Nooksack River Transboundary Technical Collaboration Group 2019-2020 Annual Report

FINAL

July 2020

Executive Summary

In August 2019, the British Columbia (B.C.) - Washington (WA) Nooksack River Transboundary Technical Collaboration Group (TCG) began its second year of coordinated work to reduce fecal indicator bacteria concentrations (fecal bacteria) in the Nooksack River watershed. This 2019-2020 TCG annual report summarizes second year project activities and focuses on the three sub-basins of the Nooksack River watershed that span the border between B.C., Canada and the State of Washington (WA), United States of America.

During the past year, B.C. and WA partners sampled surface water throughout the lower Nooksack River watershed, including sites located at the international border. In 2019 B.C. and WA partners set short-term (by 2021) and long-term (by 2024) border benchmarks for Escherichia coli (*E. coli*) concentrations at four border monitoring sites. B.C. data analysis shows that 2019 dry and wet season *E. coli* concentrations met the short-term border benchmark at the border sites, except for Cave Creek during the summer. However, B.C. and WA data analysis for 2019-2020 noted an increase in fecal bacteria concentrations in the Bertrand, Pepin, and Fishtrap sub-basins when compared to the 2018-2019 period. Throughout the Bertrand and Pepin sub-basins, elevated fecal coliform and *E. coli* concentrations were more common during the wet season (October to March) and following significant rain events. This data supports that the wet season is the critical period to focus pollution identification and correction (PIC) efforts to sustain progress toward overall reduced fecal coliform levels and ultimately to marine water quality that supports year-round shellfish harvest throughout the Portage Bay Shellfish Growing Area.

The Nooksack River is the largest freshwater source to Portage Bay and to the Lummi Nation's Portage Bay Shellfish Growing Area. Multi-year efforts to reduce fecal bacteria concentrations have successfully improved spring season water quality in the Conditionally Approved portion of the shellfish growing area. In early 2019, access to spring season shellfish harvest in Portage Bay was restored. The area remains closed to harvest from October-December each year due to fall and early winter season elevated concentrations of fecal coliform in the marine water.

TCG work to reduce fecal bacteria concentrations in the Nooksack River watershed continues. B.C. and WA collected water samples to help identify potential fecal bacteria sources. Agencies acted on complaints, offered technical assistance to control fecal bacteria sources, and conducted regulatory compliance activities. Both jurisdictions engaged commercial and non-commercial agricultural, rural residential, and suburban community members through non-regulatory education and outreach.

A TCG outreach subcommittee promoted compliance and shared event schedules and education materials. A TCG data subcommittee discussed monitoring data and status relative to *E. coli* concentration border benchmarks. This report includes a resource list and an assessment of results in comparison to the short- and long-term benchmarks.

Based on completion of the project's second year, the TCG recommends that the remaining data comparability assessment workplan item be completed as soon as COVID-19 related international travel restrictions are lifted. Additionally, during the fall 2020 wet season, WA will sample and analyze for *E. coli* at border locations following similar frequency and timing as B.C. As future budget allows, WA may also complete 2021 dry season border *E. coli* sampling aligned with B.C. frequency and timing. This shared process will help evaluate *E. coli* results for this project's final year.

Overall, 2019-2020 water quality monitoring results show deteriorating water quality (increased fecal bacteria) in the transboundary waterways compared to 2018-2019 reporting period. This observation is largely driven by seasonally elevated fecal bacteria and rain events. However, compliance, stewardship, and communication activities continue to successfully reach key audiences and help to address fecal bacteria concentration sources. The TCG will continue to implement work plan tasks during the 2020-2021 project period.

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Introduction

In late 2016 through the structure of the British Columbia (B.C.) - Washington (WA) Environmental Cooperation Council (BC-WA ECC), representatives from environment, health, and agriculture agencies at provincial/state and federal government levels formed the BC-WA Nooksack River Transboundary Water Quality Task Group (WQTG). The WQTG inventoried and analyzed topics related to fecal bacteria in transboundary sub-basins of the Nooksack River watershed. In mid-2018 the WQTG recommended to BC-WA ECC the formation of a new B.C.-WA Nooksack River Transboundary Technical Collaboration Group (TCG). Guided by a terms of reference and three-year workplan, the TCG began its formal partnership in August 2018 to reduce fecal indicator bacteria (fecal bacteria) concentrations in Nooksack River watershed transboundary sub-basins. Further background information about TCG partnership origins and first year project data, sampling methodologies, and activities can be found in the *Nooksack River Transboundary Technical Collaboration Group 2018-2019 Annual Report*.

The Nooksack River watershed (Figure 1) encompasses the northwestern slopes of the Cascade Mountain Range through foothills and lowlands to Bellingham Bay in Whatcom County, Washington (WA). Much of the Nooksack River delta and the entirety of the Portage Bay Shellfish Growing Area are located within the boundaries of the Lummi Indian Reservation. The mountainous part of the upper basin is drained by the North, Middle, and South forks of the Nooksack River. In the lower elevations of the watershed near the town of Deming, WA, the forks converge as the mainstem Nooksack River.

Downstream of Deming, the lower Nooksack River watershed drains mostly valley lands including three sub-basins that span the international border between British Columbia (B.C.), Canada and WA, United States. The three transboundary sub-basins - Bertrand Creek, Pepin Brook, and Fishtrap Creek - are the focus of the B.C.-WA Nooksack River Transboundary Technical Collaboration Group (TCG)[1].

The three transboundary sub-basins contribute a significant proportion of flow to the lower Nooksack River watershed. Land use activities on both sides of the international border periodically contribute to high fecal bacteria loads in the sub-basin waterways. The seasonal fecal bacteria loading from these sub-basins contribute to high fecal counts in the Nooksack River and in the downstream Portage Bay where some marine monitoring sites fail to meet fecal bacteria criteria to allow year-round shellfish harvest. Portions of the Lummi Nation's Portage Bay Shellfish Growing Area remain closed to harvest October through December each year due to poor water quality.

Partners in B.C. and WA established the TCG in August 2018 to carry out tasks to reduce fecal bacteria concentrations in transboundary sub-basins flowing to the Nooksack River. In August 2019, the TCG began its second year of coordinated work. This *Nooksack River Transboundary Technical Collaboration Group 2019-2020 Annual Report* (herein referred to as the 2019-2020 Annual Report) summarizes the second-year data analysis, project activities, observations, and list of resources related to project work.

This 2019-2020 Annual Report evaluates conditions in the three Nooksack River watershed transboundary sub-basins, including areas within the sub-basins north of the border, at the border, and south of the border. The 2019-2020 Annual Report also provides an update on the implementation of the TCG's workplan items (Appendix 2) and recommends changes or additions for next year's workplan.

[1] In the 2018-2019 TCG annual report, Fishtrap and Pepin were described as a single sub-basin. However, the two sub-basins are represented separately here to better reflect both the fecal bacteria reduction work and the mapping efforts being conducted for these sub-basins.

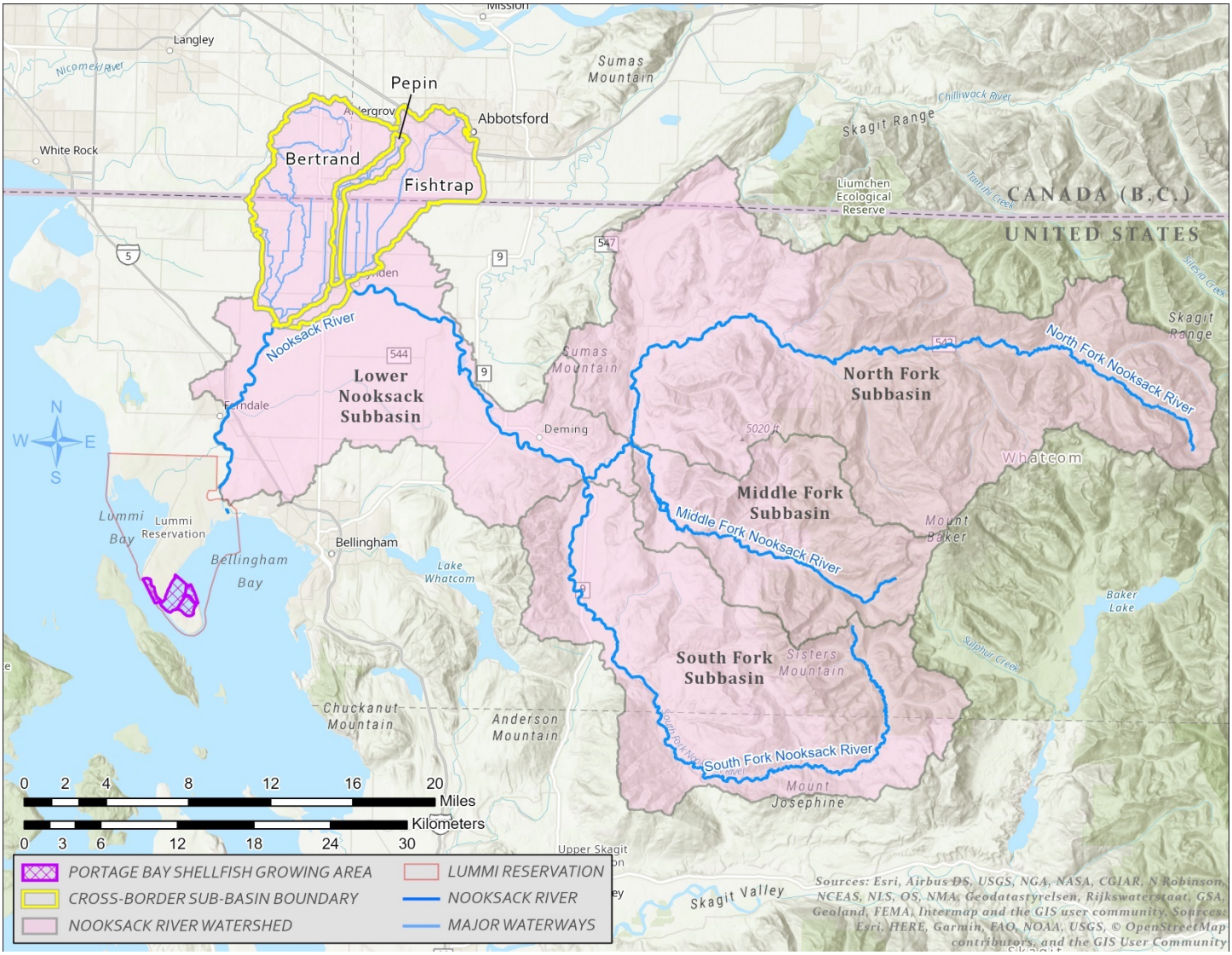

Figure 1. The Nooksack River Watershed including its transboundary sub-basins. Portage Bay Shellfish Growing Area is shown in purple (hatched).

Conditions Evaluation

This section highlights relevant B.C. and WA bacterial water quality sampling and analysis for data gathered from April 1, 2019 through March 31, 2020, which are tabled in Appendix 4. The summaries cover three distinct transboundary sub-basins: Bertrand Creek, Pepin Brook, and Fishtrap Creek. Described are three portions of each sub-basin from upstream to downstream:

- B.C.– North of the border
- Border monitoring sites
- WA – South of the border to the confluence with Nooksack River.

Surface water monitoring in B.C. includes collecting and analyzing samples for both fecal coliform and for Escherichia coli *(E. coli)* as indicators of fecal bacteria concentrations and measured in colony forming units (CFU) per 100 mL. B.C. samples ambient locations on a monthly basis and complements the monthly data with seasonal five consecutive weekly samples collected at a subset of the ambient sites in 30 days (5-in-30) as required for comparison to B.C. water quality guidelines. The project uses these 5-in-30 sampling event results to evaluate status relative to border benchmarks established for the project, as summarized in the "Border benchmark evaluation" sub-section on page 15. See Appendix 1 for a table listing B.C. and WA evaluation standards, including bacterial indicator, criteria, and dataset used for evaluation.

In WA, Whatcom Clean Water Program partner monitoring focuses primarily on fecal coliform bacteria, though some partners collect and analyze samples for both fecal coliform and for *E. coli.* In WA, after December 31, 2020, *E.coli* and associated criteria will replace fecal coliform as the fecal bacteria criteria to protect water contact recreation use in fresh waters (Chapter 173-201A-200 WAC). Analyzing samples for *E. coli* concentrations in WA may then become more common. WA monitoring partners collect ambient samples at multiple locations within the Nooksack River watershed, including sites at the border. WA partners complement ambient sampling with storm event and source identification sampling throughout the lower Nooksack River watershed, including in the Bertrand, Pepin, and Fishtrap sub-basins.

The monitoring results summarized in this report and in Appendix 4 can be found online on WA's Surface Water Monitoring for Fecal Coliform Bacteria map or B.C.'s Surface Water Monitoring Sites Interactive Map (for complete links, see Online Resources). Detailed water quality analysis for B.C. sites will be presented in a water quality report in the fall of 2020. In the interim, for a complete dataset or with data related questions, please contact Meg Harris (WA; mharris@whatcomcd.org) or Lyndsey Johnson (B.C.; Lyndsey.Johnson@gov.bc.ca).

Bertrand Creek sub-basin

Bertrand Creek is a fish-bearing tributary of the Nooksack River, with its headwaters located in the top northwest end of the Nooksack River watershed in Aldergrove and Langley, B.C., Canada (Figure 2). The Bertrand Creek sub-basin covers approximately 42.8 square kilometers, or 17 square miles, of land and is the largest of the three transboundary Nooksack River sub-basins. Bertrand Creek flows south across the border just south of 0 Avenue. Cave Creek is a four kilometers long tributary to Bertrand Creek. Cave Creek joins Bertrand Creek approximately 250 meters south of the border; therefore, water quality results are combined for both creeks. Bertrand Creek and its many tributaries, including Cave Creek and Howe's Creek, flow through both urban areas and a mix of agricultural operations in B.C., which directly influence the types and amounts of fecal bacteria entering the system north of the international border. In WA, the sub-basin is comprised largely of rural residential, smaller non-dairy livestock operations, and other agriculture, including berry production.

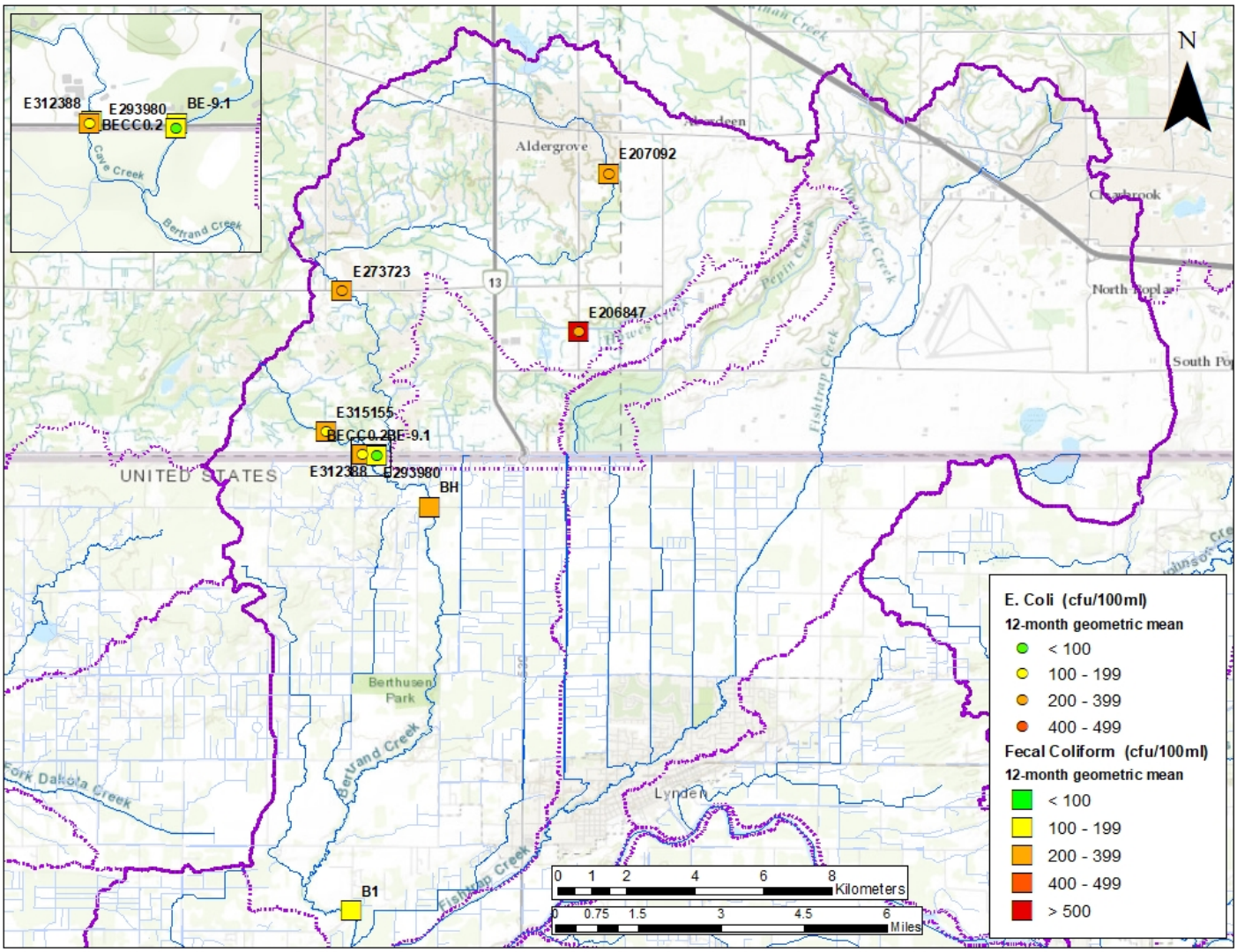

Figure 2. *E. coli* and fecal coliform April 2019-March 2020, Bertrand Creek Sub-basin.

North of the Border

B.C. Ministry of Environment and Climate Change Strategy (ENV) monitored several locations monthly in the Bertrand Creek sub-basin north of the border. This section highlights monitoring results from four locations - an upstream site located in a residential area and three others located in predominantly agricultural areas. Monitoring results show fluctuations in fecal bacteria counts over the past year. High concentrations are typically seen following rain events of 25 millimeters (1 inch) or greater in the previous 24 hours. However, during one sampling event in May 2019, concentrations were notably high (above 1000 CFU/100 mL) at three sites, despite there being little rain preceding the sampling. It is likely that seasonal land management practices (i.e. manure storage and spreading) and/or other factors such as an isolated event may have contributed to the high concentration. B.C. continues to identify these sources, respond to complaints, and take appropriate compliance measures.

Overall, analysis of ambient monitoring results indicates that fecal bacteria concentrations in Bertrand Creek were higher in 2019-2020 than those seen in 2018-2019. In the 2019-2020 monitoring period, 41 percent of monthly samples from these four sites exceeded the B.C. single sample maximum *E. coli* concentration of 400 CFU/100 mL compared to 26 percent of monthly samples in 2018-2019. In 2018-2019, none of the coordinated monthly sampling dates followed a rainfall event of 25 millimeters (1 inch) or greater in the previous 24 hours, while one third of monthly sampling dates in 2019-2020 did. The higher precipitation preceding sampling during 2019-2020 likely contributed to higher 2019-2020 monthly concentrations as compared to 2018-2019 monthly data. In general, higher concentrations are measured at upstream locations (near Aldergrove) and by the time the water reaches the border sites, bacterial concentrations are typically low.

Border

B.C. and WA partners sample at the same border locations on Bertrand Creek (E293980, BE-9.1) and Cave Creek (E312388, BECCO.2). Both sampling locations are accessed from the B.C. side of the border.

Monthly monitoring results show that both Cave Creek and Bertrand Creek continue to have intermittently elevated fecal bacteria at these sites. The annual geometric means for *E. coli* calculated from monthly ambient sampling were below 200 CFU/100 mL for both sites. However, elevated counts at these two sites during monthly ambient sampling are somewhat common in the wet season (October-March) and contribute to increased seasonal fecal bacteria loading in Bertrand Creek.

Evaluation of the monthly ambient sampling during the wet season (October-March) data shows that four sampling events exceeded the B.C. single sample maximum criteria for *E. coli* of 400 CFU/100 mL. Evaluation of monthly ambient sampling during the dry season (April-September) data shows improved water quality patterns with only one sampling event at each site exceeding the B.C. single sample maximum criteria for *E. coli* of 400 CFU/100 mL. The fecal coliform geometric mean and estimated 90th percentile for both sites for this reporting period do not meet WA's targets for fecal coliform (see WA's Evaluation Standards in Appendix 1). Monitoring of both *E. coli* and fecal coliform showed increases in fecal bacteria concentrations since the 2018-19 period.

South of the border to B1 (Bertrand enters Nooksack mainstem)

Monitoring site B1 (Bertrand at Rathbone Road) is the keystone monitoring station in the Bertrand Creek sub-basin. In addition to B1, two sites have been added to ambient monitoring efforts in the Bertrand sub-basin (Bertrand Creek at H

Street and Bertrand Creek at Berthusen Park)[2]. Several Whatcom Clean Water Program partner agencies sample an additional seven to ten source identification sites during storm events.

Elevated fecal bacteria results from twice monthly ambient sampling at B1 from October to December 2019 were notable (three of six samples exceeded 1,000 CFU/100 mL), leading to an increase in the geometric mean and estimated 90th percentile for this site compared to past years. The geometric mean (106 CFU) and 90th percentile (800 CFU) for this reporting period exceed WA's targets for fecal coliform.

High counts throughout the Bertrand Creek watershed are much more common in the wet season (October-March) and following rain events. The highest counts seen at this site during the wet season 2019-2020 all followed rain events of 10 millimeters (0.33 inches) or greater within 24 hours.

[2] Only two samples have been collected thus far at sites BH and BHPB on the same dates as coordinated transboundary sampling. Thus, geometric means and estimated 90th percentiles were not calculated for these sample sites. In 2020-21, WA will continue to monitor these two sites to provide a more complete picture of the watershed south of the international border.

Pepin Brook sub-basin

Pepin Brook is a fish-bearing stream located east of the Bertrand Creek sub-basin (Figure 3). It covers approximately 15.2 square kilometers, or six square miles, north of the border flowing south through Aldergrove Regional Park and then across the border. Pepin Brook flows past poultry operations, berry farms, and cattle-grazing land in B.C. At the international border, Pepin Brook travels through a culvert system that separates the waterway in WA into two roadside ditches referred to as Double Ditch. The ditches flow south along the west and east sides of Double Ditch Road until reconnecting just within the City of Lynden. Pepin Brook flows to Fishtrap Creek before Fishtrap Creek enters the Nooksack River.

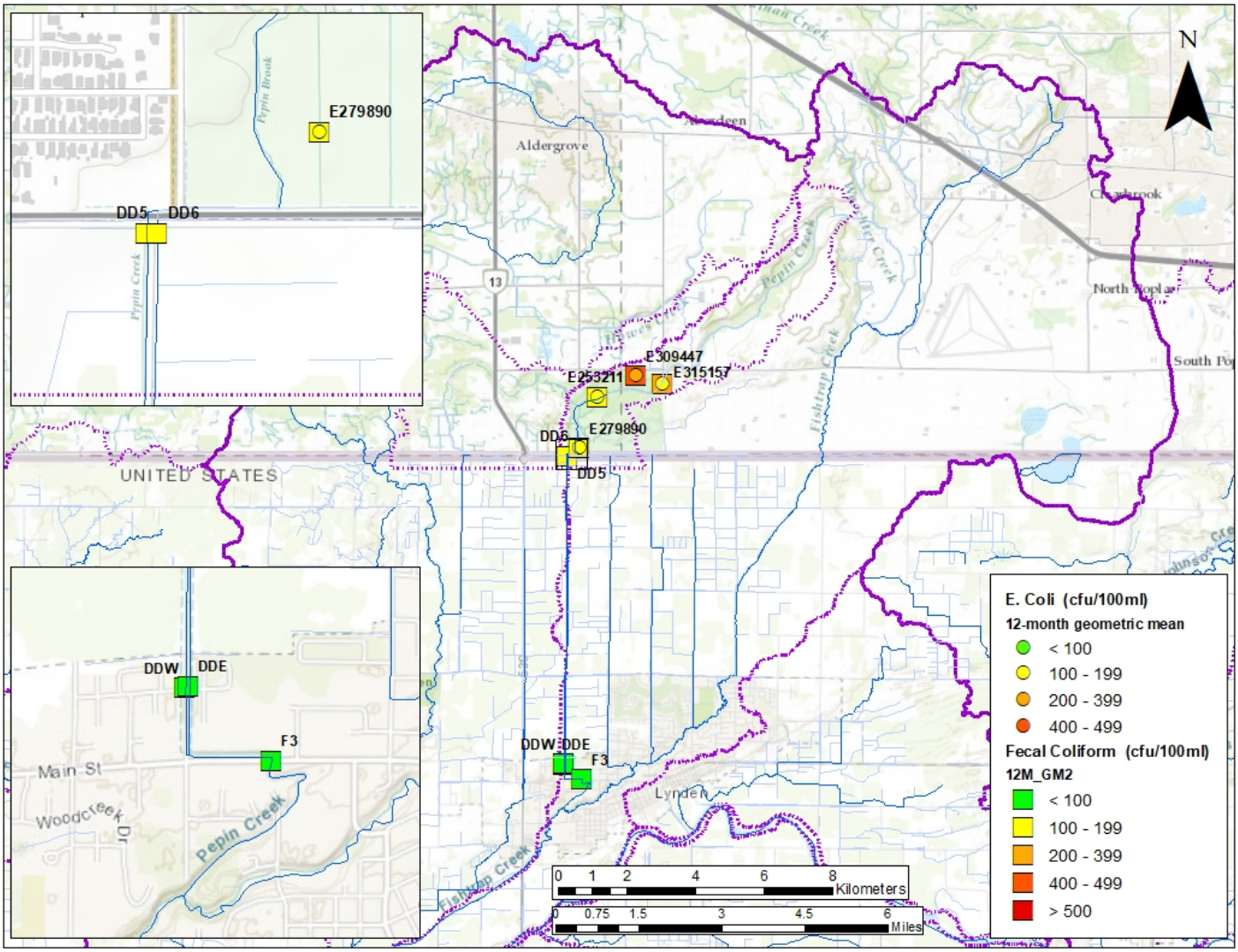

Figure 3. *E. coli* and fecal coliform April 2019- March 2020, Pepin Brook Sub-basin.

North of the Border

A tributary to Pepin Brook flows through the property of a large privately owned composting facility and connects to Pepin Brook within Aldergrove Regional Park. The lower portion of Pepin Brook flows through a series of wetland

complexes, meadows, and mixed forests in Aldergrove Regional Park. Four of the ENV sample sites are in Aldergrove Regional Park, including the border site on 0 Avenue. The annual geometric means for *E. coli* at all three sites north of the border were less than 400 CFU/100 mL; however, 25 percent of the sample results exceeded *E. coli* concentrations of 1,000 CFU/100 mL, typically following rainfall events. Elevated bacterial concentrations at sites E315157 and E309447 also occurred following consecutive dry days suggesting that factors other than precipitation contributed to the elevated bacterial levels at these locations. B.C. will continue to identify sources and follow up.

Overall, the 2019-2020 monitoring results show higher bacterial concentrations compared to 2018-2019, with the highest counts following rain events of 25 millimeters (1 inch) or greater within 24 hours. In 2019-2020, 44 percent of all monthly samples exceeded the BC single sample maximum *E. coli* concentration of 400 CFU/100 mL compared to 15 percent of all monthly samples in 2018-2019.

Border

B.C. ENV monitors Pepin Brook at the international boundary (E279890). WA partners monitor Pepin Brook on the south side of 0 Avenue, after it splits into two roadside ditches, West and East Double Ditch (sample sites DD5 and DD6, respectively).

The annual geometric mean for *E. coli* from monthly sampling was below 200 CFU/100 mL (Appendix 4). This site also experienced occasional elevated bacterial concentrations during the wet season (October-March), typically following rainfall events of greater than 25 millimeters (1 inch) in 24 hours. During the wet season, three sampling events exceeded the B.C. single sample maximum criteria for *E. coli* of 400 CFU/100 mL compared to one exceedance during the dry season (April-September).

The fecal coliform geometric mean and estimated 90th percentile of the three sites for this reporting period do not meet WA's targets for fecal coliforms. During a sampling event at the end of March 2020, in which B.C. did not sample due to COVID-19 restrictions, fecal coliform concentrations at the two WA sites (DD5 and DD6) were very elevated (5,200 and 5,700 CFU/100 mL, respectively) following consecutive days of significant rainfall. This resulted in elevated geometric means and 90th percentile at these two sites in comparison to the B.C. site (see Appendix 4).

South of the border to F3 (Pepin enters Fishtrap mainstem)

WA partners monitor Pepin Brook at least four times per month: twice monthly as part of Nooksack Routine sampling and twice monthly for the Fishtrap Focus Area sampling. On the south side of Boundary Road, paired sampling sites DD5 and DD6 monitor Pepin Brook flowing across the border on the west and east sides of Double Ditch Road. Pepin Brook continues to flow south as Double Ditch. WA monitors Double Ditch at DDW and DDE as the waterways enter the city limits of Lynden. Further south, Double Ditch/Pepin Brook becomes a single waterway again and WA monitors it at Main Street (F3) in Lynden before the waterway meets Fishtrap Creek.

Fecal bacteria concentrations at DDW, DDE, and F3 meet WA's target for geometric mean but do not meet the target for the estimated 90th percentile with annual 90th percentiles of 1,100; 420; and 358 CFU/100mL, respectively. The late March 2020 sampling event saw elevated fecal bacteria concentrations (1,400-2,100 CFU/100 mL) at these sites in addition to DD5 and DD6 at the border. This is an increase in fecal bacteria compared to the 2018-19 period during which no results at these sites exceeded 200 CFU/100 mL and the sites met both parts of WA's targets for fecal coliform. 2019 was more reflective of patterns observed between 2015-2017 when 25-35 percent of sample results exceeded 1,000 CFU/100 mL. Consistent with the border sites, elevated fecal bacteria in this portion of the sub-basin is much more likely during the wet season.

Fishtrap Creek sub-basin

Fishtrap Creek is a fish-bearing stream draining a watershed approximately 80 square kilometers, or 31 square miles, in size. It flows south through West Abbotsford to the border (Figure 4). Waechter Creek is a significant tributary to Fishtrap Creek north of the border. Fishtrap Creek and its tributaries flow through mostly agriculture land use in the B.C. portion, specifically berry growing and poultry operations. In the WA portion, Fishtrap flows through a mix of agriculture land use and an urban area (City of Lynden). The agricultural land use area includes four notable ditch systems that originate near or north of the international border, flow north to south, and act as tributaries of Fishtrap Creek.

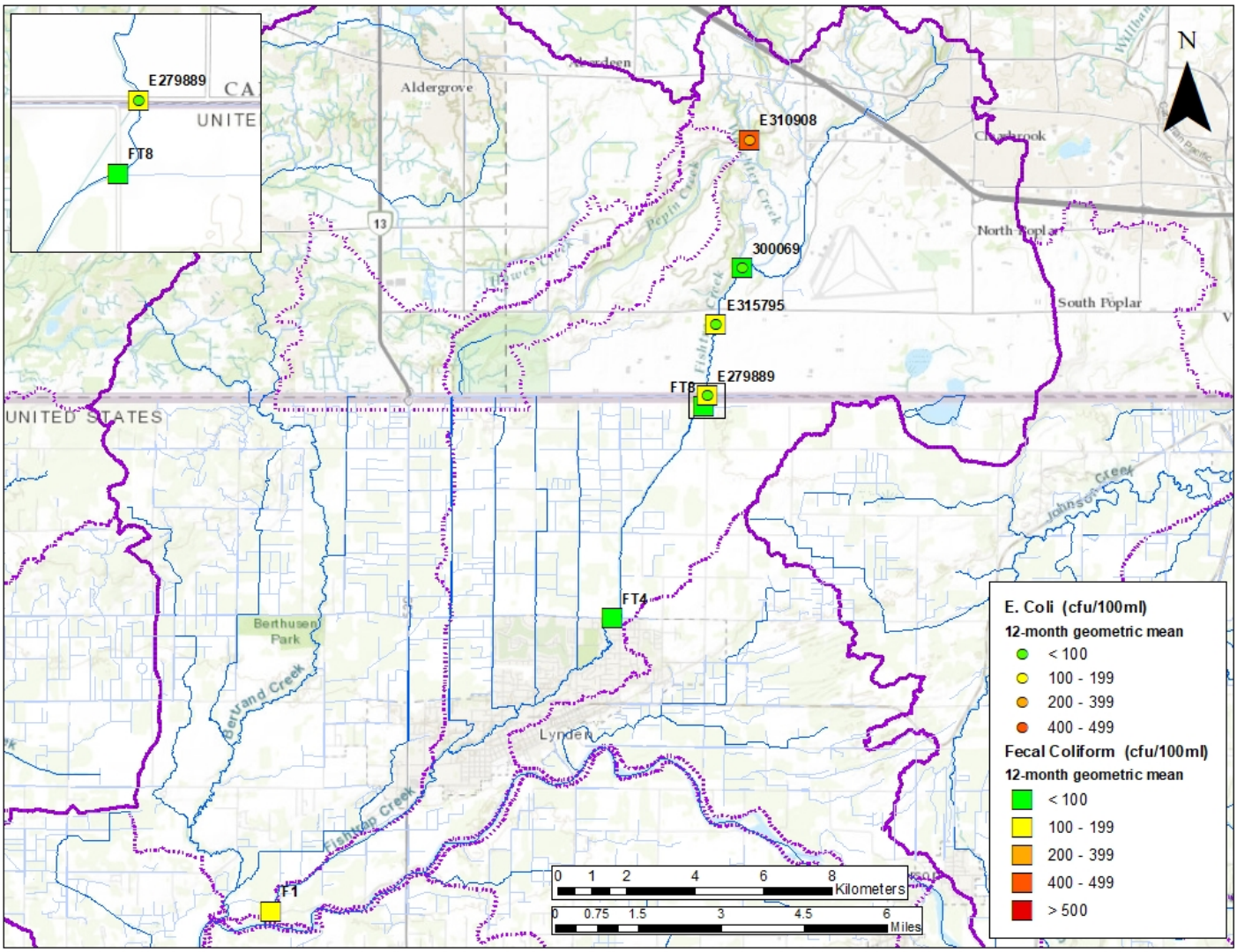

Figure 4. *E. coli* and fecal coliform April 2019- March 2020, Fishtrap Creek Sub-basin.

North of the Border

B.C. samples Fishtrap Creek monthly at three sites north of the border, with one of the sites located on Waechter Creek. The monitoring results show that the two sites on the mainstem of Fishtrap Creek have low fecal bacteria concentrations and have annual geometric means for *E. coli* of less than 100 CFU/100 mL. In general, bacterial

concentrations at these two sites are typically consistent throughout the year and experience less elevated concentrations following significant rain events. Compared to the 2018-2019 period, site 0300069 has seen a slight increase in bacterial concentrations but still shows significant reduction of bacterial concentrations compared to the 2017-2018 period.

The Waechter Creek site (E310908) has higher fecal bacteria concentrations than the two sites on the Fishtrap Creek mainstem with an annual geometric mean for *E. coli* of 221 CFU/100 mL. In 2019-2020, *E. coli* concentrations at this site exceeded the B.C. single sample maximum of 400 CFU/100 ml one third of the time following rain events of greater than 25 millimeters (1 inch) in 24 hours. Compared to the 2018-2019 period, site E310908 has seen a 30 percent reduction in the annual geometric mean for *E. coli.*

Border

B.C. ENV monitors Fishtrap Creek at the international boundary (E279889). WA partners monitor Fishtrap Creek approximately 200 meters downstream at Northwood Road (FT8). Monitoring results at these two sites show the lowest fecal bacteria concentrations of the border sites.

WA data evaluation shows that site FT8 meets WA's annual geometric mean target for fecal coliform and nearly meets the target for 90th percentile. This site has shown improvements since the 2018-2019 reporting period, with an over 50 percent reduction in the annual estimated 90th percentile.

Wet season elevated counts are somewhat common October through January, though focused work in this sub-basin over the past year has significantly reduced the magnitude of the elevated counts.

South of the border to F1 (Fishtrap enters Nooksack mainstem)

WA partners monitor Fishtrap Creek at least four times per month: twice monthly as part of the Nooksack Routine sampling and twice monthly for the Fishtrap Focus Area sampling. In WA, two routine sample sites - Fishtrap at Badger Road (FT4) and Fishtrap at River Road (F1) - offer a snapshot of water quality along Fishtrap Creek. One ditch that originates in B.C. and three ditch systems that begin in WA near the international border run north-south through the agricultural areas of the sub-basin and act as tributaries of Fishtrap Creek. WA samples these ditches twice monthly, in addition to sites along Fishtrap Creek within the City of Lynden.

Fishtrap Creek at Badger Road (FT4) meets WA's target for annual geometric mean but does not meet the target for the annual estimated 90th percentile. Fishtrap Creek at River Road (F1) exceeds both parts of this water quality target. Fishtrap Creek has seen a slight increase in fecal bacteria compared to the 2018-19 period; however, analysis shows significant improvement since the 2015-2017 monitoring. Compared to the other waterways, fecal bacteria levels in Fishtrap Creek are more consistent throughout the year and experience fewer wet season high fecal bacteria counts.

Something notable about this watershed is a substantial area on both sides of the border with well-drained soils and without surface flows into the creek. The higher proportion of flow originating from groundwater rather than surface water runoff likely contributes to lower fecal bacteria concentrations measured in Fishtrap Creek.

Border Benchmark Evaluation

In June 2019, B.C. and WA TCG partners adopted short-term (by 2021) and long-term (by 2024) border benchmarks using *E. coli* as the bacterial indicator. The short- and long-term border benchmarks apply at the four border locations (i.e. the main waterways of Cave (E312388), Bertrand (E293980), Pepin (E279890), and Fishtrap (E279889)).

The project's border benchmarks differ from B.C.'s water quality guidelines and from WA's water quality standards. Data collected during one dry season and one wet season confirms whether the short- and long-term project border benchmarks are met.

Border benchmarks were set as follows:

- *E. coli* of 200 CFU/100 mL – Short-term border benchmark to be achieved at border stations over two-years:
    - Benchmark is based on the geometric mean calculation of five weekly samples collected over 30 days (known as 5-in-30) and should apply to both wet and dry seasons.
- *E. coli* of 100 CFU/100 mL – Long-term border benchmark to be achieved at border stations within five years:
    - Benchmark is based on the geometric mean calculation of 5-in-30 samples and should apply to both wet and dry seasons.

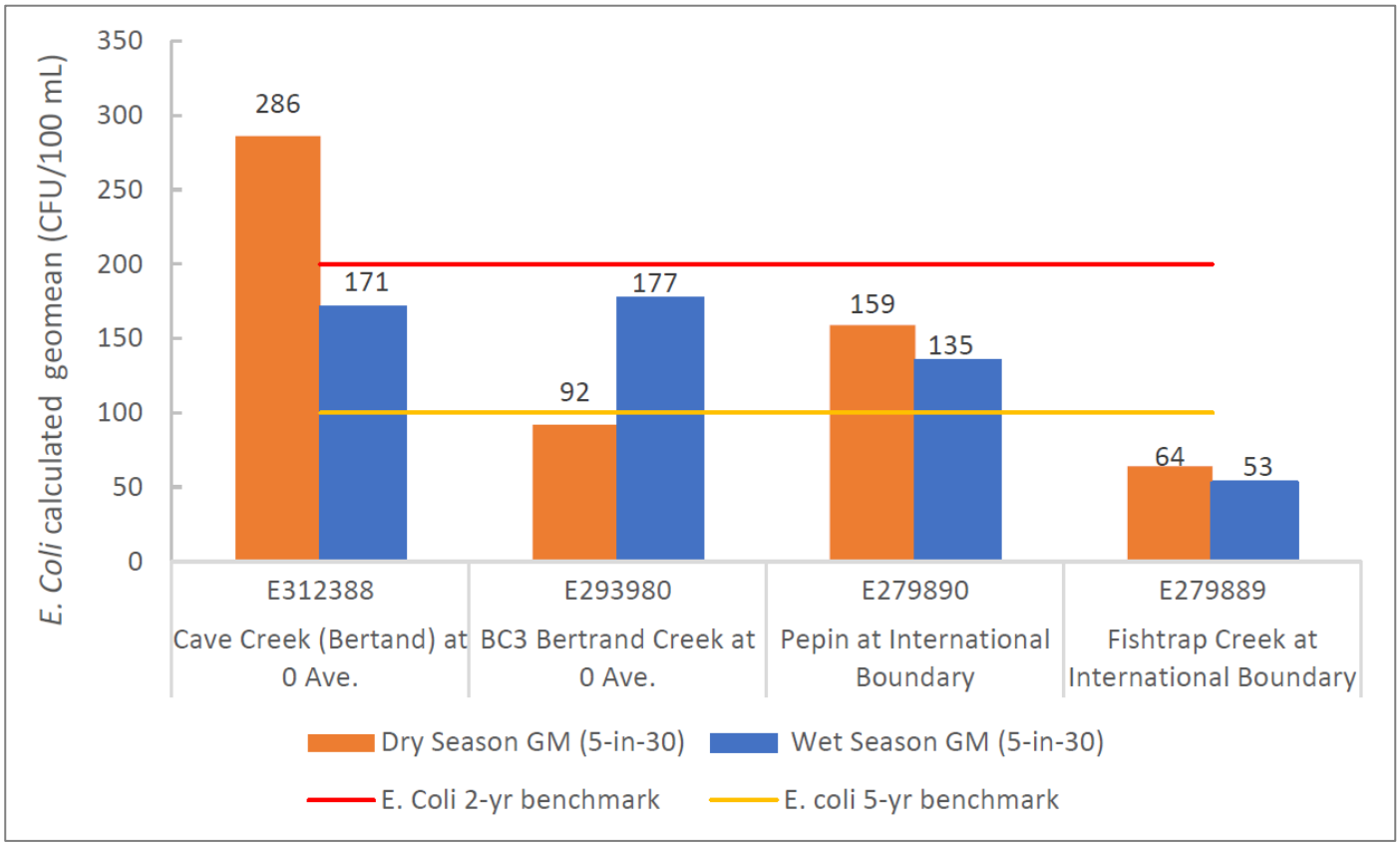

Figure 5. Border benchmark evaluation (geometric mean calculations) at the four border locations in dry season (July) 2019 and wet season (November-December) 2019; evaluation based on 5-in-30 datasets.

Figure 5 illustrates status relative to the short- and long-term border benchmarks based on data collected during two 5-in-30 sampling events completed at each of four border sites during 2019. B.C. completed one 5-in-30 sampling event during July 2019 (dry season) and one 5-in-30 event during November-December 2019 (wet season).

Data analysis for 5-in-30 dry and wet season 2019 sampling shows that:

- Bertrand Creek sub-basin: Sub-basin benchmark evaluation sites include both the Cave (E312388) and the Bertrand (E293980) sites.
    - Dry season 2019 –
        - Cave Creek at 0 Avenue (E312388) failed to achieve the short-term benchmark, with an *E. coli* geometric mean of 286 CFU/100 mL.
            - Cave Creek had an extremely high *E. coli* concentration during one of the 5-in-30 dry season sampling dates, which contributed to an elevated geometric mean. B.C. is working to identify the source(s) and to follow up.
        - Bertrand achieved the short-term benchmark.
    - Wet season 2019 –
        - Cave and Bertrand achieved the short-term border benchmark.
- Pepin Brook sub-basin:
    - Dry and wet seasons 2019 –
        - Pepin achieved the short-term benchmark during both seasonal 5-in-30 sampling events.
- Fishtrap sub-basin:
    - Dry and wet seasons 2019 -
        - Fishtrap achieved the short-term border benchmark during both seasonal 5-in-30 sampling events.

Lower Nooksack River

The 'Lower Nooksack River' refers to the generally lowland portion of the mainstem Nooksack River downstream of the town of Everson, WA.

Nooksack mainstem at Everson downstream to M1

To evaluate long term trends, WA partners continue to sample ambient water quality at five key sites on the mainstem Nooksack River. From Everson, WA to downstream, the mainstem monitoring site locations are M5, M4, MGM, M2a, and M1.

- M5 (Everson), M4 (Lynden), and MGM (Guide Meridian) sites are located upstream of where Fishtrap Creek and Bertrand Creek enter the Nooksack River.
- M2a (Ferndale) and M1 (Marine Drive) are downstream of Fishtrap and Bertrand confluences with the Nooksack River.

Water quality from the upper reaches of the Nooksack River watershed is generally excellent, with the Nooksack forks draining national park and forest land and some low population density rural areas.

Elevated flow and/or flooding of the Nooksack River can be an indication of increased fecal bacteria in the freshwater systems, but Nooksack River flows tend to better predict lowland fecal bacteria pollution in the fall and winter periods than in the spring. In any season, rain events lead to runoff from both rural and urban pollution sources, increase the flows in freshwater creeks and rivers, and can lead to elevated bacteria. During the fall and winter, precipitation in the higher elevation eastern part of the Nooksack River watershed is held as snow, while rainfall and associated runoff from the lowlands generally contributes a higher percentage of flow to the Nooksack River. In the spring, high flows in the Nooksack River are often a result of snow melt during periods of warm weather and is not observed as contributing excess fecal bacteria to the system. However, lowland rain events in the spring can still contribute runoff and elevate fecal bacteria levels.

Contribution of Fishtrap and Bertrand to Nooksack mainstem

By water volume, Fishtrap and Bertrand Creeks are the largest of the lowland tributaries of the Nooksack River (TMDL Evaluation, 2000). Accordingly, data continues to support that seasonal fecal bacteria loading from Bertrand Creek and Fishtrap Creek (including Pepin Brook) sub-basins can have significant seasonal effects on the downstream water quality of the Nooksack River and Portage Bay (Figure 6).

Similar to 2018-2019 observations, 2019-2020 data collected at sites in the cross-border sub-basins and downstream in the watershed confirmed that elevated fecal bacteria counts occur during and after rain events and when river flows are high. This data supports that the wet season is the critical period to focus pollution identification and correction (PIC) efforts to sustain progress in reducing fecal coliform bacteria concetrations and ultimately to achieving marine water quality that supports year-round shellfish harvest throughout the Portage Bay Shellfish Growing Area.

PIC program outreach and technical assistance in WA emphasize that activities during late summer and early fall - days and weeks leading up to when fields become saturated and preferential pathways start to flow - can have big water quality impacts when water moves into ditches, creek and rivers.

It is important to note that while fall 2019 and early 2020 produced some high fecal bacteria counts, WA analysis of data for keystone sites in the Nooksack River watershed show declines in 3-year fecal coliform geometric means. Three-year fecal coliform geometric means calculated for 2017-2019 are significantly better than 2015-2017 geometric means.

Water quality improvements are attributed to focused PIC program efforts, including pollution prevention actions by community members.

Figure 6 illustrates rolling 12-month geometric mean values for keystone monitoring sites in Bertrand Creek (B1) and Fishtrap Creek (F1), along with rolling geometric means of lower Nooksack River mainstem sites at Ferndale (M2a) and near the mouth of the Nooksack River at Marine Drive (M1). The geometric mean values are calculated using ambient monthly sampling data sets. WA's Water Quality Standard geometric mean criterion for fecal coliform is 100 CFU/100 mL (see Appendix 1). The *Nooksack River Watershed Bacteria Total Maximum Daily Load Detailed Implementation Plan* (January 2002) established a fecal coliform target of 39 CFU/100 mL at M1. The recommended TMDL target for M1 was based on meeting a 90th percentile FC density of 200 CFU/100 mL and was evaluated to ensure shellfish harvest use was supported.

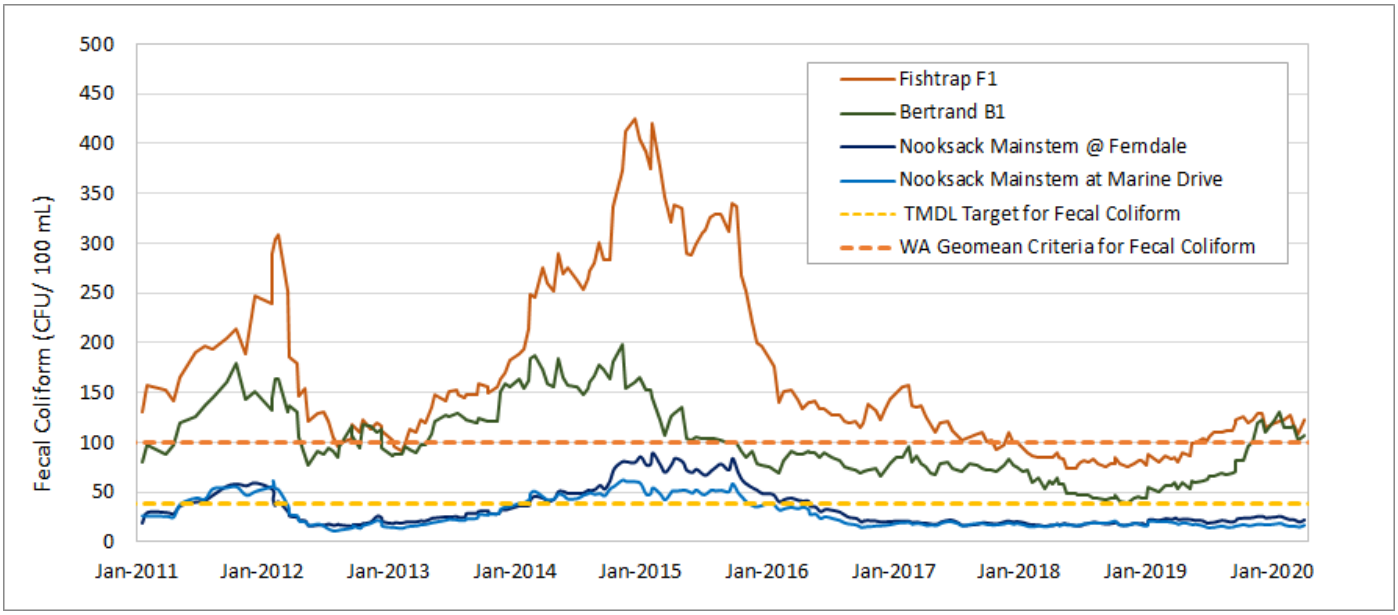

Figure 6. Rolling 12-month geometric means Nooksack River Mainstem and Tributaries (B1 and F1); evaluation based on monthly ambient datasets.

Portage Bay Shellfish Growing Area

Late summer and fall 2019 through early 2020 brought significant water quality challenges to the Portage Bay Shellfish Growing Area. Pre-scheduled marine sampling dates in September, October, and November 2019 took place following rain events. September and October 2019 sampling resulted in notably high fecal bacteria counts in the marine water followed by high counts again in January 2020. November 2019 marine sampling produced a few moderately high results. These marine sampling results demonstrated the challenges of protecting water quality during rainy periods.

Washington State Department of Health (DOH) marine data records can be accessed at ftp://ftp.doh.wa.gov/MarineWater/PreliminaryWaterData/ or results can be viewed on the commercial shellfish Map Viewer https://fortress.wa.gov/doh/oswpviewer/index.html.

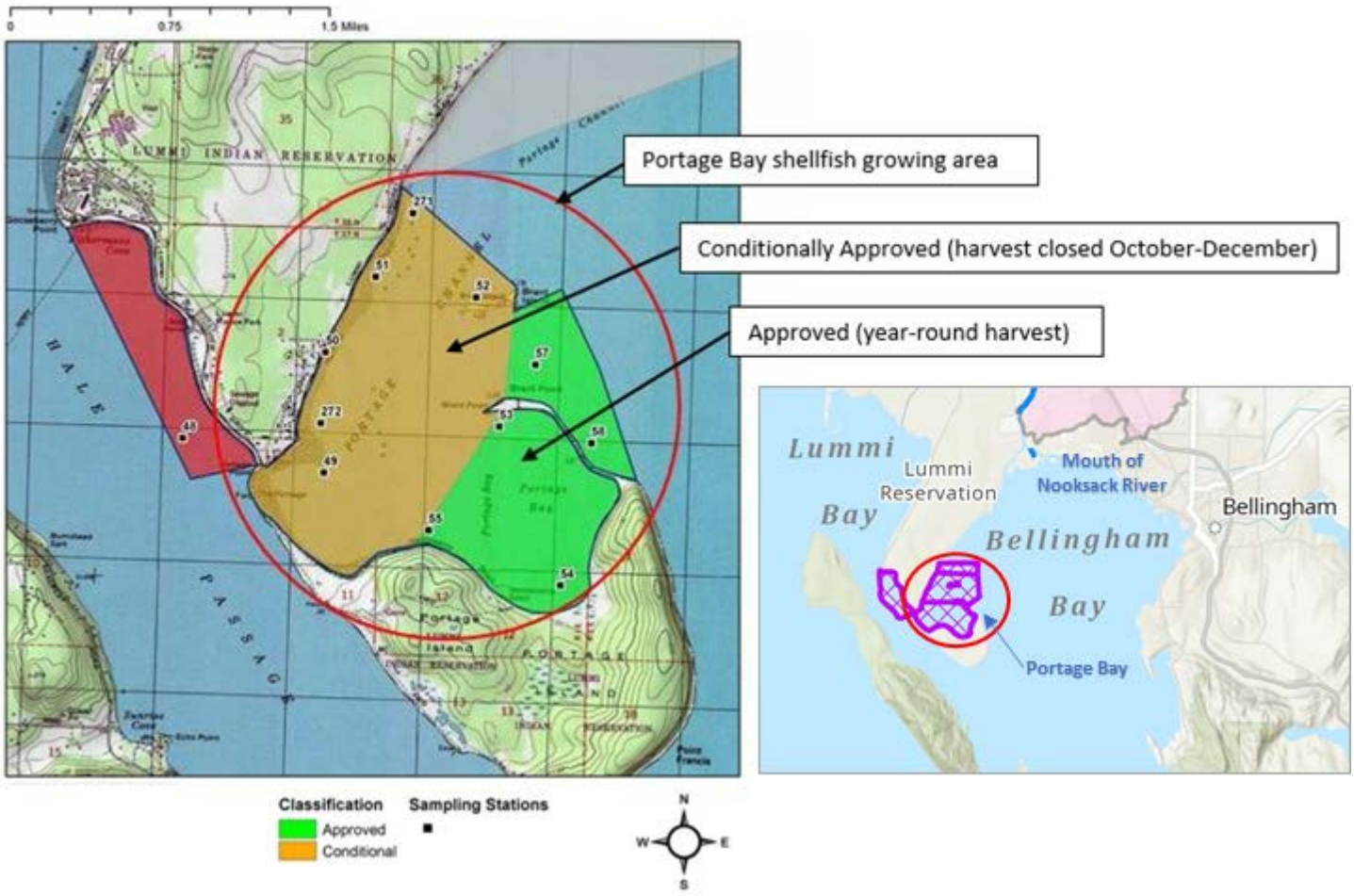

Figure 7. Map of Portage Bay Shellfish Growing Area classifications and marine water quality monitoring stations. The 2019 Portage Bay Annual Shellfish Growing Area Review identified stations 52, 57, and 58 as threatened.

WA monitors freshwater sampling sites in the Nooksack River watershed on the day prior to monthly marine water sampling in Portage Bay. High fecal bacteria densities measured at the Nooksack River watershed freshwater sites on the dates prior to each fall 2019 and January and February 2020 marine sampling events support that the Nooksack River has a strong influence on Portage Bay water quality. For contrast to conditions during these wet weather sampling events, ambient monitoring during a dry period of December 2019 produced low results in both freshwater and in marine water. These observations help support that high fecal bacteria levels are not present in the watershed nor in the marine waters during all conditions.

WA will continue work to better understand precipitation and river flow conditions that contribute to elevated fecal bacteria in the marine waters. Seasonal observations for marine water quality at 12 sampling sites include:

- Spring (April–June): Notable improvements. Sampling resulted in only two moderate fecal coliform counts (23-49 MPN range) during spring months since 2017. All other spring sampling results were low (less than 23 MPN).
- Summer (July-September): Some deterioration. August 2018 results included three sites with moderate fecal coliform counts and five sites with high counts (over 50 MPN). September 2018 results include three moderate counts and one count over 50 MPN. August 2019 results included one moderate count. September 2019

sampling occurred during a first flush event and produced five results in the moderate range and four results above 50 MPN.

- Fall (October-December): During the fall season, elevated fecal bacteria counts remain a problem across the lower Nooksack River watershed and in the shellfish growing area. October 2018 marine sampling results included four sites with moderate counts and one site with a count over 50 MPN. November 2018 counts included four sites in the moderate range and eight sites over 50 MPN. October 2019 sampling resulted in five sites with moderate counts and six sites with counts above 50 MPN. November 2019 sampling resulted in four sites with moderate counts and two sites with counts over 50 MPN.
- Winter (January-March): Overall, analysis suggests some improvement related to lower magnitude of high counts as compared to historic data. Similar to fall, elevated fecal bacteria counts are measured during and after rain events and when river flow increases. Winter season 2018 sampling resulted in only one moderate count of 23. Winter 2019 sampling resulted in counts below 12 MPN for all sites. January 2020 sampling resulted in eight sites with moderate counts and three sites above 50 MPN. February 2020 sampling resulted in six sites with moderate counts and one site above 50 MPN.

Harvest Status and Season Critical Conditions

Washington State Department of Health (DOH) annually reviews marine water quality data and potential pollution sources for commercial shellfish growing areas. Reviews assess whether conditions meet the growing area's classification status, with the classification determining whether shellfish can be harvested for people to eat. In Portage Bay, DOH reviews and classifies the growing area in consultation with the Lummi Nation.

Portions of the Portage Bay Shellfish Growing Area are classified as:

- Approved: Year-round harvest is allowed for human consumption; an Approved classification authorizes commercial shellfish harvest for direct marketing.
- Conditionally Approved: Closed to commercial harvest October 1-December 31 each year; also closed to ceremonial and subsistence harvest October 1-December 31; open to harvest January 1-September 30 each year (Figure 7).

Portage Bay's 2019 Annual Shellfish Growing Area Review determined that marine water monitoring stations meet necessary criteria, but stations 52, 57, and 58 are threatened with a downgrade in classification. In addition to annual reviews for individual growing areas, DOH prepares Early Warning System Summary reports that highlight marine water sample stations where water quality is "threatened" or "of concern." The 2020 Whatcom County Water Quality Early Warning System Report summarizes the threatened status of Portage Bay's marine monitoring stations 52, 57, and 58. The fall 2019 (Sept-Nov) and January 2020 high fecal bacteria counts in the marine water described previously contributed to the increasing trend in the geometric mean and estimated 90th percentile at each of these three sites, leading to their classification as *threatened*.

Contributing Factors and Observations

Ensuring Data Quality

Sampling procedures, timing, and location, laboratory procedures, and environmental variability all introduce scientific uncertainty into water quality monitoring programs. B.C. and WA have worked together over the past two years to ensure high quality monitoring data is collected and to assess the data comparability from multiple sampling programs. In its first year, the TCG compared monitoring procedures and quality assurance plans (see References). Evaluation determined that B.C. and WA agencies and organizations conducted monitoring using similar procedures and methods. The following activities were identified to continue this quality assurance in the second year of the workplan:

- Coordinate and prioritize monthly ambient sampling to occur on the same day in B.C. and WA.
- Compare laboratory variability by splitting water samples for analysis at both B.C. and WA labs (see below).
- Evaluate border sampling coordination between jurisdictions by statistically comparing datasets from geographically close B.C. and WA sites to determine if site data can be used interchangeably.
- Include B.C. 5-in-30 day sampling during key seasons for tracking the progress of meeting the border benchmark.

One remaining workplan follow-up activity was not completed as planned during spring 2020 due to COVID-19 related international travel restrictions; it will be conducted in 2020 as travel allows:

- Conduct multi-agency same site duplicate samples to evaluate comparability of data.

To evaluate data comparability, B.C. collected split samples at three sites in November 2019 and submitted the samples to ALS Lab (B.C.) and to Exact Lab (WA). All samples were tested for the following nine parameters using the same methods: pH, total suspended solids, turbidity, chloride, nitrate and nitrite, nitrate, nitrite, *E. coli*, and fecal coliforms. The results from the three sites were all within a relative percent difference of 20 percent except for two *E. coli*, two fecal coliforms, and two TSS results. These results were expected as these parameters do not perform well in split samples given the nature of *E. coli*, fecal coliform, and TSS data and the difficulty in replicating using the membrane filtration methodology. These split sample results confirm the comparability of laboratories in each jurisdiction.

Influence of Season and Weather

Monitoring results demonstrate seasonal differences in fecal bacteria concentrations in each of the sub-basins (Figure 8). Understanding these seasonal differences allows us to focus our work on specific times of year that are critical for reducing fecal bacteria concentration and thus protecting downstream water quality and shellfish harvest use. The seasonal differences in fecal bacteria concentrations are largely due to seasonal variability of four factors:

1. Rainfall;
2. Flow;
3. Soil saturation[3]; and,
4. Seasonal land management activities or practices.

[3] Whatcom Conservation District is coordinating with U.S. Department of Agriculture Natural Resources Conservation Service and with Washington State University to complete further work to address the question of soil saturation and its impact on runoff and surface water quality. Since October 2019, new soil probes have been installed at four locations in Whatcom County agricultural lands to better understand soil moisture throughout the year.

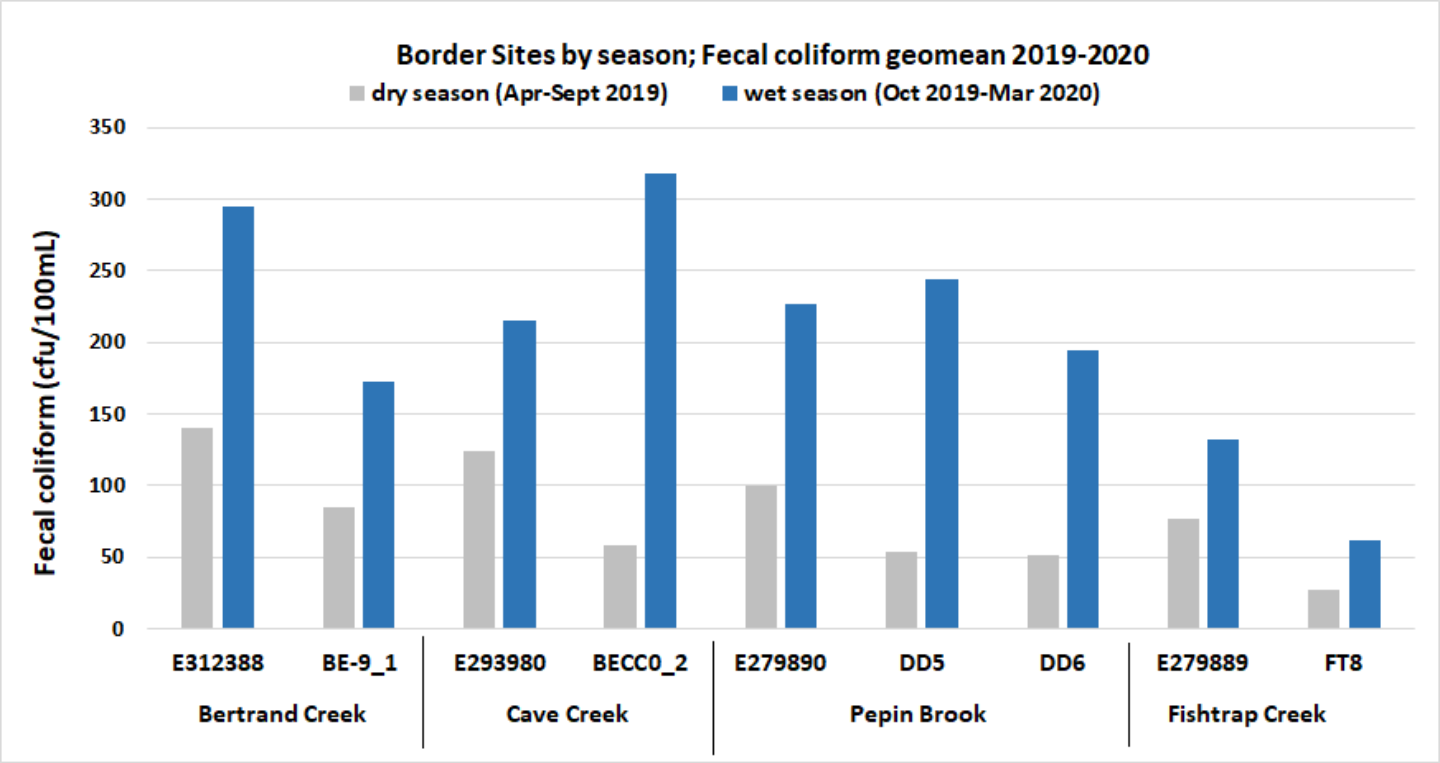

Figure 8. Average concentrations (geometric mean) of fecal coliform at the border sites by wet season (Oct-Mar) and dry season (Apr-Sept). B.C. monitoring sites precede WA monitoring sites for each waterway; evaluation based on monthly ambient dataset. Fecal coliform mean concentrations are two to six times higher in the wet season than the dry season for every border site.

Within any season, rainfall can result in runoff from the land and elevated fecal bacteria concentrations. Generally, monitoring dates that follow rainfall days (at least 0.33 inches or 10 millimeters in 24 hours) show higher fecal bacteria concentrations across sites. However, low flow conditions can also result in elevated fecal bacteria concentrations because the fecal bacteria load is not diluted by large flow volumes. This is the case in some of the uppermost sites in B.C. where dry season fecal bacteria concentrations are higher than wet season fecal bacteria concentrations due to minimal dry season flows. For these reasons, seasonal calculations of fecal bacteria loading (rather than concentration) can be useful and are being considered as a workplan activity (Monitoring tasks, Appendix 2). Further work to identify loading at these sites and the border sites is currently underway.

Outreach and Compliance Promotion

B.C. and WA partners conducted outreach activities and promoted compliance throughout the watershed during the second year of this project. A joint TCG outreach subcommittee held two meetings to share information and materials. Through different regulatory and stewardship structures, each jurisdiction delivered messages and assistance to help residents and businesses reduce preventable fecal bacteria from various sources. COVID-19 restrictions on both sides of the border beginning March 2020 limited in-person contacts and events and prevented fulfillment of some planned spring 2020 outreach and stewardship activities.

North of the border, B.C.'s outreach and compliance promotion focused on the new Code of Practice for Agricultural Environmental Management (new agricultural rules). B.C. government staff attended events and forums to promote the new agricultural rules as well as raise awareness of the Nooksack project. This promotion was delivered via the following communication mediums and events and targeted agricultural associations, community members and local farmers. Many of these agricultural associations also promoted the new agricultural rules to their members. In addition, because of the new agricultural rules, all Environmental Farm Plan (EFP) documents were updated to reflect the current rules.

Social media

- B.C. Agricultural Research and Development Corporation (ARDCorp) promoted new rules monthly using Facebook, Instagram, and Twitter.
- B.C. ENV promoted booths at upcoming community events and announced the posting of project related reports.

Website

- B.C. Ministry of Agriculture (AGRI) and ENV updated websites with new rules, maps, and nutrient management tools. Web analytics showed an increase in visitors to the promoted webpages after community events.
- B.C. ENV also posted the project's annual report and related water quality reports.

Publications

- B.C. provided articles and advertorials that were published five major B.C. agricultural publications to promote new agricultural rules.
- B.C. Agriculture Council provided monthly updates to members.
- B.C. created a new On-Farm Composting Guide.
- B.C. updated the Land Management Guide.

Educational and community events

- B.C. presented or displayed at nine local events to engage with the community and local farmers.
- B.C. presented the new farm rules at six agricultural association meetings.

In Washington, Whatcom County Public Works and Whatcom Conservation District led non-regulatory outreach to communicate that protecting water quality takes community effort. Messages promoted community benefits of addressing preventable fecal bacteria pollution from farm animals and manure use, septic systems, pet waste, small city storm and wastewater management systems, and urban wildlife. Regulatory agency compliance work included sharing information about water quality protection rules and ways to reach and to stay in compliance with rules. Regulatory and non-regulatory agencies worked together to pair information about requirements with information about tools, technical assistance, and financial incentives to help landowners act to prevent pollution. (See Work Plan activity summary for WA regulatory agencies).

Data sharing – Mapping and communication:

- WA agencies posted preliminary fecal coliform monitoring data to an online, interactive map.
- Whatcom County Public Works and Whatcom Conservation District produced and shared data summaries.

Farms – Outreach, technical assistance, and financial incentives:

- Whatcom Conservation District (WCD) provided technical assistance to 59 non-dairy agriculture properties and completed 26 farm plans. WCD provided technical assistance to 16 dairies and continued to help other dairies put in place best management practices (BMPs) through the federal Environmental Quality Incentive Program (EQIP) and state cost-share programs.

- WCD provided no cost soil tests, tarps to cover manure piles, and a manure spreader loan program; with Whatcom County Public Works administered small farm best management practice rebates and small farm cost-share program.
- WCD hosted monthly farm speaker series workshops, an online Farm Expo, promoted use of the manure spreading advisory, and with Washington State Department of Agriculture, hosted a dairy nutrient management training.
- WCD carried out a Farm Smart campaign through e-news, social media posts, mailings, events, radio interviews, and landowner spotlights.
- WCD partnered with watershed improvement districts, Whatcom Family Farmers, and Darigold to share water quality and farm education opportunities with agriculture community members.

Septic systems – Technical and financial assistance:

- Whatcom County Health Department (WCHD) hosted in-person workshops and online training to qualify participants to self-inspect their septic systems; during 2019, WCHD trained 1,248 homeowners to evaluate their septic systems and sent out system evaluation reminder letters to 5,178 sites in the Nooksack River watershed.
- Attending a workshop allows participants to be eligible for rebates related to septic system evaluation and maintenance work.
- Whatcom County Public Works and WCHD continued a social marketing campaign to increase awareness of and compliance with system evaluation requirements; during 2019, WCHD received 4,864 Reports of System Status related to evaluations completed for septic systems within the Nooksack River watershed.

Community education and outreach:

- Whatcom Clean Water Program partner agencies shared stewardship information with the public at two September 2019 Whatcom Water Week events and a December 2019 shellfish celebration.
- Whatcom County Public Works published a monthly E-newsletter; led social marketing campaigns for pet waste cleanup and septic system maintenance; campaigns used social media, signage, mailings, and incentives.
- Whatcom Conservation District (WCD) conducted school youth education sessions using a mobile watershed model; WCD worked with cities of Lynden and Ferndale to conduct stormwater education; coordinated citizen science volunteer water quality monitoring in Lynden/Fishtrap watershed; maintained Wildlife Tracker app.
- Washington State Department of Agriculture Dairy Nutrient Management Program staff maintained a story map with data, interpretation, and resource links.

Recommendations

The first annual report recommended workplan changes that TCG members mostly completed during the project's second year. Due to spring 2019 COVID-19 international travel restrictions, TCG members were not able to complete the workplan task to conduct multi-agency same site duplicate samples to evaluate the comparability of data. This item will be completed when travel restrictions are lifted.

B.C. recommends WA conduct similar 5-in-30 sampling at border sites during the same 2020 wet season and 2021 dry season periods as B.C. During the fall 2020 wet season, WA will conduct 5-in-30 sampling for *E. coli* at border sites following similar frequency and timing as B.C. WA completion of 2021 dry season 5-in-30 border *E. coli* sampling will depend on future budget allowances. Similar B.C. and WA 5-in-30 sampling will help evaluate consistency of *E. coli* analysis and can inform comparison to B.C. water quality guidelines and to the short- and long-term border benchmarks.

The TCG will complete the workplan during the 2020-2021 final year of the project and discuss future work in this shared watershed beyond the dissolution of the TCG in August of 2021.

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Appendices

Appendix 1: BC WA Evaluation Standards Table

Evaluation Standards	Bacterial indicator*	Criteria	Data used for evaluation
Border benchmark (freshwater)	*Escherichia coli (E. coli)* colony forming units (CFU) per 100 milliliters (mL)	≤ 200 CFU/100 mL geometric mean – Short-term border benchmark to be achieved at border stations over two-years ≤ 100 CFU/100 mL geometric mean – Long-term border benchmark to be achieved at border stations within five years	5-in-30 seasonal sampling results Evaluation based on geometric mean calculation of five weekly samples collected over 30 days (known as 5-in-30); should apply to both wet and dry seasons used to calculate geometric mean
B.C. Recreational Water Quality Guideline freshwater)	*E. coli* most probable number (MPN) or *E. coli*/100 mL	≤ 200 *E. coli* / 100 mL; geometric mean concentration (minimum of 5 samples) **or** ≤ 400 E. coli / 100 mL; single sample maximum concentration	5-in-30 sampling results to determine geometric mean value; or single sample result
WA Surface Water Quality Standard to protect water contact recreational use – expires December 31, 2020 (freshwater) *E. coli will replace fecal coliform bacteria criteria to protect water contact recreation in fresh waters as described in next row.*	Fecal coliform CFU or MPN / 100 mL	≤ 100 CFU or MPN /100 mL geometric mean value **and** ≤ 10 percent of all samples (or any single sample when less than ten sample points exist) obtained within an averaging period exceeding 200 CFU or MPN / 100 mL	Monthly ambient sampling to determine annual geometric mean and annual 90th percentile
WA Surface Water Quality Standard to protect water contact recreational use - (freshwater)	*E. coli* CFU or MPN / 100 mL	≤ 100 CFU or MPN / 100 mL geometric mean value **and** ≤ 10 percent of all samples (or any single sample when less than ten sample points exist) obtained within the averaging period exceeding 320 CFU or MPN / 100 mL	Monthly ambient sampling to determine annual geometric mean and annual 90th percentile
WA - **National Shellfish Sanitation Program guidelines** to evaluate fecal bacteria levels in shellfish harvesting areas (marine waters)	Fecal coliform organisms/100 mL (fc/100 mL)	For year-round harvest (Approved classification): ≤ 14 fc/ 100 mL geometric mean **and** ≤ 43 fc/ 100 mL estimated 90th percentile	Monthly ambient data used to calculate geometric mean and estimated 90th percentile; evaluation uses a 30-sample dataset

*Units are retained from their relevant criteria. However, for comparison purposes, CFU/100ml, MPN/100mL and organisms/100 ml (fc/100 mL) are all considered equivalent units.

Appendix 2: Workplan Activities Summary

Red text denotes new activities for Year 2 (2019-2020) of the TCG workplan. Black text denotes ongoing activities from Year 1.

List of acronyms in workplan summary table:

Canada	**United States**
• AGRI - B.C. Ministry of Agriculture • ARDCorp – B.C. Agricultural Research and Development Corporation • EFP – Environmental Farm Plan • ENV - B.C. Ministry of Environment and Climate Change Strategy • LEPS - Langley Environmental Partner Society	• DOH – Washington State Department of Health • ECY – Washington State Department of Ecology • PDS – Whatcom County Planning and Development Services • PIC – Pollution Identification and Correction • WCD – Whatcom Conservation District • WCHD – Whatcom County Health Department • WCPW – Whatcom County Public Works • WCWP - Whatcom Clean Water Program • WSDA – Washington State Department of Agriculture

	BC/WA joint initiative
	British Columbia (B.C.) lead
	Washington (WA) lead

COMMUNICATION		
***TASK**: Periodic meetings or conference calls as necessary between B.C. management and Washington/local managers of the Pollution Identification and Correction program*		
Who	**Activities**	**Next Steps**
Joint	▪ Official TCG meetings: February and June 2020 o ENV and DOH co-chairs plan agendas, conduct meetings, track action items, and follow up.	▪ Continue twice yearly meetings.
ENV	▪ Every two to three months B.C. team coordinate work plan meetings.	▪ Continue meeting.
WCWP	▪ Twice monthly field staff meetings; once monthly pollution identification and correction (PIC) program manager meeting.	▪ Continue field staff and PIC manager meeting schedule.

TASK: *Increase non-regulatory engagement with the agricultural/rural residential community by participating in relevant events and forums. Take advantage of transboundary opportunities for outreach and promotional engagement at events in the Nooksack River watershed and Whatcom County*		
Joint	▪ No joint B.C./WA TCG participation in transboundary outreach event with ag/rural residential community. ▪ Formed outreach subcommittee to facilitate non-regulatory compliance promotion information exchange; shared online access to event schedules and farm planning and septic system education promotional materials. Outreach sub-committee met April 2020 to share work to date and plans. ▪ Joint participation in April 2019 North Puget Sound Pollution Identification and Correction (PIC) program meeting focused on source tracking tools; ENV staff participated by phone; meeting took place in WA.	▪ Continue to strengthen communication about opportunities for agency partners to collaborate on outreach and promotional engagement during 2020-2021 where agricultural and rural residential residents will be in attendance. ▪ Continue resource information exchange.
AGRI	▪ Contributes to and oversees Environmental Farm Plan (EFP) program and supports EFP workshops. Continue to support EFP events and forums. ▪ Updated the EFP documents to reflect the new agricultural rules.	▪ Continue to support EFP events and forums.
ENV	▪ Participated in outreach events and forums. ▪ Met with agricultural associations to explain the new agricultural waste rules (see Outreach and Compliance Promotion section above for details). ▪ Participated in EFP workshop.	▪ Continue to participate in events and forums with target audiences for the project's final year.

WCWP	▪ Hosted and participated in agricultural land use-related forums including workshops, farm tours, speaker series, online learning opportunities. ▪ Hosted and participated in community events to promote clean water goals: Fun Run, SeaFeast, Shellebration. ▪ Participated in routine meetings with Nooksack project area watershed improvement district representatives to share data and contact landowners. ▪ Conducted in-person and online homeowner training opportunities to support code-required septic system operation & maintenance actions. ▪ Carried out social marketing campaign to encourage septic system evaluations. ▪ Distributed septic system maintenance rebates; shared information about regional loan program to assist with septic system repair and replacement.	▪ Continue to promote clean water goals and availability of farm planning services, and financial help through rebates, grants, or cost-share programs. ▪ Adapt engagement and educational opportunities to address COVID-19 social distancing needs. ▪ Continue septic system owner educational opportunities, pursue compliance with code-required evaluations, and administer related financial incentive programs.
***TASK**: Expand Regional Operations Branch (ROB) Nooksack team. Invite non-ENV agencies to planning and work meetings*		
ENV	▪ Extended invitations to various local, federal and First Nation governments, provincial agencies, and stakeholders; provided updates after every TCG meeting and when reports are posted ▪ Met with representatives, shared monitoring results, and proposed promotional work.	▪ Continue to share implementation progress and work with representatives to implement the workplan.
***TASK**: Continue managing and improving a shared database for multi-agency water quality data, including online results mapping*		
WCWP	▪ Maintained multi-agency data submittal processes, ArcGIS layers, and collector apps to support online data mapping. ▪ Worked with laboratories to facilitate prompt online access to preliminary data to post to online map.	▪ Continue supporting Data Coordinator position. ▪ Continue multi-agency data team meetings to address challenges and improve water quality outcomes.
TASK: Identify and use an approved shared platform for producing B.C. and WA joint documents		
Joint	▪ Using Box™ for online collaboration and file sharing.	▪ Continue to use shared platform.
TASK: Compile a list of online resources and related projects to showcase the project's resource development and collaboration		
Joint	▪ See the compiled list of online resources and related projects (Appendix 3).	▪ Continue to add to this list for the 2020-21 report.

COMPLIANCE AND STEWARDSHIP		
***TASK**: Continue source identification and correction work (compliance inspections and compliance actions)*		
Who	**Activities**	**Next Steps**
Joint	▪ WCWP, led by WSDA, communicated to ENV high fecal bacteria results and/or visual observations of potential water quality concerns at border location sampling sites; ENV communicated plans and follow up results and inspected sites to determine sources of contamination. ▪ Communication resulted in source identification and/or plans for future monitoring.	▪ Continue communicating amongst WA and ENV TCG members to share water quality observations and follow up actions, evaluate and adjust sampling program, identify and address hotspots, track progress, and refer water quality concerns to additional agencies as needed.
ENV	▪ ENV completed follow up with previously inspected sites to determine compliance and escalated compliance responses when appropriate. ▪ ENV conducted new inspections at sites around fecal hotspot areas based on monitoring results to determine compliance and identify possible fecal bacteria sources. ▪ ENV conducted inspections to respond to complaint.	▪ Continue to inspect in fecal hotspot areas and follow up on past non-compliance inspections.
***TASK**: Set goal for reduced fecal coliform bacteria concentrations at border stations*		
Joint	▪ Established short-term and longer-term border benchmarks to reflect the targeted fecal bacteria concentration reductions at border monitoring locations. ▪ In B.C., the border benchmark was met for all sites except one in the summer and all sites in the fall.	▪ Continue to evaluate water quality data and track annual and seasonal progress relative to the border benchmark.
***TASK:** Promotional compliance project(s)*		
AGRI, ENV and LEPS	▪ AGRI and LEPS created On-Farm Composting Guide – promotional workshop postponed due to COVID19. ▪ LEPS updated the Land Management Guide. ▪ Creating a risk management plan for vulnerable areas, will work with TCG's non-regulatory outreach subcommittee to refine plan and coordinate implementation with applicable watershed programs. ▪ Connecting with other groups/projects that improve riparian areas in the watershed and discussing future support by ENV for this watershed work.	▪ Continue to promote compliance and provide guidance. ▪ Will present On-Farm composting guide at a workshop.
***TASK**: Education and Outreach Program on New ENV Regulations*		
ENV	▪ Promoted the new Code of Practice for Agricultural Management through the following mediums or events: o Social medium (Facebook, Instagram, Twitter)	▪ Continue to promote and provide guidance.

	○ ENV website ○ Magazine articles or advertorials ○ Various agricultural events.	
AGRI	▪ Updated the Environmental Farm Plan (EFP) documents to incorporate the new Code of Practice for Agricultural Management requirements.	
***TASK**: Environmental Farm Plan outreach and cost-sharing initiative in the Nooksack tributaries*		
AGRI ARDCorp	▪ Updated agencies and stakeholders in January 2019 on the Environmental Farm Plan (EFP) program in watershed. ▪ Delivered EFP training and workshops in watershed.	▪ Item complete.
***TASK:** Effectiveness assessment of Environmental Farm Plan Program [Beneficial Management Practices]*		
AGRI ARDCorp	▪ AGRI continues to oversee and assist EFP and annually reviews Best Management Practices to update when necessary.	▪ Continue to oversee and support EFP.
***TASK**: Target implementation of AGRI's Manure Spreading Advisory/Application Risk Management tool in Nooksack tributaries; develop nutrient management planning calculator and communicate to users*		
AGRI	▪ Distributed manure spreading advisories in 2018 and now replacing advisories with the Application Risk Management (ARM) tool, an adaptation of WA's ARM tool is developed specifically for an area of the province that includes the Nooksack River watershed. ▪ Developed, launched, and posted nutrient management planning calculator on ENV and AGRI websites. Presenting calculator to agricultural associations.	▪ Item complete.
***TASK:** Creation of a communication list for farm operations within the Fishtrap and Bertrand Creek watershed*		
ENV	▪ Identifying operations near vulnerable watershed areas to create a communication list.	▪ Continue to develop communication list.
***TASK**: Riparian Health Framework project to explore monitoring protocols for riparian health*		
AGRI	▪ Developed a pilot project on Bertrand Creek. ▪ Spring 2020 pilot in Bertrand Creek delayed due to COVID-19.	▪ Continue to expand on this project and present the findings.
***TASK**: Use a Living Lands/Discovery Farm approach to engage stakeholders*		
AGRI	▪ Agriculture and Agri-Food Canada is setting up a "Living Laboratories" initiative across Canada, and there was potential for applied research to be set up to address water quality issues in the Nooksack, but B.C. is not scheduled to have a Living Laboratory site until 2021.	▪ Item was removed from work plan.

***TASK**: Continue farm planning and cost-share funding initiatives*		
WCWP	▪ WCWP partners identified agricultural properties with water quality concerns for pollution identification and correction (PIC) program contact; WCD offered non-regulatory technical assistance. ▪ WCD and WCPW promoted farm planning services and offered incentives through soil tests, tarps to cover manure piles, rebates for qualifying practices, and cost-share program. ▪ WCD worked with farmers to produce farm plans and put in place water quality protection practices; technical assistance included working with dairy and crop producers related to manure and facility management.	▪ Support continued funding to deliver and expand farm planning and financial incentive programs to engage the agriculture community in clean water solutions.
***TASK**: Continue educating and reaching out to landowners about clean water goals; offer technical assistance and financial incentives to reduce pollution risk and encourage cooperative compliance*		
WCWP	▪ Field staff and outreach workgroup developed focused seasonal messages for fall 2019 and spring 2020. ▪ Outreach venues and methods included printed materials, events, social marketing campaigns, social media posts, pet waste kits, signage, radio ads, phone text alerts, online learning opportunities through Zoom webinars and Facebook Live, and links to online resources such as water quality results map and story map.	▪ Develop fall 2020 and spring 2021 focused messages for partners to deliver based on each agency's program role and responsibility. ▪ Continue multi-prong approaches to delivering coordinated messages.
***TASK**: Collaborate to maintain and improve online water quality results and data communication*		
WCWP	▪ Continued multi-agency data collection to support online mapping and hotspot follow up. ▪ Consistently made preliminary results available to the public via the online results map. ▪ Provided relevant and timely content to the public via WSDA StoryMap. ▪ Consistently created and posted monthly water quality summaries to the WCPW website.	▪ Continue improvements to the online data mapping of preliminary results, including the addition of DOH marine sampling results to the map. ▪ Include alerts for WSDA StoryMap in WCPW, WCD, and PDS newsletters. ▪ Conduct a survey of data users to understand how they are using the online resources.
***TASK**: Maintain regulatory backstop programs, including relevant outreach/technical and financial assistance components*		

WCWP	(numbers reported for this task are for calendar year 2019 within the Nooksack River watershed) Dairy - WSDA Dairy Nutrient Management Program ▪ Conducted 56 routine and follow up compliance inspections at 36 dairy facilities (32 in compliance or in compliance after following up; three new facilities (compliance not applicable at inspection time). ▪ Inspections included six investigations and review of records for compliance. ▪ Issued four warning letters (informal compliance) related to water quality or record keeping violations. ▪ Ongoing investigation and compliance work with four dairies that may result in formal or informal compliance actions. ▪ Offered technical assistance and/or referrals to WCD to address identified problems. Non-dairy agriculture ECY Water Quality Program ▪ Offered technical assistance to 24 landowners in response to water quality complaints and/or PIC program referrals. ▪ Visited eight properties. ▪ Issued 1 warning letter (informal compliance). Whatcom County PDS Related to Critical Areas Ordinance compliance: ▪ Requested landowners complete farm plans: five farm plans completed; three landowners working with WCD; seven moved agriculture land use from regulated critical area. ▪ Conducted annual review of farm plans; approximately 90 percent in compliance, with others no longer conducting agriculture on property. ▪ Issued three Notices of Violation.	▪ Continue routine and follow up inspections of dairy facilities and dairy record-keeping documents. ▪ Follow up on complaints and/or high fecal bacteria counts related to dairy operations. ▪ Continue work to improve efficiency and effectiveness of regulatory backstop programs for non-dairy agriculture land use sources of fecal bacteria pollution. ▪ Continue regulatory agency work with non-regulatory agencies offering technical assistance, rebate, and cost-share opportunities to encourage implementation and maintenance of water quality protection practices.

***TASK**: Assess effectiveness of management practices*		
WCWP	▪ WCD continued conducting a multi-year, controlled edge-of-field monitoring study (Discovery Farms Washington: Edge of Field Monitoring). See more information in Appendix 3.	▪ Perform a needs assessment for effectiveness monitoring. ▪ Based on assessment results, incorporate effectiveness monitoring into future implementation projects as resources allow.
***TASK**: Continued administration of OSS compliance efforts; operations & maintenance program (regular system evaluations) including repair/replacement of failing systems; oversight of OSS design and installation; financial incentives*		
WCWP	▪ WCHD administered Whatcom County's On-Site Sewage system (OSS) operation & maintenance (O&M) program including permitting, conducting homeowner OSS education classes, evaluating reports of system status, notifying landowners of OSS evaluation requirements, ensuring failing systems are repaired or replaced, and sharing information about rebates and regional loan program. ▪ WCHD responded to complaints and to PIC program referrals to address possible human waste sources of fecal bacteria pollution. ▪ If human waste source identified, WCHD followed up using agency enforcement protocols. ▪ WCPW and WCHD cooperatively administered a rebate program for OSS O&M actions.	▪ Continue OSS compliance efforts, including landowner contacts and follow-ups. ▪ Continue to adapt homeowner training and rebate eligibility in response to COVID-19 social distancing needs.
MONITORING		
***TASK**: Continue source identification sampling to identify fecal coliform sources*		
Who	**Activities**	**Next Steps**
Joint	▪ WA continued to collect storm event samples at 9 border sites. ▪ WA increased the frequency of sampling of the Bertrand and Cave Creek border sites by adding a monthly 'focus area' sample run. ▪ B.C. conducted additional targeted sampling based on unusual site conditions and/or information received about specific sites in the watershed. ▪ Additional bacterial source tracking (BST)/microbial source tracing (MST) sampling by B.C. in these watersheds for environmental DNA analysis. ▪ B.C./WA communicate following high results at the border which can result in additional sampling.	▪ Continue to consider source ID sampling data with field condition information to better characterize critical conditions and potential pollution sources. ▪ B.C. will continue to coordinate and communicate internally with Compliance and Authorization departments. ▪ WA to continue storm event sampling.
***TASK**: Continue long- and short-term ambient sampling in freshwater and in shellfish growing areas*		

Joint	▪ B.C. and WA performed monthly ambient sampling throughout the annual data reporting period (April 2019-March 2020). ▪ Coordinated WA freshwater sampling in the Nooksack River watershed with monthly DOH and Lummi Natural Resources marine sampling in Portage Bay. ▪ B.C. sampled monthly at 19 stations on Bertrand and Fishtrap Creeks and Pepin Brook, including four sites on the Canada-US border. ▪ B.C. and WA coordinated on same-day sampling on 12 events during the annual data reporting period. ▪ B.C. completed two sampling events for establishing and tracking progress towards a border benchmark and evaluating seasonal trends in data, one sampling event is within the annual data reporting period. ▪ B.C. and WA data subcommittee continues to coordinate monitoring, data sharing and collective analysis. ▪ B.C. and WA continue to share sampling plans and standard operating procedures.	▪ Continue coordination of sampling dates for monthly ambient sampling, where possible. ▪ Data subcommittee will continue to evaluate trends in ambient data (twice annually). ▪ B.C. will continue its twice annual border benchmark sampling on border sites.
***TASK**: Microbial/bacterial source tracking project (BST/MST)*		
ENV	▪ B.C. collected additional BST water samples and analyzed 16S and Shotgun, and collected additional scat samples to expand the existing library.	▪ Evaluation of results for gap analysis and potential additional sampling. ▪ Communicate additional results to key partners for education and compliance promotion and audits.
***TASK**: Research and evaluate usefulness of source tracking methodologies (e.g. microbial source tracking, metagenomics, ZAPS)*		
WCWP	▪ WCD/Exact Scientific Services completed a July 2019 report detailing work to develop a fecal source reference library. Report is available at WCD research page (Appendix 3). ▪ WCPW and WCD began using Coliscan Easygel method to test water samples for *E. coli*; useful as an inexpensive tool to inform follow up.	▪ Continue exploring source identification tools and making use of tools determined to be helpful and cost effective. ▪ Communicate final results to key partners and the public.
***TASK:** Coordinate and prioritize sampling events to occur on same day north and south of border at least once monthly*		
Joint	▪ B.C. and WA staff are sampling monthly on same dates; pre-scheduled coordination sent well in advance of sampling.	▪ Will continue to coordinate sampling, as possible.
***TASK:** Compare laboratory variability by splitting water samples for analysis at both B.C. and WA laboratories*		

Joint	▪ B.C. collected split samples at three sites in November 2019 and submitted the samples to ALS Lab (B.C.) and Exact Lab (WA). The relative percent difference for the results at the three sites were all below 20 percent except for two *E. coli*, two fecal coliforms, and two TSS results.	▪ Item complete.
TASK: *Conduct multi-agency same site duplicate or replicate samples to evaluate comparability of data*		
Joint	▪ Was not completed in the past year due to COVID-19 related international travel restrictions.	▪ Will complete in 2020-2021 as travel regulations allow.
TASK: *Evaluate border sampling coordination between jurisdictions:* *a. Prioritize sampling sites* *b. Statistically compare datasets from geographically close B.C. and WA sites to determine if site data can be used interchangeably* *c. Determine if sampling sites can be removed or more sites added* *d. Include required 5-in-30 day sampling during key seasons*		
Joint	a. Monthly sampling data is used to calculate site statistics and prioritize sites for follow up work. b. Datasets from adjacent sites have been evaluated; this work is ongoing. Some discrepancies exist due to differences in sampling dates, but generally the sampling programs produce comparable datasets for each site. c. B.C. and WA conduct review of all sampling sites (at least annually) to determine whether sites should be added or removed, based on sampling results. Sampling sites are added based on concerns within a specific area. d. B.C. conducts 5-in-30 day sampling twice per year: wet season (Nov/Dec) and dry season (May).	▪ Will continue to conduct annual evaluation of sites and follow up on areas of interest. ▪ Statistical comparisons of datasets in ongoing.
TASK: *Gather hydrogeological information to understand loading from Canadian portions of Bertrand and Fishtrap watersheds to downstream WA tributaries and to the mainstem Nooksack River*		
Joint	▪ B.C. and WA to predict concentrations using data at the mouth of the Nooksack River and evaluate loadings from both sides of the border and dilution with the full flow of the Nooksack.	▪ In progress

Appendix 3: List of Online Resources and Projects

Federal	Agency/Organization	Description
Mapping Updates-Watershed Delineation and Stream Network Adjustments	Natural Resources Canada/ENV/Whatcom County	A contiguous stream network and updated watershed boundary delineation for the Nooksack River watershed is being completed by NRCAN partners
Habitat Improvement Grants	Department of Fisheries and Oceans	Small amounts of funds are available for riparian area improvements relating to the Nooksack Dave and Salish Sucker Critical Habitat areas
Weather data	Environment Canada	Aldergrove, B.C. https://weather.gc.ca/past_conditions/index_e.html?station=yxx
Puget Sound Action Agenda	US Environmental Protection Agency	Resources for protecting and restoring Puget Sound https://www.epa.gov/puget-sound
Environmental Quality Incentives Program	USDA Natural Resources Conservation Service	Financial and technical assistance to agricultural producers to address natural resource concerns https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/financial/eqip/
Streamflow data	US Geological Survey	USGS WaterWatch (Includes Fishtrap @ Kok Road and Bertrand @ H Street) https://waterwatch.usgs.gov/?m=real&r=wa

Provincial/State	Agency/Organization	Description
Nutrient Management Calculator	AGRI	Provides a starting point for the efficient use of fertilizer and manure on farms and assists in choosing the right rate and nutrient source for crops https://www2.gov.bc.ca/gov/content/industry/agriculture-seafood/agricultural-land-and-environment/soil-nutrients/nutrient-management/nutrient-management-calculator
Manure Application Risk Management Tool	AGRI	The B.C. Application Risk Management (ARM) Tool is an online application risk assessment tool that allows producers to quickly determine the risk of manure or nutrient loss after a field application https://www2.gov.bc.ca/gov/content/industry/agriculture-seafood/agricultural-land-and-environment/soil-nutrients/nutrient-management/what-to-apply/manure-application-seasonal-restrictions/instructions-for-using-the-bc-arm-tool

On-Farm Composting	AGRI	On-Farm Composting in British Columbia – Step-by-Step Guide for Small to Medium-Sized Farm Operations https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/agriculture-and-seafood/agricultural-land-and-environment/waste-management/manure-management/composting_guide.pdf
Water Quality Mapping	ENV	Web map for water quality results throughout B.C. https://governmentofbc.maps.arcgis.com/apps/webappviewer/index.html?id=0ecd608e27ec45cd923bdcfeefba00a7
Shellfish Program	Washington State Department of Health	Shellfish growing area maps, monitoring, and restoration information https://www.doh.wa.gov/communityandenvironment/shellfish DOH marine data records can be accessed at ftp://ftp.doh.wa.gov/MarineWater/PreliminaryWaterData/ or results can be viewed on the commercial shellfish Map Viewer https://fortress.wa.gov/doh/oswpviewer/index.html
Puget Sound Nutrient Reduction	Washington State Department of Ecology	Multi-stakeholder nutrient forum to agree on ways to reduce nutrient sources and improve Puget Sound water quality https://ecology.wa.gov/Water-Shorelines/Puget-Sound/Helping-Puget-Sound/Reducing-Puget-Sound-nutrients/Puget-Sound-Nutrient-Reduction-Project
Streamflow data	Washington State Department of Ecology	Water Resource Inventory Area 1 Nooksack River Basin instream flow data https://fortress.wa.gov/ecy/eap/flows/irpp-wria.asp?id=01 Flow and precipitation for Bertrand Creek near mouth https://fortress.wa.gov/ecy/eap/flows/station.asp?sta=01n060
Dairy Nutrient Management	Washington State Department of Agriculture	Water quality program requiring licensed cow dairies to develop and implement nutrient management plans https://agr.wa.gov/departments/land-and-water/livestock-nutrients and https://agr.wa.gov/departments/land-and-water/livestock-nutrients/nutrient-management-plans
Data mapping and interpretation	Washington State Department of Agriculture	Dairy Nutrient Management Program staff created and maintain a story map to share water quality results, interpret data, and provide links to resources https://nras.maps.arcgis.com/apps/MapJournal/index.html?appid=d191d07f2cbf47e9a54e78c78c06c1a8
Weather data	Washington State University	AgWeatherNet https://weather.wsu.edu/?p=88650

Local/Municipal/Regional	Agency/Organization	Description
Ecological Services Initiative	Township of Langley / Farmland Advantage	Pilot project included 10 farms. Initiative focusses on integrity of riparian areas and compensating farmers for the ecological value it provides. https://langleysaf.ca/projects/ecological-services-initiative/
Septic System Awareness	Fraser Valley Health Aut	https://www.fraserhealth.ca/health-topics-a-to-z/onsite-sewerage-systems#.XpkREshKiUk
Septic System Awareness	Fraser Valley Regional District	https://www.fvrd.ca/EN/main/services/sewer-septic.html
Discovery Farms Washington: Edge of field monitoring	Whatcom Conservation District	Multi-year research project to understand best management practices effects on field runoff of sediment, bacteria, and/or nutrients. https://www.whatcomcd.org/research-projects https://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/water/quality/tr/?cid=stelprdb1240285
DNA molecular source tracking	Whatcom Conservation District	Project to test if DNA of fecal bacteria in waterways can accurately identify sources of fecal pollution https://www.whatcomcd.org/sites/default/files/research/WSCC_DNAProject_FinalReport_071119_FINAL_Posted.pdf
Manure Spreading Advisory	Whatcom Conservation District	Guidance for determining when applying manure is advisable https://www.whatcomcd.org/msa
Data mapping	multi-agency	Interactive map to view preliminary results from multi-agency fecal coliform sampling of surface water http://whatcomcounty.us/2618/Interactive-Water-Quality-Maps and https://nras.maps.arcgis.com/apps/webappviewer/index.html?id=5395274198aa4365b96fbaf01b4db43b
Septic system maintenance and operation	Whatcom County Health Department	Evaluation requirements, financial assistance, and homeowner training opportunities https://www.whatcomcounty.us/1744/Operation-and-Maintenance-OM
Watershed improvement districts	Ag Water Board	Special purpose districts to address issues that impact agricultural landowners https://www.agwaterboard.com/
Multi-agency partnership to reduce	Whatcom Clean Water Program	Program overview including partner list http://whatcomcounty.us/DocumentCenter/View/41596/WhatcomCleanWaterProgram

fecal bacteria pollution		

Industry Programs	Agency/Organization	Description
Environmental Farm Plan	ARDCorp	Voluntary assessment and certification process. https://ardcorp.ca/programs/environmental-farm-plan/
Riparian Management	B.C. Agricultural Council	Riparian Management Field Workbook

Non-Profit Program	Agency/Organization	Description
ManureLink	Langley Environmental Partners	Tips for manure storage and use. Advisors available for on-farm help. http://www.manurelink.com/
Land Management Guide for Horse Owners and Small-Lot Farmers	LEPS/AGRI	Updating 2007 version https://www.leps.bc.ca/wp-content/uploads/2015/04/Land-Management-Guide-web.pdf
Horse Manure Management	Horse Council of B.C.	Linked to Horses for Clean Water Washington
Information Sharing	Langley Small Farm Network	https://www.facebook.com/LangleySmallFarmNetwork/
Salmon Safe Certification	Salmon Safe B.C. (Pacific Salmon Foundation, Fraser Basin Council	Salmon-Safe recognizes the practices of farmers who help protect stream habitat and water quality. Farm certification – One farm in Aldergrove certified. https://salmonsafe.ca/
Shared Water Alliance	Multi-party	Informal working group first formed more than a decade ago.
Public Awareness and Engagement	Bertrand Creek Enhancement Society	Events, work parties, educational tours http://www.bertrandcreek.ca/
Citizen advocacy	Tenmile Clean Water project	Citizen group to improve water quality in the Tenmile Creek sub-basin of the lower Nooksack River watershed https://tenmilecleanwater.org/

Appendix 4: Monthly Monitoring Data Summary: April 2019 through March 2020

				E. Coli (CFU/ 100 mL)				Fecal Coliforms (CFU/ 100 mL)			
Site Name	Sample ID (EMS)	Creek	n	range	12M GM	90th %	% > 1000	range.	12M GM.	90th %.	% > 1000.
Bertrand Creek D/S of Aldergrove Lagoon	E207092	Bertrand	11	40-2900	235	1080	18%	52-2900	306	1080	18%
#2 Howe's Creek Upstream W of 272nd	E206847	Bertrand	12	27-4000	356	1236	33%	57-6000	544	3460	42%
Bertrand Creek at 16 Ave. Langley	E273723	Bertrand	11	14-2500	242	1700	27%	16-3800	356	3400	36%
Cave Creek 248th (C-01)	E315155	Cave/Bertrand	12	9-2700	181	1170	17%	10-8700	243	2640	25%
Cave Creek (Bertand) at 0 Ave.	**E312388**	Cave/Bertrand	11	6-800	117	600	0%	7-8700	210	1200	18%
BC3 Bertrand Creek at 0 Ave.	**E293980**	Bertrand	12	4-2600	94	1545	17%	4-2700	164	2505	33%
Cave Creek at 0 Ave.	**BECC0.2**	Bertrand Creek	12					7-3200	118	789	8%
Bertrand Creek at 0 Ave.	**BE-9.1**	Bertrand Creek	12					10-1200	114	474	8%
Bertrand Creek at H St	BH	Bertrand Creek	2					219-280	248	274	0%
Bertrand Creek at Berthusen Park	BHPB	Bertrand Creek	2					14-240	58	217	0%
Bertrand Creek at Rathbone Rd.	B1	Bertrand Creek	27					10-5900	107	800	11%
Pepin Creek Lefeuvre S Huntington (P-02)	E315157	Pepin	12	9-11000	187	9070	17%	13-85000	395	30830	33%
Pepin Creek Tributary	E309447	Pepin	12	2-19000	297	2950	33%	2-25000	481	4000	42%
Pepin Creek in Aldergrove Park	E253211	Pepin	12	2-6000	131	2733	25%	2-6000	160	4560	17%
Pepin at International Boundary	**E279890**	Pepin	12	6-900	106	708	0%	11-1900	150	600	8%
Double Ditch West at Boundary Rd.	**DD5**	Pepin Creek	15					2-8400	120	3680	20%
Double Ditch East at Boundary Rd.	**DD6**	Pepin Creek	15					2-9200	104	3620	13%
Double Ditch West at Pine St	DDW	Pepin Creek	16					2-2100	78	1100	13%
Double Ditch East at Pine St	DDE	Pepin Creek	15					2-2100	43	420	7%
Double Ditch at E. Main St.	F3	Pepin Creek	23					3-2100	71	358	4%
Waechter Creek Near Simpson Rd Extension	E310908	Fishtrap	9	13-12000	221	2768	11%	15-53000	438	11264	11%
Fishtrap At Echo Rd	0300069	Fishtrap	12	11-1400	63	552	8%	14-1800	93	573	8%
Fishtrap Creek at Ross Rd S of Huntington Rd	E315795	Fishtrap	12	8-1700	99	1290	17%	8-1800	117	1571	17%
Fishtrap Creek at International Boundary	**E279889**	Fishtrap	12	3-1100	65	671	8%	4-16700	101	965	8%
Fishtrap Creek at Northwood Rd.	**FT8**	Fishtrap Creek	15					4-500	42	230	0%
Fishtrap Creek at Badger Road	FT4	Fishtrap Creek	22					8-1100	88	389	5%
Fishtrap Creek at River Road	F1	Fishtrap Creek	25					5-600	120	406	0%
Mainstem @ Everson	M5	Mainstem	27					2-118	13	72.8	0%
Mainstem @ Lynden	M4	Mainstem	27					2-114	16	65.6	0%
Mainstem @ GM	MGM	Mainstem	27					2-88	20	78.4	0%
Mainstem @ Ferdale	M2a(M2)	Mainstem	27					2-230	22	140	0
Mainstem @ Marine Drive	M1	Mainstem	24					2-200	16	91	0

NOTES

Site IDs in Bold are the border sites where the 2-year border benchmark applies for attainment 5-in-30 sampling results

For the BC sites, range, 12M GM, and 90th percentiles were calculated from routine monthly sampling and did not include attainment 5-in-30 sampling results.