

Chapter 4. Water Quality Assessment

Groundwater and surface water quality data for WRIA 31 are relatively sparse. Because all WRIA 31 streams are ephemeral, and there are negligible recorded water rights (approximately 1.3 cfs surface water rights in entire WRIA 31) for diversion from these streams, it is concluded that surface waters in WRIA 31 streams are put to limited out of stream uses. According to Washington Department of Fish and Wildlife's (WDFW) 1998 Salmonid Stock Survey, Rock Creek supports summer steelhead and summer Chinook; the mouth of Chapman Creek supports Coho; and Wood Gulch Creek supports summer steelhead. Therefore, surface water quality information is potentially of greatest interest in the western part of the WRIA where it is a factor in habitat quality.

Groundwater is a major source of water supply for most of WRIA 31, with irrigation being the single largest groundwater use. Evaluation of the quality of groundwater in the WRIA has been largely limited to the Glade/Fourmile subbasin, which is the most heavily irrigated subbasin in the WRIA. Studies of groundwater from the shallow alluvial aquifer and deeper Saddle Mountains Basalt and Wanapum Basalt aquifers have focused primarily on nitrate, which is a common derivative of agricultural land use practices. In addition to miscellaneous groundwater quality studies, groundwater quality data are also collected from public water supply systems as required by Washington State Department of Health (DOH).

In addition, water quality information for the Columbia River adjacent to WRIA 31 is also mentioned briefly here.

Subsequent sections of this chapter present the water quality standards established for surface water and groundwater (Section 4.1), and discussion of the available water quality data relative to the established standards (Section 4.2). Section 4.2 also discusses potential reasons why water quality does not meet standards.

4.1 Water Quality Standards

4.1.1 Surface Water Quality Standards

Water quality standards for all surface waters are defined by the State of Washington (WAC 173-201A). The state adopted changes to WAC 173-201A in 2003, but the Environmental Protection Agency (EPA) has not yet approved the new standards (approval expected at the end of 2004). Until EPA approval is obtained, the state's 1997 standards remain in effect for any federal Clean Water Act actions.

Under the 2003 standards, all surface waters in the state are protected by narrative criteria, designated uses, and an anti-degradation policy. Designated uses are those uses specified in Chapter 173-201A for each water body, regardless of whether or not the uses currently exist. Based on the use designations, numeric and narrative criteria are assigned to protect existing and designated uses of a water body. Freshwater uses designated by the state include:

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- Aquatic life uses, which include six categories based on presence of key aquatic species;
- Recreation uses, which include the three categories of extraordinary primary contact, primary contact, and secondary contact;
- Water supply uses, which include domestic, industrial, agricultural, and stock watering; and
- Miscellaneous uses, which include wildlife habitat, harvesting, commerce and navigation, boating, and aesthetics.

For freshwater water bodies that do not have designated uses specified in WAC 173-201A-600 (Table 602), the following designated uses apply:

- Salmon and trout spawning, non-core rearing, and migration;
- Primary contact recreation;
- Domestic, industrial, agricultural and stock water uses; and
- Wildlife habitat, fish harvesting, commerce and navigation, boating, and aesthetic values.

This is the case for all WRIA 31 streams. There are no specific WRIA 31 water bodies listed in WAC 173-201A-600 (Table 602), so these default water uses and associated water quality criteria are implied for all surface waters in the WRIA (Table 4-1). Although many of the surface waters in WRIA 31 are not necessarily used for all categories described in Table 4-1, the water quality criteria defined for these default uses apply to all surface waters in the WRIA unless Washington State Department of Ecology (Ecology) were to make a site-specific determination to the contrary.

Note that when a water body does not meet its assigned criteria due to natural climatic or landscape attributes, the natural conditions constitute the water quality criteria (WAC 173-201A-260[1]). This may be of particular importance with regards to stream temperature in WRIA 31.

Table 4-1. Water Quality Criteria for all Surface Waters in WRIA 31

Designated Uses for Surface Water in WRIA 31 ¹		Temperature ²	Dissolved Oxygen ³	Turbidity	pH
Aquatic	Salmon and trout spawning, noncore rearing, migration	17.5 °C (63.5 °F)	8.0 mg/L	5 NTU over background if the background is 50 NTU or less, 10% increase in turbidity when the background is > 50 NTU	6.5 - 8.5 with human caused variations within the above range of less than 0.2 units
Bacteria					
Recreation	Primary contact recreation	Fecal coliform organism levels must not exceed a geometric mean value of 100			
		Toxics		Aesthetics	
Water Supply	Domestic, industrial, agricultural, stock watering	Toxic, radioactive, or deleterious material concentrations must be below those which have the potential, either singularly or cumulatively, to adversely affect biota dependent upon those waters, or adversely effect public health (see WAC 172-201A-440)		Aesthetic values must 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 (see WAC 170-201A-230 for guidance on establishing lake nutrient standards to protect aesthetics).	
Miscellaneous	Wildlife habitat, fish harvesting, commerce and navigation, boating, aesthetic values				

Notes:

1) As defined in WAC 173-201A

2) Temperature standards are compared against the highest 7-day average of the daily maximum temperature

3) The Dissolved Oxygen standard is compared against the lowest one-day minimum

State 303(d) List and TMDLs

Washington State is also required under Section 303(d) of the federal Clean Water Act to periodically compile for EPA a list of all surface waters in the state that are impaired by pollutants. This 303(d) list is restricted to impaired water bodies that have a designated beneficial use such as for drinking, recreation, aquatic habitat and industrial purposes.

Ecology prepares the 303(d) list based on federal laws, state water quality standards, and the state’s 303(d) policy. As a part of Ecology’s Water Quality Assessment program all monitored water bodies are classified as Categories 1 through 5 (Table 4-2). Waters classified as Category 5 are placed on the 303(d) list and require the preparation of Total Maximum Daily Loads (TMDLs). TMDLs identify the maximum amount of pollutant that can be released into a water body that will not impair the uses of the water.

There are no WRIA 31 streams listed on Ecology’s 2002/2004 303(d) list of impaired waters (Category 5). Therefore, there are no TMDLs established for WRIA 31 streams. On Ecology’s 1998 303(d) list and their 2002/2004 Water Quality Assessment list (not yet finalized), Rock Creek is listed twice as being impaired but not requiring a TMDL (discussed in Section 4.2.1). Ecology’s 303(d) list includes portions of the Columbia River as being within WRIA 31 (with fourteen 303(d) listings). Those fourteen 303(d) listings are for the following parameters: 4,4’-DDE, chlordane, and total PCBs in fish tissue; sediment toxicity (based on bioassay); and water temperature.

The only TMDLs currently established for the reaches of the Columbia River adjoining WRIA 31 are for total dissolved gas (TDG) and water temperature. TDG is produced by water flowing over spillways on dams, where air bubbles are entrained in the water. As these air bubbles are forced into deep water, the water becomes supersaturated with dissolved oxygen, nitrogen, and other constituents of air (Pickett and Harding 2002).

Water with elevated levels of TDG can cause air bubbles to develop in the tissues of fish that inhabit these waters for extended periods. This condition is known as gas bubble trauma and can cause chronic impairment or death to fish.

Table 4-2. Assessment Categories for Water Quality Assessment Program

Category	Description	Comments
Category 5	Poluted waters that require a TMDL	This is the 303(d) list
Category 4a	Poluted waters that do not require a TMDL	Has an approved TMDL in place and are currently being implemented
Category 4b		Has a pollution control plan in place
Category 4c		Impared by a non-pollutant that cannot be addressed through a TMDL
Category 3	No Data	All untested waters are assigned this category
Category 2	Waters of Concern	Some evedience of a water quality program but not enough to require a TMDL
Category 1	Meets standards for clean waters	Water body meets te standards only for the pollutants in which it was tested

4.1.2 Groundwater Quality Standards

Water quality standards for state groundwaters are defined by the State of Washington in WAC 173-200. The state groundwater quality standards protect drinking water, since it is the beneficial use generally requiring the highest quality of groundwater. The state's establishment of standards based on drinking water quality does not imply that all groundwaters are used for drinking water or that all groundwaters are presently suitable for drinking water.

4.2 Water Quality Data

4.2.1 Surface Water Quality Data

Surface water quality information for the WRIA was compiled from Ecology's River and Stream Ambient Monitoring Program, the 303(d) list of impaired water bodies, and miscellaneous data and reports. The EPA STORET database was also searched for additional data.

Ecology has completed no water quality monitoring of WRIA 31 streams under its River and Stream Ambient Monitoring Program. As part of this program, Ecology monitors one station in the Columbia River, adjacent to WRIA 31, which is listed as being within WRIA 31 (Columbia River at Umatilla; Station 31A070). Review of long-term monitoring data (1959-2002) from this station indicates that dissolved oxygen and pH routinely meet water quality standards, but temperature can exceed 63.5°F (17.5°C) in summer months. The EPA STORET database only contained a few miscellaneous WRIA 31 groundwater quality data points from the 1979-1982 time period. As stated above, there are no WRIA 31 streams listed on Ecology's 2002/2004 303(d) list of impaired waters (Category 5).

The majority of surface water quality data available for WRIA 31 is from miscellaneous reports and the Eastern Klickitat Conservation District (EKCD). Miscellaneous reports are discussed in the subbasin-specific discussions below. The EKCD has been

monitoring summer water temperature and additional water quality parameters throughout the Rock Creek and Wood/Alder Creeks subbasins since the mid 1990's. One station on Glade Creek has also been monitored by the EKCD. Figure 4-1 shows locations of EKCD's water quality monitoring stations within WRIA 31.

Raw data received from the EKCD (May 2004) were compiled in a database and each monitoring station was assigned to its appropriate subbasin for subsequent analysis. When the EKCD monitoring program began, water temperature data were typically recorded every 6 minutes by instream data loggers. This frequency creates an enormous dataset with an extremely fine time resolution. Later in the monitoring program, the EKCD started collecting data every hour. The EKCD database contains approximately 1.4 million records for water temperature and 8,499 records for other parameters.

For analysis of this very large dataset, water temperature statistics were calculated monthly for each monitoring station in WRIA 31. Prior to running these statistics, the data were checked for apparent outliers, and these outliers were not included in the calculations. Possible outliers were identified by examining weekly graphs of water temperature for each station. Typically, outliers would exist at the beginning and end of a year, presumably as the temperature probe was being installed and removed from the stream, and would thus record the air temperature. Note that, upon examining the graphs, some streams seem to run dry during the summer and the temperature probes appear to record air temperature during these periods. Because it was not possible to determine exactly when the stream at each of 25 data logger stations changed from almost dry to truly dry each year, these records were not removed from the statistical calculations for this Level 1 assessment. More detailed assessment and management of the large EKCD water quality dataset for Rock Creek has been proposed as a component of the supplemental water quality grant applied for by the Planning Unit.

Existing water quality information for each of the four subbasins is discussed below.

Rock Creek Subbasin

On Ecology's 2002/2004 water quality assessment list, Rock Creek is listed twice as being impaired but not requiring a TMDL (not on the 303[d] list). The upper reach (T5N R17E section 13) is listed for temperature, but a pollution control plan has been established (Ecology/EKCD Memorandum of Agreement described below); thus it listed as Category 4b. The lower reach of Rock Creek (T3N R19E section 29) and a small Unnamed Creek immediately west of it (T3N R18E section 23) are listed as Category 4c, which means impaired by a non-pollutant (fish habitat and fish passage barrier for the two creeks, respectively).

In 1995, Ecology, in cooperation with EKCD and the Natural Resources Conservation Service (NRCS), completed an evaluation of water temperature, including the influence of riparian canopy cover, in Rock Creek (Ehinger 1996). For the study, EKCD and the NRCS deployed continuous water temperature loggers at ten stations within Rock Creek during summer 1995. The ten monitoring stations are shown on Figure 4-1, but the stations were named differently in Ehinger (1996). A stream habitat evaluation was also conducted at each station. Daily maximum stream temperatures were above the current default water temperature standard of 63.5°F (17.5°C) throughout the 1995 summer months at most stations monitored. Temperatures as high as 90°F were measured at

Rock Creek Stations 8 and 9 located in the lowermost reach of Rock Creek (Figure 4-1). No discussion of whether monitoring stations were dry (i.e., measuring air temperature) was presented.

The study concluded that the high water temperatures in upper Rock Creek “may be natural for a small creek in a hot, sunny summer climate”. It was inferred that the lack of riparian shading and rocky substrate are contributing to elevated water temperatures in the lower stream reaches. Review of General Land Office (GLO) cadastral survey notes from the 1860s documents that this rocky substrate and lack of trees existed at that time, suggesting it may be the natural condition (Chapter 5). The Ehinger (1996) study pointed out that it would be difficult to quantitatively estimate what portion of the observed high water temperature is natural versus due to anthropogenic causes.

Based on the stream habitat survey, the Ehinger (1996) study concluded that most of Rock Creek showed little impact from current forestry or agricultural practices, but evidence of past grazing practices and episodic flood events were apparent in the lower reaches. Six of the ten stations had riparian canopy (vegetative) cover more than 10 percent below state target goals for eastern Washington Class A streams.

The outcome of this water quality study was a set of management recommendations to protect water quality, speed riparian recovery, and potentially prevent future flood-related damage in Rock Creek. A Memorandum of Agreement (MOA) was subsequently established in 1996 between Ecology and EKCD concerning actions to be implemented and reporting requirements. The EKCD has implemented these actions in accordance with the MOA and is monitoring water temperatures and other water quality parameters (e.g., dissolved oxygen [DO], pH, nitrate). These monitoring data are being transmitted to Ecology.

The EKCD has been monitoring summer water temperature via continuous water temperature loggers at ten locations on Rock Creek since 1995 (excluding the Rock Creek 3 station, for which data start in 1996). The duration of data collection at specific monitoring stations is variable, with some stations’ records ending in 1996 and others continuing to present. Data have generally been collected at an hourly (or shorter) time step. The monthly average, minimum, and maximum water temperatures calculated from these data are presented for each Rock Creek station in Table 4-3. Note that data are not available during portions of some months; the first and last days of data collection for each month are listed in Table 4-3, and months with data for each day are denoted with an asterisk (*).

In Table 4-3, monthly average water temperatures greater than the default standard of 63.5°F (17.5°C) are bolded. For the purposes of evaluating compliance with the state temperature standard, water temperature is to be represented by the highest 7-day average of the daily maximum temperatures (7-DADMax; WAC 173-201A-200). The calculations of 7-DADMax have not been performed for the very large EKCD dataset, pending more detailed assessment to identify time periods when the logger appeared to be measuring air temperature instead of water temperature (i.e., logger station was dry). This more detailed evaluation is part of the WRIA 31 supplemental water quality project being initiated. Because the monthly average temperature will always be less than the 7-DADMax for that month, the number of months when water temperature exceeded the standard will be greater than those months when the average exceeded.

Table 4-4 presents a synthesis of late-season water temperature by Rock Creek monitoring station over the full period of monitoring record. “Late-season” is here defined as the months of July, August, and September. Although the stations have different periods of record, this synthesis allows a general comparison of late-season water temperature by location along Rock Creek. Based on these data, Rock Creek water temperature generally increases in the downstream direction. For example, the average late-season water temperature is above 63.5°F only in the four lowermost stations (Rock Creek 7, 8, 9, and 10; Figure 4-1). The higher elevation Rock Creek headwaters occur within steep forested canyons; this setting helps substantially in maintaining relatively lower instream temperatures. The temperature increase downstream is consistent with a lack of (cooler) groundwater contribution to streamflow in Rock Creek (discussed in Section 3.3.3 of Chapter 3). As stated above, the reported maximum water temperatures for many stations (e.g., 100°F) are likely air temperatures rather than water temperatures.

If water temperature (7-DADMax) in Rock Creek is naturally above 63.5°F, then the natural 7-DADMax condition constitutes the temperature standard. Ehinger (1996) points out that it would be difficult to quantitatively estimate what portion of the observed high water temperature in Rock Creek is a result of natural conditions versus anthropogenic (man-made) influences. Irrespective of the temperature standard, actions taken under the Ecology/EKCD MOA for Rock Creek (e.g., planting riparian vegetation in year 2000) should eventually effect some reduction in water temperatures. The recently started supplemental water quality project will evaluate all water temperature data collected to date to document baseline conditions, and thus assist in future comparative analysis of stream temperature changes attributable to the riparian plantings.

Other water quality parameters were collected as spot measurements when the temperature data loggers were downloaded every four to eight weeks. The EKCD has periodically collected DO, pH, nitrate, and/or stream discharge measurements at the ten Rock Creek monitoring stations since the mid 1990s. These data are presented in Table 4-5 (nitrate is not presented because all concentrations were reportedly below the detection limit of the field instrument used). In Table 4-5, pH and DO values exceeding water quality standards are bolded. The default standards for WRIA 31 surface waters are pH within the range of 6.5 to 8.5, and DO at or above 8.0 mg/L. Each station had at least one DO measurement below the 8.0 mg/L standard. DO measurements below 8.0 mg/L occurred most commonly during the late-season months (August through October), when flows are lowest and the water most stagnant. Measured pH values outside of the water quality standard range (6.5-8.5) occur periodically at some but not all stations, and the measurements tend to be variable over time at a given station (Table 4-5).

The USGS sampled water temperature and suspended sediment at their Rock Creek streamflow gaging station near Roosevelt (Station 14036600) on six occasions between January 1965 and December 1966. These data are presented in Table 4-6. The six values were collected during higher flow events (600 to 1,800 cfs) in winter and spring. During these events, relatively high water turbidity occurred (up to 1,300 mg/L total suspended solids). Based on these data, Rock Creek can carry between roughly 400 and 4,000 tons of suspended sediment per day during high flow events. These USGS data include multiple measurements within a day’s time, and show the rapid changes in sediment load corresponding to rapid changes in flow (Table 4-6).

**Table 4-3. Summary of EKCD Water Temperature Data for Rock Creek
(Sheet 1 of 6)**

Monit. Site	Year	Month	Water Temperature			Measurement Period	
			Avg (°F)	Max (°F)	Min (°F)	First Day	Last Day
Rock Creek 1	1995	June	53.0	80.2	45.4	6/5/95	6/30/95
	1995	July *	58.1	71.9	49.9	7/1/95	7/31/95
	1995	August	59.5	70.7	53.0	8/1/95	8/2/95
	1995	October	44.9	61.6	35.5	10/12/95	10/31/95
	1995	November	41.3	49.5	34.9	11/1/95	11/16/95
	1996	May	48.1	82.1	40.3	5/16/96	5/31/96
	1996	June *	52.9	65.6	44.2	6/1/96	6/30/96
	1996	July *	58.1	69.1	47.6	7/1/96	7/31/96
Rock Creek 2	1996	August	59.1	69.4	52.9	8/1/96	8/13/96
	1995	June	51.4	73.2	43.8	6/12/95	6/30/95
	1995	July *	56.2	70.8	48.0	7/1/95	7/31/95
	1995	August *	53.8	76.9	45.8	8/1/95	8/31/95
	1995	September	53.8	59.8	48.3	9/1/95	9/25/95
	1996	May	46.4	87.6	39.1	5/20/96	5/31/96
Rock Creek 3	1996	June *	51.6	71.7	39.1	6/1/96	6/30/96
	1996	July	64.6	100.4	35.1	7/1/96	7/22/96
	1996	July	63.2	70.4	58.5	7/24/96	7/31/96
	1996	August *	60.9	85.9	56.6	8/1/96	8/31/96
	1996	September	59.4	72.5	52.9	9/1/96	9/16/96
	1997	June	55.0	73.8	49.6	6/18/97	6/30/97
	1997	July *	58.6	68.7	51.3	7/1/97	7/31/97
	1997	August *	60.9	71.3	55.2	8/1/97	8/31/97
	1997	September *	55.3	62.0	49.9	9/1/97	9/30/97
	1997	October *	49.1	56.0	43.8	10/1/97	10/31/97
	1997	November	45.8	48.8	43.8	11/1/97	11/3/97
	1998	June *	55.4	68.4	46.8	6/1/98	6/30/98
	1998	July *	63.7	87.9	53.8	7/1/98	7/31/98
	1999	May	48.5	75.3	38.7	5/11/99	5/31/99
	1999	June *	54.1	64.9	44.3	6/1/99	6/30/99
	1999	July *	58.7	70.1	49.3	7/1/99	7/31/99
	1999	August *	62.3	68.9	54.9	8/1/99	8/31/99
	1999	September	56.4	88.6	38.4	9/1/99	9/25/99
	2000	May	52.2	70.7	47.9	5/31/00	5/31/00
	2000	June *	55.2	70.1	45.7	6/1/00	6/30/00
2000	July *	60.8	75.9	51.3	7/1/00	7/31/00	
2000	August *	68.6	100.8	47.7	8/1/00	8/31/00	
2000	September	72.6	78.4	65.4	9/1/00	9/19/00	
Rock Creek 4	1995	May	61.7	85.7	57.9	5/31/95	5/31/95
	1995	June *	55.9	63.9	48.7	6/1/95	6/30/95
	1995	July	59.0	64.5	55.4	7/1/95	7/5/95
	1995	August	56.7	70.9	51.5	8/3/95	8/31/95
	1995	September *	56.5	62.5	52.9	9/1/95	9/30/95
	1995	October *	48.9	58.2	39.5	10/1/95	10/31/95
	1995	November	39.4	40.3	38.9	11/1/95	11/1/95
	1996	May	52.0	64.2	44.8	5/21/96	5/31/96
	1996	June *	56.5	63.0	50.1	6/1/96	6/30/96
	1996	July	59.5	63.0	55.1	7/1/96	7/23/96
	1996	September	82.1	82.1	82.1	9/19/96	9/19/96
	1997	May	55.4	81.2	47.8	5/15/97	5/31/97
	1997	June *	56.9	76.1	50.6	6/1/97	6/30/97
	1997	July *	59.9	69.7	53.7	7/1/97	7/31/97
	1997	August *	62.0	64.8	58.8	8/1/97	8/31/97
	1997	September *	57.6	61.3	53.7	9/1/97	9/30/97
	1997	October *	49.6	56.2	43.9	10/1/97	10/31/97
1997	November	46.5	49.0	43.9	11/1/97	11/5/97	

**Table 4-3. Summary of EKCD Water Temperature Data for Rock Creek
(Sheet 2 of 6)**

Monit. Site	Year	Month	Water Temperature			Measurement Period	
			Avg (°F)	Max (°F)	Min (°F)	First Day	Last Day
Rock Creek 5	1995	June	56.9	68.7	50.0	6/8/95	6/30/95
	1995	July *	61.1	70.2	54.5	7/1/95	7/31/95
	1995	August	58.9	69.3	51.7	8/1/95	8/25/95
	1995	September	53.1	56.4	49.4	9/21/95	9/30/95
	1995	October *	46.4	53.9	34.8	10/1/95	10/31/95
	1995	November	40.2	48.9	32.5	11/1/95	11/14/95
	1996	May	52.7	63.5	44.2	5/22/96	5/31/96
	1996	June *	56.9	66.1	49.2	6/1/96	6/30/96
	1996	July *	62.5	71.7	52.5	7/1/96	7/31/96
	1996	August *	60.9	67.0	54.2	8/1/96	8/31/96
	1996	September *	53.6	60.9	45.6	9/1/96	9/30/96
1996	October	52.7	56.7	48.9	10/1/96	10/10/96	
Rock Creek 6	1995	May	62.4	90.9	58.2	5/30/95	5/31/95
	1995	June *	58.3	66.8	50.3	6/1/95	6/30/95
	1995	July *	63.3	72.7	57.3	7/1/95	7/31/95
	1995	August	63.4	90.2	53.7	8/1/95	8/29/95
	1995	October	47.9	73.6	37.5	10/12/95	10/31/95
	1995	November	43.7	50.9	34.6	11/1/95	11/16/95
	1996	May	53.5	64.2	46.7	5/20/96	5/31/96
	1996	June *	58.7	65.6	51.2	6/1/96	6/30/96
	1996	July *	64.2	90.2	55.1	7/1/96	7/31/96
	1996	August	62.8	68.8	56.5	8/1/96	8/19/96
	1997	May	58.0	93.7	50.4	5/12/97	5/31/97
	1997	June *	58.8	67.1	52.6	6/1/97	6/30/97
	1997	July *	63.0	74.2	55.1	7/1/97	7/31/97
	1997	August *	64.7	74.8	58.5	8/1/97	8/31/97
	1997	September *	58.7	64.8	52.3	9/1/97	9/30/97
	1997	October *	50.2	58.8	42.9	10/1/97	10/31/97
	1997	November	47.4	50.7	43.7	11/1/97	11/5/97
	1998	May	53.6	83.7	47.6	5/5/98	5/27/98
	1998	June	60.0	67.7	54.0	6/18/98	6/30/98
	1998	July *	66.2	78.6	59.3	7/1/98	7/31/98
	1998	August *	64.3	72.1	57.6	8/1/98	8/31/98
	1998	September *	60.1	68.3	53.7	9/1/98	9/30/98
	1998	October	53.1	58.2	48.1	10/1/98	10/10/98
	1999	May	52.2	65.6	41.2	5/5/99	5/31/99
	1999	June *	58.7	68.8	48.7	6/1/99	6/30/99
	1999	July *	61.7	68.8	52.3	7/1/99	7/30/99
	2000	June	61.3	68.6	54.1	6/12/00	6/30/00
	2000	July *	63.1	73.7	53.2	7/1/00	7/31/00
	2000	August *	62.8	71.6	54.6	8/1/00	8/31/00
	2000	September *	57.2	65.7	45.4	9/1/00	9/30/00
	2000	October *	50.9	61.7	42.9	10/1/00	10/24/00
	2001	June	61.6	73.7	55.8	6/28/01	6/30/01
	2001	July *	63.6	70.1	58.0	7/1/01	7/31/01
2001	August *	64.1	71.0	57.2	8/1/01	8/31/01	
2001	September *	58.6	65.1	50.5	9/1/01	9/30/01	
2001	October *	49.7	56.6	44.1	10/1/01	10/31/01	
2001	November	45.1	51.9	38.8	11/1/01	11/26/01	
2002	April	52.5	55.1	48.6	4/30/02	4/30/02	
2002	May *	52.6	63.0	41.1	5/1/02	5/31/02	
2002	June	60.0	95.3	47.8	6/1/02	6/24/02	

**Table 4-3. Summary of EKCD Water Temperature Data for Rock Creek
(Sheet 3 of 6)**

Monit. Site	Year	Month	Water Temperature			Measurement Period	
			Avg (°F)	Max (°F)	Min (°F)	First Day	Last Day
Rock Creek 7	1995	May	63.5	92.0	59.7	5/30/95	5/31/95
	1995	June *	60.2	77.1	53.5	6/1/95	6/30/95
	1995	July *	65.5	77.1	59.9	7/1/95	7/31/95
	1995	August	64.0	84.2	59.7	8/1/95	8/29/95
	1996	May	55.3	63.4	49.6	5/17/96	5/31/96
	1996	June *	60.0	66.9	53.5	6/1/96	6/30/96
	1996	July *	65.4	73.1	57.7	7/1/96	7/31/96
	1996	August *	66.2	99.9	54.3	8/1/96	8/31/96
	1996	September	61.5	89.2	49.3	9/1/96	9/19/96
	1997	May	59.6	85.8	52.9	5/8/97	5/31/97
	1997	June *	61.2	78.3	55.4	6/1/97	6/30/97
	1997	July *	65.3	74.3	57.9	7/1/97	7/31/97
	1997	August *	67.5	75.2	61.6	8/1/97	8/31/97
	1997	September *	61.9	69.2	56.0	9/1/97	9/30/97
	1997	October *	53.9	63.1	47.6	10/1/97	10/31/97
	1997	November	51.6	54.9	48.5	11/1/97	11/5/97
	1998	May	56.3	81.2	51.5	5/5/98	5/31/98
	1998	June *	61.4	69.2	56.3	6/1/98	6/30/98
	1998	July *	68.0	74.9	61.9	7/1/98	7/31/98
	1998	August *	67.3	74.3	60.5	8/1/98	8/31/98
	1998	September *	63.5	71.6	56.8	9/1/98	9/30/98
	1998	October	56.9	62.5	52.7	10/1/98	10/10/98
	1999	May	55.3	66.3	46.2	5/5/99	5/31/99
	1999	June *	61.0	69.8	52.9	6/1/99	6/30/99
	1999	July *	64.8	73.1	56.8	7/1/99	7/31/99
	1999	August *	67.4	74.3	59.9	8/1/99	8/31/99
	1999	September *	59.5	66.0	49.9	9/1/99	9/30/99
	1999	October	52.8	59.4	47.1	10/1/99	10/29/99
	2000	June *	62.1	97.1	54.3	6/1/00	6/30/00
	2000	July *	66.2	79.6	57.7	7/1/00	7/31/00
	2000	August *	66.7	81.5	56.3	8/1/00	8/31/00
	2000	September *	60.8	73.1	48.5	9/1/00	9/30/00
	2000	October *	53.7	66.3	46.8	10/1/00	10/31/00
	2000	November *	45.0	53.5	38.4	11/1/00	11/30/00
	2000	December	42.7	46.0	39.2	12/1/00	12/11/00
	2001	May	59.8	81.0	50.8	5/11/01	5/31/01
	2001	June *	61.4	73.8	53.6	6/1/01	6/30/01
	2001	July *	69.4	81.7	59.8	7/1/01	7/31/01
	2001	August *	72.7	100.8	57.8	8/1/01	8/31/01
	2001	September *	63.6	74.4	52.2	9/1/01	9/30/01
	2001	October *	52.3	58.7	46.7	10/1/01	10/31/01
	2001	November	48.2	56.1	41.6	11/1/01	11/26/01
	2002	April	57.9	79.4	53.7	4/30/02	4/30/02
	2002	May *	55.7	65.3	45.9	5/1/02	5/31/02
	2002	June *	62.4	73.8	52.6	6/1/02	6/30/02
	2002	July *	69.1	79.1	51.2	7/1/02	7/31/02
	2002	August *	68.2	92.2	50.1	8/1/02	8/31/02
	2002	September *	61.7	70.5	54.0	9/1/02	9/30/02
2002	October	52.8	74.2	44.0	10/1/02	10/29/02	
2003	May	57.7	72.8	48.4	5/12/03	5/31/03	
2003	June *	63.0	73.4	55.7	6/1/03	6/30/03	
2003	July *	69.4	100.7	58.2	7/1/03	7/31/03	
2003	August *	70.6	100.7	56.0	8/1/03	8/31/03	
2003	September *	62.4	71.0	55.4	9/1/03	9/30/03	
2003	October *	54.6	61.1	41.8	10/1/03	10/31/03	
2003	November *	44.0	51.8	40.1	11/1/03	11/30/03	
2003	December	44.5	77.7	42.3	12/1/03	12/23/03	

**Table 4-3. Summary of EKCD Water Temperature Data for Rock Creek
(Sheet 4 of 6)**

Monit. Site	Year	Month	Water Temperature			Measurement Period	
			Avg (°F)	Max (°F)	Min (°F)	First Day	Last Day
Rock Creek 8	1995	May	64.9	93.2	58.7	5/30/95	5/31/95
	1995	June *	61.4	74.1	52.8	6/1/95	6/30/95
	1995	July *	67.1	94.7	58.4	7/1/95	7/31/95
	1995	August *	65.3	88.3	50.3	8/1/95	8/23/95
	1996	May	56.9	68.5	48.6	5/16/96	5/31/96
	1996	June *	62.1	73.2	53.1	6/1/96	6/30/96
	1996	July *	67.7	84.3	57.3	7/1/96	7/31/96
	1996	August *	69.7	100.8	53.6	8/1/96	8/31/96
	1996	September	67.6	100.8	50.9	9/1/96	9/13/96
	1997	May	60.3	82.3	51.7	5/8/97	5/31/97
	1997	June *	62.3	82.3	54.2	6/1/97	6/30/97
	1997	July *	66.9	78.4	57.2	7/1/97	7/31/97
	1997	August *	69.9	84.2	60.6	8/1/97	8/31/97
	1997	September *	63.5	79.4	55.9	9/1/97	9/30/97
	1997	October *	56.0	74.4	49.4	10/1/97	10/31/97
	1997	November	52.7	56.7	49.4	11/1/97	11/5/97
	1998	May	56.8	83.3	50.0	5/5/98	5/31/98
	1998	June *	62.8	75.6	55.0	6/1/98	6/30/98
	1998	July *	70.3	92.1	60.3	7/1/98	7/31/98
	1998	August *	73.9	100.3	50.8	8/1/98	8/31/98
	1998	September *	68.2	100.3	50.6	9/1/98	9/30/98
	1998	October	59.3	68.7	53.9	10/1/98	10/10/98
	1999	May	55.5	78.1	43.9	5/5/99	5/31/99
	1999	June *	61.5	74.1	51.4	6/1/99	6/30/99
	1999	July *	66.2	81.0	55.6	7/1/99	7/31/99
	1999	August *	70.5	85.6	57.0	8/1/99	8/31/99
	1999	September *	62.4	75.0	48.3	9/1/99	9/30/99
	1999	October	56.1	66.1	48.0	10/1/99	10/8/99
	2000	May	56.2	66.7	52.5	5/30/00	5/31/00
	2000	June *	62.9	78.1	51.7	6/1/00	6/30/00
	2000	July *	70.4	100.3	54.5	7/1/00	7/31/00
	2000	August *	77.4	95.8	67.3	8/1/00	8/1/00
	2001	May *	59.8	87.6	50.3	5/11/01	5/31/01
	2001	June *	62.3	79.4	52.2	6/1/01	6/30/01
	2001	July *	74.5	100.8	48.3	7/1/01	7/31/01
	2001	August	55.2	62.4	50.3	8/1/01	8/1/01
	2002	April	58.9	83.0	52.5	4/30/02	4/30/02
	2002	May *	56.2	68.7	45.0	5/1/02	5/31/02
	2002	June *	63.3	79.4	52.2	6/1/02	6/30/02
	2002	July *	78.0	100.5	56.1	7/1/02	7/31/02
	2002	August *	74.4	100.5	53.3	8/1/02	8/31/02
	2002	September *	66.3	93.3	42.2	9/1/02	9/30/02
2002	October	55.2	77.9	41.9	10/1/02	10/30/02	
2003	May	58.4	90.1	48.1	5/12/03	5/31/03	
2003	June *	63.8	76.7	55.6	6/1/03	6/30/03	
2003	July *	74.8	100.8	57.3	7/1/03	7/31/03	
2003	August	81.9	100.8	53.7	8/1/03	8/21/03	

**Table 4-3. Summary of EKCD Water Temperature Data for Rock Creek
(Sheet 5 of 6)**

Monit. Site	Year	Month	Water Temperature			Measurement Period	
			Avg (°F)	Max (°F)	Min (°F)	First Day	Last Day
Rock Creek 9	1995	May	69.4	82.7	62.4	5/30/95	5/31/95
	1995	June *	65.5	86.3	52.9	6/1/95	6/30/95
	1995	July *	71.3	98.9	55.9	7/1/95	7/31/95
	1995	August	68.3	100.5	54.8	8/1/95	8/23/95
	1996	May	59.5	71.2	50.6	5/16/96	5/31/96
	1996	June *	65.8	77.9	54.8	6/1/96	6/30/96
	1996	July *	72.8	87.7	59.3	7/1/96	7/31/96
	1996	August *	70.6	86.0	59.0	8/1/96	8/31/96
	1996	September *	63.9	81.4	49.2	9/1/96	9/30/96
	1996	October	62.1	71.5	53.1	10/1/96	10/9/96
	1998	May	59.0	81.3	51.4	5/6/98	5/31/98
	1998	June *	66.2	80.7	55.8	6/1/98	6/30/98
	1998	July *	72.3	82.7	63.8	7/1/98	7/31/98
	1998	August *	71.1	80.4	66.4	8/1/98	8/31/98
	1998	September *	69.2	74.7	66.7	9/1/98	9/30/98
	1998	October *	60.2	71.1	49.7	10/1/98	10/31/98
	1999	May	58.7	85.3	48.6	5/10/99	5/31/99
	1999	June *	63.9	73.8	54.7	6/1/99	6/30/99
	1999	July *	69.8	80.1	58.9	7/1/99	7/31/99
	1999	August *	71.5	83.3	62.6	8/1/99	8/31/99
	1999	September *	64.1	69.0	55.3	9/1/99	9/30/99
	1999	October	59.8	62.6	56.1	10/1/99	10/8/99
	2001	June	70.1	76.9	61.5	6/29/01	6/30/01
	2001	July *	70.6	82.9	61.8	7/1/01	7/31/01
	2001	August *	71.2	81.0	64.4	8/1/01	8/31/01
	2001	September *	65.1	72.3	58.1	9/1/01	9/30/01
	2001	October *	56.1	66.1	47.6	10/1/01	10/31/01
	2001	November	51.7	63.0	44.8	11/1/01	11/26/01
	2002	April	61.2	85.1	55.5	4/30/02	4/30/02
	2002	May *	58.9	72.2	47.4	5/1/02	5/31/02
	2002	June *	67.0	82.8	53.8	6/1/02	6/30/02
	2002	July *	72.5	84.8	61.4	7/1/02	7/31/02
	2002	August	70.0	79.9	63.7	8/1/02	8/26/02
	2003	August	67.8	73.0	65.3	8/21/03	8/31/03
	2003	September *	64.5	69.7	59.0	9/1/03	9/30/03
	2003	October *	59.9	65.0	50.1	10/1/03	10/31/03
2003	November *	49.6	52.6	45.3	11/1/03	11/30/03	
2003	December	46.5	70.9	44.8	12/1/03	12/23/03	

**Table 4-3. Summary of EKCD Water Temperature Data for Rock Creek
(Sheet 6 of 6)**

Monit. Site	Year	Month	Water Temperature			Measurement Period	
			Avg (°F)	Max (°F)	Min (°F)	First Day	Last Day
Rock Creek 10	1995	July	70.0	92.5	64.7	7/19/95	7/31/95
	1995	August	73.3	81.6	66.1	8/1/95	8/4/95
	1996	May	59.3	87.6	50.0	5/16/96	5/31/96
	1996	June *	65.7	78.8	53.1	6/1/96	6/30/96
	1996	July *	70.5	82.9	58.9	7/1/96	7/31/96
	1996	August	70.5	81.0	64.7	8/1/96	8/12/96
	1996	September	65.3	81.0	57.2	9/13/96	9/30/96
	1996	October	65.3	74.7	58.4	10/1/96	10/8/96
	1997	May	62.7	85.2	52.4	5/8/97	5/31/97
	1997	June *	64.9	77.8	55.2	6/1/97	6/30/97
	1997	July *	69.2	78.7	23.1	7/1/97	7/31/97
	1997	August	24.4	59.4	23.1	8/1/97	8/4/97
	1998	May	58.8	88.8	51.3	5/5/98	5/31/98
	1998	June *	65.4	79.6	56.6	6/1/98	6/30/98
	1998	July *	69.6	80.9	62.3	7/1/98	7/31/98
	1998	August *	71.6	100.6	50.5	8/1/98	8/31/98
	1998	September *	68.8	82.2	61.7	9/1/98	9/30/98
	1998	October	65.4	68.3	62.8	10/1/98	10/10/98
	1999	May	57.5	77.7	45.2	5/5/99	5/31/99
	1999	June *	64.2	77.7	52.7	6/1/99	6/30/99
1999	July *	68.7	84.1	56.9	7/1/99	7/31/99	
1999	August *	73.0	100.6	48.8	8/1/99	8/31/99	
1999	September	70.4	100.6	43.6	9/1/99	9/26/99	
2000	May	57.6	62.5	53.3	5/30/00	5/31/00	
2000	June *	65.5	81.5	52.7	6/1/00	6/30/00	
2000	July *	74.1	100.6	55.2	7/1/00	7/31/00	
2000	August	75.6	100.6	66.6	8/1/00	8/1/00	

Notes:

*: Data are available for each day of the month.

Bolded average temperatures exceed default surface water quality standard of 63.5° F (17.5°C) for highest 7-day average of daily maximum temperature.

Table 4-4. Comparison of Late-Season (July-September) Water Temperatures in Rock Creek by Monitoring Station

Station	Period of Record for Temperature Monitoring	Late-Season (July-Sept) Water Temperatures During Period of Record		
		Avg (°F)	Max (°F)	Min (°F)
Rock Creek 1	Jun-95 to Aug-96	58.7	71.9	47.6
Rock Creek 2	Jun-95 to Jul-96	57.1	100.4	35.1
Rock Creek 3	Jul-96 to Sep-00	61.6	100.8	38.4
Rock Creek 4	May-95 to Nov-97	61.6	82.1	51.5
Rock Creek 5	Jun-95 to Oct-96	58.4	71.7	45.6
Rock Creek 6	May-95 to Jun-02	62.5	90.2	45.4
Rock Creek 7	May-95 to Dec-03	65.7	100.8	48.5
Rock Creek 8	May-95 to Aug-03	69.7	100.8	42.2
Rock Creek 9	May-95 to Dec-03	69.3	100.5	49.2
Rock Creek 10	Jul-95 to Aug-00	67.7	100.6	23.1

Notes:

Bolded average temperatures exceed default surface water quality standard of 63.5° F (17.5°C).

Maximum temperatures for some stations likely are air, not water, temperatures (refer to text).

Table 4-5. EKCD Water Quality Data for the Rock Creek Subbasin (Sheet 1 of 2)

Monit. Site	Date	DO (mg/l)	Flow (cfs)	pH	Monit. Site	Date	DO (mg/l)	Flow (cfs)	pH	Monit. Site	Date	DO (mg/l)	Flow (cfs)	pH	
Rock Creek 1	6/27/95	7	1.77	7.25	Rock Creek 4	7/5/95	10	1.2	7.5	Rock Creek 7	6/27/95	9	4.47	8	
	7/21/95	8	0.91	7		8/3/95	--	1.38	7.5		7/25/95	9	--	7.5	
	8/30/95	5	--	7.25		9/1/95	5	--	7		8/23/95	7	--	7	
	10/12/95	9	--	7		10/2/95	6	--	--		10/5/95	--	--	7	
	6/17/96	9	0.68	7.5		11/1/95	9	--	7.5		6/18/96	9	5.8	8	
	7/17/96	8	1.5	7		6/21/96	10	9.47	7.5		7/17/96	10	--	8	
	5/29/98	--	0.55	--		7/23/96	10	--	7.5		8/16/96	10	--	8	
	6/18/98	11	0.55	6.42		8/29/96	5	--	7		9/19/96	9	--	8	
	7/2/98	--	0.25	--		9/19/96	10	--	7.5		5/27/98	--	17.46	--	
	7/16/98	--	--	6.91		Rock Creek 5	6/27/95	11	27		8	6/17/98	12	11.06	7.63
	5/19/99	--	2.59	--			7/26/95	--	--		8	7/2/98	--	5.47	--
	6/3/99	11.25	1.65	7.05			8/26/95	11	0.2		8	7/16/98	11	2.22	7.67
	6/15/99	--	0.71	--			9/21/95	10	--		7.5	8/6/98	--	1.42	--
	6/29/99	--	0.5	--			10/27/95	7	--		7.5	8/17/98	9.5	0.66	7.52
	6/9/00	--	0.51	--			6/21/96	10	10.3		8	10/10/98	--	0.94	--
6/22/00	--	0.32	6.91	7/23/96	9		--	7.5	5/17/99	--	56.43	--			
7/3/00	--	0.16	--	8/22/96	8		--	7.5	6/4/99	--	23.01	8.22			
Rock Creek 2	7/5/95	10	0.34	7.5	9/23/96		10	0.63	8	6/21/99	--	10.53	--		
	8/3/95	--	--	7.5	6/27/95		6	28	7	7/6/99	--	10.45	8.32		
	8/30/95	7	--	7.5	7/25/95	9	--	8	7/20/99	--	7.6	--			
	9/25/95	8	--	7.5	6/17/96	11	3.5	8	7/30/99	8	5.65	7.79			
	11/2/95	7	--	7.5	7/15/96	6	--	8	6/12/00	--	9.28	--			
	6/20/96	11	--	7.5	8/12/96	3	--	7	6/23/00	--	6.24	8.23			
	6/1/98	--	1.1	--	9/13/96	2	--	7	7/5/00	--	5.1	--			
	6/19/98	10.75	0.09	6.62	5/27/98	--	60.54	--	7/14/00	10.25	6.6	6.6			
	6/9/99	8	1.24	7.4	6/17/98	11	21.39	7.89	8/1/00	--	0.25	--			
	6/23/99	--	0.6	--	7/2/98	--	9.15	--	8/10/00	--	--	7.67			
	7/15/99	--	--	7.03	7/17/98	11.5	4.06	6.98	8/15/00	9.25	--	--			
	8/3/99	8.5	--	7.49	8/6/98	--	0.79	--	10/6/00	--	0.52	--			
	6/16/00	--	0.99	--	8/17/98	9	--	7.24	10/23/00	7.85	0.88	6.15			
	6/26/00	--	0.89	7.09	10/10/98	--	1.78	--	11/13/00	--	2.35	7.57			
	7/11/00	--	0.33	--	5/17/99	--	131.78	--	3/1/01	--	13.02	--			
Rock Creek 3	6/28/95	10	2.3	7.5	6/4/99	--	42.43	8.22	3/28/01	--	21.76	--			
	7/26/95	--	--	7.5	6/22/99	--	29.62	--	5/11/01	--	3.66	--			
	6/20/96	7	--	7.5	7/6/99	--	15.74	8.32	5/21/01	--	10.68	--			
	7/23/96	9	--	7.5	7/21/99	--	7.88	--	6/7/01	11	8.26	--			
	8/16/96	4	--	7	8/2/99	8	2.95	7.79	6/27/01	9	3.1	7.36			
	6/1/98	--	5.29	--	6/13/00	--	23.7	--	7/17/01	9	0.2	7.02			
	6/19/98	9.25	2.96	7.05	7/5/00	--	4.11	--	7/27/01	7	--	7.45			
	7/6/98	--	0.78	--	7/17/00	--	1.44	8.15	8/13/01	--	--	8.52			
	7/20/98	8.25	0.56	7.14	3/1/01	--	26.82	--	8/23/01	11	--	5.83			
	7/31/98	--	0.03	--	5/11/01	--	11.61	--	9/12/01	12	--	5.93			
	5/24/99	--	15.67	--	5/21/01	--	11.1	--	10/26/01	11	2.27	7.16			
	6/10/99	10.25	8.12	6.45	6/7/01	10	3.4	7.91	11/1/01	--	3.83	--			
	6/22/99	--	3.26	--	6/27/01	12	1.99	7.55	11/26/01	12	6.45	7.28			
	7/12/99	--	1.37	6.84	7/17/01	9	--	6.89	12/3/01	--	16.43	--			
	7/21/99	--	0.78	--	11/26/01	12	7.58	7.42	6/24/02	12	0.93	7.82			
8/2/99	7	0.53	6.49	5/12/03	11	9.43	7.4	8/5/02	14	--	8.43				
6/13/00	--	3.1	--	6/5/03	11	4.16	8.55	8/26/02	8	--	7.6				
6/23/00	--	2.09	7.04	7/16/03	7	--	--	9/23/02	10	--	7.56				
7/6/00	--	1.14	--					10/9/02	10	--	--				
7/17/00	10	0.24	7.46					10/29/02	9	0.24	7.56				
								5/12/03	11	3.02	7.61				
								6/5/03	11	2.24	7.9				
								7/16/03	8	0.11	--				
								8/21/03	14	--	--				

Table 4-5. EKCD Water Quality Data for the Rock Creek Subbasin (Sheet 2 of 2)

Monit. Site	Date	DO (mg/l)	Flow (cfs)	pH	Monit. Site	Date	DO (mg/l)	Flow (cfs)	pH	Monit. Site	Date	DO (mg/l)	Flow (cfs)	pH
Rock Creek 6	6/27/95	6	--	8	Rock Creek 9	6/27/95	9	11.57	7.75	Rock Creek 10	10/12/95	8	--	7
	7/25/95	8	--	8		6/26/96	9	15.09	8		6/17/96	9	13.8	8
	8/23/95	10	--	8		7/15/96	9	--	8.5		7/15/96	8	--	7.5
	10/12/95	9	--	7.5		8/12/96	12	--	8.5		8/12/96	8	--	7.5
	6/20/96	8	16.1	7.5		9/13/96	9	--	8		9/13/96	8	--	7
	7/23/96	8	--	8		5/27/98	--	74.24	--		5/26/98	--	42.58	--
	8/19/96	10	--	8		6/15/98	13	33.91	8.38		6/17/98	9	23.89	7.78
	5/27/98	--	25	--		7/2/98	--	12.42	--		7/2/98	--	7.94	--
	6/18/98	9.75	12.32	7.55		7/17/98	7.5	3.99	7.11		7/17/98	6.5	1.05	6.89
	7/2/98	--	5.68	--		7/31/98	--	3.57	--		8/17/98	7	--	6.48
	7/15/98	9	2.47	7.51		8/17/98	9.25	0.95	7.95		5/20/99	--	65.76	--
	8/4/98	--	1.57	--		5/20/99	--	79.79	--		6/4/99	--	61.16	7.29
	8/17/98	9.25	0.51	7.55		6/7/99	12.5	59.41	7.62		6/22/99	--	25.5	--
	10/10/98	--	1.37	--		6/22/99	--	30.62	--		7/6/99	--	13.08	8.04
	5/17/99	--	99.02	--		7/6/99	--	15.62	8.55		7/21/99	--	2.22	--
	6/3/99	11.25	39.16	7.55		7/21/99	--	11.99	--		8/2/99	6	--	7.24
	6/21/99	--	34.73	--		8/2/99	9.25	4.05	7.65		6/13/00	--	21.72	--
	7/1/99	--	12.49	6.85		6/13/00	--	19.13	--		6/23/00	--	9.64	8
	7/20/99	--	5.15	--		6/23/00	--	13.85	8.02		7/5/00	--	0.61	--
	7/30/99	7.25	3.21	7.17		7/5/00	--	4.59	--		7/17/00	--	--	7.69
	6/12/00	--	20.99	--		7/18/00	8.5	--	7.62		1/4/01	--	214.02	--
	6/22/00	--	7.27	7.81		8/3/00	--	0.18	--		3/28/01	--	25.87	--
	7/3/00	--	4.09	--		8/11/00	--	0.13	8.16					
	7/14/00	--	2.22	7.53		10/6/00	--	0.38	--					
	8/1/00	--	0.47	--		10/23/00	7.5	4.02	6.98					
	8/10/00	--	0.4	6.55		11/13/00	--	9.07	7.87					
	8/15/00	7.75	--	--		5/11/01	--	12.22	--					
	10/6/00	--	2.11	--		5/21/01	--	11.65	--					
	10/23/00	8.25	4.3	6.86		6/7/01	10	9.62	7.4					
	11/13/00	--	3.81	7.62		6/27/01	10	3.29	7.56					
	5/10/01	--	11.36	--		7/17/01	8	0.67	7.86					
	5/21/01	--	9.44	--		7/25/01	--	0.17	8.8					
6/7/01	9	7.65	--	8/13/01	8	--	7.34							
6/27/01	8	5.27	7.02	8/23/01	8	--	6.51							
7/17/01	7	2.22	6.89	9/12/01	3	--	6.85							
7/27/01	7	1.07	6.92	10/26/01	5	--	6.79							
8/13/01	8	2.42	7.3	11/1/01	--	0.51	--							
8/23/01	9	0.78	6.78	11/26/01	11	11.06	7.25							
9/12/01	8	2.38	7.33	12/3/01	--	50.92	--							
10/26/01	11	2.32	7	6/26/02	12	1.61	9.11							
11/1/01	--	3.44	--	8/5/02	9	0.1	7.45							
11/26/01	12	8.16	7.09	8/26/02	5	--	7.27							
12/3/01	--	27.76	--	9/23/02	5	--	7.08							
6/24/02	10	3.29	7.4	10/9/02	5	--	--							
8/5/02	10	0.23	7.36	10/29/02	5	--	6.87							
8/26/02	8	0.26	7.91	11/29/02	--	2.1	--							
9/23/02	9	0.36	7.22	5/12/03	12	14.08	7.78							
10/9/02	9	0.27	--	6/5/03	11	5.45	8.05							
10/28/02	11	0.89	6.89	7/16/03	10	0.36	--							
5/12/03	11	6.16	6.99	8/21/03	8	--	--							
6/5/03	10	3.14	7.41											
7/16/03	9	0.2	--											
8/21/03	9	0.08	--											

Notes:
 Bolded DO values exceed default surface water quality standard of 8.0 mg/L (for lowest 1-day minimum).
 Bolded pH values exceed default surface water quality standard of 6.5 to 8.5.

Table 4-6. USGS Water Quality Data for Rock Creek

Rock Creek near Roosevelt, WA (14036600)					
Date	Time	Water Temperature (°F)	Suspended Sediment Concentration (mg/L)	Suspended Sediment Load (tons/day)	Calculated Discharge (cfs)
1/27/65	11:30	39.9	993	4,400	1,810
3/9/66	0:30	44.1	337	490	590
3/9/66	14:00	39.9	1,320	2,920	900
12/12/66	20:15	42.1	170	368	880
12/12/66	23:10	43.0	629	2,070	1,340
12/13/66	14:40	45.0	263	817	1,270

Wood/Alder Creeks Subbasin

The EKCD has also collected water temperature and other parameter data from fifteen stations on five streams in the Wood/Alder Creeks subbasin, including (see Figure 4-1): Alder Creek (3 stations), Chapman Creek (2 stations), Pine Creek (5 stations), Six Prong Creek (2 stations), and Wood Gulch (3 stations). Water temperature data were generally collected via continuous instream data loggers at an hourly (or shorter) time step, and the periods of records for the 15 stations are variable. The monthly average, minimum, and maximum water temperatures calculated from these data are presented for each station in Table 4-7.

The monthly temperature data indicate that most all stations have late-season (July-September) monthly average temperatures above 63.5°F, except Pine Creek 3 and Wood Gulch 3. Both of these stations are located in high elevation headwater areas (both also have only 2-year data records from 1995-1996). As stated above for the Rock Creek temperature data, the representative temperature used for comparison against the water quality standard (7-DADmax) will always be higher than the monthly average; therefore, more months would exceed the standard than indicated by the monthly average data.

To help distill this large quantity of data, Table 4-8 presents average late-season (July-September) water temperatures by monitoring station over the full period of record, despite the variable periods of records for each station. Based on these data, the following observations are made for individual drainages in this subbasin (station locations shown on Figure 4-1):

- **Chapman Creek.** Over a 7- to 8-year period of record, the long-term average late-season water temperatures at both monitoring stations in Chapman Creek, the westernmost drainage in the subbasin, are below 63.5°F. Stream temperatures increase in the downstream direction (61.1°F to 63.1°F between the Chapman Creek 2 and 1 stations, respectively).
- **Wood Gulch.** Long-term average late-season water temperatures within most of Wood Gulch are below 63.5°F but increase in a downstream direction (52.4°F and 63.4°F at Wood Gulch 3 and Wood Gulch 2, respectively). The relatively low

temperatures at the uppermost station (Wood Gulch 3) are likely a result of this headwater reach lying within a forested area that receives some early-season snowmelt runoff. Wood Gulch 1, located near the mouth, has a calculated average of 65.0°F, but this is from a one-year record in 2001, which was a severe drought year; therefore, this value is likely overestimated relative to the long-term average condition.

- **Pine Creek.** Pine Creek has the greatest range in average late-season water temperature, with both the lowest and highest average temperatures in the subbasin (49.1°F at Pine Creek 3 in the high elevation headwaters, and 66.7°F at Pine Creek 4 near the mouth, respectively). The high elevation Pine Creek 3 station occurs within a relatively steep, forested, east-west-trending canyon that helps shade the stream and maintain cooler water temperatures. Only Pine Creek 1 and 5, located along the middle reach, have more than a 2-year period of temperature record. In contrast to the typical trend of downstream warming, Pine Creek 1 has a slightly lower average late-season water temperature (63.0°F) than the upstream Pine Creek 5 (64.8°F).
- **Six Prong Creek.** The low elevation, east-west-trending Six Prong Creek (tributary to Alder Creek) shows the typical trend of increased water temperature in the downstream direction (66.7°F at Six Prong Creek 2 to 62.0°F at Six Prong Creek 1). Six Prong Creek is located entirely in a low elevation shrubland/grassland setting, and thus has little riparian shading.
- **Alder Creek.** In the easternmost drainage, Alder Creek, both the upstream (Alder Creek 3) and downstream (Alder Creek 1) monitoring stations have average late-season water temperatures above 63.5°F. However, Alder Creek 3 only has a 2-year period of record. Alder Creek 2, a short distance upstream of Alder Creek 1, has a slightly lower average temperature (62.4°F) across the late season.
- **Alder Creek 2** is located immediately downstream of the confluence with Six Prong Creek and the Six Prong Creek 1 monitoring station. The two stations are close enough that they plot essentially on top of each other on Figure 4-1. Although they have different periods of record, the long-term average late-season water temperature for the Six Prong 1 station is 4°F higher than that of the Alder Creek 2 (66.2 vs. 62.1°F). Comparing monthly average temperatures (Table 4-7), Six Prong 1 was typically 4 to 7°F warmer than Alder Creek 2 in comparable summer months of 1996 and 1999, but only 1 to 3°F warmer in comparable summer months of 1998. The reason for this apparent change with time is not known.

Other water quality parameters were collected as spot measurements when the temperature data loggers were downloaded every four to eight weeks. These data are presented in Table 4-9, with values above surface water quality standards bolded. Corresponding spot stream discharge measurements are also presented. Like the water quality data collected in Rock Creek, the DO and pH measurements are variable at every station and between stations. Alder Creek 1 and 2 and Chapman Creek 1 stations had no measured DO or pH values exceeding respective standards. Pine Creek 1 is the one station with a relatively high proportion (13 of 26) of DO measurements below the 8.0 mg/L standard, with measured values as low as 2.5 mg/L in July 2000. Surface water pH is generally within the 6.5 to 8.5 range, with only 12 of 215 measurements from the entire subbasin outside of that range (Table 4-9).

Table 4-7. Summary of EKCD Water Temperature Data for Wood/Alder Creeks Subbasin (Sheet 1 of 8)

Monit. Site	Year	Month	Water Temperature			Measurement Period	
			Avg (°F)	Max (°F)	Min (°F)	First Day	Last Day
Alder Creek 1	1995	June	63.4	76.3	55.9	6/7/95	6/30/95
	1995	July *	68.8	81.3	58.6	7/1/95	7/31/95
	1995	August *	65.1	79.7	54.5	8/1/95	8/31/95
	1995	September	60.9	71.1	50.3	9/14/95	9/30/95
	1995	October *	51.8	62.9	36.3	10/1/95	10/31/95
	1995	November	43.4	73.2	32.5	11/1/95	11/13/95
	1996	May	61.8	88.6	50.8	5/10/96	5/31/96
	1996	June *	63.1	73.5	52.5	6/1/96	6/30/96
	1996	July *	69.0	80.0	57.0	7/1/96	7/31/96
	1996	August	66.9	77.5	57.5	8/1/96	8/19/96
	1996	September	57.3	68.1	47.8	9/13/96	9/30/96
	1996	October	57.2	62.3	50.3	10/1/96	10/9/96
	1997	May	62.0	77.1	51.5	5/5/97	5/31/97
	1997	June *	62.8	72.8	55.4	6/1/97	6/30/97
	1997	July *	66.4	74.6	57.1	7/1/97	7/31/97
	1997	August *	67.2	77.7	57.9	8/1/97	8/31/97
	1997	September *	60.4	70.1	52.1	9/1/97	9/30/97
	1997	October *	51.4	59.9	41.8	10/1/97	10/31/97
	1997	November	49.8	53.2	45.4	11/1/97	11/6/97
	1998	May	56.9	71.3	50.4	5/7/98	5/31/98
	1998	June *	62.8	71.9	55.7	6/1/98	6/30/98
	1998	July *	68.7	77.4	60.8	7/1/98	7/31/98
	1998	August *	66.2	76.2	57.1	8/1/98	8/31/98
	1998	September	61.2	69.8	53.8	9/1/98	9/30/98
	1999	May	57.3	71.0	46.5	5/4/99	5/31/99
	1999	June *	62.7	75.8	52.6	6/1/99	6/30/99
	1999	July *	66.1	75.8	55.4	7/1/99	7/31/99
	1999	August *	67.7	77.4	55.7	8/1/99	8/31/99
	1999	September	59.5	65.4	53.2	9/1/99	9/25/99
	2000	May	59.2	83.5	52.9	5/24/00	5/31/00
	2000	June *	63.2	72.8	52.4	6/1/00	6/30/00
	2000	July *	66.7	78.0	57.4	7/1/00	7/31/00
	2000	August *	66.0	76.5	56.6	8/1/00	8/31/00
	2000	September *	59.9	69.8	47.1	9/1/00	9/30/00
	2000	October	57.8	64.8	50.4	10/1/00	10/3/00
	2001	May	62.9	73.5	52.7	5/17/01	5/31/01
	2001	June *	62.7	72.6	53.6	6/1/01	6/30/01
	2001	July *	67.9	76.0	60.9	7/1/01	7/31/01
	2001	August *	67.6	75.6	59.2	8/1/01	8/31/01
	2001	September *	61.6	68.4	52.5	9/1/01	9/30/01
	2001	October	54.0	59.8	49.1	10/1/01	10/15/01
	2002	April	62.7	89.0	58.1	4/30/02	4/30/02
	2002	May *	58.6	66.4	47.8	5/1/02	5/31/02
	2002	June *	64.4	72.0	53.6	6/1/02	6/30/02
	2002	July *	68.0	75.3	58.6	7/1/02	7/31/02
	2002	August *	65.0	69.6	59.8	8/1/02	8/31/02
	2002	September *	59.9	67.6	52.8	9/1/02	9/30/02
2002	October	55.8	83.9	46.7	10/1/02	10/18/02	
2002	May *	60.1	75.9	48.8	5/6/03	5/31/03	
2003	June *	65.0	71.3	56.9	6/1/03	6/30/03	
2003	July *	67.6	72.8	58.6	7/1/03	7/31/03	
2003	August *	66.2	71.0	60.3	8/1/03	8/31/03	
2003	September *	61.0	68.7	54.7	9/1/03	9/30/03	
2003	October *	55.4	61.7	41.6	10/1/03	10/31/03	
2003	November *	43.5	52.5	37.1	11/1/03	11/30/03	
2003	December *	41.8	46.9	33.7	12/1/03	12/31/03	
2004	January	36.9	78.4	32.2	1/1/04	1/22/04	

Table 4-7. Summary of EKCD Water Temperature Data for Wood/Alder Creeks Subbasin (Sheet 2 of 8)

Monit. Site	Year	Month	Water Temperature			Measurement Period	
			Avg (°F)	Max (°F)	Min (°F)	First Day	Last Day
Alder Creek 2	1995	June	60.0	77.9	53.9	6/7/95	6/30/95
	1995	July *	62.9	70.8	55.6	7/1/95	7/31/95
	1995	August *	60.6	68.8	53.1	8/1/95	8/31/95
	1995	September	58.4	78.5	50.3	9/14/95	9/30/95
	1995	October *	52.7	65.6	40.5	10/1/95	10/31/95
	1995	November	47.3	73.2	37.7	11/1/95	11/13/95
	1996	May	57.3	85.0	52.0	5/16/96	5/31/96
	1996	June *	59.6	67.6	52.0	6/1/96	6/30/96
	1996	July *	62.9	69.9	54.2	7/1/96	7/31/96
	1996	August *	61.6	68.2	53.7	8/1/96	8/31/96
	1996	September *	57.7	67.3	48.6	9/1/96	9/30/96
	1996	October	56.0	59.8	50.3	10/1/96	10/9/96
	1997	June	60.4	69.5	54.4	6/5/97	6/30/97
	1997	July *	62.9	68.9	55.5	7/1/97	7/31/97
	1997	August *	63.7	71.0	56.0	8/1/97	8/31/97
	1997	September *	59.2	66.3	52.1	9/1/97	9/30/97
	1997	October *	52.8	63.1	44.6	10/1/97	10/31/97
	1997	November	51.4	54.4	47.1	11/1/97	11/6/97
	1998	May	56.5	82.5	51.6	5/7/98	5/31/98
	1998	June *	60.9	67.5	55.5	6/1/98	6/30/98
	1998	July *	64.6	70.7	58.5	7/1/98	7/31/98
	1998	August *	63.1	70.1	56.3	8/1/98	8/31/98
	1998	September *	59.8	65.7	53.8	9/1/98	9/30/98
	1999	May	56.8	68.0	47.9	5/4/99	5/31/99
	1999	June *	61.1	70.4	53.0	6/1/99	6/30/99
	1999	July *	63.5	71.0	56.0	7/1/99	7/31/99
	1999	August *	64.4	71.6	56.3	8/1/99	8/31/99
	1999	September	58.4	63.1	53.0	9/1/99	9/25/99
	2000	May	58.6	82.5	54.1	5/24/00	5/31/00
	2000	June *	61.3	68.0	53.0	6/1/00	6/30/00
	2000	July	64.9	71.0	57.4	7/13/00	7/31/00
	2000	August *	63.3	69.5	56.3	8/1/00	8/31/00
	2000	September *	59.1	66.0	49.0	9/1/00	9/30/00
	2000	October	57.3	62.8	51.3	10/1/00	10/3/00
	2001	July	64.6	84.4	60.6	7/17/01	7/31/01
	2001	August *	64.7	70.7	58.0	8/1/01	8/31/01
	2001	September *	60.4	65.4	52.7	9/1/01	9/30/01
	2001	October	54.6	59.2	50.0	10/1/01	10/15/01
	2002	April	64.1	83.2	58.6	4/30/02	4/30/02
	2002	May *	58.6	66.6	48.5	5/1/02	5/31/02
	2002	June *	62.7	71.3	54.1	6/1/02	6/30/02
	2002	July *	65.6	72.5	57.2	7/1/02	7/31/02
2002	August *	63.2	67.8	58.0	8/1/02	8/31/02	
2002	September *	59.2	65.7	52.2	9/1/02	9/30/02	
2002	October	56.5	77.4	47.4	10/1/02	10/18/02	
2003	May	58.9	73.1	49.9	5/6/03	5/31/03	
2003	June *	62.7	69.5	55.8	6/1/03	6/30/03	
2003	July *	65.1	70.4	56.9	7/1/03	7/31/03	
2003	August *	63.8	68.6	57.7	8/1/03	8/31/03	
2003	September *	59.5	66.0	53.5	9/1/03	9/30/03	
2003	October *	55.3	60.0	45.2	10/1/03	10/31/03	
2003	November *	46.4	53.0	40.7	11/1/03	11/30/03	
2003	December *	45.2	48.8	38.8	12/1/03	12/31/03	
2004	January	40.9	73.1	34.2	1/1/04	1/22/04	

Table 4-7. Summary of EKCD Water Temperature Data for Wood/Alder Creeks Subbasin (Sheet 3 of 8)

Monit. Site	Year	Month	Water Temperature			Measurement Period	
			Avg (°F)	Max (°F)	Min (°F)	First Day	Last Day
Alder Creek 3	1995	June	61.6	81.2	50.2	6/13/95	6/30/95
	1995	July *	63.7	77.7	53.0	7/1/95	7/31/95
	1995	August	61.5	70.1	56.6	8/1/95	8/2/95
	1996	May	58.9	78.3	51.8	5/16/96	5/31/96
	1996	June	62.6	71.5	52.9	6/1/96	6/27/96
	1996	July	68.6	93.4	57.6	7/17/96	7/31/96
	1996	August	72.0	99.4	51.8	8/1/96	8/13/96
	1996	October	68.3	99.0	59.6	10/9/96	10/24/96
Chapman Creek 1	1995	June	60.4	80.1	53.4	6/7/95	6/30/95
	1995	July *	64.3	73.0	55.9	7/1/95	7/31/95
	1995	August *	61.1	71.2	52.5	8/1/95	8/31/95
	1995	September *	59.5	65.9	47.8	9/1/95	9/30/95
	1995	October *	50.4	58.1	35.4	10/1/95	10/31/95
	1995	November	45.8	55.3	32.5	11/1/95	11/17/95
	1996	May	57.2	78.9	48.3	5/16/96	5/31/96
	1996	June *	61.1	70.3	50.0	6/1/96	6/30/96
	1996	July *	65.5	73.3	53.9	7/1/96	7/31/96
	1996	August *	62.9	77.9	53.7	8/1/96	8/31/96
	1996	September	59.7	65.9	53.1	9/1/96	9/16/96
	1996	October	68.2	98.9	59.0	10/8/96	10/23/96
	1997	May	60.5	90.1	49.2	5/9/97	5/31/97
	1997	June *	61.1	72.0	52.3	6/1/97	6/30/97
	1997	July *	64.7	72.0	54.8	7/1/97	7/31/97
	1997	August *	65.6	74.5	56.4	8/1/97	8/31/97
	1997	September *	59.5	69.1	51.2	9/1/97	9/30/97
	1997	October *	51.0	59.5	41.4	10/1/97	10/31/97
	1997	November	49.0	52.8	44.5	11/1/97	11/5/97
	1998	May	55.7	87.2	49.0	5/6/98	5/31/98
	1998	June *	61.0	68.9	55.2	6/1/98	6/30/98
	1998	July *	67.6	75.9	60.8	7/1/98	7/31/98
	1998	August *	65.2	73.7	56.3	8/1/98	8/31/98
	1998	September *	60.8	70.7	52.4	9/1/98	9/30/98
	1999	May	57.3	71.0	45.1	5/10/99	5/31/99
	1999	June *	61.1	72.5	49.3	6/1/99	6/30/99
	1999	July *	64.1	74.0	53.5	7/1/99	7/31/99
	1999	August *	65.8	74.3	54.9	8/1/99	8/31/99
	1999	September *	56.1	63.4	44.8	9/1/99	9/30/99
	1999	October	51.2	56.8	44.3	10/1/99	10/8/99
	2000	May	73.8	88.5	64.8	5/31/00	5/31/00
	2000	June *	67.0	80.6	54.9	6/1/00	6/30/00
	2000	July *	65.8	76.8	54.9	7/1/00	7/31/00
	2000	August *	63.0	74.6	53.2	8/1/00	8/31/00
	2000	September *	58.4	69.2	42.9	9/1/00	9/30/00
	2000	October	51.4	63.4	41.8	10/1/00	10/24/00
	2001	May	60.2	77.7	49.9	5/10/01	5/31/01
	2001	June *	61.4	75.5	50.7	6/1/01	6/30/01
	2001	July *	66.7	79.3	56.6	7/1/01	7/31/01
	2001	August *	67.1	78.3	54.9	8/1/01	8/31/01
2001	September *	60.0	71.0	48.5	9/1/01	9/30/01	
2001	October	52.3	60.2	45.4	10/1/01	10/15/01	
2002	April	64.1	85.5	56.9	4/30/02	4/30/02	
2002	May *	56.8	66.1	46.4	5/1/02	5/31/02	
2002	June *	62.6	74.1	50.3	6/1/02	6/30/02	
2002	July *	67.5	78.4	55.0	7/1/02	7/31/02	
2002	August *	64.1	72.0	54.4	8/1/02	8/31/02	
2002	September *	58.4	68.7	46.9	9/1/02	9/30/02	
2002	October	54.0	77.2	41.1	10/1/02	10/18/02	

Table 4-7. Summary of EKCD Water Temperature Data for Wood/Alder Creeks Subbasin (Sheet 4 of 8)

Monit. Site	Year	Month	Water Temperature			Measurement Period	
			Avg (°F)	Max (°F)	Min (°F)	First Day	Last Day
Chapman Creek 2	1995	July	63.0	94.7	54.1	7/17/95	7/31/95
	1995	August *	59.9	72.9	51.4	8/1/95	8/31/95
	1995	September *	59.2	69.3	49.1	9/1/95	9/30/95
	1995	October *	49.8	57.5	37.6	10/1/95	10/31/95
	1995	November	46.9	55.3	37.1	11/1/95	11/20/95
	1996	May	52.0	59.2	48.8	5/17/96	5/31/96
	1996	June *	54.5	60.3	49.4	6/1/96	6/30/96
	1996	July	58.7	67.0	51.6	7/1/96	7/17/96
	1996	August	60.3	68.1	52.5	8/15/96	8/31/96
	1996	September *	55.5	64.9	46.1	9/1/96	9/30/96
	1996	October	55.6	61.5	49.4	10/1/96	10/9/96
	1997	May	53.0	76.3	49.7	5/9/97	5/31/97
	1997	June *	53.8	72.9	50.5	6/1/97	6/30/97
	1997	July *	56.7	68.4	51.6	7/1/97	7/31/97
	1997	August *	58.7	64.9	54.1	8/1/97	8/31/97
	1997	September *	56.6	62.3	52.4	9/1/97	9/30/97
	1997	October *	51.7	62.0	46.6	10/1/97	10/31/97
	1997	November	51.2	54.7	48.8	11/1/97	11/5/97
	1998	May	51.8	84.0	48.3	5/6/98	5/31/98
	1998	June *	55.7	64.0	49.9	6/1/98	6/30/98
	1998	July *	61.7	70.2	55.0	7/1/98	7/31/98
	1998	August *	62.3	71.4	54.4	8/1/98	8/31/98
	1998	September *	60.0	70.5	52.4	9/1/98	9/30/98
	1999	May	52.1	74.9	47.3	5/10/99	5/31/99
	1999	June *	54.4	62.7	48.1	6/1/99	6/30/99
	1999	July *	57.8	67.4	49.5	7/1/99	7/31/99
	1999	August *	61.0	69.7	51.7	8/1/99	8/31/99
	1999	September *	55.6	65.1	45.6	9/1/99	9/30/99
	1999	October *	50.1	59.6	42.8	10/1/99	10/31/99
	1999	November *	48.7	58.2	43.7	11/1/99	11/30/99
	1999	December *	44.7	51.7	40.3	12/1/99	12/31/99
	2000	January *	43.1	47.6	39.7	1/1/00	1/31/00
	2000	February *	47.1	52.0	38.3	2/1/00	2/29/00
	2000	March *	49.3	54.8	46.7	3/1/00	3/31/00
	2000	April *	51.3	57.3	46.7	4/1/00	4/30/00
	2000	May *	52.9	60.5	47.0	5/1/00	5/31/00
	2000	June *	57.1	67.4	49.0	6/1/00	6/30/00
	2000	July *	61.2	73.6	51.2	7/1/00	7/31/00
	2000	August *	61.6	71.8	52.0	8/1/00	8/31/00
	2000	September *	56.5	68.3	43.4	9/1/00	9/30/00
	2000	October	50.8	60.7	43.1	10/1/00	10/23/00
	2001	May	55.9	84.3	47.1	5/10/01	5/31/01
2001	June *	56.8	68.1	48.8	6/1/01	6/30/01	
2001	July *	62.6	72.6	53.8	7/1/01	7/31/01	
2001	August *	64.2	74.1	54.7	8/1/01	8/31/01	
2001	September *	59.3	69.3	51.3	9/1/01	9/30/01	
2001	October	52.2	59.7	47.7	10/1/01	10/23/01	
2002	April	74.7	87.3	55.9	4/30/02	4/30/02	
2002	May *	71.2	98.1	39.9	5/1/02	5/31/02	
2002	June *	72.2	100.8	54.2	6/1/02	6/30/02	
2002	July *	77.7	100.8	47.5	7/1/02	7/31/02	
2002	August *	72.9	100.8	43.0	8/1/02	8/31/02	
2002	September *	61.4	75.7	50.6	9/1/02	9/30/02	
2002	October *	50.2	65.3	39.4	10/1/02	10/31/02	
2002	November	66.7	76.6	38.8	11/1/02	11/5/02	
2003	May	58.6	83.4	46.0	5/6/03	5/31/03	
2003	June *	62.3	71.2	53.5	6/1/03	6/30/03	
2003	July	63.9	70.3	56.5	7/1/03	7/10/03	

Table 4-7. Summary of EKCD Water Temperature Data for Wood/Alder Creeks Subbasin (Sheet 5 of 8)

Monit. Site	Year	Month	Water Temperature			Measurement Period	
			Avg (°F)	Max (°F)	Min (°F)	First Day	Last Day
Pine Creek 1	1995	June	60.7	86.8	52.8	6/2/95	6/30/95
	1995	July *	59.9	68.8	57.0	7/1/95	7/31/95
	1995	August *	60.3	81.2	48.9	8/1/95	8/31/95
	1995	September	61.9	96.0	50.1	9/1/95	9/14/95
	1996	May	56.1	81.5	47.3	5/16/96	5/31/96
	1996	June	60.4	72.7	52.3	6/1/96	6/17/96
	1996	July	59.8	66.2	57.0	7/16/96	7/19/96
	1996	August	61.9	68.5	56.2	8/14/96	8/31/96
	1996	September	57.7	67.7	48.4	9/1/96	9/16/96
	1997	June	61.5	73.6	53.7	6/6/97	6/30/97
	1997	July *	63.2	77.9	56.2	7/1/97	7/31/97
	1997	August *	63.1	67.3	61.0	8/1/97	8/31/97
	1997	September *	61.4	69.1	58.7	9/1/97	9/30/97
	1997	October *	56.7	61.3	52.0	10/1/97	10/31/97
	1997	November	54.2	57.6	51.5	11/1/97	11/6/97
	1998	May	54.6	82.4	47.3	5/7/98	5/29/98
	1998	June	62.3	78.8	53.9	6/18/98	6/30/98
	1998	July *	65.3	74.1	58.1	7/1/98	7/31/98
	1998	August *	64.8	74.4	56.7	8/1/98	8/31/98
	1998	September *	61.5	74.1	54.5	9/1/98	9/30/98
	1998	October *	55.7	62.9	50.9	10/1/98	10/10/98
	1999	May	55.5	71.7	43.3	5/7/99	5/31/99
	1999	June *	59.9	71.4	49.5	6/1/99	6/30/99
	1999	July *	62.1	68.7	54.8	7/1/99	7/31/99
	1999	August *	62.9	65.8	60.7	8/1/99	8/31/99
	1999	September	60.9	64.7	54.2	9/1/99	9/25/99
	2000	May	56.6	70.2	50.9	5/26/00	5/31/00
	2000	June *	61.4	72.0	50.6	6/1/00	6/30/00
	2000	July *	65.5	76.3	54.8	7/1/00	7/31/00
	2000	August *	69.1	84.3	53.6	8/1/00	8/31/00
	2000	September *	63.1	77.8	50.0	9/1/00	9/30/00
	2000	October *	54.5	67.6	48.3	10/1/00	10/31/00
	2000	November *	46.7	53.6	42.2	11/1/00	11/30/00
	2000	December *	44.1	47.2	41.1	12/1/00	12/31/00
	2001	January *	41.9	45.6	39.4	1/1/01	1/31/01
	2001	February *	41.0	46.1	37.2	2/1/01	2/28/01
	2001	March	44.5	76.6	38.0	3/1/01	3/20/01
	2001	May	58.3	81.6	50.5	5/10/01	5/31/01
	2001	June *	58.1	62.8	52.5	6/1/01	6/30/01
	2001	July *	60.8	72.2	56.6	7/1/01	7/31/01
	2001	August *	66.4	83.5	54.4	8/1/01	8/31/01
	2001	September *	60.6	75.9	50.2	9/1/01	9/30/01
	2001	October	53.7	63.1	49.1	10/1/01	10/15/01
	2002	May	56.6	80.0	47.1	5/14/02	5/31/02
	2002	June *	61.4	80.0	50.2	6/1/02	6/30/02
	2002	July *	69.7	100.8	44.9	7/1/02	7/31/02
	2002	August	66.2	100.8	43.2	8/1/02	8/6/02
	2003	May	57.0	82.3	45.4	5/7/03	5/31/03
2003	June *	60.7	69.0	55.1	6/1/03	6/30/03	
2003	July *	61.8	66.7	58.4	7/1/03	7/31/03	
2003	August *	67.9	89.7	55.1	8/1/03	8/31/03	
2003	September *	60.8	77.9	49.8	9/1/03	9/30/03	
2003	October *	55.2	65.6	46.2	10/1/03	10/31/03	
2003	November *	49.6	55.1	45.6	11/1/03	11/30/03	
2003	December	58.9	74.4	44.5	12/1/03	12/19/03	

Table 4-7. Summary of EKCD Water Temperature Data for Wood/Alder Creeks Subbasin (Sheet 6 of 8)

Monit. Site	Year	Month	Water Temperature			Measurement Period	
			Avg (°F)	Max (°F)	Min (°F)	First Day	Last Day
Pine Creek 2	1995	June	60.6	80.6	49.6	6/13/95	6/30/95
	1995	July *	66.2	83.8	54.4	7/1/95	7/31/95
	1995	August	62.3	100.6	35.6	8/1/95	8/23/95
Pine Creek 3	1995	June	49.8	68.9	42.7	6/14/95	6/30/95
	1995	July	56.1	98.8	45.5	7/1/95	7/25/95
	1996	September	42.2	59.5	39.7	9/18/96	9/30/96
	1996	October	57.9	98.4	40.2	10/1/96	10/24/96
Pine Creek 4	1996	May	59.4	76.0	50.6	5/20/96	5/31/96
	1996	June *	65.3	76.9	56.1	6/1/96	6/30/96
	1996	July *	66.4	78.4	63.2	7/1/96	7/31/96
	1996	August	66.9	96.9	52.0	8/1/96	8/19/96
Pine Creek 5	1997	May	60.5	77.8	49.1	5/8/97	5/31/97
	1997	June *	62.3	80.3	51.6	6/1/97	6/30/97
	1997	July *	64.5	82.2	54.1	7/1/97	7/31/97
	1997	August *	62.2	80.3	51.6	8/1/97	8/31/97
	1997	September *	55.3	72.5	46.6	9/1/97	9/30/97
	1997	October *	47.3	56.9	36.8	10/1/97	10/31/97
	1997	November	43.2	48.3	38.5	11/1/97	11/6/97
	1998	May	55.1	76.5	46.1	5/11/98	5/31/98
	1998	June *	62.3	80.9	52.2	6/1/98	6/30/98
	1998	July *	69.3	85.2	57.5	7/1/98	7/31/98
	1998	August *	65.5	79.0	53.9	8/1/98	8/31/98
	1998	September *	59.9	75.6	49.4	9/1/98	9/30/98
	1998	October	50.5	61.5	42.2	10/1/98	10/10/98
	1999	May	54.3	82.5	38.2	5/6/99	5/31/99
	1999	June *	61.8	78.1	47.5	6/1/99	6/30/99
	1999	July *	66.9	100.7	46.1	7/1/99	7/31/99
	1999	August *	67.5	85.9	50.0	8/1/99	8/31/99
	1999	September *	57.7	72.8	43.3	9/1/99	9/30/99
	1999	October	50.9	61.7	41.0	10/1/99	10/15/99
	2000	June *	64.5	82.2	56.6	6/21/00	6/30/00
	2000	July *	67.2	92.8	53.0	7/1/00	7/31/00
	2000	August *	72.1	100.7	43.3	8/1/00	8/31/00
	2000	September *	59.1	100.7	34.8	9/1/00	9/30/00
	2000	October	51.0	72.5	38.5	10/1/00	10/3/00
	2001	May	59.3	76.8	48.8	5/17/01	5/31/01
	2001	June *	59.9	78.7	50.5	6/1/01	6/30/01
	2001	July	68.8	100.7	45.0	7/1/01	7/16/01
	2002	May	57.5	72.3	48.9	5/14/02	5/31/02
	2002	June *	59.6	68.1	50.6	6/1/02	6/30/02
	2002	July *	61.1	64.9	56.7	7/1/02	7/31/02
2002	August *	62.7	77.2	54.2	8/1/02	8/31/02	
2002	September *	58.5	71.1	47.5	9/1/02	9/30/02	
2002	October	54.6	76.3	46.1	10/1/02	10/18/02	
2003	May	55.9	89.3	42.7	5/7/03	5/31/03	
2003	June *	62.5	78.7	54.1	6/1/03	6/30/03	
2003	July *	70.8	100.7	53.9	7/1/03	7/31/03	
2003	August	73.0	100.7	50.0	8/1/03	8/21/03	

Table 4-7. Summary of EKCD Water Temperature Data for Wood/Alder Creeks Subbasin (Sheet 7 of 8)

Monit. Site	Year	Month	Water Temperature			Measurement Period	
			Avg (°F)	Max (°F)	Min (°F)	First Day	Last Day
Six Prong Creek 1	1995	June	65.0	76.4	57.3	6/7/95	6/30/95
	1995	July *	68.9	77.0	60.7	7/1/95	7/31/95
	1995	August *	64.6	74.5	55.7	8/1/95	8/31/95
	1995	September	60.7	68.5	51.5	9/14/95	9/30/95
	1995	October *	51.7	60.7	37.5	10/1/95	10/31/95
	1995	November	43.1	73.0	33.8	11/1/95	11/13/95
	1996	May	61.9	80.5	51.8	5/16/96	5/31/96
	1996	June *	65.6	76.4	54.8	6/1/96	6/30/96
	1996	July *	69.7	78.3	59.3	7/1/96	7/31/96
	1996	August *	66.9	74.5	57.6	8/1/96	8/31/96
	1996	September *	59.7	67.9	49.0	9/1/96	9/30/96
	1996	October	56.2	59.9	50.7	10/1/96	10/9/96
	1997	May	62.0	75.0	48.6	5/6/97	5/31/97
	1997	June *	62.8	77.8	52.8	6/1/97	6/30/97
	1997	July *	67.6	79.4	56.7	7/1/97	7/31/97
	1997	August *	60.0	62.1	57.5	8/1/97	8/31/97
	1997	September *	58.2	67.6	53.3	9/1/97	9/30/97
	1997	October *	49.8	57.5	43.9	10/1/97	10/31/97
	1997	November	48.2	51.9	46.7	11/1/97	11/6/97
	1998	May	58.3	90.7	50.8	5/7/98	5/31/98
	1998	June *	63.7	70.2	56.4	6/1/98	6/30/98
	1998	July *	66.8	71.4	60.3	7/1/98	7/31/98
	1998	August *	64.3	71.1	57.0	8/1/98	8/31/98
	1998	September *	59.8	65.5	53.3	9/1/98	9/30/98
	1999	May	61.4	77.2	46.4	5/7/99	5/31/99
	1999	June *	66.7	81.3	54.2	6/1/99	6/30/99
	1999	July *	70.3	82.3	58.6	7/1/99	7/31/99
	1999	August *	70.7	82.9	57.5	8/1/99	8/31/99
	1999	September	58.9	66.1	53.6	9/1/99	9/25/99
	2000	May	61.7	87.6	54.5	5/24/00	5/31/00
	2000	June *	65.5	83.6	53.1	6/1/00	6/30/00
	2000	July *	71.1	83.9	60.3	7/1/00	7/31/00
	2000	August	72.8	92.5	60.1	8/1/00	8/10/00
	2002	April	66.2	70.9	61.0	4/30/02	4/30/02
	2002	May *	63.4	76.4	48.9	5/1/02	5/31/02
	2002	June *	70.5	84.1	55.4	6/1/02	6/30/02
	2002	July *	72.1	94.9	56.7	7/1/02	7/31/02
	2002	August	63.1	73.6	52.3	8/1/02	8/6/02
	2003	May	63.2	76.1	49.5	5/6/03	5/31/03
	2003	June *	70.1	82.1	60.2	6/1/03	6/30/03
2003	July *	74.2	85.7	60.5	7/1/03	7/31/03	
2003	August *	70.9	82.4	58.8	8/1/03	8/31/03	
2003	September *	64.4	74.2	57.3	9/1/03	9/30/03	
2003	October *	55.5	62.5	43.2	10/1/03	10/31/03	
2003	November *	40.9	46.8	37.0	11/1/03	11/30/03	
2003	December *	40.0	43.4	33.0	12/1/03	12/31/03	
2004	January	35.5	91.2	32.1	1/1/04	1/22/04	
Six Prong Creek 2	1996	June	61.8	73.3	51.0	6/17/96	6/30/96
	1996	July	65.1	77.0	52.9	7/1/96	7/17/96
	1998	May *	56.4	90.6	48.8	5/7/98	5/31/98
	1998	June *	63.1	74.9	54.6	6/1/98	6/30/98
	1998	July *	68.4	81.9	57.7	7/1/98	7/31/98
	1998	August *	66.3	85.5	54.1	8/1/98	8/31/98
	1998	September *	60.3	74.9	50.2	9/1/98	9/30/98
	1998	October	54.3	66.9	47.1	10/1/98	10/10/98
	1999	May	56.4	79.0	47.9	5/7/99	5/31/99
	1999	June *	58.2	70.4	50.7	6/1/99	6/30/99
	1999	July *	58.8	68.3	51.6	7/1/99	7/31/99
	1999	August *	60.5	79.9	51.3	8/1/99	8/31/99
	1999	September *	54.6	61.7	47.1	9/1/99	9/30/99
	1999	October	52.1	57.1	46.8	10/1/99	10/7/99

Table 4-7. Summary of EKCD Water Temperature Data for Wood/Alder Creeks Subbasin (Sheet 8 of 8)

Monit. Site	Year	Month	Water Temperature			Measurement Period	
			Avg (°F)	Max (°F)	Min (°F)	First Day	Last Day
Wood Gulch 1	2001	May	61.0	79.8	48.4	5/10/01	5/31/01
	2001	June *	62.3	76.6	51.5	6/1/01	6/30/01
	2001	July *	68.1	81.0	57.9	7/1/01	7/31/01
	2001	August *	67.2	76.9	58.7	8/1/01	8/31/01
	2001	September *	59.7	67.6	51.5	9/1/01	9/30/01
	2001	October	50.9	57.3	46.8	10/1/01	10/15/01
Wood Gulch 2	1995	June	63.4	100.7	52.8	6/14/95	6/30/95
	1997	May	62.1	96.6	53.2	5/9/97	5/31/97
	1997	June *	60.4	78.9	54.6	6/1/97	6/30/97
	1997	July *	58.7	71.8	55.7	7/1/97	7/31/97
	1997	August *	60.6	76.4	47.0	8/1/97	8/31/97
	1997	September	57.6	76.4	47.3	9/1/97	9/8/97
	1998	May *	56.5	71.8	50.1	5/28/98	5/31/98
	1998	June *	62.6	78.3	51.8	6/1/98	6/30/98
	1998	July *	70.5	83.7	58.7	7/1/98	7/31/98
	1998	August *	67.5	82.4	56.0	8/1/98	8/31/98
	1998	September *	60.7	74.5	50.9	9/1/98	9/30/98
	1998	October *	47.0	59.0	37.5	10/1/98	10/31/98
	1998	November	44.5	47.9	40.0	11/1/98	11/6/98
	1999	May	55.6	72.1	42.6	5/6/99	5/31/99
	1999	June *	61.0	75.1	49.3	6/1/99	6/30/99
	1999	July *	65.4	77.6	51.8	7/1/99	7/31/99
	1999	August *	65.8	76.1	53.2	8/1/99	8/31/99
	1999	September	57.5	64.2	51.2	9/1/99	9/25/99
	2000	May	56.6	75.1	48.1	5/25/00	5/31/00
	2000	June *	63.7	79.5	48.1	6/1/00	6/30/00
	2000	July *	67.4	80.1	55.4	7/1/00	7/31/00
	2000	August	63.7	90.9	41.6	8/10/00	8/31/00
	2000	September *	57.6	84.1	27.8	9/1/00	9/30/00
	2000	October	47.9	69.8	25.7	10/1/00	10/23/00
	2000	November	29.7	47.4	23.6	11/13/00	11/30/00
	2000	December	29.7	44.4	23.6	12/1/00	12/11/00
	2001	May	57.7	81.5	48.0	5/10/01	5/31/01
	2001	June	56.4	65.1	49.7	6/1/01	6/14/01
	2002	May	59.6	72.1	48.7	5/14/02	5/31/02
	2002	June *	64.4	82.7	48.7	6/1/02	6/30/02
2002	July *	70.2	87.1	56.0	7/1/02	7/31/02	
2002	August *	65.6	78.3	55.4	8/1/02	8/31/02	
2002	September *	57.4	70.6	46.8	9/1/02	9/30/02	
2002	October	47.2	75.2	37.3	10/1/02	10/29/02	
2003	May	57.8	90.0	46.1	5/7/03	5/31/03	
2003	June *	65.2	79.1	53.0	6/1/03	6/30/03	
2003	July *	69.9	82.9	56.4	7/1/03	7/31/03	
2003	August	68.1	76.9	60.6	8/1/03	8/21/03	
Wood Gulch 3	1995	June	49.0	74.0	43.5	6/13/95	6/30/95
	1995	July *	53.2	61.1	47.4	7/1/95	7/31/95
	1995	August *	52.7	62.5	45.1	8/1/95	8/31/95
	1995	September *	53.2	61.9	44.9	9/1/95	9/30/95
	1995	October *	43.8	94.5	24.1	10/1/95	10/30/95
	1996	May	45.6	92.3	40.4	5/16/96	5/31/96
	1996	June *	47.6	56.0	40.7	6/1/96	6/30/96
	1996	July *	52.2	59.1	44.9	7/1/96	7/31/96
	1996	August *	52.4	59.6	46.0	8/1/96	8/31/96
1996	September	50.7	59.4	43.7	9/1/96	9/17/96	

Notes:

*: Data are available for each day of the month.

Bolded average temperatures exceed default surface water quality standard of 63.5° F (17.5°C) for highest 7-day average of daily maximum temperature.

Table 4-8. Comparison of Late-Season (July-September) Water Temperatures in Wood/Alder Subbasin by Monitoring Station

Station	Temperature Monitoring Period of Record	Late-Season (July-Sept) Water Temperatures During Period of Record		
		Avg (°F)	Max (°F)	Min (°F)
Alder Creek 1	Jun-95 to Jan-04	64.8	81.3	47.1
Alder Creek 2	Jun-95 to Jan-04	62.1	84.4	48.6
Alder Creek 3	Jun-95 to Oct-96	66.4	99.4	51.8
Chapman Creek 1	Jun-95 to Oct-02	63.1	100.8	43.0
Chapman Creek 2	Jul-95 to Jul-03	61.1	100.8	43.0
Pine Creek 1	Jun-95 to Dec-03	63.0	100.8	43.2
Pine Creek 2	Jun-95 to Aug-95	64.2	100.6	35.6
Pine Creek 3	Jun-95 to Oct-96	49.1	98.8	39.7
Pine Creek 4	May-96 to Aug-96	66.7	96.9	52.0
Pine Creek 5	May-97 to Aug-03	64.8	100.7	34.8
Six Prong Creek 1	Jun-95 to Jan-04	66.2	94.9	49.0
Six Prong Creek 2	Jun-96 to Oct-99	62.0	85.5	47.1
Wood Gulch 1	May-01 to Oct-01	65.0	81.0	51.5
Wood Gulch 2	Jun-95 to Aug-03	63.4	90.9	27.8
Wood Gulch 3	Jun-95 to Sep-96	52.4	62.5	43.7

Notes:

Bolded average temperatures exceed default surface water quality standard of 63.5° F (17.5°C).

Maximum temperatures for some stations likely are air, not water, temperatures (refer to text).

Table 4-9. EKCD Water Quality Data for the Wood/Alder Subbasin (Sheet 1 of 2)

Monit. Site	Date	DO (mg/l)	Flow (cfs)	pH	Monit. Site	Date	DO (mg/l)	Flow (cfs)	pH	Monit. Site	Date	DO (mg/l)	Flow (cfs)	pH	
Alder Creek 1	6/24/96	10	6.83	8	Alder Creek 2	6/24/96	10	2.09	7.5	Chapman Creek 1	6/25/96	11	5.73	7.5	
	7/15/96	9	--	8		7/16/96	8	--	8		7/17/96	10	--	5	
	9/4/96	8	--	7		8/13/96	10	--	8		8/13/96	9	--	8	
	9/13/96	11	6.1	8		9/13/96	10	5.9	7.5		9/19/96	11	--	6.5	
	5/26/98	--	5.54	--		5/26/98	--	5.1	--		6/2/98	--	--	3.3	--
	6/15/98	11	5.01	--		6/15/98	11.5	3.15	7.36		6/22/98	--	2.66	7.52	--
	6/30/98	--	4.23	--		6/30/98	--	2.78	--		7/8/98	--	1.4	--	--
	7/14/98	9.5	3.58	7.73		7/14/98	10	2.47	7.36		7/23/98	8.5	2.9	7.35	--
	7/30/98	--	2.59	--		7/30/98	--	1.79	--		8/13/98	--	1.36	--	--
	8/19/98	8.5	2.1	8.38		8/19/98	8	1.41	7.81		5/21/99	--	5.19	--	--
	5/18/99	--	13.04	--		5/18/99	--	7.99	--		6/8/99	11.75	6.68	6.29	--
	6/1/99	10.25	10.59	7.5		6/1/99	11	8.12	8.01		6/22/99	--	6.13	--	--
	6/14/99	--	7.7	--		6/14/99	--	4.34	--		7/14/99	--	3.73	8.08	--
	7/1/99	--	4	8.43		7/1/99	--	5.22	7.96		7/28/99	--	3.69	--	--
	7/19/99	--	5.19	--		7/19/99	--	3.86	--		6/19/00	--	3.55	--	--
	7/29/99	9	4.17	7.36		7/29/99	9	4.82	7.6		6/29/00	--	2.28	--	--
	6/7/00	--	5.82	--		6/7/00	--	5.7	--		8/3/00	--	1.2	--	--
	6/20/00	11.75	7.1	7.99		6/20/00	8.75	3.57	7.26		8/11/00	--	1.18	7.8	--
	6/30/00	--	4.72	--		6/30/00	--	3.24	--		10/5/00	--	1.39	--	--
	7/13/00	10.5	4.36	7.72		7/13/00	10	4.44	7.61		10/24/00	9	1.03	7.05	--
	7/31/00	--	2.28	--		7/31/00	--	1.5	--		6/6/01	10	1.52	--	--
	8/10/00	--	2.58	7.74		8/10/00	--	1.85	7.14		6/29/01	9	1.2	8.35	--
	5/17/01	--	2.61	--		6/21/01	8	1.44	7.21		7/23/01	--	1.06	7.79	--
	6/21/01	9	3.1	7.52		7/16/01	7	0.69	6.93		8/8/01	8	0.56	7.81	--
	7/16/01	8	2.18	7.09		7/25/01	--	0.84	7.3		8/24/01	11	0.54	7.59	--
	7/25/01	--	1.66	7.92		8/8/01	7	0.91	7.05		9/12/01	11	0.73	7.97	--
	8/8/01	8	2.14	7.32		8/21/01	8	1.59	5.45		10/15/01	12	1.83	7.67	--
	8/21/01	9	1.78	7.05		9/5/01	8	1.2	6.99		8/5/02	10	0.24	8.38	--
	9/5/01	10	3.79	7.4		10/15/01	10	0.98	6.81		8/26/02	9	0.17	8.08	--
	10/15/01	11	3.58	7.29		12/6/01	--	2.19	--		9/23/02	9	0.11	8	--
	12/6/01	--	3.27	--		1/8/02	--	63.05	--		10/16/02	11	0.14	--	--
	1/8/02	--	62.4	--		6/26/02	8	0.5	7.5		5/7/03	11	0.55	7.83	--
6/26/02	8	0.7	7.5	8/6/02	9	0.4	7.55	6/2/03	10	0.54	7.57	--			
8/6/02	9	0.46	7.57	8/27/02	9	0.79	7.39	7/10/03	9	0.34	--	--			
8/27/02	8	0.38	7.58	9/30/02	9	0.48	7.14	6/18/96	9	--	7.5	--			
9/30/02	10	0.47	7.68	10/16/02	10	0.67	--	7/17/96	10	--	7.5	--			
10/16/02	11	0.71	--	5/6/03	12	0.98	7.71	8/15/96	9	--	7.5	--			
5/6/03	11	1.35	7.9	6/2/03	11	1.39	7.48	9/17/96	8	--	8	--			
6/2/03	10	1.28	7.86	7/10/03	9	0.29	--	5/21/99	--	4.45	--	--			
7/10/03	9	0.89	--	8/20/03	9	0.55	--	6/8/99	--	2.05	--	--			
8/20/03	9	0.84	--	6/24/96	10	6.75	8	6/22/99	--	2.08	--	--			
Pine Creek 2	6/29/95	7	1.28	7.5	Alder Creek 3	7/17/96	10	--	8	7/14/99	--	1.37	7.38	--	
	7/27/95	7	--	--		8/13/96	10	--	8	7/28/99	--	1.06	--	--	
	6/25/96	10	--	8		9/13/96	12	12.3	8	6/19/00	--	0.9	--	--	
	7/16/98	--	0.48	7.07		7/3/95	10	--	7.5	7/7/00	--	0.64	--	--	
	8/4/98	--	0.24	--		6/25/96	11	--	7	10/5/00	--	0.1	--	--	
	5/26/99	--	8.86	--		9/18/96	7	--	7	5/10/01	--	0.41	--	--	
	6/2/99	10.5	4.79	7.38		5/29/98	--	0.76	--	6/12/01	9	0.67	6.48	--	
	6/21/99	--	2.85	--		6/16/98	6.86	0.19	--	6/29/01	9	0.36	7.97	--	
	7/2/99	--	0.91	--		5/18/99	--	4.43	--	7/23/01	--	0.18	7.86	--	
	7/20/99	--	0.4	--		6/3/99	9	0.59	7.05	8/8/01	9	0.14	7.32	--	
8/3/99	11	--	6.45	6/13/99	--	0.31	--	8/24/01	10	0.37	6.67	--			
6/7/00	--	0.65	--	6/26/00	--	0.54	6.82	9/12/01	10	0.19	7.66	--			
Pine Creek 4	6/17/96	8	--	7.5	7/14/00	--	6.22	6.22	10/23/01	10	--	6.78	--		
	7/15/96	2	--	7					5/6/03	10	0.24	7.35	--		
									6/2/03	10	0.14	7.9	--		
									7/10/03	8	0.07	--	--		
									8/20/03	8	0.03	--	--		

Table 4-9. EKCD Water Quality Data for the Wood/Alder Subbasin (Sheet 2 of 2)

Monit. Site	Date	DO (mg/l)	Flow (cfs)	pH	Monit. Site	Date	DO (mg/l)	Flow (cfs)	pH	Monit. Site	Date	DO (mg/l)	Flow (cfs)	pH	
Pine Creek 1	6/7/95	--	--	7.5	Pine Creek 5	5/29/98	--	4.92	--	Six Prong Creek 2	6/29/95	8	0.28	7.5	
	6/29/95	8	1.02	7		6/16/98	--	2.93	7.54		8/15/95	7	--	--	8
	7/27/95	--	--	7.5		7/6/98	--	0.83	--		9/14/95	8	--	--	7.5
	10/12/95	4	--	7		7/21/98	8	0.18	7.12		10/10/95	5	--	--	7.5
	6/17/96	11	2.66	8		8/11/98	--	0.01	--		6/27/96	10	--	--	7.5
	7/16/96	9	--	7		8/26/98	6	--	7.23		7/17/96	9	--	--	7.5
	8/14/96	7	--	7		5/27/99	--	9.44	--		8/15/96	21	--	--	8
	9/16/96	9	0.12	8		6/9/99	9.5	8.89	7.26		9/17/96	10	1.18	7.5	7.5
	5/29/98	--	5.89	--		7/2/99	--	1.68	7.3		5/26/98	--	0.37	--	--
	6/17/98	6	2.47	6.61		10/23/00	6.25	--	6.53		6/15/98	12	0.12	7.14	7.14
	7/1/98	--	1.88	--		5/17/01	--	3.33	--		6/30/98	--	0.29	--	--
	7/15/98	--	0.79	6.6		6/12/01	9	1.35	6.69		7/14/98	16	0.2	8.32	8.32
	7/29/98	--	0.35	--		7/2/01	7	--	8.91		8/19/98	7.75	0.016	6.8	6.8
	8/14/98	7.25	0.051	6.31		7/16/01	8	--	6.68		5/18/99	--	1.58	--	--
	5/20/99	--	17.19	--		1/23/02	--	7.99	--		6/1/99	10	1.95	7.8	7.8
	6/2/99	8	8.75	6.66		6/27/02	6	0.1	6.9		6/14/99	--	1.85	--	--
	6/14/99	--	5.65	--		8/6/02	4	--	6.82		7/1/99	--	2.09	7.18	7.18
	7/1/99	--	1.8	6.93		8/27/02	18	--	7.32		7/19/99	--	2.21	--	--
	7/19/99	--	0.99	--		9/23/02	7	--	6.88		7/29/99	8	1.82	6.55	6.55
	7/30/99	4.75	--	6.49		10/16/02	5	--	--		6/23/98	10	1.5	7.29	7.29
	6/7/00	--	2.89	--		5/7/03	11	2.94	7.26		7/10/98	--	1.26	--	--
	6/21/00	--	1.36	6.63		6/3/03	10	0.71	7.26		7/21/98	7.75	0.6	7.17	7.17
	7/7/00	2.5	--	--		7/15/03	8	--	--		8/25/98	9	0.82	9.98	9.98
	8/12/00	6	--	6.72		6/29/95	9	--	8		5/20/99	--	5.14	--	--
	10/23/00	5.5	--	6.54		7/27/95	--	--	8		6/2/99	8.5	2.6	7.91	7.91
	11/13/00	--	--	6.6		8/15/95	10	1.92	8		6/15/99	--	1.77	--	--
	3/1/01	--	3.48	--		9/14/95	9	--	8		6/30/99	--	1.36	8.69	8.69
	5/10/01	--	1.36	--		10/10/95	6	--	8		7/20/99	--	1.46	--	--
	5/21/01	--	3.17	--		6/17/96	10	3.61	7.5		7/30/99	6.75	0.79	6.89	6.89
	6/6/01	--	0.73	--		7/16/96	--	--	7.5		6/22/00	--	1.62	7.09	7.09
	7/2/01	9	--	8.96		8/13/96	8	--	8		7/3/00	--	1.49	--	--
	7/16/01	2	--	6.34		9/13/96	12	0.21	7.5		7/14/00	--	0.89	6.91	6.91
	7/27/01	2	--	6.3		5/26/98	--	2.4	--		7/31/00	--	0.48	--	--
	8/9/01	3	--	--		6/15/98	11.25	1.56	7.52		8/10/00	--	0.8	6.61	6.61
	8/22/01	10	--	6.65		6/30/98	--	1.18	--		10/3/00	--	0.93	--	--
9/12/01	9	--	6.76	7/14/98	9.5	0.68	7.44	10/23/00	8	0.56	6.22	6.22			
10/15/01	13	--	6.5	7/30/98	--	0.42	--	11/13/00	--	1.27	7.63	7.63			
12/6/01	5	0.23	--	8/19/98	8	0.6	7.81	5/10/01	--	1.97	--	--			
6/27/02	9	0.06	7.28	5/18/99	--	4.35	--	5/21/01	--	1.64	--	--			
5/7/03	12	2.86	7.73	6/1/99	10.5	2.98	7.94	6/6/01	10	1.56	--	--			
6/3/03	9	0.55	7.28	6/14/99	--	1.37	--	6/29/01	7	0.75	7.49	7.49			
7/15/03	3	--	--	7/1/99	--	0.84	8.26	7/16/01	7	0.21	6.82	6.82			
8/20/03	23	--	--	7/19/99	--	0.33	--	7/27/01	7	0.31	7.15	7.15			
6/30/95	8	--	7	7/29/99	8.5	0.38	7.54	8/9/01	8	0.35	7.24	7.24			
8/2/95	--	--	7	6/7/00	--	0.7	--	8/22/01	9	0.45	7.01	7.01			
8/30/95	8	--	7.5	6/20/00	6.5	0.71	7.33	9/12/01	9	0.34	7.41	7.41			
9/25/95	8	--	7.5	6/30/00	--	0.16	--	10/15/01	10	0.52	6.68	6.68			
6/17/96	9	--	6.5	7/13/00	7.5	0.25	6.97	6/27/02	10	0.23	7.41	7.41			
7/16/96	10	--	7	7/31/00	--	0.04	--	8/6/02	11	0.12	8.67	8.67			
8/13/96	6	--	7	6/6/01	10	3.13	6.83	8/27/02	9	0.08	7.18	7.18			
9/18/96	9	0.45	7.5	6/21/01	6	0.09	7.62	9/30/02	12	0.13	7.19	7.19			
				12/6/01	12	0.39	7.51	10/28/02	12	0.33	7.14	7.14			
				1/8/02	--	0.42	--	5/7/03	13	0.45	7.23	7.23			
				6/26/02	9	0.05	7.78	6/3/03	11	0.12	7.63	7.63			
				5/6/03	10	0.3	7.72	7/15/03	9	0.08	--	--			
				6/2/03	9	0.53	7.66	8/21/03	8	0.08	--	--			
				7/10/03	9	0.03	--								
				8/20/03	4	--	--								

Notes:
 Bolded DO values exceed default surface water quality standard of 8.0 mg/L (for lowest 1-day minimum).
 Bolded pH values exceed default surface water quality standard of 6.5 to 8.5.

On Ecology's 2002/2004 Water Quality Assessment list, Pine Creek is listed as Category 2 (waters of concern) for fine sediment that affects fish habitat. The only published surface water quality data that exist for the Wood/Alder Creeks subbasin are from discrete water samples taken by the USGS at the Alder Creek streamflow gaging station at Alderdale (Station 14034350). The USGS sampled waters there on six occasions between January 1965 and March 1966. The parameters measured were water temperature and suspended sediment and the data are presented in Table 4-10. Stream discharge measurements are also presented.

Table 4-10. USGS Water Quality Data for Alder Creek

Alder Creek at Alderdale, WA (14034350)					
Date	Time	Water Temperature (°F)	Suspended Sediment Concentration (mg/L)	Suspended Sediment Load (tons/day)	Calculated Discharge (cfs)
1/27/65	14:25	44.1	5,950	7,200	490
8/23/65	10:10	69.1	13,500	583	20
1/6/66	9:00	37.9	3,020	1,280	170
1/6/66	21:05	42.1	16,300	18,900	470
3/9/66	3:50	46.0	2,860	2,030	290
3/10/66	2:45	42.1	1,110	639	240

Note:

Bolded temperatures exceed default surface water quality standard of 63.5° F (17.5°C)

Relative to the data collected by the USGS in Rock Creek in this time period (Table 4-6), Alder Creek carries higher suspended sediment quantities, even at its much lower discharge rates. Comparing measurements collected in the two streams at the same times (January 1995 and March 1996), Rock Creek's average discharge was more than three times greater than Alder Creek (1,100 vs. 340 cfs), but its average suspended sediment concentration was only 30 percent that of Alder Creek (880 vs. 3,300 mg/L). This difference may be attributable to less area of unconsolidated (erodible) overburden present in the Rock Creek drainage relative to the Alder Creek drainage. The net result is that Rock Creek transported roughly 80 percent of the sediment load that Alder Creek did in those time periods (2,600 vs. 3,300 tons/day).

Glade/Fourmile Creeks Subbasin

Although the EKCD has conducted surface water quality monitoring at only one station in this subbasin (Glade Creek 1; Figure 4-1), Ecology has completed miscellaneous water quality studies that have included limited surface water sampling and analysis.

Ecology (Davis 1993) sampled surface water at the mouth of Glade Creek as part of the Washington State Pesticide Monitoring Program (WSPMP). Nitrate was detected in that sample at 34.5 mg/L and a suite of pesticides were detected at trace concentrations (less than 0.0004 mg/L).

Ecology (Garrigues 1996) completed a groundwater and surface water quality characterization, focusing on nitrate, for the Glade Creek drainage. The study involved sampling of three surface water locations in Glade Creek – one at the mouth and one each on the East Branch Glade Creek and Upper Glade Creek (mainstem) just upstream of their confluence (near corner of T6N/R24E, T6N/R25E, T5N/R24E, and T5N/R25E). The Glade Creek sampling location at the mouth was the same as that sampled in 1993 during the WSPMP. Samples were collected from the three locations in May 1995; the location at the mouth was sampled again in September 1995. In May 1995, nitrate concentrations increased in the downstream direction, from 11 to 13 mg/L at the two upstream locations to 36 mg/L at the mouth. In September 1995 sampling at the stream mouth, nitrate was detected at 40 mg/L. The surface water samples also contained elevated TDS levels, ranging from 503 mg/L in the East Branch to 908 mg/L at the mouth. pH was above the 6.5-8.5 range only in the sample collected from the East Branch location (pH = 8.77). Water temperatures exceeded 63.5°F at all three locations (63.7 to 66.2°F). This study concluded that nitrate contamination is widespread in Glade Creek surface water, with higher concentrations detected during the September sampling event. The nitrate impacts, and other water quality indicators, were generally correlated with the location of larger scale irrigation within the drainage. The study also concluded that surface water flow in Glade Creek in May and September 1995 was water from irrigation return flow.

The EKCD collected water temperature, DO, and pH data at the Glade Creek 1 station, located in the stream's upper reaches (Figure 4-1), from 1995 to 2000. Water temperature data were collected at an hourly (or shorter) time step by instream data loggers. The monthly average, minimum, and maximum water temperatures calculated from these data are presented for each site in Table 4-11. Average monthly water temperature did not exceed 63.5°F during this time period.

In addition, EKCD collected other water quality parameters every four to eight weeks (Table 4-12). DO was below the 8.0 mg/L standard in 1 of 11 measurements collected, and all pH measurements were within the 6.5-8.5 range. Stream discharge was low (less than 4.7 cfs) each time it was measured.

Table 4-11. Summary of EKCD Water Temperature Data for Glade/Fourmile Creeks Subbasin

Monit. Site	Year	Month	Water Temperature			Measurement Period	
			Avg (°F)	Max (°F)	Min (°F)	First Day	Last Day
Glade Creek 1	1995	June	55.5	76.9	48.5	6/13/95	6/30/95
	1995	July	58.4	73.2	51.6	7/1/95	7/19/95
	1996	May	51.7	91.8	44.1	5/16/96	5/31/96
	1996	June *	55.1	65.2	45.5	6/1/96	6/30/96
	1996	July	59.6	74.7	47.4	7/1/96	7/16/96
	1996	August	56.8	66.4	46.3	8/14/96	8/31/96
	1996	September *	50.5	62.0	37.3	9/1/96	9/30/96
	1996	October	49.4	55.8	41.3	10/1/96	10/8/96
	1997	May	57.1	60.5	54.3	5/29/97	5/31/97
	1997	June *	54.8	62.5	47.6	6/1/97	6/30/97
	1997	July *	57.5	67.7	48.1	7/1/97	7/31/97
	1997	August *	59.1	64.8	51.2	8/1/97	8/31/97
	1997	September *	53.3	63.3	44.5	9/1/97	9/30/97
	1997	October *	44.8	55.4	35.2	10/1/97	10/31/97
	1997	November	43.2	49.0	37.5	11/1/97	11/6/97
	1998	May	50.9	66.8	44.3	5/11/98	5/31/98
	1998	June *	55.7	63.3	48.1	6/1/98	6/30/98
	1998	July *	60.7	71.5	51.5	7/1/98	7/31/98
	1998	August	61.1	69.7	52.6	8/1/98	8/14/98
	1999	May	51.0	78.0	38.4	5/4/99	5/31/99
	1999	June *	55.2	67.4	43.4	6/1/99	6/30/99
	1999	July *	57.0	68.9	45.9	7/1/99	7/31/99
	1999	August *	59.6	70.0	47.3	8/1/99	8/31/99
	1999	September	51.4	59.6	43.4	9/1/99	9/25/99
2000	May	51.4	84.8	45.7	5/25/00	5/31/00	
2000	June *	54.5	61.6	45.7	6/1/00	6/30/00	
2000	July	55.2	61.9	46.8	7/1/00	7/14/00	

Table 4-12. EKCD Water Quality Data for the Glade/Fourmile Creeks Subbasin

Monit. Site	Date	DO (mg/l)	Flow (cfs)	pH
Glade Creek 1	7/3/95	9	0.18	8.5
	6/24/96	9	0.61	8
	7/16/96	11	--	8
	8/14/96	18	--	8
	9/16/96	12	--	7
	6/1/98	--	2.04	--
	6/16/98	12	1.36	7.78
	7/1/98	--	0.61	--
	7/15/98	9.75	0.1	7.47
	8/14/98	9	0.08	7.85
	5/18/99	--	4.68	--
	6/1/99	9.5	2.72	7.07
	6/13/99	--	0.67	--
	6/28/99	8	--	7.9
	7/2/99	--	1.22	--
	7/20/99	--	0.62	--
	8/3/99	7.75	--	7.83
	6/7/00	--	1.15	--
	6/22/00	--	0.6	7.83
	7/3/00	--	0.61	--
7/14/00	--	--	7.98	

Notes:

Bolded DO values exceed default surface water quality standard of 8.0 mg/L (for lowest 1-day minimum).

Bolded pH values exceed default surface water quality standard of 6.5 to 8.5.

Kennewick Subbasin

There are no surface water quality data available for the Kennewick subbasin.

4.2.2 Groundwater Quality Data

There are no regional groundwater quality monitoring programs in WRIA 31. The only systematic groundwater quality dataset available for the WRIA is from DOH, who regulates water quality monitoring of public water system wells.

In May 2004, DOH provided water quality data for inorganics (metals and conventional parameters including nitrate) from WRIA 31 Group A and B public water systems (PWS), for the time period January 2000 through April 2004. Table 4-13 provides a summary of reported PWS constituent concentrations exceeding respective groundwater quality standards by subbasin. The type of groundwater quality standard (primary or secondary maximum contaminant level [MCL], etc.) is also listed. Note that primary MCLs are health-based standards, whereas secondary MCLs are based on aesthetic (not health-based) considerations like color, staining, taste, etc.

Groundwater quality information for the WRIA was compiled from information on the DOH PWS wells and miscellaneous reports. The available groundwater quality information for each subbasin is discussed below.

Rock Creek Subbasin

Although there are four PWS in this subbasin, there are no groundwater quality data available from DOH since 2000 or from other sources.

Wood/Alder Creeks Subbasin

In the early 1980s, the USGS completed spot sampling of four wells in the Wood/Alder Creeks subbasin (Steinkampf et al. 1985). Measurements of fifteen water quality parameters were taken from wells finished in both the Saddle Mountain Basalt and Wanapum Basalt. All parameters fell within state and federal drinking water quality standards.

DOH has groundwater quality data from ten PWS in this subbasin. One PWS had detectable sodium (33.6 mg/L) above the 20 mg/L recommended level of concern (Table 4-13). Although there is no established MCL for sodium, EPA has established this recommended level for persons that may be restricted for dietary sodium intake. Sodium is a common element in minerals comprising basalt; higher sodium concentrations can occur in groundwaters that have long residence times in basalt aquifers (e.g., deeper aquifers). In addition, sodium concentrations in shallow groundwaters can increase if long-term irrigation leaches natural salts from the soil. One PWS also had detectable lead (0.028 mg/L) above the 0.015 mg/L drinking water action level. Lead in drinking water is a result of plumbing and it is highly unlikely that it is present at concentrations of concern in subbasin groundwater.

Although large-scale irrigation occurs in portions of this subbasin, nitrate in groundwater (a common indicator of agricultural land use) does not appear to be an issue for this subbasin, based on available information.

Glade/Fourmile Creeks Subbasin

Steinkampf et al. (1985) sampled 30 wells in the Glade/Fourmile Creeks subbasin. Measurements of fifteen water quality parameters were taken from wells finished in both the Saddle Mountains Basalt and Wanapum Basalt. Three wells finished in the Saddle Mountains Basalt exceeded the drinking water MCL for nitrate (10 mg/L) (wells located within T5N/R27E, T6N/R26E, and T7N/R27E). Groundwater from two of these wells also exceeded the secondary MCL for color and hardness caused by elevated total dissolved solids (mineralized water). All other groundwaters sampled, including all Wanapum Basalt wells, fell within state and federal drinking water standards.

In 1993, the Benton-Franklin Health District sampled six wells in the Glade Creek drainage. Nitrate concentrations in the six wells ranged from 0.7 to 3.3 mg/L (all below the drinking water standard), with an average of 1.9 mg/L.

As a part of Ecology's surface water and groundwater quality study of the Glade Creek drainage (Garrigues 1996), field measurements and general chemistry samples were collected from eleven wells finished in both the Saddle Mountains Basalt and Wanapum Basalt. Samples were taken during May and September 1995. Four of the wells sampled

were the same as those sampled by the USGS in the early 1980s (Steinkampf et al. 1985), allowing comparison of groundwater quality more than a decade later. Elevated nitrate levels were detected in the two uppermost aquifers (Alluvium and Saddle Mountains Basalt). The nitrate impacts, and other water quality indicators, were generally correlated with the location of larger scale irrigation within the drainage. Nitrate was not detected in any of the four Wanapum Aquifer wells, indicating that the Mabton Interbed (separating Saddle Mountains and Wanapum Basalts) provides effective hydraulic isolation from the overlying aquifers. Comparison of the 1995 and 1980s data showed no appreciable water quality changes for the two Wanapum Basalt wells; one Saddle Mountains Basalt well showed no appreciable difference while the other (in T6N/R26E) had higher nitrate and other constituents in the 1995 samples.

DOH reports water quality data from 31 PWS in this subbasin. Based on the PWS monitoring data, constituents with reported concentrations above respective primary MCLs are nitrate (up to 32.5 mg/L) and thallium (up to 0.005 mg/L); the nitrate exceedences were most prevalent (19 percent of the subbasin PWS). Constituents exceeding secondary MCLs in one or more PWS are iron, manganese, total dissolved solids (TDS), and conductivity (another measure of TDS). In addition, sodium was reported at concentrations (up to 120 mg/L) exceeding its 20 mg/L recommended level in approximately one quarter of the subbasin's PWS (Table 4-13).

The WRIA 31 supplemental water quality project includes sampling and analysis of nitrate for groundwater wells and surface water locations across the Glade/Fourmile subbasin. To the extent possible, the locations sampled by Garrigues (1996) will be sampled again to allow evaluation of nitrate concentration trends over time.

Kennewick Subbasin

Based on DOH's PWS water quality data, constituents present above groundwater quality standards are similar to those reported for the Glade/Fourmile Creeks subbasin. Nitrate exceeds its 10 mg/L MCL, but only in 3 percent of the subbasin's PWS and the maximum reported concentration is only 12 mg/L. Because irrigation is prevalent in this subbasin, the localized nitrate exceedences may be a result of agricultural practices. Arsenic also marginally exceeds its 0.010 mg/L MCL in one sample (0.011 mg/L) from one PWS; note that the arsenic MCL was recently reduced from 0.050 mg/L. Arsenic is often naturally present in groundwater at low concentrations, and it is highly probable that these concentrations are attributable to natural groundwater quality. Manganese, TDS, and conductivity exceed respective secondary MCLs in only one PWS. Sodium is present at concentrations (up to 119 mg/L) above its recommended level in 5 percent of subbasin PWS. Finally, copper and lead exceed respective drinking water action levels in one and three PWS, respectively. Both metals are associated with plumbing and are not likely present at concentrations of concern in subbasin groundwater. Therefore, they are issues for public health but not for this watershed water quality assessment.

In addition to the PWS data, there are spot water quality data from wells just outside of the Kennewick subbasin that suggest the Wanapum Basalt aquifer in the area is susceptible to elevated temperatures, methane gas, and hydrogen sulfide gas (Golder Associates 2001). Water from the Badger Mountain Irrigation District Well No. 4 (T08N/R28E) also had levels of manganese and iron above the secondary MCL. Water

quality from the shallow alluvial aquifer in the Badger Canyon area (T09N/R28E) has elevated levels of nitrates and sodium (JUB 2003). These wells are just west of WRIA 31's western boundary, but may have groundwater quality generally representative of aquifers within the western portion of the WRIA.

Table 4-13. Constituents Exceeding Groundwater Quality Standards Based on DOH Public Water System Monitoring Data (2000-2004)

Rock Creek Subbasin (4 PWS)					
Parameter	Numerical Water Quality Standard	No. of PWS Exceeding Standard	% of PWS Exceeding Standard	No. of Sample Occurrences Exceeding Standard	Maximum Concentration (mg/L)
None	N/A	None	0%	N/A	N/A
Wood/Alder Creeks Subbasin (10 PWS)					
Parameter	Numerical Water Quality Standard	No. of PWS Exceeding Standard	% of PWS Exceeding Standard	No. of Sample Occurrences Exceeding Standard	Maximum Concentration
Lead	0.015 mg/L (AL ¹)	1	10%	1	0.028
Sodium	20 mg/L (Rec. ²)	1	10%	3	33.6
Glade/Fourmile Creeks Subbasin (31 PWS)					
Parameter	Numerical Water Quality Standard	No. of PWS Exceeding Standard	% of PWS Exceeding Standard	No. of Sample Occurrences Exceeding Standard	Maximum Concentration
Arsenic	0.01 mg/L (MCL ³)	3	10%	2	0.01
Conductivity	700 umhos/cm (SMCL ⁴)	3	10%	4	983*
Iron	0.3 mg/L (SMCL ⁴)	1	3%	1	1.94
Manganese	0.05 mg/L (SMCL ⁴)	1	3%	1	0.22
Nitrate	10 mg/L (SMCL ⁴)	6	19%	49	32.5
Sodium	20 mg/L (Rec. ²)	8	26%	12	120
TDS	500 mg/L (SMCL ⁴)	3	10%	3	810
Thallium	0.002 mg/L (MCL ³)	1	3%	1	0.005
Kennewick Subbasin (148 PWS)					
Parameter	Numerical Water Quality Standard	No. of PWS Exceeding Standard	% of PWS Exceeding Standard	No. of Sample Occurrences Exceeding Standard	Maximum Concentration
Arsenic	0.01 mg/L (MCL ³)	1	1%	1	0.011
Conductivity	700 umhos/cm (SMCL ⁴)	1	1%	1	867*
Copper	1.3 mg/L (AL ¹)	1	1%	1	1.695
Lead	0.015 mg/L (AL ¹)	3	2%	5	0.039
Manganese	0.05 mg/L (SMCL ⁴)	1	1%	1	0.08
Nitrate	10 mg/L (SMCL ⁴)	4	3%	4	12.2
Sodium	20 mg/L (Rec. ²)	8	5%	12	118.8
TDS	500 mg/L (SMCL ⁴)	1	1%	1	542

Notes:

1) AL: Drinking Water Action Level. EPA has established distribution system levels at which a system is required to consider corrosion control.

2) Rec.: Recommended Level of Concern. Although there is no established MCL for sodium, EPA has established a recommended level of concern for those consumers that may be restricted for daily sodium intake in their diets.

3) MCL: The primary maximum contaminant level is the highest allowable level of a chemical constituent in drinking water.

4) SMCL: The secondary maximum contaminant levels are non-enforceable guidelines regulating constituents that may cause cosmetic effects (e.g. skin or tooth discoloration) or aesthetic effects (e.g. taste, color, odor) in drinking water.

*: Units of umho/cm.

Legend

- ◆ Monitoring Stations
- Populated Places (WSDOT)
- State Routes (WSDOT)
- Watercourses (Ecology)
- + Waterbodies (Ecology)
- + Delineated Subbasins (Aspect Consulting)
- + Counties (WSDOT)
- + Township and Range (DNR)

0 30,000 60,000 Feet

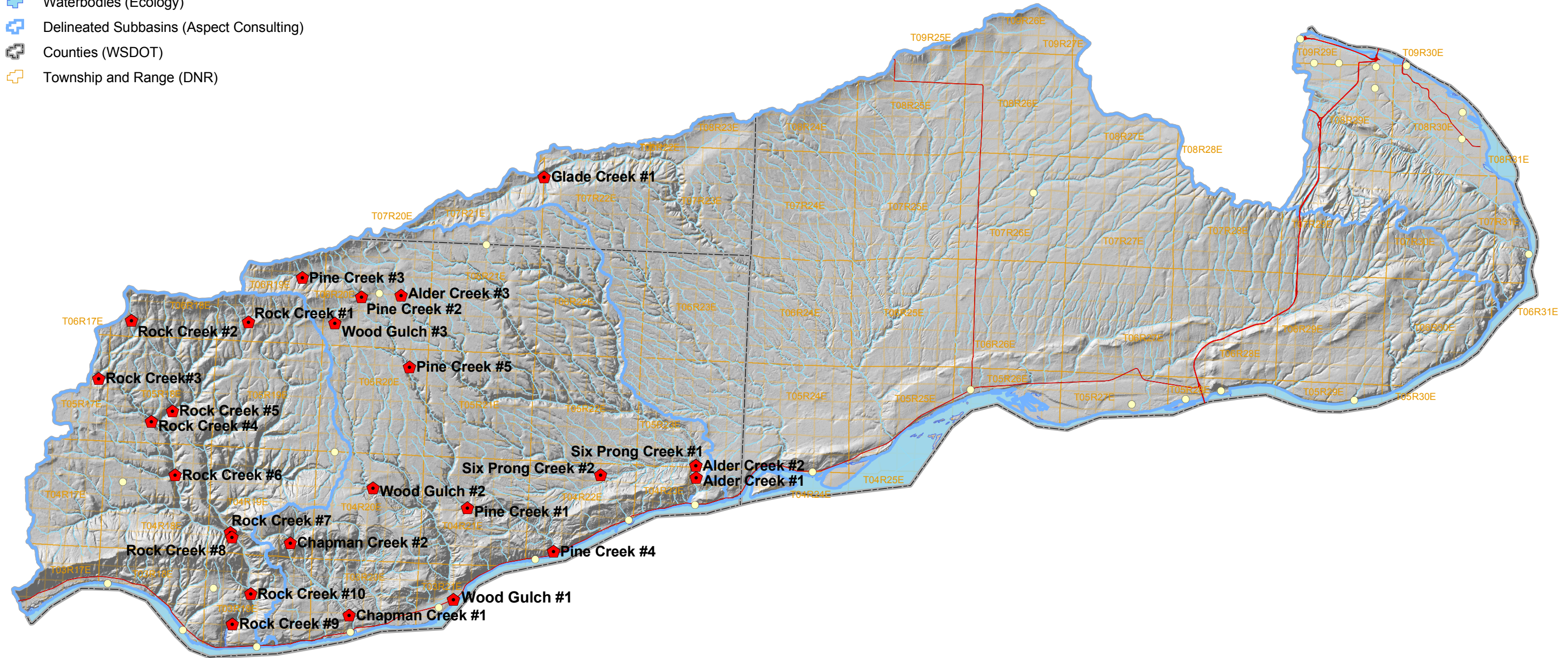
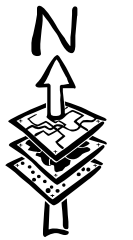


Figure 4-1
EKCD SURFACE WATER QUALITY MONITORING STATIONS
WRIA31 Watershed Planning
Benton, Klickitat and Yakima Counties, WA