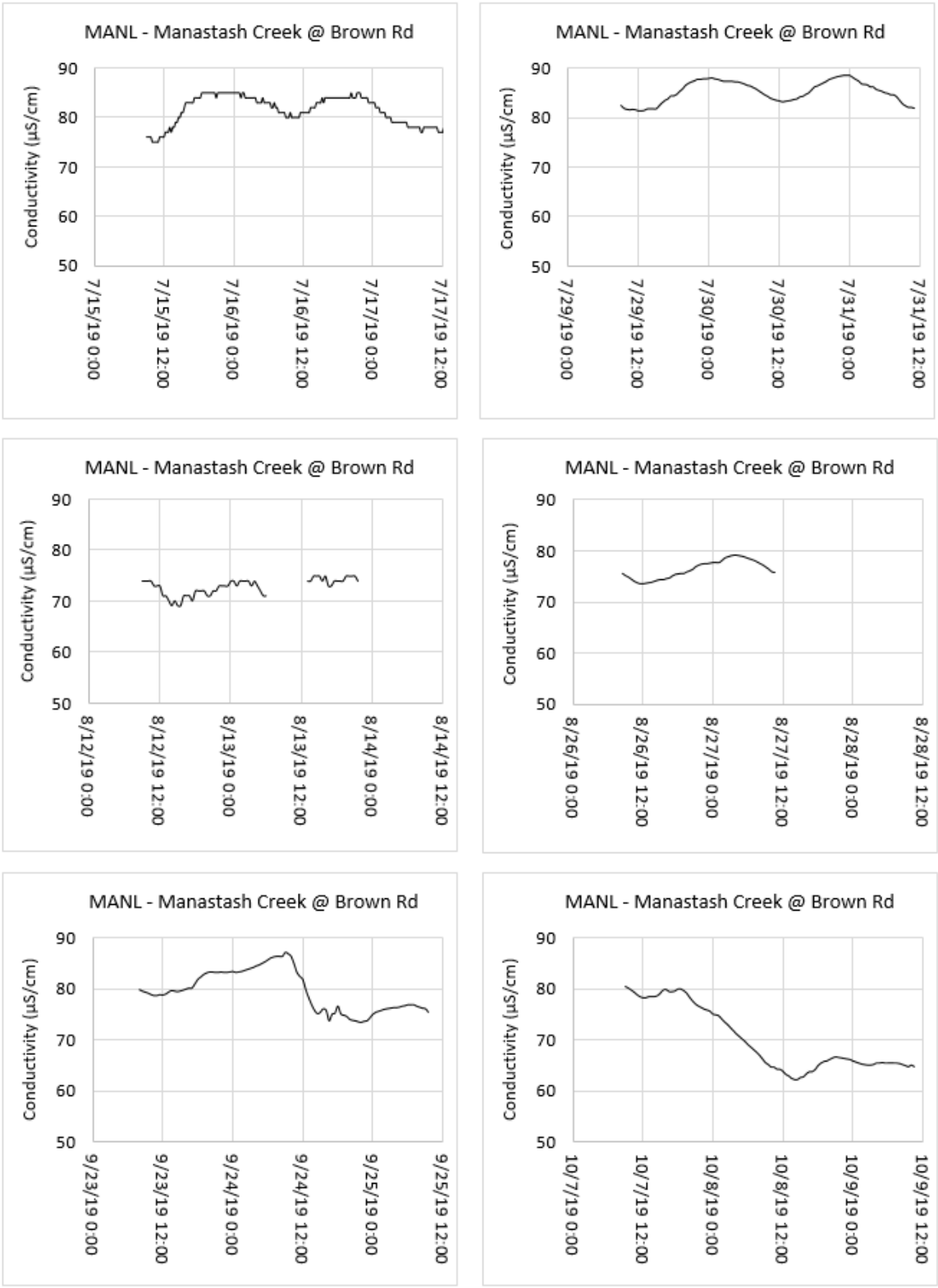


Figure E10.5. Continuous short-term conductivity monitoring results for MANL.

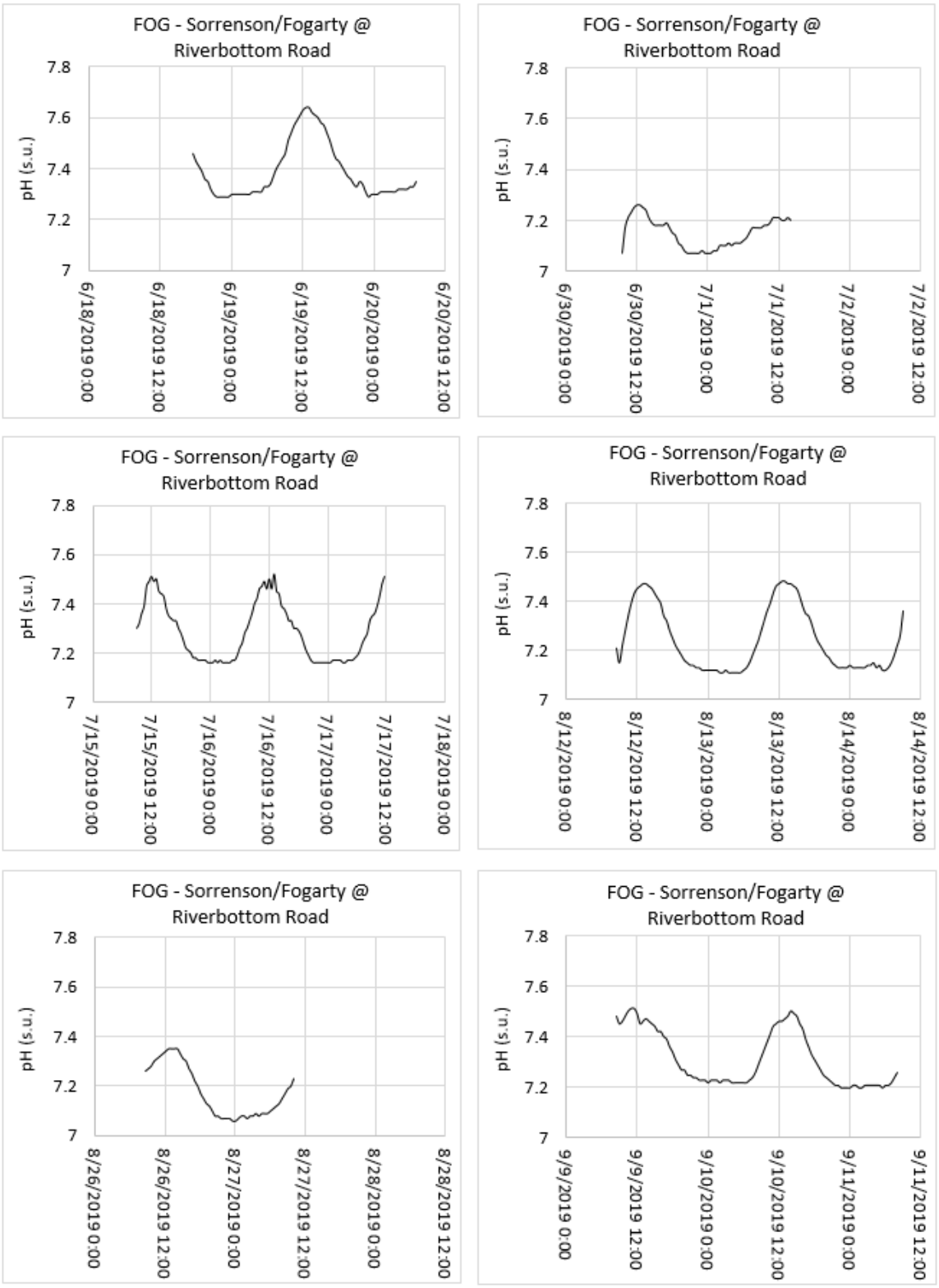
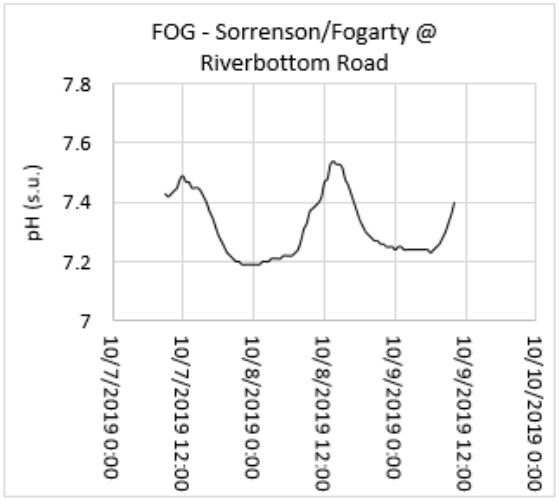
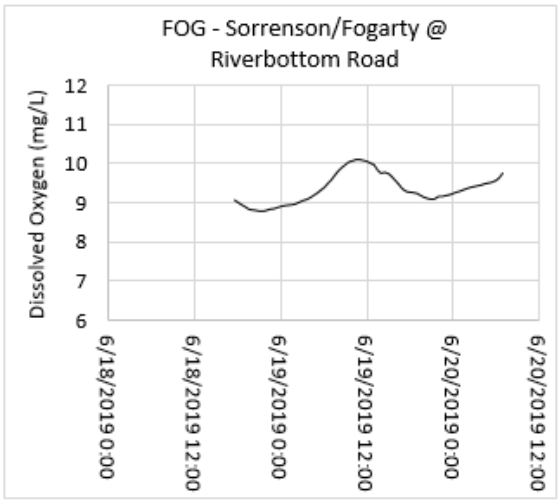
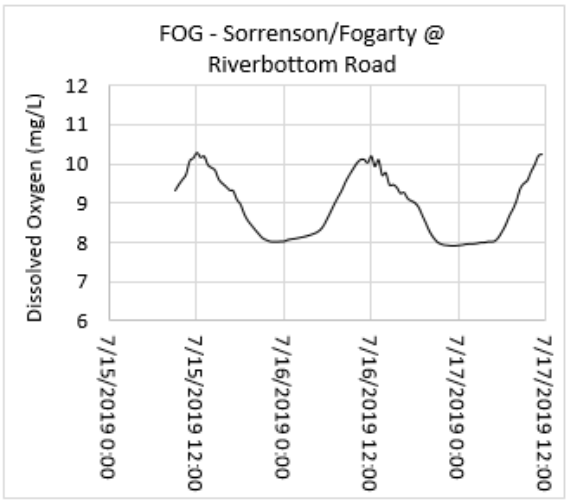
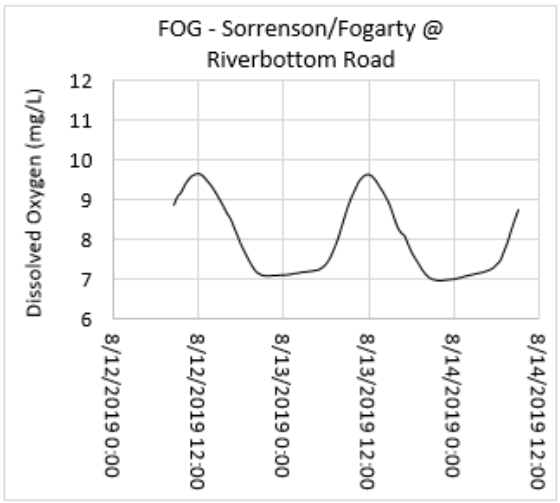


Figure E11.1. Continuous short-term pH monitoring results for FOG.









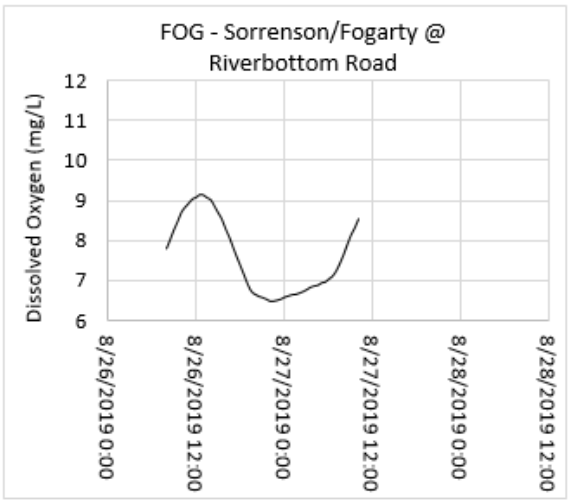


Figure E11.2. Continuous short-term pH (continued) and dissolved oxygen monitoring results for FOG.

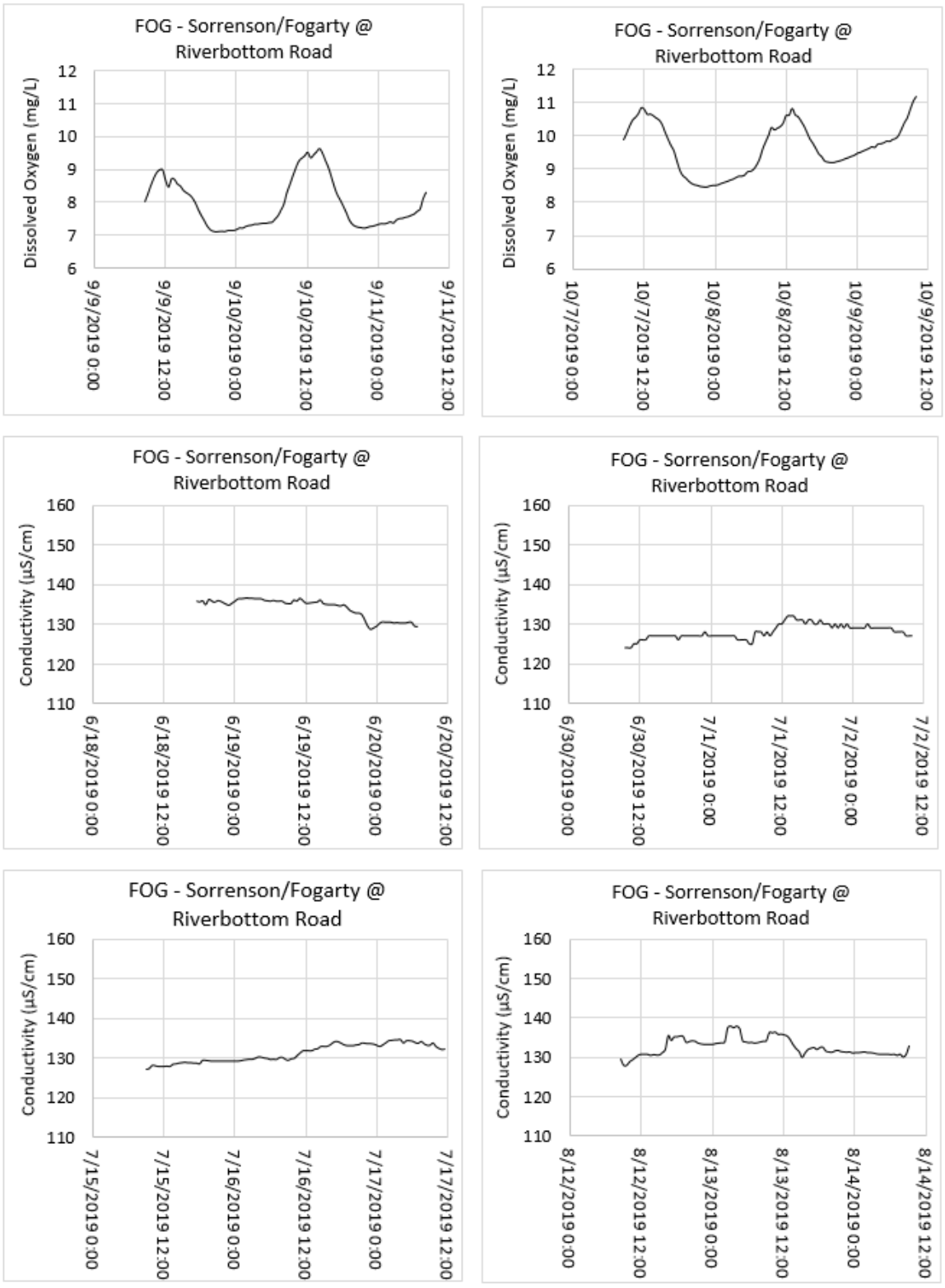


Figure E11.3. Continuous short-term dissolved oxygen (continued) and conductivity monitoring results for FOG.

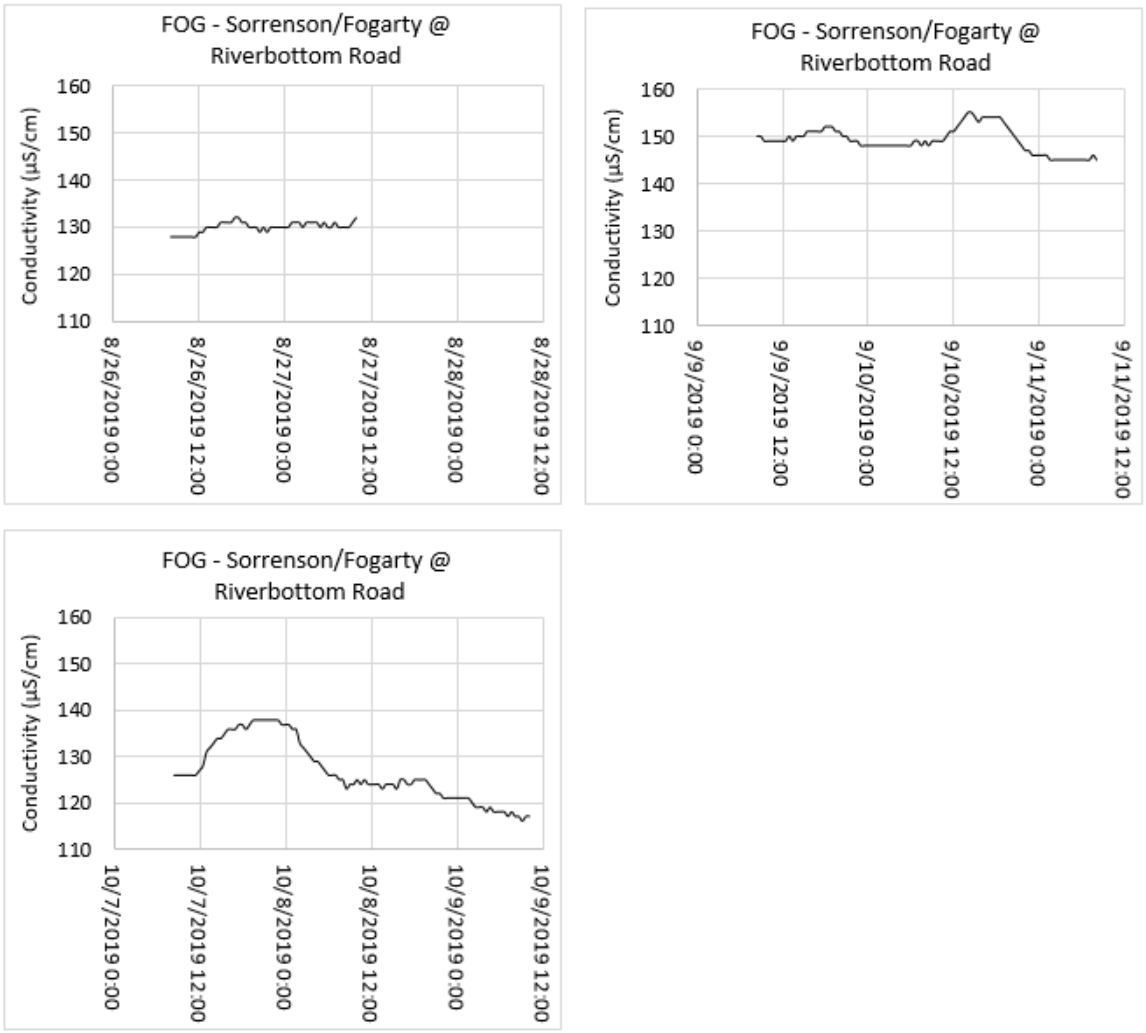


Figure E11.4. Continuous short-term conductivity (continued) monitoring results for FOG.

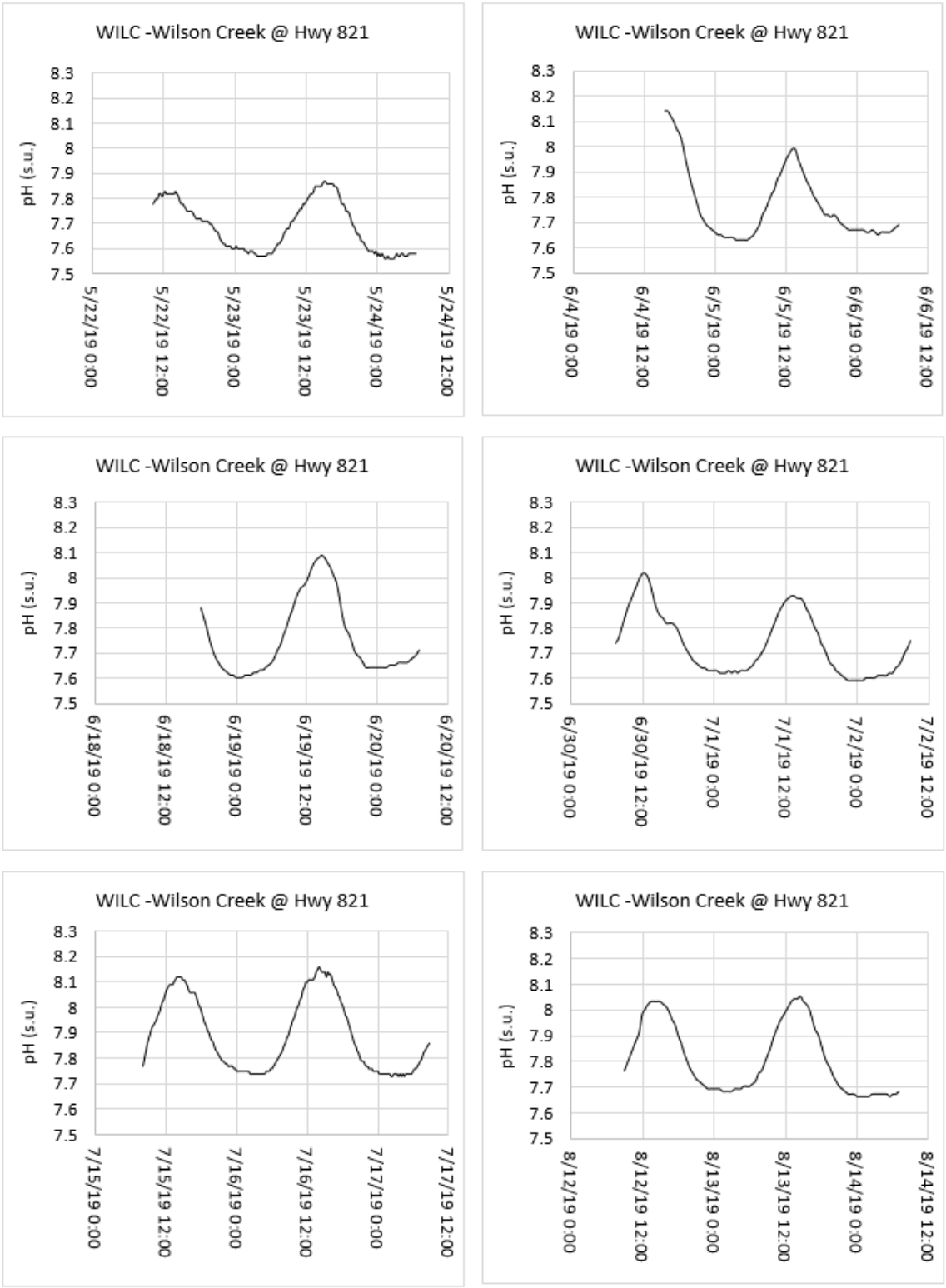


Figure E12.1. Continuous short-term pH monitoring results for WILC.

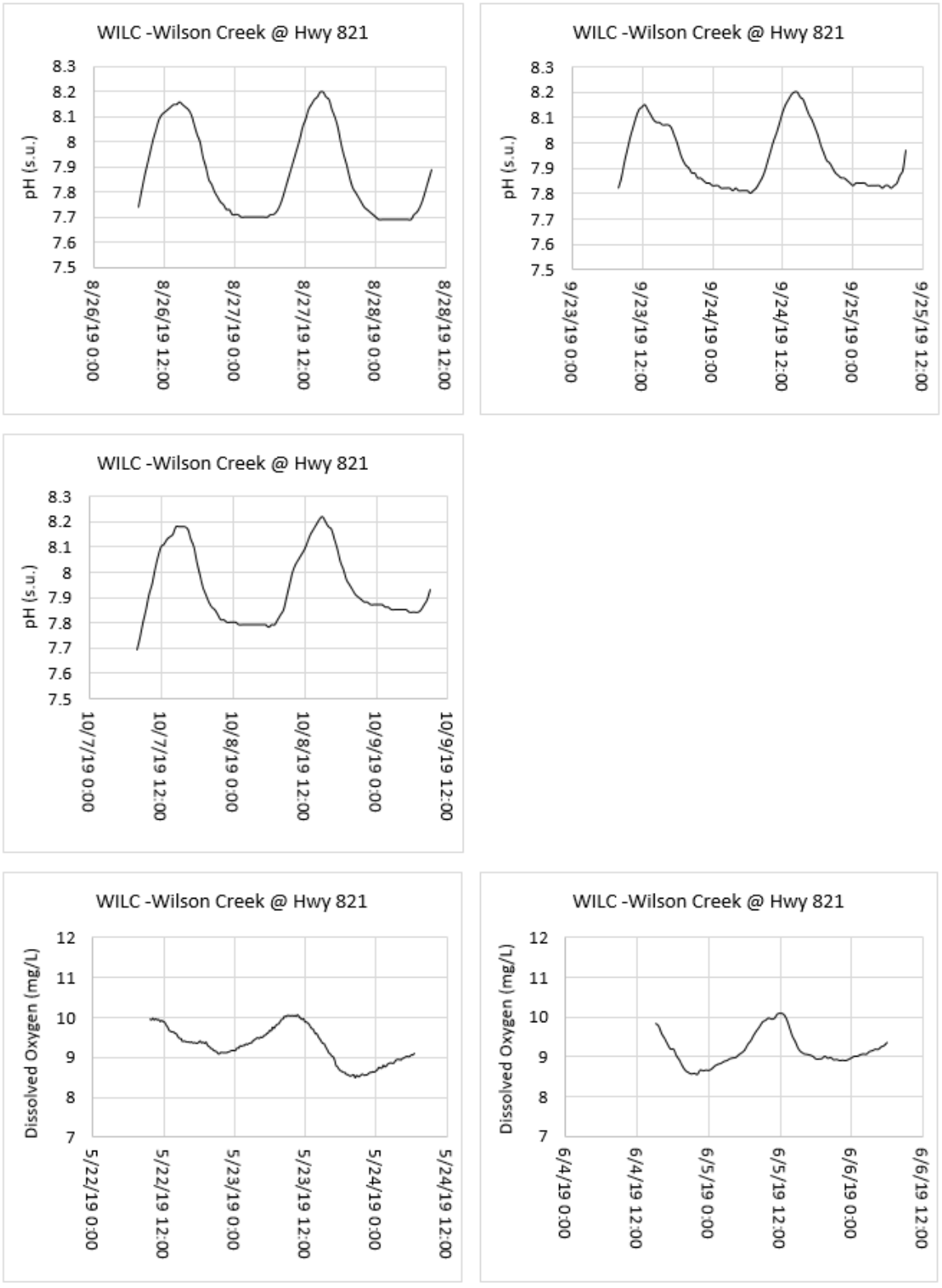


Figure E12.2. Continuous short-term pH (continued) and dissolved oxygen monitoring results for WILC.

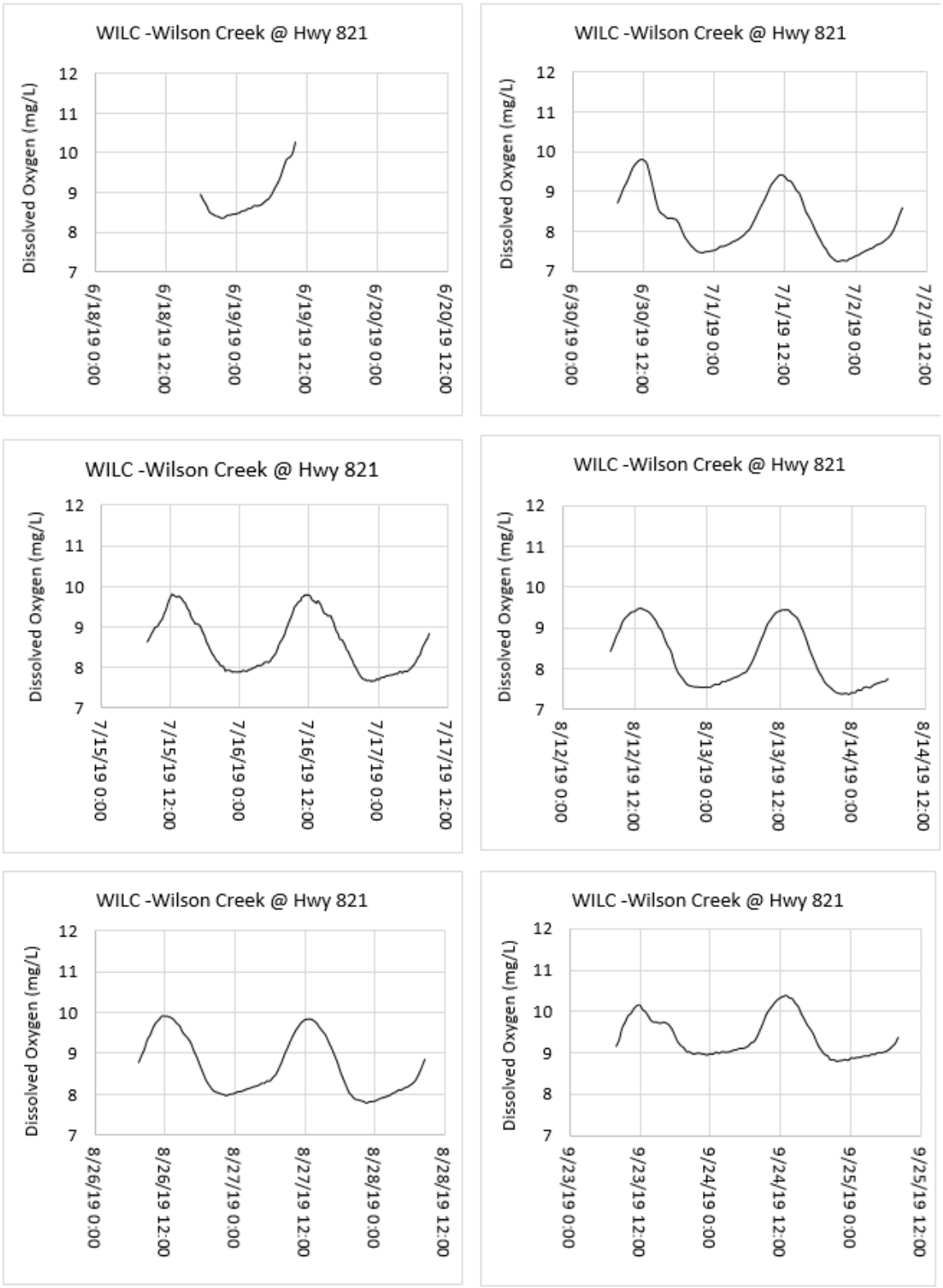
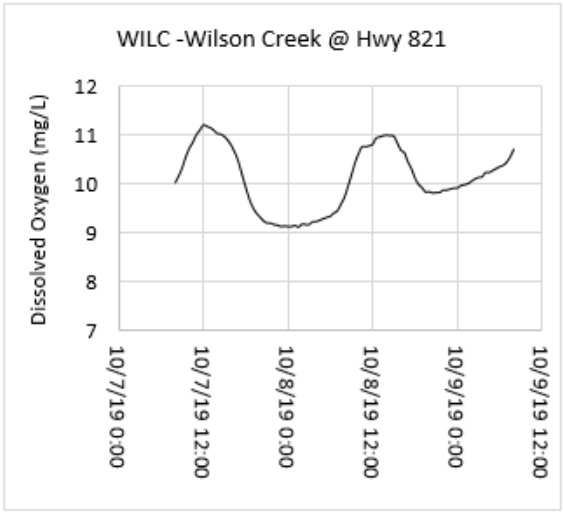
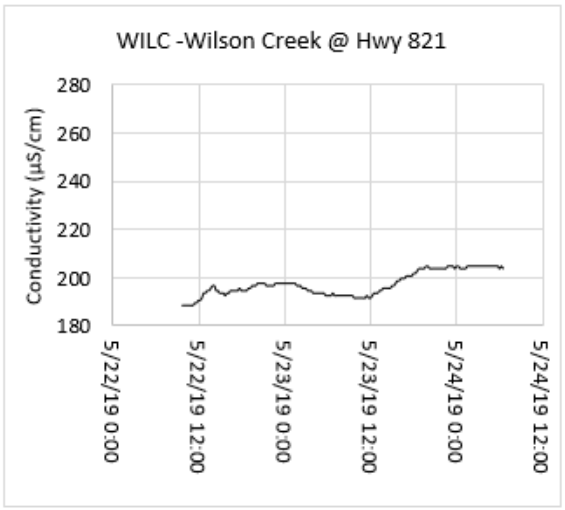
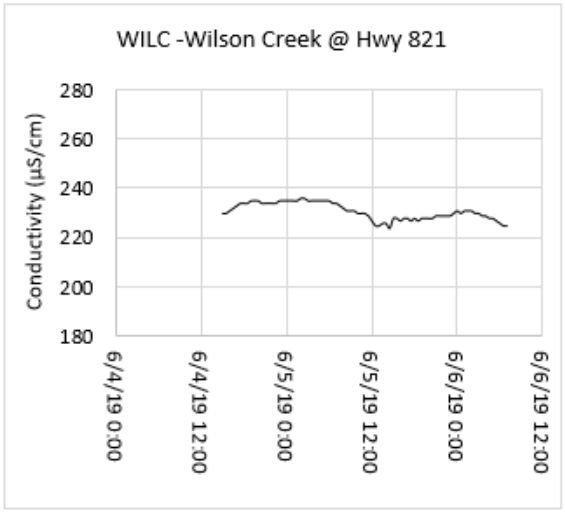
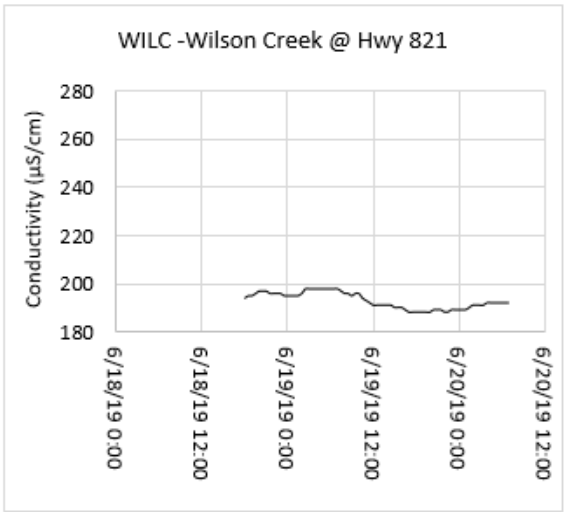


Figure E12.3. Continuous short-term dissolved oxygen monitoring results for WILC.









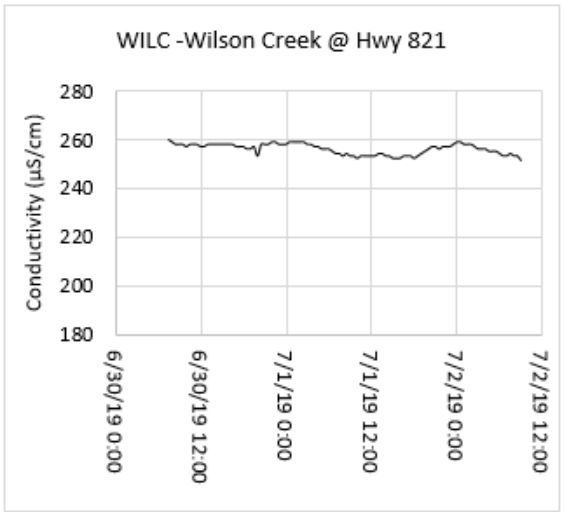


Figure E12.4. Continuous short-term dissolved oxygen (continued) and conductivity monitoring results for WILC.

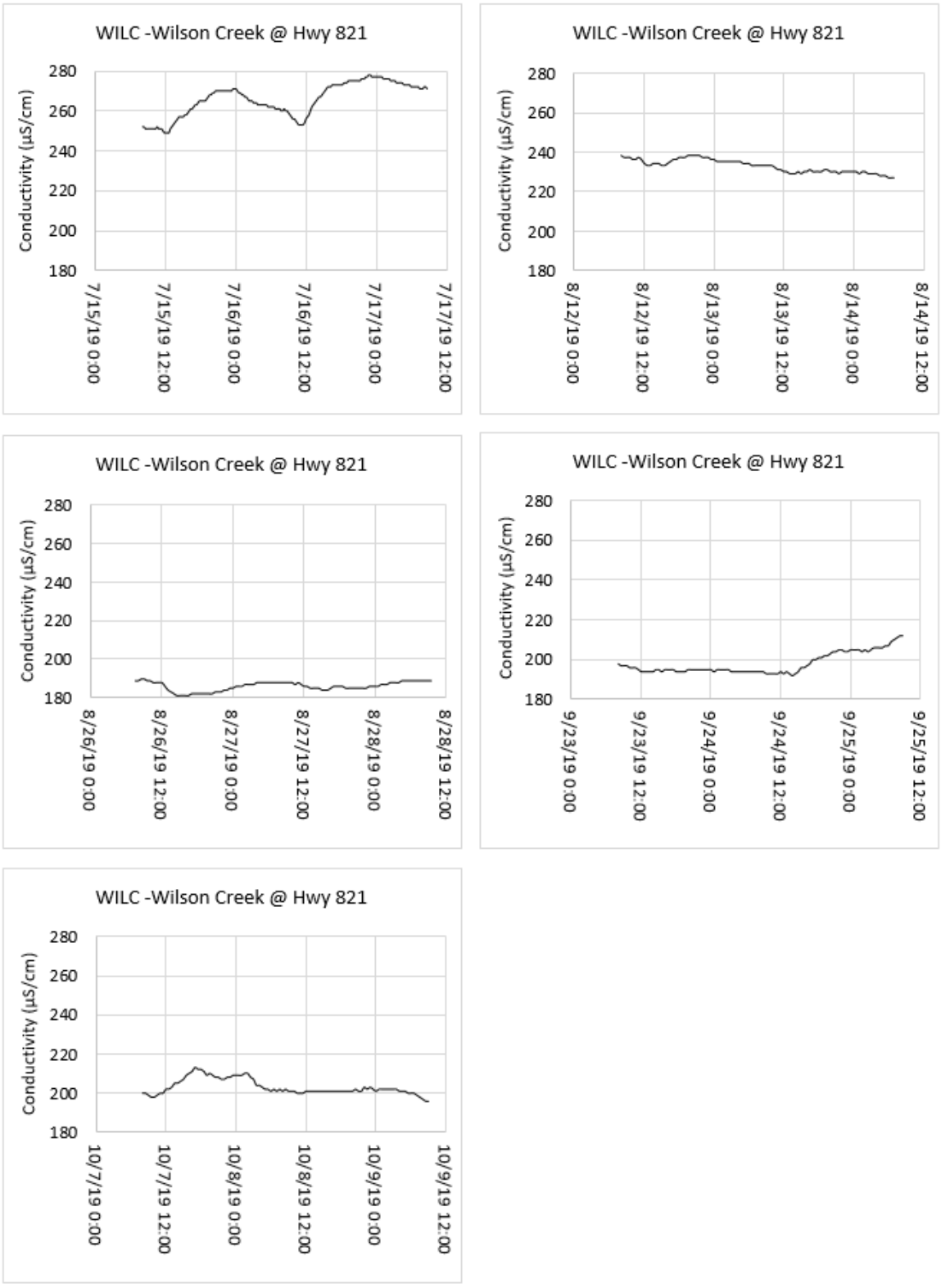


Figure E12.5. Continuous short-term conductivity monitoring results for WILC.

Appendix F. Onset Hobo Dissolved Oxygen Data

Dissolved oxygen (DO) data loggers deployed at locations other than established telemetered long-term water quality monitoring stations.

Continuous DO data presented below are in chart format. The continuous data records are too large to include in the report. All data are available from Ecology's Environmental Information Management (EIM) online database located at https://apps.ecology.wa.gov/eim/search/default.aspx.

Table F1. Continuous DO locations with instrument information, deployment dates, and qualifiers.

Study Location ID	Instrument ID	Start Date/Time (PST)	End Date/Time (PST)	Data Qualifiers	Bias Adjust (mg/L)
YKNS	20645555	7/15/2019 14:00	10/21/2019 10:15	blank	blank
CLE	20645552	7/23/2019 15:15	10/21/2019 9:00	IA	0.2
YKCE	20645553	7/15/2019 16:30	10/21/2019 11:30		
YKEL	20645551	7/15/2019 10:00	10/22/2019 7:45		
WILC	20645550	7/15/2019 8:15	10/23/2019 9:45		
YKUM	20645554	7/15/2019 7:45	10/23/2019 8:15	IA	0.2

IA = Instrument result was adjusted.

Table F2. Continuous DO – Data rejected due to sensor fouling or logger error codes.

Study Location ID	Instrument ID	Start Date/Time (PST)	End Date/Time (PST)
YKNS	20645555	7/22/2019 13:45	7/22/2019 14:15
YKNS	20645555	7/31/2019 15:45	7/31/2019 16:15
YKNS	20645555	8/13/2019 5:15	8/13/2019 5:15
YKNS	20645555	8/13/2019 21:00	8/13/2019 21:00
YKNS	20645555	9/5/2019 13:15	9/5/2019 13:15
CLE	20645552	8/15/2019 13:45	8/15/2019 14:00
CLE	20645552	9/11/2019 12:45	9/11/2019 12:45
CLE	20645552	9/11/2019 13:30	9/11/2019 13:30
CLE	20645552	9/16/2019 13:15	9/16/2019 13:15
CLE	20645552	9/16/2019 14:00	9/16/2019 14:00
CLE	20645552	9/19/2019 13:15	9/19/2019 13:15
CLE	20645552	9/20/2019 13:15	9/20/2019 13:45
CLE	20645552	9/21/2019 13:15	9/21/2019 13:15
CLE	20645552	9/25/2019 13:15	9/25/2019 13:30
CLE	20645552	10/2/2019 13:15	10/2/2019 13:15
CLE	20645552	10/3/2019 13:15	10/3/2019 13:15

Study Location ID	Instrument ID	Start Date/Time (PST)	End Date/Time (PST)
CLE	20645552	10/4/2019 13:15	10/4/2019 13:15
CLE	20645552	8/13/2019 19:00	8/13/2019 19:30
CLE	20645552	8/16/2019 14:30	8/16/2019 14:30
CLE	20645552	8/16/2019 15:30	8/16/2019 15:30
YKCE	20645551	9/9/2019 0:00	9/23/2019 7:45
YKEL	20645551	9/5/2019 11:00	9/5/2019 11:15
YKNS	20645555	7/22/2019 13:45	7/22/2019 14:15
YKNS	20645555	7/31/2019 15:45	7/31/2019 16:15
YKNS	20645555	8/13/2019 5:15	8/13/2019 5:15
YKNS	20645555	8/13/2019 21:00	8/13/2019 21:00
YKNS	20645555	9/5/2019 13:15	9/5/2019 13:15
WILC	20645550	8/12/2019 7:30	8/12/2019 7:30
WILC	20645550	9/22/2019 22:15	9/23/2019 2:30
WILC	20645550	9/5/2019 9:15	9/5/2019 9:30
WILC	20645550	8/12/2019 7:30	8/12/2019 7:30
WILC	20645550	9/22/2019 22:15	9/23/2019 2:30
WILC	20645550	9/5/2019 9:15	9/5/2019 9:30
YKUM	20645554	7/17/2019 11:45	7/17/2019 12:00
YKUM	20645554	7/18/2019 12:00	7/18/2019 12:30
YKUM	20645554	7/18/2019 13:00	7/18/2019 13:30
YKUM	20645554	7/19/2019 12:00	7/19/2019 12:00
YKUM	20645554	7/19/2019 12:30	7/19/2019 13:00
YKUM	20645554	7/19/2019 13:30	7/19/2019 14:15
YKUM	20645554	7/20/2019 11:45	7/20/2019 14:00
YKUM	20645554	7/21/2019 12:30	7/21/2019 13:00
YKUM	20645554	7/21/2019 13:30	7/21/2019 13:30
YKUM	20645554	7/22/2019 13:15	7/22/2019 13:15
YKUM	20645554	7/22/2019 13:45	7/22/2019 13:45
YKUM	20645554	7/23/2019 14:15	7/23/2019 14:15
YKUM	20645554	7/24/2019 12:45	7/24/2019 12:45
YKUM	20645554	7/24/2019 13:15	7/24/2019 13:15
YKUM	20645554	7/24/2019 13:45	7/24/2019 13:45
YKUM	20645554	7/25/2019 14:00	7/25/2019 14:00
YKUM	20645554	7/26/2019 12:30	7/26/2019 12:30
YKUM	20645554	7/26/2019 13:15	7/26/2019 13:45
YKUM	20645554	7/27/2019 12:45	7/27/2019 12:45
YKUM	20645554	7/27/2019 14:00	7/27/2019 14:00
YKUM	20645554	7/28/2019 13:45	7/28/2019 14:00
YKUM	20645554	7/29/2019 2:15	7/29/2019 2:15
YKUM	20645554	7/29/2019 13:45	7/29/2019 13:45
YKUM	20645554	7/30/2019 13:30	7/30/2019 13:30

Study Location ID	Instrument ID	Start Date/Time (PST)	End Date/Time (PST)
YKUM	20645554	7/31/2019 13:30	7/31/2019 13:30
YKUM	20645554	7/31/2019 14:00	7/31/2019 14:00
YKUM	20645554	8/1/2019 12:45	8/1/2019 12:45
YKUM	20645554	8/3/2019 13:30	8/3/2019 13:30
YKUM	20645554	8/4/2019 12:45	8/4/2019 12:45
YKUM	20645554	8/4/2019 13:15	8/4/2019 13:15
YKUM	20645554	8/5/2019 5:30	8/5/2019 5:30
YKUM	20645554	8/5/2019 13:30	8/5/2019 13:30
YKUM	20645554	8/6/2019 13:30	8/6/2019 13:30
YKUM	20645554	8/7/2019 13:00	8/7/2019 13:00
YKUM	20645554	8/8/2019 13:15	8/8/2019 13:15
YKUM	20645554	8/20/2019 1:15	8/20/2019 1:15
YKUM	20645554	9/5/2019 1:45	9/5/2019 1:45
YKUM	20645554	9/12/2019 0:00	9/12/2019 1:30
YKUM	20645554	9/12/2019 3:45	9/12/2019 3:45
YKUM	20645554	10/2/2019 17:30	10/2/2019 17:30
YKUM	20645554	10/2/2019 21:30	10/2/2019 22:00
YKUM	20645554	10/3/2019 12:15	10/3/2019 12:30
YKUM	20645554	10/3/2019 16:30	10/3/2019 16:30
YKUM	20645554	10/3/2019 23:00	10/6/2019 19:00
YKUM	20645554	10/7/2019 14:00	10/7/2019 14:00
YKUM	20645554	10/7/2019 23:00	10/8/2019 6:15
YKUM	20645554	10/9/2019 2:30	10/9/2019 2:30
YKUM	20645554	10/9/2019 14:15	10/9/2019 14:45
YKUM	20645554	10/10/2019 14:00	10/10/2019 14:00
YKUM	20645554	10/10/2019 14:45	10/10/2019 14:45
YKUM	20645554	10/15/2019 7:30	10/15/2019 7:30
YKUM	20645554	10/15/2019 16:00	10/15/2019 17:15
YKUM	20645554	10/17/2019 8:00	10/21/2019 14:45

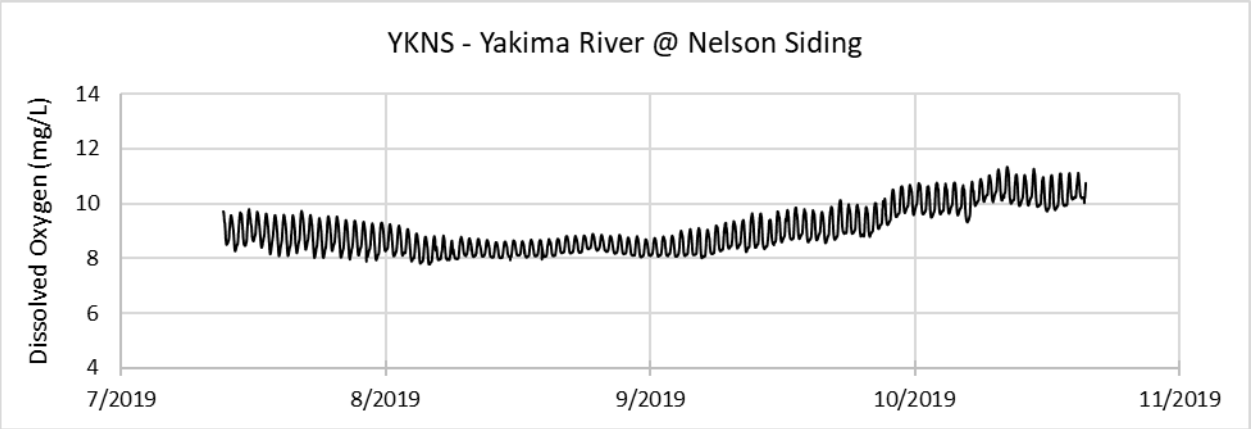


Figure F1. Continuous DO results for YKNS deployed from 7/15/19 to 10/21/19.

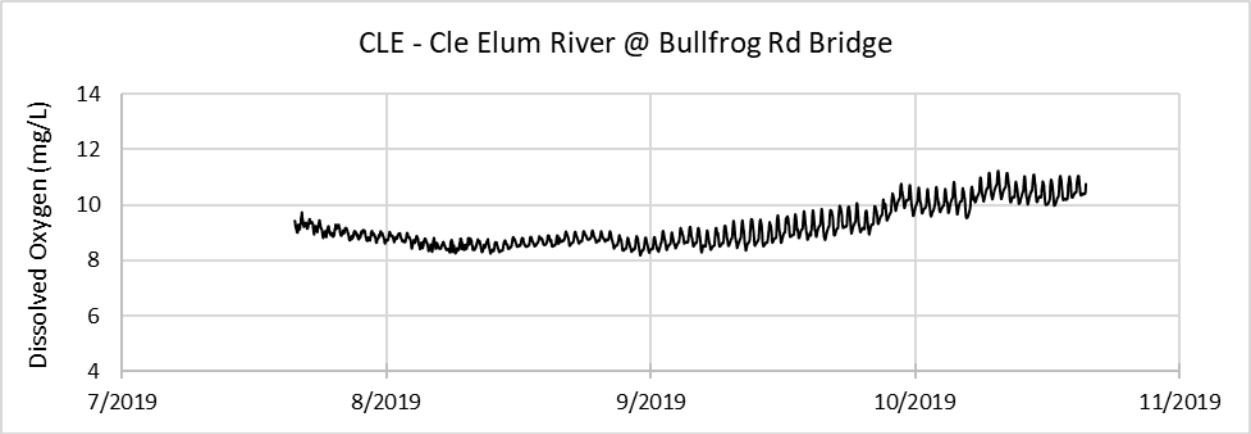


Figure F2. Continuous DO results for CLE deployed from 7/23/19 to 10/21/19.

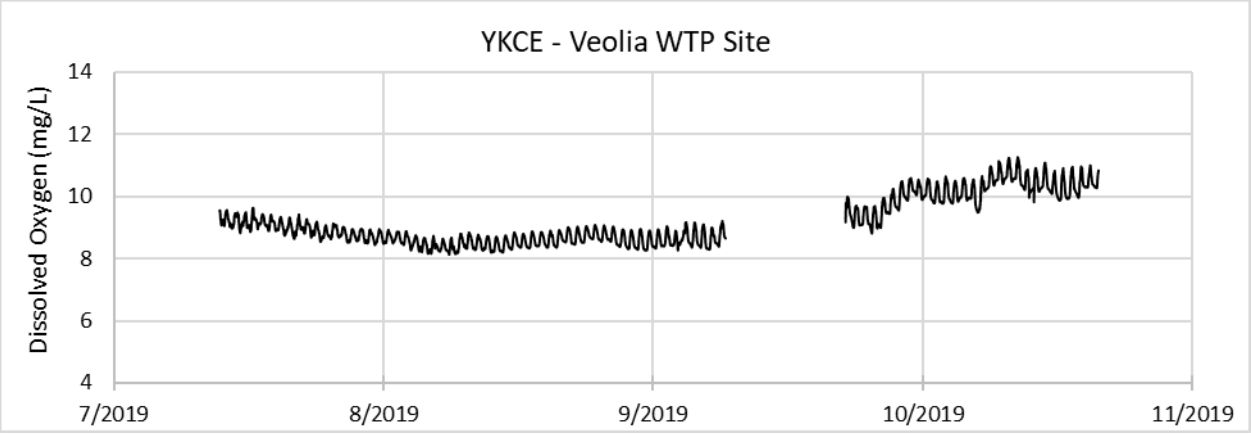


Figure F3. Continuous DO results for YKCE deployed from 7/15/19 to 10/21/19.

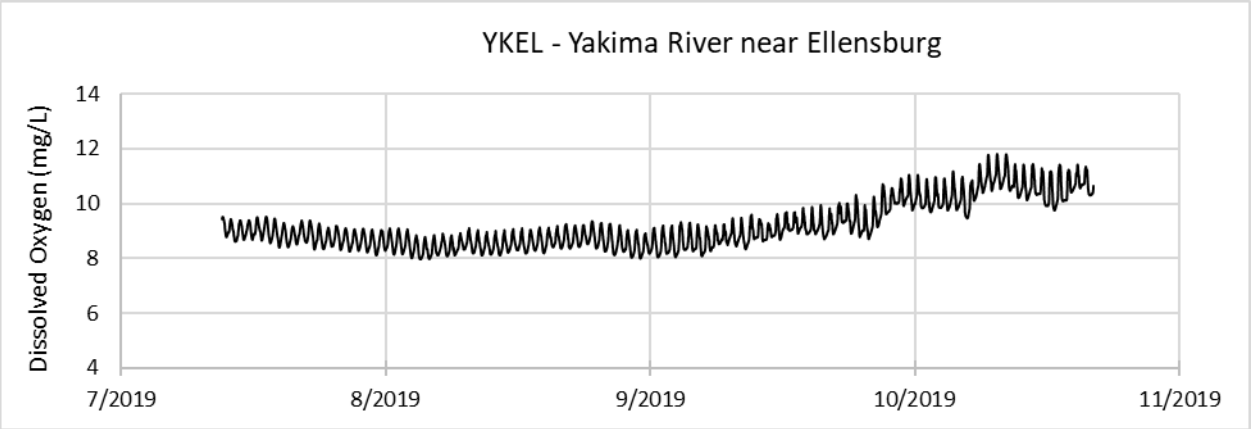


Figure F4. Continuous DO results for YKEL deployed from 7/15/19 to 10/22/19.

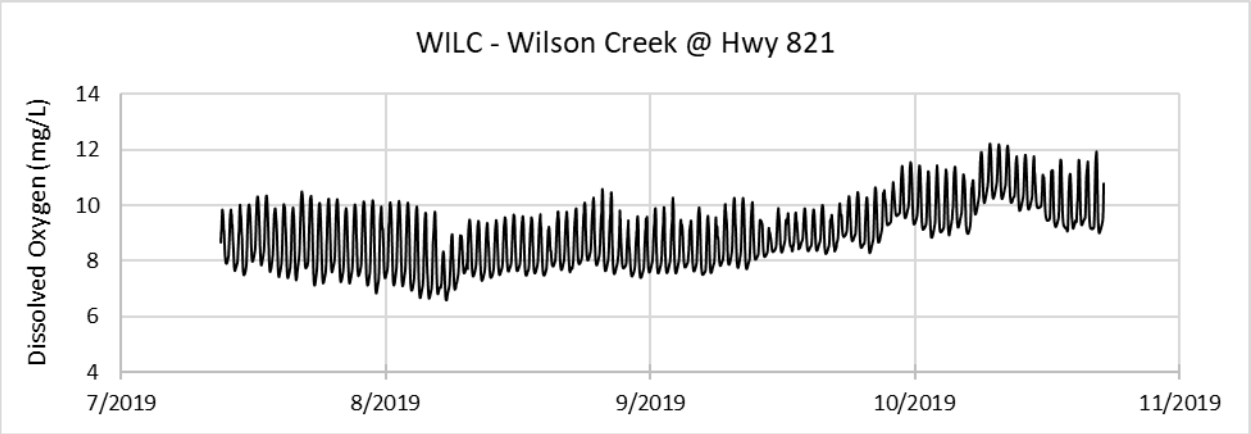


Figure F5. Continuous DO results for WILC deployed from 7/15/19 to 10/23/19.

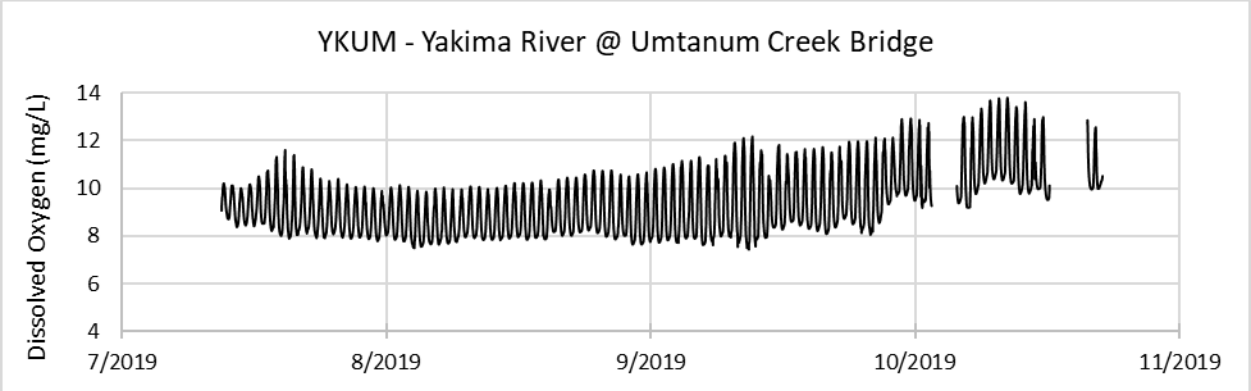


Figure F6. Continuous DO results for YKUM deployed from 7/15/19 to 10/23/19.

Appendix G. Temperature and Dew Point Results

Following are temperature data for air, water, and dew point monitoring in 2019.

Continuous temperature monitoring data presented below are in chart format. The continuous data records are too large to include in the report. All data are available from Ecology's Environmental Information Management (EIM) online database located at https://apps.ecology.wa.gov/eim/search/default.aspx.

Table G1. Temperature and dew point data logger locations with instrument information and deployment dates.

Study Location ID	Water			Air			Dew Point		
	Serial No.	Start Date/Time (PST)	End Date/Time (PST)	Serial No.	Start Date/Time (PST)	End Date/Time (PST)	Serial No.	Start Date/Time (PST)	End Date/Time (PST)
YKSP	10225480	6/17/2019 9:00	10/7/2019 9:30						
KCALE	10225467	6/17/19 9:30	10/7/2019 10:00						
YKALE	10225433	6/18/19 16:30	10/28/19 12:45						
YKEA	10227090	4/22/2019 11:00	10/22/2019 8:30	10225426	4/22/2019 12:00	10/22/2019 8:00	1002566	4/22/2019 11:00	10/22/2019 9:00
BIGC	10225451	4/22/19 12:30	10/22/19 10:00						
YKNS	10227076	4/22/2019 11:00	10/21/2019 10:00	10225285	4/22/2019 11:00	10/21/2019 10:00			
YKAC	10227077	5/7/2019 16:30	10/8/2019 11:00						
CLE	10225468	4/22/19 9:00	10/21/19 8:30						
CLEM	10225469	5/7/19 16:00	10/28/19 23:30						
YKFC	10225452	4/17/2019 14:00	10/7/2019 13:30	10227107	4/17/2019 15:00	10/7/2019 13:00			
YKCE	10227068	4/17/2019 12:30	10/16/2019 7:30	10227098	4/17/2019 14:00	10/16/2019 7:00	538477	5/6/2019 13:00	10/22/2019 11:00
YKAT	10225436	4/22/2019 14:00	10/21/2019 13:30	10227114	5/6/2019 13:00	10/21/2019 13:00	462003	5/6/2019 13:00	10/21/2019 13:00

Study Location ID	Water			Air			Dew Point		
	Serial No.	Start Date/Time (PST)	End Date/Time (PST)	Serial No.	Start Date/Time (PST)	End Date/Time (PST)	Serial No.	Start Date/Time (PST)	End Date/Time (PST)
TEANM	10225427	4/22/19 15:00	10/21/19 13:30	10225282	5/6/2019 9:00	10/21/2019 13:00			
YKHO	10225446	4/22/2019 16:00	10/21/2019 15:00	10227097	5/6/2019 17:00	10/21/2019 15:00	538479	4/22/2019 16:00	10/28/2019 13:00
SWAC	10225444	4/22/19 16:00	10/21/19 14:00						
YKTC	10225477	4/23/2019 12:00	10/21/2019 11:30						
TANC	10227079	4/23/19 11:00	10/21/19 12:00	10227096	4/23/2019 12:00	10/21/2019 12:00	462012	4/23/2019 12:00	10/21/2019 12:00
YKFT	10225432	4/17/2019 12:00	10/21/2019 10:30	10227121	4/17/2019 12:00	10/21/2019 11:00			
YKIT	10225425	5/7/2019 11:00	10/8/2019 15:30						
DRYM	10225440	4/25/19 12:30	10/23/19 10:00				462004	5/7/2019 10:00	10/23/2019 10:00
PACK	10225465	4/25/19 13:30	10/22/19 23:30						
YKEL	10227093	4/16/2019 14:30	10/22/2019 7:30	10472584	4/16/2019 15:00	10/22/2019 7:00			
MANL	10225476	5/7/19 12:30	10/22/19 11:00						
REEC	10227075	4/23/19 13:00	10/23/19 9:30						
YKUB	10227072	4/23/2019 10:00	10/8/2019 15:00						
YKAW	10225434	4/23/2019 14:30	10/21/2019 8:30	10225283	4/23/2019 15:00	10/21/2019 8:00	1002563	4/23/2019 14:00	10/21/2019 8:00
WILC	10225458	4/16/19 13:30	10/23/19 9:30						
YKUM	10227089	4/16/2019 12:00	10/23/2019 11:30	10227120	4/16/2019 13:00	10/23/2019 11:00			
UMT	10225411	4/30/19 13:30	10/23/19 9:30						

Study Location ID	Water			Air			Dew Point		
	Serial No.	Start Date/Time (PST)	End Date/Time (PST)	Serial No.	Start Date/Time (PST)	End Date/Time (PST)	Serial No.	Start Date/Time (PST)	End Date/Time (PST)
YKWY	10225474	4/30/2019 7:30	10/9/2019 7:00						
YKBB	10225472	4/16/2019 11:00	10/23/2019 11:00	10227116	4/16/2019 11:00	10/23/2019 11:00			
YKBR	10227070	5/8/2019 10:00	10/23/2019 10:30						
YKSM	10225422	4/24/2019 11:30	10/23/2019 12:30	10225290	4/24/2019 13:00	10/23/2019 12:00	1002564	4/24/2019 12:00	10/23/2019 13:00
WENASF	10225410	5/1/19 11:30	10/30/19 11:00						
YKHB	10225415	4/16/2019 9:30	10/28/2019 15:30	10221703	4/16/2019 9:00	10/28/2019 15:00			
YKPP	20234974	4/24/2019 15:00	8/28/2019 7:00	10221679	5/22/2019 14:00	10/30/2019 11:00			

Table G2. Rejected water temperature data due to air exposure.

Study Location ID	Instrument ID	Start Date/Time (PST)	End Date/Time (PST)
KCALE	10225467	9/28/2019 22:00	9/30/2019 10:30
KCALE	10225467	10/2/2019 20:00	10/3/2019 10:30
YKAT	10225436	4/29/2019 7:30	5/6/2019 12:00
TEANM	10225427	7/1/2019 0:00	9/15/2019 23:30
YKHO	10225436	4/26/2019 7:30	5/6/2019 13:30
YKHO	10225446	5/27/2019 0:00	6/3/2019 15:30
YKSM	10225422	4/30/2019 0:00	5/8/2019 10:00
YKPP	20234974	4/26/2019 0:00	5/22/2019 13:30
YKPP	20234974	5/31/2019 6:30	6/16/2019 23:30

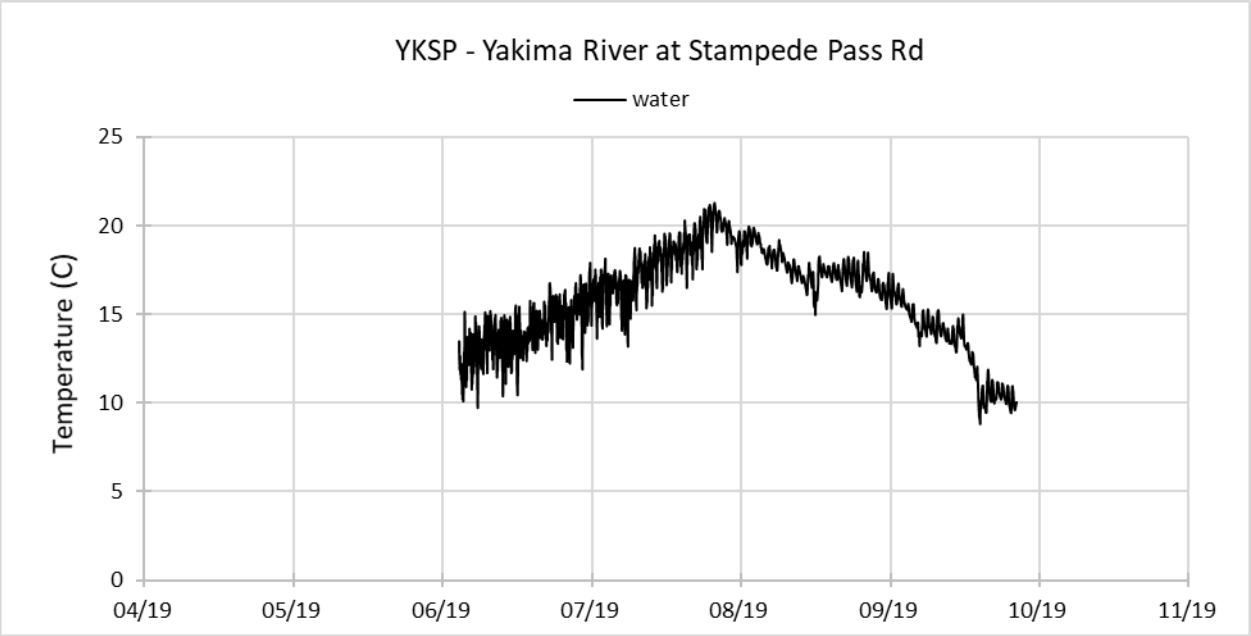


Figure G1. Continuous water temperature results for YKSP.

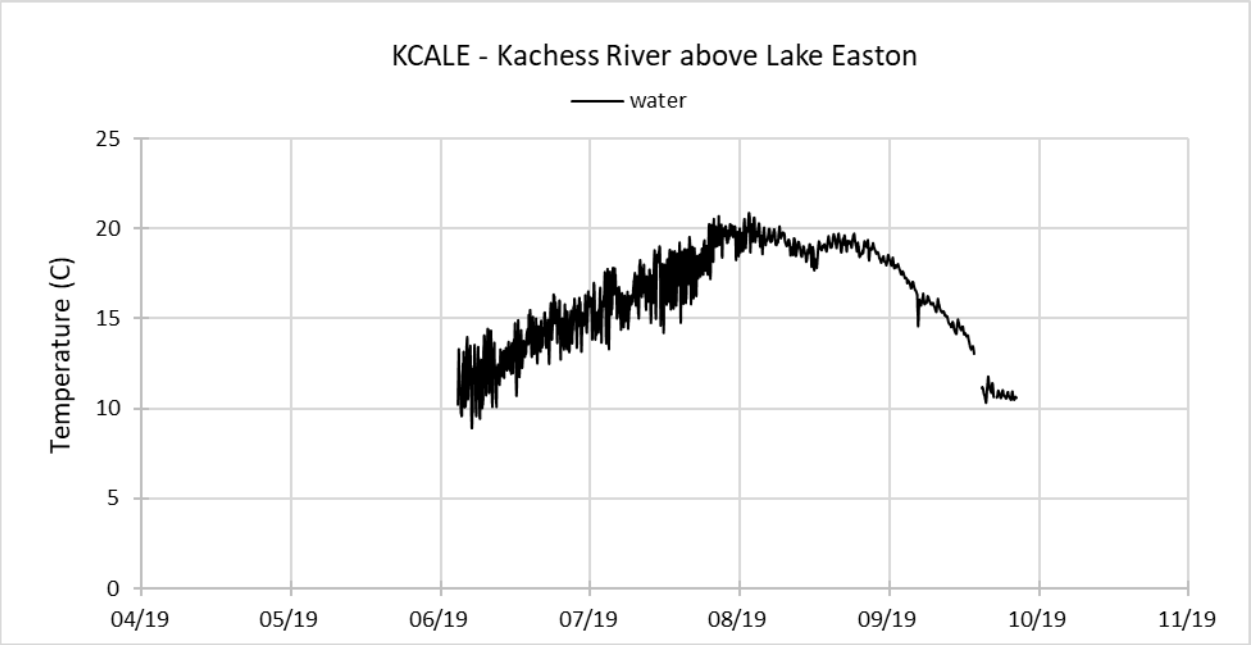


Figure G2. Continuous water temperature results for KCALE.

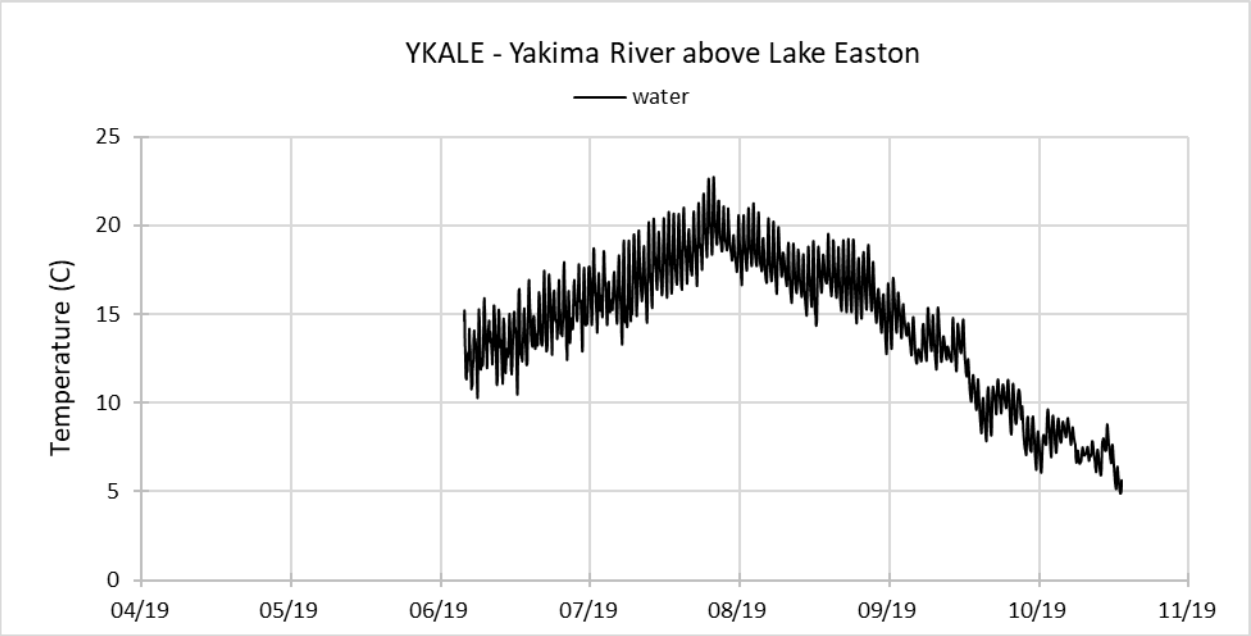


Figure G3. Continuous water temperature results for YKALE.

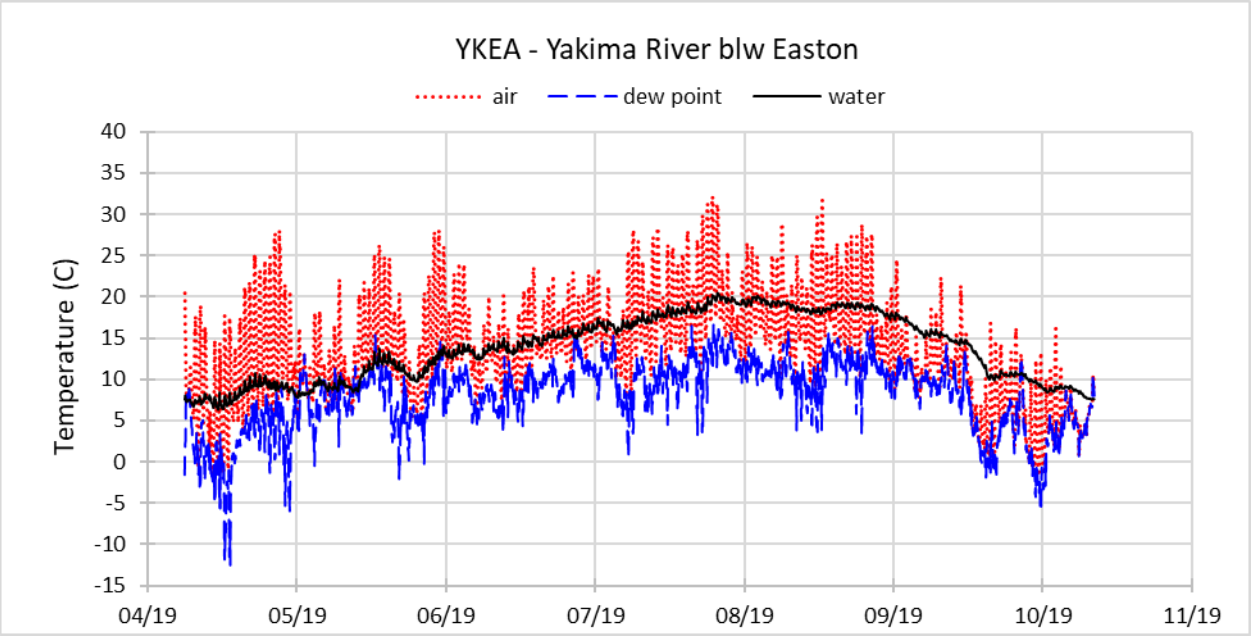


Figure G4. Continuous air, water, and dew point temperature results for YKEA.

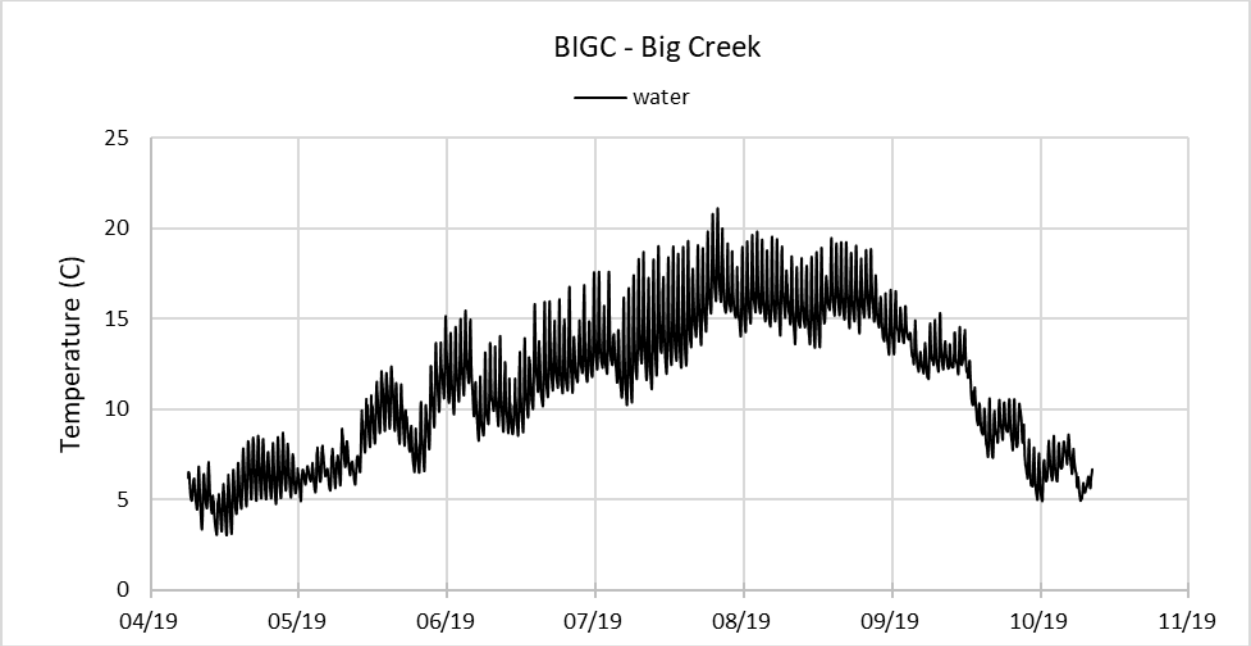


Figure G5. Continuous water temperature results for BIGC.

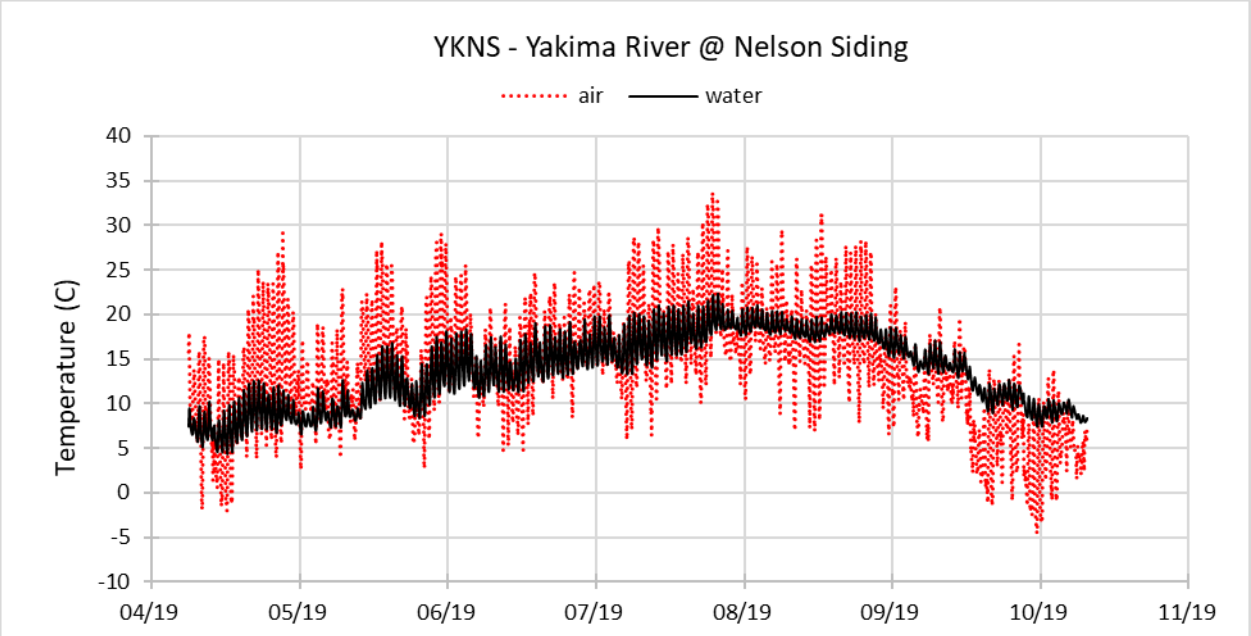


Figure G6. Continuous air and water temperature results for YKNS.

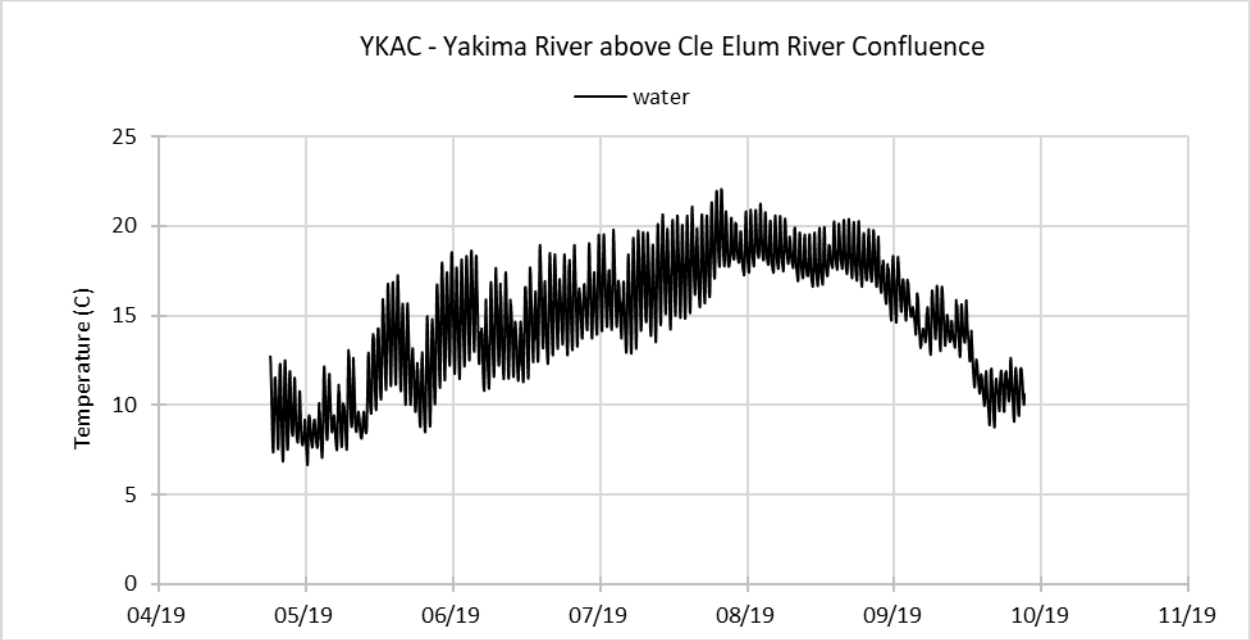


Figure G7. Continuous water temperature results for YKAC.

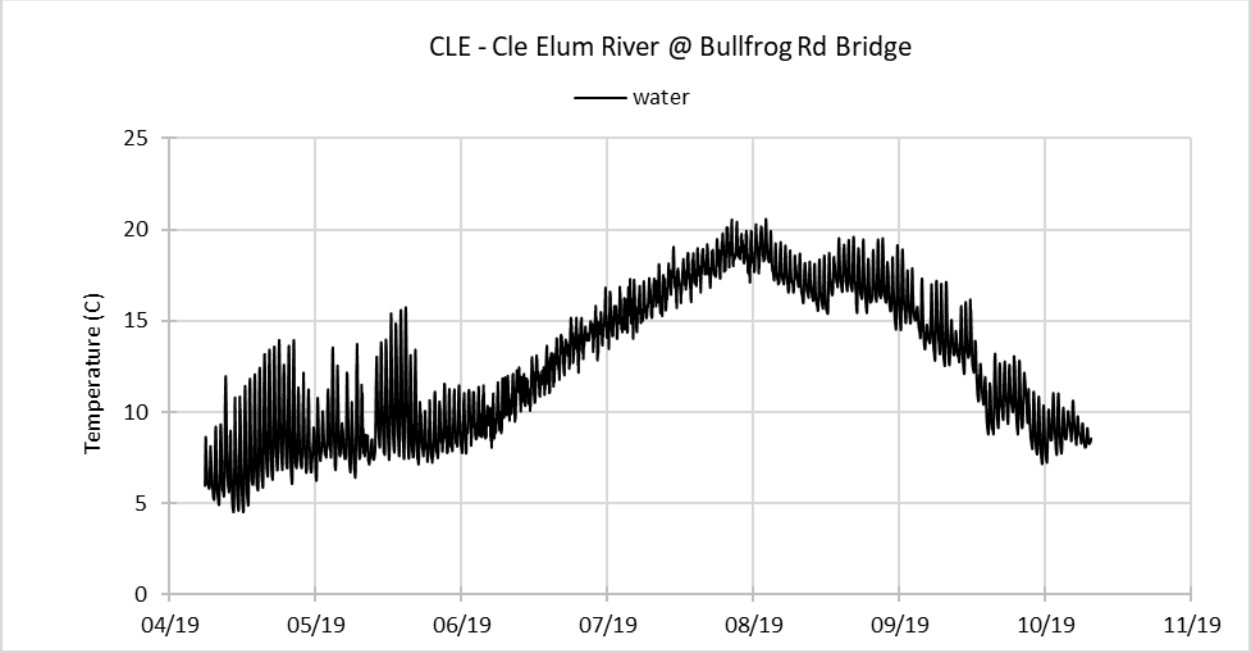


Figure G8. Continuous water temperature results for CLE.

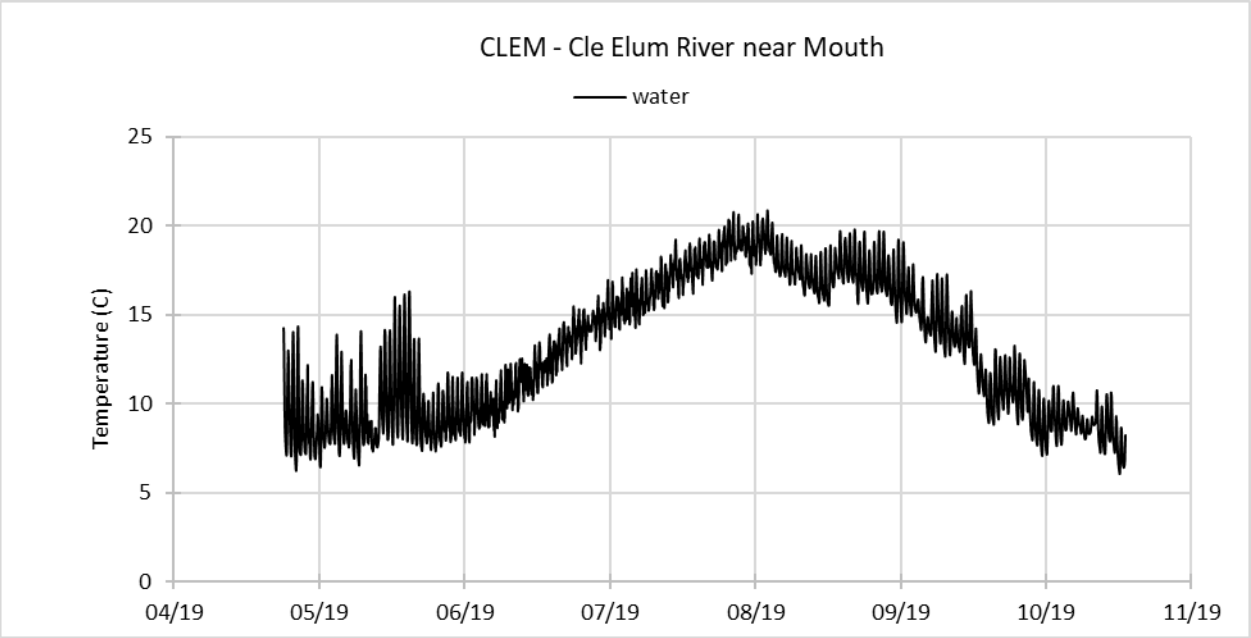


Figure G9. Continuous water temperature results for CLEM.

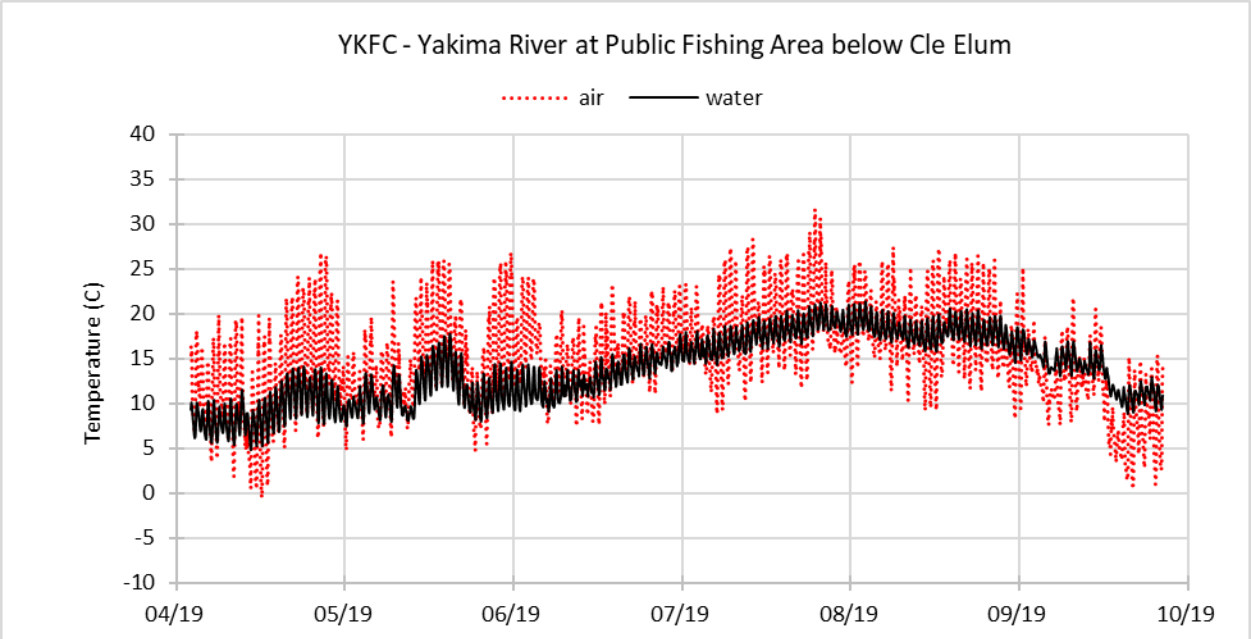


Figure G10. Continuous air and water temperature results for YKFC.

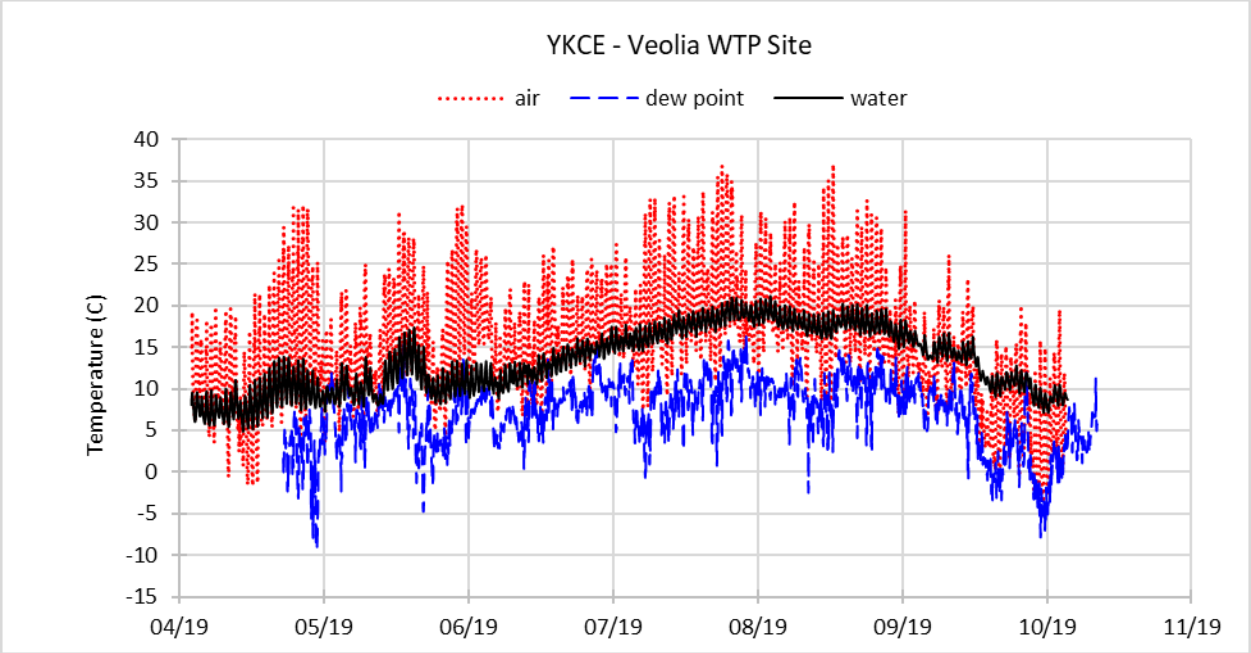


Figure G11. Continuous air, water, and dew point temperature results for YKCE.

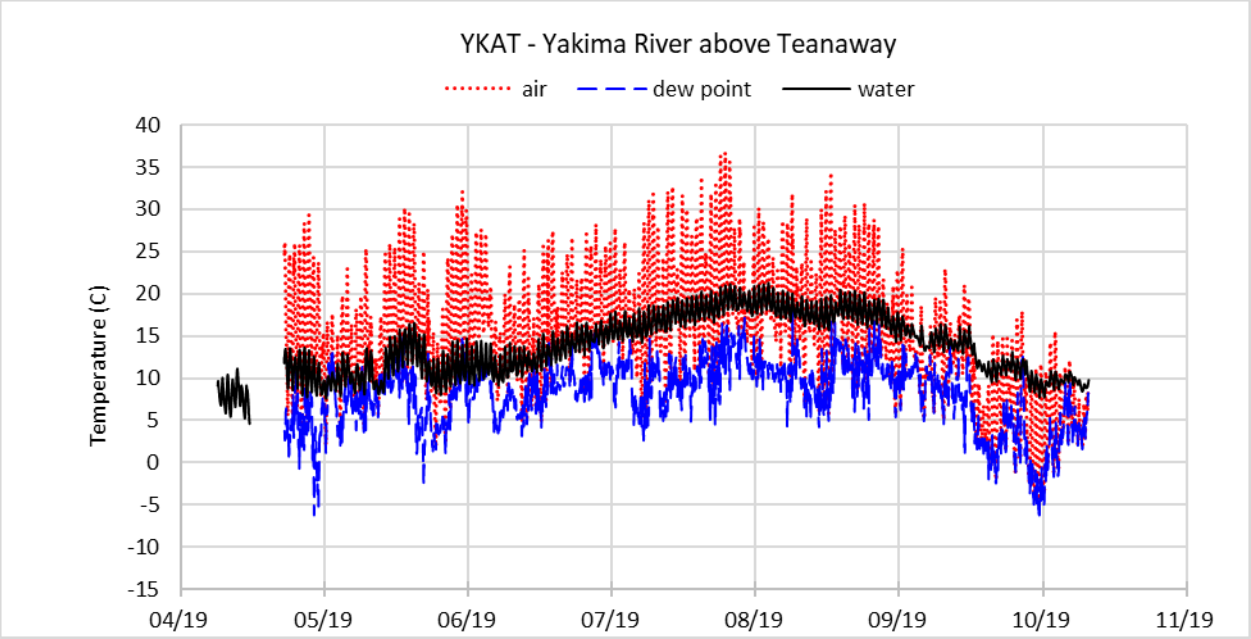


Figure G12. Continuous air, water, and dew point temperature results for YKAT.

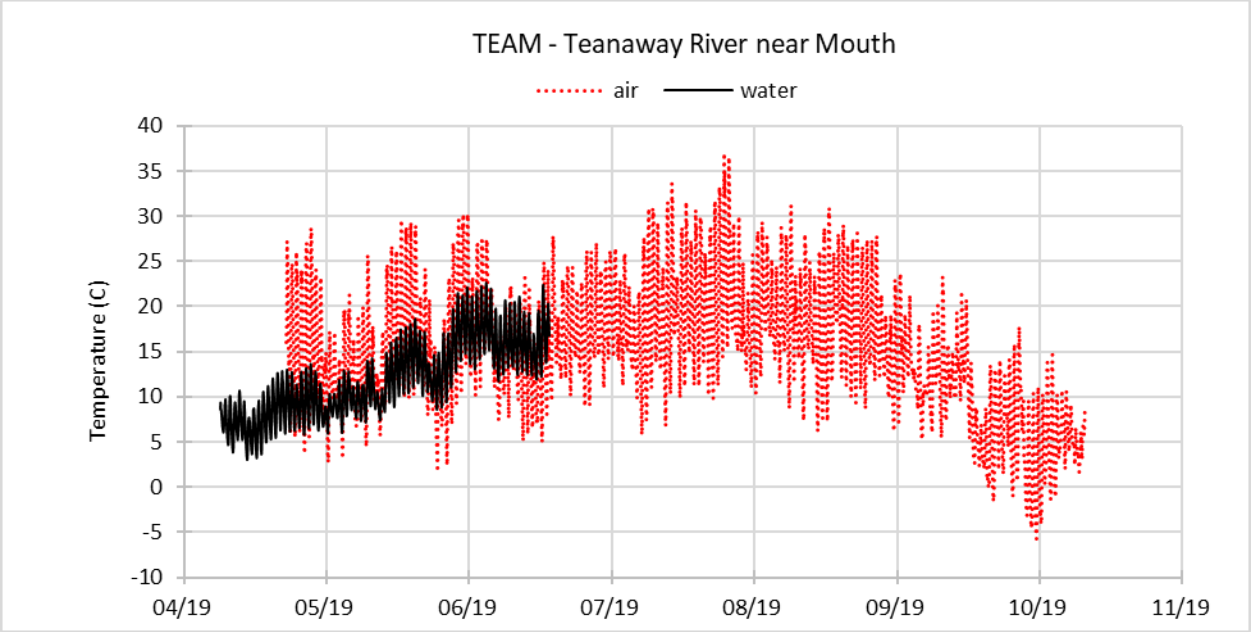


Figure G13. Continuous air and water temperature results for TEAM.

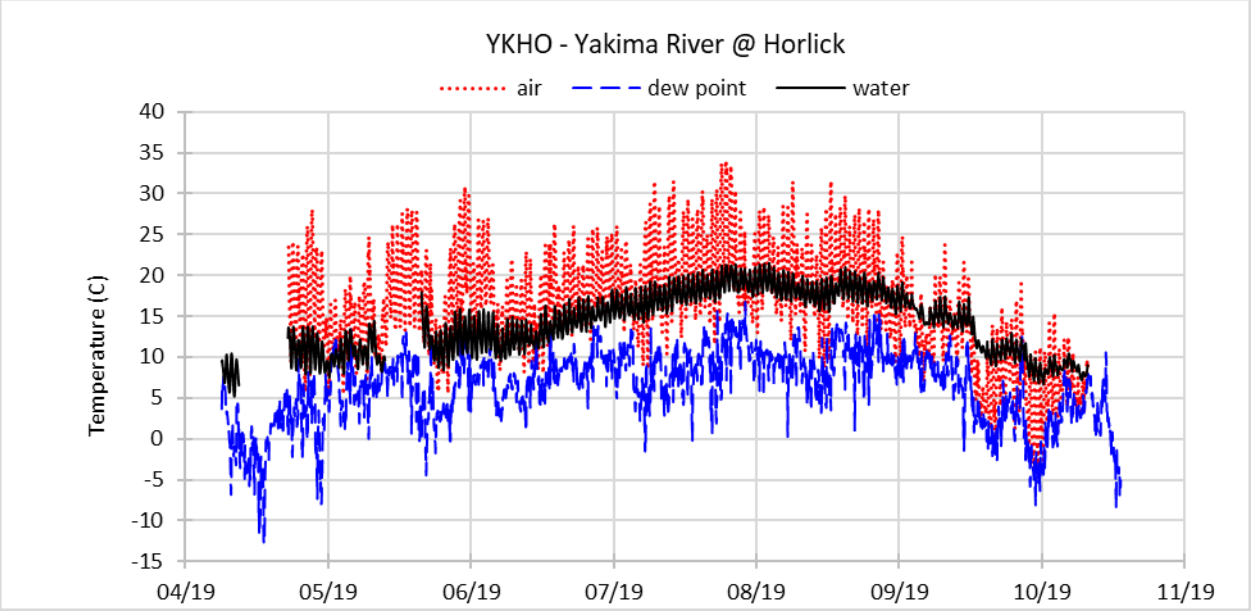


Figure G14. Continuous air, water, and dew point temperature results for YKHO.

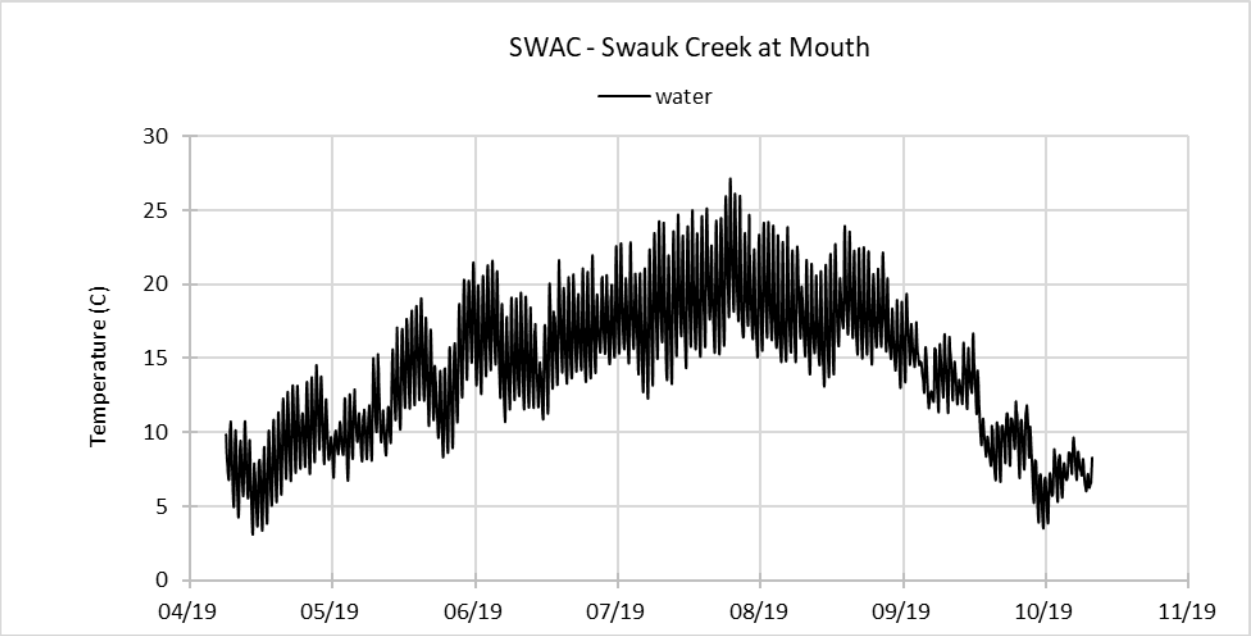


Figure G15. Continuous water temperature results for SWAC.

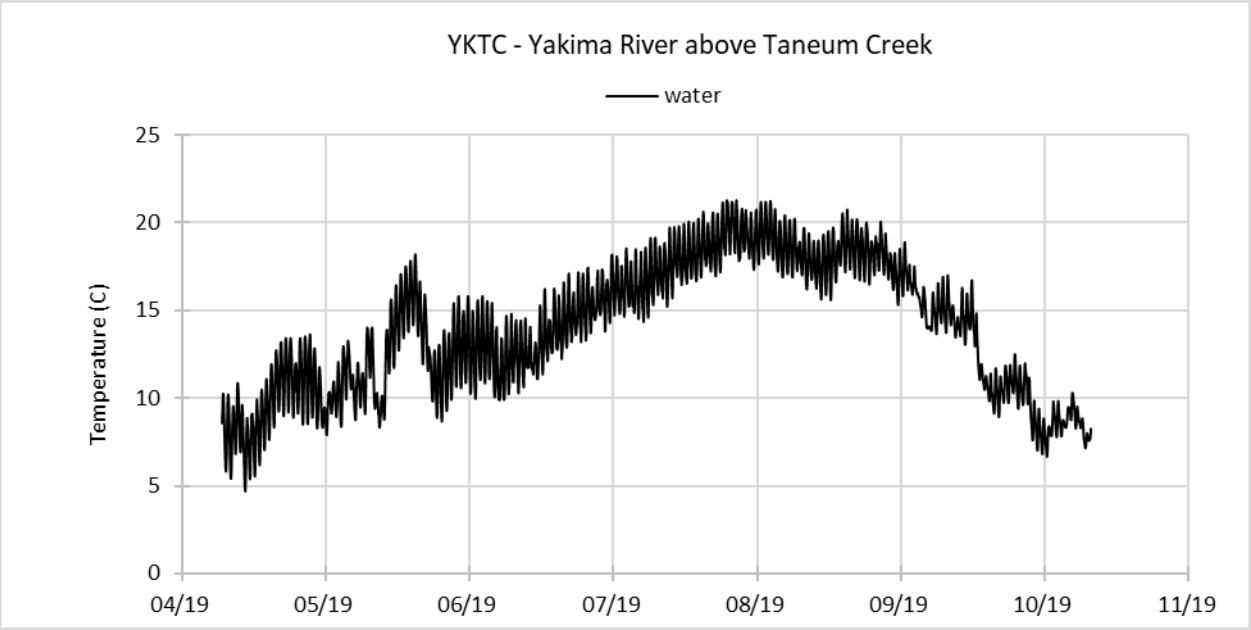


Figure G16. Continuous water temperature results for YKTC.

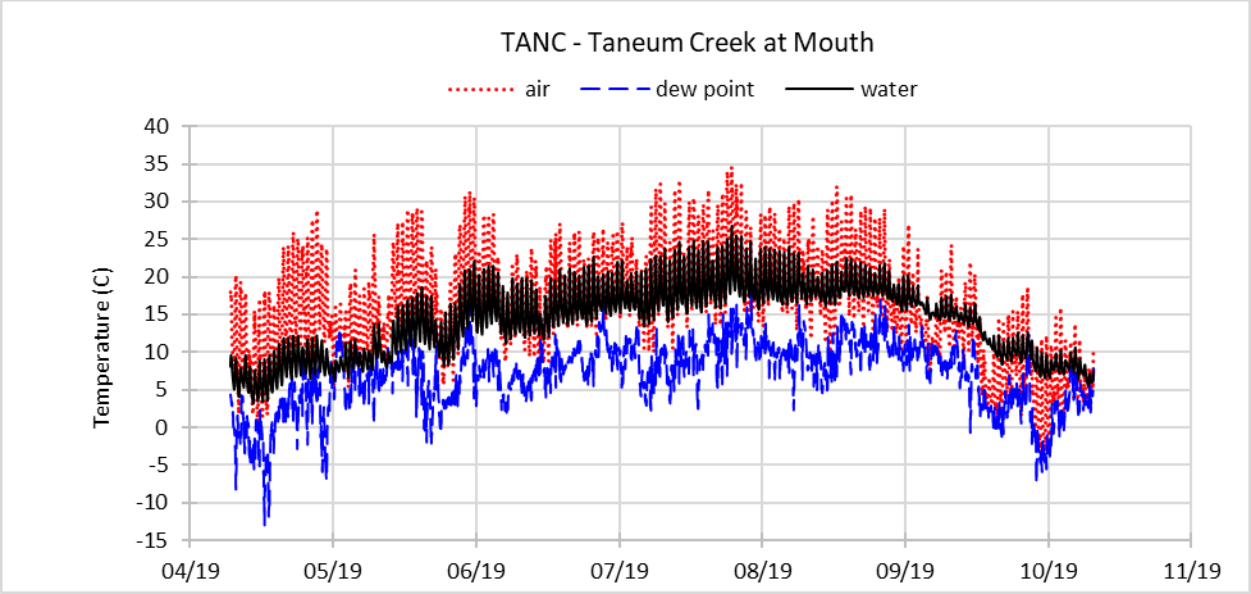


Figure G17. Continuous air, water, and dew point temperature results for TANC.

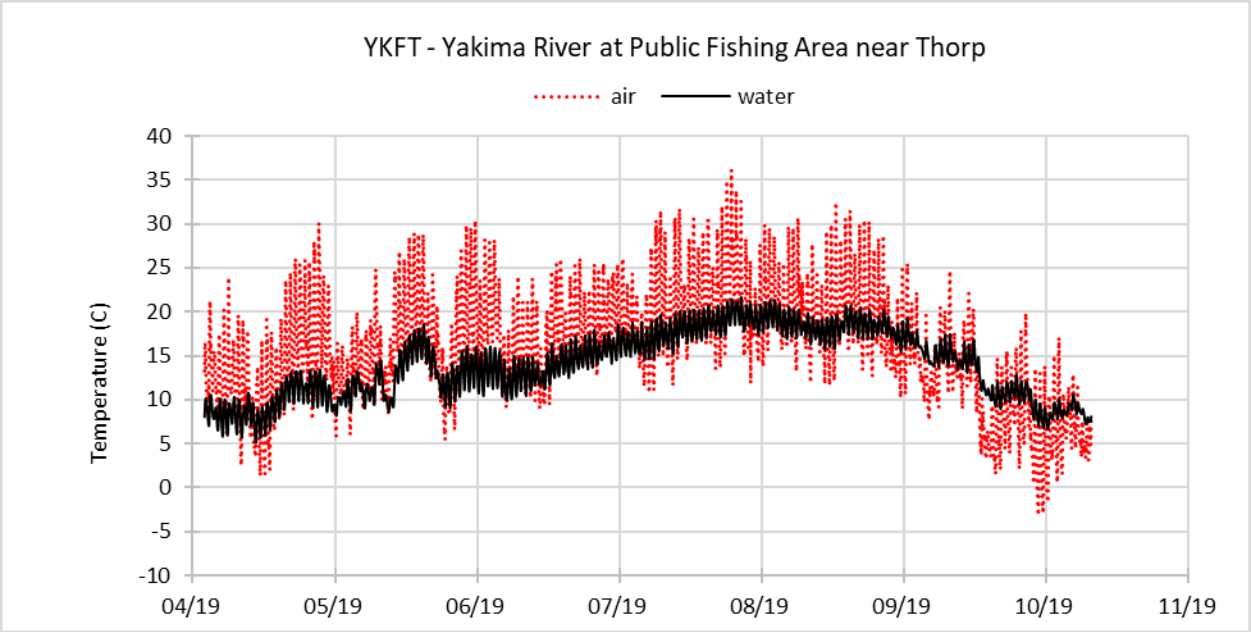


Figure G18. Continuous air and water temperature results for YKFT.

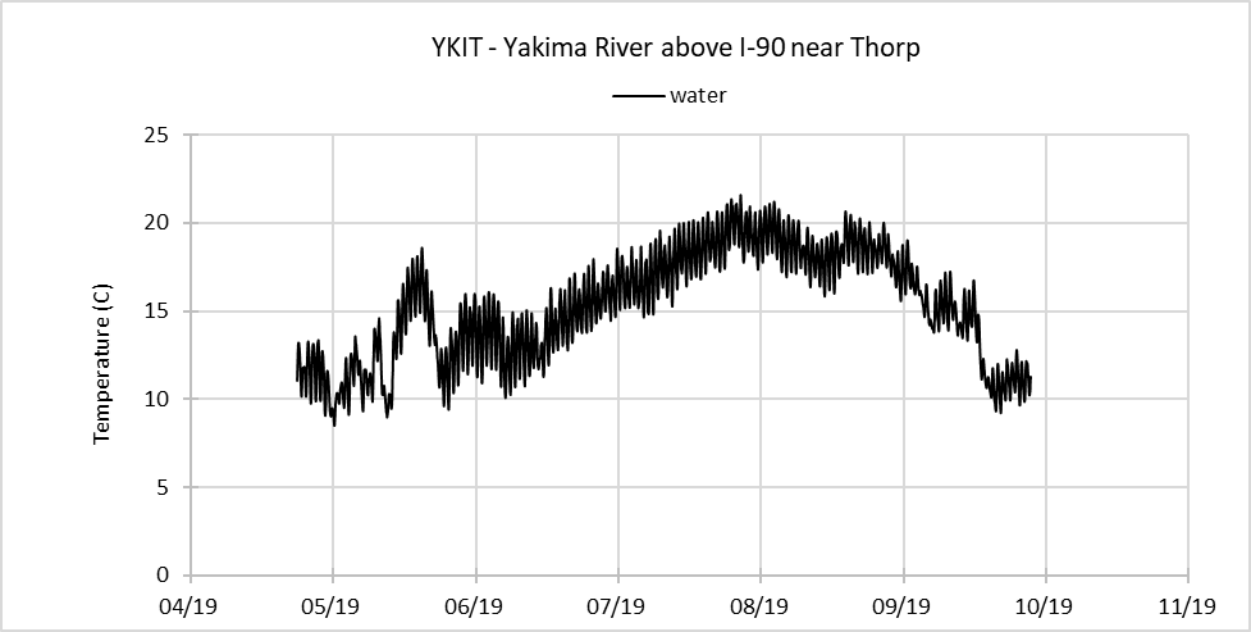


Figure G19. Continuous water temperature results for YKIT.

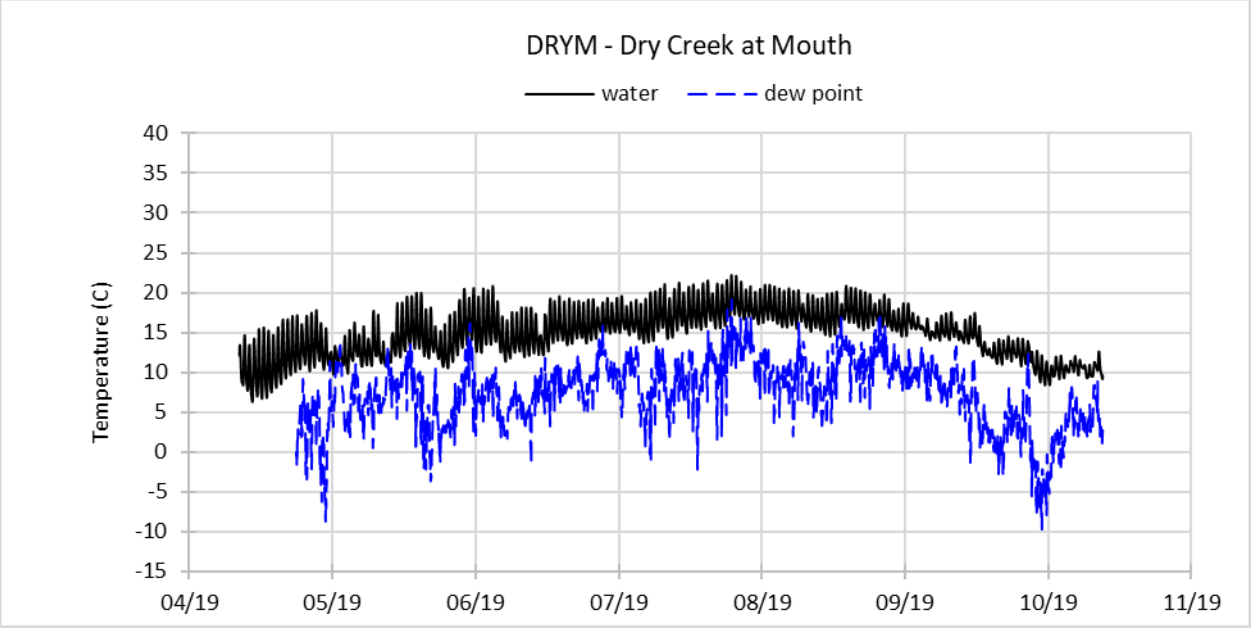


Figure G20. Continuous water and dew point temperature results for DRYM.

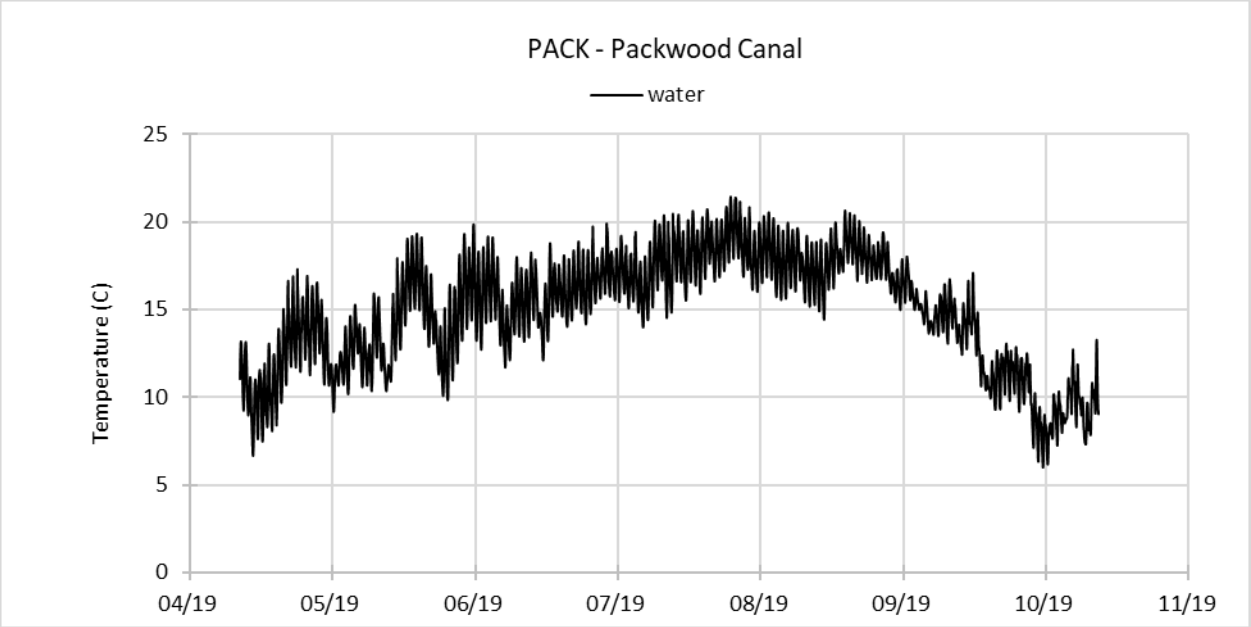


Figure G21. Continuous water temperature results for PACK.

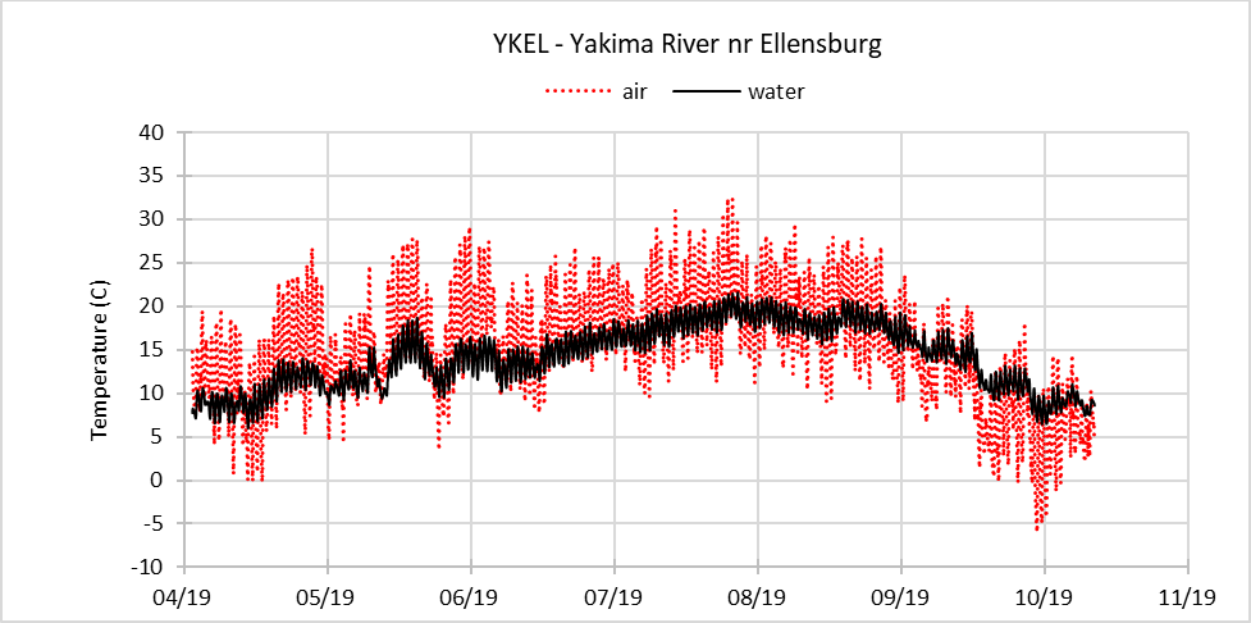


Figure G22. Continuous air and water temperature results for YKEL.

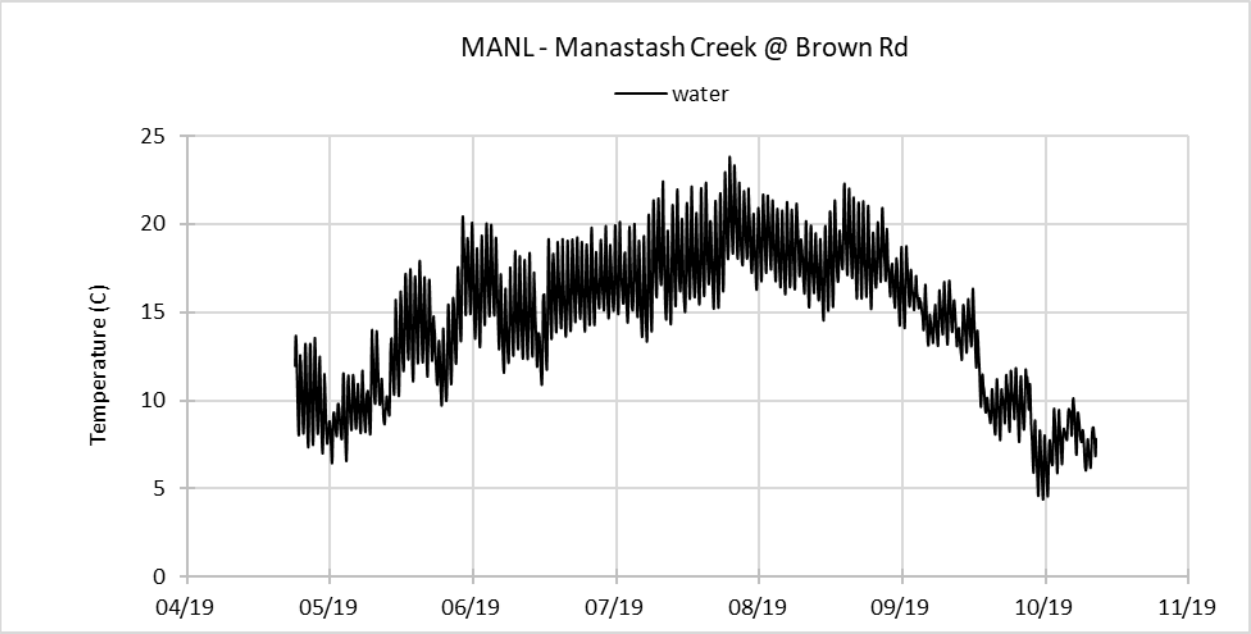


Figure G23. Continuous water temperature results for MANL.

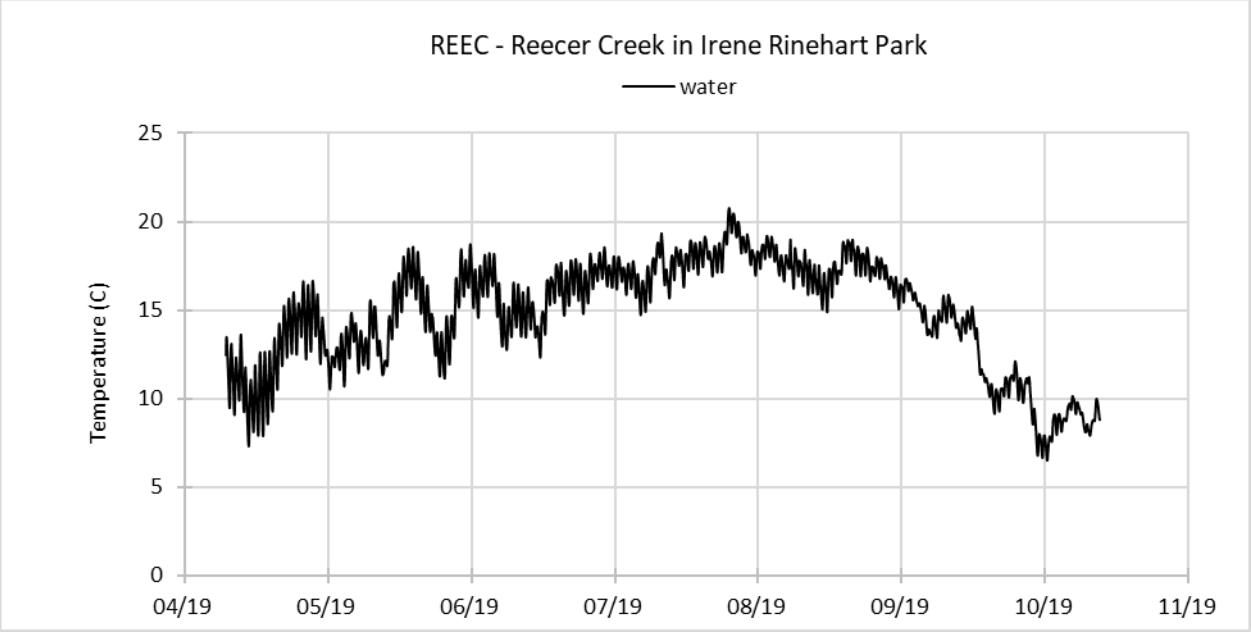


Figure G24. Continuous water temperature results for REEC

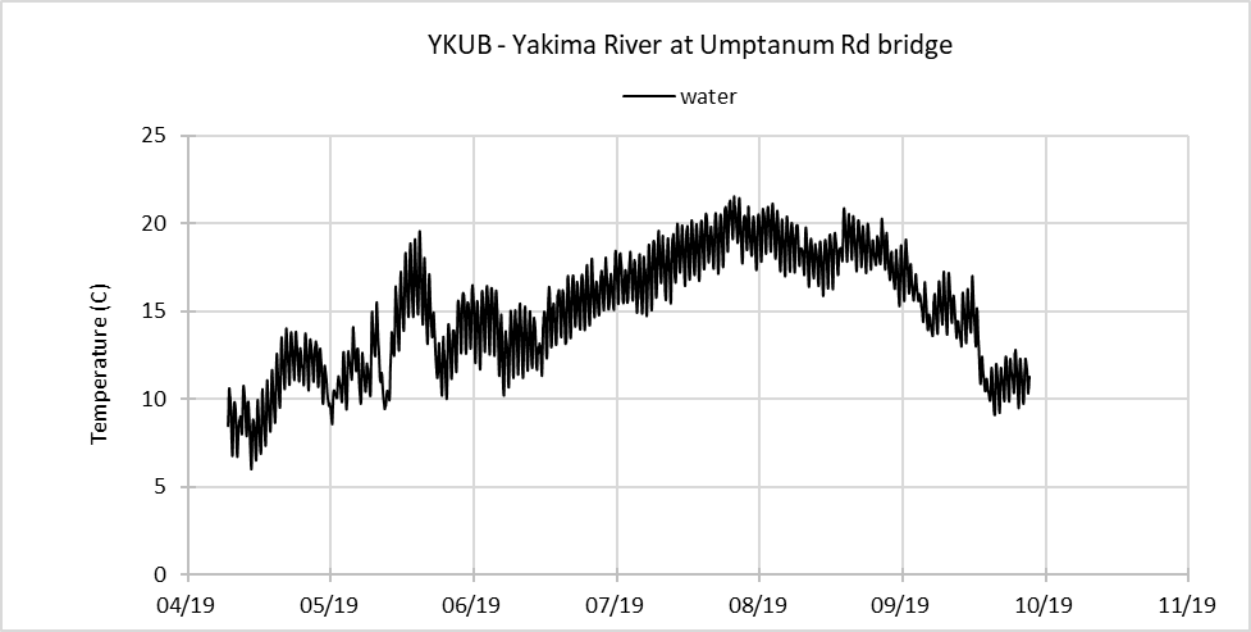


Figure G25. Continuous water temperature results for YKUB.

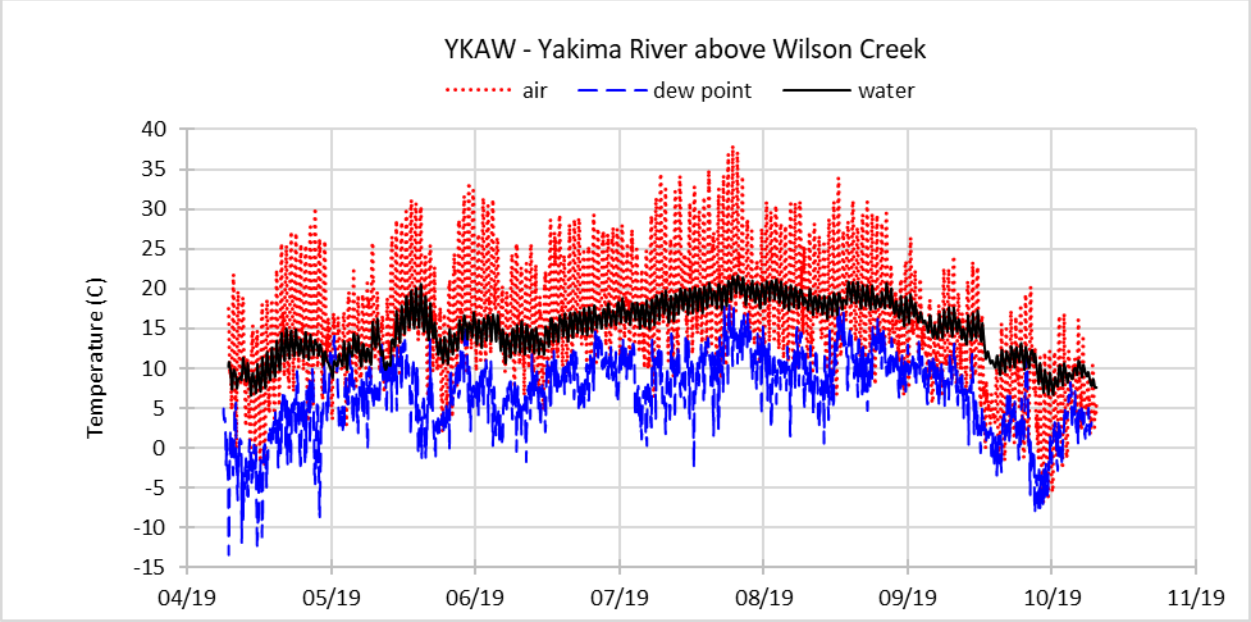


Figure G26. Continuous air, water, and dew point temperature results for YKAW.

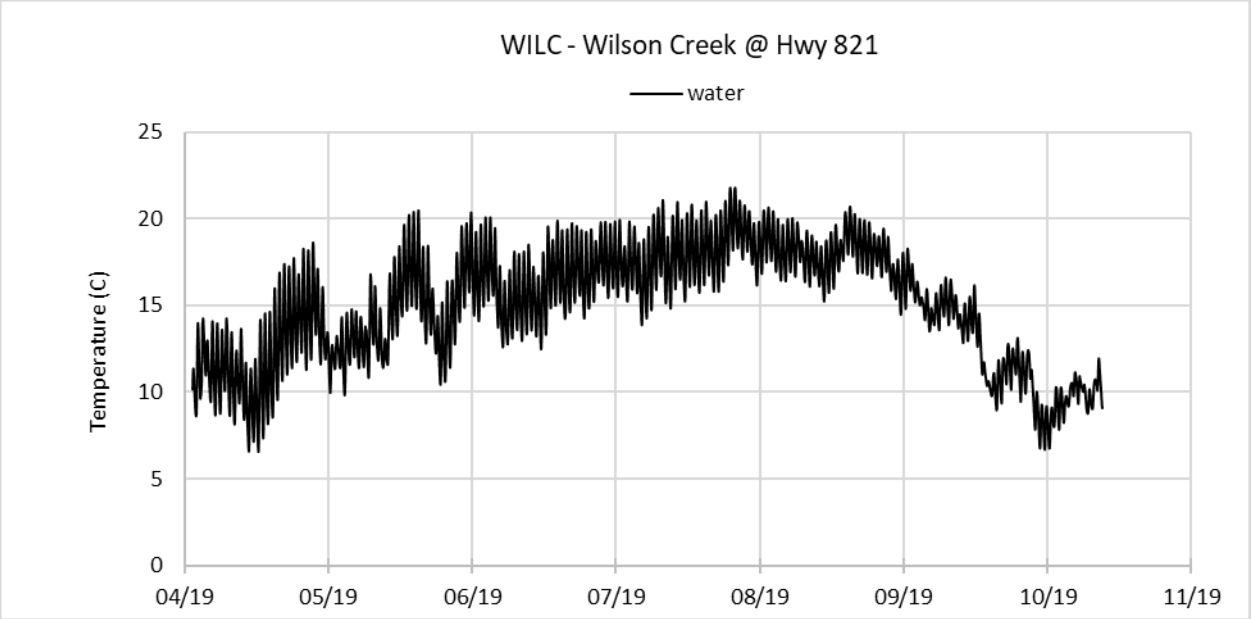


Figure G27. Continuous water temperature results for WILC.

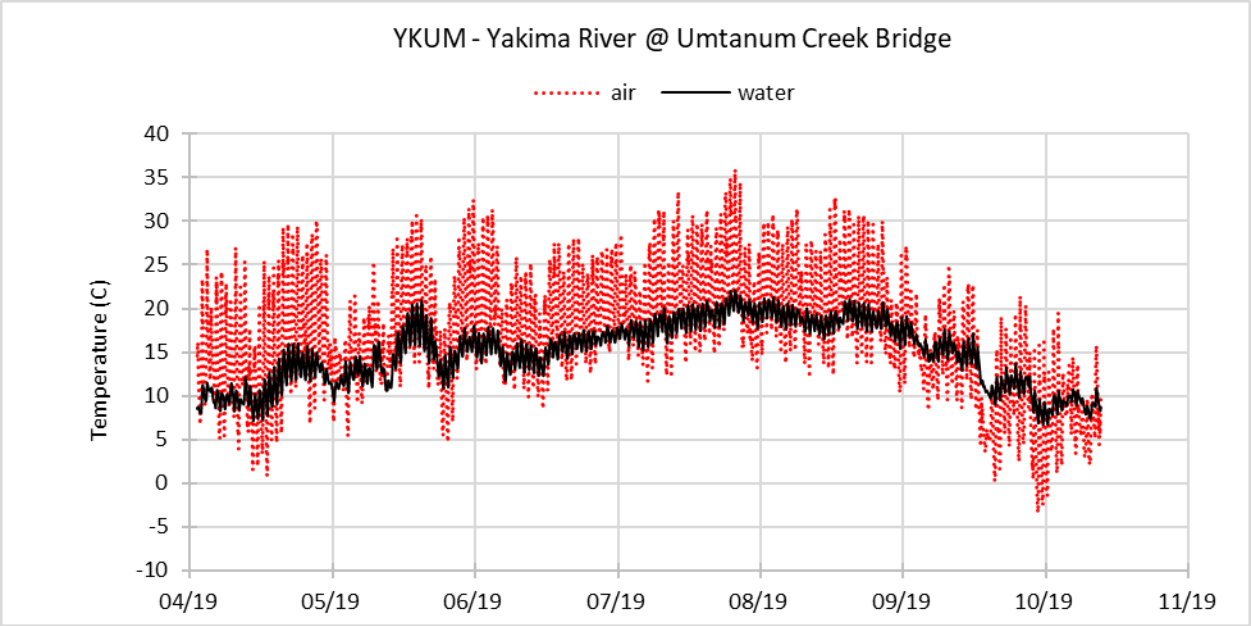


Figure G28. Continuous air and water temperature results for YKUM.

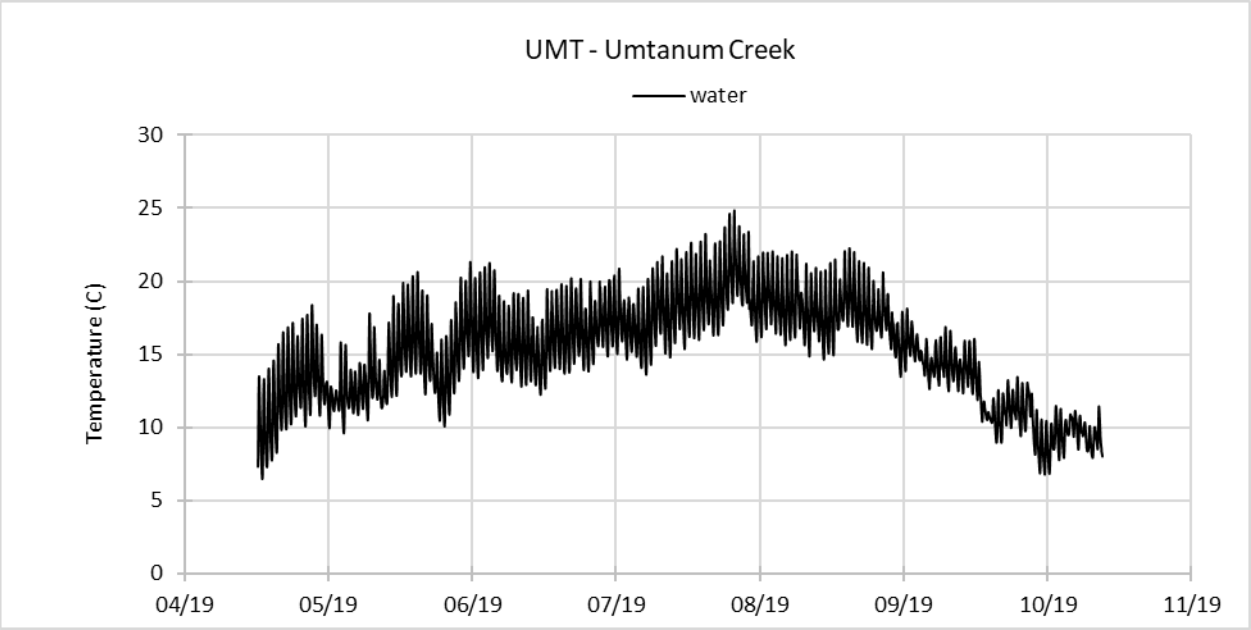


Figure G29. Continuous water temperature results for UMT.

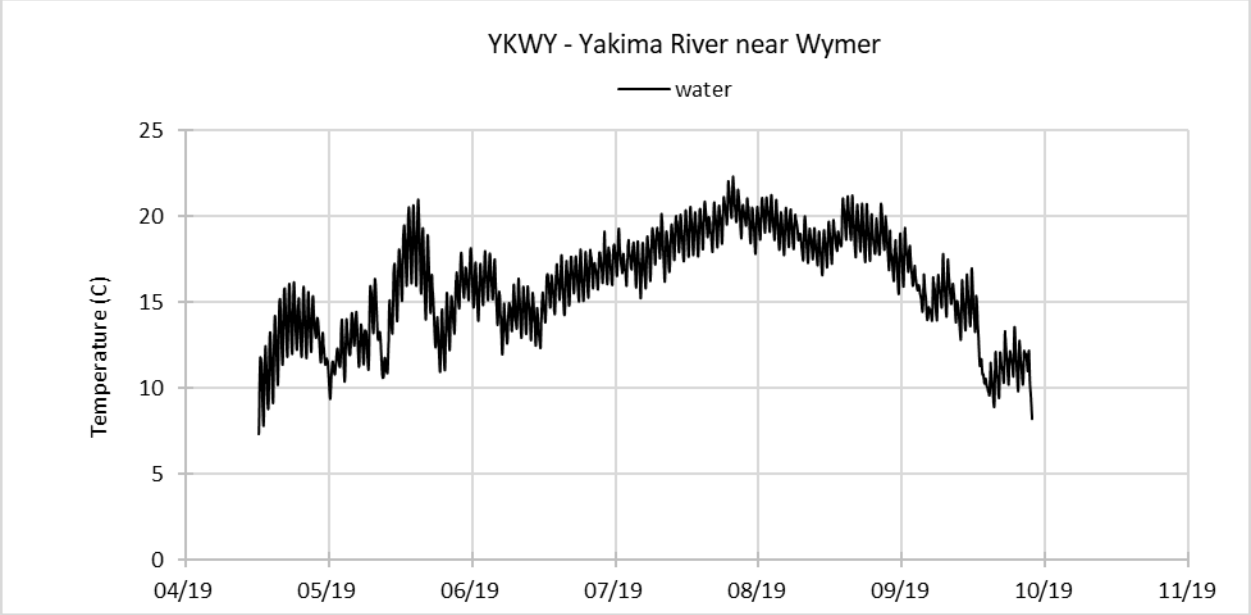


Figure G30. Continuous water temperature results for YKWY.

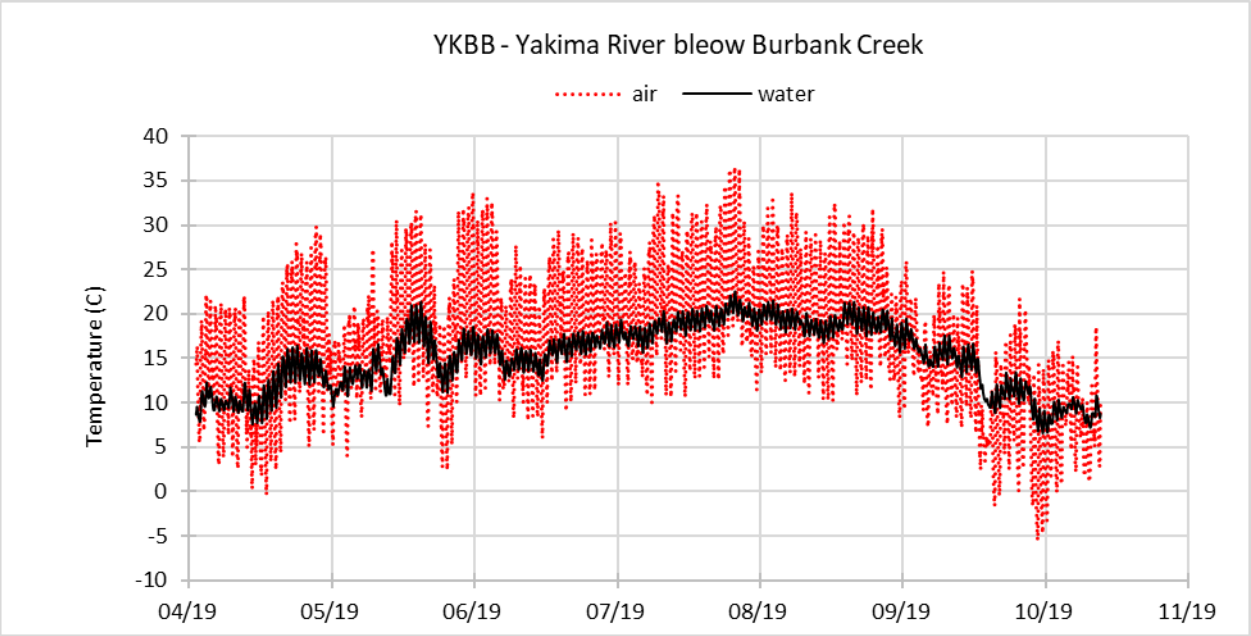


Figure G31. Continuous air and water temperature results for YKBB.

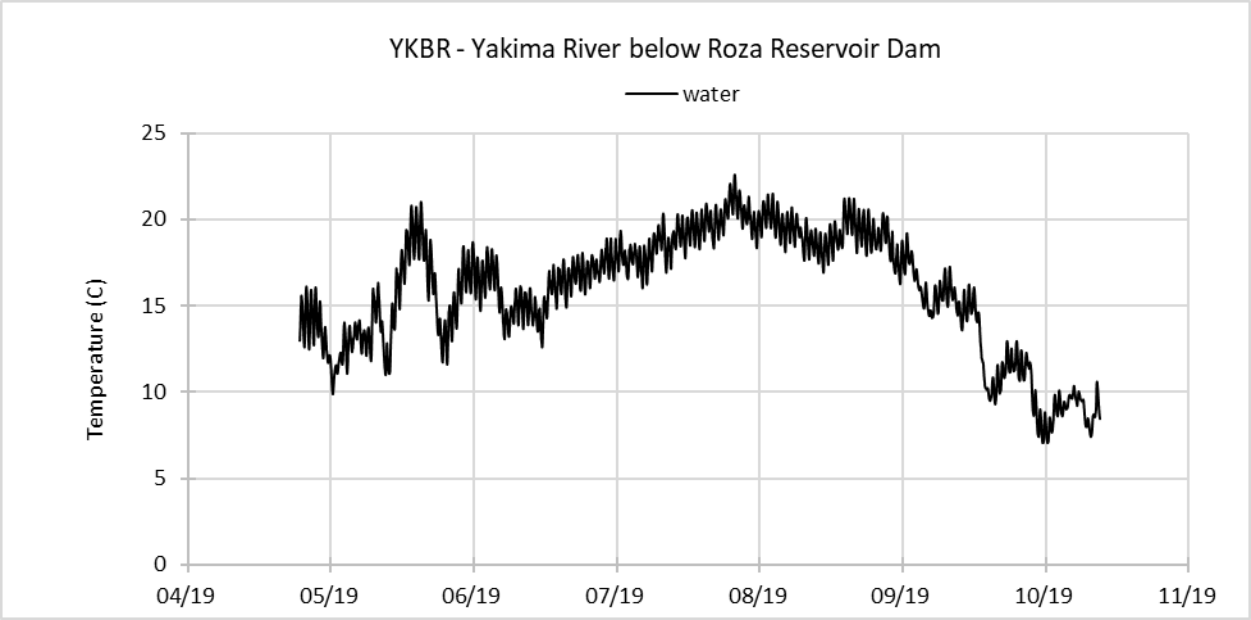


Figure G32. Continuous water temperature results for YKBR.

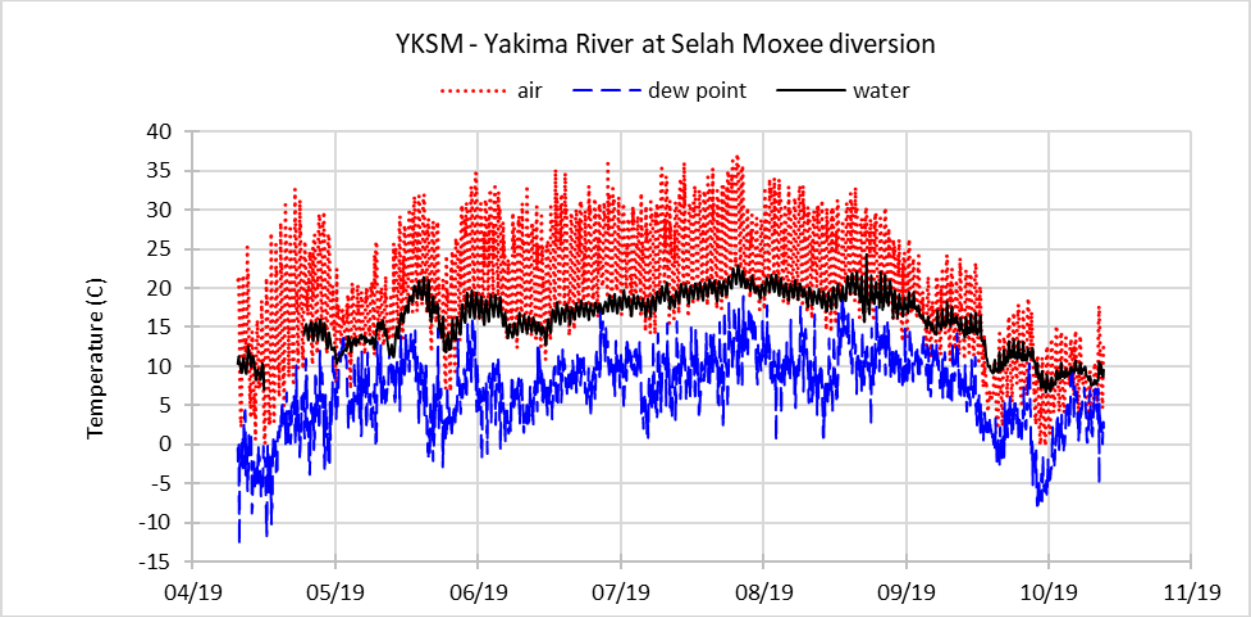


Figure G33. Continuous air, water, and dew point temperature results for YKSM.

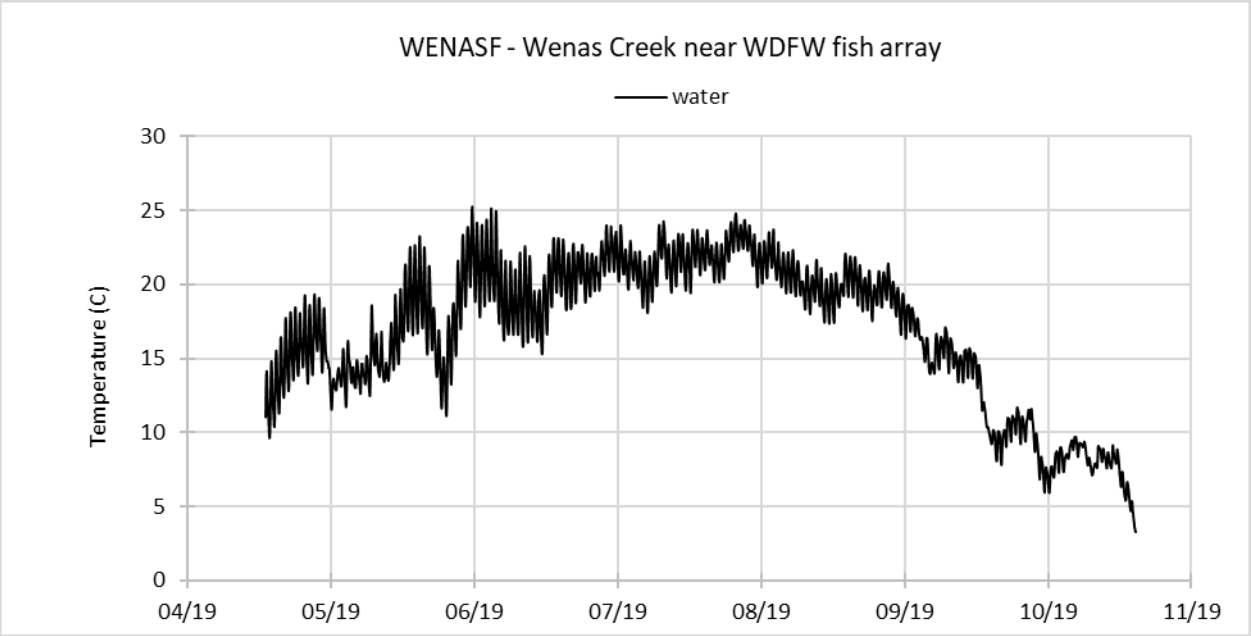


Figure G34. Continuous water temperature results for WENASF.

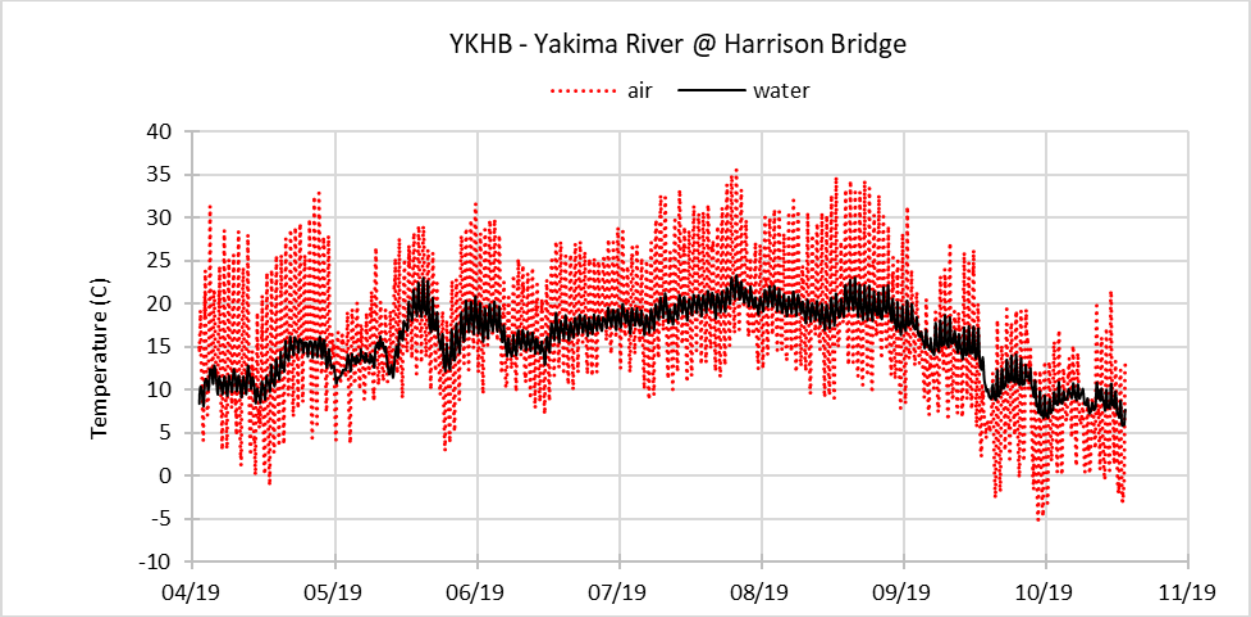


Figure G35. Continuous air and water temperature results for YKHB.

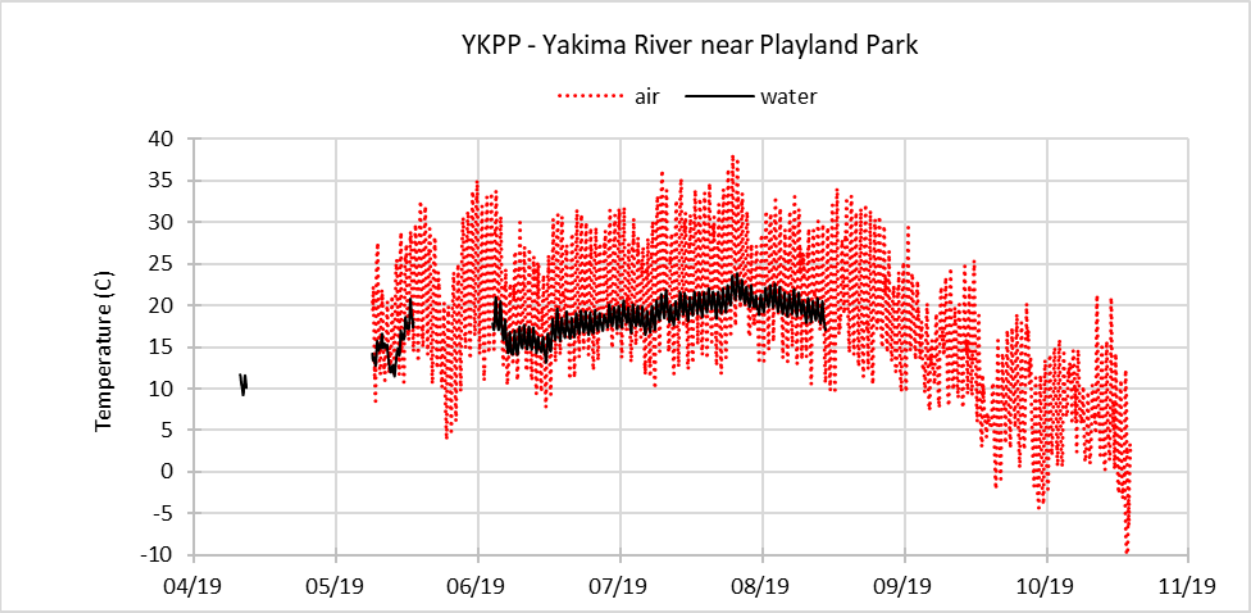


Figure G36. Continuous air and water temperature results for YKPP.

Appendix H. Groundwater Results

This appendix includes groundwater measurements and sample results at two locations. It also includes surface water measurements collected in conjunction with the groundwater monitoring. Data includes laboratory results, discrete sonde measurements, and temperature data logger results.

Continuous temperature monitoring data presented below are in chart format. The continuous data records are too large to include in the report. All data are available from Ecology's Environmental Information Management (EIM) online database located at https://apps.ecology.wa.gov/eim/search/default.aspx.

Table H1. Laboratory results from 2019 groundwater samples.

Study LOC ID	Date	Time	Sample ID	Rep Y/N	Alk (mg/L)	NH3 (mg/L)	DOC (mg/L)	NO3/NO2 (mg/L)	OP (mg/L)	TPN (mg/L)	TP (mg/L)
WLTH-GW	8/12/2019	17:00	1908026-43	N	135	0.013	2.2 JL	0.735 JL	0.0227	0.915 J	0.0211
WLTH-GW	8/12/2019	17:30	1908026-44	Y	135	0.013	2.32 JL	0.73 JL	0.0225	0.892 J	0.0211
WLTH-GW	9/9/2019	12:15	1909025-43	N	136 J	0.01 U	2.26 JL	0.934 JL	0.022	1.07 J	0.0226
WLTH-GW	9/9/2019	12:45	1909025-44	Y	135 J	0.011	2.32 JL	0.937 JL	0.0219	1.03 J	0.0219
WLTH-GW	10/7/2019	11:35	1910017-43	N	137	0.01 U	2.26 JL	0.693 JL	0.0205	0.842 J	0.0204
WLTH-GW	10/7/2019	12:05	1910017-44	Y	134	0.01 U	2.14 JL	0.701 JL	0.0208	0.869 J	0.0197
WLTH-GW	11/4/2019	10:00	1911015-43	N	134	0.01 U	2.05 JL	0.198 JL	0.0193 J	0.342 J	0.022
YKAT-GW	8/12/2019	13:45	1908026-42	N	111	0.01 U	0.96 JL	0.01 UJL	0.0044	0.025 UJ	0.0115
YKAT-GW	9/9/2019	15:45	1909025-42	N	107	0.022	0.94 JL	0.01 UJL	0.0051	0.034 J	0.0136
YKAT-GW	10/7/2019	14:30	1910017-42	N	117	0.01 U	0.81 JL	0.01 UJL	0.0039	0.031 J	0.0081
YKAT-GW	11/4/2019	12:10	1911015-42	N	119	0.01 U	1.17 JL	0.01 UJL	0.005 J	0.051 J	0.0052
YKAT-GW	11/4/2019	12:15	1911015-44	Y	119	0.01 U	1.15 JL	0.01 UJL	0.0064 J	0.025 UJ	0.005 U

Rep = Replicate
Alk = Alkalinity
NH3 = Ammonia
DOC = Dissolved Organic Carbon
NO3/NO2 = Nitrate/Nitrite
OP = Orthophosphate
TPN = Total Persulfate Nitrogen
TP = Total Phosphorus

Notes continue on next page

J = Analyte was positively identified. The reported result is an estimate.
JL = Analyte was positively identified. Value may be less than the reported estimate.
U = Analyte was not detected at or above the reported result.
UJ = Analyte was not detected at or above the reported estimate
UJL = Analyte was not detected at or above the reported estimate with likely high bias.

Table H2. Groundwater discrete sonde measurements from 2019.

Study Location ID	Date	Time (local)	Temperature (°C)	pH (s.u.)	Conductivity (uS/cm)	Dissolved Oxygen (mg/L)	ORP (mV)	Vertical Hydraulic Gradient[1] (ft/ft)
YKAT-GW	8/12/2019	12:45	13.78	7.43	302	0.55	-217	0.0968
YKAT-GW	9/9/2019	14:16	13.71	7.43	247	3.03 EST	-150	0.0917
YKAT-GW	10/7/2019	13:31	13.3	7.91 EST	291.7	4.96	102	0.0611
YKAT-GW	11/3/2019	16:42	11.18	7.94	297.6	6.93	33	0.0442
YKAT-GW	12/9/2019	14:50						0.0484
WLTH-GW	8/12/2019	16:51	16.83	6.61	313.9	0.00	19	0.0058
WLTH-GW	9/9/2019	12:10	15.64	6.26	320.9	0.23 EST	70	0.0223
WLTH-GW	10/7/2019	11:23	12.55	6.83 EST	307.4	0.00	145	0.0115
WLTH-GW	11/4/2019	9:55	9.56	6.46	283	0.00	39	0.0116
WLTH-GW	12/9/2019	10:45						0.0295

ORP = Oxidation Reduction Potential
[1] = Water level accuracy = WL2 (+/- 0.01ft)
EST = Measurement value reported is estimated.

Table H3. Surface water sonde measurements taken in conjunction with groundwater monitoring.

Study Location ID	Date	Time (local)	Temperature (°C)	pH (s.u.)	Conductivity (uS/cm)	Dissolved Oxygen (mg/L)
YKAT-SEEP	8/12/2019	11:00	14.61	7.58	77.3	3.86
YKAT-SEEP	9/9/2019	14:00	15.5	6.75	69.6	4.93 EST
YKAT-SEEP	10/7/2019	13:15	12.51	7.9 EST	88.6	5.01
YKAT-SEEP	11/3/2019	16:42	10.63	6.27	92.3	4.69
WLTH	8/12/2019	16:10	20.3	7.69	184.4	9.37
WLTH	9/9/2019	11:45	17.06	7.54	207.1	9.5 EST
WLTH	10/7/2019	11:00	10.4	7.78 EST	190.6	10.57
WLTH	11/4/2019	9:55	5.69	6.76	239.1	12.28

EST = Measurement value reported is estimated.

Table H4. Groundwater temperature data logger locations with instrument information and deployment dates.

Study Location ID	Instrument ID	Start Date/Time (PST)	End Date/Time (PST)
WLTH-GW	10227066	8/12/2019 16:30	12/9/2019 8:00
YKAT-GW	10227081	8/12/2019 13:30	12/9/2019 1:00

Table H5. Surface water temperature data logger locations with instrument information and deployment dates.

Study Location ID	Instrument ID	Start Date/Time (PST)	End Date/Time (PST)
WLTH	10225438	8/12/2019 16:00	12/9/2019 8:30
YKAT	10225437	8/12/2019 10:30	12/9/2019 14:30

Table H6. Data rejected from continuous temperature data due to outliers within the data set.

Study Location ID	Instrument ID	Start Date/Time (PST)	End Date/Time (PST)
WLTH-GW	10227066	9/9/2019 10:30	9/9/2019 11:30
WLTH-GW	10227066	11/4/2019 10:00	11/4/2019 10:00
YKAT-GW	10227081	9/9/2019 13:30	9/9/2019 17:00
YKAT-GW	10227081	10/7/2019 12:30	10/7/2019 15:00
YKAT-GW	10227081	11/3/2019 16:30	11/3/2019 19:30
YKAT-GW	10227081	11/4/2019 10:30	11/4/2019 12:30
WLTH	10225438	11/29/2019 14:30	11/29/2019 15:00
WLTH	10225438	11/30/2019 13:30	11/30/2019 15:30

This is from the data loggers associated with the groundwater monitoring.

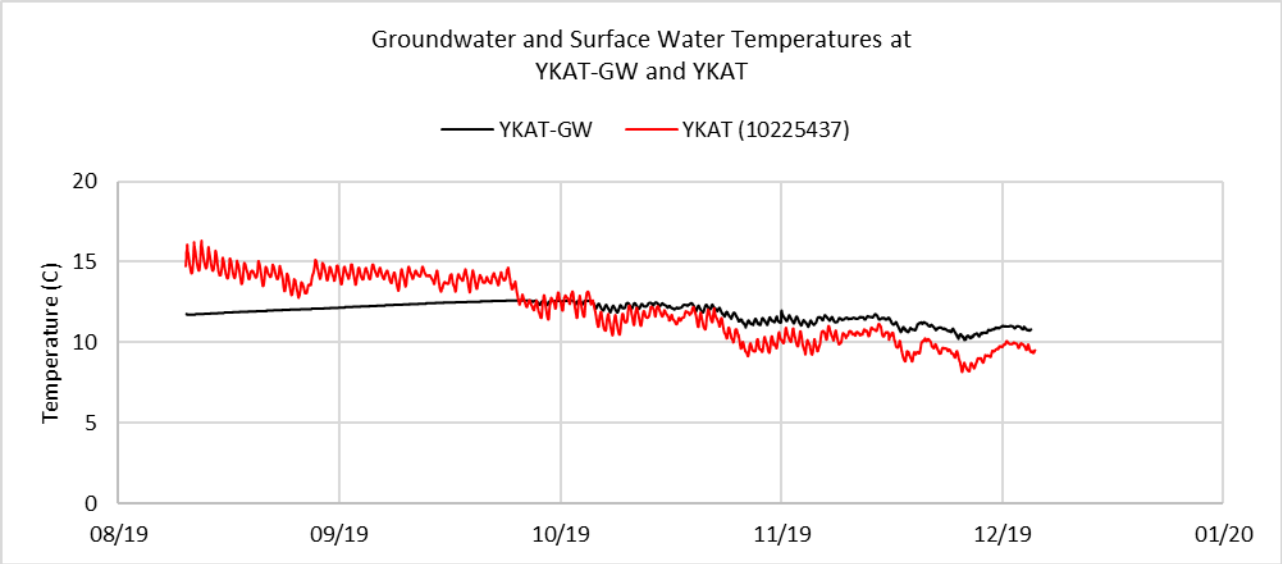


Figure H1. Groundwater and surface water temperature data for two locations, YKAT-GW and YKAT.

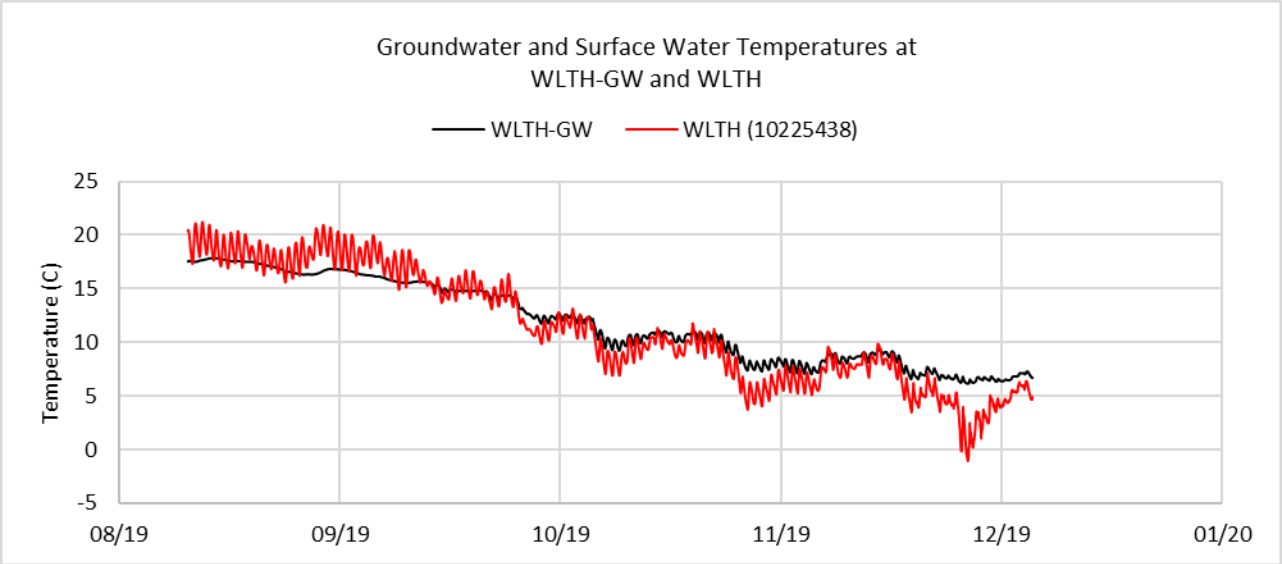


Figure H2. Groundwater and surface water temperature data for two locations, WLTH-GW and WLTH.