Whatcom County 2017 Water Quality Report and Priority Areas
Fecal Coliform in Coastal Drainages
Whatcom County Public Works
February 2018

Executive Summary

Whatcom County Public Works (WCPW) uses water quality monitoring, priority area ranking, pollution source identification, community education, technical and financial assistance programs, and regulatory enforcement to protect public health and prevent pollution of surface waters.

This annual report summarizes Whatcom County's bacterial water quality concerns, outlines the routine monitoring program, characterizes the current status of water quality at each monitoring station based upon the last three years of data, prioritizes areas for water quality improvement projects, and describes the areas where Whatcom County will be focusing efforts in the next year.

WCPW coordinates regular monitoring of fecal coliform levels at a fixed-network of approximately 90 sites in county watersheds that discharge to marine waters. All samples are analyzed at Department of Ecology certified laboratories using standard methods for fecal coliform analysis. Quality control steps are used to measure variability due to sampling methods and conditions. Sampling events are pre-scheduled, typically a month in advance, and provide data from a broad spectrum of environmental conditions throughout the year.

In 2017, 34 of the 88 (39%) freshwater stations with at least three years of data met water quality standards for fecal coliform. This is a marked improvement from the initiation of the enhanced PIC Program in 2014 when only 13% of the routine stations met standards for fecal coliform. However, there are still many sites that are not meeting both parts of the water quality standard and shellfish beds are still experiencing closures.

The status of each drainage area was evaluated based upon the most current water quality data available. The criteria and associated scores are described below for the five categories analyzed: annual geometric mean, annual 90th percentile, three year geometric mean, three year geometric mean for the dry season, and three year geometric mean for the wet season. Additionally, each site was scored for current status of the shellfish growing area to which the waterbody discharges. Higher points indicate higher levels of bacterial impairment. The top five ranked drainages based upon 2017 data and the above described ranking criteria and scores are:

1. CA14c- California Creek (33 points)
2. CA9- California Creek (24 points)
3. TribDak3- Dakota Creek (24 points)
4. S1- Scott Ditch (24 points)
5. F3- Fishtrap Creek/Double Ditch (21 points)

Based upon this ranking and other considerations, WCPW will continue source tracking monitoring, community engagement and landowner assistance programs for water quality improvement projects in the current Drayton Harbor Focus Areas (CA14c, CA9, TribDak3) through a partnership with the Whatcom Conservation District and other County departments. Additionally, WCPW will continue work with the Whatcom Conservation District, North Lynden Watershed Improvement District and City of Lynden in the Fishtrap Creek watershed to monitor water quality and provide technical and financial assistance to landowners (F3). A new focus area that will be added to the program in 2018 will be the Scott Ditch watershed. WCPW will continue partnering with the Whatcom Clean Water Program to coordinate monitoring and landowner contacts. As resources allow, partnerships are formed, or water quality improves, additional focus areas will be addressed.

Three additional areas will be added to the routine monitoring program this year including coastal sites discharging to the eastern portion of Drayton Harbor, Jordan Creek which discharges to Lummi Bay, and the Sumas River which flows to the north into Canada to assist with pollution identification and correction efforts in these areas with emerging issues.

Introduction

Purpose

Whatcom County Public Works' (WCPW) Pollution Identification and Correction (PIC) Program includes water quality monitoring, follow up monitoring at sites with elevated bacteria levels, community outreach, and coordination with County departments and other agencies to identify and correct potential bacteria sources.

Whatcom County's PIC Program includes an annual review of routine monitoring sites located throughout the county. This annual review helps characterize the current status of watershed health and associated public health threats, focus limited county resources on the areas that will most benefit from water quality improvement efforts, and engage landowners in community solutions.

Currently, Whatcom County Public Works (WCPW) monitors fecal coliform and other water quality parameters at approximately 90 stations on at least a monthly basis. Sample collection is conducted following standard protocols by trained staff, project partners, and volunteers (WCPW 2008, WCPW 2013). Sample analysis is conducted following standard methods and quality control and assurance measures at DOE-certified laboratories. Data from the routine monitoring program assist the County Health Department, County Planning and Development Services (PDS), and other agencies to identify sources of bacterial pollution.

The Whatcom County PIC Program builds off several elements of the Kitsap County PIC program (BKCHD, KCHD 2011). These are routine monitoring, annual review and ranking of drainages, and initial voluntary interactions with landowners to identify pollution sources and provide tools to help improve management practices that may be impacting water quality. The annual review and ranking of drainages focuses pollution prevention efforts in areas that have most consistently shown high bacteria counts.

This annual report summarizes Whatcom County's bacterial water quality areas of concern, outlines the routine monitoring program, characterizes the current status of water quality at each monitoring station, prioritizes areas for water quality improvement projects, and describes the areas where Whatcom County will be focusing efforts in the next year.

Fecal Coliform in Whatcom County Waters

Water Resource Inventory Area (WRIA) 1 is located in the northwest corner of Washington State and encompasses over 60 percent of Whatcom County which is the most populated portion (Blake and Peterson 2005). WRIA 1 also includes small portions of Skagit County and British Columbia. Since 1998 a variety of water resource management stakeholders, local and state agencies, and tribal governments have worked together under the Watershed Management Act to characterize issues related to water quantity, water quality, fish habitat, and instream flows as well as to identify potential management solutions. The characterization completed in 2005 found fecal coliform to be the predominant water quality issue in Whatcom County based upon 303(d) listings. Of the 274 individual 303(d) listings for WRIA 1 in 1998, 82 were for fecal coliform, while the next most frequent, dissolved oxygen, had 48 listings. In 2008, there were 253 individual Category 5 303(d) listings for water in WRIA 1. Sixty-six of these Category 5 listings were for fecal coliform and listings for dissolved oxygen increased to 106. In 2016, there were 322 individual Category 5 303(d) listings for water in WRIA 1, with 85 of these for bacteria.

This widespread problem of elevated fecal coliform concentrations in Whatcom County waters was also observed through the WCPW routine monitoring program data, recurring shellfish harvest closures, and public health advisories. Elevated bacteria levels in marine waters led to the establishment of three shellfish protection districts in Whatcom County: Drayton Harbor, established in 1995, Portage Bay, established in 1998, and Birch Bay, established in 2009. While Portage Bay shellfish growing areas had been completely reopened in 2006, a reoccurrence of declining water quality in the Nooksack River and Portage Bay resulted in another shellfish downgrade of approximately 496 acres in 2015 and an additional 300 acres in 2016.

Drayton Harbor historically supported non-tribal commercial, tribal commercial, ceremonial, and subsistence harvests, and recreational shellfish harvesting. The harbor had been at the top of the Washington State Department of Health (DOH) Fecal Pollution Index (FPI) list for over 10 years. Water quality improvements led to upgrades of commercial harvest in portions of the harbor to Conditional Approval in 2004 and 2010. In 2015, DOH and the Washington State Department of Fish and Wildlife reopened the recreational shellfish beach on the southwest corner of Drayton Harbor between April and October. This was the first time the recreational beach had been open to recreational harvest in over 15 years. In 2016, seasonal harvesting restrictions were removed from 810 acres allowing year-round commercial, tribal, and recreational shellfish harvest for the first time in over 20 years. However, a large portion of the harbor remains prohibited year-round. The community is currently tackling the harder non-point sources in an effort to regain "Approved" status throughout the harbor (with the exception of WWTP and marina closure zones).

Portage Bay supports commercial, ceremonial, and subsistence shellfish harvest for members of the Lummi Nation. Portions of the Portage Bay shellfish growing area were re-opened in 2003 and the remaining closed areas were reopened in 2006; however, starting in 2004 fecal coliform levels in the mainstem of the Nooksack River began increasing again. Between 2009 and 2012, the fecal coliform geometric mean at the mainstem site located at Marine Drive (M1) more than doubled. The majority of freshwater sites exhibited the highest bacteria levels in 2014 which was also reflected in the marine water and led to downgrades of shellfish beds in 2015 and 2016 resulting in 801 acres with seasonal closures from April through June and October through December each year.

Birch Bay is a large draw for recreational shellfish harvesters, including both locals and tourists. Birch Bay State Park has consistently been one of the top recreational shellfish areas of the state. The shellfish growing area around the mouth of Terrell Creek was downgraded to Prohibited in 2008 due to elevated levels of fecal coliform bacteria in the creek. Bacteria levels in Terrell Creek have been declining since the downgrade and implementation of water quality improvement programs. A review of the status of the shellfish beds led to a recommendation for upgrading 129 acres in late 2017.

Northern Chuckanut Bay has been closed for recreational shellfish harvest since 1994 due to elevated bacteria levels and on-site sewage system (OSS) failures. Beginning in 2011, Wildcat Cove in Larrabee State Park was posted with a swimming advisory due to elevated bacteria levels. These advisories and closures are included in the *Whatcom County Fecal Coliform Levels and Shellfish Growing Area Status* map (Appendix B).

In 2017, 34 of the 88 (39%) freshwater stations with at least three years of data met water quality standards for fecal coliform. This is a marked improvement from the initiation of the enhanced PIC Program in 2014 when only 13% of the routine stations met standards for fecal coliform. This illustrates that water quality improvements have been seen in many freshwater and marine areas over the past two years, however hard work continues to be needed to meet standards throughout these areas and to upgrade shellfish growing areas.

Sources of Fecal Coliform Water Pollution

The primary cause of pollution in Whatcom County's creeks and marine waters is nonpoint source pollution. Nonpoint source pollution is the term used to describe pollutants that come from many smaller sources, rather than a few large sources. This accumulation of pollutants often results from common activities in both urban and rural areas.

Although there are many types of water pollutants, Whatcom County focuses on fecal coliform bacteria as the primary indicator of surface water quality. Fecal coliform bacteria are found in the feces of human and warm-blooded animals. While most fecal coliform strains do not cause human illness, detection in a creek or bay do indicate that human and/or animal wastes and the associated harmful pathogens may be present. Examples of pathogen-related illnesses are giardia, salmonella, viral gastroenteritis, hepatitis, and cholera. People are exposed to these pathogens through direct water contact, such as swimming, wading, or eating shellfish from waters with high bacteria levels.

The key potential sources of bacteria that have been identified in Whatcom County coastal drainages are (1) **animal waste** from agricultural operations, domestic pets, waterfowl, and wildlife, and (2) **human sewage** from failing on-site sewage systems (OSS), leaking sewers, or cross-connections.

Water Quality Program

Water Quality Monitoring

WCPW conducts routine water quality monitoring to guide water quality improvement projects and meet the following goal and objectives.

Goal: Reduce fecal coliform levels at priority drainages to meet applicable water quality standards and support human health, recreational uses, animal health, and shellfish harvest.

Objectives:

- Assess surface water quality status and trends through long-term monitoring.
- Compare results against applicable standards.
- Prioritize hot spots for water quality improvement projects (both within the county and within drainage areas).
- Identify public health concerns.
- Identify potential sources of bacteria and guide implementation of water quality improvement projects.
- Provide water quality data to the public and other interested parties.

Washington State Water Quality Standards

Table 1 lists water quality standards for fecal coliform bacteria at marine and freshwater sites in Whatcom County coastal drainages. These water quality standards that govern Whatcom County are established and regulated by the Washington State Department of Ecology and approved by the U.S. Environmental Protection Agency. They are described more fully in Chapter 173-201A of the Washington Administrative Code (WAC). The Lummi Nation has similar water quality standards for the Lummi Indian Reservation (Table 2). These standards apply to the Nooksack River downstream of Marine Drive and are monitored by the Lummi Natural Resources Department.

Table 1. Department of Ecology Water Quality Standards for coastal drainages.

Marine Water Standards	**Freshwater Standards**	**Freshwater Standards**
All Areas	Extraordinary Primary Contact Birch Bay watershed	Primary Contact Nooksack, Drayton, and Chuckanut watersheds
• Geometric Mean- 14FC/100mL • Estimated 90th Percentile- 43 FC/100mL	• Geometric Mean- 50FC/100mL • Not more than 10% exceed 100 FC/100mL	• Geometric Mean- 100FC/100mL • Not more than 10% exceed 200 FC/100mL

Table 2. Lummi Nation Freshwater Water Quality Standards.

Freshwater Water Standards
Nooksack River (Downstream of Marine Drive)
• Geometric Mean- 50FC/100mL • Estimated 90th Percentile- 100 FC/100mL

Routine Monitoring

WCPW coordinates regular monitoring of fecal coliform levels at a fixed-network of approximately 90 sites in county watersheds that discharge to marine waters. Water samples are collected by WCPW staff, Washington Conservation Corps (WCC) crew members, and trained community volunteers. Field teams are trained in sampling, storage, and lab delivery protocols. All samples are analyzed at Department of Ecology-certified laboratories using standard methods for fecal coliform analysis. Quality control steps are used to measure variability due to sampling methods and conditions. Results are compared against data quality objectives to measure precision of results. Sampling events are pre-scheduled, typically at least a month in advance, and provide data from a broad spectrum of environmental conditions throughout the year. During some seasons, samples are unable to be collected due to no flow, tidal, or other environmental conditions. Water quality data are used to prioritize drainages for pollution identification and correction projects and to characterize general patterns in declining and improving water quality. The WCPW staff coordinates with County Health, County Planning and Development Services (PDS), Whatcom Conservation District (WCD), State Departments of Agriculture (WSDA) and Ecology (DOE), and Watershed Improvement Districts (WIDs) to respond to drainages where elevated bacteria levels are consistently observed.

Data Quality Objectives

Completeness

The completeness goal for this project was to collect and analyze 100% of the scheduled samples and 100% of the sites for a complete data set. WCPW data entry includes coding for missed samples to facilitate the review of missed samples. Some sites have low flow, no flow, or stagnant conditions during a portion of the year and missed samples due to these conditions were not included in the completeness evaluation.

Coastal sites had missing samples due to high tides, small craft advisories, unavailable volunteers, or error in sample collection. This resulted in missing 42 samples during coastal sampling runs (12%).

Bias

The Quality Assurance Project Plan (QAPP) established a fixed network of sites that are sampled during pre-scheduled sampling runs to capture a wide variety of environmental conditions. WCPW staff and volunteers are trained in standard operating procedures (SOPS). These SOPs are consistently used for sampling collection, storage, delivery to lab, and quality control procedures to reduce error due to bias. Sampling procedures and field conditions and challenges are reviewed on a frequent basis to ensure consistency with SOPS.

Precision

The following sections describe measures of precision through field duplicates for each sampling run. The various fecal coliform monitoring programs coordinated by Whatcom County include collection of field duplicates for 10% of the samples. For example, eight samples would require one field duplicate and fourteen samples would require two field duplicates. Field duplicates are collected immediately after the original sample in the same location. Precision of the field duplicates is evaluated in terms of relative standard deviation (RSD). The data quality objectives are 1) not more than 50% of duplicates have a RSD of greater than 20% and, 2) not more than 10% of duplicates have an RSD of greater than 50%. These data objectives are consistent with DOE objectives for bacteria Total Maximum Daily Load (TMDL) studies. Field duplicates with low bacteria levels (below 20 cfu/100mL) often show the higher variability and are analyzed separately from other duplicates for calculation of the RSD (Mathieu 2006). As summarized below, fecal coliform data collected over the last three years were compared to the data quality objectives for Drayton Harbor, Birch Bay, Portage Bay, and Coastal Drainage routine monitoring programs.

Drayton Harbor Watershed (WCPW)
From 2015 through 2017, there were 36 sampling events in the Drayton Harbor routine monitoring program conducted by WCPW staff. Field duplicates were collected for 106 of the 1,017 samples (10%). The first data quality objective was over the threshold with 16% of field duplicates with a RSD of greater than 50%. The second data objective was slightly over the threshold with 52% of field duplicates with a RSD of greater than 20%. Of the 17 RSDs that exceeded 50%, 6 of these had average fecal coliform concentrations below 20 FC/100mL. When duplicates with low bacteria levels are separated, the first objective was still slightly over the threshold with 13% of duplicates with a RSD over 50%. The second data objective was met with 44% of RSDs exceeding 20%. Removal of field duplicates with low bacteria levels follows the methodology described by Mathieu (2006) for replicate precision evaluation. Separation of field duplicates for samples with low average bacteria concentrations (less than 20 FC/100mL) did not lead to meeting the second data objective. This highlights there was a high level of variability in fecal coliform during certain environmental conditions in the Drayton Harbor watershed.

Birch Bay Watershed (WCPW)
From 2015 through 2017, there were 69 sampling events in the Terrell Creek/Birch Bay routine monitoring program conducted by WCPW. Field duplicates were collected for 114 of 836 (14%) the samples. Review of field duplicates show 47 % of the field duplicates had a RSD of greater than 20%, meeting this data objective. However, 13% had a RSD of greater than 50% exceeding this data objective. Of the 15 RSDs that exceeded 50%, 9 of these had average fecal coliform concentrations below 20 FC/100mL. When duplicates with low bacteria levels are separated, both data objectives are met with 42% of RSDs exceeding 20% and 8% of RSDs exceeding 50%.

Nooksack River Watershed (WCPW)
From 2015 through 2017, there were 73 sampling events in the Nooksack River watershed routine monitoring program conducted by WCPW staff. Field duplicates were collected for 142 of the 1,351 approximately 11% of the samples. Review of the field duplicates show approximately 44% had a RSD of greater than 20% meeting this data objective. However, approximately 15% had a RSD of greater than 50%, exceeding this data objective. Separation of field duplicates for samples with low average bacteria concentrations (less than 20 FC/100mL) did not lead to meeting the second data objective. This highlights that in the Portage Bay Shellfish Protection District (Nooksack River watershed), there is a high level of variability in fecal coliform during certain environmental conditions.

Coastal Drainages (WCC, WCPW, MRC volunteers)
From 2015 through 2017, there were 36 sampling events in the Birch Bay and Drayton Harbor Coastal Drainage routine monitoring program conducted by the WCC crew, WCPW staff, and trained MRC volunteers. Field duplicates were collected for 84 of 411 (20%) samples. Data objectives were exceeded with 20% of the duplicates having a RSD of greater than 50% and 57% having a RSD of greater than 20%. When duplicates with low bacteria levels are separated (less than 20FC/100mL), the data objectives were met with 10% exceeding the 50% RSD objective and 42% exceeding the 20% RSD objective.

From 2015 through 2017, there were 58 sampling events in the Chuckanut Bay Coastal Drainage routine monitoring program conducted by WCPW staff and trained MRC volunteers. Field duplicates were collected for 59 of 332 (18%) samples. Data objectives were exceeded with 22% of the duplicates having a RSD of greater than 50% and 68% having a RSD of greater than 20%. Separation of field duplicates for samples with low average bacteria concentrations (less than 20 FC/100mL) led to meeting one data objective with 6% of samples exceeding a RSD of 50%. However, this did not lead to meeting the second data objective with 66% of samples exceeding and RSD of 20%. This highlights that there is a high level of variability in fecal coliform concentrations in the Chuckanut Creek system.

Response to Data Objective Exceedances
In response to not meeting data quality objectives for RSD during some sampling runs, several steps were taken midway through 2017 to help evaluate potential problems and identify solutions. Additional steps have been added to WCPW quality control measures as a result of this review.

The WCPW project lead and Whatcom Conservation District (WCD) data coordinator met with the lab supervisor and lab staff to evaluate steps for receiving and analyzing samples as well as field procedures. Additional steps that have been added to the process include field blanks, more frequent check-ins between project manager and field staff to identify changes or challenges, immediate review of field duplicates and follow up with lab when objectives are not met, aligning sample bottles with COC organization, and WCPW review of bench sheets.

Water Quality Status in Whatcom County Creeks and Rivers
The following tables summarize how 2016 and 2017 fecal coliform results at each routine monitoring site compared to the state water quality standards. The total number of sites and the number of sites failing the standard, partially meeting the standard, and meeting the standard are summarized for each watershed. In 2017, more sites were meeting both parts of the fecal coliform standard and fewer sites were failing to meet both parts of the fecal coliform standard. More specific details for each monitoring site are provided in Appendix A.

Table 2. Summary of monitoring sites within each watershed in comparison to fecal coliform standards in 2016.

Watershed	Number of Sites	Number of Sites Failing Both Parts of Standards[a]	Number of Sites Failing One Part of Standard[b]	Number of Sites Meeting Both Parts of Standards[c]
California Creek	13	5 (39%)	4 (31%)	4 (31%)
Dakota Creek	17	4 (24%)	5 (29%)	8 (47%)
Terrell Creek	15	5 (33%)	8 (53%)	2 (13%)
Nooksack River (Portage)	15	7 (47%)	4 (27%)	4 (27%)
Birch Bay Coastal	14	4 (29%)	7 (50%)	3 (21%)
Drayton Coastal	5	0 (0%)	3 (60%)	2 (40%)
Chuckanut Coastal	3	0 (0%)	2 (67%)	1 (33%)
Totals	**82**	**25 (30%)**	**33 (40%)**	**24 (29%)**

a- Indicates frequent elevated fecal coliform levels, b- Indicates occasional elevated fecal coliform levels (or spikes), c- Indicates consistently lower fecal coliform levels.

Table 3. Summary of monitoring sites within each watershed in comparison to fecal coliform standards in 2017.

Watershed	Number of Sites	Number of Sites Failing Both Parts of Standards[a]	Number of Sites Failing One Part of Standard[b]	Number of Sites Meeting Both Parts of Standards[c]
California Creek	13	2 (15%)	10 (77%)	1 (8%)
Dakota Creek	17	1 (6%)	13 (76%)	3 (18%)
Terrell Creek	15	2 (13%)	4 (27%)	9 (60%)
Nooksack River (Portage)	19	2 (11%)	8 (42%)	9 (47%)
Birch Bay Coastal	13	5 (38%)	2 (15%)	6 (46%)
Drayton Coastal	4	0 (0%)	3 (75%)	1 (25%)
Chuckanut Coastal	7	0 (0%)	2 (29%)	5 (71%)
Totals	**88**	**12 (14%)**	**42 (48%)**	**34 (39%)**

a- Indicates frequent elevated fecal coliform levels, b- Indicates occasional elevated fecal coliform levels (or spikes), c- Indicates consistently lower fecal coliform levels.

At the end of 2014, when the enhanced PIC program was established, only 13% of the routine freshwater sites met water quality standards for fecal coliform. At the end of 2017, of the 88 freshwater stations with at least three years of data, 34 (39%) met the water quality standard. The following graphs compare the 2014 and 2017 levels for average fecal coliform levels at all routine sites. The bars represent the last three years of data in comparison with the black diamonds which represent the last year of data. At sites where the diamond falls below the top of the bar, there is an indication of lower bacteria levels in the last year in comparison to the last three years. The red bars indicate averages that are over two times the standard, orange bars are one to two times the standard, and blue bars meet the standard. These patterns have guided the establishment of focus areas for the PIC program.

Water quality improvements were observed in the majority of the Drayton Harbor watershed between 2014 and 2017 (Figures 1 and 2). In December 2014, 6 of 30 routine sites were over two times the standard versus one site over two times the standard in December 2017. Similarly in 2014, 15 sites met the geometric mean standard versus 22 sites meeting the standard in 2017.

Water quality improvements were observed in the majority of the Terrell Creek/Birch Bay watershed between 2014 and 2017 (Figures 3 and 4). In December 2014, 7 of 15 routine sites were over the standard versus 3 sites over the standard in December 2017. In 2017, all sites except one showed lower average bacteria levels in comparison to the last three years.

In the Nooksack River watershed, water quality improvements were also observed in the majority of sites between 2014 and 2017 (Figures 5 and 6). In December 2014, 7 of 13 routine sites with at least three years of data were over the standard versus 6 of 19 sites in December 2017. In December 2014, 2 of these 7 sites were over two times the standard for fecal coliform geometric mean. In 2017, all sites demonstrated declining bacteria levels or levels below the standard holding steady.

Water quality in the coastal drainages is generally meeting standards for fecal coliform geometric mean with the exception of four sites discharging into Birch Bay (Figures 7, 8, and 9). Three of these four sites demonstrated higher levels in 2017 in comparison to the previous three years.

Drayton Harbor Watershed

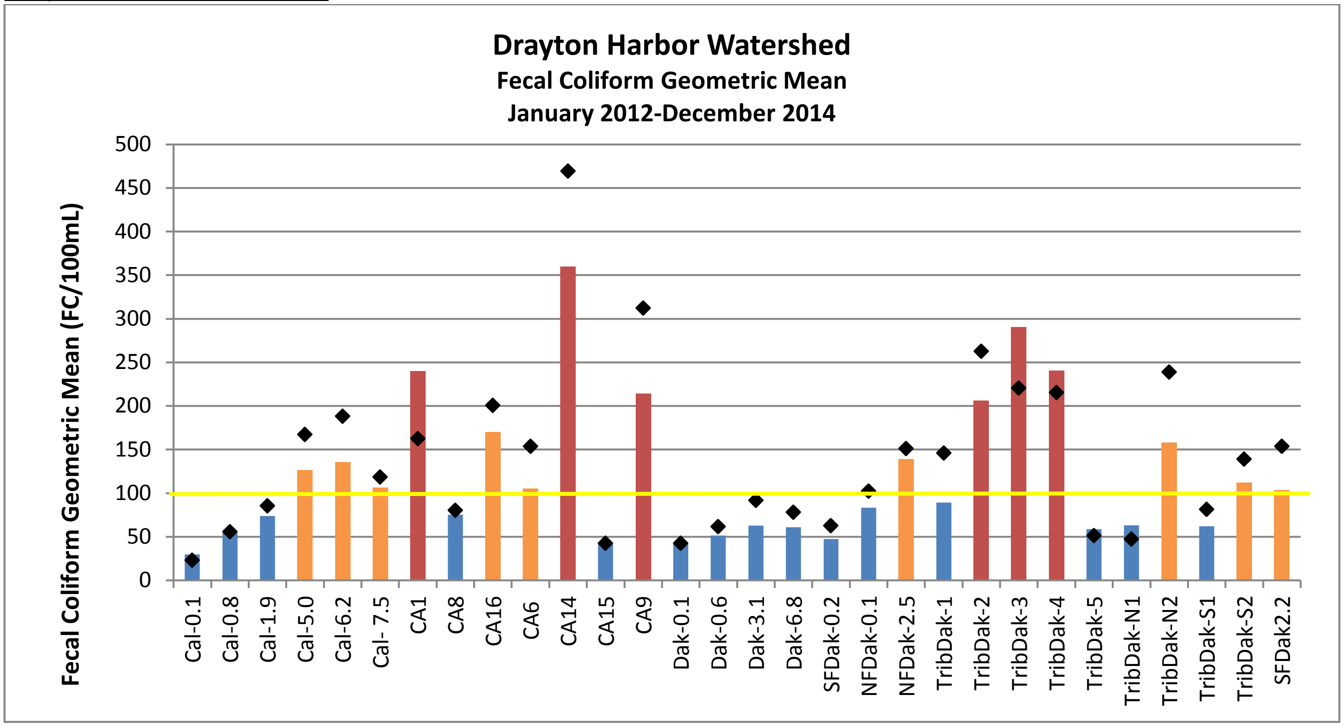

Figure 1. Fecal coliform geometric means for California and Dakota Creek sites within the Drayton Harbor watershed for the period of January 2012 to December 2014. Bars indicate the geometric mean for a three year period and the black diamonds represent a one year geometric mean. Diamonds above the bars indicate increasing bacteria levels over the last year of the three year period. Red bars indicate levels over two times the standards, orange bars indicate one to two times the standards, and blue bars indicate meeting the geometric mean standard.

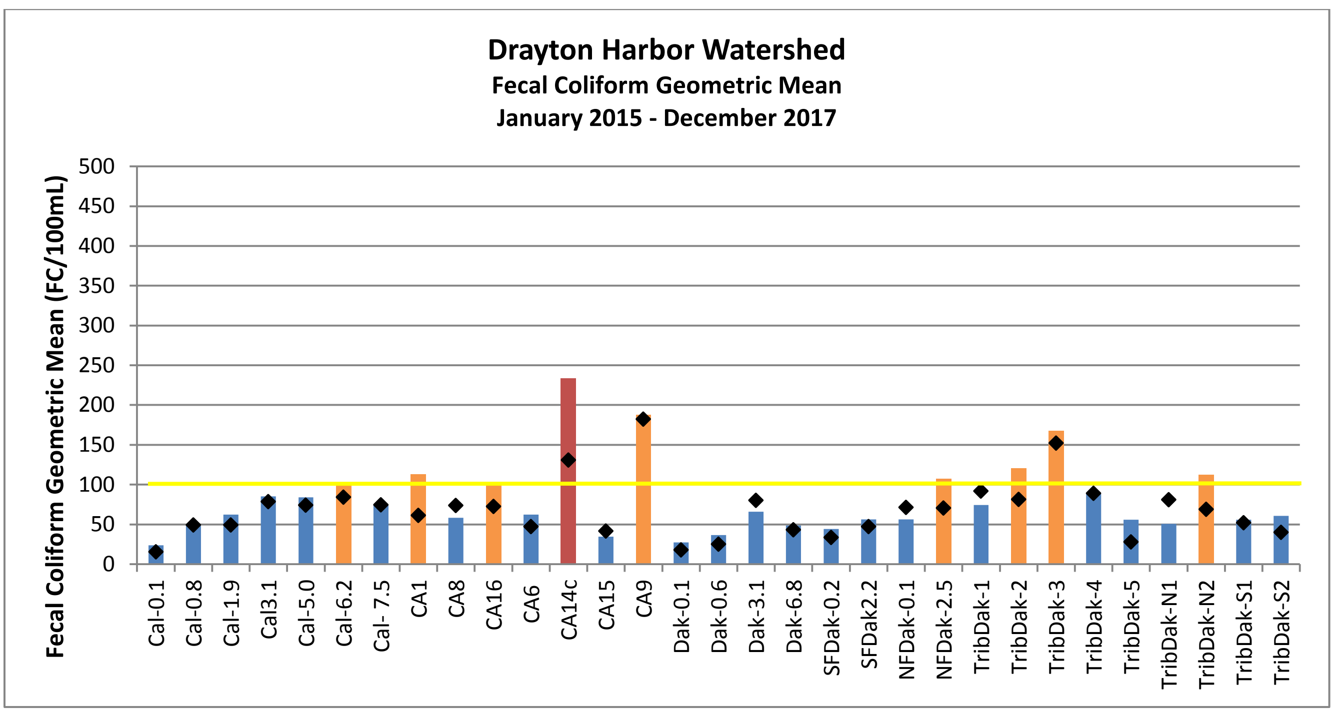

Figure 2. Fecal coliform geometric means for California and Dakota Creek sites within the Drayton Harbor watershed for the period of January 2015 to December 2017. Bars indicate the geometric mean for a three year period and the black diamonds represent a one year geometric mean. Diamonds above the bars indicate increasing bacteria levels over the last year of the three year period. Red bars indicate levels over two times the standards, orange bars indicate levels one to two times the standards, and blue bars indicate levels meeting the geometric mean standard.

Terrell Creek Watershed

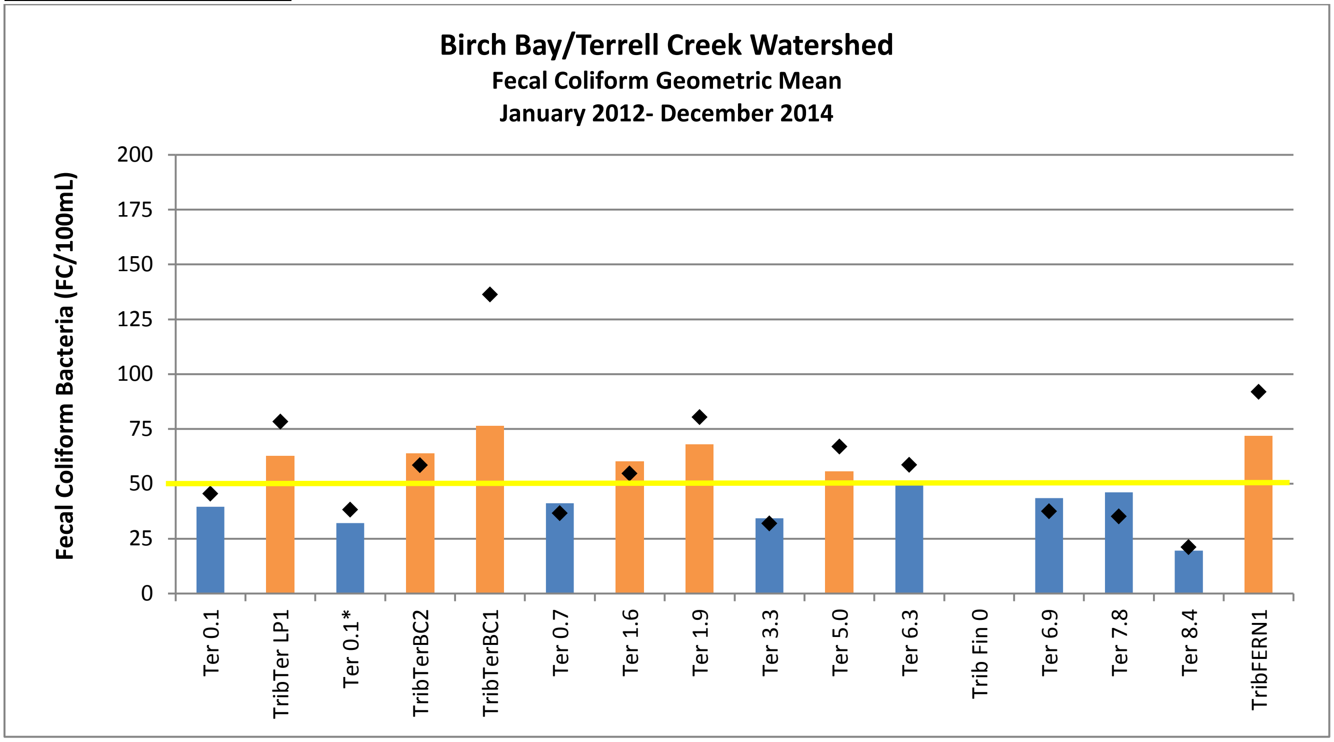

Figure 3. Fecal coliform geometric means for Terrell Creek sites for the period of January 2012 to December 2014. Bars indicate the geometric mean for a three year period and the black diamonds represent a one year geometric mean. Diamonds above the bars indicate increasing bacteria levels over the last year of the three year period. Orange bars indicate levels one to two times the standards and blue bars indicate levels meeting the geometric mean standard. No samples had been collected for site TribFin0 in 2014.

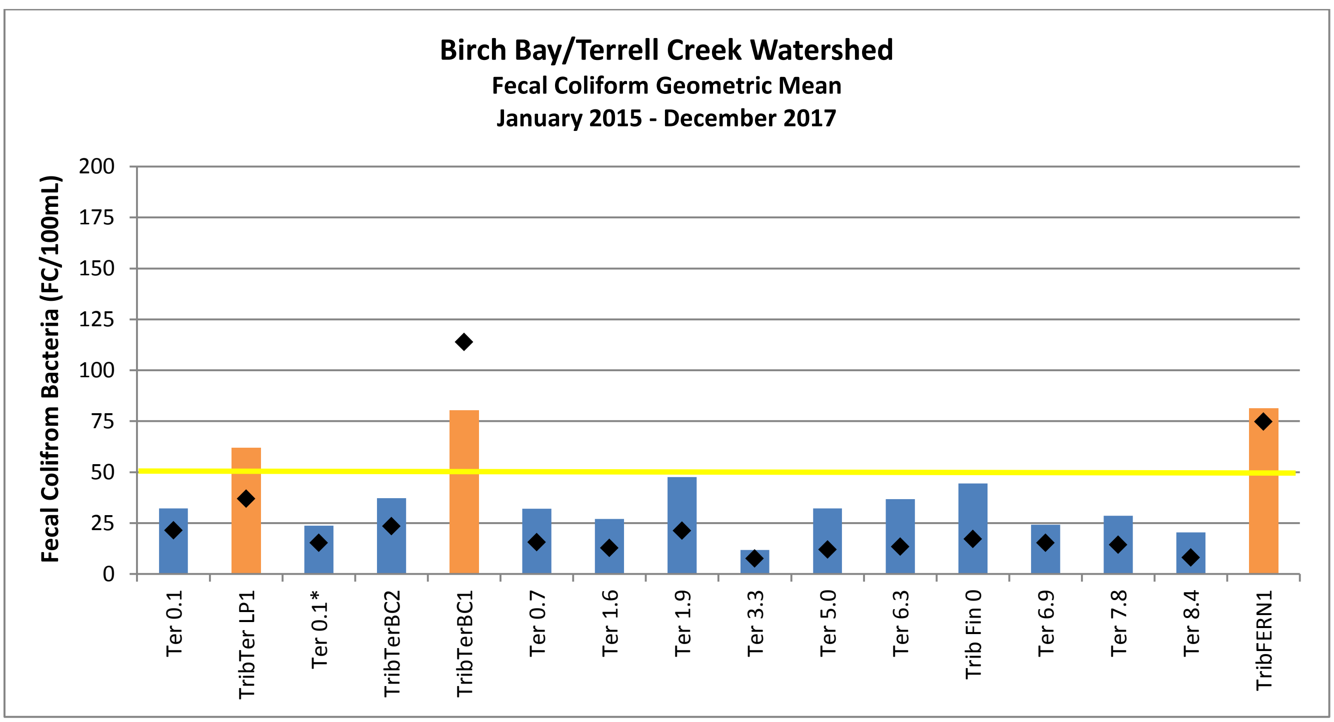

Figure 4. Fecal coliform geometric means for Terrell Creek sites for the period of January 2015 to December 2017. Bars indicate the geometric mean for a three year period and the black diamonds represent a one year geometric mean. Diamonds below the bars indicate decreasing bacteria levels over the last year of the three year period. Orange bars indicate levels one to two times the standards and blue bars indicate levels meeting the geometric mean standard.

Nooksack River

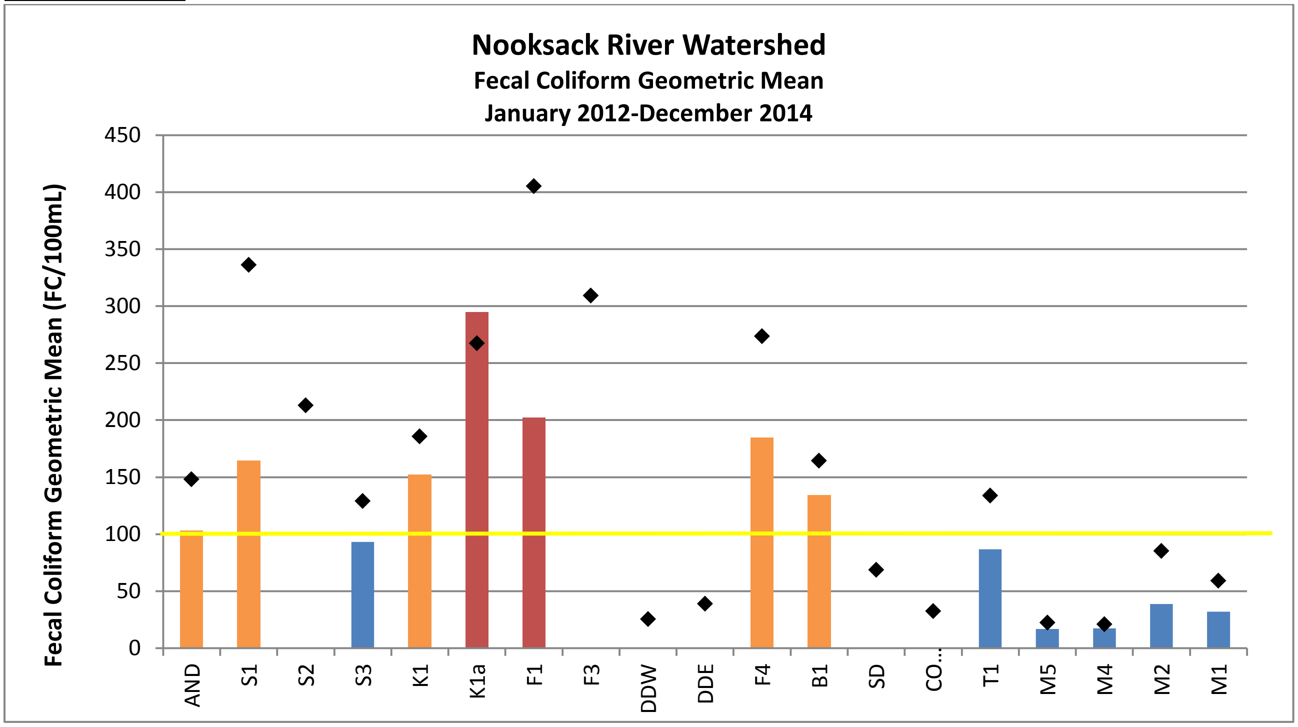

Figure 5. Fecal coliform geometric means for Nooksack River watershed sites for January 2012 to December 2014. Bars indicate the geometric mean for a three year period and the black diamonds represent a one year geometric mean. Diamonds above the bars indicate increasing bacteria levels over the last year of the three year period. Red bars indicate levels over two times the standards, orange bars indicate levels one to two times the standards, and blue bars indicate levels meeting the geometric mean standard. All sites without a bar did not have three years of data collected in 2014.

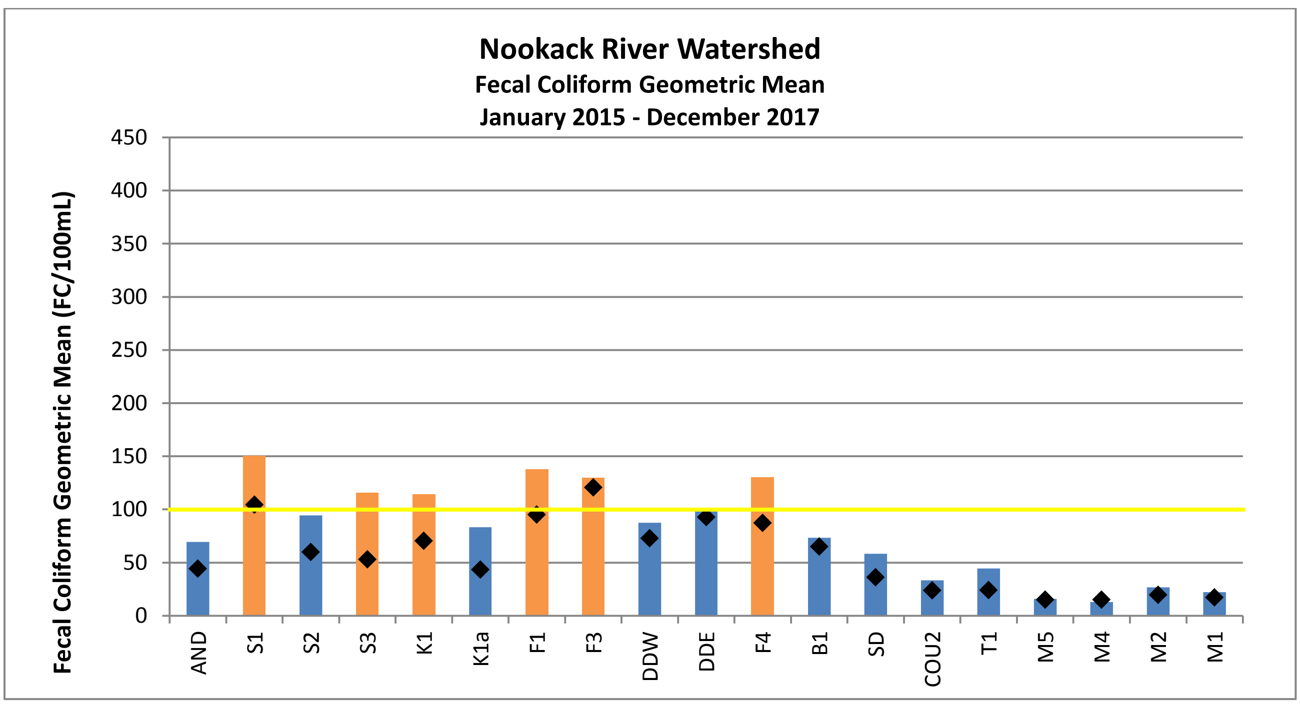

Figure 6. Fecal coliform geometric means for Nooksack River watershed sites for January 2015 to December 2017. Bars indicate the geometric mean for a three year period and the black diamonds represent a one year geometric mean. Diamonds below the bars indicate decreasing bacteria levels over the last year of the three year period. Red bars indicate levels over two times the standards, orange bars indicate levels one to two times the standards, and blue bars indicate levels meeting the geometric mean standard.

Birch Bay Coastal

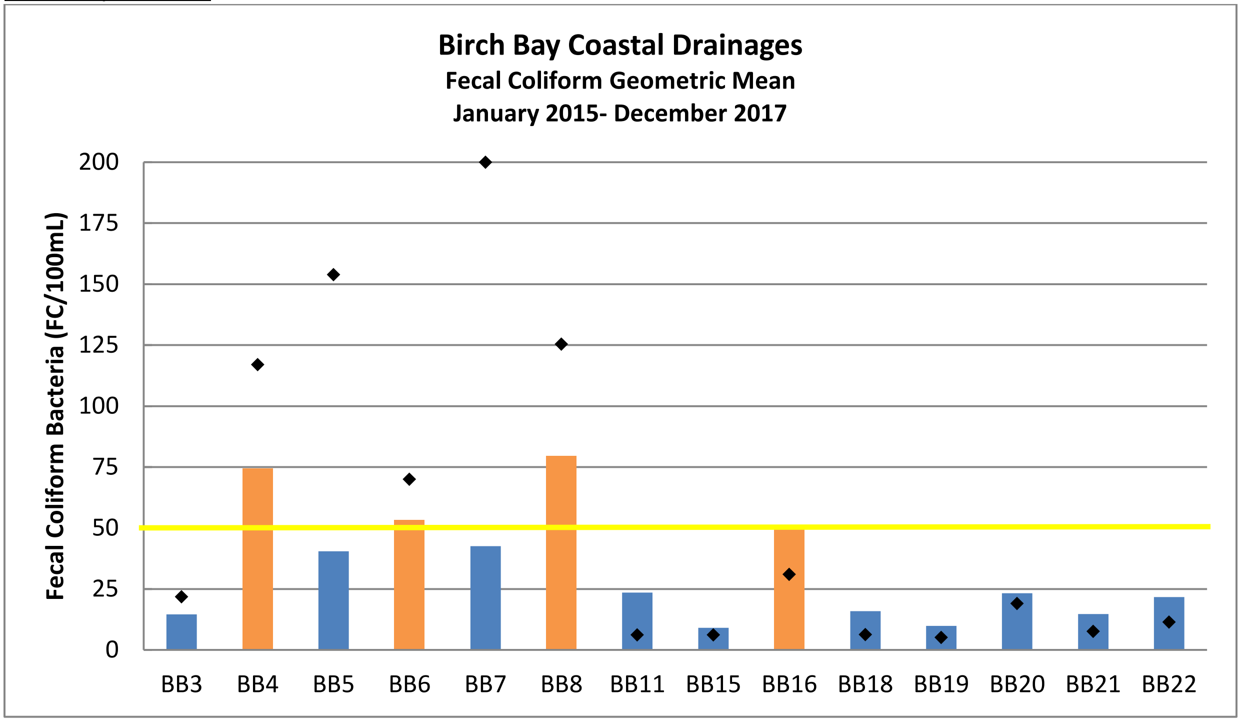

Figure 7. Fecal coliform geometric means for Birch Bay coastal drainages for the period of January 2015 to December 2017. Bars indicate the geometric mean for a three year period and the black diamonds represent a one year geometric mean. Diamonds above the bars indicate increasing bacteria levels over the last year of the three year period. Orange bars indicate levels one to two times the standards and blue bars indicate levels meeting the geometric mean standard.

Drayton Coastal

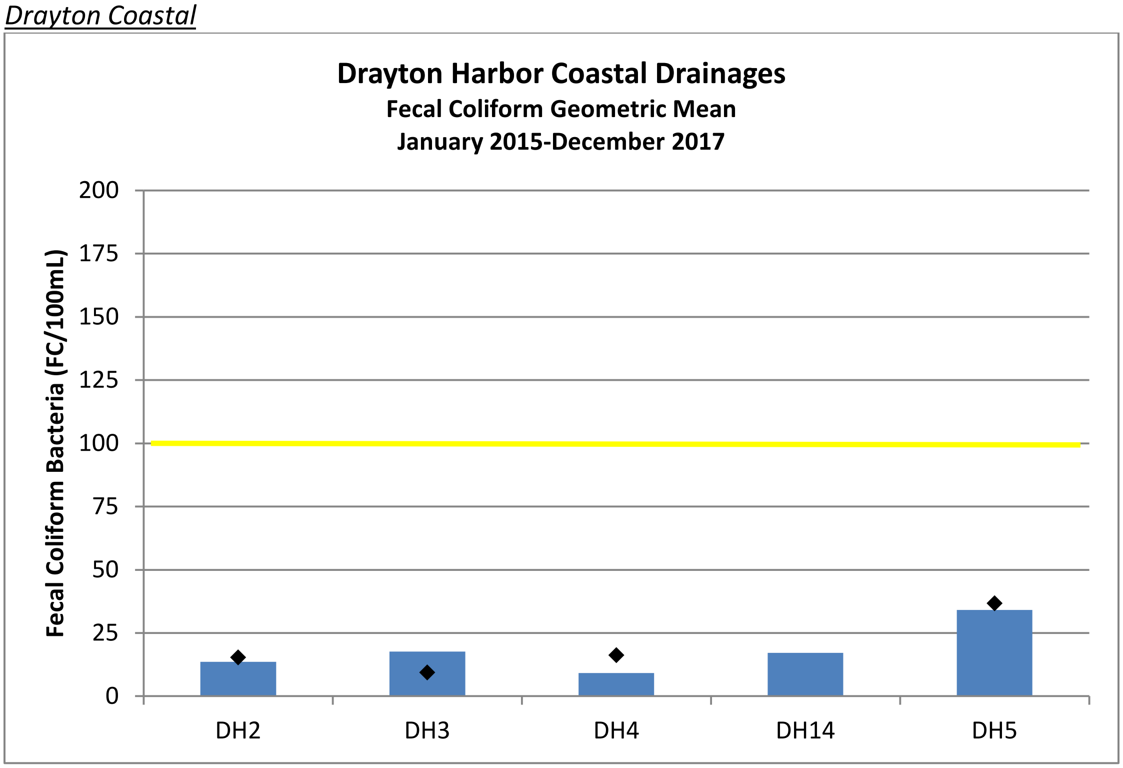

Figure 8. Fecal coliform geometric means for Drayton Harbor coastal drainages for the period of January 2015 to December 2017. Bars indicate the geometric mean for a three year period and the black diamonds represent a one year geometric mean. Diamonds above the bars indicate increasing bacteria levels over the last year of the three year period. Blue bars indicate levels meeting the geometric mean standard.

Chuckanut Coastal

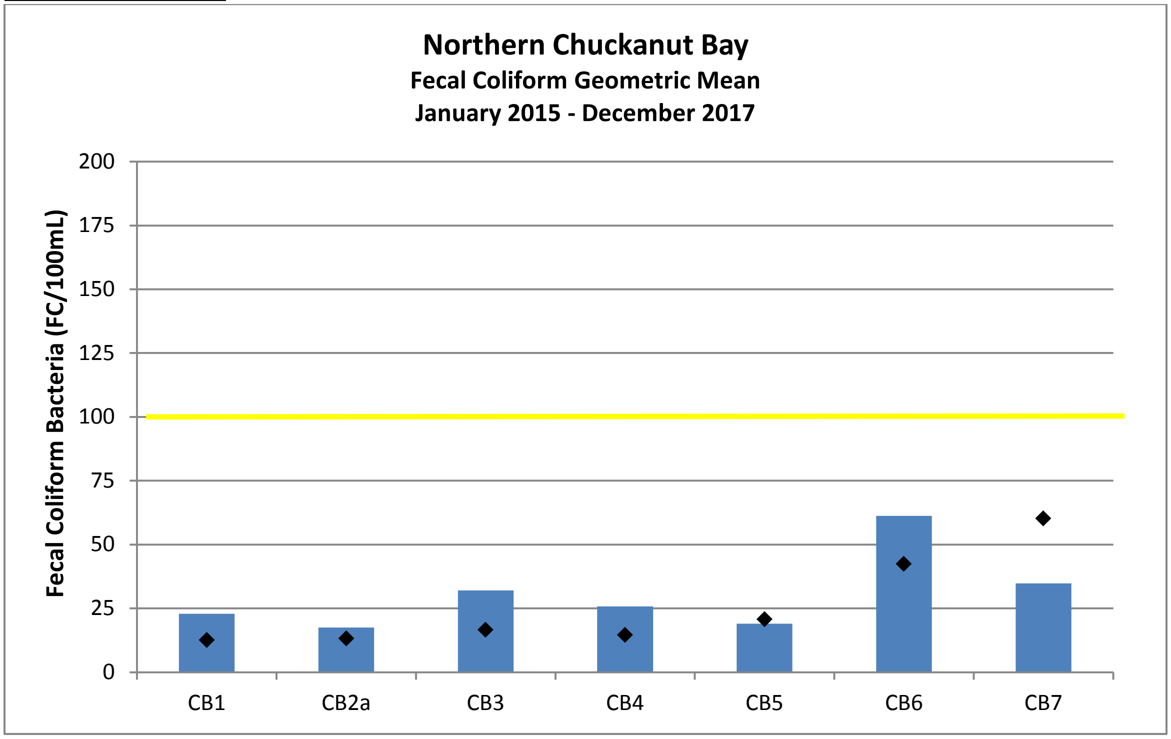

Figure 9. Fecal coliform geometric means for Chuckanut Bay coastal drainages for the period of January 2015 to December 2017. Bars indicate the geometric mean for a three year period and the black diamonds represent a one year geometric mean. Diamonds above the bars indicate increasing bacteria levels over the last year of the three year period. Blue bars indicate levels meeting the geometric mean standard.

Water Pollution Clean Up Programs

Through the enhanced PIC program, Whatcom County watersheds discharging to marine waters are ranked and drainage-specific water quality improvement strategies are developed and implemented through community outreach and engagement for the highest priority areas. Each year staff determines the extent of priority areas that can be targeted based upon staff and other resource availability. Whatcom County, in partnership with the Whatcom Conservation District, work with landowners to identify and implement community solutions to elevated fecal coliform bacteria levels. Through community engagement, technical assistance, and incentive programs a community sense of ownership and stewardship is developed for neighborhood creeks. A regulatory backstop is utilized as a final tool when elevated fecal coliform levels remain in an area and where landowners have selected not to participate in the voluntary program and there are egregious or repeated violations of regulations.

Once high ranking drainages are identified through routine monitoring, bracketed monitoring is needed to help track down hot spots in the drainage and identify stretches of the creek to be targeted for outreach, technical assistance, and financial assistance programs. Developing a framework for improving water quality is most effective when hot spots or areas of consistently high bacteria levels can be identified within the neighborhood creek. Microbial source tracking and monitoring surrogate parameters may be used to assist landowners in developing a greater understanding of the bacteria sources within their neighborhood creek and where to focus best management practices. The use of these techniques will be limited to areas where very specific questions about bacteria sources have been identified.

When landowners are asked to change their practices to improve water quality, it is important to make these changes as easy as possible to implement. Two key resources that assist landowners to implement new farm management practices and repairs to OSS are technical and financial assistance. Agricultural Best Management Practices (BMP) technical assistance is provided by the Whatcom Conservation District. A small grants (or cost-share) program for agricultural BMPs is available to landowners. Rebates for septic system operation and maintenance practices and low-interest loans for landowners replacing or making repairs to their OSS are also available.

Ranking Purpose, Criteria, and Methods

Through this program, watersheds in Whatcom County that discharge to marine waters have been ranked by order of priority for Whatcom County water quality improvement programs. Drainage-specific water quality improvement strategies are developed and implemented for the highest priority drainages first.

The following ranking methods are an adaptation of the ranking methods used for the Kitsap County PIC Program (KCHD 2011). They consider water quality status (short and moderate-term) and potential public health threats. The application of the ranking methods to the routine monitoring stations identifies priority areas for water quality improvement projects. Some routine monitoring sites did not have three years of data as of December 2017 and thus were not included in the 2017 ranking process.

The water quality status category evaluated waterbodies based upon the most current water quality data available. Water quality data were evaluated for the most recent calendar year and the previous three years (Appendix A). The data objective was a minimum of monthly sampling; however, some sites were not able to be sampled every month due to no or low flow conditions. Data for each site were compared to applicable standards for that waterbody.

The criteria and associated scores are described below for the five categories analyzed: annual geometric mean, annual 90th percentile, three year geometric mean, three year geometric mean for the dry season, and three year geometric mean for the wet season. Additionally, each site was scored for current status of the shellfish growing area to which the waterbody discharges. For each monitoring site, points were assigned for each of these five categories and the sum of the five scores was multiplied by the shellfish growing area score. The scores for each monitoring site are included in Appendix C.

<u>Scoring Formula:</u>
Total Water Quality Score = (12month GM score + 12month %score + 3year GM score + 3yeardry GMscore + 3yearwet GMscore)* shellfish growing area score

<u>Twelve Month (2017) Geometric Mean:</u>
- Creek meets the standard for FC geometric mean during most recent calendar year – 0 points.
- Creek 2017 geometric mean is 1 to 5 times the standard – 2 points.
- Creek 2017 geometric mean is over 5 times the standard – 4 points.

<u>Twelve Month (2017) 90th Percentile:</u>
- Creek meets the standard for FC 90th percentile during most recent calendar year – 0 points.
- Creek 2017 90th percentile is 1 to 5 times the standard – 2 points.
- Creek 2017 90th percentile is over 5 times the standard – 4 points.

<u>Three Year Geometric Mean:</u>
- Creek FC three-year geometric mean meets the standard– 0 points.
- Creek FC three-year geometric mean is 1 to 2 times the standard – 1 point.
- Creek FC three-year geometric mean is 2 to 5 times the standard – 2 points.
- Creek FC three-year geometric mean is 5 to 10 times the standard – 4 points.

- Creek FC three-year geometric mean is greater than 10 times the standard – 6 points.

Three Year Geometric Mean for Dry Season:
- Creek FC three-year dry season geometric mean (May-September) meets standard– 0 points.
- Creek FC three-year dry season geometric mean (May-September) is 1 to 2 times standard – 1 point.
- Creek FC three-year dry season geometric mean (May-September) is 2 to 5 times standard – 2 points.
- Creek FC three-year dry season geometric mean (May-September) is 5 to 10 times standard – 4 points.
- Creek FC three-year dry season geometric mean (May-September) is greater than 10 times standard – 6 points.

Three Year Geometric Mean for Wet Season:
- Creek FC three-year wet season geometric mean (October- April) meets standard– 0 points.
- Creek FC three-year wet season geometric mean (October- April) is 1 to 2 times standard – 1 point.
- Creek FC three-year wet season geometric mean (October- April) is 2 to 5 times standard – 2 points.
- Creek FC three-year wet season geometric mean (October- April) is 5 to 10 times standard – 4 points.
- Creek FC three-year wet season geometric mean (October- April) is greater than 10 times standard – 6 points.

Shellfish Growing Area Score:
- Recreational, tribal, and commercial shellfish growing area with no advisory or closure – 1 point.
- Closed recreational shellfish growing area – 2 points.
- Threatened tribal or commercial shellfish growing area – 2.5 points.
- Closed or conditionally approved tribal or commercial shellfish growing area – 3 points.

Ranking Results

The water quality scores were calculated for all monitoring stations that had three years of data (Appendix C). Higher points indicate higher levels of bacterial impairment. The top five ranked drainages for Whatcom County water quality improvement projects based upon 2017 data and the above described ranking criteria and scores are:

1. CA14c- California Creek (33 points)
2. CA9- California Creek (24 points)
3. TribDak3- Dakota Creek (24 points)
4. S1- Scott Ditch (24 points)
5. F3- Fishtrap Creek/Double Ditch (21 points)

Discussion

Drayton Harbor

Three of 31 routine sites (CA14c, CA9, TribDak3) in the Drayton Harbor watershed ranked in the top five priority areas for the PIC Program. The Dakota and California Creek watersheds are the two major areas discharging to Drayton Harbor. While 810 acres of shellfish growing area were upgraded in Drayton Harbor in 2016, a large portion of the harbor remains closed to harvesting. In 2017, the marine sites near the tidal channels for Dakota and California Creek had “of Concern” status based upon shellfish growing area classification standards. This was an improvement for the Dakota Creek station, however, still an indicator of impact to marine waters by creek water quality under certain environmental conditions.

CA14c and CA9 are seasonal creeks located in the upper portion of the California Creek watershed above Cal6.5. This area was identified as being in most need of fecal coliform reductions through the *Draft Drayton Harbor Watershed Fecal Coliform Total Maximum Daily Load: Water Quality Improvement Report* (Hood and Mathieu

2010). CA14 has shown consistently high bacteria levels since 2006 when the creek was first monitored. Bacteria levels appear to be improving over the past six months. The 2017 geometric mean was 130 cfu/100mL in comparison to the three year geometric mean of 235 cfu/100mL. The highest bacteria levels in this drainage continue to be observed during the dry season (Appendix A). The 2017 geometric mean for CA9 was 180 cfu/100mL in comparison to the three year geometric mean of 190 cfu/100mL. Fifty percent of the 2017 samples exceeded 200FC/100mL at each of these sites.

TribDak3 is a perennial creek located in the lower portion of the Dakota Creek watershed. TribDak3 had a 2017 geometric mean of 150 cfu/100mL in comparison to the three year geometric mean of 170 cfu/100mL. The highest bacteria levels in this drainage continue to be observed during the dry season. Over forty percent of the samples in 2017 exceeded 200FC/100mL.

Nooksack River Watershed

Two of 19 routine sites (F3, S1) in the Nooksack River watershed ranked in the top five priority areas for the PIC Program. Although water quality improvements have been observed throughout the Nooksack River watershed over the past three years, several sites are still not meeting standards for fecal coliform and the Portage Bay shellfish growing areas continue to show impacts during large rain events and have season harvesting restrictions.

Double-Ditch/Pepin Creek (F3) is a perennial creek located in the Fishtrap watershed on both sides of the international boundary. Fishtrap Creek discharges into the Nooksack River between Lynden and Ferndale and is one of the two largest creeks in the Lower Nooksack system. F3 had a 2017 geometric mean of 120 cfu/100mL in comparison to the three year geometric mean of 130 cfu/100mL. About forty percent of the samples in 2017 exceeded 200FC/100mL. Scott Ditch (S1) is a perennial creek that discharges into the Nooksack River between Lynden and Ferndale. The 2017 geometric mean was 105 cfu/100mL in comparison to the three year geometric mean of 150 cfu/100mL. Over thirty percent of the samples collected at S1 in 2017 exceeded 200FC/100mL.

Other Areas

Three areas with emerging issues will be added to the routine monitoring program this year, coastal discharges on the east side of Drayton Harbor, Jordan Creek, and Sumas River. All of these watershed areas have demonstrated elevated bacteria levels that are impacting shellfish growing areas or Canadian waters.

Recommendations

The following are recommendations for 2018 County water quality improvement programs in the priority areas described above (Figure 10).

- Priority Area 1- Upper California Creek Watershed: There are several tributaries with elevated bacteria levels that are located in the upper California Creek watershed. Outreach to landowners and opportunities for technical and financial assistance to identify and address non-dairy livestock and septic issues in these areas should continue.
    - Continue enhanced water quality monitoring and landowner communication in Brown-Malloy drainage (CA14c). This is a seasonal creek located in the upper California Creek watershed and is generally dry for 3-4 months of the year. Work has been underway in this drainage for several years and significant improvements have been observed in the past twelve months. While this area should remain a priority, a greater priority should be placed on high ranking perennial creeks.
    - Continue enhanced water quality monitoring in the Fox Road drainage (CA9) to identify hot spots and potential sources of bacteria. This is a smaller creek with low to no flow during the dry season. Outreach to landowners with potential bacteria sources should be expanded in this drainage.

- Priority Area 2- In 2014, PIC work began in the Lower Dakota drainage (TribDak2, TribDak3, TribDak4). Water quality improvements have been observed in all three drainages with TribDak4 now meeting the fecal coliform geometric mean standard. Work has included enhanced monitoring, technical and financial assistance for non-dairy livestock management and septic systems. While water quality has improved substantially, continued identification and reduction of bacteria sources are needed in TribDak3 in particular. Enhanced monitoring should continue in 2018 as well as additional outreach and follow up with landowners.
- Priority Area 3- Water quality improvements have been observed in the Scott Ditch watershed over the past three years, however levels continue to fail water quality standards. WCPW will coordinate with the South Lynden Watershed Improvement District to identify opportunities to support water quality monitoring and improvement efforts.
- Priority Area 4- Water quality improvements have been observed in the Fishtrap Creek watershed over the past three years, however levels continue to fail water quality standards. WCPW and the WCD will continue partnering with the North Lynden Watershed Improvement District to conduct water quality monitoring and support improvement efforts. Communication with Canadian partners regarding water quality patterns will continue and opportunities to share resources and successful methods for improving water quality will be further explored and pursued.
- Additional Areas- Three new areas will be added to the PIC Program in 2018. These are based upon water quality trends in marine areas and cross-boundary waters.
    - Drayton Urban- The active commercial shellfish growing area in Drayton Harbor is located on the eastern side of the harbor. There are several seasonal drainages that discharge directly to the east side of Drayton Harbor. Elevated bacteria levels have been observed in these areas in previous studies. Expanded monitoring will provide information to assist work with the City of Blaine and Port of Bellingham in the urban portions of this watershed.
    - Jordan Creek- Jordan Creek discharges into the northern portion of Lummi Bay, another critical shellfish growing area for the Lummi Nation. Increasing bacteria levels have been observed at the DOH marine site 286 in Lummi Bay, near the mouth of Jordan Creek. A new PIC focus area is being established in the Jordan Creek watershed to reduce bacteria levels prior to a downgrade in the shellfish growing area.
    - Sumas River- The Sumas River flows to the north into Canada and the Fraser River basin. Agriculture and rural residential are the dominant land uses in Whatcom County adjacent to the international border. Elevated bacteria levels have been observed in this area through source identification monitoring and previous studies. A TMDL for bacteria in Johnson Creek (a subwatershed of the Sumas) was established in 2000 (Butkus et al. 2000). In order to support cross-border work in Drayton Harbor, Bertrand Creek, and Fishtrap Creek, routine monitoring sites will be established in the Sumas watershed in 2018.

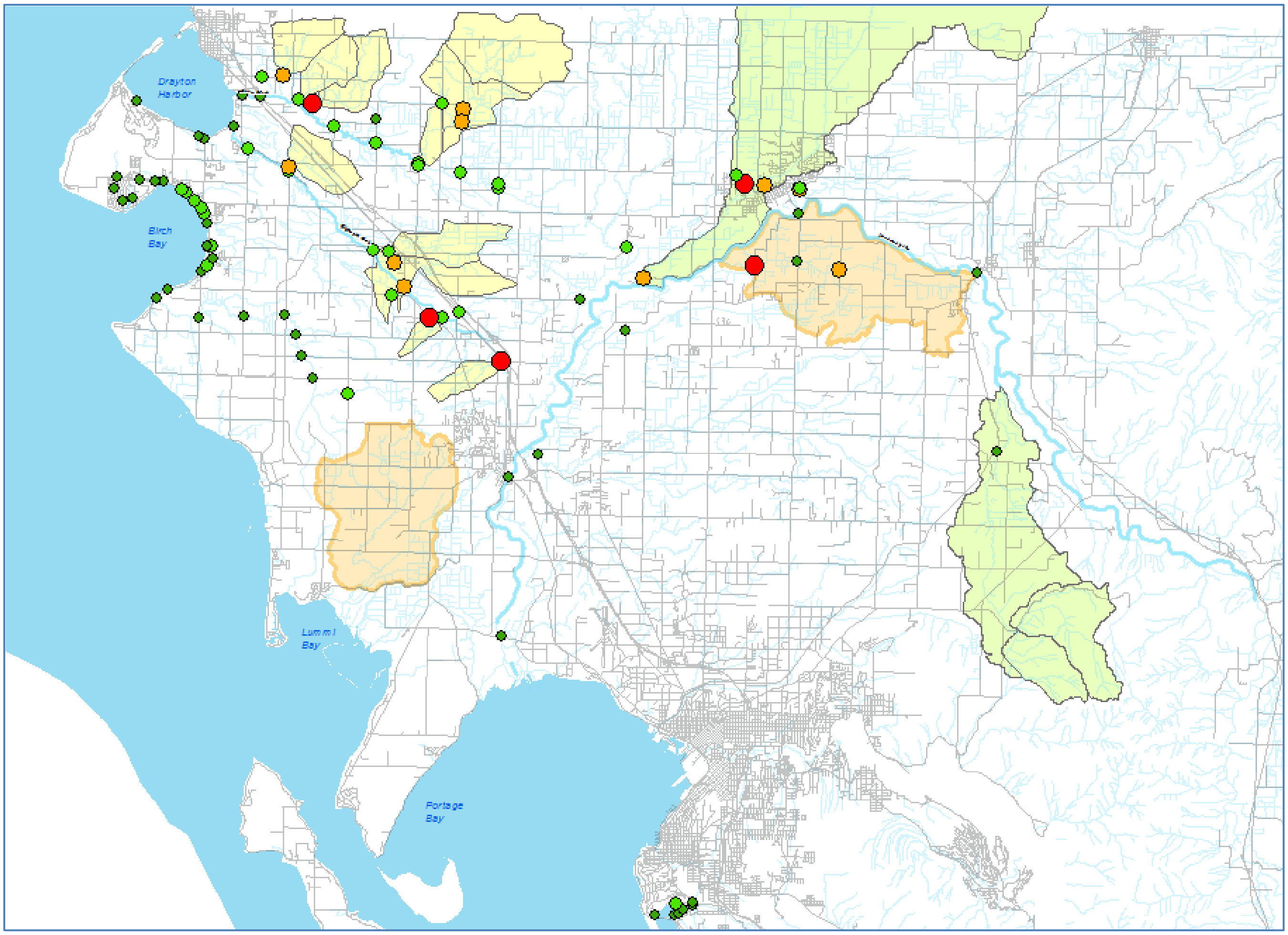

Figure 10. This map illustrates ranked drainages for the Whatcom County Pollution Identification and Control (PIC) Program for 2018. The water quality scores are reflective of calculations included in Appendices A and C. Red dots indicate highest priority drainages (water quality score ≥ 20), orange dot indicate moderate priority drainages (water quality score 15-19), yellow dot indicates low priority (water quality score 6-14), and green dot indicates lowest priority (water quality score 0-5). Drainages shaded in light yellow are existing Drayton Harbor watershed focus areas, drainages shaded in light green are existing Nooksack River watershed focus areas, and drainages shaded in orange are new priority areas to be considered for 2018.

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Appendix A: Water Quality Review by Monitoring Station

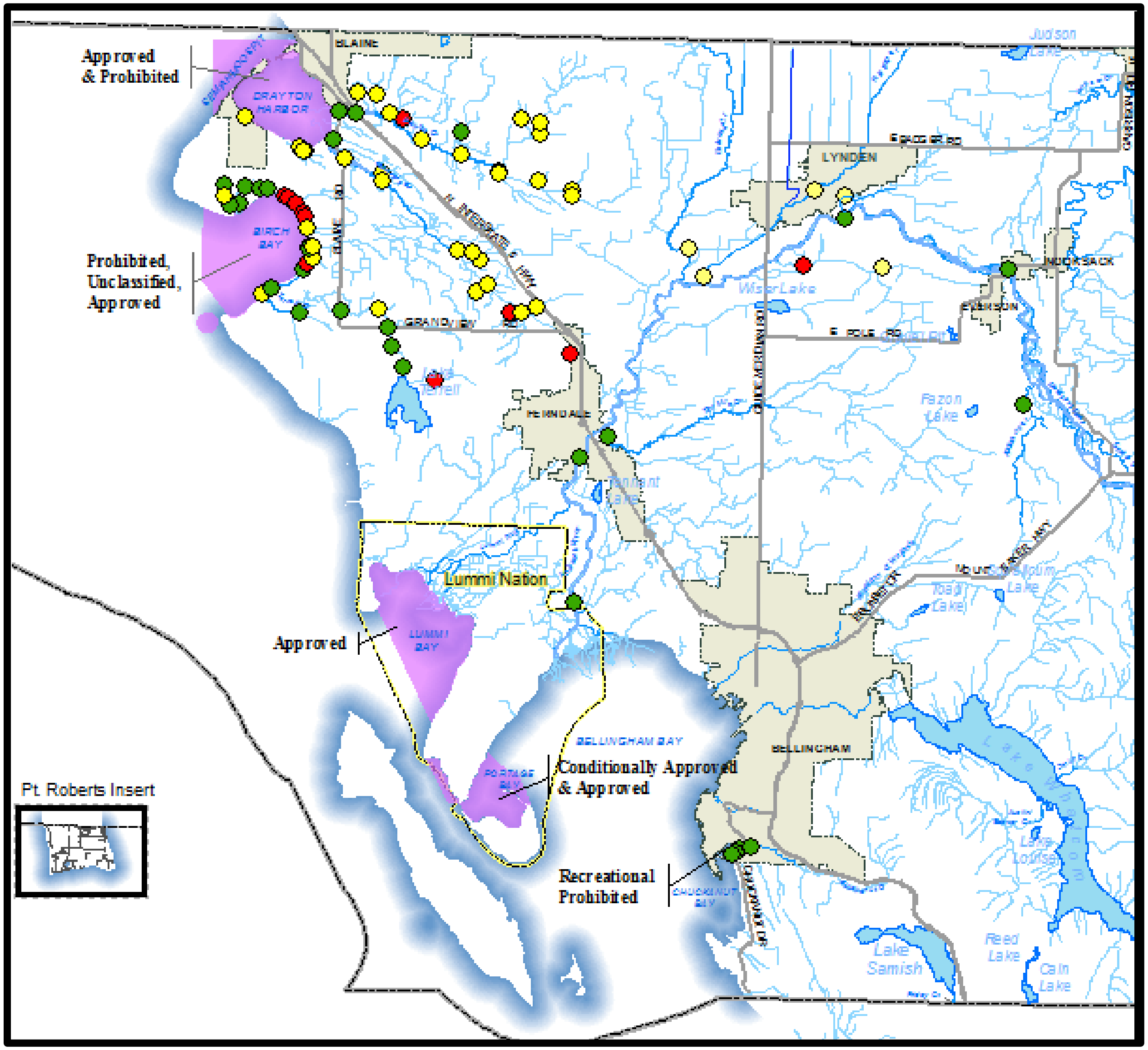
Project Area	Station	2017 #	2017 GMV	2017 %>200*	2017 Meets Std?	2015-2017 GMV All	2015-2017 GMV Wet	2015-2017 GMV Dry
BB Coastal	BB7	5	418.1	80.0	Exceeds Both	47.6	34.1	98.0
BB Coastal	BB5	5	153.8	60.0	Exceeds Both	40.5	21.8	188.1
BB Coastal	BB8	11	125.4	54.5	Exceeds Both	79.5	101.3	31.8
BB Coastal	BB4	6	117.0	50.0	Exceeds Both	74.5	50.3	198.8
BB Coastal	BB6	8	70.0	50.0	Exceeds Both	52.3	39.4	50.2
BB Coastal	BB3	7	21.8	14.3	Exceeds One	14.6	18.8	7.9
BB Coastal	BB21	9	7.5	22.2	Exceeds One	14.8	18.1	3.7
BB Coastal	BB16	9	31.0	0.0	Meets Both	50.3	56.4	26.7
BB Coastal	BB20	9	19.1	0.0	Meets Both	23.3	21.0	35.1
BB Coastal	BB22	8	11.4	0.0	Meets Both	21.7	24.9	9.1
BB Coastal	BB15	7	6.2	0.0	Meets Both	9.1	8.8	11.6
BB Coastal	BB11	4	6.2	0.0	Meets Both	23.6	15.6	101.8
BB Coastal	BB19	5	5.0	0.0	Meets Both	9.9	9.9	
California	CA9	10	182.2	50.0	Exceeds Both	187.9	167.1	240.4
California	CA14c	8	130.9	50.0	Exceeds Both	233.7	188.3	986.8
California	Cal 6.2	12	84.0	25.0	Exceeds One	101.9	59.5	216.7
California	Cal 7.5	10	74.6	40.0	Exceeds One	75.0	57.0	126.6
California	Cal 5.0	12	74.0	33.3	Exceeds One	83.9	54.3	154.3
California	CA8	9	73.5	11.1	Exceeds One	58.1	46.3	128.7
California	CA16	12	72.3	16.7	Exceeds One	100.4	43.4	389.9
California	CA1	12	61.3	25.0	Exceeds One	113.0	50.0	354.7
California	Cal 1.9	12	49.4	25.0	Exceeds One	62.3	46.3	94.2
California	Cal 0.8	12	49.1	16.7	Exceeds One	48.3	39.9	64.1
California	CA6	12	47.4	41.7	Exceeds One	62.3	44.2	100.6
California	CA15	9	41.6	11.1	Exceeds One	34.7	32.6	64.0
California	Cal 0.1	12	15.4	8.3	Meets Both	23.7	23.2	24.4
Coastal	CB7	14	60.2	21.4	Exceeds One	34.8	21.1	59.1
Coastal	CB6	13	42.3	15.4	Exceeds One	61.2	42.3	151.3
Coastal	DH5	10	36.7	19.8	Exceeds One	34.2	19.8	272.0
Coastal	DH4	7	16.2	14.3	Exceeds One	9.1	5.7	48.4
Coastal	DH3	7	9.3	14.3	Exceeds One	17.6	11.2	60.8
Coastal	CB5	13	20.7	0.0	Meets Both	19.0	12.2	49.7
Coastal	CB3	21	16.5	0.0	Meets Both	32.0	16.6	61.5
Coastal	DH2	10	15.3	10.0	Meets Both	13.6	8.5	79.9
Coastal	CB4	21	14.6	0.0	Meets Both	25.8	17.6	37.8
Coastal	CB2a	21	13.0	0.0	Meets Both	17.5	9.7	30.8
Coastal	CB1	14	12.5	0.0	Meets Both	22.9	7.8	295.8
Dakota	TribDak3	12	152.1	41.7	Exceeds Both	167.3	109.5	303.0

		2017				2015-2017 GMV		
Project Area	Station	#	GMV	%>200*	2017 Meets Std?	All	Wet	Dry
Dakota	TribDak4	12	88.9	25.0	Exceeds One	88.4	61.7	146.1
Dakota	TribDak2	12	81.4	25.0	Exceeds One	120.7	70.8	254.3
Dakota	TribDakN1	8	81.0	12.5	Exceeds One	50.7	47.0	81.3
Dakota	Dak 3.1	12	80.1	25.0	Exceeds One	66.0	44.3	115.3
Dakota	NFDak0.1	12	71.4	25.0	Exceeds One	56.2	51.0	64.3
Dakota	NFDak2.5	12	70.6	25.0	Exceeds One	107.4	57.2	276.8
Dakota	TribDakN2	12	68.8	33.3	Exceeds One	112.2	45.8	393.3
Dakota	TribDakS1	10	51.9	40.0	Exceeds One	55.8	30.8	182.7
Dakota	SFDak2.2	10	47.0	20.0	Exceeds One	56.2	39.9	102.1
Dakota	Dak 6.8	12	43.3	16.7	Exceeds One	48.8	40.5	63.4
Dakota	TribDakS2	10	39.9	30.0	Exceeds One	60.6	35.8	225.3
Dakota	SFDak0.2	12	33.6	16.7	Exceeds One	44.0	29.5	77.0
Dakota	TribDak5	12	27.9	0.0	Meets Both	55.7	31.5	124.1
Dakota	Dak 0.6	12	25.0	8.3	Meets Both	36.4	44.4	27.7
Dakota	Dak 0.1	12	17.9	8.3	Meets Both	27.4	27.3	27.6
Portage	F3	23	120.7	39.1	Exceeds Both	129.8	117.4	158.5
Portage	S1	25	104.3	32.0	Exceeds Both	150.7	124.7	205.6
Portage	DDE	22	98.1	31.8	Exceeds One	103.6	94.7	122.3
Portage	F1	25	95.2	28.0	Exceeds One	137.7	107.9	193.6
Portage	F4	24	87.2	16.7	Exceeds One	130.5	89.6	221.1
Portage	DDW	23	75.4	21.7	Exceeds One	88.8	86.4	92.5
Portage	K1	25	70.5	20.0	Exceeds One	114.5	103.8	131.9
Portage	B1	25	65.0	24.0	Exceeds One	73.4	62.9	91.5
Portage	S3	24	59.9	12.5	Exceeds One	115.8	102.1	138.1
Portage	K1a	24	43.5	16.7	Exceeds One	83.4	55.2	144.3
Portage	S2	24	59.9	8.3	Meets Both	94.5	79.9	120.5
Portage	AND	25	44.5	8.0	Meets Both	69.5	43.2	137.4
Portage	SD	22	36.2	4.5	Meets Both	58.4	39.6	120.3
Portage	T1	25	24.0	8.0	Meets Both	44.3	23.9	107.7
Portage	COU2	23	23.8	8.7	Meets Both	33.3	19.3	71.7
Portage	M2	25	19.6	8.0	Meets Both	26.7	25.4	28.7
Portage	M1	25	17.3	8.0	Meets Both	22.2	22.7	21.6
Portage	M5	25	15.1	8.0	Meets Both	15.8	8.1	41.2
Portage	M4	25	15.1	4.0	Meets Both	12.9	7.8	27.1
Terrell	TribTerBC1	12	113.9	66.7	Exceeds Both	80.4	69.2	257.8
Terrell	TribFERN1	12	74.8	50.0	Exceeds Both	81.3	69.9	214.0
Terrell	TribTerLP1	21	36.9	23.8	Exceeds One	61.8	18.0	259.0
Terrell	TribTerBC2	14	23.4	21.4	Exceeds One	37.2	32.6	89.8
Terrell	Ter1.9	21	21.2	19.0	Exceeds One	47.5	19.4	158.5
Terrell	Ter6.3	15	13.4	13.3	Exceeds One	36.8	30.6	75.8

		2017				2015-2017 GMV		
Project Area	Station	#	GMV	%>200*	2017 Meets Std?	All	Wet	Dry
Terrell	Ter0.1	21	21.4	9.5	Meets Both	32.2	31.2	34.5
Terrell	Ter0.7	21	15.7	4.8	Meets Both	32.0	32.7	33.1
Terrell	Ter0.1*	21	15.4	9.5	Meets Both	23.8	29.1	18.3
Terrell	Ter6.9	18	15.3	5.6	Meets Both	24.3	16.4	69.9
Terrell	Ter7.8	14	14.4	0.0	Meets Both	28.6	15.7	164.1
Terrell	Ter1.6	20	12.9	10.0	Meets Both	27.0	16.9	51.4
Terrell	Ter5.0	15	12.0	6.7	Meets Both	32.1	24.4	80.1
Terrell	Ter8.4	13	8.1	0.0	Meets Both	20.4	12.4	76.0
Terrell	Ter3.3	14	7.7	0.0	Meets Both	11.8	10.2	20.8

* Greater than 100FC/100mL in Birch Bay and Terrell Creek.

Appendix B: Whatcom County 2017 Fecal Coliform Levels and Shellfish Growing Area Status Map



This map illustrates 2017 water quality status for sites sampled through the County's routine monitoring program. Red dots indicate fecal coliform results exceed both parts of the water quality standard, yellow dots indicate results exceed one part of the standard, and green dots indicate results meet both parts of the water quality standard. Areas highlighted in purple are shellfish growing areas monitored by the Washington State Department of Health.

Appendix C: Water Quality Scores by Station

Stream	Station	12 Month GM	12 Month % > 200	3 Year GM	3 Year Wet Season GM	3 Year Dry Season GM	Shellfish Area Multiplier*	Total Score**	Comments
California	CA14c	2	2	2	1	4	3	33	WC Focus Area, Seasonal, Upper California Creek
California	CA9	2	2	1	1	2	3	24	WC Focus Area, Seasonal, Upper California Creek
Dakota	TribDak3	2	2	1	1	2	3	24	WC Focus Area, Perennial
Portage	S1	2	2	1	1	2	3	24	SLWID, Previous DOE focus area
Portage	F3	2	2	1	1	1	3	21	WC Focus Area, NLWID, Lynden
California	CA16	0	2	1	0	2	3	15	WC Focus Area, Small Perennial
California	Cal 6.2	0	2	1	0	2	3	15	
California	CA1	0	2	1	0	2	3	15	WC Focus Area, Perennial
Dakota	TribDakN2	0	2	1	0	2	3	15	WC Focus Area, Perennial
Dakota	TribDak2	0	2	1	0	2	3	15	WC Focus Area, Perennial
Dakota	NFDak2.5	0	2	1	0	2	3	15	WC Focus Area, Low Flow Dry Season
Portage	F4	0	2	1	0	2	3	15	WC Focus Area, NLWID, Lynden
Portage	F1	0	2	1	1	1	3	15	WC Focus Area, NLWID, Lynden
Portage	K1	0	2	1	1	1	3	15	SLWID, DOE focus area
Portage	S3	0	2	1	1	1	3	15	SLWID, Previous DOE focus area
Dakota	TribDakS2	0	2	0	0	2	3	12	
Portage	DDE	0	2	1	0	1	3	12	WC Focus Area, NLWID, Lynden
Terrell	TribTerBC1	2	4	1	1	4	1	12	
BB Coastal	BB8	2	4	1	2	0	1	9	BBWARM, Seasonal
BB Coastal	BB7	4	4	0	0	1	1	9	
California	Cal 5.0	0	2	0	0	1	3	9	
California	CA8	0	2	0	0	1	3	9	
California	Cal 7.5	0	2	0	0	1	3	9	
California	CA6	0	2	0	0	1	3	9	WC Focus Area, Perennial
Dakota	TribDak4	0	2	0	0	1	3	9	WC Focus Area, Perennial

Stream	Station	12 Month GM	12 Month % > 200	3 Year GM	3 Year Wet Season GM	3 Year Dry Season GM	Shellfish Area Multiplier*	Total Score**	Comments
Dakota	SFDak2.2	0	2	0	0	1	3	9	
Dakota	TribDakS1	0	2	0	0	1	3	9	
Dakota	Dak 3.1	0	2	0	0	1	3	9	
Portage	K1a	0	2	0	0	1	3	9	
BB Coastal	BB4	2	2	1	1	2	1	8	
BB Coastal	BB5	2	4	0	0	2	1	8	
Terrell	TribFERN1	2	2	1	1	2	1	8	
Terrell	TribTerLP1	0	2	1	0	4	1	7	
BB Coastal	BB6	2	2	1	1	0	1	6	
California	CA15	0	2	0	0	0	3	6	
California	Cal 1.9	0	2	0	0	0	3	6	
California	Cal 0.8	0	2	0	0	0	3	6	
Coastal	CB6	0	2	0	0	1	2	6	
Dakota	TribDak1	0	2	0	0	0	3	6	
Dakota	TribDakN1	0	2	0	0	0	3	6	
Dakota	Dak 6.8	0	2	0	0	0	3	6	
Dakota	NFDak0.1	0	2	0	0	0	3	6	
Dakota	SFDak0.2	0	2	0	0	0	3	6	
Portage	B1	0	2	0	0	0	3	6	Previous DOE focus area, Bertrand WID
Portage	DDW	0	2	0	0	0	3	6	WC Focus Area, NLWID, Lynden
Coastal	DH5	0	2	0	0	2	1	4	
Coastal	CB1	0	0	0	0	2	2	4	
Coastal	CB7	0	2	0	0	0	2	4	
Terrell	Ter1.9	0	2	0	0	2	1	4	
Dakota	TribDak5	0	0	0	0	1	3	3	
Portage	S2	0	0	0	0	1	3	3	SLWID, Previous DOE focus area
Portage	AND	0	0	0	0	1	3	3	WC Focus Area

Stream	Station	12 Month GM	12 Month % > 200	3 Year GM	3 Year Wet Season GM	3 Year Dry Season GM	Shellfish Area Multiplier*	Total Score**	Comments
Portage	T1	0	0	0	0	1	3	3	Tenmile Clean Water Project
Portage	SD	0	0	0	0	1	3	3	
Terrell	TribTerBC2	0	2	0	0	1	1	3	
BB Coastal	BB16	0	0	1	1	0	1	2	
BB Coastal	BB21	0	2	0	0	0	1	2	
BB Coastal	BB3	0	2	0	0	0	1	2	
Coastal	DH3	0	2	0	0	0	1	2	
Coastal	DH4	0	2	0	0	0	1	2	
Terrell	Ter6.3	0	2	0	0	0	1	2	
BB Coastal	BB11	0	0	0	0	1	1	1	
Terrell	Ter5.0	0	0	0	0	1	1	1	
Terrell	Ter7.8	0	0	0	0	1	1	1	
Terrell	Ter1.6	0	0	0	0	1	1	1	
Terrell	Ter8.4	0	0	0	0	1	1	1	
BB Coastal	BB22	0	0	0	0	0	1	0	
BB Coastal	BB19	0	0	0	0	0	1	0	
BB Coastal	BB20	0	0	0	0	0	1	0	
BB Coastal	BB15	0	0	0	0	0	1	0	
California	Cal 0.1	0	0	0	0	0	3	0	
Coastal	CB3	0	0	0	0	0	2	0	
Coastal	CB4	0	0	0	0	0	2	0	
Coastal	CB2a	0	0	0	0	0	2	0	
Coastal	CB5	0	0	0	0	0	2	0	
Coastal	DH2	0	0	0	0	0	1	0	
Dakota	Dak 0.1	0	0	0	0	0	3	0	
Dakota	Dak 0.6	0	0	0	0	0	3	0	
Portage	COU2	0	0	0	0	0	3	0	

Stream	Station	12 Month GM	12 Month % > 200	3 Year GM	3 Year Wet Season GM	3 Year Dry Season GM	Shellfish Area Multiplier*	Total Score**	Comments
Portage	M1	0	0	0	0	0	3	0	
Portage	M2	0	0	0	0	0	3	0	
Portage	M4	0	0	0	0	0	3	0	
Portage	M5	0	0	0	0	0	3	0	
Terrell	Ter0.7	0	0	0	0	0	1	0	
Terrell	Ter0.1	0	0	0	0	0	1	0	
Terrell	Ter0.1*	0	0	0	0	0	1	0	
Terrell	Ter3.3	0	0	0	0	0	1	0	
Terrell	Ter6.9	0	0	0	0	0	1	0	

*Shellfish growing area score = 1 for open area, 2 for closed recreational area, 2.5 for threatened tribal/commercial area, 3 for closed or CA tribal/commercial area

** Total Score= (12GM score + 12%score + 3yr GM score + 3yrdry GMscore + 3yrwet GMscore)* shellfish growing area score

Appendix D: Routine Sampling Stations in Whatcom County

Watershed	Project Site ID	Site Location
Terrell	Ter 0.1	Mouth of Terrell Creek
Terrell	Ter 0.1*	Mouth of Terrell Creek, upstream of confluence with Leisure Park
Terrell	TribTer LP1	Leisure Park Tributary, East of Birch Bay Drive
Terrell	TribTer BC2	Birch Creek @Leeside
Terrell	TribTer BC1	Birch Creek @Morrison/Wooldridge
Terrell	Ter 0.7	Lower Terrell Creek @ Jackson Road
Terrell	Ter 1.6	Terrell Creek @Birch Bay State Park Bridge
Terrell	Ter 1.9	Terrell Creek @ Helwig Bridge (State Park)
Terrell	Ter 3.3	Terrell Creek @ Jackson Road, North of Grandview
Terrell	Ter 5.0	Terrell Creek @ Blaine Road
Terrell	Ter 6.3	Terrell Creek @Kickerville Rd
Terrell	Ter 6.9	Terrell Creek @ Grandview
Terrell	Ter 7.8	Terrell Creek @Brown Road
Terrell	Ter 8.4	Terrell Creek @Aldergrove Road
Terrell	Trib FERN1	North Star Road, South of Aldergrove
Terrell	TribFIN0	Fingalson @Grandview, west of North Star
California	Cal0.1	Mouth of California Creek at Drayton Harbor Road Bridge
California	Cal0.8	California Creek at Blaine Road Bridge
California	Cal1.9	California Creek at Kickerville Bridge
California	CA1	Downstream side of cross-culvert at Kickerville, west of Cal Creek
California	Cal3.1	California Creek @ Birch Bay Lynden Road
California	Cal5.0	California Creek at Valley View, downstream bridge
California	CA6	Upstream side of cross culvert at Arnie Road, west of Bruce
California	CA16	Main Street Custer at dead end
California	Cal6.2	California Creek at Bruce Road
California	CA8	Upstream side of cross culvert at Bay Road, west of Bruce Road
California	CA9	Upstream side of cross culvert at Fox and Vista
California	Cal 7.5	California Creek at Fox Road, east of Vista
California	CA15	Upstream side of cross culvert at Portal, south of Farris
California	CA14c	Cross culvert at Brown Road, west of railroad
Dakota	Dak0.1	Dakota Creek at Blaine Road Bridge
Dakota	TribDak1	Downstream end of cross culvert at Sweet Road, east of Odell
Dakota	TribDak2	Upstream of cross culvert at Sweet Road, west of Harvey
Dakota	TribDak4	Upstream of cross culvert at Hoier Road, east of Harvey
Dakota	TribDak3	Downstream end of cross culvert at Rogers Road, south of Hoier
Dakota	Dak3.1	Dakota Creek at Giles Road
Dakota	TribDak5	Bridge at Valley View, south of McGee
Dakota	Dak6.8	Dakota Creek at Valley View and Behme Roads
Dakota	NFDak0.1	NF Dakota at Custer School Road (upstream of bridge)
Dakota	SFDak0.2	SF Dakota at Custer School Road (downstream of bridge)
Dakota	TribDakN1	Downstream end of cross culvert at Haynie Road, east of Stein
Dakota	NFDak2.5	NF Dakota Creek at Delta Line Road, south of Haynie
Dakota	TribDakN2	Upstream side of cross culvert at Delta Line, north of Badger
Dakota	TribDakS1	Downstream of 2nd culvert @ Delta Line, south of Loomis Trail
Dakota	SFDak2.2	Upstream side of bridge for SF Dakota at Sunrise Road
Dakota	TribDakS2	Downstream side of bridge at Sunrise Road, north of SF Dakota
Chuckanut	CB1	Small Woodstock Farm creek at culvert below dam structure

Watershed	Project Site ID	Site Location
Chuckanut	CB2a	Chuckanut Creek @ Arroyo Park
Chuckanut	CB3	Chuckanut Creek 18th Street Alley Bridge
Chuckanut	CB4	Mouth of Chuckanut Creek @ end of the footpath from Woodstock
Chuckanut	CB5	Culvert on Chuckanut DRive
Chuckanut	CB6	Creek under foot bridge at end of Fairhaven Ave.
Chuckanut	CB7	Outfall by trestle at NW corner of North Chuckanut Bay
Birch Bay	BB3	Birch Bay Golf Club, 7900 BB. Dr.
Birch Bay	BB4	8036 BB Dr., Mariners Cove 24" concrete pipe on shoreline
Birch Bay	BB5	24"concrete pipe on shoreline across BB Dr. from Century Realty
Birch Bay	BB6	Outfall across from old Thai Steakhouse. Concrete culvert.
Birch Bay	BB7	8178 BB Dr. & Beach Way
Birch Bay	BB8	Shoreline outfall @ 8208 Birch Bay Dr. (Cedar)
Birch Bay	BB11	Deer Trail, Birch Point Rd., 1/2 submerged, 12" metal pipe.
Birch Bay	BB15	BB Village, structure draining "Big Lake" detention pond to marina
Birch Bay	BB16	BB Village, Beaver Pond inlet structure to marina @ Comox&Chehalis
Birch Bay	BB19	BB Village, ditch running perpendicular to Salish @ Cowichan
Birch Bay	BB20	BB Village, inlet to Roger's Slough, located near "old" BB Village gate
Birch Bay	BB21	BB Village, Northeast corner of Skeena Way and Quinault Rd.
Birch Bay	BB22	Culvert under Birch Point Rd. into BB Village (speed limit sign)
Drayton	DH2	Outfall at shoreline at junction of Harborview & Drayton Harbor Rds
Drayton	DH3	24" cement pipe 10 m west of DH2 outfall
Drayton	DH4	24" cement pipe 20 m west of DH3 near 4985 DH Rd.
Drayton	DH5	Harbor Hillside Phase 1, 8" PVC pipe via public trail below bioswale
Nooksack	M5	Mainstem Nooksack River at Everson @ E.Pole Rd
Nooksack	M4	Mainstem Nooksack River at Lynden @ Hannegan Rd
Nooksack	M2	Mainstem Nooksack River at Ferndale @ Axton Rd
Nooksack	M1	Mainstem Nooksack River at Marietta @ Marine Dr
Nooksack	AND	Anderson Creek @ Roberts
Nooksack	S1	Scott @ Blysma Rd
Nooksack	S2	Scott @ Hannegan
Nooksack	S3	Scott @ Thiel Rd
Nooksack	K1	Kamm @ Hampton Rd
Nooksack	K1a	Side tributary to Kamm upstream of bridge at Hampton Road
Nooksack	B1	Bertrand Creek @ Rathbone Rd
Nooksack	F1	Fishtrap Creek @ River Rd
Nooksack	F4	Fishtrap Creek @ E. Main (7th)
Nooksack	F3	Double Ditch @ Main Street
Nooksack	DDW	Double Ditch West @ Pine
Nooksack	DDE	Double Ditch East @ Pine
Nooksack	COU2	Cougar Creek @ Woodlyn
Nooksack	SD	Schneider Ditch @ Harksell
Nooksack	T1	Tenmile Creek @ Barrett Rd

(Data collected by WCPW, MRC volunteers, and WCC crew in 2015-2017)