Skagit County Monitoring Program

SCMP

Annual Report

2020 Water Year
(October 2019 – September 2020)

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April 2021

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Acknowledgements

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Definitions

Ag-CAO	-	Critical Areas Ordinance: Ongoing Agriculture
Ag-NRL	-	Agricultural Natural Resource Lands
BMP	-	Best Management Practice
County	-	Skagit County
CSI	-	Clean Samish Initiative
CV	-	Coefficient of Variation
DO	-	Dissolved Oxygen
Ecology	-	Washington State Department of Ecology
EPA	-	Environmental Protection Agency
FC	-	Fecal Coliform
GMHB	-	Growth Management Hearings Board
MPN	-	Most Probable Number
NH3	-	Ammonia
NO3+NO2	-	Nitrate + Nitrite
NTU	-	Nephelometric Turbidity Units
OP	-	Ortho-Phosphorous
pH	-	Power of Hydrogen
PIC	-	Pollution Identification and Correction
QAPP	-	Quality Assurance Project Plan
RR-NRL	-	Rural Resource Natural Resource Lands
RSD	-	Relative Standard Deviation
SCC	-	Skagit County Code
SCMP	-	Skagit County Monitoring Program
7-DADMax	-	7-Day Average of Daily Maximum Temperatures
SRC	-	Site Report Card
TKN	-	Total Kjeldahl Nitrogen
TMDL	-	Total Maximum Daily Load
TP	-	Total Phosphorous
TSS	-	Total Suspended Solids
VSP	-	Voluntary stewardship Program
WQI	-	Water Quality Index
WRC	-	State of Washington Water Research Center
WY	-	Water Year

Executive Summary

Skagit County Public Works has completed the seventeenth year of water quality monitoring under the Skagit County Water Quality Monitoring Program, and this is the seventeenth annual report, for the 2020 water year.

Data collected during this project indicates that many Skagit County streams, within and outside of the agricultural areas, do not meet state water quality standards for fecal coliform, temperature, and/or dissolved oxygen. None of the 39 sites has met all water quality standards for the entire project, although some sites meet the standards most of the time. The standards are developed to protect salmonid populations, recreation, and downstream shellfish resources, so streams not meeting the standards represent less-than-ideal conditions for those uses. Conditions in Skagit County streams range from watercourses with occasional failures to a pattern of continual inability to meet the standards. The Samish and Skagit Rivers have shown drastic improvement and a strong ratio of positive trends over the course of this program. Most of the substandard water quality occurs in slow-moving agricultural sloughs and in creeks that have low flow in the warmer months. Further investigation is ongoing to determine the causes of poor water quality in each case. Some cases may represent natural conditions rather than human-caused problems.

Trends analyses looking at water temperature, dissolved oxygen, fecal coliform concentration, and other metrics reveal strong differences between watersheds and timeframes across the county. Some watersheds have a majority of negative trends across a seventeen year period, but show a majority of positive trends in a more recent timeframe, such as the last five years.

The majority of trends in fecal coliform reduction county-wide are positive over all three analyzed time periods, and can only be a result of the hard work and dedication of the residents, farmers, tribes, government, environmental groups, establishing and enforcing strong regulations, and continued vision for a clean and sustainable environment that the citizens of Skagit County and the state of Washington continually portray. These improvements in water quality will continue to shine as an example for other communities and states across the country. Dissolved oxygen trends across all timeframes across the valley show a majority of positive increase, despite an abundant increase in water temperatures. This may suggest large reductions on biological oxygen demand in the watercourses, and is great news for salmon.

It is the intention of the author that this new format of report be used as the means to sit down and form action plans to address trends in watercourses and sampling sites. The site report cards (SRCs), trends maps, and tabled trends summaries can paint a picture of the overall water quality at each site, in an effort to inform future action and to most efficiently direct public resources and efforts.

The Skagit County Water Quality Monitoring Program has now collected 17 years of high-quality data. Questions on the program can be addressed to Kevin Jackman at kevinj@co.skagit.wa.us or 360-416-1443

What's New and What's Next

There was a lot of new content in last year's report, there is more in this year's report, and sure enough, there will be more on the way in next year's report!

Changes in this year's Water Year 2020 report include:

- Historical site sampling times – See the time windows that the ambient sites have been sampled in over seventeen years, and in the most recent year.
- Historical precipitation and air temperatures – See how much rain has been recorded every month for the entire seventeen year program, and what the average monthly air temperature was. Summary statistics show how a month or year compares to the averages and extremes of the others.
- Site Report Cards have several changes:
    - Addition of more sensitive statistical findings to complement the Up or Down arrows in the trends analysis graphics
    - Removal of the traditional line graphs for water temperature, dissolved oxygen, and fecal coliform. As the program completes more and more years of data collection, traditional line graphs become ungainly and difficult to visually interpret
    - Addition of 3D graphs to replace traditional line graphs. These graphs offer a greater visual understanding of a very large dataset that exhibits a lot of seasonality.
    - Addition of boxplots to assist in visualization of the historical seasonality of each month at each sampling site. This is a different arrangement of information than the 3D plots, and makes a great complement.
    - An introduction section to help assist in interpreting the new plots and figures.

Changes in the works for next year's report include:

- A sampling dataset that includes fecal coliform AND E. coli sampling at every site, all year. The new state standard for recreational water quality, as set forth by the State Department of Ecology, is E. coli. The existing standard on which the outstanding TMDLs were created remains fecal coliform. The standard for shellfish harvesting, as determined by the State Department of Health, will remain as fecal coliform as well. To achieve the aims of all three of these standards, the SCMP will now sample both metrics at each site.
- Addition of new sampling sites and removal of some existing sampling sites. The SCMP is adapting to new changes and information, and will adjust the sites on the sampling route according to their necessity and value to the program and the public.

Skagit County Monitoring Program Annual Report

2020 Water Year
(October 2019-September 2020)

Introduction

The Skagit County Monitoring Program (SCMP) began in October 2003 as part of Skagit County's (County) program to assess the effectiveness of Skagit County Code (SCC) Chapter 14.24.120: Critical Areas Ordinance for Areas of Ongoing Agriculture (Ag-CAO). The revised ordinance (Skagit County Ordinance O20030020) was passed by the Skagit County Board of Commissioners in June 2003 in response to a compliance order from the Western Washington Growth Management Hearings Board (GMHB).

The ordinance requires farmers to "do no harm" to adjacent watercourses and relies on specific watercourse protection measures and more generalized best management practices (BMPs) to protect the watercourses instead of requiring buffers. The associated Skagit County Resolution R20030210 committed the County to conduct water quality monitoring in the agricultural areas as one method of assessing if the ordinance was sufficient to protect the aquatic resources in agricultural areas. The resolution was subsequently amended in June 2004 as Resolution R20040211 in response to additional compliance orders from the Western Washington GMHB. This second resolution provided details about the water quality monitoring program in addition to other topics not associated with water quality. Included in R20040211 is the requirement for annual reporting on the water quality monitoring program. This document is intended to satisfy that requirement for the 2020 Water Year (WY).

R20040211 also required the County to conduct a triennial review of the Ag-CAO, including the water quality monitoring program, to seek public comment and to make changes if necessary. However, the State of Washington passed SSB 5248 in 2007, which placed a "time out" on changes to critical areas regulations impacting agriculture until 2010, while the statewide issues regarding agricultural regulation were studied. The legislature subsequently passed additional legislation to extend the "time out" to 2011. In 2011, the Washington State Legislature adopted the recommendations from one research group studying the critical areas regulations and created the Voluntary Stewardship Program (VSP). Skagit County enrolled in the program in 2012. Any county that enrolled agreed to maintain existing critical areas protections and ensure streams are protected using voluntary measures.

Sampling Locations

Figure 1 is a map with the sampling sites monitored by the SCMP, while **Table 1** and **Table 2** list the sampling site's names and their designations. Forty sites are currently included in the program. These sites are located primarily in agricultural zones, designated by the County as Agriculture-Natural Resource Lands (Ag-NRL) and Rural Resource-Natural Resource Lands (RR-NRL). Other sites were selected to provide context to, and comparisons with, the sites in the agricultural zones. These include sites located just upstream or downstream of agricultural areas or in streams draining suburban watersheds. The SCMP was designed to determine current conditions and long-term trends in water quality at these sampling locations. The data is also suitable for determining compliance with state water quality standards.

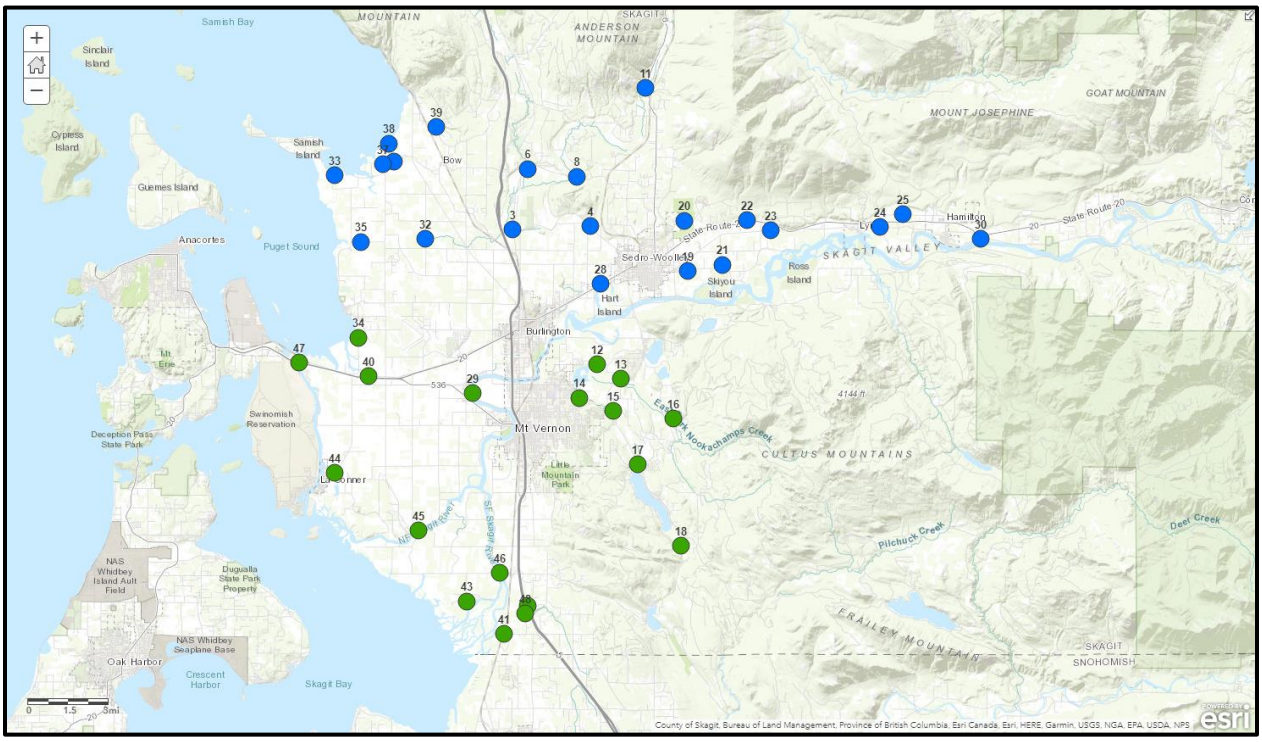


Figure 1 – Ambient sampling sites in the SCMP

A secondary purpose for some of the sites included in the SCMP is to provide data to the Washington State Department of Ecology (Ecology) in support of their Total Maximum Daily Load (TMDL) or water cleanup programs in Skagit County. The sites that provide TMDL data are also in the agricultural zones and are integral to the determination of trends and conditions in those areas. Active water cleanup plans in Skagit County include the Lower Skagit Tributaries Temperature TMDL, the Samish Bay Watershed Fecal Coliform TMDL, and the Lower Skagit River Fecal Coliform TMDL. Improvements made as a result of the latter program indicate that the Lower Skagit River is a candidate for removal from Ecology's Impaired Waters list.

Table 1 - Sample site locations and types in the SCMP

Site Number	Watercourse	Location	Latitude	Longitude	Site Type[1]
3	Thomas Creek	Old Hwy 99 N	48.526	-122.339	3
4	Thomas Creek	F&S Grade Rd	48.528	-122.276	2
6	Friday Creek	Prairie Rd	48.559	-122.327	4
8	Swede Creek	Grip Rd	48.555	-122.287	3
11	Samish River	State Route 9	48.602	-122.231	1
12	Nookachamps Creek	Swan Rd	48.454	-122.270	3,6
13	E.F. Nookachamps Creek	State Route 9	48.446	-122.251	3,6
14	College Way Creek	College Way	48.436	-122.286	4
15	Nookachamps Creek	Knapp Rd	48.429	-122.258	2,6
16	E.F. Nookachamps Creek	Beaver Lake Rd	48.424	-122.208	2,6
17	Nookachamps Creek	Big Lake Outlet	48.400	-122.237	1,6
18	Lake Creek	State Route 9	48.356	-122.202	1,6
19	Hansen Creek	Hoehn Rd	48.504	-122.197	3,6
20	Hansen Creek	Northern State	48.531	-122.199	1,6
21	Coal Creek	Hoehn Rd	48.507	-122.169	3
22	Coal Creek	Hwy 20	48.531	-122.149	1
23	Wiseman Creek	Minkler Rd	48.526	-122.130	1
24	Mannser Creek	Lyman Hamilton Hwy	48.528	-122.041	2
25	Red Cabin Creek	Hamilton Cem. Rd	48.534	-122.023	1
28	Brickyard Creek	Hwy 20	48.497	-122.268	4
29	Skagit River	River Bend Rd	48.439	-122.372	5,6
30	Skagit River	Cape Horn Rd	48.521	-121.960	5
32	Samish River	Thomas Rd	48.521	-122.410	3
33	Alice Bay Pump Station	Samish Island Rd	48.555	-122.483	3
34	No Name Slough	Bayview-Edison Rd	48.468	-122.464	3
35	Joe Leary Slough	D'Arcy Rd	48.520	-122.462	3
36	Edison Slough at school	W. Bow Hill Rd	48.562	-122.436	3
37	Edison Pump Station	Farm to Market Rd	48.561	-122.444	3
38	North Edison Pump Station	North Edison Rd	48.572	-122.441	3
39	Colony Creek	Colony Rd	48.581	-122.401	2
40	Big Indian Slough	Bayview-Edison Rd	48.447	-122.457	3
41	Maddox Slough/Big Ditch	Milltown Rd	48.309	-122.346	3
42	Hill Ditch	Cedardale Rd	48.324	-122.327	3
43	Wiley Slough	Wylie Rd	48.326	-122.372	3
44	Sullivan Slough[2]	La Conner-Whitney	48.395	-122.485	3
45	Skagit River – North Fork	Moore Rd	48.364	-122.416	5,6
46	Skagit River – South Fork	Fir Island Rd	48.342	-122.349	5,6
47	Swinomish Channel	County Boat Launch	48.455	-122.512	7
48	Fisher Creek	Franklin Rd	48.320	-122.328	3,6

[1]See Table 2 for site type descriptions
[2]Site 44 was moved to its current location in June, 2005. See text for details

Table 2 - Sample site type descriptions for the SCMP

Site Type Number	Description	Number of Sites[1]
1	Ag-upstream: Located to determine status/trends at upstream end of agricultural areas.	6
2	Ag-midstream: Located to determine status/trends in the middle of agricultural areas.	6
3	Ag-downstream: Located to determine status/trends at downstream end of a watercourse in agricultural areas.	20
4	Reference: Located to determine status/trends in a non-agricultural area, such as urban/suburban or rural reserve, for comparison with agricultural area results.	3
5	Skagit River: Located to determine status/trends in the mainstem Skagit River or the forks. The Skagit may show effects from a wide variety of sources.	4
6	TMDL: Located to provide information for the Department of Ecology's TMDL efforts.	12
7	Swinomish Channel: Located to provide a water quality baseline for Swinomish Channel	1

[1]Some sites have more than one type designation

Sample Site Revisions

Nineteen of the 40 sites (sites 3-25) are continued from the Skagit County Baseline Monitoring Project (Skagit County 2004a). The Baseline project used nearly identical methods to monitor water quality at 27 sites. Five additional sites were part of the Samish Bay Watershed Water Quality Monitoring Program (Skagit County 2003). The data from the Baseline and Samish Projects is used to help interpret trends in water quality for sites continued in the SCMP. Not all of the Baseline sites could be continued into the current program due to limited resources and the need to expand the current program into the Skagit Delta, where there were no Baseline sites. Several intermediate sites on the Samish River were discontinued, leaving one upstream and one downstream site on the Samish.

Three sample sites were moved from their original locations as delineated in the Quality assurance Project Plan (QAPP). Site 35 on Joe Leary Slough was moved approximately 3,500 feet upstream from Bayview-Edison Road to D'Arcy Road to solve right-of-entry problems. Site 40 on Big Indian Slough was moved approximately 2,800 feet upstream to solve right-of-entry problems and to move away from the tide gate and associated saltwater intrusion. These two changes were made prior to any sampling. Site 42 on Hill Ditch/Carpenter Creek was moved approximately 4,300 feet upstream because the original site at Pioneer Highway was subject to backwater from the Skagit River, and in early samples it was determined that primarily Skagit River water was being sampled instead of Hill Ditch/Carpenter Creek water. These changes were approved by Ecology as revisions to the QAPP in 2003 and 2004.

In June 2005, the sample site at Rexville Pump Station (Site 44), at the east end of the Sullivan Slough watershed, was moved to the west end of Sullivan Slough, at La Conner-Whitney Road. This move was made in consultation with Ecology and the Western Washington Agricultural Association. The majority of flow from that system discharges through the west end into Swinomish Channel. The Rexville Pump Station site was initially chosen because it was cited as a possible fecal coliform source in the Lower Skagit Fecal Coliform TMDL (Pickett 1997). However, fecal coliform (FC) readings at the site during this study were generally low, and coupled with the infrequent discharges from the pump station, it was determined that sampling efforts would be better spent nearer the outlet of the slough.

For the 2017 season, Skagit County re-designated two sites to better reflect current land use patterns: Site 16 (East Fork Nookachamps Creek) was moved from Ag-Upstream to Ag-Midstream due to some agricultural activity directly upstream of the sample location. Site 23 (Wiseman Creek) was moved from Ag-Midstream to Ag-Upstream due to the cessation of agricultural activities upstream of the sample location.

Results from the first sixteen years of this program have been reported previously (Skagit County 2004-2019). This current report contains data and analysis from water years 2004 – 2020.

Sampling Frequency

Ambient Sampling

Weekly or bi-weekly sampling on a regular schedule is often referred to as ambient sampling to distinguish it from storm sampling, which takes place in response to heavy rain events. All ambient sampling trips were conducted on schedule during the 2020 water year, beginning in October 2019. Sampling takes place on a different day each week, depending on scheduling and logistics.

Storm Sampling

As part of its Pollution Identification and Correction (PIC) Program, Skagit County conducts additional water quality sampling in the Samish Basin during significant rain events. Data collected during these rain events is not included in the tabulation of ambient sampling events to preclude undue influence of storm events on ambient trends analysis.

Clean Samish Initiative

The Clean Samish Initiative (CSI) was established by Ecology in the fall of 2008 to foster cooperation between local, state, tribal, and federal agencies, non-governmental groups, and citizens to address FC pollution in the Samish Bay Watershed. Excess FC pollution in the

Samish River and other bay tributaries has resulted in numerous closures of the commercial shellfish beds in Samish Bay. The CSI participants (over 20 organizations) developed a work plan that included education and outreach, detailed water quality sampling to locate pollution sources, referrals of landowners to resource agencies for pollution abatement, and enforcement of water quality and land use regulations if necessary. Skagit County applied for and received EPA funding in 2010 to conduct a PIC project in the Samish Basin, incorporating CSI work plan elements into a program designed to locate and eliminate FC pollution in the Samish Basin.

The CSI grew out of Ecology's TMDL activities in the Samish Basin. Ecology sampling demonstrated that the Samish River was the largest source of FC bacteria to Samish Bay. While some of the independent Samish Bay tributaries (e.g. Edison Slough and Colony Creek) and agricultural drainages also contribute bacterial pollution to Samish Bay, the comparatively high discharge rate of the river combined with occasional high coliform counts determined that the river was, and continues to be, the most important pollution source for Samish Bay.

2008 Review by the State of Washington Water Research Center

Skagit County contracted with the State of Washington Water Research Center (WRC) for a review of its water quality program. The WRC Review Report draft was received in March, 2008, and the final report was received in June 2008. The report is available at: www.skagitcounty.net/SCMP.

Skagit County is implementing the report recommendations as the budget allows. Recommendations that have already been incorporated into the program include expansion of the sampling program to better identify pollution source locations (through the PIC program), increased use of stream discharge information, and some of the statistical analysis recommendations.

Funding

A proposal was submitted in February 2003 to Ecology for consideration in its FY 2004 Centennial Clean Water Grants program. The proposal was accepted and a grant of nearly $500,000 was awarded to support five years of the monitoring program, fiscal year 2004 through fiscal year 2008.

The Centennial Clean Water Grant, that funded the program at 75%, ended in December 2008, with the remaining 25% having come from County funds. Work since that date has been funded by Skagit County's Clean Water Program (CWP). Skagit County has received some EPA funding to address Samish Bay watershed FC issues, but the core activities of the SCMP will continue to be funded out of the CWP.

Methods

Standard water quality monitoring methods are used in the SCMP. The methods are derived from several sources, including guidance from Ecology and the EPA. A brief description of monitoring procedures follows, and detailed monitoring procedures can be found in the QAPP developed for the program (Skagit County 2004b).

Each site in the monitoring program is visited every two weeks. At each visit, dissolved oxygen (DO), temperature, pH, turbidity, conductivity, and salinity are measured and samples are obtained for FC determinations. Additional water samples are obtained for laboratory quantification of plant nutrients (total nitrogen (TKN), ammonia (NH3), nitrate (NO3), nitrite (NO2), total phosphorus (TP), orthophosphate (OP), and total suspended solids (TSS)) on a quarterly basis. Stream discharge was measured at selected sites as time and staffing permitted through 2008.

The sample routes are designed so that each station is visited at approximately the same time of day on each visit, to minimize the effects of diurnal variation in water quality parameters on overall data variability through the length of the program.

Data is collected on paper field sheets and later entered into an electronic database which is then checked for accuracy against the original data sheets. Microsoft Excel spreadsheets are used for data summary and analysis. These spreadsheets are also published on the County's web site: http://www.skagitcounty.net/SCMP

Data Analysis

Summary statistics for all measured parameters at each sampling site can be found in **Appendix B**. These statistics can be used as a general indication of water quality conditions at each station. However, water quality conditions vary greatly at each station over time and the summary statistics should not be used as a sole indicator of water quality.

A primary goal of the SCMP is to detect trends in water quality over time. The purpose of the trends analysis is to provide indications of whether water quality in agricultural areas is improving, staying the same, or deteriorating. Once trends are detected, efforts should be undertaken to determine if the they are caused by local activities or by regional conditions such as changes in climate. By comparing trends at stations inside and outside of the agricultural areas and by monitoring climate conditions, it should be possible to determine conditions that are likely caused by local circumstances.

One important statistical tool in trends monitoring is the Seasonal Kendall's Test. This test is designed to determine overall trends in water quality for parameters that vary seasonally, such as temperature and DO. The Seasonal Kendall's Test has been widely employed for similar purposes in Washington, Oregon, and throughout the country (e.g. Cude 2002, Ehinger 1993, Holdeman et al 2003). Most parameters measured in the SCMP have seasonal variation, caused by our local climate, which produces comparatively high water flows and low

temperatures in the winter and spring, and lower flows with higher temperatures in the summer and early fall.

The Seasonal Kendall's Test for this report was computed using Sanitas software (Intelligent Design Technologies, 1998). For most analyses, twelve seasons were designated, starting with the beginning of each month. This approach was recommended in the review of the SCMP by the WRC. Observations below detection limits were replaced with one-half of the detection limit per the software user manual. The software was able to ignore missing data, so no accommodation for missing data was necessary.

The SCMP completed trends analysis via the Seasonal Kendall's Test for 18 key parameters or calculated factors at each sampling location. The parameters tested include pH, DO, DO% saturation, temperature, turbidity, FC, NH3, NO3+NO2, TP, OP, TKN, and TSS. Temperature data from biweekly sampling visits were used for this analysis instead of continuous data collected during the summer months because the test is not designed for summer-only data. Skagit County continues to examine methods for determining trends in the continuous temperature data. Since the temperature data from bi-weekly visits was collected at the same time of day for any individual station, the trends analysis should not be biased by differences caused by sampling time of day.

Three periods were analyzed for trends in this report: The 17 full years of SCMP data, the most recent ten years of data, and the most recent five years of data. Analyzing trends over three different timeframes allows for a more detailed picture of what changes have been occurring across the county. For example, a creek may exhibit a small trend in increasing DO from 17 years ago as compared to now, but it may also show a strong trend in decreasing DO from five years ago as compared to now. Analyzing a combination of time periods reveals a clearer picture of what is happening than can be ascertained from a single trend over the course of 17 years.

Several sites have extended dry periods during most summers and/or are flooded during high water events and not sampled. The Sanitas trends analysis program was unable to compute trends based on 12 seasons for those sites due to the consistent lack of data for the dry or flooded periods. For those sites, trends were calculated based on four seasons, beginning in January, April, July, and October. All trends analyses on plant nutrient data mentioned above are also performed using four seasons, as these are only sampled quarterly.

Data used for the Seasonal Kendall's Test can be subject to autocorrelation, where each successive data point is correlated with the previous point. This situation usually occurs when samples are collected more frequently than monthly. For the SCMP, DO, temperature, and FC data are collected biweekly. Tests are available to detect autocorrelation, but in some cases may be confounded by the very seasonality we are trying to accommodate. Our approach for these parameters has been to conduct the analysis using all data, and repeat the analysis using monthly averages to avoid autocorrelation. In the cases where there are differences, it would probably be prudent to use the monthly averages. A summary of Seasonal Kendall's Test results for all parameters, significant or not, can be found in Appendix C.

Data Quality

Quality Assurance Project Plan (QAPP)

The SCMP operates under a QAPP that was approved by Ecology in 2003. This plan details sampling strategies, equipment to be used, and all other aspects of the sampling program. Ecology approval of the QAPP was required in order for Skagit County to be eligible for grant funds.

Equipment Calibration and Maintenance

The turbidity meter (Lamotte Model 2020we) is calibrated the afternoon before or the morning of each sampling trip, and the reading before calibration is recorded.

The pH meter (Hanna Instruments Model 8314) is calibrated on the morning of each sampling trip. The pH meter is recalibrated during the trip if questionable results are obtained.

The DO/temperature/conductivity meter (YSI Model 2030 Pro) is calibrated for DO using the built-in calibration chamber (water-saturated air). The meter is recalibrated to local elevation at each sample site prior to sampling.

The DO meter probe is deployed in areas with sufficient current (> 0.5 fps) to produce reliable results, or the probe is stirred to produce adequate velocity across the membrane. Samples for pH and turbidity are obtained from the thalweg of the stream whenever possible with sample containers rinsed at least three times with sample water, and are analyzed immediately.

Lab Samples

Laboratory samples for nutrients are collected using clean equipment and proper procedures, collected with a sampling wand from the thalweg of the watercourse, and care is taken to prevent oversampling of the surface film or disturbing the bottom. The sampling container is rinsed at least three times with the water to be sampled. The sample is then poured into the bottles provided by the contract lab, Edge Analytical of Burlington, WA, an Ecology-certified laboratory. Samples are capped and placed in a cooler with ice until they are picked up by the lab on the same day.

Samples for FC are collected directly into sterile bottles and transported under ice to the laboratory within eight hours of collection.

Personnel

The project manager performs the majority of samplings that generate data for this report. Any other staff that perform samplings and collections are adequately trained by the project manager according to EPA-approved sampling methods prior to sampling. Due to regular

staff turnover and availability of assisting staff members, some staff may collect sample data only once, though repeated participation and experience with the project manager is preferred when possible.

Duplicate Analysis

Duplicate samples are collected for FC at a 20% rate and for selected nutrients at a 10% rate. Selected nutrient duplicates (TP, OP, NO3, and/or NH3) are intended to provide a precision estimate for all the nutrient analyses.

Table 3 summarizes the results of the duplicate analyses for the 2020 water year, using the coefficient of variation (CV) statistic. Variability in FC was above the original target level set out in the 2003 QAPP, of 33. However, the annual average across this program is 44, with a very small annual standard deviation of 3. A score of 41 is on the very lowest end of this program's history. In this report, coefficient of variation is considered synonymous with relative standard deviation (RSD).

The high variability of the FC results is at least partially due to the use of the Most Probable Number (MPN) analysis technique. This method was chosen for the SCMP because the Skagit County Health Department laboratory was certified for the method, and because it is reportedly more reliable for samples with high turbidity, which are often encountered in the SCMP (Michaud 1991). The program continued using MPN when it switched to Edge Analytical in 2009 to maintain data comparability. Fecal coliform variability in the SCMP, although higher than the initial target level, is similar to that seen in other studies in Washington.

Table 3 - Data quality duplicate analysis for 2020 Water Year

		Coefficient of Variation (RSD)	
Parameter	**n**	**2020 Results**	**Target**
Fecal Coliform	176*	41.0	33[1]
Total Phosphorus	3	5.1	10 [2]
Orthophosphate	13	7.7	10 [2]
Nitrate	8	3.0	10 [2]
Ammonia	8	7.5	10 [2]

*Four weeks on each route (eight weeks total) were missed due to COVID-19, resulting in the absence of 32 duplicates (typically 208 for the year).

[1] Target precision as listed in 2003 QAPP
[2] 10% CV target was listed for all nutrients

Site Sampling Times

The SCMP maintains sampling times as a temporal control for data analysis. The higher the precision of sampling time each week, the better. This is an exceptionally difficult task over such a long time period. Unexpected situations have to be expected, and it is common to experience equipment problems, staff availability issues, bad weather, injuries, flat tires, closed roads, and inaccessible watercourses. Despite all of these regularly-encountered obstacles, the SCMP has maintained remarkably small sampling windows across 17 years.

Route 1 - All 17 years combined					
Site	Mean	Min	Max	Range (hrs)	n
28	8:21	7:30	9:40	2:10	190
22	8:39	7:45	10:05	2:20	230
25	8:57	8:10	10:20	2:10	203
30	9:09	8:20	10:30	2:10	230
24	9:26	8:35	10:50	2:15	228
23	9:43	8:50	11:00	2:10	211
21	9:58	9:00	11:20	2:20	208
19	10:10	9:15	11:30	2:15	216
20	10:24	9:15	12:00	2:45	229
11	10:48	9:35	12:05	2:30	230
8	11:28	10:00	12:55	2:55	229
4	11:52	10:15	13:35	3:20	228
3	12:07	10:30	13:50	3:20	228
6	12:20	10:50	14:05	3:15	230
39	12:43	11:05	14:20	3:15	227
36	12:57	11:20	14:35	3:15	229
38	13:12	11:35	14:50	3:15	227
37	13:27	11:50	15:05	3:15	228
33	13:42	12:05	15:20	3:15	226
35	13:56	12:25	15:40	3:15	229
32	14:10	12:35	15:50	3:15	230

Table 4 – Historical sampling times for Route 1, which primarily samples the northern half of Skagit County. The table on the left includes all years of the program that sampling times were recorded. The table on the right is from the most recent water year.

Route 1 - Water Year 2020					
Site	Mean	Min	Max	Range (hrs)	n
28	7:53	7:30	8:20	0:50	14
22	8:10	7:45	8:40	0:55	22
25	8:30	8:10	9:00	0:50	16
30	8:44	8:20	9:15	0:55	22
24	9:04	8:40	9:45	1:05	20
23	9:19	8:55	10:00	1:05	21
21	9:36	9:15	10:15	1:00	20
19	9:51	9:25	10:30	1:05	20
20	10:11	9:50	10:55	1:05	21
11	10:36	10:15	11:20	1:05	22
8	10:56	10:35	11:40	1:05	22
4	11:13	10:50	11:55	1:05	22
3	11:32	11:10	12:15	1:05	22
6	11:47	11:20	12:30	1:10	22
39	12:04	11:35	12:45	1:10	22
36	12:22	11:50	12:55	1:05	22
38	12:38	12:05	13:15	1:10	22
37	12:56	12:20	13:35	1:15	22
33	13:14	12:39	13:55	1:16	22
35	13:32	12:50	14:20	1:30	22
32	13:47	13:08	14:40	1:32	22

Route 1 primarily samples the northern half of the county, while Route 2 primarily covers the southern half. Throughout the years, some short-term project-oriented sites were added in to the sampling days, and those contributed to wider variation in sampling times for certain sites on the routes over the years.

Route 2 - All 17 years combined					
Site	Mean	Min	Max	Range (hrs)	n
29	8:24	7:15	9:44	2:29	228
40	8:51	7:50	10:13	2:23	225
34	9:04	8:05	10:26	2:21	224
47	9:18	8:20	10:40	2:20	231
44	9:36	8:35	11:00	2:25	229
45	10:01	8:55	11:40	2:45	228
43	10:20	9:00	11:56	2:56	231
46	10:35	9:10	12:07	2:57	229
41	10:50	9:25	12:30	3:05	231
48	11:02	9:35	12:47	3:12	231
42	11:17	9:45	13:04	3:19	229
18	11:47	10:10	13:40	3:30	229
17	12:03	10:25	14:00	3:35	229
16	12:24	10:40	14:19	3:39	229
15	12:44	10:55	14:46	3:51	229
13	12:58	11:05	15:01	3:56	228
12	13:12	11:20	15:30	4:10	226
14	13:29	11:30	15:30	4:00	227

Table 5 - Historical sampling times for Route 2, which primarily samples the southern half of Skagit County. The table on the left includes all years of the program that sampling times were recorded. The table on the right is from the most recent water year.

Route 2 - Water Year 2020					
Site	Mean	Min	Max	Range (hrs)	n
29	7:46	7:30	8:04	0:34	20
40	8:15	7:50	8:34	0:44	22
34	8:30	8:05	8:50	0:45	22
47	8:49	8:25	9:10	0:45	22
44	9:09	8:45	9:30	0:45	21
45	9:37	9:15	10:00	0:45	22
43	9:58	9:35	10:20	0:45	22
46	10:14	9:50	10:40	0:50	22
41	10:31	10:05	10:55	0:50	22
48	10:44	10:20	11:10	0:50	22
42	11:00	10:35	11:25	0:50	22
18	11:27	11:00	11:50	0:50	22
17	11:44	11:15	12:10	0:55	22
16	12:09	11:35	12:35	1:00	22
15	12:29	11:55	12:55	1:00	22
13	12:46	12:05	13:20	1:15	22
12	13:02	12:20	13:35	1:15	21
14	13:33	12:35	14:20	1:45	21

Annual Rainfall and Air Temperatures

Monthly precipitation totals and average air temperatures were collected from the Washington State University AgWeatherNet Mount Vernon station for the entire 17 water years of this program and organized into tables. Summary statistics are calculated on the right for each month and below for each year. There is a wealth of information in these tables that can possibly help lend interpretation to changes in water quality geographically over time.

	WY 2004	WY 2005	WY 2006	WY 2007	WY 2008	WY 2009	WY 2010	WY 2011	WY 2012	WY 2013	WY 2014	WY 2015	WY 2016	WY 2017	WY 2018	WY 2019	WY 2020
October	5.34	2.71	4.01	1.98	4.82	1.37	5.67	1.76	1.96	3.87	1.51	6.07	3.39	5.26	5.39	2.32	4.21
November	4.94	6.84	4.20	5.61	2.68	5.55	5.31	3.74	4.67	3.89	3.48	3.90	7.85	5.99	6.22	4.20	2.14
December	2.87	4.36	3.36	3.05	3.71	3.18	1.25	3.26	1.25	3.52	2.34	3.73	7.05	3.21	3.76	3.79	3.50
January	4.01	4.02	6.54	5.47	2.75	3.79	2.81	6.01	2.92	5.13	4.70	4.69	3.21	1.62	4.79	1.81	5.90
February	1.35	2.92	3.2	2.96	2.91	1.25	1.25	1.72	4.49	2.02	3.89	2.97	4.63	3.18	5.78	2.27	4.82
March	3.44	2.77	1.51	4.52	4.36	2.24	2.16	3.37	3.77	2.10	4.45	2.51	3.88	5.01	2.79	1.35	2.84
April	0.28	4.11	3.16	0.89	2.40	2.81	2.53	3.90	4.31	4.60	3.26	1.48	2.17	3.00	4.73	2.45	1.61
May	3.65	1.73	2.24	1.09	2.09	2.24	4.57	4.17	2.4	2.58	3.68	0.60	1.27	2.36	0.35	0.88	3.13
June	1.80	1.90	1.10	1.58	2.25	0.16	1.66	0.91	3.14	1.27	1.14	0.61	2.78	0.94	1.52	1.42	3.07
July	0.64	0.74	0.82	1.27	0.64	0.51	0.05	1.39	1.3	0.00	1.29	0.11	0.59	0.01	0.04	0.83	0.83
August	6.29	2.22	0.23	0.81	2.23	0.52	1.17	0.42	0.01	1.34	0.88	1.46	2.88	0.04	0.17	0.86	0.64
September	3.27	1.96	1.78	2.36	0.50	1.31	2.87	0.87	0.14	4.10	2.64	2.12	1.32	1.59	1.36	5.24	1.07

Raw Data Source: WSU AgWeatherNet Mount Vernon Station

	Mean	Low	High
Annual	32.68	24.93	41.02
Low	0.37	0	0.88
High	5.83	4.67	7.85
Mean	2.73	2.08	3.42
Mean Wet (Oct-Apr)	3.55	2.60	4.78
Mean Dry (May-Sep)	1.58	0.69	3.13
Seasonal Extremes	2.65	1.01	6.95

	Total	Low	High	Mean
October	61.64	1.37	6.07	3.63
November	81.21	2.14	7.85	4.78
December	57.19	1.25	7.05	3.36
January	70.17	1.62	6.54	4.13
February	51.61	1.25	5.78	3.04
March	53.07	1.35	5.01	3.12
April	47.69	0.28	4.73	2.81
May	39.03	0.35	4.57	2.30
June	27.25	0.16	3.14	1.60
July	11.06	0.00	1.39	0.65
August	22.17	0.01	6.29	1.30
September	34.50	0.14	5.24	2.03
	556.59	0.00	7.85	2.79

No data, filled in with mean value

Neutral value is within +- 0.5 of mean

Greater than 0.5 above mean

Greater than 0.5 below mean

Table 6 - Monthly precipitation totals for the entire history of the Skagit County Monitoring Program. Cells are shaded blue or red to illustrate above and below average rainfall for a month, respectively. The threshold of 0.5 inches of rain to constitute an "average" shading of grey is arbitrarily chosen and does not constitute an authoritative metric.

Some of the most interesting statistics on **Table 6** are at the bottom: The mean wet and dry seasonal rainfall, and the seasonal extremes category, which divides the wet by the dry. This creates a ratio that can illustrate extremes in seasonal rainfall. Monitoring these ratios across a changing climate can be informative in monitoring changes in water quality. You can see that some years you may get a near equivalent amount of total precipitation in the wet season as the dry season, whereas a year can be as extreme as nearly seven times as much precipitation in the wet season as occurs in the dry.

Following the arbitrary 0.9 degrees Fahrenheit rule to average each month as described in the caption of **Table 7**, the Annual total category in the lower section summarizes all of the months of that year in to one large number. If that number exceeds the 0.9 degree average multiplied by twelve months (10.8 total), then it receives a red or blue for above or below for the entire year. Only six out of 17 years exceeded this average above or below.

The Seasonal Extremes ratio in the bottom row is lower if the wet and dry seasons are more disparate in average temperatures, or higher if the two seasons are more similar to each other in that year.

	WY 2004	WY 2005	WY 2006	WY 2007	WY 2008	WY 2009	WY 2010	WY 2011	WY 2012	WY 2013	WY 2014	WY 2015	WY 2016	WY 2017	WY 2018	WY 2019	WY 2020	Total	Low	High	Mean
October	54.3	50.6	46.8	47.2	48.0	50.0	50.6	51.9	50.7	51.3	49.1	56.8	54.4	53.5	49.6	49.8	47.9	862.5	46.8	56.8	50.7
November	44.0	43.2	34.4	42.8	41.1	47.8	47.1	42.5	42.5	46.4	43.7	43.9	41.7	51.0	46.4	46.1	42.9	747.5	34.4	51.0	44.0
December	41.9	41.1	39.8	39.5	38.3	35.9	36.4	42.8	39.6	41.2	37.1	43.1	42.4	36.2	37.4	41.4	42.3	676.4	35.9	43.1	39.8
January	41.9	40.9	43.6	36.2	36.7	38.2	46.7	40.7	40.1	37.2	41.0	43.5	42.6	36.4	44.1	41.7	43.7	695.2	36.2	46.7	40.9
February	43.5	41.2	39.1	41.5	40.0	39.9	45.6	38.0	42.2	43.0	38.7	47.5	46.5	40.1	39.3	33.5	40.9	700.5	33.5	47.5	41.2
March	47.5	46.7	44.0	45.3	40.8	41.4	46.1	45.2	43.1	45.7	46.8	49.3	48.7	45.8	43.6	43.1	42.4	723.1	40.8	49.3	45.0
April	52.4	49.4	46.8	47.4	45.4	49.2	49.2	45.1	49.8	48.6	50.5	49.6	53.4	50.5	49.3	49.8	49.7	786.4	45.1	53.4	49.2
May	56.3	56.2	55.1	52.3	53.7	55.1	52.1	51.6	53.2	55.4	57.1	56.3	56.9	55.4	57.1	56.6	56.0	880.4	51.6	57.1	55.1
June	61.3	57.1	58.6	56.0	55.6	60.0	56.8	57.4	56.1	60.5	59.2	62.8	59.6	59.8	58.9	59.2	58.2	938.9	55.6	62.8	58.7
July	62.3	61.4	61.1	62.0	59.7	64.4	60.7	60.1	60.6	62.5	64.1	65.9	63.1	62.5	64.5	63.0	61.7	997.9	59.7	65.9	62.3
August	65.4	61.5	59.2	59.9	61.9	61.7	60.8	61.1	62.9	63.9	64.4	64.3	63.8	63.7	62.6	64.0	61.9	1001.1	59.2	65.4	62.5
September	57.0	54.7	56.0	54.6	57.0	59.2	58.8	60.4	57.1	59.7	60.4	57.2	57.6	59.7	57.5	59.1	60.2	926.0	54.6	60.4	58.0
																		Mean	Low	High	
Annual	627.8	604	584.5	584.7	578.2	602.80	610.90	596.8	597.9	615.4	612.1	640.2	630.7	614.6	610.30	607.3	607.8	607.41	578.20	640.2	9935.9	33.5	65.9	50.6
Low	41.9	40.9	34.4	36.2	36.7	35.9	36.4	38	39.6	37.2	37.1	43.1	41.7	36.2	37.4	33.5	40.9	38.06	33.5	43.1				
High	65.4	61.5	61.1	62	61.9	64.4	60.8	61.1	62.9	63.9	64.4	65.9	63.8	63.7	64.5	64	61.9	63.13	60.80	65.90				
Mean	52.3	49.9	48.0	48.2	47.4	49.4	50.2	48.8	49.2	50.5	50.2	53.0	52.1	50.4	50.3	49.8	49.8	49.97	47.38	53.00				
Mean Wet (Oct-Apr)	45.5	44.0	41.3	42.1	40.8	42.2	45.4	43.5	43.0	44.1	42.7	47.4	46.1	43.8	43.4	42.6	43.4	43.60	40.82	47.35				
Mean Dry (May-Sep)	59.1	56.7	56.1	55.4	55.6	58.3	56.4	56.0	56.6	58.4	59.3	59.4	59.1	58.6	58.3	58.6	58.0	57.63	55.37	59.35				
Seasonal Extremes	0.77	0.77	0.74	0.76	0.73	0.72	0.81	0.78	0.76	0.76	0.72	0.80	0.78	0.75	0.74	0.73	0.75	0.76	0.72	0.81				

Raw Data Source: WSU AgWeatherNet Mount Vernon Station

	No data, filled in with mean value
	Neutral value is within +- 0.9 of mean
	Greater than 0.9 above mean
	Greater than 0.9 below mean

Table 7 - Monthly air temperature averages for the entire history of the Skagit County Monitoring Program. Cells are shaded red or blue to illustrate above and below average temperature for a month, respectively. The threshold of 0.9 degrees Fahrenheit to constitute an "average" shading of grey is arbitrarily chosen and does not constitute an authoritative metric.

Data Summaries and Trends Analysis

Trends were calculated for 30 measured or calculated parameters (such as monthly averages) at each of 39 sites, for a total of 1,170 tests. Of those, 459 tests showed a statistically significant trend at the 95% confidence level. Trends judged as improving or positive (e.g. increased dissolved oxygen, reduced temperature) made up 272 of the significant trends, or 59 percent. Negative or deleterious trends (e.g. reduced dissolved oxygen, increased nutrients) accounted for the remaining 187, or 41 percent of the significant trends. In relation to the global trend in acidification of surface waters, declining pHs were considered as negative trends for this report. There were also statistically significant nutrient trends where the slope was zero. The statistical analysis used was very sensitive, and a slope of zero simply means that the slope was less than 0.0001 units, though the directionality as positive or negative was still given.

All trends can be found in the tables in **Appendix C**. Positive significant trends are shaded green and negative are shaded red. Trends that achieved 95% confidence in statistical significance are shaded the darkest blue in the confidence column. Some trends were very close to achieving 95% confidence, but fell short. Trends that achieved 90% confidence are shaded in a slightly lighter blue, and trends that achieved 80% confidence in even lighter blue. This helps to inform the reader of all changes that may be occurring at the sampling site, even if they are not statistically significant at a 95% confidence level. Any parameters that showed a significant trend with a slope of 0 are highlighted in yellow in the slope column.

Trend statistics are tools to help us understand changing conditions in our watercourses, but do not completely describe the condition of a watercourse. Many of the sites with no significant trends or improving trends in water quality parameters still do not meet state water quality standards, and therefore still qualify as areas of concern. Many Skagit County sites remain on Ecology's Impaired Waters list. As previously discussed, high fecal coliform levels in the Samish Bay watershed have led to closures of shellfish beds and loss of revenue for shellfish growers. Dissolved oxygen and temperature conditions are still substandard in many watercourses, resulting in less than ideal rearing conditions for salmonids and other aquatic life.

Gaps in the data represent streams that were either flooded or dry at sampling time, or may represent equipment malfunctions.

Temperature

Water temperature governs the metabolic rate of aquatic organisms. Excessive temperature can serve as a stress on fish and other cold-water organisms, and extreme temperatures can be lethal.

Background

For the water years 2004-2007 and 2009-2020, temperatures were measured with Stowaway Tidbit® data loggers from Onset Computer Company. These devices were set to measure water temperature every half hour. They are normally deployed in late June and retrieved in early September. During those years, several of the data loggers went missing by the end of each monitoring period. Some may have been lost due to channel changes associated with heavy rains in late summer, while others may have been vandalized. For the 2008 water year, a computer programming error resulted in the data loggers measuring temperature for only two weeks in late June and early July. Since annual peak temperatures occur later in the summer, the 2008 data logger data was not very useful. Readers interested in the continuous temperature data collected in 2004-2007 can access those graphs in the 2007 Water Year Annual Report at this web address: www.skagitcounty.net/scmp.

In the fall of 2006, Ecology revised its water quality standards (WAC 173-201a) to comply with a request from the EPA. Included in this revision were several changes to temperature and DO standards for Skagit County watercourses. In particular, the lower Skagit River, Hansen, Nookachamps, Fisher, and Carpenter Creeks, and the upper Samish River and its tributaries were placed in the "Core salmonid spawning and rearing" use category. This change had the effect of imposing more stringent temperature and DO standards on these streams. Formerly, each of these streams was held to a 7-day average of the daily maximum temperatures (7-DADMax) standard of 17.5ºC, but with the revised standards, these streams must now meet a 7-DADMax standard of 16ºC. There were no changes to other streams in the county. Currently, Sites 3-4, 28, 31-44, and 48 are held to the 17.5 ºC standard, while all other sites are held to the 16ºC standard, including marine Site 47.

In addition to changes in the general standard, the revisions to the state temperature standards in 2006 also added spawning period temperature standards to some streams in the county. Portions of the Samish River, Friday Creek, Hansen Creek, Lake Creek, and East Fork Nookachamps Creek have a 13ºC limit from February 15 to June 15 to protect steelhead spawning and egg incubation. The Skagit River upstream from Sedro-Woolley has a 13ºC limit from September 1 through May 15 to protect spawning and egg incubation for several salmonids.

After a very dry 2015 water year and higher than normal precipitation in 2016, 2017 was characterized by a series of wetter and dryer than normal months. Overall precipitation was near normal for the entire year. The 2018 water year saw a return to below-normal precipitation. The 2019 water year was the driest overall year in the last ten, and would have been worse, had it not been for the rainiest September in the sixteen-year history of this

program occurring in the final month of the water year. Water Year 2020 ended slightly above average for the year, with a drier than average August and September at the end.

Results

Table 8 shows the daily maximum temperatures for the last five years of the study, based on data collected at bi-weekly samplings. Because the state water quality standards are based on 7-DADMax, the maximums reported on **Table 8** are not directly comparable to the state temperature standard, but are displayed here as an indication of the relative condition of each stream and for comparison of the temperature conditions from year to year.

Table 9 contains the 7-DADMax values for those sample sites where continuous temperature data is available. These data are directly comparable to the state water quality standards as described on the table and in the next paragraph.

Twenty-three dataloggers were deployed for the summer of 2020. Of these, one went missing and was not recoverable, and one had been taken out of the water and thrown up the river bank. The remaining 21 dataloggers were retrieved and their data analyzed.

Trends analyses reveal that in comparison to 17 years ago, at the start of this program, nine sites have shown an increase in temperature and one site has shown a decrease (**Figure 2**). Looking at the map of trends from the most recent ten years (**Figure 3**), fourteen sites show an increase, while no sites show a decrease. All of these sites are located in the northern half of the county.

Trends from the most recent five years of data (**Figure 4**) show six sites significantly decreasing in temperature, with no sites showing a significant increase. Two-thirds of these decreasing sites are in the Nookachamps watershed.

Ecology has developed temperature remediation plans (TMDLs) for Fisher, Carpenter, Nookachamps, and Hansen Creeks, but many other Skagit County streams also exceed temperature standards.

Table 8 - Maximum watercourse temperatures recorded from bi-weekly sampling. Cells shaded green pass state standard. There is a 0.2 allowance in the standard for variation in equipment calibration. These samplings are taken at nearly the same time of day, each week they are sampled, and do not represent the hottest temperature that each site may have reached on a given day.

Site Number	Watercourse	Location	Highest daily temperature (°C)				
			2016	2017	2018	2019	2020
3	Thomas Creek	Old Hwy 99 North	19.6	19.2	18.4	17.8	18.4
4	Thomas Creek	F&S Grade Rd	15.9	15.3	14.9	14.8	14.7
6	Friday Creek	Prairie Rd	20.1	18.6	19.2	18.0	17.8
8	Swede Creek	Grip Rd	17.8	17.8	16.9	16.5	16.2
11	Samish River	State Route 9	14.1	13.5	13.2	13.6	15.2
12	Nookachamps Creek	Swan Rd	21.4	21.1	22.5	21.0	20.1
13	E.F. Nookachamps Creek	State Route 9	19.1	19.6	21.9	19.4	18.6
14	College Way Creek	College Way	17.7	17.3	19.0	16.7	17.0
15	Nookachamps Creek	Knapp Rd	21.8	22.0	22.7	20.1	22.1
16	E.F. Nookachamps Creek	Beaver Lake Rd	18.7	18.1	19.8	17.5	17.0
17	Nookachamps Creek	Big Lake Outlet	21.9	22.8	23.6	21.3	22.5
18	Lake Creek	State Route 9	16.3	16.3	18.1	16.4	16.3
19	Hansen Creek	Hoehn Rd	18.1	17.3	17.6	18.1	18.5
20	Hansen Creek	Northern State	15.3	15.3	15.4	14.9	14.8
21	Coal Creek	Hoehn Rd	16.1	15.7	15.2	15.6	16.5
22	Coal Creek	Hwy 20	14.6	15.3	15.2	15.3	15.1
23	Wiseman Creek	Minkler Rd	15.2	15.0	14.1	14.2	15.5
24	Mannser Creek	Lyman Ham. Hwy	12.1	12.5	11.9	12.5	12.9
25	Red Cabin Creek	Hamilton Cem. Rd	11.8	11.7	11.2	11.9	12.4
28	Brickyard Creek	Hwy 20	16.7	14.5	14.3	14.7	16.2
29	Skagit River	River Bend Rd	16.6	15.9	16.2	16.0	14.7
30	Skagit River	Cape Horn Rd	14.8	15.3	15.4	15.6	15.0
32	Samish River	Thomas Rd	20.7	20.1	19.3	18.8	18.2
33	Alice Bay Pump Station	Samish Island Rd	23.4	22.7	25.0	22.1	22.9
34	No Name Slough	Bayview-Edison Rd	25.9	21.5	27.0	25.3	24.8
35	Joe Leary Slough	D'Arcy Rd	20.5	20.3	21.3	21.4	18.9
36	Edison Slough at school	W. Bow Hill Rd	27.6	27.0	30.2	28.3	27.0
37	Edison Pump Station	Farm to Market Rd	26.3	23.6	25.5	23.3	25.8
38	North Edison Pump Sta.	North Edison Rd	22.4	22.2	24.4	22.3	20.9
39	Colony Creek	Colony Rd	17.1	16.6	17.4	15.3	20.5
40	Big Indian Slough	Bayview-Edison Rd	17.3	19.4	19.5	18.3	17.7
41	Maddox/Big Ditch	Milltown Rd	21.4	22.4	21.7	21.4	20.8
42	Hill Ditch	Cedardale Rd	21.3	22.0	20.8	20.9	21.2
43	Wiley Slough	Wylie Rd	20.1	19.6	27.2	20.2	19.3
44	Sullivan Slough	La Conner-Whitney	18.1	20.0	18.3	16.7	20.1
45	Skagit River – N. Fork	Moore Rd	17.3	16.4	16.4	17.0	15.6
46	Skagit River – S. Fork	Fir Island Rd	17.7	16.7	16.7	17.0	15.9
47	Swinomish Channel	County Boat Launch	17.0	18.5	16.1	16.2	17.0
48	Fisher Creek	Franklin Rd	13.4	13.5	15.3	14.0	14.0

Table 9 - Seven-day average of the daily maximum temperatures (7-DADMax). This data is from continuous temperature loggers (TidbiTs), with measurements taken every 30 minutes. Cells shaded green pass state standard. There is a 0.2 allowance in the standard for variation in equipment calibration.

Site Number	Watercourse	Location	7-DADMax (°C)				
			2016	2017	2018	2019	2020
3	Thomas Creek	Old Hwy 99 North	21.2	20.2	20.2	n/a	19.9
4	Thomas Creek	F&S Grade Rd	16.7	16.1	17.0	16.5	16.2
6	Friday Creek	Prairie Rd	21.6	n/a	22.6	21.3	20.0
8	Swede Creek	Grip Rd	18.4	17.6	19.0	17.8	17.4
11	Samish River	State Route 9	14.8	14.8	14.8	n/a	15.1
12	Nookachamps Creek	Swan Rd	23.5	22.9	23.5	23.5	21.0*
13	E.F. Nookachamps Creek	State Route 9	20.8	20.5	21.7	n/a	20.7
15	Nookachamps Creek	Knapp Rd	23.3	22.3	23.8	n/a	23.0
16	E.F. Nookachamps Creek	Beaver Lake Rd	21.2	20.8	22.2	20.1	n/a
17	Nookachamps Creek	Big Lake Outlet	25.2	25.5	26.5	n/a	25.6
18	Lake Creek	State Route 9	18.2	18.0	19.5	19.2	18.6
19	Hansen Creek	Hoehn Rd	21.1	19.0	20.1	19.7	20.3
20	Hansen Creek	Northern State	16.3	17.1	17.8	n/a	16.5
21	Coal Creek	Hoehn Rd	20.0	15.9	18.6	20.3	17.8
22	Coal Creek	Hwy 20	17.4	n/a	17.5	16.8	16.7
24	Mannser Creek	Lyman Hamilton Hwy	17.2	13.9	13.7	13.4	14.0
30	Skagit River	Cape Horn Rd	15.2	11.9	n/a	17.1	14.8**
32	Samish River	Thomas Rd	n/a	20.2	21.2	20.6	n/a
39	Colony Creek	Colony Rd	18.3	17.3	18.4	17.5	17.4
41	Maddox Creek/Big Ditch	Milltown Rd	21.1	24.9	25.9	25.0	24.4
42	Hill Ditch	Cedardale Rd	25.9	25.7	25.9	24.9	24.6
45	Skagit River – North Fork	Moore Rd	18.7	17.7	19.4	n/a	17.2*
48	Fisher Creek	Franklin Rd	15.1	14.8	16.8	16.5	16.1

*Incomplete dataset, as the TidbiT probe was out of the water for some of the summer measurement period. It is possible that this value could have been higher.

**TidbiT out of water for part of season. Analysis of USGS temperature monitoring station 12200500 near Mount Vernon, in comparison to the incomplete data from SCMP site 30 infers that the actual 7-DADMAX likely occurred near 16.0 °C.

Figure 2 - Seventeen-year trends in watercourse temperatures

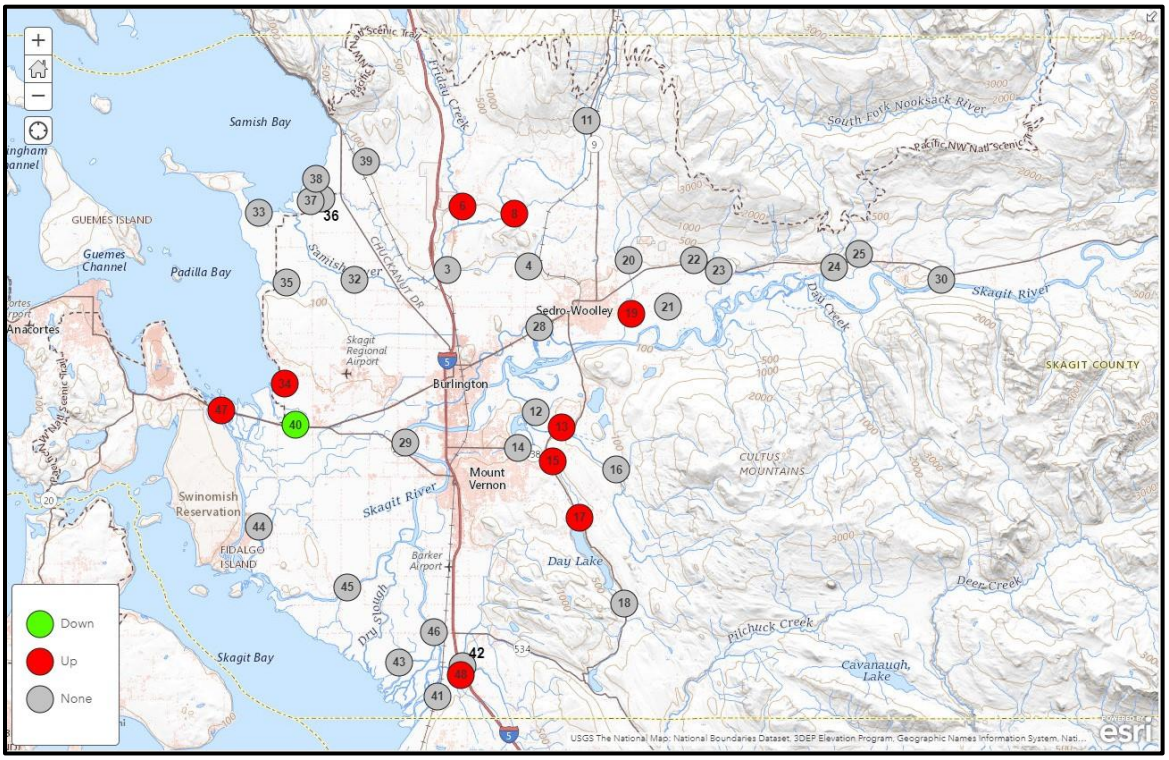


Figure 3 - Ten-year trends in watercourse temperatures

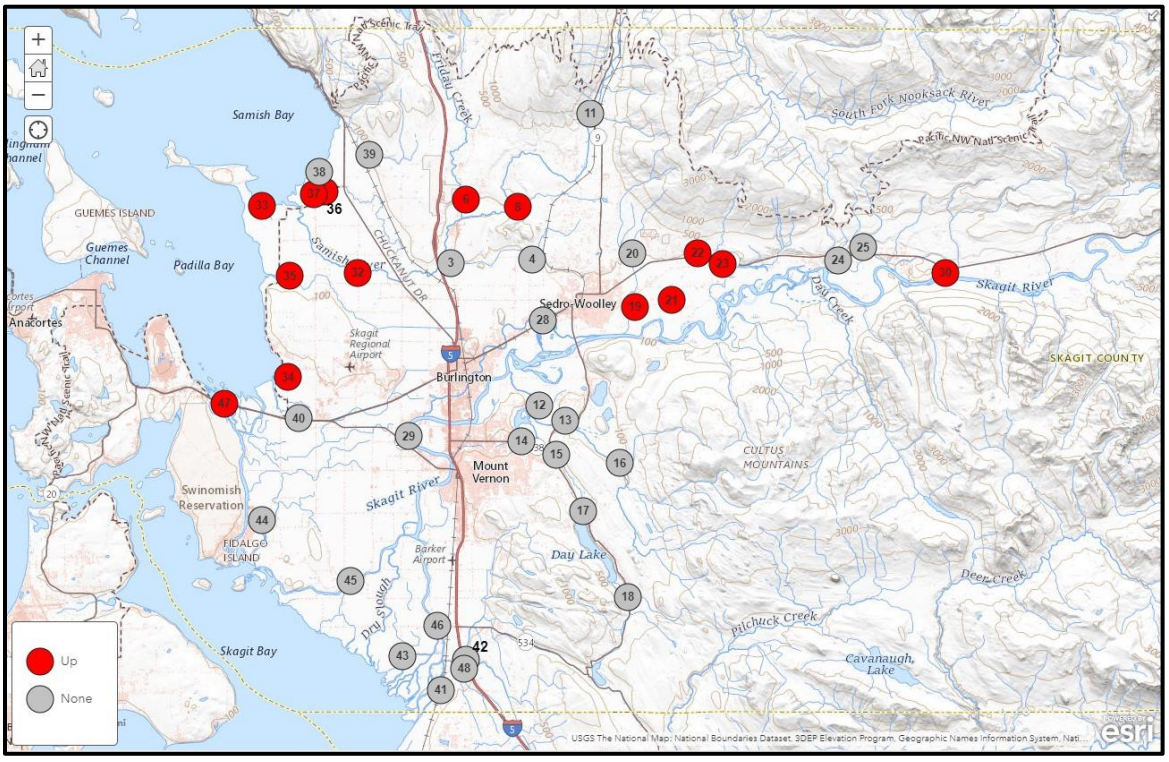
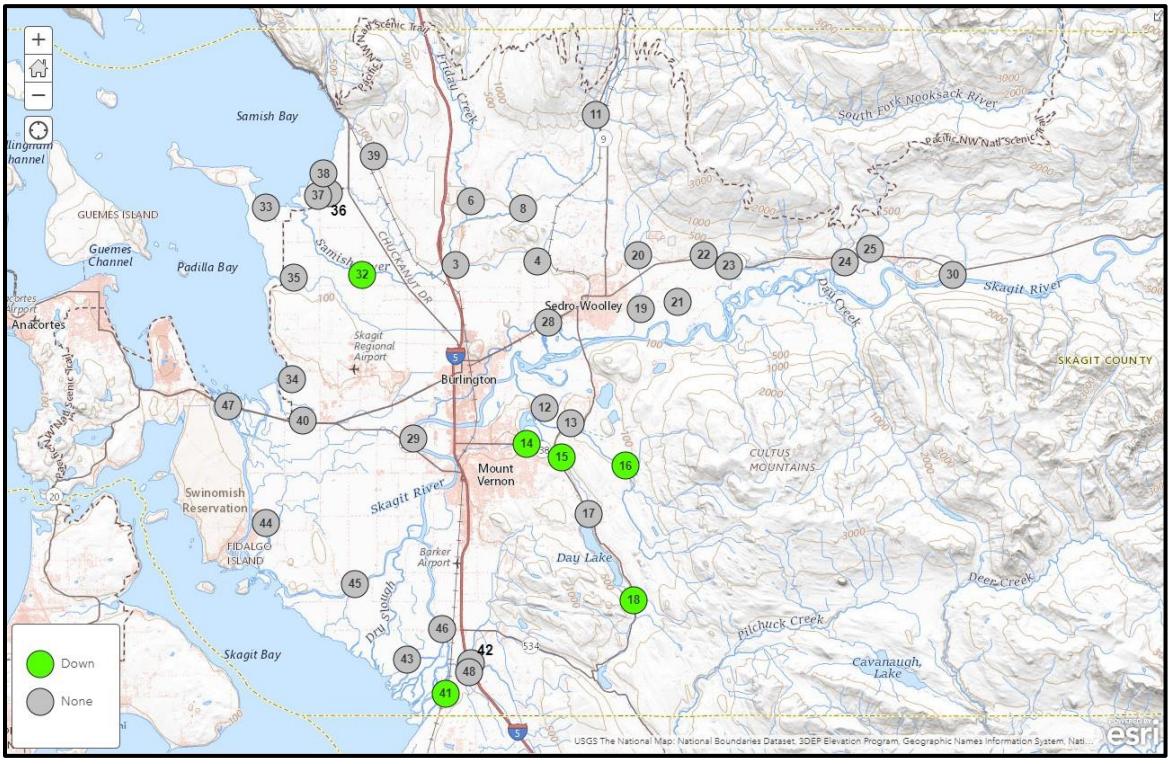


Figure 4 - Five-year trends in watercourse temperatures



Dissolved Oxygen (DO)

Dissolved oxygen measurements determine how much oxygen is available in the water for fish and other organisms.

Background

The state water quality standards for DO are based on single-day minimum measurements. For some lowland watercourses in the SCMP (Sites 3-4, 28, 31-44, and 48), the minimum standard is 8.0 mg/L. For the marine site (Site 47), the standard is 6.0 mg/L. For all other sites, the standard is 9.5 mg/L. The solubility of oxygen in water is inversely related to temperature, so that higher temperatures frequently result in lower dissolved oxygen values.

Results

A summary of DO readings (in mg/L) obtained during the 2020 water year is provided in **Table 10**. A summary of data from the most recent five years of this program can be found in **Table 11**.

Ten sites met the oxygen standards for the entire 2020 water year, compared to eight in 2019. Others met the oxygen standard for most of the year. In a few streams, oxygen levels show steep declines in summer, as can be seen by the graphs on their SRCs. These declines are usually associated with very low flows, less velocity, and higher temperatures.

In the drainage infrastructure and lower sloughs, DO levels can be greatly influenced by algal activity. During large algae blooms, the oxygen produced during photosynthesis can lead to very high oxygen levels during the day. However, night-time oxygen levels can be very low, as the large populations of algae turn from producing oxygen to consuming it. Because our oxygen readings are taken during the day, the monitoring program does not account for these night-time oxygen reductions. During times when algae blooms are dying off, the decomposition of the dying algae can lead to very low oxygen levels, both day and night. The results, as can be seen in the graphs of the drainage sites in their SRCs, are widely fluctuating DO levels, depending on the state of the algal blooms at sampling time. These fluctuations are very extreme, and data has been recorded from as low as 0% to as high as 300% typical oxygen saturation.

Trends analysis shows that in the 17 years since the program began, thirteen sites have shown an increase in DO levels, while four have shown a decrease (**Figure 5**). There is a clustering of improved sites in the Samish and South Skagit watersheds. In the most recent ten years (**Figure 6**), trends show fifteen sites increasing DO levels, while only one is decreasing. These sites appear to be spread county-wide. In the most recent five years (**Figure 7**), trends show eight sites increasing DO levels, while only two sites are decreasing. These sites appear to also be spread county-wide. This increase of sites with rising DO levels is great news for water quality across the county, and possible contributions could be from lower water temperatures and lower biological oxygen demand (BOD), which can be a result of a decrease in pollution.

Table 10 - Dissolved oxygen (DO) measurements for 2020 water year. Cells shaded green pass state standard. A margin of error allowance is given at 0.2 mg/L.

Site Number	Watercourse	Location	Mean DO (mg/L)	Minimum DO (mg/L)	St. Std[1]
3	Thomas Creek	Old Hwy 99 N	6.52	0.27	8.0
4	Thomas Creek	F&S Grade Rd	11.42	9.63	8.0
6	Friday Creek	Prairie Rd	11.43	9.07	9.5
8	Swede Creek	Grip Rd	10.95	8.01	9.5
11	Samish River	State Route 9	9.30	7.83	9.5
12	Nookachamps Creek	Swan Rd	8.49	3.94	9.5
13	E.F. Nookachamps Creek	State Route 9	8.91	3.01	9.5
14	College Way Creek	College Way	9.46	7.36	9.5
15	Nookachamps Creek	Knapp Rd	8.14	1.15	9.5
16	E.F. Nookachamps Creek	Beaver Lake Rd	11.66	9.89	9.5
17	Nookachamps Creek	Big Lake Outlet	9.59	7.03	9.5
18	Lake Creek	State Route 9	11.25	9.30	9.5
19	Hansen Creek	Hoehn Rd	10.27	6.72	9.5
20	Hansen Creek	Northern State	11.48	9.13	9.5
21	Coal Creek	Hoehn Rd	11.16	7.12	9.5
22	Coal Creek	Hwy 20	11.76	9.80	9.5
23	Wiseman Creek	Minkler Rd	11.77	9.85	9.5
24	Mannser Creek	Lyman Hamilton Hwy	7.86	5.19	9.5
25	Red Cabin Creek	Hamilton Cem. Rd	11.82	10.28	9.5
28	Brickyard Creek	Hwy 20	8.34	4.03	8.0
29	Skagit River	River Bend Rd	11.42	9.40	9.5
30	Skagit River	Cape Horn Rd	11.43	9.21	9.5
32	Samish River	Thomas Rd	11.30	9.80	8.0
33	Alice Bay Pump Station	Samish Island Rd	8.64	1.82	8.0
34	No Name Slough	Bayview-Edison Rd	7.37	0.00	8.0
35	Joe Leary Slough	D'Arcy Rd	6.42	4.04	8.0
36	Edison Slough at school	West Bow Hill Rd	7.99	4.84	8.0
37	Edison Pump Station	Farm to Market Rd	4.82	0.30	8.0
38	North Edison Pump Station	North Edison Rd	4.00	0.47	8.0
39	Colony Creek	Colony Rd	11.01	7.68	9.5
40	Big Indian Slough	Bayview-Edison Rd	5.06	2.04	8.0
41	Maddox Slough/Big Ditch	Milltown Rd	6.35	0.13	8.0
42	Hill Ditch	Cedardale Rd	7.85	4.67	9.5
43	Wiley Slough	Wylie Rd	4.09	1.13	8.0
44	Sullivan Slough	La Conner-Whitney	7.31	2.25	8.0
45	Skagit River – North Fork	Moore Rd	11.54	8.39	9.5
46	Skagit River – South Fork	Fir Island Rd	11.62	9.54	9.5
47	Swinomish Channel	County Boat Launch	8.71	6.44	6.0
48	Fisher Creek	Franklin Rd	11.44	10.00	9.5

[1]Washington State Water Quality Standard per WAC 173-201A

Table 11 - Mean dissolved oxygen (DO) levels for the most recent five years. Cells shaded green pass state standard. A margin of error allowance is given at 0.2 mg/L.

Site Number	Watercourse	Location	Mean Dissolved Oxygen (mg/L)				
			2016	2017	2018	2019	2020
3	Thomas Creek	Old Hwy 99 North	6.2	6.6	6.1	5.8	6.5
4	Thomas Creek	F&S Grade Rd	11.2	11.5	11.6	11.5	11.4
6	Friday Creek	Prairie Rd	11.4	11.8	11.6	11.6	11.4
8	Swede Creek	Grip Rd	10.4	10.6	10.8	10.7	11.0
11	Samish River	State Route 9	8.7	9.4	9.4	9.0	9.30
12	Nookachamps Creek	Swan Rd	9.1	8.4	9.0	9.4	8.5
13	E.F. Nookachamps Creek	State Route 9	9.9	10.0	10.0	9.6	8.9
14	College Way Creek	College Way	9.0	9.7	9.9	9.8	9.5
15	Nookachamps Creek	Knapp Rd	7.7	8.4	8.6	8.3	8.1
16	E.F. Nookachamps Creek	Beaver Lake Rd	11.3	11.7	11.7	12.0	11.7
17	Nookachamps Creek	Big Lake Outlet	9.6	10.2	10.4	10.2	9.7
18	Lake Creek	State Route 9	10.8	11.2	11.1	11.3	11.3
19	Hansen Creek	Hoehn Rd	10.2	10.4	10.3	10.3	10.3
20	Hansen Creek	Northern State	11.3	11.6	11.6	11.5	11.5
21	Coal Creek	Hoehn Rd	11.2	11.7	11.8	11.6	11.2
22	Coal Creek	Hwy 20	11.6	11.9	12.1	11.8	11.8
23	Wiseman Creek	Minkler Rd	11.6	12.3	12.2	12.2	11.8
24	Mannser Creek	Lyman Ham. Hwy	7.0	7.5	7.9	7.9	7.9
25	Red Cabin Creek	Hamilton Cem. Rd	12.1	12.3	12.2	12.2	11.8
28	Brickyard Creek	Hwy 20	9.2	10.2	10.4	9.5	8.3
29	Skagit River	River Bend Rd	11.0	11.4	11.4	11.1	11.4
30	Skagit River	Cape Horn Rd	11.2	11.7	11.5	11.3	11.4
32	Samish River	Thomas Rd	10.9	11.4	10.9	11.2	11.3
33	Alice Bay Pump Station	Samish Island Rd	10.3	8.2	11.1	9.2	8.6
34	No Name Slough	Bayview-Edison Rd	7.6	7.8	8.0	7.0	7.4
35	Joe Leary Slough	D'Arcy Rd	5.4	5.0	5.6	5.6	6.4
36	Edison Slough at school	W. Bow Hill Rd	9.9	10.4	11.2	8.9	8.0
37	Edison Pump Station	Farm to Market Rd	8.6	8.3	7.9	8.2	4.8
38	N. Edison Pump Station	North Edison Rd	10.4	8.4	7.5	7.4	4.0
39	Colony Creek	Colony Rd	10.7	11.0	11.0	11.1	11.0
40	Big Indian Slough	Bayview-Edison Rd	4.1	4.7	5.4	5.1	5.1
41	Maddox/Big Ditch	Milltown Rd	7.8	6.6	7.1	7.4	6.4
42	Hill Ditch	Cedardale Rd	9.0	8.3	8.9	8.5	7.9
43	Wiley Slough	Wylie Rd	5.3	4.5	5.0	4.8	4.1
44	Sullivan Slough	La Conner-Whitney	6.2	7.5	6.3	6.3	7.3
45	Skagit River – North Fork	Moore Rd	11.0	11.5	11.6	11.3	11.5
46	Skagit River – South Fork	Fir Island Rd	11.3	11.4	11.6	11.4	11.6
47	Swinomish Channel	County Boat Launch	8.5	9.0	8.8	8.8	8.7
48	Fisher Creek	Franklin Rd	11.0	11.6	11.4	11.6	11.4

Figure 5 - Seventeen-year trends in dissolved oxygen (DO)

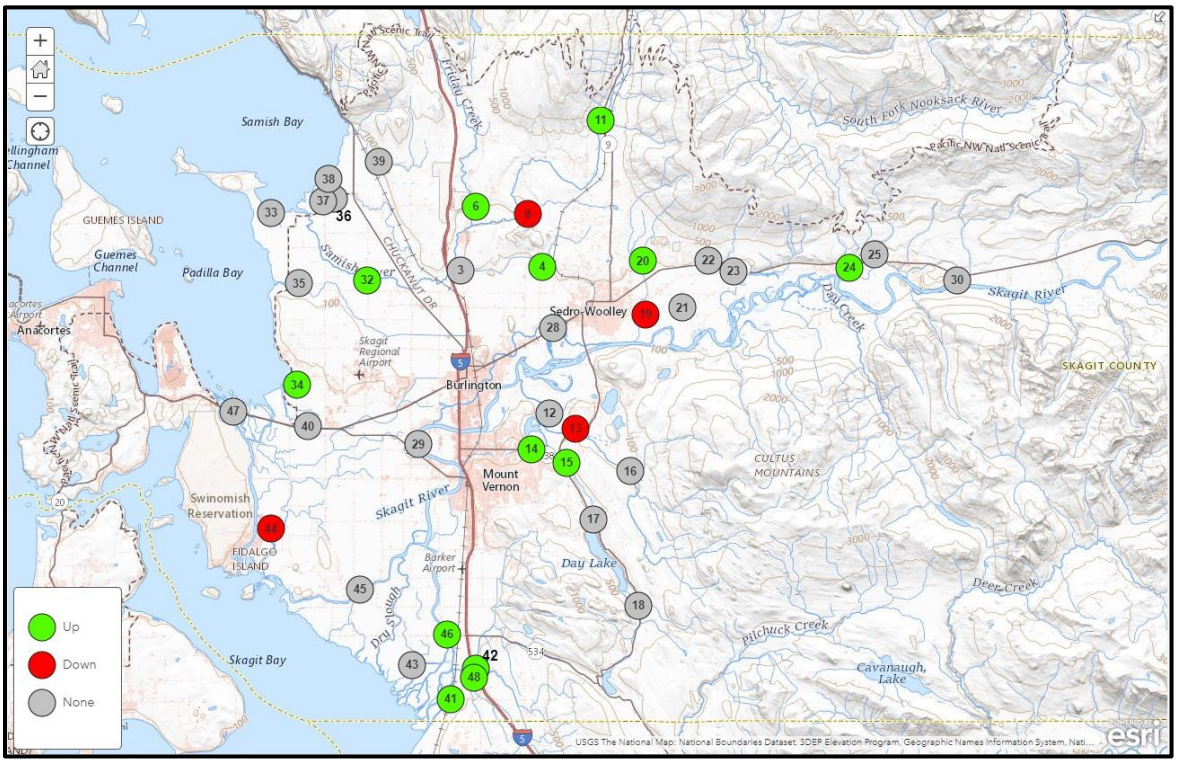


Figure 6 - Ten-year trends in dissolved oxygen (DO)

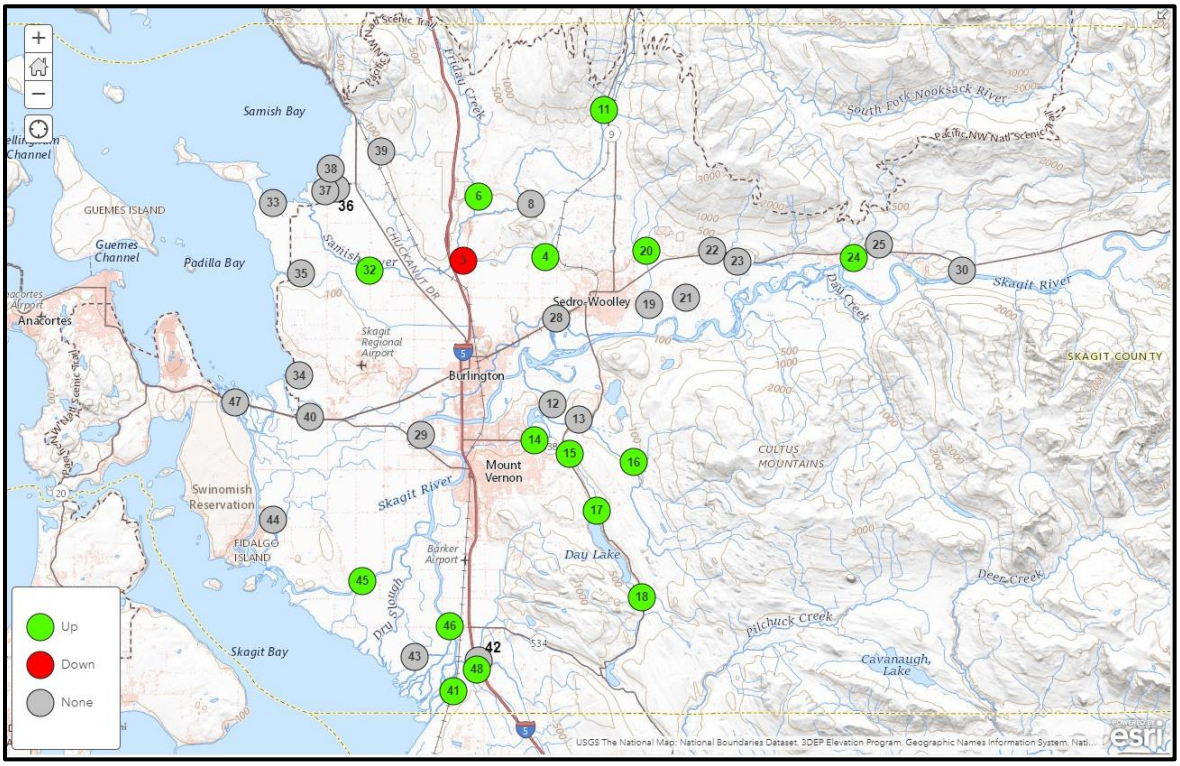
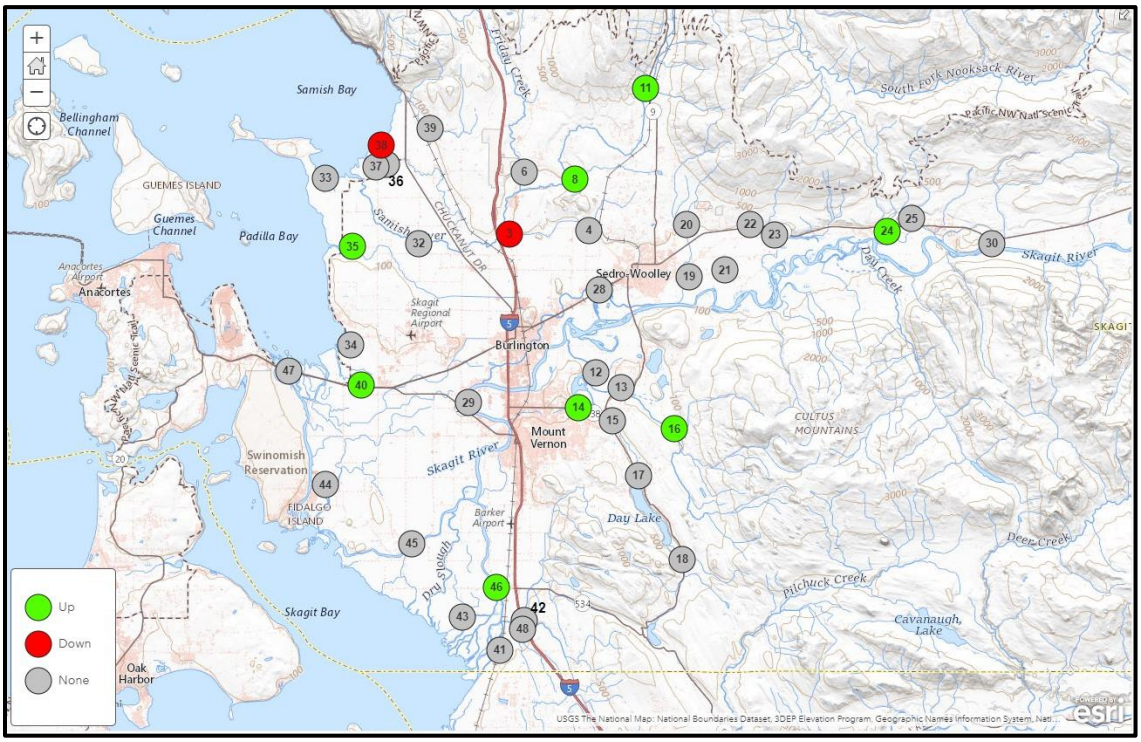


Figure 7 - Five-year trends in dissolved oxygen (DO)



Fecal Coliform (FC)

Fecal coliform is a measurement aimed at estimating the amount of enteric bacteria from warm-blooded animals present in a watercourse. Although FC measurements do not directly quantify disease-causing organisms, they serve as an indicator of the possible presence of such bacteria, viruses, and protozoa. The sources of FC organisms reaching the watercourses of Skagit County may include runoff from failing septic tanks, livestock operations, wildlife, recreationists, and pets.

Background

Samples for FC measurements were taken at each site during each visit and were submitted to the Skagit County Health Department Water Lab (2003-2008) or Edge Analytical (2009-2020) for analysis by the most probable number (MPN) method. State standards for FC are based on the geometric mean of the samples as well as the percent of the samples that exceed given criteria. For most of the watercourses in the SCMP (sites 3-20, 28-29, 31-46, 48), FC is not to exceed a geometric mean of 100 MPN, with no more than 10% of the measurements exceeding 200 MPN. For the upriver sites (sites 21-25, 30), the standard is a geometric mean of 50 MPN, with no more than 10% of the measurements exceeding 100 MPN. For the marine site (site 47), a more stringent standard of 14 MPN with no more than 10% exceeding 41 MPN is enforced to protect shellfish beds.

Results

Fecal coliform measurements for the 2020 water year, in MPN of bacterial colonies per 100 ml, are summarized in **Table 12**. The geometric mean FC at each site for the last five years of this program can be found in **Table 13**.

For the 2020 water year, 19 sites met the standard based on ambient sampling for the entire water year, compared to 16 sites in 2019. Most sites that did not meet the standard did so due to having more than 10% of samples with FC counts in excess of 200 MPN. Storm sampling in the Samish Basin also continues to show excessive FC during rain events.

Trends analysis shows that in the 17 years since the program began, twelve sites have shown improvement through a decline in FC counts, while six sites have shown deterioration through an increase in FC counts (**Figure 8**). There is a clear clustering of improved sites in the Samish Bay watershed, relative to the rest of the county. In the most recent ten years, three sites have shown improvement, while two sites have shown deterioration (**Figure 9**). In the most recent five years, four sites have shown improvement, while one site has shown significantly increased FC counts (**Figure 10**).

Table 12 - Fecal coliform (FC) results for 2020 water year (MPN/100ml). Cells shaded green pass state standard.

Site Number	Watercourse	Location	n	Geometric mean (MPN)[1]	% > 100 or 200[1]
3	Thomas Creek	Old Hwy 99 N	22	37	4.5
4	Thomas Creek	F&S Grade Rd	22	94	32
6	Friday Creek	Prairie Rd	22	26	0
8	Swede Creek	Grip Rd	22	54	18
11	Samish River	State Route 9	22	15	0
12	Nookachamps Creek	Swan Rd	21	56	14
13	E.F. Nookachamps Creek	State Route 9	22	42	14
14	College Way Creek	College Way	21	192	48
15	Nookachamps Creek	Knapp Rd	22	50	6
16	E.F. Nookachamps Creek	Beaver Lake Rd	22	19	0
17	Nookachamps Creek	Big Lake Outlet	22	10	0
18	Lake Creek	State Route 9	22	39	14
19	Hansen Creek	Hoehn Rd	20	29	5
20	Hansen Creek	Northern State	21	45	5
21	Coal Creek	Hoehn Rd	20	49	30
22	Coal Creek	Hwy 20	22	7	5
23	Wiseman Creek	Minkler Rd	21	14	10
24	Mannser Creek	Lyman Hamilton Hwy	20	12	5
25	Red Cabin Creek	Hamilton Cemetery Rd	16	10	7
28	Brickyard Creek	Hwy 20	14	13	0
29	Skagit River	River Bend Rd	20	9	5
30	Skagit River	Cape Horn Rd	22	4	0
32	Samish River	Thomas Rd	22	55	14
33	Alice Bay Pump Station	Samish Island Rd	22	42	18
34	No Name Slough	Bayview-Edison Rd	22	88	36
35	Joe Leary Slough	D'Arcy Rd	22	72	23
36	Edison Slough at school	W. Bow Hill Rd	22	106	36
37	Edison Pump Station	Farm to Market Rd	22	291	64
38	N. Edison Pump Station	North Edison Rd	22	127	45
39	Colony Creek	Colony Rd	22	36	23
40	Big Indian Slough	Bayview-Edison Rd	22	92	27
41	Maddox/Big Ditch	Milltown Rd	22	64	14
42	Hill Ditch	Cedardale Rd	22	111	27
43	Wiley Slough	Wylie Rd	22	56	19
44	Sullivan Slough	La Conner-Whitney Rd	21	107	33
45	Skagit River – North Fork	Moore Rd	22	6	0
46	Skagit River – South Fork	Fir Island Rd	22	11	0
47	Swinomish Channel	County Boat Launch	22	7	0
48	Fisher Creek	Franklin Rd	22	60	10

[1] State water quality standards for fecal coliform requires water bodies to have a geometric mean of less than 50 (sites 21-25,30) or 100 (sites 3-20,28-29, 31-46, 48) colony forming units (CFU) or Most Probable Number (MPN) per 100 ml and less than 10% of the samples >100 (sites 21-25,30) or >200 cfu (sites 3-20,28-29, 31-46, 48). Marine locations (site 47) are required to be <14 cfu with no more than 10% >41 cfu. Cells shaded green represent sites that pass state standards.

Table 13 - Geometric mean FC results for most recent five years (MPN/100ml). Cells shaded green pass state standard.

Site Number	Watercourse	Location	2016	2017	2018	2019	2020
3	Thomas Creek	Old Hwy 99 N	49	63	47	50	37
4	Thomas Creek	F&S Grade Rd	138	107	138	131	94
6	Friday Creek	Prairie Rd	34	29	39	28	26
8	Swede Creek	Grip Rd	59	40	53	29	54
11	Samish River	State Route 9	26	14	12	11	15
12	Nookachamps Creek	Swan Rd	65	79	56	45	56
13	E.F. Nookachamps Creek	State Route 9	59	41	22	38	42
14	College Way Creek	College Way	106	172	83	113	192
15	Nookachamps Creek	Knapp Rd	54	62	63	64	50
16	E.F. Nookachamps Creek	Beaver Lake Rd	44	28	22	22	19
17	Nookachamps Creek	Big Lake Outlet	16	12	14	17	10
18	Lake Creek	State Route 9	50	24	26	41	39
19	Hansen Creek	Hoehn Rd	114	53	57	62	29
20	Hansen Creek	Northern State	35	50	48	37	45
21	Coal Creek	Hoehn Rd	84	53	65	63	49
22	Coal Creek	Hwy 20	22	18	13	11	7
23	Wiseman Creek	Minkler Rd	12	10	18	10	14
24	Mannser Creek	Lyman Hamilton Hwy	12	15	13	14	12
25	Red Cabin Creek	Hamilton Cemetery Rd	6	12	5	6	10
28	Brickyard Creek	Hwy 20	33	42	45	53	13
29	Skagit River	River Bend Rd	14	9	9	7	9
30	Skagit River	Cape Horn Rd	6	3	5	4	4
32	Samish River	Thomas Rd	54	48	41	58	55
33	Alice Bay Pump Station	Samish Island Rd	54	30	24	33	42
34	No Name Slough	Bayview-Edison Rd	71	65	59	48	88
35	Joe Leary Slough	D'Arcy Rd	98	91	108	93	72
36	Edison Slough at school	W. Bow Hill Rd	120	97	56	49	106
37	Edison Pump Station	Farm to Market Rd	386	317	214	188	291
38	North Edison Pump Station	North Edison Rd	264	148	148	113	127
39	Colony Creek	Colony Rd	76	57	61	58	36
40	Big Indian Slough	Bayview-Edison Rd	29	43	81	47	92
41	Maddox Slough/Big Ditch	Milltown Rd	61	87	52	46	64
42	Hill Ditch	Cedardale Rd	43	42	51	48	111
43	Wiley Slough	Wylie Rd	106	68	82	74	56
44	Sullivan Slough	La Conner-Whitney Rd	157	127	67	45	107
45	Skagit River – North Fork	Moore Rd	6	7	8	4	6
46	Skagit River – South Fork	Fir Island Rd	9	13	13	9	11
47	Swinomish Channel	County Boat Launch	6	6	6	4	7
48	Fisher Creek	Franklin Rd	92	69	78	56	60

Figure 8 - Seventeen-year trends in fecal coliform (FC)

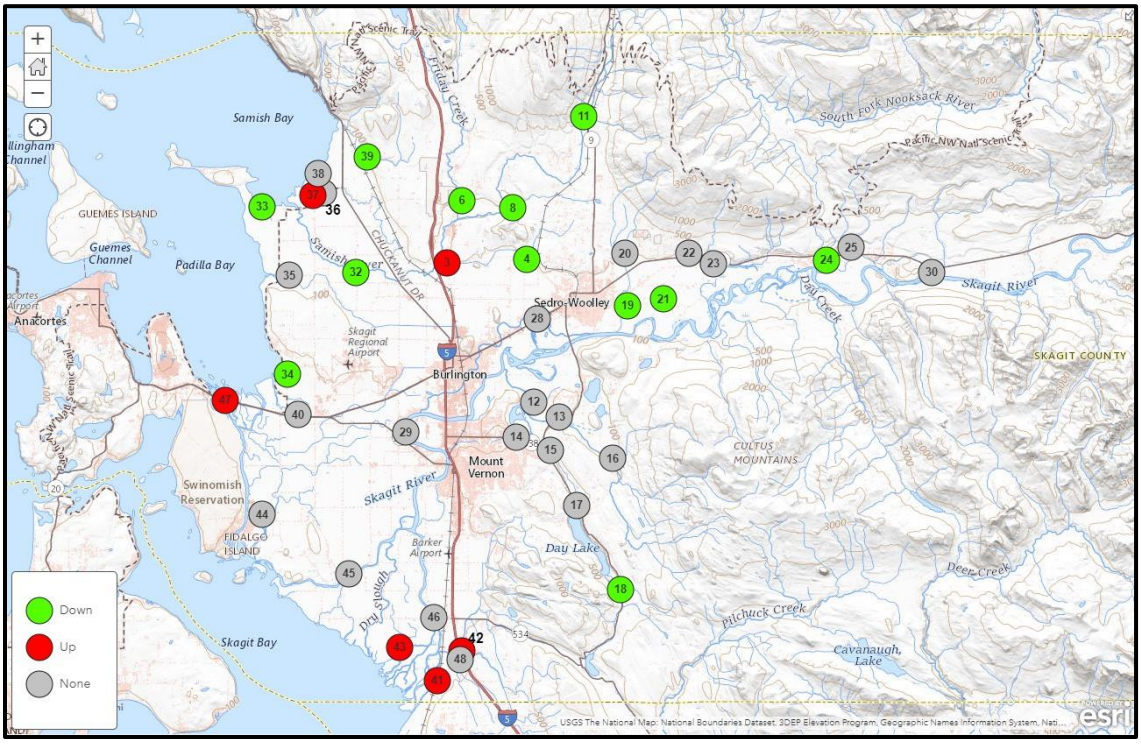


Figure 9 - Ten-year trends in fecal coliform (FC)

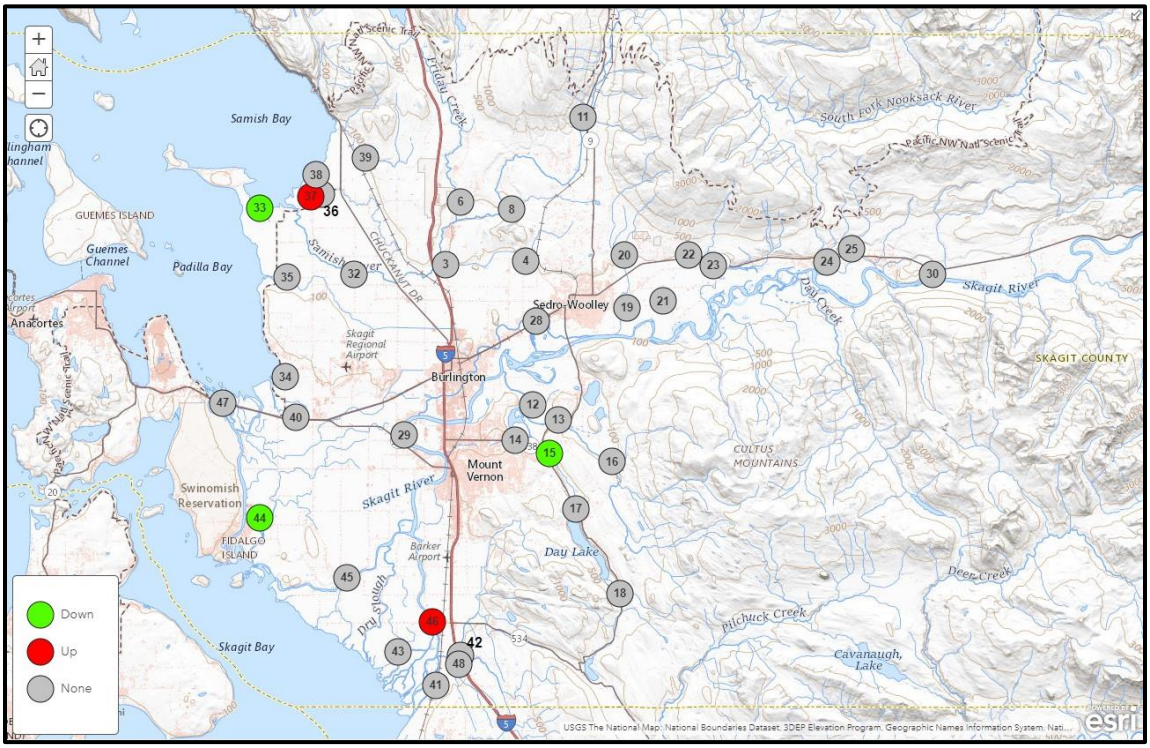
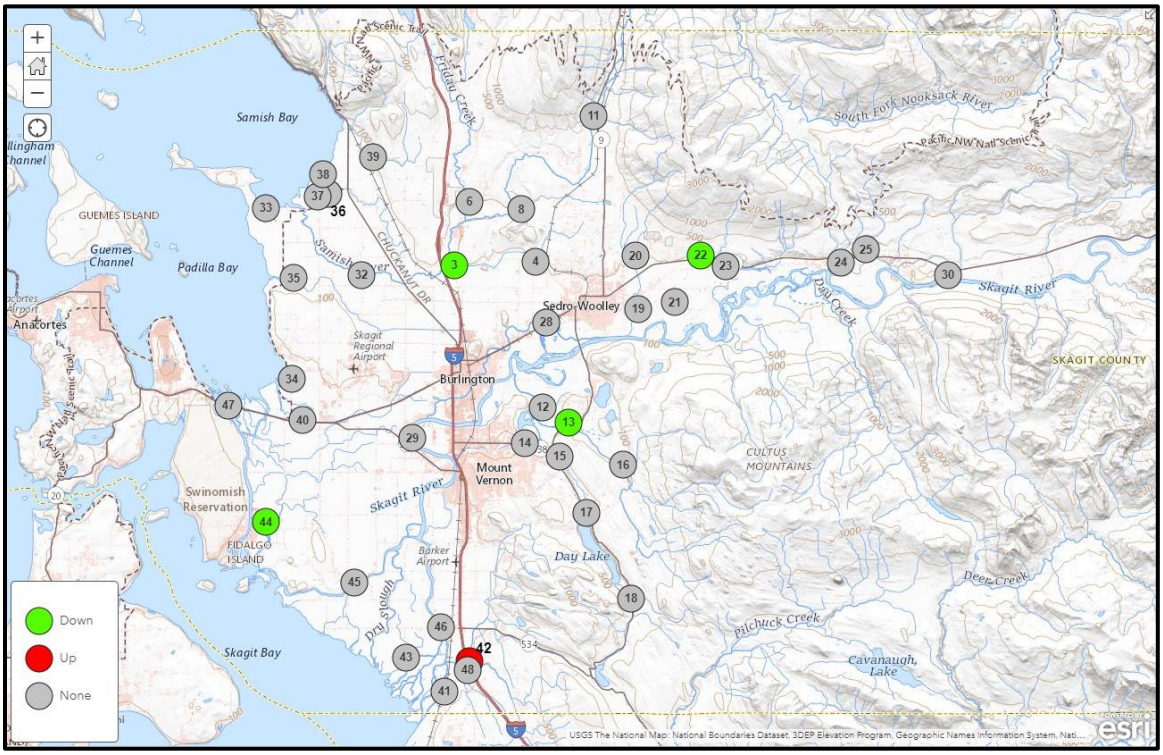


Figure 10 - Five-year trends in fecal coliform (FC)



Nutrients

Nutrient levels in watercourses help determine the potential for algal activity. Excessive nutrient levels can lead to large blooms of algae, which can increase DO levels during the day but lead to large decreases in DO at night, when the algae are respiring, and also when the algae die and decompose. Nutrients from freshwater sources discharged into Puget Sound bays can contribute to marine algal blooms as well. Algal blooms can become harmful to recreationists when there are cyanobacteria present, which make ingestion of the water toxic to humans and their pets.

Background

From the beginning of the program in water year 2004 up until the close of water year 2008 nutrients were sampled on a monthly basis. After the close of the grant from Ecology, maintaining monthly sampling of all nutrients was deemed too cost-prohibitive for the ongoing project budget and was switched to quarterly samplings to allow for four-season trend determinations rather than 12-season.

The subsequent section of this report covering Water Quality Index (WQI) is generated with contribution of this quarterly nutrient data. Therefore, since water year 2008, WQI data has been a four-season metric for this report.

Results

Water samples for measurement of plant nutrients were taken at each station quarterly. Samples were analyzed by Edge Analytical of Burlington, WA. Quarterly sampling brings with it a large caveat: these trends results are determined by a single sampling snapshot in time, on one day, of an entire three-month period. Needless to say, while this method is imperfect, it is still valuable for collecting and analyzing possible trends. If the conditions of the watercourses sampled were truly randomly assorted based on sampling, with too great of an intermittence (3 months) to have value, then running a trends analysis should theoretically show no discernible trend in the data, and any direction of the data would be determined as non-existent or non-significant. The trends analyses returning a large number of significant trends across the county, even with incredibly small slopes (e.g. parts per billion).

A second caveat must be taken: As mentioned in the first, some of these trends are statistically significant, even though the actual change in nutrient levels observed in the watercourse may be incredibly small. Take into consideration the actual change over time of that nutrient in the watercourse, as is provided in the tables in **Appendix C**. For example, over the sixteen year course of this program, a nutrient at a site may have increased by half of a milligram per liter (part per million), or at a different site it may have increased by one microgram per liter (part per billion), or less. Despite this, both analyses could show statistically significant increases in this nutrient on a map.

Table 14 gives mean nutrient values for selected parameters for the 2020 water year. All nutrient values are included in **Appendix A**, with summary statistics found in **Appendix B**, and trends analyses in **Appendix C**.

Most of the natural streams in the program showed moderate levels of total nitrogen, ammonia, and total phosphorus. The drainage infrastructure sampling sites generally had higher levels of nutrients compared to the stream stations.

There are no numeric state standards for nutrients as factors in algal blooms. However, the state has both acute and chronic water quality standards for ammonia toxicity that are calculated from the ammonia level combined with the water temperature, pH, and other factors for each individual ammonia measurement.

The following trends analyses were performed only on the 17-year dataset, representing the entire length of this program's monitoring:

Total Kjeldahl Nitrogen shows a decrease at seven sites, and an increase at no sites, with no obvious clustering pattern (**Figure 11**).

Total Phosphorous shows an increase at fifteen sites, and a decrease in twelve sites (**Figure 12**). The improvements are clustered in the Middle Skagit watershed and down the Skagit River. The sites showing increasing phosphorous levels are observed all across the valley.

Ortho-phosphorous shows an increase at 23 sites, and a decrease in zero sites (**Figure 13**). This is a very negative trend map, and was the worst overall trend among the nutrients measured.

Ammonia levels have gone down at 16 sites around the county and have increased at only one. The decreases are observed all across the valley (**Figure 14**).

Nitrate + Nitrite levels have decreased at nine sites across the county, concentrated in the north and east, and have increased at only one site, the Swinomish Channel (**Figure 15**).

Overall, phosphorous (total and ortho) is the only nutrient showing an increase across the valley. Combination of all significant nutrient trends shows a total of 44 positive trends, or decreases, and 40 negative trends, or increases, with 38 of those being phosphorous. Phosphorous is the most common "limiting nutrient" for algal blooms in the natural environment, which means that when an excess of phosphorous shows up in the watercourse, it is often the only thing required to trigger an algal bloom.

Table 14 - Mean nutrient values (mg/L) for 2020 water year

Site Number	Watercourse	Location	Total Kjeldahl Nitrogen [1]	Total Phosphorus	Ammonia	Nitrate + Nitrite
3	Thomas Creek	Old Hwy 99 N	0.84	0.18	0.17	0.39
4	Thomas Creek	F&S Grade Rd	0.42	0.06	0.02	0.76
6	Friday Creek	Prairie Rd	0.26	0.02	0.01	0.31
8	Swede Creek	Grip Rd	0.37	0.05	0.01	0.27
11	Samish River	State Route 9	0.26	0.02	0.02	0.23
12	Nookachamps Creek	Swan Rd	0.45	0.07	0.09	0.21
13	E.F. Nookachamps Creek	State Route 9	0.42	0.04	0.06	0.18
14	College Way Creek	College Way	0.30	0.05	0.03	0.35
15	Nookachamps Creek	Knapp Rd	0.35	0.08	0.03	0.23
16	E.F. Nookachamps Creek	Beaver Lake Rd	0.25	0.01	0.02	0.29
17	Nookachamps Creek	Big Lake Outlet	0.27	0.03	0.05	0.16
18	Lake Creek	State Route 9	0.26	0.02	0.02	0.36
19	Hansen Creek	Hoehn Rd	0.31	0.03	0.02	0.27
20	Hansen Creek	Northern State	0.28	0.02	0.02	0.37
21	Coal Creek	Hoehn Rd	0.29	0.01	0.01	0.75
22	Coal Creek	Hwy 20	0.28	0.01	0.01	0.66
23	Wiseman Creek	Minkler Rd	0.26	0.01	0.01	0.77
24	Mannser Creek	Lyman Hamilton Hwy	0.28	0.03	0.02	0.19
25	Red Cabin Creek	Hamilton Cem. Rd	0.25	0.01	0.01	0.39
28	Brickyard Creek	Hwy 20	0.32	0.04	0.02	0.47
29	Skagit River	River Bend Rd	0.25	0.01	0.03	0.08
30	Skagit River	Cape Horn Rd	0.25	0.02	0.01	0.07
32	Samish River	Thomas Rd	0.30	0.04	0.03	0.46
33	Alice Bay Pump Station	Samish Island Rd	2.64	0.63	0.83	0.91
34	No Name Slough	Bayview-Edison Rd	0.95	0.93	0.16	0.22
35	Joe Leary Slough	D'Arcy Rd	0.78	0.28	0.57	0.71
36	Edison Slough at school	W. Bow Hill Rd	0.92	0.75	0.15	0.34
37	Edison Pump Station	Farm to Market Rd	16.32	1.35	1.76	0.59
38	N. Edison Pump Station	North Edison Rd	3.62	1.24	2.21	0.47
39	Colony Creek	Colony Rd	0.37	0.07	0.02	0.63
40	Big Indian Slough	Bayview-Edison Rd	0.70	0.15	0.27	0.57
41	Maddox/Big Ditch	Milltown Rd	1.21	0.28	0.46	0.99
42	Hill Ditch	Cedardale Rd	0.39	0.05	0.04	0.36
43	Wiley Slough	Wylie Rd	1.47	0.12	0.86	0.75
44	Sullivan Slough	La Conner-Whitney	1.39	0.25	0.72	0.55
45	Skagit River – North Fork	Moore Rd	0.25	0.01	0.02	0.08
46	Skagit River – South Fork	Fir Island Rd	0.25	0.01	0.03	0.08
47	Swinomish Channel	County Boat Launch	0.25	0.07	0.07	0.24
48	Fisher Creek	Franklin Rd	0.60	0.18	0.04	0.53

Figure 11 - Seventeen-year trends in Total Kjeldahl Nitrogen (TKN)

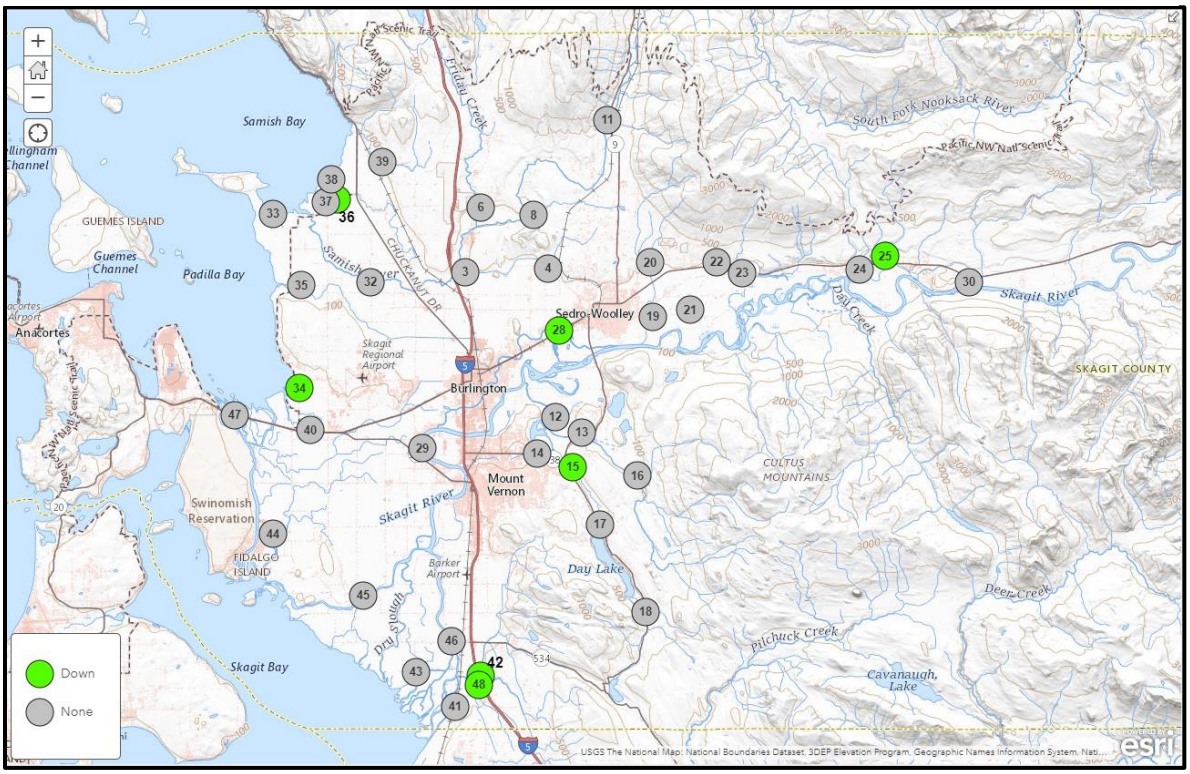


Figure 12 - Seventeen-year trends in Total Phosphorous (TP)

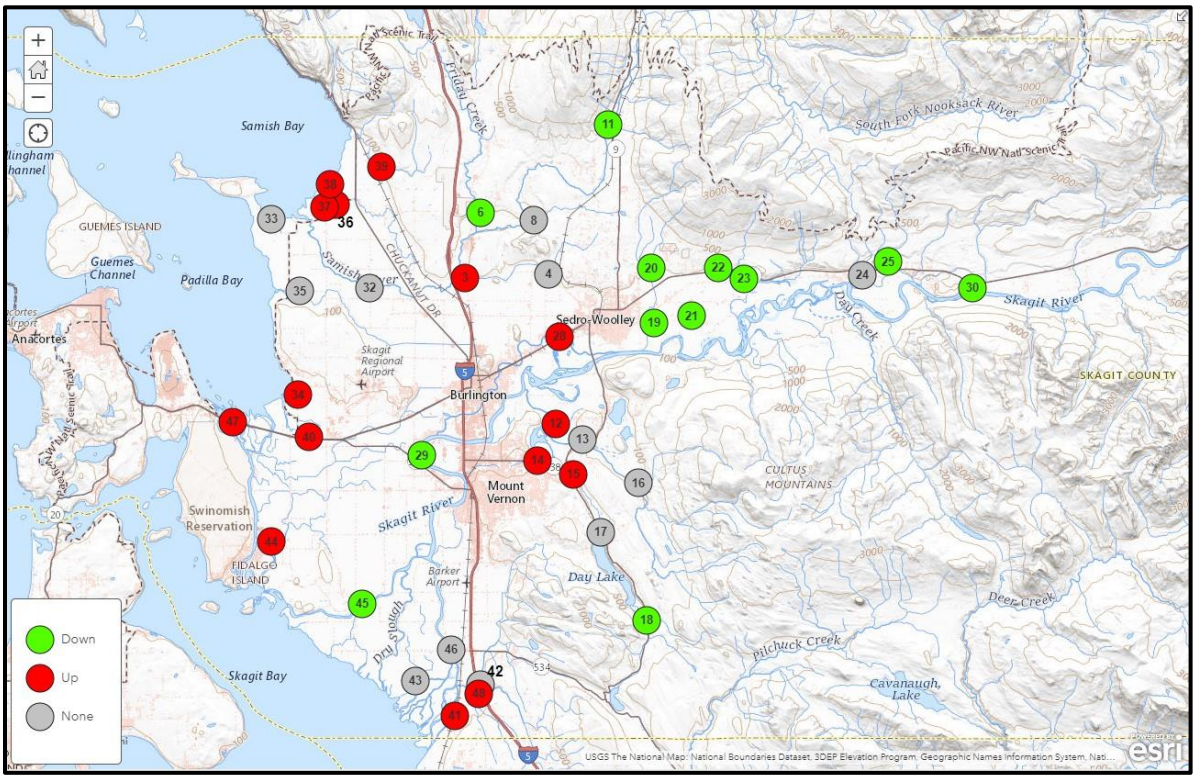


Figure 13 - Seventeen-year trends in Ortho-phosphorous (OP)

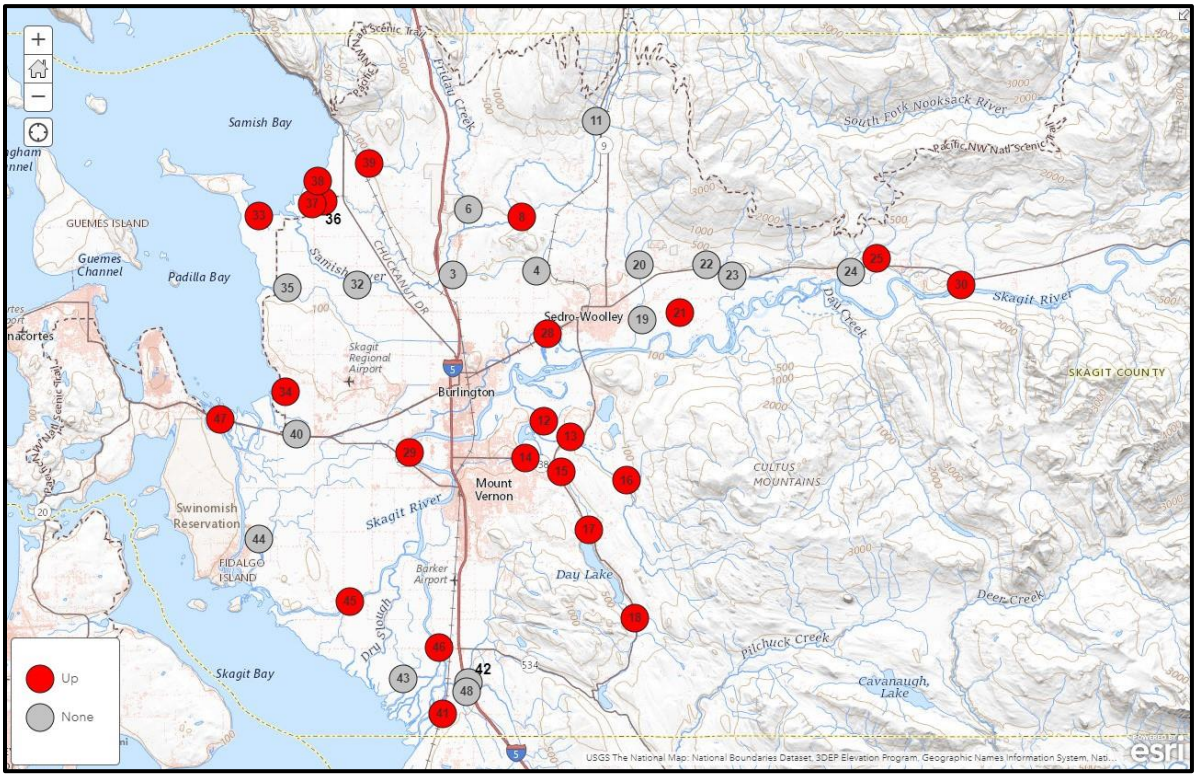


Figure 14 - Seventeen-year trends in Ammonia (NH3)

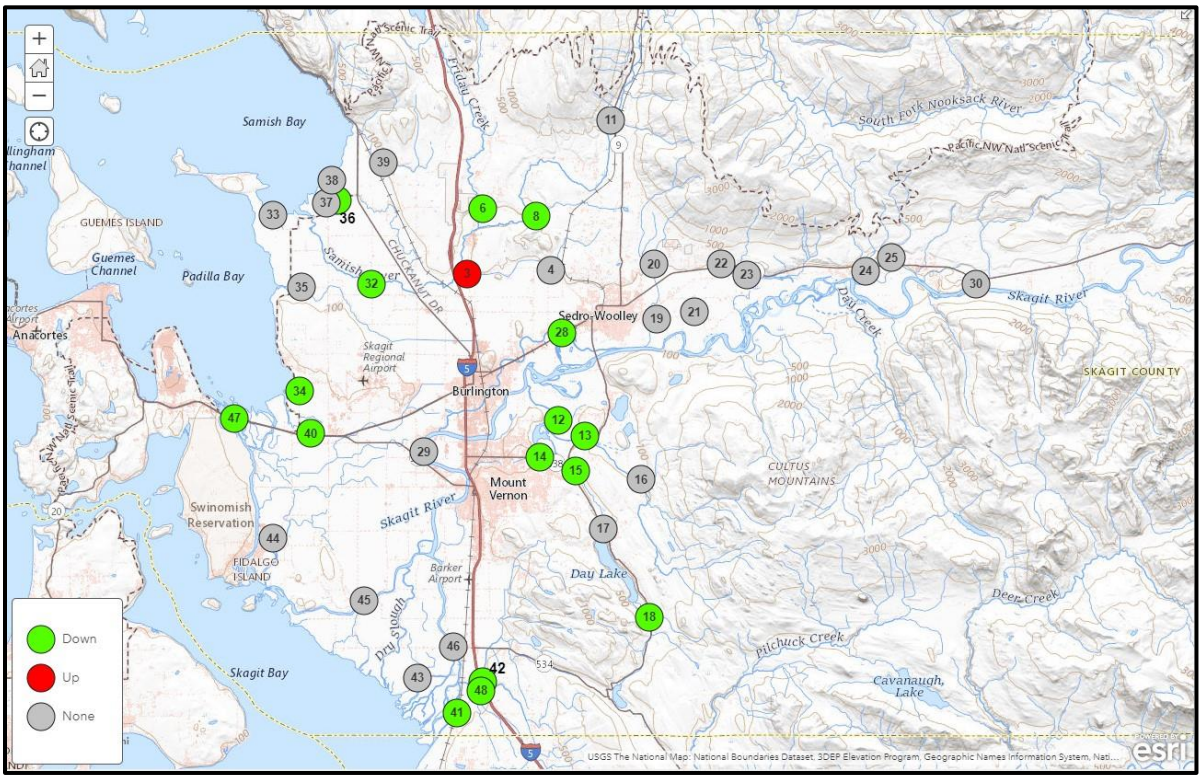
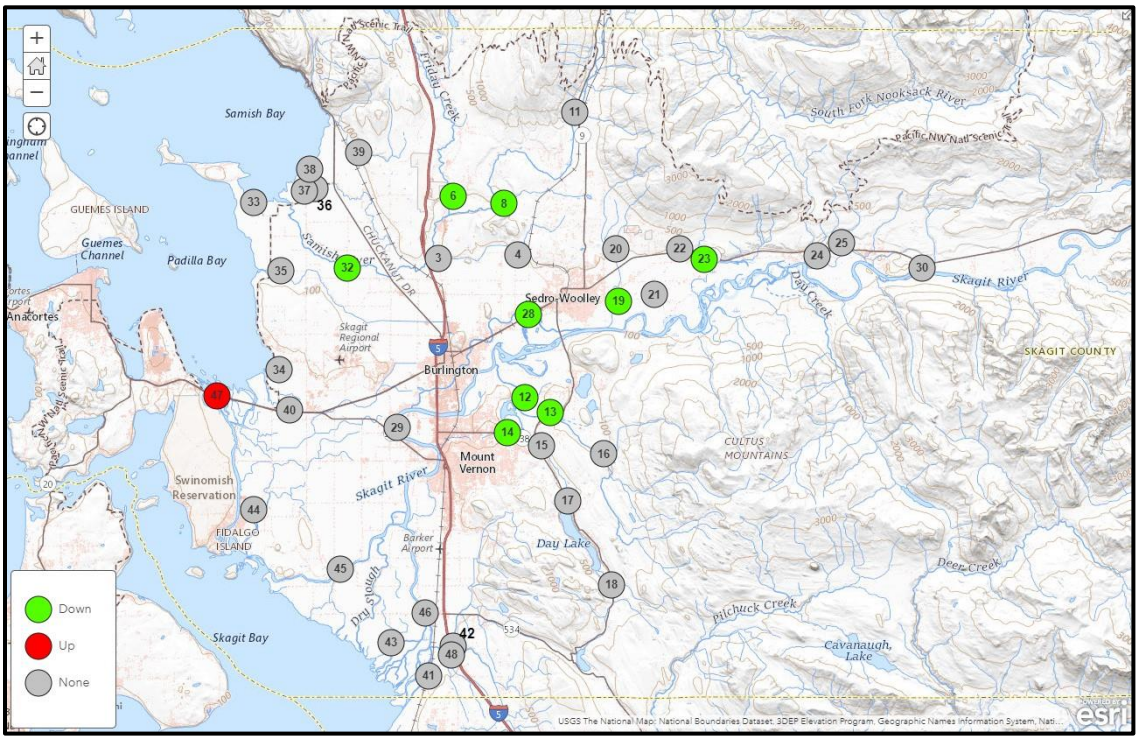


Figure 15 - Seventeen-year trends in Nitrate and Nitrite (NO3 + NO2)



Other Parameters

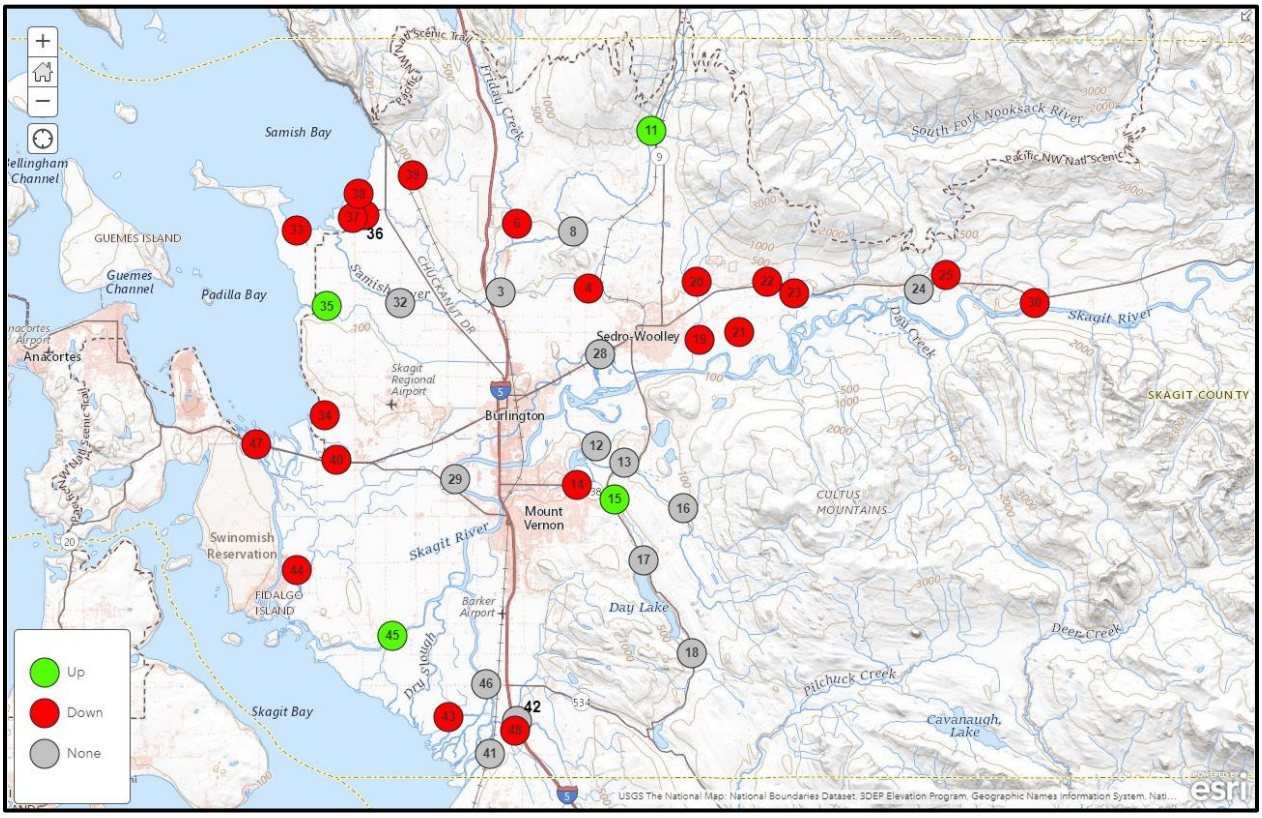
The SCMP also measures pH, during each visit to each site. Measurement of pH shows whether a watercourse is within the range that supports aquatic life. In general, pH in the SCMP has been within state standards.

Discharge measurements were made up until 2008 in selected locations and were intended to provide a general indication of the flow regime for that watercourse and as an aid in interpreting other water quality parameters. As Ecology has added several stream gauges in the area, Skagit County has de-emphasized performing manual discharge measurement.

Seventeen-year trends analysis on pH across Skagit County revealed 21 sites with significantly decreasing pH and four sites with an increase (**Figure 16**).

All measurements for these parameters are available in **Appendix A** and are summarized in **Appendix B**.

Figure 16 - Seventeen-year trends in pH



Summary Statistics of Significant Trends across Skagit County

In an effort to construct a bird's-eye view of what trends are occurring across Skagit County, two summary tables were created. These summary tables were populated from the site-specific tables provided in **Appendix C**. These tables take into account all trends analyses from the 17-year data (18 trends), the ten-year data (six trends), and the five-year data (six trends), combined, for a total of 30 possible significant trends. The results on these tables are biased toward the temperature and FC parameters, as they account for six of the 30 total trends in the group, and biased even further toward DO, as it accounts for eight total categories. Other parameters populate one or two categories each. For this report, positive trends were listed as: Increase in pH, increase in DO, increase in DO% saturation, decrease in temperature, decrease in turbidity, decrease in FC, decrease in nutrients, and decrease in TSS. Negative, or deleterious trends, were considered as the opposite of these statements.

The first table (**Table 15**) arranges all ambient monitoring sites by their percentage of positive significant trends as a ratio of total significant trends. Some sites recorded fewer than ten significant trends, while others recorded over twenty. The first table does not arrange by the number of trends total, but simply by how positively or negatively a particular site is trending overall. The sites in the county that have the highest ratio of positive trends are listed at the top, and the sites exhibiting the highest ratio of negative trends are at the bottom. This table is a quick reference for overall improving or deteriorating water quality for a site.

The second table (**Table 16**) arranges all ambient sampling monitoring sites by their total number of significant trends recorded. Some sites recorded fewer than ten significant trends, while others recorded over twenty. The second table does not arrange by the ratio of positive or negative trends recorded, but simply by the amount of significant change that is occurring at that site. This table is a quick reference for identifying which sites around the county are experiencing the most significant statistical change in water quality, and which sites are not. Sites located at the top of the table are those that have had their water quality parameters change the most.

Table 15 - Summary Statistics of Significant Trends, by Positive/Negative

Site		Significant Trends				Category
		Total	Positive	Negative	% Positive	
Samish River	11	15	15	0	100	Ag - Up
Skagit River	45	11	10	1	91	Skagit - Low
Samish River	32	16	14	2	88	Ag - Down
Thomas Creek	4	12	10	2	83	Ag - Up
Nookachamps Creek	15	16	13	3	81	Ag - Mid
Lake Creek	18	10	8	2	80	Ag - Up
Hansen Creek	20	10	8	2	80	Ag - Up
College Way Creek	14	13	10	3	77	Ref - Urban
Mannser Creek	24	13	10	3	77	Ag - Mid
EF Nookachamps	16	13	10	3	77	Ag - Mid
Skagit River	46	17	13	4	76	Skagit - Low
Joe Leary Slough	35	10	7	3	70	Ag - Down
Friday Creek	6	16	11	5	69	Ref - RR
Alice Bay Pump	33	12	8	4	67	Ag - Down
Nookachamps Creek	12	9	6	3	67	Ag - Down
Skagit River	29	6	4	2	67	Skagit - Mid
Fisher Creek	48	14	9	5	64	Ag - Down
Skagit River	30	13	8	5	62	Skagit - Up
Coal Creek	21	13	8	5	62	Ag - Down
No Name Slough	34	19	11	8	58	Ag - Down
Wiseman Creek	23	7	4	3	57	Ag - Up
Swede Creek	8	18	10	8	56	Ag - Down
Colony Creek	39	9	5	4	56	Ag - Down
Red Cabin Creek	25	11	6	5	55	Ref - RR
EF Nookachamps	13	13	7	6	54	Ag - Down
Thomas Creek	3	13	7	6	54	Ag- Down
Maddox/Big Ditch	41	15	8	7	53	Ag - Down
Brickyard Creek	28	6	3	3	50	Ref - Urban
Hill Ditch/Carpenter	42	14	6	8	43	Ag - Down
Big Indian Slough	40	10	4	6	40	Ag - Mid
Coal Creek	22	8	3	5	38	Ag - Up
Sullivan Slough	44	11	4	7	36	Ag - Down
Hansen Creek	19	15	5	10	33	Ag - Down
Nookachamps Creek	17	7	2	5	29	Ag - Up
Edison Slough	36	8	2	6	25	Ag - Down
N. Edison Pump	38	9	2	7	22	Ag - Down
Swinomish Channel	47	13	2	11	15	Ref - Marine
S. Edison Pump	37	10	1	9	10	Ag - Down
Wiley Slough	43	6	0	6	0	Ag - Down

Table 16 - Summary Statistics of Significant Trends, by Total Count

Site		Significant Trends				Category
		Total	Positive	Negative	% Positive	
No Name Slough	34	19	11	8	58	Ag - Down
Swede Creek	8	18	10	8	56	Ag - Down
Skagit River	46	17	13	4	76	Skagit - Low
Samish River	32	16	14	2	88	Ag - Down
Friday Creek	6	16	11	5	69	Ref - RR
Nookachamps Creek	15	16	13	3	81	Ag - Mid
Maddox/Big Ditch	41	15	8	7	53	Ag - Down
Samish River	11	15	15	0	100	Ag - Up
Hansen Creek	19	15	5	10	33	Ag - Down
Fisher Creek	48	14	9	5	64	Ag - Down
Hill Ditch/Carpenter	42	14	6	8	43	Ag - Down
EF Nookachamps	13	13	7	6	54	Ag - Down
Swinomish Channel	47	13	2	11	15	Ref - Marine
Thomas Creek	3	13	7	6	54	Ag- Down
College Way Creek	14	13	10	3	77	Ref - Urban
Mannser Creek	24	13	10	3	77	Ag - Mid
Skagit River	30	13	8	5	62	Skagit - Up
EF Nookachamps	16	13	10	3	77	Ag - Mid
Coal Creek	21	13	8	5	62	Ag - Down
Thomas Creek	4	12	10	2	83	Ag - Up
Alice Bay Pump	33	12	8	4	67	Ag - Down
Skagit River	45	11	10	1	91	Skagit - Low
Sullivan Slough	44	11	4	7	36	Ag - Down
Red Cabin Creek	25	11	6	5	55	Ref - RR
Lake Creek	18	10	8	2	80	Ag - Up
Hansen Creek	20	10	8	2	80	Ag - Up
Big Indian Slough	40	10	4	6	40	Ag - Mid
S. Edison Pump	37	10	1	9	10	Ag - Down
Joe Leary Slough	35	10	7	3	70	Ag - Down
Nookachamps Creek	12	9	6	3	67	Ag - Down
N. Edison Pump	38	9	2	7	22	Ag - Down
Colony Creek	39	9	5	4	56	Ag - Down
Coal Creek	22	8	3	5	38	Ag - Up
Edison Slough	36	8	2	6	25	Ag - Down
Nookachamps Creek	17	7	2	5	29	Ag - Up
Wiseman Creek	23	7	4	3	57	Ag - Up
Wiley Slough	43	6	0	6	0	Ag - Down
Skagit River	29	6	4	2	67	Skagit - Mid
Brickyard Creek	28	6	3	3	50	Ref - Urban

Water Quality Index (WQI)

The Water Quality Index is a tool developed by Ecology as an overall indicator of water quality at a given site. The index compares typical water quality parameters with established standards and yields a single, unitless number between 1 and 100 to describe the overall water quality of a site at the time of sampling. The index can then be summarized in a number of ways to give a site an overall score for a water year. The parameters included in the WQI are DO, temperature, pH, turbidity, suspended solids, FC, and nutrients.

The WQI is best used to answer general questions about the condition of watercourses, such as "What is the general condition of this stream?" or "How does this stream compare to others in the area?" (Hallock 2002). Because the index is a distillation of many parameters, it is unsuitable for answering detailed questions concerning the water quality of an individual stream. As is demonstrated by the Samish River, a stream can have an adequate WQI score based on ambient sampling, but significant pollution problems revealed by storm sampling.

Ecology rates streams with WQI Overall Score of 80 or greater "of lowest concern." Streams with ratings of 40-79 are considered "of moderate concern," while scores less than 40 are considered "of highest concern."

Water Quality Index calculations for the sample sites in the SCMP during the 2019 water year are summarized in **Table 17,** and are mapped geographically in **Figure 17**. WQI scores over the length of this program are categorized for the years 2009-2019 in **Table 18**. Note that although the WQI was designed for freshwater bodies, we have applied the index to the Swinomish Channel monitoring site (Site 47), which is primarily marine. This allows trend detection over time at this station, but the WQI for Site 47 should not be compared to the freshwater sites.

The WQI results show that several watercourses in the study area fall into the "highest concern" category. Most, but not all, are agricultural drainages with little summer flow that are not considered salmonid habitat.

Over the course of the SCMP, the number of sites in the Lavender (Lowest Concern) category has generally increased since 2012, while the number of sites in the Red (Highest Concern) category has held steady. Streams and ditches in the Red category can have either one water quality parameter that is well below standards or several categories that are below standards.

Water quality during storm events remains problematic as the results from storm event monitoring in the Samish Basin associated with the CSI continue to show excessive fecal coliform concentrations.

Table 17 - Water Quality Index (WQI) results for the 2020 Water Year

Site Number	Watercourse	Location	Overall Score*
3	Thomas Creek	Old Hwy 99 N	56
4	Thomas Creek	F&S Grade Rd	72
6	Friday Creek	Prairie Rd	87
8	Swede Creek	Grip Rd	75
11	Samish River	State Route 9	82
12	Nookachamps Creek	Swan Rd	58
13	E.F. Nookachamps Creek	State Route 9	57
14	College Way Creek	College Way	66
15	Nookachamps Creek	Knapp Rd	63
16	E.F. Nookachamps Creek	Beaver Lake Rd	90
17	Nookachamps Creek	Big Lake Outlet	69
18	Lake Creek	State Route 9	89
19	Hansen Creek	Hoehn Rd	80
20	Hansen Creek	Northern State	81
21	Coal Creek	Hoehn Rd	93
22	Coal Creek	Hwy 20	81
23	Wiseman Creek	Minkler Rd	96
24	Mannser Creek	Lyman Hamilton Hwy	63
25	Red Cabin Creek	Hamilton Cem. Rd.	94
28	Brickyard Creek	Hwy 20	79
29	Skagit River	River Bend Rd	82
30	Skagit River	Cape Horn Rd	84
32	Samish River	Thomas Rd	83
33	Alice Bay Pump Station	Samish Island Rd	26
34	No Name Slough	Bayview-Edison Rd	20
35	Joe Leary Slough	D'Arcy Rd	29
36	Edison Slough	W. Bow Hill Rd	17
37	Edison Pump Station	Farm to Market Rd	1
38	N. Edison Pump Station	North Edison Rd	1
39	Colony Creek	Colony Rd	75
40	Big Indian Slough	Bayview-Edison Rd	13
41	Maddox Slough/Big Ditch	Milltown Rd	18
42	Hill Ditch	Cedardale Rd	74
43	Wiley Slough	Wylie Rd	7
44	Sullivan Slough	La Conner-Whitney	23
45	Skagit River – North Fork	Moore Rd	93
46	Skagit River – South Fork	Fir Island Rd	93
47	Swinomish Channel	County Boat Launch	75
48	Fisher Creek	Franklin Rd	85

Color code: Lowest Concern (>80 Overall Score), Moderate Concern (40-80), Highest Concern (<40)

*Note: Overall score is the mean of the three lowest monthly scores (Hallock 2002)

Figure 17 - Color coded map of 2020 WQI results

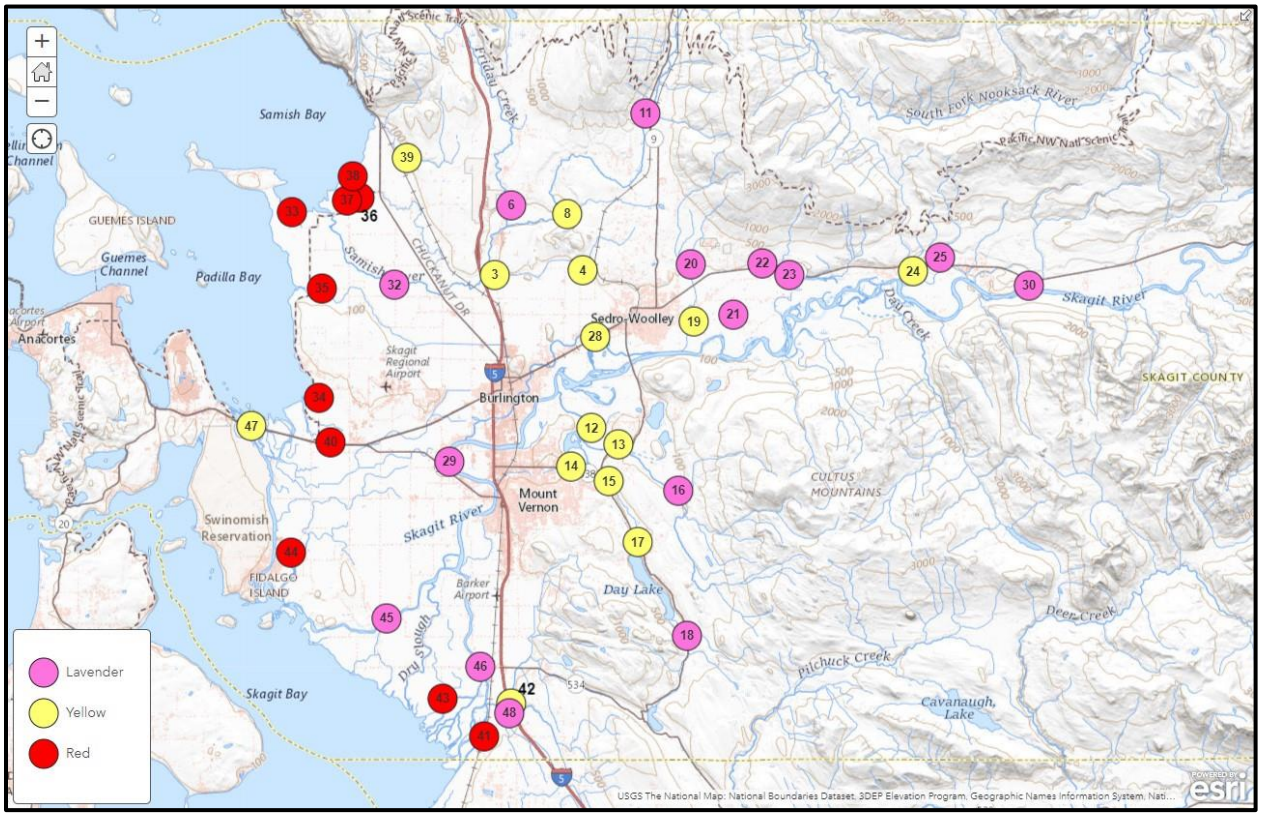


Table 18 - Number of sites in each WQI category for 2019 Water Year

Year	Lavender (80-100)	Light yellow (40-79)	Red (1-40)
2009	17	11	12
2010	13	19	8
2011	20	9	11
2012	13	16	11
2013	15	14	11
2014	16	13	11
2015	16	13	11
2016	15	15	10
2017	20	8	12
2018*	23	6	10
2019*	15	12	12
2020*	15	14	10

*39 sites sampled from 2018 forward

Site Report Cards (SRCs)

The figures on the following pages report results from the Skagit County Monitoring Program for dissolved oxygen, temperature, and fecal coliform. Full data listings for each sampling event at each sample site for the entire history of the program are included in Appendix A. A summary of water quality results for each sample site for water year 2020 is included in Appendix B.

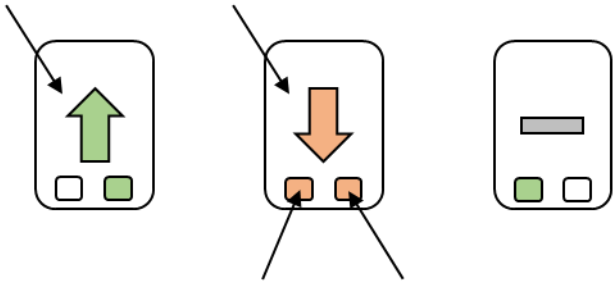
The graphs are meant to give an overall picture of the water quality at a given site over time. They are not intended to fully describe the conditions at that site, only to give an "at a glance" indication of the conditions over the course of the project. Trends analysis statistics tables are included in Appendix C.

Note that the y-axes on the graphs in this section are not all equivalent. The y-axes color schemes for temperature and DO align with the particular state standard that is in accordance with that sampling site. The y-axes for FC counts are vastly different to accommodate the large variance in sampling data for each site. Normalizing these y-axes to each other would render data un-viewable and un-interpretable at several sites. Some data points are outliers to a data set and would stretch the size of the y-axis to a point that this same effect is seen, and have therefore been cropped at the top of the plot, and the quantification of the data point has been added next to the crop to inform the reader of its value. Logarithmic y-axes can help with scientific interpretation, but are not intuitive for most readers to understand the actual large difference in scale of the data.

All photographs in the following section were taken by the author and are therefore public property.

How to interpret the SRCs

- If there is an arrow, the statistic showed significant change on a monthly examination, at 95% confidence. This is our main statistic for determining changes.
- If the arrow is green, the direction of the change is a positive one.
- If the arrow is red, the direction of change is a negative one.



- If the lower left box is shaded in, the statistic showed significant change on a bi-weekly examination. This is more sensitive and less robust.
- If the lower right box is shaded in, then the statistic was nearly significant on a monthly examination, at 90% confidence.
- These extra boxes exist to show a more sensitive view of what may be occurring at a site, rather than simply a binary yes or no statistic using the main monthly metric.
- A site with an arrow and both boxes filled in shows the strongest trend.

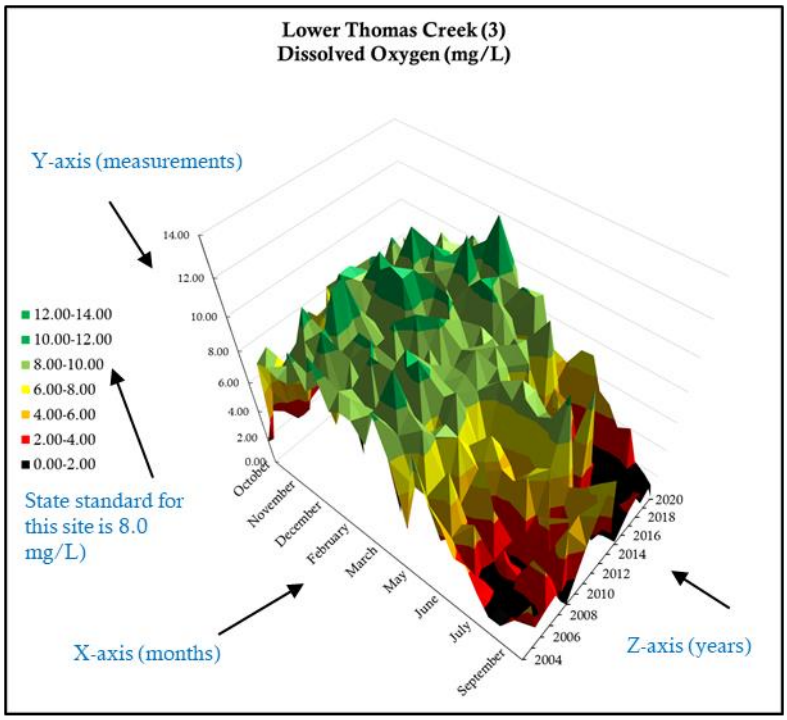
The graphic on the left shows a positive significant monthly trend downward, at 95% and 90% confidence levels.

The graphic in the middle shows a negative significant monthly trend downward, at 95% and 90% confidence levels, and was also significant on a bi-weekly basis, at 95% confidence.

The graphic on the right shows no significant monthly trend at the 95% or 90% confidence levels, but shows a significant trend on the bi-weekly examination, at 95% confidence.

3D Maps

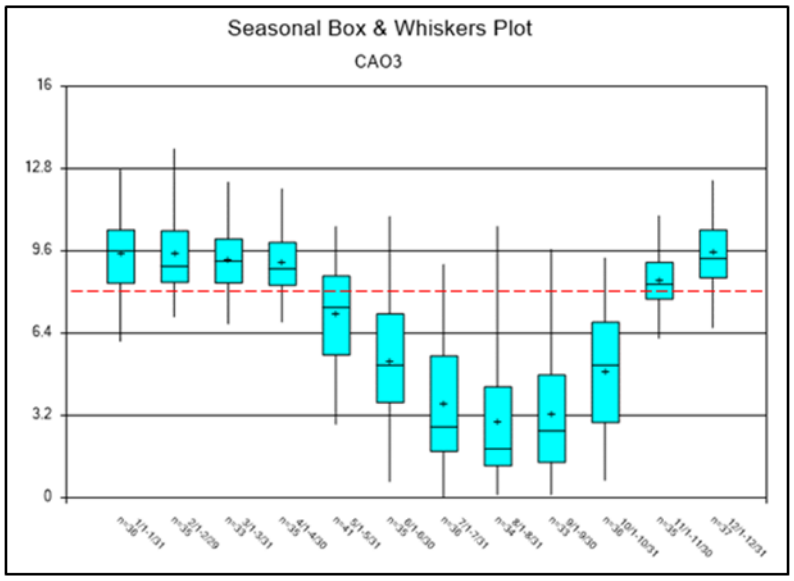
- Each 3D map has a threshold color for that particular metric and sampling site.
- For dissolved oxygen, everything passing state standard is green.
- For temperature, everything failing state standard is red.
- For fecal coliform, everything passing state standard is green.



- The x-axis contains the months of the water year, from October through September.
- The y-axis contains the values of the metric, in this case, mg/L of dissolved oxygen.
- The z-axis contains the years of the program, from 2004 until present.

Boxplots

- Each box is a month, starting with January on the left, and ending in December on the right.
- The box represents 50% of the data. The lines above and below show the extreme range of the data values.
- The horizontal line through the middle of the box is the mean average of the values.
- The + sign in the box is the median of the values.

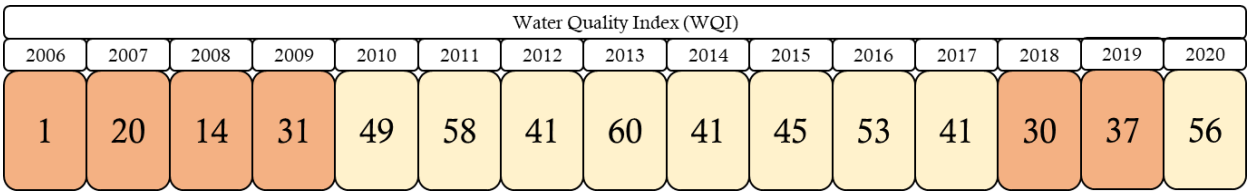


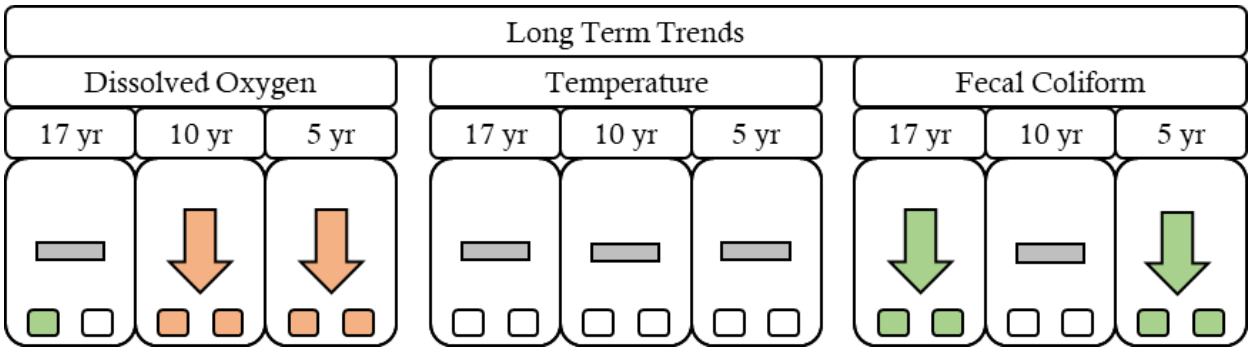
- The y-axis represents the measurements of the metric, which are the same as the 3D map above it.
- The dashed red line represents the state standard for this site

3

Thomas Creek
@ Highway 99

Downstream Ag



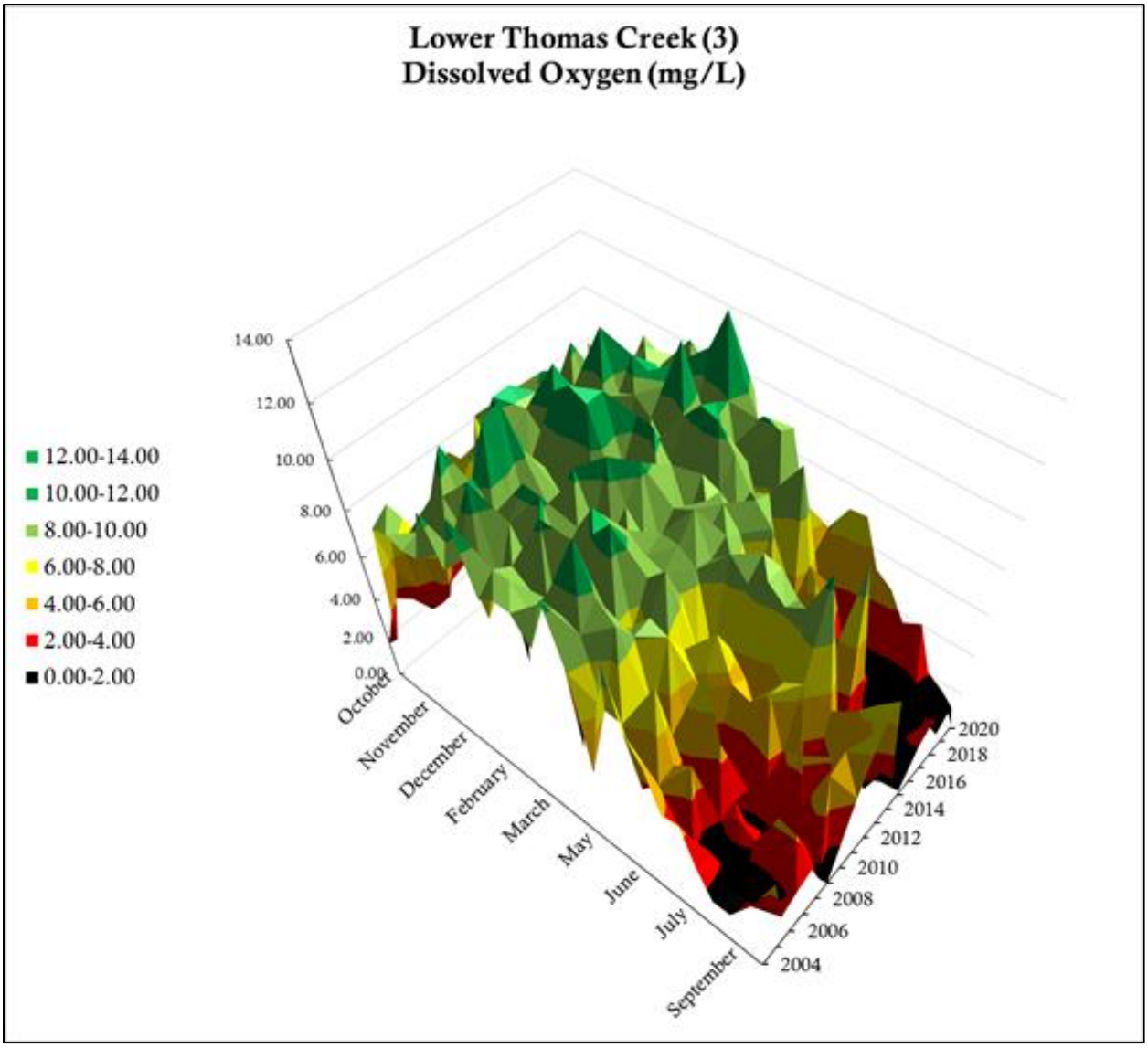


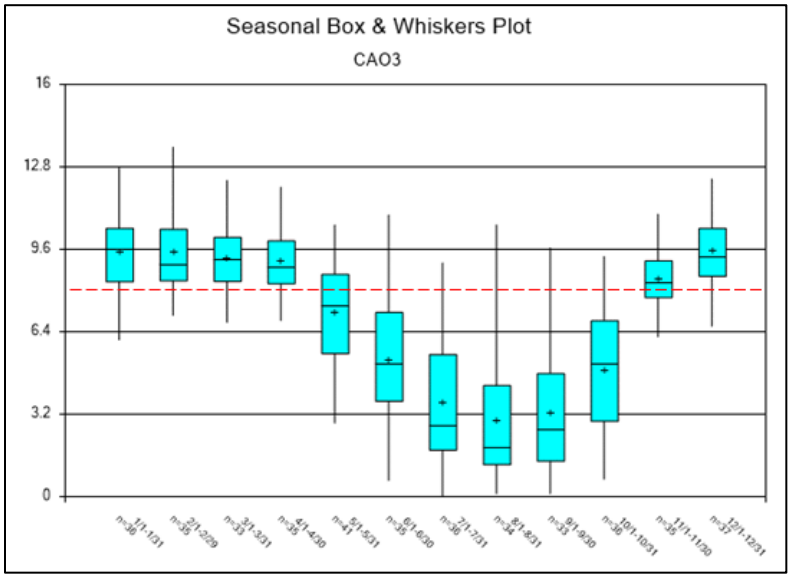
Site 3 is Thomas Creek, downstream from site 4, and sits just prior to the creek joining the Samish River. This section of the creek is more of a slough, with slow-moving, channelized water. This site has substantially lower flow volumes in the summer months. This site is designated as salmonid spawning, rearing, and migration (SRM) status.

Dissolved oxygen has declined over the last ten years and over the last five years. Fecal coliform counts are lower than they were seventeen years ago. WQI scores have improved since monitoring began, but have never reached the category of lowest concern.

Site 3 regularly fails to meet state standards for DO and temperature in the warmer months. Annual FC levels meet state standards.

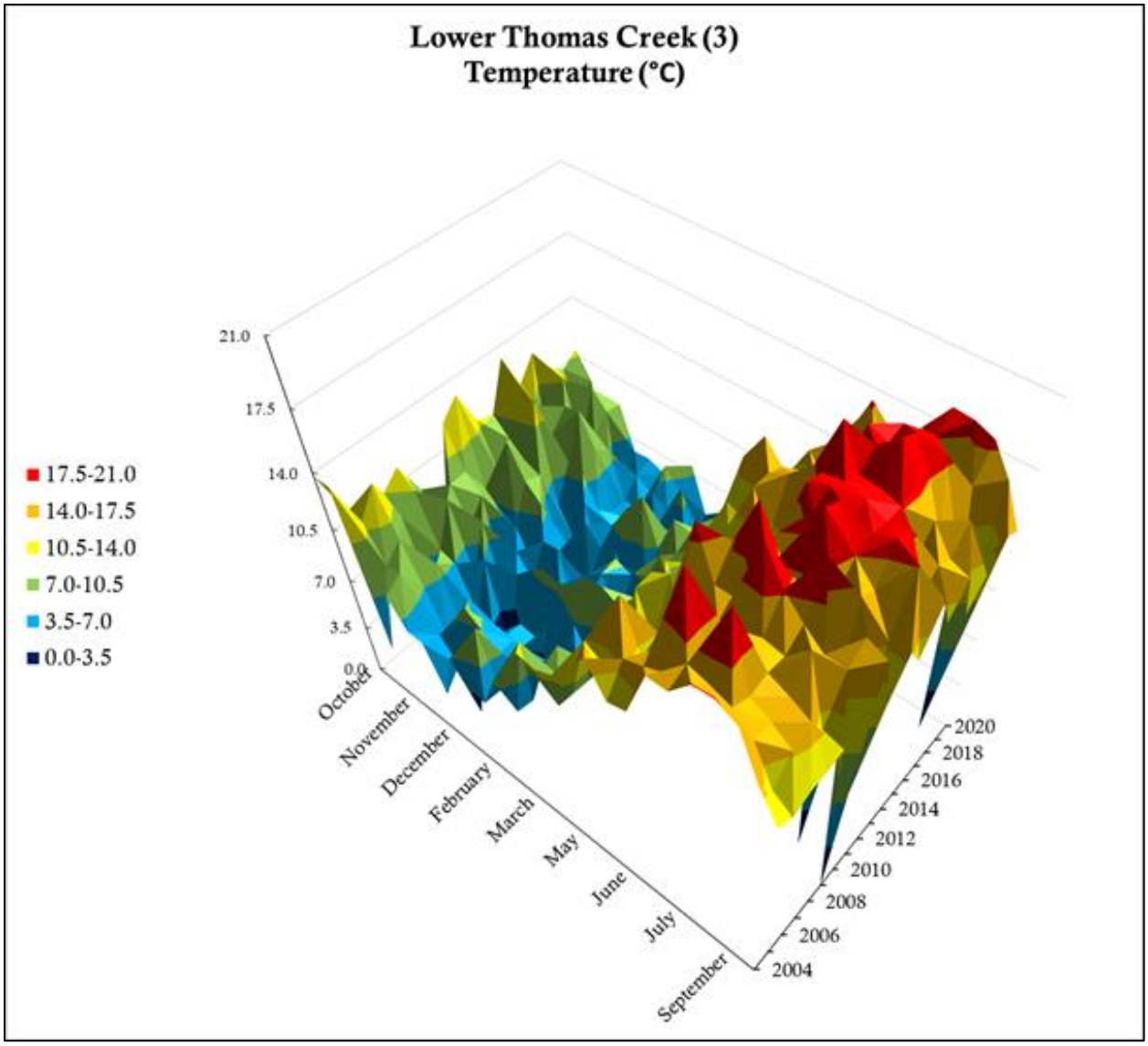
Site 3 is tied for 12th out of 39 sites for number of significant trends, with 13, and 26th out of 39 sites for positive trends, at 54%.

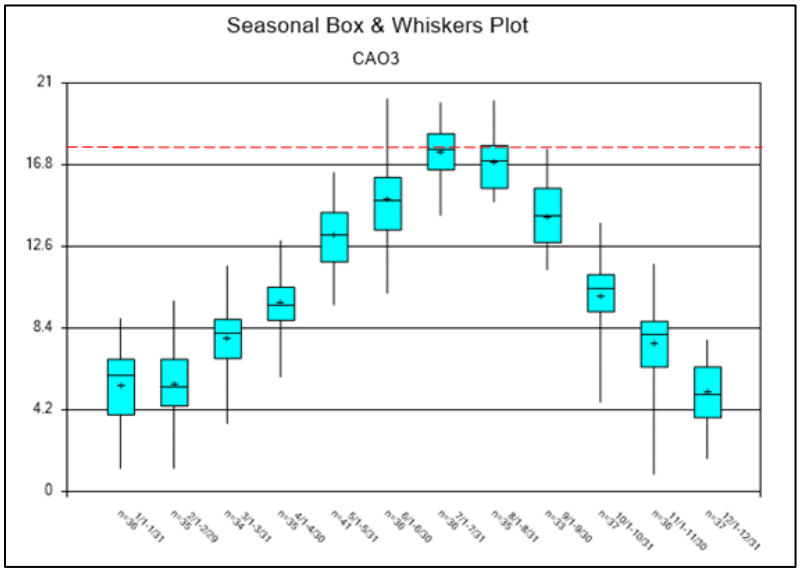




The dissolved oxygen (DO) standard for this site is 8.0 mg/L. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.

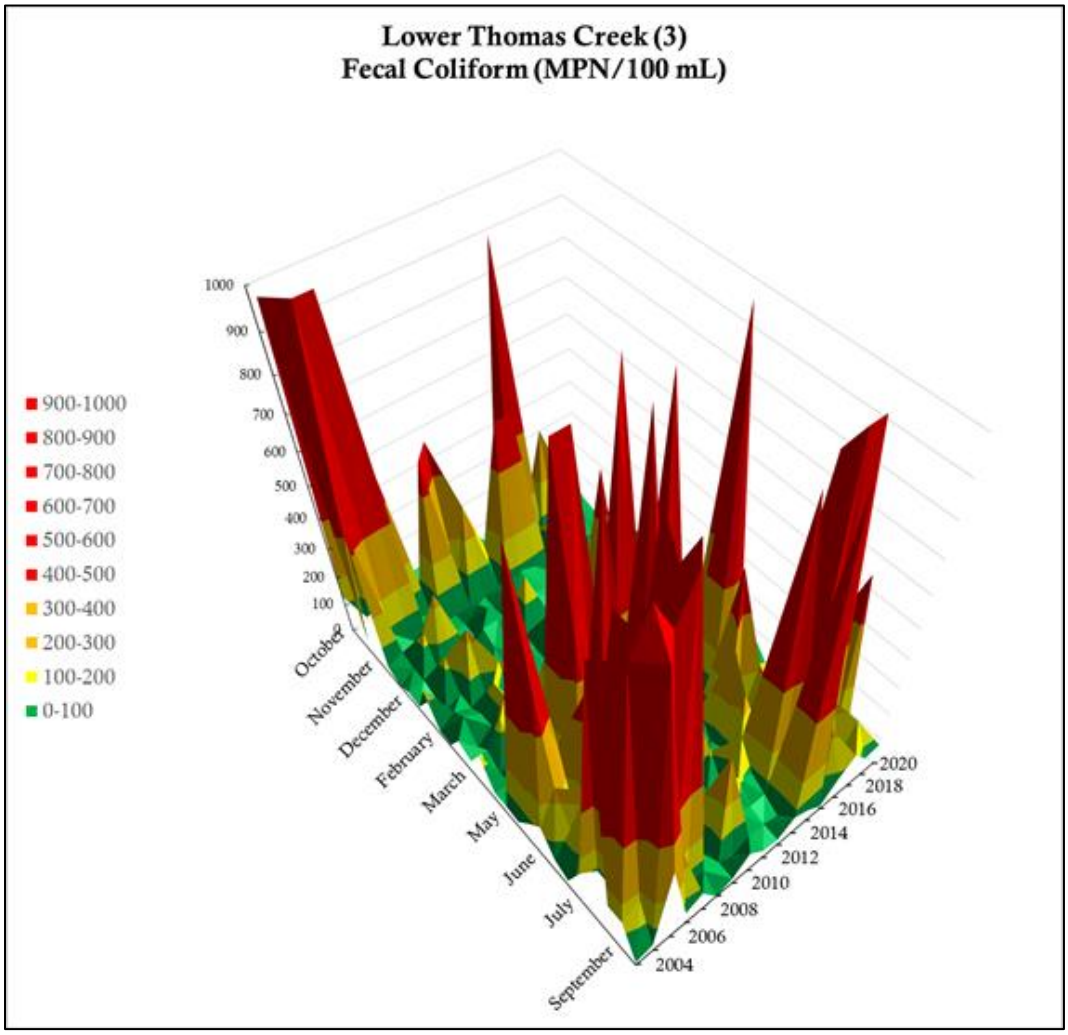
The dashed red line on the monthly box plot represents the 8.0 mg/L standard, and is approximate. The calendar year on the x-axis begins in January and ends in December.

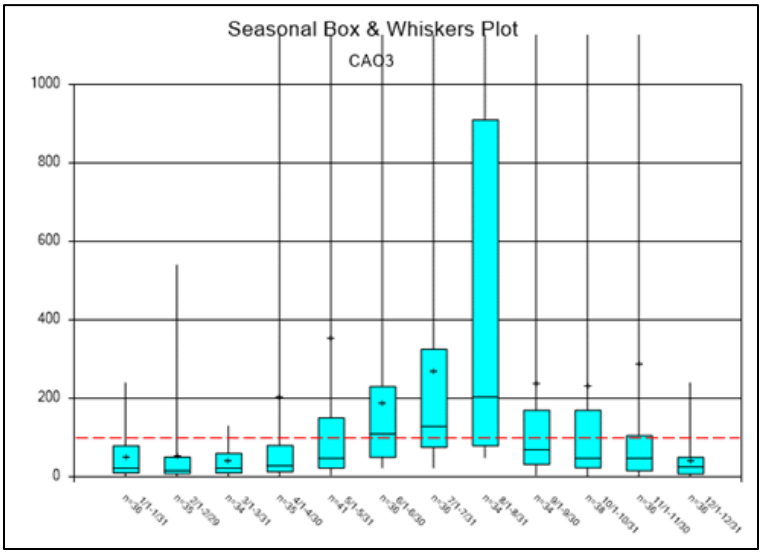




The temperature standard for this site is 17.5 °C. Any part of the 3D plot that is in red is hotter than that standard. The water year on the x-axis begins in October and ends in September.

The dashed red line on the monthly box plot represents the 17.5 °C standard, and is approximate. The calendar year on the x-axis begins in January and ends in December.





The fecal coliform (FC) standard for this site is 100 MPN/100 mL. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.

The dashed red line on the monthly box plot represents the 100 MPN/100 mL standard, and is approximate. The calendar year on the x-axis begins in January and ends in December.

4

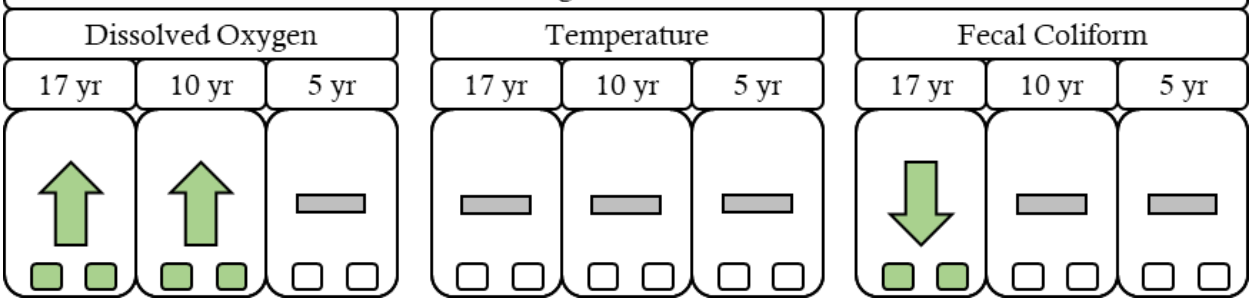
Thomas Creek
@ F&S Grade Road

Upstream Ag

Water Quality Index (WQI)

2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
15	54	39	66	76	77	62	81	89	71	52	89	81	65	72

Long Term Trends

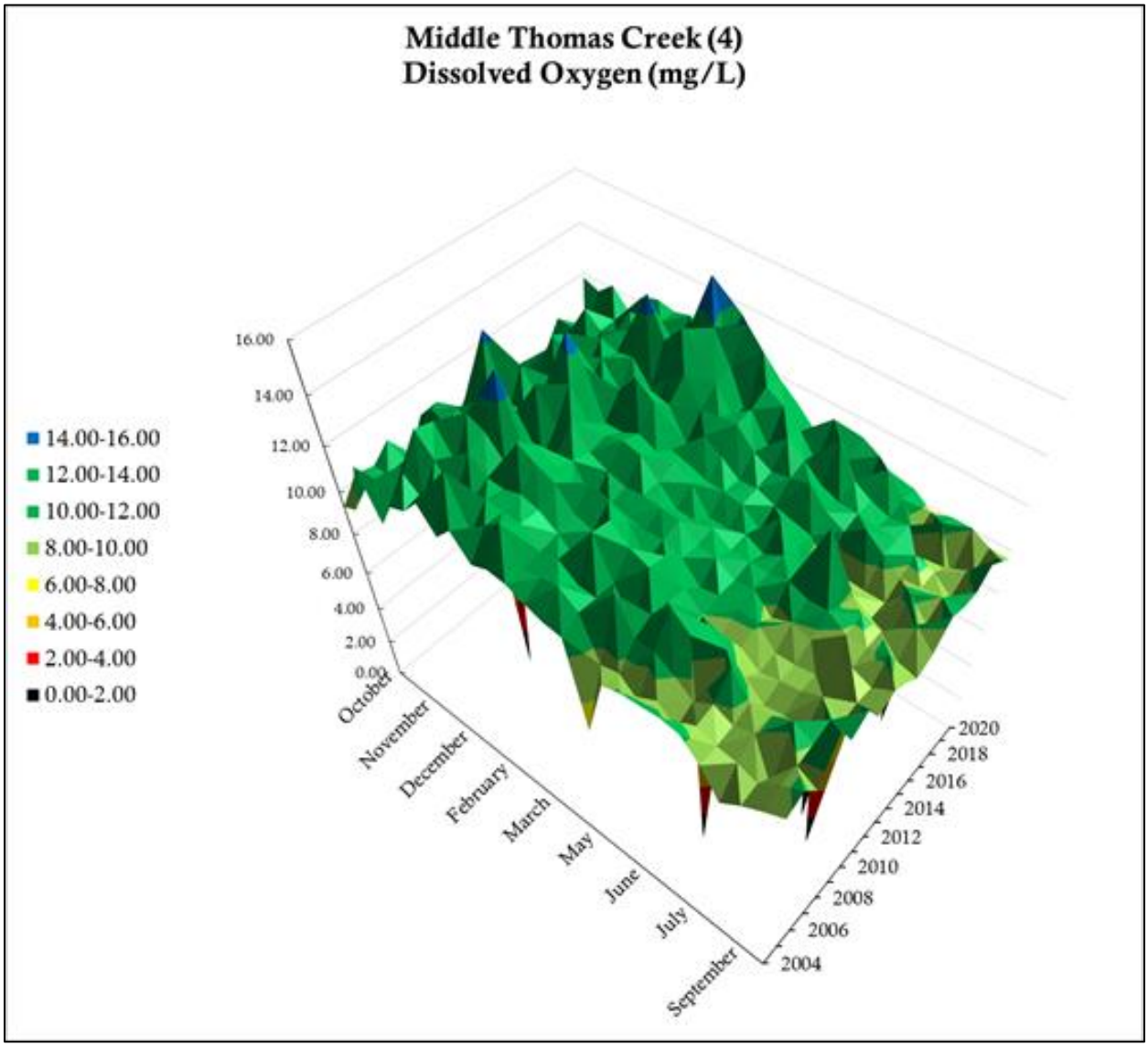


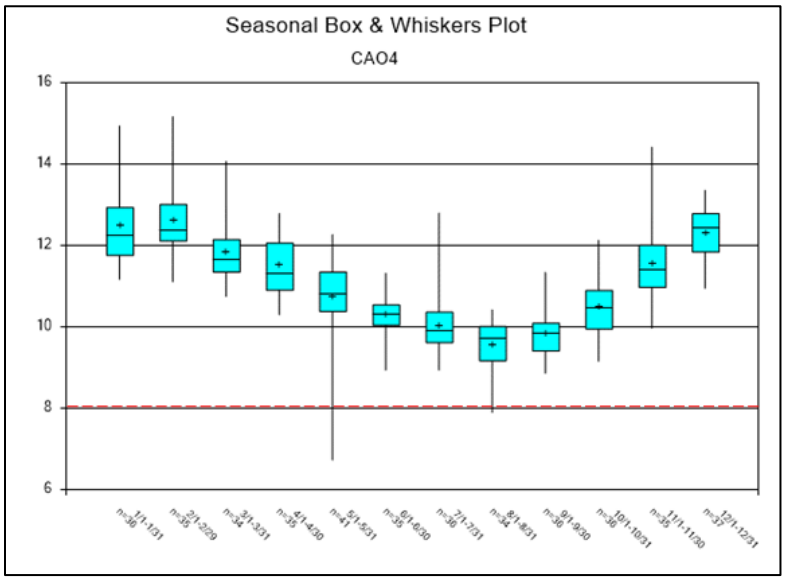
Site 4 is Thomas Creek, upstream of site 3. Upstream of this sampling site, the creek is fairly oxygenated and fast-moving. This site has substantially lower flow volumes in the summer months. This site is designated as salmonid spawning, rearing, and migration (SRM) status.

Dissolved oxygen has increased significantly across the last 17 years and ten years. Fecal coliform counts are lower than they were 17 years ago. WQI scores have substantially improved since monitoring began.

Site 4 regularly meets state standards for temperature and DO year-round. Annual fecal coliform levels for WY2020 were just barely passing the 100 FC standard, but not close to passing the 90th percentile requirement.

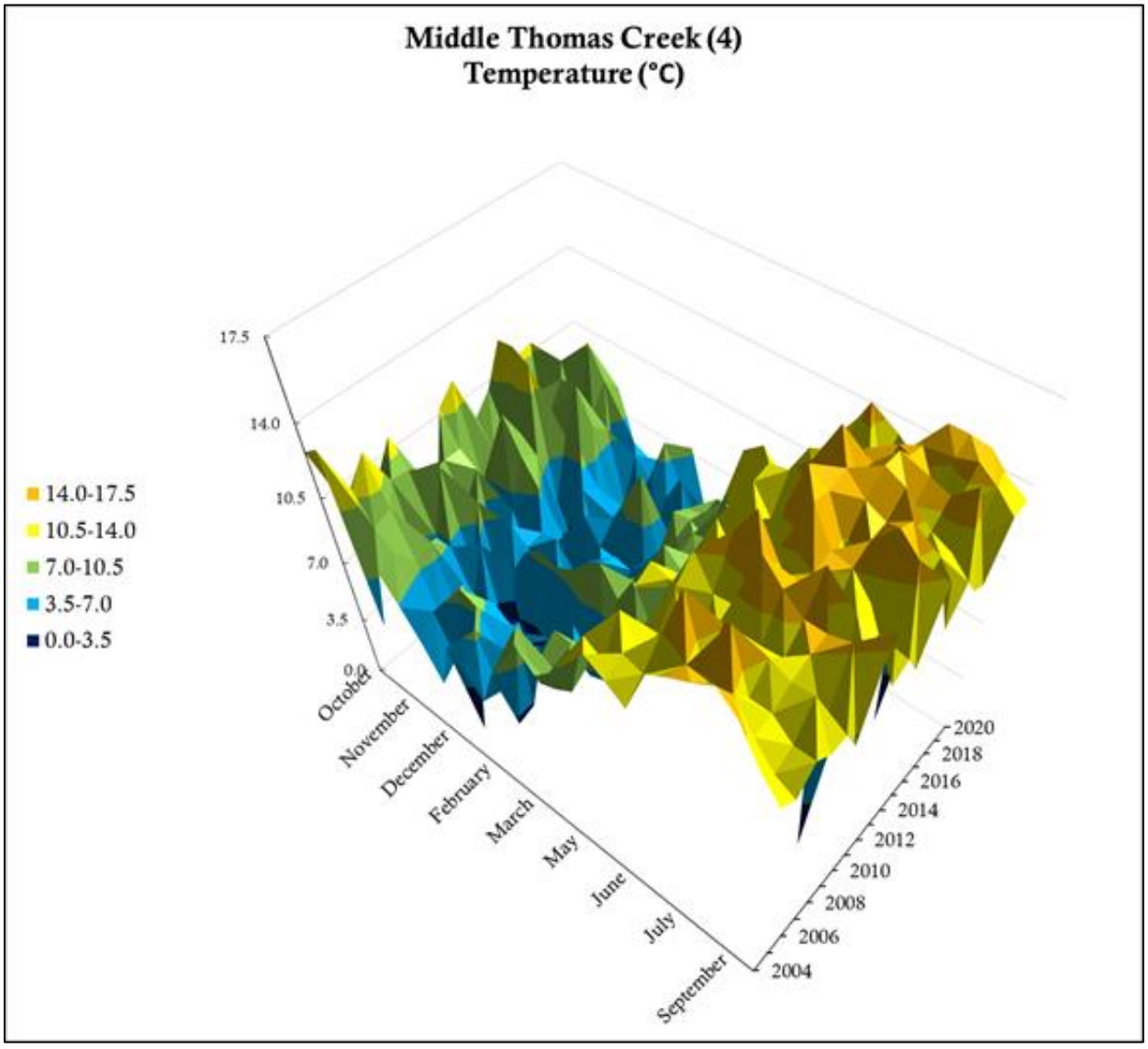
Site 4 is tied for 20th out of 39 sites for number of significant trends, with 12, and 4th out of 39 sites for positive trends, at 83%.

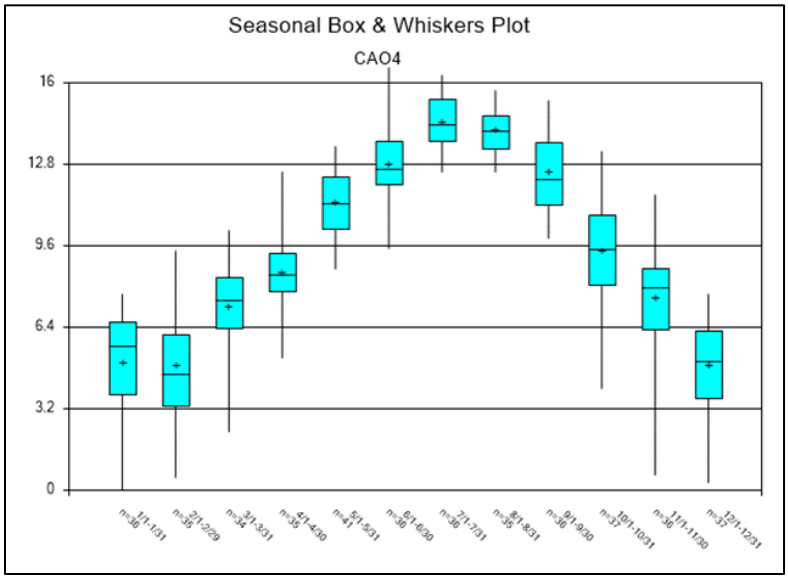




The dissolved oxygen (DO) standard for this site is 8.0 mg/L. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.

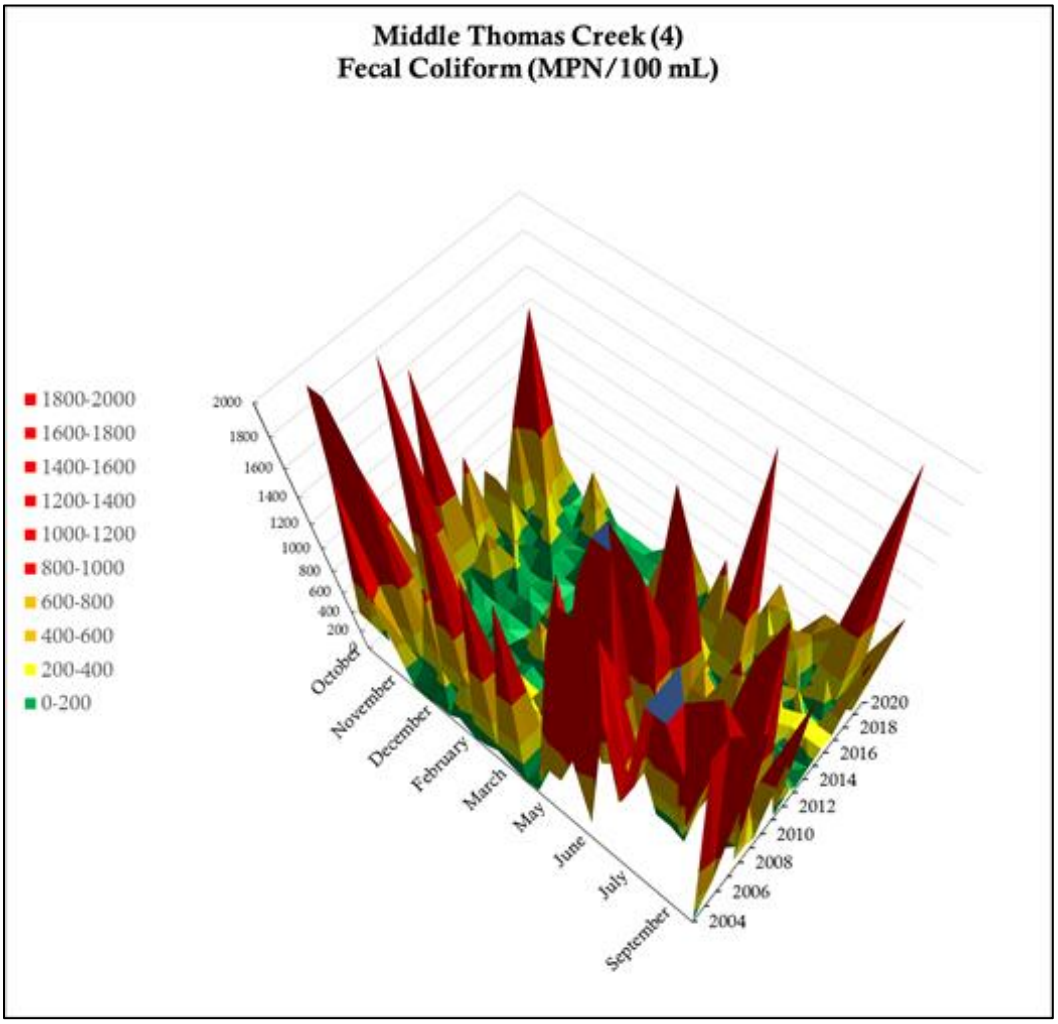
The dashed red line on the monthly box plot represents the 8.0 mg/L standard, and is approximate. The calendar year on the x-axis begins in January and ends in December.

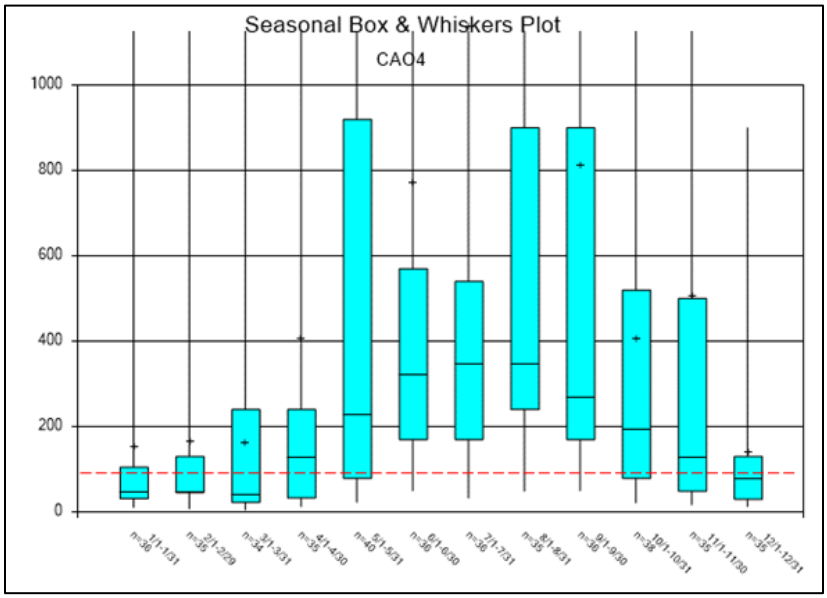




The temperature standard for this site is 17.5 °C. Any part of the 3D plot that is in red is hotter than that standard. The water year on the x-axis begins in October and ends in September.

The dashed red line on the monthly box plot represents the 17.5 °C standard, and is approximate. The calendar year on the x-axis begins in January and ends in December.





The fecal coliform (FC) standard for this site is 100 MPN/100 mL. Any part of the 3D plot that is in green almost meets that standard. The water year on the x-axis begins in October and ends in September.

The dashed red line on the monthly box plot represents the 100 MPN/100 mL standard, and is approximate. The calendar year on the x-axis begins in January and ends in December.

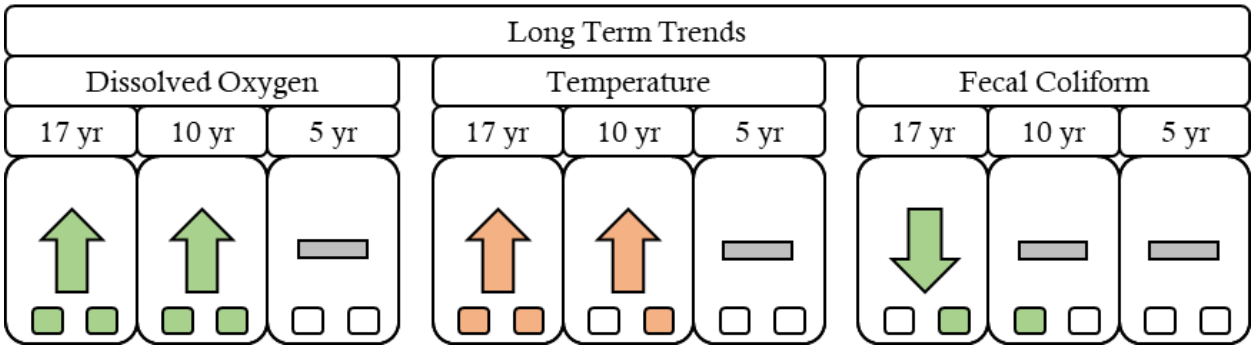
6

Friday Creek
@ Prairie Road

Reference – Rural Reserve

Water Quality Index (WQI)

2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
45	81	65	86	90	94	81	88	88	90	85	86	91	87	87

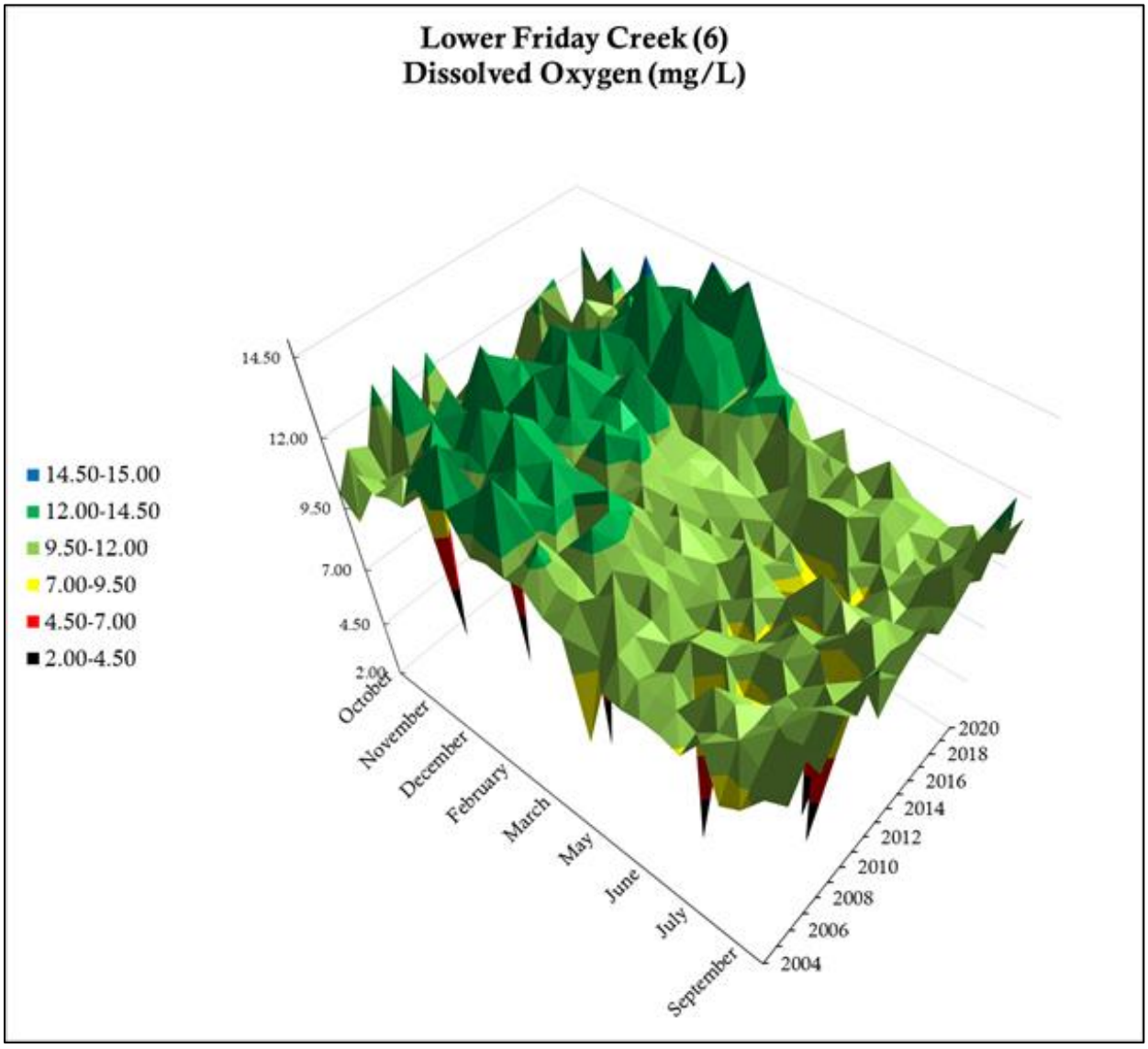


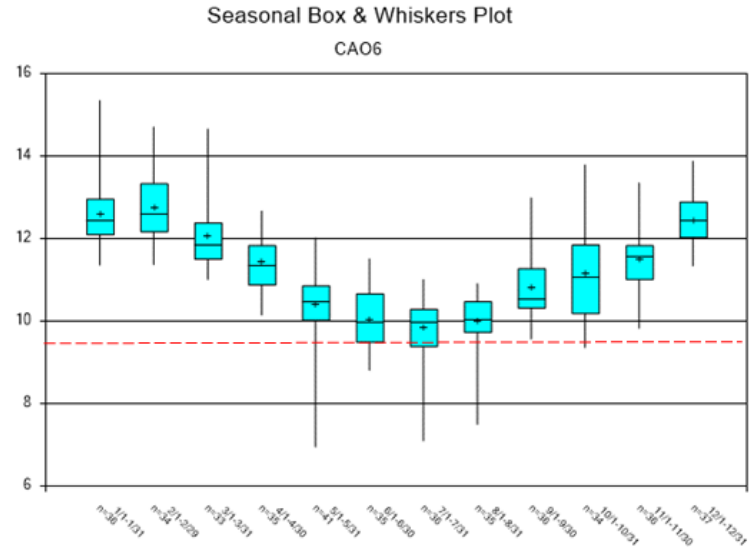
Site 6 is Friday Creek, and sits just prior to the creek joining the Samish River. This creek has a high flow volume and rate, and can seasonally contribute around 40% or more of the total volume of the Samish River. This site is designated as core salmonid habitat.

Dissolved oxygen has significantly increased over the last 17 and ten years. Temperature is significantly higher now than it was 17 years and ten years ago. Fecal coliform is lower than it was 17 years ago. WQI is consistently in the category of least concern.

Site 6 regularly meets state standards for DO year-round. Temperature exceeds state standards during the hottest time of the year. The FC levels for the 2020 water year easily met state standards.

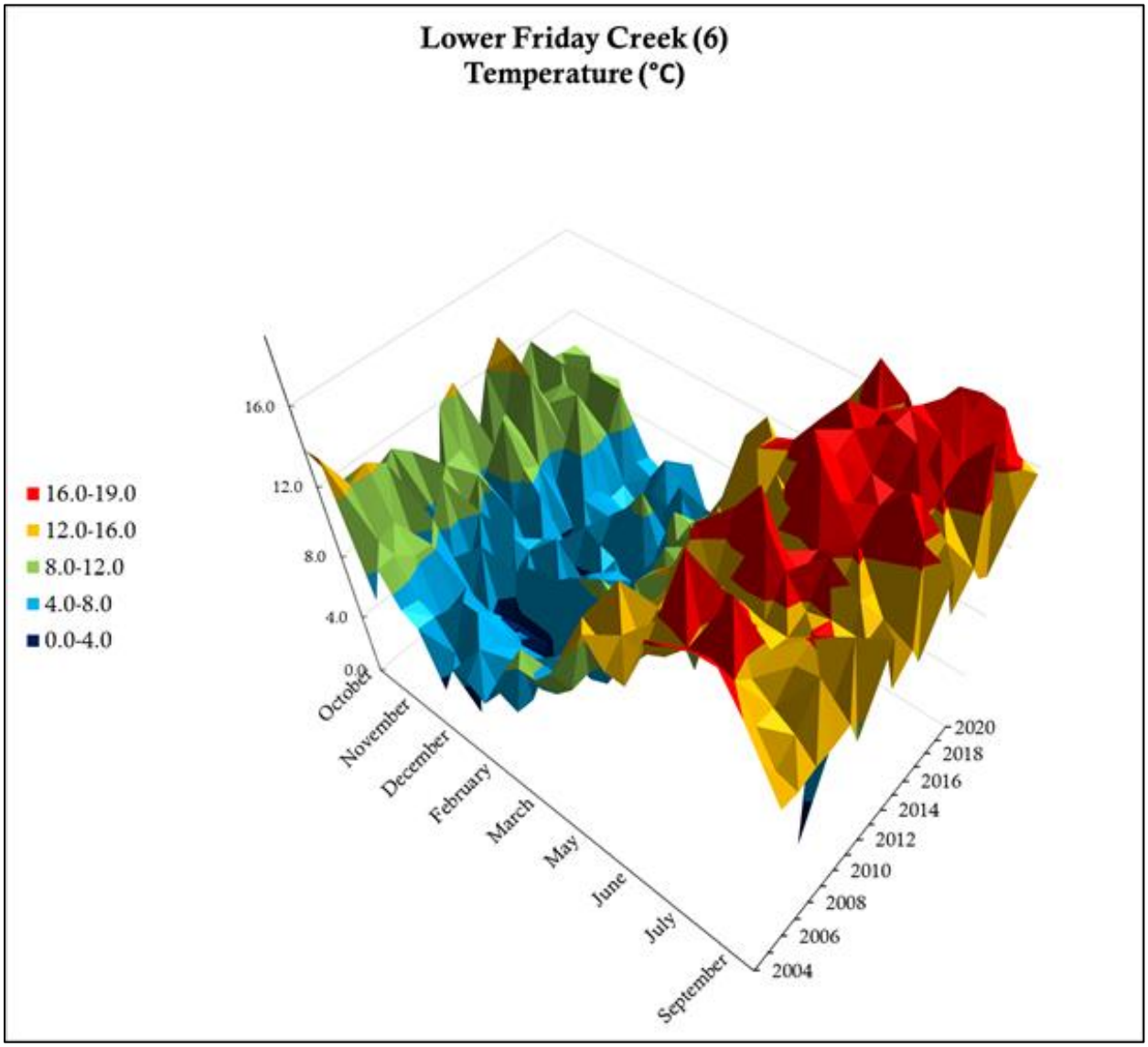
Site 6 is tied for 4th out of 39 sites for number of significant trends, with 16, and is 13th out of 39 sites for positive trends, at 69%.

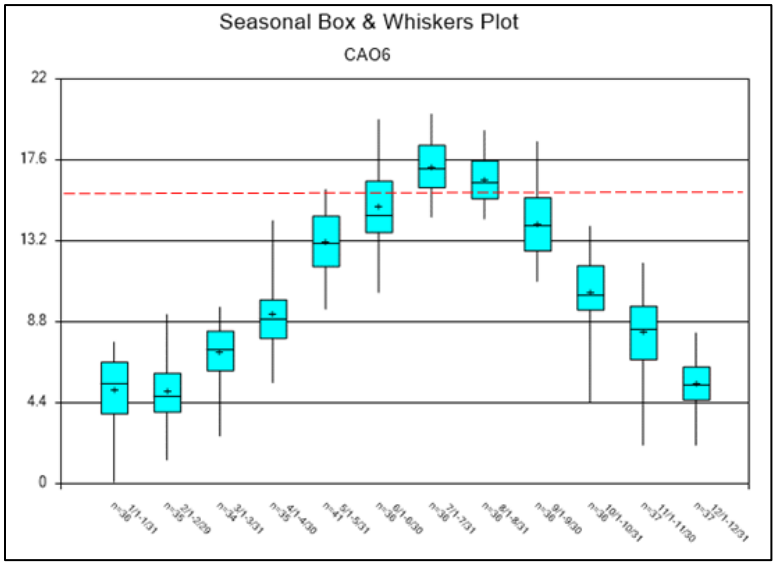




The dissolved oxygen (DO) standard for this site is 9.50 mg/L. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.

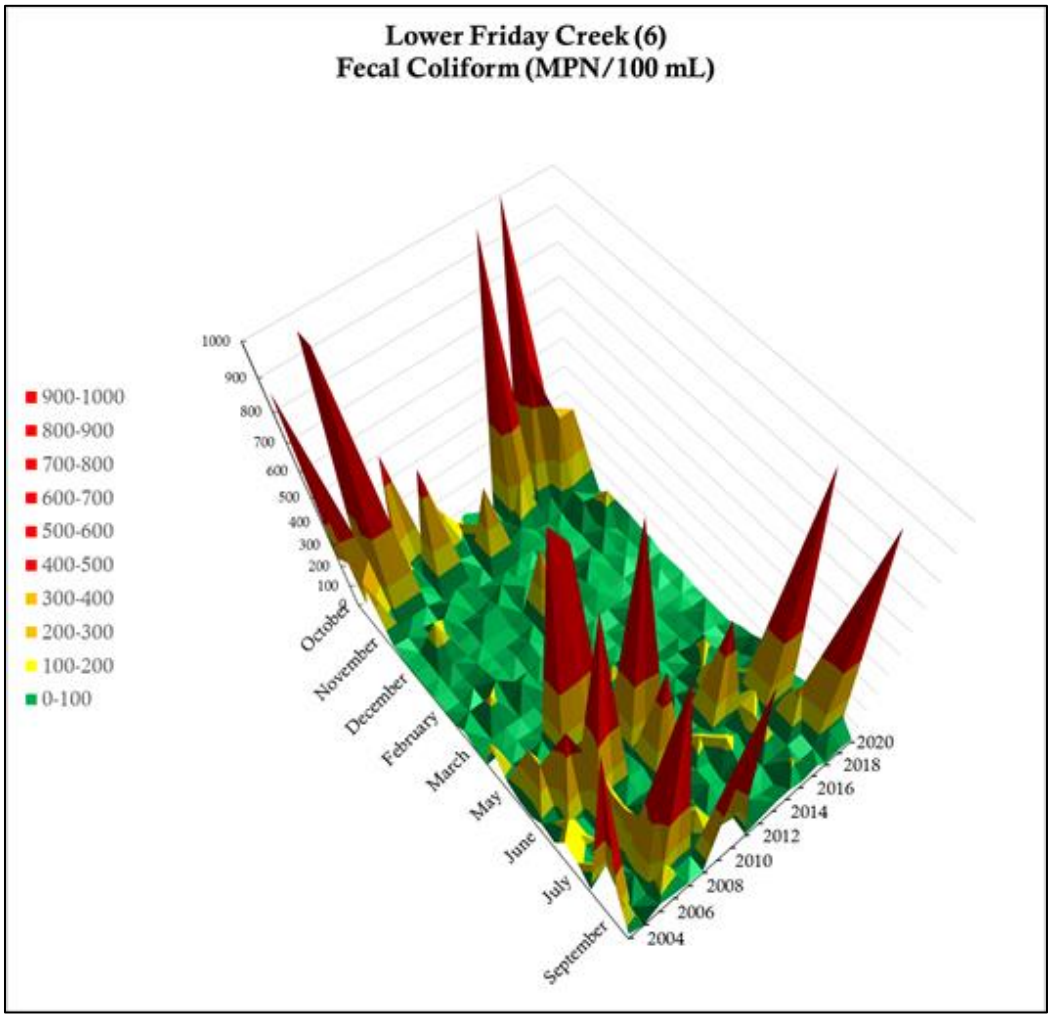
The dashed red line on the monthly box plot represents the 9.5 mg/L standard, and is approximate. The calendar year on the x-axis begins in January and ends in December.

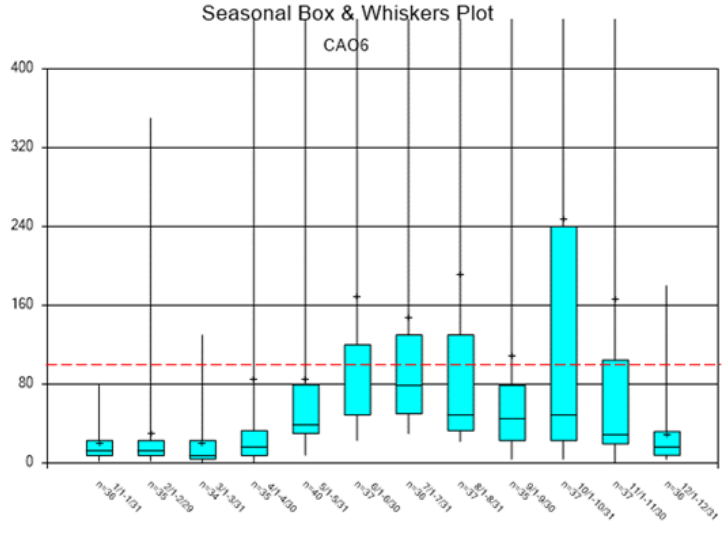




The temperature standard for this site is 16.0 °C. Any part of the 3D plot that is in red is hotter than that standard. The water year on the x-axis begins in October and ends in September.

The dashed red line on the monthly box plot represents the 16.0 °C standard, and is approximate. The calendar year on the x-axis begins in January and ends in December.





The fecal coliform (FC) standard for this site is 100 MPN/100 mL. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.

The dashed red line on the monthly box plot represents the 100 MPN/100 mL standard, and is approximate. The calendar year on the x-axis begins in January and ends in December.

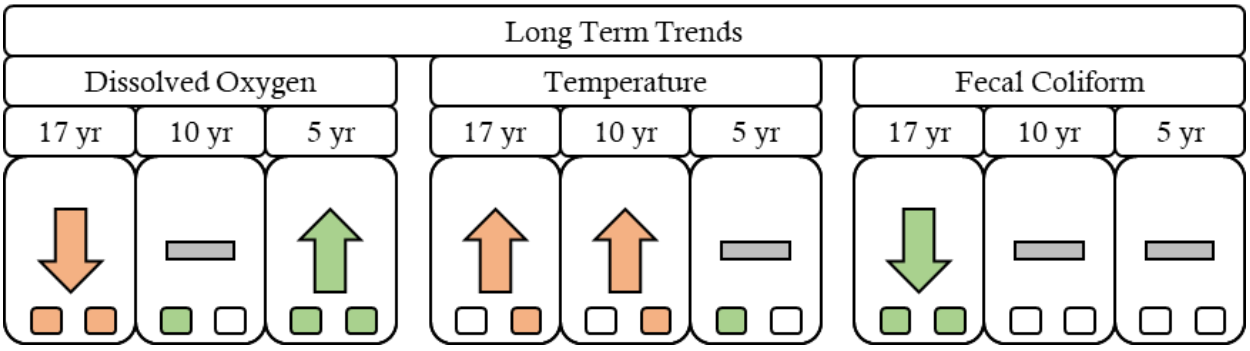
8

Swede Creek
@ Grip Road

Downstream Ag

Water Quality Index (WQI)

2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
34	58	48	72	76	90	71	83	77	75	61	75	81	59	75

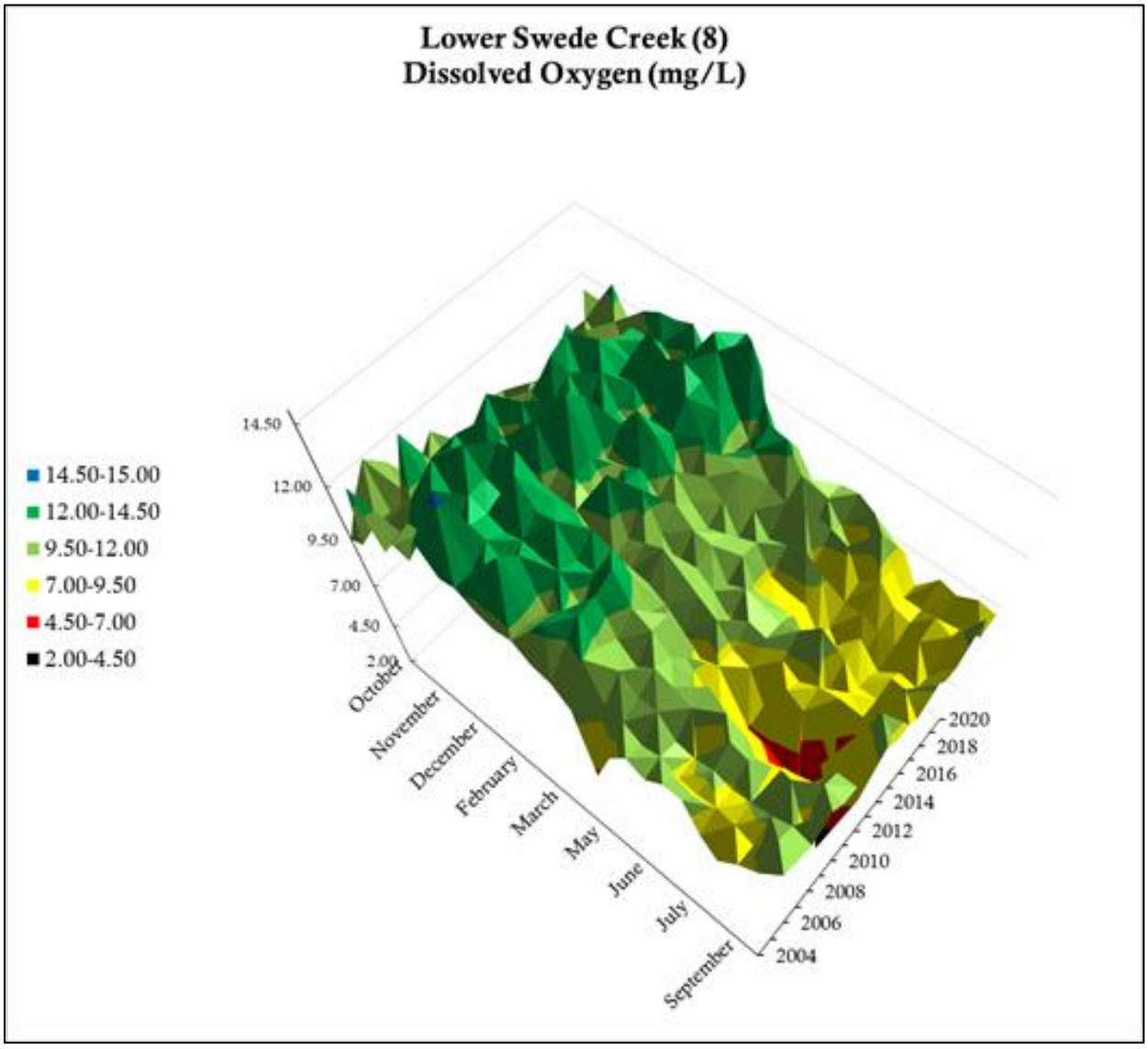


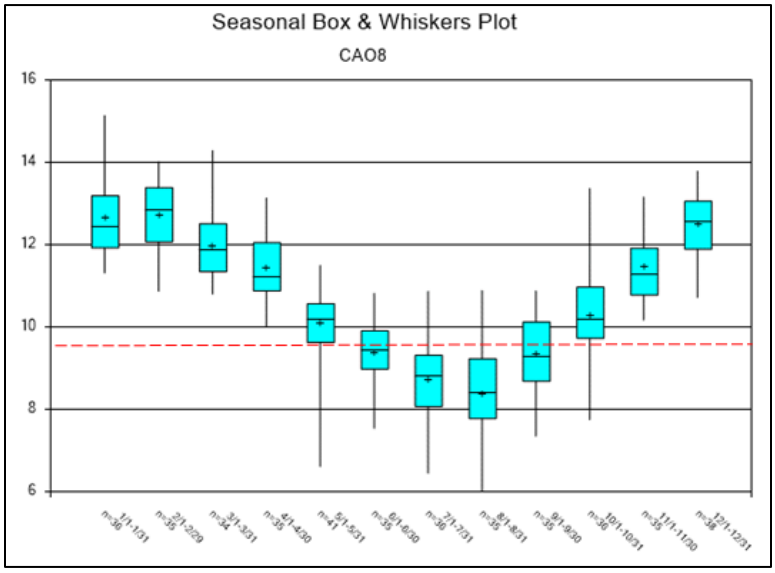
Site 8 is Swede Creek, and sits just prior to the creek joining the Samish River. Swede Creek has been a focus of pollution monitoring efforts in the Samish basin, with rural residential and agricultural sources in the watershed. The site is designated as core salmonid habitat.

Dissolved oxygen has declined as compared to 17 years ago, but has improved over the last five. Temperatures are higher than they were 17 and ten years ago. Fecal coliform counts are lower than they were 17 years ago. WQI scores are generally in the higher-scoring end of the moderate concern category, and sometimes score as least concern.

Site 8 fails to meet state DO standards in the warmer months, and fails to meet state temperature standards only at the warmest time of year. Annual fecal coliform levels for WY2020 easily passed the 100 FC standard, but did not pass the 90th percentile requirement.

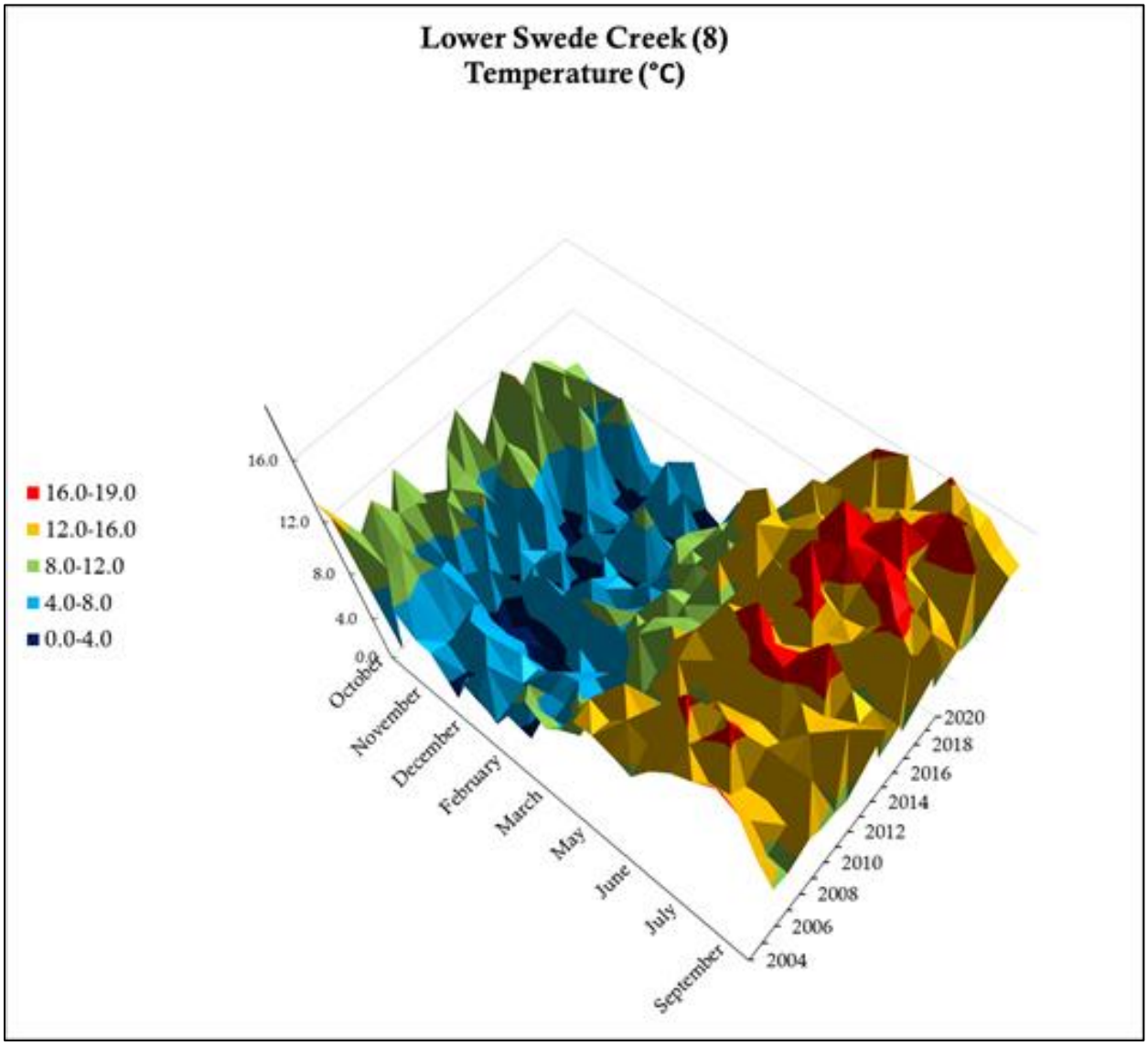
Site 8 is 2nd out of 39 sites for number of significant trends, with 18, and tied for 22nd out of 39 sites for positive trends, at 56%.

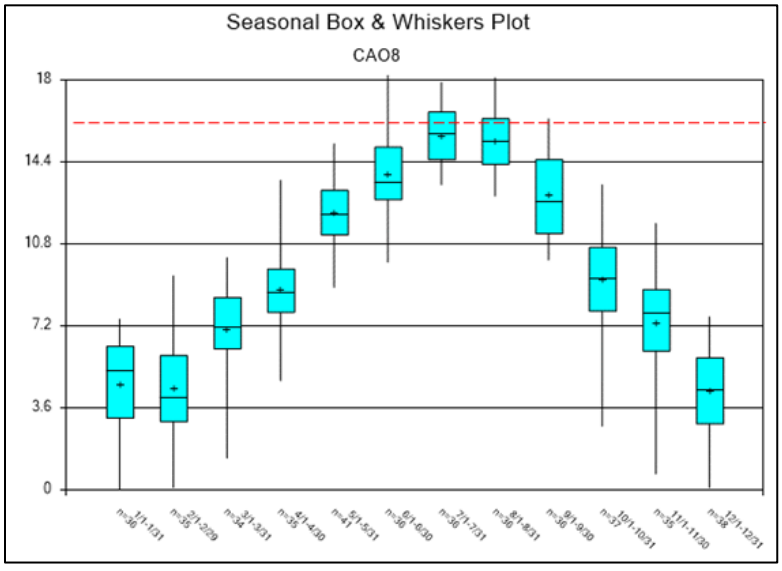




The dissolved oxygen (DO) standard for this site is 9.50 mg/L. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.

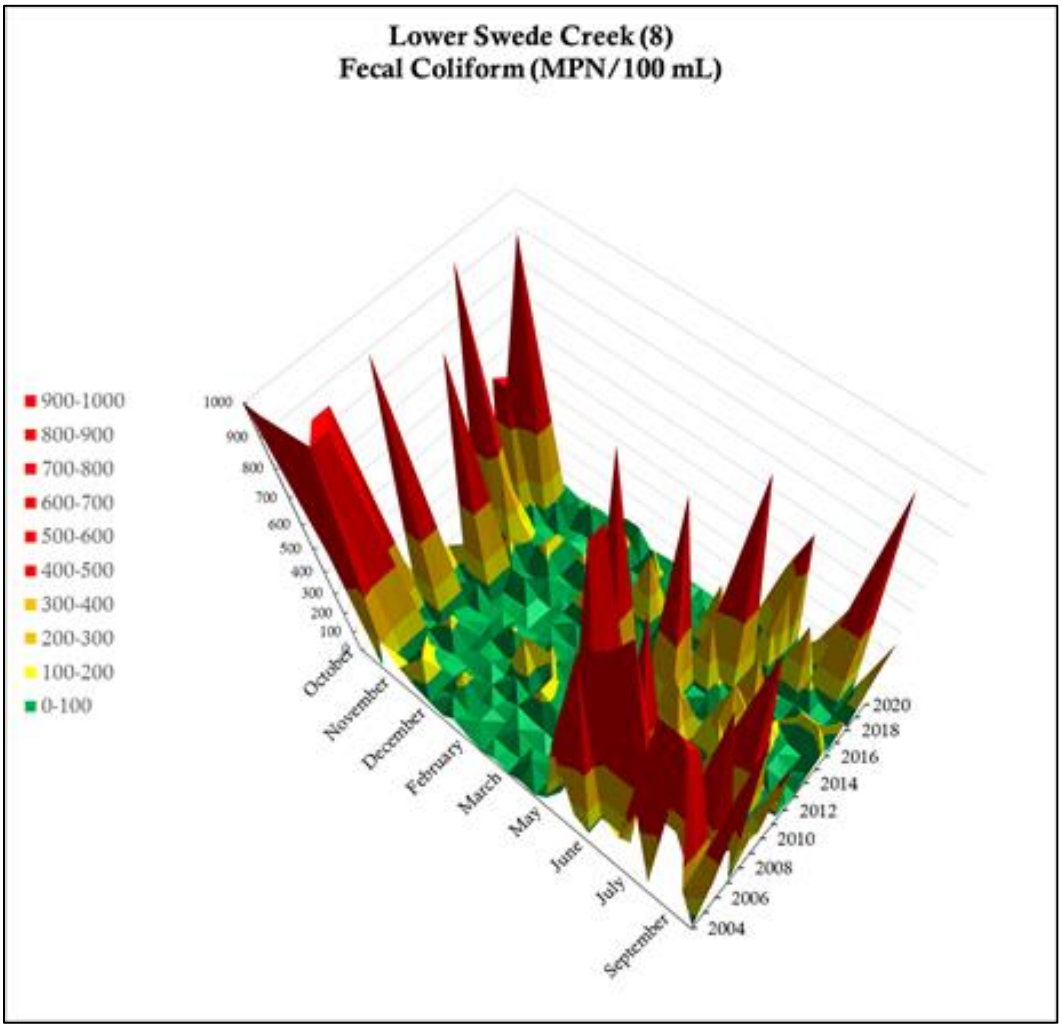
The dashed red line on the monthly box plot represents the 9.5 mg/L standard, and is approximate. The calendar year on the x-axis begins in January and ends in December.

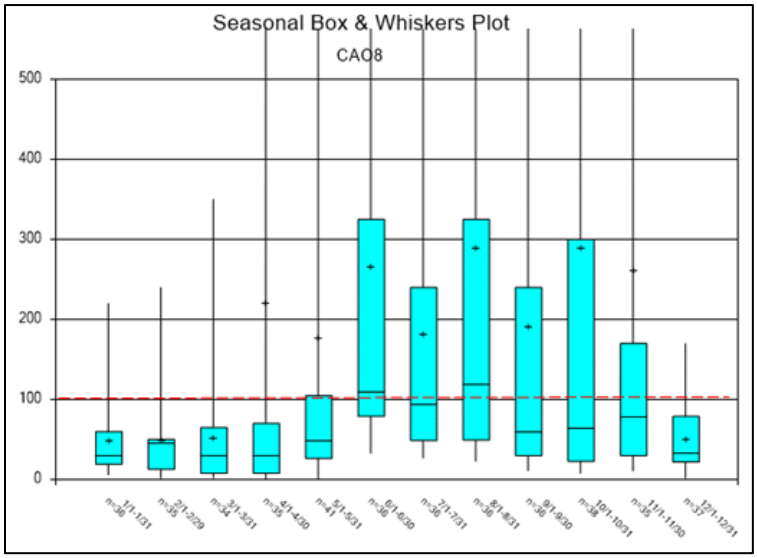




The temperature standard for this site is 16.0 °C. Any part of the 3D plot that is in red is hotter than that standard. The water year on the x-axis begins in October and ends in September.

The dashed red line on the monthly box plot represents the 16.0 °C standard, and is approximate. The calendar year on the x-axis begins in January and ends in December.





The fecal coliform (FC) standard for this site is 100 MPN/100 mL. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.

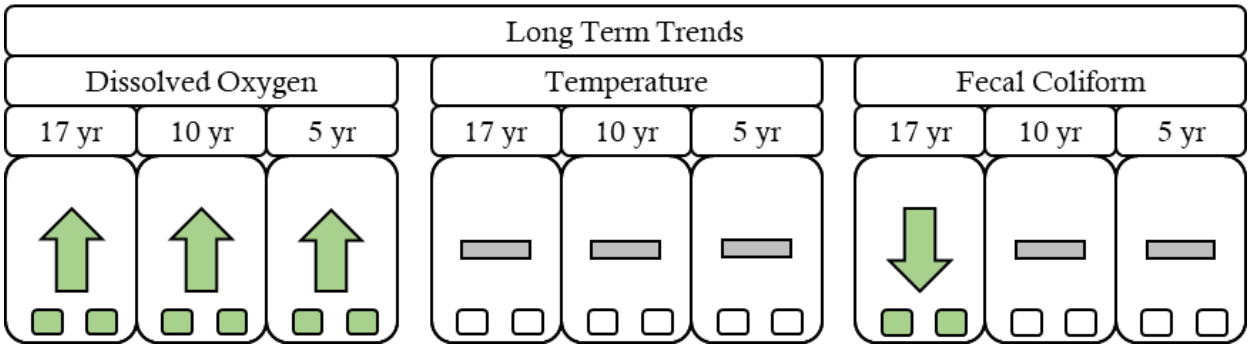
The dashed red line on the monthly box plot represents the 100 MPN/100 mL standard, and is approximate. The calendar year on the x-axis begins in January and ends in December.

11

Samish River
@ Highway 9

Upstream Ag

Water Quality Index (WQI)														
2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
57	85	68	81	78	86	65	72	68	66	80	82	87	81	82

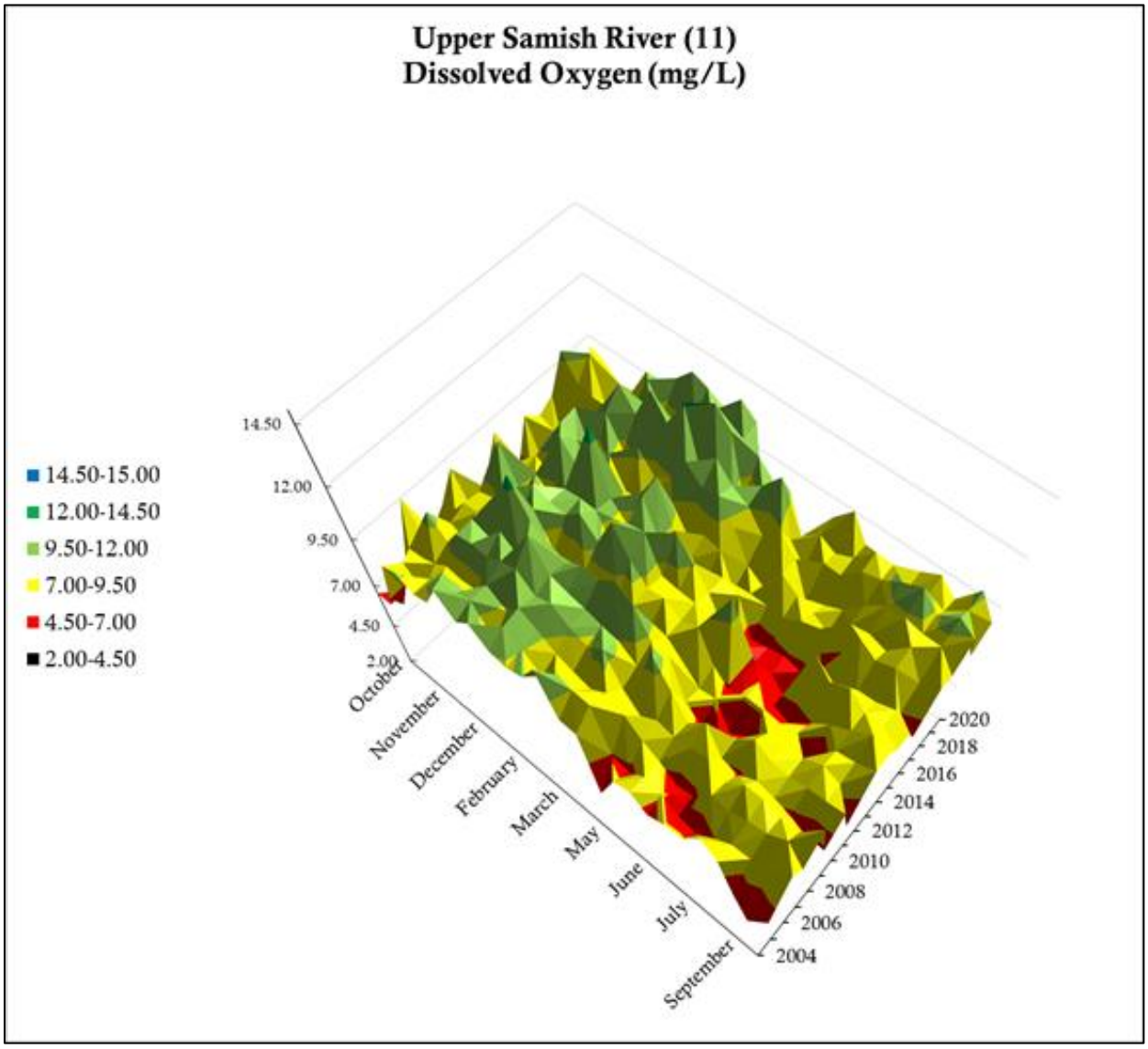


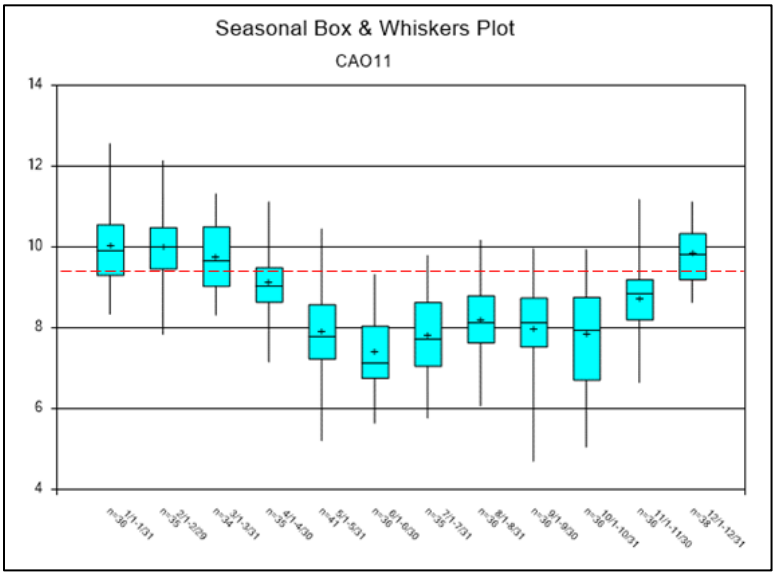
Site 11 is the Samish River, upstream of all other Samish River sampling sites. This site shows the condition of the Samish River prior to all monitored tributaries. This site is designated as core salmonid habitat.

Dissolved oxygen has significantly increased over all time periods. Fecal coliform counts are lower than they were 17 years ago. WQI scores are generally in the higher-scoring end of the moderate concern category, and often score as least concern.

Site 11 regularly fails to meet state standards for DO, but easily passes state standards for temperature, year-round. Annual FC levels easily meet state standards.

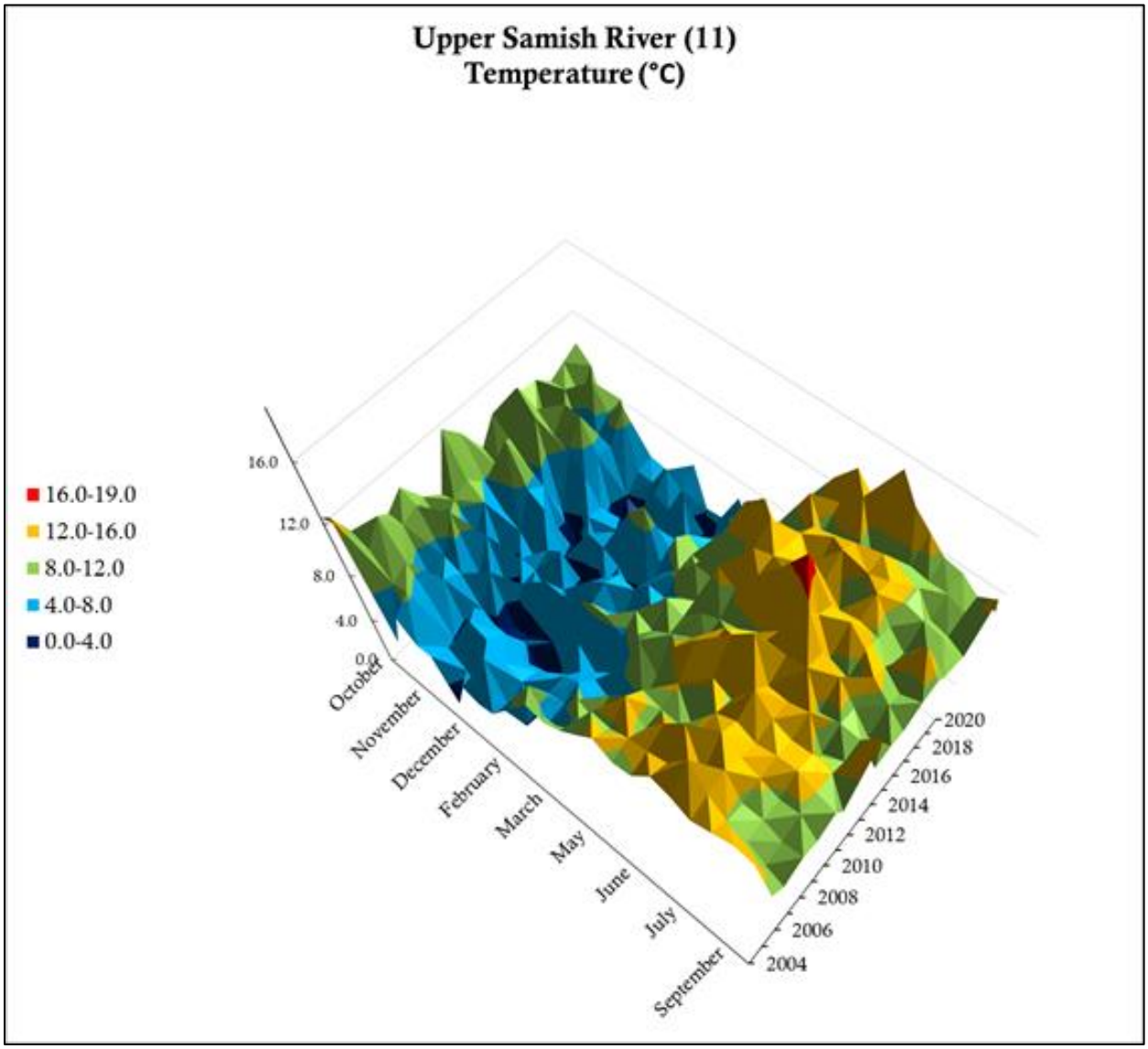
Site 3 is tied for 7th out of 39 sites for number of significant trends, with 15, and 1st out of 39 sites for positive trends, with 100%.

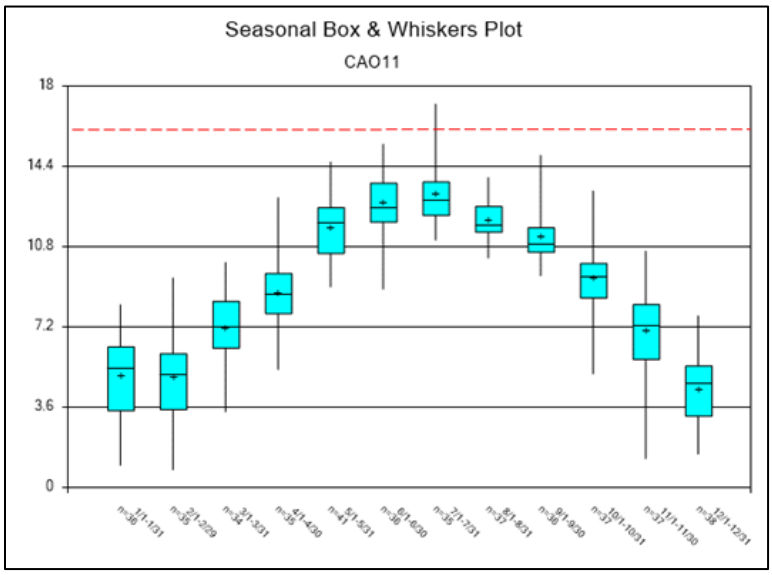




The dissolved oxygen (DO) standard for this site is 9.50 mg/L. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.

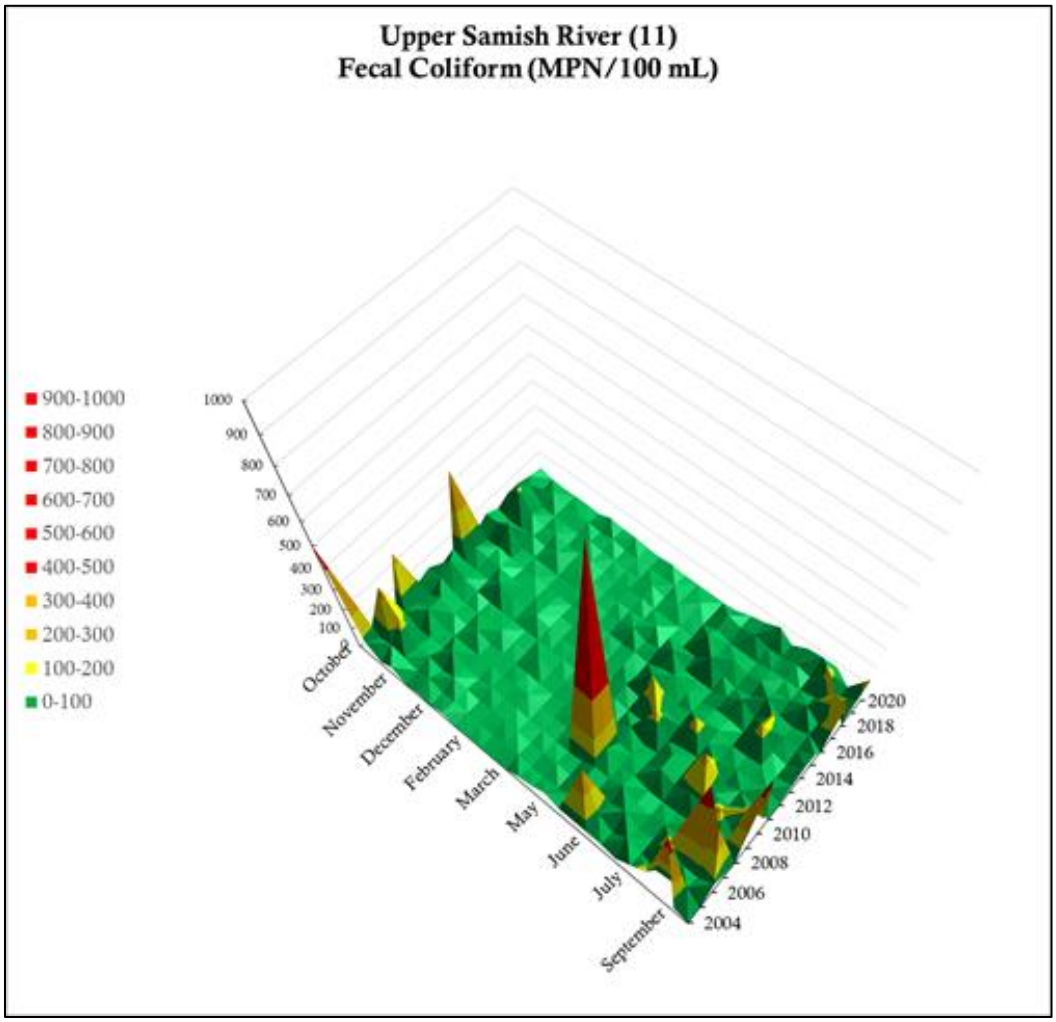
The dashed red line on the monthly box plot represents the 9.5 mg/L standard, and is approximate. The calendar year on the x-axis begins in January and ends in December.

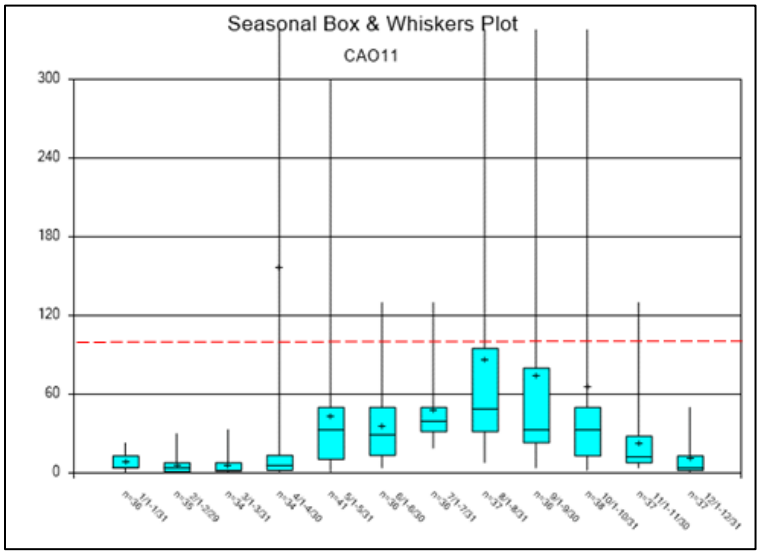




The temperature standard for this site is 16.0 °C. Any part of the 3D plot that is in red is hotter than that standard. The water year on the x-axis begins in October and ends in September.

The dashed red line on the monthly box plot represents the 16.0 °C standard, and is approximate. The calendar year on the x-axis begins in January and ends in December.





The fecal coliform (FC) standard for this site is 100 MPN/100 mL. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.

The dashed red line on the monthly box plot represents the 100 MPN/100 mL standard, and is approximate. The calendar year on the x-axis begins in January and ends in December.

12

Nookachamps Creek
@ Swan Road

Downstream Ag, TMDL

Water Quality Index (WQI)

2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
63	72	38	72	58	68	50	62	58	59	67	59	49	72	58

Long Term Trends

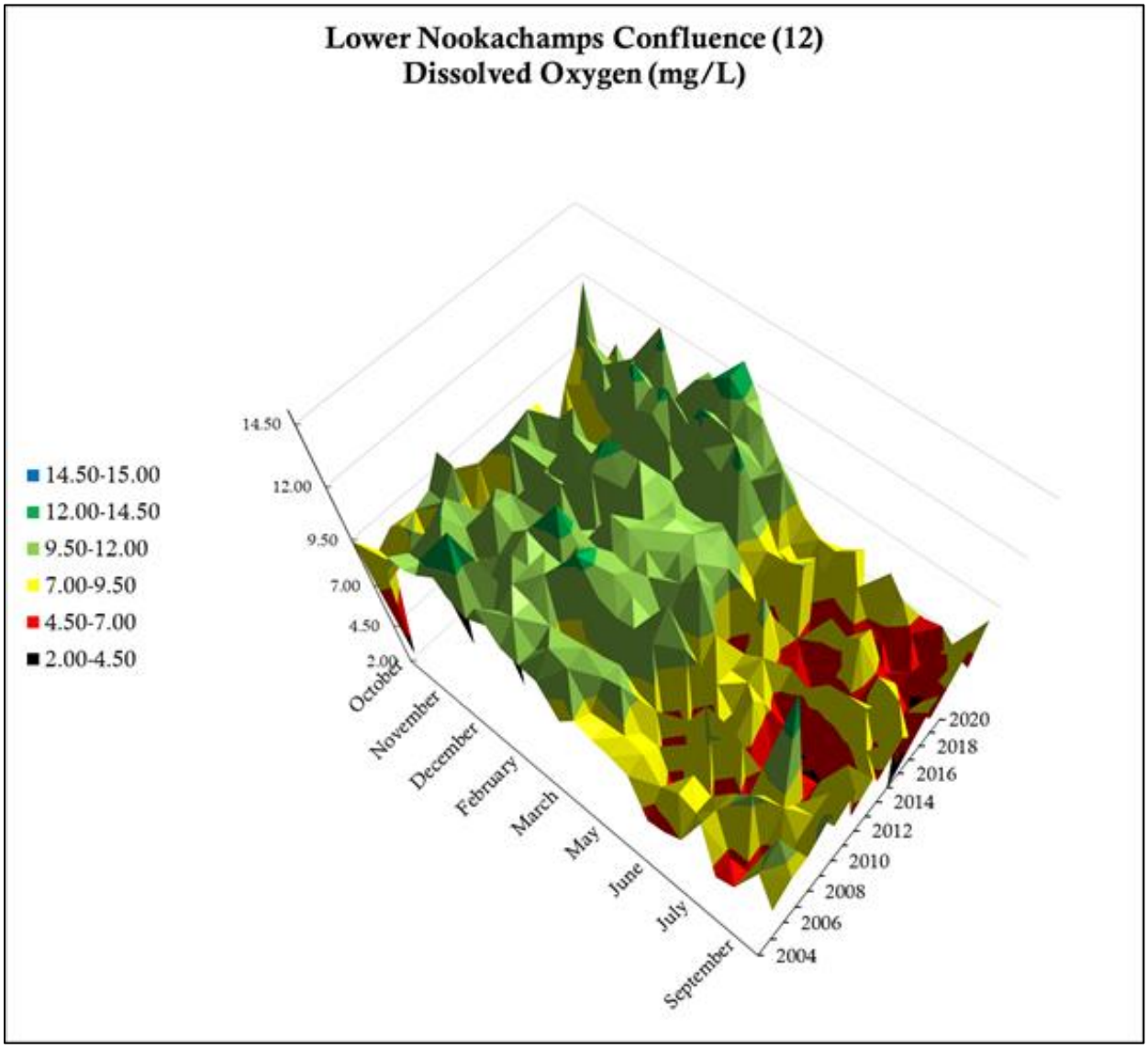
Dissolved Oxygen			Temperature			Fecal Coliform		
17 yr	10 yr	5 yr	17 yr	10 yr	5 yr	17 yr	10 yr	5 yr

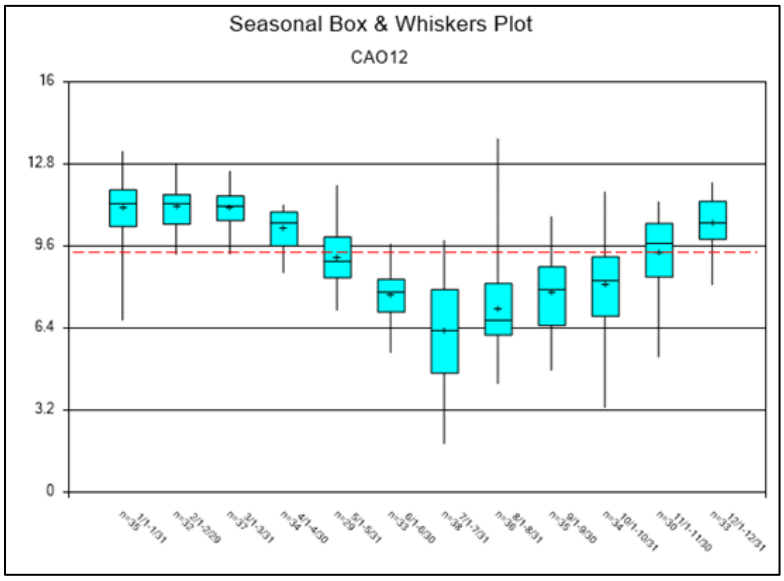
Site 12 is Nookachamps Creek, and is the furthest downstream site of the creek in this program, located just prior to joining the Skagit River. This creek drains a large valley of rural residential and agriculturally-zoned areas. This site is designated as core salmonid habitat.

There have been no significant changes in dissolved oxygen, temperature, or FC during any of the observed time periods. WQI scores are regularly in the category of moderate concern.

Site 12 regularly fails to meet state standards for DO and temperature during the warmer months. Annual fecal coliform levels for WY2020 easily passed the 100 FC standard, but did not pass the 90th percentile requirement.

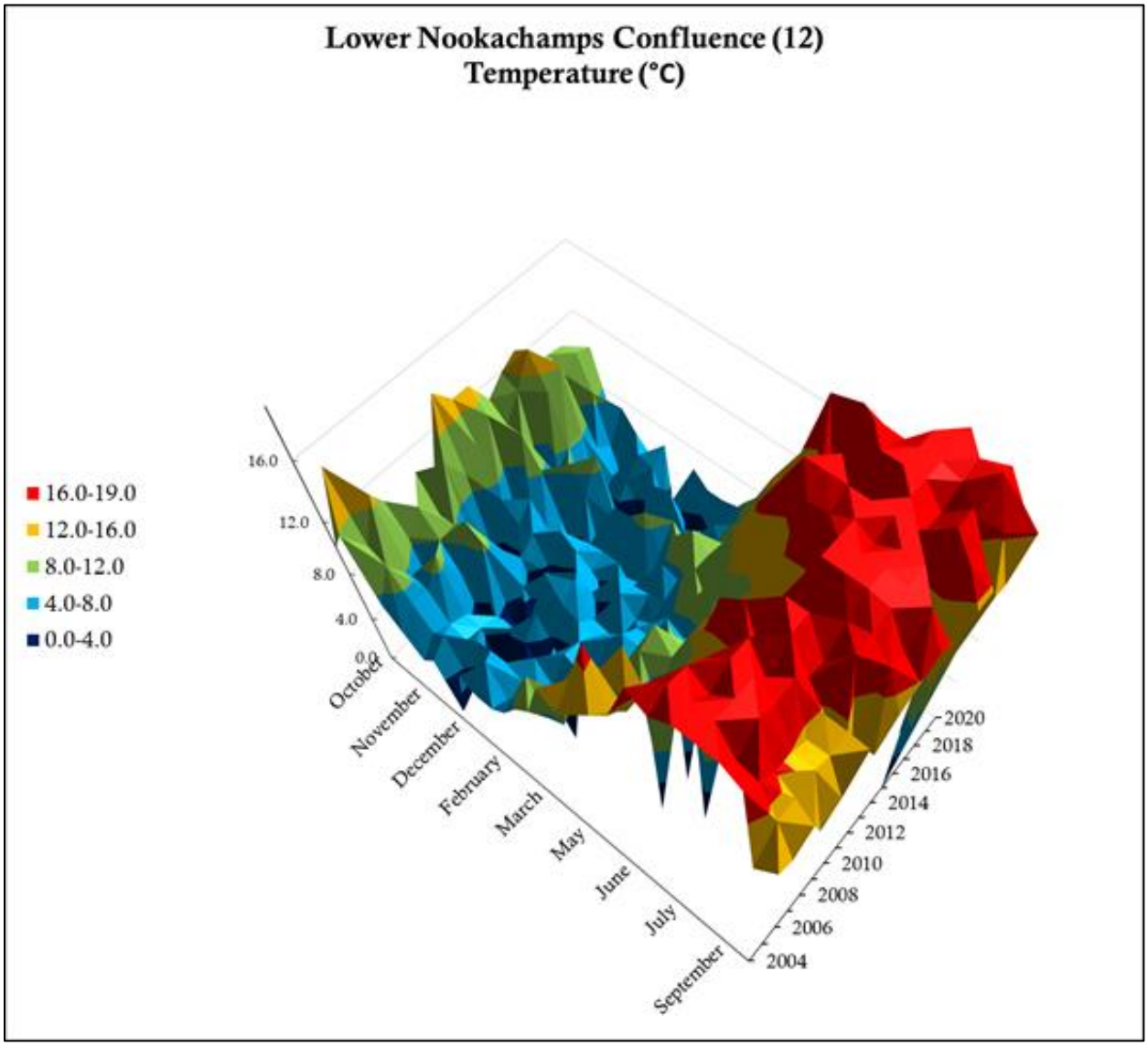
Site 12 is tied for 30th out of 39 sites for number of significant trends, with 9, and is tied for 14th out of 39 sites for positive trends, with 67%.

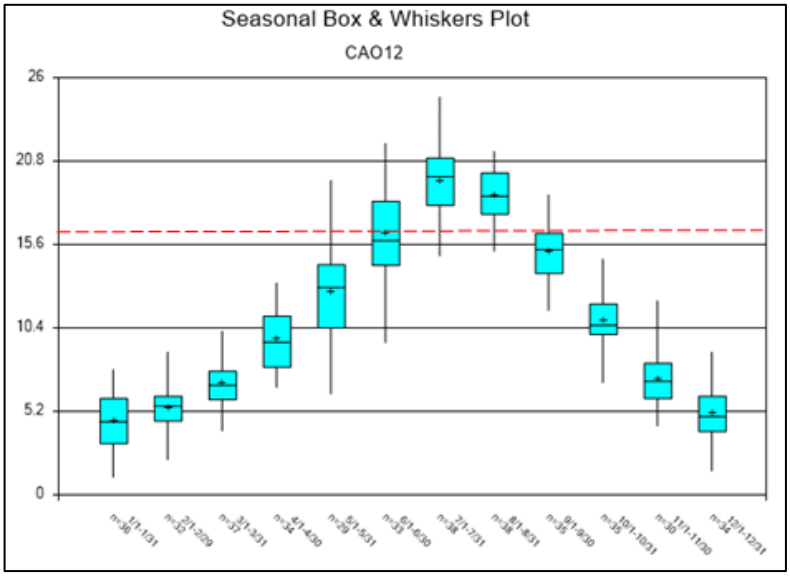




The dissolved oxygen (DO) standard for this site is 9.50 mg/L. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.

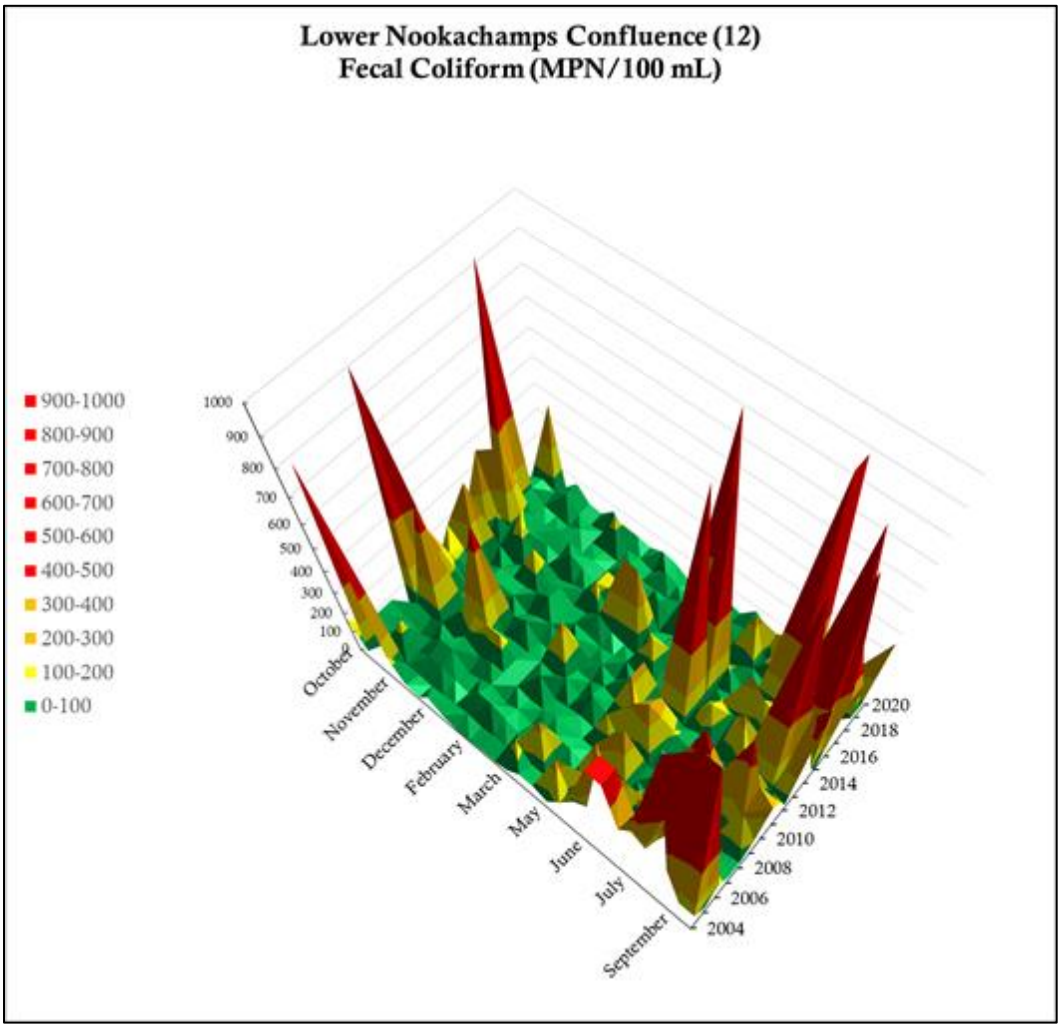
The dashed red line on the monthly box plot represents the 9.5 mg/L standard, and is approximate. The calendar year on the x-axis begins in January and ends in December.

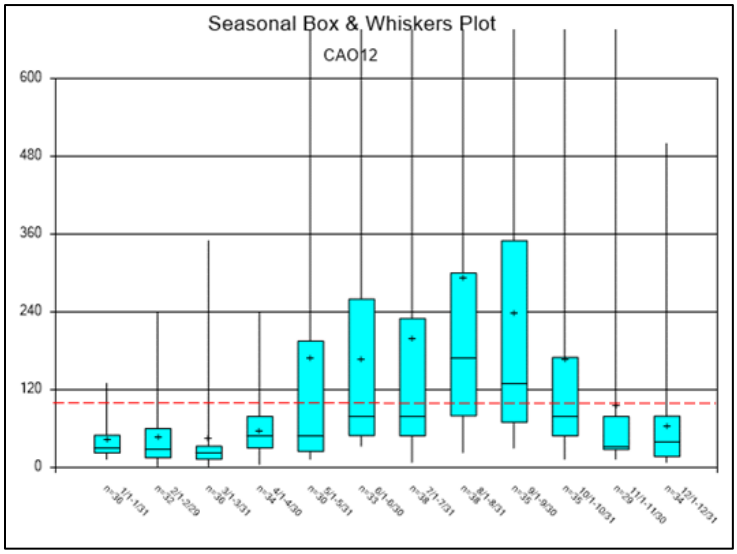




The temperature standard for this site is 16.0 °C. Any part of the 3D plot that is in red is hotter than that standard. The water year on the x-axis begins in October and ends in September.

The dashed red line on the monthly box plot represents the 16.0 °C standard, and is approximate. The calendar year on the x-axis begins in January and ends in December.





The fecal coliform (FC) standard for this site is 100 MPN/100 mL. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.

The dashed red line on the monthly box plot represents the 100 MPN/100 mL standard, and is approximate. The calendar year on the x-axis begins in January and ends in December.

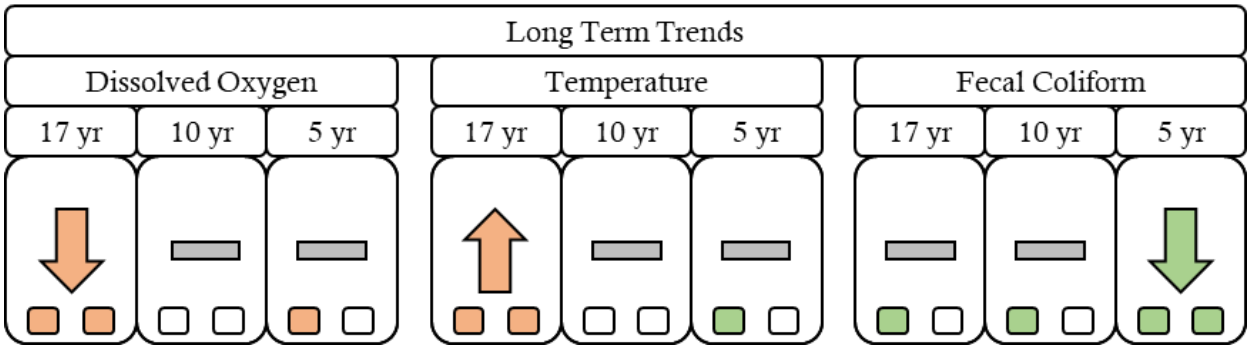
13

EF Nookachamps Creek
@ Highway 9

Downstream Ag, TMDL

Water Quality Index (WQI)

2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
74	77	88	85	85	91	65	70	76	74	75	64	80	74	57

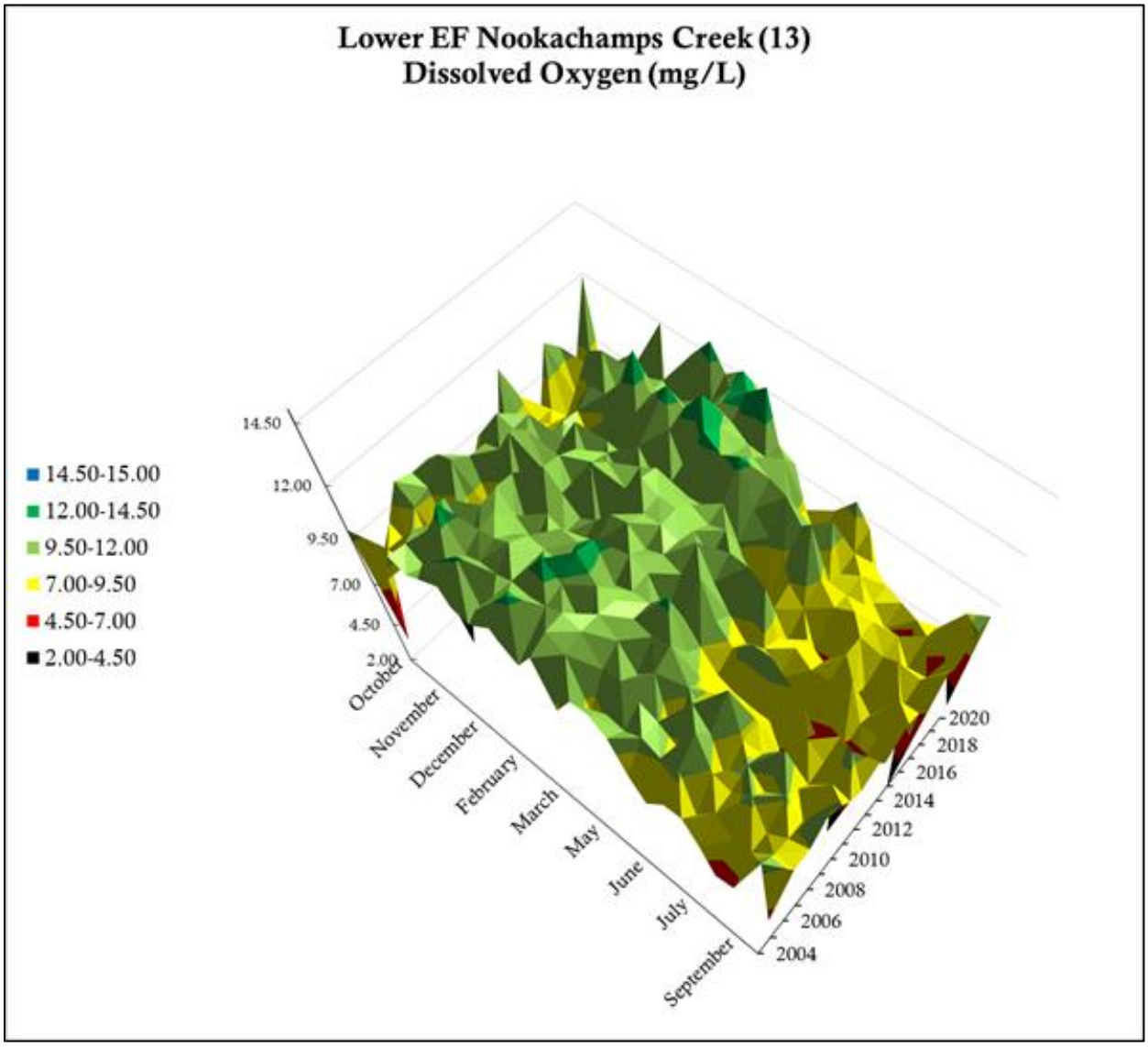


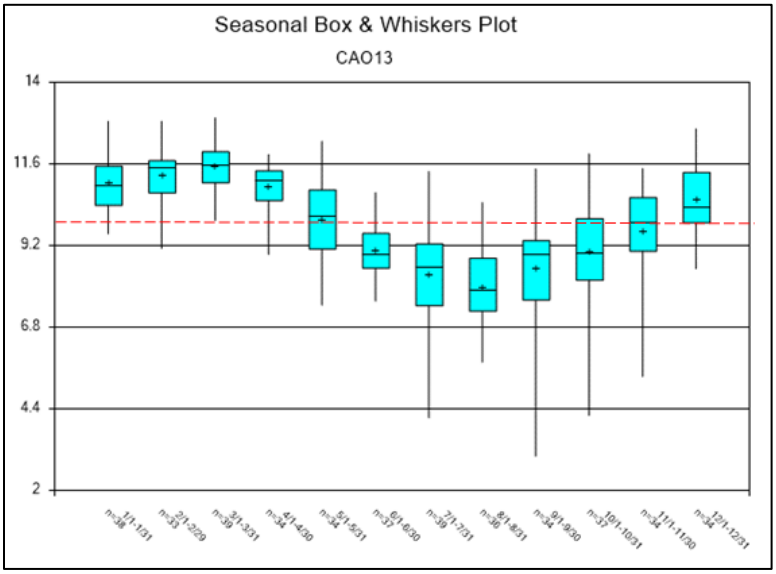
Site 13 is East Fork Nookachamps Creek, downstream of site 16, and sitting just prior to joining Nookachamps Creek and ultimately the Skagit River. It sits downstream of a stretch of agricultural activity. This site is designated as char spawning and rearing status.

Dissolved oxygen has declined since 17 years ago. Temperature is higher than it was 17 years ago. Fecal coliform counts are significantly lower over the last five years. WQI scores are generally in the higher-scoring end of the moderate concern category, and sometimes score as least concern.

Site 13 regularly fails to meet state standards for DO and temperature during the warmer months. Annual fecal coliform levels for WY2020 easily passed the 100 FC standard, but did not pass the 90th percentile requirement.

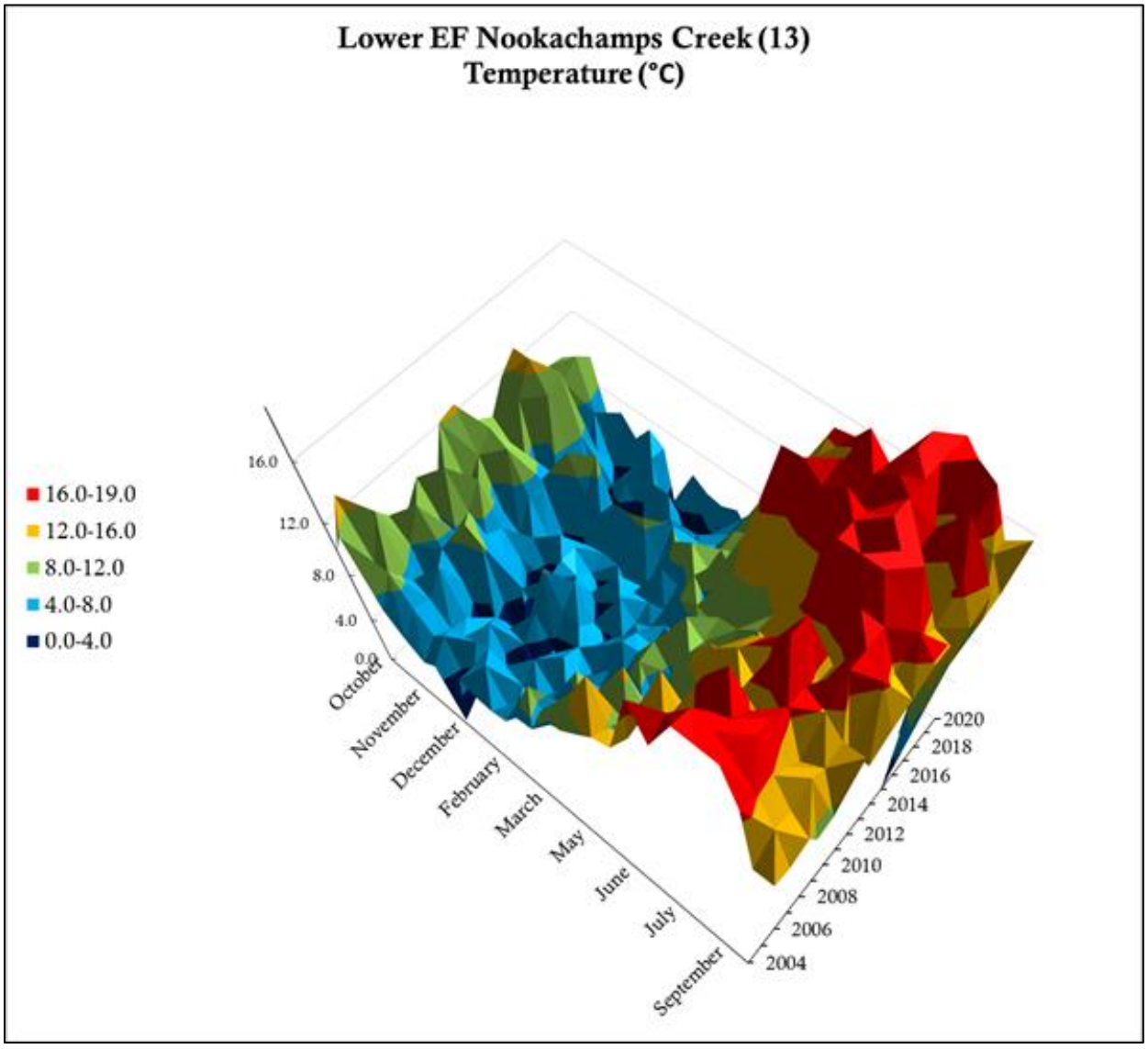
Site 13 is tied for 12th out of 39 sites for number of significant trends, with 13, and tied for 25th out of 39 sites for positive trends, with 54%.

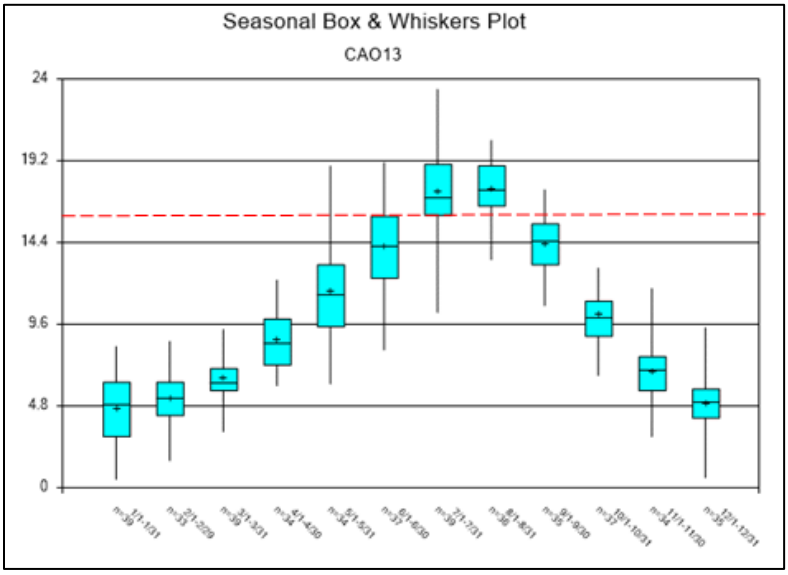




The dissolved oxygen (DO) standard for this site is 9.50 mg/L. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.

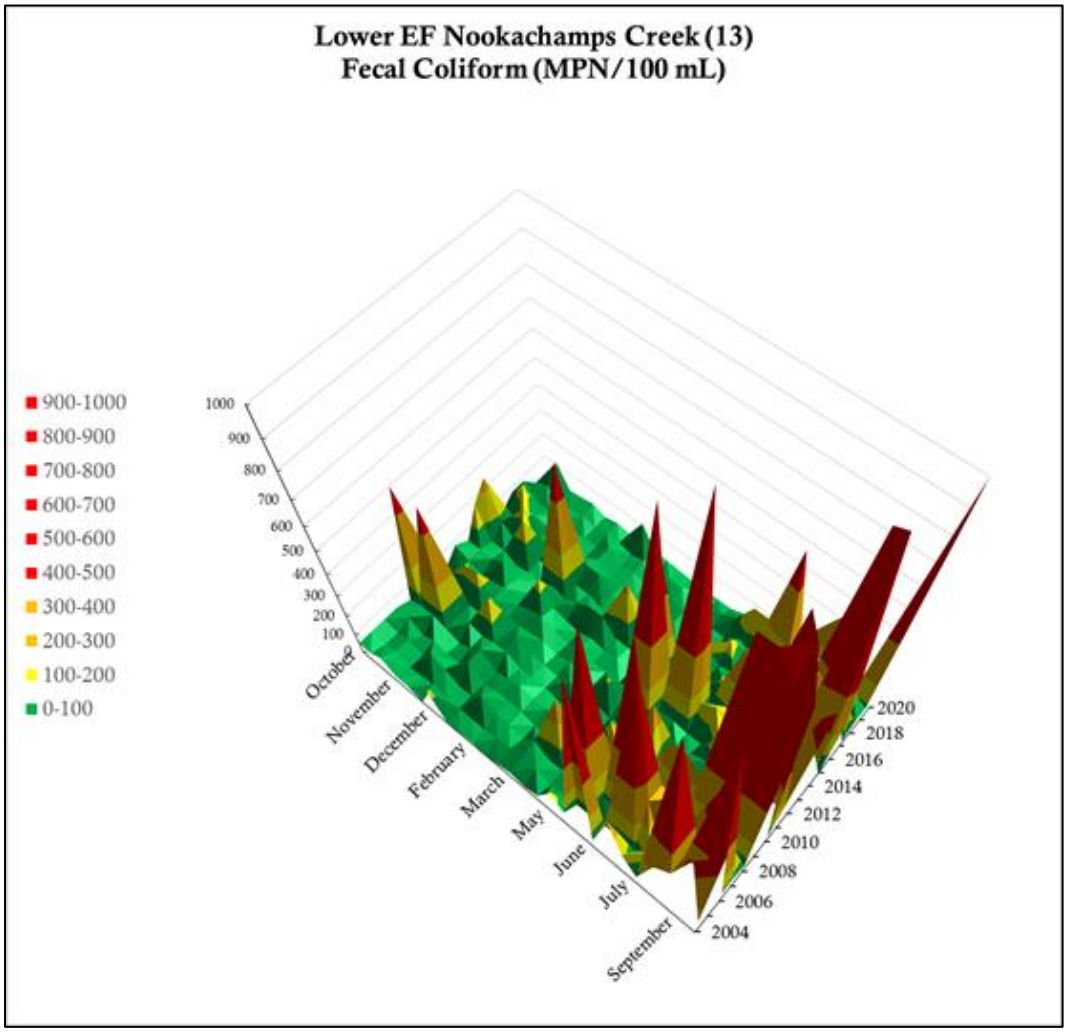
The dashed red line on the monthly box plot represents the 9.5 mg/L standard, and is approximate. The calendar year on the x-axis begins in January and ends in December.

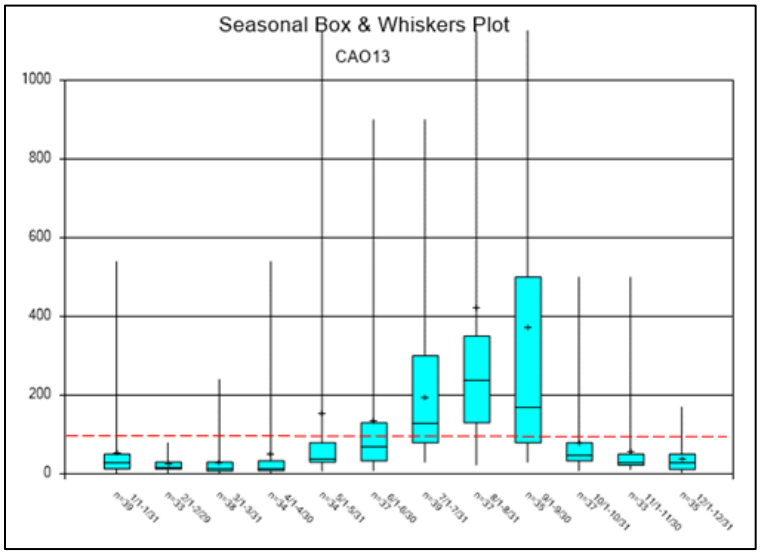




The temperature standard for this site is 16.0 °C. Any part of the 3D plot that is in red is hotter than that standard. The water year on the x-axis begins in October and ends in September.

The dashed red line on the monthly box plot represents the 16.0 °C standard, and is approximate. The calendar year on the x-axis begins in January and ends in December.





The fecal coliform (FC) standard for this site is 100 MPN/100 mL. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.

The dashed red line on the monthly box plot represents the 100 MPN/100 mL standard, and is approximate. The calendar year on the x-axis begins in January and ends in December.

14

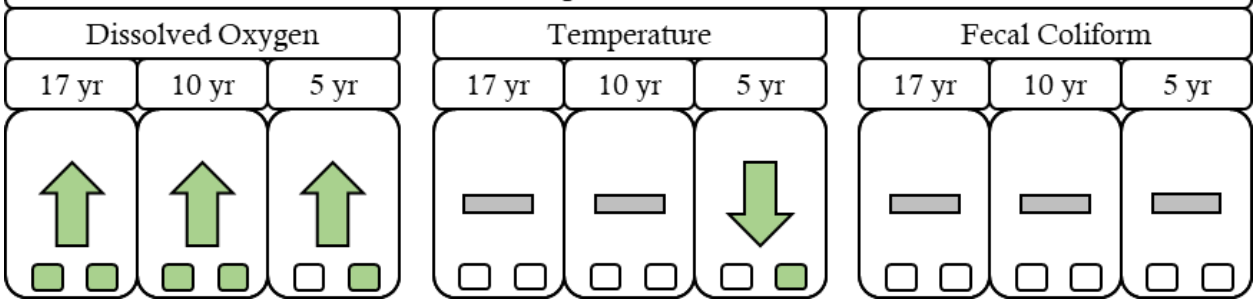
College Way Creek
@ College Way

Reference – Urban/suburban

Water Quality Index (WQI)

2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
48	35	24	46	44	75	40	47	53	55	73	47	55	54	66

Long Term Trends

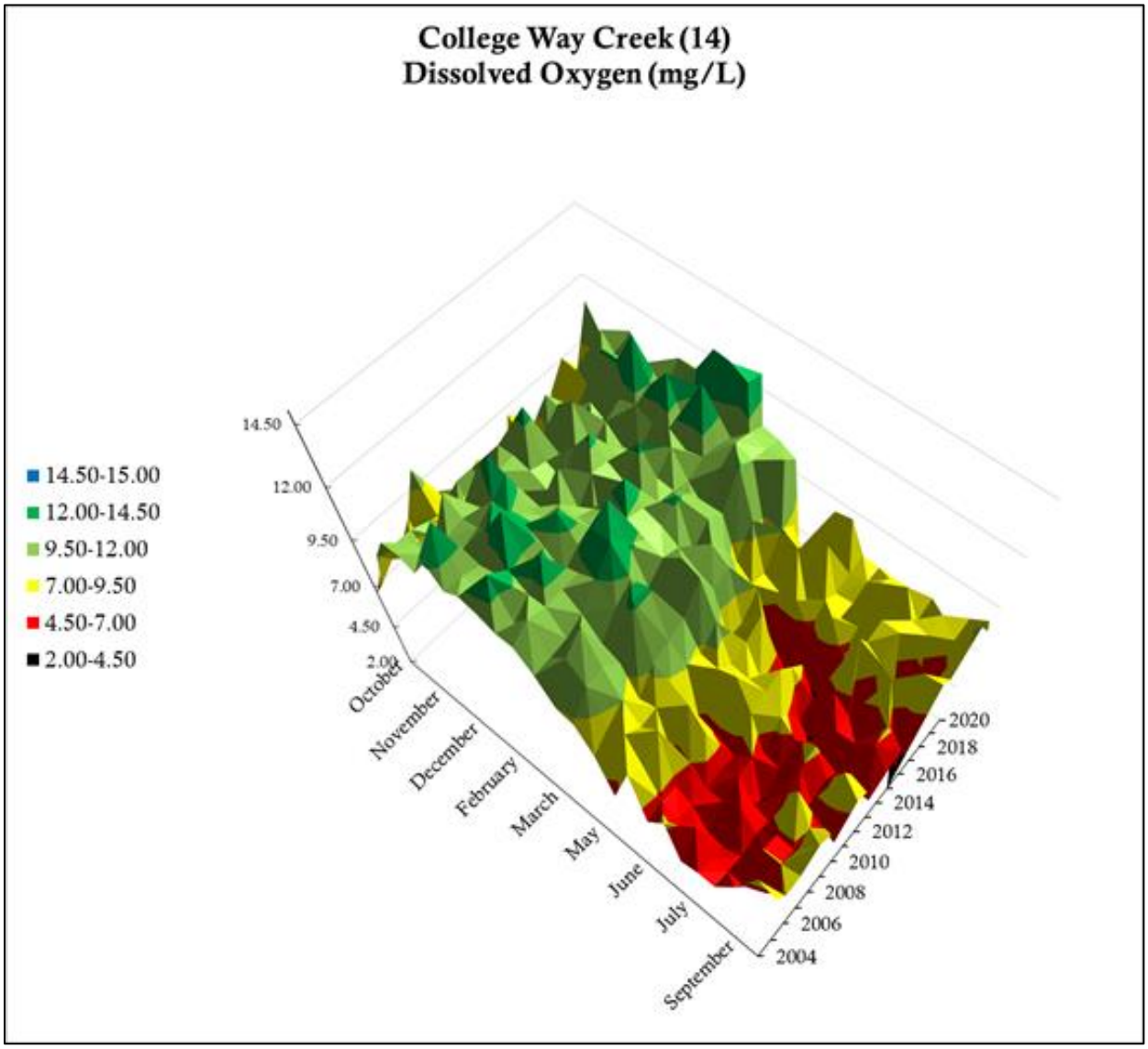


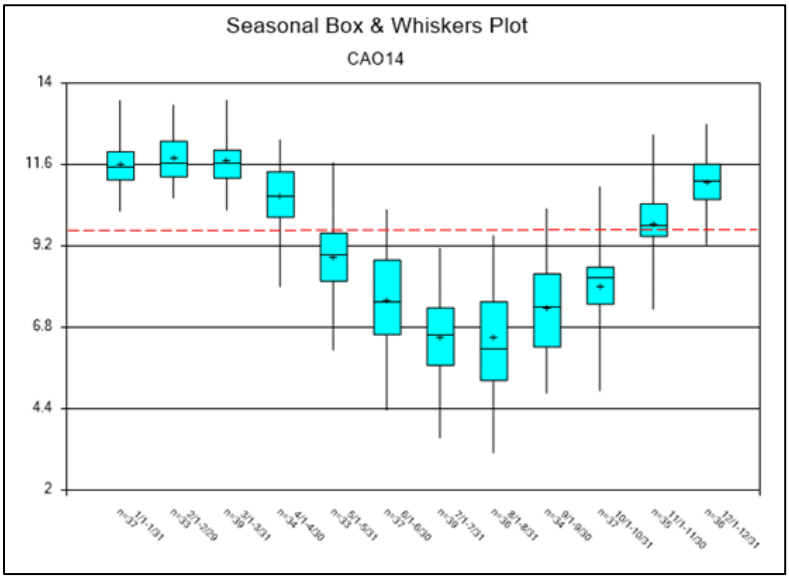
Site 14 is College Way Creek. This creek drains an urban/suburban area of northeast Mount Vernon, and terminates into Nookachamps Creek just prior to Barney Lake, and eventually into the Skagit River. This site is designated as core salmonid habitat.

Dissolved oxygen has significantly increased over all three monitored time periods. Water temperature has decreased over the last five years. WQI scores are regularly in the category of moderate concern.

Site 14 regularly fails to meet state standards for DO during the warmer months, and often fails to meet state standards for temperature during the hottest time of the year. Annual FC levels consistently and exceedingly fail to meet state standards.

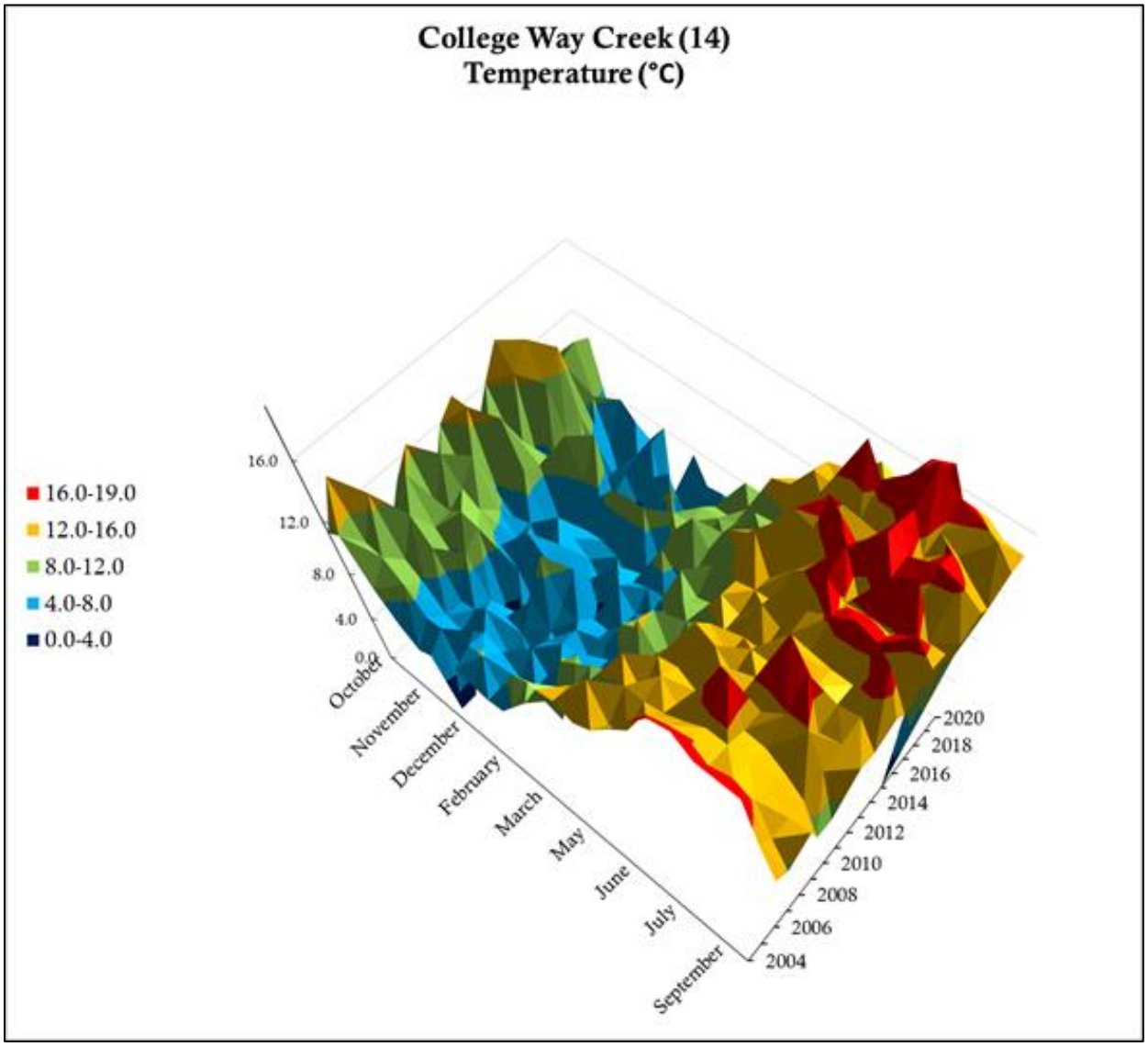
Site 14 is tied for 12th out of 39 sites for number of significant trends, with 13, and is tied for 8th out of 39 sites for positive trends, with 77%.

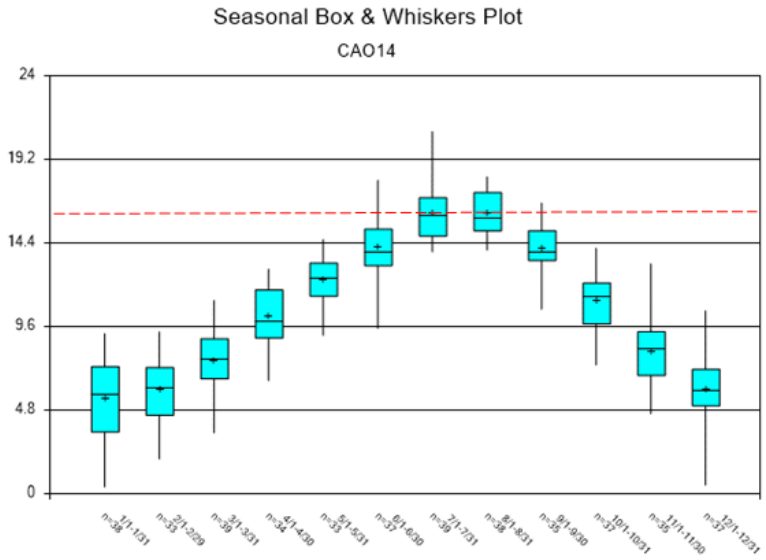




The dissolved oxygen (DO) standard for this site is 9.50 mg/L. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.

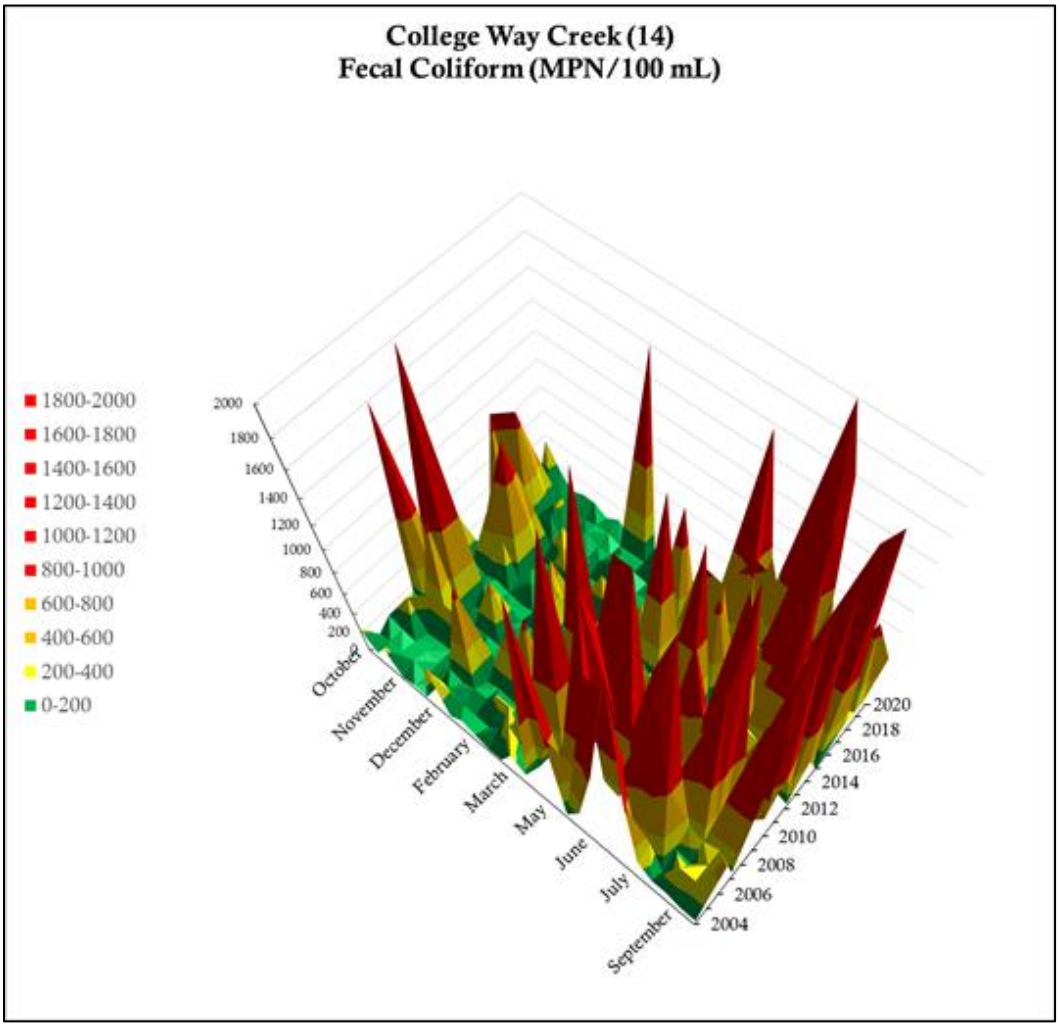
The dashed red line on the monthly box plot represents the 9.5 mg/L standard, and is approximate. The calendar year on the x-axis begins in January and ends in December.

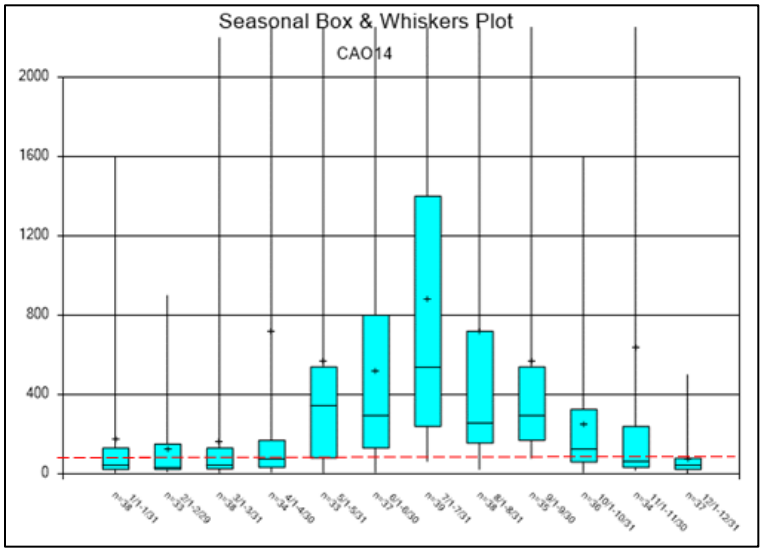




The temperature standard for this site is 16.0 °C. Any part of the 3D plot that is in red is hotter than that standard. The water year on the x-axis begins in October and ends in September.

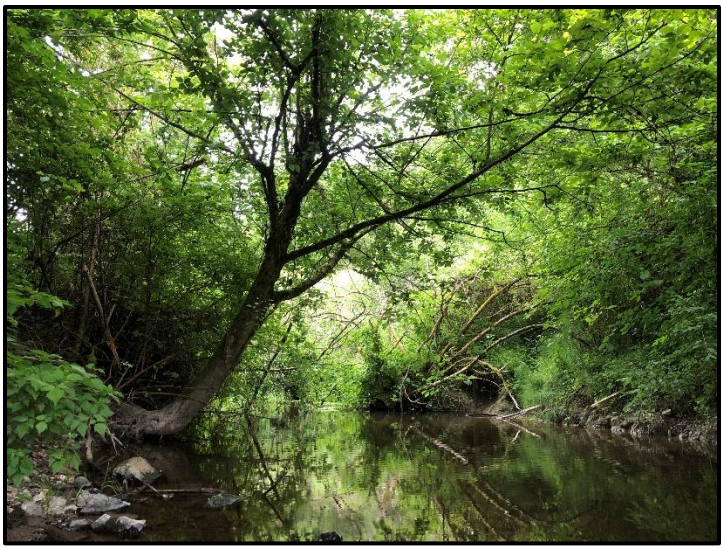
The dashed red line on the monthly box plot represents the 16.0 °C standard, and is approximate. The calendar year on the x-axis begins in January and ends in December.





The fecal coliform (FC) standard for this site is 100 MPN/100 mL. Any part of the 3D plot that is in green almost meets that standard. The water year on the x-axis begins in October and ends in September.

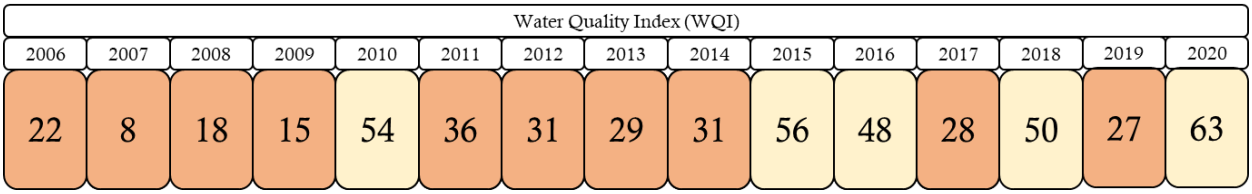
The dashed red line on the monthly box plot represents the 100 MPN/100 mL standard, and is approximate. The calendar year on the x-axis begins in January and ends in December.

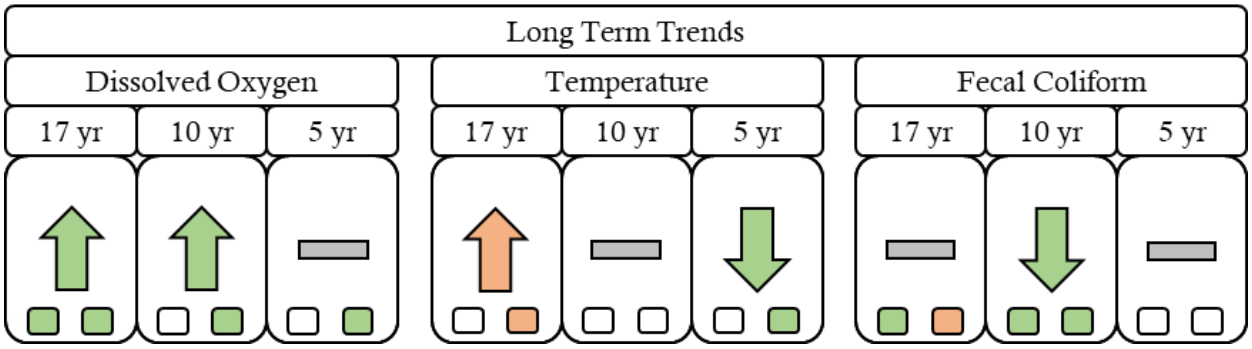


15

Nookachamps Creek
@ Knapp Road

Midstream Ag, TMDL



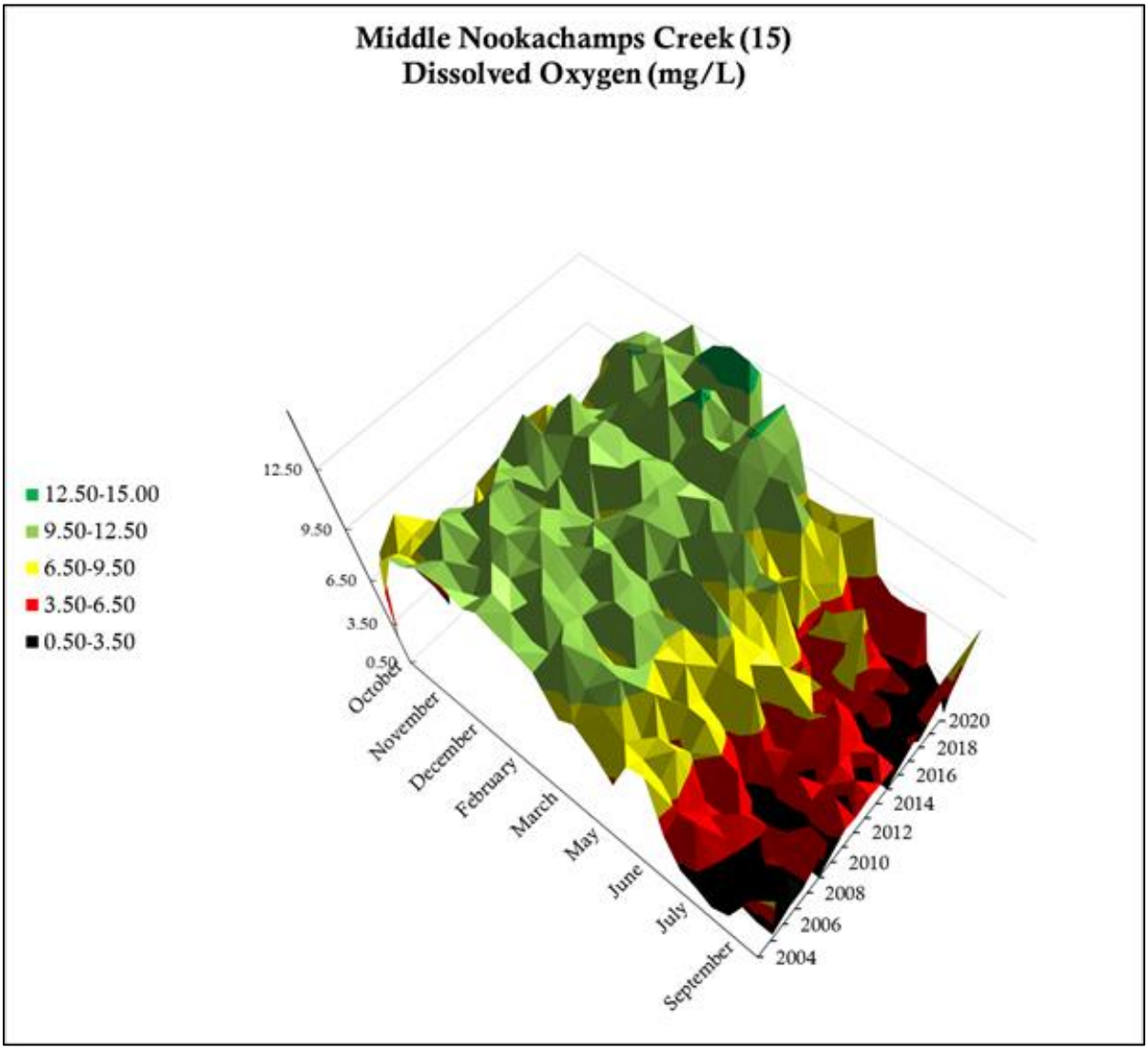


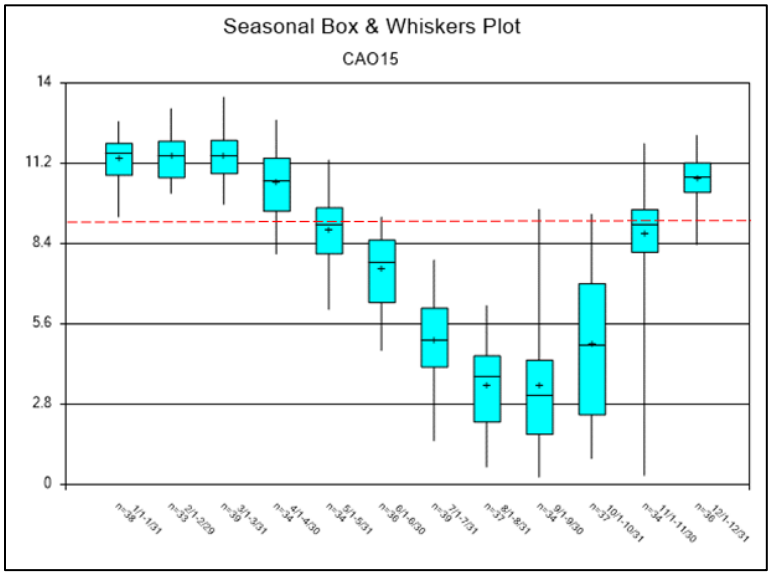
Site 15 is Nookachamps Creek mid-stream, upstream from site 12, and downstream from Big Lake and site 17. This site is designated as core salmonid habitat.

Dissolved oxygen is higher than it was 17 and ten years ago. Water temperature is higher than it was at the beginning of this study, but lower than it was five years ago. Fecal coliform counts are lower now than they were ten years ago. WQI scores are consistently in the category of highest concern, but improving since the beginning of this study.

Site 15 regularly fails to meet state standards for DO and temperature during the warmer months. Annual fecal coliform levels for WY2020 easily passed state standards, and this is a marked improvement.

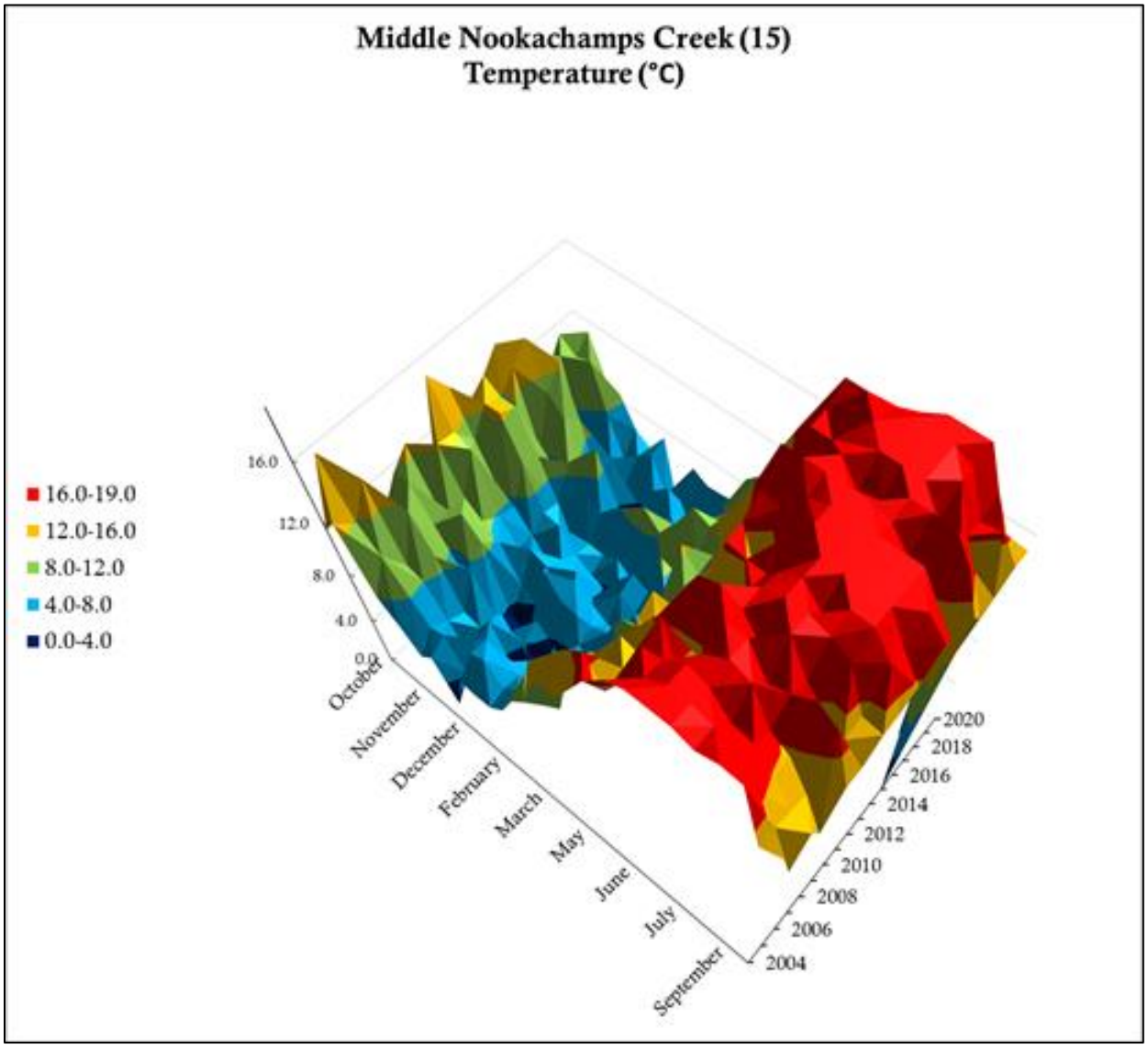
Site 15 is tied for 4th out of 39 sites for number of significant trends, with 16, and is 5th of 39 sites for positive trends, with 81%.

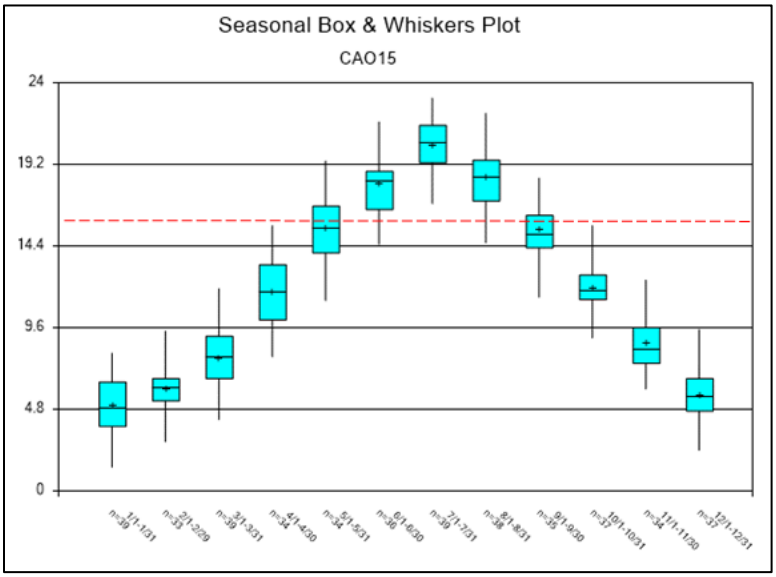




The dissolved oxygen (DO) standard for this site is 9.50 mg/L. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.

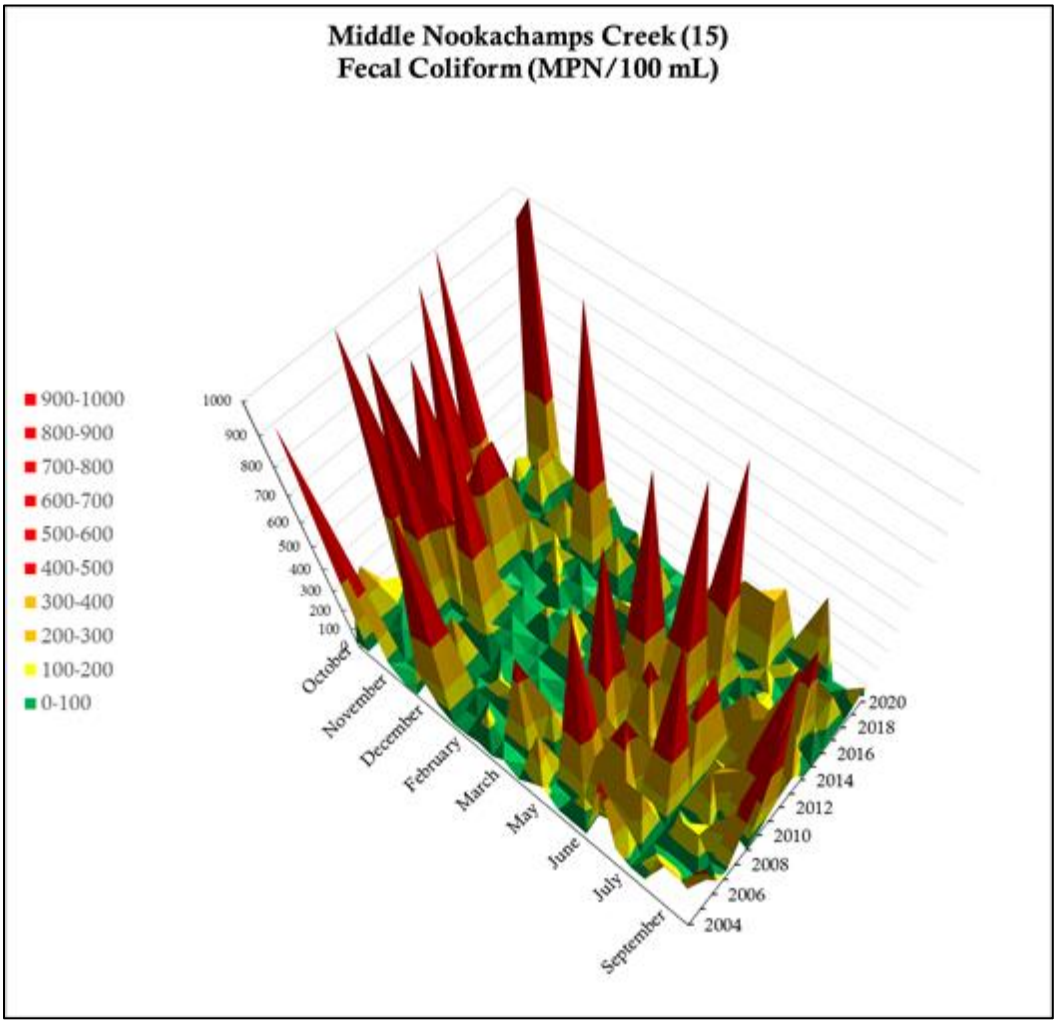
The dashed red line on the monthly box plot represents the 9.5 mg/L standard, and is approximate. The calendar year on the x-axis begins in January and ends in December.

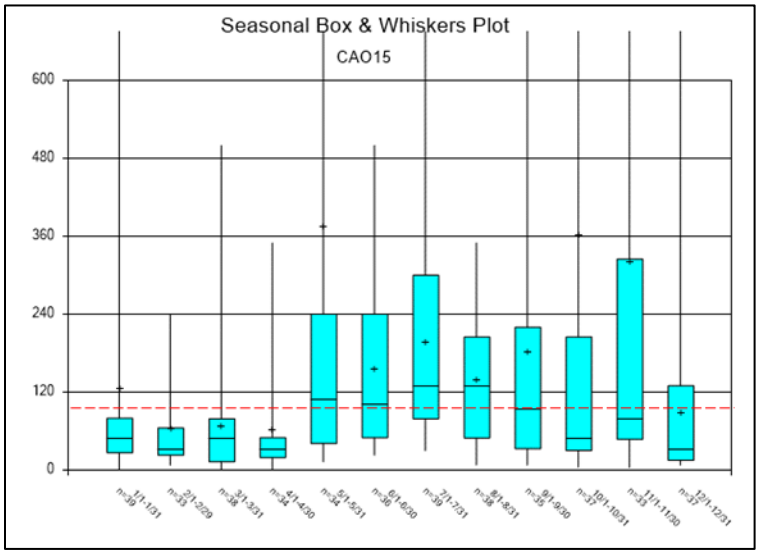




The temperature standard for this site is 16.0 °C. Any part of the 3D plot that is in red is hotter than that standard. The water year on the x-axis begins in October and ends in September.

The dashed red line on the monthly box plot represents the 16.0 °C standard, and is approximate. The calendar year on the x-axis begins in January and ends in December.





The fecal coliform (FC) standard for this site is 100 MPN/100 mL. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.

The dashed red line on the monthly box plot represents the 100 MPN/100 mL standard, and is approximate. The calendar year on the x-axis begins in January and ends in December.

16

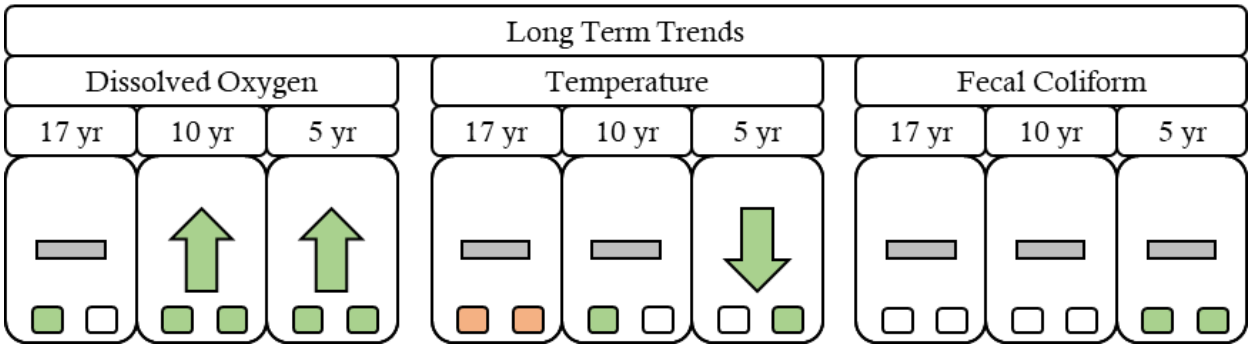
EF Nookachamps Creek
@ Beaver Lake Road

Midstream Ag, TMDL

Water Quality Index (WQI)

2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
88	86	89	91	97	84	91	80	92	95	88	83	89	87	90

Long Term Trends

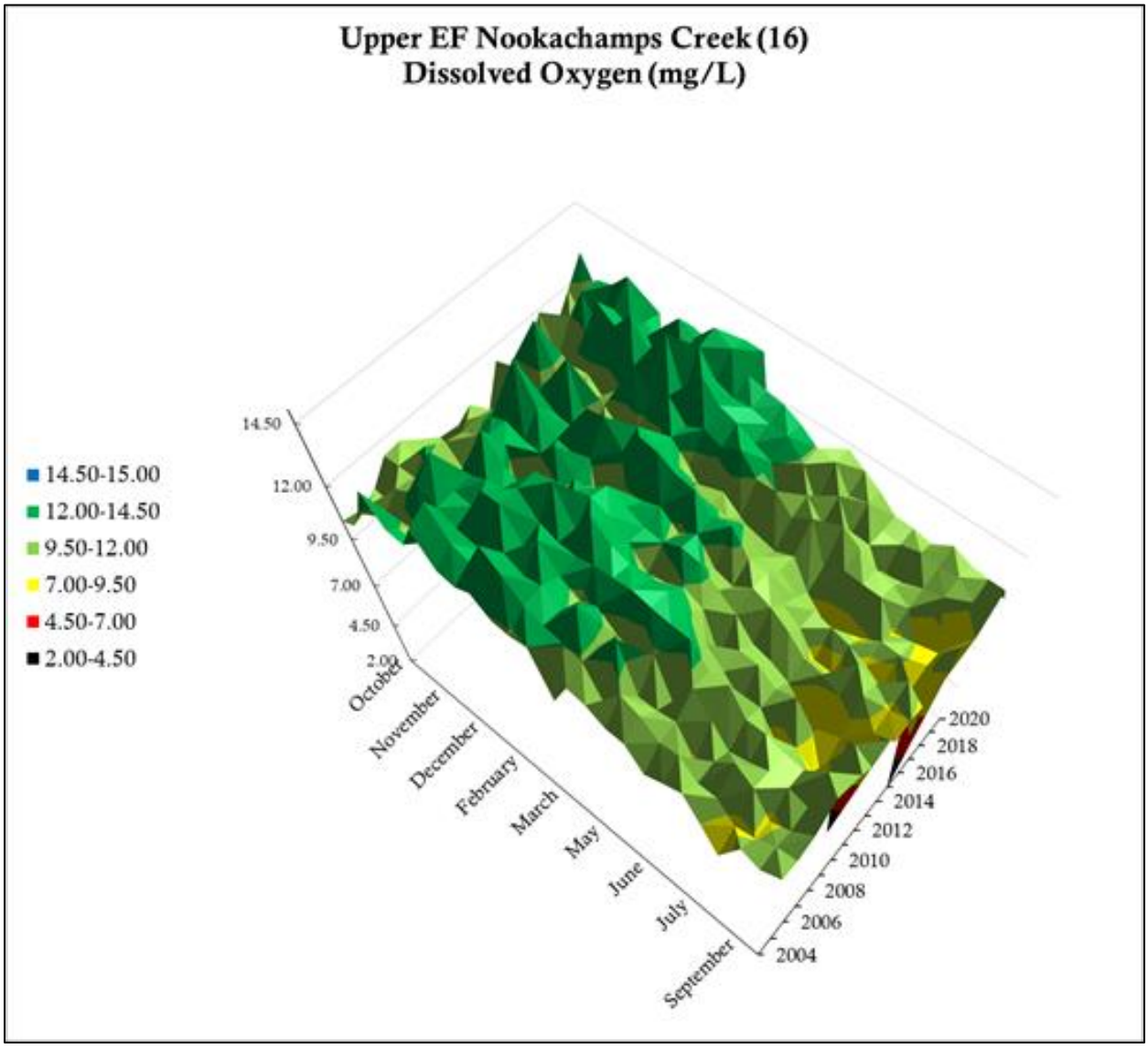


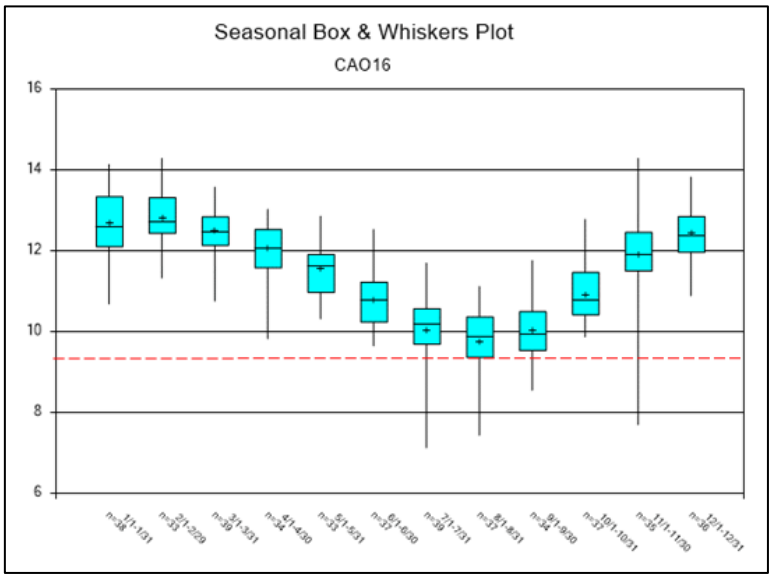
Site 16 is East Fork Nookachamps Creek, upstream of site 13, and immediately after adjoining with Cold Spring Creek. This site is influenced by light agricultural uses and undeveloped land. This site is designated as char spawning and rearing status.

Dissolved oxygen has significantly increased over the last ten years and five years. Water temperatures have decreased in the most recent five years. There were no significant trends in fecal coliform. WQI scores have never been outside of the category of least concern.

Site 16 easily passes state standards for DO, but water temperatures can often exceed state standards during the warmest time of year. Annual FC levels easily meet state standards.

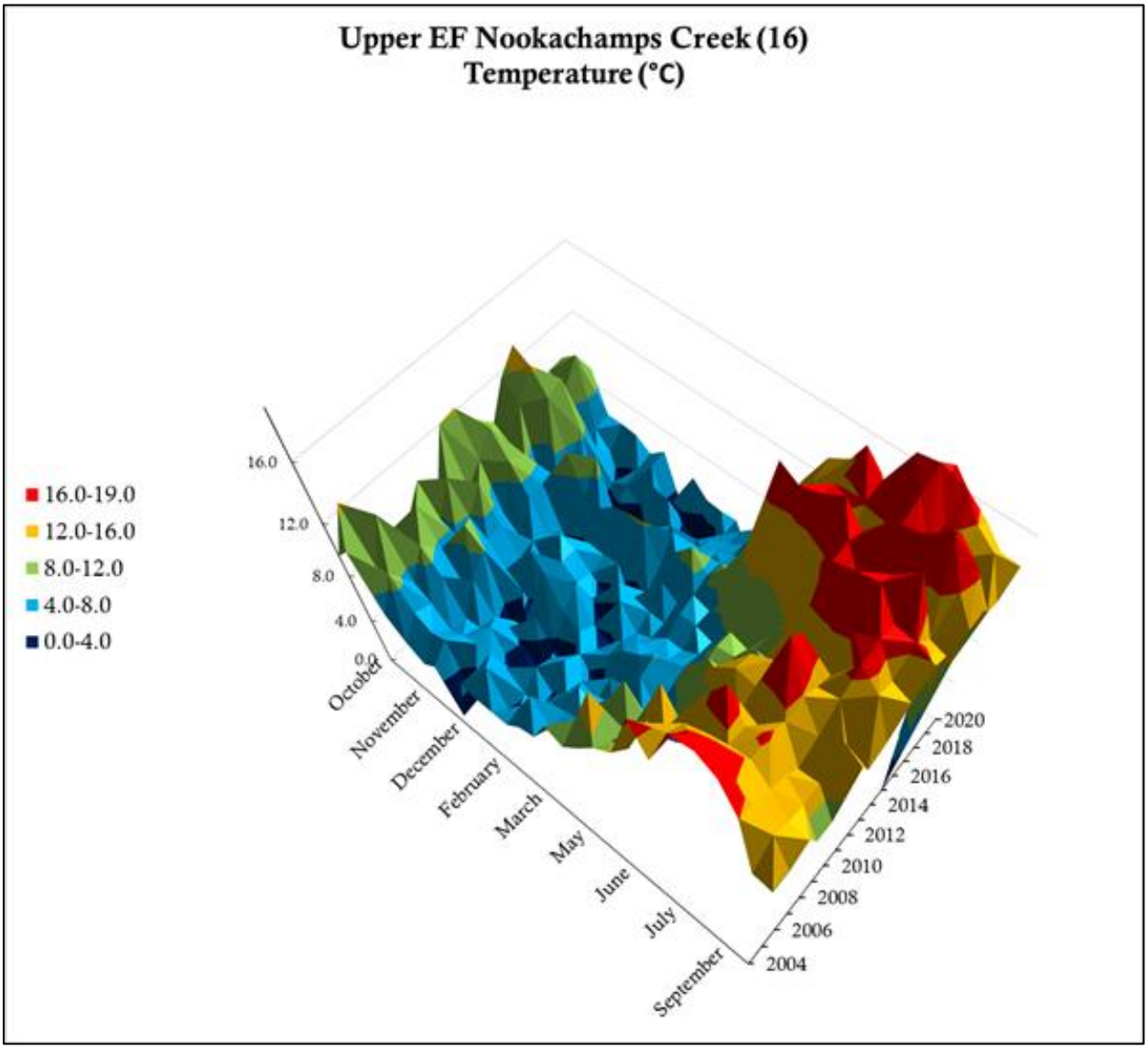
Site 16 is tied for 12th out of 39 sites for number of significant trends, with 13, and is tied for 8th out of 39 sites for positive trends, with 77%.

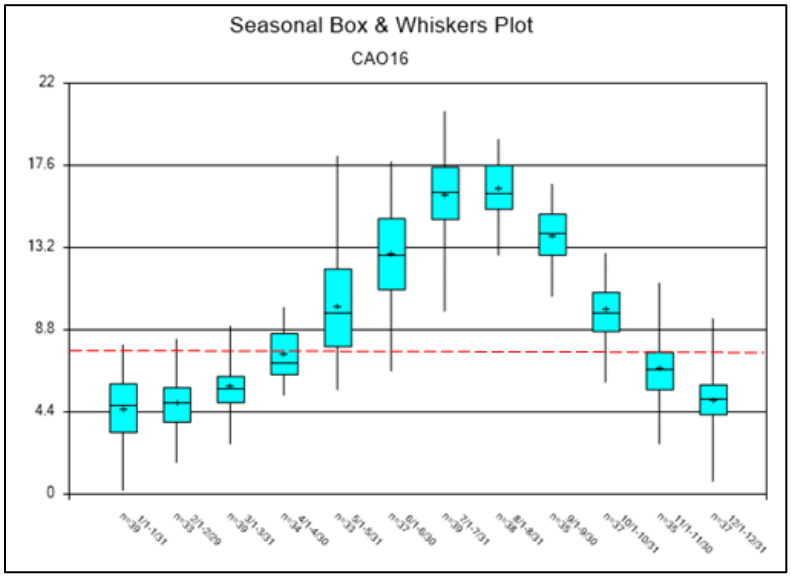




The dissolved oxygen (DO) standard for this site is 9.50 mg/L. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.

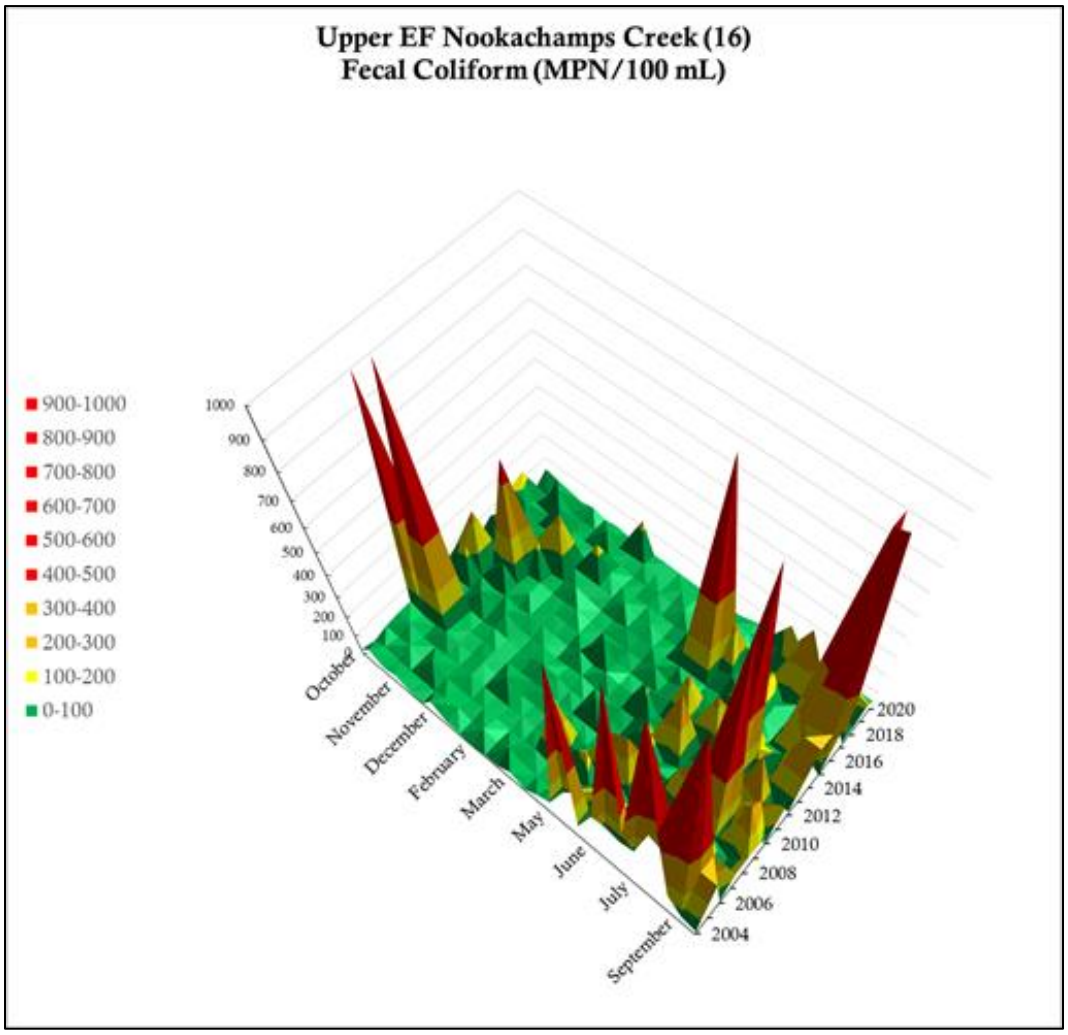
The dashed red line on the monthly box plot represents the 9.5 mg/L standard, and is approximate. The calendar year on the x-axis begins in January and ends in December.

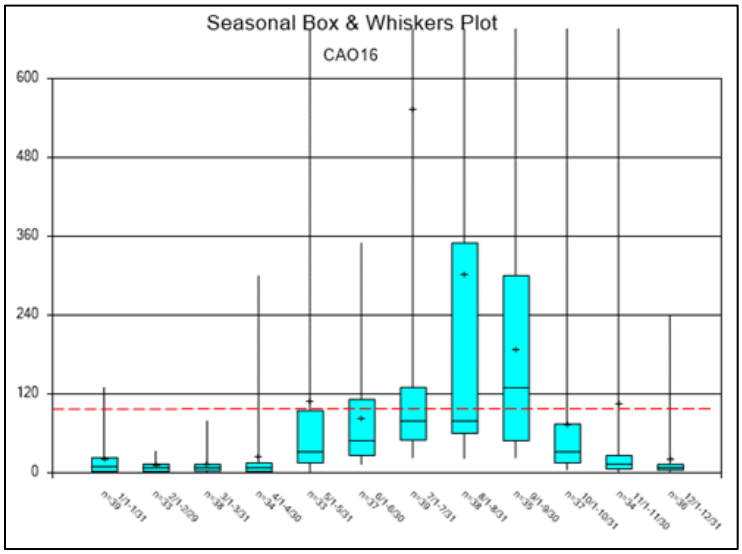




The temperature standard for this site is 16.0 °C. Any part of the 3D plot that is in red is hotter than that standard. The water year on the x-axis begins in October and ends in September.

The dashed red line on the monthly box plot represents the 16.0 °C standard, and is approximate. The calendar year on the x-axis begins in January and ends in December.





The fecal coliform (FC) standard for this site is 100 MPN/100 mL. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.

The dashed red line on the monthly box plot represents the 100 MPN/100 mL standard, and is approximate. The calendar year on the x-axis begins in January and ends in December.

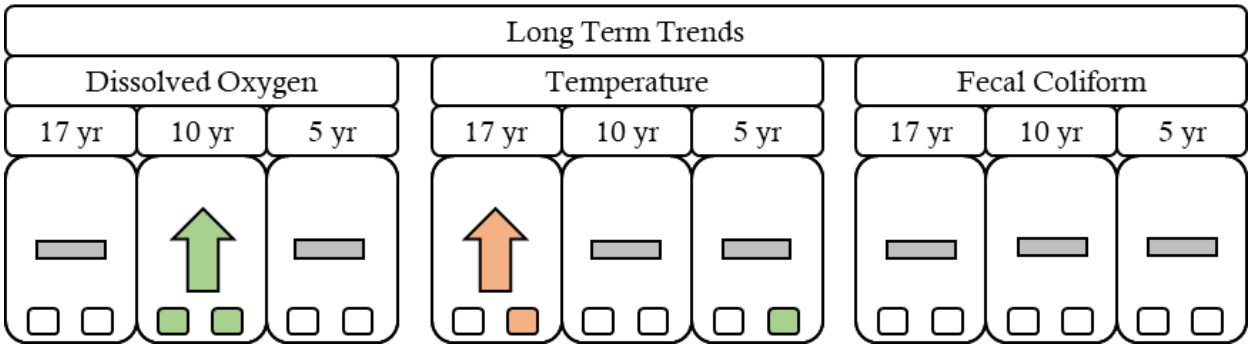
17

Nookachamps Creek
@ Big Lake Outlet

Upstream Ag, TMDL

Water Quality Index (WQI)

2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
60	83	69	84	75	91	74	64	60	79	71	78	67	65	69

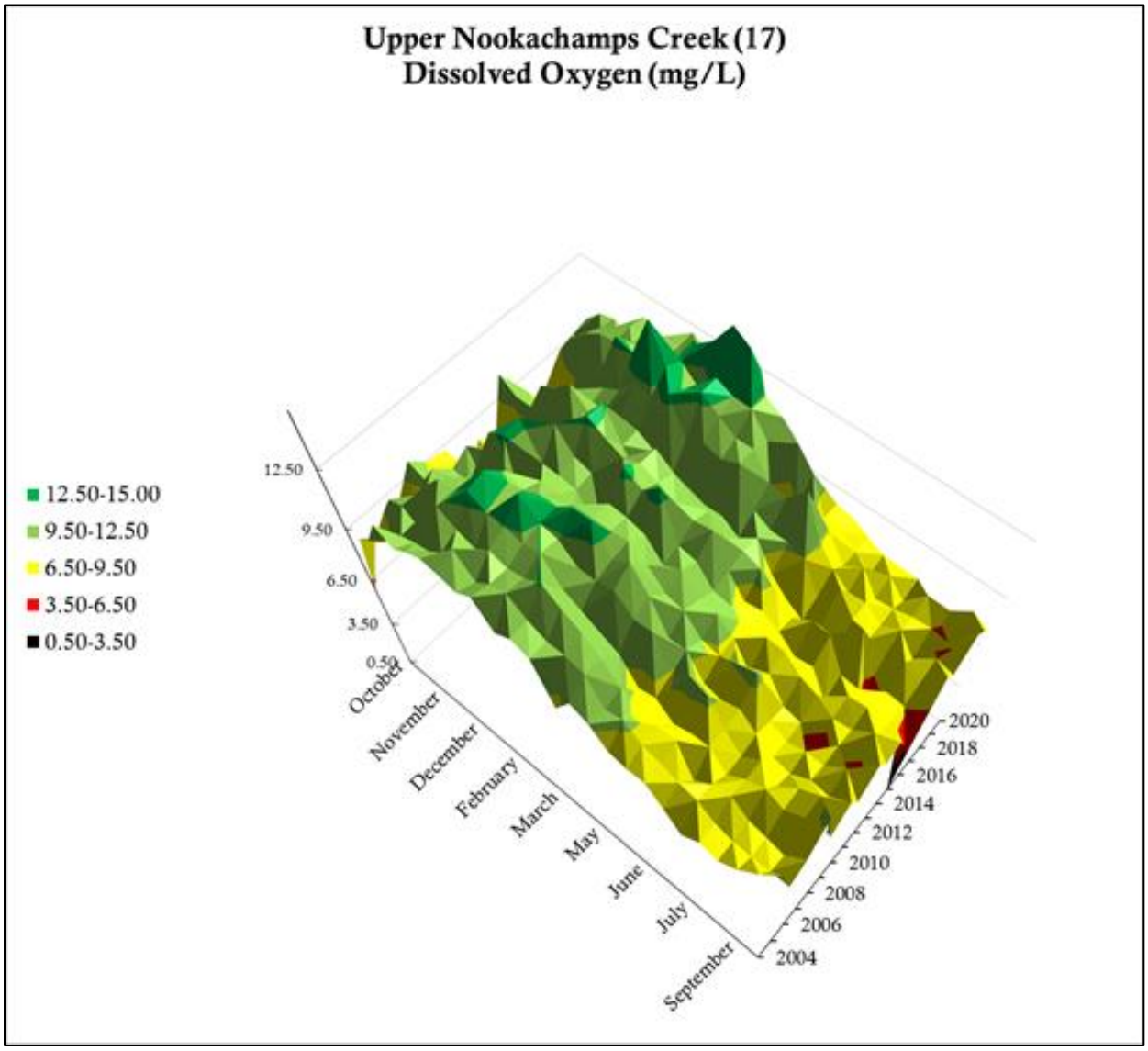


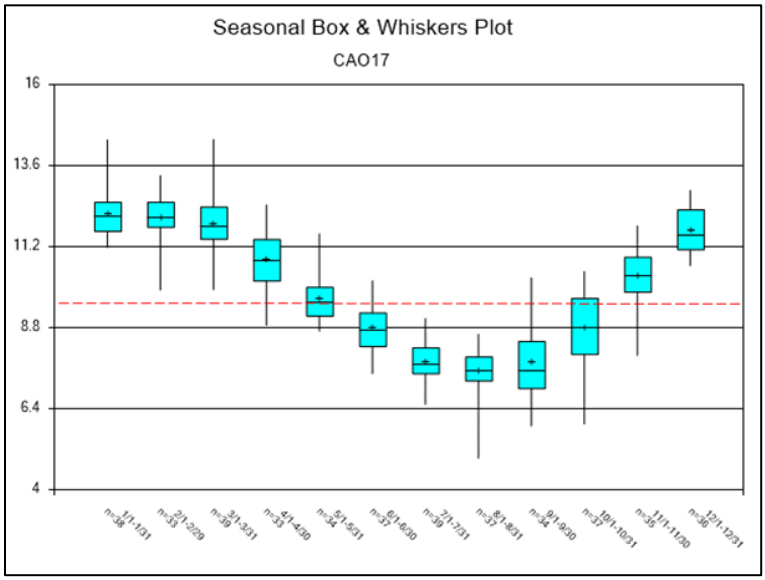
Site 17 is Nookachamps Creek, at its source, immediately after leaving Big Lake. This site is upstream from sties 15 and 12. This site is designated as core salmonid habitat.

Over the most recent ten years, dissolved oxygen has increased. Water temperature has increased since 17 years ago. WQI scores are generally in the upper-score end of the moderate concern category, and has scored in the least concern category in the past.

Site 17 regularly fails to meet state standards for DO and temperature during the warmer months. Annual FC levels easily meet state standards.

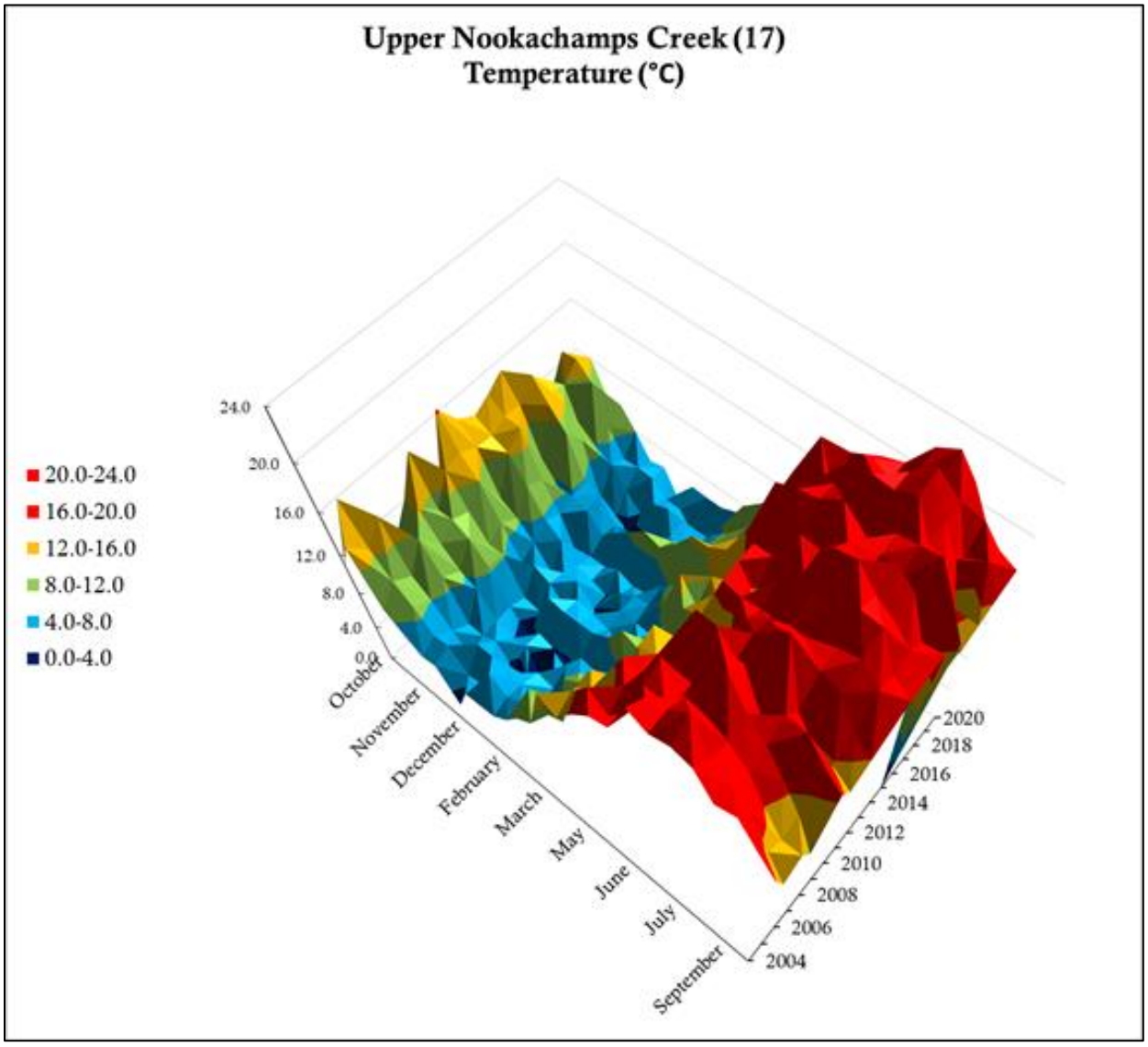
Site 17 is tied for 35th out of 39 sites for number of significant trends, with 7, and is 34th out of 39 sites for positive trends, with 29%.

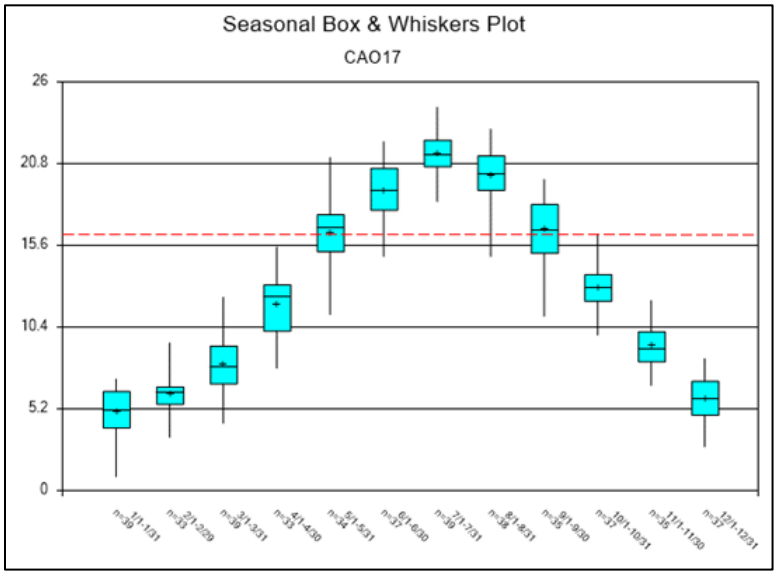




The dissolved oxygen (DO) standard for this site is 9.50 mg/L. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.

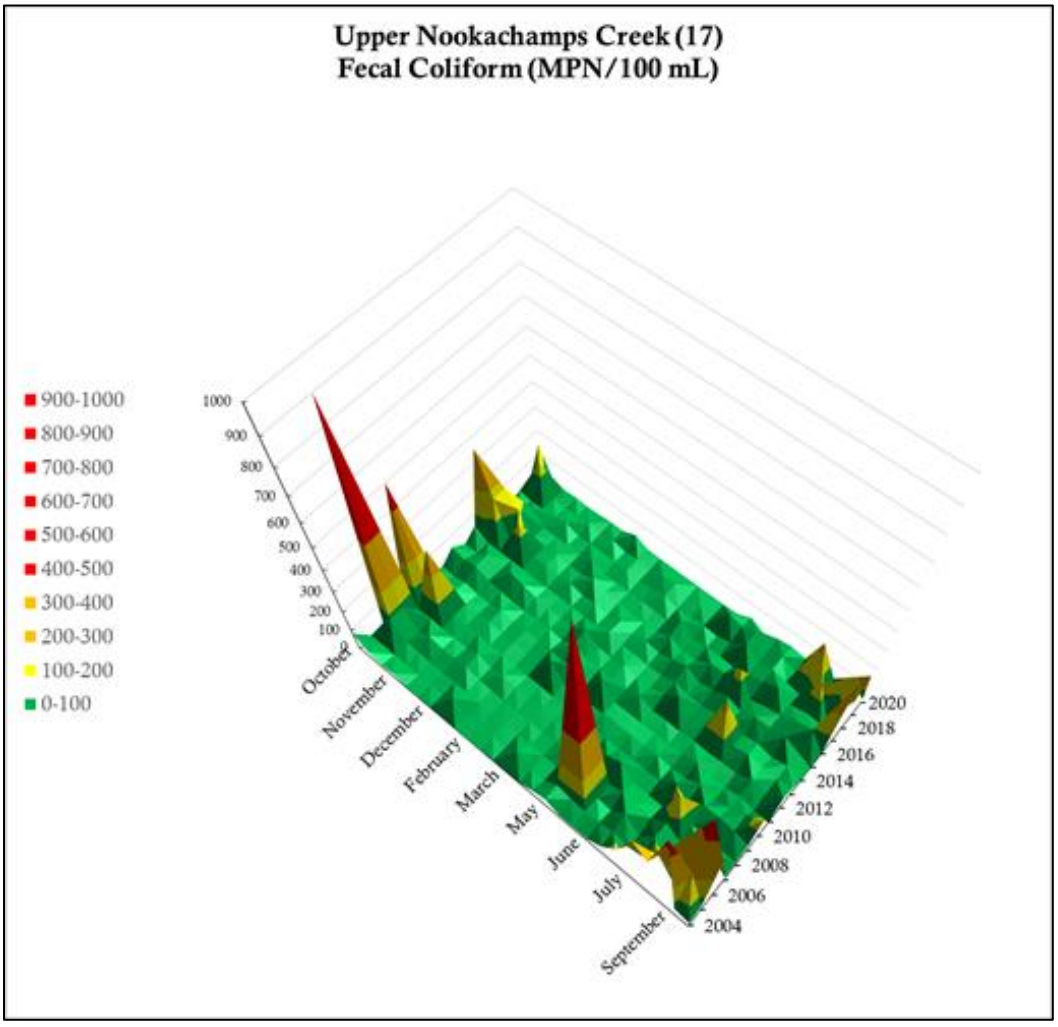
The dashed red line on the monthly box plot represents the 9.5 mg/L standard, and is approximate. The calendar year on the x-axis begins in January and ends in December.

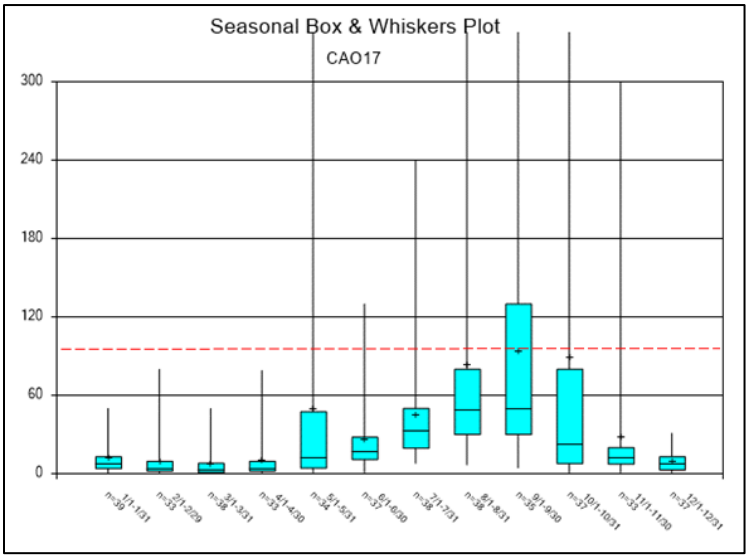




The temperature standard for this site is 16.0 °C. Any part of the 3D plot that is in red is hotter than that standard. The water year on the x-axis begins in October and ends in September.

The dashed red line on the monthly box plot represents the 16.0 °C standard, and is approximate. The calendar year on the x-axis begins in January and ends in December.





The fecal coliform (FC) standard for this site is 100 MPN/100 mL. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.

The dashed red line on the monthly box plot represents the 100 MPN/100 mL standard, and is approximate. The calendar year on the x-axis begins in January and ends in December.

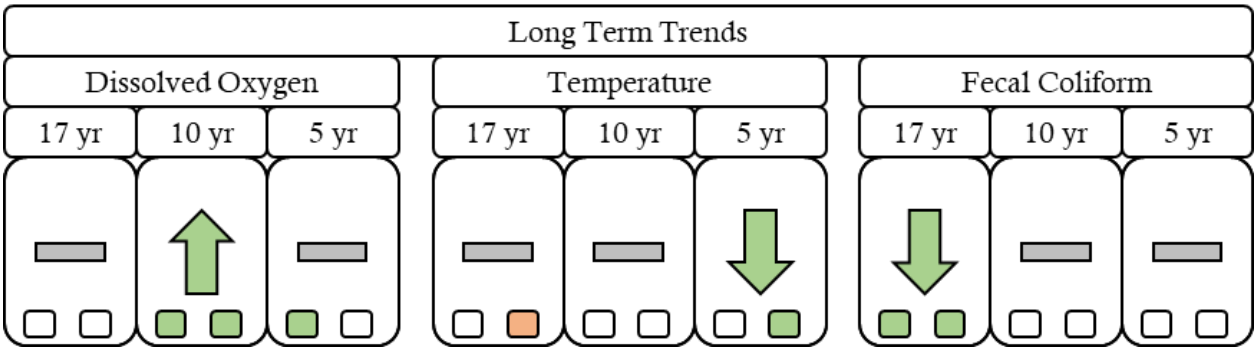
18

Lake Creek
@ Big Lake Boulevard

Upstream Ag, TMDL

Water Quality Index (WQI)

2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
84	66	80	93	63	80	87	80	90	88	84	86	87	82	89

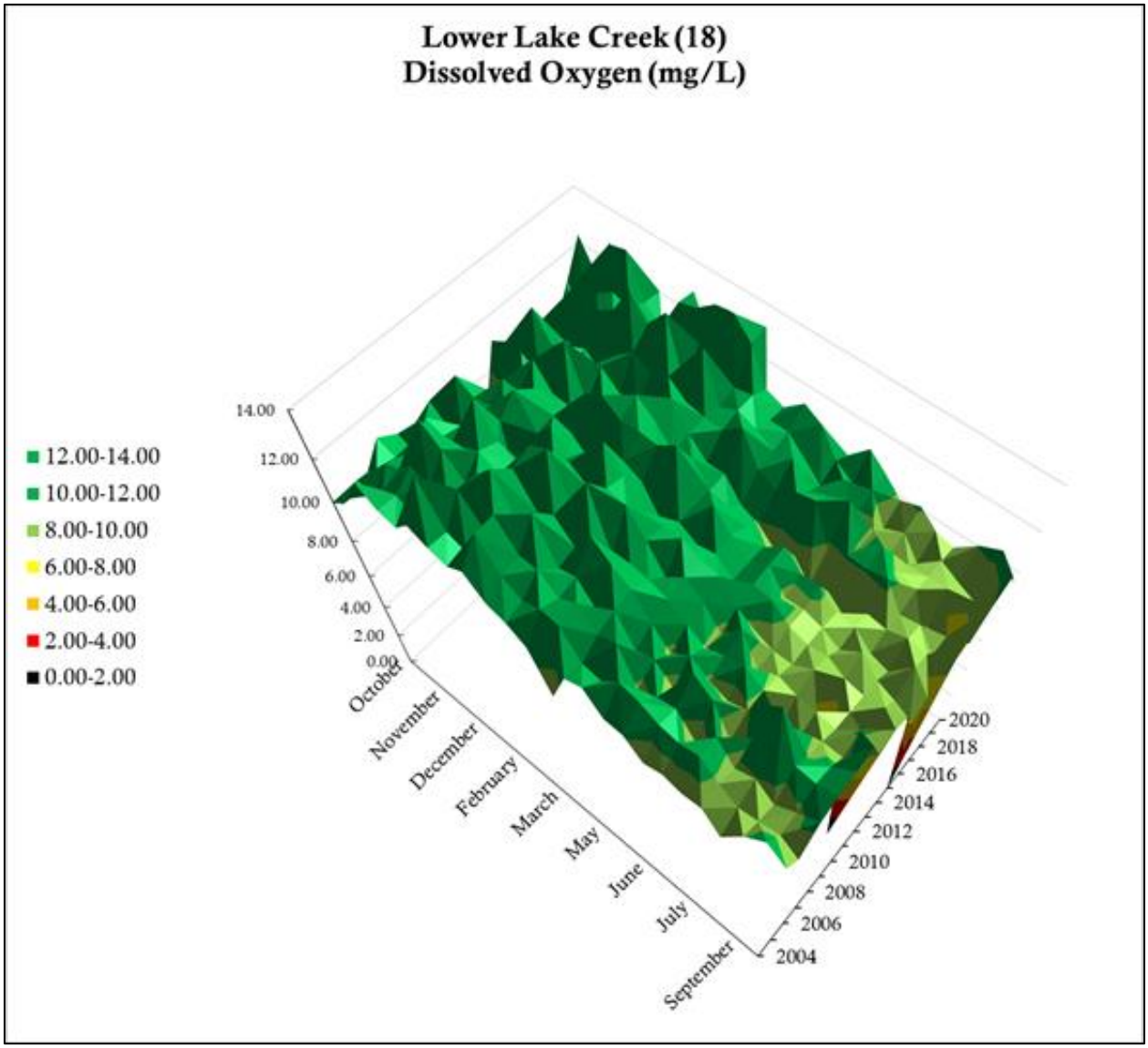


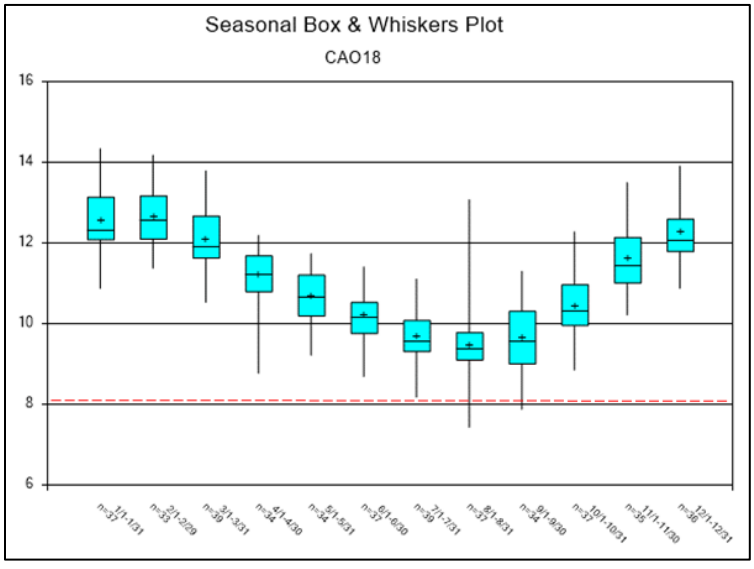
Site 18 is Lake Creek, coming out of Lake McMurray, and just prior to entering Big Lake. This site contributes to water quality data bracketing of Big Lake along with site 17. This site is designated as core salmonid habitat.

Dissolved oxygen has increased in the most recent ten years. Water temperature has decreased in the last five years. Fecal coliform is lower than it was 17 years ago.

Site 18 easily passes state standards for DO, and fails state standards for temperature in the warmest months. Annual FC levels for the 2020WY pass the state standard for geomean of 100, but do closely fail the state standard for a 90th percentile of 200.

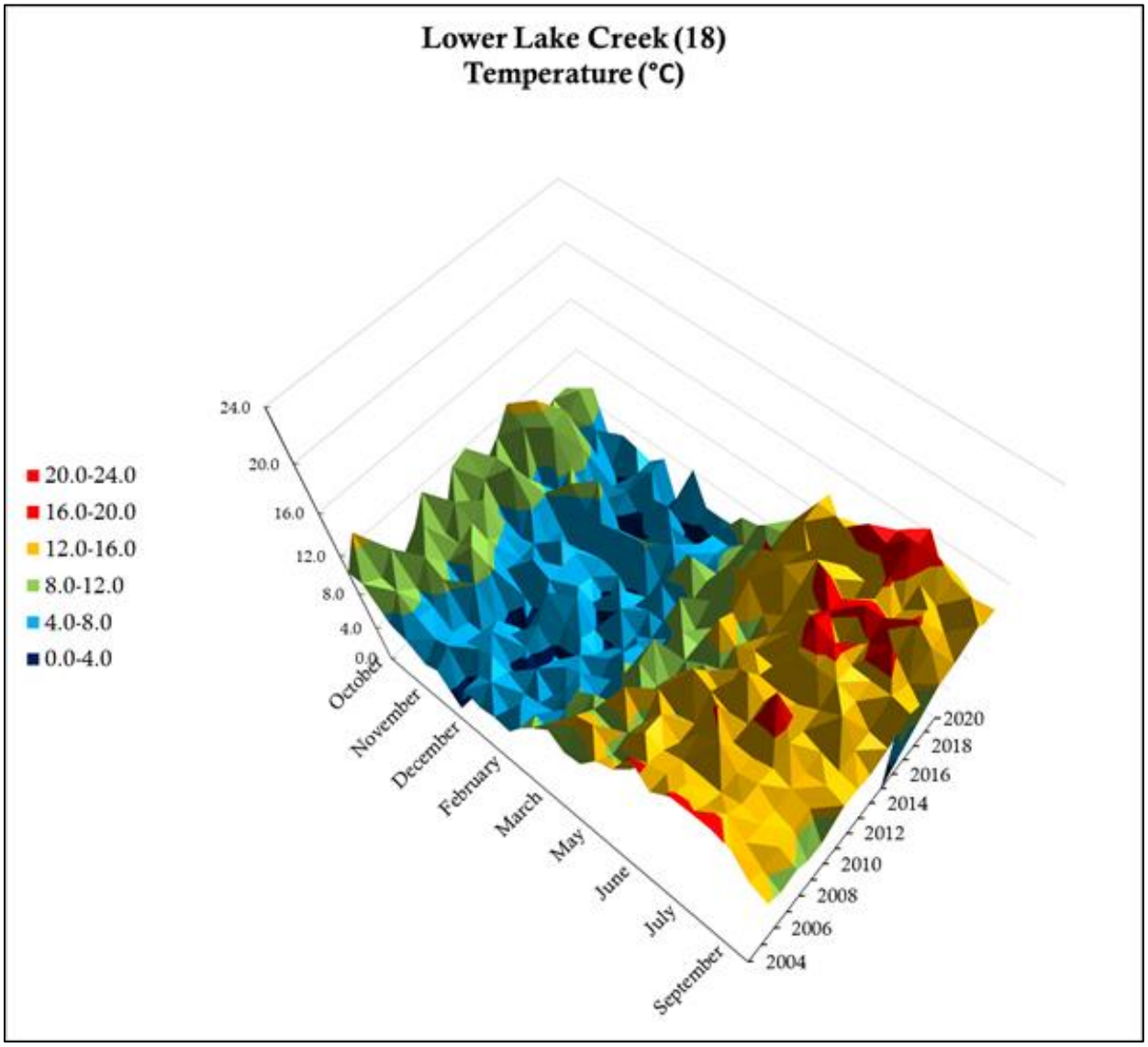
Site 18 is tied for 25th out of 39 sites for number of significant trends, with 10, and is tied for 6th out of 39 sites for positive trends, with 80%.

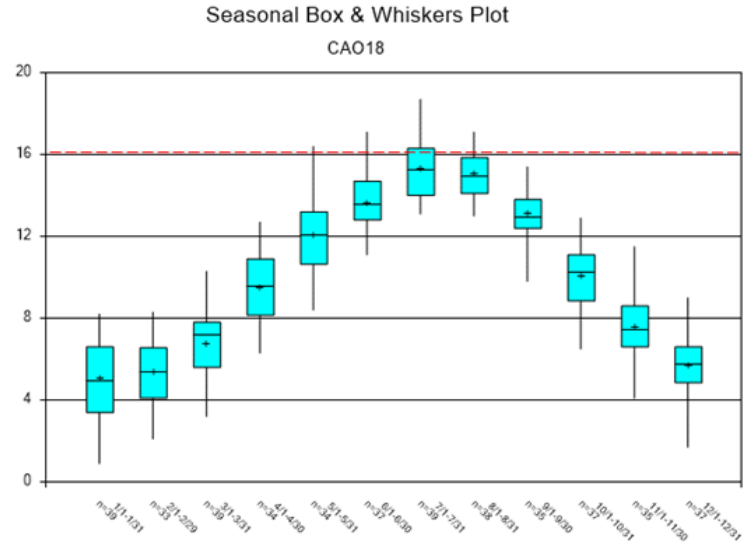




The dissolved oxygen (DO) standard for this site is 8.0 mg/L. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.

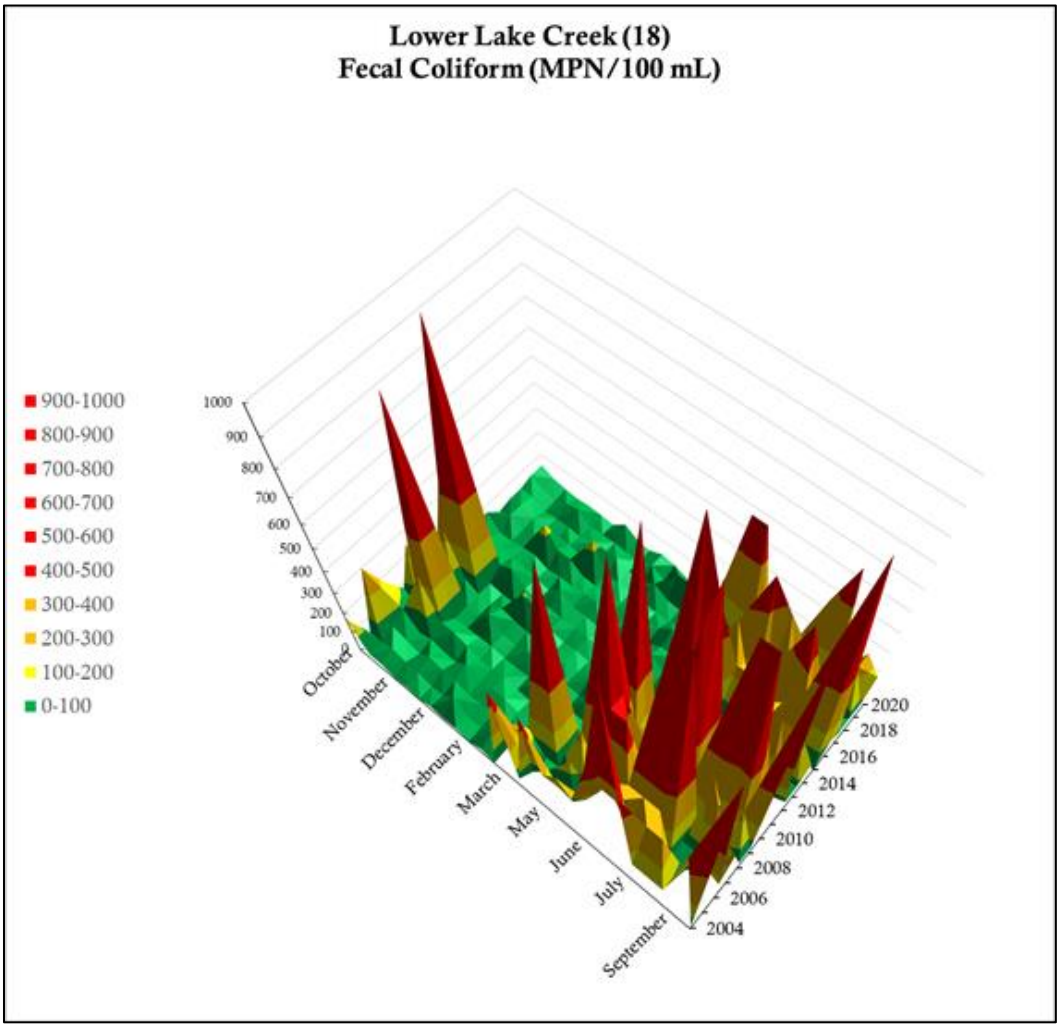
The dashed red line on the monthly box plot represents the 8.0 mg/L standard, and is approximate. The calendar year on the x-axis begins in January and ends in December.

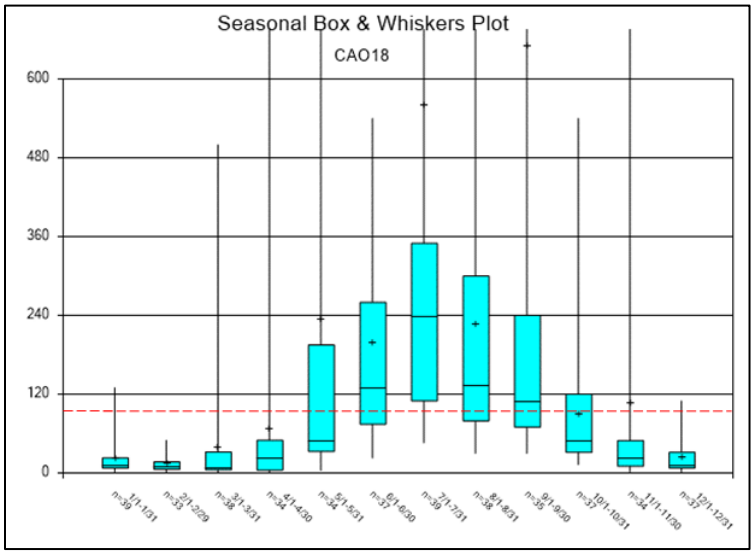




The temperature standard for this site is 16.0 °C. Any part of the 3D plot that is in red is hotter than that standard. The water year on the x-axis begins in October and ends in September.

The dashed red line on the monthly box plot represents the 16.0 °C standard, and is approximate. The calendar year on the x-axis begins in January and ends in December.





The fecal coliform (FC) standard for this site is 100 MPN/100 mL. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.

The dashed red line on the monthly box plot represents the 100 MPN/100 mL standard, and is approximate. The calendar year on the x-axis begins in January and ends in December.

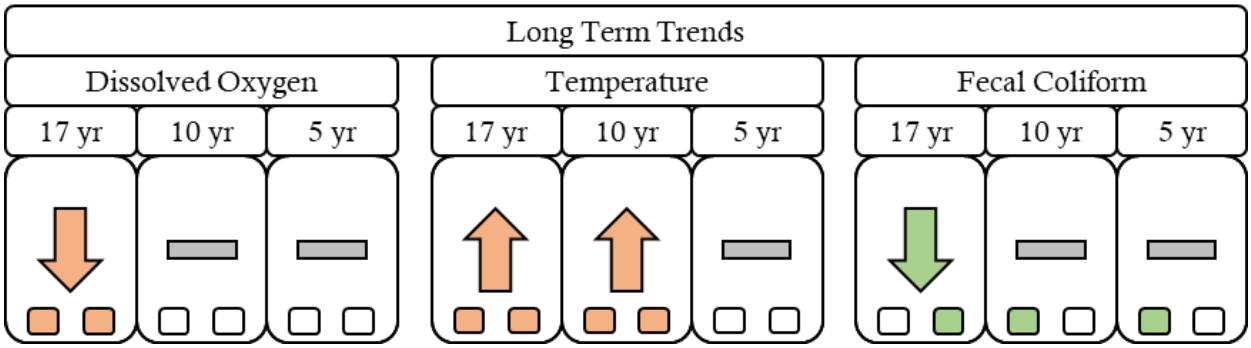
19

Hansen Creek
@ Hoehn Road

Downstream Ag, TMDL

Water Quality Index (WQI)

2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
28	40	58	91	72	78	62	74	63	75	71	85	80	73	80

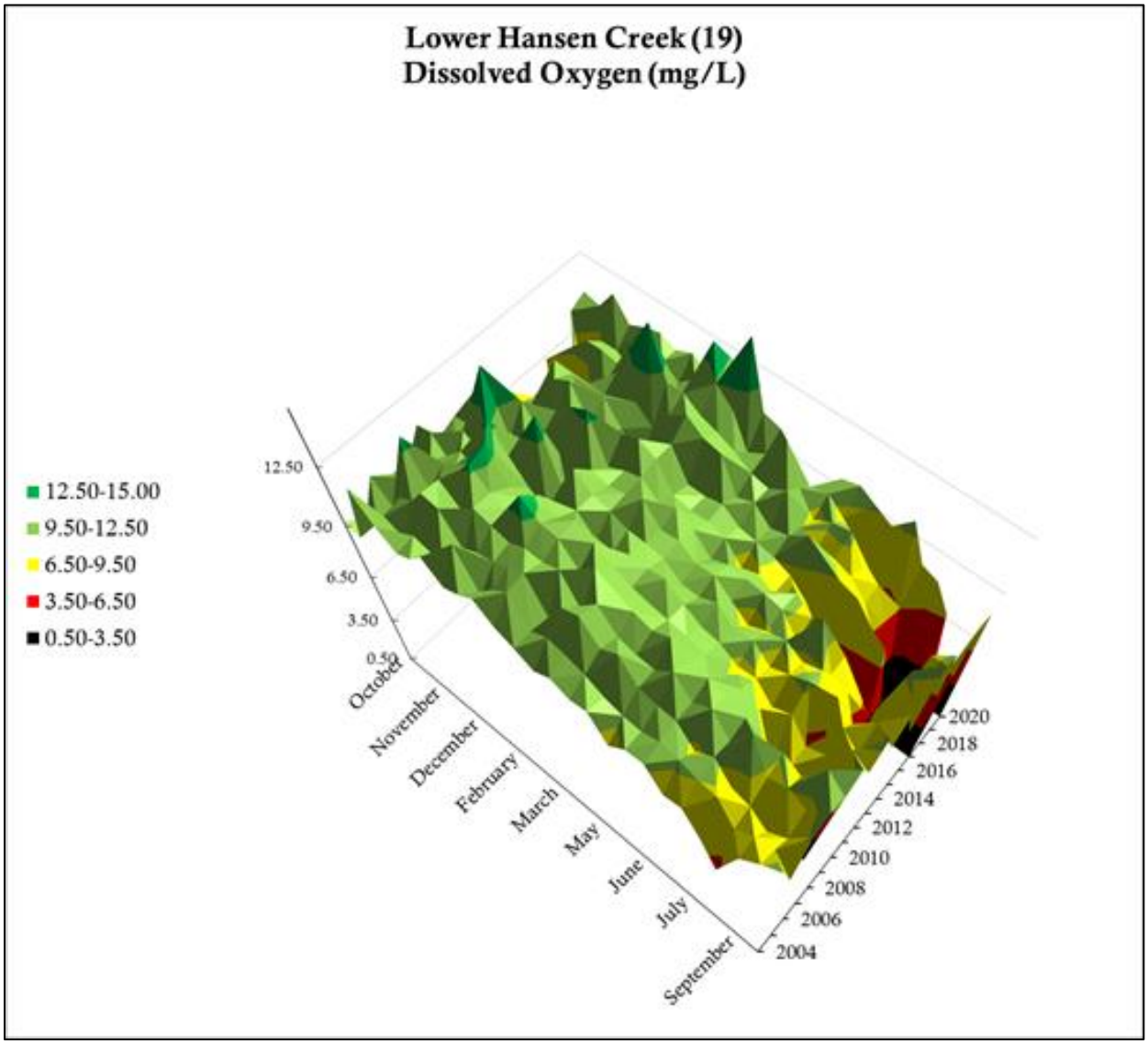


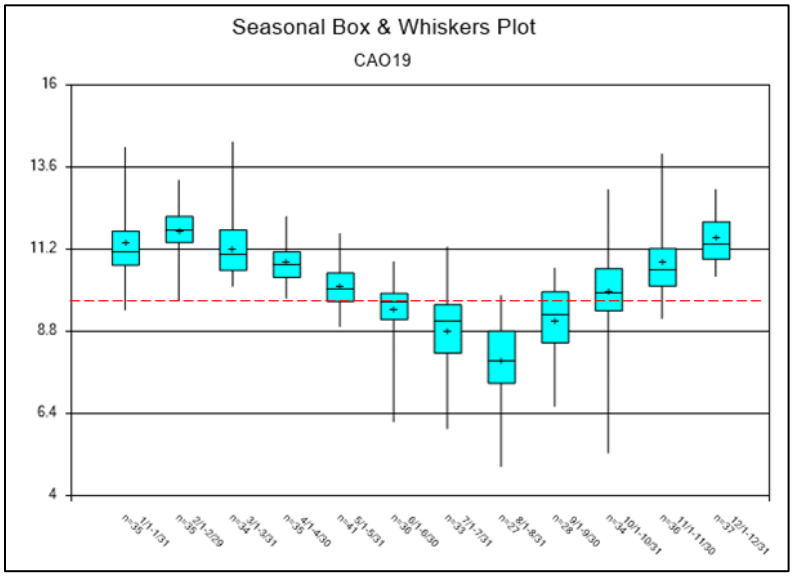
Site 19 is Hansen Creek, downstream from site 20 at the Northern State Recreation Area. This site is pseudo-ephemeral and often can stop flowing by the end of the summer. This site is designated as core salmonid habitat.

Over the 17-year life of this program, DO has declined and water temperatures have increased, while FC has gone down. WQI scores are generally in the upper-score end of the moderate concern category.

Site 19 typically fails to meet state standards for DO during the warmer months when its flow volume becomes extremely low, and often fails to meet state standards for temperature during the hottest time of the year. Annual FC levels for WY2020 easily passed state standards.

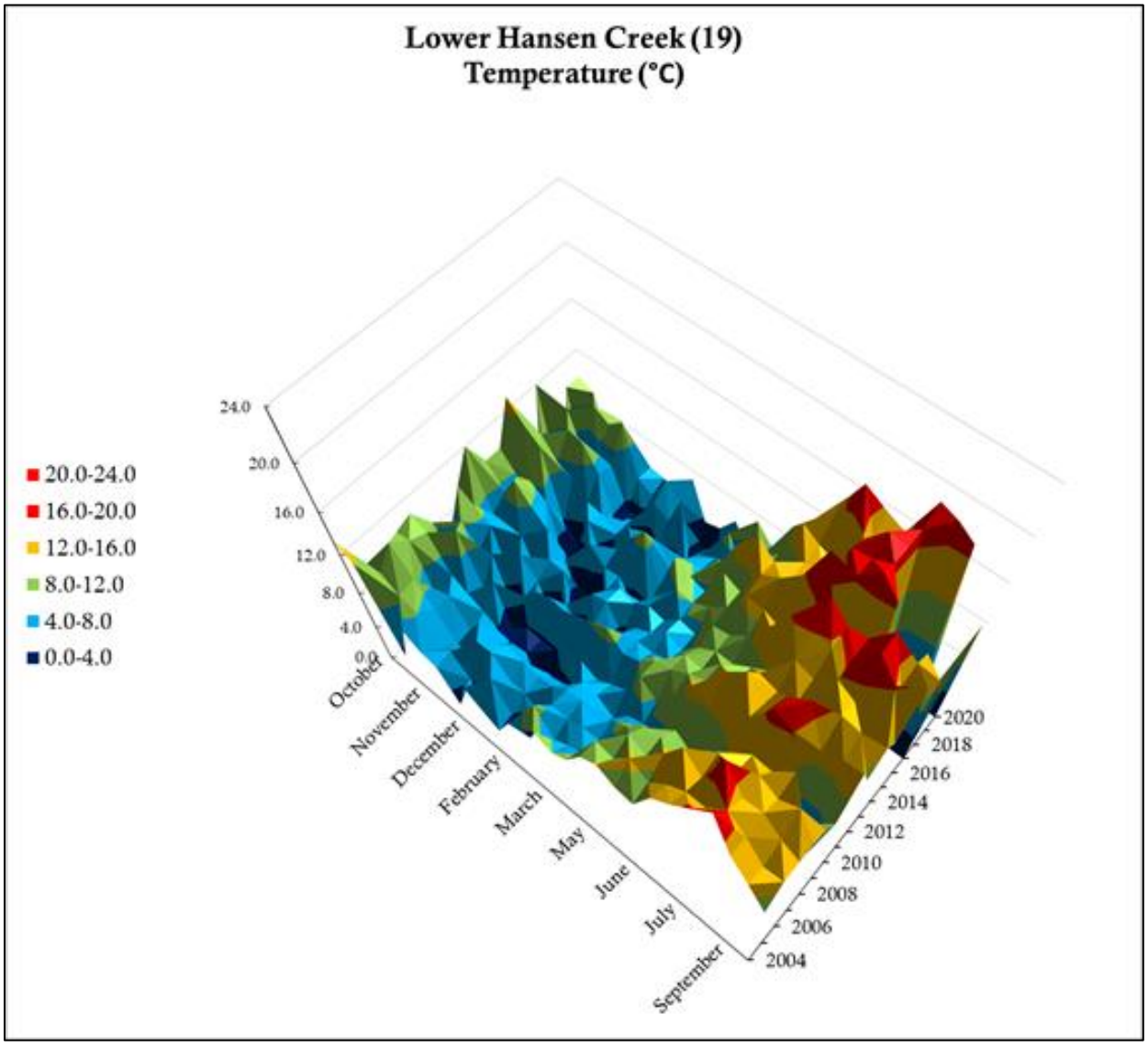
Site 19 is tied for 7th out of 39 sites for number of significant trends, with 15, and is 33rd out of 39 sites for positive trends, with 33%.

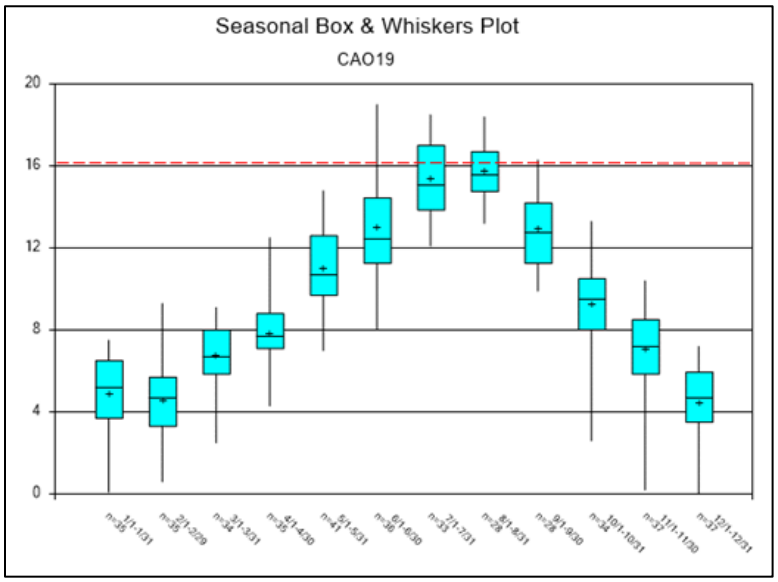




The dissolved oxygen (DO) standard for this site is 9.50 mg/L. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.

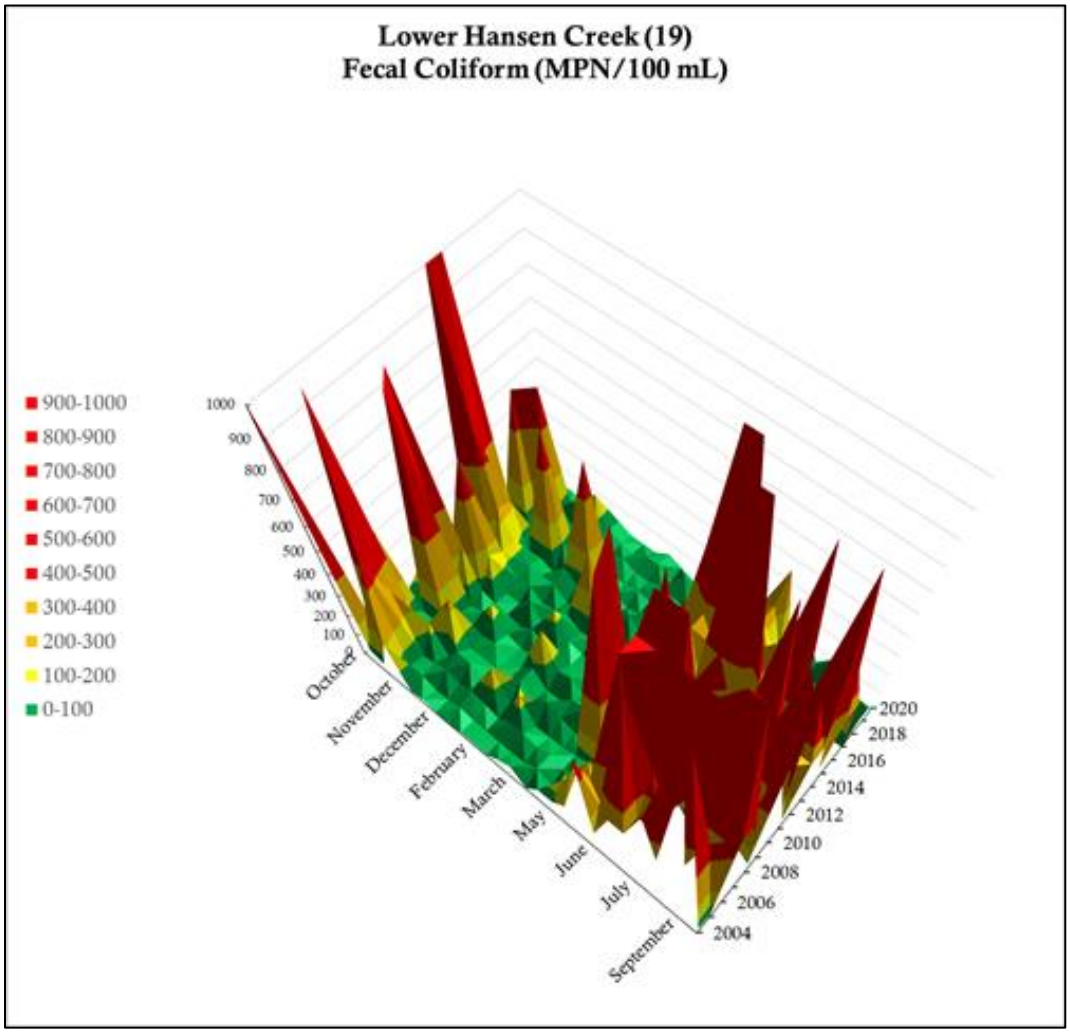
The dashed red line on the monthly box plot represents the 9.5 mg/L standard, and is approximate. The calendar year on the x-axis begins in January and ends in December.

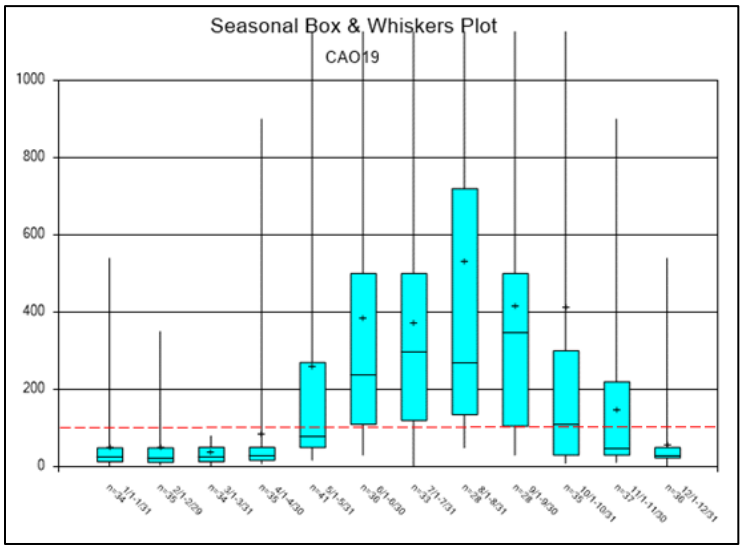




The temperature standard for this site is 16.0 °C. Any part of the 3D plot that is in red is hotter than that standard. The water year on the x-axis begins in October and ends in September.

The dashed red line on the monthly box plot represents the 16.0 °C standard, and is approximate. The calendar year on the x-axis begins in January and ends in December.





The fecal coliform (FC) standard for this site is 100 MPN/100 mL. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.

The dashed red line on the monthly box plot represents the 100 MPN/100 mL standard, and is approximate. The calendar year on the x-axis begins in January and ends in December.

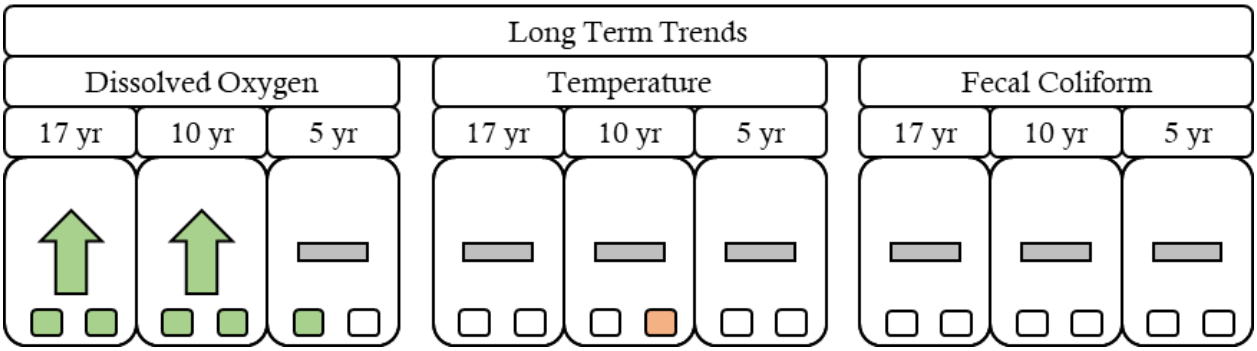
20

Hansen Creek
@ Northern State

Upstream Ag, TMDL

Water Quality Index (WQI)

2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
25	39	67	89	91	90	82	89	82	87	79	84	84	85	81

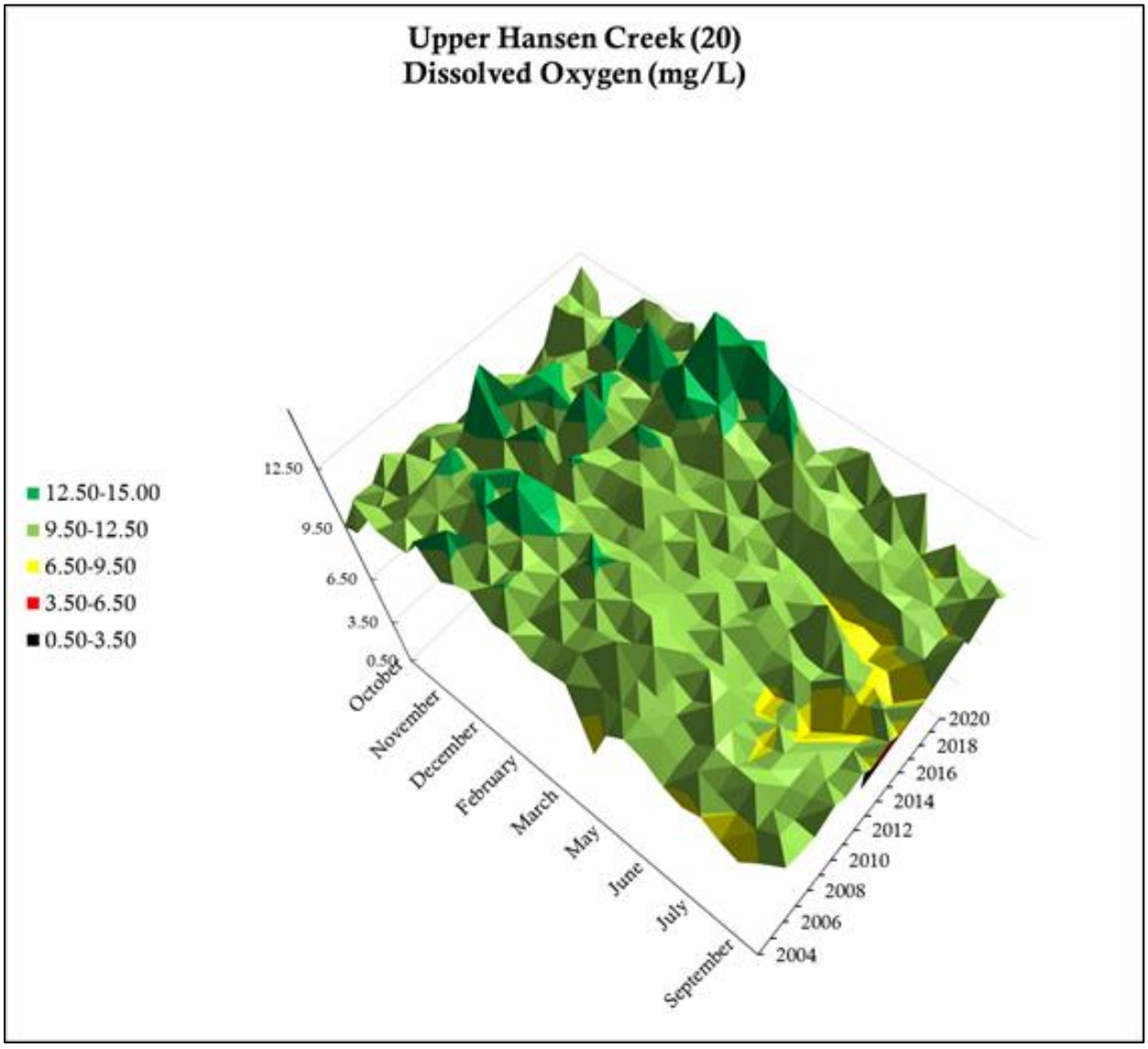


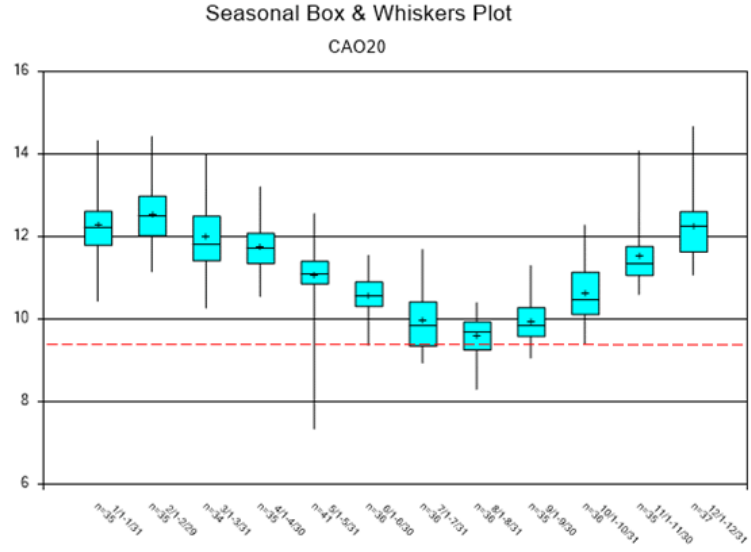
Site 20 is Hansen Creek at the Northern State Recreation Area, upstream from site 19. Water input to this site comes down from Lyman Hill and has very little developed land. This site is designated as core salmonid habitat.

Dissolved oxygen has been increasing over the last 17 years and ten years. Trends at this site are distinctly different than those downstream at site 19. WQI scores have typically been in the category of least concern over the past ten years.

Site 20 rarely ever fails to pass state standards for both DO and temperature, year-round. Annual FC levels for WY2020 easily passed state standards.

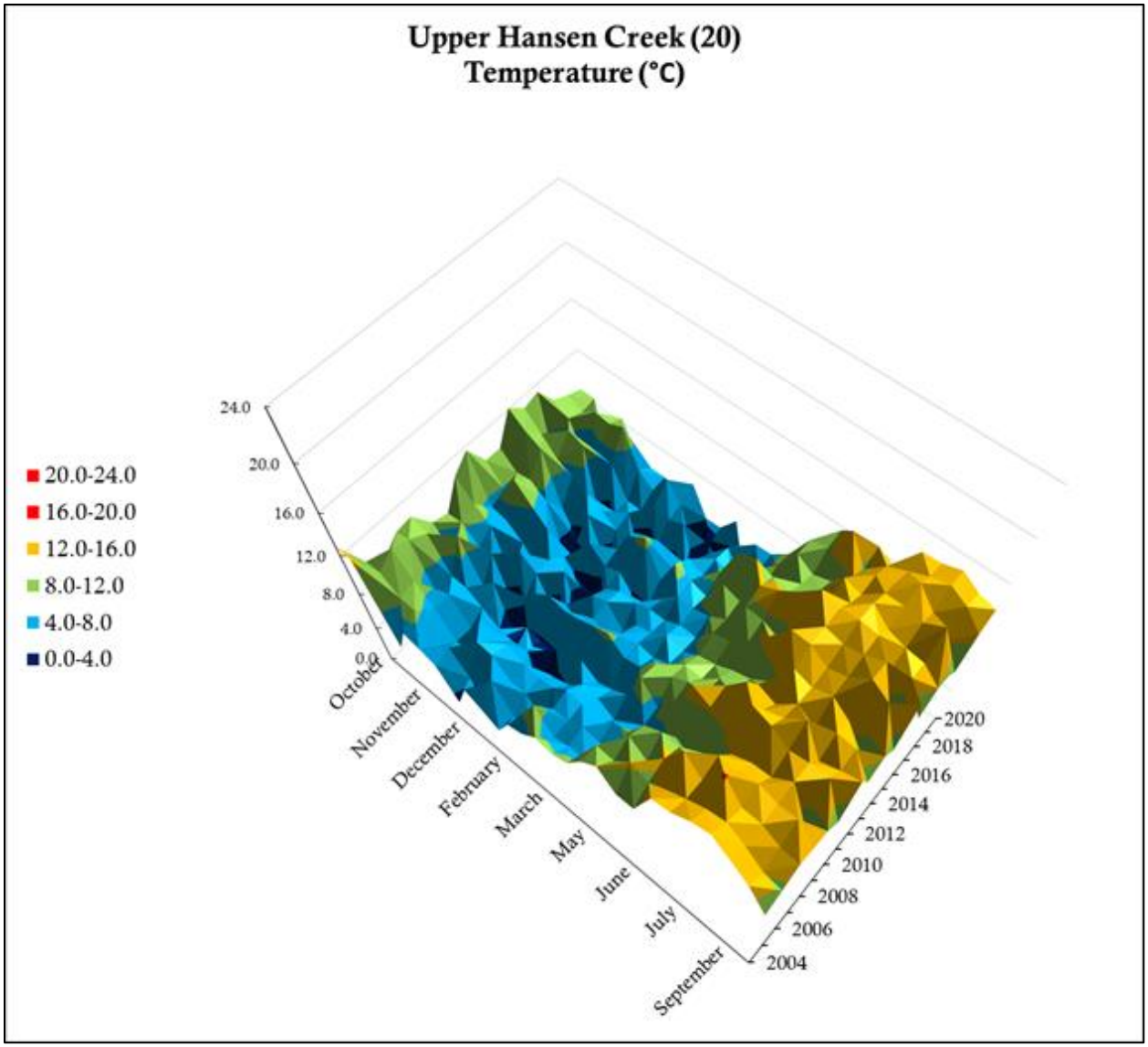
Site 20 is tied for 25^{sth} out of 39 sites for number of significant trends, with 10, and is tied for 6th out of 39 sites for positive trends, with 80%.

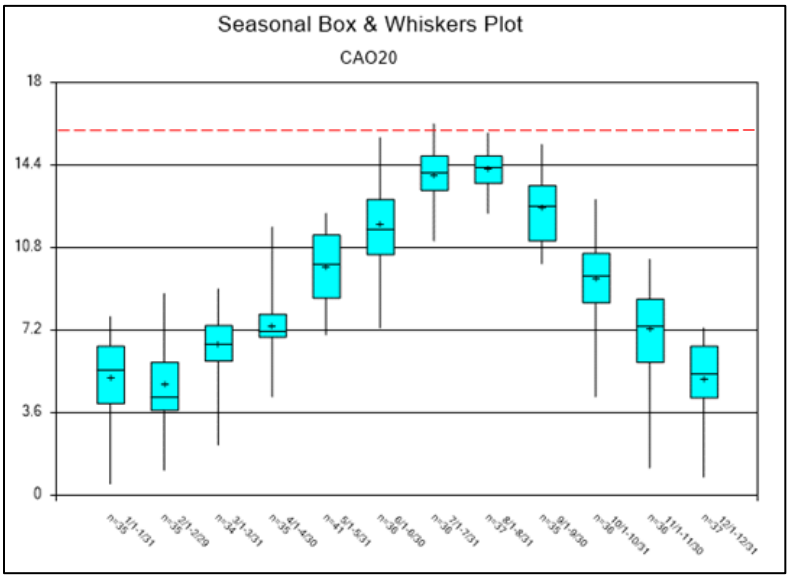




The dissolved oxygen (DO) standard for this site is 9.50 mg/L. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.

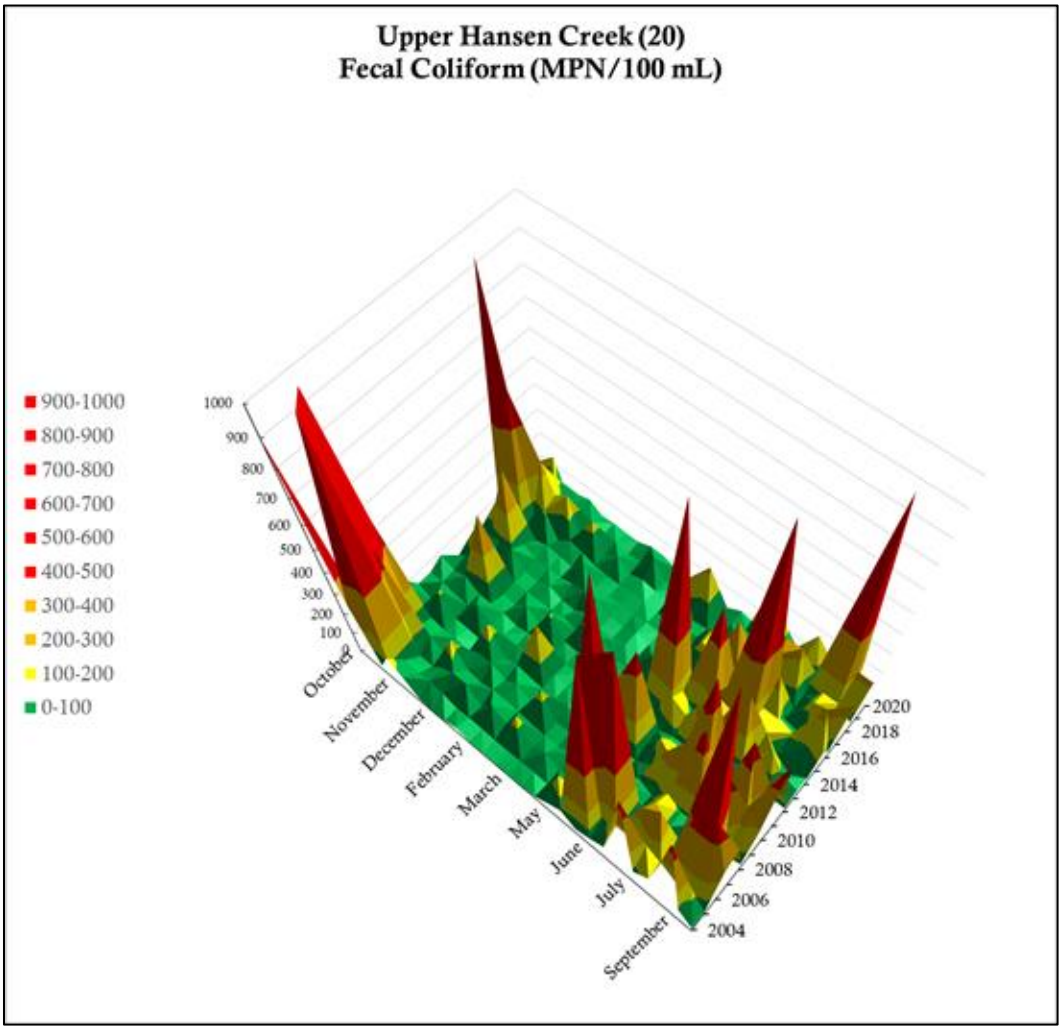
The dashed red line on the monthly box plot represents the 9.5 mg/L standard, and is approximate. The calendar year on the x-axis begins in January and ends in December.

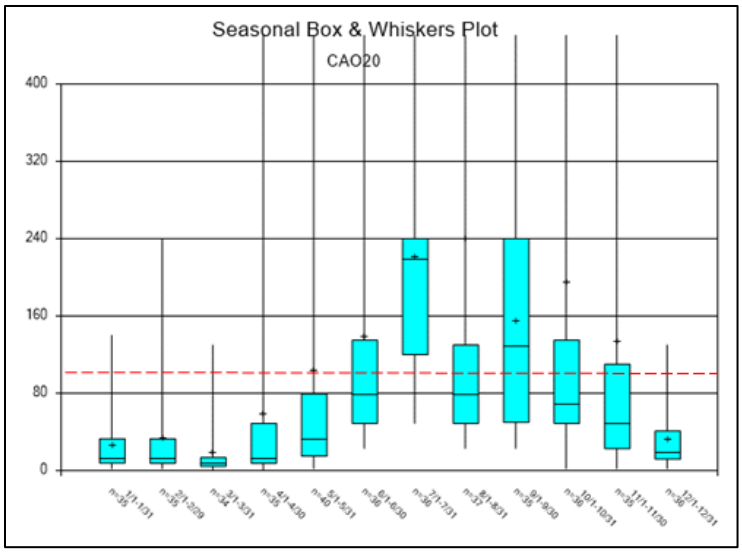




The temperature standard for this site is 16.0 °C. Any part of the 3D plot that is in red is hotter than that standard. The water year on the x-axis begins in October and ends in September.

The dashed red line on the monthly box plot represents the 16.0 °C standard, and is approximate. The calendar year on the x-axis begins in January and ends in December.





The fecal coliform (FC) standard for this site is 100 MPN/100 mL. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.

The dashed red line on the monthly box plot represents the 100 MPN/100 mL standard, and is approximate. The calendar year on the x-axis begins in January and ends in December.

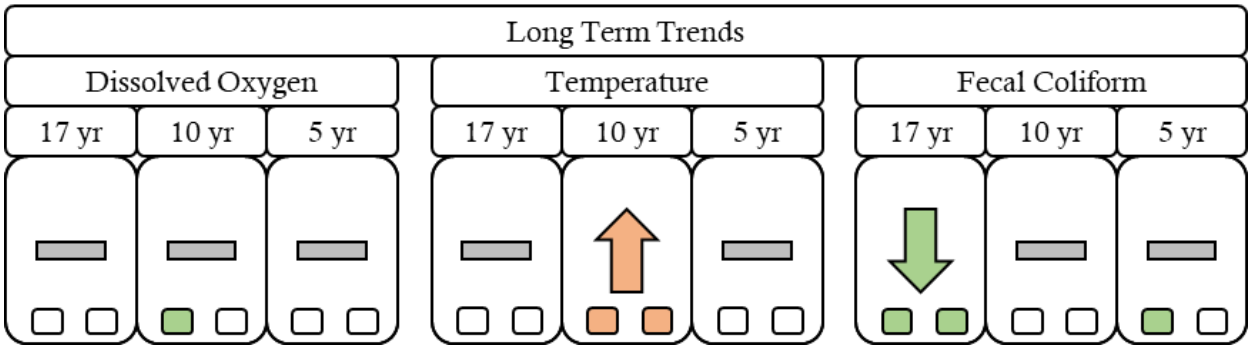
21

Coal Creek
@ Hoehn Road

Downstream Ag

Water Quality Index (WQI)

2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
36	34	46	87	80	91	82	76	86	68	76	88	80	74	93

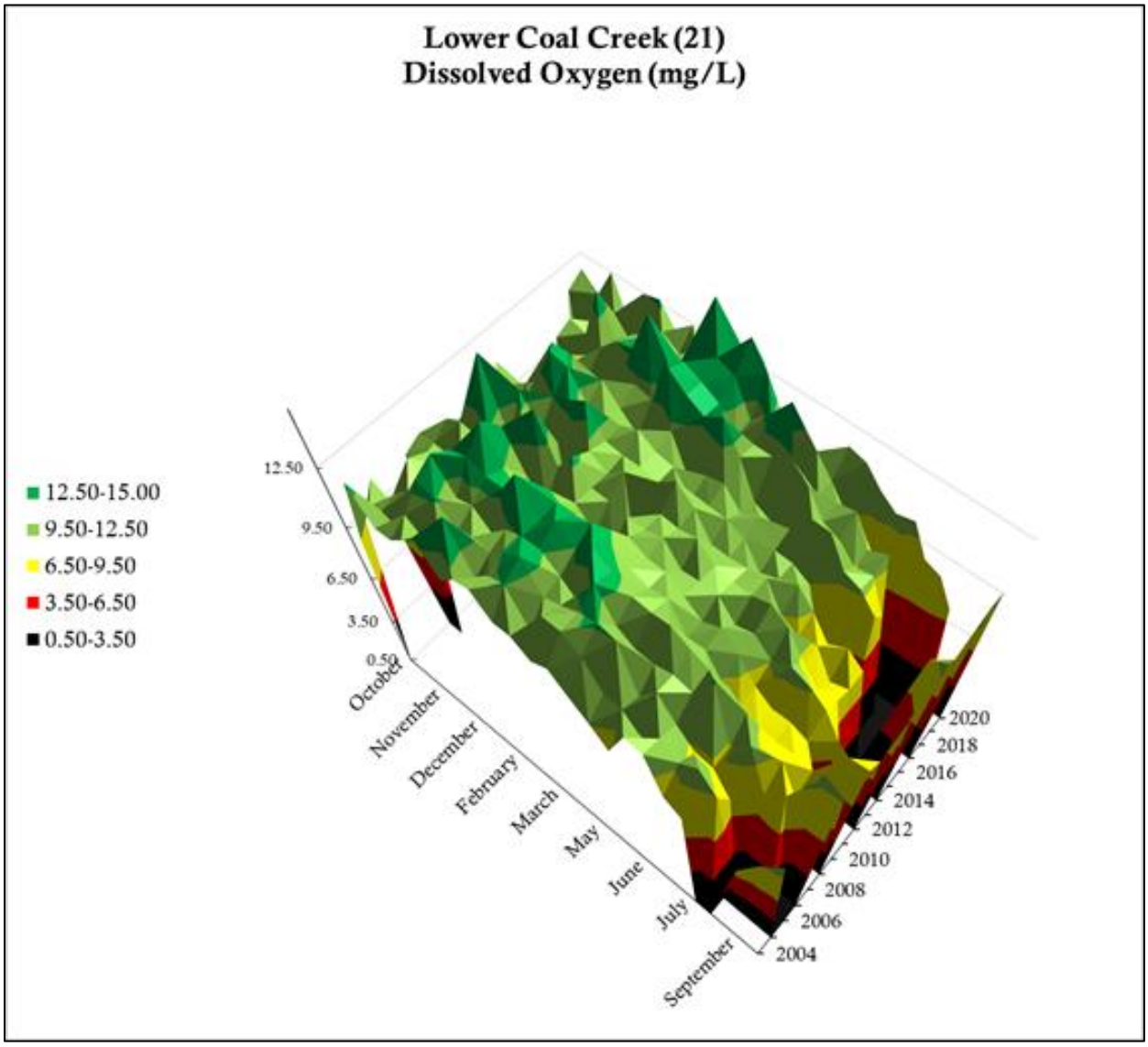


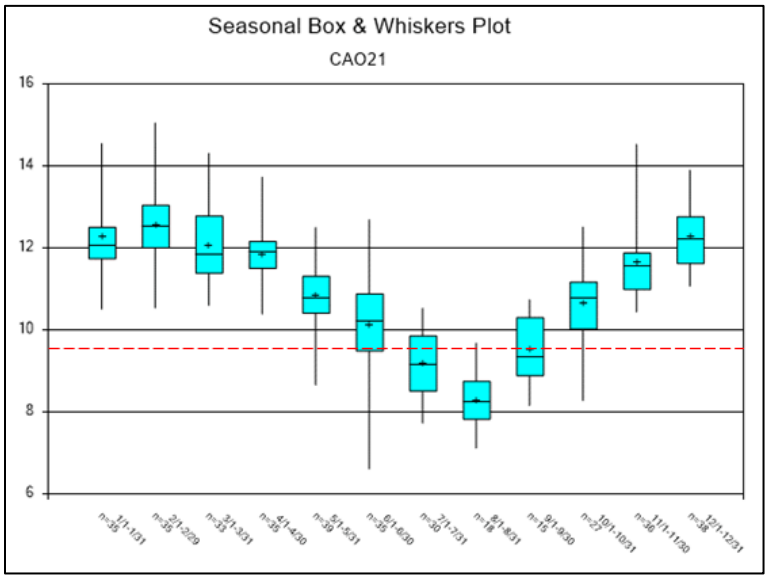
Site 21 is Coal Creek, downstream from site 22, and just prior to arriving in Skiyou Slough and ultimately the Skagit River. This site is pseudo-ephemeral and can often stop flowing by the end of the summer. This site is designated as core salmonid habitat.

Water temperature is higher than it was ten years ago. Fecal coliform counts are lower than they were 17 years ago. WQI scores are generally in the upper-score end of the moderate concern category, and often score as least concern.

Site 21 regularly fails to meet state standards for DO during the warmest months, but rarely fails to meet state standards for water temperature. Annual fecal coliform levels for WY2020 easily passed the 100 FC standard, but did not pass the 90th percentile requirement.

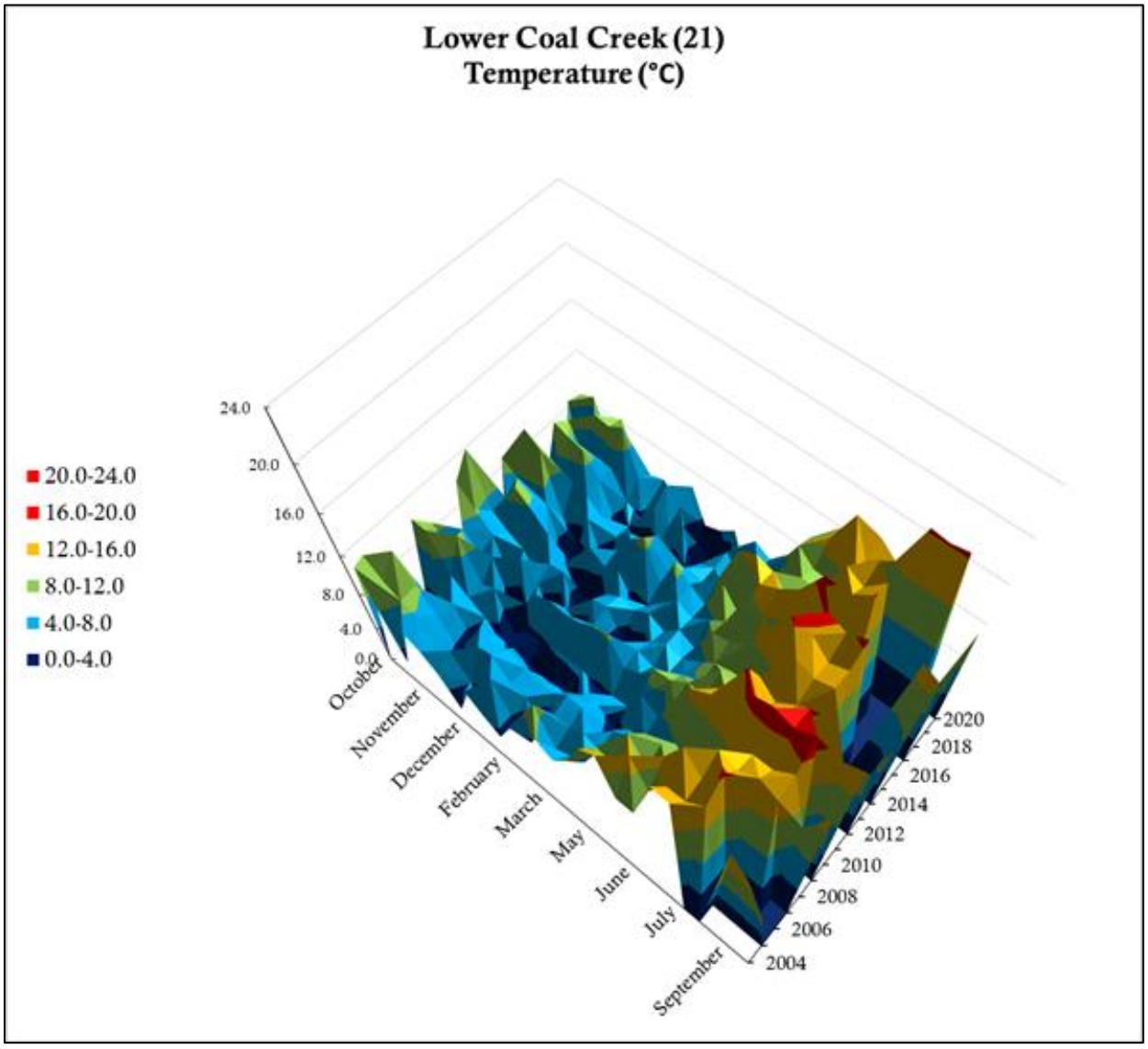
Site 21 is tied for 12th out of 39 sites for number of significant trends, with 13, and is tied for 18th out of 39 sites for positive trends, with 62%.

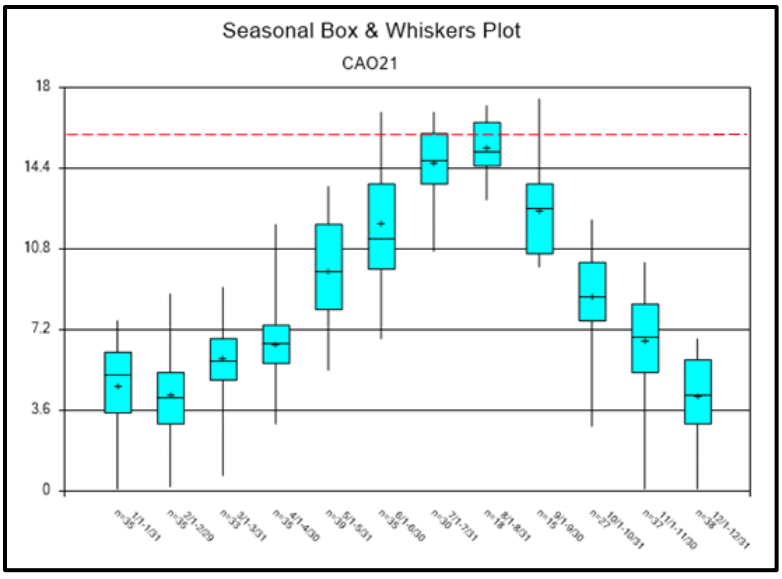




The dissolved oxygen (DO) standard for this site is 9.50 mg/L. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.

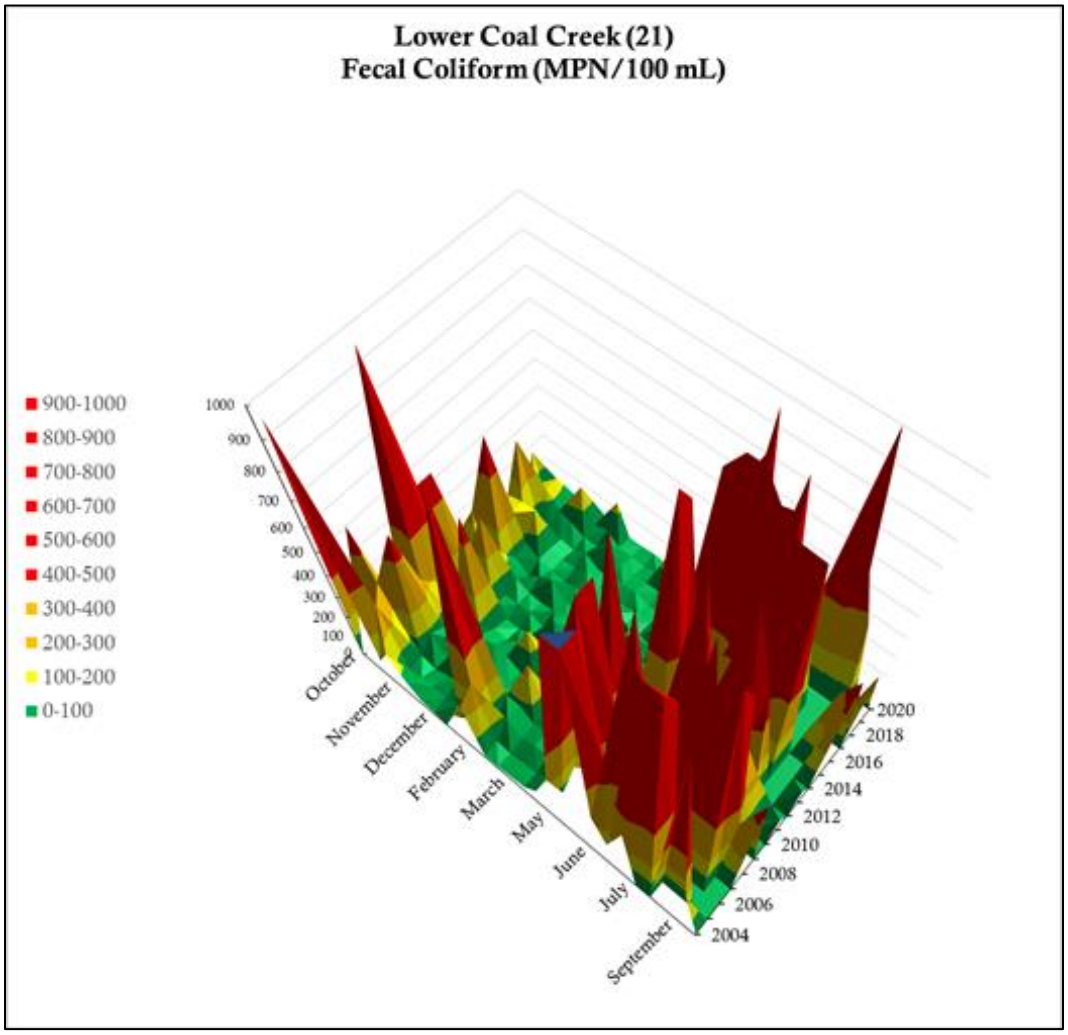
The dashed red line on the monthly box plot represents the 9.5 mg/L standard, and is approximate. The calendar year on the x-axis begins in January and ends in December.

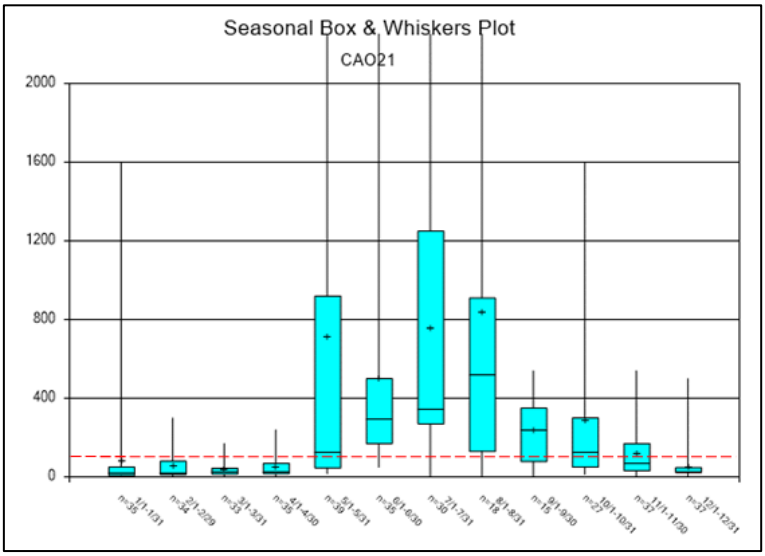




The temperature standard for this site is 16.0 °C. Any part of the 3D plot that is in red is hotter than that standard. The water year on the x-axis begins in October and ends in September.

The dashed red line on the monthly box plot represents the 16.0 °C standard, and is approximate. The calendar year on the x-axis begins in January and ends in December.





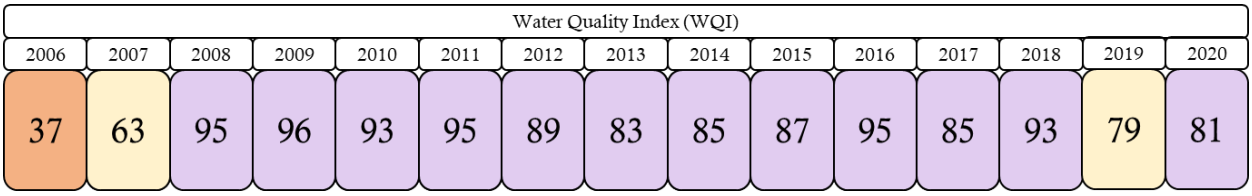
The fecal coliform (FC) standard for this site is 100 MPN/100 mL. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.

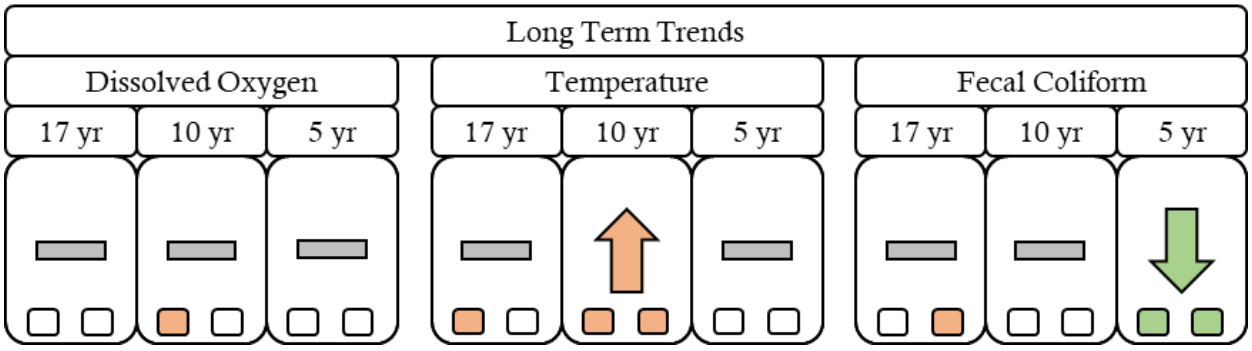
The dashed red line on the monthly box plot represents the 100 MPN/100 mL standard, and is approximate. The calendar year on the x-axis begins in January and ends in December.

22

Coal Creek
@ Highway 20

Upstream Ag



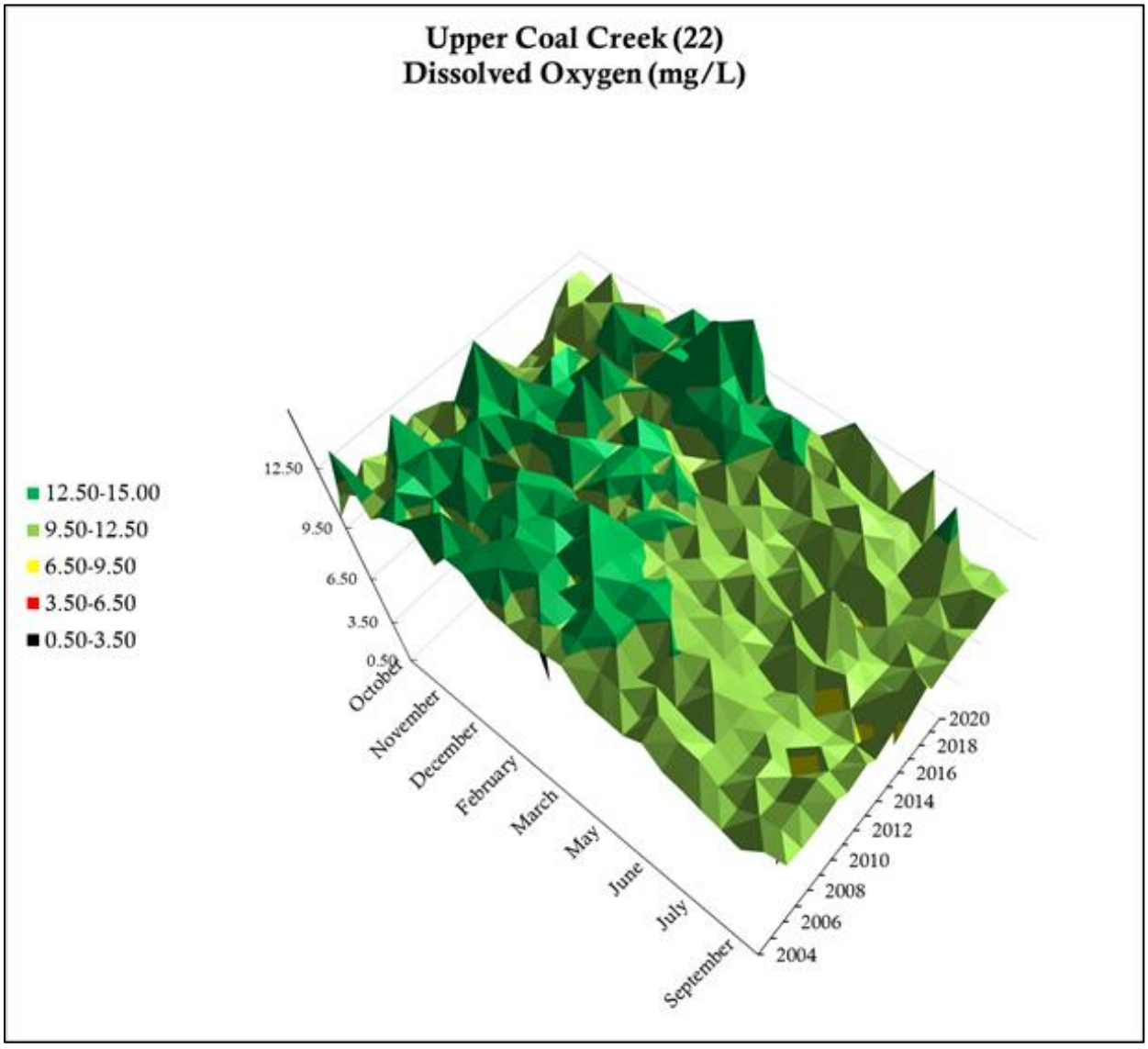


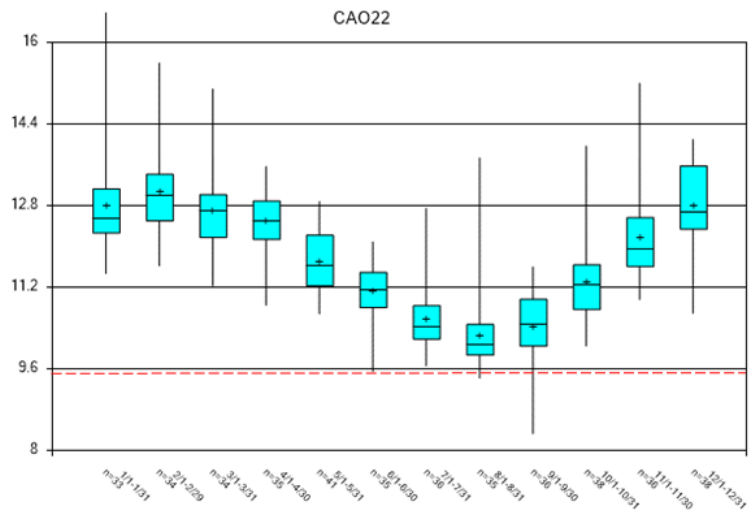
Site 22 is Coal Creek as it comes down off of Lyman Hill, and is upstream of site 21. This site is designated as core salmonid habitat.

Temperature increased since ten years ago, and FC counts are lower than they were five years ago. WQI scores are regularly in the category of least concern.

Site 22 rarely fails to meet state standards for DO or temperature, year-round. Annual FC levels for the 2020WY easily passed state standards.

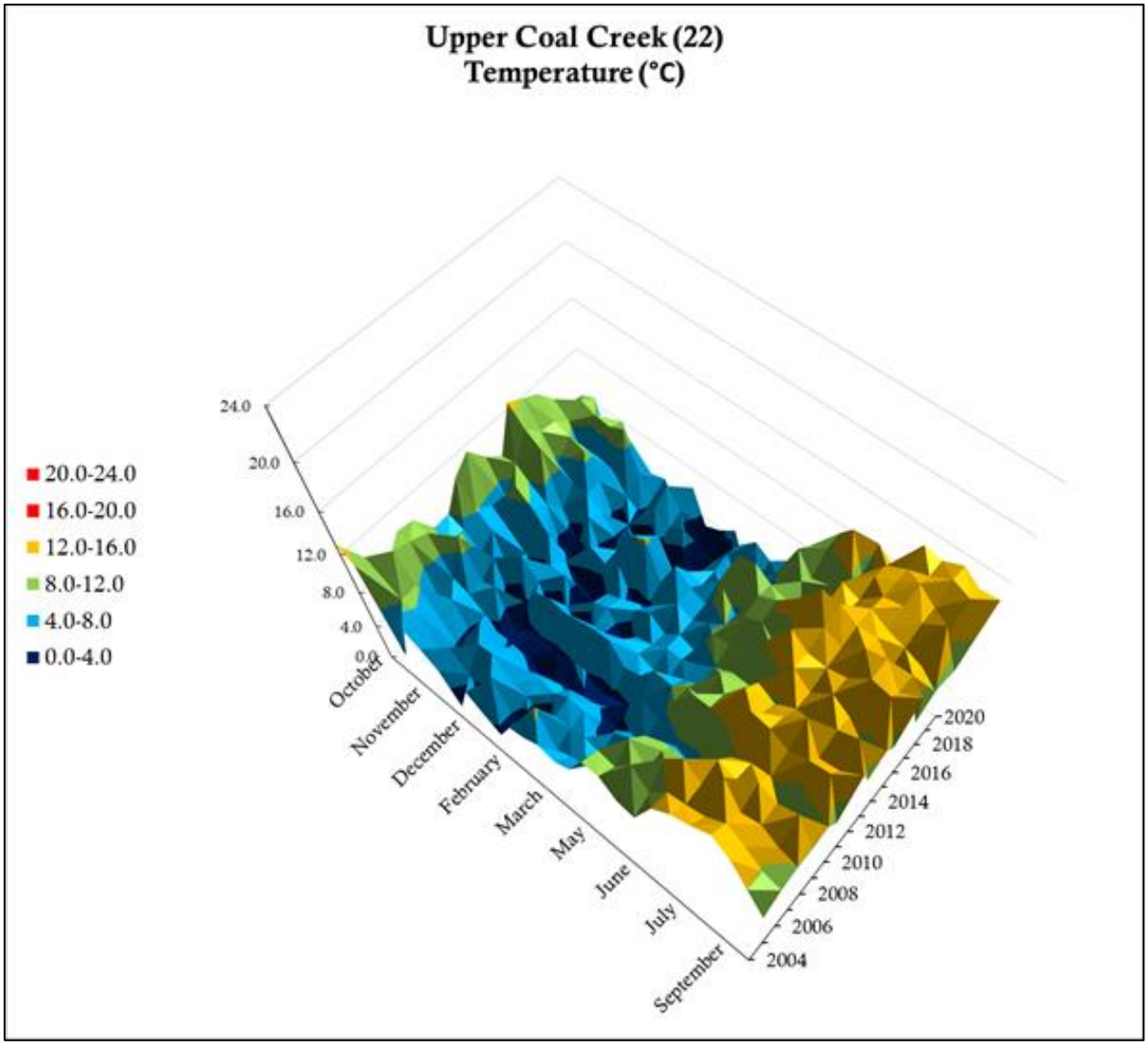
Site 22 is tied for 33rd out of 39 sites for number of significant trends, with 8, and 31st out of 39 sites for positive trends, with 38%.

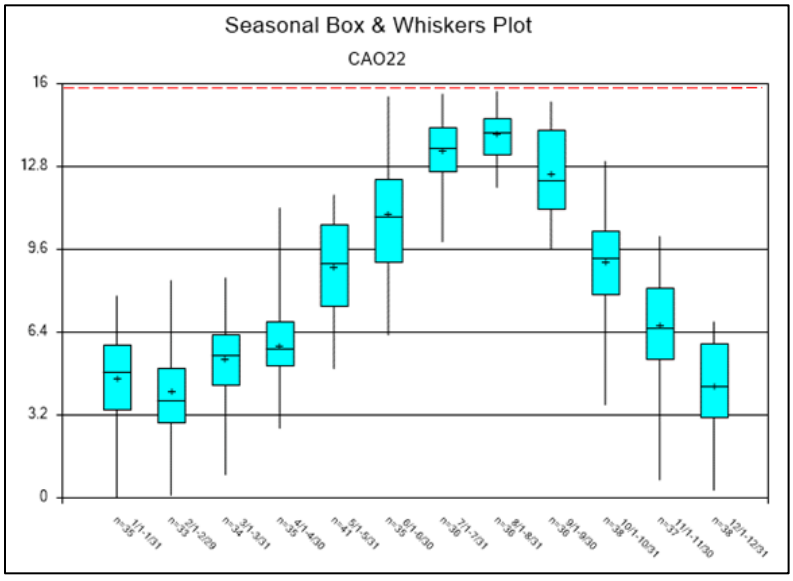




The dissolved oxygen (DO) standard for this site is 9.50 mg/L. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.

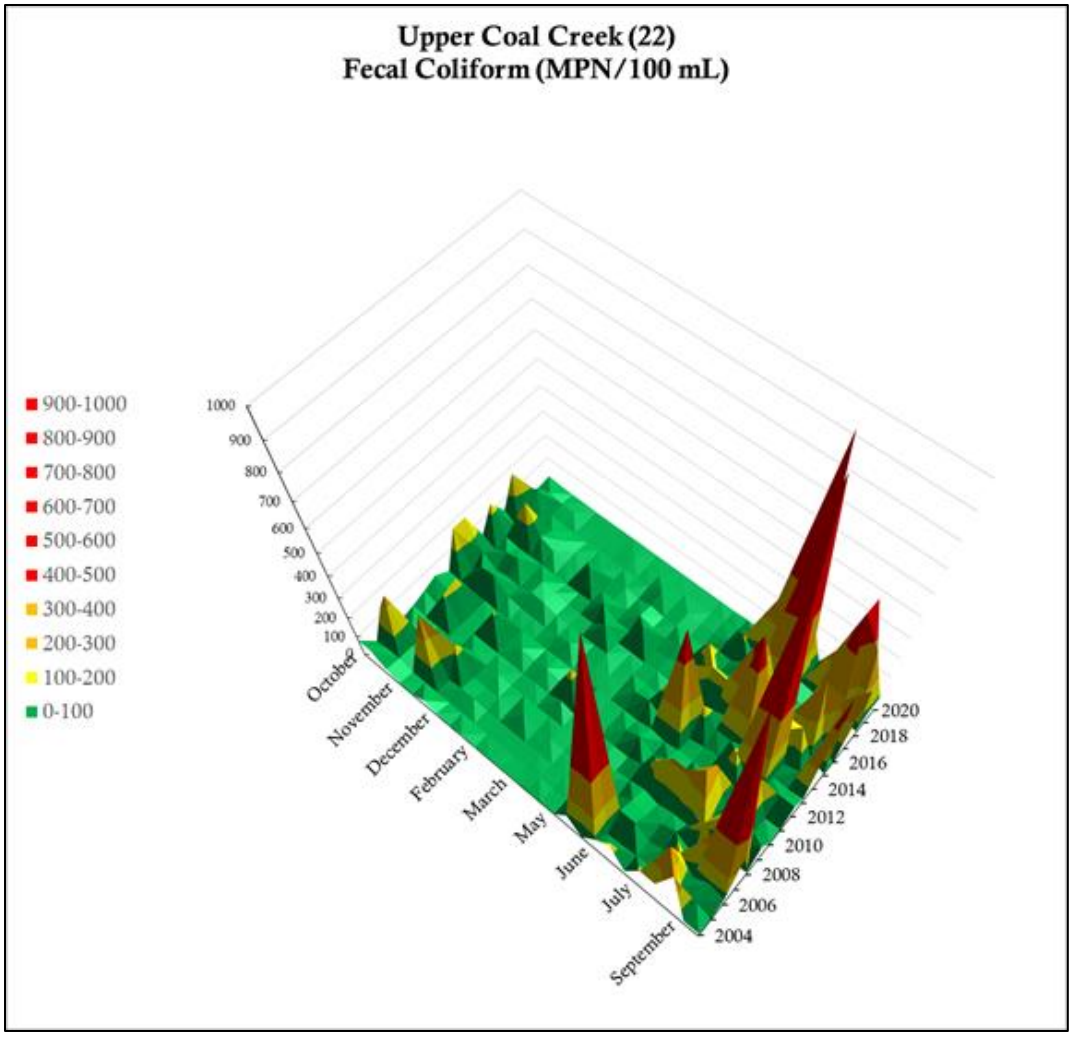
The dashed red line on the monthly box plot represents the 9.5 mg/L standard, and is approximate. The calendar year on the x-axis begins in January and ends in December.

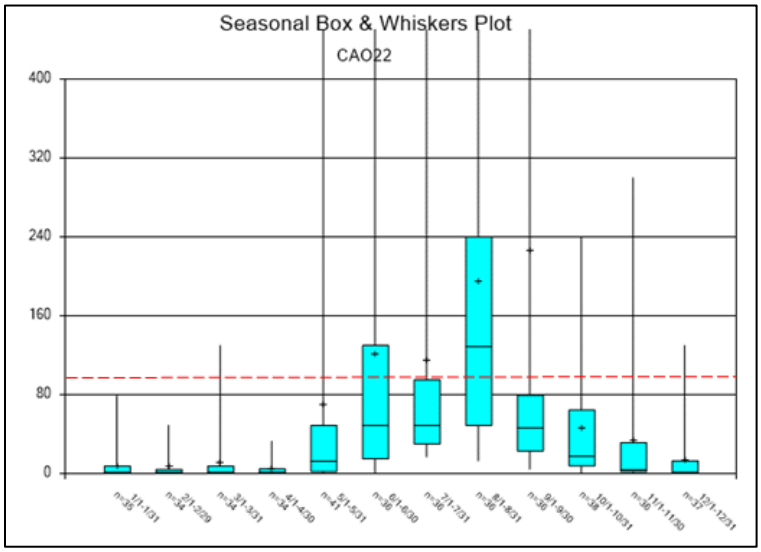




The temperature standard for this site is 16.0 °C. Any part of the 3D plot that is in red is hotter than that standard. The water year on the x-axis begins in October and ends in September.

The dashed red line on the monthly box plot represents the 16.0 °C standard, and is approximate. The calendar year on the x-axis begins in January and ends in December.





The fecal coliform (FC) standard for this site is 100 MPN/100 mL. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.

The dashed red line on the monthly box plot represents the 100 MPN/100 mL standard, and is approximate. The calendar year on the x-axis begins in January and ends in December.

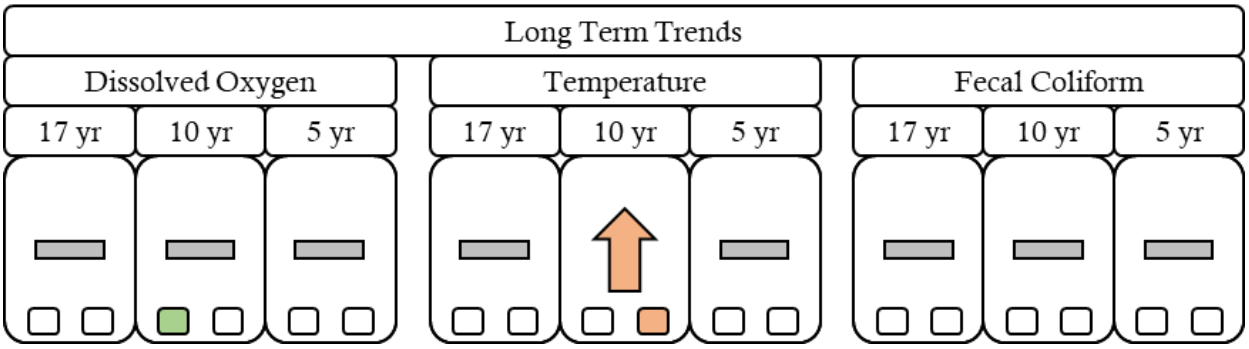
23

Wiseman Creek
@ Minkler Road

Upstream Ag

Water Quality Index (WQI)

2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
27	48	85	98	95	98	95	90	96	83	90	95	85	89	96

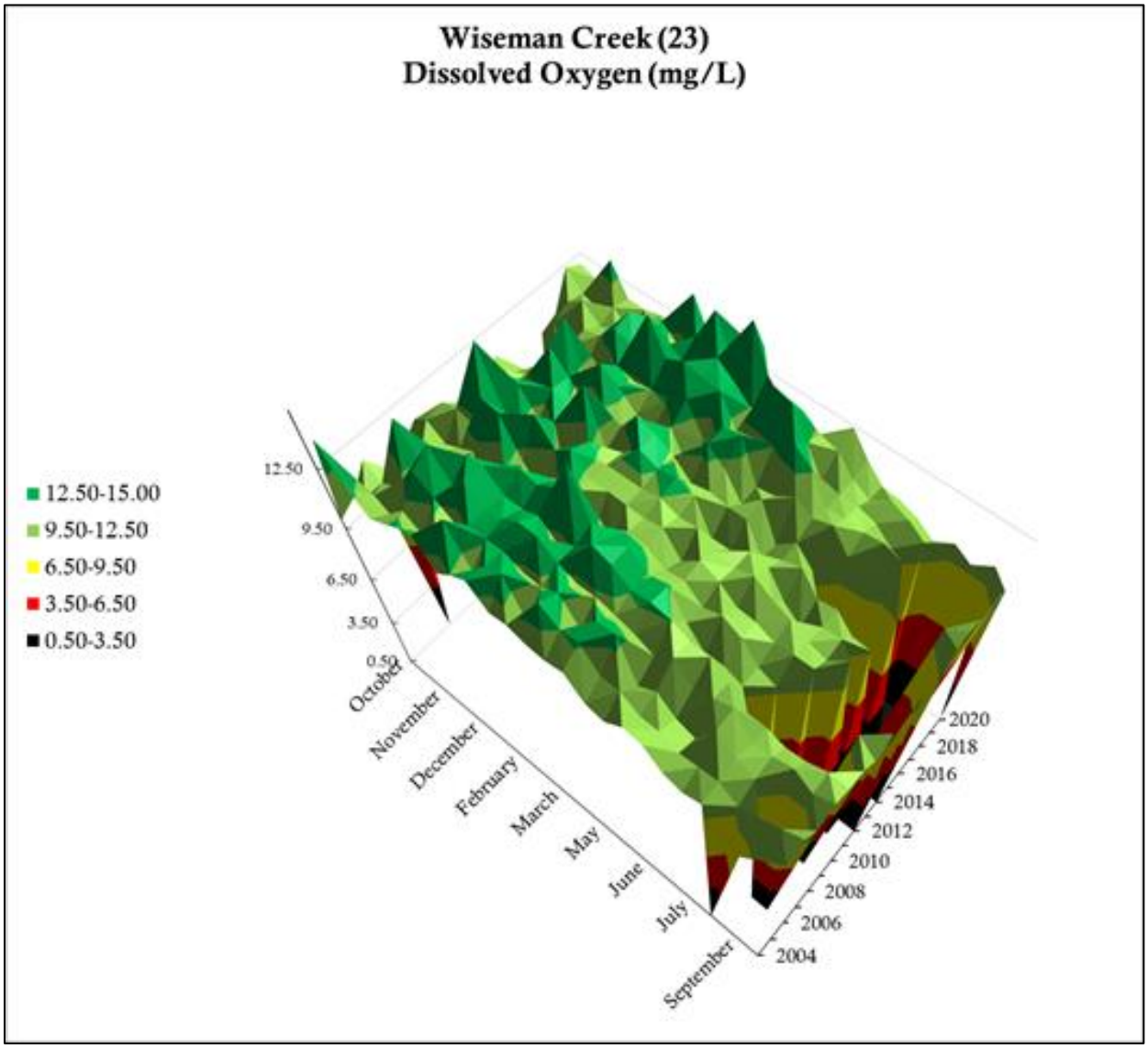


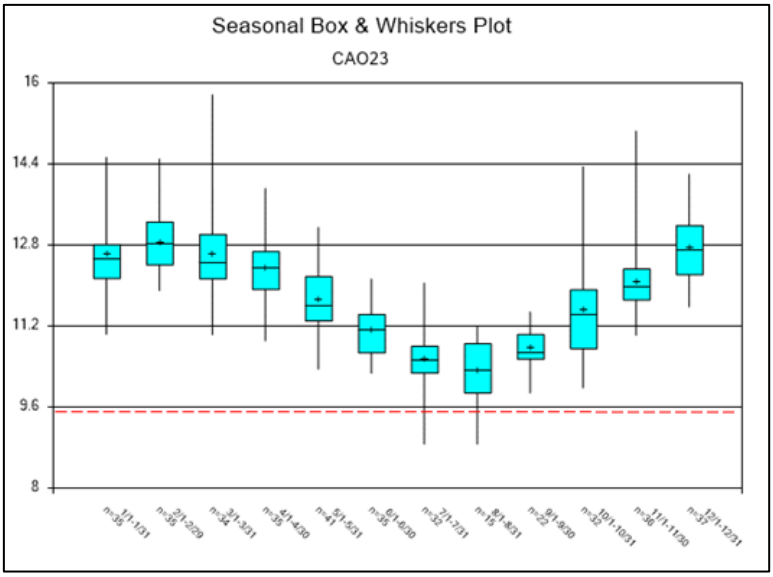
Site 23 is Wiseman Creek as it comes down off Lyman Hill, and prior to entering Skiyou Slough and ultimately the Skagit River. This site is designated as core salmonid habitat.

No significant monthly trends were observed in dissolved oxygen or fecal coliform at this site, over any of the time periods analyzed. Temperature is warmer now than ten years ago. WQI is consistently in the category of least concern.

Site 23 rarely, if ever, fails to meet state standards for DO and water temperature, year-round. Annual FC levels easily meet state standards.

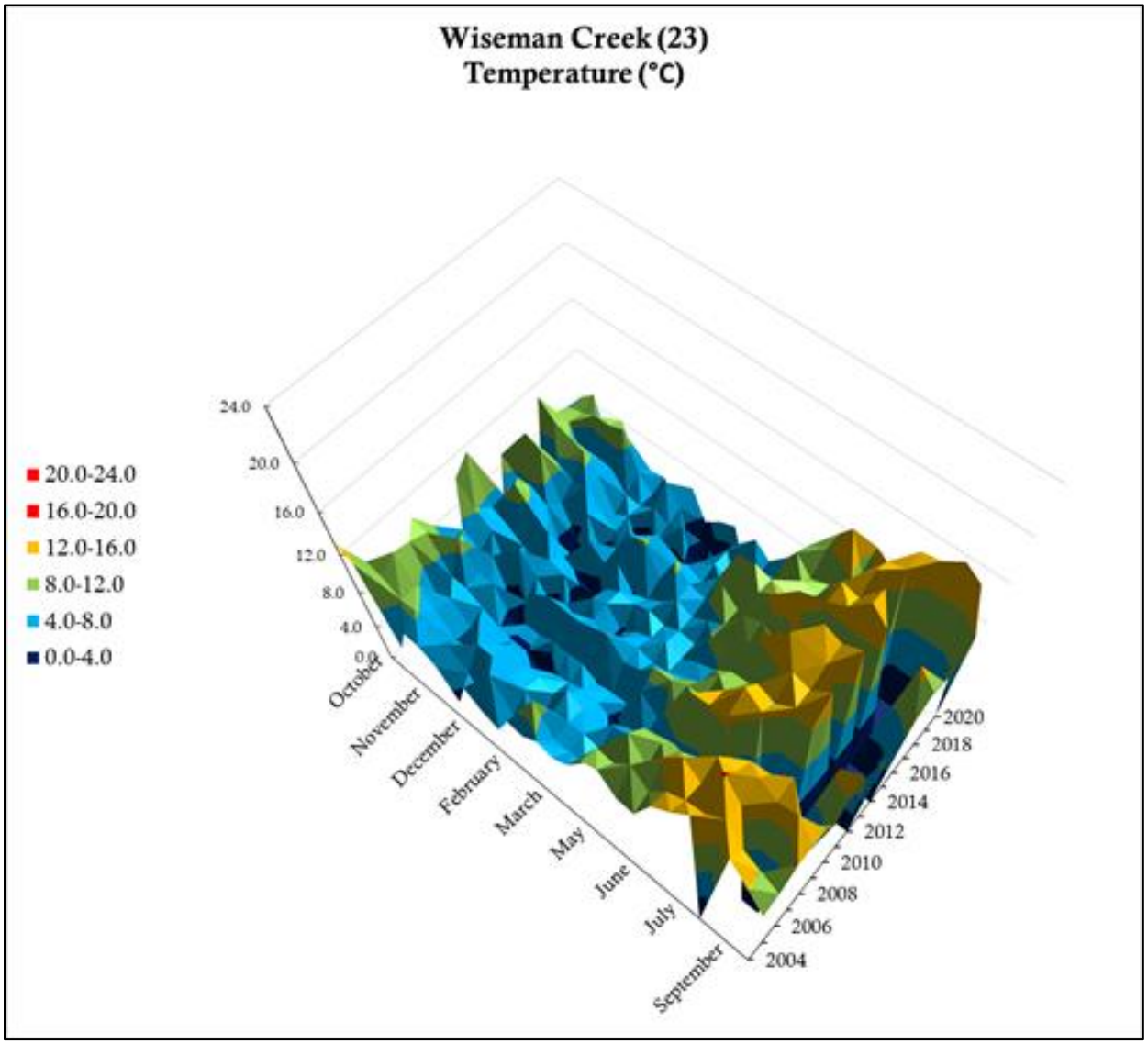
Site 23 is tied for 35th out of 39 sites for number of significant trends, with 7, and 21st out of 39 sites for positive trends, with 57%.

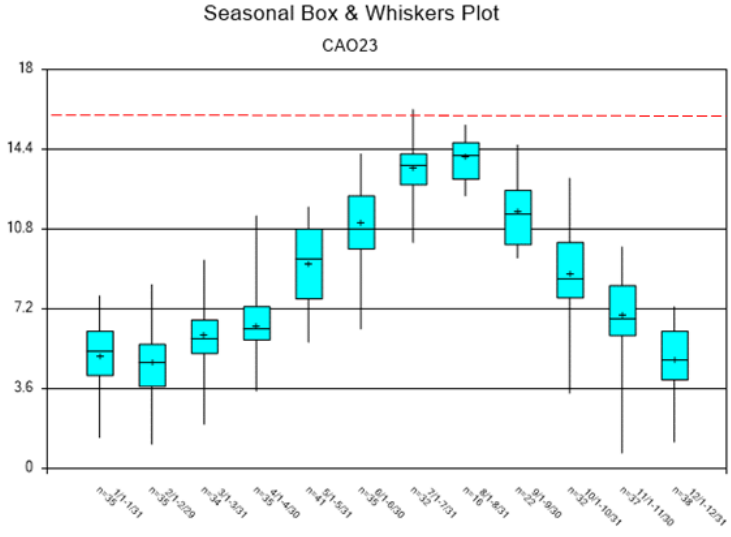




The dissolved oxygen (DO) standard for this site is 9.50 mg/L. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.

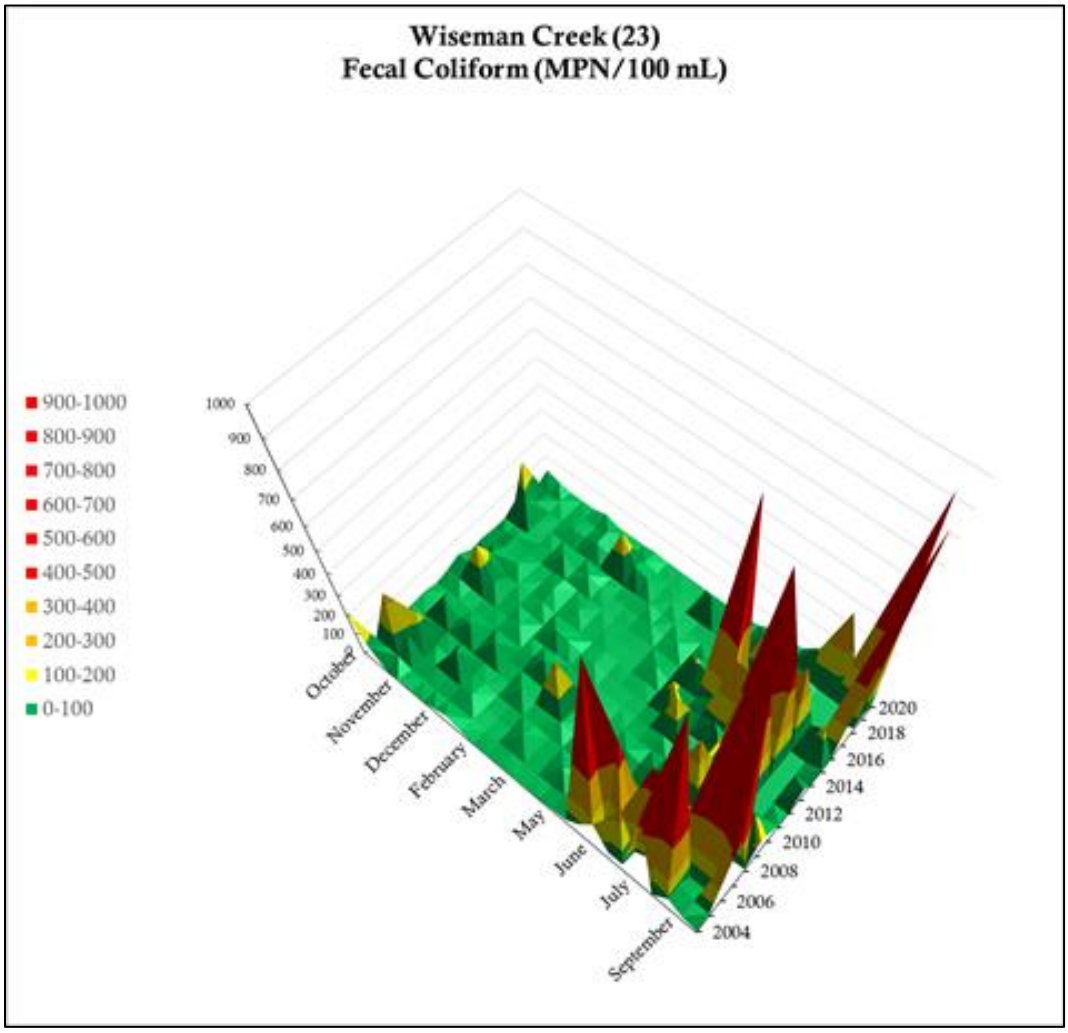
The dashed red line on the monthly box plot represents the 9.5 mg/L standard, and is approximate. The calendar year on the x-axis begins in January and ends in December.

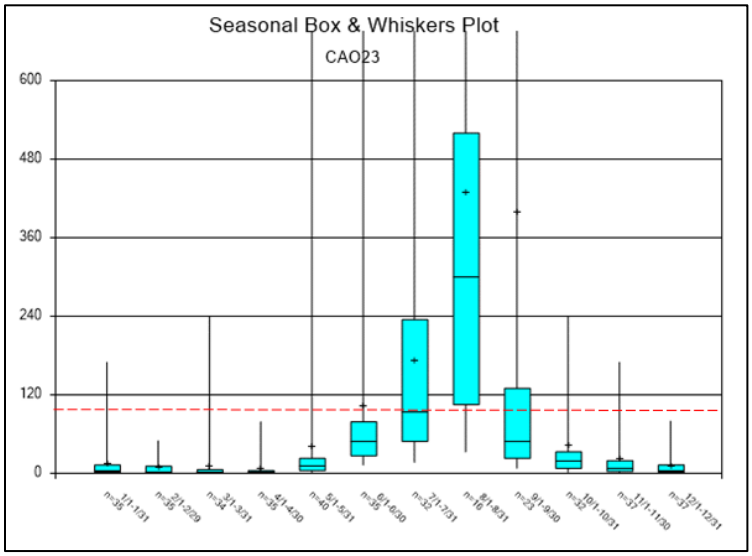




The temperature standard for this site is 16.0 °C. Any part of the 3D plot that is in red is hotter than that standard. The water year on the x-axis begins in October and ends in September.

The dashed red line on the monthly box plot represents the 16.0 °C standard, and is approximate. The calendar year on the x-axis begins in January and ends in December.





The fecal coliform (FC) standard for this site is 100 MPN/100 mL. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.

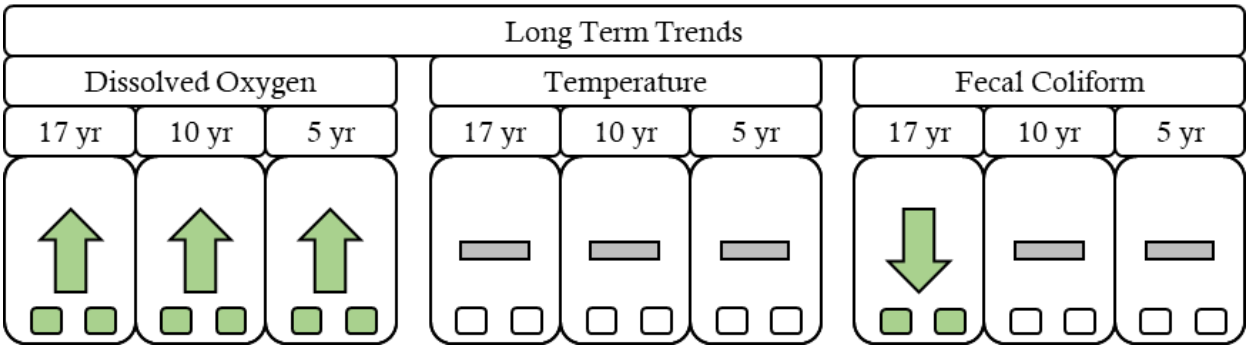
The dashed red line on the monthly box plot represents the 100 MPN/100 mL standard, and is approximate. The calendar year on the x-axis begins in January and ends in December.

24

Mannser Creek
@ Lyman-Hamilton Highway

Midstream Ag

Water Quality Index (WQI)														
2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
35	56	41	69	63	62	45	52	50	62	31	64	71	47	63

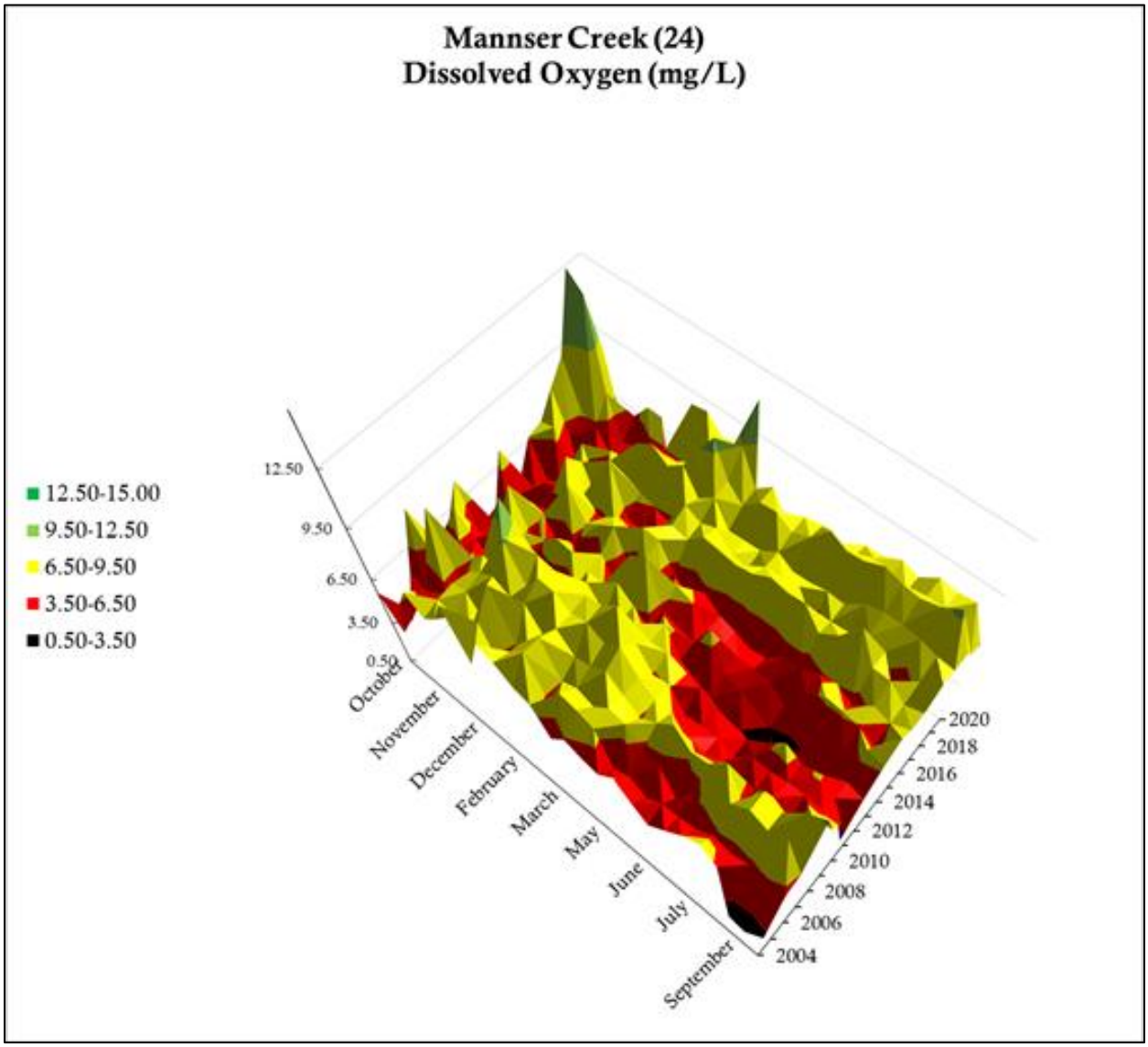


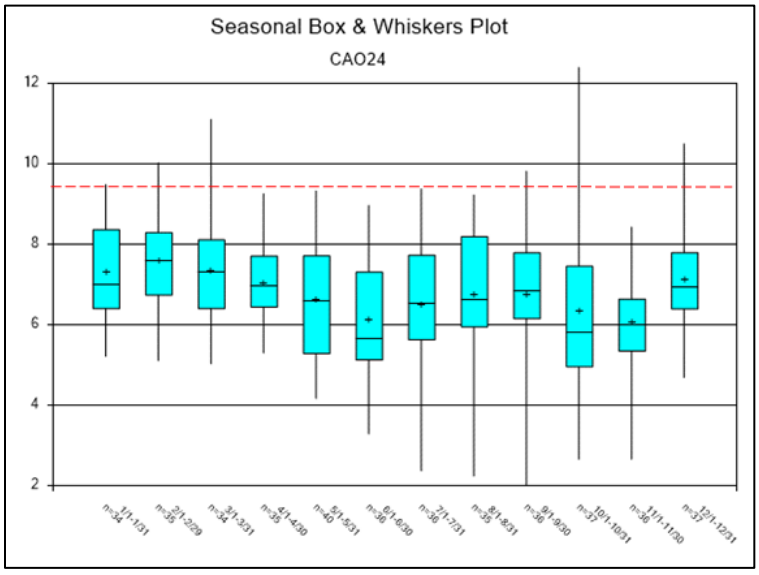
Site 24 is Mannser Creek, after descending off of Mount Josephine and prior to joining the Skagit River, just east of Lyman. This site is designated as core salmonid habitat.

Dissolved oxygen has significantly increased across all three measured time periods. Fecal coliform has decreased compared to 17 years ago. WQI scores are regularly in the category of moderate concern.

Site 24 is slow-moving and inundated with invasive reed canary grass. This has the effect of lowering DO but also decreasing temperature. As a result, this site is almost always below state standards for DO year-round, but has never exceeded state temperature standards even once in the history of this program. Annual FC levels also easily meet state standards.

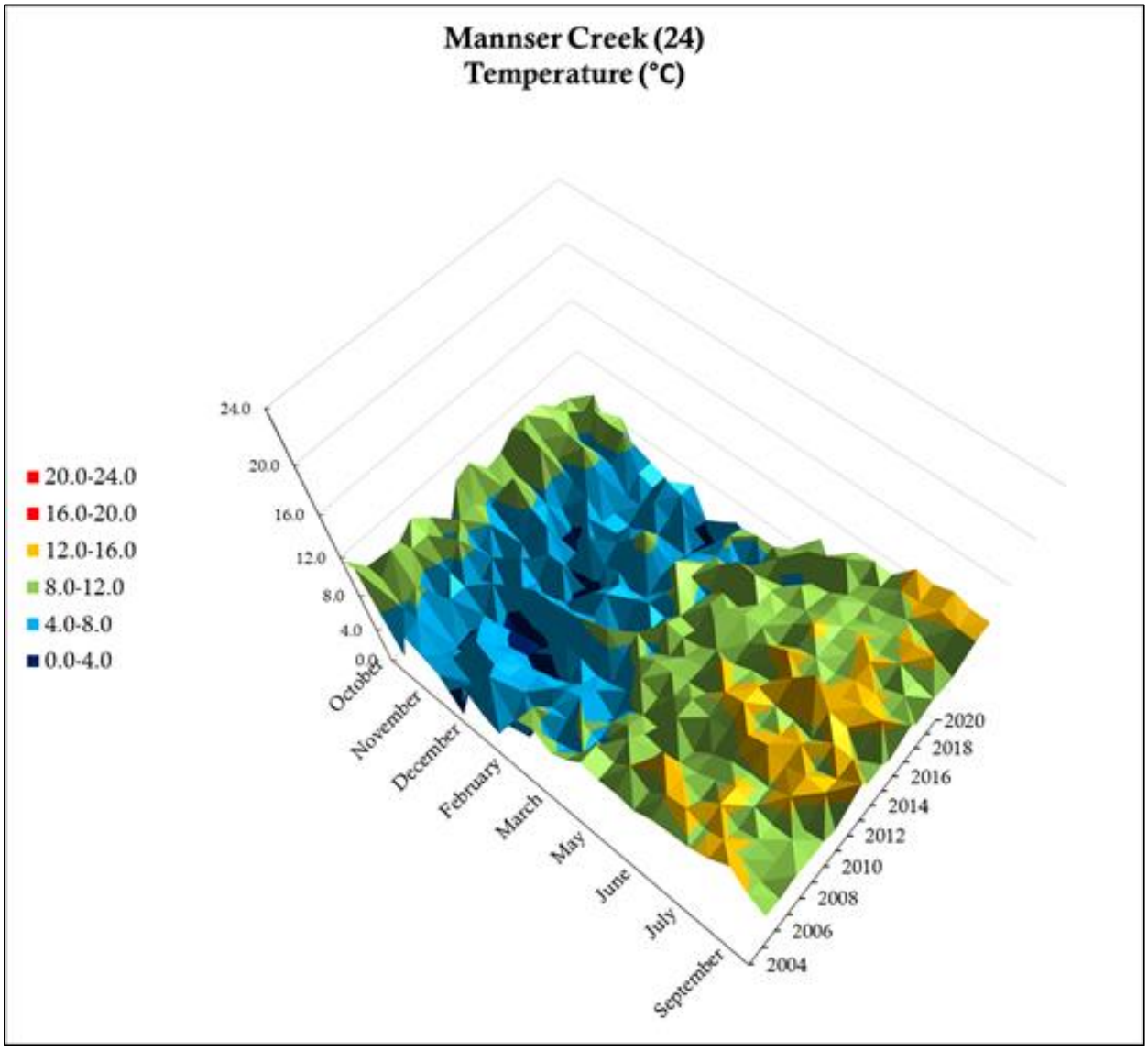
Site 24 is tied for 12th out of 39 sites for number of significant trends, with 13, and is tied for 8th out of 39 sites for positive trends, with 77%.

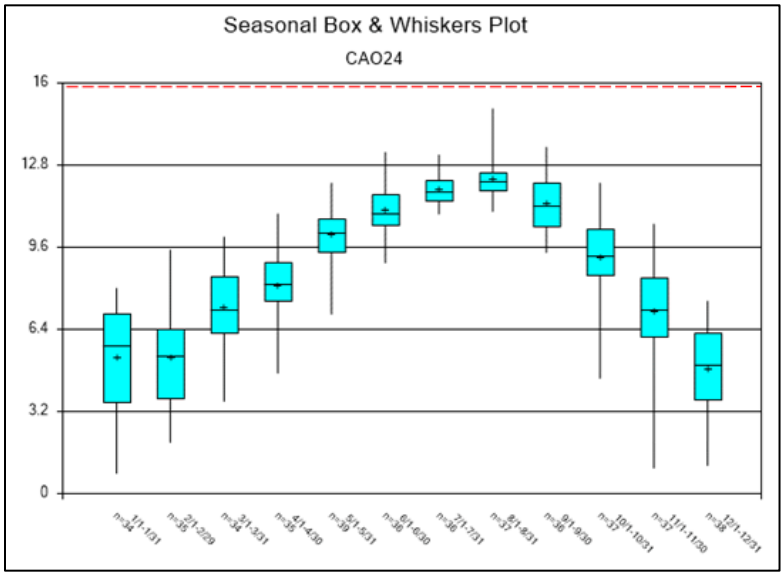




The dissolved oxygen (DO) standard for this site is 9.50 mg/L. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.

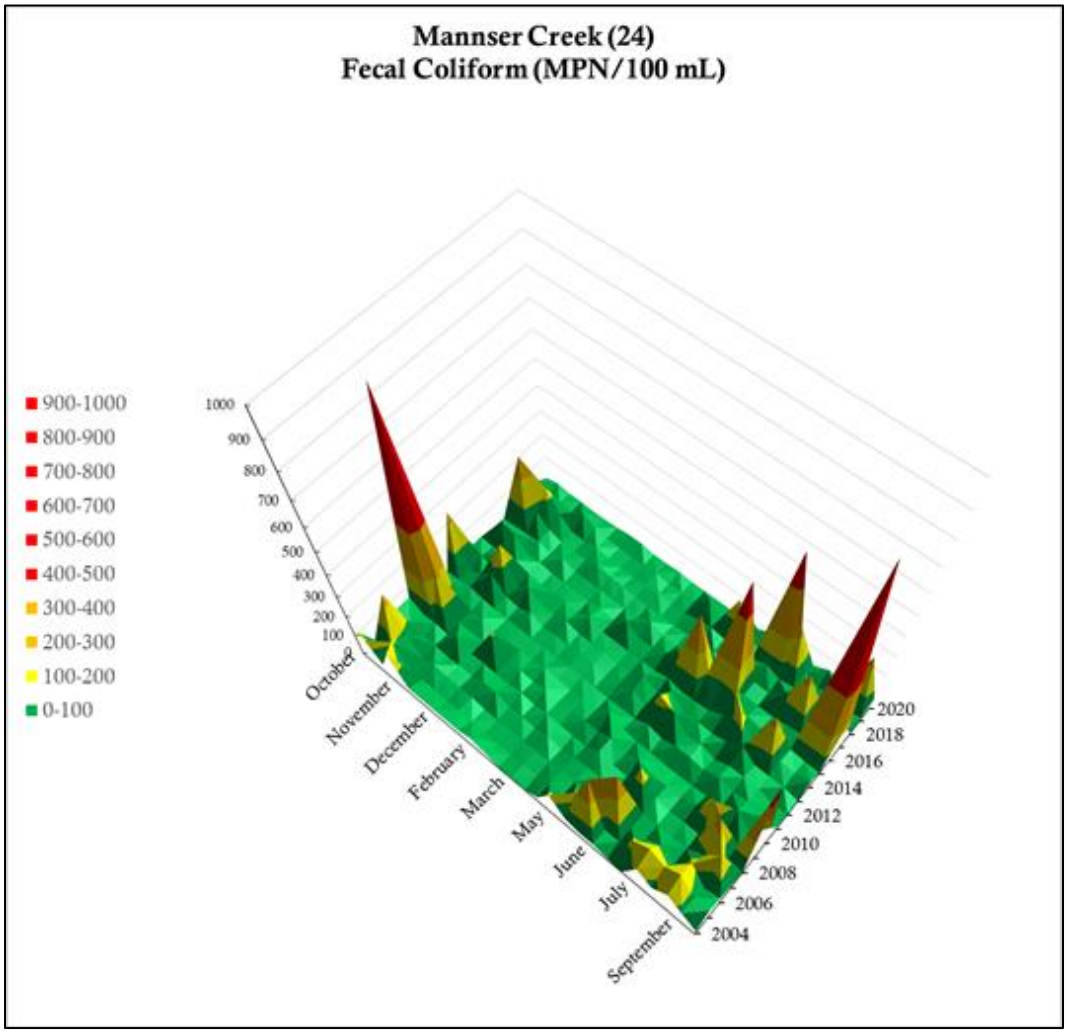
The dashed red line on the monthly box plot represents the 9.5 mg/L standard, and is approximate. The calendar year on the x-axis begins in January and ends in December.

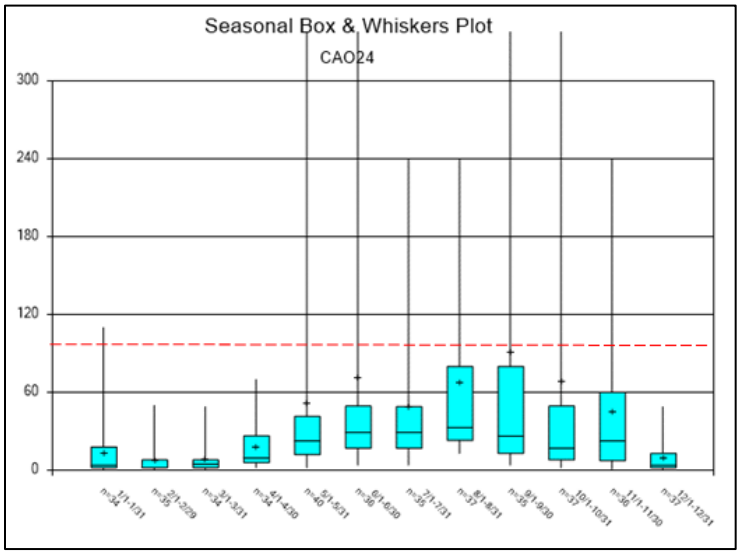




The temperature standard for this site is 16.0 °C. Any part of the 3D plot that is in red is hotter than that standard. The water year on the x-axis begins in October and ends in September.

The dashed red line on the monthly box plot represents the 16.0 °C standard, and is approximate. The calendar year on the x-axis begins in January and ends in December.





The fecal coliform (FC) standard for this site is 100 MPN/100 mL. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.

The dashed red line on the monthly box plot represents the 100 MPN/100 mL standard, and is approximate. The calendar year on the x-axis begins in January and ends in December.

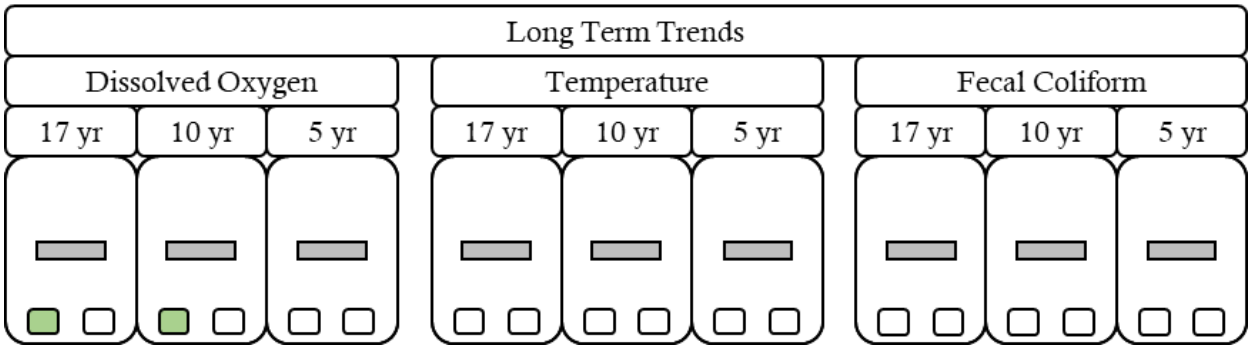
25

Red Cabin Creek
@ Hamilton Cemetery Road

Reference – Rural Reserve

Water Quality Index (WQI)

2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
74	90	87	97	97	96	96	97	97	94	93	94	96	91	94

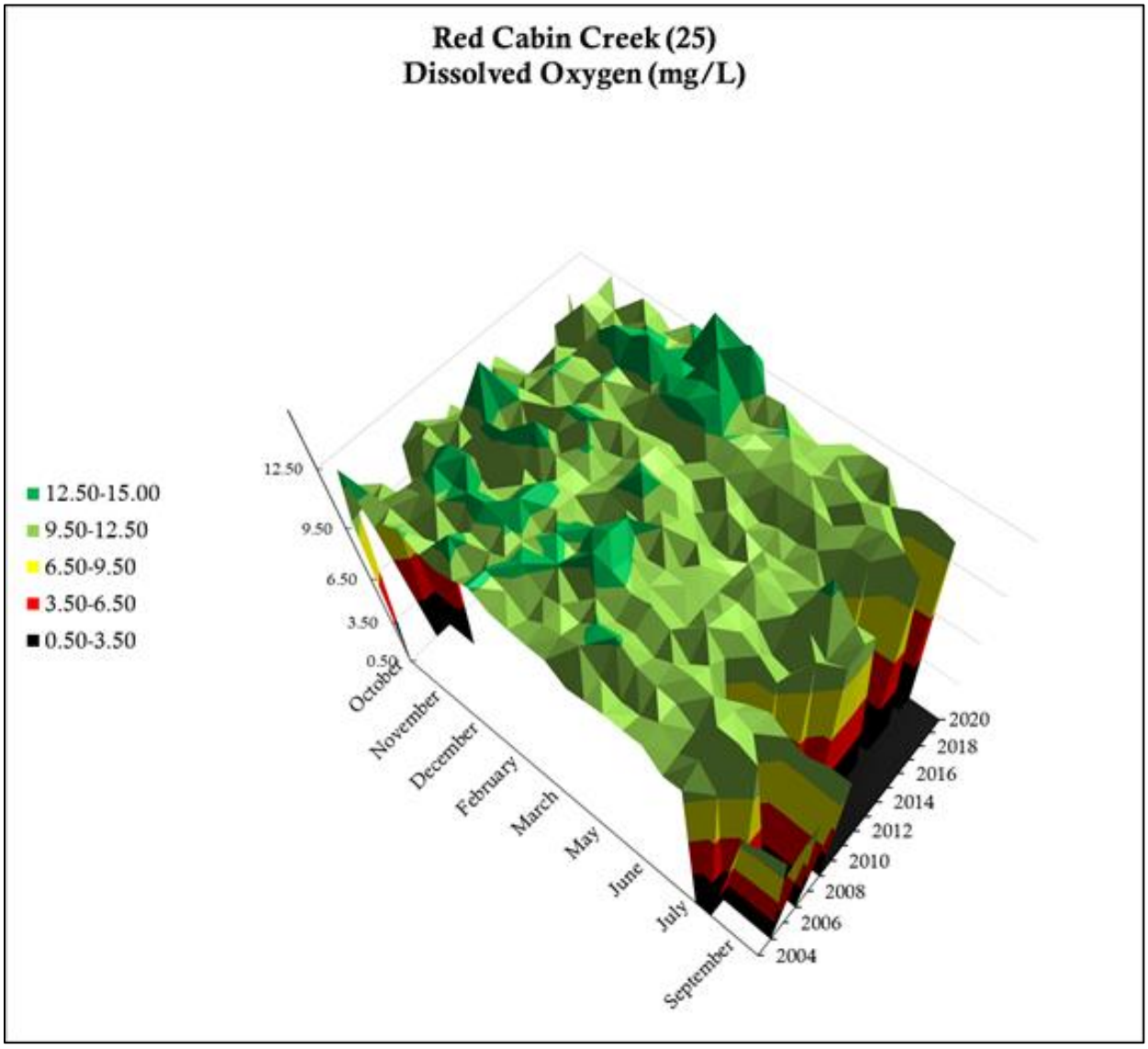


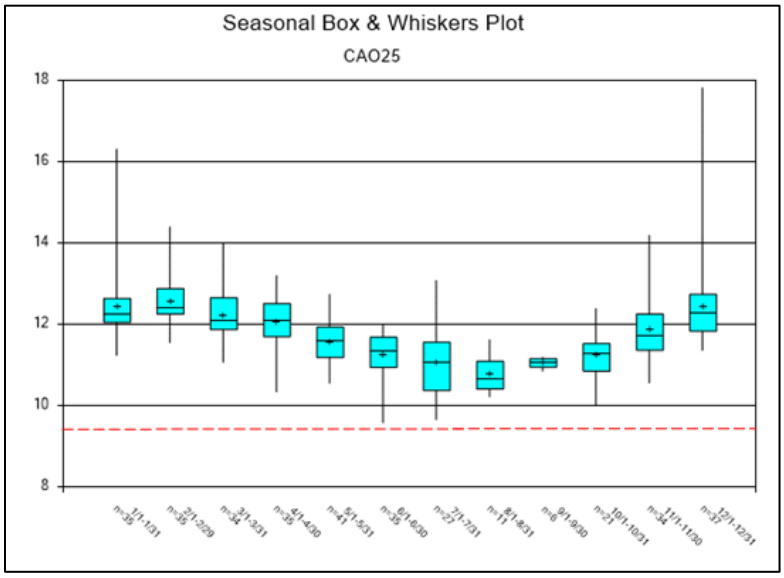
Site 25 is Red Cabin Creek, after it comes off of Mount Josephine, in between Lyman and Hamilton. This is an ephemeral creek that regularly dries up by the end of summer. This site is designated as core salmonid habitat.

No significant trends in DO, temperature, or FC were observed across any time period. Except for the first year of WQI monitoring, this creek has solely been in the category of least concern.

Site 25 has never failed to meet state standards for DO or water temperature on any collection day over the history of this program. Annual FC levels easily meet state standards.

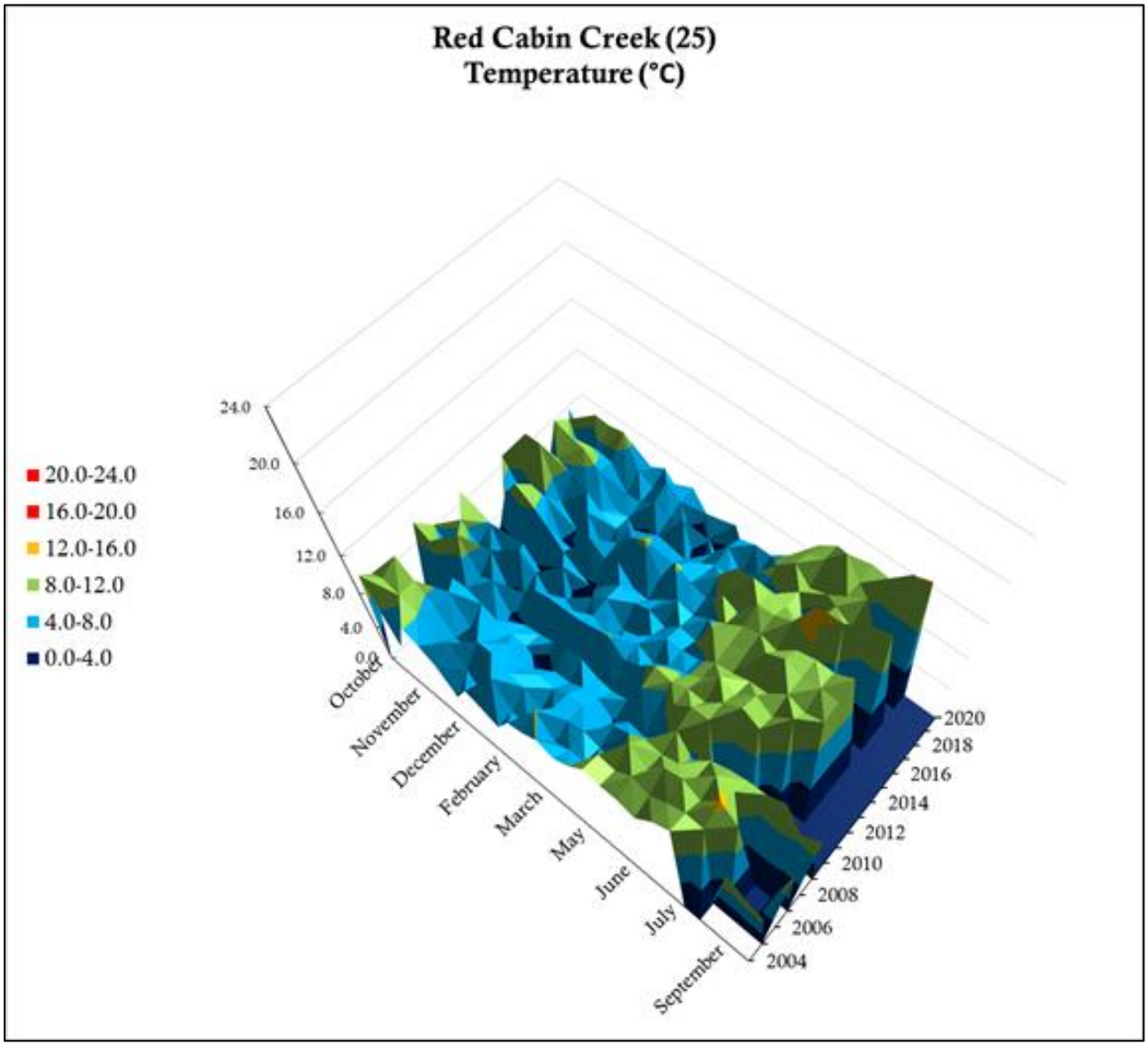
Site 25 is tied for 22nd out of 39 sites for number of significant trends, with 11, and is 24th out of 39 sites for positive trends, with 55%.

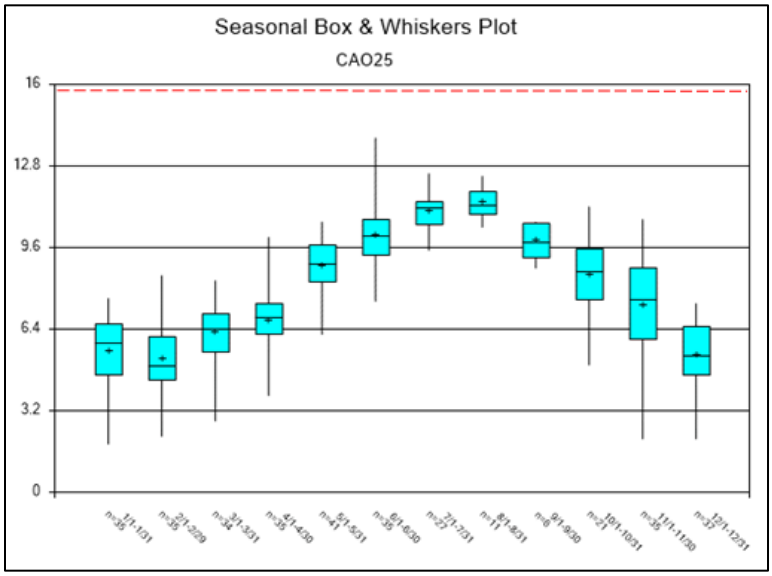




The dissolved oxygen (DO) standard for this site is 9.50 mg/L. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.

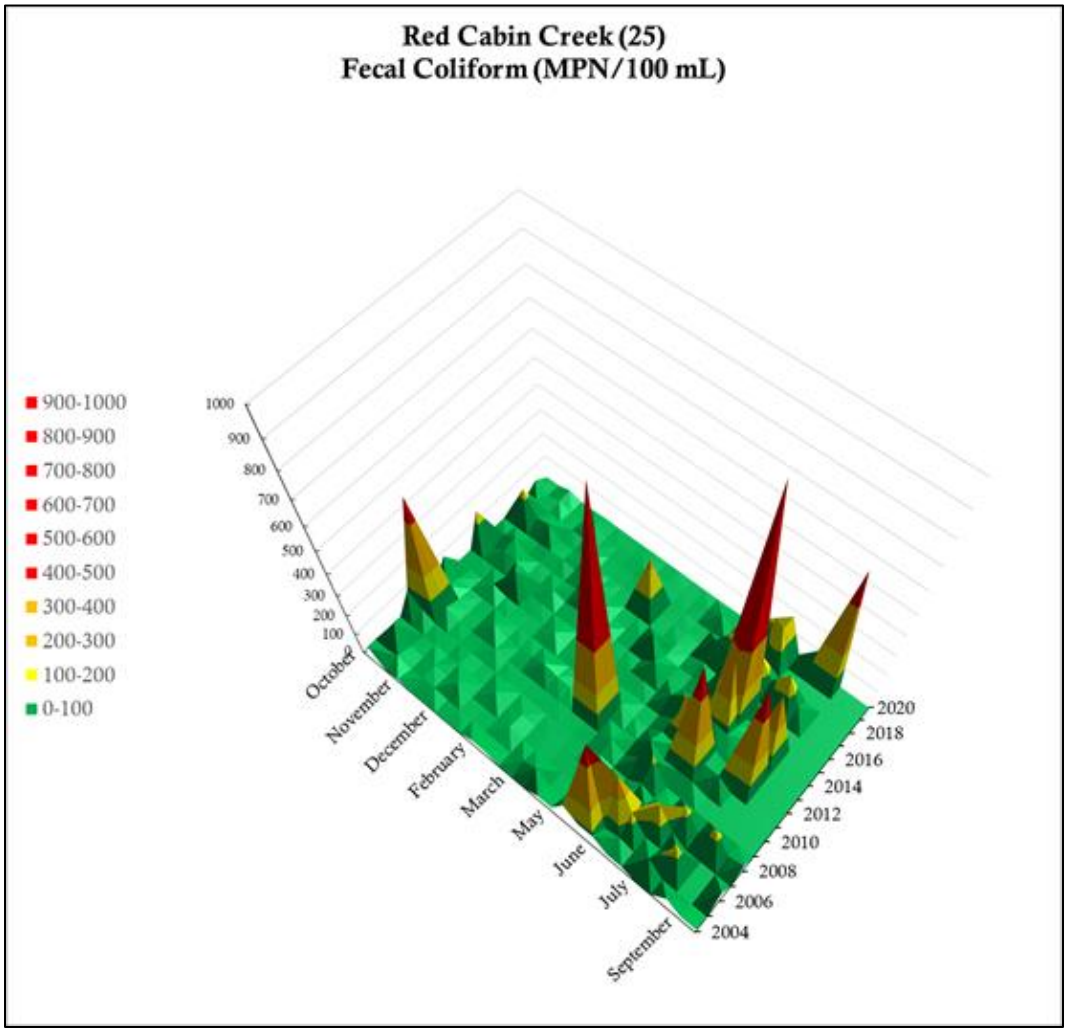
The dashed red line on the monthly box plot represents the 9.5 mg/L standard, and is approximate. The calendar year on the x-axis begins in January and ends in December.

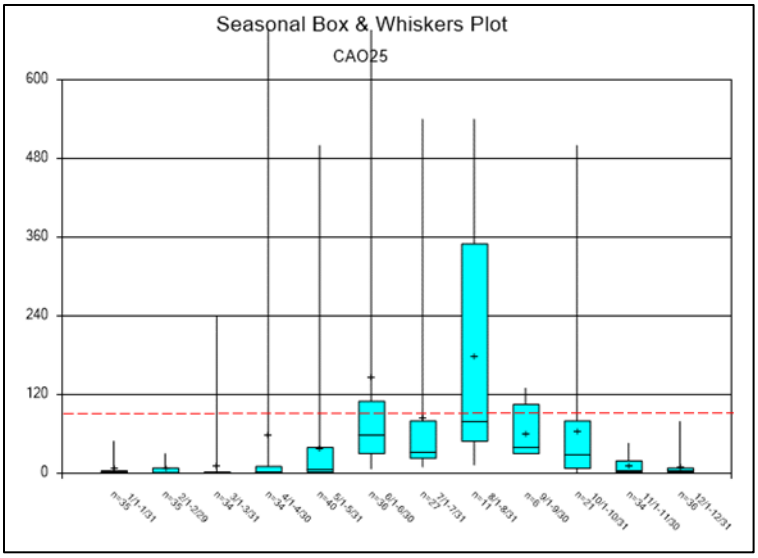




The temperature standard for this site is 16.0 °C. Any part of the 3D plot that is in red is hotter than that standard. The water year on the x-axis begins in October and ends in September.

The dashed red line on the monthly box plot represents the 16.0 °C standard, and is approximate. The calendar year on the x-axis begins in January and ends in December.





The fecal coliform (FC) standard for this site is 100 MPN/100 mL. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.

The dashed red line on the monthly box plot represents the 100 MPN/100 mL standard, and is approximate. The calendar year on the x-axis begins in January and ends in December.

28

Brickyard Creek
@ Highway 20

Reference – Urban/suburban

Water Quality Index (WQI)														
2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
62	77	56	71	79	83	65	75	84	88	77	93	84	85	79

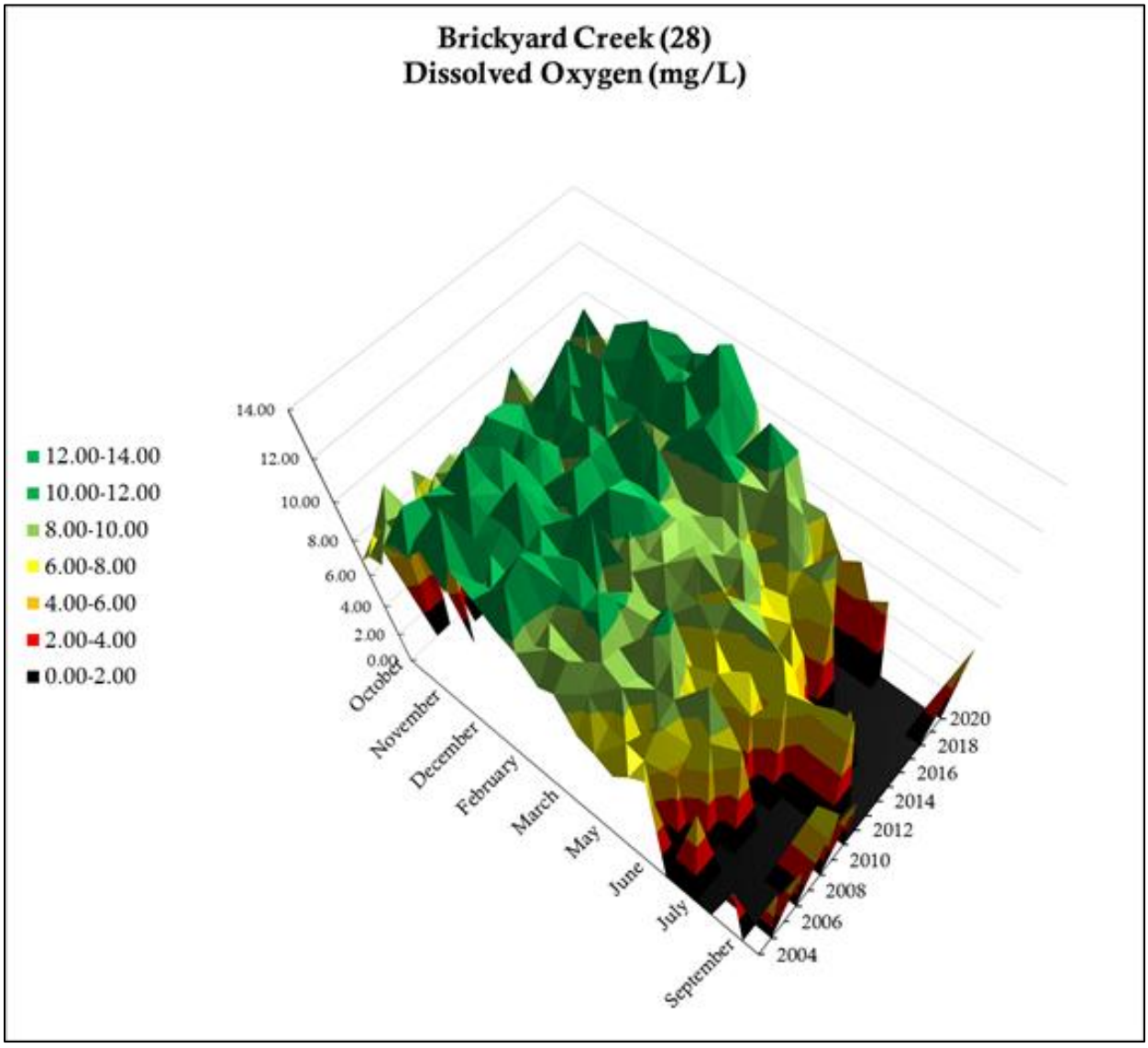
Long Term Trends								
Dissolved Oxygen			Temperature			Fecal Coliform		
17 yr	10 yr	5 yr	17 yr	10 yr	5 yr	17 yr	10 yr	5 yr
		Not Enough Data			Not Enough Data			Not Enough Data

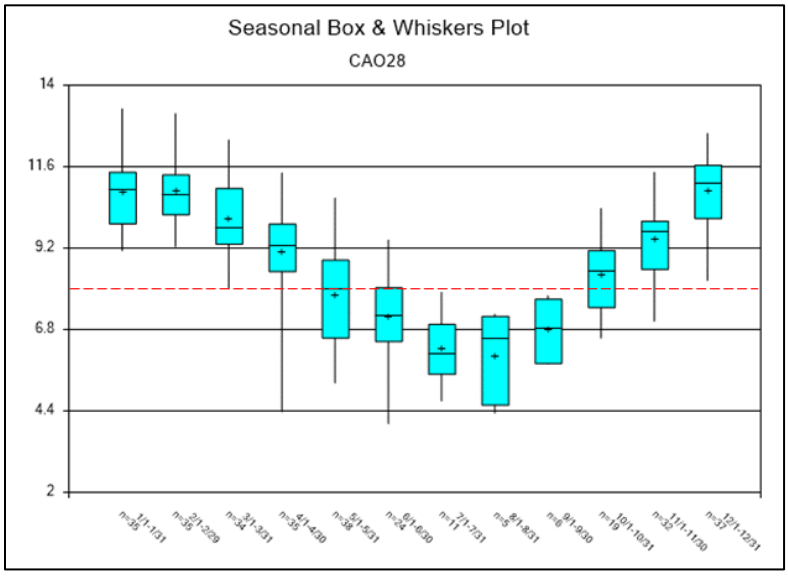
Site 28 is Brickyard Creek, after it has passed through northern Sedro-Woolley, just prior to entering Hart Slough, and eventually the Skagit River. This is an ephemeral creek that regularly dries up by the end of summer. This site is designated as salmonid spawning, rearing, and migration (SRM) status.

Due to the ephemeral nature of this creek, there were not enough data points collected to be sufficient for generating five-year monthly trends. No monthly trends for DO, temperature, or FC were observed across any of the time periods analyzed in this report.

Site 28 regularly fails to meet state standards for DO during the warmer months, but rarely fails state standards for water temperature. Annual FC levels for WY2020 easily passed state standards.

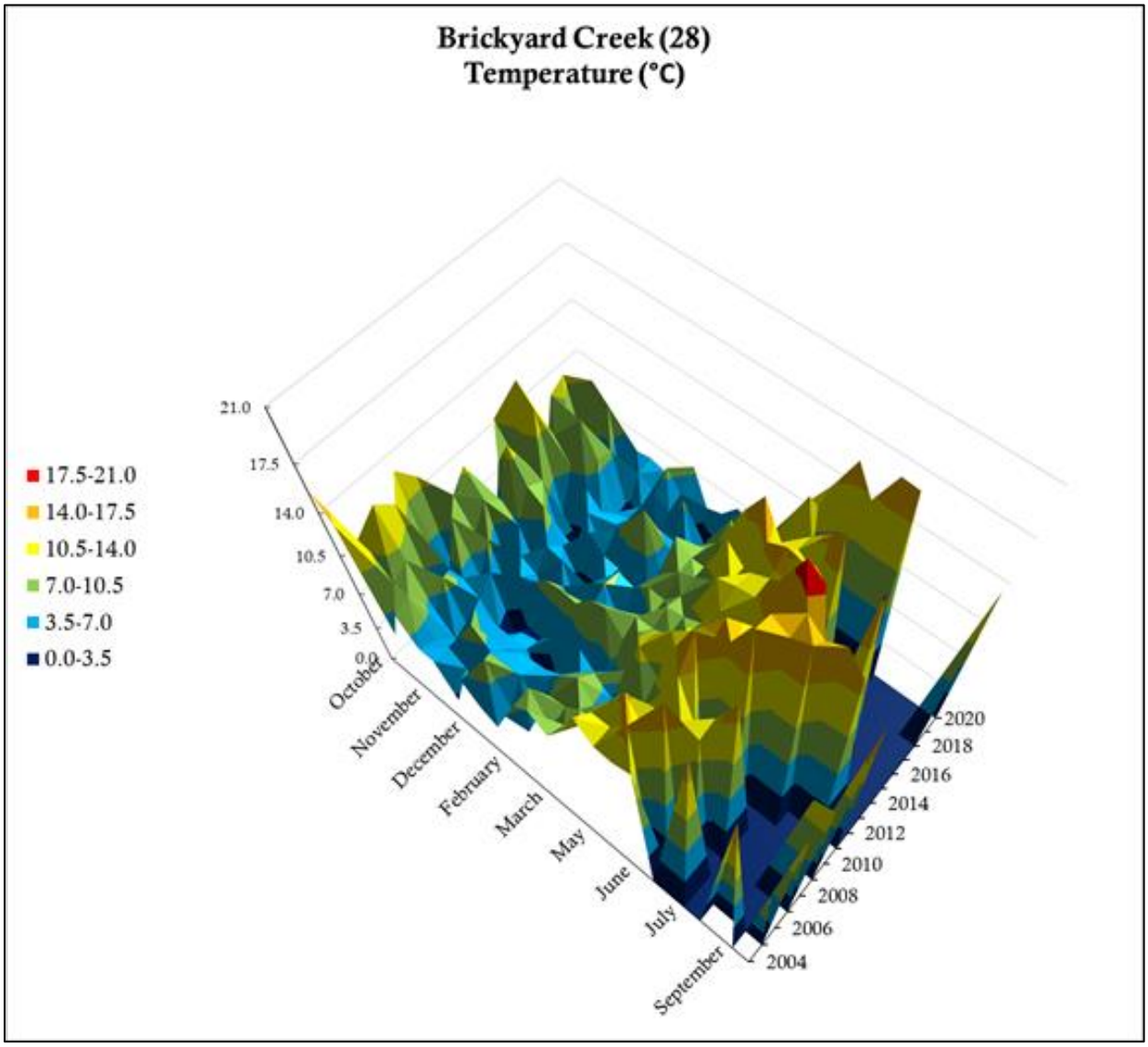
Site 28 is tied for last out of 39 sites for number of significant trends, with 6, and is 28th out of 39 sites for positive trends, with 50%.

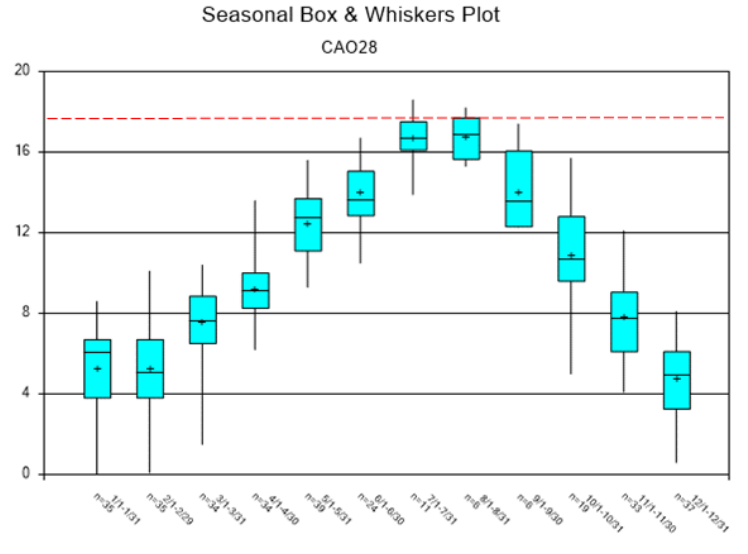




The dissolved oxygen (DO) standard for this site is 8.0 mg/L. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.

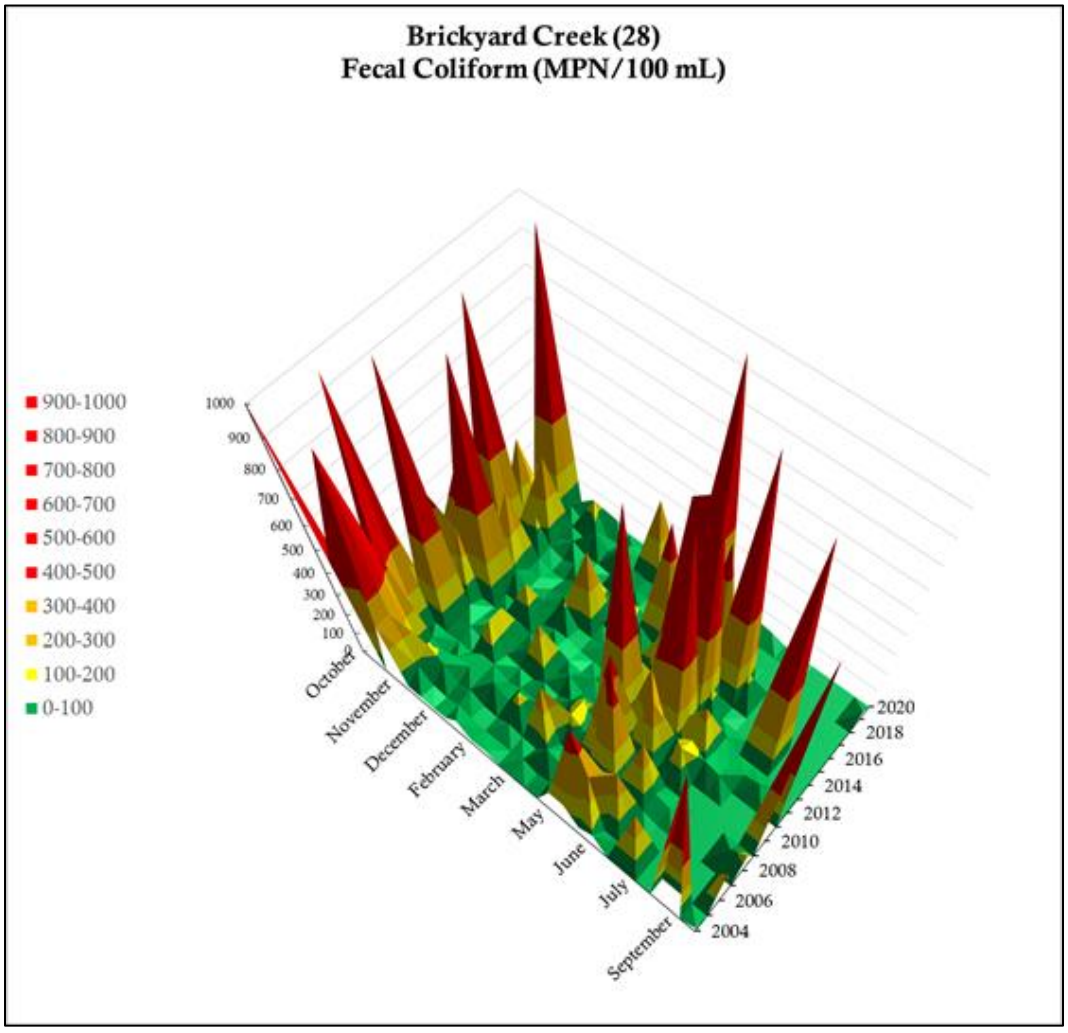
The dashed red line on the monthly box plot represents the 8.0 mg/L standard, and is approximate. The calendar year on the x-axis begins in January and ends in December.

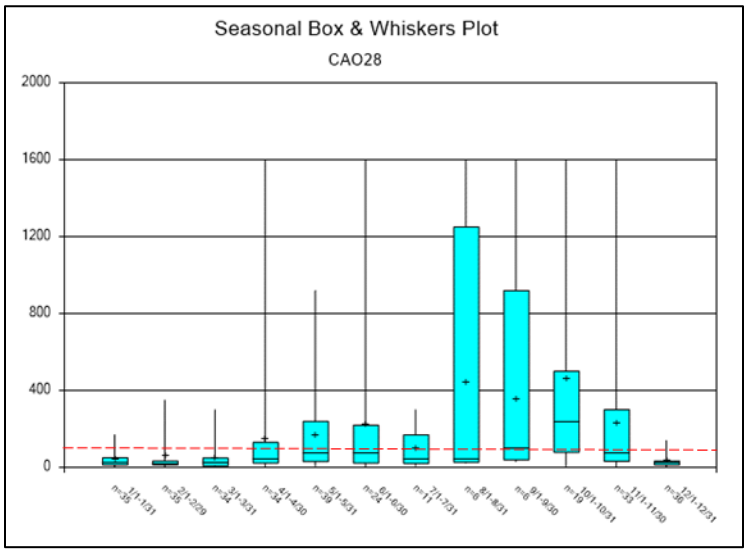




The temperature standard for this site is 17.5 °C. Any part of the 3D plot that is in red is hotter than that standard. The water year on the x-axis begins in October and ends in September.

The dashed red line on the monthly box plot represents the 17.5 °C standard, and is approximate. The calendar year on the x-axis begins in January and ends in December.





The fecal coliform (FC) standard for this site is 100 MPN/100 mL. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.

The dashed red line on the monthly box plot represents the 100 MPN/100 mL standard, and is approximate. The calendar year on the x-axis begins in January and ends in December.

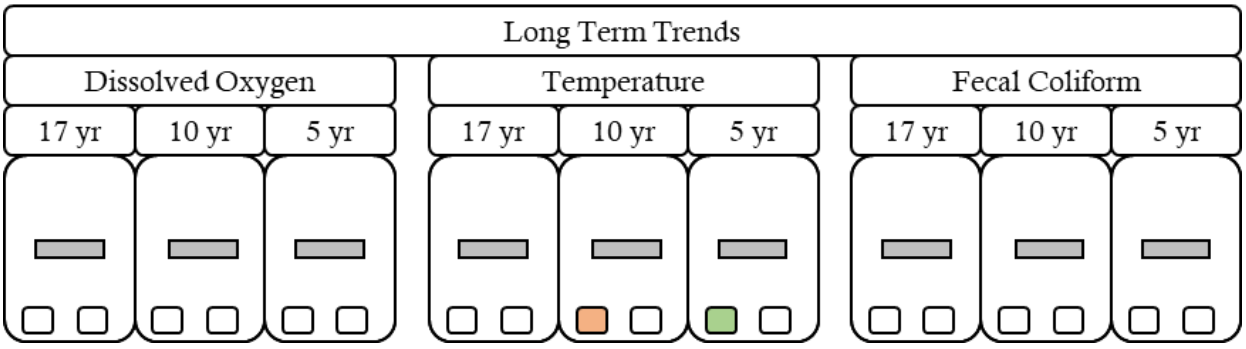
29

Skagit River
@ River Bend Road

Mainstem Skagit – Mid, TMDL

Water Quality Index (WQI)

2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
76	63	82	94	92	86	82	87	94	93	93	85	92	81	82

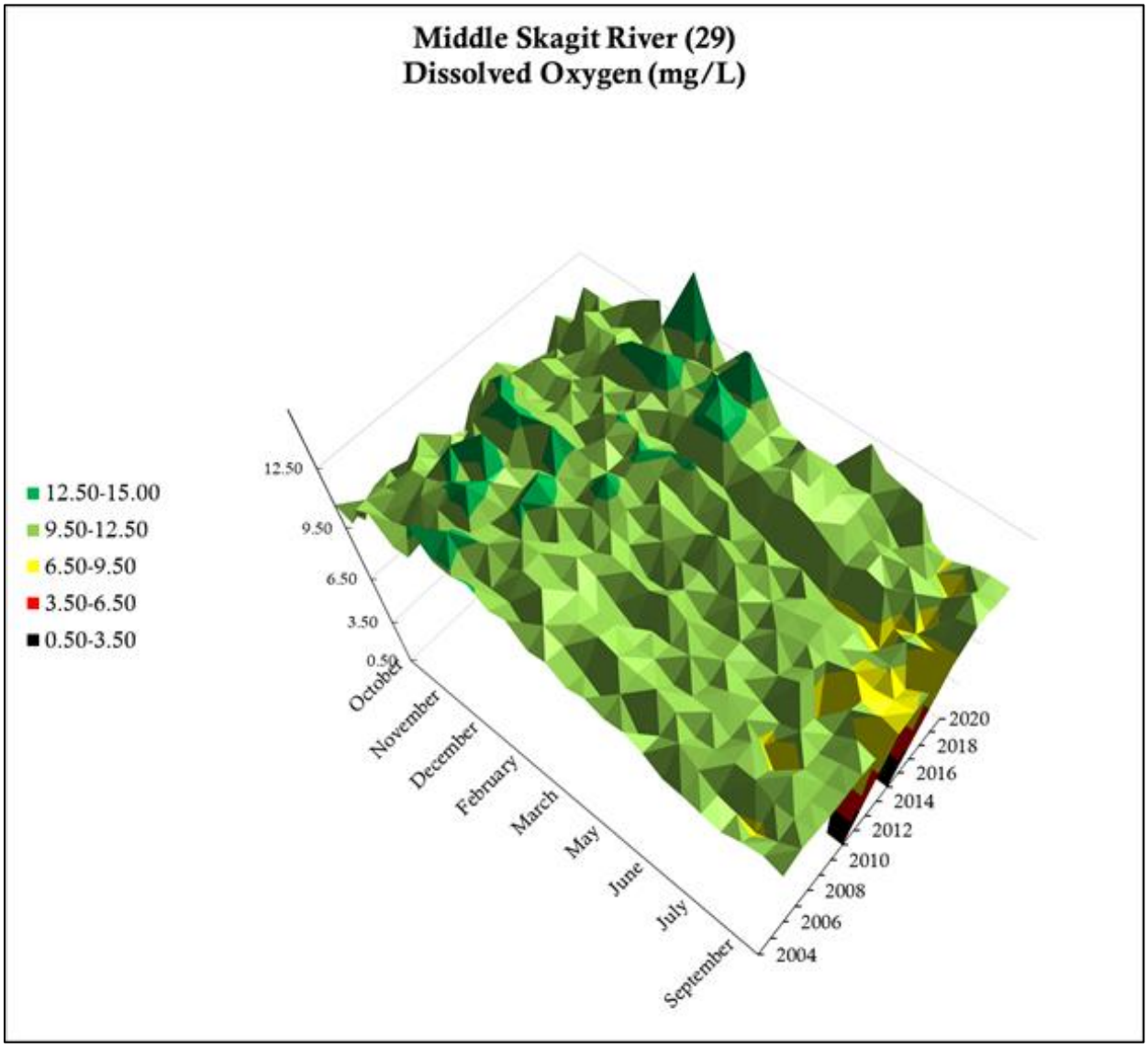


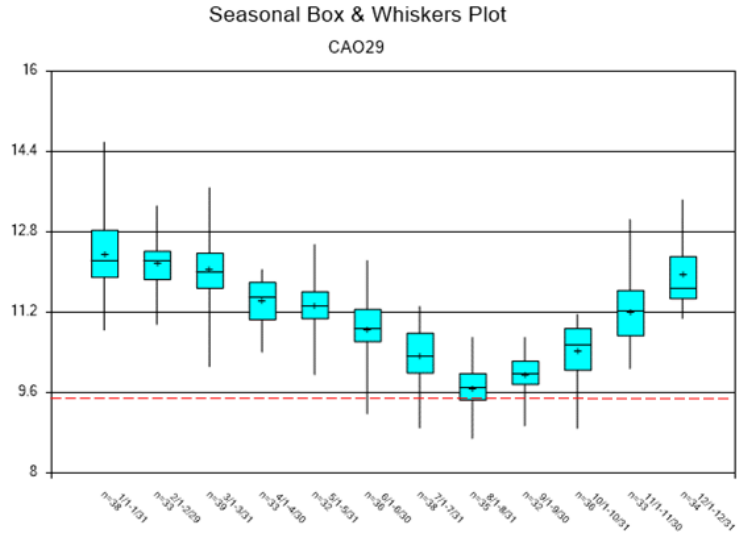
Site 29 is the Skagit River, after it intersects Burlington and Mount Vernon, and prior to the terminal fork. The river is designated as core salmonid habitat and as salmonid spawning, rearing, and migration (SRM) status.

No significant long term trends were observed in DO, temperature, or FC across all time periods measured. WQI scores are consistently in the category of least concern.

Site 29 rarely fails to meet state standards for DO and water temperature, and only ever at the warmest days of the year. Annual FC levels easily meet state standards.

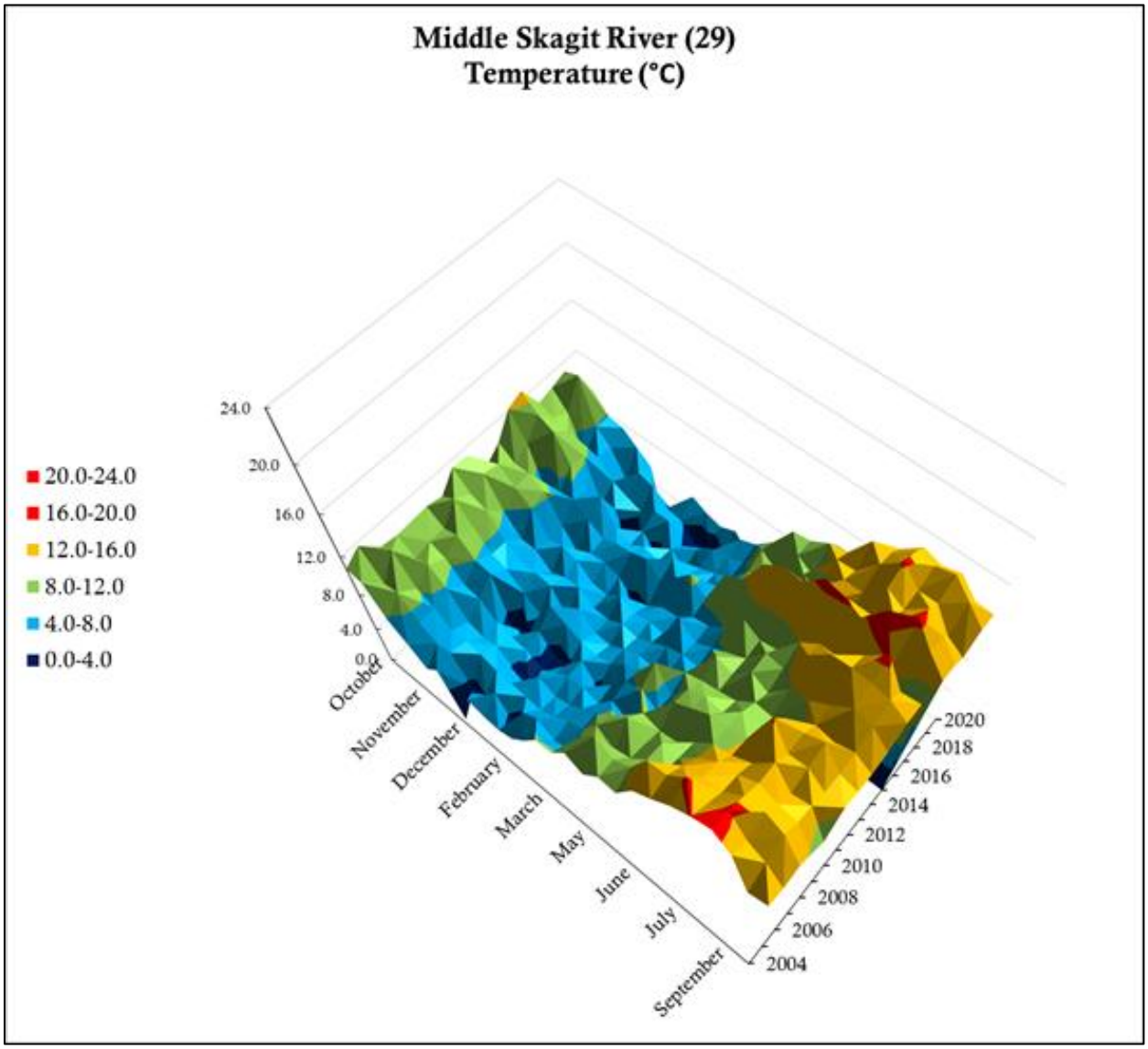
Site 29 is tied for last out of 39 sites for number of significant trends, with 6, and is tied for 14th out of 39 sites for positive trends, with 67%.

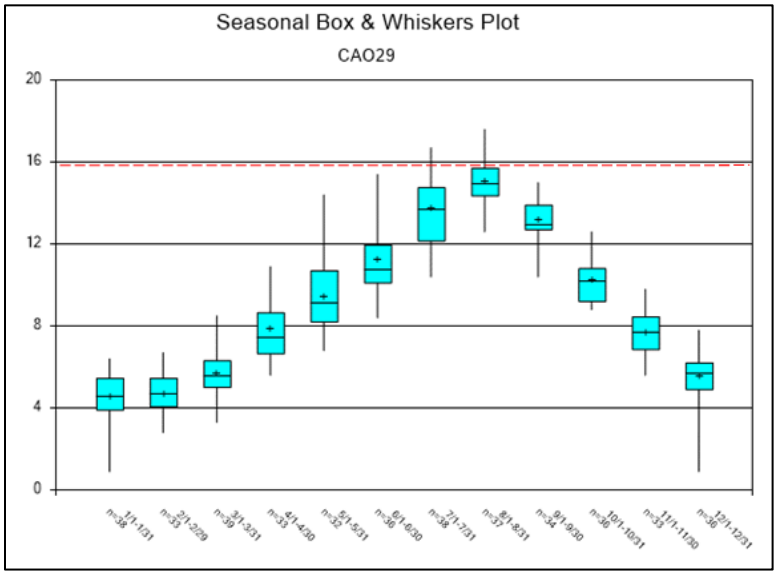




The dissolved oxygen (DO) standard for this site is 9.50 mg/L. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.

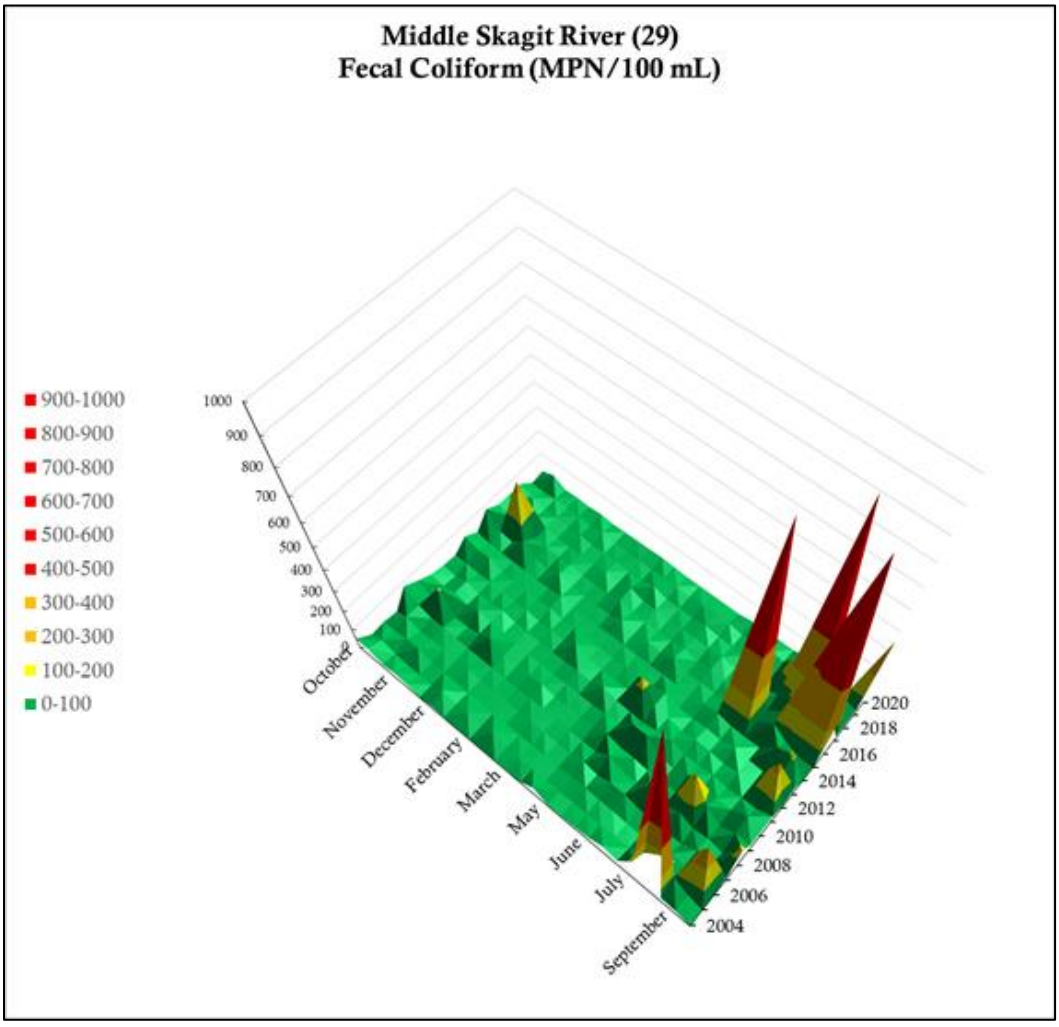
The dashed red line on the monthly box plot represents the 9.5 mg/L standard, and is approximate. The calendar year on the x-axis begins in January and ends in December.

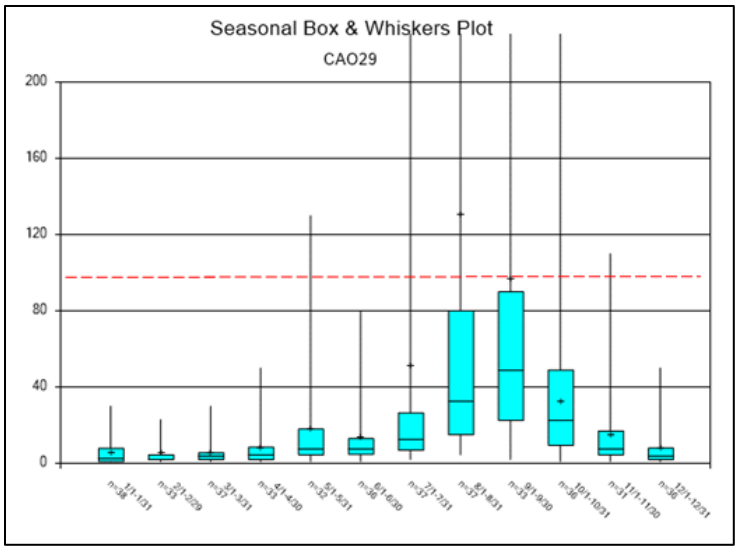




The temperature standard for this site is 16.0 °C. Any part of the 3D plot that is in red is hotter than that standard. The water year on the x-axis begins in October and ends in September.

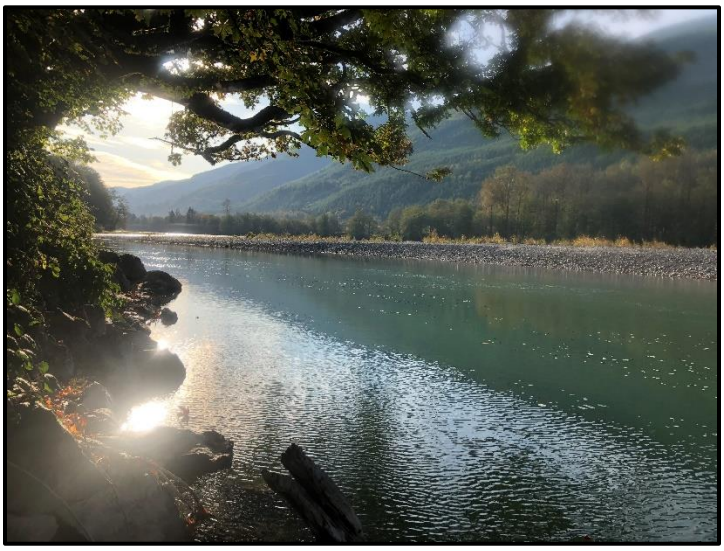
The dashed red line on the monthly box plot represents the 16.0 °C standard, and is approximate. The calendar year on the x-axis begins in January and ends in December.





The fecal coliform (FC) standard for this site is 100 MPN/100 mL. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.

The dashed red line on the monthly box plot represents the 100 MPN/100 mL standard, and is approximate. The calendar year on the x-axis begins in January and ends in December.



30

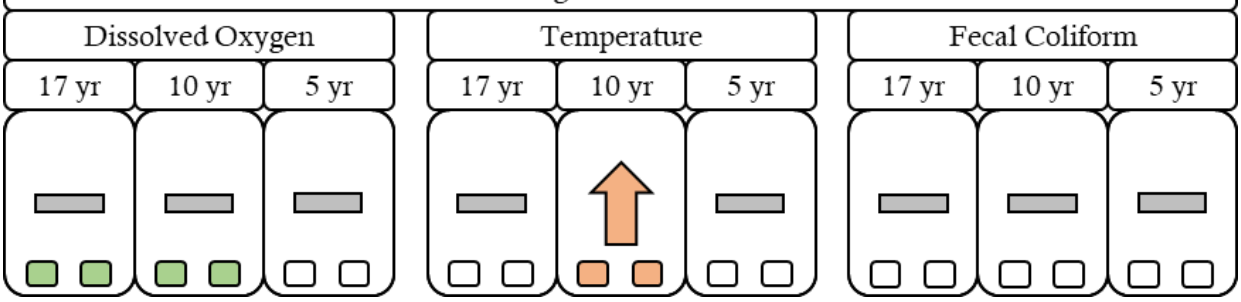
Skagit River
@ Cape Horn Road

Mainstem Skagit - Upper

Water Quality Index (WQI)

2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
66	78	85	89	93	90	90	94	90	85	92	88	96	93	84

Long Term Trends

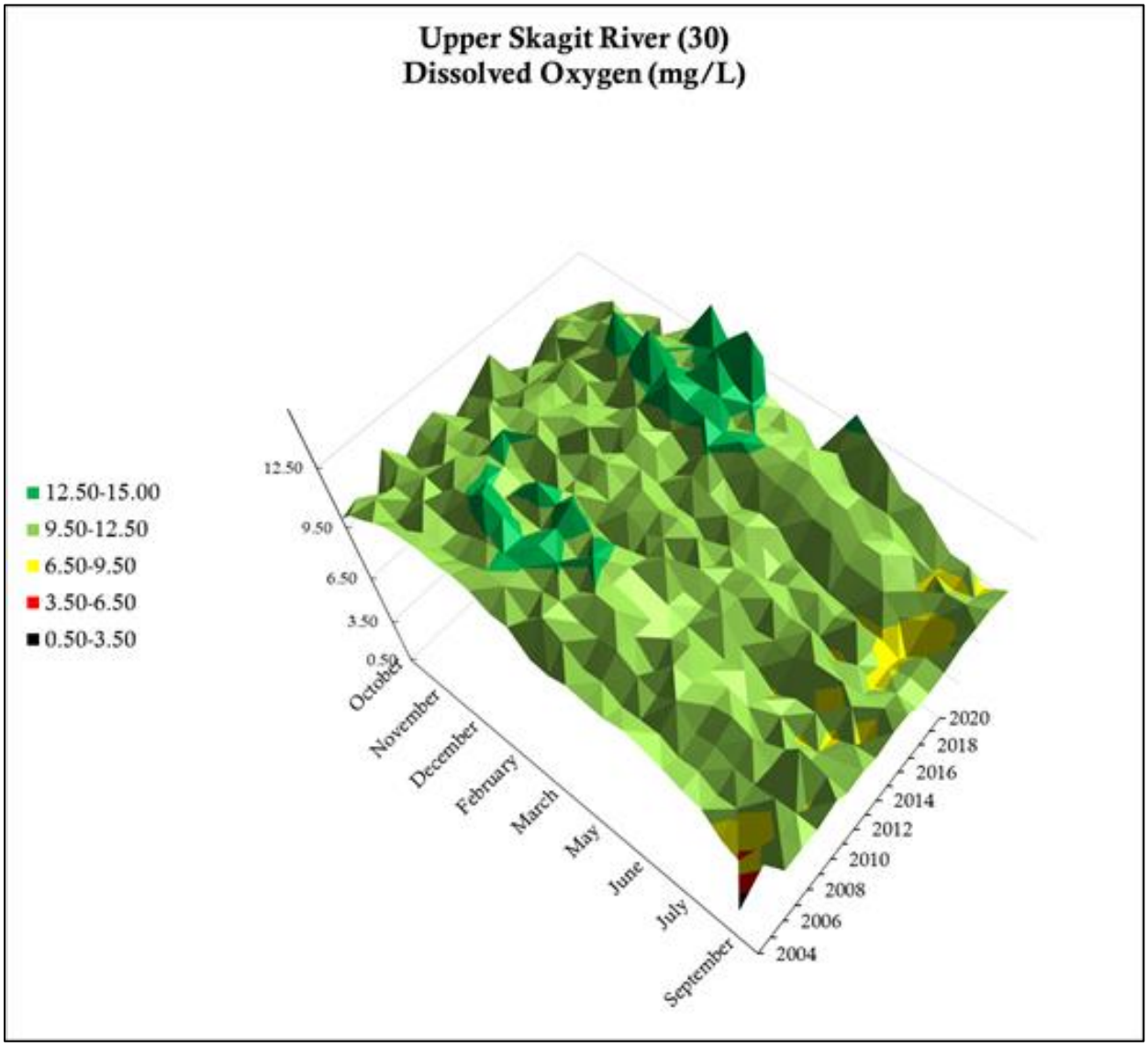


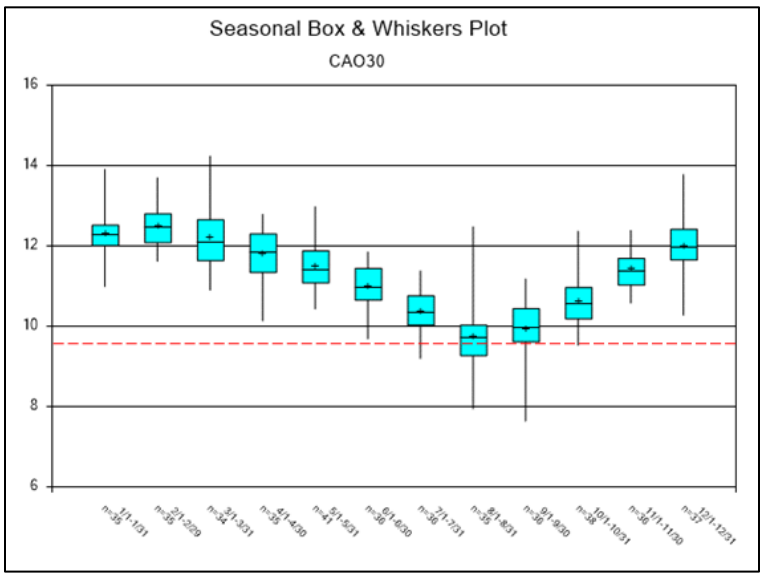
Site 30 is the Skagit River, at its furthest upstream sampling point for this program, east of Hamilton. The river is designated as core salmonid habitat.

Dissolved oxygen has nearly significantly increased over the last 17 years and ten years. Water temperature is warmer now than it was ten years ago. WQI scores are consistently in the category of least concern.

Site 30 rarely fails to meet state standards for DO and water temperature, and only ever at the very warmest days of the year. Annual FC levels easily meet state standards.

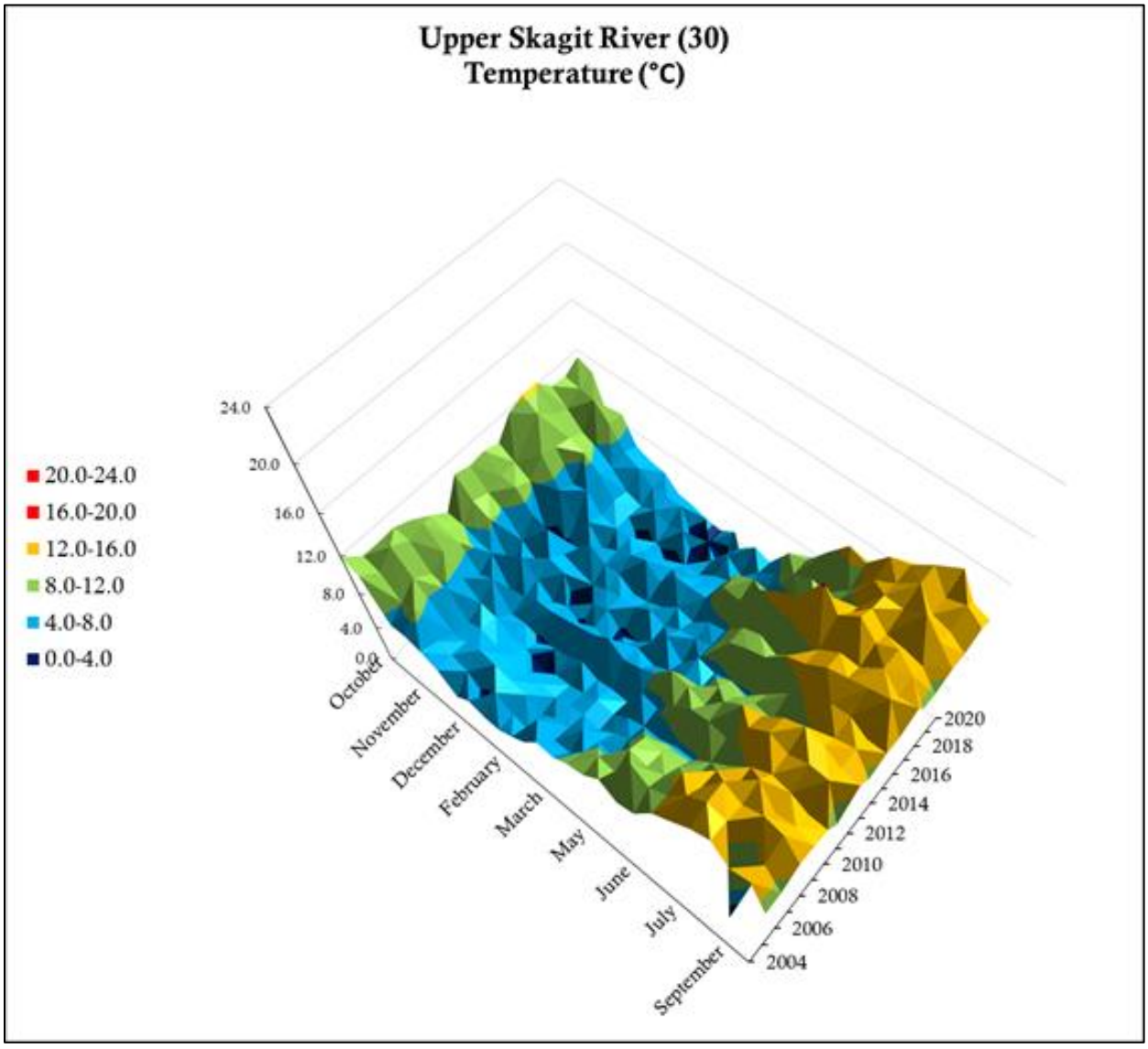
Site 30 is tied for 12th out of 39 sites for number of significant trends, with 13, and is tied for 18th out of 39 sites for positive trends, with 62%.

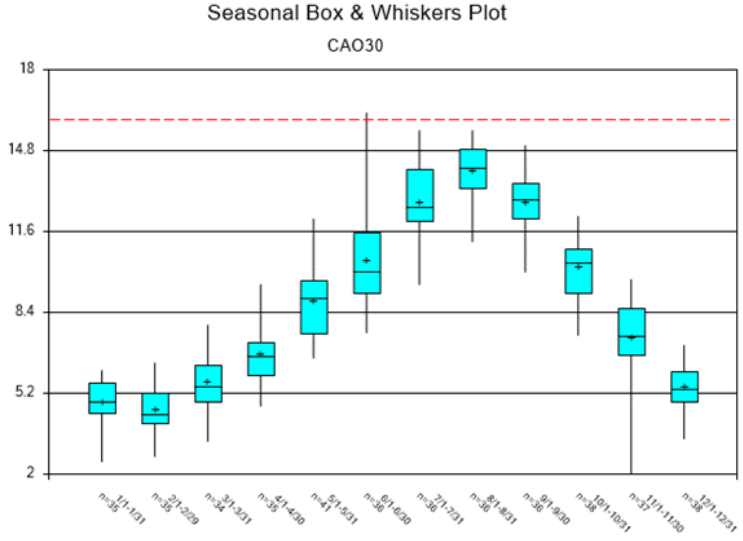




The dissolved oxygen (DO) standard for this site is 9.50 mg/L. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.

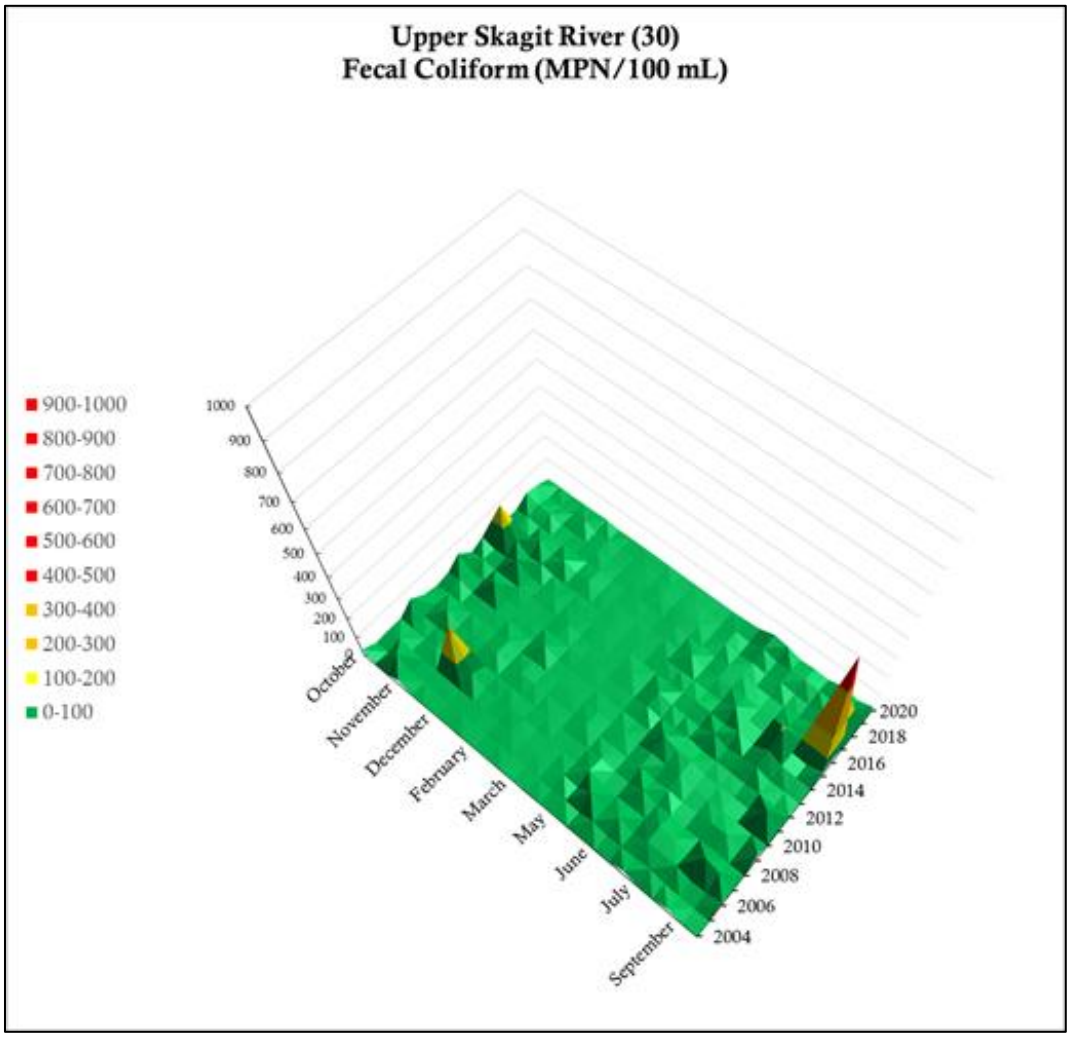
The dashed red line on the monthly box plot represents the 9.5 mg/L standard, and is approximate. The calendar year on the x-axis begins in January and ends in December.

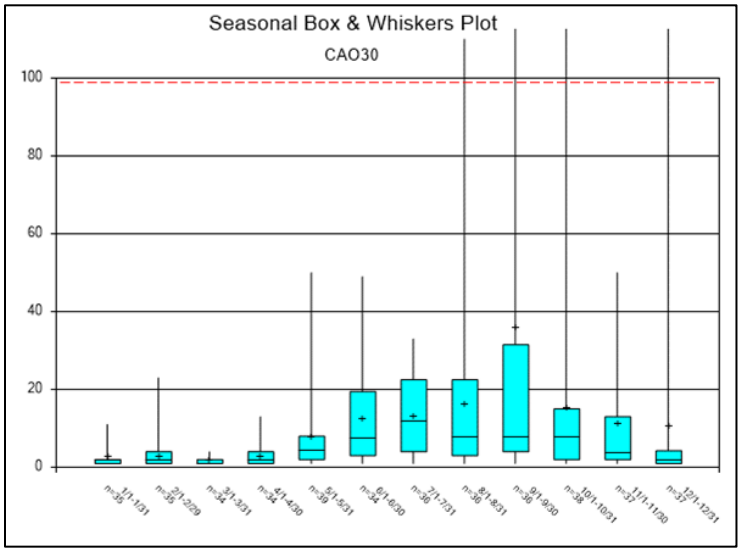




The temperature standard for this site is 16.0 °C. Any part of the 3D plot that is in red is hotter than that standard. The water year on the x-axis begins in October and ends in September.

The dashed red line on the monthly box plot represents the 16.0 °C standard, and is approximate. The calendar year on the x-axis begins in January and ends in December.





The fecal coliform (FC) standard for this site is 100 MPN/100 mL. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.

The dashed red line on the monthly box plot represents the 100 MPN/100 mL standard, and is approximate. The calendar year on the x-axis begins in January and ends in December.

32

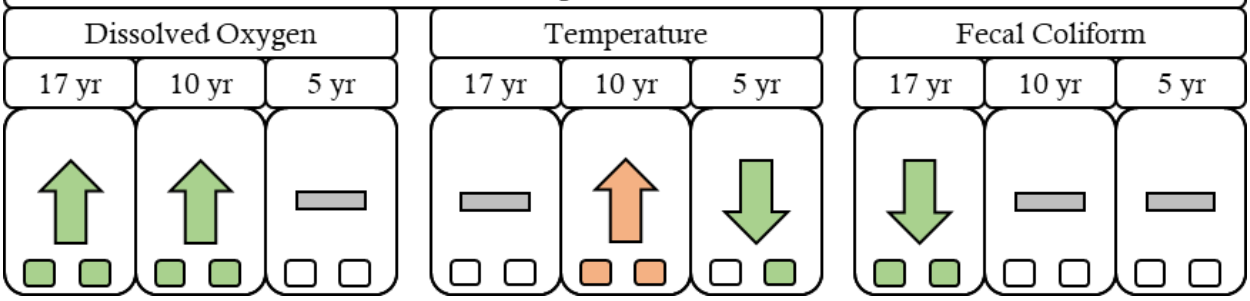
Samish River
@ Thomas Road

Downstream Ag

Water Quality Index (WQI)

2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
34	47	43	75	83	92	70	89	88	83	80	84	93	91	83

Long Term Trends

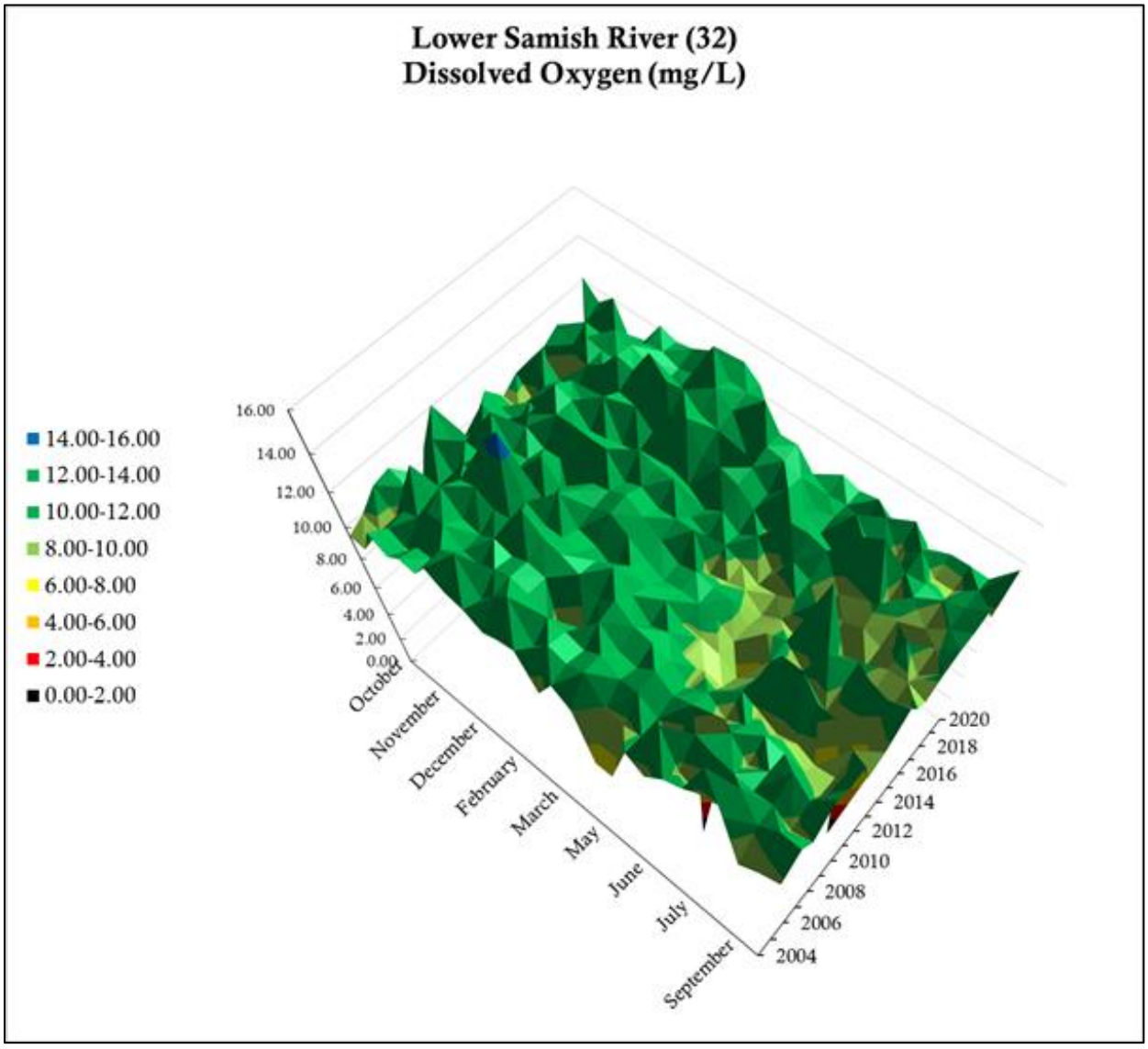


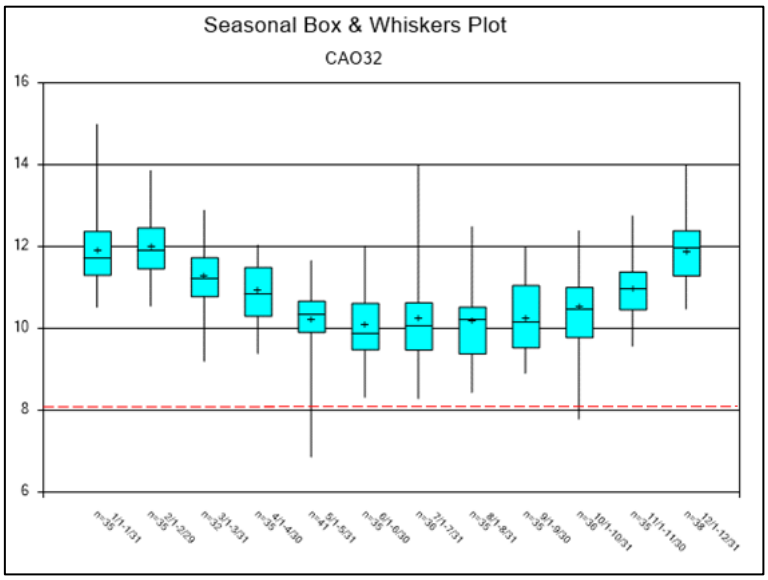
Site 32 is the Samish River, and is the last site that is sampled by this program prior to the river terminating in Samish Bay. The Samish River's watershed contains expansive agricultural activity. This site is designated as salmonid spawning, rearing, and migration (SRM) status.

Dissolved oxygen has increased over the last 17 and ten years. Water temperatures have increased since ten years ago, but have decreased in the most recent five years. Fecal coliform counts are lower now than they were when this program began. WQI Scores have improved over the length of this program and are now consistently in the category of least concern.

Site 32 almost never fails to meet state standards for DO, but typically exceeds state standards for water temperature during the warmer months of the year. Annual FC levels easily pass the state standard for geomean of 100, but fail the state standard for a 90th percentile of 200.

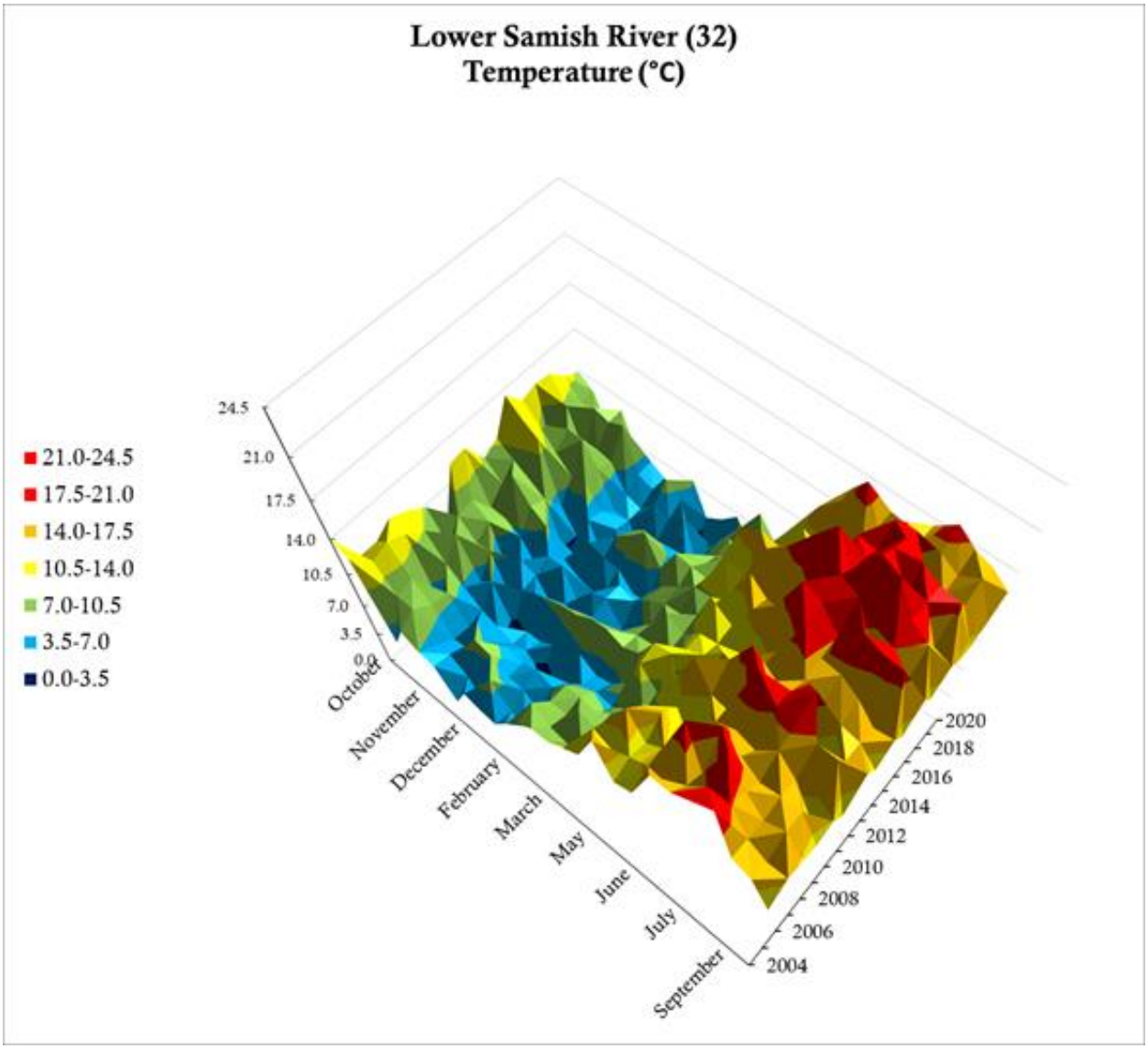
Site 32 is tied for 4th out of 39 sites for number of significant trends, with 18, and is 3rd out of 39 sites for positive trends, with 88%.

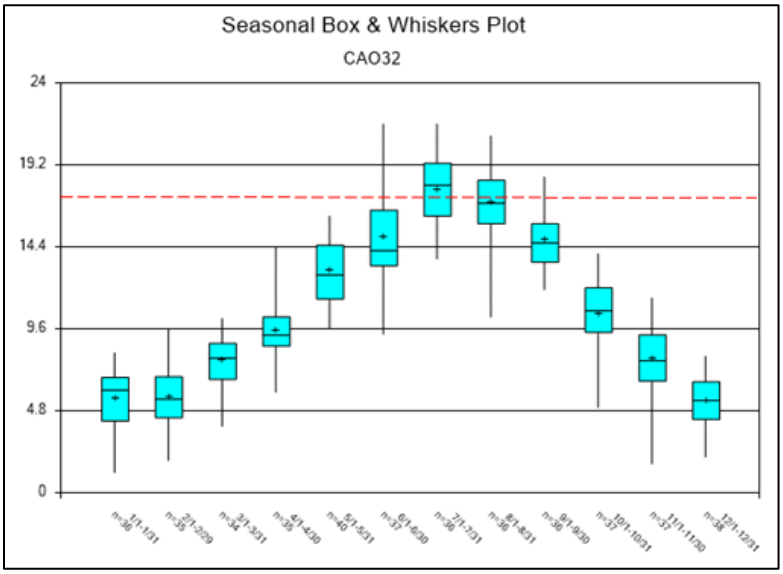




The dissolved oxygen (DO) standard for this site is 8.0 mg/L. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.

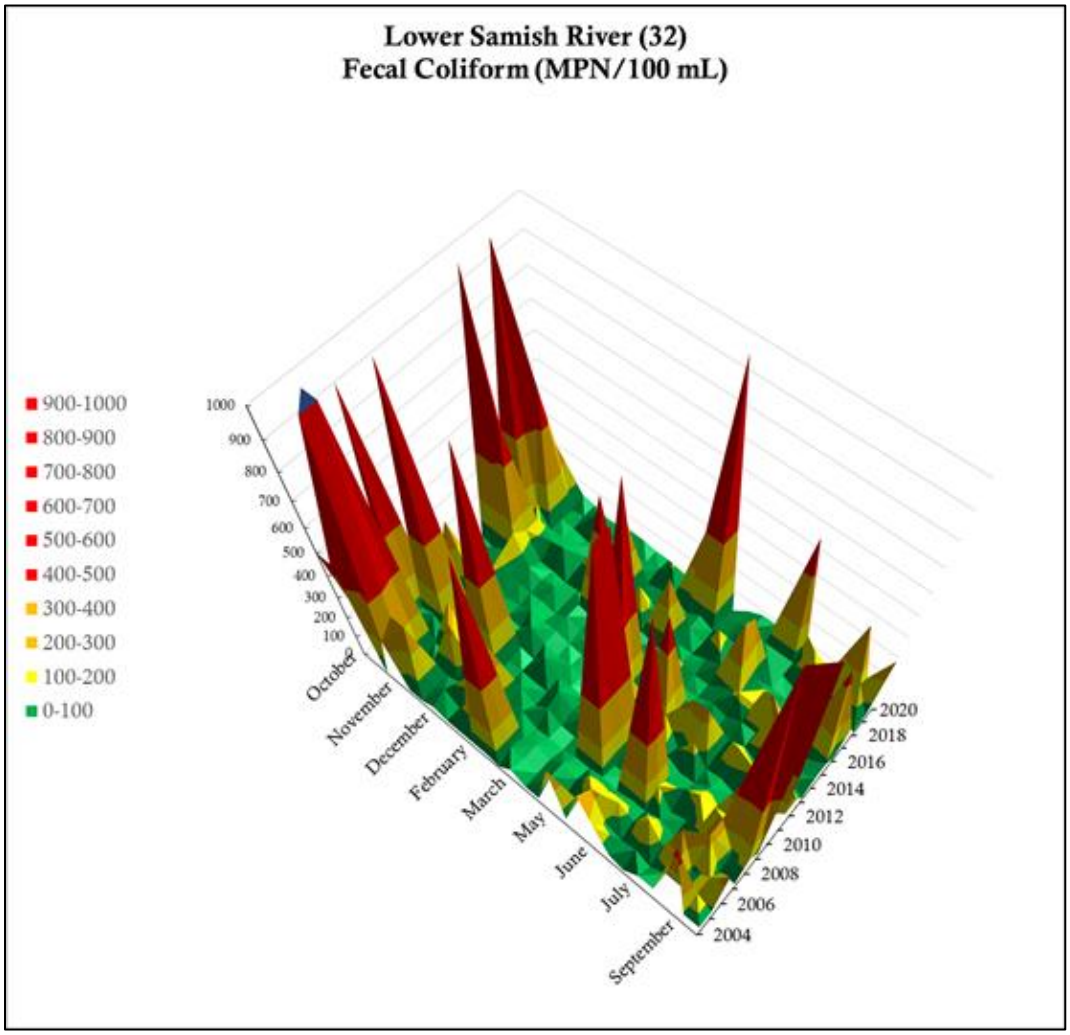
The dashed red line on the monthly box plot represents the 8.0 mg/L standard, and is approximate. The calendar year on the x-axis begins in January and ends in December.

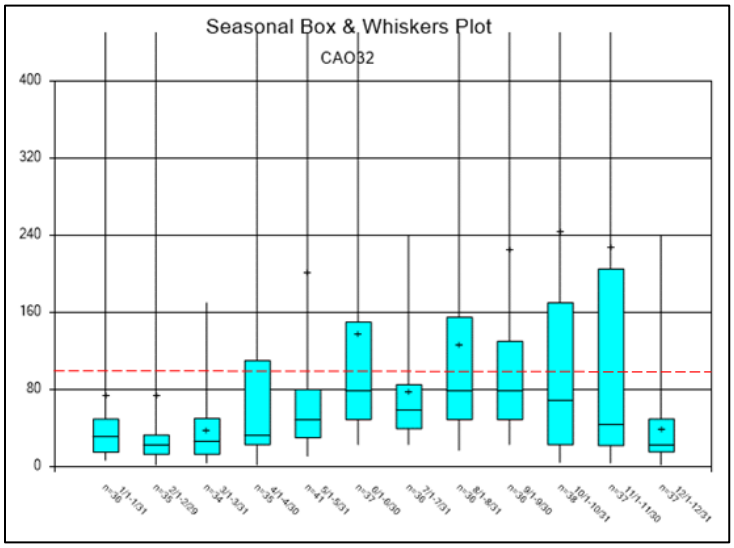




The temperature standard for this site is 17.5 °C. Any part of the 3D plot that is in red is hotter than that standard. The water year on the x-axis begins in October and ends in September.

The dashed red line on the monthly box plot represents the 17.5 °C standard, and is approximate. The calendar year on the x-axis begins in January and ends in December.





The fecal coliform (FC) standard for this site is 100 MPN/100 mL. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.

The dashed red line on the monthly box plot represents the 100 MPN/100 mL standard, and is approximate. The calendar year on the x-axis begins in January and ends in December.

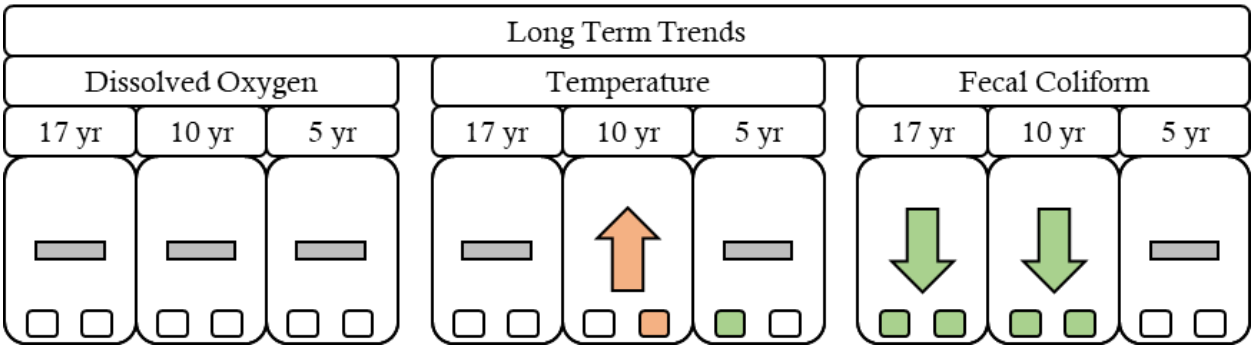
33

Alice Bay Pump Station
@ Samish Island Road

Downstream Ag

Water Quality Index (WQI)

2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
2	5	6	15	12	33	37	24	17	24	23	35	42	16	26

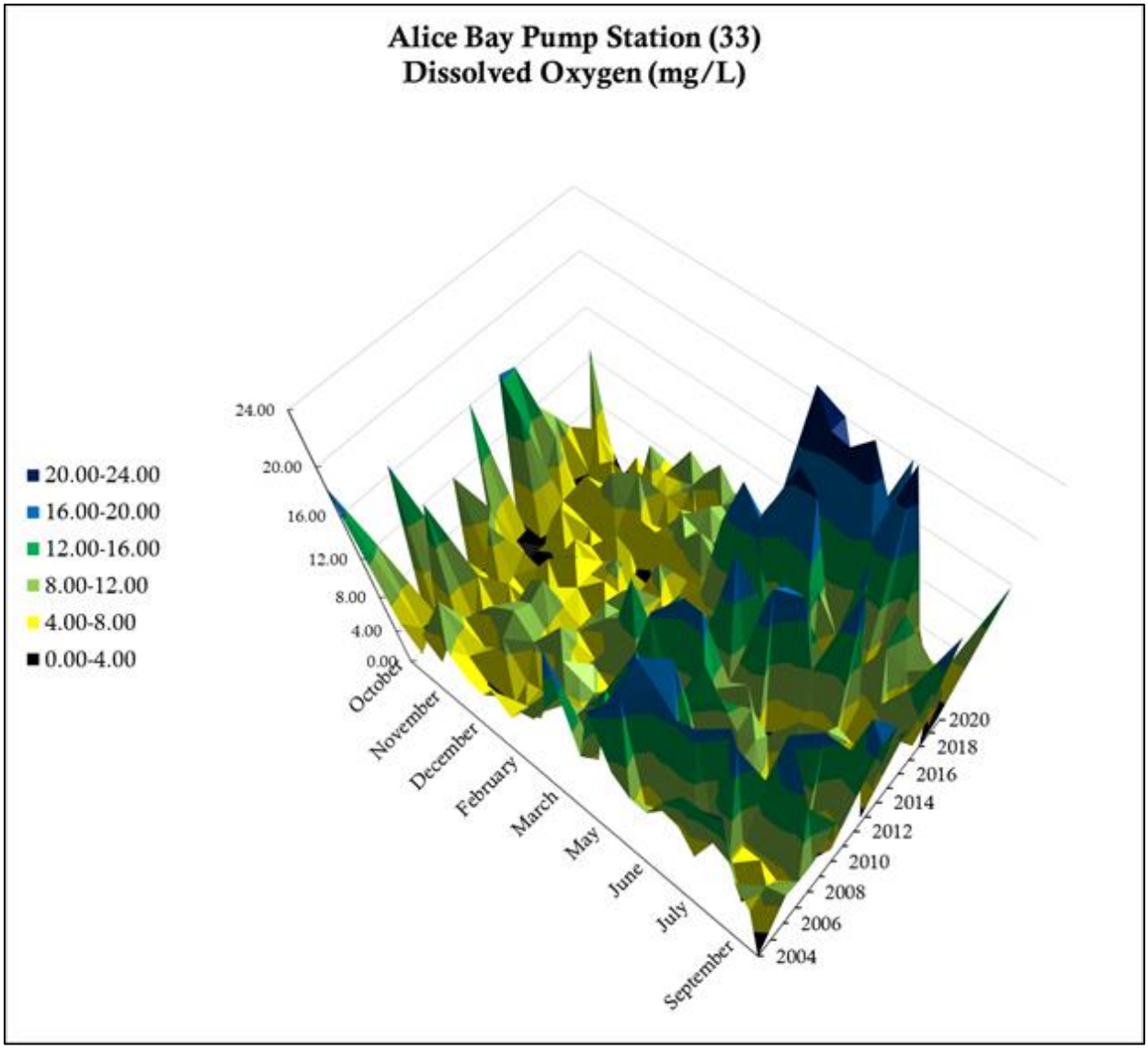


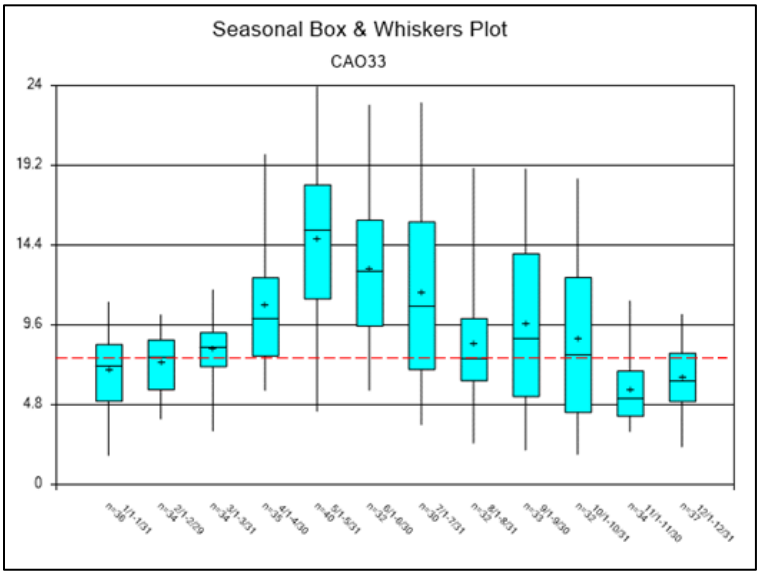
Site 33 is the pump station for the agricultural drainage ditches at Alice Bay, just to the west of the mouth of the Samish River. Sites like this are characterized by being stagnant or slow-moving, and are heavily tidally-influenced. This site is designated as salmonid spawning, rearing, and migration (SRM) status.

The water temperature has increased since ten years ago. Fecal coliform counts at this site have declined over the last 17 years and the last ten years. WQI scores are consistently in the category of highest concern.

Site 33 regularly fails to meet state standards for DO and water temperature. Annual FC levels pass the state standard for geomean of 100, but narrowly fail the state standard for a 90th percentile of 200.

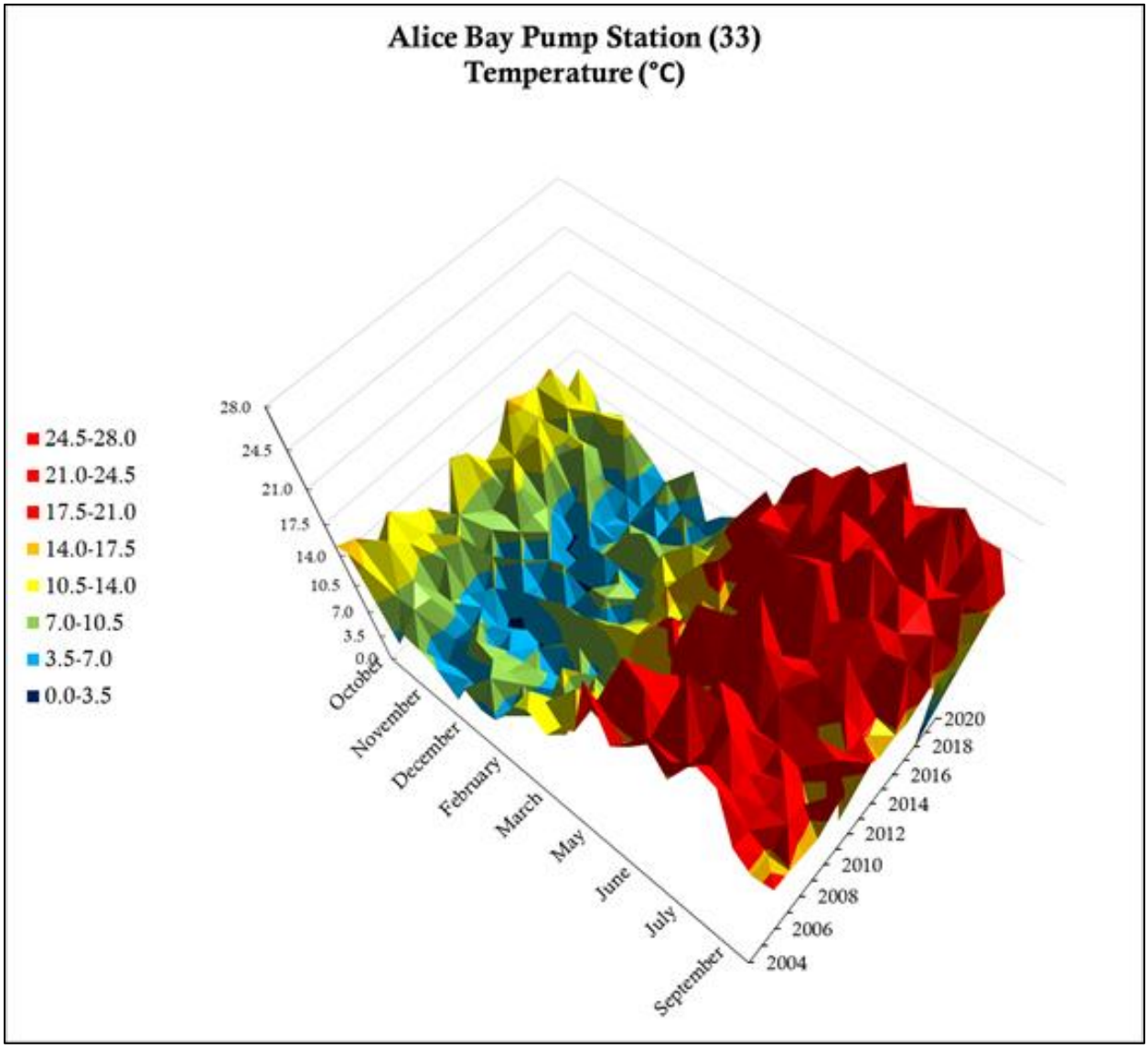
Site 33 is tied for 20th out of 39 sites for number of significant trends, with 12, and is tied for 14th out of 39 sites for positive trends, with 67%.

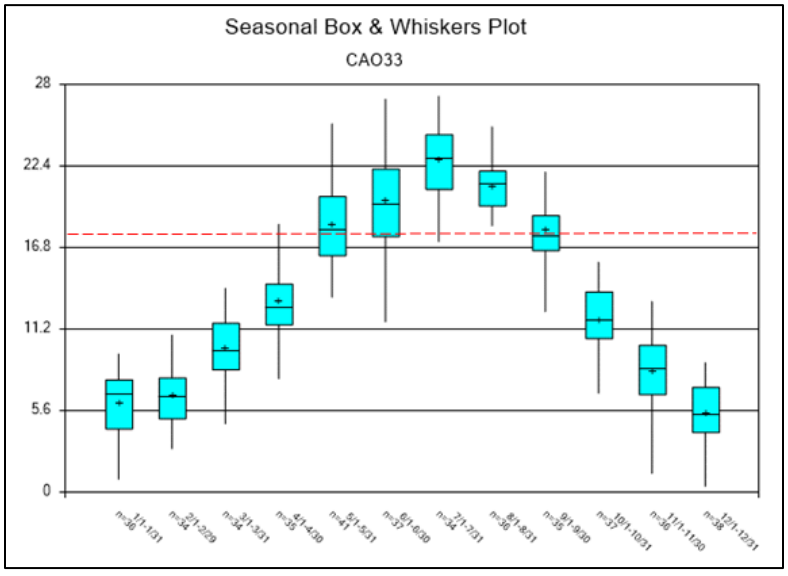




The dissolved oxygen (DO) standard for this site is 8.0 mg/L. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.

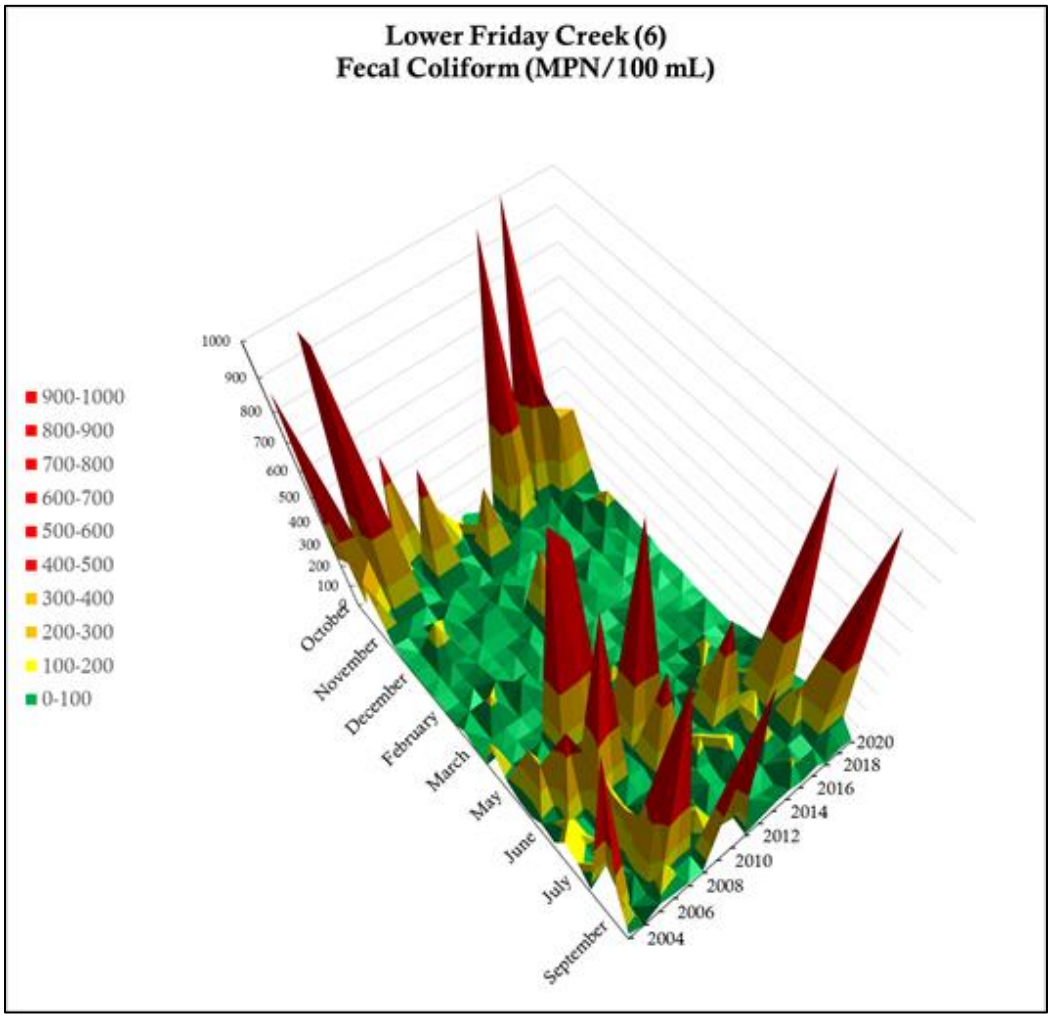
The dashed red line on the monthly box plot represents the 8.0 mg/L standard, and is approximate. The calendar year on the x-axis begins in January and ends in December.

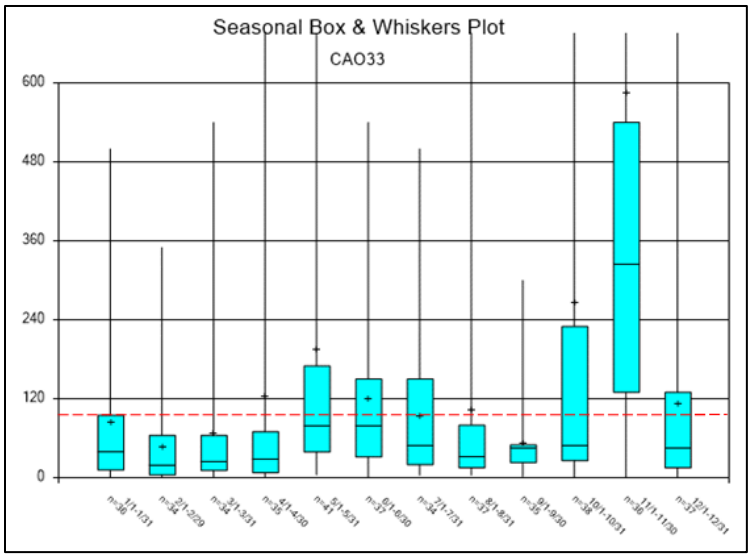




The temperature standard for this site is 17.5 °C. Any part of the 3D plot that is in red is hotter than that standard. The water year on the x-axis begins in October and ends in September.

The dashed red line on the monthly box plot represents the 17.5 °C standard, and is approximate. The calendar year on the x-axis begins in January and ends in December.





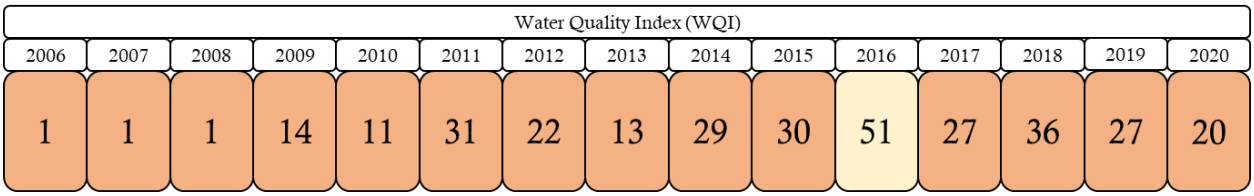
The fecal coliform (FC) standard for this site is 100 MPN/100 mL. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.

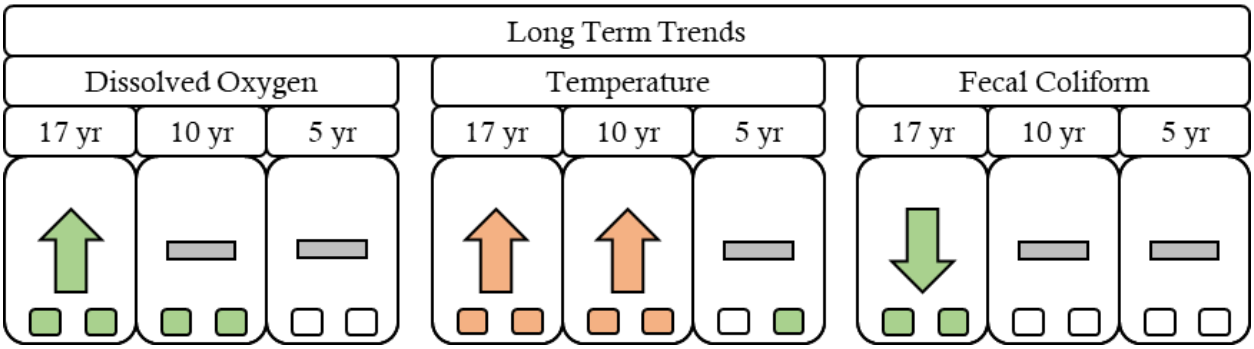
The dashed red line on the monthly box plot represents the 100 MPN/100 mL standard, and is approximate. The calendar year on the x-axis begins in January and ends in December.

34

No Name Slough
@ Bayview-Edison Road

Downstream Ag



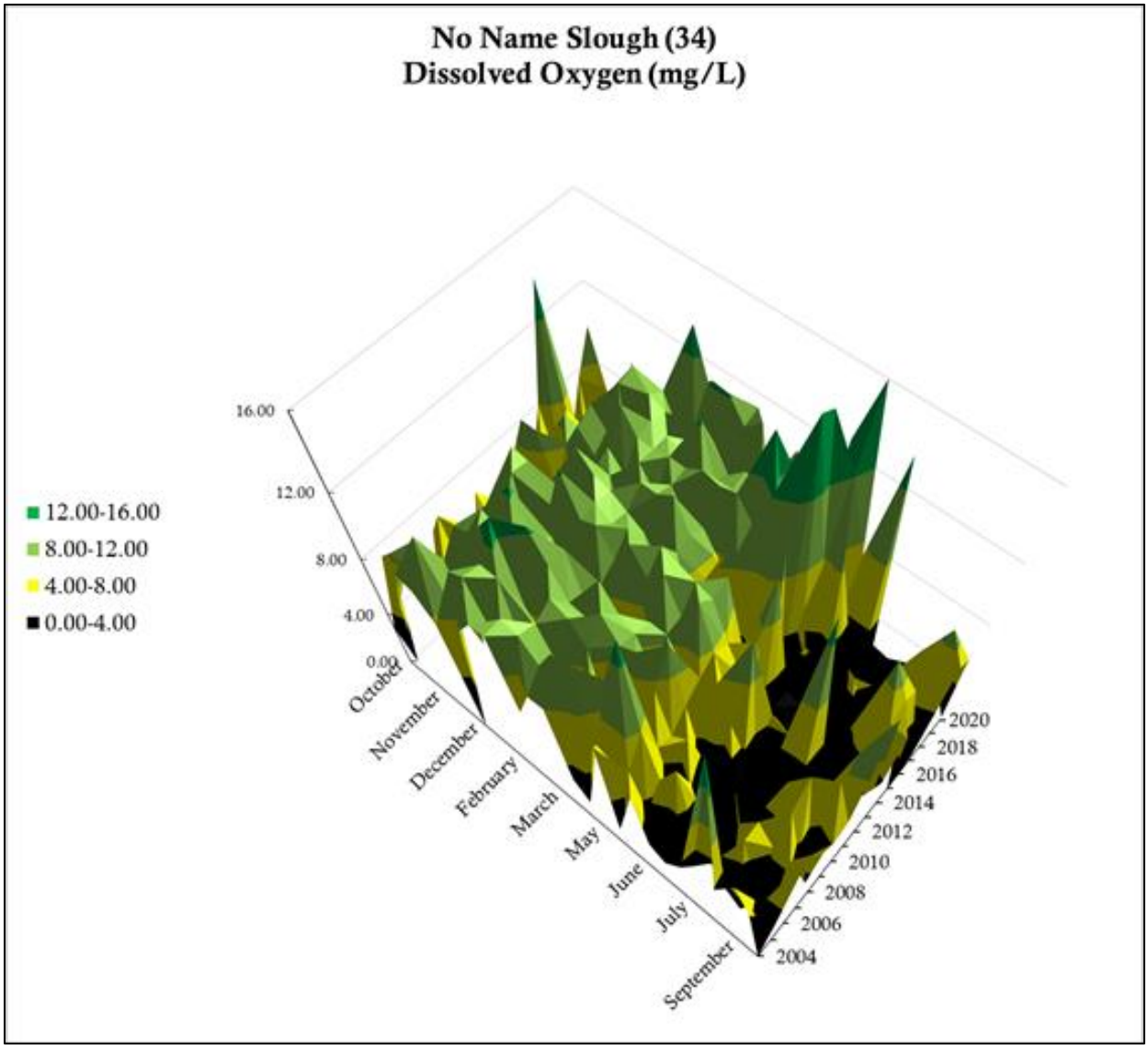


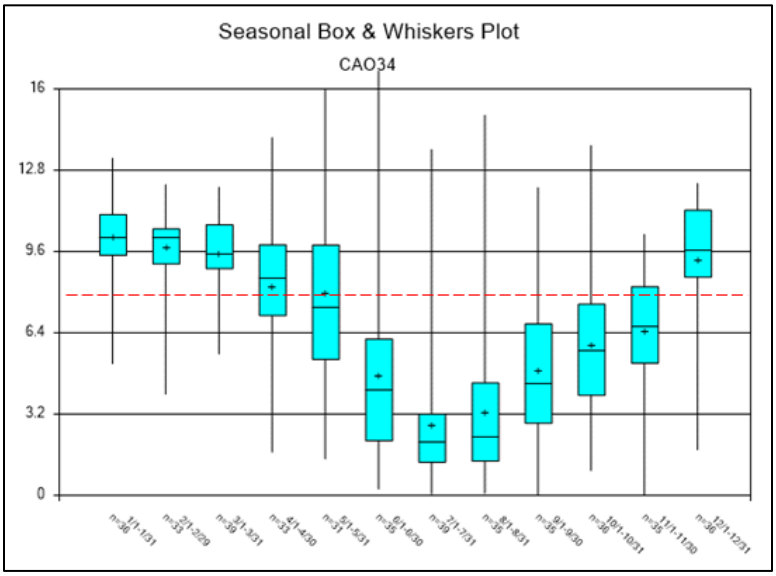
Site 34 is No Name Slough, west of the Skagit Regional Airport, and just prior to terminating in Padilla Bay. Sites like this are characterized by being stagnant or slow-moving, and are heavily tidally-influenced. This site is designated as salmonid spawning, rearing, and migration (SRM) status.

Dissolved oxygen has increased since this program began 17 years ago. Water temperatures are warmer now than they were at the beginning of the program and 10 years ago. Fecal coliform counts are lower than they were at the beginning of this program 17 years ago.

Site 34 regularly fails to meet state standards for DO and water temperature. Annual FC levels narrowly pass the state standard for geomean of 100, but strongly fail the state standard for a 90th percentile of 200.

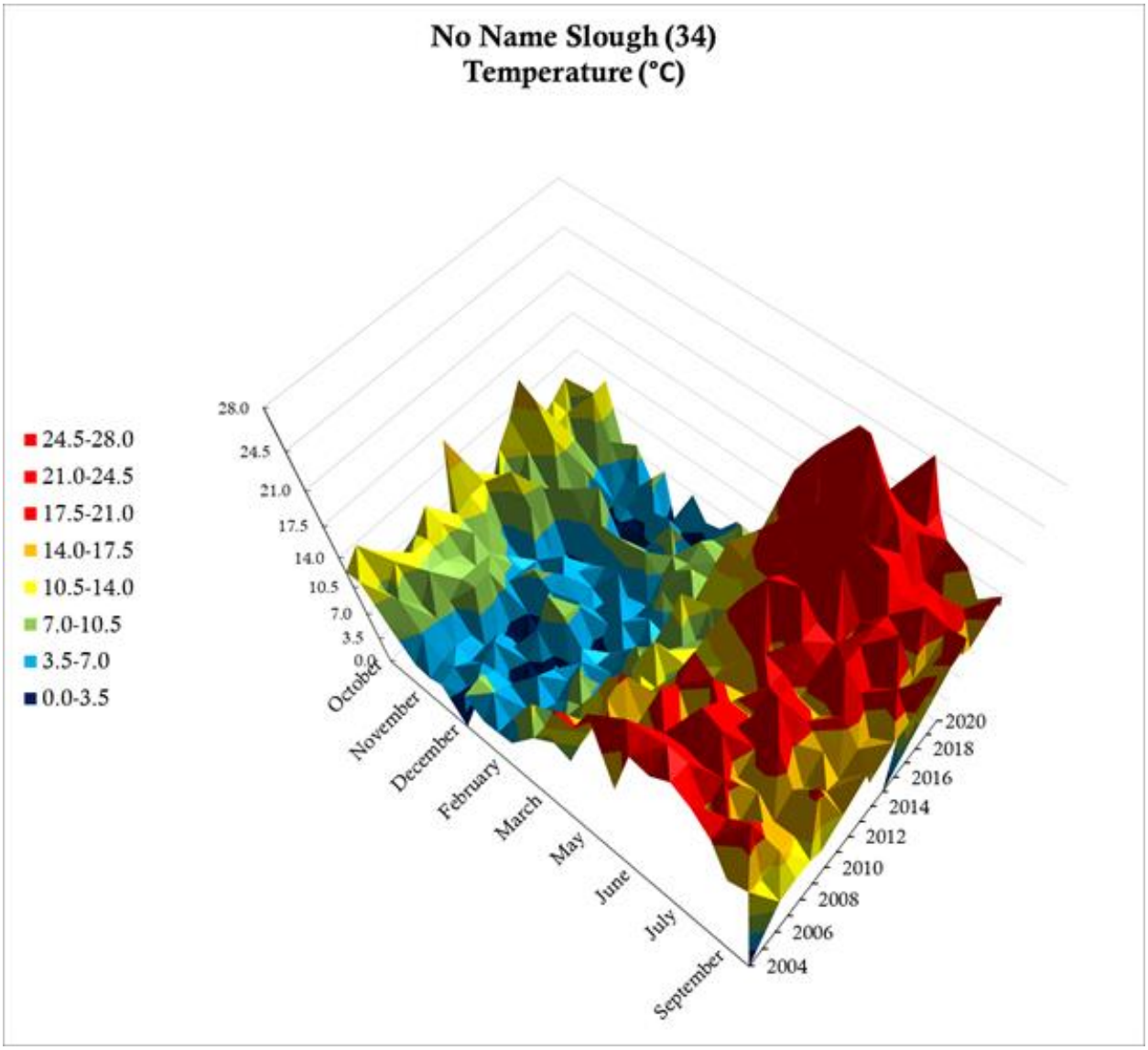
Site 34 is 1st out of 39 sites for number of significant trends, with 19, and is tied for 20th out of 39 sites for positive trends, with 58%.

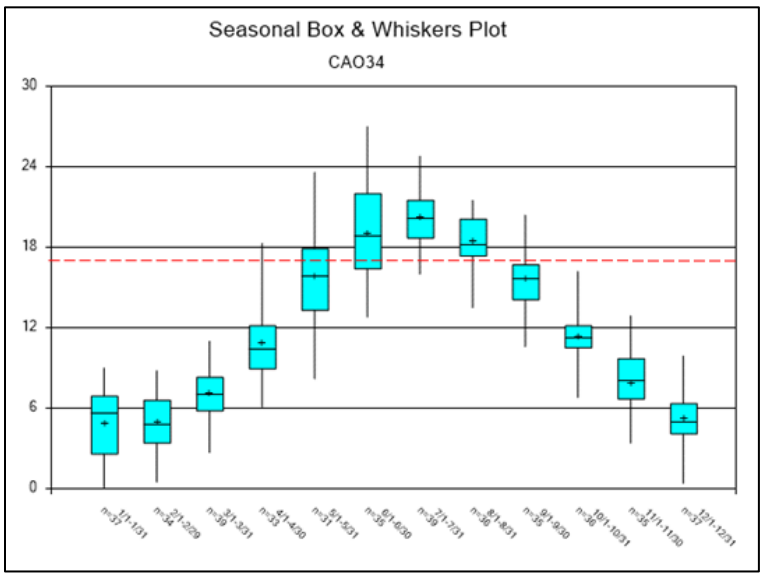




The dissolved oxygen (DO) standard for this site is 8.0 mg/L. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.

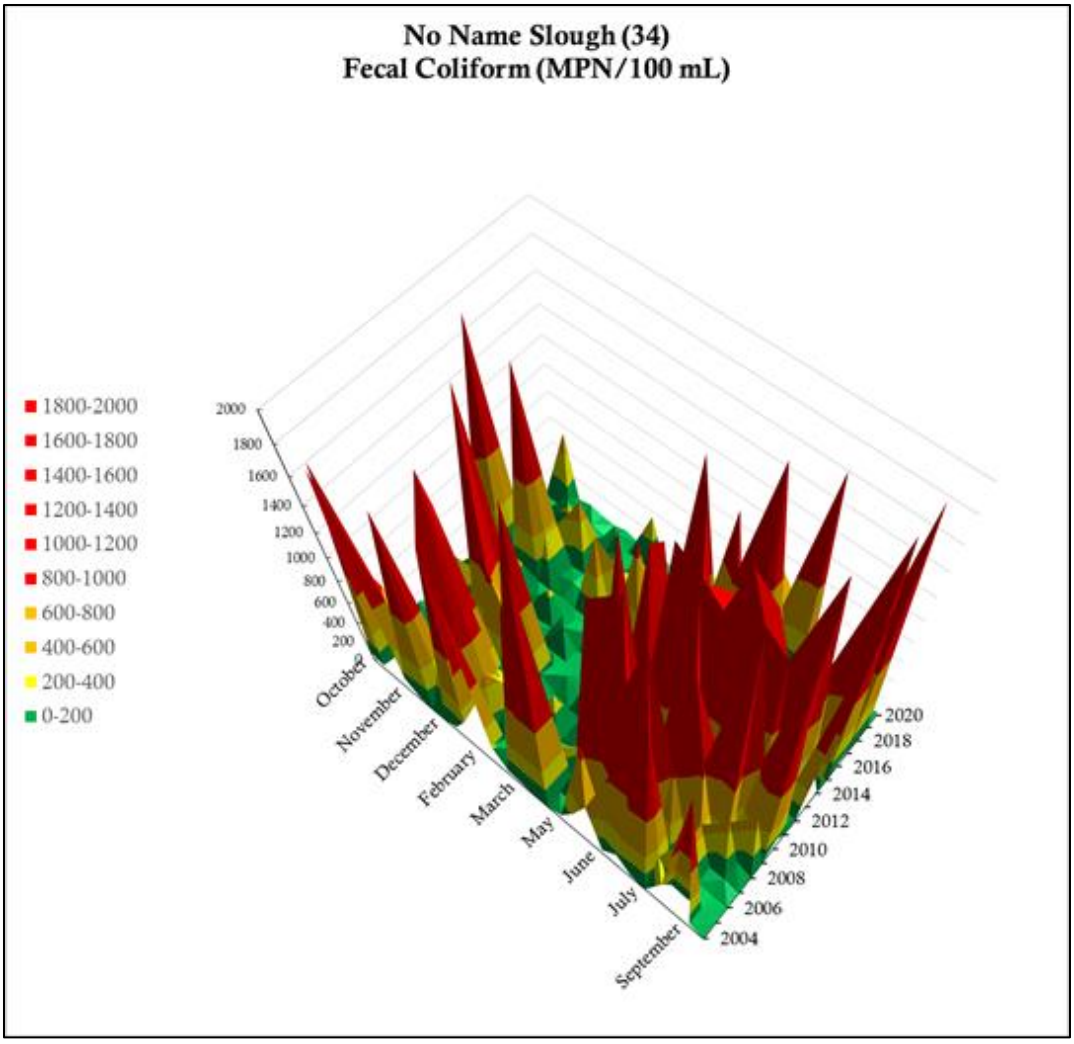
The dashed red line on the monthly box plot represents the 8.0 mg/L standard, and is approximate. The calendar year on the x-axis begins in January and ends in December.

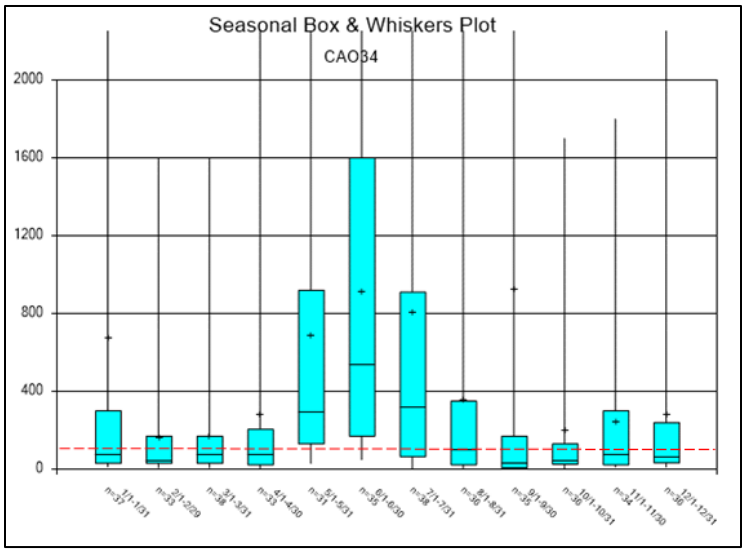




The temperature standard for this site is 17.5 °C. Any part of the 3D plot that is in red is hotter than that standard. The water year on the x-axis begins in October and ends in September.

The dashed red line on the monthly box plot represents the 17.5 °C standard, and is approximate. The calendar year on the x-axis begins in January and ends in December.





The fecal coliform (FC) standard for this site is 100 MPN/100 mL. Any part of the 3D plot that is in green almost meets that standard. The water year on the x-axis begins in October and ends in September.

The dashed red line on the monthly box plot represents the 100 MPN/100 mL standard, and is approximate. The calendar year on the x-axis begins in January and ends in December.

35

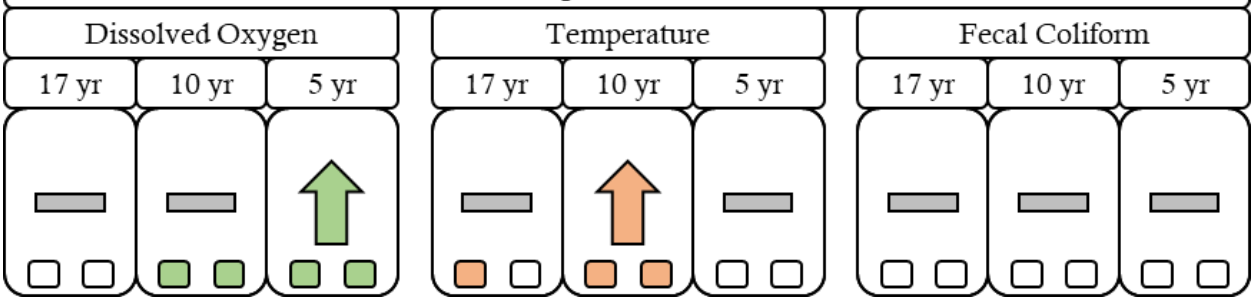
Joe Leary Slough
@ D'Arcy Road

Downstream Ag

Water Quality Index (WQI)

2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
1	1	6	15	9	24	22	14	8	15	13	24	5	15	29

Long Term Trends

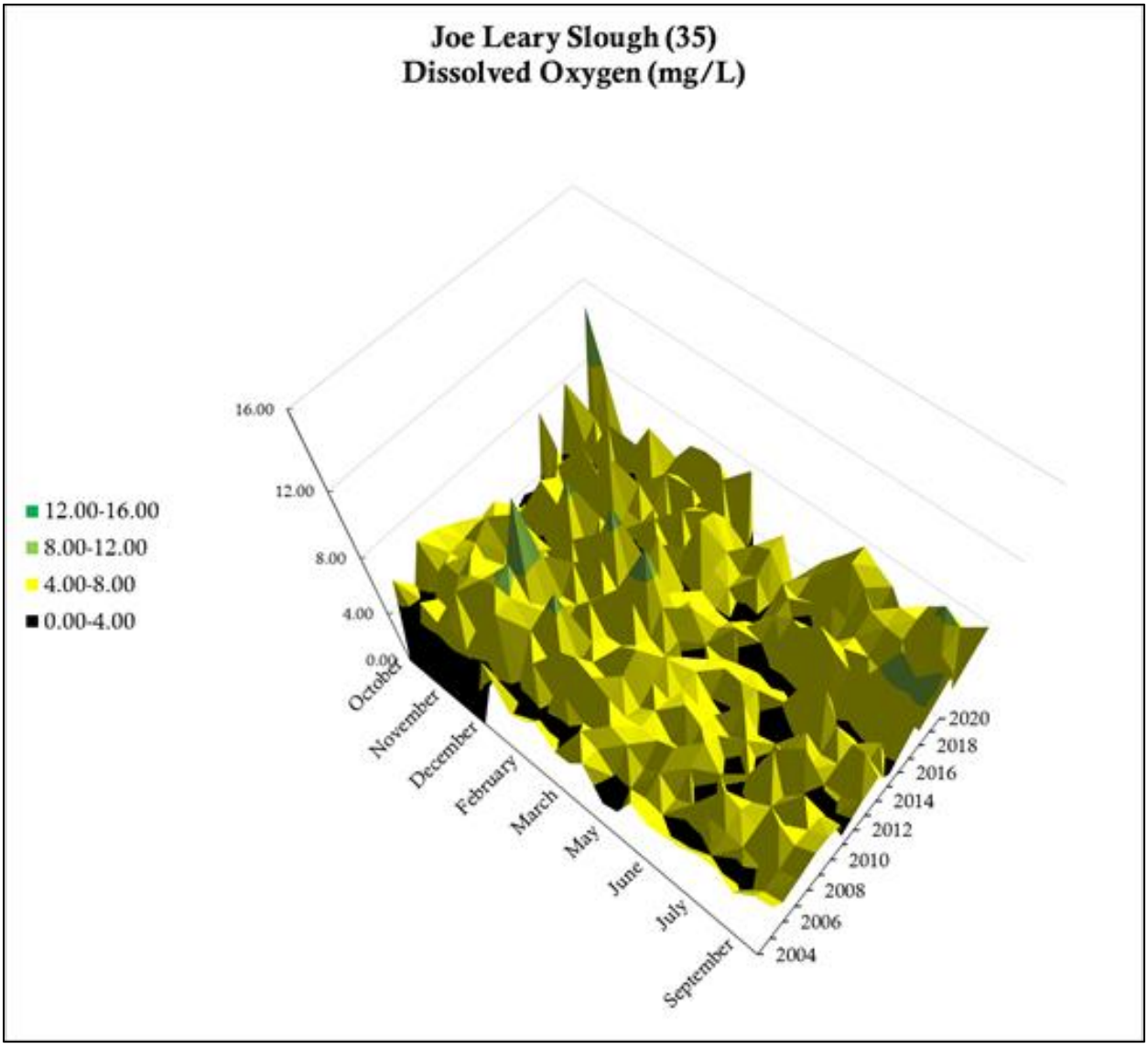


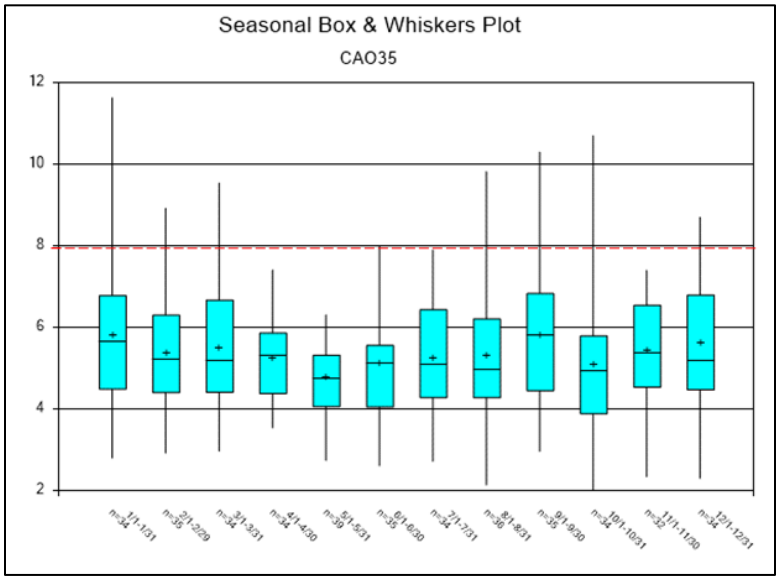
Site 35 is Joe Leary Slough, just prior to where it enters Padilla Bay. This slough was constructed for agricultural drainage and was not naturally formed. Sites like this are characterized by being stagnant or slow-moving, and are heavily tidally-influenced. This site is designated as salmonid spawning, rearing, and migration (SRM) status.

Dissolved oxygen as increased significantly in the last five years. Water temperatures are higher now than they were ten years ago. WQI scores are consistently in the category of highest concern.

Site 35 very rarely ever meets state standards for DO, and fails to meet state standards for water temperature during the warmer months. Annual FC levels pass the state standard for geomean of 100, but fail the state standard for a 90th percentile of 200.

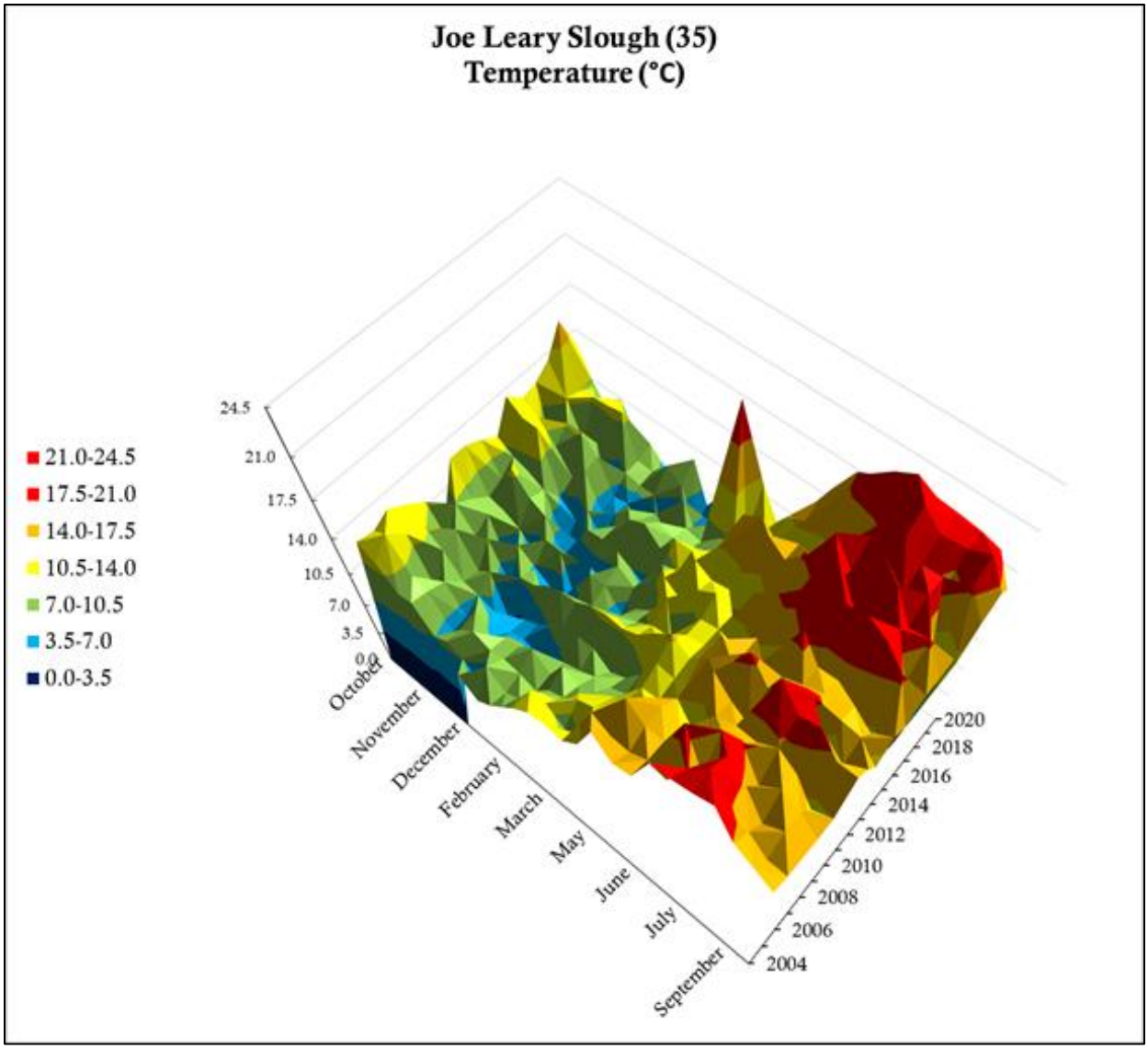
Site 35 is 38th out of 39 sites for number of significant trends, with seven, and is tied for 23rd out of 39 sites for positive trends, with 57%.

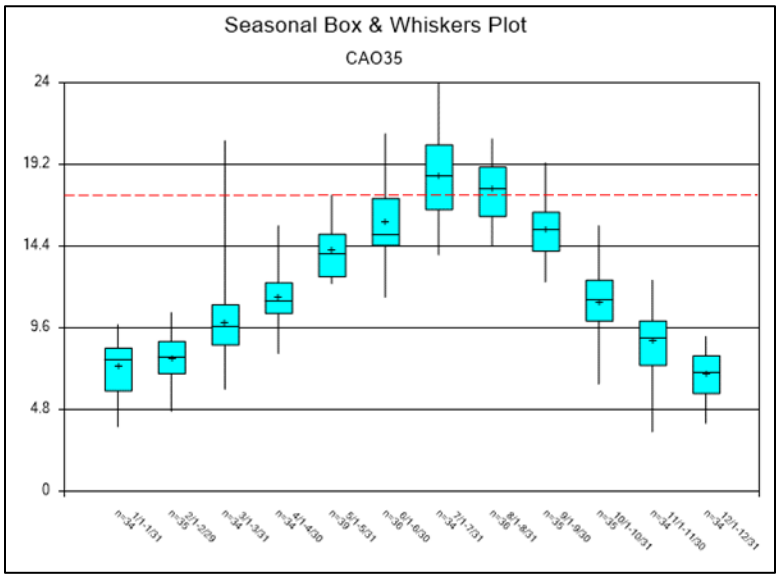




The dissolved oxygen (DO) standard for this site is 8.0 mg/L. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.

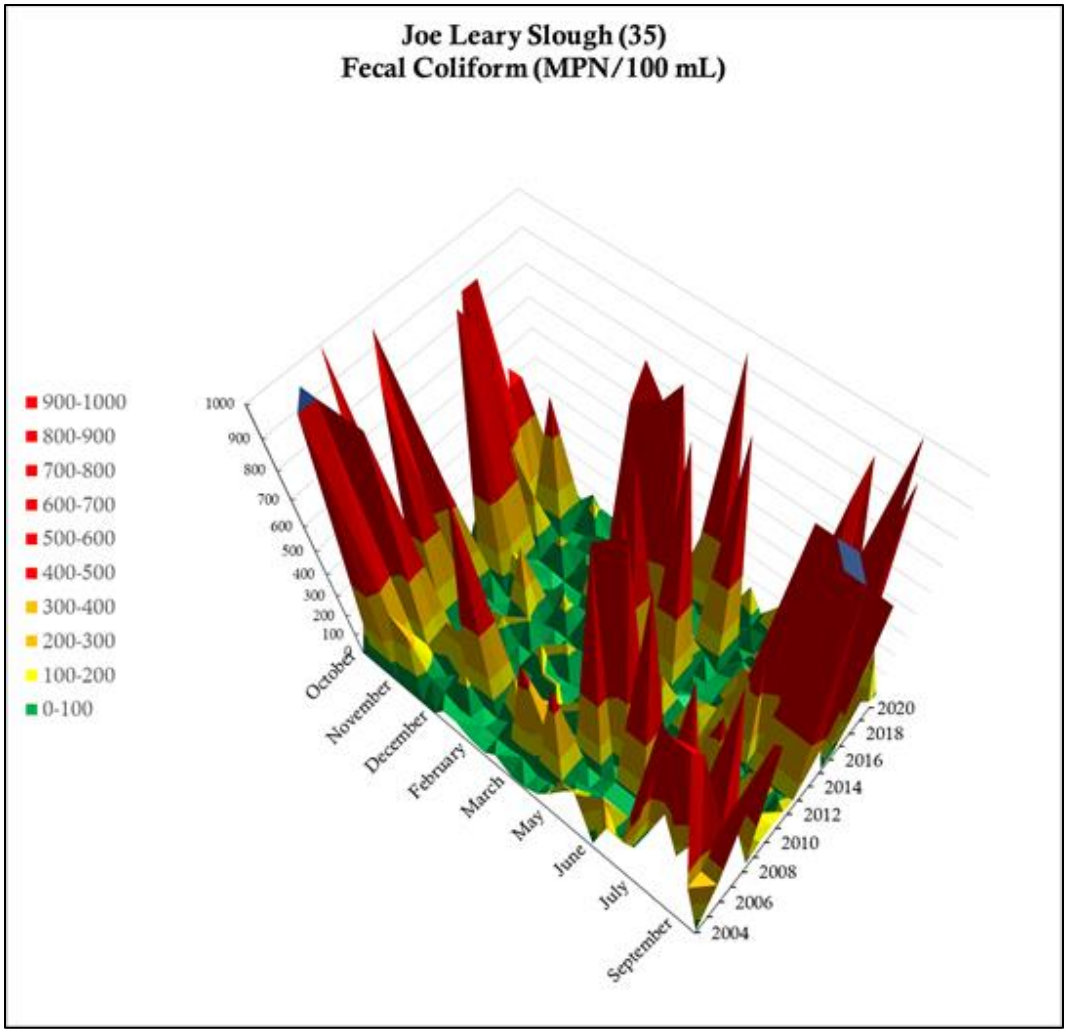
The dashed red line on the monthly box plot represents the 8.0 mg/L standard, and is approximate. The calendar year on the x-axis begins in January and ends in December.

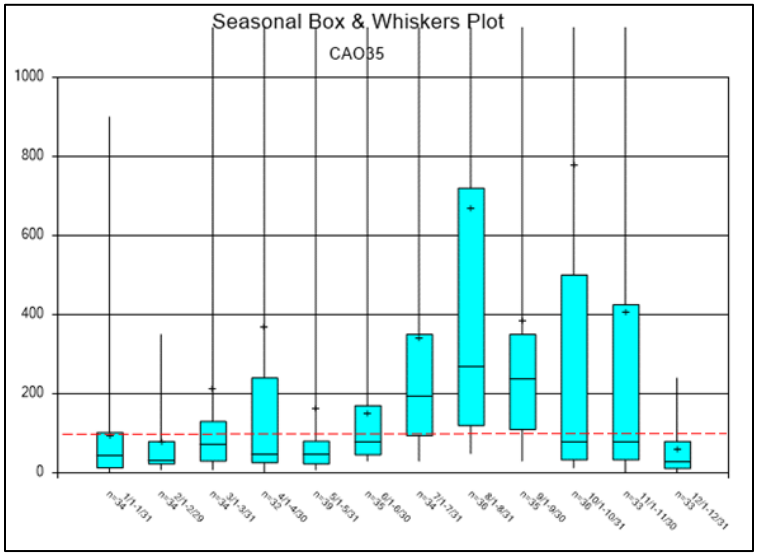




The temperature standard for this site is 17.5 °C. Any part of the 3D plot that is in red is hotter than that standard. The water year on the x-axis begins in October and ends in September.

The dashed red line on the monthly box plot represents the 17.5 °C standard, and is approximate. The calendar year on the x-axis begins in January and ends in December.





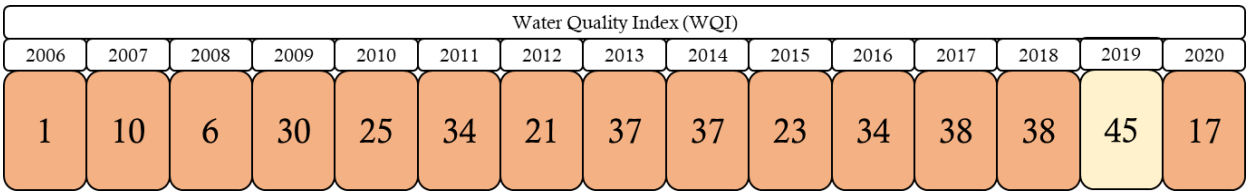
The fecal coliform (FC) standard for this site is 100 MPN/100 mL. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.

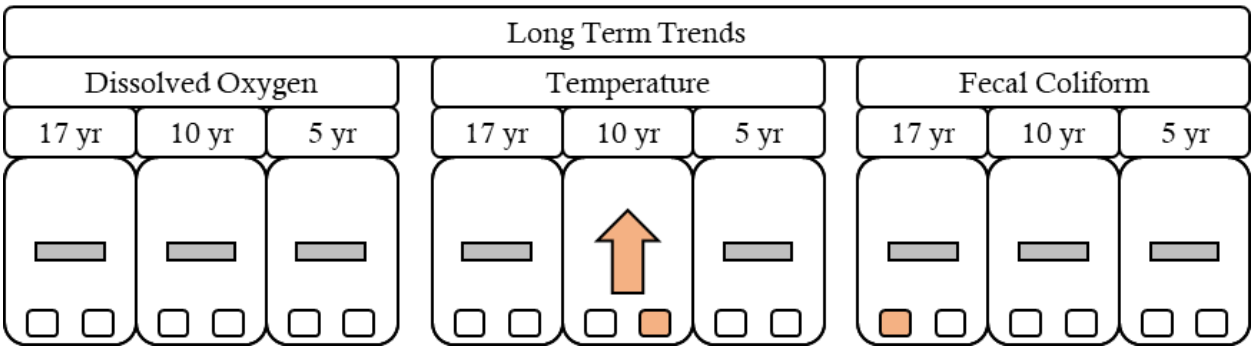
The dashed red line on the monthly box plot represents the 100 MPN/100 mL standard, and is approximate. The calendar year on the x-axis begins in January and ends in December.

36

Edison Slough
@ Edison Elementary

Downstream Ag



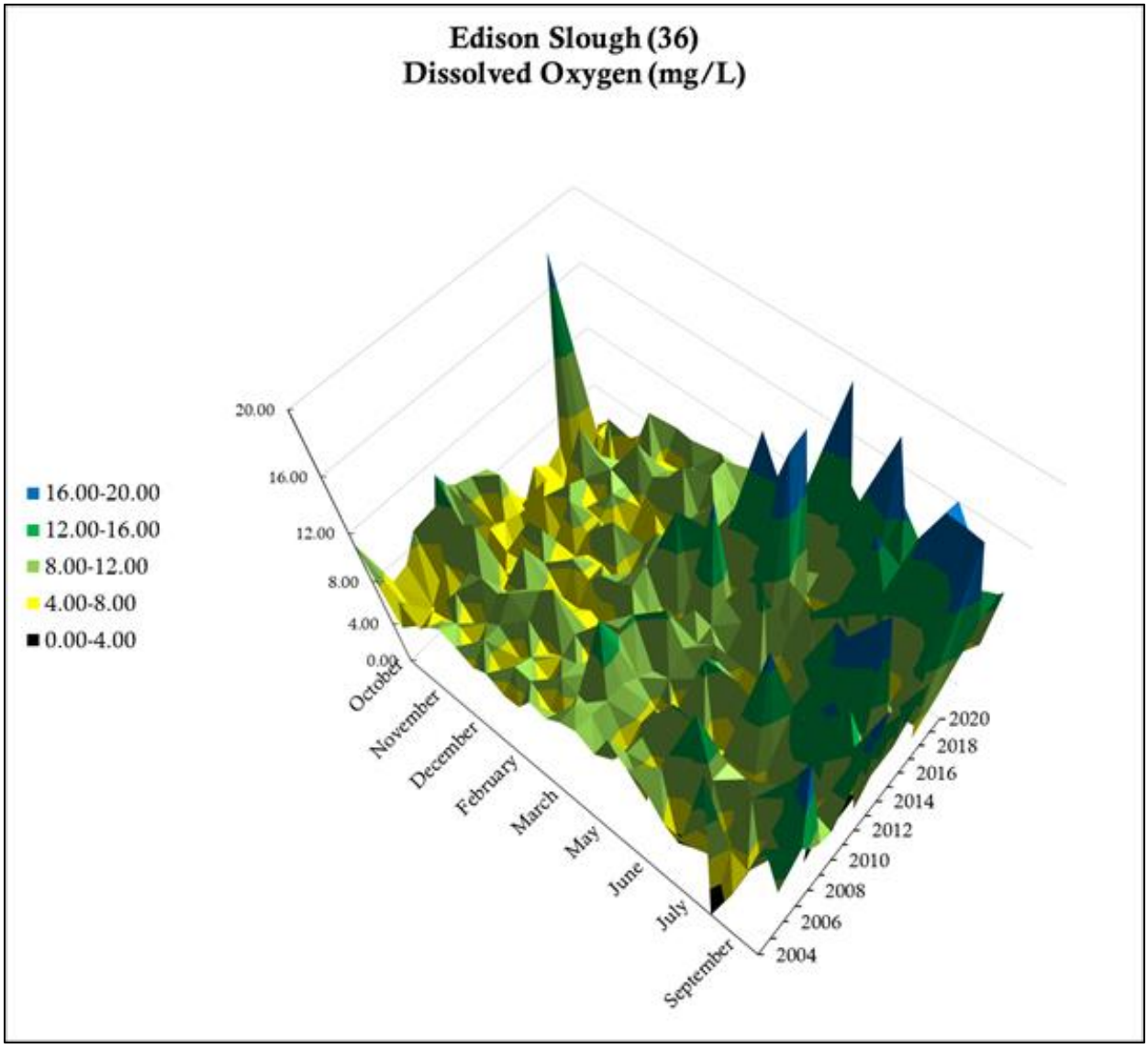


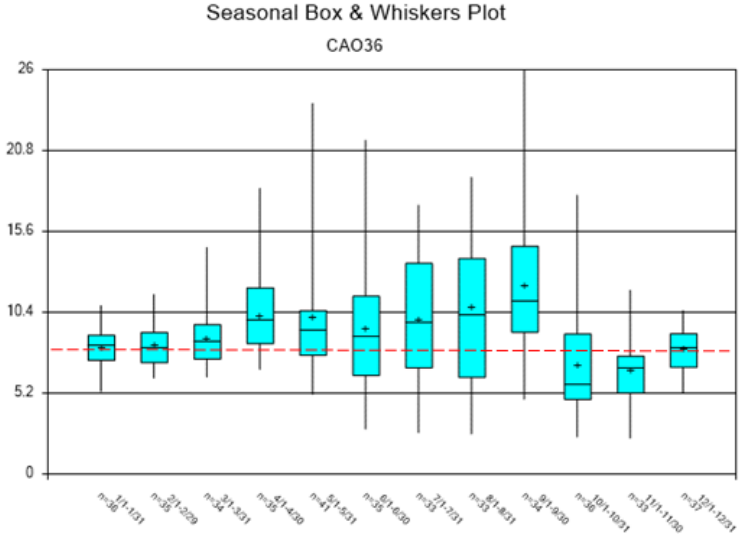
Site 36 is Edison Slough, just prior to the town of Edison and its terminal discharge into Samish Bay. Sites like this are characterized by being stagnant or slow-moving, and are heavily tidally-influenced. This site is designated as salmonid spawning, rearing, and migration (SRM) status.

No monthly trends for DO or FC were observed across any of the time periods analyzed in this report. Temperature has increased compared to ten years ago. WQI scores are consistently in the category of highest concern.

Site 36 regularly fails to meet state standards for DO and water temperature. Annual FC levels for WY2020 did not pass state standards.

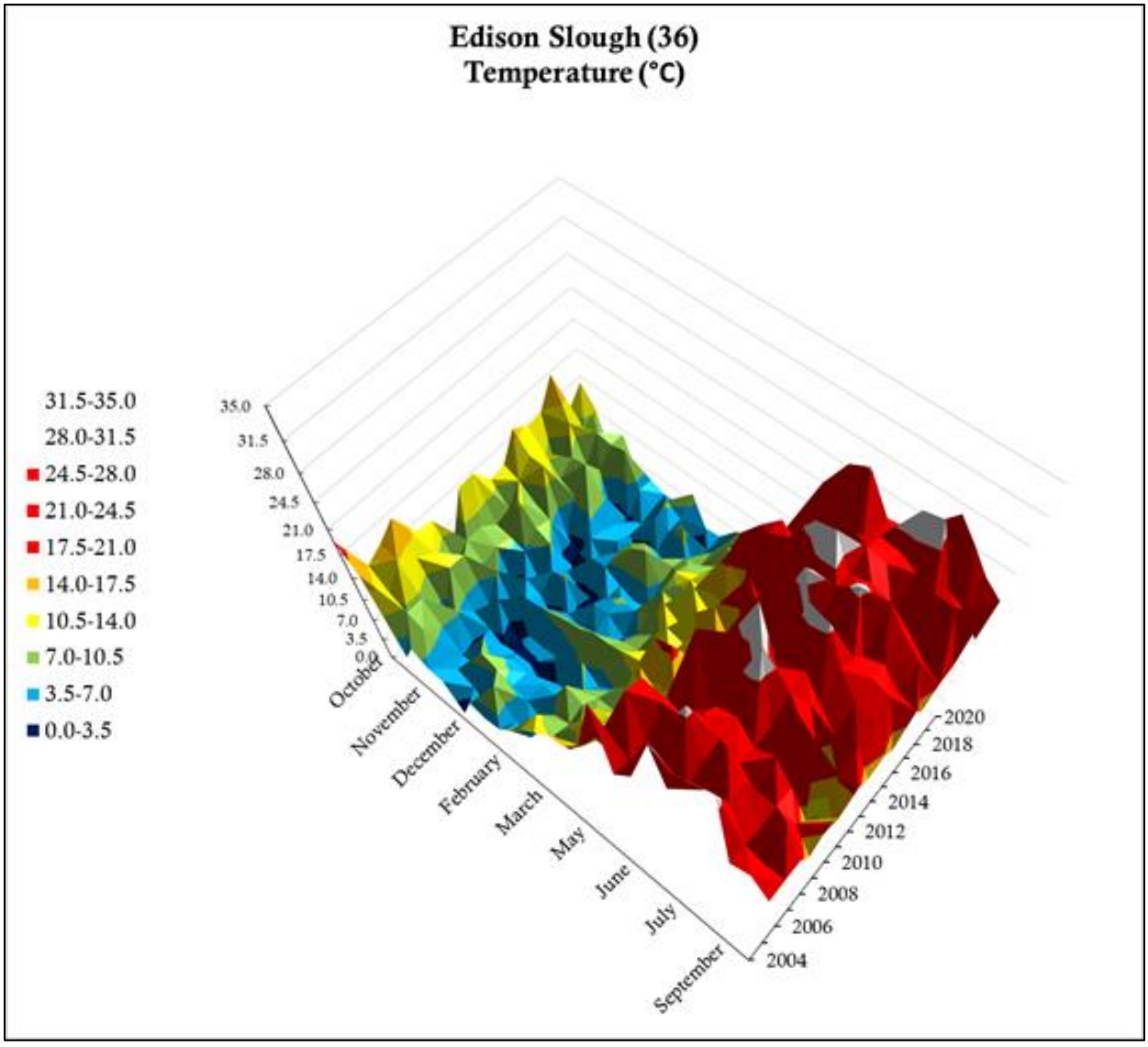
Site 36 is tied for 33rd out of 39 sites for number of significant trends, with 8, and is 35th out of 39 sites for positive trends, with 25%.

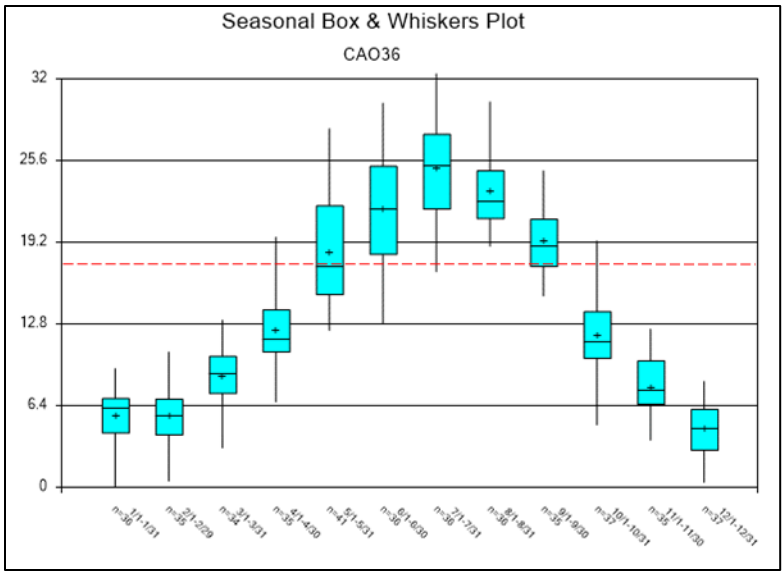




The dissolved oxygen (DO) standard for this site is 8.0 mg/L. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.

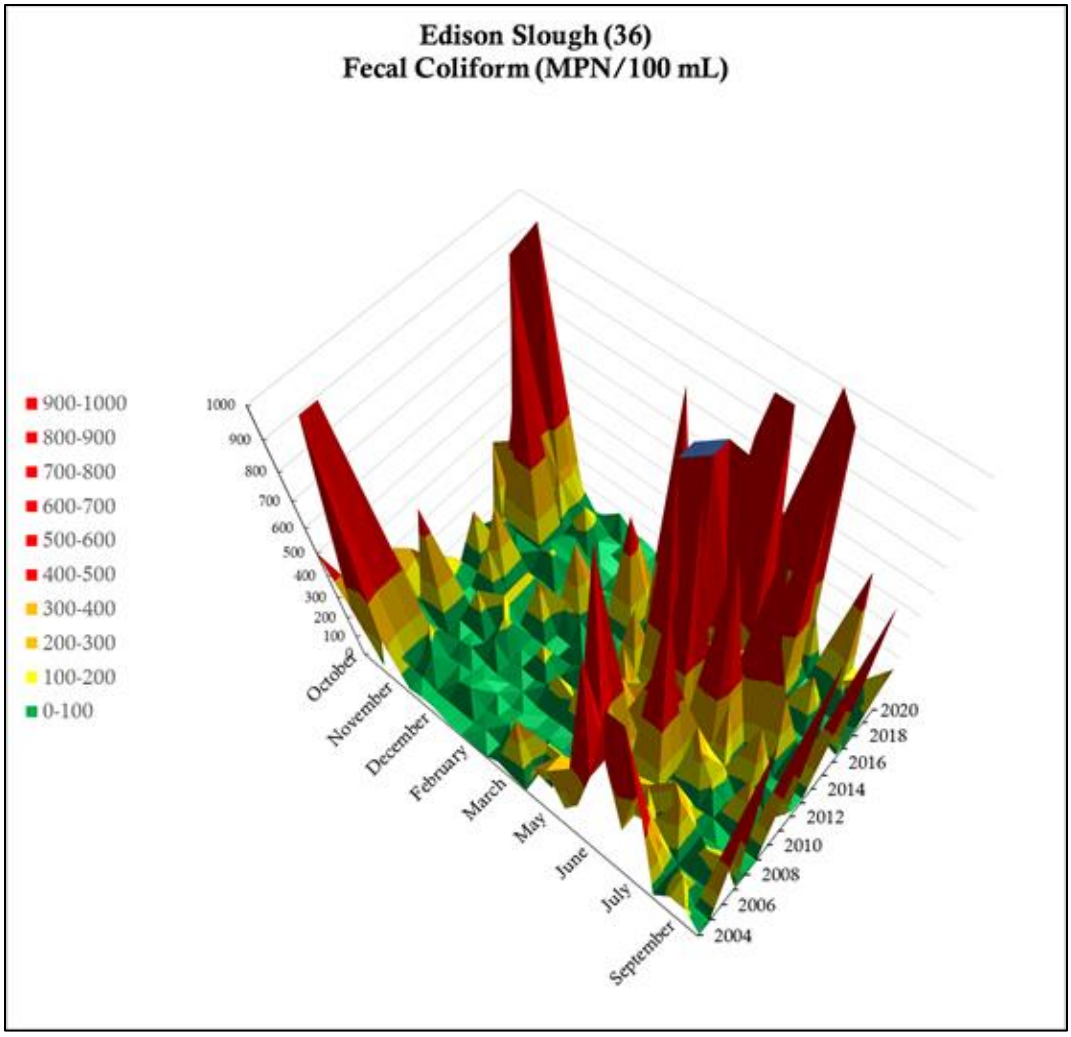
The dashed red line on the monthly box plot represents the 8.0 mg/L standard, and is approximate. The calendar year on the x-axis begins in January and ends in December.

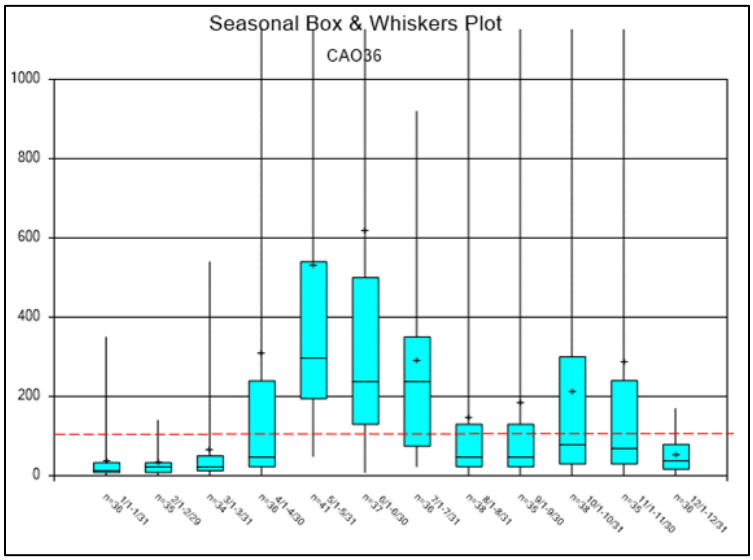




The temperature standard for this site is 17.5 °C. Any part of the 3D plot that is in red is hotter than that standard. The water year on the x-axis begins in October and ends in September.

The dashed red line on the monthly box plot represents the 17.5 °C standard, and is approximate. The calendar year on the x-axis begins in January and ends in December.





The fecal coliform (FC) standard for this site is 100 MPN/100 mL. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.

The dashed red line on the monthly box plot represents the 100 MPN/100 mL standard, and is approximate. The calendar year on the x-axis begins in January and ends in December.

37

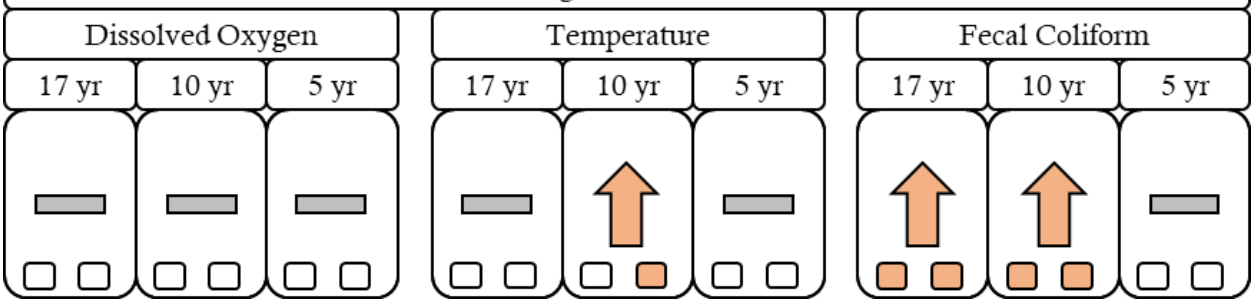
South Edison Drainage
@ Farm to Market Road

Downstream Ag

Water Quality Index (WQI)

2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
1	1	5	18	1	26	16	2	10	1	7	7	9	11	1

Long Term Trends

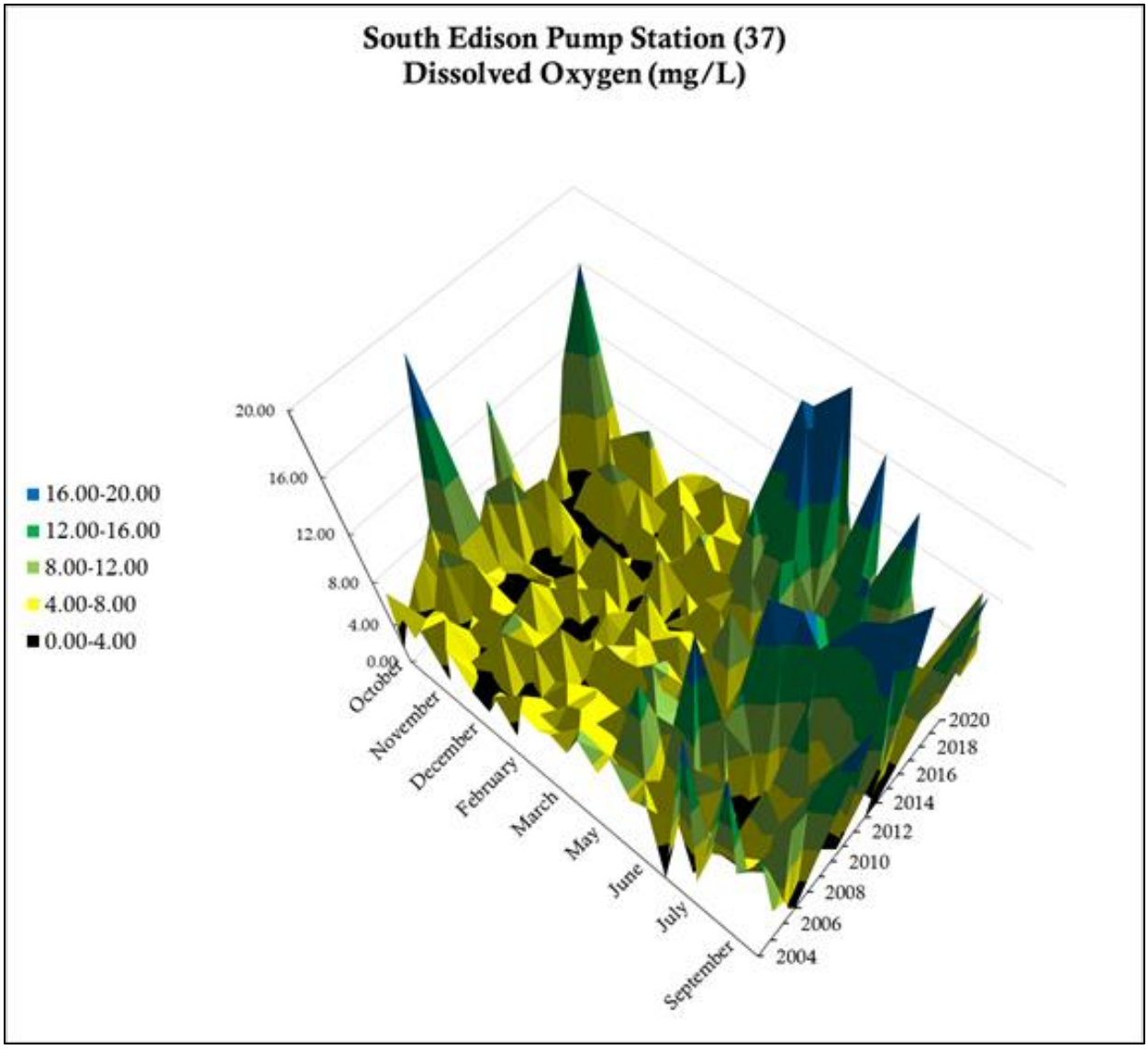


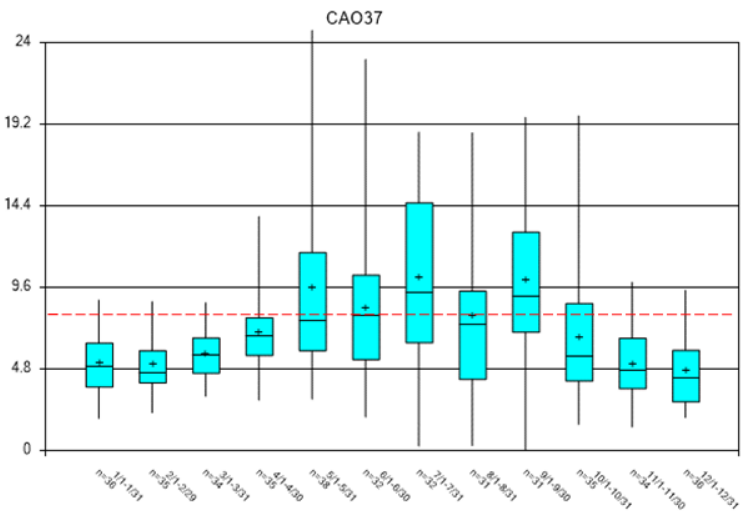
Site 37 is the south pump station of agricultural drainages in the town of Edison, on Samish Bay. Sites like this are characterized by being stagnant or slow-moving, and are heavily tidally-influenced. This site is designated as salmonid spawning, rearing, and migration (SRM) status.

Water temperatures have increased over the past ten years. Fecal coliform counts are higher now than they were at the beginning of the program, and in the most recent ten years. WQI scores are consistently in the category of highest concern, and often in the single digits.

Site 37 regularly fails to meet state standards for DO and water temperature. Annual FC levels strongly fail state standards, and were the highest of all sites recorded in this program.

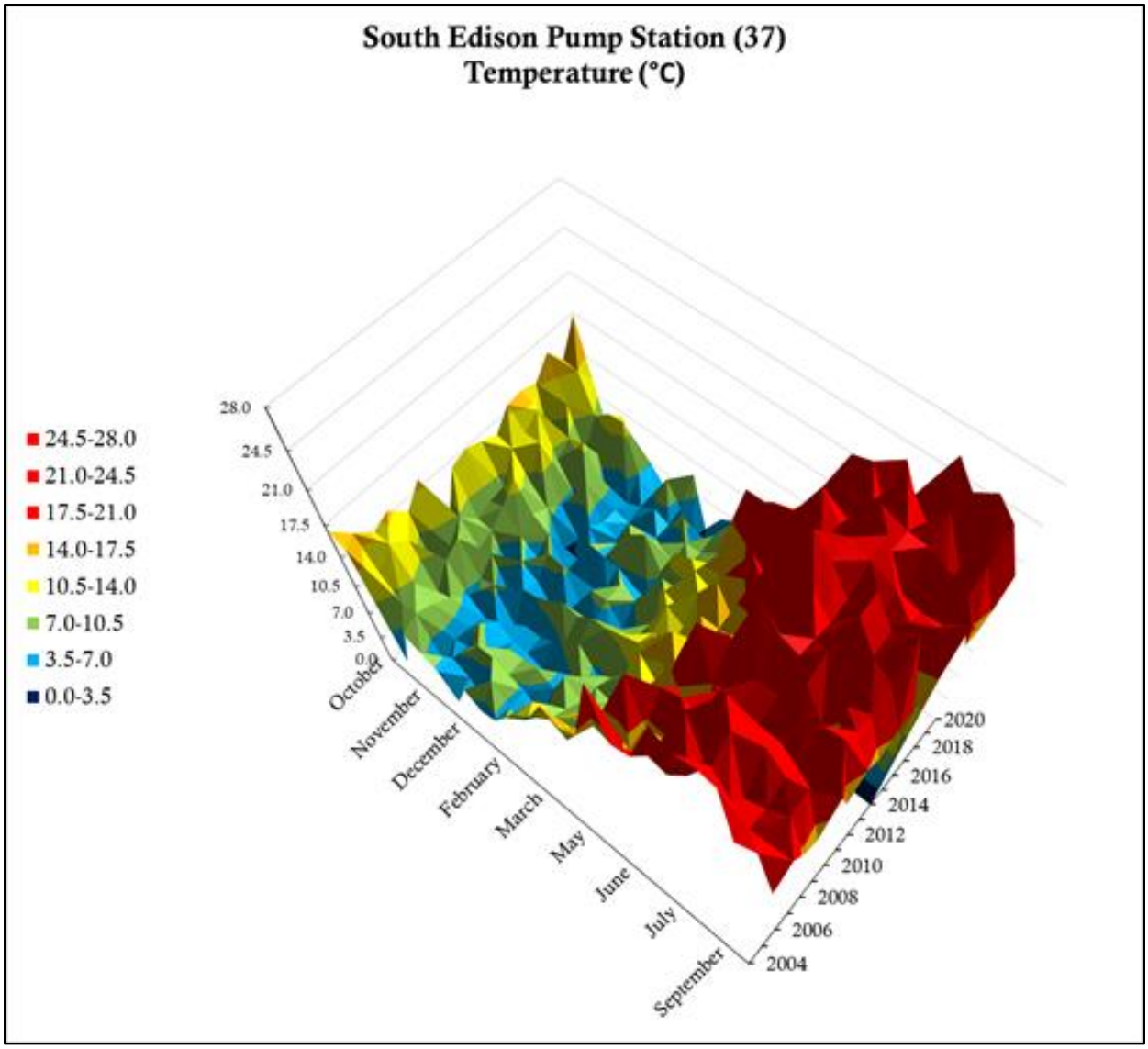
Site 37 is tied for 25th out of 39 sites for number of significant trends, with 10, and 38th out of 39 sites for positive trends, with 10%.

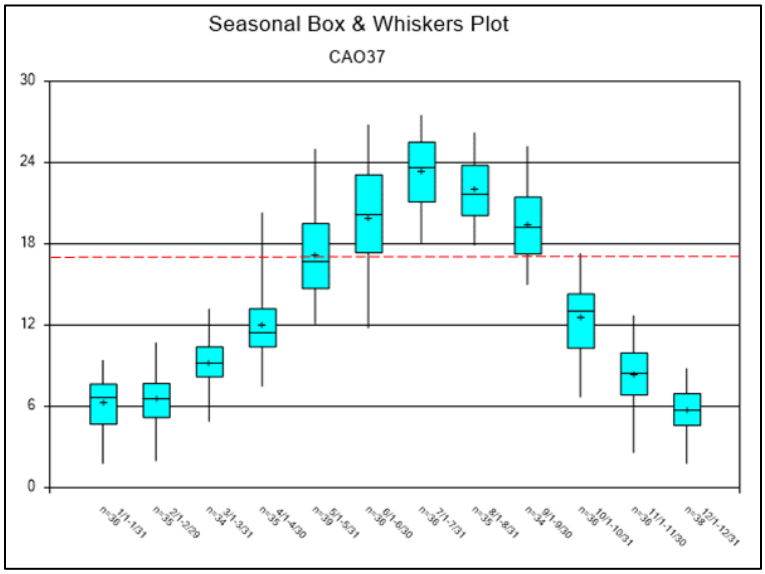




The dissolved oxygen (DO) standard for this site is 8.0 mg/L. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.

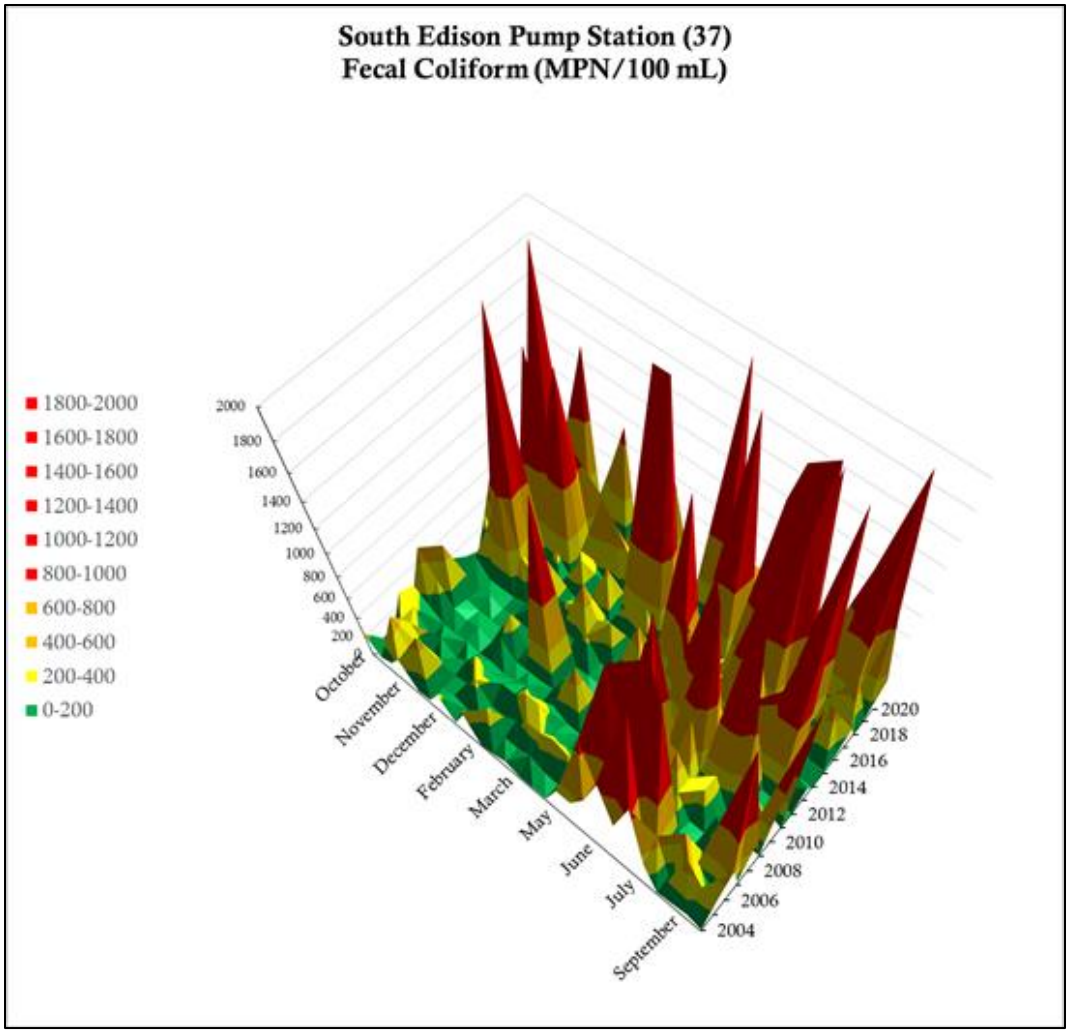
The dashed red line on the monthly box plot represents the 8.0 mg/L standard, and is approximate. The calendar year on the x-axis begins in January and ends in December.

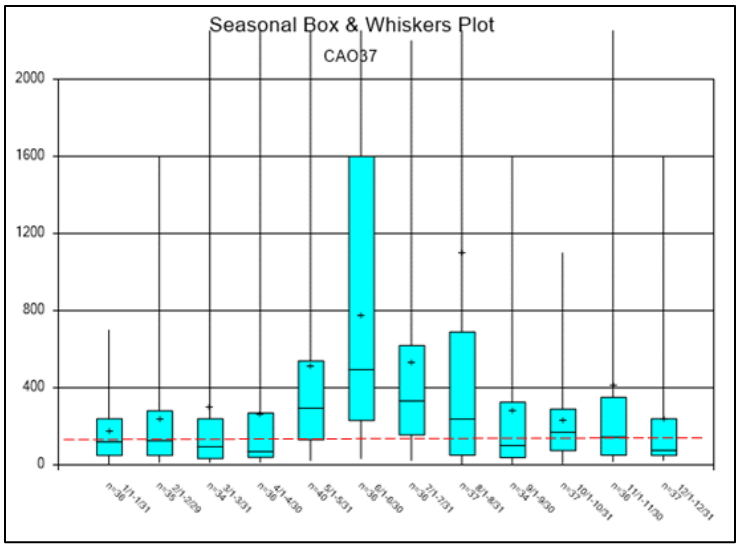




The temperature standard for this site is 17.5 °C. Any part of the 3D plot that is in red is hotter than that standard. The water year on the x-axis begins in October and ends in September.

The dashed red line on the monthly box plot represents the 17.5 °C standard, and is approximate. The calendar year on the x-axis begins in January and ends in December.





The fecal coliform (FC) standard for this site is 100 MPN/100 mL. Any part of the 3D plot that is in green almost meets that standard. The water year on the x-axis begins in October and ends in September.

The dashed red line on the monthly box plot represents the 100 MPN/100 mL standard, and is approximate. The calendar year on the x-axis begins in January and ends in December.

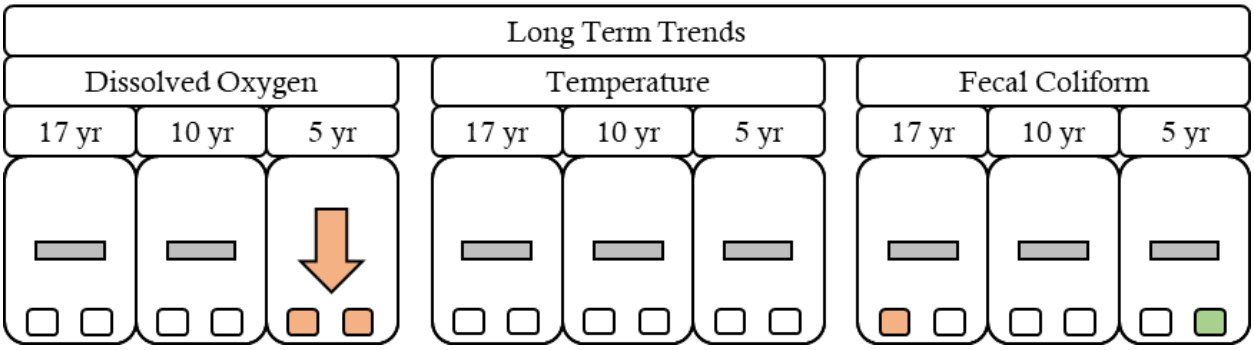
38

North Edison Drainage
@ Smith Road

Downstream Ag

Water Quality Index (WQI)

2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
1	6	1	13	16	36	12	13	3	6	19	18	20	5	1

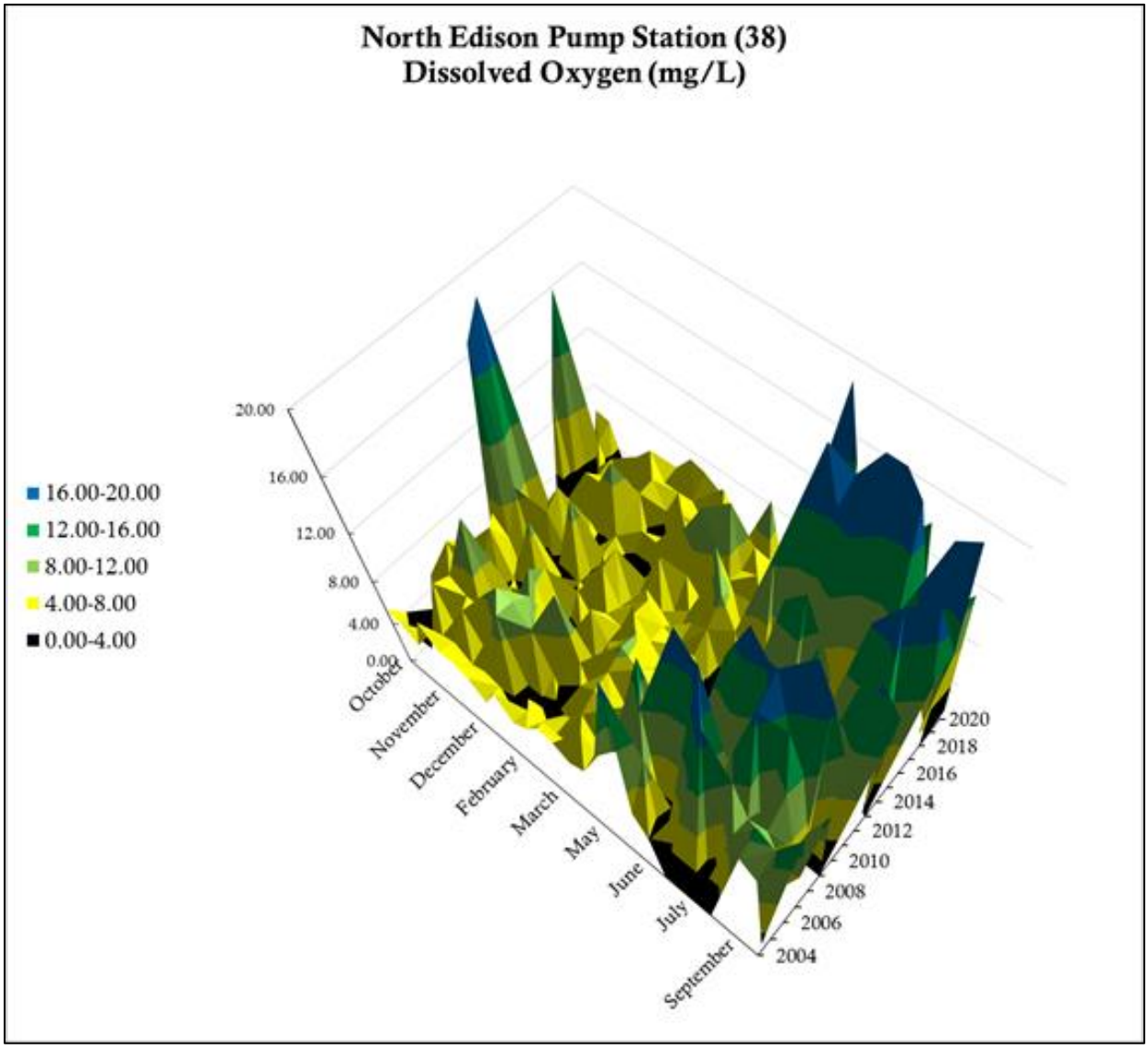


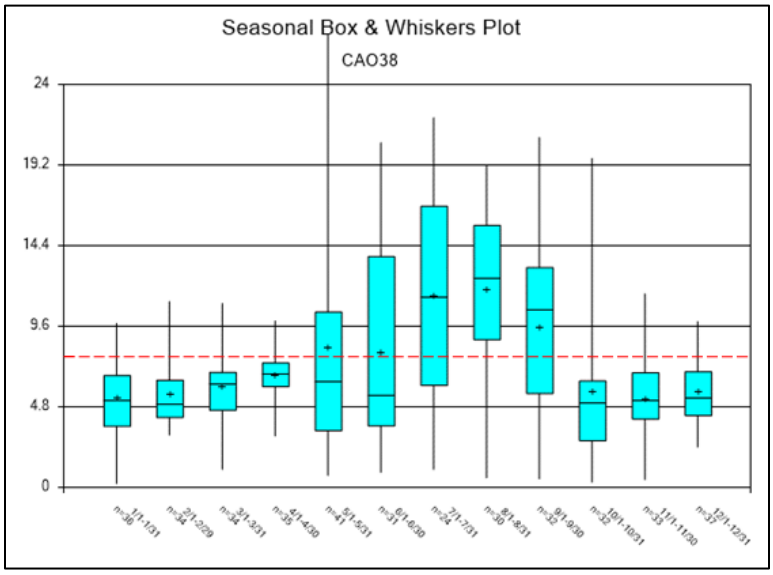
Site 38 is the north pump station of agricultural drainages in the town of Edison, on Samish Bay. Sites like this are characterized by being stagnant or slow-moving, and are heavily tidally-influenced. This site is designated as salmonid spawning, rearing, and migration (SRM) status.

Dissolved oxygen is lower now than it was five years ago. WQI scores are consistently in the category of highest concern, and often in the single digits.

Site 38 regularly fails to meet state standards for DO and water temperature. Annual FC levels strongly fail state standards.

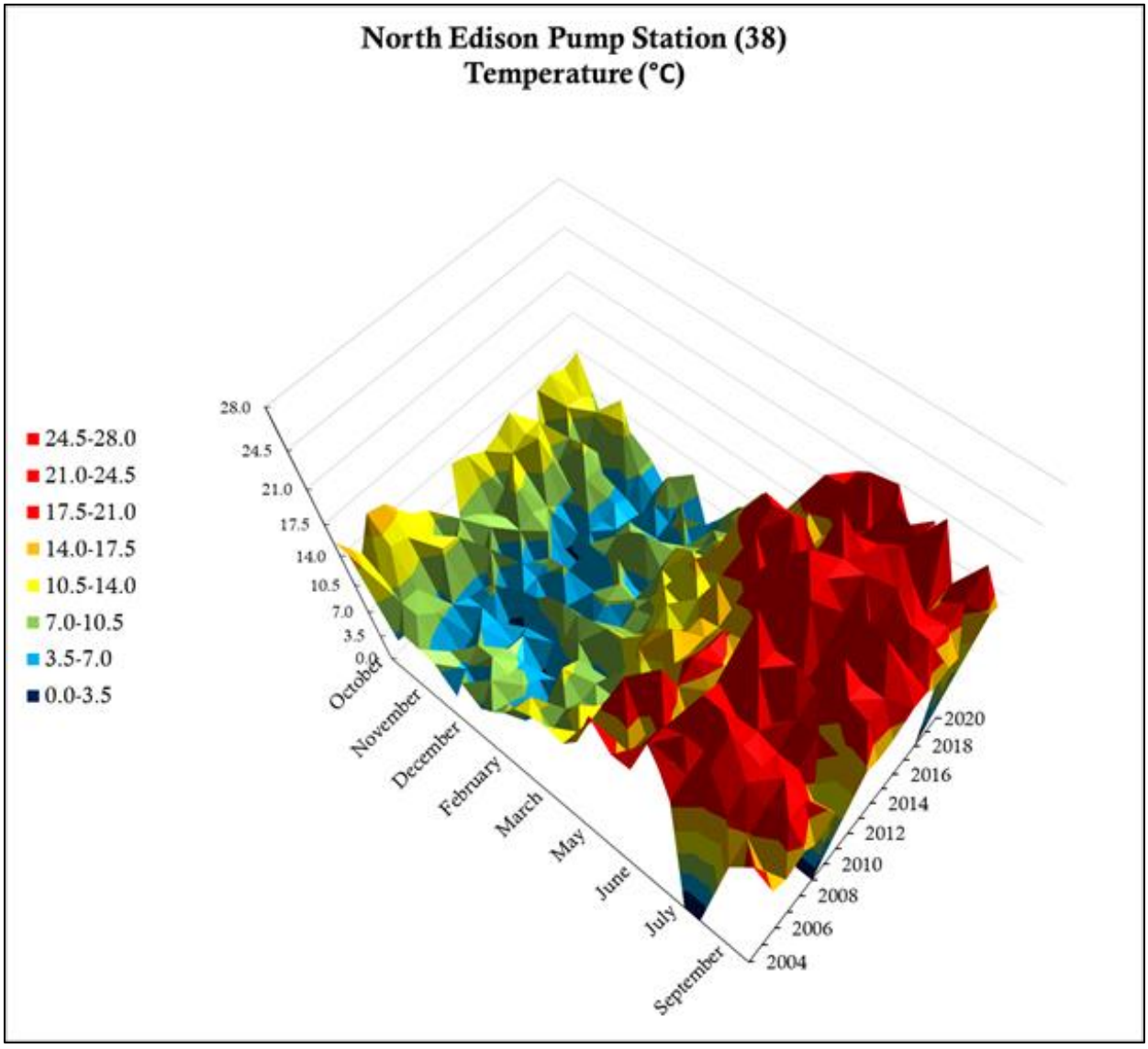
Site 38 is tied for 30th out of 39 sites for number of significant trends, with 9, and is 36th out of 39 sites for positive trends, with 22%.

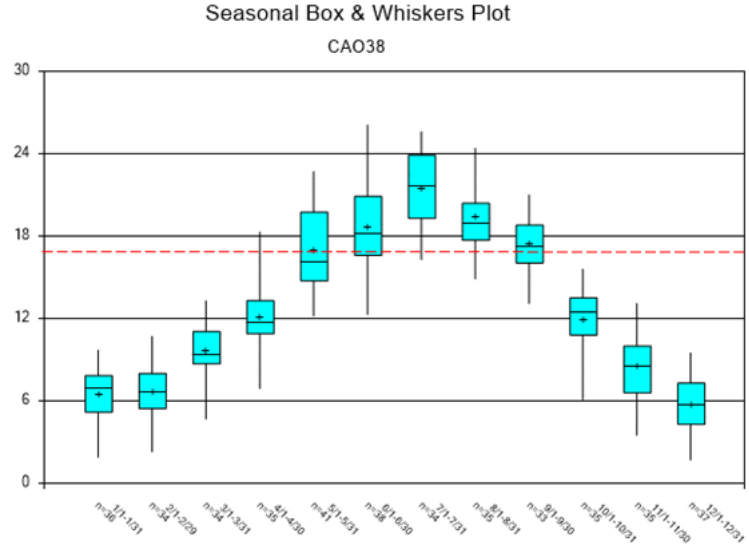




The dissolved oxygen (DO) standard for this site is 8.0 mg/L. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.

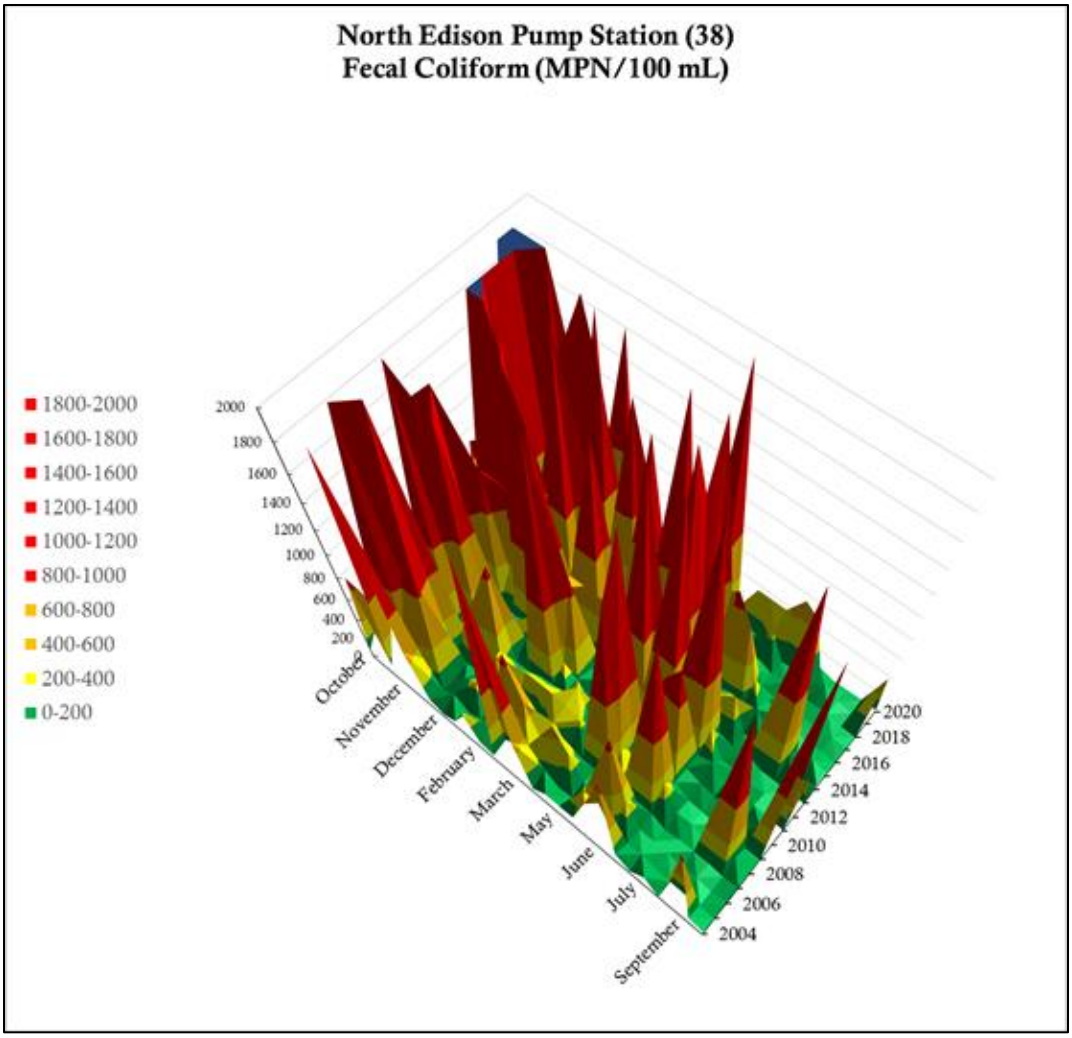
The dashed red line on the monthly box plot represents the 8.0 mg/L standard, and is approximate. The calendar year on the x-axis begins in January and ends in December.

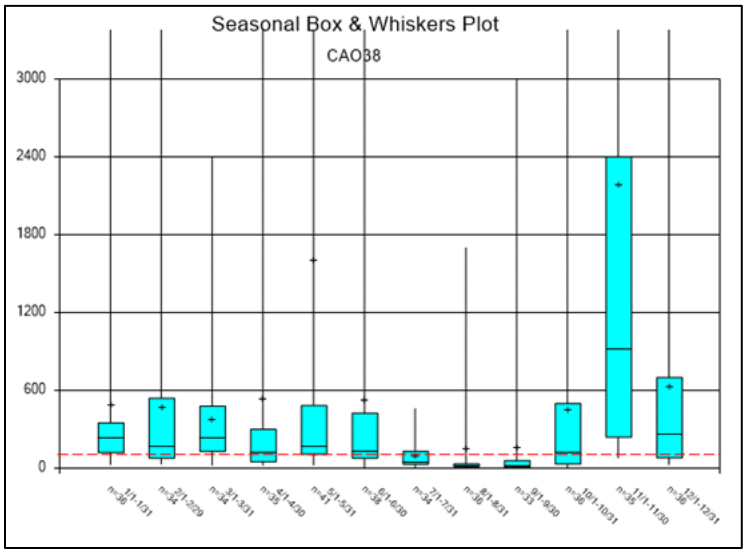




The temperature standard for this site is 17.5 °C. Any part of the 3D plot that is in red is hotter than that standard. The water year on the x-axis begins in October and ends in September.

The dashed red line on the monthly box plot represents the 17.5 °C standard, and is approximate. The calendar year on the x-axis begins in January and ends in December.





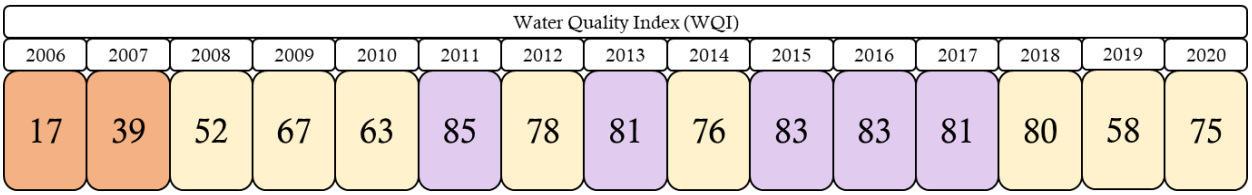
The fecal coliform (FC) standard for this site is 100 MPN/100 mL. Any part of the 3D plot that is in green almost meets that standard. The water year on the x-axis begins in October and ends in September.

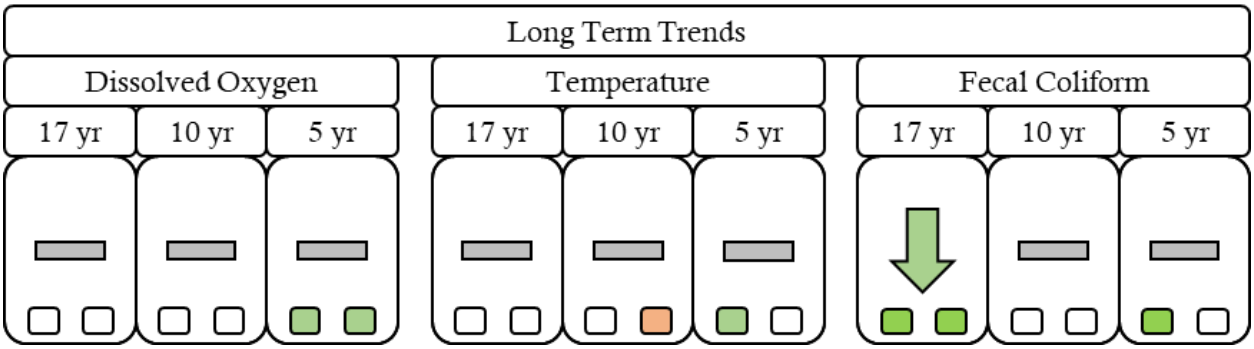
The dashed red line on the monthly box plot represents the 100 MPN/100 mL standard, and is approximate. The calendar year on the x-axis begins in January and ends in December.

39

Colony Creek
@ Colony Road

Downstream Ag



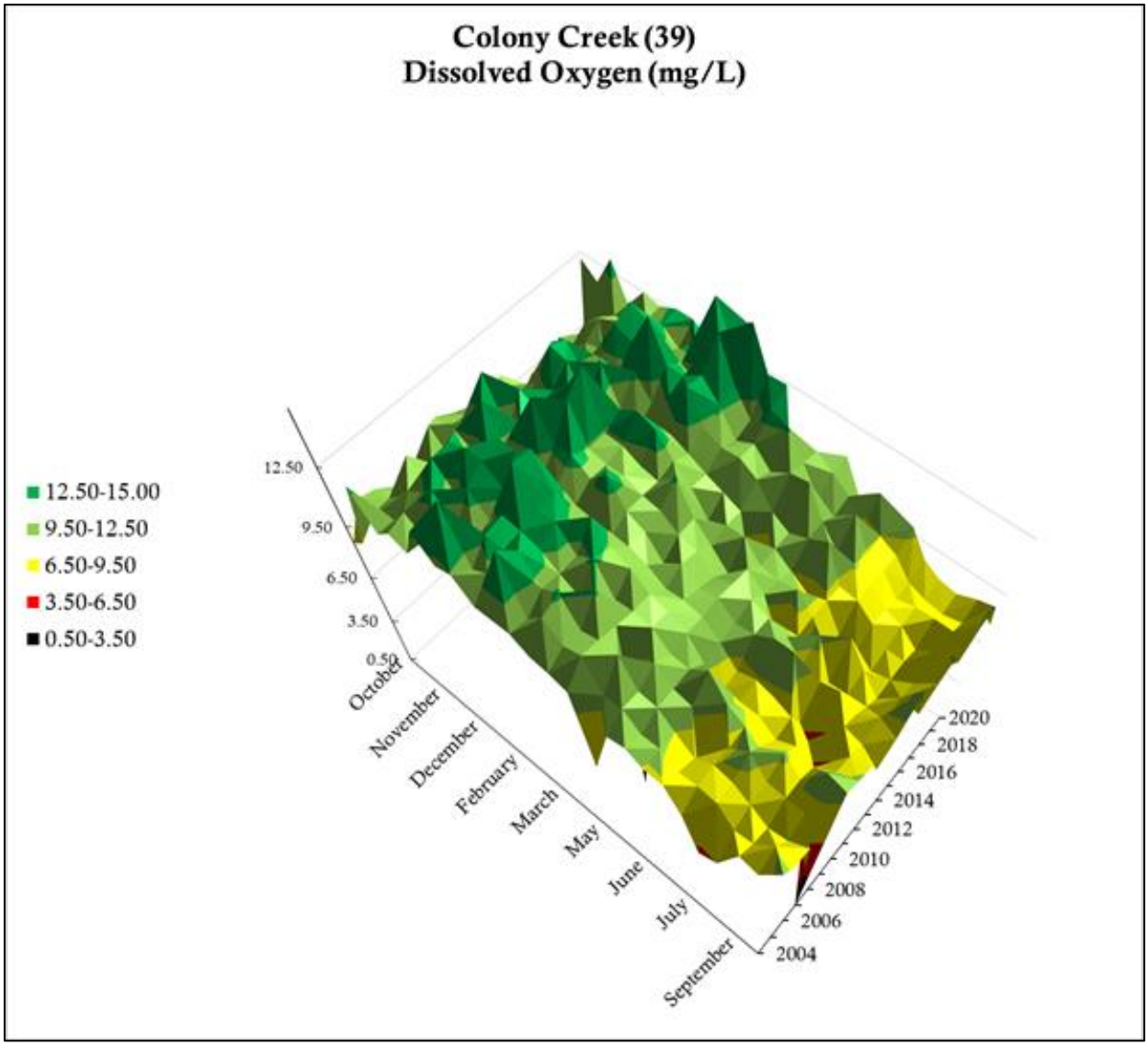


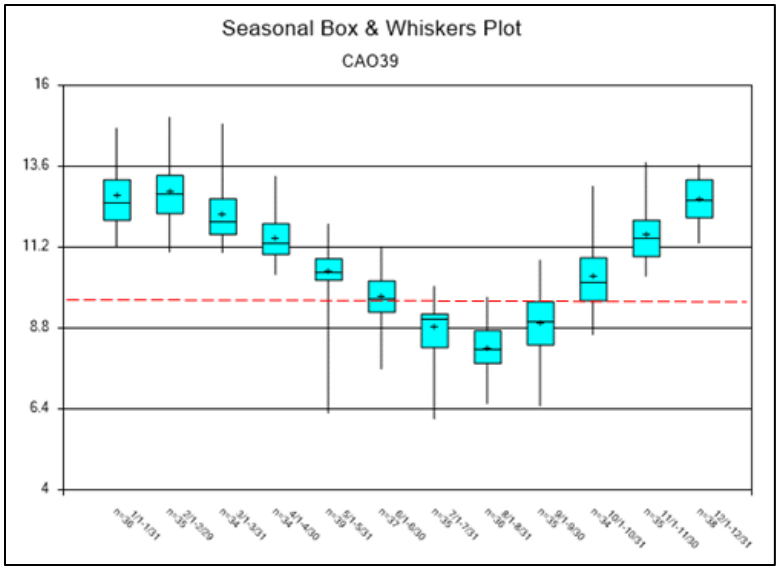
Site 39 is Colony Creek, prior to its convergence with Harrison Creek and termination in to the north end of Samish Bay, and has rural residential and agricultural influences. This site is designated as core salmonid habitat.

Fecal coliform counts are lower than they were 17 years ago. WQI scores are generally in the upper-score end of the moderate concern category, and sometimes score as least concern.

Site 39 rarely fails to meet state standards for DO and water temperature, and only does so at the warmest time of year. Annual FC levels easily pass the state standard for geomean of 100, but fail the state standard for a 90th percentile of 200.

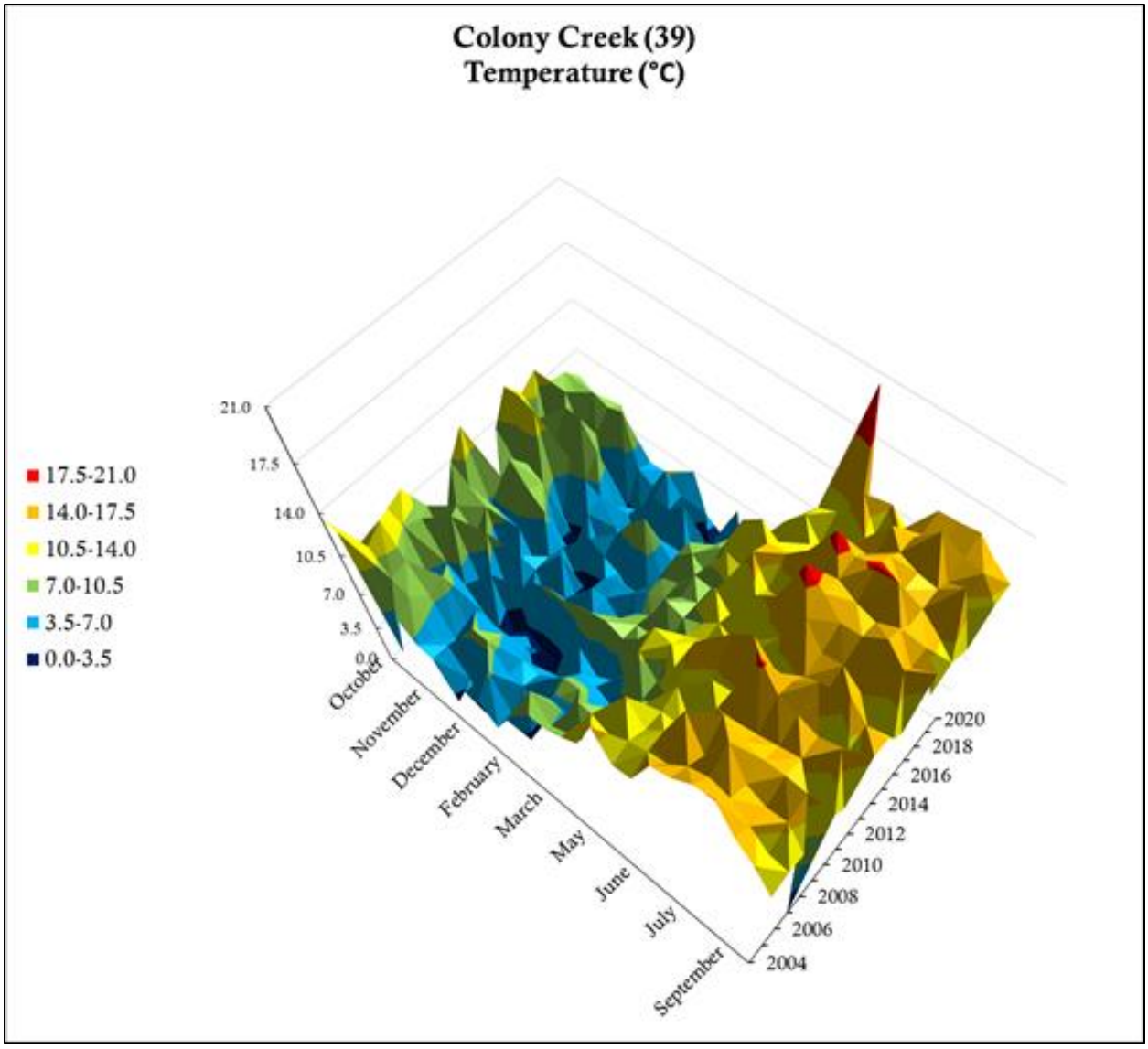
Site 39 is tied for 30th out of 39 sites for number of significant trends, with 9, and is tied for 22nd out of 39 sites for positive trends, with 56%.

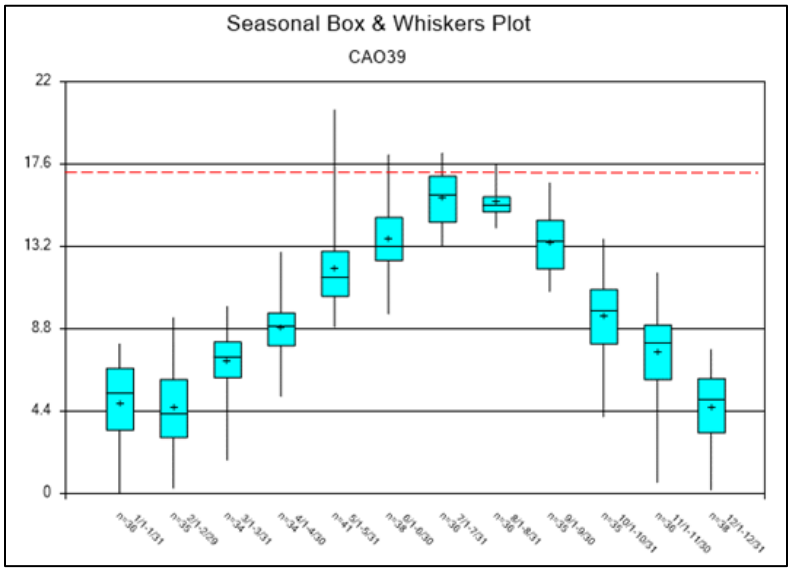




The dissolved oxygen (DO) standard for this site is 9.50 mg/L. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.

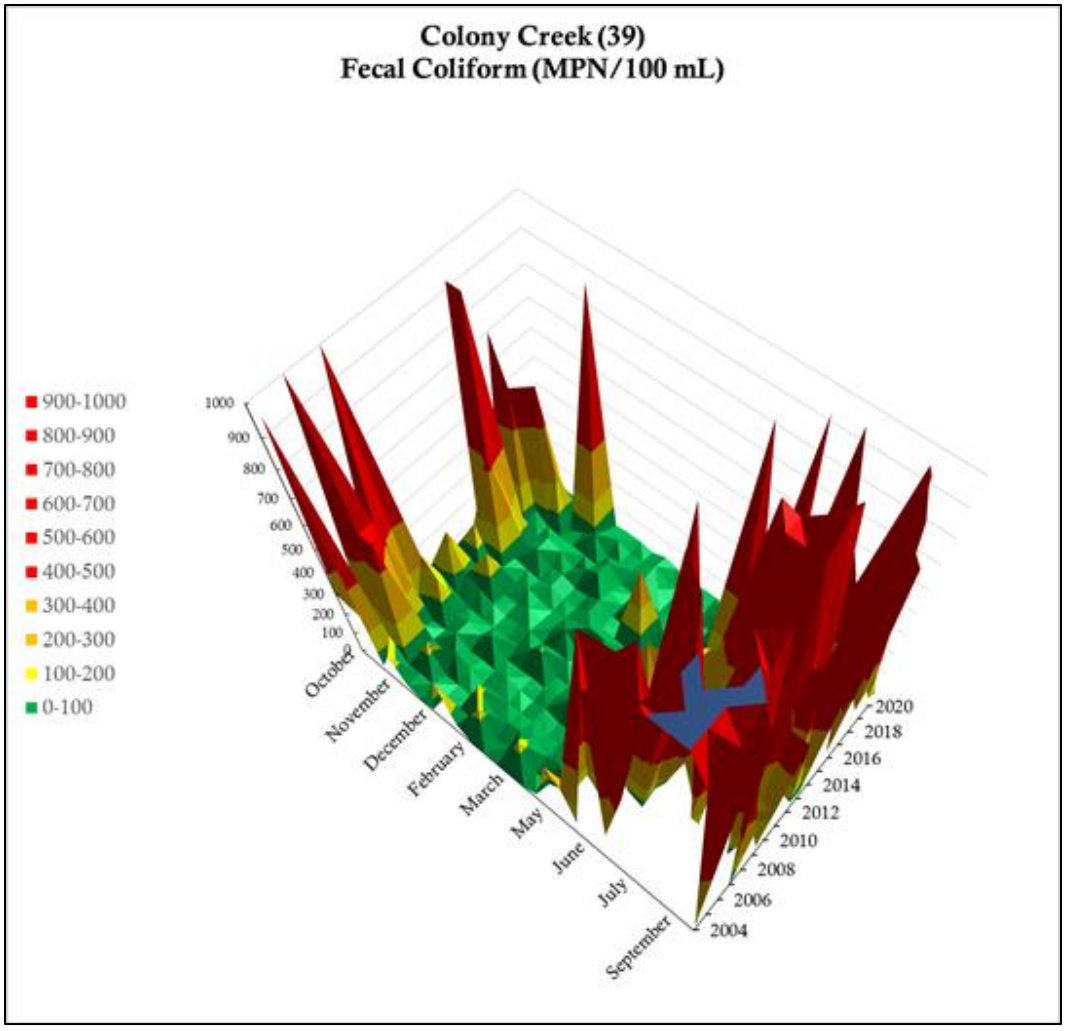
The dashed red line on the monthly box plot represents the 9.5 mg/L standard, and is approximate. The calendar year on the x-axis begins in January and ends in December.

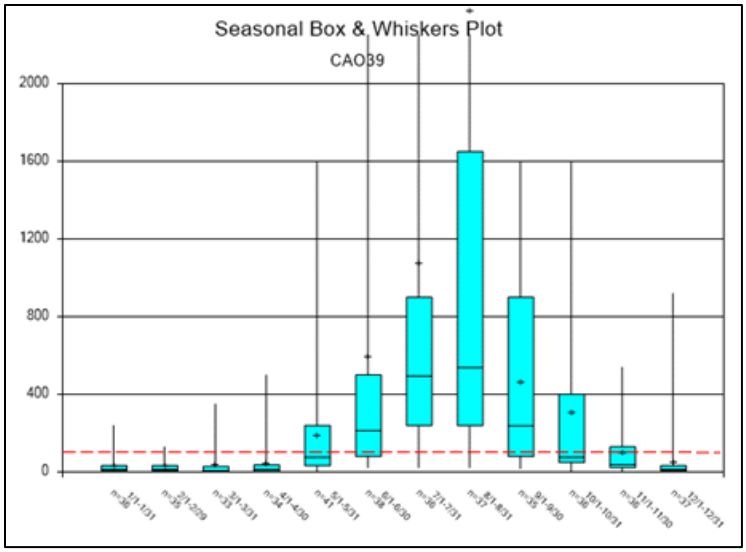




The temperature standard for this site is 17.5 °C. Any part of the 3D plot that is in red is hotter than that standard. The water year on the x-axis begins in October and ends in September.

The dashed red line on the monthly box plot represents the 17.5 °C standard, and is approximate. The calendar year on the x-axis begins in January and ends in December.





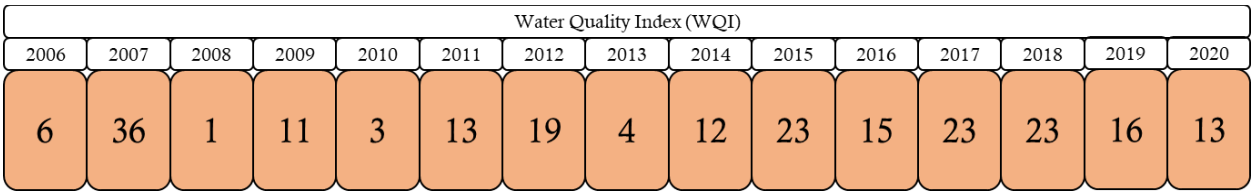
The fecal coliform (FC) standard for this site is 100 MPN/100 mL. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.

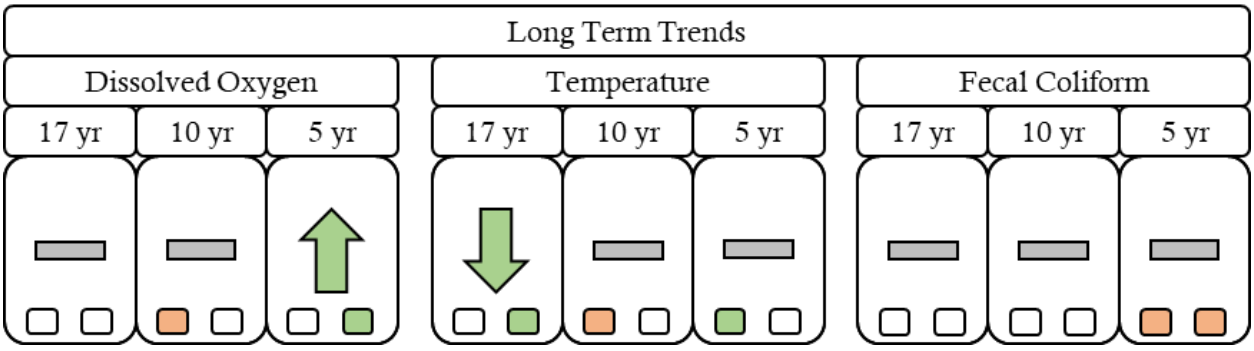
The dashed red line on the monthly box plot represents the 100 MPN/100 mL standard, and is approximate. The calendar year on the x-axis begins in January and ends in December.

40

Big Indian slough
@ Highway 20

Midstream Ag



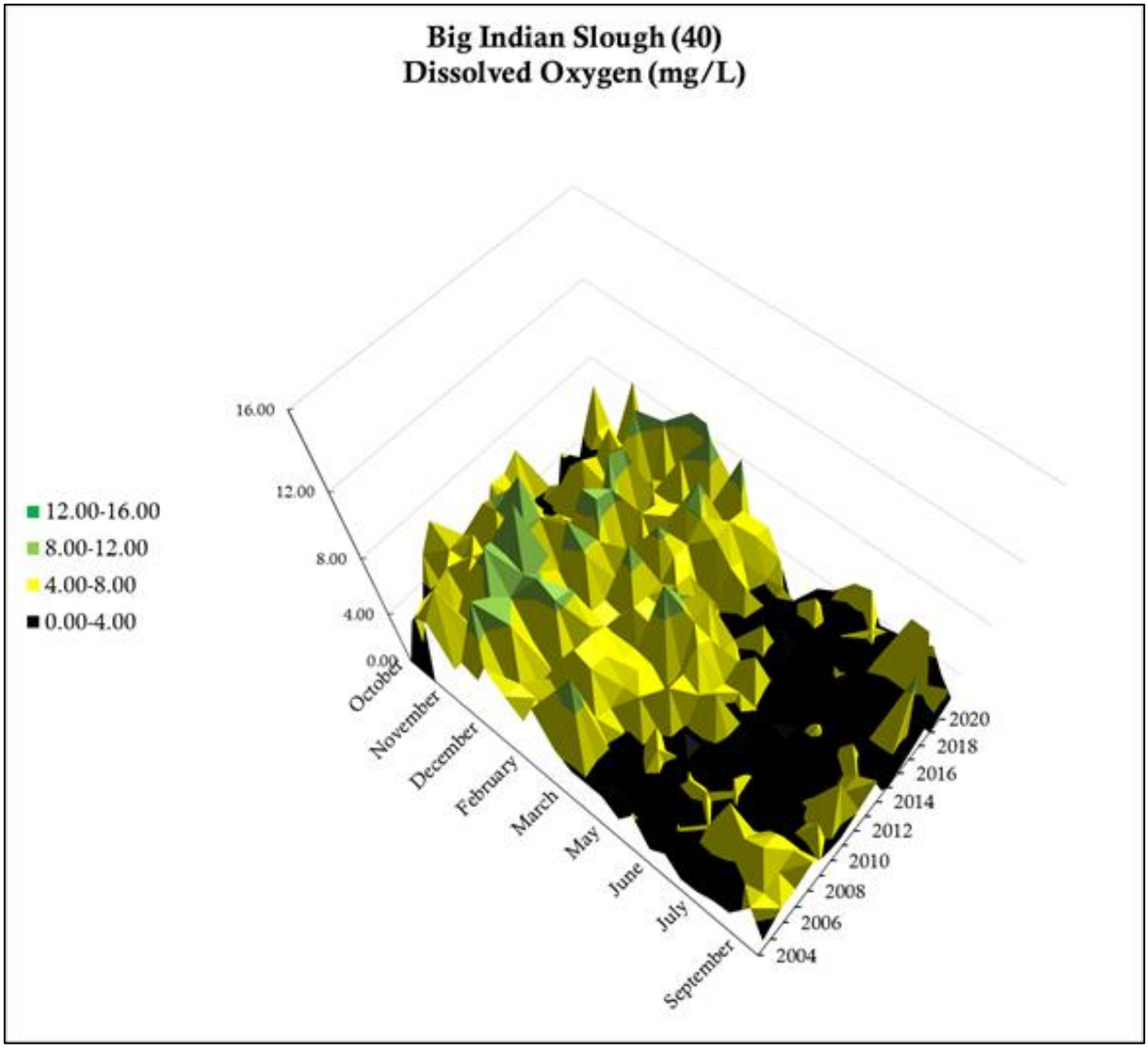


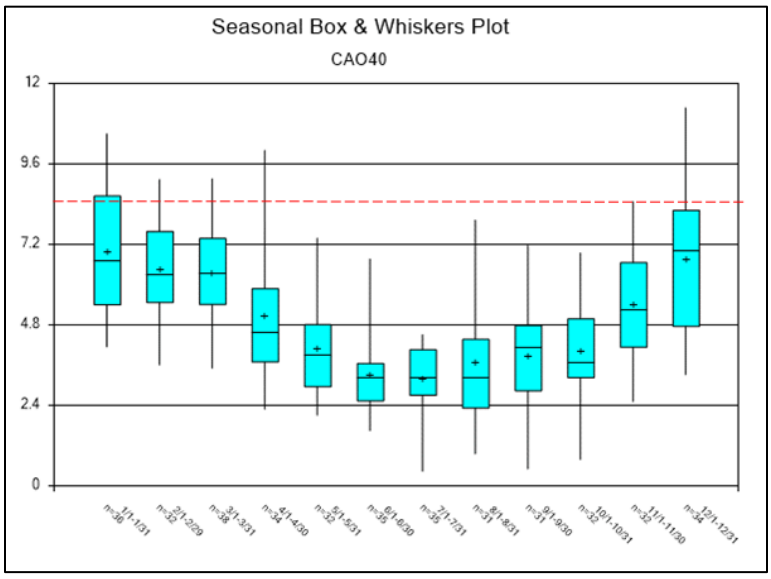
Site 40 is Big Indian Slough, just north of Highway 20 and prior to entering Padilla Bay. This site has industrial, agricultural, and urban influences. Sites like this are characterized by being stagnant or slow-moving, and may be tidally-influenced. This site is designated as salmonid spawning, rearing, and migration (SRM) status.

Dissolved oxygen levels have increased since five years ago. Water temperature is lower than it was at the beginning of this program. WQI scores are consistently in the category of highest concern.

Site 40 regularly fails to meet state standards for DO, and fails to meet state standards for water temperature during the warmer months. Annual FC levels narrowly pass the state standard for geomean of 100, but fail the state standard for a 90th percentile of 200.

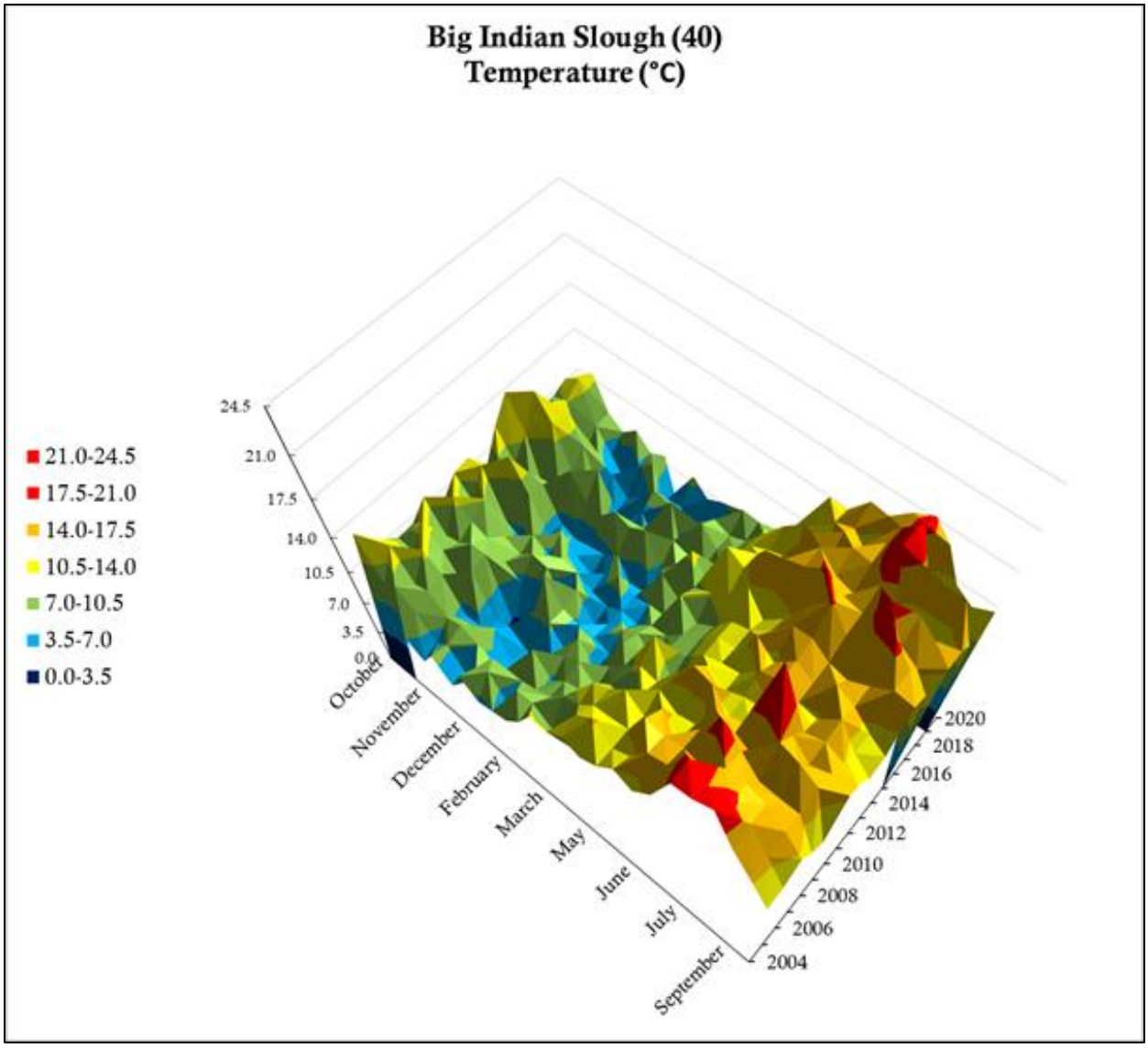
Site 40 is tied for 25th out of 39 sites for number of significant trends, with 10, and is 30th out of 39 sites for positive trends, with 40%.

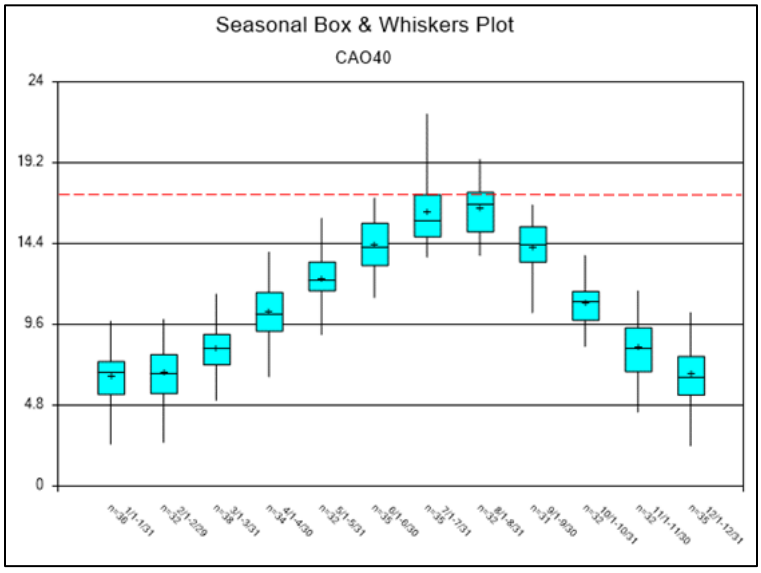




The dissolved oxygen (DO) standard for this site is 8.0 mg/L. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.

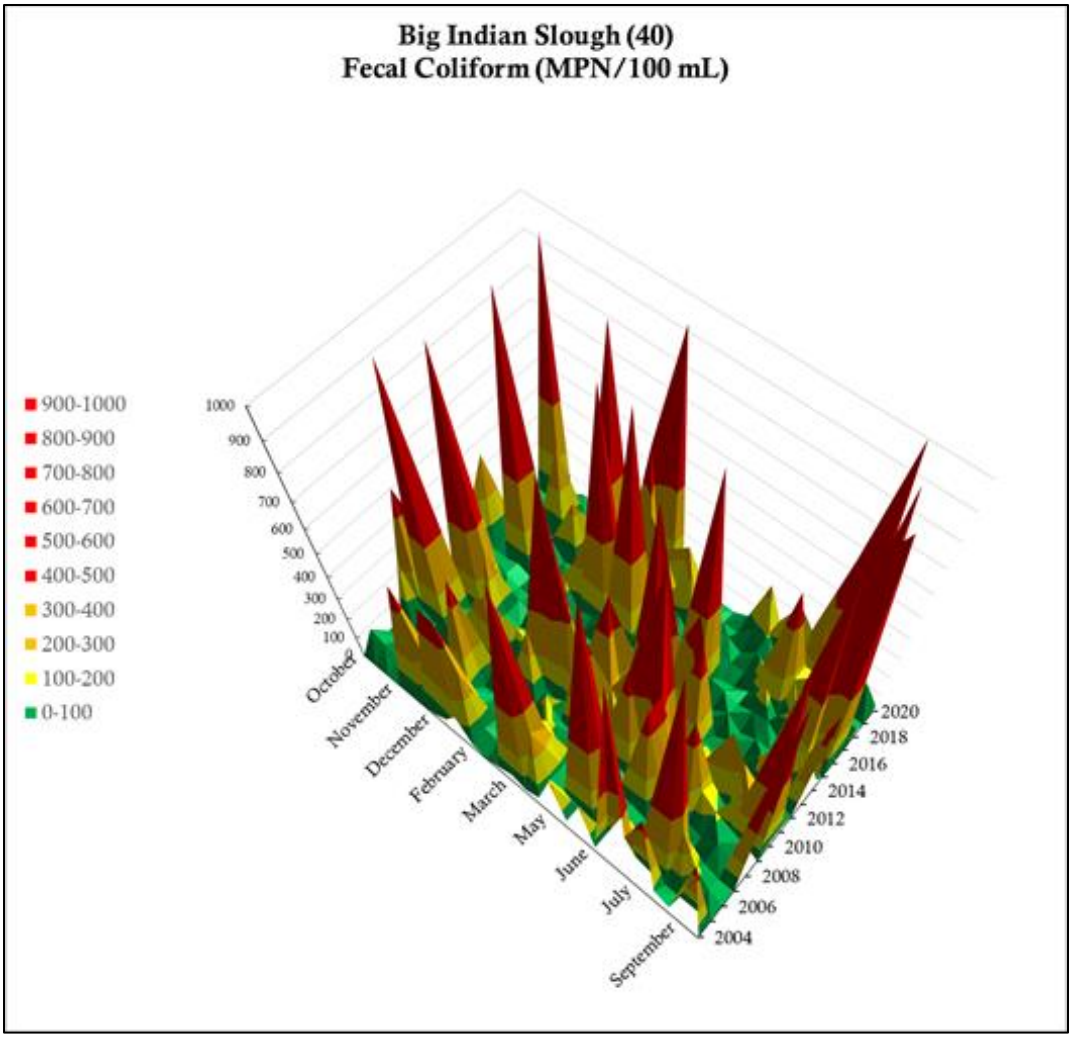
The dashed red line on the monthly box plot represents the 8.0 mg/L standard, and is approximate. The calendar year on the x-axis begins in January and ends in December.

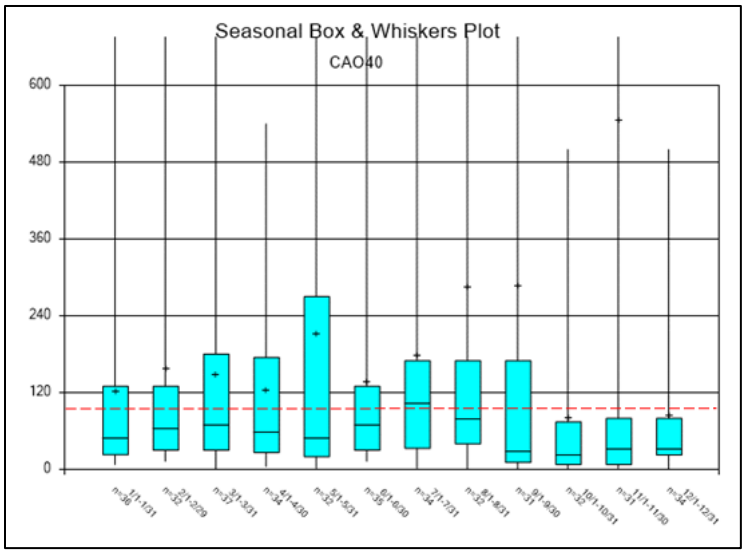




The temperature standard for this site is 17.5 °C. Any part of the 3D plot that is in red is hotter than that standard. The water year on the x-axis begins in October and ends in September.

The dashed red line on the monthly box plot represents the 17.5 °C standard, and is approximate. The calendar year on the x-axis begins in January and ends in December.





The fecal coliform (FC) standard for this site is 100 MPN/100 mL. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.

The dashed red line on the monthly box plot represents the 100 MPN/100 mL standard, and is approximate. The calendar year on the x-axis begins in January and ends in December.

41

Maddox Slough
@ Milltown Road

Downstream Ag

Water Quality Index (WQI)

2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
15	27	23	56	55	27	34	19	24	30	39	39	25	33	18

Long Term Trends

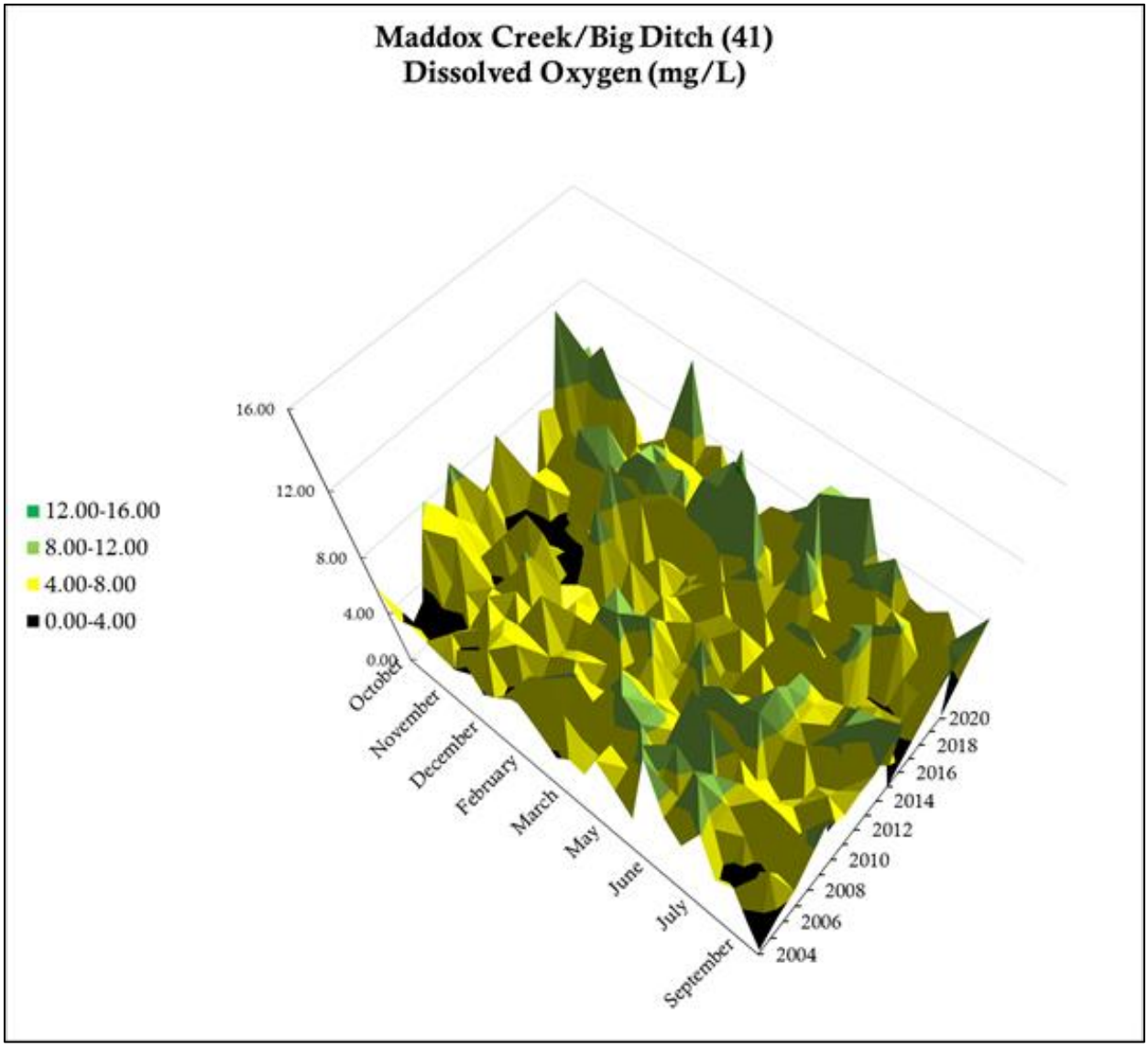
Dissolved Oxygen			Temperature			Fecal Coliform		
17 yr	10 yr	5 yr	17 yr	10 yr	5 yr	17 yr	10 yr	5 yr
↑	↑	–	–	–	↓	↑	–	↓

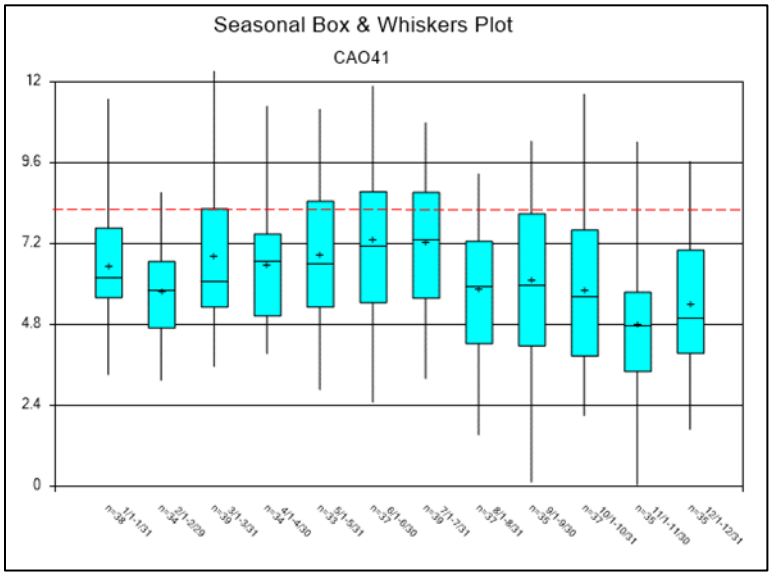
Site 41 is Maddox Slough, or Big Ditch, prior to entering Skagit Bay. Sites like this are characterized by being stagnant or slow-moving, and are heavily tidally-influenced. This site is designated as salmonid spawning, rearing, and migration (SRM) status.

Dissolved oxygen is higher than it was 17 years ago and ten years ago. Water temperature and FC levels are lower than they were five years ago, though FC levels are still higher than they were at the beginning of this program. WQI scores are consistently in the category of highest concern.

Site 41 rarely meets state standards for DO, and exceeds state standards for water temperature during the warmer months. Annual FC levels pass the state standard for geomean of 100, but narrowly fail the state standard for a 90th percentile of 200.

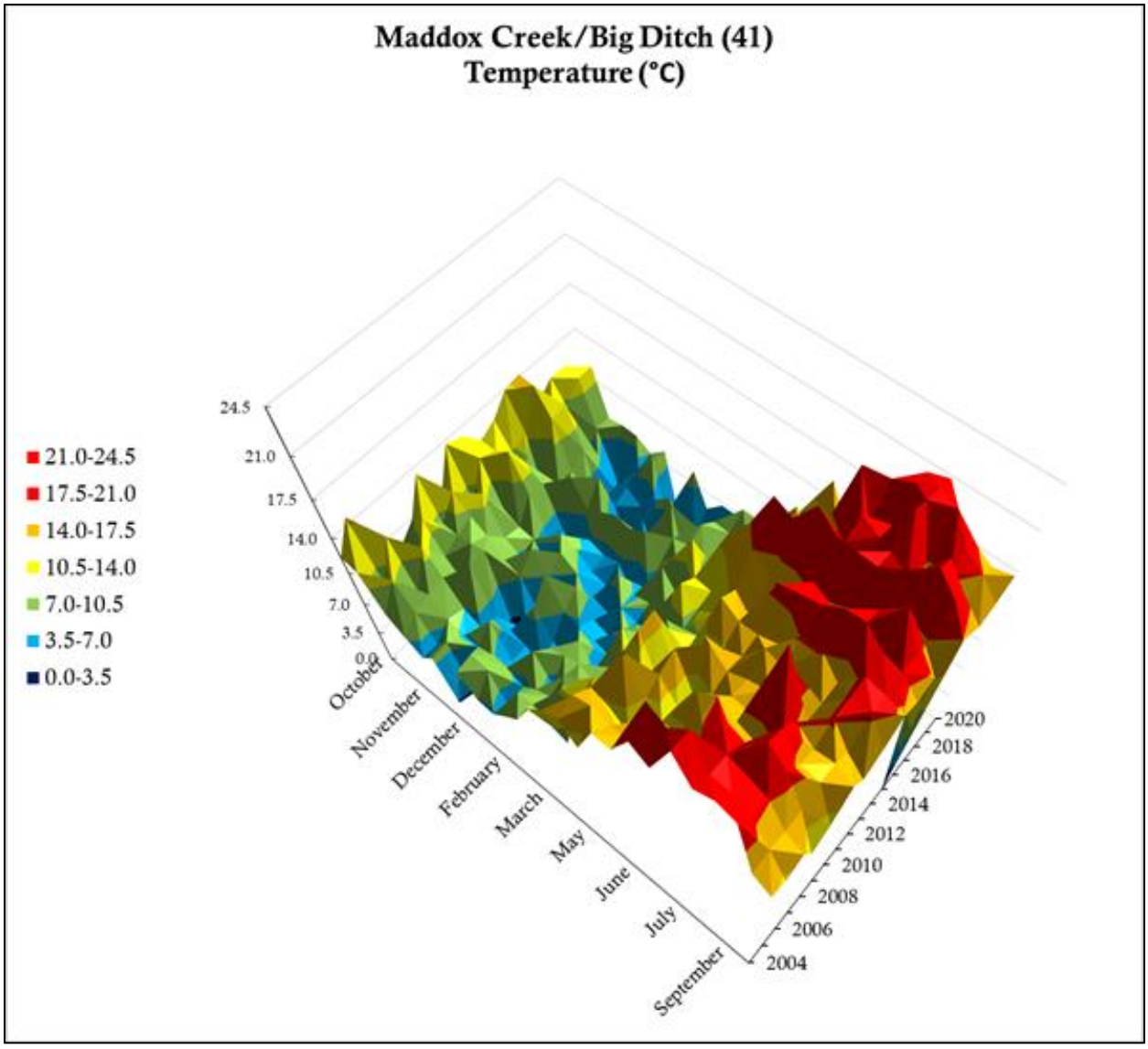
Site 41 is tied for 7th out of 39 sites for number of significant trends, with 15, and is 27th out of 39 sites for positive trends, with 53%.

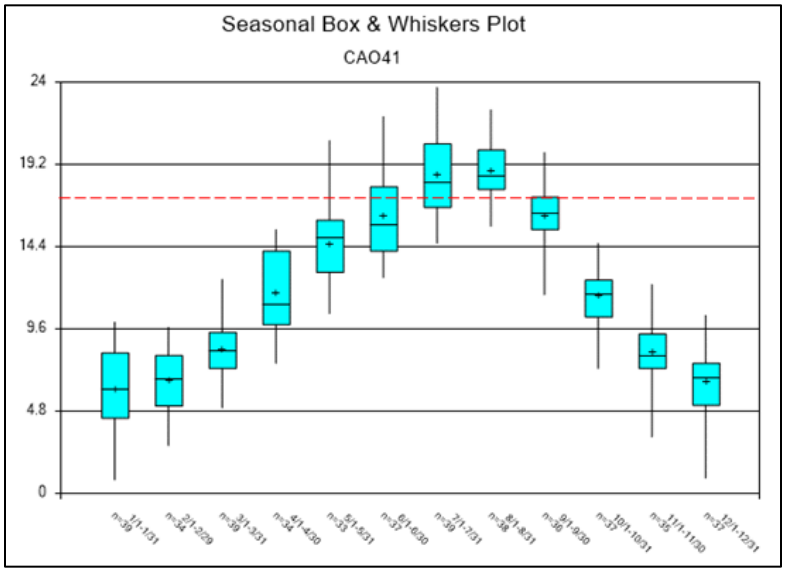




The dissolved oxygen (DO) standard for this site is 8.0 mg/L. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.

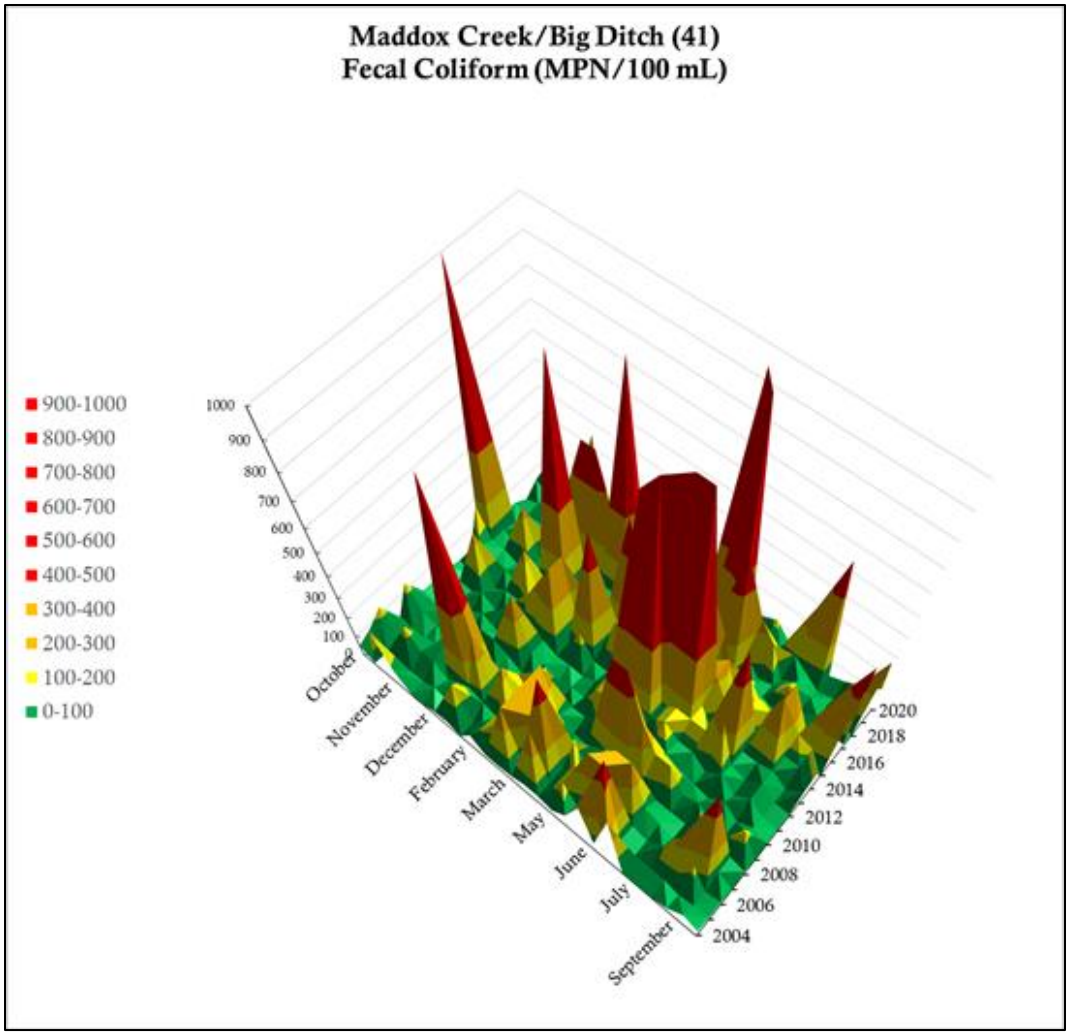
The dashed red line on the monthly box plot represents the 8.0 mg/L standard, and is approximate. The calendar year on the x-axis begins in January and ends in December.

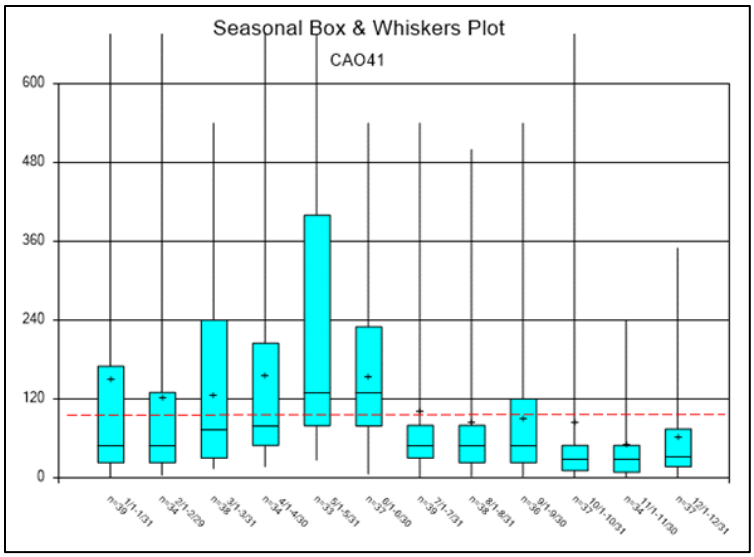




The temperature standard for this site is 17.5 °C. Any part of the 3D plot that is in red is hotter than that standard. The water year on the x-axis begins in October and ends in September.

The dashed red line on the monthly box plot represents the 17.5 °C standard, and is approximate. The calendar year on the x-axis begins in January and ends in December.





The fecal coliform (FC) standard for this site is 100 MPN/100 mL. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.

The dashed red line on the monthly box plot represents the 100 MPN/100 mL standard, and is approximate. The calendar year on the x-axis begins in January and ends in December.

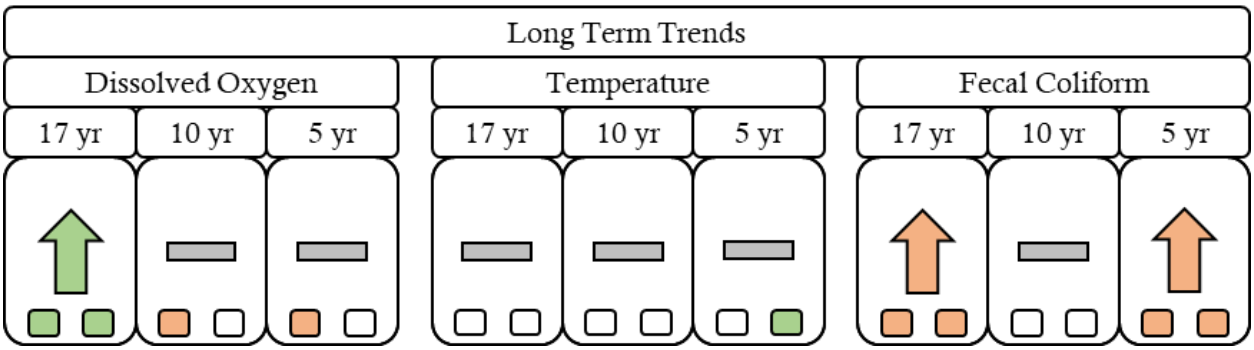
42

Hill Ditch
@ Cedardale Road

Downstream Ag

Water Quality Index (WQI)

2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
50	35	7	39	58	66	70	60	74	77	75	81	80	73	74

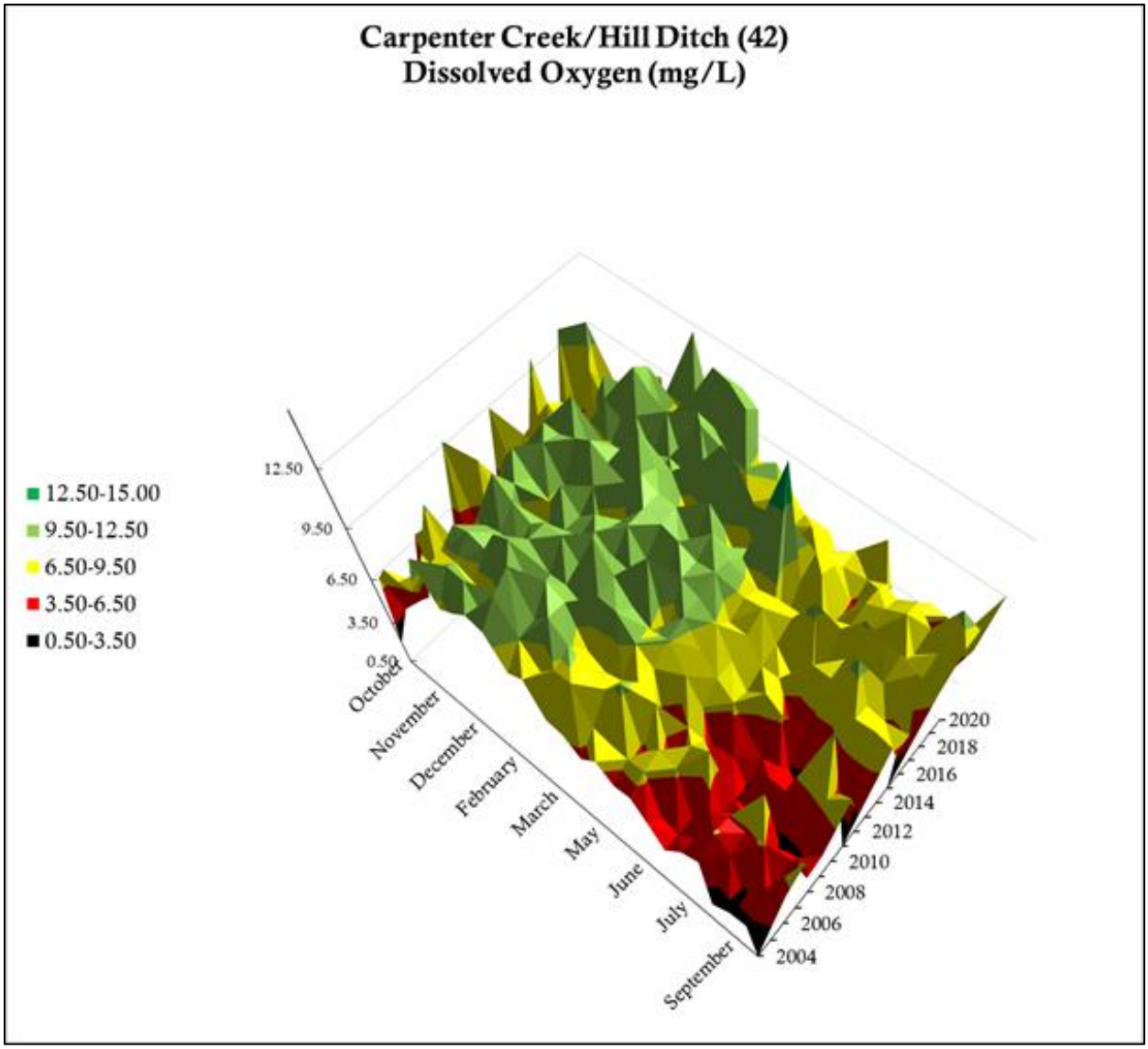


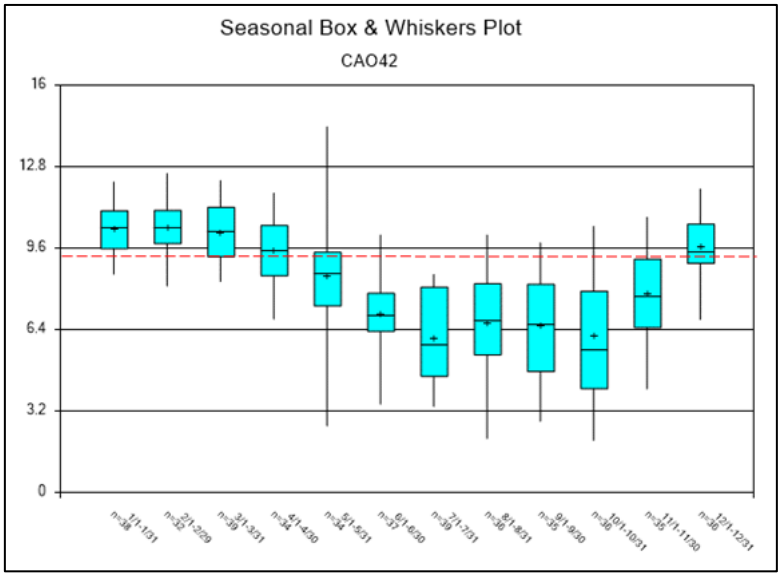
Site 42 is Carpenter Creek, or Hill Ditch, prior to being joined by Fisher Creek and entering Skagit Bay. This watercourse has urban, rural residential, and agricultural influences. This site is designated as core salmonid habitat.

Dissolved oxygen is higher than it was 17 years ago. Fecal coliform counts are higher than they were at the beginning of this program, and as compared to five years ago. WQI scores have improved over the years from the category of highest concern to the category of moderate concern.

Site 42 fails state standards for DO about half of the year, and fails state standards for water temperature during the warmer months. Annual FC levels for WY2020 failed to meet state standards.

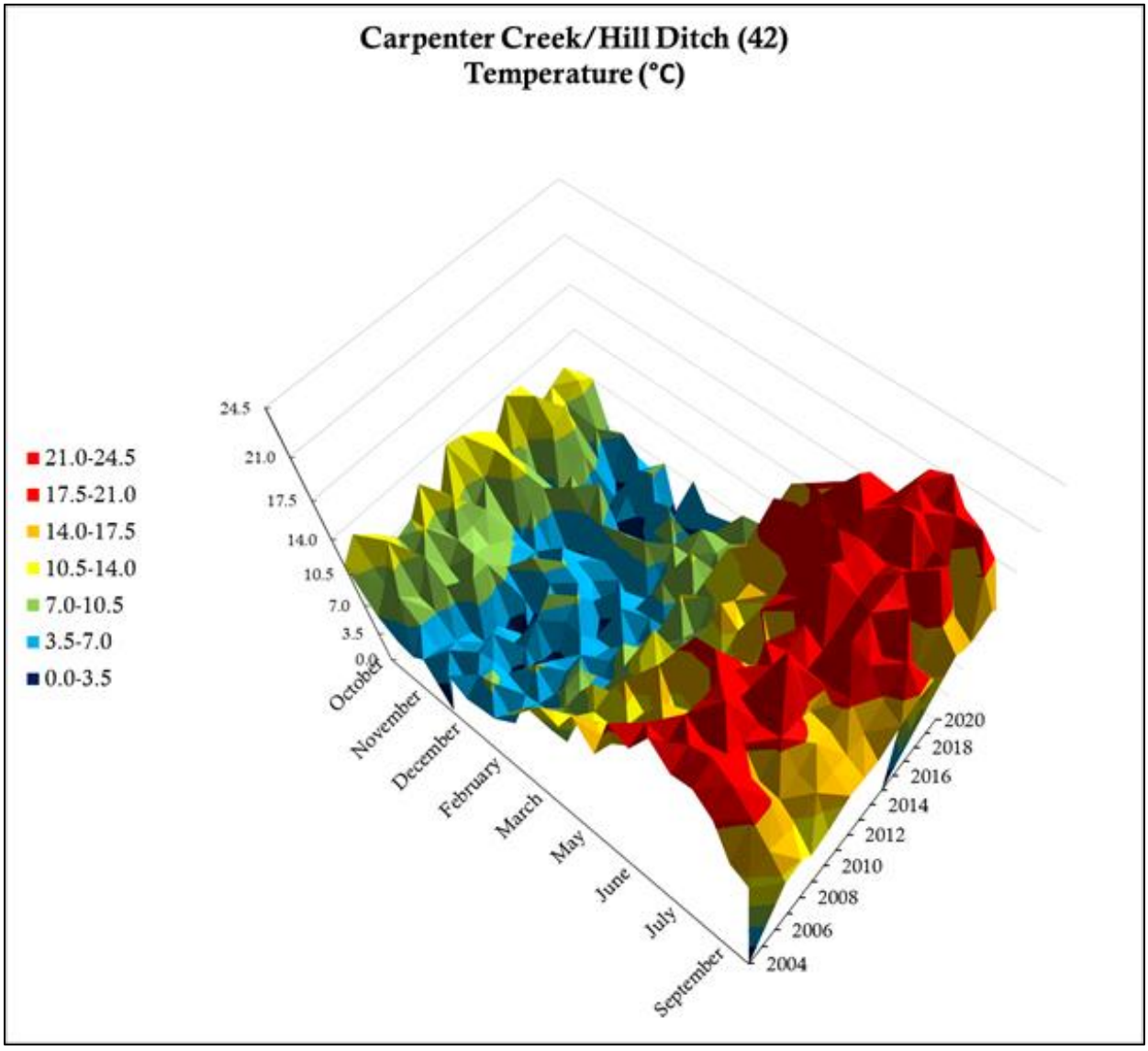
Site 42 is tied for 10th out of 39 sites for number of significant trends, with 14, and is 29th out of 39 sites for positive trends, with 43%.

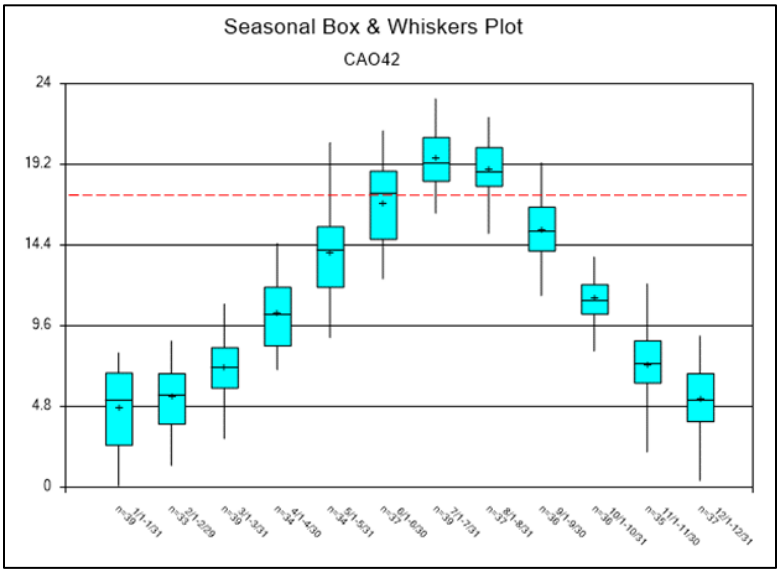




The dissolved oxygen (DO) standard for this site is 9.50 mg/L. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.

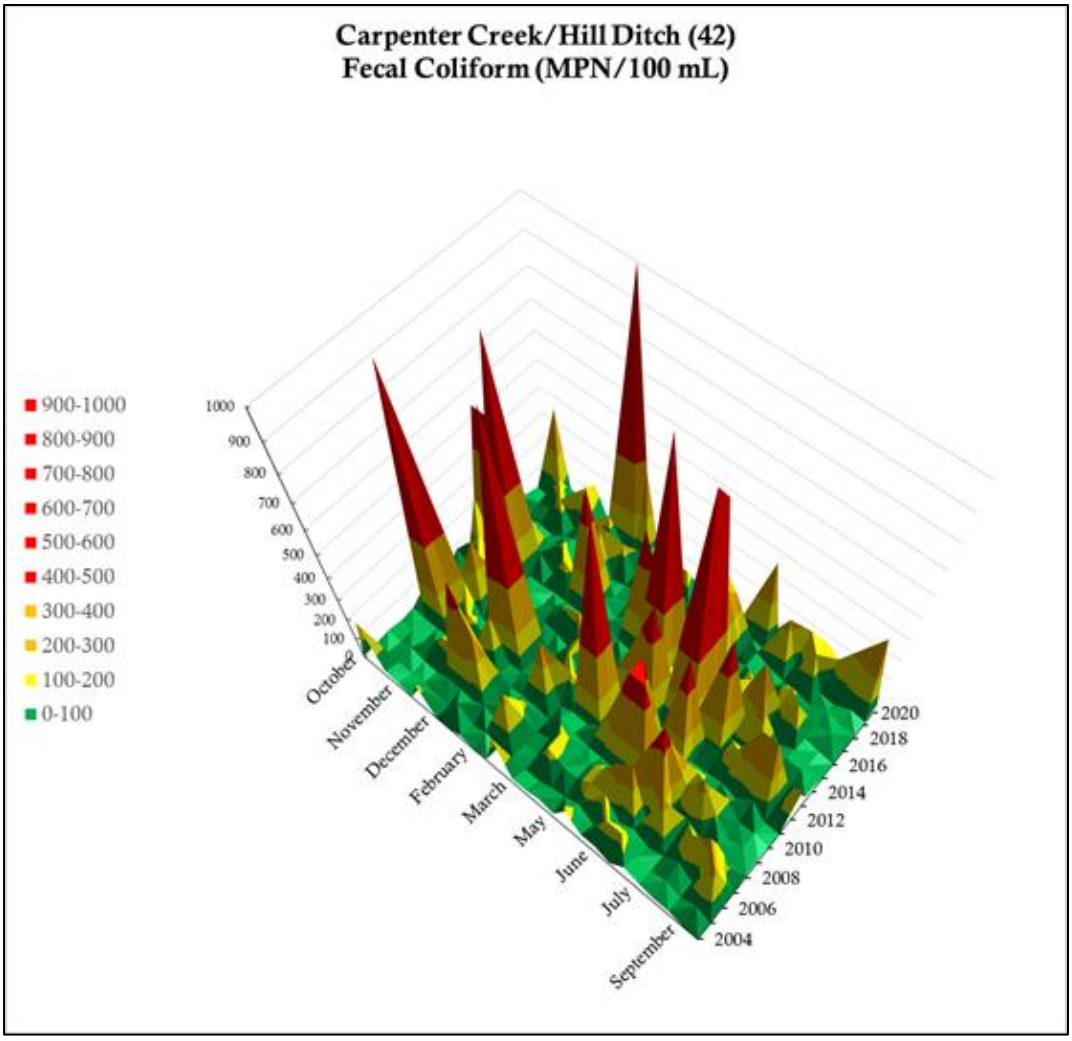
The dashed red line on the monthly box plot represents the 9.5 mg/L standard, and is approximate. The calendar year on the x-axis begins in January and ends in December.

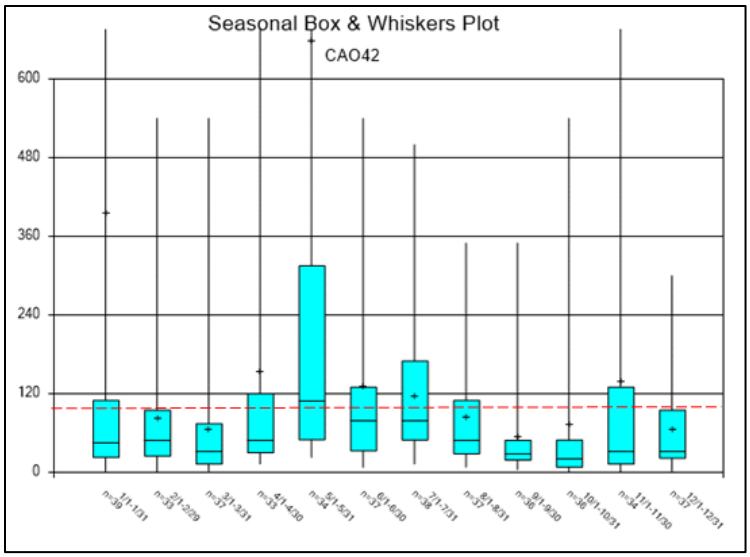




The temperature standard for this site is 17.5 °C. Any part of the 3D plot that is in red is hotter than that standard. The water year on the x-axis begins in October and ends in September.

The dashed red line on the monthly box plot represents the 17.5 °C standard, and is approximate. The calendar year on the x-axis begins in January and ends in December.





The fecal coliform (FC) standard for this site is 100 MPN/100 mL. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.

The dashed red line on the monthly box plot represents the 100 MPN/100 mL standard, and is approximate. The calendar year on the x-axis begins in January and ends in December.

43

Wiley Slough
@ Wylie Road

Downstream Ag

Water Quality Index (WQI)

2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
1	19	17	10	22	6	19	11	12	3	13	1	16	26	7

Long Term Trends

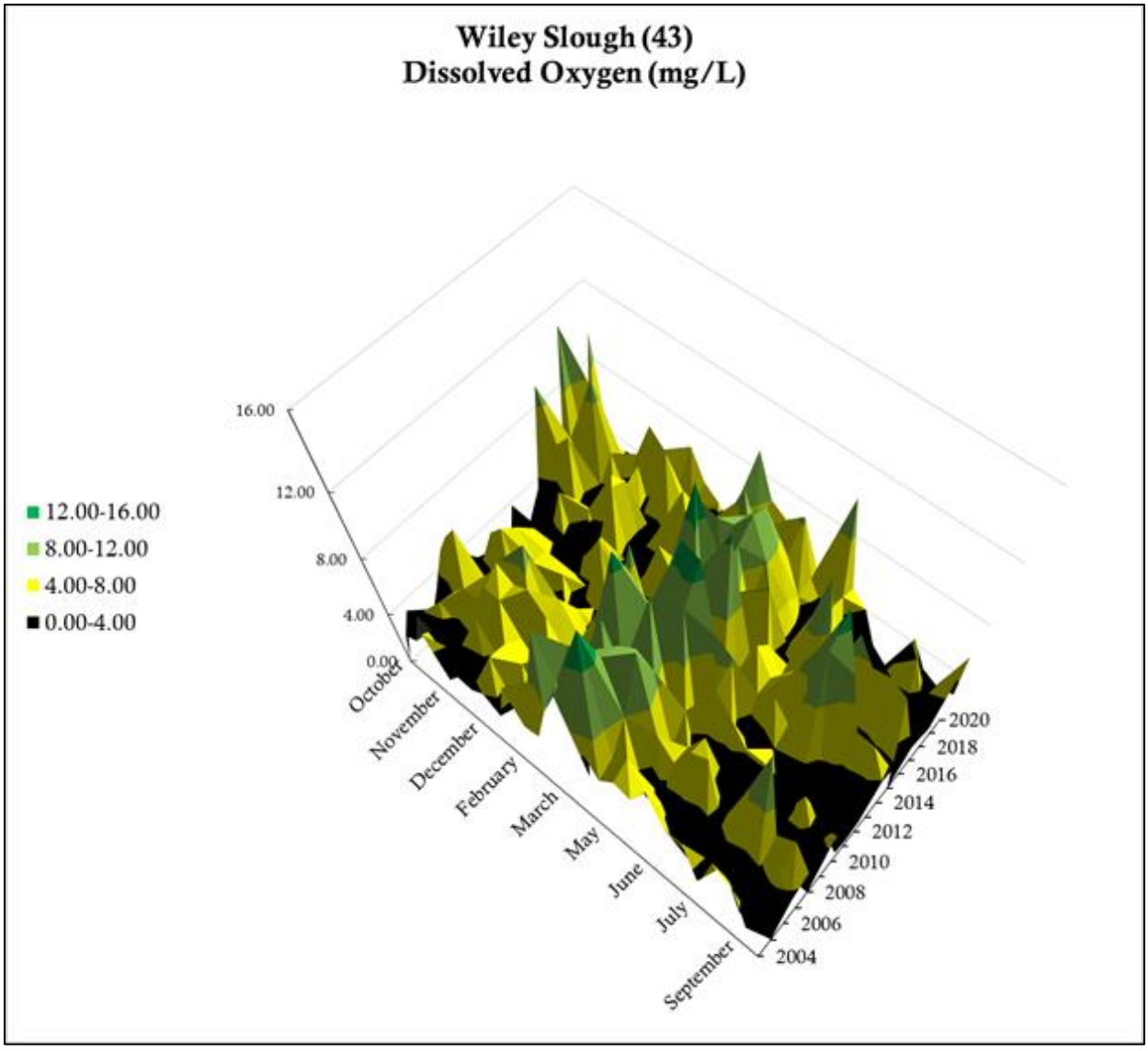
Dissolved Oxygen			Temperature			Fecal Coliform		
17 yr	10 yr	5 yr	17 yr	10 yr	5 yr	17 yr	10 yr	5 yr
—	—	—	—	—	—	↑	—	—

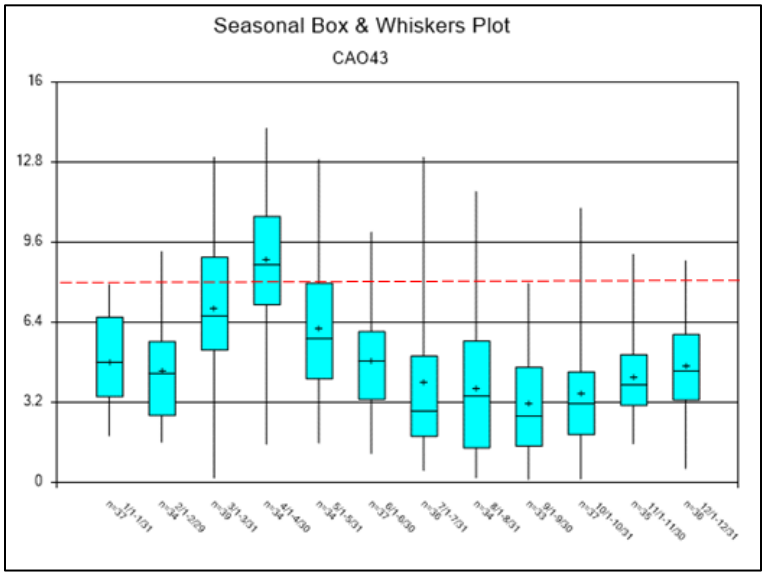
Site 43 is Wiley Slough, prior to its termination into the Skagit Wildlife Area wetlands and Skagit Bay. This site drains a large amount of agricultural area on Fir Island. Sites like this are characterized by being stagnant or slow-moving, and are heavily tidally-influenced. This site is designated as salmonid spawning, rearing, and migration (SRM) status.

Fecal coliform levels are higher now than they were at the beginning of this program. WQI scores are consistently in the category of highest concern.

Site 43 rarely meets state standards for DO, and fails to meet state standards for water temperature in the warmer months. Annual FC levels pass the state standard for geomean of 100, but fail the state standard for a 90th percentile of 200.

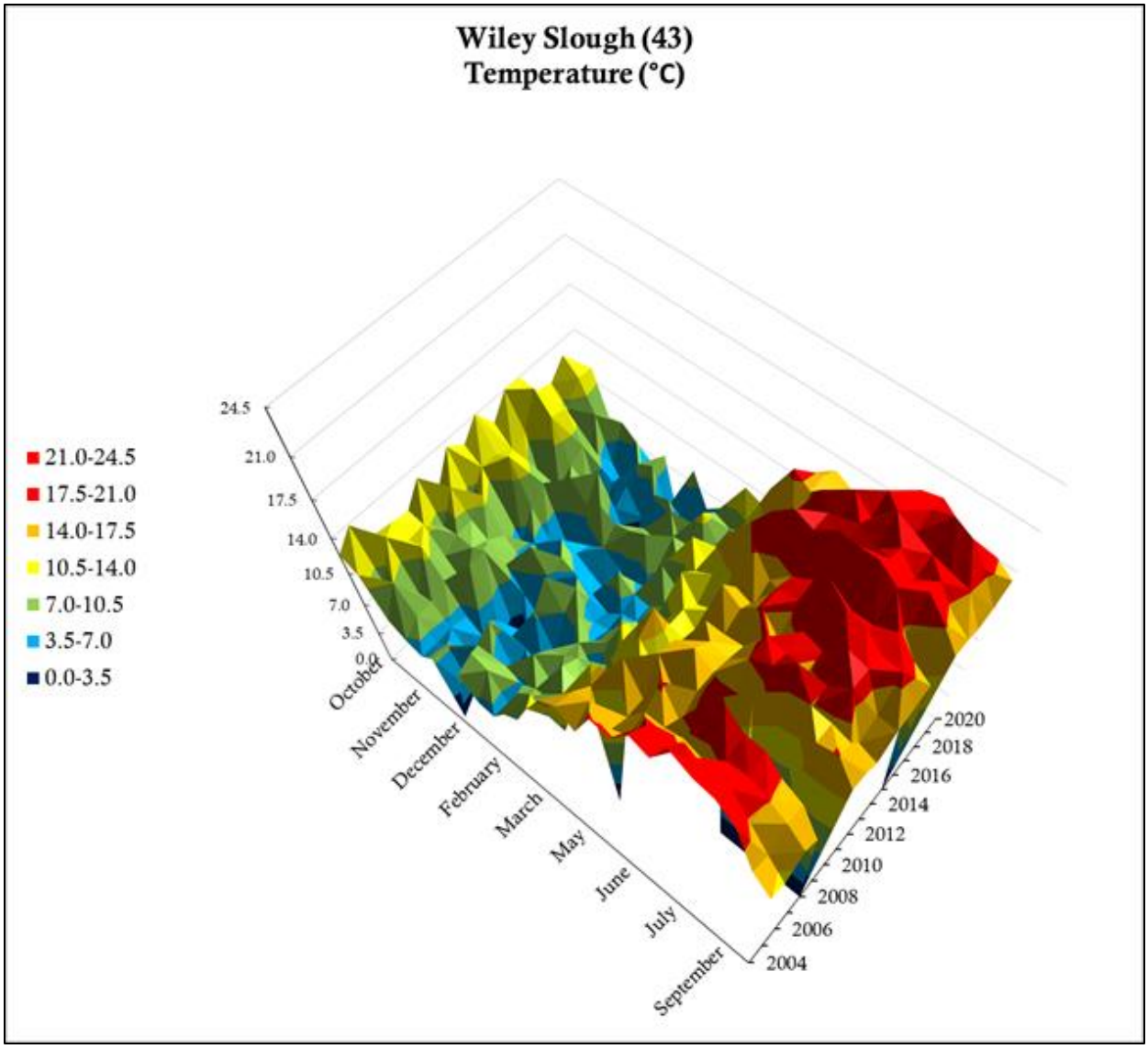
Site 43 is tied for last out of 39 sites for number of significant trends, with 6, and is last out of 39 sites for positive trends, with 0%.

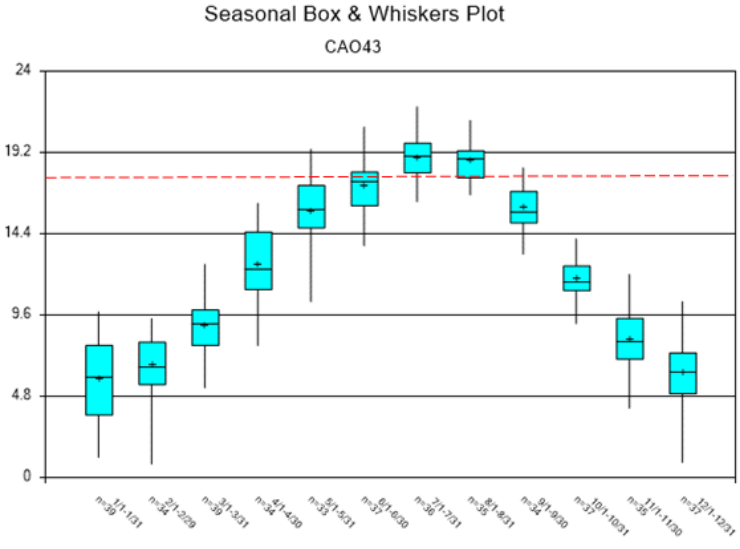




The dissolved oxygen (DO) standard for this site is 8.0 mg/L. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.

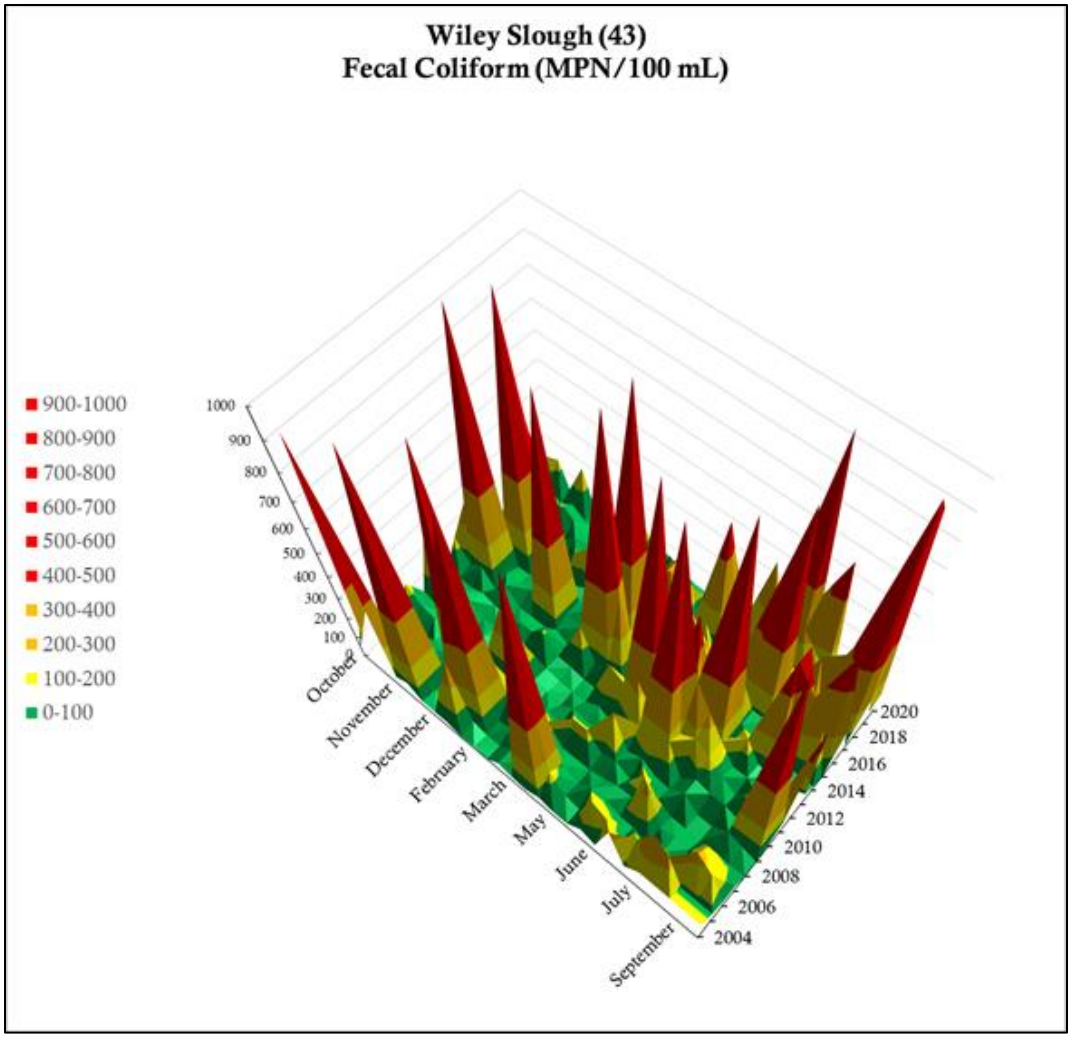
The dashed red line on the monthly box plot represents the 8.0 mg/L standard, and is approximate. The calendar year on the x-axis begins in January and ends in December.

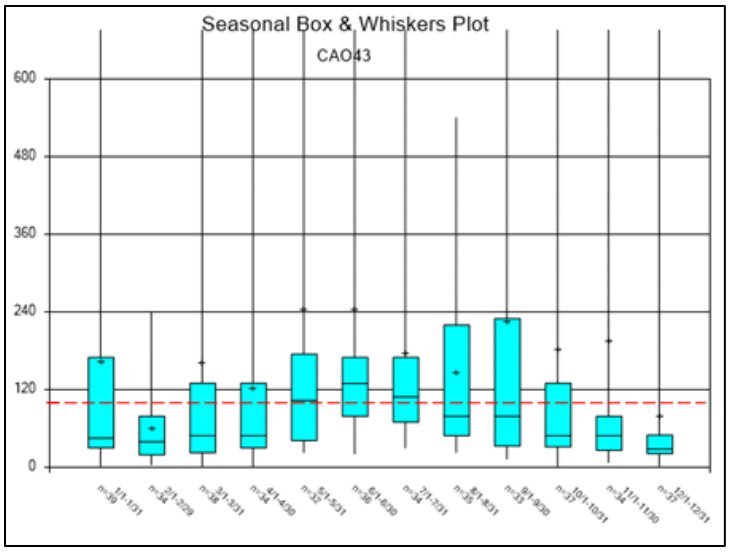




The temperature standard for this site is 17.5 °C. Any part of the 3D plot that is in red is hotter than that standard. The water year on the x-axis begins in October and ends in September.

The dashed red line on the monthly box plot represents the 17.5 °C standard, and is approximate. The calendar year on the x-axis begins in January and ends in December.





The fecal coliform (FC) standard for this site is 100 MPN/100 mL. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.

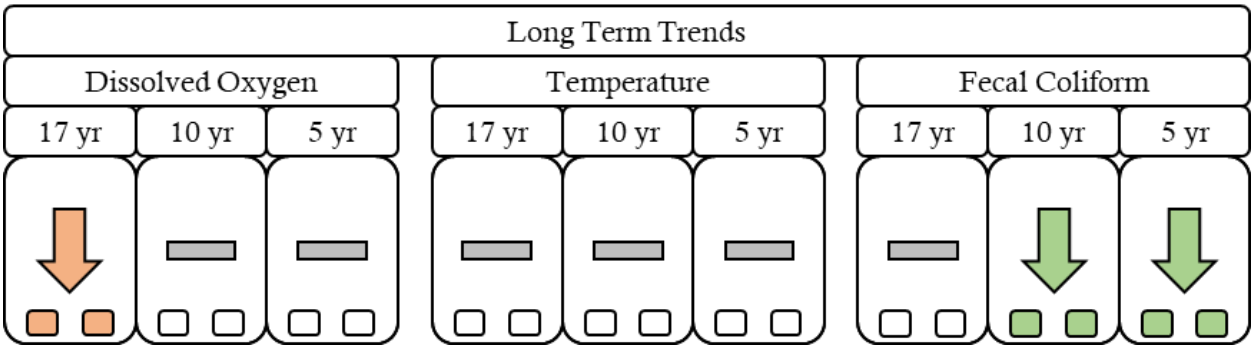
The dashed red line on the monthly box plot represents the 100 MPN/100 mL standard, and is approximate. The calendar year on the x-axis begins in January and ends in December.

44

Sullivan Slough
@ La Conner-Whitney Road

Downstream Ag

Water Quality Index (WQI)														
2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
28	21	2	33	47	29	36	25	12	11	8	16	8	32	23

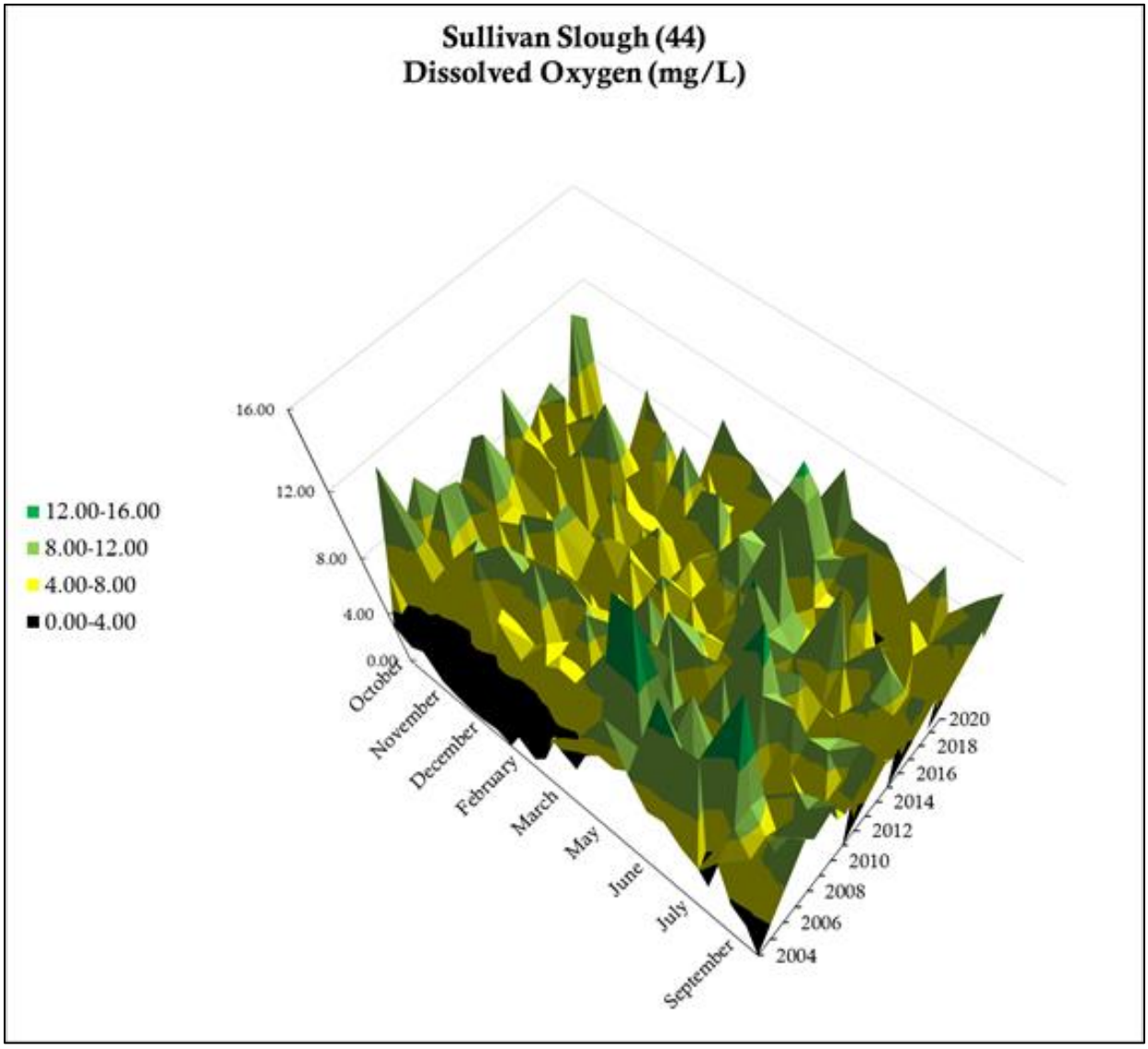


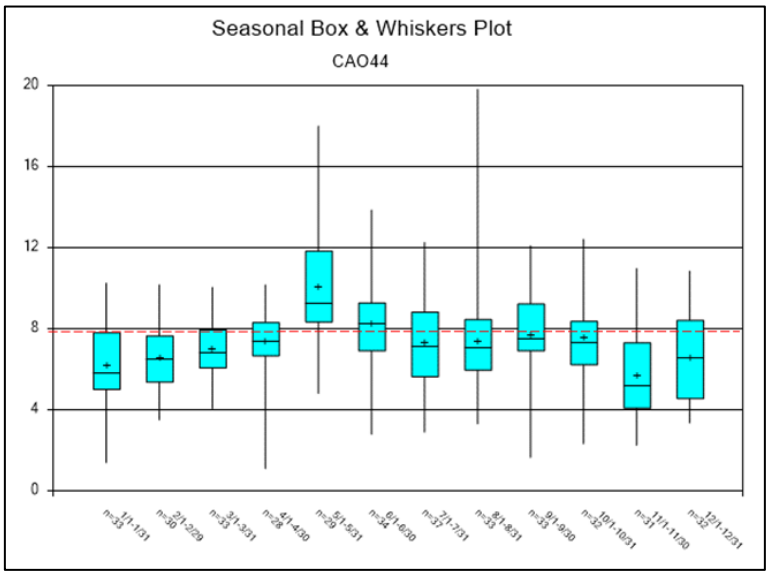
Site 44 is Sullivan Slough, at its west end, just prior to entering the Swinomish Channel. Sites like this are characterized by being stagnant or slow-moving, and are heavily tidally-influenced. This site is designated as salmonid spawning, rearing, and migration (SRM) status.

Dissolved oxygen is lower than it was 17 years ago. Fecal coliform counts have decreased over the last ten years and five years. WQI scores are consistently in the category of highest concern.

Site 44 spends the majority of the year below state standards for DO, and fails to meet state standards for water temperature during the warmer months. Annual FC levels for WY2020 failed to meet state standards.

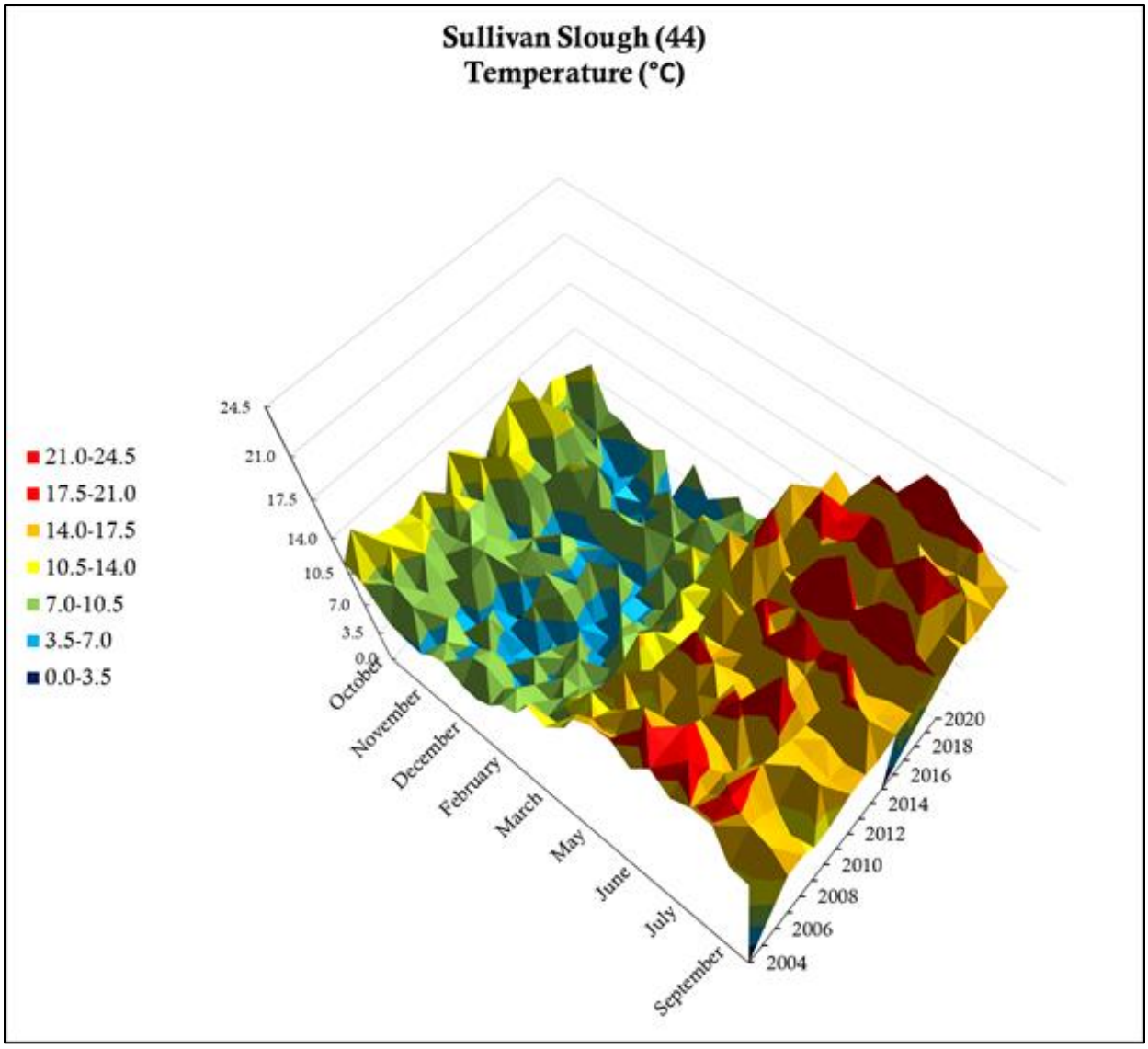
Site 44 is tied for 22nd out of 39 sites for number of significant trends, with 11, and is 32nd out of 39 sites for positive trends, with 36%.

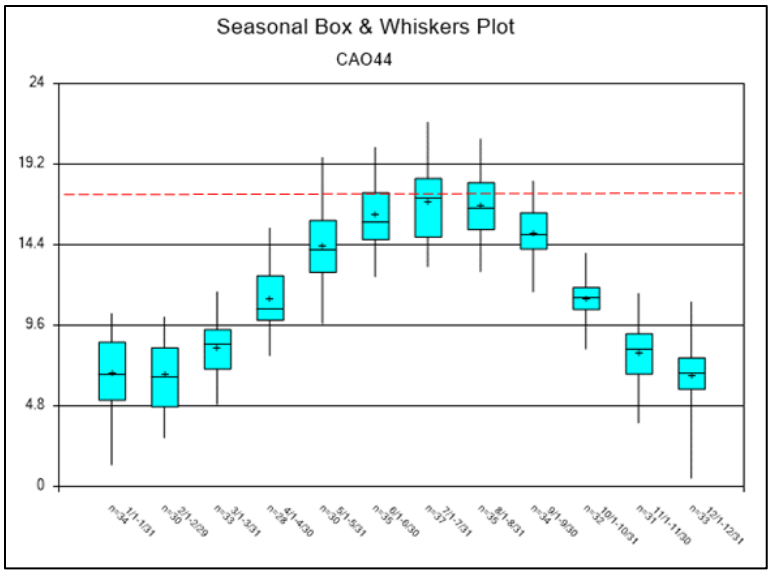




The dissolved oxygen (DO) standard for this site is 8.0 mg/L. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.

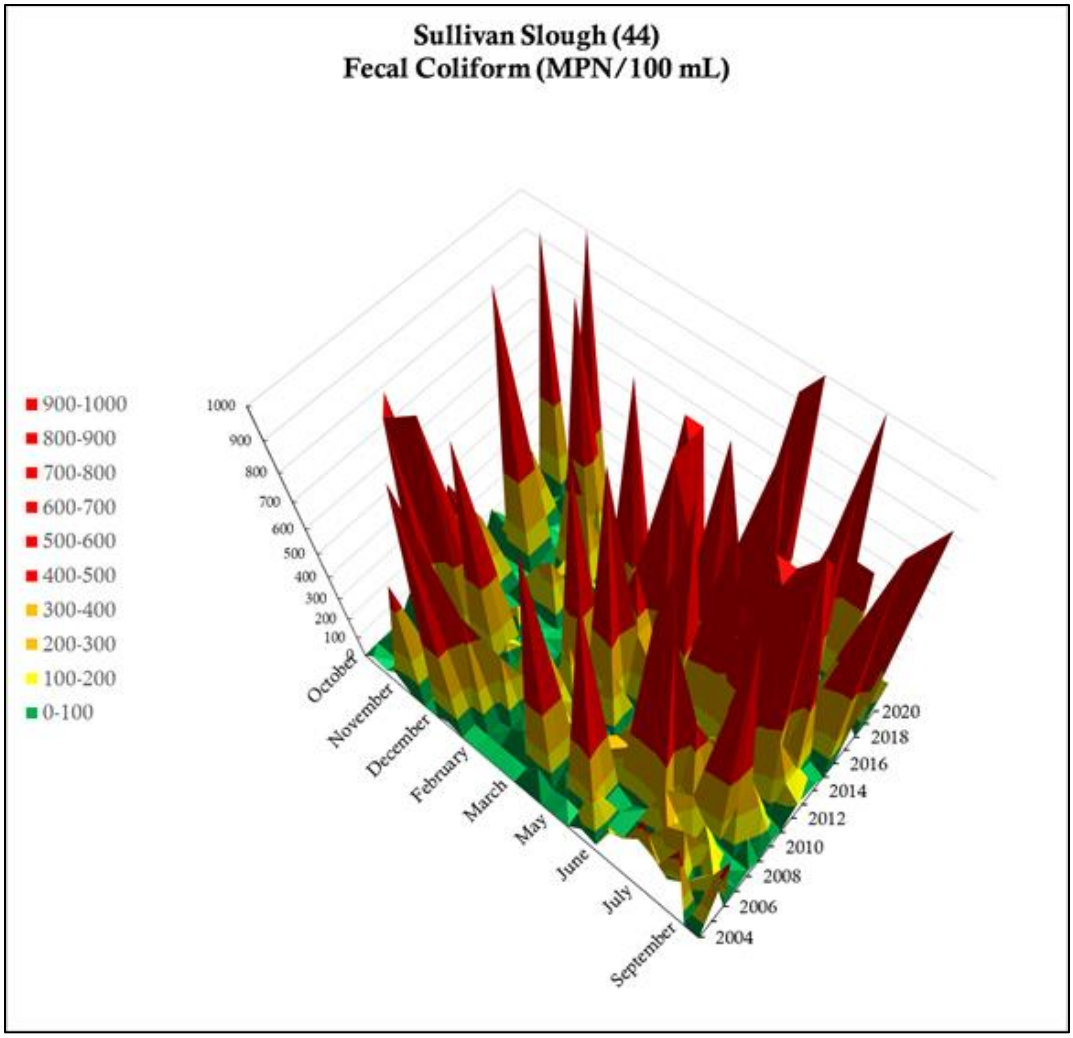
The dashed red line on the monthly box plot represents the 8.0 mg/L standard, and is approximate. The calendar year on the x-axis begins in January and ends in December.

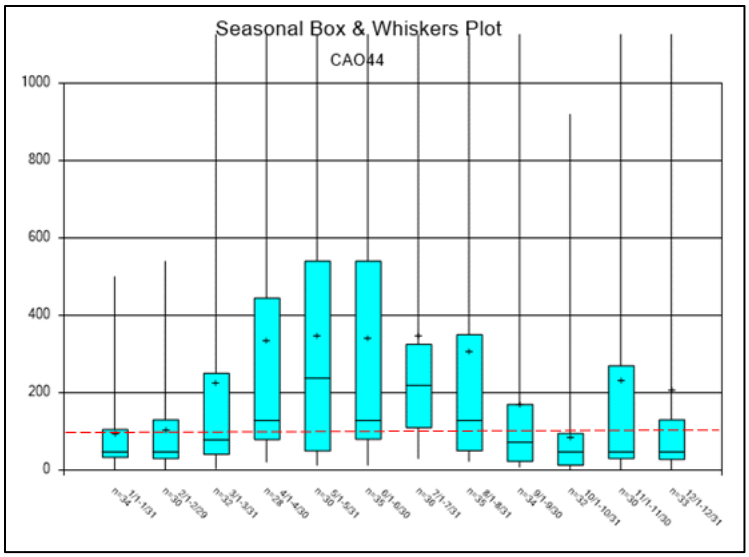




The temperature standard for this site is 17.5 °C. Any part of the 3D plot that is in red is hotter than that standard. The water year on the x-axis begins in October and ends in September.

The dashed red line on the monthly box plot represents the 17.5 °C standard, and is approximate. The calendar year on the x-axis begins in January and ends in December.





The fecal coliform (FC) standard for this site is 100 MPN/100 mL. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.

The dashed red line on the monthly box plot represents the 100 MPN/100 mL standard, and is approximate. The calendar year on the x-axis begins in January and ends in December.

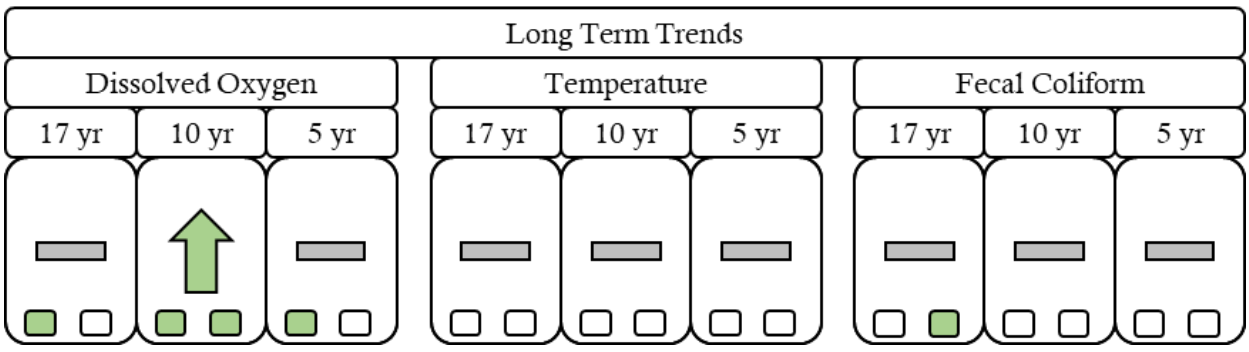
45

North Fork Skagit River
@ Moore Road

Skagit River – Lower, TMDL

Water Quality Index (WQI)

2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
78	71	88	95	95	95	80	86	85	93	89	89	89	88	93

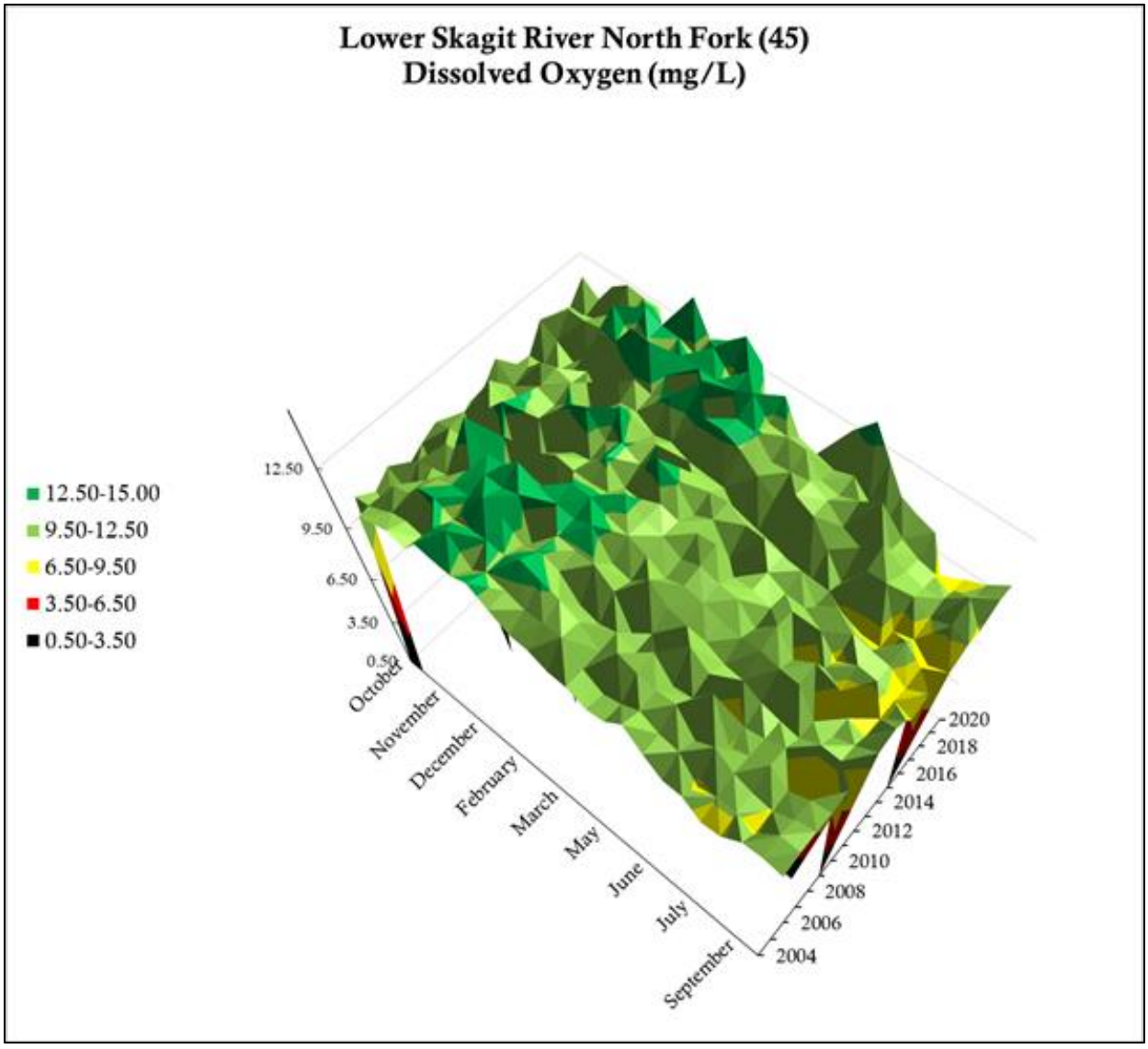


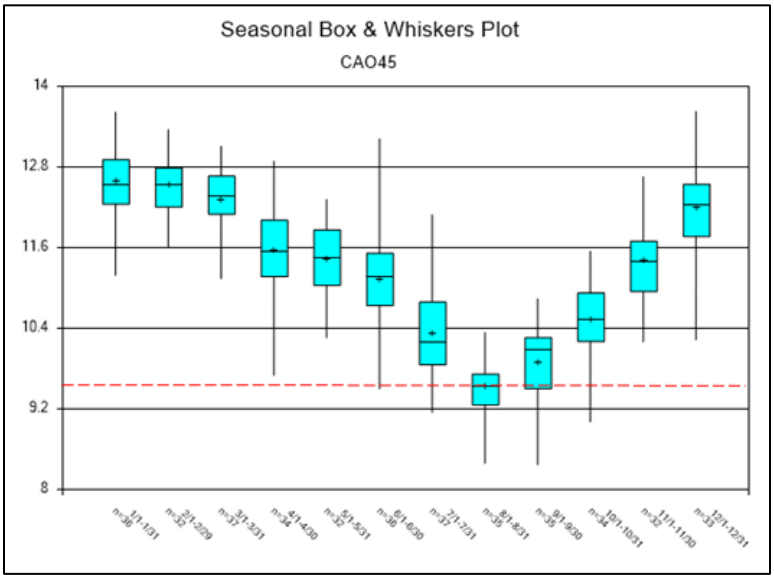
Site 45 is the north fork of the Skagit River, downstream of Mount Vernon. The river is designated as core salmonid habitat and as salmonid spawning, rearing, and migration (SRM) status.

Dissolved oxygen has increased over the most recent ten years. WQI scores are consistently in the category of least concern.

Site 45 rarely fails to meet state standards for DO and temperature. Annual FC counts easily meet state standards.

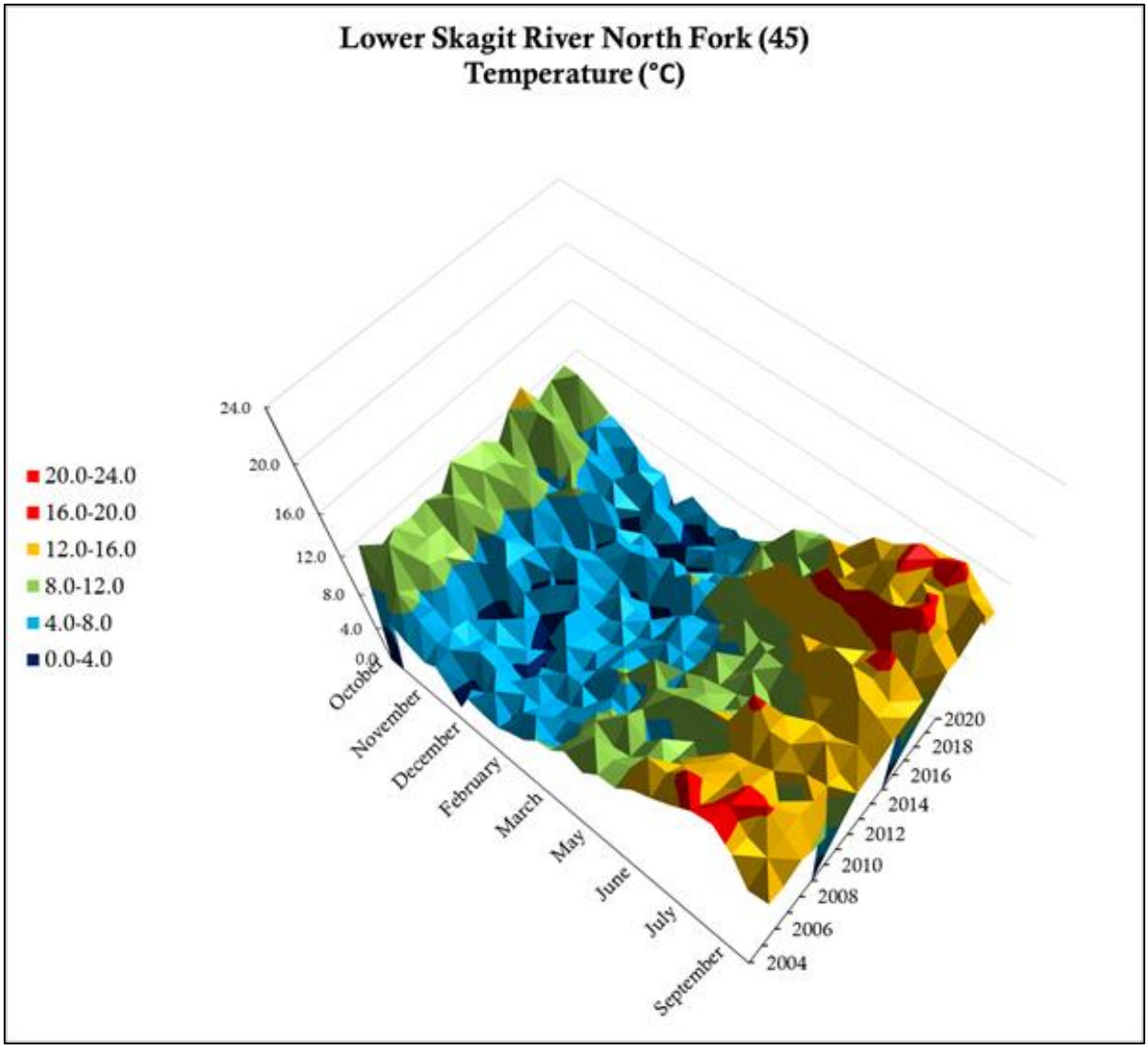
Site 45 is tied for 22nd out of 39 sites for number of significant trends, with 11, and is tied for 2nd out of 39 sites for positive trends, with 91%.

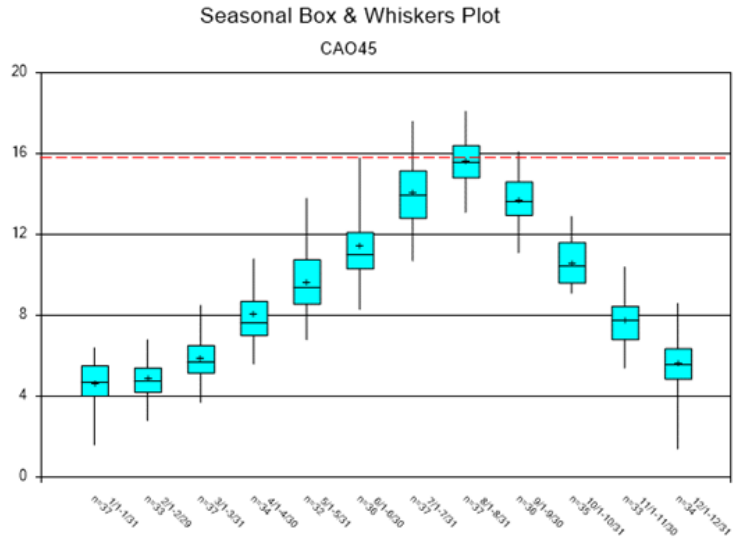




The dissolved oxygen (DO) standard for this site is 9.50 mg/L. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.

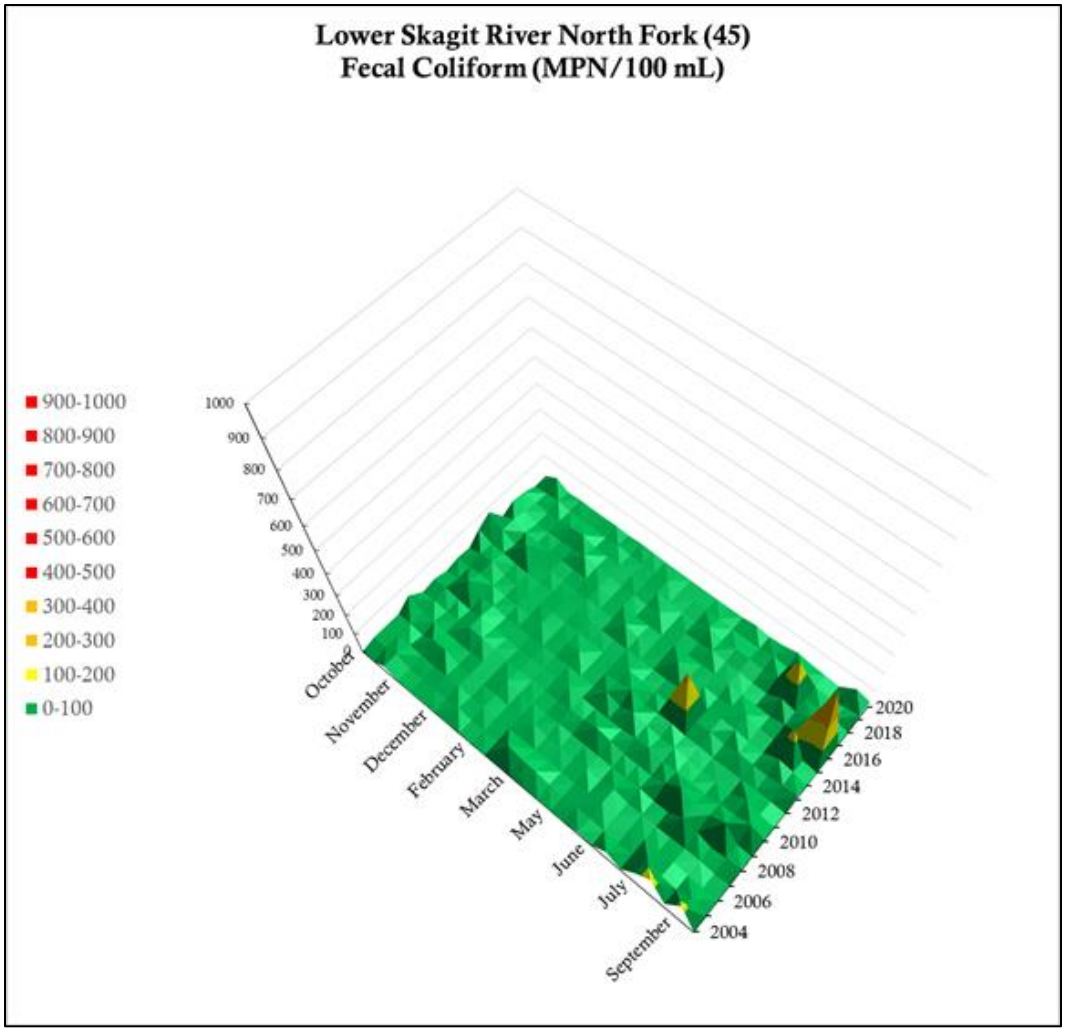
The dashed red line on the monthly box plot represents the 9.5 mg/L standard, and is approximate. The calendar year on the x-axis begins in January and ends in December.

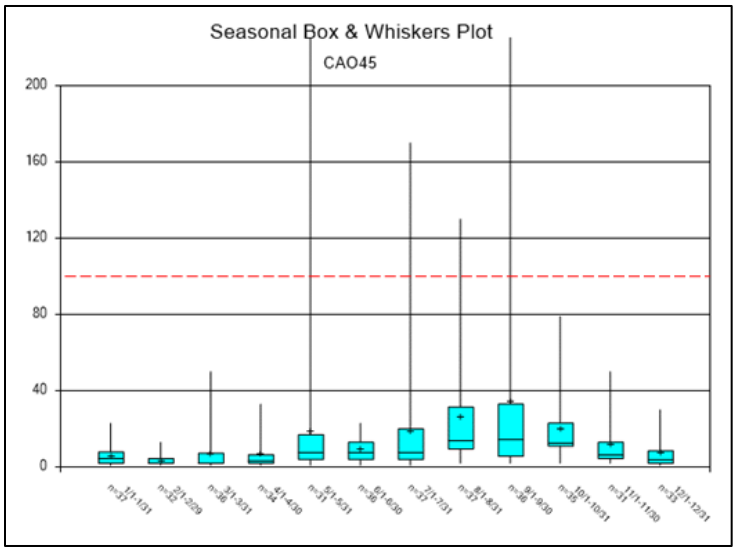




The temperature standard for this site is 16.0 °C. Any part of the 3D plot that is in red is hotter than that standard. The water year on the x-axis begins in October and ends in September.

The dashed red line on the monthly box plot represents the 16.0 °C standard, and is approximate. The calendar year on the x-axis begins in January and ends in December.





The fecal coliform (FC) standard for this site is 100 MPN/100 mL. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.

The dashed red line on the monthly box plot represents the 100 MPN/100 mL standard, and is approximate. The calendar year on the x-axis begins in January and ends in December.

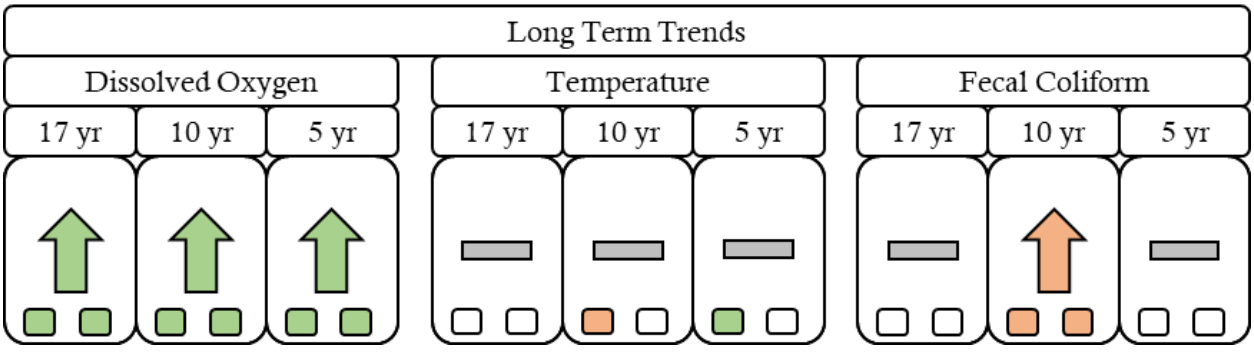
46

South Fork Skagit River
@ Conway Bridge

Skagit River – Lower, TMDL

Water Quality Index (WQI)

2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
81	73	80	93	91	95	89	83	91	91	93	88	92	86	93

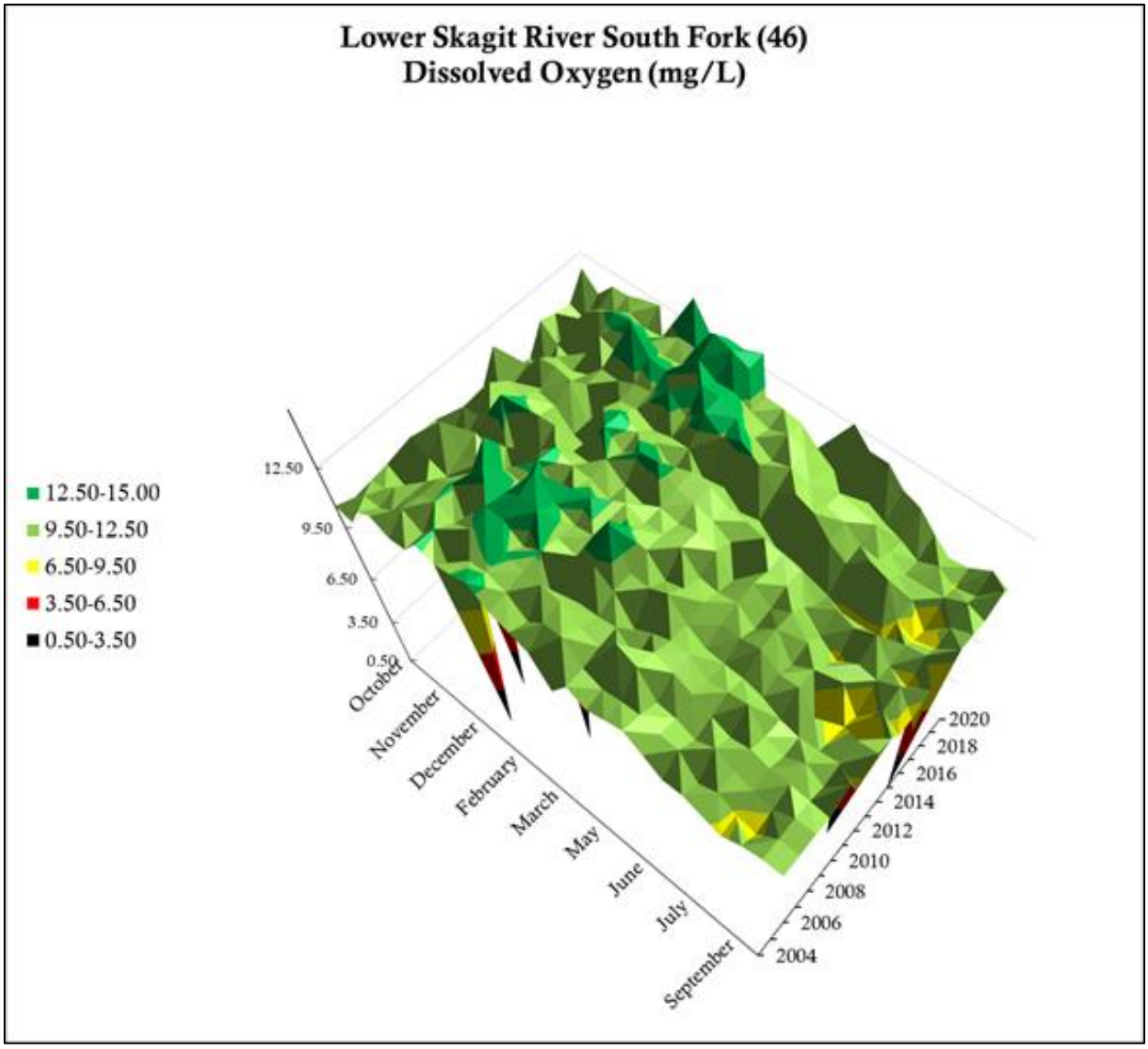


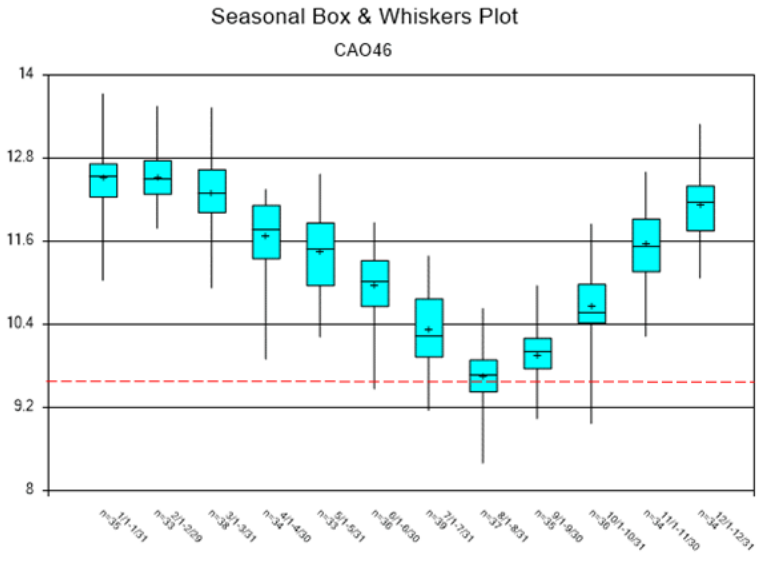
Site 46 is the south fork of the Skagit River, downstream of Mount Vernon. The river is designated as core salmonid habitat and as salmonid spawning, rearing, and migration (SRM) status.

Dissolved oxygen has increased over all analyzed time periods. Fecal coliform counts are higher now than ten years ago. WQI scores are consistently in the category of least concern.

Site 46 rarely fails to meet state standards for DO and water temperature. Annual FC counts easily meet state standards.

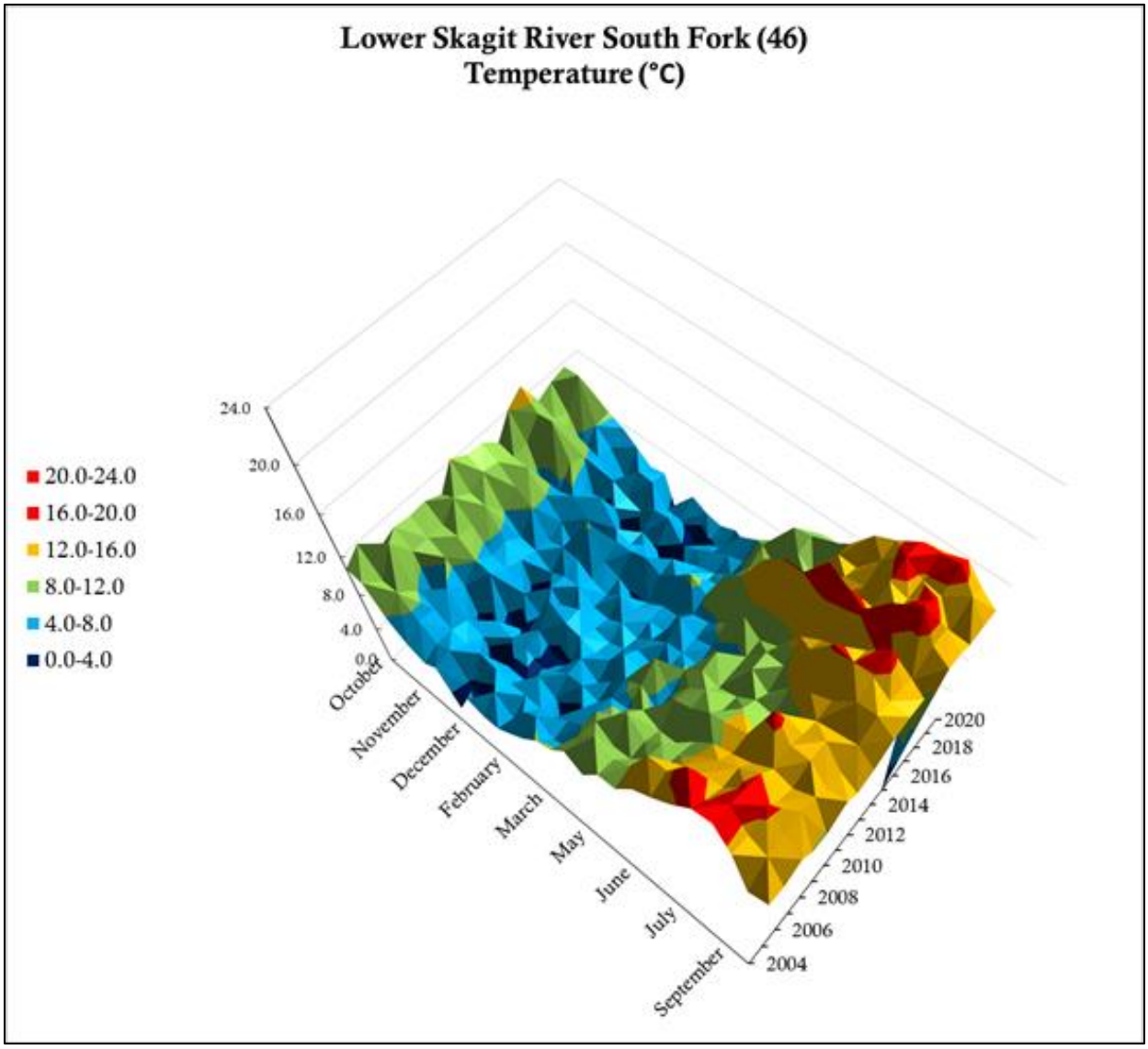
Site 46 is tied for 3rd out of 39 sites for number of significant trends, with 17, and is 11th out of 39 sites for positive trends, with 76%.

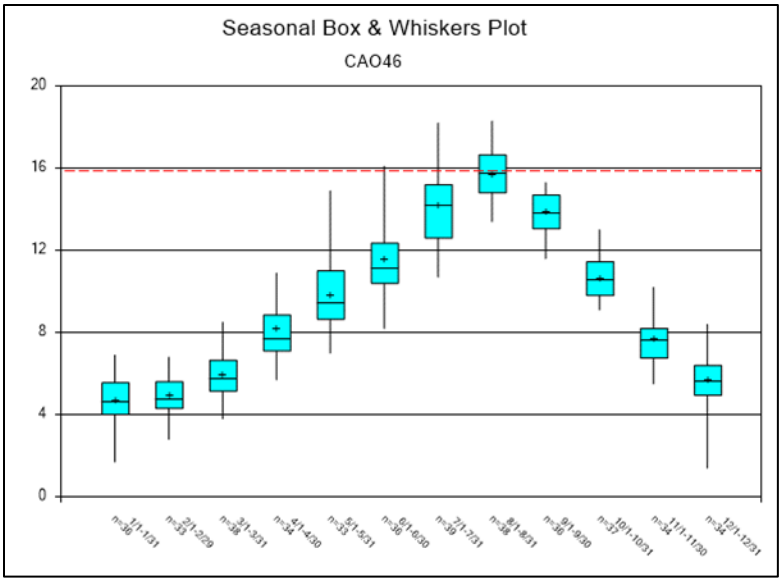




The dissolved oxygen (DO) standard for this site is 9.50 mg/L. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.

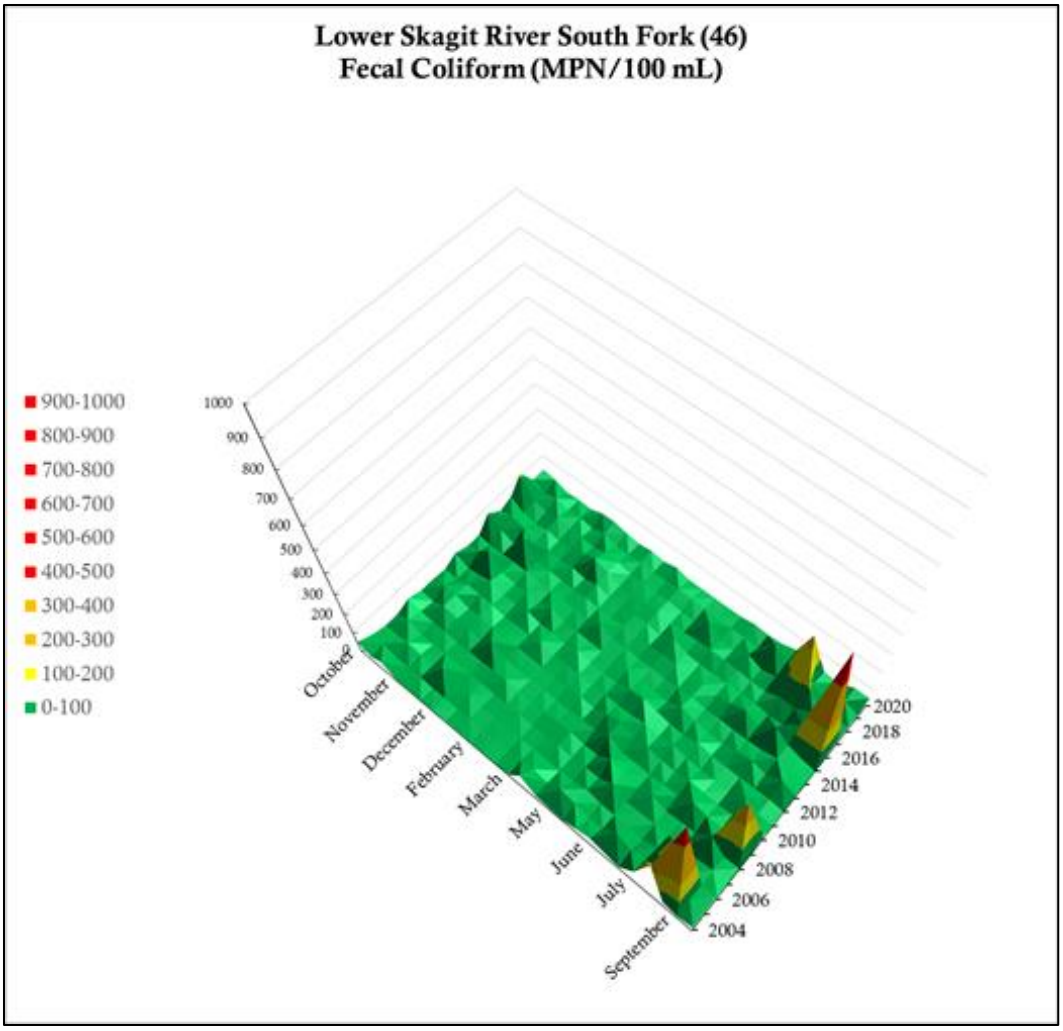
The dashed red line on the monthly box plot represents the 9.5 mg/L standard, and is approximate. The calendar year on the x-axis begins in January and ends in December.

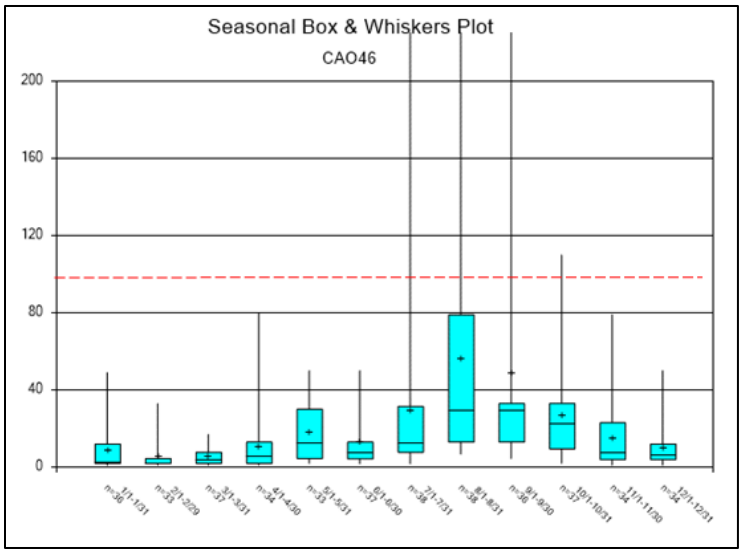




The temperature standard for this site is 16.0 °C. Any part of the 3D plot that is in red is hotter than that standard. The water year on the x-axis begins in October and ends in September.

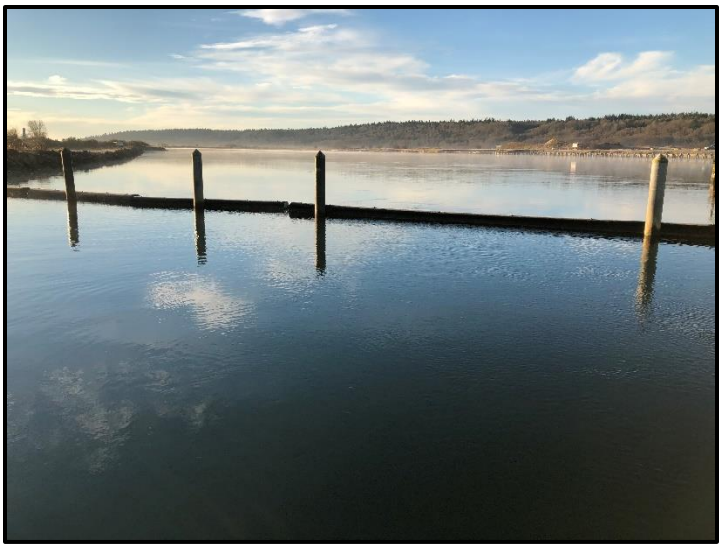
The dashed red line on the monthly box plot represents the 16.0 °C standard, and is approximate. The calendar year on the x-axis begins in January and ends in December.





The fecal coliform (FC) standard for this site is 100 MPN/100 mL. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.

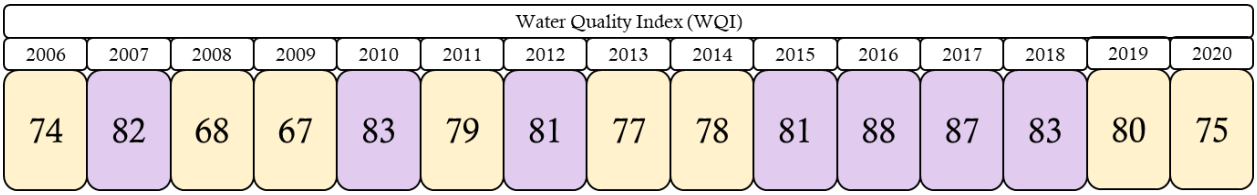
The dashed red line on the monthly box plot represents the 100 MPN/100 mL standard, and is approximate. The calendar year on the x-axis begins in January and ends in December.

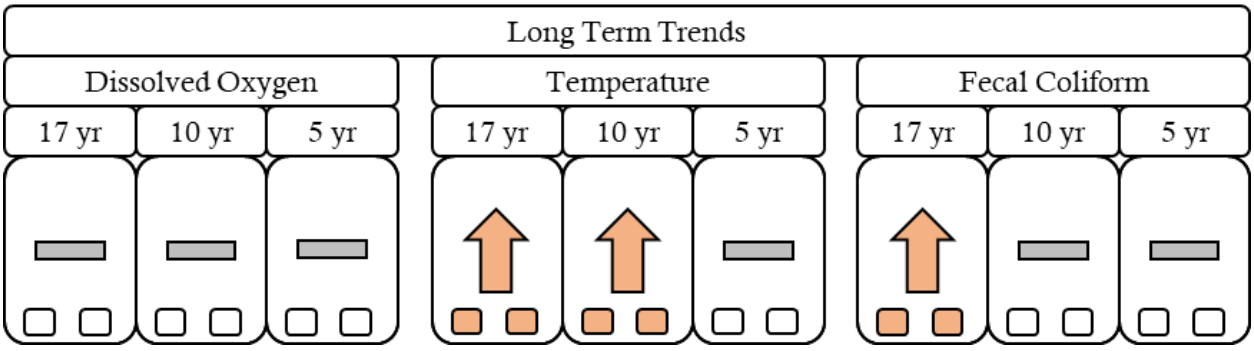


47

Swinomish Channel
@ Berentson Bridge

Reference - Marine



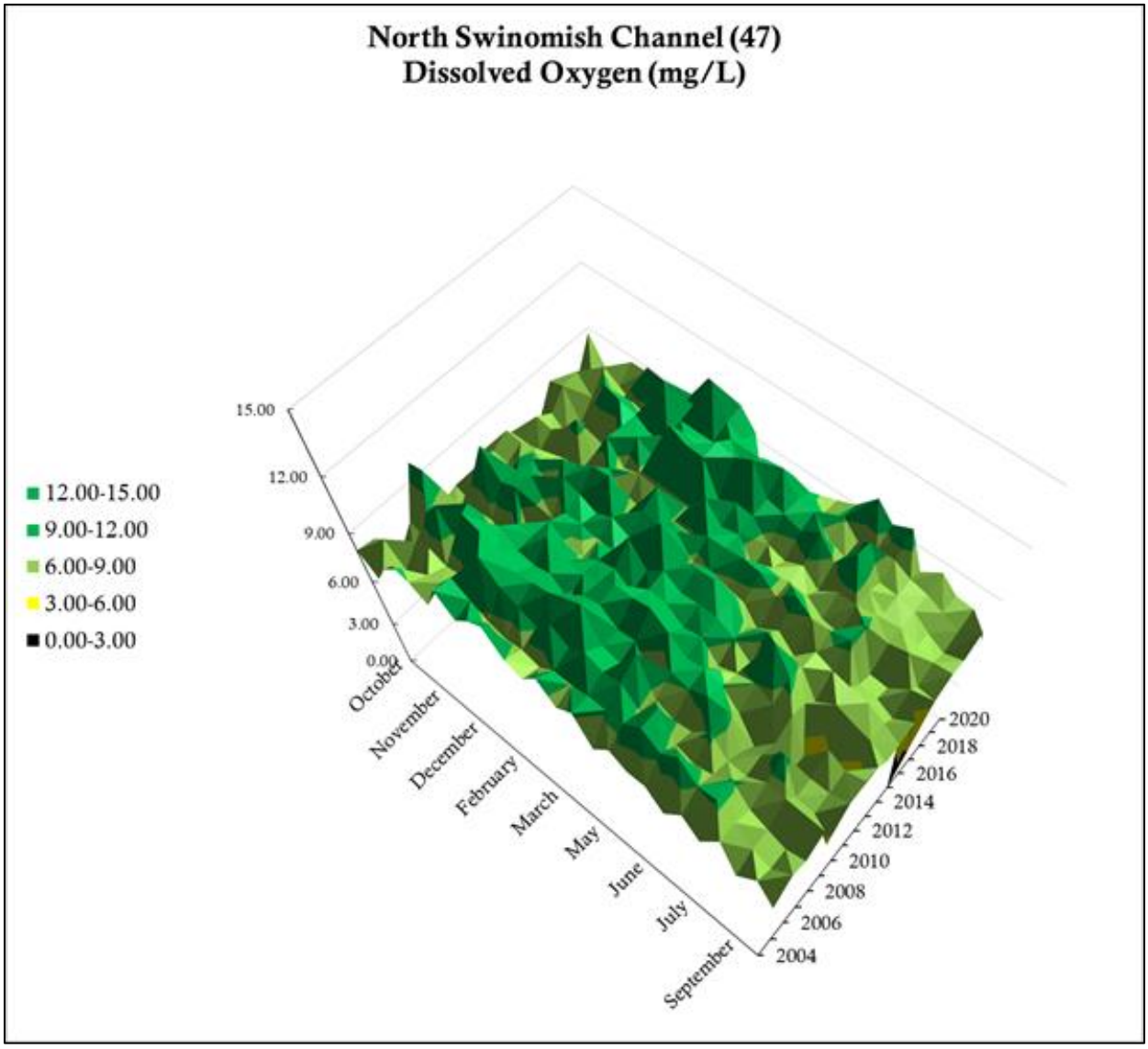


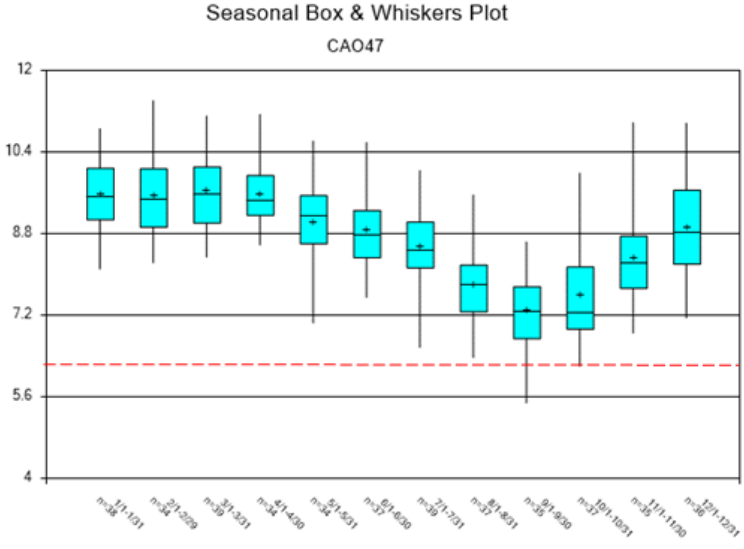
Site 47 is the Swinomish Channel, at the north end, just prior to Padilla Bay, and connects Padilla Bay to Skagit Bay. This site is designated as marine water.

Water temperature is higher than it was 17 years ago and ten years ago. Fecal coliform counts are higher now than they were at the beginning of this program. WQI scores are generally in the higher-scoring end of the moderate concern category, and often score as least concern.

Site 47 rarely fails to meet state standards for DO and water temperature. Annual FC counts easily meet state standards.

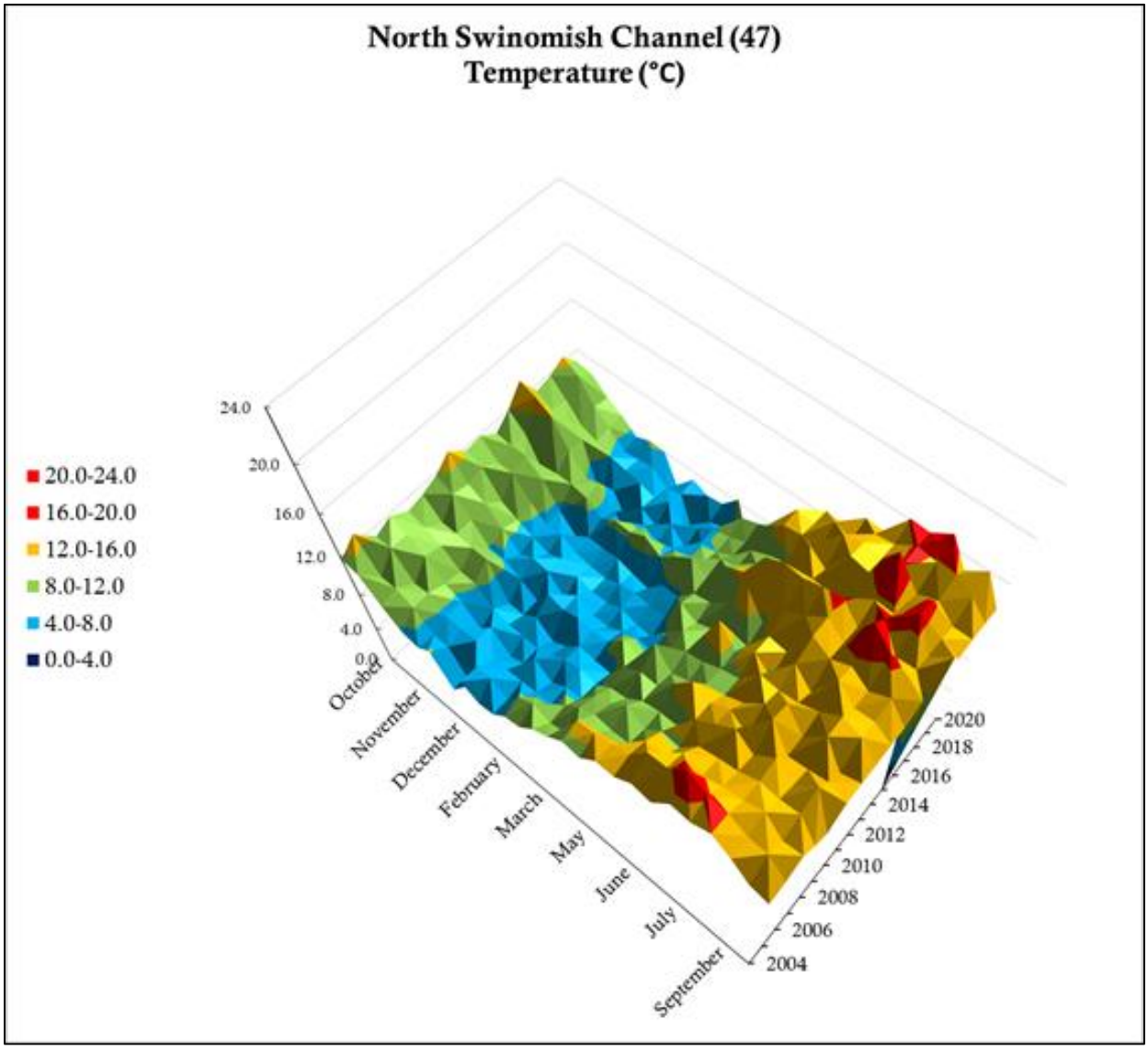
Site 47 is 12th out of 39 sites for number of significant trends, with 13, and is 37th out of 39 sites for positive trends, with 15%.

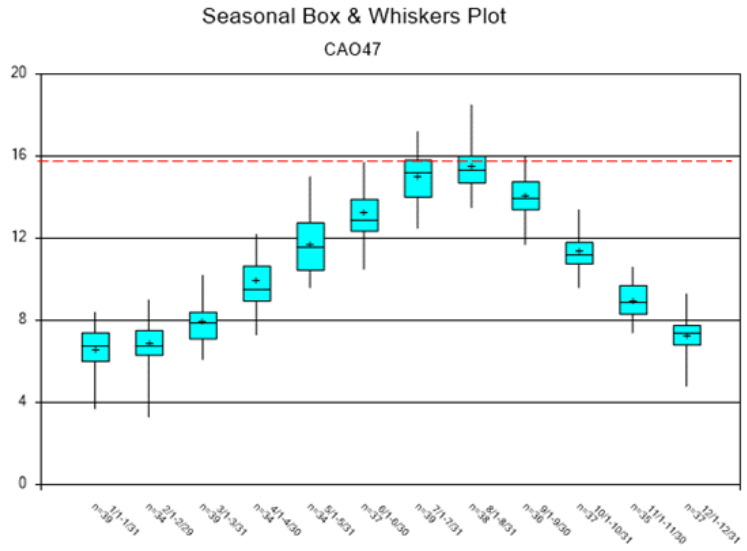




The dissolved oxygen (DO) standard for this site is 6.0 mg/L. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.

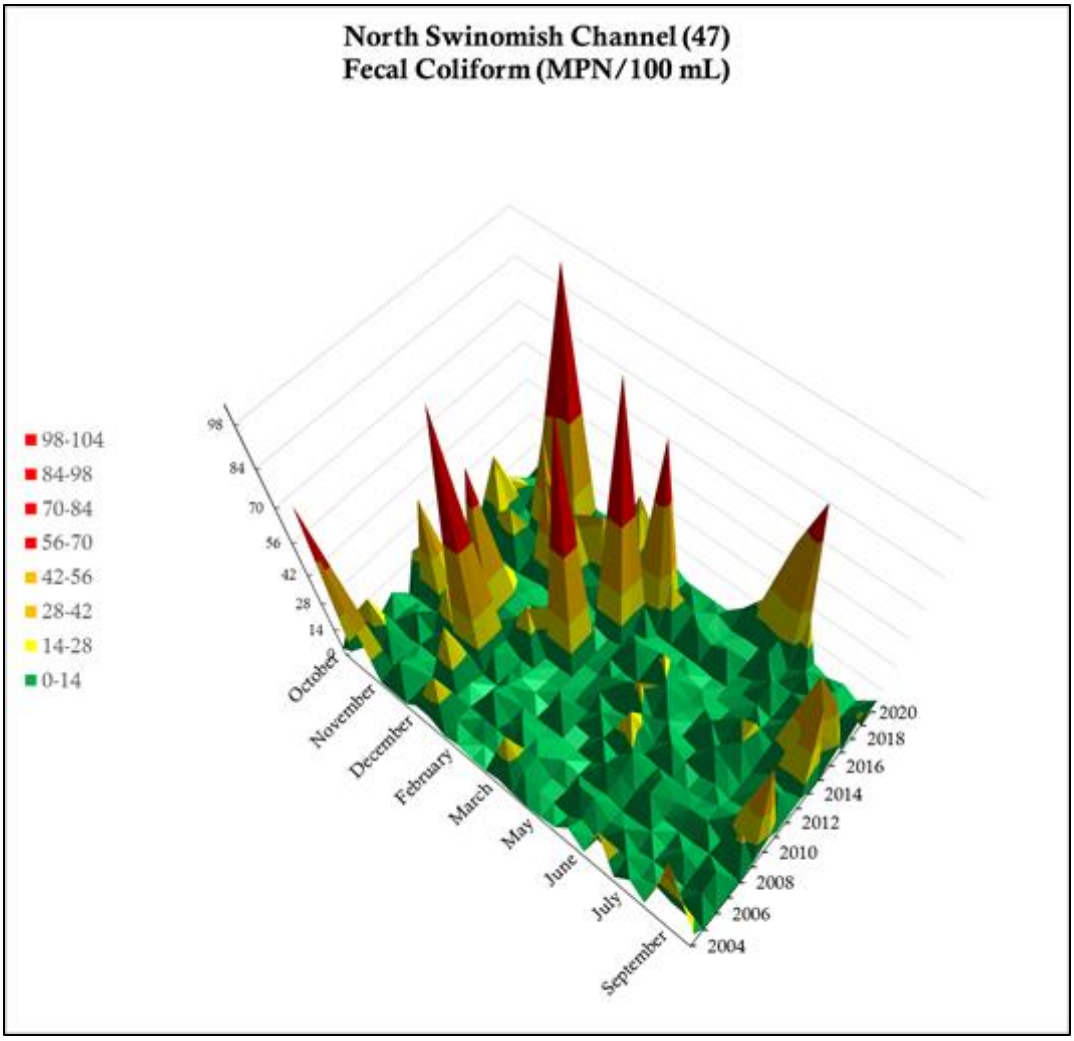
The dashed red line on the monthly box plot represents the 6.0 mg/L standard, and is approximate. The calendar year on the x-axis begins in January and ends in December.

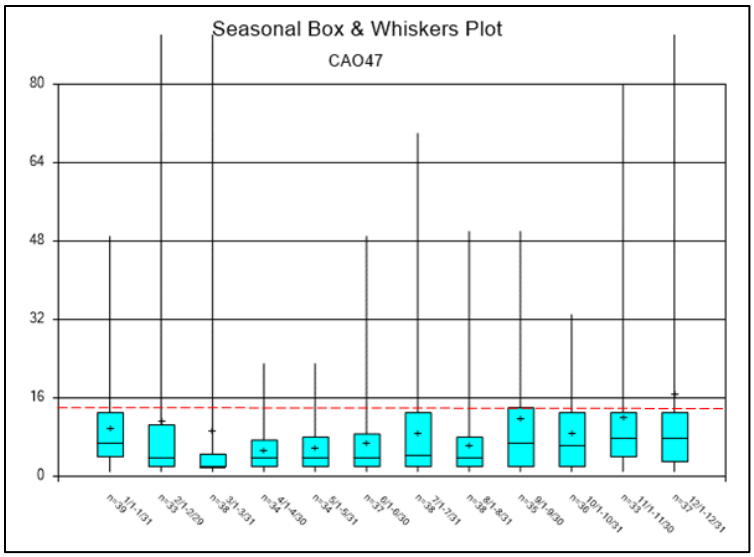




The temperature standard for this site is 16.0 °C. Any part of the 3D plot that is in red is hotter than that standard. The water year on the x-axis begins in October and ends in September.

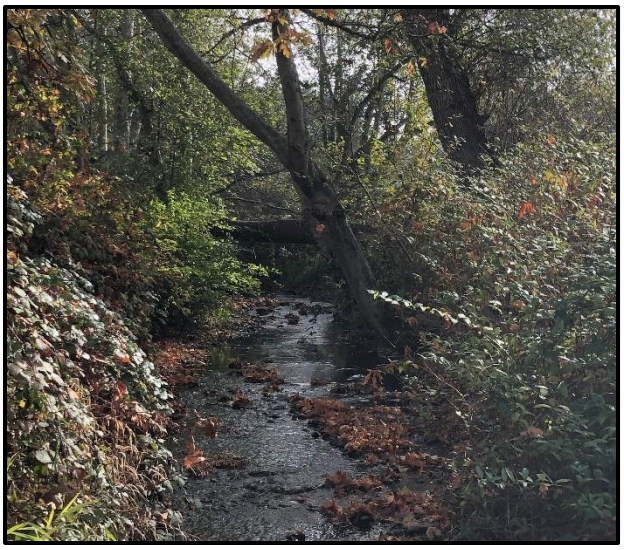
The dashed red line on the monthly box plot represents the 16.0 °C standard, and is approximate. The calendar year on the x-axis begins in January and ends in December.





The fecal coliform (FC) standard for this site is 14 MPN/100 mL. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.

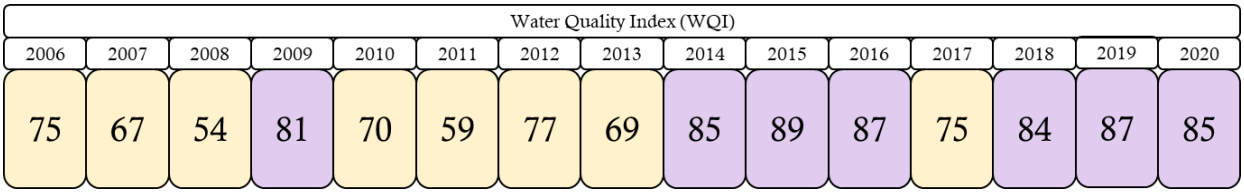
The dashed red line on the monthly box plot represents the 14 MPN/100 mL standard, and is approximate. The calendar year on the x-axis begins in January and ends in December.

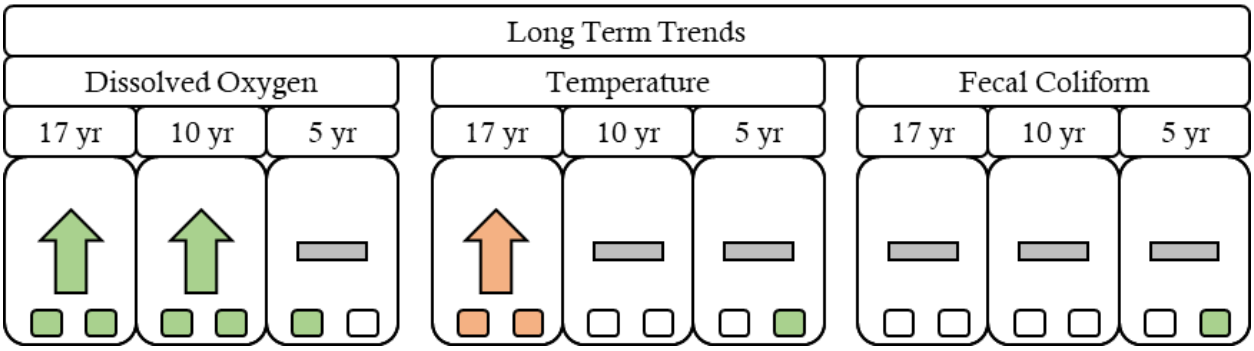


48

Fisher Creek
@ Franklin Road

Downstream Ag, TMDL



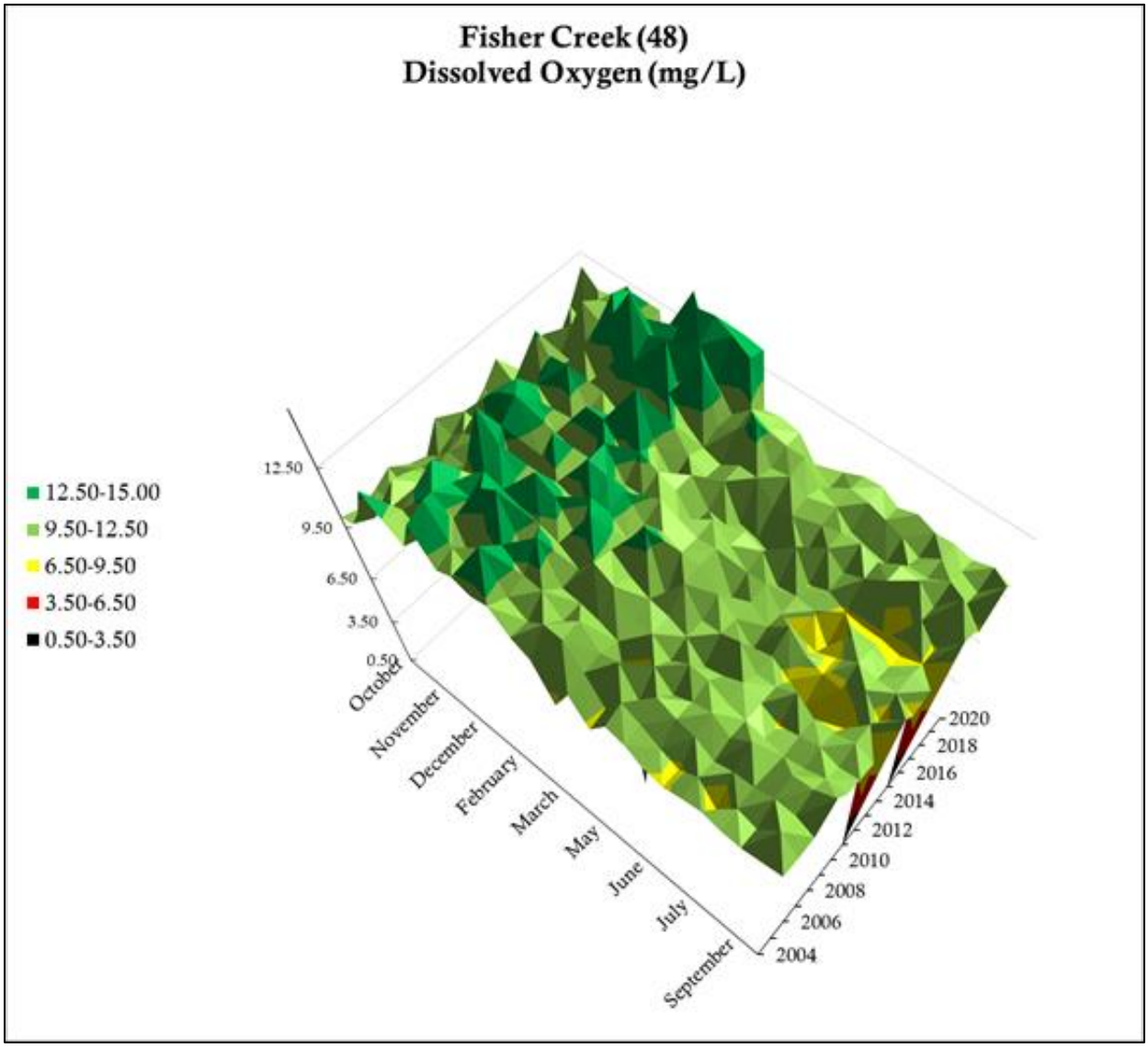


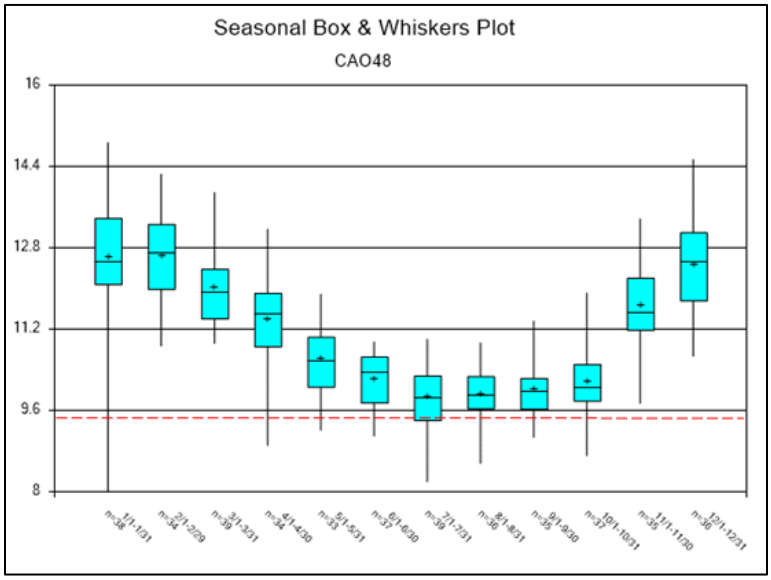
Site 48 is Fisher Creek, just prior to adjoining Carpenter Creek/Hill Ditch, and ultimately Skagit Bay. This site is influenced by rural residential and light agricultural activities. This site is designated as core salmonid habitat.

Dissolved oxygen has increased as compared to 17 years ago and ten years ago. Water temperature is higher than it was 17 years ago. WQI scores are generally in the higher-scoring end of the moderate concern category, and often score as least concern.

Site 48 rarely fails to meet state standards for DO, and has never failed to meet state standards for water temperature across the life of this program. Annual FC levels for WY2020 passed state standards.

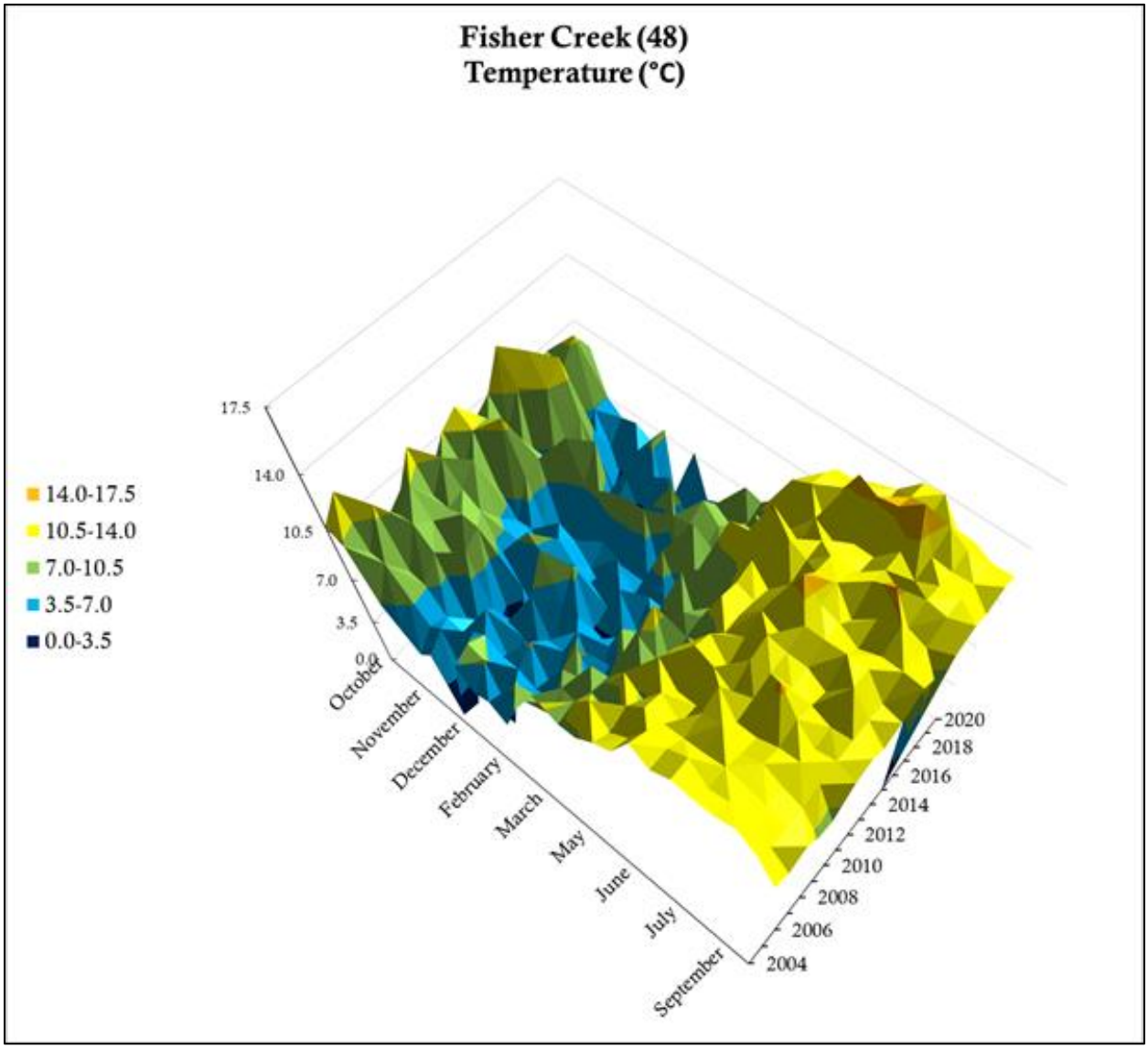
Site 48 is tied for 10th out of 39 sites for number of significant trends, with 14, and is 17th out of 39 sites for positive trends, with 64%.

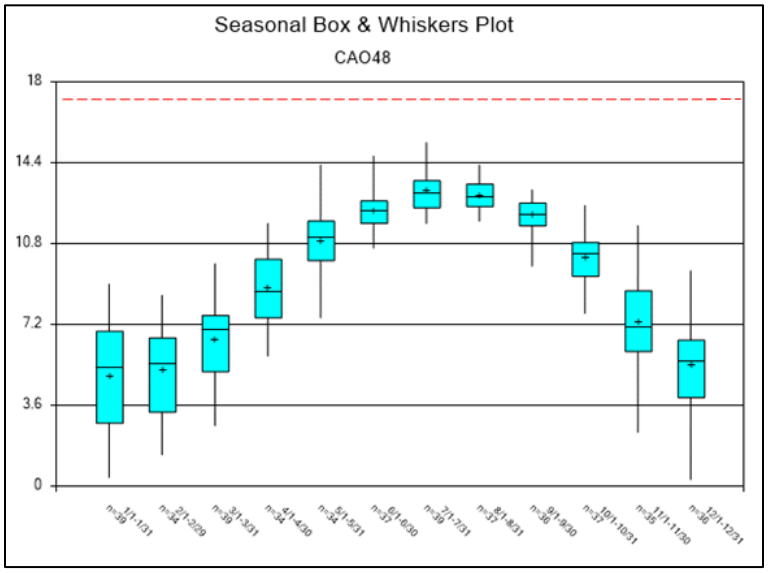




The dissolved oxygen (DO) standard for this site is 9.50 mg/L. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.

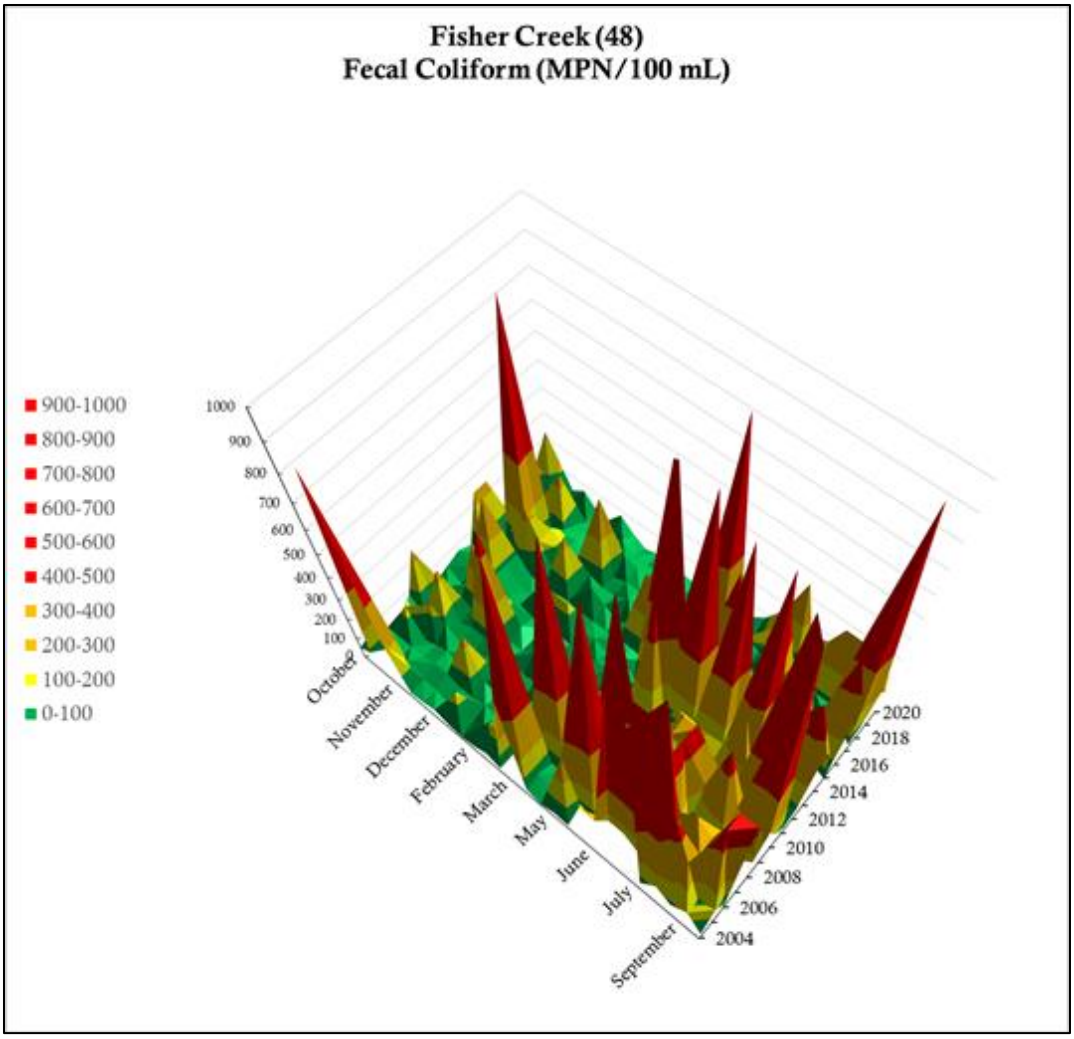
The dashed red line on the monthly box plot represents the 9.5 mg/L standard, and is approximate. The calendar year on the x-axis begins in January and ends in December.

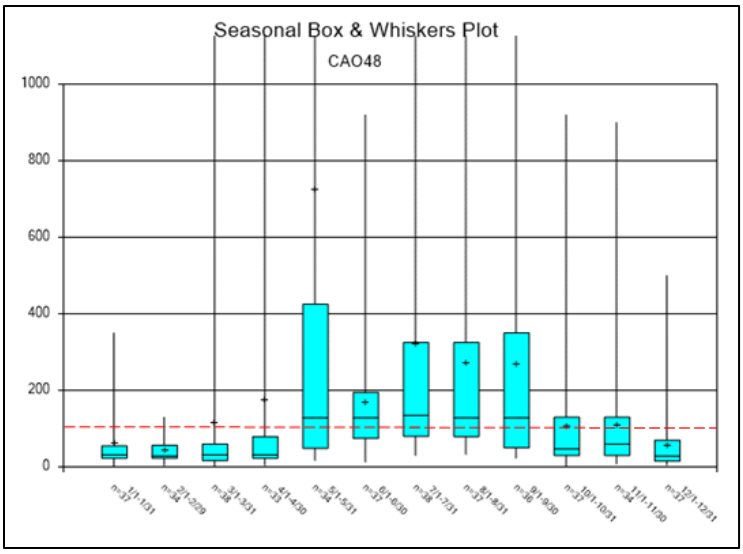




The temperature standard for this site is 17.5 °C. Any part of the 3D plot that is in red is hotter than that standard. The water year on the x-axis begins in October and ends in September.

The dashed red line on the monthly box plot represents the 17.5 °C standard, and is approximate. The calendar year on the x-axis begins in January and ends in December.





The fecal coliform (FC) standard for this site is 100 MPN/100 mL. Any part of the 3D plot that is in green meets that standard. The water year on the x-axis begins in October and ends in September.

The dashed red line on the monthly box plot represents the 100 MPN/100 mL standard, and is approximate. The calendar year on the x-axis begins in January and ends in December.

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Appendix A - Raw Data Archive of data points, Oct. 2003 – Sep. 2020

Appendix A is a Microsoft Excel file that contains all of the individual data points taken from every site for the entire history of the program. Due to its size, it is not included in this hard-copy report, but is available upon request.

Appendix B - Summary statistics for sample sites, Oct. 2003 – Sep. 2020

Fecal coliform (FC) means are geometric means, but the standard deviations were left in arithmetic form. Appendix B begins on the following page.

Metric	pH	DO	DO	Temp	Turb	Conductivity (°C compensated)	Salinity	Fecal Coliform	Nitrite + Nitrate	Total Kjehldahl Nitrogen	Total Phosphorus	Ortho-Phosphate	Nitrate	Ammonia	TSS
	units	mg/L	% sat	°C	NTU	µs/cm	ppt	cfu/100ml	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Site 3: Thomas Creek at Highway 99															
n	403	426	427	431	387	424	430.0	431	112	112	112	111	111	112	111
Mean	6.93	6.63	57.39	10.72	14.46	151.99	0.1	417	0.58	0.77	0.08	0.04	0.57	0.12	8
SD	0.24	3.18	25.28	4.73	13.88	97.11	0.0	4453	0.53	0.51	0.06	0.03	0.52	0.14	14
Max	7.59	12.45	114.50	20.20	113.00	1799.00	0.2	92000	2.22	3.68	0.44	0.18	2.22	0.92	90
Min	6.17	0.03	0.40	0.90	0.98	49.90	0.0	1	0.01	0.25	0.02	0.01	0.01	0.01	2
Site 4: Thomas Creek at F&S Grade Road															
n	409	430	431	434	392	423	432.0	431	113	113	113	113	112	113	113
Mean	7.22	11.10	95.94	9.40	19.86	123.01	0.0	659	1.01	0.49	0.06	0.04	1.00	0.04	14
SD	0.31	1.27	6.81	3.80	29.62	49.77	0.0	2026	0.30	0.29	0.04	0.03	0.30	0.04	25
Max	8.20	15.17	128.40	16.60	291.00	213.30	0.1	23000	1.99	2.22	0.35	0.16	1.99	0.25	147
Min	6.29	6.73	13.70	0.00	0.84	47.60	0.0	5	0.01	0.25	0.03	0.01	0.01	0.01	2
Site 6: Friday Creek at Prairie Road															
n	409	428	430	435	393	432	435.0	435	113	113	113	113	112	113	113
Mean	7.29	11.22	99.62	10.55	6.08	78.70	0.0	109	0.51	0.38	0.05	0.02	0.51	0.03	9
SD	0.38	1.25	6.88	4.65	10.14	20.67	0.0	285	0.29	0.24	0.06	0.01	0.29	0.03	28
Max	8.72	15.35	119.80	20.10	118.00	140.80	0.1	3000	1.64	1.92	0.40	0.07	1.64	0.16	238
Min	6.26	6.95	14.40	0.10	0.33	41.70	0.0	1	0.03	0.25	0.01	0.01	0.02	0.01	2
Site 8: Swede Creek at Grip Road															
n	409	431	432	435	393	422	436.0	435	113	113	113	113	112	113	113
Mean	7.16	10.73	92.78	9.63	13.82	68.22	0.0	173	0.45	0.46	0.05	0.03	0.43	0.04	12
SD	0.34	1.75	7.87	4.45	20.25	17.29	0.0	404	0.37	0.26	0.03	0.02	0.33	0.03	32
Max	10.43	15.14	112.00	18.20	224.00	118.10	0.1	5000	2.17	1.94	0.26	0.14	1.58	0.17	282
Min	5.99	5.62	59.50	0.10	1.98	33.20	0.0	1	0.03	0.25	0.02	0.01	0.01	0.01	2
Site 11: Samish River at Highway 9															
No.	413	434	435	437	395	429	438.0	438	112	113	113	112	112	113	112
Mean	7.01	8.69	74.60	8.95	3.39	72.18	0.0	46	0.31	0.29	0.04	0.01	0.31	0.03	8
SD	0.31	1.33	7.84	3.44	9.20	19.41	0.0	245	0.12	0.13	0.05	0.01	0.12	0.03	34
Max	8.11	12.56	96.20	17.20	155.00	129.40	0.1	5000	0.79	1.36	0.36	0.07	0.79	0.12	333
Min	6.00	4.70	45.10	0.80	0.00	39.20	0.0	1	0.11	0.21	0.01	0.01	0.11	0.01	2

Metric	pH	DO	DO	Temp	Turb	Conductivity (°C compensated)	Salinity	Fecal Coliform	Nitrite + Nitrate	Total Kjehldahl Nitrogen	Total Phosphorus	Ortho-Phosphate	Nitrate	Ammonia	TSS
	units	mg/L	% sat	°C	NTU	µs/cm	ppt	cfu/100ml	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Site 12: Nookachamps Creek at Swan Road															
No.	384	407	409	412	378	410	412.0	411	108	108	108	108	107	108	108
Mean	7.16	9.09	80.80	11.15	7.77	106.68	0.0	133	0.38	0.50	0.06	0.02	0.37	0.08	10
SD	0.29	2.10	13.54	5.61	14.62	33.36	0.0	230	0.23	0.22	0.04	0.02	0.23	0.05	16
Max	8.07	13.79	139.50	24.80	208.00	221.50	0.1	2400	0.94	1.44	0.40	0.10	0.93	0.34	156
Min	6.40	1.90	22.00	1.10	1.52	11.00	0.0	2	0.01	0.25	0.02	0.01	0.01	0.01	2
Site 13: East Fork Nookachamps Creek at Highway 9															
No.	405	429	430	432	397	430	433.0	431	112	112	112	112	111	112	112
Mean	7.27	9.79	86.05	10.18	5.12	92.20	0.0	133	0.30	0.38	0.04	0.01	0.30	0.05	6
SD	0.31	1.62	10.26	5.02	8.25	28.11	0.0	289	0.21	0.17	0.02	0.01	0.21	0.04	12
Max	8.08	12.96	110.40	23.40	84.60	165.70	0.1	3000	0.97	0.92	0.10	0.06	0.96	0.24	113
Min	6.43	3.01	30.30	0.50	0.00	0.80	0.0	1	0.01	0.25	0.01	0.01	0.01	0.01	2
Site 14: College Way Creek at College Way															
No.	404	432	433	435	396	431	435.0	432	111	111	111	111	110	111	111
Mean	7.28	9.24	81.55	10.67	6.84	222.72	0.1	453	0.40	0.53	0.06	0.06	0.39	0.07	5
SD	0.29	2.30	14.98	4.16	25.60	50.83	0.0	1146	0.32	0.25	0.04	0.05	0.32	0.05	7
Max	8.00	13.50	114.00	20.80	489.00	336.80	0.2	16000	1.57	1.55	0.40	0.28	1.57	0.25	60
Min	6.23	3.10	32.40	0.40	0.00	103.00	0.0	5	0.01	0.23	0.02	0.01	0.01	0.01	2
Site 15: Nookachamps Creek at Knapp Road															
No.	408	432	433	436	399	435	436.0	434	113	113	113	113	112	113	113
Mean	7.22	8.11	72.55	12.03	5.16	113.30	0.0	176	0.31	0.63	0.08	0.06	0.30	0.10	6
SD	0.28	3.34	26.05	5.53	3.98	36.18	0.0	430	0.28	0.27	0.05	0.09	0.27	0.08	4
Max	7.92	13.51	114.30	23.10	62.40	329.10	0.2	5400	1.01	1.72	0.38	0.87	1.01	0.54	32
Min	6.50	0.26	2.60	1.40	1.21	69.00	0.0	1	0.00	0.25	0.05	0.01	0.01	0.01	2
Site 16: East Fork Nookachamps Creek at Beaver Lake Road															
No.	408	432	433	436	399	432	436.0	433	112	112	112	112	111	112	112
Mean	7.42	11.44	99.02	9.47	3.86	89.79	0.0	128	0.34	0.32	0.04	0.01	0.33	0.03	6
SD	0.31	1.30	5.58	4.65	8.45	32.86	0.0	800	0.20	0.15	0.02	0.01	0.20	0.02	21
Max	8.38	14.29	116.40	20.50	82.60	179.70	0.1	16000	1.09	1.31	0.10	0.06	1.09	0.10	190
Min	6.42	7.13	67.50	0.20	0.00	0.00	0.0	1	0.01	0.25	0.01	0.01	0.01	0.01	2

Metric	pH	DO	DO	Temp	Turb	Conductivity (°C compensated)	Salinity	Fecal Coliform	Nitrite + Nitrate	Total Kjehldahl Nitrogen	Total Phosphorus	Ortho-Phosphate	Nitrate	Ammonia	TSS
	units	mg/L	% sat	°C	NTU	µs/cm	ppt	cfu/100ml	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Site 17: Nookachamps Creek at Big Lake Outlet															
No.	405	432	433	436	398	434	436.0	432	113	113	113	113	112	113	113
Mean	7.43	9.91	91.65	12.74	2.47	87.24	0.0	39	0.23	0.44	0.04	0.02	0.23	0.05	3
SD	0.32	1.89	9.60	5.97	1.86	14.44	0.0	88	0.22	0.20	0.02	0.03	0.22	0.03	2
Max	8.46	14.38	123.90	24.40	12.90	221.50	0.1	900	0.90	1.23	0.12	0.23	0.90	0.18	19
Min	6.44	4.94	51.80	0.90	0.17	3.20	0.0	1	0.01	0.25	0.01	0.01	0.01	0.01	2
Site 18: Lake Creek at Highway 9															
No.	409	432	433	437	400	436	437.0	435	113	113	113	113	112	113	113
Mean	7.44	11.02	96.62	9.93	2.85	90.32	0.0	186	0.46	0.37	0.04	0.02	0.45	0.03	5
SD	0.32	1.34	5.49	4.02	3.81	25.29	0.0	907	0.21	0.32	0.02	0.02	0.20	0.03	10
Max	8.34	14.34	128.60	18.70	39.80	173.80	0.1	16000	0.97	3.22	0.10	0.11	0.97	0.10	72
Min	6.40	7.43	74.70	0.90	0.00	0.00	0.0	1	0.05	0.25	0.01	0.01	0.05	0.01	2
Site 19: Hansen Creek at Hoehn Road															
No.	391	412	413	414	376	402	414.0	413	109	109	110	109	109	109	109
Mean	7.09	10.31	88.53	9.16	14.51	81.65	0.0	224	0.42	0.41	0.07	0.02	0.42	0.04	39
SD	0.30	1.44	6.87	4.33	67.73	18.66	0.0	435	0.22	0.61	0.16	0.04	0.22	0.03	142
Max	8.64	14.34	110.00	19.00	848.00	228.90	0.1	5000	1.10	6.14	1.07	0.36	1.10	0.14	902
Min	6.06	4.85	49.50	0.10	0.17	39.30	0.0	1	0.03	0.25	0.01	0.01	0.03	0.01	2
Site 20: Hansen Creek at Northern State Hospital															
No.	408	431	432	433	389	427	433.0	431	113	113	113	113	112	113	113
Mean	7.13	11.15	95.85	9.03	15.16	79.00	0.0	113	0.47	0.37	0.10	0.02	0.46	0.03	59
SD	0.30	1.18	4.74	3.66	75.41	21.36	0.0	232	0.24	0.32	0.27	0.03	0.24	0.03	233
Max	8.18	14.67	115.60	16.20	900.00	199.10	0.1	3000	1.17	2.20	1.90	0.27	1.17	0.15	1720
Min	6.08	7.34	66.50	0.50	0.02	39.70	0.0	1	0.05	0.25	0.01	0.01	0.05	0.01	2
Site 21: Coal Creek at Hoehn Road															
No.	355	378	378	379	341	368	379.0	376	100	100	100	100	99	100	100
Mean	7.09	11.15	93.44	8.17	13.17	81.09	0.0	285	0.76	0.33	0.05	0.02	0.75	0.03	21
SD	0.29	1.48	5.75	4.10	62.91	24.00	0.2	643	0.30	0.18	0.07	0.03	0.30	0.04	69
Max	8.32	15.05	115.90	17.50	1005.00	229.50	3.9	5000	2.09	1.30	0.49	0.23	2.09	0.26	438
Min	6.07	6.61	68.10	0.10	0.00	39.50	0.0	1	0.29	0.25	0.01	0.01	0.21	0.01	2

Metric	pH	DO	DO	Temp	Turb	Conductivity (°C compensated)	Salinity	Fecal Coliform	Nitrite + Nitrate	Total Kjehldahl Nitrogen	Total Phosphorus	Ortho-Phosphate	Nitrate	Ammonia	TSS
	units	mg/L	% sat	°C	NTU	µs/cm	ppt	cfu/100ml	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Site 22: Coal Creek at Highway 20															
No.	412	430	431	434	395	424	433.0	433	111	112	112	111	111	112	111
Mean	7.19	11.75	99.26	8.33	11.13	80.14	0.0	71	0.63	0.32	0.06	0.01	0.63	0.02	22
SD	0.43	1.20	4.66	3.90	65.80	21.94	0.0	281	0.31	0.20	0.11	0.02	0.32	0.02	88
Max	8.29	15.60	137.00	15.70	1138.00	158.60	0.1	5000	2.23	1.50	0.79	0.12	2.23	0.15	650
Min	5.54	8.33	73.20	0.00	0.00	18.30	0.0	1	0.01	0.25	0.01	0.01	0.16	0.01	2
Site 23: Wiseman Creek at Minkler Road															
No.	367	388	390	391	353	385	391.0	389	105	106	106	106	104	106	105.0
Mean	7.23	11.89	100.14	8.07	13.80	74.18	0.0	78	0.93	0.33	0.07	0.02	0.92	0.02	26.8
SD	0.36	1.05	5.37	3.42	83.40	18.91	0.0	312	0.32	0.20	0.12	0.02	0.32	0.03	107.8
Max	8.52	15.77	157.70	16.20	1072.00	217.90	0.1	5000	2.21	1.52	0.91	0.16	2.10	0.33	640.0
Min	6.06	8.87	87.20	0.70	0.00	15.00	0.0	1	0.40	0.25	0.01	0.01	0.22	0.01	2.0
Site 24: Mannser Creek at Lyman-Hamilton Highway															
No.	414	432	433	435	394	429	436.0	431	113	113	113	113	112	113	113
Mean	6.93	6.77	57.91	8.64	1.97	107.69	0.1	42	0.23	0.35	0.04	0.03	0.23	0.02	4
SD	0.30	1.48	11.95	2.93	1.97	21.67	0.0	89	0.12	0.55	0.03	0.06	0.12	0.02	5
Max	7.97	12.40	104.20	15.00	25.73	407.60	0.2	920	0.56	6.00	0.33	0.59	0.56	0.08	36
Min	6.06	1.97	18.50	0.80	0.00	1.40	0.0	1	0.01	0.25	0.01	0.01	0.01	0.01	2
Site 25: Red Cabin Creek at Hamilton Cemetery Road															
No.	336	349	351	352	320	350	351.0	349	94	94	94	94	93	94	94
Mean	7.23	11.82	98.72	7.56	3.31	67.03	0.0	45	0.53	0.29	0.05	0.02	0.52	0.02	9
SD	0.40	0.79	4.83	2.38	21.79	21.41	0.0	170	0.21	0.15	0.04	0.02	0.19	0.02	44
Max	8.35	14.40	133.80	13.90	291.00	110.00	0.1	2400	1.40	1.18	0.44	0.09	1.05	0.16	410
Min	6.14	9.58	84.00	1.90	0.00	17.20	0.0	1	0.24	0.25	0.01	0.01	0.23	0.01	2
Site 28: Brickyard Creek at Highway 20															
No.	298	311	312	313	285	307	314.0	312	84	84	84	84	83	84	84
Mean	7.06	9.29	78.96	8.81	8.31	107.06	0.1	145	0.62	0.54	0.05	0.03	0.61	0.07	4
SD	0.47	1.84	10.27	4.05	6.81	34.76	0.0	294	0.31	0.26	0.01	0.04	0.31	0.07	7
Max	8.42	13.31	110.40	18.60	60.60	208.90	0.1	1600	1.41	1.68	0.11	0.23	1.41	0.51	46
Min	5.35	4.03	41.00	0.00	0.53	20.70	0.0	1	0.01	0.25	0.02	0.01	0.01	0.01	2

Metric	pH	DO	DO	Temp	Turb	Conductivity (°C compensated)	Salinity	Fecal Coliform	Nitrite + Nitrate	Total Kjehldahl Nitrogen	Total Phosphorus	Ortho-Phosphate	Nitrate	Ammonia	TSS
	units	mg/L	% sat	°C	NTU	µs/cm	ppt	cfu/100ml	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Site 29: Skagit River at River Bend															
No.	408	430	431	436	398	432	436.0	430	111	111	110	111	110	111	111
Mean	7.21	11.14	95.85	9.08	12.09	54.72	0.0	33	0.08	0.32	0.05	0.01	0.08	0.04	23
SD	0.47	1.06	4.88	3.76	37.86	11.50	0.0	117	0.05	0.25	0.05	0.02	0.05	0.25	58
Max	8.84	14.59	110.30	17.60	608.00	101.10	0.0	1600	0.20	2.10	0.40	0.10	0.19	2.65	383
Min	5.81	7.63	78.10	0.90	0.78	28.60	0.0	1	0.01	0.25	0.01	0.01	0.01	0.01	2
Site 30: Skagit River at Cape Horn Road															
No.	412	429	430	433	391	431	433.0	427	103	103	103	103	103	103	103
Mean	7.13	11.29	96.26	8.63	8.06	57.17	0.0	11	0.08	0.28	0.05	0.01	0.08	0.02	16
SD	0.40	1.09	4.83	3.44	19.15	13.00	0.0	33	0.04	0.13	0.05	0.02	0.04	0.01	37
Max	8.49	14.24	118.00	16.30	211.00	132.20	0.1	540	0.20	1.34	0.47	0.17	0.20	0.07	325
Min	6.02	7.64	72.50	0.00	0.00	27.70	0.0	1	0.01	0.25	0.01	0.01	0.01	0.01	2
Site 31: Drainage District 20 ditch at floodgate															
No.	189	195	195	198	178	192	197.0	196	59	59	59	59	59	59	59
Mean	7.14	7.70	64.91	8.47	10.59	212.25	0.1	178	0.49	1.00	0.09	0.04	0.47	0.15	13
SD	0.44	2.88	22.95	3.99	15.13	86.37	0.1	693	0.39	1.27	0.08	0.04	0.38	0.17	21
Max	8.17	15.70	131.00	19.40	131.00	455.30	0.2	9000	1.50	9.80	0.48	0.20	1.49	1.16	147
Min	6.02	0.40	5.30	0.80	0.00	45.00	0.0	1	0.01	0.25	0.03	0.01	0.01	0.02	2
Site 32: Samish River at Thomas Road															
No.	406	428	430	436	393	433	435.0	437	112	114	114	112	112	114	112
Mean	7.50	10.83	97.27	10.80	11.23	96.12	0.0	173	0.60	0.38	0.06	0.03	0.60	0.06	19
SD	0.45	1.18	9.63	4.75	18.68	25.16	0.1	885	0.21	0.24	0.07	0.03	0.20	0.08	40
Max	8.66	14.99	150.00	21.60	181.00	141.80	0.8	17000	1.69	1.60	0.47	0.16	1.65	0.68	229
Min	6.50	2.58	14.10	1.20	0.82	45.30	0.0	2	0.01	0.25	0.02	0.01	0.33	0.01	2
Site 33: Alice Bay Pump Station															
No.	404	407	426	431	390	422	430.0	429	109	110	110	109	109	110	109
Mean	7.18	9.25	110.04	13.45	28.05	24925.80	15.4	157	0.65	2.94	0.53	0.29	0.60	1.21	43
SD	0.83	4.53	74.36	6.50	57.07	13568.91	8.9	371	0.80	1.86	0.52	0.34	0.80	0.83	30
Max	8.88	23.93	348.60	27.20	910.00	44390.00	28.7	5000	3.60	17.80	2.59	1.71	3.57	3.94	160
Min	5.66	1.76	15.40	0.40	2.65	204.50	0.1	1	0.01	0.74	0.03	0.01	0.01	0.01	2

Metric	pH	DO	DO	Temp	Turb	Conductivity (°C compensated)	Salinity	Fecal Coliform	Nitrite + Nitrate	Total Kjehldahl Nitrogen	Total Phosphorus	Ortho-Phosphate	Nitrate	Ammonia	TSS
	units	mg/L	% sat	°C	NTU	µs/cm	ppt	cfu/100ml	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Site 34: Noname Slough at Bayview-Edison Road															
No.	400	423	423	427	390	417	425.0	422	110	110	110	110	109	110	110
Mean	7.04	6.84	62.08	11.73	16.26	15525.63	9.8	473	0.50	1.40	0.55	0.39	0.48	0.28	25
SD	0.52	3.60	31.27	6.20	16.44	17800.83	11.6	1320	0.72	0.71	0.82	0.71	0.71	0.29	31
Max	8.58	16.71	201.50	27.00	211.00	56800.00	38.0	16000	4.14	5.34	4.62	3.76	4.14	1.70	233
Min	5.84	0.00	0.00	0.10	0.93	30.80	0.0	1	0.01	0.25	0.05	0.01	0.01	0.01	2
Site 35: Joe Leary Slough at D'Arcy Road															
No.	394	417	417	422	379	419	421.0	416	106	106	107	105	107	106	105
Mean	7.21	5.34	49.92	12.07	38.22	485.09	0.2	308	0.93	1.20	0.21	0.11	0.91	0.61	18
SD	0.51	1.43	14.00	4.36	27.85	1106.03	0.6	797	0.77	0.39	0.14	0.08	0.76	0.26	21
Max	9.05	11.63	103.00	24.00	275.00	19280.00	11.7	9000	4.85	2.02	0.85	0.48	4.78	1.15	151
Min	6.25	1.85	17.20	0.00	3.08	5.31	0.0	1	0.01	0.25	0.04	0.01	0.21	0.02	2
Site 36: Edison Slough at Edison Elementary School															
No.	402	420	427	431	387	418	429.0	434	111	111	111	111	110	111	111
Mean	7.33	9.05	97.22	13.67	9.79	13393.02	8.2	230	0.41	1.26	0.46	0.34	0.40	0.24	20
SD	0.72	3.50	57.02	7.79	6.53	15624.41	9.9	606	0.52	0.71	0.60	0.52	0.52	0.34	21
Max	9.58	26.00	359.20	32.40	49.30	44360.00	28.9	9200	1.92	4.82	2.81	2.73	1.92	2.51	95
Min	5.98	2.32	21.30	0.10	0.64	52.60	0.0	1	0.01	0.59	0.05	0.01	0.01	0.01	2
Site 37: Edison Drainage in Edison															
No.	402	409	426	430	390	425	428.0	432	112	112	112	112	111	112	112
Mean	7.34	7.05	81.79	13.47	45.81	10698.18	6.3	421	0.79	3.48	0.86	0.49	0.76	1.51	43
SD	0.68	4.13	68.94	6.71	119.93	11132.70	7.0	1004	1.03	5.37	0.86	0.61	1.03	1.04	47
Max	9.35	24.72	387.30	27.50	1567.00	43450.00	27.9	16000	5.66	58.30	4.26	3.22	5.66	6.71	250
Min	6.16	0.04	0.60	1.80	4.16	172.40	0.1	1	0.01	0.25	0.17	0.01	0.01	0.01	8
Site 38: North Edison drainage at Smith Road															
No.	398	398	414	425	384	419	424.0	426	110	109	110	110	110	110	110
Mean	7.26	7.27	87.46	12.90	41.80	17501.15	10.6	649	0.44	2.93	0.89	0.57	0.41	1.23	54
SD	0.85	4.72	80.93	5.85	134.72	13665.83	8.8	2160	0.52	1.04	0.79	0.69	0.52	0.76	73
Max	9.20	37.78	455.10	26.10	2300.00	45100.00	29.2	30000	1.90	7.04	3.50	3.19	1.87	4.24	524
Min	5.60	0.24	2.10	1.70	1.84	111.90	0.0	1	0.01	1.00	0.02	0.01	0.01	0.02	5

Metric	pH	DO	DO	Temp	Turb	Conductivity (°C compensated)	Salinity	Fecal Coliform	Nitrite + Nitrate	Total Kjehldahl Nitrogen	Total Phosphorus	Ortho-Phosphate	Nitrate	Ammonia	TSS
	units	mg/L	% sat	°C	NTU	µs/cm	ppt	cfu/100ml	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Site 39: Colony Creek near Colony Road															
No.	404	427	429	433	388	422	433.0	433	111	111	111	111	111	111	111
Mean	7.19	10.82	93.94	9.79	15.81	131.40	0.0	445	0.86	0.59	0.10	0.06	0.86	0.06	37
SD	0.31	1.77	7.63	4.43	37.59	85.49	0.1	1708	0.59	0.66	0.17	0.05	0.59	0.05	198
Max	7.97	15.06	111.60	20.50	377.00	397.90	0.2	16000	2.59	4.96	1.70	0.21	2.58	0.34	1996
Min	6.19	6.11	58.30	0.00	0.33	44.50	0.0	1	0.10	0.25	0.01	0.01	0.19	0.01	2
Site 40: Big Indian Slough at Highway 20 truck scales															
No.	401	424	424	427	390	426	426.0	423	108	109	109	108	109	109	108
Mean	6.78	4.96	43.57	10.83	23.94	443.65	0.2	194	0.74	1.00	0.11	0.09	0.71	0.37	9
SD	0.32	2.06	15.89	3.94	14.78	2061.43	1.3	603	0.50	0.38	0.08	0.08	0.49	0.22	9
Max	7.92	11.28	87.90	22.10	150.00	42784.00	27.8	9000	2.25	2.10	0.31	0.49	2.22	0.84	54
Min	5.59	0.44	4.60	2.40	2.48	93.40	0.0	1	0.01	0.25	0.01	0.01	0.01	0.04	2
Site 41: Maddox Creek/Big Ditch at Milltown Road															
No.	409	433	434	438	400	434	438.0	436	113	113	113	112	112	113	113
Mean	7.19	6.26	58.39	11.96	18.64	515.25	0.2	164	1.04	1.18	0.17	0.08	1.01	0.37	10
SD	0.35	2.12	21.41	5.07	28.76	492.62	0.3	584	1.06	0.72	0.12	0.07	1.03	0.36	14
Max	8.80	12.32	118.80	23.70	268.00	8358.00	4.7	9200	3.46	2.79	0.62	0.34	3.46	1.49	91
Min	6.20	0.05	0.60	0.80	1.89	44.70	0.0	1	0.01	0.25	0.05	0.01	0.01	0.01	2
Site 42: Carpenter Creek/Hill Ditch at Cedardale Road															
No.	407	432	433	436	398	433	436.0	431	113	113	113	113	111	113	113
Mean	7.31	8.20	73.38	11.34	3.86	189.04	0.1	166	0.58	0.57	0.07	0.05	0.57	0.08	3
SD	0.32	2.33	17.87	5.67	3.95	51.84	0.0	907	0.51	0.25	0.06	0.04	0.50	0.04	2
Max	8.74	14.37	159.10	23.10	47.20	364.70	0.2	16000	1.96	1.78	0.46	0.21	1.94	0.30	16
Min	6.30	2.05	19.10	0.10	0.00	53.30	0.0	1	0.01	0.25	0.02	0.01	0.01	0.01	2
Site 43: Wiley Slough at Wylie Road															
No.	402	427	428	430	393	428	430.0	423	110	110	125	110	109	110	110
Mean	7.17	4.94	46.06	12.13	22.74	2917.41	1.5	165	1.35	1.49	0.27	0.19	1.30	0.51	17
SD	0.41	2.81	27.19	5.16	52.63	2855.15	1.5	379	1.78	0.86	0.40	0.28	1.72	0.42	31
Max	8.98	14.16	147.00	27.20	612.00	21560.00	9.5	3500	7.06	7.04	2.10	1.56	6.96	1.93	264
Min	6.08	0.12	1.40	0.80	1.29	59.70	0.0	1	0.01	0.25	0.01	0.01	0.01	0.01	2

Metric	pH	DO	DO	Temp	Turb	Conductivity (°C compensated)	Salinity	Fecal Coliform	Nitrite + Nitrate	Total Kjehldahl Nitrogen	Total Phosphorus	Ortho-Phosphate	Nitrate	Ammonia	TSS
	units	mg/L	% sat	°C	NTU	µs/cm	ppt	cfu/100ml	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Site 44: Sullivan Slough															
No.	407	427	430	434	397	431	434.0	430	112	113	113	112	112	113	112
Mean	7.26	6.88	66.92	11.55	36.50	8374.47	4.9	220	0.66	1.46	0.27	0.13	0.63	0.66	27
SD	0.43	2.75	31.46	4.43	91.83	7550.25	4.8	356	1.04	0.75	0.50	0.33	1.01	0.58	37
Max	9.08	19.82	237.90	21.70	1345.00	31950.00	26.5	2400	7.21	4.50	5.00	3.50	7.16	3.10	280
Min	6.25	0.09	0.80	0.50	1.47	200.70	0.1	1	0.01	0.25	0.01	0.01	0.01	0.01	4
Site 45: North Fork Skagit River near Moore Road															
No.	394	415	415	422	387	417	418.0	417	109	109	109	109	109	109	109
Mean	7.66	11.26	97.34	9.36	10.93	55.39	0.0	14	0.08	0.29	0.05	0.01	0.08	0.02	19
SD	0.45	1.17	4.69	3.91	33.92	10.27	0.0	27	0.05	0.17	0.07	0.02	0.05	0.02	48
Max	9.10	13.63	118.10	18.10	576.00	96.30	0.1	350	0.19	1.34	0.60	0.16	0.18	0.10	452
Min	5.93	7.35	76.00	1.40	0.55	30.80	0.0	1	0.01	0.25	0.01	0.01	0.01	0.01	2
Site 46: South Fork Skagit River at Conway boat ramp															
No.	399	424	425	428	394	439	439.0	428	110	110	110	110	109	110	110
Mean	7.59	11.27	97.84	9.49	8.71	33629.96	21.1	21	0.09	0.29	0.04	0.01	0.08	0.02	16
SD	0.40	1.09	4.10	3.94	11.81	6293.55	4.3	45	0.06	0.17	0.03	0.01	0.05	0.02	29
Max	8.91	13.73	112.30	18.30	109.00	45590.00	29.1	540	0.51	1.66	0.23	0.05	0.21	0.10	231
Min	6.38	8.40	83.90	1.40	0.87	11027.00	6.4	1	0.01	0.25	0.01	0.01	0.01	0.01	2
Site 47: Swinomish Channel at County boat ramp															
No.	411	435	436	439	400	417	417.0	433	113	113	113	113	112	113	113
Mean	7.32	8.72	88.88	10.68	5.46	33606.81	21.1	9	0.19	0.33	0.08	0.05	0.19	0.06	31
SD	0.56	1.08	9.70	3.30	6.32	6288.46	4.3	15	0.11	0.23	0.04	0.08	0.11	0.03	21
Max	8.11	11.41	115.40	18.50	80.20	45590.00	29.1	130	0.69	1.84	0.40	0.83	0.69	0.17	140
Min	5.86	5.48	7.25	3.30	0.56	11027.00	6.4	1	0.01	0.25	0.04	0.01	0.01	0.01	2
Site 48: Fisher Creek at Franklin Road															
No.	410	433	434	437	400	435	438.0	432	113	112	113	113	112	113	113
Mean	7.51	11.12	95.80	9.12	3.04	167.41	0.1	199	0.64	0.62	0.20	0.21	0.63	0.08	5
SD	0.31	1.31	5.18	3.42	4.53	116.28	0.1	820	0.50	0.28	0.18	0.19	0.50	0.04	11
Max	8.18	14.87	114.70	15.30	40.70	2215.00	1.1	16000	2.25	1.38	0.81	0.63	2.25	0.17	98
Min	6.60	7.53	62.40	0.30	0.00	60.90	0.0	1	0.01	0.25	0.04	0.01	0.01	0.01	2

Appendix C - Summary of Seasonal Kendall's results for the Water Year 2020

Site	Period (years)	Parameter	n	Slope	Δ (units/period)	Z-score	Significant (95%)	Confidence (%)
3	17	pH	402	-0.0039	-0.066	-1.569	No	80
		mpH	213	-0.0050	-0.084	-1.554	No	80
		DO	426	0.0405	0.689	2.322	Yes	95
		mDO	217	0.0232	0.395	1.025	No	< 80
		DO % sat	427	0.3276	5.569	2.503	Yes	95
		mDO % sat	218	0.2129	3.619	0.838	No	< 80
		Temp	431	0.0214	0.364	1.336	No	80
		mTemp	217	0.0168	0.286	0.780	No	< 80
		Turb	387	0.1193	2.028	2.176	Yes	95
		mTurb	204	0.07191	1.222	1.020	No	< 80
		FC	430	-0.5812	-9.880	-2.683	Yes	95
		mFC	216	-1.4930	-25.381	-2.516	Yes	95
		NO3+NO2	112	-0.0022	-0.037	-1.091	No	< 80
		TKN	112	-0.0107	-0.183	-1.620	No	80
		TP	112	0.0000	0.000	2.548	Yes	95
		OP	111	0.0007	0.012	1.876	No	90
		NH3	112	-0.0050	-0.085	-3.893	Yes	95
		TSS	111	0.0000	0.000	0.344	No	< 80
	10	DO	248	-0.1458	-1.458	-3.061	Yes	95
		mDO	127	-0.1909	-1.909	-3.217	Yes	95
		Temp	254	0.0000	0.000	-0.156	No	< 80
		mTemp	127	0.0223	0.223	0.584	No	< 80
		FC	252	0.0000	0.000	-0.448	No	< 80
		mFC	126	0.0000	0.000	0.000	No	< 80
	5	DO	120	-0.8683	-4.342	-5.574	Yes	95
		mDO	63	-0.8533	-4.267	-4.252	Yes	95
		Temp	122	0.0501	0.250	0.579	No	< 80
		mTemp	63	-0.0314	-0.157	-0.062	No	< 80
		FC	123	-6.5660	-32.830	-3.268	Yes	95
		mFC	62	-7.6060	-38.030	-2.633	Yes	95

Site	Period (years)	Parameter	n	Slope	Δ (units/period)	Z-score	Significant (95%)	Confidence (%)
4	17	pH	409	-0.0277	-0.471	-9.867	Yes	95
		mpH	215	-0.0269	-0.458	-7.513	Yes	95
		DO	430	0.0430	0.732	6.635	Yes	95
		mDO	219	0.0441	0.749	5.570	Yes	95
		DO % sat	431	0.3008	5.114	8.138	Yes	95
		mDO % sat	219	0.3009	5.115	6.663	Yes	95
		Temp	433	0.0111	0.189	0.870	No	< 80
		mTemp	219	0.0125	0.213	0.887	No	< 80
		Turb	392	-0.2487	-4.228	-4.999	Yes	95
		mTurb	205	-0.3499	-5.948	-4.483	Yes	95
		FC	431	-8.5760	-145.792	-6.763	Yes	95
		mFC	217	-15.6900	-266.730	-5.667	Yes	95
		NO3+NO2	113	-0.0074	-0.127	-1.207	No	< 80
		TKN	113	0.0000	0.000	-0.778	No	< 80
		TP	113	0.0000	0.000	1.362	No	80
		OP	113	0.0000	0.000	0.575	No	< 80
		NH3	113	0.0000	0.000	-1.893	No	90
		TSS	113	0.0000	0.000	-0.859	No	< 80
	10	DO	250	0.0641	0.641	4.681	Yes	95
		mDO	128	0.0401	0.401	2.721	Yes	95
		Temp	252	0.0249	0.249	0.822	No	< 80
		mTemp	128	0.0592	0.592	1.594	No	80
		FC	252	0.0000	0.000	0.070	No	< 80
		mFC	126	1.0020	10.020	0.473	No	< 80
	5	DO	121	0.0491	0.245	1.500	No	80
		mDO	63	0.0468	0.234	1.111	No	< 80
		Temp	122	-0.2007	-1.004	-1.860	No	90
		mTemp	63	-0.2173	-1.087	-1.794	No	90
		FC	123	0.0000	0.000	-0.529	No	< 80
		mFC	63	-4.7560	-23.780	-0.308	No	< 80

Site	Period (years)	Parameter	n	Slope	Δ (units/period)	Z-score	Significant (95%)	Confidence (%)
6	17	pH	408	-0.0192	-0.327	-6.289	Yes	95
		mpH	215	-0.0190	-0.323	-5.001	Yes	95
		DO	428	0.0244	0.415	3.454	Yes	95
		mDO	218	0.0218	0.370	2.652	Yes	95
		DO % sat	430	0.2827	4.806	6.555	Yes	95
		mDO % sat	218	0.2681	4.558	4.877	Yes	95
		Temp	435	0.0339	0.576	2.234	Yes	95
		mTemp	219	0.0502	0.853	2.302	Yes	95
		Turb	393	0.0133	0.225	0.930	No	< 80
		mTurb	205	-0.0155	-0.264	-0.536	No	< 80
		FC	435	0.0000	0.000	-1.608	No	80
		mFC	219	-0.5680	-9.656	-2.124	Yes	95
		NO3+NO2	113	-0.0100	-0.171	-3.288	Yes	95
		TKN	113	0.0000	0.000	-0.413	No	< 80
		TP	113	0.0000	0.000	-3.690	Yes	95
		OP	113	0.0000	0.000	0.784	No	< 80
		NH3	113	0.0000	0.000	-2.804	Yes	95
		TSS	113	0.0000	0.000	-0.230	No	< 80
	10	DO	250	0.0709	0.709	4.572	Yes	95
		mDO	127	0.0652	0.652	3.256	Yes	95
		Temp	255	0.0662	0.662	1.768	No	90
		mTemp	128	0.1437	1.437	2.794	Yes	95
		FC	254	-0.5538	-5.538	-2.489	Yes	95
		mFC	128	-0.9087	-9.087	-1.691	No	90
	5	DO	121	0.0304	0.152	0.482	No	< 80
		mDO	62	0.0421	0.210	0.688	No	< 80
		Temp	125	-0.1999	-1.000	-1.361	No	80
		mTemp	63	-0.1851	-0.926	-1.111	No	< 80
		FC	125	-0.9812	-4.906	-1.462	No	80
		mFC	63	-1.2000	-6.000	-1.235	No	< 80

Site	Period (years)	Parameter	n	Slope	Δ (units/period)	Z-score	Significant (95%)	Confidence (%)
8	17	pH	409	-0.0065	-0.111	-2.162	Yes	95
		mpH	215	-0.0075	-0.127	-1.851	No	90
		DO	431	-0.0173	-0.294	-1.990	Yes	95
		mDO	219	-0.0277	-0.471	-2.468	Yes	95
		DO % sat	432	-0.1255	-2.134	-2.592	Yes	95
		mDO % sat	219	-0.1753	-2.980	-2.551	Yes	95
		Temp	434	0.0250	0.425	1.331	No	80
		mTemp	219	0.0400	0.679	2.005	Yes	95
		Turb	393	-0.0831	-1.413	-2.546	Yes	95
		mTurb	206	-0.1458	-2.479	-2.865	Yes	95
		FC	435	-1.7260	-29.342	-5.199	Yes	95
		mFC	219	-2.7070	-46.019	-3.979	Yes	95
		NO3+NO2	112	-0.0060	-0.102	-3.129	Yes	95
		TKN	112	0.0000	0.000	0.108	No	< 80
		TP	112	0.0000	0.000	0.062	No	< 80
		OP	112	0.0000	0.000	2.396	Yes	95
		NH3	112	-0.0025	-0.043	-4.080	Yes	95
		TSS	112	0.0000	0.000	0.611	No	< 80
	10	DO	250	0.0458	0.458	2.424	Yes	95
		mDO	128	0.0069	0.069	0.231	No	< 80
		Temp	252	0.0251	0.251	0.672	No	< 80
		mTemp	128	0.1005	1.005	2.010	Yes	95
		FC	253	0.0000	0.000	-1.048	No	< 80
		mFC	128	0.0000	0.000	0.069	No	< 80
	5	DO	122	0.1747	0.874	3.143	Yes	95
		mDO	63	0.1863	0.932	2.157	Yes	95
		Temp	123	-0.3017	-1.509	-2.066	Yes	95
		mTemp	63	-0.2340	-1.170	-1.175	No	< 80
		FC	125	-0.3386	-1.693	-0.932	No	< 80
		mFC	63	-2.2810	-11.405	-0.309	No	< 80

Site	Period (years)	Parameter	n	Slope	Δ (units/period)	Z-score	Significant (95%)	Confidence (%)
11	17	pH	413	0.0100	0.170	3.483	Yes	95
		mpH	215	0.0088	0.150	2.716	Yes	95
		DO	434	0.0494	0.840	5.126	Yes	95
		mDO	219	0.0484	0.823	3.935	Yes	95
		DO % sat	435	0.3942	6.701	5.731	Yes	95
		mDO % sat	219	0.3931	6.683	4.607	Yes	95
		Temp	437	-0.0111	-0.189	-0.850	No	< 80
		mTemp	219	-0.0084	-0.142	-0.433	No	< 80
		Turb	393	-0.0292	-0.496	-2.604	Yes	95
		mTurb	204	-0.0400	-0.680	-2.614	Yes	95
		FC	436	-0.1090	-1.853	-3.112	Yes	95
		mFC	216	-0.3503	-5.955	-2.928	Yes	95
		NO3+NO2	111	-0.0028	-0.048	-1.232	No	< 80
		TKN	112	0.0000	0.000	-0.395	No	< 80
		TP	112	0.0000	0.000	-3.548	Yes	95
		OP	111	0.0000	0.000	0.963	No	< 80
		NH3	112	0.0000	0.000	-0.277	No	< 80
		TSS	111	0.0000	0.000	-0.415	No	< 80
	10	DO	251	0.1152	1.152	4.656	Yes	95
		mDO	128	0.0925	0.925	2.997	Yes	95
		Temp	254	-0.0249	-0.249	-0.794	No	< 80
		mTemp	128	-0.0073	-0.073	-0.069	No	< 80
		FC	255	0.0000	0.000	0.677	No	< 80
		mFC	126	0.1253	1.253	0.637	No	< 80
	5	DO	123	0.1268	0.634	2.386	Yes	95
		mDO	63	0.1592	0.796	2.157	Yes	95
		Temp	124	-0.0745	-0.373	-0.662	No	< 80
		mTemp	63	-0.1008	-0.504	-0.678	No	< 80
		FC	126	0.0000	0.000	0.292	No	< 80
		mFC	63	0.4865	2.433	0.555	No	< 80

Site	Period (years)	Parameter	n	Slope	Δ (units/period)	Z-score	Significant (95%)	Confidence (%)
12	17	pH	383	0.0069	0.118	2.399	Yes	95
		mpH	207	0.0069	0.118	1.676	No	90
		DO	406	-0.0246	-0.418	-1.826	No	90
		mDO	216	-0.0313	-0.533	-1.564	No	90
		DO % sat	408	-0.1916	-3.257	-2.173	Yes	95
		mDO % sat	215	-0.1678	-2.853	-1.366	No	80
		Temp	411	0.0333	0.566	1.906	No	90
		mTemp	217	0.0410	0.697	1.674	No	90
		Turb	377	-0.0569	-0.967	-2.367	Yes	95
		mTurb	203	-0.0626	-1.065	-1.840	No	90
		FC	410	-0.0908	-1.544	-2.034	Yes	95
		mFC	217	-0.1990	-3.383	-0.537	No	< 80
		NO3+NO2	108	-0.0134	-0.227	-3.204	Yes	95
		TKN	107	-0.0035	-0.060	-0.910	No	< 80
		TP	108	0.0000	-0.060	3.827	Yes	95
		OP	108	0.0013	0.021	4.445	Yes	95
		NH3	108	-0.0027	-0.046	-2.121	Yes	95
		TSS	108	-0.1434	-2.438	-2.178	Yes	95
	10	DO	237	-0.0033	-0.033	-0.057	No	< 80
		mDO	125	0.0382	0.382	1.102	No	< 80
		Temp	240	0.0425	0.425	0.951	No	< 80
		mTemp	126	-0.0264	-0.264	-0.523	No	< 80
		FC	240	0.0000	0.000	-0.698	No	< 80
		mFC	126	-0.9951	-9.951	-0.714	No	< 80
	5	DO	119	0.0067	0.033	0.104	No	< 80
		mDO	61	0.1120	0.560	0.913	No	< 80
		Temp	120	-0.1978	-0.989	-1.341	No	80
		mTemp	62	-0.2666	-1.333	-1.736	No	90
		FC	120	-0.7452	-3.726	-1.280	No	< 80
		mFC	62	-4.3680	-21.840	-0.964	No	< 80

Site	Period (years)	Parameter	n	Slope	Δ (units/period)	Z-score	Significant (95%)	Confidence (%)
13	17	pH	405	0.0038	0.065	1.174	No	< 80
		mpH	212	0.0033	0.057	0.877	No	< 80
		DO	429	-0.0281	-0.477	-2.631	Yes	95
		mDO	219	-0.0267	-0.454	-2.067	Yes	95
		DO % sat	430	-0.1432	-2.434	-1.805	No	90
		mDO % sat	219	-0.1736	-2.951	-1.884	No	90
		Temp	432	0.0431	0.732	2.422	Yes	95
		mTemp	219	0.0502	0.854	2.291	Yes	95
		Turb	395	0.0000	0.000	-0.054	No	< 80
		mTurb	205	-0.0007	-0.011	-0.012	No	< 80
		FC	431	-0.2339	-3.976	-2.831	Yes	95
		mFC	219	-0.7370	-12.529	-1.783	No	90
		NO3+NO2	112	-0.0058	-0.099	-2.645	Yes	95
		TKN	111	0.0000	0.000	0.608	No	< 80
		TP	111	0.0000	0.000	-1.731	No	90
		OP	112	0.0000	0.000	3.216	Yes	95
		NH3	112	-0.0028	-0.048	-3.574	Yes	95
		TSS	112	0.0000	0.000	-1.631	No	80
	10	DO	250	-0.0285	-0.285	-1.058	No	< 80
		mDO	128	-0.0126	-0.126	-0.280	No	< 80
		Temp	252	0.0669	0.669	1.624	No	80
		mTemp	128	0.0166	0.166	0.257	No	< 80
		FC	252	-0.7521	-7.521	-2.122	Yes	95
		mFC	128	-2.1870	-21.870	-1.939	No	90
	5	DO	124	-0.1661	-0.831	-2.547	Yes	95
		mDO	63	-0.0602	-0.301	-0.443	No	< 80
		Temp	124	-0.2552	-1.276	-2.201	Yes	95
		mTemp	63	-0.3776	-1.888	-1.707	No	90
		FC	125	-2.5070	-12.535	-2.137	Yes	95
		mFC	63	-5.2400	-26.200	-2.035	Yes	95

Site	Period (years)	Parameter	n	Slope	Δ (units/period)	Z-score	Significant (95%)	Confidence (%)
14	17	pH	404	-0.0284	-0.482	-9.213	Yes	95
		mpH	213	-0.0285	-0.484	-7.016	Yes	95
		DO	430	0.0293	0.499	2.513	Yes	95
		mDO	218	0.0303	0.515	2.217	Yes	95
		DO % sat	432	0.1431	2.433	1.939	No	90
		mDO % sat	218	0.1802	3.063	1.852	No	90
		Temp	435	0.0083	0.142	0.525	No	< 80
		mTemp	219	0.0223	0.379	1.305	No	80
		Turb	396	-0.0861	-1.463	-4.894	Yes	95
		mTurb	204	-0.1070	-1.819	-3.482	Yes	95
		FC	432	-0.4370	-7.429	-1.890	No	90
		mFC	219	-1.0010	-17.017	-1.071	No	< 80
		NO3+NO2	111	-0.0044	-0.075	-2.090	Yes	95
		TKN	110	-0.0013	-0.023	-0.756	No	< 80
		TP	110	0.0000	0.000	2.097	Yes	95
		OP	111	0.0000	0.000	0.562	No	< 80
		NH3	111	-0.0040	-0.068	-4.931	Yes	95
		TSS	111	0.0000	0.000	0.422	No	< 80
	10	DO	249	0.0714	0.714	2.846	Yes	95
		mDO	127	0.0929	0.929	3.693	Yes	95
		Temp	253	0.0512	0.512	1.616	No	80
		mTemp	128	0.0250	0.250	0.630	No	< 80
		FC	252	2.0070	20.070	1.952	No	90
		mFC	128	2.5220	25.220	1.330	No	80
	5	DO	123	0.1349	0.675	1.553	No	80
		mDO	62	0.1126	0.563	2.694	Yes	95
		Temp	125	-0.1740	-0.870	-1.372	No	80
		mTemp	63	-0.2750	-1.375	-2.024	Yes	95
		FC	124	2.4810	12.405	0.952	No	< 80
		mFC	63	-0.3339	-1.670	0.000	No	< 80

Site	Period (years)	Parameter	n	Slope	Δ (units/period)	Z-score	Significant (95%)	Confidence (%)
15	17	pH	408	0.0075	0.128	2.440	Yes	95
		mpH	213	0.0086	0.146	2.239	Yes	95
		DO	431	0.0406	0.690	3.692	Yes	95
		mDO	219	0.0376	0.639	2.035	Yes	95
		DO % sat	432	0.3947	6.710	4.446	Yes	95
		mDO % sat	219	0.3905	6.639	2.996	Yes	95
		Temp	435	0.0251	0.426	1.628	No	80
		mTemp	219	0.0499	0.847	2.132	Yes	95
		Turb	399	0.0007	0.012	0.088	No	< 80
		mTurb	205	-0.0104	-0.177	-0.431	No	< 80
		FC	433	-0.2480	-4.216	-2.665	Yes	95
		mFC	219	1.2770	21.709	1.846	No	90
		NO3+NO2	113	0.0000	0.000	-0.112	No	< 80
		TKN	112	-0.0099	-0.169	-2.507	Yes	95
		TP	113	0.0002	0.003	4.217	Yes	95
		OP	113	0.0027	0.046	4.401	Yes	95
		NH3	113	-0.0039	-0.067	-3.667	Yes	95
		TSS	113	0.0000	0.000	-0.718	No	< 80
	10	DO	250	0.0295	0.295	1.245	No	< 80
		mDO	128	0.0858	0.858	2.284	Yes	95
		Temp	253	0.0000	0.000	-0.304	No	< 80
		mTemp	128	-0.0610	-0.610	-1.050	No	< 80
		FC	253	-1.6220	-16.220	-2.143	Yes	95
		mFC	128	-5.4100	-54.100	-2.219	Yes	95
	5	DO	124	0.1150	0.575	1.605	No	80
		mDO	63	0.1687	0.844	1.767	No	90
		Temp	125	-0.2005	-1.003	-1.756	No	90
		mTemp	63	-0.4679	-2.340	-2.281	Yes	95
		FC	125	0.0000	0.000	0.000	No	< 80
		mFC	63	0.6600	3.300	0.126	No	< 80

Site	Period (years)	Parameter	n	Slope	Δ (units/period)	Z-score	Significant (95%)	Confidence (%)
16	17	pH	407	-0.0066	-0.113	-2.165	Yes	95
		mpH	213	-0.0040	-0.069	-1.103	No	< 80
		DO	432	0.0176	0.298	2.550	Yes	95
		mDO	219	0.0153	0.260	1.431	No	80
		DO % sat	433	0.1897	3.225	4.325	Yes	95
		mDO % sat	219	0.2005	3.409	3.473	Yes	95
		Temp	436	0.0362	0.615	2.164	Yes	95
		mTemp	219	0.0400	0.679	1.920	No	90
		Turb	389	0.0133	0.226	1.557	No	80
		mTurb	201	0.0100	0.169	0.952	No	< 80
		FC	432	0.0000	0.000	-1.404	No	80
		mFC	218	-0.1669	-2.837	-0.632	No	< 80
		NO3+NO2	112	-0.0033	-0.057	-1.332	No	80
		TKN	111	0.0000	0.000	0.398	No	< 80
		TP	111	0.0000	0.000	-1.694	No	90
		OP	112	0.0000	0.000	2.527	Yes	95
		NH3	112	0.0000	0.000	-1.699	No	90
		TSS	112	0.0000	0.000	0.571	No	< 80
	10	DO	251	0.0798	0.798	5.351	Yes	95
		mDO	128	0.0955	0.955	4.547	Yes	95
		Temp	125	-0.3660	-3.660	-3.102	Yes	95
		mTemp	128	0.0000	0.000	-0.117	No	< 80
		FC	252	0.0000	0.000	-0.062	No	< 80
		mFC	127	-0.3512	-3.512	-0.593	No	< 80
	5	DO	124	0.1511	0.756	2.908	Yes	95
		mDO	63	0.1845	0.923	3.408	Yes	95
		Temp	254	0.0492	0.246	1.080	No	< 80
		mTemp	63	-0.4763	-2.382	-2.349	Yes	95
		FC	125	-2.5280	-12.640	-2.663	Yes	95
		mFC	63	-4.2620	-21.310	-1.901	No	90

Site	Period (years)	Parameter	n	Slope	Δ (units/period)	Z-score	Significant (95%)	Confidence (%)
17	17	pH	405	-0.0065	-0.110	-2.184	Yes	95
		mpH	213	-0.0069	-0.118	-1.699	No	80
		DO	432	0.0036	0.062	0.506	No	< 80
		mDO	219	-0.0064	-0.109	-0.710	No	< 80
		DO % sat	433	0.0636	1.081	0.907	No	< 80
		mDO % sat	219	-0.0173	-0.294	-0.169	No	< 80
		Temp	436	0.0300	0.509	1.676	No	90
		mTemp	219	0.0557	0.948	2.122	Yes	95
		Turb	398	0.0592	1.007	6.087	Yes	95
		mTurb	205	0.0591	1.005	4.628	Yes	95
		FC	432	0.0000	0.000	-0.166	No	< 80
		mFC	218	0.0000	0.000	0.182	No	< 80
		NO3+NO2	113	0.0000	0.000	0.552	No	< 80
		TKN	112	-0.0036	-0.062	-1.425	No	80
		TP	112	0.0000	0.000	-0.926	No	< 80
		OP	112	0.0000	0.000	2.984	Yes	95
		NH3	113	0.0000	0.000	-1.645	No	80
		TSS	113	0.0000	0.000	-0.132	No	< 80
	10	DO	251	0.0416	0.416	2.263	Yes	95
		mDO	128	0.0452	0.452	2.145	Yes	95
		Temp	254	0.0000	0.000	-0.112	No	< 80
		mTemp	128	-0.0500	-0.500	-0.723	No	< 80
		FC	254	0.1328	1.328	1.644	No	< 80
		mFC	127	0.5440	5.440	1.086	No	< 80
	5	DO	124	0.0255	0.127	0.640	No	< 80
		mDO	63	0.0404	0.202	0.757	No	< 80
		Temp	125	-0.0995	-0.497	-1.168	No	< 80
		mTemp	63	-0.3259	-1.630	-1.647	No	90
		FC	125	0.0000	0.000	-1.087	No	< 80
		mFC	63	-1.2280	-6.140	-1.077	No	< 80

Site	Period (years)	Parameter	n	Slope	Δ (units/period)	Z-score	Significant (95%)	Confidence (%)
18	17	pH	409	0.0027	0.046	0.834	No	< 80
		mpH	213	0.0016	0.026	0.364	No	< 80
		DO	432	0.0008	0.014	0.165	No	< 80
		mDO	219	-0.0012	-0.020	-0.148	No	< 80
		DO % sat	433	0.0133	0.227	0.301	No	< 80
		mDO % sat	219	0.0146	0.249	0.275	No	< 80
		Temp	437	0.0222	0.378	1.560	No	80
		mTemp	219	0.0334	0.567	1.730	No	90
		Turb	400	0.0284	0.483	2.978	Yes	95
		mTurb	205	0.0153	0.260	1.073	No	< 80
		FC	435	-0.4371	-7.431	-0.322	Yes	95
		mFC	219	-1.0010	-17.017	-2.546	Yes	95
		NO3+NO2	113	0.0034	0.058	1.167	No	< 80
		TKN	112	0.0000	0.000	0.980	No	< 80
		TP	113	0.0000	0.000	-3.466	Yes	95
		OP	112	0.0000	0.000	2.492	Yes	95
		NH3	113	0.0000	0.000	-3.121	Yes	95
		TSS	113	0.0000	0.000	0.468	No	< 80
	10	DO	251	0.0549	0.549	3.835	Yes	95
		mDO	128	0.0617	0.617	3.263	Yes	95
		Temp	255	0.0251	0.251	0.705	No	< 80
		mTemp	128	-0.0133	-0.133	-0.210	No	< 80
		FC	255	0.0000	0.000	-1.152	No	< 80
		mFC	128	-0.5300	-5.300	-0.700	No	< 80
	5	DO	124	0.1052	0.526	2.325	Yes	95
		mDO	63	0.1707	0.854	1.641	No	80
		Temp	126	-0.1681	-0.841	-1.645	No	90
		mTemp	63	-0.3223	-1.612	-2.087	Yes	95
		FC	126	0.0000	0.000	-0.343	No	< 80
		mFC	63	-1.5180	-7.590	-0.949	No	< 80

Site	Period (years)	Parameter	n	Slope	Δ (units/period)	Z-score	Significant (95%)	Confidence (%)
19	17	pH	388	-0.0081	-0.138	-2.622	Yes	95
		mpH	206	-0.0085	-0.145	-2.411	Yes	95
		DO	411	-0.0381	-0.648	-4.609	Yes	95
		mDO	212	-0.0415	-0.705	-3.852	Yes	95
		DO % sat	411	-0.2355	-4.004	-5.083	Yes	95
		mDO % sat	212	-0.2507	-4.262	-3.875	Yes	95
		Temp	412	0.0668	1.136	3.447	Yes	95
		mTemp	213	0.0713	1.212	2.735	Yes	95
		Turb	375	-0.0214	-0.364	-0.889	No	< 80
		mTurb	200	-0.0541	-0.919	-1.797	No	90
		FC	412	-0.1001	-1.702	-1.747	No	90
		mFC	211	-1.6650	-28.305	-2.182	Yes	95
		NO3+NO2	109	-0.0084	-0.142	-2.450	Yes	95
		TKN	109	0.0000	0.000	0.505	No	< 80
		TP	110	0.0000	0.000	-2.682	Yes	95
		OP	109	0.0000	0.000	0.636	No	< 80
		NH3	109	0.0000	0.000	-1.422	No	80
		TSS	110	0.0000	0.000	-1.236	No	< 80
	10	DO	230	-0.0199	-0.199	-0.784	No	< 80
		mDO	121	-0.0376	-0.376	-1.637	No	80
		Temp	232	0.1968	1.968	4.187	Yes	95
		mTemp	122	0.2309	2.309	4.071	Yes	95
		FC	232	-1.4970	-14.970	-2.121	Yes	95
		mFC	121	-2.3570	-23.570	-1.490	No	80
	5	DO	107	0.0049	0.024	0.081	No	< 80
		mDO	58	0.0017	0.008	0.000	No	< 80
		Temp	108	0.0000	0.000	0.170	No	< 80
		mTemp	58	0.0467	0.233	0.127	No	< 80
		FC	109	-5.0090	-25.045	-2.425	Yes	95
		mFC	58	-5.0550	-25.275	-1.420	No	80

Site	Period (years)	Parameter	n	Slope	Δ (units/period)	Z-score	Significant (95%)	Confidence (%)
20	17	pH	408	-0.0114	-0.194	-3.612	Yes	95
		mpH	215	-0.0100	-0.171	-2.641	Yes	95
		DO	431	0.0273	0.464	4.414	Yes	95
		mDO	219	0.0247	0.420	3.281	Yes	95
		DO % sat	432	0.2185	3.715	5.893	Yes	95
		mDO % sat	219	0.2407	4.092	4.850	Yes	95
		Temp	433	0.0000	0.000	0.039	No	< 80
		mTemp	219	0.0000	0.000	0.042	No	< 80
		Turb	389	-0.0173	-0.293	-1.661	No	90
		mTurb	205	-0.0300	-0.509	-1.805	No	90
		FC	430	0.0000	0.000	-0.800	No	< 80
		mFC	218	-0.3334	-5.668	-0.949	No	< 80
		NO3+NO2	113	0.0013	0.021	0.647	No	< 80
		TKN	113	0.0000	0.000	-1.316	No	80
		TP	113	0.0000	0.000	-4.063	Yes	95
		OP	112	0.0000	0.000	>4677	No	< 80
		NH3	113	0.0000	0.000	-1.298	No	80
		TSS	113	0.0000	0.000	-0.709	No	< 80
	10	DO	249	0.0802	0.802	5.540	Yes	95
		mDO	128	0.0610	0.610	2.883	Yes	95
		Temp	251	0.0572	0.572	1.571	No	80
		mTemp	128	0.0922	0.922	1.851	No	90
		FC	250	0.0000	0.000	0.561	No	< 80
		mFC	127	1.0850	10.850	1.457	No	80
	5	DO	122	0.0604	0.302	1.988	Yes	95
		mDO	63	0.0261	0.131	0.617	No	< 80
		Temp	123	-0.1502	-0.751	-1.521	No	80
		mTemp	63	-0.1507	-0.754	-1.311	No	80
		FC	124	-0.1649	-0.825	-0.947	No	< 80
		mFC	63	0.0000	0.000	0.000	No	< 80

Site	Period (years)	Parameter	n	Slope	Δ (units/period)	Z-score	Significant (95%)	Confidence (%)
21	17	pH	353	-0.0089	-0.152	-2.584	Yes	95
		mpH	196	-0.0096	-0.163	-2.445	Yes	95
		DO	376	0.0125	0.213	1.425	No	80
		mDO	201	0.0180	0.306	1.577	No	80
		DO % sat	376	0.1395	2.372	3.137	Yes	95
		mDO % sat	202	0.1672	2.842	3.290	Yes	95
		Temp	377	0.0248	0.422	1.213	No	< 80
		mTemp	201	0.0232	0.394	0.945	No	< 80
		Turb	339	-0.0507	-0.861	-1.722	No	90
		mTurb	188	-0.0847	-1.439	-2.343	Yes	95
		FC	375	-0.8752	-14.878	-3.334	Yes	95
		mFC	201	-1.8510	-31.467	-2.650	Yes	95
		NO3+NO2	100	-0.0038	-0.065	-0.921	No	< 80
		TKN	100	0.0000	0.000	1.321	No	80
		TP	100	0.0000	0.000	-2.310	Yes	95
		OP	99	0.0000	0.000	2.915	Yes	95
		NH3	100	0.0000	0.000	-0.217	No	< 80
		TSS	100	0.0000	0.000	-0.635	No	< 80
	10	DO	213	0.0398	0.398	2.093	Yes	95
		mDO	117	0.0443	0.443	1.590	No	80
		Temp	214	0.1014	1.014	2.365	Yes	95
		mTemp	117	0.1423	1.423	2.324	Yes	95
		FC	213	0.0000	0.000	0.031	No	< 80
		mFC	117	0.7521	7.521	0.835	No	< 80
	5	DO	122	0.1061	0.531	1.572	No	80
		mDO	66	0.1191	0.596	1.526	No	80
		Temp	123	-0.2003	-1.002	-1.225	No	< 80
		mTemp	66	-0.1504	-0.752	-0.991	No	< 80
		FC	122	-3.5780	-17.890	-2.228	Yes	95
		mFC	66	-2.6080	-13.040	-0.973	No	< 80

Site	Period (years)	Parameter	n	Slope	Δ (units/period)	Z-score	Significant (95%)	Confidence (%)
22	17	pH	412	-0.0316	-0.536	-6.822	Yes	95
		mpH	213	-0.0300	-0.509	-5.363	Yes	95
		DO	431	-0.0091	-0.155	-1.377	No	80
		mDO	218	-0.0053	-0.090	-0.689	No	< 80
		DO % sat	432	-0.0182	-0.400	-0.538	No	< 80
		mDO % sat	219	0.0028	0.047	0.074	No	< 80
		Temp	434	0.0332	0.565	1.985	Yes	95
		mTemp	218	0.0320	0.543	1.633	No	80
		Turb	395	-0.0117	-0.198	-1.179	No	< 80
		mTurb	204	-0.0365	-0.620	-1.852	No	90
		FC	432	0.0000	0.000	1.568	No	80
		mFC	216	0.1345	2.287	1.655	No	90
		NO3+NO2	111	0.0053	0.091	1.359	No	80
		TKN	111	0.0000	0.000	-0.674	No	< 80
		TP	112	0.0000	0.000	-3.062	Yes	95
		OP	110	0.0000	0.000	1.600	No	80
		NH3	112	0.0000	0.000	-1.094	No	< 80
		TSS	111	0.0000	0.000	-1.829	No	90
	10	DO	250	0.0291	0.291	1.860	No	90
		mDO	128	0.0244	0.244	1.107	No	< 80
		Temp	252	0.1003	1.003	2.561	Yes	95
		mTemp	128	0.1472	1.472	2.817	Yes	95
		FC	253	0.0000	0.000	-0.256	No	< 80
		mFC	126	0.2308	2.308	1.010	No	< 80
	5	DO	122	0.0401	0.040	0.948	No	< 80
		mDO	63	0.0251	0.125	0.678	No	< 80
		Temp	123	-0.0971	-0.485	-0.886	No	< 80
		mTemp	63	-0.1087	-0.544	-1.116	No	< 80
		FC	125	-1.8380	-9.190	-3.841	Yes	95
		mFC	63	-2.0660	-10.330	-2.489	Yes	95

Site	Period (years)	Parameter	n	Slope	Δ (units/period)	Z-score	Significant (95%)	Confidence (%)
23	17	pH	368	-0.0263	-0.446	-7.195	Yes	95
		mpH	189	-0.0242	-0.412	-5.455	Yes	95
		DO	389	0.0065	0.111	0.873	No	< 80
		mDO	195	0.0078	0.133	0.879	No	< 80
		DO % sat	391	0.0863	1.467	2.127	Yes	95
		mDO % sat	197	0.0800	1.360	1.738	No	90
		Temp	392	0.0000	0.000	-0.048	No	< 80
		mTemp	196	-0.0125	-0.212	-0.609	No	< 80
		Turb	354	0.0136	0.232	1.221	No	< 80
		mTurb	184	-0.0006	-0.011	-0.146	No	< 80
		FC	391	0.0000	0.000	0.163	No	< 80
		mFC	195	-0.0712	-1.211	-0.587	No	< 80
		NO3+NO2	105	-0.0169	-0.287	-3.564	Yes	95
		TKN	106	0.0000	0.000	0.140	No	< 80
		TP	106	0.0000	0.000	-3.598	Yes	95
		OP	105	0.0000	0.000	1.240	No	< 80
		NH3	106	0.0000	0.000	0.000	No	< 80
		TSS	105	0.0000	0.000	-1.212	No	< 80
	10	DO	220	0.0329	0.329	1.973	Yes	95
		mDO	107	0.0125	0.125	0.378	No	< 80
		Temp	222	0.0665	0.665	1.635	No	80
		mTemp	108	0.0815	0.815	2.172	Yes	95
		FC	223	0.0000	0.000	0.875	No	< 80
		mFC	107	0.2883	2.883	1.138	No	< 80
	5	DO	111	0.0219	0.109	0.291	No	< 80
		mDO	59	0.0400	0.200	0.227	No	< 80
		Temp	112	-0.0994	-0.497	-0.736	No	< 80
		mTemp	59	-0.0703	-0.352	-0.429	No	< 80
		FC	113	0.0000	0.000	0.278	No	< 80
		mFC	59	0.1671	0.836	0.076	No	< 80

Site	Period (years)	Parameter	n	Slope	Δ (units/period)	Z-score	Significant (95%)	Confidence (%)
24	17	pH	413	-0.0067	-0.114	-2.131	Yes	95
		mpH	216	-0.0074	-0.125	-1.647	No	90
		DO	431	0.0682	1.159	4.855	Yes	95
		mDO	220	0.0717	1.219	3.772	Yes	95
		DO % sat	432	0.5545	9.427	5.244	Yes	95
		mDO % sat	219	0.5918	10.061	4.153	Yes	95
		Temp	434	0.0000	0.000	-0.172	No	< 80
		mTemp	219	0.0000	0.000	-0.381	No	< 80
		Turb	393	0.0557	0.946	6.683	Yes	95
		mTurb	205	0.0547	0.930	4.880	Yes	95
		FC	430	-0.2019	-3.432	-3.722	Yes	95
		mFC	218	-0.4632	-7.874	-3.197	Yes	95
		NO3+NO2	113	0.0026	0.044	1.503	No	80
		TKN	111	0.0000	0.000	-0.295	No	< 80
		TP	113	0.0000	0.000	-0.681	No	< 80
		OP	112	0.0000	0.000	0.620	No	< 80
		NH3	113	0.0000	0.000	0.258	No	< 80
		TSS	113	0.0000	0.000	1.471	No	80
	10	DO	248	0.2866	2.866	9.442	Yes	95
		mDO	129	0.3060	3.060	6.936	Yes	95
		Temp	251	-0.0251	-0.251	-0.933	No	< 80
		mTemp	128	0.0063	0.063	0.301	No	< 80
		FC	251	0.0000	0.000	0.856	No	< 80
		mFC	127	0.0879	0.879	0.257	No	< 80
	5	DO	120	0.1404	0.702	2.772	Yes	95
		mDO	64	0.1772	0.886	2.235	Yes	95
		Temp	122	-0.0745	-0.373	-0.968	No	< 80
		mTemp	63	-0.0355	-0.178	-0.559	No	< 80
		FC	122	0.0000	0.000	0.670	No	< 80
		mFC	63	0.7808	3.904	0.497	No	< 80

Site	Period (years)	Parameter	n	Slope	Δ (units/period)	Z-score	Significant (95%)	Confidence (%)
25	17	pH	336	-0.0278	-0.472	-6.110	Yes	95
		mpH	176	-0.0269	-0.457	-4.679	Yes	95
		DO	351	0.0134	0.227	2.023	Yes	95
		mDO	179	0.0138	0.235	1.251	No	< 80
		DO % sat	351	0.1253	2.130	2.875	Yes	95
		mDO % sat	180	0.0984	1.672	1.781	No	90
		Temp	352	0.0000	0.000	0.428	No	< 80
		mTemp	179	-0.0041	-0.070	-0.261	No	< 80
		Turb	320	0.0216	0.367	6.020	Yes	95
		mTurb	165	0.0158	0.268	2.676	Yes	95
		FC	349	0.0000	0.000	0.335	No	< 80
		mFC	178	0.0000	0.000	0.241	No	< 80
		NO3+NO2	94	-0.0046	-0.078	-1.166	No	< 80
		TKN	94	0.0000	0.000	-2.600	Yes	95
		TP	94	0.0000	0.000	-3.453	Yes	95
		OP	94	0.0000	0.000	2.458	Yes	95
		NH3	94	0.0000	0.000	0.371	No	< 80
		TSS	94	0.0000	0.000	-1.345	No	80
	10	DO	198	0.0640	0.640	3.892	Yes	95
		mDO	98	0.0322	0.322	1.591	No	80
		Temp	199	0.0483	0.483	1.125	No	< 80
		mTemp	98	0.0762	0.762	1.557	No	80
		FC	199	0.0000	0.000	1.299	No	80
		mFC	97	0.0716	0.716	0.618	No	< 80
	5	DO	94	-0.0559	-0.279	-1.385	No	80
		mDO	42	-0.1307	-0.654	-1.351	No	80
		Temp	95	-0.0983	-0.491	-0.838	No	< 80
		mTemp	42	0.1755	0.878	0.618	No	< 80
		FC	95	0.0000	0.000	0.034	No	< 80
		mFC	42	-0.5000	-2.500	-0.548	No	< 80

Site	Period (years)	Parameter	n	Slope	Δ (units/period)	Z-score	Significant (95%)	Confidence (%)
28	17	pH	298	-0.0149	-0.253	-2.323	Yes	95
		mpH	161	-0.0157	-0.266	-1.809	No	90
		DO	311	-0.0033	-0.056	-0.257	No	< 80
		mDO	165	0.0000	0.000	0.000	No	< 80
		DO % sat	312	-0.0501	-0.852	-0.673	No	< 80
		mDO % sat	161	-0.0615	-1.046	-0.490	No	< 80
		Temp	313	0.0000	0.000	-0.015	No	< 80
		mTemp	165	-0.0100	-0.169	-0.437	No	< 80
		Turb	285	-0.0354	-0.601	-1.111	No	< 80
		mTurb	155	-0.0607	-1.031	-1.011	No	< 80
		FC	312	-0.1054	-1.792	-1.305	No	80
		mFC	165	-0.5095	-8.662	-1.014	No	< 80
		NO3+NO2	84	-0.0130	-0.222	-2.040	Yes	95
		TKN	84	-0.0149	-0.254	-2.975	Yes	95
		TP	84	0.0000	0.000	2.108	Yes	95
		OP	84	0.0005	0.008	2.251	Yes	95
		NH3	84	-0.0036	-0.061	-4.345	Yes	95
		TSS	84	0.0000	0.000	-0.228	No	< 80
	10	DO	176	-0.0162	-0.162	-0.434	No	< 80
		mDO	89	-0.0426	-0.426	-1.248	No	< 80
		Temp	178	-0.0287	-0.287	-0.452	No	< 80
		mTemp	89	-0.0188	-0.188	-0.202	No	< 80
		FC	179	-1.4320	-14.320	-1.844	No	90
		mFC	89	-2.1830	-21.830	-1.766	No	90
	5	DO	Insufficient Data					
		mDO						
		Temp						
		mTemp						
		FC						
		mFC						

Site	Period (years)	Parameter	n	Slope	Δ (units/period)	Z-score	Significant (95%)	Confidence (%)
29	17	pH	398	-0.0045	-0.076	-1.072	No	< 80
		mpH	215	-0.0071	-0.121	-0.915	No	< 80
		DO	419	0.0087	0.149	1.528	No	80
		mDO	218	0.0034	0.058	0.522	No	< 80
		DO % sat	420	0.0269	0.457	0.686	No	< 80
		mDO % sat	219	0.0500	0.849	0.868	No	< 80
		Temp	425	0.0000	0.000	0.201	No	< 80
		mTemp	219	0.0083	0.141	0.637	No	< 80
		Turb	387	-0.1754	-2.982	-4.884	Yes	95
		mTurb	205	-0.2107	-3.582	-3.879	Yes	95
		FC	419	0.0000	0.000	-0.952	No	< 80
		mFC	219	0.0000	0.000	-0.287	No	< 80
		NO3+NO2	111	0.0000	0.000	-0.069	No	< 80
		TKN	110	0.0000	0.000	-0.778	No	< 80
		TP	110	0.0000	0.000	-2.823	Yes	< 80
		OP	111	0.0000	0.000	2.588	Yes	95
		NH3	111	0.0000	0.000	1.171	No	< 80
		TSS	111	0.0000	0.000	-1.020	No	< 80
	10	DO	239	0.0267	0.267	1.937	No	90
		mDO	127	0.0312	0.312	1.624	No	80
		Temp	243	0.0501	0.501	1.991	Yes	95
		mTemp	128	0.0299	0.299	0.653	No	< 80
		FC	242	0.0000	0.000	1.039	No	< 80
		mFC	128	0.0000	0.000	-0.140	No	< 80
	5	DO	125	0.0405	0.203	1.098	No	< 80
		mDO	63	0.0751	0.376	0.884	No	< 80
		Temp	125	-0.1673	-0.837	-2.249	Yes	95
		mTemp	63	-0.2460	-1.230	-1.641	No	80
		FC	124	-0.1664	-0.832	-1.229	No	< 80
		mFC	63	-1.0770	-5.385	-1.010	No	< 80

Site	Period (years)	Parameter	n	Slope	Δ (units/period)	Z-score	Significant (95%)	Confidence (%)
30	17	pH	416	-0.0159	-0.270	-4.240	Yes	95
		mpH	215	-0.0135	-0.230	-3.095	Yes	95
		DO	434	0.0116	0.196	2.009	Yes	95
		mDO	219	0.0114	0.194	1.824	No	90
		DO % sat	435	0.1143	1.943	2.890	Yes	95
		mDO % sat	219	0.1215	2.066	2.330	Yes	95
		Temp	437	0.0100	0.171	1.044	No	< 80
		mTemp	219	0.0071	0.121	0.771	No	< 80
		Turb	395	-0.1153	-1.960	-3.668	Yes	95
		mTurb	205	-0.1971	-3.351	-3.610	Yes	95
		FC	431	0.0000	0.000	0.527	No	< 80
		mFC	216	0.0000	0.000	-0.531	No	< 80
		NO3+NO2	112	0.0000	0.000	-1.315	No	80
		TKN	111	0.0000	0.000	-0.032	No	< 80
		TP	112	0.0000	0.000	-2.665	Yes	95
		OP	111	0.0000	0.000	2.355	Yes	95
		NH3	111	0.0000	0.000	-1.369	No	80
		TSS	112	0.0000	0.000	-2.083	Yes	95
	10	DO	252	0.0582	0.582	3.672	Yes	95
		mDO	128	0.0278	0.278	1.846	No	90
		Temp	255	0.0859	0.859	3.125	Yes	95
		mTemp	128	0.1253	1.253	3.930	Yes	95
		FC	255	0.0000	0.000	0.532	No	< 80
		mFC	125	0.0000	0.000	-0.868	No	< 80
	5	DO	124	0.0299	0.149	0.687	No	< 80
		mDO	63	0.0385	0.192	1.171	No	< 80
		Temp	126	-0.0990	-0.495	-0.984	No	< 80
		mTemp	63	-0.0125	-0.063	0.000	No	< 80
		FC	126	0.0000	0.000	-0.298	No	< 80
		mFC	63	-0.5007	-2.504	-1.329	No	80

Site	Period (years)	Parameter	n	Slope	Δ (units/period)	Z-score	Significant (95%)	Confidence (%)
32	17	pH	406	0.0057	0.097	1.547	No	80
		mpH	216	0.0033	0.057	0.572	No	< 80
		DO	428	0.0318	0.541	3.777	Yes	95
		mDO	220	0.0335	0.569	3.200	Yes	95
		DO % sat	431	0.2929	4.979	5.550	Yes	95
		mDO % sat	220	0.2650	4.505	4.324	Yes	95
		Temp	437	0.0333	0.567	1.791	No	90
		mTemp	220	0.0365	0.620	1.565	No	80
		Turb	394	-0.0415	-0.706	-2.232	Yes	95
		mTurb	208	-0.0919	-1.562	-2.917	Yes	95
		FC	437	-0.1253	-2.130	-2.362	Yes	95
		mFC	216	-1.0750	-18.275	-2.193	Yes	95
		NO3+NO2	112	-0.0058	-0.099	-2.050	Yes	95
		TKN	114	0.0000	0.000	-0.529	No	< 80
		TP	114	0.0000	0.000	-0.988	No	< 80
		OP	112	0.0000	0.000	0.482	No	< 80
		NH3	114	-0.0033	-0.057	-4.492	Yes	95
		TSS	112	-0.0835	-1.420	-2.000	Yes	95
	10	DO	248	0.0988	0.988	5.872	Yes	95
		mDO	129	0.0844	0.844	4.989	Yes	95
		Temp	256	0.0866	0.866	2.030	Yes	95
		mTemp	129	0.1482	1.482	2.692	Yes	95
		FC	256	0.0000	0.000	0.603	No	< 80
		mFC	129	0.5470	5.470	0.755	No	< 80
	5	DO	121	0.0837	0.418	1.872	No	90
		mDO	63	0.0794	0.397	1.605	No	80
		Temp	125	-0.2695	-1.348	-1.849	No	90
		mTemp	63	-0.2419	-1.210	-1.975	Yes	95
		FC	125	0.0000	0.000	0.884	No	< 80
		mFC	63	1.8720	9.360	0.685	No	< 80

Site	Period (years)	Parameter	n	Slope	Δ (units/period)	Z-score	Significant (95%)	Confidence (%)
33	17	pH	405	-0.0266	-0.453	-5.740	Yes	95
		mpH	214	-0.0260	-0.443	-4.674	Yes	95
		DO	409	-0.0121	-0.205	-0.454	No	< 80
		mDO	216	-0.0126	-0.214	-0.376	No	< 80
		DO % sat	428	-0.3409	-5.795	-1.110	No	< 80
		mDO % sat	221	-0.5063	-8.607	-1.474	No	80
		Temp	433	0.0000	0.000	0.192	No	< 80
		mTemp	219	0.0200	0.340	0.526	No	< 80
		Turb	391	-0.4512	-7.670	-5.448	Yes	95
		mTurb	204	-0.4441	-7.550	-4.456	Yes	95
		FC	434	-1.0490	-17.833	-3.463	Yes	95
		mFC	218	-1.8830	-32.011	-2.315	Yes	95
		NO3+NO2	109	0.0027	0.046	1.825	No	90
		TKN	110	0.0245	0.417	1.560	No	80
		TP	110	0.0090	0.152	1.127	No	< 80
		OP	109	0.0100	0.171	2.724	Yes	95
		NH3	110	-0.0066	-0.112	-0.759	No	< 80
		TSS	109	-1.3600	-23.120	-2.550	Yes	95
	10	DO	240	0.1084	1.084	1.652	No	90
		mDO	128	0.1138	1.138	1.153	No	< 80
		Temp	251	0.0877	0.877	1.368	No	80
		mTemp	129	0.1333	1.333	2.190	Yes	95
		FC	251	-2.2790	-22.790	-2.838	Yes	95
		mFC	128	-2.9040	-29.040	-2.062	Yes	95
	5	DO	141	0.0104	0.052	0.081	No	< 80
		mDO	76	-0.0543	-0.272	-0.144	No	< 80
		Temp	145	-0.3703	-1.852	-2.506	Yes	95
		mTemp	76	-0.1939	-0.970	-1.250	No	< 80
		FC	146	0.3681	1.841	0.675	No	< 80
		mFC	75	4.1200	20.600	0.945	No	< 80

Site	Period (years)	Parameter	n	Slope	Δ (units/period)	Z-score	Significant (95%)	Confidence (%)
34	17	pH	400	-0.0332	-0.565	-7.434	Yes	95
		mpH	211	-0.0304	-0.516	-5.256	Yes	95
		DO	423	0.0616	1.047	3.259	Yes	95
		mDO	216	0.0591	1.004	2.434	Yes	95
		DO % sat	423	0.6015	10.226	3.546	Yes	95
		mDO % sat	217	0.6120	10.404	2.472	Yes	95
		Temp	427	0.0793	1.347	3.072	Yes	95
		mTemp	217	0.1065	1.811	3.559	Yes	95
		Turb	390	-0.4331	-7.363	-6.442	Yes	95
		mTurb	203	-0.5789	-9.841	-6.189	Yes	95
		FC	422	-3.0080	-51.136	-3.902	Yes	95
		mFC	204	-6.2350	-105.995	-2.605	Yes	95
		NO3+NO2	110	0.0000	0.000	-1.614	No	80
		TKN	109	-0.0200	-0.340	-2.409	Yes	95
		TP	110	0.0051	0.086	2.926	Yes	95
		OP	110	0.0031	0.053	2.174	Yes	95
		NH3	110	-0.0124	-0.211	-4.907	Yes	95
		TSS	110	-0.2533	-4.306	-1.133	No	< 80
	10	DO	244	0.0767	0.767	1.985	Yes	95
		mDO	127	0.1223	1.223	1.834	No	90
		Temp	247	0.1628	1.628	2.717	Yes	95
		mTemp	127	0.1386	1.386	2.329	Yes	95
		FC	246	-1.4310	-14.310	-1.702	No	90
		mFC	114	-4.5120	-45.120	-1.296	No	80
	5	DO	116	-0.0518	-0.259	-0.267	No	< 80
		mDO	63	0.0624	0.312	0.505	No	< 80
		Temp	118	-0.2354	-1.177	-1.331	No	80
		mTemp	63	-0.4044	-2.022	-1.767	No	90
		FC	117	-1.5020	-7.510	-0.956	No	< 80
		mFC	63	-2.7580	-13.790	-0.507	No	< 80

Site	Period (years)	Parameter	n	Slope	Δ (units/period)	Z-score	Significant (95%)	Confidence (%)
35	17	pH	393	0.0136	0.232	3.393	Yes	95
		mpH	210	0.0131	0.223	2.888	Yes	95
		DO	416	0.0260	0.442	1.529	No	80
		mDO	214	0.0175	0.298	1.386	No	80
		DO % sat	416	0.2544	4.325	1.674	No	90
		mDO % sat	216	0.2005	3.409	1.454	No	80
		Temp	421	0.0497	0.844	2.752	Yes	95
		mTemp	214	0.0334	0.568	1.299	No	80
		Turb	378	-0.6587	-11.198	-4.887	Yes	95
		mTurb	200	-0.8959	-15.230	-4.468	Yes	95
		FC	415	-0.0767	-1.304	-1.200	No	< 80
		mFC	214	-0.1990	-3.383	-0.253	No	< 80
		NO3+NO2	106	0.0008	0.013	0.133	No	< 80
		TKN	106	-0.0105	-0.179	-1.033	No	< 80
		TP	107	0.0023	0.038	1.750	No	90
		OP	105	0.0000	0.000	0.250	No	< 80
		NH3	106	-0.0100	-0.171	-1.727	No	90
		TSS	105	0.0000	0.000	-0.480	No	< 80
	10	DO	243	0.0799	0.799	2.224	Yes	95
		mDO	128	0.0618	0.618	1.821	No	90
		Temp	247	0.1772	1.772	3.822	Yes	95
		mTemp	128	0.2130	2.130	4.111	Yes	95
		FC	247	1.1220	11.220	1.538	No	80
		mFC	128	3.2770	32.770	1.224	No	< 80
	5	DO	118	0.2492	1.246	2.517	Yes	95
		mDO	63	0.1682	0.841	2.034	Yes	95
		Temp	120	0.0506	0.253	0.362	No	< 80
		mTemp	63	0.0564	0.282	0.247	No	< 80
		FC	121	0.0000	0.000	-0.360	No	< 80
		mFC	63	2.5120	12.560	0.308	No	< 80

Site	Period (years)	Parameter	n	Slope	Δ (units/period)	Z-score	Significant (95%)	Confidence (%)
36	17	pH	406	-0.0220	-0.375	-5.936	Yes	95
		mpH	217	-0.0233	-0.396	-4.088	Yes	95
		DO	422	0.0212	0.360	0.998	No	< 80
		mDO	219	0.0314	0.534	1.041	No	< 80
		DO % sat	429	0.2640	4.488	1.158	No	< 80
		mDO % sat	221	0.1816	3.087	0.841	No	< 80
		Temp	433	0.0143	0.243	0.497	No	< 80
		mTemp	220	0.0389	0.661	0.867	No	< 80
		Turb	389	-0.0521	-0.886	-1.179	No	< 80
		mTurb	206	-0.0942	-1.602	-1.625	No	80
		FC	437	0.7965	13.541	2.656	Yes	95
		mFC	220	1.2110	20.587	1.420	No	80
		NO3+NO2	112	0.0000	0.000	-0.873	No	< 80
		TKN	112	-0.0174	-0.296	-2.189	Yes	95
		TP	112	0.0050	0.085	3.034	Yes	95
		OP	112	0.0033	0.056	2.358	Yes	95
		NH3	112	-0.0100	-0.171	-4.304	Yes	95
		TSS	112	0.0000	0.000	-0.518	No	< 80
	10	DO	245	0.0318	0.318	0.697	No	< 80
		mDO	128	0.0014	0.014	0.092	No	< 80
		Temp	253	0.1145	1.145	1.751	No	90
		mTemp	128	0.1882	1.882	2.512	Yes	95
		FC	254	0.0000	0.000	0.965	No	< 80
		mFC	128	1.3370	13.370	0.761	No	< 80
	5	DO	122	-0.1872	-0.936	-1.206	No	< 80
		mDO	63	-0.3281	-1.641	-1.417	No	80
		Temp	124	-0.2500	-1.250	-1.648	No	90
		mTemp	63	-0.2169	-1.085	-1.358	No	80
		FC	125	0.0000	0.000	-0.617	No	< 80
		mFC	63	0.0000	0.000	0.000	No	< 80

Site	Period (years)	Parameter	n	Slope	Δ (units/period)	Z-score	Significant (95%)	Confidence (%)
37	17	pH	402	-0.0136	-0.232	-4.215	Yes	95
		mpH	214	-0.0141	-0.240	-2.590	Yes	95
		DO	409	0.0162	0.276	0.676	No	< 80
		mDO	215	0.0265	0.451	0.984	No	< 80
		DO % sat	426	-0.0200	-0.340	-0.080	No	< 80
		mDO % sat	219	-0.1000	-1.699	-0.337	No	< 80
		Temp	430	0.0300	0.509	0.990	No	< 80
		mTemp	218	0.0357	0.607	1.459	No	80
		Turb	390	-0.0353	-0.600	-0.523	No	< 80
		mTurb	205	-0.2500	-4.250	-2.264	Yes	95
		FC	433	5.3960	91.732	4.140	Yes	95
		mFC	217	9.1820	156.094	3.635	Yes	95
		NO3+NO2	112	0.0000	0.000	0.107	No	< 80
		TKN	112	0.0000	0.000	0.000	No	< 80
		TP	112	0.0101	0.172	2.163	Yes	95
		OP	112	0.0100	0.171	2.722	Yes	95
		NH3	112	-0.0160	-0.272	-0.700	No	< 80
		TSS	112	-0.3342	-5.681	-0.850	No	< 80
	10	DO	239	0.0856	0.856	1.288	No	80
		mDO	126	0.0823	0.823	1.202	No	< 80
		Temp	249	0.0992	0.992	1.341	No	80
		mTemp	127	0.1378	1.378	2.095	Yes	95
		FC	250	14.3800	143.800	3.627	Yes	95
		mFC	126	23.0800	230.800	3.041	Yes	95
	5	DO	120	-0.2263	-1.132	-1.463	No	80
		mDO	63	-0.3339	-1.670	-1.541	No	80
		Temp	122	-0.0331	-0.166	-0.102	No	< 80
		mTemp	63	-0.0411	-0.206	0.309	No	< 80
		FC	123	-5.0170	-25.085	-0.758	No	< 80
		mFC	63	-31.9300	-159.650	-0.801	No	< 80

Site	Period (years)	Parameter	n	Slope	Δ (units/period)	Z-score	Significant (95%)	Confidence (%)
38	17	pH	399	-0.0251	-0.426	-5.848	Yes	95
		mpH	214	-0.0250	-0.426	-4.244	Yes	95
		DO	399	-0.0059	-0.101	-0.209	No	< 80
		mDO	211	-0.0279	-0.474	-0.810	No	< 80
		DO % sat	416	-0.1051	-1.787	-0.351	No	< 80
		mDO % sat	219	-0.3124	-5.311	-0.979	No	< 80
		Temp	427	0.0201	0.341	0.834	No	< 80
		mTemp	218	0.0251	0.426	0.804	No	< 80
		Turb	386	-0.3216	-5.467	-3.492	Yes	95
		mTurb	204	-0.4119	-7.002	-3.625	Yes	95
		FC	427	0.9901	16.832	2.153	Yes	95
		mFC	218	1.6640	28.288	1.365	No	80
		NO3+NO2	111	0.0025	0.043	1.309	No	80
		TKN	111	0.0167	0.284	0.887	No	< 80
		TP	111	0.0155	0.264	2.035	Yes	95
		OP	111	0.0173	0.293	4.033	Yes	95
		NH3	111	-0.0100	-0.170	-0.324	No	< 80
		TSS	111	-0.4992	-8.486	-1.019	No	< 80
	10	DO	235	0.0315	0.315	0.449	No	< 80
		mDO	125	0.0095	0.095	0.072	No	< 80
		Temp	252	0.0285	0.285	0.575	No	< 80
		mTemp	129	0.0970	0.970	1.322	No	80
		FC	252	-2.8480	-28.480	-1.867	No	90
		mFC	129	-6.6120	-66.120	-1.550	No	80
	5	DO	118	-0.7036	-3.518	-2.564	Yes	95
		mDO	62	-0.6961	-3.481	-2.441	Yes	95
		Temp	121	-0.2356	-1.178	-1.677	No	90
		mTemp	63	-0.1589	-0.795	-0.864	No	< 80
		FC	122	-9.0250	-45.125	-1.796	No	90
		mFC	63	-25.8500	-129.250	-1.787	No	90

Site	Period (years)	Parameter	n	Slope	Δ (units/period)	Z-score	Significant (95%)	Confidence (%)
39	17	pH	405	-0.0185	-0.315	-6.537	Yes	95
		mpH	216	-0.0183	-0.311	-4.397	Yes	95
		DO	428	0.0070	0.119	0.957	No	< 80
		mDO	219	0.0058	0.098	0.432	No	< 80
		DO % sat	430	0.0498	0.846	1.127	No	< 80
		mDO % sat	221	0.0501	0.852	0.843	No	< 80
		Temp	434	0.0000	0.000	-0.351	No	< 80
		mTemp	220	0.0055	0.094	0.356	No	< 80
		Turb	389	-0.0389	-0.661	-1.246	No	< 80
		mTurb	205	-0.0915	-1.555	-1.741	No	90
		FC	434	-0.5829	-9.909	-2.695	Yes	95
		mFC	220	-2.0220	-34.374	-2.729	Yes	95
		NO3+NO2	112	0.0008	0.013	0.341	No	< 80
		TKN	112	-0.0011	-0.018	-0.901	No	< 80
		TP	112	0.0000	0.000	2.716	Yes	95
		OP	112	0.0017	0.028	3.854	Yes	95
		NH3	112	-0.0018	-0.030	-1.731	No	90
		TSS	112	0.0000	0.000	-0.864	No	< 80
	10	DO	249	0.0334	0.334	1.503	No	80
		mDO	130	-0.0050	-0.050	-0.113	No	< 80
		Temp	253	0.0165	0.165	0.519	No	< 80
		mTemp	130	0.1000	1.000	1.921	No	90
		FC	253	0.0000	0.000	-0.809	No	< 80
		mFC	130	1.0600	10.600	0.632	No	< 80
	5	DO	121	0.1352	0.676	2.531	Yes	95
		mDO	63	0.0998	0.499	1.787	No	90
		Temp	123	-0.2786	-1.393	-2.550	Yes	95
		mTemp	63	-0.2555	-1.278	-1.235	No	< 80
		FC	124	-5.8000	-29.000	-2.487	Yes	95
		mFC	63	-4.7800	0.000	-1.171	No	< 80

Site	Period (years)	Parameter	n	Slope	Δ (units/period)	Z-score	Significant (95%)	Confidence (%)
40	17	pH	378	-0.0134	-0.228	-4.053	Yes	95
		mpH	196	-0.0119	-0.202	-2.526	Yes	95
		DO	402	-0.0102	-0.174	-0.733	No	< 80
		mDO	200	0.0036	0.060	0.181	No	< 80
		DO % sat	402	-0.0944	-1.605	-0.589	No	< 80
		mDO % sat	202	0.0301	0.511	0.262	No	< 80
		Temp	404	0.0000	0.000	0.017	No	< 80
		mTemp	202	-0.0539	-0.917	-2.507	Yes	95
		Turb	367	0.1137	1.933	1.126	No	< 80
		mTurb	187	0.1526	2.594	0.990	No	< 80
		FC	400	0.0000	0.000	0.190	No	< 80
		mFC	201	0.4982	8.469	0.670	No	< 80
		NO3+NO2	104	0.0000	0.000	-0.078	No	< 80
		TKN	105	-0.0090	-0.152	-1.216	No	< 80
		TP	105	0.0022	0.038	3.308	Yes	95
		OP	104	0.0000	0.000	0.026	No	< 80
		NH3	105	-0.0144	-0.245	-2.139	Yes	95
		TSS	104	0.0000	0.000	-0.212	No	< 80
	10	DO	224	-0.0838	-0.838	-2.371	Yes	95
		mDO	113	-0.0811	-0.811	-1.525	No	80
		Temp	225	0.1322	1.322	2.809	Yes	95
		mTemp	113	0.0000	0.000	0.111	No	< 80
		FC	225	0.0000	0.000	-0.259	No	< 80
		mFC	113	1.2540	12.540	0.861	No	< 80
	5	DO	96	0.2774	1.387	1.846	No	80
		mDO	49	0.3146	1.573	2.035	Yes	95
		Temp	96	-0.3630	-1.815	-2.316	Yes	95
		mTemp	49	-0.4551	-2.276	-1.796	No	80
		FC	96	9.8380	49.190	2.878	Yes	95
		mFC	49	12.5000	62.500	1.899	No	90

Site	Period (years)	Parameter	n	Slope	Δ (units/period)	Z-score	Significant (95%)	Confidence (%)
41	17	pH	409	-0.0042	-0.072	-1.294	No	80
		mpH	214	-0.0017	-0.028	-0.362	No	< 80
		DO	433	0.0655	1.114	3.457	Yes	95
		mDO	217	0.0765	1.300	2.870	Yes	95
		DO % sat	434	0.5589	9.501	3.119	Yes	95
		mDO % sat	219	0.5250	8.925	2.414	Yes	95
		Temp	438	0.0000	0.000	-0.254	No	< 80
		mTemp	219	0.0046	0.078	0.149	No	< 80
		Turb	400	0.3032	5.154	6.297	Yes	95
		mTurb	204	0.2811	4.779	3.873	Yes	95
		FC	436	1.0020	17.034	2.694	Yes	95
		mFC	218	1.7930	30.481	2.123	Yes	95
		NO3+NO2	113	0.0000	0.000	-0.486	No	< 80
		TKN	112	-0.0100	-0.171	1.276	No	< 80
		TP	113	0.0061	0.104	4.199	Yes	95
		OP	113	0.0042	0.071	5.118	Yes	95
		NH3	113	-0.0067	-0.114	-2.768	Yes	95
		TSS	113	0.3317	5.639	3.004	Yes	95
	10	DO	252	0.1859	1.859	3.822	Yes	95
		mDO	128	0.1386	1.386	2.751	Yes	95
		Temp	256	-0.0142	-0.142	-0.248	No	< 80
		mTemp	128	-0.0489	-0.489	-0.583	No	< 80
		FC	256	0.0000	0.000	0.250	No	< 80
		mFC	128	0.0000	0.000	0.047	No	< 80
	5	DO	124	-0.2605	-1.303	-1.032	No	< 80
		mDO	63	-0.2156	-1.078	-1.010	No	< 80
		Temp	126	-0.2687	-1.344	-1.926	No	90
		mTemp	63	-0.4686	-2.343	-2.146	Yes	95
		FC	125	0.0000	0.000	-0.538	No	< 80
		mFC	63	-3.3490	-16.745	-0.507	No	< 80

Site	Period (years)	Parameter	n	Slope	Δ (units/period)	Z-score	Significant (95%)	Confidence (%)
42	17	pH	407	-0.0023	-0.039	-0.696	No	< 80
		mpH	211	-0.0025	-0.042	-0.506	No	< 80
		DO	431	0.1022	1.737	6.625	Yes	95
		mDO	216	0.1127	1.916	5.761	Yes	95
		DO % sat	433	0.7682	13.059	6.882	Yes	95
		mDO % sat	218	0.8229	13.989	6.152	Yes	95
		Temp	436	0.0333	0.566	1.747	No	90
		mTemp	217	-0.0285	-0.484	-1.400	No	80
		Turb	397	0.0549	0.933	3.965	Yes	95
		mTurb	203	0.0608	1.033	2.869	Yes	95
		FC	430	1.6710	28.407	4.423	Yes	95
		mFC	216	2.3500	39.950	3.129	Yes	95
		NO3+NO2	113	-0.0070	-0.119	-1.057	No	< 80
		TKN	112	-0.0125	-0.212	-2.608	Yes	95
		TP	112	0.0000	0.000	0.580	No	< 80
		OP	113	0.0005	0.008	1.681	No	90
		NH3	113	-0.0033	-0.056	-3.056	Yes	95
		TSS	113	0.0000	0.000	1.681	No	90
	10	DO	251	-0.0751	-0.751	-2.340	Yes	95
		mDO	128	-0.0628	-0.628	-1.282	No	< 80
		Temp	255	0.0399	0.399	0.867	No	< 80
		mTemp	128	-0.0162	-0.162	-0.327	No	< 80
		FC	254	0.0000	0.000	0.626	No	< 80
		mFC	128	1.3760	13.760	0.420	No	< 80
	5	DO	125	-0.1995	-0.998	-2.078	Yes	95
		mDO	63	-0.1352	-0.676	-1.515	No	80
		Temp	126	-0.1999	-1.000	-1.476	No	80
		mTemp	63	-0.3722	-1.861	-1.774	No	90
		FC	125	5.5150	27.575	2.550	Yes	95
		mFC	63	7.6040	38.020	2.222	Yes	95

Site	Period (years)	Parameter	n	Slope	Δ (units/period)	Z-score	Significant (95%)	Confidence (%)
43	17	pH	401	-0.0200	-0.339	-5.807	Yes	95
		mpH	209	-0.0201	-0.341	-4.616	Yes	95
		DO	426	-0.0281	-0.477	-1.343	No	80
		mDO	212	-0.0196	-0.333	-0.838	No	< 80
		DO % sat	428	-0.2982	-5.069	-1.282	No	80
		mDO % sat	216	-0.1783	-3.031	-0.738	No	< 80
		Temp	430	0.0000	0.000	0.340	No	< 80
		mTemp	214	0.0214	0.363	1.322	No	80
		Turb	393	0.3231	5.493	5.873	Yes	95
		mTurb	200	0.2864	4.869	3.980	Yes	95
		FC	423	0.3321	5.646	2.026	Yes	95
		mFC	214	2.4600	41.820	2.533	Yes	95
		NO3+NO2	110	0.0000	0.000	0.376	No	< 80
		TKN	109	0.0058	0.098	0.923	No	< 80
		TP	110	0.0000	0.000	0.164	No	< 80
		OP	110	0.0000	0.000	-0.140	No	< 80
		NH3	110	-0.0036	-0.062	-1.345	No	80
		TSS	110	0.1829	3.109	1.356	No	80
	10	DO	253	0.0408	0.408	0.816	No	< 80
		mDO	127	0.1372	1.372	1.364	No	80
		Temp	257	0.0332	0.332	0.919	No	< 80
		mTemp	128	0.0313	0.313	0.631	No	< 80
		FC	254	0.0000	0.000	0.679	No	< 80
		mFC	128	1.4670	14.670	0.513	No	< 80
	5	DO	126	-0.1255	-0.628	-0.822	No	< 80
		mDO	63	-0.0676	-0.338	-0.505	No	< 80
		Temp	127	-0.1020	-0.510	-1.219	No	< 80
		mTemp	63	-0.3025	-1.513	-1.581	No	80
		FC	124	-2.9550	-14.775	-1.224	No	< 80
		mFC	63	1.4410	7.205	0.063	No	< 80

Site	Period (years)	Parameter	n	Slope	Δ (units/period)	Z-score	Significant (95%)	Confidence (%)
44	17	pH	365	-0.0405	-0.688	-9.629	Yes	95
		mpH	192	-0.0416	-0.707	-7.511	Yes	95
		DO	385	-0.0980	-1.665	-4.057	Yes	95
		mDO	195	-0.0870	-1.478	-2.984	Yes	95
		DO % sat	388	-0.9867	-16.774	-4.138	Yes	95
		mDO % sat	197	-0.8482	-14.419	-2.609	Yes	95
		Temp	392	0.0167	0.283	0.705	No	< 80
		mTemp	197	0.0346	0.588	1.230	No	< 80
		Turb	355	-0.0144	-0.245	-0.140	No	< 80
		mTurb	184	-0.0874	-1.485	-1.049	No	< 80
		FC	389	0.0000	0.000	0.266	No	< 80
		mFC	197	0.0832	1.415	0.172	No	< 80
		NO3+NO2	91	-0.0011	-0.018	-0.892	No	< 80
		TKN	91	-0.0166	-0.283	-1.242	No	< 80
		TP	92	0.0089	0.151	4.794	Yes	95
		OP	91	0.0000	0.000	-0.499	No	< 80
		NH3	92	-0.0065	-0.110	-1.474	No	80
		TSS	91	-0.0978	-1.663	-0.484	No	< 80
	10	DO	250	-0.0099	-0.099	-0.124	No	< 80
		mDO	127	0.0000	0.000	0.000	No	< 80
		Temp	253	0.0199	0.199	0.339	No	< 80
		mTemp	128	0.0401	0.401	0.630	No	< 80
		FC	253	-3.9780	-39.780	-2.508	Yes	95
		mFC	128	-5.1590	-51.590	-2.007	Yes	95
	5	DO	122	-0.0590	-0.295	-0.325	No	< 80
		mDO	62	-0.0768	-0.768	-0.579	No	< 80
		Temp	123	0.0246	0.123	0.198	No	< 80
		mTemp	63	0.0167	0.084	0.127	No	< 80
		FC	123	-12.7000	-63.500	-2.651	Yes	95
		mFC	63	-14.3400	-71.700	-2.281	Yes	95

Site	Period (years)	Parameter	n	Slope	Δ (units/period)	Z-score	Significant (95%)	Confidence (%)
45	17	pH	393	0.0143	0.242	2.945	Yes	95
		mpH	212	0.0134	0.228	2.339	Yes	95
		DO	413	0.0144	0.245	2.560	Yes	95
		mDO	214	0.0094	0.160	1.307	No	80
		DO % sat	413	0.0899	1.528	2.263	Yes	95
		mDO % sat	217	0.0664	1.129	1.344	No	80
		Temp	421	0.0000	0.000	0.270	No	< 80
		mTemp	217	0.0131	0.222	0.826	No	< 80
		Turb	386	-0.1923	-3.269	-4.745	Yes	95
		mTurb	201	-0.2300	-3.910	-3.536	Yes	95
		FC	415	0.0000	0.000	-1.308	No	80
		mFC	217	-0.0833	-1.416	-1.709	No	90
		NO3+NO2	108	0.0000	0.000	-0.677	No	< 80
		TKN	107	0.0000	0.000	0.284	No	< 80
		TP	107	0.0000	0.000	-2.937	Yes	95
		OP	107	0.0000	0.000	2.327	Yes	95
		NH3	108	0.0000	0.000	-0.882	No	< 80
		TSS	108	-0.1933	-3.286	-1.787	No	90
	10	DO	220	0.0691	0.691	4.262	Yes	95
		mDO	115	0.0884	0.884	4.250	Yes	95
		Temp	222	0.0125	0.125	0.443	No	< 80
		mTemp	115	-0.0427	-0.427	-1.005	No	< 80
		FC	221	0.0000	0.000	-0.227	No	< 80
		mFC	115	-0.0504	-0.504	-0.461	No	< 80
	5	DO	124	0.0958	0.479	2.054	Yes	95
		mDO	63	0.0881	0.440	1.389	No	80
		Temp	125	-0.1003	-0.502	-1.643	No	80
		mTemp	63	-0.1505	-0.753	-1.206	No	< 80
		FC	125	0.0000	0.000	-0.575	No	< 80
		mFC	63	-0.3923	-1.962	-1.075	No	< 80

Site	Period (years)	Parameter	n	Slope	Δ (units/period)	Z-score	Significant (95%)	Confidence (%)
46	17	pH	399	0.0087	0.147	2.024	Yes	95
		mpH	210	0.0064	0.110	1.144	No	< 80
		DO	424	0.0172	0.292	3.516	Yes	95
		mDO	216	0.0256	0.436	3.911	Yes	95
		DO % sat	425	0.1010	1.717	3.021	Yes	95
		mDO % sat	218	0.1087	1.848	2.406	Yes	95
		Temp	428	0.0000	0.000	0.351	No	< 80
		mTemp	217	-0.0248	-0.422	-1.622	No	80
		Turb	394	-0.1971	-3.351	-5.059	Yes	95
		mTurb	203	-0.2418	-4.111	-3.733	Yes	95
		FC	427	0.0000	0.000	1.023	No	< 80
		mFC	217	0.1266	2.152	1.386	No	80
		NO3+NO2	110	0.0000	0.000	0.238	No	< 80
		TKN	109	0.0000	0.000	1.135	No	< 80
		TP	109	0.0000	0.000	-1.612	No	80
		OP	109	0.0000	0.000	2.639	Yes	95
		NH3	110	0.0000	0.000	1.600	No	80
		TSS	109	-0.3321	-5.646	-2.692	Yes	95
	10	DO	248	0.0517	0.517	4.235	Yes	95
		mDO	128	0.0703	0.703	4.012	Yes	95
		Temp	251	0.0597	0.597	2.046	Yes	95
		mTemp	128	0.0244	0.244	0.467	No	< 80
		FC	252	0.2494	2.494	2.311	Yes	95
		mFC	128	0.4565	4.565	1.989	Yes	95
	5	DO	123	0.0769	0.385	2.245	Yes	95
		mDO	63	0.0968	0.484	2.087	Yes	95
		Temp	124	-0.1417	-0.709	-2.069	Yes	95
		mTemp	63	-0.1861	-0.931	-1.394	No	80
		FC	126	0.0000	0.000	0.245	No	< 80
		mFC	63	0.0000	0.000	0.064	No	< 80

Site	Period (years)	Parameter	n	Slope	Δ (units/period)	Z-score	Significant (95%)	Confidence (%)
47	17	pH	411	-0.0585	-0.994	-13.740	Yes	95
		mpH	214	-0.0627	-1.065	-10.490	Yes	95
		DO	435	0.0020	0.034	0.214	No	< 80
		mDO	217	-0.0033	-0.057	-0.398	No	< 80
		DO % sat	436	0.0262	0.445	0.473	No	< 80
		mDO % sat	219	0.0571	0.971	0.900	No	< 80
		Temp	439	0.0273	0.463	2.558	Yes	95
		mTemp	218	0.0369	0.627	2.916	Yes	95
		Turb	400	-0.0145	-0.247	-0.731	No	< 80
		mTurb	204	-0.0179	-0.304	-0.786	No	< 80
		FC	432	0.0000	0.000	2.626	Yes	95
		mFC	217	0.1392	2.366	2.503	Yes	95
		NO3+NO2	113	0.0047	0.081	3.447	Yes	95
		TKN	112	0.0000	0.000	1.578	No	80
		TP	113	0.0003	0.005	2.586	Yes	95
		OP	113	0.0020	0.034	3.976	Yes	95
		NH3	113	-0.0012	-0.020	-2.769	Yes	95
		TSS	113	-1.0020	-17.034	-2.358	Yes	95
	10	DO	254	0.0149	0.149	0.829	No	< 80
		mDO	128	0.0226	0.226	1.026	No	< 80
		Temp	257	0.0830	0.830	3.668	Yes	95
		mTemp	128	0.0561	0.561	2.173	Yes	95
		FC	254	0.0000	0.000	-0.413	No	< 80
		mFC	127	-0.0388	-0.388	-0.496	No	< 80
	5	DO	126	0.0369	0.185	0.532	No	< 80
		mDO	63	-0.0112	-0.056	0.000	No	< 80
		Temp	127	-0.0966	-0.483	-1.174	No	< 80
		mTemp	63	-0.1248	-0.624	-1.333	No	80
		FC	125	0.0000	0.000	-1.016	No	< 80
		mFC	62	-0.5134	-2.567	-0.902	No	< 80

Site	Period (years)	Parameter	n	Slope	Δ (units/period)	Z-score	Significant (95%)	Confidence (%)
48	17	pH	410	-0.0188	-0.319	-6.037	Yes	95
		mpH	214	-0.0175	-0.298	-4.533	Yes	95
		DO	433	0.0254	0.432	3.943	Yes	95
		mDO	217	0.0226	0.384	3.036	Yes	95
		DO % sat	434	0.1982	3.369	4.997	Yes	95
		mDO % sat	219	0.2003	3.405	3.960	Yes	95
		Temp	437	0.0283	0.482	2.370	Yes	95
		mTemp	218	0.0355	0.603	2.475	Yes	95
		Turb	400	0.0040	0.068	0.403	No	< 80
		mTurb	204	-0.0041	-0.070	-0.235	No	< 80
		FC	431	0.0000	0.000	-1.113	No	< 80
		mFC	218	-1.0750	-18.275	-1.600	No	80
		NO3+NO2	113	-0.0041	-0.070	-1.873	No	90
		TKN	111	-0.0120	-0.204	-2.881	Yes	95
		TP	112	0.0018	0.031	4.014	Yes	95
		OP	113	0.0019	0.032	1.083	No	< 80
		NH3	112	-0.0055	-0.093	-6.945	Yes	95
		TSS	113	0.0000	0.000	-0.232	No	< 80
	10	DO	253	0.0682	0.682	4.158	Yes	95
		mDO	128	0.0762	0.762	3.636	Yes	95
		Temp	255	0.1658	1.658	0.706	No	< 80
		mTemp	128	0.0000	0.000	0.000	No	< 80
		FC	253	0.0000	0.000	0.158	No	< 80
		mFC	127	0.0000	0.000	0.047	No	< 80
	5	DO	125	0.0820	0.410	2.104	Yes	95
		mDO	63	0.0572	0.286	1.010	No	< 80
		Temp	126	-0.1000	-0.500	-1.112	No	< 80
		mTemp	63	-0.1510	-0.755	-1.707	No	90
		FC	125	-3.9750	-19.875	-1.485	No	80
		mFC	63	-6.7690	-33.845	-1.647	No	90