Quality Assurance Project Plan

Walla Walla River Basin Fecal Coliform Bacteria and pH Total Maximum Daily Load Study

by
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1998 303(d) Listings Addressed in this Study: See Table 1

Waterbody Number: See Table 1

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Abstract

The Walla Walla River, Touchet River, and Mill Creek have been listed by the State of Washington under Section 303(d) of the Clean Water Act for non-attainment of Washington State fecal coliform bacteria and pH criteria. The listings are based on sampling done by the Washington State Department of Ecology (Ecology) since 1991.

EPA requires the states to set priorities for cleaning up 303(d) listed waters and to establish a Total Maximum Daily Load (TMDL) for each. A TMDL entails an analysis of how much of a pollutant load a waterbody can assimilate without violating water quality standards. This Quality Assurance (QA) Project Plan describes the technical study that will monitor levels of the above mentioned contaminants in the Walla Walla River basin, and form the basis for a proposal to allocate contaminant loads to sources. The study will be conducted by the Ecology Environmental Assessment Program.

Background and Problem Statement

The U.S. Environmental Protection Agency (EPA) requires states to set priorities for cleaning up 303(d) listed waters[1] and to establish a Total Maximum Daily Load (TMDL) for each. A TMDL entails an analysis of how much of a pollutant load a waterbody can assimilate without violating water quality standards. This QA Project Plan describes the technical study that will evaluate fecal coliform, pH, dissolved oxygen, and ancillary parameters in the Walla Walla River watershed. The Walla Walla bacteria and pH TMDL will form the basis for a proposal to set instream water quality targets to meet water quality standards and allocate contaminant loads to sources. The study will be conducted by the Ecology Environmental Assessment Program, Water Quality Studies Unit.

Basin Description

The Walla Walla River is located in the southeast corner of Washington State (Figure 1). The river extends 61 river miles (RM) from the headwaters of its north fork in Oregon to its confluence with the Columbia River in Washington. The drainage basin covers approximately 1,760 square miles and flows through four counties: Umatilla and Wallowa counties in Oregon, and Columbia and Walla Walla counties in Washington. Two-thirds of the Walla Walla drainage basin and the last 40 miles of the main stem lie within Washington. Major tributaries include the Touchet River, Mill Creek, Dry Creek, and Pine Creek.

The four primary forks of the Touchet River (Robinson Creek, Wolf Creek, North Fork Touchet, and South Fork Touchet) originate deep in the Blue Mountains at an elevation of 6,074 feet. The four forks are mainly located in forested areas of the Blue Mountain Ecoregion with some small farms in the valleys. As the forks converge just above the city of Dayton to form the main stem Touchet River, the river enters the Columbia Basin Ecoregion. The Touchet River flows through the cities of Dayton, Waitsburg, and Prescott reaching its confluence with the Walla Walla River by the town of Touchet at an elevation of 469 feet. Land use in the Touchet basin from Dayton to the confluence of the Walla Walla River is predominantly agricultural with both irrigated and non-irrigated crops.

Dry Creek is located in a 239 square mile basin with elevations from 450 feet at the confluence with the Walla Walla River near Lowden to 4,600 feet in the Blue Mountains. Dry Creek's watershed is mainly used for dry wheat agriculture with only sparse forests in the headwaters.

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[1] Section 303(d) of the federal Clean Water Act requires Washington State periodically to prepare a list of all surface waters in the state for which beneficial uses of the water – such as for drinking, recreation, aquatic habitat, and industrial use – are impaired by pollutants. These are water quality limited estuaries, lakes, and streams that fall short of state surface water quality standards, and are not expected to improve within the next two years.

Mill Creek flows from Class AA municipal watershed conditions (Appendix 1) in the Blue Mountains. Most city of Walla Walla's drinking water comes from the 36 square mile managed and protected portion of upper Mill Creek. At RM 25.2, the waterworks dam, the creek becomes Class A until RM 6.4, the 13th Street bridge in the city of Walla Walla. The creek flows through agricultural and urban/residential areas in this section. The division and diversion structures at RM 10.5 are used for flood control and irrigation operations. Much of the water is diverted to Yellowhawk and Garrison creeks from May through October. The creek channel is armored and groined from RM 11.5 to RM 4.5 for flood control. Portions of the creek that are not entirely concrete have revetments to stabilize the banks and a rubble bottom. Below RM 6.4, the creek is Class B (with additional special conditions) through the western part of the city of Walla Walla and the agricultural areas to the confluence with the Walla Walla River.

Drinking water for the city of Walla Walla is supplemented by groundwater from a deep basalt aquifer. A relatively dynamic, shallower gravel aquifer is used by residents in the basin as well, mainly for irrigation. Recent studies (1995) identified nitrate and coliform bacteria contamination of the gravel aquifer near Walla Walla (Pacific Groundwater Group, 1995).

Springs supply base-flow to surface waters year-round. Infrequent storm events during the winter months sometimes cause severe flooding from heavy rainfall and rapid snowmelt. Seasonal snowmelt and runoff in the spring increase river discharge volumes. Rivers and streams in the basin experience greatly reduced flows in the summer from a combination of reduced supply and diversion for irrigation. For example, the Walla Walla River has often gone dry at the Oregon-Washington border and Mill Creek usually has little to no flow between points of irrigation withdrawals and returns. Conditions have improved recently in the main stem Walla Walla River as a result of farmers diverting less water in response to bull trout Endangered Species Act (ESA) listings. Flows near the state line now range from 4 – 15 cubic feet per second (cfs) in the summer.

The Walla Walla basin is predominantly rural with few urban areas. The major towns are Walla Walla and College Place, with a combined population of less than 40,000. Smaller towns of Dayton, Waitsburg, and Milton-Freewater (Oregon) support surrounding agriculture. Currently, spring and summer wheat, alfalfa seed & hay, and peas are the largest percentage of the irrigated crops. Other crops include grapes, apples, asparagus, wheat, barley, and onions.

Headwaters are mostly forest and rangeland managed by the U.S. Forest Service. Some Confederated Tribes of the Umatilla Indian Reservation (CTUIR) lands are located in or near the upper Walla Walla watershed. The CTUIR has expressed interest in this project and are concerned with salmon and steelhead production in the Walla Walla River basin.

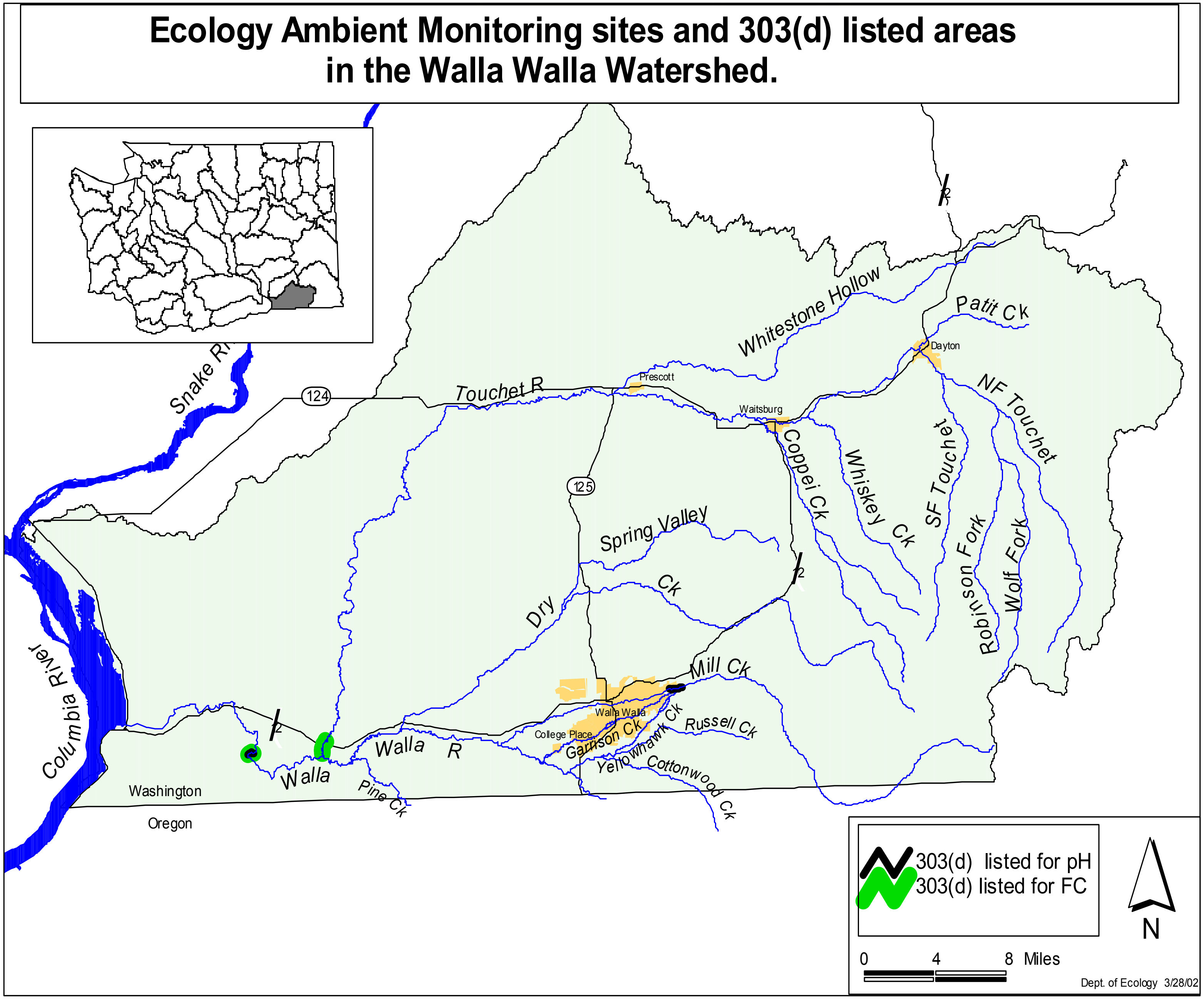


Figure 1. 1998 303(d) Listed Segments in the Walla Walla Watershed.

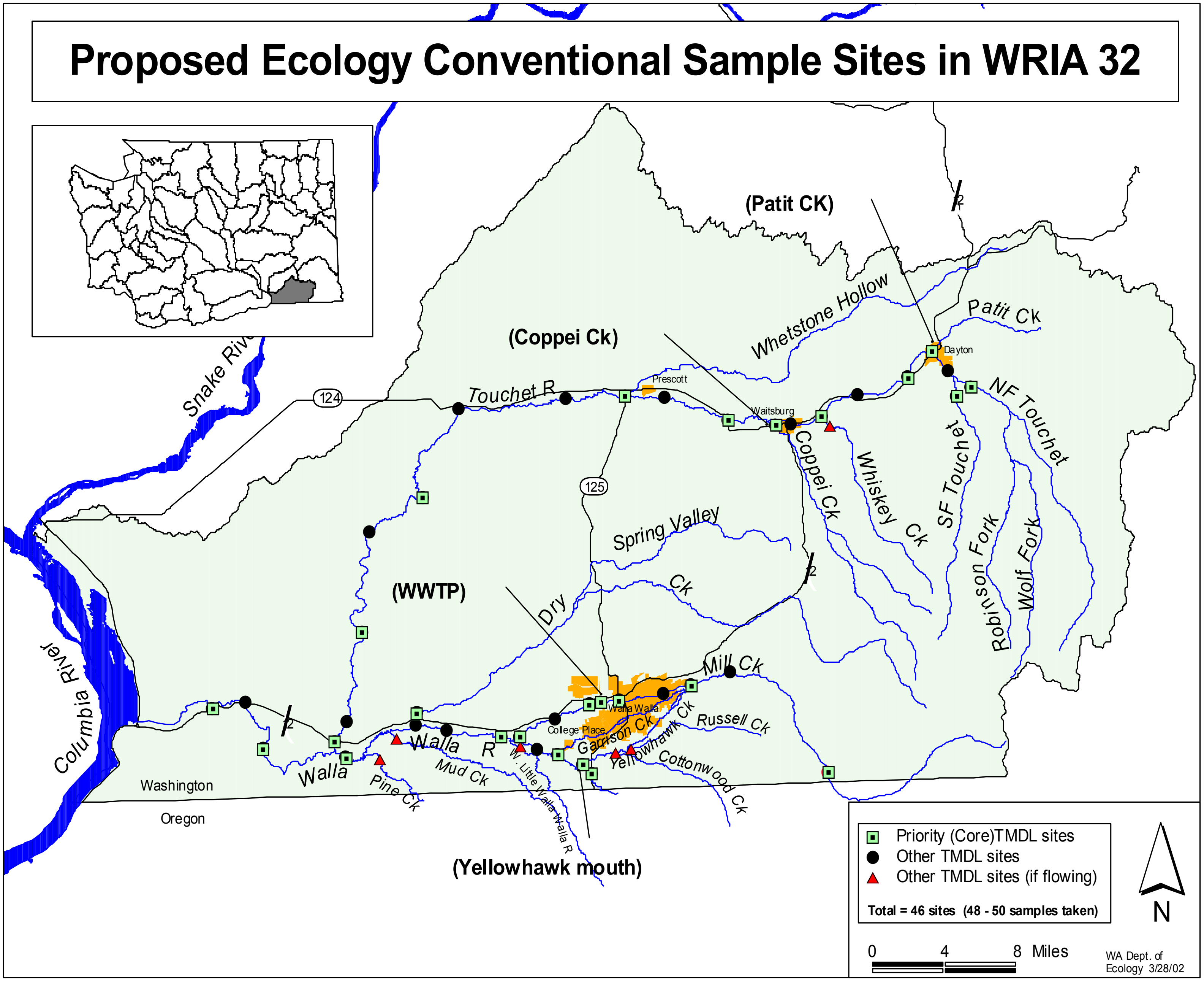


Figure 2. Proposed Conventional TMDL Sample Sites in the Walla Walla Watershed.

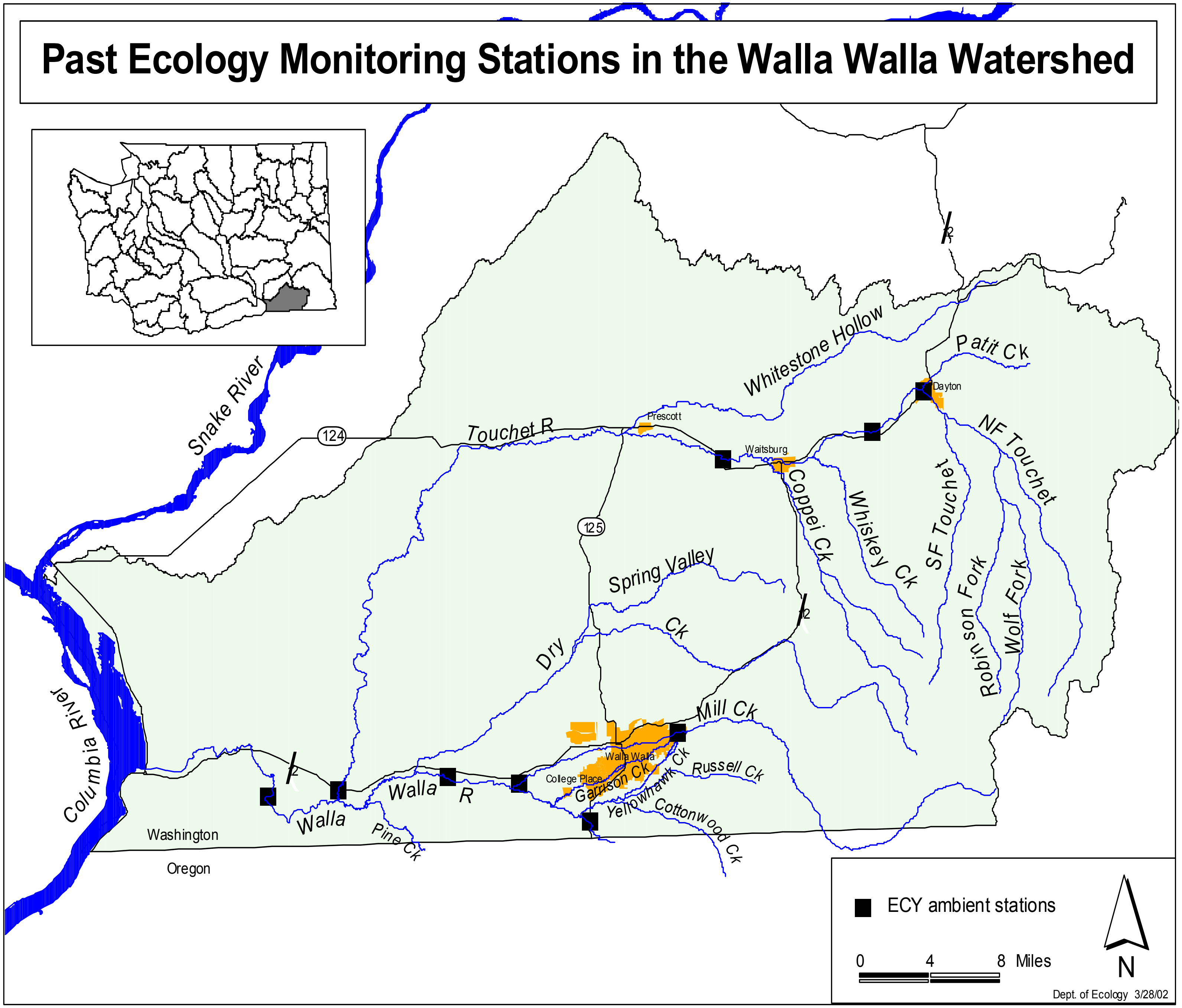


Figure 3. Ecology's Ambient Monitoring Stations in the Walla Walla Watershed.

Water Quality Issues

303(d) Conventional Parameter Listings

The Walla Walla River at RM 15.3, Touchet River (RM 0.5), and Mill Creek (RM10) are on the 1998 303(d) list for pH and bacteria based on previous monitoring work (Table 1 and Figure 1). Temperature and pesticides are also on the 303(d) list, although not necessarily in the same area (e.g. the Touchet River is listed for high temperatures at RM 0.5 and near the city of Dayton). Most pesticide violations occurred near the mouth of the Walla Walla River. Ecology ambient monitoring stations can be seen in Figure 3.

Table 1. Walla Walla River basin water bodies on the 1998 303(d) list. Bold type indicates parameters addressed in this TMDL evaluation. WBID is the water body identification number; old WBIDs were used in the 1996 303(d) list & new WBID will be used in 2002.

Waterbody	Old WBID	New WBID	Parameters
Walla Walla River	WA-32-1010	QE90PI	**Fecal Coliform**, **pH**, Temperature, Heptachlor, PCB-1260, Hexachlorobenzene, Heptachlor Epoxide, 4,4'-DDT, 4,4'DDE, Dieldrin, Chlordane
Touchet River	WA-32-1020	LV94PX	**Fecal Coliform**, Temperature
Mill Creek	WA-32-1060	SS77BG	**pH**, Temperature

ESA Listings

Spring chinook (Oncorhynchus tshawytscha) were historically present in the Walla Walla basin but are now extinct (VanCleve and Ting, 1960). On August 8, 2000, the Confederated Tribes of the Umatilla Indian Reservation (CTUIR) released about 200 pair of sexually mature spring chinook from the Ringhold Hatchery near the Tri-Cities, Washington, into the upper Walla Walla River in Oregon in hopes of establishing a naturally spawning population (Kuttel Jr., 2001).

Changes in flow regime, water quality, riparian conditions, water temperatures, substrate, and passage impediments have had a less dramatic effect on steelhead (Oncorhynchus mykiss) runs than spring chinook (Kuttel Jr., 2001). Steelhead enter the Walla Walla system earlier, generally by September or October, but can remain for long periods of time until conditions are more favorable. They then spawn in the spring. Steelhead in this system were listed as threatened under the Endangered Species Act in March 1999.

Dams, diversions and high water temperatures have disrupted the historic bull trout (Salvelinus confluentus) migrations throughout the basin. Today, North and South Forks of the Walla Walla

River, upper Mill Creek, North Fork Touchet River, Wolf Fork, and South Fork Touchet River still support bull trout, but they are isolated populations. The U.S. Fish and Wildlife Service (USFWS) listed bull trout as a threatened species in June 1998.

Beneficial Uses

Rivers and streams in the Walla Walla watershed are a mix of class AA (excellent), A (extraordinary), and B (good) as defined by the Water Quality Standards for Surface Waters of the State of Washington (Chapter 173-201A WAC). All segments and tributaries to Class AA waters are Class AA as well. All other tributaries in Washington not listed in Table 2 are considered Class A waters.

Good water quality is essential in the Walla Walla River basin to support a variety of beneficial uses.

- *Recreation:* fishing and swimming in class A and AA waters; fishing and secondary contact (e.g. wading and boating) in class B waters (Table 2).

- *Fish:* all waters shall support salmonid migration, rearing, and harvesting. Class A and AA waters shall support salmonid spawning. Salmonid species include: Summer steelhead/rainbow trout, bull trout, and mountain whitefish. Steelhead are the only anadromous species presently available to sport anglers. Introduced species include: smallmouth and largemouth bass, bluegill, carp, brown trout, channel catfish, bullheads, and tadpole madtom.

- *Water Supply and Stock Watering:* shall support permitted domestic, industrial, and agricultural uses for class A and AA, and industrial and agricultural uses for class B waters.

Currently, monitoring data used for the 303(d) list indicate that some beneficial uses in the watershed are not being met. Recreational uses are not safe because bacteria indicator results are elevated. Fish and aquatic life are threatened by elevated pH. This TMDL will address these beneficial uses by evaluating bacterial indicators and several biological and chemical parameters.

Fecal coliform (FC) bacteria, as an indicator of the presence of other pathogenic organisms, are in greater concentrations at some sites than that allowed by current water quality standards (Appendix 1). This indicates fecal wastes are entering waterways and creating a greater potential for infection by pathogens when people use these waterways. Additional FC samples will be collected to address the 303(d) listings in Table 1 and to address any problems in other areas of the watershed.

After evaluating a range of options, Ecology is proposing to use new indicator bacteria – Escherichia coli (*E. coli)* – to protect people who come in contact with waters contaminated with human and other animal waste. *E. coli* are a sub-set of fecal coliform. The EPA highly recommends using this indicator as it will better help ensure that waters do not contain unhealthy levels of pathogens. Since E. coli may replace FC in the state water quality standards in the next five years, E.coli samples will be collected to make the TMDL relevant over the transition period. The additional indicator data may also be helpful for determining sources of contamination.

There are a few informal swimming areas on the Walla Walla and Touchet rivers. Specifically, primary contact (i.e. swimming) on the Touchet River is mostly limited to the stretch between Dayton and Waitsburg and during the summer months. Swimming on the Walla Walla River is known to occur between Dry Creek and Mill Creek but may be more widespread (Mendel, personal communication). Secondary contact (e.g. fishing) may occur throughout the basin, but the extent is not well known. Peak recreational fishing occurs in the spring, when fecal coliform is usually at its highest. Therefore, bacterial indicators will be monitored throughout the year and over a large geographic area to address recreational uses in the basin.

Aquatic organisms, including fish and the food they eat, are exposed to high pH levels in some portions of lower Mill Creek and the lower Walla Walla River. High pH stresses aquatic organisms by impairing their osmoregulatory processes, and increasing the toxicity of some contaminants. Anadromous species of fish encounter this stress in their adult upstream migration, and more importantly, their juvenile offspring face this in their precarious downstream migration. High pH values can be a result of local soil and mineral properties. However, they are often an effect of photosynthesis of free-floating algae, algal-type organisms attached to bottom substrate and other fixed objects (periphyton), or macrophytes which in turn are responding to elevated nutrient levels (nitrogen and/or phosphorus) and high light (Erickson, 1996). When these conditions are present, dissolved oxygen depletion at night can also occur and cause additional stress to organisms.

Evaluation of the effects of pH problem on aquatic communities in the Walla Walla basin is complicated by the chemical and biological interactions. Nutrient concentrations, light exposure, water temperature, buffering capacity, substrate availability, water velocity and discharge volumes all play a role in the resulting pH concentration in a water body. If the problem is primarily related to algal or macrophyte growth, it may be present any time during the growing season (March through October). The interaction of the parameters and the approach taken in the TMDL to assess the situation will be explained in more detail in later sections of this QA Project Plan.

The beneficial uses of water in the Walla Walla basin are also affected by other problems as well. High stream temperatures can stress or kill many of the organisms normally accustomed to cooler water. High temperatures and obstructions in the Walla Walla basin deter bull trout from migrating downstream and may be the cause of their genetic isolation in upper stream reaches (Kuttel Jr., 2001). High temperatures also affect somes stream processes directly and indirectly. For example, high temperatures can lower dissolved oxygen (D.O.) concentrations because of lower saturation rates, increase plant growth rates, and increase the toxicity and volitility of certain chemicals and pesticides. Temperature issues are being addressed by the Nonpoint Studies Unit of Environmental Assessment (EA) Program (Stohr and LeMoine, 2002). Their data will be available for the bacteria and pH TMDL evaluation.

Fine sediment loading is a concern as well. Many of the streambanks in the Walla Walla watershed are unstable or eroding at a fast rate (Kuttel Jr., 2001). Sediments can cover gravel and fill pores in the substrate, decreasing oxygen to salmon eggs and alevins. Sediments have also been correlated to increased bacteria and pesticide concentrations. Since Washington State water quality standards do not directly address fine sediment loading, turbidity and narrative criteria are sometimes used to address such problems. The bacteria and pH TMDL will not fully address fine sediment problems, but some data will be collected that may be useful for future work.

Table 2. Water quality classifications for the Walla Walla River, North Fork Touchet River, and Mill Creek in the Walla Walla basin.

Waterbody	Location	Special Conditions	Class
Walla Walla River	Mouth to Dry Creek. (RM 27.2)	NA	B
	Lowden (Dry Creek at RM 27.2) to Oregon border (RM 40)	Temperature shall not exceed 20.0 C due to human activities. When natural conditions exceed 20.0 C, no temperature increase will be allowed which will raise the receiving water temperature by greater than 0.3 C.	A
NF Touchet River	At Dayton water intake structure (RM 3.0) to headwaters	NA	AA
Mill Creek	Mouth to 13th St. Bridge (RM 6.4)	Dissolved oxygen concentration shall exceed 5.0 mg/L	B
	13th St. Bridge to Walla Walla Waterworks Dam (RM 11.5)	NA	A
	City of Walla Walla Waterworks Dam (RM 21.6) to headwaters	No waste discharge will be permitted	AA

Oregon Standards and Listings

Waters of the Walla Walla River basin that flow through Oregon are subject to slightly different water quality criteria than those in Washington. The Oregon Department of Environmental Quality (ODEQ) water quality standards are specific for the Walla Walla basin, and are based on their beneficial uses. The only 303(d) listings for the Walla Walla River in Oregon are for temperature and flow.

Bacteria: Coliform bacteria shall not exceed a 30-day log mean of 126 *E. coli* organisms per 100 ml, based on a minimum of five (5) samples. No single sample shall exceed 406 *E. coli* organisms per 100 ml.

pH: pH is a core indicator driven by fish health. The pH criterion is 6.5-8.7 standard units, or up to 9.0 if it can be shown to be non-anthropogenic.

Nutrients: Typically, nutrient TMDLs are generated when modeling shows that eutrophic conditions from excessive nutrient loading cause a pH exceedence. In the neighboring Umatilla Basin, however, modeling showed that temperature TMDL attainment through shading would alleviate pH exceedences by limiting light to the stream, so the ODEQ did not allocate nutrient loads (Butcher, personal communication).

D.O.: Oregon's dissolved oxygen standards are statewide and consist of cold, cool, and warm water criteria (Appendix 3) (ODEQ, 2001). Some implementation of intergravel D.O. criteria has occurred as well.

Temperature: The temperature standard is narrative, with numeric values of 50 (Bull Trout), 55 (salmonid spawning), and 64 (everywhere else) degrees F as triggers for "no human caused temperature increase" (Butcher, personal communication).

Possible Pollution Sources

Much of the past water quality monitoring in the Walla Walla basin focused on the Walla Walla River from RM 4 to the Oregon border. The lower 10.5 miles of Mill Creek and the Touchet River near the mouth and from Waitsburg upstream were also routinely monitored by Ecology and others' project sampling in the past. The Touchet River, from RM 0.5 up to RM 40, has not received much attention. Livestock rearing and cropland most likely dominate in this stretch. Except for a few point sources, these nonpoint sources are likely the primary contributors of high pH and fecal coliform concentrations in the Walla Walla watershed.

In general, the low flow issues of most streams in the Walla Walla watershed profoundly affect water quality. This is a major issue that needs attention if water quality and quantity issues are to be resolved. Many water rights in the Walla Walla basin have very early priority dates (dates of origin), dating back to the mid-to-late 1800s. Water rights issues are not in the scope of this TMDL.

Mill Creek System

Sources of pollution to Mill Creek include residential sources, agriculture, stormwater, and wastewater. Also, shallow water in the summer, resulting from municipal and agricultural usage, exacerbates already high temperatures from little riparian vegetation and low shading. Nutrient influxes indirectly elevate pH levels by stimulating excessive primary productivity, and are worsened by low dilution from low flows. Wastes in runoff from livestock, pets, and wildlife may introduce fecal coliform bacteria to Mill Creek as well. However, sufficient data have not been collected to detect a serious bacterial contamination problem in the Mill Creek sub-basin from these sources.

The Walla Walla Wastewater Treatment Plant (WWTP) discharges into Mill Creek from December 1 through April 30 of each year, subject to NPDES permit conditions (Appendix 4). The Walla Walla WWTP discharges at RM 5.4. An upstream diversion on Mill Creek diverts nearly all in-stream flows above the WWTP discharge from May through October to Garrison and Yellowhawk creeks for irrigation purposes. Most of the city of Walla Walla's effluent to Mill Creek is available for irrigation use from April 15 through December 15. Irrigation flows are then returned to the creek downstream of the diversion stretch. The major suspected causes of pollution in Mill Creek are nonpoint sources such as agriculture and re-used city wastewater returned to Mill Creek from the irrigation system. Effluent discharged directly into Mill Creek from December through April is not expected to cause a water quality problem.

The smaller College Place WWTP discharges from May through October through wetlands prior to discharge into Garrison Creek, a branch of Mill Creek from the diversion structure at RM 10.5 (Appendix 4). The effluent is discharged November through April directly to Garrison Creek. Garrison Creek joins the Walla Walla River at RM 36.7 upstream of the confluence with Mill Creek.

The 303(d) pH listing on Mill Creek is actually above both WWTPs at RM 10.5; therefore, high pH is a problem even before additional nutrient loading from urban and WWTP sources. Agricultural and residential sources may be present in the reaches above RM 10. However, monitoring data will likely confirm high pH farther downstream in Mill Creek as was documented by CH2M Hill (CH2M Hill, 1998). Bacteria and pH problems are expected to be minimal nearer to the Oregon/Washington border at RM 21.6 and the city of Walla Walla water supply diversion.

Touchet River

The fecal coliform counts in the Touchet basin are most likely from nonpoint sources. Much of the land adjacent to the Touchet River is used for agricultural purposes; some properties have direct access to the river by livestock. Other sources of fecal coliform may include wildlife and septic tanks. Currently, wastewater discharge and other point sources from Dayton, Waitsburg, and Touchet are not suspected as having a significant impact on bacterial water quality (Appendix 4), especially since the Waitsburg and Touchet facilities do not have surface water discharges. Their contributions will be further assessed in this study. State water quality standards do not distinguish between human and other sources of fecal coliform bacteria since disease organisms that affect humans are carried in fecal wastes from other animals as well. E. coli testing should provide additional information on the sources of bacterial contamination.

Walla Walla River

Nonpoint sources such as livestock access to riparian areas are the suspected cause of fecal coliform criteria violations in the Walla Walla River. Other sources of fecal coliform and nutrients/pH are present as well (e.g. wildlife and septic tanks) but may not be as significant as agricultural sources. The nutrient and fecal coliform contributions from Mill Creek, the Touchet River, and other tributaries may also contribute to the criteria violations noted in the lower Walla Walla River. The TMDL study will attempt to evaluate the effect of the tributary and Oregon contaminant loads on the lower main stem.

Previous Monitoring Activities

As shown in Figure 3, Ecology's EA Program has monitored nine different sites in the basin. These sites have been monitored at monthly intervals but during various years in the past (Table 3). The two Ecology stations in the basin with the longest monitoring records have been the Walla Walla River near Touchet (32A070) and the Touchet River at Touchet (32B070).

The cities of Walla Walla, Dayton, Waitsburg, and College Place have been the subjects of EA Program WWTP inspections and receiving water surveys in the past (Hoyle-Dodson, 1997; Chase and Cunningham, 1981; Joy, 1987; Heffner, 1988). Various pesticide monitoring by Ecology has taken place in the Walla Walla drainage as well (Johnson, 1997; Davis, 1995; Davis, 1993). Additionally, Ecology conducted receiving water surveys for Mill and Garrison Creeks, and the Touchet River (Joy, 1987; White, 1998; Joy, 1986).

Table 3. Ecology ambient water quality monitoring sites in the Walla Walla basin.

ID	Station Name	River Mile	Monitoring Years Since 1989
32A070	Walla Walla R. near Touchet	15.3	1989-present
32A100	Walla Walla R. at East Detour Rd. Br.	32.8	1999
32B070	Touchet River at Touchet	0.5	1989-1992; 1996-97
32B080	Touchet River at Sims Road	9	1999
32B100	Touchet River at Bolles	40.4	1999
32B130	Touchet River at Dayton	53.3	1991-92
32B140	Touchet River above Dayton	53.7	1996-97
32C110	Mill Creek at Tausick Way	10	1992-93

Oregon's Department of Environmental Quality is currently performing a temperature TMDL on the main stem Walla Walla River in Oregon and Washington. This includes using Thermal Infrared (TIR) technology to assess differences in stream surface temperatures. The ODEQ is also including channel morphology and streamside vegetation data in their temperature TMDL analysis. No conventional parameters' samples were taken; however, some historical ODEQ data has been collected for selected conventional parameters in the Walla Walla River and Pine Creek (Table 4).

Table 4. ODEQ ambient water quality monitoring sites in the Walla Walla Basin.

ID	Stream Name	Site Location	Lat./Lon.	Monitoring Years
10712	Walla Walla River	Milton-Freewater	45.9038/118.3675	1967-75
10713	Pine Creek	Pine Creek Near Umapine	45.9681/118.5296	1967;1968

Based on studies conducted in 1982 and 1986 on Mill Creek by Ecology, a TMDL for ammonia was developed by Ecology and approved by the U.S. EPA in February 1993. CH2M Hill performed a year-long evaluation of Mill Creek in 1997–1998 to modify the terms of the original TMDL (CH2M Hill, 1998). CH2M Hill studied many conventional parameters, including diurnal D.O. and pH, and most nutrients under contract for the city of Walla Walla. A final evaluation of the data has not been completed.

The Washington Department of Fish and Wildlife (WDFW) performed an assessment of salmonids and their habitat in the Walla Walla River basin in 2000 (Mendel et al., 2001). The primary objective of the study was to collect and assess biological and habitat data. Some summertime pH and conductivity data were recorded for the Touchet and Walla Walla Rivers and several of their tributaries.

The Washington State Conservation Commission performed a salmonid habitat limiting factors study in the Walla Walla basin in 2000 (Kuttle Jr., 2001). Its focus was on factors limiting salmonid migration and overall survival. Water quality data included total suspended solids (TSS) and temperature. Temperature was listed as a limiting factor and TSS was mentioned as having adverse impacts on salmonid habitat in several streams (e.g. Patit Creek, Touchet River, and the lower Walla Walla River).

The Walla Walla Basin Watershed Council (WWBWC) is planning to measure water quality conditions at eight to ten sites on the Walla Walla River in Oregon in the summer of 2002 (WWBWC, 2002). Local ODEQ staff and state and tribal fisheries staff have assisted in determining monitoring locations. Parameters to be monitored this year include: temperature, D.O., pH, conductivity, turbidity, and macro-invertebrates.

The WSU Center for Environmental Education also conducted water quality monitoring in the Columbia County portion of the Touchet River (Krause et al. 2001). Temperature, TSS, fecal coliform (FC), ammonia, nitrate, total Kjeldahl nitrogen (TKN), total phosphorous (TP), and flow were monitored at nine sites.

The USGS studied nutrients, benthic algae and stream quality in the nearby Palouse River Basin (Greene, et al., 1997), which is very similar in land use, geology, climate, and flow regime. The USGS study is a good study reference for the Walla Walla TMDL.

Historical Data Assessment

Historical monitoring data provide a description of water quality problems in the Walla Walla basin. Ecology ambient monitoring data and some ODEQ data were analyzed to determine seasonal characteristics, criteria violation frequency, and long-term trends. The graphs generated from Ecology's ambient data are in Appendix 5. These data analyses focused on monitoring conducted in the past 10-12 years.

Bacteria

Fecal Coliform

Fecal coliform bacteria are present in the intestines of warm-blooded animals. They are used as indicators of the sanitary quality of water and indicate the potential presence of pathogenic organisms (USEPA, 2001). Fecal coliform is measured as the number of colony forming units (cfu) per 100mL of sample water.

The Walla Walla River near Touchet and the Touchet River near Touchet show seasonal trends in fecal coliform concentrations (Appendix 5). April signifies the beginning of the bacteria "season" in the Walla Walla River which extends through July. The Touchet River has a slightly different temporal pattern. Its bacteria "season" starts in May and lasts through September. No significant increase or decrease could be found in yearly fecal coliform densities in both rivers since 1990.

Fecal coliform data collected in 2000 by the WSU Center for Environmental Education showed that the upper Touchet River had numerous water quality violations. Samples were taken from nine water quality stations in the Columbia County portion of the Touchet River. The data indicated higher fecal coliform concentrations in the summer and major changes in fecal coliform levels as water traveled downstream (Krause et al., 2001). There appeared to be no trend in fecal coliform levels as water traveled downstream.

Escherichia (E.) Coli

E. coli is a subgroup of the fecal coliform bacteria. *E. coli* is part of the normal intestinal flora in humans and animals and is, therefore, a direct indicator of fecal contamination in a waterbody. The O157 strain, sometimes transmitted in contaminated waterbodies, can cause serious infection resulting in gastroenteritis (USEPA, 2001).

In response to urging by environmental groups, industries, and the EPA, Ecology conducted a technical evaluation of the current use of fecal coliform bacteria as a general indicator of pathogens from human and animal sources. After evaluating a range of options, Ecology proposed to use *E. coli* in freshwater. The EPA highly recommends using this indicator to help ensure that waters do not contain unhealthy levels of pathogens, and thus more effectively protect people who play and work in our waters. Proposed *E. coli* criteria are shown in Table 5.

No previous data were found regarding E. coli concentrations in the Walla Walla River basin and no nearby basins have *E. coli* results. However, statewide monitoring experience has shown that *E. Coli* usually compose a majority (80-95%) of the fecal coliform count. The remaining organisms could be Klebsellia species that are more associated with decaying vegetation than with fecal matter. The mix of sources in the Walla Walla basin could result in significant seasonal changes in E. coli to fecal coliform ratios.

pH

Previous Ecology monitoring data in the Walla Walla and Touchet Rivers indicate seasonal variation regarding pH. Although the data are from instantaneous samples only, pH tends to increase in the summer months, peak in mid- to late summer, and decline again in the fall to the lowest relative values in winter (Appendix 5). High pH in the summer could be due to upstream benthic or macrophyte productivity (due to high light and high temperatures) and indicate the possibility of nutrient enrichment problems. The pH 303(d) listings are often seen by Ecology staff as indicators of eutrophication and nutrient problems.

In a simplified example of a freshwater system, plants as primary producers combine sunlight with dissolved carbon, nitrogen, and phosphorus in the water (or from sediment if they are rooted plants) to create chlorophyll and oxygen as they grow. In the absence of light, oxygen is consumed out of the water column by the plants and nutrients are released. Nitrogen and phosphorus are usually considered more limiting to plant growth than inorganic carbon because carbon dioxide in the atmosphere is readily available in the water. The carbon dioxide concentration is regulated by a balance with bicarbonate and carbonate ions. In turn, the balance between these chemicals influences the pH of the stream as hydrogen ions are released (low pH – acidic conditions), or bound (high pH – basic conditions). Also involved is the water's alkalinity - a measurement of the water's capacity to neutralize acid and resist changes in pH.

Usually this balance of ions results in a pH around 7 unless large amounts of inorganic carbonate are available from geologic sources, or unless organic processes such as bacterial decomposition or accelerated plant growth occur. In this last situation, nitrogen, phosphorus, and sunlight can become overabundant. If plants consume more carbon dioxide from the water and overcome the water's alkalinity, the reactions push the pH to basic conditions of 8, 9, or 10 units – sometimes to the detriment of other aquatic organisms that rely on the pH remaining closer to 7. At night, the pH may return closer to 7 as respiring plants return carbon to the water, but oxygen levels also may drop below levels acceptable to sustain a healthy aquatic community. When these conditions occur, the water often does not meet state water quality criteria or support all beneficial uses.

Mill Creek and the lower main stem Walla Walla River are listed for high pH. Ecology's monitoring data showed that the Touchet River near the mouth did not have any pH criteria violations; however, monitoring on the Touchet River at Dayton found one exceedence in April 1992 and one above Dayton in April 1991. These infrequent pH exceedences are not enough to list the Touchet River on the 1998 303(d) list for pH. Diel pH monitoring has not been conducted at the Ecology sites.

Water quality data collected by WDFW showed pH criteria violations. Four out of six samples taken in late June and early July on the Walla Walla River at RM 29.3, 32.9, 34.0, 36.5, and 39.6 exceeded water quality standards (Mendel, et al., 2000). Mendel et al. (2000) also sampled the Touchet River during this time at RM 1.5, 11.3, 40.5, and 53.5 and found three out of the six total samples taken there were above the pH 8.5 criterion. The single pH sample taken in early June on Pine Creek at RM 1.3 also exceeded the criterion.

No other Ecology stations have detected pH violations; however, many other streams in the basin have higher than normal pH values and some have values that frequently reach near the pH criterion of 8.5. This will be further investigated in the TMDL study.

CH2M Hill (1998) recorded high pH values (>8.5) in Mill Creek. In the afternoon and evening hours during their July and August diurnal (diel) survey, pH values of 9.12 and 8.94 were recorded at river miles 5.5 and 4.8, respectively. CH2M Hill also found higher than pH 8.5 at other sample sites in Mill Creek during their regularly scheduled monitoring. The study area included sites between river RM 0.4 and 500 feet above Walla Walla's WWTP at RM 5.5. The data indicate that pH problems extend downstream of the 303(d) listed area on Mill Creek above RM 10.5.

Nutrients

Nutrients affect the health of the aquatic system directly and indirectly. Ammonia can be a toxicant at high concentrations or when pH and temperature conditions are elevated. Organic nitrogen and ammonia can also exert an oxygen demand as the aquatic community converts them to nitrite and nitrate. Nitrogen and phosphorus are essential for a healthy community, but they can overstimulate aquatic growth and cause D.O. and pH problems in the water column.

There are no nutrients on the 1998 303(d) list for the basin because Washington does not have nutrient criteria for streams and rivers. However, total phosphorus and total nitrogen were listed on the 1996 303(d) list as potential contributors to the low D.O. conditions in Mill Creek. Although not recognized by USEPA Region 10 as a nutrient TMDL, the Mill Creek TMDL submitted in 1992 limited nutrients by limiting Walla Walla WWTP effluent discharge to Mill Creek from May to November.

Ecology's ambient data for the lower Touchet River (32B070) and the lower Walla Walla River (32A070) showed relative increases in nitrite-nitrate and total phosphorous concentrations during late winter and early spring in the lower portions of both rivers. Not enough data was collected to see trends in Mill Creek's (32C110) monthly nutrient concentrations.

Dissolved Oxygen

Most of the D.O. sample results reported in the Walla Walla River basin were from instantaneous daytime collections. However, CH2M HILL performed a diurnal D.O. monitoring survey on lower Mill Creek in July and August 1997 (CH2M HILL, 1998). Although the study reported major diurnal changes in D.O. concentrations (e.g. from 5.8 mg/L in early morning up to 13.4 mg/L during the afternoon), D.O. did not fall below the special condition criteria of 5.0 mg/L for Mill Creek below RM 6.4 (Table 2). High diurnal variations together with more extensive sampling might show that a D.O. problem exists in Mill Creek.

Diurnal changes in D.O. concentrations on the main stem Walla Walla River near Touchet are not well understood because of the lack of continuous, 24-hour sampling. The widest range of concentrations is presumably in July and August when temperatures and primary productivity are at their highest and flows at their lowest. According to Ecology's ambient monitoring data, the closest to a violation of the 6.5 mg/L D.O. criterion for Class B streams occurred in August 1997 (6.5 mg/L D.O.) (Appendix 5). Sampling time changes over the years limit the usefulness of this data for yearly trend analysis. Dissolved oxygen saturation maxima occur in the daytime in August and minima in January and May. Summer supersaturated conditions suggest upstream benthic or macrophyte productivity and the possibility of nutrient enrichment problems.

The USGS found diel swings in D.O. concentrations as a result of aquatic plant productivity in the nearby Palouse basin (Greene, et al., 1997). The magnitude of diel swings of D.O. ranged from 4.6 mg/L to 14.7 mg/L at five 24-hour monitoring sites in the basin. Nutrient concentrations changed over a 24-hour period as well. The climatic and physical conditions of this basin are very similar to those in the Walla Walla basin.

Ecology's monthly data for the Touchet River near Touchet and Mill Creek at Tausick Way were very similar regarding seasonal D.O. trends. The Touchet River had 4 violations out of 35 samples taken monthly in the years 1990, 1991, 1992, 1996, and 1997, with 3 violations in the summer of 1997. This was not enough to include the Touchet River for D.O. on the 1998 303(d) list. Ecology's Mill Creek monitoring data from October 1992 through September 1993 show similar seasonal trends, but no criteria violations were recorded for that period.

Project Description

The primary purpose of the TMDL evaluation is to determine if 303(d)-listed segments of the Walla Walla River and its tributaries, Touchet River and its tributaries, and Mill Creek are in compliance with water quality standards so that all applicable beneficial uses are available. Through the TMDL study, historical and current water quality data will be evaluated and the decision for de-listing or TMDL target setting is made. The TMDL targets are set when the loading capacities of water bodies are determined and contaminant limits are recommended for point and nonpoint sources. An implementation strategy is designed around these recommendations to reduce contamination from the sources and to meet the TMDL limits within a set schedule. Public participation is a key feature throughout the entire TMDL process.

The Walla Walla Basin TMDL will use a "single entry into one watershed" approach. All parameters on the 303(d) list (and other supporting parameters) will be assessed by units within the Ecology Environmental Assessment Program: pesticides and herbicides by the Toxics Studies Unit, temperature by the Nonpoint Studies Unit, and conventional parameters (e.g. fecal coliform and pH) by the Water Quality Studies Unit. Although different parameters will be assessed, the three units will collectively "enter" the basin and start sampling in early summer 2002 and likely finish sampling during 2003. Communication between the three units is essential in increasing efficiency of the overall TMDL process.

Based on the historical data review and meetings with interested citizens, the following TMDL and water quality issues have been raised for conventional parameters:

- Bacteria and pH water quality problems may be more widespread than the 303(d) list and historical studies indicate.

- From monitoring data, pH exceedences appear to be associated with nutrient/primary productivity problems exacerbated by low flows and high temperature.

- Dissolved oxygen problems may surface while sampling for pH.

- Fish and Endangered Species Act issues are of concern.

Listed below are the goals for the Walla Walla TMDL pH and fecal coliform study:

- Determine the geographic and seasonal extent of bacterial contamination to the Walla Walla River and the Touchet River, and where appropriate propose reductions to sources, reaches, or tributaries in the form of TMDL load and wasteload allocations.

- Calculate the loading capacity for pH in Mill Creek, the Walla Walla River, and other areas in the Walla Walla basin as appropriate. Set load allocations for various tributaries and reaches using one or more appropriate parameters, e.g. limiting nutrient, temperature, or light.

- Determine if there is a D.O. or nutrient/primary productivity problem in the main stem Walla Walla River, Touchet River, and Mill Creek. If necessary, calculate the seasonal loading capacity for limiting nutrient(s) and oxygen-demanding substances in portions of the Walla Walla River, Touchet River, or Mill Creek to meet the D.O. criterion. Set seasonal load allocations and wasteload allocations for sources.

Additional monitoring data and the evaluation of historical data will be used to meet the objectives for the TMDL project. The data collected to date indicate that water quality problems are not limited to one season or source type – although, in general, more water quality problems exist in the early spring and summer. Some problems, e.g. pH and D.O., occur in the late summer and fall and are low-flow related. Additional monitoring data are necessary to better describe both the spatial and temporal extent of the problems as well as describe the current conditions compared to state water quality criteria. The TMDL study report will contain recommendations for de-listing parameters or setting TMDL targets based on comparisons of data to the criteria in Table 5. Additional TMDLs may be established for more water bodies or parameters than are currently on the 3030(d) list.

Ecology Water Quality Program Policy 1-11 (Ecology, 1997) guidance on data interpretation will be followed to determine if water bodies or contaminants can be de-listed (Appendix 2). Statistical characteristics such as geometric means and 90th percentiles will be calculated for annual and seasonal periods when bacteria data are available. pH and D.O. data from sites within the study area that meet all quality control requirements and show a clear violation of criteria, such as falling below a minimum allowable value or exceeding a maximum value, will result in a TMDL target calculation.

The pH, fecal coliform, *E. coli*, and dissolved oxygen data will be compared to current criteria proposed for the revised water quality standards (Ecology, 2002). To meet some of the proposed criteria, all tributaries and main stem reaches will be assumed to be capable of salmonid rearing and migration. Fisheries technical reports will be used to define areas of steelhead and/or salmon spawning where more stringent criteria are proposed.

Table 5. Water quality criteria that will be used to determine if Walla Walla River basin waters are supporting beneficial uses.

Parameter	Criteria Category	Statistic	Criterion
Fecal Coliform	Class AA Freshwater	Geometric Mean	50 cfu/100 mL
		90th percentile value**	100 cfu/100 mL
	Class A Freshwater	Geometric Mean	100 cfu/100 mL
		90th percentile value**	200 cfu/100 mL
	Class B Freshwater	Geometric Mean	200 cfu/100 mL
		90th percentile value**	400 cfu/100 mL
E. Coli*	Freshwater	Geometric Mean	100 cfu/100 mL
		90th percentile value**	200 cfu/100 mL
pH	Freshwater	Minimum	6.5
		Maximum	8.5
Dissolved Oxygen	Class AA Freshwater	Minimum	9.5 mg/L
	Class A Freshwater	Minimum	8.0
	Class B Freshwater	Minimum	6.5
	Class B Freshwater – Special Condition[1]	Minimum	5.0
Dissolved Oxygen*	Freshwater	Daily average	10.5 mg/L
		Minimum	9.0 mg/L
		Minimum	8.0 mg/L
		Minimum	8.0 mg/L

* Proposed water quality criteria, Ecology, 2001.

** Criteria wording states that not more than 10% of the samples obtained for calculating the geometric mean shall exceed the criterion.

1 Lower 6.4 mi. of Mill Creek special condition.

Data Quality Objectives

The decision to de-list or set TMDL targets on a water body for a particular parameter will require data adequate to reliably estimate the temporal and spatial variability of that parameter. Sampling, laboratory analysis, and data evaluation steps have several sources of error that should be addressed by data quality objectives. Accuracy in laboratory measurements (measurement quality objectives) can be more easily controlled than field sampling variability. Analytical bias needs to be low and precision as high as possible in the laboratory. Sampling variability can be somewhat controlled by strictly following standard procedures and collecting quality control samples, but natural spatial and temporal variability can contribute greatly to the overall variability in the parameter value. Resources limit the number of samples that can be taken at one site spatially or over various intervals of time. Finally, laboratory and field errors are further expanded by estimate errors in seasonal loading calculations and modeling estimates.

The Walla Walla TMDL study poses some significant challenges. The 303(d) list parameters – fecal coliform and pH – as well as some of the ancillary parameters are quite reactive in the aquatic environment. Table 6 summarizes the field and laboratory measurement quality objectives for reasonable decisions for the study. Stratified seasonal sampling and other sampling design features will be used to better evaluate critical conditions on which to develop TMDL targets for the parameters.

Data quality objectives are more stringent for parameters at sites with few samples over the course of the survey than for parameters with large sample sets. Parameters with relatively large field and laboratory variability (e.g., fecal coliform, *E. coli*, and chlorophyll *a*) will need to have increased numbers of replicate samples in the field and laboratory to increase precision. Some parameters that demonstrate strong diel changes (e.g. D.O. and pH) will need accurate and nearly continuous monitoring during critical seasonal events so rates of change and diel minimums and/or maximums can be observed. These issues will be discussed in *Sampling Design, Field Procedures, Laboratory Procedures, and Quality Control Sections.*

Table 6. Summary measurement quality objectives of laboratory and field parameters. The required reporting limits are also listed.

Measurement	Accuracy % deviation from true value	Precision Relative Standard Deviation	Bias % deviation from true value	Required Reporting Limits Concentration units
Field				
Velocity*	0.1 f/s	0.1 f/s	N/A	0.05 f/s
pH*	0.05 s.u.	0.05 s.u.	0.10 s.u.	1-14 s.u.
Temperature*	0.1°C	0.025°C	0.05°C	1°C to 40°C
Dissolved Oxygen	15	5% RSD	5	0.1 mg/L to 15 mg/L
Specific Conductivity	25	10% RSD	5	1 umhos/cm
Laboratory				
Fecal Coliform (MF)	N/A	25% RSD[2]	N/A	1 cfu/100 mL
E. coli	N/A	25% RSD[2]	N/A	1 cfu/100 mL
Biochemical oxygen demand	N/A	25% RSD	N/A	1 mg/L
Chlorophyll a	N/A	20% RSD	N/A	0.05 ug/L
Total organic carbon	30	10% RSD	10	1 mg/L
Total Suspended Solids	20	10% RSD	N/A	1 mg/L
Total Non-Volatile Suspended Solids	20	10% RSD	N/A	1 mg/L
Turbidity	20	10% RSD	N/A	1 NTU
Chloride	15	5% RSD	5	0.1 mg/L
Total Persulfate Nitrogen	30	10% RSD	10	25 ug/L
Ammonia Nitrogen	25	10% RSD	5	10 ug/L
Nitrate & Nitrite Nitrogen	25	10% RSD	5	10 ug/L
Orthophosphate P	25	10% RSD	5	2 ug/L
Total Phosphorus	25	10% RSD	5	2 ug/L

[2] Logtransformed data

*as units of measurements, not percentages

Sampling Design

General Approach

The TMDL evaluation study will require field data collection and a closer analysis of historical data. The TMDL surveys will be conducted to answer specific issues from the 303(d) listings. See Figure 2 and Table 7 for specific site locations, including priority core sites and all (expanded) sites.

The primary focus of the evaluation will be in the Columbia Basin Ecoregion:

- Walla Walla River from RM 9.9 to RM 40.6 (near state border).
- Touchet River (from mouth to just above the confluence of the North and South Forks at RM 54.0).
- Mill Creek from mouth to RM 22.0 (near state border).

Historical monitoring data show that water quality standard violations occur with enough seasonal variation to warrant a sampling design that takes this variation into account. The network design needs to address the geographic extent of the pH and bacteria problems. Therefore, an expanded sampling network (~45 sites) is proposed during the critical spring and summer months when high fecal coliform, elevated nutrient loads, and high pH tend to occur. A core sampling network of approximately 25 sites for September through March has been developed for periods when criteria violations are less likely to occur (Table 7). Sampling will be more frequent in the spring and summer. Because of the low incidence of violations in historical data and the restricted lab budget, Ecology will not sample during the months of December and February.

Field synoptic surveys will examine the following special monitoring issues: within-season variability in indicator bacteria, diel changes in D.O. and pH, and nutrient effects on productivity. The water quality conditions, the source of problem, and their potential solutions can be better determined with these types of studies.

Seasonal bacteria variability will be addressed by increasing the frequency of monitoring runs in the spring and summer. Core sites will be visited approximately twice a month in these seasons, and sites in the expanded network will be visited once a month. There will be approximately 11 samples per core site in the spring-summer and six samples per expanded network site. Data from key sites among the core network will be fit to probability distribution curves. The statistical rollback method (Ott, 1995) will be applied to estimate target concentrations based on the distribution statistics. Seasonal bacteria loads will be estimated from calculations based on discharge data and sample results.

Table 7. Walla Walla bacteria and pH TMDL sites for 2002 - 2003.

site #	Station name	Description	River Mile[1]	Parameters[2]	Expanded /Core
1	T0	Touchet near mouth @ Hwy 12 bridge	0.6	F,FC,EC,Cl,TSS,TNVSS,N,OC,A	E and C
2	T1	Touchet @ Cummins Rd	1.9	F,FC,Cl,TSS,TNVSS,N, P,HL	E and C
3	T2	Touchet above Hoffer Diversion @ Touchet N Rd	6.8	F,FC,EC,Cl,TSS,TNVSS,N,OC,A	E and C
4	T5	Touchet @ Touchet N Rd South of Luckenbill Rd	14.3	F,FC,Cl,TSS	E
5	T6	Touchet @ Luckenbill Rd	18.2	F,FC,Cl,TSS,TNVSS,N,OC,A	E and C
6	T7	Touchet @ Lamar Rd	24.2	F,FC,Cl,TSS	E
7	T9	Touchet @ PettyJohn Rd	30.3	F,FC,Cl,TSS	E
8	T10	Touchet @ HWY 125 below Prescott	33.4	F,FC,EC,Cl,TSS,TNVSS,N,OC,A	E and C
9	T11	Touchet @ Hart Rd above Prescott	36.0	F,FC,Cl,TSS	E
10	T12	Touchet @ HWY 124 near Bolles Rd	39.5	F,FC,Cl,TSS,N,OC,A	E and C
11	Cop0	Coppei Ck @ HWY 124, west of Waitsburg	0.5	F,FC,Cl,TSS,TNVSS,N,	E
12	T13	Touchet @ Waitsburg, above Coppei Ck	43.1	F,FC,Cl,TSS	E
13	T14	Touchet @ Lower Hogeye/Whiskey Ck Rd	44.9	F,FC,EC,Cl,TSS,N,OC,A	E and C
14	T15	Touchet @ Lewis and Clark State Park	47.3	F,FC,Cl,TSS	E
15	T16	Touchet @ Ward Rd (downstream of Dayton)	50.3	F,FC,Cl,TSS,N,OC	E and C
16	Pat0	Patit Ck @ Front St Bridge	0.1	F,FC,Cl,TSS,TNVSS,N	E
17	Day	City of Dayton WWTP	~52	F,FC,EC,Cl,TSS,N,OC,BOD	E and C
18	T17	Touchet @ Dayton City Park	54.0	F,FC,Cl,TSS,A	E
19	NFT0	NF Touchet just above confluence with South Fork	0.1	F,FC,EC,Cl,TSS,N,OC,A, P,HL	E and C
20	SFT0	SF Touchet just above confluence with North Fork	0.1	F,FC,EC,Cl,TSS,N,OC,A	E and C
21	M0	Mill Ck @ Mission Rd	0.5	F,FC,EC,Cl,TSS,TNVSS,N,OC,A, P,HL	E and C
22	M1	Mill Ck @ Wallula Ave	2.9	F,FC,Cl,TSS,N	E and C
23	M2	Mill Ck @ Gose St	5.0	F,FC,EC,Cl,TSS,TNVSS,N,OC,A	E and C
24	M3	Walla Walla WWTP (on Mill Ck)	5.7	F,FC,EC,Cl,TSS,N,OC	E and C
25	M4	Mill Ck @ 9th St	6.7	F,FC,Cl,TSS,N,OC	E and C
26	M5	Mill Ck @ Roosevelt	9.4	F,FC,Cl,TSS,N	E
27	M6	Mill Ck @ diversion (Reservoir Rd)	11.1	F,FC,Cl,TSS,N,OC,A	E and C
28	Yel1	Yellowhawk Ck @ diversion on Mill Ck	0.0	Same samples/bottles as M6	E and C
29	Gar1	Garrison Ck @ diversion on Mill Ck	0.0	Same samples/bottles as M6	E and C
30	Gar 2	College Place WWTP on Garrison Creek	~3.0	F,FC,EC,Cl,TSS,N,OC,BOD	E and C
31	M7	Mill Ck @ Five Mile Rd	13.4	F,FC,Cl,TSS,N	E and C
32	M12	Mill Ck south of Kooskooskie near state line	22.0	F,FC,EC,Cl,TSS,N,OC,A P,HL	E and C
33	Gar0	Garrison Ck @ Mission Rd	0.5	F,FC,Cl,TSS,N	E and C
34	Yel0	Yellowhawk Ck @ Old Milton Highway	0.2	F,FC,Cl,TSS,TNVSS,N,OC	E and C
35	Rus0	Russell Ck @ McDonald Rd/Plaza Way	0.1	F,FC,Cl,TSS	E
36	Cot0	Cottonwood Ck @ Braden Rd	0.1	F,FC,Cl,TSS	E
37	W0	Walla Walla @ 1st access (Pierce's RV park on Hwy 12)	9.9	F,FC,EC,Cl,TSS,TNVSS,N,OC,A, HL	E and C
38	W1	Walla Walla @ Hwy 12 bridge	12.4	F,FC,Cl,TSS	E
39	W2	Walla Walla @ Byerley/Cummins Bridge	16.0	F,FCEC,Cl,TSS,TNVSS,N,OC, P	E and C
40	W4	Walla Walla @ Touchet-Gardena Rd (above Touchet R)	23.7	F,FC,EC,Cl,TSS,TNVSS,N,OC,A	E and C
41	Pin0	Pine Ck @ Sand Pit Rd	1.4	F,FC,Cl,TSS	E
42	Mud0	Mud Ck @ Borgen/Detour Rd	0.6	F,FC,Cl,TSS	E
43	Dry0	Dry Ck @ Hwy 12	0.5	F,FC,Cl,TSS	E
44	W5	Walla Walla @ Lowden Rd	29.5	F,FC,Cl,TSS,TNVSS,N,OC,A	E and C
45	W6	Walla Walla @ McDonald Rd	31.6	F,FC,Cl,TSS,N	E and C
46	W7	Walla Walla @ Detour Rd	35.2	F,FC,EC,Cl,TSS,TNVSS,N,OC,A	E and C
47	WLWW0	West Little Walla Walla @ Swegle Rd	0.7	F,FC,Cl,TSS	E
48	W8	Walla Walla @ Last Chance Rd	35.1	F,FC,Cl,TSS	E
49	W9	Walla Walla @ 125 near state line	40.6	F,FC,EC,Cl,TSS,N,OC,A P,HL	E and C

[1] River Miles have been estimated from GIS watershed maps (Ecology).

[2] **F** = parameters taken in the field (flow, pH, conductivity, temperature, D.O.); **FC**= fecal coliform, **EC**= *E coli*.; **Cl**= chloride; **TSS**= total suspended solids; **TNVSS**= total nonvolatile suspended solids; **N**=nutrients 5, total persulfate nitrogen, chlorophyll a; **OC**= (total and dissolved organic carbon); **A**=alkalinity; **P**= periphyton chlorophyll a; **BOD**= biological/biochemical oxygen demand; **HL** = Hydrolab diel site for July and August.

Ecology will deploy Hydrolab DataSondes to monitor continuously (over 2-3 days) D.O. (mg/L), pH (units), temperature (^{o}C), and conductivity (umhos/cm) during one survey in July and one in August, 2002. DataSondes will be placed near the mouths of the Walla Walla River and Mill Creek, midway between the mouths and the state border, and upstream, near the state border to measure changes within a response to a potential source or instream influence. Ecology may also monitor the Touchet River using DataSondes, depending on previous sampling results. Habitat measurements will be taken to reduce site variability from water velocity, depth, incident light, and substrate characteristics. Ecology will also look for reference conditions where measurements indicate pH and D.O. criteria are met. Reference conditions will be helpful in determining the background water quality conditions and what factors are most important in affecting instream pH and D.O. The data will be used with the free-water diurnal curve method to estimate community primary productivity (APHA, 1998). As a secondary check on the continuous data, the Delta Method (Chapra, 2000) will be used to estimate diel pH and D.O. maxima and minima. The method will also be used at sites where only instantaneous data are collected.

Ecology will take estimates of primary production by measuring chlorophyll a in periphyton samples and estimating periphyton density during the diel dissolved oxygen/pH surveys in July and August. Water column samples of nitrogen, phosphorus, total organic carbon, (TOC), dissolved organic carbon (DOC), and alkalinity will also be collected to help interpret the diel data, and to help with nutrient mass balances and nutrient dynamics.

The steady-state, one-dimensional water quality model, QUAL2K, will be used for the main branches of the Walla Walla basin if a critical condition can be defined for pH and/or D.O. conditions. Chapra (2000) has upgraded the USEPA model QUAL2E to include pH modeling and fixed plant and periphyton effects on D.O., pH, carbon, phosphorus and nitrogen dynamics. The temperature TMDL group also uses QUAL2K to model the heat budget of the river system (LeMoine and Stohr, 2002).

All monitoring will be coordinated with local monitoring groups and other Ecology TMDL project leads. Temperature and discharge data collected by these groups will be useful for interpreting the diel and instantaneous data. Habitat data and local knowledge of potential instream influences or contaminant sources will be essential for data interpretation.

Monitoring Schedule

Ecology will sample from June 2002 to June 2003 with an option to continue to October 2003. The proposed monitoring schedule with expanded sampling and core sampling is shown in Table 8.

Table 8. Monthly sampling design for indicator bacteria, pH and nutrients, and dissolved oxygen. Shaded areas indicate no sampling. "exp." is expanded sampling network and "core" is core site sampling only.

	2002							2003					
	June	July	August	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March	April	May	June
# surveys	1	2	2	1	1	1		1		1	2	2	2
Bacteria (FC and *E. Coli*)	core	exp. + core	exp. + core	core	core	core		core		core	exp. + core	exp. + core	exp. + core
pH / nutrient	core	exp. + core	exp. + core	exp.	core	core		core		core	exp.	exp.	exp.
Dissolved Oxygen		exp.	exp.										

Intensive bacteria (i.e. expanded or expanded plus core) surveys will be conducted in the spring and summer months when major runoff and irrigation resume. This involves taking grab samples and analyzing for fecal coliform and *E. coli* concentrations. Intensive nutrient and pH sampling will occur in the months of April through September. Sampling for biological oxygen demand (BOD) will occur during expanded sampling events and at WWTPs that are operating at the time. This could include (depending on time of year and if they discharge to a stream) the Walla Walla, College Place, Waitsburg, and/or Dayton WWTPs. The diel D.O. and pH surveys using Hydrolab DataSondes will be conducted in critical environmental conditions (high heat, light, and instream algal growth and increased water withdrawals and low flows) of July and August. The DataSondes will be set up to take recordings of D.O., pH, conductivity, and temperature every 15 minutes during a 2-3 day period. Core and expanded sampling will occur separately within the same month to get a clearer picture of any existing water quality problems (Tables 7). See Table 11 for a description of the parameters that are included in the core and expanded sampling networks.

Methods

Stream Flows

Five on-site continuous flow-monitoring stations will be established by Ecology's Environmental Assessment Program's Stream Hydrology Unit in the study area during the duration of sampling. The standard protocols for the on-site continuous data loggers will follow those currently established by the Stream Hydrology Unit (Ecology, 2000). Stations maintained by the USGS provide a continuous flow monitoring site on the Walla Walla River and two sites on Mill Creek (Figure 4). Additional sites established by the basin watermaster in cooperation with the Washington State Department of Fish and Wildlife may also be utilized during this project (Mendel and Neve, personal communication). Discharge monitoring reports will be used to obtain the WWTP discharge records.

Instantaneous flows will be measured at tributary and all other sites without continuous flow-monitoring equipment when samples are taken. Discharge will be calculated by measuring velocities and depths in sixteen or more divisions of a cross-section (WAS, 1993). The record of instantaneous measurements at these sites will be compared to the discharge record of nearby continuous monitoring sites. Correlations will be developed to create a continuous or partially-continuous record for the sites.

Field Procedures

Standard Ecology protocols will be used for sample collection, preservation, and shipping to the Manchester Environmental Laboratory (MEL) (MEL, 2000). Chain-of-custody signatures will be required during sample transport. EA Program field methods will be followed for the collection of flow, dissolved oxygen, pH, temperature, and specific conductance and for the deployment of data recording equipment (WAS, 1993). All sampling sites will have unique identification numbers. Field notes and field measurement data will be maintained in ink on water-resistant paper. Field meter calibration will follow EA Program protocols (WAS, 1993) under manufacturer's instructions. Calibration data will be recorded in the field notebooks.

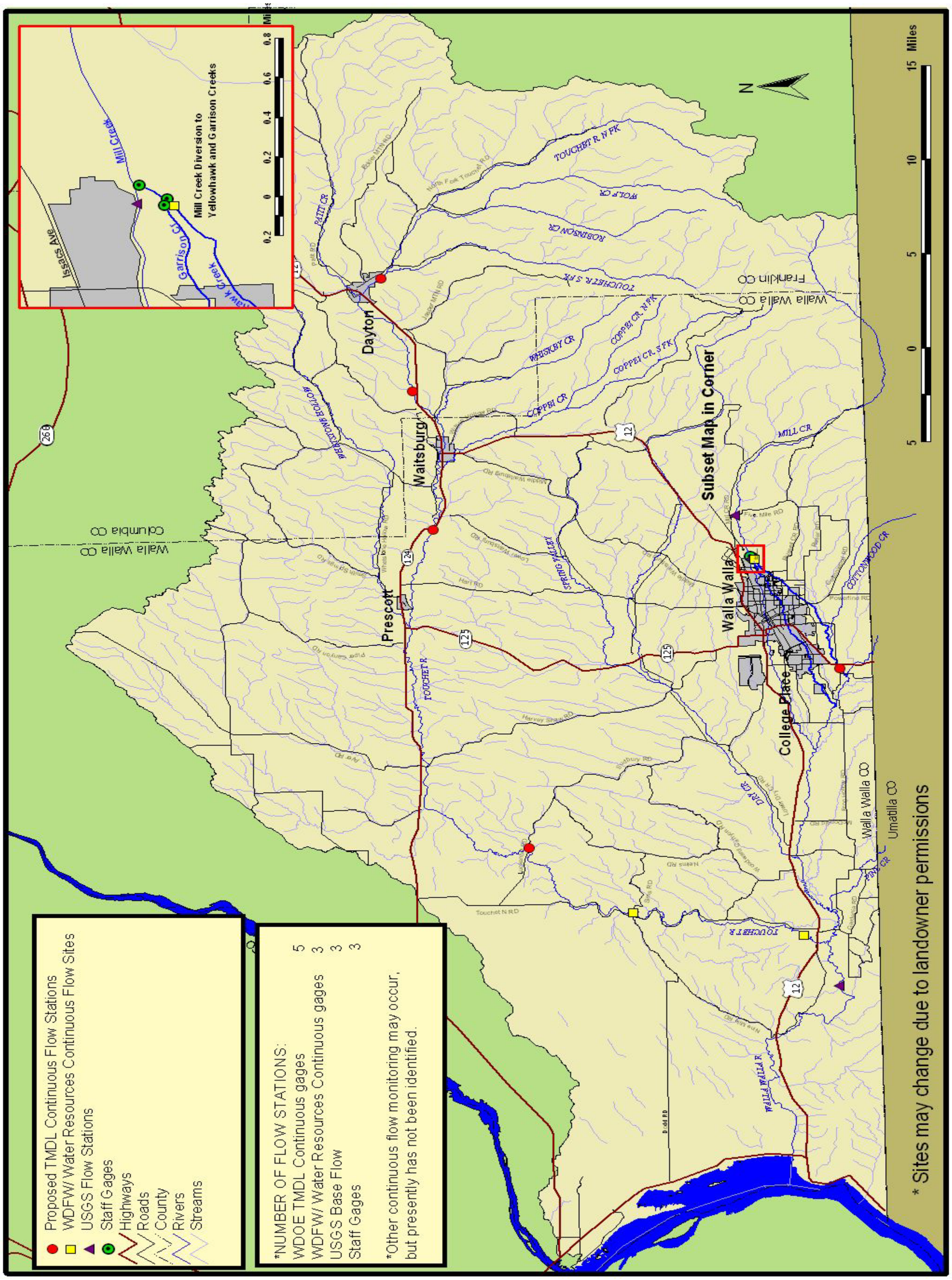
Samples for analysis at Manchester Environmental Laboratory will be collected directly into pre-cleaned containers supplied by MEL. Samples will be stored in the dark, on ice, and shipped to MEL. Samples will be available at MEL for analysis within 30 hours of collection. When possible, bacteria samples will be delivered for analysis within 24-hours of collection.

Hydrolab DataSonde dissolved oxygen, pH, conductivity, and temperature probes will be maintained, calibrated, and checked as adopted from the Electronic Data Solution's *Hydrolab Maintenance and Calibration Workshop Training Manual* (2002) and Hydrolab Corporation's *DataSonde® 4 and MiniSonde® User's Manual* (1999). All probes will be cleaned, maintained, calibrated, and checked before and after each DataSonde deployment to ensure proper functioning in the field. DataSondes and their probes will be properly stored when not in use, following Hydrolab's recommendations.

Laboratory Procedures

Nutrient analyses will include total organic carbon (TOC), dissolved organic carbon (DOC), total phosphorus (TP), orthophosphate, nitrate and nitrite, ammonia, and total nitrogen. The required quantification limits for laboratory data to meet the measurement quality objectives in Table 6 should be attainable through the analytical methods listed in Table 9. The MEL laboratory staff will consult the project manager if any changes in procedures over the course of the project are recommended or if matrix difficulties are encountered.

Figure 4: Proposed Continuous Flow Stations for the Walla Walla Temperature TMDL.



Map provided by Mike LeMoine, WA Department of Ecology, EA Program, 2002.

Table 9. Recommended methods for field measurements and for laboratory determinations in water samples taken from the Walla Walla River basin for the TMDL evaluation.

	Method[1]	Estimated Range (including detection limit)	Estimated Number of Samples[2]
Field Measurements			
Velocity	WAS, 1993	0 – 9 ft/sec.	315
pH	150.1/4500H	6.0 – 9.0 s.u.	445
Temperature	/2550B	0 – 30 ° C	445
Dissolved Oxygen	360.2/4500-OC	0 – 15 mg/L	445
Specific Conductivity	/2510	10 - >24,000 umhos/cm	445
Laboratory Determination			
Fecal Coliform (MF)	/9222D	<1 - > 5000 cfu/100 mL	450
E. Coli	1103/	<1 - > 5000 cfu/100 mL	450
Biochemical oxygen demand	405.1/5210B	<3 – 20 mg/L	25
Chlorophyll a	/10200H(3)	<1 – 100 ug/L	285
Periphyton chlorophyll a	/10200H(3)	<1 – 100 ug/L	36
Total organic carbon	415.1/5310B	1 – 20 mg/L	230
Dissolved organic carbon	415.1/5310B	1 – 20 mg/L	230
Total Suspended Solids	160.2/2540D	1 – 5000 mg/L	450
Total Non-Volatile Sus. Solids	/2540E	1 – 5000 mg/L	120
Turbidity	180.1/2130B	1 – 1000 NTU	445
Chloride	300/4110D	0.5 – 200 mg/L	450
Alkalinity	/2320B	10-500 mg/L	175
Total Persulfate Nitrogen	/4500-N C	0.5 – 20 mg/L	295
Ammonia Nitrogen	350.1/4500-NH3D	<0.01 – 20 mg/L	285
Nitrate & Nitrite Nitrogen	353.2/4500-NO3F	0.05 – 10 mg/L	285
Orthophosphate P	365.3/4500PF	<0.005 – 0.5 mg/L	285
Total Phosphorus	365.3/4500PF	0.01 – 10 mg/L	295

[1] USEPA, 1983 /APHA, et al., 1998 (Standard Methods)
[2] Numbers do not include QA samples.

Sample quantities and processing procedures should not overwhelm the laboratory capacity. The project manager will follow normal procedures for notification and scheduling. If laboratory sample load capacities are in doubt, rescheduling of individual surveys may be negotiated.

Bacteria samples have a holding time of 24 hours, after which results are listed as estimates. Samples sent to Manchester via Horizon Airlines usually are processed within the holding time (Ross, personal communication). However, at times it may not be possible to send such samples to MEL and process them within 24 hours.

Primary productivity is determined using Standard Methods 10300D-4 (2), the free-water diel curve method (APHA, 1998). Reaeration rates applied to the curve method will be estimated from channel depth and water velocity characteristics during the period when dissolved oxygen measurements are recorded.

Periphyton biomass samples will be collected by scraping material from a measured surface area on representative rocks. Three samples will be collected at each site. The material will then be analyzed for chlorophyll a.

Quality Control Procedures

Collecting replicate samples will assess total variation for field sampling and laboratory analysis and thereby provide an estimate of total precision. At least 10% of the total number of laboratory samples and field measurements per parameter (except velocity/discharge) will be replicated (Table 10).

All water samples for laboratory analysis will be directly collected in pre-cleaned containers supplied by the Manchester Environmental Laboratory (MEL) except ortho-phosphorus and dissolved organic carbon, which will be collected in a syringe and filtered into a pre-cleaned container. The syringe will be rinsed with ambient water at each sampling site three times before filtering. All samples for laboratory analysis will be preserved as specified by Manchester Environmental Laboratory (MEL, 2000) and delivered to MEL within 24 hours of collection. Any waste water treatment plant effluent sampling may require sample splitting and interlaboratory comparisons. At least two effluent samples from these point sources will be split if the municipalities choose qualified independent laboratories. A field replicate will be collected for at least one site during each sampling event (Table 10). Field blanks will be created by exposing reagent-grade water in the field to all appropriate equipment, preservatives, and pre-cleaned containers.

Table 10. Summary of field and laboratory quality control procedures for the Walla Walla and Touchet Rivers, and Mill Creek.

Analysis	Field Blanks	Field Replicates	Lab Check Standard	Lab Method Blank	Lab Replicate	Matrix Spikes
Field Measurements						
Velocity/Discharge	N/A	1/run	N/A	N/A	N/A	N/A
pH	N/A	5/run	N/A	N/A	N/A	N/A
Temperature	N/A	5/run	N/A	N/A	N/A	N/A
Dissolved Oxygen	N/A	1/5 samples	N/A	N/A	N/A	N/A
Specific Conductivity	N/A	5/run	N/A	N/A	N/A	N/A
Laboratory Analyses						
Fecal Coliform (MF)	N/A	1/5 samples	N/A	1/run	1/run	N/A
E. Coli	N/A	1/5 samples	N/A	1/run	1/run	N/A
Biochemical oxygen demand	N/A	1/run	1/run	1/run	N/A	N/A
Chlorophyll a	N/A	1/10 samples	N/A	N/A	1/10 samples	N/A
Total organic carbon	N/A	1/10 samples	1/run	1/run	1/10 samples	1/20 samples
Dissolved organic carbon	N/A	1/10 samples	1/run	1/run	1/10 samples	1/20 samples
Total Suspended Solids	N/A	1/10 samples	1/run	1/run	1/10 samples	N/A
Total Non-volatile Sus. Solids	N/A	1/10 samples	1/run	1/run	1/10 samples	N/A
Turbidity (if applicable)	N/A	1/10 samples	1/run	1/run	1/10 samples	N/A
Chloride	1/survey	1/10 samples	1/run	1/run	1/10 samples	N/A
Alkalinity	N/A	1/10 samples	1/run	1/run	1/10 samples	N/A
Total Persulfate Nitrogen	1/survey	1/10 samples	1/run	1/run	1/10 samples	1/20 samples
Ammonia Nitrogen	1/survey	1/10 samples	1/run	1/run	1/10 samples	1/20 samples
Nitrate & Nitrite Nitrogen	1/survey	1/10 samples	1/run	1/run	1/10 samples	1/20 samples
Orthophosphate P	1/survey	1/10 samples	1/run	1/run	1/10 samples	1/20 samples
Total Phosphorus	1/survey	1/10 samples	1/run	1/run	1/10 samples	1/20 samples

Data Assessment Procedures and Reporting

Laboratory data reduction, review, and reporting will follow procedures outlined in MEL's User Manual (MEL 2000). Sample losses and samples exceeding holding times because of transport or lab load problems will be reported to the project manager immediately upon their discovery. Laboratory staff will be responsible for internal quality control validation, and for proper data transfer and reporting data to the project manager via LIMS.

All laboratory data, except microbiological data, will be transferred to the project manager as close to 30 days as possible. Elevated fecal coliform densities (> 200 cfu/100 mL) will be reported to the project manager within a week so that Ecology's Eastern Regional Office (ERO) can be notified in accordance with the official notification procedure. The project manager or principal investigator will validate the quality of the data received from the laboratory and collected in the field in reference to the measurement quality objectives (MQO) in Table 6. The review will be performed as often as possible, but at a quarterly interval at a minimum. Adjustments to field or laboratory procedure or to MQOs may be necessary after such a review, and clients and QA Project Plan signature parties will be notified of major changes.

All water quality data will be entered into Ecology's Environmental Information Management (EIM) system. Data will be verified and a random 25% of the data entries will be independently reviewed for errors. If errors are detected, another 25% will be reviewed until no errors are detected. All preliminary data will be made available to the ERO for disbursement after basic quality control and EIM are completed.

Data analysis will include evaluation of data distribution characteristics and, if necessary, appropriate distribution transformations. Estimation of univariate statistical parameters and graphical presentation of the data (box plots, time series, regressions) will be made using EXCEL or WQHYDRO (Aroner, 1994) computer software.

The modeling software Ecology will use includes: QUAL2K (Chapra, 2000) for quasi-dynamic analysis of pH during critical conditions in critical reaches, and the Statistical Rollback method (Ott, 1995) for bacteria with tributary targets matching river target reductions. The Walla Walla TMDL data analysis will also rank the relative importance of reaches or tributaries as sources for TMDL actions.

Project Organization and Schedule

The roles and responsibilities of staff involved in this project are provided below:

- *Joe Joy* (Ecology): Project Manager, Environmental Assessment Program, Watershed Ecology Section. Responsible for overall project supervision and project design. Also supports principle investigator with project plan preparation, collecting, and analyzing data. Responsible for TMDL target development, modeling, developing graphs and figures, and writing and editing draft and final reports. Also responsible for coordinating activities with Anita Stohr, the temperature project manager, and with Art Johnson, the pesticides project manager (360-407-6486).

- *Trevor Swanson* (Ecology): Principal Investigator, Environmental Assessment Program, Watershed Ecology Section. Responsible for QA Project Plan preparation, reconnaissance work, field data collection, data quality assurance, general field and data collection logistics. Also assists with data analysis and report writing (360-407-6685).

- *Anita Stohr and Mike LeMoine* (Ecology): Environmental Assessment Program, Watershed Ecology Section. Responsible for the temperature TMDL portion of the project (360-407-6979).

- *Art Johnson and Brandee Era* (Ecology): Environmental Assessment Program, Watershed Ecology Section. Responsible for the toxics TMDL portion of the project (360-407-6766).

- *Chuck Springer* (Ecology): Environmental Assessment Program, Environmental Monitoring and Trends Section. Responsible for the stream hydrology portion of the project – including installation of flow equipment, downloading information, and assessing stream flows (360-407-6997).

- *Will Kendra* (Ecology): Section Manager of the Watershed Ecology Section of the Environmental Assessment Program. Responsible for approving the project QA Project Plan, project budget, and project reports (360-407-6698).

- *Karol Erickson* (Ecology): Unit Supervisor of the Watershed Studies Unit of the Environmental Assessment Program. Responsible for internal review of the project QA Project Plan and draft data summary reports (360-407-6694).

- *Stuart Magoon and Will White* (Ecology): Manchester Environmental Laboratory (MEL) staff responsible for sample delivery and analysis/reporting of chemical data (360-871-8860).

- *Cliff Kirchmer* (Ecology): Quality Assurance Section staff responsible for review of the project QA Project Plan. Also, available as a technical advisor for quality assurance and quality control of data collected during the duration of the project (360-407-6455).

- *Don Nichols* (Ecology): Eastern Regional Office, Water Quality Program Section Manager. Reviews and approves QA Project Plan and technical documents (509-456-6169).

- *Marcie Mangold* (Ecology): Eastern Regional Office, Water Quality Program, Walla Walla Basin TMDL Lead. Responsible for coordination of local groups with TMDL activities, communicating TMDL information to the public and local agencies, review of QA Project Plan and technical documents, and implementation of TMDL recommendations (509-456-3069).

- *Victoria Leuba* (Ecology): Eastern Regional Office, Shorelands and Environmental Assistance Program. Watershed Planning Lead. Responsible for coordination of those involved with the 2514 process and watershed planning (509-625-5179).

The proposed schedule for the TMDL project is as follows:

Reconnaissance Survey:	February 13-14 2002
Submit Initial QA Project Plan for Internal Review:	June 10, 2002
TMDL Survey Sampling:	June 2002 – June 2003
Possible Expanded Sampling Period:	June 2003 – October 2003*
Draft to Karol, Client, and Advisory Group:	January 2004
Draft to General Review:	April 2004
Final Received by Client:	June 2004

* Expanded sampling is planned to be a minor effort to fill data gaps, if necessary, and should not interfere with analysis of the data collected from June 2002 – June 2003. A Project Change Form will be submitted by May 2003 if scheduled reporting dates are shifted because of additional data collection.

The laboratory budget for FY03 is outlined in Table 11. Additional costs of gage installation by the Stream Hydrology Unit have not been calculated. The total laboratory budget for FY03 is estimated to be $87,000. Sampling in June 2002 (FY02) will amount to about $10,200, and additional sampling in July-October 2003 may cost approximately $27,000.

The sampling plan for bacteria requires analysis within 24-hours. To meet this requirement, a local laboratory may need to be contracted to analyze the samples. The cost incurred by contracting this work has not been determined.

Table 11. TMDL laboratory sample cost estimate plan from June 2002 through June 2003.

Expanded survey sampling plan

		# sites	QA/survey	Price[1]	Total per survey	Total/run	Number of Runs	Cost for Project
Walla Walla								
Bacteria Basin wide		(15 x 3)						
	Fecal Coliform	45	6	$ 20	$ 1020			
	E. coli	14	3	$ 35	$ 595			
	Chloride	45	6	$ 12	$ 612			
	TSS	45	5	$ 10	$ 500			
	TNVSS	15	1	$ 21	$ 336	$ 3063	5	$15,300
Nutrient and pH related		(10 x 3)						
	Nutrients 5	30	3	$ 53	$ 1,749			
	Total Persulfate N	30	3	$ 16	$ 528			
	BOD5	4	1	$ 46	$ 230			
	TOC	21	3	$ 29	$ 696			
	DOC	21	3	$ 29	$ 696			
	Alkalinity	12	1	$ 14	$ 182			
	Chlorophyll a	30	3	$ 46	$ 1,518	$ 5,599	6	$33.600
Dissolved Oxygen Survey								
	Periphyton chl a	18	3	$ 46	$ 966	$ 966	2	$1,932

Core site sampling plan

		# sites	QA/survey	price	Total per survey	Total/run	Number of Runs	Cost for Project
Bacteria								
	Fecal Coliform	25	3	$ 20	$ 560			
	E. coli	10	3	$ 35	$ 455			
	Chloride	25	3	$ 12	$ 336			
	TSS	25	3	$ 10	$ 280			
	TNVSS	5	1	$ 21	$ 126	$ 1,757	11	$19,300
Nutrient and pH related								
	Nutrients 5	15	3	$ 53	$ 954			
	Total Persulfate N	15	3	$ 16	$ 288			
	TOC	15	3	$ 29	$ 522			
	DOC	15	3	$ 29	$ 522			
	Alkalinity	15	1	$ 14	$ 224			
	Chlorophyll a	15	3	$ 46	$ 828	$ 3,338	7	$23,400
							Total =	**$93,500**

1 Costs listed here are 50% of actual cost; the other 50% is provided through base funding from the Watershed Ecology Section.

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Appendices

Appendix 1
Washington State Water Quality Standards

Class AA (extraordinary), Class A (excellent), and Class B (good) fresh water quality standards and characteristic uses.

	Class AA	Class A
General Characteristic:	Shall markedly and uniformly exceed the requirements for all, or substantially all uses.	Shall meet or exceed the requirements for all, or substantially all uses.
Characteristic Uses:	Shall include, but not be limited to, the following: domestic, industrial, and agricultural water supply; stock watering; salmonid and other fish migration, rearing, spawning, and harvesting; wildlife habitat; primary contact recreation, sport fishing, boating, and aesthetic enjoyment; and commerce and navigation.	Same as AA.
Water Quality Criteria:		
Fecal Coliform:	Shall not exceed a geometric mean value of 50 organisms/100 mL, with not more than 10% of samples exceeding 100 organisms/100 mL.	Shall not exceed a geometric mean value of 100 organisms/100 mL, with not more than 10% of samples exceeding 200 organisms/100 mL.
Dissolved Oxygen:	Shall exceed 9.5 mg/L.	Shall exceed 8.0 mg/L.
Total Dissolved Gas:	Shall not exceed 110% saturation.	Same as AA.
Temperature:	Shall not exceed 16.0°C due to human activities. When conditions exceed 16.0°C, no temperature increase will be allowed which will raise the receiving water temperature by greater than 0.3°C. Increases from non-point sources shall not exceed 2.8°C.	Shall not exceed 18.0°C due to human activities. When conditions exceed 18.0°C, no temperature increase will be allowed which will raise the receiving water temperature by greater than 0.3°C. Increases from non-point sources shall not exceed 2.8°C.
pH:	Shall be within the range of 6.5 to 8.5 with a human-caused variation with a range of less than 0.2 units	Shall be within the range of 6.5 to 8.5 with a human-caused variation with a range of less than 0.5 units.
Turbidity:	Shall not exceed 5 NTU over background turbidity when the background turbidity is 50 NTU or less, or have more than a 10% increase in turbidity when the background is more than 50 NTU.	Same as AA.
Toxic, Radioactive, or Deleterious Material:	Shall be below concentrations which have the potential singularly or cumulatively to adversely affect characteristic uses, cause acute or chronic conditions to the most sensitive aquatic biota, or adversely affect public health.	Same as AA.
Aesthetic Values:	Shall not be impaired by the presence of materials or their effects, excluding those of natural origin, which offend the senses of sight, smell, touch, or taste.	Same as AA.

Class B

General Characteristic:	Shall meet or exceed the uses for most uses.
Characteristic Uses:	Shall include, but not be limited to, the following: water supply (industrial and agricultural); stock watering; fish and shellfish; salmonid and other fish migration, rearing, spawning, and harvesting; wildlife habitat; secondary contact recreation, sport fishing, boating, and aesthetic enjoyment; and commerce and navigation.

Water Quality Criteria:

Fecal Coliform:	Shall both not exceed a geometric mean value of 200 organisms/100 mL, with not more than 10% of samples exceeding 400 organisms/100 mL.
Dissolved Oxygen:	Shall exceed 6.5 mg/L.
Total Dissolved Gas:	Shall not exceed 110% saturation.
Temperature:	Shall not exceed 21.0°C due to human activities. When conditions exceed 21.0°C, no temperature increase will be allowed which will raise the receiving water temperature by greater than 0.3°C. Increases from non-point sources shall not exceed 2.8°C.
pH:	Shall be within the range of 6.5 to 8.5 with a human-caused variation with a range of less than 0.5 units
Turbidity:	Shall not exceed 10 NTU over background turbidity when the background turbidity is 50 NTU or less, or have more than a 20% increase in turbidity when the background is more than 50 NTU.
Toxic, Radioactive, or Deleterious Material:	Shall be below concentrations which have the potential singularly or cumulatively to adversely affect characteristic uses, cause acute or chronic conditions to the most sensitive aquatic biota, or adversely affect public health.
Aesthetic Values:	Shall not be reduced by dissolved, suspended, floating, or submerged matter not attributed to natural causes, so as to affect water use or taint the flesh of edible species.

Appendix 2
Criteria for Information Used in 303(d) Listing and De-listing (Currently Under Revision)

Guidelines applicable to the Walla Walla Basin TMDL evaluation as summarized from Department of Ecology Water Quality Program Policy 1-11, June 1997 revision.

Data received must meet one of the following criteria:

- For water measurements of temperature, dissolved oxygen, pH, turbidity and total dissolved gas in 10% or more of the measurements and a minimum of at least two measurements are beyond the numeric state surface water quality criteria within the most recent five-year period that data has been collected.

- For water samples of toxic pollutants, a minimum of at least two samples exceed the numeric state water quality criteria or the national toxic rule criteria (40 CFR Part 131) and must be sampled within the same waterbody segment and within the most recent three-year period that data has been collected.

Data will be interpreted according to the following policies:

- Measurements of instantaneous concentrations are assumed to represent the averaging periods specified in the state surface water quality standards for acute and chronic criteria.

- Sample data that are below detection limits will not be used with criteria that are also below such detection limits.

- Nondetected analytes will not be used as a basis for listing.

- Sample data collected below the quantitation limit, but above the detection limit, will be used with criteria that are below the detection limit.

- Sample data collected between the quantitation limit and the detection limit will not be used with criteria that are also between the quantitation limit and the detection limit unless replicate samples confirm the result.

- Sample data of fecal coliform from freshwater will require a minimum of 5 samples collected within a 30-day period to calculate the geometric mean. Sample data of fecal coliform from marine waters will require a minimum of 30 from a systematic random sampling survey or 15 samples from a storm event sampling survey to calculate the geometric mean. If sample sizes are less than that specified, data from two single samples can be used with the criterion for 10% of samples used in calculating the geometric mean (e.g. 100 cfu/100mL for Class A freshwaters or 43 cfu/100mL for Class A marine waters) to list a water segment.

- Data collected over ten years old will not be used for listing unless specific information is identified and/or rationale can be posed that shows these older data likely represent current conditions.

Waterbody segments can be excluded from the proposed list for any one of the following:

- New information showing that water quality standards are being met. This may include more recent or more accurate data; more sophisticated analysis using a calibrated model; identification of flaws in the original assessment; or changes in standards, guidance, or policy. New data showing standards that are now being met should at a minimum be collected at about the same time of year or during the most critical period for the parameter and at the same frequency as the monitoring that was used as a basis to list the water.

Appendix 3

Oregon DEQ Dissolved Oxygen & Intergravel Dissolved Oxygen Criteria (Applicable to All Basins)

<table>
<tr><th rowspan="2">Class</th><th colspan="5">Concentration and Period[1]
(All Units are mg/L)</th><th rowspan="2">Use/Level of protection</th></tr>
<tr><th>30-D</th><th>7-D</th><th>7-Mi</th><th colspan="2">Min</th></tr>
<tr><td rowspan="2">Salmonid spawning</td><td rowspan="2"></td><td rowspan="2">11.0[2,3]</td><td rowspan="2"></td><td colspan="2">9.0[3]</td><td rowspan="2">Principal use of salmonid spawning and incubation of embryos until emergence from the gravels. Low risk of impairment to cold-water aquatic life, other native fish and invertebrates. The IGDO criteria represents an acute threshold for survival based on field studies.</td></tr>
<tr><td>8.0[4]</td><td>6.0[5]</td></tr>
<tr><td>Cold Water</td><td>8.0[6]</td><td></td><td>6.5</td><td colspan="2">6.0</td><td>Principally cold-water aquatic life. Salmon, trout, cold-water invertebrates, and other native cold-water species exist throughout all or most of the year. Juvenile anadromous salmonids may rear throughout the year. No measurable risk level for these communities</td></tr>
<tr><td>Cool Water</td><td>6.5</td><td></td><td>5.0</td><td colspan="2">4.0</td><td>Mixed native cool-water aquatic life, such as sculpins, smelt, and lampreys. Waterbodies includes estuaries. Salmonids and other cold-water biota may be present during part or all of the year but do not form a dominant component of the community structure. No measurable risk to cool-water species, slight risk to cold-water species present.</td></tr>
<tr><td>Warm Water</td><td>5.5</td><td></td><td></td><td colspan="2">4.0</td><td>Waterbodies whose aquatic life beneficial uses are characterized by introduced, or native, warm-water species.</td></tr>
<tr><td>No Risk</td><td colspan="5">No Risk from background</td><td>No Risk No Change from Background
The only DO criterion that provides no additional risk is “no change from background”. Waterbodies accorded this level of protection include marine waters and waters in Wilderness areas.</td></tr>
</table>

1 30-D = 30-day mean minimum as defined in OAR 340-41-006.
7-D = 7-day mean minimum as defined in OAR 340-41-006.
7-Mi = 7-day minimum mean as defined in OAR 340-41-006.
Min = Absolute minimums for surface samples when applying the averaging period, spatial median of IGDO.
2 When Intergravel DO levels are 8.0 mg/L or greater, DO levels may be as low as 9.0 mg/L, without triggering a violation.
3 If conditions of barometric pressure, altitude and temperature preclude achievement of the footnoted criteria, then 95 percent saturation applies.
4 Intergravel DO action level, spatial median minimum.
5 Intergravel DO criterion, spatial median minimum.
6 If conditions of barometric pressure, altitude and temperature preclude achievement of 8.0 mg/L, then 90 percent saturation applies.

Note:

Shaded values present the absolute minimum criteria, unless the Department believes adequate data exists to apply the multiple criteria and associated periods.

Oregon DEQ, 2001

Appendix 4

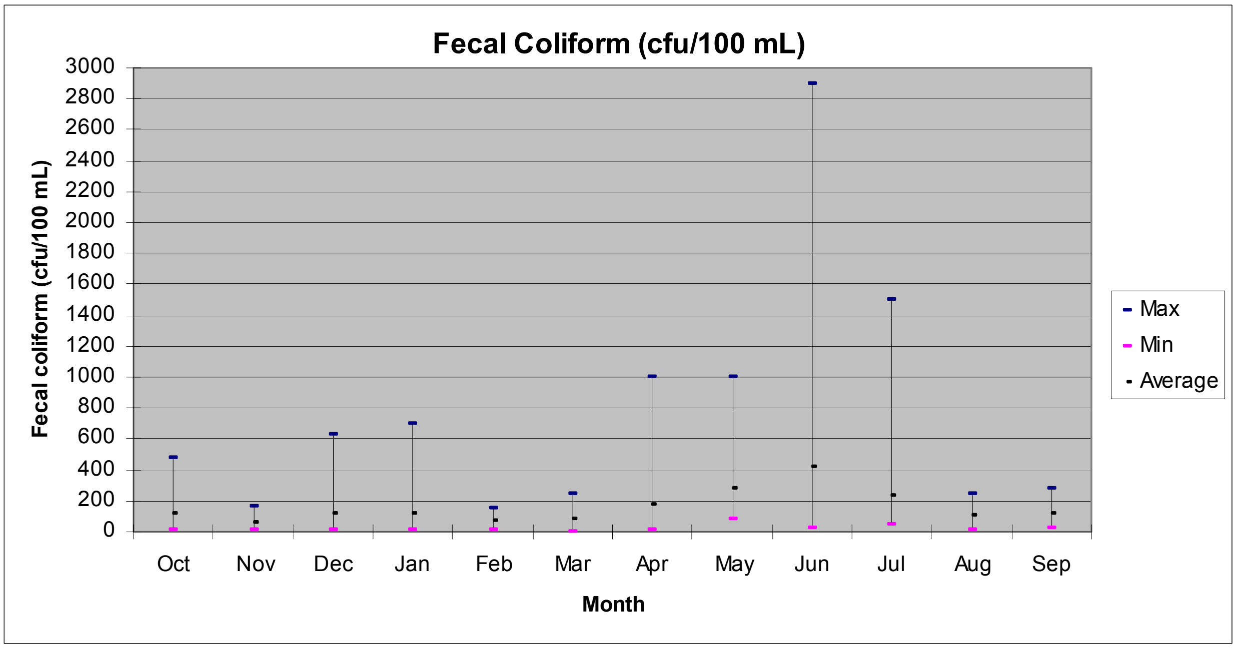
Brief Descriptions and National Pollutant Discharge Elimination System (NPDES) Permit Limits for Five Wastewater Treatment Plants (WWTPs) in the Walla Walla Basin, Washington

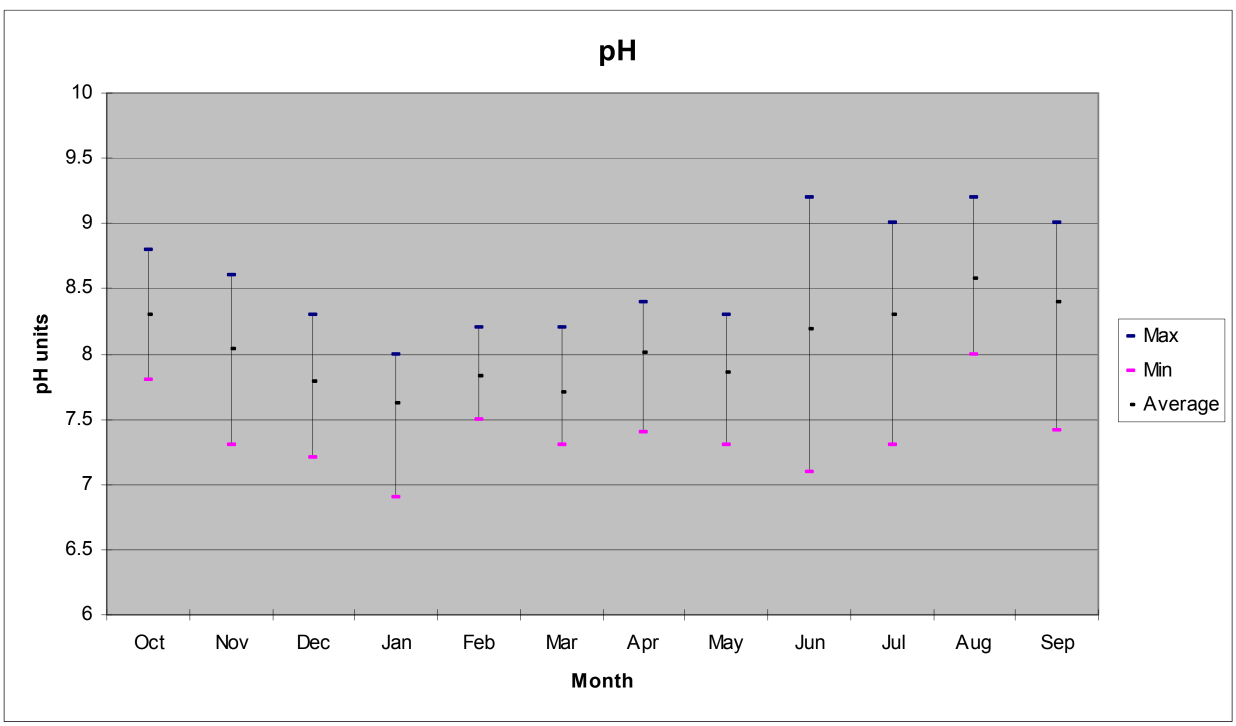
Facility	Type of Treatment	Discharge Location	Season	Effluent Volume		NPDES Permit Limits						
				Maximum (mgd) month avg.	Maximum (mgd) daily	BOD (mg/L) mo/week	TSS (mg/L) mo/week	Fecal coli cfu/100 mL mo/week	pH s.u. daily range	Temp. degrees C daily max.	Ammonia (mg/L) mo./day	Chlorine (mg/L) mo./day
Walla Walla	Trickling filters w/ activated sludge & duo-media filtration	Mill Creek/ Irrigation	Dec.-May Jun.-Nov.	9.6	12.3	15 / 22* 16 / 24	30/45 10/15	200 / 400 2.2 / 23	6 - 9 7 - 9		8 / 12**	0.009/0.012
College Place	Activated sludge (sequencing batch reactor)	Garrison Cr/ wetland or spray fields	Apr.-Nov. Dec.-Mar.	1.65	2	15 / 23	15/23	23 / 240*** - / 23***	6 - 9	20	1 / 2 2 / 3	
Waitsburg	Oxidation ditch to infiltration lagoon	Hyporheic zone of Touchet R.	Dec.-May Jun.-Nov.		0.236	15 / 20	15 / 20	100 / 200	7 - 9		7 - 14 5.8 - 11.6	
Dayton	Trickling filter w/ nitrification & UV disinfection	Touchet R.		0.75	2.25	30 / 45	30 / 45	200 / 400	6.5 - 8.5			
Touchet	Infiltration lagoon	Hyporheic zone of Touchet R.										

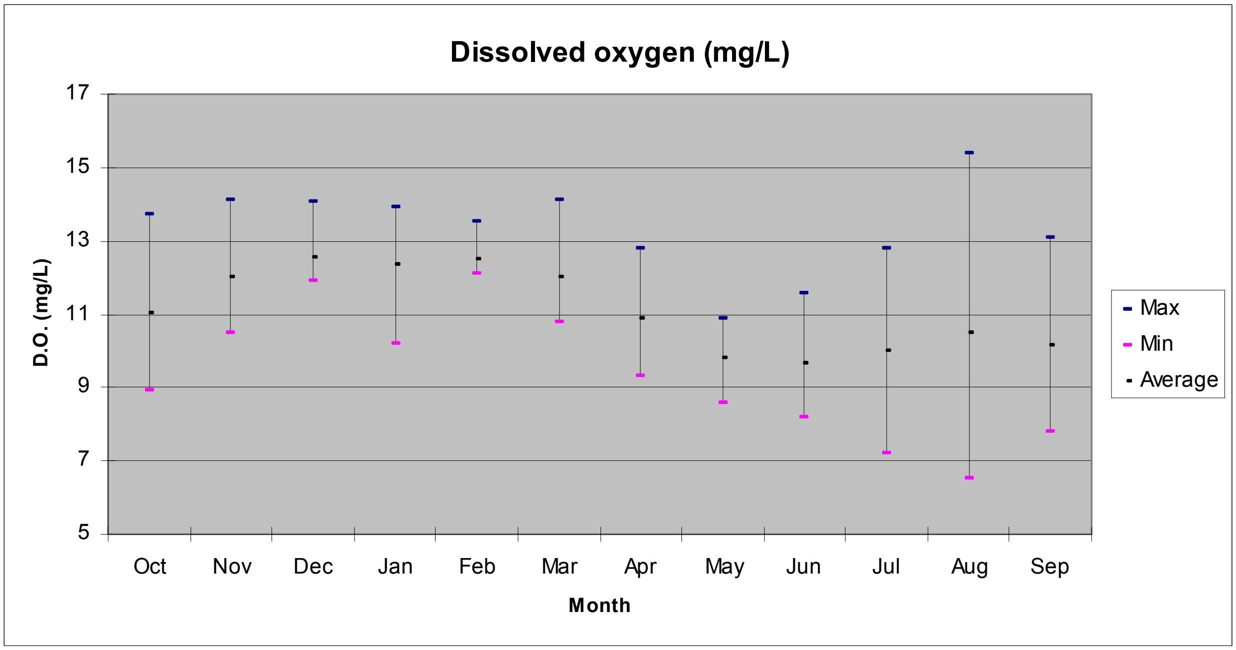
* Biochemical oxygen demand (BOD) regulated for City of Walla Walla as carbonaceous biochemical oxygen demand (CBOD).
** Interim limit until December 2003 or if the ammonia TMDL for Mill Creek is modified before then. After 12/03, ammonia limits become 1.49 / 3.9 mg/L.
*** Total coliform, not fecal coliform - limits are 7-day median and daily maximum counts.

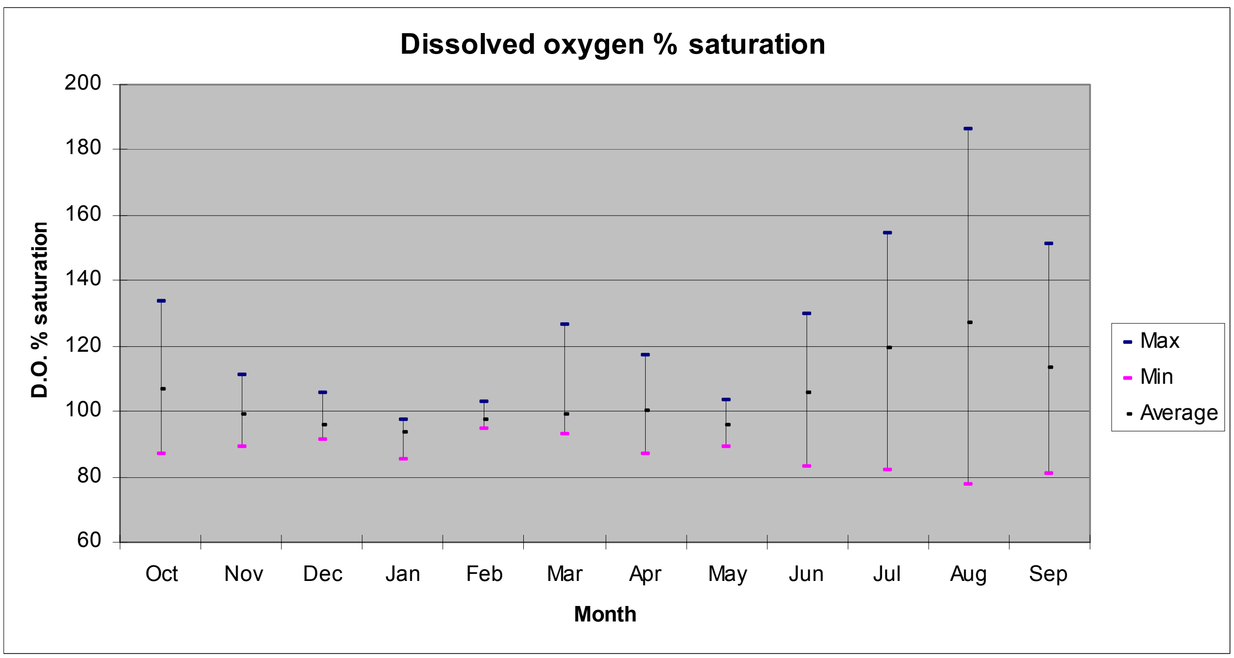
Appendix 5

Twelve Year Averaged Monthly Parameter Data from Daytime Grab Samples Taken from the Walla Walla River near Touchet (Ambient Monitoring Station 32A070)

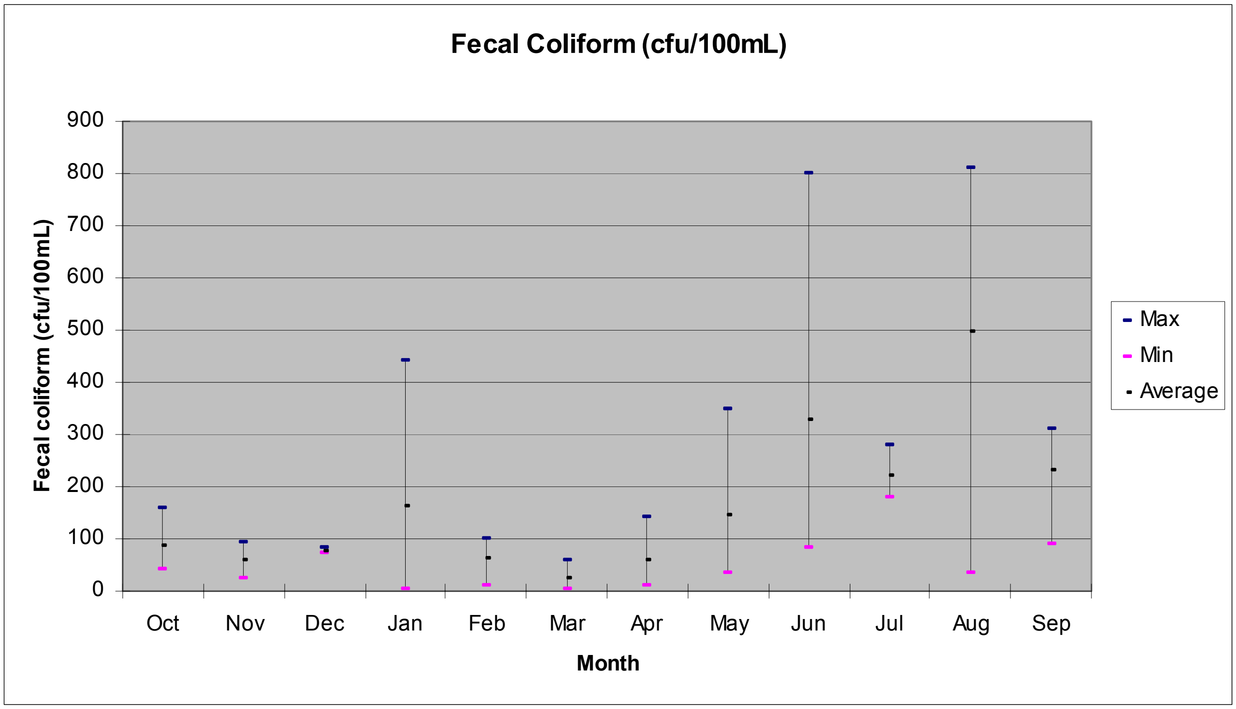


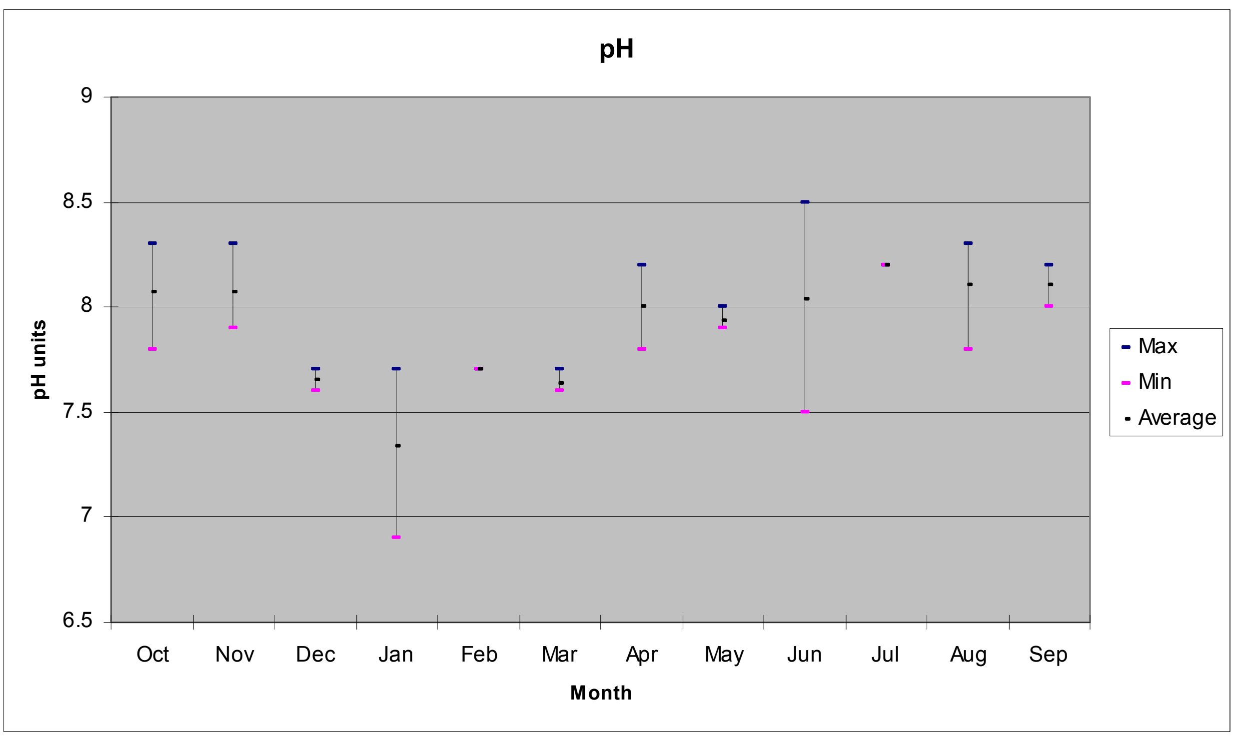


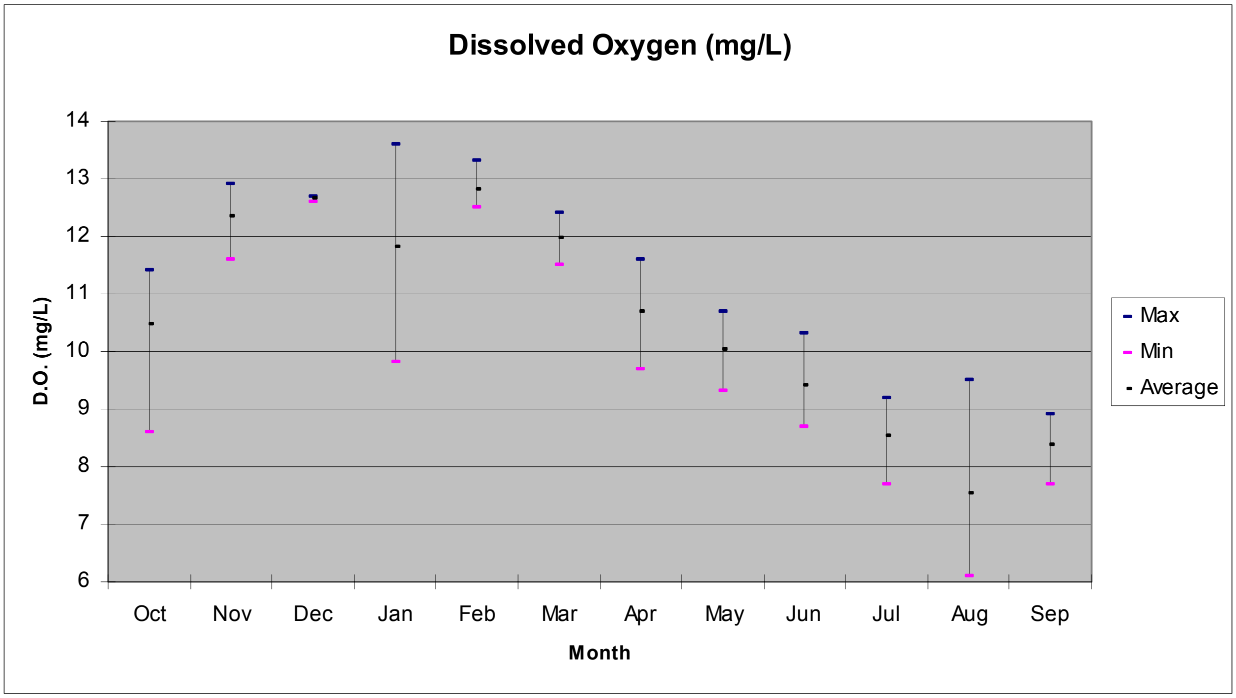

Dissolved oxygen (mg/L)
D.O. (mg/L)
17
15
13
11
9
7
5
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Month
Max
Min
Average

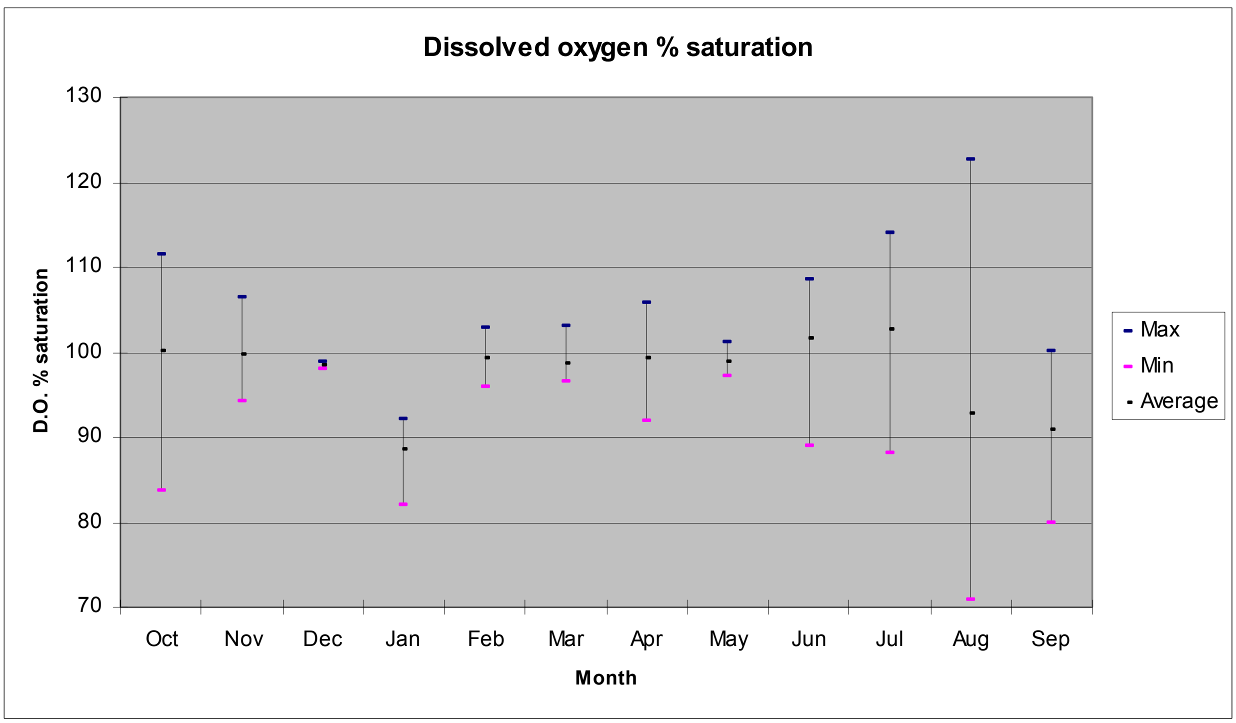

Dissolved oxygen % saturation
D.O. % saturation
200
180
160
140
120
100
80
60
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Month
Max
Min
Average

Three Year Averaged Monthly Parameter Data from Daytime Grab Samples Taken from the Touchet River at Touchet (Ambient Monitoring Station 32B070)






Dissolved Oxygen (mg/L)
D.O. (mg/L)
14
13
12
11
10
9
8
7
6
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Month
Max
Min
Average


Dissolved oxygen % saturation
D.O. % saturation
130
120
110
100
90
80
70
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Month
Max
Min
Average