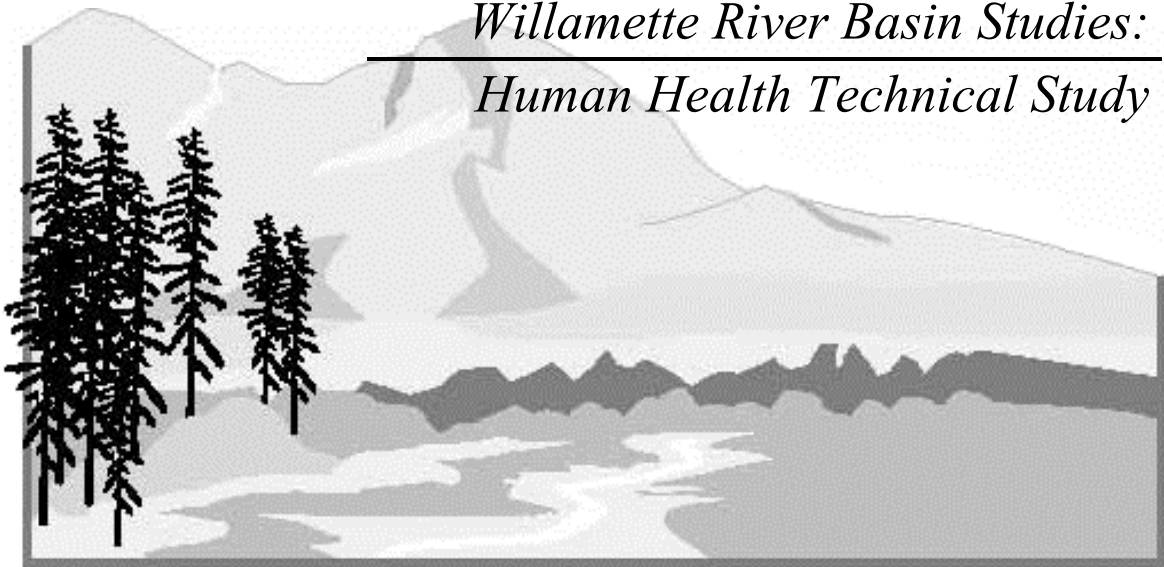


APPENDIX A

Results of 1998 Recreational Water Contact Survey
of the Newberg Pool, Willamette River, Oregon



Willamette River Basin Studies:
Human Health Technical Study

TECHNICAL MEMORANDUM 1

*Results of 1998 Recreational Water Contact Survey
of the Newberg Pool, Willamette River, Oregon*

Prepared for

Oregon Department of Environmental Quality
Water Quality Division
811 SW Sixth Ave.
Portland, Oregon 97204

DEQ Contract No.: 004-99

Prepared by

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EVS Project No.: 2/839-01

February 1999

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LIST OF ACRONYMS

DEQ	Oregon Department of Environmental Quality
EVS	EVS Environment Consultants
Marine Board	Oregon State Marine Board
RM	river mile
WRBTF	Willamette River Basin Task Force
WRTASC	Willamette River Technical Advisory Steering Committee

1998 RECREATIONAL WATER CONTACT SURVEY

Protecting and improving the water quality and overall health of the Willamette River and its tributaries has been a high priority for the Oregon Department of Environmental Quality (DEQ) for several decades. Before the implementation of wastewater treatment regulations in the 1970s, sewage and industrial discharges caused severe water quality problems in the form of low dissolved oxygen and elevated bacteria and nutrient concentrations (Merryfield and Wilmot 1945; Merryfield et al. 1947). These problems were addressed by requiring secondary treatment of discharged wastewater, which resulted in a dramatic improvement in water quality. DEQ's efforts were hailed as a national success story. However, by the late 1980s, concerns about the health of the Willamette River were once again raised by reports of trace metals and organic contaminants in water and sediments and evidence of impaired biota within the Willamette River Basin (Hughes and Gannon 1987; DEQ 1990). These reports, along with concerns that changing land uses and projected increases in the basin's population could result in additional adverse effects to the river's water quality, led DEQ to initiate further efforts to characterize and determine the causes of water quality problems.

In early 1990, the Oregon Joint Legislative Emergency Board directed DEQ to form the Willamette River Technical Advisory Steering Committee (WRTASC). DEQ and WRTASC designed a comprehensive study to compile data about environmental contaminants in the water column and sediments, and the abundance and diversity of aquatic life in the river, as well as land use in the basin. A second emphasis of the study was to develop tools, both predictive models and biological indices, to help DEQ manage the river proactively. The study was conducted during three two-year phases, which culminated in the completion of summary reports on the current status and health of the Willamette River (Tetra Tech 1995).

Although the multi-year multi-phased study substantially advanced our understanding of the environmental problems in the Willamette River Basin and helped identify the potential sources of these problems, a lack of resources precluded addressing all the pertinent topics. In particular, the phased efforts did not include studies to determine the amounts and types of fish consumed by anglers and if the consumed fish species contain chemical concentrations that may pose an unacceptable health risk to individuals regularly consuming fish from the river. Nor were studies conducted to evaluate the health risks associated with recreational water contact activities or the suitability of the Willamette River as a drinking water source. The Willamette River Basin Task Force (WRBTF), which assessed the status of the waters of the Willamette River Basin, issued a report of their recommendations to Governor Kitzhaber and the Oregon Legislature in December 1997 (WRBTF 1997). The WRBTF identified three human health concerns in

the Willamette River Basin that should be evaluated: fish consumption, water contact recreation, and drinking water.

Tasks 2A and 2B, as defined in the Scope of Work (EVS 1998), were designed to collect information about health risks to humans who engage in water contact recreation in the Willamette River. The process that was used to identify sites of high usage for water contact recreation in the Willamette River and the selection of a subset of sites where bacteria sampling will be conducted are described in this report.

TASK OBJECTIVES

- Conduct a water contact recreation survey to identify high-use areas along the Wheatland-Willamette Falls Reach, and record the types of recreational and other water contact activities that occur in these areas.
- Select four bacterial sampling sites from the high-use areas identified in the reconnaissance survey and information received from agencies.
- Collect bacteria samples at chosen sites to determine compliance with Oregon water quality standards for fecal coliform bacteria and *Escherichia coli*.

The results of the bacterial sampling in the Willamette River will be used to:

- Develop a list of sources of bacterial contaminants in the Wheatland-Willamette Falls Reach and develop strategies for remediating these contaminants.
- Develop recommendations for future bacteria monitoring in the Willamette River to determine whether remedial efforts are successful. Recommendations for monitoring will incorporate the final design developed by the U.S. Geological Survey and DEQ for their long-term Ambient Monitoring Program and consider the value of monitoring traditional bacterial indices (e.g., fecal coliforms and *E. coli*) and additional indicators of bacterial or pathogen presence.
- Develop public outreach tools to inform the populations at greatest risk for bacterial exposure about the study conclusions. Develop strategies and tools for determining whether providing information to users about health risks associated with contact recreation is effective in reducing individual risk.

The results of the first two task objectives are presented below.

High-Use Area Characterization

The Willamette River has the second highest recreational usage of any waterbody in Oregon, with only the Columbia River being used more. The stretch of the Willamette River that runs through Clackamas County (from RM 29 to RM 42) had the second highest number of use days in the state in 1992 and 1995 (Marine Board 1996).

In September 1998, EVS Environment Consultants (EVS) conducted a water contact reconnaissance survey by jet boat along a 45-mile stretch of the Willamette River extending from Wheatland Ferry, at river mile (RM) 72, to Willamette Falls near Oregon City, at RM 26.5 (the Wheatland-Willamette Falls Reach; Figure 1). This reach was previously chosen as the area of interest by DEQ, in part because it includes the Newberg Pool (RM 52 to RM 26.5). It was important to observe recreational use in this area to determine the extent of water contact because the Newberg Pool has been historically identified as an area of poor water quality.

During the field survey, recreational use along the Wheatland-Willamette Falls Reach was documented by videotaping the stretch of river and by annotating maps of the reach with observations of recreational use or areas of potential recreational use. Special note was taken of boat ramps, docks, beaches, parks, and on-going recreational activities such as waterskiing and fishing. Weather conditions during this survey were clear during the morning, changing to overcast conditions and rain in the afternoon. In addition, Adolfson Associates, Inc. analyzed aerial photographs of the reach taken in April and August of 1998 (by WAC, Inc. for DEQ) to estimate the number of recreational boats using specific locations along the river. EVS also compiled data from the Oregon State Marine Board (Marine Board), Oregon State Parks Department, and the Clackamas County River Patrol on types of activities and amount of use in the area. These data were used to characterize recreational use of the reach and to select sites with high primary-contact use. A subset of high-use sites was then selected for bacterial sampling based on all available information.

Seven sites were identified during the field survey which could be potential high water-contact areas based on waterfront access, boat docks and ramps, and on-going use at the time of the survey. Table 1 summarizes the types and amount of contact at each of these sites, which are described in greater detail below.

Waterskiers were seen entering the river at Bernert Landing (RM 28) and using a ski jump nearby. Picnicking and moorage are available at a riverfront park, and in aerial photographs of the area, three boats were counted nearby. The Marine Board (1996) calculated that Bernert Landing had 22,700 activity days (as defined in Marine Board

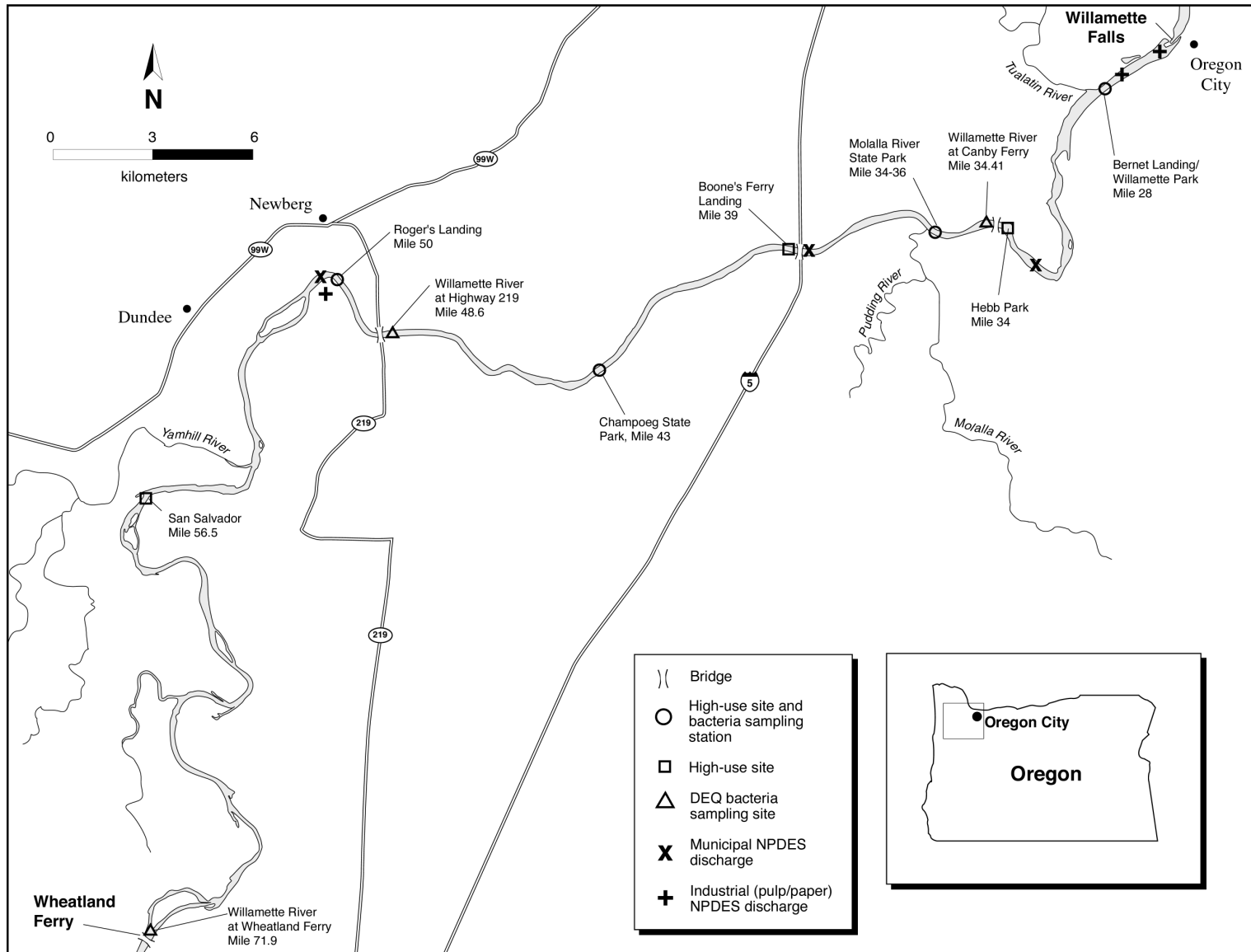


Figure 1. The Wheatland-Willamette Falls reach of the Willamette River – the proposed area for bacterial sampling

Table 1. Frequency and types of recreational use of seven high-use sites on the Willamette River

	NO. BOATS (AERIAL PHOTO- GRAPHS)	ACTIVITY DAYS^a	FISHING DAYS	FISHING PERCENT	SAILING DAYS	SAILING PERCENT	JETSKIING DAYS	JETSKIING PERCENT	WATERSKIING DAYS	WATERSKIING PERCENT	CRUISING DAYS	CRUISING PERCENT	OTHER ACTIVITIES
Bernert Landing RM 28	3	22,700	1,082	4.8%	0	0.0%	552	2.4%	19,429	85.6%	1,637	7.2%	Moorage, picnicking
Hebb Park RM 33	5	1,568	0	0.0%	0	0.0%	756	48.2%	813	51.8%	0	0.0%	Moorage, picnicking, hiking, biking
Molalla River S.P. RM 34–36	3	6,139	305	5.0%	0	0.0%	0	0.0%	4,566	74.4%	1,268	20.7%	Picnicking, hiking, biking
Boones Ferry Landing RM 39	2	13,216	1,351	10.2%	0	0.0%	2,325	17.6%	6,820	51.6%	2,720	20.6%	Moorage
Champoeg State Park RM 43–46	6	na	na	na	na	na	na	na	na	na	na	na	Public dock, camping, picnicking, hiking, biking
Roger's Landing RM 50	8	25,811	1,903	7.4%	2,049	7.9%	1,164	4.5%	17,700	68.6%	2,995	11.6%	Moorage, picnicking, hiking
San Salvador RM 56.5	7	923	825	89.4%	0	0.0%	98	10.6%	0	0.0%	0	0.0%	Picnicking

SOURCE: Marine Board (1996)

NOTE: na - not available
RM - river mile

^a As defined in Marine Board (1996).

1996) in 1995. Of these activity days, 4.8 percent were spent fishing, 2.4 percent jetskiing, 85.6 percent waterskiing, and 7.2 percent cruising.

Hebb Park (RM 33) offers a boat ramp and moorage, along with hiking, biking, and picnicking. The Clackamas County River Patrol identified Hebb Park as a high-use area. Five boats were counted nearby in aerial photographs. Activities at this park, as determined by the Marine Board (1996), were primarily jetskiing at 48.2 percent and waterskiing at 51.8 percent.

Between RM 34 and RM 36, Molalla River State Park is considered by the Greenways parcel manager to be a very nice park with steady use, group picnicking, and special events like civil war reenactments. Lots of recreational and fishing boats use the park, and there is a primitive ramp where visitors can launch motorized craft (Havel pers. comm. 1998). A ramp improvement project is underway for this park and hiking, biking, and car access are available. A group of boat campers was also seen swimming nearby in the Willamette at the mouth of the Molalla River. Five boats were counted in the vicinity in aerial photographs. The Marine Board (1996) calculated 6,139 activity days, with fishing making up 5.0 percent, waterskiing 74.4 percent, and cruising 20.7 percent of the usage.

Boones Ferry Landing (RM 39), located under the I-5 bridge, is a public landing that is accessible by boat. It is situated next to the Boatworks Ltd. Marina where more than 60 boats were moored. During the field survey, we talked with a family in their boat who planned on skiing and cruising in the area. Two boats were seen in this area in the aerial photographs. The Marine Board (1996) reports 13,216 activity days, with fishing making up 10.2 percent, jetskiing 17.6 percent, waterskiing 51.6 percent, and cruising 20.6 percent of the usage.

Champoeg State Park, between RM 43 and RM 46, offers hiking, biking, camping, picnicking, a transient use public dock, and car access. Several people were seen playing in the water here during the field survey and six boats were counted in the area in the aerial photographs. The Marine Board (1996) does not have statistics for this park because there is no boat launch, though there is a tie-up for boats. Oregon State Parks recorded 42,528 visitors for one segment of the park between 1994 and 1995. Numerous private homes situated along the banks of the river 2 to 3 miles downstream from the park had private docks, boats, and personal water craft.

At Roger's Landing (RM 50), several boaters were putting in and taking out of the river. Birders were also seen enjoying the park. Hiking and picnicking, as well as a boat ramp, are available. Eight boats were counted in the aerial photographs of this area. The Marine Board (1996) reported 25,811 activity days for this site, with all activities

represented. Fishing accounted for 7.4 percent of the activity days, sailing 7.9 percent, jetskiing 4.5 percent, waterskiing 68.6 percent, and cruising 11.6 percent.

San Salvador (RM 56.5) had a boat ramp and a couple of picnic tables; however, this area was predominantly occupied by pheasant hunters, fly-fishermen, and cast-fishermen in boats. Seven boats were counted in aerial photographs of the area. The Marine Board (1996) reported much lower usage of this site than the others, with only 923 activity days. Fishing accounted for 89.4 percent of these activity days and jetskiing the other 10.6 percent.

Sampling Location Selection

Four high-use recreational sites along the study area of the river have been selected as bacteria sampling locations. The sampling stations were selected based on the level of primary contact recreational use as determined by the field reconnaissance survey, the usage statistics presented by the Marine Board (1996), the opinions of State Parks managers and the Clackamas County River Patrol, and aerial photographs of the river on a sunny day. The proximity to previous bacterial sampling sites (at RM 55, 52, 50, 42, 39, 33, 32, 30, and 29) also influenced the selection of current sampling locations.

Three of the seven sites characterized above were eliminated. Hebb Park was removed from the list because it is only one mile downstream of Molalla River State Park and the number of use days at Hebb Park was much lower than at the State Park. Boones Ferry Landing was eliminated because, although the Marine Board (1996) reports a high number of activity days, 13,216, only two boats were observed in aerial photographs of the area. Since the marina is so near Boones Ferry, we suggest that boaters, waterskiers, and jetskiers would spread out from this point to other, less crowded areas. Swimmers would not be expected to use such a high-traffic area. Finally, San Salvador was eliminated because the State Parks manager in charge of this parcel described it as an area which is underwater most of the year and is prone to illicit activities. Based on this description, it is unlikely that many people would use the area for recreational water contact activities.

No stations were chosen for sampling upstream of RM 50 because the stretch of river between Roger's Landing and Wheatland Ferry is too shallow (1 to 3 feet of water) in most places to allow use by propeller boats. Few jet boats, which are capable of navigating in water of these depths, were observed on the river during the field reconnaissance survey. In addition, the density of residences along the river with boats and personal water craft drops off significantly between RM 50 and RM 72 and the river banks are heavily wooded, allowing little access to the river. The small number of recreationers observed upstream from RM 50 included anglers, hunters, and canoeists.

The sites chosen for bacterial sampling are presented below, in Table 2 and in Figure 1.

Table 2. Bacteria sampling stations selected

BACTERIA SAMPLING STATION	RIVER MILE	PRIMARY CONTACT RECREATION	NEARBY POINT SOURCES	OTHER FACTORS AFFECTING STATION SELECTION
1 - Bernert Landing/ Willamette Park	28	Boat launch, public dock, riverfront park	Upstream from Oregon City	Evidence of high-use found during field survey
2 - Molalla River State Park	34–36	Boat use (recreational and fishing), public dock, riverfront park	na	State Parks designated as high-use area
3 - Champoeg State Park	43	Public dock, riverfront park/ beach area	na	State Parks designated as high-use area
4 - Roger's Landing	50	Boat launch, riverfront park	Downstream from City of Newberg	Evidence of high-use found during field survey; designated by River Patrol as high-use area

NOTE: na - not applicable

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APPENDIX B

Laboratory Methods

LABORATORY METHODS

The laboratory method chosen to quantify bacteria living in natural waters depends on the target bacteria, and on the water's salinity, turbidity, and other factors (APHA 1992). In this study, two bacteria taxa were measured: concentrations of fecal coliform bacteria, and concentrations of *E. coli*. Fecal coliform concentrations were analyzed using Method 9222D (APHA 1992). Two different methods, Methods 9222D and 9213D (APHA 1992), were used to estimate *E. coli* concentrations in laboratory replicates of each water sample. These two methods have both been used in the Willamette/Columbia River Basin. The Oregon Department of Health, which analyzes water samples for the Oregon Department of Environmental Quality, currently uses Method 9213D to determine *E. coli* density in natural waters, and Method 9222D to determine fecal coliform density.

FECAL COLIFORM ANALYSIS USING METHOD 9222D

Fecal coliform concentrations were analyzed using a membrane filtration procedure, Method 9222D (APHA 1992). The concentration of bacteria in the water column was estimated by 1) filtering a known volume of sample water through a membrane filter, 2) transferring the filter to a petri dish filled with a food resource (medium), 3) incubating the dish at a specific temperature and time period, and 4) counting the colonies that formed. M-FC medium was used for the fecal coliform Method 9222D analysis, and the sample was incubated at $44.5 \pm 0.2^\circ\text{C}$ for 24 hours. The presence of blue colonies on the media indicated fecal coliform bacteria. The bacteria were then transferred to EC medium, a broth-like mixture, and incubated for 4 more hours at $44.5 \pm 0.2^\circ\text{C}$. Gas formation and turbidity in this medium, indicative of growth, reconfirmed the presence of fecal coliform bacteria (Domenighini pers. comm. 1999). This reconfirmation step was modified to determine whether the fecal coliform bacteria were *E. coli* (see method below).

E. COLI ANALYSIS USING METHOD 9222D

E. coli are the predominant members of the fecal coliform group (APHA 1992). In addition to determining the presence of fecal coliform bacteria, the M-FC medium can also be used to estimate *E. coli* concentrations, because both bacteria grow on this medium. Once blue colonies formed, the laboratory transferred the blue colonies to EC/ECMUG medium (broth). ECMUG is specific to *E. coli*. As stated above, gas formation and turbidity verified the presence of fecal coliform bacteria; fluorescence verified the presence of *E. coli*. If all blue colonies in the broth mixture became gaseous and turbid, but did not fluoresce, they were determined to be fecal coliform colonies, but

not *E. coli*. If the medium also fluoresced, the laboratory determined the colony to be *E. coli*.

E. COLI ANALYSIS USING METHOD 9213D

Method 9213D is an alternative membrane filtration technique that can be used to estimate *E. coli* concentrations. This method differs from Method 9222D in that the filter is placed on mTEC medium instead of M-FC. As with Method 9222D, the plate is incubated at $44.5 \pm 0.2^\circ\text{C}$ for 24 hours. The filter is then transferred to a urea substrate, and yellow colonies, which are indicative of *E. coli*, are counted. The laboratory reconfirmed the identification of *E. coli* by transferring colonies to ECMUG and looking for fluorescence, as with Method 9222D.

LABORATORY REPORTING OF NOT-DETECTED DATA

The membrane filtration techniques used in this study require a serial dilution of the original sample into subsamples in which the bacterial colonies can easily be counted; the desired range for a countable sample is 20–60 colonies. The appropriate level of dilution is subjectively determined by the analyst on a case-by-case basis, and will vary from sample to sample depending on the perceived turbidity of the sample. The more turbid or dense the sample appears, the greater the dilution (e.g., a dilution series of 10 percent, 1 percent, and 0.1 percent); the clearer the sample, the smaller the dilution (e.g., a dilution series of 50 percent, 25 percent, and 5 percent). Bacteria concentrations were reported as not detected when no colonies were present on the plate for a subsample of a particular dilution level, and the higher dilution samples had too many colonies to count. For example, if the dilution subsample with 25 percent of the original sample had too many colonies to count, and the dilution subsample with 5 percent of the original sample had zero colonies then the reported value would be undetected at 20 colonies/100mL. The undetected results for this study range from 4 (no colonies present in 25 percent of the sample) to 100 (no colonies present in 1 percent of the sample).

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APPENDIX C

Raw Data

Table C-1. Willamette River bacteria concentrations (colonies/100 mL)

STATION	LOCATION	RM	LATITUDE	LONGITUDE	7/1/99			7/8/99		
					REP 1	REP 2	REP 3	REP 1	REP 2	REP 3
Fecal Coliform, Method SM 9222										
1	Willamette Park - Bernet Landing	28	45° 20.334	122° 38.978	600	125	nd (< 100)	100	200	nd (< 100)
2	Mollalla River State Park	35	45° 17.817	122° 42.130	30	13	25	10	20	40
3	Champoeg State Park	43	45° 15.288	122° 53.040	5.0	8.0	3.0	nd (< 20)	nd (< 20)	nd (< 20)
4	Roger's Landing	50	45° 17.160	122° 57.965	3.0	5.0	30	nd (< 20)	20	20
<i>E. coli</i>, Method SM 9222										
1	Willamette Park - Bernet Landing	28	45° 20.334	122° 38.978	600	125	nd (< 100)	100	200	nd (< 100)
2	Mollalla River State Park	35	45° 17.817	122° 42.130	30	13	25	10	20	40
3	Champoeg State Park	43	45° 15.288	122° 53.040	5.0	8.0	3.0	nd (< 20)	nd (< 20)	nd (< 20)
4	Roger's Landing	50	45° 17.160	122° 57.965	3.0	5.0	30	nd (< 20)	20	20
<i>E. coli</i>, Method SM 9213										
1	Willamette Park - Bernet Landing	28	45° 20.334	122° 38.978	na	na	na	100	200	30
2	Mollalla River State Park	35	45° 17.817	122° 42.130	na	na	na	10	nd (< 4.0)	12
3	Champoeg State Park	43	45° 15.288	122° 53.040	na	na	na	10	4.0	nd <4.0
4	Roger's Landing	50	45° 17.160	122° 57.965	na	na	na	nd <4.0	8.0	4.0

Table C-1, continued

STATION	LOCATION	RM	LATITUDE	LONGITUDE	7/15/99			7/22/99		
					REP 1	REP 2	REP 3	REP 1	REP 2	REP 3
Fecal Coliform, Method SM 9222										
1	Willamette Park - Bernet Landing	28	45° 20.334	122° 38.978	nd (< 100)	nd (< 100)	nd (< 100)	80 ^a	20 ^a	30 ^a
2	Mollalla River State Park	35	45° 17.817	122° 42.130	nd (< 100)	nd (< 100)	50	30 ^a	20	10
3	Champoeg State Park	43	45° 15.288	122° 53.040	nd (< 100)	nd (< 100)	nd (< 100)	10	10	60
4	Roger's Landing	50	45° 17.160	122° 57.965	nd (< 100)	50	nd (< 100)	30	30	70
<i>E. coli</i>, Method SM 9222										
1	Willamette Park - Bernet Landing	28	45° 20.334	122° 38.978	nd (< 100)	nd (< 100)	nd (< 100)	80 ^a	20 ^a	30 ^a
2	Mollalla River State Park	35	45° 17.817	122° 42.130	nd (< 100)	nd (< 100)	50	30 ^a	20	10
3	Champoeg State Park	43	45° 15.288	122° 53.040	nd (< 100)	nd (< 100)	nd (< 100)	10	10	60
4	Roger's Landing	50	45° 17.160	122° 57.965	nd (< 100)	50	nd (< 100)	30	30	70
<i>E. coli</i>, Method SM 9213										
1	Willamette Park - Bernet Landing	28	45° 20.334	122° 38.978	nd (< 100)	10	10	50 ^a	30 ^a	10 ^a
2	Mollalla River State Park	35	45° 17.817	122° 42.130	20	50	50	10 ^a	nd (< 10)	nd (< 10)
3	Champoeg State Park	43	45° 15.288	122° 53.040	10	10	nd (< 10)	nd (< 10)	10	10
4	Roger's Landing	50	45° 17.160	122° 57.965	nd (< 10)	nd (< 10)	nd (< 10)	10	20	10

Table C-1, continued

STATION	LOCATION	RM	LATITUDE	LONGITUDE	7/29/99		
					REP 1	REP 2	REP 3
Fecal Coliform, Method SM 9222							
1	Willamette Park - Bernet Landing	28	45° 20.334	122° 38.978	300	510	175
2	Mollalla River State Park	35	45° 17.817	122° 42.130	20	20	60
3	Champoeg State Park	43	45° 15.288	122° 53.040	10	30	30
4	Roger's Landing	50	45° 17.160	122° 57.965	nd (< 10)	nd (< 10)	10
<i>E. coli</i>, Method SM 9222							
1	Willamette Park - Bernet Landing	28	45° 20.334	122° 38.978	300	510	175
2	Mollalla River State Park	35	45° 17.817	122° 42.130	20	20	60
3	Champoeg State Park	43	45° 15.288	122° 53.040	10	30	30
4	Roger's Landing	50	45° 17.160	122° 57.965	nd (< 10)	nd (< 10)	10
<i>E. coli</i>, Method SM 9213							
1	Willamette Park - Bernet Landing	28	45° 20.334	122° 38.978	270	210	200
2	Mollalla River State Park	35	45° 17.817	122° 42.130	nd (< 10)	70	40
3	Champoeg State Park	43	45° 15.288	122° 53.040	10	30	10
4	Roger's Landing	50	45° 17.160	122° 57.965	10	nd (< 10)	nd (< 10)

NOTE: na - not analyzed
 nd - not detected (detection limit follows)

^a Holding time for samples was exceeded.

APPENDIX D

Quality Assurance/Quality Control
Review of July 1999 Bacterial Survey Data

**QUALITY ASSURANCE/QUALITY CONTROL
REVIEW OF JULY 1999 BACTERIAL SURVEY DATA**

All samples were analyzed within the designated holding time except for samples collected from Bernet Landing on July 22, 1999 (1BE0722991, 1BE0722992, and 1BE0722993) and Replicate Number One from Mollalla River State Park (1MO0722991). During incubation of these four samples, laboratory personnel, following quality assurance/quality control procedures, noted that the incubator temperature had drifted by more than 0.5°C. Therefore, the samples were reanalyzed on July 24, 1999 using the remaining portion of water samples archived by the laboratory at 4°C. Table D-1 summarizes bacteria concentrations measured in the original analyses and the reanalyses for fecal coliform bacteria and *E. coli*.

**Table D-1. Results of the original analyses and reanalyses
of the four samples subjected to high incubation temperatures**

SAMPLE	METHOD 9222D FECAL COLIFORM (colonies/100 mL)		METHOD 9222D <i>E. COLI</i> (colonies/100 mL)		METHOD 9213D <i>E. COLI</i> (colonies/100 mL)	
	7/22/99	7/24/99	7/22/99	7/24/99	7/22/99	7/24/99
	1BE0722991	nd < 10	80	nd < 10	80	nd < 10
1BE0722992	nd < 10	20	nd < 10	20	nd < 10	30
1BE0722993	nd < 10	30	nd < 10	30	nd < 10	10
1MO0722991	nd < 10	30	nd < 10	30	nd < 10	10

NOTE: nd - not detected (detection limit follows)

Surface temperature measurements were collected at each site for each sampling date, except for Bernet Landing and Mollalla River State Park on July 15, 1999 because of equipment failure. On this same date, the sampling depth for Champoeg State Park was modified because of the high water table, which prevented access to the desired sampling depth. Samples were collected in water 9 cm deep at approximately mid-depth (4-5 cm).