A Department of Ecology Technical Memo

McAllister Creek
Fecal Coliform Bacteria Monitoring
Summer 2009

Purpose of this technical memo

The purpose of this technical memo is to provide the Washington State Department of Ecology (Ecology) South Puget Sound Total Maximum Daily Load (TMDL) Coordinator with current information about bacterial water quality between river mile (RM) 3.7 and RM 3.1 in McAllister Creek, Thurston County. Fecal coliform (FC) bacteria samples were collected on eight sampling events from, June 22, 2009, through October 14, 2009, during an ebbing tide. Data are compared to the state Extraordinary Primary Contact water quality standard for FC bacteria in marine water.

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Background

McAllister Creek flows into the Nisqually Reach of Puget Sound. McAllister Creek was placed on Ecology's list of impaired waters (the 303(d) list) for FC bacteria in 1998. Sampling was conducted for the TMDL water cleanup study from June 2002 through August 2003. Salinity profiles were conducted in McAllister Creek and marine water quality standards were determined to be appropriate for FC bacteria downstream of RM 4.2 (Sargeant et al., 2005). Before the TMDL study the freshwater standards had been applied to the entire creek.

The Extraordinary Primary Contact standard for FC bacteria in marine water is:

> Fecal coliform organism levels must not exceed a geometric mean value of 14 colonies/100 mL, with not more than 10 percent of all samples (or any single sample when less than ten sample points exist) obtained for calculating the geometric mean value exceeding 43 colonies /100mL (WAC 173-201A).

Implementation efforts to reduce FC bacteria have moved forward as a result of the TMDL. Thurston Conservation District informed Ecology that all planned agricultural implementation efforts, such as fencing, have been completed in the upper watershed. Data collected by the Thurston Environmental Health show elevated bacteria concentrations downstream of the I-5 bridge overpass at RM 3.1 (http://www.co.thurston.wa.us/cm-ehswat/station.asp?site=NISMC0000&yrnbr=2008).

Protection of beneficial uses such as human health and shellfish beds has been an on-going concern in the McAllister/Nisqually Reach area. This 2009 water quality investigation was conducted to characterize FC bacteria during low flow conditions in McAllister Creek in the reach from RM 3.7 to RM 3.1. Additional details of the study design can be reviewed in the Quality Assurance Project Plan (Dickes, 2009).

Goals and objectives

The project goal for Ecology's water quality monitoring in McAllister Creek was:

- Characterize FC bacteria in the reach between RM 3.7 and RM 3.1 during low tide from June through October 2009.

Project objectives for McAllister Creek water quality monitoring were:

- Collect water quality samples to be analyzed for FC bacteria.
- Identify potential source areas for bacteria during low flow conditions.
- Provide the South Puget Sound TMDL Coordinator with additional data to prioritize implementation of water quality improvement activities.

Study design

Water samples were collected midstream from three bridges in the lower reach of McAllister Creek (Figure 1, Table 1) from June 22, 2009, through October 14, 2009. Samples were collected during an ebbing tide to minimize tidal influence and improve the ability to identify potential sources along the creek. Tidal elevation was determined using the DuPont Wharf/Nisqually tide station (Station ID 1093). Due to tidal lag, samples could be collected approximately two hours after the predicted low tide. Conductivity was measured as an indirect check that freshwater samples were taken.

The study reach starts at RM 3.7, on the Martin Way Bridge (Table 1). This is upstream of an area where BMP implementation efforts are not yet complete. The creek is wide at this location and there are several tide gates immediately upstream of the bridge that could potentially discharge into the creek. Therefore, two samples were collected at sample site RM 3.7. One sample was collected from the left third of the creek cross-section (RM 3.7 LB) and one from the right third of the cross-section (RM 3.7 RB).

Sample site RM 3.2 was chosen to provide a site that is above the impacts from swallows roosting under the bridges. Sample site RM 3.1 was selected since it characterizes the lower end of concentrated human impacts, and that it is the area sampled by Thurston County Environmental Health.

Quality Assurance

Laboratory

Laboratory duplicates (sub-samples) were taken for laboratory quality assurance and were not used in data analysis (Table 3). All laboratory blank samples were below detection.

On July 20, 2009, the result value of 28 cfu/100 mL is qualified as an estimate ('J') for RM 3.7. The duplicate pairs had a relative percent difference (RPD) of 42; which exceeded the laboratory's expected quality assurance objective of an RPD of 40. The laboratory therefore qualified the routine replicate sample 19 cfu/100 mL with the 'J' qualifier. The project manager retained the qualifier after averaging the associated site values for that day.

On August 31, 2009, the result value of 120 cfu/100 mL for RM 3.1 was qualified as an estimate by the laboratory. The laboratory duplicate taken from this sample was 64 cfu/100 mL. The RPD was 61, exceeding the laboratory quality assurance objective of a RPD of 40. The project manager decided that due to the variability of bacteria in the environment it was more reasonable to retain the result than to eliminate it from the data set.

Field

Data for routine and associated replicate samples were averaged and the mean value used in data analysis (Table 2 and Table 3).

When less than ten replicate samples are collected the project manager determines the usability of the data (Mathieu, 2006). Six of the seven replicate pairs in this project have a relative standard deviation (RSD) below 20% and all had a RSD below 50%. The project manager accepts this data as useable and meeting the quality objectives as described in the Quality Assurance Plan (Dickes 2009).

Bacteria concentrations collected at the two cross-section locations at RM 3.7 were averaged and the arithmetic mean values used in data analysis.

Conductivity samples were collected at each site to characterize salinity. Conductivity never exceeded 900 umhos/cm, verifying that freshwater samples were collected. Freshwater was targeted to capture the potential freshwater sources. The conductivity meter was pre-calibrated with a 100 umhos/cm

standard. However, strict quality assurance guidelines, such as taking replicate readings and conducting post calibration, were not followed. Therefore, conductivity results are not presented in this document.

The replicate sample taken at RM 3.2 on August 3, 2009, was eliminated from the data set. Field notes reflect that the sample may have been contaminated at the time of collection. Additional sample bottles were not available for collecting another replicate sample.

Results and Conclusions

Data from this study can be reviewed in Table 2 and Table 3.

McAllister Creek between RM 3.7 and RM 3.1 exceeded both parts of the marine Extraordinary Primary Contact standard for FC bacteria (Table 2). All three sample sites had a geometric mean value that exceeded 14 cfu/100 mL and had at least two out of eight samples with FC bacteria concentrations over 43 cfu/100 mL.

Fecal coliform bacteria source areas were not clearly identified in this project. The geometric mean of FC bacteria data ranged from 40 cfu/100 mL to 51 cfu/100 mL upstream to downstream respectively. The gradual increase downstream may reflect sources, but the variation may also reflect the natural variability of FC bacteria in the environment. For the most part, this natural variability could also explain the variation in concentrations seen within and between sample events. On August 31, 2009, the FC bacteria concentration at RM 3.1 was noticeably higher than upstream. However, since the lab qualified that value as an estimate, the project manager hesitated to make any conclusions about FC bacteria source areas.

The sample event on October 14, 2009, occurred during a rain event whereas the previous seven sample events occurred during relatively dry conditions (Table 4). The October event was one of the first rainy days of the fall season. However, the data were analyzed with the rest of the data set since the October results were within expected variability for FC bacteria and did not skew the dataset. If the data for October were removed from all sample locations, the geometric mean values did not decrease by more than 4 cfu/100mL

During this 2009 study the geometric mean value for FC bacteria at RM 3.1 was 51cfu/100 mL (n=8). Data collected by Thurston County Environmental Health from June through September 2009 (n=4) at the same sample location had similar results and geometric mean (Davis, 2009). In 2008 Thurston County data from June through September 2008 (n=4) resulted in geometric mean of 128 cfu/100 mL. The project manager determined that these data sets are too small to make conclusive decisions about improved water quality

Recommendations

- Investigate potential sources of FC bacteria resulting from human activities, including agriculture, septic systems, and pet waste. It is critical that human health and other beneficial uses are protected from bacterial contamination.

- Implement BMPs where sources of FC bacteria concentrations are identified.

- Maintain existing BMPs to ensure their on-going effectiveness.

References

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Figure 1. Map of McAllister Creek Sampling Locations and Surrounding Area.

Table 1. Sample Site Locations.

Site Name at River Mile (RM)	Description	Latitude	Longitude
RM 3.1	I-5 south on-ramp, upstream side of bridge	47□04' 07.6"	122° 43' 11.9"
RM 3.2	I-5 north off-ramp, upstream side of bridge	47□04' 02.2"	122° 43' 14.9"
RM 3.7	Martin Way, downstream side of bridge	47□03' 54.0"	122° 43' 26.3"

Table 2. Summarized Data for McAllister Creek June 22, 2009 through October 14, 2009

Date	Site Location		
	RM3.1	RM3.2	RM3.7
6/22/2009	37	35	27
7/6/2009	35	39	55
7/20/2009	60	57	28 J
8/3/2009	36	36	46
8/17/2009	59	56	36
8/31/2009	120 J	31	31
9/14/2009	79	42	42
10/14/2009	68	82	86
geometric mean	57	45	40

J = estimate

Table 3. McAllister Creek Field and Laboratory Data for McAllister Creek June 22, 2009 through October 14, 2009

Site Name	Date	Time	Result	Q	Laboratory Duplicate		Result Field Replicate	Q	Laboratory Duplicate	Q
RM 3.1	6/22/09	14:10	37		45					
RM 3.2		14:20	35							
RM 3.7LB		14:35	24				32			
RM 3.7RB		14:30	25							
RM 3.1	7/6/09	13:40	35							
RM 3.2		13:45	37				41			
RM 3.7LB		13:58	69		91					
RM 3.7RB		13:55	40							
RM 3.1	7/20/09	12:40	60							
RM 3.2		12:50	57							
RM 3.7LB		13:05	35				19	J	29	J
RM 3.7RB		13:00	29							
RM 3.1	8/3/09	13:15	76		60					
RM 3.2		13:20	36				*120**	*J*		
RM 3.7LB		13:30	44							
RM 3.7RB		13:28	47							
RM 3.1	8/17/09	11:20	59							
RM 3.2		11:25	56							
RM 3.7LB		11:40	39							
RM 3.7RB		11:30	28		32		35			
RM 3.1	8/31/09	12:05	120	J	64	J				
RM 3.2		12:15	27				35			
RM 3.7LB		12:23	29							
RM 3.7RB		12:21	32							
RM 3.1	9/14/09	11:05	79							
RM 3.2		11:10	45				39			
RM 3.7LB		11:25	41							
RM 3.7RB		11:20	43		49					
RM 3.1	10/14/09	10:40	68							
RM 3.2		10:50	76		69		88			
RM 3.7RB		10:55	88							
RM 3.7LB		10:58	84							

Q= data qualifier
RB= right third of channel
LB=left third of channel
J= estimate
*= value not used in analysis due to potential contamination of the sample bottle in the field

Table 4. Precipitation (inches) Recorded at the Olympia, WA Airport. *Data were obtained from the MesoWest database*

DATE	TIME	12 HOUR	24 HOUR
June 22, 2009	1345	0	0
July 6, 2009	1320	0.01	0.01
July 20, 2009	1205	0	0
August 3, 2009	1230	0.01	0.02
August 17, 2009	1040	0.01	0.01
August 31, 2009	1145	0	0.01
September 14, 2009	1040	0.02	0.02
October 14, 2009	1025	0.27	0.33