

**Fecal Coliforms in Shawnigan Lake, Vancouver Island, B.C.
During August, 1995.**

**Water Quality Branch
Environmental Protection Department
Ministry of Environment, Lands and Parks**

February, 1996

Canadian Cataloguing in Publication Data

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Fecal coliforms in Shawnigan Lake, Vancouver Island,
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Author: T.N. Webber. Cf. p.

Includes bibliographical references: p.

ISBN 0-7726-2878-5

1. Water quality - British Columbia - Shawnigan Lake
(Lake) 2. Sewage - Environmental aspects - British
Columbia - Shawnigan Lake (Lake) I. BC Environment.
Water Quality Branch. II. Title.

TD227.B7W426 1996 363.73'942'0971128 C96-960131-X

EXECUTIVE SUMMARY

This report assesses the fecal coliform data collected at Shawnigan Lake on Vancouver Island in August, 1995. A one-month sampling program was undertaken in cooperation with the Cowichan Valley Regional District (C.V.R.D.) in response to their continued concerns with fecal coliforms in Shawnigan Lake. It is anticipated that the C.V.R.D. will use this report in conjunction with other studies to assist in the determination of the best plan to inform local property owners about the need for disinfection and possibly other treatment of drinking water drawn from Shawnigan Lake.

There are no known errors within the data set and these data were compared to BC Environment's Approved and Working Criteria for raw drinking water.

The main conclusions of the fecal coliform data assessment are as follows:

- This study revealed that 3 out of 22 sample sites failed to meet the objective for raw drinking water that receives only disinfection (i.e., 90th percentile \leq 10/100 mL).
- The recreation criterion was easily met at all sites.
- The source(s) of the fecal coliform contamination is unclear at this time. The fecal coliform contamination may have many sources including faulty domestic underground septic systems, stormwater runoff, agricultural activities, livestock and pets and waterfowl, etc.

Our main recommendation is:

Continue monitoring for fecal coliform contamination in Shawnigan Lake. Consider designing and implementing a monitoring program to determine the source(s) of the fecal coliform input and the nature of seasonal variability within the lake, including nearby inflows. Particular attention should focus on "high risk" sites in the northern portion of the lake such as the West Arm. Samples need to be collected as close as possible to selected water intakes or sample actual tap water in an effort to determine if fecal coliform contamination is actually penetrating domestic water supplies.

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ACKNOWLEDGMENTS

Collection of the water samples for this site was carried out by a summer student hired by the Cowichan Valley Regional District (C.V.R.D.) out of the Duncan office. Preliminary drafts of this document were distributed to representatives of Environment Protection Department for their consideration and input. The author would like to acknowledge the contributions and extend his appreciation to the following people; Larry Pommen, PEng., and Roland Rocchini, PEng., Water Quality Branch, EPD, Victoria, B.C., and Barry Boettger, Water Quality Consultant, Public Health Protection Branch, MOH, Victoria, B.C.

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1. Introduction

Shawnigan Lake is a moderate-sized lake (537 ha surface area) located near the southern end of Vancouver Island (Figure 1) within a watershed area of approximately 69.5 km². For many years this lake was largely a summer resort and retirement community, but has continued to receive considerable residential and other development pressure since the early 1970's. Residential growth has spread throughout the watershed, particularly in the area of the West Arm. The lake remains an important recreational location for many activities including canoeing, boating, water skiing, and swimming and continues to serve as an important source of domestic water supply for two waterworks and numerous private water intakes around the lake. It is likely that Shawnigan Lake supports a number of unlicensed water withdrawals as well. Figure 3 illustrates the approximate distribution and number of known domestic water withdrawals. Shawnigan Lake is of particular concern because there is considerable sewage disposal to the ground within the watershed, while the lake remains an important source for drinking water. The Central Vancouver Island Health Unit continues to address the issue of on-site sewage disposal as a source of fecal contamination of Shawnigan Lake particularly in the areas of new construction and upgrades of existing marginal and poor sewage disposal systems. The Health Unit has recommended that the C.V.R.D. develop more rigorous standards in regard to development of lakefront properties.

At the request of the Cowichan Valley Regional District Engineering office in Duncan, B.C., the Water Quality Branch assisted Brian Dennison of the regional office in the development of a short-term fecal coliform monitoring program. The purpose of this program was to collect near-surface water samples from 22 newly established SEAM sites around the lake over a 30-day period during the month of August, 1995, and to analyze each sample for fecal coliform content. The objective of this water sampling study was to evaluate the results of the Shawnigan Lake fecal coliform analyses and assess their levels at each of the various sites for the month of August, 1995. Part of this assessment includes the evaluation of the lake as a drinking water source and suitability for recreation purposes.

2. Methods

A total of five samples were collected at each of the 22 sites over 30 days in August, 1995. Figure 2 shows the location of each of the 22 sites. Water samples were collected using approved Water Quality Branch collection techniques which are described in the Water Quality Branch Biological Sampling Manual (Cavanagh *et al*, 1994) using pre-sterilized, 250-mL polyethylene containers supplied by Zenon Environmental Laboratories Inc. located in Burnaby, B.C. Access to individual sites was accomplished by wading out to shallow sites or in the case of the deeper sites, by way of canoe or row boat. All samples were collected just below the surface of the lake water by plunging the open end of each bottle beneath the water before turning it upright to fill. Each set of samples was shipped in small coolers filled with packaged ice (to reduce and maintain sample temperatures around 4° C) and immediately shipped to JR Laboratories Inc., in Burnaby, B.C. via courier service prior to 5 PM of the same day. All sets of samples were received by JR Labs within 24 hours of sample collection and the temperature of the samples were recorded when received as being at or below 5° C.

3. Results

The results of JR Lab's analyses are summarized in Table 1. Precipitation data collected by the Environment Canada, Atmospheric Environment Service weather office for the Shawnigan Lake climatological station (# 1017230), are summarized in Table 2 for July and August, 1995.

4. Quality Assurance

The water quality data were reviewed, and no values were removed or suspected to be in error. The precipitation data are raw data that have not been verified by Environment Canada. No quality assurance samples such as field blanks, trip blanks or replicates, were collected as part of this study.

5. State of the Water Quality

The state of the water quality was assessed by comparing the fecal coliform values in Table 1 to BC Environment's Approved and Working Criteria for Water Quality (Nagpal, Pommen & Swain, 1995). The criterion for raw water receiving disinfection prior to drinking is a 30-day 90th percentile of $\leq 10/100$ mL for fecal coliforms. The criterion for water at the tap is 0/100 mL for fecal coliforms. This criterion should also be used for raw water that is not disinfected. The Ministry of Health (MOH) Regulation (O.I.C. 1072), July 3, 1992, **requires** that water purveyors must disinfect all surface water. Further, MOH **recommends** that all surface water be disinfected prior to drinking. Any levels or trends in water quality that are deleterious to sensitive water uses, particularly drinking water and recreation, were noted.

The Fecal coliform criterion for the 90th percentile at $\leq 10/100$ mL over 30 days for raw drinking water prior to disinfection was exceeded at the following three sites:

Site # 6 (end of the West Arm area): 90th percentile = **38/100 mL**

Site #9 (Shawnigan L. school boathouse area): 90th percentile = **18/100 mL**

Site #11 (head of small bay east side of lake): 90th percentile = **36/100 mL**

When combined with a few other sites where fecal coliform levels occasionally equaled or exceeded 10/100 mL, it is apparent that the fecal contamination problem was localized in the near shore areas, particularly at the north end of the lake. There are numerous domestic drinking water intakes in close vicinity to these sites where the criterion has been exceeded. The recreation criterion (i.e., geometric mean of 200/100 mL in 30 days) was not exceeded at any of the sample sites. Although unusually wet at times, it is not clear whether there was sufficient precipitation in August at the right time to contribute to increases in lake fecal coliform contamination by way of run-off or increased flushing of inlets and subterranean water flow. For example, there doesn't appear to be good correlation between the highest daily rainfall of 48.8 mm recorded on August 7th and the August 9th coliform levels, as the highest coliform levels were recorded 10 days later on August 17, 1995.

6. Conclusions and Recommendations

6.1 Conclusions

- There were 3 sample sites where the objective for raw drinking water with disinfection only has been exceeded (i.e., 90th percentile > 10/100 mL).
- There was no indication by the sampler of waterfowl or waterfowl feces in the vicinity of any of the sampling sites at the time of sampling. However, waterfowl have been identified as a concern by the Central Island Health Unit and, at certain times and locations, waterfowl contribute significant elevations in fecal coliform levels.
- The recreation criterion of the geometric mean of 200/100 mL in 30 days was easily met at all sites on all sampling occasions.
- The source of the fecal coliform contamination is unclear at this time, but it may be related to input from faulty domestic underground septic systems in combination with other sources such as waterfowl, garden manure and the introduction of livestock and pets etc. that contribute to varying degrees at other times of the year.
- Small and narrow bays such as the West Arm appear to be “high risk” areas for increased and persistent accumulations of higher than acceptable levels of fecal coliforms. The shallow water depths, low flushing rates and reduced vertical and horizontal circulation in these bays may also exacerbate the problem.
- It is not known whether inflow streams to these lake arms and bays may independently contribute to fecal coliform levels within the lake.
- The quality of local individual home-owner’s tap water is unknown at this time.
- It is not clear whether local rainfall in August (as summarized in Table 2) had sufficient runoff impact and correct timing so as to increase localized fecal coliform levels in the near shore areas around the lake.

6.2 Remediation

- All drinking water withdrawals from Shawnigan Lake should be disinfected.
- There is a need to identify and remediate the sources of fecal coliform contamination as 3 of the 22 sampling sites failed to meet the raw drinking water criterion for water receiving only disinfection.
- There may be a need to increase the water treatment (i.e., filtration plus disinfection) or relocate some water intakes into deeper or more distant locations (i.e., away from the lake shore).

6.3 Monitoring

- To identify and quantify the sources of fecal contamination to Shawnigan Lake, we recommend:
 - continued monitoring of these sites to provide a better picture of the spatial and temporal distribution of fecal contamination. However, this would contribute little in identifying probable sources. Fecal contamination may be originating from nearby underground septic systems, which are either faulty or subject to the effects of local heavy rainfall, particularly first events that follow a long dry spell or after prolonged period of rainfall resulting in an elevated watertable.
 - monitoring inflow streams (e.g., West Arm inflow) which may also carry contaminated water into the lake.
 - conducting sanitary surveys as part of the monitoring program. These surveys may include dye studies to evaluate failure of on-site sewage disposal systems and/or fluorescent surveys along the shore in suspect areas to identify septic systems that are likely sources for contaminating the lake.
 - investigating other potential and confirmed sources of fecal coliform contamination in particular, the seasonal accumulations and impact as a result of local waterfowl congregations in the vicinity of grassy areas and public beaches.
 - involving and encouraging local stewardship programs to aid in the identification of probable contamination sources and facilitation of remedial activities requiring local buy-in with regard to local land-use practices.

- We recommend that the recording of precipitation data from the Shawnigan Lake climatological station be retained for correlation with the collection of future fecal coliform sampling within the watershed.

REFERENCES

Cavanagh, N., N. Nordin & P.D. Warrington, 1994. Biological Sampling Manual. Water Quality Branch, Environmental Protection Department, Victoria, B.C.

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Safe Drinking Water Regulation, 1992. Order In Council No. 1072, July 3, 1992. Health Act, section 5 (mm) (ii) (B).

Fecal Coliforms in Shawnigan Lake, B.C.

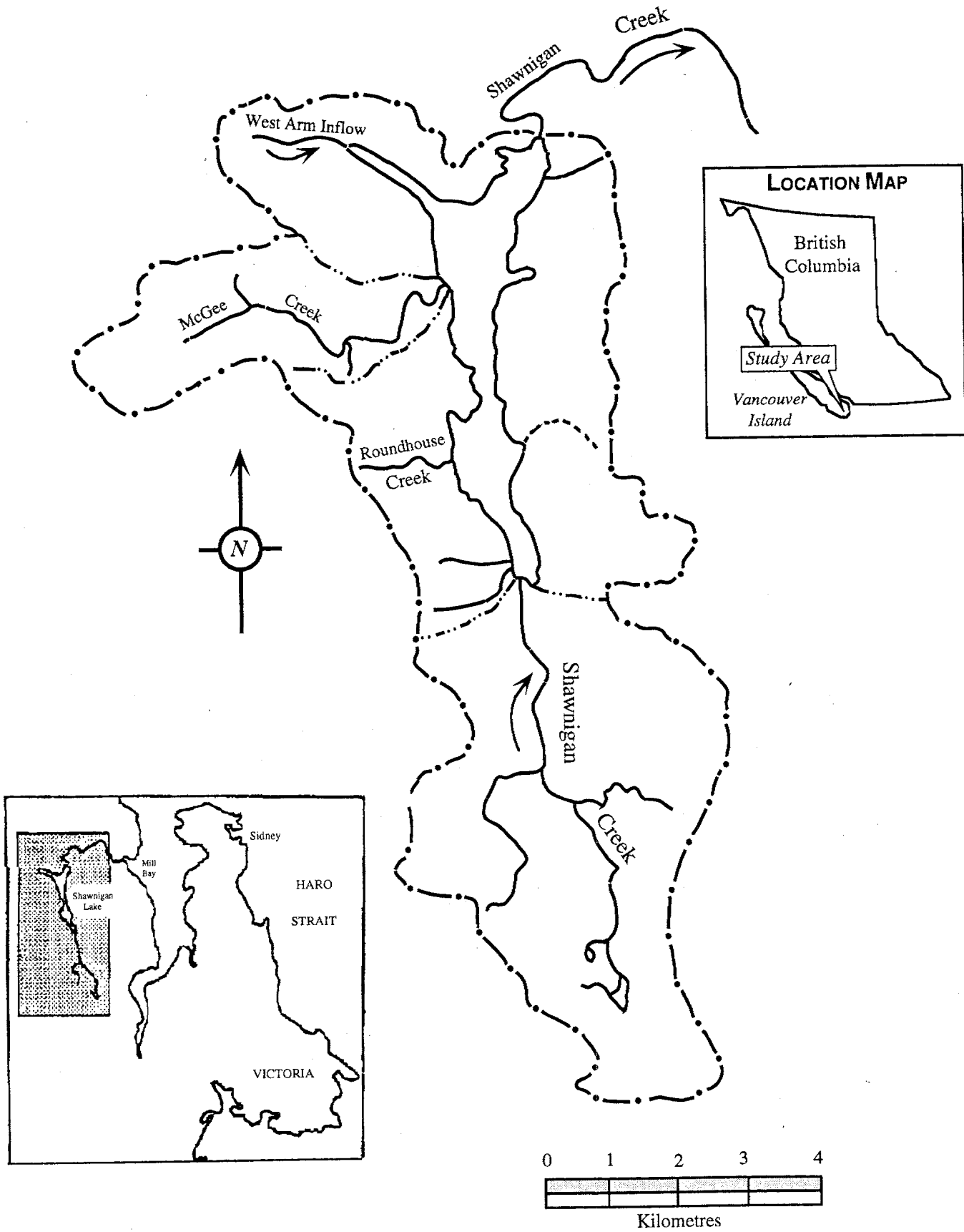
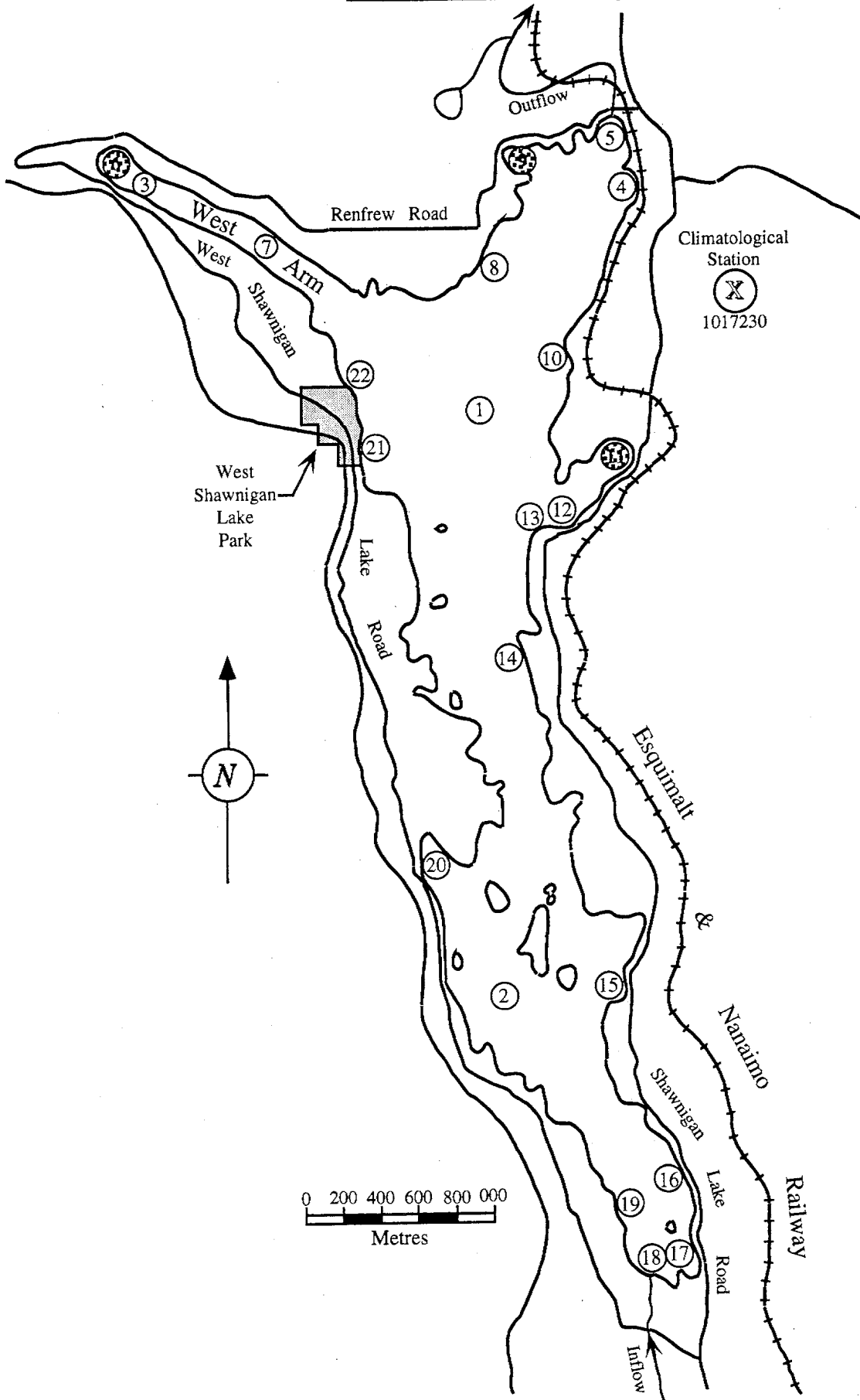


Figure 1: Shawnigan Lake Watershed

Fecal Coliforms in Shawnigan Lake, B.C.



☒ = sites exceeding the criterion for raw drinking water (90th percentile >10/100 mL).

Figure 2: Shawnigan Lake Water Quality Sampling Sites and Environment Canada Climatological station.

Fecal Coliforms in Shawnigan Lake, B.C.

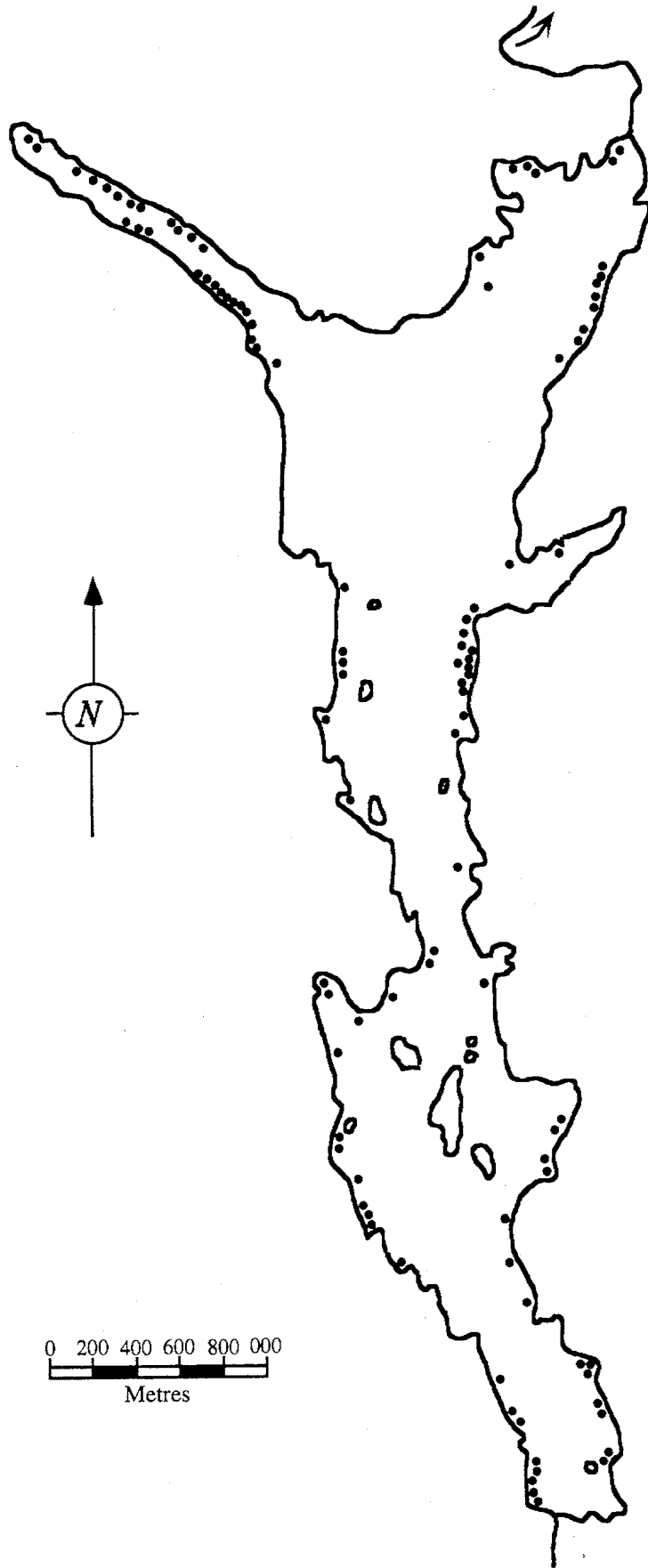


Figure 3: Shawnigan Lake Domestic Water Withdrawals

Fecal Coliforms in Shawnigan Lake, B.C.

TABLE 1
Shawnigan Lake Fecal Coliform Data

SITE #:	SEAM #:	SITE DESCRIPTION:	SAMPLING DATES:					90th Percentile (<1's = 0)	Geometric Mean (<1's = 1)
			9-Aug	14-Aug	17-Aug	22-Aug	29-Aug		
1	1199901	Deepest point of main basin.	4	<1	1	<1	<1	1	
2	1199902	Deep point in south basin midway between Memory Island & west shore of lake.	<1	<1	<1	<1	<1	3	
3	1199903	West Arm, mid channel directly in line with A-frame home.	7	5	8	<1	<1	1	
4	1199904	North end of lake, 25 metres west of Shawnigan railway station.	5	1	<1	1	1	4	
5	1199905	Near lake outlet, 100 metres south of outlet	4	1	2	<1	<1	1	
6	E222040	End of West Arm in front of Jaegar House restaurant docks.	10	24	48	6	15	16	
7	E222041	West Arm 5 m off BC tel cable docks (Renfrew Fronting Road).	10	1	1	2	2	2	
8	E222042	25 m off Beach Estate condominiums beach.	9	<1	1	1	<1	2	
9	E222043	25 m off docks at Shawnigan Lake school boathouse.	7	19	17	3	3	7	
10	E222044	Beach at Old Mill Park.	3	<1	<1	<1	<1	1	
11	E222045	Head of bay opening behind Galley Restaurant area	31	10	20	39	9	19	
12	E222046	25m off shore in front of Bahai School.	2	<1	11	2	2	3	
13	E222047	Galley Restaurant docks.	1	1	2	2	2	1	
14	E222048	In front of Easter Seal camp beach.	11	2	4	2	<1	3	
15	E222049	South Basin, 5 m off south-east tip of Memory Island.	4	<1	<1	<1	<1	1	
16	E222050	Swimming area at south end of lake on east shore (foot of Oshea Road).	2	<1	1	<1	<1	1	
17	E222051	Marsh area at south end of lake.	5	1	4	<1	<1	2	
18	E222052	Inlet of Shawnigan Creek.	6	<1	<1	2	<1	2	
19	E222053	Swimming area at south end of lake on west shore (foot of Haybrook Road).	2	<1	2	2	2	2	
20	E222054	Head of bay on north/west side of south basin (near Butler Ave.).	6	4	<1	4	1	2	
21	E222055	Beach at West Shawnigan Lake Provincial Park.	3	<1	2	<1	<1	1	
22	E222056	Beach at church camp next to provincial park.	4	<1	1	<1	<1	2	

For the purposes of calculating the 90th percentiles, all <1's are treated as zeros.

For the purposes of calculating the geometric means, all <1's are treated as 1.

* MF refers to Membrane Filtration Method.

* CFU refers to Colony Forming Unit; <1 means zero.

Fecal Coliforms in Shawnigan Lake, B.C.

TABLE 2

Shawnigan Lake Precipitation Data (Unverified) *

(Station #: 1017230)

JULY, 1995

Morning observation at 0730

DATE:	RAIN (mm)
1	0.0
2	0.0
3	0.0
4	0.0
5	0.0
6	0.0
7	0.0
8	0.0
9	0.0
10	7.0
11	1.0
12	0.2
13	0.0
14	0.0
15	0.0
16	0.0
17	0.0
18	0.0
19	0.0
20	0.0
21	0.0
22	0.0
23	0.0
24	0.0
25	0.0
26	10.6
27	0.0
28	0.0
29	0.0
30	0.0
31	0.0

AUGUST, 1995

Morning observation at 0730

DATE:	RAIN (mm)
1	0.0
2	0.0
3	0.0
4	0.0
5	0.0
6	0.6
7	48.8
8	2.0
9	0.0
10	0.0
11	3.6
12	0.0
13	0.2
14	0.0
15	2.8
16	0.0
17	18.0
18	0.0
19	2.6
20	0.2
21	0.0
22	0.0
23	0.0
24	0.0
25	0.0
26	0.0
27	0.0
28	0.0
29	0.4
30	0.0
31	0.0

* Environment Canada, Atmospheric Environment Service.

Station Location: NTS mapsheet # 92 B12, 48°-39" N : 123°-37' W; Elevation: 137 m ASL.