McKenzie River Watershed Baseline Monitoring Report

2000 to 2009

EWEB

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Acknowledgements

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Executive Summary

The McKenzie River is a critical water resource, providing drinking water to nearly 200,000 residents in Eugene, Oregon as well as having some of the last remaining native Bull Trout populations in the Northwest. Water quality data collection is an important component in determining the health of the watershed over time. Baseline monitoring for basic water quality parameters has been underway in the McKenzie Watershed since 1993. This report summarizes water quality monitoring data from 2000 to 2009.

The purpose of continuing to conduct ambient water quality monitoring at sites throughout the McKenzie Watershed on a regular basis is to look at long-term trends in water quality. Data collected as part of this effort can be compared to human health and aquatic toxicity benchmarks to determine if there are any exceedances or problem areas and to assess whether there is appreciable degradation of water quality in the watershed.

The current scope of baseline monitoring includes collecting grab water samples for metals, nutrients, bacteria and other general water quality parameters from thirteen sites six times per year (Map 1-3). These sites include:
1. McKenzie River at Frissell Bridge (E182);
2. McKenzie River at Brutgers Bridge (E170);
3. South Fork McKenzie at USFS Route 19 (above Cougar Dam) (E482);
4. South Fork McKenzie at Cougar Dam Road Bridge (below Cougar Dam) (E480);
5. Blue River at HWY 126 (E540);
6. McKenzie River at Holden Creek Rd Bridge (E060);
7. McKenzie River at Hendricks Park (E020);
8. Camp Creek at Camp Creek Road (E310);
9. Cedar Creek at Saunders (E210);
10. Keizer Slough at SUB Bridge (E810);
11. McKenzie River at Hayden Bridge (E010);
12. Mohawk River at Hill Road (E01M); and,
13. Mohawk River at Wendling Road Bridge (E02M).

During the study period for this report (2000-2009), monitoring sites were not always consistent. While most sites were uniformly sampled from 2006 through 2009, the same cannot be said for sampling activity from 2000 through 2005. As a result, identifying trends of contaminants over time was difficult due to insufficient data.

Dissolved and total metals analysis of water samples included arsenic, copper, cadmium, chromium, lead, manganese, nickel, and zinc. It appears the majority of metals that were detected in water samples collected from the McKenzie watershed do not present a drinking water quality problem. The main sources of metals in the McKenzie appear to be from Camp and Cedar Creeks and Keizer Slough, with Blue River contributing barium and manganese. There were occasional exceedances of human health (arsenic, lead), secondary MCLs (manganese) and aquatic toxicity criteria (copper) from samples collected at EWEB's intake (copper, lead, manganese), the Mohawk River (manganese), Camp Creek (copper, manganese), Cedar Creek

(arsenic) and Keizer Slough (lead, manganese).

Analytical results of nutrients (ammonia nitrogen, nitrates, nitrites, total Kjeldahl nitrogen, orthophosphate, and total phosphorus) indicate levels in the McKenzie Watershed that do not appear to present water quality problems. Patterns of detections indicate an increase of nitrates in the mainstem McKenzie at Hendricks Park with additional sources of nitrates in Camp and Cedar Creeks. The increased levels associated with the Hendricks Park site may be due to the fact that this is a dewatered area of the McKenzie River due to EWEB's Walterville Power Canal diversion. The increase in nitrate levels in the lower portion of the river may be due to fertilizer applications associated with agricultural operations, increased density of septic systems, and residential use of fertilizers along the river. None of the nitrate levels exceeded the human health criteria of 10 mg/L.

Evaluation of naturally-occuring orthophosphate with total phosphorus measurements indicated the potential sources of phosphorus in the lower watershed may be from fertilizers, human/animal wastes and re-suspension of sediment during storms and reservoir operations. Phosphorus levels exceed an EPA recommended criteria to prevent algal growth five times at four sites. Phosphorus levels have been increasing over the last eight years for sites where sufficient data has been collected to support an evaluation of trends (Camp and Cedar Creeks).

E. coli is a species of fecal coliform bacteria that is specific to fecal material from humans and other warm-blooded animals. In addition to possible health risks associated with the presence of elevated levels of fecal bacteria, they can also cause cloudy water, unpleasant odors, and an increased oxygen demand (or a reduction in dissolved oxygen levels in the water). Sources of fecal bacteria contamination to surface waters include septic systems, domestic and wild animal manure, and stormwater and urban runoff. Oregon has two E. coli human health criteria based on a single event (406 MPN/100 ml) and a 5-day average (126 MPN/100 ml). E. coli bacteria levels exceeded the Oregon mean criteria 36 times and the Oregon maximum criteria 7 times. The majority of these exceedances occurred at the lower Mohawk River, Camp Creek, and Keizer Slough. E. coli levels have been increasing over the last eight years for sites where sufficient data has been collected to support evaluation of trends (Mohawk River, McKenzie River at Hayden Bridge and McKenzie River at Hendricks Park).

Trend analysis was done at a few sites where sufficient data allowed a reasonable attempt at evaluating trends. Varying laboratory detection limits and methods for handling non-detects in this analysis are some of the issues that need to be resolved for future trend analysis.

In summary, the collection of baseline data is critical to long-term analysis of water quality in the McKenzie. However, the data analysis and conclusions are limited by the number of monitoring sites and analytes that can be practically monitored within time and budget constraints. The current monitoring approach is not able to target geographically-specific land use activities that may be contributing pollution loads and resulting in increasing trends of nutrients and bacteria in the river. However, it seems fairly clear that the two main land use activities that are tied to these contaminants are development (including septic systems) and agriculture. It should also be noted

that in order to conduct more robust trend analysis it will be necessary to continue to collect water quality data over a longer time period.

Currently, the McKenzie River has excellent water quality that is well below human health benchmarks and standards. However, baseline monitoring has identified some potential water quality issues in certain parts of the watershed (namely downstream tributaries like Cedar and Camp Creek, Keizer Slough and the Mohawk River) that may need to be addressed going forward so that they do not pose a threat to safe drinking water and aquatic health in the future. Treating contaminated water is orders of magnitude more expensive than preventing degradation in the first place, so we recommend making a concerted effort to keep the McKenzie River and watershed in the best condition possible and continue these and other water quality monitoring efforts to measure progress over time.

1 BACKGROUND

The hydrology of the McKenzie River is dominated by discharge from the upper reaches in the McKenzie Watershed. An important feature is the presence of large headwater springs which provides high, steady flows throughout the year (Sherrod and Smith, 2000, Tague and Grant, 2004). The Western Cascades are generally lower in elevation and heavily forested, with streamflows that are determined more by rainfall runoff than snowmelt or groundwater. Following rainfall patterns, highest discharges occur in the winter with low flows in the dry summer and fall.

In the upper portion of the McKenzie Watershed the Eugene Water & Electric Board (EWEB) operates the Carmen-Smith River Hydroelectric Project. The project diverts McKenzie River water from the Carmen Diversion Reservoir to the Smith River Reservoir. Water is then conveyed through a power tunnel to the Carmen powerhouse and then into Trailbridge Reservoir. Smith River Reservoir has a storage capacity of 1.86×10^7 m^3 and a catchment area of 17 mi^2, and Trailbridge Reservoir has a storage capacity of 2.59×10^6 m^3 and a catchment area of 184 mi^2 (USGS, 2010).

Two flood control reservoirs operated by the Army Corps of Engineers, Cougar and Blue River, are located in the Western Cascades on the South Fork McKenzie and Blue River, respectively (Map 1-1). Cougar has a storage capacity of 1.89×10^8 m^3 and a catchment area of 210 mi^2, and Blue River has a storage capacity of 1.02×10^8 m^3 and a catchment area of 88 mi^2 (USGS, 2010). Cougar reservoir was drained from 2002-2004 in order to modify the withdrawal structure to allow multilevel withdrawals for enhanced control of temperatures in the released water; during the drawdown period vegetation grew on the exposed bed material and was subsequently inundated when the reservoir was refilled (Anderson, 2007). The primary inflow to Cougar Reservoir is the South Fork McKenzie River which heads in the High Cascades and includes at least one major spring source (Jefferson, 2006), whereas inflows to Blue River Reservoir are entirely from Western Cascades streams. Aside from the upper McKenzie River springs, withdrawals from these two reservoirs are the largest source of water to the McKenzie River during low flows in summer and fall: outflows from Cougar contribute about 10-35% of mainstem flows while Blue River reservoir contributes about 5-20%.

Downstream of the South Fork McKenzie and Blue River, the hydrology and landscape become increasingly engineered: two major diversions put up to 60% of summer flows into large canals for hydroelectric power production in Leaburg (River Mile (RM) 34.2) and Walterville (RM 24). In-stream discharges remaining in the McKenzie River are reduced to 1,050 cfs to comply with minimum flow requirements, until the return flows from the Walterville Canal enter the river at RM 17.1. Additional inflows in the reaches between the Walterville Canal and EWEB's intake include relatively small tributaries with runoff from agricultural and urban areas. Despite the influence of reservoirs, consumptive withdrawals, multiple smaller tributaries, and urban runoff, the water in the McKenzie River at EWEB's intake has exceptional water quality due to dilution effects from the strong influence of the headwater springs in the basin's upper reaches (Kraus et. al., 2010).

The Eugene Water and Electric Board (EWEB) relies on the McKenzie River as its sole source

of drinking water for approximately 200,000 people in Eugene, Oregon. The McKenzie drains a watershed of approximately 1,380 square miles, with forested lands comprising the large majority of the watershed area, predominantly in the upper reaches and upland areas. Several small communities and agricultural land (primarily orchards, nurseries, row crops, and pastureland) are located in alluvial areas near the valley floor along several reaches, and the adjacent cities of Springfield and Eugene, Oregon (combined population, approximately 340,000), are located near the mouth. EWEB's drinking water intake is located at river mile (RM) 11, within the Springfield city limits.

From 1993 to 2005, the Oregon Department of Environmental Quality (DEQ) collected water quality samples from seven monitoring sites in the McKenzie Watershed for analytical analysis on behalf of the McKenzie Watershed Council (MWC), Eugene Water & Electric Board (EWEB), Willamette National Forest (USFS), U.S. Bureau of Land Management (BLM), Springfield Utility Board (SUB) and the U.S. Army Corps of Engineering (ACOE) (Map 1-2). The DEQ watershed monitoring efforts were conducted eight times a year and samples were analyzed by the DEQ Laboratory for general water quality parameters (temperature, dissolved oxygen, turbidity, pH, conductivity, total suspended solids, total organic carbon, alkalinity, and biological oxygen demand), nutrients (total Kjeldahl Nitrogen, nitrates, nitrites, orthophosphate, ammonia, and total phosphate), and bacteria/algal communities (E. coli, fecal coliform, pheophytin-a, and chlorophyll-a) (Oregon DEQ, 2000; Oregon DEQ, 2001; Oregon DEQ 2003). The purpose of this monitoring effort was to assess long-term trends in water quality and was part of a state-wide water quality monitoring program.

Results from the DEQ monitoring over a 13 year period indicated consistently excellent water quality as measured by the Oregon Water Quality Index (OWQI). The OWQI analyzes a defined set of water quality variables and produces a score describing general water quality. The water quality variables included in the OWQI are temperature, dissolved oxygen, biological oxygen demand, pH, total solids, ammonia, nitrate, total phosphorus, and fecal coliform/E. coli (Oregon DEQ, 2002; Oregon DEQ, 2003). OWQI scores range from 10 (worst case) to 100 (ideal water quality). In general, results indicate that water quality in the McKenzie is good to excellent and the quality tends to decrease as one moves down river. Six of the seven monitoring sites in the McKenzie had an average OWQI score that ranged between 93 to 96 (indicating some of the highest water quality in the state). The Mohawk River was the lone site that averaged 86 and was considered "good" water quality. Water quality was found to be temperature-limited during various times of the year because temperature standards set by DEQ to protect salmonid populations were exceeded (Oregon DEQ, 2002; Oregon DEQ 2003).

In 2006, it was decided that a watershed partner monitoring effort funded by EWEB, MWC and SUB would be initiated to partially replace the work done by DEQ. DEQ continued to monitor three of the seven sites as part of the state-wide water quality monitoring program. EWEB led an effort to continue and expand this long-term monitoring program by coordinating watershed baseline monitoring at 13 sites with multiple partners (McKenzie Watershed Council, USFS, City of Springfield, Springfield Utility Board, and DEQ) (Map 1-3).

This report focuses on the implementation and results associated with the long-term baseline monitoring program as part of the McKenzie Watershed Council's Water Quality Committee.

McKenzie River Watershed

OREGON

Smith Reservoir

Carmen Reservoir

Trailbridge Reservoir

LINN COUNTY
LANE COUNTY

Mohawk River

LINN COUNTY
LANE COUNTY

Blue River Reservoir

McKenzie River

Camp Creek

McKenzie R

Leaburg Canal

Walterville Canal

Quartz Creek

High Cascades

Eugene

Cougar Reservoir

Springfield

Western Cascades

South Fork McKenzie R
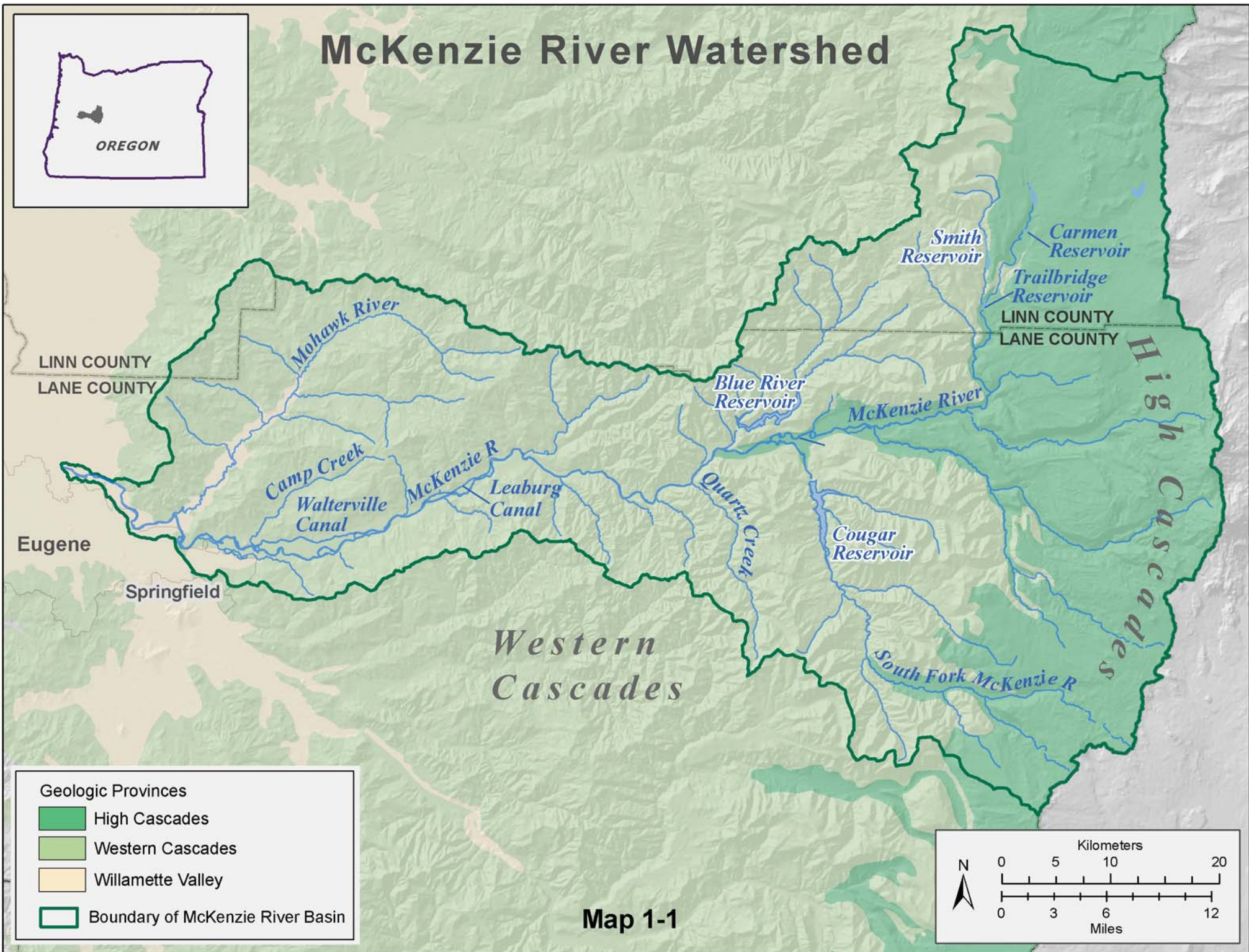
Geologic Provinces

- High Cascades
- Western Cascades
- Willamette Valley
- Boundary of McKenzie River Basin

Map 1-1

Kilometers
0   5   10   20

N

0   3   6   12
Miles
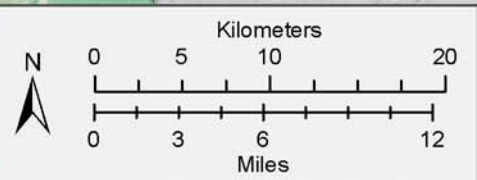
Map 1-2: McKenzie Watershed DEQ Baseline Monitoring Sites

E190

E186

Rainbow

Blue River

E540

E480

McKenzie Bridge

Vida

Nimrod

Marcola

Leaburg

E050

E01M

Walterville

E020

Eugene-Springfield

McKenzie Watershed
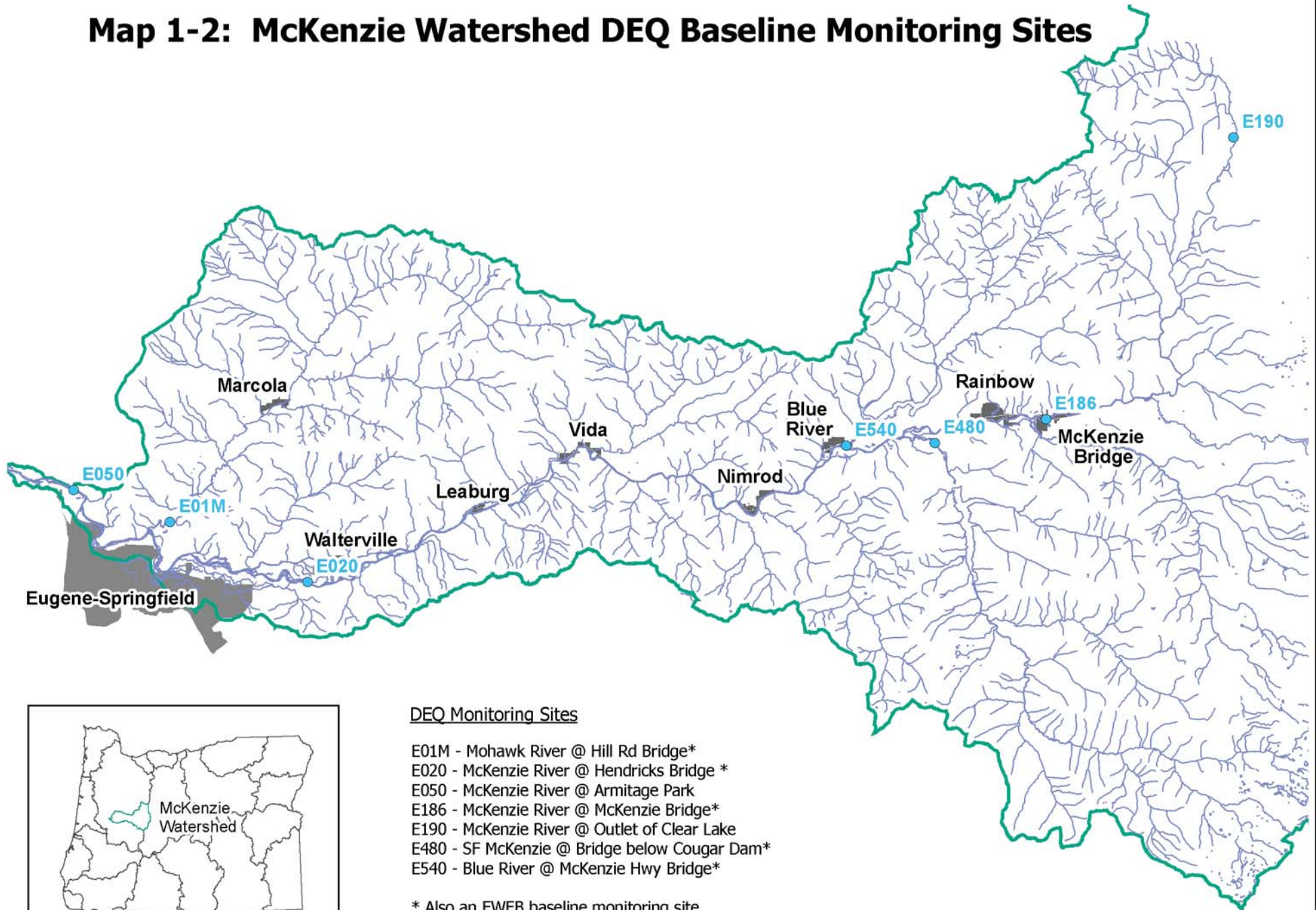
DEQ Monitoring Sites

E01M - Mohawk River @ Hill Rd Bridge*

E020 - McKenzie River @ Hendricks Bridge *

E050 - McKenzie River @ Armitage Park

E186 - McKenzie River @ McKenzie Bridge*

E190 - McKenzie River @ Outlet of Clear Lake

E480 - SF McKenzie @ Bridge below Cougar Dam*

E540 - Blue River @ McKenzie Hwy Bridge*

* Also an EWEB baseline monitoring site

N

9   4.5   0   9 Miles
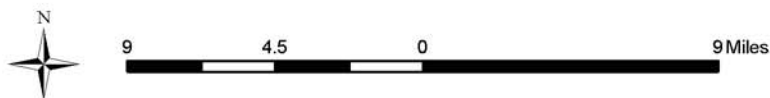
EWEB

Map 1-3: McKenzie Watershed EWEB Baseline Monitoring Sites
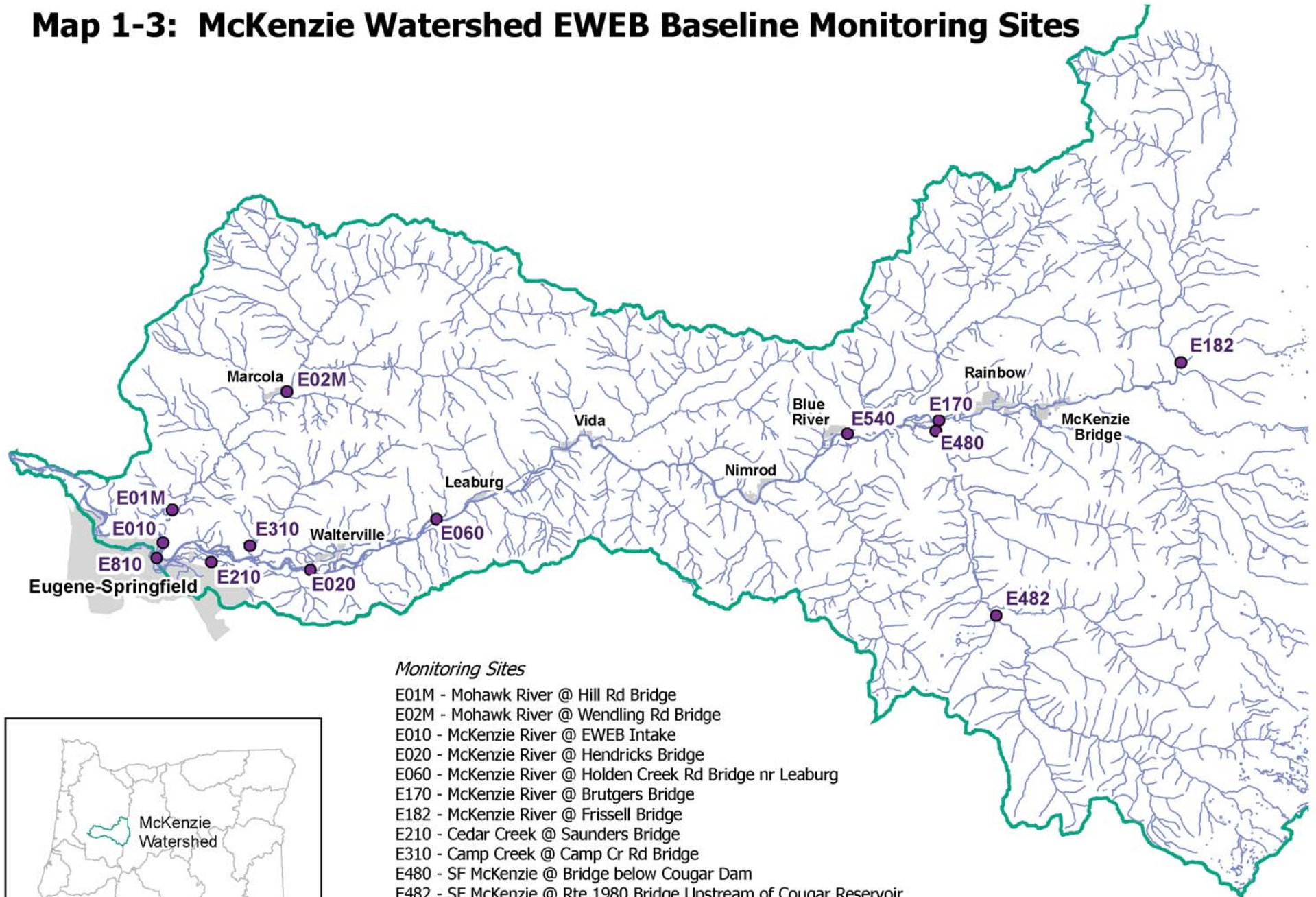
Marcola **E02M**

Blue River

E182

Rainbow

E170

E540

E480

Vida

McKenzie Bridge

Nimrod

Leaburg

E01M

E060

E010

E310

Walterville

E810

E210

E020

E482

Eugene-Springfield

McKenzie Watershed

Monitoring Sites

E01M - Mohawk River @ Hill Rd Bridge
E02M - Mohawk River @ Wendling Rd Bridge
E010 - McKenzie River @ EWEB Intake
E020 - McKenzie River @ Hendricks Bridge
E060 - McKenzie River @ Holden Creek Rd Bridge nr Leaburg
E170 - McKenzie River @ Brutgers Bridge
E182 - McKenzie River @ Frissell Bridge
E210 - Cedar Creek @ Saunders Bridge
E310 - Camp Creek @ Camp Cr Rd Bridge
E480 - SF McKenzie @ Bridge below Cougar Dam
E482 - SF McKenzie @ Rte 1980 Bridge Upstream of Cougar Reservoir
E540 - Blue River @ McKenzie Hwy Bridge
E810 - Keizer Slough @ SUB Bridge

N

8   4   0   8 Miles
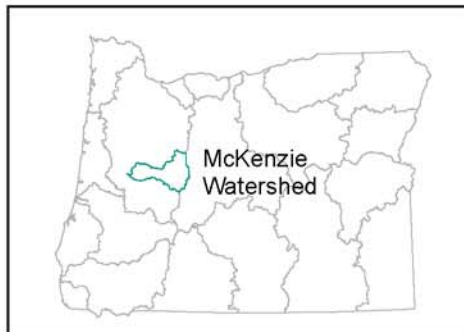
2   PURPOSE AND OBJECTIVES

2.1   Purpose of Watershed Baseline Monitoring

Baseline monitoring for basic water quality parameters has been underway since 1993. The purpose of continuing to conduct ambient water quality monitoring at sites throughout the watershed on a regular basis is to look at long-term trends in water quality. Data collected as part of this effort can be compared to human health and aquatic toxicity benchmarks to determine if there are any exceedances or problem areas and to assess whether there is appreciable degradation of water quality in the watershed. This data can be used with other monitoring and modeling efforts (like storm event monitoring, passive sampling, DHI MIKE 11 model, MIKE BASINS model, etc.) to look at changes in land use and/or pollution load sources that might explain negative water quality trends.

2.2   Baseline Monitoring Objectives

Several objectives were identified for the McKenzie River baseline monitoring program:

1. To determine the water quality effects from pollution sources and correlate pollution loading estimates with measured effects in the river;
2. To evaluate trends in water quality and correlate with trends in pollution loadings from various watershed sources over time as land use in the area changes and implementation of watershed protection and conservation strategies take place; and,
3. To evaluate and measure the relative health of the lower McKenzie River over time to determine the effectiveness of watershed protection and conservation programs.

To achieve these objectives, the following general tasks were conducted:

1. Determine the drainage area associated with each of the sample locations and evaluate the types and percentages of the various land use located in the drainage area;
2. Collect water samples at regular intervals (i.e., every other month) from each of the thirteen monitoring sites. During sample collection deploy YSI water quality sondes to measure temperature, dissolved oxygen, turbidity, conductivity and pH;
3. Document sample collection activities followed the protocol established in the monitoring plan and quality assurance/quality control (QA/QC) plan (EWEB, 2001);
4. Analyze the water samples for general water quality parameters, nutrients, total and dissolved metals, and bacteria/algal communities; and,
5. Evaluate analytical results to make sure the data meets the QA/QC criteria and discuss the results.

3   SCOPE OF BASELINE MONITORING EFFORTS

The scope of the watershed baseline monitoring program has changed over the years while at the same time attempting to maintain consistency to allow long-term trend analysis. The most significant changes occurred when EWEB took over coordination of the monitoring in 2006.

3.1   Scope of McKenzie Watershed Baseline Monitoring (DEQ)
From 1993 to 2005, the Oregon Department of Environmental Quality (DEQ) monitored seven locations on the McKenzie River eight times per year (Map 1-2). These sites included:
1. McKenzie River at HWY 126 downstream of Clear Lake;
2. McKenzie River at McKenzie Bridge;
3. South Fork McKenzie River at USFS Route 19;
4. Blue River at Blue River Drive;
5. McKenzie River at Hendricks Bridge;
6. Mohawk River at Hill Road; and,
7. McKenzie River at Coburg Road.

The focus of the DEQ sampling was on the mainstem McKenzie River and the three largest tributaries (Blue River, South Fork and Mohawk). After EWEB and MWC took over baseline monitoring in 2006, the DEQ monitoring was reduced to three of the seven sites six times per year (McKenzie River at Clear Lake, McKenzie River at Hendricks Bridge, and McKenzie River at Coburg).

DEQ samples are analyzed by their Portland laboratory for alkalinity, ammonia, biological oxygen demand, total organic carbon, chemical oxygen demand, chlorophyll-a, color, conductivity, E. coli, fecal coliform, total Kjeldahl nitrogen, dissolved nitrate/nitrite, dissolved orthophosphate, temperature, turbidity, pH, dissolved oxygen, total suspended solids, total solids, total phosphate, and pheophytin-a (Oregon DEQ, 2003).

3.2   Scope of McKenzie Watershed Baseline Monitoring (MWC and EWEB)
The current scope of baseline monitoring includes collecting grab water samples from thirteen sites six times per year (Map 1-3). These sites include:
14. McKenzie River at Frissell Bridge;
15. McKenzie River at Brutgers Bridge;
16. South Fork McKenzie at USFS Route 19 (above Cougar Dam);
17. South Fork McKenzie at Cougar Dam Road Bridge (below Cougar Dam);
18. Blue River at HWY 126;
19. McKenzie River at Holden Creek Rd Bridge;
20. McKenzie River at Hendricks Park;
21. Camp Creek at Camp Creek Road;
22. Cedar Creek at Saunders;
23. Keizer Slough at SUB Bridge;
24. McKenzie River at Hayden Bridge
25. Mohawk River at Hill Road; and,

26. Mohawk River at Wendling Road Bridge.

EWEB and MWC expanded the watershed monitoring effort to include smaller tributaries that drain urban areas (Cedar Creek and Keizer Slough) and Camp Creek. In addition, upstream monitoring sites were added to the South Fork McKenzie River to assess impacts of Cougar Dam and in the Mohawk River to get a better understanding of where impacts to water quality are occurring.

EWEB and MWC maintained the same analytical parameters as the previous DEQ monitoring effort, except for alkalinity, color and fecal coliform. Alkalinity and color were dropped to reduce analytical costs and total coliform replaced fecal coliform as a preferred measurement of bacteria when combined with E. coli (see Section 4.1.7). Parameters that were added include: total and dissolved metals (arsenic, barium, cadmium, chromium, copper, iron, lead, magnesium, manganese, nickel, and zinc) and total coliforms. EWEB uses a Yellow Springs Institute (YSI) water quality sonde to measure temperature, dissolved oxygen, turbidity, conductivity and pH.

3.3 Summary of Other Monitoring Efforts in the McKenzie Watershed

A number of other monitoring efforts are conducted on a regular basis in the McKenzie Watershed by EWEB, MWC, SUB, Springfield School District and other organizations to address specific needs that may not be related to long-term trend analysis or have a slightly different geographic focus. The following is a summary of the focus, scope and timing of these monitoring efforts.

3.3.1 EWEB/USGS Storm Event Monitoring

In 2002, EWEB began working with the U.S. Geological Survey (USGS) to design and implement a storm event monitoring program that focuses on pesticides and other dissolved organic compounds that are flushed off the land surface during storms events. EWEB used the USGS laboratory in Denver, Colorado to analyze for nearly 180 different pesticides, pesticide degradation products and other organic compounds. Pesticides were the primary focus of these monitoring efforts since pesticide compounds and their degradation products are known to have adverse effects on human health and aquatic life. These effects are of particular concern for potential impacts on source water for drinking water supply, particularly because many organic compounds are unaffected by conventional drinking-water treatment (Coupe and Blomquist, 2004; Stackelberg and others, 2004).

EWEB used Hach/American Sigma automated samplers with integrated flow meters to measure flow and trigger samplers to begin sampling once the level of the creek/stormwater channel began to rise. The samplers use peristaltic pumps to collected flow-weighted aliquots into clean 950 ml glass bottles throughout the storm hydrograph (USGS, 2000c). YSI sondes were also deployed at each monitoring location to collect turbidity, dissolved oxygen, conductivity, pH, and temperature prior to, during and after the storm event. The flow and turbidity data were then used to select a subset of bottles that represented the initial flush/peak of flow/turbidity. These bottles were then homogenized using a Teflon churn splitter, filtered into sample bottles and sent to the USGS laboratory for analysis.

The three primary land uses that were evaluated to date for storm runoff include: 1) urban runoff from east Springfield; 2) runoff from industrial forests that received chemical applications; and 3) runoff from agricultural areas in the Walterville area (Table 3-1).

- Urban Runoff: Numerous studies have demonstrated that 70-90% of annual contaminant loading to receiving streams from urban runoff occurs during the flushing action of major storm events following periods of dry weather. Typically, the longer the dry period between storm events, the larger the potential contaminant loading associated with that particular urban stormwater runoff event (Schueler and Holland, 2000; Ferguson, 1998; USGS, 2000a; Kerst, 1996). EWEB monitored 5 stormwater outfalls (42nd, 52nd, 64th, 69th, and 72nd Street outfalls), Cedar Creek, Keizer Slough, Camp Creek, McKenzie River at Hayden Bridge (EWEB's intake) and the McKenzie River at Hendricks Bridge.
- Forestry: EWEB used the notification forms that forest operations are required to submit to the Oregon Department of Forestry (ODF) to map areas where pesticide applications occurred using geographic information system (GIS) software. Monitoring locations were selected based on those creek basins that tended to receive higher amounts of chemical applications relative to other creek basins in the McKenzie watershed.

Table 3-1: Summary of Land-Use Focus for Storm Event Monitoring Efforts.

Year	Season	Month	Land use focus	N sites
2002	Fall storm	October	Urban / mixed	11
2003	Winter storm	December	Urban / mixed	9
2004	Spring storm	May	Urban / mixed	9
	Fall storm	September	Urban / mixed	11
2005	Spring storm	May	Urban / mixed	11
	Fall storm	September / October	Forestry	8
2006	Fall storm	October	Forestry	12
2007	Fall storm	September / October	Mixed	4
2008	Fall storm	October	Mixed	3
2009	Baseline	March	Urban / mixed	4
		August	Urban / mixed	4
	Spring storm	May	Agriculture / forestry / urban / mixed	13
	Fall storm	October	Urban / mixed	6
	Winter storm	December	Intake	1
2010	Baseline	March	Intake	1
	Spring storm	June	Agriculture / forestry / urban / mixed	8

- Agriculture: EWEB focused on creeks/drainages in the large agricultural area around Walterville for storm event monitoring. Because these creeks were fairly flat, it became apparent that surface runoff from this area would be difficult to collect. EWEB focused on collecting grab samples from these streams during major rain events when shallow groundwater was clearly increasing the flow in these systems.

3.3.2 MWC/Springfield School District Stormwater Sampling
From 2001 to present Thurston High School (THS) students have been sampling approximately

once a month at 3 stormwater outfalls (64th, 69th, and 72nd Street outfalls) and along various locations of Cedar Creek from the headwaters to below where the outfalls dump into Cedar Creek (a total of seven monitoring locations along the creek). The students analyze the water samples in the THS chemistry laboratory for nutrients (ammonia, nitrates, nitrites, total nitrogen, reactive phosphorus, and total phosphorus), metals (cadmium, chromium, copper, nickel, and zinc), bacteria (total coliforms and E. coli), conductivity, dissolved oxygen, turbidity, pH and temperature.

EWEB collects split samples with the students at each of the three stormwater outfalls and the downstream Cedar Creek sample location. EWEB also collects samples at 42nd and 52nd Street outfalls and Keizer slough as part of this monitoring effort. These samples are submitted to a commercial lab for metals, nutrients and bacteria analysis to allow the students to check their lab results with a commercial lab. The split sampling occurs periodically throughout the year (approximately 2-4 times per year).

3.3.2 MWC/Springfield School District Camp Creek Basin Sampling
Since 2003, MWC and THS students have been monitoring at various locations in Camp Creek on a regular basis (approximately monthly). The students analyze the water samples in the THS chemistry laboratory for nutrients (ammonia, nitrates, nitrites, total nitrogen, reactive phosphorus, and total phosphorus), bacteria (total coliforms and E. coli), conductivity, dissolved oxygen, turbidity, pH and temperature. Approximately 4-5 sites were sampled from near the confluence with the McKenzie River to the upper part of Camp Creek.

EWEB collects split samples with the students at the downstream Camp Creek sample location (Camp Creek at Camp Creek Road). These samples are submitted to a commercial lab for metals, nutrients and bacteria analysis to allow the students to check their lab results with a commercial lab. The split sampling occurs periodically throughout the year (approximately 2-4 times per year).

In 2006, MWC and THS collaborated with, EWEB, U.S. BLM and Weyerheauser to create the Camp Creek Education Basin project. This effort expands the number of monitoring sites, added macroinvertebrate sampling, streamside bio-assessment surveys and student involvement in riparian restoration projects with landowners. The idea is for student teams to build on the data/efforts of previous teams over time as a long-term project and teach students about statistical analysis, mapping, use of GIS, biology, chemistry, writing, and working with landowners.

3.3.3 EWEB Septic System Cluster Monitoring
In the McKenzie Watershed, upriver of EWEB's drinking water intake, approximately 4,000 households rely on septic systems to dispose of their wastewater and sewage. Septic systems represent the highest total volume of wastewater discharged to groundwater and are the most frequently recorded sources of contamination of groundwater and surface water (Novotny and Olem, 1994). In the McKenzie, this amounts to over 900,000 gallons of sewage discharged to shallow groundwater on a daily basis (or 330 million gallons per year). Approximately 10 to

25% of septic systems fail, often releasing untreated wastewater into the underlying groundwater and/or nearby surface water (U.S. EPA, 2003; Schueler and Holland, 2000).

To assess the threat of septic systems to water quality in the McKenzie, EWEB conducted a GIS analysis to identify high risk areas where higher density of septic systems existed (i.e., clusters) in permeable soils, in close proximity (within 300 feet) of a waterbody (EWEB, 2006). Seven cluster areas were identified. Numerous monitoring efforts were conducted in 2005 and 2007 to assess potential water quality impacts to surface water and shallow groundwater from these cluster areas of septic systems.

A total of twenty-three surface water monitoring stations were sampled on September 26 and October 7, 2005 during the low flow period before fall precipitation events. These monitoring stations included:
- Four in the McKenzie Bridge area (two from the McKenzie River and two from Horse Creek);
- Five in the Blue River area (three from the McKenzie River and two from Blue River);
- Three from Leaburg Lake area;
- Three from small development below Leaburg Dam;
- Three from Greenwood Drive area: and,
- Five from the Deerhorn area (three from the McKenzie River and two from Haagen Creek).

The water samples were sent to a commercial laboratory for total metals (arsenic, cadmium, chromium, copper, nickel, lead, manganese and zinc), nutrients (nitrate-nitrogen, ammonia, and total phosphates), E. coli bacteria, fecal coliform and total organic carbon analysis (EWEB, 2006).

In 2007, EWEB's monitoring efforts included: shallow groundwater well sampling of domestic wells that were in and/or downgradient of septic cluster areas (as well as a few background or upgradient wells in each area), and upstream and downstream surface water samples in the Leaburg and Deerhorn septic cluster areas (EWEB, 2009). A total of 20 domestic wells were sampled in five of the high priority septic cluster areas. The five cluster areas targeted for shallow groundwater monitoring do not have community drinking water systems, meaning every home has its own domestic well. Deerhorn and Blue River areas are serviced by a community water system and did not have domestic wells available to sample. In addition, EWEB collected a total of four surface water samples from upstream and downstream locations in two septic cluster areas (Leaburg and Deerhorn). The water samples were sent to a commercial laboratory for total and dissolved metals (arsenic, cadmium, chromium, copper, nickel, lead, manganese and zinc), nutrients (nitrate-nitrogen, ammonia, and total phosphates), E. coli bacteria, and total coliform bacteria (EWEB, 2009).

3.3.4   EWEB/USGS Organic Carbon and Disinfection By-Product Formation Study

EWEB and the USGS conducted this study to determine the main sources of dissolved organic carbon (DOC) and disinfection byproduct (DBP) precursors to the McKenzie River (Kraus, et. al., 2010). This was in response to increasing levels of DBPs in EWEB's finished water following the filling and operation of Cougar Reservoir after construction of the temperature control tower in 2006. Water samples were collected in August 2007, September 2007, November 2007, March 2008, and January 2008. To assess the amount and character of dissolved organic matter (DOM) entering the McKenzie River, samples were collected from four sites along the mainstem of the river including EWEB's intake, from downstream of Blue River and Cougar reservoirs, and from Camp Creek, Cedar Creek and Keizer Slough (although August 2007 and January 2008 sampling efforts did not include all sites).

Samples were analyzed for DOC concentration and DBP formation potentials (trihalomethanes [THMFPs] and haloacetic acids [HAAFPs]). In addition, optical properties (absorbance and fluorescence) of DOM were measured to provide insight into DOM composition and assess whether optical properties are useful proxies for DOC and DBP precursor concentrations (Kraus, et. al., 2010).

3.3.5   EWEB/USGS Passive Sampling Efforts

Since 2007, EWEB has been working with the USGS to evaluate the effectiveness of using passive sampling techniques to assess for the presence of anthropogenic organic contaminants (USGS, 2009). Among the organic compounds of interest are those that may have significant ecological and(or) human-health consequences at concentrations that are orders of magnitude less than the detection limits associated with conventional water-sampling techniques. In addition, many compounds of interest may be present only during episodic events. As part of this effort, two types of passive samplers—polar organic chemical integrative samplers (POCIS) and semipermeable membrane devices (SPMDs)—were used to address the challenges of measuring a wide range of organic compounds (pesticides, PCBs, poly aromatic hydrocarbons, pharmaceuticals, solvents , etc.) at low concentrations and accumulating these compounds over time to record episodic or storm generated flushing of these compounds (Alvarez et. al., 2004; Alvarez et. al., 2007; Alvarez et. al., 2008).

In order to evaluate the use of passive samplers in long-term monitoring for organic compounds in the McKenzie River basin, passive samplers were deployed at three sites (Camp Creek, Cedar Creek, McKenzie @ EWEBs intake) for 35 days during September–October 2007. Passive samplers were deployed at four sites (upper Haagen Creek, lower Haagen Creek, EWEB's intake –raw water and EWEB's finished water) for approximately 30 days between March-April 2010 and May-June 2010. In addition, two sites (Camp and Cedar Creek) were added to the May-June 2010 deployment for a total of six monitoring sites. Passive samplers were deployed at two sites (EWEB's intake –raw water and finished water) for 30 days in September-October 2010. Results from these sampling efforts are still in process of being reviewed and finalized by the USGS.

4   OVERVIEW OF BASELINE MONITORING PARAMETERS

The baseline monitoring parameters were selected to include a range of typical analytes that occur in nature and are a product of human activities in the watershed. This allows multiple uses of the long term data record rather than just focusing on anthropogenic contaminants like petroleum hydrocarbons, pesticides and herbicides, chlorides, poly aromatic hydrocarbons, and other organic compounds. The following is a summary of some of the characteristics and potential sources of the parameters that were chosen for long term monitoring in the watershed.

4.1   Baseline Monitoring Pollutant Characteristics

4.1.1   Metals
A number of metals are found in natural environments due to the mineralogy of the soil and geology. For example, low levels of arsenic are often associated with soils derived from basalt. The sources of anthropogenic metals found in the environment are most commonly found in stormwater runoff from urban areas, and often include metals such as arsenic, cadmium, cobalt, chromium, copper, iron, manganese, nickel, lead, and zinc (Whalen and Cullum, 1988; USGS, 2000b; Novotny and Olem, 1994). The metals that are most frequently detected in urban and stormwater runoff studies across the nation are arsenic (52%), cadmium (48%), chromium (58%), copper (91%), lead (94%), nickel (43%), and zinc (94%). The percent of these detections that exceeded freshwater ambient acute toxicity criteria (FA), freshwater ambient chronic toxicity criteria (FC), and/or human health criteria (HH) nationwide are as follows (US EPA, 1983; Whalen and Cullum, 1988):

- Arsenic, 52% of detections exceed HH criteria;
- Cadmium, 8% of detections exceed FA, 48% exceed FC, 1% exceed HH criteria;
- Chromium, 1% of detections exceed FC; 1% exceed HH criteria;
- Copper, 47% of detections exceed FA, 82% exceed FC criteria;
- Lead, 23% of detections exceed FA, 94% exceed FC, 73% exceed HH criteria;
- Nickel, 5% of detections exceed FC, 21% exceed HH criteria; and,
- Zinc, 14% of detections exceed FA, 77% exceed FC criteria.

As indicated in the brief summary above, these metals present a significant threat to aquatic organisms for short duration (acute or FA) and long-term (chronic or FC) exposures. Acute or FA toxicity criteria evaluate effects from short term (1 hour) exposure to an average concentration of a chemical to determine the level above which known adverse effects to aquatic organisms are observed. Chronic or FC toxicity criteria represent a similar analysis over a longer period of time (96 hours) to determine levels that longer term exposures cause known adverse affects in aquatic organisms (see www.deq.state.or.us/wq/standards/toxics.htm). In addition, the national data indicate that arsenic, lead, and nickel are at high enough concentrations to pose a risk to human health.

Although some metals are associated with pesticides (especially arsenic and cadmium), paint, wood preservatives, metal corrosion, and other uses, the majority of these metals are found in

urban runoff and along highways because of automobile use (Whalen and Cullum, 1988; Novotny and Olem, 1994; USGS, 2000b). A significant portion of the McKenzie River is paralleled by Highway 126. Table 4-1 summarizes the relationship of automobile use and presence of metals in urban and highway runoff.

Table 4-1: Sources of Heavy Metals Found in Stormwater Runoff

Source	Cd	Cr	Cu	Ni	Pb	Zn
Fuel related (gasoline and diesel)	X		X		X	X
Motor Oil & Grease	X		X	X	X	X
Antifreeze			X			X
Exhaust Emissions	X	X		X	X	
Batteries	X			X	X	
Undercoating					X	X
Brake Linings	X	X	X	X	X	X
Tires	X		X		X	X
Engine Wear	X	X	X		X	
Asphalt			X	X		X
Concrete			X		X	X

Source: Whalen and Cullum, 1988 (Table 2-1)

The behavior of metals in runoff from paved surfaces is fundamentally different physically, chemically, and hydraulically from metals found in natural systems. Physical mobilization, pulverization, and transport of roadway dirt and dust, lubricants, hydraulic fluid, and other materials on paved surfaces and from vehicles is enhanced by the erosive power of precipitation and the kinetic energy of moving vehicles (USGS, 2000b). As indicated in Table 4-1, vehicles are composed of trace-element-laden parts that are exposed to high temperatures, pressures, and kinetic energy during combustion of fuel, lubrication of moving parts, and braking. Also tires and pavement contribute various metals and organic compounds through road and tire wear. Vehicle exhaust tends to form a hot acidic solution that contains hundreds of hydrocarbons and 20 or more different trace elements and anions. These organic and inorganic compounds in exhaust particulates and aerosols that are washed out of the atmosphere, and from vehicles, the road surface, dust, and dirt can form complex forms of trace elements in the runoff.

Complexation of metals, or the ability of metals to bind with other compounds or soil particles, increases their mobility and transport into the natural environment. For example, studies have demonstrated that copper (Cu) was found to be 84-99 percent dissolved in unfiltered water samples from urban runoff. Conversely, existing scientific knowledge of the behavior of metals in the natural environment would predict that less than 10 percent of copper would be in the dissolved phase (USGS, 2000b). This may explain why total suspended solids and conductivity measurements of urban and highway runoff do not always correlate with total metals concentrations. The City of Eugene storm event monitoring results found no correlation between

selected metals and conductivity, but did find a correlation (0.79) between total zinc and total suspended solids (Kerst, 1996; Strecker et al., 1997).

4.1.2 Nutrients
The two primary nutrients of concern for water quality are nitrogen and phosphorus. Nitrogen is found in nature in all three environmental media (air, water, and soil) and can exist in eight different forms. Nitrogen can act as a pollutant in surface waters in four primary ways:
1. As a nutrient for photosynthetic activity in streams and lakes (eutrophication);
2. By producing toxic effects on fish when present as ammonia;
3. As an acid when present as nitric acid; and,
4. By exerting an oxygen demand when in the form of organic nitrogen, ammonium, or ammonia.

Nitrogen can also exert a significant chlorine demand and can therefore affect the disinfection process associated with drinking water treatment (NRC, 2000). Nitrate is especially important to monitor because it is relatively soluble in water compared to the other nitrogen forms.

There are many sources of nitrogen in the environment including: atmospheric deposition (automobile exhaust); fertilizer runoff from agricultural fields and urban areas; septic tanks; municipal wastewater treatment plants; manure and animal wastes; and industrial discharges.

Phosphorus also comes in many different forms. The two most commonly monitored forms are orthophosphate and total phosphorus. Orthophosphate includes the dissolved forms of phosphorus (including soluble reactive phosphorus), which are available for aquatic plant use. Total phosphorus includes dissolved and particulate, organic and inorganic forms (OWEB, 1999). Sources of phosphorus include automobile exhaust, fuel and lubricants, fertilizers, manure and animal wastes, septic tanks, and sewage and soil erosion.

Elevated levels of phosphorus (especially in dissolved form) can lead to increased aquatic plant growth and eutrophication in lakes or slack water. The most important negative impacts from eutrophication include (NRC, 2000):
1. An increase in water turbidity caused by algal material and byproducts;
2. An increase in total organic carbon derived from algal biomass that can lead to formation of disinfection byproducts (DBPs) when water is treated;
3. Algal production of potentially toxic compounds, some of which may create taste and odor problems; and,
4. A decrease in dissolved oxygen levels and the associated negative impacts on fish habitat.

4.1.3 Total Organic Carbon
Organic carbon compounds in drinking water sources can be problematic because some can react with chlorine to form disinfection byproducts (DBPs) in the water distribution system. Several DBPs, including trihalomethanes (THMs) and haloacetic acids (HAAs), have been shown to be carcinogenic (Leenheer and Croue, 2003). Dissolved organic carbon tends to be the precursor to the formation of DBPs in chlorinated water supplies (Kraus et. al., 2010; NRC, 2000).

A number of methods exist for the measurement of organic carbon. Natural organic material (NOM) is used to determine the amount of organic compounds from natural sources versus human-synthesized sources. Total organic carbon (TOC) is the most common measurement and it includes all particulate and dissolved organic matter (both natural as well as artificial human created compounds). The final two forms are particulate organic carbon (POC) and dissolved organic carbon (DOC).

4.1.4   Dissolved Oxygen and Biochemical Oxygen Demand
A stream system both produces and consumes oxygen. It gains oxygen from the atmosphere and from plants as a result of photosynthesis. Streams and rivers dissolve oxygen from churning and splashing as water flows through rapids or over falls. Respiration by aquatic organisms, decomposition of organic material, and various chemical reactions consume oxygen in streams or rivers. Oxygen is measured in its dissolved form as dissolved oxygen (DO). If more oxygen is consumed than is produced, DO levels decline and some sensitive aquatic organisms may move away, weaken, or die (US EPA, 1997).

Biochemical oxygen demand (BOD) measures the amount of oxygen consumed by microorganisms in the decomposition of organic materials (i.e., plant matter, sewage, hydrocarbons, etc.). Chemical oxygen demand (COD) can also be used to measure the amount of oxygen taken out of the system to decompose organic materials. In stormwater and urban runoff, greases and oils from vehicle operations are the most common source of organics in the water column. The chemical oxygen demand test may be a better indicator of oxygen demand produced by stormwater runoff than the biochemical oxygen demand test. Stormwater and urban runoff may contain several potential sources of toxins, which may interfere with the BOD test (Whalen and Cullum, 1988).

4.1.5   Total Suspended Solids and Turbidity
Total suspended solids (TSS) and turbidity measure the amount of materials in the water column (clay, silt, algae, plankton, microbes, etc.), but these two tests measure suspended material in very different ways. Turbidity is a measure of water clarity or how much the material suspended in water decreases the passage of light through the water. Turbidity measures only the amount of light that is scattered by suspended particles. TSS measures the amount of dissolved solids, suspended solids, and settleable solids that will pass through a filter with pores of approximately 2 microns in size. Measurement of total suspended solids is a more direct measurement of the amount of material suspended and dissolved in the water.

For drinking water systems, an increase in turbidity or TSS may cause interference with chlorination (NRC, 2000). Higher concentrations of suspended solids may indicate higher concentrations of toxics, such as metals, nutrients, polycyclic aromatic hydrocarbons, pesticides, PCBs, and other organic compounds that readily attach to suspended particles. Increases in total dissolved solids can affect the water balance in cells of aquatic organisms. This in turn will affect the organism's ability to maintain the proper cell density, making it difficult to keep its position in the water column. The organism may float up or sink down to a depth to which it is

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not adapted, and it might not survive. In addition, suspended materials can clog fish gills, reducing resistance to disease in fish, lowering growth rates, and affecting egg and larval development. As the particles settle, they can blanket the stream bottom, especially in slower waters, and smother fish eggs and benthic macroinvertebrates (US EPA, 1997; DEQ, 1998a).

Higher turbidity increases water temperatures because suspended particles absorb more heat. This, in turn, reduces the concentration of dissolved oxygen (DO) because warm water holds less DO than cold water. Higher turbidity also reduces the amount of light penetrating the water, which reduces photosynthesis and the production of DO (US EPA, 1997).

Sources of turbidity and suspended solids include soil erosion, industrial waste discharges, urban runoff, eroding stream banks, sewage, fertilizers, excessive algal growth, and large numbers of bottom feeders (which stir up bottom sediments) (US EPA, 1997).

4.1.6   Conductivity
Conductivity is a measure of the ability of water to pass an electrical current. Conductivity in the water is affected by the presence of inorganic dissolved solids such as chloride, nitrate, sulfate, phosphate anions or sodium, magnesium, calcium, iron, and aluminum cations. Organic compounds like oil, phenol, and alcohol do not conduct electrical current very well and therefore have a low conductivity when in water. Studies of inland fresh waters indicate that streams supporting good mixed fisheries have a conductivity range between 150 and 500 μmhos/cm. Industrial wastewaters can range as high as 10,000 μmhos/cm (US EPA, 1997).

4.1.7   Coliform Bacteria
Members of two bacteria groups, coliforms and fecal streptococci, are used as indicators of possible sewage contamination because they are commonly found in human and animal feces. Although they are generally not harmful themselves, they indicate the possible presence of pathogenic (disease-causing) bacteria, viruses, and protozoa that also live in human and animal digestive systems. Two protozoa-*Giardia lamblia* and *Cryptosporidium parvum*- can be a problem if present in a drinking water source because they are resistant to disinfection with chlorine (NRC, 2000).

Fecal coliforms, a subset of total coliform bacteria, are more fecal-specific in origin. However, even this group contains a genus, *Klebsiella*, with species that are not fecal in origin, but rather associated with pulp and paper mill wastes (US EPA, 1997). Due to the presence of the International Paper (IP) containerboard plant, fecal coliform results may be skewed if high concentrations of *Klebsiella* are present.

E. coli is a species of fecal coliform bacteria that is specific to fecal material from humans and other warm-blooded animals. Fecal streptococci generally occur in the digestive systems of humans and other warm-blooded animals. Enterococci are a subgroup within the fecal streptococcus group. Enterococci are distinguished by their ability to survive in salt water, and in this respect mimic many more pathogens than do other indicators. Enterococci are typically

more human-specific than the larger fecal streptococci group. The US EPA recommends *E. coli* and enterococci as the best indicators of health risk from recreational water contact. Fecal coliforms as a group are a poor indicator of potential health risk due to direct contact with contaminated water (US EPA, 1997).

In addition to possible health risks associated with the presence of elevated levels of fecal bacteria, they can also cause cloudy water, unpleasant odors, and an increased oxygen demand (or a reduction in dissolved oxygen levels in the water). Sources of fecal bacteria contamination to surface waters include septic systems, domestic and wild animal manure, and stormwater and urban runoff.

5 BASELINE SAMPLING AND DATA ANALYSIS APPROACH

The watershed baseline monitoring program focuses on evaluation of the major tributaries and potential pollution inputs to the McKenzie River and at various locations along the river to assess long term water quality trends and highlight areas that have increased levels of contaminants. The sampling is coordinated by and uses equipment from EWEB. Partners assist with sample collection activities (USFS, DEQ, MWC, City of Springfield) and contribute funding toward the program (SUB and MWC). EWEB provides the majority of funding and manages the contract with the analytical laboratory (Test America in Portland). This section provides an overview of the sampling approach for the watershed baseline monitoring program. Please refer to EWEB's *Lower McKenzie River Watershed, Stormwater and Urban Runoff Monitoring Plan* for additional detail on the sampling approach, quality assurance and quality control plan, and other aspects of this monitoring program *(*EWEB, 2001).

5.1 Sample Collection Methodology

All baseline samples are collected as grab samples from well-mixed portions of the creek or river. Attempts are made at each sampling site to use an extended sampling pole to reach the center of flow, or at least an area with active flow and velocity. A certified clean, unpreserved sample bottle is zip-tied onto the sampling pole and rinsed three times with native water before collecting water to fill the other laboratory bottles. All laboratory bottles that do not contain preservative are also rinsed with native water before filling.

For a brief period of time, EWEB used various methods to sample off of bridges using peristaltic pumps with clean dedicated tubing. However, this method was difficult on bridges that were higher than 20-30 feet from the water surface and tended to not collect a representative sample of suspended particulates.

Care was taken to avoid collecting particulates that were re-suspended as the result of bumping the sampler on the stream-bed. If sampling from a bridge, care was taken to avoid sampling downstream or near large in-stream obstructions (the eddy created by these obstructions could cause artificially elevated suspended sediments).

Sampling personnel wear new clean disposable gloves at each sampling site to avoid any possibility of cross contamination. All necessary sample preservatives are premeasured into the appropriate bottles at the laboratory prior to shipping the bottles for baseline monitoring events. All samples are labeled and stored on ice until being properly packaged for shipment via Greyhound Bus the same day to Portland for pick-up and analysis by Test America Laboratory. All samples that are filtered for dissolved analysis are filtered at the laboratory.

In addition, a calibrated YSI 6920 multi-parameter water quality sonde is deployed at each monitoring site upon arrival to log turbidity, conductivity, dissolved oxygen, temperature, and pH at ten-second intervals. The sonde is allowed to run as long as possible before being removed, cleaned and set up for the next site. (Generally the sonde is deployed during the time that the grab samples are collected.)

All baseline samples are analyzed by a commercial laboratory for the following:
- Total and dissolved metals (arsenic, cadmium, chromium, copper, mercury, magnesium, manganese, nickel, lead, and zinc);
- Nutrients (nitrate-nitrogen, nitrite-nitrogen, ammonia, Total Kjeldahl nitrogen, orthophosphate-phosphorus, and total phosphorus);
- *E. coli* bacteria and total coliforms;
- Total suspended solids;
- Total organic carbon; and,
- Chemical oxygen demand.

5.2   Sample Number, Type, and Location
A total of thirteen monitoring sites are sampled every other month. These monitoring stations include (Map 1-3):
1. McKenzie River at Frissell Bridge;
2. McKenzie River at Brutgers Bridge;
3. South Fork McKenzie at USFS Route 19 (above Cougar Dam);
4. South Fork McKenzie at Cougar Dam Road Bridge (below Cougar Dam);
5. Blue River at HWY 126;
6. McKenzie River at Holden Creek Rd Bridge;
7. McKenzie River at Hendricks Park;
8. Camp Creek at Camp Creek Road;
9. Cedar Creek at Saunders;
10. Keizer Slough at SUB Bridge;
11. McKenzie River at Hayden Bridge
12. Mohawk River at Hill Road; and,
13. Mohawk River at Wendling Road Bridge.

One grab water sample is collected at each monitoring station (13 water samples). In addition, one duplicate sample is collected during each monitoring event per Section 5.4. The following discussion provides brief descriptions of the monitoring sites and primary land uses upstream of the monitoring sites.

5.2.1   *Upper McKenzie River Basin Monitoring Sites (E182 and E170)*
The upper portion of the McKenzie Watershed consists mainly of forested land that is part of the Willamette National Forest. There is some limited rural residential development near site E170 (McKenzie @ Brutgers Bridge) which is downstream of the communities of Rainbow and McKenzie Bridge. Site E182 (McKenzie @ Frissell Bridge, below Trailbridge Reservoir) is above the community of McKenzie Bridge and is largely influenced by springs from the High Cascades.

5.2.2   *South Fork McKenzie Basin (E480, E482)*
The South Fork of the McKenzie River is a major tributary that originates in the High Cascades

and is fed in part by groundwater from springs. It flows through alpine and national forestland, as well as some commercial forestland. The Army Corps of Engineers built Cougar dam on the South Fork, which is a large dam used for flood control and hydroelectric power. Between 2002 and 2004, the Army Corps installed a temperature control tower on the reservoir to help regulate seasonal temperatures, which had been too warm for native salmon in the fall and too cold in the summer (USGS, 2010). Site E482 is located above the dam, while E480 is below the dam near the confluence with the McKenzie.

5.2.3   Blue River at McKenzie Highway Bridge (E540)
This monitoring site is located below Blue River reservoir and near/downstream of the community of Blue River. In addition to the small town development and residents, land use in the vicinity includes both private industrial forestland and national forest. The Army Corps of Engineers built Blue River dam for flood control. The reservoir captures tributaries originating in the Western Cascades.

5.2.4   McKenzie River at Holden Creek (E060)
Mainstem site located downstream of the community of Leaburg; nearby land uses include residential development, two fish hatcheries, hazelnuts orchards, and commercial forestland.

5.2.5   McKenzie River at Hendricks Park (E020)
This monitoring site is located in a dewatered stretch of the river as a result of EWEB's Walterville Power Canal diversion. Land use in the vicinity includes residential homes along the river, the community of Walterville, agricultural crops in the valley (pasture, row crops, hazelnuts, grass seed, Christmas trees, nurseries, etc.), and commercial forestland in the surrounding hills.

5.2.6   Camp Creek at Camp Creek Road (E310)
Camp Creek drains an area of approximately 22 square miles in the south Coburg Hills area. The headwaters of the creek start at an elevation of approximately 1,900 feet above mean sea level (AMSL). The creek drops 1,100 feet in elevation over the first two miles of flow before flattening out in a valley floor with an elevation change of 300 feet over the remaining 7.5 miles before it discharges into the McKenzie River. The creek forms a 0.5-mile wide valley with steeper slopes on either side. Camp Creek enters the McKenzie River along the east side of a small butte between USGS river miles 20 and 21. The average annual flow in Camp Creek is estimated at 106 cfs (Golder, 1995).

Land use in the basin includes agriculture in the valley (pasture, Christmas trees, livestock, blueberries, etc.), commercial forestland in the hills, and rural residential development in the lower portion. A total of 85 percent of the watershed is being managed for timber production along the steeper hillsides and surrounding ridges. Approximately 13.5 percent of the watershed is being used for agriculture and is concentrated along the valley floor. About 1.5 percent of the Camp Creek basin consists of residential development located in the lower portion of the watershed (EWEB, 2001; NRCS, 1987).

5.2.7 Cedar Creek at Saunders Bridge (E210)

Cedar Creek drains an area of approximately 10 square miles in the Cedar Flats and Thurston area. The headwaters of the creek start at an elevation of approximately 1,200 ft AMSL. The creek drops 600 feet in elevation over the first mile of flow before flattening out with an elevation change of 120 feet over the remaining 7 miles before it discharges into the McKenzie River. The creek forks into North and South Fork of Cedar Creek in the Thurston area and rejoins after flowing in separate channels for approximately 1.5 miles. Cedar Creek enters the McKenzie River through braided channels encompassing USGS river miles 16 to 18. The average annual flow in Cedar Creek is estimated at 53 cubic feet per second (cfs) (Golder, 1995). It should be noted that Cedar Creek receives supplemental flow from the McKenzie River via head gates located in the Cedar Flats area. The supplemental flow from the McKenzie River is controlled by local land owners and members of the Cedar Creek Association.

Approximately 55 percent of the Cedar Creek basin consists of forested land with some rural development along hillsides and moderately steep slopes in the upper portions of the watershed. Once the creek flattens out, the predominant land use is agriculture with some rural development (approximately 30% of the basin) until it discharges into the McKenzie River (EWEB, 2001). Approximately 15% of the Cedar Creek basin consists of residential and commercial urban development in the southwest portion of the watershed. The creek receives stormwater runoff from three major outfalls: 64th Street, 69th Street and 72nd Street in the East Springfield area (EWEB, 2001; NRCS, 1987).

5.2.8 Keizer Slough at SUB Bridge (E810)

Keizer slough is a diversion channel from the McKenzie River that initially supplied the International Paper Company (IP) containerboard plant with water for cooling and other industrial purposes. In late December, 2009 IP moved the mill intake water system to the mainstem of the McKenzie. Since then IP rarely draws water from Keizer Slough, except during maintenance outages. Keizer Slough receives non-contact cooling water discharges from the IP plant, as well as stormwater from 52nd Street, 42nd Street (only during times of high flow), and some minor streams north of Highway 126. Treated wastewater from IP is discharged into the McKenzie River below Hayden Bridge boat ramp. Over the past few years, there has been a significant reduction in the non-contact cooling water discharged into Keizer Slough due to energy recovery projects. The DEQ required temperature total maximum daily load (TMDL) will likely require the mill to eliminate this discharge during low flow periods and planned energy recovery projects will eliminate this flow the remainder of the year. Keizer Slough discharges into the McKenzie approximately 0.25 miles upstream of EWEB's drinking water intake.

5.2.9 McKenzie River at Hayden Bridge (EWEB Intake) (E010)

EWEB's drinking water intake is immediately upstream of Hayden Bridge, where a USGS gage is located. The monitoring site is upstream of the Mohawk River confluence with the McKenzie, but downstream of all other monitoring sites. Water samples are collected from the raw water taps within the Hayden Bridge treatment plant.

5.2.10 Mohawk River Basin (E01M and E02M)

The Mohawk River is the largest tributary of the McKenzie River. Its headwaters are in the foothills below the Cascade Mountain Range at an elevation of approximately 3,859 ft AMSL. The Mohawk River flows over 30 miles to its confluence with the McKenzie River at about 450 ft AMSL.

The upper part of the watershed is primarily industrial forest lands interspersed with federal forest lands managed by the Bureau of Land Management (BLM). The lower part of the watershed consists of privately-owned agricultural land, small timber operations, and rural residential development. The confluence of the Mohawk River with the McKenzie River is below EWEB's drinking water intake.

5.3   Decontamination Procedures

The majority of equipment used as part of the baseline monitoring is dedicated to each site and comes pre-cleaned (sample bottles). The sampling extension pole is rinsed in native water prior to use. The YSI sonde is rinsed and cleaned between sites and is deployed away from the sample collection area to avoid interference. In the event that equipment needs to be decontaminated after or before use the following are the decontamination protocols EWEB uses:

- Tap water rinse to remove sediment or other large material;
- Alconox/water solution wash using appropriate brushes;
- Tap water rinse;
- Deionized (DI) water rinse
- Methanol rinse; and,
- Final DI water rinse (if not able to air dry equipment).

5.4   Quality Assurance/Quality Control Samples

The quality assurance (QA) objectives for this project are to develop and implement procedures that will ensure the collection of representative physical and chemical data of known and acceptable quality. Please refer to EWEB's *Lower McKenzie River Watershed, Stormwater and Urban Runoff Monitoring Plan (November 2001)* for additional detail on the quality assurance/quality control project plan (EWEB, 2001) (Appendix A).

For the baseline monitoring effort, typically two types of QA samples are collected; duplicate samples and matrix spike/matrix spike duplicate samples. Due to the limited use of equipment that is not dedicated to each sampling site (i.e., the sampling extension pole and YSI sonde), it was decided that equipment rinseate blanks are not necessary for this monitoring program.

Matrix Spike/Matrix Spike Duplicate

Matrix spike samples are collected from one location where collection of extra sample volume is not a problem. One matrix spike and matrix spike duplicate are periodically collected to evaluate laboratory analyte recovery rates and precision. The samples are shipped to the laboratory with instructions to spike. The laboratory does matrix spike analysis of each sample as part of its laboratory procedures.

Duplicate Samples

At least one duplicate sample will be collected per monitoring event. A duplicate sample is collected by alternating filling two sets of laboratory bottles. The duplicate sample is provided a unique monitoring site number and is collected to match as closely as possible to the original sample.

Equipment Rinseate Samples

Equipment rinseate blanks are used to determine if decontamination procedures were adequate and to determine if cross contamination occurred during sampling. A rinseate sample is collected by pouring or pumping DI water through clean equipment and collecting the rinse water into the appropriate laboratory containers for analysis. As previously indicated, equipment rinseate samples are not currently collected as part of the baseline monitoring program.

5.5   Analytical Parameters

The analytical parameters associated with the watershed baseline monitoring program are listed in Section 5.1. The specific analytical methods, required sample quantity, preservation methods, sample container type, filtration method, and holding times associated with these analytical parameters are summarized in Table 5-1.

Table 5-1: Summary of Analytical Requirements

Analyte	Vol. Req. (mL)	Container	Preservation	Filter	EPA Method	Holding Times
Total Metals - (As, Ba, Cd, Cr, Cu, Pb, Mn, Ni, Zn)	100	250 ml poly bottle	Nitric Acid (pH<2)	No	200 Series	6 Months
Dissolved Metals - (As, Ba, Cd, Cr, Cu, Pb, Mn, Ni, Zn)	100	1 L poly bottle	NA – Lab filtered	0.45 μm filter	200 Series	6 Months
E. coli and Total Coliforms	75	150 ml poly bottle	Ice	No	SM 9223B	30 Hours (Hrs)
Nitrate + Nitrite Orthophosphate	100	1 L poly bottle	NA – Lab filtered	No	300 365.2	28 Days
Total Kjeldahl Nitrogen	500	500 ml poly bottle	Sulfuric Acid (pH<2)	No	351.2	28 Days
Total Phosphorus	50	500 ml poly bottle	Sulfuric Acid (pH<2)	No	365.1	28 Days
Total Organic Carbon	250	250 ml brown glass bottle	Sulfuric Acid (pH<2), Ice	No	415.2	28 Days
Chlorophyll-a Pheophytin-a	250	1 L brown glass bottle	Ice	0.45 μm filter	SM 10200H	24 Hrs (filter) 30 Days
Ammonia-N	250	500 ml poly bottle	Sulfuric Acid (pH<2)	No	SM 4500	28 Days
Chemical Oxygen Demand	50	500 ml poly bottle	Sulfuric Acid (pH<2)	No	410.4	28 Days
Total Suspended Solids	200	1 L poly bottle	Ice	No	SM 2540D	7 Days

Sources of information: NRCS, 1996; DEQ, 1998b; NCA, 2001; PNW, 2001.

5.6   Data Analysis – Methods, Approaches and Limitations

Censored data (i.e. analytical results falling above or below a method type threshold such as a

reporting limit), varying analytical objectives and sampling frequency all factored into the analytical approach applied to data in this report. Several analytes were detected consistently throughout the watershed and provided robust datasets that could be used to construct boxplots and investigate trends. Other analytes were detected sporadically and provided only enough data to highlight spatial distribution of detections. A few analytes were rarely detected, if at all, and provided very little data for analysis. In general, the data analysis presented in this report is more descriptive in nature, although future revisions of this report will incorporate statistical-based methods for trend analysis as more data is collected over time.

Reporting Limits
An important consideration regarding data analysis in this report is the spectrum of method reporting limits (MRLs) observed for each analyte. The MRL is the lowest reportable concentration of an analyte in a sample that can be quantitatively determined at set precision and accuracy guidelines. Factors that influence MRLs can include sample preparation procedures (such as dilution or extraction techniques) and instrumentation sensitivity. The MRL is always greater than or equal to the method detection limit (MDL), which is the minimum concentration of an analyte that can be identified, measured and reported with 99% confidence that the analyte concentration is above zero (U.S. Environmental Protection Agency, 1997). The variability of MRLs is often directly related to the specific method type being employed for each analysis, which can vary from one data source to another.

Non-detects
Non-detects, or concentrations falling below the MRL, are routinely observed in the dataset. Non-detects do not necessarily mean that the analyte was not present, but rather that it was not reliably detected using the specified lab method. Detection frequencies ranging from 0% (barium) to 100% (total coliforms) occur across all monitoring sites. Many water quality analyses include multiple MRLs. For example, the MRL for barium ranges from 1 to 100 µg/L. Unfortunately, if the MRL is set too high, the results can be significantly censored. This situation is especially apparent with nitrate/nitrite values provided in Appendix C for site E540 (Blue River). Numerous nitrate/nitrite detections from 2000 through 2005 provided by the DEQ show a range of values from 5.5 to 30.8 µg/L. After 2005 the number of detections drops to zero. The reason is that the MRL provided by DEQ is 5 µg/L whereas the MRL provided by TestAmerica is 100 µg/L. TestAmerica, formerly North Creek Analytical, began analyzing samples on behalf of EWEB in 2006. Non-detects were not estimated unless a specific statistical or graphical approach warranted such action (see section 6.1.5 below).

Upper Enumeration Limit for Total Coliform
The upper limit of enumeration for total coliform via the Quanti-Tray/2000 method is 2,419. In other words, this method is unable to quantify total coliform counts exceeding 2,419 in a water sample, unless the sample is first diluted. This value was reached a total of 45 times across all sites, including two samples that were diluted. This represents 14.9% of all total coliform detections. Results reaching the 2,419 threshold (it appears some results were rounded up to 2420 from 2419.2) were given a ">" symbol, since the actual values likely exceeded the

threshold. Beginning in 2010, lab dilution requests for total coliform analysis now accompany all samples sent in from areas with suspected high bacteria counts.

Temporal and Spatial Variability
During the study period for this report (2000-2009) monitoring sites were not always consistent. While most sites were uniformly sampled from 2006 through 2009, the same cannot be said for sampling activity from 2000 through 2005. For example, only five sites (E010, E01M, E020, E480 and E540) were sampled consistently from 2000 through 2009. Several sites were added in 2002, but only with a limited selection of the current analysis suite (sites E210, E310 and E810). The remaining sites were not added to the baseline monitoring list until 2005/2006 (sites E02M, E060, E170, E182 and E482).

Boxplots
The use of boxplots provides an effective means to convey a wide range of data in a relatively small, compact figure. Boxplots were typically created for datasets where the detection percentage exceeded 70%. Under these conditions non-detects were estimated at ½ the reporting limit. While this approach is routinely used for data analysis, a number of studies have found potential flaws with substitution methods, especially when detections percentages are low (Helsel, 2005). However, due to the complexity of the data sources (highly variable sample sizes and detection ranges) the substitution method was selected to provide an efficient way to look at analytes with higher detection rates. Furthermore, a quick observation of the m and n values (m = number of detections, n = number of samples) provided for each boxplot indicates the number of non-detects that were estimated, which may signify potential areas of data skewing. As previously mentioned in section 6.1.3, 14.9% of the total coliform results likely exceeded the upper limit of enumeration for the method being applied. These results were not estimated since the range of possible values are not confined. Analytes with median values falling close to the MRL will also likely experience a higher degree of error using substitution methods.

The geometric mean was added to boxplot figures to accommodate analytical results that differed by several orders of magnitude, as it serves as a more accurate representation than the arithmetic mean. Total suspended solids (TSS) provide a good example of this difference with values ranging from 1,000 to 82,700 µg/L.

Figure 5-1: Boxplot Explanation
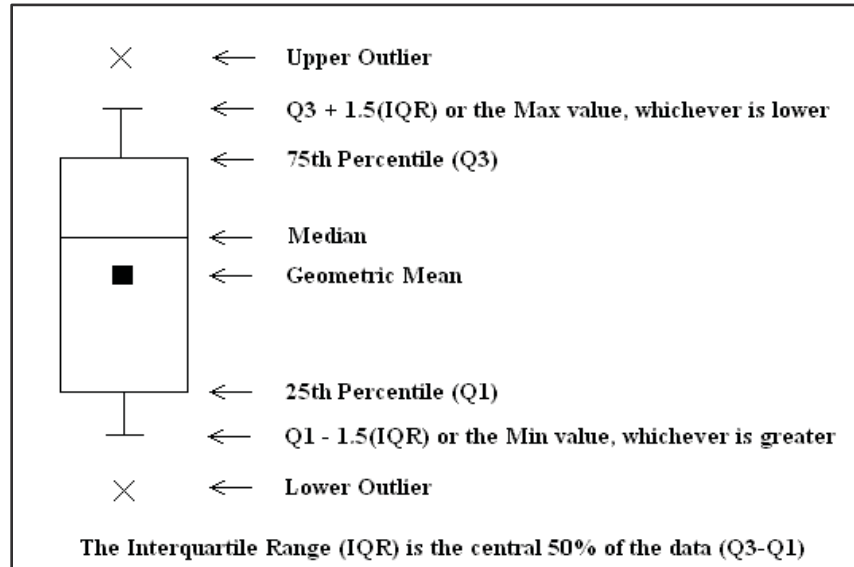
Distribution Plots

In several situations the use of distribution plots provides an effective means for exploring datasets where detections are distributed infrequently (either spatially, temporally or both). Total chromium was displayed using this method since results were only detected at three sites of the thirteen sites (see Figure 6-1b). Detections appearing on each distribution plot are oriented chronologically from left to right for each monitoring site.

Trend Analysis

Linear trend lines were applied sparingly to only a few datasets where samples sizes were adequate to include a best fit approach. However, even in these situations the R^2 values (coefficient of determination) are low. Trend analysis will be able to be used more frequently in future analyses as sample sizes increase with additional monitoring events.

6 SUMMARY OF MONITORING RESULTS

The baseline monitoring program focuses on evaluation of water quality from major tributaries (South Fork McKenzie, Blue River, Mohawk River), critical creek basins (Camp Creek, Cedar Creek, Keizer Slough) and the mainstem of the McKenzie River from the headwaters to Hayden Bridge (Map 6-1). This section discusses analytical results and other data collected as part of baseline monitoring program. All watershed data from baseline monitoring, storm event monitoring, student water quality programs, macro invertebrate sampling, USGS and DEQ monitoring efforts, along with other water quality-related data, is housed in a database at Lane Council of Governments (LCOG) and provided to the public via a website at www.mckenziewaterquality.org. Sample collection methodology and other details associated with sampling were discussed in Section 5.0. The objectives of the baseline monitoring program were discussed in Section 2.0.

6.1 Baseline Monitoring Results

Baseline monitoring includes fixed interval (e.g., every other month) sampling efforts from three different sampling efforts (EWEB/McKenzie Watershed Council, Oregon DEQ, and EWEB Hayden Bridge) (Table 6-1). These baseline monitoring efforts provide data for thirteen monitoring sites in the watershed (Map 6-1). Due to the nature of fixed interval monitoring, water samples were collected in various weather and stream flow conditions (e.g., low flow, high flow, dry weather, storm runoff events). In general data analysis included: 1) assessing the frequency of detections and ranges of detected values (mainstem versus tributaries); 2) patterns of changes in concentrations from upstream to downstream; 3) trends of concentrations over time and by season (when sufficient data existed); and 4) comparison of data to aquatic and human health criteria.

Table 6-1: Summary of Analytical Data Sources
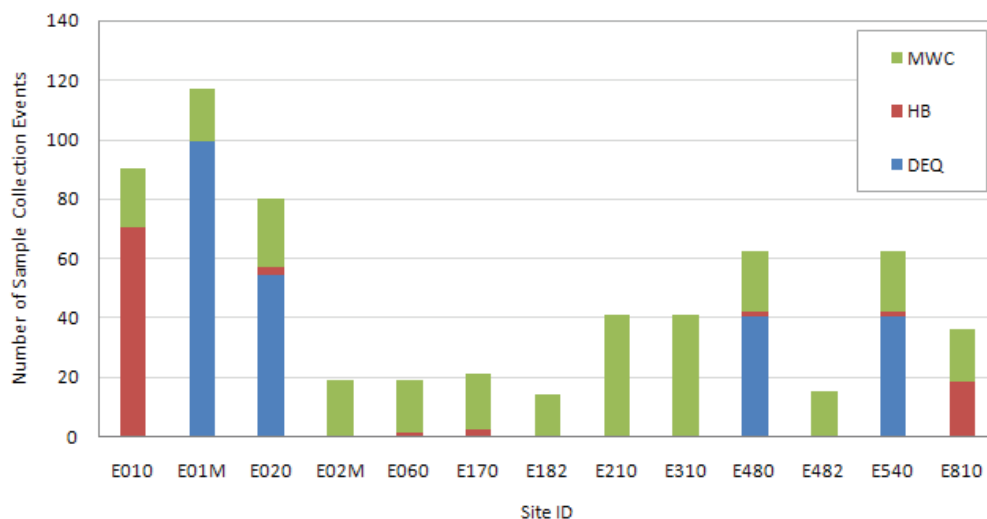
6.1.1 Baseline Metals Results

As part of the baseline monitoring program, samples were analyzed for total and dissolved metals, which included arsenic, barium, cadmium, chromium, copper, lead, manganese, nickel, and zinc. The complete summary of analytical results is contained in Appendix C.

It should be noted that samples collected prior to 2004 were filtered in the field for dissolved metals analysis. Results during this timeframe indicate a trend that dissolved levels of some metals (such as zinc) exceed total levels in the same sample. It appeared the field filter material may have been leaching some metals into the dissolved metals sample as part of the filtration process. Field filtering was no longer used after January 2004 and dissolved samples were sent to the commercial laboratory for filtration.

Arsenic, Cadmium, Lead and Nickel

Analytical results indicate that cadmium was not detected above the instrument reporting limit (RL) and arsenic, lead, and nickel were detected infrequently (1-2% of total samples analyzed) at levels near the RLs (Table 6-2). When detections of these metals did happen, they were found in the tributaries of Camp Creek, Cedar Creek and/or Keizer Slough. A detection of total arsenic was found at 11.2 ug/L in Cedar Creek (October 2003), which exceeds the EPA Maximum Contaminant Level (MCL) of 10 ug/L for protection of human health in drinking water (Appendix C). However, dissolved arsenic for this sample was not detected above the instrument RL which indicates the arsenic was not in dissolved form and less susceptible to human ingestion after water treatment. Given the infrequent detection of these metals, evaluating trends over time was not warranted.

Table 6-2: Summary of Metals Frequency of Detections and Ranges of Values

Analyte (µg/L)	Arsenic Diss.	Arsenic Total	Barium Diss.	Barium Total	Cadmium Diss.	Cadmium Total	Chromium Diss.	Chromium Total	Copper Diss.	Copper Total	Lead Diss.	Lead Total	Manganese Diss.	Manganese Total	Nickel Diss.	Nickel Total	Zinc Diss.	Zinc Total
Minimum Value	1.13	1.01	1	1	1.47	0	1.06	1.07	1.16	1.09	1.06	1.11	0.83	2.04	1.07	2.12	5.07	5.08
Maximum Value	1.17	11.2	6.81	22.7	1.47	0	2.08	5.09	80.9	25.3	1.44	1.64	76.4	139	3.01	30.5	88.4	20.5
Detection Totals	2	3	155	174	1	0	13	30	41	54	3	4	135	159	5	4	53	21
Non-detects	270	291	61	60	271	307	259	264	229	236	269	303	132	68	265	301	217	282
Total Analyses	272	294	216	234	272	307	272	294	270	290	272	307	267	227	270	305	270	303
Detection %	1%	1%	72%	74%	0%	0%	5%	10%	15%	19%	1%	1%	51%	70%	2%	1%	20%	7%

Chromium, Copper and Zinc

Chromium, copper and zinc were detected at a frequency ranging from 10-20% (Table 6-2). Chromium levels ranged from 1.06 to 5.09 ug/L, which is below the EPA MCL of 100 ug/L. The vast majority of chromium detections occurred in Camp and Cedar Creeks (Figure 6-1a). Detections of copper were mainly found in EWEB's raw water, which appears to be a result of

the copper tubing used as part of the internal sample spigot plumbing at the Hayden Bridge treatment plant. Outside of the copper detections at Hayden Bridge, the majority of detections were found in Camp and Cedar Creeks (6-1b). There was one exceedance of acute and chronic aquatic toxicity standards, but this sample had high dissolved copper levels during the timeframe that EWEB was field filtering. Zinc levels were influenced by the use of field filtering method as apparent from the much higher levels of detection in dissolved samples versus total. The majority of zinc detections occurred in Camp and Cedar Creeks and Keizer Slough (Figure 6-1c). Zinc levels did not exceed any aquatic or human health benchmarks. Given the limited number of detections of these metals, evaluating trends over time was not conducted.

Figure 6-1a: Distribution of Total Copper Detections
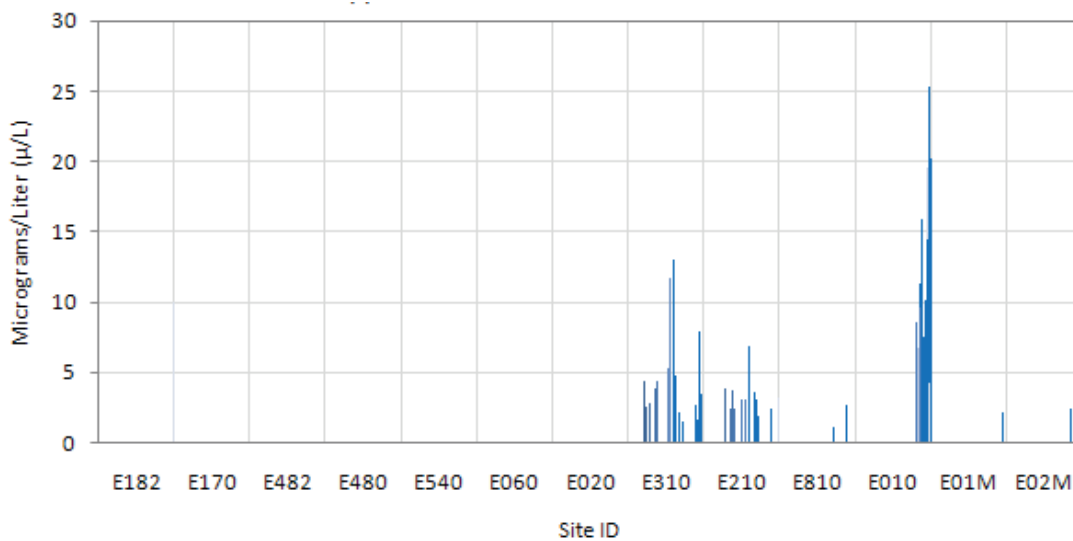
Barium and Manganese
Barium and manganese were detected frequently (>70%) in the watershed (Table 6-2). Figure 6-2 provides the range of detected concentrations of barium in water samples and the pattern of detections from upstream (E182 - McKenzie @ Frissell Bridge) to downstream (E01M – Mohawk @ Hill Road). As indicated in Figure 6-2, the major inputs of barium above EWEB's intake appear to be from Camp Creek (E310), Cedar Creek (E210) and Keizer Slough (E810), with Camp Creek exhibiting the highest levels. The Mohawk River is also a source of barium with levels increasing from upstream (E02M) to downstream (E01M). None of the barium concentrations exceeded any aquatic or human health benchmark criteria (Appendix C).

Figure 6-3 shows barium levels in the mainstem of the McKenzie River, from upstream to downstream. Although there appears to be an increasing pattern of barium from upstream to downstream, it should be noted that the range of these values (approximately 0.5 to 3.5 ug/L) is small. The MCL for barium is 2,000 ug/L (Table 6-2). A trend analysis over time was not conducted on barium due to the lack of data to make a trend analysis meaningful (sample numbers range from 12-18). Common sources of barium contamination for drinking water sources include discharge of well drilling wastes, discharge from metal refineries, and natural

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weathering of mineral deposits (Comstock, 2010).

Figure 6-1b: Distribution of Total Chromium Detections
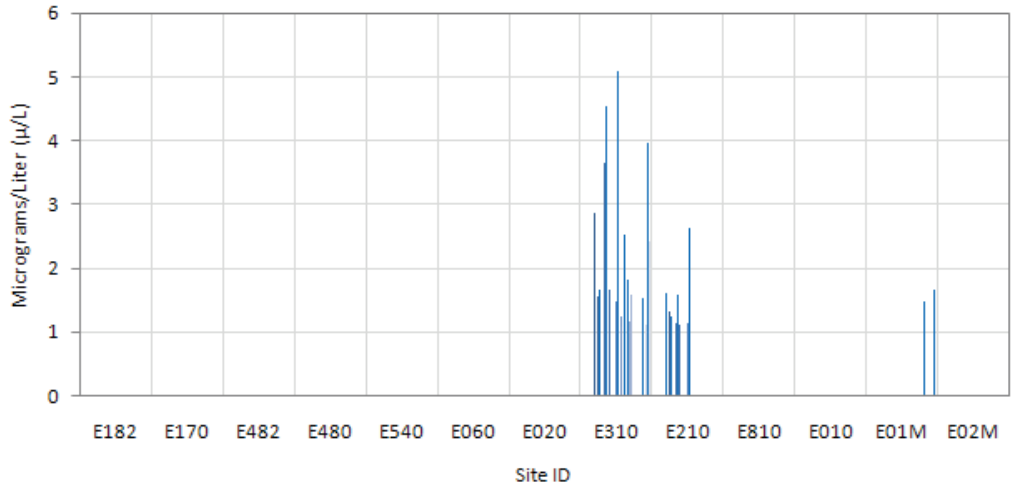
Figure 6-1c: Distribution of Total Zinc Detections
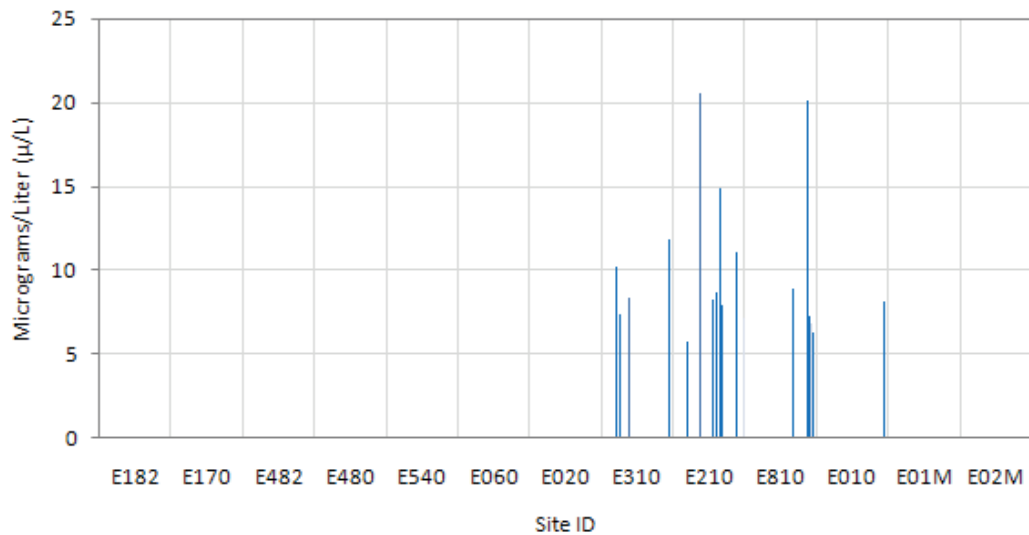
Figure 6-4 provides the range of detected manganese levels in water samples from upstream to downstream in the McKenzie watershed. As indicated in Figure 6-4 and Map 6-2, there are a number of manganese sources to the McKenzie River including Blue River, Camp Creek and Keizer Slough. It appears that reservoirs may have an influence on downstream manganese levels (Figure 6-5). This is apparent in the downstream samples from Cougar reservoir on the South Fork McKenzie River (E480) and below Blue River reservoir (E540). Samples collected upstream of Cougar reservoir (E482) did not detect manganese above instrument RLs (<2 ug/L), however, samples collected below the dam detected manganese nearly 70% of the time at levels ranging from approximately 2 to 9.5 ug/L. Although samples were not collected upstream of

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Blue River reservoir, downstream samples indicated a 100% detection frequency with values ranging from 2.31 ug/L to 28.2 ug/L (Figure 6-5). As indicated in Figure 6-4 and 6-5, Camp Creek and Keizer Slough were other main sources of manganese above EWEB's intake. The Mohawk River is also a source of manganese with levels increasing from upstream (E02M) to downstream (E01M).

Figure 6-2: Summary of Barium Levels from Upstream to Downstream
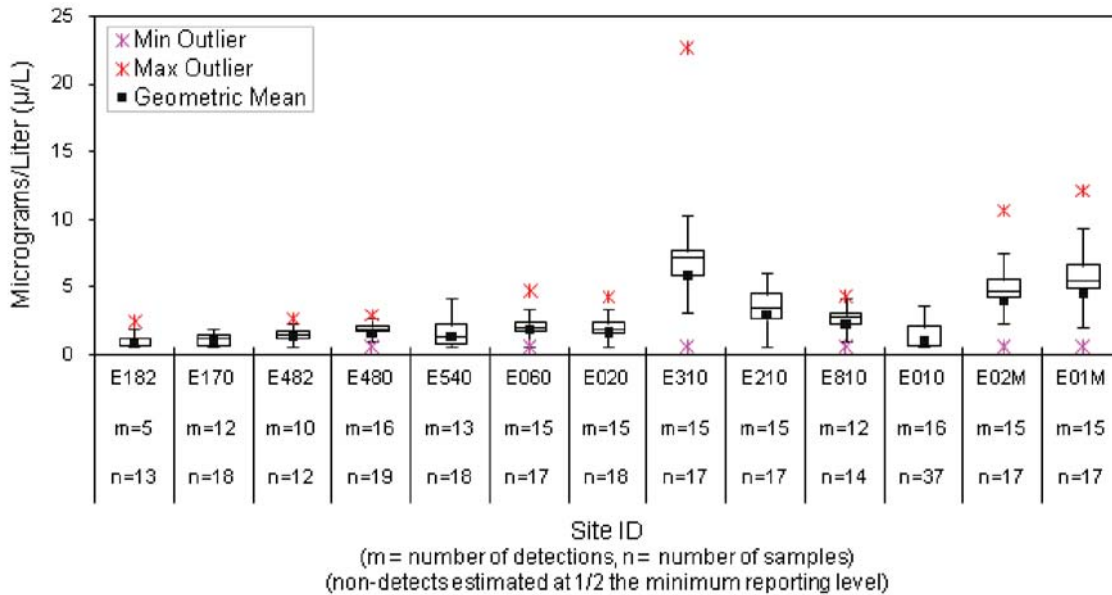
Figure 6-3: Summary of Barium Levels in the Mainstem McKenzie River
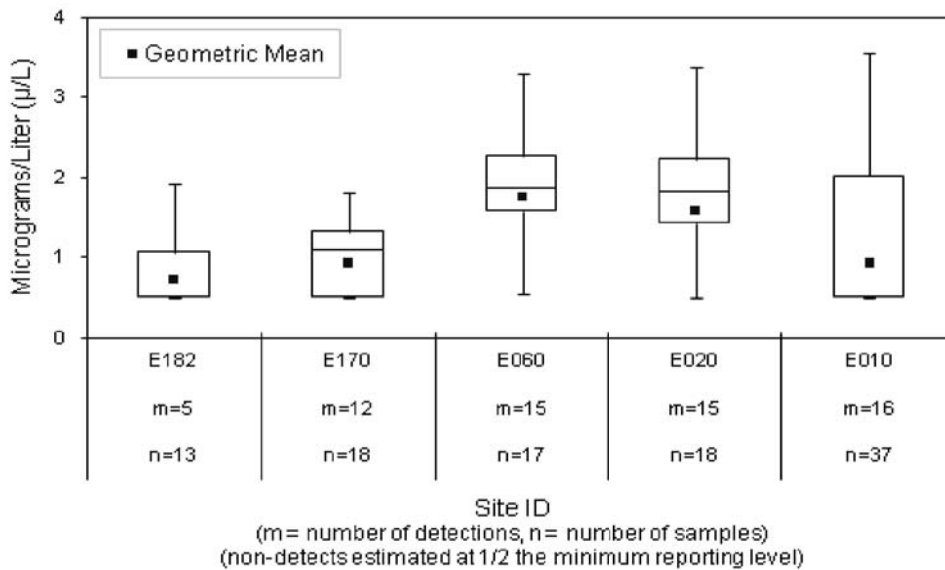
A number of manganese detections exceeded the EPA secondary MCL criteria of 50 ug/L, which are designed to minimize taste and odor or other aesthetic problems with drinking water and are not related to protecting human health. Manganese will cause odor problems in drinking water and scale deposits if at high enough concentrations (WHO, 2004; Oregon DEQ, 2003). Exeedence of the secondary MCL occurred at EWEB's intake (once), Mohawk River (3 times), Camp Creek (3 times) and Keizer Slough (4 times) (Appendix C).

Figure 6-6 shows manganese levels in the mainstem McKenzie River from upstream to downstream. It appears that manganese levels in the mainstem McKenzie begin to increase around the Deerhorn area (E060). Upstream sources may include the inputs from Blue River and South Fork McKenzie. Mainstem levels do not change much between Holden Creek or Deerhorn and EWEB's intake at Hayden Bridge. In general, manganese levels in the mainstem are approximately an order of magnitude less than those found in the tributaries. A trend analysis over time was not conducted on manganese due to the lack of data to make a trend analysis meaningful (sample numbers range from 12-18).

Figure 6-4: Summary of Manganese Levels from Upstream to Downstream

Site ID
(m = number of detections, n = number of samples)
(non-detects estimated at 1/2 the minimum reporting level)
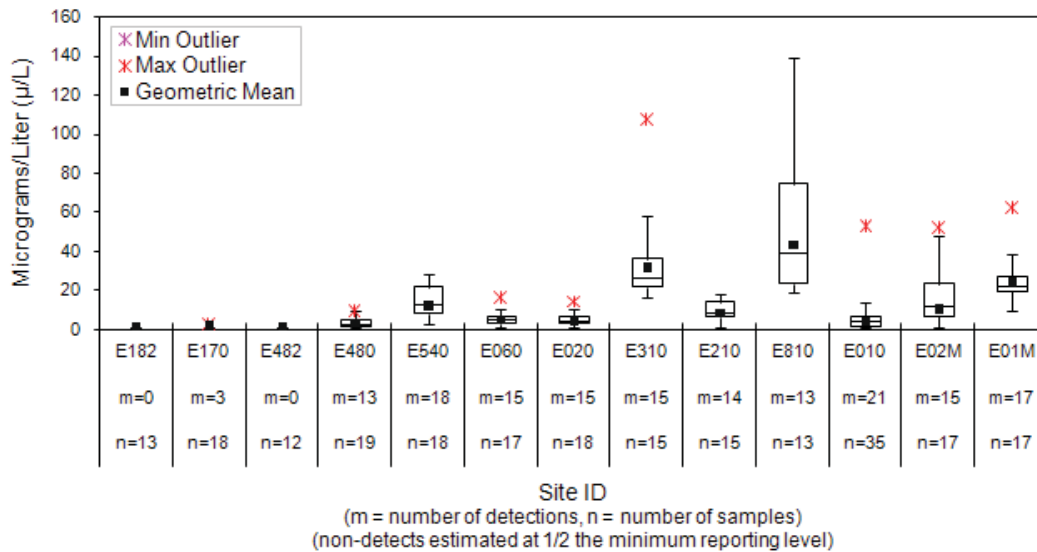
Manganese is one of the most abundant metals in the earth's crust and is typically associated with iron. Manganese is used principally in the manufacture of iron and steel alloys. Manganese dioxide and other manganese compounds are used in products such as batteries, glass and fireworks. Potassium permanganate is used as an oxidant for cleaning, bleaching and disinfection purposes.

An organic manganese compound, methylcyclopentadienyl manganese tricarbonyl (MMT), is used as an octane-enhancing agent in unleaded gasoline. Other manganese compounds are used

in fertilizers, varnish and fungicides and as livestock feeding supplements (WHO, 2004).

Figure 6-5: Summary of Manganese Levels in the Mainstem McKenzie River
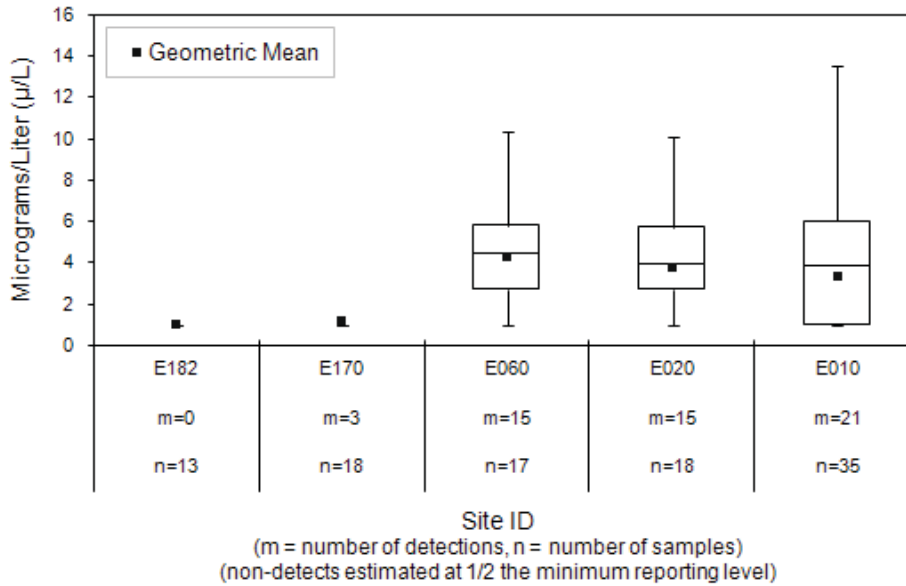
Summary
In summary, it appears the majority of metals that were detected in water samples collected from the McKenzie watershed do not present a drinking water quality problem. The main sources of metals in the McKenzie appear to be from Camp and Cedar Creeks and Keizer Slough, with Blue River contributing for barium and manganese. There were occasional exceedances of human health (arsenic, lead), secondary MCLs (manganese) and aquatic toxicity criteria (copper) from samples collected at EWEB's intake (copper, lead, manganese), the Mohawk River (manganese), Camp Creek (copper, manganese), Cedar Creek (arsenic) and Keizer Slough (lead, manganese).

6.1.2   Baseline Nutrients Results
As part of the baseline monitoring program samples were analyzed for ammonia-nitrogen, nitrate/nitrite-total nitrogen, total and dissolved orthophosphate, total phosphorus, and total kjeldahl nitrogen. Total organic carbon and total suspended solids are also analyzed as part of the discussion of nutrients. The complete summary of analytical results is contained in Appendix C. Table 6-3 summarizes the range of values and frequency of detection of the various nutrients analyzed for as part of the baseline monitoring effort.

Table 6-3: Summary of Nutrients Frequency of Detections and Ranges of Values

Analyte (µg/L)	Ammonia-N Total	Nitrate/Nitrite-N Diss.	Ortho-P Diss.	Ortho-P Total	P Total	Kjeldahl N Total	Organic C Total	TSS Total
Minimum Value	20	5	5	6.7	10	200	468	1000
Maximum Value	170	4523	44	48.9	1000	7820	4560	82700
Detection Totals	70	245	164	120	373	23	176	209
Non-detects	370	223	5	103	78	416	220	186
Total Analyses	440	468	169	223	451	439	396	395
Detection %	16%	52%	97%	54%	83%	5%	44%	53%

Ammonia and Total Kjeldahl Nitrogen

Analytical results indicate that ammonia-nitrogen and total Kjeldahl nitrogen (TKN) were detected above instrument reporting limits (RLs) relatively infrequently (5-16% of total samples analyzed) (Table 6-3). The vast majority of ammonia detections occurred below Cougar Dam (E480) and Blue River Dam (E540), at the McKenzie River at Hendricks Park (E020) and at the downstream monitoring station in the Mohawk basin (E01M) (Figure 6-6a). The highest levels were found in the South Fork McKenzie. Ammonia nitrogen is a natural and common nutrient for plants transformed by microorganisms from organic nitrogen. Ammonia is also part of commercial fertilizers, such as urea. Ammonia is relatively immobile in soils and groundwater because of adsorption on soil surfaces, but is susceptible to nitrification (transforming to nitrate) under aerobic conditions. Nitrate is highly mobile in water (NRC, 2000). TKN was only detected in 5% of the samples and was not concentrated in any specific area(s) (Figure 6-6b). TKN is essentially ammonia plus organic nitrogen.

Nitrate/Nitrite

Analytical results indicate that nitrate/nitrite nitrogen was detected in over 50% of the samples at concentrations that ranged three orders of magnitude from 5 ug/L to 4,523 ug/L (Table 6-3). The most frequent detections of nitrate and highest concentrations occurred at Camp and Cedar Creeks, the downstream Mohawk River site, and McKenzie at Hendricks Park (Figure 6-7 and Map 6-3). The upstream sources of nitrates seem to be minimal, except for below Blue River and Cougar dams. Nitrates do not appear in the mainstem McKenzie until Hendricks Park. The increased levels associated with the Hendricks Park site may be due to the fact that this is a dewatered area of the McKenzie River due to EWEB's Walterville Power Canal diversion.

Trends of nitrate concentrations over time in Cedar and Camp Creeks are shown in Figures 6-8a and 6-8b. It appears that the trends in Cedar Creek are slightly increasing over time, while the reverse is true in Camp Creek. It should also be noted that nitrogen concentrations in water are seasonal. Highest and most consistent detections occur in the winter months and values tend to drop during growing season as increased plant uptake of nitrogen occurs.

Figure 6-6a: Distribution of Ammonia-Nitrogen Detections
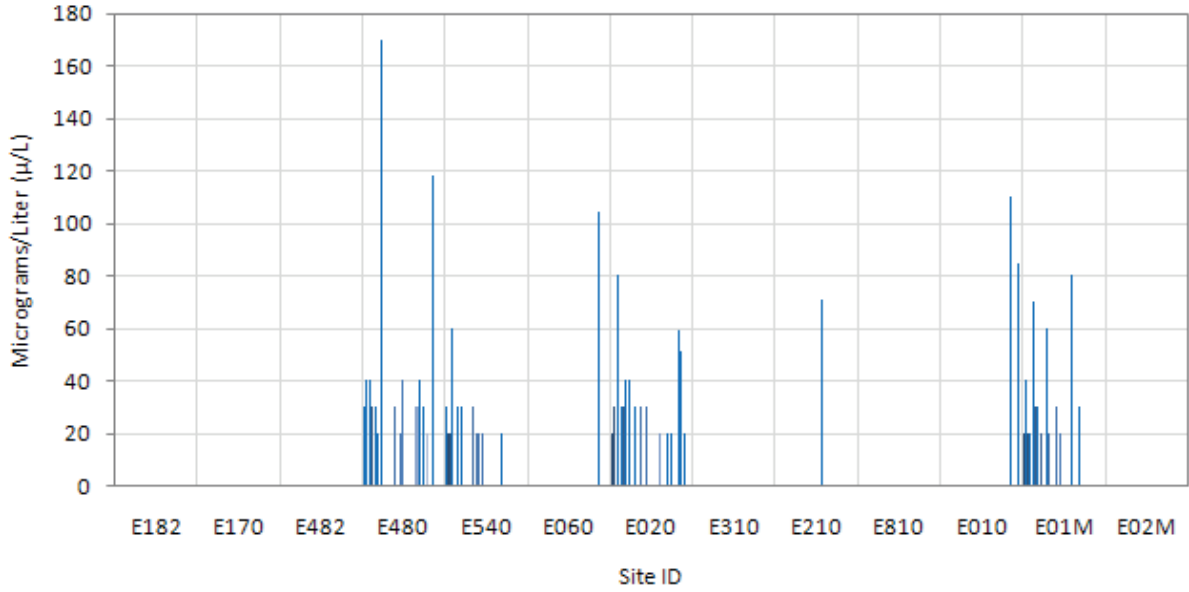
Figure 6-6b: Distribution of TKN Detections
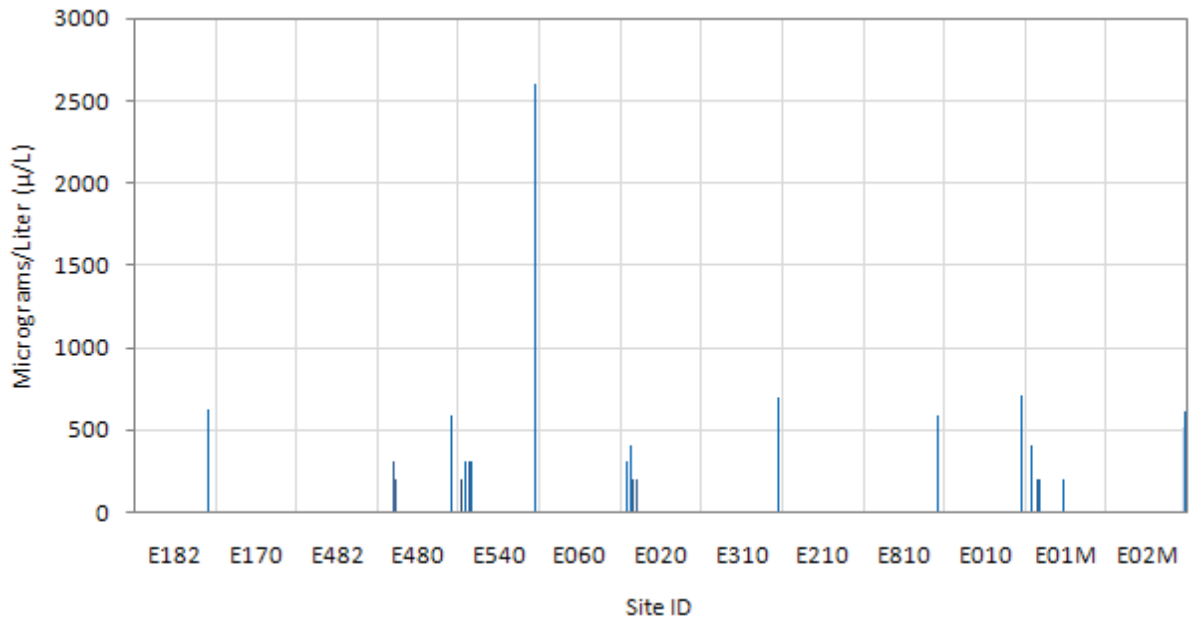
Figure 6-7: Distribution of Nitrate/Nitrite Detections
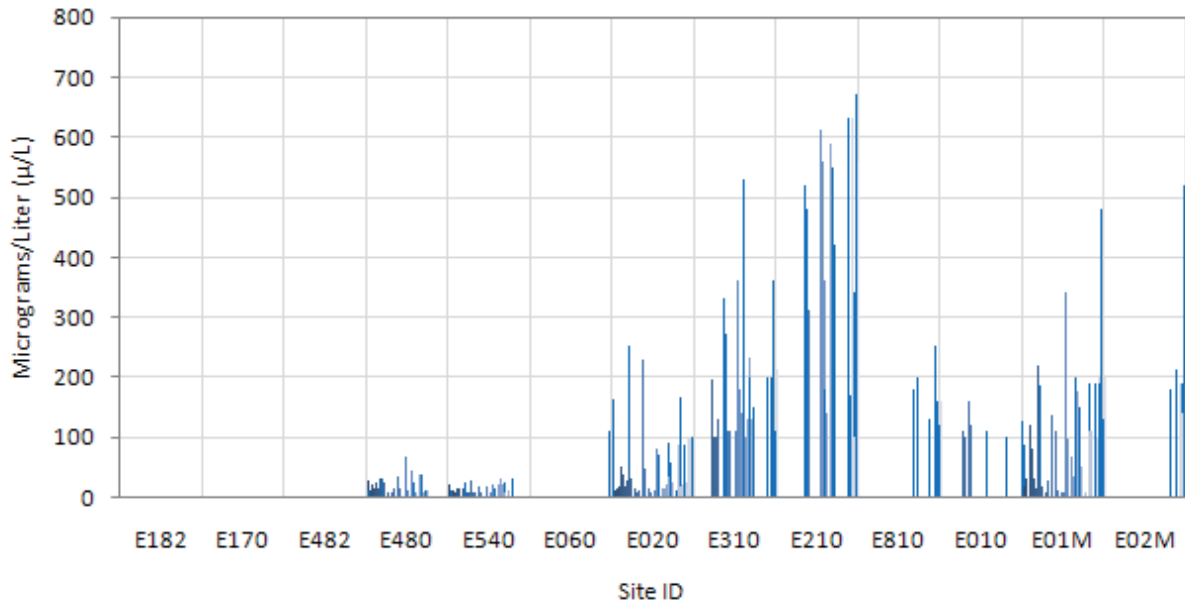
Figure 6-8a: Nitrate Trends in Cedar Creek, 2002-2009
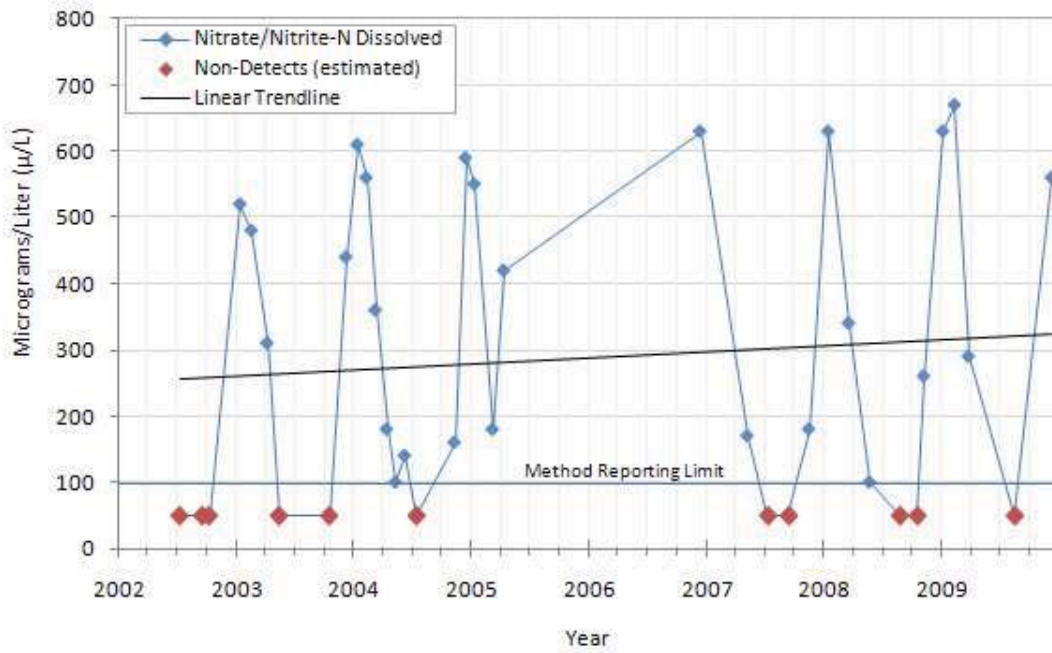
Figure 6-8b: Nitrate Trends in Camp Creek, 2002-2009
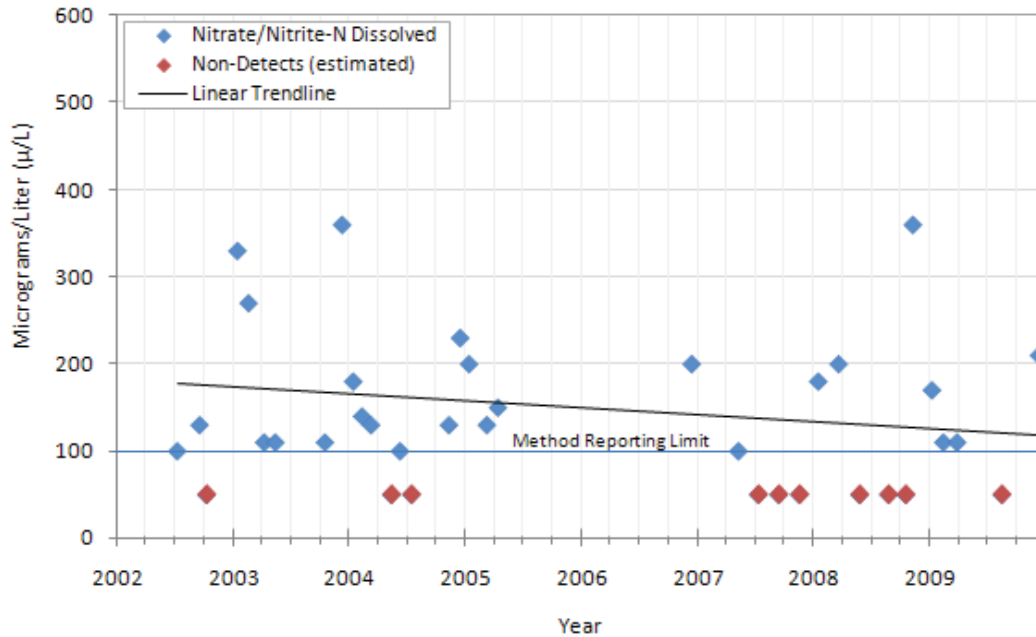
Orthophosphate and Total Phosphorus

Orthophosphate is a form of phosphorus that tends to be stable and is a key nutrient used by plants. Phosphorus exists in water in either a particulate phase or a dissolved phase. Particulate matter includes living and dead plankton, precipitates of phosphorus, phosphorus adsorbed to particulates, and amorphous phosphorus. Phosphorus in natural waters is usually found in the form of phosphates (PO_4^{-3}) (USGS, 2007). Phosphates can be in inorganic form (including orthophosphates and polyphosphates), or organic form (organically-bound phosphates). Total phosphorus is a measure of all forms of phosphorus (dissolved and particulate, organic and inorganic). Organic phosphorous can be a result of animal wastes or excretions and macromolecular colloidal phosphorus (USGS, 2007; Osmond, 1995).

Analytical results of total orthphosphate indicates a 54% detection frequency at levels ranging from approximately 7 to 49 ug/L (Table 6-3). Dissolved orthophosphate was detected 97% of the time at fewer monitoring locations and at lower laboratory detection limits than total orthophosphate. Figure 6-9 and Map 6-4 shows results of the total orthophosphate detections, which indicates a strong natural source in the headwaters and upper portion of the McKenzie and South Fork Mckenzie (E182, E170, and E482). Orthophosphate in the headwaters is found 100% of the time at higher concentrations when compared to sites lower in the mainstem (E060, E020, and E010) where orthophosphate was found approximately 70% of the time (Figure 6-10). In general, orthophosphate levels in the tributaries was found less frequently (5-45%) at lower concentrations (except Keizer Slough (E810), which is diverted McKenzie water). This may be a result of plant uptake as the waters in the upper watershed deliver natural sources of

orthophosphate from the younger volcanic geology downstream. There are no aquatic toxicity or human health benchmarks to compare with Mckenzie orthophosphate levels.

As previously mentioned, total phosphorus is a measure of all forms of phosphorus, including orthophospate. Total phosphorus was detected above laboratory detection limits 83% of the time at levels ranging from 10 to1,000 ug/L (Table 6-3). Total phosphorus levels in the upper part of the watershed are similar to the orthophospate levels, meaning that the majority of phosphorus is in inroganic form as would be expected from young volcanic sources (Figure 6-11). Total phosphorus was detected more frequently and at significantly higher levels than orthophosphate in the lower tributaries (E310, E210, E01M, E02M), which indicates the increased presence of other inorganic forms of phosphorus (polyphosphate) and/or organic forms of phosphorus (such as human and animal waste). This trend is evident in total phosphorus results for the mainstem McKenzie as well (Figure 6-12 and Map 6-4). The geometric mean in the lower Mckenzie sites (E060, E020, and E020) has increased two to threefold over orthophosphate levels indicating increased sources of phosphorus from polyphosphate (inorganic) and/or organic forms such as human and animal waste. Another source of phosphorus is the resuspension of sediment associated with major storms and turning over of reservoirs (Osmond et. al., 1995).

Figure 6-9: Summary of Orthophosphate Levels from Upstream to Downstream

(m = number of detections, n = number of samples)
(non-detects estimated at 1/2 the minimum reporting level)
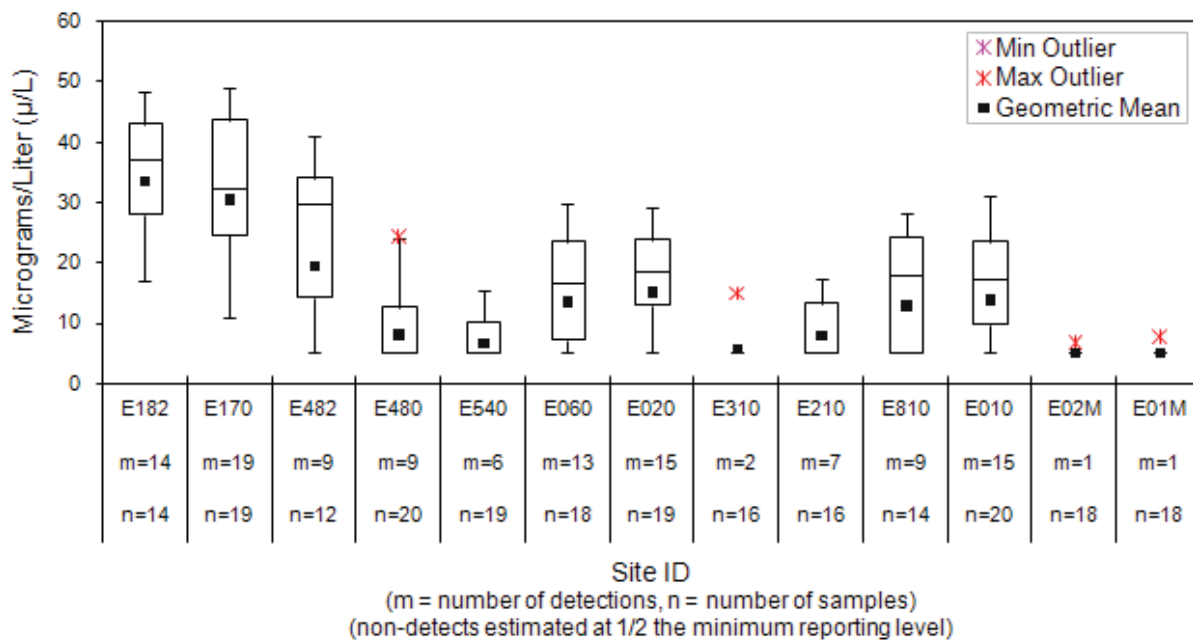
Aquatic toxicity and human health benchmarks do not exist for total phosphorus. However, the EPA has developed water quality criteria that states phosphates should not exceed .05 mg/l if streams discharge into lakes or reservoirs, .025 mg/l within a lake or reservoir, and .1 mg/l in streams or flowing waters not discharging into lakes or reservoirs to control algal growth (U.S. EPA, 1986; Osmond et. al., 1995). There are five exceedances of this standard at South Fork McKenzie below Cougar Dam (twice), Camp Creek (once), Keizer Slough (once) and lower Mohawk River (once).

Figure 6-10: Summary of Orthophosphate Levels in the Mainstem McKenzie
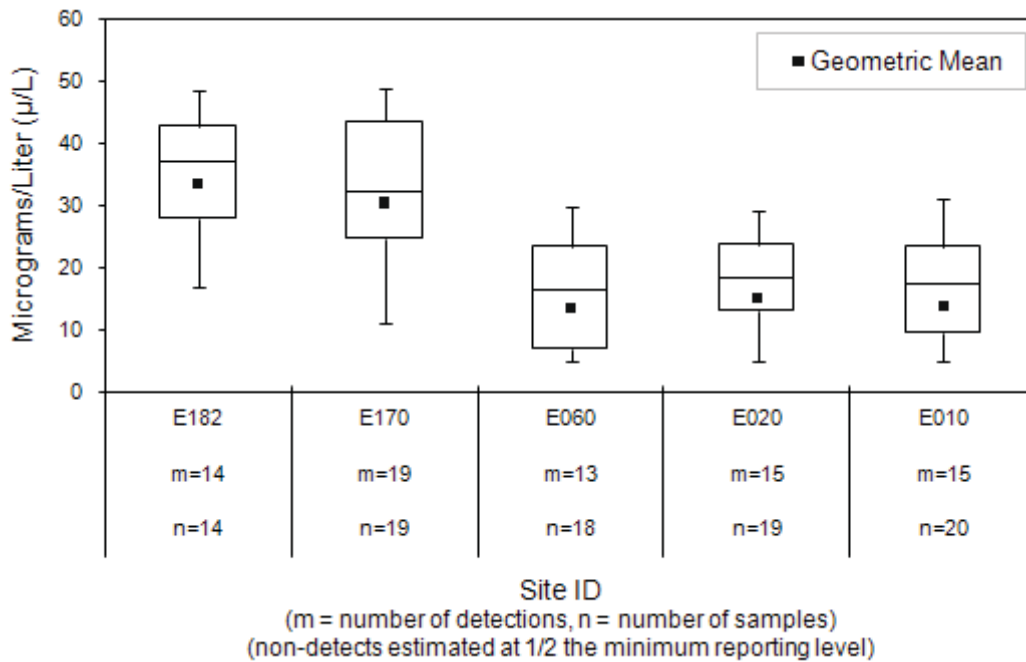
Total phosphate phosphorus concentrations that exceed 100 ug/L may interfere with coagulation in water treatment plants (U.S. EPA, 1986). When such concentrations exceed 25 ug/L at the time of the spring turnover on a volume-weighted basis in lakes or reservoirs, they may occasionally stimulate excessive or nuisance growths of algae and other aquatic plants. Algal growth can cause undesirable tastes and odors to water, interfere with water treatment, become aesthetically unpleasant, and alter the chemistry of the water supply (U.S. EPA, 1986). They contribute to the phenomenon of cultural eutrophication. Surface waters that are maintained at .01 to .03 mg/l of total phosphorus tend to remain uncontaminated by algal blooms (U.S. EPA, 1986; Osmond et. al., 1995).

Figures 6-13a and 6-13b illustrate total phosphorus trends over time at Cedar and Camp Creeks since these sites had sufficient amount of data collected. Trends at both of these monitoring sites indicate phosphorus levels have been increasing over the last eight years.

Figure 6-11: Summary of Phosphorus Levels from Upstream to Downstream

Site ID
(m = number of detections, n = number of samples)
(non-detects estimated at 1/2 the minimum reporting level)
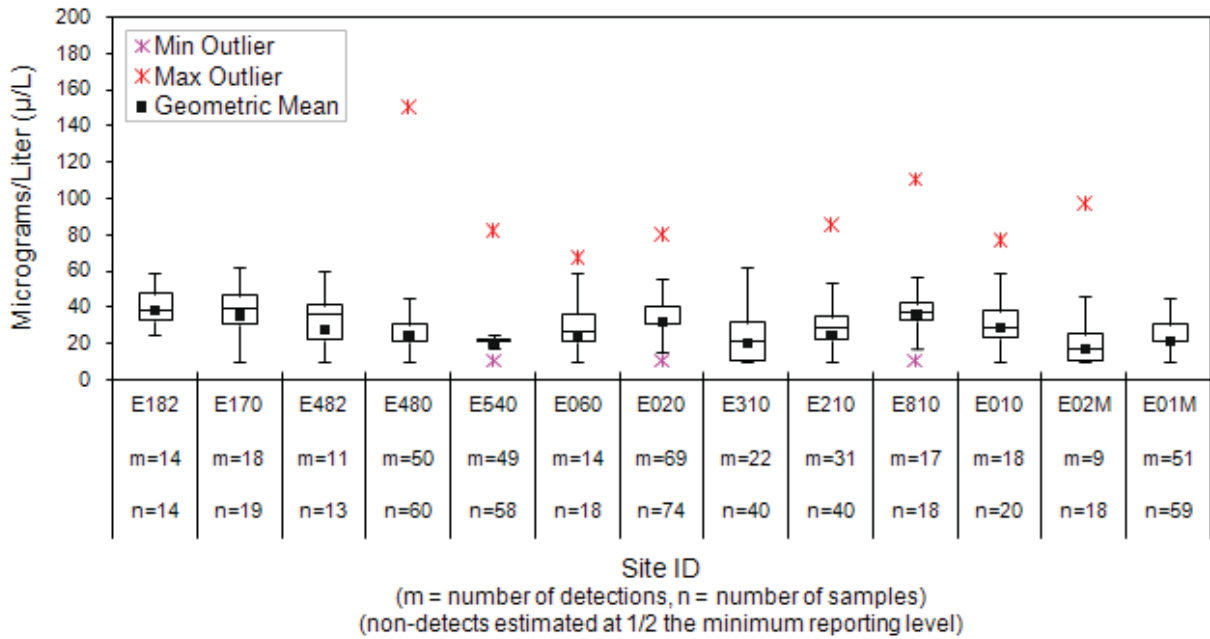
Figure 6-12: Summary of Phosphorus Levels in Mainstem McKenzie

Site ID
(m = number of detections, n = number of samples)
(non-detects estimated at 1/2 the minimum reporting level)
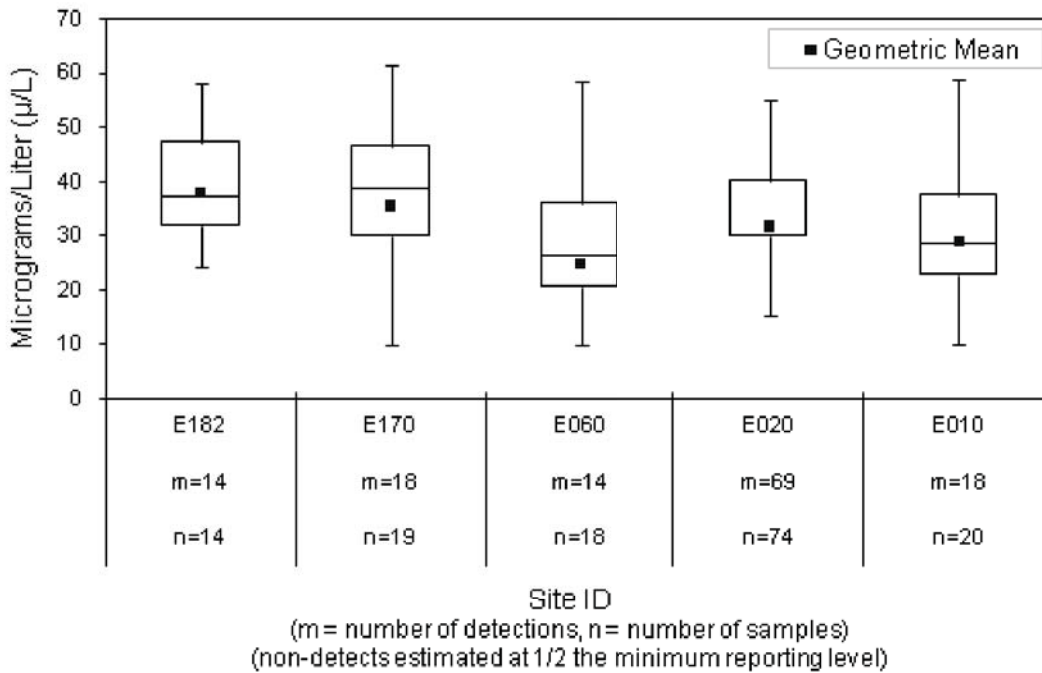
Figure 6-13a: Phosphorus Trends in Cedar Creek, 2002-2009
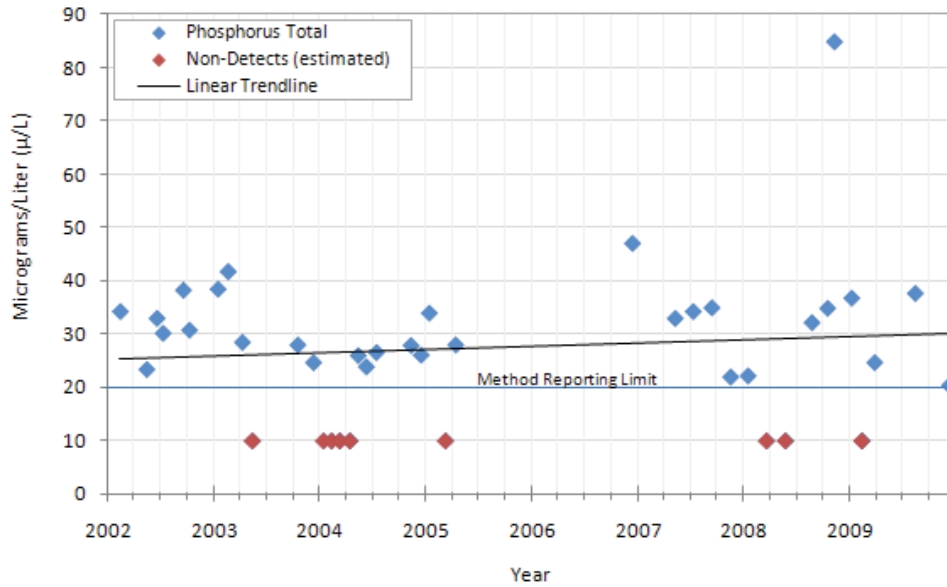
Figure 6-13b: Phosphorus Trends in Camp Creek, 2002-2009

(Note: Max outlier of 810 ug/L on Nov 6, 2008 is not included in this figure)
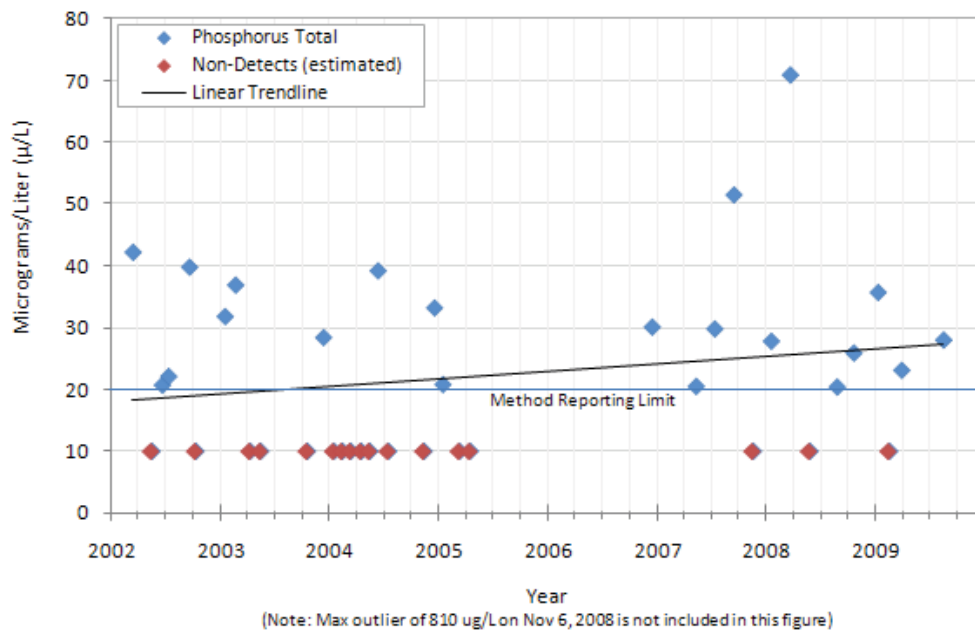
Some of the primary potential sources of the downstream increases in total phosphorus that are not associated with orthophosphate are fertilizers and human/animal wastes (Osmond et. al., 1995; NRC, 2000; Rehm et. al., 2002). Figure 6-14 illustrates the commercial manufacturing process of phosphorus fertilizer, which creates ortho and poly forms of phosphate. Polyphosphates are usually marketed as liquid ammonium polyphosphate fertilizers. Because water is removed in the manufacturing process, these materials have a higher phosphorus concentration than materials in which the phosphate is in the orthophosphate form. The polyphosphate liquids are also more convenient for the fertilizer dealer to handle and allow for the formulation of blends that are not possible with the orthophosphate liquids (Rehm et. al., 2002). Agricultural operations in the lower portion of the watershed that use polyphosphate fertilizers could account for some of the increases in total phosphorus observed in water quality data.

The other potential source is human and animal waste. A number of livestock operations are present in the lower portion of the watershed and tributaries which could be a source for animal manure entering nearby waterbodies. The other potential organic source is septic system effluent. A normal adult excretes 1.3 - 1.5 grams of phosphorus per day. Additional phosphorus originates from the use of industrial products, such as toothpaste, detergents, pharmaceuticals, and food-treating compounds (Osmond et. al., 1995).

Figure 6-14: The process used in the manufacture of various phosphate fertilizers
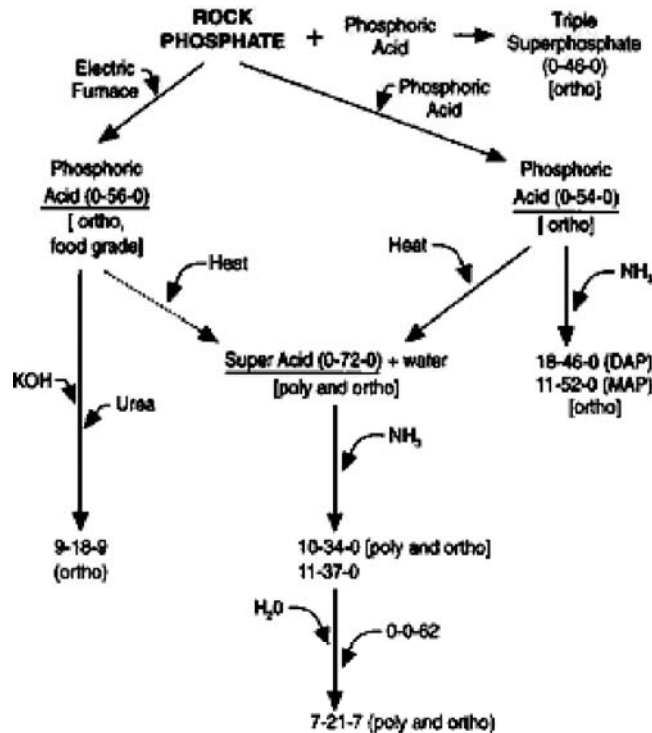
Total Organic Carbon and Total Suspended Solids

Analytical results indicate total organic carbon (TOC) was detected above laboratory reporting limits 44% of the time at levels ranging from 468 to 4,560 ug/L (Table 6-3). As indicated in Figure 6-15 and Map 6-5, the headwaters of the McKenzie (E182 and E170) have lower concentrations (especially in the 75th percentile) of organic matter. South Fork McKenzie and Blue River provide TOC inputs that appear to increase levels seen in the mainstem downstream (E060 and E020) (Figure 6-16). Camp and Cedar Creeks, and Keizer Slough have higher levels of organic matter, but don't appear to impact levels in the mainstem at EWEB's intake (Map 6-5). Aquatic toxicity and human health benchmarks do not exist for TOC.

Figure 6-15: Summary of TOC Levels from Upstream to Downstream
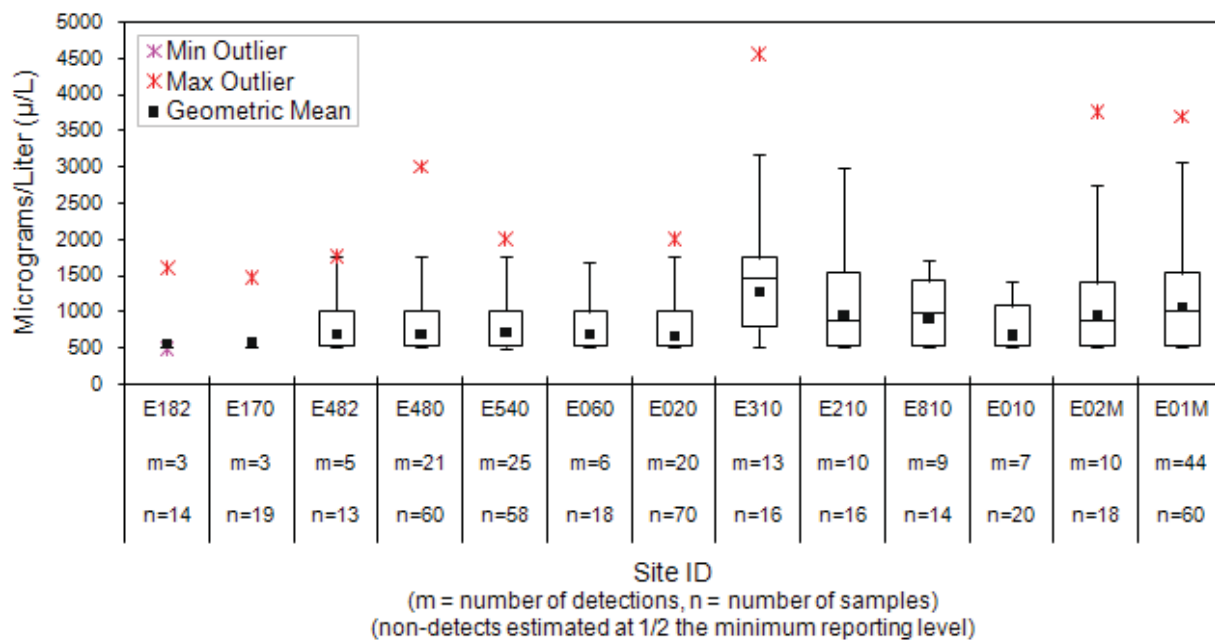
Watershed sources of TOC include decomposing organic matter leaching out of soils by both surface and groundwater flow; leaching of fresh and senescing plant material; algal production within the water column; and anthropogenic sources such as domestic sewage (Kraus et. al., 2010). The amount and reactivity of organic matter that arrives at a drinking water intake is a function of the amount and quality of organic matter entering the water throughout the watershed, as well as environmental processes (e.g. biodegradation, photodegradation and sorption) that occur during transport (Kraus et. a., 2010). The organic matter in raw water causes the formation of disinfection by-products during drinking water treatment as it reacts with chlorine.

Analytical results indicate total suspended solids (TSS) were detected above laboratory reporting limits 53% of the time at levels ranging from 1,000 to 82,700 ug/L (Table 6-3). As indicated in

Figure 6-17, TSS levels were infrequently detected above RLs in the spring dominated portions of the upper watershed (E182, E170, E482). Blue River (E540) appears to be an upriver source of suspended solids. Camp Creek has the highest levels of suspended solids in the watershed. Mainstem McKenzie levels of suspended solids increase from upstream to downstream, especially in the area of Deerhorn and Hendricks Bridge, before significant reductions at EWEB's intake (Figure 6-18). This reduction may be associated with EWEB's power canal operations creating dewatered portions of the river and returning flows of clean water to dilute these inputs. Another possibility is the intake structure at Hayden Bridge is not an isokinetic sampling point and may not provide a respresentative sample of the McKenzie for TSS.

Figure 6-16: Summary of TOC Levels in the Mainstem McKenzie
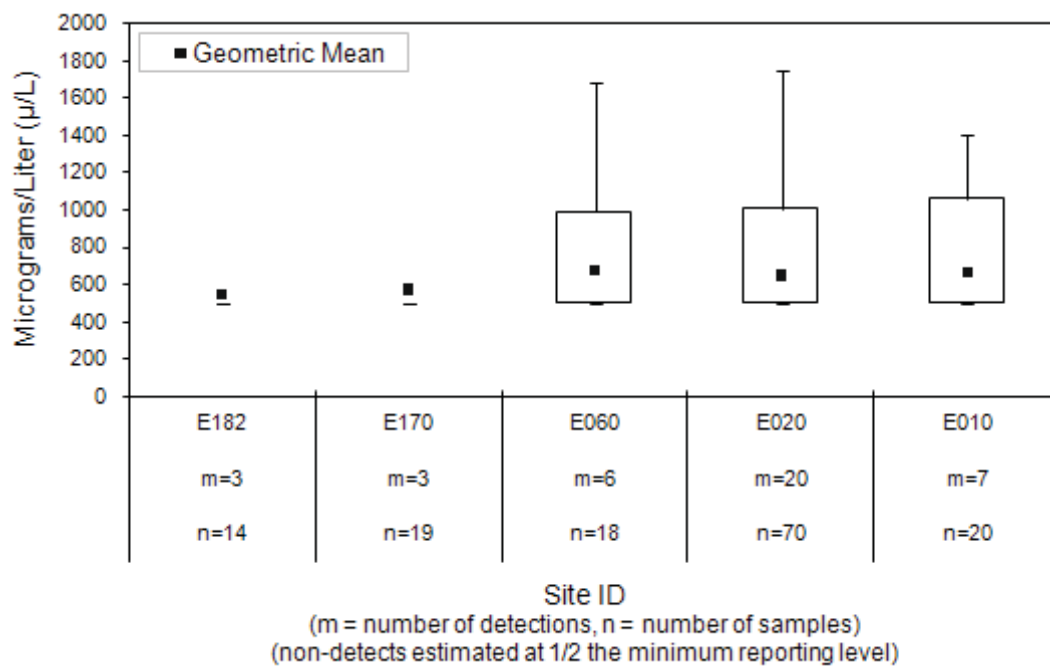
Summary
Nutrient, TOC and TSS levels in the McKenzie watershed do not appear to present water quality problems. Patterns of detections indicate an increase of nitrates in the mainstem McKenzie at Hendricks Park with additional sources of nitrates in Camp and Cedar Creeks. The increased levels associated with the Hendricks Park site may be due to the fact that this is a dewatered area of the McKenzie River due to EWEB's Walterville Power Canal diversion. The increase in nitrate levels in the lower portion of the river may be due to fertilizer applications associated with agricultural operations, increased density of septic systems, and residential use of fertilizers along the river. None of the nitrate levels exceeded human health criteria of 10 mg/L.

Evaluation of naturally-occuring orthophosphate with total phosphorus measurements indicated the potential sources of phosphorus in the lower watershed may be from fertilizers,

human/animal wastes and re-suspension of sediment during storms and reservoir operations. Phosphorus levels exceed an EPA recommended criteria to prevent algal growth five times at four sites. Phosphorus levels have been increasing over the last eight years for sites where sufficient data has been collected to support an evaluation of trends (Camp and Cedar Creeks).

Figure 6-17: Summary of TSS Levels from Upstream to Downstream

Site ID
(m = number of detections, n = number of samples)
(non-detects estimated at 1/2 the minimum reporting level)
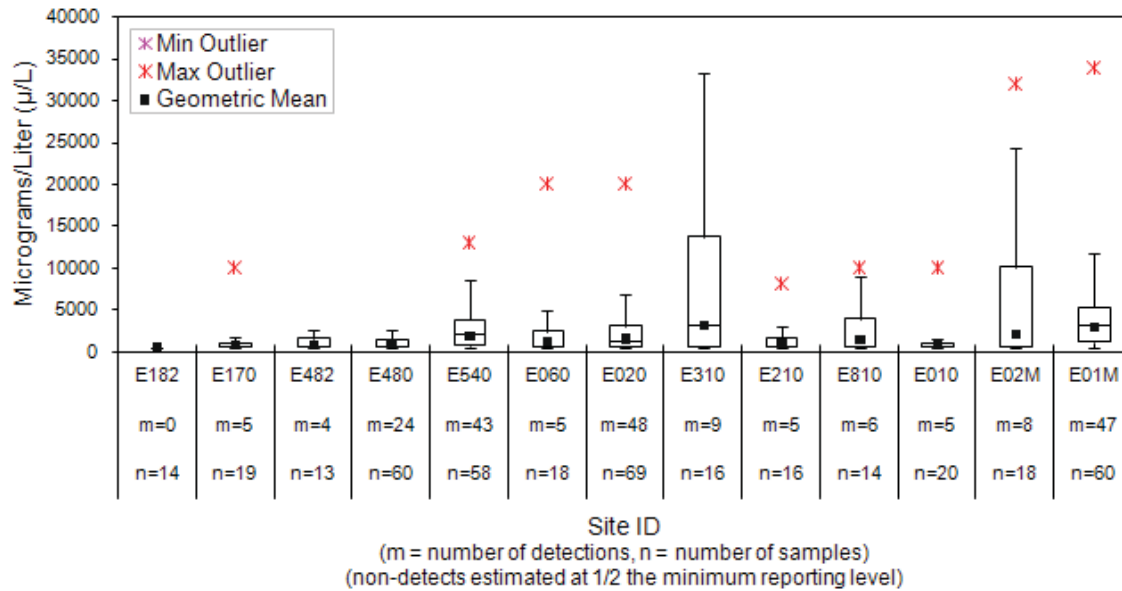
Figure 6-18: Summary of TSS Levels in the Mainstem McKenzie

Site ID
(m = number of detections, n = number of samples)
(non-detects estimated at 1/2 the minimum reporting level)
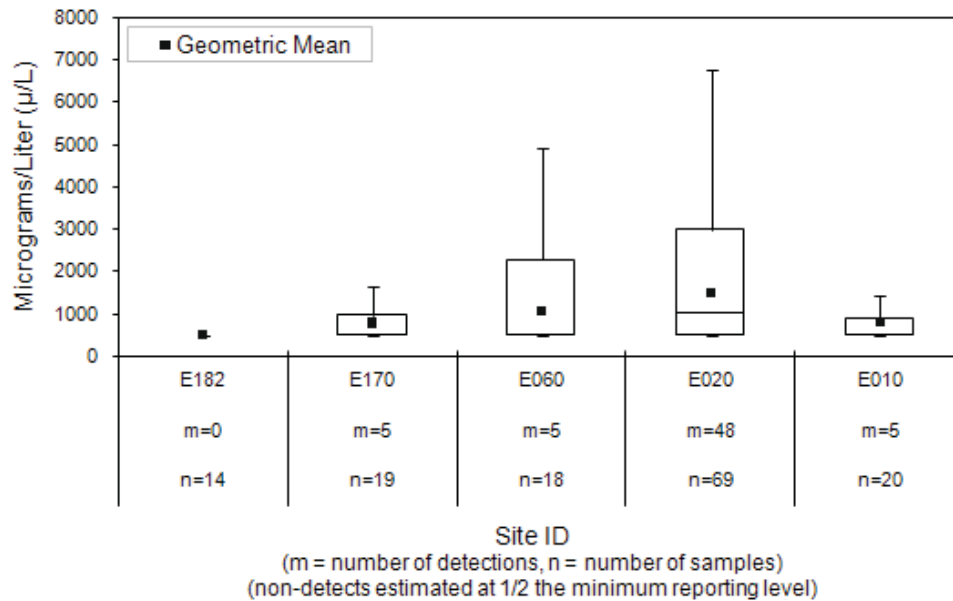
6.1.3 Baseline Bacteria Results

As part of the baseline monitoring program, samples were analyzed for E. coli and total coliform bacteria, total pheophytin-a and chlorophyll-a. The complete summary of analytical results is contained in Appendix C. Table 6-4 summarizes the range of values and frequency of detection of the various bacteria analyses conducted as part of the baseline monitoring effort.

Table 6-4: Summary of Bacteria Frequency of Detections and Ranges of Values

Analyte	E. Coli MPN	Total Coliforms MPN	Chlorophyll α µg/L	Pheophytin α µg/L
Minimum Value	1	5.2	0.024	0.2
Maximum Value	866	2420	24	9.93
Detection Totals	370	234	163	110
Non-detects	88	0	109	143
Total Analyses	458	234	272	253
Detection %	81%	100%	60%	43%

E. coli and Total Coliform

Analytical results indicate that E. coli was detected above laboratory reporting limits 81% of the time at values ranging from 1 to 866 MPN/100 ml (Table 6-4). Figure 6-19 shows E. coli values from upstream to downstream in the watershed. The main areas with high E. coli values are Camp Creek, Cedar Creek, Keizer Slough and the Mohawk River (Figure 6-19 and Map 6-6). One potential source of bacterial contamination in Keizer Slough could be associated with heavy geese use of IP's cooling ponds. E. coli is nearly nonexistent in the headwaters of the McKenzie and increases in frequency of detection and in concentrations as you move downstream (Figure 6-20).

Figure 6-19 and Map 6-7 show seasonal trends of E. coli bacteria contamination in the lower part of the watershed where the vast majority of E. coli levels are found. As indicated, summer consistently has the highest levels of bacteria possibly due to much lower flows reducing dilution. Fall is the season with the second highest E. coli pollution levels which may reflect continued low flow conditions and possibly first flush events that are able to mobilize bacteria populations.

Trends of E. coli contamination over time were evaluated at a couple sites with the largest number of samples (E01M, E010, and E020). Figures 6-21a, 6-21b, and 6-21c show an

increasing trend line over time for all three sites evaluated with McKenzie at Hendricks Park having the highest increase.

Figure 6-19: Summary of E. coli Levels from Upstream to Downstream

Site ID
(m = number of detections, n = number of samples)
(non-detects estimated at 1/2 the minimum reporting level)
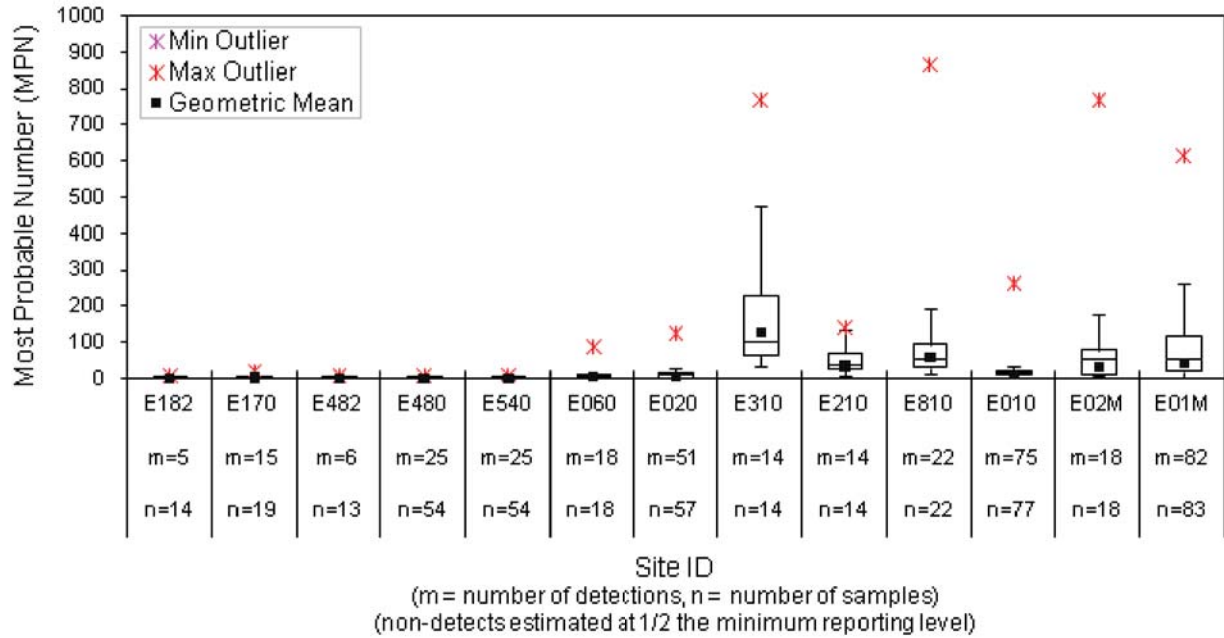
Figure 6-20: Summary of E. coli Levels in the Mainstem McKenzie

Site ID
(m = number of detections, n = number of samples)
(non-detects estimated at 1/2 the minimum reporting level)

49
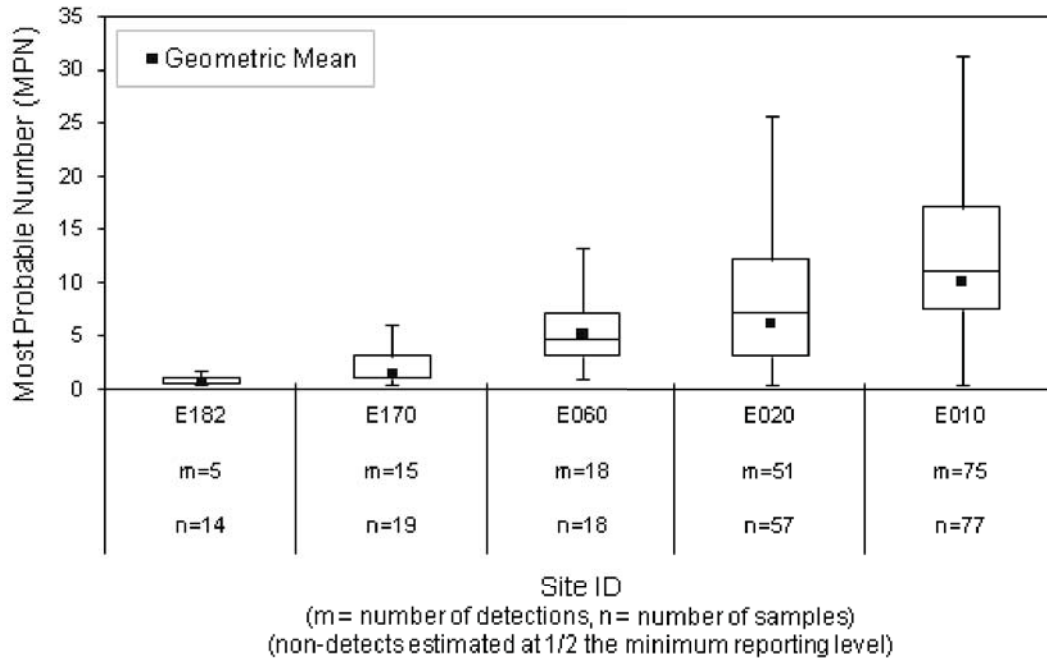
Figure 6-21a: E. coli Trends in the Lower Mohawk River, 2000-2009
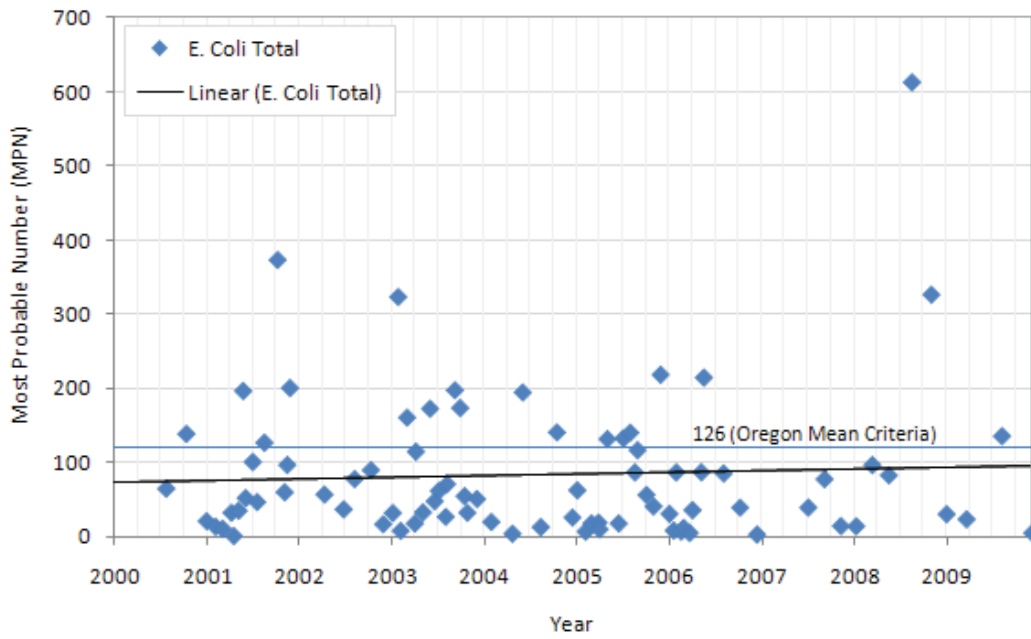
Figure 6-21b: E. coli Trends at McKenzie River at Hayden Bridge, 2002-2009
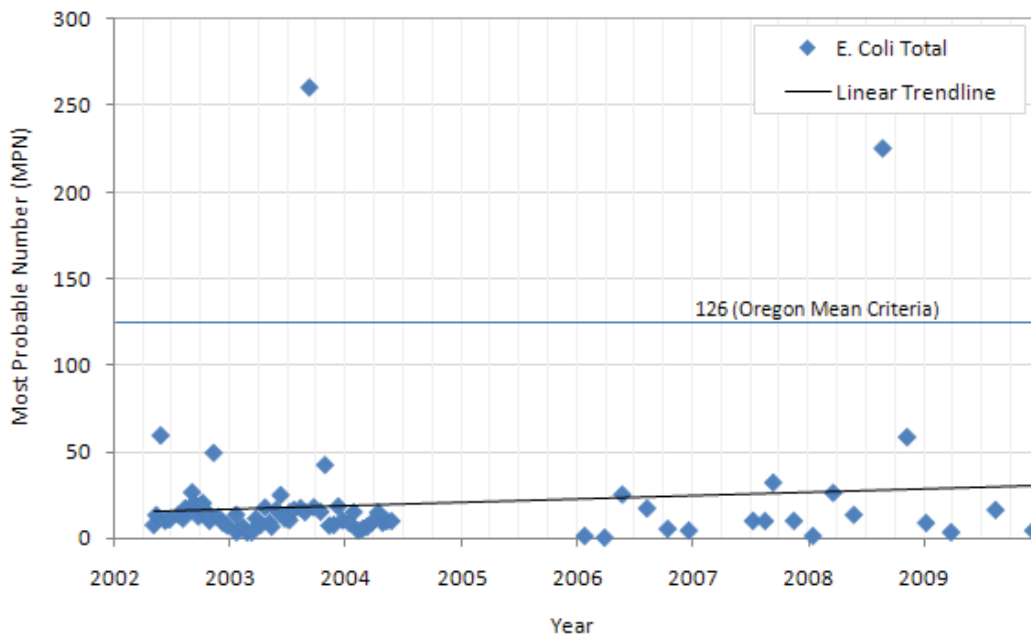
Figure 6-21c: E. coli Trends at McKenzie River at Hendricks Park, 2002-2009

E. coli is a species of fecal coliform bacteria that is specific to fecal material from humans and other warm-blooded animals. In addition to possible health risks associated with the presence of elevated levels of fecal bacteria, they can also cause cloudy water, unpleasant odors, and an increased oxygen demand (or a reduction in dissolved oxygen levels in the water). Sources of fecal bacteria contamination to surface waters include septic systems, domestic and wild animal manure, and stormwater and urban runoff. Oregon has two E. coli human health criteria based on a single event (406 MPN/100 ml) and a 5-day average (126 MPN/100 ml). E. coli bacteria levels exceeded the Oregon mean criteria 36 times and the Oregon maximum criteria 7 times. The majority of these exceedances occurred at the lower Mohawk River, Camp Creek, and Keizer Slough (Appendix C).

As indicated on Table 6-4, total coliform bacteria was detected in 100% of the samples at values ranging from 5.2 to 2,420 MPN/100 ml. One of the problems with total coliform data was that the laboratory did not dilute samples to achieve a higher upper limit to the analysis. Undiluted analysis for total coliform had a ceiling of 2,420 MPN/100ml. Due to the truncating of this upper limit all sites with total coliform values higher than 2,420 MPN/100ml were reported as ">2,420 MPN/100ml", which significantly skewed the box plots making the data less informative.

Figure 6-22 depicts total coliform bacteria levels significantly increasing from upstream to

downstream in the watershed with the major inputs from Blue River and Cougar reservoirs, Camp and Cedar Creeks, Keizer Slough and the Mohawk River (Map 6-8). The headwaters of the McKenzie have low levels of total coliform and levels increase dramatically by the Deerhorn area (Figure 6-23). Total coliform levels continue to increase from Deerhorn to Hendricks Park and drop back down at EWEB's intake. This pattern is likely a result of Hendricks Park being a dewatered portion of the river resulting in less dilution of bacteria contamination. EWEB's Walterville Power Canal returns flows above the intake resulting in dilution of these high bacteria counts.

Total coliform is a general measurement of bacteria that includes bacteria that are found in the soil, in water that has been influenced by surface water, and in human or animal waste.

Figure 6-22: Summary of Total Coliform Levels from Upstream to Downstream

Site ID
(m = number of detections, n = number of samples)
(non-detects estimated at 1/2 the minimum reporting limit)
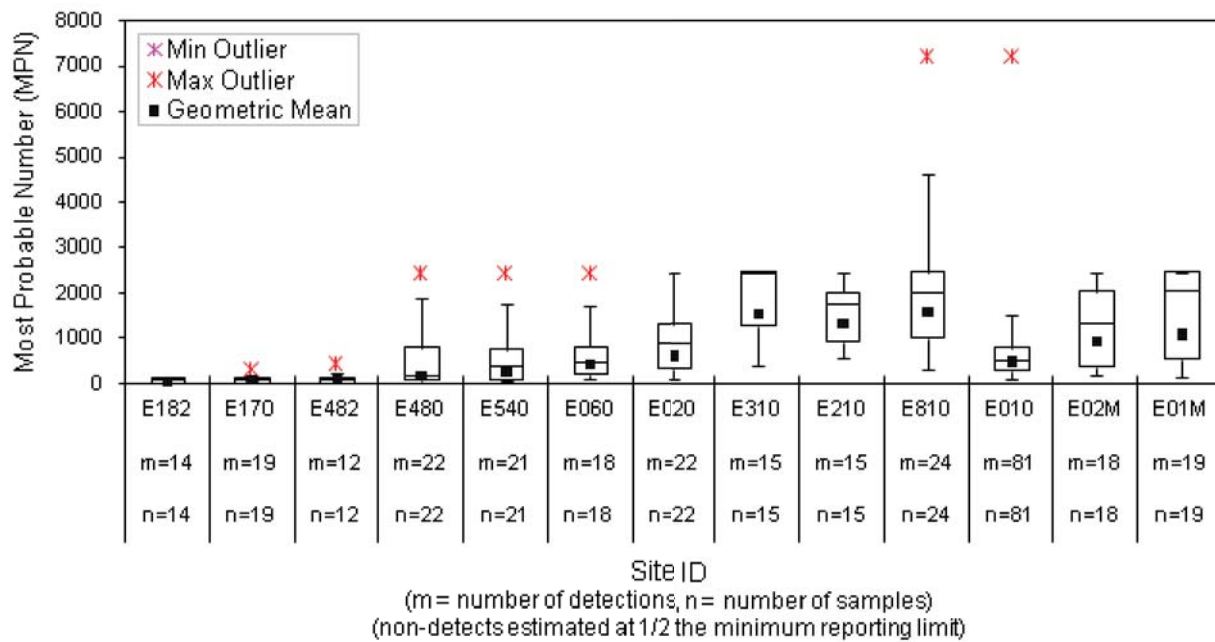
Chlorophyll-a and Pheophytin-a
Chlorophyll is the pigment that allows plants (including algae) to use sunlight to convert carbon, oxygen, and hydrogen into simple sugars via the process of photosynthesis. Measuring chlorophyll *a* concentrations in water is a surrogate for actually measuring algae biomass. Since chlorophyll-containing organisms are the first step in the food chain, the health and /or abundance of these primary producers will have cascading effects to all organisms (Michaud, 1994). The determination of chlorophyll concentration is one of the key indices of monitoring the health of a natural system. Pheophytin-a is a degradation product of chlorophyll. Too little chlorophyll-*a* indicates that there may not be enough food to support an abundant biological

community. On the other hand, too much chlorophyll-*a* indicates that nutrient levels in the waterbody may be artificially high (Michaud, 1994).

Figure 6-23: Summary of Total Coliform Levels in the Mainstem McKenzie
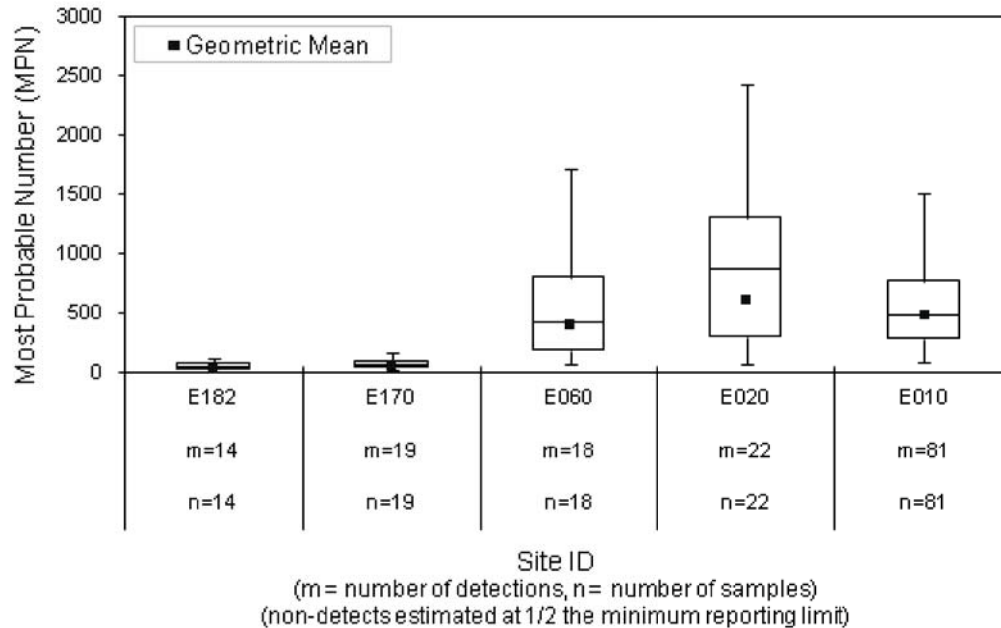
Analytical results indicate that chlorophyll-a was detected above laboratory reporting limits 60% of the time at values ranging from 0.024 to 24 ug/L (Table 6-4). Figure 6-24 shows the distribution and concentrations of chlorophyll-a from upstream to downstream in the watershed. As expected, the main areas of chlorophyll-a detection are below the two reservoirs (E480 and E540), the dewatered portion of the McKenzie River (Hendricks Park – E020) and the lower Mohawk River. The highest levels were found in the South Fork McKenzie and Mohawk River.

Analytical results indicate that pheophytin-a was detected above laboratory reporting limits 43% of the time at values ranging from 0.02 to 9.93 ug/L (Table 6-4). Figure 6-25 shows the distribution and concentrations of pheophytin-a from upstream to downstream in the watershed. As expected, the patterns of detection follow those of chlorophyll-a since pheophytin-a is a degradation product of chlorophyll. The majority of pheophytin-a detections occurred below the two reservoirs (E480 and E540), the dewatered portion of the McKenzie River (Hendricks Park – E020) and the lower Mohawk River. The highest levels were found in the Blue River and McKenzie at the dewatered portion of the McKenzie at Hendricks Park.

Figure 6-24: Distribution of Chlorophyll-a Detections
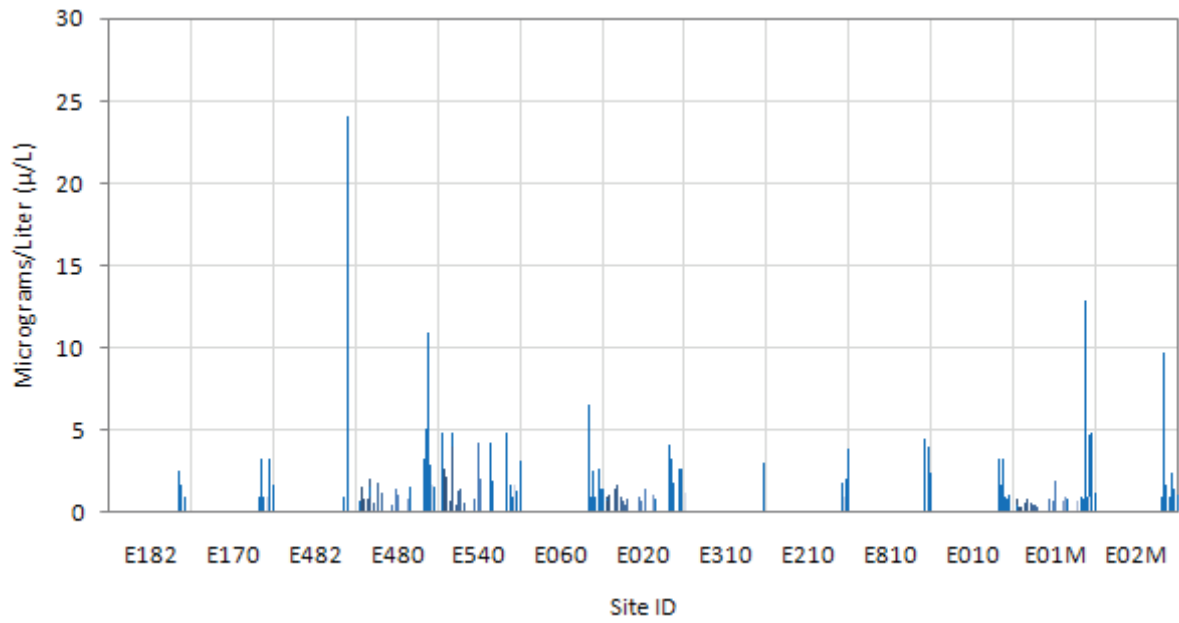
Figure 6-25: Distribution of Pheophytin-a Detections
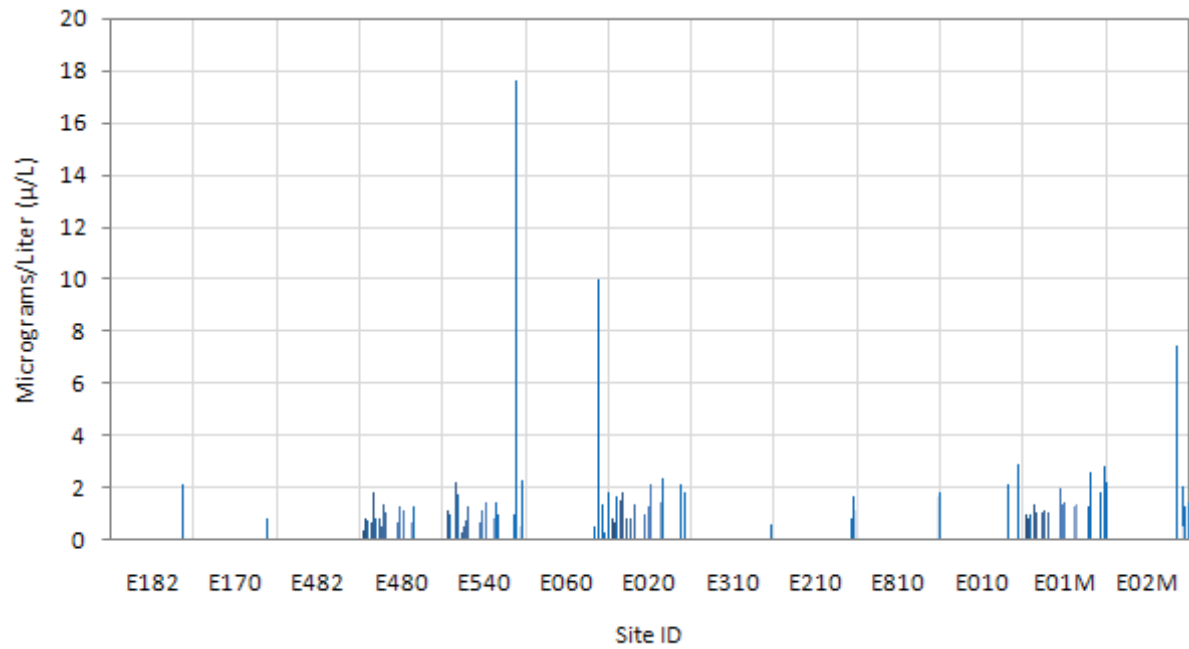
6.1.4 Baseline General Water Quality Parameter Results

As previously mentioned in Section 5.1, the baseline monitoring effort includes the collection of general water quality parameters including turbidity, conductivity, pH, temperature and dissolved oxygen using a YSI sonde to measure and record readings at each monitoring site. The complete summary of this data is provided in Appendix C. Temperature, dissolved oxygen, and pH fluctuate daily on a diurnal schedule and any single measurement at a point in time provides limited information. These parameters can provide some meaningful information if site conditions are severely impacted and help provide context of the site conditions when a sample was collected, but this data does not lend itself to drawing larger conclusions about water quality.

Measuring conductivity has some value since the variability of conductivity in water is more stable. Conductivity is a measure of the ability of water to pass an electrical current. Conductivity in the water is affected by the presence of inorganic dissolved solids such as chloride, nitrate, sulfate, phosphate anions or sodium, magnesium, calcium, iron, and aluminum cations. As indicated in Figure 6-26 and Map 6-9, areas of increased conductivity in the watershed are Cedar and Camp Creeks and Keizer Slough. Figure 6-27 shows that conductivity from upstream to downstream in the mainstem McKenzie does not have much variability. This supports the discussion of total and dissolved metals analysis, where there was not a lot of detections or high concentrations of metal cations in the mainstem McKenzie.

Figure 6-26: Summary of Conductivity Levels from Upstream to Downstream
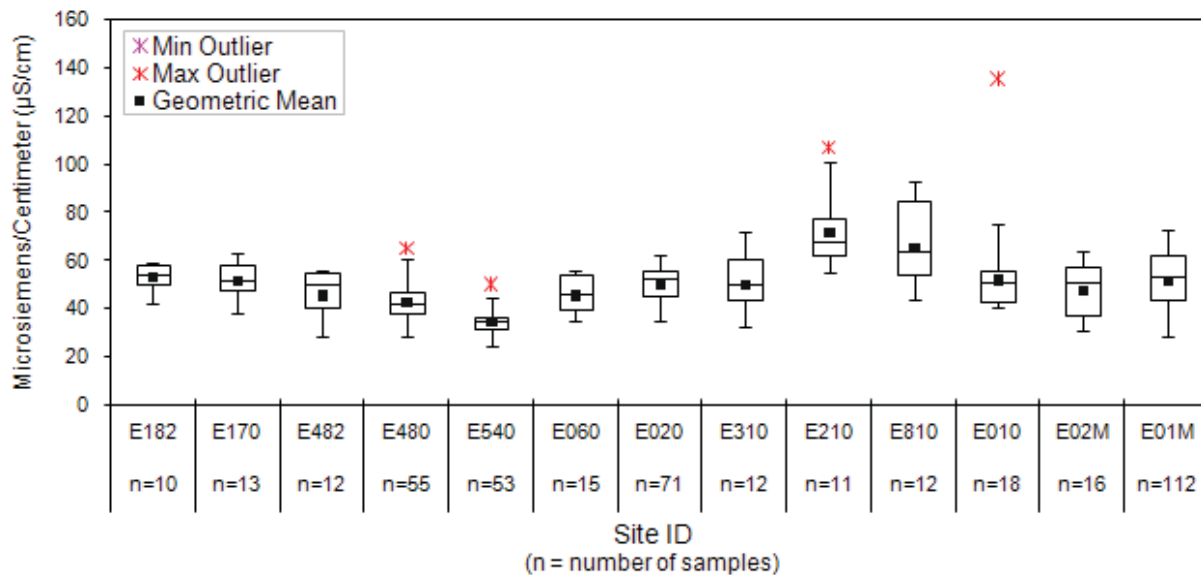
Figure 6-27: Summary of Conductivity Levels in the Mainstem McKenzie
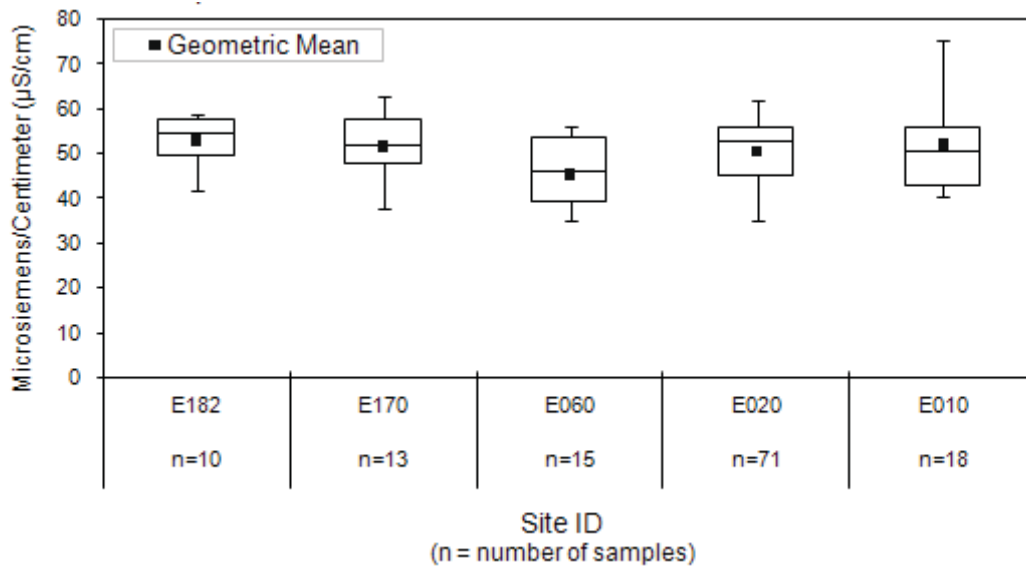
Map 6-1: McKenzie Watershed Baseline Monitoring Sites

Legend:
- ● DEQ baseline site
- ● EWEB baseline site
- ● Both EWEB and DEQ baseline site
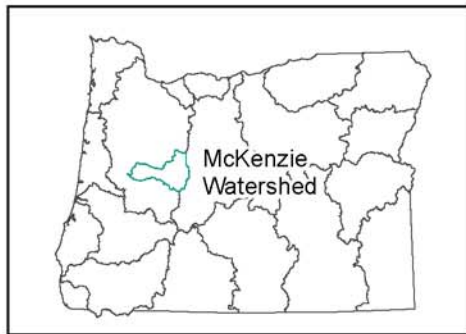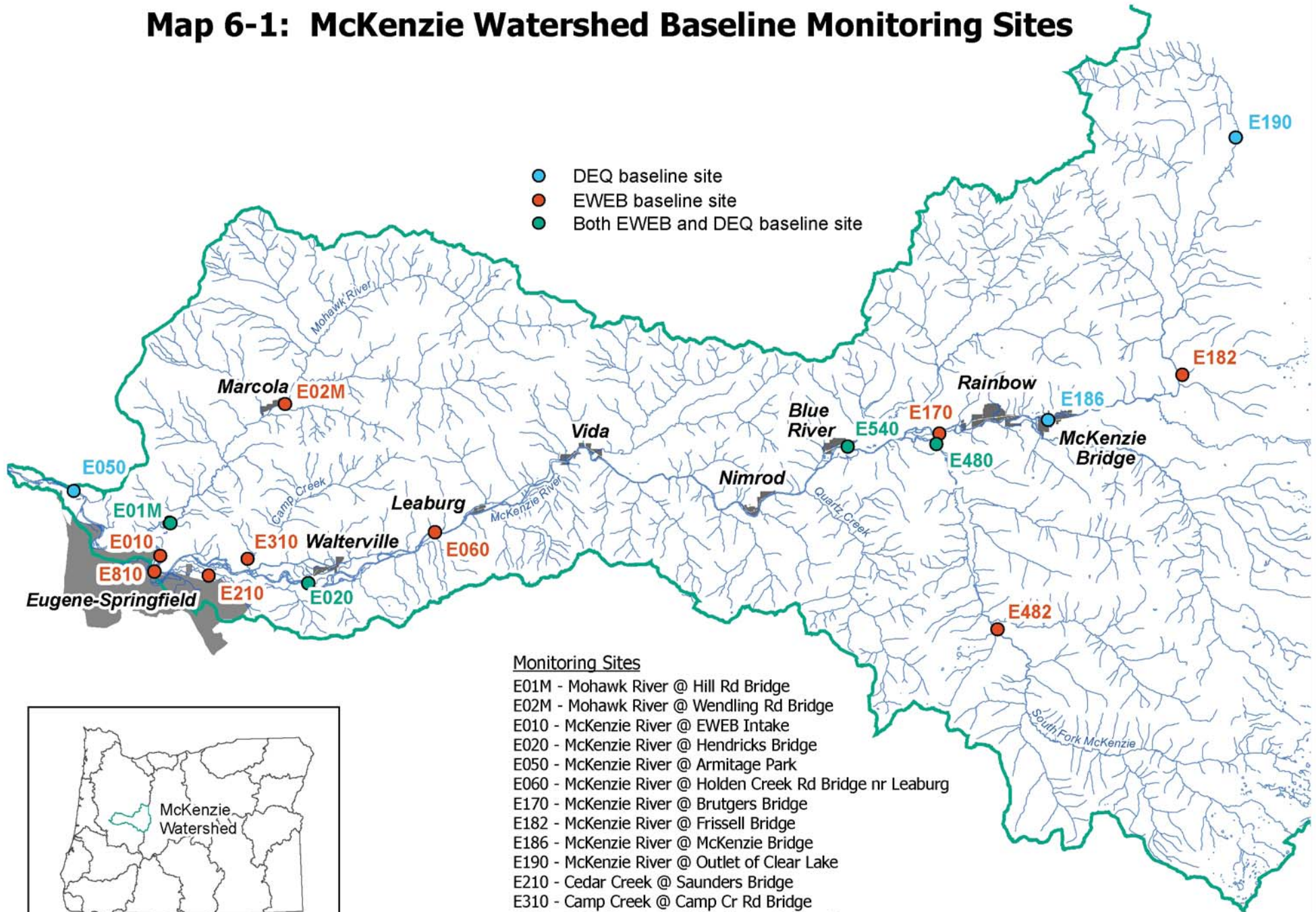
E190

E182

Marcola E02M

E050

Vida

Blue River E540 E170 Rainbow E186

E01M

E010

E310 Walterville Leaburg

E810

E210 E020 E060

Eugene-Springfield

Nimrod E480

McKenzie Bridge

E482

McKenzie Watershed

N

5   2.5   0   5 Miles

Monitoring Sites

E01M - Mohawk River @ Hill Rd Bridge
E02M - Mohawk River @ Wendling Rd Bridge
E010 - McKenzie River @ EWEB Intake
E020 - McKenzie River @ Hendricks Bridge
E050 - McKenzie River @ Armitage Park
E060 - McKenzie River @ Holden Creek Rd Bridge nr Leaburg
E170 - McKenzie River @ Brutgers Bridge
E182 - McKenzie River @ Frissell Bridge
E186 - McKenzie River @ McKenzie Bridge
E190 - McKenzie River @ Outlet of Clear Lake
E210 - Cedar Creek @ Saunders Bridge
E310 - Camp Creek @ Camp Cr Rd Bridge
E480 - SF McKenzie @ Bridge below Cougar Dam
E482 - SF McKenzie @ Rte 1980 Bridge Upstream of Cougar Reservoir
E540 - Blue River @ McKenzie Hwy Bridge
E810 - Keizer Slough @ SUB Bridge

EWEB
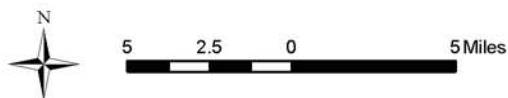
Map 6-2: McKenzie Baseline Monitoring

Manganese Values, 75th Percentile

E182

Marcola — E02M

Rainbow

McKenzie Bridge

E170

Blue River

E480

Vida

E540

E01M

Leaburg

Nimrod

Walterville

E010

E310

E060

E810

E210

E020

E482

Manganese (ug/l)

- <15
- 15-40
- 40-75
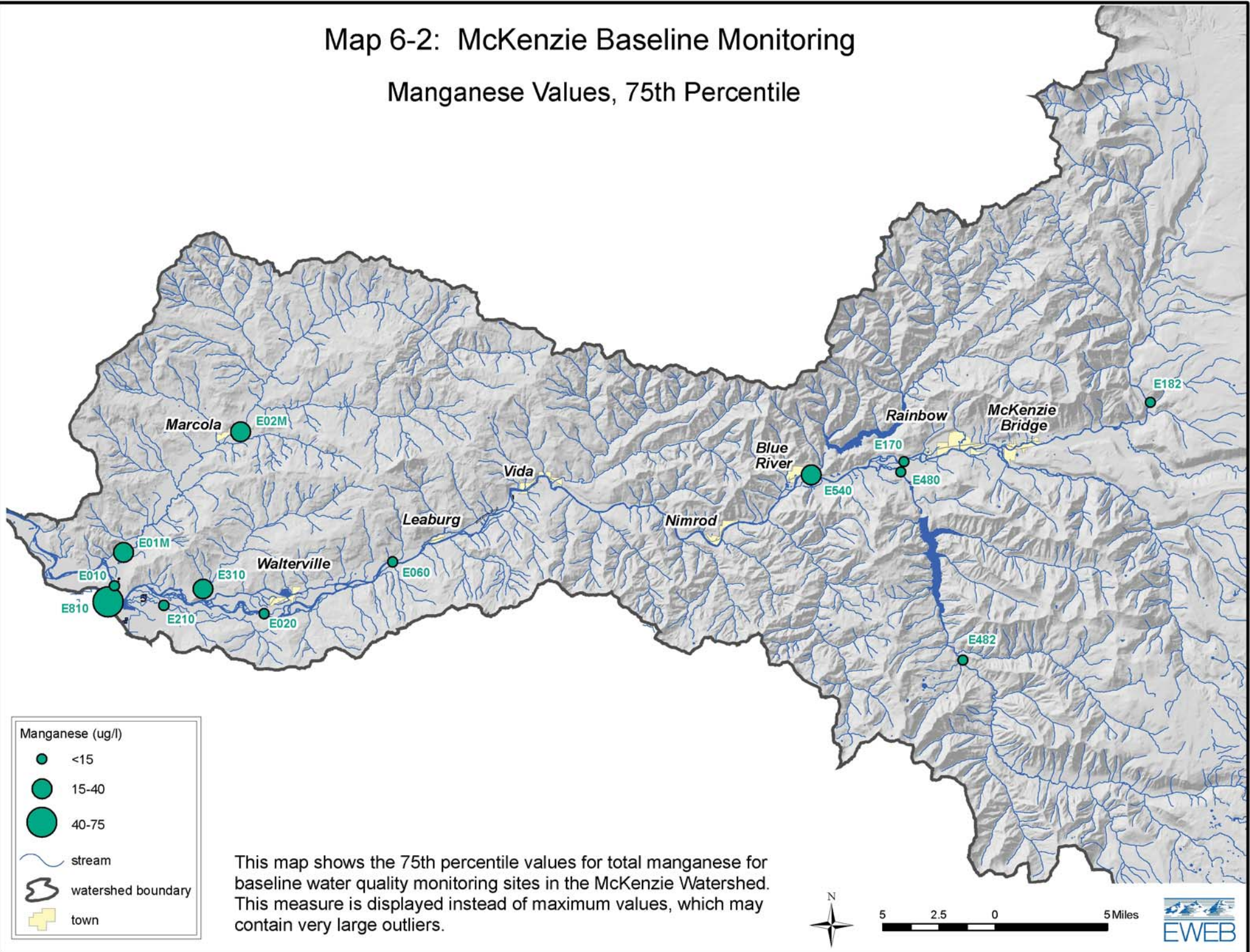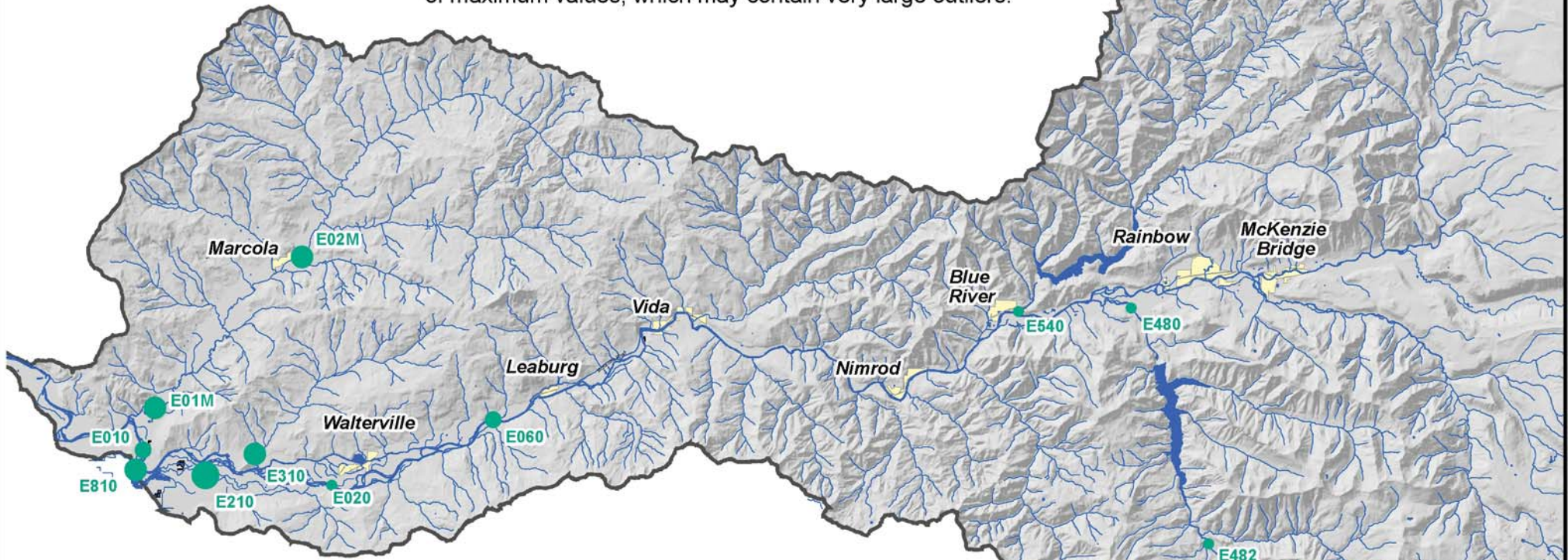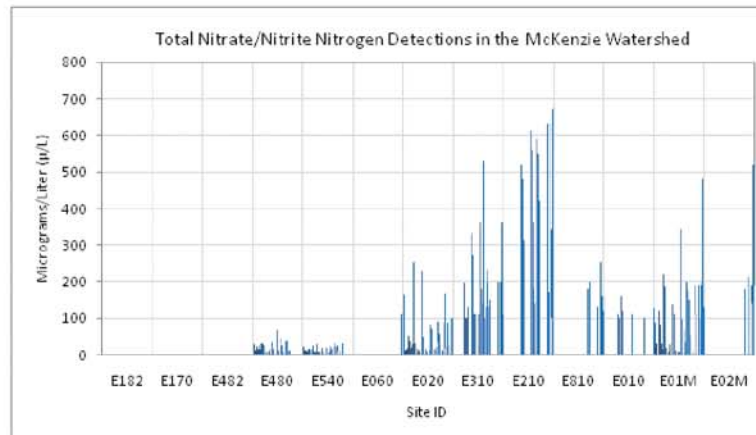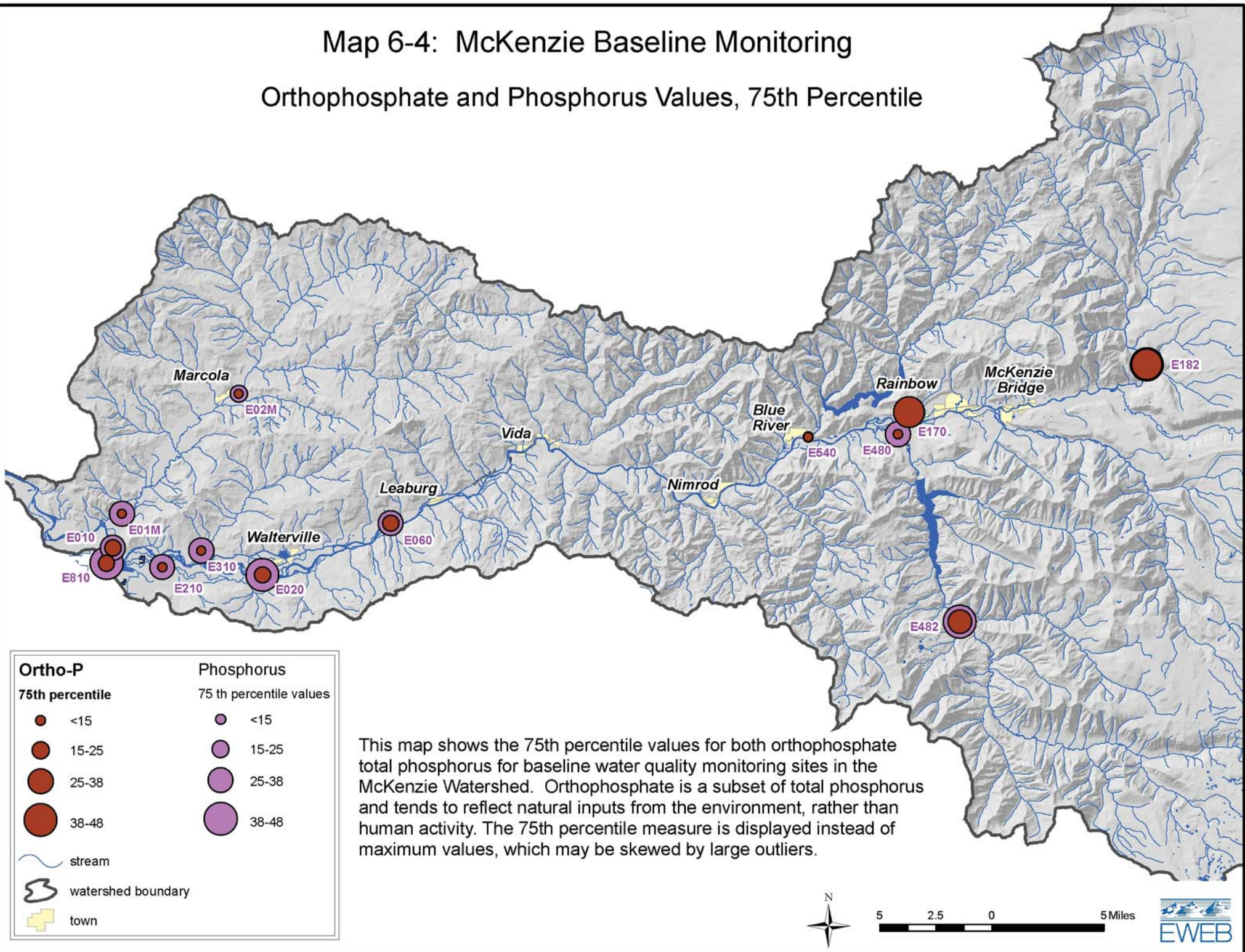
~~~ stream

⌇ watershed boundary

▯ town

This map shows the 75th percentile values for total manganese for baseline water quality monitoring sites in the McKenzie Watershed. This measure is displayed instead of maximum values, which may contain very large outliers.

N

5   2.5   0   5 Miles

EWEB

Map 6-3: McKenzie Baseline Monitoring

Nitrate/Nitrite-N Values, 75th Percentile

This map shows the 75th percentile values for total dissolved nitrate/nitrite-nitrogen for baseline water quality monitoring sites in the McKenzie Watershed. This measure is displayed instead of maximum values, which may contain very large outliers.

Nitrate/Nitrite-N

75th percentile

- 18-62
- 62-117
- 117-207
- 207-575

~ stream

⬭ watershed boundary

▱ town

Total Nitrate/Nitrite Nitrogen Detections in the McKenzie Watershed

Micrograms/Liter (µL)

Site ID: E182 E170 E482 E480 E540 E060 E020 E310 E210 E810 E010 E01M E02M

5 2.5 0 5 Miles

EWEB

Map 6-4: McKenzie Baseline Monitoring

Orthophosphate and Phosphorus Values, 75th Percentile

Ortho-P

75th percentile

- <15
- 15-25
- 25-38
- 38-48

Phosphorus

75 th percentile values

- <15
- 15-25
- 25-38
- 38-48

stream

watershed boundary

town

This map shows the 75th percentile values for both orthophosphate total phosphorus for baseline water quality monitoring sites in the McKenzie Watershed. Orthophosphate is a subset of total phosphorus and tends to reflect natural inputs from the environment, rather than human activity. The 75th percentile measure is displayed instead of maximum values, which may be skewed by large outliers.

EWEB

Map 6-5: McKenzie Baseline Monitoring

Total Organic Carbon (TOC) Values, 75th Percentile and Maximum

E182

Marcola
E02M

Rainbow
McKenzie
Bridge

Blue
River   E540

E170

E01M   Vida   Nimrod   E480

E310

Leaburg
E060

Walterville

E010

E810   E210   E020   E482

TOC (ug/l)

2,300

75th percentile

Maximum

stream

watershed boundary

town

This map shows both the 75th percentile values and maximum
values for total organic carbon for baseline water quality monitoring
sites in the McKenzie Watershed.

N

5   2.5   0   5 Miles

EWEB

Map 6-6: McKenzie Baseline Monitoring

E. coli Values, 75th Percentile and Maximum

E. Coli (MPN)

- 430
- 75th percentile
- Maximum
- stream
- watershed boundary
- town

This map shows both the 75th percentile values and maximum values for e. coli for baseline water quality monitoring sites in the McKenzie Watershed.

5 2.5 0 5 Miles

EWEB

Map 6-7: McKenzie Watershed Baseline Monitoring
E. coli Average Values by Season

E. coli Avg Values

180

- Winter
- Spring
- Summer
- Fall
- stream
- watershed boundary
- town

Mohawk River

E02M

Marcola

Vida

Camp Creek

Leaburg

McKenzie River

E01M

E010

E310

Walterville

E060

E810

E210

E020

N

2   1   0   2 Miles

EWEB

Map 6-8: McKenzie Baseline Monitoring

Total Coliform Values, 75th Percentile and Maximum

E182

Marcola   E02M

McKenzie
Bridge

Rainbow

E170

Blue
River   E540

E010   Vida   E480

E01M   Nimrod

Leaburg
E310   E060

Walterville

E810   E210

E020   E482

Total Coliform (MPN)

3,600

75th percentile

Maximum

stream

watershed boundary

town

This map shows both the 75th percentile values and maximum
values for total coliform for baseline water quality monitoring sites
in the McKenzie Watershed.

N

5   2.5   0   5 Miles

EWEB

Map 6-9: McKenzie Baseline Monitoring

Conductivity Values, 75th Percentile and Maximum

This map shows both the 75th percentile values and maximum values for conductivity for baseline water quality monitoring sites in the McKenzie Watershed.

Conductivity

- 68
- 75th percentile
- Maximum
- stream
- watershed boundary
- town

7   CONCLUSIONS AND RECOMMENDATIONS

This section summarizes the work conducted by EWEB, MWC and other project partners to collect and analyze baseline monitoring data to evaluate long term trends of water quality in the McKenzie watershed. The conclusions also discuss the overall monitoring approach and if this approach achieved the desired goals and objectives of the project. The recommendations section discusses future directions for continued baseline watershed monitoring and the efforts EWEB, MWC, SUB, USFS and others are taking to address water quality issues and threats to Eugene's sole source of drinking water.

7.1   Conclusions

EWEB provided funding to the Oregon DEQ to begin conducting regular baseline water quality monitoring in 1993. In 2006, EWEB, SUB and MWC took over control of the baseline monitoring program and increased its scope to include additional monitoring sites that would provide a more complete picture of general water quality conditions in the watershed. Project goals and objectives were discussed in Section 2.0. McKenzie baseline monitoring efforts will continue as a critical measurement of general water quality over time. It should be noted that this monitoring program does not assess trends of organic contaminants such as pesticides and pharmaceuticals due to the excessive cost of doing this on a regular basis. As discussed in Section 3.3, EWEB, USGS and MWC are conducting other monitoring efforts that focus on specific land use activities and geographic areas to assess potential impacts to water quality, which may include organic compounds and other types of contaminants.

Project objectives for the baseline monitoring program includes identifying potential pollution sources based on observed water quality impacts, assessing water quality trends over time and measuring if current watershed protection and conservation efforts are being effective in maintaining the good water quality of the McKenzie. The following conclusions were drawn from the analysis of the baseline data presented in Section 6.0.

- The data collected as part of the baseline monitoring effort is useful and provides meaningful information about water quality in the McKenzie. The following is a summary of some of the statistics on this data:
  - Over 12,000 analyses were done from 2000 to 2009 looking at a total of 37 analytes (total and dissolved analysis were counted separately).
  - 29% of the analytes monitored were detected greater than (>) 70% of the time.
  - 26% of the analytes monitored were detected less than (<) 5% of the time.
  - 41% of the analytes have some type of water quality standard, criteria or guidance, which if exceeded, could indicate adverse impacts to water quality, aquatic environments or human health.
  - 6,362 analyses were done on analytes that had some type of water quality benchmark to compare data to and determine potential water quality problems. Eighty-two (82) of these exceeded the water quality benchmark value at eight different sites in the watershed (not including MCL goals and copper detections at EWEB's intake, which is due to copper piping) (see Map 7-1).
- The data indicates a general trend of increasing metals, nutrients and bacteria from

upstream to downstream. The following observations were made based on this data:

- o Cougar and Blue River reservoirs are significant sources for chlorophyll-a, pheophytin-a, ammonia, total organic carbon, manganese and total coliform bacteria. Blue River tends to have higher concentrations than South Fork McKenzie and also is a source for total suspended solids.
- o McKenzie at Hendricks Park has some of the highest levels in the mainstem McKenzie of total coliform bacteria, total organic carbon, ammonia, nitrates, chlorophyll-a, and pheophytin-a possibly due to this part of the river being dewatered from EWEB's Walterville Power Canal and having less flow to dilute pollutants.
- o Camp Creek, Cedar Creek and Keizer Slough show the highest concentrations in the watershed of metals, nitrates, total phosphorus, TOC, TSS, E. coli, total coliform and specific conductance.

- Potential sources of increased levels of nitrates, total phosphorus, E. coli and total coliform in the river may be from agricultural operations and septic systems/development along the river in the lower part of the watershed. The types of analysis conducted as part of the baseline monitoring are not able to differentiate between potential sources of pollution nor does the geographic distribution of sampling sites allow quantitative assessment of source contributions.

- Identifying trends of contaminants over time is difficult and misleading without sufficient data. Trend analysis was done at a few sites where sufficient data allowed a reasonable attempt at evaluating trends. Varying laboratory detection limits and methods for handling nondetections in this analysis are some of the issues that need to be resolved for future trend analysis. Trends analysis for nitrates, total phosphorus, and E. coli indicates patterns of increasing contaminant levels over time, except for nitrate trends in Camp Creek (which were declining over time).

- Seasonal trends were also difficult to perform due to the lack of data for most of the analytes evaluated. A few seasonal trends were noticed, including the season fluctuation of nitrates and total phosphorus due to plant uptake during the growing season. Nutrient values tended to be higher in the winter months. E. coli had peak concentrations in the summer months and early fall when lower flows prevented dilution and warmer weather increased bacteria activity.

In summary, the collection of baseline data is critical to long-term analysis of water quality in the McKenzie. However, the data analysis and conclusions are limited by the number of monitoring sites and analytes that can be practically monitored within time and budget constraints. The current monitoring approach is not able to target geographically-specific land use activities that may be contributing pollution loads and resulting in increasing trends of nutrients and bacteria in the river. However, it seems fairly clear that the two main land use activities that are tied to these contaminants are development (including septic systems) and agriculture. It should also be noted that in order to conduct more robust trend analysis it will be necessary to continue to collect water quality data over a longer time period.

Currently, the McKenzie River has excellent water quality that is well below human health benchmarks and standards. However, baseline monitoring has identified some potential water quality issues in certain parts of the watershed (namely downstream tributaries like Cedar and Camp Creek, Keizer Slough and the Mohawk River) that may need to be addressed going forward so that they do not pose a threat to safe drinking water and aquatic health in the future. Treating contaminated water is orders of magnitude more expensive than preventing degradation in the first place, so we recommend making a concerted effort to keep the McKenzie River and watershed in the best condition possible and continue these and other water quality monitoring efforts to measure progress over time.

7.2 Recommendations

Based on review and analysis of the McKenzie watershed baseline monitoring data a number of recommendations are evident for improving this program. The following is a summary of those recommendations.

- It is important to maintain regular baseline monitoring efforts for all 13 sites. Monitoring frequency to date has been 5 to 6 times per year. Due to cost constraints, 2011 baseline monitoring will be conducted on a quarterly basis. It is hoped that if economic conditions improve that future baseline monitoring will be restored to 6 times per year.
- The number of analytes that are monitored for will be maintained with one minor adjustment, which is to remove bromide (never detected above laboratory reporting limits) and add back alkalinity since it is critical to analysis of metals.
- Evaluation of laboratory reporting limits for analytes is needed to reduce reporting limits for as many analytes as possible (such as nitrates). This will likely result in increased analytical cost, so a cost-benefit assessment will be needed to adjust reporting limits where it makes sense to provide the best data to meet monitoring goals and objectives while maintaining cost effectiveness.
- The analytical laboratory should be required to provide detection of analytes that are below reporting limits, but above method detection limits. Laboratory reporting limits are set higher than the method detection limit. If the laboratory provides detections of analytes that are below reporting limits, but above method detection limits these values could be flagged as "estimated" and used in data analysis with qualifiers.
- Methods need to be researched and established for how to deal with nondetections of anaytes in trend and statistical analysis of data. Reducing laboratory reporting limits for some analytes and having labs provide "estimated" values as described above will help reduce the number of nondetected analytes.
- Incorporate water quality data being collected as split samples with student monitoring efforts that assess east Springfield stormwater outfalls into the baseline water quality report.
- Continue tracking, updating and incorporating the various aquatic, human health and other water quality benchmarks that provide a basis for comparing observed water quality data to determine when and where potential adverse impacts are occurring in the watershed.
- Continue conducting and coordinating the numerous other monitoring efforts (water

quality, macroinvertebrate, streamside assessments, algal blooms, etc.) in the McKenzie by EWEB, MWC, SUB, students, USFS, BLM, USGS, City of Springfield, and others and provide a forum to share this information on a regular basis.

- Work to develop watershed models that are calibrated with existing water quality and other data to allow assessment of pollution loads from current land use activities and the potential water quality impacts from these loads, as well as predict future impacts from changes in land use in the watershed over time.
- Due to the new IP intake system installed in the mainstem McKenzie in 2009, flows in Keizer Slough will likely be significantly reduced during summer and fall. With less dilution, the pollutant concentrations in the slough from stormwater discharges may increase during low flow months but would likely not change the overall pollution load to the McKenzie River.
- Baseline monitoring and analysis reports should be completed on a regular basis. It is recommended that this report be completed every other year to allow for sufficient data to be collected for seasonal and trend analysis.
- Develop ways to share water quality data in more transparent manner via a website reporting application that is updated quarterly so the MWC Water Quality committee, partner agencies and organizations and the public can view this information between issuance of biannual baseline data analysis reports.
- Use water quality data to support watershed restoration and protection efforts that maintain and improve water quality in the McKenzie watershed for current and future generations.

Map 7-1: McKenzie Baseline Monitoring

Number of benchmark exceedances by site*

Marcola — E02M

E01M

E010

E810

E310

E210

E020

Walterville

Leaburg

E060

Vida

Nimrod

Blue River — E540

Rainbow

McKenzie Bridge

E170

E480

E182

E482

Number of Exceedances

- 0
- 1-5
- 5-12
- 12-21

stream

watershed boundary

town

* Benchmark exceedances for ambient water quality are based on a variety of regulatory and non-regulatory standards aimed at protecting both human health and the health of other biological communities. See Appendix A for more detail.

Note: Not shown are exceedances of the copper benchmark at the Hayden Bridge Intake (site E010). These are likely due to the copper piping from the intake facility to the treatment plant and are not indicative of copper levels in the raw water itself.

N

5   2.5   0   5 Miles

EWEB

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APPENDIX A

QUALITY ASSURANCE PROJECT PLAN

QUALITY ASSURANCE PROJECT PLAN

1   Data Quality Objectives

All data was gathered and handled in accordance with the *Oregon Plan for Salmon and Watersheds* "Water Quality Monitoring Guide Book"; the USGS *National Field Manual for the Collection of Water-Quality Data;* and the USGS *Field Guide for Collecting and Processing Stream Water Samples for the National Water-Quality Assessment Program* (USGS, 1994; USGS, 1999; OWEB, 1999). Sample collection protocol and analytical requirements are discussed in Section 5.0. The objectives for the baseline monitoring program are discussed in Section 2.0. The data collected as part of the watershed baseline monitoring program is used to assess water quality trends, identify problem areas, and support overall water quality assessment in the McKenzie Watershed.

This Quality Assurance Project Plan (QAPP) describes the quality assurance and quality control (QA/QC) procedures that are implemented as part of the watershed baseline monitoring program. The QAPP has been designed to ensure that the data generated are of sufficient quality to meet the study objectives. This QAPP has been prepared in accordance with the documents listed above and the Oregon Department of Environmental Quality 303(d) list minimum data requirements.

2   Project Organization

Personnel responsible for laboratory and data analysis are described below.

2.1   Baseline Monitoring Project Manager

Karl A. Morgenstern (EWEB, Eugene) is the Project Manager responsible for overall project coordination, including the production of all project deliverables, collection and submittal of environmental samples to the designated laboratories for the chemical and physical analyses specified in this QAPP. The Project Manager is responsible for coordinating these tasks with the other interested and involved parties associated with this monitoring effort (EWEB Hayden Bridge, City of Springfield, McKenzie Watershed Council, USFS, SUB, ACOE, USGS, Landowners, and others), and ensuring that the monitoring plan is implemented as specified.

2.2   Project QA/QC Manager

David Donahue (EWEB, Eugene) is the Project QA/QC Manager, responsible for coordinating with the analytical laboratories, ensuring conformance with data quality objectives, overseeing data validation, and managing project quality assurance and quality control.

2.3   Contract Laboratory Project Manager

Estella Rieben or designee, Test America Laboratory. The laboratory project manager provides analytical support to this project and is responsible for ensuring that laboratory analyses are performed in accordance with the protocols, quality control criteria, and other specifications detailed in this QAPP.

3   Contract Laboratory Requirements

The contract laboratory is expected to meet the following minimum requirements:

1. Adhere to the methods outlined in the statement of work, including methods referenced for each analytical procedure;

2. Deliver fax, hard copy, and electronic data as specified;

3. Meet reporting requirements for deliverables;

4. Meet turnaround times for deliverables;

5. Implement QA/QC procedures, including the QAPP data quality requirements, laboratory analysis plan requirements, and performance evaluation testing requirements;

6. Allow laboratory and data audits to be performed, if deemed necessary; and

7. Follow documentation, chain of custody, and sample logbook procedures.

Changes in the laboratory procedures specified in the QAPP are not to be permitted without written documentation of the intended change and the rationale. All changes must be approved in advance by the Project QA/QC Manager.

4 Quality Assurance Objectives

Surface water samples were submitted for analysis of:

- Total Organic Carbon
- Chemical Oxygen Demand
- Total Suspended Solids
- Nutrients
- Metals (total & dissolved)
- Bacteria (E.coli, total coliform)
- Chlorophyll-a and pheophytin-a

The quality assurance objectives for this project are to implement procedures that ensure the collection of representative physical and chemical data of known and acceptable quality. Table 7-1 summarizes the quality assurance objectives for each type of water analysis in accordance with protocols for water analyses. The data quality parameters used to assess the acceptability of the data are precision, accuracy, representativeness, comparability, and completeness. These parameters are discussed below.

4.1 Precision

Precision measures the reproducibility of measurements under a given set of conditions. Analytical precision is measured through matrix spike/matrix spike duplicate (MS/MSD) samples for organic analysis and through laboratory duplicate samples for inorganic analyses. Analytical precision measurements will be carried on project specific samples at a minimum frequency of 1 per laboratory analysis group or 1 in 20 samples, whichever is more frequent, per matrix analyzed. Laboratory precision will be evaluated against quantitative relative percent difference (RPD) performance criteria presented in Table 7-1.

Table 1-1: Quality Assurance Objectives

Analyte	Units	Precision	Accuracy	Completeness	EPA Method	Holding Times
Total and Dissolved Metals - (As, Ba, Cd, Cr, Cu, Pb, Mn, Ni, Zn)	mg/L	± 20%	± 25%	90%	200 Series	6 Months
Total Coliform and *E. coli*	MPN	± 20%	± 40%	90%	SM 9222	30 Hours
Nitrate + Nitrite	mg/L	± 20%	± 30%	90%	300	28 Days
Total Kjeldahl Nitrogen	mg/L	± 20%	± 30%	90%	351.3, 351.4	28 Days
Total Phosphorus and Orthophosphate	mg/L	± 20%	± 30%	90%	365.1, 365.3	28 Days
Chemical Oxygen Demand	mg/L	± 20%	± 30%[1]	90%	410.4	28 Days
Total Suspended Solids	mg/L	± 20%	± 30%[1]	90%	160.2	7 Days

[1] = For those analyses on which sample spiking cannot be performed, QC reference standards will be analyzed to determine accuracy.

Field precision is evaluated by the collection of field duplicates. One field duplicate per matrix was collected. Currently, no performance criteria have been established for field duplicates. Field duplicate precision is therefore screened against a RPD of 75 percent for water samples. However, no data is qualified based solely on field duplicate precision. Precision measurements can be affected by the nearness of a chemical concentration to the method detection limit, where the percent error (expressed as either %RSD or RPD) increases. The equations used to express precision are as follows:

$$RPD = \frac{(C_1 - C_2) \times 100\%}{(C_1 + C_2)/2}$$

Where:

RPD = relative percent difference
C_1 = larger of the two observed values
C_2 = smaller of the two observed values

$\%RSD = (SD/ D_{ave}) \times 100$

Where: $SD = 3\rho(D - D_{ave} 1)/(n - 1)$
D = sample value
D_{ave} = average sample value
n = number of samples

4.2   Accuracy

Accuracy is an expression of the degree to which a measured or computed value represents the true value. Field accuracy is controlled by adherence to sample collection procedures outlined in the monitoring plan. To assess the potential for cross contamination in the field, one rinseate blank from the surface water sampling device is collected. However, since the baseline monitoring does not share sample collection equipment between sites (i.e., certified clean sample bottles are used) rinseate blanks were not collected at this time.

Analytical accuracy may be assessed by analyzing "spiked" samples with known standards (surrogates, laboratory control samples, and/or matrix spike) and measuring the percent recovery. Accuracy measurements on matrix spike samples are carried out at a minimum frequency of one in 20 samples per matrix analyzed. Surrogate recoveries are determined for every sample analyzed for organics.

Laboratory accuracy is evaluated against quantitative matrix spike and surrogate spike recovery performance criteria as presented in Table 7-1. Accuracy can be expressed as a percentage of the true or reference value, or as a percent recovery in those analyses where reference materials are not available and spiked samples are analyzed. The equation used to express accuracy is as follows:

$$\%R = 100\% \text{ x } (S-U)/C_{sa}$$

Where:

$\%R$ = percent recovery
S = measured concentration in the spiked aliquot
U = measured concentration in the unspiked aliquot
C_{sa} = actual concentration of spike added

4.3 Representativeness

Representativeness expresses the degree to which data accurately and precisely represent an environmental condition. For this program, the selected analyte has been identified as a constituent of concern based on numerous studies indicating the typical pollutants associated with baseline watershed conditions in the McKenzie watershed. Representative water quality data had previously been obtained from other studies conducted by the EPA and USGS (EPA, 1983; USGS, 2001; USGS, 2000a; USGS, 1997; USGS, 1998a; USGS, 1998b).

4.4 Comparability

Comparability expresses the confidence with which one data set can be evaluated in relation to another data set. For this monitoring program, comparability of data is established through the use of standard analytical methodologies and reporting formats and of common National Institute of Standard and Technology or other traceable calibration and reference materials. Data is used to evaluate trends over time and evaluate areas that appear to be contributing higher relative pollution loads to receiving water bodies.

4.5 Completeness

Completeness is a measure of the amount of data that is determined to be valid in proportion to the amount of data collected. Completeness is calculated as follows:

$$C = \frac{(\text{Number of acceptable data points}) \text{ x}100}{(\text{Total number of data points})}$$

The data quality objective for completeness for all components of this project is 90 percent.

Data that have been qualified as estimated because the quality control criteria were not met are considered valid for the purpose of assessing completeness. Data that have been qualified as rejected are not considered valid for the purpose of assessing completeness.

5 Quality Control Procedures

Sampling procedures for this investigation are described in detail in the Sampling and Analysis Plan (Section 5.0). Section 5.1 discusses the field quality assurance samples (duplicate, rinseate blank, and MS/MSD sample) that were collected for water.

5.1 Field Quality Control Procedures

Field sampling procedures are detailed in Section 5.0. To control the quality of field samples, one field duplicate was analyzed. Although validation guidelines have not been established for field quality control samples, their analysis is useful in identifying possible problems resulting from sample collection or sample processing in the field. All field quality control samples are documented in the field logbook. The field quality control samples that are collected as part of the baseline monitoring are discussed below.

Field Duplicates. For all water samples collected, one homogenized field duplicate was collected and submitted for analysis. One field duplicate was collected per 20 water samples.

Rinseate Blanks. Rinseate blanks are used to determine if cross contamination has occurred during sampling. For baseline monitoring rinseate blanks are currently not necessary due to the use of dedicated equipment for each site.

5.2 Sample Handling

Sample collection and handling procedures are detailed in the Sampling Plan (Section 5.0). To control the integrity of the samples during transit to the laboratory and during hold prior to analysis, established preservation and storage measures were taken. Table 5-1 of the SAP presents container type, preservation, and maximum holding times for the various analyses of baseline monitoring water samples.

5.3 Sample Custody Documentation

Sample labeling and custody documentation was performed to accurately track sample ID, locations, collection methods, date/time, conditions, requested analysis and any other notes to document as necessary.

6 Laboratory Quality Control Procedures

The Laboratory Standard Operating Procedures (SOP) provided by the contract analytical laboratory describes in detail the chemical analytical procedures for this study. These SOPs are kept in the project file at the analytical laboratory and include written protocols for the analytical methods used.

6.1 Analytical Methods and Reporting Limits

The laboratory calculates the method detection limit for each analyte in each matrix of interest

and establishes an initial calibration curve for all analytes.

The methods of analysis, associated reporting limits, and screening levels for the water analyses are identified in Appendix A. Reporting limits have been set at or below ambient water quality criteria for chronic exposure and maximum contaminant levels for drinking water.

6.2   Laboratory Quality Control Criteria

The analyst reviewed results of the quality control samples from each sample group immediately after a sample group had been analyzed. The quality control sample results were evaluated to determine if control limits had been exceeded. If control limits are exceeded in the sample group, the Project Manager or Project QA Manager was contacted immediately and corrective action (e.g., method modifications followed by reprocessing the affected samples) was initiated prior to processing a subsequent group of samples.

All primary chemical standards and standard solutions used in this project are traceable to the National Institute of Standards and Technology, Environmental Resource Associates, National Research Council of Canada, or other documented, reliable, commercial sources. Standards were validated to determine their accuracy by comparison with an independent standard. Any impurities found in the standard were documented.

The following sections summarize the procedures that were used to assess data quality throughout sample analysis.

Initial and Continuing Calibration. Multipoint initial calibration was performed on each instrument at the start of the project, after each major interruption to the analytical instrument, and when any ongoing calibration did not meet control criteria. Ongoing calibration was performed daily for organic analyses and with every sample batch for conventional parameters (when applicable) to track instrument performance.

Instrument blanks or continuing calibration blanks provide information on the stability of the baseline established. Continuing calibration blanks were analyzed immediately prior to continuing calibration verification at a frequency of 1 continuing calibration blank for every 10 samples analyzed at the instrument for inorganic analyses and every 21 hours for organic analyses. If the ongoing calibration was out of control, the analysis came to a halt until the source of the control failure was eliminated or reduced to meet control specifications. All project samples analyzed while instrument calibration was out of control were reanalyzed.

Matrix Replicates. Analytical replicates provide information on the precision of the analysis and are useful in assessing potential sample heterogeneity and matrix effects. Analytical replicates are subsamples of the original sample that are prepared and analyzed as a separate sample. A minimum of 1 replicate was analyzed per sample group or for every 20 samples, whichever was more frequent. When matrix spikes were not available or appropriate, a matrix triplicate was analyzed per sample group or for every 20 samples, whichever was more frequent.

Matrix Spikes and Matrix Spike Duplicates. Analysis of matrix spike samples provides information on the extraction efficiency of the method on the sample matrix. By performing

duplicate matrix spike analyses, information on the precision of the method was also provided for organic analyses. A minimum of 1 matrix spike was analyzed for every sample group or for every 20 samples, whichever was more frequent, when possible

Surrogate Spikes. All project samples analyzed for organic compounds were spiked with appropriate surrogate compounds as defined in the analytical methods. Surrogate recoveries were reported by the laboratories; however, no sample result was corrected for recovery using these values.

Method Blanks. Method blanks are analyzed to assess possible laboratory contamination at all stages of sample preparation and analysis. A minimum of 1 method blank was analyzed for every extraction batch or for every 20 samples (10 samples for conventional parameters), whichever was more frequent.

7 Data Review and Reporting

All data underwent two levels of QA/QC evaluation: one at the laboratory, and one by EWEB.

Initial data reduction, evaluation, and reporting at the laboratory was carried out as described in the appropriate analytical protocols and the laboratory's QA Manual. Quality control data resulting from methods and procedures described in this document were reported.

7.1 Minimum Data Reporting Requirements
The following describes the minimum data reporting requirements necessary for proper QA/QC evaluation of the analytical data.

Sample IDs. Records were produced that clearly match all duplicate QA samples with laboratory sample IDs.

Sample Receipt. Chain of custody forms were filled out for all sample shipments to document problems in sample packaging, custody, and sample preservation upon receipt at the laboratory.

Reporting. For each analytical method run, analytes were reported as a detected concentration or as less than the specific reporting limit. The laboratories also reported dilution factors for each sample as well as date of extraction (if applicable) and date of analysis. Standard data packages consisted of a case narrative, sample results, QA sample results, and chain of custody forms.

7.2 Internal Quality Control Reporting
Internal quality control samples were analyzed at the rates specified in the applicable analytical method.

- *Laboratory Blanks.* All analytes were reported for each laboratory blank. All non-blank sample results were designated as corresponding to a particular laboratory blank in terms of analytical batch processing.

- *Surrogate Spike Samples.* Surrogate spike recoveries were reported with all organic reports where appropriate. The report also specified the control limits for surrogate

spike results. Any out of control recoveries (as defined in the specified method) resulted in the sample being rerun or the data being qualified.

- *Matrix Spike Samples.* Matrix spike recoveries were reported for all analyses. All general sample results were designated as corresponding to a particular matrix spike sample. The report indicated what sample was spiked. The report also specified the control limits for matrix spike results for each method and matrix.

- *Laboratory Duplicates and/or Matrix Spike Duplicate Pairs.* Relative percent differences were reported for all duplicate pairs as well as analyte/matrix specific control limits.

- *Laboratory Control Samples (LCS).* When run for internal quality control, LCS results were reported with the corresponding sample data. Control limits for LCS were reported as specified.

- *Duplicates.* Duplicates were reported as any other sample. Relative percent differences were calculated for duplicate samples and evaluated as part of the data quality review.

7.3   Independent Data Quality Review

Once data are received from the laboratory, a number of QC procedures were followed to provide an accurate evaluation of the data quality. Specific procedures were followed to assess data precision, accuracy, and completeness.

A data quality review was performed by a qualified person. The laboratories delivered complete data packages for all chemical analyses. The data was evaluated in accordance with the QAPP. All chemical data analyzed under contract with EWEB was reviewed with regard to the following, as appropriate to the particular analysis:

- Holding times;

- Blanks;

- Detection limits;

- Surrogate recoveries;

- Matrix spike/matrix spike recoveries; and

- Laboratory and field duplicate relative percent differences.

The results of the data quality review were communicated to the project QA Manager for final review and confirmation of the validity of the data.

8   Laboratory Audits and Corrective Actions

Laboratory and field performance audits and corrective action procedures are described in this section.

8.1   Laboratory and Field Performance Audits

Laboratory and field performance audits consist of on-site reviews of quality assurance systems and equipment for sampling, calibration, and measurement. Laboratory audits were not conducted as part of this study; however, all laboratory audit reports were made available to the Project QC Coordinator upon request. All laboratories are required to have written procedures addressing internal QA/QC; these procedures were submitted and reviewed by the Project QA/QC Manager to ensure compliance with the QAPP. All laboratories must ensure that personnel engaged in sampling and analysis tasks have appropriate training.

8.2   Corrective Action Procedures

Corrective Action for Field Sampling

The Project Manager was responsible for correcting equipment malfunctions during the field sampling effort and for resolving situations in the field that may result in noncompliance with the QAPP. All corrective measures were immediately documented in the field logbook.

Corrective Action for Laboratory Analyses

All laboratories are required to submit and comply with their Standard Operating Procedures (SOPs). The Laboratory Project Manager was responsible for ensuring that appropriate corrective actions are initiated as required for conformance with this QAPP. All laboratory personnel were responsible for reporting problems that may compromise the quality of the data.

The Project Manager or QA/QC Manager was notified immediately if any quality control sample exceeds the project-specified control limits. The analyst identified and corrected the anomaly before continuing with the sample analysis. The Laboratory Project Manager documented the corrective action taken in a memorandum submitted to the QA/QC Manager within five days of the initial notification. A narrative describing the anomaly, the steps taken to identify and correct the anomaly, and the treatment of the relevant sample batch (i.e., recalculation, reanalysis, re-extraction) was submitted with the data package in the form of a cover letter.

APPENDIX B

ABBREVIATIONS, ACRONYMS AND UNITS OF MEASURE

ABBREVIATIONS, ACRONYMS AND UNITS OF MEASURE

ACOE	United States Army Corp of Engineers
AMSL	Above mean sea level
As	Arsenic
Ba	Barium
BLM	Bureau of Land Management
Cd	Cadmium
cfs	cubic feet per second
COD	Chemical oxygen demand
Cr	Chromium
Cu	Copper
DBP	Disinfection byproduct
DEQ	Oregon Department of Environmental Quality
DI	Deionized water
DL	Detection limit
DO	Dissolved oxygen
DOC	Dissolved organic carbon
DOM	Dissolved organic material
E. coli	Escherichia coli
EPA	United States Environmental Protection Agency
EWEB	Eugene Water & Electric Board
FA	Freshwater acute
FC	Freshwater chronic
ft	foot (feet)
FW	Fresh water
GIS	Geographic information system
HAAFP	Haloacetic acids
HB	Hayden Bridge Filtration Plant
HBSL	Health-Based Screening Level (USGS)
HH	Human health
HWY	Highway
ID	Identification
L	Liter
LCOG	Lane Council of Governments
m	meter
m^2	square meter
m^3	cubic meter
MCL	Maximum Contaminant Level (EPA)
mg	milligram
mL	milliliter
Mn	Manganese
MPN	Most probable number

MRL	Method reporting limit
MWC	McKenzie Watershed Council
Ni	Nickel
NOM	Natural organic material
NRC	National Research Council
NRCS	Natural Resources Conservation Service
NTU	Nephelometric turbidity unit
ODF	Oregon Department of Forestry
OWQI	Oregon Water Quality Index (DEQ)
Pb	Lead
PCB	Polychlorinated biphenyl
PO_4^{-3}	Phosphate
POC	Particulate organic carbon
POCIS	Polar organic chemical integrated sampler
ppb	parts per billion
QA	Quality Assurance
QC	Quality Control
RL	Reporting limit
RM	River Mile
RSL	Regional Screening Level (EPA)
SPMD	Semipermeable membrane
SUB	Springfield Utility Board
THMFP	Trihalomethanes
THS	Thurston High School
TKN	Total Kjeldahl nitrogen
TSS	Total suspended sediment
USFS	United States Forest Service
USGS	United States Geological Survey
WHO	World Health Organization
YSI	Yellow Springs Institute
Zn	Zinc
μg	microgram
μm	micron
μmhos/cm	micromhos per centimeter
μs/cm	microsiemens per centimeter

APPENDIX C

ANALYTICAL DATA

Analytical Data

Site ID	Data Source	Date/Time	Ammonia-Nitrogen Total***	Arsenic Dissolved	Arsenic Total	Barium and compounds Dissolved	Barium and compounds Total	Bromide Total	Cadmium Dissolved	Cadmium Total	Chemical Oxygen Demand	Chlorophyll a Total	Chromium Dissolved	Chromium Total	Copper Dissolved	Copper Total	Dissolved o2 percent saturation	Dissolved oxygen	E. Coli Total	Lead Dissolved	Lead Total	Manganese and compounds Dissolved	Manganese and compounds Total	Nickel Dissolved	Nickel Total	Nitrate/Nitrite-Nitrogen Dissolved	Orthophosphate Dissolved	Orthophosphate Total	pH	Pheophytin a Total	Phosphorus Total	Specific Conductance	Total Coliforms	Total Kjeldahl Nitrogen	Total Organic Carbons	Total Suspended Solids	Turbidity	Water Temp	Zinc Dissolved	Zinc Total
			ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	%	mg/L	MPN*	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	pH	ug/L	ug/L	us/cm	MPN*	ug/L	ug/L	ug/L	NTU	°C	ug/L	ug/L
E010	HB	05/06/2002 11:00		<5		<100				<1						<20		<10	7.3	<2			15	<20		<100							365.0							<20
E010	HB	05/14/2002 10:00																	13														461.0							
E010	HB	05/28/2002 10:00																	59.1														727.0							
E010	HB	06/11/2002 10:00																	9.7														410.6							
E010	HB	06/25/2002 10:00																	10.6														410.6							
E010	HB	07/09/2002 10:00																															488.4							
E010	HB	07/23/2002 10:00																	13.2														866.4							
E010	HB	08/06/2002 11:45		<5		<100				<1						<20		<10	11	<2			<10	<20		<100			6.4			56.2	547.5							<20
E010	HB	08/13/2002 10:00																	16.9														613.1							
E010	HB	08/27/2002 10:00																	17.1														770.1							
E010	HB	09/04/2002 8:25		<5		<100				<1						<20			26.2	<2			<10	<20		110			6.2			57.1	488.4							
E010	HB	09/10/2002 7:35																<10	19.9				<10	<20					6.8			58	461.1							<20
E010	HB	09/24/2002 10:00																	12.2														648.8							
E010	HB	10/02/2002 11:30		<5		<100				<1						<20		<10	18.9	<2			<10	<20		<100			6.9			53	727.0							<20
E010	HB	10/08/2002 10:00																	20														478.0							
E010	HB	10/22/2002 10:00																	14.6														410.6							
E010	HB	10/29/2002 11:30		<5		<100				<1						<20			9.7	<2			100	<20		100			7			51.2	290.9							
E010	HB	10/30/2002 11:30																	10.9														387.3							
E010	HB	11/11/2002 10:00																	49																					
E010	HB	11/25/2002 10:00																	12														411.0							
E010	HB	12/10/2002 10:00																	8.6														209.8							
E010	HB	12/24/2002 10:00																	7														435.0							
E010	HB	01/07/2003 10:00																															>7200.5							
E010	HB	01/21/2003 10:00																	13.2														214.0							
E010	HB	01/22/2003 10:00		<5		<100				<1						<20			3.1	<2				<20		160			6.7			48.6	137.6							
E010	HB	02/11/2003 10:00																	6.3														179.3							
E010	HB	02/19/2003 7:30		<5		<100				<1						<20		<10		<2			<10	<20		120			6.8			42								<20
E010	HB	02/25/2003 10:00																	3														80.0							
E010	HB	03/11/2003 10:00																	3.1														2359.0							
E010	HB	03/25/2003 10:00																	11														275.5							
E010	HB	04/08/2003 10:00																	7.4														291.0							
E010	HB	04/22/2003 10:00																	17.5														209.8							
E010	HB	05/06/2003 10:30		<5		<100				<1						<20		<10	8.6	<2			<10	<20		<100			6.7			43	197.0							<20
E010	HB	05/13/2003 10:00																	6.3														261.3							
E010	HB	05/27/2003 10:00																	16														325.5							
E010	HB	06/10/2003 10:00																	24.6														613.1							
E010	HB	06/24/2003 10:00																	10.9														579.4							
E010	HB	07/08/2003 10:00																	10.1														517.2							
E010	HB	07/09/2003 10:30		<5		<100				<1						<20		<10	14.6	<2			<10	<20		<100			6.9			54.5	488.4							<20
E010	HB	07/22/2003 10:00																	16.1														648.3							
E010	HB	08/12/2003 10:00																	17.1														1119.9							
E010	HB	08/26/2003 10:00																	14.8														816.2							
E010	HB	09/09/2003 10:00																	260.2														>2419.17							
E010	HB	09/23/2003 10:00																	17.5														1413.6							
E010	HB	10/14/2003 10:00																	15														1120.0							
E010	HB	10/28/2003 10:00																	42														517.0							
E010	HB	11/11/2003 10:00																	7														1119.9							
E010	HB	11/25/2003 10:00																	7.4														517.2							

Analytical Data

Site ID	Data Source	Date/Time	Ammonia-Nitrogen Total***	Arsenic Dissolved	Arsenic Total	Barium and compounds Dissolved	Barium and compounds Total	Bromide Total	Cadmium Dissolved	Cadmium Total	Chemical Oxygen Demand	Chlorophyll a Total	Chromium Dissolved	Chromium Total	Copper Dissolved	Copper Total	Dissolved o2 percent saturation	Dissolved oxygen	E. Coli Total	Lead Dissolved	Lead Total	Manganese and compounds Dissolved	Manganese and compounds Total	Nickel Dissolved	Nickel Total	Nitrate/Nitrite-Nitrogen Dissolved	Orthophosphate Dissolved	Orthophosphate Total	PH	Pheophytin a Total	Phosphorus Total	Specific Conductance	Total Coliforms	Total Kjeldahl Nitrogen	Total Organic Carbons	Total Suspended Solids	Turbidity	Water Temp	Zinc Dissolved	Zinc Total
E010	HB	12/09/2003 10:00																	18															613.0							
E010	HB	12/23/2003 10:00																	10															816.0							
E010	HB	01/13/2004 10:00																	8.5															488.4							
E010	HB	01/27/2004 8:00			<5		<100			<1				<20		<10			14.8		<2		31		<20	<100			7.3			40.4	365.4							<20
E010	HB	02/10/2004 10:00																	4.1															195.6							
E010	HB	02/17/2004 8:15			<5		<100			<1				<20		<10					<2		53		<20	110			7.2			42.4								<20
E010	HB	02/24/2004 10:00																	5.2															172.3							
E010	HB	03/09/2004 10:00																	6.3															162.4							
E010	HB	03/23/2004 10:00																	8.6															248.1							
E010	HB	04/13/2004 10:00																	14.6															344.9							
E010	HB	04/14/2004 11:00			<5		<100			<1				<20		<10					<2		12		<20	<100			7.4			43								<20
E010	HB	04/27/2004 10:00																	8.6															166.9							
E010	HB	05/11/2004 7:40			<5		<100			<1				<20		<10			9.6		<2		<10		<20	<100			7.4			43.6	214.3							<20
E010	HB	05/25/2004 10:00																	9.6															365.4							
E010	HB	06/08/2004 9:40			<5		<100			<1				<20		<10					<2		<10		<20	<50			7.1			45								<20
E010	HB	07/06/2004 7:30			<5		<100			<1				<20		<10					<2		<50		<20	<50			7.1			55.4								<20
E010	HB	09/01/2004 7:30			<5		<100			<1				<20		<100					<2		20		<20	<100			7.4			58.4								<20
E010	HB	10/27/2004 11:00			<5		<100			<1				<20		<10					<2		<10		<20	<100			7.5			136								<20
E010	HB	01/25/2005 8:30			<5		<100			<1				<20		<10					<2		<10		<20	<100			6.9			50.3								<20
E010	HB	07/29/2005 13:15																															>2419.2							
E010	HB	08/03/2005 15:25																															1110.0							
E010	HB	08/18/2005 13:00																															831.0							
E010	MWC	01/24/2006 8:15	<50	<1	<2				<1	<1	<5000	2.4	<1	<1	5.6	8.53			1	<1	<1			<2	<2	100		12.6		2.08	28.2	276.0	<500	1390	<10000				<5	<5
E010	MWC	03/28/2006 7:50	<50	<1	<1	2.11	2.23		<1	<1	<5000	3.2	<1	<1	9.1	6.68			<1	<1	<1			<2	<2	<100		15		<.2	21.4	416.0	<500	1400	<10000				<5	<5
E010	MWC	05/23/2006 8:00	110	<1	<1	1.43	2.1		<1	<1	10400	1.54	<1	<1	8.28	11.3			24.9	<1	<1	2.56	4.93	<2	<2	<100		19.5		<.2	22.6	770.0	<500	1400	<10000				<5	<5
E010	MWC	08/09/2006 7:55	<50	<1	<1	2.28	2.71		<1	<1	7090	0.8	<1	<1	6.38	10.4			16.9	<1	<1	2.19	5.97	<2	<2	<100		16.3		<.2	28.5	1120.0	<500	<1000	<10000				<5	<5
E010	MWC	10/13/2006 8:10	<50	<1	<1	1.59	1.14		<1	<1	<5000	2.33	<1	<1	6.6	9.54			5.1	<1	<1	<2	4.35	<2	<2	<100		<10		<.2	32	1050.0	<500	<2000	<10000				<5	<5
E010	MWC	12/19/2006 8:15	<50	<1	<1	1.62	2.21		<1	<1	<5000	3.2	<1	<1	7.4	7.84			4.1	<1	<1	2.37	9.54	<2	<2	<100		<10		<.2	35.4	285.0	<500	1000	<10000				<5	<5
E010	MWC	05/08/2007	<50	<1	<1	1.65	2.72		<1	<1					8.51	15.8				<1	<1	2.19	3.51	<2	<2	<100		21.2			24.6	199.0	<500	<1000					<5	<5
E010	MWC	07/09/2007 8:15	<50	<1	<1	<10	<10		<1	<1	<5000	0.87	<1	<1	4.31	7.1			9.7	<1	<1	<10	<10	<1	<1	<100		23.1			33	1410.0	<500	<1000	<10000				<10	<10
E010	MWC	08/16/2007 10:30	<50	<1	<1	<10	<10		<1	<1	<5000	0.24	<1	<1	4.11	5.74			9.6	<1	<1	<10	<10	<1	<1	<100		25.2		<.006	54	461.0	<500	<1000	<10000				<10	<10
E010	MWC	09/11/2007 9:35	<50	<1	<1	<10	<10	<500	<1	<1	<5000	0.79	<1	<1	4.82	7.49			31.8	<1	<1	<10	<10	<1	<1	<100		26.3		<.2	41.8	579.0	<500	<1000	<10000				<10	<10
E010	MWC	11/15/2007 8:50	<50	<1	<1	1.75	1.8	<500	<1	<1	<5000	<.2	<1	<1	7.16	7.9			9.7	<1	<1	<2	4.17	<2	<2	<100		23.7		<.2	24.6	250.0	<500	1190	<10000				<5	<5
E010	MWC	01/14/2008 10:20	<50	<1	<1	1.89	2.24	<500	<1	<1	<5000	0.79	<1	<1	7.67	10.1			1	<1	<1	<2	5.3	<2	<2	<100		15.6		<.2	26.2	187.0	<1000	<1000	<10000				<5	<5
E010	MWC	03/18/2008 9:20	<100	<1	<1	1.99	2.59	<500	<1	<1	<15000	<.2	<1	<1	6.98	12.7			25.9	<1	1.11	2.38	6.05	<2	<2	<100		18		2.82	<20	345.0	715	1030	2000				<5	8.06
E010	MWC	05/22/2008 8:25	<50	<1	<1	1.31	2.02	<500	<.5	<.5	5310	<.2	<2	<2	12.7	19.5			13.2	<1	<1	<2	5.12	<1	<1	<100		<10		<.2	<20	201.0	<500	1000	2500				5.13	<5
E010	MWC	08/21/2008 8:30	84.7	<1	<1	1.43	1.82	<500	<.5	<.5	14200	1	<2	<2	5.15	8.2			225	<1	<1	<2	11.6	<1	<1	<100		19			38.4	1986.3	<500	<1000	2860				<5	<5
E010	MWC	11/06/2008 9:40	<50	<1	<1	1.56	2.15	<500	<.5	<.5	7130	<1	<2	<2	10.4	14.4			58.1	<1	1.64	<2	5.34	<1	<1	<100		<10		<1	77	1730.0	<500	1260	2860				5.4	<5
E010	MWC	01/05/2009 15:55	<50	<1	<1	1.63	3.55	<500	<.5	<.5	5570		<2	<2	19.3	25.3			8.5	<1	<1	2.76	12.4	1.07	<1	<100		<10			36.9	488.4	<500	1140	<10000				5.23	<5
E010	MWC	03/25/2009 15:50	<50	<1	<1	1.76	1.85	<500	<.5	<.5	<5000	<1	<2	<2	11.5	13.6			3.1	<1	<1	<2	3.77	<1	<1	<100		11		<1	21.8	866.4	<500	605	<10000				<5	<5
E010	MWC	08/12/2009 8:50	<50	<1	<1	1.6	1.72	<500	<.5	<.5	<5000	<1	<2	<2	8.33	4.17			16	<1	<1	<2	3.83	<1	<1	<100		31		<1	58.7	579.4	<500	<1000	<10000				<5	<5
E010	MWC	12/09/2009 8:50	<50	<1	<1	1.47	1.58	<500	<1	<1	<5000	<1	<2	<2	15.7	20.2			4.1	<1	<1	2.56	3.54	<2	<2	<100		24		<1	22.9	101.4	<500	<1000	<10000				<10	<10
E01M	DEQ	01/08/2000 8:10																10.2											7.7			40					7	7.8		
E01M	DEQ	01/19/2000 14:05	20								<5000						96	11.6								13.5	127	7	6.8		30	36	<200	1000	9000		16	6.5		
E01M	DEQ	02/05/2000 8:00																11											7.6			40					5	7.8		
E01M	DEQ	02/08/2000 9:15	<20								<5000						94	11								15.1	84.8	<5	7.3		20	41	<200	1000	5000		6	8.6		
E01M	DEQ	03/04/2000 8:00																10.7											7.4			40					7	8.4		
E01M	DEQ	04/01/2000 8:00																10.9											7.5			43					6	8.5		
E01M	DEQ	04/11/2000 16:10	40								<5000						103	10.6								17.2	17.9	6	7.4		10	49	<200	<1000	2000		6	14.7		

Analytical Data

Site ID	Data Source	Date/Time	Ammonia-Nitrogen Total***	Arsenic Dissolved	Arsenic Total	Barium and compounds Dissolved	Barium and compounds Total	Bromide Total	Cadmium Dissolved	Cadmium Total	Chemical Oxygen Demand	Chlorophyll a Total	Chromium Dissolved	Chromium Total	Copper Dissolved	Copper Total	Dissolved o2 percent saturation	Dissolved oxygen	E. Coli Total	Lead Dissolved	Lead Total	Manganese and compounds Dissolved	Manganese and compounds Total	Nickel Dissolved	Nickel Total	Nitrate/Nitrite-Nitrogen Dissolved	Orthophosphate Dissolved	Orthophosphate Total	PH	Pheophytin a Total	Phosphorus Total	Specific Conductance	Total Coliforms	Total Kjeldahl Nitrogen	Total Organic Carbons	Total Suspended Solids	Turbidity	Water Temp	Zinc Dissolved	Zinc Total
E01M	DEQ	05/23/2000 16:30	40								<5000	0.7					102	10.1					14.6			29.2		6	7.3	0.9	10	46	<200	1000	2000		6	15.7		
E01M	DEQ	06/04/2000 16:00																9.7											7.6			47					4	17.8		
E01M	DEQ	07/11/2000 8:30	20								<5000	0.4					98	9.4					16.1			<5		6	7.5	0.8	20	57	<200	1000	4000		4	17.6		
E01M	DEQ	07/15/2000 15:30																9.2											7.9			52					3	20.4		
E01M	DEQ	07/31/2000 15:00	<20								<5000	0.3					95	8	64				17.8			10		7	7.7	0.5	20	57	<200	1000	1000		2	25		
E01M	DEQ	09/09/2000 8:10																9.4											7.2			61					3	15.4		
E01M	DEQ	09/10/2000 16:00																9.6											7			61					3	16.7		
E01M	DEQ	09/18/2000 10:20																8.7											7.4			65.2					3.74	16.2		
E01M	DEQ	10/07/2000 7:00																9.5											7.6			64					4	12.3		
E01M	DEQ	10/18/2000 9:50	20								<5000	0.3					92	9.6	138				5.78			<5		9	7.4	0.9	20	65	400	2000	2000		4	12.7		
E01M	DEQ	11/04/2000 8:20																9.9											7.3			66					3	10.8		
E01M	DEQ	11/14/2000 9:32	<20								<5000						90	12					20.6			9.2		5	7.5		20	63	<200	2000	<1000		2	3.6		
E01M	DEQ	12/02/2000 8:00																11.9											7.8			63					5	5.8		
E01M	DEQ	01/06/2001 8:15																10.8	20										7.3			54.5					3	7.1		
E01M	DEQ	01/29/2001 16:00	<20								<5000						96	12.1					15.4			120		5	7.5		20	50	<200	1000	2000		5	6.1		
E01M	DEQ	02/10/2001 8:10																11.4	12.6										7.5			51.8					5	5.3		
E01M	DEQ	02/27/2001 10:35	<20								<5000						98	12.1					23.4			78.3		5	7.4		10	51	<200	<1000	1000		4	5.6		
E01M	DEQ	03/10/2001 8:15																11.3	9.7										7.3			55.3					5	6.8		
E01M	DEQ	04/14/2001 8:10																10.8	31.5										7.6			50.8					8	6.7		
E01M	DEQ	04/23/2001 16:03	70								6000						100	11.1	<2				21.4			58.9		<5	7.4		10	45	<200	1000	3000		6	10.8		
E01M	DEQ	05/12/2001 8:10																9	34.1										7.3			54.4					4	13.3		
E01M	DEQ	05/30/2001 8:40	<20								6000	0.5					95	10	196				19.7			28.3		6	7.3	1.3	10	49	<200	1000	3000		4	12.3		
E01M	DEQ	06/09/2001 8:00																8.6	51.2										7.5			56.3					5	17.2		
E01M	DEQ	07/07/2001 8:00																8.4	100										7.5			58.7					5	18.1		
E01M	DEQ	07/24/2001 16:40	30								<5000	0.3					101	8.2	46				19.9			8.6		6	7.6	0.7	20	63	200	1000	3000		4	25.4		
E01M	DEQ	08/22/2001 15:50	30								7000	0.7					91	8.4	126				16.4			8.2		8	7.5	1	30	66	<200	2000	5000		4	19.9		
E01M	DEQ	10/01/2001 14:58	<20								6000	0.3					94	9.3								13.3		9	7.6	1	20	69	<200	2000	3000		5	16.7		
E01M	DEQ	10/13/2001 8:00																9.5	373										7.9			66.8					7	12.3		
E01M	DEQ	11/10/2001 8:08																11	59.1										7.7			63					3	5.8		
E01M	DEQ	11/20/2001 7:50	30								9000						94	10.8	96							135			7.4		30	53	<200	3000	4000		8	9.6		
E01M	DEQ	12/01/2001 8:00																10.2	200										7.3			43.7					14	8.4		
E01M	DEQ	01/23/2002 15:30	<20								5000						93	11.2								218		7	7.1		50	40	200	1000	13000		14	6.7		
E01M	DEQ	02/25/2002 16:10	<20								<5000						97	11.8								123		7	7.3		20	42	<200	1000	5000		5	7.1		
E01M	DEQ	04/16/2002 9:15	<20								5000						91	11	56							184		9	7.1		30	41	<200	2000	7000		10	7.5		
E01M	DEQ	05/09/2002 9:00	20								6000	0.5					93	10.4								21.3		<5	7.2	1	20	46	<200	<1000	2000		4	9.6		
E01M	DEQ	07/01/2002 14:45	<20								6000	0.4					103	9.3	36							17		6	7.6	0.7	20	55	<200	2000	2000			21		
E01M	DEQ	08/13/2002 9:20									<5000	0.4					83	7.2	77							<5		8	7.4	1.1	30	69		1000	5000		5	21.4		
E01M	DEQ	10/16/2002 10:40	60								<5000	0.2					91	10.3	89							5.6		8	7.7	1	20	70	<200	1000	3000		7	10.1		
E01M	DEQ	12/04/2002 10:30	20								<5000						93	11.6	16							26		9	7.4		20	64	<200	1000	2000		3	6.1		
E01M	DEQ	01/11/2003 8:00																10.93	31										7.76			29.7					7.98	6.7		
E01M	DEQ	02/01/2003 8:00																9.3	323										7.36			28.5					50.5	9		
E01M	DEQ	02/11/2003 12:07	<20								<5000						97	11.9	7							137		6	7.4		20	42	<200	1000	6000		6	6.2		
E01M	DEQ	03/08/2003 8:30																10.18	160										8.68			32.9					49	8.7		
E01M	DEQ	04/08/2003 8:07	30								<5000						97	11	17							110		9	7.3		30	42	<200	1000	11000		8	8.9		
E01M	DEQ	04/12/2003 8:00																9.9	114										7.41			45.6					8.4	9.9		
E01M	DEQ	05/10/2003 8:00																9.7	32										7.9								5.22	9.5		
E01M	DEQ	06/07/2003 8:00																	172										7.42			55.5					4.05	18.5		
E01M	DEQ	06/25/2003 7:52	20								<5000	0.7					87	8.7	47							8.8		7	7.4	1.9	20	54	<200	1000	4000		4	15.8		
E01M	DEQ	07/12/2003 8:10																6.8	61										7.41			61.2					5.02	21.3		

Analytical Data

Site ID	Data Source	Date/Time	Ammonia-Nitrogen Total***	Arsenic Dissolved	Arsenic Total	Barium and compounds Dissolved	Barium and compounds Total	Bromide Total	Cadmium Dissolved	Cadmium Total	Chemical Oxygen Demand	Chlorophyll a Total	Chromium Dissolved	Chromium Total	Copper Dissolved	Copper Total	Dissolved o2 percent saturation	Dissolved oxygen	E. Coli Total	Lead Dissolved	Lead Total	Manganese and compounds Dissolved	Manganese and compounds Total	Nickel Dissolved	Nickel Total	Nitrate/Nitrite-Nitrogen Dissolved	Orthophosphate Dissolved	Orthophosphate Total	PH	Pheophytin a Total	Phosphorus Total	Specific Conductance	Total Coliforms	Total Kjeldahl Nitrogen	Total Organic Carbons	Total Suspended Solids	Turbidity	Water Temp	Zinc Dissolved	Zinc Total
E01M	DEQ	08/08/2003 8:00																8.3	25.9										7.97			67.1					3.33	22.1		
E01M	DEQ	08/13/2003 11:47	<20								5000	0.6					87	7.5	70							5.1	7		7.3	1.3	30	69		200	1000	3000	4	22		
E01M	DEQ	09/13/2003 8:00																10.5	**197**										7.96			70					6.96	16.5		
E01M	DEQ	10/04/2003 8:00																8.15	**173**										7.45			72.6					5.14	16.8		
E01M	DEQ	10/21/2003 16:10	<20								6000	1.8					98	9.4	54							5.1	6		7.6	1.4	20	66		<200	2000	<1000	4	17.4		
E01M	DEQ	11/01/2003 8:00																16.2	31.5										8.15			64.7					2.56	2.6		
E01M	DEQ	12/06/2003 8:00																9.6											8.02			46.8					39	9.3		
E01M	DEQ	12/09/2003 15:22	<20								6000						92	10.9	50							342	7		7.2		30	42		<200	2000	8000	10	8		
E01M	DEQ	02/04/2004 15:30	<20								<5000						96	11.3	19							96.5	9		7.3		30	39		<200	1000	6000	10	8.6		
E01M	DEQ	04/27/2004 15:50	80								6000						98	10	3							65.9	6		7.4		20	47		<200	1000	4000	4	14.8		
E01M	DEQ	06/07/2004 17:30	<20								7000	0.6					96	10	**194**							33.5	8		7.5	1.2	30	50		<200	3000	5000	5	13.9		
E01M	DEQ	08/09/2004 11:00															86	7.7											7.6			62			<1000	2000		21.2		
E01M	DEQ	08/17/2004 16:43	<20								<5000	0.8					100	8.2	12							<5	7		7.7	1	20	67		<200	1000	<1000	3	24.9		
E01M	DEQ	10/20/2004 16:05	<20								12000	0.7					96	10.5	**140**							198	10		7.4	1.3	30	59		<200	3000	4000	11	11.8		
E01M	DEQ	12/20/2004 15:45	<20								<5000						93	11.2	25							176	8		7.2		20	48		<200	<1000	3000	7	7.4		
E01M	DEQ	01/08/2005 8:00																11.18	61.8										8.09			32					8.7	4.9		
E01M	DEQ	02/05/2005 8:05																11.48											8.27			53.9					3.59	5.7		
E01M	DEQ	02/10/2005 14:35	30								5000						100	12.6	6							106	6		7.4		20	55		<200	<1000	1000	4	5.6		
E01M	DEQ	03/05/2005 8:00																10.5	17.1										7.88			55.7					3.89	7.2		
E01M	DEQ	04/02/2005 8:00																10.7	18.1										7.73			45.9					12.5	7.4		
E01M	DEQ	04/06/2005 16:25	<20								6000						98	10.9	9							150	6		7.4		30	44		<200	<1000	9000	9	10.8		
E01M	DEQ	05/07/2005 7:30																10.06	**131**										7.62			39.6					11.7	11		
E01M	DEQ	05/25/2005 12:35															99	10.4											7.3			47						13.5		
E01M	DEQ	06/11/2005 7:11																9.87											7.94			50.2					6.65	12		
E01M	DEQ	06/21/2005 16:34	<20								5000						101	9.8	17							49.8	6		7.6		10	53		<200	<1000	5000	6	16.9		
E01M	DEQ	06/24/2005 13:15																8.94											7.36			53.5						15.7		
E01M	DEQ	07/09/2005 7:15																9.05	**132**										7.31			55.9					3.6	15.4		
E01M	DEQ	07/26/2005 13:40																11.76											7.43			59.9						21		
E01M	DEQ	07/27/2005 12:45															100	8.8											7.5			60			<1000	2400		22		
E01M	DEQ	08/05/2005 7:15																9.22	**139.6**										7.42			64.9					4.02	20.2		
E01M	DEQ	08/19/2005 16:45																9.86											7.63			65.8						23.1		
E01M	DEQ	08/24/2005 11:45	<20								6000	0.6					89	8.3	86							5.5	7		7.5	1.2	20	69		<200	1000	3000	3	19.3		
E01M	DEQ	09/03/2005 6:55																7.98	116										7.4			62.2					3.3	19		
E01M	DEQ	09/28/2005 15:30																9.36											7.54			57.6						15.3		
E01M	DEQ	10/08/2005 7:15																9.57	55.6										7.55			53.6					3.34	12.4		
E01M	DEQ	11/05/2005 7:20																9.95	40										7.55			39.3					9.06	8.6		
E01M	DEQ	12/03/2005 7:20																10.68	**218**										7.07			47.7					29.9	6.9		
E01M	DEQ	01/07/2006 7:30																9.42	30										7.16			41.6					13.2	9.7		
E01M	MWC	01/24/2006 15:55	<50	<1	<2				<1	<1	9600	<.2	<1	1.46	<2	<2			7.4	<1	<1			<2	<2	190	<10		7.4	2.53	23.1	517.0		<500	<1000	21000			<5	<5
E01M	DEQ	02/03/2006 7:30																9.88	86										7.16			39.2					19.8	8.8		
E01M	DEQ	02/22/2006 16:49	<20														99	11.9	6							110	8		7.4		20	44	121.0				5	7		
E01M	DEQ	03/04/2006 7:30																11.19	10.9										7.54								6.31	6.4		
E01M	MWC	03/28/2006 14:50	<50	<1	<1	3.87	5.19		<1	<1	5150	0.81	<1	<1	<2	<2			4.1	<1	<1	7.12	14.2	<2	<2	110	<10			<.2	<20	219.0		<500	<1000	<10000			<5	<5
E01M	DEQ	04/08/2006 7:30																9.93	35										7.29			46.6					5.14	9.8		
E01M	DEQ	05/13/2006 7:30																9.64	86.2										7.38			53.8					4.67	11.5		
E01M	MWC	05/23/2006 8:45	<200	<1	<1	4.19	6.4		<1	<1	15400	0.77	<1	<1	<2	<2	101.3	10.37	**214**	<1	<1	12	20.6	<2	<2	<100	<10		7.21	<.2	<40	56	>2420	<500	2710	<10000	4.8	14.33	<5	<5
E01M	MWC	08/09/2006 8:45	<50	<1	<1	5.83	6.75		<1	<1	10700	<.2	<1	<1	2.5	<2			84.5	<1	<1	8.47	22.8	<2	<2	<100	<10			<.2	<20		>2420	<500	1030	<10000			6.54	<5
E01M	MWC	10/13/2006 11:10	<50	<1	<1	4.93	4.94		<1	<1	<5000	1.59	<1	<1	<2	<2	96.3	10.58	38.4	<1	<1	2.97	19.3	<2	<2	<100	<10		7.22	<.2	<20	70	1730.0	<500	2000	<10000	2.5	11.13	<5	<5
E01M	MWC	12/19/2006 14:35	<50	<1	<1	2.91	2.88		<1	<1	<5000	12.8	<1	<1	<2	<2	99.1	12.43	2	<1	<1	2.61	9.14	<2	<2	190	<10		7.11	<.2	<20	34	727.0	<500	<1000	<10000	3.4	5.71	<5	<5

Analytical Data

Site ID	Data Source	Date/Time	Ammonia-Nitrogen Total***	Arsenic Dissolved	Arsenic Total	Barium and compounds Dissolved	Barium and compounds Total	Bromide Total	Cadmium Dissolved	Cadmium Total	Chemical Oxygen Demand	Chlorophyll a Total	Chromium Dissolved	Chromium Total	Copper Dissolved	Copper Total	Dissolved o2 percent saturation	Dissolved oxygen	E. Coli Total	Lead Dissolved	Lead Total	Manganese and compounds Dissolved	Manganese and compounds Total	Nickel Dissolved	Nickel Total	Nitrate/Nitrite-Nitrogen Dissolved	Orthophosphate Dissolved	Orthophosphate Total	PH	Pheophytin a Total	Phosphorus Total	Specific Conductance	Total Coliforms	Total Kjeldahl Nitrogen	Total Organic Carbons	Total Suspended Solids	Turbidity	Water Temp	Zinc Dissolved	Zinc Total
E01M	MWC	07/09/2007 9:15	<50	<1	<1	<10	<10		<1	<1	<5000	0.83	<1	<1	<1	<1	93.1	8.35	38.4	<1	<1	11.1	26.8	<1	<1	<100		<10	7.56		29	62	>2420	<500	<1000	<10000	2.8	20.67	<10	<10
E01M	MWC	09/11/2007 7:25	<50	<1	<1	<10	<10	<500	<1	<1	8840	4.62	<1	<1	<1	<1	87.2	8.25	76.8	<1	<1	<10	21.8	<1	<1	<100		<10	7.4	<.2	30.7	69	>2420	<500	1070	<10000	2.5	18.05	<10	<10
E01M	MWC	11/15/2007 9:10	<50	<1	<1	4.8	4.76	<500	<1	<1	<5000	<.2	<1	<1	<2	<2	93.9	11.37	13.5	<1	<1	10.8	15.4	<2	<2	100		<10	7.38	1.75	25.2	53	866.0	<500	2110	<10000	4	7.1	<25	<25
E01M	MWC	01/14/2008 9:15	<50	<1	<1	3.53	6.59	<500	<1	<1	<5000	0.83	<1	<1	<2	<2	105.3	12.88	13.2	<1	<1	4.47	24.8	<2	<2	200		<10	7.22	<.2	27.3	37	548.0	<1000	20000	20000	14.5	6.71	<5	<5
E01M	MWC	03/18/2008 15:10	<100	<1	<1	3.66	12.1	<500	<1	<1	15800	1.07	<1	1.65	<2	<2	108.9	12.86	95.9	<1	<1	4.05	62.5	<2	<2	190		7.7	7.12	<.2	41.4	41	>2420	7820	1370	34000	23.5	8.14	<5	<5
E01M	MWC	05/22/2008 9:25	<50	<1	<1	3.67	5	<500	<.5	<.5	5310	<.2	<2	<2	<2	<2			82	<1	<1	<2	21.4	<1	<1	<100		<10	7.39	<.2	<20	45	1990.0	<500	1350	5000	4.8	10.37	<5	<5
E01M	MWC	08/21/2008 9:10	<50	<1	<1	4.53	6.42	<500	<.5	<.5	13900	4.8	<2	<2	<2	<2			613	<1	<1	4.7	38.1	<1	<1	<100		<10	7.75		23.7	62	>2419.2	<500	1240	10000	7.3	17.58	<5	<5
E01M	MWC	11/06/2008 10:22	<50	<1	<1	4.68	10.7	<500	<.5	<.5	12400	<1	<2	<2	<2	2.12	98.9	11.41	326	<1	<1	4.85	61.5	<1	<1	480		<10	7.27	<1	1000	53	>2420	<500	3690	25000	18.1	9.1	<5	<5
E01M	MWC	01/05/2009 9:15	<50	<1	<1	3.21	8.42	<500	<.5	<.5	11000		<2	<2	<2	<2	102.3	12.5	29.5	<1	<1	5.53	33.1	<1	<1	210		<10	7.01		26.9	34	>2419.2	<500	1170	20000	14.4	6.74	<5	<5
E01M	MWC	03/25/2009 9:15	<50	<1	<1	3.98	5.33	<500	<.5	<.5	<5000	<1	<2	<2	<2	<2	89	10.7	22.6	<1	<1	5.71	16.7	<1	<1	130		<10	7.08	1.2	<20	42	307.6	<500	942	10000	8	7.38	<5	<5
E01M	MWC	08/12/2009 10:15	<50	<1	<1	4.55	5.44	<500	<.5	<.5	7660	1.1	<2	<2	<2	<2	94.4	8.28	135	<1	<1	<2	19.8	<1	<1	<100		<10	7.46	2.2	28.8	67	>2419.2	<500	915	<10000	3	21.86	<5	<5
E01M	MWC	12/09/2009 9:15	<50	<1	<1	3.56	4.41	<500	<1	<1	<5000	<1	<2	<2	<2	<2	88.9	13.04	4.1	<1	<1	19.6	23.2	<2	<2	200		<10	7.25	2.8	<40	55	275.5	<500	<1000	<10000	3.2	-0.11	<10	<10
E020	DEQ	01/19/2000 15:10	<20								5000						99	12.1				4.65				162	19		7.4		30	44	<200	1000	2000		4	5.7		
E020	DEQ	02/08/2000 10:02									<5000						100	11.8	<2			6.62				66.8	17		7.5		30	44	<200	<1000	1000		2	6.7		
E020	DEQ	04/11/2000 17:10	20								<5000						106	11.6				2.96				11.1	22		7.5		30	42	<200	<1000	1000		3	11		
E020	DEQ	05/23/2000 17:30	30								<5000	0.9					108	11.4	<2			3.29				9.9	22		7.5	0.2	30	44	<200	<1000	1000		3	11.8		
E020	DEQ	07/11/2000 9:15	30								<5000	0.7					100	10.3				2.79				5.5	30		7.7	0.8	40	53	<200	<1000	2000		1	13.6		
E020	DEQ	07/31/2000 15:50	<20								<5000	0.6					110	10				6.22				12	33		8	0.6	50	52	<200	<1000	2000		4	19.7		
E020	DEQ	10/18/2000 10:45	80								<5000	1					99	10.6				<.2				8.9	31		7.5	1.6	30	55	300	<1000	1000		1	11.7		
E020	DEQ	11/14/2000 10:29	<20								<5000						95	11.5	<2			5.12				15	26		7.5		40	56	<200	<1000	1000		1	6.8		
E020	DEQ	01/30/2001 9:16	<20								<5000						98	12.3				3.84				50.3	26		7.6		30	59	<200	<1000	1000		1	4.8		
E020	DEQ	02/27/2001 11:45	<20								5000						104	12.4				17.5				38.4	28		7.6		30	57	<200	<1000	<1000		1	7.1		
E020	DEQ	04/23/2001 16:45	30								<5000						109	11.9	<2			11.9				36.6	21		7.6		30	50	400	<1000	<1000		1	11		
E020	DEQ	05/30/2001 9:20	<20								<5000	1.3					98	10.7				3.92				20.7	20		7.4	1.5	30	47	<200	<1000	1000		1	11.2		
E020	DEQ	07/24/2001 18:00	30								<5000	1					113	9.9				4.65				15	32		8.3	1.1	60	57	200	1000	16000		3	21.5		
E020	DEQ	08/22/2001 16:25	<20								<5000	0.8					102	10.1				2.82				14.3	28		7.7	1.3	40	56	<200	1000	2000		1	15.4		
E020	DEQ	10/01/2001 15:46	20								<5000	1.6					111	10.7								12	34		8	1.8	40	60	<200	<1000	1000		1	16.5		
E020	DEQ	11/20/2001 8:35	40								<5000						93	10.8								26			7.5		40	54	<200	2000	2000		2	8.9		
E020	DEQ	01/24/2002 8:35	<20								<5000						104	13								250	23		7.3		40	53	<200	1000	2000		2	5.2		
E020	DEQ	02/25/2002 16:55	<20								<5000						99	12.2								42.8	20		7.6		30	46	200	1000	<1000		1	6.6		
E020	DEQ	04/16/2002 9:55	40								<5000						97	11.7								28.9	19		7.2		80	35	<200	2000	18000		21	6.4		
E020	DEQ	05/08/2002 17:00	30								<5000	0.9					107	11.8								25.9	19		7.5	0.8	50	45	<200	<1000	13000		17	9.8		
E020	DEQ	07/01/2002 14:05	<20								<5000	0.6					106	10.4	3							<5	29		7.8	0.7	40	51	<200	<1000	2000		2	16.2		
E020	DEQ	08/13/2002 9:55	<20								<5000	0.4					96	9.5	6							12.6	34		7.5	0.8	40	59			1000			15.7		
E020	DEQ	10/16/2002 11:15	30								<5000	0.7					97	10.7	5							6.5	31		7.7	1.3	40	57	<200	<1000	2000		1	10.6		
E020	DEQ	12/04/2002 11:15	<20								<5000						99	12.3	4							10.6	38		7.5		40	62	<200	<1000	2000		1	5.5		
E020	DEQ	02/12/2003 9:40	30								<5000						92	11.4	2							228	22		7.1		30	54	<200	<1000	2000		3	5.3		
E020	DEQ	04/07/2003 14:35	<20								<5000						101	11.6	1							45.4	18		7.5		30	44	<200	<1000	3000		3	8.3		
E020	DEQ	06/24/2003 14:50	30								<5000	0.8					106	10.4	4							14.2	34		7.7	0.9	50	54	<200	<1000	3000		1	16		
E020	DEQ	08/13/2003 12:42	<20								<5000	0.6					105	9.9	15							8	30		7.6	1.2	40	58	<200	<1000	1000		<1	17.2		
E020	DEQ	10/22/2003 8:13	<20								<5000	1.3					92	9.6	12							10.7	32		7.4	2.1	50	59	<200	<1000	4000		2	12.6		
E020	DEQ	12/10/2003 9:22	<20								<5000						95	11.5	5							78.9	21		7.5		30	45	<200	2000	2000		3	6.7		
E020	DEQ	02/05/2004 8:37	<20								<5000						98	12.3	5							70.9	19		7.4		30	42	<200	1000	4000		5	5.9		
E020	DEQ	04/28/2004 8:50	20								6000						94	10.4	40							<5	20		7.4		20	47	<200	1000	1000		2	10.3		
E020	DEQ	06/08/2004 11:08	<20								6000	1					99	10.8	55							12.7	21		7.2	1.4	30	45	<200	2000	4000		4	10.9		
E020	DEQ	08/18/2004 9:37	<20								<5000	0.7					92	9	9							14.2	29		7.5	1.5	40	60	<200	1000	1000		1	15.8		
E020	DEQ	10/21/2004 9:45	<20								<5000						91	9.9	17							19.2	26		7.6	2.3	30	56	<200	1000	1000		2	11.2		
E020	DEQ	12/21/2004 10:15	<20								<5000						96	11.8	7							89.9	26		7.3		30	53	<200	<1000	2000		2	5.8		
E020	DEQ	02/10/2005 10:05	20								<5000						99	12.4	<1							33	26		7.5		30	58	<200	<1000	<1000		1	4.8		

Analytical Data

Site ID	Data Source	Date/Time	Ammonia-Nitrogen Total***	Arsenic Dissolved	Arsenic Total	Barium and compounds Dissolved	Barium and compounds Total	Bromide Total	Cadmium Dissolved	Cadmium Total	Chemical Oxygen Demand	Chlorophyll a Total	Chromium Dissolved	Chromium Total	Copper Dissolved	Copper Total	Dissolved o2 percent saturation	Dissolved oxygen	E. Coli Total	Lead Dissolved	Lead Total	Manganese and compounds Dissolved	Manganese and compounds Total	Nickel Dissolved	Nickel Total	Nitrate/Nitrite-Nitrogen Dissolved	Orthophosphate Dissolved	Orthophosphate Total	PH	Pheophytin a Total	Phosphorus Total	Specific Conductance	Total Coliforms	Total Kjeldahl Nitrogen	Total Organic Carbons	Total Suspended Solids	Turbidity	Water Temp	Zinc Dissolved	Zinc Total
E020	DEQ	04/07/2005 10:30	<20								8000						98	11.2	9							55.8	21		7.5		30	49	<200	<1000	4000		3	9		
E020	MWC	04/12/2005 12:48	<50	<1	<1				<1	<1			<1	<1	<1	<1				<1	<1			<1	<1	<100							<20	<500					<10	<10
E020	DEQ	06/22/2005 9:54	20								7000						93	9.3	31							22.9	22		7.4		30	54	<200	<1000	3000		2	14.2		
E020	HB	07/29/2005 12:15																	>2419.72																					
E020	HB	08/03/2005 15:00																	870.0																					
E020	HB	08/18/2005 12:20																	1298.0																					
E020	DEQ	08/23/2005 18:30	<20								<5000						104	9.6	23							10.3	28		7.8		40	58	<200	<1000	<1000		1	18.3		
E020	DEQ	10/20/2005 10:25	<20								<5000						98	10.4	8							16.2	25		7.4		40	54	<200	<1000	<1000		2	11.8		
E020	DEQ	12/14/2005 10:20	<20								<5000						96	12.3	9							85.7	44		7.5		50	53	<200	<1000	<1000		2	4		
E020	MWC	01/24/2006 8:50	59	<1	<2				<1	<1	6540	4.01	<1	<1	<2	<2			6.3	<1	1.41			<2	<2	<100		12.9		<.2	24.1		139.0	<500	1180	<10000			<5	<5
E020	DEQ	02/15/2006 9:35	<20								<5000						92	11.9	1							165	25		7.2		40	51	<200	<1000	3000		3	5.4		
E020	MWC	03/28/2006 9:00	<50	<1	<1	1.93	2.23		<1	<1	<5000	3.2	<1	<1	<2	<2			3.1	<1	<1	<2	2.59	<2	<2	<100		12.9		<.2	<20		276.0	<500	1000	<10000			<5	<5
E020	DEQ	04/04/2006 9:42	<20								6000						96	11.4	1							15.3	22		7.5		40	47	<200	<1000	3000		4	7.5		
E020	MWC	05/23/2006 10:20	51	<1	<1	1.49	1.7		<1	<1	8480	1	<1	<1	<2	<2	106.7	11.96	12.1	<1	<1	<2	2.97	<2	<2	<100		16.9	7.45	<.2	22.8	47	866.0	<500	1370	<5	0.7	10.28	<5	<5
E020	DEQ	06/26/2006 10:40	<20								5000						96	9.1	68							7.7	26		7.5	1	40	50	<200	<1000	4000		2	16.9		
E020	MWC	08/09/2006 10:15	<50	<1	<1	1.72	2.05		<1	<1	<5000	1.65	<1	<1	<2	<2			7.4	<1	<1	<2	4.45	<2	<2	<100		18.2	7.94	<.2	29	53	1990.0	<500	<1000	<10000	1	14.79	8.21	<5
E020	DEQ	08/16/2006 10:15	<20								<5000						96	9.6	27							19.2	22		7.7	1.2	30	54	<200	<1000	3000		1	14.8		
E020	MWC	10/13/2006 10:00	<50	<1	<1	1.43	1.1		<1	<1	5700	0.79	<1	<1	<2	<2	102.3	11.63	12.1	<1	<1	<2	3.85	<2	<2	<100		21	7.68	<.2	30.8	55	1050.0	<500	<2000	<10000	0.4	9.71	<5	<5
E020	DEQ	10/25/2006 10:20	<20								<5000						93	10.6	12							11.3	29		7.7	2.1	40	54	<200	<1000	<1000		3	9.1		
E020	DEQ	12/06/2006 10:20	<20								<5000						94	12	4							86.5			7.4		30	55					4	5.3		
E020	MWC	12/19/2006 8:45	<50	<1	<1	1.38	2.45		<1	<1	<5000	<.2	<1	<1	<2	<2	99.5	12.72	6.3	<1	<1	<2	10	<2	<2	<100		<10	7.33	<.2	33.1	39	365.0	<500	<1000	<10000	5.7	4.97	<5	<5
E020	DEQ	02/22/2007 10:20	<20														97	12	3							62.1			7.4		30	44					2	5.6		
E020	DEQ	04/26/2007 10:30	<20														132	11.5	9							23.3	22		7.5		50	47					2	9.9		
E020	DEQ	06/13/2007 10:12	<20								<5000						99	10	121							<5	25		7.7		40	51		<1000	3000		3	14.7		
E020	MWC	07/09/2007 10:30	<50	<1	<1	<10	<10		<1	<1	<5000	<.2	<1	<1	<1	<1	109.1	10.62	12.1	<1	<1	<10	<10	<1	<1	<100		23.4	7.6		38.1	55	>2420	<500	<1000	<10000	0.6	16.62	<10	<10
E020	DEQ	08/15/2007 10:01	20								<5000						85	9.3	15							12.3	28		7.7	1.5	40	59		<1000	1000		2	15.7		
E020	MWC	08/16/2007 12:00	<50	<1	<1	<10	<10		<1	<1	<5000	<.006	<1	<1	<1	<1	111.3	10.91	6.3	<1	<1	<10	<10	<1	<1	<100		26.8	8.25	<.006	46.1	57	1120.0	<500	<1000	<10000	0.9	16.36	<10	<10
E020	MWC	09/11/2007 10:30	<50	<1	<1	<10	<10	<500	<1	<1	6780	0.83	<1	<1	<1	<1	104.7	10.87	11	<1	<1	<10	<10	<1	<1	<100		27.4	7.76	<.2	38.9	55	1050.0	<500	<1000	<10000		13.65	<10	<10
E020	DEQ	10/10/2007 9:45	<20								<5000						96	10.5	37							8.4	32		7.6	1.8	40	58		<1000	2000		2	10.6		
E020	MWC	11/15/2007 11:30	<50	<1	<1	1.58	1.74	<500	<1	<1	<5000	2.56	<1	<1	<2	<2	98.5	11.66	5.2	<1	<1	<2	3.94	<2	<2	<100		24.5	7.57	<.2	20.5	49	435.0	<500	1010	<10000	1.2	7.99	<5	<5
E020	MWC	01/14/2008 11:10	<50	<1	<1	1.68	2.18	<500	<1	<1	<5000	<.2	<1	<1	<2	<2	112.8	14.18	<1	<1	<1	<2	5.65	<2	<2	100		16.1	7.27	<.2	22.9	40	126.0	<1000	<1000	<10000	2.4	5.61	<5	<5
E020	DEQ	02/13/2008 10:05	<20								<5000						96	12	2							96.9	21		7.3		30	49		<1000	1000		5	6		
E020	MWC	03/18/2008 12:00	<100	<1	<1	1.81	2.46	<500	<1	<1	<15000	<.2	<1	<1	<2	<2	109.7	13.54	7.4	<1	<1	<2	5.15	<2	<2	<100		18.5	7.44	<.2	22	42	219.0	<500	<1000	4000	2.4	6.36	<5	<5
E020	MWC	05/22/2008 10:45	<50	<1	<1	1.02	1.89	<500	<.5	<.5	7920	<.2	<1	<1	<2	<2			9.7	<1	<1	<2	5.68	<1	<1	<100		<10	7.53	<.2	<20	35	387.0	<500	1020	5000	2.7	7.28	5.07	<5
E020	MWC	08/21/2008 11:35	<50	<1	<1	1.39	1.61	<500	<.5	<.5	11600	2.6	<2	<2	<2	<2			105	<1	<1	<2	5.72	<1	<1	<100		17	7.83		31.8	51	>2419.2	<500	2860	<10000	1.9	13.22	<5	<5
E020	MWC	11/06/2008 14:52	<50	<1	<1	1.72	3.21	<500	<.5	<.5	8700	2.2	<2	<2	<2	<2	103.4	12.09	19.9	<1	<1	<2	10.8	<1	<1	100		<10	7.5	<1	<50	45	1300.0	<500	1610	8570	4	8.54	<5	<5
E020	MWC	01/05/2009 10:45	<50	<1	<1	1.54	4.23	<500	<.5	<.5	7130		<2	<2	<2	<2	106.3	13.53	5.2	<1	<1	<2	14.3	<1	<1	<100		<10	7.29		26	36	387.3	<500	1010	20000	7.7	5.14	<5	<5
E020	MWC	03/25/2009 11:00	<50	<1	<1	1.8	1.9	<500	<.5	<.5	<5000	1	<2	<2	<2	<2	93.1	11.41	5.2	<1	<1	<2	3.55	<1	<1	<100		24	7.33	<1	20.4	44	137.6	<500	602	<10000	1.8	6.61	<5	<5
E020	MWC	08/12/2009 16:15	<50	<1	<1	1.34	1.51	<500	<.5	<.5	<5000	<.2	<2	<2	<2	<2	111.7	10.54	12.1	<1	1.44	<2	3.57	<1	<1	<100		29	8.03	<1	39.8	55	1553.1	<500	<1000	<10000	1.4	18.2	6.17	<5
E020	MWC	12/09/2009 10:40	<50	<1	<1	1.33	1.41	<500	<.5	<.5	<5000	1.1	<2	<2	<2	<2	90.7	13	1	<1	<1	<2	2.63	<2	<2	<100		23	7.22	<1	<40	62	72.7	<500	<1000	<10000	0.7	0.7	<5	<5
E02M	MWC	01/24/2006 16:45	<50	<1	<2				<1	<1	<5000	0.8	<1	<1	<2	<2			6.3	<1	<1			<2	<2	180		<10		<.2	<20		249.0	<500	<1000	<10000			<5	<5
E02M	MWC	03/28/2006 15:35	<50	<1	<1	3.6	4.29		<1	<1	6820	9.61	<1	<1	<2	<2			3.1	<1	<1	3.08	7	<2	<2	<100		<10		<.2	<20		150.0	<500	<1000	<10000			<5	<5
E02M	MWC	05/23/2006 9:20	<50	<1	<1	3.82	5.29		<1	<1	12400	<.2	<1	<1	<2	<2	109.6	11.65	52	<1	<1	3.7	11	<2	<2	<100		<10	7.48	<.2	24.2	52	1120.0	<500	2130	<10000	3.1	12.61	<5	<5
E02M	MWC	08/09/2006 9:10	<50	<1	<1	4.96	5.83		<1	<1	9600	1.63	<1	<1	<2	2.33			118	<1	<1	4.24	9.33	<2	<2	<100		<10	7.69		<20	59	>2420	<500	1040	<10000	1.2	16.75	<5	<5
E02M	MWC	10/13/2006 11:55	<50	<1	<1	4.15	3.79		<1	<1	7370	<.2	<1	<1	<2	<2	101.3	11.88	68.3	<1	<1	2.91	4.63	<2	<2	<100		<10	7.38		<20	64	1550.0	<500	<2000	<10000	0.1	8.41	<5	<5
E02M	MWC	12/19/2006 14:10	<50	<1	<1	3.26	4.6		<1	<1	<5000	<.2	<1	<1	<2	<2	97.3	12.35	11.9	<1	<1	5.91	22.9	<2	<2	210		<10	7.19	<.2	25.4	38	866.0	<500	<1000	10000	8.3	5.22	<5	<5
E02M	MWC	07/09/2007 9:25	<50	<1	<1	<10	<10		<1	<1	<5000	0.83	<1	<1	<1	<1	101.5	9.8	156	<1	<1	<10	<10	<1	<1	<100		<10	7.52		25.4	57	1990.0	<500	<1000	<10000	1.2	17.06	<10	<10
E02M	MWC	09/11/2007 7:50	<50	<1	<1	<10	<10	<500	<1	<1	<5000	<.2	<1	<1	<1	<1	94.7	9.71	65	<1	<1	<10	<10	<1	<1	<100		<10	7.57	1.98	22.4	64	1890.0	<500	<1000	<10000	0	14.26	<10	<10
E02M	MWC	11/15/2007 9:40	<50	<1	<1	4.13	4.26	<500	<1	<1	<5000	2.29	<1	<1	<2	<2	95.2	11.33	21.1	<1	<1	3.03	5.35	<2	<2	100		<10	7.45	<.2	<20	49	479.0	<500	1850	<10000	2.5	7.81	<5	<5

Site ID	Data Source	Date/Time	Ammonia-Nitrogen Total***	Arsenic Dissolved	Arsenic Total	Barium and compounds Dissolved	Barium and compounds Total	Bromide Total	Cadmium Dissolved	Cadmium Total	Chemical Oxygen Demand	Chlorophyll a Total	Chromium Dissolved	Chromium Total	Copper Dissolved	Copper Total	Dissolved o2 percent saturation	Dissolved oxygen	E. Coli Total	Lead Dissolved	Lead Total	Manganese and compounds Dissolved	Manganese and compounds Total	Nickel Dissolved	Nickel Total	Nitrate/Nitrite-Nitrogen Dissolved	Orthophosphate Dissolved	Orthophosphate Total	PH	Pheophytin a Total	Phosphorus Total	Specific Conductance	Total Coliforms	Total Kjeldahl Nitrogen	Total Organic Carbons	Total Suspended Solids	Turbidity	Water Temp	Zinc Dissolved	Zinc Total
E02M	MWC	01/14/2008 9:40	<50	<1	<1	3.07	4.75	<500	<1	<1	<5000	<.2	<1	<1	<2	<2	107.4	13.19	6.3	<1	<1	2.03	15.6	<2	<2	190		<10	7.23	0.49	<20	33	276.0	<1000	<1000	10000	7.5	6.55	<5	<5
E02M	MWC	03/18/2008 15:30	<100	<1	<1	3.22	10.6	<500	<1	<1	18500	<.2	<1	<1	<2	<2	110.7	13.08	71.2	<1	<1	2.73	52.3	<2	<2	190		6.7	7.16	1.25	38.2	35	921.0	508	1360	32000	22.1	8.11	<5	<5
E02M	MWC	05/22/2008 9:45	<50	<1	<1	3.25	4.55	<500	<.5	<.5	8440	<.2	<2	<2	<2	<2			44.3	<1	<1	<2	13.8	<1	<1	<100		<10	7.5	<.2	<20	40	1410.0	<500	1410	5000	4.4	9.11	5.16	<5
E02M	MWC	08/21/2008 9:45	<50	<1	<1	4.34	5.5	<500	<.5	<.5	22800	1.4	<2	<2	2.22	<2			770	<1	<1	3.55	23.1	<1	<1	140		<10	7.76		23.8	56	2419.2	<500	2710	7140	6.2	15.67	<5	<5
E02M	MWC	11/06/2008 11:12	<50	<1	<1	4.03	9.03	<500	<1	<2	12900	<1	<2	<2	<2	<2	101.5	11.61	178	<1	<1	2.8	46	<1	<1	520		<10	7.3	<1	97	50	>2420	604	3760	24000	15.9	9.44	<5	<5
E02M	MWC	01/05/2009 9:35	<50	<1	<1	2.89	6.56	<500	<.5	<.5	10000		<2	<2	<2	<2	102.7	12.44	17.3	<1	<1	2.26	23.5	<1	<1	200		<10	7.09		21.4	31	1986.3	<500	1170	10000	9.8	7.1	<5	<5
E02M	MWC	03/25/2009 9:50	<50	<1	<1	3.46	4.21	<500	<.5	<.5	<5000	1	<2	<2	<2	<2	91.6	11.11	7.4	<1	<1	2.28	11.1	<1	<1	120		<10	7.12	<1	<20	37	228.2	<500	868	10000	5.3	7.01	<5	<5
E02M	MWC	08/12/2009 10:50	<50	<1	<1	4.19	4.53	<500	<.5	<.5	8700	<1	<2	<2	<2	<2	105.6	9.66	77.1	<1	<1	3	9.2	<1	<1	<100		<10	7.7	1.4	24.1	62	>2419.2	<500	835	<10000	1.6	19.67	<5	<5
E02M	MWC	12/09/2009 9:45	<50	<1	<1	4.92	3.41	<500	<1	<1	<5000	<1	<2	<2	<2	<2	82.5	12.1	3	<1	<1	5.07	6.41	<2	<2	190		<10	7.34	<1	<40	54	313.0	<500	<1000	<10000	2.1	-0.1	<10	<10
E060	HB	08/18/2005 11:35																															831.0							
E060	MWC	01/24/2006 10:15	<50	<1	<2				<1	<1	<5000	<.2	<1	<1	<2	<2			3.1	<1	<1			<2	<2	<100		13.2			0.48	24.5		99.0	<500	1170	<10000			<5	<5
E060	MWC	03/28/2006 9:45	<50	<1	<1	1.85	2		<1	<1	<5000	6.41	<1	<1	<2	<2			2	<1	<1	<2	2.24	<2	<2	<100		15.9			<.2	23		260.0	<500	<1000	<10000			<5	<5
E060	MWC	05/23/2006 11:00	104	<1	<1	1.38	1.66		<1	<1	10400	0.8	<1	<1	<2	<2	103.8	11.85	5.2	<1	<1	<2	2.67	<2	<2	<100		16.9	7.63	<.2	<40	46	548.0	<500	1420	<10000		9.56	<5	<5
E060	MWC	08/09/2006 10:45	<50	<1	<1	1.59	1.84		<1	<1	8210	0.82	<1	<1	<2	<2			8.5	<1	<1	<2	3.58	<2	<2	<100		19.9	8	<.2	31.9		1730.0	<500	<1000	<10000		13.67	<5	<5
E060	MWC	10/13/2006 9:10	<50	<1	<1	1.43	1.12		<1	<1	<5000	2.43	<1	<1	<2	<2	101.2	11.54	4.1	<1	<1	<2	3.64	<2	<2	<100		<10			<.2	34.2	54	816.0	<500	<2000	<10000		9.58	<5	<5
E060	MWC	12/19/2006 9:20	<50	<1	<1	1.15	1.93		<1	<1	<5000	<.2	<1	<1	<2	<2	101.9	13.03	4.1	<1	<1	<2	9.89	<2	<2	<100		<10	7.08	9.93	30.1	38	167.0	<500	<1000	<10000	6.6	4.97	<5	<5
E060	MWC	07/09/2007 11:15	<50	<1	<1	<10	<10		<1	<1	<5000	0.84	<1	<1	<1	<1	108.1	10.68	7.4	<1	<1	<10	<10	<1	<1	<100		24.5	7.6		44.5	55	1990.0	<500	<1000	<10000	0.5	15.96	<10	<10
E060	MWC	09/10/2007 15:30	<50	<1	<1	<10	<10	<500	<1	<1	<5000	<.2	<1	<1	<1	<1	109.5	11.3	5.2	<1	<1	<10	<10	<1	<1	<100		29.7	7.87	1.28	50	54	613.0	<500	<1000	<10000	0.1	13.94	<10	<10
E060	MWC	11/15/2007 12:40	<50	<1	<1	1.74	1.85	<500	<1	<1	<5000	<.2	<1	<1	<2	<2	100.3	11.97	4.1	<1	<1	<2	4.43	<2	<2	<100		26.5	7.7	1.35	21.1	48	201.0	<500	<1000	<10000	1.6	7.71	<5	<5
E060	MWC	01/14/2008 11:30	<50	<1	<1	1.87	2.37	<500	<1	<1	<5000	<.2	<1	<1	<2	<2	110.9	13.94	3.1	<1	<1	<2	5.71	<2	<2	<100		15.9	7.3	<.2	<20	38	129.0	<1000	<1000	<10000	3	5.64	<5	<5
E060	MWC	03/18/2008 12:40	<100	<1	<1	2.37	3.83	<500	<1	<1	<15000	<.2	<1	<1	<2	<2	110.5	13.69	3.1	<1	<1	<2	15.2	<2	<2	<100		18	7.49	0.26	23.7	41	313.0	<500	<1000	10000	2.5	6.21	<5	<5
E060	MWC	05/22/2008 11:00	<50	<1	<1	1.11	1.95	<500	<.5	<.5	<5000	<.2	<2	<2	<2	<2			6.3	<1	<1	<2	5.78	<1	<1	<100		<10	7.54	<.2	<20	35	194.0	<500	1010	5000	2.7	7.1	<5	<5
E060	MWC	08/21/2008 12:10	<50	<1	<1	1.41	1.62	<500	<.5	<.5	12900	2.5	<2	<2	<2	<2			83.9	<1	<1	<2	4.75	<1	<1	<100		19	7.97		36.3	50	>2419.2	<500	<1000	2860	1.7	12.05	<5	<5
E060	MWC	11/06/2008 12:24	<50	<1	<1	2.23	3.44	<500	<.5	<.5	5050	1.3	<2	<2	<2	<2	105.2	12.38	18.5	<1	<1	<2	11.3	<1	<1	110		<10	7.51	<1	67	45	1200.0	<500	1680	7140	3.8	8.25	<5	<5
E060	MWC	01/05/2009 11:05	<50	<1	<1	1.89	4.72	<500	<.5	<.5	7660		<2	<2	<2	<2	107.6	13.68	5.1	<1	<1	<2	16.6	<1	<1	<100		<10	7.34		28	35	727.0	<500	1140	20000	8.1	5.16	<5	<5
E060	MWC	03/25/2009 11:25	<50	<1	<1	2.02	2.26	<500	<.5	<.5	<5000	1.3	<2	<2	<2	<2	92.1	11.42	8.6	<1	<1	<2	5.37	<1	<1	<100		13	7.32	<1	20.4	42	172.3	<500	924	<10000	2.6	6.16	<5	<5
E060	MWC	08/12/2009 12:05	<50	<1	<1	1.32	1.57	<500	<.5	<.5	6090	1.4	<2	<2	<2	<2	110.2	11.31	3	<1	<1	<2	2.71	<1	<1	<100		29	7.73	1.8	41.6	54	517.2	<500	<1000	<10000	1.2	14.22	<5	<5
E060	MWC	12/09/2009 11:15	<50	<1	<1	1.28	1.39	<500	<1	<1	<5000	<1	<2	<2	<2	<2	92.3	12.98	1	<1	<1	<2	2.73	<2	<2	<100		26	7.46	<1	<40	56	69.1	<500	<1000	<10000	0.7	1.4	<10	<10
E170	HB	07/29/2005 10:15																															275.5							
E170	HB	08/03/2005 13:20																															100.0							
E170	MWC	01/24/2006 12:25	<50	<1	<2				<1	<1	6820	0.8	<1	<1	<2	<2			1	<1	<1			<2	<2	<100		23.9			<.2	23.6		44.3	<500	<1000	<10000			<5	<5
E170	MWC	03/28/2006 12:50	<50	<1	<1	1.02	1.35		<1	<1	<5000	3.2	<1	<1	<2	<2			1	<1	<1	<2	<2	<2	<2	<100		31.8			<.2	30.9		33.5	<500	<1000	<10000			<5	<5
E170	MWC	05/23/2006 13:30	<200	<1	<1	1.08	1.13		<1	<1	12700	0.8	<1	<1	<2	<2	102.8	11.98	19.3	<1	<1	<2	<2	<2	<2	<100		30.2	7.68	<.2	27.8	51	120.0	<500	1470	<10000	0.1	8.69	<5	<5
E170	MWC	08/09/2006 13:45	<50	<1	<1	1.26	1.34		<1	<1	<5000	0.8	<1	<1	<2	<2			1	<1	<1	<2	<2	<2	<2	<100		41.2			<.2	41.3		66.9	<500	<1000	<10000			<5	<5
E170	MWC	10/13/2006 15:15	<50	<1	<1	<1	<1		<1	<1	6820	<.2	<1	<1	<2	<2	104.6	12.38	1	<1	<1	<2	<2	<2	<2	<100		37.8	7.76	0.78	46.4		27.5	<500	<2000	<10000		8.04	<5	<5
E170	MWC	12/19/2006 12:00	<50	<1	<1	<1	<1		<1	<1	<5000	<.2	<1	<1	<2	<2	99.9	12.98	3.1	<1	<1	<2	<2	<2	<2	<100		16.3	7.22	<.2	28.6	41	78.5	<500	<1000	<10000		4.31	<5	<5
E170	MWC	07/09/2007 14:10	<50	<1	<1	<10	<10		<1	<1	<5000	<.2	<1	<1	<1	<1	109.9	11.73	1	<1	<1	<10	<10	<1	<1	<100		48.9	7.89		54.5		42.6	<500	<1000	<10000		12.45	<10	<10
E170	MWC	08/16/2007 16:00	<50	<1	<1	<10	<10		<1	<1	<5000	<.006	<1	<1	<1	<1	104	11.07	1	<1	<1	<10	<10	<1	<1	<100		46.2	7.92	<.006	61.5		61.6	<500	<1000	<10000		12.57	<10	<10
E170	MWC	09/10/2007 13:35	<50	<1	<1	<10	<10	<500	<1	<1	<5000	0.8	<1	<1	<1	<1	104.4	11.8	1	<1	<1	<10	<10	<1	<1	<100		47	7.79	<.2	56.7	62	95.9	<500	<1000	<10000		9.95	<10	<10
E170	MWC	11/16/2007 12:20	<50	<1	<1	1.42	1.82	<500	<1	<1	<5000	<.2	<1	<1	<2	<2	101.5	12.28	4.1	<1	<1	<2	<2	<2	<2	<100		48.1	7.62	<.2	31.3	56	272.0	<500	<1000	10000	0.5	7.13	<5	<5
E170	MWC	01/14/2008 12:55	<50	<1	<1	1.16	1.22	<500	<1	<1	<5000	0.81	<1	<1	<2	<2	107.7	13.71	2	<1	<1	<2	<2	<2	<2	<100		28.3	7.55	<.2	31.8	48	66.3	<500	<1000	<10000	0.5	5.12	<5	<5
E170	MWC	03/17/2008 12:40	<100	<1	<1	<1	1.06	<500	<1	<1	<15000	3.14	<1	<1	<2	<2	102.6	13.02	1	<1	<1	<2	<2	<2	<2	<100		33.7	7.64	<.2	32.2	52	27.8	<500	<1000	2000	0	5.24	<5	<5
E170	MWC	05/22/2008 13:40	<50	<1	<1		1.27	<500	<.5	<.5	6870	<.2	<2	<2	<2	<2			<1	<1	<1	<2	2.26	<1	<1	<100		11	7.66	<.2	<20	38	43.2	<500	<1000	2500	1.8	6.36	<5	<5
E170	MWC	08/21/2008 14:55	<50	<1	<1	<1	1.11	<500	<.5	<.5			<2	<2	<2	<2			3	<1	<1	<2	2.15	<1	<1	<100		32	8.24		42.4	57	82.6	<500	1430	1430	5.9	9.76	<5	<5
E170	MWC	11/06/2008 13:31	<50	<1	<1	1	1.48	<500	<.5	<.5	6610	<1	<2	<2	<2	<2	103.9	12.64	3.1	<1	<1	<2	<2	<1	<1	<100		25	7.71	<1	55	58	158.0	<500	1150	1430	0.4	6.93	<5	<5
E170	MWC	01/05/2009 13:35	<50	<1	<1	1.13	1.65	<500	<.5	<.5	7660		<2	<2	<2	<2	106.2	13.64	5.1	<1	<1	<2	2.6	<1	<1	<100		13	7.43		38.5	43	231.0	<500	871	<10000	1	4.76	<5	<5
E170	MWC	03/25/2009 12:15	<50	<1	<1	1.1	1.01	<500	<.5	<.5	<5000	<1	<2	<2	<2	<2	92.4	11.7	1	<1	<1	<2	<2	<1	<1	<100		24	7.52	<1	27	51	30.9	<500	<1000	<10000	0.5	5.34	<5	<5
E170	MWC	08/12/2009 13:15	<50	<1	<1		1	<500	<.5	<.5	5830	1.6	<2	<2	<2	<2	109.3	12.07	<1	<1	<1	<2	<2	1.8	<1	<100		45	7.87	<1	46.2	59	47.1	<500	<1000	<10000	0.8	10.91	<5	<5
E170	MWC	12/09/2009 13:10	<50	<1	<1	<1	<1	<500	<1	<1	<5000	<1	<2	<2	<2	<2	91.7	12.66	<1	<1	<1	<2	<2	<2	<2	<100		42	7.47	<1	39.1	63	24.3	<500	<1000	<10000	0.4	2.06	<10	<10

Analytical Data

Site ID	Data Source	Date/Time	Ammonia-Nitrogen Total***	Arsenic Dissolved	Arsenic Total	Barium and compounds Dissolved	Barium and compounds Total	Bromide Total	Cadmium Dissolved	Cadmium Total	Chemical Oxygen Demand	Chlorophyll a Total	Chromium Dissolved	Chromium Total	Copper Dissolved	Copper Total	Dissolved o2 percent saturation	Dissolved oxygen	E. Coli Total	Lead Dissolved	Lead Total	Manganese and compounds Dissolved	Manganese and compounds Total	Nickel Dissolved	Nickel Total	Nitrate/Nitrite-Nitrogen Dissolved	Orthophosphate Dissolved	Orthophosphate Total	PH	Pheophytin a Total	Phosphorus Total	Specific Conductance	Total Coliforms	Total Kjeldahl Nitrogen	Total Organic Carbons	Total Suspended Solids	Turbidity	Water Temp	Zinc Dissolved	Zinc Total
E182	MWC	01/24/2006 13:20	<50	<1	<2				<1	<1	<5000	<.2	<1	<1	<2	<2			1	<1	<1			<2	<2	<100	25.1			<.2	24.2		31.8	<500	<1000	<10000			<5	<5
E182	MWC	03/28/2006 13:15	<50	<1	<1	1.01	<1		<1	<1	<5000	2.4	<1	<1	<2	<2			<1	<1	<1			<2	<2	<100	32.1			<.2	33.1		5.2	<500	<1000	<10000			<5	<5
E182	MWC	05/23/2006 14:15	<200	<1	<1	<1	1.03		<1	<1	<5000	1.6	<1	<1	<2	<2	103.5	12.28	<1	<1	<1			<2	<2	<100	26.3		7.63	<.2	26.6	50	19.9	<500	1600	<10000		7.93	<5	<5
E182	MWC	08/09/2006 14:20	<50	<1	<1	<1	1.09		<1	<1	<5000	<.2	<1	<1	<2	<2			<1	<1	<1			<2	<2	<100	41.5		8.07	2.08	42.1	58	67.7	<500	<1000	<10000		10.02		<5
E182	MWC	10/13/2006 15:45	<50	<1	<1	<1	<1		<1	<1	6540	<.2	<1	<1	<2	<2	99.1	11.89	1	<1	<1			<2	<2	<100	36.5		8.08	<.2	47.4	59	34.5	<500	<2000	<10000		7.48	<5	<5
E182	MWC	12/19/2006 12:40	<100	<1	<1	<1	<1		<1	<1	<5000	<.2	<1	<1	<2	<2	97.7	12.75	<1	<1	<1			<2	<2	<100	17.3		7.04	<.2	34.8		111.0	<500	<1000	<10000		4.2	<5	<5
E182	MWC	07/09/2007 15:10	<50	<1	<1	<10	<10		<1	<1	<5000	0.83	<1	<1	<1	<1	113.9	12.69	<1	<1	<1	<10	<10	<1	<1	<100	42.3		7.63		58.1	58	48.7	<500	<1000	<10000		10.57	<10	<10
E182	MWC	09/10/2007 11:20	<50	<1	<1	<10	<10	<500	<1	<1	<5000	<.2	<1	<1	<1	<1			1	<1	<1	<10	<10	<1	<1	<100	46.6			<.2	53.6		83.9	622	<1000	<10000			<10	<10
E182	MWC	11/16/2007 11:40	<50	<1	<1	1.04	1.31	<500	<1	<1	5350	<.2	<1	<1	<2	<2	99.9	12.37	4.1	<1	<1			<2	<2	<100	48.4		7.64	<.2	31.8	52	96.0	<500	<1000	<10000	0.4	6.24	<5	<5
E182	MWC	03/17/2008 16:20	<100	<1	<1	<1		<500	<1	<1	<15000	<.2	<1	<1	<2	<2	105	13.46		<1	<1			<2	<2	<100	37.3		7.69	<.2	29.2	50	15.8	<500	<1000	<2000	5.25	4.85		
E182	MWC	01/05/2009 14:10	<50	<1	<1	<1	1.07	<500	<.5	<.5	5570		<2	<2	<2	<2	104.3	13.56	4.1	<1	<1	<2	<2	<1	<1	<100	17		7.47		39.2	42	74.9	<500	538	<10000	0.6	4.31	<5	<5
E182	MWC	03/25/2009 14:00	<50	<1	<1	1.26	<1	<500	<.5	<.5	<5000	<1	<2	<2	<2	<2	91	11.62	<1	<1	<1	<2	<2	<1	<1	<100	32		7.55	<1	31.6	49	7.4	<500	479	<10000	0.3	5.01	<5	<5
E182	MWC	08/12/2009 15:05	<50	<1	<1	<1	<1	<500	<.5	<.5	6090	<1	<2	<2	80.9	10	102.8	11.8	<1	<1	<1	<2	<2	<1	17.9	<100	46		7.83	<1	53.9	57	48.7	<500	<1000	<10000	0.7	9.29	12	<5
E182	MWC	12/09/2009 15:00	<50	<1	<1		2.4	<500	<1	<1	<5000	<1	<2	<2	<2	<2	88.9	11.87	<1	<1	<1	<2	<2	<2	<2	<100	43		7.56	<1	46.6	58	40.8	<500	<1000	<10000	0.3	3.27	<10	<10
E210	MWC	02/12/2002 9:10			<1					<1				1.59		<2															34.3			<500						5.66
E210	MWC	05/14/2002 9:27		<1	<1				<1	<1					1.16	<2				<1	<1			<2	<2	<100					23.4			<500				10.1		<5
E210	MWC	06/18/2002 9:11		<1	<1				<1	<1				1.31	2.15	<2				<1	<1			<2	<2	4523					33			<500				10.8		<5
E210	MWC	07/09/2002 9:05		<1	<1				<1	<1			1.29	<1	1.87	<2				<1	<1			<2	<2	<100					30.2			<500				28.2		<5
E210	MWC	09/17/2002 9:20	<50	1.13	<1				<1	<1				1.22	3.71	3.81				<1	<1			<2	<2	<100					38.3			<500				66.8		<5
E210	MWC	10/08/2002 9:40	<50	<1	<1				<1	<1										<1	<1			<2	<2	<100					30.8			<500				8.52		
E210	MWC	01/14/2003 8:57	<50		<1					<1				1.12		2.37										520					38.5			<500						<5
E210	MWC	02/18/2003 9:03	<50		<1					<1				1.58		3.73										480					41.8			<500						20.5
E210	MWC	04/08/2003 9:10	<50	<1	<1				<1	<1				1.11	<2	2.35				<1	<1			<2	<2	310					28.5			<500				15.5		<5
E210	MWC	05/13/2003 8:55	<50	<1	<1				<1	<1						<2				<1	<1			<2	<2						<20			<500				9.38		<5
E210	MWC	10/16/2003 9:45	<50	<1	11.2				<1	<1			1.44	1.13	2.13	2.98				<1	<1			<2	<2	<100					28			<500				17.3		
E210	MWC	12/09/2003 9:06	<50	<1	<1				<1	<1			2.01	2.62	2.01	2.95				<1	<1			<2	<2	440					24.7			<500				10.8		<5
E210	MWC	01/13/2004 8:50	70.6	<1	<1				<1	<1			<1	<1	<2	<2				<1	<1			<2	<2	610					<20			<500				5.7		8.22
E210	MWC	02/10/2004 9:00	<50	<1	<1				<1	<1			<1	<1	<2	<2				<1	<1			<2	<2	560					<20			<500				7.66		<5
E210	MWC	03/09/2004 9:08	<50	<1	<1	3.69	3.95		<1	<1			<1	<1						<1	<1			<2	<2	360					<20			<500						<5
E210	MWC	04/13/2004 9:01	<50	<1	<1				<1	<1			<1	<1	<2	<2				<1	<1			<2	<2	180					<20			<500					<5	<5
E210	MWC	05/11/2004 8:49	<50	<1	<1				<1	<1			<1	<1	<2	6.79				<1	<1			<2	<2	100					26			<500				5.32		8.61
E210	MWC	06/08/2004 9:30	<50	<1	<1				<1	<1			<1	<1	2.75	<2				<1	<1			<2	<2	140					23.9			<500				7.08		<5
E210	MWC	07/13/2004 8:50	<50	<1	<1				<1	<1			<1	<1						<1	<1			<2	<2	<100					26.6			<500						<5
E210	MWC	11/09/2004 9:00	<50	<1	<1				<1	<1			<1	<1	<2	<2				<1	<1			<2	<2	160					27.9			<500						<5
E210	MWC	12/14/2004 9:30	<50	<1	<1				<1	<1			<1	<1	<2	<2				<1	<1			<2	<2	590					26.1			<500				10.3		14.9
E210	MWC	01/11/2005 8:56	<50	<1	<1				1.47	<1			<1	<1	<2	3.5				<1	<1			<2	<2	550					34			<500				7.61		7.81
E210	MWC	03/08/2005 8:47	<50	<1	<1				<1	<1			1.77	<1	<2	3.05				<1	<1			<2	<2	180					<20			<500				5.4		<5
E210	MWC	04/12/2005 9:03	<50	<1	<1				<1	<1			<1	<1	<1	1.82				<1	<1			<1	<1	420					28			<500					<10	<10
E210	MWC	12/12/2006	<50	<1	<1	4.32	4.49		<1	<1	<5000		<1	<1	<2	<2				<1	<1			<2	<2	630	<10				47.1			<500	1490	<10000		14.4		11
E210	MWC	05/08/2007	<50	<1	<1	2.75	3.44		<1	<1			<1	<1	2.01	2.38				<1	<1	7.26	13.8	<2	<2	170	10.1				33		1410.0	<500	1520	<10000		6.31		<5
E210	MWC	07/09/2007 7:40	<50	<1	<1	<10	<10				<5000	1.69	<1	<1	<1		64.5	6.21	26.2	<1	<1	<10	18.3	<1	<1	<100	<10				34.3	107	1730.0	<500	<1000	<10000	0.6	17.14	<10	<10
E210	MWC	09/11/2007 10:50	<50	<1	<1	<10	<10	<500	<1	<1	6730	<.2	<1	<1	<1				123			<10	<10	<1	<1	<100	13.1		7.12	0.77	35	78	1990.0	<500	<1000	<10000		15.31	<10	<10
E210	MWC	11/15/2007 10:55	<50	<1	<1	3.38	3.26	<500	<1		<5000	<.2			<2	<2			7.4	<1	<1	3.54	4.93	<2	<2	180	17.4			<.2	22		548.0	<500	1580	<10000			<5	<5
E210	MWC	01/14/2008 13:50	<50	<1	<1	4	5.13	<500	<1	<1	<5000	0.88	<1	<1	<2	<2	105.1	12.56	20.1	<1	<1	8.54	13	<2	<2	630	13		6.92		22.2	67	548.0	<500	<1000	<10000	7.8	7.61	<5	<5
E210	MWC	03/18/2008 9:50	<100	<1	<1	3.13	5.97	<500	<1	<1	<15000	<.2	<1	<1	<2	<2	97.2	11.64	70.8	<1	<1	3.6	17.4	<2	<2	340	16.4		6.92	1.6	22.2	55	1730.0	<500	2110	8000	20.4	7.56	<5	<5
E210	MWC	05/22/2008 15:00	<50	<1	<1	1.6	2.22	<500	<.5	<.5	7920	<.2	<2	<2	<2	<2			65	<1	<1	<2	11.5	<1	<1	100	<10		7.24	<.2	<20	58	1300.0	<500	1090	2500	1.7	9.71	5.25	<5
E210	MWC	08/21/2008 16:00	<50	<1	<1	2.31	2.52	<500	<.5	<.5	11600	1.9	<2	<2	<2	<2			137	<1	<1	2.8	7.4	<1	<1	<100	<10		8.01		32.2	62	1986.3	<500	<1000	2860	2.2	15.98	<5	<5
E210	MWC	10/14/2008	<50	<1	<1	3.5	2.74	<500	<.5	<.5	<5000		<2	<2	<2	<2			67.6	<1	<1	5.02	5.64	<1	<1	<100	<10				34.9		>2419.2	<500	<1000	1670		5.33		<5
E210	MWC	11/06/2008 16:11	<50	<1	<1	3.03	3.94	<500	<.5	<.5	11300	<1	<2	<2	<2	<2	85	9.45	35.9	<1	<1	4.21	6.98	2.18	<1	260	<10		6.9	1.1	85	70	>2420	<500	2990	1430	5	10.61	<5	<5

Site ID	Data Source	Date/Time	Ammonia-Nitrogen Total***	Arsenic Dissolved	Arsenic Total	Barium and compounds Dissolved	Barium and compounds Total	Bromide Total	Cadmium Dissolved	Cadmium Total	Chemical Oxygen Demand	Chlorophyll a Total	Chromium Dissolved	Chromium Total	Copper Dissolved	Copper Total	Dissolved o2 percent saturation	Dissolved oxygen	E. Coli Total	Lead Dissolved	Lead Total	Manganese and compounds Dissolved	Manganese and compounds Total	Nickel Dissolved	Nickel Total	Nitrate/Nitrite-Nitrogen Dissolved	Orthophosphate Dissolved	Orthophosphate Total	PH	Pheophytin a Total	Phosphorus Total	Specific Conductance	Total Coliforms	Total Kjeldahl Nitrogen	Total Organic Carbons	Total Suspended Solids	Turbidity	Water Temp	Zinc Dissolved	Zinc Total
E210	MWC	01/05/2009 15:25	<50	<1	<1	3.75	5.45	<500	<.5	<.5	8960		<2	<2	<2	<2	92.9	10.93	25.6	<1	<1	9.17	14.9	<1	<1	630		<10	6.89		36.8	68	1986.3	<500	1590	<10000	7.8	8.26	5.94	6.12
E210	MWC	02/10/2009	<50	<1	<1	2.68	3.15	<500	<.5	<.5	8440		<2	<2	<2	<2			14.8	<1	<1	4.41	5.45	<1	<1	670		<10			<20		727.0	<500	640	<10000			8.9	7.05
E210	MWC	03/25/2009 15:20	<50	<1	<1	3.38	4.41	<500	<.5	<.5	<5000	3.8	<2	<2	<2	<2	96	11.23	32.7	<1	<1	5.23	11.6	<1	<1	290		<10	7.05	<1	24.7	63	1046.2	<500	1500	<10000	9.9	8.51	<5	<5
E210	MWC	08/12/2009 16:50	<50	<1	<1	1.73	2.2	<500	<.5	<.5	8180	3.1	<2	<2	<2	<2			41.9	<1	<1	<2	5.85	<1	<1	<100	15			1.2	37.7	78	1732.9	<500	626	<10000		20.88	<5	<5
E210	MWC	12/08/2009 8:55	<50	<1	<1	2.92	3.34	<500	<1	<1	<5000	<1	<2	<2	<2	3.13	80	10.79	8.4	1.17	<1	4.09	6.22	<2	<2	560		<10	6.71	2.1	20.4	95	579.4	<500	<1000	<10000	3.3	2.92	<10	<10
E310	MWC	03/12/2002 12:37		<1	<1					<1	<1			1.44	2.86	2.72	4.26				<1	<1			<2	<2	194					42.2			<500				27	10.1
E310	MWC	05/14/2002 12:30		<1	<1					<1	<1			<1	<1	1.21	2.53				<1	<1			<2	<2	100					<20			<500				8.44	<5
E310	MWC	06/18/2002 11:55		<1	<1					<1	<1			<1	1.55	<2	<2				<1	<1			<2	<2	4160					20.7			<500				<5	7.33
E310	MWC	07/09/2002 11:45		<1	1.01					<1	<1			1.06	1.37	1.43	<2				<1	<1			<2	<2	100					22.1			<500				7.54	<5
E310	MWC	09/17/2002 11:40	<50	1.17	<1					<1	<1			<1	1.66	4.73	2.73				<1	<1			<2	<2	130					39.8			<500				28.2	<5
E310	MWC	10/08/2002 12:00	<50	<1	<1					<1	<1			<1	<1	1.57	<2				<1	<1			<2	<2	<100					<20			<500				13.1	<5
E310	MWC	01/14/2003 11:49	<50	<1	<1					<1	<1			1.3	3.64	1.9	3.84				<1	<1			<2	<2	330					31.8			<500				8.03	<5
E310	MWC	02/18/2003 12:50	<50		<1						<1				4.52		4.36					<1				<2	270					36.9			<500					8.32
E310	MWC	04/08/2003 10:50	<50	<1	<1					<1	<1			<1	1.65	<2	<2				<1	<1			<2	<2	110					<20			<500				7.22	<5
E310	MWC	05/13/2003 11:35	<50	<1	<1					<1	<1			<1	<1	<2	<2				<1	<1			<2	<2	110					<20			<500				19.2	<5
E310	MWC	10/16/2003 12:45	<50	<1	3.57					<1	<1			1.64	1.47	47.8	<2				<1	<1			<2	<2	110					<20			<500				12.6	<5
E310	MWC	12/09/2003 12:02	<50	<1	<1					<1	<1			<2	5.09	2.21	5.25				<1	<1			<2	<2	360					28.4			<500				<5	<5
E310	MWC	01/13/2004 12:02	<50	<1	<1					<1	<1			<1	<1	<2	11.7				<1	<1			<2	30.5	180					<20			<500				<5	<5
E310	MWC	02/10/2004 12:00	<50	<1	<1					<1	<1			<1	1.22	<2	<2				<1	<1			<2	<2	140					<20			<500				10.2	<5
E310	MWC	03/09/2004 11:34	<50	<1	<1	4.25	7.36			<1	<1			<1	1.07						<1	<1			<2	<2	130					<20			<500					
E310	MWC	04/13/2004 11:50	<50	<1	<1					<1	<1			<1	<1	<2	<2				<1	<1			<2	<2	530					<20			<500				<5	<5
E310	MWC	05/11/2004 11:55	<50	<1	<5					<1	<5			<1	<5	<2	13				<1	<5			<2	<10	<100					<20			<500				<5	<25
E310	MWC	06/08/2004 11:59	<50	<1	<1					<1	<1			1.39	2.52	2.55	4.73				<1	<1			2.11	2.12	100					39.2			<500				<5	<5
E310	MWC	07/13/2004 11:48	<50	<1	<1					<1	<1			<1	<1	<2	<2				<1	<1			<2	<2	<100					<20			<500				<5	<5
E310	MWC	11/09/2004 11:42	<50	<1	<1					<1	<1			<1	<1	<2	<2				<1	<1			<2	<2	130					<20			<500				<5	<5
E310	MWC	12/14/2004 12:38	<50	<1	<1					<1	<1			<1	1.82	<2	<2				<1	<1			<2	<2	230					33.2			<500				<5	<5
E310	MWC	01/11/2005 11:40	<50	<1	<1					<1	<1			2.08	1.14	<2	2.08				<1	<1			<2	<2	200					20.8			<500				<5	<5
E310	MWC	03/08/2005 11:32	<50	<1	<1					<1	<1			1.71	<1	<2	<2				<1	<1			<2	<2	130					<20			<500				<5	<5
E310	MWC	04/12/2005 12:10	<50	<1	<1					<1	<1			<1	1.57	<2	1.41				<1	<1			<1	<1	150					<20			<500				<10	<10
E310	MWC	12/12/2006	<50	<1	<1	5.91	7.95			<1	<1	7090		<1	1.51	<2	<2				<1	<1			<2	<2	200	<10				30.1			<500	2080	<10000		6.97	<5
E310	MWC	05/08/2007	<50	<1	<1	4.74	5.91			<1	<1			<1	<1	<2	2.58				<1	<1	13.7	18	<2	<2	100	<10				20.5		>2420	<500	<1000	<10000			<5	<5
E310	MWC	07/09/2007 10:10	<50	<1	<1	<10	<10		<1	<1	<5000	<.2	<1	<1	<1	1.36	87.6	7.97	172	<1	<1	10.2	33.9	<1	<1	<100		<10	7.66		29.8	60	>2420	<500	<1000	29000	7.8	19.99	<10	<10
E310	MWC	09/11/2007 12:50	<50	<1	<1	<10	<10	<500	<1	<1	10300	<.2	<1	<1	<1	1.6	86.1	8.35	199	<1	<1	<10	38	<1	<1	<100		<10	7.18	<.2	51.5	72	1730.0	<500	1520	<10000	8	16.84	<10	<10
E310	MWC	11/15/2007 9:40	<50	<1	<1	5.4	5.89	<500	<1	<1	5690	<.2	<1	<1	<2	<2	91.3	10.93	58.6	<1	<1	11.6	16.1	<1	<1	<100		<10	7.32	<.2		54	1410.0	<500	1830	<10000	8.1	7.56	<5	<5
E310	MWC	01/14/2008 10:50	<50	<1	<1	3.91	7.06	<500	<1	<1	6810	<.2	<1	1.1	<2	<2	107.1	13.13	32.7	<1	<1	4.85	22.2	<2	<2	180		<10	7.04	<.2	27.8	35	365.0	<1000	<1000	10000	13.7	6.61	<5	<5
E310	MWC	03/18/2008 14:30	<100	<1	<1	4.14	22.7	<500	<1	<1	18800	<.2	<1	3.96	<2	7.88	107.5	12.72	411	<1	<1	4.5	108	<2	3.46	200	14.4		7.02	0.57	70.9	42	>2420	<500	2200	82700	56.2	8.04	<5	11.8
E310	MWC	05/22/2008 10:20	<50	<1	<1	4.71	5.8	<500	<.5	<.5	9480	<.2	<2	<2	<2	<2			236	<1	<1	3.17	21.4	<1	<1	<100		<10	7.38	<.2	<20	48	>2420	<500	1300	2500	5.3	11.06	5.23	<5
E310	MWC	08/21/2008 11:10	<50	<1	<1	5.45	7.6	<500	<.5	<.5	16200	2.9	<2	<2	<2	<2			411	<1	<1	11	32.4	<1	<1	<100		<10	7.79		20.4	62	>2419.2	<500	1460	5710	10.1	17.74	<5	<5
E310	MWC	10/16/2008	<50	<1	<1	6.81	6.74	<500	<.5	<.5	7920		<2	<2	<2	<2			69.7	<1	<1	12	24	<1	<1	<100		<10			25.9		1732.9	<500	1680	3330			<5	<5
E310	MWC	11/06/2008 11:48	<50	<1	<1	5.47	14.5	<500	<.5	<.5	12900	<1	<2	2.06	<2	3.36	96.1	10.98	770	<1	<1	10.8	92.3	<1	<1	360		<10	7.17	<1	810	49	>2420	694	4560	24400	31.1	9.52	<5	<5
E310	MWC	01/05/2009 10:10	<50	<1	<1	4.04	16.1	<500	<.5	<.5	5830		<2	2.41	<2	3.06	100.1	12.21	69.7	<1	<1	5.74	66.7	<1	<1	170		<10	6.99		35.7	33	>2419.2	<500	1430	30000	23.5	6.81	<5	<5
E310	MWC	02/12/2009	<50	<1	<1	4.42	5.62	<500	<.5	<.5	12100		<2	<2	<2	<2			44.1	<1	<1	12.2	16	<1	<1	110		<10			<20		436.0	<500	692	<10000			<5	<5
E310	MWC	03/25/2009 10:30	<50	<1	<1	4.97	7.61	<500	<.5	<.5	<5000	<1	<2	<2	<2	<2	89.2	10.74	77.6	<1	<1	10.1	25.6	<1	<1	110		<10	7.07	<1	23.1	45	1046.2	<500	1690	10000	14.1	7.32	<5	<5
E310	MWC	08/12/2009 11:30	<50	<1	<1	5.58	7.03	<500	<.5	<.5	10000	<1	<2	<2	<2	<2	87.3	7.94	59.4	<1	<1	5.92	33	<1	<1	<100		<10	7.44	<1	28	66	>2419.2	<500	1260	<10000	7.5	19.97	<5	<5
E310	MWC	12/10/2009 9:15	<50	<1	<1	4.15	5.14	<500	<1	<1	5240	<1	<2	<2	<2	<2	88.2	12.91	114	<1	<1	16.4	20.7	<2	<2	210		15	7.67		<40	51	648.8	<500	793	<10000	5.7	-0.06	<10	<10
E480	DEQ	01/20/2000 9:50	30								5000						102	12.6	<2			6.29				26.3	14		7.1		20	38		<200	1000	1000	4	4.4		
E480	DEQ	02/08/2000 11:50	<20								<5000						104	12.2	<2			3.53				8.7	9		7.7		20	38		<200	1000	1000	3	6.3		
E480	DEQ	04/12/2000 10:20	<20								<5000						104	12.1	<2			2.37				<5	14		7.4		20	39		<200	<1000	<1000	1	7.2		
E480	DEQ	05/24/2000 10:10	40								<5000	0.4					106	11.7	<2			1.06				<5	12		7.4	0.3	20	35		<200	<1000	<1000	1	8.9		

Analytical Data

Site ID	Data Source	Date/Time	Ammonia-Nitrogen Total***	Arsenic Dissolved	Arsenic Total	Barium and compounds Dissolved	Barium and compounds Total	Bromide Total	Cadmium Dissolved	Cadmium Total	Chemical Oxygen Demand	Chlorophyll a Total	Chromium Dissolved	Chromium Total	Copper Dissolved	Copper Total	Dissolved o2 percent saturation	Dissolved oxygen	E. Coli Total	Lead Dissolved	Lead Total	Manganese and compounds Dissolved	Manganese and compounds Total	Nickel Dissolved	Nickel Total	Nitrate/Nitrite-Nitrogen Dissolved	Orthophosphate Dissolved	Orthophosphate Total	PH	Pheophytin a Total	Phosphorus Total	Specific Conductance	Total Coliforms	Total Kjeldahl Nitrogen	Total Organic Carbons	Total Suspended Solids	Turbidity	Water Temp	Zinc Dissolved	Zinc Total
E480	DEQ	07/11/2000 10:50	<20								<5000	0.6					107	11.7					3.32			10.8		12	7.7	0.6	20	36	<200	<1000		1000	2	9.8		
E480	DEQ	08/01/2000 9:25	<20								<5000	1.5					104	11.3					1.91			19.4		12	7.3	0.8	20	33	<200	<1000		<1000	<1	9.7		
E480	DEQ	10/18/2000 12:30	40								<5000	0.7					103	10.4	<2				<.2			7		21	7.7	0.7	20	49	<200	<1000		<1000	2	13		
E480	DEQ	11/14/2000 12:38	<20								<5000						101	10.8					3.57			12.8		13	7.6		30	47	<200	<1000		<1000	1	10.4		
E480	DEQ	01/30/2001 11:08	30								<5000						105	12.9	<2				0.97			22.5		16	7.5		20	47	<200	<1000		<1000	1	4.8		
E480	DEQ	02/27/2001 13:35	<20								<5000						110	12.5	<2				4.93			<5		14	7.7		20	46	<200	<1000		<1000	2	8		
E480	DEQ	04/24/2001 10:14	<20								<5000						105	12.2					2.01			<5		13	7.3		20	42	<200	<1000		<1000	1	7		
E480	DEQ	05/30/2001 11:05	<20								6000	0.7					106	12	<2				0.83			13.4		13	7.4	0.6	20	39	<200	<1000		1000		8		
E480	DEQ	07/25/2001 9:55	30								<5000	2					107	11.4	<2				2.44			18		13	7.4	1.8	20	40	<200	1000		1000		10.7		
E480	DEQ	08/23/2001 9:42	<20								<5000	1.5					102	10.9					2.75			28.6		17	7.5	1.5	20	40	<200	<1000		1000	1	10.4		
E480	DEQ	10/02/2001 10:05	<20								<5000	0.9					102	10.1	<2							6.4		21	7.5	0.8	30	51	<200	<1000		1000	1	14.1		
E480	DEQ	11/20/2001 10:03	20								<5000						97	10.6								5			7.5		20	49	<200	1000		<1000	1	9.5		
E480	DEQ	01/24/2002 10:15	<20								<5000						98	12	<2							28.1		15	7.4		20	42	<200	1000		1000	2	4.9		
E480	DEQ	02/26/2002 10:15	<20								<5000						99	11.9	<2							<5		16	7.5		20	42	<200	<1000		1000	1	5.6		
E480	DEQ	04/16/2002 11:30	130								<5000						101	11.9								19.6		12	7.1		150	32	300	3000		42000	71	6.4		
E480	DEQ	05/08/2002 15:30	170								<5000	0.5					103	11.2	<2							21.7		8	7.3	0.8	150	45	200	2000		58000	81	9.4		
E480	DEQ	07/01/2002 12:45	<20								<5000	0.7					103	9.7	1							<5		18	7.7	0.5	30	51	<200	1000		4000	7	16.5		
E480	DEQ	08/13/2002 11:40									<5000	1.7					106	9.8	2							5.4		19	8.1	1.3	30	65		<1000		2000	2	16.8		
E480	DEQ	10/17/2002 10:30	<20								<5000	1.1					100	10.9	<1							7.7		27	7.8	1	40	65	<200	<1000		1000	2	9.6		
E480	DEQ	12/05/2002 10:05	<20								<5000						103	12.5	<2							13.6		26	7.5		30	61	<200	<1000		2000	3	5.3		
E480	DEQ	02/12/2003 11:12	30								<5000						103	12.3	<2							32.8		13	7.6		50	39	<200	1000		9000	14	6.2		
E480	DEQ	04/07/2003 13:10	<20								<5000						102	11.9	1							13.6		12	7.6		40	38	<200	<1000		5000	5	7		
E480	DEQ	06/24/2003 13:10	20								<5000	0.4					97	9.2	1							<5		20	7.7	0.6	50	45	<200	<1000		2000	1	16.2		
E480	DEQ	08/13/2003 14:20	40								<5000	1.3					103	9	3							67.1		21	7.8	1.2	30	59	<200	<1000		2000	2	20		
E480	DEQ	10/22/2003 9:50	<20								<5000	1					100	10.2	2							10.5		25	7.6	1.1	30	58	<200	<1000		1000	1	12.3		
E480	DEQ	12/10/2003 10:57	<20								<5000						100	11.8	1							43.8		17	7.5		30	42	<200	1000		1000	3	6.6		
E480	DEQ	02/05/2004 10:05	<20								<5000						105	12.7	5							22.3		13	7.3		30	34	<200	1000		5000	9	5.5		
E480	DEQ	04/28/2004 10:14	<20								5000						100	11.2	<1							6.5		12	7.5		20	37	<200	1000		<1000	1	8.7		
E480	DEQ	06/08/2004 12:39	<20								6000	0.7					102	10.8								<5		14	7.3	0.6	20	38	<200	2000		2000	3	10.8		
E480	DEQ	08/18/2004 10:58	30								<5000	1.5					104	9.5	1							35.7		23	7.7	1.2	30	57	<200	<1000		<1000	1	17.6		
E480	DEQ	10/21/2004 11:15	30								<5000	1.3					104	10.4	<1							24.7		22	7.8	1	30	54	<200	<1000		<1000	3	11.4		
E480	DEQ	12/21/2004 11:50	40								<5000						101	11.9	1							35.8		16	7.4		30	38	<200	<1000		2000	3	6.4		
E480	DEQ	02/10/2005 11:35	20								<5000						103	12.4	1							7.9		18	7.6		20	45	<200	<1000		<1000	1	5.7		
E480	DEQ	04/07/2005 12:20	<20								<5000						102	12.2	<1							10.1		15	7.6		20	43	<200	<1000		<1000	1	6.2		
E480	DEQ	06/22/2005 11:34	30								<5000						103	10.4	2							9.9		10	7.8		100	39	<200	<1000		1000	<1	13.2		
E480	HB	07/29/2005 10:00																																>2419.17							
E480	HB	08/03/2005 13:05																																2200.0							
E480	DEQ	08/23/2005 17:15	20								<5000						99	9.6	2							<5		14	7.7		20	49	<200	<1000		1000	1	14.9		
E480	MWC	01/24/2006 12:00	<50	<1	<2				<1	<1	9600	3.2	<1	<1	<2	<2			2	<1	<1			<2	<2	<100	10.1				<.2	20.8	33.1	<500	1500	<10000			<5	<5
E480	MWC	03/28/2006 11:00	<50	<1	<1	1.53	1.88		<1	<1	<5000	5.01	<1	<1	<2	<2			<1	<1	<1	<2	2.86	<2	<2	<100	<10				<.2	<20	77.1	<500		<10000			<5	<5
E480	MWC	05/23/2006 12:20	118	<1	<1	1.51	1.65		<1	<1	11500	0.8	<1	<1	<2	<2	103.8	11.94	2	<1	<1	<2	<2	<2	<2	<100	<10		7.59		<.2	19.2	42.6	<500	1790	<10000		9.23	<5	<5
E480	MWC	08/09/2006 12:18	<50	<1	<1	1.9	2.14		<1	<1	7370	10.8	<1	<1	<2	<2			1	<1	<1	<2	2.16	<2	<2	<100	<10			<.2	<20	44	1550.0	<500	<1000	<10000	1	16.01	<5	<5
E480	MWC	10/13/2006 13:50	<50	<1	<1	1.82	1.68		<1	<1	<5000	<.2	<1	<1	<2	<2	103.5	11.81	<1	<1	<1	<2	2.81	<2	<2	<100	<10		7.43	<.2	<20	29	261.0	<500	2000	<10000		9.56	<5	<5
E480	MWC	12/19/2006 11:45	<50	<1	<1	1.65	1.74		<1	<1	<5000	1.6	<1	<1	<2	<2	105.4	13.36	2	<1	<1	<2	9.43	<2	<2	<100	<10		7.03	<.2	22.8	38	99.0	<500		<10000	10.6	5.28	<5	<5
E480	MWC	07/09/2007 13:45	<50	<1	<1	<10	<10		<1	<1	<5000	2.81	<1	<1	<1	<1	111.3	11.09	<1	<1	<1	<10	<10	<1	<1	<100	<10		8.12		<20	42	816.0	<500	<1000	<10000	0.7	15.55	<10	<10
E480	MWC	08/16/2007 16:50	<50	<1	<1	<10	<10		<1	<1	<5000	0.024	<1	<1	<1	<1	102.2	10.67	1	<1	<1	<10	<10	<1	<1	<100	11.4		7.73	<.006	27.4	45	1550.0	<500	<1000	<10000	0.9	13.38	<10	<10
E480	MWC	09/10/2007 12:50	<50	<1	<1	<10	<10	<500	<1	<1	<5000	1.6	<1	<1	<1	<1	104.4	10.98	<1	<1	<1	<10	<10	<1	<1	<100	15.8		7.82	<.2	36.9	44	210.0	589	<1000	<10000		13.08	<10	<10
E480	MWC	11/16/2007 12:40	<50	<1	<1	2.22	2.88	<500	<1	<1	<5000	<.2	<1	<1	<2	<2	102.1	12.3	1	<1	<1	<2	4.88	<2	<2	<100	24.5		7.51	<.2	<20	43	179.0	<500	<1000	10000	1	7.32	<5	<5
E480	MWC	01/14/2008 12:30	<50	<1	<1	1.62	1.8	<500	<1	<1	6980	<.2	<1	<1	<2	<2	105.8	13.72	<1	<1	<1	2.33	6.02	<2	<2	<100	12.5		7.43	<.2	<20	38	30.9	<1000	<1000	<10000		4.41	<5	<5

Site ID	Data Source	Date/Time	Ammonia-Nitrogen Total***	Arsenic Dissolved	Arsenic Total	Barium and compounds Dissolved	Barium and compounds Total	Bromide Total	Cadmium Dissolved	Cadmium Total	Chemical Oxygen Demand	Chlorophyll a Total	Chromium Dissolved	Chromium Total	Copper Dissolved	Copper Total	Dissolved o2 percent saturation	Dissolved oxygen	E. Coli Total	Lead Dissolved	Lead Total	Manganese and compounds Dissolved	Manganese and compounds Total	Nickel Dissolved	Nickel Total	Nitrate/Nitrite-Nitrogen Dissolved	Orthophosphate Dissolved	Orthophosphate Total	PH	Pheophytin a Total	Phosphorus Total	Specific Conductance	Total Coliforms	Total Kjeldahl Nitrogen	Total Organic Carbons	Total Suspended Solids	Turbidity	Water Temp	Zinc Dissolved	Zinc Total
E480	MWC	03/17/2008 10:40	<100	<1	<1	1.5	1.72	<500	<1	<1	<15000	<.2	<1	<1	<2	<2	99.6	12.54	<1	<1	<1	<2	3.21	<2	<2	<100		14.6	7.55	<.2	24.2	39	29.2	<500	<1000	2000	0.5	5.54	<5	<5
E480	MWC	05/22/2008 12:10	<50	<1	<1	1.38	1.7	<500	<.5	<.5	7130	<.2	<2	<2	<2	<2				<1	<1	<2	2.22	<1	<1	<100		<10	7.58	<.2	<20	33	40.8	<500	<1000	1250	0.8	7.39	<5	<5
E480	MWC	08/21/2008 14:40	<50	<1	<1	1.41	1.6	<500	<.5	<.5	11000	1.5	<2	<2	<2	<2			2	<1	<1	<2	3.86	<1	<1	<100		<10	8.4		<20	39	>2419.2	<500	<1000	1430	1.7	14.69	<5	<5
E480	MWC	11/06/2008 13:52	<50	<1	<1	1.46	2.3	<500	<.5	<.5	7130	<1	<2	<2	<2	<2	102.3	12.49	3	<1	<1	<2	<2	<1	<1	<100		<10	7.33	<1	71	36	122.0	<500	<1430	1430	0	6.75	<5	<5
E480	MWC	01/05/2009 12:20	<50	<1	<1	1.66	2.31	<500	<.5	<.5	7920		<2	<2	<2	<2			6.2	<1	<1	<2	6.05	<1	<1	<100		<10			26.5		104.3	<500	1090	<10000				<5
E480	MWC	03/25/2009 12:30	<50	<1	<1	1.53	1.53	<500	<.5	<.5	<5000	<1	<2	<2	<2	<2	93.5	11.81	<1	<1	<1	<2	2.09	<1	<1	<100		<10	7.43	<1	<20	37	24.3	<500	642	<10000	1.8	5.43	<5	<5
E480	MWC	08/12/2009 13:35	<50	<1	<1	1.62	1.71	<500	<.5	<.5	6090	<1	<2	<2	<2	<2	107.8	10.8	1	<1	<1	<2	2.04	<1	<1	<100		12	7.99	<1	25.6	43	686.7	<500	<1000	<10000	1.2	15.33	<5	<5
E480	MWC	12/09/2009 13:42	<50	<1	<1	1.36	2.9	<500	<1	<1	<5000	<1	<2	<2	<2	<2	87.5	11.44	<1	<1	<1	<2	6.67	<2	<2	<100		13	7.19	<1	<40	47	8.6	<500	<1000	<10000	0.9	4.1	<10	<10
E482	MWC	05/23/2006 13:00	<200	<1	<1	1.06	1.18		<1	<1	12100	0.8	<1	<1	<1	<2	100.3	11.83	1	<1	<1	<2	<2	<2	<2	<100		19.2	7.63	<.2	27.6		58.3	<500	1510	<10000		8.16	<5	<5
E482	MWC	08/09/2006 12:45	<50	<1	<1	1.55	1.59		<1	<1	6820	<.2	<1	<1	<2	<2				<1	<1	<1	<2	<2	<2	<100		33.1	7.91	<.2	35.2	56	68.3	<500	<10000	<10000	0.3	10.39	<5	<5
E482	MWC	10/13/2006 14:35	<50	<1	<1	1.17	1.1		<1	<1	<5000	<.2	<1	<1	<2	<2	101.3	12.25	<1	<1	<1	<2	<2	<2	<2	<100		28.1		<.2	38.9	56	49.5	<500	<2000	<10000		7.12	<5	<5
E482	MWC	12/19/2006 11:00	<50	<1	<1	1.22	1.04		<1	<1	<5000	24	<1	<1	<2	<2	97.9	13.01	1	<1	<1	<2	<2	<2	<2	<100		<10	6.97	<.2	27.2	33	41.3	<500	<1000	<10000		3.48	<5	<5
E482	MWC	07/09/2007 12:45	<50	<1	<1	<10	<10		<1	<1	<5000	<.2	<1	<1	<1	<1	105.2	11.54	4.1	<1	<1	<10	<10	<1	<1	<100		33.9	7.67		44.5	55	44.1	<500	<1000	<10000	0.3	11.23	<10	<10
E482	MWC	09/10/2007 10:40	<50	<1	<1	<10	<10		<1	<1	<5000	<.2	<1	<1	<1	<1				<1	<1	<10	<10	<1	<1	<100		41		<.2	40.6		71.2	<500	<1000	<10000			<10	<10
E482	MWC	11/16/2007 13:20	<50	<1	<1	1.73	2.62	<500	<1	<1	5450	<.2	<1	<1	<2	<2	98.8	11.91	6.2	<1	<1	<2	<2	<2	<2	<100		34.3	7.57		21.5	43	411.0	<500	1180	<10000	0.8	7.26	<5	<5
E482	MWC	05/22/2008 13:00	<50	<1	<1	<1	1.55	<500	<.5	<.5	7400	<.2	<2	<2	<2	<2				<1	<1	<1	<2	<2	<1	<100		<10	7.6	<.2	<20	29	44.8	<500	1130	2500	1.5	5.46	5.11	<5
E482	MWC	08/21/2008 14:05	<50	<1	<1	1.3	1.39	<500	<.5	<.5	12900	<1	<2	<2	<2	<2			2	<1	<1	<2	<2	<1	<1	<100		24	8.25		35.9	53	133.4	<500	<1000	1430	4.7	9.48	<5	<5
E482	MWC	11/06/2008 14:26	<50	<1	<1	1.69	2.12	<500	<.5	<.5	10300	<1	<2	<2	<2	<2	100	12.08	3.1	1.06	<1	<2	<2	<2	<1	<100		<10	7.65	<1	60	48	261.0	<500	1770	1430	0.1	7.19	<5	<5
E482	MWC	03/25/2009 13:00	<50	<1	<1	1.49	1.38	<500	<.5	<.5	5000	<1	<2	<2	<2	<2	90.3	11.65	<1	<1	<1	<2	<2	<1	<1	<100		17	7.51	<1	21.3	45	14.5	<500	644	<10000	0.4	4.6	<5	<5
E482	MWC	08/12/2009 14:20	<50	<1	<1	1.32	1.35	<500	<.5	<.5	5050	<1	<2	<2	<2	<2	102.8	11.43	2	<1	<1	<2	<2	<1	<1	<100		39	7.87	<1	42.8	55	93.3	<500	<1000	<10000	0.7	10.68	<5	<5
E482	MWC	12/09/2009 14:18	<50	<1	<1	1.12	1.13	<500	<1	<1	<5000	<1	<2	<2	<2	<2	88.8	12.75	<1	<1	<1	<2	<2	<2	<2	<100		31	7.42	<1	<40	54	13.5	<500	<1000	<10000	0.3	0.64	<10	<10
E540	DEQ	01/20/2000 9:15	30								<5000						104	12.8	<2							8.02	19.8	16	7.5		20	33	<200	1000	2000		3	4.9		
E540	DEQ	02/08/2000 11:15	20								<5000						104	12.5	<2							8.66	11.3	11	7.6		30	30	<200	1000	3000		6	6.1		
E540	DEQ	04/12/2000 9:10	<20								<5000						105	12.3	<2							3.88	<5	12	7.3		20	32	<200	1000	1000		2	7.1		
E540	DEQ	05/24/2000 9:15	20								<5000	0.5					106	11.4	<2							3.48	<5	7	7.4	0.4	20	34	<200	<1000	1000		3	10.3		
E540	DEQ	07/11/2000 10:15	20								<5000	4.8					108	11.9								4.67	<5	5	7.8	0.9	20	35	200	1000	6000		7	9.9		
E540	DEQ	08/01/2000 8:45	<20								<5000	2.6					106	11.4	<2							8.76	9.5	8	7.4	1.1	20	34	<200	1000	2000		2	10.3		
E540	DEQ	10/18/2000 11:50	60								31000	2.1					101	9.7								<.2	6	<5	7.5	0.9	20	38	300	1000	2000		6	15.9		
E540	DEQ	11/14/2000 11:37	<20								<5000						103	11.2	<2							21.3	6.2	7	7.5		20	42	<200	6000	6000		5	10		
E540	DEQ	01/30/2001 10:30	<20								<5000						105	13	<2							5.43	9.7	11	7.4		20	39	<200	1000	1000		2	4.7		
E540	DEQ	02/27/2001 13:05	<20								<5000						108	12.5	<2							4.96	12.1	12	7.2		20	39	<200	<1000	<1000		2	7.4		
E540	DEQ	04/24/2001 9:30	<20								<5000						105	12	<2							3.48	<5	9	7.4		20	33	300	1000	1000		2	7.9		
E540	DEQ	05/30/2001 10:25	<20								8000	0.6					105	11.4	<2							2.72	12.2	11	7	0.6	20	32	<200	1000	2000		3	10		
E540	DEQ	07/25/2001 9:05	30								<5000	2.4					100	10.1	<2							12.7	<5	6	7.2	1.1	20	40	<200	1000	5000		6	13.5		
E540	DEQ	08/23/2001 9:15	<20								6000	4.7					98	8.7								14.5	<5	6	7.5	2.2	30	42	300	1000	4000		9	20.1		
E540	DEQ	10/02/2001 9:40	<20								6000	3.9					99	9.1	<2							5.5		5	7.6	1.7	20	50	<200	1000	10000		8	17.4		
E540	DEQ	11/20/2001 9:30	30								<5000						98	11.3								13.7			7.6		20	44	<200	<1000	2000		2	8.4		
E540	DEQ	01/24/2002 9:35	<20								<5000						100	12.8	<2							22.6		12	7.3		20	37	<200	<1000	2000		3	3.7		
E540	DEQ	02/26/2002 9:10	<20								<5000						98	12.1	<2							<5		12	7.3		20	36	<200	<1000	<1000		2	4.9		
E540	DEQ	04/16/2002 10:50	<20								<5000						105	12.5	<2							5.7		17	7.3		30	30	<200	1000	4000		2	6.5		
E540	DEQ	05/08/2002 16:05	<20								<5000	0.4					104	11.8	<2							<5		12	7.4	0.2	20	28	<200	<1000	2000		4	8.6		
E540	DEQ	07/01/2002 13:10	<20								<5000	1.2					110	11.8	<1							6		12	7.8	0.5	20	30	<200	<1000	1000		2	11		
E540	DEQ	08/13/2002 11:15									<5000	1.3					107	11.6	2							25.5		11	7.3	0.7	20	33		1000	2000		1	9.8		
E540	DEQ	10/17/2002 9:55									<5000	0.5					97	9.4	1							6.7		6	7.3	1.2	20	36	<200	1000	4000		4	15.6		
E540	DEQ	12/05/2002 9:30	30								<5000						99	11.8	<2							6.1		<5	7.3		20	44	<200	1000	3000		4	6.8		
E540	DEQ	02/12/2003 10:40	20								<5000						102	12.4	3							15.8		13	7.4		20	35	<200	1000	1000		3	5.4		
E540	DEQ	04/07/2003 13:30	20								<5000						101	11.7	<2							5.8		15	7.5		30	32	<200	<1000	2000		3	7.5		
E540	DEQ	06/24/2003 14:00	20								<5000	0.7					105	10.8	5							<5		12	7.9	0.6	10	33	<200	<1000	1000		2	12.3		
E540	DEQ	08/13/2003 13:50	<20								5000	4.1					107	11.6	<1							16.6		11	7.6	1.1	20	33	<200	<1000	8000		2	10.7		

Site ID	Data Source	Date/Time	Ammonia-Nitrogen Total***	Arsenic Dissolved	Arsenic Total	Barium and compounds Dissolved	Barium and compounds Total	Bromide Total	Cadmium Dissolved	Cadmium Total	Chemical Oxygen Demand	Chlorophyll a Total	Chromium Dissolved	Chromium Total	Copper Dissolved	Copper Total	Dissolved o2 percent saturation	Dissolved oxygen	E. Coli Total	Lead Dissolved	Lead Total	Manganese and compounds Dissolved	Manganese and compounds Total	Nickel Dissolved	Nickel Total	Nitrate/Nitrite-Nitrogen Dissolved	Orthophosphate Dissolved	Orthophosphate Total	PH	Pheophytin a Total	Phosphorus Total	Specific Conductance	Total Coliforms	Total Kjeldahl Nitrogen	Total Organic Carbons	Total Suspended Solids	Turbidity	Water Temp	Zinc Dissolved	Zinc Total
E540	DEQ	10/22/2003 9:14	<20								<5000	1.9					97	9.3	1							5.7	5		7.4	1.4	20	39	<200	<1000	6000		6	16		
E540	DEQ	12/10/2003 10:24	<20								<5000						101	12	4							21.2	13		7.5		30	35	<200	1000	4000		5	6.4		
E540	DEQ	02/05/2004 9:36	<20								<5000						105	12.8	1							11.9	15		7.4		20	30	<200	1000	2000		6	5.6		
E540	DEQ	04/28/2004 9:44	<20								<5000						98	11.5	1							18.7	9		7.4		30	33	<200	2000	1000		3	7.1		
E540	DEQ	06/08/2004 12:00	<20								6000	2.1					104	11.8	3							6.2	15		7.2	0.8	20	33	<200	2000	3000		5	8.4		
E540	DEQ	08/18/2004 10:30	<20								<5000	4.1					102	10.7	<1							29.1	9		7.6	1.4	20	35	<200	<1000	3000		5	11.4		
E540	DEQ	10/21/2004 10:40	<20								<5000	1.8					99	9.8	4							18.9	8		7.6	0.9	20	39	<200	1000	5000		7	14.6		
E540	DEQ	12/21/2004 11:20	20								<5000						102	12.2	<1							23.8	17		7.5		20	37	<200	<1000	1000		3	6.4		
E540	DEQ	02/10/2005 11:05	<20								7000						105	12.9	<1							6.7	11		7.6		20	40	<200	<1000	<1000		2	5.1		
E540	DEQ	04/07/2005 11:45	<20								<5000						103	12.2	7							<5	9		7.5		20	36	<200	<1000	1000		3	6.7		
E540	DEQ	06/22/2005 11:00	<20								<5000						104	11.6	<1							9.4	8		7.5		20	36	<200	<1000	2000		2	8.9		
E540	HB	07/29/2005 10:40																															>2419.2							
E540	HB	08/03/2005 13:40																															750.0							
E540	DEQ	08/23/2005 17:40	<20								<5000						103	11	1							30.8	8		7.5		20	40	<200	<1000	2000		2	10.8		
E540	MWC	01/24/2006 11:25	<50	<1	<2			<1	<1		7650	2.4	<1	<1	<2	<2			1	<1	<1			<2	<2	<100	10.1			<.2	20.5		74.4	<500	1350	<10000			<5	<5
E540	MWC	03/28/2006 10:40	<50	<1	<1	<1	1.78	<1	<1		<5000	4.81	<1	<1	<2	<2			1	<1	<1	2.7	7.84	<2	<2	<100	<10			<.2	<20		32.3	<500	<1000	<10000			<5	<5
E540	MWC	05/23/2006 11:58	<50	<1	<1	<1	1.26	<1	<1		11000	<.2	<1	<1	<2	<2	103.6	12.69	<1	<1	<1	<2	4.49	<2	<2	<100	<10		7.39	<.2	19.4	35	42.6	<500	1760	<10000	1	6.63	<5	<5
E540	MWC	08/09/2006 11:30	<50	<1	<1	<1	1.71	<1	<1		<5000	<.2	<1	<1	<2	<2			1	<1	<1	3.49	10.3	<2	<2	<100	<10		7.72	0.96	22.1	32	387.0	<500	<1000	<10000	2.4	8.8	<5	<5
E540	MWC	10/13/2006 13:25	<50	<1	<1	<1	2.04	<1	<1		<5000	1.63	<1	<1	<2	<2	104.4	10.16	<1	<1	<1	<2	28.2	<2	<2	<100	<10		7.47	3.51	<20	37	980.0	<500	2000	<10000	5.2	16.68	<5	<5
E540	MWC	12/19/2006 10:00	<50	<1	<1	<1	3.37	<1	<1		<5000	1.36	<1	<1	<2	<2	112.6	14.05	<1	<1	<1	<2	18.2	<2	<2	<100	<10		7.21		38.7		345.0	<500	13000			5.91	<5	<5
E540	MWC	07/09/2007 11:40	<50	<1	<1	<10	<10	<1	<1		<5000	0.84	<1	<1	<1	<1	111.5	12.16	2	<1	<1	<10	11.5	<1	<1	<100	<10		7.68		25	35	326.0	<500	<1000	<10000	2.4	11.49	<10	<10
E540	MWC	08/16/2007 19:00	<50	<1	<1	<10	<10	<1	<1		<5000	0.024	<1	<1	<1	<1	104.2	11.59	<1	<1	<1	11.2	26.5	<1	<1	<100	<10		7.31	<.006	24.9	37	>2420	<500	<1000	<10000	4.8	10.61	<10	<10
E540	MWC	09/10/2007 13:00	<50	<1	<1	<10	<10	<500	<1	<1	<5000	<.2	<1	<1	<1	<1			3.1	<1	<1	11.5	22.3	<1	<1	<100	<10		7.78	0.48	40.9	36	313.0	<500	<1000	<10000	1.8	14.7	<10	<10
E540	MWC	11/16/2007 10:20	<50	<1	<1	2.09	2.35	<500	<1	<1	6890	1.6	<1	<1	<2	<2	102.8	11.89	4	<1	<1	2.61	19.9	<2	<2	<100	14.4		7.25	<.2	<20	37	411.0	<500	1270	<10000	4.4	8.96	<5	<5
E540	MWC	01/14/2008 12:15	<50	<1	<1	<1	2.11	<500	<1	<1	<5000	<.2	<1	<1	<2	<2	110.6	14	1	<1	<1	15	23	<2	<2	<100	10.1		7.3	<.2	<20	32	90.9	<500	10000		6.5	5.33	<5	<5
E540	MWC	03/17/2008 13:10	<100	<1	<1	<1	1.04	<500	<1	<1	<15000	<.2	<1	<1	<2	<2	105	13.25	1	<1	<1	<2	3.32	<2	<2	<100	15.2		7.41	2.21	<20		41.9	2600	<1000	2000		5.48	8.96	<5
E540	MWC	05/22/2008 11:45	<50	<1	<1	<1	1.1	<500	<.5	<.5	6870	<.2	<2	<2	<2	<2			<1	<1	<1	<2	2.31	<1	<1	<100	<10		7.49	<.2	<20	29	32.3	<500	1000	2500	2.5	6.87	5.52	<5
E540	MWC	08/21/2008 13:15	<50	<1	<1	<1	1.08	<500	<.5	<.5	11000	1.2	<2	<2	<2	<2			1	<1	<1	2.03	8.39	<1	<1	<100	<10		8.11		<20	30	1299.7	<500	<1000	2860	2.3	8.59	<5	<5
E540	MWC	11/06/2008 13:08	<50	<1	<1	<1	2.31	<500	<.5	<.5	8440	<1	<2	<2	<2	<2	104	11.35	6.2	<1	<1	2.61	12.6	<1	<1	<100	<10		7.36	<1	82	37	727.0	<500	1560	5710	3.2	11.47	<5	<5
E540	MWC	01/05/2009 12:00	<50	<1	<1	<1	4.11	<500	<.5	<.5	9480	<1	<2	<2	<2	<2	115.8	14.62	5.2	<1	<1	<2	17.1	<1	<1	<100	11		7.27		40.8	25	261.3	<500	1320	10000	11.5	5.46	<5	<5
E540	MWC	03/25/2009 12:00	<50	<1	<1	<1	1.26	<500	<.5	<.5	<5000	<1	<2	<2	<2	<2	94.6	12.08	<1	<1	<1	<2	5.98	<1	<1	<100	<10		7.23	<1	<20	32	36.9	<500	690	<10000	2.8	5	<5	<5
E540	MWC	08/12/2009 12:50	<50	<1	<1	<1	<1	<500	<.5	<.5	8180	3	<2	<2	<2	<2	114.4	13.18	2	<1	<1	<2	10.8	<1	<1	<100	13		7.81	<1	27.7	31	365.4	<500	468	<10000	2	9.13	<5	<5
E540	MWC	12/09/2009 12:50	<50	<1	<1	<1	<1	<500	<1	<1	<5000	<1	<2	<2	<2	<2			1	<1	<1	26	28	<2	<2	<100	<10			<1	<40		50.4	<500	<1000	<10000			88.4	<10
E810	HB	05/14/2002 12:00								<1											<2				<20															<20
E810	HB	09/04/2002 10:30																	34.1																					<20
E810	HB	10/02/2002 10:30								<1											<2				<20															<20
E810	HB	10/29/2002 10:30								<1									49.5		<2				<20								>2419							<20
E810	HB	01/22/2003 8:30								<1									24.3		<2				<20								488.4							<200
E810	HB	06/11/2003 11:00								<1									68.7		<2				<20								>2419.2							<20
E810	HB	07/09/2003 10:30								<1									38.4		<2				<20								>7200.5							<20
E810	HB	11/17/2003 11:00																															>2419							
E810	HB	12/30/2003 11:00																	61														1301.0							
E810	HB	01/27/2004 10:30																	41.3														1555.0							
E810	HB	02/17/2004 10:30								<1									63.1		<2				<20								>2419							<20
E810	HB	03/22/2004 11:00																	11.9														290.9							
E810	HB	04/14/2004 9:00								<1									54.6		<2				<20								1986.3							<20
E810	HB	05/11/2004 10:00								<1											<2				<20															<20
E810	HB	06/08/2004 10:00								<1											<2				<20															<20
E810	HB	07/06/2004 10:00								<1											<2				<20															<20

Analytical Data

Site ID	Data Source	Date/Time	Ammonia-Nitrogen Total***	Arsenic Dissolved	Arsenic Total	Barium and compounds Dissolved	Barium and compounds Total	Bromide Total	Cadmium Dissolved	Cadmium Total	Chemical Oxygen Demand	Chlorophyll a Total	Chromium Dissolved	Chromium Total	Copper Dissolved	Copper Total	Dissolved o2 percent saturation	Dissolved oxygen	E. Coli Total	Lead Dissolved	Lead Total	Manganese and compounds Dissolved	Manganese and compounds Total	Nickel Dissolved	Nickel Total	Nitrate/Nitrite-Nitrogen Dissolved	Orthophosphate Dissolved	Orthophosphate Total	PH	Pheophytin a Total	Phosphorus Total	Specific Conductance	Total Coliforms	Total Kjeldahl Nitrogen	Total Organic Carbons	Total Suspended Solids	Turbidity	Water Temp	Zinc Dissolved	Zinc Total
E810	HB	09/01/2004 9:30								<1											<2				<20															<20
E810	HB	10/27/2004 10:10								<1											<2				<20															<20
E810	MWC	12/14/2004 12:40	<50	<1	<1				<1	<1			1.38	<1	<2	<2				<1	<1			3.01	<2	140					42.7		<500						5.22	8.56
E810	MWC	01/11/2005 12:05	<50	<1	<1				<1	<1			<1	<1	<2	<2				<1	<1			<2	<2	180					38.6		<500						<5	8.8
E810	MWC	03/08/2005 11:15	<50	<1	<1				<1	<1			1.37	<1	<2	<2				<1	<1			<2	<2	<100					32.4		<500						<5	<5
E810	MWC	04/12/2005 13:23	<50	<1	<1				<1	<1			<1	<1	<1	1.09				<1	<1			<1	<1	200					31.3		<500						<10	<10
E810	MWC	12/12/06 0:00	<50	<1	<1	2.36	2.85		<1	<1	<5000		<1	<1	<2	<2				<1	<1			<2	<2	130	<10				36.4		<500	1090	<10000				14	20.1
E810	MWC	5/8/07 0:00	<50	<1	<1	1.97	2.32		<1	<1			<1	<1	5.19	2.64				<1	<1	29.9	38.2	<2	<2	<100	28.3				37.5	770.0	<500	<1000	<10000				6.67	7.22
E810	MWC	07/09/2007 8:40	<50	<1	<1	<10	<10		<1	<1	5530	<.2	<1	<1	<1	<1	68.6	5.85	248	<1	<1	51.2	102	<1	<1	<100	24.5		7.54		48	93	>2420	<500	<1000	<10000	1.8	23.33	<10	<10
E810	MWC	09/11/2007 11:30	<50	<1	<1	<10	<10	<500	<1	<1	6370	4.45	<1	<1	<1	<1	103.5	9.48	199	<1	<1	76.4	115	<1	<1	<100	13.3		7.57	<.2	50.5	86	>2420	585	<1000	<10000	1.7	19.58	<10	<10
E810	MWC	11/15/2007 10:10	<50	<1	<1	2.23	2.31	<500	<1	<1	<5000	0.81	<1	<1	<2	<2	90.3	10.51	15.5	<1	<1	30.2	40.5	<2	<2	<100	23.2		7.33	<.2	24.2	64	980.0	<500	1290	<10000	1.5	8.7	<5	6.75
E810	MWC	01/14/2008 8:45	<50	<1	<1	2.42	2.88	<500	<1	<1	<5000	<.2	<1	<1	<2	<2	105.6	12.96	20.1	<1	<1	18.2	22.9	<2	<2	210	21.5		7.49	<.2	34.5	56	770.0	<1000	1660	<10000	3.4	6.58	5.5	5.08
E810	MWC	03/18/2008 11:00	<100	<1	<1	2.91	3.89	<500	<1	<1	<15000	<.2	<1	<1	<2	<2	101.7	12.2	140	<1	<1	24.5	30.7	<2	<2	250	21.6		7.14	<.2	35.5	64	1730.0	<500	1420	6000	6.5	7.49	<5	6.24
E810	MWC	05/22/2008 9:00	<50	<1	<1	1.38	2.04	<500	<.5	<.5	<5000		<2	<2	<2	<2						47.2		<2	18.7	<100	<10		7.3	<.2	<20	46	1730.0	1540	2500		2.4	8.49		<5
E810	MWC	08/21/2008 10:30	<50	<1	<1	1.75	2.03	<500	<.5	<.5	12600	3.9	<2	<2	<2	<2			866	<1	<1	31.6	42.8	<1	<1	<100	14		7.66		38.6	64	>2419.2	<500	<1000	1430	1.9	14.11	<5	<5
E810	MWC	11/06/2008 9:10	<50	<1	<1	1.82	2.91	<500	<.5	<.5	9740	1.1	<2	<2	<2	<2	96.1	11.19	101	<1	1.41	7.09	19.1	<1	<1	100	<10		7.25	<1	110	50	>2420	<500	1700	4290	2.5	8.71	5.37	<5
E810	MWC	01/05/2009 8:50	<50	<1	<1	1.9	4.25	<500	<.5	<.5	8960		<2	<2	<2	<2	103.6	13.08	52.8	<1	<1	8.46	20.9	<1	<1	160	<10		7.22		35.6	44	1986.3	<500	1410	10000	7.2	5.44	<5	<5
E810	MWC	03/25/2009 9:00	<50	<1	<1	2.32	2.57	<500	<.5	<.5	<5000	1.1	<2	<2	<2	<2	87.2	10.46	20.9	<1	<1	31	35.5	<1	<1	120	<10		7.13	1.6	24.4	64	920.8	<500	828	<10000	2.5	7.46	<5	<5
E810	MWC	08/12/2009 9:30	<50	<1	<1	2.56	3.28	<500	<.5	<.5	7400	2.3	<2	<2	<2	<2	75.2	7.06	613	<1	<1	39.5	139	<1	<1	<100	28		7.19	<1	57.3	84	>2419.2	<500	734	<1000	2.8	18.4	<5	<5
E810	MWC	12/09/2009 8:25	<50	<1	<1	2.12	2.67	<500	<1	<1	<5000	<1	<2	<2	<2	<2	84.5	12.01	13.5	<1	<1	61.4	74.1	<2	<2	160	28		7.23	1.8	31.5	90	410.6	<500	<1000	10000	2.8	1.01	<10	<10
		Minimum Value	20	1.13	1.01	1	1	0	1.47	0	5000	0.024	1.06	1.07	1.16	1.09	64.5	5.85	1	1.06	1.11	0.83	2.04	1.07	2.12	5	5	6.7	6.2	0.2	10	25	5.2	200	468	1000	0	-0.11	5.07	5.08
		Maximum Value	170	1.17	11.2	6.81	22.7	0	1.47	0	31000	24	2.08	5.09	80.9	25.3	132	16.2	866	1.44	1.64	76.4	139	3.01	30.5	4523	44	48.9	8.68	9.93	1000	136	7200.5	7820	4560	82700	81	25.4	88.4	20.5
		Detection Totals	70	2	3	155	174	0	1	0	140	163	13	30	41	54	316	370	370	3	4	135	159	5	4	245	164	120	415	110	373	410	303	23	176	209	364	403	53	21
		Non-reportable (<RL)	370	270	291	61	60	140	271	307	250	109	259	264	229	236	0	0	86	269	303	132	68	265	301	223	5	103	0	143	78	0	0	416	220	186	3	0	217	282
		Total Analyses	440	272	294	216	234	140	272	307	390	272	272	294	270	290	316	370	456	272	307	267	227	270	305	468	169	223	415	253	451	410	303	439	396	395	367	403	270	303
		Detection %	15.9%	0.7%	1.0%	71.8%	74.4%	0.0%	0.4%	0.0%	35.9%	59.9%	4.8%	10.2%	15.2%	18.6%	100.0%	100.0%	81.1%	1.1%	1.3%	50.6%	70.0%	1.9%	1.3%	52.4%	97.0%	53.8%	100.0%	43.5%	82.7%	100.0%	100.0%	5.2%	44.4%	52.9%	99.2%	100.0%	19.6%	6.9%

Benchmarks (BMs)*****

	Ammonia-Nitrogen Total***	Arsenic Dissolved	Arsenic Total	Barium and compounds Dissolved	Barium and compounds Total	Bromide Total	Cadmium Dissolved	Cadmium Total	Chemical Oxygen Demand	Chlorophyll a Total	Chromium Dissolved	Chromium Total	Copper Dissolved	Copper Total	Dissolved o2 percent saturation	Dissolved oxygen	E. Coli Total	Lead Dissolved	Lead Total	Manganese and compounds Dissolved	Manganese and compounds Total	Nickel Dissolved	Nickel Total	Nitrate/Nitrite-Nitrogen Dissolved	Orthophosphate Dissolved	Orthophosphate Total	PH	Pheophytin a Total	Phosphorus Total	Specific Conductance	Total Coliforms	Total Kjeldahl Nitrogen	Total Organic Carbons	Total Suspended Solids	Turbidity	Water Temp	Zinc Dissolved	Zinc Total
FW Acute Oregon[1]	****	360	360				3.9	3.9					18	18				82	82			1400	1400														120	120
FW Chronic Oregon[1]	****	190	190				1.1	1.1					12	12				3.2	3.2			160	160														110	110
FW Acute National[2]		340	340				2	2										65	65			470	470														120	120
FW Chronic National[2]		150	150				0.25	0.25										2.5	2.5			52	52														120	120
MCL Goal[3]		0	0	2000	2000		5	5			100	100	1300	1300			0	0	0					10000														
MCL Primary[3]		10	10	2000	2000		5	5			100	100	1300	1300				15	15					10000														
MCL Secondary[3]													1000	1000						50	50																5000	5000
RSL[4]		0.045	0.045	7300	7300		18	18					1500	1500						880	880	730	730														11000	11000
USGS HBSL High[5]																				300	300	100	100														2000	2000
USGS HBSL Low[5]																				300	300	100	100														2000	2000
Oregon Mean Criteria[6]																	126																					
Oregon Max Criteria[6]																	406																					
EPA Recommedation[7]																													100									

BM Exceedance Total

	Ammonia-Nitrogen Total***	Arsenic Dissolved	Arsenic Total	Barium and compounds Dissolved	Barium and compounds Total	Bromide Total	Cadmium Dissolved	Cadmium Total	Chemical Oxygen Demand	Chlorophyll a Total	Chromium Dissolved	Chromium Total	Copper Dissolved	Copper Total	Dissolved o2 percent saturation	Dissolved oxygen	E. Coli Total	Lead Dissolved	Lead Total	Manganese and compounds Dissolved	Manganese and compounds Total	Nickel Dissolved	Nickel Total	Nitrate/Nitrite-Nitrogen Dissolved	Orthophosphate Dissolved	Orthophosphate Total	PH	Pheophytin a Total	Phosphorus Total	Specific Conductance	Total Coliforms	Total Kjeldahl Nitrogen	Total Organic Carbons	Total Suspended Solids	Turbidity	Water Temp	Zinc Dissolved	Zinc Total	Total
FW Acute Oregon[1]													3	3																									6
FW Chronic Oregon[1]							1						5	8																									14
FW Acute National[2]																																							0
FW Chronic National[2]							1																																1
MCL Goal[3]		2	3														370	3	4																				382
MCL Primary[3]			1																																				1

Site ID	Data Source	Date/Time	Ammonia-Nitrogen Total***	Arsenic Dissolved	Arsenic Total	Barium and compounds Dissolved	Barium and compounds Total	Bromide Total	Cadmium Dissolved	Cadmium Total	Chemical Oxygen Demand	Chlorophyll a Total	Chromium Dissolved	Chromium Total	Copper Dissolved	Copper Total	Dissolved o2 percent saturation	Dissolved oxygen	E. Coli Total	Lead Dissolved	Lead Total	Manganese and compounds Dissolved	Manganese and compounds Total	Nickel Dissolved	Nickel Total	Nitrate/Nitrite-Nitrogen Dissolved	Orthophosphate Dissolved	Orthophosphate Total	PH	Pheophytin a Total	Phosphorus Total	Specific Conductance	Total Coliforms	Total Kjeldahl Nitrogen	Total Organic Carbons	Total Suspended Solids	Turbidity	Water Temp	Zinc Dissolved	Zinc Total	Total**
	MCL Secondary[3]																					3	11																		14
	RSL[4]			2	3																																					5
	USGS HBSL High[5]																																									0
	USGS HBSL Low[5]																																									0
	Oregon Mean Criteria[6]																	36																								36
	Oregon Max Criteria[6]																	7																								7
	EPA Recommendation[7]																															5										5
BM Exceedance by Site																																										
E010																	3	7		2	2												1									12
E01M																			19				2									1										22
E020																				1	1																					1
E02M																			3				1																			4
E060																																										0
E170																																										0
E182																		1																								0
E210				1	1				1													1		1																		2
E310				1	2									1	1			6					3									1										13
E480																																2										2
E482																								1																		0
E540																																										0
E810																		5		1	3	4										1										11
Total Detections by Site																																										
E010			2			16	16				6	11			20	20		75		2	8	21		1			6		15	18	2	18	18	81.0	1	7	5				3	1	
E01M			16			15	15				30	29	2	1	1	57	111	82		28	17			47	37	1	114	24	51	112	19.0	5	44	47	106	114				1		
E020			20			15	15				16	28			68	68		51		1	1	13	15			53	51	15	71	23	69	71	22.0	4	20	48	69	71		3		
E02M						15	15				10	7		1	1	13	13		18			14	15			10		1	15	5	9	16	18.0	2	10	8	16	16		1		
E060			1			15	15				6	9			13	13		18				15				1	13	15	6	14	15	18.0		6	5	13	16				
E170						8	12				7	8			14	14		15				3	1			19	16	1	18	13	19.0		3	5	11	16				
E182						3	5				4	3		1	1	10	10		5					1		14	11	1	14	10	14.0	1	3		5	11		2		
E210			1	1	1	15	15	1			7	5	4	8	8	12	7	7	14	1	11	14	1		27	7	9	5	31	11	15.0	10	5	9	11	22		9		
E310				1	2	15	15				13	1	7	20	9	17	10	10	14			14	15	1	3	30	2	12	1	22	12	15.0	1	13	9	12	12		12	4	
E480			18			15	15				13	27			53	53		14	13			31	39	8	55	18	49	55	21.0	3	20	24	48	56					
E482						10	11				7	2			9	9	7	1						10	11		11	11	13.0	5	3	9	12	1					
E540			12			1	13				15	27			52	52		25			21	18			30	37	6	56	22	50	54	21.0	5	26	44	54	56		3		
E810						12	12	2			1	2	10	10	22			1	12	13	1		10		9	12	2	17	12	24.0	1	9	6	12	12		5	7		

Key

Site ID	Site Description		Abbreviations	
E010	McKenzie River @ EWEB Intake		<	Analyte not detected at or above the listed Method Reporting Limit (MRL).
E01M	MOHAWK RIVER NEAR SPRINGFIELD		>	Bacteria exceeded upper limit of enumeration
E020	McKenzie River @ Hendricks Park		ug/L	Micrograms per Liter
E02M	Mohawk River @ Wendling Rd Bridge		MPN	Most Probable Number
E060	McKenzie River at Holden Creek Road Bridge Near Leaburg		us/cm	Microsiemens per centimeter at 25 °C
E170	McKenzie River at Cougar Dam Road Bridge		NTU	Nephelometric Turbidity Units
E182	McKenzie River @ Frissell Bridge			
E210	Cedar Cr @ Saunders Bridge		**Notes**	
E310	Camp Cr @ Camp Creek Rd Bridge		*	Several results are measured in CFU
E480	South Fork McKenzie River at Bridge to Cougar Dam		**	Totals do not include dissolved metals
E482	South Fork McKenzie River at Rte 1980 Bridge Upstream of Cougar Reservoir		***	Ammonia/Dissolved/Total/Nitrogen have been combined into Ammonia-Nitrogen Total
E540	Blue River at McKenzie Hwy Bridge		****	Ammonia Criteria are pH and Temperature dependent: See document USEPA January 1985
E810	Keizer Slough @ SUB Bridge		*****	Several trace metal benchmarks are hardness dependent
				Benchmark exceeded

Data Source Description			Data Source Event Totals
DEQ	Analytical and field measurements provided by Department of Environmental Quality.		**233**
HB	Analytical and field measurements provided by Hayden Bridge Water Quality Lab.		**98**
MWC	Analytical results provided by various certified labs. Field measurements collected by EWEB staff using YSI water quality sondes.		**276**

Benchmark References

[1] Fresh Water (FW) Acute and Chronic Criteria, Oregon Water Quality Criteria, Source: www.deq.state.or.us/wq/standards/toxics.htm

[2] Fresh Water (FW) Acute and Chronic Criteria, EPA National Recommended Water Quality Criteria, Source: http://water.epa.gov/scitech/swguidance/waterquality/standards/current/index.cfm

[3] MCL - Maximum Contaminant Level, EPA National Primary Drinking Water Standards, Source: http://water.epa.gov/drink/contaminants/index.cfm#7

[4] RSL - Regional Screening Level, EPA, Source: www.epa.gov/region9/superfund/prg/

[5] USGS HBSL - U. S. Geological Survey Health-Based Screening Levels, Source: http://infotrek.er.usgs.gov/apex/f?p=HBSL:HOME:0:

[6] Oregon Water Quality Standards for Bacteria, Source: http://arcweb.sos.state.or.us/rules/OARs_300/OAR_340/340_041.html

[7] U.S. Environmental Protection Agency, 1986, Quality criteria for water 1986: U.S. Environmental Protection Agency, EPA 440-5-86-001, Source: www.epa.gov/waterscience/criteria/library/goldbook.pdf