

SECTION 2

Coliform bacteria



A lake re-emerges: Analysis of contaminants in the *Semá:th Xó:tsa* (Sumas Lake) region following the BC floods of 2021
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COLIFORM BACTERIA

Capsule

Coliform bacteria from humans, livestock and/or wildlife have degraded surface waters of the former *Semá:th Xó:tsa* (Sumas Lake), rendering them unsafe to drink or play in. Fecal coliform and *E.coli* appeared to increase during the course of our study, suggesting that the catastrophic British Columbia floods of late 2021 may have caused a release of these biological pollutants into fish habitat. Further work to track bacteria back to source type, along with the determination of other contaminants of concern, will enable solutions that protect and restore fish habitat in the area.

Introduction

The catastrophic floods of late 2021 in British Columbia and Washington State overwhelmed urban, agricultural and industrial infrastructure in the *Semá:th Xó:tsa* (Sumas Lake) area, raising concerns about the impacts of contaminant discharges into fish habitat. The absence of pre-flood baseline data and ongoing monitoring of freshwater quality in the area highlighted the urgent need for water sampling and analysis to assess the level of risk to fish and the environment.

Coliform is a general name for bacteria found in the environment that provides an indication of contamination for livestock, wildlife or humans. As measured, total coliform is a collection of different coliform species in the environment. Fecal coliform is a total measure of coliform found in the gut and

feces or warm-blooded animals. *E. coli* is the primary coliform species found in feces. As the latter does not grow on its own in the environment, its measurement provides the best indicator of fecal pollution and of the presence of other pathogens.

Coliform measurements provide an indication of coliform bacterial contamination from all sources, including human, livestock, wildlife and environmental. Fecal coliform provides an indication of the presence of coliform from the gut of mammals. *E. coli* provides a specific indication of recent fecal contamination from mammals, including humans, livestock and wildlife. While some strains of *E. coli* are harmful, its detection in water signals the potential presence of other dangerous microorganisms including bacteria, viruses and parasites.

Methods

We collected 27 surface water samples from 11 sites in the Sumas Lake area of the Fraser Valley (British Columbia; 10 on December 15, 2021; 9 on December 23, 2021; 6 on January 27, 2022; and 2 on February 2, 2022), as well as 4 groundwater samples on February 2, 2022. Two of these samples from Abbotsford groundwater sources will be evaluated separately. Details for sampling sites are listed in the Executive Summary. Samples were stored in the field at 4°C in suitable containers supplied by partnering laboratories, and delivered the same day to CARO Analytical Services in Richmond, BC (CARO Analytical Services - Water, Soil, Air, Plant, Food Testing) for analysis according to their SM 9223 protocol (2017). Data are presented as Mean Probable Number (MPN) per 100mL.

We report here results for three coliform measures:

- » total coliform, which provides an indication of overall bacteria of this kind in the sampled environment;
- » fecal coliform, which provides a measure of bacterial contamination from warm-blooded animals; this can include pets, livestock, wild birds and people;
- » *E. coli*: this is a measure that is similar to fecal coliform but provides a more specific indication of bacterial contamination from warm blood animals. This latter method is now the preferred means of reporting on risks from human wastewater.

There are no pan-Canadian Environmental Quality Guidelines to protect fish and fish habitat from coliform. Guidelines exist for human uses, including drinking water and recreational uses. Generally, on-reserve guidelines used by the First Nations Health Authority (1) are sourced from Canadian Drinking Water Quality Guidelines (2), while all off-reserve Drinking Water in BC draws from BC Water Quality Guidelines (3).

The following provide guidance on the interpretation of water quality results in the Sumas Lake area:

- » Canadian Drinking Water Quality Guideline - used by BC: no detectable *E. coli* in drinking water.
- » Canadian Recreational Water Quality (5) - used by BC for *E. coli*: <200 Mean Probable Number (MPN) per 100 mL average of five samples or <400 MPN/ 100 mL per single sample.
- » Canadian Irrigation Water Standards for *E. coli*: <1000 MPN/ 100 mL.
- » BC Ministry of Environment and Health Canada standards for crops eaten raw for *E. coli*: <77 MPN/ 100 mL.

Results

We found no to very low (0-2 MPN coliform per 100 mL) coliform levels in surface waters at the reference site (Frost Creek), but much higher levels at all other surface water sites.

- » Average total coliforms ranged from 1.5 MPN at the reference site at Frost Creek to an average 962 MPN across the 10 downstream surface water sites of the former Sumas Lake;
- » Average fecal coliforms ranged from 0.7 MPN at the reference site at Frost Creek to 885 MPN across the 10 downstream surface water sites of the former Sumas Lake. Average *E. coli* ranged from 0.5 MPN at the reference site at Frost Creek to an average of 885 MPN across our 10 surface water sites in former Sumas Lake;
- » Coliform counts in groundwater 457 were >2420 MPN (total coliform), 3MPN (fecal coliform) and 2 MPN (*E. coli*);
- » Coliform counts in groundwater 008 were 24 MPN (total coliform), 0 MPN (fecal coliform) and 0 MPN (*E. coli*);
- » Average total coliform counts declined by 25% (0.8 times) between December 15 and December 23 (2021) across all surface water sites in former Sumas Lake;
- » Average fecal coliform counts increased by 242% (2.4 times) between December 15 and December 23 (2022) across all surface water sites in former Sumas Lake;
- » Average *E. coli* counts increased by 338% (3.4 times) between December 15 and December 23 (2022) across all surface water sites in former Sumas Lake.

The presence of high numbers of fecal coliform and *E. coli* in surface waters downstream of the reference site provide a clear indication of potentially dangerous microorganisms from livestock and/or humans from nearby agricultural operations and homes.

Figure 2.1: Coliform bacteria contaminate Sumas waterways

Numbers of all three coliform metrics were low at the upstream surface water reference site (Frost Creek), but increased in the Sumas Lake area. These measures also revealed fecal coliform and E coli downstream.



