Skagit County Monitoring Program Annual Report

Water Year 2024

October 2023 – September 2024

Skagit County Public Works
Natural Resources Division
1800 Continental Place
Mount Vernon, WA 98273

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Acknowledgements

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This report is available online at
https://www.skagitcounty.net/Departments/PublicWorksCleanWater/WQmonitoring.htm

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Executive Summary

The Skagit County Monitoring Program (SCMP) has collected **21 years of water quality data from water years 2004 to 2024**. This report highlights the most recent data from water year 2024 and includes trend analysis on the full dataset.

Many Skagit County waterways do not meet state water quality standards for temperature, and/or dissolved oxygen. **The *E. coli* state standard was passed at over half of the sites,** with 22 out of 40 sites meeting the standard (55%). Substandard water quality is most common in slow-moving agricultural sloughs and low flow creeks during warmer months.

Based on the Water Quality Index (WQI) for water year 2024, **10 sites (25%) were classified as "highest concern", 14 sites (35%) were "moderate concern", and 16 sites (40%) were "lowest concern".** The number of sites in these categories are consistent with the past few years. Most "high concern" sites are agricultural drainages with little summer flow that are not considered salmonid habitat.

Trends analyses of water temperature, dissolved oxygen, bacteria, and other metrics revealed **mixed result of improving, worsening, and not changing water quality at sites across the county.** Of the trends analyzed on the 21 years of data, 52% of trends were not significantly changing, 32% indicated improving water quality, and 16% showed worsening conditions. Notably, there were two times more improving trends than worsening. Most sites have not had significant changes in temperature based on our discrete measurements, while dissolved oxygen levels improved at 44% of sites and worsened at 17%. Bacteria levels improved at 33% of sites, worsened at 17%, and remained unchanged at 50%. Bacteria improvements were most common in the Samish Bay and Nookachamps watersheds, while worsening levels were concentrated in the Lower Skagit watershed. Nitrogen levels have generally improved across the county, but phosphorus levels have worsened, particularly in western Skagit County.

Water quality improvements across the county reflect the dedication of residents, farmers, tribes, government agencies, and environmental groups. While progress has been made, continued efforts are needed to protect and enhance water resources for future generations.

Introduction

The Skagit County Monitoring Program (SCMP) has collected ambient water quality data in freshwater streams, rivers, and drainages across Skagit County since 2003. The goals of the SCMP are to assess current waterway conditions, analyze long term trends, and to help support other water quality projects in the county. This report focuses on SCMP data collected in water year 2024 (October 1st, 2023 – September 31st, 2024) and includes an analysis of the full monitoring dataset from 2003 to 2024.

The program currently monitors 40 sampling sites, which are visited biweekly on a north and south route through the county (Figure 1). The SCMP was initially started by Skagit County to evaluate the success of water protection measures required in agricultural areas. As a result, many sites are located in or surrounding agricultural zoning. Additional sites were selected to contribute data to various water clean-up efforts. Detailed information on site locations and revisions are available in the SCMP Backgrounds and Methods document (Skagit County, 2024).

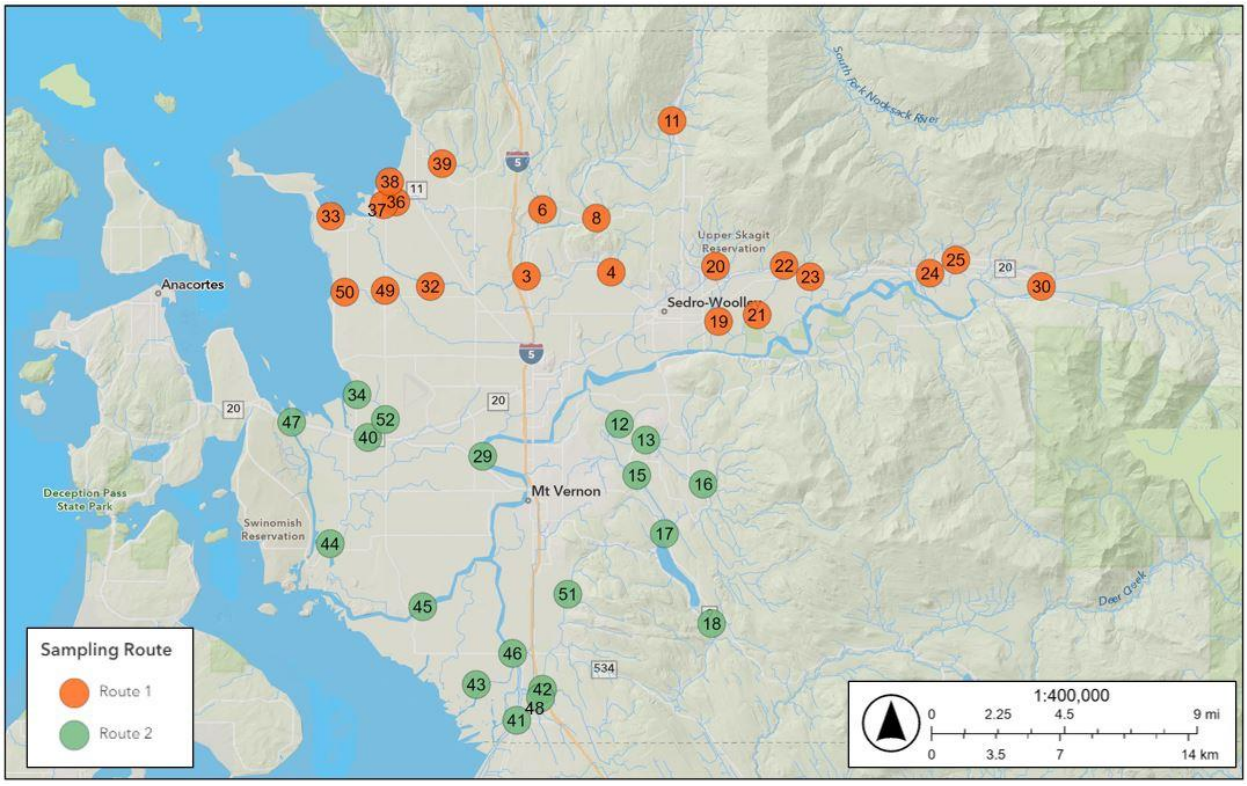


Figure 1. Ambient monitoring sites in the Skagit County Monitoring Program (SCMP).

Methods

Sampling and Data Collection

The SCMP uses standard water quality sampling and data collection methods, as outlined in the SCMP Quality Assurance Project Plan (QAPP; Skagit County, 2004) and the SCMP Background and Methods document (Skagit County, 2024).

At each site visit, dissolved oxygen (DO), temperature, conductivity, and salinity are measured *in situ* with a water quality probe, and turbidity and pH are measured with other instruments in the field. Water samples are collected for fecal coliform and *Escherichia coli* (*E. coli*) analysis at every site visit (Figure 2). On a quarterly basis, additional water samples are taken for nutrient analysis that include nitrate (NO_3^-), nitrite (NO_2^-), ammonia (NH_3), total Kjeldahl nitrogen (TKN), orthophosphate (OP), total phosphorus (TP), and total suspended solids (TSS).

All sampling trips were completed on schedule during water year 2024. Each station is visited at approximately the same time of day to minimize variations due to diurnal changes in water quality parameters. In 2024, the timing of site visits varied by no more than 2.5 hours.

Figure 2. Sampling No Name Slough at Bayview-Edison Road.

During the summer, continuous temperature loggers are deployed at 24 of the monitoring sites to assess compliance with state temperature standards. Priority for logger deployment is based on factors such as fish presence and historical temperature data. Loggers are deployed from June through September and record temperature every 30 minutes.

In water year 2024, two loggers were lost due to washout or theft on upper Hansen Creek and the lower East Fork Nookachamps Creek. Four additional loggers, located at Mannser Creek, lower Thomas Creek, lower Nookachamps Creek, and Big Ditch/Maddox Creek had incomplete or compromised datasets, likely preventing accurate determinization of the highest 7-day average of the daily maximum temperatures (7-DADMax) required for state compliance.

The full SCMP dataset from water years 2004 – 2024 is available upon request.

Data Quality

The SCMP operates under a Quality Assurance Project Plan (QAPP) approved by Washington State Department of Ecology (Ecology) that details quality control and assurance procedures (Skagit County 2004). Laboratory samples for bacteria and nutrients are analyzed by Edge Analytical of Burlington, WA, an Ecology-certified laboratory.

Duplicate field samples are collected to assess the accuracy and precision of the analytical methods. In water year 2024, the fecal coliform and *E. coli* duplicate results had average relative standard deviations (RSD) of 44% and 47%, respectively. These results did not meet the quality control criteria of 33% RSD. Despite this, these RSDs are consistent with the average RSDs observed over the past 21 years of bacteria data collection. The nutrient duplicates analyzed for orthophosphate and nitrate met the 10% RSD quality control criteria. Total phosphorus and ammonia were both slightly above the quality control criteria at 10.8% and therefore did not meet the criteria.

Data Analysis

Summary statistics for each parameter at all sites are available in *Appendix A* ***and*** *Appendix B*. These statistics offer a general overview of the current and historical water quality at each station.

To assess long-term trends, the Seasonal Kendall's Test was used. This statistical method detects trends in parameters that vary seasonally, such as temperature and DO. Detailed results from the Seasonal Kendall's test, including p-values and slopes, are in *Appendix C*. Trend analysis was not completed for sites added in water year 2022 (Sites 49, 50, 51, and 52) due to insufficient data of less than 5 years. Similarly, trends for *E. coli* were not assessed as five years of data have not yet been collected.

This report focuses on trends observed over the full 21-year dataset. The previous ten- and five-year periods were also analyzed to provide a more detailed understanding of changes across the county but are not presented in this report. For simplicity, they can be found in *Appendix C.* For some parameters, statistics were analyzed using both monthly averages and individual results from each site visit. Monthly averages reduce the probability of autocorrelation and are displayed throughout this report when applicable, including the parameters temperature, dissolved oxygen, fecal coliform, and turbidity. The trends using individual site visits are also provided in *Appendix C*.

Improving and Worsening Water Quality Health

In this report, significant trends are classified as either improving or worsening water quality health (Table 1). Increasing trends are classified as worsening water quality health, while decreasing trends are considered improving for all parameters other than DO and pH. The significant DO trends are classified as the opposite. Both increasing and decreasing pH trends can be harmful when pH measurements move outside the range of 6.5 to 8.5 units. As these conditions vary by site and to simplify results, significant pH trends are not considered improving or worsening water quality health.

Table 1. Classifications on whether significantly increasing (↗) or decreasing (↘) trends are considered improving or worsening water quality health. pH trends are not classified as either.

Parameter	Improving Health	Worsening Health
Temperature	↘	↗
Dissolved Oxygen	↗	↘
Fecal coliform	↘	↗
Turbidity	↘	↗
Ammonia	↘	↗
Nitrate + Nitrite	↘	↗
Total Kjeldahl Nitrogen	↘	↗
Orthophosphate	↘	↗
Total Phosphorus	↘	↗
pH	-	-

Water Quality Standards

Washington state has established water quality standards for multiple parameters measured in the SCMP (WAC 173-201A-200). These standards differ for each site depending on how the water is used, the impact the parameter has on aquatic life, and the natural conditions of the site. The standards for each site are detailed in the SCMP Background and Methods document (Skagit County, 2024).

Washington State uses the highest 7-day average of the daily maximum water temperatures (7DADMax) to determine temperature compliance. Continuous temperature measurements over the warmest parts of the year are required to assess this standard.

For DO levels, Washington state determines compliance based on the minimum concentration recorded throughout the day. Although continuous DO measurements aren't collected in the SCMP, the discrete measurements collected can still indicate whether a site is likely to have met or not met the standard. This standard can be assessed by DO concentrations measured in mg/L or percent saturation.

The *E. coli* standard for Washington state has two components. The *E. coli* results within a sample period must have a geometric mean (geomean) below 100 MPN/100 mL. Additionally, no more than 10% of the samples can be greater than 320 MPN/100 mL.

The measurements used to determine the compliance with water quality standards can be found in *Appendix D*.

Water Quality Index

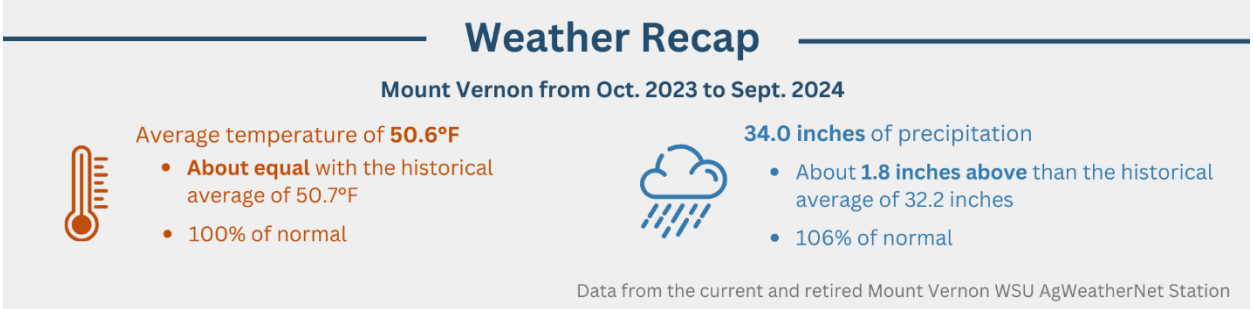
The Water Quality Index (WQI) is a tool created by Ecology to assess water quality at a site. It combines various water quality measures, including temperature, DO, pH, turbidity, TSS, fecal coliform, and nutrients, and a single number from one to 100 is calculated. A higher number indicates better water quality. We calculate the annual WQI using quarterly data (four site visits), as our nutrient data is collected at this frequency. The most ideal scenario would be to calculate the annual WQI scores from 12 data points instead of four, to capture the full variability between seasons and reduce the chance of skewed results. The annual WQI scores are categorized into one of three concern levels listed below:

0 – 40 High Concern	41 – 80 Moderate Concern	81 – 100 Low Concern

Water Year 2024 Overview

Water Year Conditions

Changes in weather can affect water quality by altering flow patterns and water temperature. The annual average temperature and precipitation accumulation in Mount Vernon were around normal, however there were periods of extremes throughout the year (WSU AgWeatherNet, 2025). December 2023 stood out with warm temperatures that contributed to minimal snow accumulation in the North Cascades (Bumbaco et. al, 2025). The snowpack, critical for maintaining summer flows in the Skagit River, was among the lowest on record in the spring. July brought record setting heat and drier than normal conditions, however August and September brought relief with late summer precipitation. This rain notably improved flow conditions and stream temperatures at a time critical for migrating salmon. Overall, drought conditions in Skagit County improved significantly over the water year—from extreme drought early on, to a mix of abnormally dry and drought-free conditions by the end.



Water Quality Standards

Data collected during this project indicates that many streams and waterways across the County do not meet state standards for temperature, DO, or *E. coli*. No sites passed all three standards where assessed. Of the 20 sites where continuous temperature measurements were successfully measured, only one site passed at upper Thomas Creek (Site 4). Only one out of 40 sites met the state standard for DO all year, which was Red Cabin Creek. The *E. coli* state standard was passed at over half of the sites, with 22 out of 40 sites meeting the standard (55%). The sites on the Skagit River and the Nookachamps watershed had the highest percentages of sites passing the *E. coli* standard (100% and 83%, respectively), while the Lower Skagit watershed had the lowest (16.7%). This marks a return to typical conditions for the Lower Skagit watershed after an unusually good year in water year 2023 when most sites met the standard.

Waterways not meeting these conditions represent less than ideal conditions for recreation, salmonoid populations, and downstream shellfish resources. Most of the substandard water quality occurs in creeks that have low flow in the warmer months and in slow-moving agricultural sloughs. Some cases may represent natural conditions rather than human-caused problems. More details about which sites met the standards can be found in the following watershed sections and *Appendix D*.

Water Quality Index

Based on WQI results in water year 2024, 10 sites in the SCMP fell into the “highest concern” category (25%). Most, but not all, are agricultural drainages with low summer flow that are not considered

salmonid habitat. The number of sites classified in this category have changed very little since 2009, ranging between 8 to 12 sites.

A total of 14 sites were classified in the “moderate concern” category (35%) and 16 were in the “lowest concern” (40%). The number of sites in these categories has remained consistent in recent years, except for water year 2023, when more sites fell into the “moderate concern” category due an early summer with warm temperatures and low DO concentrations.

Since about 2010, the watersheds in Skagit County have had mostly consistent average WQI scores (Figure 3). In water year 2022, three new sites were added to Padilla Bay watershed, and one was dropped, which explains the fall in average WQI that year. The Padilla Bay average WQI score has increased over the past couple of years.

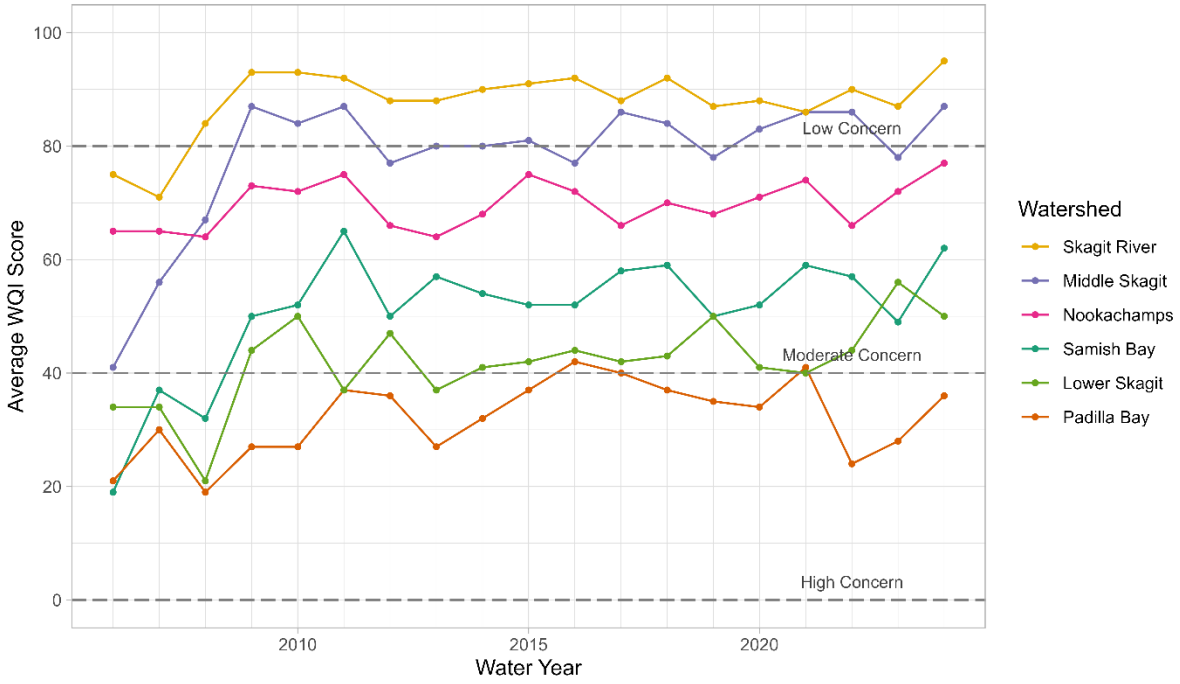


Figure 3. Average Water Quality Index (WQI) scores for each watershed from water year 2005 – 2024.

Trends

Over the past 21 years of monitoring, most sites and watersheds have a mix of improving, worsening, and not changing water quality. Of all the statistics analyzed, a majority of trends are not significantly changing (52%). The remainder of trends are mix of both improving (32%) and worsening water quality (16%). It’s important to note that parameters without significant trends may be continuing to sustain good water quality or potentially the opposite, with continuing poor water quality. All the SCMP sites have seen changes in at least two water quality parameters since the start of the program. The amount of change observed is not generally discussed in this report but can be found in *Appendix C* by comparing the slopes of significant trends.

Most sites did not have significant changes in temperature over the length of the program (Figure 4). The 19% of sites that did have significant temperature trends were all warming. These temperature trends are based on the discrete measurements that may not capture the extreme temperatures during different days of the week or during the warmest times of the day.

About 44% of the SCMP sites had significant improvements in DO over the past 21 years, while about 17% had worsening conditions. The improving DO levels were scattered throughout Skagit County.

About half of the sites in the SCMP have had no significant changes in fecal coliform levels over the length of the program, while about one-third of the sites had worsening bacteria levels and the remaining 17% had improving levels. Most of the improvements in fecal coliform were found in the upper Samish Bay and Nookachamps watersheds and most of the worsening conditions were in the Lower Skagit watershed.

Nearly all the significant trends in nitrogen concentrations (NH_3, NO_3^- + NO_2^-, TKN, and TN) were decreasing, pointing to improvements in water quality. On the other hand, all the significant changes in phosphorus levels (OP and TP) have increasing concentrations, indicating worsening water quality. Most of the sites with worsening total phosphorus levels were in the western portions of the county.

Most sites in the SCMP had decreasing pH trends (61%), indicating more acidic waters than at the beginning of the program. A small percentage are becoming more basic (8%).

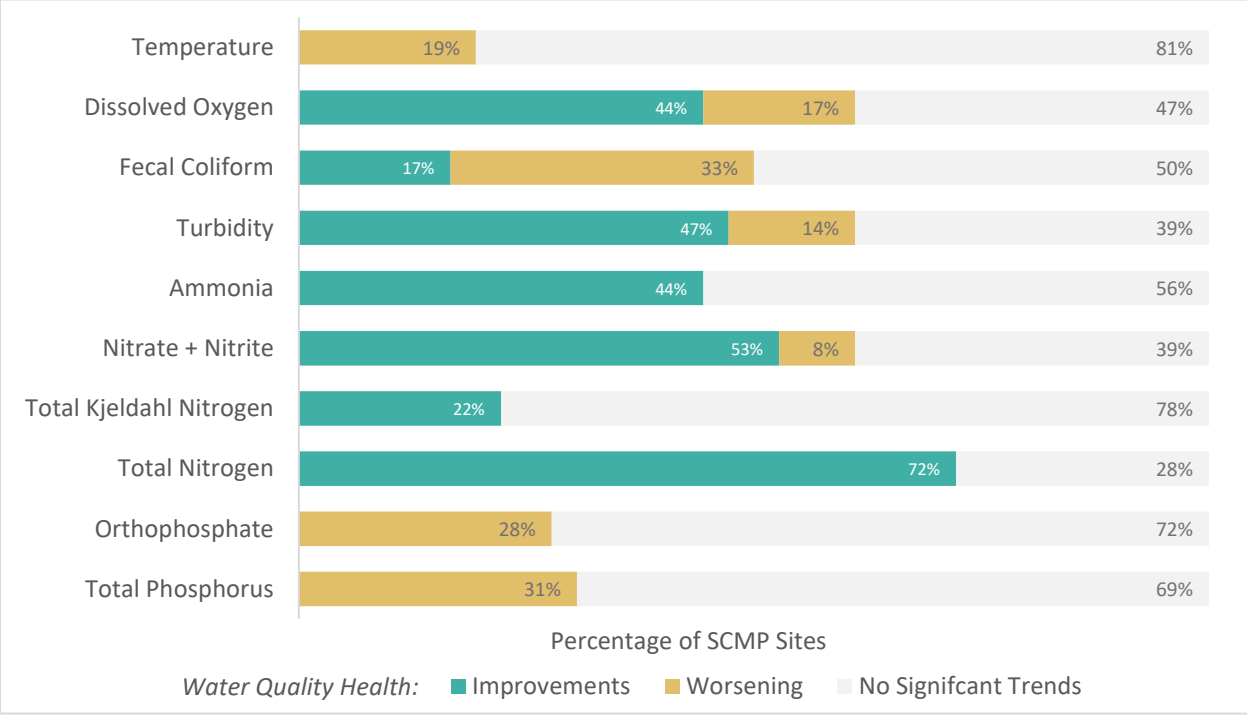


Figure 4. Percentage of sites with trends that show improving, worsening or no significant changes in water quality health.

Samish Bay Watershed

The Samish Bay watershed is in the northwestern portion of Skagit County and extends north into Whatcom County (Figure 5). The largest subbasins within the watershed are the Samish River and two of its tributaries, Friday, and Thomas Creeks. Other waterways, including Colony Creek, Oyster Creek, and several other drainages and sloughs, empty directly into Samish Bay. Most of the lower Samish watershed land is used for agriculture, such as crop farming and cattle operations. The upper watershed is dominated by rural residential uses, with small agriculture and natural resource practices throughout.

Watershed Statistics

143 sq. miles

~19,600 people

11 SCMP Monitoring Sites

Top 3 Land Covers: forest, cultivated crops, and development

~18% of watershed is used for **agriculture**

~74% of watershed has **tree cover**

~11% of watershed has **impervious surfaces**

Data sources: Dewitz, 2023; ESRI, 2023; WSDA, 2023.

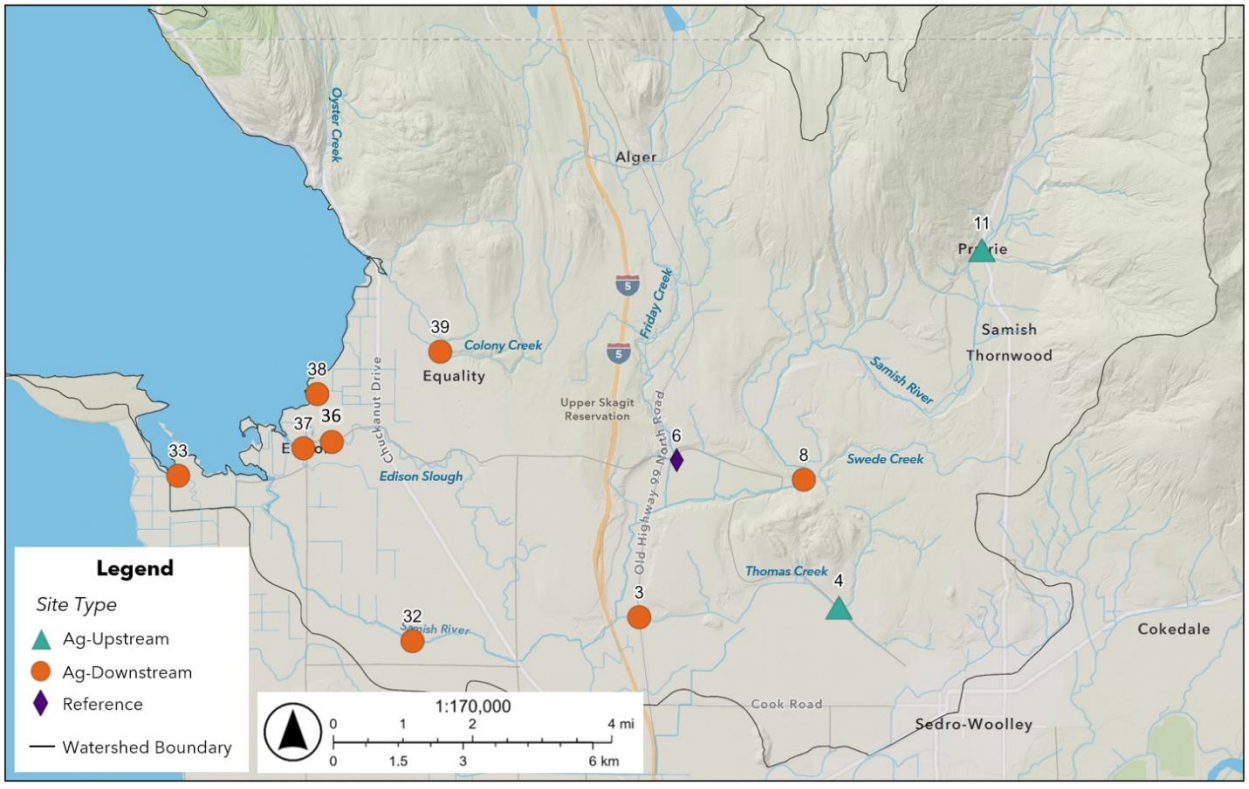


Figure 5. Monitoring sites in the Samish Bay watershed and the site type.

Current Conditions in WY2024 – Samish Bay Watershed

No sites in the Samish watershed met all three measured water quality standards in water year 2024 where measured (Table 2). Friday Creek met the DO and *E. coli* standards, but did not meet the temperature standard. Upper Thomas Creek met the temperature and DO standards but failed the *E. coli* standard. Overall, five out of the 11 sites in the watershed met the *E. coli* standard.

Based on WQI scores, three sites were ranked in the "highest concern" category, including the North and South Edison drainages, and the Alice Bay drainage. The lowest scoring site in the watershed was the North Edison Drainage with a score of 3, which is also the lowest out of all the sites this year. The highest WQI score in the watershed was found at the lower Samish River with a score of 92, with Friday Creek closely behind with a score of 91.

Edison Slough and lower Thomas Creek had their highest WQI scores since the start of the program, with scores of 63 and 80, respectively.

Table 2. Site compliance with state water quality standards and water quality index (WQI) scores in the Samish Bay watershed in water year 2024. Sites are organized upstream to downstream along the Samish River and then north to south for the remaining sites.

Site	Waterbody	Temperature Standard (7DADMax)	Dissolved Oxygen Standard	*E. coli* Standard	WQI Score
11	Upper Samish River	X	X	✓	77
8	Swede Creek	X	X	✓	86
6	Friday Creek	X	✓	✓	91
4	Upper Thomas Creek	✓	✓	X	80
3	Lower Thomas Creek	-*	X	X	72
32	Lower Samish River	X	X	✓	92
39	Colony Creek	X	X	X	76
38	North Edison Drainage	-	X	X	3
36	Edison Slough	-	X	X	63
37	South Edison Drainage	-	X	X	21
33	Alice Bay Drainage	-	X	✓	16

*Incomplete dataset.
For further details see Appendix D.

Legend				
Water Quality Standards:	✓ Passed	X Failed	- Not measured	
WQI Scores:	Highest Concern (0 – 40)	Moderate Concern (41 – 80)	Lowest Concern (81 – 100)	

Long Term Trends – Samish Bay Watershed

Over the past 21 years, most trends in the Samish Bay watershed showed improvements in water quality (Table 3). Friday Creek was the one site in the watershed with significantly warming temperature. DO concentrations significantly improved at Friday Creek, upper Thomas Creek, and the upper and lower Samish River. Improving fecal coliform trends were found in Swede, upper Thomas, and Colony Creeks, while the North and South Edison Drainage and Edison Slough have worsened. Nitrogen concentrations (NH_3, NO_3^- + NO_2^-, and/or TKN) improved at most of the sites other than drainages around Edison (Sites 37, 36, 38, 33). Significant phosphorus trends showed worsening water quality generally located in the lower portions of the watershed, with the exception of Swede Creek. Most pH trends in the watershed were decreasing or acidifying, other than the two Samish River sites. The drainages and sloughs near Edison had a greater proportion of worsening trends when compared to those further upstream in the watershed.

Table 3. Trend analysis results for sites in the Samish Bay watershed over the past 21 years. Sites are organized upstream to downstream along the Samish River and then north to south for the remaining sites.

Site	Waterbody	Temp.	DO	FC	Turb.	Amm-onia	Nitrate + Nitrite	TKN	Ortho-phos.	Total Phos.	pH
11	Upper Samish River	-	↗	-	-	-	↘	-	-	-	↗
8	Swede Creek	-	-	↘	↘	↘	↘	-	↗	-	↘
6	Friday Creek	↗	↗	-	-	-	↘	-	-	-	↘
4	Upper Thomas Creek	-	↗	↘	↘	↘	↘	-	-	-	↘
3	Lower Thomas Creek	-	-	-	-	↘	↘	↘	↗	↗	-
32	Lower Samish River	-	↗	-	↘	↘	↘	-	-	-	↗
39	Colony Creek	-	-	↘	-	↘	↘	-	↗	-	↘
38	North Edison Drainage	-	↘	↗	↘	-	↗	-	↗	↗	↘
36	Edison Slough	-	-	↗	-	↘	-	↘	↗	↗	↘
37	South Edison Drainage	-	-	↗	↘	-	-	-	-	-	↘
33	Alice Bay Drainage	-	↘	-	↘	-	-	-	-	-	↘

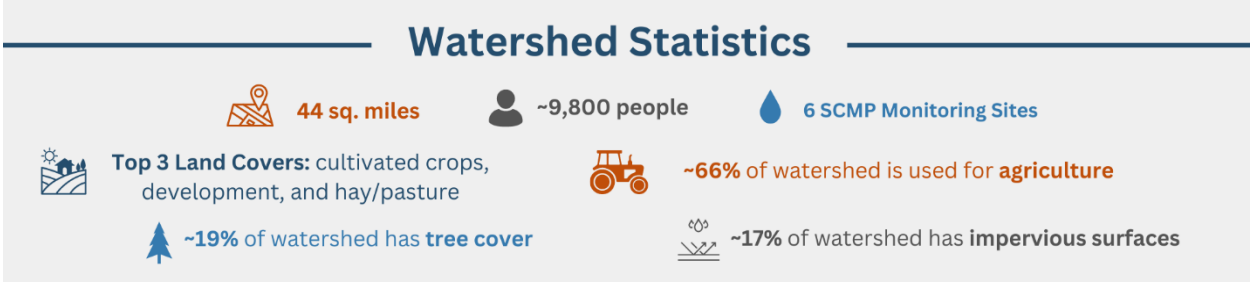
Temp. = Temperature, DO = Dissolved oxygen (mg/L), FC = Fecal coliform, Turb. = Turbidity, TKN = Total Kjeldahl Nitrogen, Ortho-Phos. = Orthophosphate, Total Phos. = Total phosphorus. For further details see Appendix C.

Legend				
	Water Quality Health:		Improving	Worsening
	Trends:	↗ Increasing	↘ Decreasing	- Not significant	No stats run

Padilla Bay Watershed

The Padilla Bay watershed is located directly south of the Samish Bay watershed in the northwest portion of Skagit County (Figure 5). Extensive diking and drainage has taken place in the watershed to make it suitable for settlement and agricultural development. The four major waterways in the Padilla Bay watershed are Joe Leary, No Name, Big Indian, and Little Indian Sloughs. Many agricultural and water management ditches flow into these sloughs. The watershed is primarily used for commercial agriculture, rural residences, and includes several large industrial areas including the Port of Skagit.

The marine reference site in the Swinomish Channel has also been included in this watershed as it exchanges with Padilla Bay. Data at this site is collected from surface water at a boat launch, so the bottom water and center of the channel could have differing results.



Data sources: Dewitz, 2023; ESRI, 2023; WSDA, 2023.

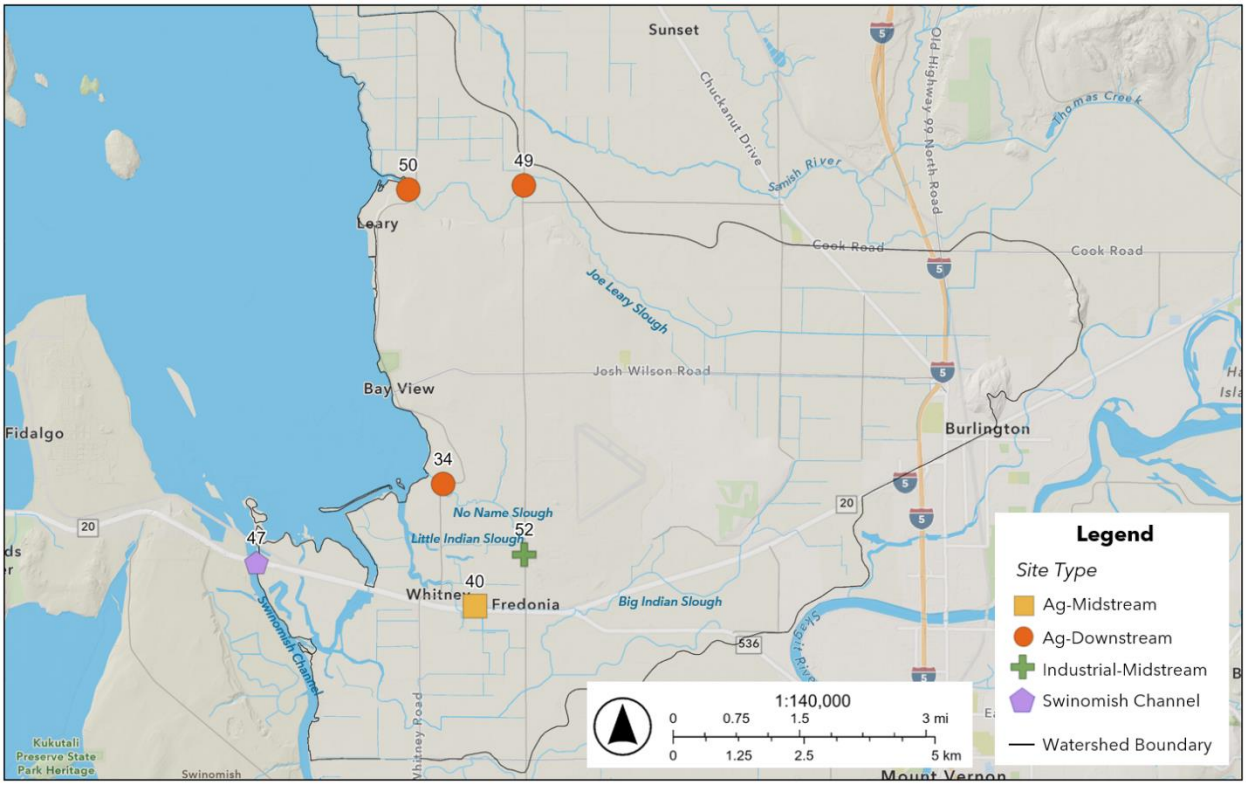


Figure 6. Monitoring sites in the Padilla Bay watershed and the site type.

Current Conditions in WY2024 – Padilla Bay Watershed

Table 4 outlines which sites met the state water quality standards of temperature, DO, and *E. coli,* and each site's WQI score in water year 2024. No continuous temperature loggers were deployed in the Padilla Bay watershed. Based on the discrete temperature measurements collected throughout the water year, it is very unlikely that these waterways would pass the temperature standard. The sloughs that flow into Padilla Bay did not meet the state water quality standard for DO in water year 2024. The *E. coli* standard was met both Joe Leary Slough sites.

Most of the waterways in the Padilla Bay watershed were ranked in the "highest concern" category. Middle Joe Leary Slough had the lowest score with a WQI of 12. The highest WQI score in the watershed, excluding the Swinomish Channel, was Little Indian Slough with a score 48. This score is a large improvement compared to two previous years of monitoring, where the site had single digit scores. This high score is influenced by relatively low fecal coliform levels on the dates that were analyzed.

Because the Swinomish Channel is a marine site, it has different state standards than the freshwater sites. These standards are ranked on a scale from "fair" to "extraordinary" quality. The Swinomish Channel met the state water quality standard under the "excellent" category with a minimum DO concentration greater than 6.0 mg/L, but less than 8.0 mg/L. The WQI was created for freshwater sites, however, a WQI score was calculated for the Swinomish Channel site for reference and to identify changes. The Swinomish Channel had the highest WQI score in the watershed, with a score of 70.

Table 4. Site compliance with state water quality standards and water quality index (WQI) scores in the Padilla Bay watershed in water year 2024. The sites are organized from north to south.

Site	Waterbody	Temperature Standard (7DADMax)	Dissolved Oxygen Standard	*E. coli* Standard	WQI Score
49	Middle Joe Leary Slough	-	X	✓	12
50	Lower Joe Leary Slough	-	X	✓	20
34	No Name Slough	-	X	X	37
52	Little Indian Slough	-	X	X	48
40	Big Indian Slough	-	X	X	28
47	Swinomish Channel	-	*Excellent*	-	70

For further details see Appendix D.

Legend	*Water Quality Standards:*	✓ Passed	X Failed	- Not measured
	WQI Scores:	Highest Concern (0 – 40)	Moderate Concern (41 – 80)	Lowest Concern (81 – 100)

Long Term Trends – Padilla Bay Watershed

Only three sites in the Padilla Bay watershed were analyzed for trends: No Name Slough, Big Indian Slough, and the Swinomish Channel (Table 5). The sites on Little Indian and Joe Leary Sloughs have only been monitored for three water years and additional data collection is needed to complete accurate trend analysis.

No Name Slough saw the greatest number of changes across the 21-year timespan in the SCMP, however it had a combination of both improving and worsening water quality health. The improving parameters included DO, fecal coliform, turbidity, and nitrogen levels. The worsening parameters included temperature and phosphorus levels. The pH trend in No Name Slough was significantly decreasing or acidifying.

Big Indian Slough was found to have improvements in turbidity levels and nitrogen concentrations. However, the site had worsening trends for fecal coliform and phosphorus levels. A significantly decreasing or acidifying pH trend was also found at Big Indian Slough.

Swinomish Channel generally has had worsening water quality health over the past 20 years, with increasing levels of fecal coliform, nitrate + nitrite, orthophosphate, and total phosphorus concentrations increasing. The one trend indicating improving water quality was declining concentrations of ammonia. Swinomish Channel also had a significantly decreasing trend in pH, indicating more acidic waters.

Table 5. Trend analysis results for sites in the Padilla Bay watershed over the past 21 years. The sites are organized from north to south.

Site	Waterbody	Temp.	DO	FC	Turb.	Amm-onia	Nitrate + Nitrite	TKN	Ortho-phos.	Total Phos.	pH
49	Middle Joe Leary Slough										
50	Lower Joe Leary Slough										
34	No Name Slough	↗	↗	↘	↘	↘	↘	↘	↗	↗	↘
52	Little Indian Slough										
40	Big Indian Slough	-	-	↗	↘	↘	↘	↘	-	↗	↘
47	Swinomish Channel	-	-	↗	-	↘	↗	-	↗	↗	↘

Temp. = Temperature, DO = Dissolved oxygen (mg/L), FC = Fecal coliform, Turb. = Turbidity, TKN = Total Kjeldahl Nitrogen, Ortho-Phos. = Orthophosphate, Total Phos. = Total phosphorus. For further details see Appendix C.

Legend				
		Water Quality Health:	Improving	Worsening
	Trends:	↗ Increasing	↘ Decreasing	- Not significant	No stats run

Middle Skagit Watershed

The Middle Skagit watershed is located between Sedro Woolley and Concrete in central Skagit County (Figure 7). This watershed has many streams and tributaries that feed into the Skagit River. The SCMP monitoring sites are located north of the Skagit River at Red Cabin, Mannser, Wiseman, Coal, and Hansen Creeks. The upland area in the watershed has been managed for timber harvest and the lowland area is dominated by small farms and rural residential development. Many of the creeks in the lowlands have been modified by channelization.

Multiple streams in this watershed run dry in the summer, including Red Cabin and Wiseman Creeks. The lower sections of Coal and Hansen Creeks also run dry during the summer. The following watershed statistics are based on the portion of the watershed north of the Skagit River.

Watershed Statistics

47 sq. miles | **~4,600 people** | **7 SCMP Monitoring Sites**

Top 3 Land Covers: forest, hay/pasture, and shrub/herbaceous vegetation

~19% of watershed is used for **agriculture**

~82% of watershed has **tree cover**

~7% of watershed has **impervious surfaces**

Data sources: Dewitz, 2023; ESRI, 2023; WSDA, 2023.

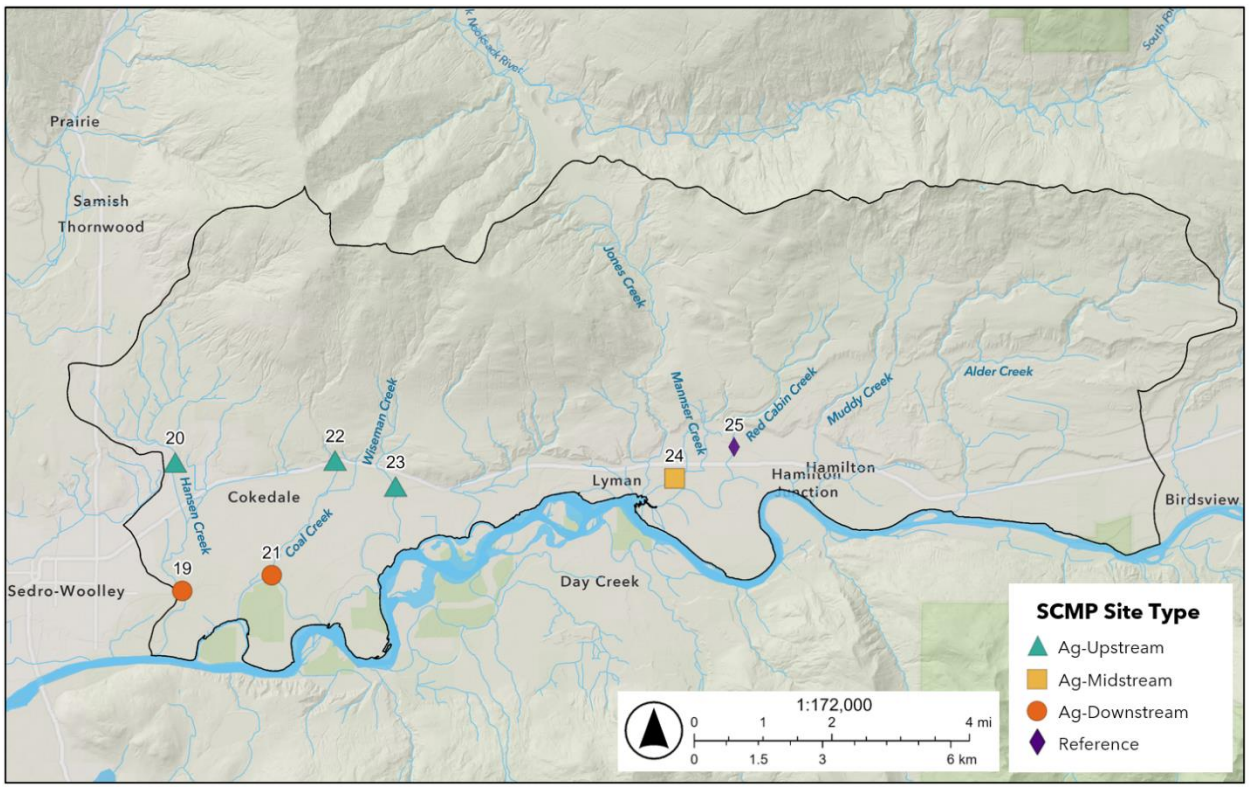


Figure 7. Monitoring sites in the Middle Skagit watershed and the site type.

Current Conditions in WY2024 – Middle Skagit Watershed

All the sites in the Middle Skagit watershed were assessed for DO and *E. coli* compliance, and a subset of four sites were tested for temperature compliance. Red Cabin Creek met both the DO and *E. coli* state water quality standards in water year 2024 (Table 6). Individual standards were met by Wiseman Creek for DO and by lower Coal Creek for *E. coli*. No sites met the temperature standard.

Based on WQI scores in water year 2024, five sites in the Middle Skagit were ranked in the "lowest concern" category. These sites all had WQI scores greater than 90. Red Cabin Creek had a WQI score of 98, which is the highest score in the SCMP this year. The two "moderate concern" sites were lower Hansen Creek with a score 74 and Mannser Creek with a score of 60. No sites in the Middle Skagit watershed were ranked in the "highest concern" category.

Table 6. Site compliance with state water quality standards and water quality index (WQI) scores in the Middle Skagit watershed in water year 2024. The sites are generally organized from east to west.

Site	Waterbody	Temperature Standard (7DADMax)	Dissolved Oxygen Standard	*E. coli* Standard	WQI Score
25	Red Cabin Creek	-	✓	✓	98
24	Mannser Creek	-*	X	✓	60
23	Wiseman Creek	-	✓	X	92
22	Upper Coal Creek	X	X	✓	94
21	Lower Coal Creek	X	X	X	94
20	Upper Hansen Creek	-*	X	✓	95
19	Lower Hansen Creek	X	X	✓	74

* Unable to retrieve logger or incomplete dataset.
For further details see Appendix D.

Legend				
Water Quality Standards:	✓ Passed	X Failed	- Not measured	
WQI Scores:	Highest Concern (0 – 40)	Moderate Concern (41 – 80)	Lowest Concern (81 – 100)	

Long Term Trends – Middle Skagit Watershed

The sites monitored in the Middle Skagit watershed had a mixture of both improving and worsening water quality health over the past 21 years (Table 7). Water temperature significantly warmed at Mannser, upper Coal, and lower Hansen Creeks. Red Cabin, Wiseman, and upper Hansen Creek saw improvements in DO concentrations. Interestingly, DO concentrations increased at Mannser Creek, despite the inverse relationship between temperature and oxygen. The only significant fecal coliform trend in the watershed found worsening levels at Wiseman Creek. Turbidity was found to be improving at the sites on Coal and Hansen Creeks, while it is worsening at Red Cabin and Mannser Creeks. Nitrate + nitrite was the only nutrient parameter to have significant trends, with improvements found at Wiseman Creek, upper and lower Coal Creek, and upper and lower Hansen Creek. Most of the sites in the watershed also had a decreasing or acidifying pH trend.

Table 7. Trend analysis results for sites in the Middle Skagit watershed over the past 21 years. The sites are generally organized from east to west.

Site	Waterbody	Temp.	DO	FC	Turb.	Amm-onia	Nitrate + Nitrite	TKN	Ortho-phos.	Total Phos.	pH
25	Red Cabin Creek	-	↗	-	↗	-	-	-	-	-	↘
24	Mannser Creek	↗	↗	-	↗	-	-	-	-	-	-
23	Wiseman Creek	-	↗	↗	-	-	↘	-	-	-	↘
22	Upper Coal Creek	↗	-	-	↘	-	↘	-	-	-	↘
21	Lower Coal Creek	-	-	-	↘	-	↘	-	-	-	-
20	Upper Hansen Creek	-	↗	-	↘	-	↘	-	-	-	↘
19	Lower Hansen Creek	↗	↘	-	↘	-	↘	-	-	-	↘

Temp. = Temperature, DO = Dissolved oxygen (mg/L), FC = Fecal coliform, Turb. = Turbidity, TKN = Total Kjeldahl Nitrogen, Ortho-Phos. = Orthophosphate, Total Phos. = Total phosphorus. For further details see Appendix C.

Legend				
	Water Quality Health:	Improving		Worsening
	Trends:	↗ Increasing	↘ Decreasing	- Not significant	No stats run

Nookachamps Watershed

The Nookachamps watershed is a main tributary of the lower Skagit River that is located east of Mount Vernon (Figure 8). Nookachamps Creek branches into two main subbasins: the mainstem Nookachamps Creek that routes through Big Lake, and the East Fork Nookachamps Creek that flows further east. The upland areas in the watershed are managed for timber harvest and the lowland areas in the valley are primarily used by small farms and residential development. Most of the downstream sections of both creeks have been channelized, which has resulted in wide, shallow channels with sparse riparian vegetation. This watershed is an important salmon-producing tributary of the lower Skagit River.

Watershed Statistics

71 sq. miles

~22,000 people

6 SCMP Monitoring Sites

Top 3 Land Covers: forest, development, and shrub/herbaceous vegetation

~8% of watershed is used for **agriculture**

~82% of watershed has **tree cover**

~14% of watershed has **impervious surfaces**

Data sources: Dewitz, 2023; ESRI, 2023; WSDA, 2023.

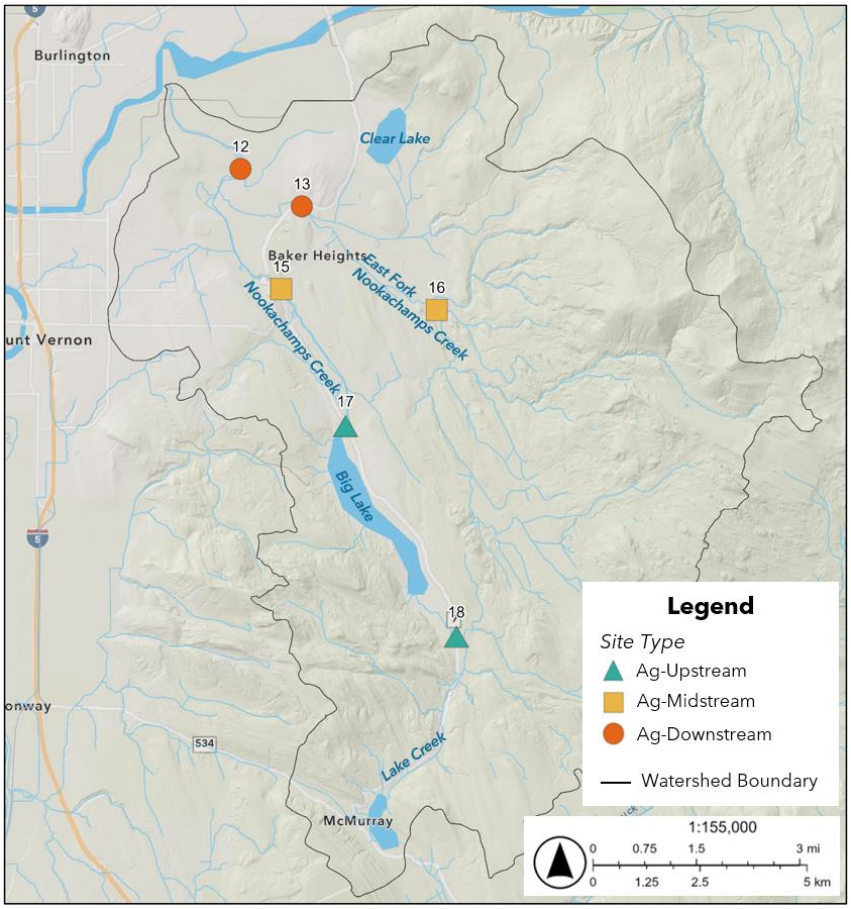


Figure 8. Monitoring sites in the Nookachamps watershed and the site type.

Current Conditions in WY2024 – Nookachamps Watershed

No sites in the Nookachamps watershed met the temperature or DO state standards in water year 2024 (Table 8). The sites further upstream in the watershed passed the *E. coli* standard, but the lower East Fork Nookachamps and the lower Nookachamps sites did not pass.

The sites furthest upstream in the sub-basins, Lake Creek and upper East Fork Nookachamps, were ranked in the "lowest concern" category. The four other sites in the watershed were in the "moderate concern" category, with WQI scores ranging from 49 - 78. The lower East Fork Nookachamps had the lowest score of 49, which is the lowest score it's had since the program started. No sites were ranked in the "highest concern" category.

Table 8. Site compliance with state water quality standards and water quality index (WQI) scores in the Nookachamps watershed in water year 2024. The sites are generally organized from upstream to downstream.

Site	Waterbody	Temperature Standard (7DADMax)	Dissolved Oxygen Standard	*E. coli* Standard	WQI Score
18	Lake Creek	X	X	✓	94
17	Upper Nookachamps Creek	X	X	✓	78
15	Middle Nookachamps Creek	X	X	✓	70
16	Upper East Fork Nookachamps Creek	X	X	✓	92
13	Lower East Fork Nookachamps Creek	-*	X	✓	49
12	Lower Nookachamps Creek	-*	X	X	77

* Unable to retrieve logger or incomplete dataset.
For further details see Appendix D.

Legend				
Water Quality Standards:	✓ Passed	X Failed	- Not measured	
WQI Scores:	Highest Concern (0 – 40)	Moderate Concern (41 – 80)	Lowest Concern (81 – 100)	

Long Term Trends – Nookachamps Watershed

Most of the Nookachamps watershed had a mixture of improving and worsening water quality health (Table 9). The lower East Fork Nookachamps was the one site in the watershed with significantly warming trend over the past 21 years. The lower East Fork Nookachamps and lower Nookachamps both had worsening health in terms of DO. Further upstream at the middle Nookachamps, upper East Fork Nookachamps, and Lake Creek sites, improving DO trends were found. Lake Creek and the middle Nookachamp Creek had reduced fecal coliform levels. The upper Nookachamps Creek site, located near the outlet of Big Lake, has seen worsening turbidity since the beginning of the program. Nitrogen levels have improved at all the sites, while phosphorus levels have worsened at the middle and lower Nookachamps Creek sites.

Table 9. Trend analysis results for sites in the Nookachamps watershed over the past 21 years. The sites are generally organized from upstream to downstream.

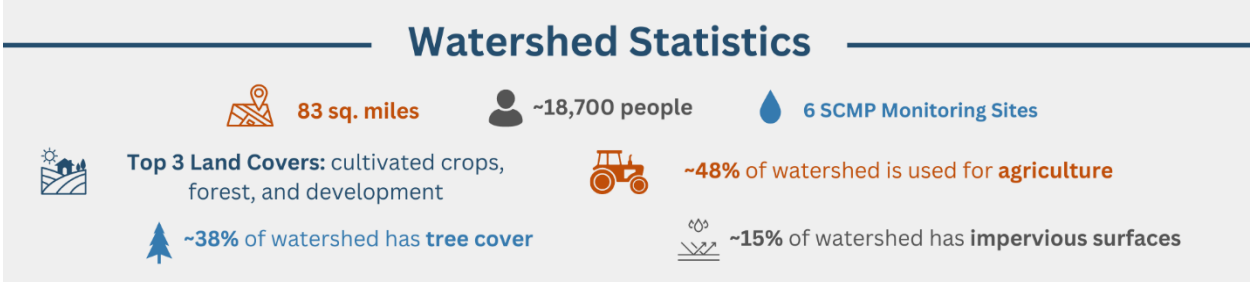
Site	Waterbody	Temp.	DO	FC	Turb.	Amm-onia	Nitrate + Nitrite	TKN	Ortho-phos.	Total Phos.	pH
18	Lake Creek	-	↗	↘	-	-	↘	-	-	-	-
17	Upper Nookachamps Creek	-	-	-	↗	↘	-	-	-	-	↘
15	Middle Nookachamps Creek	-	↗	↘	-	↘	-	↘	↗	↗	-
16	Upper East Fork Nookachamps Creek	-	↗	-	-	-	↘	-	-	-	↘
13	Lower East Fork Nookachamps Creek	↗	↘	-	-	↘	↘	-	-	-	-
12	Lower Nookachamps Creek	-	↘	-	↘	↘	↘	↘	↗	-	-

Temp. = Temperature, DO = Dissolved oxygen (mg/L), FC = Fecal coliform, Turb. = Turbidity, TKN = Total Kjeldahl Nitrogen, Ortho-Phos. = Orthophosphate, Total Phos. = Total phosphorus. For further details see Appendix C.

Legend				
	Water Quality Health:		Improving	Worsening
	Trends:	↗ Increasing	↘ Decreasing	- Not significant	No stats run

Lower Skagit Watershed

The Lower Skagit watershed is a combination of the streams, drainages, and sloughs that flow into the Skagit River or Skagit Bay in southwest Skagit County (Figure 9). The main waterways monitored in the SCMP include Carpenter Creek (Hill Ditch), Fisher Creek, Wiley Slough, and Maddox Creek/Slough (Big Ditch). We also monitor Sulivan Slough, a drainage that flows into Swinomish Channel and Skagit Bay near La Conner. The upper portions of Carpenter and Fisher Creeks drain the hills located to the east and southeast of the low-lying Skagit plain. The creeks and drainages in the Skagit plain are often channelized and diked with little riparian vegetation. Most of the Lower Skagit watershed is used for commercial agriculture and rural residential development.



Data sources: Dewitz, 2023; ESRI, 2023; WSDA, 2023.

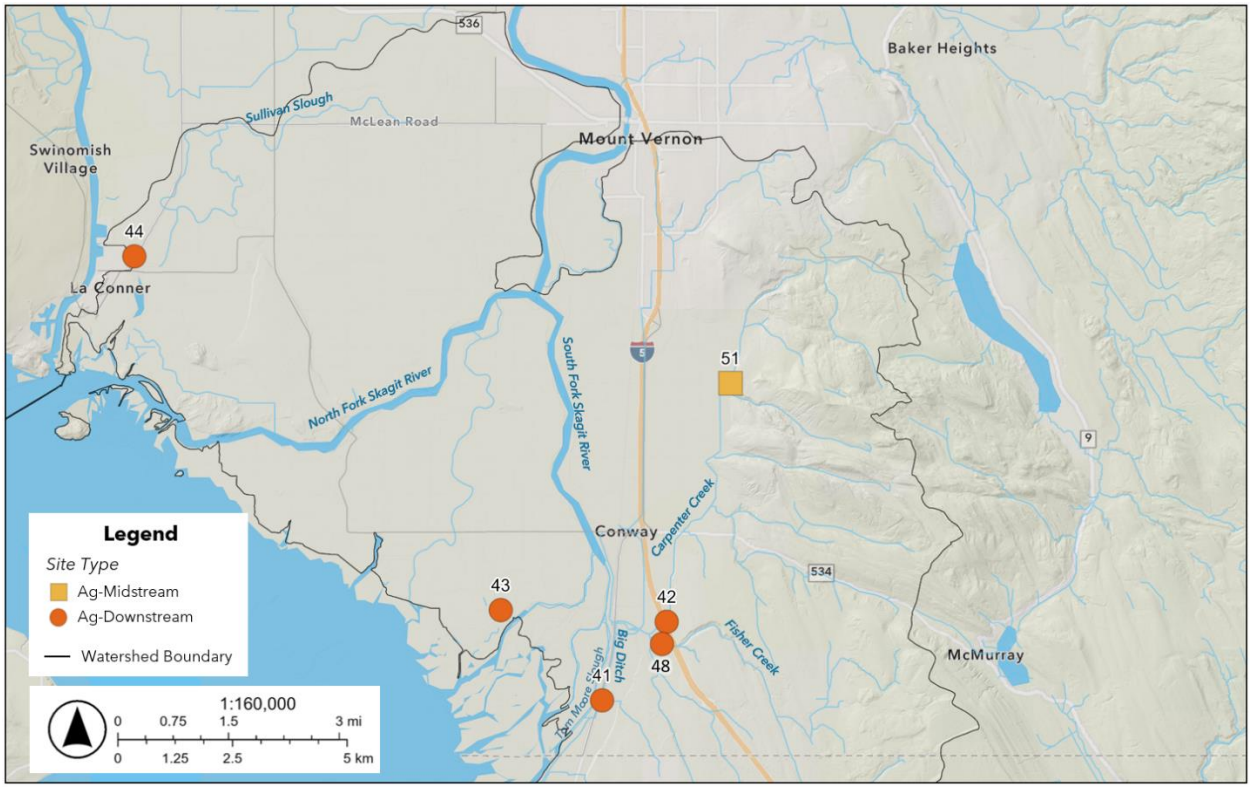


Figure 9. Monitoring sites in the Lower Skagit watershed and the site type.

Current Conditions in WY2024 – Lower Skagit Watershed

None of the Lower Skagit watershed sites met the temperature or DO state standard in water year 2024 (Table 10). Wiley Slough was the only site in the Lower Skagit that met the *E.* coli standard this year.

The highest WQI scores in the Lower Skagit watershed were Fisher Creek and lower Carpenter Creek with scores of 81, placing them in the "lowest concern" category. At lower Carpenter Creek, this ties as the highest WQI score over the past 21 years. Upper Carpenter Creek ranked in the "moderate concern" category. The lowest scoring sites were Wiley Slough, Sullivan Slough, and Maddox Creek/Big Ditch with scores ranging from 13 – 29.

Table 10. Site compliance with state water quality standards and water quality index (WQI) scores in the Lower Skagit watershed in water year 2024. The sites are generally organized from north to south.

Site	Waterbody	Temperature Standard (7DADMax)	Dissolved Oxygen Standard	*E. coli* Standard	WQI Score
51	Upper Carpenter Creek	X	X	X	68
42	Lower Carpenter Creek/Hill Ditch	X	X	X	81
48	Fisher Creek	X	X	X	81
43	Wiley Slough	-	X	✓	13
44	Sullivan Slough	-	X	X	28
41	Maddox Creek/Big Ditch	-*	X	X	29

* Incomplete dataset.

For further details see Appendix D.

Legend				
Water Quality Standards:	✓ Passed	X Failed	- Not measured	
WQI Scores:	Highest Concern (0 – 40)	Moderate Concern (41 – 80)	Lowest Concern (81 – 100)	

Long Term Trends – Lower Skagit Watershed

Improving and worsening water quality health was observed in the Lower Skagit watershed (Table 11). Data has only been collected at upper Carpenter Creek for three years, so additional data collection is needed to complete accurate trend analysis.

Fisher Creek was the one site in the Lower Skagit watershed that had a significant temperature trend, which was warming over the past 21 years. Interestingly, Fisher Creek also had increasing DO concentrations. Lower Carpenter and Fisher Creek had improving DO trends, while Sullivan Slough had a worsening DO trend.

All the sites in the Lower Skagit watershed with the exception of Fisher Creek, had worsening fecal coliform levels. Turbidity worsened Wiley Slough and Maddox Creek/Big Ditch. Nitrogen concentrations improved at lower Carpenter Creek, Fisher Creek, and Maddox Creek/Big Ditch, while Sullivan Slough had worsening nitrate + nitrite concentrations. Phosphorus concentrations were worsening at most of the sites in the watershed. Significantly decreasing or acidifying pH trends were found at Fisher Creek, Wiley Slough, and Sullivan Slough.

Table 11. Trend analysis results for sites in the Lower Skagit watershed over the past 21 years. The sites are generally organized from north to south.

Site	Waterbody	Temp.	DO	FC	Turb.	Amm-onia	Nitrate + Nitrite	TKN	Ortho-phos.	Total Phos.	pH
51	Upper Carpenter Creek										
42	Lower Carpenter Creek/Hill Ditch	-	↗	↗	-	↘	-	↘	-	-	-
48	Fisher Creek	↘	↗	-	-	↘	↘	↘	-	↗	↘
43	Wiley Slough	-	-	↗	↗	-	-	-	-	↗	↘
41	Maddox Creek/ Big Ditch	-	-	↗	↗	↘	-	-	↗	↗	-
44	Sullivan Slough	-	↘	↗	-	-	↗	-	-	↗	↘

Temp. = Temperature, DO = Dissolved oxygen (mg/L), FC = Fecal coliform, Turb. = Turbidity, TKN = Total Kjeldahl Nitrogen, Ortho-Phos. = Orthophosphate, Total Phos. = Total phosphorus. For further details see Appendix C.

Legend				
	Water Quality Health:		Improving	Worsening
	Trends:	↗ Increasing	↘ Decreasing	- Not significant	No stats run

Skagit River

The Skagit River is the largest river flowing into Puget Sound, supplying about one-third of its fresh water. The river originates in British Columbia, flows across the border into Ross Lake, and continues westward through Skagit County for a total length of 150 miles. The Skagit River watershed encompasses the sub-basins Middle Skagit, Nookachamps, and Lower Skagit focused on in this report. The river supports many wildlife and their habitats, including wild populations of all five salmon species (Chinook, coho, pink, sockeye, and chum) and three species of anadromous trout (bull, steelhead, and chum).

The SCMP monitors four sites on the Skagit River, ranging as far upstream as Hamilton to downstream locations in the North and South Forks (Figure 10). The Skagit River data collected in the SCMP is not a comprehensive analysis of the river's health but can be used as indicators for further investigation. The water quality data and samples are collected from the banks of the river at the surface, so the thalweg and deeper depths could have differing results than those we recorded.

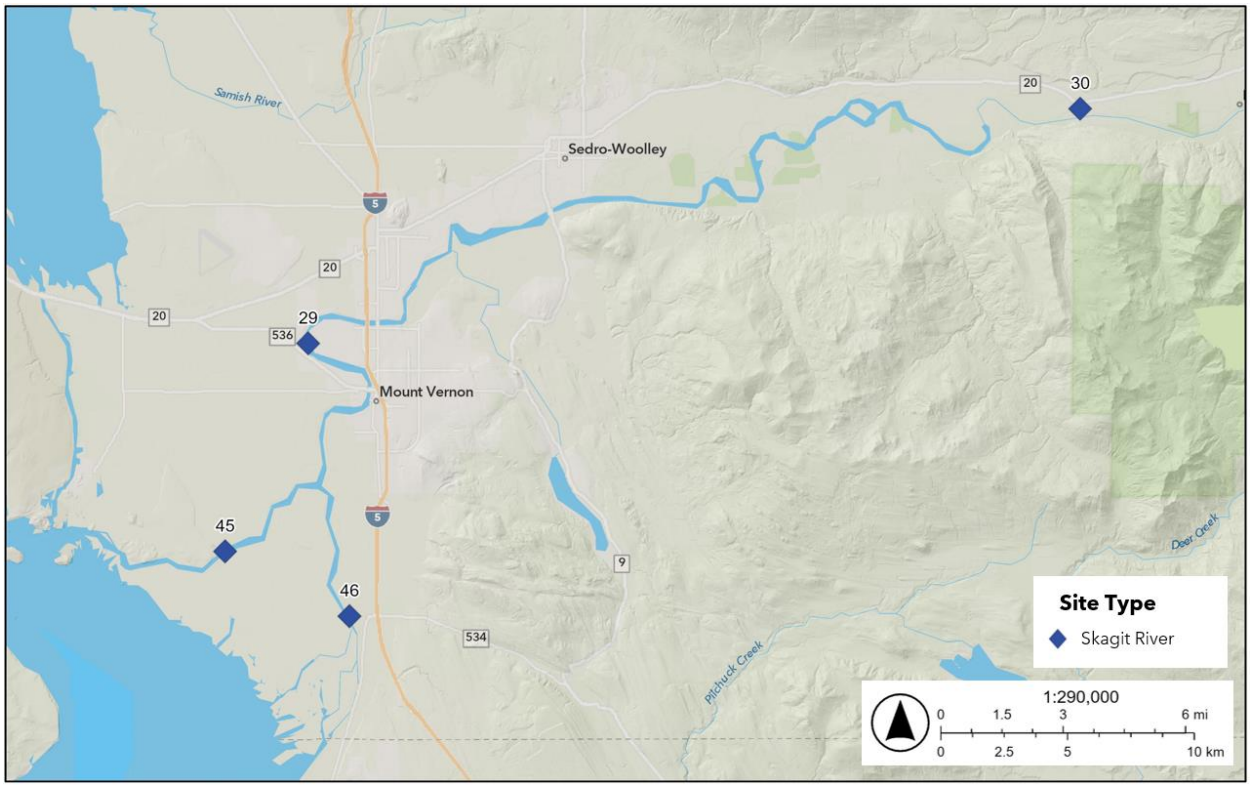


Figure 10. Monitoring sites on the Skagit River.

Current Conditions in WY2024 – Skagit River

The Skagit River at Hamilton and the North Fork did not meet the state temperature standards in water year 2024 (Table 12). None of the Skagit River sites met the state DO standard, while all the sites met the *E. coli* state standard.

In water year 2024, all four Skagit River sites were categorized in the "lowest concern" category based on WQI scores. The scores ranged from 91 – 96, with the highest scoring being the North and South Fork sites.

Table 12. Site compliance with state water quality standards and water quality index (WQI) scores on the Skagit River in water year 2024. The sites are organized from upriver to downriver.

Site	Waterbody	Temperature Standard (7DADMax)	Dissolved Oxygen Standard	*E. coli* Standard	WQI Score
30	Skagit River near Hamilton	X	X	✓	91
29	Skagit River near Mount Vernon	-	X	✓	95
45	North Fork Skagit River	X	X	✓	96
46	South Fork Skagit River	-	X	✓	96

For further details see Appendix D.

Legend				
Water Quality Standards:	✓ Passed	X Failed	- Not measured	
WQI Scores:	Highest Concern (0 – 40)	Moderate Concern (41 – 80)	Lowest Concern (81 – 100)	

Long Term Trends – Skagit River

The Skagit River sites have had very few significant trends and little change over the past 21 years (Table 13). Based on our discrete temperature measurements, there were no significant changes in temperature at the Skagit River sites. Nitrogen and phosphorus concentrations also did not change significantly at any of the Skagit River sites.

The few significant changes that were identified include improving turbidity levels at all the Skagit River sites. The sites near Mount Vernon and the South Fork both had improving DO concentrations, however also had worsening fecal coliform levels. Decreasing or acidifying pH levels were found at the site near Mount Vernon, while further downstream at the North Fork site, pH levels were found to be increasing or becoming more basic.

Table 13. Trend analysis results for sites on the Skagit River over the past 21 years. The sites are organized from upriver to downriver.

Site	Waterbody	Temp.	DO	FC	Turb.	Amm-onia	Nitrate + Nitrite	TKN	Ortho-phos.	Total Phos.	pH
30	Skagit River near Hamilton	-	-	-	↘	-	-	-	-	-	-
29	Skagit River near Mount Vernon	-	↗	↗	↘	-	-	-	-	-	↘
45	North Fork Skagit River	-	-	-	↘	-	-	-	-	-	↗
46	South Fork Skagit River	-	↗	↗	↘	-	-	-	-	-	-

Temp. = Temperature, DO = Dissolved oxygen (mg/L), FC = Fecal coliform, Turb. = Turbidity, TKN = Total Kjeldahl Nitrogen, Ortho-Phos. = Orthophosphate, Total Phos. = Total phosphorus. For further details see Appendix C.

Legend				
		Water Quality Health:	Improving	Worsening
	Trends:	↗ Increasing	↘ Decreasing	- Not significant / No stats run

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