VIII. Water Quality Assessment

Introduction

This section of the watershed assessment focuses on the physical, chemical, and biological characteristics of water. An evaluation of water quality encompasses the water column and the physical channel required to sustain aquatic life. The federal Clean Water Act serves "to protect and maintain the chemical, physical, and biological integrity of the nation's waters". The physical characteristics of water include suspended sediments and temperature. Chemical characteristics include nutrients, toxics, and dissolved oxygen. Biological aspects include bacteria, algae, insects, and fish.

The purpose of this section is to complete a screening-level assessment of the physical, chemical, and biological characteristics of the water column with regard to a set of standards. This is accomplished by comparing selected water quality data to a set of evaluation criteria based on state and federal standards for water quality. Water quality standards are benchmarks established to assess whether the quality of Oregon's rivers and lakes is adequate for fish and other aquatic life, recreation, drinking, agriculture, industry and other beneficial uses. Water quality standards are also regulatory tools used by the state Department of Environmental Quality (DEQ) and the federal Environmental Protection Agency (EPA) to prevent pollution of our waters. The federal Clean Water Act requires states to adopt water quality standards and to receive approval of the standards from the EPA (ODEQ, 2001). This screening level assessment is used to identify areas of concern for a more detailed study and analysis. More rigorous analysis may be required to evaluate seasonal fluctuations, to evaluate trends over time, or to evaluate the specific sources of pollution by increasing the sampling frequency and density of sample sites.

Beneficial Uses

Water quality standards are developed to protect the "beneficial uses" of the resource. Beneficial uses are defined as existing or potential uses of the water; this might include supporting activities such as swimming, fishing, or irrigation. Although ground water is tied to surface water, the focus of the water quality assessment is strictly surface waters. Beneficial uses are defined by basin within the Oregon Water Quality Rules (OAR 340.41). The Lower Columbia-Clatskanie Subbasin is contained within the North Coast Basin. The beneficial uses for the North Coast Basin include: domestic water supply, industrial water supply, irrigation, livestock watering, anadromous fish passage, salmonid fish rearing, salmonid fish spawning, resident fish and aquatic life, wildlife and hunting, fishing, boating, water contact recreation, and aesthetic quality. The most sensitive of these uses are fish, wildlife, domestic, and recreational use.

Within the subbasin there are approximately 623 miles of streams and sloughs. Fish presence has been confirmed for 271 miles and another 214 miles have yet to be identified as either having fish presence or not (ODF, 1999). Domestic and recreational water rights permits from the Oregon Department of Water Resources have been issued for 45 out of 492 streams and tributaries within the subbasin, although it can safely be assumed that swimming occurs in many other locations throughout the subbasin.

303(d) List

The 303(d) list is a report of streams and other water bodies that have not met the state's water quality standards. Section 303(d) of the federal Clean Water Act requires states to list all water bodies that do not meet an acceptable set of criteria and to develop a Total Maximum Daily Load (TMDL) plan for each. Within the Lower Columbia-Clatskanie Subbasin there are two stream segments that have been listed as not meeting one or more water quality standards. The Clatskanie River from its mouth to Conyers Creek is listed as not meeting bacteria and dissolved oxygen standards. Bacteria levels were found to be high during the summer months of the years 1993-1995. Dissolved oxygen levels did not meet the standard in the same years for the period May through September.

South Fork Goble Creek is also included on the 303(d) list of water quality limited streams. In the case of this stream, the parameter that was exceeded is the "biological criteria". The biological criteria is a description of the biological integrity of aquatic communities within the range of a given designated aquatic life use, such as anadromous salmonids. The biological integrity is measured by surveying the water body, collecting information about the species present, water quality, habitat types and habitat conditions. The information collected is then compared to an appropriate reference site or region resulting in a score from 1 to 100 of the similarities between the biological integrity of the sites. An appropriate reference site or region is a site on the same water body, or within the same basin or ecoregion that has similar habitat conditions, and represents the water quality and biological community attainable within the areas of concern (ODEQ, 1998). The aquatic communities sampled within South Fork Goble Creek had a score of 45% when compared to a reference community.

Methodology

The water quality assessment is based on a process which identifies the beneficial uses that occur within the watershed, identifies the evaluation criteria which apply to these uses, and evaluates water quality conditions by comparing existing data with these criteria. The beneficial uses have been described in previous paragraphs. The next step is to identify the most sensitive beneficial uses and to come up with a set of water quality evaluation criteria. The criteria are standards or limits that water quality must meet to support the sensitive beneficial uses. For example, the uses typically most sensitive to dissolved oxygen are fish and aquatic life. Fish and other aquatic organisms need an adequate supply of oxygen in the water to be healthy and productive. In this case, the criteria identify minimal amounts of dissolved oxygen that need to be in the water to protect the fish. In other cases, as with bacteria, the criteria identify the maximum amount that may be in the water without posing a risk to human health (ODEQ, 2001).

Sensitive Beneficial Uses

Sensitive beneficial uses applicable to this water quality assessment are listed in the box to the right. Aquatic species, particularly salmonid fish, are often considered the most sensitive beneficial uses in a watershed. Salmonid species—the pacific salmon, steelhead, rainbow trout, and cutthroat trout—

Sensitive Beneficial Uses
Aesthetic quality
Fishing
Domestic water supply
Resident fish and aquatic life
Salmonid fish rearing
Salmonid fish spawning
Water contact recreation

are adapted to cold-water, high-gradient habitats where temperatures are cool and dissolved oxygen is high. Salmonids have highly variable life histories, but display similarity in laying eggs in gravels and have fry and juveniles that rear close to where they hatch from the egg. These life stages are particularly sensitive to changes in the water quality parameters of temperature, dissolved oxygen, and suspended sediments (WPN, 1999).

Evaluation Criteria

The water quality criteria that are applicable for the chosen set of most sensitive beneficial uses are listed in the box to the right. For each water quality attribute there is an evaluation criteria, which is the level or standard measure that the attribute must not exceed in order to have no effect on the sensitive beneficial uses. If a sample is found to exceed an evaluation criterion, then the sample is considered to be impaired for that water quality attribute.

Water Quality Attribute	**Evaluation Criteria**
Temperature	May not exceed a 7-day average maximum of 17.8˚C (64˚F) for the period June 1 – September 30.
Dissolved Oxygen	At least 8.0 mg/l
pH	Between 6.5 to 8.5 units
Total phosphorus	No more than 0.05 mg/l
Total nitrogen	No more than 0.30 mg/l
Bacteria	No more than: 120 MPN/100 ml (Clastkanie STP) 406 MPN/100 ml (DEQ data sets)
Turbidity	No more than 50 NTU above background levels

Temperature is measured as the average of the maximum temperatures recorded during a seven-day period. The temperature criterion is based on the cold-water rearing standard for salmonids that covers the time period of June 1st through September 30th of the year. Temperature data were not evaluated for the salmonid spawning, incubation, and emergence period of October through May because limited data exists for this period. Bacteria were evaluated based on one of two criteria depending on the type of sampling technique used to measure bacteria levels. Samples collected by the Lower Columbia River Watershed Council (LCRWC) were tested by the Clatskanie Sewage Treatment Plant (STP), which uses a maximum of 120 MPN/100 ml as the test criterion. E. Coli data from DEQ are evaluated based on a maximum of 406 MPN/100 ml. Turbidity is a surrogate for measuring suspended sediments. However, it can also be caused by other sources of suspended material such as algae.

Data Sources

Water quality information has been collected from DEQ and from the LCRWC. DEQ has made their holdings of water quality information, collected from various agencies and private entities, available to the public for the purpose of investigating water quality issues. LCRWC has collected water quality samples within streams and sloughs of the subbasin since 1999. Temperature data was collected using Vemco minilogs borrowed from DEQ. The LCRWC placed fifteen minilogs in streams of the subbasin during 1998 and 1999. Temperature monitoring focused on the summer months with limited data for the months of June and October.

Evaluate Water Quality Impairment Level

Percent Exceedance of Criteria	Impairment Category
<15%	No Impairment (No or few exceedances of criteria)
15-50%	Moderately Impaired (Exceedance occurs on a regular basis)
>50%	Impaired (Exceedance occurs a majority of the time)
Potentially Impaired	Unknown (One or more impaired samples but not enough data on which to base an evaluation.)

After the data has been evaluated based on the water quality criteria listed above, the results are totaled for each site and the site is given a rating based on the number of exceedances of each parameter. The number of exceedances is divided by the total number of samples to yield a percent of exceedance. The box to the right lists the impairment categories based on a range of exceedances. In the case where less than five samples were collected but one or more of the samples were impaired, the site is considered to have insufficient data for evaluation of the level of impairment. Sites noted as having exceedances but insufficient data are considered potential problems that need further investigation.

Temperature data were evaluated separately from the other parameters. Maximum temperatures were reported for each day based on hourly readings for 1999 and readings every half-hour for 1998. A 7-day average maximum was then calculated starting at the seventh day of record and continuing through to the last day of record. As a general rule, if 10% or more of the 7-day average maximums exceed the temperature standard of 17.8˚C then the stream is considered to be impaired (personal communication with Karen Williams of ODEQ, April 23, 2001). However, other factors are considered when evaluating the temperature parameter; air temperatures, rainfall records, and streamflow are all considered. If the year of record had above normal air temperatures or there was a drought, then these factors will be taken into consideration when evaluating stream temperatures. For the purposes of this assessment, impairment categories are not used in the case of the temperature standard. All temperature records where the average maximum was exceeded are summarized and the percent exceedance reported.

Results

LCRWC Water Quality Data

The evaluation of water quality data collected by LCRWC is summarized in Tables 8.1 and 8.2. Four of the seven water quality parameters are reported within these two tables. The LCRWC did not collect nutrient samples for total nitrogen or total phosphorus, and temperature is reported separately below. The results are reported as a percent exceedance within Table 8.1. Table 8.2 reports the total number of samples that exceeded the standard and the total number of samples collected for each site. Not all of the sites have data for each of the water quality parameters.

The pH criterion was exceeded in two out of fifteen sites sampled. Plympton Creek is moderately impaired for pH. However, the Clatskanie River Boat Ramp site has a percent exceedance below 15%, which places it into the "No Impairment" category.

Low dissolved oxygen levels are a far more common problem with exceedances in eighteen of thirty sites sampled. Three of these sites scored less than 15%, and seven more of the sites do not have enough information to evaluate the impairment level. Six of the sites, including the highest scores for exceedances of the dissolved oxygen criterion, are in the lower Clatskanie River from the Highway 30 crossing downstream, where tidal fluctuations influence water quality (Figure 8.1). Five more sites are found in the middle and upper Clatskanie River with two listed as Moderately Impaired, one that needs more information, and two that show No Impairment.

The Clatskanie Sewage Treatment Plant (STP) tested E. Coli samples collected by the LCRWC. The test procedure used by the STP has a criterion of 120 MPN/100ml or greater indicating an impaired condition. Within Table 8.1, eight out of twenty-two sites tested for E. Coli had at least one sample test positive. However, only one site scored above 15%, indicating a Moderately Impaired condition. Turbidity was sampled in thirty-three of the sample sites but never measured above the level of 50 NTU in any samples.

Table 8.1: LCRWC water quality data: percent of samples that did not meet water quality standards (1999-2000). An X's indicates that a site does not have enough data to evaluate the impairment level, but has at least one sample that does not meet the water quality standards. Blank cells indicate that no samples were taken.

Site	pH	Dissolved Oxygen	Turbidity	E. Coli
Beaver Slough	0%	21%	0%	6%
Carcus Creek mouth		0%	0%	
Clatskanie River Bauder Bridge		0%	0%	0%
Clatskanie River Beaver Slough D/S	0%	24%	0%	0%
Clatskanie River Boat Ramp	4%	37%	0%	5%
Clatskanie River Carcus Creek U/S	0%	5%	0%	12%
Clatskanie River Girt D/S		0%	0%	
Clatskanie River Girt U/S		0%	0%	
Clatskanie River Grayson		0%	0%	
Clatskanie River Hwy 30 tidegate U/S	0%		0%	
Clatskanie River Hwy 30 U/S	0%	26%	0%	9%
Clatskanie River Jaspers	0%	20%	0%	0%
Clatskanie River Little Clatskanie D/S		0%	0%	
Clatskanie River Little Clatskanie U/S	0%	25%	0%	0%
Clatskanie River Miller Creek U/S		0%	0%	
Clatskanie River Mini Storage		40%	0%	0%
Clatskanie River Schaffer Rd Pittsburg	0%	8%	0%	0%
Clatskanie River Schaffer Rd Culvert		**X**	0%	0%
Clatskanie River STP D/S	0%	32%	0%	6%
Clatskanie River Westport Slough site	0%	**X**	0%	0%
Conyers Creek Kaiser		0%	0%	
Fox Creek Fallen tree			0%	
Goble Creek Barker Rd		0%	0%	
Goble Creek Barker/Gregory		0%	0%	0%
Goble Creek Hwy 30 Bridge		**X**	0%	**X**
Goble Creek South Fork D/S		0%	0%	
Goble Creek South Fork U/S		0%	0%	0%
Graham Creek Mouth		**X**		0%
Miller Creek mouth		**X**	0%	
Page Creek mouth		0%	0%	
Plympton Creek D/S	0%	0%	0%	0%
Plympton Creek U/S	29%	11%	0%	20%
Westport Slough Culvert	0%	**X**	0%	0%
Westport Slough 1 mile D/S		0%		0%
Westport Slough Pump Station	0%	**X**	0%	**X**

DEQ Water Quality Data

Table 8.2: LCRWC water quality data: number of impaired samples / total number of samples (1999-2000).				
Site	**pH**	**Dissolved Oxygen**	**Turbidity**	**E. Coli**
Beaver Slough	0 / 12	4 / 19	0 / 13	1 / 18
Carcus Creek mouth		0 / 1	0 / 2	
Clatskanie River Bauder Bridge		0 / 4	0 / 2	0 / 2
Clatskanie River Beaver Slough D/S	0 / 12	5 / 21	0 / 13	0 / 19
Clatskanie River Boat Ramp	1 / 27	10 / 27	0 / 27	1 / 21
Clatskanie River Carcus Creek U/S	0 / 22	1 / 22	0 / 23	2 / 17
Clatskanie River Girt D/S		0 / 1	0 / 2	
Clatskanie River Girt U/S		0 / 1	0 / 2	
Clatskanie River Grayson		0 / 1	0 / 2	
Clatskanie River Hwy 30 tidegate U/S	0 / 1		0 / 1	
Clatskanie River Hwy 30 U/S	0 / 23	8 / 31	0 / 28	2 / 23
Clatskanie River Jaspers	0 / 19	4 / 20	0 / 20	0 / 16
Clatskanie River Little Clatskanie D/S		0 / 1	0 / 1	
Clatskanie River Little Clatskanie U/S	0 / 23	6 / 24	0 / 24	0 / 23
Clatskanie River Miller Creek U/S		0 / 1	0 / 1	
Clatskanie River Mini Storage		2 / 5	0 / 2	0 / 3
Clatskanie River Schaffer Rd Pittsburg	0 / 23	2 / 24	0 / 24	0 / 23
Clatskanie River Schaffer Rd Culvert		1 / 2	0 / 1	0 / 1
Clatskanie River STP D/S	0 / 11	6 / 19	0 / 17	1 / 18
Clatskanie River Westport Slough site	0 / 3	1 / 4	0 / 3	0 / 4
Conyers Creek Kaiser		0 / 1	0 / 2	
Fox Creek Fallen tree			0 / 1	
Goble Creek Barker Rd		0 / 1	0 / 1	
Goble Creek Barker/Gregory		0 / 1	0 / 2	0 / 1
Goble Creek Hwy 30 Bridge		1 / 2	0 / 1	1 / 2
Goble Creek South Fork D/S		0 / 1	0 / 1	
Goble Creek South Fork U/S		0 / 2	0 / 1	0 / 1
Graham Creek Mouth		1 / 1		0 / 1
Miller Creek mouth		1 / 3	0 / 3	
Page Creek mouth		0 / 1	0 / 1	
Plympton Creek D/S	0 / 8	0 / 9	0 / 9	0 / 5
Plympton Creek U/S	2 / 7	1 / 9	0 / 8	1 / 5
Westport Slough Culvert	0 / 2	2 / 2	0 / 2	0 / 2
Westport Slough 1 mile D/S		0 / 1		0 / 1
Westport Slough Pump Station	0 / 1	2 / 2	0 / 2	1 / 3

The analysis of data gathered from DEQ's holdings is summarized in Tables 8.3 and 8.4. In all but one of the sample sites, the Clatskanie River at Highway 30, the number of samples taken was less than three for each parameter. Because of the lack of data, the level of impairment cannot be assessed for all but the Clatskanie River at Highway 30 site. Sample sites that have at least one exceedance indicate that there is a potential problem, but more samples are needed. The Clatskanie River at Highway 30 has a 57% exceedance for total nitrogen (nitrate/nitrite) and is considered impaired for this parameter. High levels of total nitrogen are also a potential problem in several other streams including Nice Creek, South Fork Goble Creek, South Fork Stewart Creek, and a tributary to Beaver Creek about a mile upstream of Parkdale Road (Figure 8.1). Total phosphorus levels were high in almost all of the same places as total nitrogen. However, the Clatskanie River at Highway 30 had no samples that exceeded acceptable levels for total phosphorus.

None of the sites had samples that exceeded the turbidity or pH criteria. Dissolved oxygen again was a problem in the tidally influenced zone of the lower Clatskanie River and Beaver Slough. There are also two sites in the middle and upper sections of Beaver Creek and one site in the South Fork of Goble Creek that have samples that exceeded the dissolved oxygen criterion.

E. Coli is a potential problem in only four sites. One or more samples tested high for E. Coli near the Clatskanie sewage treatment plant and in the middle section of Beaver Creek at Parkdale Road.

Table 8.3: DEQ water quality data: an X indicates that a site does not have enough data to evaluate the impairment level, but has at least one sample that does not meet the water quality standards.

Location	pH	Oxygen, total dissolved	Turbidity	E Coli	Nitrate/nitrite	Phosphorus
Beaver Creek at Beaver Falls and Rutter Road (COLCO 080)						
Beaver Creek at Beaver Falls Raod (Tidewater, u/s of Stewart Creek)						
Beaver Creek at Beaver Springs Road (u/s of Girt Creek)		X				
Beaver Creek at Parkdale Road				X		
Beaver Slough U/S Clatskanie Boat Club Entrance		X				
Clatskanie River						
Clatskanie River - Culvert at RM 4.69						
Clatskanie River 20 Ft. D/S Clatskanie STP		X		X	X	X
Clatskanie River 200 Ft. D/S Clatskanie STP		X		X		X
Clatskanie River 200 Ft. U/S Clatskanie STP		X		X	X	X
Clatskanie River Across from Westport Slough						
Clatskanie River At Hwy 30, year 2000					57%	
Clatskanie River at Swedetown Rd.						
Clatskanie River D/S Beaver Slough		X				
Clatskanie River D/S STP		X				
Clatskanie River just u/s of Little Clatskanie River						
Lost Creek At New Hwy 30 (Delena)						
Mcbride Creek At North 6Th (Columbia City)						
Nice Creek U/S Ranier STP Outfall					X	X
South Fork Beaver Creek At Old Hwy 30 (Delena)		X				
South Fork Goble Creek At Rm 0.9		X			X	X
South Fork Stewart Creek At Rm 2.30					X	X
Tide Creek At Hwy 30 (Deer Island)						
Tributary To Beaver Cr At Confluence					X	X

Temperature Data

A total of fifteen temperature recorders were installed in the summer of 1998 and again in the summer of 1999. The analysis of the temperature data resulted in sixteen sites where the 7-day average maximum was exceeded during 1998 and/or 1999 (Figures 8.2 – 8.5). The 7-day average maximum temperatures for these sites are graphed in Figures 8.3 & 8.5, with the temperature standard of 17.8˚C plotted across the center of the graph. The percentage of the 7-day average maximums for each site that exceeded the standard of 17.8˚C is summarized in Figures 8.3 & 8.5, where sites with values above ten percent are considered impaired.

Temperature logs for 1998 captured a smaller portion of the season, with the earliest records starting in late August; three sites were not set up until early September. Records for 1999 begin much earlier, with most of the temperature monitoring starting in the first week of July. Monitoring of stream temperatures focused on the Clatskanie River and Goble Creek subwatersheds in both years (Figure 8.1). Not all of the sites used in 1998 were used again in 1999. In 1998 five of the sites that had temperature exceedances were in the Clatskanie River subwatershed and the other five were in the Goble Creek subwatershed. In 1999 seven sites with exceedances were in the Clatskanie River subwatershed.

Table 8.4: DEQ water quality data: an X indicates that a site does not have enough data to evaluate the impairment level, but has at least one sample that does not meet the water quality standards.						
Location	**pH**	**Oxygen, total dissolved**	**Turbidity**	**E. Coli**	**Nitrate/nitrite**	**Phosphorus**
Beaver Creek at Beaver Falls and Rutter Road (COLCO 080)	0 / 2	0 / 2	0 / 2	0 / 1	0 / 1	0 / 1
Beaver Creek at Beaver Falls Raod (Tidewater, u/s of Stewart Creek)	0 / 2	0 / 2	0 / 2	0 / 1	0 / 1	0 / 1
Beaver Creek at Beaver Springs Road (u/s of Girt Creek)	0 / 2	2 / 2	0 / 2	0 / 1	0 / 1	0 / 1
Beaver Creek at Parksdale Road	0 / 2	0 / 2	0 / 2	1 / 1	0 / 1	0 / 1
Beaver Slough U/S Clatskanie Boat Club Entrance	0 / 1	1 / 1	0 / 1	0 / 1		
Clatskanie River					0 / 1	
Clatskanie River - Culvert at RM 4.69	0 / 1	0 / 1	0 / 1			
Clatskanie River 20 Ft. D/S Clatskanie STP	0 / 1	1 / 1	0 / 1	1 / 1	1 / 1	1 / 1
Clatskanie River 200 Ft. D/S Clatskanie STP	0 / 1	1 / 1	0 / 1	1 / 1	0 / 1	1 / 1
Clatskanie River 200 Ft. U/S Clatskanie STP	0 / 1	1 / 1	0 / 1	1 / 1	1 / 1	1 / 1
Clatskanie River Across from Westport Slough	0 / 1	0 / 1	0 / 1	0 / 1		
Clatskanie River At Hwy 30, year 2000	0 / 10	0 / 10	0 / 10	0 / 9	5 / 9	0 / 8
Clatskanie River at Swedetown Rd.	0 / 3	0 / 3	0 / 3	0 / 2	0 / 2	0 / 2
Clatskanie River D/S Beaver Slough	0 / 1	1 / 1	0 / 1	0 / 1		
Clatskanie River D/S STP	0 / 1	1 / 1	0 / 1	0 / 1		
Clatskanie River just u/s of Little Clatskanie River	0 / 2	0 / 2	0 / 2	0 / 1	0 / 1	0 / 1
Lost Creek At New Hwy 30 (Delena)		0 / 1				
Mcbride Creek At North 6Th (Columbia City)		0 / 2				
Nice Creek U/S Ranier STP Outfall	0 / 1	0 / 1	0 / 1	0 / 1	1 / 1	1 / 1
South Fork Beaver Creek At Old Hwy 30 (Delena)		1 / 2				
South Fork Goble Creek At Rm 0.9	0 / 3	2 / 3	0 / 5		2 / 3	1 / 3
South Fork Stewart Creek At Rm 2.30	0 / 1	0 / 1	0 / 1		1 / 1	1 / 1
Tide Creek At Hwy 30 (Deer Island)		0 / 2				
Tributary To Beaver Cr At Rm 0	0 / 1	0 / 1	0 / 1		1 / 1	1 / 1

Between the two years, eight of the sites with exceedances were distributed within the middle and lower parts of the Clatskanie River. In 1998 six sites within the Clatskanie River subwatershed had percent exceedance levels of 10% or more (Figure 8.2), but for 1999 four out of seven Clatskanie River subwatershed sites were over the 10% exceedance level (Figure 8.4). In both years the Goble Creek subwatershed sites had exceedance levels above 10%.

Conclusion

Information describing water quality within the Lower Columbia-Clatskanie Subbasin is fairly abundant. Water quality data have been collected within several subwatersheds including the Clatskanie River, Plympton Creek, Beaver Creek, Goble Creek, and Clatskanie Floodplain subwatersheds. The LCRWC has been actively collecting water quality information through sampling of streams since 1998.

Temperature

Stream temperatures are an area of concern in the Lower Columbia-Clatskanie subbasin. During the summer and fall of 1998 and 1999, temperature recorders captured high temperatures in a total of sixteen sites situated within three different streams: Clatskanie River, Conyers Creek, and Goble Creek (Figures 8.2 – 8.5). During the 1998 season, the temperature loggers were installed in the middle of August, missing the first

Data sources: ODF stream class maps, ODEQ and LCRWC water quality monitoring data,
ODWR water rights maps, SSCGIS city limits and county boundaries.

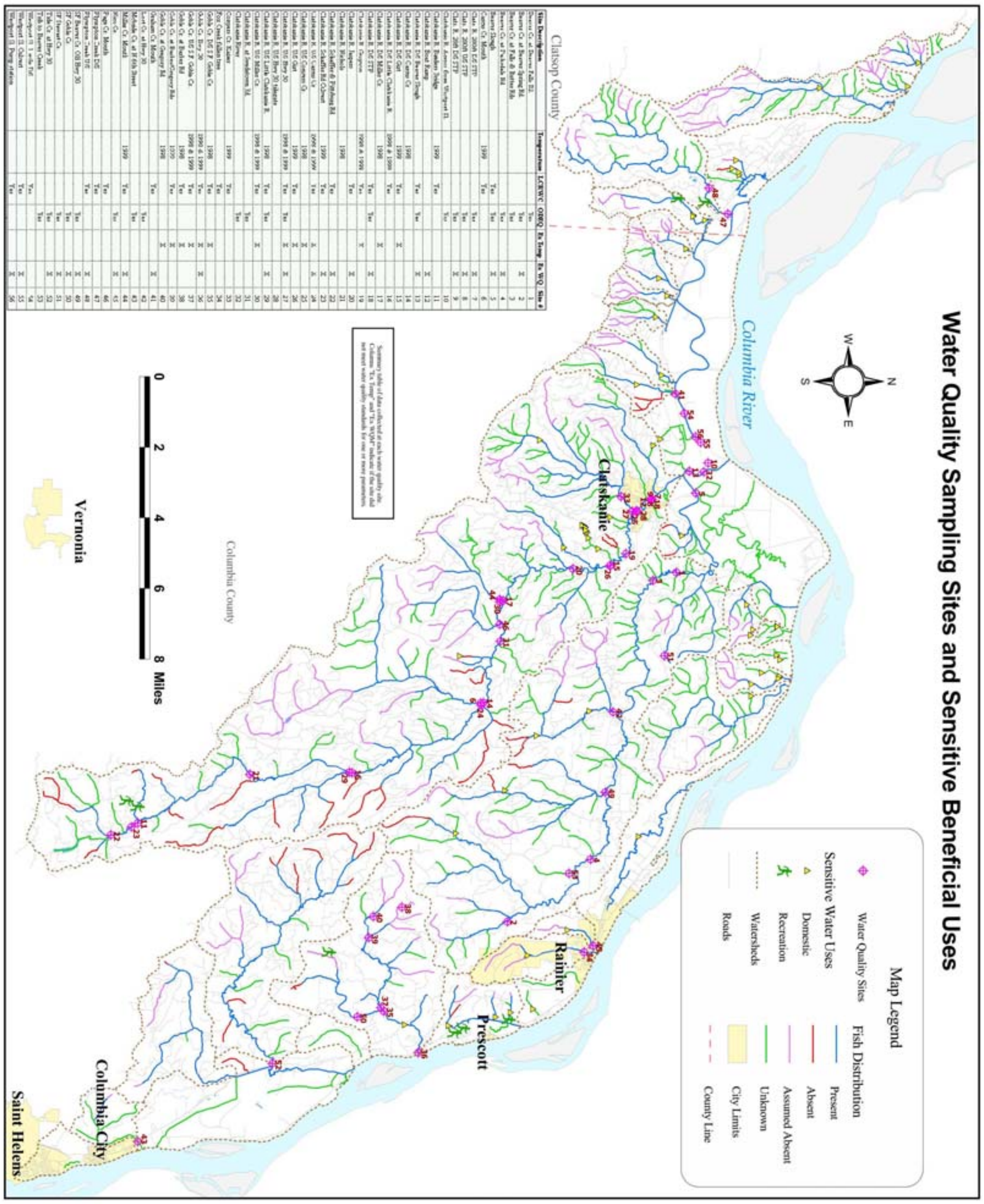

Figure 8.1: Water quality monitoring sites for 1999 and 2000, and sensitive beneficial uses.

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Figure 8.2: 7-day average maximum temperatures for sites that exceeded the standard of 17.8 degrees Celsius during August and September of 1998.

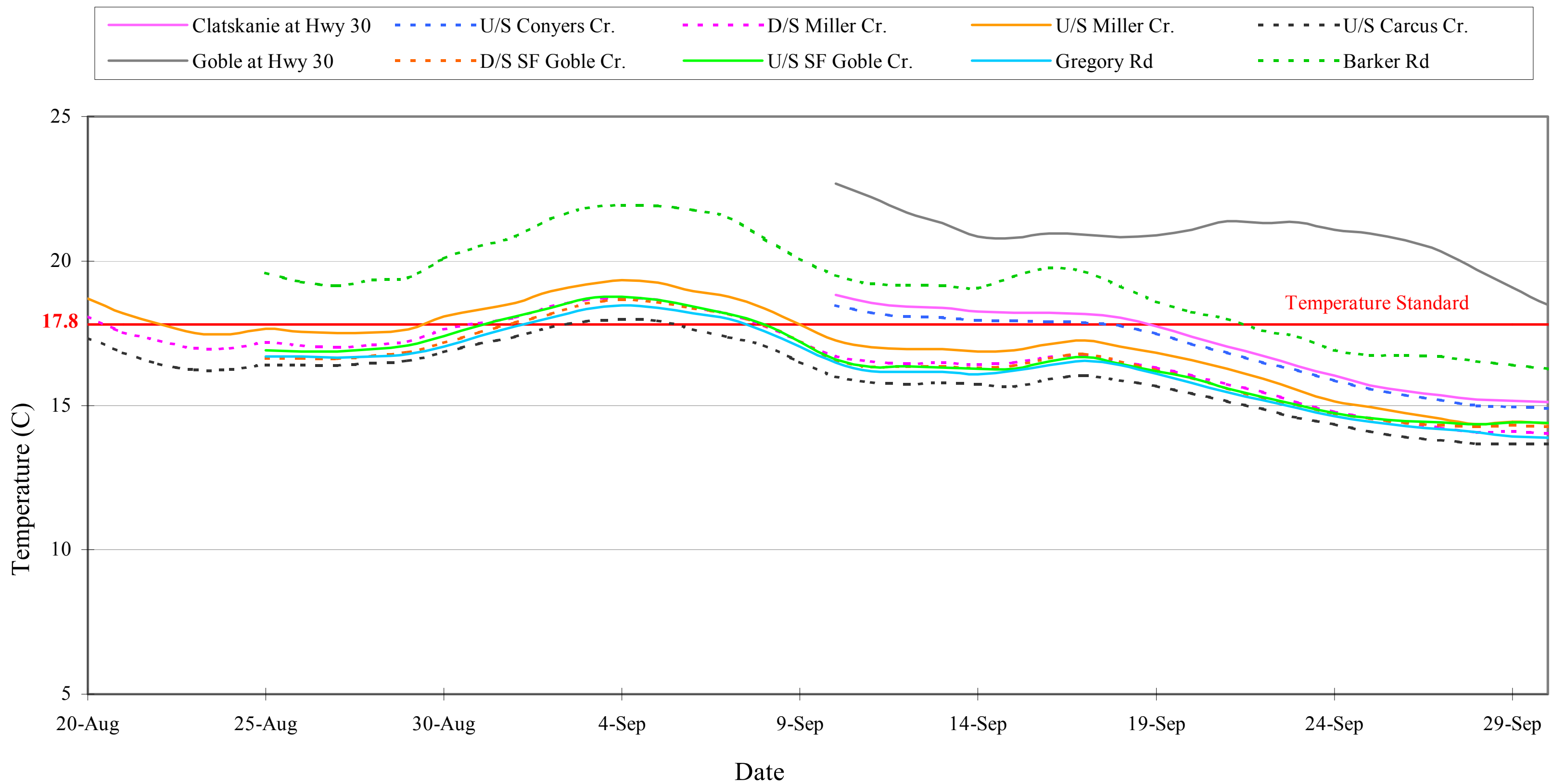
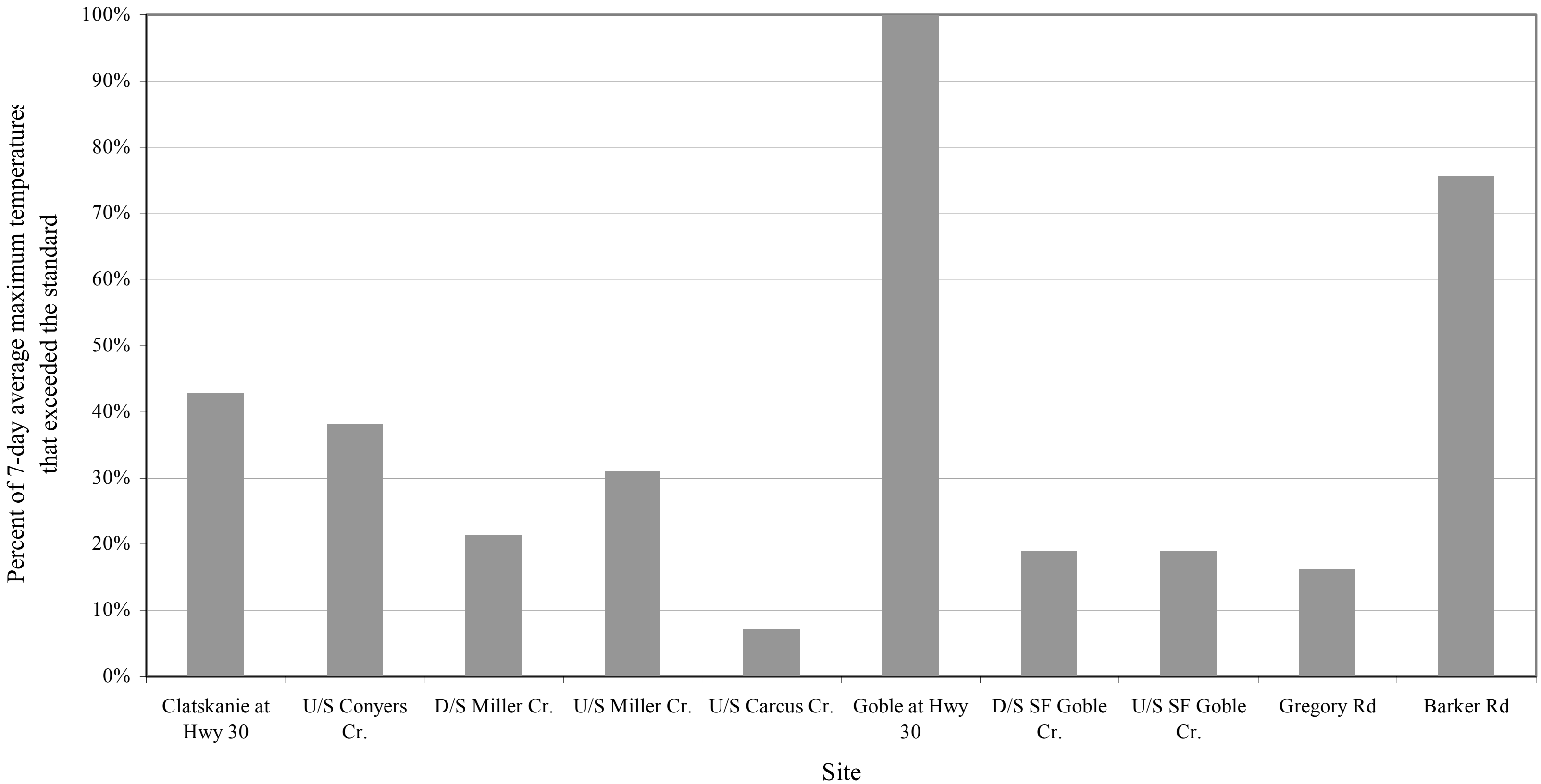


Figure 8.3: Percent exceedance of the 7-day average maximum temperature standard of 17.8 degrees Celsius during August and September of 1998.



half of the rearing period for salmonids. In 1999 the temperature loggers captured more of the season but still missed the month of June. The missing time periods may result in a decrease of the percent exceedance for 1999, but it is unclear what the result would be on the 1998 data (Figures 8.3 & 8.5). Seven of the fifteen temperature stations of 1999 registered percent exceedances well above 10%, indicating a significant impairment of this water quality parameter (Figure 8.5). It can be seen in Figure 8.4 that the percent exceedances for these seven sites in 1999 would drop slightly if the record could be extended backwards to June first and if we assumed that there were no additional exceedances of the temperature standard. However, the percent exceedance for seven out of fifteen sites would still be much greater than 10%.

The Clatskanie River has temperature impairments at several sites from the Highway 30 Bridge to the station upstream of Miller Creek. Analysis of riparian conditions, land use, and channel modifications show patterns of disturbance leading to low shading and bare or paved surfaces adjacent to the stream channel within the lower river (see sections I, IV, and VI of this watershed assessment for information on these watershed features). The lower Clatskanie River is influenced by the Columbia River and its tidal fluctuations. The tidal influence extends for over five miles to a point upriver of the city of Clatskanie (personal communication with the LCRWC April 17, 2001). Temperature exceedances in the lower Clatskanie River may be partly due to the influence of the Columbia River. However, riparian degradation, bank stabilization, and flood plain development are also apparently influencing stream temperatures.

The middle section of the Clatskanie River near Miller Creek exceeded the temperature standard at least 34% of the time in 1999, if the extrapolated data are included (Figure 8.5). Stream temperatures are influenced by many factors, including rate of flow; slow moving waters will absorb more heat from their surroundings and large streams are not as easily shaded by riparian trees. The section of the Clatskanie River upstream of Miller Creek is low gradient (<2%) and unconfined with several rural residences directly upstream of the temperature station. Additionally, there is poor riparian shading within that section of the mainstem its and tributaries. For instance, the next major tributary of the Clatskanie River upstream of Miller Creek is Page Creek, about ¾ mile upstream. Page Creek has roughly 11 miles of stream channels, including tributaries, of which more than 50% are poorly shaded.

Goble Creek has the highest percent exceedance of the temperature standard, with 100% for the site where Highway 30 crosses the stream. Similar to the Clatskanie River, the lower section of Goble Creek is influenced by the Columbia River to a point upstream of the Highway 30 crossing. The distance from Highway 30 to the Columbia River is less than 500 feet of low gradient (<1%), unconfined channel (Channel Habitat Types Assessment, Section II of this watershed assessment). Stream temperatures in the middle and upper sections of Goble Creek are most likely a factor of riparian conditions and channel habitat types. The middle section of Goble Creek winds through a valley that has a high density of rural residences, low stream gradient, and poor riparian conditions. Riparian shade is critical to maintaining adequate temperatures for salmonids in small low gradient streams such as Goble Creek. 76% of the mainstem of Goble Creek from

Figure 8.4: 7-day average maximum temperatures for sites that exceeded the standard of 17.8 degrees Celsius from July through September of 1999.

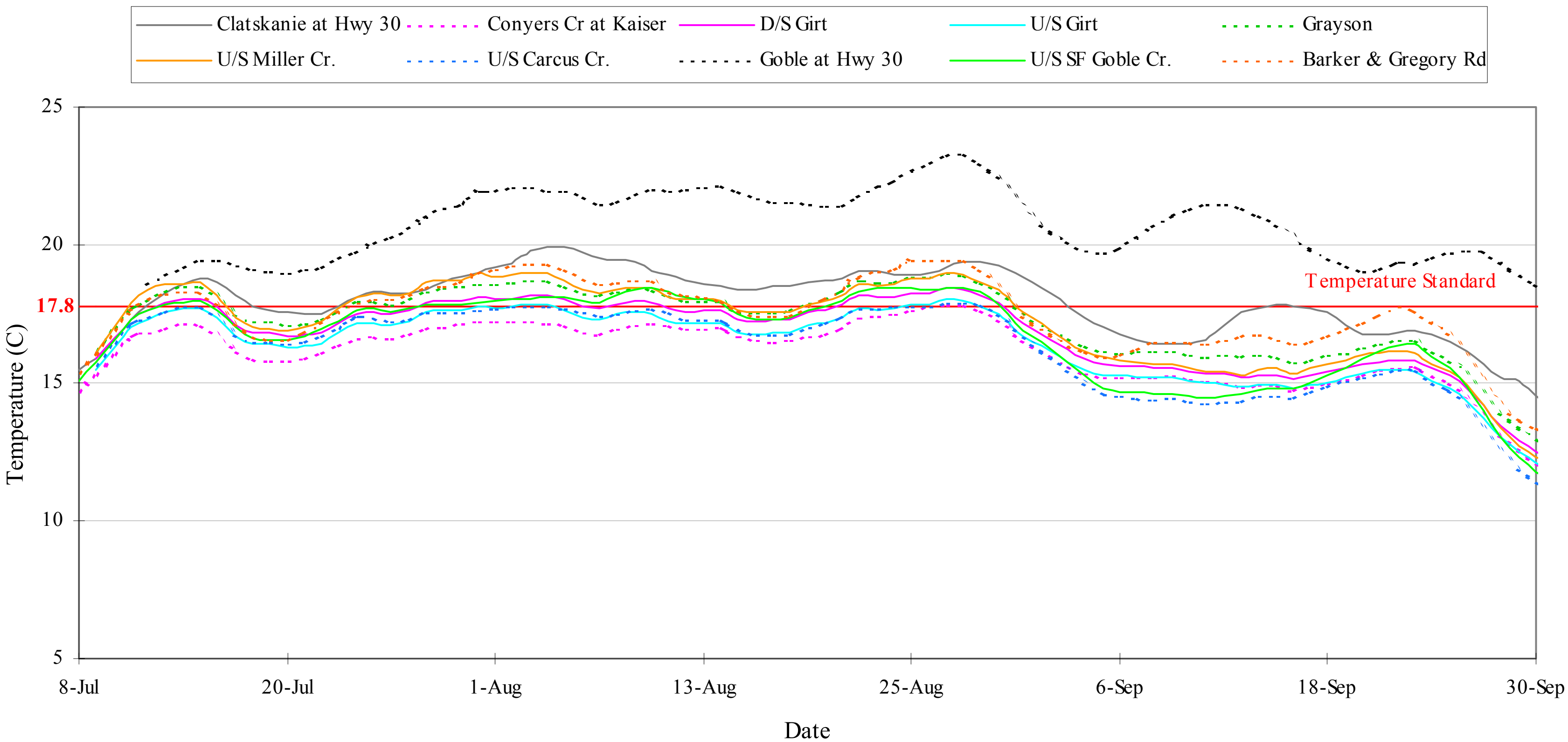
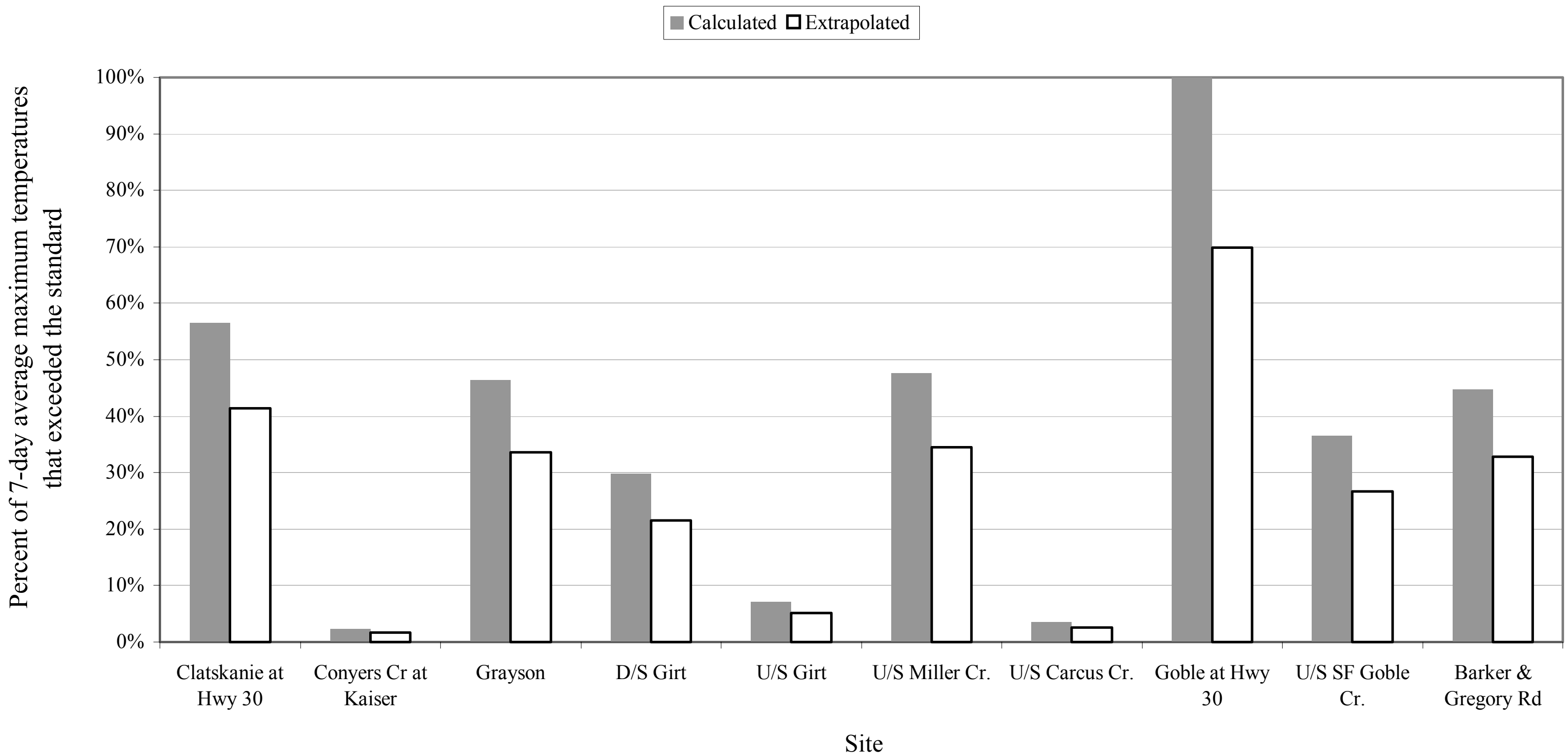


Figure 8.6: Percent exceedance of the 7-day average maximum temperature standard from July through September of 1999. The extrapolated data are based on the assumption that there were no exceedances in the month of June.



the South Fork confluence upstream to the next temperature gage at Barker and Gregory Roads is poorly shaded. Riparian conditions upstream of the Barker and Gregory Roads temperature station are not as clearly related to temperature exceedances. Shading is poor in only 23% of the length of stream channels, but the gradient is also low.

Turbidity

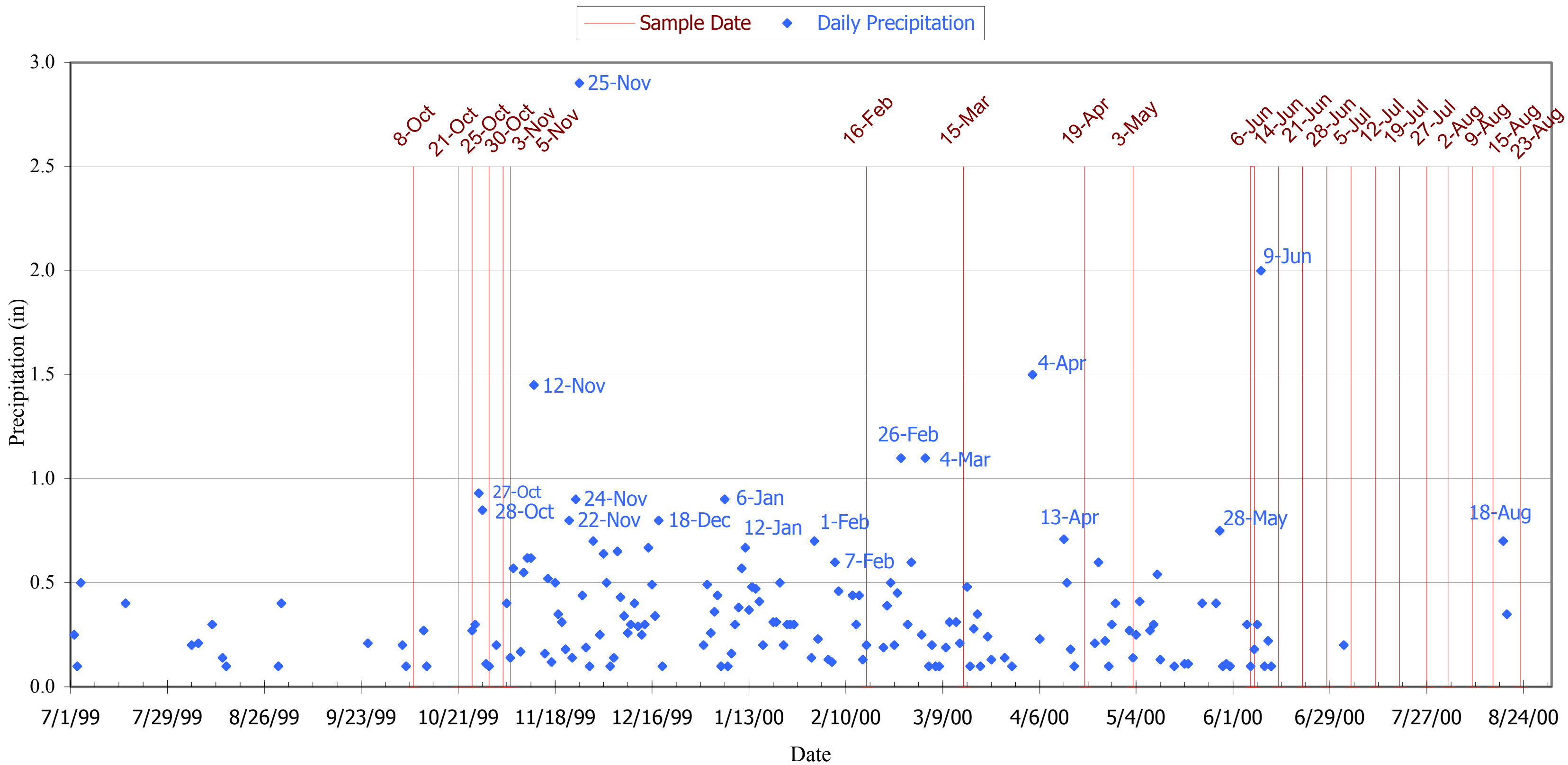
Extensive sedimentation can lead to smothering of incubating salmonid eggs and disrupt the feeding habits of juvenile and adult fish (Bjornn and Reiser, 1991). Clogging of surface gravels by fine inorganic sediment can restrict intergravel flow enough to lower dissolved oxygen concentrations. This problem usually occurs only when large or persistent volumes of sediment emanate from active road systems, mass soil movements, bank slumps, or destabilized upstream channels (Chamberlin et al., 1991).

Turbidity was sampled at nearly all of the water quality stations, but there were no exceedances of the water quality criterion for this parameter. Out of 285 samples collected by the LCRWC and DEQ, only 5 samples tested above 20 NTU, and no samples tested above 50 NTU. The lack of any exceedances of this parameter is surprising considering that the subbasin has many miles of gravel and dirt roads and the land uses within the subbasin are more than 75% forestry. These findings lead to a closer examination of the timing of the turbidity samples.

Turbidity is caused by one of several factors including suspended sediments, particulate organic matter, and algae. Suspended sediments are an issue in well roaded and actively harvested forests. Turbidity due to suspended sediments is directly related to the amount of energy within the stream or the velocity of the flow, and is therefore highest during peak flows (Swanston, 1991). Stream flow in the rain-dominated zone of the Pacific Northwest mirrors the seasonal nature of precipitation with the highest flows occurring in the winter. Samples taken during the summer and fall would not capture the majority of sediment transport that takes place in the winter. Data collected from DEQ primarily consisted of samples taken during July, August, and October, but samples from LCRWC were taken throughout the year with multiple samples taken each month.

An appropriate time to collect turbidity samples is not only during the rainy season but immediately following large rainfall events or storms (Swanston, 1991). Most small, mountain channels respond quickly to individual precipitation events, exhibiting rapidly increasing streamflow and an expanding channel network shortly after rainfall begins. When rainfall decreases or ceases altogether, streamflow peaks almost immediately and then decreases rapidly as soil water on steep slopes drains rapidly into the channel. During a western winter rainy season, this sequence of events may occur 10 to 20 times or more, depending on the frequency of storms entering the region from the Pacific Ocean (Swanston, 1991). An analysis of the timing of the turbidity samples compared to daily rainfall recorded at St. Helens shows that none of the samples from the Clatskanie River, above the tidal influences of the Columbia River, were collected close to the largest daily rainfall events of 1 inch or more (Figure 8.6). None of the turbidity samples were collected within less than two days of a day where at least a 1/2-inch of rain fell.

Figure 8.6: Dates on which turbidity samples were collected within the Clatskanie River upstream of tidal influences, plotted against daily rainfall records from St. Helens, Oregon.



The results of turbidity samples taken to date in the Lower Columbia-Clatskanie Subbasin are inconclusive because of the timing of the samples. The issue of sedimentation within streams of the subbasin needs to be further investigated by sampling for turbidity during and immediately after storms, especially winter storms.

Dissolved Oxygen

High dissolved oxygen is characteristic of watersheds throughout the Pacific Northwest that support cold-water organisms such as native salmon and trout. Developing salmon and trout embryos are especially sensitive to dissolved oxygen levels (WPN, 1999). The minimum of 8 mg/l of dissolved oxygen used here to evaluate water quality data is based on the standards for streams during spawning of salmon and trout (ODEQ, 1998).

A number of factors can influence dissolved oxygen levels including: temperature, organic compounds, turbulence, and aquatic plants. Dissolved oxygen levels vary inversely with temperature; colder water contains a higher concentration of oxygen. Oxygen levels are also influenced by the decomposition of organic matter. The breakdown of organic compounds occurs naturally in streams, as leaves, bark, and similar materials are decomposed. A problem arises, however, when large amounts of biodegradable material such as sewage, animal wastes, and wastes from the processing of dairy products, crops, or wood pulp enter the hydrologic cycle (Dunne and Leopold, 1978). Turbulence within a stream can increase dissolved oxygen levels by facilitating the diffusion of oxygen from the atmosphere. Aquatic plants alter the concentration of oxygen through photosynthesis and respiration. Daily fluctuations in dissolved oxygen can be observed in streams with high aquatic plant productivity (Allan, 1995).

Data collected by LCRWC indicate that dissolved oxygen levels are moderately impaired in the lower Clatskanie River from around river mile 8 downstream, and at one site in the upper Clatskanie River above the confluence with the Little Clatskanie River. Potentially impaired sites were also found in Beaver Creek, Goble Creek, Westport Slough, and in tributaries of Clatskanie River. If the cause of the low dissolved oxygen levels was sewage or animal wastes then E. Coli levels may in turn be high. There was only one site that tested as impaired for E. Coli, Plympton Creek, and several sites that had levels within the acceptable limit. The lower Clatskanie River and Beaver Slough tested positive for E. Coli, but are not impaired for this water quality standard. The correlation between E. Coli and dissolved oxygen levels is not very strong and does not indicate that low dissolved oxygen is being caused by sewage and animal wastes, though further investigation is recommended.

While E. Coli levels were within the safe limit for water contact recreation and drinking water, perhaps in combination with temperature and nutrients all three factors are acting on dissolved oxygen, reducing it to a level that imposes problems for salmon and trout. The results of the temperature analysis show similarities between low dissolved oxygen levels and high temperatures. The lower Clatskanie River had several exceedances of the temperature standard; water temperature is an important factor for dissolved oxygen concentrations. Fresh water streams at a temperature of 17.8˚C can hold a maximum of ~9.4 mg/l of dissolved oxygen under normal conditions (Dingman, 1993). The total nitrogen standard was exceeded 57% of the time in the Clatskanie River at the Highway 30 Bridge. High levels of nutrients can lead to elevated algal growth and low dissolved oxygen (see the appropriate section below).

E. Coli

Bacteria in the coliform group are used as indicators to test the sanitary quality of water for drinking, swimming, and shellfish culture (WPN, 1999). A few of the samples collected by LCRWC tested positive for E. Coli, but only one site had more than 15% of the samples exceed the standard for E. Coli. Plympton Creek is rated as moderately impaired for the E. Coli water quality standard with a score of 20%. Data from DEQ tested above the standard in the Clatskanie River near the sewage treatment plant, and at one site in Beaver Creek. However, there are not enough samples from DEQ to ascertain if there is an impairment of this water quality standard. Based on the existing data, bacteria levels do not appear to pose a problem for water contact recreation uses within the Lower Columbia-Clatskanie Subbasin.

pH

None of the samples from DEQ tested outside of the acceptable range for pH. Two of the sample sites monitored by LCRWC tested outside of the pH standard, but only one exceeded the impairment level at least 15% of the time. Based on the samples collected by LCRWC, water quality is impaired for pH in Plympton Creek. Conversations with the watershed coordinator, Margaret Magruder, indicated that the level of confidence in the pH samples is low; the device used to sample pH was inconsistent when double samples were taken. In conclusion, pH does not appear to be an area of concern for water quality within the subbasin.

Nitrate/nitrite & Phosphorus

Nutrient tests were not conducted by LCRWC, the only source of data for these parameters was DEQ. The Clatskanie River at Highway 30 is severely impaired for nitrate/nitrite concentrations (DEQ samples water quality at this site several times a year). An abundance of nutrients can lead to increased algal production and turbidity within the stream channel. Excess algae and aquatic plant growth can create a problem in slow-moving streams and rivers. The excessive growth can result in low or no dissolved oxygen, can interfere with recreation, and with certain algae can produce chemicals that are toxic to livestock and wildlife (WPN, 1999). DEQ's data indicated that several other sites are potentially impaired for total phosporus and nitrogen, there were not enough samples to rate these sites. Further investigation is recommended for the sites which are potentially impaired.

Data Gaps

Analysis of the data holdings of DEQ indicate that there are several streams or locations within subwatersheds that need further investigation. Temperature exceedances show a correlation with low dissolved oxygen levels, but the affects of nutrients and organic matter on dissolved oxygen needs to investigated. The issue of low dissolved oxygen could be caused by a combination of high temperatures, nutrients, and organic matter. E. Coli tests would indicate if human and animal wastes, which are high in organic matter, were a problem in the subbasin. Only one site is impaired for E. Coli, but several sites had detectable levels of E. Coli.

Confidence Evaluation

High. Water quality data have been collected in several streams and subwatersheds throughout the subbasin. The only parameter that was not confidently sampled was pH. The LCRWC stated that the pH samples were highly irregular and that dual samples rarely came close to matching. The water quality standard of pH is a significant issue in streams where mining is among the land uses. The Lower Columbia-Clatskanie Subbasin does not has a few small rock quarries but no mining operations that would pose a problem to stream pH.

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