MONITORING REPORT

Thornton Creek and Matthews Beach Microbial Source Tracking Study

Prepared for

Seattle Public Utilities

March 2007

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Thornton Creek and Matthews Beach Microbial Source Tracking Study

Prepared for

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Introduction

Fecal coliform bacteria concentrations in Thornton Creek and at Matthews Beach (Lake Washington) exceed the state water quality standard and pose a potential threat to public health. Two segments of Thornton Creek, as well as that portion of Lake Washington at Matthews Beach Park, are included on the Washington State Department of Ecology's (Ecology's) 303(d) list of threatened and impaired water bodies. The reason for their listing is the presence of fecal coliform bacteria (Ecology 2006). King County has observed high bacteria concentrations at Matthews Beach, which has resulted in closures of this public swimming beach, and has suggested that Thornton Creek may be the primary source of the contamination.

The primary purpose of this microbial source tracking (MST) study was to determine potential sources of the bacteria in Thornton Creek and at Matthews Beach, and to evaluate the relative contribution of Thornton Creek to the contamination observed at Matthews Beach. This report summarizes the findings of the MST study.

The molecular ribotyping technique has been used for many other studies to identify sources of fecal contamination in watersheds throughout western Washington (Herrera 1993, 1999, 2001, 2004b, 2005b, 2006) and is considered by Ecology to be an effective investigative technique (Ecology 1999). This microbial source tracking method isolates pure cultures of *Escherichia coli* (*E. coli*), which is the most common member of the fecal coliform bacteria group, from samples of receiving waters and suspected sources that include domestic wastewater, industrial effluent, and fecal matter from humans and other warm-blooded animals. The *E. coli* cultures obtained are then genetically typed and compared to a library of unique genotypes to determine the presence of specific sources. Sources of other bacteria in the fecal coliform bacteria group (e.g., *Klebsiella*, *Enterobacter*, and *Serratia*) and some other enteric bacteria (e.g., *Enterococcus*) are not identifiable using this method.

Background Information

This section presents background information for the Thornton Creek and Matthews Beach microbial source tracking study. A description of the Thornton Creek watershed is presented, followed by a summary of previous monitoring efforts in the basin. The Thornton Creek watershed is briefly described in terms of land use, hydrology, habitat, and water quality.

Watershed Description

Land Use and Hydrology

Thornton Creek drains a 7,414-acre (11-square mile) urban watershed in northwestern King County, between Puget Sound and Lake Washington, and is located in water resource inventory area (WRIA) 8. The Thornton Creek watershed extends roughly from NE 190th Street in the City of Shoreline to NE 80th Street in Seattle (Figure 1). Two-thirds of the basin lies within the Seattle city limits; the remainder is within the Shoreline city limits. Approximately half of the watershed is covered by impervious surfaces. Land use consists of single-family and multifamily residences (53 percent), highways and roads (24 percent), commercial development (8 percent), parks and golf courses (4 percent), schools (4 percent), vacant land (4 percent), and mixed use/industry/utilities/unknown (3 percent) (Seattle 2000).

Thornton Creek consists of three major stream channels and their associated subbasins: the north fork, the south fork, and the main stem. The north fork drainage basin covers approximately 4,455 acres and includes two major tributaries (Little's Creek and Little Brook). The north fork flows from the headwaters at Ronald Bog in Shoreline, under Interstate 5, through the Jackson Park golf course and several neighborhoods, to the confluence with the south fork.

The south fork drainage basin covers approximately 2,332 acres and includes three major tributaries (Victory Creek, Willow Creek, and Kramer Creek). The south fork originates west of Interstate 5 near the North Seattle Community College campus, then flows east under Interstate 5 and through several residential neighborhoods before joining the north fork.

The main stem drainage basin includes 627 acres in addition to the drainage of the south and north forks. The main stem flows past Meadowbrook Pond to Lake Washington near Matthews Beach. During high-flow events, a diversion structure located at Meadowbrook Pond (see Figure 1) directs flows to Lake Washington by way of a 72- to 90-inch pipeline. Two small tributaries draining to the main stem are Mock Creek and Maple Creek (Seattle 2000).

Habitat and Water Quality

Thornton Creek historically has supported coho salmon, sockeye salmon, chinook salmon, steelhead trout, rainbow trout, and cutthroat trout (Seattle 2000). However, habitat degradation along with deteriorating water quality, fish passage barriers, and overfishing have contributed to a severe decline in most of these species in Thornton Creek. Recent fish surveys indicate that

only cutthroat trout populations are surviving in significant numbers. Beginning in 1990, coho and chinook salmon fry have been released by the Washington Department of Fish and Wildlife on several occasions as part of an educational program. Surveys conducted through 1999 have found limited numbers of adult coho and chinook salmon (Seattle 2000).

Based on water quality data collected by SPU, fecal coliform bacteria concentrations in Thornton Creek do not meet state standards for extraordinary primary contact recreation (Minton 2000). Thornton Creek was included on Ecology's 1996 and 1998 303(d) lists for threatened and impaired water bodies for fecal coliform bacteria as measured at the mouth of the main stem (Ecology 2004). Thornton Creek was also included on the 2002/2004 Section 303(d) list for fecal coliform bacteria as measured at the mouth of the main stem and in the lower half of the south fork (Ecology 2006). Thornton Creek was also included on the 2002/2004 Section 303(d) list for temperature and dissolved oxygen (Ecology 2006).

For lakes and their tributaries (which are designated as extraordinary primary contact recreation use), the Washington state water quality standard for fecal coliform bacteria is a geometric mean not to exceed 50 colony-forming units (CFU) per 100 milliliters (mL), with no more than 10 percent of the samples having a concentration greater than 100 CFU/100 mL (WAC 173-201A). Water quality at the swimming area of Matthews Beach, located near the mouth of Thornton Creek, occasionally exceeds Washington State Department of Health and Seattle-King County Public Health Department beach closure criteria for fecal coliform bacteria, which is a geometric mean not to exceed 200 CFU/100 mL with no single sample exceeding 1,000 CFU/100 mL (King County 2004). The waters of Lake Washington at the Matthews Beach swimming area are also listed on the 2002/2004 Section 303(d) list for fecal coliform bacteria (Ecology 2006).

Previous Bacteriological Monitoring

Historic Bacteriological Testing

Water quality monitoring has been routinely conducted near the mouth of Thornton Creek by SPU and King County. Water quality data near the mouth were previously compiled for the period of February 1990 through March 2001 (Minton 2000). Summary statistics for these data have been computed and are presented as box and whisker plots in Figure 2. Water samples were collected during 32 storm events and 204 base flow events during this period and were analyzed for metals, conventional water quality parameters, and bacteria (including fecal coliform bacteria). The geometric mean concentration of fecal coliform bacteria during base flow events was 827 CFU/100 mL, with a maximum concentration of 31,000 CFU/100 mL for the period of March 1990 through March 2001. The geometric mean concentration of fecal coliform bacteria during storm flow events for the period of February 1990 through December 1997 was 2,185 CFU/100 mL, with a maximum concentration of 9,300 CFU/100 mL. Thus, fecal coliform bacteria concentrations in Thornton Creek are typically higher during storm flow than base flow events, and geometric mean concentrations substantially exceed the water quality standard (50 CFU/100 mL) during storm and base flow. In addition, the geometric mean fecal coliform bacteria concentration was slightly higher for the dry season (1,314 CFU/100 mL for

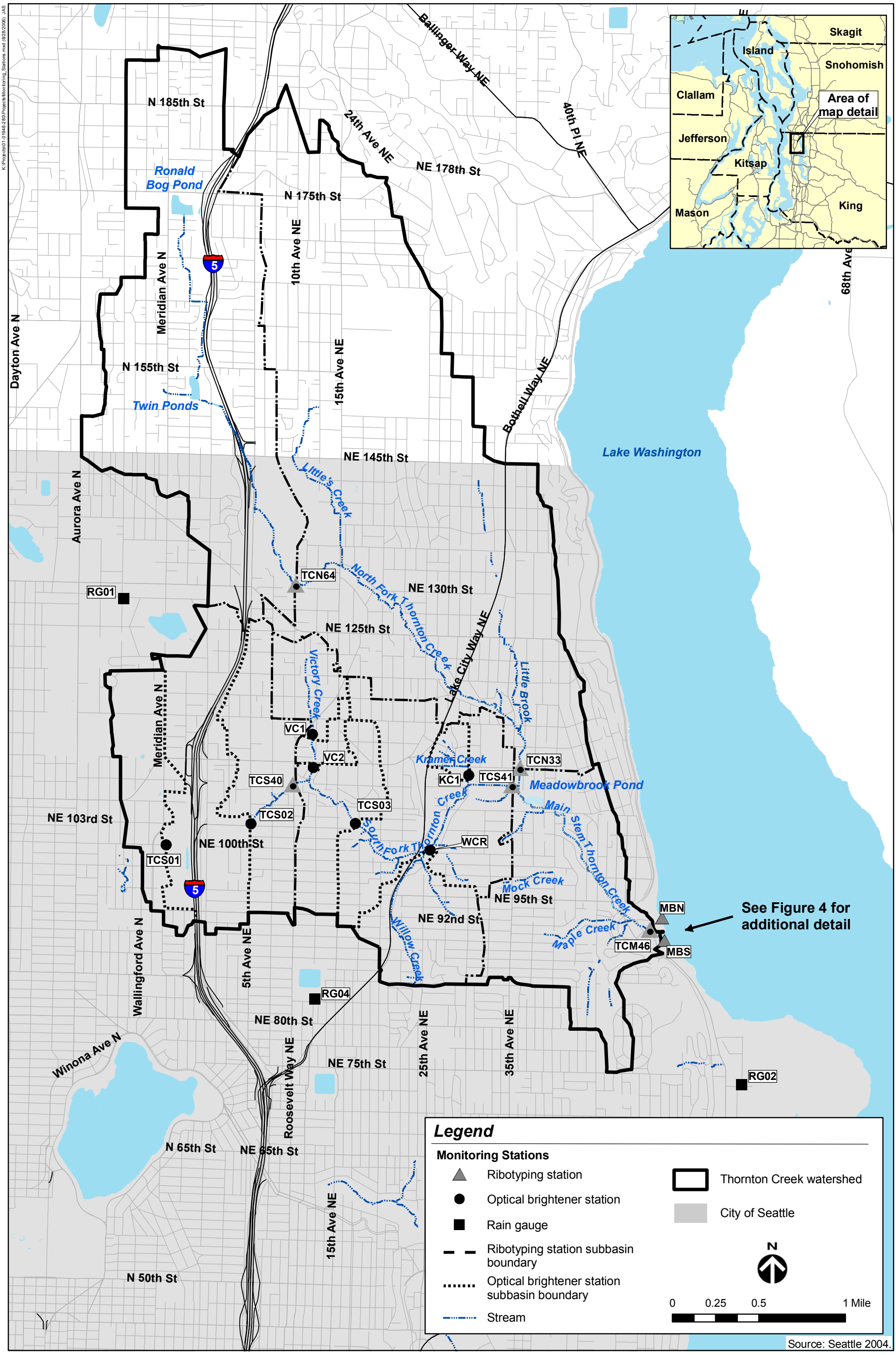


Figure 1. Microbial source tracking stations and subbasin boundaries in the Thornton Creek watershed, Seattle, Washington.

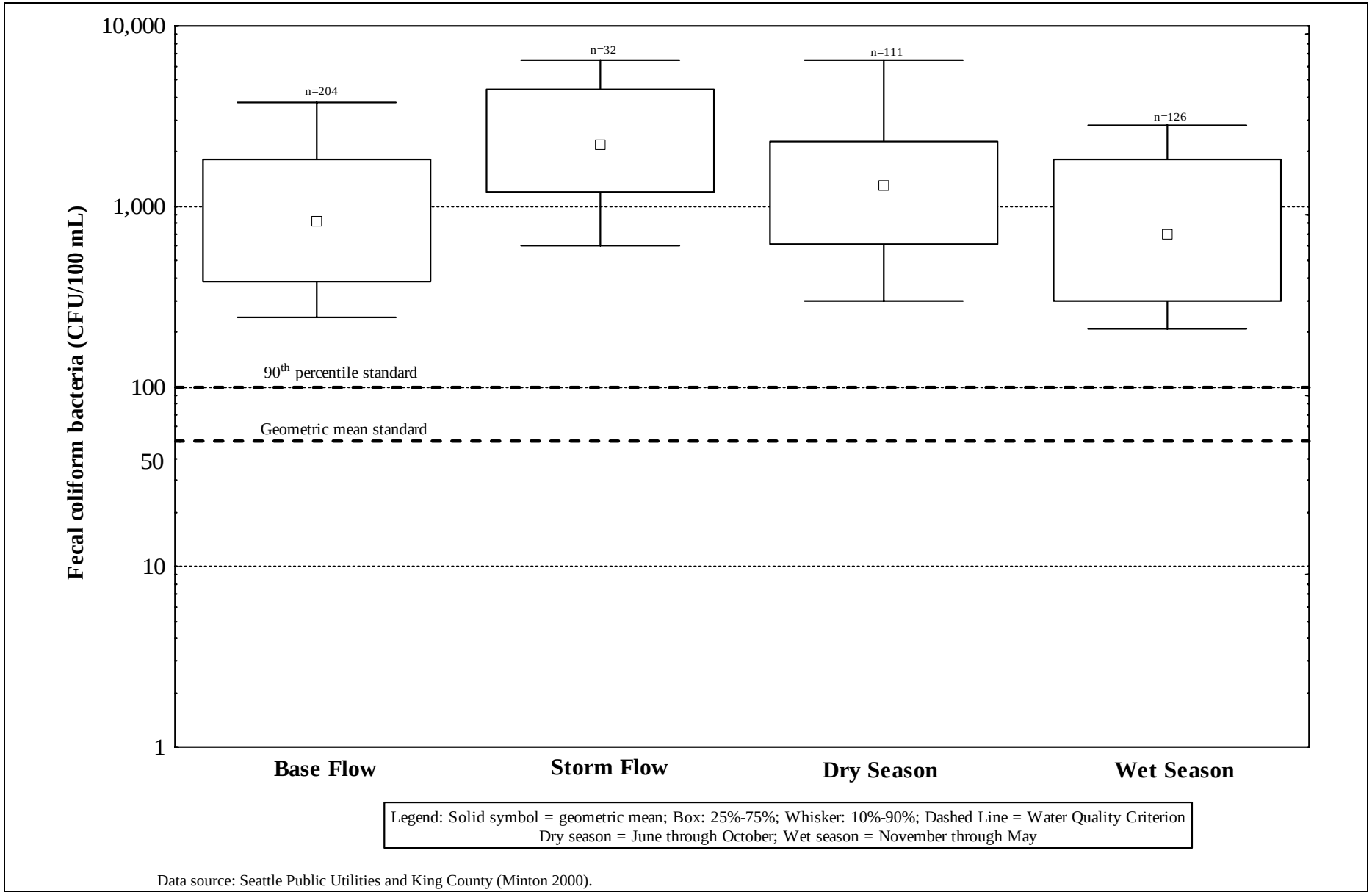


Figure 2. Fecal coliform bacteria concentrations near the mouth of Thornton Creek by hydrologic and seasonal condition for the period from February 1990 through March 2001.

June through October) than the wet season (704 CFU/100 mL for November through May) (see Figure 2).

MST Studies

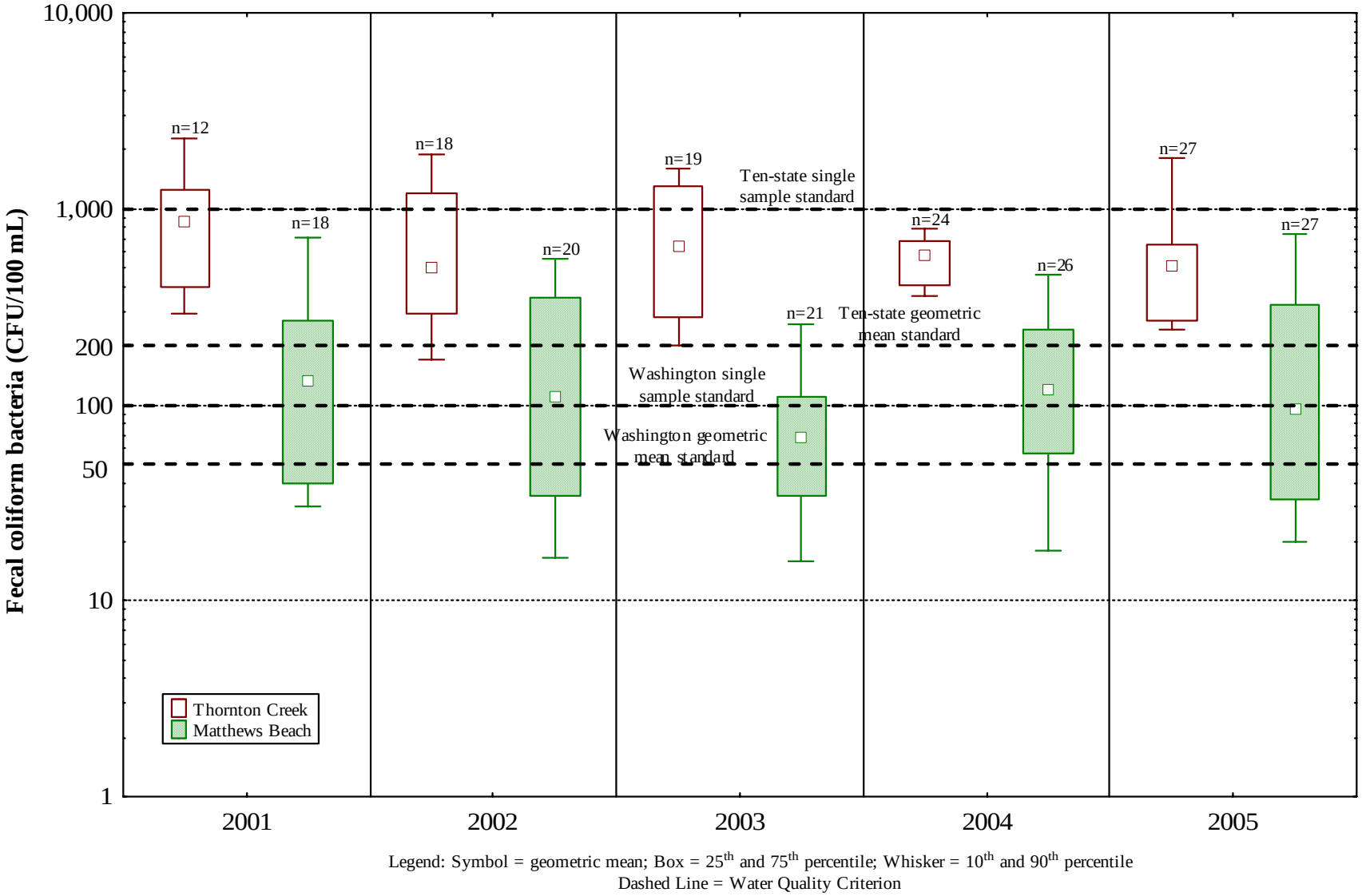
In April and May 2001, King County conducted a microbial source tracking study of Thornton Creek to determine if domestic sewage was a source of the observed fecal coliform bacteria contamination (King County 2001). Water samples were collected during three monitoring events from 13 stations on the north fork, south fork, and main stem of Thornton Creek. Single samples were collected during the first monitoring event, and three replicates were collected during the second and third monitoring events. For the first monitoring event, which was conducted during dry weather, fecal coliform bacteria concentrations ranged from 200 to 1,600 CFU/100 mL. For the second monitoring event, which was conducted during a rain event, all samples analyzed had concentrations greater than 600 CFU/100 mL. For the third monitoring event, which was conducted two days after the rain event, fecal coliform bacteria concentrations ranged from less than 100 to 600 CFU/100 mL. The highest fecal coliform bacteria concentration (greater than 600 CFU/100 mL) was measured in two samples collected below Meadowbrook Pond on the main stem of Thornton Creek.

The King County (2001) microbial source tracking study found that urban wildlife and pets were the principal sources of fecal coliform bacteria in Thornton Creek. A total of 273 isolates were recovered from 91 water samples collected for the study, and 240 (88 percent) of the isolates were matched to known sources. Of the 240 matched isolates, only 9 (4 percent) of the isolates were matched to human sources. Human isolates were observed at four stations on the south fork of Thornton Creek, one station on the north fork of Thornton Creek, and one station on the upper main stem (just below the confluence of the north and south forks). The remaining 231 isolates were matched to the following ten types of animal sources: avian (birds), dog, cat, rodent, opossum, muskrat, squirrel, raccoon, rabbit, and beaver/otter. Overall, birds and dogs were the most frequently observed sources, together representing 59 percent of all matched isolates.

Recent Bacteriological Testing

King County monitors fecal coliform bacteria concentrations at Matthews Beach Park and the mouth of Thornton Creek during the summer as part of its swimming beach monitoring program. The Seattle-King County Department of Public Health uses the “ten-state standard” to determine whether fecal coliform bacteria concentrations pose a risk for public health, requiring swimming areas to be closed. The ten-state standard was developed for swimming beaches in the Great Lakes region, and is a geometric mean of fecal coliform bacteria concentrations not to exceed 200 CFU/100 mL with no single sample exceeding 1,000 CFU/100 mL (King County 2004).

Summaries of the King County swimming beach monitoring data collected from 2001 through 2005 for Matthews Beach and Thornton Creek are presented in Figure 3. Geometric mean fecal coliform bacteria concentrations during each swimming season ranged from 508 to 865 CFU/100



Legend: Symbol = geometric mean; Box = 25th and 75th percentile; Whisker = 10th and 90th percentile
Dashed Line = Water Quality Criterion

Data source: King County Swimming Beach Monitoring Program (King County 2006).

Figure 3. Fecal coliform bacteria concentrations at Thornton Creek and Matthews Beach during the swimming seasons (May through September) of 2001 through 2005.

mL in Thornton Creek and from 68 to 131 CFU/100 mL at Matthews Beach. As shown in Figure 3, no increasing or decreasing trends are apparent between years at either station. In addition, year to year variations in bacteria concentrations at Matthews Beach do not appear to be related to year to year variations in bacteria concentrations in Thornton Creek.

The Matthews Beach swimming area was closed on two occasions between 2001 and 2005. It was closed on July 6, 2004, because the ten-state standard was exceeded in lake water samples collected after a storm event that resulted in high fecal coliform bacteria concentrations in Thornton Creek. The maximum daily mean concentration of fecal coliform bacteria reported for Matthews Beach was 3,000 CFU/100 mL on July 6, 2004, which compares to a concentration of 6,000 CFU/100 mL for Thornton Creek on the same date. The geometric mean fecal coliform bacteria concentrations for the period of May 18 to July 6, 2004, were 133 CFU/100 mL at Matthews Beach and 721 CFU/100 mL at Thornton Creek (King County 2004).

The Matthews Beach swimming area was also closed from July 14 to 20, 2005, due to elevated levels of fecal coliform bacteria that exceeded the ten-state standard. The concentration of fecal coliform bacteria reported for Matthews Beach was 750 CFU/100 mL on July 12, 2005 and the fecal coliform bacteria concentration in Thornton Creek was 410 CFU/100 mL on this date. The geometric mean fecal coliform bacteria concentration for the period of June 14 to July 12, 2005, was 359 CFU/100 mL at Matthews Beach and 455 CFU/100 mL at Thornton Creek (King County 2006).

Methods

The primary objectives of the Thornton Creek and Matthews Beach microbial source tracking study are to identify the sources of fecal coliform bacteria in Thornton Creek and Matthews Beach, and to evaluate the relative contribution of bacteria in Thornton Creek to the contamination observed at the Matthews Beach swimming area. A secondary objective is to collect sufficient data to evaluate how the fecal coliform bacteria concentrations, loadings, and sources vary with hydrologic conditions, seasons, and locations within the Thornton Creek watershed. The study design is summarized below, followed by a description of the sampling locations and schedule, and sample collection and analysis methods. Quality assurance objectives and procedures are described in the sampling and analysis plan (Herrera 2005a).

Study Design

To meet the study objectives, the following study components were implemented:

- The collection and analysis of water samples for fecal coliform bacteria at five stream stations on Thornton Creek and two lake stations at Matthews Beach Park.
- The isolation of pure strains of *E. coli* bacteria from the water samples, development of a genetic fingerprint (ribotype) for each isolate, and comparison of those isolates to the molecular ribotyping library of bacteria sources.
- The collection of hydrologic data at the five stream stations on Thornton Creek to evaluate fecal coliform bacteria loadings.
- The collection of wind data to evaluate the effects of wind on bacteria concentrations at Matthews Beach.
- Implementation of optical brightener monitoring to evaluate whether this low-cost approach is useful for detecting the presence of municipal sewage in Seattle streams.
- The collection of stream and lake sediment samples for analysis of bacteria concentrations and sources.

A total of 252 water samples were to be collected from five locations on Thornton Creek and two locations at Matthews Beach (see Figure 1). The water samples were to be collected during six base flow and six storm flow events. During each monitoring event, three samples were to be collected and analyzed for fecal coliform bacteria from each station. The ribotyping technique was to be applied to an average of three distinct *E. coli* bacterial colonies from each of the

252 water samples, for a total of 756 isolates. Discharge data were to be collected from continuous streamflow gauges, operated and maintained by SPU, which are located at or upstream of each of the five water sampling stations on Thornton Creek. Wind data were to be obtained from the weather monitoring station on the Evergreen Point Bridge (State Route 520), which is operated and maintained by Washington State Department of Transportation. Optical brightener monitoring was to be conducted at 12 locations on Thornton Creek during each of the six base flow sampling events described above.

The molecular ribotyping component was conducted in accordance with the sampling and analysis plan (Herrera 2005). Deviations from the sampling and analysis plan did occur for the bacteria enumeration, discharge, wind, and optical brightener monitoring components. However, the data that was generated was of acceptable quality and as a result the study objectives were met. The optical brightener monitoring was discontinued after three monitoring events because no positive results were obtained, indicating a lack of sewage contamination of stream waters. A limited amount of sediment monitoring was then added to the study design to determine if bacteria concentrations and sources in sediment could be correlated to those observed in stream and lake waters. The study components are summarized in Table 1 and the monitoring procedures are described below.

The water samples were collected and analyzed as designed, with 36 samples collected from each of the seven sampling locations (see Figure 1), for a total of 252 water samples. A total of six base flow and 11 storm flow events were sampled from February 2005 through December 2005. A greater number of storm events were sampled than planned for because fewer samples were collected during several of the storm events due to the early cessation of rainfall and the subsequent decrease in stream flow (three samples were collected during two storm events, two samples were collected during three storm events, and one sample was collected during six storm events). This deviation from the sampling design was implemented to maximize the potential to obtain multiple sources of fecal coliform bacteria during storm flow conditions. A greater number of isolates were obtained from the collected samples than was planned for in the study design (i.e., 791 isolates were obtained at an average of 3.14 isolates per sample versus the design of three isolates per sample for a total of 756 isolates).

Seattle Public Utilities (SPU) discontinued discharge monitoring at station TCS40 (Upper South Fork) in April 2005 due to poor data quality resulting from the installation of in-stream logs just below the discharge monitoring station, which resulted in a backwater effect. Flow data from a discharge monitoring station located just downstream of TCS40 were used to estimate flows at TCS40 once the station was removed. As discussed in the sampling and analysis plan (Herrera 2005), stream flow at the Lower South Fork station was to be estimated using flow meters located at the mouth of Kramer Creek and at the South Fork Thornton Creek, upstream of Kramer Creek. In September 2005, the flow meter located upstream of Kramer Creek was removed, and a new station was established at 35th Avenue NE (location of TCS41 for this study). Discharge volumes for the Lower South Fork (TCS41) station from September through December 2005 were based on data collected at this location. In October 2005, Seattle Public Utilities discontinued discharge monitoring at station 46 (located on the main stem at Sand Point Way, upstream of station TCM46 monitored for this study) because the United States Geologic

Survey (USGS) operates a stream flow gauge at the same location. Stream flow data measured at the USGS gauge for January through December 2005 was then used for this study.

Table 1. Sampling and analysis summary for the Thornton Creek and Matthews Beach microbial source tracking study.

Station	Fecal Coliform Bacteria Analyses of Water Samples [a]	*E. coli* Ribotyping Isolates from Water Samples [b]	Optical Brightener Analyses [c]	Fecal Coliform Bacteria Analyses of Sediment Samples [d]	*E. coli* Ribotyping Isolates from Sediment Samples [e]
TCN64	36	111	3	3	0
TCS41	36	113	3	0	0
TCS40	36	113	3	0	0
TCN33	36	109	3	0	0
TCM46	36	117	3	0	16
MBS	36	111	0	3	16
MBN	36	117	0	3	17
TCS01	0	0	3	0	0
TCS02	0	0	3	0	0
VC1	0	0	3	0	0
VC2	0	0	3	0	0
TCS03	0	0	3	0	0
WCR	0	0	3	0	0
KC1	0	0	3	0	0
Totals	252	791	42	9	49

[a] Analysis of three grab samples per station collected during six base flow sampling events, and between one and three grab samples per station collected during 11 storm flow sampling events. Laboratory analyses conducted by Aquatic Research, Inc.
[b] Analysis of three isolates per sample on average (ranging from 0 to 6 isolates/sample) from fecal coliform bacteria cultures. Laboratory analyses conducted by the Institute for Environmental Health.
[c] Optical brightener sample pads were deployed during each of three base flow sampling events and collected following between 2 and 12 days of exposure.
[d] Analysis of three sediment samples collected during one sampling event. Laboratory analyses conducted by the Institute for Environmental Health.
[e] Analysis of five isolates per sample on average (ranging from 5 to 7 isolates/sample) from fecal coliform bacteria cultures. Laboratory analyses conducted by the Institute for Environmental Health.

Wind data collected at the Evergreen Point Bridge (State Route 520) weather monitoring station was incomplete, due to equipment malfunctions and data collection errors. As a result, wind data were not available for five of the 17 water sampling dates. As a result, the influence of wind on beach water bacteria concentrations was analyzed using manual wind speed and direction data collected at the time of sampling the lake stations.

Optical brightener monitoring was conducted at 12 locations during the first three base flow events only. Optical brightener pads were deployed for 2, 10, and 12 days for the first, second, and third base flow monitoring events, respectively. The optical brightener pads were dried at least 12 hours and exposed to ultraviolet light to screen for the presence of optical brighteners. A filter soaked in distilled water was used as a negative control for each screening conducted. A positive control (a filter soaked in a water and detergent solution) was used for each screening conducted. Due to a lack of positive results (no optical brighteners were detected at any

monitoring location), the optical brightener monitoring was discontinued after the third monitoring event.

An additional component of the MST study was implemented to address the primary objective of identifying the sources of fecal coliform bacteria in Thornton Creek and at Matthews Beach. Sediment monitoring was conducted to determine if stream sediment near the mouth of Thornton Creek and lake sediment around the Matthews Beach swimming area are contributing fecal coliform bacteria observed in lake waters at the swimming beach. Stream sediments provide an environment suitable for the extended survival and possible growth of fecal microorganisms (Burton et al. 1987; Doyle et al. 1992; Sherer et al., 1992), and bacteria concentrations observed in stream sediments are typically higher than concentrations observed in the overlying water (Burton et. al. 1987). As a result, stream sediments may act as a reservoir (sink) for bacteria which can enter the stream water column during storm events (Jamieson 2005). Nearshore sediment sampling was conducted during base flow conditions on September 7, 2005. Three sediment samples were collected from the North Lake (MBN) and South Lake (MBS) stations and from the station at the mouth of Thornton Creek (TCM46), for a total of nine samples.

Sampling Locations

Water samples were collected at seven locations (see below) that are currently monitored by SPU and King County. Five sampling stations were selected on Thornton Creek because these stations are representative of the major subbasins of Thornton Creek, and discharge is continuously measured at each location (see Figure 1). Two sampling stations were selected at Matthews Beach Park because they are stations used by King County to assess water quality as part of the swimming beach assessment program, and these stations are located on either side of the mouth of Thornton Creek (Figure 4).

Water samples were collected moving from upstream to downstream in the watershed, in order to follow the progression of the hydrograph during storm flow events. The following stations were sampled in the order presented below (with stream bank direction determined looking downstream):

- Station TCN64 (Upper North Fork station): Thornton Creek north fork upstream, located at SPU station 64 (at 10th Avenue NE, below the Jackson Park golf course). Samples were collected from the left bank, upstream of the culvert under 10th Avenue NE.
- Station TCS40 (Upper South Fork station): Thornton Creek south fork upstream, located at SPU station 40 (at 8th Avenue NE and NE 105th Street). Samples were collected from the right bank, downstream of the culvert under 8th Avenue NE.
- Station TCS41 (Lower South Fork station): Thornton Creek south fork downstream, located at SPU station 41 (at 35th Avenue NE, south of NE 110th Street). Samples were collected from the right bank, upstream of the culvert under 35th Avenue NE.

Figure 4. Microbial source tracking stations at Matthews Beach Park and near the mouth of Thornton Creek, Seattle, Washington.

- Station TCN33 (Lower North Fork station): Thornton Creek north fork downstream, located at SPU station 33 (at NE 110th Street, east of 35th Avenue NE). Samples were collected from the left bank, upstream of the culvert under NE 110th Street.

- Station TCM46 (Main Stem Mouth station): Thornton Creek main stem downstream, located near the stream mouth below SPU station 46 (at Sand Point Way). Samples were collected from the left bank, upstream of the pedestrian bridge located at 51st Avenue NE in Matthews Beach Park.

- Station MBS (South Lake station): Lake Washington at Matthews Beach Park south of Thornton Creek. Samples were collected directly offshore of the southern boundary of the park at a depth of approximately 2 feet.

- Station MBN (North Lake station): Lake Washington at Matthews Beach Park north of Thornton Creek within the swimming area. Samples were collected at the rope separating shallow and deep areas at the center of the swimming beach, located near the northern boundary of the park.

Optical brighteners were monitored at the five *E. coli* ribotyping stations located in Thornton Creek (TCN64, TCS40, TCS41, TCN33, and TCM46) and at the following seven stream stations (presented in order from upstream to downstream):

- Station TCS01: Thornton Creek south fork above Northgate Mall, on the North Seattle Community College campus at the culvert outfall located 500 feet east of College Way North and N 100th Street.

- Station TCS02: Thornton Creek south fork below Northgate Mall, located at 5th Avenue NE and NE 103rd Street.

- Station VC1: Victory Creek above Victory Creek Park, located at NE 112th Avenue.

- Station VC2: Victory Creek near the mouth, located at NE 108th Avenue and 12th Avenue NE.

- Station TCS03: Thornton Creek south fork, located at NE 105th Avenue and 17th Avenue NE.

- Station WCR: Willow Creek near the mouth, located at NE 100th Avenue.

- Station KC1: Kramer Creek near the mouth, located at 30th Avenue NE approximately 75 feet north of NE 107th Street.

Sediment samples were collected at three of the fecal ribotyping stations established for the MST study (TCM46, MBS, and MBN).

Sampling Schedule

Field personnel collected water samples during 17 sampling events, including six base flow events and 11 storm events during the period of February 2005 through December 2005. Three base flow events were conducted during the winter season (November through April) and summer season (May through October). Monitoring was conducted during six storm events during the winter season, and five storm events during the summer season. Sediment samples were collected during a single sampling event on September 7, 2005.

Table 2 presents the schedule for storm and base flow sampling, and total precipitation amounts for each sampled storm event. A storm event is defined as having a minimum precipitation total of 0.02 inches and a preceding dry period of at least six hours. The timing of storm event sampling is also presented in relation to the portion of the hydrograph when the sampling occurred (i.e., the rising limb or falling limb). Precipitation totals were obtained from the Matthews Beach/Magnuson Park rain gauge (RG02) that is operated and maintained by Seattle Public Utilities (Seattle 2006b).

Sample Collection

During each base flow or storm flow sampling event, three water samples were collected manually as grab samples at each of the seven sampling stations. For base flow events, samples at each station were collected at least 5 minutes apart during a single round of sampling. For storm flow events, one sample was collected from each station during multiple sampling rounds. Between one and three sampling rounds were completed for each storm sampling event depending on the length of the storm. The number of sampling rounds (or samples per station) per storm event is presented in Table 2. All water samples were collected using aseptic techniques, placed on ice, and delivered to Aquatic Research, Inc. within 24 hours of sample collection.

Optical brightener monitoring occurred coincident with each of the first three base flow sampling events (see Table 2). At each monitoring station, one optical brightener sample pad was placed in a plastic-coated wire cage and the cage was anchored in the stream with wooden stakes. After between 2 and 12 days of exposure, the sample pad cages were detached from the wooden stakes and the pads removed from each cage. Each pad was rinsed in stream water to remove any sediment and then placed in a labeled, Ziploc plastic bag for transport to the Herrera laboratory. Pads were dried for at least 12 hours in a lint-free environment (under a covered container that allows air flow), and stored in a freezer prior to screening for the presence of optical brighteners.

Three sediment samples were collected as core samples at each of the three sediment sampling stations (TCM46, MBS, and MBN). The samples were collected from the top 2 inches of the substrate, and were placed in clean and sterile 50 mL sample jars. Organic matter content of the samples was estimated based on visual observations of sediment grain size and relative abundance of sand, gravels, and fine sediments/organic material. The beach sediment samples were collected approximately 3 feet from the waters' edge, at a water depth of 6 inches. The

Table 2. Sampling schedule and precipitation totals for the Thornton Creek and Matthews Beach microbial source tracking study.

Sampling Event ID	Number of Samples per Station	Sampling Event		Storm Event		Portion of Hydrograph	Event Precipitation (inches) [a]
		Start Date/Time	End Date/Time	Start Date/Time	End Date/Time		
Base 1	3	2/1/2005 7:54	2/1/2005 10:00	NA	NA	–	0.00
Base 2	3	4/19/2005 12:15	4/19/2005 14:05	NA	NA	–	0.00
Base 3	3	6/29/2005 10:40	6/29/2005 12:35	NA	NA	–	0.00
Base 4	3	8/16/2005 8:53	8/16/2005 11:40	NA	NA	–	0.00
Sediment	3	9/7/2005 10:50	9/7/2005 12:05	NA	NA	–	0.00
Base 5	3	10/25/2005 12:45	10/25/2005 14:45	NA	NA	–	0.00
Base 6	3	11/21/2005 8:50	11/21/2005 10:35	NA	NA	–	0.00
Storm 1a	2	3/19/2005 16:57	3/19/2005 19:10	3/19/2005 11:00	3/19/2005 18:00	falling	0.29
Storm 1b	1	3/26/2005 11:45	3/26/2005 12:47	3/26/2005 2:00	3/28/2005 15:00	rising	1.84
Storm 2a	2	4/1/2005 4:25	4/1/2005 6:45	3/31/2005 14:00	4/1/2005 6:00	falling	0.33
Storm 2b	1	4/16/2005 6:30	4/16/2005 9:30	4/15/2005 13:00	4/16/2005 10:00	falling	0.94
Storm 3	3	5/18/2005 7:05	5/18/2005 9:45	5/17/2005 21:00	5/19/2005 4:00	rising	0.53
Storm 4	3	10/2/2005 13:20	10/2/2005 16:00	10/2/2005 10:00	10/2/2005 19:00	falling	0.22
Storm 5a	1	10/28/2005 3:50	10/28/2005 4:40	10/27/2005 21:00	10/28/2005 4:00	falling	0.24
Storm 5b	1	10/31/2005 5:15	10/31/2005 6:05	10/30/2005 17:00	10/31/2005 10:00	rising	0.52
Storm 5c	1	11/1/2005 7:25	11/1/2005 8:40	10/31/2005 19:00	11/1/2005 15:00	rising	0.72
Storm 6a	1	12/20/2005 6:35	12/20/2005 9:55	12/19/2005 4:00	12/20/2005 8:00	rising	0.41
Storm 6b	2	12/21/2005 6:55	12/21/2005 11:30	12/20/2005 14:00	12/22/2005 19:00	rising	1.54

[a] Event precipitation includes all precipitation during the sampled storm event and all precipitation preceding the sampled base flow event.

creek sediment samples were collected just upstream of the pedestrian bridge in Matthews Beach Park, from the middle of the channel. All sediment samples were collected using aseptic techniques, placed on ice, and delivered to the Institute for Environmental Health within 3 hours of sample collection.

Sample Analysis

Each water sample was analyzed for fecal coliform bacteria using the membrane filter method (Method 9222D) as outlined in *Standard Methods for the Examination of Water and Wastewater* (APHA et al. 1995). Aquatic Research, Inc. is accredited by Ecology to perform the required analyses. Generally, sample volumes of 0.1 mL, 1.0 mL, and 10.0 mL were filtered for the analysis of those stream samples collected during storm flow events. For all lake samples and stream samples collected during base flow events, sample volumes of 0.5 mL, 5.0 mL, and 50 mL were filtered for the analysis. After enumeration, fecal coliform bacteria culture plates were delivered to the Institute for Environmental Health (IEH) laboratory for *E. coli* isolation and ribotyping analysis.

Each sediment sample was analyzed for the presence of fecal coliform bacteria using the 5-replicate multiple tube fermentation test method (Standard Methods 9221B & C) as outlined in *Standard Methods for the Examination of Water and Wastewater* (APHA et al. 1995). Sediment samples were homogenized in the sample containers, 12 gram portions were removed and placed in sterile mixing bags, and 108 ml of sterile APHA buffered water were added to each mixing bag. The samples were thoroughly mixed and portions were transferred to make serial 10-fold dilutions. Sample portions were inoculated to Lauryl Tryptose Broth (LTB) in five replicates, starting with a 1 gram inoculum and proceeding to 0.0001 gram (10^{-4} dilution). After enumeration, samples from positive culture tubes were plated onto MacConkey's agar and tested to verify the presence of *E. coli* bacteria.

Pure cultures of *E. coli* bacteria were obtained from the sample culture plates by the laboratory. An average of three *E. coli* isolates for the water samples and five *E. coli* isolates for the sediment samples were prepared from cultures developed for each sample, then analyzed using the ribotyping technique. The laboratory employed the ribotyping technique according to Standard Operating Procedures, which include the following steps:

- Isolation and labeling of *E. coli* ribosomal ribonucleic acid (RNA) to create the genetic probe
- Isolation of genomic deoxyribonucleic acid (DNA) from the source samples and the receiving water samples
- Hybridization of the DNA with the genetic probe
- Analysis of the ribotype information to compare the characteristic patterns for the *E. coli* isolated from receiving waters with the *E. coli* isolated from source samples.

In addition, two blind source samples were prepared by Aquatic Research, Inc. to check the accuracy of the ribotyping method. Cultures from one goose or duck fecal sample and one dog fecal sample were prepared and shipped to the Institute for Environmental Health for matching to the ribotype library. (The goose/duck fecal sample was initially identified in the field as a duck fecal sample; however, both duck and goose fecal material were present at the sampling location and a definitive identification could not be made at the time of sample collection.)

As noted above, optical brightener pads were dried and stored in a freezer until screened for the presence of optical brighteners. The pads were screened for the presence of optical brighteners using a hand-held ultraviolet light at 365 nanometers. Positive and negative controls were screened with each batch of filter pads analyzed. For quality assurance purposes, one optical brightener pad from each sampling event was sent to Ozark Underground Laboratory for analysis by the spectrophotometer method to confirm the results of the initial screening.

Results and Discussion

Results of the microbial source tracking study are presented and discussed separately below for data validation, hydrology, bacteria concentrations, fecal coliform bacteria loadings, wind effects, ribotyping, and optical brighteners. Laboratory analysis reports and data quality assurance worksheets are presented in Appendix A. The project database is presented in Appendix B and includes all bacteriological and ribotyping laboratory data.

Data Validation

The overall data quality objective of the study was to ensure that data of known and acceptable quality were obtained. Field notes and laboratory results were reviewed for precision, accuracy, representativeness, completeness, and comparability. Although quality control problems were identified, as noted below, no data were rejected (flagged with an *R*) during the data review. Therefore, all of the data collected are considered to be of acceptable quality and are used here for evaluation purposes. Data validation results are summarized below for bacteria enumeration and ribotyping.

Bacteria

During the quality assurance review, data quality issues were identified and noted in the quality control worksheets (see Appendix A). The method used to measure bacteria concentrations recommends that between 20 and 60 colonies are present on each culture plate to achieve the most accurate count. The analytical laboratory reported 69 (27 percent) of the 252 bacteria results as estimates (flagged with an "*est*") due to colony counts of less than 20, and reported seven (2.8 percent) of the 252 bacteria results as "*greater than*" the reported value (flagged with a ">" due to colony counts greater than 60). However, the laboratory discontinued the practice of flagging data associated with low or high colony counts approximately half-way through the sampling period. In addition, this data flagging procedure is not required by the analytical method and was not specified in the sampling and analysis plan (Herrera 2005). Therefore, data flags assigned by the laboratory for low or high colony counts were not included in the project database. These data flags can be found in the laboratory analysis reports in Appendix A.

Four (1.6 percent) of the bacteria results were reported by the analytical laboratory as "*greater than*" the measured value (flagged with a ">") because the numbers of colonies on all sample culture plates were too numerous to count. The laboratory estimated the sample value using a count of 200 colonies for the culture of the highest sample dilution. These data were entered into the project database with a "*G*" qualifier, signifying that the actual value is greater than the reported value.

Bacteriological results were assessed for analytical precision using laboratory duplicates. The precision criteria consisted of two levels: the relative percent difference (RPD) of laboratory

duplicates shall be less than or equal to 35 percent for values that are greater than five times the detection limit, and the difference between duplicates shall be within two times the detection limit for values less than or equal to five times the detection limit. These quality assurance objectives were met for all of the 17 laboratory duplicates analyzed and no data were flagged as estimates.

Ribotyping

Ribotyping is a microbial source tracking technique that identifies sources of fecal coliform bacteria contamination by comparing patterns in the genetic material of bacterial isolates to patterns from known sources. This method has been developed and used by the Institute of Environmental Health, and it includes various proprietary quality control procedures that provide data of high quality.

Fecal coliform bacteria cultures from goose/duck and dog fecal samples were submitted to the Institute for Environmental Health as blind quality control samples. The cultures were prepared by mixing a small amount of feces in sterile water and analyzing the water as routine water samples. A total of three isolates from the goose/duck sample and three isolates from the dog sample were analyzed by the laboratory, and all of the blind isolates were correctly matched to the ribotype database.

A comprehensive independent study of 22 researchers using 12 different microbial source tracking methods was recently conducted by the Southern California Coastal Water Research Project (Griffith et al. 2003). This study included the ribotyping method (Method D) used by the Institute of Environmental Health as part of six microbial source tracking methods that are genotype-based and require a host origin database (Myoda et al. 2003). Blind, labeled water samples were prepared, and contained between one and three of five possible fecal sources (i.e., sewage, human, dog, cow, and gull), and were analyzed by each study participant.

The study of microbial source tracking methods found that the ribotyping method (Method D) performed well in several of the evaluation criteria (Myoda et al. 2003). Method D had high sensitivity rates (i.e., the percentage of time the source was correctly identified as present in the sample), at 88 percent for human and sewage sources and 81 percent for all sources. The false positive rates (i.e., the percentage of time the source was incorrectly identified as present in the sample) for Method D were low, at 17 percent for human and sewage sources and 23 percent for all sources. Method D correctly identified the dominant source of contamination in 75 percent of all samples.

Several study design issues were identified by Myoda et al. (2003) that might have underestimated the reliability of the methods. Only 50 isolates were examined, representing a small percentage of the bacterial sample population. Also, heterogeneity of sample preparation and differential bacterial die-off might have resulted in a misrepresentation of the bacteria population. Because the goal for the Thornton Creek and Matthews Beach study was to collect a total of 756 isolates, these factors were considered to have only a minor influence on the overall level of confidence in identifying either the dominant fecal sources or the relative proportion of fecal sources in the drainage basin.

Hydrology

Discharge and precipitation data for the Thornton Creek and Matthews Beach MST study are summarized below. Discharge data for each monitoring location on Thornton Creek is presented for January through December 2005. Precipitation data is presented for January through December 2005 as measured at the three gauges operated by SPU.

Discharge

Discharge data was obtained from SPU for monitoring that occurred at, or upstream of, the Upper and Lower North Fork stations (TCN64 and TCN33, respectively) and the Upper and Lower South Fork stations (TCS40 and TCS41, respectively). Discharge data was obtained from USGS for monitoring upstream of the Main Stem Mouth station (TCM46).

Figure 5 presents discharge data for the North Fork and South Fork Thornton Creek monitoring stations. Figure 6 presents discharge data for the Main Stem Thornton Creek monitoring station. Discharge rates at the time of sample collection are shown on these figures. Table 3 presents the total annual discharge volume (in acre-feet [acre-ft]) for January through December 2005 and areal hydraulic loading (in cubic feet/acre [cf/acre]) for each location.

Table 3. Annual discharge rates and volumes and areal hydraulic loadings from January through December 2005 measured in Thornton Creek.

	Upper North Fork (TCN64)	Lower North Fork (TCN33)	Upper South Fork (TCS40)	Lower South Fork (TCS41)	Main Stem Mouth (TCM46)
Average annual discharge rate (cfs)	2.34	4.35	1.34	3.42	7.72
Maximum discharge rate (cfs)	31.0	105	79.8	127	84.7
Annual discharge (acre-ft)	1,694	3,133	1,033	2,615	5,591
Area (acres)	1,536	4,137	1,003	2,210	6,973
Areal hydraulic loading (cf/acre)	48,037	32,987	44,833	51,551	34,689

Average annual discharge rates for the Upper and Lower South Fork monitoring stations in 2005 were 1.34 and 3.42 cubic feet per second (cfs), respectively. Maximum discharge rates for the Upper and Lower South Fork monitoring stations were 79.8 and 127 cfs, respectively. The maximum flow rate at the Upper South Fork station occurred during a storm event on April 15 and 16, 2005 that produced 0.77 inches of rain at the Maple Leaf Reservoir rain gauge. The maximum flow rate at the Lower South Fork station occurred during a storm event on December 24, 2005 that produced 1.12 inches of rain at the Maple Leaf Reservoir rain gauge.

Average annual discharge rates for the Upper and Lower North Fork monitoring stations in 2005 were 2.34 and 4.35 cfs, respectively. Maximum flow rates for the Upper and Lower North Fork monitoring stations were 31.0 and 105 cfs, respectively. The maximum flow rate for both monitoring stations occurred coincident with a storm event on December 24, 2005 that produced 1.12 inches of precipitation at the Maple Leaf reservoir rain gauge.

Average annual and maximum discharge rates for the Main Stem monitoring station in 2005 were 7.72 and 84.7 cfs, respectively. The maximum flow rate for the Main Stem monitoring station occurred coincident with a storm event on January 17, 2005 that produced 1.29 inches of precipitation at the Maple Leaf reservoir rain gauge. It should be noted that during high-flow events, a diversion structure located at Meadowbrook Pond (just below the confluence of the north and south fork) directs flows to Lake Washington by way of a 72- to 90-inch pipeline.

The annual discharge volume is higher for the Lower North Fork (3,133 acre-ft) than the Lower South Fork (2,615), but the drainage area is much greater for the Lower North Fork (4,137 acres) than the Lower South Fork (2,210 acres). Thus, the areal hydraulic loading rate is much lower for the North Fork (32,987 cf/acre) than the South Fork (51,551 cf/acre). The annual discharge volume for the Main Stem Mouth (5,591 acre-ft) is less than the sum of the two forks (5,748 acre-ft), likely due in part to the diversion of high storm flows from Meadowbrook Pond directly to the lake.

Precipitation

Table 4 presents a summary of precipitation data collected from three rain gauges located adjacent to the Thornton Creek watershed. The gauges are located at Haller Lake (RG01), Matthews Beach/Magnuson Park (RG02), and Maple Leaf Reservoir (RG04), (see Figure 1). The Haller Lake rain gauge (RG02) is located just west of the Thornton Creek watershed at North 128th Street and Ashworth Avenue North. Rain gauge RG02 was located at the Matthews Beach pump station at NE 93rd Street and Sandpoint Way until March 2005, when it was moved southeast of the watershed to NE 74th Street and 63rd Avenue NE in Magnuson Park. The Maple Leaf Reservoir rain gauge (RG04) is located just south of the Thornton Creek watershed at NE 82nd Street and 12th Avenue NE.

Table 4. Monthly precipitation totals (inches) for rain gauges adjacent to the Thornton Creek watershed.

	Haller Lake (gauge RG01)	Matthews Beach/Magnuson Park (gauge RG02)	Maple Leaf Reservoir (gauge RG04)
January	2.40	3.02	2.86
February	0.83	1.05	1.00
March	2.61	3.29	2.56
April	2.72	2.20	2.47
May	2.47	2.86	2.57
June	1.83	2.26	1.74
July	0.70	0.92	0.72
August	0.29	0.31	0.28
September	1.22	1.43	1.53
October	2.53	2.56	2.58
November	4.49	4.85	4.30
December	6.59	7.29	6.41
Totals (inches)	**28.68**	**32.04**	**29.02**

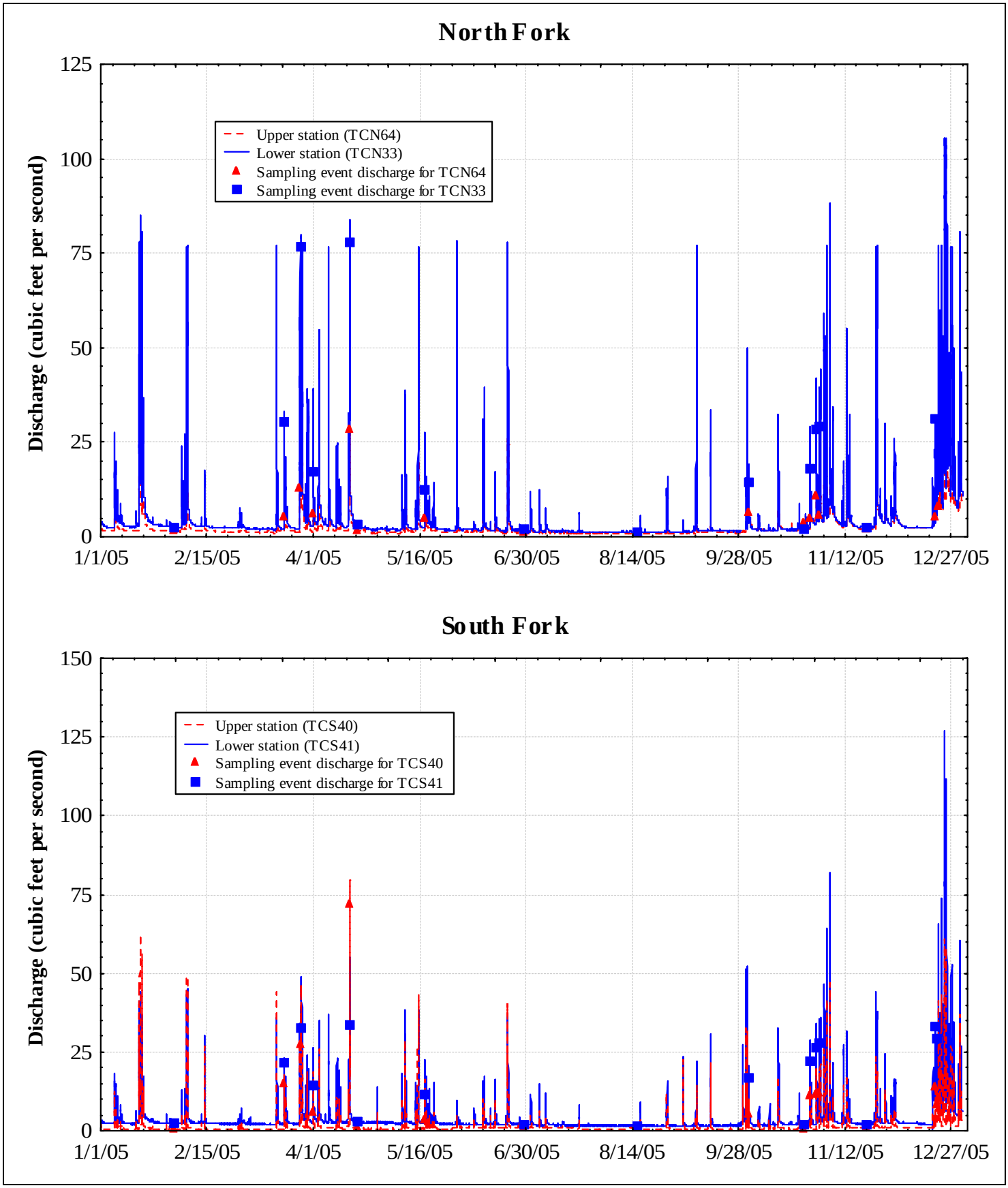


Figure 5. Hydrograph for the North Fork and South Fork Thornton Creek monitoring stations for January through December 2005.

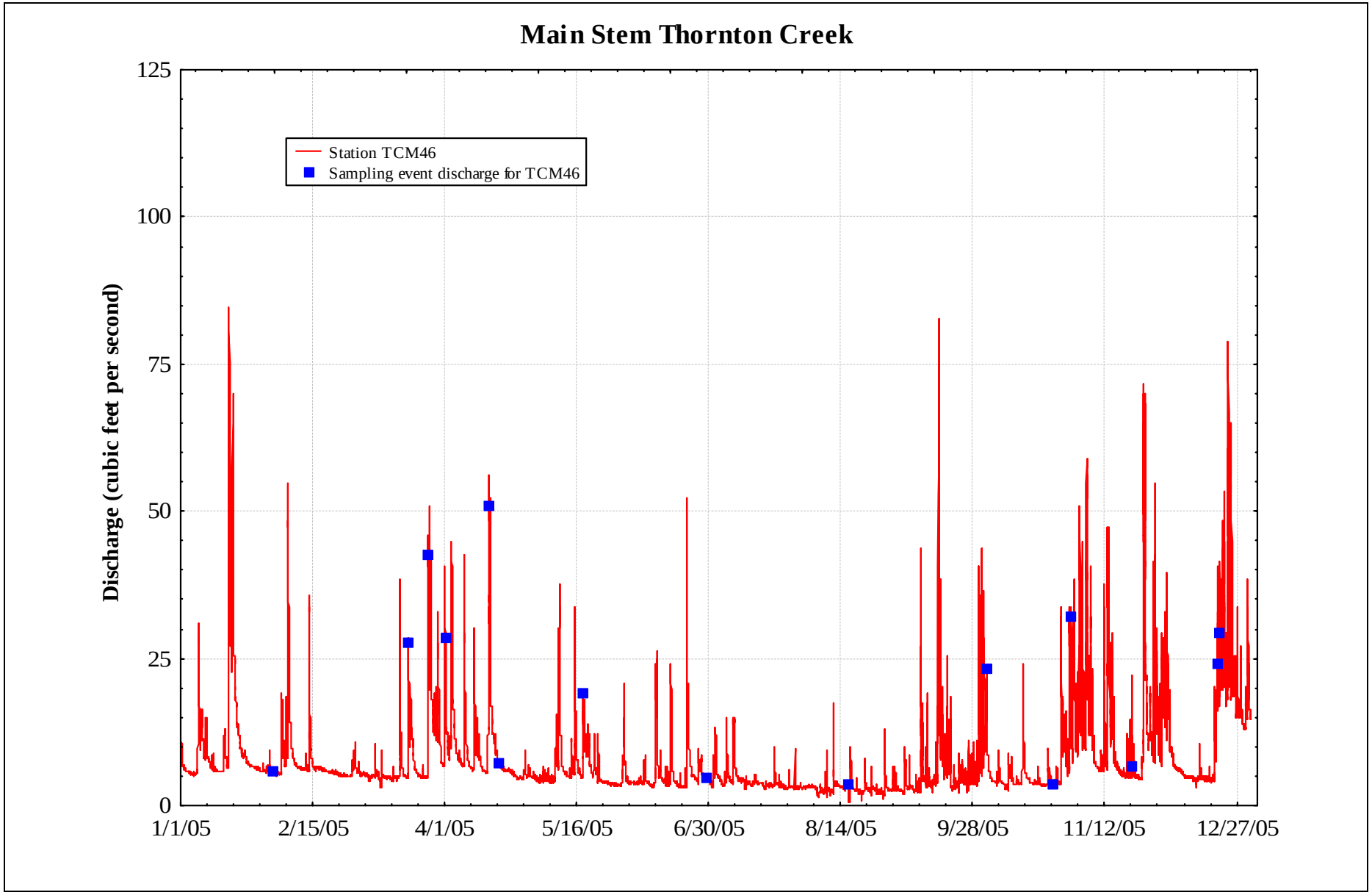


Figure 6. Hydrograph for main stem Thornton Creek monitoring station for January through December 2005.

Average annual precipitation in the Thornton Creek watershed is 34.9 inches (Seattle 2000). Precipitation totals from Table 4 indicate that 2005 was a drier than average year. A comparison of annual precipitation totals shows the variability in rainfall patterns over the watershed, with a slightly higher rainfall total at the rain gauge near the mouth of Thornton Creek compared to the other two rain gauges located along the western and southern boundaries of the watershed. Approximately twice as much rain fell during the winter season of 2005 (between 19.6 and 21.7 inches in November through April) than the summer season of 2005 (between 9.0 and 10.3 inches in May through October).

Bacteria Concentrations in Water

In the following section, fecal coliform bacteria concentrations measured in water samples are summarized and discussed with regard to water quality standards, season of the year, hydrologic condition, station location, and historical data. The project database that includes all laboratory data is presented in Appendix B.

Fecal coliform bacteria concentrations for the Thornton Creek and Matthews Beach MST study are summarized as box and whisker plots in Figure 7. Box and whisker plots show the geometric mean as a point, 25th and 75th percentiles of the data as a box, and the 10th and 90th percentiles of the data as whiskers.

Nonparametric statistical procedures were used to test for significant differences among bacteria data sets because these data do not exhibit a normal distribution. A two-tailed Mann-Whitney U test was used to test for differences between hydrologic conditions (i.e., base versus storm flow), season (i.e., summer versus winter), and different studies (i.e., MST study versus historical data). The Mann-Whitney U test is a nonparametric analogue to the paired t-test. Differences between the creek monitoring stations were tested using a Friedman's ANOVA. If statistical differences were detected, nonparametric multiple comparison tests were performed to determine which stations were significantly different from the others. Bacteria data from the Main Stem Mouth station were compared to bacteria data from each of the lake stations using a Kendall t correlation. All tests were conducted at a significance level (α) of 0.10.

Water Quality Standard Comparison

Thornton Creek and Matthews Beach (Lake Washington) are both designated as extraordinary primary contact recreation by Washington State water quality standards (WAC 173-201A). The fecal coliform bacteria standard is a geometric mean not to exceed 50 colony-forming units (CFU) per 100 milliliters (mL), with no more than 10 percent of the samples having a concentration of bacteria greater than 100 CFU/100 mL. As shown in Figure 7, the fecal coliform bacteria standard was exceeded at all seven stations during both summer and winter storm flow conditions. The bacteria standard was exceeded during summer base flow at all stations except the South Lake station (MBS), and was exceeded during winter base flow at all stream stations except the Upper North Fork station (TCN64).

Washington State Department of Health and Seattle-King County Public Health Department use the "ten-state standard" to determine whether fecal coliform bacteria concentrations pose a risk for public health, requiring swimming areas to be closed. The ten-state standard is a geometric mean of fecal coliform bacteria concentrations not to exceed 200 CFU/100 mL with no single sample exceeding 1,000 CFU/100 mL (King County 2004). King County applies this standard to a moving geometric mean of the five most recent sampling events and subsequently conducts verification sampling if either the geometric mean or single sample criteria are exceeded. Beaches are then closed if the verification sampling results exceed the standard. As shown in Figure 7, summer base flow and storm flow fecal coliform bacteria concentrations collected for this MST study did not exceed the geometric mean criterion, but the single sample criterion was exceeded in two of three samples collected during a summer storm flow event at Matthews Beach North (location of the Matthews Beach Park swimming area).

Based on data collected by King County, the Matthews Beach Park swimming area was closed for one week in July 2005 due to elevated fecal coliform bacteria concentrations. Through July 12, 2005, the moving geometric mean fecal coliform bacteria concentration was 230 CFU/100 mL, and required the collection of verification samples to determine the need for a beach closure. The mean fecal coliform bacteria concentration of verification samples collected on July 14, 2005 was 456 CFU/100 mL, and resulted in the closure of the swimming beach. The maximum fecal coliform bacteria concentration reported by King County at Matthews Beach for the 2005 swimming season was 1,500 CFU/100 mL on August 9, 2005. This observation did not result in a beach closure because the moving geometric mean fecal coliform bacteria concentration of the five most recent samples was 54 CFU/100 mL, and the verification samples collected on August 11, 2005 exhibited a mean bacteria concentration of 33 CFU/100 mL.

Spatial, Hydrologic, and Seasonal Comparisons

Bacteria data for samples collected at the five stream stations and two beach stations were compared to evaluate spatial, hydrologic, and seasonal differences in fecal coliform bacteria in Thornton Creek and at Matthews Beach. As shown in Figure 7, geometric means of these bacteria concentrations increase from upstream to downstream in the North Fork and South Fork of Thornton Creek both seasonally (summer and winter) and hydrologically (storm and base flow). Bacteria concentrations at the Matthews Beach North Lake station were higher than the South Lake station during summer and winter base flow, but lower than the South Lake station during summer and winter storm flow. Results from the statistical comparisons are presented in Tables 5 and 6.

Results from a Friedman's ANOVA test show that the significance of the observed increase in bacteria concentrations from upstream to downstream stations depends on the hydrologic condition. For example, bacteria concentrations during storm flow showed a significant increase downstream in the North Fork ($p<0.00001$) and South Fork ($p<0.00001$) of Thornton Creek. However, the increase downstream was only significant in the North Fork ($p<0.00001$) during base flow (see Table 5). The Lower North Fork and Lower South Fork stations and the Main Stem mouth station were not significantly different from each other during either base flow or storm flow conditions at a significance level (α) of 0.10. These results suggest that stormwater is

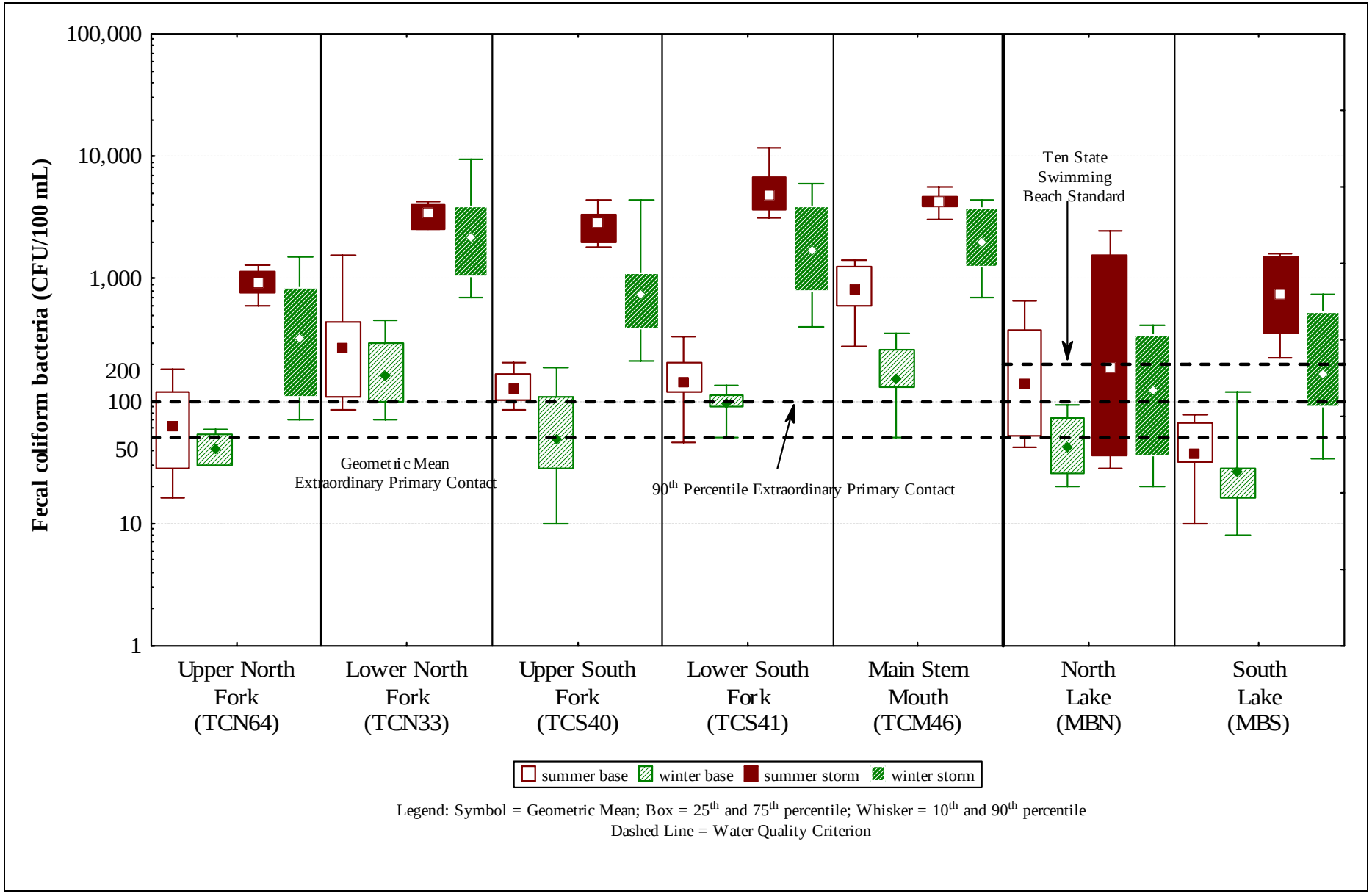


Figure 7. Fecal coliform bacteria concentrations for the Thornton Creek and Matthews Beach Microbial Source Tracking Study from February through December 2005.

a significant source of bacteria contamination in the Thornton Creek watershed, and the bacteria sources are primarily located between the upper and lower stations on both the south and north forks of Thornton Creek.

Table 5. Spatial comparison of bacteria data collected for the Thornton Creek microbial source tracking study.

Fecal Coliform Bacteria Data Set	p-value [a]	Site [b]				
		Low Mean Rank				High Mean Rank
All data	**<0.00001**	TCN64	TCS40	TCS41	TCN33	TCM46
Storm flow	**<0.00001**	TCN64	TCS40	TCS41	TCN33	TCM46
Base flow	**<0.00001**	TCN64	TCS40	TCS41	TCN33	TCM46

a Values in **bold** indicate significant differences exist between sites based on a Friedman ANOVA (alpha = 0.10).
b Monitoring stations connected by a single unbroken line are not significantly different based on a nonparametric multiple range test.
TCN64 = Upper North Fork station.
TCN33 = Lower North Fork station.
TCS40 = Upper South Fork station.
TCS41 = Lower South Fork station.
TCM46 = Main Stem Mouth station.

Results from a Kendall's τ correlation test show that fecal coliform bacteria concentrations at the Main Stem Mouth station are significantly correlated to those at the South Lake station (p=0.000134), but not to those at the North Lake station (p=0.155) (see Table 6). These results suggest that Thornton Creek is a major source of bacteria to Matthews Beach, and the effects of the stream on bacteria concentrations in the lake are significant to the area south of the creek mouth but may not be to the area north. Thus, the shorter distance from the mouth of Thornton Creek to the South Lake station (350 feet) than the North Lake station (700 feet) points to a larger dilutional effect on Thornton Creek water with lake water that is reducing fecal coliform bacteria concentrations in the area of the North Lake station.

A comparison of bacteria concentrations during base flow and storm flow conditions shows that bacteria concentrations are higher during storm flow than base flow at all of the monitoring stations (see Figure 7). Results from a Mann-Whitney U test indicate that fecal coliform bacteria concentrations are significantly higher during storm flow conditions at all of the monitoring stations except the North Lake station (MBN) (see Table 6). Again, these results also show that stormwater runoff is a significant factor affecting bacterial contamination in the Thornton Creek basin.

The seasonal and hydrologic patterns in fecal coliform bacteria concentrations were also similar among the five stream stations and two lake stations (see Figure 7). Hydrologically, geometric mean bacteria concentrations were higher during storm flow than base flow for both summer and winter. Seasonally, geometric mean concentrations were higher during summer than winter for base and storm flow conditions. These patterns were less pronounced at the North Lake station

than at the South Lake station, and at the five stream stations. Results from a Mann-Whitney U test show that storm flow concentrations were significantly higher than base flow concentrations at all stations except the North Lake station (p=0.28). However, these test results also show that the fecal coliform bacteria concentrations observed during summer and winter were only significantly different at the Main Stem Mouth station (see Table 6).

Table 6. Statistical test results[a] for spatial, hydrologic, and seasonal comparisons of fecal coliform bacteria data collected for the Thornton Creek MST study.

Comparison	Difference of Medians (CFU/100 mL)	p-value [a]
Spatial		
TCM46 versus MBN	NA	0.1546
TCM46 versus MBS	NA	**0.0001**
Hydrologic		
TCN64 base versus storm	707.0	**<0.0001**
TCN33 base versus storm	2,292.0	**<0.0001**
TCS41 base versus storm	996.0	**<0.0001**
TCS40 base versus storm	2,790.0	**<0.0001**
TCM46 base versus storm	3,002.0	**<0.0001**
MBN base versus storm	178.0	0.2819
MBS base versus storm	306.0	**<0.0001**
Seasonal		
TCN64 winter versus summer	82.0	0.5105
TCN33 winter versus summer	140.0	0.7849
TCS41 winter versus summer	-20.0	0.5209
TCS40 winter versus summer	-136.0	0.5527
TCM46 winter versus summer	560.0	**0.0749**
MBN winter versus summer	62.0	0.1442
MBS winter versus summer	-38.0	0.3520

[a] A Kendall's tau correlation was conducted for the spatial comparison and a Mann-Whitney U test was conducted for the hydrologic and seasonal comparisons.
[b] Values in **bold** indicate significant differences exist at $\alpha = 0.10$.
NA = not applicable because the Kendall's tau correlation is based on a comparison of ranks of the data, not the median.
TCN64 = Upper North Fork station.
TCN33 = Lower North Fork station.
TCS40 = Upper South Fork station.
TCS41 = Lower South Fork station.
TCM46 = Main Stem Mouth station.
MBN = North Lake station.
MBS = South Lake station.

Historical Data Comparison

As described in the Background Information section, Seattle Public Utilities has monitored fecal coliform bacteria concentrations near the mouth of Thornton Creek, and King County currently monitors bacteria concentrations at Matthews Beach Park and at the mouth of Thornton Creek. In order to determine if fecal coliform bacteria concentrations in Thornton Creek and at

Matthews Beach Park have changed over time, bacteria data from the MST study were compared to the historical bacteria data. Comparisons between the MST study bacteria data and the SPU and King County bacteria data are presented below. Geometric mean bacteria concentrations from the current MST study and from the SPU and King County monitoring data are presented in Table 7.

Table 7. Geometric mean fecal coliform bacteria concentrations (CFU/100 mL) for the Thornton Creek and Matthews Beach microbial source tracking study and historical bacteria monitoring.

	Microbial Source Tracking Study (2005)		City of Seattle (1990–2001 [a])	King County (2001–2005 [b])	
	Main Stem Mouth (TCM46)	North Lake (MBN)	Main Stem Mouth (TCM46)	Main Stem Mouth (TCM46)	North Lake (MBN)
Summer	1,575	157	1,314	**581**	102
Winter	666	78	704	–	–
Base	353	77	**827**	–	–
Storm	2,576	142	2,185	–	–

Bold value indicates that the value is significantly different from the value for the microbial source tracking study at a significance level of α= 0.1.
[a] Data source: Minton (2000).
[b] Data source: King County (2006).

The fecal coliform bacteria data collected at the Main Stem Thornton Creek station (TCM46) for this MST study were compared to the fecal coliform bacteria data collected by Seattle Public Utilities from February 1990 through March 2001 (Minton 2000). Results from the Mann-Whitney U test indicate that there is not a statistically significant difference (p=0.75) between the historical bacteria data and the MST study bacteria data. When comparing base flow and storm flow data separately, there is a statistically significant difference (p=0.004) between the historical and MST study fecal coliform bacteria data during base flow conditions, but not during storm flow conditions (p=0.56). The base flow geometric mean concentration of fecal coliform bacteria was 655 CFU/100 mL for the MST study data compared to 827 CFU/100 mL for the historical data. This result indicates that fecal coliform bacteria concentrations measured at the Main Stem Thornton Creek station for the MST study are not significantly different than those measured at the same location from 1990 to 2001 during storm flow, but bacteria concentrations were significantly lower for the MST study than have been historically observed during base flow conditions.

King County monitors fecal coliform bacteria concentrations at Matthews Beach Park and the mouth of Thornton Creek during the summer as part of its swimming beach monitoring program. Water samples are collected and analyzed for fecal coliform bacteria concentrations on a weekly basis from the middle of the swimming area in Matthews Beach Park, which corresponds to the North Lake Station for this MST study, and from the mouth of Thornton Creek, which corresponds to the Main Stem Mouth station for this MST study. The fecal coliform bacteria data collected at the Main Stem Thornton Creek station (TCM46) and the North Lake station

(MBN) were compared to the fecal coliform bacteria data collected by King County from May 2001 through September 2004 (King County 2004).

Results from the Mann-Whitney U test indicate that there is a statistically significant difference (p=0.0004) between the historical King County bacteria data collected at the mouth of Thornton Creek and the MST study bacteria data collected at the Main Stem Mouth station (TCM46). There is not a statistically significant difference (p=0.40) between the historical King County bacteria data and the MST study bacteria data collected at the North Lake station (MBN).

Bacteria Concentrations in Sediment

In the following section, fecal coliform bacteria concentrations observed in sediment samples from Thornton Creek and the two lake stations are presented and discussed and compared to fecal coliform bacteria concentrations observed in water samples. Table 8 presents a summary of bacteria data for the sediment and water samples collected from the mouth of Thornton Creek (TCM46), Matthews Beach North (MBN), and Matthews Beach South (MBS).

Table 8. Comparison of fecal coliform bacteria concentrations in sediment (organisms/gram sediment) and water samples collected for the Thornton Creek and Matthews Beach MST study.

Station	Sample 1	Sample 2	Sample 3	Geometric Mean in Sediment (organisms/gram)	Geometric Mean in Water (CFU/100 mL)		
					Base Flow	Storm Flow	All Samples
Main Stem Mouth of Thornton Creek (TCM46)	1,300	5,000	330	599	656	2,576	953
Matthews Beach North Lake (MBN)	5	11	3	5	77	142	104
Matthews Beach South Lake (MBS)	17	50	50	35	3	348	93

Results of the fecal coliform bacteria analysis of sediment samples show a much higher geometric mean concentration at the Main Stem Mouth station (599 organisms/gram) than either lake station (35 organisms/gram at the South Lake station and 5 organisms/gram at the North Lake station). Bacteria concentrations in the creek and lake water samples exhibited a similar pattern as the sediment samples (see Table 8), with bacteria concentrations decreasing from the Main Stem Mouth station to the two lake stations. Sediment bacteria concentrations were higher at Matthews Beach South (MBS) than Matthews Beach North (MBN), which was also observed in storm flow water samples but not in base flow water samples. During storm events, sediment from Thornton Creek can be resuspended and deposited in areas downstream. Because the distance from the mouth of Thornton Creek to the South Lake station is shorter than the distance to the North Lake station (350 feet and 700 feet, respectively), it is likely that more suspended sediment, and associated bacteria, would accumulate near the South Lake station than near the North Lake station. In addition, the accumulated sediment would be subject to wave action

which would resuspend the sediment and associated bacteria. These results suggest that stream sediment is a potential source of fecal coliform bacteria contamination for Matthews Beach during storm events, both directly from the discharge of stream sediment and indirectly from the resuspension of beach sediment originating from Thornton Creek.

Based on visual observations of the sediment samples, sediment bacteria concentrations appear to be related to the organic matter content. The estimated organic matter content of the sediment was 50 percent at the Main Stem Mouth station compared to 25 percent at the South Lake station and less than 1 percent at the North Lake station. Thus, organic matter content appears to be an important factor in the accumulation of fecal coliform bacteria in stream and lake sediment, with higher bacteria concentrations being observed in sediments with a relatively high organic matter content. Bacteria concentrations in lake sediment have been shown to be higher in sediment with high organic matter when compared to bacteria concentrations in low organic matter sediment (Schallenberg and Kalff 1993). The increased bacteria concentrations in high organic matter sediment is likely due to the greater available surface area of the organic matter particulates when compared to sand or small gravel, resulting in the adsorption of more bacteria to the organic matter present.

Thornton Creek Bacteria Loadings

Annual fecal coliform bacteria loadings were calculated to identify the relative contribution of the monitored drainage subbasins to fecal coliform bacteria contamination in Thornton Creek. Regression models of stream discharge versus bacteria loading rates (i.e., bacteria concentration multiplied by the stream discharge rate at the time of sample collection) were developed for each of the five creek stations. A relatively strong positive relationship (r^2 ranging from 0.64 to 0.86) was observed for each station using log transformed values of discharge and fecal coliform bacteria loading rate. An example regression model for the Main Stem Mouth station is presented in Figure 8.

Each of these models can be used to calculate an annual fecal coliform bacteria loading by applying the regression equation to the stream discharge record for 2005 and summing the results. Further examination of the data distribution shows that the base flow and storm flow data are grouped separately, and neither group exhibits a significantly positive relationship (i.e., loading rates do not significantly increase with discharge when base and storm flow data are analyzed separately) (see Figure 8). Therefore, bacteria loadings were calculated by multiplying the geometric mean concentration of the summer and winter base flow and storm flow samples by the corresponding volume of water associated with each seasonal flow condition for the monitoring period of interest (2005). Base flow and storm flow volumes for each station were estimated using a hydrograph separation method which uses a computer algorithm to define intervals of the hydrograph corresponding to base flow and storm flow periods (Herrera 2004c). To normalize the bacteria loadings to the size of the drainage area, areal bacteria loadings were calculated for each monitoring station.

Areal Bacteria Loadings

Table 9 presents annual areal fecal coliform bacteria loadings for the five creek stations in this MST study and compares them to literature values for forest and residential land uses (Horner 1994). The loadings presented for each monitoring station represent the cumulative loadings to that station, such that the loadings for the Main Stem Mouth station represent the average areal loadings for the entire Thornton Creek basin.

Table 9. Annual areal fecal coliform bacteria loadings ($1x10^9$ bacteria/acre-year) for monitoring stations on Thornton Creek, compared to literature values for forest and residential land uses.

	Base Flow	Storm Flow	Total Flow
Upper North Fork	0.4	2.2	2.6
Lower North Fork	0.5	17.1	17.7
Upper South Fork	0.5	11.9	12.3
Lower South Fork	0.6	28.1	28.7
Main Stem Mouth	2.0	11.5	13.5
Forest [a]	–	–	1.6
Residential [a]	–	–	3.8 - 8.5

[a] Horner et al. (1994).

Annual areal bacteria loadings were substantially higher during storm flow than base flow. The lowest areal fecal coliform bacteria loadings were observed at the Upper North Fork (TCN64), and the highest areal fecal coliform bacteria loadings were observed at the Lower South Fork (TCS41). The low bacteria loadings at the Upper North Fork (TCN64) during storm flow conditions may be the result of drainage detention features located in this subbasin. Ronald Bog Pond and Twin Ponds likely improve water quality by the settling of stormwater particulates, including bacteria. Additional off-channel stormwater ponds located on the Jackson Park Golf Course may further reduce bacteria loadings observed at the Upper North Fork (TCN64). These observations suggest that bacteria removal by the ponds outweighs the additional loadings from waterfowl use of the ponds, which is supported by the ribotyping results discussed below.

Annual areal bacteria loadings during storm flow increase downstream in both the north and south forks of Thornton Creek (see Table 7). However, annual areal bacteria loadings during storm flow decrease from the Lower North and South fork stations (46.4 billion/acre-ft) to the Main Stem Mouth (13.5 billion/acre-ft). This may be attributed to Meadowbrook Pond, an off-channel retention/detention pond located just below the confluence of the North Fork and South Fork that diverts storm flow from Thornton Creek to Lake Washington. Because the areal bacteria loading to the upper main stem is equivalent to the combined Lower North and South Fork stations, these results suggest that diversion of storm water from Thornton Creek below these stations to Meadowbrook Pond (and Lake Washington) results in a decrease in the bacteria loadings observed at the Main Stem Mouth.

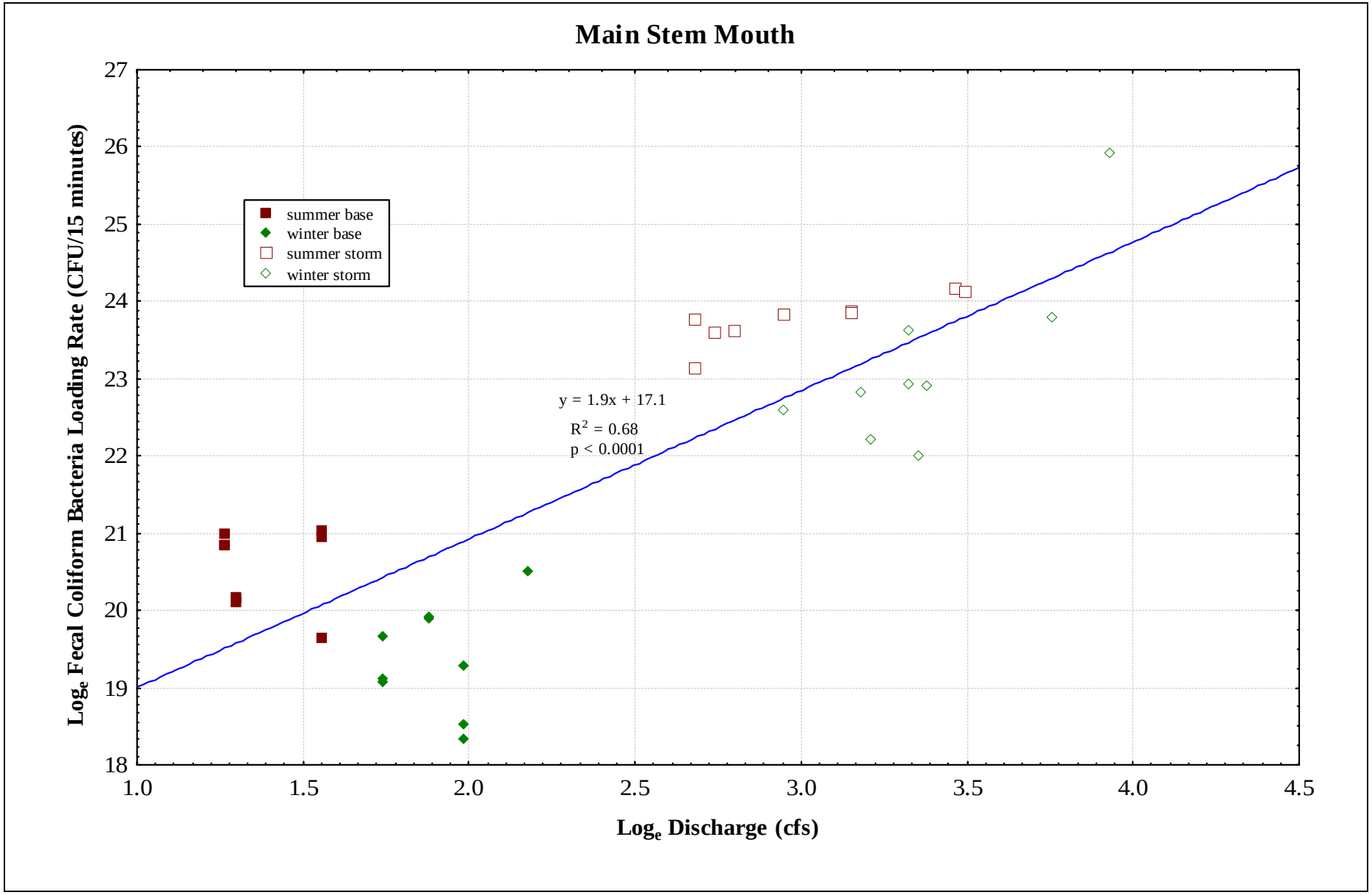


Figure 8. Natural log of discharge versus natural log of fecal coliform bacteria loading rates for the Main Stem Mouth station (TCM46) on Thornton Creek.

All subbasins except the Upper North Fork exhibit high bacteria loadings compared to those reported by others (Horner et al. 1994) for residential land uses (see Table 7). The particularly high areal loadings for the Lower North Fork and Lower South Fork stations suggest that runoff from subbasins located between the upper and lower stream fork stations contribute the majority of bacteria present in Thornton Creek. Bacteria sources observed in the subbasins draining to these stations are discussed for the ribotyping results below.

Figure 9 presents two scatter plots of fecal coliform bacteria loading rates at the Main Stem Mouth station versus fecal coliform bacteria concentrations at the North Lake and South Lake stations. Results from a Kendall's τ correlation test show that fecal coliform bacteria loadings at the Main Stem Mouth station are significantly correlated to bacteria concentrations at the South Lake station ($p=0.000008$), and North Lake station ($p=0.096$). As previously noted for the bacteria concentration comparisons, these results suggest that Thornton Creek is a major source of bacteria to Matthews Beach. Because the effects of the stream discharge on bacteria concentrations in the lake are more significant at the South lake station than the North Lake station, and the mouth of the Thornton Creek is much closer to the South Lake station (350 feet) than the North Lake station (700 feet), these results suggest that the distance from the mouth of Thornton Creek is an important factor affecting bacteria concentrations in the lake.

Bacteria Load Duration Curve

Load duration curves are useful for evaluating bacteria contamination of surface waters, for identifying hydrologic patterns of the contamination, and for assessing potential sources and corrective actions. Bacteria load duration curves were developed for the mouth of Thornton Creek to compare fecal coliform bacteria loadings in the stream to those meeting the Washington state water quality standard for fecal coliform bacteria (Figure 10). The bacteria load duration curves for Thornton Creek presented in Figure 10 are based on the two-part Washington state water quality standard and a 10-year period of daily average discharge as measured at the USGS gauging station. One fecal coliform bacteria loading rate (target) curve is based on the geometric mean criterion (not to exceed 50 CFU/100 mL) and the other target curve is based on the 90th percentile/single sample criterion (not to exceed 100 CFU/100 mL). Bacteria loading rates were calculated for the mouth of Thornton Creek from the individual water sample bacteria concentrations and the daily average stream discharge, and were plotted on the load duration curve by season and flow condition. Thus, calculated bacteria loading rates that plot above the target curves exceed the associated water quality standard for fecal coliform bacteria.

As shown in Figure 10, the measured bacteria loadings exceeded the target values for the geometric mean and individual samples during each of the seasonal flow regimes. Only two samples collected during winter base flow conditions did not exceed the target loading rate for individual samples. As previously described, the particularly high bacteria loadings during storm flow indicate that stormwater runoff is an important source of bacteria contamination in Thornton Creek. However, high bacteria loadings during base flow, particularly during the summer, indicate that in-stream sources are also important. Identifying the specific bacteria sources in stormwater runoff and base flow is important in determining appropriate source

control or treatment corrective actions to reduce bacteria loadings in Thornton Creek. Because the bacteria loadings in the creek strongly influence the bacteria concentrations observed at Matthews Beach, corrective actions would be most beneficial during the summer to reduce the occurrence of beach closures.

Effect of Wind on Matthews Beach Bacteria Concentrations

Wind direction and speed may affect the concentrations of fecal coliform bacteria observed at Matthews Beach. Wind direction likely affects the direction of longshore currents in the lake, such that southerly winds may direct currents to the north and northerly winds (blowing south to north) may direct currents to the south. Thus, southerly winds may direct more of the bacteria in Thornton Creek towards the North Lake station located at the swimming beach. Wind speed affects both the strength of the current and the size of the waves, which suspend near shore sediments. Therefore, strong winds may increase bacteria concentrations at the swimming beach due to the resuspension of sediment bacteria.

To evaluate the influence of wind on bacteria concentrations at the two beach stations, bacteria concentrations in samples collected from the North Lake and South Lake stations were plotted as a function of wind speed (Figure 11). Bacteria concentrations at these stations exhibited a similar range during low wind speeds (less than 5 miles per hour) and moderate wind speeds (10 to 13 miles per hour). These results suggest that wind speed does not have a substantial effect on bacteria concentrations observed at either lake station. Bacteria concentrations were higher at both lake stations during moderate southerly winds compared to moderate northerly winds (see Figure 11). The higher bacteria concentrations observed at the south lake station during moderate southerly winds suggests that wind direction does not affect bacteria concentrations in the lake by directing lake currents from the stream mouth to the South Lake station.

To determine if the lack of an observed effect of wind on fecal coliform bacteria concentrations at the two lake stations was a result of the influence of stream discharge on those bacteria concentrations, wind speed at the two lake stations was plotted with residuals from the comparison of bacteria loading rates at the Main Stem Mouth station versus bacteria concentrations at the two lake stations shown in Figure 9. The resulting graph (Figure 12) removes the influence of Thornton Creek bacteria loadings from the comparison of lake bacteria concentrations to wind. To avoid pseudoreplication bias (i.e., bias from the use of data for replicate samples that are not statistically independent), daily mean fecal coliform bacteria concentrations were calculated, and as a result 17 data points were used for this analysis. As shown in Figure 12, no significant relationship was observed for either the North Lake stations ($p=0.16$) or the South Lake station ($p=0.45$). Although these results indicate that the effect of wind on bacteria concentrations at Matthews Beach is not significant, a limited number of samples were collected during northerly winds and a significant relationship may become apparent if more data are available.

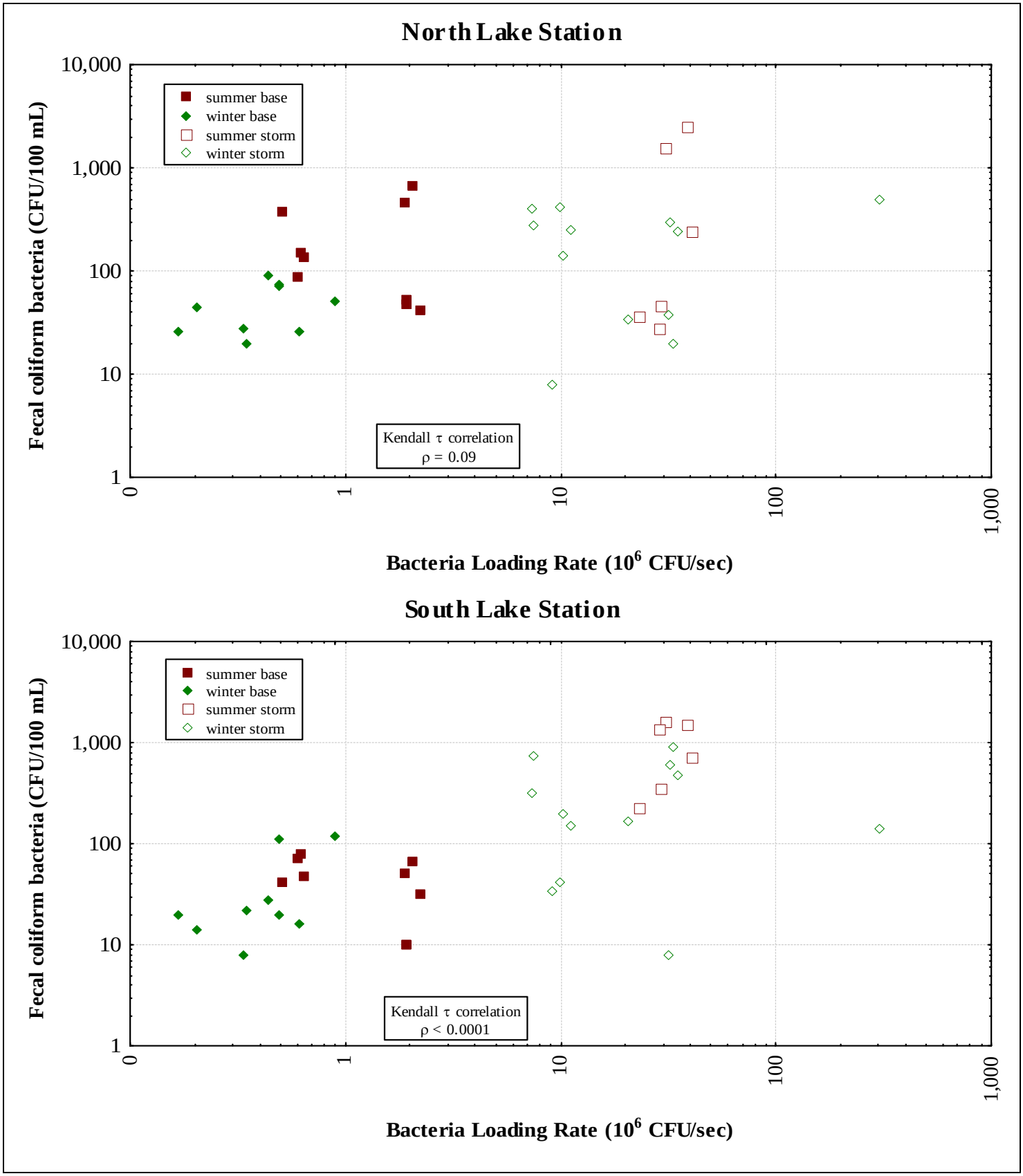


Figure 9. Fecal coliform bacteria loading rates at the mouth of Thornton Creek versus fecal coliform bacteria concentrations at the North Lake and South Lake stations at Matthews Beach.

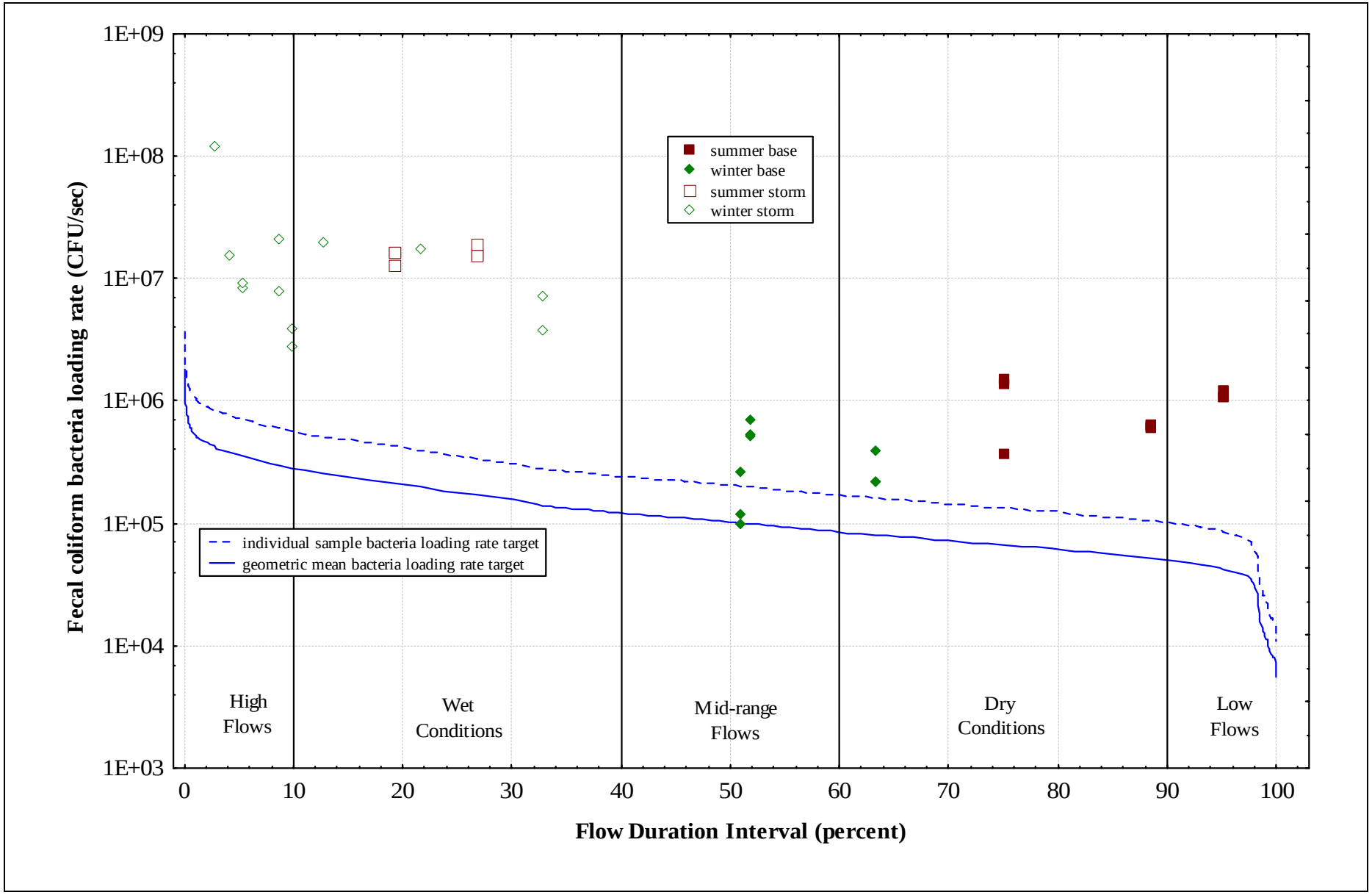


Figure 10. Fecal coliform bacteria loading rates measured at the mouth of Thornton Creek compared to fecal coliform bacteria load duration curves (bacteria loading rate targets) based on Washington state water quality criteria and a 10-year flow record.

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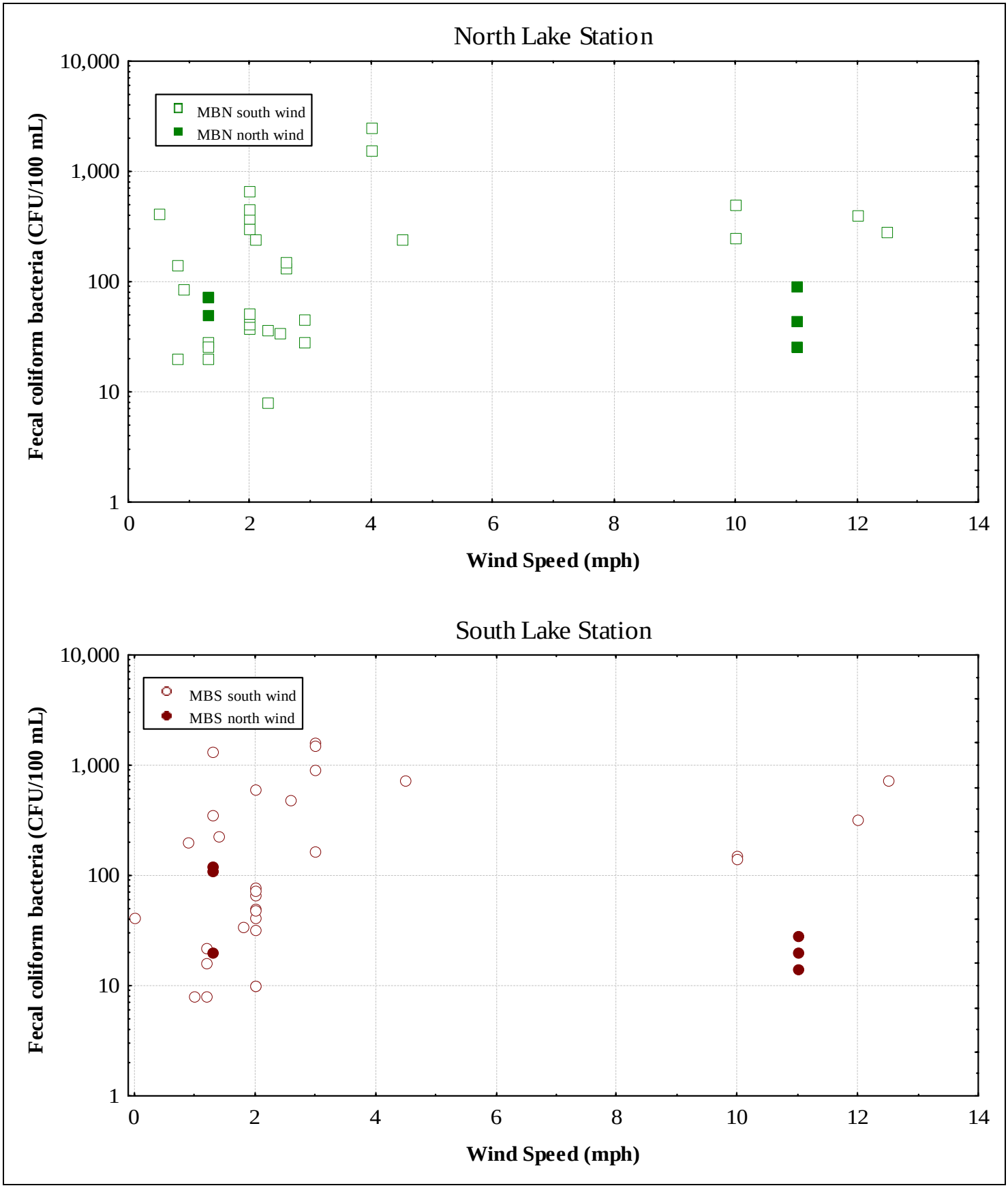

Figure 11. Wind speed versus fecal coliform bacteria concentrations observed at the North Lake and South Lake stations at Matthews Beach Park.

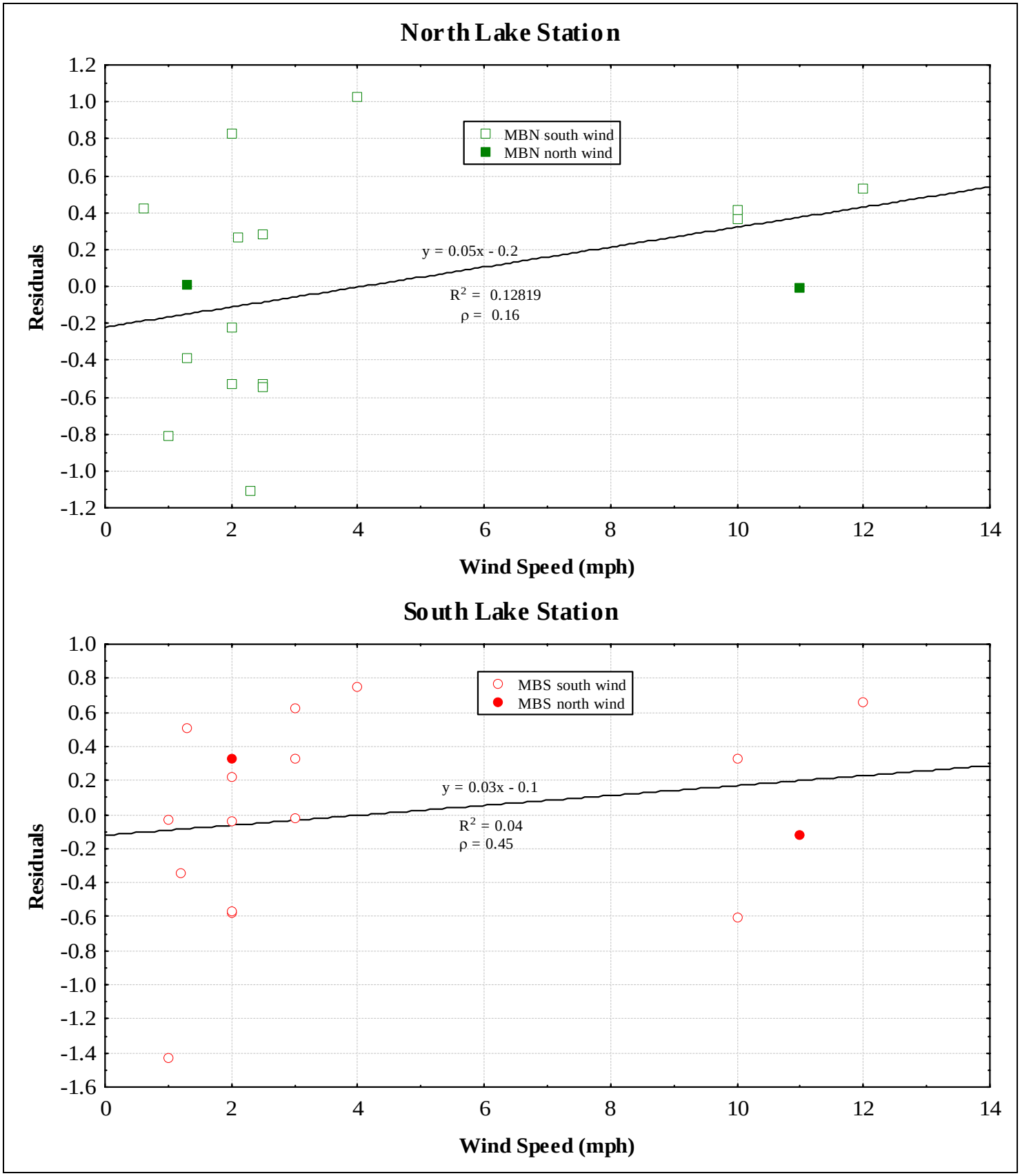

Figure 12. Wind speed versus the regression residuals of fecal coliform bacteria loading rates for the Main Stem Mouth station of Thornton Creek versus fecal coliform bacteria concentrations for the North Lake and South Lake stations.

Bacteria Ribotyping

A total of 793 isolates were obtained from the 252 water samples collected for this MST study. An additional 49 isolates were obtained from the nine sediment samples collected for this study. These isolates were then matched to the ribotype database (library) maintained by the Institute for Environmental Health. Approximately 94 percent of the water isolates and 86 percent of the sediment isolates were matched to a known fecal source. The high number of isolates and high matching rate provide a high level of confidence that the predominant bacteria sources were correctly identified.

The ribotyping results from the water samples are presented in Table 10. The number and percentage of source isolates are presented for each station and for all stations combined. Several sources were combined into one category for ease of interpretation. The human category includes sources originating from human waste or sewage samples. The canine category includes sources identified as dog or canine (i.e., bacteria strains common to both domestic dog and coyote). The waterfowl category includes sources identified as duck or goose. The avian category includes sources identified as avian, which consists of bacteria strains common to more than one type of bird (e.g., crow, pigeon, sparrow, starling, songbird, seagull, coot, duck, or goose). The rodent category includes sources identified as rodent, which consists of bacteria strains common to more than one type of rodent (e.g., rat, mouse, vole, mole, muskrat, bat, or beaver).

The overall matching results for the water and sediment samples are described below. Comparisons of matching results for the water samples are then summarized in separate sections for hydrologic condition and season, and for historical data comparison.

Overall Matching Results

Water Samples

Figure 13 presents a schematic pie-chart diagram of bacteria sources in Thornton Creek and Matthews Beach. The pie charts present the percentage of source categories observed at each of the seven ribotyping stations, showing the flow path from upstream to downstream stations. For ease of interpretation, identified bacteria sources were grouped together to create the following general source categories:

- Human (human and sewage)
- Pet (canine and feline)
- Avian (avian, duck and goose)
- Wildlife (beaver, opossum, raccoon, rodent, and squirrel)
- Unknown (unknown source).

Although canine could include coyote and feline could include bobcat or cougar, canine and feline bacteria isolates were grouped into the pet category because it is likely that domestic dogs and cats represent the majority of canine and feline sources in Seattle.

Table 10. Number and sources of *E. coli* bacteria isolates obtained from water samples for the Thornton Creek and Matthews Beach microbial source tracking study.

	Stream Sites										Lake Sites				Sum of All Stations	
	TCN64 Upper North Fork		TCN33 Lower North Fork		TCS40 Upper South Fork		TCS41 Lower South Fork		TCM46 Main Stem Mouth		MBN Lake North		MBS Lake South			
Fecal Source	Number of Isolates	Percent of Total	Number of Isolates	Percent of Total	Number of Isolates	Percent of Total	Number of Isolates	Percent of Total	Number of Isolates	Percent of Total	Number of Isolates	Percent of Total	Number of Isolates	Percent of Total	Number of Isolates	Percent of Total
Human	3	2.7%	7	6.4%	6	5.3%	2	1.8%	4	3.4%	1	0.9%	0	0.0%	23	2.9%
Canine	11	9.9%	15	13.8%	9	7.9%	13	11.4%	10	8.5%	10	8.5%	11	9.9%	79	10.0%
Feline	0	0.0%	2	1.8%	1	0.9%	0	0.0%	0	0.0%	2	1.7%	2	1.8%	7	0.9%
Avian	39	35.1%	46	42.2%	43	37.7%	46	40.4%	51	43.6%	51	43.6%	41	36.9%	317	40.0%
Waterfowl	8	7.2%	2	1.8%	4	3.5%	8	7.0%	5	4.3%	2	1.7%	3	2.7%	32	4.0%
Beaver	0	0.0%	0	0.0%	1	0.9%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	1	0.1%
Opossum	0	0.0%	0	0.0%	2	1.8%	1	0.9%	3	2.6%	1	0.9%	1	0.9%	8	1.0%
Raccoon	23	20.7%	14	12.8%	14	12.3%	14	12.3%	18	15.4%	13	11.1%	17	15.3%	113	14.2%
Rodent	24	21.6%	17	15.6%	28	24.6%	18	15.8%	21	17.9%	24	20.5%	28	25.2%	160	20.2%
Squirrel	0	0.0%	0	0.0%	0	0.0%	2	1.8%	0	0.0%	0	0.0%	1	0.9%	3	0.4%
Unknown	3	2.7%	6	5.5%	6	5.3%	10	8.8%	5	4.3%	13	11.1%	7	6.3%	50	6.3%
Total	111	100.0%	109	100.0%	114	100.0%	114	100.0%	117	100.0%	117	100.0%	111	100.0%	**793**	100.0%

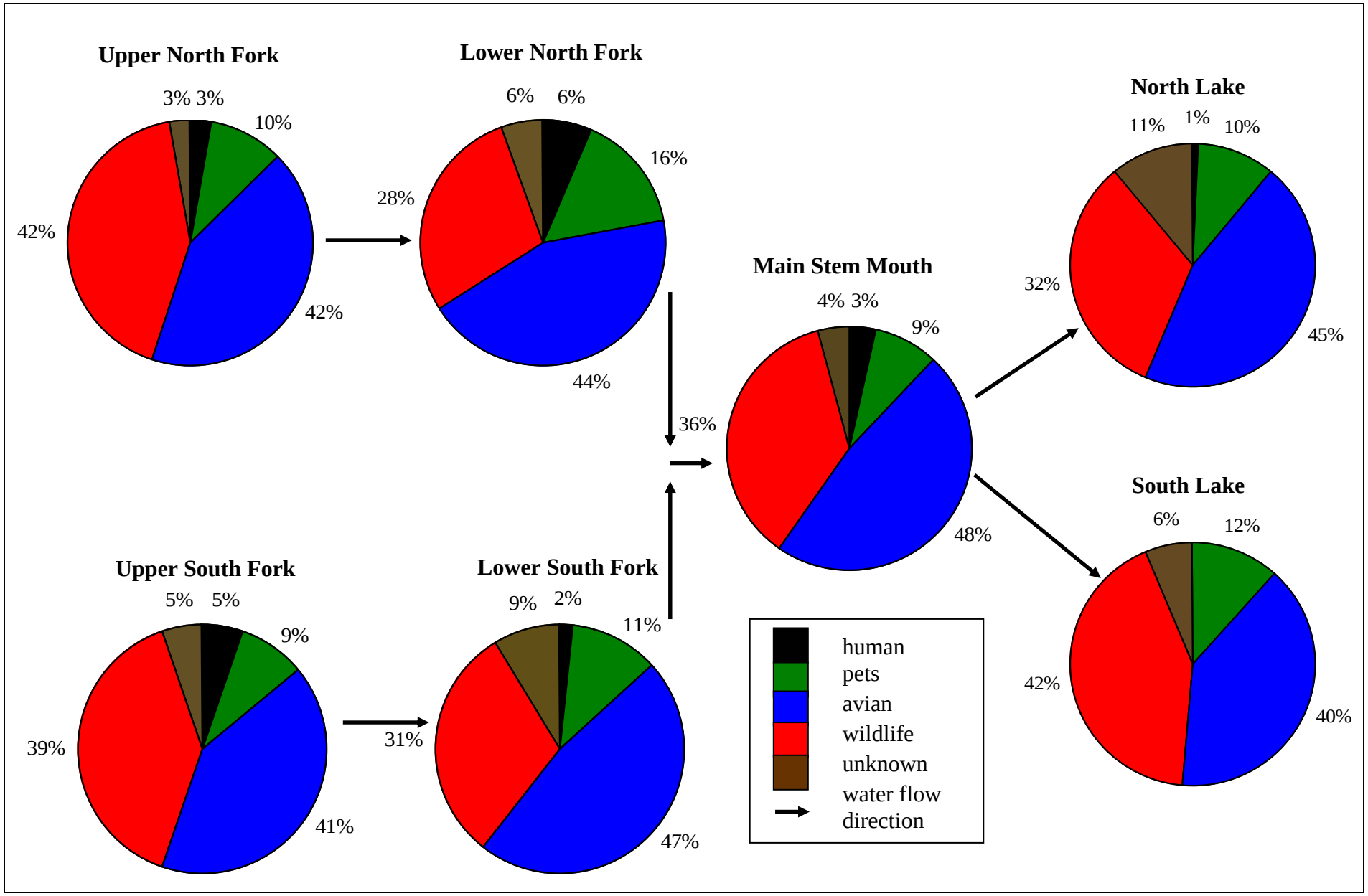

Figure 13. Schematic diagram of *E. coli* bacteria sources and their percentages observed in Thornton Creek and Matthews Beach, Seattle, Washington.

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As shown in Figure 13, avian and wildlife bacteria sources were the dominant bacteria sources at each of the ribotyping stations. Human source isolates were observed at a low frequency at all stations except the South Lake station, where no humanisolates were observed. In general, no significant trends in sources were apparent from upstream to downstream in Thornton Creek.

Human sources of fecal coliform bacteria represented 2.9 percent of the total isolates for this study, and were present at all seven monitoring stations except the Matthews Beach South station. Only one human isolate was observed at the Matthews Beach North station.

Table 11 presents the spatial and seasonal/hydrologic distribution of human isolates observed for this MST study. As shown in Table 11, over 75 percent of the human isolates were observed during base flow conditions, and no human isolates were observed during winter storm flow conditions. The lack of human sources observed during winter storm flow suggest that sanitary or combined sewer overflows were not a major source of fecal coliform bacteria during the sampled storm events. The low percentage of human isolates observed overall (3 percent of all isolates) coupled with the elevated proportion of human isolates observed during base flow conditions (78 percent of all human isolates) suggests that a small number of cross connections from single residences or small groupings of residences, or leaks from side sewer lines, may be discharging sewage into the municipal storm drain system. In addition, over 50 percent of the human isolates were observed at the lower fork stations, suggesting that a majority of these cross connections discharge to the storm drain system (and the creek) between the upper and lower fork stations where the highest areal bacteria loadings were observed.

Table 11. Numbers of human *E. coli* bacteria isolates observed in water and sediment samples collected for the Thornton Creek and Matthews Beach microbial source tracking study.

	Summer Base	Winter Base	Summer Storm	Winter Storm	Sediment	Total
Upper North Fork (TCN64)	1	2	–	–	–	3
Lower North Fork (TCN33)	2	4	1	–	–	7
Upper South Fork (TCS41)	–	–	2	–	–	2
Lower South Fork (TCS40)	5	–	1	–	–	6
Main Stem Mouth (TCM46)	–	4	–	–	–	4
North Lake (MBN)	–	–	1	–	–	1
South Lake (MBS)	–	–	–	–	1	1
	8	10	5	0	1	24

As shown in Table 10, pet sources, which include both canine and feline fecal sources, represented approximately 11 percent of the total isolates for this study, and were found at all seven monitoring stations. Canine fecal sources represented 10 percent of the total isolates, while feline fecal sources represented less than 1 percent of the total isolates.

Avian sources, including waterfowl fecal sources, comprised the largest percentage (44 percent) of all ribotypes isolated from Thornton Creek and Matthews Beach. Avian sources were the

predominant sources observed at each of the seven monitoring stations, and generally increased from upstream to downstream. As noted previously, areal bacteria loadings also increased from upstream to downstream, suggesting that avian fecal sources are a particularly significant source of fecal bacteria loading in Thornton Creek. Avian source percentages remained the same from the Main Stem mouth station to the North Beach station, and decreased from the Main Stem mouth station to the South Beach station.

Sources specifically identified as waterfowl (i.e., duck or goose) comprised a relatively small proportion of all avian isolates obtained from the stream and lake water samples (i.e., waterfowl comprised 11 and 5 percent of all avian sources from the stream and lake stations, respectively; see Table 10). The low proportion of waterfowl sources observed in Thornton Creek coupled with the low bacteria loadings observed at the Upper North Fork station suggest that waterfowl do not contribute a significant loading of bacteria to Thornton Creek from drainage detention features such as Ronald Bog and Twin Ponds, which drain to the Upper North Fork station.

Wildlife sources (i.e., beaver, opossum, raccoon, rodent, and squirrel) were frequently observed at each of the seven monitoring station, representing a combined 36 percent of the total isolates. Raccoon and rodent fecal sources were relatively abundant at all seven stations, representing approximately 14 percent and 20 percent of the total isolates, respectively. It is likely that rodent sources primarily consisted of rats in the Thornton Creek samples based on the relatively high abundance of rats in urban watersheds compared to other rodent types (e.g., mouse, vole, mole, muskrat, bat, or beaver). Opossum, beaver, and squirrel fecal sources were rarely observed at the seven monitoring stations.

Sediment Samples

The ribotyping results from the sediment samples are presented in Table 12. The number and percentage of isolates are presented for each station and for all stations combined. Overall, the distribution of bacteria sources in sediment samples was similar to that observed for the isolates obtained from the water samples. Avian sources of fecal coliform bacteria were the predominant fecal source at each station, comprising 55 percent of the total isolates. Rodent fecal sources were also relatively abundant, representing 20 percent of the total isolates. Avian sources were more abundant and rodent sources were less abundant at the North Lake station compared to the South Lake and Main Stem Mouth stations. Human and canine fecal sources were rarely observed in the sediment samples, with only one human isolate obtained from the South Lake station and one canine isolate obtained from the Main Stem Mouth station. Feline, waterfowl, beaver, and squirrel fecal sources were not observed in the sediment samples.

Clone Co-Occurrence

Isolates from the same bacterial clone have identical ribotypes (genetic fingerprint) and may have originated from the same or closely related organism. The occurrence of identical isolates (clones) was evaluated to assess the similarity of bacteria populations present in water samples collected from Thornton Creek and Matthews Beach. Table 13 presents a matrix of the percentage of clones that co-occurred at each station. Approximately 50 percent of the isolates

observed in water samples collected from the two lake stations were identical to those observed at the mouth of Thornton Creek. (Co-occurrence between the stream stations was generally lower). The high similarity of bacteria sources observed in Thornton Creek and Matthews Beach further suggests that the water of Thornton Creek contributes directly to the fecal coliform bacteria contamination observed at Matthews Beach.

Table 12. Number and sources of *E. coli* bacteria isolates obtained from sediment samples for the Thornton Creek and Matthews Beach microbial source tracking study.

	TCM46 Main Stem Mouth		MBN North Lake		MBS South Lake		Sum of All Stations	
Fecal Source	Number of Isolates	Percent of Total	Number of Isolates	Percent of Total	Number of Isolates	Percent of Total	Number of Isolates	Percent of Total
Human	0	0.0%	0	0.0%	1	6.3%	1	2.0%
Canine	1	6.3%	0	0.0%	0	0.0%	1	2.0%
Feline	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Avian	8	50.0%	13	76.5%	6	37.5%	27	55.1%
Waterfowl	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Beaver	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Opossum	0	0.0%	1	5.9%	0	0.0%	1	2.0%
Raccoon	0	0.0%	2	11.8%	0	0.0%	2	4.1%
Rodent	5	31.3%	1	5.9%	4	25.0%	10	20.4%
Squirrel	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Unknown	2	12.5%	0	0.0%	5	31.3%	7	14.3%
Total	16	100.0%	17	100.0%	16	100.0%	49	100.0%

Hydrologic and Seasonal Comparisons

Figures 14 and 15 present percent matching results for water samples for each monitoring station in pairs of stacked bars. For Figure 14, each pair of bars represents the percentage of sources observed in samples collected during base flow and storm flow events. For Figure 15, each pair of bars represents the percentage of sources observed in samples collected during the summer and winter seasons (i.e., May through October and November through April, respectively). The number of isolates (n) associated with each bar is included. Generally, percentages of bacteria sources did not vary substantially with hydrologic condition or season. However, small differences are apparent from comparisons of these environmental data.

Human source isolates were observed more frequently during base flow compared to storm flow. As noted above, this observation suggests that human sources originated from cross-connections discharging sewage into the municipal storm drain system during base flow rather than from sanitary or combined sewer overflows occurring during storm events. Raccoon source isolates were also observed more frequently during base flow compared to storm flow, while rodent source isolates were observed more frequently during storm flow compared to base flow. These observations may be related to differences in animal behavior where feces are deposited more

frequently on impervious surfaces by rodents (e.g., rats) than by raccoons, increasing the occurrence of rodent source isolates in runoff.

Table 13. Percentage of identical clones co-occurring at sample stations for the Thornton Creek and Matthews Beach microbial source tracking study.

	Water Samples							Sediment Samples		
	Upper North Fork (TCN64)	Lower North Fork (TCN33)	Upper South Fork (TCS40)	Lower South Fork (TCS41)	Main Stem Mouth (TCM46)	North Lake (MBN)	South Lake (MBS)	Main Stem Mouth (TCM46)	North Lake (MBN)	South Lake (MBS)
Water Samples										
Upper North Fork (TCN64)	–	36	44	39	45	42	51	38	41	44
Lower North Fork (TCN33)	–	–	46	46	55	54	57	63	82	63
Upper South Fork (TCS40)	–	–	–	38	51	50	52	56	29	44
Lower South Fork (TCS41)	–	–	–	–	48	47	53	19	88	38
Main Stem Mouth (TCM46)	–	–	–	–	–	53	52	63	88	63
North Lake (MBN)	–	–	–	–	–	–	62	56	88	56
South Lake (MBS)	–	–	–	–	–	–	–	69	76	50
Sediment Samples										
Main Stem Mouth (TCM46)	–	–	–	–	–	–	–	–	41	19
North Lake (MBN)	–	–	–	–	–	–	–	–	–	38
South Lake (MBS)	–	–	–	–	–	–	–	–	–	–

Historical Data Comparison

As summarized in the Background Information section, King County conducted a microbial source tracking study (MST) for Thornton Creek in 2001 (King County 2001). The ribotyping results for the current study were compared to the results from the King County MST study to evaluate any long-term temporal changes in bacteria sources in Thornton Creek. Although avian bacteria sources were the predominant source for both MST studies, the percentage of avian sources, which includes avian and waterfowl isolates was, for the current MST study, slightly higher than that observed for the King County MST study (45 percent and 32 percent, respectively). In addition, the percentage of unknown isolates for the King County MST study (12 percent) was approximately twice that observed for the current MST study (6 percent). In general, the remaining bacteria sources were observed at similar frequencies, including human sources which were observed at low frequencies for both studies (3 percent). However, the percentage of pet isolates observed for the King County MST study was approximately twice that observed for the current MST study (23 percent versus 11 percent, respectively). These results suggest that human bacteria sources are still a relatively small source of fecal coliform bacteria contamination in Thornton Creek, and also that pet owner education programs regarding

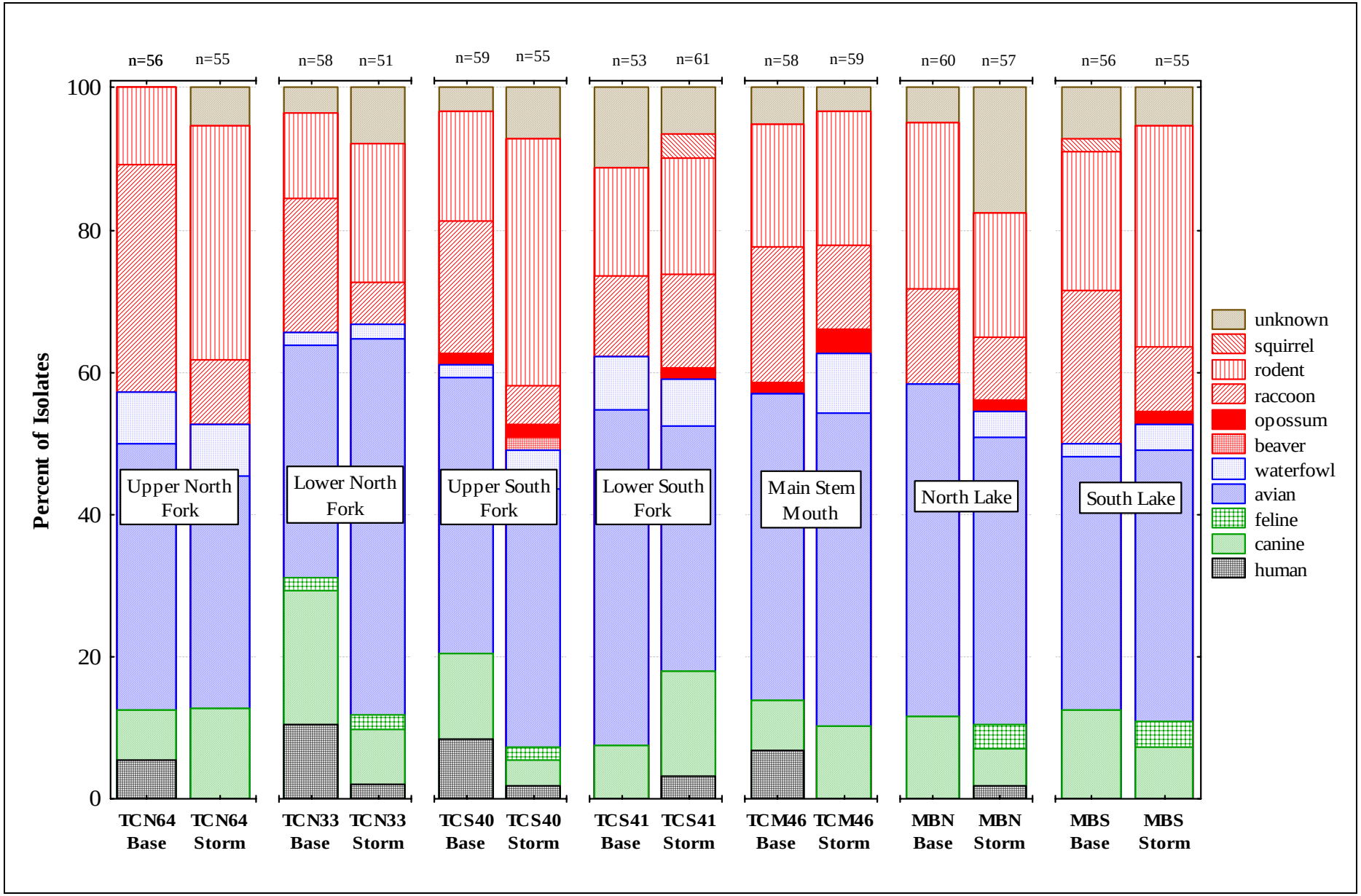

Figure 14. ***E. coli*** **source percentages observed during base flow and storm flow conditions for the Thornton Creek and Matthews Beach microbial source tracking study.**

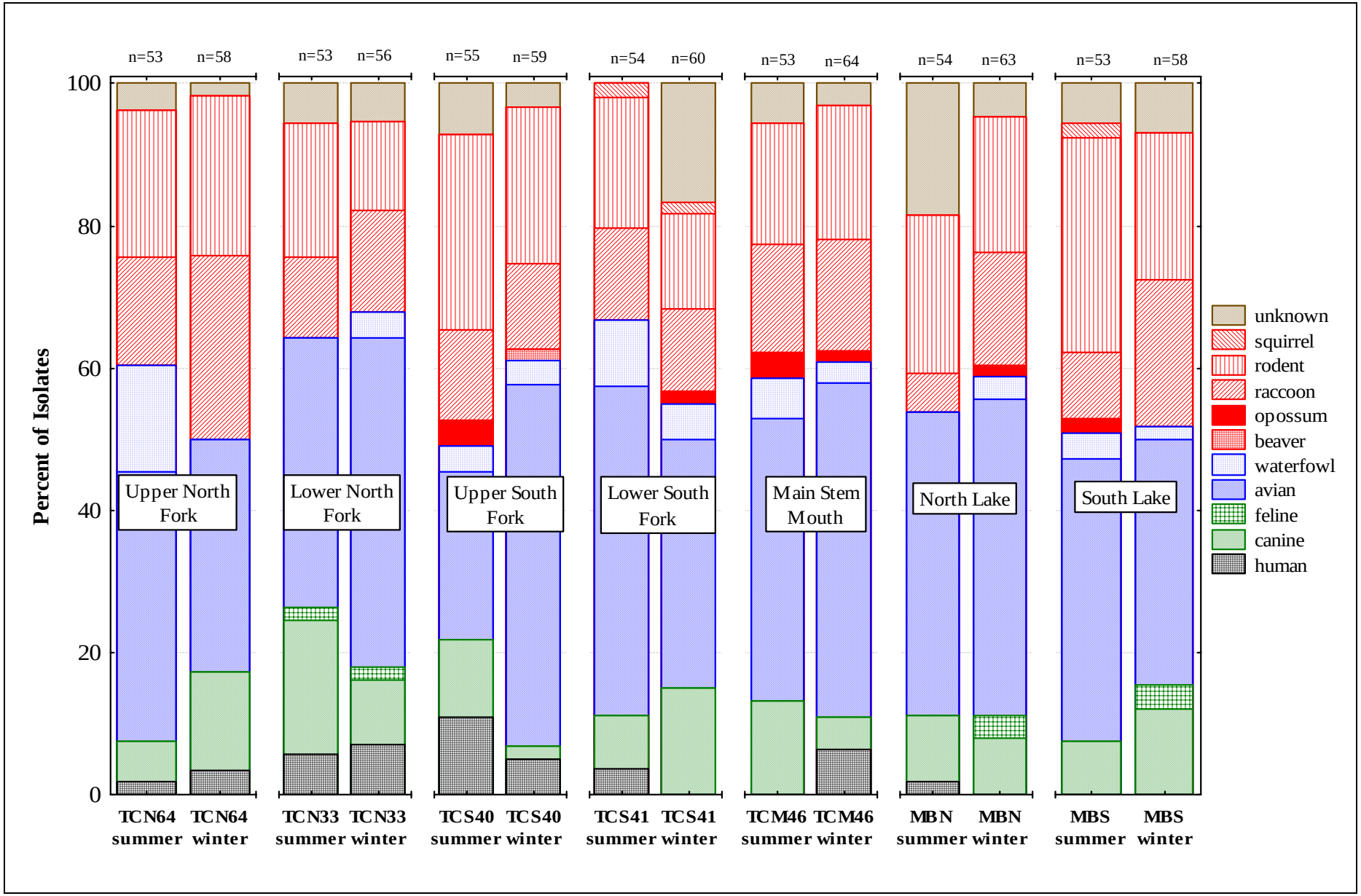

Figure 15. ***E. coli*** **source percentages observed during summer season (May through October) and winter season (November through April) for the Thornton Creek and Matthews Beach microbial source tracking study.**

the impact of pet waste on water quality may have been successful in reducing pet waste inputs to Thornton Creek.

The percentage of pet bacteria sources observed in Thornton Creek for this MST study (11 percent) is generally lower than that observed in other urban streams in western Washington. A MST study conducted by Herrera (1999) for the City of Blaine, Washington, found that the percentage of pet bacteria sources in two urban drainages, Cain Creek and Portal Creek, were 21 and 27 percent, respectively. Pet bacteria sources comprised 15 percent of the bacteria sources observed in upper Des Moines Creek, which is located in King County adjacent to Seattle-Tacoma International Airport (Herrera 2001). In Hamm Creek, which drains an urban area in King County, pets comprised 21 percent of the total bacteria sources (Herrera 2006a). A study on an urban stream in Renton, Washington, found that pets comprised 20 percent of the total bacteria sources (Herrera 2006b).

The low percentage of human bacteria sources observed in Thornton Creek for this MST study (3 percent) is similar to that observed in other urban streams in western Washington. Human sources comprised less than 5 percent of all bacteria sources observed in those MST studies of streams draining sewered areas in the City of Blaine (Herrera 1999), King County (Herrera 2001, 2006a), and the City of Renton (Herrera 2006b).

Optical Brighteners

Results for the optical brightener monitoring are presented in Table 14, including precipitation totals during the exposure period, sample pad exposure duration, and spectral analysis data. Optical brightener pads were deployed on February 1, April 19, and June 29, 2005, with exposure periods of two, 10, and 12 days, respectively. All filter pads retrieved from the 12 optical brightener monitoring stations were negative for optical brighteners using the ultraviolet light test. All three sample pads tested for optical brighteners using the spectral analysis method were negative.

The optical brightener monitoring results indicate that domestic wastewater was not present in sufficient quantities to be detected by this technique. A review of matching data indicates that human fecal isolates were present in Thornton Creek during each of the three optical brightener monitoring periods. Human fecal isolates were present in low numbers at each of the five combined optical brightener/ribotyping monitoring stations during at least one of the three optical brightener monitoring periods. These results suggest that optical brightener monitoring is not useful for detecting small amounts of municipal sewage in urban streams draining sewered basins. Based on these findings, optical brightener monitoring was discontinued following the third monitoring event and sample pads were not deployed for the remaining three planned monitoring events for use in moderate to large stream systems located in watersheds with municipal sewage conveyance systems.

Table 14. Optical brightener monitoring results for the Thornton Creek and Matthews Beach microbial source tracking study.

Station	Deployment Date	Exposure Duration (days)	Precipitation Amount During Exposure (in)[a]	Ultraviolet light test	Spectral Analysis[b]
TCM46	2/1/2005	2	0.00	negative	–
TCN33	2/1/2005	2	0.00	negative	–
TCS41	2/1/2005	2	0.00	negative	–
KC1	2/1/2005	2	0.00	negative	–
WC1	2/1/2005	2	0.00	negative	–
TCN64	2/1/2005	2	0.00	negative	–
VC1	2/1/2005	2	0.00	negative	–
VC2	2/1/2005	2	0.00	negative	–
TCS03	2/1/2005	2	0.00	negative	–
TCS40	2/1/2005	2	0.00	negative	ND
TCS02	2/1/2005	2	0.00	negative	–
TCS01	2/1/2005	2	0.00	negative	–
TCM46	4/19/2005	10	0.23	negative	–
TCN33	4/19/2005	10	0.23	negative	–
TCS41	4/19/2005	10	0.23	negative	–
KC1	4/19/2005	10	0.23	negative	–
WC1	4/19/2005	10	0.23	negative	ND
TCN64	4/19/2005	10	0.23	negative	–
VC1	4/19/2005	10	0.23	negative	–
VC2	4/19/2005	10	0.23	negative	–
TCS03	4/19/2005	10	0.23	negative	–
TCS40	4/19/2005	10	0.23	negative	–
TCS02	4/19/2005	10	0.23	negative	–
TCS01	4/19/2005	10	0.23	negative	–
TCM46	6/29/2005	12	0.68	negative	–
TCN33	6/29/2005	12	0.68	negative	–
TCS41	6/29/2005	12	0.68	negative	ND
KC1	6/29/2005	12	0.68	negative	–
WC1	6/29/2005	12	0.68	negative	–
TCN64	6/29/2005	12	0.68	negative	–
VC1	6/29/2005	12	0.68	negative	–
VC2	6/29/2005	12	0.68	negative	–
TCS03	6/29/2005	12	0.68	negative	–
TCS40	6/29/2005	12	0.68	negative	–
TCS02	6/29/2005	12	0.68	negative	–
TCS01	6/29/2005	12	0.68	negative	–

[a] Measured at Matthews Beach/Magnuson Park rain gauge (RG02) (Seattle 2006b).
[b] Analyzed by Ozark Underground Laboratory, Protem, Missouri.
ND – Not detected.

Conclusions and Recommendations

Bacteria Concentrations and Loadings

A total of 252 fecal coliform bacteria enumeration analyses were performed on water samples collected from five monitoring stations on Thornton Creek and two monitoring stations at Matthews Beach. These samples were collected over a one-year period during six base flow events and six storm flow events. In addition, continuous stream discharge data were collected at the five stream stations for the calculation of bacteria loadings. Conclusions reached from these components of this MST study include the following:

- The Washington State water quality standard for fecal coliform bacteria was exceeded at all stream and lake stations during storm flow and base flow with two exceptions: summer base flow at the South Lake station and winter base flow at the Upper South Fork station.
- Fecal coliform bacteria concentrations were significantly higher during storm flow than base flow at all stations except the North Lake station.
- Fecal coliform bacteria concentrations were higher during summer than winter at all stations, although the difference was not statistically significant.
- Fecal coliform bacteria concentrations significantly increased downstream in Thornton Creek.
- Fecal coliform bacteria concentrations in sediment samples were higher at the Main Stem mouth station compared to both lake stations, and sediment bacteria concentrations were positively related to organic matter content.
- Fecal coliform bacteria loading rates were substantially higher during storm flow compared to base flow at all stations except at the Upper North Fork station.
- Stormwater runoff is a significant source of fecal coliform bacteria contamination in Thornton Creek and at Matthews Beach.
- The highest areal bacteria loading rates were observed in subbasins located between both upper and lower North Fork and South Fork stations.
- Thornton Creek is a major source of fecal coliform bacteria to Matthews Beach, and the distance from the mouth of the creek is an important factor affecting bacteria concentrations in the lake.

Ribotyping

The ribotyping analysis successfully matched 94 percent of the 791 *E. coli* isolates obtained from the water sample bacteria analyses, and 71 percent of the 49 *E. coli* isolates obtained from the sediment samples. Conclusions reached from the ribotyping analysis performed for this study include:

- Human sources represented approximately 3 percent of the total isolates collected, and were recovered from all stations except for the South Lake station.
- Avian sources were the most abundant bacteria source (45 percent), with wildlife sources also observed at a high frequency (36 percent).
- Pet sources (primarily dogs) represented approximately 11 percent of the total isolates recovered, which is low compared to that previously observed in Thornton Creek and other urban streams in western Washington.
- Fecal bacteria sources identified in Thornton Creek were similar to those observed by King County in 2001, with the exception that the proportion of pet sources decreased from 23 percent to 11 percent in the current study.
- The proportion of bacteria sources generally did not vary substantially in relation to spatial, hydrologic, or seasonal variables except that human and rodent bacteria sources were observed more frequently during base flow than storm flow, and raccoon bacteria sources were observed more frequently during storm flow than base flow.
- Fecal bacteria sources identified in the sediment samples were similar to those observed in the water samples, with approximately 80 percent of the isolates represented by avian and wildlife sources.
- Greater than 50 percent of the isolates observed in the lake water samples were genetically identical to those observed in the creek water samples, providing further evidence that Thornton Creek is a major source of fecal coliform bacteria to Matthews Beach.

Optical Brighteners

Optical brightener monitoring was conducted at 12 stream monitoring stations during three base flow monitoring periods. Optical brighteners were not detected in any of the samples, whereas ribotyping identified the presence of human bacteria sources in water samples collected concurrent with the optical brightener sample collection. These results suggest that the optical

brightener method is not sensitive enough to detect the presence of domestic wastewater (i.e., human fecal sources) in the Thornton Creek watershed.

Recommendations

Based on the results and conclusions of this study, the following actions are recommended for reducing fecal coliform bacteria concentrations and the threat to public health associated with these bacteria and their sources observed in Thornton Creek and at Matthews Beach:

- Continue implementation of pet owner education programs to further reduce pet waste inputs as a source of fecal coliform bacteria contamination in Thornton Creek and at Matthews Beach.
- Evaluate urban wildlife management alternatives for reducing fecal coliform bacteria concentrations in stormwater runoff.
- Continue to evaluate off-channel stormwater treatment facilities and the addition of enhanced treatment to existing facilities to reduce fecal coliform bacteria concentrations during storm flow events.
- Continue watershed activities, including riparian and in-stream restoration programs in Thornton Creek, to reduce the delivery of sediment and associated pollutants (including bacteria).
- Continue to evaluate national/international innovative actions to reduce fecal coliform bacteria in stormwater runoff and surface waters.
- Evaluate the human health risk of the multiple fecal sources identified in this study. This could include analysis of water samples collected from Thornton Creek and Matthews Beach for the presence of specific human pathogens (i.e., bacteria, protozoa, and viruses), and could also include screening of the samples for fish pathogens.
- Investigate the appropriateness and applicability of bacteria water quality standards for storm flow conditions in terms of the risk to human health and with consideration of background bacteria concentrations in undeveloped watersheds.
- Evaluate notification procedures for the Matthews Beach Park swimming area to include consideration of an immediate closure during storm flow (rain events) in concert with daily collection and analysis of fecal coliform bacteria samples to determine when to safely re-open the swimming area.
- Post signs at the swimming beach area describing the potential risks to human health of water contact during wet weather conditions.

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APPENDIX A

Laboratory Reports and Data Quality Assurance Worksheets

AQUATIC RESEARCH INCORPORATED

LABORATORY & CONSULTING SERVICES

3927 AURORA AVENUE NORTH, SEATTLE, WA 98103

PHONE: (206) 632-2715 FAX: (206) 632-2417

CASE FILE NUMBER: HER071-02 **PAGE 1**
REPORT DATE: 02/04/05
DATE SAMPLED: 02/01/05 **DATE RECEIVED:** 02/01/05
FINAL REPORT, LABORATORY ANALYSIS OF SELECTED PARAMETERS ON WATER SAMPLES FROM HERRERA ENVIRONMENTAL

CASE NARRATIVE

Twenty one water samples were received by the laboratory in good condition. The samples were analyzed according to the chain of custody. No difficulties were encountered in the preparation or analysis of these samples. Sample data follows, while QA/QC data is contained on subsequent pages.

SAMPLE DATA

SAMPLE ID	FECAL COLIFORM (#/100ml)
TCN64-020105-1	54
TCN64-020105-2	54
TCN64-020105-3	58
TCS40-020105-1	40
TCS40-020105-2	est 20
TCS40-020105-3	est 10
TCS41-020105-1	112
TCS41-020105-2	134
TCS41-020105-3	112
TCN33-020105-1	120
TCN33-020105-2	100
TCN33-020105-3	74
TCM46-020105-1	134
TCM46-020105-2	est 240
TCM46-020105-3	138
MBS-020105-1	est 8
MBS-020105-2	est 16
MBS-020105-3	est 22
MBN-020105-1	est 28
MBN-020105-2	est 26
MBN-020105-3	est 20

entered MCC

AQUATIC RESEARCH INCORPORATED

LABORATORY & CONSULTING SERVICES

3927 AURORA AVENUE NORTH, SEATTLE, WA 98103

PHONE: (206) 632-2715 FAX: (206) 632-2417

CASE FILE NUMBER: HER071-02 **PAGE 2**
REPORT DATE: 02/04/05
DATE SAMPLED: 02/01/05 **DATE RECEIVED:** 02/01/05
FINAL REPORT, LABORATORY ANALYSIS OF SELECTED PARAMETERS ON WATER SAMPLES FROM HERRERA ENVIRONMENTAL

QA/QC DATA

QC PARAMETER	FECAL COLIFORM (#/100ml)
METHOD	SM18 9222D
DATE ANALYZED	02/01/05
DETECTION LIMIT	2
DUPLICATE	
SAMPLE ID	MBN-020105-3
ORIGINAL	est 20
DUPLICATE	est 18
RPD	NC
SPIKE SAMPLE	
SAMPLE ID	
ORIGINAL	
SPIKED SAMPLE	
SPIKE ADDED	
% RECOVERY	NA
QC CHECK	
FOUND	
TRUE	
% RECOVERY	
BLANK	< 2

RPD = RELATIVE PERCENT DIFFERENCE.
NA = NOT APPLICABLE OR NOT AVAILABLE.
NC = NOT CALCULABLE DUE TO ONE OR MORE VALUES BEING BELOW THE DETECTION LIMIT.
OR = RECOVERY NOT CALCULABLE DUE TO SPIKE SAMPLE OUT OF RANGE OR SPIKE TO LOW RELATIVE TO SAMPLE CONCENTRATION.

SUBMITTED BY:

Steven Lazoff
Laboratory Director

HER071-02

Aquatic Research Incorporated

3927 Aurora Ave. N / Seattle, WA 98103 / (206) 632-2715

CHAIN-OF-CUSTODY RECORD

CLIENT: Herrera
SAMPLING DATE: @ Feb 1 2005
SAMPLERS: M Cawise

SHEET 1 OF
PROJECT ID:
CASE FILE NO.:
DATA RECORDED BY:

SAMPLE INFORMATION

PARAMETERS

SAMPLE ID	DATE/TIME COLLECTED	FECAL COLIFORM	BOTTLE #	NOTES
TCN64-020105-1	2/1/05 0754	✓		
TCN64-020105-2	" 0759	✓		
TCN64-020105-3	" 0804	✓		
TCS40-020105-1	2/1/05 0817	✓		
TCS40-020105-2	" 0822	✓		
TCS40-020105-3	" 0827	✓		
TCS41-020105-1	2/1/05 0840	✓		
TCS41-020105-2	" 0845	✓		
TCS41-020105-3	" 0850	✓		
TCN33-020105-1	2/1/05 0853	✓		
TCN33-020105-2	" 0903	✓		
TCN33-020105-3	" 0908	✓		
TCM46-020105-1	2/1/05 0922	✓		
TCM46-020105-2	" 0927	✓		
TCM46-020105-3	" 0932	✓		
MBS-020105-1	2/1/05 0935	✓		
MBS-020105-2	2/1/05 0940	✓		
MBS-020105-3	" 0945	✓		
MBN-020105-1	2/1/05 0950	✓		
MBN-020105-2	" 0955	✓		
MBN-020105-3	" 1000	✓		

	Relinquished By	Date/Time	Received By	Date/Time
Printed Name	Michael Cawise	2-1-05 1145	S Nicholson	2/1/05
Signature	[signature]		[signature]	1145
Affiliation	Herrera		ARI	

	Relinquished By	Date/Time	Received By	Date/Time
Printed Name				
Signature				
Affiliation				

Miscellaneous Notes (Hazardous Materials, Quick turn-around time, etc.):

D. I. E. H

2/2/05

AQUATIC RESEARCH
206 632-2715

Project HER071-02

ANALYSES REQUEST:

ecoli RYBOTYPING
3 ISOLATES per SAMPLE.

SAMPLE ID	PLATE #		# of PLATES			
TCN64-1	1		2			
-2	2		3			
-3	3		2			
TCS40-1	4		2			
-2	5		2			
-3	6		1			
TCS41-1	7		2			
-2	8		2			
-3	9		3			
TCN33-1	10		2			
-2	11		2			
-3	12		2			
TCN46-1	13		2			
-2	14		3			
-3	15		2			
MBS-1	16		1			
-2	17		2			
-3	18		2			
MBN-1	19		1			
-2	20		1			
-3	21		2			

S. NIELSON 2/2/05
ARI 1600

AQUATIC RESEARCH INCORPORATED

LABORATORY & CONSULTING SERVICES

3927 AURORA AVENUE NORTH, SEATTLE, WA 98103

PHONE: (206) 632-2715 FAX: (206) 632-2417

CASE FILE NUMBER: HER071-06 **PAGE 1**
REPORT DATE: 03/22/05
DATE SAMPLED: 03/19/05 **DATE RECEIVED:** 03/20/05
FINAL REPORT, LABORATORY ANALYSIS OF SELECTED PARAMETERS ON WATER SAMPLES FROM HERRERA ENVIRONMENTAL

CASE NARRATIVE

Fourteen water samples were received by the laboratory in good condition. The samples were analyzed according to the chain of custody. No difficulties were encountered in the preparation or analysis of these samples. Sample data follows, while QA/QC data is contained on subsequent pages.

SAMPLE DATA

SAMPLE ID	FECAL COLIFORM (#/100ml)
TCN64-031905-1	120
TCN64-031905-2	est 350
TCS40-031905-1	est 600
TCS40-031905-2	est 650
TCN33-31905-1	3800
TCN33-31905-2	2300
TCS41-031905-1	2400
TCS41-031905-2	2650
TCM46-031905-1	1350
TCM46-031905-2	2600
MBS-031905-1	150
MBS-031905-2	est 600
MBN-031905-1	est 250
MBN-031905-2	est 300

entered MCC
7-8-05

AQUATIC RESEARCH INCORPORATED

LABORATORY & CONSULTING SERVICES

3927 AURORA AVENUE NORTH, SEATTLE, WA 98103

PHONE: (206) 632-2715 FAX: (206) 632-2417

CASE FILE NUMBER: HER071-06 **PAGE 2**
REPORT DATE: 03/22/05
DATE SAMPLED: 03/20/05 **DATE RECEIVED:** 03/20/05
FINAL REPORT, LABORATORY ANALYSIS OF SELECTED PARAMETERS ON WATER SAMPLES FROM HERRERA ENVIRONMENTAL

QA/QC DATA

QC PARAMETER	FECAL COLIFORM (#/100ml)
METHOD	SM18 9222D
DATE ANALYZED	03/20/05
DETECTION LIMIT	2
DUPLICATE	
SAMPLE ID	MBN-031905-2
ORIGINAL	est 300
DUPLICATE	est 250
RPD	NC
SPIKE SAMPLE	
SAMPLE ID	
ORIGINAL	
SPIKED SAMPLE	
SPIKE ADDED	
% RECOVERY	NA
QC CHECK	
FOUND	
TRUE	
% RECOVERY	
BLANK	< 2

RPD = RELATIVE PERCENT DIFFERENCE.
NA = NOT APPLICABLE OR NOT AVAILABLE.
NC = NOT CALCULABLE DUE TO ONE OR MORE VALUES BEING BELOW THE DETECTION LIMIT.
OR = RECOVERY NOT CALCULABLE DUE TO SPIKE SAMPLE OUT OF RANGE OR SPIKE TO LOW RELATIVE TO SAMPLE CONCENTRATION.

SUBMITTED BY:

Steven Lazoff
Laboratory Director

HC2071-06

Aquatic Research Incorporated

3927 Aurora Ave. N / Seattle, WA 98103 / (206) 632-2715

CHAIN-OF-CUSTODY RECORD

CLIENT: Herrera Environmental
SAMPLING DATE: 3/19/05
SAMPLERS: Rob Zisette

SHEET 1 OF 1
PROJECT ID:
CASE FILE NO.:
DATA RECORDED BY:

SAMPLE INFORMATION

PARAMETERS

SAMPLE ID	DATE/TIME COLLECTED	Fecal Coliform	Ribotyping	BOTT #	NOTES
TCN04-031905-1	3/19/05 1653	X	X	1	
TCN04-031905-2	3/19/05 1825			1	
TCS40-031905-1	3/19/05 1708			1	
TCS40-031905-2	3/19/05 1835			1	
TCN33-031905-1	3/19/05 1720			1	
TCN33-031905-2	3/19/05 1845			1	
TCS41-031905-1	3/19/05 1727			1	
TCS41-031905-2	3/19/05 1850			1	
TCM46-031905-1	3/19/05 1734			1	
TCM46-031905-2	3/19/05 1905			1	
MBS031905-1	3/19/05 1755			1	
MBS-031905-2	3/19/05 1858			1	
MBN-031905-1	3/19/05 1803			1	
MBN-031905-2	3/19/05 1910	✓	✓	1	

	Relinquished By	Date/Time	Received By	Date/Time
Printed Name	John Lauth	3/20/05 11:40	Steven Lazoff	3/20/05 11:40
Signature				
Affiliation	HEL		AR	

	Relinquished By	Date/Time	Received By	Date/Time
Printed Name				
Signature				
Affiliation				

Miscellaneous Notes (Hazardous Materials, Quick turn-around time, etc.):
5 colonies / sample

Cultures to JEHA (Bothell) for Ribotyping

2 hrs OVR

AQUATIC RESEARCH INCORPORATED

LABORATORY & CONSULTING SERVICES

3927 AURORA AVENUE NORTH, SEATTLE, WA 98103

PHONE: (206) 632-2715 FAX: (206) 632-2417

CASE FILE NUMBER: HER071-11 **PAGE 1**

REPORT DATE: 3/31/05 REVISED 04/01/05

DATE SAMPLED: 03/27/05 **DATE RECEIVED:** 03/27/05

FINAL REPORT. LABORATORY ANALYSIS OF SELECTED PARAMETERS ON WATER SAMPLES FROM HERRERA ENVIRONMENTAL

CASE NARRATIVE

Seven water samples were received by the laboratory in good condition. The samples were analyzed according to the chain of custody. No difficulties were encountered in the preparation or analysis of these samples. Sample data follows, while QA/QC data is contained on subsequent pages.

SAMPLE DATA

SAMPLE ID	FECAL COLIFORM (#/100ml)
TCN64-032605-1	est 800
TCS40-032605-1	210
TCN33-032605-1	est 1600
TCS41-032605-1	est 300
TCM46-032605-1	est 2000
MBS-032605-1	est 8
MBN-032605-1	est 38

entered MCC
7-8-05

AQUATIC RESEARCH INCORPORATED

LABORATORY & CONSULTING SERVICES

3927 AURORA AVENUE NORTH, SEATTLE, WA 98103

PHONE: (206) 632-2715 FAX: (206) 632-2417

CASE FILE NUMBER: HER071-11 **PAGE 2**
REPORT DATE: 3/31/05 REVISED 04/01/05
DATE SAMPLED: 03/27/05 **DATE RECEIVED:** 03/27/05
FINAL REPORT, LABORATORY ANALYSIS OF SELECTED PARAMETERS ON WATER SAMPLES FROM HERRERA ENVIRONMENTAL

QA/QC DATA

QC PARAMETER	FECAL COLIFORM (#/100ml)
METHOD	SM18 9222D
DATE ANALYZED	03/27/05
DETECTION LIMIT	2
DUPLICATE	
SAMPLE ID	MBN-032605-1
ORIGINAL	est 38
DUPLICATE	est 32
RPD	NC
SPIKE SAMPLE	
SAMPLE ID	
ORIGINAL	
SPIKED SAMPLE	
SPIKE ADDED	
% RECOVERY	NA
QC CHECK	
FOUND	
TRUE	
% RECOVERY	
BLANK	< 2

RPD = RELATIVE PERCENT DIFFERENCE.
NA = NOT APPLICABLE OR NOT AVAILABLE.
NC = NOT CALCULABLE DUE TO ONE OR MORE VALUES BEING BELOW THE DETECTION LIMIT.
OR = RECOVERY NOT CALCULABLE DUE TO SPIKE SAMPLE OUT OF RANGE OR SPIKE TO LOW RELATIVE TO SAMPLE CONCENTRATION.

SUBMITTED BY:

Steven Lazoff
Laboratory Director

HER071 11

HERRERA ENVIRONMENTAL CONSULTANTS
200 Sixth Avenue, Suite 1100
Seattle, Washington 98121
(206) 441-9080
FAX (206) 441-9108

CHAIN OF CUSTODY RECORD

PROJECT NAME: Thornton Inst
PROJECT NUMBER: 02-01945-250
CLIENT: SPU
REPORT TO: Rob Zisette
COPY TO:
SAMPLED BY: Rob Zisette
DELIVERY METHOD: hand
LABORATORY: Aquatic Research
REQUESTED COMPLETION DATE: Std
TOTAL # OF CONTAINERS: 7
LAB USE:

ANALYSES REQUESTED: Fecal coliform bacteria; Cultures to IEH for ribotyping 3 colonies/sample

SAMPLE ID:	~~DATE~~ Date	~~TIME~~ Time	SAMPLE DESCRIPTION	# OF CONTAINERS:	Fecal coliform bacteria	Cultures to IEH for ribotyping 3 colonies/sample
TCN64-032605-1	3/26/05	1145	* Stormwater	1	X	X
TCS40-032605-1	↓	1158	↓	↓	↓	↓
TCN33-032605-1	↓	1210	↓	↓	↓	↓
TCS41-032605-1	↓	1218	↓	↓	↓	↓
TCM46-032605-1	↓	1228	↓	↓	↓	↓
MBS-032605-1	↓	1235	* Lake Water	↓	↓	↓
MBN-032605-1	↓	1247	↓	↓	↓	↓

REMARKS: Please send all cultures to IEH in Bothell for ribotyping of 3 E. coli isolates in each sample. *Stormwater filter volumes = ~~0.01, 0.1 and 10 mL~~ *Lake water filter volumes = 0.5, 5 and 50 mL

RELINQUISHED BY (NAME/CO.):	SIGNATURE:	DATE/TIME:	RECEIVED BY (NAME/CO.):	SIGNATURE:	DATE/TIME:
Rob Zisette	[signature]	3/26/05 0830	Steven Lazoff	[signature]	3/27/05
RELINQUISHED BY (NAME/CO.):	SIGNATURE:	DATE/TIME:	RECEIVED BY (NAME/CO.):	SIGNATURE:	DATE/TIME:

* Stormwater filter vol. = 0.1, 1, and 10 mL

rs /document2

AQUATIC RESEARCH INCORPORATED

LABORATORY & CONSULTING SERVICES

3927 AURORA AVENUE NORTH, SEATTLE, WA 98103

PHONE: (206) 632-2715 FAX: (206) 632-2417

CASE FILE NUMBER:	**HER071-13**	**PAGE 1**	
REPORT DATE:	**04/19/05**		
DATE SAMPLED:	**04/01/05**	**DATE RECEIVED:**	**04/01/05**

FINAL REPORT, LABORATORY ANALYSIS OF SELECTED PARAMETERS ON WATER SAMPLES FROM HERRERA ENVIRONMENTAL

CASE NARRATIVE

Fourteen water samples were received by the laboratory in good condition. The samples were analyzed according to the chain of custody. No difficulties were encountered in the preparation or analysis of these samples. Sample data follows, while QA/QC data is contained on subsequent pages.

SAMPLE DATA

SAMPLE ID	FECAL COLIFORM (#/100ml)
TCN64-040105-1	est 100
TCN64-040105-2	est 60
TCS40-040105-1	est 500
TCS40-040105-2	est 170
TCS41-040105-1	est 600
TCS41-040105-2	est 400
TCN33-31905-1	est 600
TCN33-31905-2	est 700
TCM46-040105-1	est 500
TCM46-040105-2	est 700
MBS-040105-1	est 320
MBS-040105-2	740
MBN-040105-1	est 400
MBN-040105-2	est 280

entered MCC
7-8-05

Called Steve 2-22-06
to verify data entry errors
values are correct as entered
for TCN33-040105-1
+ TCN33-040105-2

MCC

AQUATIC RESEARCH INCORPORATED

LABORATORY & CONSULTING SERVICES

3927 AURORA AVENUE NORTH, SEATTLE, WA 98103

PHONE: (206) 632-2715 FAX: (206) 632-2417

CASE FILE NUMBER:	**HER071-13**	**PAGE 2**
REPORT DATE:	**04/19/05**	
DATE SAMPLED:	**04/01/05**	**DATE RECEIVED: 04/01/05**

FINAL REPORT, LABORATORY ANALYSIS OF SELECTED PARAMETERS ON WATER SAMPLES FROM HERRERA ENVIRONMENTAL

QA/QC DATA

QC PARAMETER	FECAL COLIFORM (#/100ml)
METHOD	SM18 9222D
DATE ANALYZED	04/01/05
DETECTION LIMIT	2
DUPLICATE	
SAMPLE ID	MBN 040105-2
ORIGINAL	est 280
DUPLICATE	400
RPD	NC
SPIKE SAMPLE	
SAMPLE ID	
ORIGINAL	
SPIKED SAMPLE	
SPIKE ADDED	
% RECOVERY	NA
QC CHECK	
FOUND	
TRUE	
% RECOVERY	
BLANK	< 2

RPD = RELATIVE PERCENT DIFFERENCE.
NA = NOT APPLICABLE OR NOT AVAILABLE.
NC = NOT CALCULABLE DUE TO ONE OR MORE VALUES BEING BELOW THE DETECTION LIMIT.
OR = RECOVERY NOT CALCULABLE DUE TO SPIKE SAMPLE OUT OF RANGE OR SPIKE TO LOW RELATIVE TO SAMPLE CONCENTRATION.

SUBMITTED BY:

Steven Lazoff
Laboratory Director

3927 Aurora Ave. N. ■ Seattle, WA 98103 ■ (206) 632-2715

MICROBIOL WORKSHEET

PAGE 1 OF 1

CLIENT/PROJECT: HERRERA (MERCER CREK) CFN: HER0071.13
DATE RECEIVED: 4/1/05 ANALYST: SD / SL
PARAMETER: FECAL COLIFORM METHOD: MF
MEDIA: MFC INCUBATION : TEMP IN: 44.5 TEMP OUT: 44.6
Media LOT #: 4271794
NOTES:

SAMPLE DATA

	SAMPLE ID	COLLECTION DATE	COLLECTION TIME	LABORATORY REC'D	LABORATORY FILT	DILUTION/VOLUME FILTERED 0.1	1.0	10	0.5	5	50	100	RESULT C/100ml
	BLANK								—	—	—	0	
									—	—	—		
1	TCH 64-1	4/1/05	~0800	4/1/05 1000	4/1/05 1200	1	1	CONF	—	—	—		est 100
2	TCH 64-2					0	0	6	—	—	—		est 60
3	TCS-10-1					0	5	CONF	—	—	—		est 500
4	TCS-10-2					0	~~CONF~~	17 ~~CONF~~	—	—	—		est 170
5	TCS-11-1					1	6	CONF	—	—	—		est 600
6	TCS-11-2					1	4	CONF	—	—	—		est 400
7	TCH 35-1					2	6	CONF	—	—	—		est 600
8	TCH 35-2					0	7	CONF	—	—	—		est 700
9	TCH 46-1					2	5	CONF	—	—	—		est 500
10	TCH 46-2					0	7	CONF	—	—	—		est 700
11	MSS-1					—	—	—	1	16	TNTC		est 320
12	MSS-2					—	—	—	3	37	TNTC		740
13	MSN-1					—	—	—	2	CONF	CONF		est 400
14	MSN-2					—	—	—	2	14	TNTC		est 280
15	MSN-2 Dup					—	—	—	2	20	TNTC		400

CALCULATIONS

ACCEPTABLE LIMITS: TOTAL COLIFORM (20-80 COLONIES) FECAL COLIFORM (20-60 COLONIES)

1) Colony counts within limits.
2) All counts below limits, use either most acceptable count or assume 1 colony for the largest filtration volume, report as either ESTIMATED or LESS THAN (<).
3) All counts above limits, use upper limit count (60 or 80) and the smallest sample volume filtered and report as GREATER THAN (>).

$$\text{COLONIES / 100 ml} = \frac{\text{COLONIES COUNTED}}{} \times 100$$

HER0071-13

HERRERA ENVIRONMENTAL CONSULTANTS
2200 Sixth Avenue, Suite 1100
Seattle, Washington 98121
(206) 441-9080
FAX (206) 441-9108

CHAIN OF CUSTODY RECORD

PROJECT NAME: Thornton MST
PROJECT NUMBER: 02 01948-280
CLIENT: SPU
REPORT TO: Rob Zisette
COPY TO:
SAMPLED BY: Mike Cowie
DELIVERY METHOD: hand
LABORATORY: Aquatic Research
REQUESTED COMPLETION DATE: STD
TOTAL # OF CONTAINERS: 14
LAB USE:

ANALYSES REQUESTED: Fecal Coliform bacteria; Cultures to FEH for ribotyping 2 colonies/sample

SAMPLE ID:	DATE:	TIME:	SAMPLE DESCRIPTION	# OF CONTAINERS:	Fecal Coliform bacteria	Cultures to FEH for ribotyping 2 colonies/sample
TCNG4-040105-1	4/1/05	0425	stormwater	1	X	X
TCNG4-040105-2		~~0425~~ 0550				
TCS40-04-0105-1		0435				
TCS40-040105-2		0555				
TCS41-040105-1		0450				
TCS41-040105-2		0610				
TCN33-040105-1		0455				
TCN33-040105-2		0615				
TCM46-040105-1		0500				
TCM46-040105-2		0625				
MBJ-040105-1		0515	lake water			
MBJ-040105-2		0635				
MBN-040105-1		0525				
MBN-040105-2		0645				

REMARKS: Please send all cultures to FEH in Bothell for ribotyping of 3 E. coli isolates in each sample.
Stormwater filter volumes = 0.1, 1.0, and 10 mL Lake water filter volumes = 0.5 5.0 + 50 mL

RELINQUISHED BY (NAME/CO.):	SIGNATURE:	DATE/TIME:	RECEIVED BY (NAME/CO.):	SIGNATURE:	DATE/TIME:
Michael Cowie	[signature]	4-1-05 0955	S NIKIFOROV / ARC	[signature]	4/1/05 0955
RELINQUISHED BY (NAME/CO.):	SIGNATURE:	DATE/TIME:	RECEIVED BY (NAME/CO.):	SIGNATURE:	DATE/TIME:

AQUATIC RESEARCH INCORPORATED

LABORATORY & CONSULTING SERVICES

3927 AURORA AVENUE NORTH, SEATTLE, WA 98103

PHONE: (206) 632-2715 FAX: (206) 632-2417

CASE FILE NUMBER:	**HER071-16**	**PAGE 1**	
REPORT DATE:	**05/17/05**		
DATE SAMPLED:	**04/16/05**	**DATE RECEIVED:**	**04/16/05**

FINAL REPORT, LABORATORY ANALYSIS OF SELECTED PARAMETERS ON WATER SAMPLES FROM HERRERA ENVIRONMENTAL

CASE NARRATIVE

Seven water samples were received by the laboratory in good condition. The samples were analyzed according to the chain of custody. No difficulties were encountered in the preparation or analysis of these samples. Sample data follows, while QA/QC data is contained on subsequent pages.

SAMPLE DATA

SAMPLE ID	FECAL COLIFORM (#/100ml)
TCN64-041605-1	est 1500
TCS40-041605-1	est 1000
TCS41-041605-1	est 6000
TCN33-041605-1	est 9500
TCM46-041605-1	14000
MBS-041605-1	>140
MBN-041605-1	500

reviewed MCC
7-8-05

AQUATIC RESEARCH INCORPORATED

LABORATORY & CONSULTING SERVICES

3927 AURORA AVENUE NORTH, SEATTLE, WA 98103

PHONE: (206) 632-2715 FAX: (206) 632-2417

CASE FILE NUMBER: HER071-16 **PAGE 2**
REPORT DATE: 05/17/05
DATE SAMPLED: 04/16/05 **DATE RECEIVED:** 04/16/05
FINAL REPORT, LABORATORY ANALYSIS OF SELECTED PARAMETERS ON WATER SAMPLES FROM HERRERA ENVIRONMENTAL

QA/QC DATA

QC PARAMETER	FECAL COLIFORM (#/100ml)
METHOD	SM18 9222D
DATE ANALYZED	04/16/05
DETECTION LIMIT	2
DUPLICATE	
SAMPLE ID	MBN-041605-1
ORIGINAL	500
DUPLICATE	480
RPD	4.08%
SPIKE SAMPLE	
SAMPLE ID	
ORIGINAL	
SPIKED SAMPLE	
SPIKE ADDED	
% RECOVERY	NA
QC CHECK	
FOUND	
TRUE	
% RECOVERY	
BLANK	< 2

RPD = RELATIVE PERCENT DIFFERENCE.
NA = NOT APPLICABLE OR NOT AVAILABLE.
NC = NOT CALCULABLE DUE TO ONE OR MORE VALUES BEING BELOW THE DETECTION LIMIT.
OR = RECOVERY NOT CALCULABLE DUE TO SPIKE SAMPLE OUT OF RANGE OR SPIKE TO LOW RELATIVE TO SAMPLE CONCENTRATION.

SUBMITTED BY:

Steven Lazoff
Laboratory Director

HER071.16

HERRERA ENVIRONMENTAL CONSULTANTS
2200 Sixth Avenue, Suite 1100
Seattle, Washington 98121
(206) 441-9080
FAX (206) 441-9108

CHAIN OF CUSTODY RECORD

Page ___ of ___

PROJECT NAME:	PROJECT NUMBER:	CLIENT:
Thornton MST	01-01948-280	SPU
REPORT TO: Rob Pirsche		COPY TO:
SAMPLED BY: Mike Cawise		DELIVERY METHOD: hand
LABORATORY: Aquatic Research	REQUESTED COMPLETION DATE: SH	TOTAL # OF CONTAINERS: 7
LAB USE:		

ANALYSES REQUESTED: Fecal coliform bacteria; Cultures 2 IEH for ribotyping 3 colonies/sample

SAMPLE ID:	DATE:	TIME:	SAMPLE DESCRIPTION	# OF CONTAINERS:
TCN64-0416	09-1 4/16/09	0630	stormwater	1
TCS90-0416	09-1	0640		
TCS91-0416	09-1	0855		
TCN33-0416	09-1	0900		
TCM46-0416	09-1	0910		
MBS-0416	09-1	0915	lake water	
MBN-0416	09-1	0930		

REMARKS: Please send all cultures to IEH for Ribotyping of 3 E. coli ~~cultures~~ isolates in each sample. Should fill volumes of 100 ml. Lab will take dilutions of 5 and 50 ml.

RELINQUISHED BY (NAME/CO.):	SIGNATURE:	DATE/TIME:	RECEIVED BY (NAME/CO.):	SIGNATURE:	DATE/TIME:
Michael Cawise	[signature]	4-16-09 10:00	Olga Amatanyan	[signature]	4-16-09 10:00
RELINQUISHED BY (NAME/CO.):	SIGNATURE:	DATE/TIME:	RECEIVED BY (NAME/CO.):	SIGNATURE:	DATE/TIME:

mc document2

3927 Aurora Ave. N. ■ Seattle, WA 98103 ■ (206) 632-2715

MICROBIOL WORKSHEET

PAGE 1 OF 1

CLIENT/PROJECT: HERRERIA (THORNTON MST) CFN: HER071.16
DATE RECEIVED: 4/16/05 ANALYST: SD/SL

PARAMETER: Fecal coliform METHOD: 44F
MEDIA: mFC INCUBATION: TEMP IN: 44.5 TEMP OUT: 44.5
Media LOT #: [illegible]1794
NOTES: Blue faded out of most colonies

SAMPLE DATA

	SAMPLE ID	COLLECTION DATE	COLLECTION TIME	LABORATORY REC'D	LABORATORY FILT	DILUTION/VOLUME FILTERED	COLONY COUNTS 0.2	2	5	50	100	RESULT C/100ml
	BLANK						—	—	—	—	0	<1
1	TCH-64-1	4/16	0800	4/16	4/16		3	0	—	—	—	est 500
2	TCS40-1			1000	1100		2	0	—	—	—	est 1000
3	TCS41-1						12	0	—	—	—	est 6000
4	TCH33-1						19	0	—	—	—	est 9500
5	TCH46-1						28	0	—	—	—	14000
6	MBS-1						—	—	4	70	—	> 140
7	MBH-1						—	—	25	TNTC	—	500
8	MBH-1 Dup						—	—	24	TNTC	—	480

CALCULATIONS

ACCEPTABLE LIMITS: TOTAL COLIFORM (20-80 COLONIES) FECAL COLIFORM (20-60 COLONIES)

1) Colony counts within limits.
2) All counts below limits, use either most acceptable count or assume 1 colony for the largest filtration volume, report as either ESTIMATED or LESS THAN (<).
3) All counts above limits, use upper limit count (60 or 80) and the smallest sample volume filtered and report as GREATER THAN (>).

$$\text{COLONIES / 100 ml} = \frac{\text{COLONIES COUNTED}}{} \times 100$$

AQUATIC RESEARCH INCORPORATED

LABORATORY & CONSULTING SERVICES

3927 AURORA AVENUE NORTH, SEATTLE, WA 98103

PHONE: (206) 632-2715 FAX: (206) 632-2417

CASE FILE NUMBER: HER071-20 **PAGE 1**
REPORT DATE: 05/17/05
DATE SAMPLED: 04/19/05 **DATE RECEIVED:** 04/19/05
FINAL REPORT, LABORATORY ANALYSIS OF SELECTED PARAMETERS ON WATER SAMPLES FROM HERRERA ENVIRONMENTAL

CASE NARRATIVE

Twenty one water samples were received by the laboratory in good condition. The samples were analyzed according to the chain of custody. No difficulties were encountered in the preparation or analysis of these samples. Sample data follows, while QA/QC data is contained on subsequent pages.

SAMPLE DATA

SAMPLE ID	FECAL COLIFORM (#/100ml)
TCM46-041905-1	est 60
TCM46-041905-2	est 50
TCM46-041905-3	est 130
MBS-041905-1	est 14
MBS-041905-2	est 20
MBS-041905-3	est 28
MBN-041905-1	44
MBN-041905-2	est 26
MBN-041905-3	92
TCS41-041905-1	est 50
TCS41-041905-2	est 90
TCS41-041905-3	est 60
TCN33-041905-1	est 180
TCN33-041905-2	est 110
TCN33-041905-3	est 70
TCN64-041905-1	est 30
TCN64-041905-2	est 40
TCN64-041905-3	est 30
TCS40-041905-1	est 190
TCS40-041905-2	est 110
TCS40-041905-3	est 190

entered MCC
7-8-05

AQUATIC RESEARCH INCORPORATED

LABORATORY & CONSULTING SERVICES

3927 AURORA AVENUE NORTH, SEATTLE, WA 98103

PHONE: (206) 632-2715 FAX: (206) 632-2417

CASE FILE NUMBER: HER071-20 **PAGE 2**

REPORT DATE: 05/17/05

DATE SAMPLED: 04/19/05 **DATE RECEIVED:** 04/19/05

FINAL REPORT, LABORATORY ANALYSIS OF SELECTED PARAMETERS ON WATER SAMPLES FROM HERRERA ENVIRONMENTAL

QA/QC DATA

QC PARAMETER	FECAL COLIFORM (#/100ml)
METHOD	SM18 9222D
DATE ANALYZED	04/19/05
DETECTION LIMIT	2
DUPLICATE	
SAMPLE ID	TCS40-041905-3
ORIGINAL	est 190
DUPLICATE	est 150
RPD	NC
SPIKE SAMPLE	
SAMPLE ID	
ORIGINAL	
SPIKED SAMPLE	
SPIKE ADDED	
% RECOVERY	NA
QC CHECK	
FOUND	
TRUE	
% RECOVERY	
BLANK	< 2

RPD = RELATIVE PERCENT DIFFERENCE.
NA = NOT APPLICABLE OR NOT AVAILABLE.
NC = NOT CALCULABLE DUE TO ONE OR MORE VALUES BEING BELOW THE DETECTION LIMIT.
OR = RECOVERY NOT CALCULABLE DUE TO SPIKE SAMPLE OUT OF RANGE OR SPIKE TO LOW RELATIVE TO SAMPLE CONCENTRATION.

SUBMITTED BY:

Steven Lazoff
Laboratory Director

3927 Aurora Ave. N. ■ Seattle, WA 98103 ■ (206) 632-2715

MICROBIOL WORKSHEET

PAGE 1 OF 1

CLIENT/PROJECT: HERRERA (THORNTON) CFN: HE2071.20
DATE RECEIVED: 4/19/05 ANALYST: SN

PARAMETER: Fecal coliform METHOD: MEMBRANE FILTRATION
MEDIA: MFC broth INCUBATION : TEMP IN: 44.6 TEMP OUT: 44.4
Media LOT #: 4271794
NOTES:

SAMPLE DATA

	SAMPLE ID	COLLECTION DATE	COLLECTION TIME	LABORATORY REC'D	LABORATORY FILT	COLONY COUNTS DILUTION/VOLUME FILTERED 0.1	1	10	5	50	100	RESULT C/100ml
	BLANK										0	<1
1	TCH46-1	4/19		4/19	4/19	0	1	6	—	—		est 60
2	TCH46-2			1415	1500	0	2	5	—	—		est 50
3	TCH46-3					0	4	13	—	—		est 130
4	MSS-1					—	—	—	4	7		est 14
5	MSS-2					—	—	—	0	10		est 20
6	MSS-3					—	—	—	0	14		est 28
7	MSN-1					—	—	—	0	22		44
8	MSN-2					—	—	—	0	13		est 26
9	MSN-3				1600	—	—	—	1	46		92
10	TCS41-1					0	1	5	—	—		est 50
11	TCS41-2					0	0	9	—	—		est 90
12	TCS41-3					0	1	6	—	—		est 60
13	TCN33-1					0	2	18	—	—		est 180
14	TCN33-2					0	1	11	—	—		est 110
15	TCN33-3					0	3	7	—	—		est 70
16	TCN64-1					0	0	3	—	—		est 30
17	TCN64-2					0	0	4	—	—		est 40
18	TCN64-3					0	0	3	—	—		est 30
19	TCS40-1				1630	0	4	19	—	—		est 190
20	TCS40-2					0	2	11	—	—		est 110
21	TCS40-3					0	4	19	—	—		est 190
22	TCS40-3 DUP					0	1	15	—	—		est 150

CALCULATIONS

ACCEPTABLE LIMITS: TOTAL COLIFORM (20-80 COLONIES) FECAL COLIFORM (20-60 COLONIES)

1) Colony counts within limits.
2) All counts below limits, use either most acceptable count or assume 1 colony for the largest filtration volume, report as either ESTIMATED or LESS THAN (<).
3) All counts above limits, use upper limit count (60 or 80) and the smallest sample volume filtered and report as GREATER THAN (>).

$$\text{COLONIES / 100 ml} = \frac{\text{COLONIES COUNTED}}{} \times 100$$

HER071-20

HERRERA ENVIRONMENTAL CONSULTANTS
2200 Sixth Avenue, Suite 1100
Seattle, Washington 98121
(206) 441-9080
FAX (206) 441-9108

CHAIN OF CUSTODY RECORD

PROJECT NAME: Thornton MST	PROJECT NUMBER: 01-01943-20	CLIENT: SPU
REPORT TO: Rob Zisette		COPY TO:
SAMPLED BY: M Gawne		DELIVERY METHOD: hand
LABORATORY: Aquatic Research	REQUESTED COMPLETION DATE: std	TOTAL # OF CONTAINERS: 21
LAB USE:		

ANALYSES REQUESTED

SAMPLE ID:	DATE:	TIME:	SAMPLE DESCRIPTION	# OF CONTAINERS:	Fecal coliform bacteria	Cultures to EEH for ribotyping
TCM46-041905-1		1215	surface water	1	X	X
	-2	1220				
	-3	1225				
MBS-041905-1		1230	lake water			
	-2	1235				
	-3	1240				
HBN-041905-1		1245				
	-2	1250				
	-3	1255				
TCS41-041905-1		1305	surface water			
	-2	1310				
	-3	1315				
TCN33-041905-1		1320				
	-2	1325				
	-3	1330				

REMARKS: Please send all cultures to EEH in Seattle for ribotyping of 3 E. coli isolates in each sample. Surface water filter volumes: 0.1, 1.0 + 10.0 mL; Lake water filter volumes 50 + 50 mL

RELINQUISHED BY (NAME/CO.):	SIGNATURE:	DATE/TIME:	RECEIVED BY (NAME/CO.):	SIGNATURE:	DATE/TIME:
Michael Gawne Herrera	[signature]	4/19/05 1430	[illegible] / HEC	[signature]	4/19/05 1430
RELINQUISHED BY (NAME/CO.):	SIGNATURE:	DATE/TIME:	RECEIVED BY (NAME/CO.):	SIGNATURE:	DATE/TIME:

HER071-CW

HERRERA ENVIRONMENTAL CONSULTANTS
2200 Sixth Avenue, Suite 1100
Seattle, Washington 98121
(206) 441-9080
FAX (206) 441-9108

CHAIN OF CUSTODY RECORD

Page ___ of ___

PROJECT NAME:	PROJECT NUMBER:	CLIENT:
Thornton MST	01-01943-230	SPU

REPORT TO: Rob Zisette
COPY TO:
SAMPLED BY: M Cawise
DELIVERY METHOD: hand
LABORATORY: Aquatic Research
REQUESTED COMPLETION DATE: std
TOTAL # OF CONTAINERS: 21
LAB USE:

ANALYSES REQUESTED: Fecal Coliform Bacteria; Cultures to IEH for ribotyping 3 colonies/sample

SAMPLE ID:	DATE:	TIME:	SAMPLE DESCRIPTION	# OF CONTAINERS:
TCNG4-04	1905-1	4-19-05	1340 Surface water	1
	-2		1345	
	-3		1350	
TCS40-04	1905-1		1355	
	-2		~~1~~ 1400	
	-3		1405	

REMARKS: see page 1

RELINQUISHED BY (NAME/CO.):	SIGNATURE:	DATE/TIME:	RECEIVED BY (NAME/CO.):	SIGNATURE:	DATE/TIME:
Michael Cawise Herrera		4-19-05 1430	S. Nelson / AQE		4/19/05 1430
RELINQUISHED BY (NAME/CO.):	SIGNATURE:	DATE/TIME:	RECEIVED BY (NAME/CO.):	SIGNATURE:	DATE/TIME:

mc /document2

AQUATIC RESEARCH INCORPORATED

LABORATORY & CONSULTING SERVICES

3927 AURORA AVENUE NORTH, SEATTLE, WA 98103

PHONE: (206) 632-2715 FAX: (206) 632-2417

CASE FILE NUMBER: HER071-22 **PAGE 1**

REPORT DATE: 06/09/05

DATE SAMPLED: 05/18/05 **DATE RECEIVED:** 05/18/05

FINAL REPORT, LABORATORY ANALYSIS OF SELECTED PARAMETERS ON WATER SAMPLES FROM HERRERA ENVIRONMENTAL

CASE NARRATIVE

Twenty one water samples were received by the laboratory in good condition. The samples were analyzed according to the chain of custody. No difficulties were encountered in the preparation or analysis of these samples. Sample data follows, while QA/QC data is contained on subsequent pages.

SAMPLE DATA

SAMPLE ID	FECAL COLIFORM (#/100ml)
TCN64-051805-1	est 1300
TCN64-051805-2	est 1000
TCN64-051805-3	est 600
TCS40-051805-1	4400
TCS40-051805-2	3300
TCS40-051805-3	3300
TCN33-051805-1	2500
TCN33-051805-2	4300
TCN33-051805-3	2500
TCS41-051805-1	>11800
TCS41-051805-2	3700
TCS41-051805-3	>6700
TCM46-051805-1	4700
TCM46-051805-2	4500
TCM46-051805-3	5700
MBS-051805-1	720
MBS-051805-2	> 1600
MBS-051805-3	> 1520
MBN-051805-1	est 240
MBN-051805-2	> 1540
MBN-051805-3	> 2480

entered MCC 6 7-8-05

AQUATIC RESEARCH INCORPORATED

LABORATORY & CONSULTING SERVICES

3927 AURORA AVENUE NORTH, SEATTLE, WA 98103

PHONE: (206) 632-2715 FAX: (206) 632-2417

CASE FILE NUMBER: HER071-22 **PAGE 2**
REPORT DATE: 06/09/05
DATE SAMPLED: 05/18/05 **DATE RECEIVED:** 05/18/05
FINAL REPORT, LABORATORY ANALYSIS OF SELECTED PARAMETERS ON WATER SAMPLES FROM HERRERA ENVIRONMENTAL

QA/QC DATA

QC PARAMETER	FECAL COLIFORM (#/100ml)
METHOD	SM18 9222D
DATE ANALYZED	05/18/05
DETECTION LIMIT	2
DUPLICATE	
SAMPLE ID	MBN-051805-3
ORIGINAL	> 2480
DUPLICATE	>2320
RPD	NC
SPIKE SAMPLE	
SAMPLE ID	
ORIGINAL	
SPIKED SAMPLE	
SPIKE ADDED	
% RECOVERY	NA
QC CHECK	
FOUND	
TRUE	
% RECOVERY	
BLANK	< 2

RPD = RELATIVE PERCENT DIFFERENCE.
NA = NOT APPLICABLE OR NOT AVAILABLE.
NC = NOT CALCULABLE DUE TO ONE OR MORE VALUES BEING BELOW THE DETECTION LIMIT.
OR = RECOVERY NOT CALCULABLE DUE TO SPIKE SAMPLE OUT OF RANGE OR SPIKE TO LOW RELATIVE TO SAMPLE CONCENTRATION.

SUBMITTED BY:

Steven Lazoff
Laboratory Director

3927 Aurora Ave. N. ■ Seattle, WA 98103 ■ (206) 632-2715

MICROBIOL WORKSHEET

PAGE 1 OF 1

CLIENT/PROJECT: HELICERICA CFN: HE2071-22
DATE RECEIVED: 5/18/05 ANALYST: SW

PARAMETER: Fecal coliform METHOD: MF
MEDIA: MFC INCUBATION : TEMP IN: 44.4 TEMP OUT: 44.5
Media LOT #: ~~4271749~~
NOTES: 4271794

SAMPLE DATA

	SAMPLE ID	COLLECTION DATE	COLLECTION TIME	LABORATORY REC'D	LABORATORY FILT	DILUTION/VOLUME FILTERED C/100ml 0.1	1	10	0.5	5	50	100	RESULT
	BLANK					—		—	—	—	—	0	<1
1	TCH64-1	5/18 0300	5/18 1025		5/18 1200	0	13	TNTC	—	—	—		est 1300
2	-2					1	10	conf	—	—	—		est 1000
3	-3					0	6	conf	—	—	—		est 600
4	TCS40-1					6	44	TNTC	—	—	—		4400
5	-2					3	33	TNTC	—	—	—		3300
6	-3					0	33	TNTC	—	—	—		3300
7	TCH33-1					6	25	TNTC	—	—	—		2500
8	-2					4	43	TNTC	—	—	—		4300
9	-3					2	25	TNTC	—	—	—		2500
10	TCS41-1					8	118	TNTC	—	—	—		>11800
11	-2					7	37	TNTC	—	—	—		3700
12	-3					9	67	TNTC	—	—	—		>6700
13	TCH46-1					0	47	conf	—	—	—		4700
14	-2					3	45	conf	—	—	—		4500
15	-3					6	57	TNTC	—	—	—		5700
16	MBS-1					—	—	—	1	36	TNTC		720
17	-2					—	—	—	5	80	TNTC		>1600
18	-3					—	—	—	9	76	TNTC		>1520
19	MBN-1					—	—	—	1	12	TNTC		est 240
20	-2					—	—	—	10	77	TNTC		>1540
21	-3					—	—	—	5	124	TNTC		>2480
22	-3 DUP					—	—	—	7	116	TNTC		>2320

CALCULATIONS

ACCEPTABLE LIMITS: TOTAL COLIFORM (20-80 COLONIES) FECAL COLIFORM (20-60 COLONIES)

1) Colony counts within limits.
2) All counts below limits, use either most acceptable count or assume 1 colony for the largest filtration volume, report as either ESTIMATED or LESS THAN (<).
3) All counts above limits, use upper limit count (60 or 80) and the smallest sample volume filtered and report as GREATER THAN (>).

$$\text{COLONIES / 100 ml} = \frac{\text{COLONIES COUNTED}}{\text{[illegible]}} \times 100$$

HER071-22

Aquatic Research Incorporated

3927 Aurora Ave. N / Seattle, WA 98103 / (206) 632-2715

CHAIN-OF-CUSTODY RECORD

CLIENT: Herrera
SAMPLING DATE: May 18, 2005
SAMPLERS: M. Cowse

SHEET 1 OF 1
PROJECT ID:
CASE FILE NO.:
DATA RECORDED BY:

SAMPLE INFORMATION

PARAMETERS

SAMPLE ID	DATE/TIME COLLECTED	Fecal Coliform Bacteria	Cultures to IEH for Ribotyping 3 Columns/Sample	BOTT #	NOTES
TCN64-051805-1	5/18/05 0705	X	X		
TCN64-051805-2	0827				
TCN64-051805-3	0832				
TCS40-051805-1	0710				
TCS40-051805-2	0842				
TCS40-051805-3	0847				
TCN33-051805-1	0730				
TCN33-051805-2	0855				
TCN33-051805-3	0900				
TCS41-051805-1	0735				
TCS41-051805-2	0906				
TCS41-051805-3	0910				
TCM46-051805-1	0747				
TCM46-051805-2	0930				
TCM46-051805-3	0935				
MBS-051805-1	0750				
MBS-051805-2	0940				
MBS-051805-3	0945				
MBN-051805-1	0802				
MBN-051805-2	0920				
MBN-051805-3	0925	X	X		

	Relinquished By	Date/Time	Received By	Date/Time
Printed Name	Michael Cowse	5/18/05 1025	[illegible]	5/18/05 1025
Signature	[illegible]		[illegible]	
Affiliation	Herrera		ARI	

	Relinquished By	Date/Time	Received By	Date/Time
Printed Name				
Signature				
Affiliation				

Miscellaneous Notes (Hazardous Materials, Quick turn-around time, etc.): Please send all cultures to IEH for ribotyping at 3 [illegible] volumes on each sample
- storm water filter volumes = 0.1, 1.0, 10.0 mL
Lake water filter volumes = 0.5, 5.0, 50 mL

AQUATIC RESEARCH INCORPORATED

LABORATORY & CONSULTING SERVICES

3927 AURORA AVENUE NORTH, SEATTLE, WA 98103

PHONE: (206) 632-2715 FAX: (206) 632-2417

CASE FILE NUMBER:	HER071-27	PAGE 1	
REPORT DATE:	07/21/05		
DATE SAMPLED:	06/29/05	DATE RECEIVED:	06/29/05

FINAL REPORT, LABORATORY ANALYSIS OF SELECTED PARAMETERS ON WATER SAMPLES FROM HERRERA ENVIRONMENTAL

CASE NARRATIVE

Twenty one water samples were received by the laboratory in good condition. The samples were analyzed according to the chain of custody. No difficulties were encountered in the preparation or analysis of these samples. Sample data follows, while QA/QC data is contained on subsequent pages.

SAMPLE DATA

SAMPLE ID	FECAL COLIFORM (#/100ml)
TCN64-062905-1	58
TCN64-062905-2	90
TCN64-062905-3	110
TCS40-062905-1	84
TCS40-062905-2	86
TCS40-062905-3	102
TCN33-062905-1	268
TCN33-062905-2	236
TCN33-062905-3	264
TCS41-062905-1	206
TCS41-062905-2	168
TCS41-062905-3	264
TCM64-062905-1	280
TCM46-062905-2	1040
TCM64-062905-3	1140
MBS-062905-1	42
MBS-062905-2	50
MBS-062905-3	66
MBN-062905-1	380
MBN-062905-2	460
MBN-062905-3	660

entered MCC
8-1-05

AQUATIC RESEARCH INCORPORATED

LABORATORY & CONSULTING SERVICES

3927 AURORA AVENUE NORTH, SEATTLE, WA 98103

PHONE: (206) 632-2715 FAX: (206) 632-2417

CASE FILE NUMBER:	**HER071-27**	**PAGE 2**
REPORT DATE:	**07/21/05**	
DATE SAMPLED:	**06/29/05**	**DATE RECEIVED: 06/29/05**

FINAL REPORT, LABORATORY ANALYSIS OF SELECTED PARAMETERS ON WATER SAMPLES FROM HERRERA ENVIRONMENTAL

QA/QC DATA

QC PARAMETER	FECAL COLIFORM (#/100ml)
METHOD	SM18 9222D
DATE ANALYZED	06/29/05
DETECTION LIMIT	2
DUPLICATE	
SAMPLE ID	MBN-062905-3
ORIGINAL	660
DUPLICATE	520
RPD	23.73%
SPIKE SAMPLE	
SAMPLE ID	
ORIGINAL	
SPIKED SAMPLE	
SPIKE ADDED	
% RECOVERY	NA
QC CHECK	
FOUND	
TRUE	
% RECOVERY	
BLANK	< 2

RPD = RELATIVE PERCENT DIFFERENCE.
NA = NOT APPLICABLE OR NOT AVAILABLE.
NC = NOT CALCULABLE DUE TO ONE OR MORE VALUES BEING BELOW THE DETECTION LIMIT.
OR = RECOVERY NOT CALCULABLE DUE TO SPIKE SAMPLE OUT OF RANGE OR SPIKE TO LOW RELATIVE TO SAMPLE CONCENTRATION.

SUBMITTED BY:

Steven Lazoff
Laboratory Director

AQUATIC RESEARCH INCORPORATED

SOP NUMBER: 7-2 PAGE 7 of 29
Revision Date: 01/11/96
Revision Number: 1.2

3927 Aurora Ave. N. ■ Seattle, WA 98103 ■ (206) 632-2715

MICROBIOL WORKSHEET

PAGE 1 OF 1

CLIENT/PROJECT: Herrera
DATE RECEIVED: 6/29/05 ANALYST: SN
CFN: HOR071.27

PARAMETER: Fecal Coliform METHOD: MF
MEDIA: m FC INCUBATION : TEMP IN: 44.5 TEMP OUT: 44.5
Media LOT #: 4271709
NOTES:

SAMPLE DATA

	SAMPLE ID	COLLECTION DATE	COLLECTION TIME	LABORATORY REC'D	LABORATORY FILT	DILUTION/VOLUME FILTERED 20	5	50			100	RESULT C/100ml
	Blank					0.5	5.0	50			100	
1	TCN64-1	6/29/05	~11:00	6/30/05 1310	6/30/05 11-1600	0	2	29	—	—	0	<1
2	TCN64-2					1	3	45	—	—	—	58
3	TCN64-3					2	7	55	—	—	—	90
4	TCS46-1					0	6	42	—	—	—	110
5	TCS46-2					1	2	43	—	—	—	84
6	TCS46-3					0	4	51	—	—	—	86
7	TCN33-1					3	15	134	—	—	—	102
8	TCN33-2					0	10	118	—	—	—	>268
9	TCN33-3					2	15	132	—	—	—	>236
10	TCS41-1					1	14	103	—	—	—	>264
11	TCS41-2					0	13	84	—	—	—	>206
12	TCS41-3					0	10	132	—	—	—	>168
13	TCM46-1					2	14	TNTC	—	—	—	>264
14	TCM46-2					8	52	TNTC	—	—	—	280
15	TCM46-3					3	57	TNTC	—	—	—	1040
16	MSS-1					0	1	21	—	—	—	1140
17	MSS-2					0	1	25	—	—	—	42
18	MSS-3					0	4	33	—	—	—	50
19	MBN-1					2	19	TNTC	—	—	—	66
20	MBN-2					0	23	TNTC	—	—	—	380
21	MBN-3					2	33	TNTC	—	—	—	460
22	MBN-3 Dup					3	26	TNTC	—	—	—	660
	CALCULATIONS											520

ACCEPTABLE LIMITS: TOTAL COLIFORM (20-80 COLONIES) FECAL COLIFORM (20-60 COLONIES)

1) Colony counts within limits.
2) All counts below limits, use either most acceptable count or assume 1 colony for the largest filtration volume, report as either ESTIMATED or LESS THAN (<).
3) All counts above limits, use upper limit count (60 or 80) and the smallest sample volume filtered and report as GREATER THAN (>).

$$\text{COLONIES / 100 ml} = \frac{\text{COLONIES COUNTED}}{} \times 100$$

HER071-27

Aquatic Research Incorporated

3927 Aurora Ave. N / Seattle, WA 98 [illegible] / (206) 632-2715

CHAIN-OF-CUSTODY RECORD

CLIENT: Herrera
SAMPLING DATE: June 29, 2005
SAMPLERS: M. Cawrse

SHEET _____ OF _____
PROJECT ID:
CASE FILE NO.:
DATA RECORDED BY:

SAMPLE INFORMATION

SAMPLE ID	DATE/TIME COLLECTED	Fecal Coliform Bacteria	Cultures to IEH for ribotyping 3 colonies/sample	PARAMETERS																	BOTT #	NOTES
TCN64-062905-1	6-29-05 1045	X	X																			
TCN64-062905-2	1050																					
TCN64-062905-3	1055																					
TCS40-062905-1	1100																					
TCS40-062905-2	1105																					
TCS40-062905-3	1110																					
TCN33-062905-1	1125																					
TCN33-062905-2	1130																					
TCN33-062905-3	1135																					
TCS41-062905-1	1140																					
TCS41-062905-2	1145																					
TCS41-062905-3	1150																					
TCM46-062905-1	1155																					
TCM46-062905-2	1200																					
TCM46-062905-3	1205																					
MBJ-062905-1	1210																					
MBJ-062905-2	1215																					
MBJ-062905-3	1220																					
MBN-062905-1	1225																					
MBN-062905-2	1230																					
MBN-062905-3	1235																					

	Relinquished By	Date/Time	Received By	Date/Time
Printed Name	Michael Cawrse	6-29-05	D. GRADUSKE	6/29/05
Signature	[signature]	1710	[signature]	13:10
Affiliation	Herrera			

	Relinquished By	Date/Time	Received By	Date/Time
Printed Name				
Signature				
Affiliation				

Miscellaneous Notes (Hazardous Materials, Quick turn-around time, etc.): Please send all cultures to IEH for ribotyping

of 3 E. Coli isolates in each sample

surface water filter volumes
lake water filter volumes } 0.5, 5.0, and 50 mL

AQUATIC RESEARCH INCORPORATED

LABORATORY & CONSULTING SERVICES

3927 AURORA AVENUE NORTH, SEATTLE, WA 98103

PHONE: (206) 632-2715 FAX: (206) 632-2417

CASE FILE NUMBER:	**HER071-32**	**PAGE 1**	
REPORT DATE:	**09/02/05**		
DATE SAMPLED:	**08/16/05**	**DATE RECEIVED:**	**08/16/05**

FINAL REPORT, LABORATORY ANALYSIS OF SELECTED PARAMETERS ON WATER SAMPLES FROM HERRERA ENVIRONMENTAL

CASE NARRATIVE

Twenty one water samples were received by the laboratory in good condition. The samples were analyzed according to the chain of custody. No difficulties were encountered in the preparation or analysis of these samples. Sample data follows, while QA/QC data is contained on subsequent pages.

SAMPLE DATA

SAMPLE ID	FECAL COLIFORM (#/100ml)
TCN64-081605-1	152
TCN64-081605-2	182
TCN64-081605-3	120
TCS40-081605-1	164
TCS40-081605-2	190
TCS40-081605-3	204
TCN33-081605-1	440
TCN33-081605-2	1540
TCN33-081605-3	840
TCS41-081605-1	118
TCS41-081605-2	162
TCS41-081605-3	126
TCM46-081605-1	1440
TCM46-081605-2	1260
TCM46-081605-3	1260
MBS-081605-1	32
MBS-081605-2	10
MBS-081605-3	10
MBN-081605-1	42
MBN-081605-2	48
MBN-081605-3	52

Entered 10-24-05 MCC

AQUATIC RESEARCH INCORPORATED

LABORATORY & CONSULTING SERVICES

3927 AURORA AVENUE NORTH, SEATTLE, WA 98103

PHONE: (206) 632-2715 FAX: (206) 632-2417

CASE FILE NUMBER:	**HER071-32**	**PAGE 2**
REPORT DATE:	**09/02/05**	
DATE SAMPLED:	**08/16/05**	**DATE RECEIVED: 08/16/05**

FINAL REPORT, LABORATORY ANALYSIS OF SELECTED PARAMETERS ON WATER SAMPLES FROM HERRERA ENVIRONMENTAL

QA/QC DATA

QC PARAMETER	FECAL COLIFORM (#/100ml)
METHOD	SM18 9222D
DATE ANALYZED	08/16/05
DETECTION LIMIT	2
DUPLICATE	
SAMPLE ID	MBN-081605-3
ORIGINAL	52
DUPLICATE	64
RPD	20.69%
SPIKE SAMPLE	
SAMPLE ID	
ORIGINAL	
SPIKED SAMPLE	
SPIKE ADDED	
% RECOVERY	NA
QC CHECK	
FOUND	
TRUE	
% RECOVERY	
BLANK	< 2

RPD = RELATIVE PERCENT DIFFERENCE.
NA = NOT APPLICABLE OR NOT AVAILABLE.
NC = NOT CALCULABLE DUE TO ONE OR MORE VALUES BEING BELOW THE DETECTION LIMIT.
OR = RECOVERY NOT CALCULABLE DUE TO SPIKE SAMPLE OUT OF RANGE OR SPIKE TO LOW RELATIVE TO SAMPLE CONCENTRATION.

SUBMITTED BY:

Steven Lazoff
Laboratory Director

AQUATIC RESEARCH INCORPORATED

SOP NUMBER: 7-2 PAGE 7 of 29
Revision Date: 01/11/96
Revision Number: 1.2

3927 Aurora Ave. N. ■ Seattle, WA 98103 ■ (206) 632-2715

MICROBIOL WORKSHEET

PAGE 1 OF 1

CLIENT/PROJECT: HERRERERA CFN: HER0071.32
DATE RECEIVED: 8 / 16 / 05 ANALYST: SN

PARAMETER: Fecal coliform METHOD: MF
MEDIA: mFC INCUBATION : TEMP IN: 44.5 °C TEMP OUT: 44.5
Media LOT #: 4271794
NOTES:

SAMPLE DATA

	SAMPLE ID	COLLECTION DATE	COLLECTION TIME	LABORATORY REC'D	LABORATORY FILT	DILUTION/VOLUME FILTERED 5	50	100	RESULT C/100ml
	10mL							0	<1
1	-1	8/16/05	0900	8/16/05	8/16/05	10	76		152
2	-2			1225	1430	16	91		182
3	-3					7	60		120
	TCS40-1					13	82		164
	-2					33	95		190
	-3					10	102		204
	TCH33-1					22	TNTC		440
	-2					77	TNTC		1540
9	-3					42	TNTC		840
10	TCS41-1					6	59		118
11	-2					27	81		162
12	-3					5	63		126
13	TCM46-1					72	TNTC		1440
14	-2					63	TNTC		1260
15	-3					63	TNTC		1260
16	MSS-1					2	16		32
17	-2					1	5		10
18	-3					1	5		10
19	MBN-1					2	21		42
20	-2					5	24		48
21	-3					2	26		52
22	MBN -3 DP					2	32		64
	APPLICATIONS								

ACCEPTABLE LIMITS: TOTAL COLIFORM (20-80 COLONIES) FECAL COLIFORM (20-60 COLONIES)

1) Colony counts within limits.
2) All counts below limits, use either most acceptable count or assume 1 colony for the largest filtration volume, report as either ESTIMATED or LESS THAN (<).
3) Counts above limits, use upper limit count (60 or 80) and the smallest sample volume filtered and report as GREATER THAN (>).

COLONIES / 100 ml = $\frac{\text{COLONIES COUNTED}}{\text{[illegible]}}$ X 100

HE2071-32

HERRERA ENVIRONMENTAL CONSULTANTS
200 Sixth Avenue, Suite 1100
Seattle, Washington 98121
(206) 441-9080
FAX (206) 441-9108

CHAIN OF CUSTODY RECORD

PROJECT NAME:	PROJECT NUMBER:	CLIENT:
Thornton Creek MST	01-01948-280	SPU

REPORT TO:	COPY TO:
Rob Zisette	

SAMPLED BY:	DELIVERY METHOD:
Mike Cawrse, Ingrid Wertz	hand

LABORATORY:	REQUESTED COMPLETION DATE:	TOTAL # OF CONTAINERS:
Aquatic Research	standard	21

LAB USE:

ANALYSES REQUESTED

SAMPLE ID:	DATE:	TIME:	SAMPLE DESCRIPTION	# OF CONTAINERS:	Fecal coliform bacteria	Cultures to IEH for ribotyping
TCN64-081605-1	8/16/05	0853	surface water	1	x	x
TCN64-081605-2	8/16/05	0858	surface water	1	x	x
TCN64-081605-3	8/16/05	0903	surface water	1	x	x
TCS40-081605-1	8/16/05	0923	surface water	1	x	x
TCS40-081605-2	8/16/05	0933	surface water	1	x	x
TCS40-081605-3	8/16/05	0938	surface water	1	x	x
TCN33-081605-1	8/16/05	1012	surface water	1	x	x
TCN33-081605-2	8/16/05	1017	surface water	1	x	x
TCN33-081605-3	8/16/05	1022	surface water	1	x	x
TCS41-081605-1	8/16/05	1028	surface water	1	x	x
TCS41-081605-2	8/16/05	1033	surface water	1	x	x
TCS41-081605-3	8/16/05	1038	surface water	1	x	x
TCM46-081605-1	8/16/05	1045	surface water	1	x	x
TCM46-081605-2	8/16/05	1050	surface water	1	x	x
TCM46-081605-3	8/16/05	1055	surface water	1	x	x

REMARKS: Please send all cultures to IEH for ribotyping of 3 E. coli isolates in each sample. Filter volumes for all samples are 5 mL and 50 mL.

RELINQUISHED BY (NAME/CO.):	SIGNATURE:	DATE/TIME:	RECEIVED BY (NAME/CO.):	SIGNATURE:	DATE/TIME:
Michael Cawrse / Herrera	[signature]	8/16/05 1225	[illegible]	[signature]	8/16/05 1225
RELINQUISHED BY (NAME/CO.):	SIGNATURE:	DATE/TIME:	RECEIVED BY (NAME/CO.):	SIGNATURE:	DATE/TIME:

HERRERA ENVIRONMENTAL CONSULTANTS
200 Sixth Avenue, Suite 1100
eattle, Washington 98121
206) 441-9080
AX (206) 441-9108

CHAIN OF CUSTODY RECORD

PROJECT NAME: see page 1	PROJECT NUMBER:	CLIENT:
REPORT TO:		COPY TO:
SAMPLED BY:		DELIVERY METHOD:
LABORATORY:	REQUESTED COMPLETION DATE:	TOTAL # OF CONTAINERS:
LAB USE:		

ANALYSES REQUESTED

SAMPLE ID:	DATE:	TIME:	SAMPLE DESCRIPTION	# OF CONTAINERS:	fecal coliform bacteria	cultures to IEH for ribotyping
MBS-081605-1	8/16/05	1106	lake water	1	X	X
MBS-081605-2	8/16/05	1111	lake water	1	X	X
MBS-081605-3	8/16/05	1116	lake water	1	X	X
MBN-081605-1	8/16/05	1130	lake water	1	X	X
MBN-081605-2	8/16/05	1135	lake water	1	X	X
MBN-081605-3	8/16/05	1140	lake water	1	X	X

REMARKS: see page 1

RELINQUISHED BY (NAME/CO.):	SIGNATURE:	DATE/TIME:	RECEIVED BY (NAME/CO.):	SIGNATURE:	DATE/TIME:
Michael Gunn/Herrera	[signature]	8/16/05 1225	[illegible]	[signature]	8/16/05 12[illegible]
RELINQUISHED BY (NAME/CO.):	SIGNATURE:	DATE/TIME:	RECEIVED BY (NAME/CO.):	SIGNATURE:	DATE/TIME:

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AQUATIC RESEARCH INCORPORATED

LABORATORY & CONSULTING SERVICES

3927 AURORA AVENUE NORTH, SEATTLE, WA 98103

PHONE: (206) 632-2715 FAX: (206) 632-2417

CASE FILE NUMBER: HER071-37 **PAGE 1**

REPORT DATE: 10/19/05

DATE SAMPLED: 10/02/05 **DATE RECEIVED:** 10/03/05

FINAL REPORT, LABORATORY ANALYSIS OF SELECTED PARAMETERS ON WATER SAMPLES FROM HERRERA ENVIRONMENTAL

CASE NARRATIVE

Twenty one water samples were received by the laboratory in good condition. The samples were analyzed according to the chain of custody. No difficulties were encountered in the preparation or analysis of these samples. Sample data follows, while QA/QC data is contained on subsequent pages.

SAMPLE DATA

SAMPLE ID	FECAL COLIFORM (#/100ml)
TCN64-100205-1	780
TCN64-100205-2	1160
TCN64-100205-3	820
TCS40-100205-1	3080
TCS40-100205-2	1840
TCS40-100205-3	1960
TCN33-100205-1	>4000
TCN33-100205-2	>4000
TCN33-100205-3	>4000
TCS41-100205-1	3960
TCS41-100205-2	3720
TCS41-100205-3	3160
TCM46-100205-1	3040
TCM46-100205-2	3920
TCN46-100205-3	3880
MBS-100205-1	226
MBS-100205-2	352
MBS-100205-3	1340
MBN-100205-1	36
MBN-100205-2	46
MBN-100205-3	28

Entered 10-24-05 MCC

AQUATIC RESEARCH INCORPORATED

LABORATORY & CONSULTING SERVICES

3927 AURORA AVENUE NORTH, SEATTLE, WA 98103

PHONE: (206) 632-2715 FAX: (206) 632-2417

CASE FILE NUMBER: HER071-37 **PAGE 2**
REPORT DATE: 10/19/05
DATE SAMPLED: 10/03/05 **DATE RECEIVED:** 10/03/05
FINAL REPORT, LABORATORY ANALYSIS OF SELECTED PARAMETERS ON WATER SAMPLES FROM HERRERA ENVIRONMENTAL

QA/QC DATA

QC PARAMETER	FECAL COLIFORM (#/100ml)
METHOD	SM18 9222D
DATE ANALYZED	10/03/05
DETECTION LIMIT	2
DUPLICATE	
SAMPLE ID	MBN-100205-3
ORIGINAL	28
DUPLICATE	24
RPD	15.38%
SPIKE SAMPLE	
SAMPLE ID	
ORIGINAL	
SPIKED SAMPLE	
SPIKE ADDED	
% RECOVERY	NA
QC CHECK	
FOUND	
TRUE	
% RECOVERY	
BLANK	< 2

RPD = RELATIVE PERCENT DIFFERENCE.
NA = NOT APPLICABLE OR NOT AVAILABLE.
NC = NOT CALCULABLE DUE TO ONE OR MORE VALUES BEING BELOW THE DETECTION LIMIT.
OR = RECOVERY NOT CALCULABLE DUE TO SPIKE SAMPLE OUT OF RANGE OR SPIKE TO LOW RELATIVE TO SAMPLE CONCENTRATION.

SUBMITTED BY:

Steven Lazoff
Laboratory Director

3927 Aurora Ave. N. ■ Seattle, WA 98103 ■ (206) 632-2715

MICROBIOL WORKSHEET

PAGE 1 OF 1

CLIENT PROJECT: HERRERA

DATE RECEIVED: 10 / 3 / 05 ANALYST: SN CFN: HEW071.37

PARAMETER: FECAL COLIFORM METHOD: MF

MEDIA: mFC INCUBATION : TEMP IN: 44.5 TEMP OUT: 44.4

Media Lot #: 4271724

NOTES:

SAMPLE DATA

	SAMPLE ID	COLLECTION DATE	COLLECTION TIME	LABORATORY REC'D	LABORATORY FILT	DILUTION/VOLUME FILTERED	COLONY COUNTS 5	COLONY COUNTS 50	COLONY COUNTS 100	RESULT C/100ml
	BLANK									
1	TCN64-1	10/2/05	1300-1600	10/3/05	10/3/05				0	<1
2	-2			0815	1000		39	conf		780
3	-3						58	TNTC		1160
4	TCS40-1						41	TNTC		820
5	-2						154	TNTC		3080
6	-3						92	TNTC		1840
7	TCN35-1						98	TNTC		1960
8	-2						TNTC	TNTC		>4000
9	-3						TNTC	TNTC		>4000
10	TCS41-1						TNTC	TNTC		>4000
11	-2						198	TNTC		3960
12	-3						186	TNTC		3720
13	TCM46-1						158	TNTC		3160
14	-2						152	TNTC		3040
15	-3						196	TNTC		3920
16	MBS-1						194	TNTC		3880
17	-2						2	113		226
18	-3						10	176		352
19	MSN-1						67	TNTC		1340
20	-2						4	18		36
21	-3						1	23		46
22	3 DUP						4	14		28
	CALCULATIONS:						1	12		24

ACCEPTABLE LIMITS: TOTAL COLIFORM (20-80 COLONIES) FECAL COLIFORM (20-60 COLONIES)

1) Colony count within limits.
2) All counts below limits, use either most acceptable count or assume 1 colony for the largest filtration volume, report as either ESTIMATED or LESS THAN (<).
3) All counts above limits, use upper limit count (60 or 80) and the smallest sample volume filtered and report as GREATER THAN (>).

$$\text{COLONIES / 100 ml} = \frac{\text{COLONIES COUNTED}}{\text{ml}} \times 100$$

HEKO71.3

Aquatic Research Incorporated

3927 Aurora Ave. N / Seattle, WA 98103 / (206) 632-2715

CHAIN-OF-CUSTODY RECORD

CLIENT: Herrera
SAMPLING DATE: Oct 2 2005
SAMPLERS: M. Cawrse

SHEET _____ OF _____
PROJECT ID:
CASE FILE NO.:
DATA RECORDED BY:

SAMPLE INFORMATION

PARAMETERS

SAMPLE ID	DATE/TIME COLLECTED	Fecal Coliform - Lab. Type to IEH	BOTT #	NOTES
TCN64-100205-1	10-2-05 1325	X		Creek water
-2	1448			
-3	1453			
TCS40-100205-1	1355			
-2	1500			
-3	1505			
TCN33-100205-1	1345			
-2	1510			
-3	1515			
TCS41-100205-1	1350			
-2	1520			
-3	1525			
TCM46-100205-1	1400			
-2	1530			
-3	1535			
MBS-100205-1	1405			lake water
-2	1540			
-3	1545			
MBN-100205-1	1415			
-2	1555			
-3	1600			

	Relinquished By	Date/Time	Received By	Date/Time
Printed Name	Michael Cawrse	10-3-05 0815	DANIEL GACHOUD	10/4/05 0815
Signature	[illegible]		[illegible]	
Affiliation	Herrera		ARI	

	Relinquished By	Date/Time	Received By	Date/Time
Printed Name				
Signature				
Affiliation				

Miscellaneous Notes (Hazardous Materials, Quick turn-around time, etc.):

AQUATIC RESEARCH INCORPORATED

LABORATORY & CONSULTING SERVICES

3927 AURORA AVENUE NORTH, SEATTLE, WA 98103

PHONE: (206) 632-2715 FAX: (206) 632-2417

CASE FILE NUMBER:	**HER071-38**	**PAGE 1**	
REPORT DATE:	**10/27/05**		
DATE SAMPLED:	**10/25/05**	**DATE RECEIVED:**	**10/25/05**

FINAL REPORT, LABORATORY ANALYSIS OF SELECTED PARAMETERS ON WATER SAMPLES FROM HERRERA ENVIRONMENTAL

CASE NARRATIVE

Twenty one water samples were received by the laboratory in good condition. The samples were analyzed according to the chain of custody. No difficulties were encountered in the preparation or analysis of these samples. Sample data follows, while QA/QC data is contained on subsequent pages.

SAMPLE DATA

SAMPLE ID	FECAL COLIFORM (#/100ml)
TCN64-10/25/05-1	18
TCN64-10/25/05-2	28
TCN64-10/25/05-3	16
TCS40-10/25/05-1	108
TCS40-10/25/05-2	144
TCS40-10/25/05-3	106
TCN33-10/25/05-1	100
TCN33-10/25/05-2	108
TCN33-10/25/05-3	86
TCS41-10/25/05-1	46
TCS41-10/25/05-2	68
TCS41-10/25/05-3	340
TCM~~64~~46-10/25/05-1	620
TCM46-10/25/05-2	600
TCM46-10/25/05-3	580
MBS-10/25/05-1	48
MBS-10/25/05-2	78
MBS-10/25/05-3	72
MBN-10/25/05-1	134
MBN-10/25/05-2	150
MBN-10/25/05-3	86

R2

entered MCC
12-29-05

AQUATIC RESEARCH INCORPORATED

LABORATORY & CONSULTING SERVICES

3927 AURORA AVENUE NORTH, SEATTLE, WA 98103

PHONE: (206) 632-2715 FAX: (206) 632-2417

CASE FILE NUMBER:	**HER071-38**	**PAGE 2**
REPORT DATE:	**10/27/05**	
DATE SAMPLED:	**10/25/05**	**DATE RECEIVED: 10/25/05**

FINAL REPORT, LABORATORY ANALYSIS OF SELECTED PARAMETERS ON WATER SAMPLES FROM HERRERA ENVIRONMENTAL

QA/QC DATA

QC PARAMETER	FECAL COLIFORM (#/100ml)
METHOD	SM18 9222D
DATE ANALYZED	10/25/05
DETECTION LIMIT	2
DUPLICATE	
SAMPLE ID	MBN-10/25/05-3
ORIGINAL	86
DUPLICATE	76
RPD	12.35%
SPIKE SAMPLE	
SAMPLE ID	
ORIGINAL	
SPIKED SAMPLE	
SPIKE ADDED	
% RECOVERY	NA
QC CHECK	
FOUND	
TRUE	
% RECOVERY	
BLANK	< 2

RPD = RELATIVE PERCENT DIFFERENCE.
NA = NOT APPLICABLE OR NOT AVAILABLE.
NC = NOT CALCULABLE DUE TO ONE OR MORE VALUES BEING BELOW THE DETECTION LIMIT.
OR = RECOVERY NOT CALCULABLE DUE TO SPIKE SAMPLE OUT OF RANGE OR SPIKE TO LOW RELATIVE TO SAMPLE CONCENTRATION.

SUBMITTED BY:

Steven Lazoff
Laboratory Director

HER071.38

AQUATIC RESEARCH INCORPORATED

SOP NUMBER: 7-2 PAGE 7 of 29
Revision Date: 01/11/96
Revision Number: 1.2

3927 Aurora Ave. N. ■ Seattle, WA 98103 ■ (206) 632-2715

MICROBIOL WORKSHEET

PAGE 1 OF 1

CLIENT/PROJECT: HERRERA
DATE RECEIVED: 10/25/05 ANALYST: SN CFN: HER071.38

PARAMETER: Fecal coliform METHOD: MF
MEDIA: mFC INCUBATION : TEMP IN: 44.5 TEMP OUT: 44.5
Media LOT #: 4271794
NOTES:

SAMPLE DATA

10/26/05 1700

	SAMPLE ID	COLLECTION DATE	COLLECTION TIME	LABORATORY REC'D	LABORATORY FILT	DILUTION/VOLUME FILTERED 0.5	5	50	100	RESULT C/100ml
	BLANK	10/25/05	1200-1445						0	<
1	TCN64-1			10/25/05 1515	10/25/05 1630	0	0	9		18
2	-2					0	1	14		28
3	-3					0	2	8		16
4	TCS40-1					1	3	54		108
5	-2					0	7	72		144
6	-3					1	2	53		106
7	TCN33 1					0	2	50		100
8	-2					0	6	54		108
9	-3					1	5	43		86
10	TCS41-1					0	0	23		46
11	-2					0	2	34		68
12	-3					2	13	170		340
13	TCN46-1					0	31	TNTC		620
14	-2					2	30	TNTC		600
15	-3					1	29	TNTC		580
16	MBS-1					—	2	24		48
17	-2					—	3	39		78
18	-3					—	4	36		72
19	MBN-1					—	4	67		134
20	-2					—	5	75		150
21	-3					—	3	43		86
22	-3 D-R					—	7	38		76
	CALCULATIONS									

ACCEPTABLE LIMITS: TOTAL COLIFORM (20-80 COLONIES) FECAL COLIFORM (20-60 COLONIES)

1) Colony counts within limits.
2) All counts below limits, use either most acceptable count or assume 1 colony for the largest filtration volume, report as either ESTIMATED or LESS THAN (<).
3) All counts above limits, use upper limit count (60 or 80) and the smallest sample volume filtered and report as GREATER THAN (>).

$$\text{COLONIES / 100 ml} = \frac{\text{COLONIES COUNTED}}{\text{[illegible]}} \times 100$$

HER071-38

HERRERA ENVIRONMENTAL CONSULTANTS
2200 Sixth Avenue, Suite 1100
Seattle, Washington 98121
(206) 441-9080
FAX (206) 441-9108

CHAIN OF CUSTODY RECORD

PROJECT NAME: Thornton Creek MST	PROJECT NUMBER: 01-01948-280	CLIENT: SPU
REPORT TO: Rob Zisette		COPY TO:
SAMPLED BY: Mike Cawrse		DELIVERY METHOD: hand
LABORATORY: Aquatic Research	REQUESTED COMPLETION DATE: standard	TOTAL # OF CONTAINERS: 21
LAB USE:		

ANALYSES REQUESTED

SAMPLE ID:	DATE:	TIME:	SAMPLE DESCRIPTION	# OF CONTAINERS:	Fecal coliform bacteria	Cultures to IEH for ribotyping
TCN64-10/~~26~~25/05-1	10/~~26~~25/05	1245	surface water	1	x	x
TCN64-10/~~26~~25/05-2	10/~~26~~25/05	1250	surface water	1	x	x
TCN64-10/~~26~~25/05-3	10/~~26~~25/05	1255	surface water	1	x	x
TCS40-10/~~26~~25/05-1	10/~~26~~25/05	1300	surface water	1	x	x
TCS40-10/~~26~~25/05-2	10/~~26~~25/05	1305	surface water	1	x	x
TCS40-10/~~26~~25/05-3	10/~~26~~25/05	1310	surface water	1	x	x
TCN33-10/~~26~~25/05-1	10/~~26~~25/05	1320	surface water	1	x	x
TCN33-10/~~26~~25/05-2	10/~~26~~25/05	1325	surface water	1	x	x
TCN33-10/~~26~~25/05-3	10/~~26~~25/05	1330	surface water	1	x	x
TCS41-10/~~26~~25/05-1	10/~~26~~25/05	1335	surface water	1	x	x
TCS41-10/~~26~~25/05-2	10/~~26~~25/05	1340	surface water	1	x	x
TCS41-10/~~26~~25/05-3	10/~~26~~25/05	1345	surface water	1	x	x
TCM46-10/~~26~~25/05-1	10/~~26~~25/05	1350	surface water	1	x	x
TCM46-10/~~26~~25/05-2	10/~~26~~25/05	1355	surface water	1	x	x
TCM46-10/~~26~~25/05-3	10/~~26~~25/05	1400	surface water	1	x	x

REMARKS: Please send all cultures to IEH for ribotyping of 3 E. coli isolates in each sample. Filter volumes for surface water samples are 0.5 mL, 5 mL, and 50 mL. Filter volume for lake water samples are 5 mL and 50 mL.

RELINQUISHED BY (NAME/CO.):	SIGNATURE:	DATE/TIME:	RECEIVED BY (NAME/CO.):	SIGNATURE:	DATE/TIME:
Michael Cawrse / Herrera	[signature]	10-25-05 1515	S. Dickson WSP	[signature]	10/25/05 1715
RELINQUISHED BY (NAME/CO.):	SIGNATURE:	DATE/TIME:	RECEIVED BY (NAME/CO.):	SIGNATURE:	DATE/TIME:

HERRERA ENVIRONMENTAL CONSULTANTS
2200 Sixth Avenue, Suite 1100
Seattle, Washington 98121
(206) 441-9080
FAX (206) 441-9108

CHAIN OF CUSTODY RECORD

PROJECT NAME: see page 1	PROJECT NUMBER:	CLIENT:
REPORT TO:		COPY TO:
SAMPLED BY:		DELIVERY METHOD:
LABORATORY:	REQUESTED COMPLETION DATE:	TOTAL # OF CONTAINERS:
LAB USE:		

ANALYSES REQUESTED

SAMPLE ID:	DATE:	TIME:	SAMPLE DESCRIPTION	# OF CONTAINERS:	fecal coliform bacteria	cultures to IEH for ribotyping
MBS-10/~~26~~25/05-1	10/26/05	1405	lake water	1	X	X
MBS-10/~~26~~25/05-2	10/26/05	1410	lake water	1	X	X
MBS-10/~~26~~25/05-3	10/26/05	1415	lake water	1	X	X
MBN-10/~~26~~25/05-1	10/26/05	1420	lake water	1	X	X
MBN-10/~~26~~25/05-2	10/26/05	1425	lake water	1	X	X
MBN-10/~~26~~25/05-3	10/26/05	1430	lake water	1	X	X
MBR-102505-1	10-25-05	1445	lake water	1	X	X

REMARKS: see page 1

RELINQUISHED BY (NAME/CO.):	SIGNATURE:	DATE/TIME:	RECEIVED BY (NAME/CO.):	SIGNATURE:	DATE/TIME:
Michael Caverse/Herrera		1515 10-25-05 ~~B15~~	S. Ligtson/ARI		10/25/05 1515
RELINQUISHED BY (NAME/CO.):	SIGNATURE:	DATE/TIME:	RECEIVED BY (NAME/CO.):	SIGNATURE:	DATE/TIME:

AQUATIC RESEARCH INCORPORATED

LABORATORY & CONSULTING SERVICES

3927 AURORA AVENUE NORTH, SEATTLE, WA 98103

PHONE: (206) 632-2715 FAX: (206) 632-2417

CASE FILE NUMBER: HER071-39 **PAGE 1**

REPORT DATE: 11/10/05

DATE SAMPLED: 10/28/05-11/01/05 **DATE RECEIVED:** 10/28/05-11/01/05

FINAL REPORT, LABORATORY ANALYSIS OF SELECTED PARAMETERS ON WATER SAMPLES FROM HERRERA ENVIRONMENTAL

CASE NARRATIVE

Twenty one water samples were received by the laboratory in good condition. The samples were analyzed according to the chain of custody. No difficulties were encountered in the preparation or analysis of these samples. Sample data follows, while QA/QC data is contained on subsequent pages.

SAMPLE DATA

SAMPLE ID	FECAL COLIFORM (#/100ml)
TCS40-102805-1	2100
TCN64-102805-1	370
TCN33-102805-1	9800
TCS41-102805-1	8600
TCM46-102805-1	4400
MBS-102805-1	168
MBN-102805-1	34
TCN64-103105-2	730
TCS40-103105-2	6500
TCN33-103105-2	4000
TCS41-103105-2	5200
TCM46-103105-2	3900
MBS-103105-2	480
MBN-103105-2	240
TCN64-110105-3	210
TCS40-110105-3	1200
TCN33-110105-3	>2000
TCS41-110105-3	2600
TCM46-110105-3	3600
MBS-110105-3	920
MBN-110105-3	20

date entered MCC
12-6-05

AQUATIC RESEARCH INCORPORATED

LABORATORY & CONSULTING SERVICES

3927 AURORA AVENUE NORTH, SEATTLE, WA 98103

PHONE: (206) 632-2715 FAX: (206) 632-2417

CASE FILE NUMBER: HER071-39 **PAGE 2**

REPORT DATE: 11/10/05

DATE SAMPLED: 10/28/05-11/01/05 **DATE RECEIVED:** 10/28/05-11/01/05

FINAL REPORT, LABORATORY ANALYSIS OF SELECTED PARAMETERS ON WATER SAMPLES FROM HERRERA ENVIRONMENTAL

QA/QC DATA

QC PARAMETER	FECAL COLIFORM (#/100ml)	FECAL COLIFORM (#/100ml)	FECAL COLIFORM (#/100ml)
METHOD	SM18 9222D	SM18 9222D	SM18 9222D
DATE ANALYZED	10/28/05	10/31/05	11/01/05
DETECTION LIMIT	2	2	2
DUPLICATE			
SAMPLE ID	MBN-102805-1	MBN-103105-2	MBN-110105-3
ORIGINAL	34	240	20
DUPLICATE	30	220	18
RPD	12.50%	8.70%	10.53%
SPIKE SAMPLE			
SAMPLE ID			
ORIGINAL			
SPIKED SAMPLE			
SPIKE ADDED			
% RECOVERY	NA	NA	NA
QC CHECK			
FOUND			
TRUE			
% RECOVERY			
BLANK	< 2	< 2	< 2

RPD = RELATIVE PERCENT DIFFERENCE.
NA = NOT APPLICABLE OR NOT AVAILABLE.
NC = NOT CALCULABLE DUE TO ONE OR MORE VALUES BEING BELOW THE DETECTION LIMIT.
OR = RECOVERY NOT CALCULABLE DUE TO SPIKE SAMPLE OUT OF RANGE OR SPIKE TO LOW RELATIVE TO SAMPLE CONCENTRATION.

SUBMITTED BY:

Steven Lazoff
Laboratory Director

3927 Aurora Ave. N. ■ Seattle, WA 98103 ■ (206) 632-2715

MICROBIOL WORKSHEET

PAGE 1 OF 3

CLIENT/PROJECT: HERRERA
DATE RECEIVED: 10/28/05 ANALYST: SD CFN: HH0071-39

PARAMETER: FECAL coliform METHOD: MF
MEDIA: mFC INCUBATION : TEMP IN: 44.5 TEMP OUT: 44.5
Media LOT #: 4271794
NOTES:

SAMPLE DATA

10/29/05 SAT 11:30

	SAMPLE ID	COLLECTION DATE	COLLECTION TIME	LABORATORY REC'D	LABORATORY FILT	COLONY COUNTS DILUTION/VOLUME FILTERED 0.1	1	10	6	50	100 C/100ml	RESULT
	BLANK					—	—	—	—	—	0	<1
1	TCS40-1	10/28	0930 0940	10/28	10/28	5	21	15	—	—		2100
2	TCN64-1			0820	11:00	0	4	37	—	—		370
3	TCN33-1					9	98	TNTC	—	—		9800
4	TCS41-1					9	86	TNTC	—	—		8600
5	TCM46-1					5	44	TNTC	—	—		4400
6	MSS-1					—	—	—	7	84		168
7	MBN-1					—	—	—	0	17		34
8	MBN-1-dup					—	—	—	4	15		30

CALCULATIONS

ACCEPTABLE LIMITS: TOTAL COLIFORM (20-80 COLONIES) FECAL COLIFORM (20-60 COLONIES)

1) Colony counts within limits.
2) All counts below limits, use either most acceptable count or assume 1 colony for the largest filtration volume, report as either ESTIMATED or LESS THAN (<).
3) All counts above limits, use upper limit count (60 or 80) and the smallest sample volume filtered and report as GREATER THAN (>).

$$\text{COLONIES / 100 ml} = \frac{\text{COLONIES COUNTED}}{} \times 100$$

AQUATIC RESEARCH INCORPORATED

SOP NUMBER: 7-2 PAGE 7 of 29
Revision Date: 01/11/96
Revision Number: 1.2

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MICROBIOL WORKSHEET

PAGE 2 OF 3

CLIENT/PROJECT: HERRERA
DATE RECEIVED: 10/31/05 ANALYST: SN CFN: HER071-39

PARAMETER: Fecal coliform METHOD: MF
MEDIA: m-FC INCUBATION : TEMP IN: 44.5 TEMP OUT: 44.4
Media LOT #: [illegible]
NOTES: 4271794

SAMPLE DATA

	SAMPLE ID	COLLECTION DATE	COLLECTION TIME	LABORATORY REC'D	LABORATORY FILT	DILUTION/VOLUME FILTERED 0.1	1	10	5	50	100	RESULT C/100ml
	BLANK					—	—	—	—	—	0	<1
1	TCN 64-2	10/31	0500-0600	10/31	10/31	1	11	73	—	—		730
2	TCS40-2			0520	0930	8	65	TNTC	—	—		6500
3	TCN33-2					4	CONF	TNTC	—	—		4000
4	TCS41-2					4	52	TNTC	—	—		5200
5	TCM46-2					5	39	TNTC	—	—		3900
6	MBS-2					—	—	—	24	TNTC		480
7	MBN-2					—	—	—	12	CONF		240
8	MBN-2Dup					—	—	—	11	CONF		220

CALCULATIONS

ACCEPTABLE LIMITS: TOTAL COLIFORM (20-80 COLONIES) FECAL COLIFORM (20-60 COLONIES)

1) Colony counts within limits.
2) All counts below limits, use either most acceptable count or assume 1 colony for the largest filtration volume, report as either ESTIMATED or LESS THAN (<).
3) All counts above limits, use upper limit count (60 or 80) and the smallest sample volume filtered and report as GREATER THAN (>).

$$\text{COLONIES / 100 ml} = \frac{\text{COLONIES COUNTED}}{\text{[illegible]}} \times 100$$

AQUATIC RESEARCH INCORPORATED

SOP NUMBER: 7-2 PAGE 7 of 29
Revision Date: 01/11/96
Revision Number: 1.2

3927 Aurora Ave. N. ■ Seattle, WA 98103 ■ (206) 632-2715

MICROBIOL WORKSHEET

PAGE 3 OF 3

CLIENT/PROJECT: HERRERA
DATE RECEIVED: 11/1/05 ANALYST: SN CFN: HERC071-39

PARAMETER: FECAL COliform METHOD: MF
MEDIA: mFC INCUBATION : TEMP IN: 44.5 TEMP OUT: 44.5
Media LOT #: 4271794
NOTES:

SAMPLE DATA

	SAMPLE ID	COLLECTION DATE	COLLECTION TIME	LABORATORY REC'D	LABORATORY FILT	DILUTION/VOLUME FILTERED 0.1	1	10	5	50	100	RESULT
	BLANK					—	—	—	—	—	0	<1
1	TCH64-3	11/1/05	~0700-0830	11/1	11/1	0	2	21	—	—	—	210
2	TC540-3			11/5	1400	6	12	conf	—	—	—	1200
3	TCH55-3					conf	conf	TNTC	—	—	—	72000
4	TC541-3					3	26	TNTC	—	—	—	2600
5	TCH46-3					1	36	conf	—	—	—	3600
6	H55-3					—	—	—	46	TNTC	—	920
7	H5N-3					—	—	—	0	10	—	20
8	H5N-3 dup					—	—	—	0	9	—	18

CALCULATIONS

ACCEPTABLE LIMITS: TOTAL COLIFORM (20-80 COLONIES) FECAL COLIFORM (20-60 COLONIES)

1) Colony counts within limits.
2) All counts below limits, use either most acceptable count or assume 1 colony for the largest filtration volume, report as either ESTIMATED or LESS THAN (<).
3) All counts above limits, use upper limit count (60 or 80) and the smallest sample volume filtered and report as GREATER THAN ( ).

$$\text{COLONIES / 100 ml} = \frac{\text{COLONIES COUNTED}}{\text{---------}} \times 100$$

HCR071.39

HERRERA ENVIRONMENTAL CONSULTANTS
2200 Sixth Avenue, Suite 1100
Seattle, Washington 98121
(206) 441-9080
FAX (206) 441-9108

CHAIN OF CUSTODY RECORD

PROJECT NAME: Thorton MST
PROJECT NUMBER: 00-01940-280
CLIENT: SPU
REPORT TO: Rob Zisette
COPY TO:
SAMPLED BY: M. Cawise
DELIVERY METHOD: hand
LABORATORY: Aquatic Research
REQUESTED COMPLETION DATE: standard
TOTAL # OF CONTAINERS: 7
LAB USE:

ANALYSES REQUESTED: Fecal coliform; ribotyping of 3 colonies by HEH

SAMPLE ID:	DATE:	TIME:	SAMPLE DESCRIPTION	# OF CONTAINERS:	Fecal coliform	ribotyping of 3 colonies by HEH
TCS40-102805-1	10-28-05	0350	surface water	1	1	1
TCN64-102805-1	10-28-05	0400	↓	↓	↓	↓
TCN31-102805-1	10-28-05	0415	↓	↓	↓	↓
TCS41-102805-1	10-28-05	0420	↓	↓	↓	↓
TCM46-102805-1	10-28-05	0430	↓	↓	↓	↓
MBS-102805-1	10-28-05	0435	lake water	↓	↓	↓
MBN-102805-1	10-28-05	0440	"	↓	↓	↓

REMARKS: dilution volumes for surface water = 0.1 mL, 1.0 mL, + 10 mL
dilution volumes for lake water = ~~0.5~~ 5 mL + 50 mL

RELINQUISHED BY (NAME/CO.):	SIGNATURE:	DATE/TIME:	RECEIVED BY (NAME/CO.):	SIGNATURE:	DATE/TIME:
Michael Cawise	[signature]	10-28-05 0820	S. Nielsen AKE	[signature]	10/28/05 0820
RELINQUISHED BY (NAME/CO.):	SIGNATURE:	DATE/TIME:	RECEIVED BY (NAME/CO.):	SIGNATURE:	DATE/TIME:

mc /document2

HERC071.39

HERRERA ENVIRONMENTAL CONSULTANTS
2200 Sixth Avenue, Suite 1100
Seattle, Washington 98121
(206) 441-9080
FAX (206) 441-9108

CHAIN OF CUSTODY RECORD

PROJECT NAME: Thorton MST
PROJECT NUMBER: 01-01948-230
CLIENT: SPU
REPORT TO: Rob Zisette
COPY TO:
SAMPLED BY: M. Cawrse
DELIVERY METHOD:
LABORATORY: Aquatic Biol.
REQUESTED COMPLETION DATE: std
TOTAL # OF CONTAINERS: 7
LAB USE:

ANALYSES REQUESTED: Fecal coliform; Subtype of Bacteria by TEH

SAMPLE ID:	DATE:	TIME:	SAMPLE DESCRIPTION	# OF CONTAINERS:	Fecal coliform	Subtype of Bacteria by TEH
TCN64-103105-2	10-31-05	0515	surface water	1	1	1
TCS40-103105-2		0525				
TCN77-103105-2		0535				
TCS41-103105-2		0540				
TCM46-103105-2		0550				
MBS-103105-2		0555	lake water			
MBN-103105-2		0605	"			

REMARKS: Filter volumes for surface water 0.1 mL, 1.0 mL, + 10 mL
Filter volumes for lake water 5 mL and 50 mL

RELINQUISHED BY (NAME/CO.):	SIGNATURE:	DATE/TIME:	RECEIVED BY (NAME/CO.):	SIGNATURE:	DATE/TIME:
Michael Cawrse		10-31-05 0820	S. Nilsson AKI		10/31/05 0820
RELINQUISHED BY (NAME/CO.):	SIGNATURE:	DATE/TIME:	RECEIVED BY (NAME/CO.):	SIGNATURE:	DATE/TIME:

mc /document2

HER071-39

HERRERA ENVIRONMENTAL CONSULTANTS
2200 Sixth Avenue, Suite 1100
Seattle, Washington 98121
(206) 441-9080
FAX (206) 441-9108

CHAIN OF CUSTODY RECORD

PROJECT NAME: Thornton MST
PROJECT NUMBER: 01-01948-200
CLIENT: SPU
REPORT TO: Rob Zirette
COPY TO:
SAMPLED BY: Mike Cawse
DELIVERY METHOD:
LABORATORY: Aquatic Research
REQUESTED COMPLETION DATE: STD
TOTAL # OF CONTAINERS:
LAB USE:

ANALYSES REQUESTED

SAMPLE ID:	DATE:	TIME:	SAMPLE DESCRIPTION	# OF CONTAINERS:	Fecal coliform	Send culture plates to IEH for ribotyping of 3 colonies
TCN64-110105-3	11-1-05	0725	surface water	1	X	X
TCS40-110105-3	↓	0735	↓	↓	↓	↓
TCN33-110105-3	↓	0755	↓	↓	↓	↓
TCS41-110105-3	↓	0800	↓	↓	↓	↓
TCM46-110105-3	↓	0815	↓	↓	↓	↓
MBS-110105-3	↓	0820	lake water	↓	↓	↓
MBN-110105-3	↓	0840	"	↓	↓	↓

REMARKS: Filter volumes for surface water = 0.1 mL, 1.0 mL, 10.0 mL
Filter volumes for lake water = 5 mL + 50 mL

RELINQUISHED BY (NAME/CO.):	SIGNATURE:	DATE/TIME:	RECEIVED BY (NAME/CO.):	SIGNATURE:	DATE/TIME:
Michael Cawse / Herrera	[signature]	11-1-05 1145	S. NIELSON BRI	[signature]	11/1/05 1145
RELINQUISHED BY (NAME/CO.):	SIGNATURE:	DATE/TIME:	RECEIVED BY (NAME/CO.):	SIGNATURE:	DATE/TIME:

mc /document2

AQUATIC RESEARCH INCORPORATED

LABORATORY & CONSULTING SERVICES

3927 AURORA AVENUE NORTH, SEATTLE, WA 98103

PHONE: (206) 632-2715 FAX: (206) 632-2417

CASE FILE NUMBER:	**HER071-48**	**PAGE 1**
REPORT DATE:	**11/25/05**	
DATE SAMPLED:	**11/21/05**	**DATE RECEIVED: 11/21/05**

FINAL REPORT, LABORATORY ANALYSIS OF SELECTED PARAMETERS ON WATER SAMPLES FROM HERRERA ENVIRONMENTAL

CASE NARRATIVE

Twenty one water samples were received by the laboratory in good condition. The samples were analyzed according to the chain of custody. No difficulties were encountered in the preparation or analysis of these samples. Sample data follows, while QA/QC data is contained on subsequent pages.

SAMPLE DATA

SAMPLE ID	FECAL COLIFORM (#/100ml)
TCN64-112105-1	42
TCN64-112105-2	30
TCN64-112105-3	36
TCS40-112105-1	50
TCS40-112105-2	36
TCS40-112105-3	28
TCN33-112105-1	296
TCN33-112105-2	388
TCN33-112105-3	462
TCS41-112105-1	122
TCS41-112105-2	106
TCS41-112105-3	108
TCM46-112105-1	268
TCM46-112105-2	264
TCM46-112105-3	356
MBS-112105-1	20
MBS-112105-2	110
MBS-112105-3	120
MBN-112105-1	72
MBN-112105-2	74
MBN-112105-3	50

data entered MCC
12-6-05

AQUATIC RESEARCH INCORPORATED

LABORATORY & CONSULTING SERVICES

3927 AURORA AVENUE NORTH, SEATTLE, WA 98103

PHONE: (206) 632-2715 FAX: (206) 632-2417

CASE FILE NUMBER:	**HER071-48**	**PAGE 2**
REPORT DATE:	**11/25/05**	
DATE SAMPLED:	**11/21/05**	**DATE RECEIVED: 11/21/05**

FINAL REPORT, LABORATORY ANALYSIS OF SELECTED PARAMETERS ON WATER SAMPLES FROM HERRERA ENVIRONMENTAL

QA/QC DATA

QC PARAMETER	FECAL COLIFORM (#/100ml)
METHOD	SM18 9222D
DATE ANALYZED	11/21/05
DETECTION LIMIT	2
DUPLICATE	
SAMPLE ID	MBN-112105-3
ORIGINAL	50
DUPLICATE	40
RPD	22.22%
SPIKE SAMPLE	
SAMPLE ID	
ORIGINAL	
SPIKED SAMPLE	
SPIKE ADDED	
% RECOVERY	NA
QC CHECK	
FOUND	
TRUE	
% RECOVERY	
BLANK	< 2

RPD = RELATIVE PERCENT DIFFERENCE.
NA = NOT APPLICABLE OR NOT AVAILABLE.
NC = NOT CALCULABLE DUE TO ONE OR MORE VALUES BEING BELOW THE DETECTION LIMIT.
OR = RECOVERY NOT CALCULABLE DUE TO SPIKE SAMPLE OUT OF RANGE OR SPIKE TO LOW RELATIVE TO SAMPLE CONCENTRATION.

SUBMITTED BY:

Steven Lazoff
Laboratory Director

AQUATIC RESEARCH INCORPORATED

SOP NUMBER: 7-2 PAGE 7 of 29
Revision Date: 01/11/96
Revision Number: 1.2

3927 Aurora Ave. N. ■ Seattle, WA 98103 ■ (206) 632-2715

MICROBIOL WORKSHEET

PAGE 1 OF 1

CLIENT/PROJECT: Honeycutt
DATE RECEIVED: 11/21/05 ANALYST: SN CFN: HEK0715-48

PARAMETER: Fecal coliform METHOD: MF
MEDIA: mFC INCUBATION : TEMP IN: 44.5 TEMP OUT: 44.5
Media LOT #: 4671794
NOTES:

SAMPLE DATA

	SAMPLE ID	COLLECTION DATE	COLLECTION TIME	LABORATORY REC'D	LABORATORY FILT	DILUTION/VOLUME FILTERED	COLONY COUNTS C/100ml 0.5	5.0	50	100	RESULT
	BLANK										
1	RN64-1	11/21	1250-	11/21	11/21					0	<1
2	-2		1055	1120	1300		0	1	21		42
3	-3						0	2	15		30
4	RS40-1						0	4	18		36
5	-2						0	2	25		50
6	-3						0	8	18		36
7	RN53-1						1	2	14		28
8	-2						1	12	148		296
9	-3						1	16	194		388
10	RS41-1						2	15	231		462
11	-2						0	3	61		122
12	-3						0	6	53		106
13	RH46-1						0	5	54		108
14	-2						1	14	134		268
15	-3						0	12	132		264
16	MS5-1						5	16	178		356
17	-2						0	2	10		20
18	-3						0	8	55		110
19	MBN-1						0	1	60		120
20	-2						1	5	36		72
21	-3						0	2	37		74
22	-3 DUP						0	2	25		50
	CALCULATIONS						0	2	20		40

ACCEPTABLE LIMITS: TOTAL COLIFORM (20-80 COLONIES) FECAL COLIFORM (20-60 COLONIES)

1) Colony counts within limits.
2) All counts below limits, use either most acceptable count or assume 1 colony for the largest filtration volume, report as either ESTIMATED or LESS THAN (<).
3) All counts above limits, use upper limit count (60 or 80) and the smallest sample volume filtered and report as GREATER THAN ( )

$$\text{COLONIES / 100 ml} = \frac{\text{COLONIES COUNTED}}{\text{[illegible]}} \times 100$$

HGR071.48

HERRERA ENVIRONMENTAL CONSULTANTS
2200 Sixth Avenue, Suite 1100
Seattle, Washington 98121
(206) 441-9080
FAX (206) 441-9108

CHAIN OF CUSTODY RECORD

PROJECT NAME: Thornton MST
PROJECT NUMBER: 01-01948-200
CLIENT: SPU
REPORT TO: Rob Zisette
COPY TO:
SAMPLED BY: Mike Cawse
DELIVERY METHOD: st hand
LABORATORY: Aquatic Res.
REQUESTED COMPLETION DATE: std
TOTAL # OF CONTAINERS: 22
LAB USE:

ANALYSES REQUESTED: field collection - bacteria; send to EH for fingerprinting of 3 colonies

SAMPLE ID:	DATE:	TIME:	SAMPLE DESCRIPTION	# OF CONTAINERS:	field collection - bacteria	send to EH for fingerprinting of 3 colonies
TCN04-112105-1	11-21-05	0850	surface water	1	1	1
TCN04-112105-2		0855				
TCN04-112105-3		0900				
TCS40-112105-1		0905				
TCS40-112105-2		0910				
TCS40-112105-3		0915				
TCN33-112105-1		0920				
TCN33-112105-2		0925				
TCN33-112105-3		0930				
~~NC~~TCS41-112105-1		0935				
TCS41-112105-2		0940				
TCS41-112105-3		0945				
TCM46-112105-1		0950				
TCM46-112105-2		~~1000~~ 0955				
TCM46-112105-3		1000				

REMARKS: filter volumes for surface water = 0.5 mL, 5.0 mL, and 50 mL
filter volumes for lake water = 0.5 mL, 5.0 mL, and 50 mL

RELINQUISHED BY (NAME/CO.):	SIGNATURE:	DATE/TIME:	RECEIVED BY (NAME/CO.):	SIGNATURE:	DATE/TIME:
Michael Cawse / Herrera	[signature]	11-21-05 1120	S Nielsen	[signature]	11/21/05 1120
RELINQUISHED BY (NAME/CO.):	SIGNATURE:	DATE/TIME:	RECEIVED BY (NAME/CO.):	SIGNATURE:	DATE/TIME:

mc /document2

HER071-48

HERRERA ENVIRONMENTAL CONSULTANTS
2200 Sixth Avenue, Suite 1100
Seattle, Washington 98121
(206) 441-9080
FAX (206) 441-9108

CHAIN OF CUSTODY RECORD

PROJECT NAME: Thornton MST	PROJECT NUMBER: 01-01948-290	CLIENT: SPU
REPORT TO: Bob Zusette		COPY TO:
SAMPLED BY: Mike Cowrie		DELIVERY METHOD: hand
LABORATORY: Aquatic Research	REQUESTED COMPLETION DATE: STD	TOTAL # OF CONTAINERS: 22
LAB USE:		

ANALYSES REQUESTED: Fecal coliform bacteria; send to IEH for Microbiology of 3 colonies

SAMPLE ID:	DATE:	TIME:	SAMPLE DESCRIPTION	# OF CONTAINERS:	Fecal coliform bacteria	send to IEH for Microbiology of 3 colonies
MBS-112105-1	11-21-05	1005	lake water	1	1	1
MBS-112105-2		1010				
MBS-112105-3		1015				
MBN-112105-1		1020				
MBN-112105-2		1025				
MBN-112105-3		1030				
MBP-112105-1		1035				

REMARKS:

RELINQUISHED BY (NAME/CO.):	SIGNATURE:	DATE/TIME:	RECEIVED BY (NAME/CO.):	SIGNATURE:	DATE/TIME:
Michael Cowrie/Herrera	[signature]	11-21-05 1120	Simpson Aug	[signature]	11/21/05 1120
RELINQUISHED BY (NAME/CO.):	SIGNATURE:	DATE/TIME:	RECEIVED BY (NAME/CO.):	SIGNATURE:	DATE/TIME:

mc /document2

AQUATIC RESEARCH INCORPORATED

LABORATORY & CONSULTING SERVICES

3927 AURORA AVENUE NORTH, SEATTLE, WA 98103

PHONE: (206) 632-2715 FAX: (206) 632-2417

CASE FILE NUMBER:	HER071-56	PAGE 1	
REPORT DATE:	12/28/05		
DATE SAMPLED:	12/20/05	DATE RECEIVED:	12/20/05

FINAL REPORT, LABORATORY ANALYSIS OF SELECTED PARAMETERS ON WATER SAMPLES FROM HERRERA ENVIRONMENTAL

CASE NARRATIVE

Seven water samples were received by the laboratory in good condition. The samples were analyzed according to the chain of custody. No difficulties were encountered in the preparation or analysis of these samples. Sample data follows, while QA/QC data is contained on subsequent pages.

SAMPLE DATA

SAMPLE ID	FECAL COLIFORM (#/100ml)
TCN64-122005-1	70
TCS40-122005-1	290
TCN33-122005-1	2400
TCS41-122005-1	990
TCM46-122005-1	1350
MBS-122005-1	34
MBN-122005-1	8

entered 1-6-06 MCC

AQUATIC RESEARCH INCORPORATED

LABORATORY & CONSULTING SERVICES

3927 AURORA AVENUE NORTH, SEATTLE, WA 98103

PHONE: (206) 632-2715 FAX: (206) 632-2417

CASE FILE NUMBER:	HER071-56	PAGE 2	
REPORT DATE:	12/28/05		
DATE SAMPLED:	12/20/05	DATE RECEIVED:	12/20/05

FINAL REPORT, LABORATORY ANALYSIS OF SELECTED PARAMETERS ON WATER SAMPLES FROM HERRERA ENVIRONMENTAL

QA/QC DATA

QC PARAMETER	FECAL COLIFORM (#/100ml)
METHOD	SM18 9222D
DATE ANALYZED	12/20/05
DETECTION LIMIT	2
DUPLICATE	
SAMPLE ID	MBN-122005-1
ORIGINAL	8
DUPLICATE	12
RPD	40.00%
SPIKE SAMPLE	
SAMPLE ID	
ORIGINAL	
SPIKED SAMPLE	
SPIKE ADDED	
% RECOVERY	NA
QC CHECK	
FOUND	
TRUE	
% RECOVERY	
BLANK	< 2

RPD = RELATIVE PERCENT DIFFERENCE.
NA = NOT APPLICABLE OR NOT AVAILABLE.
NC = NOT CALCULABLE DUE TO ONE OR MORE VALUES BEING BELOW THE DETECTION LIMIT.
OR = RECOVERY NOT CALCULABLE DUE TO SPIKE SAMPLE OUT OF RANGE OR SPIKE TO LOW RELATIVE TO SAMPLE CONCENTRATION.

SUBMITTED BY:

Steven Lazoff

Laboratory Director

AQUATIC RESEARCH INCORPORATED

SOP NUMBER: 7-2 PAGE 7 of 29
Revision Date: 01/11/96
Revision Number: 1.2

3927 Aurora Ave. N. ■ Seattle, WA 98103 ■ (206) 632-2715

MICROBIOL WORKSHEET

PAGE 1 OF 1

CLIENT/PROJECT: HEREEEA
DATE RECEIVED: 12 / 20 / 05 ANALYST: SN
CFN: HE0071 56

PARAMETER: Fecal coliform METHOD: MF
MEDIA: MFC INCUBATION : TEMP IN: 44.5 TEMP OUT: 44.5
Media LOT #: 4271744
NOTES:

SAMPLE DATA

~1300

	SAMPLE ID	COLLECTION DATE	COLLECTION TIME	LABORATORY REC'D	LABORATORY FILT	DILUTION/VOLUME FILTERED 0.1	1	10	0.5	5.0	50	C/100ml 100	RESULT
	BLANK					—	—	—	—	—	—	0	<1
1	TEH64-1	12/20	1045-0955	12/20	12/20	—	0	3	7	—	—	—	70
2	TES40-1			1200	1300	—	0	5	29	—	—	—	290
3	TEN55-1					—	2	24	TNTC	—	—	—	2400
4	TES41-1					—	3	17	99	—	—	—	990
5	TEM46-1					—	5	19	135	—	—	—	1350
6	MSS-1					—	—	—	—	0	0	17	34
7	GMN-1					—	—	—	—	0	0	4	8
8	HSN-1 Dup					—	—	—	—	0	0	6	12

CALCULATIONS

ACCEPTABLE LIMITS: TOTAL COLIFORM (20-80 COLONIES) FECAL COLIFORM (20-60 COLONIES)

1) Colony counts within limits.
2) All counts below limits, use either most acceptable count or assume 1 colony for the largest filtration volume, report as either ESTIMATED or LESS THAN (<).
3) All counts above limits, use upper limit count (60 or 80) and the smallest sample volume filtered and report as GREATER THAN (>)

$$\text{COLONIES / 100 ml} = \frac{\text{COLONIES COUNTED}}{\text{[illegible]}} \times 100$$

AQUATIC RESEARCH INCORPORATED

LABORATORY & CONSULTING SERVICES

3927 AURORA AVENUE NORTH, SEATTLE, WA 98103

PHONE: (206) 632-2715 FAX: (206) 632-2417

CASE FILE NUMBER:	HER071-58	PAGE 1	
REPORT DATE:	12/28/05		
DATE SAMPLED:	12/21/05	DATE RECEIVED:	12/21/05

FINAL REPORT, LABORATORY ANALYSIS OF SELECTED PARAMETERS ON WATER SAMPLES FROM HERRERA ENVIRONMENTAL

CASE NARRATIVE

Fourteen water samples were received by the laboratory in good condition. The samples were analyzed according to the chain of custody. No difficulties were encountered in the preparation or analysis of these samples. Sample data follows, while QA/QC data is contained on subsequent pages.

SAMPLE DATA

SAMPLE ID	FECAL COLIFORM (#/100ml)
TCN64-122105-2	210
TCN64-122105-3	900
TCS40-122105-2	870
TCS40-122105-3	570
TCN33-122105-2	1080
TCN33-122105-3	1010
TCS41-122105-2	1400
TCS41-122105-3	1480
TCM46-122105-2	1200
TCM46-122105-3	1300
MBS-122105-2	42
MBS-122105-3	200
MBN-122105-2	420
MBN-122105-3	140

entered 1-6-06 MCC

AQUATIC RESEARCH INCORPORATED

LABORATORY & CONSULTING SERVICES

3927 AURORA AVENUE NORTH, SEATTLE, WA 98103

PHONE: (206) 632-2715 FAX: (206) 632-2417

CASE FILE NUMBER:	HER071-58	PAGE 2	
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FINAL REPORT, LABORATORY ANALYSIS OF SELECTED PARAMETERS ON WATER SAMPLES FROM HERRERA ENVIRONMENTAL

QA/QC DATA

QC PARAMETER	FECAL COLIFORM (#/100ml)
METHOD	SM18 9222D
DATE ANALYZED	12/21/05
DETECTION LIMIT	2
DUPLICATE	
SAMPLE ID	MBN-122105-3
ORIGINAL	140
DUPLICATE	160
RPD	13.33%
SPIKE SAMPLE	
SAMPLE ID	
ORIGINAL	
SPIKED SAMPLE	
SPIKE ADDED	
% RECOVERY	NA
QC CHECK	
FOUND	
TRUE	
% RECOVERY	
BLANK	< 2

RPD = RELATIVE PERCENT DIFFERENCE.
NA = NOT APPLICABLE OR NOT AVAILABLE.
NC = NOT CALCULABLE DUE TO ONE OR MORE VALUES BEING BELOW THE DETECTION LIMIT.
OR = RECOVERY NOT CALCULABLE DUE TO SPIKE SAMPLE OUT OF RANGE OR SPIKE TO LOW RELATIVE TO SAMPLE CONCENTRATION.

SUBMITTED BY:

Steven Lazoff
Laboratory Director

AQUATIC RESEARCH INCORPORATED

SOP NUMBER: 7-2 PAGE 7 of 29
Revision Date: 01/11/96
Revision Number: 1.2

3927 Aurora Ave. N. ■ Seattle, WA 98103 ■ (206) 632-2715

MICROBIOL WORKSHEET

PAGE 1 OF 1

CLIENT/PROJECT: Herrera / Thornton
DATE RECEIVED: 12/21/05 ANALYST: SL CFN: HM071-53

PARAMETER: Fecal METHOD: MF
MEDIA: MFC INCUBATION : TEMP IN: 44.5 TEMP OUT: 44.5
Media LOT #: 427194
NOTES:

SAMPLE DATA

	SAMPLE ID	COLLECTION DATE	COLLECTION TIME	LABORATORY REC'D	FILT	DILUTION/VOLUME FILTERED 21	1	10	.5	5	C/100ml 50	RESULT
1	TCN64-2	12/21/05	655	1500		0	2	21				~~2100~~ GD CG
2	" -3			12/21/05		0	7	90				900
3	TC540-2					1	13	87				870
4	-3					2	5	57				570
5	TCN53-2					0	5	108				1080
6	" -3					4	8	101				1010
7	TC541-2					0	8	140				1400
8	-3					2	7	148				1480
9	TCM46-2					0	12	THTC				1200
10	-3					3	13	THTC				1300
11	MBS-2								0	1	21	42
12	" -3								2	10	THTC	200
13	MBN-2								1	21	THTC	420
14	" -3								2	7	THTC	140
14 Dup	" -3 Dup		1130						0	8	THTC	160
									~~0~~			
	Blank										0	<1

CALCULATIONS

ACCEPTABLE LIMITS: TOTAL COLIFORM (20-80 COLONIES) FECAL COLIFORM (20-60 COLONIES)

1) Colony counts within limits.
2) All counts below limits, use either most acceptable count or assume 1 colony for the largest filtration volume, report as either ESTIMATED or LESS THAN (<).
3) All counts above limits, use upper limit count (60 or 80) and the smallest sample volume filtered and report as GREATER THAN (>)

$$\text{COLONIES / 100 ml} = \frac{\text{COLONIES COUNTED}}{} \times 100$$

HER071-56

Aquatic Research Incorporated

3927 Aurora Ave. N / Seattle, WA 98103 / (206) 632-2715

CHAIN-OF-CUSTODY RECORD

CLIENT: Herrera

SAMPLING DATE: December 20, 2005

SAMPLERS: M. Cawrse

SHEET 1 OF 1

PROJECT ID:

CASE FILE NO.:

DATA RECORDED BY:

SAMPLE INFORMATION

PARAMETERS

surface water

SAMPLE ID	DATE/TIME COLLECTED	Fecal Coliform	to IEH for analysis 3 colonies / sample	BOTT #	NOTES
TCN04-122005-1	12/20/05 0645	✓	✓		
TCS40-122005-1	12/20/05 0635	✓	✓		
TCN33-122005-1	12/20/05 0705	✓	✓		
TCS41-122005-1	12/20/05 0710	✓	✓		
TCM46-122005-1	12/20/05 0735	✓	✓		
QMBS-122005-1	12/20/05 0740	✓	✓		
MBN-122005-1	12/20/05 0755	✓	✓		
lake water					

	Relinquished By	Date/Time	Received By	Date/Time
Printed Name	Michael Cawrse	12-20-05 12:00	S Nielson	12/20/05
Signature	[signature]		[signature]	1200
Affiliation	Herrera		ARI	

	Relinquished By	Date/Time	Received By	Date/Time
Printed Name				
Signature				
Affiliation				

Miscellaneous Notes (Hazardous Materials, Quick turn around time, etc.): Filter volumes for lake samples 0.5, 5, 50 mL
Filter volumes for surface water 0.1, 1.0, 10 mL

HRO71-50

Aquatic Research Incorporated

3927 Aurora Ave. N / Seattle, WA 98103 / (206) 632-2715

CHAIN-OF-CUSTODY RECORD

CLIENT: Herrera
SAMPLING DATE: Dec 21, ~~2004~~ 2005
SAMPLERS: M. Cawrse

SHEET 1 OF 1
PROJECT ID: Thornton MST
CASE FILE NO.:
DATA RECORDED BY:

SAMPLE INFORMATION

PARAMETERS

SAMPLE ID	DATE/TIME COLLECTED	Feed solution bacteria	to FEH for rototy filing of 3 colonies	BOTT #	NOTES
Surfacewater Samples					
TCN64-122105-2	12-21-05 0655	X	X		
-3	~~0700~~ 1030				
TCS40-122105-2	0705				
-3	1035				
TCN33-122105-2	0720				
-3	1045				
TCS41-122105-2	0725				
-3	1055				
TCM46-122105-2	0735				
-3*	1115				
MBS-122105-2	0740				
-3	1120				
MBN-122105-2	0750				
-3	1130				
lake Samples					

	Relinquished By	Date/Time	Received By	Date/Time
Printed Name	Michael Cawrse	12-21-05 1230	Jamieen Gadomski	12/21/05 12:30
Signature	[signature]		[signature]	
Affiliation	Herrera		ARI	

	Relinquished By	Date/Time	Received By	Date/Time
Printed Name				
Signature				
Affiliation				

Miscellaneous Notes (Hazardous Materials, Quick turn-around time, etc.): filter volumes for lake samples = 0.5 mL, 5 mL, + 50 mL
filter volumes for surface water samples = 0.1 mL, 1.0 mL, + 10 mL
* in Dolphin water bottle

MOLECULAR EPIDEMIOLOGY, INC.

a division of IEH Laboratories & Consulting Group

Rob Zisette/ Mike Cawrse
Herrera Environmental Consultants
2200 Sixth Ave., Suite 1100
Seattle, WA 98121

March 10, 2006

Dear Mike/Rob,

Enclosed are the results for Sediment samples collected at Thornton Creek/ Matthews Beach in September, 2005.

Samples were processed for Fecal Coliform counts and Microbial Source Tracking (MST). MST results will be sent separately. Sediment samples were processed by the Multiple Tube Fermentation Test method (Standard Methods 9221B & C). All controls performed as expected, there were no anomalies reported.

Sample ID	MPN/ 1 gm	95% C.I.
TCM46-090705-1S	1300	500-3900
TCM46-090705-2S	500	200-1700
TCM46-090705-3S	330	150-770
MBS-090705-1S	17	7-48
MBS-090705-2S	50	20-200
MBS-090705-3S	50	20-200
MBN-090705-1S	5	2-17
MBN-090705-2S	11	0.4-30
MBN-090705-2S	3	0.1-12

Sincerely,

Gregory Ma, SM(AAM), MSPH
Senior Scientist & Director General Microbiology
Molecular Epidemiology, Inc.
15300 Bothell Way NE
Lake Forest Park, WA 98155

Office (206) 306-8882
Fax (206) 306-8883
Mobile
Email
www.molecularepi.com

HERRERA ENVIRONMENTAL CONSULTANTS
2200 Sixth Avenue, Suite 1100
Seattle, Washington 98121
(206) 441-9080
FAX (206) 441-9108

CHAIN OF CUSTODY RECORD

PROJECT NAME:	PROJECT NUMBER:	CLIENT:
Thornton/Matthews MST	01-01948-280	SPU

REPORT TO: Rob Zisette
COPY TO:
SAMPLED BY: Mike Cawrse
DELIVERY METHOD: hand
LABORATORY: Institute for Environmental Health
REQUESTED COMPLETION DATE: standard
TOTAL # OF CONTAINERS: 9
LAB USE:

ANALYSES REQUESTED

SAMPLE ID:	DATE:	TIME:	SAMPLE DESCRIPTION	# OF CONTAINERS:	fecal coliform bacteria by MPN	ribotyping of 5 isolates per sample
TCM46-090705-1S	9/7/05	1050	creek sediment	1	X	X
TCM46-090705-2S	9/7/05	1057	creek sediment	1	X	X
TCM46-090705-3S	9/7/05	1105	creek sediment	1	X	X
MBS-090705-1S	9/7/05	1125	lakeshore sediment	1	X	X
MBS-090705-2S	9/7/05	1132	lakeshore sediment	1	X	X
MBS-090705-3S	9/7/05	1137	lakeshore sediment	1	X	X
MBN-090705-1S	9/7/05	1155	lakeshore sediment	1	X	X
MBN-090705-2S	9/7/05	1200	lakeshore sediment	1	X	X
MBN-090705-3S	9/7/05	1205	lakeshore sediment	1	X	X

REMARKS: Please ribotype 5 isolates per sample

RELINQUISHED BY (NAME/CO.):	SIGNATURE:	DATE/TIME:	RECEIVED BY (NAME/CO.):	SIGNATURE:	DATE/TIME:
Michael Cawrse/Herrera	[signature]	9-7-05 1230	Gregory Ma	[signature]	8/7/05 1230pm
RELINQUISHED BY (NAME/CO.):	SIGNATURE:	DATE/TIME:	RECEIVED BY (NAME/CO.):	SIGNATURE:	DATE/TIME:

Ozark Underground Laboratory for Herrera Environmental Consultants

Project: Thornton MST - Project Number: 01-01948-280
Samples Collected By: Michael Cawrse
Date Samples shipped: August 1, 2005
Date Samples Rec'd at OUL: August 2, 2005
Date Analyzed by OUL: August 3, 2005

Table 1. Results for cotton samplers analyzed for the presence of optical brighteners.

OUL Lab #	Side	Sample ID	Date Placed	Date Collected 2005	Peak (nm)	Hgt of Peak on 16X Ordinate Scale	Result
Z0948	A	TCS40-020105	2/1 1605	2/3 1425	--	--	ND
Z0948	B	TCS40-020105	2/1 1605	2/3 1425	--	--	ND
Z0949	A	WC1-041905	4/19 NT	4/29 NT	--	--	ND
Z0949	B	WC1-041905	4/19 NT	4/29 NT	--	--	ND
Z0950	A	TCS41-062905	6/29 NT	7/11 NT	--	--	ND
Z0950	B	TCS41-062905	6/29 NT	7/11 NT	--	--	ND
Z0951	A	Laboratory Control Cotton Blank analyzed 8/3/2005			--	--	ND
Z0951	B	Laboratory Control Cotton Blank analyzed 8/3/2005			--	--	ND

Footnotes:

ND = None detected

NT = No time given

HERRERA ENVIRONMENTAL CONSULTANTS
2200 Sixth Avenue, Suite 1100
Seattle, Washington 98121
(206) 441-9080
FAX (206) 441-9108

CHAIN OF CUSTODY RECORD

PROJECT NAME: Thornton MST	PROJECT NUMBER: 01-01948-280	CLIENT:
REPORT TO: Rob Zisette		COPY TO:
SAMPLED BY: Michael Cawrse		DELIVERY METHOD: Fedex
LABORATORY: Ozark Underground Laboratory, Inc	REQUESTED COMPLETION DATE: standard	TOTAL # OF CONTAINERS: 3
LAB USE:		

ANALYSES REQUESTED

SAMPLE ID:	DATE:	TIME:	SAMPLE DESCRIPTION	# OF CONTAINERS:	optical brightener analysis	# of Cotton Pad by OUL		Date placed MR	Time placed MR	Date Collected MR	Time Collected MR				OUL Lab #'s					
TCS40-020105	2-3-05		optical brightener pad	1	X	1		2/1	1605	2/3	1425			Z	0	9	4	8		
WC1-041905	4-29-05		optical brightener pad	1	X	1		4/19		4/29				Z	0	9	4	9		
TCS41-062905	7-11-05		optical brightener pad	1	X	1		6/29		7/11				Z	0	9	5	0		
			OUL Cotton Blank											Z	0	9	5	1		

REMARKS: Analyzed 8/3/05 by MR

Charts for samples on this page proofed by Marty/OUL

RELINQUISHED BY (NAME/CO.):	SIGNATURE:	DATE/TIME:	RECEIVED BY (NAME/CO.):	SIGNATURE:	DATE/TIME:
Michael Cawrse/Herrera	Michael Cawrse	8-1-05 1520	J. Arnold/OUL	[illegible]	8/2/05 1250
RELINQUISHED BY (NAME/CO.):	SIGNATURE:	DATE/TIME:	RECEIVED BY (NAME/CO.):	SIGNATURE:	DATE/TIME:

OUL 1 of 1

mc /document2

OZARK UNDERGROUND LABORATORY, INC.

DISCREPANCIES BETWEEN CHAIN-OF-CUSTODY SHEETS AND ACTUAL SAMPLES RECEIVED Page 1 of 1

Company & Project Name: Herrera/Thornton MST **Date Rec'd by OUL:** 8/2/05 **Wk #** _____

Lab #	Sta #	Station Name	Date Pulled	Problem	Solution

Comments: Date & Time placed & Time Collected taken from information written on Ziploc bags MR OUL also added these dates & times to COC.

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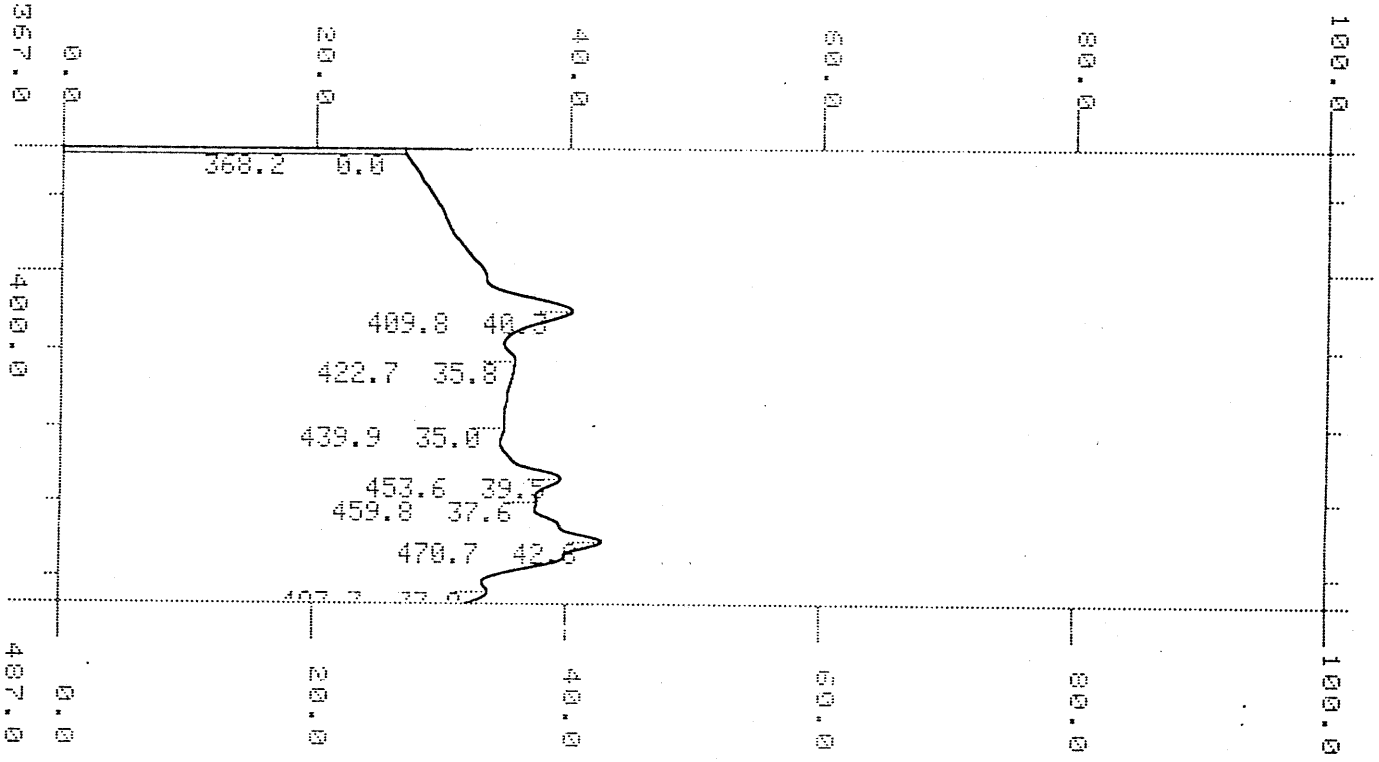
rev. 12/28/99

Herrera Environmental Consultants
Thornton MST
OUL # Z0948 Side: A
Station Name: TCS40-020105
Date/Time Placed: 2/01/2005 1605
Date/Time Recovered: 2/03/2005 1425
Date Analyzed: 8/03/2005



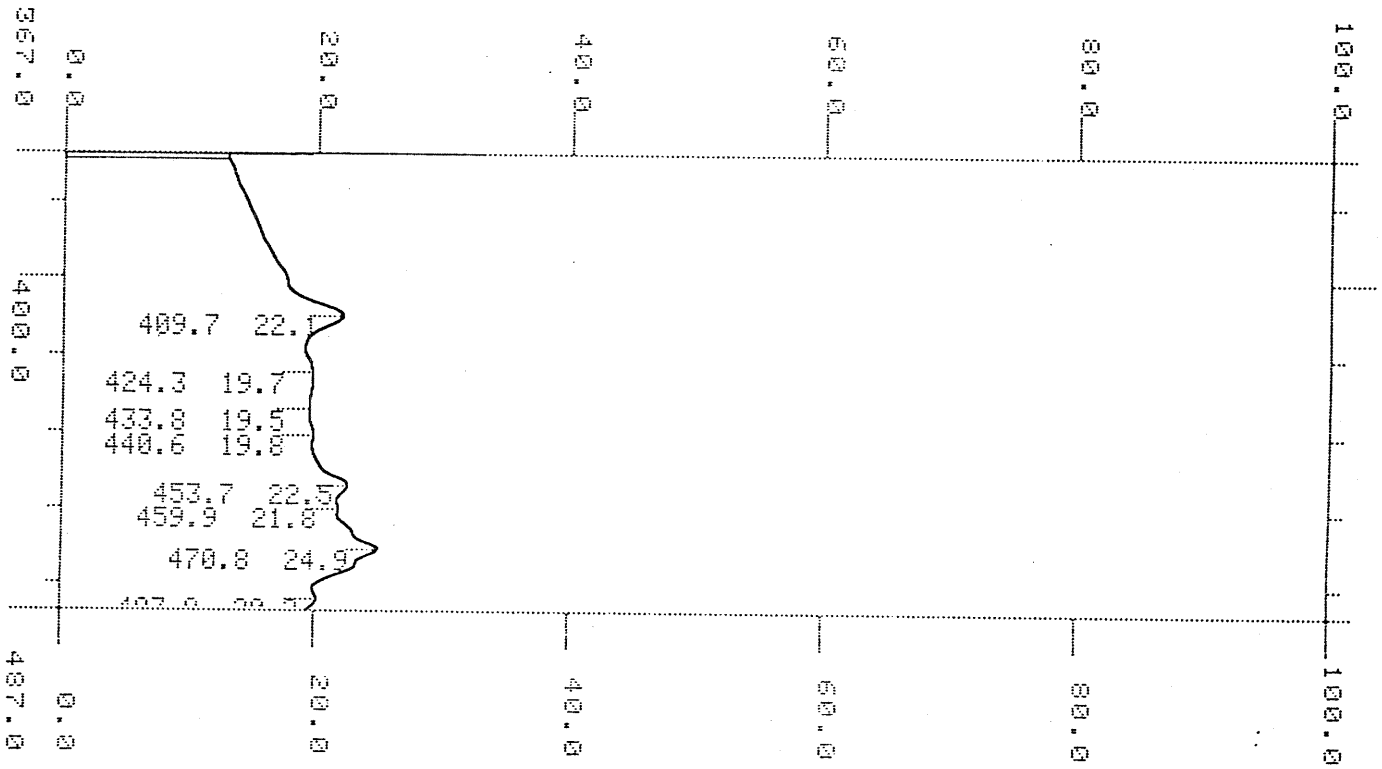
LIST OF PARAMETER

ABSCISSA SCALE	X4	ORDINATE SCALE	X16
SCAN SPEED	VERY FAST	SENSITIVITY	HIGH
EXCITATION SLIT(NM)	5	EMISSION SLIT(NM)	2
EXCITATION WAVELENGTH	470.0	EMISSION WAVELENGTH	487.0
EXCITATION START WAVELENGTH	350.0	EXCITATION END WAVELENGTH	470.0
EMISSION START WAVELENGTH	367.0	EMISSION END WAVELENGTH	487.0

CORPORATION CHART 200-91527
SHIMADZU COR

RATION CHART 200-91527

Herrerra Environmental Consultants
Thornton MST
OUL # Z0948 Side: B
Station Name: TCS40-020105
Date/Time Placed: 2/01/2005 1605
Date/Time Recovered: 2/03/2005 1425
Date Analyzed: 8/03/2005



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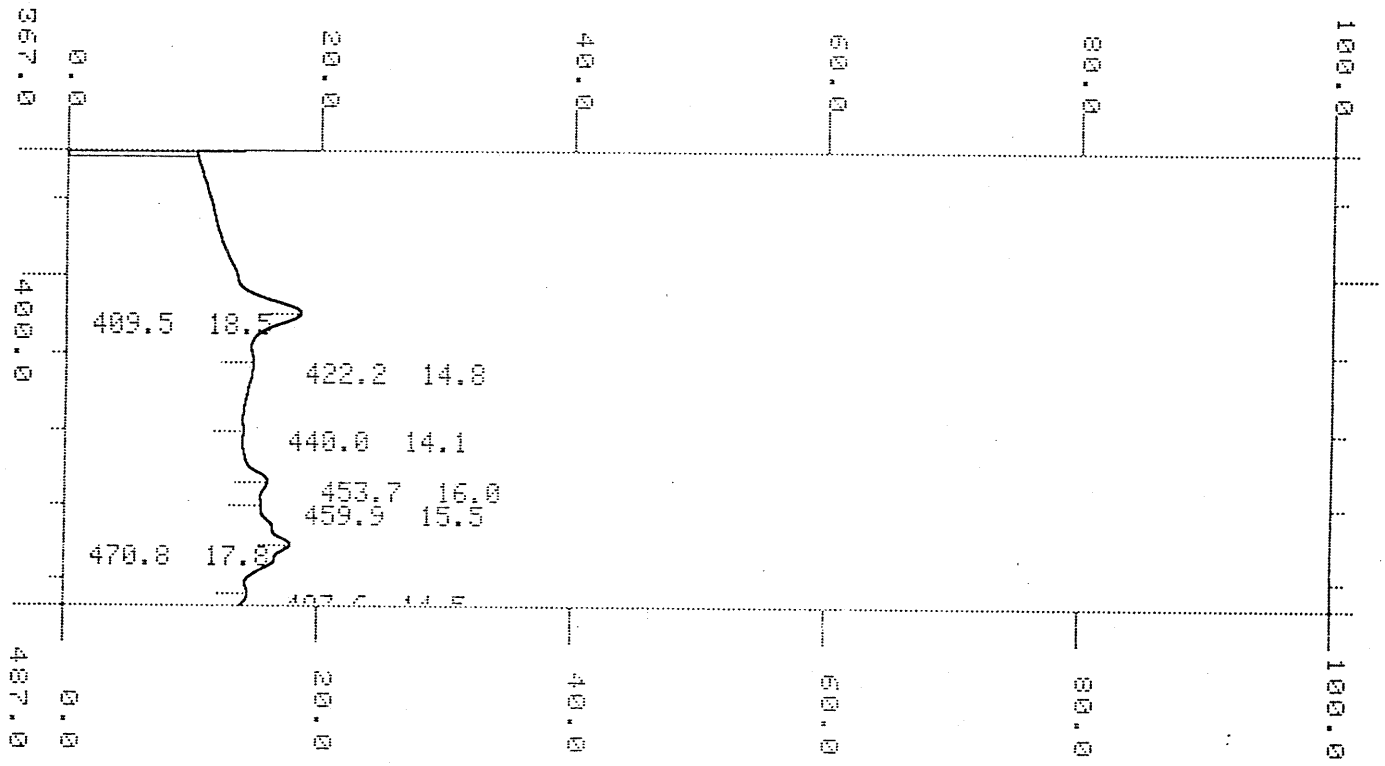
EMISSION START WAVELENGTH	367.0	EMISSION END WAVELENGTH	487.0

⊕ SHIMADZU CORPORATI

Herrera Environmental Consultants
Thornton MST
OUL # Z0949 Side: A
Station Name: WC1-041905
Date/Time Placed: 4/19/2005 NT
Date/Time Recovered: 4/29/2005 NT
Date Analyzed: 8/03/2005



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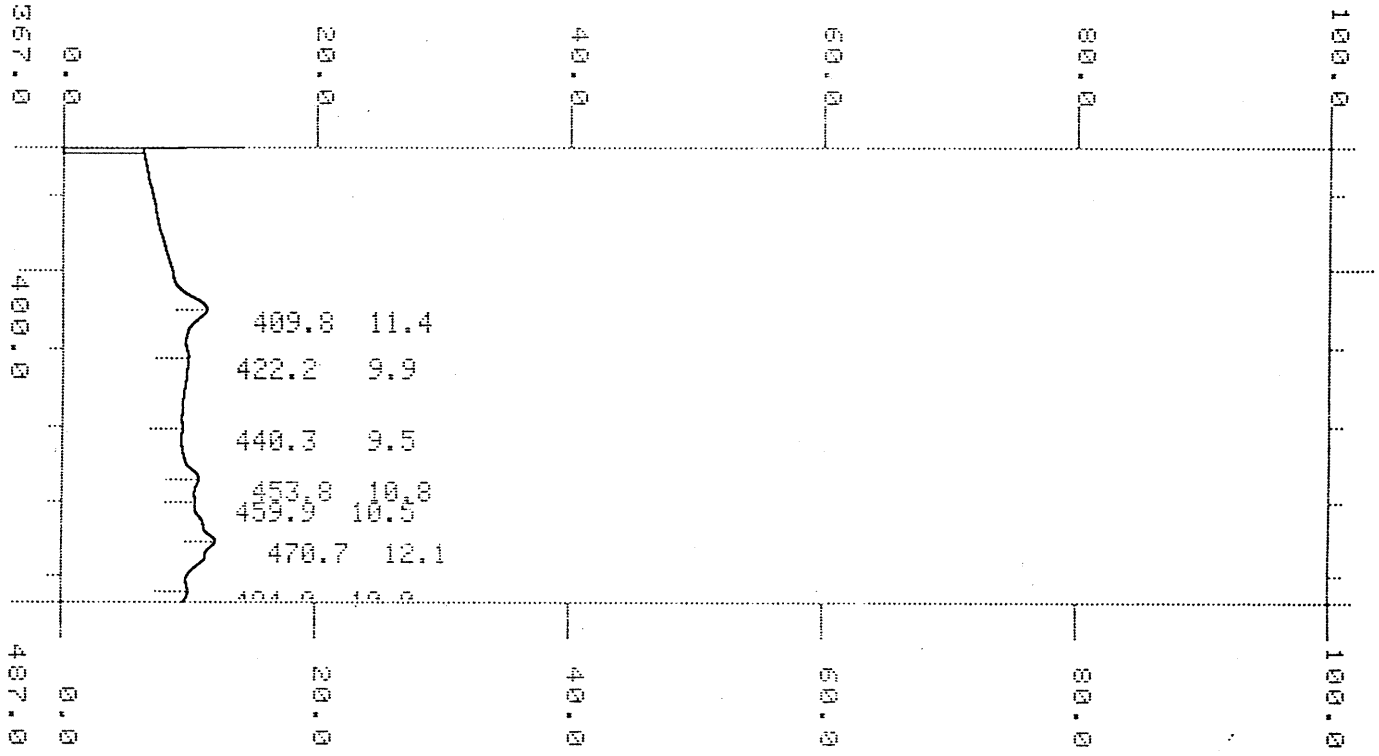
EMISSION START WAVELENGTH	367.0	EMISSION END WAVELENGTH	487.0

'N CHART 200-91527
⊕ SHIMADZU CORPORATION

Herrera Environmental Consultants
Thornton MST
OUL # Z0949 Side: B
Station Name: WC1-041905
Date/Time Placed: 4/19/2005 NT
Date/Time Recovered: 4/29/2005 NT
Date Analyzed: 8/03/2005



LIST OF PARAMETER

ABSCISSA SCALE	X4	ORDINATE SCALE	X16
SCAN SPEED	VERY FAST	SENSITIVITY	HIGH
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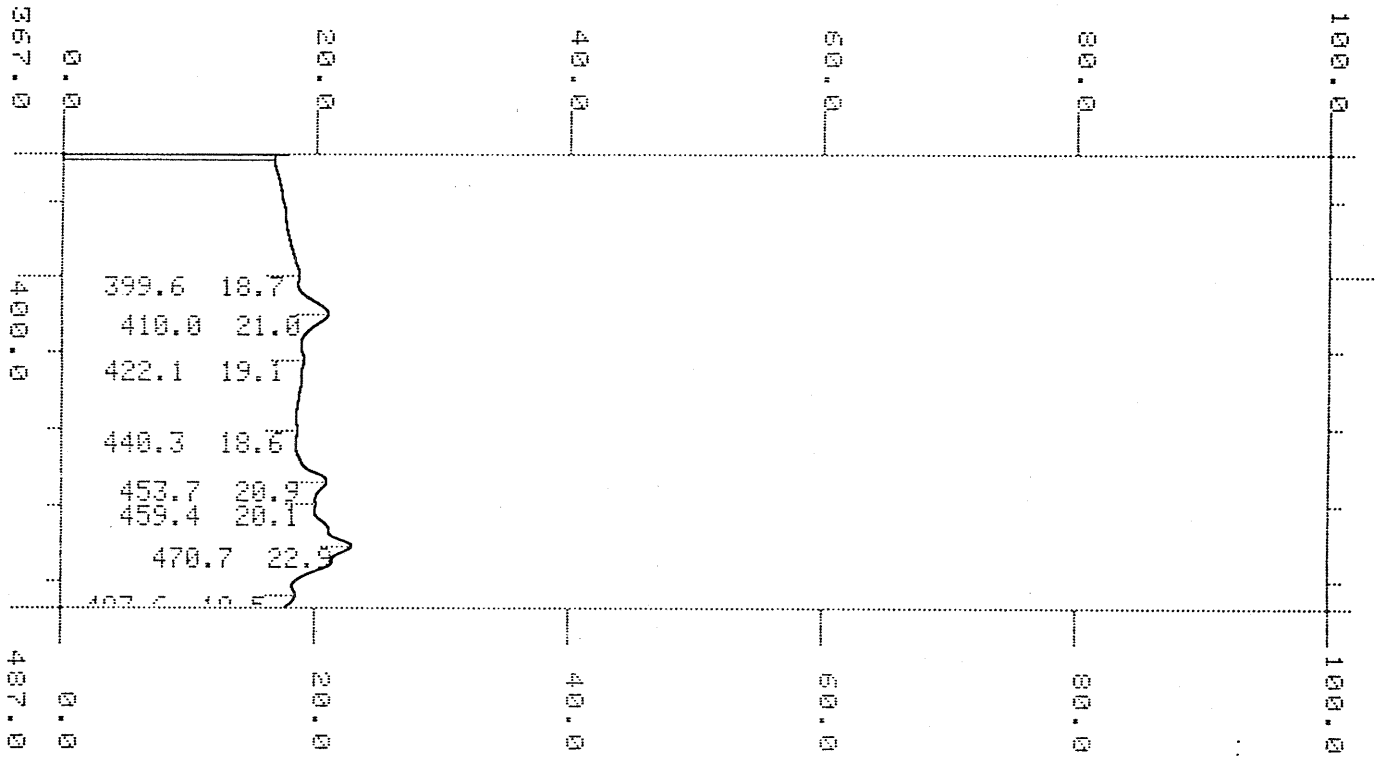
EXCITATION START WAVELENGTH	350.0	EXCITATION END WAVELENGTH	470.0
EMISSION START WAVELENGTH	367.0	EMISSION END WAVELENGTH	487.0

HART 200-91527
SHIMADZU CORPORATION CHAR

Herrera Environmental Consultants
Thornton MST
OUL # Z0950 Side: A
Station Name: TCS41-062905
Date/Time Placed: 6/29/2005 NT
Date/Time Recovered: 7/11/2005 NT
Date Analyzed: 8/03/2005



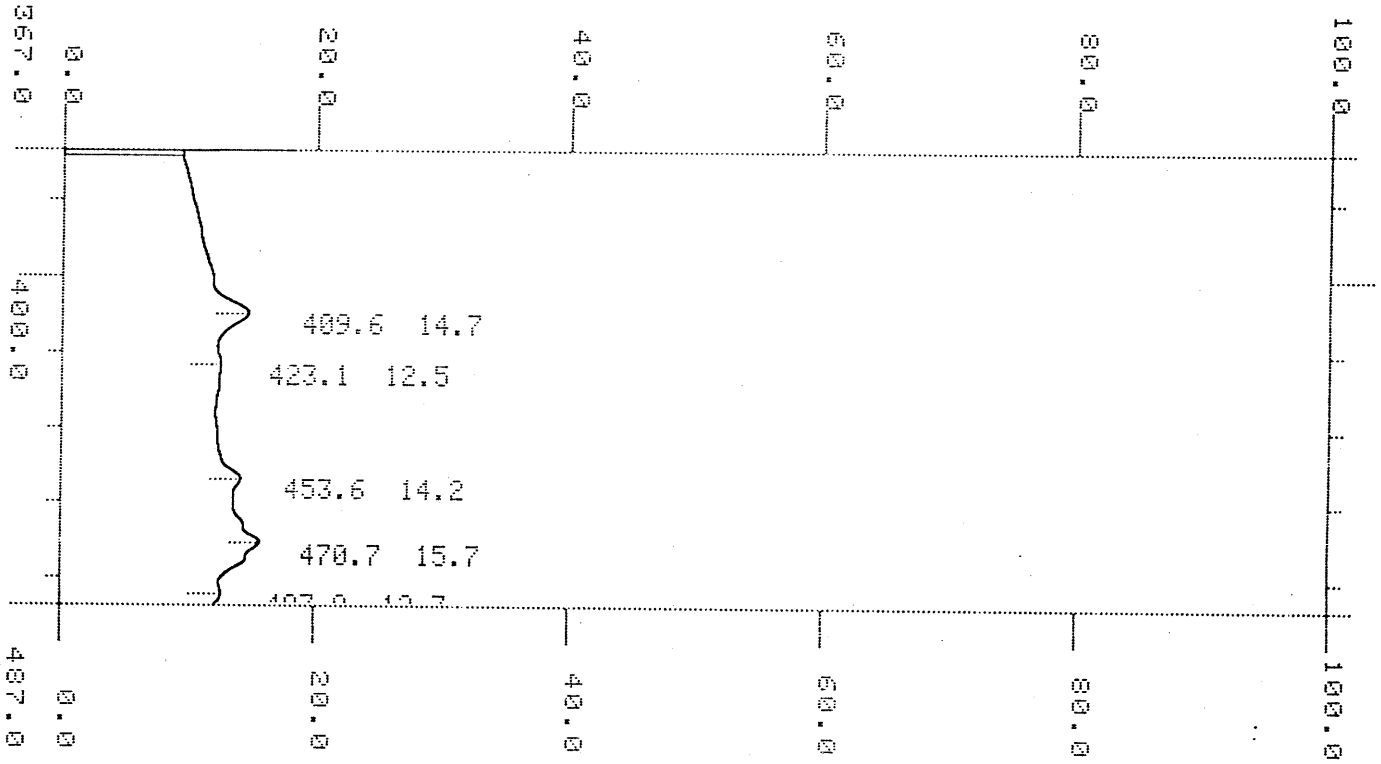
LIST OF PARAMETER

ABSCISSA SCALE	X4	ORDINATE SCALE	X16
SCAN SPEED	VERY FAST	SENSITIVITY	HIGH
EXCITATION SLIT(NM)	5	EMISSION SLIT(NM)	2
EXCITATION WAVELENGTH	470.0	EMISSION WAVELENGTH	487.0
EXCITATION START WAVELENGTH	350.0	EXCITATION END WAVELENGTH	470.0
EMISSION START WAVELENGTH	367.0	EMISSION END WAVELENGTH	487.0

200-91527

SHIMADZU CORPORATION CHART 20

Herrera Environmental Consultants
Thornton MST
OUL # Z0950 Side: B
Station Name: TCS41-062905
Date/Time Placed: 6/29/2005 NT
Date/Time Recovered: 7/11/2005 NT
Date Analyzed: 8/03/2005



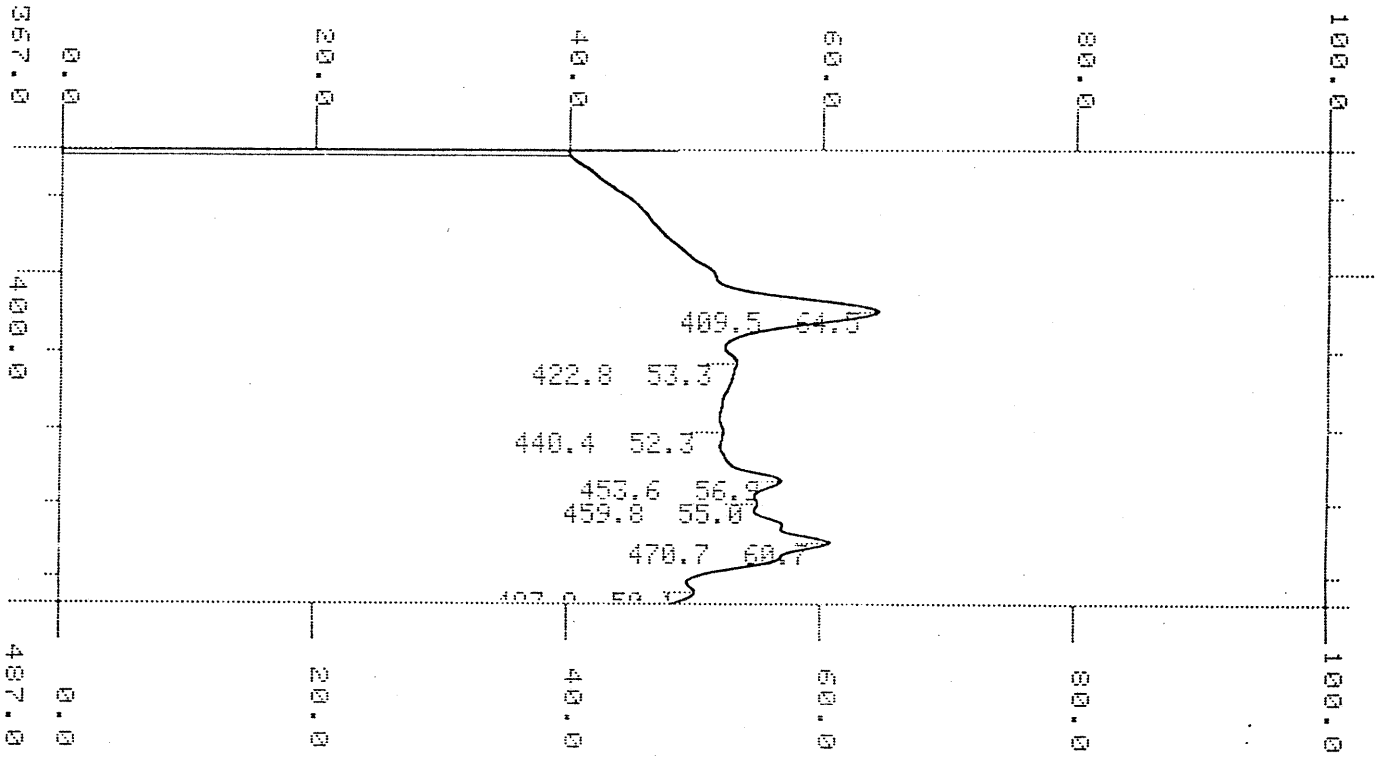
LIST OF PARAMETER

ABSCISSA SCALE	X4	ORDINATE SCALE	X16
SCAN SPEED	VERY FAST	SENSITIVITY	HIGH
EXCITATION SLIT(NM)	5	EMISSION SLIT(NM)	2
EXCITATION WAVELENGTH	470.0	EMISSION WAVELENGTH	487.0
EXCITATION START WAVELENGTH	350.0	EXCITATION END WAVELENGTH	470.0
EMISSION START WAVELENGTH	367.0	EMISSION END WAVELENGTH	487.0

'1527
SHIMADZU CORPORATION CHART 200-91527

ART 200-91527

Herrera Environmental Consultants
Thornton MST
OUL # Z0951 Side: A
Station Name: OUL Cotton Control Blank
Date Analyzed: 8/03/2005



LIST OF PARAMETER

ABSCISSA SCALE	X4	ORDINATE SCALE	X16
SCAN SPEED	VERY FAST	SENSITIVITY	HIGH
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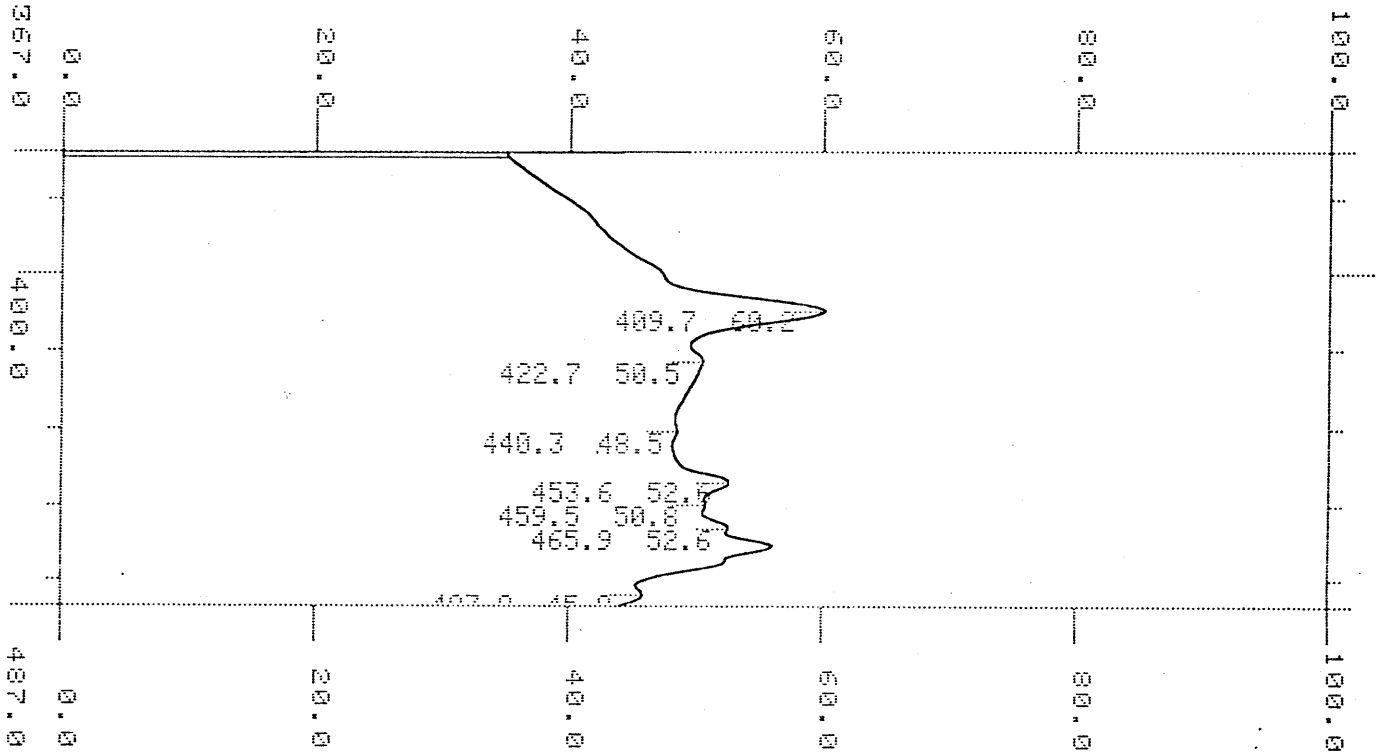
EMISSION START WAVELENGTH	367.0	EMISSION END WAVELENGTH	487.0

SHIMADZU CORPORATION CHART

Herrera Environmental Consultants
Thornton MST
OUL # Z0951 Side: B
Station Name: OUL Cotton Control Blank
Date Analyzed: 8/03/2005



LIST OF PARAMETER

ABSCISSA SCALE	X4	ORDINATE SCALE	X16
SCAN SPEED	VERY FAST	SENSITIVITY	HIGH
EXCITATION SLIT(NM)	5	EMISSION SLIT(NM)	2
EXCITATION WAVELENGTH	470.0	EMISSION WAVELENGTH	487.0
EXCITATION START WAVELENGTH	350.0	EXCITATION END WAVELENGTH	470.0
EMISSION START WAVELENGTH	367.0	EMISSION END WAVELENGTH	487.0

00-91527
SHIMADZU CORPORATION CHART 200-

Data Quality Assurance Worksheet

HERRERA ENVIRONMENTAL CONSULTANTS

Project Name/No./Client: Thornton MST/01-01943-230 / SPLA
Laboratory/Parameters: Aquatic Research, Inc / Fecal coliform
Sample Date/Sample ID: 2-1-05 thru 4-19-05 / TCN04, TCN33, TCS40, TCS41, TCM46, MBN, MBS

By: M. Caulfse
Date: 2-22-06 Page 1 of 3
Checked: initials ____ date ____

Parameter	Completeness/ Methodology	Holding Times	Blanks/ Detection Limits	Matrix Spikes/ Surrogate Recoveries	Lab Duplicates	Field Duplicates	Lab Control Samples	Instrument Calibration/ Performance	ACTION
Fecal coliform 2-1-05	ok	ok	<2 / 2	NA	MBN-020105-3 20E/13E (10.53%)	NA	NA	NA	none *
Fecal coliform 3-19-05	ok	ok	<2 / 2	NA	MBN-031905-2 300E/250E (13.13%)	NA	NA	NA	none *
Fecal coliform 3-26-05	ok	ok	<2 / 2	NA	MBN-032605-1 38E/32E (17.14%)	NA	NA	NA	none *
Fecal coliform 4-1-05	ok	ok	<2 / 2	NA	MBN-040105-2 280E/400 (35 %)	NA	NA	NA	none
Fecal coliform 4-16-05	ok	ok	<2 / 2	NA	MBN-041605-1 500/480 (4.08%)	NA	NA	NA	none *
Fecal coliform 4-19-05	ok	ok	<2 / 2	NA	TCS40-041905-3 190E/150E (23.53%)	NA	NA	NA	none *

Notes: * Analytical laboratory reported results of some samples as "estimated" because colony counts were below 20. Because this data quality procedure is not part of Herrera's [illegible] these data will not be qualified [illegible]

file: DATAQA3.XLS

Data Quality Assurance Worksheet

HERRERA ENVIRONMENTAL CONSULTANTS

By: M. Course
Date: 2-22-06
Page 2 of 3
Checked initials:
date:

Project Name/No./Client: Thornton MST / 01-01943-280 / SPU
Laboratory/Parameters: Aquatic Research / Fecal coliform
Sample Date/Sample ID: 5-18-05 through 10-25-05 / TCN64, TCN33, TCS40, TCS41, TCM46, MBN, MBS

Parameter	Completeness/ Methodology	Holding Times	Blanks/ Detection Limits	Matrix Spikes/ Surrogate Recoveries	Lab Duplicates	Field Duplicates	Lab Control Samples	Instrument Calibration/ Performance	ACTION
Fecal coliform 5-13-05	ok	ok	<2 / 2	NA	MBN-051305-3 2480G/2320G (6.67%)	NA	NA	NA	none *
Fecal coliform 6-29-05	ok	ok	<2 / 2	NA	MBN-062905-3 660/520 (23.73%)	NA	NA	NA	none
Fecal coliform 8-16-05	ok	ok	<2 / 2	NA	MBN-081605-3 52/64 (20.69%)	NA	NA	NA	none
Fecal coliform 10-2-05	ok	ok	<2 / 2	NA	MBN-100205-3 28/24 (15.38%)	NA	NA	NA	none +
Fecal coliform 10-25-05	ok	ok	<2 / 2	NA	MBN-102505-3 86/76 (12.35%)	NA	NA	NA	none
Fecal coliform 10-28-05	ok	ok	<2 / 2	NA	MBN-102805-1 34/30 (12.50%)	NA	NA	NA	none

Notes: * [illegible]
+ reported value flagged as qualitative (TNTC) value because colonies were too numerous to count (TNTC)

file: DATAQA3.XLS

Data Quality Assurance Worksheet

HERRERA ENVIRONMENTAL CONSULTANTS

By: M. Cowise
Date: 2-22-06
Page 3 of 3
Checked: initials ____ date ____

Project Name/No./Client: Thornton MST / 01-01948-280 / SPU
Laboratory/Parameters: Aquatic Research Inc / Fecal coliform
Sample Date/Sample ID: 10-31-05 through 12-21-05 / TC4GN, TC4J3, TC5H0, TC5H1, TC4H6, MBS, MBN

Parameter	Completeness/ Methodology	Holding Times	Blanks/ Detection Limits	Matrix Spikes/ Surrogate Recoveries	Lab Duplicates	Field Duplicates	Lab Control Samples	Instrument Calibration/ Performance	ACTION
Fecal coliform 10-31-05	ok	ok	<2 / 2	NA	MBN-103105-2 240/220 (8.70%)	NA	NA	NA	none
Fecal coliform 11-1-05	ok	ok	<2 / 2	NA	MBN-110105-3 20/18 (10.53%)	NA	NA	NA	none *
Fecal coliform 11-21-05	ok	ok	<2 / 2	NA	MBN-112105-3 55/40 (22.22%)	NA	NA	NA	none
Fecal coliform 12-20-05	ok	ok	<2 / 2	NA	MBN-122005-1 8/17 (RD=7) +	NA	NA	NA	none
Fecal coliform 12-21-05	ok	ok	<2 / 2	NA	MBN-122105-3 140/160 (13.33%)	NA	NA	NA	none
Fecal coliform Sediment 9-7-05	ok	ok		NA		NA	NA	NA	

Notes: + Relative difference calculated due to values < 5 times detection limit
* see note previous page regarding values reported as greater than (>).

file: DATAQA3.XLS

APPENDIX B

Project Database

Station	Date	Time	season	event type	Sample ID	result	comment
MBN	6/29/2005	12:25	summer	base	MBN-062905-1	380	
MBN	6/29/2005	12:30	summer	base	MBN-062905-2	460	
MBN	6/29/2005	12:35	summer	base	MBN-062905-3	660	
MBN	8/16/2005	11:30	summer	base	MBN-081605-1	42	
MBN	8/16/2005	11:35	summer	base	MBN-081605-2	48	
MBN	8/16/2005	11:40	summer	base	MBN-081605-3	52	
MBN	10/25/2005	14:20	summer	base	MBN-102505-1	134	
MBN	10/25/2005	14:25	summer	base	MBN-102505-2	150	
MBN	10/25/2005	14:30	summer	base	MBN-102505-3	86	
MBN	9/7/2005	11:55	summer	sediment	MBN-090705-1S	5	
MBN	9/7/2005	12:00	summer	sediment	MBN-090705-1S	11	
MBN	9/7/2005	12:05	summer	sediment	MBN-090705-1S	3	
MBN	5/18/2005	8:02	summer	storm	MBN-051805-1	240	
MBN	5/18/2005	9:20	summer	storm	MBN-051805-2	1540	
MBN	5/18/2005	9:25	summer	storm	MBN-051805-3	2480	
MBN	10/2/2005	14:15	summer	storm	MBN-100205-1	36	
MBN	10/2/2005	15:55	summer	storm	MBN-100205-2	46	
MBN	10/2/2005	16:00	summer	storm	MBN-100205-3	28	
MBN	2/1/2005	9:50	winter	base	MBN-020105-1	28	
MBN	2/1/2005	9:55	winter	base	MBN-020105-2	26	
MBN	2/1/2005	10:00	winter	base	MBN-020105-3	20	
MBN	4/19/2005	12:45	winter	base	MBN-041905-1	44	
MBN	4/19/2005	12:50	winter	base	MBN-041905-2	26	
MBN	4/19/2005	12:55	winter	base	MBN-041905-3	92	
MBN	11/21/2005	10:20	winter	base	MBN-112105-1	72	
MBN	11/21/2005	10:25	winter	base	MBN-112105-2	74	
MBN	11/21/2005	10:30	winter	base	MBN-112105-3	50	
MBN	3/19/2005	18:03	winter	storm	MBN-031905-1	250	
MBN	3/19/2005	19:10	winter	storm	MBN-031905-2	300	
MBN	3/26/2005	12:47	winter	storm	MBN-032605-1	38	
MBN	4/1/2005	5:25	winter	storm	MBN-040105-1	400	
MBN	4/1/2005	6:45	winter	storm	MBN-040105-2	280	
MBN	4/16/2005	9:30	winter	storm	MBN-041605-1	500	
MBN	10/28/2005	4:40	winter	storm	MBN-102805-1	34	
MBN	10/31/2005	6:05	winter	storm	MBN-103105-2	240	
MBN	11/1/2005	8:40	winter	storm	MBN-110105-3	20	
MBN	12/20/2005	9:55	winter	storm	MBN-122005-1	8	
MBN	12/21/2005	7:50	winter	storm	MBN-122105-2	420	
MBN	12/21/2005	11:30	winter	storm	MBN-122105-3	140	
MBP	10/25/2005	14:45	summer	base	MBP-102505-1		
MBP	11/21/2005	10:35	winter	base	MBP-112105-1		
MBS	6/29/2005	12:10	summer	base	MBS-062905-1	42	
MBS	6/29/2005	12:15	summer	base	MBS-062905-2	50	
MBS	6/29/2005	12:20	summer	base	MBS-062905-3	66	
MBS	8/16/2005	11:06	summer	base	MBS-081605-1	32	
MBS	8/16/2005	11:11	summer	base	MBS-081605-2	10	
MBS	8/16/2005	11:17	summer	base	MBS-081605-3	10	
MBS	10/25/2005	14:05	summer	base	MBS-102505-1	48	
MBS	10/25/2005	14:10	summer	base	MBS-102505-2	78	
MBS	10/25/2005	14:15	summer	base	MBS-102505-3	72	

Station	Date	Time	season	event type	Sample ID	result	comment
MBS	9/7/2005	11:25	summer	sediment	MBS-090705-1S	17	
MBS	9/7/2005	11:32	summer	sediment	MBS-090705-2S	50	
MBS	9/7/2005	11:37	summer	sediment	MBS-090705-3S	50	
MBS	5/18/2005	7:50	summer	storm	MBS-051805-1	720	
MBS	5/18/2005	9:40	summer	storm	MBS-051805-2	1600	
MBS	5/18/2005	9:45	summer	storm	MBS-051805-3	1520	
MBS	10/2/2005	14:05	summer	storm	MBS-100205-1	226	
MBS	10/2/2005	15:40	summer	storm	MBS-100205-2	352	
MBS	10/2/2005	15:45	summer	storm	MBS-100205-3	1340	
MBS	2/1/2005	9:35	winter	base	MBS-020105-1	8	
MBS	2/1/2005	9:40	winter	base	MBS-020105-2	16	
MBS	2/1/2005	9:45	winter	base	MBS-020105-3	22	
MBS	4/19/2005	12:30	winter	base	MBS-041905-1	14	
MBS	4/19/2005	12:35	winter	base	MBS-041905-2	20	
MBS	4/19/2005	12:40	winter	base	MBS-041905-3	28	
MBS	11/21/2005	10:05	winter	base	MBS-112105-1	20	
MBS	11/21/2005	10:10	winter	base	MBS-112105-2	110	
MBS	11/21/2005	10:15	winter	base	MBS-112105-3	120	
MBS	3/19/2005	17:55	winter	storm	MBS-031905-1	150	
MBS	3/19/2005	18:58	winter	storm	MBS-031905-2	600	
MBS	3/26/2005	12:35	winter	storm	MBS-032605-1	8	
MBS	4/1/2005	5:15	winter	storm	MBS-040105-1	320	
MBS	4/1/2005	6:35	winter	storm	MBS-040105-2	740	
MBS	4/16/2005	9:15	winter	storm	MBS-041605-1	140	
MBS	10/28/2005	4:35	winter	storm	MBS-102805-1	168	
MBS	10/31/2005	5:55	winter	storm	MBS-103105-2	480	
MBS	11/1/2005	8:20	winter	storm	MBS-110105-3	920	
MBS	12/20/2005	9:40	winter	storm	MBS-122005-1	34	
MBS	12/21/2005	7:40	winter	storm	MBS-122105-2	42	
MBS	12/21/2005	11:20	winter	storm	MBS-122105-3	200	
TCM46	6/29/2005	11:55	summer	base	TCM46-062905-1	280	
TCM46	6/29/2005	12:00	summer	base	TCM46-062905-2	1040	
TCM46	6/29/2005	12:05	summer	base	TCM46-062905-3	1140	
TCM46	8/16/2005	10:45	summer	base	TCM46-081605-1	1440	
TCM46	8/16/2005	10:50	summer	base	TCM46-081605-2	1260	
TCM46	8/16/2005	10:55	summer	base	TCM46-081605-3	1260	
TCM46	10/25/2005	13:50	summer	base	TCM46-102505-1	620	
TCM46	10/25/2005	13:55	summer	base	TCM46-102505-2	600	
TCM46	10/25/2005	14:00	summer	base	TCM46-102505-3	580	
TCM46	9/7/2005	10:50	summer	sediment	TCM46-090705-1S	1300	
TCM46	9/7/2005	10:57	summer	sediment	TCM46-090705-2S	500	
TCM46	9/7/2005	11:05	summer	sediment	TCM46-090705-3S	330	
TCM46	5/18/2005	7:47	summer	storm	TCM46-051805-1	4700	
TCM46	5/18/2005	9:30	summer	storm	TCM46-051805-2	4500	
TCM46	5/18/2005	9:35	summer	storm	TCM46-051805-3	5700	
TCM46	10/2/2005	14:00	summer	storm	TCM46-100205-1	3040	
TCM46	10/2/2005	15:30	summer	storm	TCM46-100205-2	3920	
TCM46	10/2/2005	15:35	summer	storm	TCM46-100205-3	3880	
TCM46	2/1/2005	9:22	winter	base	TCM46-020105-1	134	
TCM46	2/1/2005	9:27	winter	base	TCM46-020105-2	240	

Station	Date	Time	season	event type	Sample ID	result	comment
TCM46	2/1/2005	9:32	winter	base	TCM46-020105-3	138	
TCM46	4/19/2005	12:15	winter	base	TCM46-041905-1	60	
TCM46	4/19/2005	12:20	winter	base	TCM46-041905-2	50	
TCM46	4/19/2005	12:25	winter	base	TCM46-041905-3	130	
TCM46	11/21/2005	9:50	winter	base	TCM46-112105-1	268	
TCM46	11/21/2005	9:55	winter	base	TCM46-112105-2	264	
TCM46	11/21/2005	10:00	winter	base	TCM46-112105-3	356	
TCM46	3/19/2005	17:34	winter	storm	TCM46-031905-1	1350	
TCM46	3/19/2005	19:05	winter	storm	TCM46-031905-2	2600	
TCM46	3/26/2005	12:28	winter	storm	TCM46-032605-1	2000	
TCM46	4/1/2005	5:08	winter	storm	TCM46-040105-1	500	
TCM46	4/1/2005	6:25	winter	storm	TCM46-040105-2	700	
TCM46	4/16/2005	9:08	winter	storm	TCM46-041605-1	14000	
TCM46	10/28/2005	4:30	winter	storm	TCM46-102805-1	4400	
TCM46	10/31/2005	5:50	winter	storm	TCM46-103105-2	3900	
TCM46	11/1/2005	8:15	winter	storm	TCM46-110105-3	3600	
TCM46	12/20/2005	9:35	winter	storm	TCM46-122005-1	1350	
TCM46	12/21/2005	7:35	winter	storm	TCM46-122105-2	1200	
TCM46	12/21/2005	11:15	winter	storm	TCM46-122105-3	1300	
TCN33	6/29/2005	11:25	summer	base	TCN33-062905-1	268	
TCN33	6/29/2005	11:30	summer	base	TCN33-062905-2	236	
TCN33	6/29/2005	11:35	summer	base	TCN33-062905-3	264	
TCN33	8/16/2005	10:12	summer	base	TCN33-081605-1	440	
TCN33	8/16/2005	10:17	summer	base	TCN33-0816105-2	1540	
TCN33	8/16/2005	10:22	summer	base	TCN33-081605-3	840	
TCN33	10/25/2005	13:20	summer	base	TCN33-102505-1	100	
TCN33	10/25/2005	13:25	summer	base	TCN33-102505-2	108	
TCN33	10/25/2005	13:30	summer	base	TCN33-102505-3	86	
TCN33	5/18/2005	7:30	summer	storm	TCN33-051805-1	2500	
TCN33	5/18/2005	8:55	summer	storm	TCN33-051805-2	4300	
TCN33	5/18/2005	9:00	summer	storm	TCN33-051805-3	2500	
TCN33	10/2/2005	13:45	summer	storm	TCN33-100205-1	4000	G
TCN33	10/2/2005	15:10	summer	storm	TCN33-100205-2	4000	G
TCN33	10/2/2005	15:15	summer	storm	TCN33-100205-3	4000	G
TCN33	2/1/2005	8:58	winter	base	TCN33-020105-1	120	
TCN33	2/1/2005	9:03	winter	base	TCN33-020105-2	100	
TCN33	2/1/2005	9:08	winter	base	TCN33-020105-3	74	
TCN33	4/19/2005	13:20	winter	base	TCN33-041905-1	180	
TCN33	4/19/2005	13:25	winter	base	TCN33-041905-2	110	
TCN33	4/19/2005	13:30	winter	base	TCN33-041905-3	70	
TCN33	11/21/2005	9:20	winter	base	TCN33-112105-1	296	
TCN33	11/21/2005	9:25	winter	base	TCN33-112105-2	388	
TCN33	11/21/2005	9:30	winter	base	TCN33-112105-3	462	
TCN33	3/19/2005	17:20	winter	storm	TCN33-031905-1	3800	
TCN33	3/19/2005	18:45	winter	storm	TCN33-031905-2	2300	
TCN33	3/26/2005	12:10	winter	storm	TCN33-032605-1	1600	
TCN33	4/1/2005	4:55	winter	storm	TCN33-040105-1	600	
TCN33	4/1/2005	6:15	winter	storm	TCN33-040105-2	700	
TCN33	4/16/2005	8:58	winter	storm	TCN33-041605-1	9500	
TCN33	10/28/2005	4:15	winter	storm	TCN33-102805-1	9800	

Station	Date	Time	season	event type	Sample ID	result	comment
TCN33	10/31/2005	5:35	winter	storm	TCN33-103105-2	4000	
TCN33	11/1/2005	7:55	winter	storm	TCN33-110105-3	2000	G
TCN33	12/20/2005	7:05	winter	storm	TCN33-122005-1	2400	
TCN33	12/21/2005	7:20	winter	storm	TCN33-122105-2	1080	
TCN33	12/21/2005	10:45	winter	storm	TCN33-122105-3	1010	
TCN64	6/29/2005	10:40	summer	base	TCN64-062905-1	58	
TCN64	6/29/2005	10:45	summer	base	TCN64-062905-2	90	
TCN64	6/29/2005	10:50	summer	base	TCN64-062905-3	110	
TCN64	8/16/2005	8:53	summer	base	TCN64-081605-1	152	
TCN64	8/16/2005	8:58	summer	base	TCN64-081605-2	182	
TCN64	8/16/2005	9:03	summer	base	TCN64-081605-3	120	
TCN64	10/25/2005	12:45	summer	base	TCN64-102505-1	18	
TCN64	10/25/2005	12:50	summer	base	TCN64-102505-2	28	
TCN64	10/25/2005	12:55	summer	base	TCN64-102505-3	16	
TCN64	5/18/2005	7:05	summer	storm	TCN64-051805-1	1300	
TCN64	5/18/2005	8:27	summer	storm	TCN64-051805-2	1000	
TCN64	5/18/2005	8:32	summer	storm	TCN64-051805-3	600	
TCN64	10/2/2005	13:20	summer	storm	TCN64-100205-1	780	
TCN64	10/2/2005	14:48	summer	storm	TCN64-100205-2	1160	
TCN64	10/2/2005	14:53	summer	storm	TCN64-100205-3	820	
TCN64	2/1/2005	7:54	winter	base	TCN64-020105-1	54	
TCN64	2/1/2005	7:59	winter	base	TCN64-020105-2	54	
TCN64	2/1/2005	8:04	winter	base	TCN64-020105-3	58	
TCN64	4/19/2005	13:40	winter	base	TCN64-041905-1	30	
TCN64	4/19/2005	13:45	winter	base	TCN64-041905-2	40	
TCN64	4/19/2005	13:50	winter	base	TCN64-041905-3	30	
TCN64	11/21/2005	8:50	winter	base	TCN64-112105-1	42	
TCN64	11/21/2005	8:55	winter	base	TCN64-112105-2	30	
TCN64	11/21/2005	9:00	winter	base	TCN64-112105-3	36	
TCN64	3/19/2005	16:57	winter	storm	TCN64-031905-1	120	
TCN64	3/19/2005	18:25	winter	storm	TCN64-031905-2	350	
TCN64	3/26/2005	11:45	winter	storm	TCN64-032605-1	800	
TCN64	4/1/2005	4:25	winter	storm	TCN64-040105-1	100	
TCN64	4/1/2005	5:45	winter	storm	TCN64-040105-2	60	
TCN64	4/16/2005	6:30	winter	storm	TCN64-041605-1	1500	
TCN64	10/28/2005	4:00	winter	storm	TCN64-102805-1	2100	
TCN64	10/31/2005	5:15	winter	storm	TCN64-103105-2	730	
TCN64	11/1/2005	7:25	winter	storm	TCN64-110105-3	210	
TCN64	12/20/2005	6:45	winter	storm	TCN64-122005-1	70	
TCN64	12/21/2005	6:55	winter	storm	TCN64-122105-2	210	
TCN64	12/21/2005	10:30	winter	storm	TCN64-122105-3	900	
TCS40	6/29/2005	11:00	summer	base	TCS40-062905-1	84	
TCS40	6/29/2005	11:05	summer	base	TCS40-062905-2	86	
TCS40	6/29/2005	11:10	summer	base	TCS40-062905-3	102	
TCS40	8/16/2005	9:28	summer	base	TCS40-081605-1	164	
TCS40	8/16/2005	9:33	summer	base	TCS40-081605-2	190	
TCS40	8/16/2005	9:38	summer	base	TCS40-081605-3	204	
TCS40	10/25/2005	13:00	summer	base	TCS40-102505-1	108	
TCS40	10/25/2005	13:05	summer	base	TCS40-102505-2	144	
TCS40	10/25/2005	13:10	summer	base	TCS40-102505-3	106	

Station	Date	Time	season	event type	Sample ID	result	comment
TCS40	5/18/2005	7:18	summer	storm	TCS40-051805-1	4400	
TCS40	5/18/2005	8:42	summer	storm	TCS40-051805-2	3300	
TCS40	5/18/2005	8:47	summer	storm	TCS40-051805-3	3300	
TCS40	10/2/2005	13:35	summer	storm	TCS40-100205-1	3080	
TCS40	10/2/2005	15:00	summer	storm	TCS40-100205-2	1840	
TCS40	10/2/2005	15:05	summer	storm	TCS40-100205-3	1960	
TCS40	2/1/2005	8:17	winter	base	TCS40-020105-1	40	
TCS40	2/1/2005	8:22	winter	base	TCS40-020105-2	20	
TCS40	2/1/2005	8:27	winter	base	TCS40-020105-3	10	
TCS40	4/19/2005	13:55	winter	base	TCS40-041905-1	190	
TCS40	4/19/2005	14:00	winter	base	TCS40-041905-2	110	
TCS40	4/19/2005	14:05	winter	base	TCS40-041905-3	190	
TCS40	11/21/2005	9:05	winter	base	TCS40-112105-1	50	
TCS40	11/21/2005	9:10	winter	base	TCS40-112105-2	36	
TCS40	11/21/2005	9:15	winter	base	TCS40-112105-3	28	
TCS40	3/19/2005	17:08	winter	storm	TCS40-031905-1	600	
TCS40	3/19/2005	18:35	winter	storm	TCS40-031905-2	650	
TCS40	3/26/2005	11:58	winter	storm	TCS40-032605-1	210	
TCS40	4/1/2005	4:35	winter	storm	TCS40-040105-1	500	
TCS40	4/1/2005	5:55	winter	storm	TCS40-040105-2	170	
TCS40	4/16/2005	6:38	winter	storm	TCS40-041605-1	1000	
TCS40	10/28/2005	3:50	winter	storm	TCS40-102805-1	4400	
TCS40	10/31/2005	5:25	winter	storm	TCS40-103105-2	6500	
TCS40	11/1/2005	7:35	winter	storm	TCS40-110105-3	1200	
TCS40	12/20/2005	6:35	winter	storm	TCS40-122005-1	290	
TCS40	12/21/2005	7:05	winter	storm	TCS40-122105-2	870	
TCS40	12/21/2005	10:35	winter	storm	TCS40-122105-3	570	
TCS41	6/29/2005	11:40	summer	base	TCS41-062905-1	206	
TCS41	6/29/2005	11:45	summer	base	TCS41-062905-2	168	
TCS41	6/29/2005	11:50	summer	base	TCS41-062905-3	264	
TCS41	8/16/2005	10:28	summer	base	TCS41-081605-1	118	
TCS41	8/16/2005	10:33	summer	base	TCS41-081605-2	162	
TCS41	8/16/2005	10:38	summer	base	TCS41-081605-3	126	
TCS41	10/25/2005	13:35	summer	base	TCS41-102505-1	46	
TCS41	10/25/2005	13:40	summer	base	TCS41-102505-2	68	
TCS41	10/25/2005	13:45	summer	base	TCS41-102505-3	340	
TCS41	5/18/2005	7:35	summer	storm	TCS41-051805-1	11800	
TCS41	5/18/2005	9:05	summer	storm	TCS41-051805-2	3700	
TCS41	5/18/2005	9:10	summer	storm	TCS41-051805-3	6700	
TCS41	10/2/2005	13:50	summer	storm	TCS41-100205-1	3960	
TCS41	10/2/2005	15:20	summer	storm	TCS41-100205-2	3720	
TCS41	10/2/2005	15:25	summer	storm	TCS41-100205-3	3160	
TCS41	2/1/2005	8:40	winter	base	TCS41-020105-1	112	
TCS41	2/1/2005	8:45	winter	base	TCS41-020105-2	134	
TCS41	2/1/2005	8:50	winter	base	TCS41-020105-3	112	
TCS41	4/19/2005	12:15	winter	base	TCS41-041905-3	60	
TCS41	4/19/2005	13:05	winter	base	TCS41-041905-1	50	
TCS41	4/19/2005	13:10	winter	base	TCS41-041905-2	90	
TCS41	11/21/2005	9:35	winter	base	TCS41-112105-1	122	
TCS41	11/21/2005	9:40	winter	base	TCS41-112105-2	106	

Station	Date	Time	season	event type	Sample ID	result	comment
TCS41	11/21/2005	9:45	winter	base	TCS41-112105-3	108	
TCS41	3/19/2005	17:27	winter	storm	TCS41-031905-1	2400	
TCS41	3/19/2005	18:50	winter	storm	TCS41-031905-2	2650	
TCS41	3/26/2005	12:18	winter	storm	TCS41-032605-1	300	
TCS41	4/1/2005	4:50	winter	storm	TCS41-040105-1	600	
TCS41	4/1/2005	6:10	winter	storm	TCS41-040105-2	400	
TCS41	4/16/2005	8:50	winter	storm	TCS41-041605-1	6000	
TCS41	10/28/2005	4:20	winter	storm	TCS41-102805-1	8600	
TCS41	10/31/2005	5:40	winter	storm	TCS41-103105-2	5200	
TCS41	11/1/2005	8:00	winter	storm	TCS41-110105-3	2600	
TCS41	12/20/2005	7:10	winter	storm	TCS41-122005-1	990	
TCS41	12/21/2005	7:25	winter	storm	TCS41-122105-2	1400	
TCS41	12/21/2005	10:55	winter	storm	TCS41-122105-3	1480	

Isolate .	Provider Sample .	Sample Date	Resident/T	Note	Study ID
104991	Hero 71-02-TCN64-1	2/1/2005	231	avian	157
104992	Hero 71-02-TCN64-1	2/1/2005	207	raccoon	157
104993	Hero 71-02-TCN64-1	2/1/2005	207	raccoon	157
104994	Hero 71-02-TCN64-2	2/1/2005	207	raccoon	157
104995	Hero 71-02-TCN64-2	2/1/2005	135	sewage	157
104996	Hero 71-02-TCN64-2	2/1/2005	207	raccoon	157
104997	Hero 71-02-TCN64-3	2/1/2005	135	sewage	157
104998	Hero 71-02-TCN64-3	2/1/2005	207	raccoon	157
104999	Hero 71-02-TCN64-3	2/1/2005	231	avian	157
105000	Hero 71-02-TCS40-1	2/1/2005	78	raccoon	157
105001	Hero 71-02-TCS40-1	2/1/2005	78	raccoon	157
105002	Hero 71-02-TCS40-1	2/1/2005	17	rodent	157
105003	Hero 71-02-TCS40-1	2/1/2005	78	raccoon	157
105004	Hero 71-02-TCS40-2	2/1/2005	217	rodent	157
105005	Hero 71-02-TCS40-2	2/1/2005	17	rodent	157
105006	Hero 71-02-TCS40-2	2/1/2005	136	avian	157
105007	Hero 71-02-TCS40-3	2/1/2005	17	rodent	157
105008	Hero 71-02-TCS40-3	2/1/2005	17	rodent	157
105009	Hero 71-02-TCS40-3	2/1/2005	213	dog	157
105010	Hero 71-02-TCS41-1	2/1/2005	122	u	157
105011	Hero 71-02-TCS41-1	2/1/2005	145	rodent	157
105012	Hero 71-02-TCS41-1	2/1/2005	145	rodent	157
105013	Hero 71-02-TCS41-2	2/1/2005	136	avian	157
105014	Hero 71-02-TCS41-2	2/1/2005	25	dog	157
105015	Hero 71-02-TCS41-2	2/1/2005	110	avian	157
105016	Hero 71-02-TCS41-3	2/1/2005	65	u	157
105017	Hero 71-02-TCS41-3	2/1/2005		avian	157
105018	Hero 71-02-TCS41-3	2/1/2005		avian	157
105019	Hero 71-02-TCN33-1	2/1/2005	231	avian	157
105020	Hero 71-02-TCN33-1	2/1/2005	124	raccoon	157
105021	Hero 71-02-TCN33-1	2/1/2005	124	raccoon	157
105022	Hero 71-02-TCN33-1	2/1/2005	154	rodent	157
105023	Hero 71-02-TCN33-2	2/1/2005	216	avian	157
105024	Hero 71-02-TCN33-2	2/1/2005	107	raccoon	157
105025	Hero 71-02-TCN33-2	2/1/2005	216	avian	157
105026	Hero 71-02-TCN33-3	2/1/2005	216	avian	157
105027	Hero 71-02-TCN33-3	2/1/2005	207	raccoon	157
105028	Hero 71-02-TCN33-3	2/1/2005	216	avian	157
105029	Hero 71-02-TCN46-1	2/1/2005	37	opossum	157
105030	Hero 71-02-TCN46-1	2/1/2005	231	avian	157
105031	Hero 71-02-TCN46-1	2/1/2005	214	sewage	157
105032	Hero 71-02-TCN46-2	2/1/2005		avian	157
105033	Hero 71-02-TCN46-2	2/1/2005	18	avian	157
105034	Hero 71-02-TCN46-2	2/1/2005	154	rodent	157
105035	Hero 71-02-TCN46-3	2/1/2005	136	avian	157
105036	Hero 71-02-TCN46-3	2/1/2005	136	avian	157
105037	Hero 71-02-TCN46-3	2/1/2005	30	avian	157
105038	Hero 71-02-MBS-1	2/1/2005	44	raccoon	157
105039	Hero 71-02-MBS-1	2/1/2005		raccoon	157
105040	Hero 71-02-MBS-1	2/1/2005	207	raccoon	157
105041	Hero 71-02-MBS-1	2/1/2005	207	raccoon	157

Isolate .	Provider Sample .	Sample Date	Resident/T	Note	Study ID
105042	Hero 71-02-MBS-2	2/1/2005	102	dog	157
105043	Hero 71-02-MBS-2	2/1/2005	139	avian	157
105044	Hero 71-02-MBS-2	2/1/2005	102	dog	157
105045	Hero 71-02-MBS-3	2/1/2005	207	raccoon	157
105046	Hero 71-02-MBS-3	2/1/2005	182	avian	157
105047	Hero 71-02-MBS-3	2/1/2005	139	avian	157
105048	Hero 71-02-MBN-1	2/1/2005	207	raccoon	157
105049	Hero 71-02-MBN-1	2/1/2005	136	avian	157
105050	Hero 71-02-MBN-1	2/1/2005	208	dog	157
105051	Hero 71-02-MBN-2	2/1/2005	207	raccoon	157
105052	Hero 71-02-MBN-2	2/1/2005	207	raccoon	157
105053	Hero 71-02-MBN-2	2/1/2005	92	avian	157
105054	Hero 71-02-MBN-3	2/1/2005	207	raccoon	157
105055	Hero 71-02-MBN-3	2/1/2005	211	avian	157
105056	Hero 71-02-MBN-3	2/1/2005	207	raccoon	157
105399	Hero 71-06-TCN64-031905-1	3/19/2005	82	raccoon	157
105400	Hero 71-06-TCN64-031905-1	3/19/2005	216	avian	157
105401	Hero 71-06-TCN64-031905-1	3/19/2005	216	avian	157
105402	Hero 71-06-TCN64-031905-1	3/19/2005	35	rodent	157
105403	Hero 71-06-TCN64-031905-2	3/19/2005	200	rodent	157
105404	Hero 71-06-TCN64-031905-2	3/19/2005	200	rodent	157
105405	Hero 71-06-TCN64-031905-2	3/19/2005	145	rodent	157
105406	Hero 71-06-TCS40-031905-1	3/19/2005	53	beaver	157
105407	Hero 71-06-TCS40-031905-1	3/19/2005	113	avian	157
105408	Hero 71-06-TCS40-031905-1	3/19/2005	218	feline	157
105409	Hero 71-06-TCS40-031905-2	3/19/2005	186	raccoon	157
105410	Hero 71-06-TCS40-031905-2	3/19/2005	133	avian	157
105411	Hero 71-06-TCS40-031905-2	3/19/2005	82	raccoon	157
105412	Hero 71-06-TCN33-031905-1	3/19/2005	212	avian	157
105413	Hero 71-06-TCN33-031905-1	3/19/2005	72	avian	157
105414	Hero 71-06-TCN33-031905-1	3/19/2005	212	avian	157
105415	Hero 71-06-TCN33-031905-2	3/19/2005	144	raccoon	157
105416	Hero 71-06-TCN33-031905-2	3/19/2005	212	avian	157
105417	Hero 71-06-TCN33-031905-2	3/19/2005	174	avian	157
105418	Hero 71-06-TCS41-031905-1	3/19/2005	169	avian	157
105419	Hero 71-06-TCS41-031905-1	3/19/2005	37	opossum	157
105420	Hero 71-06-TCS41-031905-1	3/19/2005	137	dog	157
105421	Hero 71-06-TCS41-031905-1	3/19/2005	136	avian	157
105422	Hero 71-06-TCS41-031905-2	3/19/2005	197	u	157
105423	Hero 71-06-TCS41-031905-2	3/19/2005	207	raccoon	157
105424	Hero 71-06-TCS41-031905-2	3/19/2005	52	goose	157
105425	Hero 71-06-TCM46-031905-1	3/19/2005	52	goose	157
105426	Hero 71-06-TCM46-031905-1	3/19/2005	24	avian	157
105427	Hero 71-06-TCM46-031905-1	3/19/2005	79	avian	157
105428	Hero 71-06-TCM46-031905-2	3/19/2005	199	avian	157
105429	Hero 71-06-TCM46-031905-2	3/19/2005	147	rodent	157
105430	Hero 71-06-TCM46-031905-2	3/19/2005	89	avian	157
105431	Hero 71-06-MBS-031905-1	3/19/2005	71	avian	157
105432	Hero 71-06-MBS-031905-1	3/19/2005	10	avian	157
105433	Hero 71-06-MBS-031905-1	3/19/2005	57	avian	157
105434	Hero 71-06-MBS-031905-2	3/19/2005	236	u	157

Isolate .	Provider Sample .	Sample Date	Resident/T	Note	Study ID
105435	Hero 71-06-MBS-031905-2	3/19/2005	207	raccoon	157
105436	Hero 71-06-MBS-031905-2	3/19/2005	207	raccoon	157
105437	Hero 71-06-MBN-031905-1	3/19/2005	35	rodent	157
105438	Hero 71-06-MBN-031905-1	3/19/2005	139	avian	157
105439	Hero 71-06-MBN-031905-1	3/19/2005	51	avian	157
105440	Hero 71-06-MBN-031905-2	3/19/2005	154	rodent	157
105441	Hero 71-06-MBN-031905-2	3/19/2005	154	rodent	157
105442	Hero 71-06-MBN-031905-2	3/19/2005	26	raccoon	157
105443	Hero 71-06-MBN-031905-2	3/19/2005	136	avian	157
105521	Hero 71-11-TCN64-032605-1	3/26/2005	9	dog	157
105522	Hero 71-11-TCN64-032605-1	3/26/2005	35	rodent	157
105523	Hero 71-11-TCN64-032605-1	3/26/2005	145	rodent	157
105524	Hero 71-11-TCS40-032605-1	3/26/2005	104	avian	157
105525	Hero 71-11-TCS40-032605-1	3/26/2005	154	rodent	157
105526	Hero 71-11-TCS40-032605-1	3/26/2005	2	canine	157
105527	Hero 71-11-TCN33-032605-1	3/26/2005	183	avian	157
105528	Hero 71-11-TCN33-032605-1	3/26/2005	134	raccoon	157
105529	Hero 71-11-TCN33-032605-1	3/26/2005	138	dog	157
105530	Hero 71-11-TCS41-032605-1	3/26/2005	40	dog	157
105531	Hero 71-11-TCS41-032605-1	3/26/2005	162	avian	157
105532	Hero 71-11-TCS41-032605-1	3/26/2005	17	rodent	157
105533	Hero 71-11-TCM46-032605-1	3/26/2005	165	avian	157
105534	Hero 71-11-TCM46-032605-1	3/26/2005	18	avian	157
105535	Hero 71-11-TCM46-032605-1	3/26/2005	165	avian	157
105536	Hero 71-11-MBS-032605-1	3/26/2005	207	raccoon	157
105537	Hero 71-11-MBS-032605-1	3/26/2005	36	feline	157
105538	Hero 71-11-MBS-032605-1	3/26/2005	36	feline	157
105539	Hero 71-11-MBN-032605-1	3/26/2005	173	avian	157
105540	Hero 71-11-MBN-032605-1	3/26/2005	36	feline	157
105541	Hero 71-11-MBN-032605-1	3/26/2005	36	feline	157
105542	Hero 71-11-MBN-032605-1	3/26/2005	207	raccoon	157
105546	Hero 71-13-TCN64-040105-1	4/1/2005	35	rodent	157
105547	Hero 71-13-TCN64-040105-1	4/1/2005	35	rodent	157
105548	Hero 71-13-TCN64-040105-1	4/1/2005	35	rodent	157
105549	Hero 71-13-TCN64-040105-1	4/1/2005	96	avian	157
105550	Hero 71-13-TCN64-040105-1	4/1/2005	35	rodent	157
105551	Hero 71-13-TCS40-040105-1	4/1/2005	154	rodent	157
105552	Hero 71-13-TCS40-040105-1	4/1/2005	3	canine	157
105553	Hero 71-13-TCS40-040105-1	4/1/2005	35	rodent	157
105554	Hero 71-13-TCS40-040105-2	4/1/2005	93	avian	157
105555	Hero 71-13-TCS40-040105-2	4/1/2005	52	goose	157
105556	Hero 71-13-TCS40-040105-2	4/1/2005	210	goose	157
105557	Hero 71-13-TCS41-040105-1	4/1/2005	182	avian	157
105558	Hero 71-13-TCS41-040105-1	4/1/2005	10	avian	157
105559	Hero 71-13-TCS41-040105-1	4/1/2005	32	dog	157
105560	Hero 71-13-TCS41-040105-2	4/1/2005	51	avian	157
105561	Hero 71-13-TCS41-040105-2	4/1/2005	51	avian	157
105562	Hero 71-13-TCS41-040105-2	4/1/2005	185	dog	157
105563	Hero 71-13-TCS41-040105-2	4/1/2005	170	dog	157
105564	Hero 71-13-TCN33-040105-1	4/1/2005	35	rodent	157
105565	Hero 71-13-TCN33-040105-1	4/1/2005		avian	157

Isolate .	Provider Sample .	Sample Date	Resident/T	Note	Study ID
105566	Hero 71-13-TCN33-040105-2	4/1/2005		avian	157
105567	Hero 71-13-TCM46-040105-1	4/1/2005	212	avian	157
105568	Hero 71-13-TCM46-040105-1	4/1/2005	92	avian	157
105569	Hero 71-13-TCM46-040105-1	4/1/2005	27	rodent	157
105570	Hero 71-13-TCM46-040105-2	4/1/2005	35	rodent	157
105571	Hero 71-13-TCM46-040105-2	4/1/2005	169	avian	157
105572	Hero 71-13-TCM46-040105-2	4/1/2005		avian	157
105573	Hero 71-13-MBS-040105-1	4/1/2005	38	avian	157
105574	Hero 71-13-MBS-040105-1	4/1/2005	212	avian	157
105575	Hero 71-13-MBS-040105-1	4/1/2005	38	dog	157
105576	Hero 71-13-MBS-040105-2	4/1/2005	212	avian	157
105577	Hero 71-13-MBS-040105-2	4/1/2005	212	avian	157
105578	Hero 71-13-MBS-040105-2	4/1/2005	212	avian	157
105579	Hero 71-13-MBN-040105-1	4/1/2005	169	avian	157
105580	Hero 71-13-MBN-040105-1	4/1/2005	49	avian	157
105581	Hero 71-13-MBN-040105-1	4/1/2005	49	avian	157
105582	Hero 71-13-MBN-040105-1	4/1/2005	136	avian	157
105583	Hero 71-13-MBN-040105-2	4/1/2005	152	goose	157
105584	Hero 71-13-MBN-040105-2	4/1/2005	147	rodent	157
105585	Hero 71-13-MBN-040105-2	4/1/2005	169	avian	157
105818	Hero 71-16 TCN64-041605-1	4/16/2005	19	dog	157
105819	Hero 71-16 TCS41-041605-1	4/16/2005		avian	157
105820	Hero 71-16 TCS41-041605-1	4/16/2005	3	canine	157
105821	Hero 71-16 TCS41-041605-1	4/16/2005	3	canine	157
105822	Hero 71-16 TCS41-041605-1	4/16/2005	69	goose	157
105823	Hero 71-16 TCS41-041605-1	4/16/2005	193	squirrel	157
105824	Hero 71-16 TCS41-041605-1	4/16/2005	207	raccoon	157
105825	Hero 71-16 TCN33-041605-1	4/16/2005	233	avian	157
105826	Hero 71-16 TCN33-041605-1	4/16/2005	207	raccoon	157
105827	Hero 71-16 TCN33-041605-1	4/16/2005	157	dog	157
105828	Hero 71-16 TCN33-041605-1	4/16/2005	136	avian	157
105829	Hero 71-16 TCM46-041605-1	4/16/2005	26	raccoon	157
105830	Hero 71-16 TCM46-041605-1	4/16/2005	237	raccoon	157
105831	Hero 71-16 TCM46-041605-1	4/16/2005	82	raccoon	157
105832	Hero 71-16 TCM46-041605-1	4/16/2005	212	avian	157
105833	Hero 71-16 TCM46-041605-1	4/16/2005		avian	157
105834	Hero 71-16 MBS-041605-1	4/16/2005	35	rodent	157
105835	Hero 71-16 MBS-041605-1	4/16/2005	35	rodent	157
105836	Hero 71-16 MBS-041605-1	4/16/2005	35	rodent	157
105837	Hero 71-16 MBN-041605-1	4/16/2005	114	goose	157
105838	Hero 71-16 MBN-041605-1	4/16/2005	101	raccoon	157
105839	Hero 71-16 MBN-041605-1	4/16/2005	66	u	157
105840	Hero 71-20 TCM46-041905-1	4/19/2005	223	sewage	157
105841	Hero 71-20 TCM46-041905-1	4/19/2005	223	sewage	157
105842	Hero 71-20 TCM46-041905-1	4/19/2005	92	avian	157
105843	Hero 71-20 TCM46-041905-1	4/19/2005	92	avian	157
105844	Hero 71-20 TCM46-041905-2	4/19/2005	10	avian	157
105845	Hero 71-20 TCM46-041905-2	4/19/2005	136	avian	157
105846	Hero 71-20 TCM46-041905-2	4/19/2005	168	canine	157
105847	Hero 71-20 TCM46-041905-3	4/19/2005	212	avian	157
105848	Hero 71-20 TCM46-041905-3	4/19/2005	223	sewage	157

Isolate .	Provider Sample .	Sample Date	Resident/T	Note	Study ID
105849	Hero 71-20 TCM46-041905-3	4/19/2005	92	avian	157
105850	Hero 71-20 MBS-041905-1	4/19/2005	56	dog	157
105851	Hero 71-20 MBS-041905-1	4/19/2005	78	raccoon	157
105852	Hero 71-20 MBS-041905-1	4/19/2005	207	raccoon	157
105853	Hero 71-20 MBS-041905-2	4/19/2005	119	avian	157
105854	Hero 71-20 MBS-041905-2	4/19/2005	35	rodent	157
105855	Hero 71-20 MBS-041905-2	4/19/2005	75	duck	157
105856	Hero 71-20 MBS-041905-3	4/19/2005	83	rodent	157
105857	Hero 71-20 MBS-041905-3	4/19/2005	92	avian	157
105858	Hero 71-20 MBS-041905-3	4/19/2005	207	raccoon	157
105859	Hero 71-20 MBN-041905-1	4/19/2005	225	dog	157
105860	Hero 71-20 MBN-041905-1	4/19/2005	211	avian	157
105861	Hero 71-20 MBN-041905-1	4/19/2005	211	avian	157
105862	Hero 71-20 MBN-041905-1	4/19/2005	30	avian	157
105863	Hero 71-20 MBN-041905-2	4/19/2005	211	avian	157
105864	Hero 71-20 MBN-041905-2	4/19/2005	211	avian	157
105865	Hero 71-20 MBN-041905-2	4/19/2005	30	avian	157
105866	Hero 71-20 MBN-041905-2	4/19/2005	211	avian	157
105867	Hero 71-20 MBN-041905-2	4/19/2005	207	raccoon	157
105868	Hero 71-20 MBN-041905-3	4/19/2005	211	avian	157
105869	Hero 71-20 MBN-041905-3	4/19/2005	225	dog	157
105973	Hero 71-20 TCS41-041905-1	4/19/2005	26	raccoon	157
105974	Hero 71-20 TCS41-041905-1	4/19/2005	101	raccoon	157
105975	Hero 71-20 TCS41-041905-2	4/19/2005	220	avian	157
105976	Hero 71-20 TCS41-041905-2	4/19/2005	231	avian	157
105977	Hero 71-20 TCS41-041905-3	4/19/2005	35	rodent	157
105978	Hero 71-20 TCS41-041905-3	4/19/2005	35	rodent	157
105979	Hero 71-20 TCS41-041905-3	4/19/2005	136	avian	157
105980	Hero 71-20 TCN33-041905-1	4/19/2005	149	dog	157
105981	Hero 71-20 TCN33-041905-1	4/19/2005	149	dog	157
105982	Hero 71-20 TCN33-041905-1	4/19/2005	84	goose	157
105983	Hero 71-20 TCN33-041905-1	4/19/2005	149	dog	157
105984	Hero 71-20 TCN33-041905-2	4/19/2005	70	sewage	157
105985	Hero 71-20 TCN33-041905-2	4/19/2005	220	avian	157
105986	Hero 71-20 TCN33-041905-3	4/19/2005	70	sewage	157
105987	Hero 71-20 TCN33-041905-3	4/19/2005	44	raccoon	157
105988	Hero 71-20 TCN33-041905-3	4/19/2005	70	sewage	157
105989	Hero 71-20 TCN64-041905-1	4/19/2005	207	raccoon	157
105990	Hero 71-20 TCN64-041905-1	4/19/2005	216	avian	157
105991	Hero 71-20 TCN64-041905-1	4/19/2005	207	raccoon	157
105992	Hero 71-20 TCN64-041905-2	4/19/2005	207	raccoon	157
105993	Hero 71-20 TCN64-041905-2	4/19/2005	207	raccoon	157
105994	Hero 71-20 TCN64-041905-2	4/19/2005	207	raccoon	157
105995	Hero 71-20 TCN64-041905-2	4/19/2005	226	raccoon	157
105996	Hero 71-20 TCN64-041905-3	4/19/2005	216	avian	157
105997	Hero 71-20 TCN64-041905-3	4/19/2005	207	raccoon	157
105998	Hero 71-20 TCS40-041905-1	4/19/2005	121	avian	157
105999	Hero 71-20 TCS40-041905-1	4/19/2005	121	avian	157
106000	Hero 71-20 TCS40-041905-2	4/19/2005		avian	157
106001	Hero 71-20 TCS40-041905-2	4/19/2005		avian	157
106002	Hero 71-20 TCS40-041905-2	4/19/2005		avian	157

Isolate .	Provider Sample .	Sample Date	Resident/T	Note	Study ID
106003	Hero 71-20 TCS40-041905-2	4/19/2005	121	avian	157
106004	Hero 71-20 TCS40-041905-2	4/19/2005		avian	157
106005	Hero 71-20 TCS40-041905-3	4/19/2005	121	avian	157
106006	Hero 71-20 TCS40-041905-3	4/19/2005	121	avian	157
106007	Hero 71-20 TCS40-041905-3	4/19/2005	121	avian	157
106008	Hero 71-20 TCS40-041905-3	4/19/2005	134	raccoon	157
106009	Hero 71-20 TCS40-041905-3	4/19/2005	121	avian	157
106529	TCN64-051805-1	5/18/2005	58	goose	157
106530	TCN64-051805-1	5/18/2005	58	goose	157
106531	TCN64-051805-1	5/18/2005	85	duck	157
106532	TCN64-051805-2	5/18/2005	207	raccoon	157
106533	TCN64-051805-2	5/18/2005	21	u	157
106534	TCN64-051805-2	5/18/2005	189	avian	157
106535	TCN64-051805-3	5/18/2005	171	rodent	157
106536	TCN64-051805-3	5/18/2005	29	rodent	157
106537	TCN64-051805-3	5/18/2005	181	avian	157
106538	TCS40-051805-1	5/18/2005	17	rodent	157
106539	TCS40-051805-1	5/18/2005	37	opossum	157
106540	TCS40-051805-1	5/18/2005	145	rodent	157
106541	TCS40-051805-1	5/18/2005	145	rodent	157
106542	TCS40-051805-2	5/18/2005	145	rodent	157
106543	TCS40-051805-2	5/18/2005	45	u	157
106544	TCS40-051805-2	5/18/2005	145	rodent	157
106545	TCS40-051805-3	5/18/2005	35	rodent	157
106546	TCS40-051805-3	5/18/2005	145	rodent	157
106547	TCS40-051805-3	5/18/2005	35	rodent	157
106548	TCN33-051805-1	5/18/2005	238	u	157
106549	TCN33-051805-1	5/18/2005	92	avian	157
106550	TCN33-051805-1	5/18/2005	79	avian	157
106551	TCN33-051805-2	5/18/2005	11	avian	157
106552	TCN33-051805-2	5/18/2005	57	avian	157
106553	TCN33-051805-2	5/18/2005	18	avian	157
106554	TCN33-051805-3	5/18/2005	161	avian	157
106555	TCN33-051805-3	5/18/2005	57	avian	157
106556	TCN33-051805-3	5/18/2005	140	dog	157
106557	TCS41-051805-1	5/18/2005	130	avian	157
106558	TCS41-051805-1	5/18/2005	187	canine	157
106559	TCS41-051805-1	5/18/2005	192	squirrel	157
106560	TCS41-051805-2	5/18/2005	17	rodent	157
106561	TCS41-051805-2	5/18/2005	17	rodent	157
106562	TCS41-051805-2	5/18/2005	207	raccoon	157
106563	TCS41-051805-2	5/18/2005	35	rodent	157
106564	TCS41-051805-3	5/18/2005	26	raccoon	157
106565	TCS41-051805-3	5/18/2005	233	avian	157
106566	TCS41-051805-3	5/18/2005	188	avian	157
106567	TCM46-051805-1	5/18/2005		avian	157
106568	TCM46-051805-1	5/18/2005	231	avian	157
106569	TCM46-051805-1	5/18/2005	56	dog	157
106570	TCM46-051805-2	5/18/2005		dog	157
106571	TCM46-051805-2	5/18/2005	46	duck	157
106572	TCM46-051805-2	5/18/2005	139	avian	157

Isolate .	Provider Sample .	Sample Date	Resident/T	Note	Study ID
106573	TCM46-051805-3	5/18/2005	83	rodent	157
106574	TCM46-051805-3	5/18/2005	141	dog	157
106575	TCM46-051805-3	5/18/2005	231	avian	157
106576	MBS-051805-1	5/18/2005	89	avian	157
106577	MBS-051805-1	5/18/2005	89	avian	157
106578	MBS-051805-1	5/18/2005	89	avian	157
106579	MBS-051805-2	5/18/2005	35	rodent	157
106580	MBS-051805-2	5/18/2005	42	dog	157
106581	MBS-051805-2	5/18/2005	35	rodent	157
106582	MBS-051805-2	5/18/2005	62	opossum	157
106583	MBS-051805-3	5/18/2005	203	rodent	157
106584	MBS-051805-3	5/18/2005	207	raccoon	157
106585	MBS-051805-3	5/18/2005	202	rodent	157
106586	MBN -051805-1	5/18/2005	89	avian	157
106587	MBN -051805-1	5/18/2005	230	u	157
106588	MBN -051805-1	5/18/2005	221	avian	157
106589	MBN -051805-2	5/18/2005	117	u	157
106590	MBN -051805-2	5/18/2005	31	dog	157
106591	MBN -051805-2	5/18/2005	35	rodent	157
106592	MBN -051805-3	5/18/2005	35	rodent	157
106593	MBN -051805-3	5/18/2005	1	avian	157
106594	MBN -051805-3	5/18/2005	207	raccoon	157
107271	TCN64-062905-1	6/29/2005	61	sewage	157
107272	TCN64-062905-1	6/29/2005	1	avian	157
107273	TCN64-062905-2	6/29/2005	207	raccoon	157
107274	TCN64-062905-2	6/29/2005	60	goose	157
107275	TCN64-062905-2	6/29/2005	92	avian	157
107276	TCN64-062905-3	6/29/2005	59	goose	157
107277	TCN64-062905-3	6/29/2005	58	goose	157
107278	TCN64-062905-3	6/29/2005	58	goose	157
107279	TCS40-062905-1	6/29/2005	124	human	157
107280	TCS40-062905-1	6/29/2005	124	human	157
107281	TCS40-062905-1	6/29/2005	124	human	157
107282	TCS40-062905-1	6/29/2005	176	canine	157
107283	TCS40-062905-2	6/29/2005	125	u	157
107284	TCS40-062905-2	6/29/2005	89	avian	157
107285	TCS40-062905-2	6/29/2005	176	canine	157
107286	TCS40-062905-3	6/29/2005	64	rodent	157
107287	TCS40-062905-3	6/29/2005	125	u	157
107288	TCS40-062905-3	6/29/2005	63	goose	157
107289	TCN33-062905-1	6/29/2005	36	feline	157
107290	TCN33-062905-1	6/29/2005	44	raccoon	157
107291	TCN33-062905-1	6/29/2005	128	avian	157
107292	TCN33-062905-2	6/29/2005	151	sewage	157
107293	TCN33-062905-2	6/29/2005	43	avian	157
107294	TCN33-062905-2	6/29/2005	158	dog	157
107295	TCN33-062905-3	6/29/2005	156	dog	157
107296	TCN33-062905-3	6/29/2005	150	sewage	157
107297	TCN33-062905-3	6/29/2005	4	u	157
107298	TCS41-062905-1	6/29/2005	212	avian	157
107299	TCS41-062905-1	6/29/2005	231	avian	157

Isolate .	Provider Sample .	Sample Date	Resident/T	Note	Study ID
107300	TCS41-062905-1	6/29/2005	44	raccoon	157
107301	TCS41-062905-1	6/29/2005	44	raccoon	157
107302	TCS41-062905-2	6/29/2005	30	avian	157
107303	TCS41-062905-2	6/29/2005	48	canine	157
107304	TCS41-062905-2	6/29/2005	232	dog	157
107305	TCS41-062905-3	6/29/2005	153	goose	157
107306	TCS41-062905-3	6/29/2005	10	avian	157
107307	TCS41-062905-3	6/29/2005	13	dog	157
107308	TCM46-062905-1	6/29/2005		dog	157
107309	TCM46-062905-1	6/29/2005	231	dog	157
107310	TCM46-062905-1	6/29/2005	228	avian	157
107311	TCM46-062905-2	6/29/2005	10	avian	157
107312	TCM46-062905-2	6/29/2005	186	raccoon	157
107313	TCM46-062905-2	6/29/2005	186	raccoon	157
107314	TCM46-062905-3	6/29/2005	186	raccoon	157
107315	TCM46-062905-3	6/29/2005	186	raccoon	157
107316	TCM46-062905-3	6/29/2005	186	raccoon	157
107317	MBS-062905-1	6/29/2005	30	avian	157
107318	MBS-062905-1	6/29/2005	41	squirrel	157
107319	MBS-062905-1	6/29/2005	230	u	157
107320	MBS-062905-2	6/29/2005	89	avian	157
107321	MBS-062905-2	6/29/2005	89	avian	157
107322	MBS-062905-2	6/29/2005	145	rodent	157
107323	MBS-062905-2	6/29/2005	79	avian	157
107324	MBS-062905-3	6/29/2005	231	avian	157
107325	MBS-062905-3	6/29/2005	35	rodent	157
107326	MBS-062905-3	6/29/2005	231	avian	157
107327	MBN-062905-1	6/29/2005	39	avian	157
107328	MBN-062905-1	6/29/2005	35	rodent	157
107329	MBN-062905-1	6/29/2005	35	rodent	157
107330	MBN-062905-2	6/29/2005	231	avian	157
107331	MBN-062905-3	6/29/2005	35	rodent	157
107332	MBN-062905-2	6/29/2005	17	rodent	157
107333	MBN-062905-2	6/29/2005	76	dog	157
107334	MBN-062905-2	6/29/2005	216	avian	157
107335	MBN-062905-2	6/29/2005	191	avian	157
108640	TCN64-081605-1	8/16/2005	207	raccoon	157
108641	TCN64-081605-1	8/16/2005	207	raccoon	157
108642	TCN64-081605-1	8/16/2005	146	avian	157
108643	TCN64-081605-1	8/16/2005	231	dog	157
108644	TCN64-081605-2	8/16/2005	207	raccoon	157
108645	TCN64-081605-2	8/16/2005	68	rodent	157
108646	TCN64-081605-2	8/16/2005	29	rodent	157
108647	TCN64-081605-3	8/16/2005	119	avian	157
108648	TCN64-081605-3	8/16/2005	136	avian	157
108649	TCN64-081605-3	8/16/2005	106	canine	157
108650	TCS40-081605-1	8/16/2005	207	raccoon	157
108651	TCS40-081605-1	8/16/2005	207	raccoon	157
108652	TCS40-081605-1	8/16/2005	207	raccoon	157
108653	TCS40-081605-2	8/16/2005	207	raccoon	157
108654	TCS40-081605-2	8/16/2005	62	opossum	157

Isolate .	Provider Sample .	Sample Date	Resident/T	Note	Study ID
108655	TCS40-081605-2	8/16/2005	112	dog	157
108656	TCS40-081605-3	8/16/2005	207	raccoon	157
108657	TCS40-081605-3	8/16/2005	207	raccoon	157
108658	TCS40-081605-3	8/16/2005	207	raccoon	157
108659	TCN33-081605-1	8/16/2005	231	avian	157
108660	TCN33-081605-1	8/16/2005	6	raccoon	157
108661	TCN33-081605-1	8/16/2005	6	raccoon	157
108662	TCN33-081605-1	8/16/2005	29	rodent	157
108663	TCN33-081605-2	8/16/2005	30	avian	157
108664	TCN33-081605-2	8/16/2005	29	rodent	157
108665	TCN33-081605-2	8/16/2005	20	raccoon	157
108666	TCN33-081605-3	8/16/2005	231	avian	157
108667	TCN33-081605-3	8/16/2005	17	rodent	157
108668	TCN33-081605-3	8/16/2005	30	avian	157
108669	TCS41-081605-1	8/16/2005	216	avian	157
108670	TCS41-081605-1	8/16/2005	159	avian	157
108671	TCS41-081605-1	8/16/2005	92	avian	157
108672	TCS41-081605-2	8/16/2005	26	raccoon	157
108673	TCS41-081605-2	8/16/2005	30	avian	157
108674	TCS41-081605-2	8/16/2005	30	avian	157
108675	TCS41-081605-3	8/16/2005	207	raccoon	157
108676	TCS41-081605-3	8/16/2005	10	avian	157
108677	TCS41-081605-3	8/16/2005	68	rodent	157
108678	TCM46-081605-1	8/16/2005	136	avian	157
108679	TCM46-081605-1	8/16/2005	231	avian	157
108680	TCM46-081605-1	8/16/2005	160	u	157
108681	TCM46-081605-1	8/16/2005	160	u	157
108682	TCM46-081605-2	8/16/2005	136	avian	157
108683	TCM46-081605-2	8/16/2005	136	avian	157
108684	TCM46-081605-2	8/16/2005	35	rodent	157
108685	TCM46-081605-3	8/16/2005	231	avian	157
108686	TCM46-081605-3	8/16/2005	1	avian	157
108687	TCM46-081605-3	8/16/2005	136	avian	157
108688	MBS-081605-1	8/16/2005	231	avian	157
108689	MBS-081605-1	8/16/2005	44	raccoon	157
108690	MBS-081605-1	8/16/2005	241	avian	157
108691	MBS-081605-2	8/16/2005	231	dog	157
108692	MBS-081605-2	8/16/2005		dog	157
108693	MBS-081605-2	8/16/2005	171	rodent	157
108694	MBS-081605-3	8/16/2005	207	raccoon	157
108695	MBS-081605-3	8/16/2005	35	rodent	157
108696	MBS-081605-3	8/16/2005	231	dog	157
108697	MBN-081605-1	8/16/2005	89	avian	157
108698	MBN-081605-1	8/16/2005	89	avian	157
108699	MBN-081605-1	8/16/2005	26	raccoon	157
108700	MBN-081605-2	8/16/2005	95	u	157
108701	MBN-081605-2	8/16/2005	95	u	157
108702	MBN-081605-2	8/16/2005	35	rodent	157
108703	MBN-081605-2	8/16/2005	44	avian	157
108704	MBN-081605-3	8/16/2005	139	avian	157
108705	MBN-081605-3	8/16/2005	1	avian	157

Isolate .	Provider Sample .	Sample Date	Resident/T	Note	Study ID
108706	MBN-081605-3	8/16/2005	212	avian	157
108707	MBN-081605-3	8/16/2005	207	raccoon	157
109854	TCM46-090705-15	9/7/2005	79	avian	157
109855	TCM46-090705-15	9/7/2005	17	rodent	157
109856	TCM46-090705-15	9/7/2005	30	avian	157
109857	TCM46-090705-15	9/7/2005	88	u	157
109858	TCM46-090705-15	9/7/2005	17	rodent	157
109859	TCM46-090705-25	9/7/2005	154	rodent	157
109860	TCM46-090705-25	9/7/2005	139	avian	157
109861	TCM46-090705-25	9/7/2005	139	avian	157
109862	TCM46-090705-25	9/7/2005	198	u	157
109863	TCM46-090705-25	9/7/2005	154	rodent	157
109864	TCM46-090705-25	9/7/2005	139	avian	157
109865	TCM46-090705-35	9/7/2005	116	dog	157
109866	TCM46-090705-35	9/7/2005	154	rodent	157
109867	TCM46-090705-35	9/7/2005	195	avian	157
109868	TCM46-090705-35	9/7/2005	215	avian	157
109869	TCM46-090705-35	9/7/2005	195	avian	157
109870	MBS-090705-15	9/7/2005	229	u	157
109871	MBS-090705-15	9/7/2005	17	rodent	157
109872	MBS-090705-15	9/7/2005	17	rodent	157
109873	MBS-090705-15	9/7/2005	18	avian	157
109874	MBS-090705-15	9/7/2005	30	avian	157
109875	MBS-090705-25	9/7/2005	92	avian	157
109876	MBS-090705-25	9/7/2005	126	sewage	157
109877	MBS-090705-25	9/7/2005	10	avian	157
109878	MBS-090705-25	9/7/2005	1	avian	157
109879	MBS-090705-25	9/7/2005	30	avian	157
109880	MBS-090705-35	9/7/2005	229	u	157
109881	MBS-090705-35	9/7/2005	229	u	157
109882	MBS-090705-35	9/7/2005	7	u	157
109883	MBS-090705-35	9/7/2005	35	rodent	157
109884	MBS-090705-35	9/7/2005	35	rodent	157
109885	MBS-090705-35	9/7/2005	229	u	157
109886	MBN-090705-15	9/7/2005	14	opossum	157
109887	MBN-090705-15	9/7/2005	105	avian	157
109888	MBN-090705-15	9/7/2005	30	avian	157
109889	MBN-090705-15	9/7/2005	10	avian	157
109890	MBN-090705-15	9/7/2005	10	avian	157
109891	MBN-090705-25	9/7/2005	35	rodent	157
109892	MBN-090705-25	9/7/2005	44	raccoon	157
109893	MBN-090705-25	9/7/2005	92	avian	157
109894	MBN-090705-25	9/7/2005	136	avian	157
109895	MBN-090705-25	9/7/2005	10	avian	157
109896	MBN-090705-35	9/7/2005	30	avian	157
109897	MBN-090705-35	9/7/2005	30	avian	157
109898	MBN-090705-35	9/7/2005	26	raccoon	157
109899	MBN-090705-35	9/7/2005	30	avian	157
109900	MBN-090705-35	9/7/2005	30	avian	157
109901	MBN-090705-35	9/7/2005	30	avian	157
109902	MBN-090705-35	9/7/2005	30	avian	157

Isolate .	Provider Sample .	Sample Date	Resident/T	Note	Study ID
110491	TCN64-100205-1	10/2/2005	16	u	157
110492	TCN64-100205-1	10/2/2005	79	avian	157
110493	TCN64-100205-1	10/2/2005	17	rodent	157
110494	TCN64-100205-2	10/2/2005	136	avian	157
110495	TCN64-100205-2	10/2/2005	52	goose	157
110496	TCN64-100205-2	10/2/2005	92	avian	157
110497	TCN64-100205-3	10/2/2005	17	rodent	157
110498	TCN64-100205-3	10/2/2005	226	raccoon	157
110499	TCN64-100205-3	10/2/2005	17	rodent	157
110500	TCS40-100205-1	10/2/2005	18	avian	157
110501	TCS40-100205-1	10/2/2005	18	avian	157
110502	TCS40-100205-1	10/2/2005	50	avian	157
110503	TCS40-100205-1	10/2/2005	145	rodent	157
110504	TCS40-100205-2	10/2/2005	111	u	157
110505	TCS40-100205-2	10/2/2005	89	avian	157
110506	TCS40-100205-2	10/2/2005	126	sewage	157
110507	TCS40-100205-3	10/2/2005	18	avian	157
110508	TCS40-100205-3	10/2/2005	79	avian	157
110509	TCS40-100205-3	10/2/2005	52	goose	157
110510	TCN33-100205-1	10/2/2005	1	avian	157
110511	TCN33-100205-1	10/2/2005	182	avian	157
110512	TCN33-100205-1	10/2/2005	35	rodent	157
110513	TCN33-100205-2	10/2/2005	154	rodent	157
110514	TCN33-100205-2	10/2/2005	18	avian	157
110515	TCN33-100205-2	10/2/2005	212	avian	157
110516	TCN33-100205-3	10/2/2005	80	u	157
110517	TCN33-100205-3	10/2/2005	216	avian	157
110518	TCN33-100205-3	10/2/2005	86	sewage	157
110519	TCS41-100205-1	10/2/2005	136	avian	157
110520	TCS41-100205-1	10/2/2005	92	avian	157
110521	TCS41-100205-1	10/2/2005	92	avian	157
110522	TCS41-100205-1	10/2/2005	231	avian	157
110523	TCS41-100205-2	10/2/2005	49	avian	157
110524	TCS41-100205-2	10/2/2005	10	avian	157
110525	TCS41-100205-2	10/2/2005	210	goose	157
110526	TCS41-100205-3	10/2/2005	35	rodent	157
110527	TCS41-100205-3	10/2/2005	143	rodent	157
110528	TCS41-100205-3	10/2/2005	224	rodent	157
110529	TCM46-100205-1	10/2/2005	154	rodent	157
110530	TCM46-100205-1	10/2/2005	62	opossum	157
110531	TCM46-100205-1	10/2/2005	62	opossum	157
110532	TCM46-100205-2	10/2/2005	10	avian	157
110533	TCM46-100205-2	10/2/2005	52	goose	157
110534	TCM46-100205-2	10/2/2005	52	goose	157
110535	TCM46-100205-3	10/2/2005	15	u	157
110536	TCM46-100205-3	10/2/2005	10	avian	157
110537	TCM46-100205-3	10/2/2005	216	avian	157
110538	MBS-100205-1	10/2/2005	17	rodent	157
110539	MBS-100205-1	10/2/2005	23	duck	157
110540	MBS-100205-1	10/2/2005	22	u	157
110541	MBS-100205-1	10/2/2005	22	u	157

Isolate .	Provider Sample .	Sample Date	Resident/T	Note	Study ID
110542	MBS-100205-2	10/2/2005	33	avian	157
110543	MBS-100205-2	10/2/2005	90	goose	157
110544	MBS-100205-2	10/2/2005	190	avian	157
110545	MBS-100205-3	10/2/2005	145	rodent	157
110546	MBS-100205-3	10/2/2005	145	rodent	157
110547	MBS-100205-3	10/2/2005	35	rodent	157
110548	MBN-100205-1	10/2/2005	10	avian	157
110549	MBN-100205-1	10/2/2005	204	sewage	157
110550	MBN-100205-1	10/2/2005	123	u	157
110551	MBN-100205-2	10/2/2005	35	rodent	157
110552	MBN-100205-2	10/2/2005	77	u	157
110553	MBN-100205-2	10/2/2005	240	u	157
110554	MBN-100205-3	10/2/2005	133	avian	157
110555	MBN-100205-3	10/2/2005	92	avian	157
110556	MBN-100205-3	10/2/2005	77	u	157
110616	TCN64-102505-1	10/25/2005	177	avian	157
110617	TCN64-102505-1	10/25/2005	92	avian	157
110618	TCN64-102505-1	10/25/2005	92	avian	157
110619	TCN64-102505-2	10/25/2005	154	rodent	157
110620	TCN64-102505-2	10/25/2005	92	avian	157
110621	TCN64-102505-2	10/25/2005	92	avian	157
110622	TCN64-102505-2	10/25/2005	92	avian	157
110623	TCN64-102505-3	10/25/2005	177	avian	157
110624	TCN64-102505-3	10/25/2005	92	avian	157
110625	TCN64-102505-3	10/25/2005	92	avian	157
110626	TCS40-102505-1	10/25/2005	120	dog	157
110627	TCS40-102505-1	10/25/2005	139	avian	157
110628	TCS40-102505-1	10/25/2005	10	avian	157
110629	TCS40-102505-2	10/25/2005	120	dog	157
110630	TCS40-102505-2	10/25/2005	127	sewage	157
110631	TCS40-102505-2	10/25/2005	120	dog	157
110632	TCS40-102505-3	10/25/2005	154	rodent	157
110633	TCS40-102505-3	10/25/2005	154	rodent	157
110634	TCS40-102505-3	10/25/2005	127	sewage	157
110635	TCN33-102505-1	10/25/2005	87	dog	157
110636	TCN33-102505-1	10/25/2005	149	dog	157
110637	TCN33-102505-1	10/25/2005	149	dog	157
110638	TCN33-102505-2	10/25/2005	149	dog	157
110639	TCN33-102505-2	10/25/2005	17	rodent	157
110640	TCN33-102505-2	10/25/2005	149	dog	157
110641	TCN33-102505-2	10/25/2005	149	dog	157
110642	TCN33-102505-3	10/25/2005	154	rodent	157
110643	TCN33-102505-3	10/25/2005	8	raccoon	157
110644	TCN33-102505-3	10/25/2005	107	raccoon	157
110645	TCS41-102505-1	10/25/2005	5	duck	157
110646	TCS41-102505-1	10/25/2005	190	rodent	157
110647	TCS41-102505-1	10/25/2005	5	duck	157
110648	TCS41-102505-2	10/25/2005	92	avian	157
110649	TCS41-102505-2	10/25/2005	92	avian	157
110650	TCS41-102505-2	10/25/2005	92	avian	157
110651	TCS41-102505-3	10/25/2005	212	avian	157

Isolate .	Provider Sample .	Sample Date	Resident/T	Note	Study ID
110652	TCS41-102505-3	10/25/2005	52	goose	157
110653	TCS41-102505-3	10/25/2005	212	avian	157
110654	TCM46-102505-1	10/25/2005	17	rodent	157
110655	TCM46-102505-1	10/25/2005	83	rodent	157
110656	TCM46-102505-1	10/25/2005	50	avian	157
110657	TCM46-102505-2	10/25/2005	50	avian	157
110658	TCM46-102505-2	10/25/2005	35	rodent	157
110659	TCM46-102505-2	10/25/2005	17	rodent	157
110660	TCM46-102505-3	10/25/2005	94	raccoon	157
110661	TCM46-102505-3	10/25/2005	94	raccoon	157
110662	TCM46-102505-3	10/25/2005	44	raccoon	157
110663	TCM46-102505-3	10/25/2005	92	avian	157
110664	MBS-102505-1	10/25/2005	35	rodent	157
110665	MBS-102505-1	10/25/2005	219	avian	157
110666	MBS-102505-1	10/25/2005	92	avian	157
110667	MBS-102505-2	10/25/2005	92	avian	157
110668	MBS-102505-2	10/25/2005	92	avian	157
110669	MBS-102505-2	10/25/2005	92	avian	157
110670	MBS-102505-3	10/25/2005	92	avian	157
110671	MBS-102505-3	10/25/2005	207	raccoon	157
110672	MBS-102505-3	10/25/2005	207	raccoon	157
110673	MBN-102505-1	10/25/2005	231	dog	157
110674	MBN-102505-1	10/25/2005	201	u	157
110675	MBN-102505-1	10/25/2005	83	rodent	157
110676	MBN-102505-2	10/25/2005	139	avian	157
110677	MBN-102505-2	10/25/2005	35	rodent	157
110678	MBN-102505-2	10/25/2005	10	avian	157
110679	MBN-102505-3	10/25/2005	47	canine	157
110680	MBN-102505-3	10/25/2005	139	avian	157
110681	MBN-102505-3	10/25/2005	139	avian	157
110682	MBN-102505-3	10/25/2005	9	dog	157
110683	MBP-102505-1	10/25/2005	239	dog	157
110684	MBP-102505-1	10/25/2005	34	dog	157
110685	MBP-102505-1	10/25/2005	239	dog	157
110755	TCS40-102805-1	10/28/2005	136	avian	157
110756	TCS40-102805-1	10/28/2005	231	avian	157
110757	TCS40-102805-1	10/28/2005	35	rodent	157
110758	TCN64-102805-1	10/28/2005	207	raccoon	157
110759	TCN64-102805-1	10/28/2005	10	avian	157
110760	TCN64-102805-1	10/28/2005	35	rodent	157
110761	TCN64-102805-1	10/28/2005	35	rodent	157
110762	TCN33-102805-1	10/28/2005	35	rodent	157
110763	TCN33-102805-1	10/28/2005	231	dog	157
110764	TCN33-102805-1	10/28/2005	92	avian	157
110765	TCS41-102805-1	10/28/2005	35	rodent	157
110766	TCS41-102805-1	10/28/2005	190	rodent	157
110767	TCS41-102805-1	10/28/2005	207	raccoon	157
110768	TCM46-102805-1	10/28/2005	139	avian	157
110769	TCM46-102805-1	10/28/2005	35	rodent	157
110770	TCM46-102805-1	10/28/2005	190	avian	157
110771	MBS-102805-1	10/28/2005	35	rodent	157

Isolate .	Provider Sample .	Sample Date	Resident/T	Note	Study ID
110772	MBS-102805-1	10/28/2005	83	rodent	157
110773	MBS-102805-1	10/28/2005	133	avian	157
110774	MBN-102805-1	10/28/2005	89	avian	157
110775	MBN-102805-1	10/28/2005	10	avian	157
110776	MBN-102805-1	10/28/2005	139	avian	157
110777	TCN64-103105-2	10/31/2005	44	raccoon	157
110778	TCN64-103105-2	10/31/2005	19	dog	157
110779	TCN64-103105-2	10/31/2005	35	rodent	157
110780	TCS40-103105-2	10/31/2005	35	rodent	157
110781	TCS40-103105-2	10/31/2005	35	rodent	157
110782	TCS40-103105-2	10/31/2005	166	avian	157
110783	TCS40-103105-2	10/31/2005	166	avian	157
110784	TCN33-103105-2	10/31/2005	119	avian	157
110785	TCN33-103105-2	10/31/2005	35	rodent	157
110786	TCN33-103105-2	10/31/2005	17	rodent	157
110787	TCS41-103105-2	10/31/2005	54	sewage	157
110788	TCS41-103105-2	10/31/2005		sewage	157
110789	TCS41-103105-2	10/31/2005	10	avian	157
110790	TCM46-103105-2	10/31/2005	187	canine	157
110791	TCM46-103105-2	10/31/2005	187	canine	157
110792	TCM46-103105-2	10/31/2005	35	rodent	157
110793	MBS-103105-2	10/31/2005	35	rodent	157
110794	MBS-103105-2	10/31/2005	79	avian	157
110795	MBN-103105-2	10/31/2005	154	rodent	157
110796	MBN-103105-2	10/31/2005		rodent	157
110797	MBN-103105-2	10/31/2005	148	u	157
110798	TCN64-110105-3	11/1/2005	119	avian	157
110799	TCN64-110105-3	11/1/2005	92	avian	157
110800	TCN64-110105-3	11/1/2005	109	canine	157
110801	TCN64-110105-3	11/1/2005	109	canine	157
110802	TCS40-110105-3	11/1/2005	207	raccoon	157
110803	TCS40-110105-3	11/1/2005	209	avian	157
110804	TCS40-110105-3	11/1/2005	10	avian	157
110805	TCN33-110105-3	11/1/2005	166	avian	157
110806	TCN33-110105-3	11/1/2005	236	u	157
110807	TCN33-110105-3	11/1/2005	74	feline	157
110808	TCS41-110105-3	11/1/2005	35	rodent	157
110809	TCS41-110105-3	11/1/2005	5	duck	157
110810	TCS41-110105-3	11/1/2005	222	raccoon	157
110811	TCM46-110105-3	11/1/2005	17	rodent	157
110812	TCM46-110105-3	11/1/2005	132	goose	157
110813	TCM46-110105-3	11/1/2005	212	avian	157
110814	MBS-110105-3	11/1/2005	216	avian	157
110815	MBS-110105-3	11/1/2005	92	avian	157
110816	MBS-110105-3	11/1/2005	227	dog	157
110817	MBN-110105-3	11/1/2005	29	rodent	157
110818	MBN-110105-3	11/1/2005	234	dog	157
110819	MBN-110105-3	11/1/2005	118	u	157
111097	TCN64-112105-1	11/21/2005	207	raccoon	157
111098	TCN64-112105-1	11/21/2005	216	avian	157
111099	TCN64-112105-1	11/21/2005	9	dog	157

Isolate .	Provider Sample .	Sample Date	Resident/T	Note	Study ID
111100	TCN64-112105-2	11/21/2005	35	rodent	157
111101	TCN64-112105-2	11/21/2005	35	rodent	157
111102	TCN64-112105-2	11/21/2005	231	dog	157
111103	TCN64-112105-2	11/21/2005	35	rodent	157
111104	TCN64-112105-3	11/21/2005	207	raccoon	157
111105	TCN64-112105-3	11/21/2005	216	avian	157
111106	TCN64-112105-3	11/21/2005	216	avian	157
111107	TCS40-112105-1	11/21/2005	28	avian	157
111108	TCS40-112105-1	11/21/2005	10	avian	157
111109	TCS40-112105-1	11/21/2005	10	avian	157
111110	TCS40-112105-2	11/21/2005	154	rodent	157
111111	TCS40-112105-2	11/21/2005	10	avian	157
111112	TCS40-112105-2	11/21/2005	10	avian	157
111113	TCS40-112105-3	11/21/2005	212	avian	157
111114	TCS40-112105-3	11/21/2005	10	avian	157
111115	TCS40-112105-3	11/21/2005	10	avian	157
111116	TCN33-112105-1	11/21/2005	92	avian	157
111117	TCN33-112105-1	11/21/2005	35	rodent	157
111118	TCN33-112105-1	11/21/2005	30	avian	157
111119	TCN33-112105-2	11/21/2005	30	avian	157
111120	TCN33-112105-2	11/21/2005	30	avian	157
111121	TCN33-112105-2	11/21/2005	30	avian	157
111122	TCN33-112105-2	11/21/2005	131	u	157
111123	TCN33-112105-3	11/21/2005	223	sewage	157
111124	TCN33-112105-3	11/21/2005	30	avian	157
111125	TCN33-112105-3	11/21/2005	30	avian	157
111126	TCS41-112105-1	11/21/2005	164	u	157
111127	TCS41-112105-1	11/21/2005	175	u	157
111128	TCS41-112105-1	11/21/2005	91	avian	157
111129	TCS41-112105-2	11/21/2005	35	rodent	157
111130	TCS41-112105-2	11/21/2005	92	avian	157
111131	TCS41-112105-2	11/21/2005	92	avian	157
111132	TCS41-112105-3	11/21/2005	35	rodent	157
111133	TCS41-112105-3	11/21/2005	115	u	157
111134	TCS41-112105-3	11/21/2005	164	u	157
111135	TCM46-112105-1	11/21/2005	144	raccoon	157
111136	TCM46-112105-1	11/21/2005	144	raccoon	157
111137	TCM46-112105-1	11/21/2005	164	u	157
111138	TCM46-112105-2	11/21/2005	154	rodent	157
111139	TCM46-112105-2	11/21/2005	35	rodent	157
111140	TCM46-112105-2	11/21/2005	154	rodent	157
111141	TCM46-112105-2	11/21/2005	154	rodent	157
111142	TCM46-112105-3	11/21/2005	226	raccoon	157
111143	TCM46-112105-3	11/21/2005	34	dog	157
111144	TCM46-112105-3	11/21/2005	172	avian	157
111145	MBS-112105-1	11/21/2005	184	avian	157
111146	MBS-112105-1	11/21/2005	196	u	157
111147	MBS-112105-1	11/21/2005	35	rodent	157
111148	MBS-112105-2	11/21/2005	35	rodent	157
111149	MBS-112105-2	11/21/2005	35	rodent	157
111150	MBS-112105-2	11/21/2005	164	u	157

Isolate .	Provider Sample .	Sample Date	Resident/T	Note	Study ID
111151	MBS-112105-3	11/21/2005	116	dog	157
111152	MBS-112105-3	11/21/2005	164	u	157
111153	MBS-112105-3	11/21/2005	35	rodent	157
111154	MBN-112105-1	11/21/2005	216	avian	157
111155	MBN-112105-1	11/21/2005	17	rodent	157
111156	MBN-112105-1	11/21/2005	17	rodent	157
111157	MBN-112105-2	11/21/2005	17	rodent	157
111158	MBN-112105-2	11/21/2005	17	rodent	157
111159	MBN-112105-2	11/21/2005	17	rodent	157
111160	MBN-112105-3	11/21/2005	212	avian	157
111161	MBN-112105-3	11/21/2005	212	avian	157
111162	MBN-112105-3	11/21/2005	17	rodent	157
111163	MBN-112105-3	11/21/2005	17	rodent	157
111164	MBP-112105-1	11/21/2005	52	goose	157
111165	MBP-112105-1	11/21/2005	52	goose	157
111166	MBP-112105-1	11/21/2005	52	goose	157
111448	TCN64-122005-1	12/20/2005	119	avian	157
111449	TCN64-122005-1	12/20/2005	168	canine	157
111450	TCN64-122005-1	12/20/2005	92	avian	157
111451	TCS40-122005-1	12/20/2005	172	avian	157
111452	TCS40-122005-1	12/20/2005	81	u	157
111453	TCS40-122005-1	12/20/2005	35	rodent	157
111454	TCN33-122005-1	12/20/2005	35	rodent	157
111455	TCN33-122005-1	12/20/2005	35	rodent	157
111456	TCN33-122005-1	12/20/2005	108	avian	157
111457	TCS41-122005-1	12/20/2005	231	dog	157
111458	TCS41-122005-1	12/20/2005	212	avian	157
111459	TCS41-122005-1	12/20/2005	172	avian	157
111460	TCM46-122005-1	12/20/2005	35	rodent	157
111461	TCM46-122005-1	12/20/2005	35	rodent	157
111462	TCM46-122005-1	12/20/2005	1	avian	157
111463	TCM46-122005-1	12/20/2005	129	avian	157
111464	MBS-122005-1	12/20/2005	179	avian	157
111465	MBS-122005-1	12/20/2005	206	avian	157
111466	MBS-122005-1	12/20/2005	99	dog	157
111467	MBN-122005-1	12/20/2005	231	dog	157
111468	MBN-122005-1	12/20/2005	139	avian	157
111469	MBN-122005-1	12/20/2005	206	avian	157
111470	TCN64-122105-2	12/21/2005	10	avian	157
111471	TCN64-122105-2	12/21/2005	55	u	157
111472	TCN64-122105-2	12/21/2005	168	canine	157
111473	TCN64-122105-2	12/21/2005	79	avian	157
111474	TCN64-122105-3	12/21/2005	136	avian	157
111475	TCN64-122105-3	12/21/2005	206	avian	157
111476	TCN64-122105-3	12/21/2005	136	avian	157
111477	TCS40-122105-2	12/21/2005	163	u	157
111478	TCS40-122105-2	12/21/2005	142	avian	157
111479	TCS40-122105-2	12/21/2005	181	avian	157
111480	TCS40-122105-3	12/21/2005	35	rodent	157
111481	TCS40-122105-3	12/21/2005	35	rodent	157
111482	TCS40-122105-3	12/21/2005	49	avian	157

Isolate .	Provider Sample .	Sample Date	Resident/T	Note	Study ID
111483	TCS40-122105-3	12/21/2005	154	rodent	157
111484	TCN33-122105-2	12/21/2005	10	avian	157
111485	TCN33-122105-2	12/21/2005	139	avian	157
111486	TCN33-122105-2	12/21/2005	35	rodent	157
111487	TCN33-122105-3	12/21/2005	52	goose	157
111488	TCN33-122105-3	12/21/2005	103	u	157
111489	TCN33-122105-3	12/21/2005	35	rodent	157
111490	TCS41-122105-2	12/21/2005	73	u	157
111491	TCS41-122105-2	12/21/2005	26	raccoon	157
111492	TCS41-122105-2	12/21/2005	73	u	157
111493	TCS41-122105-3	12/21/2005	205	avian	157
111494	TCS41-122105-3	12/21/2005	148	u	157
111495	TCS41-122105-3	12/21/2005	101	raccoon	157
111496	TCM46-122105-2	12/21/2005	231	dog	157
111497	TCM46-122105-2	12/21/2005	67	u	157
111498	TCM46-122105-2	12/21/2005	154	rodent	157
111499	TCM46-122105-3	12/21/2005	44	raccoon	157
111500	TCM46-122105-3	12/21/2005	26	raccoon	157
111501	TCM46-122105-3	12/21/2005	26	raccoon	157
111502	TCM46-122105-3	12/21/2005	44	raccoon	157
111503	MBS-122105-2	12/21/2005	186	raccoon	157
111504	MBS-122105-2	12/21/2005	97	rodent	157
111505	MBS-122105-2	12/21/2005	35	rodent	157
111506	MBS-122105-3	12/21/2005	154	rodent	157
111507	MBS-122105-3	12/21/2005	10	avian	157
111508	MBS-122105-3	12/21/2005	206	avian	157
111509	MBN-122105-2	12/21/2005	139	avian	157
111510	MBN-122105-2	12/21/2005	178	u	157
111511	MBN-122105-2	12/21/2005	186	raccoon	157
111512	MBN-122105-3	12/21/2005	92	avian	157
111513	MBN-122105-3	12/21/2005	180	opossum	157
111514	MBN-122105-3	12/21/2005	139	avian	157