Skagit County Monitoring Program

SCMP

Annual Report

2019 Water Year
(October 2018 – September 2019)

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This report is available online at www.skagitcounty.net/SCMP

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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

Skagit County Water Quality Monitoring Program – 2019 Water Year Annual Report

Executive Summary

Skagit County Public Works has completed the sixteenth year of water quality monitoring under the Skagit County Water Quality Monitoring Program, and this is the 16th annual report, for the 2019 water year. This program was established to help determine if the Skagit County Critical Areas Ordinance for Ongoing Agriculture (SCC 14.24.120) was sufficient to protect water quality in areas of ongoing agriculture. Forty monitoring stations were established in agricultural areas as well as reference locations outside of the agricultural zones. Monitoring began in October 2003 and is continuing. Reports are published after each water year (October 1- September 30).

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 40 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.

Based on court decisions that the Growth Management Act requires protection, but not restoration, of critical areas, the county uses trends monitoring as a method to determine whether water quality conditions are deteriorating in the county. Trends analysis for the 16 years of the program, alongside trends analysis of the last ten years and the last five years, reveals a mixed pattern of beneficial and deleterious trends both inside and outside of the agricultural areas.

Although county-wide trends in dissolved oxygen, water temperature, and fecal coliform count over 16 years reveals 23 positive trends and 21 negative, trend totals from the most recent five and ten years are starkly different. Looking at these same three metrics across their five and ten year timelines, positive trends massively outnumber negative, 75 to 13. Of all sites, the Samish River has shown the most remarkable improvement in the program. Of 16 significant trends at the upstream site of the Samish River, all 16 were positive. Of 19 significant trends at the downstream site of the Samish River, 17 were positive.

In looking at comparison of upstream and downstream measurements, a site that stood out from the rest for deterioration of water quality was the downstream sampling site of Hansen Creek. The downstream site had the worst percentage of positive trends in this report, with 8

percent positive, and 92 percent negative. In contrast, and being only roughly two miles away, 83 percent of significant trends at the upstream site of Hansen Creek were considered positive. The stretch of land between these two sites has been the target of ongoing restoration efforts and data from this program can aid in effectiveness monitoring.

Skagit County data has also proved useful to Ecology in their water cleanup (Total Maximum Daily load or TMDL) efforts, especially the Samish Bay Watershed Fecal Coliform TMDL. Skagit County, in cooperation with many local and state partners through the Clean Samish Initiative, is comprehensively addressing pollution in the Samish Bay Watershed. The County has received Environmental Protection Agency funding to address Samish Bay Watershed pollution issues and is working in partnership with the Washington State Department of Ecology (Ecology), the Skagit Conservation District, local tribes, and other partners in locating properties with possible pollution sources and seeking cooperative solutions to those problems.

Ecology used Skagit County data from the South Fork Skagit River to determine that additional monitoring for the County's National Pollutant Discharge Elimination System (NPDES) Phase II Stormwater Permit was not necessary. In most cases, water bodies with TMDLs require additional monitoring in association with the stormwater permits, but County data showed that the South Fork Skagit had improved substantially since the TMDL went into effect, and that additional stormwater monitoring was not necessary at the time of permit issuance.

Trends in fecal coliform reduction county-wide are overwhelmingly 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.

County staff participate in local and regional technical groups and in training of volunteer monitoring groups. Skagit County staff sponsor many community outreach events and participate in other events organized by partner organizations. Staff also give numerous presentations throughout the year to interested organizations.

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 16 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.

Skagit County Monitoring Program Annual Report

2019 Water Year
(October 2018-September 2019)

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 2019 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.

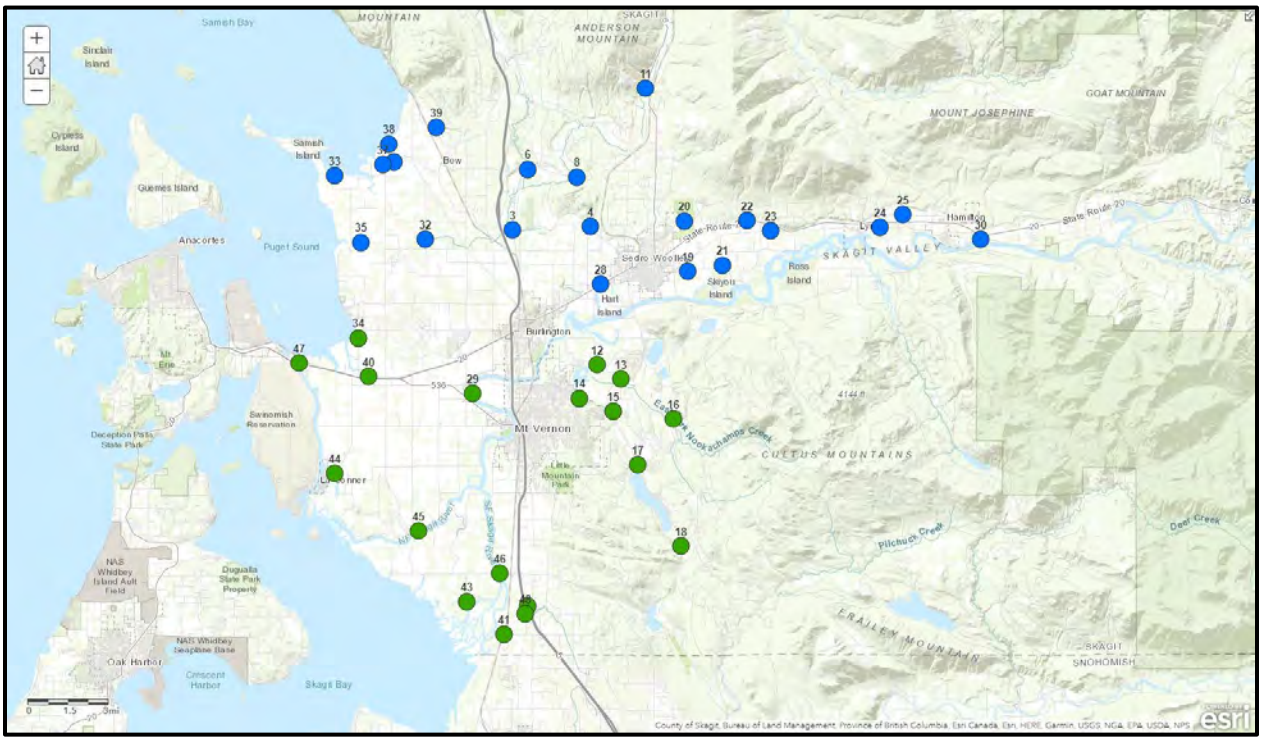


Figure 1 – Ambient sampling sites in the SCMP

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
31	Drainage Dist 20 floodgate	Francis Rd	48.445	-122.317	3
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 fifteen years of this program have been reported previously (Skagit County 2004-2017). This current report contains data and analysis from water years 2004 – 2019.

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 2019 water year, beginning in October 2018. Sampling normally took place on Tuesdays, but took place on other days to accommodate holiday and workplace schedules. Occasionally, samples are taken on different days due to flooding or other acts of nature.

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.

Numerous PIC water quality sampling, education, and outreach activities continued during the 2019 water year, and will be summarized in a separate CSI report. In addition, County staff, in cooperation with Ecology, have conducted site visits in areas where water quality sampling results indicate that pollution sources are present. These visits form the core of the PIC program and are summarized in the separate quarterly CSI reports, as well as the PIC Annual Report which can be found at the following link:

https://www.skagitcounty.net/PublicWorksCleanWater/Documents/2019%20PIC%20Annual%20Report.pdf

Water quality sampling in the Samish watershed consists of storm event sampling and investigatory sampling, in addition to the ambient sampling reported here. Storm event sampling consists of watershed-wide sampling during storm events in order to characterize the event and locate stream reaches with elevated FC counts. Investigatory sampling involves samples that may be taken in conjunction with investigations of specific areas or properties.

Recent sampling results for all sites, including those in the Samish Basin, are available at this site:
http://nras.maps.arcgis.com/apps/MapJournal/index.html?appid=d191d07f2cbf47e9a54e78c78c06c1a8

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 WQStat Plus 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 16 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 16 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 16 years.

Several sites have extended dry periods during most summers and/or are flooded during high water events and not sampled. The WQStat 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. All trends shown on the Site Report Card (SRC) section of this report are 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. The plan forms the basis for all sampling activities and may be viewed at:

https://www.skagitcounty.net/PublicWorksSurfaceWaterManagement/Documents/QAplanfinal103003.pdf

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 2019 water year, using the coefficient of variation (CV) statistic. Variability in FC was above target level, but similar or slightly better than what was seen in previous years. The reason for the higher nitrate variability is from one large discrepancy of 3.33 to 0.22 of one duplicate, out of a collection of only three duplicates total. 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 2019 Water Year

		Coefficient of Variation (CV %)	
Parameter	**n**	**2018 Results**	**Target**
Fecal Coliform	207	39.9	33[1]
Total Phosphorus	8	10.3	10 [2]
Orthophosphate	6	0.0	10 [2]
Nitrate	3	44.3	10 [2]
Ammonia	10	8.2	10 [2]

[1] Target precision as listed in QAPP

[2] 10% CV target was listed for all nutrients

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, 509 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 313 of the significant trends, or 61.5 percent. Negative or deleterious trends (e.g. reduced dissolved oxygen, increased nutrients) accounted for 196, or 38.5 percent of the significant trends. The implications of changes in pH for watercourses are not clear at this point, but 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. 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.

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 FC 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 2009-2019, 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.

Results

Table 4 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 4** 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 5 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 2019. Of these, four went missing or were not recoverable, two were out of the water for all of August due to abnormally low watercourse levels, and one was found damaged and had stopped recording at the end of June. The remaining 16 dataloggers were retrieved and their data analyzed. Of these, four of the sites recorded 7DADMax values passing state standards (**Table 5**). Temperature dataloggers are generally not deployed in agricultural drainage ditches.

Trends analyses reveal that in comparison to 16 years ago, at the start of this program, ten sites have shown an increase in temperature and one site has shown a decrease (**Figure 2**). Of these ten sites showing an increase, there is a notable concentration in the Nookachamps watershed. Looking at the map of trends from the most recent ten years (**Figure 3**), seven sites show an increase, while no sites show a decrease. These seven sites are located in the northern half of the county.

Trends from the most recent five years of data (**Figure 4**) show 24 sites significantly decreasing in temperature, with no sites showing a significant increase. A concentration of sites not showing this decreasing trend seem to be sites up the canyon and scattered throughout the Samish and Padilla watersheds. This observation seems to correlate well with the average annual air temperature dropping each year for the last five years, according to data from the Mount Vernon weather station provided by Washington State University's AgWeatherNet.

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

Table 4 – Maximum watercourse temperatures recorded from bi-weekly sampling

Site Number	Watercourse	Location	Highest daily temperature (°C)				
			2015	2016	2017	2018	2019
3	Thomas Creek	Old Hwy 99 North	20.1	19.6	19.2	18.4	17.8
4	Thomas Creek	F&S Grade Rd	16.6	15.9	15.3	14.9	14.8
6	Friday Creek	Prairie Rd	19.8	20.1	18.6	19.2	18.0
8	Swede Creek	Grip Rd	18.2	17.8	17.8	16.9	16.5
11	Samish River	State Route 9	14.6	14.1	13.5	13.2	13.6
12	Nookachamps Creek	Swan Rd	21.4	21.4	21.1	22.5	21.0
13	E.F. Nookachamps Creek	State Route 9	20.4	19.1	19.6	21.9	19.4
14	College Way Creek	College Way	18.0	17.7	17.3	19.0	16.7
15	Nookachamps Creek	Knapp Rd	21.8	21.8	22.0	22.7	20.1
16	E.F. Nookachamps Creek	Beaver Lake Rd	19.0	18.7	18.1	19.8	17.5
17	Nookachamps Creek	Big Lake Outlet	23.0	21.9	22.8	23.6	21.3
18	Lake Creek	State Route 9	17.2	16.3	16.3	18.1	16.4
19	Hansen Creek	Hoehn Rd	19.0	18.1	17.3	17.6	18.1
20	Hansen Creek	Northern State	15.6	15.3	15.3	15.4	14.9
21	Coal Creek	Hoehn Rd	16.9	16.1	15.7	15.2	15.6
22	Coal Creek	Hwy 20	15.5	14.6	15.3	15.2	15.3
23	Wiseman Creek	Minkler Rd	14.1	15.2	15.0	14.1	14.2
24	Mannser Creek	Lyman Ham. Hwy	12.5	12.1	12.5	11.9	12.5
25	Red Cabin Creek	Hamilton Cem. Rd	13.9	11.8	11.7	11.2	11.9
28	Brickyard Creek	Hwy 20	14.9	16.7	14.5	14.3	14.7
29	Skagit River	River Bend Rd	17.6	16.6	15.9	16.2	16.0
30	Skagit River	Cape Horn Rd	16.3	14.8	15.3	15.4	15.6
31	DD20 near floodgate	Francis Rd	13.7	15.2	10.8	ND	ND
32	Samish River	Thomas Rd	21.6	20.7	20.1	19.3	18.8
33	Alice Bay Pump Station	Samish Island Rd	25.9	23.4	22.7	25.0	22.1
34	No Name Slough	Bayview-Edison Rd	21.1	25.9	21.5	27.0	25.3
35	Joe Leary Slough	D'Arcy Rd	21.8	20.5	20.3	21.3	21.4
36	Edison Slough at school	W. Bow Hill Rd	30.1	27.6	27.0	30.2	28.3
37	Edison Pump Station	Farm to Market Rd	26.8	26.3	23.6	25.5	23.3
38	North Edison Pump Sta.	North Edison Rd	26.1	22.4	22.2	24.4	22.3
39	Colony Creek	Colony Rd	18.1	17.1	16.6	17.4	15.3
40	Big Indian Slough	Bayview-Edison Rd	18.7	17.3	19.4	19.5	18.3
41	Maddox/Big Ditch	Milltown Rd	22.0	21.4	22.4	21.7	21.4
42	Hill Ditch	Cedardale Rd	21.7	21.3	22.0	20.8	20.9
43	Wiley Slough	Wylie Rd	21.2	20.1	19.6	27.2	20.2
44	Sullivan Slough	La Conner-Whitney	19.6	18.1	20.0	18.3	16.7
45	Skagit River – N. Fork	Moore Rd	18.1	17.3	16.4	16.4	17.0
46	Skagit River – S. Fork	Fir Island Rd	18.3	17.7	16.7	16.7	17.0
47	Swinomish Channel	County Boat Launch	16.8	17.0	18.5	16.1	16.2
48	Fisher Creek	Franklin Rd	14.3	13.4	13.5	15.3	14.0

Data from biweekly site visits

Table 5 – Seven-day average of the daily maximum temperatures (7-DADMax)

Site Number	Watercourse	Location	7-DADMax (°C)				
			2015	2016	2017	2018	2019
3	Thomas Creek	Old Hwy 99 North	21.5	21.2	20.2	20.2	n/a
4	Thomas Creek	F&S Grade Rd	17.8	16.7	16.1	17.0	16.5
6	Friday Creek	Prairie Rd	22.9	21.6	n/a	22.6	21.3
8	Swede Creek	Grip Rd	20.4	18.4	17.6	19.0	17.8
11	Samish River	State Route 9	15.4	14.8	14.8	14.8	n/a
12	Nookachamps Creek	Swan Rd	n/a	23.5	22.9	23.5	23.5
13	E.F. Nookachamps Creek	State Route 9	23.3	20.8	20.5	21.7	n/a
14	College Way Creek	College Way	n/a	n/a	n/a	n/a	n/a
15	Nookachamps Creek	Knapp Rd	24.7	23.3	22.3	23.8	n/a
16	E.F. Nookachamps Creek	Beaver Lake Rd	23.4	21.2	20.8	22.2	20.1
17	Nookachamps Creek	Big Lake Outlet	27.1	25.2	25.5	26.5	n/a
18	Lake Creek	State Route 9	n/a	18.2	18.0	19.5	19.2
19	Hansen Creek	Hoehn Rd	21.2	21.1	19.0	20.1	19.7
20	Hansen Creek	Northern State	n/a	16.3	17.1	17.8	n/a
21	Coal Creek	Hoehn Rd	n/a	20.0	15.9	18.6	20.3
22	Coal Creek	Hwy 20	18.9	17.4	n/a	17.5	16.8
23	Wiseman Creek	Minkler Rd	n/a	n/a	n/a	n/a	n/a
24	Mannser Creek	Lyman Hamilton Hwy	14.2	17.2	13.9	13.7	13.4
25	Red Cabin Creek	Hamilton Cemetery Rd	n/a	n/a	n/a	n/a	n/a
28	Brickyard Creek	Hwy 20	n/a	n/a	n/a	n/a	n/a
29	Skagit River	River Bend Rd	n/a	n/a	n/a	n/a	n/a
30	Skagit River	Cape Horn Rd	17.1	15.2	11.9	n/a	17.1
31	DD 20 near floodgate	Francis Rd	n/a	n/a	n/a	n/a	n/a
32	Samish River	Thomas Rd	22.7	n/a	20.2	21.2	20.6
33	Alice Bay Pump Station	Samish Island Rd	n/a	n/a	n/a	n/a	n/a
34	No Name Slough	Bayview-Edison Rd	n/a	n/a	n/a	n/a	n/a
35	Joe Leary Slough	D'Arcy Rd	n/a	n/a	n/a	n/a	n/a
36	Edison Slough at school	W. Bow Hill Rd	n/a	n/a	n/a	n/a	n/a
37	Edison Pump Station	Farm to Market Rd	n/a	n/a	n/a	n/a	n/a
38	North Edison Pump Station	North Edison Rd	n/a	n/a	n/a	n/a	n/a
39	Colony Creek	Colony Rd	19.4	18.3	17.3	18.4	17.5
40	Big Indian Slough	Bayview-Edison Rd	n/a	n/a	n/a	n/a	n/a
41	Maddox Creek/Big Ditch	Milltown Rd	25.4	21.1	24.9	25.9	25.0
42	Hill Ditch	Cedardale Rd	27.3	25.9	25.7	25.9	24.9
43	Wiley Slough	Wylie Rd	n/a	n/a	n/a	n/a	n/a
44	Sullivan Slough	La Conner-Whitney Rd	n/a	n/a	n/a	n/a	n/a
45	Skagit River – North Fork	Moore Rd	n/a	18.7	17.7	19.4	n/a
46	Skagit River – South Fork	Fir Island Rd	n/a	n/a	n/a	n/a	n/a
47	Swinomish Channel	County Boat Launch	n/a	n/a	n/a	n/a	n/a
48	Fisher Creek	Franklin Rd	16.1	15.1	14.8	16.8	16.5

*Data from continuous temperature data loggers. Cells shaded green pass state standard.

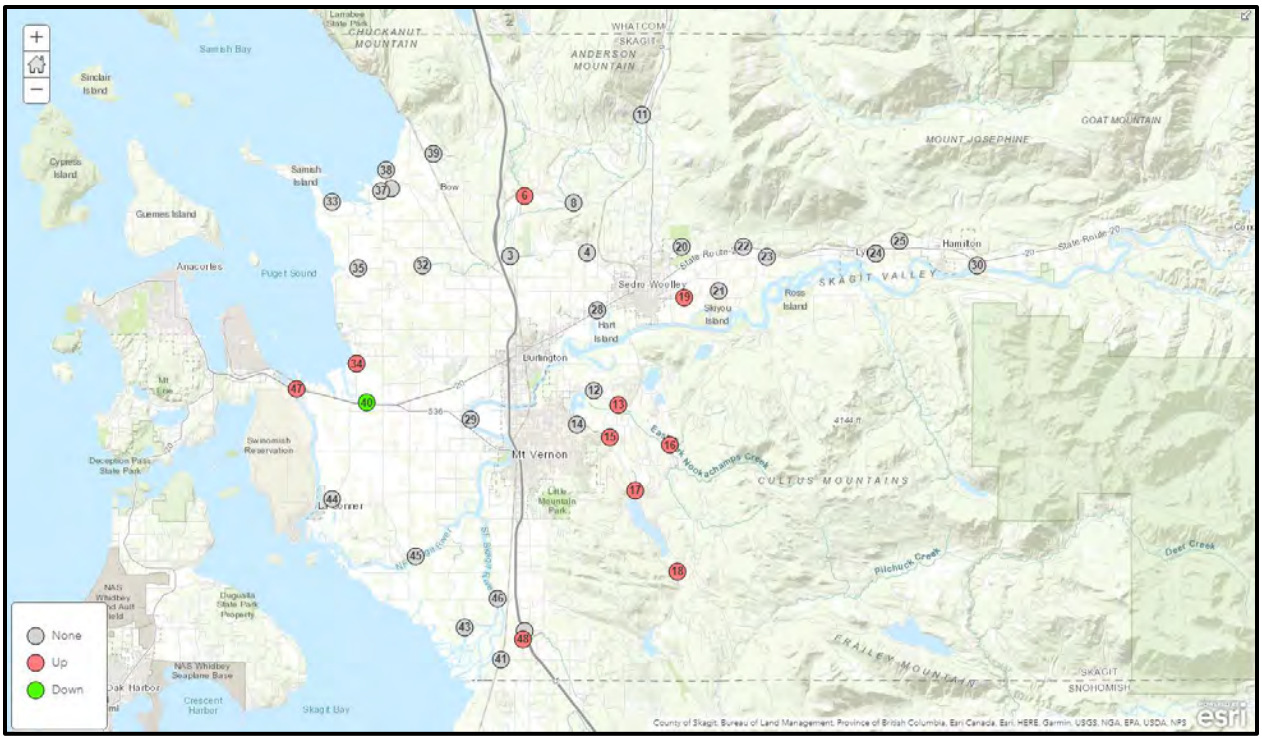


Figure 2 – Sixteen-year trends in watercourse temperatures

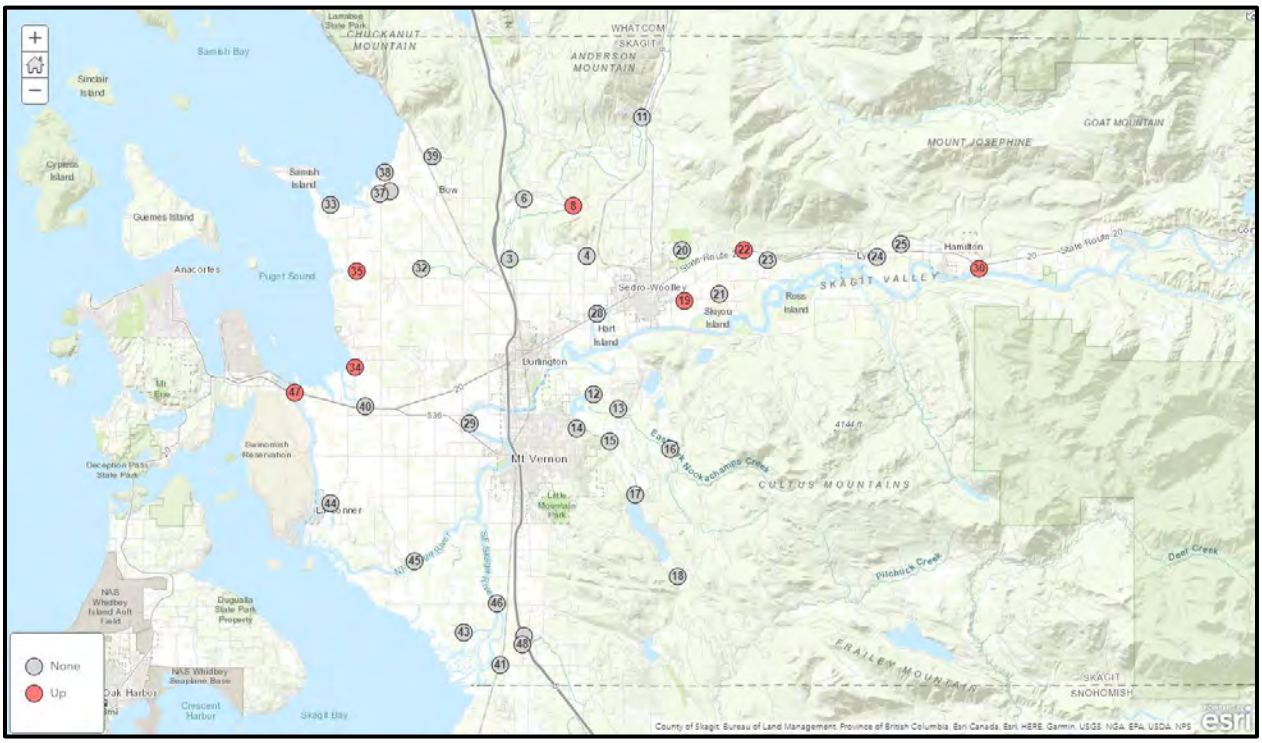


Figure 3 – Ten-year trends in watercourse temperatures

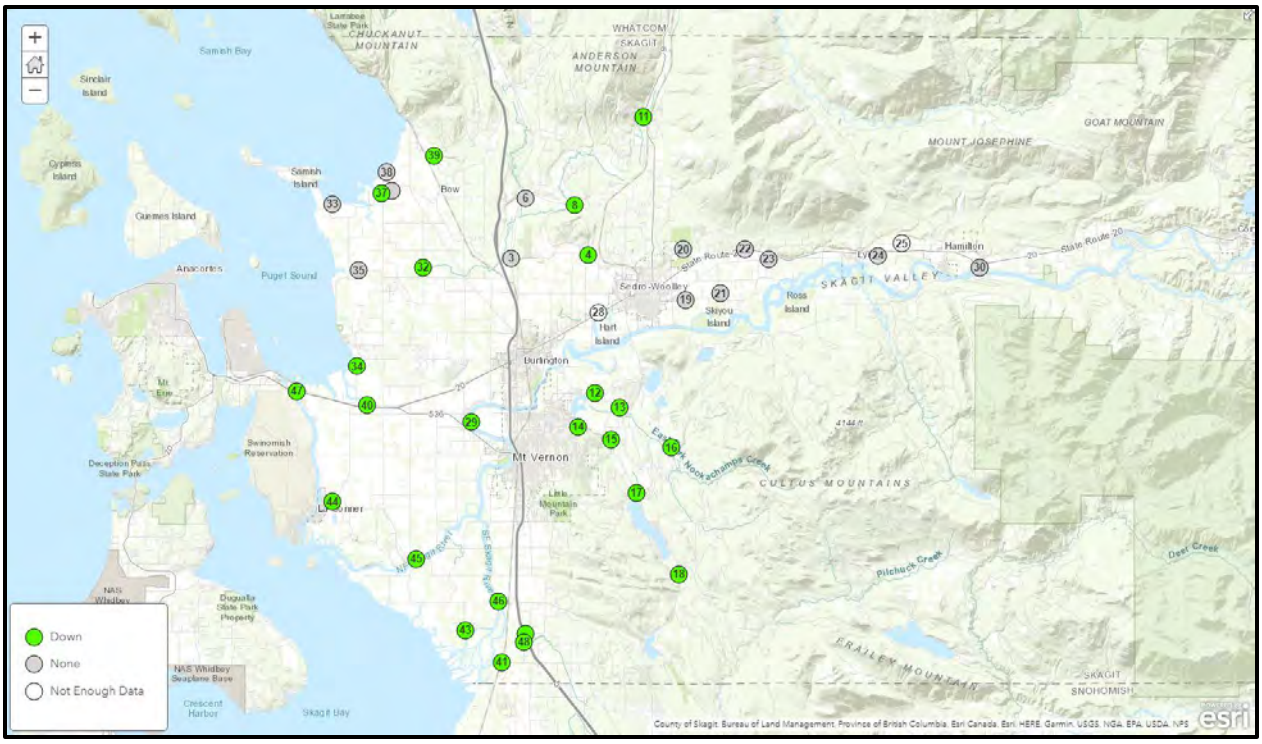


Figure 4 – Five-year trends in watercourse temperatures

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 2019 water year is provided in **Table 6**. A summary of data from the most recent five years of this program can be found in **Table 7**.

Eight sites met the oxygen standards for the entire 2019 water year, compared to eight in 2018. 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 16 years since the program began, 11 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 18 sites increasing DO levels, while only three are decreasing. These sites appear to be spread county-wide. In the most recent five years (**Figure 7**), trends show 22 sites increasing DO levels, while only one site (Site 3 – Thomas Creek) is 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 6 - Dissolved oxygen (DO) measurements for 2019 water year

Site Number	Watercourse	Location	Mean DO (mg/L)	Minimum DO (mg/L)	St. Std[1]
3	Thomas Creek	Old Hwy 99 N	5.82	0.16	8.0
4	Thomas Creek	F&S Grade Rd	11.46	8.49	8.0
6	Friday Creek	Prairie Rd	11.63	9.82	9.5
8	Swede Creek	Grip Rd	10.72	7.80	9.5
11	Samish River	State Route 9	9.03	7.38	9.5
12	Nookachamps Creek	Swan Rd	9.42	5.43	9.5
13	E.F. Nookachamps Creek	State Route 9	9.62	7.46	9.5
14	College Way Creek	College Way	9.78	6.17	9.5
15	Nookachamps Creek	Knapp Rd	8.34	1.08	9.5
16	E.F. Nookachamps Creek	Beaver Lake Rd	11.98	9.90	9.5
17	Nookachamps Creek	Big Lake Outlet	10.18	4.94	9.5
18	Lake Creek	State Route 9	11.31	8.62	9.5
19	Hansen Creek	Hoehn Rd	10.30	6.60	9.5
20	Hansen Creek	Northern State	11.52	9.25	9.5
21	Coal Creek	Hoehn Rd	11.55	7.87	9.5
22	Coal Creek	Hwy 20	11.77	9.96	9.5
23	Wiseman Creek	Minkler Rd	12.19	10.54	9.5
24	Mannser Creek	Lyman Hamilton Hwy	7.86	5.25	9.5
25	Red Cabin Creek	Hamilton Cem. Rd	12.16	10.84	9.5
28	Brickyard Creek	Hwy 20	9.54	6.46	8.0
29	Skagit River	River Bend Rd	11.05	8.72	9.5
30	Skagit River	Cape Horn Rd	11.34	9.22	9.5
31	Drain District 20 floodgate	Francis Rd	ND	ND	8.0
32	Samish River	Thomas Rd	11.19	9.31	8.0
33	Alice Bay Pump Station	Samish Island Rd	9.18	2.08	8.0
34	No Name Slough	Bayview-Edison Rd	7.03	0.14	8.0
35	Joe Leary Slough	D'Arcy Rd	5.56	3.35	8.0
36	Edison Slough at school	West Bow Hill Rd	8.86	2.95	8.0
37	Edison Pump Station	Farm to Market Rd	8.20	3.41	8.0
38	North Edison Pump Station	North Edison Rd	7.35	0.51	8.0
39	Colony Creek	Colony Rd	11.06	7.75	9.5
40	Big Indian Slough	Bayview-Edison Rd	5.07	1.65	8.0
41	Maddox Slough/Big Ditch	Milltown Rd	7.37	1.53	8.0
42	Hill Ditch	Cedardale Rd	8.54	3.36	9.5
43	Wiley Slough	Wylie Rd	4.77	0.48	8.0
44	Sullivan Slough	La Conner-Whitney	6.34	2.90	8.0
45	Skagit River – North Fork	Moore Rd	11.33	9.31	9.5
46	Skagit River – South Fork	Fir Island Rd	11.41	9.44	9.5
47	Swinomish Channel	County Boat Launch	8.80	7.13	6.0
48	Fisher Creek	Franklin Rd	11.55	9.69	9.5

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

Table 7 - Mean dissolved oxygen (DO) levels for the most recent five years

Site Number	Watercourse	Location	Mean Dissolved Oxygen (mg/L)				
			2015	2016	2017	2018	2019
3	Thomas Creek	Old Hwy 99 North	5.4	6.2	6.6	6.1	5.8
4	Thomas Creek	F&S Grade Rd	10.9	11.2	11.5	11.6	11.5
6	Friday Creek	Prairie Rd	10.8	11.4	11.8	11.6	11.6
8	Swede Creek	Grip Rd	10.3	10.4	10.6	10.8	10.7
11	Samish River	State Route 9	8.3	8.7	9.4	9.4	9.0
12	Nookachamps Creek	Swan Rd	8.0	9.1	8.4	9.0	9.4
13	E.F. Nookachamps Creek	State Route 9	9.0	9.9	10.0	10.0	9.6
14	College Way Creek	College Way	8.5	9.0	9.7	9.9	9.8
15	Nookachamps Creek	Knapp Rd	7.3	7.7	8.4	8.6	8.3
16	E.F. Nookachamps Creek	Beaver Lake Rd	10.7	11.3	11.7	11.7	12.0
17	Nookachamps Creek	Big Lake Outlet	9.1	9.6	10.2	10.4	10.2
18	Lake Creek	State Route 9	10.5	10.8	11.2	11.1	11.3
19	Hansen Creek	Hoehn Rd	9.8	10.2	10.4	10.3	10.3
20	Hansen Creek	Northern State	10.7	11.3	11.6	11.6	11.5
21	Coal Creek	Hoehn Rd	10.8	11.2	11.7	11.8	11.6
22	Coal Creek	Hwy 20	11.2	11.6	11.9	12.1	11.8
23	Wiseman Creek	Minkler Rd	11.8	11.6	12.3	12.2	12.2
24	Mannser Creek	Lyman Ham. Hwy	7.2	7.0	7.5	7.9	7.9
25	Red Cabin Creek	Hamilton Cem. Rd	11.4	12.1	12.3	12.2	12.2
28	Brickyard Creek	Hwy 20	8.8	9.2	10.2	10.4	9.5
29	Skagit River	River Bend Rd	10.6	11.0	11.4	11.4	11.1
30	Skagit River	Cape Horn Rd	10.9	11.2	11.7	11.5	11.3
31	DD20 near floodgate	Francis Rd	5.7	7.4	5.9	ND	ND
32	Samish River	Thomas Rd	10.4	10.9	11.4	10.9	11.2
33	Alice Bay Pump Station	Samish Island Rd	9.3	10.3	8.2	11.1	9.2
34	No Name Slough	Bayview-Edison Rd	6.6	7.6	7.8	8.0	7.0
35	Joe Leary Slough	D'Arcy Rd	5.3	5.4	5.0	5.6	5.6
36	Edison Slough at school	W. Bow Hill Rd	8.7	9.9	10.4	11.2	8.9
37	Edison Pump Station	Farm to Market Rd	6.0	8.6	8.3	7.9	8.2
38	N. Edison Pump Station	North Edison Rd	6.5	10.4	8.4	7.5	7.4
39	Colony Creek	Colony Rd	10.2	10.7	11.0	11.0	11.1
40	Big Indian Slough	Bayview-Edison Rd	4.3	4.1	4.7	5.4	5.1
41	Maddox/Big Ditch	Milltown Rd	5.7	7.8	6.6	7.1	7.4
42	Hill Ditch	Cedardale Rd	8.9	9.0	8.3	8.9	8.5
43	Wiley Slough	Wylie Rd	5.3	5.3	4.5	5.0	4.8
44	Sullivan Slough	La Conner-Whitney	6.7	6.2	7.5	6.3	6.3
45	Skagit River – North Fork	Moore Rd	10.7	11.0	11.5	11.6	11.3
46	Skagit River – South Fork	Fir Island Rd	10.8	11.3	11.4	11.6	11.4
47	Swinomish Channel	County Boat Launch	8.4	8.5	9.0	8.8	8.8
48	Fisher Creek	Franklin Rd	10.7	11.0	11.6	11.4	11.6

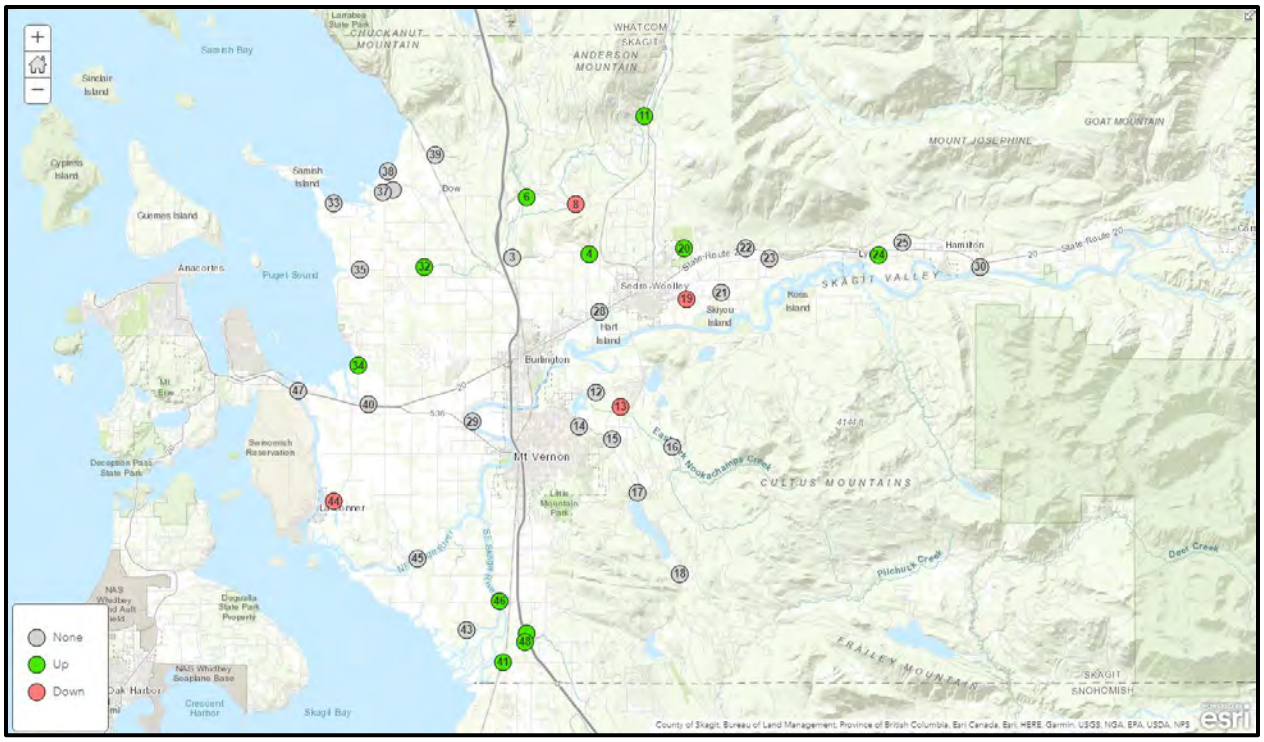


Figure 5 – Sixteen-year trends in dissolved oxygen (DO)

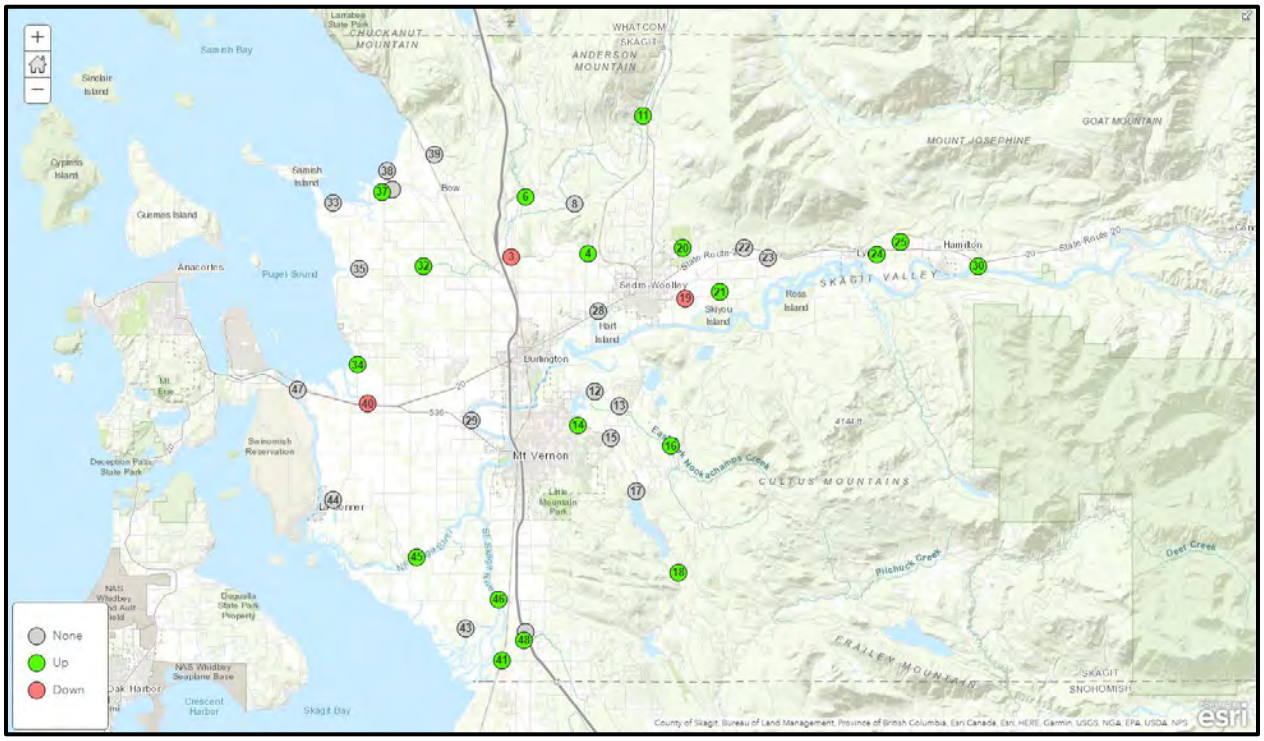


Figure 6 – Ten-year trends in dissolved oxygen (DO)

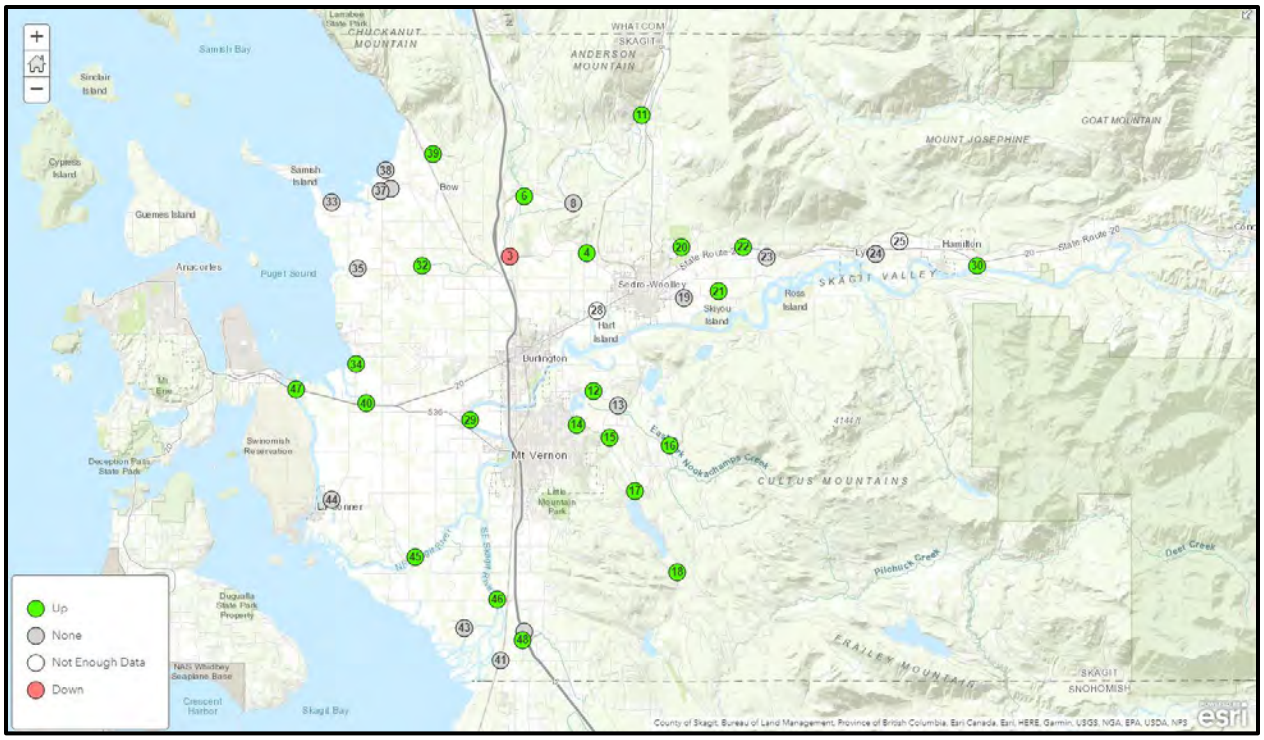


Figure 7 – Five-year trends in dissolved oxygen (DO)

Fecal Coliform (FC)

Fecal coliform is a measurement of 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 (2009-2019) for analysis by the 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.

The 2008 water year was marked by several incidents of high FC counts at County monitoring stations in the Samish Bay Watershed. Each incident was triggered by moderate to heavy rainfall. These high counts resulted in at least four closures of the Samish Bay shellfish beds to commercial harvest. The most serious incident resulted in a mandatory closure of Samish Bay in response to a sample count of 17,000 MPN/100 mL from the Samish River at Thomas Road on April 29, 2008.

The 2009, 2010, and 2011 water years saw continued high FC counts in the Samish River and elsewhere in the Samish Bay Watershed, and many additional closures of shellfish beds. County and Storm Team volunteer monitoring continued to document the relationship between high rainfall events and excess FC. This ongoing situation prompted Ecology to initiate the Clean Samish Initiative in 2009, a partnership of over 20 Federal, State, and County governmental organizations, as well as shellfish industry and non-profit groups. This effort is aimed at making immediate improvements in the Samish Bay Watershed.

Results

Fecal coliform measurements for the 2019 water year, in MPN of bacterial colonies per 100 ml, are summarized in **Table 8**. The geometric mean FC at each site for the last five years of this program can be found in **Table 9**.

For the 2019 water year, 16 sites met the standard based on ambient sampling for the entire water year, compared to the same total of 16 sites in 2018. 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 16 years since the program began, 11 sites have showed improvement through a decline in FC counts, while seven sites have showed 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, eight sites have shown improvement, while zero sites have shown deterioration (**Figure 9**). Improved sites have small clusters in the Nookachamps and South Skagit watersheds. In the most recent five years, four sites have shown improvement, while two sites (37 in Edison and 15 in Nookachamps) have shown significantly increased FC counts (**Figure 10**).

Table 8 - Fecal coliform (FC) results for 2019 water year (MPN/100ml)

Site Number	Watercourse	Location	n	Geometric mean (MPN)[1]	% > 100 or 200[1]
3	Thomas Creek	Old Hwy 99 N	24	50	13
4	Thomas Creek	F&S Grade Rd	24	131	42
6	Friday Creek	Prairie Rd	25	28	8
8	Swede Creek	Grip Rd	26	29	12
11	Samish River	State Route 9	26	11	0
12	Nookachamps Creek	Swan Rd	26	45	4
13	E.F. Nookachamps Creek	State Route 9	26	38	4
14	College Way Creek	College Way	26	113	42
15	Nookachamps Creek	Knapp Rd	26	64	47
16	E.F. Nookachamps Creek	Beaver Lake Rd	26	22	4
17	Nookachamps Creek	Big Lake Outlet	26	17	8
18	Lake Creek	State Route 9	26	41	12
19	Hansen Creek	Hoehn Rd	21	62	14
20	Hansen Creek	Northern State	26	37	15
21	Coal Creek	Hoehn Rd	19	63	16
22	Coal Creek	Hwy 20	26	11	23
23	Wiseman Creek	Minkler Rd	23	10	0
24	Mannser Creek	Lyman Hamilton Hwy	26	14	8
25	Red Cabin Creek	Hamilton Cemetery Rd	19	6	0
28	Brickyard Creek	Hwy 20	15	53	20
29	Skagit River	River Bend Rd	26	7	0
30	Skagit River	Cape Horn Rd	26	4	0
31	Drain. Dist. 20 floodgate	Francis Rd	ND	ND	ND
32	Samish River	Thomas Rd	26	58	12
33	Alice Bay Pump Station	Samish Island Rd	25	33	12
34	No Name Slough	Bayview-Edison Rd	20	48	15
35	Joe Leary Slough	D'Arcy Rd	26	93	23
36	Edison Slough at school	W. Bow Hill Rd	26	49	19
37	Edison Pump Station	Farm to Market Rd	24	188	50
38	N. Edison Pump Station	North Edison Rd	26	113	31
39	Colony Creek	Colony Rd	25	58	28
40	Big Indian Slough	Bayview-Edison Rd	20	47	15
41	Maddox/Big Ditch	Milltown Rd	26	46	15
42	Hill Ditch	Cedardale Rd	25	48	4
43	Wiley Slough	Wylie Rd	25	74	24
44	Sullivan Slough	La Conner-Whitney Rd	25	45	4
45	Skagit River – North Fork	Moore Rd	26	4	0
46	Skagit River – South Fork	Fir Island Rd	26	9	4
47	Swinomish Channel	County Boat Launch	25	4	0
48	Fisher Creek	Franklin Rd	26	56	19

[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 9 - Geometric mean FC results for most recent five years (MPN/100ml)

Site Number	Watercourse	Location	2015	2016	2017	2018	2019
3	Thomas Creek	Old Hwy 99 N	46	49	63	47	50
4	Thomas Creek	F&S Grade Rd	133	138	107	138	131
6	Friday Creek	Prairie Rd	36	34	29	39	28
8	Swede Creek	Grip Rd	63	59	40	53	29
11	Samish River	State Route 9	13	26	14	12	11
12	Nookachamps Creek	Swan Rd	107	65	79	56	45
13	E.F. Nookachamps Creek	State Route 9	64	59	41	22	38
14	College Way Creek	College Way	148	106	172	83	113
15	Nookachamps Creek	Knapp Rd	93	54	62	63	64
16	E.F. Nookachamps Creek	Beaver Lake Rd	25	44	28	22	22
17	Nookachamps Creek	Big Lake Outlet	23	16	12	14	17
18	Lake Creek	State Route 9	41	50	24	26	41
19	Hansen Creek	Hoehn Rd	71	114	53	57	62
20	Hansen Creek	Northern State	45	35	50	48	37
21	Coal Creek	Hoehn Rd	91	84	53	65	63
22	Coal Creek	Hwy 20	19	22	18	13	11
23	Wiseman Creek	Minkler Rd	7	12	10	18	10
24	Mannser Creek	Lyman Hamilton Hwy	17	12	15	13	14
25	Red Cabin Creek	Hamilton Cemetery Rd	12	6	12	5	6
28	Brickyard Creek	Hwy 20	34	33	42	45	53
29	Skagit River	River Bend Rd	10	14	9	9	7
30	Skagit River	Cape Horn Rd	5	6	3	5	4
31	Drainage District 20 floodgate	Francis Rd	83	15	21	ND	ND
32	Samish River	Thomas Rd	50	54	48	41	58
33	Alice Bay Pump Station	Samish Island Rd	27	54	30	24	33
34	No Name Slough	Bayview-Edison Rd	171	71	65	59	48
35	Joe Leary Slough	D'Arcy Rd	63	98	91	108	93
36	Edison Slough at school	W. Bow Hill Rd	105	120	97	56	49
37	Edison Pump Station	Farm to Market Rd	166	386	317	214	188
38	North Edison Pump Station	North Edison Rd	222	264	148	148	113
39	Colony Creek	Colony Rd	91	76	57	61	58
40	Big Indian Slough	Bayview-Edison Rd	119	29	43	81	47
41	Maddox Slough/Big Ditch	Milltown Rd	123	61	87	52	46
42	Hill Ditch	Cedardale Rd	104	43	42	51	48
43	Wiley Slough	Wylie Rd	109	106	68	82	74
44	Sullivan Slough	La Conner-Whitney Rd	179	157	127	67	45
45	Skagit River – North Fork	Moore Rd	7	6	7	8	4
46	Skagit River – South Fork	Fir Island Rd	12	9	13	13	9
47	Swinomish Channel	County Boat Launch	5	6	6	6	4
48	Fisher Creek	Franklin Rd	96	92	69	78	56

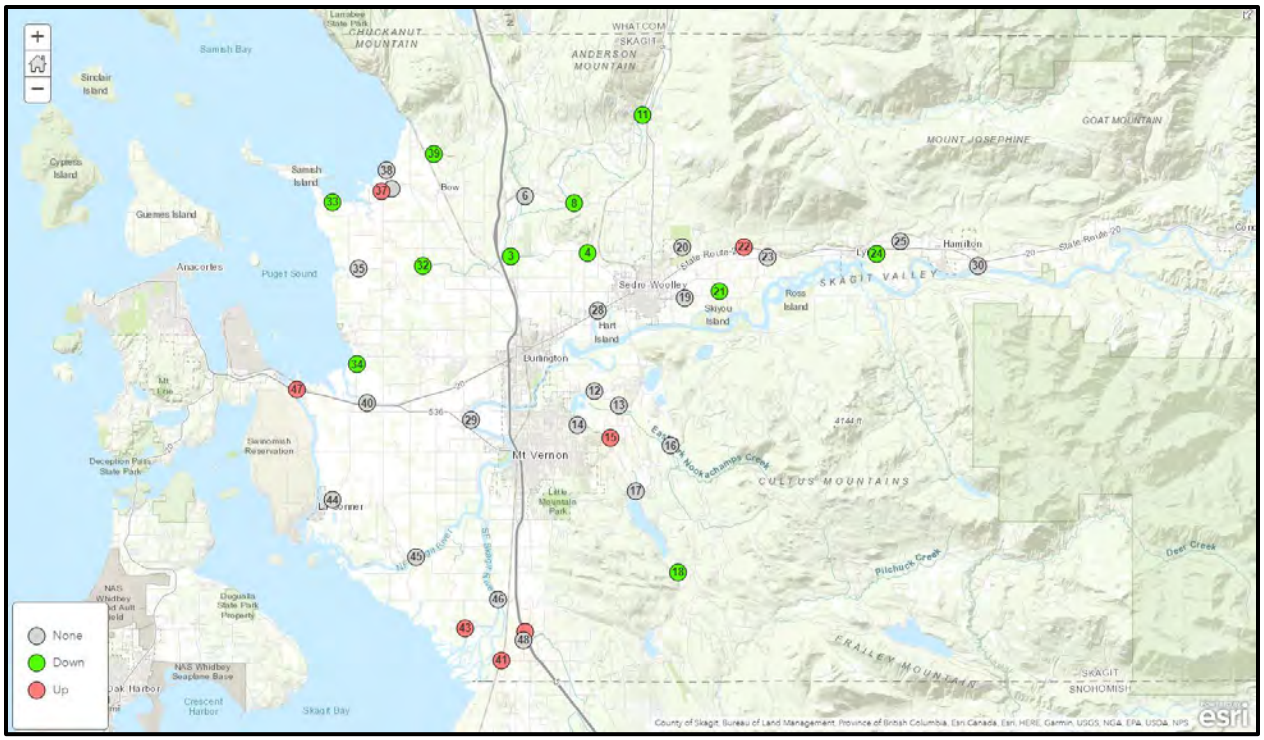


Figure 8 – Sixteen-year trends in fecal coliform (FC)

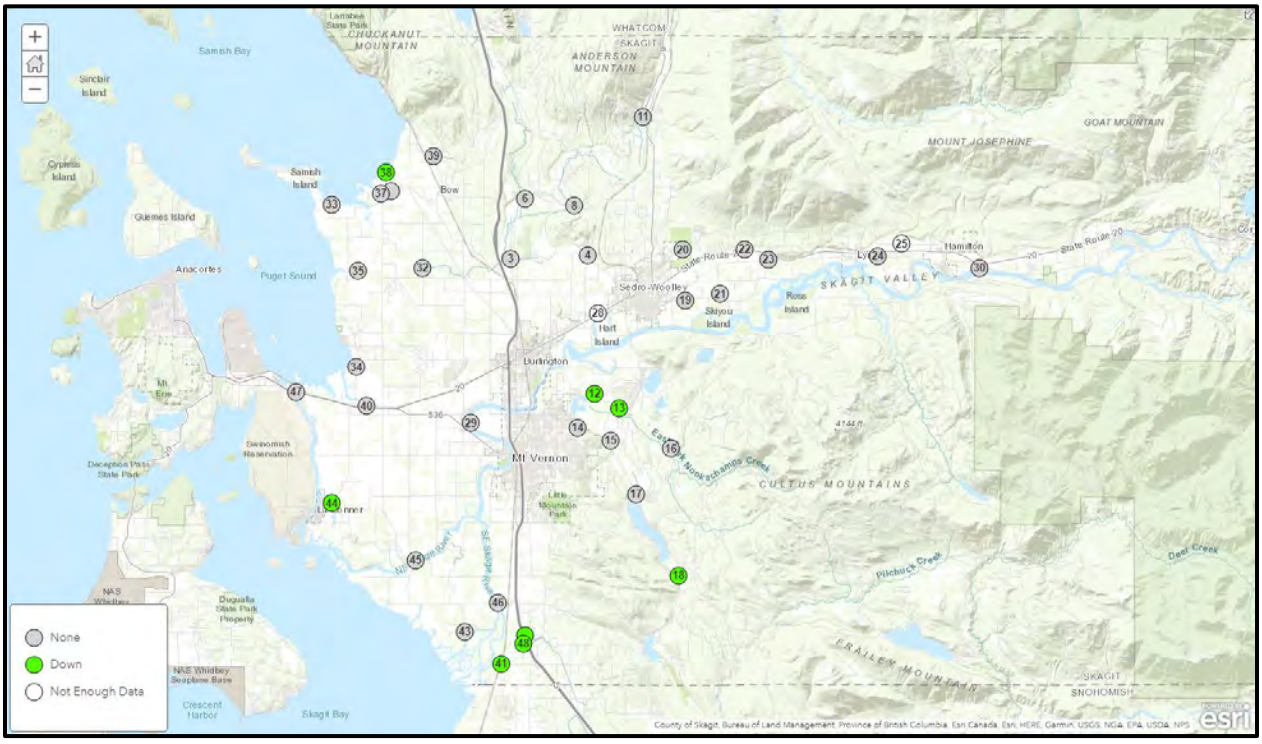


Figure 9 – Ten-year trends in fecal coliform (FC)

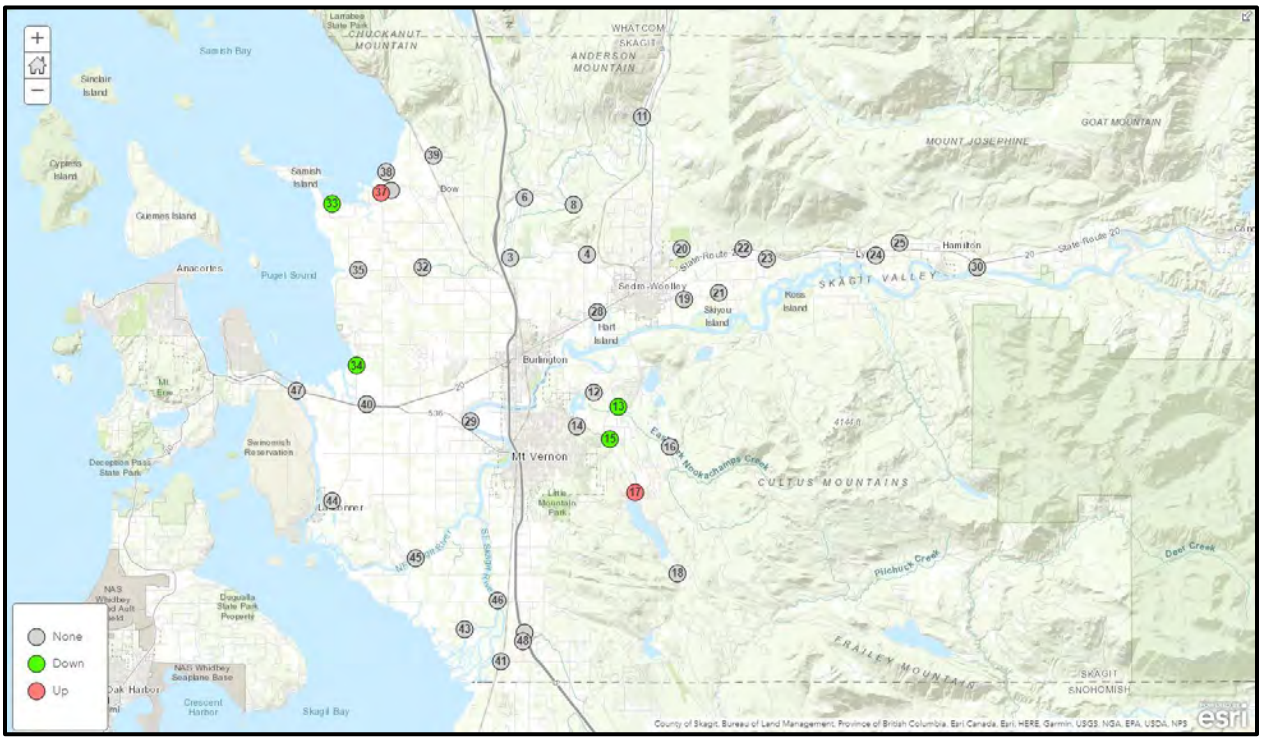


Figure 10 – Five-year trends in fecal coliform (FC)

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.

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) is evidence that the data is still accurately representing the condition of these watercourses over time, even if it is taken less frequently than what may be considered optimal.

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 would show statistically significant increases in this nutrient on a map.

Table 10 gives mean nutrient values for selected parameters for the 2019 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 16-year dataset, representing the entire length of this program's monitoring:

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

Total Phosphorous shows an increase at ten sites, and a decrease in zero sites, and is occurring almost entirely in sloughs (**Figure 12**).

Ortho-phosphorous shows an increase at 12 sites, and a decrease in zero sites, spread a little more uniformly around the county than total phosphorous (**Figure 13**).

Ammonia levels have gone down at 15 sites around the county, have increased at zero sites, and the trends appear to be occurring all across the valley (**Figure 14**).

Nitrate + Nitrite levels have decreased at ten sites across the county, concentrated in the north and east, and have increased at two sites, on the west edge of the valley (**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 28 positive trends, or decreases, and 25 negative trends, or increases, with 22 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 the only thing required to trigger an algal bloom.

Table 10 - Mean nutrient values (mg/l) for 2019 water year

Site Number	Watercourse	Location	Total Nitrogen [1]	Total Phosphorus	Ammonia	Nitrate + Nitrite
3	Thomas Creek	Old Hwy 99 N	0.62	0.08	0.03	0.43
4	Thomas Creek	F&S Grade Rd	0.42	0.06	0.02	0.84
6	Friday Creek	Prairie Rd	0.36	0.02	0.01	0.34
8	Swede Creek	Grip Rd	0.49	0.05	0.01	0.28
11	Samish River	State Route 9	0.27	0.02	0.02	0.24
12	Nookachamps Creek	Swan Rd	0.32	0.03	0.02	0.15
13	E.F. Nookachamps Creek	State Route 9	0.33	0.02	0.02	0.20
14	College Way Creek	College Way	0.44	0.05	0.02	0.43
15	Nookachamps Creek	Knapp Rd	0.43	0.13	0.13	0.19
16	E.F. Nookachamps Creek	Beaver Lake Rd	0.25	0.01	0.01	0.23
17	Nookachamps Creek	Big Lake Outlet	0.30	0.03	0.03	0.18
18	Lake Creek	State Route 9	0.24	0.02	0.01	0.34
19	Hansen Creek	Hoehn Rd	0.30	0.03	0.02	0.30
20	Hansen Creek	Northern State	0.30	0.02	0.01	0.42
21	Coal Creek	Hoehn Rd	0.43	0.03	0.04	1.29
22	Coal Creek	Hwy 20	0.32	0.03	0.01	1.05
23	Wiseman Creek	Minkler Rd	0.33	0.03	0.01	0.83
24	Mannser Creek	Lyman Hamilton Hwy	0.36	0.06	0.02	0.18
25	Red Cabin Creek	Hamilton Cem. Rd	0.25	0.02	0.06	0.35
28	Brickyard Creek	Hwy 20	0.49	0.04	0.02	0.37
29	Skagit River	River Bend Rd	0.25	0.06	0.01	0.05
30	Skagit River	Cape Horn Rd	0.29	0.03	0.01	0.06
31	Drain. Dist. 20 floodgate	Francis Rd	ND	ND	ND	ND
32	Samish River	Thomas Rd	0.29	0.03	0.02	0.46
33	Alice Bay Pump Station	Samish Island Rd	2.38	0.47	1.27	1.38
34	No Name Slough	Bayview-Edison Rd	1.07	0.90	0.11	0.33
35	Joe Leary Slough	D'Arcy Rd	0.90	0.15	0.41	0.72
36	Edison Slough at school	W. Bow Hill Rd	0.96	0.56	0.09	0.19
37	Edison Pump Station	Farm to Market Rd	2.15	0.95	1.08	0.74
38	N. Edison Pump Station	North Edison Rd	2.30	1.44	2.18	0.37
39	Colony Creek	Colony Rd	0.43	0.13	0.09	0.67
40	Big Indian Slough	Bayview-Edison Rd	0.83	0.19	0.28	0.84
41	Maddox/Big Ditch	Milltown Rd	0.98	0.20	0.24	0.86
42	Hill Ditch	Cedardale Rd	0.30	0.06	0.02	0.34
43	Wiley Slough	Wylie Rd	1.11	0.13	0.28	1.31
44	Sullivan Slough	La Conner-Whitney	1.10	0.18	0.62	0.72
45	Skagit River – North Fork	Moore Rd	0.25	0.04	0.01	0.05
46	Skagit River – South Fork	Fir Island Rd	0.25	0.05	0.02	0.06
47	Swinomish Channel	County Boat Launch	0.27	0.07	0.05	0.20
48	Fisher Creek	Franklin Rd	0.49	0.28	0.02	0.44

[1]Total Kjeldahl Nitrogen

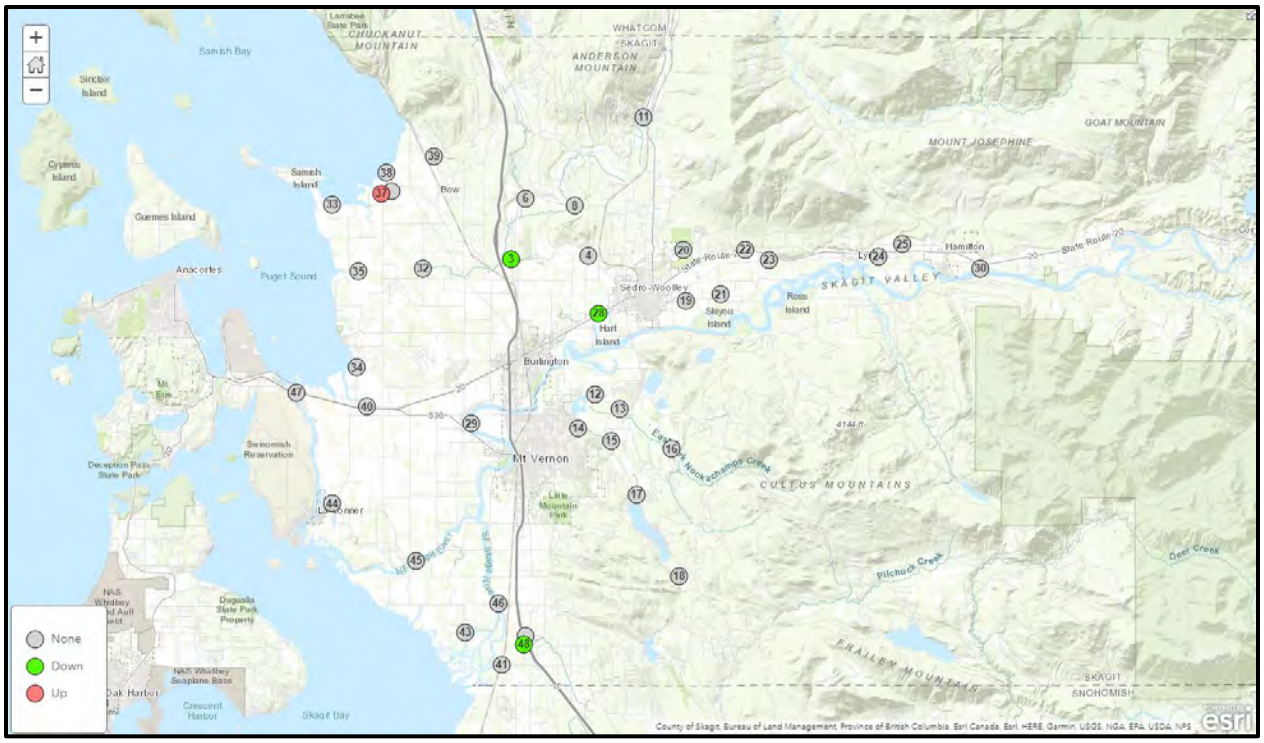


Figure 11 – Sixteen-year trends in Total Kjeldahl Nitrogen (TKN)

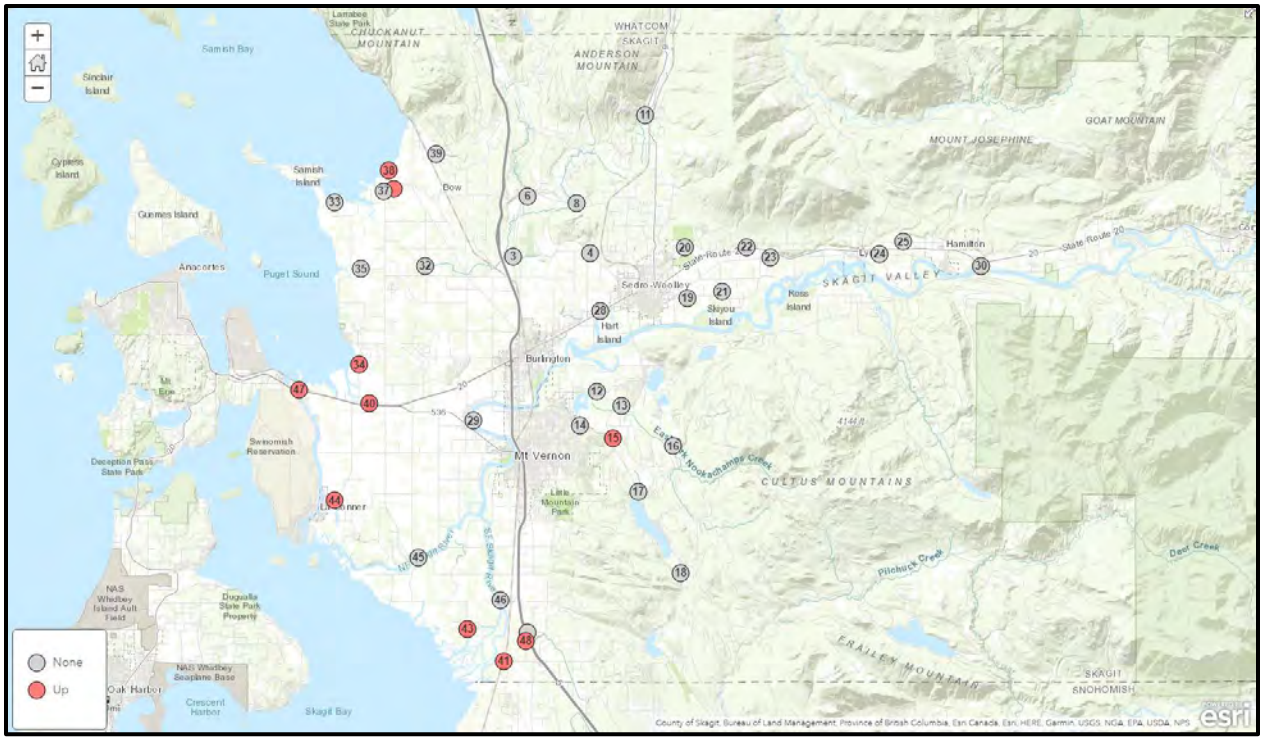


Figure 12 – Sixteen-year trends in Total Phosphorous (TP)

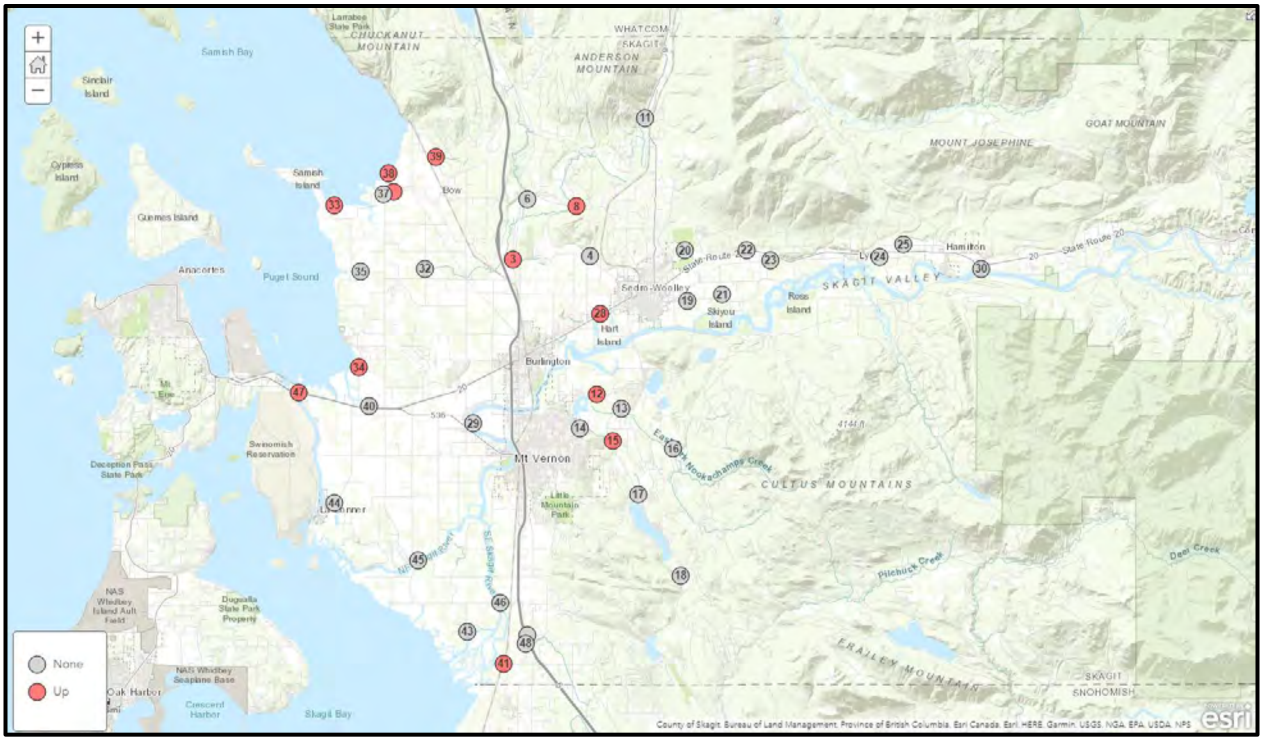


Figure 13 – Sixteen-year trends in Ortho-phosphorous (OP)

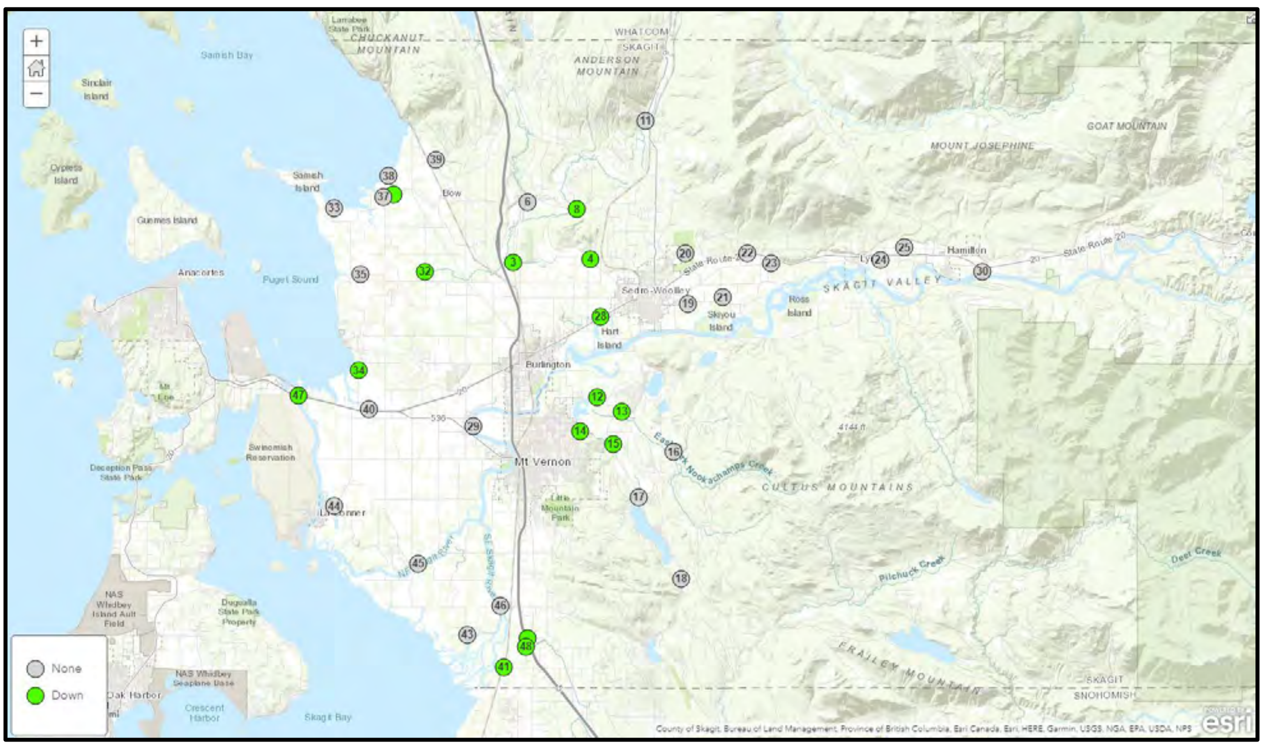


Figure 14 – Sixteen-year trends in Ammonia (NH3)

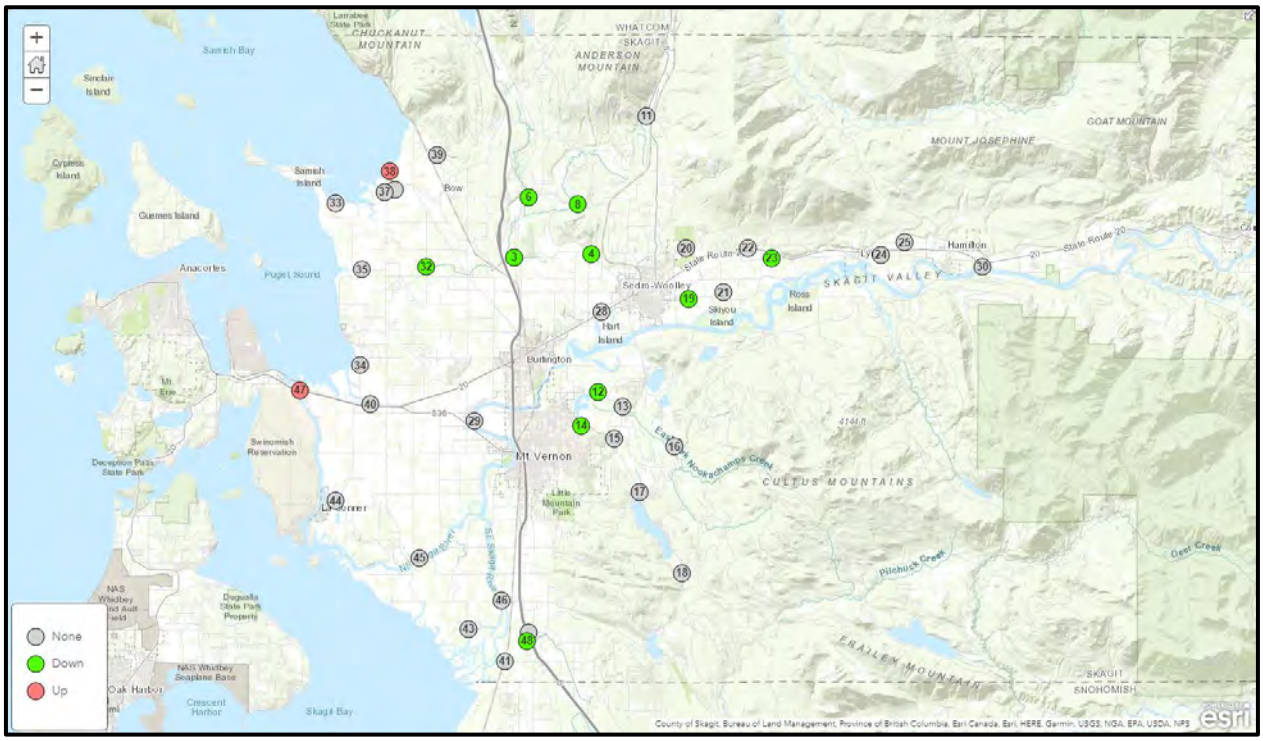


Figure 15 – Sixteen-year trends in Nitrate and Nitrite (NO3 + NO2)

Other Parameters

The SCMP also measures pH, conductivity, and salinity during each visit to each site. Conductivity and salinity are measured to help interpret other water quality parameters. 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 our area, Skagit County has de-emphasized performing manual discharge measurement.

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

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

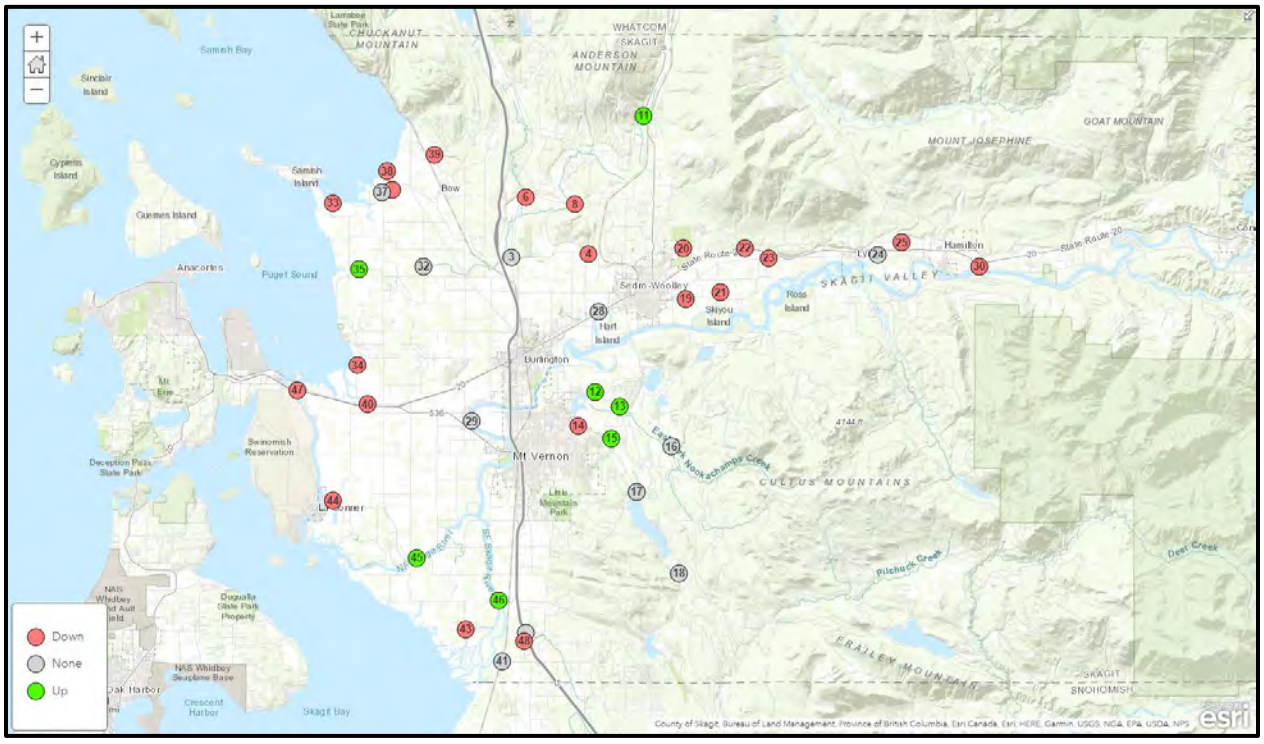


Figure 16 – Sixteen-year trends in pH

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 16-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 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 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 11 - Summary Statistics of Significant Trends, by Positive/Negative

Site		Significant Trends				Category
		Total	Positive	Negative	% Positive	
Samish River	11	16	16	0	100	Ag - Up
Samish River	32	19	17	2	89	Ag - Down
Thomas Creek	4	18	16	2	89	Ag - Up
Skagit River	46	14	12	2	86	Skagit - Low
Hansen Creek	20	12	10	2	83	Ag - Up
Skagit River	45	12	10	2	83	Skagit - Low
EF Nookachamps	16	12	9	3	75	Ag - Mid
Fisher Creek	48	20	15	5	75	Ag - Down
Nookachamps Creek	15	15	11	4	73	Ag - Mid
Alice Bay Pump	33	11	8	3	73	Ag - Down
College Way Creek	14	14	10	4	71	Ref - Urban
Mannser Creek	24	14	10	4	71	Ag - Mid
Coal Creek	21	10	7	3	70	Ag - Down
Lake Creek	18	13	9	4	69	Ag - Up
Nookachamps Creek	12	15	10	5	67	Ag - Down
No Name Slough	34	24	16	8	67	Ag - Down
Friday Creek	6	17	11	6	65	Ref - RR
EF Nookachamps	13	17	11	6	65	Ag - Down
Skagit River	30	14	9	5	64	Skagit - Up
Wiseman Creek	23	8	5	3	63	Ag - Up
Maddox/Big Ditch	41	18	11	7	61	Ag - Down
Hill Ditch/Carpenter	42	15	9	6	60	Ag - Down
Thomas Creek	3	14	8	6	57	Ag- Down
Joe Leary Slough	35	7	4	3	57	Ag - Down
Colony Creek	39	9	5	4	56	Ag - Down
Swede Creek	8	16	8	8	50	Ag - Down
Red Cabin Creek	25	10	5	5	50	Ref - RR
Brickyard Creek	28	4	2	2	50	Ref - Urban
Skagit River	29	8	4	4	50	Skagit - Mid
Big Indian Slough	40	12	6	6	50	Ag - Mid
Nookachamps Creek	17	11	5	6	45	Ag - Up
N. Edison Pump	38	11	5	6	45	Ag - Down
Edison Slough	36	8	3	5	38	Ag - Down
Sullivan Slough	44	11	4	7	36	Ag - Down
S. Edison Pump	37	10	3	7	30	Ag - Down
Coal Creek	22	11	3	8	27	Ag - Up
Wiley Slough	43	9	2	7	22	Ag - Down
Swinomish Channel	47	17	3	14	18	Ref - Marine
Hansen Creek	19	13	1	12	8	Ag - Down

Table 12 - Summary Statistics of Significant Trends, by Total Count

Site		Significant Trends				Category
		Total	Positive	Negative	% Positive	
No Name Slough	34	24	16	8	67	Ag - Down
Fisher Creek	48	20	15	5	75	Ag - Down
Samish River	32	19	17	2	89	Ag - Down
Thomas Creek	4	18	16	2	89	Ag - Up
Maddox/Big Ditch	41	18	11	7	61	Ag - Down
Friday Creek	6	17	11	6	65	Ref - RR
EF Nookachamps	13	17	11	6	65	Ag - Down
Swinomish Channel	47	17	3	14	18	Ref - Marine
Swede Creek	8	16	8	8	50	Ag - Down
Samish River	11	16	16	0	100	Ag - Up
Nookachamps Creek	12	15	10	5	67	Ag - Down
Nookachamps Creek	15	15	11	4	73	Ag - Mid
Hill Ditch/Carpenter	42	15	9	6	60	Ag - Down
Thomas Creek	3	14	8	6	57	Ag- Down
College Way Creek	14	14	10	4	71	Ref - Urban
Mannser Creek	24	14	10	4	71	Ag - Mid
Skagit River	30	14	9	5	64	Skagit - Up
Skagit River	46	14	12	2	86	Skagit - Low
Lake Creek	18	13	9	4	69	Ag - Up
Hansen Creek	19	13	1	12	8	Ag - Down
EF Nookachamps	16	12	9	3	75	Ag - Mid
Hansen Creek	20	12	10	2	83	Ag - Up
Big Indian Slough	40	12	6	6	50	Ag - Mid
Skagit River	45	12	10	2	83	Skagit - Low
Nookachamps Creek	17	11	5	6	45	Ag - Up
Coal Creek	22	11	3	8	27	Ag - Up
Alice Bay Pump	33	11	8	3	73	Ag - Down
N. Edison Pump	38	11	5	6	45	Ag - Down
Sullivan Slough	44	11	4	7	36	Ag - Down
Coal Creek	21	10	7	3	70	Ag - Down
Red Cabin Creek	25	10	5	5	50	Ref - RR
S. Edison Pump	37	10	3	7	30	Ag - Down
Colony Creek	39	9	5	4	56	Ag - Down
Wiley Slough	43	9	2	7	22	Ag - Down
Wiseman Creek	23	8	5	3	63	Ag - Up
Skagit River	29	8	4	4	50	Skagit - Mid
Edison Slough	36	8	3	5	38	Ag - Down
Joe Leary Slough	35	7	4	3	57	Ag - Down
Brickyard Creek	28	4	2	2	50	Ref - Urban

Water Quality Index (WQI)

The Water Quality Index is an indicator 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, unit-less 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 13,** and are mapped geographically in **Figure 17**. WQI scores over the length of this program are categorized for the years 2009-2019 in **Table 14**. 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 13 - Water Quality Index (WQI) results for the 2019 Water Year

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

Site Number	Watercourse	Location	Mean WQI	Overall Score*	Max	Min
3	Thomas Creek	Old Hwy 99 N	49	37	88	1
4	Thomas Creek	F&S Grade Rd	73	65	96	38
6	Friday Creek	Prairie Rd	89	87	98	81
8	Swede Creek	Grip Rd	69	59	97	30
11	Samish River	State Route 9	85	81	96	62
12	Nookachamps Creek	Swan Rd	77	72	94	41
13	E.F. Nookachamps Creek	State Route 9	80	74	98	52
14	College Way Creek	College Way	63	54	92	15
15	Nookachamps Creek	Knapp Rd	42	27	86	1
16	E.F. Nookachamps Creek	Beaver Lake Rd	90	87	98	84
17	Nookachamps Creek	Big Lake Outlet	72	65	96	44
18	Lake Creek	State Route 9	85	82	94	74
19	Hansen Creek	Hoehn Rd	76	73	60	79
20	Hansen Creek	Northern State	88	85	98	75
21	Coal Creek	Hoehn Rd	79	74	95	47
22	Coal Creek	Hwy 20	84	79	98	66
23	Wiseman Creek	Minkler Rd	96	89	98	76
24	Mannser Creek	Lyman Hamilton Hwy	55	47	77	32
25	Red Cabin Creek	Hamilton Cem. Rd.	91	91	99	79
28	Brickyard Creek	Hwy 20	89	85	93	85
29	Skagit River	River Bend Rd	85	81	96	76
30	Skagit River	Cape Horn Rd	95	93	99	87
31	Drain Dist 20 Floodgate	Francis Rd	ND	ND	ND	ND
32	Samish River	Thomas Rd	92	91	97	84
33	Alice Bay Pump Station	Samish Island Rd	39	16	67	1
34	No Name Slough	Bayview-Edison Rd	36	27	66	1
35	Joe Leary Slough	D'Arcy Rd	19	15	26	13
36	Edison Slough	W. Bow Hill Rd	52	45	72	34
37	Edison Pump Station	Farm to Market Rd	13	11	19	1
38	N. Edison Pump Station	North Edison Rd	10	5	16	1
39	Colony Creek	Colony Rd	68	58	97	24
40	Big Indian Slough	Bayview-Edison Rd	23	16	54	16
41	Maddox Slough/Big Ditch	Milltown Rd	39	33	57	12
42	Hill Ditch	Cedardale Rd	77	73	88	64
43	Wiley Slough	Wylie Rd	34	26	56	1
44	Sullivan Slough	La Conner-Whitney	42	32	72	2
45	Skagit River – North Fork	Moore Rd	91	88	98	86
46	Skagit River – South Fork	Fir Island Rd	89	86	97	81
47	Swinomish Channel	County Boat Launch	84	80	95	74
48	Fisher Creek	Franklin Rd	88	87	93	84

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

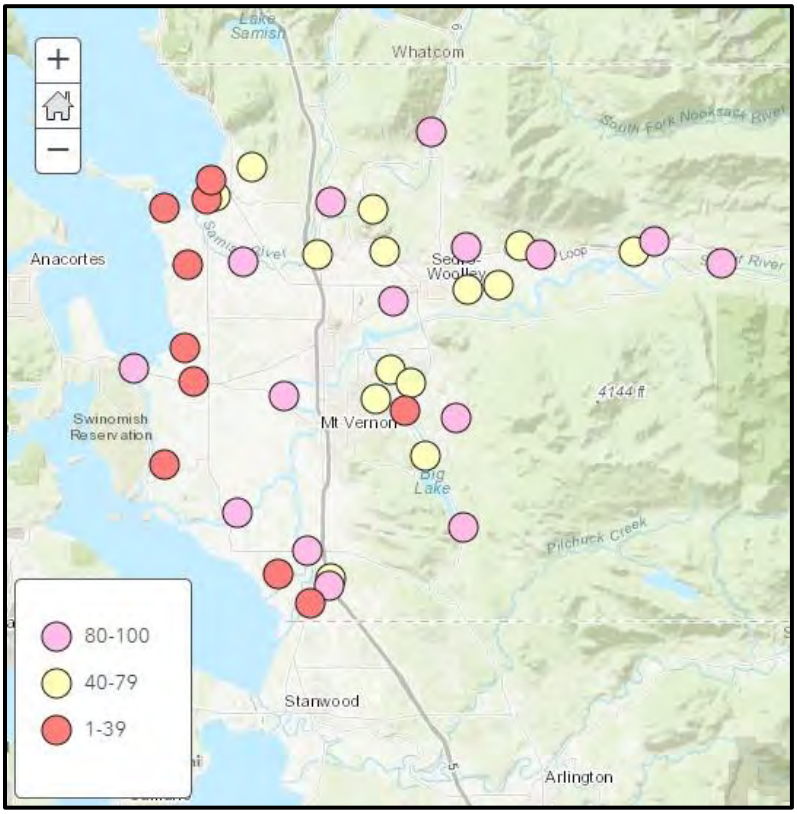


Figure 17 - Color coded map of 2019 WQI results

Table 14 - 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

*39 sites sampled in 2018 and 2019

Site Report Cards (SRCs)

Tables and maps on the following pages report results from the SCMP for DO, temperature, and FC. Please note that each graph within a series may have a different Y-axis scale due to differences in magnitude between sample sites. Full data listings for each sampling event at each sample site are included in Appendix A. A summary of water quality results for each sample site 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. Detailed descriptive statistics are included in the summary tables and in Appendix B. Results of the Trends Analysis are described in the Data Analysis section that follows the Data Summary.

Note that the y-axes on the graphs in this section are not all equivalent. The y-axes 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 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.

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

3

Thomas Creek
@ Highway 99

Downstream Ag

Water Quality Index (WQI)													
2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
1	20	14	31	49	58	41	60	41	45	53	41	30	37

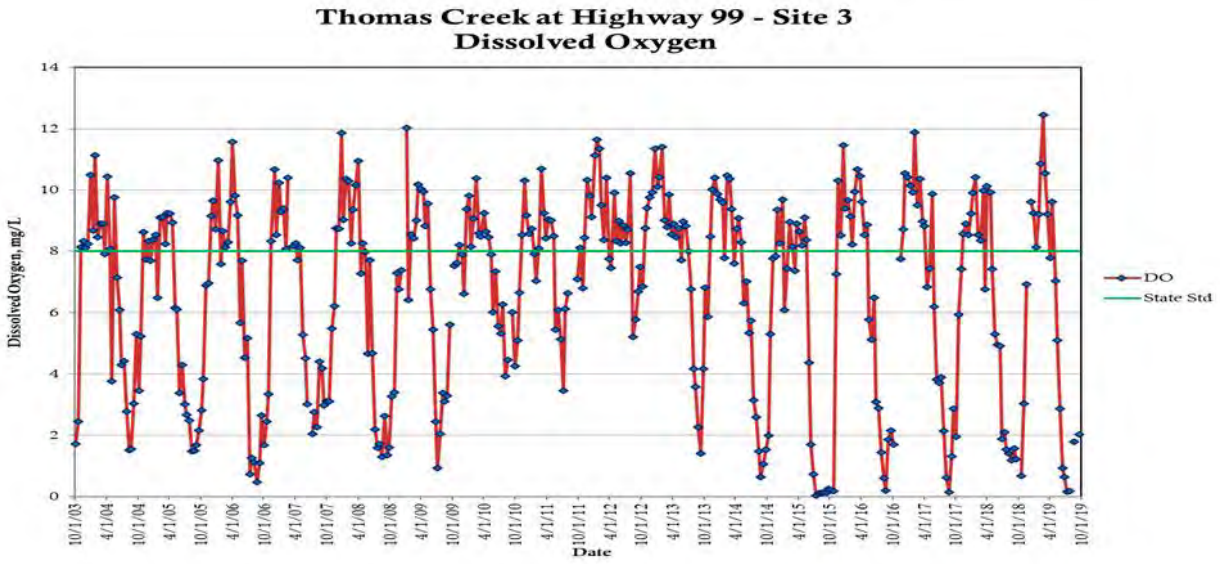
Long Term Trends								
Dissolved Oxygen			Temperature			Fecal Coliform		
16 yr	10 yr	5 yr	16 yr	10 yr	5 yr	16 yr	10 yr	5 yr
—	↓	↓	—	—	—	↓	—	—

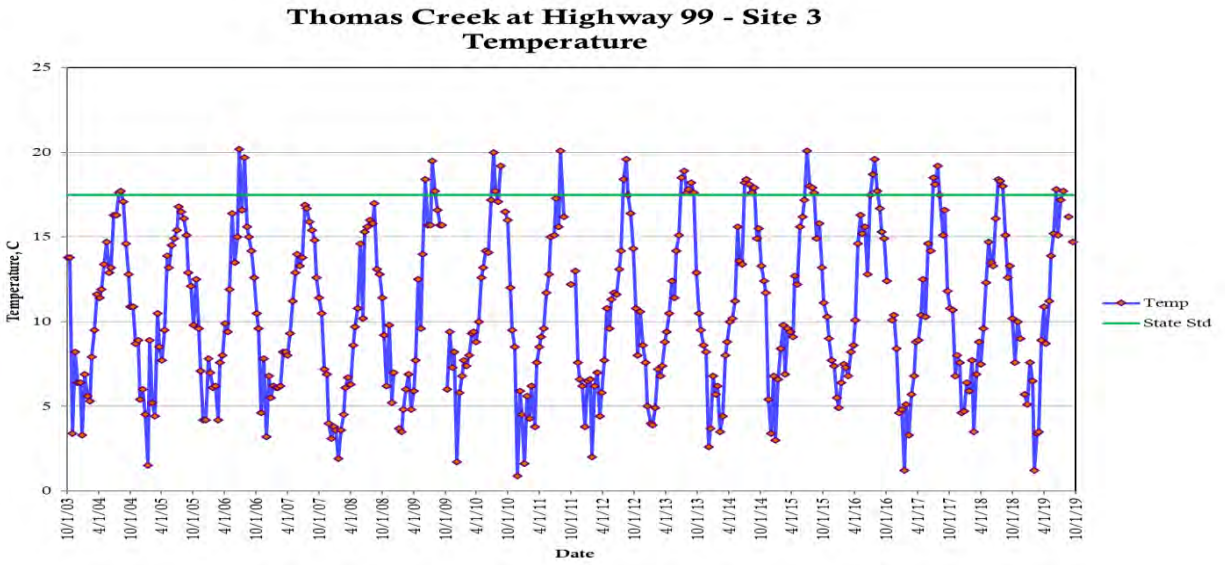
Site 3 is Thomas Creek, downstream from site 4, and sits just prior to the creek joining the Samish River. This section of the creek is more of a slough, with slow-moving, channelized water. This site has substantially lower flow volumes in the summer months. This site is designated as salmonid spawning,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

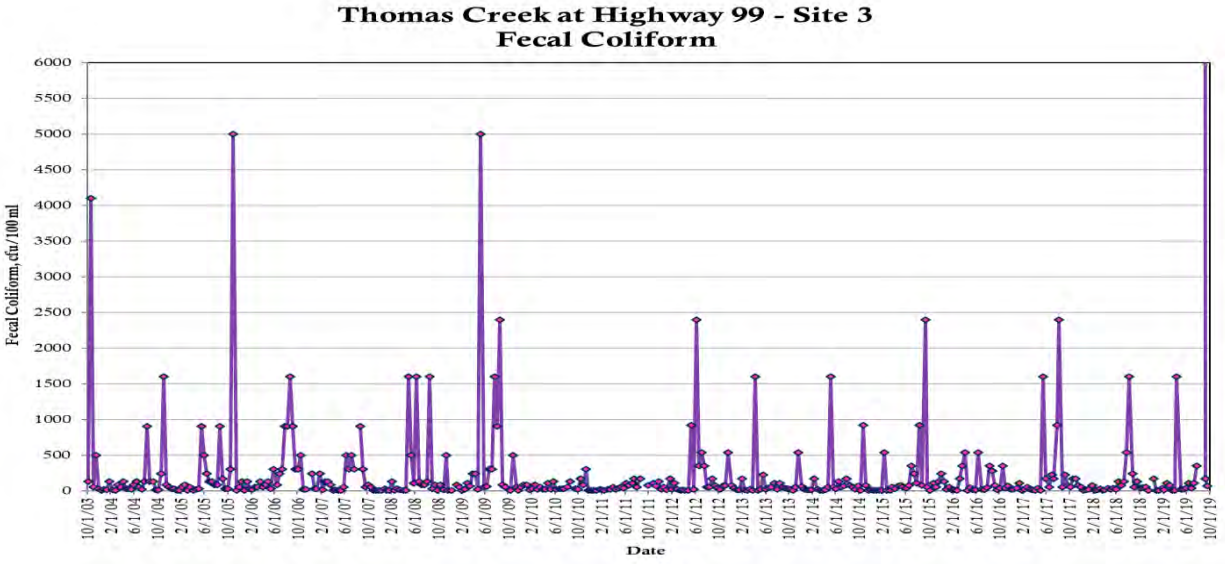
Dissolved oxygen has declined over the last ten years and over the last five years. Fecal coliform counts are lower than they were sixteen years ago. WQI scores have improved since monitoring began, but have never reached the category of lowest concern.

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

Site 3 is tied for 14th out of 39 sites for number of significant trends, with 14, and 23rd out of 39 sites for positive trends, at 57%.


Thomas Creek at Highway 99 - Site 3
Dissolved Oxygen
Dissolved Oxygen, mg/L
Date
DO
State Std


Thomas Creek at Highway 99 - Site 3
Temperature
Temperature, C
Date
Temp
State Std


Thomas Creek at Highway 99 - Site 3
Fecal Coliform
Fecal Coliform, cfu/100 ml
Date

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
15	54	39	66	76	77	62	81	89	71	52	89	81	65

Long Term Trends								
Dissolved Oxygen			Temperature			Fecal Coliform		
16 yr	10 yr	5 yr	16 yr	10 yr	5 yr	16 yr	10 yr	5 yr
↑	↑	↑	–	–	↓	↓	–	–

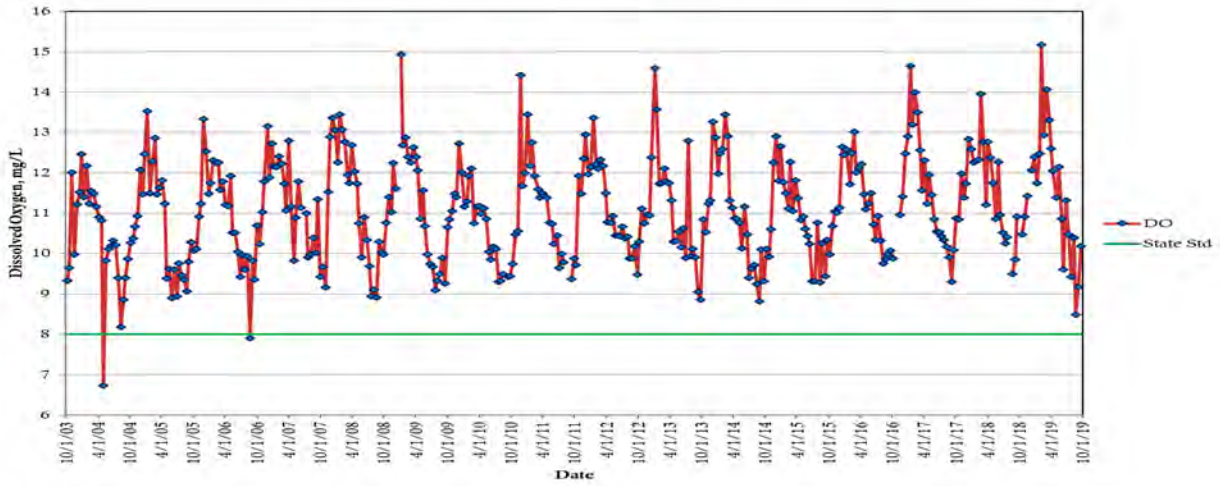
Site 4 is Thomas Creek, upstream of site 3. Upstream of this sampling site, the creek is fairly oxygenated and fast-moving. This site has substantially lower flow volumes in the summer months. This site is designated as salmonid spawning, rearing, and migration (SRM) status.

Dissolved oxygen has increased significantly across all time periods. Temperature has declined over the most recent five years. Fecal coliform counts are lower than they were 16 years ago. WQI scores have substantially improved since monitoring began.

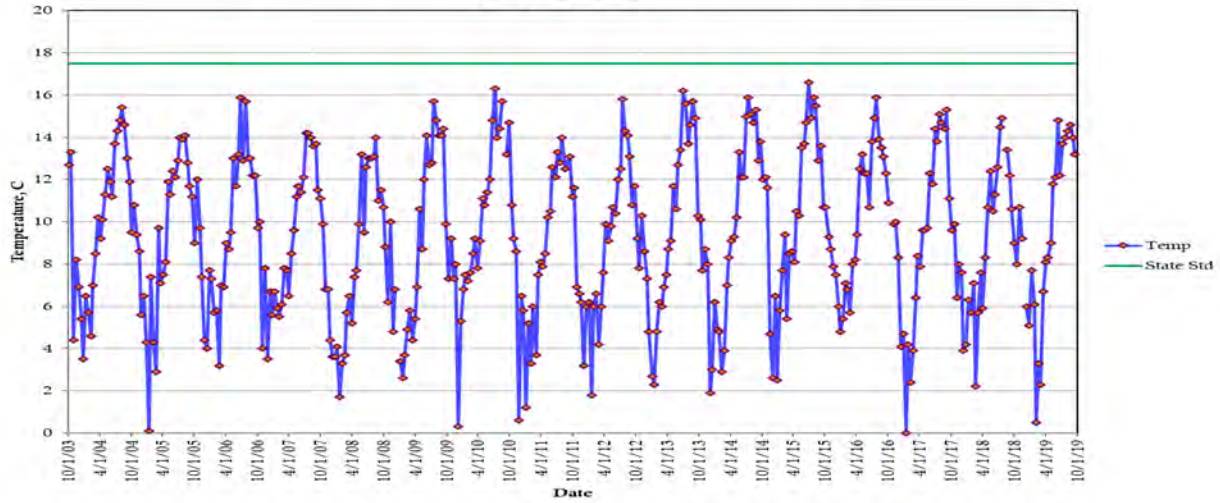
Site 4 regularly meets state standards for temperature and DO year-round. Fecal coliform levels regularly exceed annual state standards.

Site 4 is tied for 4th out of 39 sites for number of significant trends, with 18, and tied for 2nd out of 39 sites for positive trends, at 89%.

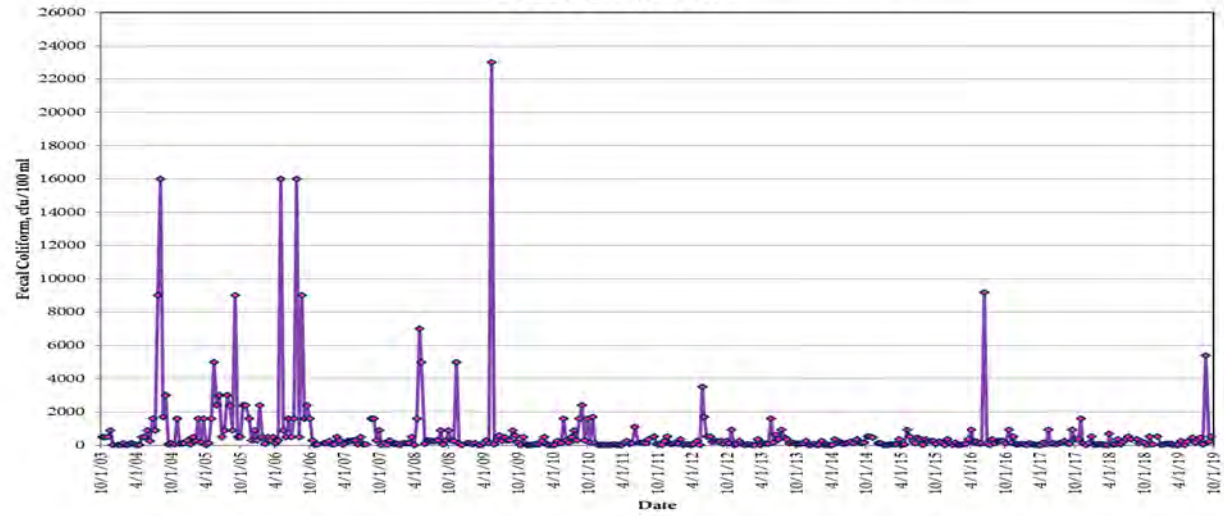
Thomas Creek at F&S Grade Road - Site 4
Dissolved Oxygen



Thomas Creek at F&S Grade Road - Site 4
Temperature



Thomas Creek at F&S Grade Road - Site 4
Fecal Coliform



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
45	81	65	86	90	94	81	88	88	90	85	86	91	87

Long Term Trends								
Dissolved Oxygen			Temperature			Fecal Coliform		
16 yr	10 yr	5 yr	16 yr	10 yr	5 yr	16 yr	10 yr	5 yr
↑	↑	↑	↑	–	–	–	–	–

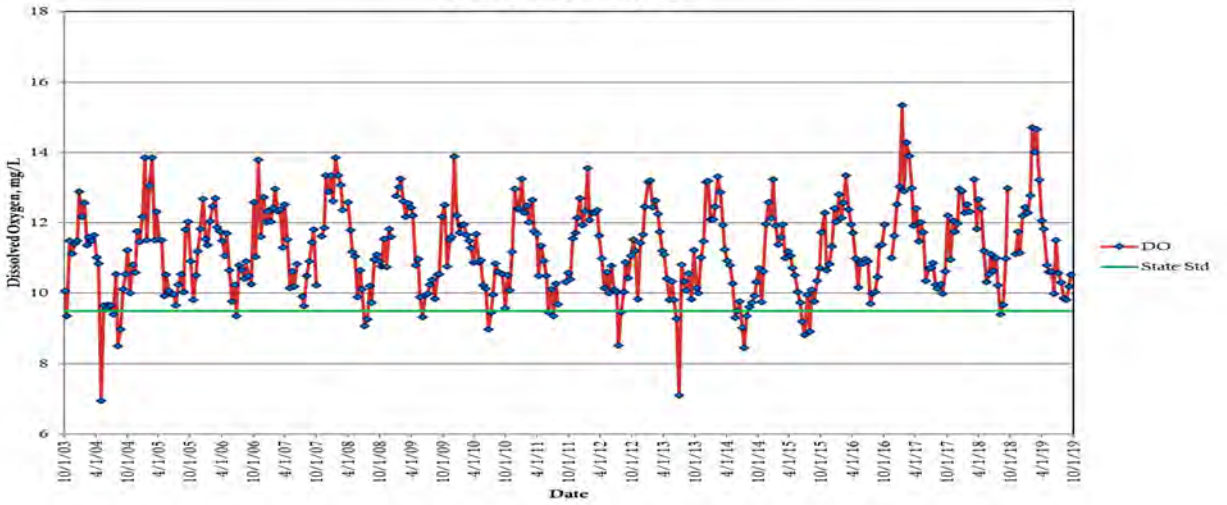
Site 6 is Friday Creek, and sits just prior to the creek joining the Samish River. This creek has a high flow volume and rate, and can seasonally contribute around 40% or more of the total volume of the Samish River. This site is designated as core salmonid habitat.

Dissolved oxygen has significantly increased across all time periods analyzed. Temperature is higher now than it was 16 years ago. No significant changes were observed in fecal coliform levels. WQI is consistently in the category of least concern.

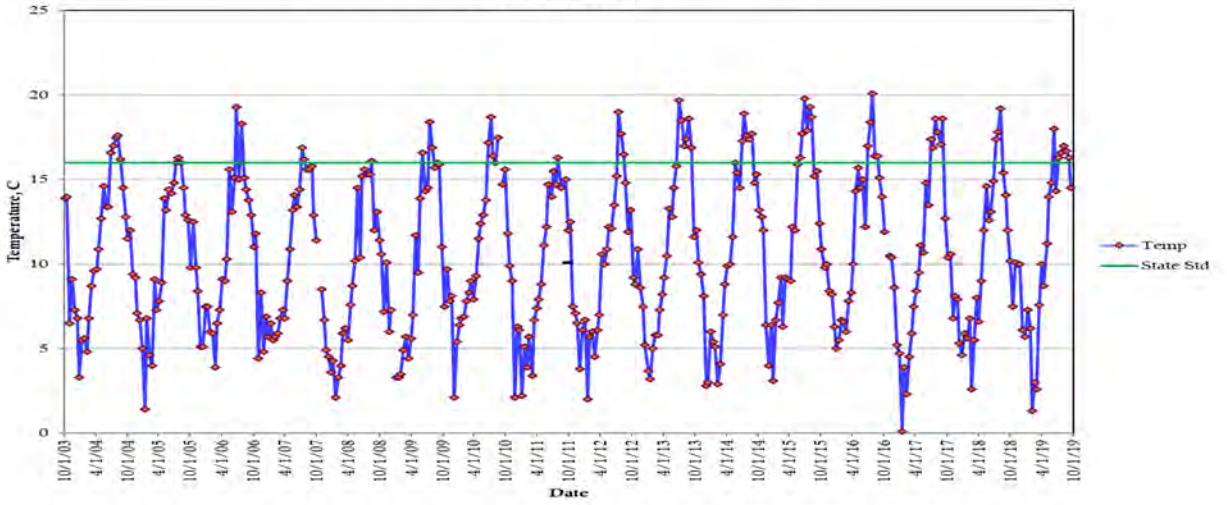
Site 6 regularly meets state standards for DO year-round. Temperature exceeds state standards during the hottest time of the year. Annual FC levels meet state standards.

Site 6 is tied for 6th out of 39 sites for number of significant trends, with 17, and is tied for 17th out of 39 sites for positive trends, at 65%.

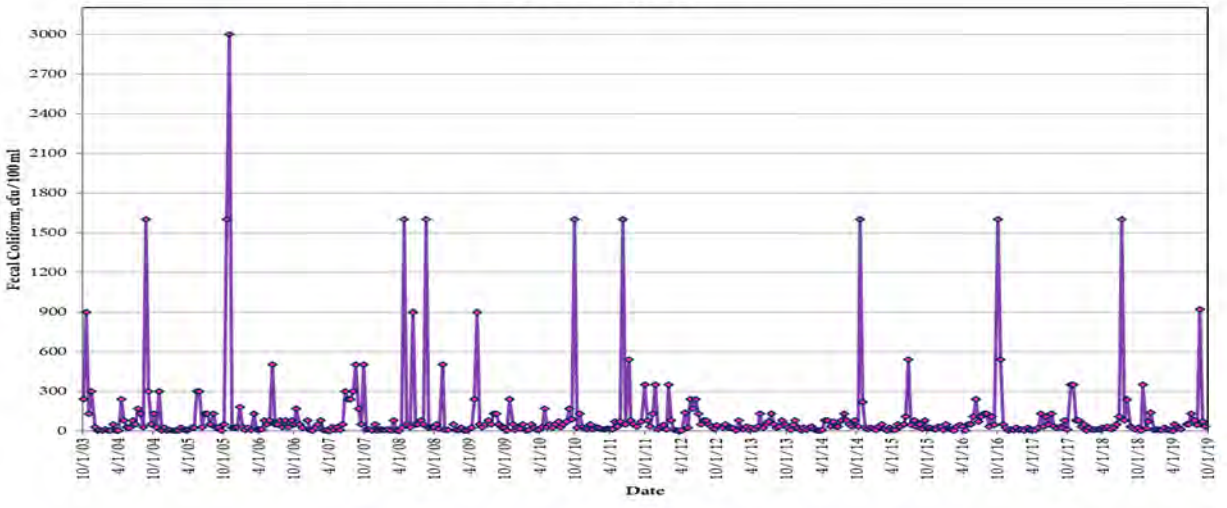
Friday Creek at Prairie Road - Site 6
Dissolved Oxygen



Friday Creek at Prairie Road - Site 6
Temperature



Friday Creek at Prairie Road - Site 6
Fecal Coliform



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
34	58	48	72	76	90	71	83	77	75	61	75	81	59

Long Term Trends								
Dissolved Oxygen			Temperature			Fecal Coliform		
16 yr	10 yr	5 yr	16 yr	10 yr	5 yr	16 yr	10 yr	5 yr
↓	–	–	–	↑	↓	↓	–	–

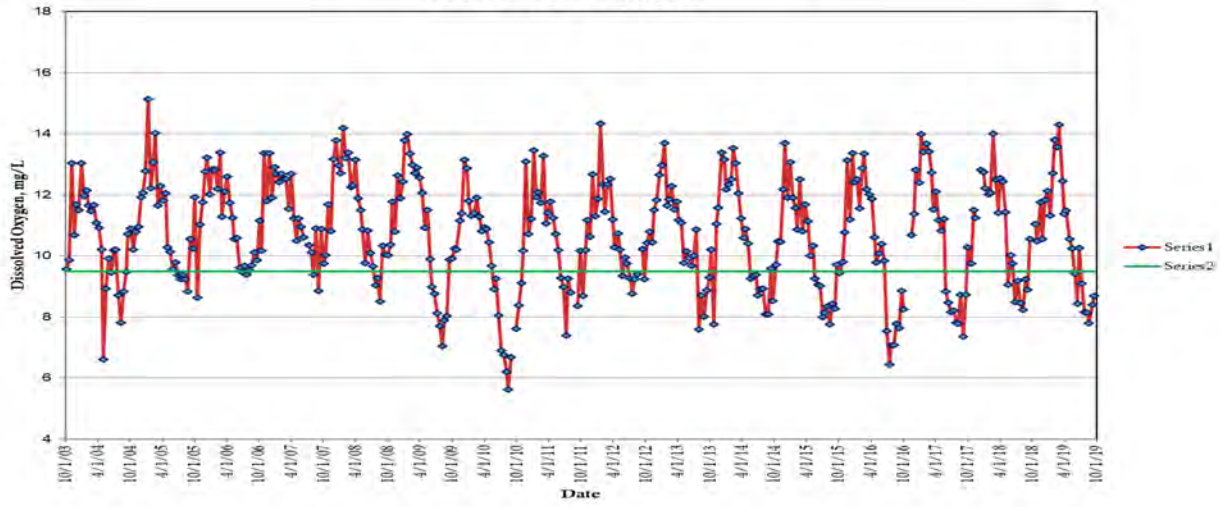
Site 8 is Swede Creek, and sits just prior to the creek joining the Samish River. Swede Creek has been a focus of pollution monitoring efforts in the Samish basin, with rural residential and agricultural sources in the watershed. The site is designated as core salmonid habitat.

Dissolved oxygen has declined as compared to 16 years ago. Temperatures are higher than they were ten years ago, but lower than they were five years ago. Fecal coliform counts are lower than they were 16 years ago. WQI scores are generally in the higher-scoring end of the moderate concern category, and sometimes score as least concern.

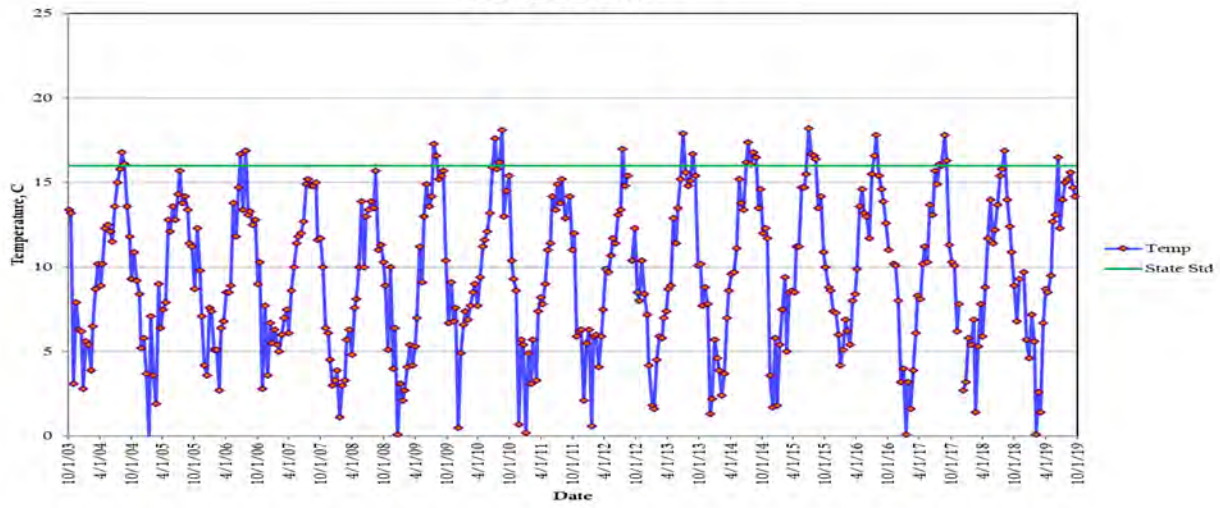
Site 8 regularly fails to meet state DO standards in the warmer months, and fails to meet state temperature standards only at the warmest time of year. Annual FC levels meet state standards.

Site 8 is tied for 9th out of 39 sites for number of significant trends, with 16, and 26th out of 39 sites for positive trends, at 50%.

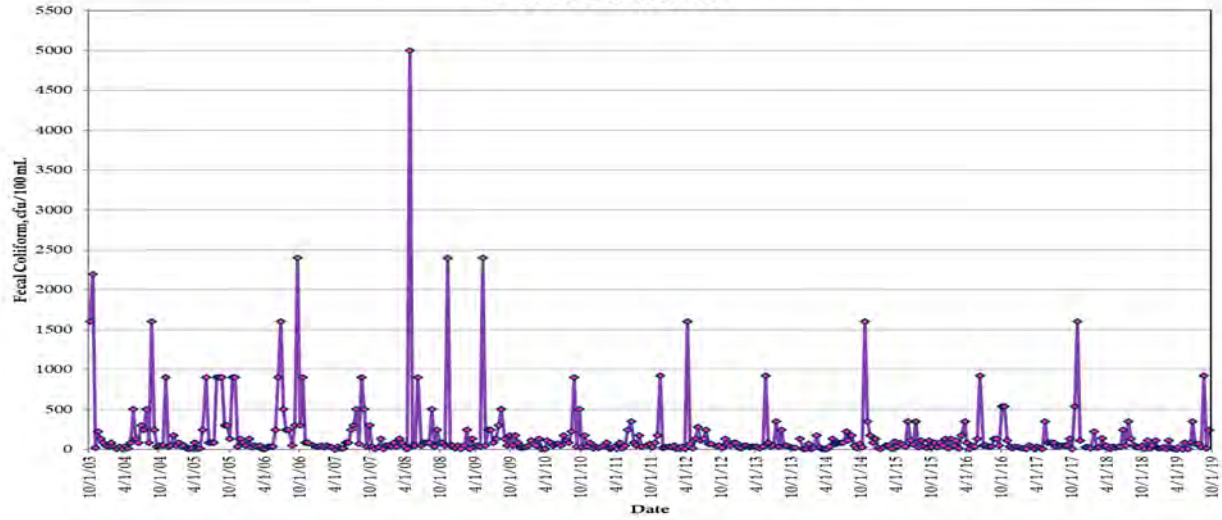
Swede Creek at Grip Road - Site 8
Dissolved Oxygen



Swede Creek at Grip Road - Site 8
Temperature



Swede Creek at Grip Road - Site 8
Fecal Coliform



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
57	85	68	81	78	86	65	72	68	66	80	82	87	81

Long Term Trends								
Dissolved Oxygen			Temperature			Fecal Coliform		
16 yr	10 yr	5 yr	16 yr	10 yr	5 yr	16 yr	10 yr	5 yr
↑	↑	↑	–	–	↓	↓	–	–

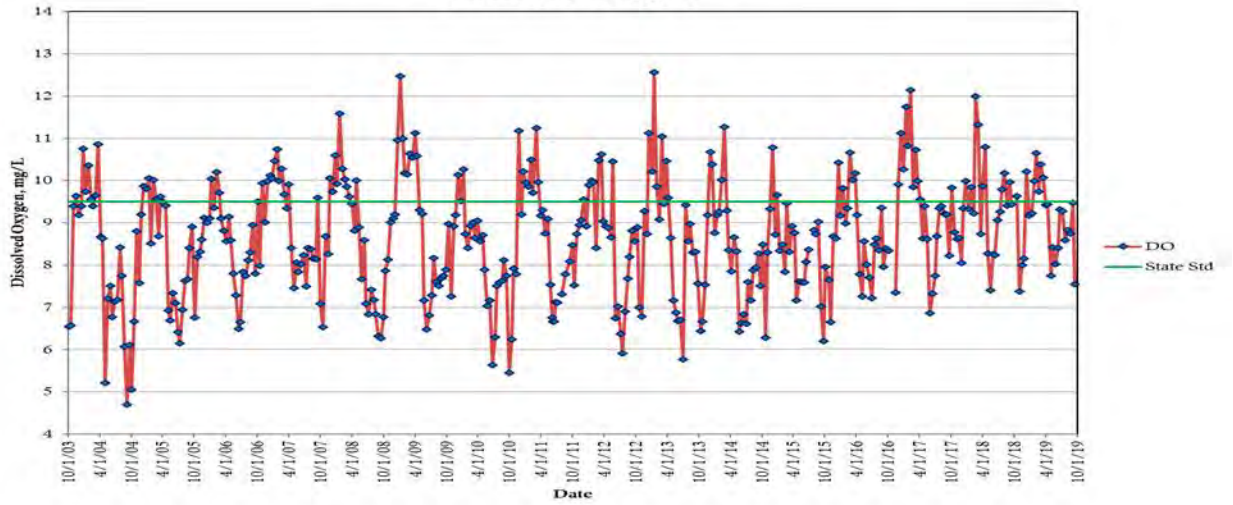
Site 11 is the Samish River, upstream of all other Samish River sampling sites. This site shows the condition of the Samish River prior to all monitored tributaries. This site is designated as core salmonid habitat.

Dissolved oxygen has significantly increased over all time periods. Temperature has decreased in the last five years. Fecal coliform counts are lower than they were 16 years ago. WQI scores are generally in the higher-scoring end of the moderate concern category, and often score as least concern.

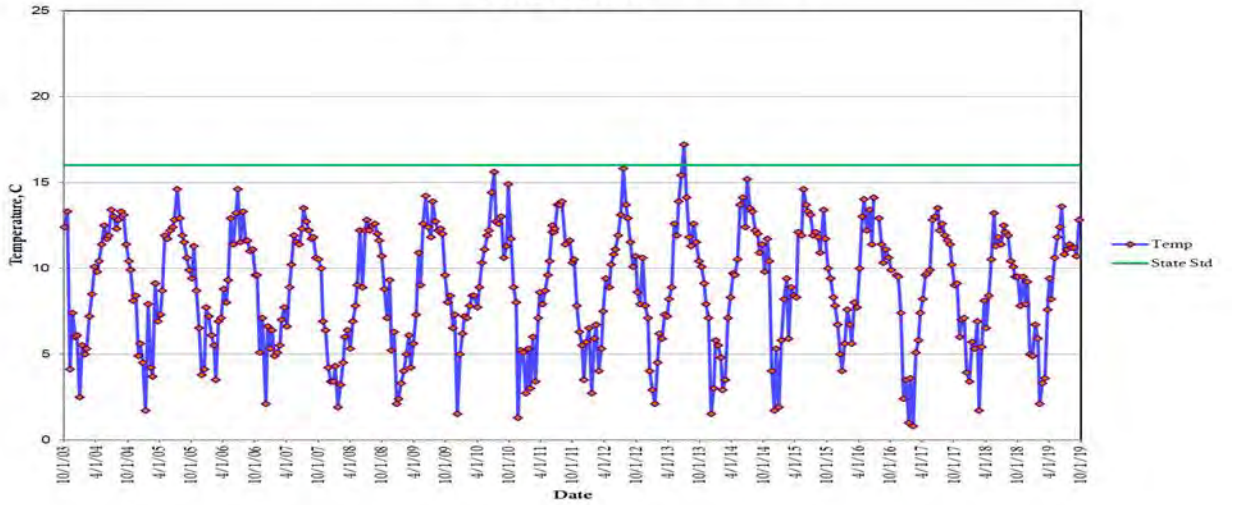
Site 11 regularly fails to meet state standards for DO, but rarely fails state standards for temperature, year-round. Annual FC levels easily meet state standards.

Site 3 is tied for 14th out of 39 sites for number of significant trends, with 14, and 1st out of 39 sites for positive trends, with 100%.

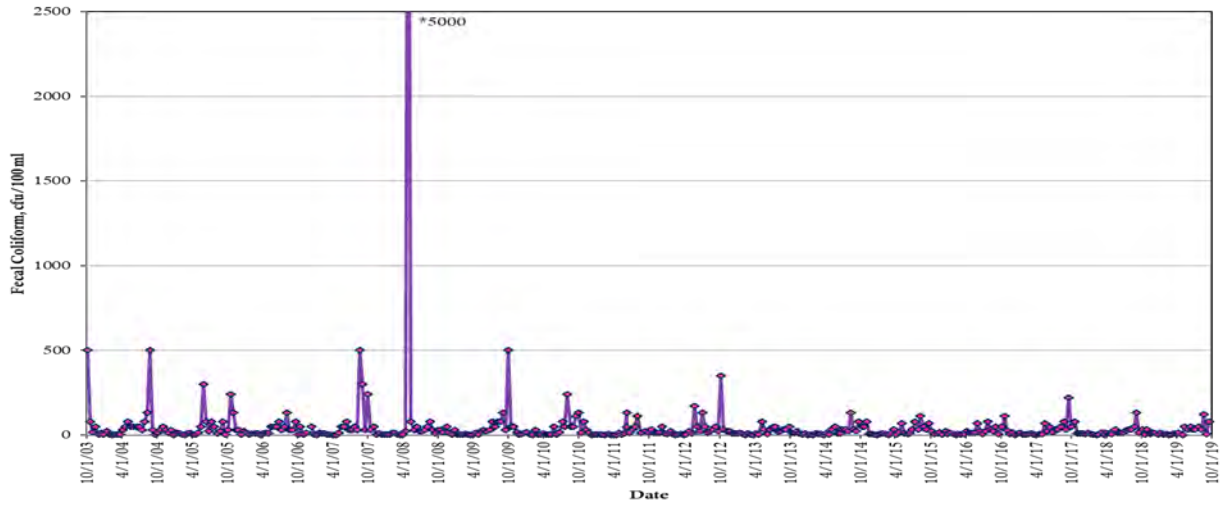
Samish River at Highway 9 - Site 11
Dissolved Oxygen



Samish River at Highway 9 - Site 11
Temperature



Samish River at Highway 9 - Site 11
Fecal Coliform



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
63	72	38	72	58	68	50	62	58	59	67	59	49	72

Long Term Trends								
Dissolved Oxygen			Temperature			Fecal Coliform		
16 yr	10 yr	5 yr	16 yr	10 yr	5 yr	16 yr	10 yr	5 yr
—	—	↑	—	—	↓	—	—	↓

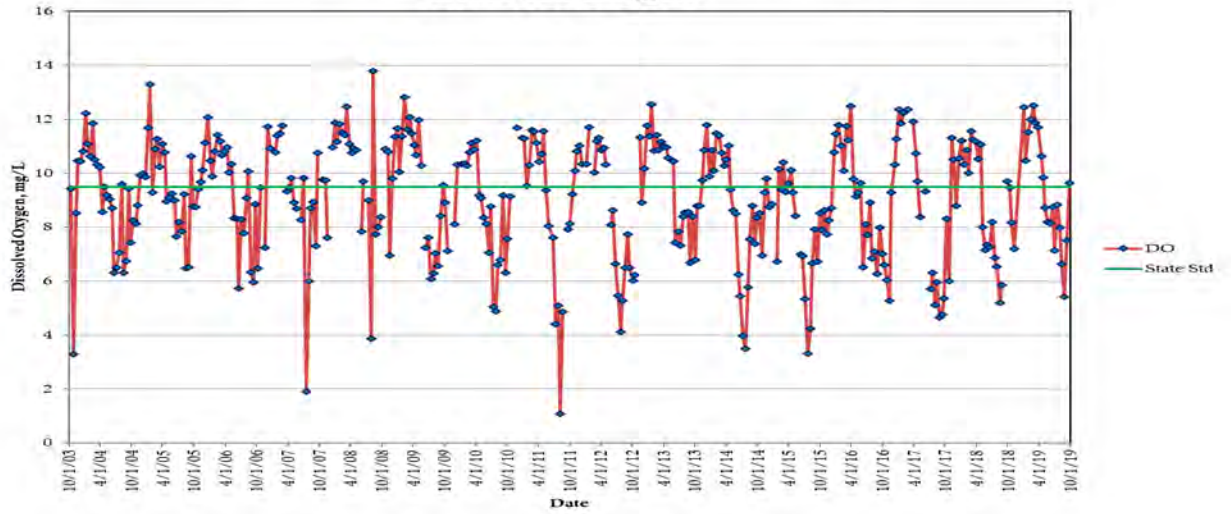
Site 12 is Nookachamps Creek, and is the furthest downstream site of the creek in this program, located just prior to joining the Skagit River. This creek drains a large valley of rural residential and agriculturally-zoned areas. This site is designated as core salmonid habitat.

Over the last five years, dissolved oxygen has increased, temperature has decreased, and fecal coliform counts have decreased. No significant trends in these categories were observed over the longer time periods. WQI scores are regularly in the category of moderate concern.

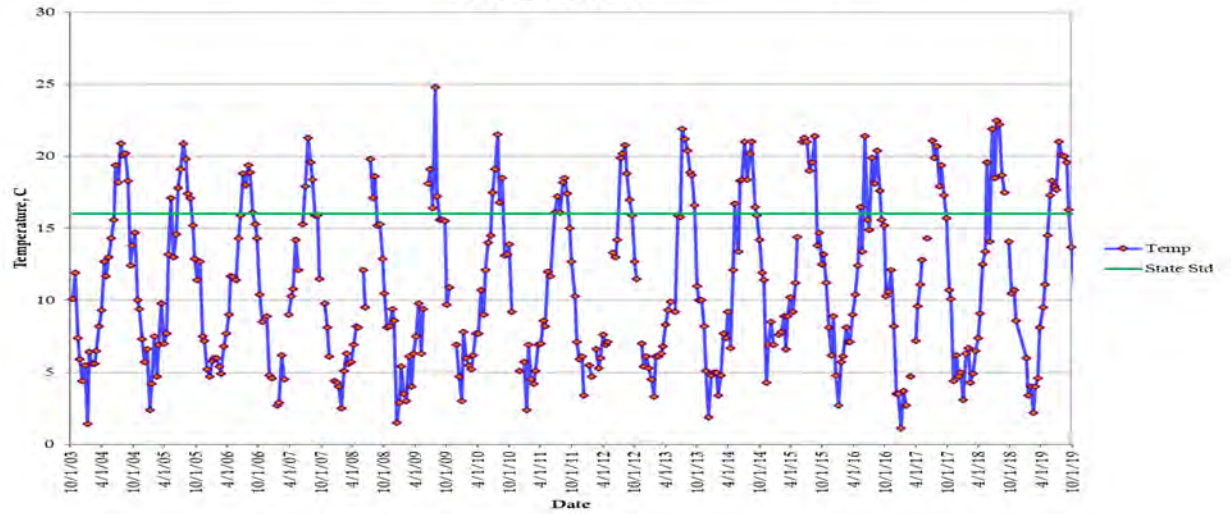
Site 12 regularly fails to meet state standards for DO and temperature during the warmer months. Annual FC levels meet state standards.

Site 12 is tied for 11th out of 39 sites for number of significant trends, with 15, and is tied for 15th out of 39 sites for positive trends, with 67%.

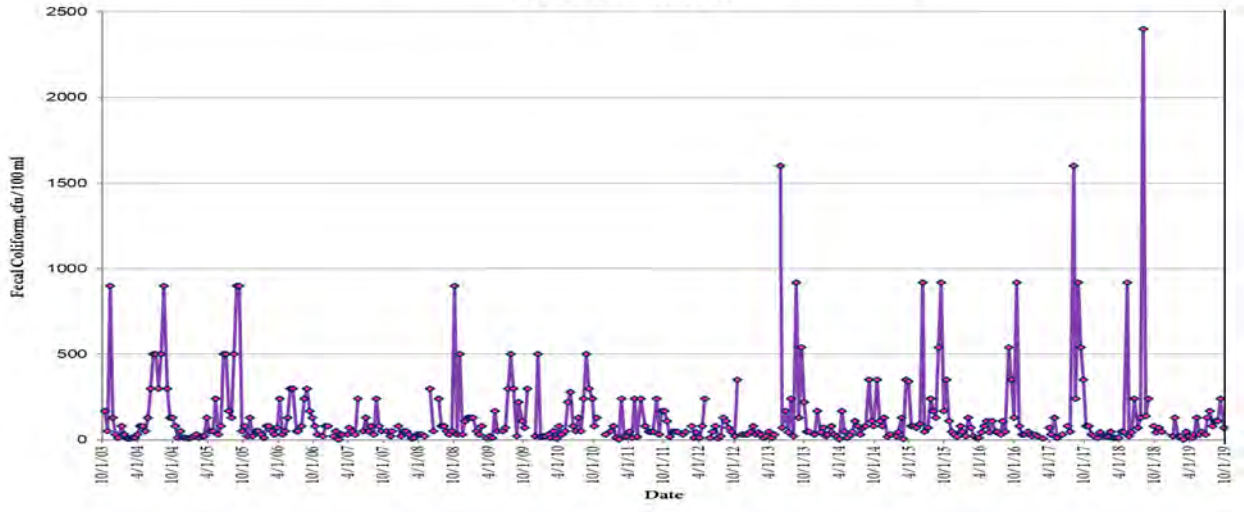
Nookachamps Creek at Swan Road - Site 12
Dissolved Oxygen



Nookachamps Creek at Swan Road - Site 12
Temperature



Nookachamps Creek at Swan Road - Site 12
Fecal Coliform



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
74	77	88	85	85	91	65	70	76	74	75	64	80	74

Long Term Trends

Dissolved Oxygen			Temperature			Fecal Coliform		
16 yr	10 yr	5 yr	16 yr	10 yr	5 yr	16 yr	10 yr	5 yr
↓	–	–	↑	–	↓	–	↓	↓

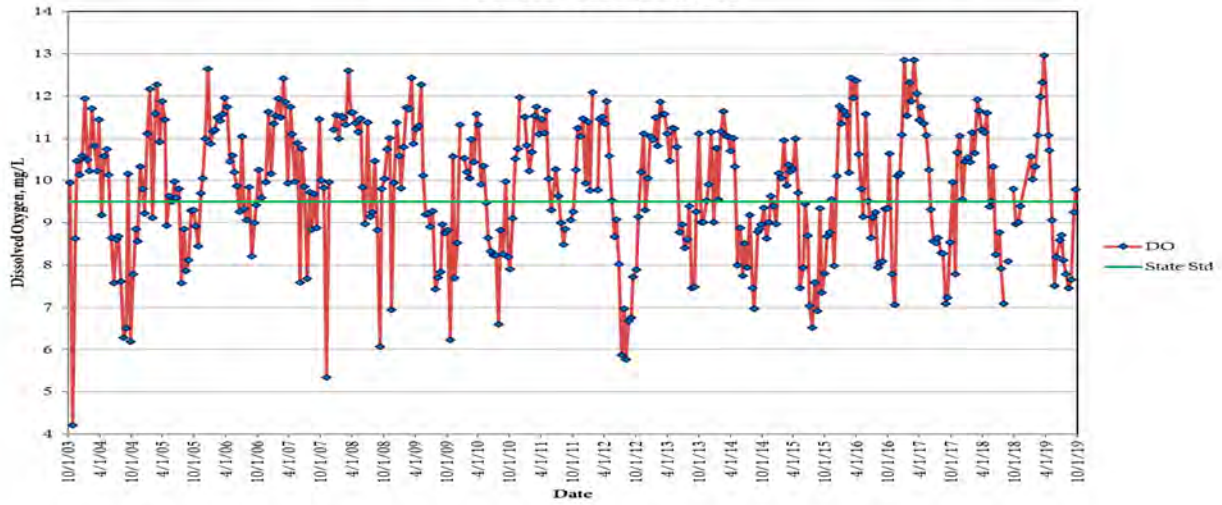
Site 13 is East Fork Nookachamps Creek, downstream of site 16, and sitting just prior to joining Nookachamps Creek and ultimately the Skagit River. It sits downstream of a stretch of agricultural activity. This site is designated as char spawning and rearing status.

Dissolved oxygen has declined since 16 years ago. Temperature is higher than it was 16 years ago, but has declined in the last five. Fecal coliform counts are significantly lower over the last ten years and five years. WQI scores are generally in the higher-scoring end of the moderate concern category, and often score as least concern.

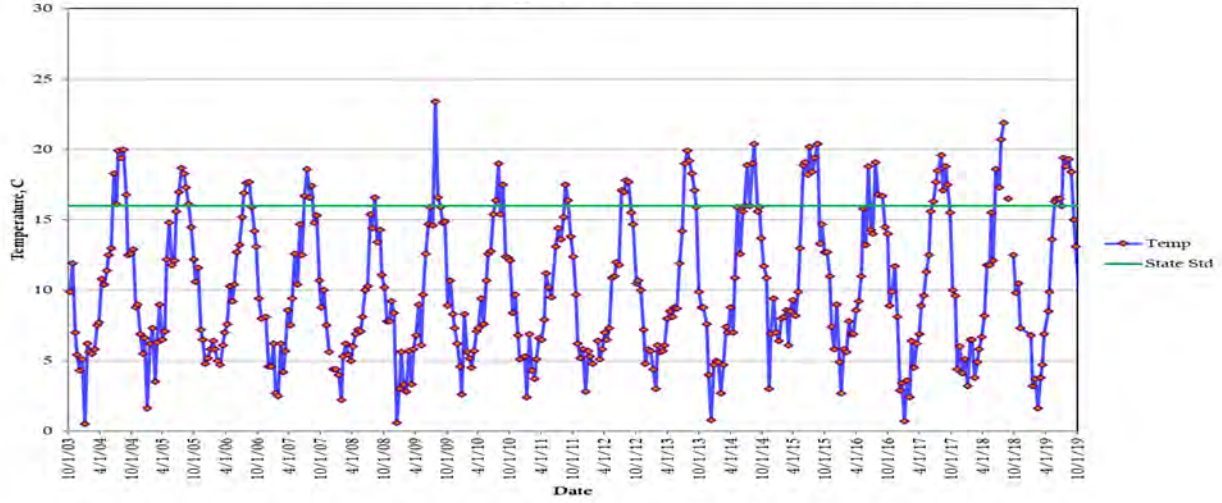
Site 13 regularly fails to meet state standards for DO and temperature during the warmer months. Annual FC levels meet state standards.

Site 13 is tied for 6th out of 39 sites for number of significant trends, with 17, and tied for 17th out of 39 sites for positive trends, with 65%.

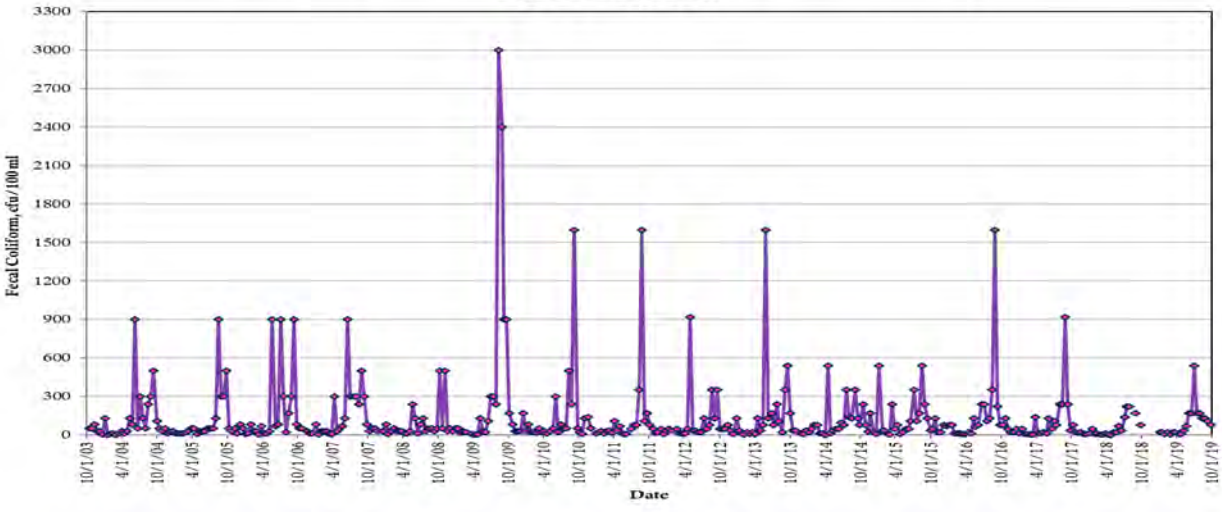
East Fork Nookachamps Creek at Highway 9 - Site 13
Dissolved Oxygen



East Fork Nookachamps Creek at Highway 9 - Site 13
Temperature



East Fork Nookachamps Creek at Highway 9 - Site 13
Fecal Coliform



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
48	35	24	46	44	75	40	47	53	55	73	47	55	54

Long Term Trends								
Dissolved Oxygen			Temperature			Fecal Coliform		
16 yr	10 yr	5 yr	16 yr	10 yr	5 yr	16 yr	10 yr	5 yr
—	↑	↑	—	—	↓	—	—	—

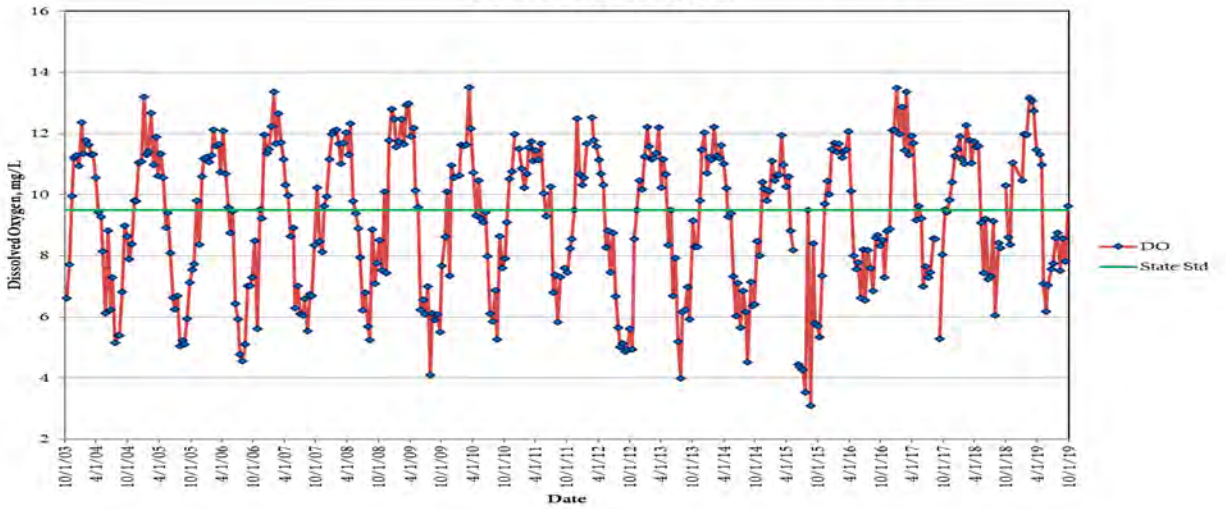
Site 14 is College Way Creek. This creek drains an urban/suburban area of northeast Mount Vernon, and terminates into Nookachamps Creek just prior to Barney Lake, and eventually into the Skagit River. This site is designated as core salmonid habitat.

Dissolved oxygen has significantly increased over the last ten years and five years. Water temperature has decreased over the last five years. WQI scores are regularly in the category of moderate concern.

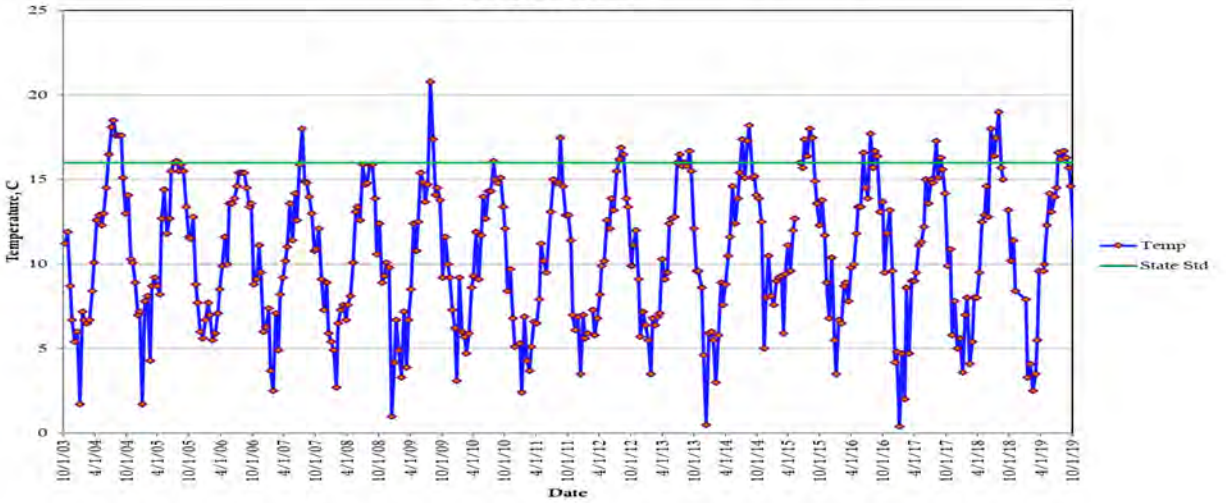
Site 14 regularly fails to meet state standards for DO during the warmer months, and often fails to meet state standards for temperature during the hottest time of the year. Annual FC levels fail to meet state standards.

Site 14 is tied for 14th out of 39 sites for number of significant trends, with 14, and is tied for 11th out of 39 sites for positive trends, with 71%.

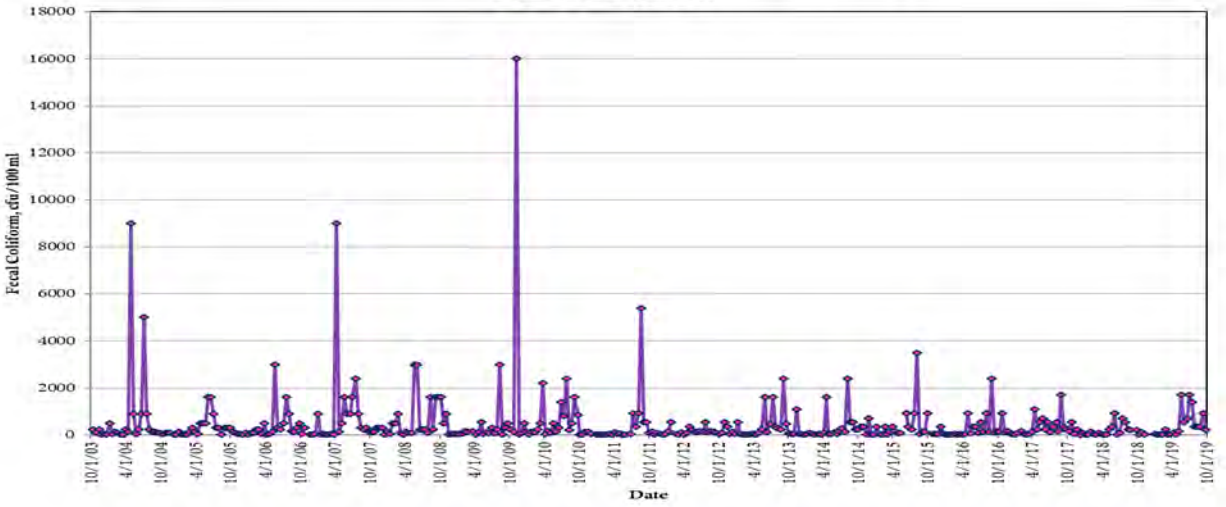
College Way Creek at College Way - Site 14
Dissolved Oxygen

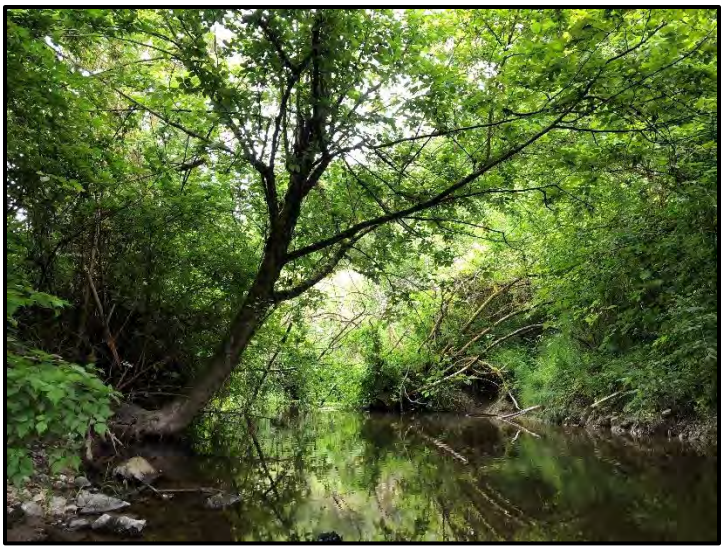


College Way Creek at College Way - Site 14
Temperature



College Way Creek at College Way - Site 14
Fecal Coliform





15

Nookachamps Creek
@ Knapp Road

Midstream Ag, TMDL

Water Quality Index (WQI)													
2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
22	8	18	15	54	36	31	29	31	56	48	28	50	27

Long Term Trends								
Dissolved Oxygen			Temperature			Fecal Coliform		
16 yr	10 yr	5 yr	16 yr	10 yr	5 yr	16 yr	10 yr	5 yr
—	—	↑	↑	—	↓	↑	↓	—

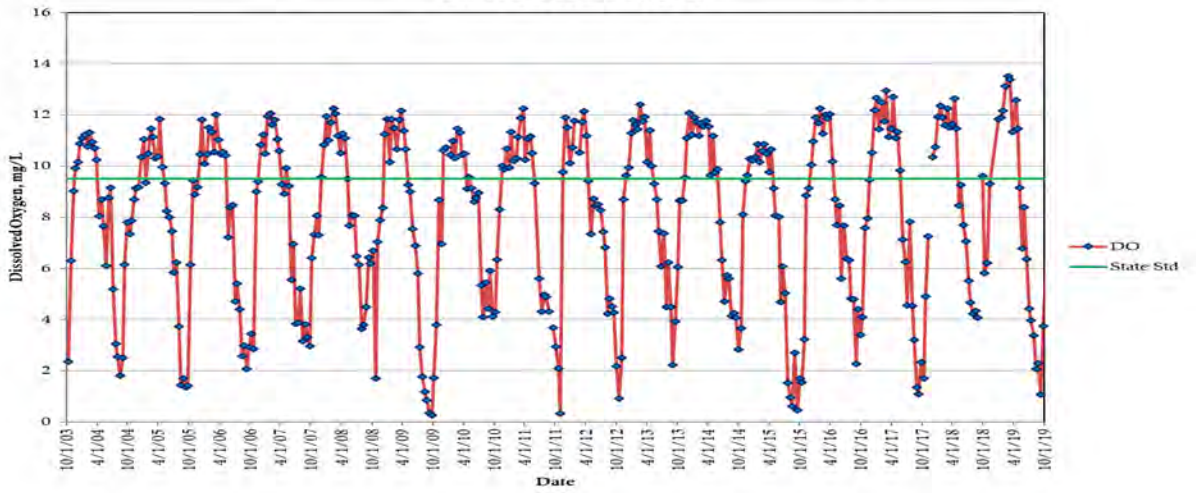
Site 15 is Nookachamps Creek mid-stream, upstream from site 12, and downstream from Big Lake and site 17. This site is designated as core salmonid habitat.

Dissolved oxygen is higher than it was five 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 higher than they were at the beginning of this study, but are lower now than they were ten years ago. WQI scores are consistently in the category of highest concern.

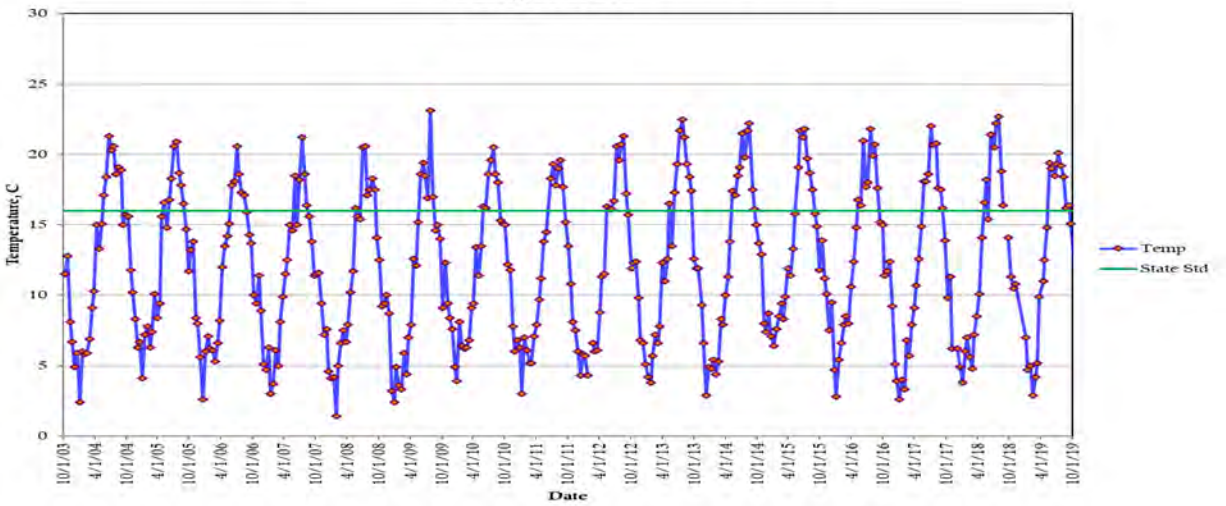
Site 15 regularly fails to meet state standards for DO and temperature during the warmer months. Annual FC levels pass the state standard for geomean of 100, but easily fail the state standard for a 90th percentile of 200.

Site 15 is tied for 11th out of 39 sites for number of significant trends, with 15, and is tied for 9th of 39 sites for positive trends, with 71%.

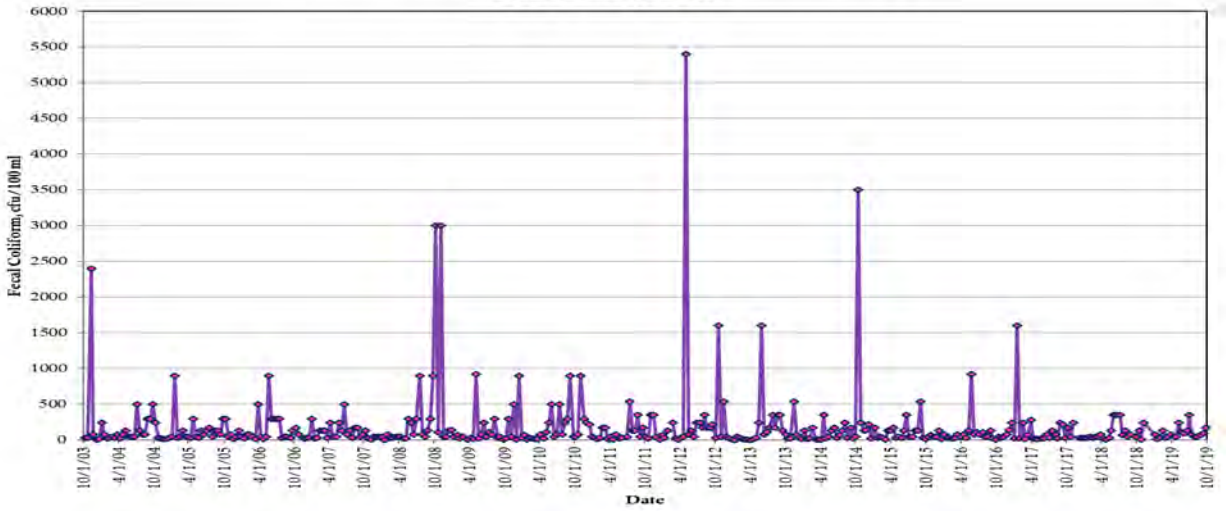
Nookachamps Creek at Knapp Road - Site 15
Dissolved Oxygen



Nookachamps Creek at Knapp Road - Site 15
Temperature



Nookachamps Creek at Knapp Road - Site 15
Fecal Coliform



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
88	86	89	91	97	84	91	80	92	95	88	83	89	87

Long Term Trends								
Dissolved Oxygen			Temperature			Fecal Coliform		
16 yr	10 yr	5 yr	16 yr	10 yr	5 yr	16 yr	10 yr	5 yr
–	↑	↑	↑	–	↓	–	–	–

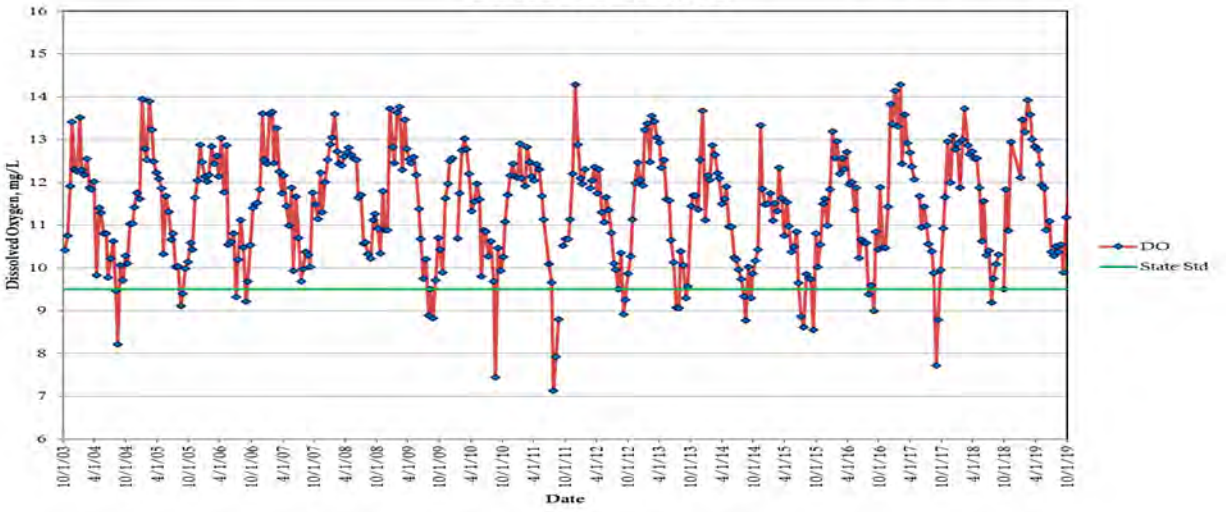
Site 16 is East Fork Nookachamps Creek, upstream of site 13, and immediately after adjoining with Cold Spring Creek. This site is influenced by light agricultural uses and undeveloped land. This site is designated as char spawning and rearing status.

Dissolved oxygen has significantly increased over the last ten years and five years. Water temperatures are higher than sixteen years ago, but 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.

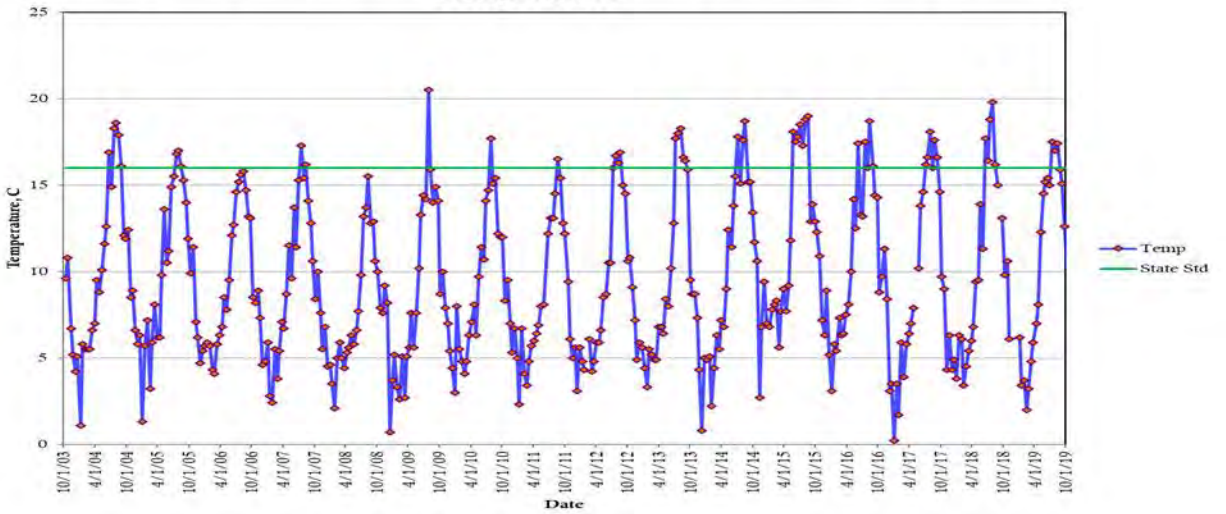
Site 16 rarely fails state standards for DO, but water temperatures can often exceed state standards during the warmest time of year. Annual FC levels easily meet state standards.

Site 16 is tied for 21st out of 39 sites for number of significant trends, with 12, and is tied for 7th out of 39 sites for positive trends, with 75%.

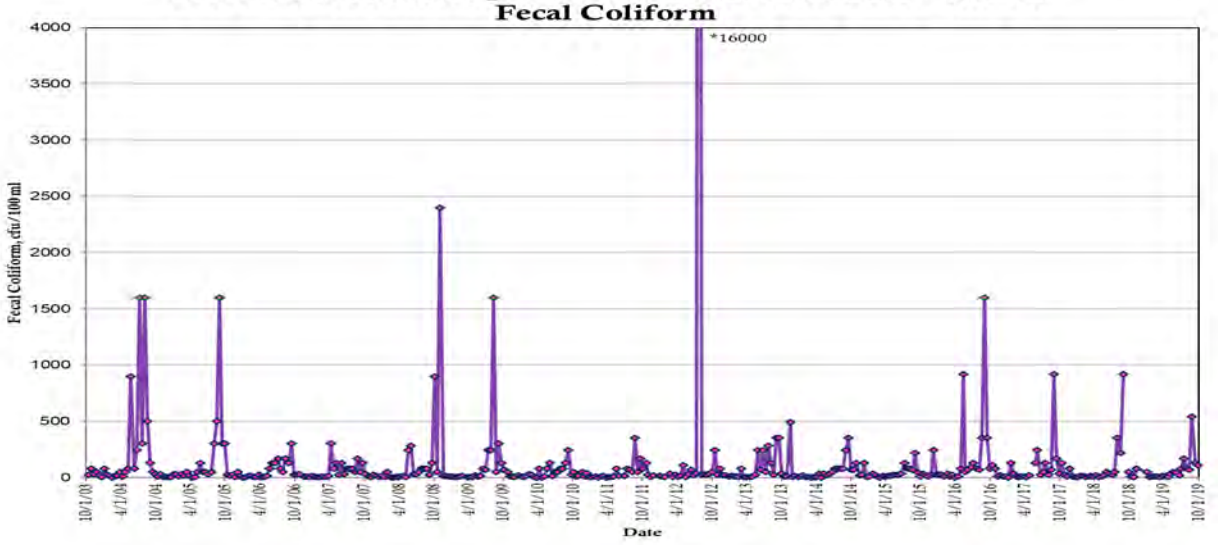
East Fork Nookachamps Creek at Beaver Lake Road - Site 16
Dissolved Oxygen



East Fork Nookachamps Creek at Beaver Lake Road - Site 16
Temperature



East Fork Nookachamps Creek at Beaver Lake Road - Site 16
Fecal Coliform



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
60	83	69	84	75	91	74	64	60	79	71	78	67	65

Long Term Trends

Dissolved Oxygen			Temperature			Fecal Coliform		
16 yr	10 yr	5 yr	16 yr	10 yr	5 yr	16 yr	10 yr	5 yr
–	–	↑	↑	–	↓	–	↑	–

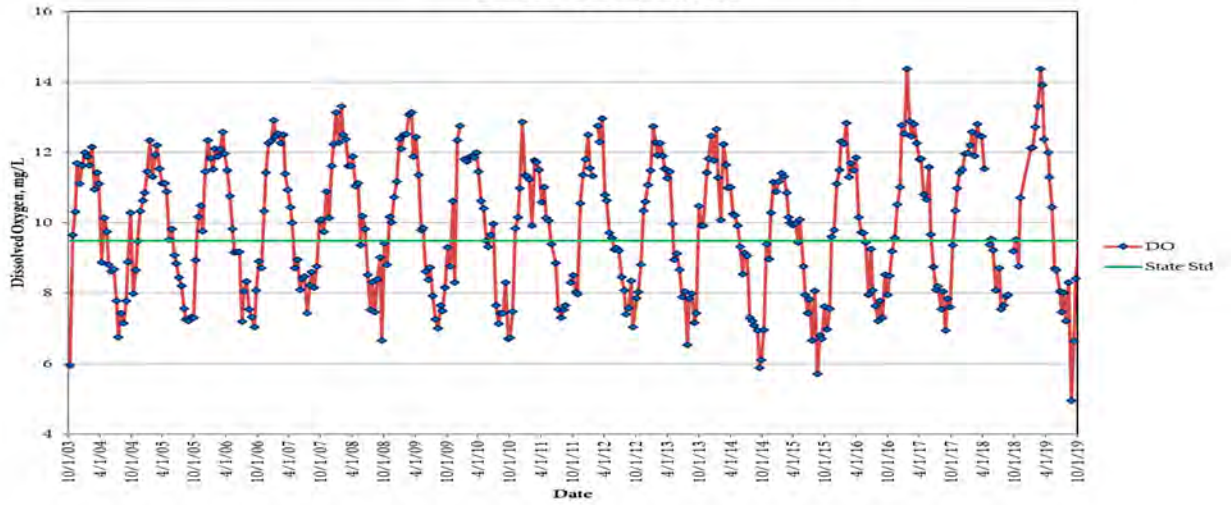
Site 17 is Nookachamps Creek, at its source, immediately after leaving Big Lake. This site is upstream from sties 15 and 12. This site is designated as core salmonid habitat.

Over the most recent five years, dissolved oxygen has increased and water temperature has decreased, though temperature has increased over the sixteen years of the program. Fecal coliform counts are higher than they were ten 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.

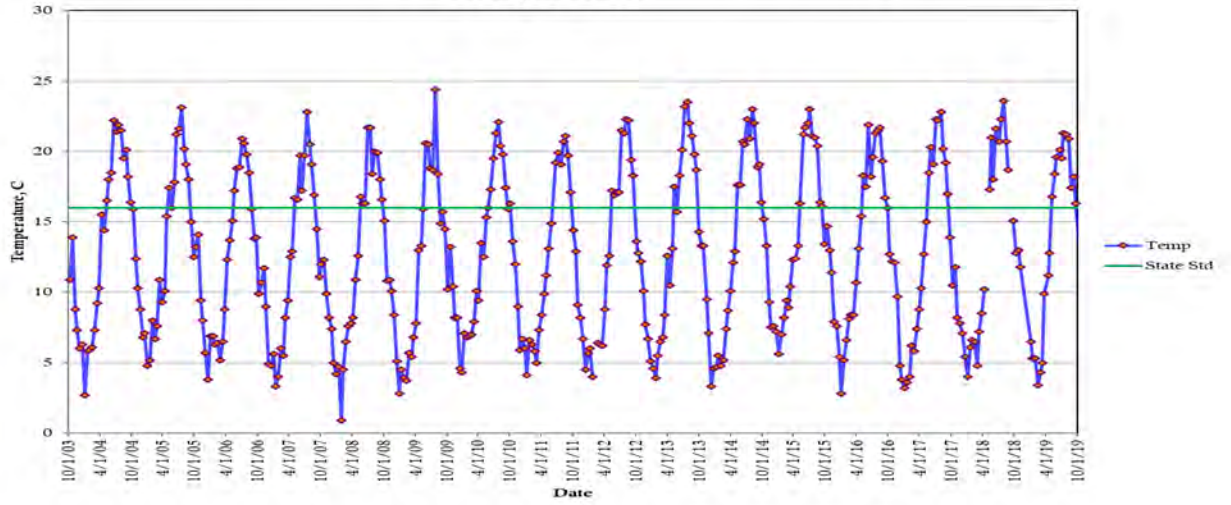
Site 17 regularly fails to meet state standards for DO and temperature during the warmer months. Annual FC levels meet state standards.

Site 17 is tied for 25th out of 39 sites for number of significant trends, with 11, and tied for 31st out of 39 sites for positive trends, with 45%.

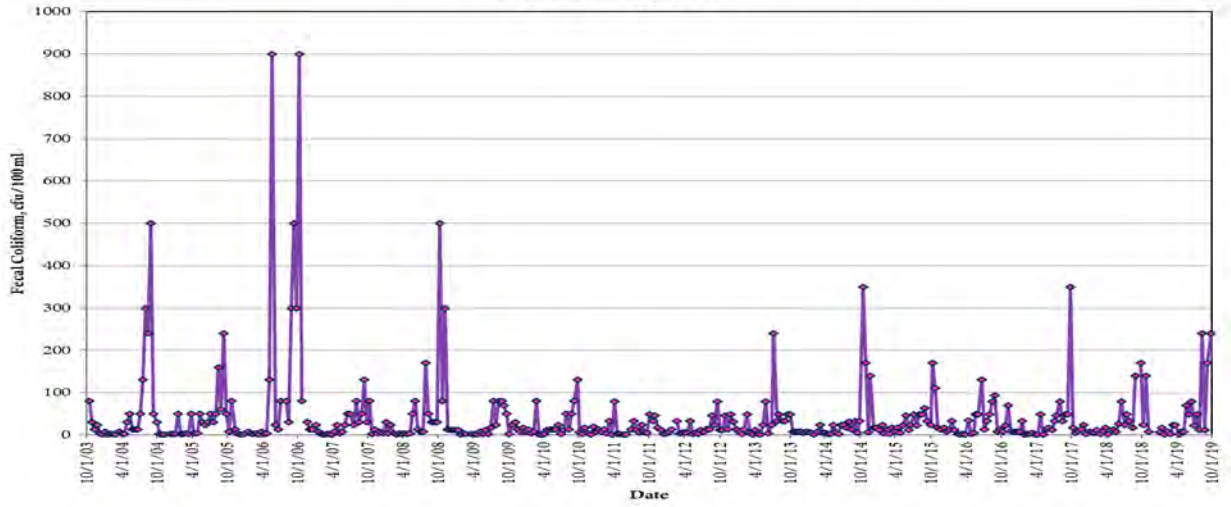
Nookachamps Creek at Big Lake Outlet - Site 17
Dissolved Oxygen



Nookachamps Creek at Big Lake Outlet - Site 17
Temperature



Nookachamps Creek at Big Lake Outlet - Site 17
Fecal Coliform



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
84	66	80	93	63	80	87	80	90	88	84	86	87	82

Long Term Trends

Dissolved Oxygen			Temperature			Fecal Coliform		
16 yr	10 yr	5 yr	16 yr	10 yr	5 yr	16 yr	10 yr	5 yr
–	↑	↑	↑	–	↓	↓	–	↓

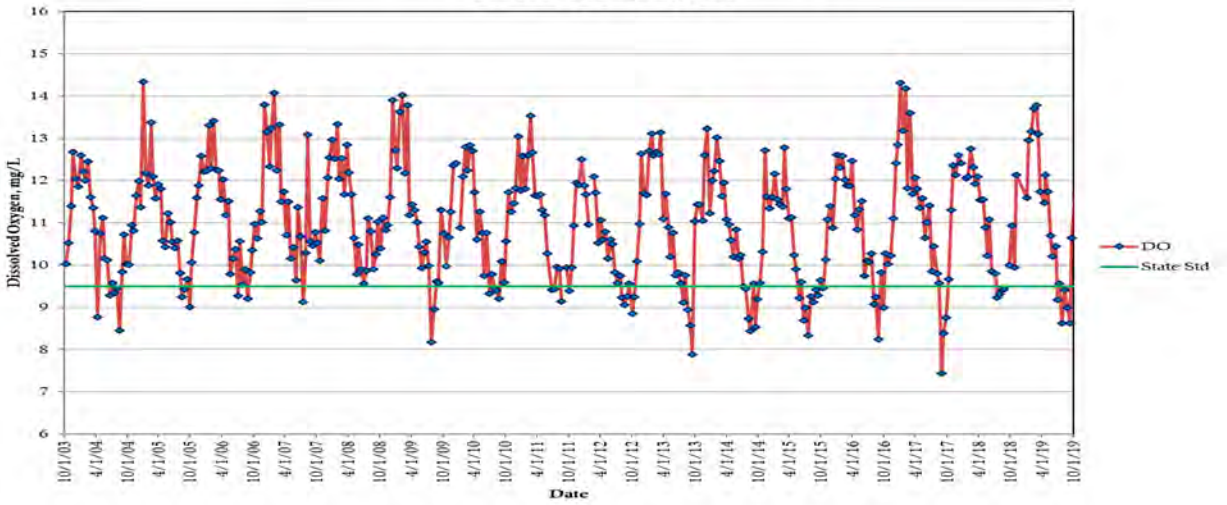
Site 18 is Big Lake Creek, just prior to entering Big Lake. This site also contributes to water quality data bracketing of Big Lake along with site 17. This site is designated as core salmonid habitat.

Dissolved oxygen has increased in the most recent ten years and five years. Water temperature is warmer than it was sixteen years ago, but has decreased in the last five years. Fecal coliform is lower than it was 16 years ago, and has also decreased over the last five years.

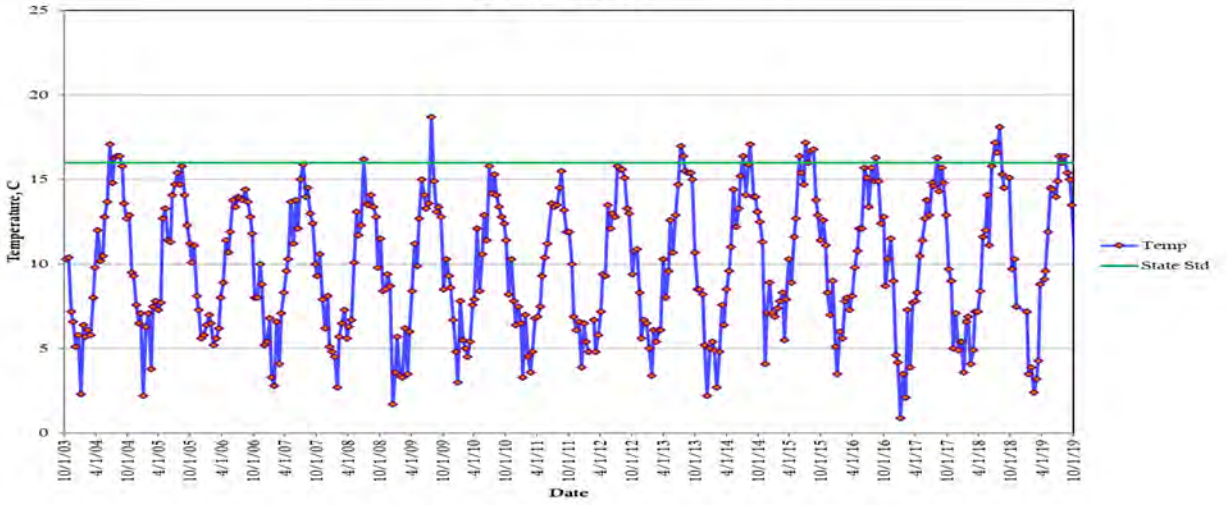
Site 18 typically stays within state standards for DO, and rarely fails state standards for temperature, even in the warmest months. Annual FC levels pass the state standard for geomean of 100, but do closely fail the state standard for a 90th percentile of 200.

Site 18 is tied for 19th out of 39 sites for number of significant trends, with 13, and is 14th out of 39 sites for positive trends, with 69%.

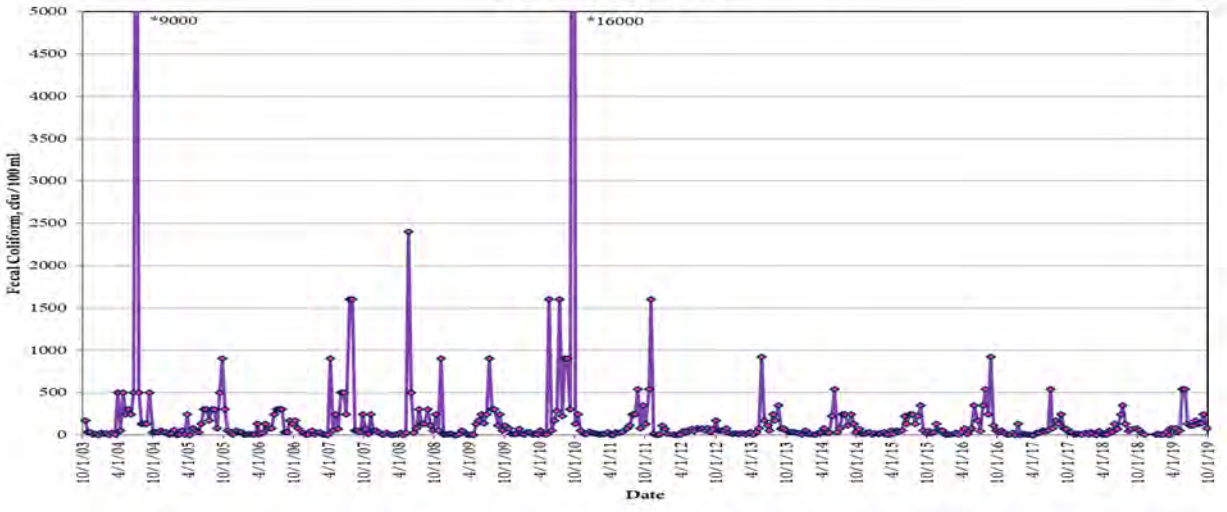
Lake Creek at Highway 9 - Site 18
Dissolved Oxygen



Lake Creek at Highway 9 - Site 18
Temperature



Lake Creek at Highway 9 - Site 18
Fecal Coliform



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
28	40	58	91	72	78	62	74	63	75	71	85	80	73

Long Term Trends

Dissolved Oxygen			Temperature			Fecal Coliform		
16 yr	10 yr	5 yr	16 yr	10 yr	5 yr	16 yr	10 yr	5 yr
↓	↓	–	↑	↑	–	–	–	–

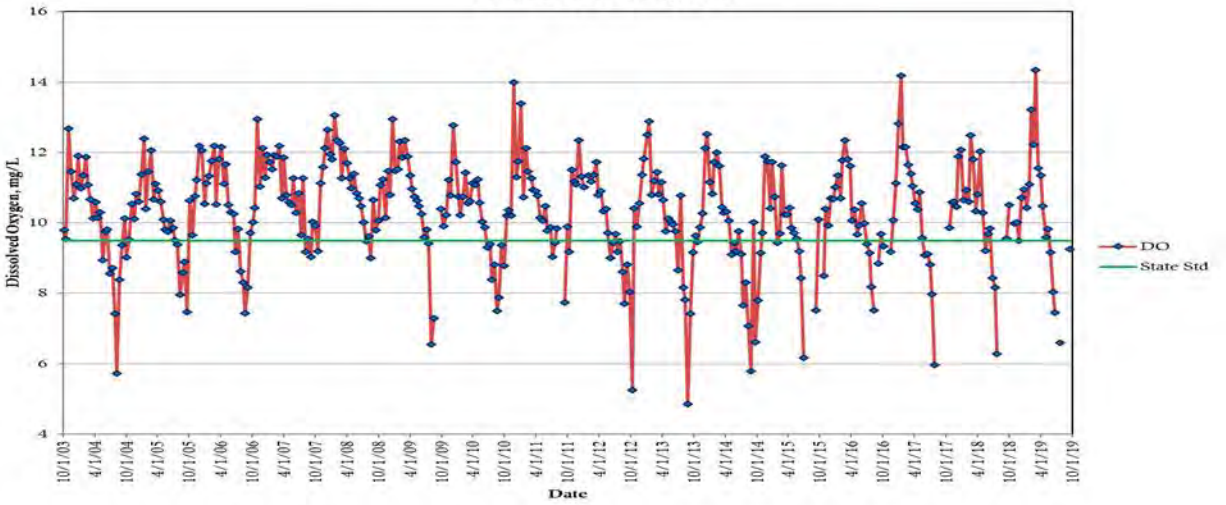
Site 19 is Hansen Creek, downstream from site 20 at the Northern State Recreation Area. This site is pseudo-ephemeral and often can stop flowing by the end of the summer. This site is designated as core salmonid habitat.

Over the sixteen-year life of this program, and over the last ten years, DO has declined and water temperatures have increased. WQI scores are generally in the upper-score end of the moderate concern category, and sometimes score as least concern.

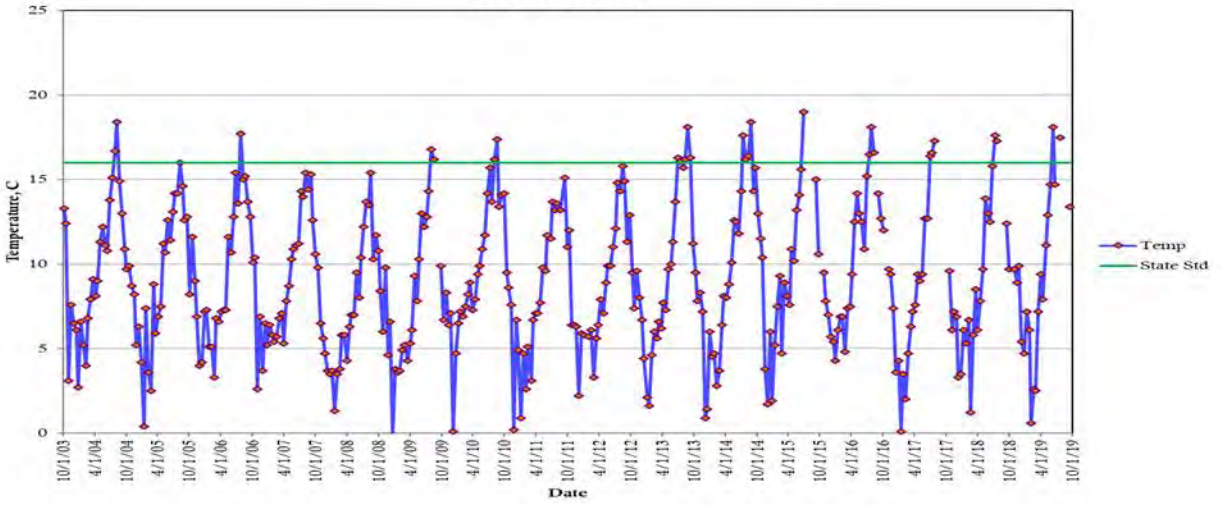
Site 19 regularly fails to meet state standards for DO during the warmer months, and often fails to meet state standards for temperature during the hottest time of the year. Annual FC levels pass the state standard for geomean of 100, but do closely fail the state standard for a 90th percentile of 200.

Site 19 is tied for 19th out of 39 sites for number of significant trends, with 13, and is 39th out of 39 sites for positive trends, with 8%.

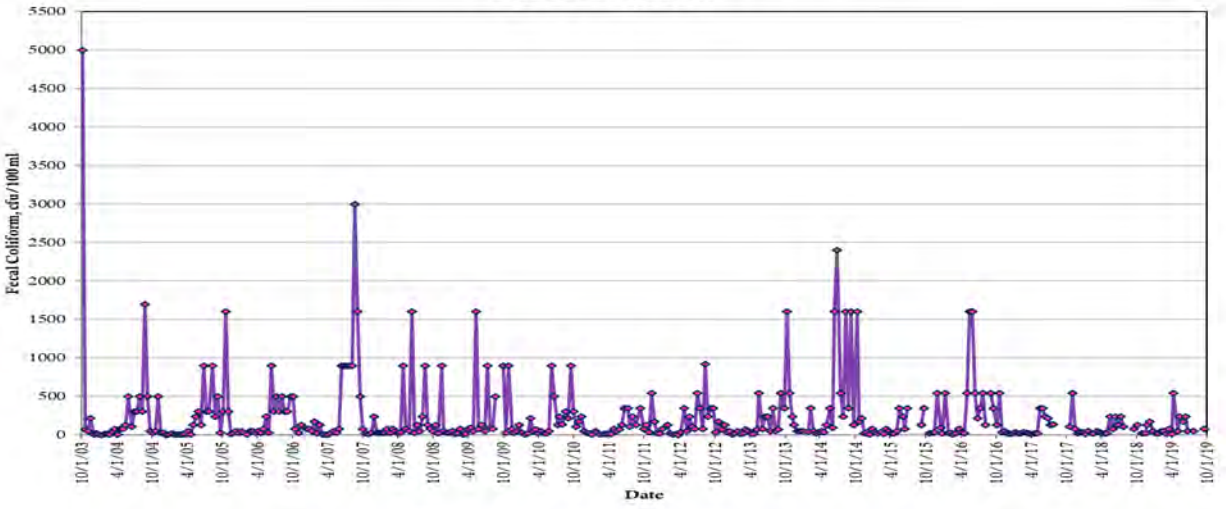
Hansen Creek at Hoehn Road - Site 19
Dissolved Oxygen



Hansen Creek at Hoehn Road - Site 19
Temperature



Hansen Creek at Hoehn Road - Site 19
Fecal Coliform



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
25	39	67	89	91	90	82	89	82	87	79	84	84	85

Long Term Trends								
Dissolved Oxygen			Temperature			Fecal Coliform		
16 yr	10 yr	5 yr	16 yr	10 yr	5 yr	16 yr	10 yr	5 yr
↑	↑	↑	–	–	–	–	–	–

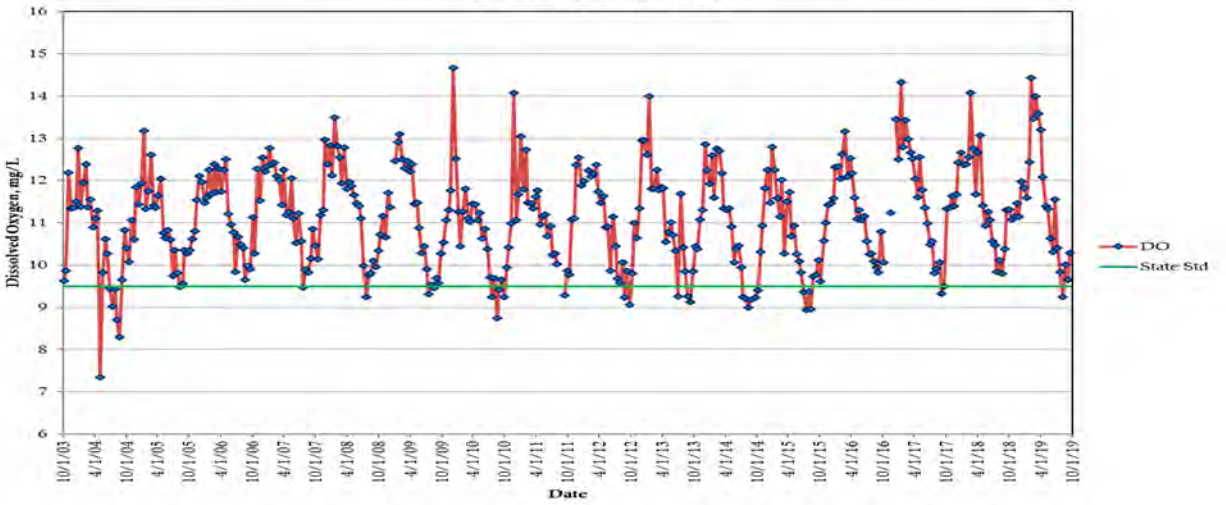
Site 20 is Hansen Creek at the Northern State Recreation Area, upstream from site 19. Water input to this site comes down from Lyman Hill and has very little developed land. This site is designated as core salmonid habitat.

Dissolved oxygen has been increasing over all time periods analyzed by this report. 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.

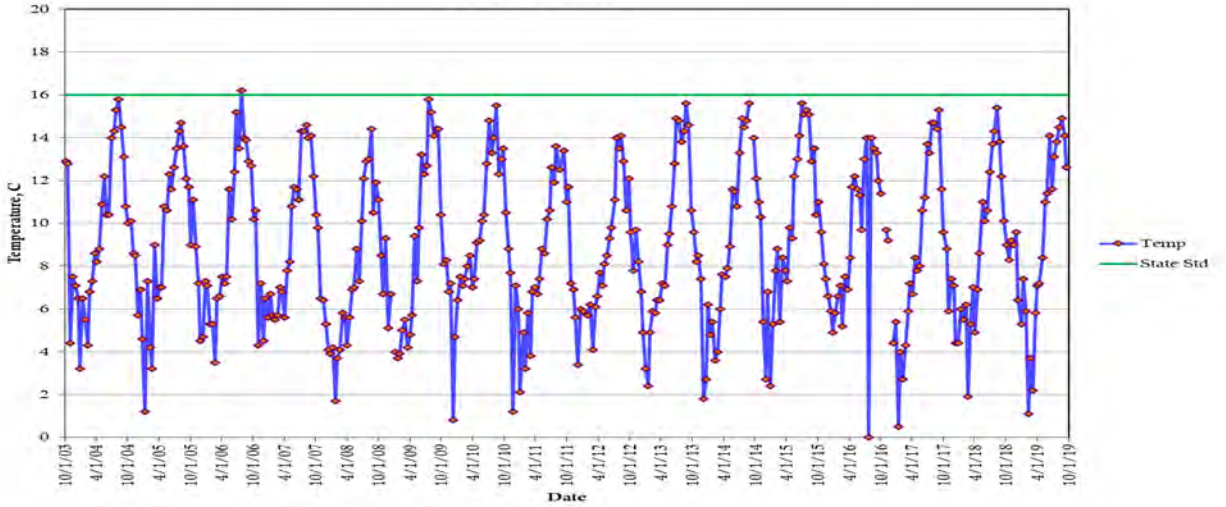
Site 20 rarely fails to pass state standards for both DO and temperature, year-round. Annual FC levels pass the state standard for geomean of 100, but do closely fail the state standard for a 90th percentile of 200.

Site 20 is tied for 21st out of 39 sites for number of significant trends, with 12, and is tied for 5th out of 39 sites for positive trends, with 83%.

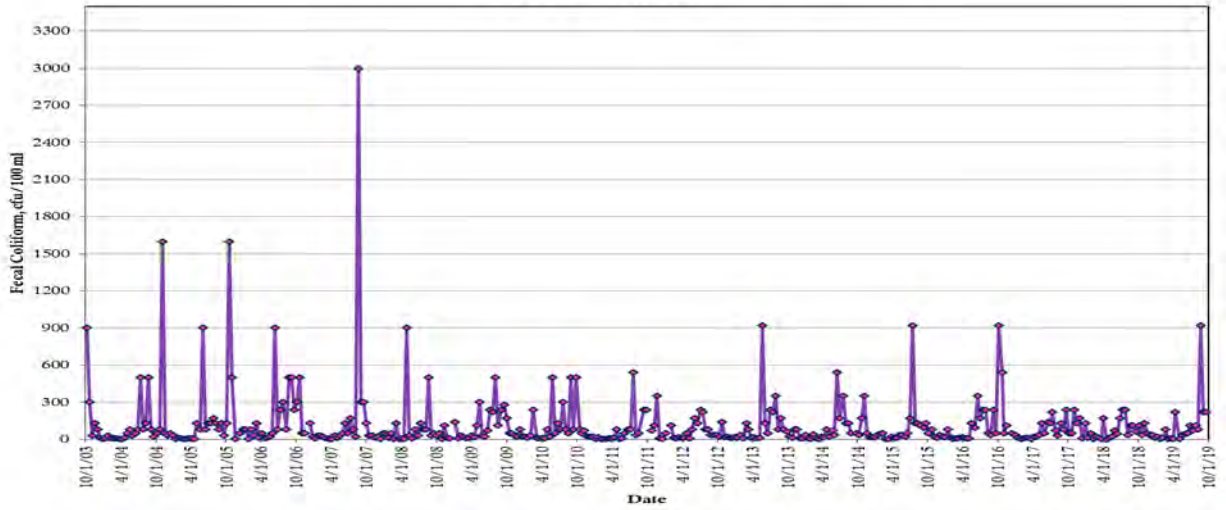
Hansen Creek at Northern State Hospital - Site 20
Dissolved Oxygen



Hansen Creek at Northern State Hospital - Site 20
Temperature



Hansen Creek at Northern State Hospital - Site 20
Fecal Coliform



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
36	34	46	87	80	91	82	76	86	68	76	88	80	74

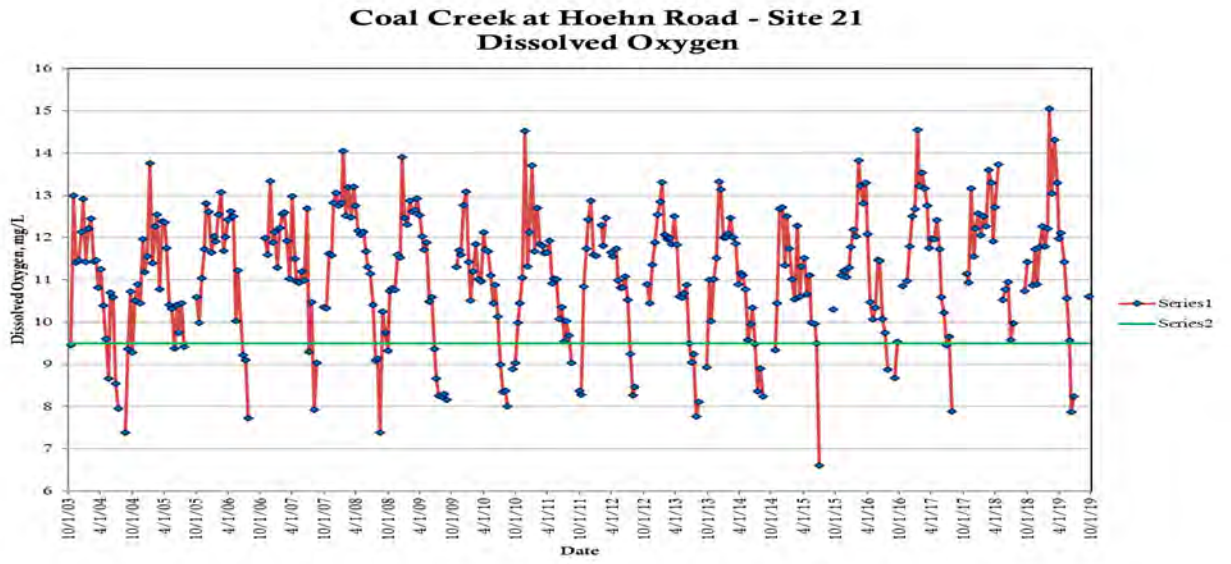
Long Term Trends								
Dissolved Oxygen			Temperature			Fecal Coliform		
16 yr	10 yr	5 yr	16 yr	10 yr	5 yr	16 yr	10 yr	5 yr
—	↑	↑	—	—	—	↓	—	—

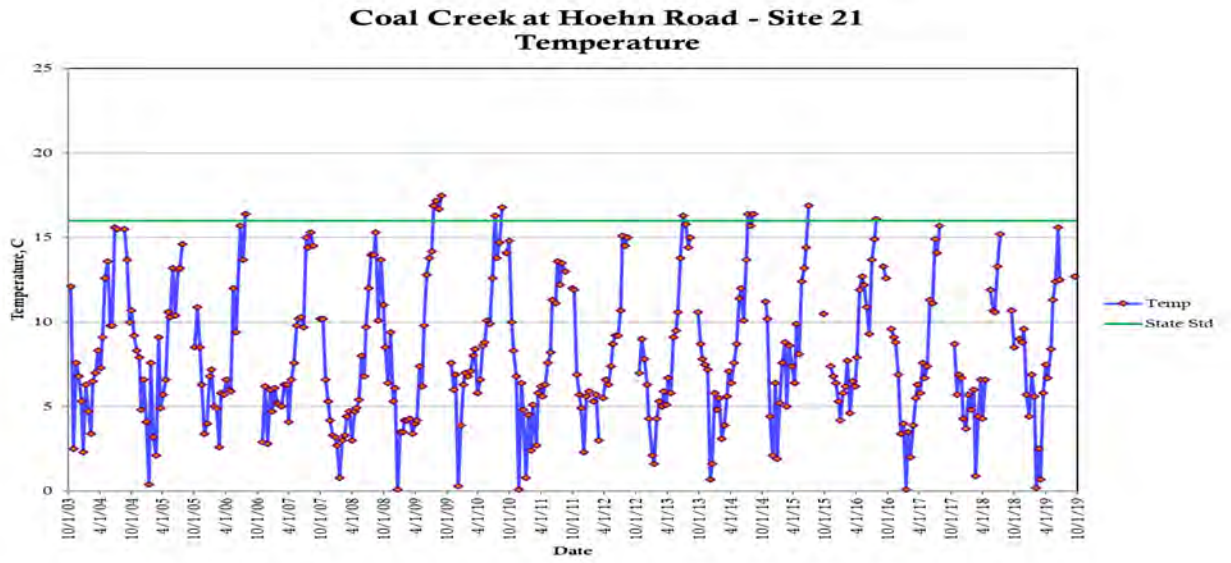
Site 21 is Coal Creek, downstream from site 22, and just prior to arriving in Skiyou Slough and ultimately the Skagit River. This site is pseudo-ephemeral and often can stop flowing by the end of the summer. This site is designated as core salmonid habitat.

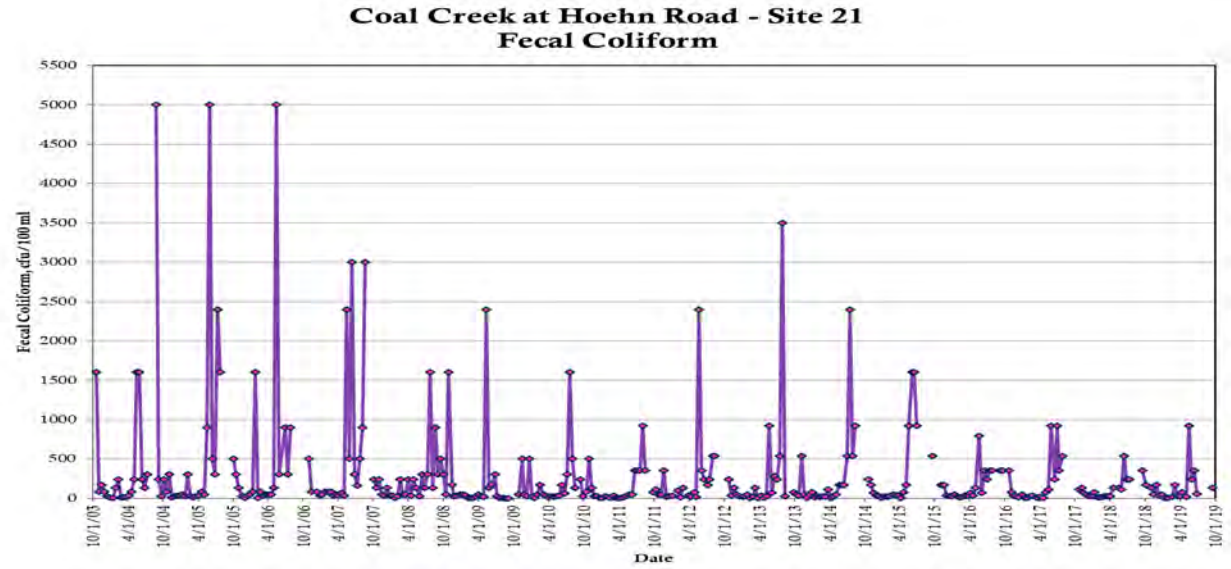
Dissolved oxygen has increased over the last ten years and five years. Fecal coliform counts are lower than they were sixteen years ago. WQI scores are generally in the upper-score end of the moderate concern category, and often score as least concern.

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 FC levels fail state standards.

Site 21 is tied for 30th out of 39 sites for number of significant trends, with 10, and is 13th out of 39 sites for positive trends, with 70%.


Coal Creek at Hoehn Road - Site 21
Dissolved Oxygen
Dissolved Oxygen, mg/L
Date
Series1
Series2


Coal Creek at Hoehn Road - Site 21
Temperature
Temperature, C
Date
Temp
State Std


Coal Creek at Hoehn Road - Site 21
Fecal Coliform
Fecal Coliform, cfu/100 ml
Date

22

Coal Creek
@ Highway 20

Upstream Ag

Water Quality Index (WQI)													
2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
37	63	95	96	93	95	89	83	85	87	95	85	93	79

Long Term Trends								
Dissolved Oxygen			Temperature			Fecal Coliform		
16 yr	10 yr	5 yr	16 yr	10 yr	5 yr	16 yr	10 yr	5 yr
–	–	↑	–	↑	–	↑	–	–

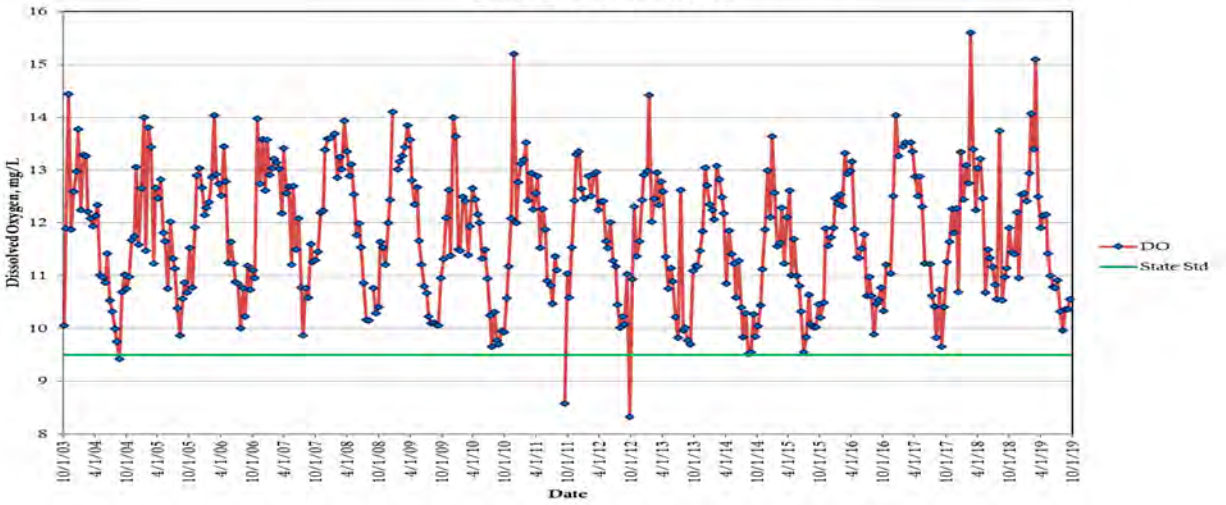
Site 22 is Coal Creek as it comes down off of Lyman Hill, and is upstream of site 21. This site is designated as core salmonid habitat.

Dissolved oxygen has increased over the most recent five years. Temperature increased since ten years ago, and FC counts are higher than they were at the start of this program. WQI scores are regularly in the category of least concern.

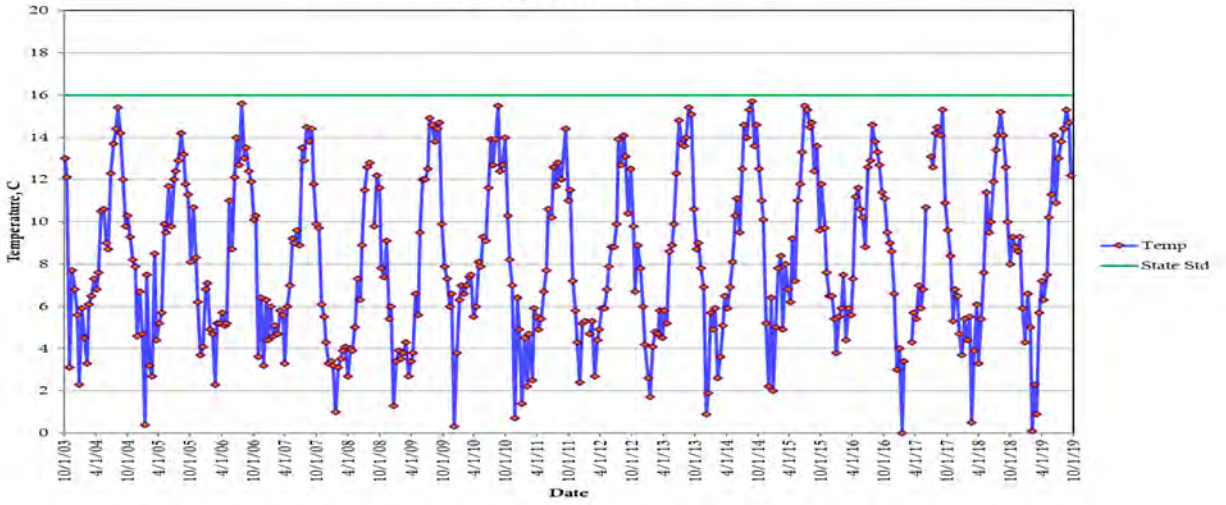
Site 22 rarely fails to meet state standards for DO or temperature, year-round. Annual FC levels pass the state standard for geomean of 100, but do fail the state standard for a 90th percentile of 200.

Site 22 is tied for 25th out of 39 sites for number of significant trends, with 11, and 36th out of 39 sites for positive trends, with 27%.

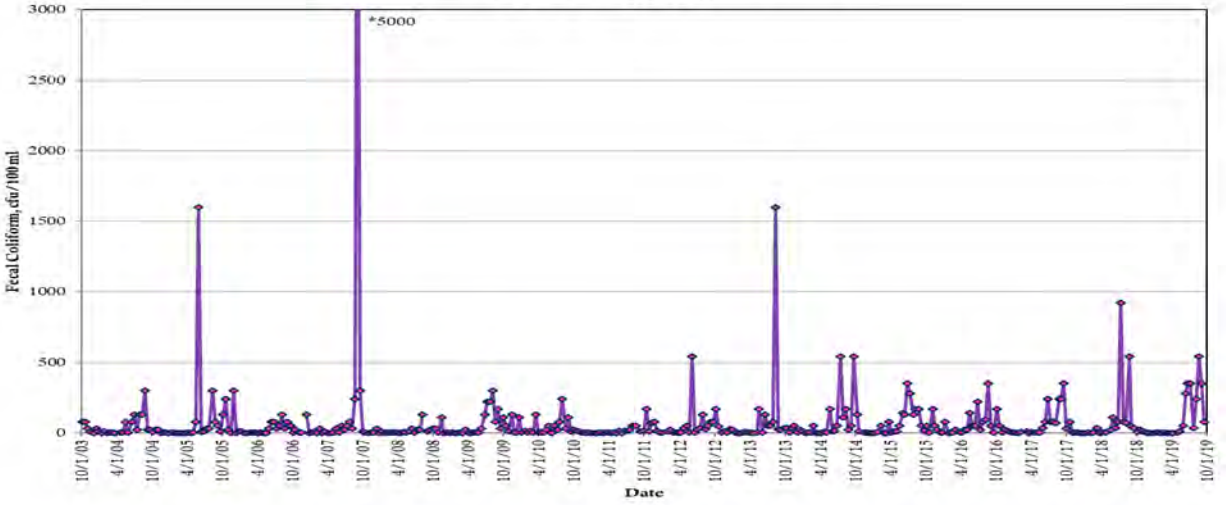
Coal Creek at Highway 20 - Site 22
Dissolved Oxygen



Coal Creek at Highway 20 - Site 22
Temperature



Coal Creek at Highway 20 - Site 22
Fecal Coliform



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
27	48	85	98	95	98	95	90	96	83	90	95	85	89

Long Term Trends								
Dissolved Oxygen			Temperature			Fecal Coliform		
16 yr	10 yr	5 yr	16 yr	10 yr	5 yr	16 yr	10 yr	5 yr
–	–	–	–	–	–	–	–	–

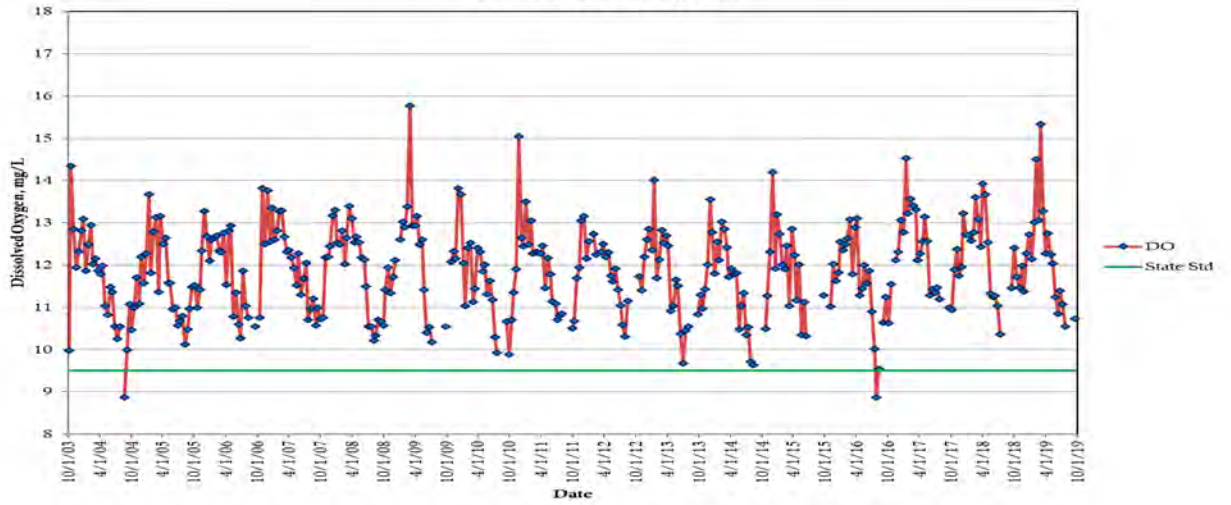
Site 23 is Wiseman Creek as it comes down off Lyman Hill, and prior to entering Skiyou Slough and ultimately the Skagit River. This site is designated as core salmonid habitat.

No significant monthly trends were observed in dissolved oxygen, temperature, or fecal coliform at this site, over any of the time periods analyzed. WQI is consistently in the category of least concern.

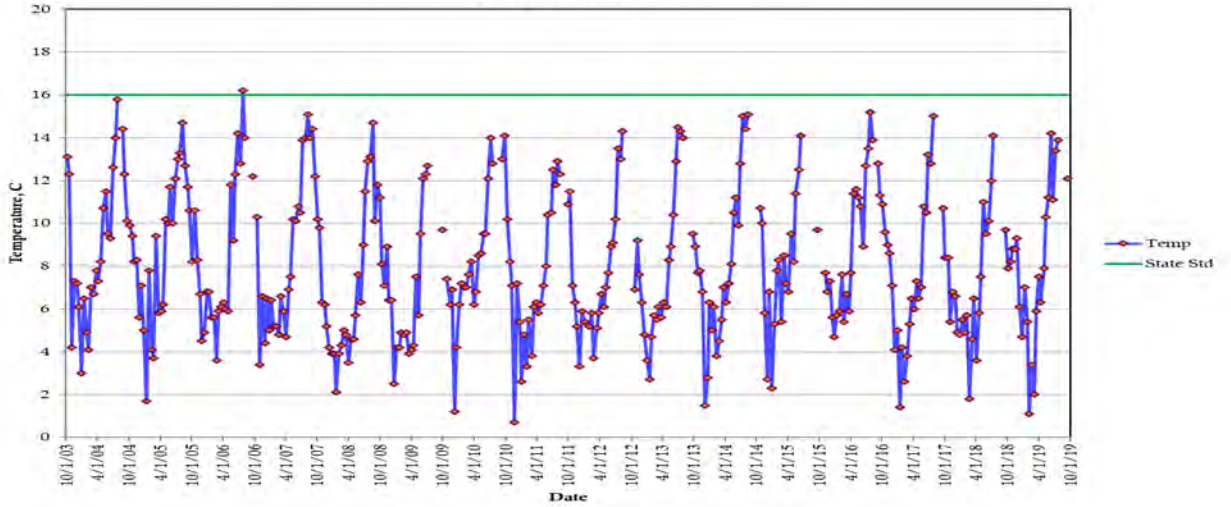
Site 23 rarely, if ever, fails to meet state standards for DO and water temperature, year-round. Annual FC levels easily meet state standards.

Site 23 is tied for 35th out of 39 sites for number of significant trends, with 8, and 20th out of 3 sites for positive trends, with 60%.

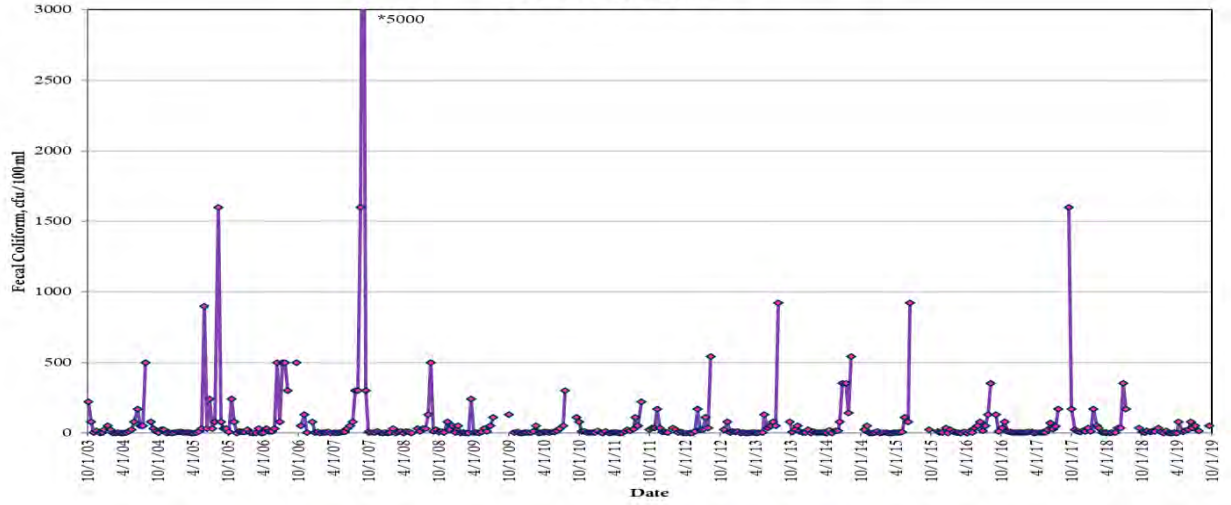
Wiseman Creek at Minkler Road - Site 23
Dissolved Oxygen



Wiseman Creek at Minkler Road - Site 23
Temperature



Wiseman Creek at Minkler Road - Site 23
Fecal Coliform



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
35	56	41	69	63	62	45	52	50	62	31	64	71	47

Long Term Trends								
Dissolved Oxygen			Temperature			Fecal Coliform		
16 yr	10 yr	5 yr	16 yr	10 yr	5 yr	16 yr	10 yr	5 yr
↑	↑	–	–	–	–	↓	–	–

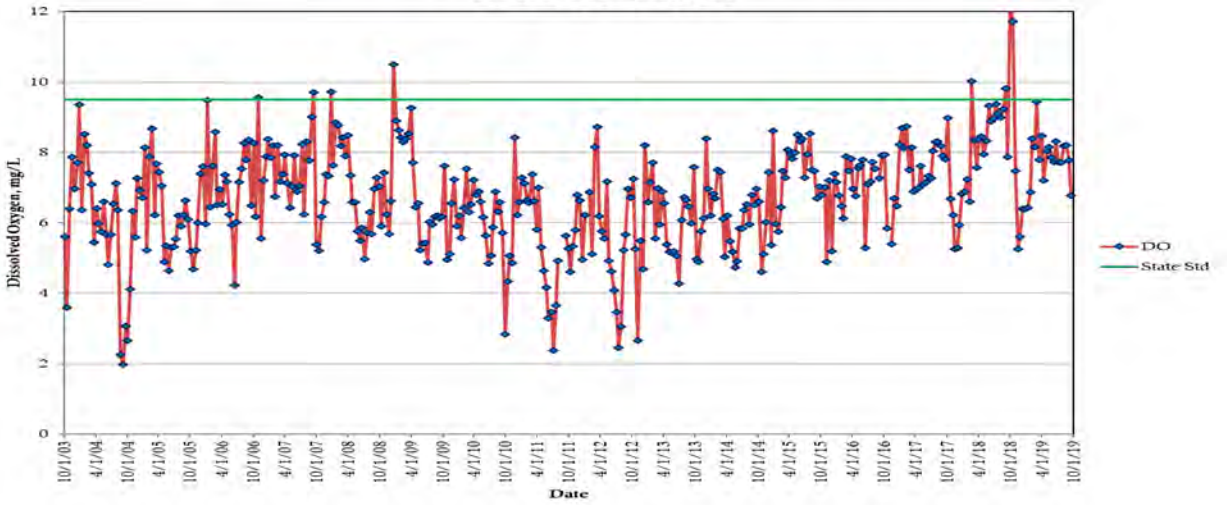
Site 24 is Mannser Creek, after descending off of Mount Josephine and prior to joining the Skagit River, just east of Lyman. This site is designated as core salmonid habitat.

Since this program began, dissolved oxygen has increased and fecal coliform has decreased. Dissolved oxygen has also been increasing for the most recent ten years. WQI scores are regularly in the category of moderate concern.

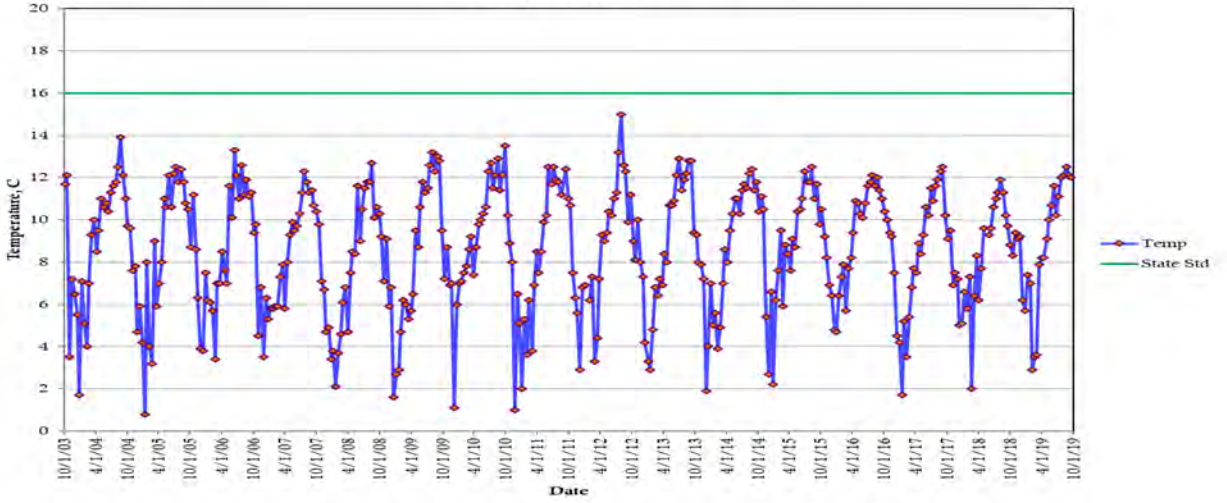
Site 24 is slow-moving and inundated with invasive reed canary grass. This has the effect of lowering DO but also decreasing temperature. As a result, this site is almost always below state standards for DO year-round, but has never exceeded state temperature standards even once in the history of this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

Site 24 is tied for 14th out of 39 sites for number of significant trends, with 14, and is tied for 11th out of 39 sites for positive trends, with 71%.

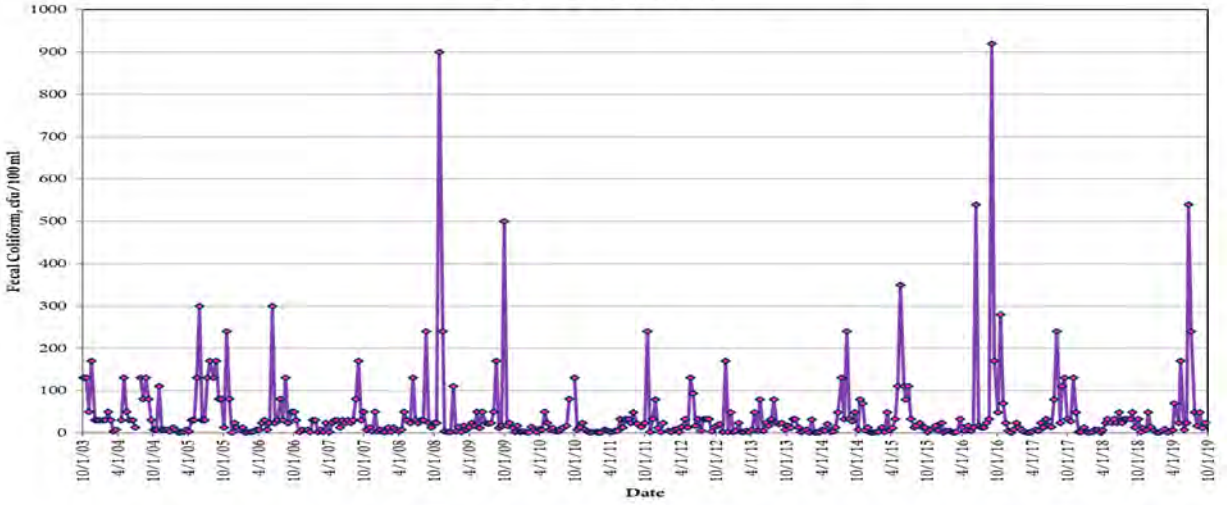
Mannser Creek at Lyman-Hamilton Highway - Site 24
Dissolved Oxygen



Mannser Creek at Lyman-Hamilton Highway - Site 24
Temperature



Mannser Creek at Lyman-Hamilton Highway - Site 24
Fecal Coliform



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
74	90	87	97	97	96	96	97	97	94	93	94	96	91

Long Term Trends								
Dissolved Oxygen			Temperature			Fecal Coliform		
16 yr	10 yr	5 yr	16 yr	10 yr	5 yr	16 yr	10 yr	5 yr
—	↑	Not Enough Data	—	—	Not Enough Data	—	—	Not Enough Data

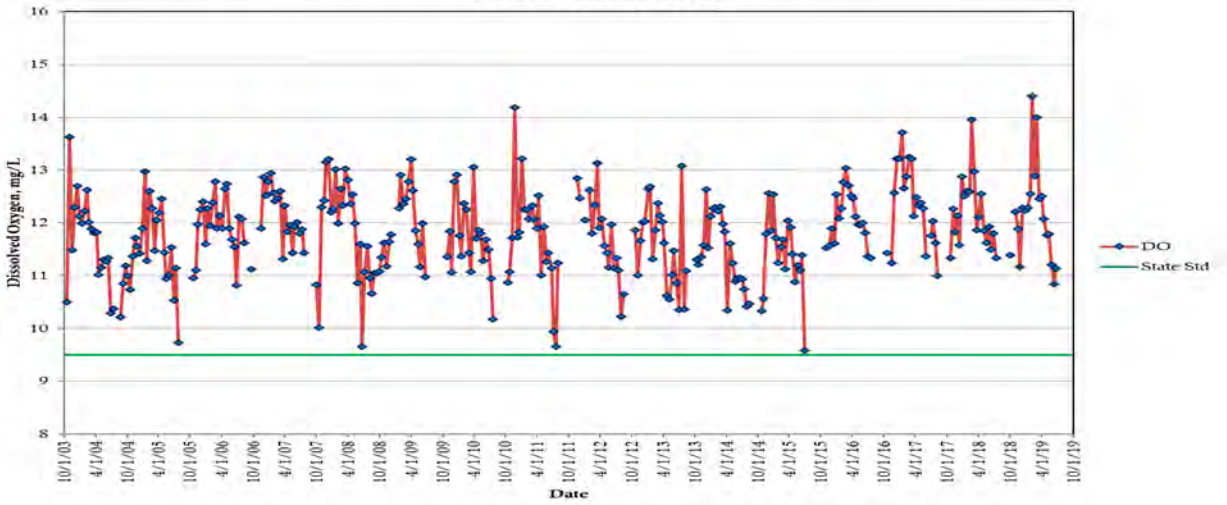
Site 25 is Red Cabin Creek, after it comes off of Mount Josephine, in between Lyman and Hamilton. This is an ephemeral creek that regularly dries up by the end of summer. This site is designated as core salmonid habitat.

Due to the ephemeral nature of this creek, there were not enough data points collected to be sufficient for generating five-year monthly trends. Dissolved oxygen has increased over the most recent ten years. Except for the first year of WQI monitoring, this creek has solely been in the category of least concern.

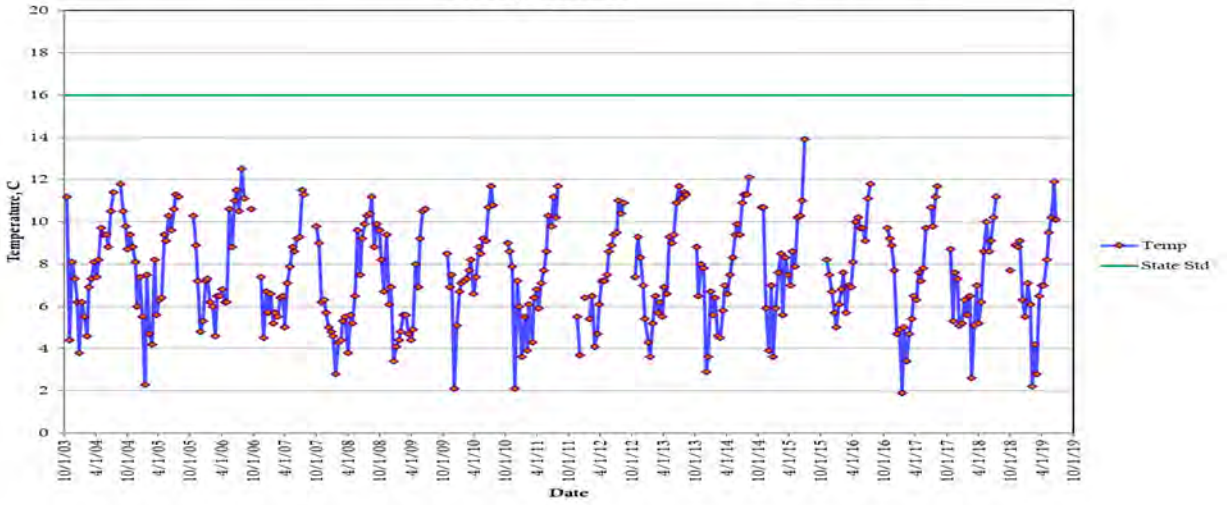
Site 25 has never failed to meet state standards for DO or water temperature on any collection day over the history of this program. Annual FC levels easily meet state standards.

Site 25 is tied for 30th out of 39 sites for number of significant trends, with 10, and is tied for 26th out of 39 sites for positive trends, with 50%.

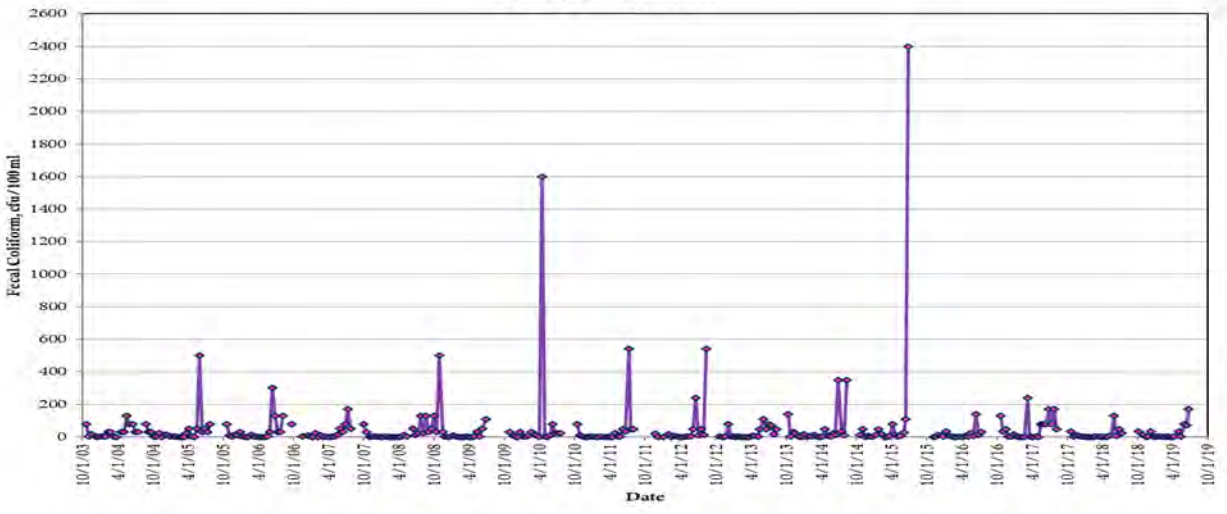
Red Cabin Creek at Hamilton Cemetery Road - Site 25
Dissolved Oxygen



Red Cabin Creek at Hamilton Cemetery Road - Site 25
Temperature



Red Cabin Creek at Hamilton Cemetery Road - Site 25
Fecal Coliform



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
62	77	56	71	79	83	65	75	84	88	77	93	84	85

Long Term Trends								
Dissolved Oxygen			Temperature			Fecal Coliform		
16 yr	10 yr	5 yr	16 yr	10 yr	5 yr	16 yr	10 yr	5 yr
–	–	Not Enough Data	–	–	Not Enough Data	–	–	Not Enough Data

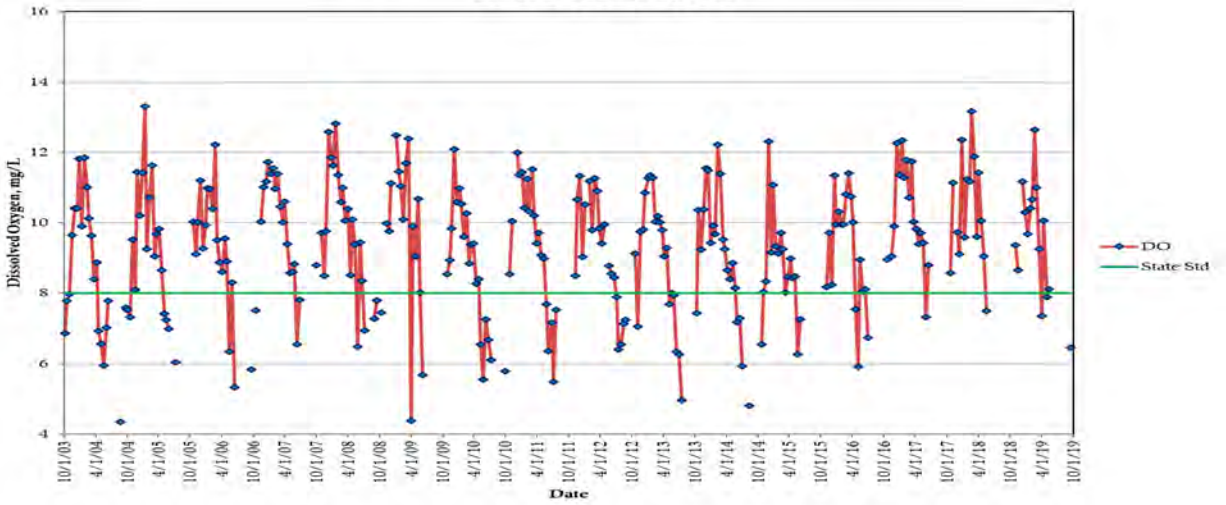
Site 28 is Brickyard Creek, after it has passed through northern Sedro-Woolley, just prior to entering Hart Slough, and eventually the Skagit River. This is an ephemeral creek that regularly dries up by the end of summer. This site is designated as salmonid spawning, rearing, and migration (SRM) status.

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.

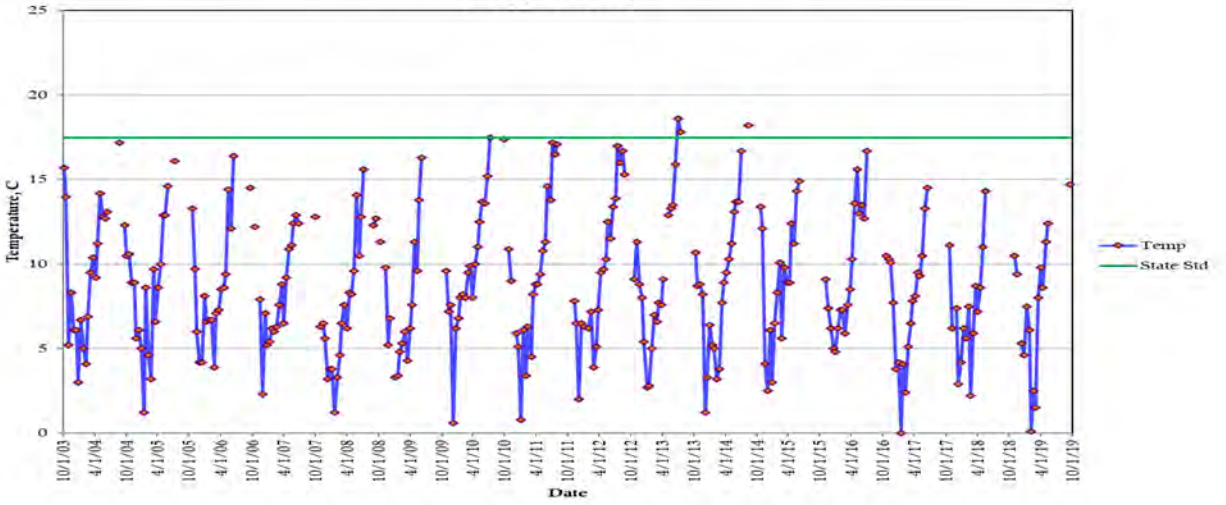
Site 28 regularly fails to meet state standards for DO during the warmer months, but rarely fails state standards for water temperature. Annual FC levels pass the state standard for geomean of 100, but fail the state standard for a 90th percentile of 200.

Site 28 is 39th out of 39 sites for number of significant trends, with four, and is tied for 26th out of 39 sites for positive trends, with 50%.

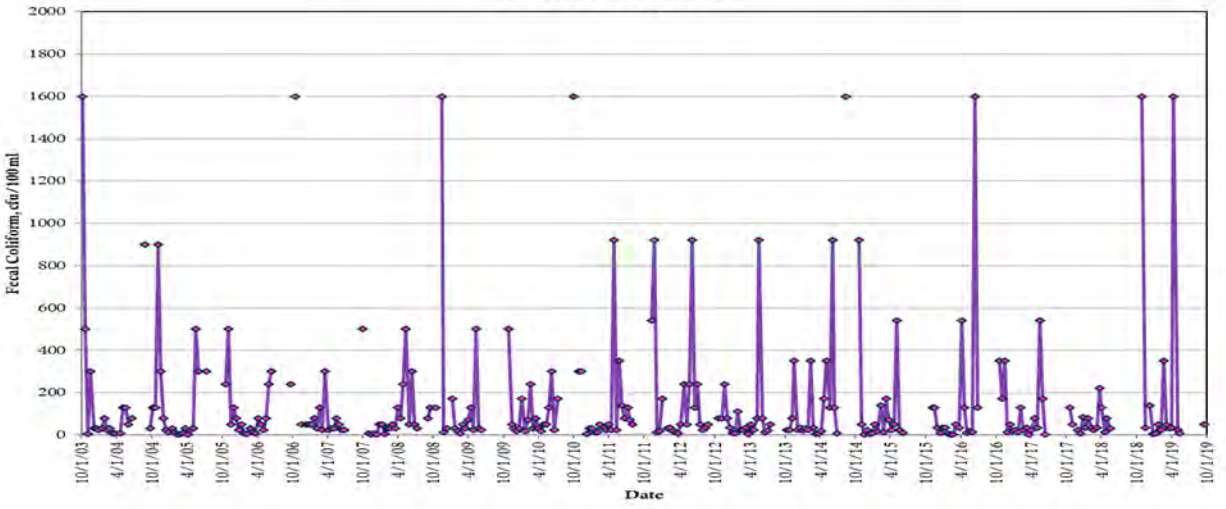
Brickyard Creek at Highway 20 - Site 28
Dissolved Oxygen



Brickyard Creek at Highway 20 - Site 28
Temperature



Brickyard Creek at Highway 20 - Site 28
Fecal Coliform



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
76	63	82	94	92	86	82	87	94	93	93	85	92	81

Long Term Trends								
Dissolved Oxygen			Temperature			Fecal Coliform		
16 yr	10 yr	5 yr	16 yr	10 yr	5 yr	16 yr	10 yr	5 yr
—	—	↑	—	—	↓	—	—	—

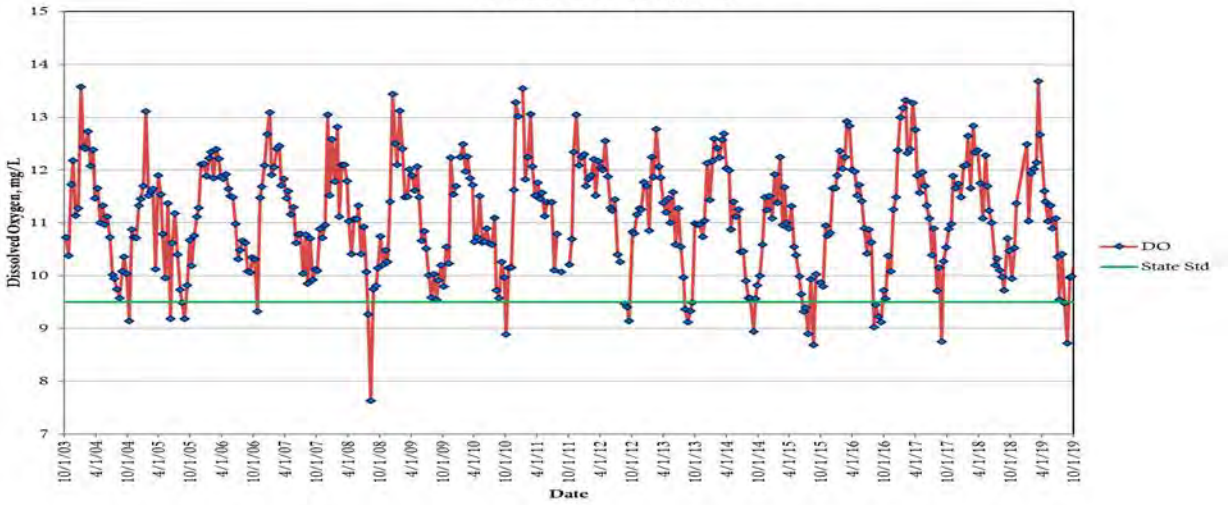
Site 29 is the Skagit River, after it intersects Burlington and Mount Vernon, and prior to the terminal fork. The river is designated as core salmonid habitat and as salmonid spawning, rearing, and migration (SRM) status.

Over the most recent five years, DO has increased and water temperature has decreased. WQI scores are consistently in the category of least concern.

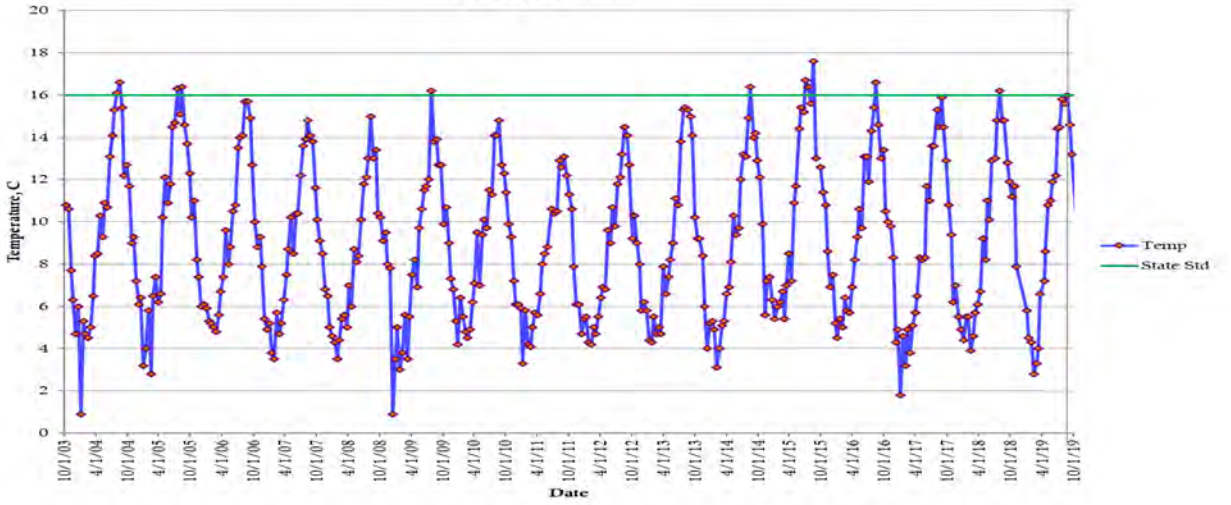
Site 29 rarely fails to meet state standards for DO and water temperature, and only ever at the warmest time of the year. Annual FC levels easily meet state standards.

Site 29 is tied for 35th out of 39 sites for number of significant trends, with eight, and is tied for 26th out of 39 sites for positive trends, with 50%.

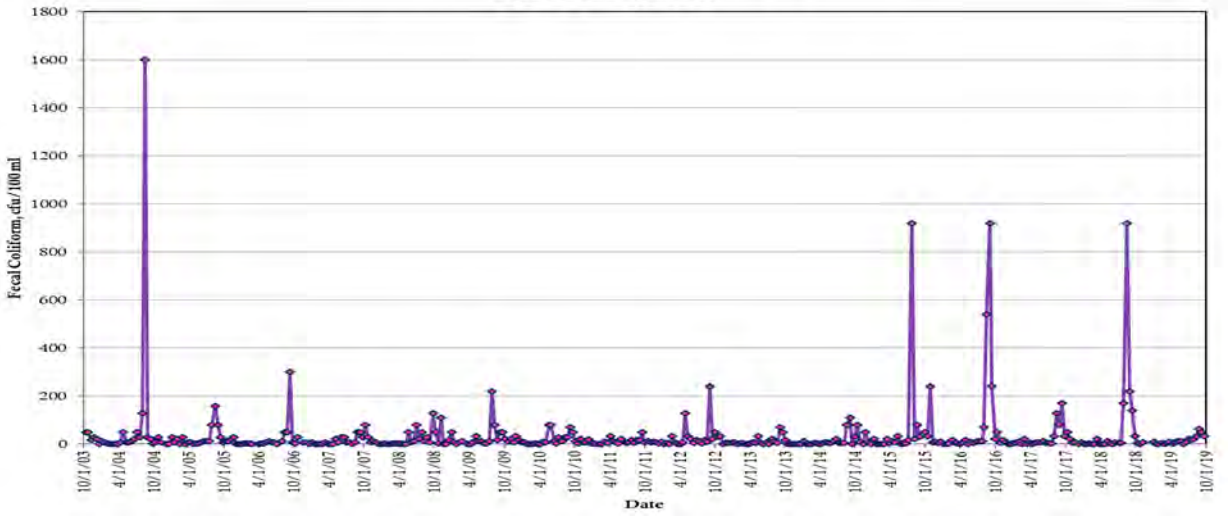
Skagit River at River Bend Road - Site 29
Dissolved Oxygen

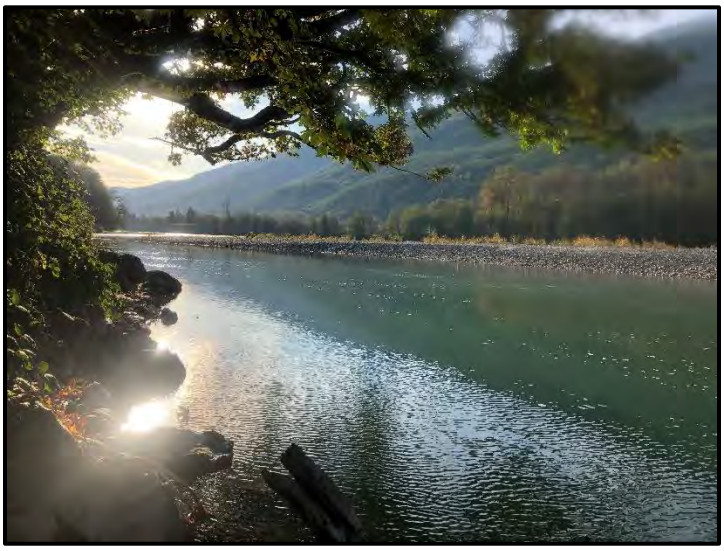


Skagit River at River Bend Road - Site 29
Temperature



Skagit River at River Bend Road - Site 29
Fecal Coliform





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
66	78	85	89	93	90	90	94	90	85	92	88	96	93

Long Term Trends

Dissolved Oxygen			Temperature			Fecal Coliform		
16 yr	10 yr	5 yr	16 yr	10 yr	5 yr	16 yr	10 yr	5 yr
—	↑	↑	—	↑	—	—	—	—

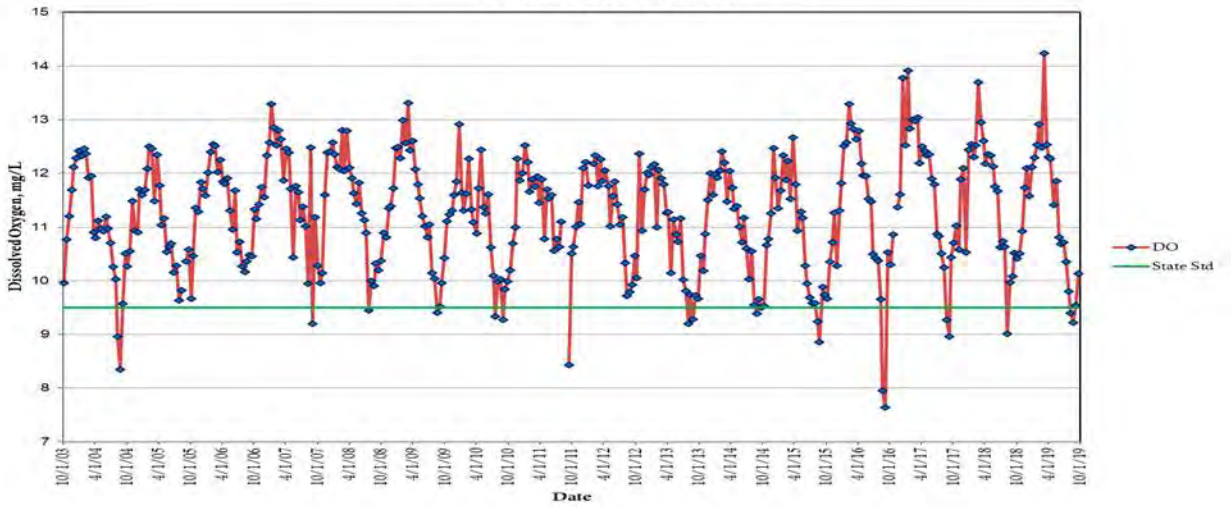
Site 30 is the Skagit River, at its furthest upstream sampling point for this program, east of Hamilton. The river is designated as core salmonid habitat.

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

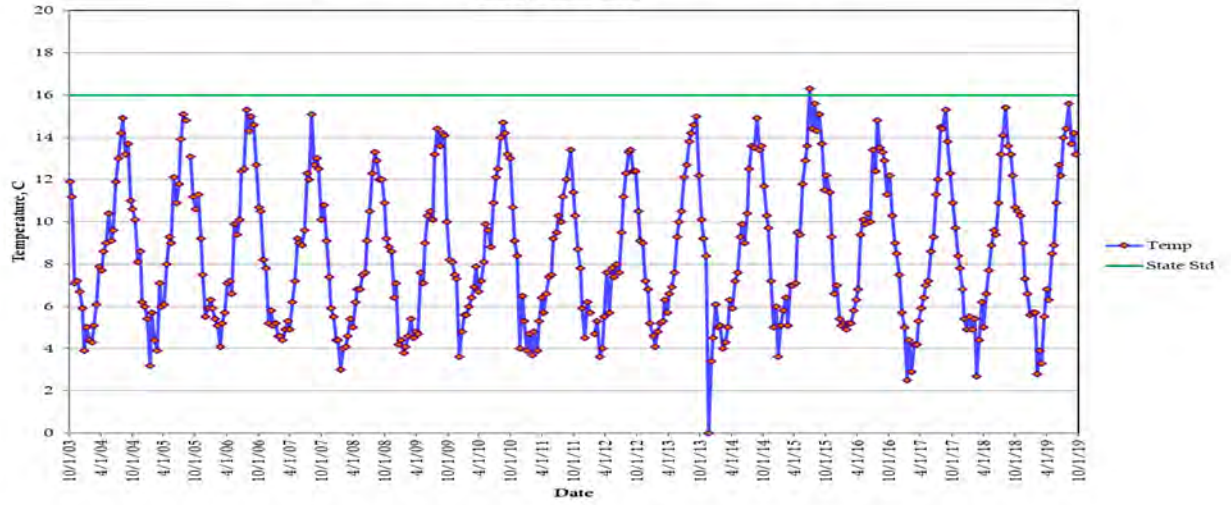
Site 30 rarely fails to meet state standards for DO and water temperature, and only ever at the warmest time of the year. Annual FC levels easily meet state standards.

Site 30 is tied for 16th out of 39 sites for number of significant trends, with 14, and is 19th out of 39 sites for positive trends, with 64%.

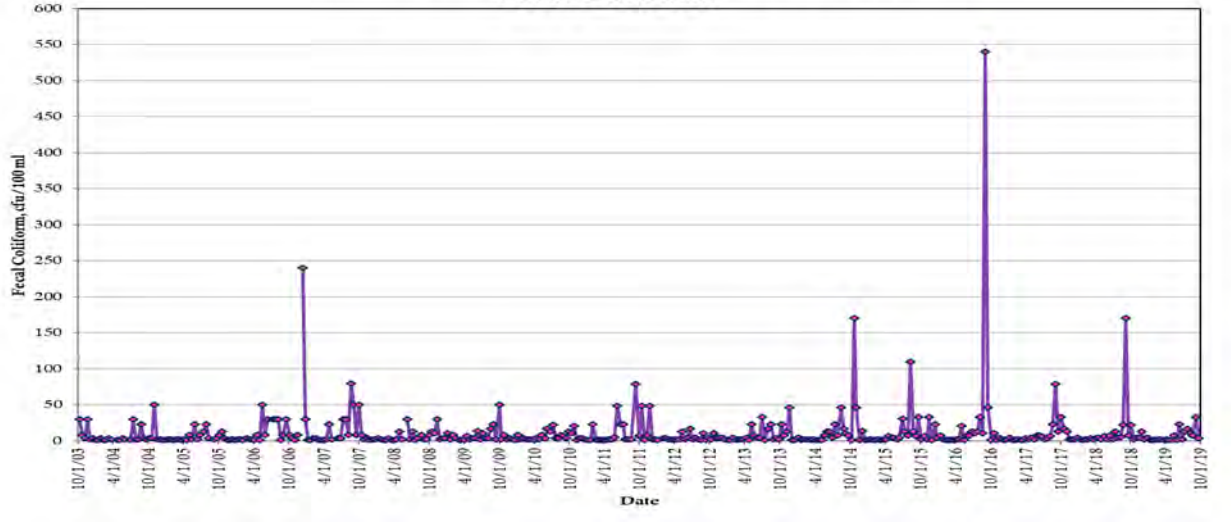
Skagit River at Cape Horn Road - Site 30
Dissolved Oxygen



Skagit River at Cape Horn Road - Site 30
Temperature



Skagit River at Cape Horn Road - Site 30
Fecal Coliform



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
34	47	43	75	83	92	70	89	88	83	80	84	93	91

Long Term Trends								
Dissolved Oxygen			Temperature			Fecal Coliform		
16 yr	10 yr	5 yr	16 yr	10 yr	5 yr	16 yr	10 yr	5 yr
↑	↑	↑	–	–	↓	↓	–	–

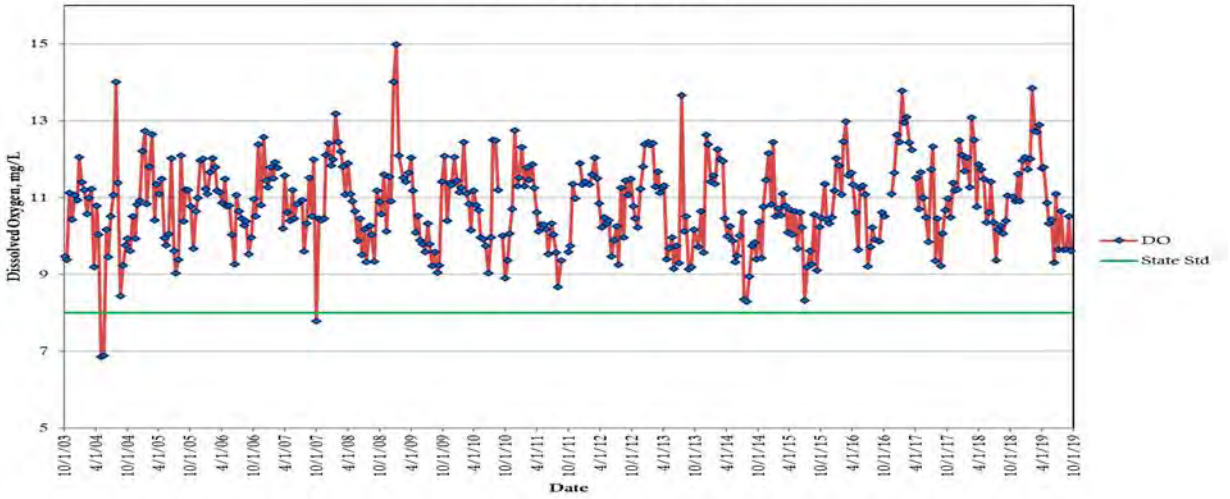
Site 32 is the Samish River, and is the last site that is sampled by this program prior to the river terminating in Samish Bay. The Samish River's watershed contains expansive agricultural activity. This site is designated as salmonid spawning, rearing, and migration (SRM) status.

Dissolved oxygen has increased across all time intervals analyzed in this report. Water temperatures 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.

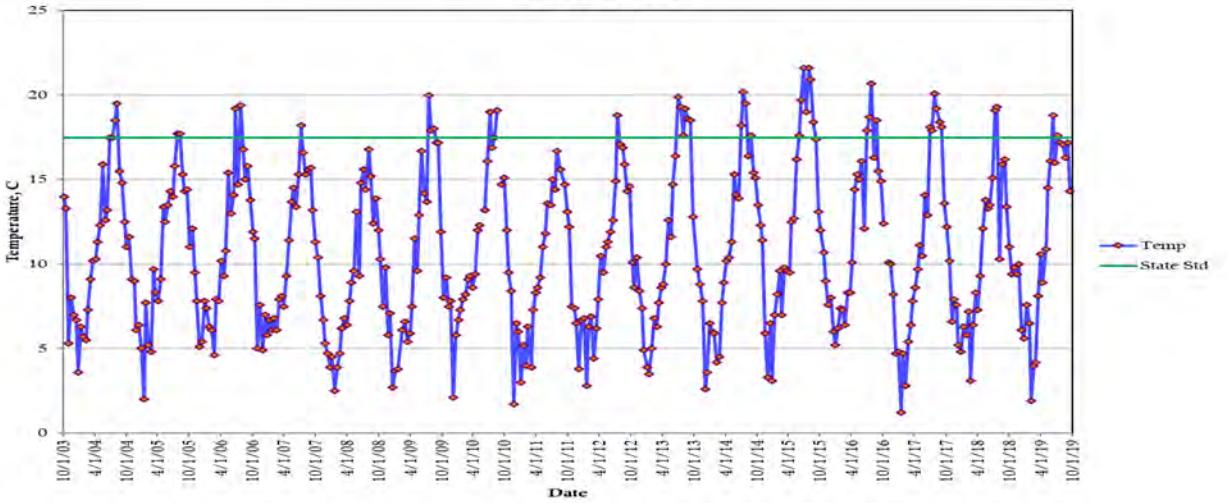
Site 32 almost never fails to meet state standards for DO, but typically exceeds state standards for water temperature during the warmer months of the year. Annual FC levels pass the state standard for geomean of 100, but fail the state standard for a 90th percentile of 200.

Site 32 is 3rd out of 39 sites for number of significant trends, with 19, and is tied for 2nd out of 39 sites for positive trends, with 89%.

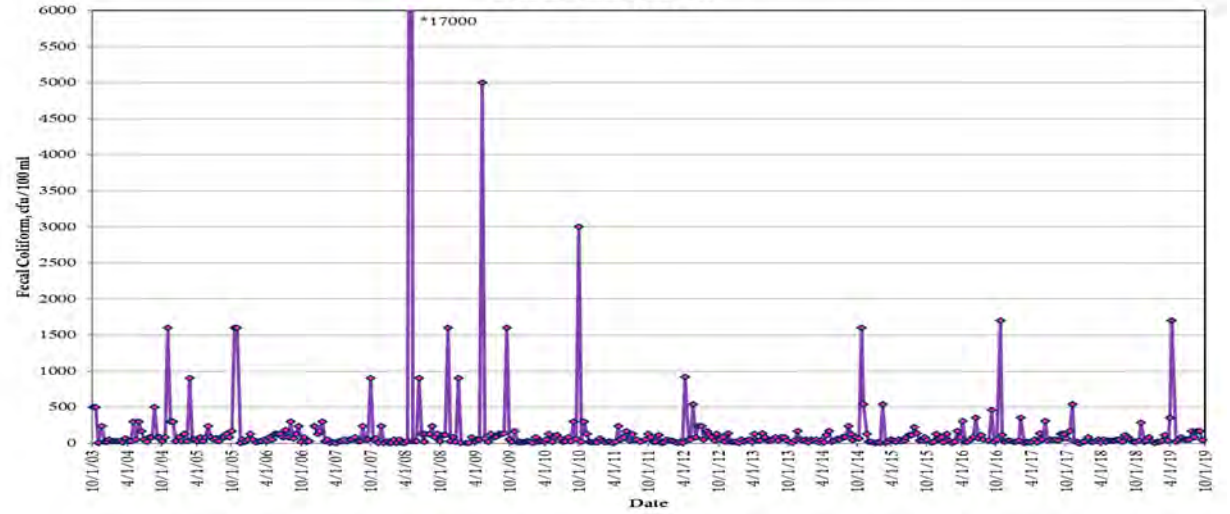
Samish River at Thomas Road - Site 32
Dissolved Oxygen



Samish River at Thomas Road - Site 32
Temperature



Samish River at Thomas Road - Site 32
Fecal Coliform



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
2	5	6	15	12	33	37	24	17	24	23	35	42	16

Long Term Trends

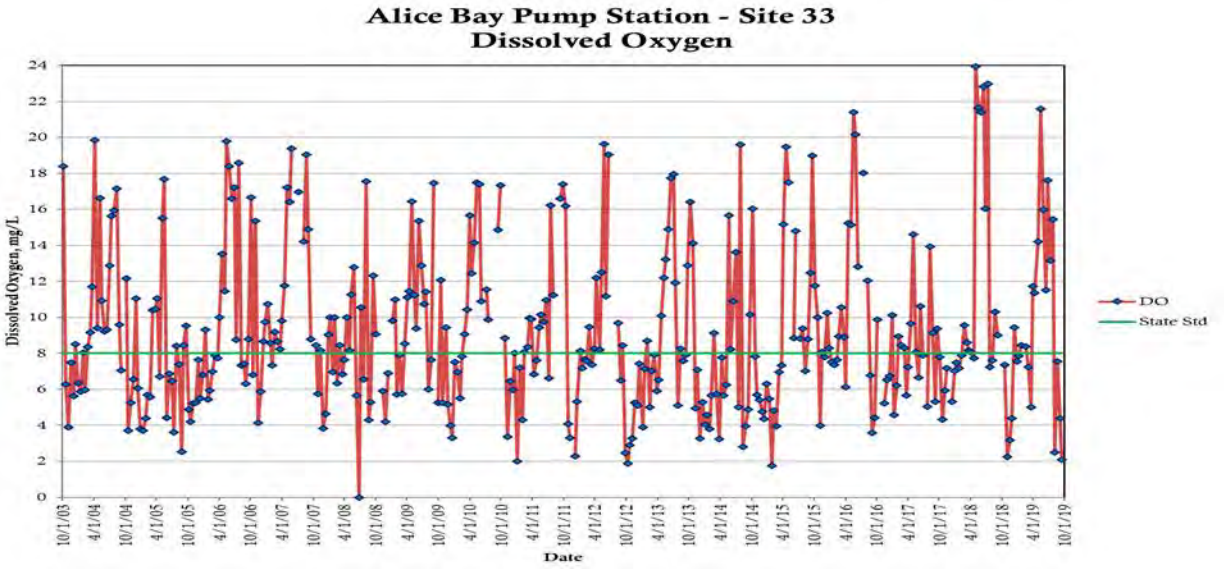
Dissolved Oxygen			Temperature			Fecal Coliform		
16 yr	10 yr	5 yr	16 yr	10 yr	5 yr	16 yr	10 yr	5 yr
—	—	—	—	—	—	↓	↓	—

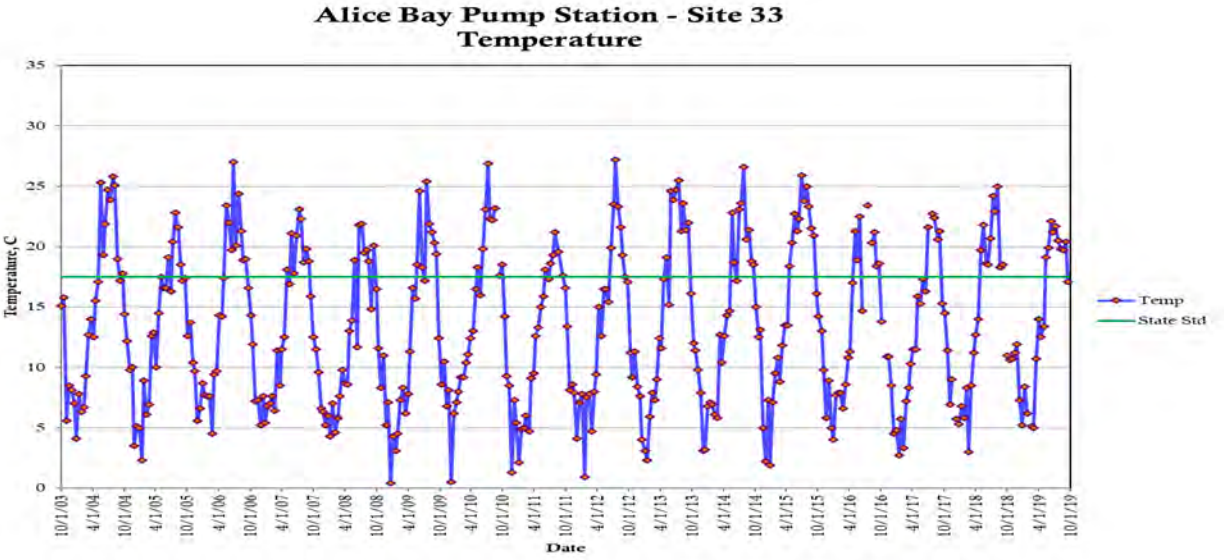
Site 33 is the pump station of agricultural drainage ditches at Alice Bay, just to the west of the mouth of the Samish River. Sites like this are characterized by being stagnant or slow-moving, and are heavily tidally-influenced. This site is designated as salmonid spawning, rearing, and migration (SRM)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

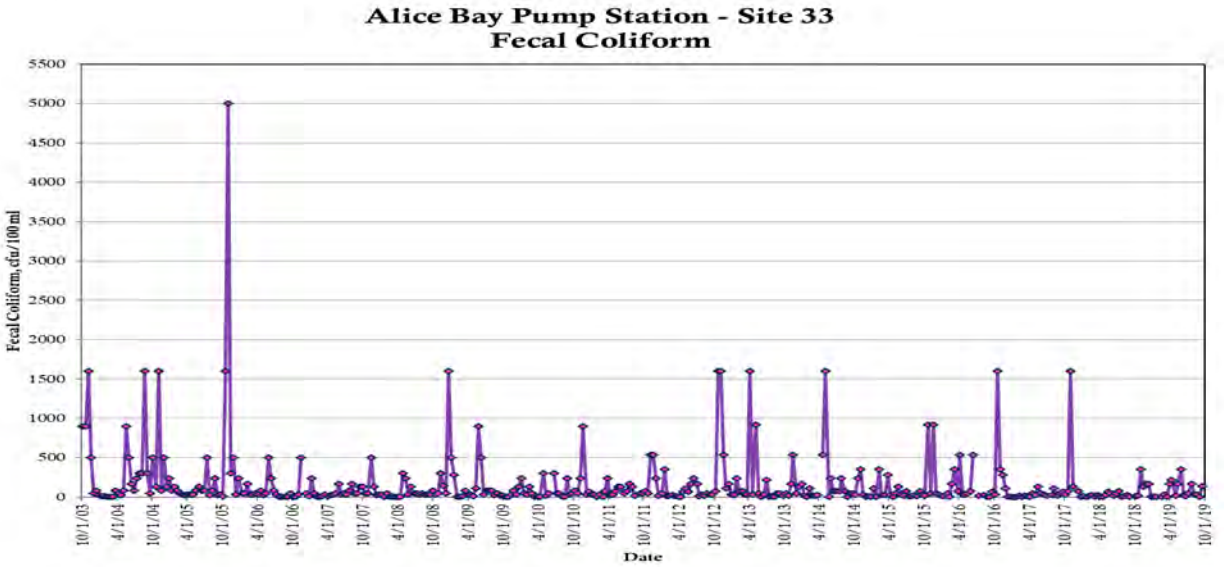
Fecal coliform counts at this site have declined over the last 16 years and the last 10 years. WQI scores are consistently in the category of highest concern.

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 25th out of 39 sites for number of significant trends, with 11, and is tied for 9th out of 39 sites for positive trends, with 73%.


Alice Bay Pump Station - Site 33
Dissolved Oxygen
Dissolved Oxygen, mg/L
Date
DO
State Std


Alice Bay Pump Station - Site 33
Temperature
Temperature, C
Date
Temp
State Std


Alice Bay Pump Station - Site 33
Fecal Coliform
Fecal Coliform, cfu/100 ml
Date

34

No Name Slough
@ Bayview-Edison Road

Downstream Ag

Water Quality Index (WQI)													
2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
1	1	1	14	11	31	22	13	29	30	51	27	36	27

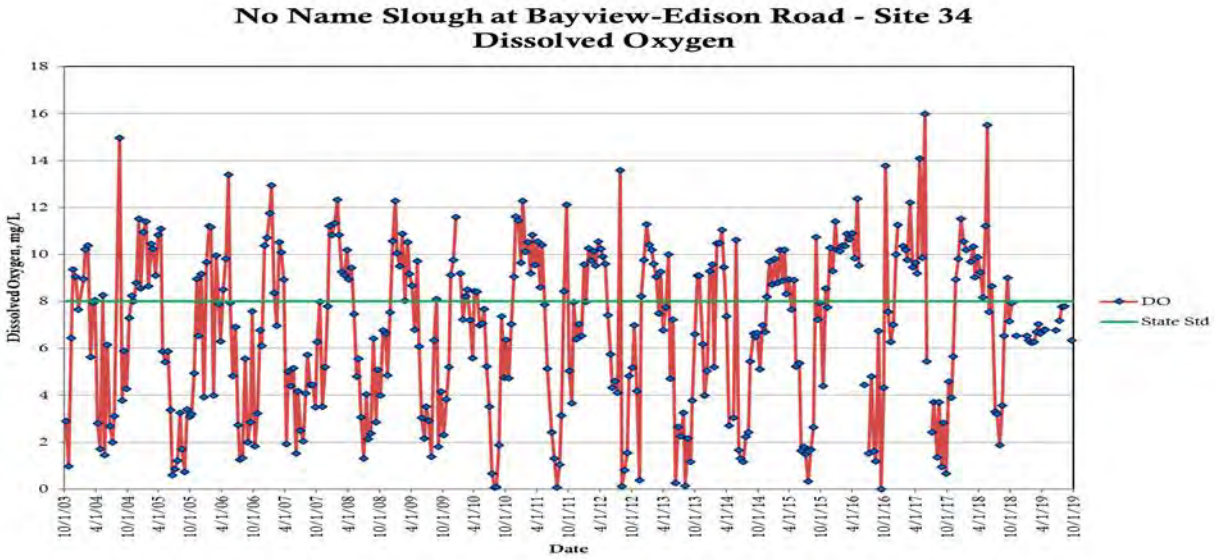
Long Term Trends								
Dissolved Oxygen			Temperature			Fecal Coliform		
16 yr	10 yr	5 yr	16 yr	10 yr	5 yr	16 yr	10 yr	5 yr
↑	↑	↑	↑	↑	↓	↓	↓	–

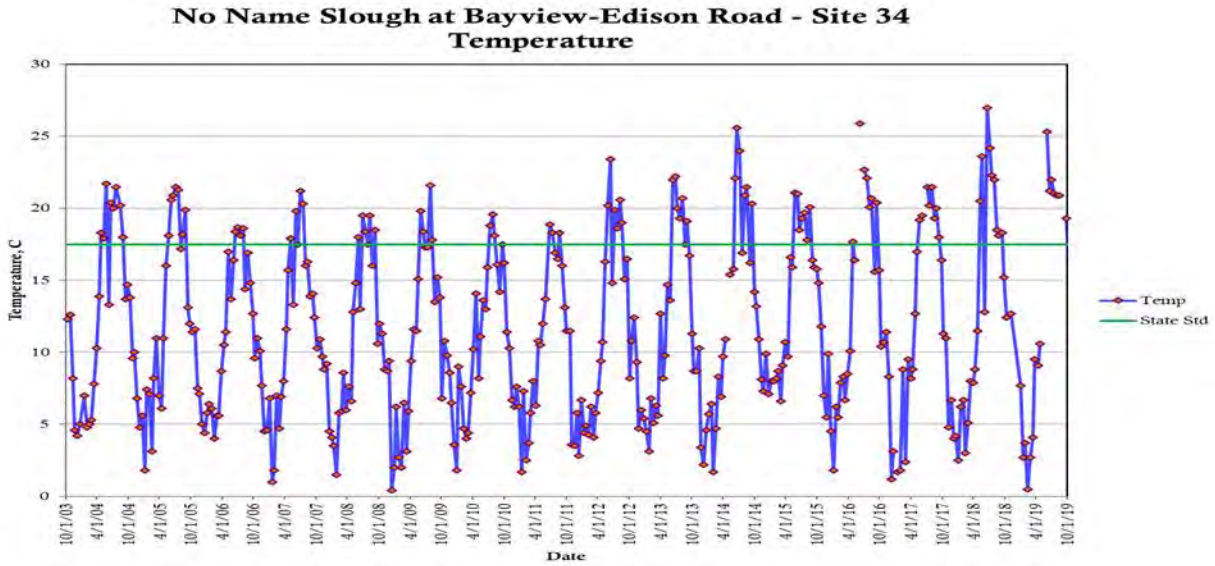
Site 34 is No Name Slough, west of the Skagit Regional Airport, and just prior to terminating in Padilla Bay. Sites like this are characterized by being stagnant or slow-moving, and are heavily tidally-influenced. This site is designated as salmonid spawning, rearing, and migration (SRM) status.

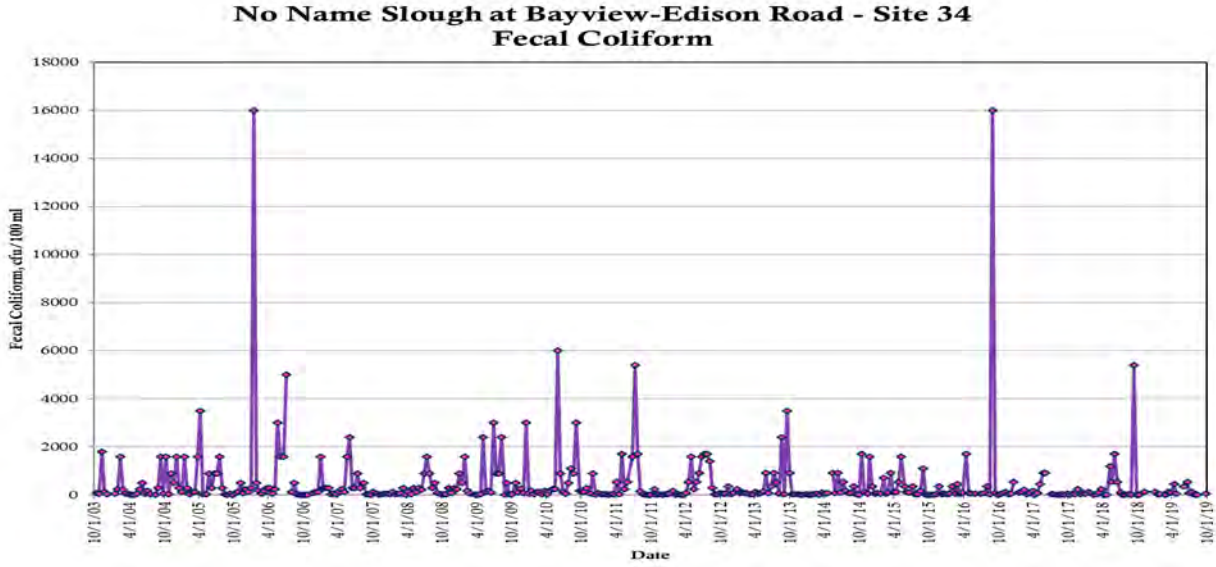
Dissolved oxygen has increased across all time periods of this program. Water temperatures are warmer now than they were at the beginning of the program or 10 years ago, but have declined in the most recent five years. Fecal coliform counts are lower than they were at the beginning of this program and ten years ago.

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

Site 34 is 1st out of 39 sites for number of significant trends, with 24, and is tied for 15th out of 39 sites for positive trends, with 67%.


No Name Slough at Bayview-Edison Road - Site 34
Dissolved Oxygen
Dissolved Oxygen, mg/L
Date
DO
State Std


No Name Slough at Bayview-Edison Road - Site 34
Temperature
Temperature, C
Date
Temp
State Std


No Name Slough at Bayview-Edison Road - Site 34
Fecal Coliform
Fecal Coliform, cfu/100 ml
Date

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
1	1	6	15	9	24	22	14	8	15	13	24	5	15

Long Term Trends								
Dissolved Oxygen			Temperature			Fecal Coliform		
16 yr	10 yr	5 yr	16 yr	10 yr	5 yr	16 yr	10 yr	5 yr
–	–	–	–	↑	–	–	–	–

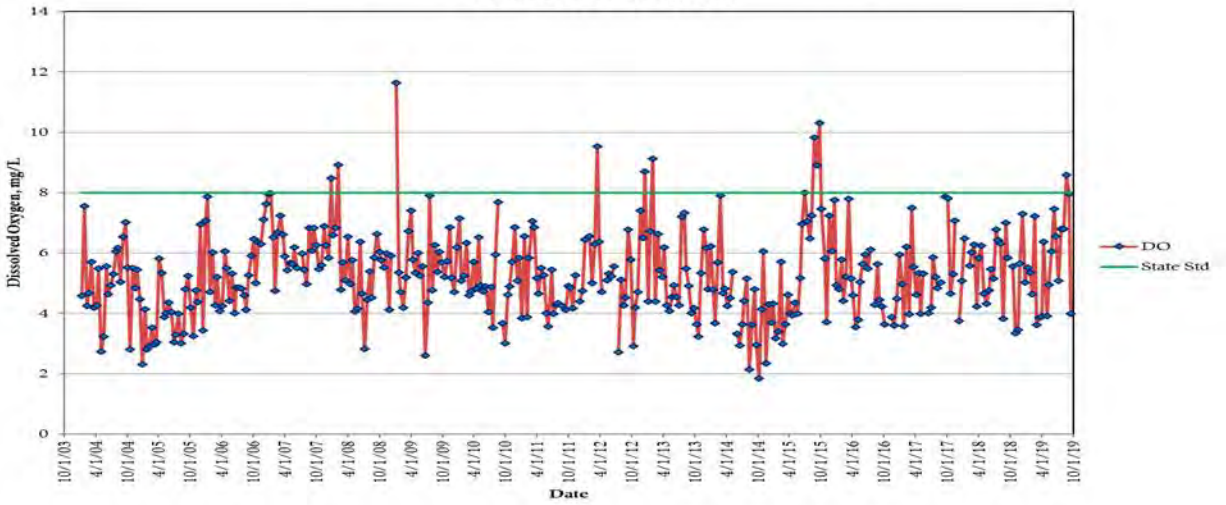
Site 35 is Joe Leary Slough, just prior to where it enters Padilla Bay. This slough was constructed for agricultural drainage and was not naturally formed. Sites like this are characterized by being stagnant or slow-moving, and are heavily tidally-influenced. This site is designated as salmonid spawning,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

Water temperatures are higher now than they were ten years ago. WQI scores are consistently in the category of highest concern.

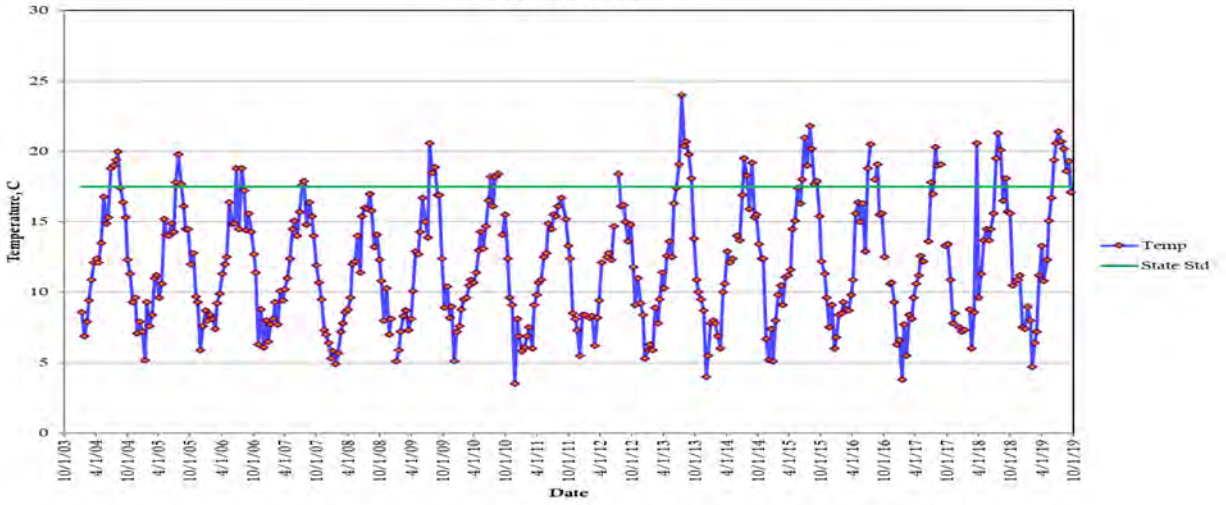
Site 35 very rarely ever meets state standards for DO, and fails to meet state standards for water temperature during the warmer months. Annual FC levels pass the state standard for geomean of 100, but fail the state standard for a 90th percentile of 200.

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%.

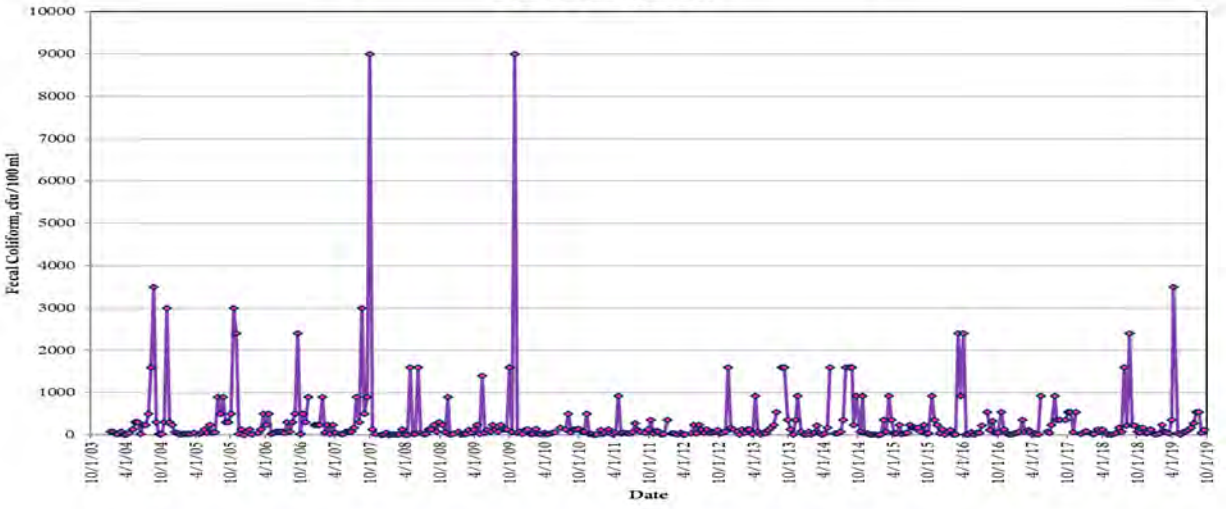
Joe Leary Slough at D'Arcy Road - Site 35
Dissolved Oxygen



Joe Leary Slough at D'Arcy Road - Site 35
Temperature



Joe Leary Slough at D'Arcy Road - Site 35
Fecal Coliform



36

Edison Slough
@ Edison Elementary

Downstream Ag

Water Quality Index (WQI)													
2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
1	10	6	30	25	34	21	37	37	23	34	38	38	45

Long Term Trends								
Dissolved Oxygen			Temperature			Fecal Coliform		
16 yr	10 yr	5 yr	16 yr	10 yr	5 yr	16 yr	10 yr	5 yr
–	–	–	–	–	–	–	–	–

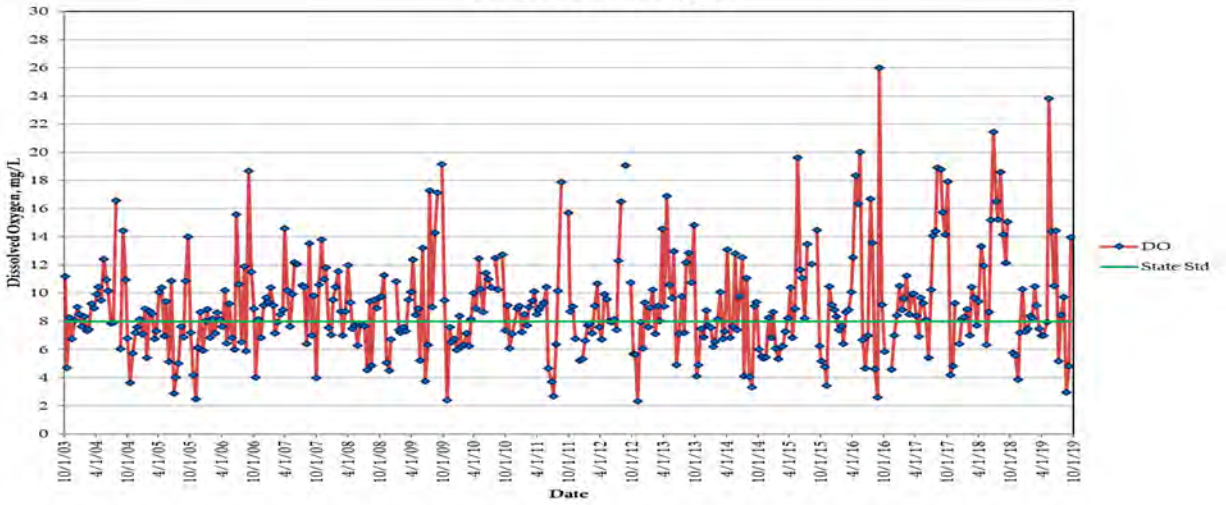
Site 36 is Edison Slough, just prior to the town of Edison and terminal discharge into Samish Bay. Sites like this are characterized by being stagnant or slow-moving, and are heavily tidally-influenced. This site is designated as salmonid spawning, rearing, and migration (SRM) status.

No monthly trends for DO, temperature, or FC were observed across any of the time periods analyzed in this report. WQI scores are consistently in the category of highest concern.

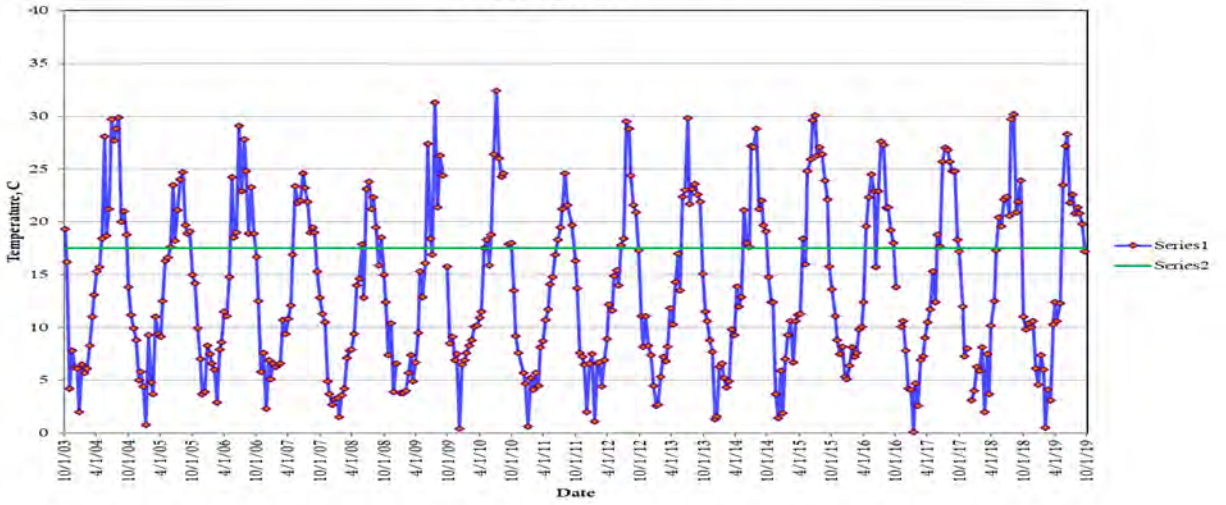
Site 36 regularly fails to meet state standards for DO and water temperature. Annual FC levels pass the state standard for geomean of 100, but fail the state standard for a 90th percentile of 200.

Site 36 is tied for 35th out of 39 sites for number of significant trends, with eight, and is 33rd out of 39 sites for positive trends, with 38%.

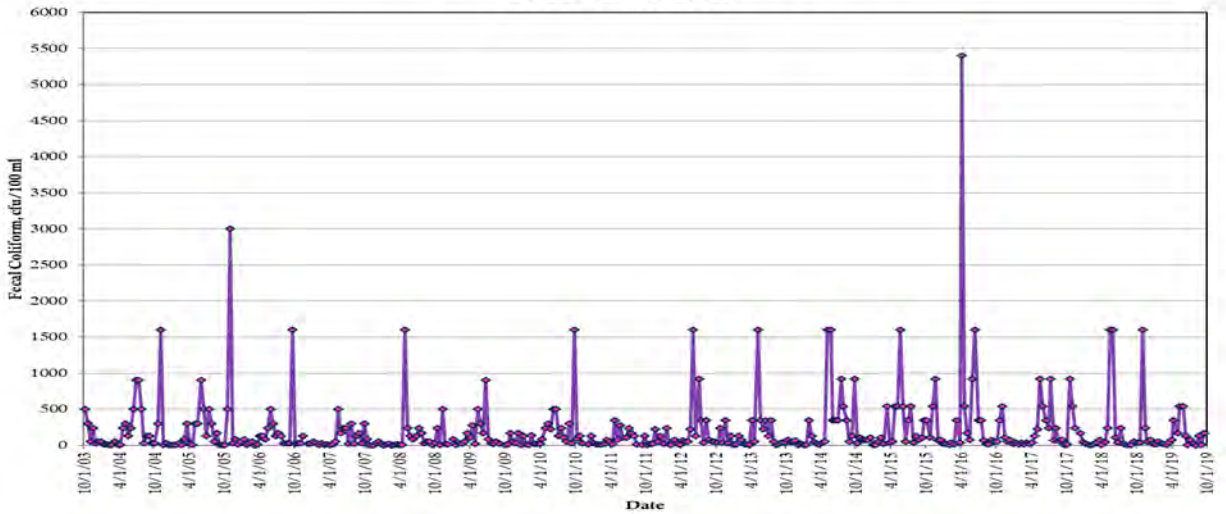
Edison Slough at Edison School - Site 36
Dissolved Oxygen



Edison Slough at Edison School - Site 36
Temperature



Edison Slough at Edison School - Site 36
Fecal Coliform



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
1	1	5	18	1	26	16	2	10	1	7	7	9	11

Long Term Trends								
Dissolved Oxygen			Temperature			Fecal Coliform		
16 yr	10 yr	5 yr	16 yr	10 yr	5 yr	16 yr	10 yr	5 yr
–	↑	–	–	–	↓	↑	↑	–

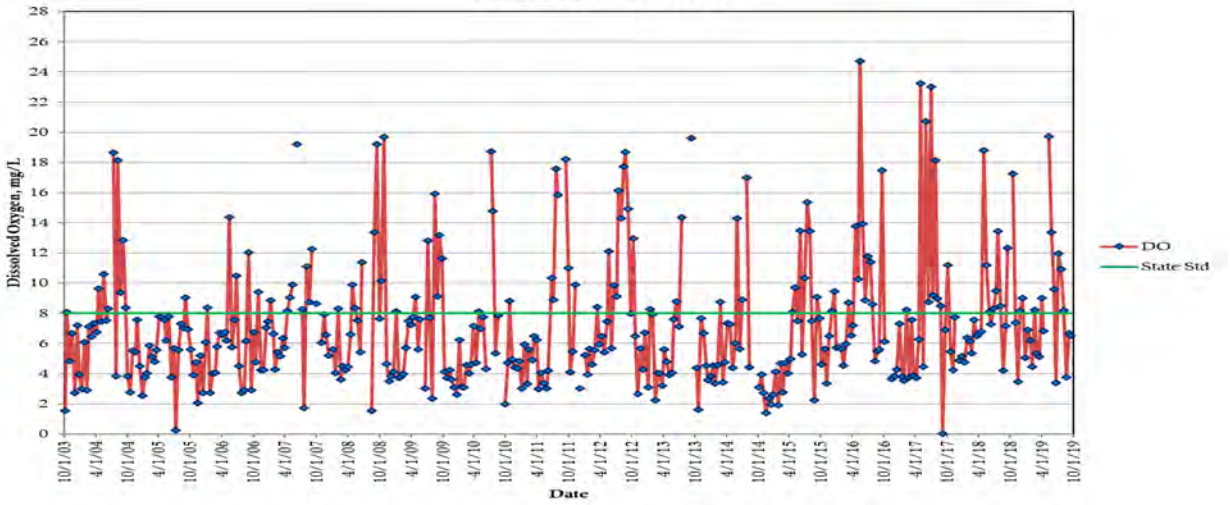
Site 37 is the south pump station of agricultural drainage in the town of Edison, on Samish Bay. Sites like this are characterized by being stagnant or slow-moving, and are heavily tidally-influenced. This site is designated as salmonid spawning, rearing, and migration (SRM) status.

Dissolved oxygen has increased in the most recent ten years. Water temperatures have decreased over the most recent five 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.

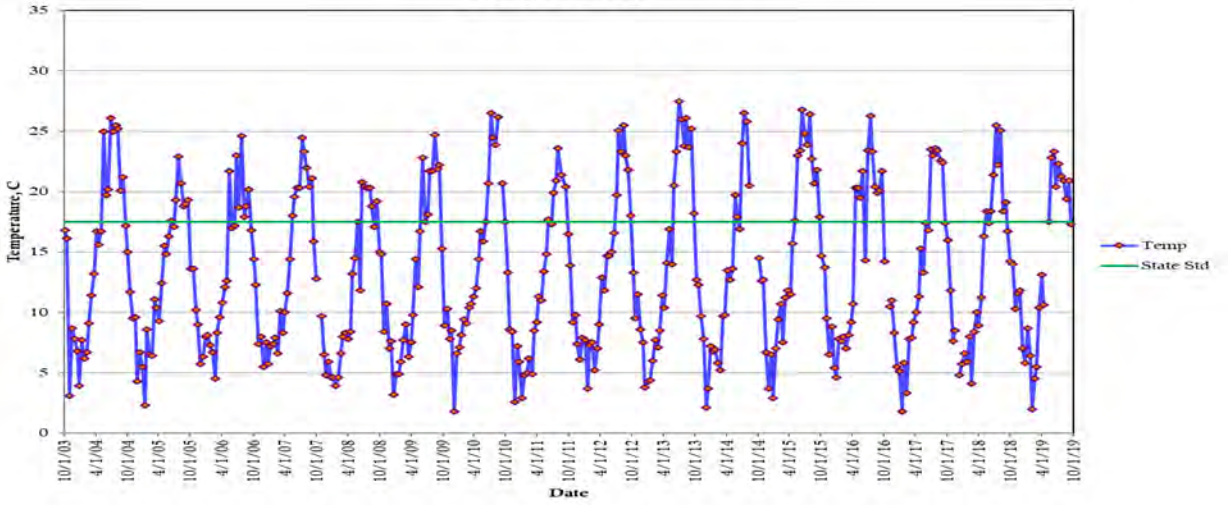
Site 37 regularly fails to meet state standards for DO and water temperature. Annual FC levels strongly fail state standards, and were the highest of all sites recorded in this program.

Site 37 is tied for 30th out of 39 sites for number of significant trends, with ten, and 35th out of 39 sites for positive trends, with 30%.

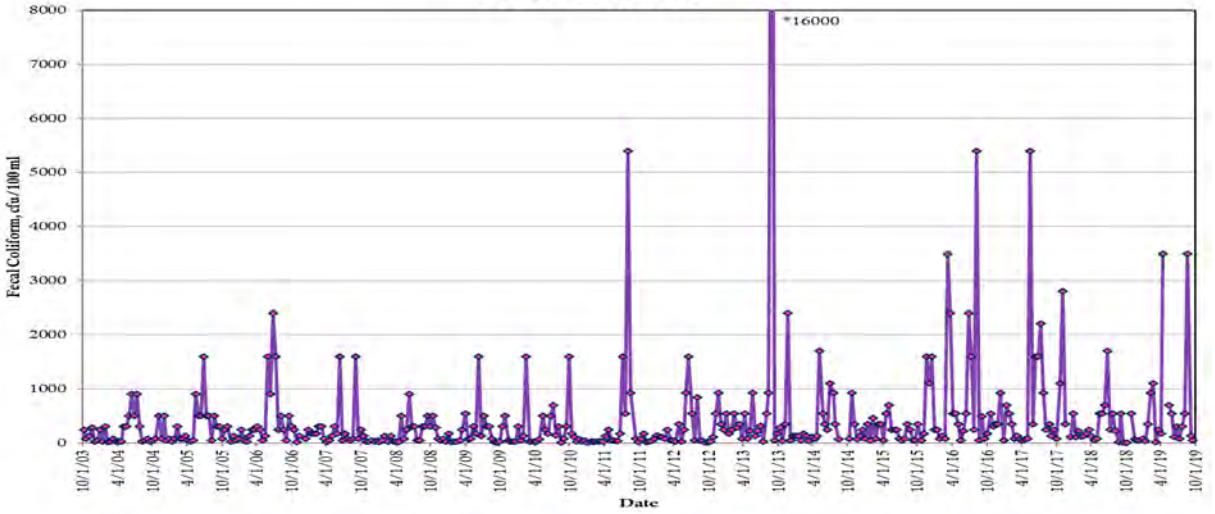
Edison Pump Station - Site 37
Dissolved Oxygen



Edison Pump Station - Site 37
Temperature



Edison Pump Station - Site 37
Fecal Coliform



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
1	6	1	13	16	36	12	13	3	6	19	18	20	5

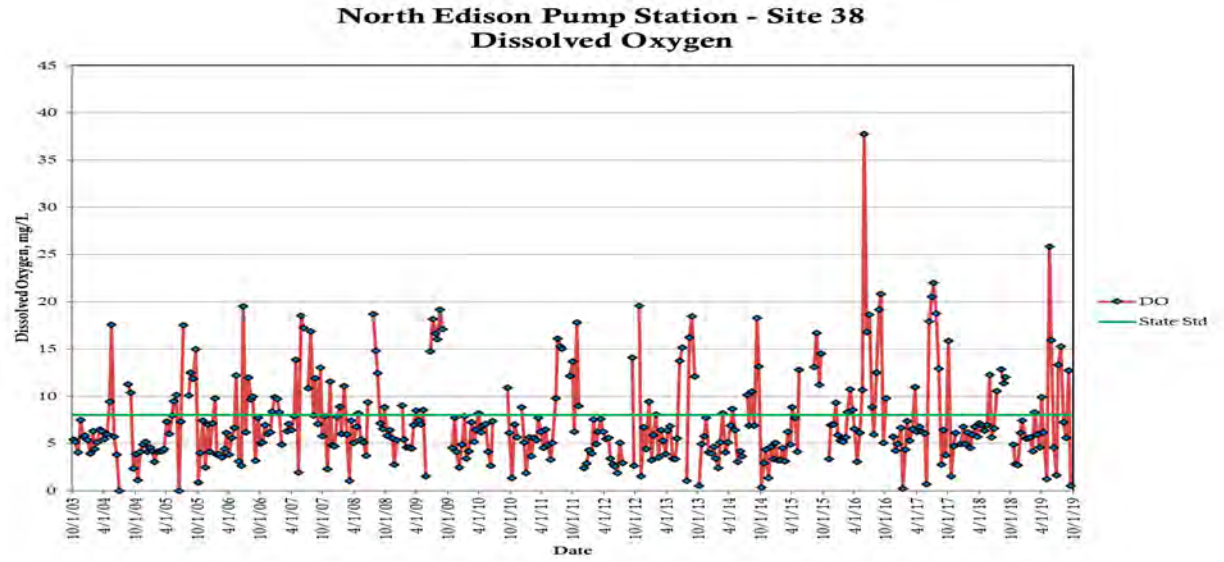
Long Term Trends								
Dissolved Oxygen			Temperature			Fecal Coliform		
16 yr	10 yr	5 yr	16 yr	10 yr	5 yr	16 yr	10 yr	5 yr
–	–	–	–	–	–	–	–	↓

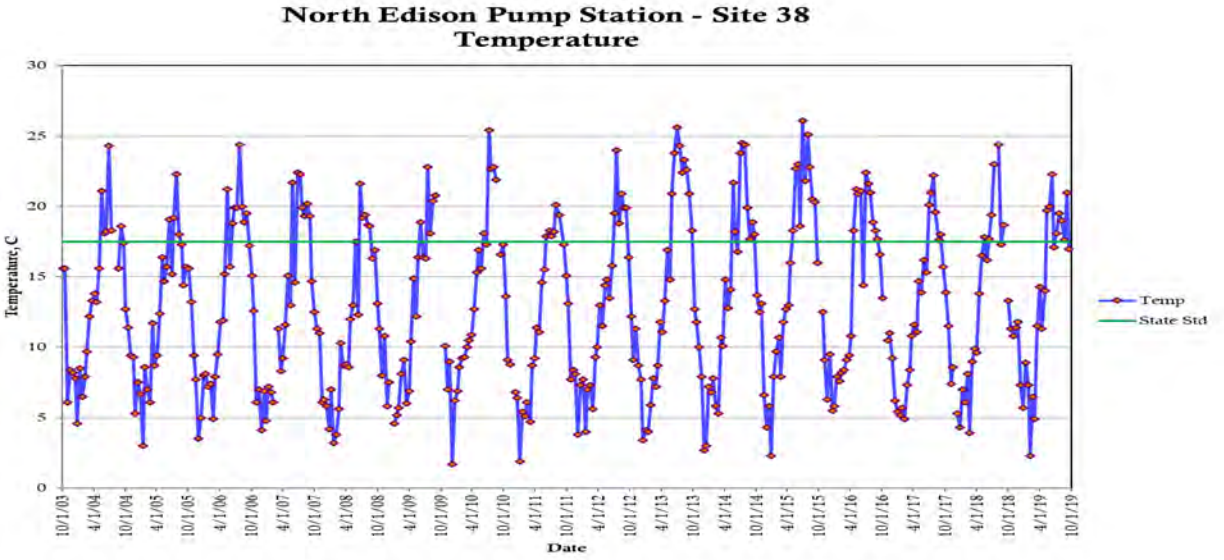
Site 38 is the north pump station of agricultural drainage in the town of Edison, on Samish Bay. Sites like this are characterized by being stagnant or slow-moving, and are heavily tidally-influenced. This site is designated as salmonid spawning, rearing, and migration (SRM) status.

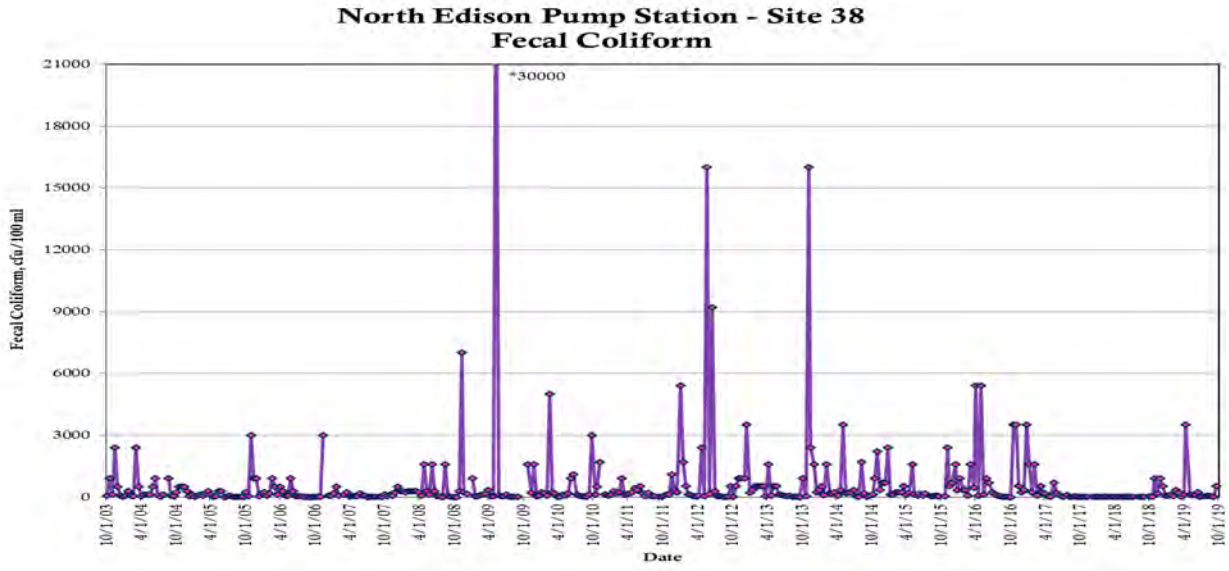
Fecal coliform counts are lower now than they were five years ago. WQI scores are consistently in the category of highest concern, and often in the single digits.

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

Site 38 is tied for 25th out of 39 sites for number of significant trends, with 11, and tied for 31st out of 39 sites for positive trends, with 45%.


North Edison Pump Station - Site 38
Dissolved Oxygen
Dissolved Oxygen, mg/L
Date
DO
State Std


North Edison Pump Station - Site 38
Temperature
Temperature, C
Date
Temp
State Std


North Edison Pump Station - Site 38
Fecal Coliform
Fecal Coliform, cfu/100 ml
*30000
Date

39

Colony Creek
@ Colony Road

Downstream Ag

Water Quality Index (WQI)													
2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
17	39	52	67	63	85	78	81	76	83	83	81	80	58

Long Term Trends								
Dissolved Oxygen			Temperature			Fecal Coliform		
16 yr	10 yr	5 yr	16 yr	10 yr	5 yr	16 yr	10 yr	5 yr
–	–	↑	–	–	↓	↓	–	–

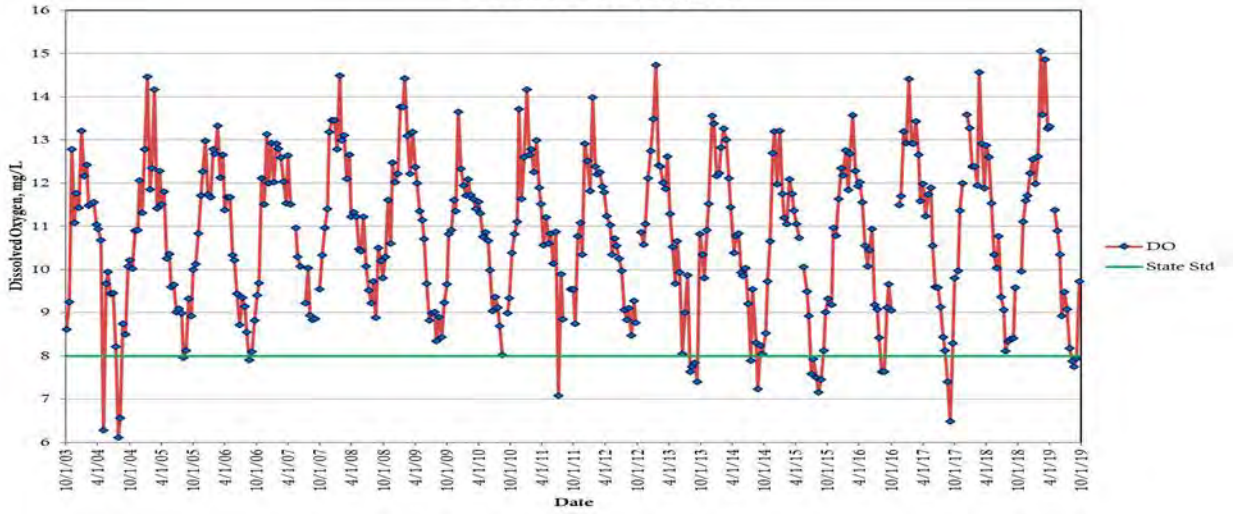
Site 39 is Colony Creek, prior to its convergence with Harrison Creek and terminating in to the north end of Samish Bay, and has rural residential and agricultural influences. This site is designated as core salmonid habitat.

In the most recent five years, DO has increased and water temperature has decreased. Fecal coliform counts are lower than they were sixteen years ago. WQI scores are generally in the upper-score end of the moderate concern category, and often score as least concern.

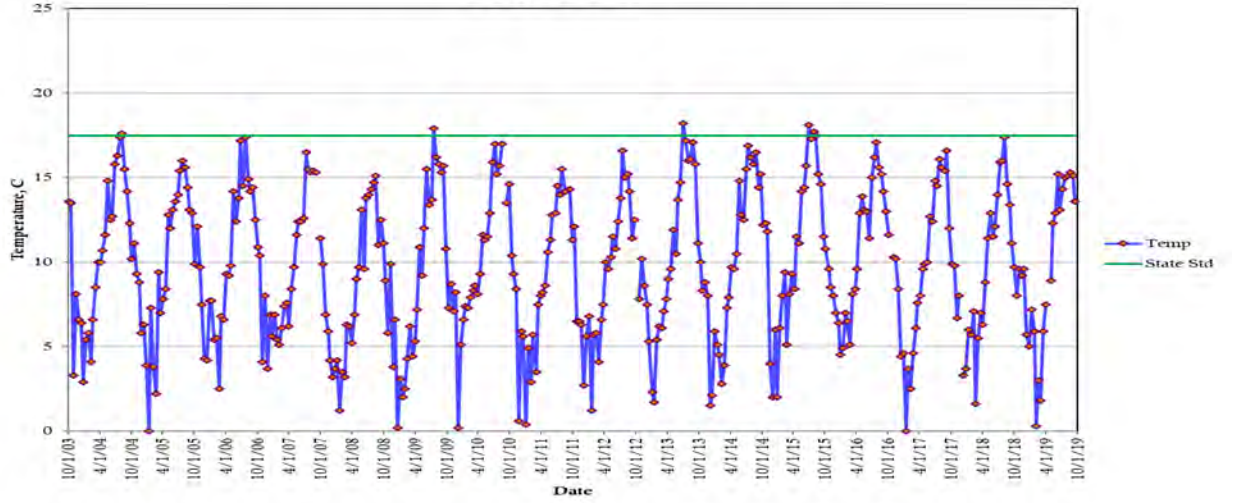
Site 39 rarely fails to meet state standards for DO and water temperature, and only does so at the warmest time of year. Annual FC levels pass the state standard for geomean of 100, but fail the state standard for a 90th percentile of 200.

Site 39 is tied for 33rd out of 39 sites for number of significant trends, with nine, and is 25th out of 39 sites for positive trends, with 56%.

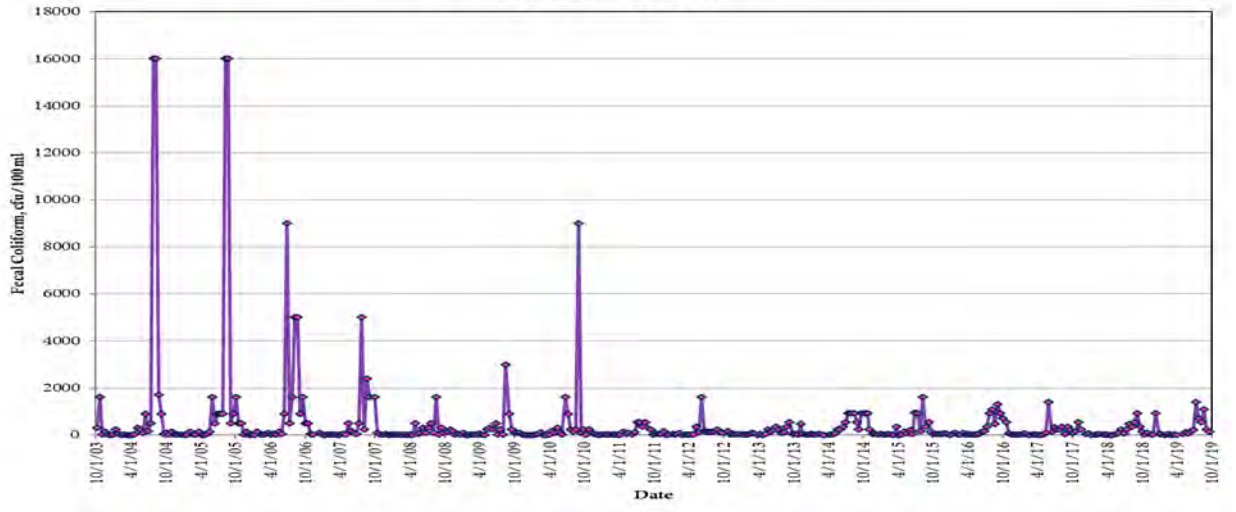
Colony Creek at Colony Road - Site 39
Dissolved Oxygen

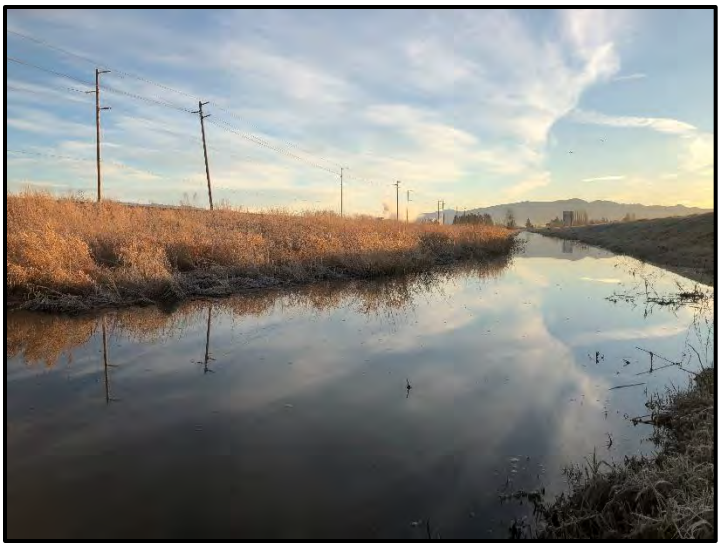


Colony Creek at Colony Road - Site 39
Temperature



Colony Creek at Colony Road - Site 39
Fecal Coliform





40

Big Indian slough
@ Highway 20

Midstream Ag

Water Quality Index (WQI)													
2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
6	36	1	11	3	13	19	4	12	23	15	23	23	16

Long Term Trends								
Dissolved Oxygen			Temperature			Fecal Coliform		
16 yr	10 yr	5 yr	16 yr	10 yr	5 yr	16 yr	10 yr	5 yr
–	↓	↑	↓	–	↓	–	–	–

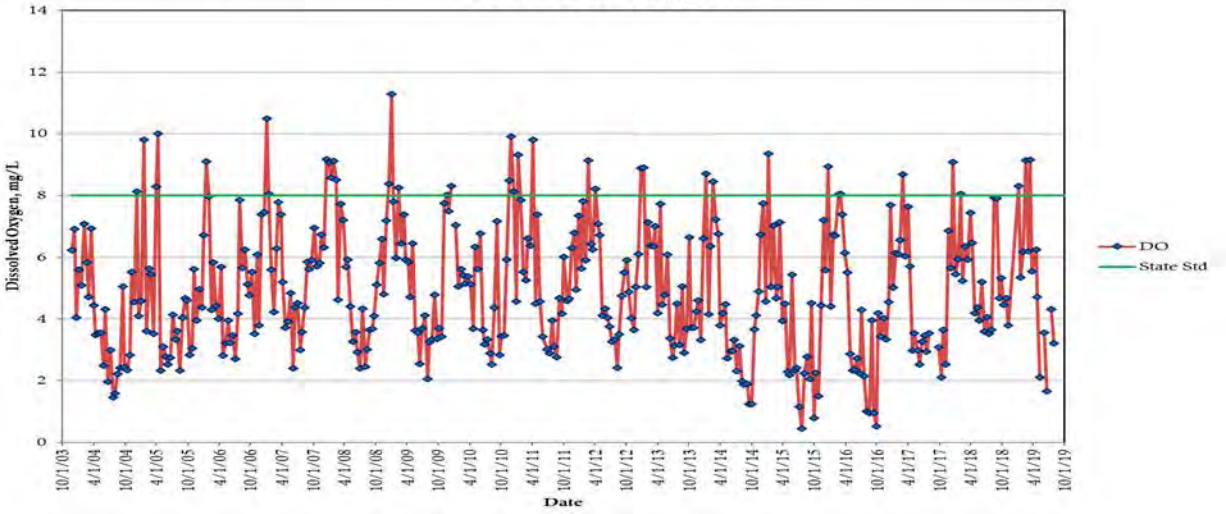
Site 40 is Big Indian Slough, just north of Highway 20 and prior to entering Padilla Bay. This site has industrial, agricultural, and urban influences. Sites like this are characterized by being stagnant or slow-moving, and are heavily tidally-influenced. This site is designated as salmonid spawning,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

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

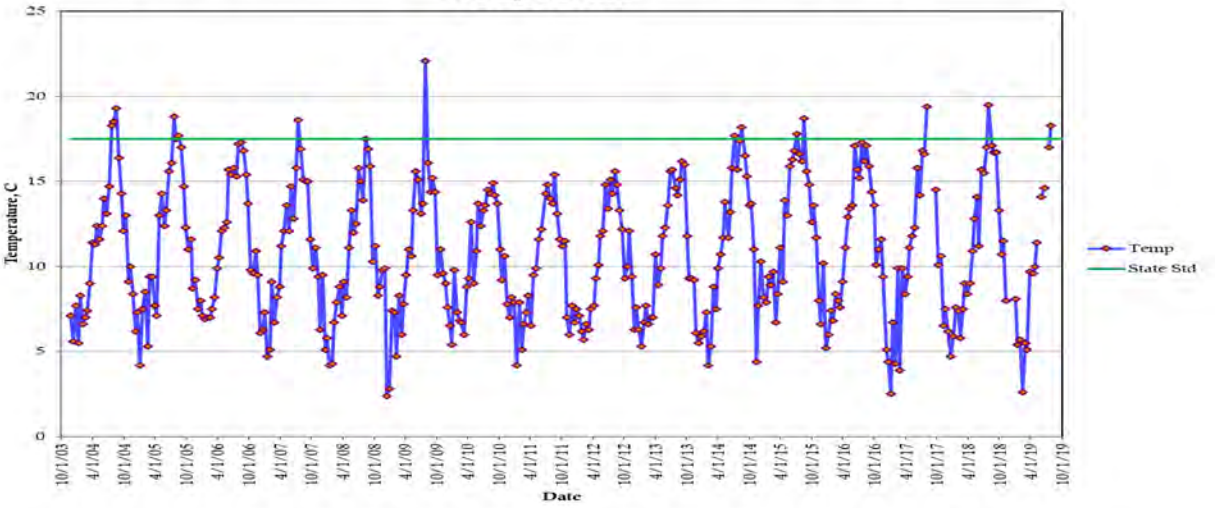
Site 40 regularly fails to meet state standards for DO, and fails to meet state standards for water temperature during the warmer months. Annual FC levels pass the state standard for geomean of 100, but narrowly fail the state standard for a 90th percentile of 200.

Site 40 is tied for 21st out of 39 sites for number of significant trends, with 12, and is tied for 26th out of 39 sites for positive trends, with 50%.

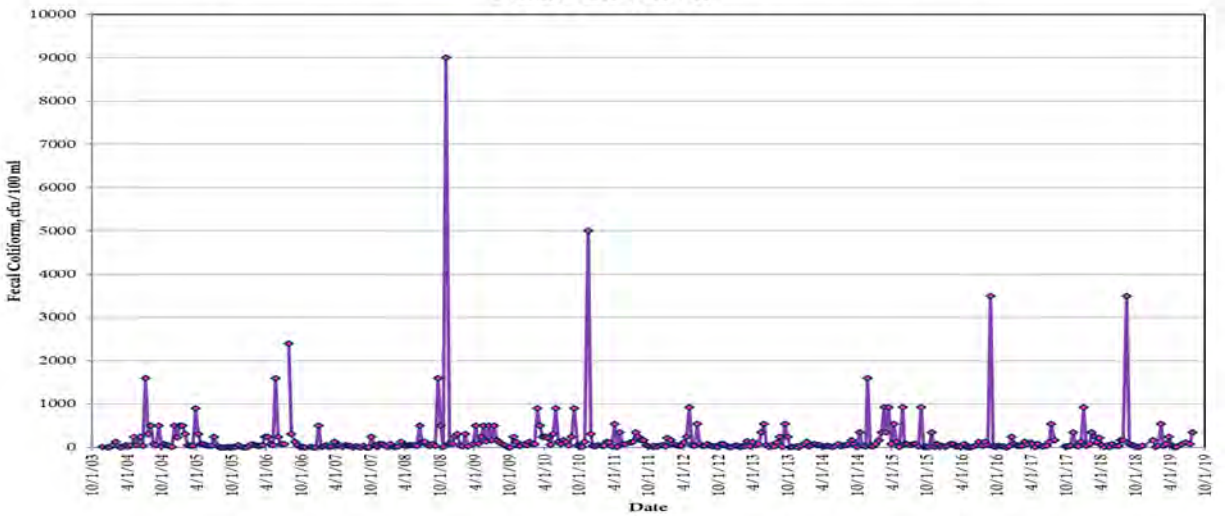
Big Indian Slough at Highway 20 Truck Scales - Site 40
Dissolved Oxygen



Big Indian Slough at Highway 20 Truck Scales - Site 40
Temperature



Big Indian Slough at Highway 20 Truck Scales - Site 40
Fecal Coliform



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
15	27	23	56	55	27	34	19	24	30	39	39	25	33

Long Term Trends								
Dissolved Oxygen			Temperature			Fecal Coliform		
16 yr	10 yr	5 yr	16 yr	10 yr	5 yr	16 yr	10 yr	5 yr
↑	↑	↓	–	–	↓	↑	–	↓

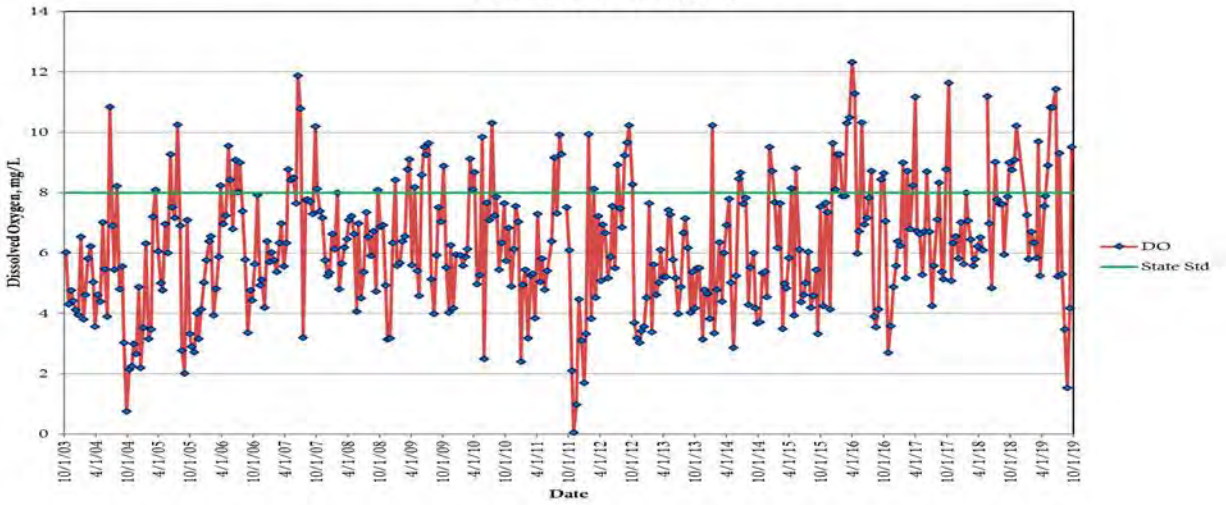
Site 41 is Maddox Slough, or Big Ditch, prior to entering Skagit Bay. Sites like this are characterized by being stagnant or slow-moving, and are heavily tidally-influenced. This site is designated as salmonid spawning, rearing, and migration (SRM) status.

Dissolved oxygen is higher than it was 16 years ago and ten years ago, but has decreased over the most recent five years. 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.

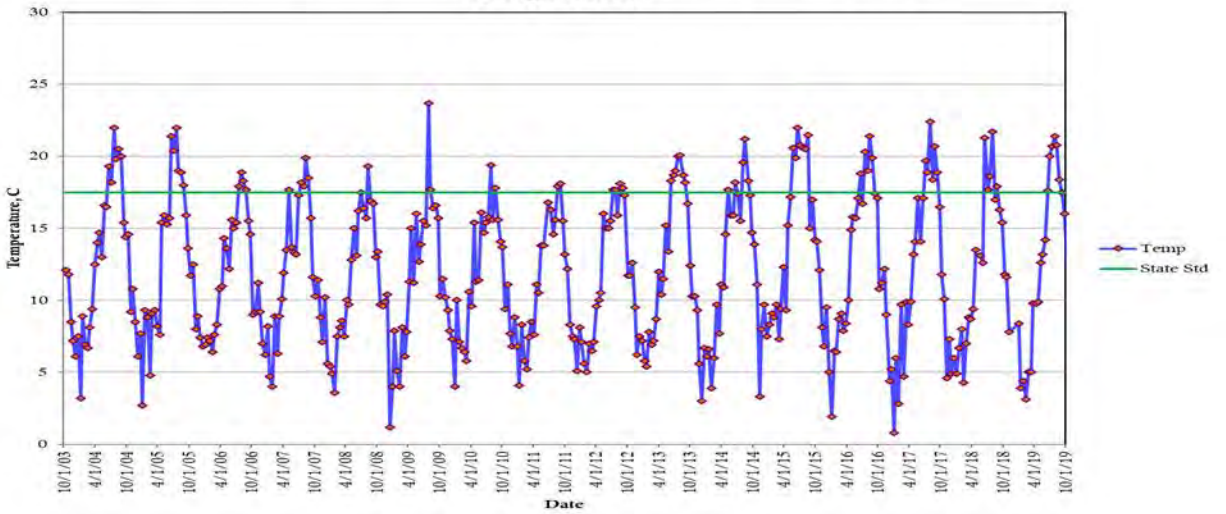
Site 41 rarely meets state standards for DO, and exceeds state standards for water temperature during the warmer months. Annual FC levels pass the state standard for geomean of 100, but narrowly fail the state standard for a 90th percentile of 200.

Site 41 is tied for 4th out of 39 sites for number of significant trends, with 18, and is 21st out of 39 sites for positive trends, with 61%.

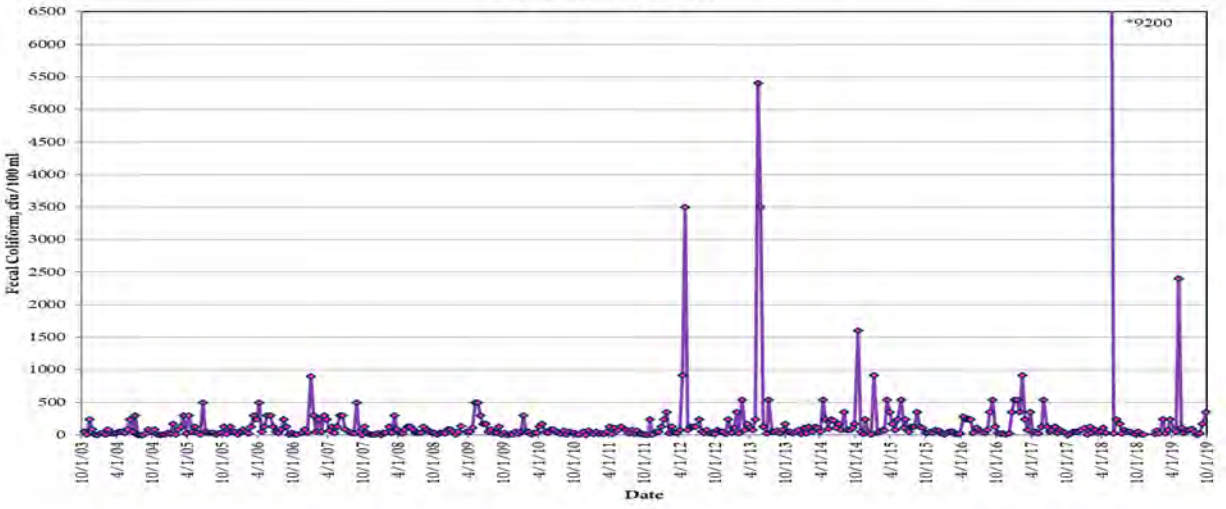
Maddox Creek/Big Ditch at Milltown Road - Site 41
Dissolved Oxygen



Maddox Creek/Big Ditch at Milltown Road - Site 41
Temperature



Maddox Creek/Big Ditch at Milltown Road - Site 41
Fecal Coliform



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
50	35	7	39	58	66	70	60	74	77	75	81	80	73

Long Term Trends								
Dissolved Oxygen			Temperature			Fecal Coliform		
16 yr	10 yr	5 yr	16 yr	10 yr	5 yr	16 yr	10 yr	5 yr
↑	–	–	–	–	↓	↑	–	↓

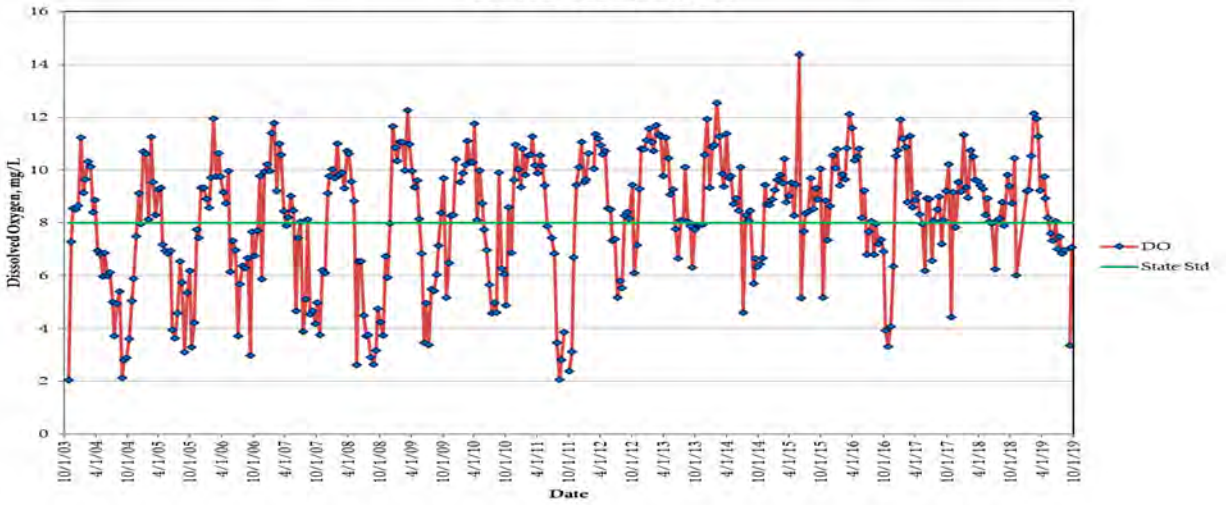
Site 42 is Carpenter Creek, or Hill Ditch, prior to being joined by Fisher Creek and entering Skagit Bay. This watercourse has urban, rural residential, and agricultural influences. This site is designated as core salmonid habitat.

Dissolved oxygen is higher than it was 16 years ago. Water temperatures and FC counts have decreased in the most recent five years, though FC counts are still higher than they were at the beginning of this program. WQI scores have improved over the years from the category of highest concern to the category of least concern.

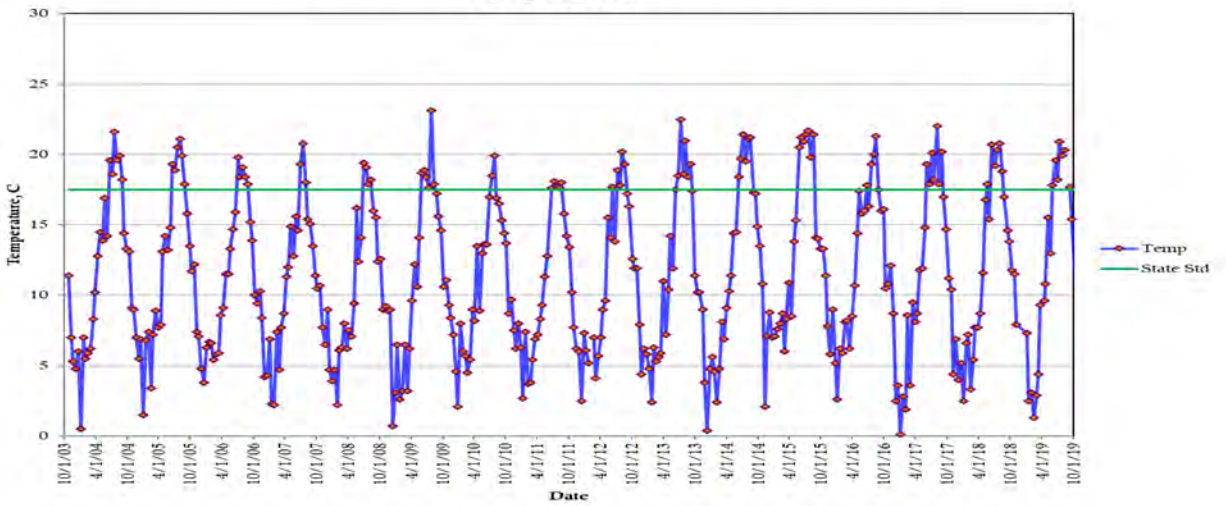
Site 42 fails state standards for DO about half of the year, and fails state standards for water temperature during the warmer months. Annual FC levels meet state standards.

Site 42 is tied for 11th out of 39 sites for number of significant trends, with 15, and is 22nd out of 39 sites for positive trends, with 60%.

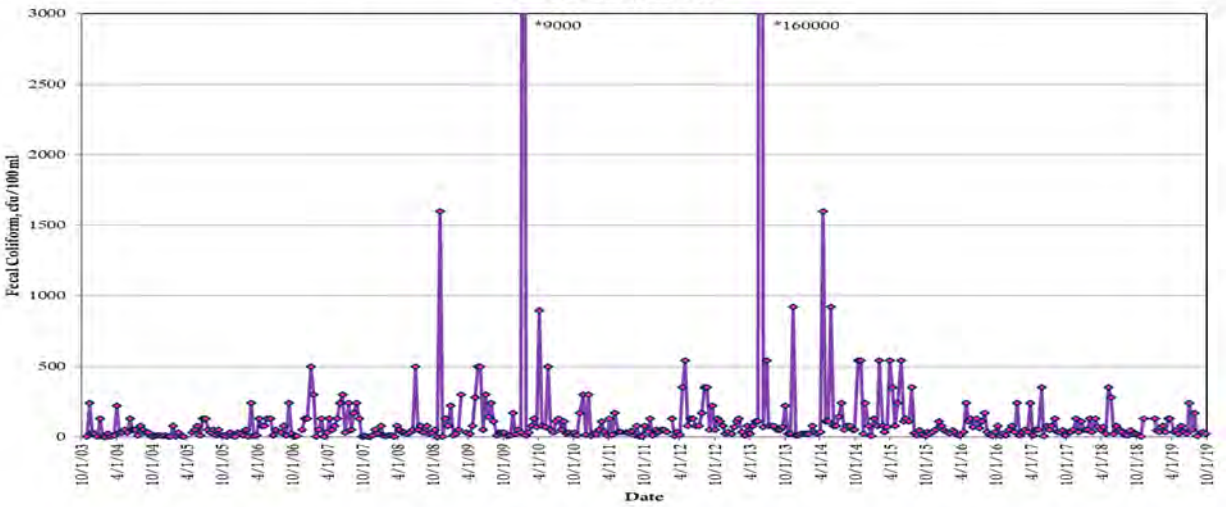
Carpenter Creek/Hill Ditch at Cedardale Road - Site 42
Dissolved Oxygen



Carpenter Creek/Hill Ditch at Cedardale Road - Site 42
Temperature



Carpenter Creek/Hill Ditch at Cedardale Road - Site 42
Fecal Coliform



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
1	19	17	10	22	6	19	11	12	3	13	1	16	26

Long Term Trends

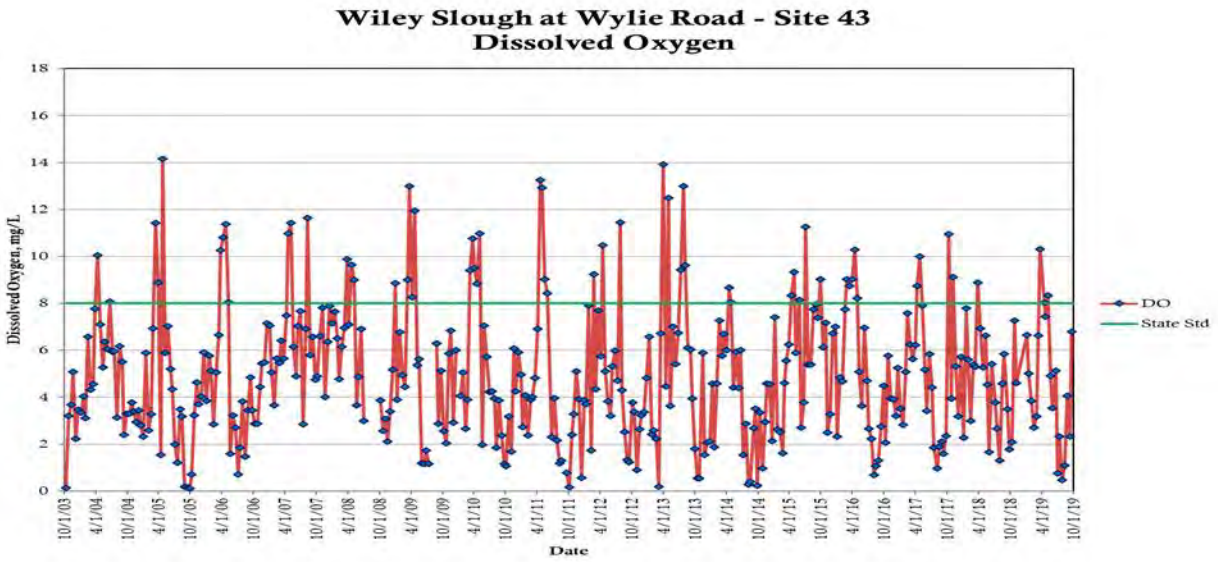
Dissolved Oxygen			Temperature			Fecal Coliform		
16 yr	10 yr	5 yr	16 yr	10 yr	5 yr	16 yr	10 yr	5 yr
—	—	—	—	—	↓	↑	—	—

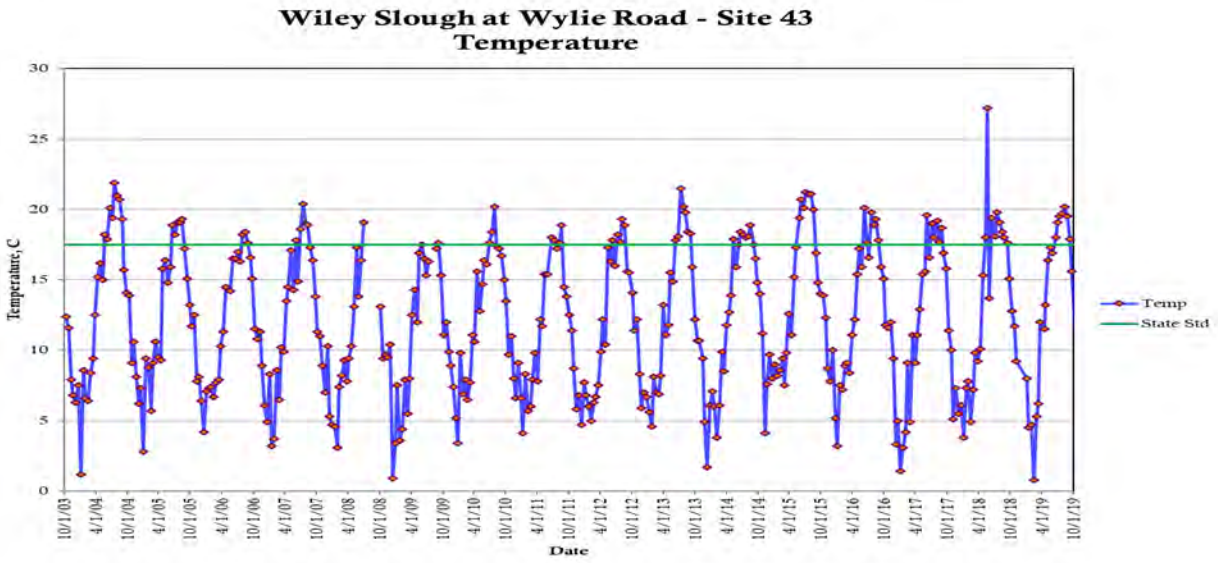
Site 43 is Wiley Slough, prior to its termination into the Skagit Wildlife Area wetlands and Skagit Bay. This site drains a large amount of agricultural area on Fir Island. Sites like this are characterized by being stagnant or slow-moving, and are heavily tidally-influenced. This site is designated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

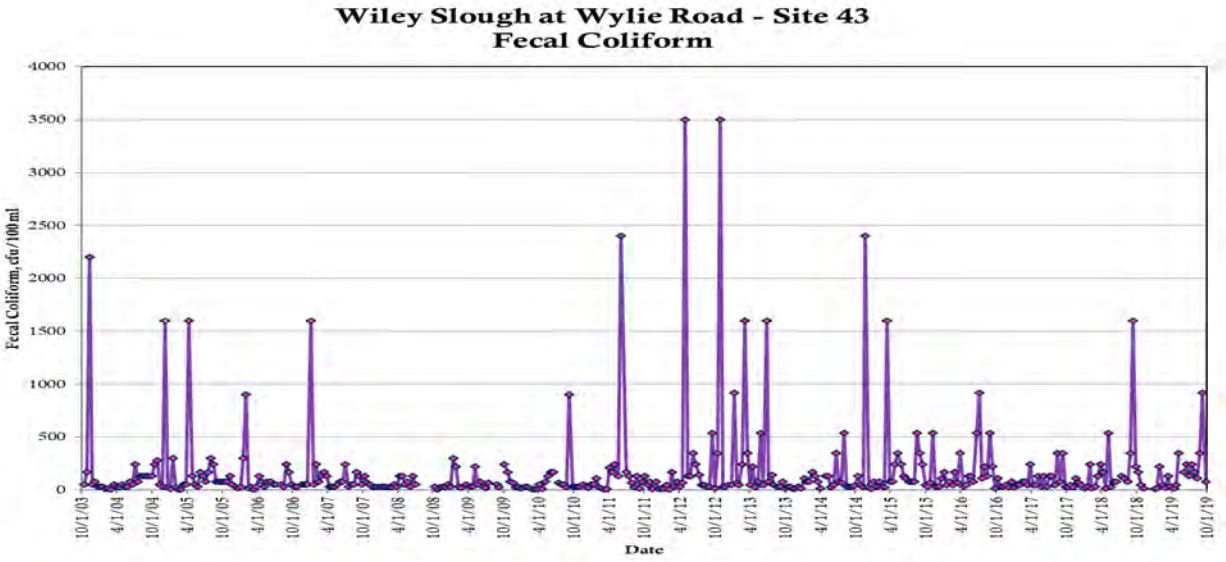
Water temperatures have decreased in the most recent five years. Fecal coliform levels are higher now than they were at the beginning of this program. WQI scores are consistently in the category of highest concern.

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 32nd out of 39 sites for number of significant trends, with nine, and is 37th out of 39 sites for positive trends, with 22%.


Wiley Slough at Wylie Road - Site 43
Dissolved Oxygen
Dissolved Oxygen, mg/L
Date
DO
State Std


Wiley Slough at Wylie Road - Site 43
Temperature
Temperature, C
Date
Temp
State Std


Wiley Slough at Wylie Road - Site 43
Fecal Coliform
Fecal Coliform, cfu/100 ml
Date

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
28	21	2	33	47	29	36	25	12	11	8	16	8	32

Long Term Trends								
Dissolved Oxygen			Temperature			Fecal Coliform		
16 yr	10 yr	5 yr	16 yr	10 yr	5 yr	16 yr	10 yr	5 yr
↓	–	–	–	–	↓	–	–	↓

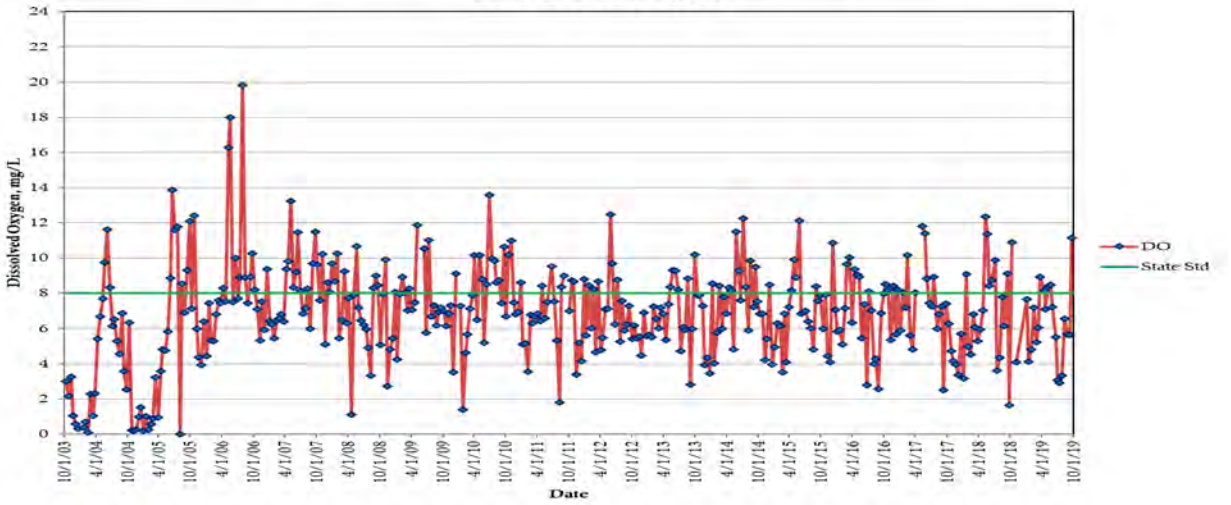
Site 44 is Sullivan Slough, at its west end, just prior to entering the Swinomish Channel. Sites like this are characterized by being stagnant or slow-moving, and are heavily tidally-influenced. This site is designated as salmonid spawning, rearing, and migration (SRM) status.

Dissolved oxygen is lower than it was 16 years ago. In the most recent five years, water temperature and FC counts have decreased. WQI scores are consistently in the category of highest concern.

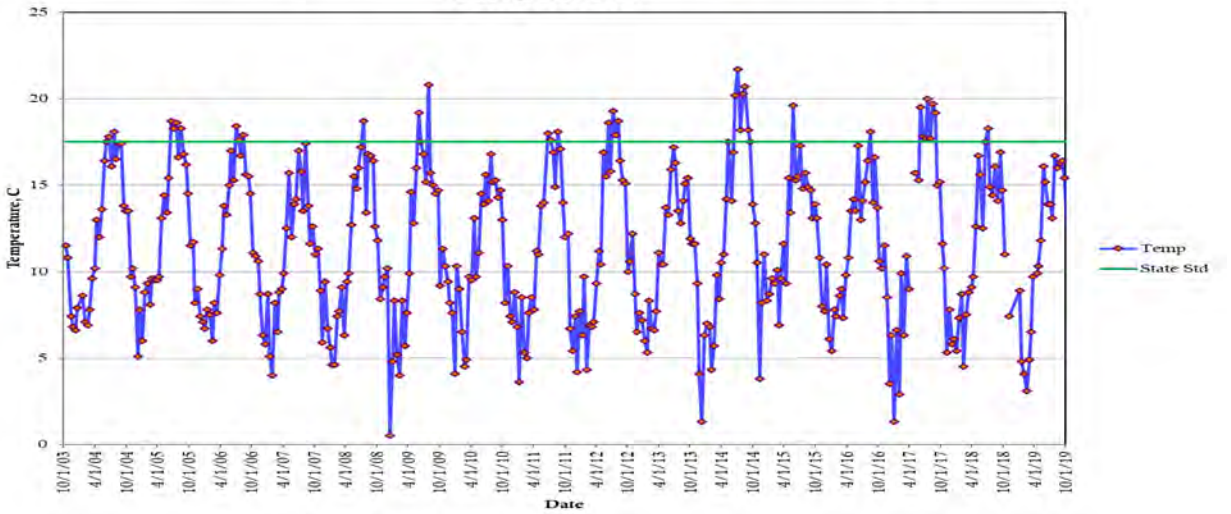
Site 44 spends the majority of the year below state standards for DO, and fails to meet state standards for water temperature during the warmer months. Annual FC levels pass the state standard for geomean of 100, but fail the state standard for a 90th percentile of 200.

Site 44 is tied for 25th out of 39 sites for number of significant trends, with 11, and is 34th out of 39 sites for positive trends, with 36%.

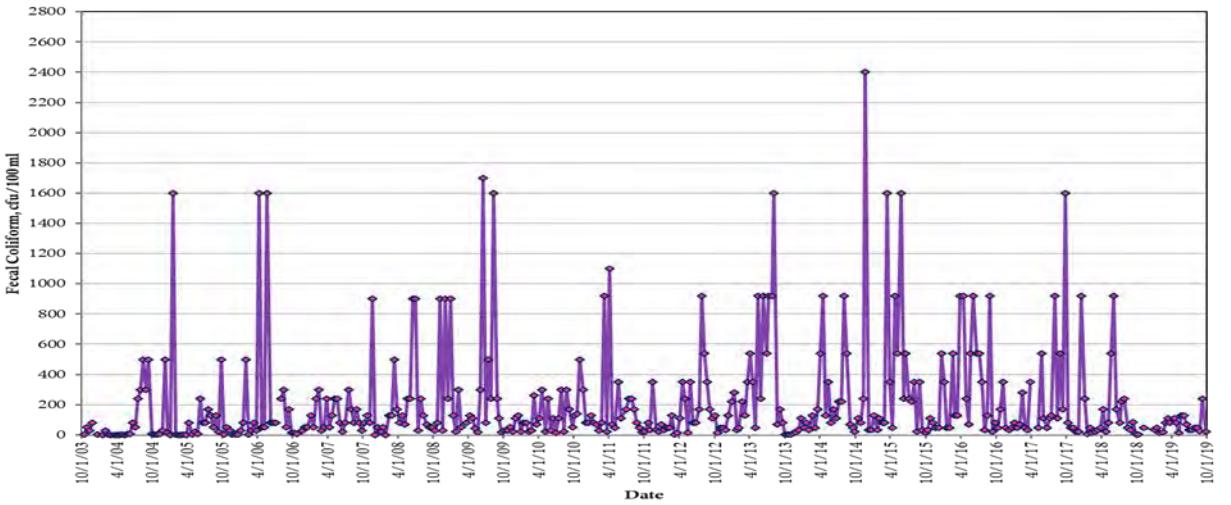
Sullivan Slough at LaConner-Whitney Road - Site 44
Dissolved Oxygen



Sullivan Slough at LaConner-Whitney Road - Site 44
Temperature



Sullivan Slough at LaConner-Whitney Road - Site 44
Fecal Coliform



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
78	71	88	95	95	95	80	86	85	93	89	89	89	88

Long Term Trends

Dissolved Oxygen			Temperature			Fecal Coliform		
16 yr	10 yr	5 yr	16 yr	10 yr	5 yr	16 yr	10 yr	5 yr
–	↑	↑	–	–	↓	–	–	–

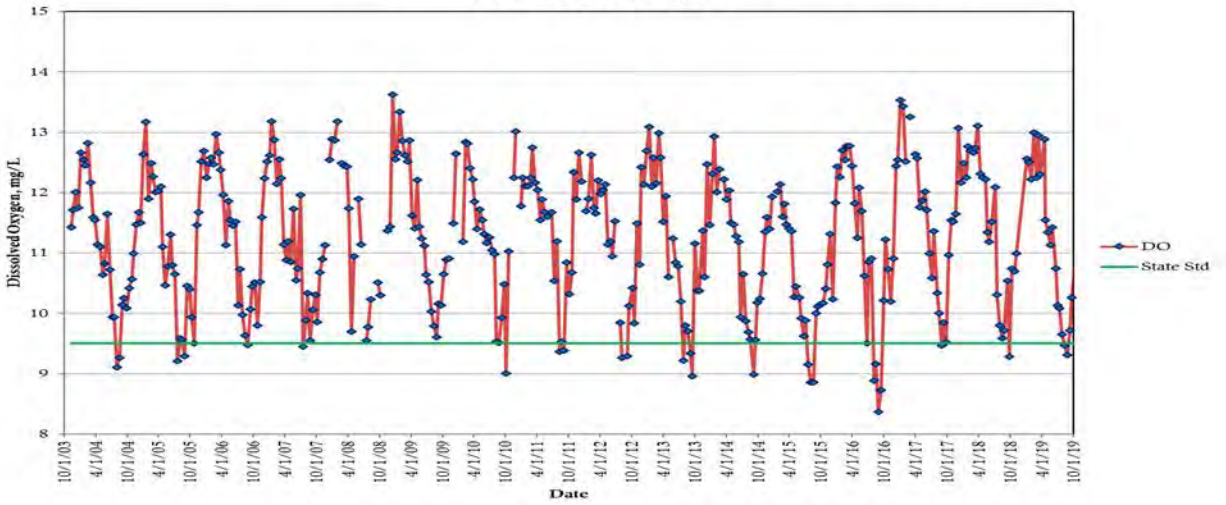
Site 45 is the north fork of the Skagit River, downstream of Mount Vernon. The river is designated as core salmonid habitat and as salmonid spawning, rearing, and migration (SRM) status.

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

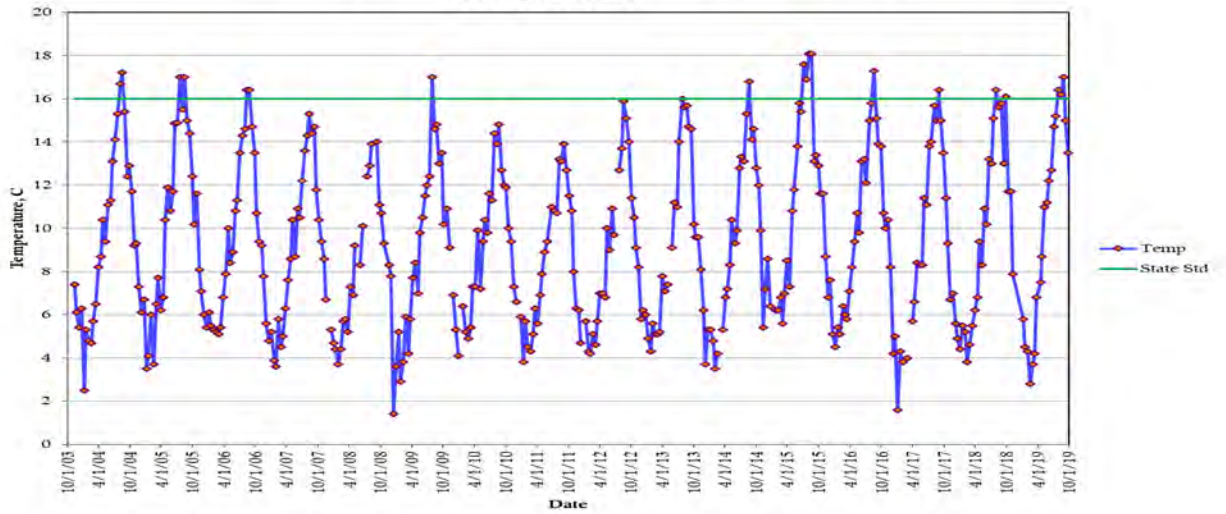
Site 45 rarely fails to meet state standards for DO and water temperature. Annual FC counts easily meet state standards.

Site 45 is tied for 21st out of 39 sites for number of significant trends, with 12, and is tied for 5th out of 39 sites for positive trends, with 83%.

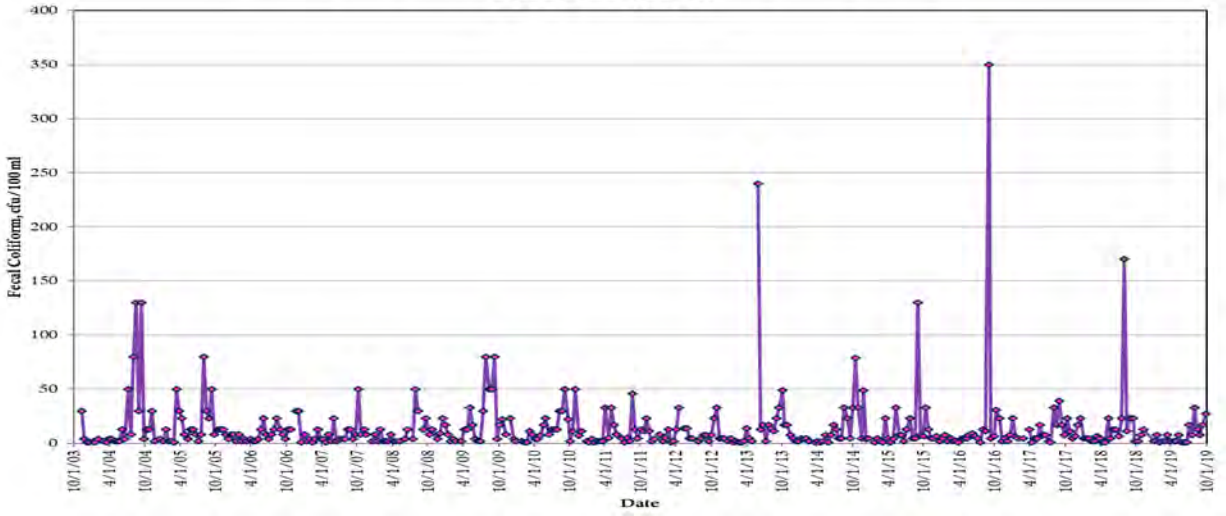
North Fork Skagit River near Moore Road - Site 45
Dissolved Oxygen



North Fork Skagit River near Moore Road - Site 45
Temperature



North Fork Skagit River near Moore Road - Site 45
Fecal Coliform



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
81	73	80	93	91	95	89	83	91	91	93	88	92	86

Long Term Trends								
Dissolved Oxygen			Temperature			Fecal Coliform		
16 yr	10 yr	5 yr	16 yr	10 yr	5 yr	16 yr	10 yr	5 yr
↑	↑	↑	–	–	↓	–	–	–

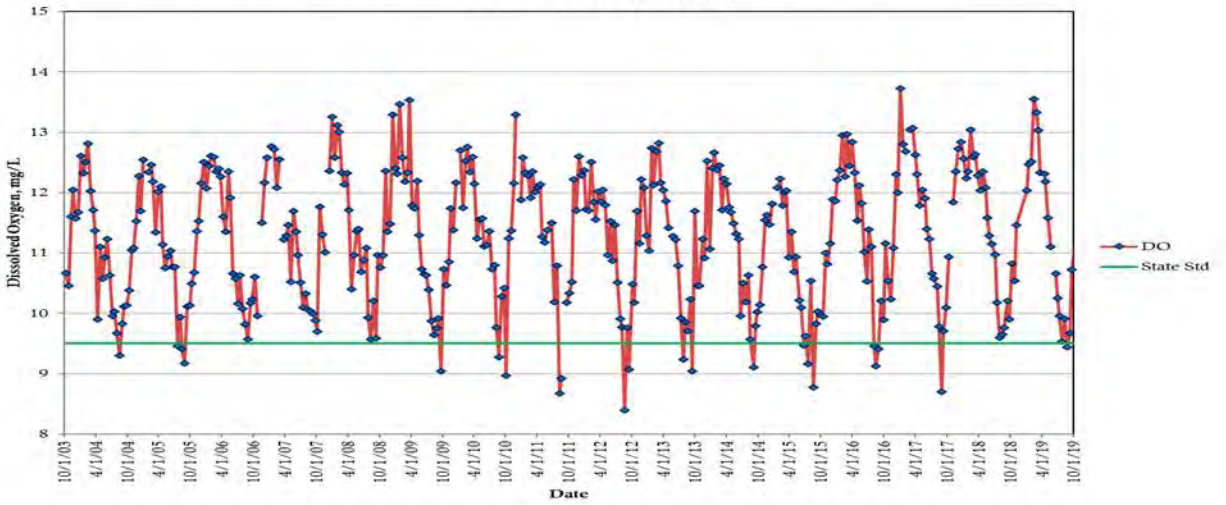
Site 46 is the south fork of the Skagit River, downstream of Mount Vernon. The river is designated as core salmonid habitat and as salmonid spawning, rearing, and migration (SRM) status.

Dissolved oxygen has increased over all analyzed time periods. Water temperature has decreased over the most recent five years. WQI scores are consistently in the category of least concern.

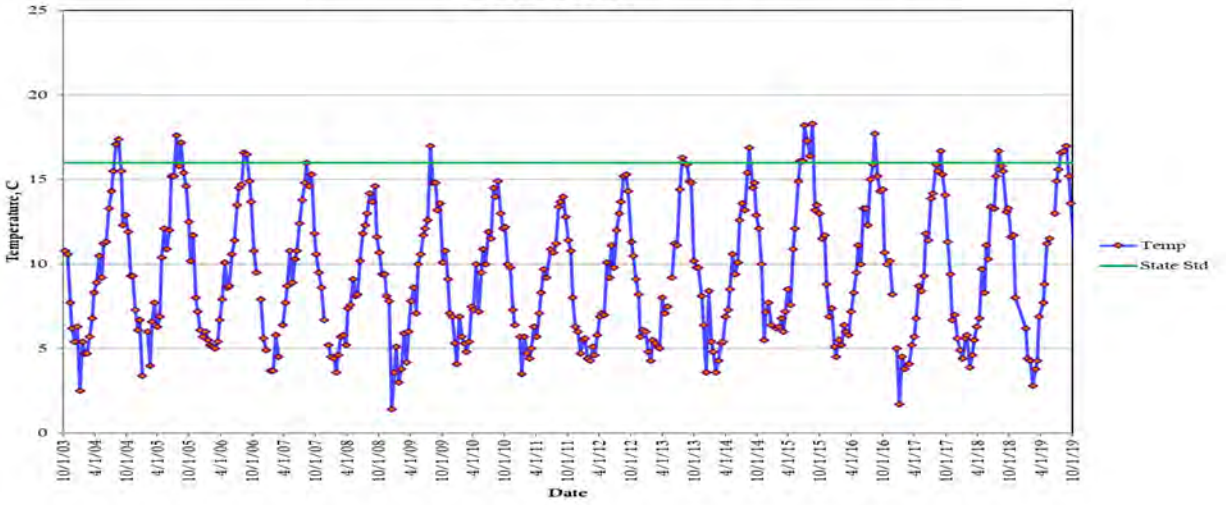
Site 46 rarely fails to meet state standards for DO and water temperature. Annual FC counts easily meet state standards.

Site 46 is tied for 14th out of 39 sites for number of significant trends, with 14, and is 4th out of 39 sites for positive trends, with 86%.

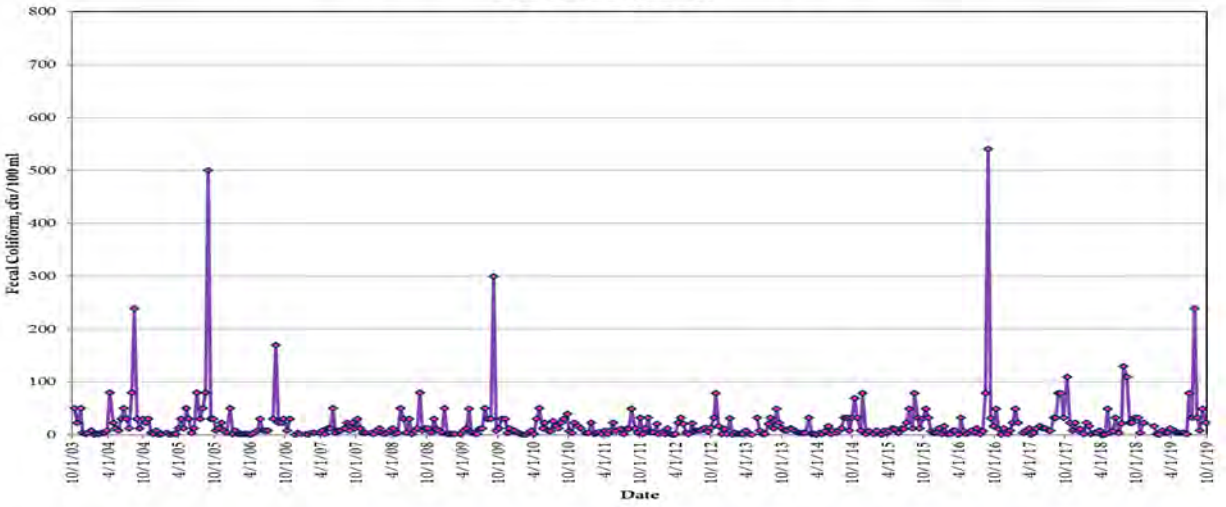
South Fork Skagit River at Conway Boat Ramp - Site 46
Dissolved Oxygen

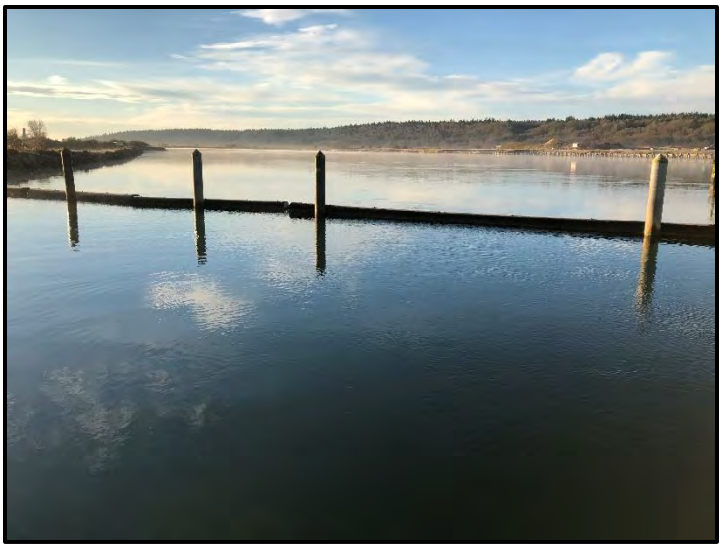


South Fork Skagit River at Conway Boat Ramp - Site 46
Temperature



South Fork Skagit River at Conway Boat Ramp - Site 46
Fecal Coliform





47

Swinomish Channel
@ Berentson Bridge

Reference - Marine

Water Quality Index (WQI)													
2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
74	82	68	67	83	79	81	77	78	81	88	87	83	80

Long Term Trends								
Dissolved Oxygen			Temperature			Fecal Coliform		
16 yr	10 yr	5 yr	16 yr	10 yr	5 yr	16 yr	10 yr	5 yr
–	–	↑	↑	↑	↓	↑	–	–

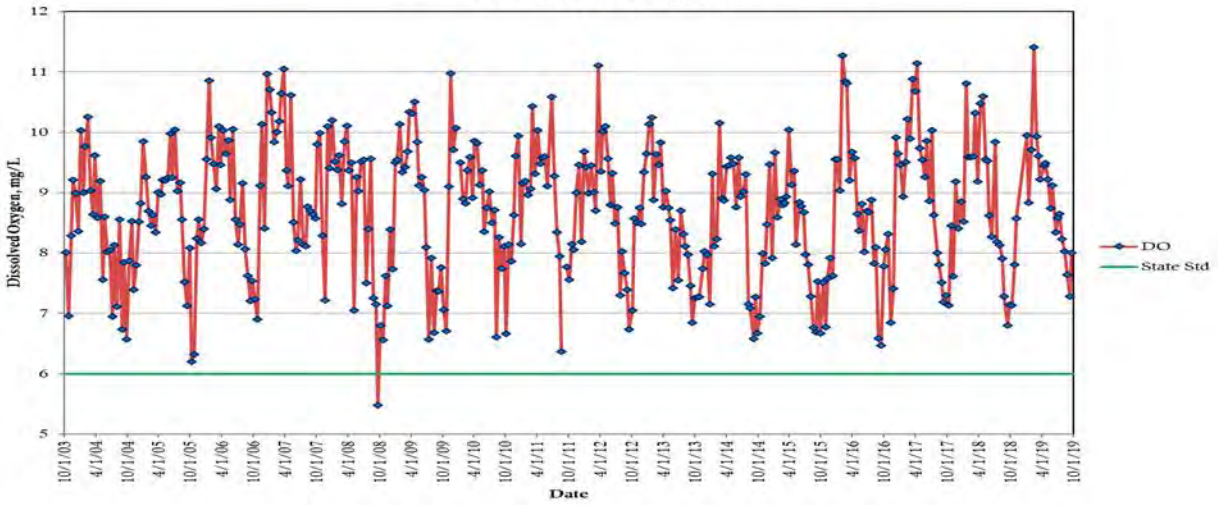
Site 47 is the Swinomish Channel, at the north end, just prior to Padilla Bay, and connects Padilla Bay to Skagit Bay. This site is designated as marine water.

Dissolved oxygen has increased over the most recent five years. Water temperature is higher than it was 16 years ago and ten years ago, but has decreased over the most recent five years. 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.

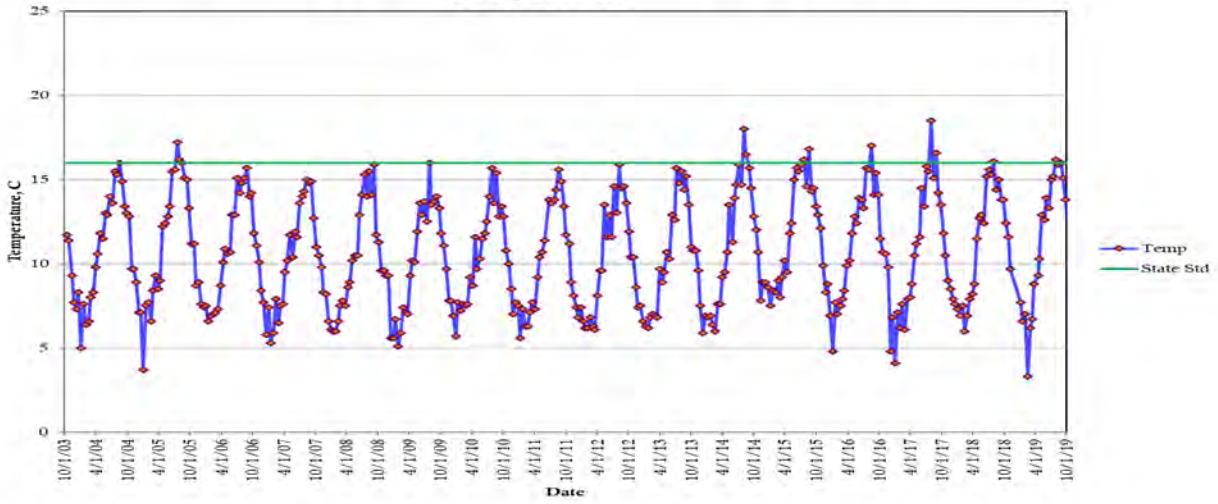
Site 47 rarely fails to meet state standards for DO and water temperature. Annual FC counts easily meet state standards.

Site 47 is 6th out of 39 sites for number of significant trends, with 17, and is 38th out of 39 sites for positive trends, with 18%.

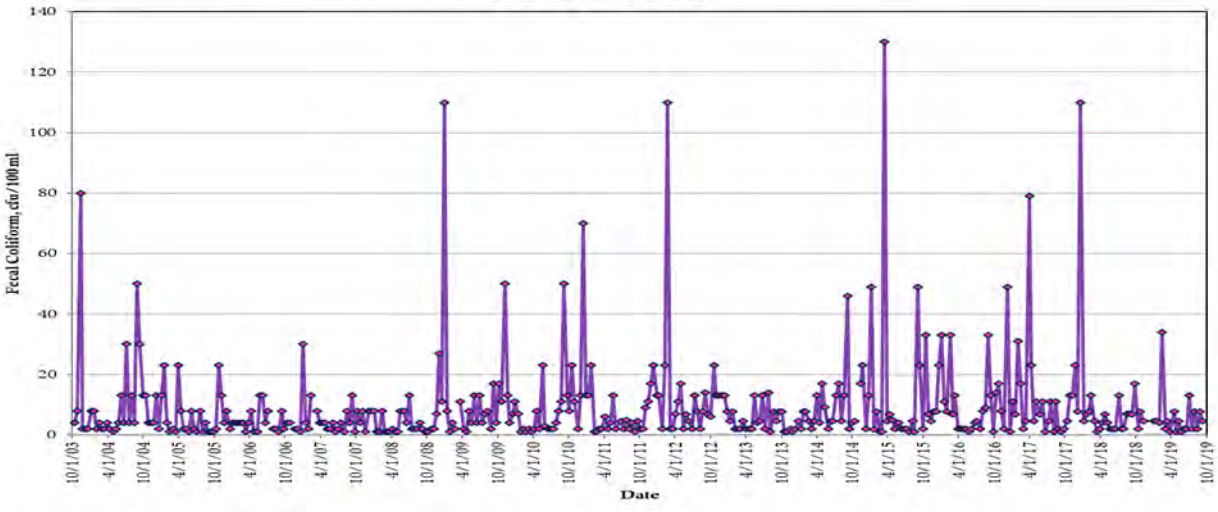
Swinomish Channel at County Boat Ramp - Site 47
Dissolved Oxygen

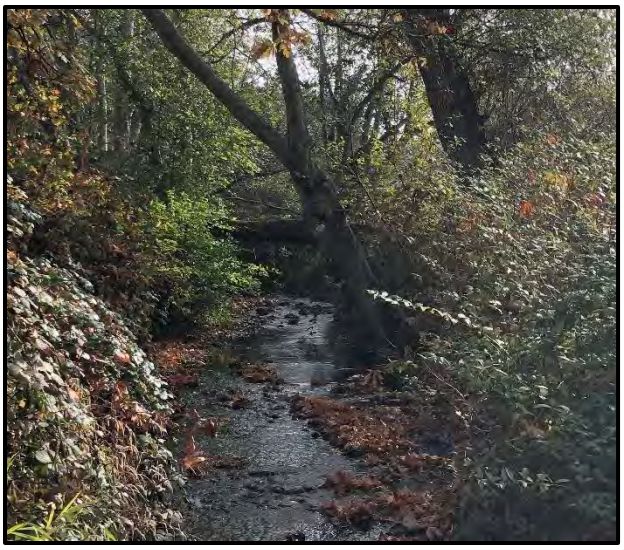


Swinomish Channel at County Boat Ramp - Site 47
Temperature



Swinomish Channel at County Boat Ramp - Site 47
Fecal Coliform





48

Fisher Creek
@ Franklin Road

Downstream Ag, TMDL

Water Quality Index (WQI)													
2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
75	67	54	81	70	59	77	69	85	89	87	75	84	87

Long Term Trends								
Dissolved Oxygen			Temperature			Fecal Coliform		
16 yr	10 yr	5 yr	16 yr	10 yr	5 yr	16 yr	10 yr	5 yr
↑	↑	↑	↑	–	↓	–	–	↓

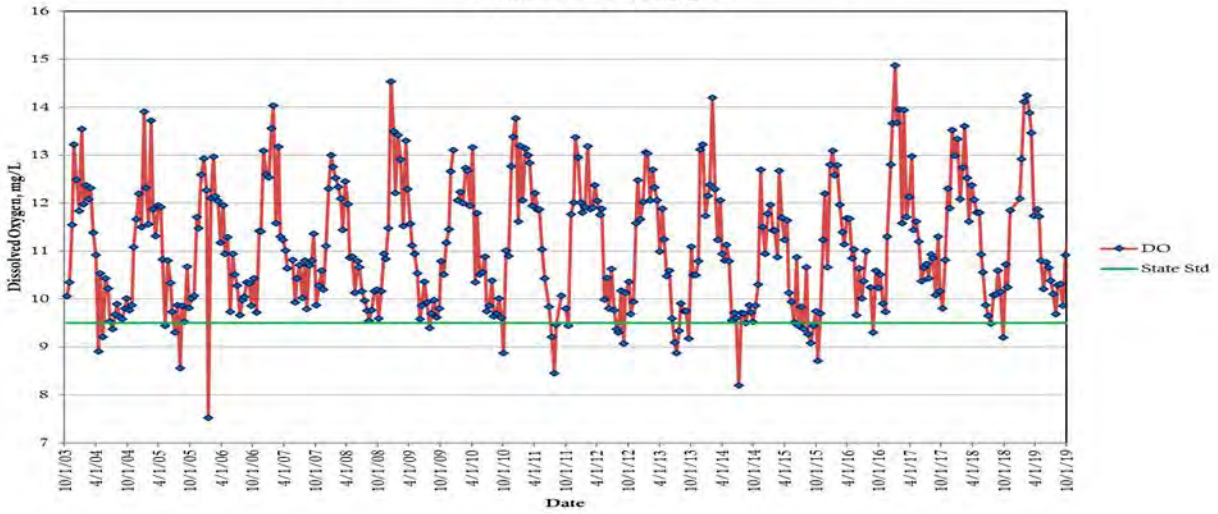
Site 48 is Fisher Creek, just prior to adjoining Carpenter Creek/Hill Ditch, and ultimately Skagit Bay. This site is influenced by rural residential and light agricultural activities. This site is designated as core salmonid habitat.

Dissolved oxygen has been increasing across all analyzed time periods. Over the most recent five years, water temperature and FC counts have decreased, though water temperature is higher now than it was 16 years ago. WQI scores are generally in the higher-scoring end of the moderate concern category, and often score as least concern.

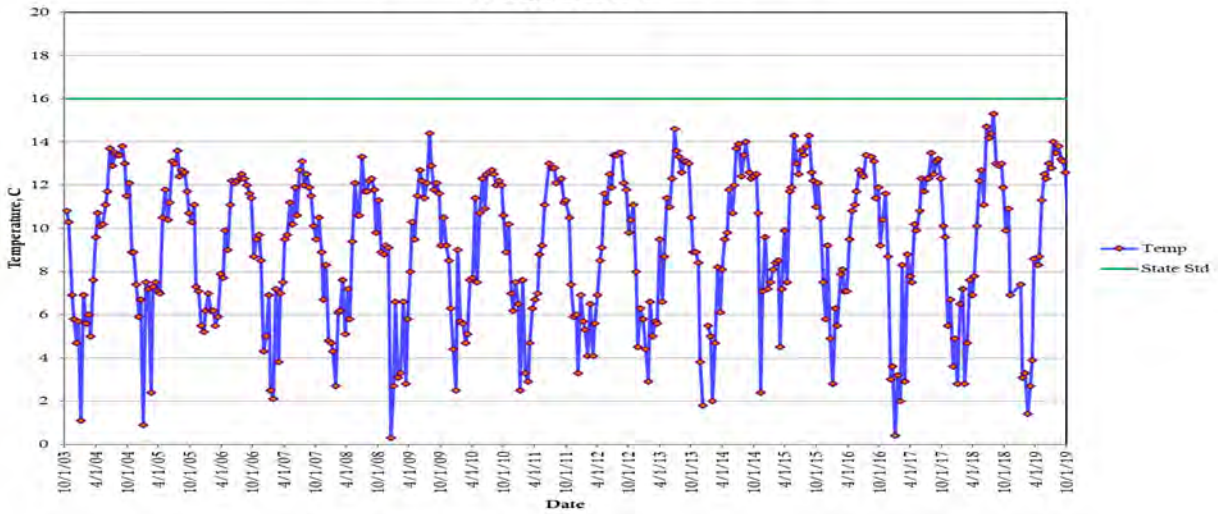
Site 48 rarely fails to meet state standards for DO, and has never failed to meet state standards for water temperature across the life of this program. Annual FC levels pass the state standard for geomean of 100, but do fail the state standard for a 90th percentile of 200.

Site 48 is 2nd out of 39 sites for number of significant trends, with 20, and is tied for 7th out of 39 sites for positive trends, with 75%.

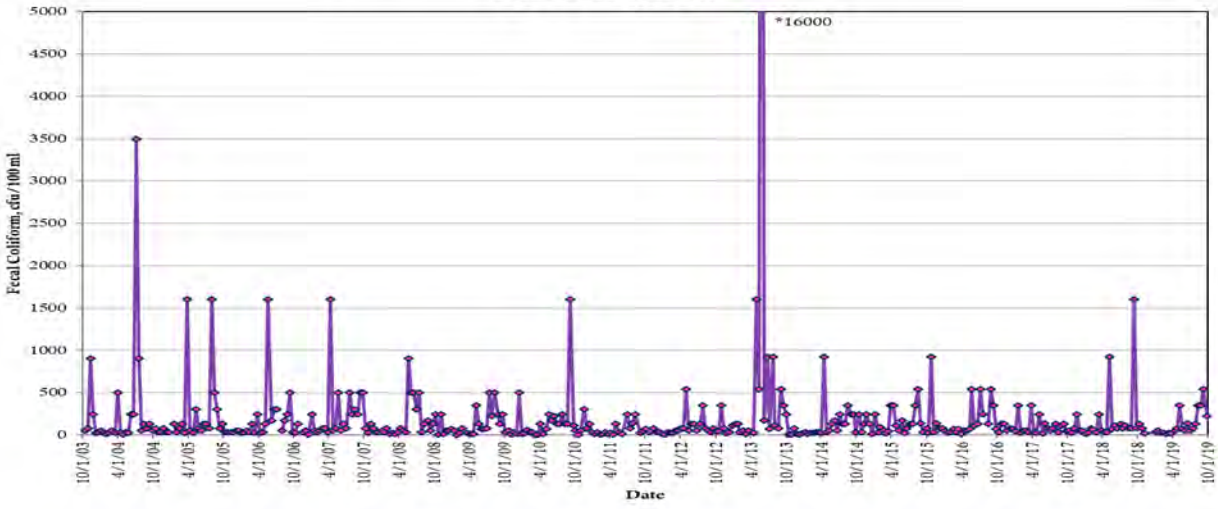
Fisher Creek at Franklin Road - Site 48
Dissolved Oxygen



Fisher Creek at Franklin Road - Site 48
Temperature



Fisher Creek at Franklin Road - Site 48
Fecal Coliform



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Appendix A - Raw Data Archive of data points, Oct. 2003 – Sep. 2019

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. 2019

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	381	404	405	409	365	402	408.0	409	108	108	108	107	107	108	107
Mean	6.94	6.64	57.43	10.71	14.66	151.72	0.1	436	0.59	0.77	0.08	0.04	0.57	0.12	8
SD	0.24	3.20	25.50	4.72	13.94	97.85	0.0	4570	0.53	0.51	0.05	0.03	0.53	0.13	13
Max	7.54	12.45	114.50	20.20	113.00	1799.00	0.2	92000	2.22	3.68	0.36	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	0.23	0.02	0.01	0.01	0.01	2
Site 4: Thomas Creek at F&S Grade Road															
n	387	408	409	412	370	401	410.0	409	109	109	109	109	108	109	109
Mean	7.24	11.08	95.79	9.40	20.46	122.87	0.0	683	1.02	0.49	0.06	0.04	1.01	0.05	14
SD	0.31	1.27	6.90	3.79	30.36	49.83	0.0	2077	0.30	0.30	0.04	0.03	0.30	0.04	26
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	0.20	0.03	0.01	0.01	0.01	2
Site 6: Friday Creek at Prairie Road															
n	387	406	408	413	371	410	413.0	413	109	109	109	109	108	109	109
Mean	7.30	11.21	99.49	10.53	6.18	78.88	0.0	113	0.52	0.39	0.05	0.02	0.52	0.03	9
SD	0.38	1.25	6.94	4.64	10.40	20.86	0.0	292	0.28	0.24	0.06	0.01	0.28	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	0.07	0.20	0.01	0.01	0.07	0.01	2
Site 8: Swede Creek at Grip Road															
n	387	409	410	413	371	400	414.0	413	109	109	109	109	108	109	109
Mean	7.15	10.72	92.68	9.63	14.20	68.27	0.0	176	0.45	0.46	0.05	0.03	0.43	0.05	12
SD	0.30	1.76	7.97	4.44	20.77	17.36	0.0	413	0.37	0.27	0.03	0.02	0.34	0.03	33
Max	8.41	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	0.04	0.25	0.02	0.01	0.01	0.01	2
Site 11: Samish River at Highway 9															
No.	391	412	413	415	373	407	416.0	416	108	109	109	108	108	109	108
Mean	7.01	8.66	74.30	8.94	3.47	72.16	0.0	47	0.31	0.29	0.04	0.01	0.31	0.03	8
SD	0.31	1.34	7.81	3.43	9.46	19.34	0.0	251	0.12	0.13	0.05	0.01	0.12	0.03	35
Max	8.09	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.	363	387	389	391	357	389	391.0	387	104	103	104	104	103	104	104
Mean	7.17	9.13	81.06	11.13	7.88	106.61	0.0	136	0.39	0.51	0.06	0.02	0.38	0.08	10
SD	0.29	2.07	13.37	5.62	14.98	33.62	0.0	236	0.23	0.23	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.	383	408	409	410	375	408	411.0	406	108	107	108	108	107	108	108
Mean	7.28	9.83	86.51	10.17	5.10	92.16	0.0	134	0.31	0.38	0.04	0.01	0.30	0.05	6
SD	0.31	1.52	9.41	5.03	8.37	27.70	0.0	288	0.21	0.17	0.02	0.01	0.21	0.04	12
Max	8.07	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	4.21	39.30	0.50	0.00	38.50	0.0	1	0.01	0.23	0.01	0.01	0.01	0.01	2
Site 14: College Way Creek at College Way															
No.	383	412	413	414	375	410	414.0	408	107	106	107	107	106	107	107
Mean	7.30	9.23	81.41	10.65	7.02	222.02	0.1	455	0.40	0.54	0.06	0.06	0.39	0.07	5
SD	0.28	2.32	15.22	4.17	26.29	50.63	0.0	1170	0.33	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	0.25	0.02	0.01	0.01	0.01	2
Site 15: Nookachamps Creek at Knapp Road															
No.	386	411	412	414	377	413	414.0	409	109	108	109	109	108	109	109
Mean	7.23	8.10	72.52	12.03	5.19	113.16	0.0	176	0.31	0.64	0.08	0.06	0.30	0.10	6
SD	0.28	3.35	26.19	5.51	4.04	35.14	0.0	434	0.28	0.26	0.06	0.09	0.27	0.08	5
Max	7.92	13.51	114.30	23.10	62.40	241.70	0.1	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	0.01	0.25	0.05	0.01	0.01	0.01	2
Site 16: East Fork Nookachamps Creek at Beaver Lake Road															
No.	385	411	412	414	377	410	414.0	408	108	107	108	108	107	108	108
Mean	7.43	11.42	98.91	9.47	3.78	89.63	0.0	134	0.34	0.32	0.04	0.01	0.33	0.03	6
SD	0.31	1.30	5.66	4.67	8.31	32.64	0.0	823	0.21	0.16	0.02	0.01	0.20	0.02	21
Max	8.10	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	29.20	0.0	1	0.01	0.20	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.	383	411	412	414	376	412	414.0	407	109	108	109	109	108	109	109
Mean	7.45	9.93	91.77	12.72	2.47	87.61	0.0	39	0.24	0.44	0.04	0.02	0.23	0.05	3
SD	0.31	1.89	9.72	5.97	1.90	14.10	0.0	90	0.22	0.21	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	49.40	0.0	1	0.01	0.22	0.01	0.01	0.01	0.01	2
Site 18: Lake Creek at Highway 9															
No.	387	411	412	415	378	414	415.0	410	109	108	109	109	108	109	109
Mean	7.45	11.01	96.54	9.94	2.85	90.55	0.0	193	0.46	0.37	0.04	0.02	0.46	0.03	5
SD	0.32	1.34	5.56	4.02	3.87	24.98	0.0	933	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	44.00	0.0	1	0.05	0.20	0.01	0.01	0.05	0.01	2
Site 19: Hansen Creek at Hoehn Road															
No.	371	392	393	394	356	382	394.0	393	106	106	107	106	106	106	106
Mean	7.09	10.31	88.49	9.13	15.16	81.84	0.0	232	0.43	0.42	0.07	0.02	0.42	0.04	36
SD	0.30	1.45	6.91	4.29	69.55	18.89	0.0	444	0.22	0.62	0.16	0.04	0.22	0.03	139
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	0.22	0.01	0.01	0.03	0.01	2
Site 20: Hansen Creek at Northern State Hospital															
No.	387	410	411	411	369	406	412.0	409	109	109	109	109	108	109	109
Mean	7.14	11.13	95.69	9.00	15.80	79.07	0.0	115	0.47	0.37	0.10	0.02	0.46	0.03	61
SD	0.30	1.18	4.67	3.65	77.38	21.42	0.0	238	0.24	0.33	0.27	0.03	0.24	0.03	237
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	0.20	0.01	0.01	0.05	0.01	2
Site 21: Coal Creek at Hoehn Road															
No.	335	358	358	359	321	348	359.0	356	97	97	96	97	96	97	96
Mean	7.10	11.15	93.39	8.13	13.72	81.38	0.0	289	0.76	0.33	0.06	0.02	0.76	0.03	22
SD	0.29	1.48	5.70	4.08	64.79	24.25	0.0	655	0.30	0.19	0.07	0.03	0.30	0.04	70
Max	8.32	15.05	115.90	17.50	1005.00	229.50	0.1	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	0.20	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.	390	408	409	412	373	402	411.0	411	107	108	108	107	107	108	107
Mean	7.22	11.75	99.20	8.31	11.66	80.03	0.0	72	0.63	0.32	0.06	0.01	0.63	0.02	23
SD	0.41	1.21	4.56	3.89	67.67	22.02	0.0	285	0.31	0.21	0.11	0.02	0.31	0.02	90
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	6.05	8.33	73.20	0.00	0.00	18.30	0.0	1	0.01	0.18	0.01	0.01	0.16	0.01	2
Site 23: Wiseman Creek at Minkler Road															
No.	347	368	370	371	333	365	371.0	369	102	103	103	103	101	103	102.0
Mean	7.24	11.89	100.14	8.05	14.46	74.40	0.0	78	0.93	0.33	0.07	0.02	0.93	0.02	27.5
SD	0.36	1.04	5.43	3.39	85.82	19.31	0.0	316	0.32	0.20	0.13	0.02	0.32	0.03	109.4
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	0.43	0.16	0.01	0.01	0.22	0.01	2.0
Site 24: Mannser Creek at Lyman-Hamilton Highway															
No.	394	413	414	415	374	409	416.0	412	109	109	109	109	108	109	109
Mean	6.94	6.72	57.47	8.64	1.98	108.13	0.1	42	0.23	0.35	0.05	0.03	0.23	0.02	4
SD	0.29	1.47	11.81	2.92	2.01	21.09	0.0	91	0.12	0.56	0.03	0.06	0.12	0.02	5
Max	7.90	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	56.20	0.0	1	0.01	0.20	0.01	0.01	0.01	0.01	2
Site 25: Red Cabin Creek at Hamilton Cemetery Road															
No.	320	333	335	336	304	334	335.0	334	91	91	91	91	90	91	91
Mean	7.25	11.82	98.72	7.55	3.42	67.20	0.0	44	0.53	0.29	0.05	0.02	0.52	0.02	10
SD	0.38	0.79	4.89	2.36	22.34	21.33	0.0	171	0.21	0.15	0.05	0.02	0.19	0.02	45
Max	8.25	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	0.25	0.20	0.01	0.01	0.23	0.01	2
Site 28: Brickyard Creek at Highway 20															
No.	284	297	298	299	271	294	300.0	298	81	81	81	81	80	81	81
Mean	7.08	9.33	79.40	8.81	8.51	105.78	0.0	151	0.62	0.55	0.05	0.03	0.62	0.08	5
SD	0.44	1.79	9.76	4.02	6.91	36.98	0.0	299	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	4.34	44.60	0.00	0.53	-99.00	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.	388	410	411	416	378	412	416.0	408	107	105	106	107	106	107	107
Mean	7.23	11.12	95.76	9.08	12.43	54.70	0.0	33	0.08	0.32	0.05	0.01	0.08	0.04	24
SD	0.46	1.04	4.84	3.76	38.80	11.60	0.0	118	0.05	0.26	0.05	0.02	0.05	0.26	59
Max	8.84	13.68	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	5.88	7.63	78.10	0.90	0.78	28.60	0.0	1	0.01	0.20	0.01	0.01	0.01	0.01	2
Site 30: Skagit River at Cape Horn Road															
No.	394	413	414	415	373	413	415.0	409	108	108	108	108	107	108	108
Mean	7.16	11.25	96.01	8.63	9.38	57.35	0.0	11	0.08	0.28	0.05	0.01	0.08	0.02	21
SD	0.36	1.06	4.69	3.43	23.15	12.66	0.0	33	0.07	0.13	0.07	0.02	0.07	0.01	59
Max	8.49	14.24	118.00	16.30	238.00	132.20	0.1	540	0.65	1.34	0.49	0.17	0.65	0.07	501
Min	6.02	7.64	72.50	0.00	0.00	27.70	0.0	1	0.01	0.20	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.	384	406	408	414	371	411	413.0	415	108	110	110	108	108	110	108
Mean	7.51	10.81	97.05	10.80	11.53	96.17	0.1	177	0.60	0.39	0.06	0.03	0.60	0.06	20
SD	0.46	1.18	9.73	4.75	19.14	25.14	0.4	908	0.21	0.25	0.07	0.03	0.20	0.08	41
Max	8.66	14.99	150.00	21.60	181.00	141.80	7.9	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	0.23	0.02	0.01	0.36	0.01	2
Site 33: Alice Bay Pump Station															
No.	382	385	404	409	368	400	408.0	407	105	106	106	105	105	106	105
Mean	7.21	9.28	110.84	13.45	28.77	24766.05	15.3	160	0.64	2.95	0.53	0.29	0.59	1.22	43
SD	0.83	4.54	75.03	6.50	58.58	13505.87	8.9	379	0.78	1.89	0.52	0.35	0.78	0.84	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	0.05	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.	378	402	402	405	368	395	403.0	398	106	105	106	106	105	106	106
Mean	7.08	6.81	61.68	11.69	16.71	15417.53	9.7	488	0.51	1.41	0.53	0.38	0.49	0.28	26
SD	0.50	3.51	29.86	6.17	16.80	17731.27	11.5	1355	0.73	0.71	0.78	0.69	0.72	0.30	32
Max	8.58	15.98	195.40	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	0.40	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.	372	395	395	400	358	397	399.0	394	102	102	103	101	103	102	101
Mean	7.23	5.28	49.34	12.06	38.50	457.57	0.2	316	0.94	1.22	0.21	0.12	0.92	0.61	18
SD	0.51	1.41	13.69	4.35	29.22	1027.44	0.6	815	0.78	0.37	0.14	0.08	0.77	0.27	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	6.30	1.85	17.20	0.00	-99.00	85.50	0.0	1	0.01	0.44	0.04	0.01	0.21	0.02	2
Site 36: Edison Slough at Edison Elementary School															
No.	381	398	405	409	365	396	407.0	412	107	107	107	107	106	107	107
Mean	7.37	9.09	97.84	13.66	9.95	13299.38	8.1	209	0.41	1.27	0.47	0.34	0.41	0.24	20
SD	0.73	3.55	57.98	7.79	6.65	15719.65	10.0	433	0.53	0.72	0.61	0.53	0.53	0.34	21
Max	10.10	26.00	359.20	32.40	49.30	44360.00	28.9	5400	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.	380	388	405	409	369	404	407.0	410	108	108	108	108	107	108	108
Mean	7.37	7.17	83.54	13.45	42.57	10526.73	6.2	418	0.79	3.00	0.84	0.48	0.77	1.50	43
SD	0.68	4.15	69.85	6.65	94.39	10946.86	6.9	1025	1.04	1.25	0.85	0.60	1.04	1.04	47
Max	9.35	24.72	387.30	27.50	939.00	43450.00	27.9	16000	5.66	7.72	4.26	3.22	5.66	6.71	250
Min	6.16	0.04	0.60	1.80	-99.00	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.	376	376	392	403	362	397	402.0	404	106	106	106	106	106	106	106
Mean	7.30	7.46	90.21	12.93	43.13	17344.27	10.5	667	0.44	1.94	0.87	0.56	0.41	1.20	55
SD	0.85	4.75	82.11	5.87	138.64	13600.84	8.8	2215	0.52	9.95	0.76	0.67	0.52	0.72	74
Max	9.20	37.78	455.10	26.10	2300.00	44380.00	28.4	30000	1.90	7.04	3.03	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	-99.00	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.	382	405	407	411	366	400	411.0	411	107	107	107	107	107	107	107
Mean	7.20	10.81	93.85	9.79	16.40	131.55	0.0	460	0.87	0.60	0.10	0.06	0.87	0.06	38
SD	0.31	1.76	7.60	4.41	38.62	85.53	0.1	1751	0.60	0.67	0.18	0.05	0.60	0.05	201
Max	7.97	15.06	111.60	18.20	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	0.21	0.01	0.01	0.19	0.01	2
Site 40: Big Indian Slough at Highway 20 truck scales															
No.	379	403	403	405	368	404	404.0	398	104	105	105	104	105	105	104
Mean	6.81	4.95	43.51	10.83	24.39	450.38	0.2	193	0.75	1.01	0.12	0.09	0.72	0.37	9
SD	0.29	2.07	16.02	3.93	15.05	2116.64	1.4	615	0.51	0.38	0.07	0.08	0.50	0.22	8
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	6.10	0.44	4.60	2.40	2.48	93.40	0.0	1	0.01	0.25	0.04	0.01	0.01	0.04	2
Site 41: Maddox Creek/Big Ditch at Milltown Road															
No.	387	413	414	416	378	412	416.0	411	109	108	109	108	108	109	109
Mean	7.22	6.26	58.38	11.96	18.69	514.99	0.2	168	1.05	1.19	0.16	0.08	1.01	0.36	9
SD	0.34	2.12	21.47	5.06	29.48	501.70	0.3	600	1.06	0.73	0.12	0.07	1.04	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	0.25	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.	385	411	412	414	376	411	414.0	406	109	108	109	109	107	109	109
Mean	7.34	8.21	73.54	11.33	3.86	189.17	0.1	160	0.59	0.57	0.07	0.05	0.58	0.08	3
SD	0.31	2.34	18.02	5.65	4.02	52.24	0.0	919	0.51	0.26	0.06	0.04	0.51	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	0.20	0.02	0.01	0.01	0.01	2
Site 43: Wiley Slough at Wylie Road															
No.	380	406	407	408	371	406	408.0	399	106	105	106	106	105	106	106
Mean	7.20	4.98	46.49	12.14	22.68	2934.17	1.5	166	1.37	1.50	0.32	0.19	1.33	0.50	17
SD	0.41	2.83	27.44	5.16	53.83	2859.03	1.5	387	1.81	0.86	0.41	0.28	1.74	0.40	32
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	1.85	264
Min	6.08	0.12	1.40	0.80	1.29	59.70	0.0	1	0.01	0.25	0.05	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.	386	407	410	413	376	410	413.0	407	108	108	109	108	108	109	108
Mean	7.29	6.86	66.63	11.49	37.12	8271.32	4.9	209	0.66	1.46	0.27	0.13	0.63	0.66	28
SD	0.41	2.76	31.65	4.40	94.13	7622.14	4.8	329	1.05	0.76	0.51	0.34	1.03	0.58	38
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	0.23	0.05	0.01	0.01	0.01	4
Site 45: North Fork Skagit River near Moore Road															
No.	372	394	394	400	365	395	396.0	392	105	105	105	105	105	105	105
Mean	7.68	11.24	97.22	9.37	11.19	55.51	0.0	14	0.08	0.29	0.05	0.01	0.08	0.03	19
SD	0.44	1.15	4.52	3.91	34.89	10.32	0.0	28	0.05	0.17	0.07	0.02	0.05	0.02	49
Max	9.10	13.63	114.30	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	0.15	0.01	0.01	0.01	0.01	2
Site 46: South Fork Skagit River at Conway boat ramp															
No.	377	403	404	406	372	403	405.0	403	106	105	106	106	105	106	106
Mean	7.61	11.26	97.70	9.49	8.85	56.58	0.0	21	0.09	0.28	0.05	0.01	0.08	0.02	16
SD	0.40	1.09	4.05	3.93	12.05	33.12	0.0	46	0.07	0.18	0.03	0.01	0.05	0.02	29
Max	8.91	13.73	110.20	18.30	109.00	687.00	0.3	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	29.50	0.0	1	0.01	0.13	0.01	0.01	0.01	0.01	2
Site 47: Swinomish Channel at County boat ramp															
No.	389	414	415	417	378	417	417.0	408	109	108	109	109	108	109	109
Mean	7.38	8.72	88.81	10.66	5.48	33606.81	21.1	9	0.19	0.33	0.08	0.05	0.19	0.06	32
SD	0.52	1.09	9.74	3.28	6.47	6288.46	4.3	15	0.11	0.24	0.04	0.08	0.11	0.03	22
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	0.20	0.04	0.01	0.01	0.01	2
Site 48: Fisher Creek at Franklin Road															
No.	388	412	413	415	378	413	416.0	408	109	107	109	109	108	108	109
Mean	7.54	11.11	95.67	9.13	3.03	167.39	0.1	205	0.65	0.62	0.20	0.21	0.63	0.09	6
SD	0.29	1.32	5.22	3.41	4.40	118.49	0.1	844	0.51	0.29	0.18	0.19	0.51	0.03	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	0.06	0.04	0.01	0.01	0.01	2

Appendix C - Summary of Seasonal Kendall's results for the Water Year 2019

Site	Period (years)	Parameter	n	Slope	Δ (units/period)	Z-score	Significant (95%)	Confidence (%)
3	16	pH	380	-0.0011	-0.018	-0.458	No	< 80
		mpH	202	-0.0021	-0.034	-0.638	No	< 80
		DO	404	0.0474	0.759	2.412	Yes	95
		mDO	206	0.0358	0.573	1.439	No	80
		DO % sat	405	0.3777	6.043	2.620	Yes	95
		mDO % sat	207	0.2607	4.171	1.175	No	< 80
		Temp	409	0.0201	0.321	1.185	No	< 80
		mTemp	206	0.0150	0.240	0.530	No	< 80
		Turb	365	0.1750	2.800	2.928	Yes	95
		mTurb	193	0.1268	2.029	1.589	No	80
		FC	408	-0.3882	-6.211	-2.151	Yes	95
		mFC	205	-1.2820	-20.512	-1.970	Yes	95
		NO3+NO2	108	-0.0066	-0.106	-1.991	Yes	95
		TKN	108	-0.0130	-0.209	-2.142	Yes	95
		TP	108	0.0000	0.000	3.575	Yes	95
		OP	107	0.0015	0.024	2.818	Yes	95
		NH3	108	-0.0039	-0.063	-3.231	Yes	95
		TSS	107	0.0000	0.000	0.950	No	< 80
	10	DO	251	-0.1091	-1.091	-2.364	Yes	95
		mDO	128	-0.1472	-1.472	-2.380	Yes	95
		Temp	254	0.0000	0.000	-0.156	No	< 80
		mTemp	128	-0.0311	-0.311	-0.509	No	< 80
		FC	255	0.0000	0.000	0.518	No	< 80
		mFC	127	1.2540	12.540	0.655	No	< 80
	5	DO	124	-0.4148	-2.074	-2.184	Yes	95
		mDO	65	-0.6841	-3.421	-1.965	Yes	95
		Temp	126	-0.2030	-1.015	1.591	No	80
		mTemp	65	-0.2758	-1.379	-1.312	No	80
		FC	127	-1.2770	-6.385	-1.151	No	< 80
		mFC	64	-4.5840	-22.920	-1.452	No	80

Site	Period (years)	Parameter	n	Slope	Δ (units/period)	Z-score	Significant (95%)	Confidence (%)
4	16	pH	387	-0.0265	-0.425	-8.876	Yes	95
		mpH	204	-0.0259	-0.414	-6.784	Yes	95
		DO	408	0.0418	0.668	5.933	Yes	95
		mDO	208	0.0449	0.718	5.145	Yes	95
		DO % sat	409	0.2967	4.747	7.121	Yes	95
		mDO % sat	208	0.2991	4.786	6.113	Yes	95
		Temp	412	0.0125	0.200	0.870	No	< 80
		mTemp	208	0.0125	0.200	0.785	No	< 80
		Turb	370	-0.2448	-3.917	-4.353	Yes	95
		mTurb	194	-0.3334	-5.334	-3.898	Yes	95
		FC	409	-9.5710	-153.136	-6.396	Yes	95
		mFC	206	-16.3500	-261.600	-5.230	Yes	95
		NO3+NO2	109	-0.0123	-0.197	-2.479	Yes	95
		TKN	109	0.0000	0.000	-1.039	No	< 80
		TP	109	0.0000	0.000	0.388	No	< 80
		OP	109	0.0006	0.010	1.388	No	80
		NH3	109	-0.0012	-0.019	-2.467	Yes	95
		TSS	109	0.0000	0.000	-1.464	No	80
	10	DO	253	0.0732	0.732	5.233	Yes	95
		mDO	130	0.0649	0.649	3.983	Yes	95
		Temp	256	0.0000	0.000	-0.171	No	< 80
		mTemp	130	0.0000	0.000	0.068	No	< 80
		FC	256	0.0000	0.000	-0.224	No	< 80
		mFC	128	0.2673	2.673	0.209	No	< 80
	5	DO	125	0.1453	0.727	3.332	Yes	95
		mDO	65	0.1050	0.525	2.322	Yes	95
		Temp	127	-0.3667	-1.834	-3.325	Yes	95
		mTemp	65	-0.3011	-1.506	-2.395	Yes	95
		FC	126	0.0000	0.000	-0.296	No	< 80
		mFC	65	1.5020	7.510	0.359	No	< 80

Site	Period (years)	Parameter	n	Slope	Δ (units/period)	Z-score	Significant (95%)	Confidence (%)
6	16	pH	386	-0.0186	-0.297	-5.603	Yes	95
		mpH	204	-0.0177	-0.283	-4.448	Yes	95
		DO	406	0.0238	0.381	3.092	Yes	95
		mDO	207	0.0225	0.360	2.456	Yes	95
		DO % sat	407	0.2797	4.475	6.087	Yes	95
		mDO % sat	206	0.2742	4.387	4.623	Yes	95
		Temp	413	0.0386	0.618	2.165	Yes	95
		mTemp	208	0.0545	0.871	2.012	Yes	95
		Turb	371	0.0067	0.107	0.431	No	< 80
		mTurb	194	-0.0244	-0.390	-0.858	No	< 80
		FC	413	0.0000	0.000	-1.201	No	< 80
		mFC	208	-0.4995	-7.992	-1.639	No	80
		NO3+NO2	109	-0.0123	-0.197	-3.841	Yes	95
		TKN	109	0.0000	0.000	0.571	No	< 80
		TP	109	0.0000	0.000	-2.758	Yes	95
		OP	109	0.0000	0.000	2.510	Yes	95
		NH3	109	0.0000	0.000	-1.954	No	90
		TSS	109	0.0000	0.000	-0.477	No	< 80
	10	DO	253	0.0697	0.697	4.455	Yes	95
		mDO	129	0.0776	0.776	3.378	Yes	95
		Temp	258	0.0501	0.501	1.311	No	80
		mTemp	130	0.0836	0.836	1.700	No	90
		FC	258	-0.2461	-2.461	-1.996	Yes	95
		mFC	130	-0.8951	-8.951	-1.386	No	80
	5	DO	125	0.1884	0.942	3.924	Yes	95
		mDO	64	0.1996	0.998	2.598	Yes	95
		Temp	129	-0.4011	-2.006	-3.156	Yes	95
		mTemp	65	-0.3205	-1.603	-1.916	No	90
		FC	129	-0.4993	-2.497	-1.243	No	< 80
		mFC	65	-0.7704	-3.852	-0.538	No	< 80

Site	Period (years)	Parameter	n	Slope	Δ (units/period)	Z-score	Significant (95%)	Confidence (%)
8	16	pH	387	-0.0071	-0.114	-2.263	Yes	95
		mpH	204	-0.0090	-0.144	-2.089	Yes	95
		DO	409	-0.0300	-0.480	-2.964	Yes	95
		mDO	208	-0.0354	-0.566	-3.168	Yes	95
		DO % sat	410	-0.2111	-3.378	-4.015	Yes	95
		mDO % sat	208	-0.2499	-3.998	-3.573	Yes	95
		Temp	413	0.0333	0.533	1.610	No	80
		mTemp	208	0.0450	0.719	1.864	No	90
		Turb	371	-0.0725	-1.159	-1.857	No	90
		mTurb	195	-0.1223	-1.957	-2.214	Yes	95
		FC	413	-1.9980	-31.968	-5.404	Yes	95
		mFC	208	-3.0070	-48.112	-4.240	Yes	95
		NO3+NO2	108	-0.0115	-0.184	-4.065	Yes	95
		TKN	108	0.0000	0.000	0.763	No	< 80
		TP	108	0.0000	0.000	0.843	No	< 80
		OP	108	0.0006	0.010	3.091	Yes	95
		NH3	108	-0.0029	-0.046	-3.933	Yes	95
		TSS	108	0.0000	0.000	0.121	No	< 80
	10	DO	228	0.0231	0.231	1.153	No	< 80
		mDO	117	-0.0332	-0.332	-0.656	No	< 80
		Temp	230	0.0432	0.432	1.021	No	< 80
		mTemp	117	0.1279	1.279	2.078	Yes	95
		FC	231	-0.3964	-3.964	-1.654	No	90
		mFC	117	-0.3237		-0.289	No	< 80
	5	DO	126	0.1570	0.785	2.457	Yes	95
		mDO	65	0.0963	0.481	1.251	No	< 80
		Temp	127	-0.4345	-2.173	-3.206	Yes	95
		mTemp	65	-0.3510	-1.755	-2.028	Yes	95
		FC	129	-5.0030	-25.015	-1.842	No	90
		mFC	65	-4.7490	-23.745	-0.896	No	< 80

Site	Period (years)	Parameter	n	Slope	Δ (units/period)	Z-score	Significant (95%)	Confidence (%)
11	16	pH	391	0.0133	0.212	4.036	Yes	95
		mpH	204	0.0110	0.176	3.116	Yes	95
		DO	412	0.0407	0.652	3.873	Yes	95
		mDO	208	0.0425	0.680	3.055	Yes	95
		DO % sat	413	0.3046	4.874	4.284	Yes	95
		mDO % sat	208	0.3457	5.531	3.606	Yes	95
		Temp	415	-0.0182	-0.291	-1.136	No	< 80
		mTemp	208	-0.0182	-0.291	-0.864	No	< 80
		Turb	373	-0.0299	-0.478	-2.389	Yes	95
		mTurb	194	-0.0421	-0.674	-2.497	Yes	95
		FC	414	-0.1253	-2.005	-3.303	Yes	95
		mFC	205	-0.4387	-7.019	-3.416	Yes	95
		NO3+NO2	107	-0.0031	-0.049	-1.281	No	< 80
		TKN	108	0.0000	0.000	1.203	No	< 80
		TP	108	0.0000	0.000	-1.499	No	80
		OP	107	0.0000	0.000	1.529	No	80
		NH3	108	0.0000	0.000	-0.880	No	< 80
		TSS	107	0.0000	0.000	-1.622	No	80
	10	DO	255	0.1103	1.103	4.523	Yes	95
		mDO	130	0.1001	1.001	3.349	Yes	95
		Temp	258	-0.0615	-0.615	-1.944	No	90
		mTemp	130	-0.0860	-0.860	-1.880	No	90
		FC	259	0.0000	0.000	-0.435	No	< 80
		mFC	128	-0.1503	-1.503	-0.952	No	< 80
	5	DO	126	0.2011	1.006	3.390	Yes	95
		mDO	65	0.2186	1.093	2.918	Yes	95
		Temp	128	-0.3008	-1.504	-3.465	Yes	95
		mTemp	65	-0.2946	-1.473	-2.442	Yes	95
		FC	130	0.0000	0.000	-0.542	No	< 80
		mFC	65	-0.7130	-3.565	-0.774	No	< 80

Site	Period (years)	Parameter	n	Slope	Δ (units/period)	Z-score	Significant (95%)	Confidence (%)
12	16	pH	362	0.0124	0.199	3.758	Yes	95
		mpH	196	0.0116	0.185	2.676	Yes	95
		DO	386	-0.0264	-0.422	-1.801	No	90
		mDO	206	-0.0360	-0.576	-1.623	No	80
		DO % sat	388	-0.2005	-3.208	-2.295	Yes	95
		mDO % sat	205	-0.1876	-3.002	-1.445	No	80
		Temp	390	0.0383	0.612	2.033	Yes	95
		mTemp	206	0.0548	0.877	1.950	No	90
		Turb	356	-0.0477	-0.762	-1.798	No	90
		mTurb	192	-0.0515	-0.824	-1.452	No	80
		FC	389	-0.0836	-1.337	-1.883	No	90
		mFC	206	-0.1161	-1.858	-0.407	No	< 80
		NO3+NO2	104	-0.0169	-0.271	-3.414	Yes	95
		TKN	103	0.0000	0.000	-0.135	No	< 80
		TP	104	0.0000	0.000	4.663	Yes	95
		OP	104	0.0010	0.015	4.554	Yes	95
		NH3	104	-0.0025	-0.039	-2.487	Yes	95
		TSS	104	0.0000	0.000	-1.576	No	80
	10	DO	240	0.0085	0.085	0.372	No	< 80
		mDO	128	0.0566	0.566	1.834	No	90
		Temp	243	0.0985	0.985	2.078	Yes	95
		mTemp	128	-0.0290	-0.290	-0.326	No	< 80
		FC	243	0.0000	0.000	-0.655	No	< 80
		mFC	128	-0.8927	-8.927	-0.722	No	< 80
	5	DO	122	0.2371	1.186	2.717	Yes	95
		mDO	64	0.3675	1.838	3.451	Yes	95
		Temp	122	-0.3129	-1.565	-2.244	Yes	95
		mTemp	64	-0.5611	-2.806	-3.143	Yes	95
		FC	123	-7.6930	-38.465	-3.120	Yes	95
		mFC	64	-12.9100	-64.550	-3.212	Yes	95

Site	Period (years)	Parameter	n	Slope	Δ (units/period)	Z-score	Significant (95%)	Confidence (%)
13	16	pH	383	0.0099	0.158	2.742	Yes	95
		mpH	201	0.0078	0.125	1.972	Yes	95
		DO	408	-0.0260	-0.417	-2.421	Yes	95
		mDO	208	-0.0307	-0.491	-2.108	Yes	95
		DO % sat	409	-0.1151	-1.842	-1.353	No	80
		mDO % sat	208	-0.1458	-2.333	-1.522	No	80
		Temp	410	0.0555	0.888	2.819	Yes	95
		mTemp	208	0.0729	1.166	2.694	Yes	95
		Turb	375	-0.0099	-0.159	-0.570	No	< 80
		mTurb	194	-0.0175	-0.281	-0.571	No	< 80
		FC	409	-0.1335	-2.136	-2.322	Yes	95
		mFC	208	-0.6616	-10.586	-1.491	No	80
		NO3+NO2	108	-0.0050	-0.080	-1.913	No	90
		TKN	107	0.0000	0.000	0.358	No	< 80
		TP	108	0.0000	0.000	-2.076	Yes	95
		OP	108	0.0000	0.000	3.372	Yes	95
		NH3	108	-0.0026	-0.042	-3.297	Yes	95
		TSS	108	0.0000	0.000	-1.544	No	80
	10	DO	254	0.0041	0.041	0.241	No	< 80
		mDO	130	0.0199	0.199	0.663	No	< 80
		Temp	256	0.1122	1.122	2.833	Yes	95
		mTemp	130	0.0567	0.567	0.710	No	< 80
		FC	256	-0.8758	-8.758	-2.336	Yes	95
		mFC	130	-2.4590	-24.590	-2.450	Yes	95
	5	DO	128	0.0913	0.456	1.584	No	80
		mDO	65	0.0504	0.252	0.124	No	< 80
		Temp	127	-0.4481	-2.241	-3.256	Yes	95
		mTemp	65	-0.6435	-3.218	-3.410	Yes	95
		FC	128	-4.0090	-20.045	-3.087	Yes	95
		mFC	65	-11.1800	-55.900	-3.658	Yes	95

Site	Period (years)	Parameter	n	Slope	Δ (units/period)	Z-score	Significant (95%)	Confidence (%)
14	16	pH	384	-0.0245	-0.391	-7.476	Yes	95
		mpH	202	-0.0251	-0.401	-5.769	Yes	95
		DO	410	0.0200	0.320	1.713	No	90
		mDO	208	0.0185	0.296	1.318	No	80
		DO % sat	412	0.0669	1.070	0.918	No	< 80
		mDO % sat	208	0.0873	1.396	0.904	No	< 80
		Temp	414	0.0100	0.160	0.544	No	< 80
		mTemp	208	0.0293	0.469	1.629	No	80
		Turb	376	-0.0934	-1.495	-4.776	Yes	95
		mTurb	193	-0.1148	-1.837	-3.437	Yes	95
		FC	411	-1.3070	-20.912	-2.524	Yes	95
		mFC	208	-1.6710	-26.736	-1.445	No	80
		NO3+NO2	107	-0.0069	-0.110	-2.502	Yes	95
		TKN	106	0.0000	0.000	-0.418	No	< 80
		TP	107	0.0000	0.000	2.993	Yes	95
		OP	107	0.0000	0.000	0.328	No	< 80
		NH3	107	-0.0042	-0.067	-4.890	Yes	< 80
		TSS	107	0.0000	0.000	-0.291	No	
	10	DO	254	0.0351	0.351	1.421	No	80
		mDO	130	0.0613	0.613	2.630	Yes	95
		Temp	258	0.0766	0.766	2.195	Yes	95
		mTemp	130	0.0372	0.372	1.168	No	< 80
		FC	256	0.0000	0.000	-0.772	No	< 80
		mFC	129	-0.6540	-6.540	-0.485	No	< 80
	5	DO	127	0.3008	1.504	3.747	Yes	95
		mDO	65	0.4271	2.136	4.510	Yes	95
		Temp	128	-0.4339	-2.170	-3.523	Yes	95
		mTemp	65	-0.6535	-3.268	-3.596	Yes	95
		FC	127	0.0000	0.000	-0.338	No	< 80
		mFC	65	-12.5600	-62.800	-1.674	No	90

Site	Period (years)	Parameter	n	Slope	Δ (units/period)	Z-score	Significant (95%)	Confidence (%)
15	16	pH	386	0.0127	0.203	3.781	Yes	95
		mpH	202	0.0134	0.214	3.392	Yes	95
		DO	410	0.0360	0.577	3.006	Yes	95
		mDO	208	0.0259	0.414	1.318	No	80
		DO % sat	411	0.3755	6.008	3.944	Yes	95
		mDO % sat	208	0.3223	5.157	2.471	Yes	95
		Temp	413	0.0334	0.535	1.869	No	90
		mTemp	208	0.0666	1.065	2.534	Yes	95
		Turb	377	0.0117	0.187	0.733	No	< 80
		mTurb	194	0.0041	0.065	0.165	No	< 80
		FC	411	-0.0907	-1.452	-1.777	No	90
		mFC	208	1.7300	27.680	2.224	Yes	95
		NO3+NO2	109	0.0000	0.000	0.318	No	< 80
		TKN	108	-0.0018	-0.029	0.542	No	< 80
		TP	109	0.0020	0.032	5.911	Yes	95
		OP	109	0.0024	0.038	4.487	Yes	95
		NH3	109	-0.0023	-0.036	-2.056	Yes	95
		TSS	109	0.0000	0.000	0.084	No	< 80
	10	DO	254	0.0198	0.198	0.811	No	< 80
		mDO	130	0.0689	0.689	1.349	No	80
		Temp	257	0.0330	0.330	0.713	No	< 80
		mTemp	130	-0.0356	-0.356	-0.343	No	< 80
		FC	257	-0.9827	-9.827	-1.784	No	90
		mFC	130	-6.6180	-66.180	-2.314	Yes	95
	5	DO	128	0.2602	1.301	3.376	Yes	95
		mDO	65	0.4400	2.200	3.274	Yes	95
		Temp	128	-0.4601	-2.301	-3.260	Yes	95
		mTemp	65	-0.6998	-3.499	-4.016	Yes	95
		FC	128	-0.7379	-3.690	-0.098	No	< 80
		mFC	65	-1.6240	-8.120	-0.186	No	< 80

Site	Period (years)	Parameter	n	Slope	Δ (units/period)	Z-score	Significant (95%)	Confidence (%)
16	16	pH	385	0.0000	0.000	0.163	No	< 80
		mpH	202	0.0009	0.015	0.191	No	< 80
		DO	411	0.0124	0.199	1.614	No	80
		mDO	208	0.0070	0.112	0.539	No	< 80
		DO % sat	412	0.1722	2.755	3.559	Yes	95
		mDO % sat	208	0.2005	3.208	3.043	Yes	95
		Temp	414	0.0501	0.802	2.766	Yes	95
		mTemp	208	0.0621	0.993	2.648	Yes	95
		Turb	377	0.0166	0.266	1.814	No	90
		mTurb	194	0.0105	0.168	0.952	No	< 80
		FC	410	0.0000	0.000	-0.747	No	< 80
		mFC	207	0.0000	0.000	-0.116	No	< 80
		NO3+NO2	108	-0.0031	-0.049	-1.036	No	< 80
		TKN	107	0.0000	0.000	1.249	No	< 80
		TP	108	0.0000	0.000	1.463	No	80
		OP	108	0.0000	0.000	-2.167	Yes	95
		NH3	108	0.0000	0.000	-0.430	No	< 80
		TSS	108	0.0000	0.000	1.291	No	80
	10	DO	255	0.0676	0.676	4.398	Yes	95
		mDO	130	0.0888	0.888	4.209	Yes	95
		Temp	258	0.1003	1.003	2.661	Yes	95
		mTemp	130	0.0253	0.253	0.710	No	< 80
		FC	256	0.0000	0.000	1.092	No	< 80
		mFC	129	0.1346	1.346	0.278	No	< 80
	5	DO	128	0.2812	1.406	6.300	Yes	95
		mDO	65	0.3111	1.556	5.498	Yes	95
		Temp	128	-0.5204	-2.602	-4.332	Yes	95
		mTemp	65	-0.7201	-3.601	-3.906	Yes	95
		FC	128	-0.7865	-3.933	-1.295	No	80
		mFC	65	-1.2620	-6.310	-0.746	No	< 80

Site	Period (years)	Parameter	n	Slope	Δ (units/period)	Z-score	Significant (95%)	Confidence (%)
17	16	pH	383	-0.0007	-0.011	-0.220	No	< 80
		mpH	202	-0.0012	-0.020	0.227	No	< 80
		DO	411	0.0079	0.127	1.019	No	< 80
		mDO	208	-0.0060	-0.095	0.596	No	< 80
		DO % sat	412	0.1003	1.605	1.495	No	80
		mDO % sat	208	0.0000	0.000	0.034	No	< 80
		Temp	414	0.0332	0.531	1.623	No	80
		mTemp	208	0.0669	1.070	2.327	Yes	95
		Turb	376	0.0693	1.108	6.139	Yes	95
		mTurb	194	0.0689	1.103	4.808	Yes	95
		FC	410	0.0000	0.000	0.419	No	< 80
		mFC	207	0.1003	1.605	0.809	No	< 80
		NO3+NO2	109	0.0000	0.000	0.711	No	< 80
		TKN	108	0.0000	0.000	0.702	No	< 80
		TP	109	0.0000	0.000	1.799	No	90
		OP	109	0.0000	0.000	3.235	Yes	95
		NH3	109	0.0000	0.000	-1.761	No	90
		TSS	109	0.0000	0.000	0.273	No	< 80
	10	DO	255	0.0379	0.379	2.058	Yes	95
		mDO	130	0.0370	0.370	1.624	No	80
		Temp	258	0.0143	0.143	0.355	No	< 80
		mTemp	130	-0.0337	-0.337	-0.481	No	< 80
		FC	258	0.3339	3.339	2.283	Yes	95
		mFC	129	0.9060	9.060	2.152	Yes	95
	5	DO	128	0.3263	1.632	5.026	Yes	95
		mDO	65	0.3892	1.946	4.263	Yes	95
		Temp	128	-0.3852	-1.926	-3.451	Yes	95
		mTemp	65	-0.5607	-2.804	-3.961	Yes	95
		FC	128	0.0000	0.000	-0.816	No	< 80
		mFC	65	-0.9376	-4.688	-0.805	No	< 80

Site	Period (years)	Parameter	n	Slope	Δ (units/period)	Z-score	Significant (95%)	Confidence (%)
18	16	pH	387	0.0068	0.109	2.334	Yes	95
		mpH	202	0.0065	0.105	1.624	No	80
		DO	411	-0.0066	-0.106	-0.833	No	< 80
		mDO	208	-0.0125	-0.200	-1.066	No	< 80
		DO % sat	412	-0.0287	-0.459	-0.637	No	< 80
		mDO % sat	208	-0.0293	-0.469	-0.515	No	< 80
		Temp	415	0.0376	0.602	2.103	Yes	95
		mTemp	208	0.0498	0.796	2.317	Yes	95
		Turb	378	0.0236	0.378	2.332	Yes	95
		mTurb	194	0.0104	0.167	0.711	No	< 80
		FC						
		mFC	208	-1.0940	-17.504	-2.453	Yes	95
		NO3+NO2	109	0.0000	0.000	0.051	No	< 80
		TKN	108	0.0000	0.000	0.138	No	< 80
		TP	109	0.0000	0.000	-1.207	No	< 80
		OP	109	0.0000	0.000	1.716	No	90
		NH3	109	0.0000	0.000	-2.096	Yes	95
		TSS	109	0.0000	0.000	0.509	No	< 80
	10	DO	255	0.0271	0.271	1.946	No	90
		mDO	130	0.0411	0.411	2.310	Yes	95
		Temp	259	0.0981	0.981	2.446	Yes	95
		mTemp	130	0.0404	0.404	0.824	No	< 80
		FC	258	-0.4556	-4.556	-1.913	No	90
		mFC	130	-1.4050	-14.050	-1.901	No	90
	5	DO	128	0.1693	0.847	3.783	Yes	95
		mDO	65	0.2381	1.191	3.274	Yes	95
		Temp	129	-0.3005	-1.503	-2.981	Yes	95
		mTemp	65	-0.5453	-2.727	-3.219	Yes	95
		FC	129	-0.7577	-3.789	-1.234	No	< 80
		mFC	65	-5.4930	-27.465	-2.294	Yes	95

Site	Period (years)	Parameter	n	Slope	Δ (units/period)	Z-score	Significant (95%)	Confidence (%)
19	16	pH	368	-0.0068	-0.108	-2.089	Yes	95
		mpH	196	-0.0082	-0.131	-2.075	Yes	95
		DO	391	-0.0461	-0.738	-5.048	Yes	95
		mDO	202	-0.0474	-0.758	-4.011	Yes	95
		DO % sat	391	-0.2889	-4.622	-5.708	Yes	95
		mDO % sat	202	-0.3019	-4.830	-4.439	Yes	95
		Temp	393	0.0708	1.133	3.321	Yes	95
		mTemp	203	0.0716	1.145	2.521	Yes	95
		Turb	355	0.0033	0.053	0.072	No	< 80
		mTurb	190	-0.0336	-0.538	-1.071	No	< 80
		FC	392	0.0000	0.000	-0.320	No	< 80
		mFC	202	-1.1660	-18.656	-1.204	No	< 80
		NO3+NO2	106	-0.0092	-0.148	-2.997	Yes	95
		TKN	106	0.0000	0.000	1.641	No	80
		TP	107	0.0000	0.000	-1.207	No	< 80
		OP	106	0.0000	0.000	1.267	No	< 80
		NH3	106	0.0000	0.000	-0.877	No	< 80
		TSS	107	0.0000	0.000	-1.271	No	< 80
	10	DO	236	-0.0488	-0.488	-2.379	Yes	95
		mDO	124	-0.0497	-0.497	-2.240	Yes	95
		Temp	238	0.1578	1.578	3.695	Yes	95
		mTemp	125	0.1503	1.503	2.980	Yes	95
		FC	238	0.0000	0.000	-0.733	No	< 80
		mFC	124	-1.6150	-16.150	-1.133	No	< 80
	5	DO	109	0.0897	0.448	1.228	No	< 80
		mDO	59	0.1116	0.558	0.808	No	< 80
		Temp	110	-0.1712	-0.856	-0.855	No	< 80
		mTemp	59	-0.0966	-0.483	-0.475	No	< 80
		FC	111	0.0000	0.000	-0.754	No	< 80
		mFC	59	-3.3420	-16.710	-0.761	No	< 80

Site	Period (years)	Parameter	n	Slope	Δ (units/period)	Z-score	Significant (95%)	Confidence (%)
20	16	pH	387	-0.0113	-0.180	-3.278	Yes	95
		mpH	204	-0.0112	-0.179	-2.615	Yes	95
		DO	410	0.0239	0.383	3.668	Yes	95
		mDO	208	0.0235	0.376	2.772	Yes	95
		DO % sat	411	0.1983	3.173	4.815	Yes	95
		mDO % sat	208	0.2245	3.592	4.072	Yes	95
		Temp	412	0.0000	0.000	0.055	No	< 80
		mTemp	208	0.0000	0.000	-0.080	No	< 80
		Turb	369	-0.0222	-0.355	-1.832	No	90
		mTurb	194	-0.0320	-0.511	-1.829	No	90
		FC	409	0.0000	0.000	-0.686	No	< 80
		mFC	207	-0.2494	-3.990	-0.655	No	< 80
		NO3+NO2	109	0.0000	0.000	0.205	No	< 80
		TKN	109	0.0000	0.000	1.620	No	80
		TP	109	0.0000	0.000	-2.801	Yes	95
		OP	109	0.0000	0.000	1.274	No	< 80
		NH3	109	0.0000	0.000	-1.290	No	80
		TSS	109	0.0000	0.000	-1.666	No	90
	10	DO	254	0.0753	0.753	5.584	Yes	95
		mDO	130	0.0706	0.706	3.711	Yes	95
		Temp	256	0.0401	0.401	1.231	No	< 80
		mTemp	130	0.0291	0.291	0.499	No	< 80
		FC	255	0.0000	0.000	0.130	No	< 80
		mFC	129	0.7480	7.480	0.853	No	< 80
	5	DO	127	0.1539	0.770	4.539	Yes	95
		mDO	65	0.1577	0.789	2.442	Yes	95
		Temp	128	-0.3102	-1.551	-3.127	Yes	95
		mTemp	65	-0.2510	-1.255	-1.798	No	90
		FC	128	0.0000	0.000	-0.579	No	< 80
		mFC	64	1.4880	7.440	0.251	No	< 80

Site	Period (years)	Parameter	n	Slope	Δ (units/period)	Z-score	Significant (95%)	Confidence (%)
21	16	pH	333	-0.0078	-0.125	-2.098	Yes	95
		mpH	186	-0.0089	-0.142	-1.982	Yes	95
		DO	356	0.0098	0.157	0.875	No	< 80
		mDO	191	0.0164	0.263	1.337	No	80
		DO % sat	356	0.1171	1.874	2.463	Yes	95
		mDO % sat	192	0.1308	2.093	2.258	Yes	95
		Temp	357	0.0260	0.416	1.251	No	< 80
		mTemp	191	0.0251	0.401	0.929	No	< 80
		Turb	319	-0.0501	-0.802	-1.508	No	80
		mTurb	178	-0.0693	-1.108	-1.727	No	90
		FC	355	-0.6020	-9.632	-2.583	Yes	95
		mFC	191	-1.8310	-29.296	-2.565	Yes	95
		NO3+NO2	97	-0.0033	-0.053	-0.680	No	< 80
		TKN	97	0.0000	0.000	1.333	No	80
		TP	97	0.0000	0.000	-0.798	No	< 80
		OP	97	0.0000	0.000	2.753	Yes	95
		NH3	97	0.0000	0.000	0.051	No	< 80
		TSS	97	0.0000	0.000	-0.189	No	< 80
	10	DO	217	0.0336	0.336	1.744	No	90
		mDO	120	0.0531	0.531	2.038	Yes	95
		Temp	218	0.0748	0.748	1.662	No	90
		mTemp	120	0.0744	0.744	1.303	No	80
		FC	217	0.0000	0.000	1.284	No	80
		mFC	120	0.2863	2.863	0.369	No	< 80
	5	DO	102	0.1786	0.893	2.031	Yes	95
		mDO	56	0.2106	1.053	1.965	Yes	95
		Temp	103	-0.3008	-1.504	-1.498	No	80
		mTemp	56	-0.2692	-1.346	-1.204	No	< 80
		FC	102	-3.2910	-16.455	-1.450	No	80
		mFC	56	-3.4240	-17.120	-0.862	No	< 80

Site	Period (years)	Parameter	n	Slope	Δ (units/period)	Z-score	Significant (95%)	Confidence (%)
22	16	pH	390	-0.0273	-0.437	-5.684	Yes	95
		mpH	202	-0.0261	-0.418	-4.460	Yes	95
		DO	409	-0.0142	-0.227	-1.897	No	90
		mDO	207	-0.0084	-0.134	-0.946	No	< 80
		DO % sat	410	-0.0334	-0.735	-0.925	No	< 80
		mDO % sat	208	-0.0224	-0.358	-0.284	No	< 80
		Temp	412	0.0334	0.535	2.006	Yes	95
		mTemp	207	0.0334	0.534	1.598	No	80
		Turb	373	-0.0173	-0.276	-1.416	No	80
		mTurb	193	-0.0386	-0.617	-1.751	No	90
		FC	410	0.0000	0.000	2.724	Yes	95
		mFC	204	0.2507	4.011	2.721	Yes	95
		NO3+NO2	107	-0.0016	-0.026	-0.462	No	< 80
		TKN	108	0.0000	0.000	-2.852	Yes	95
		TP	108	0.0000	0.000	-1.094	No	< 80
		OP	107	0.0000	0.000	2.729	Yes	95
		NH3	108	0.0000	0.000	-1.684	No	90
		TSS	107	0.0000	0.000	-1.950	No	90
	10	DO	254	0.0234	0.234	1.623	No	80
		mDO	129	0.0254	0.254	1.392	No	80
		Temp	256	0.0986	0.986	2.338	Yes	95
		mTemp	129	0.1002	1.002	2.355	Yes	95
		FC	257	0.0000	0.000	0.923	No	< 80
		mFC	127	0.4986	4.986	1.881	No	90
	5	DO	126	0.1313	0.131	2.863	Yes	95
		mDO	65	0.1323	0.662	2.442	Yes	95
		Temp	127	-0.2011	-1.006	-1.828	No	90
		mTemp	65	-0.1614	-0.807	-1.020	No	< 80
		FC	128	-0.4985	-2.493	-1.909	No	90
		mFC	65	-0.5021	-2.511	-0.718	No	< 80

Site	Period (years)	Parameter	n	Slope	Δ (units/period)	Z-score	Significant (95%)	Confidence (%)
23	16	pH	347	-0.0267	-0.426	-6.853	Yes	95
		mpH	178	-0.0255	-0.408	-5.211	Yes	95
		DO	368	0.0068	0.108	0.942	No	< 80
		mDO	184	0.0100	0.160	1.017	No	< 80
		DO % sat	370	0.0909	1.454	2.119	Yes	95
		mDO % sat	186	0.0857	1.371	1.633	No	80
		Temp	371	0.0000	0.000	0.103	No	< 80
		mTemp	185	-0.0157	-0.252	-0.698	No	< 80
		Turb	333	0.0100	0.160	0.923	No	< 80
		mTurb	173	0.0000	0.000	-0.029	No	< 80
		FC	369	0.0000	0.000	0.191	No	< 80
		mFC	184	0.0000	0.000	-0.026	No	< 80
		NO3+NO2	102	-0.0285	-0.455	-4.708	Yes	95
		TKN	103	0.0000	0.000	0.762	No	< 80
		TP	103	0.0000	0.000	-2.827	Yes	95
		OP	103	0.0000	0.000	2.102	Yes	95
		NH3	103	0.0000	0.000	0.327	No	< 80
		TSS	102	0.0000	0.000	-1.858	No	90
	10	DO	221	0.0336	0.336	2.212	Yes	95
		mDO	108	0.0376	0.376	1.485	No	80
		Temp	223	0.0493	0.493	1.205	No	< 80
		mTemp	109	0.0401	0.401	0.996	No	< 80
		FC	223	0.0000	0.000	1.634	No	80
		mFC	108	0.4813	4.813	1.516	No	80
	5	DO	109	0.1297	0.649	2.208	Yes	95
		mDO	48	0.1108	0.554	0.904	No	< 80
		Temp	110	-0.2657	-1.329	-1.668	No	90
		mTemp	48	-0.2090	-1.045	-0.971	No	< 80
		FC	110	0.1686	0.843	1.083	No	< 80
		mFC	48	0.5014	2.507	0.167	No	< 80

Site	Period (years)	Parameter	n	Slope	Δ (units/period)	Z-score	Significant (95%)	Confidence (%)
24	16	pH	393	-0.0037	-0.060	-1.215	No	< 80
		mpH	204	-0.0039	-0.062	-0.840	No	< 80
		DO	412	0.0599	0.959	3.753	Yes	95
		mDO	209	0.0558	0.892	2.874	Yes	95
		DO % sat	413	0.4678	7.485	4.131	Yes	95
		mDO % sat	208	0.4871	7.794	3.232	Yes	95
		Temp	414	0.0000	0.000	-0.256	No	< 80
		mTemp	208	-0.0099	-0.158	-0.637	No	< 80
		Turb	373	0.0637	1.019	6.794	Yes	95
		mTurb	194	0.0604	0.966	4.941	Yes	95
		FC	411	-0.2300	-3.680	-3.589	Yes	95
		mFC	207	-0.3978	-6.365	-2.618	Yes	95
		NO3+NO2	109	0.0027	0.044	1.334	No	80
		TKN	108	0.0000	0.000	1.068	No	< 80
		TP	109	0.0000	0.000	2.595	Yes	95
		OP	109	0.0000	0.000	0.984	No	< 80
		NH3	109	0.0000	0.000	1.021	No	< 80
		TSS	109	0.0000	0.000	2.158	Yes	95
	10	DO	255	0.2487	2.487	8.790	Yes	95
		mDO	131	0.2356	2.356	6.272	Yes	95
		Temp	257	-0.0334	-0.334	-1.601	No	80
		mTemp	130	-0.0408	-0.408	-1.793	No	90
		FC	257	0.0000	0.000	1.520	No	< 80
		mFC	129	0.4404	4.404	1.215	No	< 80
	5	DO	127	0.1614	0.807	2.761	Yes	95
		mDO	66	0.1717	0.859	1.929	No	90
		Temp	128	-0.1478	-0.739	-2.045	Yes	95
		mTemp	65	-0.1004	-0.502	-0.959	No	< 80
		FC	129	0.0000	0.000	0.426	No	< 80
		mFC	65	1.4540	7.270	1.079	No	< 80

Site	Period (years)	Parameter	n	Slope	Δ (units/period)	Z-score	Significant (95%)	Confidence (%)
25	16	pH	320	-0.0245	-0.392	-5.233	Yes	95
		mpH	167	-0.0249	-0.398	-4.184	Yes	95
		DO	335	0.0142	0.227	1.748	No	90
		mDO	170	0.0150	0.240	1.292	No	80
		DO % sat	335	0.1493	2.389	3.289	Yes	95
		mDO % sat	171	0.1082	1.731	1.744	No	90
		Temp	336	0.0125	0.201	0.733	No	< 80
		mTemp	170	-0.0087	-0.139	-0.447	No	< 80
		Turb	304	0.0201	0.321	5.262	Yes	95
		mTurb	158	0.0150	0.239	2.265	Yes	95
		FC	334	0.0000	0.000	-0.124	No	< 80
		mFC	169	0.0000	0.000	0.189	No	< 80
		NO3+NO2	91	-0.0025	-0.039	-0.555	No	< 80
		TKN	91	0.0000	0.000	-2.693	Yes	95
		TP	91	0.0000	0.000	-1.938	No	90
		OP	91	0.0000	0.000	2.457	Yes	95
		NH3	91	0.0000	0.000	0.706	No	< 80
		TSS	91	0.0000	0.000	-1.153	No	< 80
	10	DO	202	0.0609	0.609	3.693	Yes	95
		mDO	100	0.0410	0.410	1.972	Yes	95
		Temp	203	0.0167	0.167	0.480	No	< 80
		mTemp	100	0.0090	0.090	0.305	No	< 80
		FC	204	0.0000	0.000	0.395	No	< 80
		mFC	99	0.0000	0.000	-0.166	No	< 80
	5	DO	97	0.1424	0.712	2.475	Yes	95
		mDO						
		Temp	98	-0.2660	-1.330	-1.876	No	90
		mTemp						
		FC	99	0.0000	0.000	1.076	No	< 80
		mFC						

Site	Period (years)	Parameter	n	Slope	Δ (units/period)	Z-score	Significant (95%)	Confidence (%)
28	16	pH	284	-0.0083	-0.133	-1.301	No	80
		mpH	153	-0.0100	-0.160	-0.926	No	< 80
		DO	297	0.0080	0.128	0.587	No	< 80
		mDO	157	0.0229	0.367	1.239	No	< 80
		DO % sat	298	0.0498	0.796	0.483	No	< 80
		mDO % sat	153	0.1022	1.635	0.834	No	< 80
		Temp	299	0.0000	0.000	-0.071	No	< 80
		mTemp	157	-0.0224	-0.359	-0.725	No	< 80
		Turb	271	0.0021	0.033	0.069	No	< 80
		mTurb	147	0.0012	0.018	0.034	No	< 80
		FC	298	0.0000	0.000	-0.176	No	< 80
		mFC	157	0.0000	0.000	0.076	No	< 80
		NO3+NO2	81	-0.0140	-0.223	-1.703	No	90
		TKN	81	-0.0130	-0.208	-2.516	Yes	95
		TP	81	0.0000	0.000	3.365	Yes	95
		OP	81	0.0010	0.016	2.468	Yes	95
		NH3	81	-0.0033	-0.053	-3.775	Yes	95
		TSS	81	0.0000	0.000	0.159	No	< 80
	10	DO	182	0.0479	0.479	1.513	No	80
		mDO	92	0.0462	0.462	1.098	No	< 80
		Temp	184	-0.0997	-0.997	-1.478	No	80
		mTemp	92	-0.1204	-1.204	-1.448	No	80
		FC	185	-0.1670	-1.670	-0.800	No	< 80
		mFC	92	-1.8360	-18.360	-0.929	No	< 80
	5	DO						
		mDO						
		Temp						
		mTemp						
		FC						
		mFC						

Site	Period (years)	Parameter	n	Slope	Δ (units/period)	Z-score	Significant (95%)	Confidence (%)
29	16	pH	378	-0.0020	-0.032	-0.411	No	< 80
		mpH	204	-0.0037	-0.059	-0.401	No	< 80
		DO	399	0.0033	0.052	0.502	No	< 80
		mDO	207	-0.0044	-0.070	-0.496	No	< 80
		DO % sat	400	0.0000	0.000	0.048	No	< 80
		mDO % sat	208	0.0179	0.286	0.298	No	< 80
		Temp	405	0.0084	0.134	0.821	No	< 80
		mTemp	208	0.0246	0.394	1.262	No	< 80
		Turb	367	-0.1869	-2.990	-4.761	Yes	95
		mTurb	194	-0.2188	-3.501	-3.714	Yes	95
		FC	400	0.0000	0.000	-1.013	No	< 80
		mFC	208	0.0000	0.000	-0.230	No	< 80
		NO3+NO2	107	0.0000	0.000	0.630	No	< 80
		TKN	106	0.0000	0.000	-1.892	No	90
		TP	106	0.0000	0.000	-0.434	No	< 80
		OP	107	0.0000	0.000	2.407	Yes	95
		NH3	107	0.0000	0.000	0.854	No	< 80
		TSS	107	0.0000	0.000	-1.092	No	< 80
	10	DO	244	0.0116	0.116	0.867	No	< 80
		mDO	129	0.0154	0.154	0.808	No	< 80
		Temp	249	0.0871	0.871	3.017	Yes	95
		mTemp	130	0.0501	0.501	1.259	No	< 80
		FC	249	0.0000	0.000	0.081	No	< 80
		mFC	130	-0.1671	-1.671	-0.666	No	< 80
	5	DO	129	0.0980	0.490	2.435	Yes	95
		mDO	65	0.1291	0.646	2.039	Yes	95
		Temp	129	-0.2974	-1.487	-3.545	Yes	95
		mTemp	65	-0.4691	-2.346	-3.151	Yes	95
		FC	129	0.0000	0.000	-0.976	No	< 80
		mFC	65	-1.3840	-6.920	-1.421	No	80

Site	Period (years)	Parameter	n	Slope	Δ (units/period)	Z-score	Significant (95%)	Confidence (%)
30	16	pH	394	-0.0119	-0.191	-3.227	Yes	95
		mpH	204	-0.0113	-0.181	-2.601	Yes	95
		DO	413	0.0084	0.134	1.293	No	80
		mDO	208	0.0092	0.147	1.384	No	80
		DO % sat	414	0.1049	1.678	2.449	Yes	95
		mDO % sat	208	0.0953	1.525	1.906	No	90
		Temp	415	0.0166	0.266	1.324	No	80
		mTemp	208	0.0077	0.123	0.750	No	< 80
		Turb	373	-0.1389	-2.222	-3.979	Yes	95
		mTurb	194	-0.2211	-3.538	-3.566	Yes	95
		FC	409	0.0000	0.000	0.501	No	< 80
		mFC	205	0.0000	0.000	-0.327	No	< 80
		NO3+NO2	108	0.0000	0.000	-0.084	No	< 80
		TKN	108	0.0000	0.000	-0.931	No	< 80
		TP	108	0.0000	0.000	-1.510	No	80
		OP	108	0.0000	0.000	2.966	Yes	95
		NH3	108	0.0000	0.000	-1.321	No	80
		TSS	108	-0.1241	-1.986	-2.486	Yes	95
	10	DO	257	0.0464	0.464	2.991	Yes	95
		mDO	130	0.0273	0.273	2.083	Yes	95
		Temp	259	0.0796	0.796	2.853	Yes	95
		mTemp	130	0.0731	0.731	2.814	Yes	95
		FC	259	0.0000	0.000	0.078	No	< 80
		mFC	127	-0.0555	-0.555	-1.302	No	80
	5	DO	129	0.1150	0.575	2.829	Yes	95
		mDO	65	0.1000	0.500	2.442	Yes	95
		Temp	130	-0.1730	-0.865	-2.201	Yes	95
		mTemp	65	-0.0918	-0.459	-0.597	No	< 80
		FC	130	0.0000	0.000	-0.480	No	< 80
		mFC	65	-0.4042	-2.021	-1.654	No	90

Site	Period (years)	Parameter	n	Slope	Δ (units/period)	Z-score	Significant (95%)	Confidence (%)
32	16	pH	384	0.0110	0.176	3.025	Yes	95
		mpH	205	0.0090	0.144	1.758	No	90
		DO	406	0.0251	0.401	2.782	Yes	95
		mDO	209	0.0271	0.434	2.553	Yes	95
		DO % sat	409	0.2582	4.131	4.628	Yes	95
		mDO % sat	209	0.2373	3.797	3.625	Yes	95
		Temp	415	0.0399	0.638	2.068	Yes	95
		mTemp	209	0.0440	0.704	1.663	No	90
		Turb	372	-0.0401	-0.642	-1.923	No	90
		mTurb	197	-0.0862	-1.379	-2.492	Yes	95
		FC	415	-0.2483	-3.973	-2.742	Yes	95
		mFC	205	-1.4520	-23.232	-2.482	Yes	95
		NO3+NO2	108	-0.0057	-0.091	-2.212	Yes	95
		TKN	110	0.0000	0.000	1.671	No	90
		TP	110	0.0000	0.000	0.375	No	< 80
		OP	108	0.0000	0.000	1.498	No	80
		NH3	110	-0.0037	-0.058	-4.992	Yes	95
		TSS	108	-0.0988	-1.580	-2.095	Yes	95
	10	DO	251	0.0784	0.784	4.570	Yes	95
		mDO	131	0.0615	0.615	3.041	Yes	95
		Temp	258	0.0831	0.831	2.074	Yes	95
		mTemp	131	0.0864	0.864	1.366	No	80
		FC	260	0.0000	0.000	0.649	No	< 80
		mFC	131	-0.6251	-6.251	-0.875	No	< 80
	5	DO	125	0.1929	0.965	3.664	Yes	95
		mDO	65	0.1702	0.851	3.102	Yes	95
		Temp	129	-0.4500	-2.250	-3.415	Yes	95
		mTemp	65	-0.4465	-2.233	-2.680	Yes	95
		FC	129	0.0000	0.000	0.071	No	< 80
		mFC	65	1.4900	7.450	0.240	No	< 80

Site	Period (years)	Parameter	n	Slope	Δ (units/period)	Z-score	Significant (95%)	Confidence (%)
33	16	pH	282	-0.0198	-0.317	-3.915	Yes	95
		mpH	203	-0.0187	-0.300	-3.392	Yes	95
		DO	387	-0.0150	-0.241	-0.528	No	< 80
		mDO	205	-0.0128	-0.205	-0.370	No	< 80
		DO % sat	406	-0.3630	-5.808	-1.123	No	< 80
		mDO % sat	210	-0.5766	-9.226	-1.507	No	80
		Temp	411	0.0000	0.000	0.347	No	< 80
		mTemp	208	0.0181	0.289	0.441	No	< 80
		Turb	369	-0.4417	-7.067	-4.673	Yes	95
		mTurb	193	-0.4173	-6.677	-3.692	Yes	95
		FC	411	-1.2940	-20.704	-3.709	Yes	95
		mFC	206	-1.9970	-31.952	-2.324	Yes	95
		NO3+NO2	105	0.0000	0.000	0.022	No	< 80
		TKN	106	0.0185	0.295	1.110	No	< 80
		TP	106	0.0095	0.152	1.175	No	< 80
		OP	105	0.0105	0.167	2.829	Yes	95
		NH3	106	-0.0082	-0.132	-0.705	No	< 80
		TSS	105	-1.3080	-20.928	-2.347	Yes	95
	10	DO	240	0.0497	0.497	0.681	No	< 80
		mDO	127	0.0822	0.822	0.932	No	< 80
		Temp	254	0.0660	0.660	1.123	No	< 80
		mTemp	129	0.1002	1.002	1.277	No	< 80
		FC	254	-2.1590	-21.590	-2.719	Yes	95
		mFC	128	-3.4260	-34.260	-2.433	Yes	95
	5	DO	119	0.0714	0.357	0.235	No	< 80
		mDO	65	-0.0174	-0.087	0.000	No	< 80
		Temp	123	-0.4385	-2.193	-2.453	Yes	95
		mTemp	65	-0.2863	-1.432	-1.319	No	80
		FC	124	-0.3377	-1.689	-0.566	No	< 80
		mFC	64	3.0060	15.030	0.375	No	< 80

Site	Period (years)	Parameter	n	Slope	Δ (units/period)	Z-score	Significant (95%)	Confidence (%)
34	16	pH	378	-0.0271	-0.434	-5.555	Yes	95
		mpH	201	-0.0241	-0.386	-3.955	Yes	95
		DO	402	0.0574	0.918	2.779	Yes	95
		mDO	205	0.0519	0.830	2.105	Yes	95
		DO % sat	402	0.5611	8.978	3.098	Yes	95
		mDO % sat	206	0.5553	8.885	2.175	Yes	95
		Temp	405	0.0899	1.438	3.024	Yes	95
		mTemp	206	0.1213	1.941	3.698	Yes	95
		Turb	368	-0.4212	-6.739	-5.663	Yes	95
		mTurb	192	-0.5812	-9.299	-5.610	Yes	95
		FC	400	-3.1200	-49.920	-3.713	Yes	95
		mFC	193	-6.4430	-103.088	-2.538	Yes	95
		NO3+NO2	106	-0.0002	-0.003	-1.423	No	80
		TKN	105	-0.0123	-0.196	-1.520	No	80
		TP	106	0.0067	0.107	3.451	Yes	95
		OP	106	0.0035	0.055	2.283	Yes	95
		NH3	106	-0.0146	-0.234	-6.252	Yes	95
		TSS	106	0.0000	0.000	0.331	No	< 80
	10	DO	248	0.1109	1.109	2.638	Yes	95
		mDO	128	0.1292	1.292	2.028	Yes	95
		Temp	251	0.2505	2.505	3.817	Yes	95
		mTemp	129	0.2292	2.292	3.338	Yes	95
		FC	250	-4.1950	-41.950	-2.710	Yes	95
		mFC	116	-8.0220	-80.220	-2.287	Yes	95
	5	DO	120	0.1517	0.759	1.451	No	80
		mDO	65	0.2746	1.373	2.162	Yes	95
		Temp	121	-0.2004	-1.002	-1.086	No	< 80
		mTemp	65	-0.5266	-2.633	-2.039	Yes	95
		FC	119	-8.6980	-43.490	-2.776	Yes	95
		mFC	52	-8.3190	-41.595	-0.865	No	< 80

Site	Period (years)	Parameter	n	Slope	Δ (units/period)	Z-score	Significant (95%)	Confidence (%)
35	16	pH	371	0.0200	0.321	5.074	Yes	95
		mpH	199	0.0200	0.320	4.031	Yes	95
		DO	394	0.0020	0.032	0.167	No	< 80
		mDO	203	0.0044	0.071	0.297	No	< 80
		DO % sat	394	0.0803	1.285	0.450	No	< 80
		mDO % sat	205	0.0766	1.225	0.504	No	< 80
		Temp	399	0.0501	0.801	2.715	Yes	95
		mTemp	203	0.0251	0.401	0.928	No	< 80
		Turb	356	-0.6351	-10.162	-4.211	Yes	95
		mTurb	189	-0.8859	-14.174	-3.842	Yes	95
		FC	393	-0.0767	-1.226	-1.157	No	< 80
		mFC	203	-0.1025	-1.640	-0.202	No	< 80
		NO3+NO2	102	0.0000	0.000	-0.022	No	< 80
		TKN	102	-0.0066	-0.105	-0.867	No	< 80
		TP	103	0.0000	0.000	0.198	No	< 80
		OP	101	-0.0021	-0.034	-0.977	No	< 80
		NH3	102	-0.0066	-0.106	-0.911	No	< 80
		TSS	101	-0.2494	-3.990	-1.572	No	80
	10	DO	246	0.0134	0.134	0.290	No	< 80
		mDO	128	0.0094	0.094	0.254	No	< 80
		Temp	250	0.1690	1.690	3.972	Yes	95
		mTemp	128	0.2297	2.297	3.880	Yes	95
		FC	249	1.4760	14.760	1.685	No	90
		mFC	128	2.6760	26.760	1.316	No	80
	5	DO	122	0.1747	0.874	1.389	No	80
		mDO	65	0.1026	0.513	0.893	No	< 80
		Temp	124	-0.0971	-0.485	-0.471	No	< 80
		mTemp	65	-0.0413	-0.206	-0.239	No	< 80
		FC	125	1.4710	7.355	0.989	No	< 80
		mFC	65	6.8960	34.480	0.955	No	< 80

Site	Period (years)	Parameter	n	Slope	Δ (units/period)	Z-score	Significant (95%)	Confidence (%)
36	16	pH	384	-0.0150	-0.241	-4.069	Yes	95
		mpH	206	-0.0150	-0.240	-2.744	Yes	95
		DO	400	0.0274	0.439	1.150	No	< 80
		mDO	208	0.0421	0.674	1.405	No	80
		DO % sat	407	0.3704	5.926	1.419	No	80
		mDO % sat	210	0.2463	3.941	0.984	No	< 80
		Temp	411	0.0142	0.227	0.432	No	< 80
		mTemp	209	0.0369	0.590	0.731	No	< 80
		Turb	367	-0.0240	-0.384	-0.444	No	< 80
		mTurb	195	-0.0641	-1.026	-0.987	No	< 80
		FC	415	0.4978	7.965	2.018	Yes	95
		mFC	209	0.9799	15.678	1.001	No	< 80
		NO3+NO2	108	-0.0004	-0.007	-1.479	No	80
		TKN	108	-0.0125	-0.200	-1.587	No	80
		TP	108	0.0050	0.080	2.772	Yes	95
		OP	108	0.0049	0.079	3.006	Yes	95
		NH3	108	-0.0100	-0.160	-4.654	Yes	95
		TSS	108	0.0000	0.000	0.935	No	< 80
	10	DO	247	0.0766	0.766	1.567	No	80
		mDO	128	0.0551	0.551	1.105	No	< 80
		Temp	256	0.0726	0.726	1.230	No	< 80
		mTemp	129	0.1146	1.146	1.863	No	90
		FC	258	0.0000	0.000	0.128	No	< 80
		mFC	129	-1.0300	-10.300	-0.523	No	< 80
	5	DO	124	0.0768	0.384	0.638	No	< 80
		mDO	65	0.0476	0.238	0.179	No	< 80
		Temp	128	-0.5209	-2.605	-2.836	Yes	95
		mTemp	65	-0.3380	-1.690	-1.312	No	80
		FC	129	-6.0160	-30.080	-2.471	Yes	95
		mFC	65	-10.8200	-54.100	-1.494	No	80

Site	Period (years)	Parameter	n	Slope	Δ (units/period)	Z-score	Significant (95%)	Confidence (%)
37	16	pH	380	-0.0055	-0.089	-1.836	No	90
		mpH	203	-0.0050	-0.080	-0.912	No	< 80
		DO	388	0.0390	0.624	1.399	No	80
		mDO	204	0.0594	0.950	1.888	No	90
		DO % sat	405	0.2001	3.202	0.665	No	< 80
		mDO % sat	208	0.0961	1.537	0.419	No	< 80
		Temp	409	0.0300	0.479	0.917	No	< 80
		mTemp	207	0.0269	0.431	1.014	No	< 80
		Turb	368	0.0000	0.000	0.010	No	< 80
		mTurb	194	-0.1995	-3.192	-1.749	No	90
		FC	411	5.0100	80.160	3.772	Yes	95
		mFC	206	8.4150	134.640	3.286	Yes	95
		NO3+NO2	108	-0.0044	-0.070	-1.301	No	80
		TKN	108	0.0373	0.596	2.105	Yes	95
		TP	108	0.0075	0.120	1.503	No	80
		OP	108	0.0097	0.154	1.922	No	90
		NH3	108	-0.0033	-0.053	-0.166	No	< 80
		TSS	108	0.0825	1.320	0.301	No	< 80
	10	DO	218	0.1767	1.767	2.343	Yes	95
		mDO	115	0.1998	1.998	2.446	Yes	95
		Temp	228	0.1044	1.044	1.468	No	80
		mTemp	116	0.1461	1.461	1.725	No	90
		FC	227	15.4300	154.300	3.688	Yes	95
		mFC	115	23.7400	237.400	2.878	Yes	95
	5	DO	125	0.4559	2.280	2.305	Yes	95
		mDO	65	0.4821	2.411	1.727	No	90
		Temp	127	-0.3138	-1.569	-2.334	Yes	95
		mTemp	65	-0.3514	-1.757	-1.972	Yes	95
		FC	127	0.0000	0.000	0.389	No	< 80
		mFC	65	5.9500	29.750	0.179	No	< 80

Site	Period (years)	Parameter	n	Slope	Δ (units/period)	Z-score	Significant (95%)	Confidence (%)
38	16	pH	377	-0.0167	-0.267	-3.769	Yes	95
		mpH	203	-0.0166	-0.266	-2.741	Yes	95
		DO	377	0.0206	0.329	0.744	No	< 80
		mDO	200	0.0007	0.011	0.000	No	< 80
		DO % sat	394	0.1940	3.104	0.808	No	< 80
		mDO % sat	208	-0.0649	-1.038	-0.181	No	< 80
		Temp	405	0.0373	0.597	1.502	No	80
		mTemp	207	0.0497	0.795	1.231	No	< 80
		Turb	364	-0.3001	-4.802	-2.795	Yes	95
		mTurb	193	-0.3720	-5.952	-2.840	Yes	95
		FC	405	1.4250	22.800	2.350	Yes	95
		mFC	206	2.0410	32.656	1.569	No	80
		NO3+NO2	107	0.0049	0.079	2.371	Yes	95
		TKN	107	0.0199	0.318	1.154	No	< 80
		TP	107	0.0146	0.233	2.026	Yes	95
		OP	107	0.0204	0.326	4.396	Yes	95
		NH3	107	-0.0099	-0.159	-0.598	No	< 80
		TSS	107	-0.4260	-6.816	-0.893	No	< 80
	10	DO	233	0.1036	1.036	1.777	No	90
		mDO	124	0.0750	0.750	1.280	No	< 80
		Temp	254	0.0498	0.498	0.947	No	< 80
		mTemp	130	0.1090	1.090	1.326	No	80
		FC	255	-2.0210	-20.210	-1.663	No	90
		mFC	130	-7.0950	-70.950	-1.528	No	80
	5	DO	117	0.1181	0.591	0.417	No	< 80
		mDO	62	0.1028	0.514	0.063	No	< 80
		Temp	125	-0.3848	-1.924	-2.578	Yes	95
		mTemp	65	-0.2833	-1.417	-1.312	No	80
		FC	125	-19.0200	-95.100	-2.998	Yes	95
		mFC	65	-23.7500	-118.750	-2.203	Yes	95

Site	Period (years)	Parameter	n	Slope	Δ (units/period)	Z-score	Significant (95%)	Confidence (%)
39	16	pH	383	-0.0170	-0.271	-5.464	Yes	95
		mpH	205	-0.0162	-0.260	-3.607	Yes	95
		DO	406	0.0027	0.044	0.371	No	< 80
		mDO	208	0.0019	0.030	0.102	No	< 80
		DO % sat	408	0.0000	0.000	0.064	No	< 80
		mDO % sat	210	0.0000	0.000	0.078	No	< 80
		Temp	412	0.0000	0.000	0.143	No	< 80
		mTemp	209	0.0067	0.107	0.349	No	< 80
		Turb	367	-0.0340	-0.544	-1.007	No	< 80
		mTurb	194	-0.0716	-1.146	-1.321	No	80
		FC	412	-0.1001	-1.602	-1.641	No	80
		mFC	209	-1.7930	-28.688	-2.093	Yes	95
		NO3+NO2	108	-0.0017	-0.026	-0.560	No	< 80
		TKN	108	0.0000	0.000	-0.769	No	< 80
		TP	108	0.0000	0.000	4.016	Yes	95
		OP	108	0.0028	0.045	4.978	Yes	95
		NH3	108	0.0000	0.000	-0.568	No	< 80
		TSS	108	0.0000	0.000	-1.257	No	< 80
	10	DO	252	0.0098	0.098	0.627	No	< 80
		mDO	130	-0.0042	-0.042	-0.045	No	< 80
		Temp	256	0.0000	0.000	0.000	No	< 80
		mTemp	131	0.0501	0.501	1.271	No	< 80
		FC	256	0.0000	0.000	0.884	No	< 80
		mFC	130	1.9820	19.820	1.762	No	90
	5	DO	123	0.2348	1.174	4.548	Yes	95
		mDO	66	0.2056	1.028	2.747	Yes	95
		Temp	126	-0.4792	-2.396	-4.121	Yes	95
		mTemp	66	-0.4247	-2.124	-2.639	Yes	95
		FC	127	-1.6530	-8.265	-1.205	No	< 80
		mFC	66	-6.3760		-0.995	No	< 80

Site	Period (years)	Parameter	n	Slope	Δ (units/period)	Z-score	Significant (95%)	Confidence (%)
40	16	pH	377	-0.0133	-0.213	-3.936	Yes	95
		mpH	196	-0.0119	-0.190	-2.526	Yes	95
		DO	402	-0.0102	-0.164	-0.733	No	< 80
		mDO	200	0.0036	0.057	0.181	No	< 80
		DO % sat	402	-0.0944	-1.511	-0.589	No	< 80
		mDO % sat	202	0.0301	0.481	0.262	No	< 80
		Temp	404	0.0000	0.000	0.017	No	< 80
		mTemp	202	-0.0539	-0.863	-2.507	Yes	95
		Turb	367	0.1137	1.819	1.126	No	< 80
		mTurb	187	0.1526	2.442	0.990	No	< 80
		FC	399	0.0000	0.000	0.248	No	< 80
		mFC	200	0.5973	9.557	0.733	No	< 80
		NO3+NO2	104	-0.0047	-0.076	-0.728	No	< 80
		TKN	105	-0.0020	-0.033	-0.468	No	< 80
		TP	105	0.0016	0.025	3.835	Yes	95
		OP	104	-0.0012	-0.020	-0.609	No	< 80
		NH3	105	-0.0072	-0.115	-1.587	No	80
		TSS	104	0.0000	0.000	0.102	No	< 80
	10	DO	249	-0.0797	-0.797	-2.287	Yes	95
		mDO	124	-0.0910	-0.910	-2.057	Yes	95
		Temp	251	0.1253	1.253	3.127	Yes	95
		mTemp	126	0.0177	0.177	0.356	No	< 80
		FC	251	-1.7910	-17.910	-2.094	Yes	95
		mFC	125	-1.5050	-15.050	-0.599	No	< 80
	5	DO	121	0.2817	1.409	2.493	Yes	95
		mDO	62	0.2464	1.232	2.803	Yes	95
		Temp	121	-0.4119	-2.060	-3.512	Yes	95
		mTemp	62	-0.6331	-3.166	-3.747	Yes	95
		FC	121	0.0000	0.000	0.280	No	< 80
		mFC	62	2.6730	13.365	0.653	No	< 80

Site	Period (years)	Parameter	n	Slope	Δ (units/period)	Z-score	Significant (95%)	Confidence (%)
41	16	pH	387	0.0033	0.053	1.142	No	< 80
		mpH	203	0.0070	0.112	1.496	No	80
		DO	413	0.0710	1.137	3.455	Yes	95
		mDO	206	0.0882	1.411	3.067	Yes	95
		DO % sat	414	0.6052	9.683	3.138	Yes	95
		mDO % sat	208	0.6414	10.262	2.734	Yes	95
		Temp	416	0.0000	0.000	-0.037	No	< 80
		mTemp	207	0.0158	0.253	0.576	No	< 80
		Turb	378	0.3007	4.811	5.616	Yes	95
		mTurb	193	0.2547	4.075	3.169	Yes	95
		FC	414	1.1170	17.872	2.653	Yes	95
		mFC	207	2.0040	32.064	2.110	Yes	95
		NO3+NO2	109	0.0000	0.000	-0.891	No	< 80
		TKN	108	-0.0025	-0.040	-0.842	No	< 80
		TP	109	0.0042	0.067	3.616	Yes	95
		OP	109	0.0032	0.052	3.825	Yes	95
		NH3	109	-0.0071	-0.114	-2.797	Yes	95
		TSS	109	0.0000	0.000	2.491	Yes	95
	10	DO	257	0.1480	1.480	3.046	Yes	95
		mDO	128	0.1422	1.422	2.990	Yes	95
		Temp	260	0.0430	0.430	0.743	No	< 80
		mTemp	129	0.0707	0.707	0.967	No	< 80
		FC	260	0.9957	9.957	1.749	No	90
		mFC	129	2.6040	26.040	1.707	No	90
	5	DO	129	0.2420	1.210	1.448	No	80
		mDO	65	0.2862	1.431	1.297	No	80
		Temp	129	-0.5707	-2.854	-3.739	Yes	95
		mTemp	65	-0.7588	-3.794	-4.139	Yes	95
		FC	129	-8.6900	-43.450	-2.453	Yes	95
		mFC	65	-8.2150	-41.075	-1.988	Yes	95

Site	Period (years)	Parameter	n	Slope	Δ (units/period)	Z-score	Significant (95%)	Confidence (%)
42	16	pH	385	0.0060	0.096	1.972	Yes	95
		mpH	200	0.0050	0.080	1.400	No	80
		DO	410	0.1204	1.926	7.132	Yes	95
		mDO	205	0.1301	2.082	6.090	Yes	95
		DO % sat	412	0.9311	14.898	7.420	Yes	95
		mDO % sat	207	0.9792	15.667	6.549	Yes	95
		Temp	414	0.0445	0.712	2.035	Yes	95
		mTemp	206	-0.0201	-0.321	-0.942	No	< 80
		Turb	375	0.0560	0.895	3.598	Yes	95
		mTurb	192	0.0595	0.952	2.577	Yes	95
		FC	409	1.2670	20.272	3.485	Yes	95
		mFC	206	1.7950	28.720	2.337	Yes	95
		NO3+NO2	109	0.0000	0.000	0.329	No	< 80
		TKN	108	-0.0042	-0.067	-1.045	No	< 80
		TP	109	0.0000	0.000	1.905	No	90
		OP	109	0.0010	0.016	1.896	No	90
		NH3	109	-0.0026	-0.042	-2.472	Yes	95
		TSS	109	0.0000	0.000	1.496	No	80
	10	DO	255	-0.0132	-0.132	-0.428	No	< 80
		mDO	128	-0.0301	-0.301	-0.467	No	< 80
		Temp	259	0.0994	0.994	2.224	Yes	95
		mTemp	129	0.0783	0.783	1.130	No	< 80
		FC	259	0.0000	0.000	-0.515	No	< 80
		mFC	129	-0.8685	-8.685	-0.645	No	< 80
	5	DO	129	-0.0826	-0.413	-1.052	No	< 80
		mDO	65	0.0039	0.019	0.000	No	< 80
		Temp	129	-0.3873	-1.937	-2.811	Yes	95
		mTemp	65	-0.7552	-3.776	-3.603	Yes	95
		FC	129	-3.7440	-18.720	-1.586	No	80
		mFC	65	-9.4810	-47.405	-2.046	Yes	95

Site	Period (years)	Parameter	n	Slope	Δ (units/period)	Z-score	Significant (95%)	Confidence (%)
43	16	pH	379	-0.0125	-0.200	-3.387	Yes	95
		mpH	198	-0.0119	-0.191	-2.928	Yes	95
		DO	405	-0.0260	-0.415	-1.097	No	< 80
		mDO	201	-0.0243	-0.389	-0.907	No	< 80
		DO % sat	407	-0.2705	-4.328	-1.004	No	< 80
		mDO % sat	205	-0.2126	-3.402	-0.821	No	< 80
		Temp	408	0.0126	0.201	0.822	No	< 80
		mTemp	203	0.0425	0.680	1.907	No	90
		Turb	371	0.3036	4.858	5.217	Yes	95
		mTurb	189	0.2184	3.494	3.068	Yes	95
		FC	402	0.4274	6.838	2.208	Yes	95
		mFC	203	2.6520	42.432	2.658	Yes	95
		NO3+NO2	106	0.0000	0.000	-0.383	No	< 80
		TKN	105	0.0012	0.020	0.218	No	< 80
		TP	106	0.0059	0.094	2.296	Yes	95
		OP	106	0.0011	0.018	0.775	No	< 80
		NH3	106	-0.0024	-0.039	-0.645	No	< 80
		TSS	106	0.1472	2.355	1.198	No	< 80
	10	DO	257	0.0109	0.109	0.229	No	< 80
		mDO	127	0.0479	0.479	0.589	No	< 80
		Temp	261	0.0712	0.712	1.805	No	90
		mTemp	129	0.0836	0.836	1.846	No	90
		FC	258	0.9811	9.811	1.890	No	90
		mFC	129	3.4900	34.900	1.775	No	90
	5	DO	130	-0.0688	-0.344	-0.393	No	< 80
		mDO	65	-0.0088	-0.044	0.000	No	< 80
		Temp	130	-0.3439	-1.720	-2.668	Yes	95
		mTemp	65	-0.5593	-2.797	-2.847	Yes	95
		FC	128	0.0000	0.000	0.962	No	< 80
		mFC	65	-1.9840	-9.920	-0.310	No	< 80

Site	Period (years)	Parameter	n	Slope	Δ (units/period)	Z-score	Significant (95%)	Confidence (%)
44	16	pH	344	-0.0320	-0.511	-7.513	Yes	95
		mpH	181	-0.0327	-0.523	-5.932	Yes	95
		DO	365	-0.1225	-1.960	-4.637	Yes	95
		mDO	185	-0.1146	-1.834	-3.577	Yes	95
		DO % sat	368	-1.2390	-19.824	-4.974	Yes	95
		mDO % sat	187	-1.1540	-18.464	-3.268	Yes	95
		Temp	371	0.0000	0.000	-0.374	No	< 80
		mTemp	186	0.0101	0.162	0.349	No	< 80
		Turb	334	0.0499	0.798	0.560	No	< 80
		mTurb	173	-0.0577	-0.923	-0.577	No	< 80
		FC	368	0.0000	0.000	0.190	No	< 80
		mFC	186	0.0000	0.000	-0.027	No	< 80
		NO3+NO2	87	-0.0008	-0.013	-0.685	No	< 80
		TKN	87	-0.0181	-0.289	-1.001	No	< 80
		TP	88	0.0093	0.149	4.738	Yes	95
		OP	87	-0.0009	-0.014	-0.799	No	< 80
		NH3	88	-0.0065	-0.103	-1.323	No	80
		TSS	87	0.0000	0.000	-0.335	No	< 80
	10	DO	255	-0.0651	-0.651	-1.572	No	80
		mDO	128	-0.0427	-0.427	-0.678	No	< 80
		Temp	258	0.0000	0.000	-0.144	No	< 80
		mTemp	129	0.0399	0.399	0.599	No	< 80
		FC	258	-0.5475	-5.475	-1.522	No	80
		mFC	129	-2.6870	-26.870	-1.245	No	< 80
	5	DO	127	-0.0966	-0.483	-0.998	No	< 80
		mDO	65	-0.1546	-1.546	-0.680	No	< 80
		Temp	127	-0.3008	-1.504	-2.285	Yes	95
		mTemp	65	-0.4542	-2.271	-2.352	Yes	95
		FC	127	-24.8800	-124.400	-4.449	Yes	95
		mFC	65	-46.2400	-231.200	-4.225	Yes	95

Site	Period (years)	Parameter	n	Slope	Δ (units/period)	Z-score	Significant (95%)	Confidence (%)
45	16	pH	371	0.0244	0.390	5.054	Yes	95
		mpH	201	0.0217	0.346	3.669	Yes	95
		DO	392	0.0098	0.157	1.605	No	< 80
		mDO	203	0.0041	0.065	0.558	No	< 80
		DO % sat	392	0.0567	0.907	1.597	No	80
		mDO % sat	206	0.0351	0.561	0.650	No	< 80
		Temp	399	0.0100	0.160	0.797	No	< 80
		mTemp	206	0.0253	0.405	1.390	No	80
		Turb	364	-0.2154	-3.446	-4.848	Yes	95
		mTurb	190	-0.2553	-4.085	-3.586	Yes	95
		FC	393	0.0000	0.000	-1.113	No	< 80
		mFC	206	-0.0712	-1.139	-1.393	No	80
		NO3+NO2	104	0.0000	0.000	0.896	No	< 80
		TKN	104	0.0000	0.000	-1.394	No	80
		TP	104	0.0000	0.000	-1.756	No	90
		OP	104	0.0000	0.000	3.153	Yes	95
		NH3	104	0.0000	0.000	-0.418	No	< 80
		TSS	104	-0.2811	-4.498	-2.432	Yes	95
	10	DO	245	0.0168	0.168	1.325	No	80
		mDO	128	0.0338	0.338	2.211	Yes	95
		Temp	249	0.0962	0.962	2.847	Yes	95
		mTemp	129	0.0783	0.783	1.567	No	80
		FC	248	0.0000	0.000	-0.855	No	< 80
		mFC	129	-0.1496	-1.496	-1.037	No	< 80
	5	DO	127	0.1695	0.848	4.014	Yes	95
		mDO	65	0.1882	0.941	3.151	Yes	95
		Temp	127	-0.3010	-1.505	-2.489	Yes	95
		mTemp	65	-0.4852	-2.426	-2.676	Yes	95
		FC	127	0.0000	0.000	-0.643	No	< 80
		mFC	65	-0.4177	-2.089	-0.745	No	< 80

Site	Period (years)	Parameter	n	Slope	Δ (units/period)	Z-score	Significant (95%)	Confidence (%)
46	16	pH	377	0.0179	0.286	3.981	Yes	95
		mpH	199	0.0154	0.247	2.543	Yes	95
		DO	403	0.0107	0.171	2.186	Yes	95
		mDO	205	0.0210	0.337	2.790	Yes	95
		DO % sat	404	0.0650	1.040	1.744	No	90
		mDO % sat	207	0.0643	1.029	1.369	No	80
		Temp	406	0.0111	0.177	0.819	No	< 80
		mTemp	206	-0.0166	-0.266	-0.993	No	< 80
		Turb	372	-0.2132	-3.411	-4.953	Yes	95
		mTurb	192	-0.2533	-4.053	-3.594	Yes	95
		FC	405	0.0000	0.000	0.639	No	< 80
		mFC	206	0.0766	1.226	1.018	No	< 80
		NO3+NO2	106	0.0009	0.015	1.486	No	80
		TKN	105	0.0000	0.000	0.503	No	< 80
		TP	106	0.0000	0.000	0.118	No	< 80
		OP	106	0.0000	0.000	3.028	Yes	95
		NH3	106	0.0000	0.000	2.311	Yes	95
		TSS	105	-0.2996	-4.794	-2.289	Yes	95
	10	DO	252	0.0198	0.198	1.781	No	90
		mDO	128	0.0416	0.416	2.804	Yes	95
		Temp	255	0.0968	0.968	2.876	Yes	95
		mTemp	129	0.0620	0.620	1.660	No	90
		FC	256	0.0000	0.000	1.481	No	80
		mFC	129	0.3349	3.349	1.687	No	90
	5	DO	126	0.1307	0.654	3.372	Yes	95
		mDO	65	0.1436	0.718	3.274	Yes	95
		Temp	126	-0.2691	-1.346	-3.471	Yes	95
		mTemp	65	-0.5236	-2.618	-3.095	Yes	95
		FC	128	0.0000	0.000	0.000	No	< 80
		mFC	65	0.0000	0.000	-0.062	No	< 80

Site	Period (years)	Parameter	n	Slope	Δ (units/period)	Z-score	Significant (95%)	Confidence (%)
47	16	pH	389	-0.0468	-0.749	-11.900	Yes	95
		mpH	203	-0.0518	-0.828	-9.215	Yes	95
		DO	414	-0.0011	-0.018	-0.147	No	< 80
		mDO	205	-0.0060	-0.096	-0.644	No	< 80
		DO % sat	414	0.0000	0.000	0.113	No	< 80
		mDO % sat	207	0.0422	0.675	0.437	No	< 80
		Temp	417	0.0251	0.401	2.220	Yes	95
		mTemp	207	0.0401	0.641	2.782	Yes	95
		Turb	378	-0.0144	-0.231	-0.658	No	< 80
		mTurb	193	-0.0207	-0.330	-0.766	No	< 80
		FC	410	0.0000	0.000	2.188	Yes	95
		mFC	206	0.1249	1.998	2.219	Yes	95
		NO3+NO2	109	0.0071	0.113	3.551	Yes	95
		TKN	108	0.0000	0.000	2.780	Yes	95
		TP	109	0.0013	0.021	5.213	Yes	95
		OP	109	0.0032	0.052	5.851	Yes	95
		NH3	109	-0.0011	-0.018	-2.531	Yes	95
		TSS	109	-0.6864	-10.982	-1.687	No	90
	10	DO	257	-0.0043	-0.043	-0.221	No	< 80
		mDO	127	0.0033	0.033	0.330	No	< 80
		Temp	261	0.0994	0.994	3.855	Yes	95
		mTemp	129	0.0748	0.748	2.860	Yes	95
		FC	258	0.0000	0.000	-0.655	No	< 80
		mFC	128	0.0000	0.000	-0.303	No	< 80
	5	DO	130	0.0953	0.477	2.340	Yes	95
		mDO	65	0.1386	0.693	2.162	Yes	95
		Temp	130	-0.1977	-0.989	-3.625	Yes	95
		mTemp	65	-0.3568	-1.784	-3.286	Yes	95
		FC	127	0.0000	0.000	0.783	No	< 80
		mFC	64	-0.5007	-2.504	-0.631	No	< 80

Site	Period (years)	Parameter	n	Slope	Δ (units/period)	Z-score	Significant (95%)	Confidence (%)
48	16	pH	388	-0.0134	-0.215	-4.378	Yes	95
		mpH	203	-0.0107	-0.171	-3.315	Yes	95
		DO	412	0.0203	0.325	3.021	Yes	95
		mDO	206	0.0181	0.290	2.248	Yes	95
		DO % sat	413	0.1658	2.653	3.991	Yes	95
		mDO % sat	208	0.1804	2.886	3.021	Yes	95
		Temp	415	0.0334	0.535	2.599	Yes	95
		mTemp	207	0.0495	0.793	2.919	Yes	95
		Turb	378	0.0000	0.000	-0.010	No	< 80
		mTurb	193	-0.0072	-0.115	-0.575	No	< 80
		FC	410	0.0000	0.000	-0.852	No	< 80
		mFC	206	-0.8187	-13.099	-1.103	No	< 80
		NO3+NO2	109	-0.0044	-0.070	-2.399	Yes	95
		TKN	107	-0.0148	-0.236	-3.136	Yes	95
		TP	109	0.0023	0.037	4.984	Yes	95
		OP	109	0.0012	0.020	0.780	No	< 80
		NH3	108	-0.0051	-0.082	-6.869	Yes	95
		TSS	109	0.0000	0.000	0.451	No	< 80
	10	DO	257	0.0387	0.387	2.519	Yes	95
		mDO	128	0.0549	0.549	2.803	Yes	95
		Temp	259	0.0597	0.597	1.936	No	90
		mTemp	129	0.0499	0.499	1.754	No	90
		FC	258	0.0000	0.000	0.766	No	< 80
		mFC	128	0.3349	3.349	0.303	No	< 80
	5	DO	129	0.1755	0.878	3.906	Yes	95
		mDO	65	0.2083	1.042	3.892	Yes	95
		Temp	129	-0.2002	-1.001	-2.675	Yes	95
		mTemp	65	-0.3962	-1.981	-2.847	Yes	95
		FC	129	-6.7730	-33.865	-2.302	Yes	95
		mFC	65	-10.1600	-50.800	-2.046	Yes	95