Siuslaw Watershed Council

Volunteer Water Quality Monitoring Program
Final Monitoring Report
OWEB GRANT #1040-14300

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Prepared by: Kyle Terry, SWC Programs Manager

Siuslaw Watershed Council
10868 East Mapleton Rd.
Mapleton, Oregon
97453

I. Project Introduction

This report is for the monitoring completed by the Siuslaw Watershed Council (SWC) Volunteer Water Quality Monitoring Program (VWQMP) in 2017 and 2018. Grant funds for this monitoring were provided by Oregon Watershed Enhancement Board (OWEB) through project #1040-14300 and match was contributed by SWC volunteers, Oregon Department of Environmental Quality (DEQ), Bureau of Land Management, Surfrider Foundation, and Mapleton School District.

Project Background & Overview

The Siuslaw River Basin was historically home to some of the largest anadromous salmonid runs in the Pacific Northwest. Today, populations of steelhead, sea-run cutthroat trout, and ESA-listed Oregon Coast coho salmon are believed to be limited by stream complexity and a lack of clean, cold water habitat within the basin and thus remain well below historic population levels. Over 236 river miles in the Siuslaw basin have been identified as "impaired" (placed on the CWA Section 303d list) by the U.S. Environmental Protection Agency (EPA) and DEQ, with temperature, bacteria, biological criteria, sedimentation and dissolved oxygen cited as water quality limitations. Likewise, the Oregon Coastal Coho Assessment identified water quality as population-limiting across the Siuslaw basin. A Total Maximum Daily Load (TMDL) has not been completed yet, but the Siuslaw Watershed Council has been working with DEQ TMDL staff since 2005 to inform the process.

It was 1999 when area residents and the SWC staff came together to establish the SWC VWQMP. In the spirit of The Oregon Plan, citizens took an active role in local watershed enhancement through water quality data collection and analysis. Originally, the goal was to establish baseline water quality data for eight sampling sites. By 2017, the program grew to 12 grab sample sites, 13 continuous temperature sites and seven continuous dissolved oxygen sites, and has progressed from establishing baseline data to identifying and understanding trends in water quality dynamics, which in turn informs watershed management and restoration decision-making.

In addition to benefitting watershed planning, the VWQMP has broader impacts that ensure the long-term sustainability of the watershed through citizen engagement. By collaborating with the Siuslaw and Mapleton School districts, students were trained as volunteers for field data collection and lab processing, building skills and personal interest in their local watershed. These same students recruited their parents to participate in SWC programs, thereby strengthening community ties to their watershed.

Grab Sampling

In 2017-18, SWC continued monthly monitoring at 12 existing grab sample sites. The following water quality parameters were monitored: temperature, dissolved oxygen (DO), turbidity, clarity, salinity (estuary sites), and bacteria. Additional qualitative metrics included weather conditions and tidal stage. Monitoring days were on the third Tuesday of each month. Trained volunteers collected samples and field measurements, and processed bacteria samples in the SWC lab. Trained Mapleton Middle and High School science students processed DO samples under direct supervision of SWC staff. All volunteers were trained to follow the protocols described in the DEQ Water Quality Volunteer Monitoring and Quality Assurance Project Plan (2009) and the Oregon Plan for Salmon and Watersheds' Water Quality Monitoring Technical Guide Book. The data were reviewed by the SWC staff, submitted to DEQ Volunteer Water Quality Monitoring Program (VWQMP), and uploaded by DEQ into the Ambient Water Quality Monitoring System (AWQMS) water monitoring data portal. The AWQMS portal allows access to DEQ data and data provided from partner groups, such as watershed councils, for the public to view, query, chart, graph, and download.

Continuous Monitoring

In addition to the grab sampling, SWC managed 12 continuous temperature monitoring sites established in the mainstem Siuslaw River and its tributaries, and Lake Creek. We also deployed six continuous DO/temp loggers at previous LASAR sites, adding to the SWC's 2016 season of continuous monitoring, providing model verification, an annual update, and support for the Siuslaw Basin Dissolved Oxygen TMDL development process.

The SWC VWQMP is multi-purpose and continuous data collection efforts help: (a) assess current conditions against state standards (b) assist in the Siuslaw Basin TMDL development process, and (c) assess and update restoration opportunities and priorities. Continuous temperature monitoring data is used to calculate a "rolling" the seven-day-average maximum temperature (based on the preceding and following three days of a given daily maximum) that will facilitate a better understanding of the frequency and extent of thermal maximums that can negatively impact salmonids and other cold water aquatic species. This metric also matches the Oregon Administrative Rules, chapter 340, Division 41: "The seven-day-average maximum temperature of a stream identified as having salmon and trout rearing and migration…may not exceed 18.0 degrees Celsius" (see appendix A). This is the same metric used by the DEQ and

EPA when listing 105 river miles of the mainstem Siuslaw as Category 5, water quality limited, needing a TMDL, 303 (d), in the Oregon Integrated Report. The results section of this Final Analysis and Report graphs the mainstem Siuslaw 7-day rolling averages with the State standard of 18˚C.

Continuous DO monitoring is used to calculate a "rolling" 30-day minimum mean of DO concentrations (based on the preceding 30 days) that will facilitate a better understanding of DO conditions along the 105 river miles of the Siuslaw also listed as Category 5, water quality limited, needing a TMDL, 303 (d), for low DO concentration. The 30-day minimum mean was used by the DEQ and EPA for the Integrated Report listing, and is the standard established in the Oregon Administrative Rules, Chapter 340, Division 41 (see appendix A). The results section of this Final Analysis and Report graphs the mainstem Siuslaw 30-day minimum mean DO concentration with the State standard of 8 mg/L.

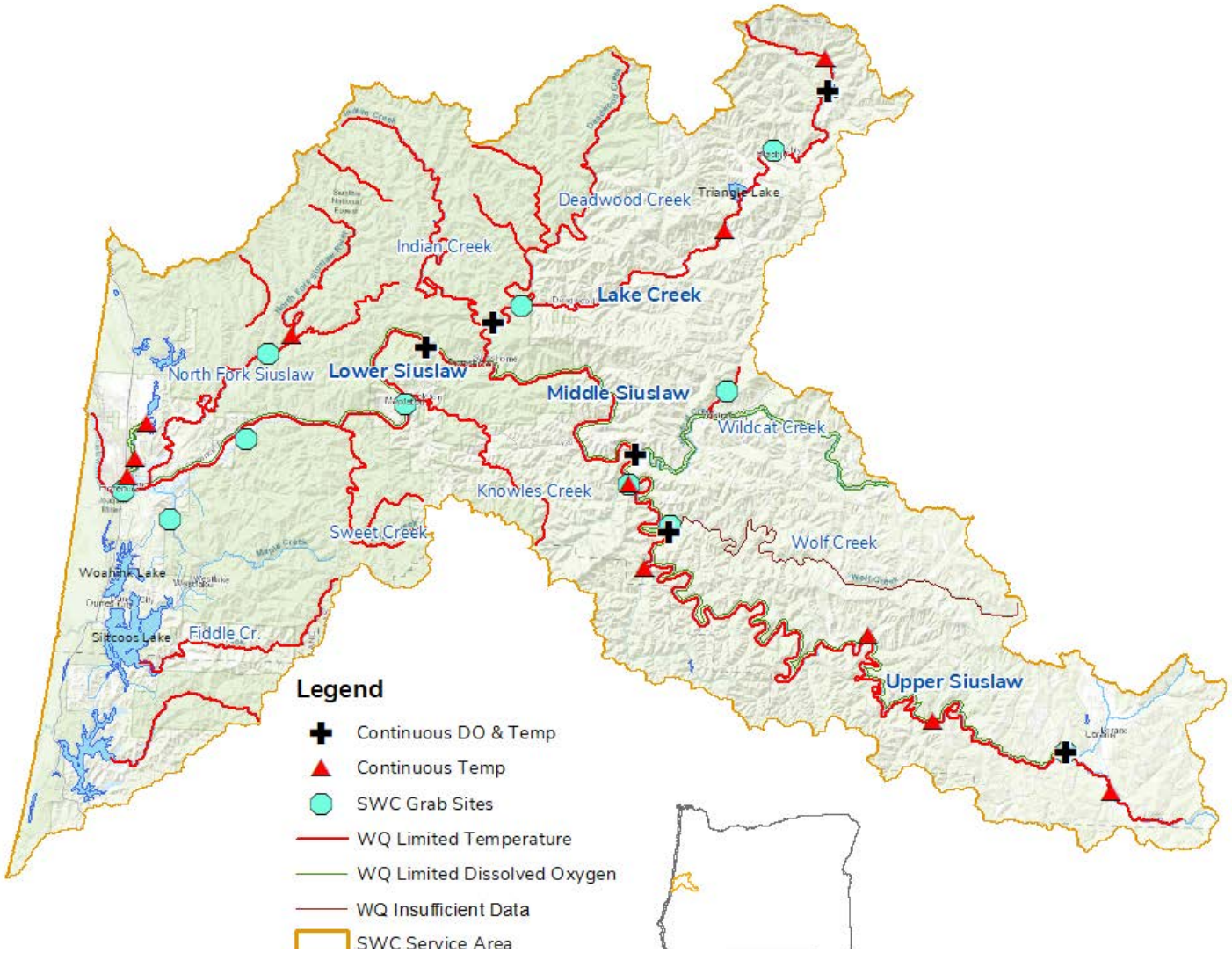
Nutrients and Supporting Chemistry/TMDL Support

DEQ is developing TMDLs on a watershed-by-watershed basis using continuous DO data collected during periods when data show standards are not consistently being met as a basis for developing nonpoint source load and point source waste load allocations. SWC continuous DO, temperature, and nutrient data are being used to populate, calibrate, and validate a process-based model, QUAL2Kw, that will enable DEQ to examine factors controlling dissolved oxygen dynamics in the Siuslaw. When continuous DO data are combined with nutrients and other supporting chemistry, analysts can assess whether the primary limiting drivers of DO are nutrients and organic matter (and associated diel photosynthetic and respiration cycles), temperature, or a combination of these factors.

DEQ performed continuous DO studies at the Tide Wayside station in 2008 (spring and fall). The 2016 SWC program complemented that dataset and provided updated information with which to calibrate and improve models. Until 2016, no continuous DO data had been collected in the upper Siuslaw watershed. Our 2016 and 2017 efforts provided a basis for use of river metabolism and mechanistic watershed models in evaluating patterns, drivers and assessment of potential management actions to improve DO conditions in the entire 303(d) (DO) listed section of the mainstem Siuslaw River.

SWC and DEQ collected nutrient and supporting chemistry samples during typical low flows, prior to onset of the spawning season in 2017 which are currently being used in the development of a Mid-coast TMDL.

II. Monitoring Sites




34877
Deadwood Creek
Triangle Lake
Indian Creek
Lake Creek
34878
33642
North Fork Siuslaw
Lower Siuslaw
Middle Siuslaw
Wildcat Creek
10989
Knowles Creek
Sweet Creek
40431
Wolf Creek
Woahink Lake
Siltcoos Lake
Fiddle Cr.
Upper Siuslaw
38329
Legend
Continuous DO & Temp
WQ Limited Temperature
WQ Limited Dissolved Oxygen
WQ Insufficient Data
SWC Service Area


40269
34877
Deadwood Creek
Triangle Lake
34220
Indian Creek
Lake Creek
38330
North Fork Siuslaw
Lower Siuslaw
Middle Siuslaw
40267
40268
40266
Wildcat Creek
10983
Knowles Creek
Sweet Creek
10984
Wolf Creek
Woahink Lake
39318
Siltcoos Lake
Fiddle Cr.
Upper Siuslaw
34880
40265
Legend
Continuous Temp
WQ Limited Temperature
WQ Limited Dissolved Oxygen
WQ Insufficient Data
SWC Service Area

Continuous Temperature & Dissolved Oxygen Monitoring Sites

All sites except Munsel and Ackerley creeks, and the 2017 additions near Hult Log Pond, were at or near sites that were previously monitored for TMDL development and most are LASAR sites. The following provides a list of the sites, starting on the Siuslaw, followed by Lake Creek, Munsel Creek, and finally Wildcat Creek, from downstream to upstream, and the parameters measured at them (CDO=continuous dissolved oxygen; temp=temperature):

• Siuslaw River at Tide wayside, CDO/temp. (SWC ID: TWS, LASAR ID: 33642): This site is a current DEQ Ambient station (Siuslaw River at Tide boat ramp) with data collected by DEQ in 2008. Conducting continuous DO-Temp data collection began in 2016 and assists in determining the current status (impaired or meeting criteria) and if impaired, whether TMDLs should be developed using steady-state or other tools.

• Siuslaw River above Whittaker Creek, temp. (SAW, 10983): This location is an established LASAR site from 2005 and continuous temperature data complemented our grab sampling efforts at MU-15. Continuous temperature data was collected here in 2005 and 2016.

• Siuslaw River below Wolf Creek, CDO/temp. (SBW, 40431): This site was established in 2017 to help fill a 70-mile gap in continuous dissolved oxygen data between Siuslaw above Barber (34222) and Siuslaw at Fire Road (38329).

• Siuslaw River above Esmond Creek, temp. (SAE, 10984): This location is an established LASAR site and helps characterize the temperature regime in the mid-to-upper Siuslaw River. Continuous temperature data was collected here in 2005, 2015 and 2016.

• Siuslaw River above Pheasant Creek, temp. (SPT, 39318): This location is an established LASAR site and helps characterize the temperature regime in the middle Upper Siuslaw sub-basin. Continuous temperature data was collected here in 2005, 2015 and 2016.

• Siuslaw above Doe Creek, temp. (SDT, 34880): This location is an established LASAR site in the Upper Siuslaw site which will facilitate an understanding of the temperature regime of the upper reaches in the mainstem Siuslaw. This site is located below Siuslaw Falls and above the transition into forested land managed by the BLM and industrial timber companies. Continuous temperature data was collected in 2005 and 2014-2016.

• Upper Siuslaw River below North and South Forks, CDO/temp. (FRB, 38329): This site is located just upstream of the LO- 16 grab sample site. Continuous temperature and conductivity data has been collected during the summers of 2014 and 2015. SWC started deploying a continuous DO/temperature logger in the summer of 2016 to determine the extent of dissolved oxygen conditions near the headwaters and compare them with the TWS and SBT sites.

• South Fork Siuslaw at Territorial Highway and Gowdyville Road, temp. (40265): SWC established this site to update the data collected in 2000 which led to the South Fork being identified as Category 5 status on Oregon's 303(d) list for temperature year-round, river mile 0 to 7.3.

• Lake Creek above Indian Creek, CDO/temp. (SIT, 34878): This location is an established LASAR site. It is above the confluence of Lake Creek and the Siuslaw, just upstream from the mouth of Indian Creek. Continuous temperature data was collected here in 2007, 2014 and 2015. SWC initially deployed a temperature/DO logger here in 2016 to aid in assessing the contribution of Lake Creek to the Middle Siuslaw temperature and dissolved oxygen concentration and saturation regimes.

• Lake Creek above Fish Creek, temp. (LFT, 34220): This location is an established LASAR site. Lake Creek is a major tributary to the mainstem Siuslaw. This site is below Triangle Lake, providing an important characterization of the lotic influences on thermal dynamics. Continuous temperature data was collected here in 2007 and 2014-2016.

• Lake Creek below Hult, CDO/temp. (LAL, 34877): This site is located on Lake Creek, a major tributary to the Siuslaw, about ¼ mile below the Hult Log Pond. Continuous temperature data has been collected here in 2007, 2014 and 2015. A temperature/DO logger initially deployed in 2016 will help us understand the dissolved oxygen conditions on Lake Creek as it discharges from this artificial lake.

• Munsel Creek at Public Works, temp. (40268): SWC managed this sample site to update the previous continuous temperature monitoring conducted here by the City of Florence. The data collected by the City has not been transferred to SWC for comparison at this time.

• Munsel Creek at Greenway Park, temp. (40266): Same as above. This site helps characterize mid-Munsel creek.

• Ackerley Creek upstream of Martin Road, temp. (40267): Same as above. This site helps characterize the temperature just upstream from Munsel Lake.

• Wildcat Creek, CDO/temp. (WCS, 10989): located 100 meters upstream of the confluence with Siuslaw River: This site is located just above the mouth of Wildcat Creek and was new in 2016. Adding density and future deployments seasons on Wildcat is a goal for DEQ and SWC.

Continuous loggers were strategically placed along the Siuslaw mainstem at 7 sites (4 temperature & 3 temperature/dissolved oxygen), 5 sites along Lake Creek (3 temperature & 2 temperature/dissolved oxygen), 3 continuous temperature sites in Munsel and Ackerley creeks, and 1 temperature site in the South Fork of the Upper Siuslaw near Lorane. The data collection will complement the 2016 continuous monitoring effort, identify spatial and temporal patterns in water quality and inform future restoration and monitoring decisions described in Section VII below. Continuous dissolved oxygen monitoring on Lake Creek in 2016-2017 became a goal after SWC staff reviewed the 6 years of grab data from BT-14 (34220) and 10 years of grab data from TL-12 (LASAR 38331) and noticed that the dissolved oxygen and percent saturation were consistently below DEQ standards in the winter and summer months (see appendix B). Starting in 2016, we deployed two temperature/dissolved oxygen loggers in Lake Creek at two existing continuous temperature LASAR sites (LAL 34877 & SIT 34878) above and below Triangle Lake. This segment is 303(d) listed for exceeding summer temperatures (cold water aquatic life criteria). The loggers will advance our ability to understand the timing and magnitude of temperature and dissolved oxygen exceedances and more accurately prioritize water-quality-focused restoration efforts.

Segments, or reaches, of the mainstem Siuslaw River have been identified as water quality limited by the DEQ for temperatures that exceed state standards (Siuslaw RM 5.7-105.9; Lake Creek RM 0 to 28.3), dissolved oxygen levels exceeding standards (RM 5.7-105.9) and high sediment loads (NF Siuslaw RM .4 to 27.3). DEQ has seasonal criteria for these pollutants based on many factors including what aquatic organisms like salmon need in order to spawn and rear in our streams.

In coordination with DEQ's TMDLs program and the DEQ Lab, we deployed three temperature/dissolved oxygen loggers at sites in the Siuslaw River near Tide (33642), the middle Siuslaw below Wolf Creek (40431), and the Upper Siuslaw River above the Fire Road bridge (38329). The two existing 303(d) listings for dissolved oxygen (spawning and non-spawning) on the mainstem Siuslaw River from River Mile 5.7 to the headwaters at River Mile 105.9 are based on data from one Mapleton monitoring location. Because of the occasional tidal incursions at the former ambient site in Mapleton, the site was moved a short distance upstream to the Tide Wayside in mid-summer 2006. DEQ conducted follow up monitoring at the Tide Wayside site in June

and November 2008 and collected continuous DO, temperature, pH, conductivity data, plus grab nutrients. Based on that monitoring, dissolved oxygen values at this site appeared to meet standards; however a data review conducted by DEQ in 2015 indicates the 2008 data does not provide a clear understanding of the status of DO conditions in this segment of the mainstem. The 2016 and 2017 SWC continuous DO data bookends the listed reach with Tide Wayside (TWS, 33642) on the downstream and Fire Road Bridge (FRB, 38329) on the upstream extent in order to provide a more clear understanding of the status of DO concentration in this reach.

Grab Sample Sites

Estuarine sites

The estuary had been determined to be of the highest priority for restoration through the 2007 SWC Siuslaw Watershed and Coastal Lakes Seventh Field Aquatic Priority Classification process. The OWEB-funded Siuslaw River Strategic Action Plan for Coho Recovery underscores the importance of the estuary in the life history strategy of Siuslaw River OC coho population and identifies the estuary as a high priority area for restoration. The estuary monitoring sites served as baseline locations for past and future restoration projects. These sites were chosen because they represent three tiers of estuarine brackish water dilution, are proximal to confluences of major estuary tributaries, and have public access. Collection at these four sites and a partnership on an additional site (North Fork Siuslaw River near the mouth, in partnership with the Confederated Tribes of the Coos, Lower Umpqua and Siuslaw Indians) resulted in a valuable long-term water quality dataset.

• Florence Boat Basin (SWC ID FB-2, LASAR ID 38327): This is the furthest downstream site in the program, and is the SWC's only urban site. Data has been collected here since August, 2002. Data from this site has been reasonably characterized, and new data is now being analyzed for trending.

• South Slough (SS-3, 34085): This site is below the tidegate on the South Slough, one of the major direct tributaries to the estuary. Data has been collected at this site since August, 2002. Data from this site has been reasonably characterized, and new data is now being analyzed for trending and is informative about tidegate management and water quality.

• Mapleton Dock (MD-6, 10392): This site is located near the head of tide and allows us to monitor a location on the mainstem that has less estuarine influence. Samples are

collected at this site by Mapleton Middle and High School Science students with Siuslaw Institute staff during the school months. Data has been collected at this site since August, 2002. This site previously served as a DEQ ambient site. According to the Oregon Water Quality Index, this site was characterized as having poor water quality and was determined to have an 80% likelihood of a negative trend in water quality. This site is no longer a state ambient water quality monitoring site yet given the aforementioned likelihood.


38331
Deadwood Creek
Triangle Lake
Indian Creek
Lake Creek
38328
38330
Lower Siuslaw
Middle Siuslaw
34879
10392
Knowles Creek
Wildcat Creek
34082
Sweet Creek
38327
10983
34085
10990
Upper Siuslaw
Woahink Lake
Siltcoos Lake
Fiddle Cr.
38329
Legend
SWC Grab Sites
WQ Limited Dissolved Oxygen
WQ Limited Temperature
SWC Service Area
DEQ Lakes

• Karnowsky Creek Lower Bridge (KC-7, 34082): This site is located downstream of the Karnowsky Creek Restoration project and serves as a long-term estuary monitoring site for this project. Samples are collected by students in the Siuslaw Institute's Mapleton Schools Natural Resource Education Program and volunteers. Data has been collected at this site since September, 2003; data has been reasonably characterized, and new data is now being analyzed for trending.

Freshwater Grab Sample Sites

The middle and upper watershed freshwater sites were selected due to their downstream proximity to rural residential areas, to medium and high priority restoration areas, and changes in land use and public access. We also selected two sites above and below the largest lake in the watershed to explore the impacts of the unique waterbody on water quality.

• North Fork Siuslaw at Minerva (NF-M, 38330): a new site in 2011. The North Fork of the Siuslaw is a major contributor to the estuary. This location is significant as it is at a transition in land use/land management from primarily USFS Late Successional Reserve managed forest lands to privately owned land managed primarily for livestock and agriculture. There is a Confederated Tribes of Coos, Lower Umpqua, and Siuslaw Indians (CTCLUSI) monitoring site downstream in the estuary, which allows for paired comparison with varied salinity when datasets are combined.

• Chickahominy Creek (CH-11, 34879): Located in the highest priority sub-basin in the Wildcat fifth-field HUC. The Chickahominy subwatershed has undergone many recent restoration projects based on its anchor coho salmon habitat and proactive community base in Walton. Data has been collected at this site since October, 2005. The bacteria data collected at this site were requested and examined by DEQ after receiving pollution complaints from landowners in the Walton area.

• Lake Creek above Triangle Lake (TL-12, 38331): This monitoring site is located above Triangle Lake, which will allow us to have better knowledge of water quality conditions up- and downstream of the lake.

• Deadwood Creek (DW-13, 38328): The site is downstream of two high priority subwatersheds (Upper and Lower Deadwood Creek). Numerous restoration projects exist upstream of this site, along with rural residential developments. An expanded role of current volunteers allowed us to reopen this site in June, 2009. Deadwood community members are supportive of a monitoring site.

• Lake Creek at Fish Creek (BT-14, 34220): This site provides a monitoring site below Triangle Lake and at the confluence of an important tributary of Lake Creek. A new volunteer allowed us to open this site in August, 2009.

• Middle/Upper Siuslaw, above Whittaker Creek (MU-15, 10983): This site is a LASAR site, established during the temperature TMDL data collection process in 2005.

• Upper Siuslaw, Lorane (LO-16, 38329): Headwaters of the Upper Siuslaw are located in a unique ecoregion compared to the rest of the basin, the Southern Willamette Ecoregion, and therefore the Upper Siuslaw is affected by different hydrologic and ecological processes. In January 2015, LO-10 was discontinued because it was located on the North Fork, not the mainstem, and a SWC volunteer sampled a new site (named LO-16) downstream of the confluence of the South Fork and North Fork Siuslaw where SWC deployed a temperature and conductivity logger in summer 2014 and 2015, and a temp/DO logger in 2016-2017. Grab and continuous sampling efforts will complement each other and allow for both broad and fine scale comparisons throughout the year. The land directly upstream of the site is intensely managed for agriculture and rural residential use, whereas downstream is used heavily for timber production.

• Wolf Creek (WC-17, 10990): This site is on BLM property 500 feet upstream of the bridge at the mouth of Wolf Creek to assist in characterizing this watershed and address its influence on the Upper Siuslaw River. This watershed is a medium priority for restoration, and therefore, a priority for water quality monitoring. The site is located far enough upstream of the confluence so that is it not influenced by the Siuslaw River, especially during high winter flows. BLM has invested effort to collect multiple years of continuous temperature data near this site (1995 to 2005), which will help complement our grab sample data. Additionally, this is an established LASAR site (10990) and DEQ has collected toxics data here in 2013, as well as a year of monthly grab samples for field parameters plus E. coli from March 2007–February 2008. There is enough data from LASAR and BLM to establish an expected range and variability of field conditions.

III. Parameters and Methods

Continuous loggers

Continuous dissolved oxygen and temperature were measured using Onset U26 Dissolved Oxygen Data Loggers and Hobo U22 temperature loggers. Pre- and post-deployment accuracy checks were performed before and after the rearing season deployments (June 1st – September 14th). Monthly audits were conducted with a NIST-certified thermometer that measures air and water temperature near the logger. DO field audits occurred at deployment and retrieval with Winkler or calibrated DO meters. Loggers must be within +/- 0.5 degrees Celsius of the reference temperature and +/- 0.3 mg/L of the calibrated DO meter in order to be useable data.

Grab Samples

Temperature grab samples were conducted using thermometers that are accuracy checked with NIST standards. Temperature impacts biological and chemical processes and aquatic organisms depend on water within a certain temperature range for survival. Temperature impacts the oxygen content of the water, photosynthesis rates, and metabolic rates of organisms.

Turbidity is the measurement of clarity. Suspended materials such as soil, algae, plankton, and microbes in water block the passage of light. High turbidity limits photosynthesis by blocking sunlight and increases water temperature because suspended particles absorb more heat. This can reduce the concentration of dissolved oxygen because warm water holds less dissolved oxygen than cold. Suspended or settling particles can also black fish gills and smother eggs. Turbidity was measured in Nephelometric Turbidity Units (NTU) using a Portable Turbidity Meter (Hach 2001P). The meter was checked for accuracy monthly and measurements were within 5% of standards during 2016. Field volunteers performed three tests with each sample and the average was recorded.

Dissolved Oxygen (DO) is both produced and consumed in streams. Streams gain oxygen from the atmosphere and from plants as a result of photosynthesis. Riffles and rapids in water, because of the agitation, dissolve more oxygen than still water, such as a lake. Respiration by aquatic organisms, decomposition, and various chemical reactions consume oxygen. DO samples were collected by field volunteers in 300 mL bottles and measured using the Winkler Titration Method. Volunteers performed two tests with 100 mL of sample water; if the results of these tests were within 5%, the average was recorded. If the results were not within 5%, another sample was titrated and used to average.

Escherichia coli (E. coli) are used as indicators of sewage and agricultural contamination because they are commonly found in human and animal feces and the EPA recommends testing for *E. coli* in recreational waters. *E. coli* was measured using the Colilert-18 method. Estuary samples were diluted 1:10, freshwater samples were not diluted. To verify the accuracy of these tests, we concurrently ran a Blank sample, using distilled water, a Replicate sample (two samples taken from the same location at the same time; for freshwater sites) and a Split sample (two tests processed from the same sample bottle; for saltwater sites). For Surfrider partner beach sites, the Enterolert method was used.

Salinity is the concentration of salt in water measured in parts per thousand (ppt). Salinity was measured using a Refractometer. Samples were read twice and the average was recorded. Estuarine organisms have tolerance ranges for salinity and when salinity goes outside of that range they are negatively affected. Salinity also affects dissolved oxygen in the estuary because the amount of oxygen that can dissolve in water decreases as salinity increases.

Clarity, or transparency, was measured using a Secchi Disk (metal disk, eight inches in diameter that is lowered into the water on a rope. The depth at which the disk can no longer be seen is the Secchi depth. When clarity is high, Secchi depth is high. SWC volunteers read the disk twice and the average depth was recorded.

IV. QA/QC

The SWC Volunteer Water Quality Monitoring Program has an approved sampling and analysis plan (SAP) on file with the DEQ. The SAP provides guidance and is a template to assist in documenting the procedural and analytical requirements for discrete and continuous collection of water quality measurements. We update QA/QC procedures as they evolve and follow the DEQ's quality assurance project plan (QAPP). The QAPP outlines the activities of a water quality monitoring program and the associated acquisition of continuous and discrete water quality data. Water Quality Volunteer Monitoring and amend SWC's SAP to include continuous dissolved oxygen loggers according to the ODEQ QAPP (See appendix C).

Trained volunteers collected data at established VWQMP sites. The volunteers represent a wide variety of watershed residents, including students from Mapleton Schools, retirees, and other community members. The volunteers were trained to follow the protocols set forth in the Oregon Plan for Salmon and Watersheds Water Quality Monitoring Technical Guide Book and the ODEQ's QAPP Water Quality Volunteer Monitoring. When volunteers were unable to sample, SWC staff collected the samples whenever possible. Trained lab volunteers and SWC staff processed bacterial and turbidity samples in the SWC lab. Trained Mapleton Middle and High School science students processed the DO samples under supervision of SWC staff. Per DEQ protocol, bacteria samples and collection methods were verified using blank, replicate, and split samples. SWC staff entered and reviewed data prior to upload, distribution, and submission to the DEQ VWQMP. If missing information could not be resolved through lab or field notes, samples were removed. Outliers were retained in the VWQMP database.

For continuous temperature loggers, SWC staff conducted pre- and post-deployment accuracy checks for dissolved oxygen and temperature loggers in June and December of 2017, respectively. In situ field audits and cleanings were conducted at the deployment sites regularly. SWC staff conducted in situ audits and cleanings on 17 different days between June 6 and October 18, 2017. Field audits were completed using an Orion ASTAR 329 multi-parameter probe that is checked for temperature and conductivity accuracy annually. In the lab, before and after field audits, SWC staff documented stable DO and temperature readings over the course of five minutes that were within .3 mg/L of each other. Field audit procedures were based on the USGS protocols for continuous water quality monitors (http://pubs.water.usgs.gov/tm1d3). Loggers must be within +/- 0.5 degrees Celsius of the reference temperature and +/- 0.3 mg/L of the calibrated DO meter.

V. Results by Parameter

Continuous Monitoring

The following tables and graphs compare the 2017 SWC VWQMP temperature and dissolved oxygen measurements to State water quality criteria. Actual discussion of these measurements follows in the Discussion section. Tables 1 and 3 follow the format of Oregon's 2012 Integrated Report Assessment Database and 303(d) List. Rows ascend by river mile in the following order: Siuslaw River, Lake Creek, Wildcat Creek, Munsel Creek, and North Fork Siuslaw for temperature; Siuslaw River, Lake Creek, and Wildcat for dissolved oxygen. In column two, logger locations describe the site relative to known tributaries or landmarks, and LASAR IDs refer to DEQ LASAR station identification number and are mapped at the beginning of this section. Although the listing for temperature on the Siuslaw River is year-round, the deployment period was during the summer rearing season and the 18˚C criterion is the standard during this time. The Siuslaw is listed for low DO concentration during the rearing season (June 1st – September 14th) which correlates to our deployment period. SWC and DEQ staff deployed loggers on the first date in the range of the Deployment Period column, and retrieved the continuous loggers on the second date. The data collected during the deployment period were all checked and validated by DEQ and are final. The 2017 Logger Data column follows the model of the Integrated Report Assessment Database format, stating the number of days during the monitoring that the pollutant exceeded the State criterion. Additionally, the column contains the exceedance rate, a percentage of the deployment period that the 7-day average maximum was higher than the State sttandard of 18°C. Exceedance rates above 60% are shaded red, 15-59% are shaded green, and those sites that cet the standard (remmained below 18°C during the entire deployment) are shaded blue.

Temperature

TABLE 1

Waterbody	Logger Location, LASAR ID	Pollutant/Season	Deployment Period	2017 Logger Data
Siuslaw River Mile 26.3 SWC ID: TWS	Siuslaw River upstream of Tide Wayside, 33642	Temperature DEQ criteria: salmon and trout rearing and migration: 18.0 degrees Celsius 7-day-average maximum (See appendix A) Year round	6/19/2017 to 10/10/2017	• **Exceedance count: 112 of 114 days with 7-day-average maximum > 18°C.** • **Exceedance percent: 98%**
Siuslaw River Mile 45 SWC ID: SAW	Siuslaw River upstream of Whittaker Creek, 10983		6/27/2017 to 10/9/2017	• **Exceedance count: 84 of 111 days with 7-day-average maximum > 18°C.** • **Exceedance percent: 76%**
Siuslaw River Mile SWC ID: SBW	Siuslaw River downstream of Wolf Creek, 40431		6/27/2017 to 10/16/2017	• **Exceedance count: 31 of 109 days with 7-day-average maximum > 18°C.** • **Exceedance percent: 28%**
Siuslaw River Mile 55 SWC ID: SAE	Siuslaw River upstream of Esmond Creek, 10984		6/27/2017 to 10/15/2016	• **Exceedance count: 83 of 111 days with 7-day-average maximum > 18°C.** • **Exceedance percent: 75%**
Siuslaw River Mile 82.4 SWC ID: SAP	Siuslaw River upstream of Pheasant Creek, 39318		6/27/2016 to 10/15/2016	• **Exceedance count: 81 of 111 days with 7-day-average maximum > 18°C.** • **Exceedance percent: 73%**

Siuslaw River Mile 95 SWC ID: SDT	Siuslaw River upstream of Doe Creek, 34880		6/27/2017 to 10/15/2017	• **Exceedance count: 36 of 111 days with 7-day-average maximum > 18°C.** • **Exceedance percent: 32%**
Siuslaw River Mile 105 SWC ID: SAF	Siuslaw River below confluence of North and South Forks, 38329		6/27/2017 to 10/16/2017	• **Exceedance count: 22 of 112 days with 7-day-average maximum > 18°C.** • **Exceedance percent: 17%**
South Fork Siuslaw SWC ID: SFST	South Fork Siuslaw River at Territorial HWY and Gowdyville Road, 40265		6/17/2017 to 10/9/2017	• **Exceedance count: 17 of 111 days with 7-day-average maximum > 18°C.** • **Exceedance percent: 15%**
Lake Creek Mile 2.5 SWC ID: SIT	Lake Creek above confluence with Indian Creek, 34878		6/25/2017 to 10/10/2017	• **Exceedance count: 87 of 108 days with a 7-day average maximum >18°C.** • **Exceedance percent: 81%**
Lake Creek Mile 17.1 SWC ID: LAF	Lake Creek above confluence with Fish Creek, 34220		6/26/2017 to 10/9/2017	• **Exceedance count: 88 of 106 days with a 7-day average maximum >18°C.** • **Exceedance percent: 83%**
Lake Creek Mile 17.1 SWC ID: LAL	Lake Creek below Hult Pond, 34877		6/28/2017 to 10/10/2017	• **Exceedance count: 85 of 105 days with a 7-day average maximum >18°C.** • **Exceedance percent: 81%**
Lake Creek Mile 30 SWC ID: LHS	Lake Creek, Hult Log Pond Spillway		6/28/2017 to 10/9/2017	• **Exceedance count: 87 of 104 days with a 7-day average maximum >18°C.** • **Exceedance percent: 84%**

Lake Creek Mile 30 SWC ID: LHOP	Lake Creek, Hult Log Pond outlet pipe, 40270		6/28/2017 to 10/9/2017	• **Exceedance count: 87 of 104 days with a 7-day average maximum >18°C.** • **Exceedance percent: 84%**
Lake Creek SWC ID: LPC	Lake Creek above Hult Dam 60 meters below BLM 15-7-35 bridge, 40269		6/28/2017 to 10/9/2017	• **Exceedance count: 0 of 104 days with 7-day-average maximum > 18°C.** • **Exceedance percent: 0%**
Wildcat Creek SWC ID WCS	Wildcat Creek 100 meters upstream of Siuslaw, 10989		6/25/2017 to 10/16/2017	• **Exceedance count: 32 of 114 days with 7-day-average maximum > 18°C.** • **Exceedance percent: 28%**
North Fork Siuslaw River SWC ID: NFM	North Fork Siuslaw at Minerva, 38330		7/13/2017 to 10/15/2017	• **Exceedance count: 66 of 95 days with a 7-day average maximum >18°C.** • **Exceedance percent: 69%**
Munsel Creek SWC ID: MWTP	Munsel Creek at Greenway Park, 40266		6/13/2017 to 10/15/2017	• **Exceedance count: 0 of 125 days with 7-day-average maximum > 18°C.** • **Exceedance percent: 0%**
Munsel Creek SWC ID: MFPW	Munsel Creek at Spruce Street, 40268		6/12/2017 to 9/16/2017	• **Exceedance count: 0 of 97 days with 7-day-average maximum > 18°C.** • **Exceedance percent: 0%**

Ackerley Creek SWC ID: AKC	Ackerley Creek upstream of Martin Road, 40267		6/12/2017 to 10/15/2017	• **Exceedance count: 114 of 126 days with a 7-day average maximum >18°C.** • **Exceedance percent: 90%**

FIGURE 1

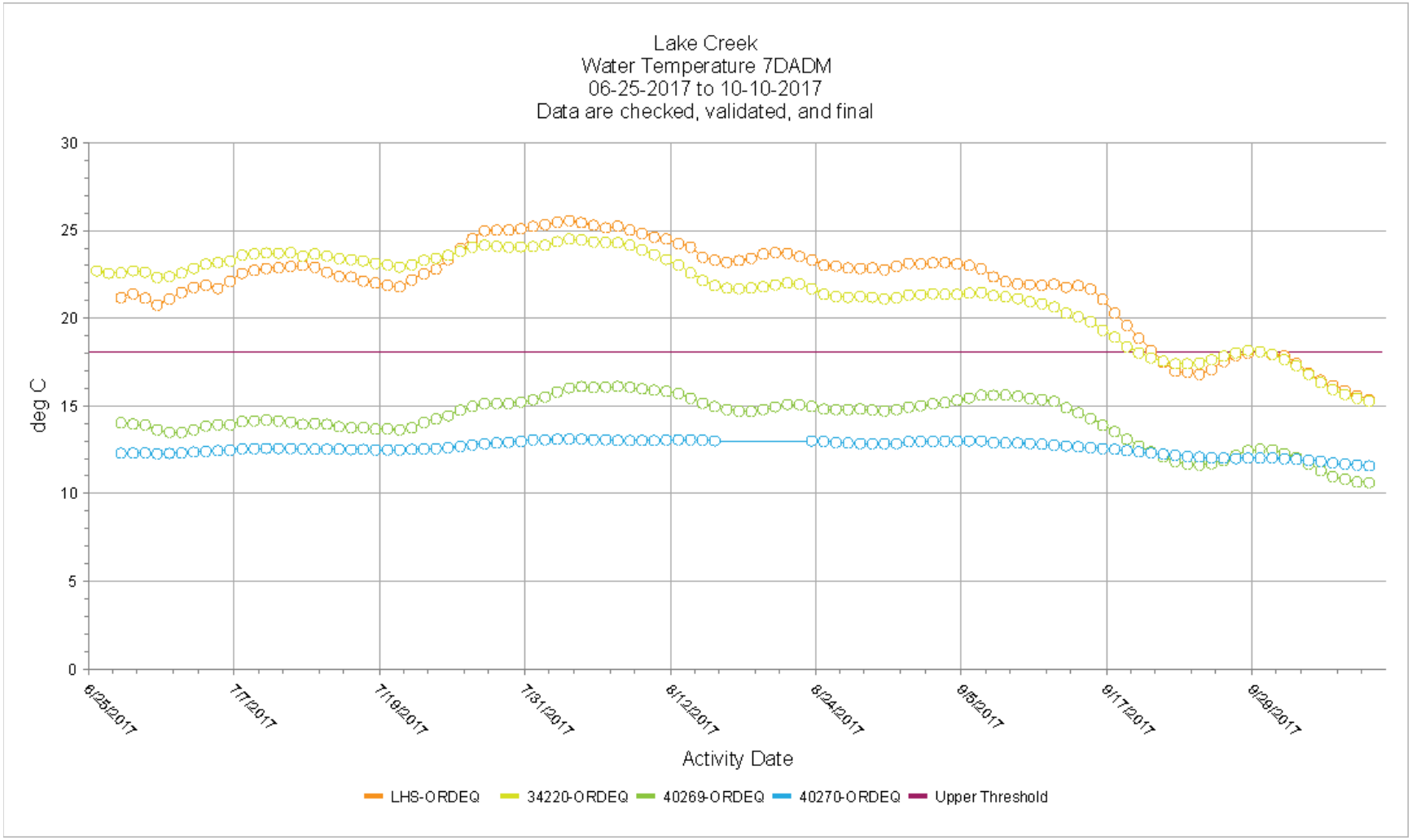

Lake Creek
Water Temperature 7DADM
06-25-2017 to 10-10-2017
Data are checked, validated, and final
deg C
30
25
20
15
10
5
0
6/25/2017
7/7/2017
7/19/2017
7/31/2017
8/12/2017
8/24/2017
9/5/2017
9/17/2017
9/29/2017
Activity Date
LHS-ORDEQ
34220-ORDEQ
40269-ORDEQ
40270-ORDEQ
Upper Threshold

FIGURE 2

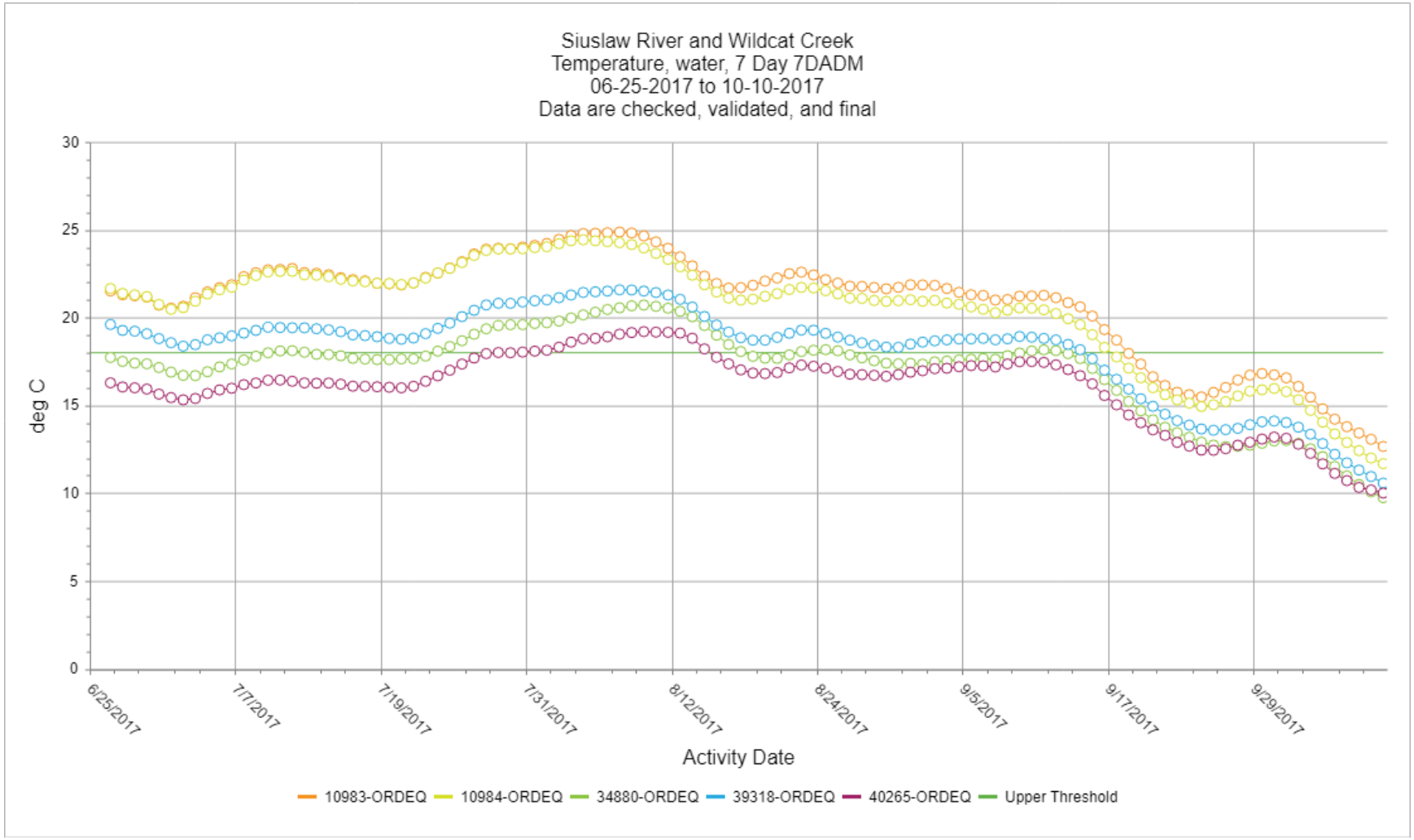

Siuslaw River and Wildcat Creek
Temperature, water, 7 Day 7DADM
06-25-2017 to 10-10-2017
Data are checked, validated, and final
deg C
30
25
20
15
10
5
0
6/25/2017
7/7/2017
7/19/2017
7/31/2017
8/12/2017
8/24/2017
9/5/2017
9/17/2017
9/29/2017
Activity Date
10983-ORDEQ
10984-ORDEQ
34880-ORDEQ
39318-ORDEQ
40265-ORDEQ
Upper Threshold

FIGURE 3

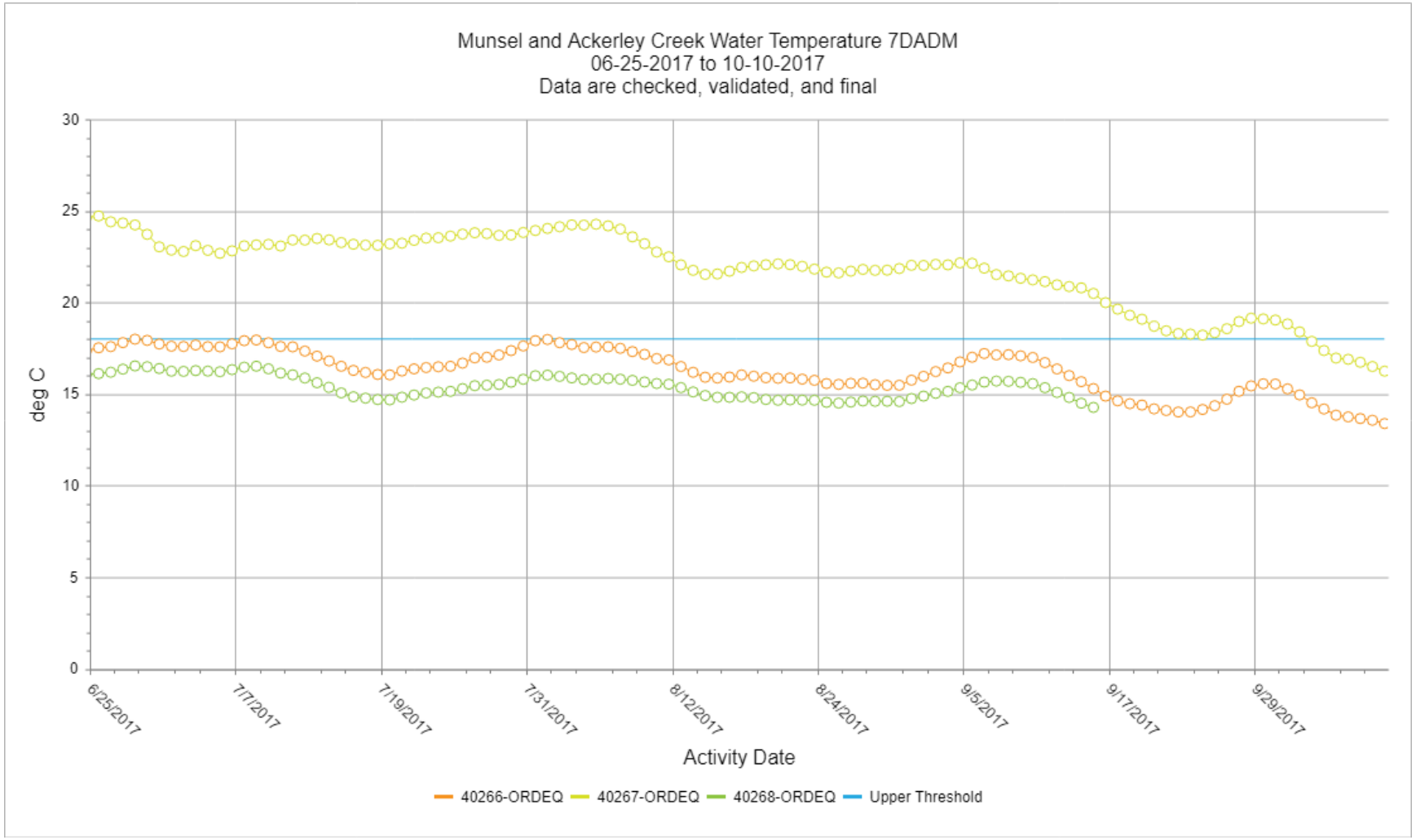

Munsel and Ackerley Creek Water Temperature 7DADM
06-25-2017 to 10-10-2017
Data are checked, validated, and final
deg C
30
25
20
15
10
5
0
6/25/2017
7/7/2017
7/19/2017
7/31/2017
8/12/2017
8/24/2017
9/5/2017
9/17/2017
9/29/2017
Activity Date
40266-ORDEQ
40267-ORDEQ
40268-ORDEQ
Upper Threshold

FIGURE 4

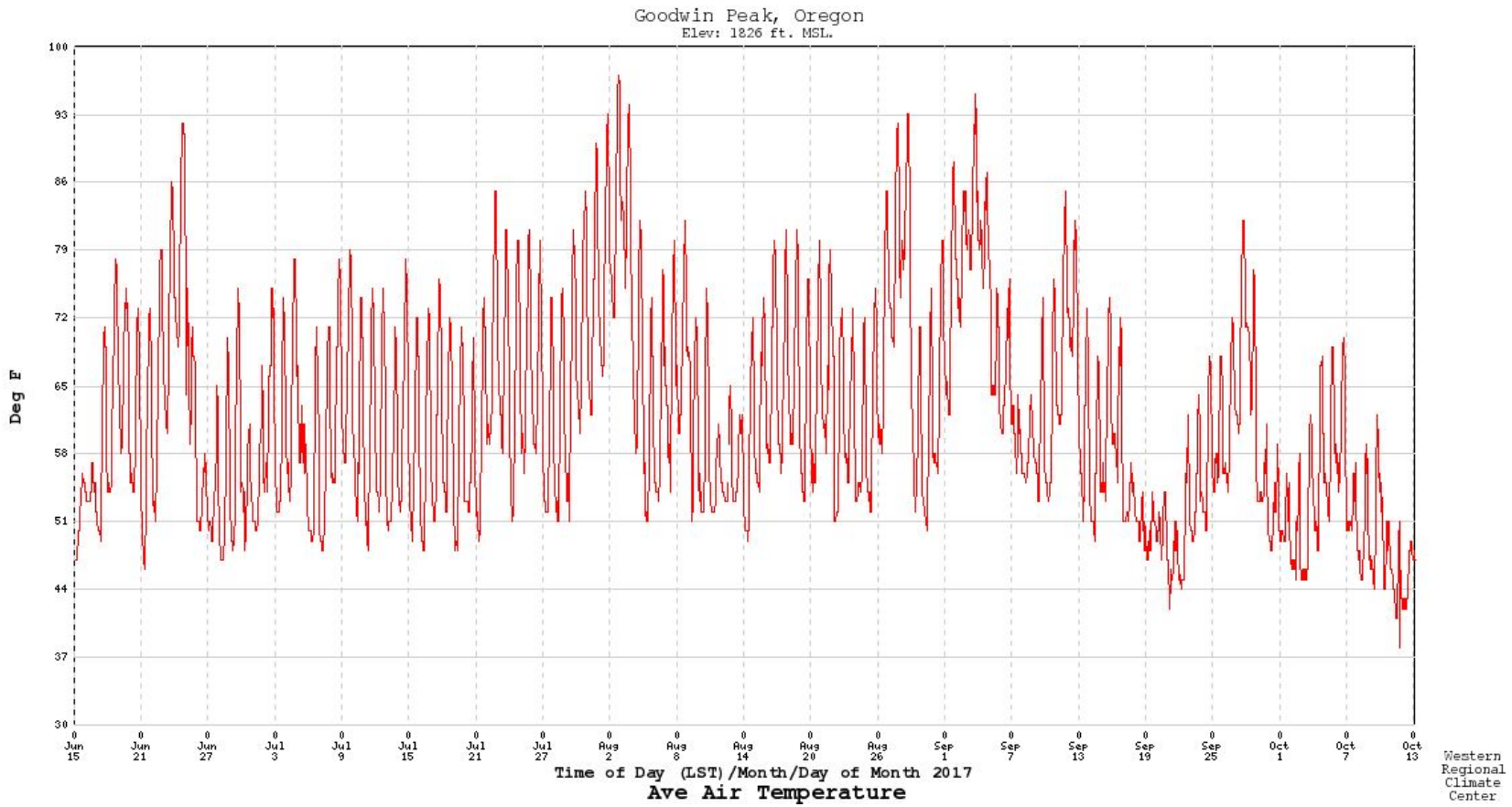

Goodwin Peak, Oregon
Elev: 1826 ft. MSL.
Deg F
100
93
86
79
72
65
58
51
44
37
30
Jun 15
Jun 21
Jun 27
Jul 3
Jul 9
Jul 15
Jul 21
Jul 27
Aug 2
Aug 8
Aug 14
Aug 20
Aug 26
Sep 1
Sep 7
Sep 13
Sep 19
Sep 25
Oct 1
Oct 7
Oct 13
Time of Day (LST)/Month/Day of Month 2017
Ave Air Temperature
Western Regional Climate Center

FIGURE 5

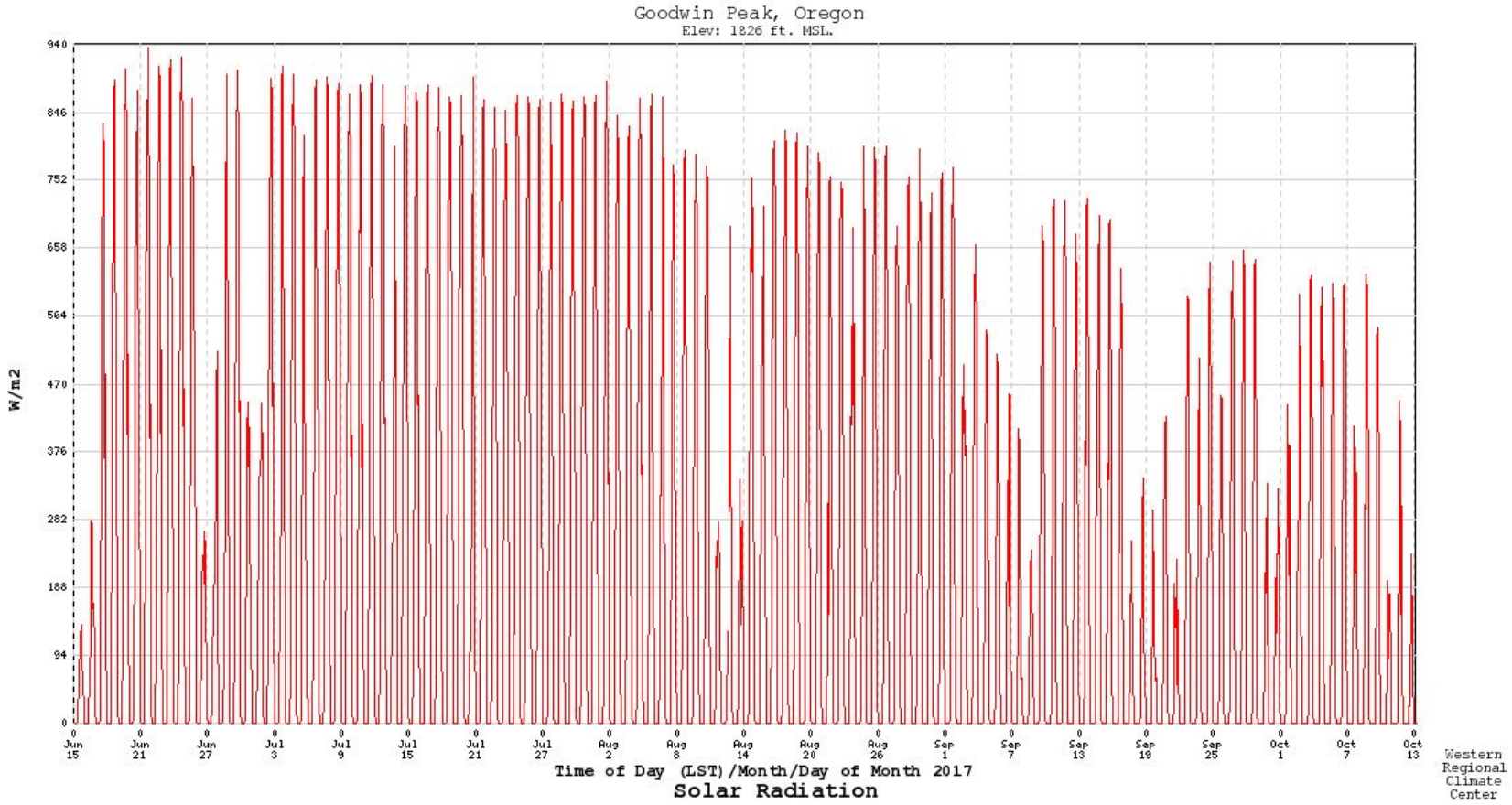

Goodwin Peak, Oregon
Elev: 1826 ft. MSL.
W/m2
940
846
752
658
564
470
376
282
188
94
0
Jun 15
Jun 21
Jun 27
Jul 3
Jul 9
Jul 15
Jul 21
Jul 27
Aug 2
Aug 8
Aug 14
Aug 20
Aug 26
Sep 1
Sep 7
Sep 13
Sep 19
Sep 25
Oct 1
Oct 7
Oct 13
Time of Day (LST)/Month/Day of Month 2017
Solar Radiation
Western Regional Climate Center

FIGURE 6

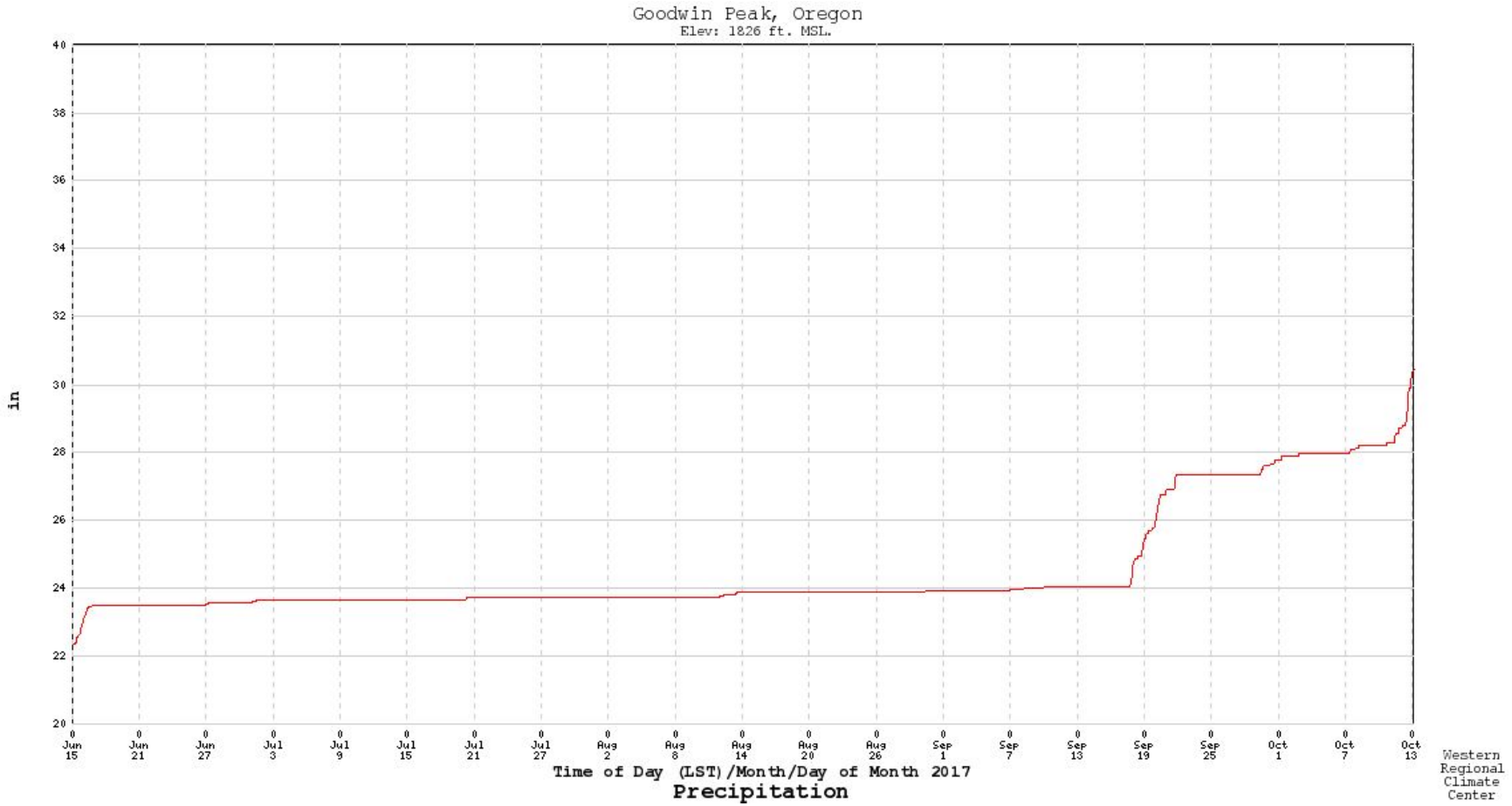

Goodwin Peak, Oregon
Elev: 1826 ft. MSL.
in
40
38
36
34
32
30
28
26
24
22
20
0 Jun 15
0 Jun 21
0 Jun 27
0 Jul 3
0 Jul 9
0 Jul 15
0 Jul 21
0 Jul 27
0 Aug 2
0 Aug 8
0 Aug 14
0 Aug 20
0 Aug 26
0 Sep 1
0 Sep 7
0 Sep 13
0 Sep 19
0 Sep 25
0 Oct 1
0 Oct 7
0 Oct 13
Time of Day (LST)/Month/Day of Month 2017
Precipitation
Western Regional Climate Center

FIGURE 7

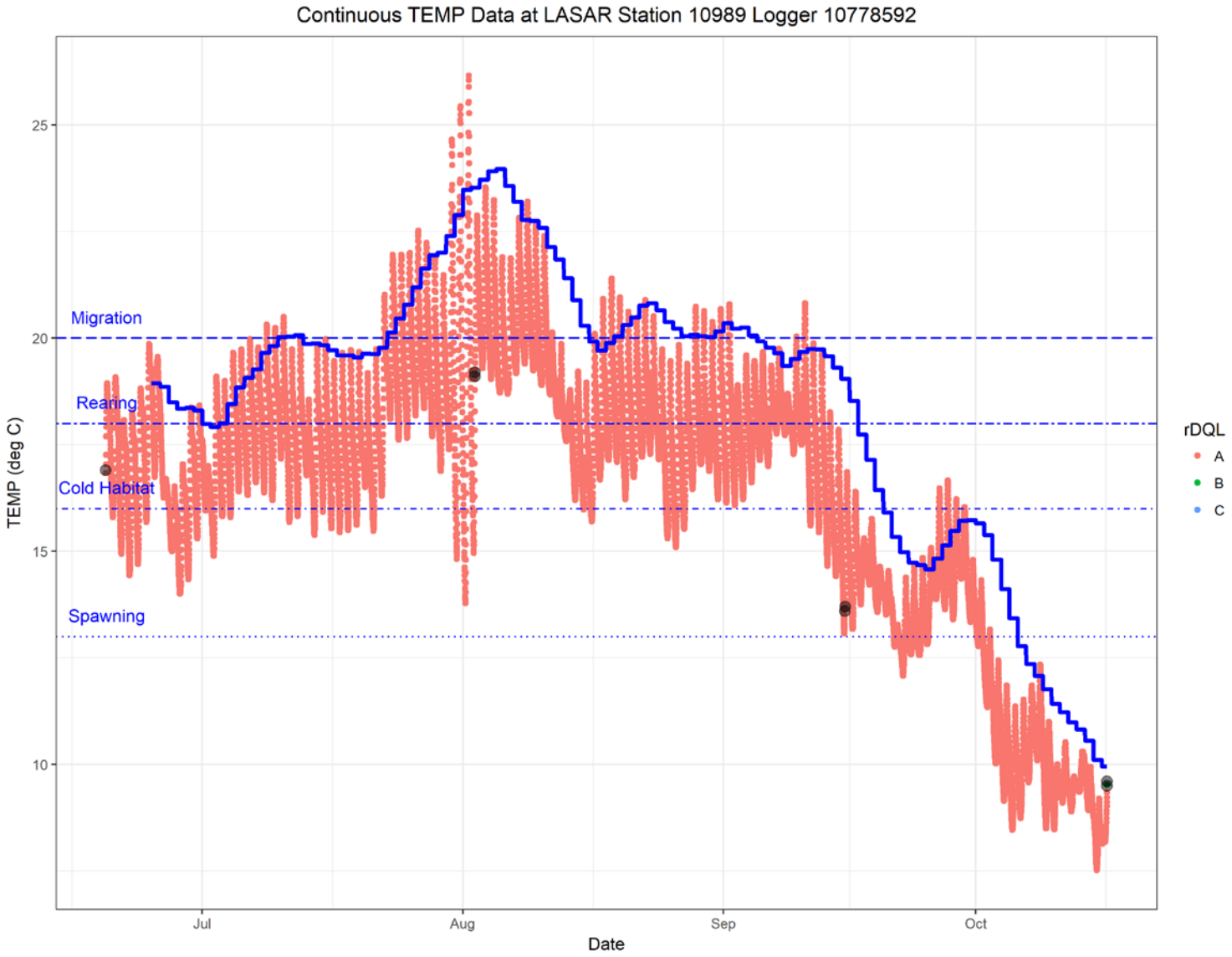

Continuous TEMP Data at LASAR Station 10989 Logger 10778592
TEMP (deg C)
25
20
15
10
Migration
Rearing
Cold Habitat
Spawning
Jul
Aug
Sep
Oct
Date
rDQL
A
B
C

FIGURE 7

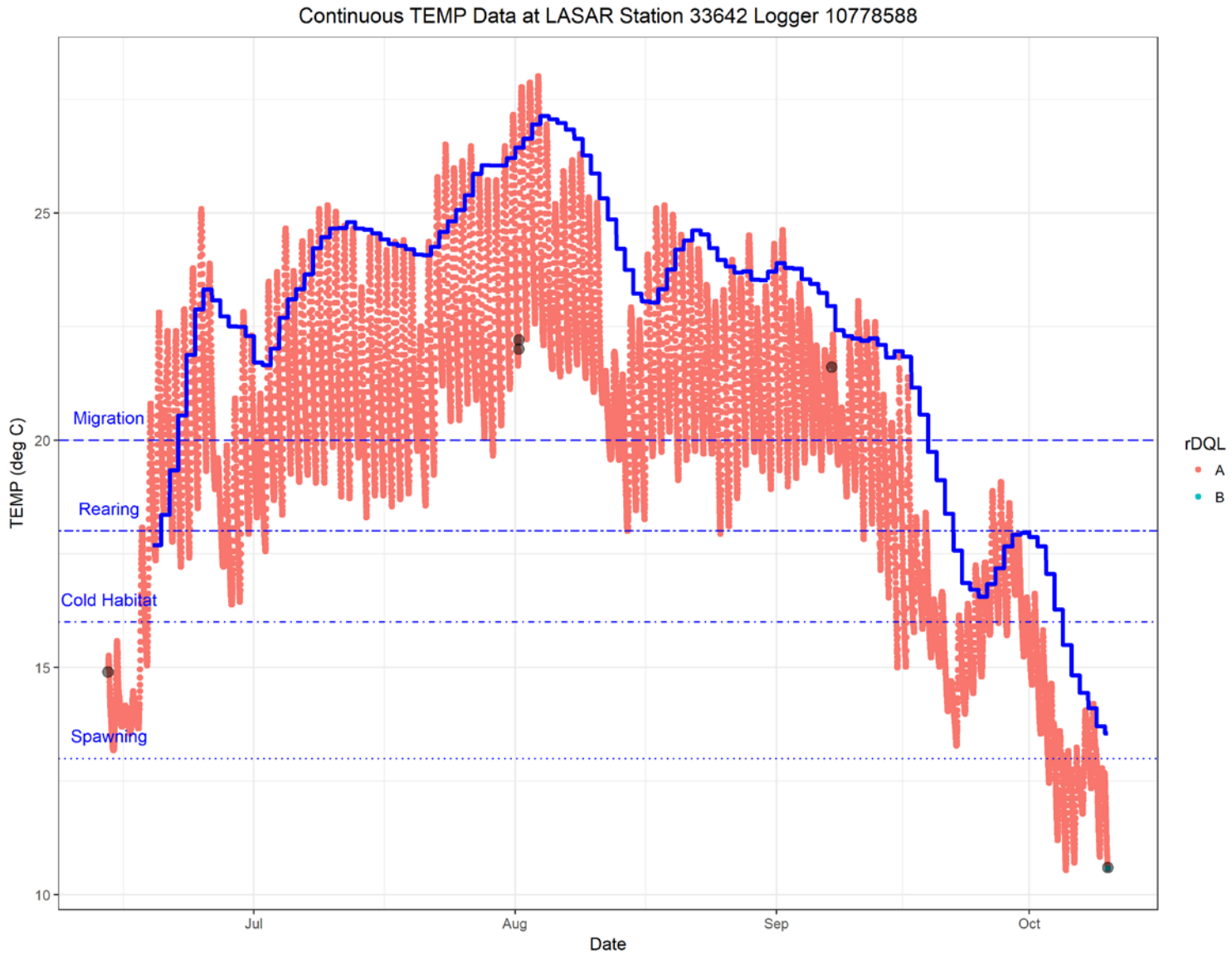

Continuous TEMP Data at LASAR Station 33642 Logger 10778588
TEMP (deg C)
25
20
15
10
Migration
Rearing
Cold Habitat
Spawning
Jul
Aug
Sep
Oct
Date
rDQL
A
B

FIGURE 8

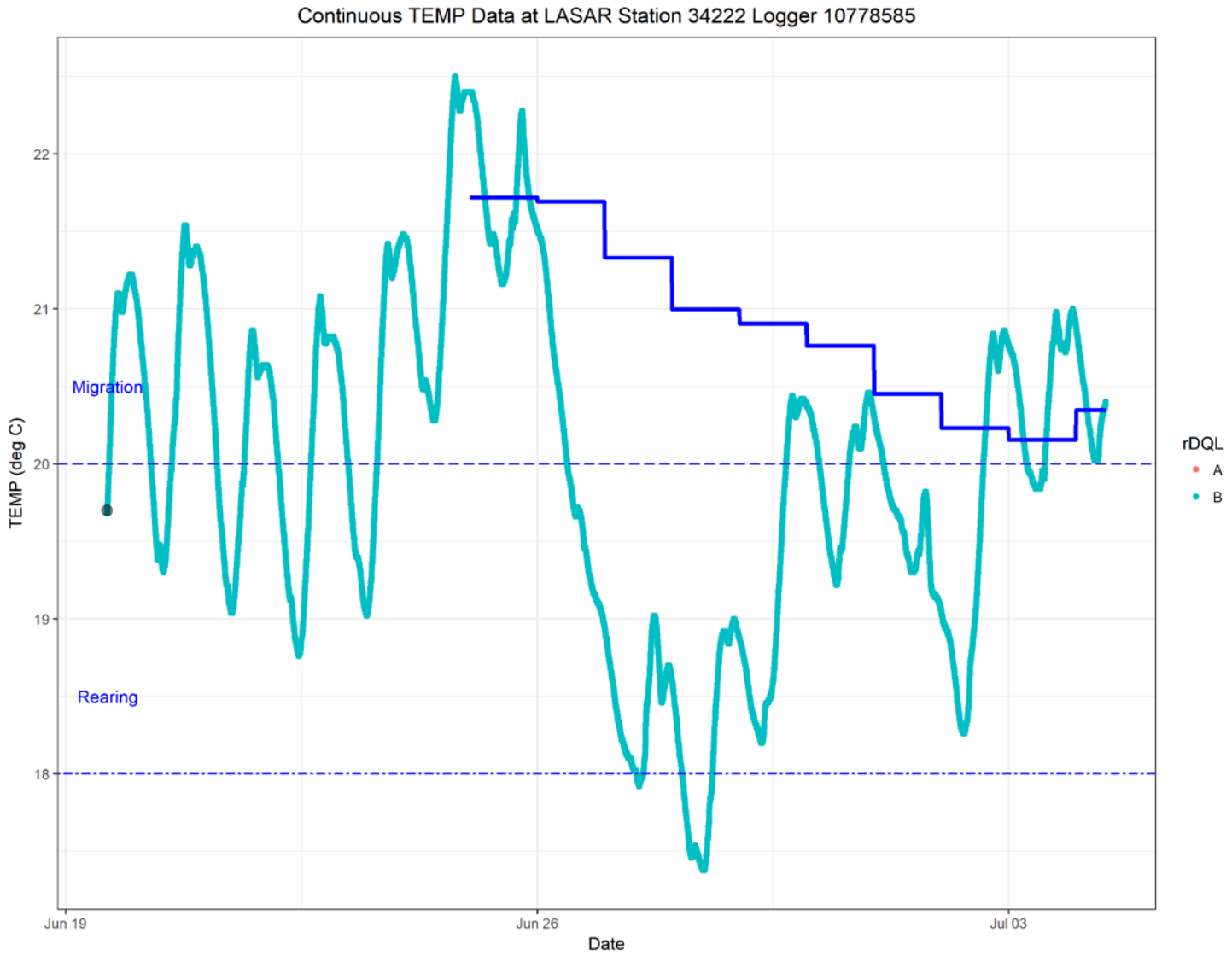

Continuous TEMP Data at LASAR Station 34222 Logger 10778585
TEMP (deg C)
22
21
20
19
18
Migration
Rearing
Jun 19
Jun 26
Jul 03
Date
rDQL
A
B

FIGURE 9

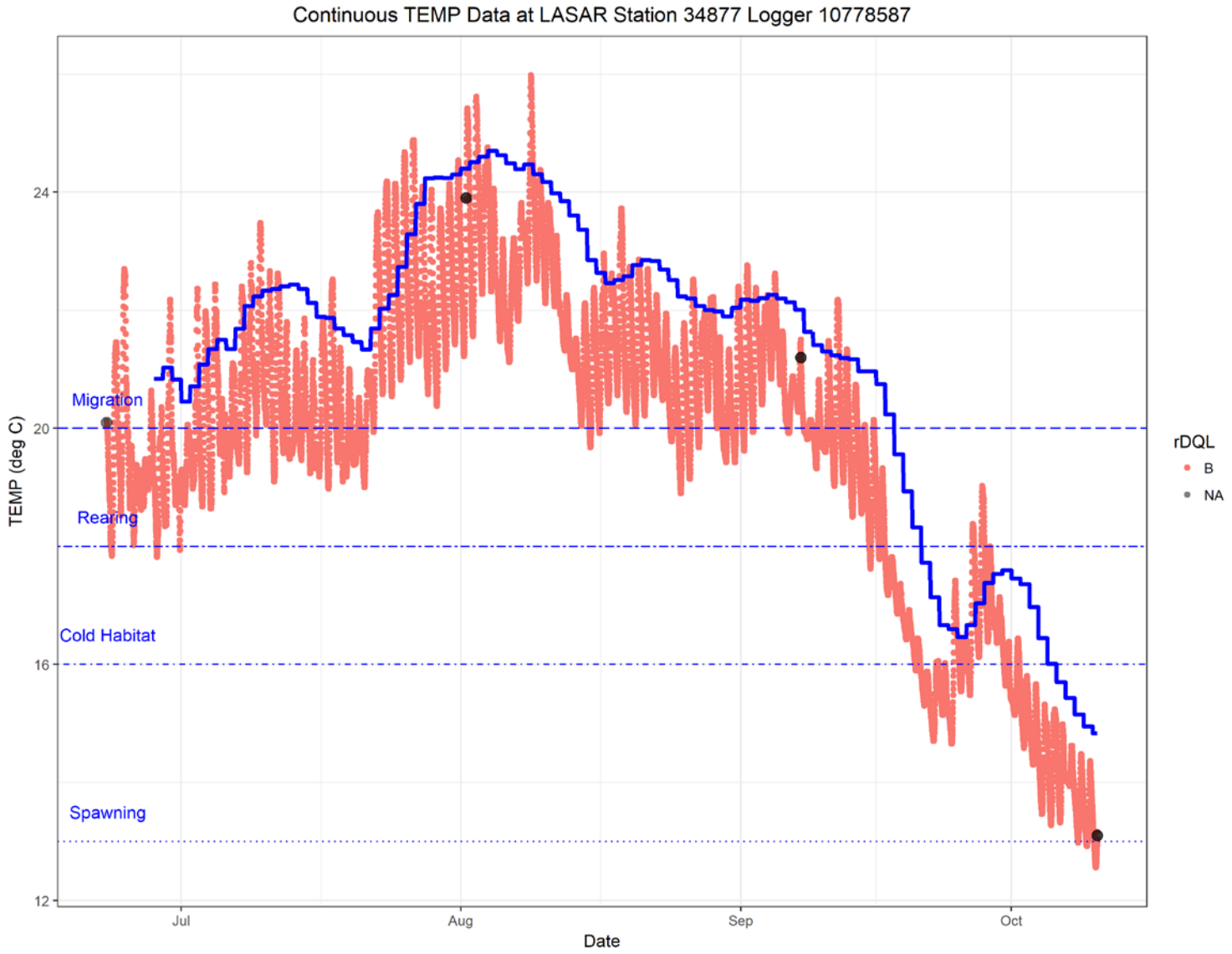

Continuous TEMP Data at LASAR Station 34877 Logger 10778587
TEMP (deg C)
24
20
16
12
Migration
Rearing
Cold Habitat
Spawning
Jul
Aug
Sep
Oct
Date
rDQL
B
NA

FIGURE 10

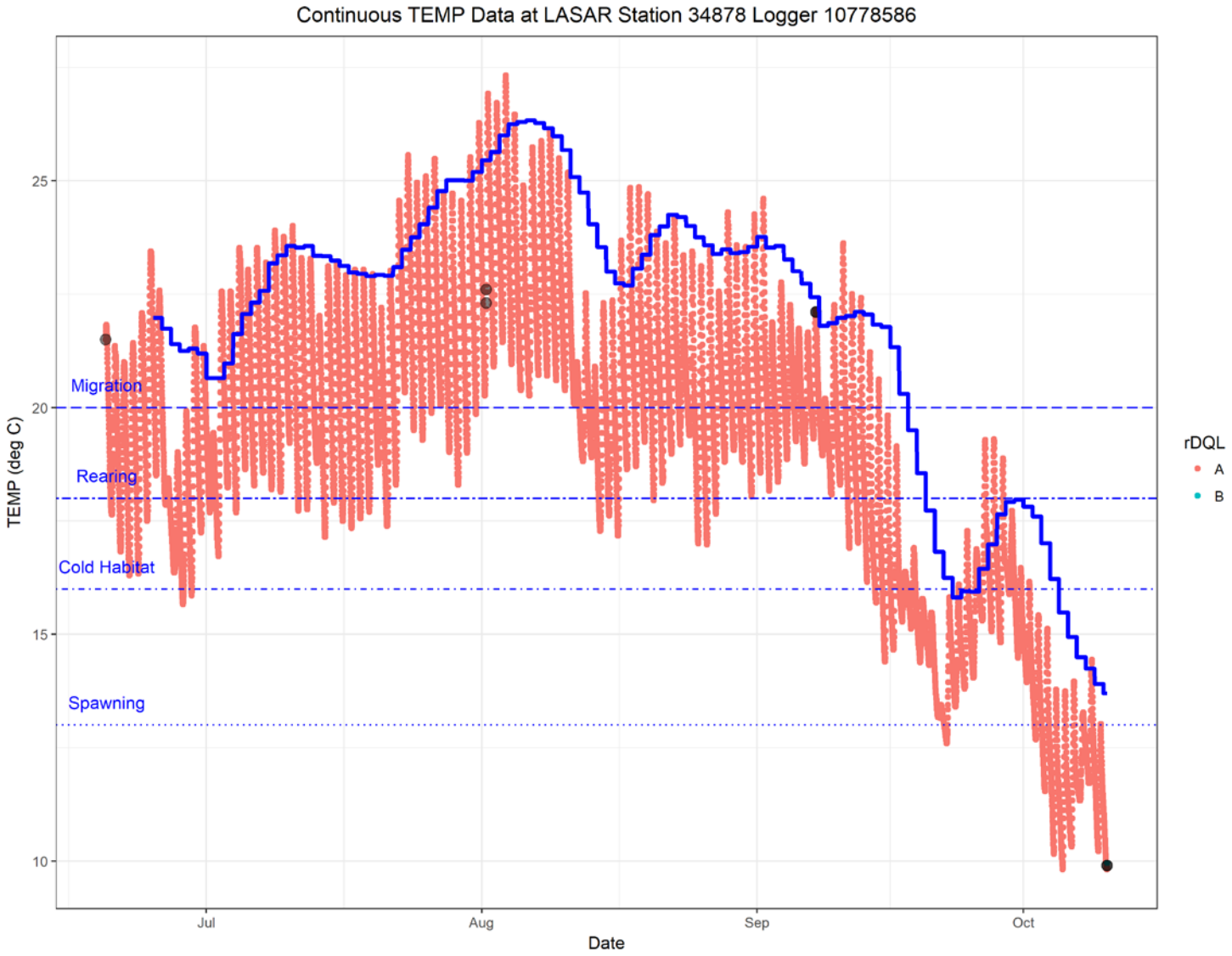

Continuous TEMP Data at LASAR Station 34878 Logger 10778586
TEMP (deg C)
25
20
15
10
Migration
Rearing
Cold Habitat
Spawning
Jul
Aug
Sep
Oct
Date
rDQL
A
B

FIGURE 11

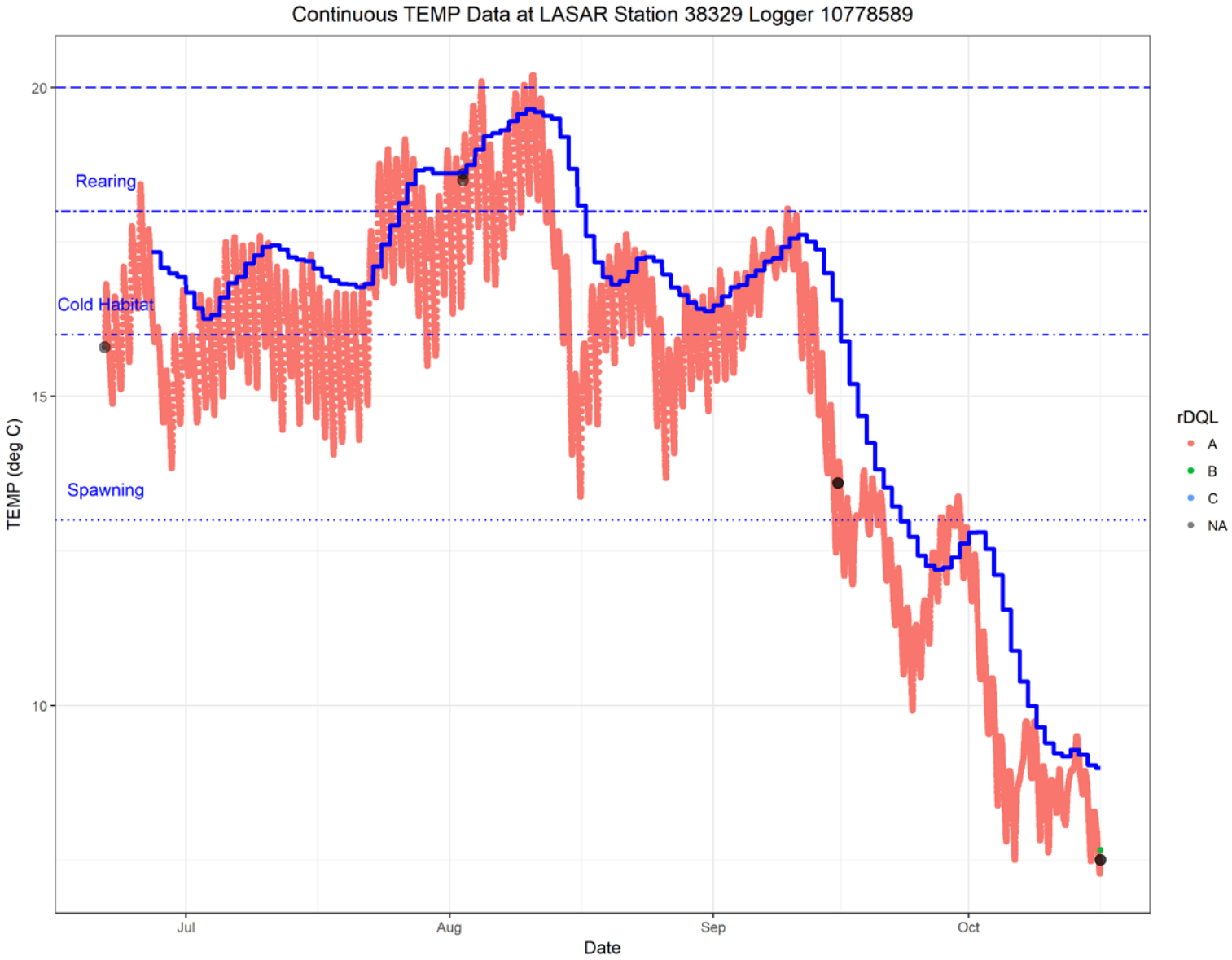
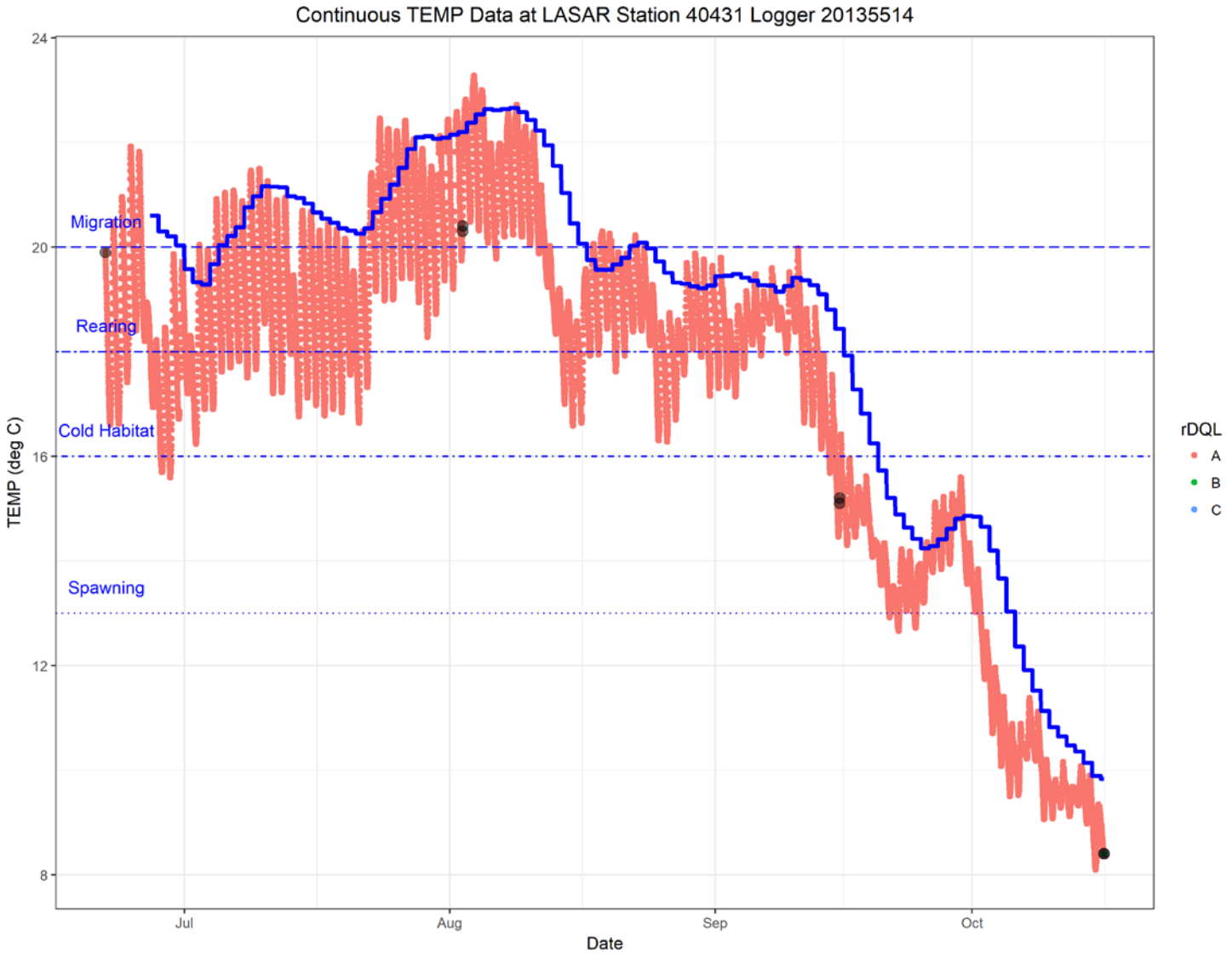

Continuous TEMP Data at LASAR Station 38329 Logger 10778589
20
15
10
Rearing
Cold Habitat
Spawning
TEMP (deg C)
Jul
Aug
Sep
Oct
Date
rDQL
A
B
C
NA

FIGURE 12


Continuous TEMP Data at LASAR Station 40431 Logger 20135514
TEMP (deg C)
24
20
16
12
8
Migration
Rearing
Cold Habitat
Spawning
Jul
Aug
Sep
Oct
Date
rDQL
A
B
C

Dissolved Oxygen

TABLE 2

Water Body/SWC ID	Logger Location, LASAR ID	Pollutant, season, criteria	Deployment Period	2017 Logger Data
Siuslaw River Mile 26.3 SWC ID TWS	Siuslaw River upstream of Tide Wayside, 33642	Dissolved Oxygen Rearing: June 1 – September 14 DEQ criteria – 30-day mean minimum not less than 8.0 mg/l or 90% of saturation See appendix A, Oregon Administrative Rules	8/1/2017 to 10/16/2017	Data currently being processed by DEQ VWQMP laboratory (see figures 13-20) [1] Cat 5 303(d) listed
Siuslaw River Mile 32 SWC ID SAB	Siuslaw River above Barber Creek, 34222		6/19/2017 to 7/4/2017	Data still being processed by DEQ laboratory (see figures 13-20)
Siuslaw River Mile 52 SWC ID SBW	Siuslaw River below Wolf Creek, 40431		6/21/2017 to 10/16/2017	Data still being processed by DEQ laboratory (see figures 13-20) Cat 5 303(d) listed
Siuslaw River Mile 105 SWC ID SAF	Siuslaw River below confluence of North and South Forks, 38329		6/21/2017 to 10/16/2017	Data still being processed by DEQ laboratory (see figures 13-20) Cat 5 303(d) listed
Lake Creek RM 2.5 SWC ID: SIT	Lake Creek above confluence with Indian Creek, 34878		6/21/2017 to 10/16/2017	Data still being processed by DEQ laboratory (see figures 13-20) Cat 5 303(d) listed

[1] Final data validation and upload to AWQMS estimated in Fall 2019

Lake Creek Mile 29.8 SWC ID: LAL	Lake Creek below Hult Log Pond, 34877		6/22/2017 to 10/10/2017	Data still being processed by DEQ laboratory (see figures 13-20) Cat 5 303(d) listed
Wildcat Creek SWC ID WCS	Wildcat Creek 100 meters upstream of Siuslaw, 10989	Dissolved Oxygen Spawning: October 15 – May 15 DEQ criteria – 30-day mean minimum not less than 11.0 mg/l or 95% of saturation	6/19/2107 to 10/16/2017 *Wildcat Creek is not on 303 (d) list during the rearing season.	Data still being processed by DEQ laboratory (see figures 13-20) Cat 5 303(d) listed *The logger at this site was repeatedly tampered with during the deployment and SWC is working with DEQ to determine what data can be used. At this point, the 2017 data at LASAR 10989 should be regarded as unverified, not graded.

FIGURE 13

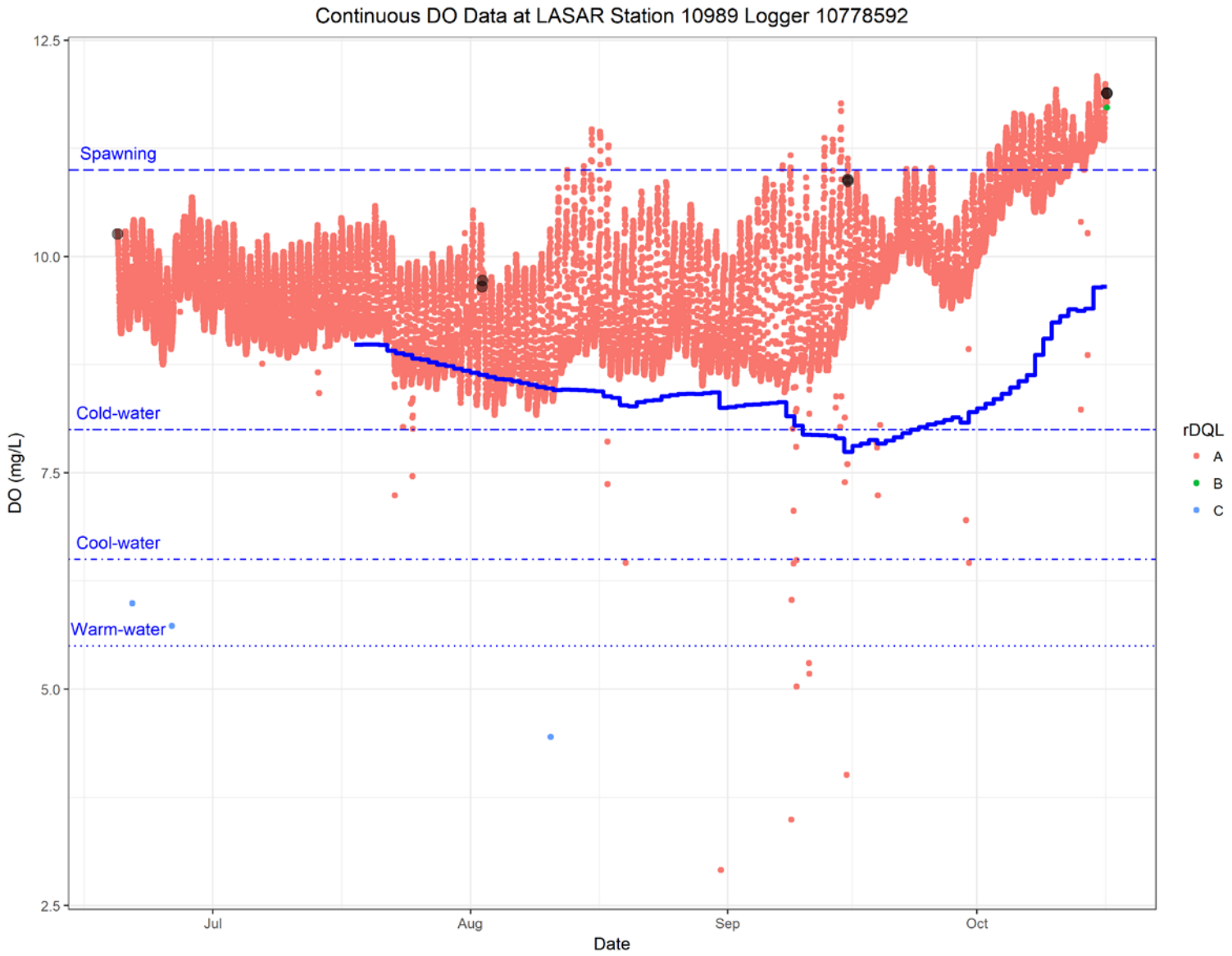

Continuous DO Data at LASAR Station 10989 Logger 10778592
12.5
10.0
7.5
5.0
2.5
DO (mg/L)
Spawning
Cold-water
Cool-water
Warm-water
Jul
Aug
Sep
Oct
Date
rDQL
A
B
C

FIGURE 14

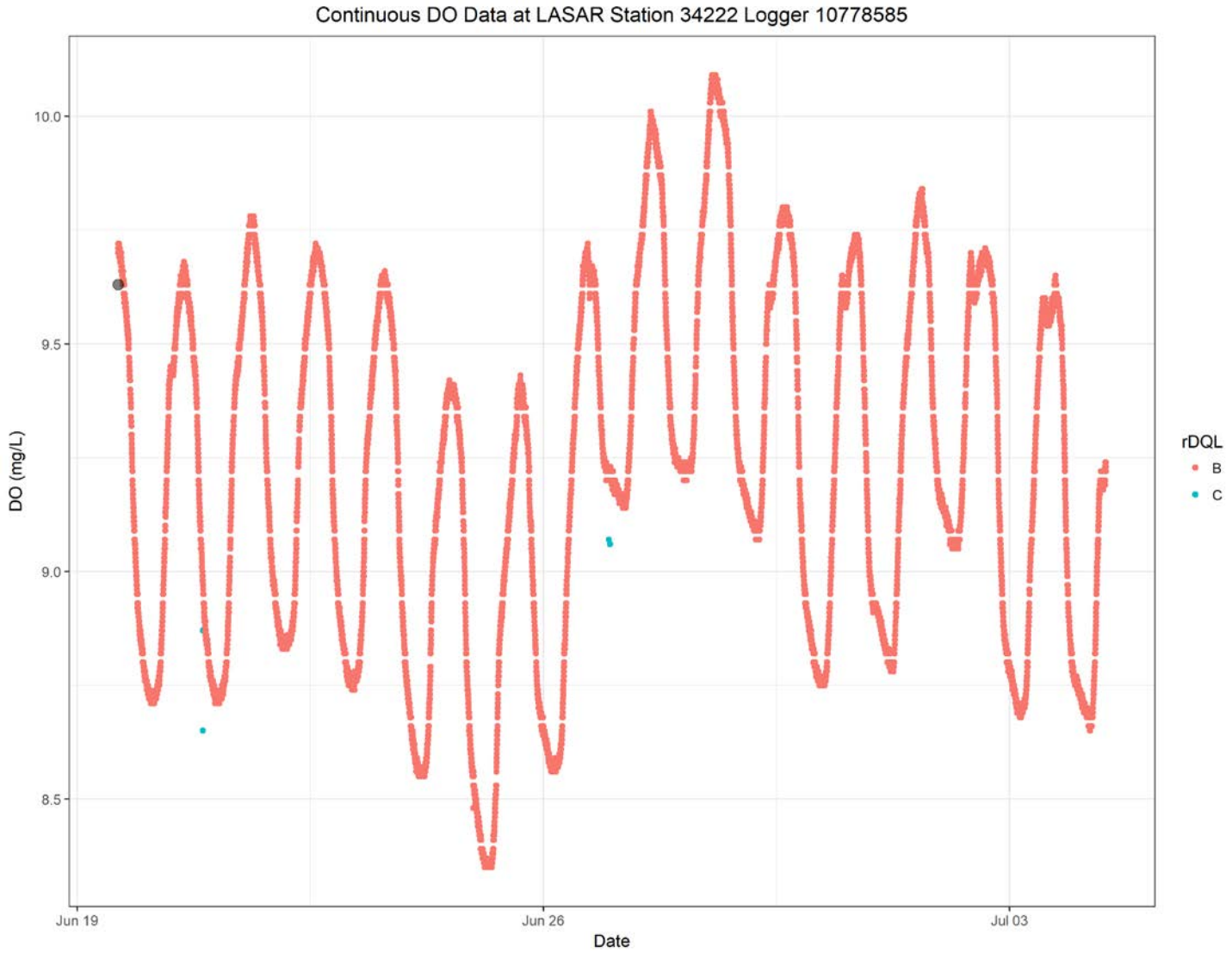

Continuous DO Data at LASAR Station 34222 Logger 10778585
10.0
9.5
9.0
8.5
DO (mg/L)
Jun 19
Jun 26
Jul 03
Date
rDQL
B
C

FIGURE 15

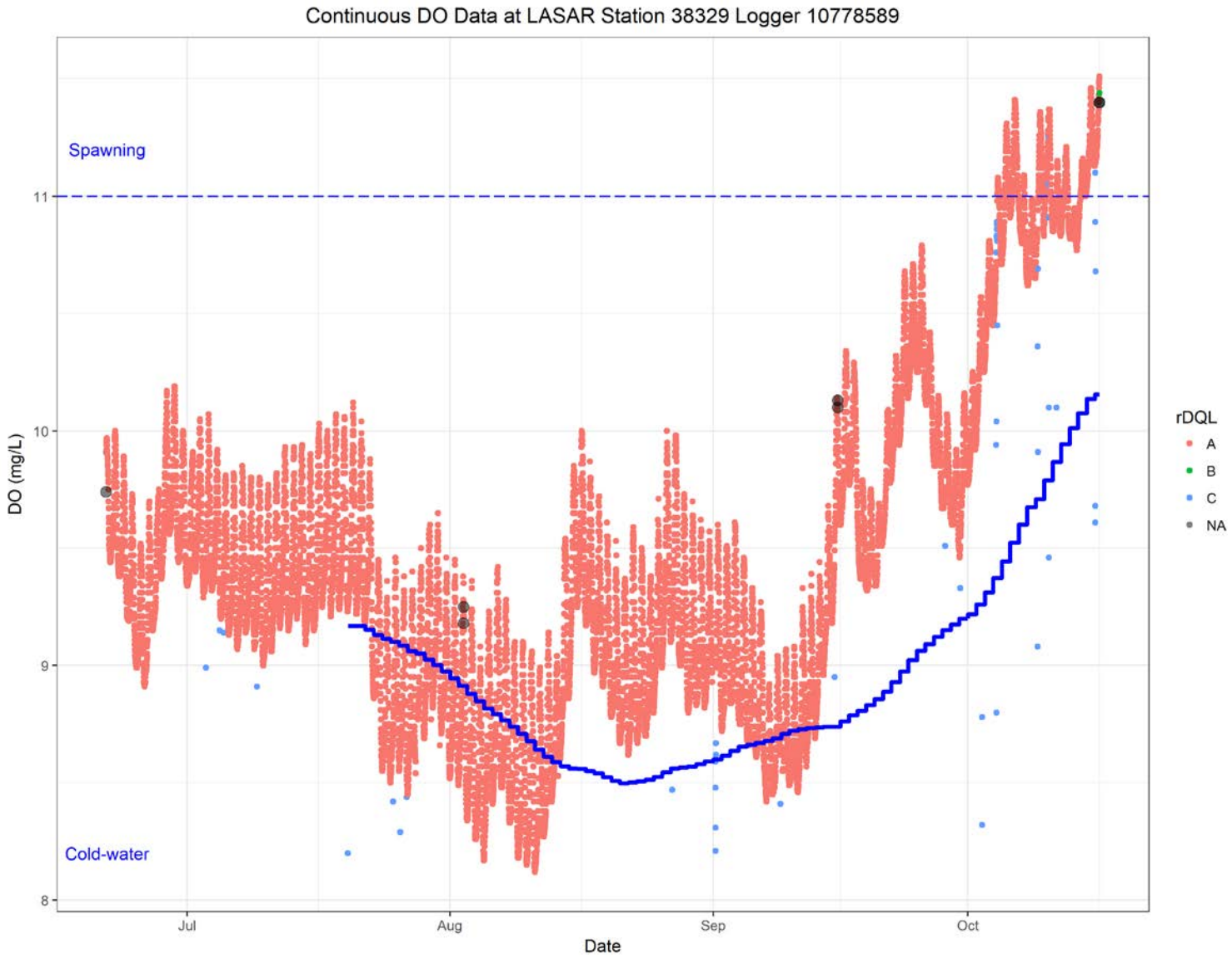

Continuous DO Data at LASAR Station 38329 Logger 10778589
Spawning
Cold-water
DO (mg/L)
11
10
9
8
Jul
Aug
Sep
Oct
Date
rDQL
A
B
C
NA

FIGURE 16

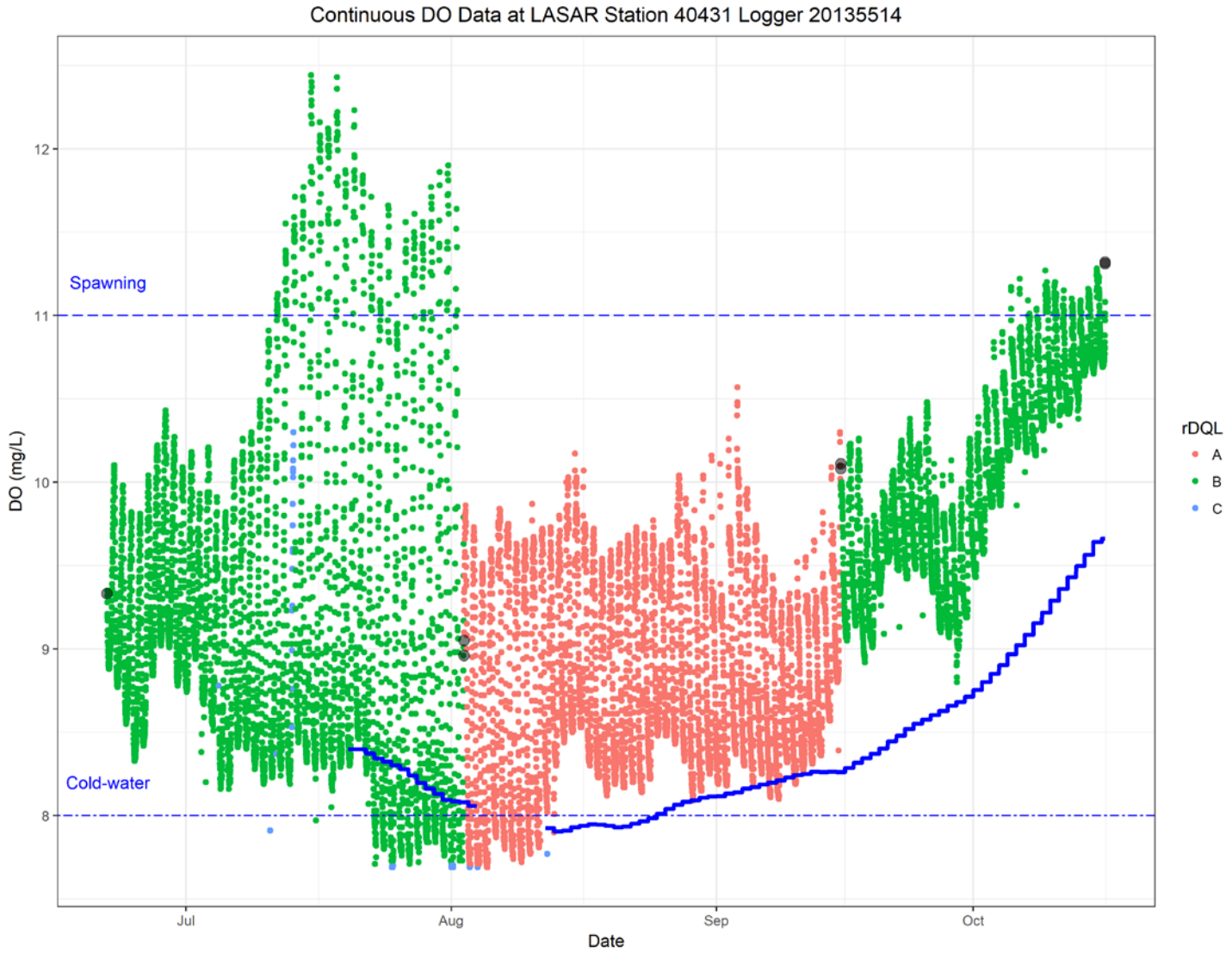

Continuous DO Data at LASAR Station 40431 Logger 20135514
DO (mg/L)
12
11
10
9
8
Spawning
Cold-water
Jul
Aug
Sep
Oct
Date
rDQL
A
B
C

FIGURE 17

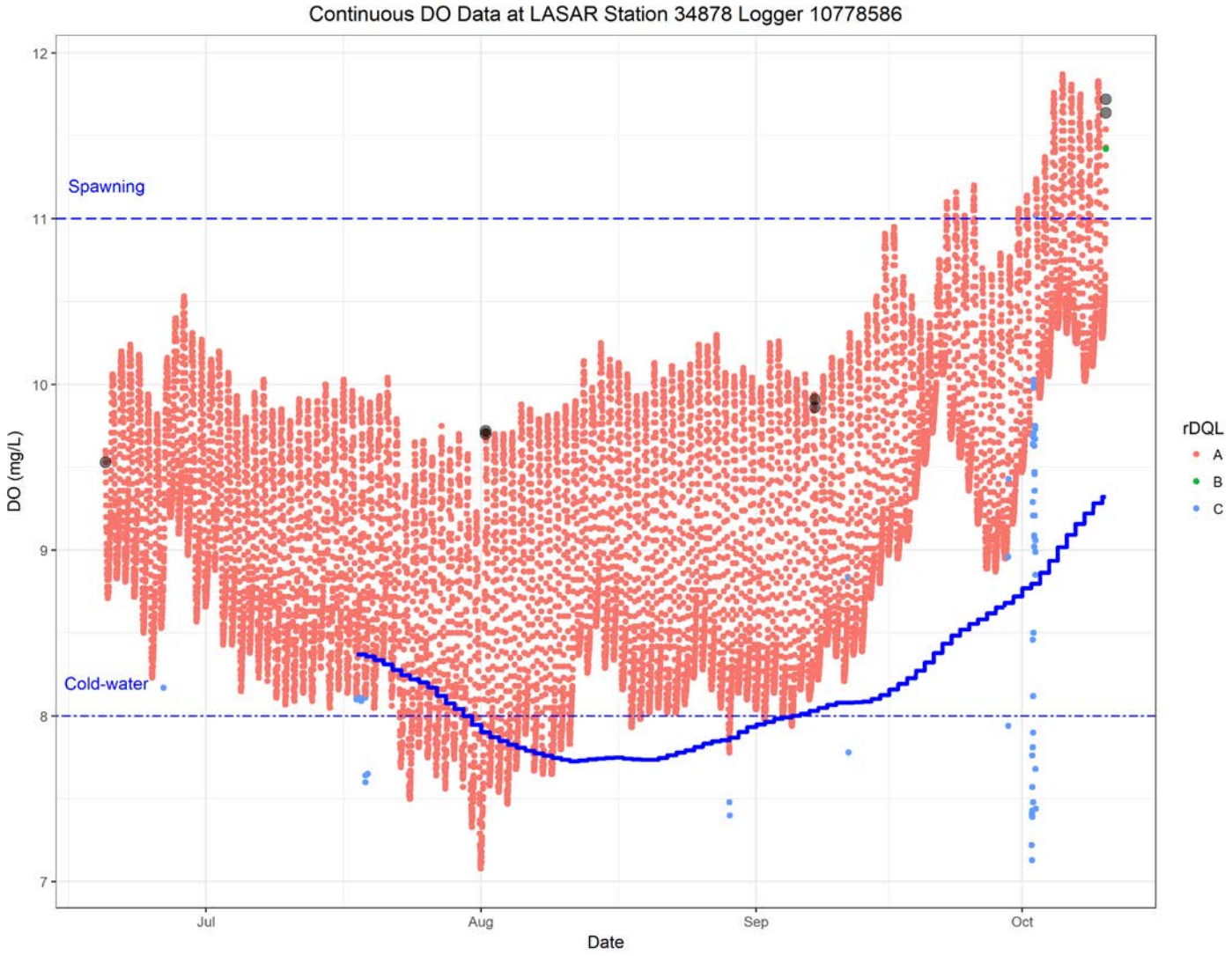

Continuous DO Data at LASAR Station 34878 Logger 10778586
Spawning
Cold-water
DO (mg/L)
12
11
10
9
8
7
Jul
Aug
Sep
Oct
Date
rDQL
A
B
C

FIGURE 18

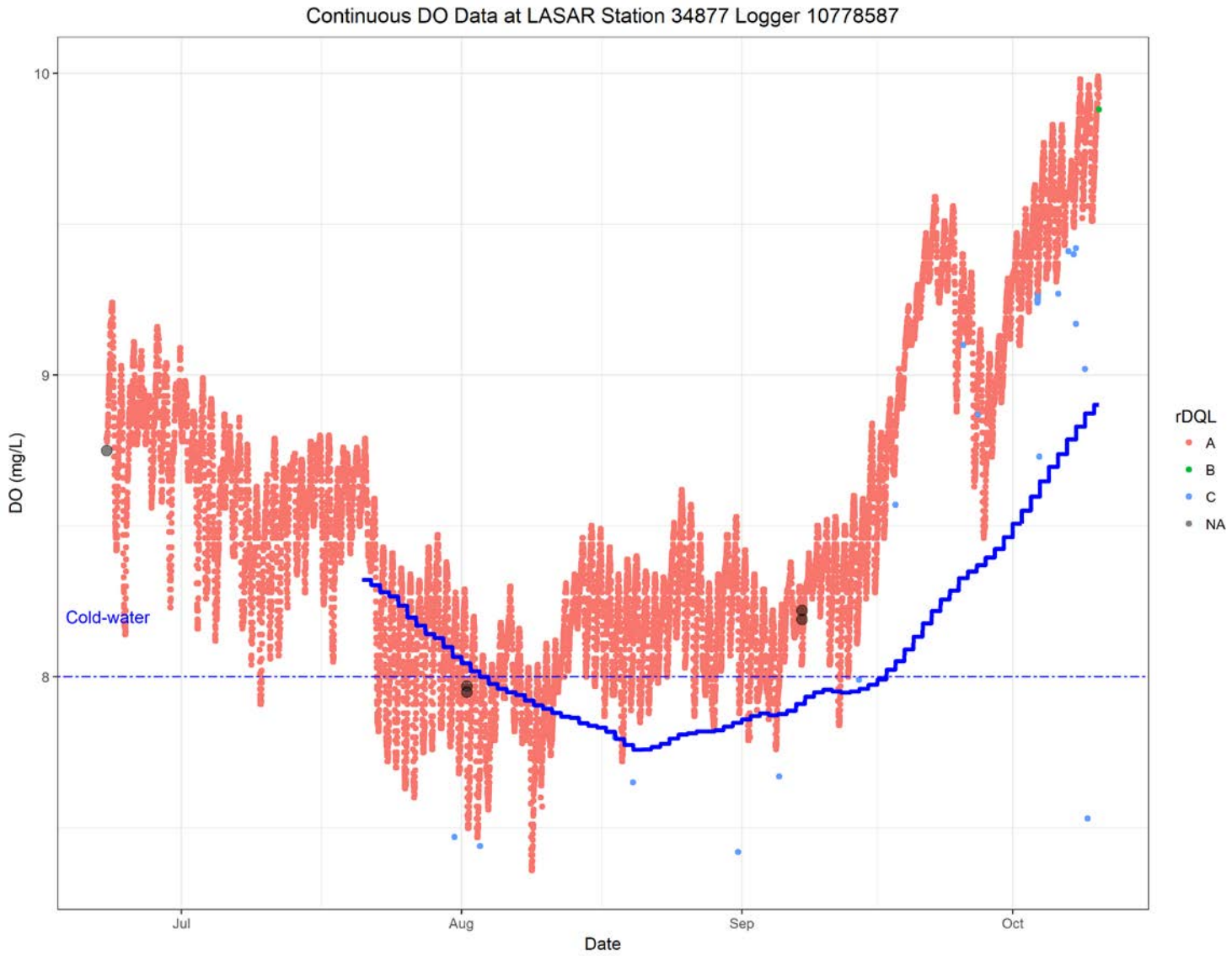

Continuous DO Data at LASAR Station 34877 Logger 10778587
DO (mg/L)
10
9
8
Cold-water
Jul
Aug
Sep
Oct
Date
rDQL
A
B
C
NA

FIGURE 19

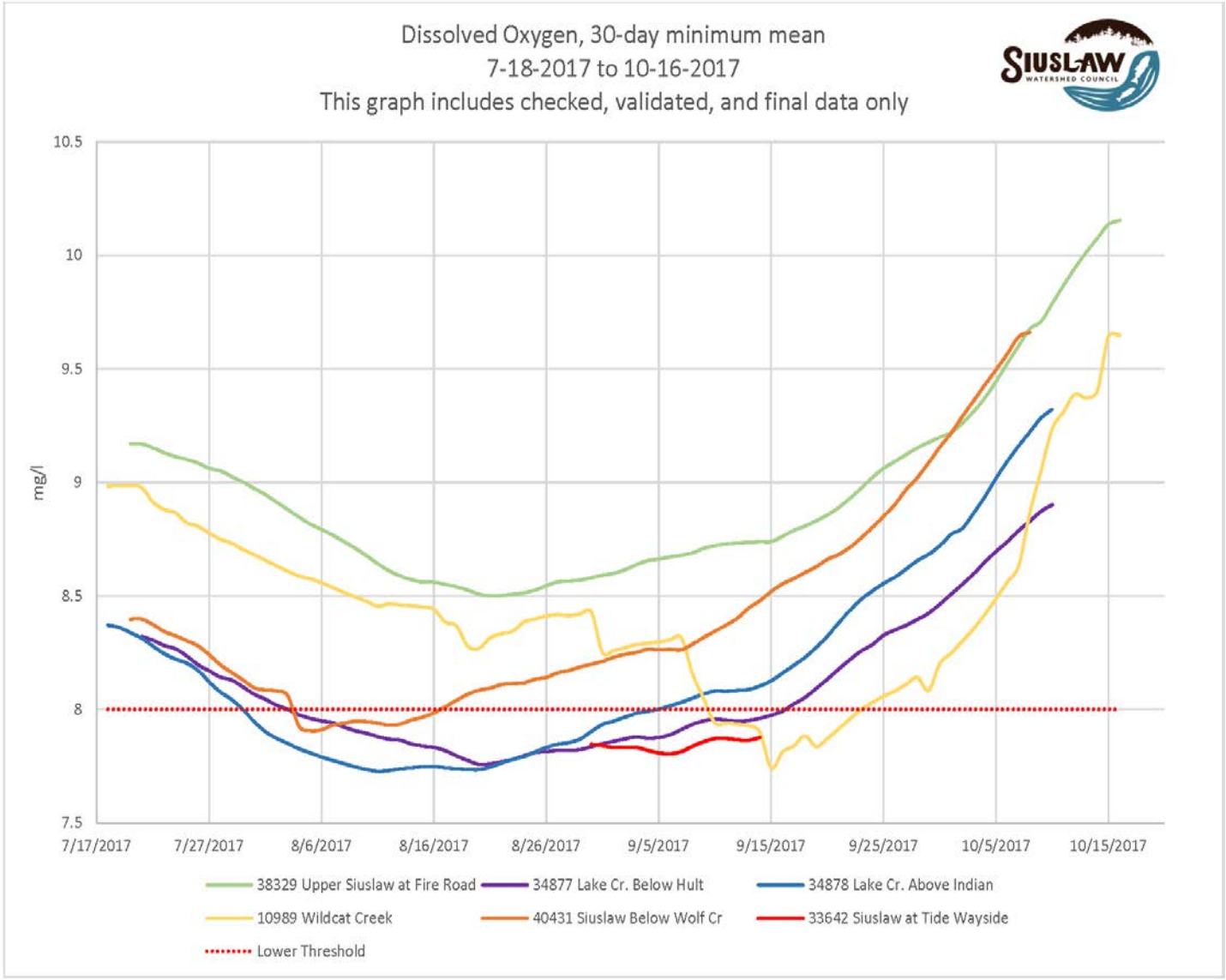
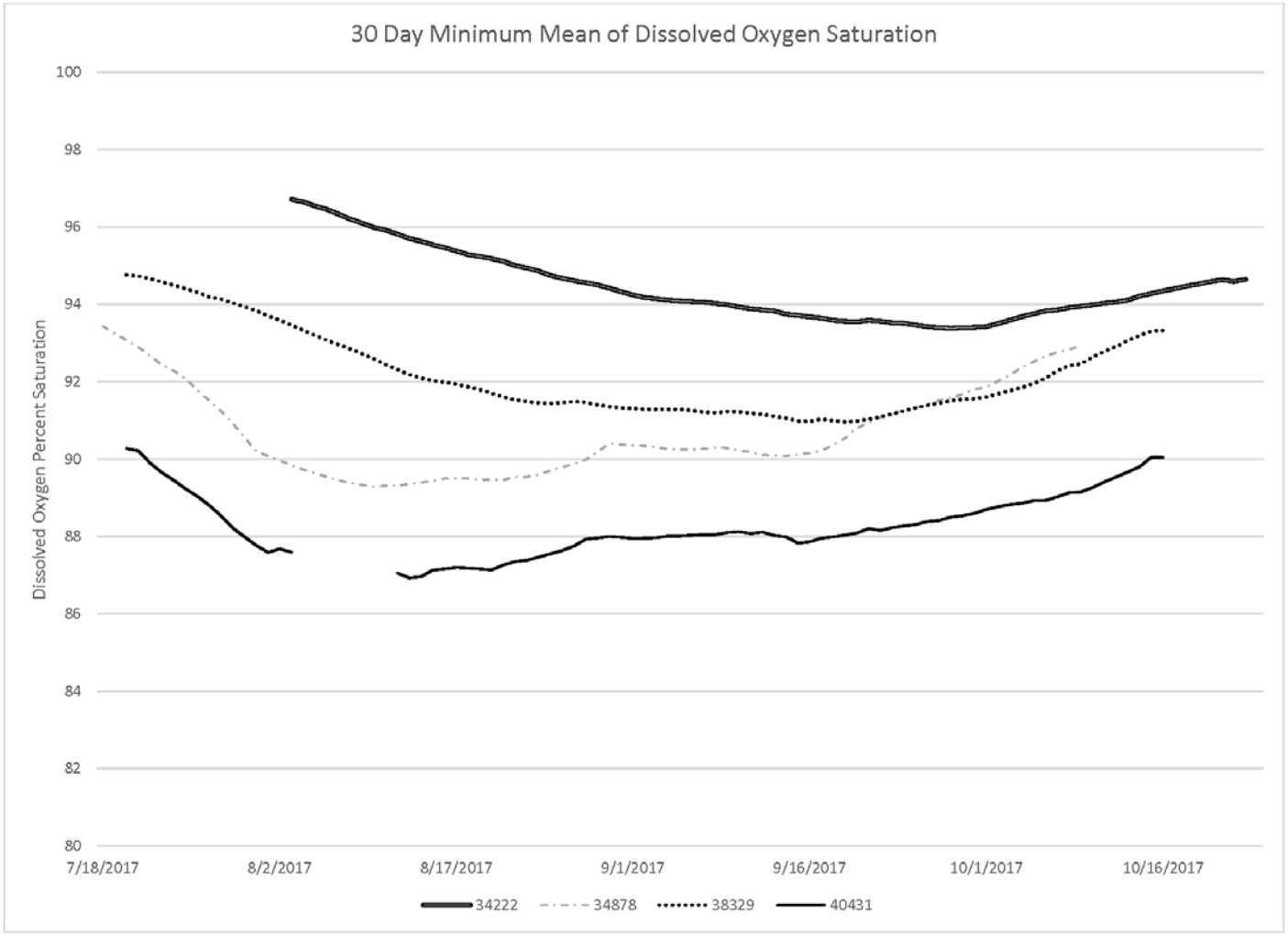
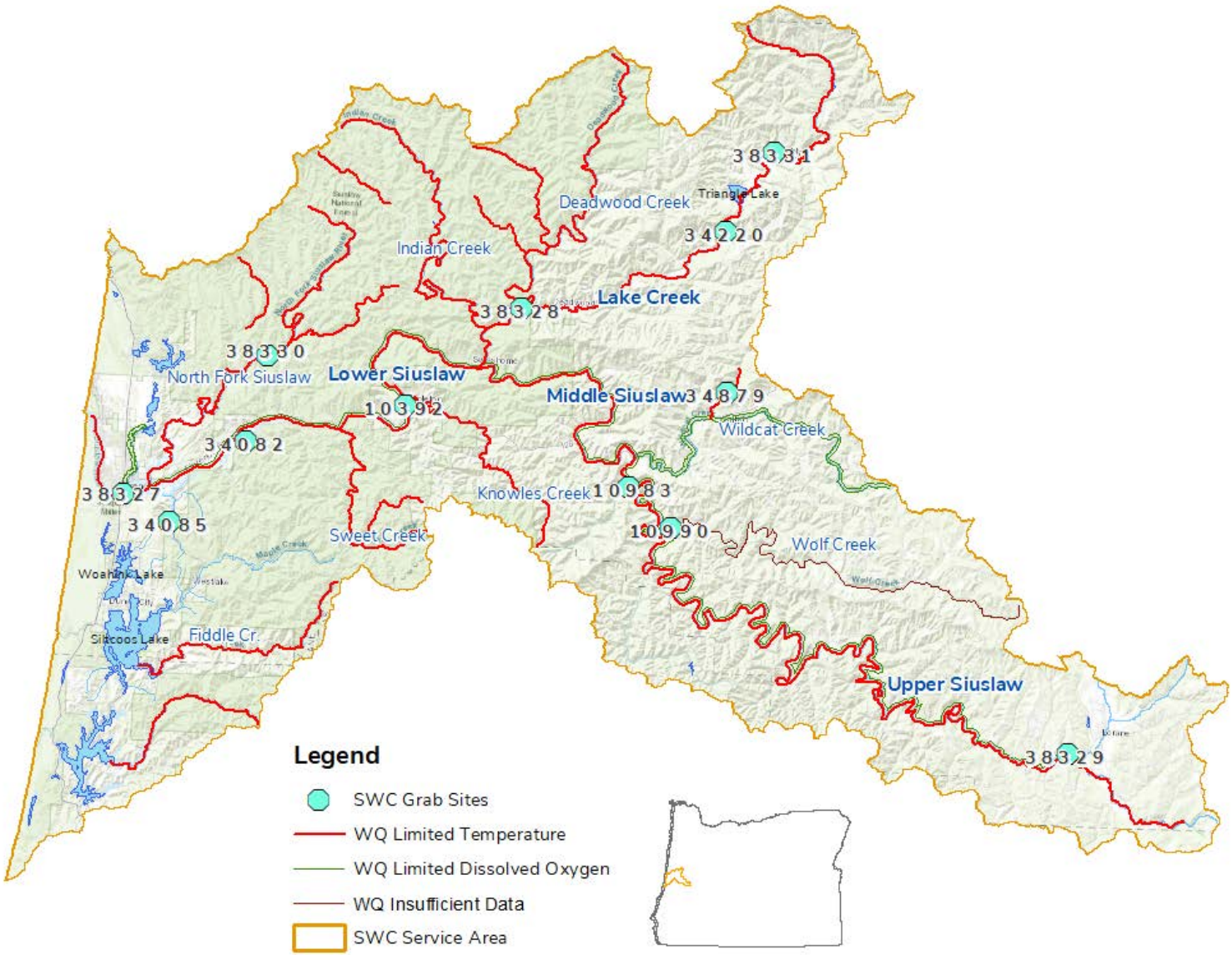

Dissolved Oxygen, 30-day minimum mean
7-18-2017 to 10-16-2017
This graph includes checked, validated, and final data only
SIUSLAW WATERSHED COUNCIL
mg/l
10.5
10
9.5
9
8.5
8
7.5
7/17/2017
7/27/2017
8/6/2017
8/16/2017
8/26/2017
9/5/2017
9/15/2017
9/25/2017
10/5/2017
10/15/2017
38329 Upper Siuslaw at Fire Road
34877 Lake Cr. Below Hult
34878 Lake Cr. Above Indian
10989 Wildcat Creek
40431 Siuslaw Below Wolf Cr
33642 Siuslaw at Tide Wayside
Lower Threshold

FIGURE 20


30 Day Minimum Mean of Dissolved Oxygen Saturation
Dissolved Oxygen Percent Saturation
100
98
96
94
92
90
88
86
84
82
80
7/18/2017
8/2/2017
8/17/2017
9/1/2017
9/16/2017
10/1/2017
10/16/2017
34222
34878
38329
40431


38331
Deadwood Creek
Triangle Lake
34220
Indian Creek
Lake Creek
38328
38330
North Fork Siuslaw
Lower Siuslaw
Middle Siuslaw
34879
10392
Wildcat Creek
34082
38327
Knowles Creek
10983
34085
Sweet Creek
10990
Wolf Creek
Woahink Lake
Siltcoos Lake
Fiddle Cr.
Upper Siuslaw
38329
Legend
SWC Grab Sites
WQ Limited Temperature
WQ Limited Dissolved Oxygen
WQ Insufficient Data
SWC Service Area

Grab Sample Results

The following figures were created to better understand the issues described in the monitoring design for this program. Graphs of each site by parameter for the 2017 season are included in Appendix D. In addition to gathering baseline data and monitoring for trends, we wanted to answer specific questions:

- Are there spatial or temporal patterns seen in the data?
- What are the baseline ambient water quality conditions at these sites?
- Are there any long term trends?
- How is the water quality different upstream and downstream of Triangle Lake?

Spatial and temporal patterns in the data

Turbidity

We saw turbidity follow precipitation patterns in all sites sampled during 2017, although not as strongly as in the 2016 dataset. Consistent with 2016 data, sites 38329 and 10983 measured the highest turbidity with the LO-16 site (LASAR 38329) measuring higher NTUs than any other sites in the Siuslaw and Lake Creek. The 2016 high at this site was in October, 131 NTUs; the highest 2017 measurement was 67.97 NTUs on February 21st. Additionally, conductivity measurements during our audits at this and other sites near the Upper Siuslaw forks confluence average 70 µS/cm while the rest of the watershed averages 40 µS/cm. Causes of high turbidity include: soil erosion, wastewater discharges, urban runoff, agricultural and forestry practices, eroding stream banks, and excessive algae growth. The mid-to-upper Siuslaw land use is predominantly industrial forestry. The checkerboard pattern of Bureau of Land Management and industrial timber company ownership fills most of this section of the Siuslaw watershed. Upstream from there, near the 38329 sites, agriculture is dominant, and the high turbidity at the 38329 site is likely due in part to practices associated with cattle production. (See Figure 26, Land Cover in the Siuslaw Watershed)

FIGURE 21

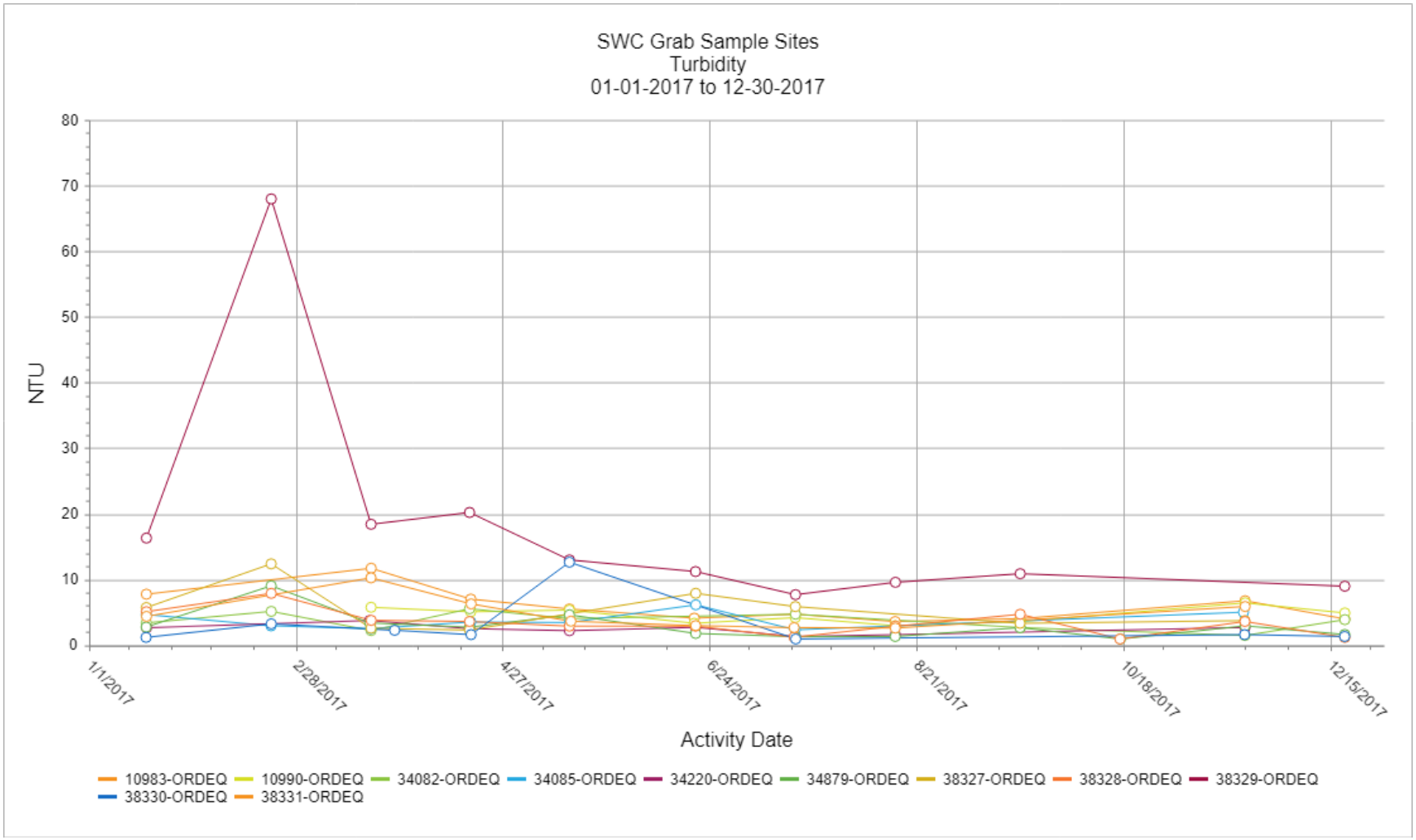
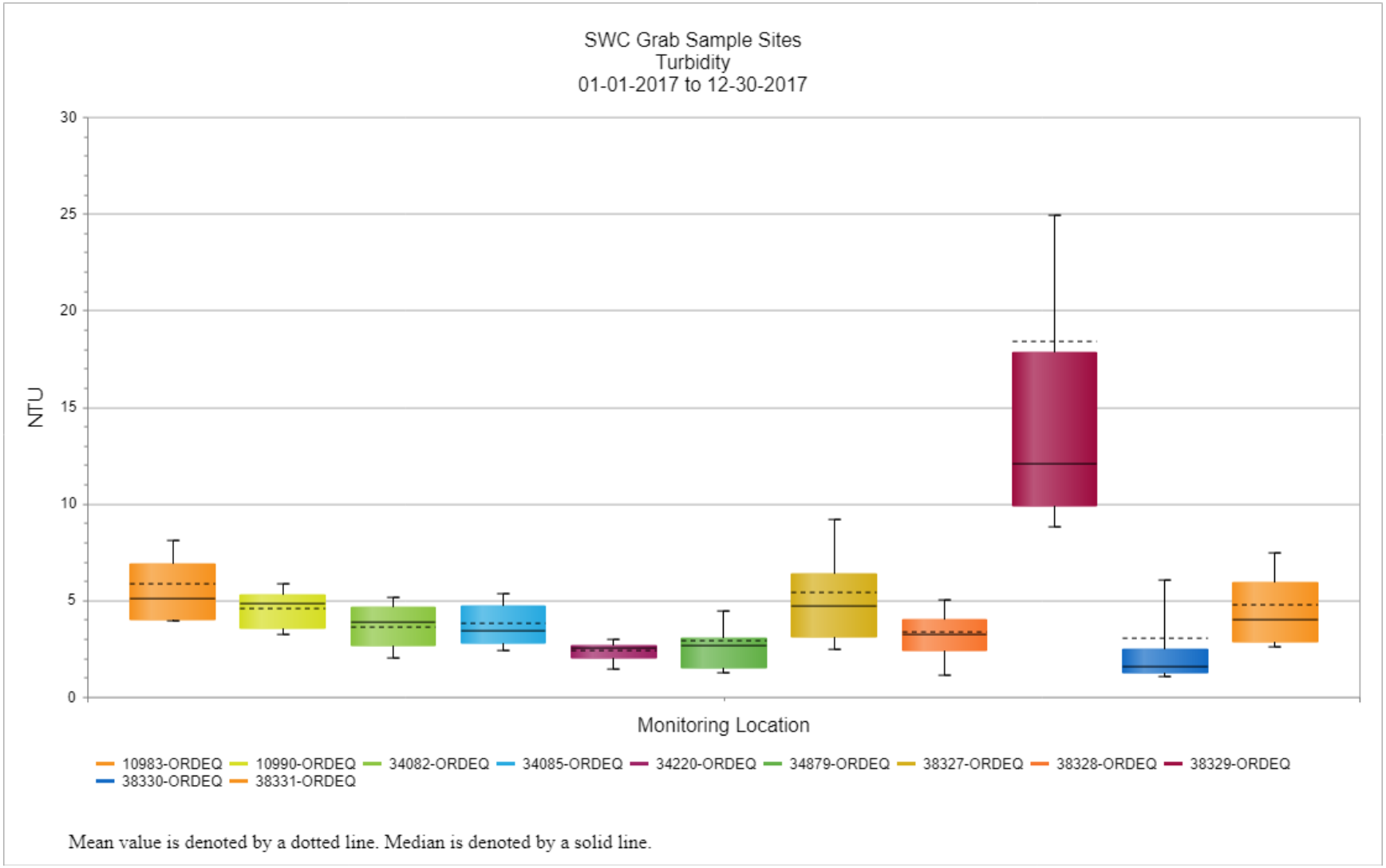
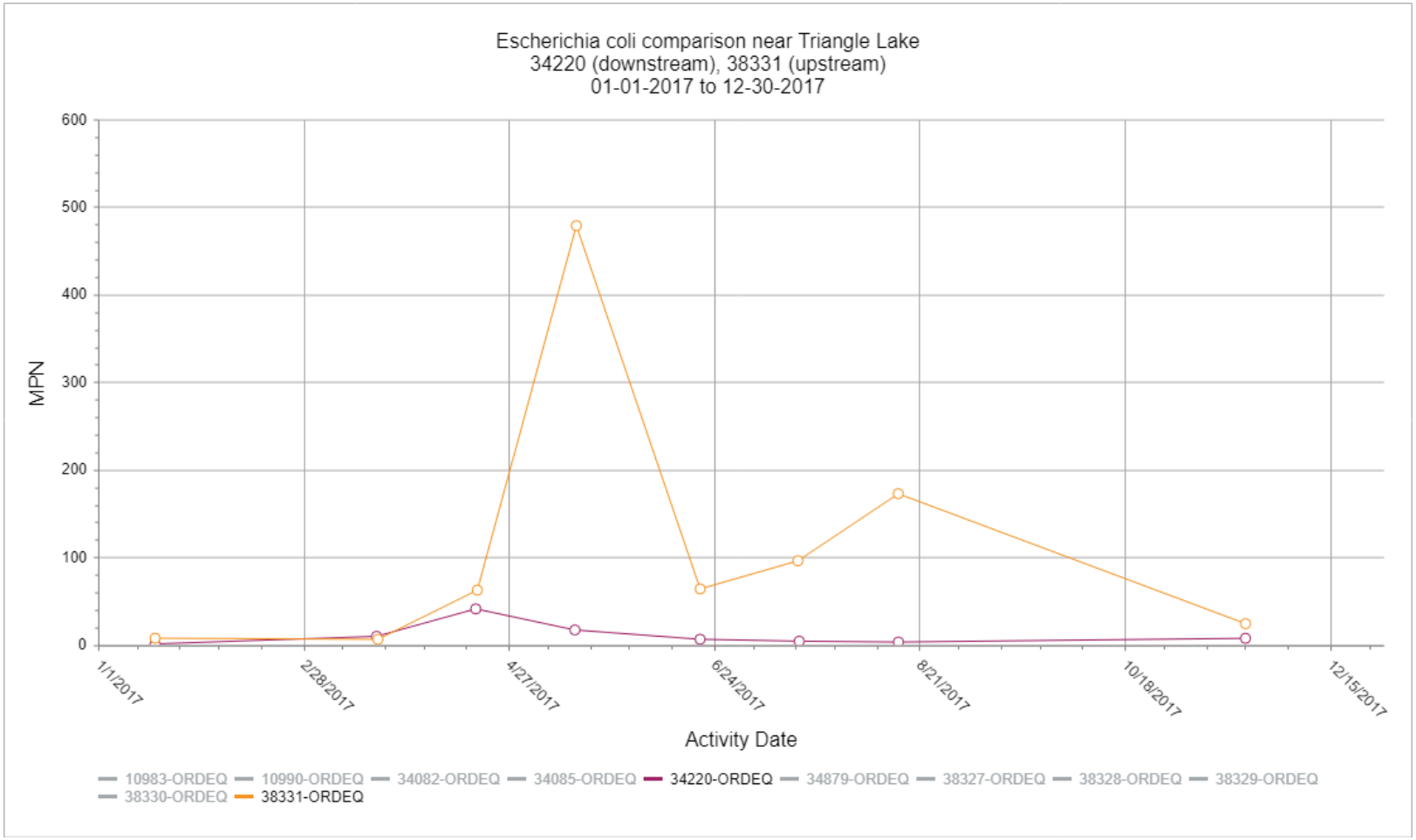

SWC Grab Sample Sites
Turbidity
01-01-2017 to 12-30-2017
NTU
80
70
60
50
40
30
20
10
0
1/1/2017
2/28/2017
4/27/2017
6/24/2017
8/21/2017
10/18/2017
12/15/2017
Activity Date
10983-ORDEQ
10990-ORDEQ
34082-ORDEQ
34085-ORDEQ
34220-ORDEQ
34879-ORDEQ
38327-ORDEQ
38328-ORDEQ
38329-ORDEQ
38330-ORDEQ
38331-ORDEQ

FIGURE 22


SWC Grab Sample Sites
Turbidity
01-01-2017 to 12-30-2017
NTU
30
25
20
15
10
5
0
Monitoring Location
10983-ORDEQ
10990-ORDEQ
34082-ORDEQ
34085-ORDEQ
34220-ORDEQ
34879-ORDEQ
38327-ORDEQ
38328-ORDEQ
38329-ORDEQ
38330-ORDEQ
38331-ORDEQ
Mean value is denoted by a dotted line. Median is denoted by a solid line.

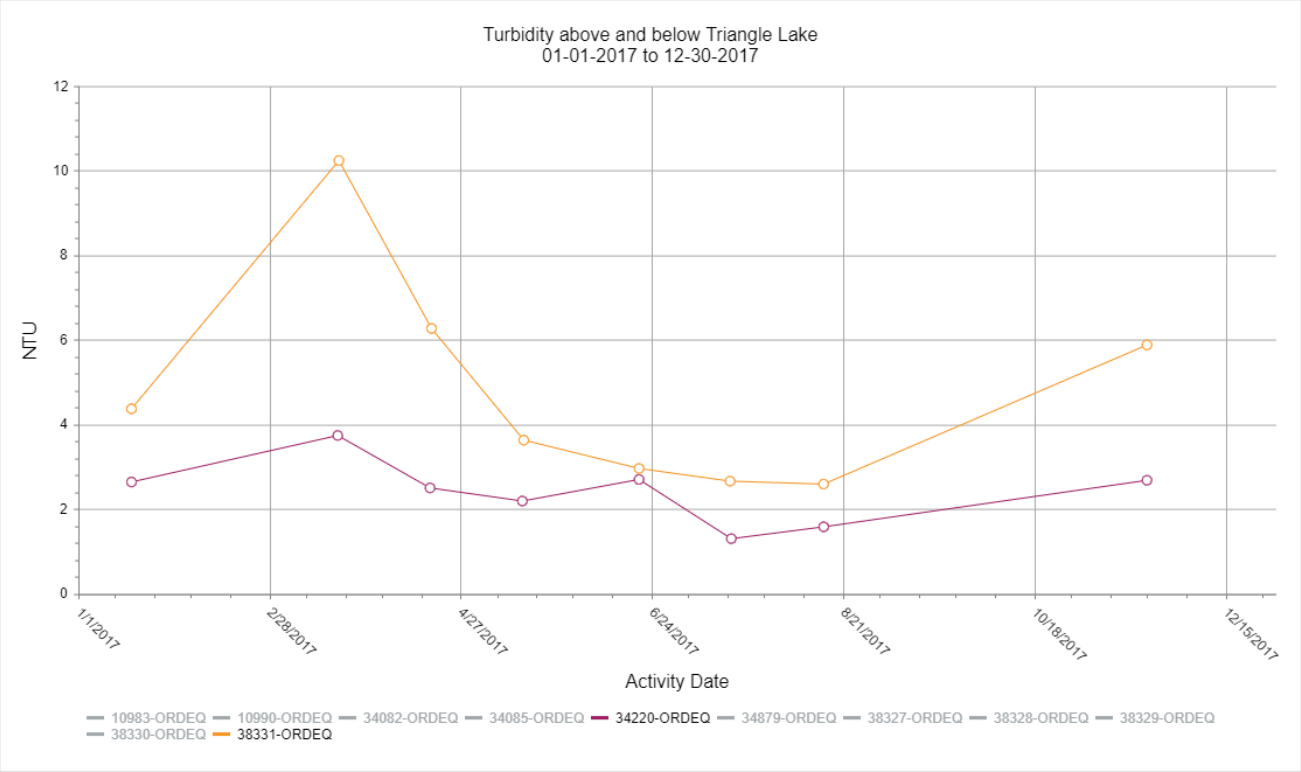
Above and below Triangle Lake

FIGURE 23



SWC established sites 38331 and 34220 upstream and downstream of Triangle Lake to explore the impact of the lake on water quality. The unincorporated community of the same name includes development on the southwest side of the 298-acre, natural lake which is popular for swimming, fishing, boating and other summer recreation. LASAR 38331 is located in a low-gradient reach upstream of the lake where agriculture is dominant. LASAR 34220 is downstream of the lake, in a higher gradient reach, upstream of all agriculture downstream of the waterbody. *E. coli* indicate sewage or livestock contamination because they are commonly found in human and animal feces and the EPA recommends testing for *E. coli* in recreational waters. Like in 2016, in 2017 *E. coli* measurements upstream of the lake were higher than downstream. Turbidity was also higher upstream of Triangle Lake than it was downstream. Anecdotally, SWC staff and volunteers have observed significant growth of *Ludwigia* in Triangle Lake, indicating nutrient loading from upstream.

FIGURE 24



The site with the most E. coli in 2016 was 38329 (upper Siuslaw below the North and South Forks). In 2017, 38329 was again the highest and was also where we measure the highest levels of turbidity and conductivity, and where we identified a lower oxygen saturation in 2016.

FIGURE 25

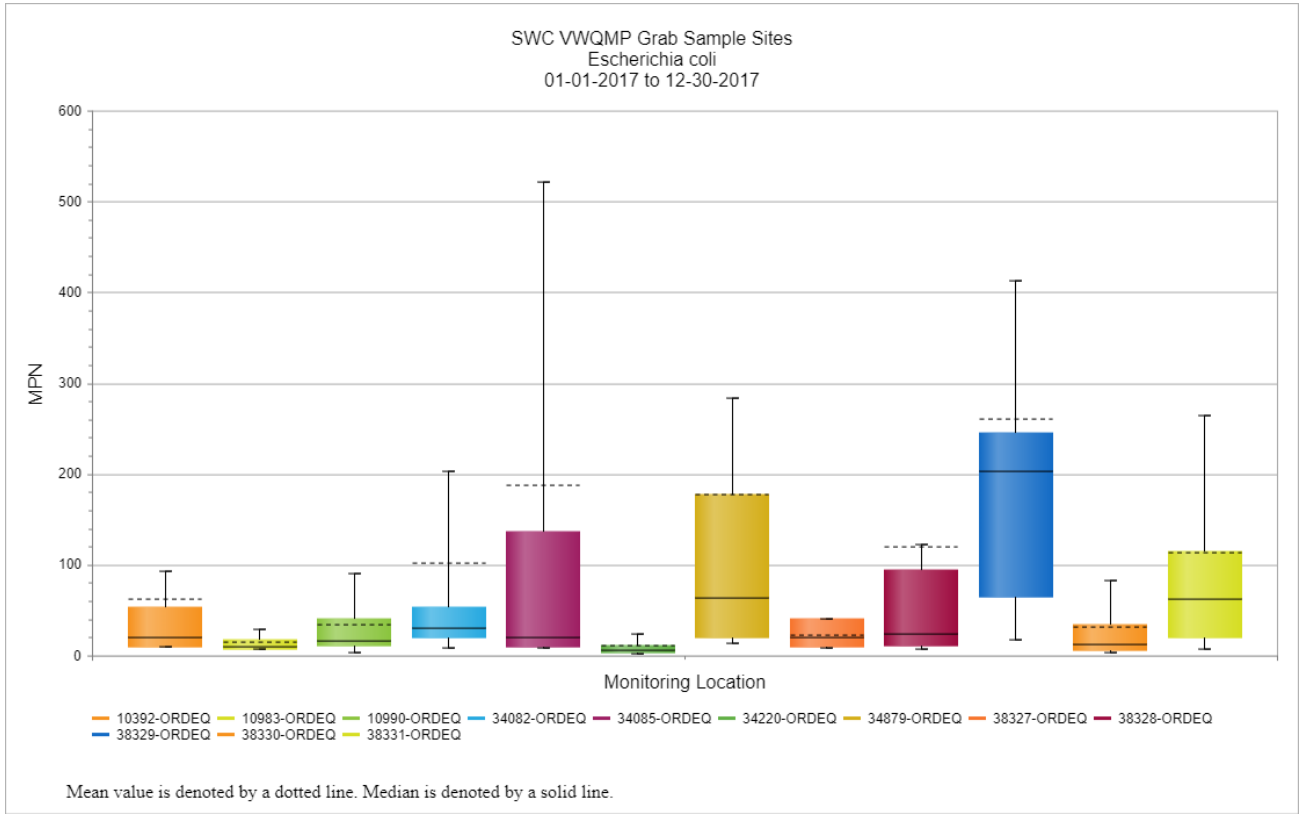
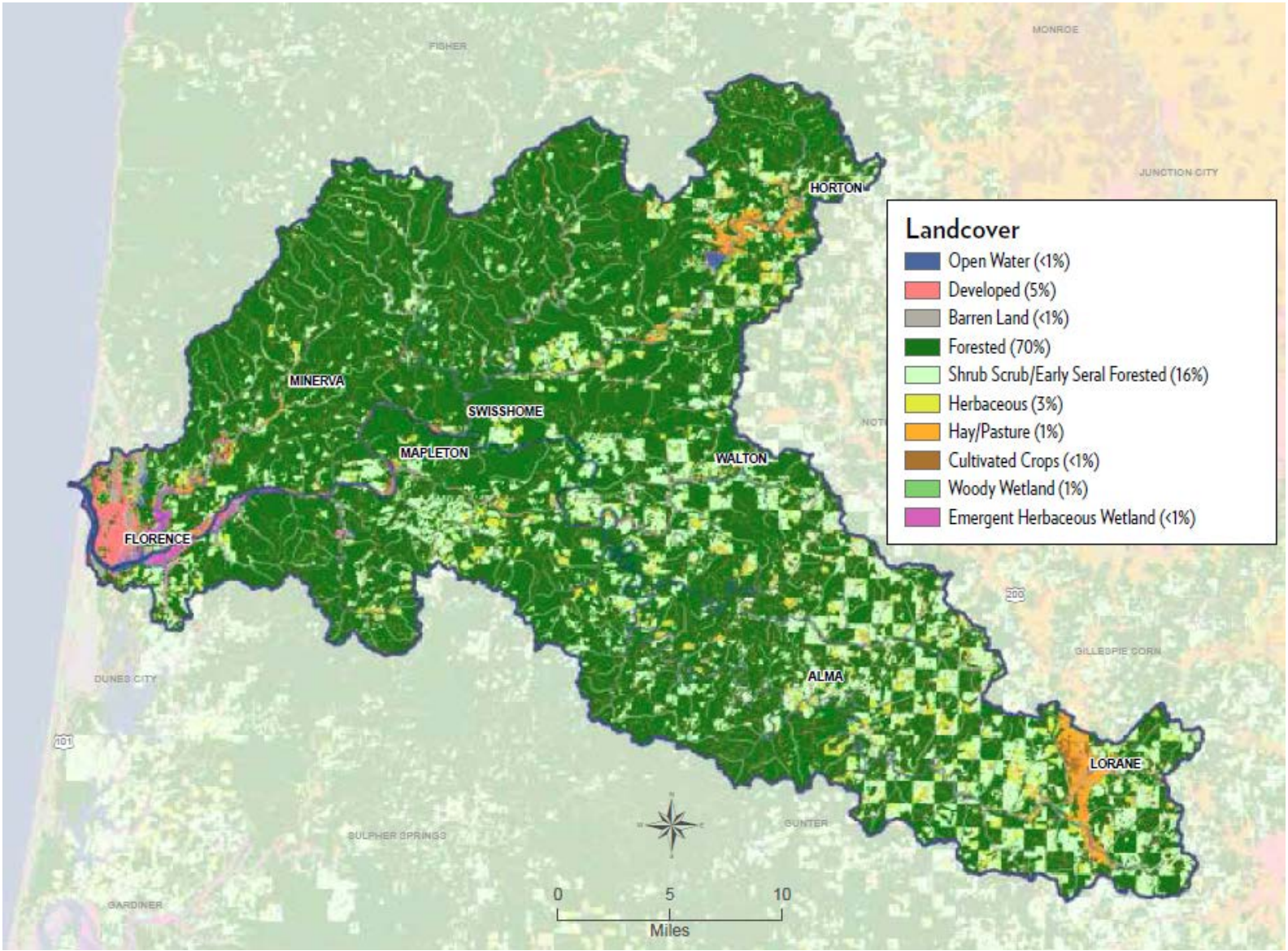


FIGURE 26 LAND COVER IN THE SIUSLAW WATERSHED *(THE SIUSLAW RIVER STRATEGIC ACTION PLAN FOR COHO SALMON AND RECOVERY)*



VI. Discussion

Temporal and spatial distribution of thermal maximums

The mainstem Siuslaw and Lake Creek temperatures started off the 2017 deployment season above the state threshold of 18˚C for rearing of juvenile salmonid fish species, excluding the most upstream sites: 38329, 34877 and 40269 (see Figure 2). Munsel Creek below Ackerley Lake was suitable for salmon rearing during the entire deployment period (see Figure 3). Water temperatures followed the pattern of air temperature, solar radiation, and precipitation, as seen in the correlation to the RAWS data from Goodwin Peak (figures 4-6). This indicates the juvenile salmon rearing in the lower and mid-Siuslaw are likely seeking refuge in colder tributaries, deep pools, and in complex habitats such as woody debris jams. Juvenile fish in the estuary may be finding cool refuge in, or near the mouth of, Munsel Creek during the rearing period. The South Fork of the Upper Siuslaw remained healthy for most of the rearing period, only exceeding the 18˚C during an early August heat wave (Figure 2). The temperatures in the upper sites breach the 18˚C threshold in the early August hot spell and remain warm until early-to-mid September, when temperatures start to fall below the threshold one by one, starting with the upstream sites and ending with the farthest downstream. The temperatures in the lower and mid mainstem Siuslaw, and all of Lake Creek, were unhealthy for salmon and trout during the majority of the rearing period. The only sites where we collected temperature data that was not above 18˚C for most of the rearing season were the three upper Siuslaw sites, near Pheasant Creek, Doe Creek, and the forks (39318, 34880, 38329); the new site just upstream of the Hult Log Pond on Lake Creek (40269); and, the two new Munsel Creek sites downstream of Ackerley Lake (40268, 40266).

We installed the temperature logger at Siuslaw downstream from Wolf (40431) to gain a better understanding of the temperature regime in the mid-Siuslaw-from Barber Creek up to Esmond (34881)—and what we found were temperatures that exceeded standards for healthy rearing of native aquatic species through the entire mid-Siuslaw from June through mid-September (Figure 2).

The temperatures measured below Hult Log Pond in Upper Lake Creek (38770) were higher than those of the upper Siuslaw sites (Figure 1). This may be a result of the shallow (<3m) spillway at the outlet of the pond, where water flowing out of the pond is heated. The temperatures below this spillway at site LHS were the hottest we measured all year (see Figure 1). Contrasting this with the temperatures above Hult Log Pond which were cool and suitable for rearing (below the standard all season) and it indicates this segment of Lake Creek could provide cool water refuge for juvenile fish

during the rearing season, like the sites in the Upper Siuslaw, if the impact from Hult Log Pond on temperature could be mitigated. The downstream extent of impacts of Hult Log Pond on temperature are unknown but the data from nearby upstream and downstream sites show a significant increase due to the heating of the artificial waterbody's surface. The upstream site (40269) has an exceedance rate of 0% while the sites approximately ¼ mile downstream exceeds state standards 81% of the deployment period.

Temperature summary

The SWC 2017 temperature data shows reason for concern through much of the salmon and trout rearing season. Temperature exceedances occur along the entire listed reach of the Siuslaw and Lake Creek, extending from the estuary to the upper watersheds. Figure 2 graphs the differences in maximum temperature for the lower, middle and upper Siuslaw River; note that the temperature exceeds state standards for 73% of the rearing period days as high up in the system as Siuslaw Below Pheasant Creek (34880) and increases as you move downstream. There are multiple factors affecting temperature, including differences in physical channel characteristics (channel roughness, substrate, depth, gradient), amount of direct solar gain on the stream, riparian conditions (shade from tree canopy), and elevation as one goes from the smaller headwater streams toward the estuary. Flow (discharge) also increases so the river responds dynamically to changes in these factors.

Dissolved Oxygen

DO Concentration

The 30-day minimum mean exceeded the State 8 mg/L standard during the 2017 rearing season at the sites in Lake Creek and the Siuslaw River, except at LASAR 38329 (See Figure 19). The site below Wolf Creek (40431) only fell below the standard for a short period of time and was relatively healthy the rest of the rearing season. The Wildcat logger was tampered with during the season and SWC is working with DEQ to determine if any of the data is usable (see Figure 19).

SWC deployed at the 38329, upper Siuslaw below the forks, site to determine dissolved oxygen conditions near the headwaters and compare them with the TWS and SBT sites. We deployed the 40431 logger below Wolf Creek to fill the 2016 data gap between Barber Creek and the Siuslaw below the confluence of its north and south forks (38329). Concentrations in the mid and upper Siuslaw were healthier than expected given the 303(d) listing. Contrary to the 303(d) listing, dissolved oxygen in Lake Creek appears to be more of a concern than the mid and upper Siuslaw. When combined with the 2016 continuous dissolved oxygen data that showed healthy conditions throughout the monitoring program, the mid and upper Siuslaw sites exhibit two consecutive years of relatively healthy dissolved oxygen levels.

VII. Recommendations

Recommendation for restoration

The state standard for dissolved oxygen was met only at the 39329 site in 2017. Although daily minimum dissolved oxygen concentration is not the state standard parameter—it is the 30-day minimum mean—the daily minimums dropped below the standards following temporal patterns in air and water temperatures, and solar radiation, indicating that those influence dissolved oxygen significantly. Considering the 2016 dissolved oxygen levels were suitable for rearing, the mid-to-upper Siuslaw were relatively healthy in 2017, while the majority of our continuous temperature monitoring sites exceeded standards throughout most or all of the rearing season, implementing restoration actions that reduce water temperatures should be prioritized over increasing dissolved oxygen concentration in the listed segments. In 2016, we determined the increases in temperature and percent saturation from Barber (34222)

to Tide (33642) were intensified by the influence of Lake Creek while the impact on DO concentration was negligible, and that projects aimed at reducing water temperature in listed segments may have the highest restoration value between the Siuslaw/Lake Creek confluence and Triangle Lake. This recommendation is the same for 2017 as the influence on temperature by Hult Log Pond is still unknown. Future temperature monitoring downstream from our 34877 site would be beneficial when prioritizing segments to restore for temperature reduction.

Turbidity grab samples at the upper Siuslaw LO-16 site (LASAR 38329) were highest in the Siuslaw and Lake Creek. The 2017 high was in February, 68 NTUs. Like in 2016, we also measured higher turbidity at LASAR 10983 in the middle Siuslaw in 2017. Furthermore, conductivity measurements during SWC audits at this and other sites near the forks average 70 µS/cm while the rest of the watershed averages 40 µS/cm. This area is dominated by agriculture and forestry practices (Figure 26). SWC staff have observed many eroding stream banks in this area as well. The mid-to-upper Siuslaw land use is predominantly forestry and ownership is staggered in the checkerboard between BLM and private industrial forestry. Restoration projects designed to restore riparian function, exclude cattle from the riparian area, and limit runoff are recommended from interpretation of water quality monitoring. (See Figure 26, Land Cover in the Siuslaw Watershed)

E. coli indicate sewage or livestock contamination because they are commonly found in human and animal feces and the EPA recommends testing for *E. coli* in recreational waters. Like 2016, *E. coli* measurements in 2017 were higher upstream of Triangle Lake than downstream. Triangle Lake is a popular destination during summer months for recreation such as water skiing, fishing, and swimming—especially downstream at the BLM-managed day use area. Restoration projects that exclude livestock from the Lake Creek and its tributaries upstream of the lake would likely decrease the number of E. coli in the water, especially during summer months. Off-channel watering systems and other best management practices for small farmers would be suitable in the communities of Blachly and Triangle Lake.

Recommendations for further monitoring and research (Figure 28)

In 2016, dissolved oxygen percent saturation in the Siuslaw and Lake Creek increased at every site during the cooling months of late summer, excluding LASAR station 38329, the upper Siuslaw below the North and South Forks, where it dropped. In 2017, this pattern did not hold true and denser sampling of continuous dissolved oxygen saturation may not be necessary as this site appears similar to others. Continued

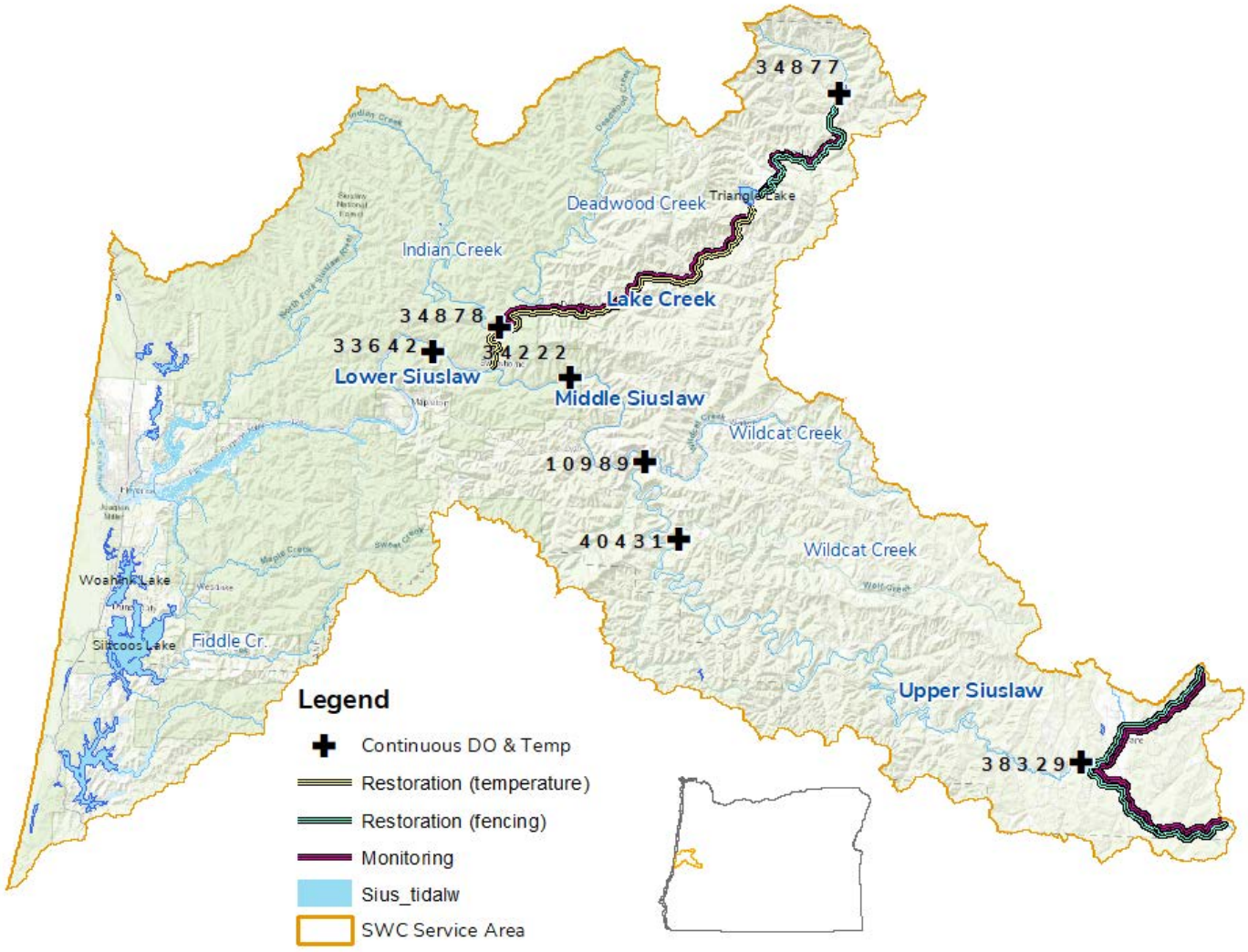
monitoring is recommended to explore if the reduction in saturation during the cooling period does happen again. Researching land use and other factors that may be causing the late summer drop in saturation is still recommended.

In 2016, the increases in temperature and percent saturation from Barber (34222) to Tide (33642) were intensified by the influence of Lake Creek while the impact on DO concentration was minute. Denser temperature monitoring in Lake Creek and its major tributaries downstream of Triangle Lake is still recommended in this 2017 final report and analysis in order to identify mainstem thermal patterns and tributary influences on temperature.

Figure 26 shows the recommendations based on the 2017 VWQMP continuous dissolved oxygen, continuous temperature, and grab sample data. The recommendations are the same as the 2016 final analysis and report recommendations but future continuous temperature monitoring between Triangle Lake and Hult Log Pond has been added because the extent of the log pond's influence on temperature downstream is only known for approximately ¼ mile. The 2017 continuous temperature monitoring showed that upstream of the pond exceeded standards 0% of the rearing season while just downstream of the pond had an exceedance rate of 81%.

These recommendations will be shared with stakeholders, the SWC Technical Advisory Team, Siuslaw Coho Partnership, and the partners supporting this program. Although future monitoring funds are not secured at this time, we intend to pursue funding from many sources to inform adaptive management and educate the members in our communities.

FIGURE 28


34877
Deadwood Creek
Triangle Lake
Indian Creek
Lake Creek
34878
33642
34222
Lower Siuslaw
Middle Siuslaw
Wildcat Creek
10989
40431
Wildcat Creek
Upper Siuslaw
38329
Woahink Lake
Siltcoos Lake
Fiddle Cr.
Legend
Continuous DO & Temp
Restoration (temperature)
Restoration (fencing)
Monitoring
Sius_tidalw
SWC Service Area

Appendix A

Oregon Administrative Rules (OARs)

340-041-0028

Temperature

(1) Background. Water temperatures affect the biological cycles of aquatic species and are a critical factor in maintaining and restoring healthy salmonid populations throughout the State. Water temperatures are influenced by solar radiation, stream shade, ambient air temperatures, channel morphology, groundwater inflows, and stream velocity, volume, and flow. Surface water temperatures may also be warmed by anthropogenic activities such as discharging heated water, changing stream width or depth, reducing stream shading, and water withdrawals.

(4) Biologically Based Numeric Criteria. Unless superseded by the natural conditions criteria described in section (8) of this rule, or by subsequently adopted site-specific criteria approved by EPA, the temperature criteria for State waters supporting salmonid fishes are as follows:

(c) The seven-day-average maximum temperature of a stream identified as having salmon and trout rearing and migration use on subbasin maps set out at OAR 340-041-0101 to 340-041-0340: Figures 130A, 151A, 160A, 170A, 220A, 230A, 271A, 286A, 300A, 310A, 320A, and 340A, may not exceed 18.0 degrees Celsius (64.4 degrees Fahrenheit);

Oregon Administrative Rules (OARs)

340-041-0016

Dissolved Oxygen

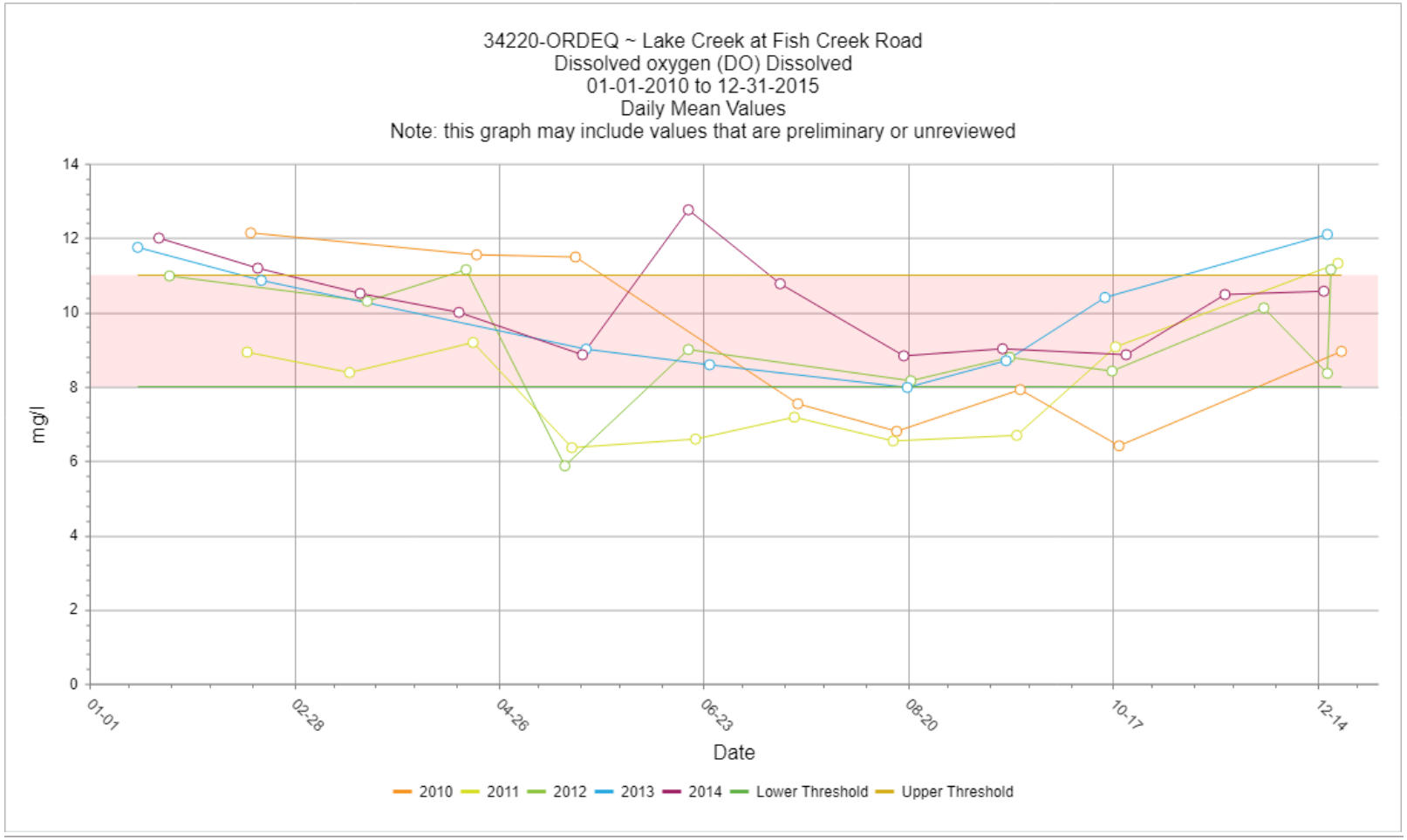
Dissolved oxygen (DO): No wastes may be discharged and no activities may be conducted that either alone or in combination with other wastes or activities will cause

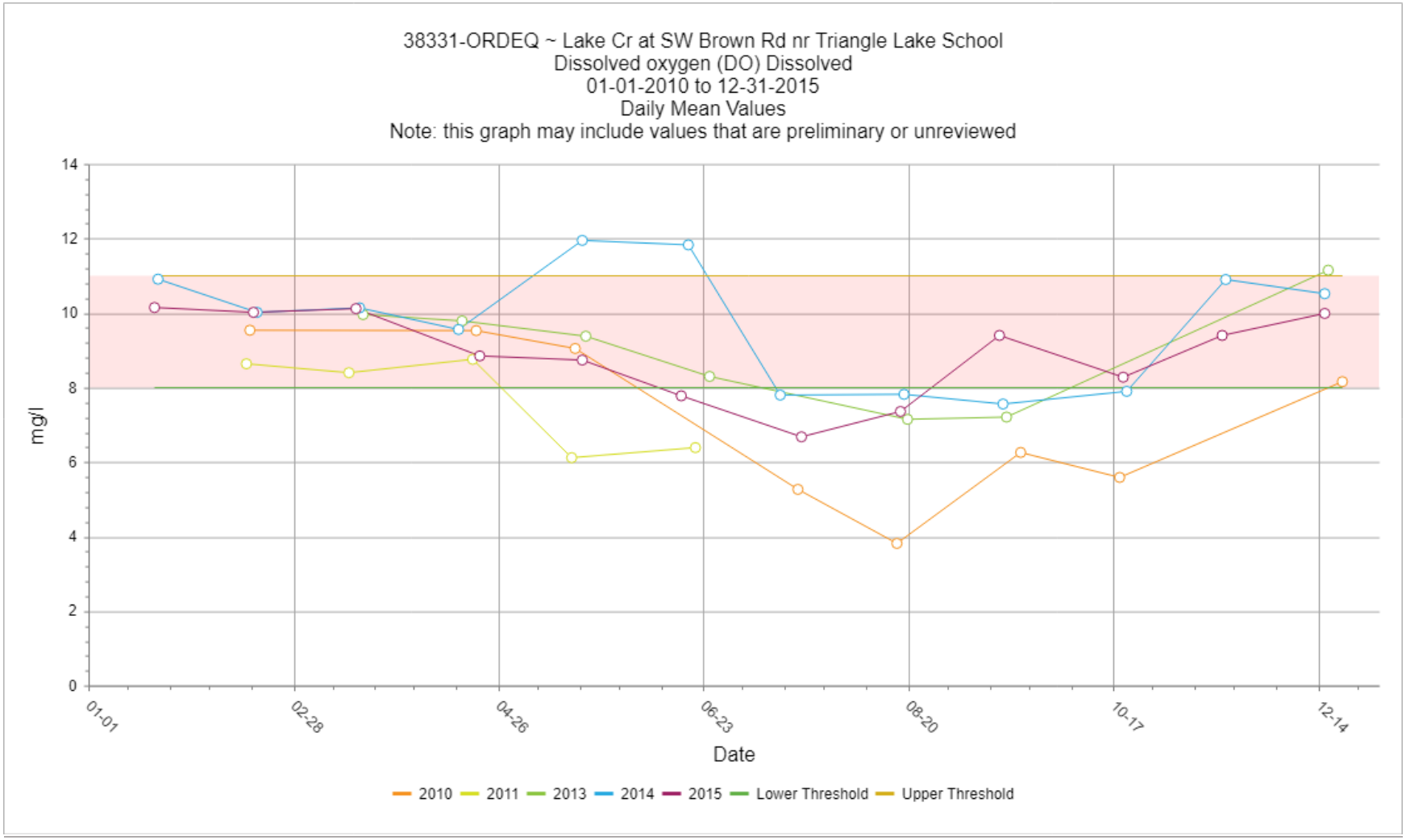
violation of the following standards: The changes adopted by the Commission on January 11, 1996, become effective July 1, 1996. Until that time, the requirements of this rule that were in effect on January 10, 1996, apply:

(2) For water bodies identified by the Department as providing cold-water aquatic life, the dissolved oxygen may not be less than 8.0 mg/l as an absolute minimum. Where conditions of barometric pressure, altitude, and temperature preclude attainment of the 8.0 mg/l, dissolved oxygen may not be less than 90 percent of saturation. At the discretion of the Department, when the Department determines that adequate information exists, the dissolved oxygen may not fall below 8.0 mg/l as a 30-day mean minimum, 6.5 mg/l as a seven-day minimum mean, and may not fall below 6.0 mg/l as an absolute minimum (Table 21);

Stat. Auth.: ORS 468.020, 468B.030, 468B.035 & 468B.048
Stats. Implemented: ORS 468B.030, 468B.035 & 468B.048
Hist.: DEQ 17-2003, f. & cert. ef. 12-9-03; DEQ 2-2007, f. & cert. ef. 3-15-07

Appendix B


34220-ORDEQ ~ Lake Creek at Fish Creek Road
Dissolved oxygen (DO) Dissolved
01-01-2010 to 12-31-2015
Daily Mean Values
Note: this graph may include values that are preliminary or unreviewed
mg/l
14
12
10
8
6
4
2
0
01-01
02-28
04-26
06-23
08-20
10-17
12-14
Date
2010
2011
2012
2013
2014
Lower Threshold
Upper Threshold


38331-ORDEQ ~ Lake Cr at SW Brown Rd nr Triangle Lake School
Dissolved oxygen (DO) Dissolved
01-01-2010 to 12-31-2015
Daily Mean Values
Note: this graph may include values that are preliminary or unreviewed
mg/l
14
12
10
8
6
4
2
0
01-01
02-28
04-26
06-23
08-20
10-17
12-14
Date
2010
2011
2013
2014
2015
Lower Threshold
Upper Threshold

Appendix C

SAMPLE & ANALYSIS PLAN

Volunteer Water Quality Monitoring: Siuslaw Watershed Council VWQMP

DEQ04-LAB-0047-SAP
Version1.3– October 2014

Siuslaw Watershed Council
PO Box 422
Mapleton, OR 97453
Phone: (541)268-3044
Fax: (541)268-3045
www.siuslaw.org

Group A: PROJECT MANAGEMENT

A1. Title and Approval Sheet

Tyler Pedersen / Project Manager Date

Dan Carpenter/ Watershed Council Coordinator Date

Monitoring Partner Date

Steve Hanson / DEQ Volunteer Monitoring Specialist Date

Chris Redman / DEQ Quality Assurance Officer (QAO) Date

December 2004

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A2. Table of Contents

A3. Distribution List

Name	Organization	Contact
Steve Hanson	DEQ	503.229.5449
Bobbi Lindberg	DEQ	541.687.7353
Bill Conroy	USFS	541.563.8406
Brian Vollmer-Buhl	Mapleton Schools	541.268.4322

A4. Project/Task Organization

In a table give information for individuals or organizations that will be leaders in the project. Example below:

Name	Project Title/Responsibility	Contact
Tyler Pedersen	Project Manager	541.268.3044
SWC Volunteers	Sample collection	541.268.3044
Tyler Pedersen	Sample Analysis	541.268.3044
Tyler Pedersen	Data Clerk/Data Management	541.268.3044
Tyler Pedersen	Data Analysis and Presentation	541.268.3044
Tyler Pedersen	Report Writing	541.268.3044
Steve Hanson	DEQ Vol. Mon. Specialist	503.229.5449

A5. Purpose Statement/Problem Definition/Background

Our objective is to document the baseline ambient water quality conditions of water in the Siuslaw River and its tributaries. The data collected will be used by the SWC, researchers, and state agency staff to characterize current water quality conditions, identify specific water quality problem areas, and to develop enhancement and restoration projects. The SWC will also use the data to educate and inform local residents on the connections between land use and water quality.

The monitoring data collected under the scope of this grant proposal will be incorporated into the EPA funded Siuslaw Watershed Restoration Initiative (SWRI). The SWRI will develop and implement a whole-basin watershed monitoring and evaluation project that tracks restoration and conservation progress across ownership and over time. This project will provide a geo-database that incorporates physical, biological, and chemical measures of the basin that will greatly aid in restoration planning and monitoring. The field data collection by the VWQM Program will serve as an important component of the SWRI.

The 504,000 acre (773 square mile) Siuslaw River Basin is located on the Central Oregon Coast. Historically, relative to its size, the Siuslaw Basin was one of the most abundant anadromous fish producers in the Pacific Northwest (Assessment, p. 14), and was the largest producer south of the Columbia River. Coho salmon, Chinook salmon, steelhead, and sea-run cutthroat trout are among the major fish populations that rely on clean, cool water for spawning and rearing. Coho salmon are especially diminished compared to historical numbers. The mainstem Siuslaw river is water-quality limited per 303(d) listings for temperature and dissolved oxygen (summer miles 20 to 105.9, 2002 list; year round miles 0 to 105.9; 2004 draft 303(d) list). Sediment issues are cited as one of the priority water-quality impairments in the basin (2004 draft 303(d) list). The mainstem Siuslaw River is water-quality limited per the 2004 303(d) listings for fecal coliform year round from mile 5.7 to 105.9.

A6. Project Task/Description

We propose to continue monitoring the following parameters: dissolved oxygen (DO), turbidity, bacteria, temperature, salinity (in estuary only), weather conditions, and tidal stages (in estuary only). Trained volunteers will collect samples/monitor for these seven parameters, once a month at the sampling sites. The volunteers are trained to follow the protocols set forth in the "Water Quality Monitoring Technical Guide Book" and the DEQ's *QAPP Water Quality Volunteer Monitoring*. Monitoring days will remain the same every month (i.e. the third Wednesday of the month). Trained Mapleton Middle and High School science students will continue to process the DO and turbidity samples under supervision of the project manager. We will continue to partner with the Siuslaw Institute's Mapleton Schools Natural Resource Education Program as we work with students in the lab and collecting field data. Lab safety equipment is provided by the SWC and Mapleton Schools.

Siuslaw VWQMP Timetable:

Tasks to be completed	Months for year 2007 - 2016											
	1	2	3	4	5	6	7	8	9	10	11	12
Sampling Planning and revision									x	x		
Monthly sampling and processing of samples	x	x	x	x	x	x	x	x	x	x	x	x
Data entry	x	x	x	x	x	x	x	x	x	x	x	x
Data analysis and reporting	x	x	x	x	x	x	x	x	x	x	x	x

The VWQMP is funded through June 2017. Funding is being sought for 2017-18. If funding is not available, the program may cease or function on a very limited basis. The level of limited sampling would have to be determined based on the resources available at the time.

A7. Measurement Quality Objectives

Parameter	**Data Quality Level**
Temperature	B
Dissolved Oxygen	A
E. coli	A
Turbidity	A

Salinity	The Clean Water Team Guidance Compendium for Watershed Monitoring and Assessment, California State Water Resources Board, SOP 3.1.3.3.

VWQMP's sampling will characterize ambient water quality.

A8. Training Requirements and Certification

The VWQMP Coordinator (SWC Projects Manager) has received training from the former Project Manager. The VWQMP Coordinator will train volunteers using the approved methods. Volunteers will be retrained annually.

A9. Documentation and Records:

Document or Record Name and Description	Storage Location	Storage Time
ODEQ Quality Assurance Project Plan (QAPP)- DEQ04-LAB-0047-QAPP project description and assurance procedures.	DEQ Internet Page	5 years
Siuslaw VWQMP Sampling Analysis Plan- specific sampling information for the Siuslaw VWQMP.	DEQ Laboratory & SWC office	5 years
OWEB Water Quality Monitoring Guidebook ODEQ Laboratory Mode of Operations Manual- Methods manual	SWC office	5 years
Equipment Notebooks - records of quality control checks, calibrations and maintenance.	DEQ equipment boxes	5 years
Field Data Sheets – records of volunteer field data collection.	SWC office	5 years

Group B: DATA GENERATION AND ACQUISITION

B1. Sampling Process Design

Parameter	Reason	Sites Sampled	Sampling Schedule
Temperature	303(d) listing, influence on DO	All	Monthly*, First flush
Dissolved Oxygen	303(d) listing	All	Monthly*, First flush
E. coli	Human health, assess land use, Fecal coliform 303(d) listing	All	Monthly*, First flush
Turbidity	Informational, Sediment 303(d) listing	All	Monthly*, First flush
Salinity	Informational	Estuary	Monthly*, First flush
* On the same day every month (for example, the third Tuesday), morning to early afternoon.			

Grab Sample Sites

Site ID #	Tributary or Mainstem	Site Name/Location	Length of record (years)	Coordinates	Site Selection Factors
FB-2	Mainstem Siuslaw/Tidal	Florence Boat Dock, Old Town Florence, RM 5	2002-2016	-124.10128, 43.96752	Estuary sites: The estuary has been determined to be of the highest priority for restoration through the 2007 SWC Siuslaw Watershed and Coastal Lakes Seventh Field Aquatic Priority Classification process. The estuary monitoring sites serve as baseline locations for historic (KC-7) and future restoration projects. These sites were chosen because they represent three tiers of estuarine brackish water dilution, are proximal to confluences of major estuary tributaries, and have public access. Continuing collection at these four sites and a partnership on an additional site (North Fork near the mouth, CTCLUSI) will allow us to have long-term water quality data that can serve as trend data and reference sites.
SS-3	Tributary/Tidal	South Slough, below tide gate, RM 2	2002-2016	-124.05996, 43.95122	
MD-6	Mainstem Siuslaw/Tidal	Mapleton Public Dock, RM 20	2004-2016	-123.85750, 44.03030	
KC-7	Tributary/Tidal	Karnowsky Creek, County Bridge above confluence with Siuslaw River	2003-2016	-123.99589, 44.00339	
NF-M	Tributary	North Fork Siuslaw River, Minerva	2011-2016	-123.979993, 44.058332	Upper-watershed/Freshwater Sites: The middle and upper watershed freshwater sites were selected due to their downstream proximity to rural residential areas, to medium and high priority restoration areas, and changes in land use and public access. We also selected two sites above and below the largest lake in the watershed.
CH-11	Tributary	Chickahominy at bridge, Walton, RM 4	2005-2016	-123.57618, 44.04639	
TL-12	Mainstem Lake Creek	Lake Creek above Triangle Lake, 4 RM above Triangle Lake	2005-2016	-123.54290, 44.19919	
DW-13	Tributary	Deadwood Creek, Hwy 36 bridge above confluence with Lake Creek	2007-2016	-123.75918, 44.09504	
BT-14	Mainstem Lake Creek	Below Triangle Lake on Lake Creek below confluence with Fish Creek, RM 17	2009-2016	-123.58324, 43.14798	

MU-15	Mainstem Siuslaw	Middle/Upper Siuslaw Mainstem above Whittaker	2011-2016	-123.65930, 43.98494	
LO-16	Mainstem Siuslaw	Above confluence of North & South Forks of Upper Siuslaw River, at Fire Road bridge near Lorane	2015-2016	-123.26780, 43.82577	
WC-17	Lower Wolf Creek (New)	0.2 miles above confluence with Upper Siuslaw River; 8.4 miles up Siuslaw River Rd from Hwy 126	2016	-123.621, 43.960	
Continuous dissolved oxygen/temperature sites					
LAL	Mainstem Lake Creek	Lake Creek below Hult Pond	2007, 2014, 2015, 2016 (temp); 2016 (DO/temp)	-123.49679, 44.23781	All continuous sites are at or near sites that were previous monitored for TMDL (LASAR sites) or are near SWC grab sites.
SIT	Mainstem Lake Creek	Lake Creek above Indian Creek, RM 11	2007, 2014, 2015, 2016 (temp); 2016 (DO/temp)	-123.78402, 44.08383	
SBT	Lower Mainstem Siuslaw	Siuslaw River above Barber Creek	2005, 2007, 2014, 2015, 2016 (temp); 2016 (DO)	-123.72179, 44.0539	
TWS	Lower Mainstem Siuslaw	Siuslaw River above Tide Wayside	2016 (DO & temp)	-123.84132, 44.06664	
SAF	Upper Mainstem Siuslaw	Siuslaw River below confluence of N/S Forks, 300 feet U/S of Fire Road bridge	2014 & 2015 (temp & conductivity); 2016 (DO & temp)	-123.2678, 43.82577	
WCS	Wildcat Creek	Wildcat Creek 100 meters above confluence with Siuslaw/covered bridge	2016	-123.65388, 44.00350	
Continuous temperature sites					
SPT	Upper Mainstem Siuslaw	Siuslaw River below Pheasant Creek	2005, 2015, 2016	-123.443, 43.8960	
SDT	Upper Mainstem Siuslaw	Siuslaw River above Doe Creek	2005, 2014, 2015, 2016	-123.38527, 43.84246	

SAE	Upper Mainstem Siuslaw	Siuslaw River above Esmond Creek	2005, 2015, 2016	-123.6420, 43.9320	
SAW	Upper Mainstem Siuslaw	Siuslaw River above Whittaker Creek	2016	-123.660, 43.984	
LFT	Mainstem Lake Creek	Lake Creek above Fish Creek	2007, 2014, 2015, 2016	-123.58324, 44.14798	
Continuous conductivity/temperature site					
NFS	North Fork Siuslaw	North Fork Siuslaw 420 feet D/S of bridge at Minerva	2014, 2015, 2016	-123.96, 44.07	

B2. Sampling Method Requirements

- Sample collection will be performed from bridges, docks, and road crossings (culverts or tidegates).
- We will follow ODEQ Volunteer Monitoring QAPP for sample collection containers, holding times, and/or preservations.

B3. Sample Handling and Custody Procedures

- In the field, samples and the field sheet will be labeled with site name, date, time, type of sample, and volunteer name(s). Field sheet is attached as Appendix 1.

B4. Analytical Methods Requirements

Parameter	Method	Method Source	Analysis Location
Field Temperature	Ambient	ODEQ QAPP DEQ04-LAB-0047-QAPP	Field
Dissolved Oxygen	Modified Winkler	ODEQ QAPP DEQ04-LAB-0047-QAPP	SWC/Mapleton Schools Lab
Turbidity	Nephlometric	ODEQ QAPP DEQ04-LAB-0047-QAPP	SWC/Mapleton Schools Lab
E. coli	IDEXX Colilert-18 (ODEQ Approved Method)	ODEQ QAPP DEQ04-LAB-0047-QAPP	SWC/Mapleton Schools Lab
Salinity	Refractometer	The Clean Water Team Guidance Compendium for Watershed Monitoring and Assessment, California State Water Resources Board, SOP 3.1.3.3.	Field

- The SWC VWQMP follows the ODEQ's protocols on sample disposal.

B5. Quality Control Requirements

- We will follow the protocols as described in the ODEQ QAPP DEQ04-LAB-0047-QAPP.
- Duplicate quality control (QC) samples for all water quality measurements will be taken at a minimum of 10% of the total number of monitoring sites (1 duplicate for every 10 sites) during each sampling period. When stream temperature and conductivity will be measured in stream, two readings should be taken to serve as a duplicate.
- IDEXX Colilert reagents will be tested with IDEXX Quanti-Cult culture to test the media at the start and end of the monitoring year. Incubator temperatures will be checked at the beginning and end of each incubation and recorded in a log book kept with the incubator.
- Marine influenced E. coli samples will be run with a 1:10 dilution. To ensure that the dilution water is not affecting the results, blank samples will be run each sampling event and spiked samples will be run with each new bottle of dilution water.
- Volunteers will run replicate titrations of the DO samples to measure the precision of the results. Where the results are not within 5% of each other a third titration will be performed.
- Accuracy checks for turbidity will be conducted at the beginning and end of each event to confirm accuracy is with in the guidelines defined for "A" level data in the Oregon DEQ Data Quality Matrix (DQM). If accuracy exceeds limits defined in the DQM the result values for that parameter will be appropriately flagged and not be used for calculations comparing CBO and DEQ results.

- For split samples duplicate quality control (QC) samples will be collected at a minimum of 10% of the total number of monitoring sites, or at least once per sample event.
- If quality control results show a sampling problem we will retest, contact the manufacturer if appropriate, and/or contact the DEQ Vol. Mon. Specialist if appropriate.

B6. Instrument/Equipment Testing, Inspection, and Maintenance Requirements

The SWC VWQMP will follow the maintenance and inspection table in the ODEQ QAPP DEQ04-LAB-0047-QAPP.

B7. Instrument Calibration and Frequency

The SWC VWQMP will follow the Instrument Calibration and Frequency table in section B7 of the ODEQ QAPP DEQ04-LAB-0047-QAPP.

B8. Inspection/Acceptance Requirements

Individual volunteers are responsible for storing their equipment between sampling dates and taking basic care of their equipment. Lab equipment and supplies will be maintained by the SWC VWQMP Project Manager and will be stored at the SWC and Mapleton School Labs.

We will follow the supply and Inspection/Acceptance Requirements in section B8 of the ODEQ QAPP DEQ04-LAB-0047-QAPP.

B9. Data Acquisition Requirements

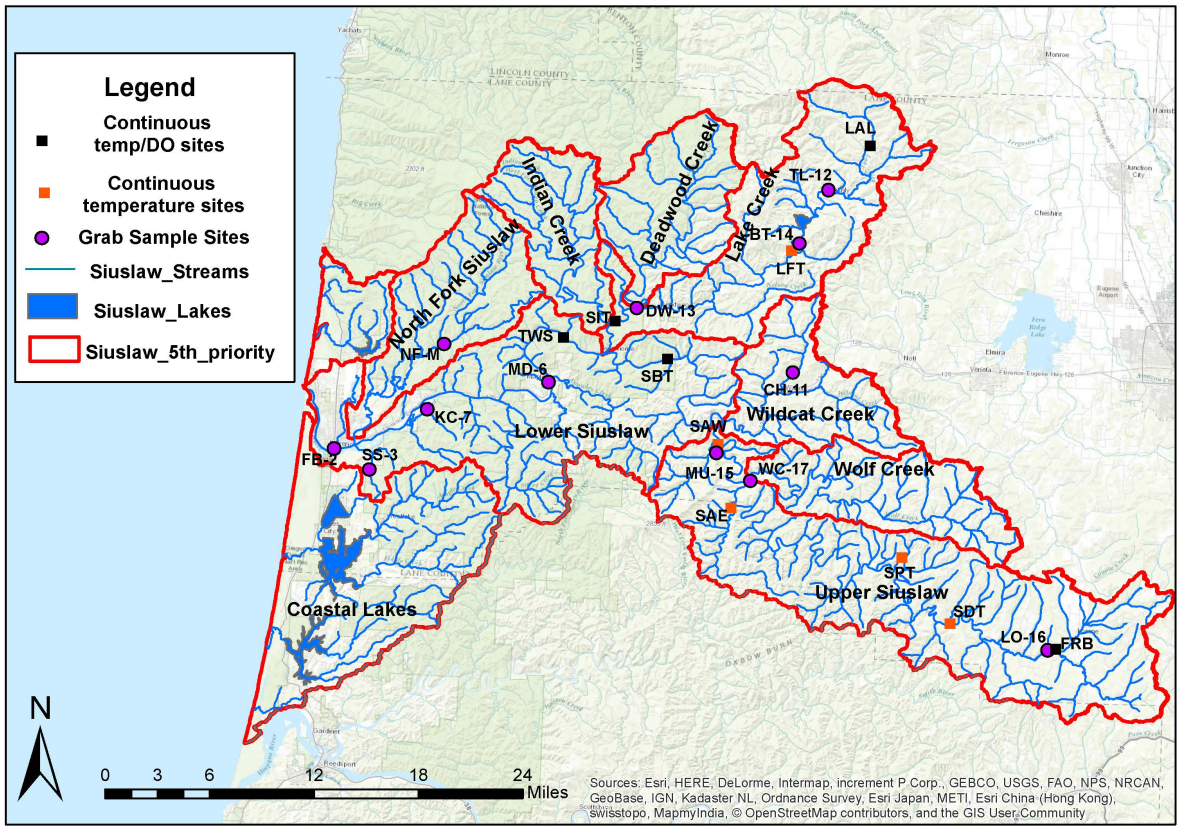
We will follow the Data Acquisition and Requirements section B9 of the ODEQ QAPP DEQ04-LAB-0047-QAPP.

B10. Data Management

Review the Data Management section B10 of the ODEQ VOLUNTEER MONITORING QAPP. Include the following information to document your internal data management:

- Field volunteers will turn their field data sheets over to the project manager. The project manager supervises use of the data sheets in the lab during analysis. The project manager will enter the data from the field data sheets into the Siuslaw VWQMP database. Data from the Siuslaw VWQMP database will be submitted to the ODEQ by the project manager.
- Field data sheets will be stored at the SWC office for a minimum of 5 years. The data will be stored electronically (Access and ArcGIS) on SWC office computers indefinitely.
- Electronic data will be stored in a Microsoft Access database (.mdb) and an ArcGIS database (.dbf) and will include date and time of sampling, abbreviations of site locations and water quality data.
- Data fields will include turbidity, dissolved oxygen, bacteria, temperature, clarity and salinity.
- Data will be checked for completeness, reasonableness, and transcription and calculation errors by the project manager.
- Electronic data will be stored on SWC office computers and will be backed up on an external hard drive.
- We will follow instructions for data formatting and submission outlined in section B10 of the ODEQ QAPP DEQ04-LAB-0047-QAPP. (A map showing all of the sites is included below.)
- The data will be analyzed in Microsoft Access and ArcGIS.

SWC Grab Sample & Continuous temp/DO Site Map



Group C: ASSESSMENT AND OVERSIGHT

C1. Assessment and Response Actions

- We will follow the procedures of assessment and response outlined in section C1 of the ODEQ QAPP DEQ04-LAB-0047-QAPP.
- We will follow the procedures of reporting the results of the quality control tests and other project assessments outlined in section C2 of the ODEQ QAPP DEQ04-LAB-0047-QAPP.

Group D: DATA VALIDATION AND USABILITY

D1. Data Review, Validation, and Verification

We will follow the procedures of data review, validation and verification in section D1 of the ODEQ QAPP DEQ04-LAB-0047-QAPP.

D2. Validation and Verification Methods

We will follow the procedures of data validation and verification in section D2 of the ODEQ QAPP DEQ04-LAB-0047-QAPP.

D3. Reconciliation with Data Quality Objectives

We will follow procedures for reconciliation with data quality objectives in section D3 of the ODEQ QAPP DEQ04-LAB-0047-QAPP.

Entered Into Database: ☐ Yes by
Database Reviewed: ☐ Yes by

SURVEY: _____ Date Sampled: _____

Major Basin: _____ Date Received in Lab: _____ Date Reported: _____

Collected by: _____ Weather: _____

BACTERIA ANALYSIS REPORT

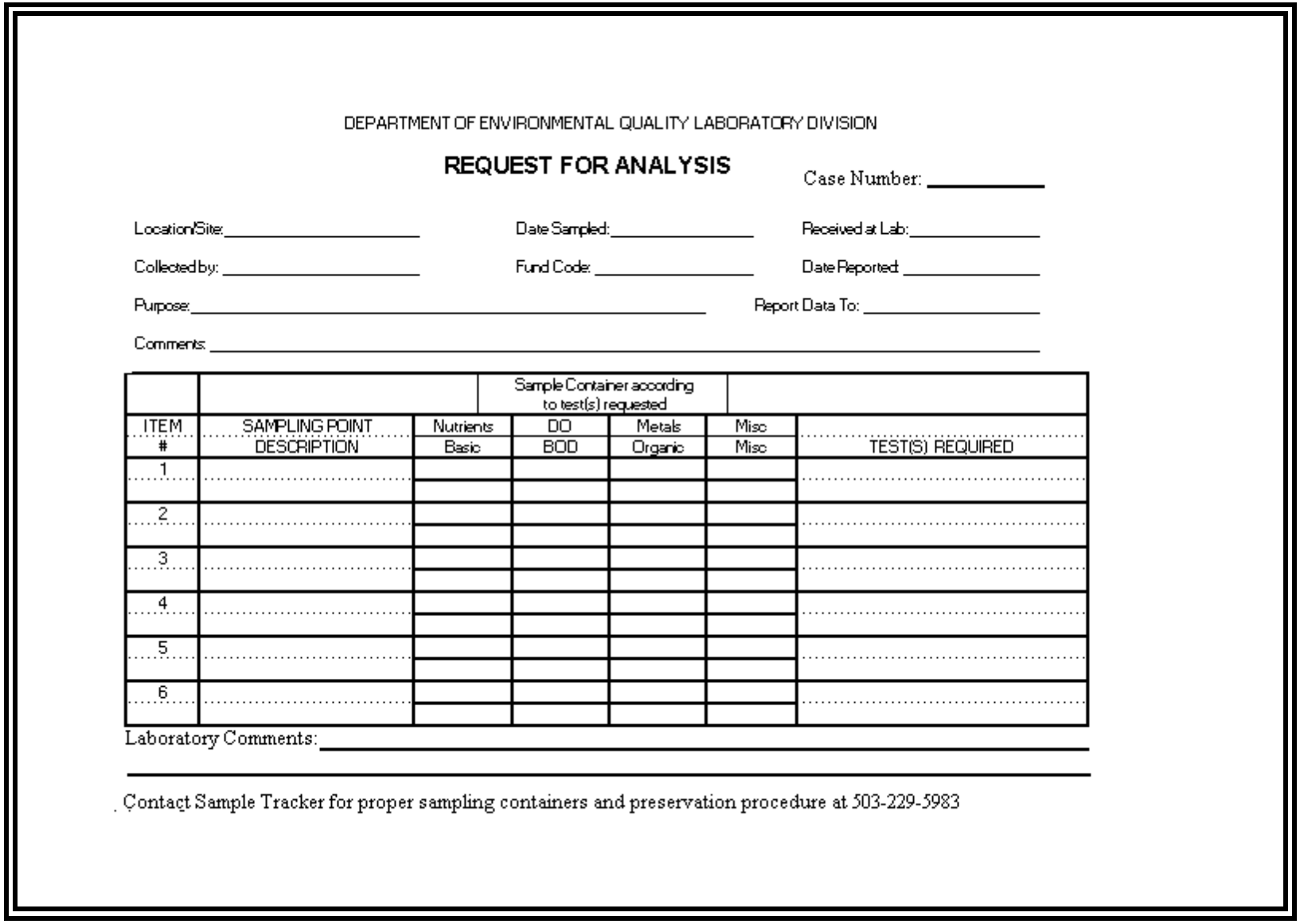
Item #	SITE #	SITE NAME	DO Poly	Time (HH MM)	Temp. (DegC)	FCond. (umhos)	D.O. (mg/l)	DO Sat. (%)	Field Turb. (NTU)	Bact Bottle	Date/Time in / Date/Time out	Temp in / Temp out	T. coliform / *E.coli*
1													
2													
3													
4													
5													
6													
7													
8													
9													
10													
		ACCUARCY DATA QUALTY LEVEL BASED ON STANDARDS CHECKS			NA		NA	NA		Cond: A ≤ ±7%, B ≤ ±10%; Turb ≤ ±5%, B ≤ ±30%			
		PRECISON DATA QUALITY LEVEL BASED ON DUPLICATE SAMPLES								Temp: A ≤ ±0.5,B ≤ ±1; Cond: A ≤ ±10%, B ≤ ±15%; DO: A ≤ ±0.3, B ≤ ±1; Turb ≤ ±5%, B ≤ ±30%			

Bacteria Analyst

Comments: _____

PAGE_____OF_____

Figure 1 Stream Survey



DEPARTMENT OF ENVIRONMENTAL QUALITY LABORATORY DIVISION

REQUEST FOR ANALYSIS

Case Number: _____

Location/Site: _____ Date Sampled: _____ Received at Lab: _____

Collected by: _____ Fund Code: _____ Date Reported: _____

Purpose: _____ Report Data To: _____

Comments: _____

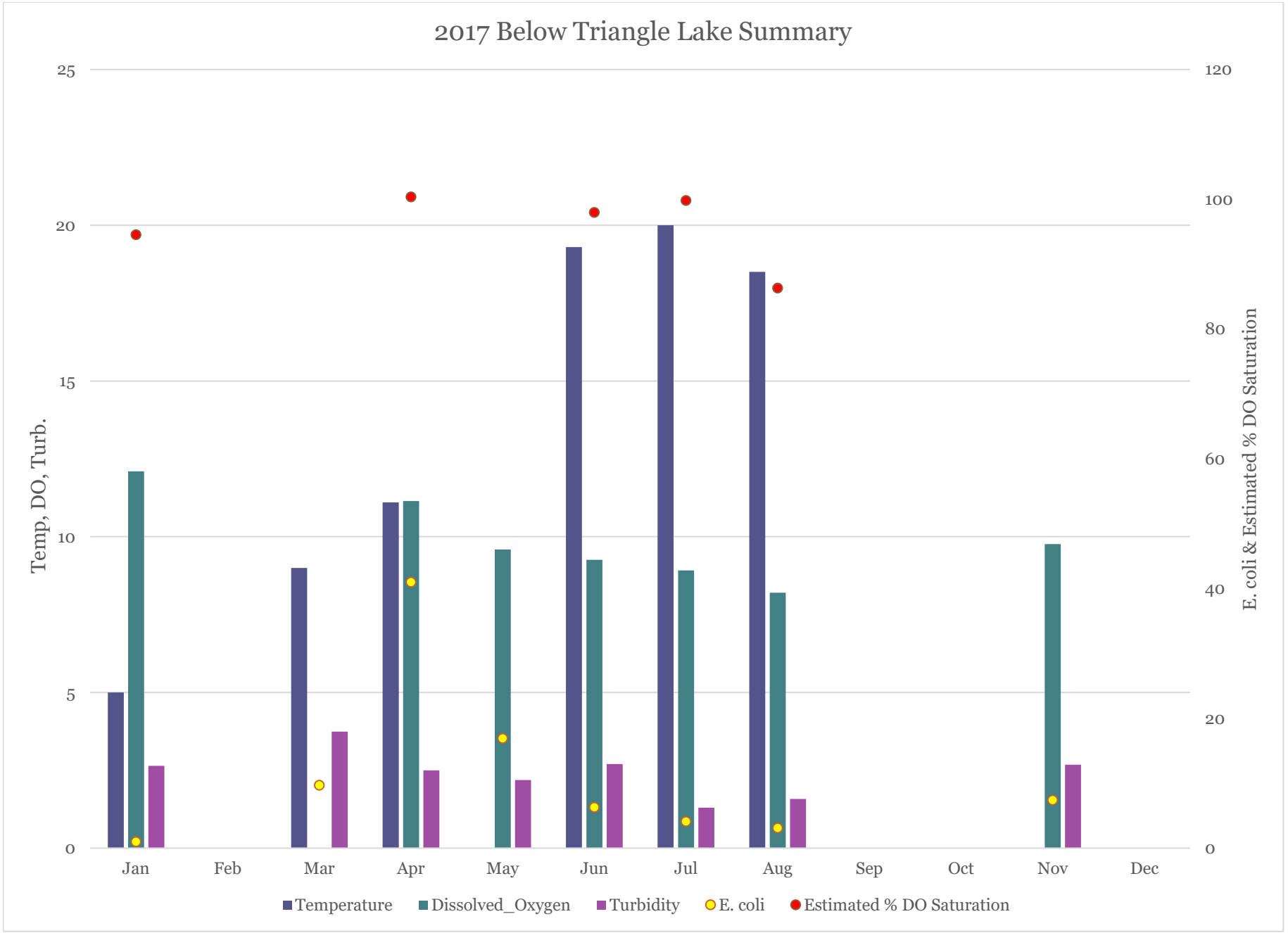
		Sample Container according to test(s) requested				
ITEM #	SAMPLING POINT DESCRIPTION	Nutrients Basic	DO BOD	Metals Organic	Misc Misc	TEST(S) REQUIRED
1						
2						
3						
4						
5						
6						

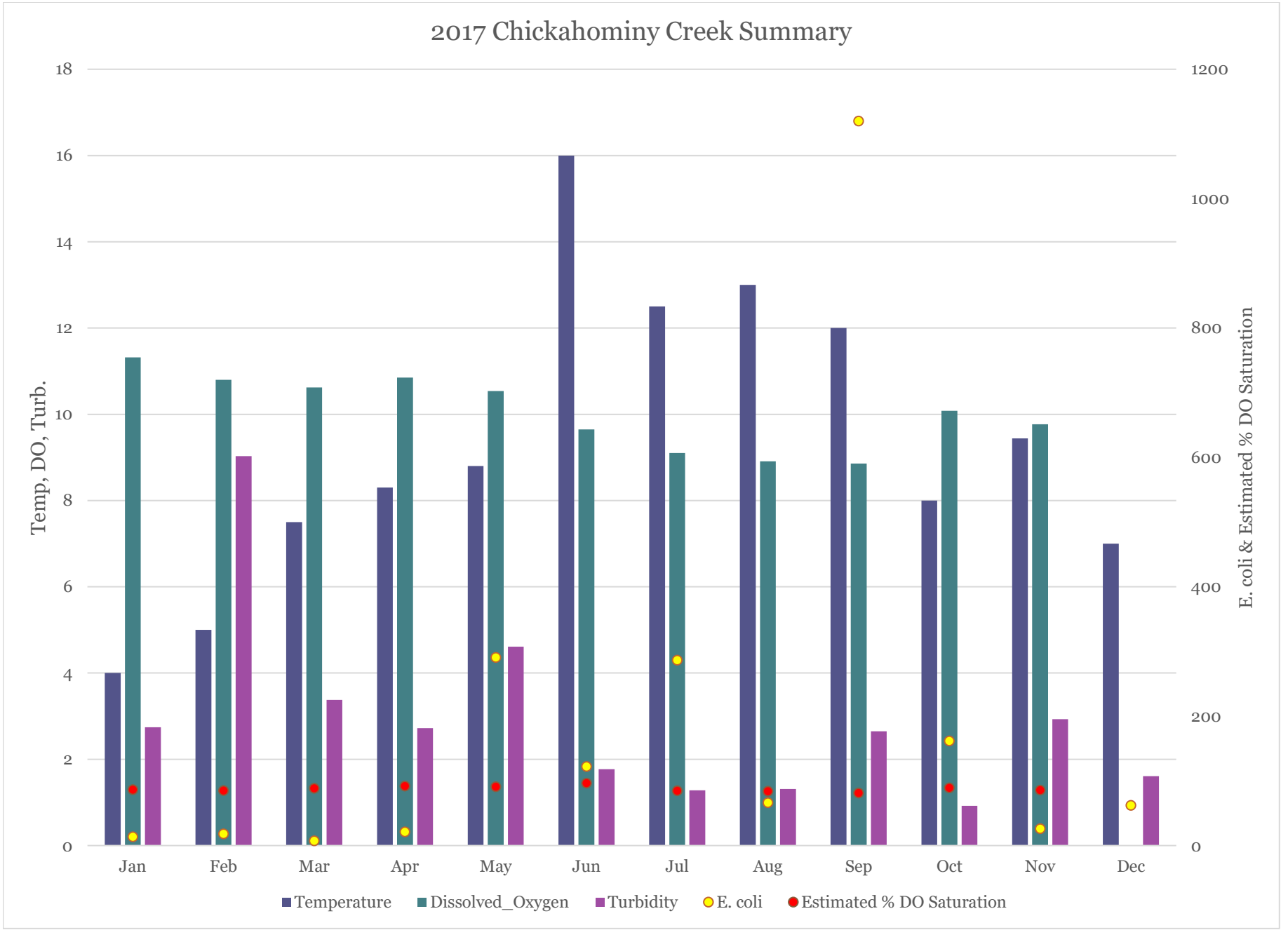
Laboratory Comments: _____

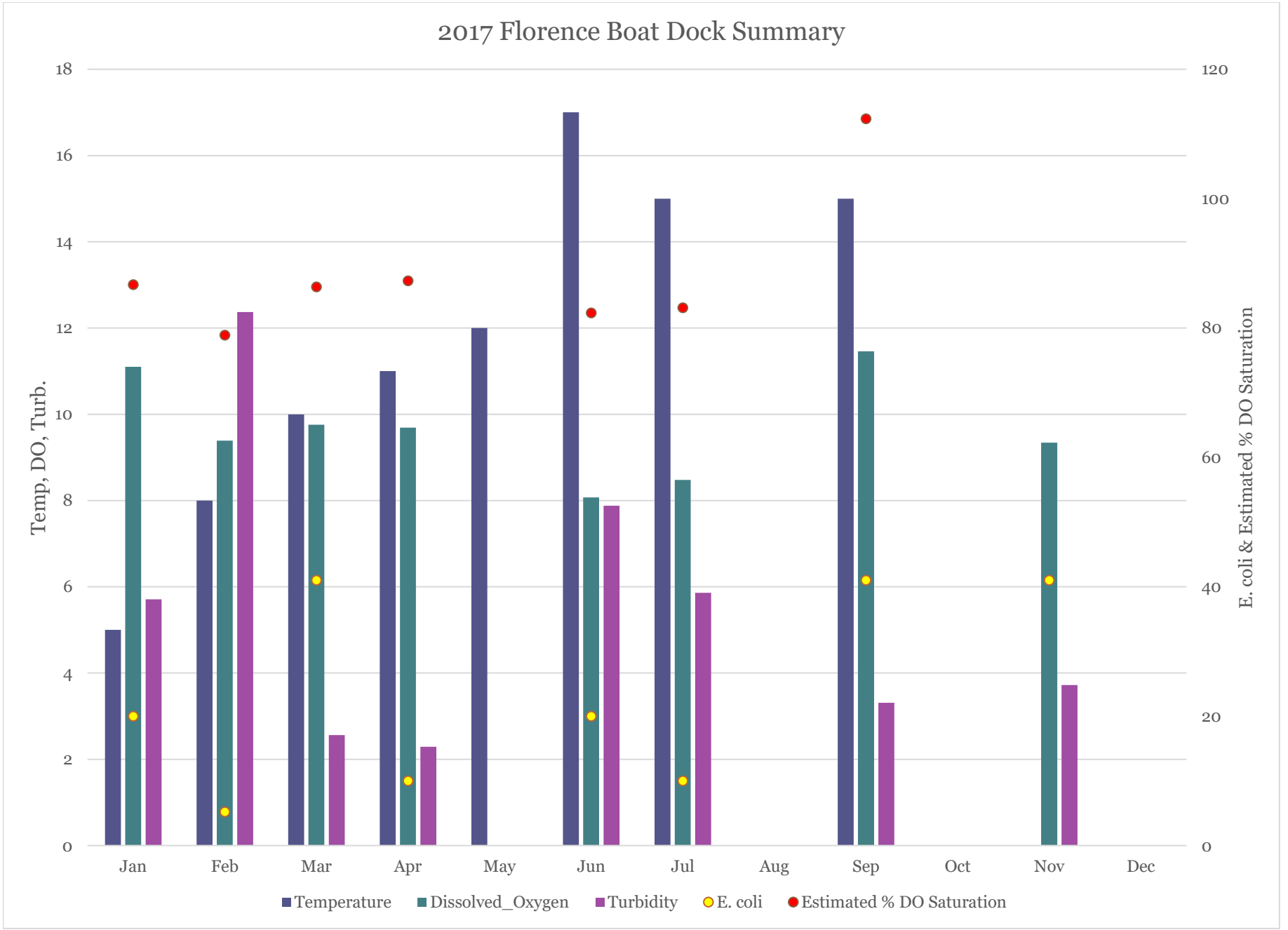
Contact Sample Tracker for proper sampling containers and preservation procedure at 503-229-5983

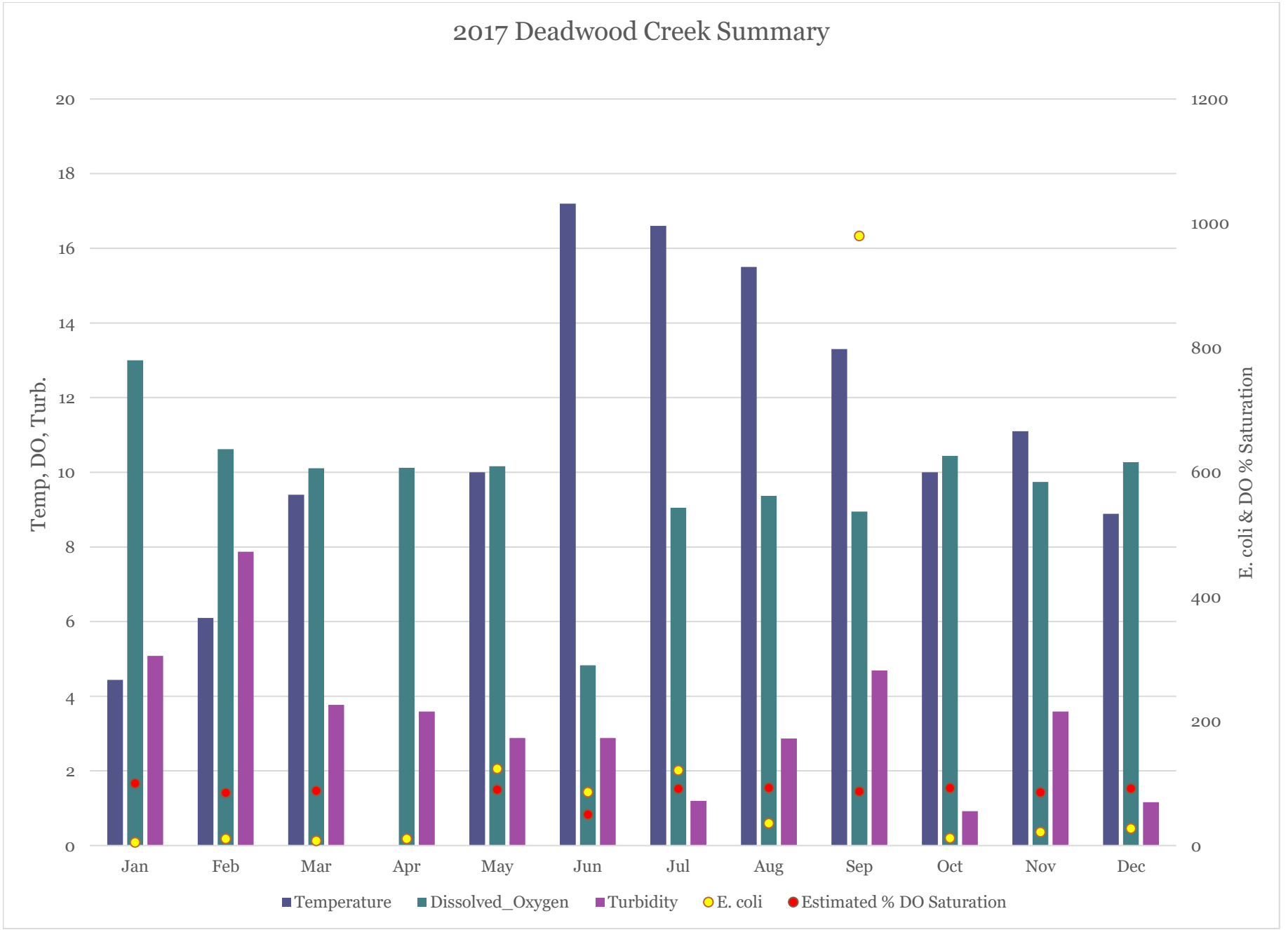
Figure 2 Blue Form

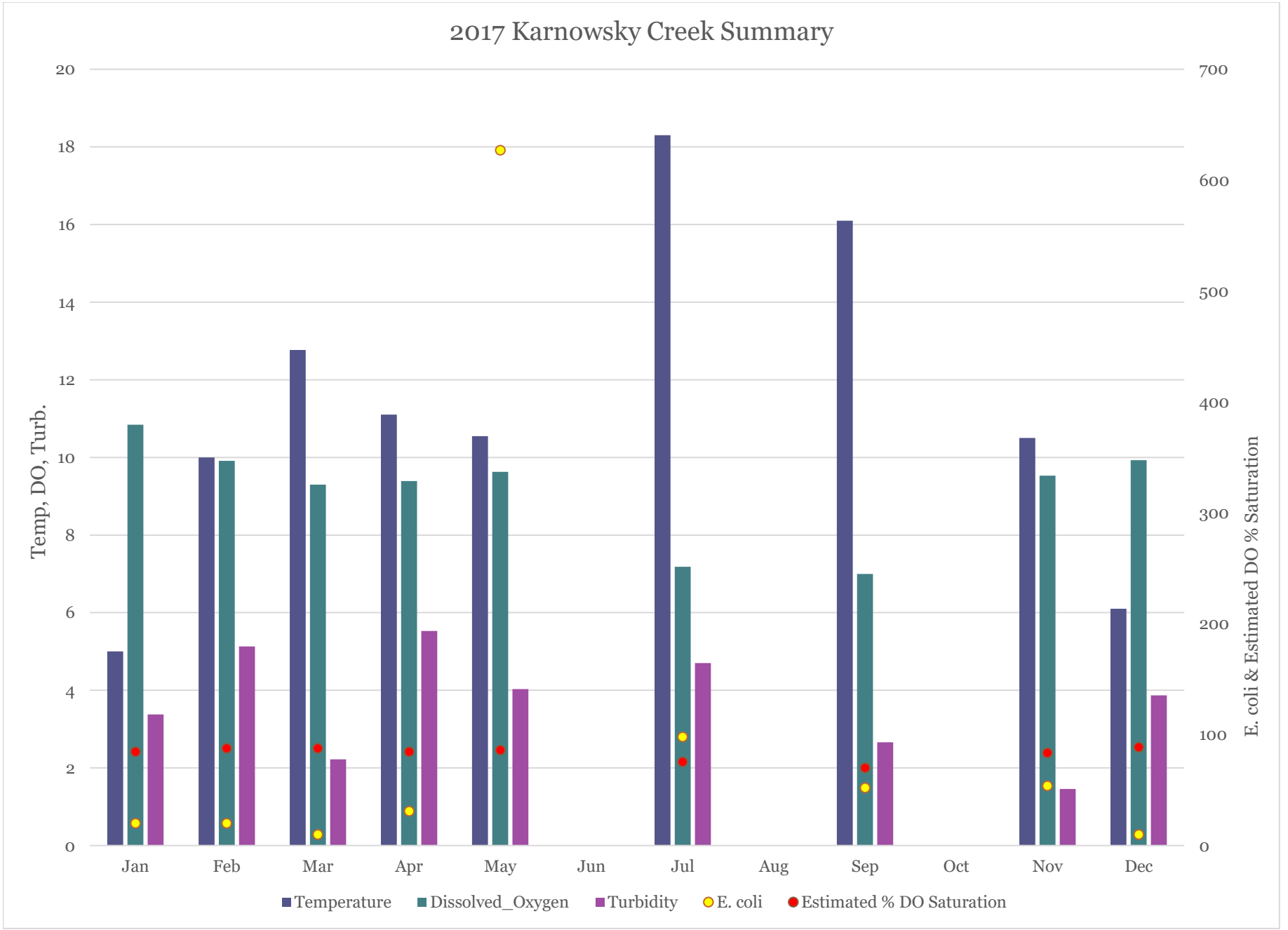
Appendix D

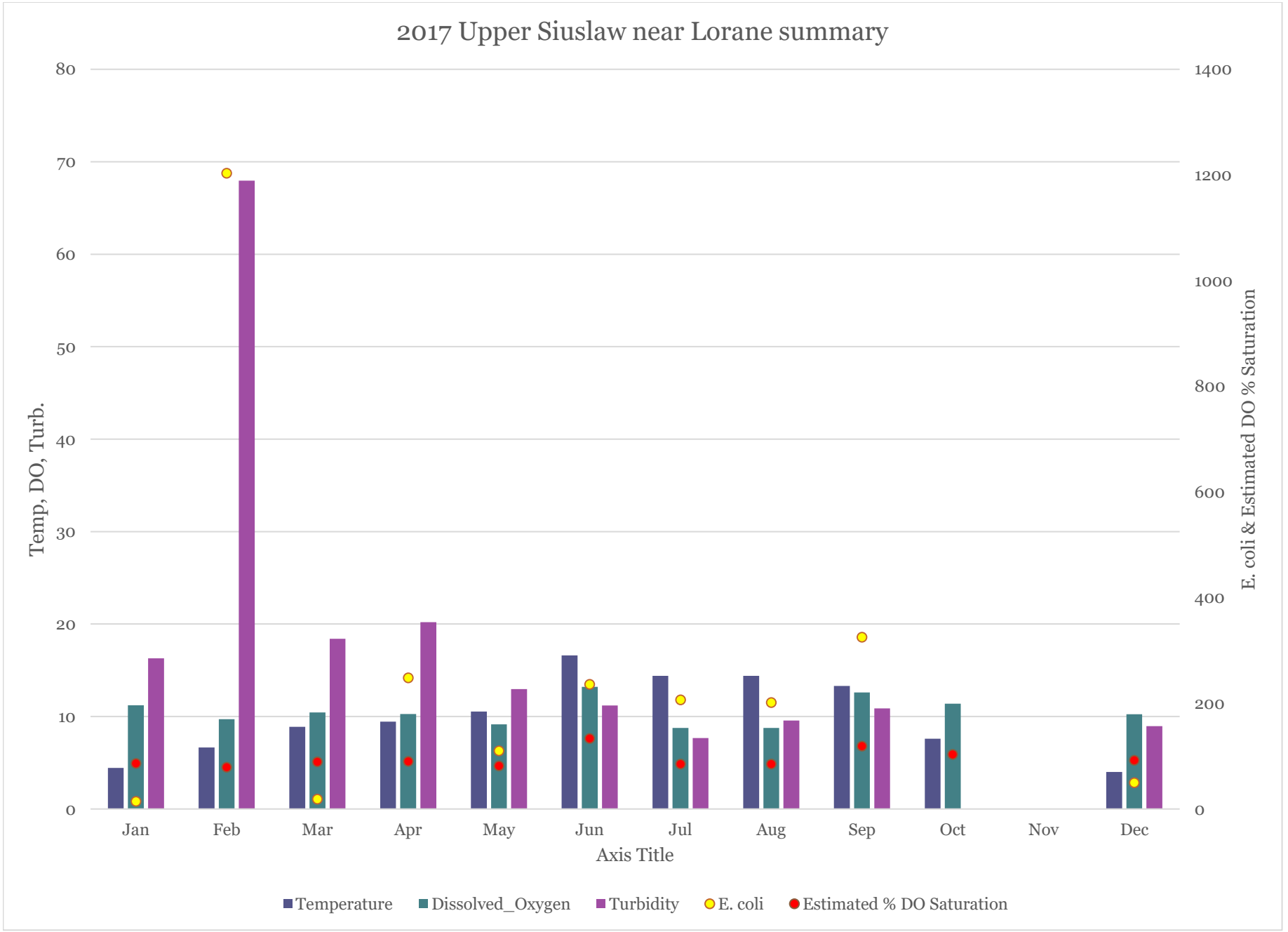

2017 Below Triangle Lake Summary
Temp, DO, Turb.
E. coli & Estimated % DO Saturation
25
20
15
10
5
0
120
100
80
60
40
20
0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Temperature
Dissolved_Oxygen
Turbidity
E. coli
Estimated % DO Saturation

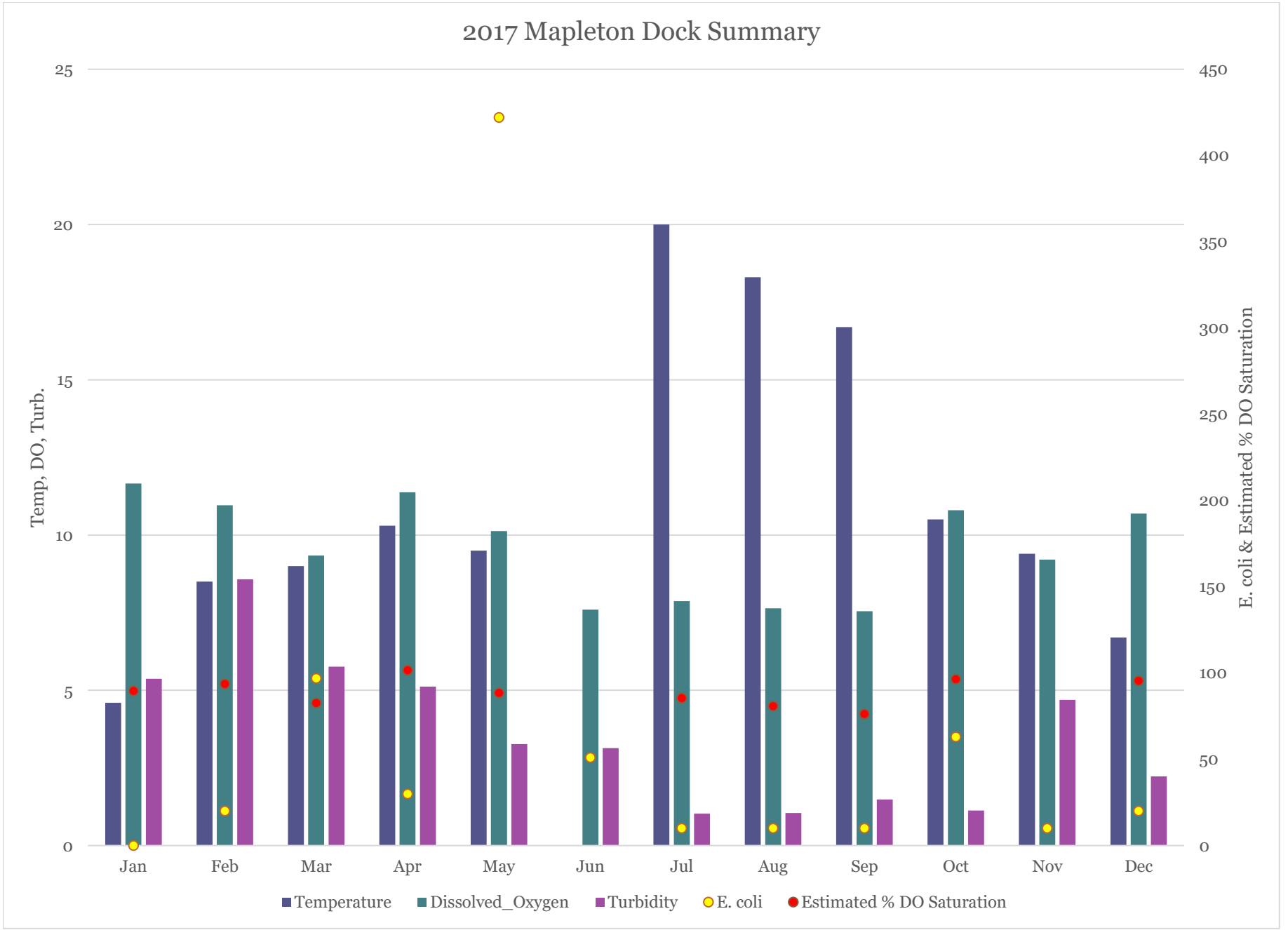

2017 Chickahominy Creek Summary
Temp, DO, Turb.
E. coli & Estimated % DO Saturation
0
2
4
6
8
10
12
14
16
18
0
200
400
600
800
1000
1200
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Temperature
Dissolved_Oxygen
Turbidity
E. coli
Estimated % DO Saturation

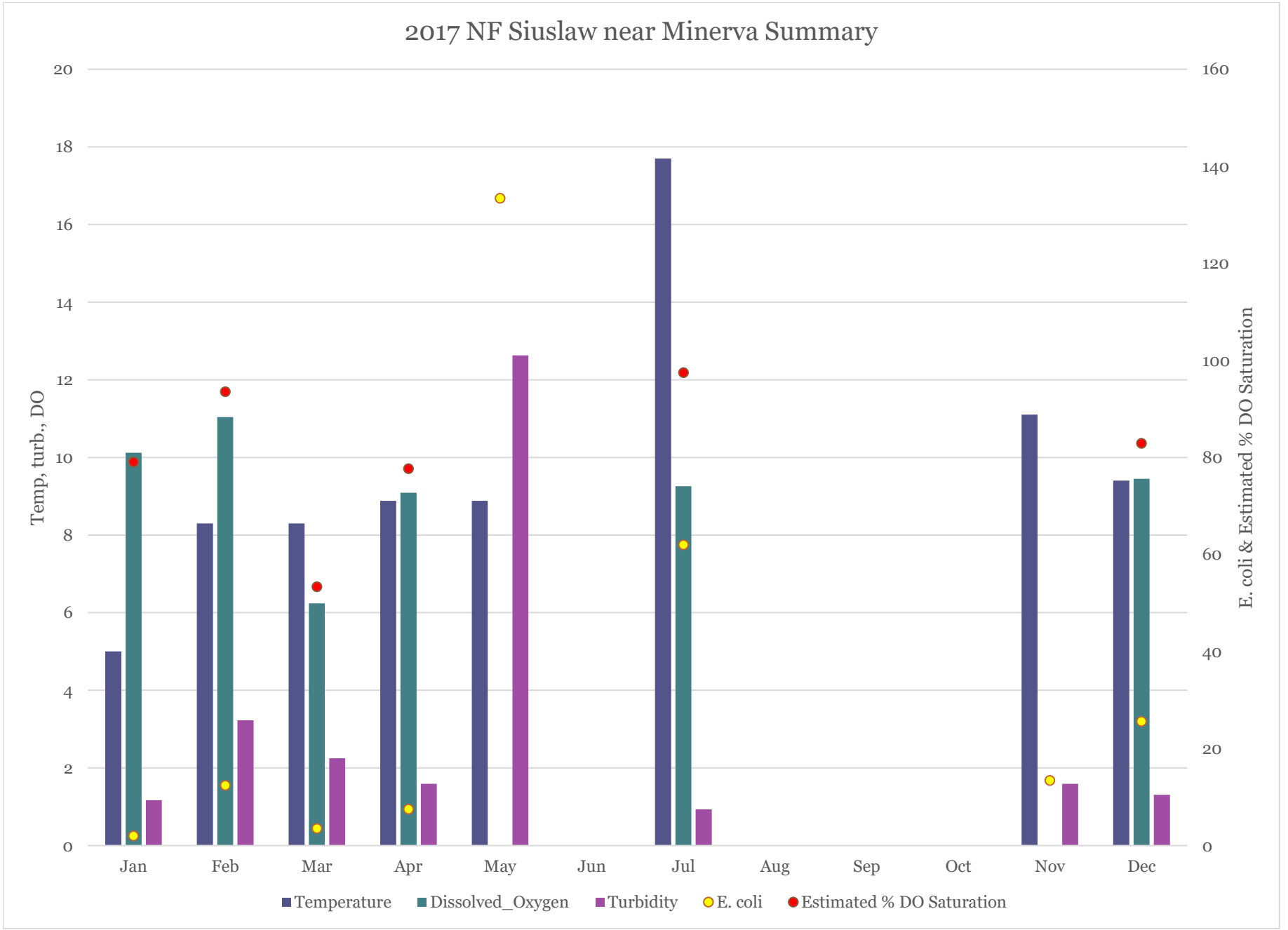

2017 Florence Boat Dock Summary
Temp, DO, Turb.
E. coli & Estimated % DO Saturation
0
2
4
6
8
10
12
14
16
18
0
20
40
60
80
100
120
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Temperature
Dissolved_Oxygen
Turbidity
E. coli
Estimated % DO Saturation

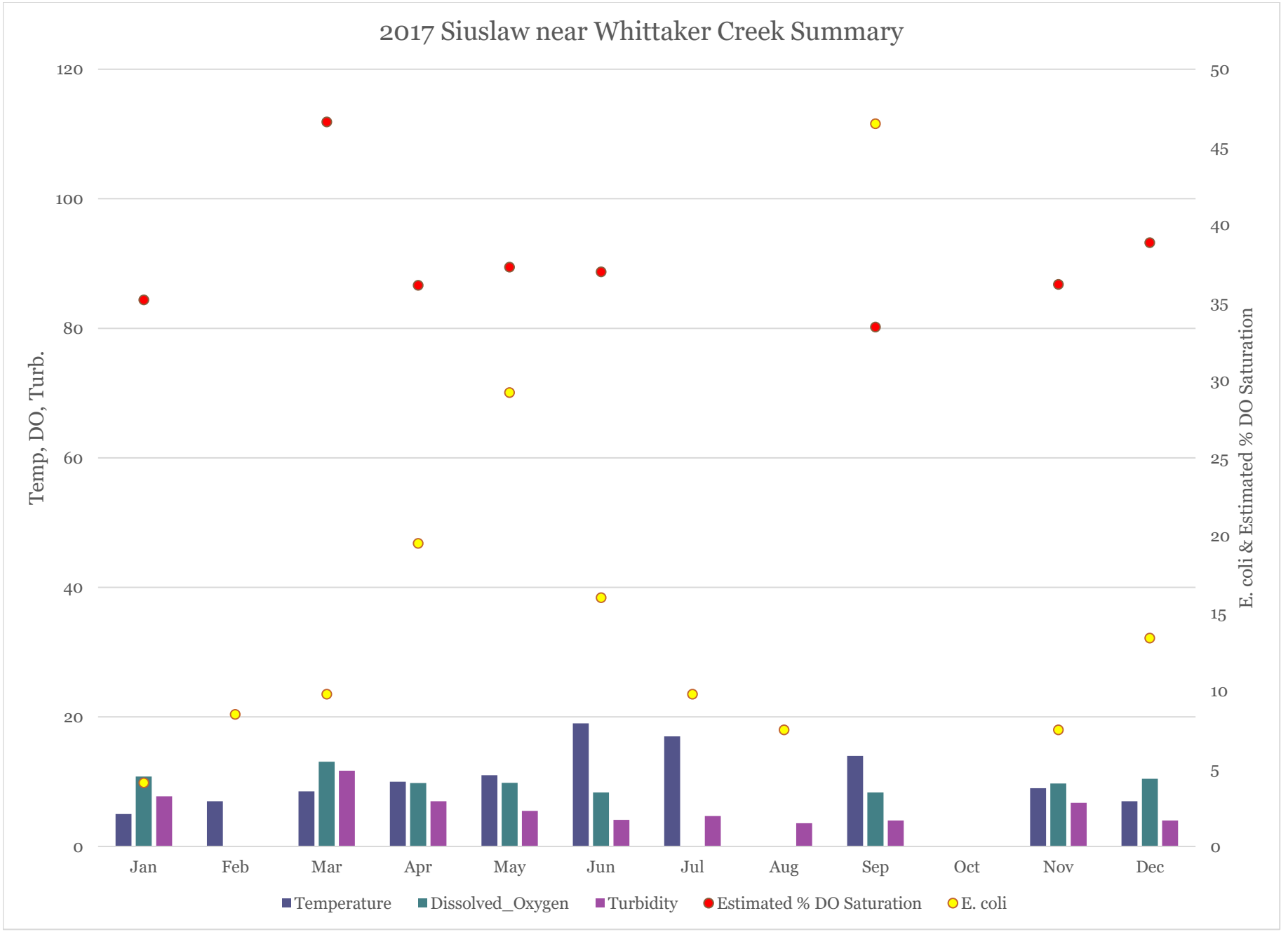

2017 Deadwood Creek Summary
Temp, DO, Turb.
E. coli & DO % Saturation
0
2
4
6
8
10
12
14
16
18
20
0
200
400
600
800
1000
1200
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Temperature
Dissolved_Oxygen
Turbidity
E. coli
Estimated % DO Saturation

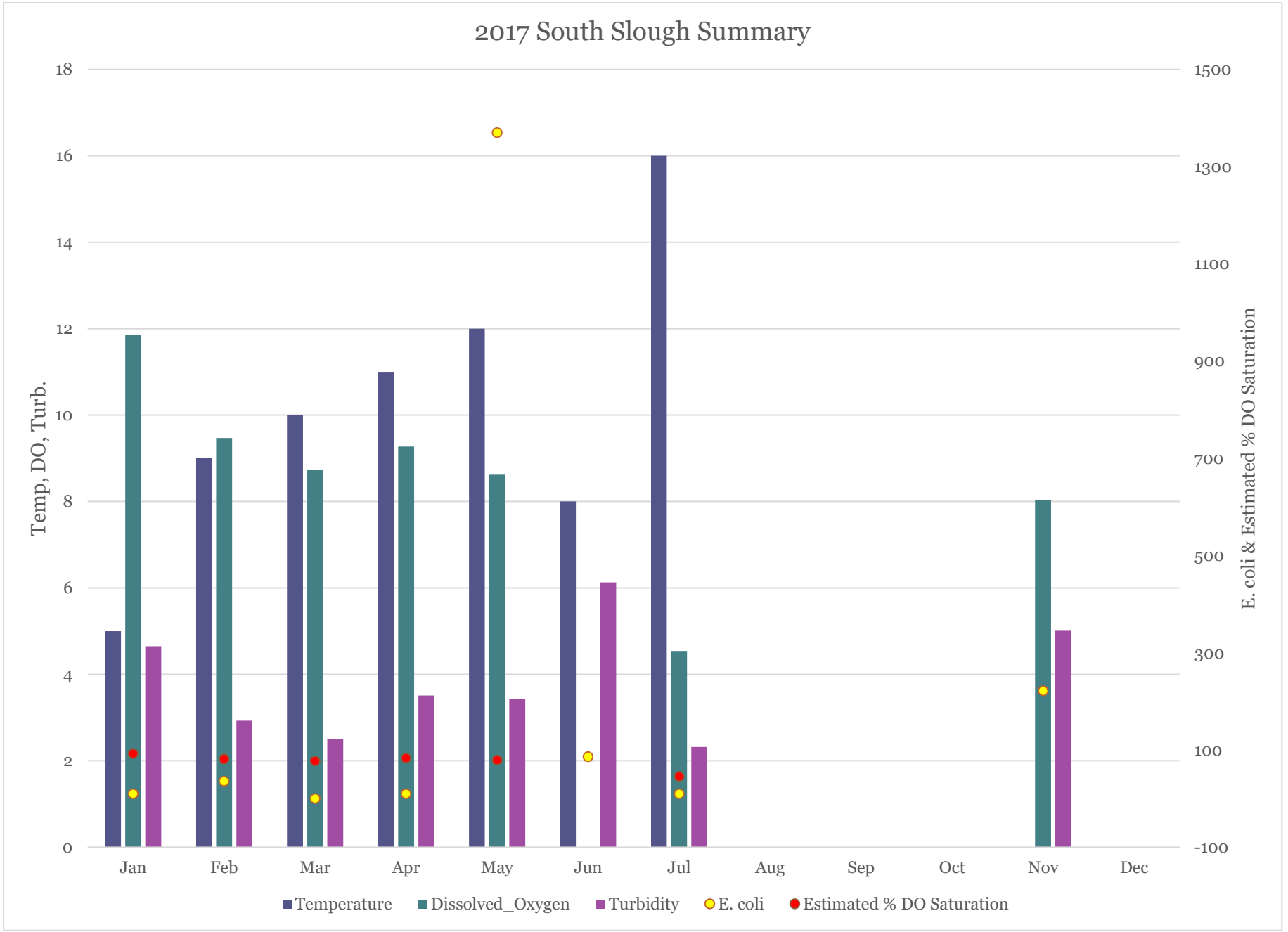

2017 Karnowsky Creek Summary
Temp, DO, Turb.
E. coli & Estimated DO % Saturation
0
2
4
6
8
10
12
14
16
18
20
0
100
200
300
400
500
600
700
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Temperature
Dissolved_Oxygen
Turbidity
E. coli
Estimated % DO Saturation

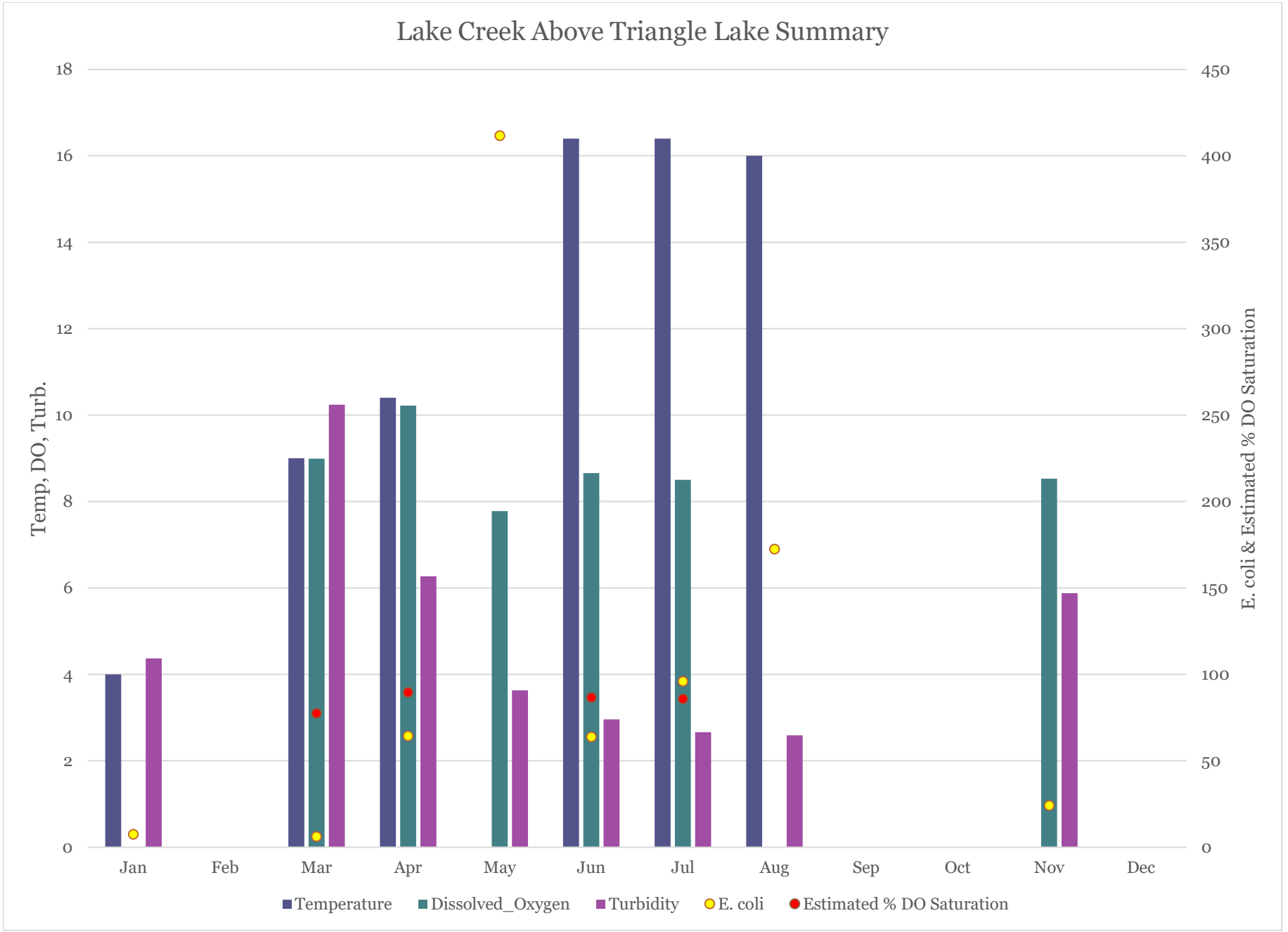

2017 Upper Siuslaw near Lorane summary
Temp, DO, Turb.
E. coli & Estimated DO % Saturation
80
70
60
50
40
30
20
10
0
1400
1200
1000
800
600
400
200
0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Axis Title
Temperature
Dissolved_Oxygen
Turbidity
E. coli
Estimated % DO Saturation

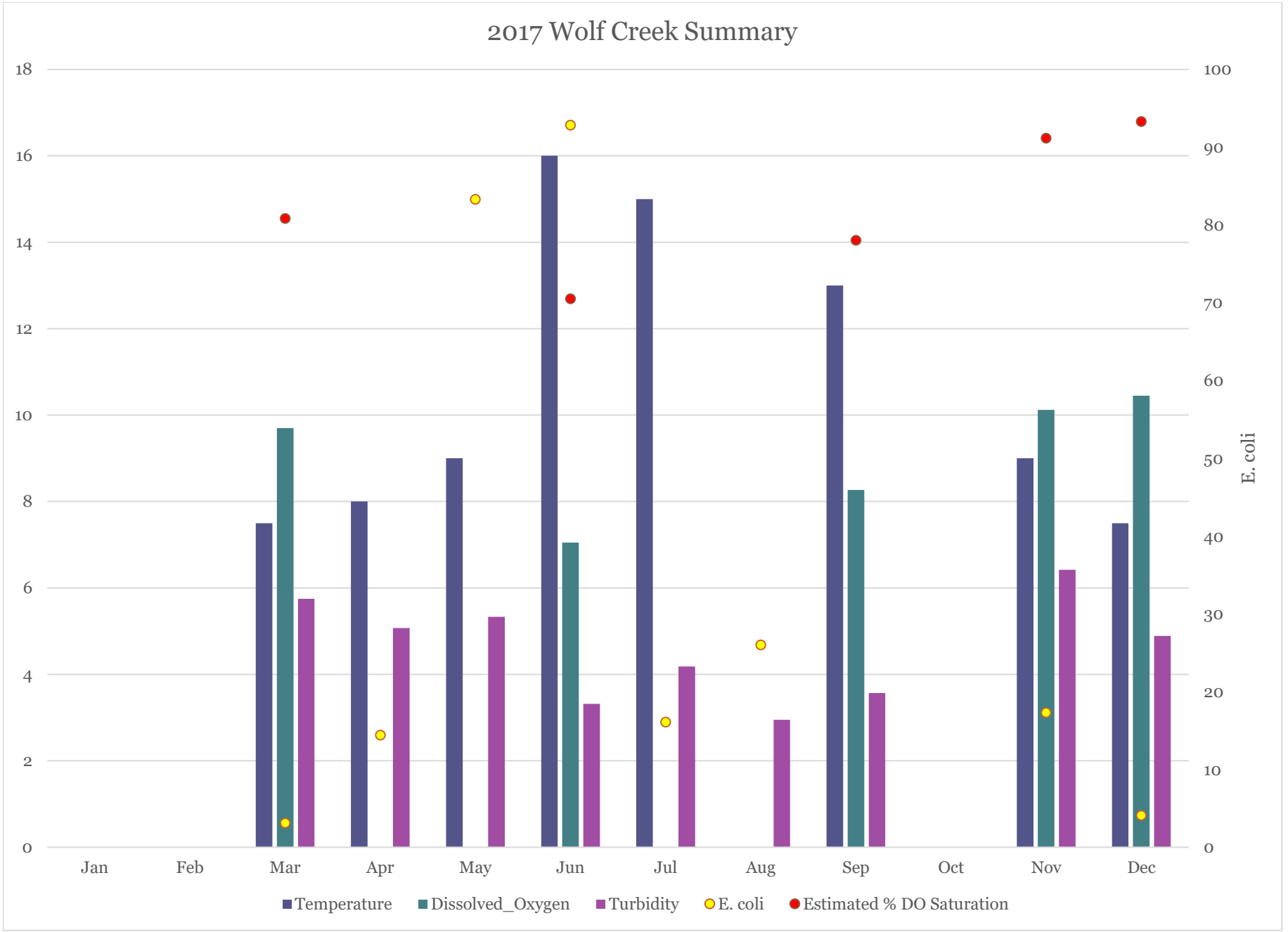

2017 Mapleton Dock Summary
Temp, DO, Turb.
E. coli & Estimated % DO Saturation
25
20
15
10
5
0
450
400
350
300
250
200
150
100
50
0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Temperature
Dissolved_Oxygen
Turbidity
E. coli
Estimated % DO Saturation


2017 NF Siuslaw near Minerva Summary
Temp, turb., DO
E. coli & Estimated % DO Saturation
0
2
4
6
8
10
12
14
16
18
20
0
20
40
60
80
100
120
140
160
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Temperature
Dissolved_Oxygen
Turbidity
E. coli
Estimated % DO Saturation


2017 Siuslaw near Whittaker Creek Summary
Temp, DO, Turb.
E. coli & Estimated % DO Saturation
120
100
80
60
40
20
0
50
45
40
35
30
25
20
15
10
5
0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Temperature
Dissolved_Oxygen
Turbidity
Estimated % DO Saturation
E. coli


2017 South Slough Summary
Temp, DO, Turb.
E. coli & Estimated % DO Saturation
18
16
14
12
10
8
6
4
2
0
1500
1300
1100
900
700
500
300
100
-100
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Temperature
Dissolved_Oxygen
Turbidity
E. coli
Estimated % DO Saturation


Lake Creek Above Triangle Lake Summary
Temp, DO, Turb.
E. coli & Estimated % DO Saturation
0
2
4
6
8
10
12
14
16
18
0
50
100
150
200
250
300
350
400
450
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Temperature
Dissolved_Oxygen
Turbidity
E. coli
Estimated % DO Saturation


2017 Wolf Creek Summary
18
16
14
12
10
8
6
4
2
0
100
90
80
70
60
50
40
30
20
10
0
E. coli
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Temperature
Dissolved_Oxygen
Turbidity
E. coli
Estimated % DO Saturation