

**APPENDIX B**

**FECAL COLIFORM SAMPLING  
QUALITY ASSURANCE AND QUALITY  
CONTROL PROGRAM FOR 2007–2008**



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## **1.0 INTRODUCTION**

Quality assurance and quality control (QA/QC) programs are a set of protocols that are adopted to ensure that the results of any study are valid, internally consistent and comparable with other similar projects. These protocols are set out in writing and are based on the most current and relevant research on the related topics. This appendix discusses the following components:

- field sampling methods
- sample handling procedures
- analytical procedures
- field and laboratory replication (quality control)
- data assessment

The data collected for the QA program are used to ensure consistency in field handling and analytical methods. If the data exceed a specified precision criterion, then the lab is notified of a potential problem in the procedure and steps are taken to resolve the issue. The QA protocols presented in this appendix are based on two CRD memorandums (Drinnan, 1995 and Hutcheson, 1995).

## **2.0 METHODS FOR FECAL COLIFORM SAMPLING**

All water samples were collected in 500 mL wide-mouth disposable bottles containing 1.5 mL of sodium thiosulphate (a sample preservative). Bottles were supplied by Cantest Ltd. in Victoria, BC. Labelled samples were stored in an insulated cooler with ice packs for protection from prolonged exposure to UV light and delivered the same day to the laboratory. Samples were analyzed for fecal coliform bacteria following the procedures in Standard Methods (APHA, 1998) and reported as colony forming units/100 mL (CFU/100 mL). However, to assist the reader, the more commonly used reporting of fecal coliform per 100 millilitres (FC/100 mL) is used in this survey.

Care was taken to ensure that the weather on sampling days was representative of the sampling season (wet or dry). Conditions such as "first flush", major storms or any other effect that might tend to prejudice the results were avoided.

### **2.1 Stormwater Flow Sampling**

Where possible, stormwater flow samples were collected from the point of discharge. Where this was not possible, the watercourse was followed upstream to the nearest point where the sample could be taken.

### **2.2 Nearshore Lake Surface Water Sampling**

Nearshore lake surface water samples were collected by canoe from St. Mary Lake in October 2008. Samples were collected by rapidly submerging an inverted 500 mL sample bottle to a depth of approximately 200 mm and then turning it upright and allowing the bottle to fill.

### **2.3 Quality Assurance**

#### **2.3.1 Stormwater Sample Replicates (Field Splits)**

Ten per cent of the samples collected were replicated and the field replicate samples identified as "field splits". A single sample was collected in a 500 mL sample bottle and inverted 30 times to ensure that the sample was well-mixed. The sample was then split evenly into two separate sample bottles. The two bottles were then labelled and sent to Cantest Ltd. for analysis. These samples were submitted to the laboratory as blind samples (not identified as field splits).

### 2.3.2 Quality Control Assessment

In 2007 and 2008, 18 field splits were collected from each year at six stormwater discharges in the core area of the CRD and analyzed for fecal coliform levels. These field splits were used to establish the 2007 and 2008 precision criteria (Section 2.3.3) for the CRD Salt Spring Island Electoral Area (SSI EA), core area, District of Sooke and Juan de Fuca EA sampling programs. The discharges were chosen based on previous (in the core) high, moderate or low levels of fecal coliform concentrations (two discharges sampled for each category) to represent the varying fecal coliform counts that would be analyzed. Three individual 500 mL grab samples were collected at each of the six stations and split into two replicate sample bottles. Three blank samples of potable water were also collected in 500 mL sample bottles as part of the assessment. All samples were submitted with unique identifying numbers to Cantest Ltd.

### 2.3.3 Calculation of Quality Assurance Results

Laboratory precision for fecal coliform analysis (e.g., a measure of consistency by the lab) is determined by analyzing 18 pairs of field samples (field splits). The following, taken from Standard Methods, 18th Edition (APHA, 1998), explains the procedure for calculating the precision criteria and determining whether the log ranges for the field splits are "acceptable" or "unacceptable":

- The data are arranged in pairs ( $D_1$  and  $D_2$ ). The log of each field measurement is determined ( $L_1$ ,  $L_2$ ) and the difference (range) in the log value between each pair of field splits is calculated:  $R = (L_2 - L_1)$ . An average range (Mean-R) is then determined for all of the pairs.
- The precision criterion is calculated by multiplying the Mean-R by 3.27 and is rounded to one decimal place.
- The log range (R) is calculated for each of the field splits and compared to the precision criterion, to determine whether the sample is acceptable or not, according to the following criteria:

Acceptable (A): If the calculation is less than the precision criterion, then the field data are within normal variability.

Unacceptable (U): If the calculation is greater than the precision criterion, then the field data are outside of the normal variability. All data collected after the last "acceptable" set of data should be discarded and no further analysis should be done until the source of the problem is identified by the lab.

It is important not to put too severe an interpretation on the results from the QA calculation, especially when they are close to the "unacceptable" guideline. Each result represents a value within a 95% confidence interval, which gets proportionately larger as the actual result gets smaller. Therefore, one can expect, through randomness, 5% of the samples to be outside of the precision criterion. Also, any fecal coliform count under 200 FC/100 mL is considered too small an amount to accurately calculate or compare to a precision criterion (APHA, 1998). It is also important to note that discharges with fecal coliform counts lower than 200 FC/100 mL receive a low public health concern rating.

The results should be rounded to one decimal place and compared to the precision criterion (e.g., 0.3). If the calculated value from the duplicate results still exceeds the criterion (e.g., 0.35 or greater) then an informal investigation of the laboratory should be initiated. If only a few duplicates are unacceptable (e.g., one out of every 20 pairs of duplicates) the lab is probably meeting the guideline.

The overall process is intended to act as an "alarm", alerting the study group to potential problems with the sampling and analytical procedures. As part of the review, the following elements are considered:

- the number of pairs exceeding the criterion
- the actual fecal coliform value of the pairs of data
- field notes on the "field split" procedure
- comments from the laboratory

## **3.0 RESULTS**

### **3.1 Quality Assurance Results**

For the 2007 and 2008 QA programs, 18 pairs of stormwater samples were collected in January of each year from six discharges having high, moderate or low levels of fecal coliform bacteria. The samples were sent to the lab for analysis of the fecal coliform concentration and the data used to calculate the precision criteria.

#### **3.1.1 Blanks**

Three blank samples (Greater Victoria tap water) were also submitted to the lab each year as part of the QA/QC and analyzed for fecal coliform bacteria. All blanks were reported as having <1 FC/100 mL. Therefore, the results meet the QA requirements.

#### **3.1.2 Precision Criteria**

##### **2007**

Table 1 shows the lab results of the 18 pairs of samples used to determine the precision criteria for the 2007 stormwater monitoring program. The calculated precision criterion for this laboratory, using these 18 sets of duplicates, was 0.42923. For comparison with subsequent field replicates, this result was rounded to 0.4.

##### **2008**

Table 2 shows the lab results of the 18 pairs of samples used to determine the precision criteria for 2008 stormwater monitoring program. The calculated precision criterion for this laboratory, using these 18 sets of duplicates, was 0.57503. For comparison with subsequent field replicates this result was rounded to 0.6.

**Table 1 Laboratory Quality Assurance Exercise Results for 2007**

CRD Data, Batch Samples: 18 pairs, January 16 and 25, 2007						
Discharge No.	Pair No.	1 <sup>st</sup> Duplicate D1	2 <sup>nd</sup> Duplicate D2	Log D1 L1	Log D2 L2	Range of Logs (Rlog) (Log L1 - Log L2)
238	1	43000	40000	4.63347	4.60206	0.03141
	2	49000	48000	4.69020	4.68124	0.00895
	3	39000	28000	4.59106	4.44716	0.14391
245	4	63000	58000	4.79934	4.76343	0.03591
	5	130000	56000	5.11394	4.74819	0.36576
	6	68000	44000	4.83251	4.64345	0.18906
301	7	820	660	2.91381	2.81954	0.09427
	8	910	890	2.95904	2.94939	0.00965
	9	870	750	2.93952	2.87506	0.06446
320	10	5700	2400	3.75587	3.38021	0.37566
	11	5300	3200	3.72428	3.50515	0.21913
	2	3800	3400	3.57978	3.53148	0.04830
641	13	80	40	1.90309	1.60206	0.30103
	14	100	60	2.00000	1.77815	0.22185
	15	300	290	2.47712	2.46240	0.01472
777A	16	210	200	2.32222	2.30103	0.02119
	17	210	140	2.32222	2.14613	0.17609
	18	220	200	2.34242	2.30103	0.04139
Mean - R <sub>log</sub> (Sum R <sub>log</sub> /18)						0.13126
Precision Criterion (3.27 x Mean-R <sub>log</sub> )						<b>0.42923</b>

**Table 2 Laboratory Quality Assurance Exercise Results for 2008**

CRD Data, Batch Samples: 18 pairs, January 11, 14 and 18, 2008						
Discharge No.	Pair No.	1 <sup>st</sup> Duplicate D1	2 <sup>nd</sup> Duplicate D2	Log D1 L1	Log D2 L2	Range of Logs (Rlog) (Log L1 - Log L2)
245	1	7800	3000	3.89209	3.47712	0.41497
	2	3800	6000	3.57978	3.77815	0.19837
	3	6400	6800	3.80618	3.83251	0.02633
320	4	50	50	1.69897	1.69897	0.00000
	5	70	40	1.84510	1.60206	0.24304
	6	100	70	2.00000	1.84510	0.15490
641	7	9100	6700	3.95904	3.82607	0.13297
	8	6900	8400	3.83885	3.92428	0.08543
	9	8700	7500	3.93952	3.87506	0.06446
805	10	61000	61000	4.78533	4.78533	0.00000
	11	31000	50000	4.49136	4.69897	0.20761
	12	45000	77000	4.65321	4.88649	0.23328
813	13	4000	3900	3.60206	3.59106	0.01100
	14	5200	2400	3.71600	3.38021	0.33579
	15	2700	4400	3.43136	3.64345	0.21209
873	16	90	90	1.95424	1.95424	0.00000
	17	60	70	1.77815	1.84510	0.06695
	18	10	60	1.00000	1.77815	0.77815
Mean - R <sub>log</sub> (Sum R <sub>log</sub> /18)						0.17585
Precision Criterion (3.27 x Mean-R <sub>log</sub> )						<b>0.57503</b>

### 3.1.3 Field Splits

#### 2007

##### **Wet Weather Sampling**

Table 3 presents the results for the single field split collected from SSI during the wet period of the 2007 stormwater sampling programs (March of 2007). Data was compared to the precision criteria of 0.5, as described in Section 3.1.2. The lone field split was found to exceed the precision criteria. This field split had fecal coliform levels below 200 FC/100 mL. Fecal coliform counts lower than 200 FC/100 mL are not expected to meet the precision criteria due to the small numbers (refer to Section 2.3.3). Therefore, the results meet the QA requirements.

##### **Dry Weather Sampling**

Due to very low precipitation levels and lack of stormwater flows, only six fecal coliform samples were collected from the Salt Spring Island Electoral Area during the summer of 2007. Therefore, since there were not enough samples collected to initiate the quality assurance program, no field splits were collected.

**Table 3 Laboratory Quality Assurance Results: Wet Period, 2007**

Date	Discharge Number	Fecal Coliform Counts for Field Splits	Log	Log Range	A/U
14-Mar-07	SML08	0	0.00000	1.00000	U <sup>1</sup>
		10	1.00000		

<sup>1</sup>Any fecal coliform count under 200 is considered too small an amount to calculate a precision criterion (APHA, 1992). However, any discharge lower than 200 FC/100 mL receives a lower rating for public health concern.

#### 2008

##### **Wet Weather Sampling**

Table 4 presents the results for the single field split collected from SSI during the wet period of the 2008 stormwater sampling programs (March of 2008). Data was compared to the precision criteria of 0.6, as described in Section 3.1.2. This field split did not exceed the precision criteria. Therefore, the results meet the QA requirements.

##### **Dry Weather Sampling**

Due to very low precipitation levels and lack of stormwater flows, only four fecal coliform samples were collected from the Salt Spring Island Electoral Area during the summer of 2008. Therefore, since there were not enough samples collected to initiate the quality assurance program, no field splits were collected.

**Table 4 Laboratory Quality Assurance Results: Wet Period, 2008**

Date	Discharge Number	Fecal Coliform Counts for Field Splits	Log	Log Range	A/U
26-Mar-08	SML07	0	0.00000	0.00000	A
		0	0.00000		

#### **4.0 CONCLUSIONS**

All requirements for the Stormwater, Harbours and Watersheds program QA/QC program were carried out in 2007 and 2008. All QA/QC results were acceptable for rating stormwater discharges for public health concerns.

#### **5.0 REFERENCES**

APHA, 1998. American Public Health Association, American Water Works Association, Water Pollution Control Federation, 20th Edition. Standard Methods for the Examination of Water and Wastewater.

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