Summary: 2011–2012 Water Quality Monitoring Results

for Shuswap and Mara Lakes

OVERVIEW

In 2011 the partner agencies in the Shuswap Lake Integrated Planning Process (SLIPP) began a three-year ***Water Quality Monitoring Program for Shuswap and Mara Lakes.*** The 2011-2012 results of this pilot program show that, in most locations in and around Shuswap and Mara Lakes, water quality is good. Most water samples met government safety guidelines for raw drinking water, for swimming, and for livestock, fish and wildlife protection.

In certain lake locations, rivers and streams, however, high concentrations of phosphorus, nitrogen or fecal coliform bacteria were found. This flags a need for a management strategy to prevent deterioration of water quality in and around the lakes.

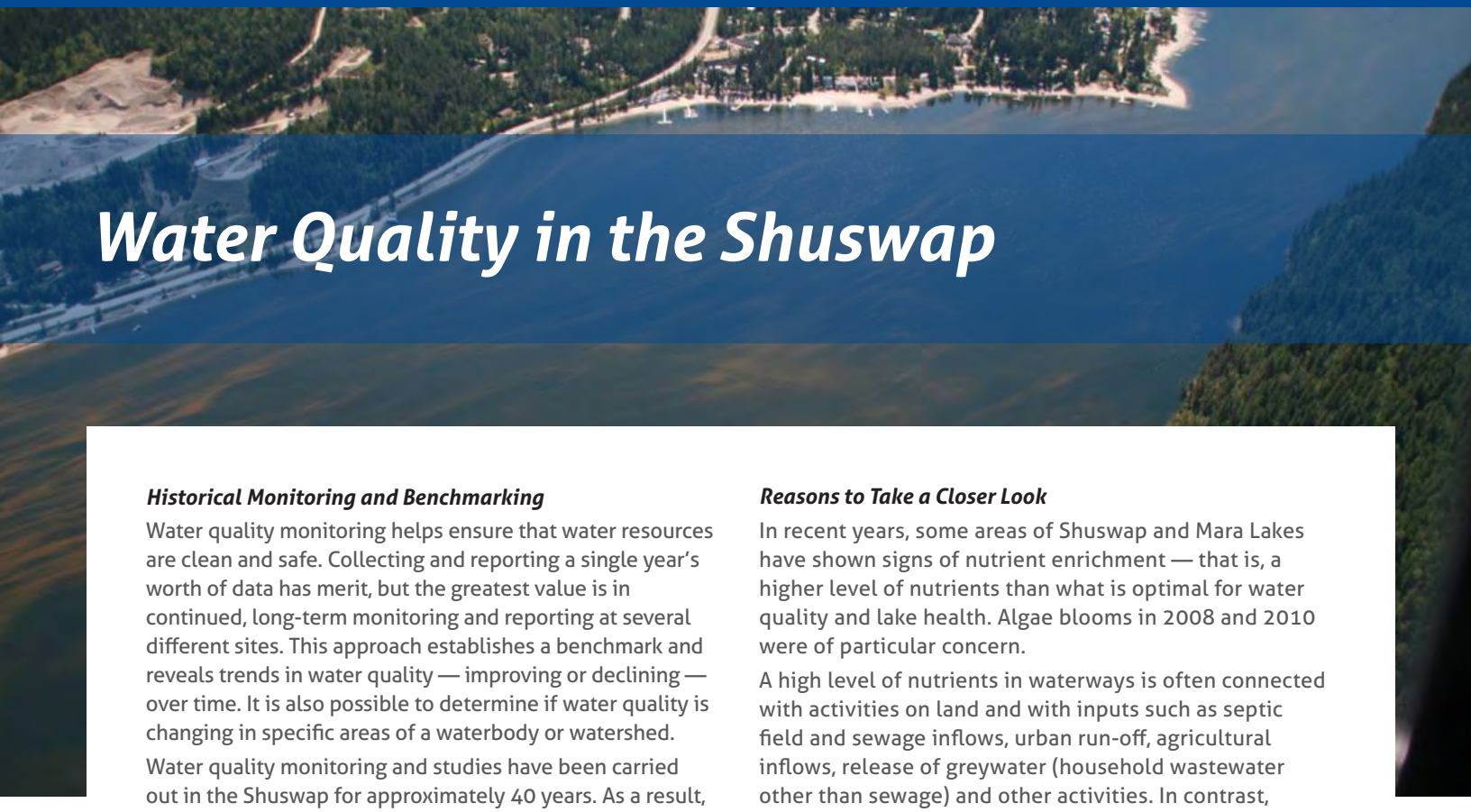
Multiple agencies with responsibilities for water are collaborating in the SLIPP pilot program, together with watershed stewardship groups and other community volunteers. Water sampling is done at over 250 sites at various depths and locations on the lakes and on tributaries, and will continue through 2013. Once the full results are compiled, they will offer an updated scientific baseline on lake health, pollutants of concern and progress on remediation. This is valuable information for effective management of the watershed and water resources. Participants in the water quality monitoring include the Province of BC (Ministry of Environment), Fisheries and Oceans Canada, Columbia Shuswap Regional District, City of Salmon Arm, District of Sicamous and Interior Health Authority, as well as small water suppliers and local volunteers.

This summary reflects key findings of monitoring in 2011-2012. For more information and background reports, visit ***www.slippbc.ca.***

SLIPP

Shuswap Lake Integrated Planning Process

Working Together to Sustain the Health and Prosperity of Shuswap and Mara Lakes



Water Quality in the Shuswap

Historical Monitoring and Benchmarking

Water quality monitoring helps ensure that water resources are clean and safe. Collecting and reporting a single year's worth of data has merit, but the greatest value is in continued, long-term monitoring and reporting at several different sites. This approach establishes a benchmark and reveals trends in water quality — improving or declining — over time. It is also possible to determine if water quality is changing in specific areas of a waterbody or watershed.

Water quality monitoring and studies have been carried out in the Shuswap for approximately 40 years. As a result, there are water quality benchmarks — that is, a historical set of data to which current data can be compared.

The historical data show that water quality in the Shuswap has generally been good. This data can be used alongside current monitoring results to identify any exceptions or emerging issues of concern.

Reasons to Take a Closer Look

In recent years, some areas of Shuswap and Mara Lakes have shown signs of nutrient enrichment — that is, a higher level of nutrients than what is optimal for water quality and lake health. Algae blooms in 2008 and 2010 were of particular concern.

A high level of nutrients in waterways is often connected with activities on land and with inputs such as septic field and sewage inflows, urban run-off, agricultural inflows, release of greywater (household wastewater other than sewage) and other activities. In contrast, relatively undeveloped regions — such as the Anstey and Seymour Arms of Shuswap Lake — have the most pristine water quality.

Managing nutrient load in the Shuswap watershed is an important priority for the long-term health of the lakes and tributaries.

2011-2013 SHUSWAP WATER QUALITY MONITORING PROGRAM

Partner agencies in the Shuswap Lake Integrated Planning Process (SLIPP) saw the need to address questions and concerns about water quality on Shuswap and Mara Lakes. In 2011 they launched a collaborative three-year pilot program to monitor water quality in and around the lakes.

This pilot program complements and extends the monitoring work undertaken by the agencies individually. Through the program, agencies are working together to meet their own responsibilities and watershed-wide objectives. That are also creating efficiencies by better coordinating efforts, eliminating any duplicate sampling and sharing data.

Specific Areas of Focus

The water quality monitoring program is intended to allow responsible agencies to:

- Assess water quality and its safety for drinking, recreation, aquatic life (e.g., algae, plants and fish), livestock watering and wildlife
- Identify water quality trends over time and in different locations
- Better understand the causes of algae blooms that have occurred in Shuswap and Mara Lakes
- Assess the effects of specific activities or discharges (e.g., sewage treatment plant discharges, boat greywater discharges and seepage from septic systems) into the lakes and tributaries
- Identify the most significant sources of excess nutrients and contaminants in and around the lakes (such as from discharges, run-off, seepage and tributaries). The most significant sources can then be managed from a cost-benefit perspective.

Four Monitoring Methods

The water quality monitoring program in the Shuswap watershed involves four categories of monitoring:

1) ***Deep Station Monitoring*** — conducted at various locations in open water at the deepest points of a lake. This type of monitoring can determine biological productivity and health of a lake overall and in specific regions. It helps agencies estimate algae growth, understand the cause of algae blooms, and monitor conditions important for fish and other aquatic organisms. The measurements at these monitoring locations focus on nutrient, algae and oxygen concentrations, all of which are important parts of the aquatic food chain and must be in balance to ensure good water quality.

2) ***Near-Shore Monitoring*** — looks at water quality along the shoreline (within about 100m) and determines whether near-shore water is safe for drinking, recreation and other uses. Monitoring can also detect any water quality impacts from on-shore activities, seepages or discharges.

3) ***Water Quality Effects of Specific Activities*** — helps agencies understand the actual effects of discharges (such as sewage treatment plant or boat greywater discharges) across the lake and in certain regions of the lake.

4) ***Watershed and Tributary Monitoring*** — determines which tributaries carry the largest volume of nutrients and contaminants into the lake. Once these have been identified, the upstream sources of the nutrients and contaminants can be investigated and managed.

Water is collected at a deep station site on Shuswap Lake. Measuring nutrients, oxygen and algae concentrations over the deepest sections of the lake helps to paint a picture of lake health.

Nutrients in the Lakes – A Question Of Balance

In a lake, algae are an important part of the food chain. They are a source of food for small free-swimming invertebrates. Invertebrates are food for small fish, which are food for larger fish. Algae need nutrients such as phosphorus, nitrogen and organic carbon to grow. Naturally occurring nutrients and algae are important to making a lake biologically productive.

It is important for nutrients to remain in a balance with plants and animals in the ecosystem. Excessive nutrients and algae can reduce water clarity, create odours and reduce the value of the water for drinking and recreation. When large amounts of algae die and sink to the lake bottom, dissolved oxygen in deep water is used up through decomposition of the algae. Low levels of dissolved oxygen can cause chemical reactions that lead to the release of compounds that are not good for drinking water quality or aquatic life. A lack of oxygen in the water is also detrimental to gill-breathing organisms such as fish.

top background photo: ambersky235

What are the Guidelines for Water Quality?

Drinking Water:

In Canada, there are federal safety guidelines on the quality of drinking water, which include multiple recommended levels of protection, from "source to tap." In BC the *Drinking Water Protection Act* and regulations define the provincial standards for drinking water systems and their operation, which are administered by health authorities and carried out by drinking water suppliers.

The federal Guidelines for Canadian Drinking Water Quality and Guidelines for Canadian Recreational Water Quality set maximum acceptable concentrations of microbiological contaminants (bacteria, viruses and protozoa) and various chemicals. If concentrations exceed specified levels, the water is not considered safe.

For both drinking water and recreation, the guidelines focus on fecal bacteria, *Escherichia coli (E. coli)*. While these bacteria are not usually harmful, they are good indicators of the presence of disease-causing bacteria, viruses or parasites. The guideline for untreated drinking water states that a safe level is zero *E. coli* bacteria in a 100 mL sample. *E. coli* are found in most lakes and streams because they come naturally from wildlife. For this reason, it is recommended that all surface water be treated before drinking.

Water for Swimming:

Federal guidelines on water quality for swimming state that a safe bacteria level is less than 400 *E. coli* in a 100 mL sample or an average of 200 *E. coli* in a 100 mL sample, based on five weekly samples. Above this, a swimming advisory may be issued.

Synopsis of the

2011–2012 Monitoring Results

Water quality monitoring is carried out with assistance from stewardship groups and other community volunteers in the Shuswap. Here a biologist prepares an attached algae sample (periphyton) for chlorophyll a analysis.

These are the key findings of the water quality monitoring program results from 2011 and currently available results from 2012. Full reports are posted on the SLIPP website.

DEEP STATION MONITORING RESULTS

Dissolved oxygen (DO): DO is important to monitor because it is crucial to gill-breathing animals such as fish and insects. It is also important for many of the reactions that take place in lake ecology. Samples from Shuswap and Little Shuswap Lakes in 2011 and 2012 show the concentration of dissolved oxygen in the water was suitable for aquatic life. At a Mara Lake site there were some notable decreases in dissolved oxygen. There was no indication of overly high nutrient levels at the deep station sampling sites.

Chlorophyll a and Algae: Chlorophyll a is important to monitor because it is an indication of how much algae is in the lake, which, in turn, is important to water quality for aquatic life, drinking water, recreation, aesthetics and the food chain in a lake ecosystem. The measurements of Chlorophyll a from 2003-2012 do not indicate a problem. During the two-week period of the algae blooms in 2008 (Shuswap Lake) and 2010 (Mara Lake), however, Chlorophyll a was higher than in most other years.

Algae growth in the lakes was higher in 2011 than in the last few decades, with the largest increases occurring in the Shuswap Main Arm and in Mara Lake. This increase can partly be attributed to the largest Sockeye salmon run of the century in 2010. As salmon carcasses decompose on shore, they release nutrients into the lake or streams. However, other factors may also play a role.

photo: christopher porter

Large photo: ***Student volunteers come on board to lend a hand and gain valuable work experience***
Inset Photo: ***Members of the water quality monitoring team measure dissolved oxygen***

At this point, it is difficult to determine the extent to which nutrients have come from decomposing salmon carcasses on the shoreline versus inputs from land use activities. Continued water quality monitoring will help answer this question.

The 2008 and 2010 algae blooms were not followed by other large blooms in subsequent years. The 2008 and 2010 blooms were composed of the algae species *Ochromonas*, a "golden-brown" algae. This species commonly occurs in lakes and is predominant in spring. It is fast growing and responds rapidly to small changes in lake conditions. While most other kinds of algae can use only light and dissolved nutrients to grow, golden-brown algae are different because they can also grow by consuming other small organisms or by absorbing organic particles from the water. The diverse feeding mechanisms of *Ochromonas*, its ability to rapidly adapt and grow, and its preference for cold water spring conditions at a time when competition from other organisms is negligible give this algae species a better opportunity to form blooms.

Lake and climate conditions in 2008 and 2010 were ideal for this algae. This is because of increased nutrient inputs over historic levels, an early winter thaw (providing increased exposure to sunlight) and extended periods of calm and sunny weather in spring. Managing lake water quality to prevent this kind of algae bloom will be challenging since climate change contributes to bloom conditions; however, management of nutrient inputs is important.

Phosphorus (P) and Nitrogen (N): These are important to monitor because they are key nutrients and measures of lake productivity. Nutrients are required in lake food chains, beginning with algae, invertebrates and insects, plants and fish. In 2011 P levels were not a cause for concern from the perspective of lake productivity and aquatic health. Furthermore, in 2011 and 2012, P concentrations were below the recommended average levels safe for drinking water (10 µg/L), except at one location (Sandy Point in Salmon Arm — not a drinking water intake), in 2012. This may have been caused by flooding and a higher-than-normal spring run-off, which washes nutrient-rich soil and debris into the lakes.

N concentrations at the Shuswap Lake Main Arm sampling locations were higher in 2011 and 2012 than historically. This was especially noticeable in areas where salmon carcasses from the dominant 2010 Sockeye run were deposited on the shoreline. This is to be expected, as salmon are very rich in nitrogen and, as they decompose, nutrients flow into the lake or stream. Historically, spikes in Shuswap Lake nitrogen levels occured after dominant or sub-dominant Sockeye runs. These higher concentrations of N are well below the nitrogen guidelines for the protection of aquatic life, and are not a problem.

NEAR SHORE MONITORING RESULTS

Near shore monitoring on Shuswap and Mara Lakes provides information about drinking water quality and the safety of swimming beaches. It helps pinpoint any shore-based inputs of nutrients, bacteria or other substances. Water is sampled at several different places near the populated shoreline, including raw drinking water intakes. Separate sampling is done to assess water quality for swimming.

Here are the 2011-2012 highlights.

Total Nitrogen (N): N is important to monitor because it is a good indicator of nutrient inputs from near the shore (such as seepage from septic fields, storm drains, agricultural and yard run-off and decaying organic matter). Nitrogen is not directly a public health concern, and there is no drinking water guideline for it. The monitoring results show N levels high enough to suggest that there are shore-based inputs of nutrients at some locations. As noted earlier, decaying salmon carcasses from the large 2010 Sockeye run are thought to be a significant factor in these results. Nitrogen levels remained well below the guidelines for the protection of aquatic life.

Total Phosphorous (P): P is important to monitor because any significant shore-based inputs of this nutrient can cause localized algae blooms or excessive surface algae growth. While some algae can produce toxins, most are not a public health concern in and of themselves. However, the treatment of water is more difficult if it contains particles as large as algae. Since waterborne pathogens may attach to algae, they may escape effective treatment, which could cause the water to be unsuitable for drinking. 2011 and 2012 results indicate that total P levels at drinking water intakes were within the drinking water guidelines (10 µg/L). Higher P levels in some surface samples in 2012 may be associated with spring flooding. One sampling location in particular — Christmas Island in Salmon Arm — had some of the highest levels of P on record, probably due to re-suspension of sediments at this shallow location.

Nitrate and Chloride: These are important to monitor as they can be indicators of septic system seepage or other in-flow of treated water. Elevated concentrations of chloride were detected at two locations: the Sorrento Water System and Christmas Island in Salmon Arm. Elevated concentrations of nitrate were detected at several sites. Some of these suggest shore-based inputs (Crescent Bay). Nitrate levels at drinking water intakes from very deep water are naturally higher.

Fecal Bacteria (E. coli): These bacteria are important to monitor because their presence may indicate contamination with waterborne pathogens and that drinking water is unsuitable for human consumption. Prior to 2010, *E. coli* numbers at some sampling locations occasionally exceeded drinking water guidelines. Causes for these have since been identified and corrected. In 2011 and 2012, none of the samples at small purveyor drinking water intakes exceeded the raw drinking water guideline. Some samples from a surface water sampling site (Christmas Island in Salmon Arm Bay — not a drinking water intake) exceeded the guideline in 2011 and 2012.

Beach water was also sampled to assess water quality for swimming. Samples showed water quality was suitable for swimming in 2011 and most of 2012. The swimming guidelines were exceeded once near Blind Bay Beach in October 2012. Follow-up samples identified that the fecal contamination came from wildlife and that it was local and of short duration.

MONITORING RESULTS RELATING TO SPECIFIC ACTIVITIES

A component of the monitoring program is aimed at assessing the impact of the Salmon Arm wastewater treatment plant on Shuswap Lake. Discharges from the treatment plant enter the lake at an outfall in the lake near the City of Salmon Arm. This is known as a point-source input. The monitoring program looks at how nutrient inputs disperse through the lake, creating zones of highly impacted and less impacted water quality. This is done by collecting samples adjacent to the outfall, and at different distances from it.

The results of the 2011-2012 monitoring indicate that the treatment plant is creating a minor increase in nitrogen levels, localized around the treatment plant outfall. It is also creating a localized increase in phosphorous levels. A separate and significant source of nitrogen and phosphorus to this area of the lake is the Salmon River, which enters Shuswap Lake near the treatment plant outfall.

Monitoring at Nielson Beach on Shuswap Lake is aimed at assessing the impact of houseboat greywater discharges, at a site with the highest density of boats. Results show that bacterial counts at the site have decreased over the years and were well below swimming guidelines in 2011. Nutrient levels were similar to shoreline areas not used by houseboats. This may show that voluntary wastewater measures taken by houseboat companies are having a positive effect.

The 2011-2012 monitoring results show that most areas of the lakes (green in the map below) have good water quality that is within drinking and swimming guidelines and contains no excess nutrients that would impact aquatic life. In some areas (yellow), there are concerns about increased bacteria or nutrient levels at some times of the year, and in a few areas (orange), levels are higher or present for longer periods. No areas of the lakes, however, show an excess of bacteria or nutrients for extended periods.

Shuswap, Little Shuswap, Mara & Mabel Lakes – Water Quality by Zone

- ***Green*** – No guidelines exceeded. No excess nutrients or impacts on aquatic life.
- ***Yellow*** – Some concerns with bacteria or nutrients, at some times of the year.
- ***Orange*** – Intermediate concerns, between yellow and red.
- ***Red*** – Extended periods in which nutrients or bacteria exceed guidelines.
  (Note: No areas of the lakes fall into this category.)

This map is a simplified visual of the 2011-2012 monitoring results and is for illustration only. For details on monitoring data and impacts, see full reports.

WATERSHED AND TRIBUTARY MONITORING RESULTS

Watershed and tributary monitoring involves taking and analysing water samples from the mouth of all large rivers and most creeks that flow into Shuswap and Mara Lakes. Additional sampling was conducted in the entire Shuswap River watershed to help identify nutrient and contaminant sources.

Fecal bacteria (E. coli): Canoe, Tappen, White and Newsome Creeks all had very high levels of *E. coli*, above the recreational guidelines. For that reason, swimming in these creeks may not be advisable during some months of the year. Concentrations of *E. coli* were lower in the Salmon River than in these creeks, and were below the recreational guidelines. The river contributes a large volume of water to the lake, however, and therefore a significant amount of bacteria. Other creeks and rivers (Adams, Scotch, Seymour and others) had low amounts of *E. coli*, below the recreational guidelines and below the partial-treatment drinking water guidelines. This is likely attributable to the lower population densities and activity in these watersheds.

Phosphorous and Other Nutrients: The Salmon River, as well as Canoe, Newsome and White Creeks, had relatively high phosphorus concentrations compared to other tributaries. However, since Canoe, Newsome and White Creeks are small creeks that contribute a very small portion of the lake water, the effect on lake water quality is minimal and localized. The Shuswap River – despite having lower concentrations of phosphorous than the Salmon River – is the largest source of phosphorous and other nutrients to the lakes because of its large volume, especially during spring run-off.

Results from Shuswap River watershed sampling indicate that most nutrient and contaminant levels in the Shuswap River are within water quality guidelines. During spring freshet, an occasional and slight exceedance of the copper guideline to protect aquatic life occurred in the Salmon River and in Newsome Creek; and the iron guideline for aquatic life was exceeded once during freshet in the Salmon and Shuswap Rivers. Results also indicate that nutrient levels are higher during spring flows, and that nutrient concentrations below Mabel Lake gradually increase where the river flows through agricultural areas. This suggests that management of agricultural nutrient inputs will help minimize the potential for algae blooms in Mara Lake and the Sicamous Arm of Shuswap Lake.

Learn More

Visit the SLIPP website at ***www.slippbc.ca*** to learn more about the water quality monitoring program.

A report on full 2011 results is now available; full 2012 results will be available in the fall.

Links

2011 Water Quality Report

Shuswap Water Quality Monitoring Map

2011-2014 Water Quality Monitoring plan

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SLIPP
Shuswap Lake Integrated Planning Process

ABOUT SLIPP

The Shuswap Lake Integrated Planning Process (SLIPP) is a multi-agency planning process working for the health and prosperity of lakes in the Shuswap watershed.

SLIPP has three priorities:

- Development that respects the environment as well as economic and social interests
- Water quality that supports public and environmental health
- Desirable recreational experiences that are safe and sustainable.

SLIPP supports better coordination among government agencies, public education and engagement, and research and policy recommendations on key issues. SLIPP has an advisory role only; it has no regulatory or enforcement mandate.

Partner government bodies and agencies in SLIPP are:

- BC Ministry of Agriculture
- BC Ministry of Environment
- BC Ministry of Forests, Lands and Natural Resource Operations
- Columbia Shuswap Regional District
- City of Salmon Arm
- District of Sicamous
- Fisheries and Oceans Canada
- Fraser Basin Council*
- Interior Health Authority
- North Okanagan Regional District
- Royal Canadian Mounted Police
- Shuswap Nation Tribal Council
- Thompson-Nicola Regional District
- Transport Canada

** Program Support*

You can contact SLIPP care of the Fraser Basin Council.

T: 250 314-9660 | E: info@slippbc.ca | W: www.slippbc.ca

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