Section 6
Tucannon River Implementation Area

6.1 Overview of the Tucannon River Implementation Area

The Tucannon River has two major drainages, the mainstem and Pataha Creek. Specific features of the Pataha Creek subbasin is described in Section 5. Besides Pataha Creek, the major tributaries to the mainstem include Willow Creek, Kellogg Creek, Cummings Creek, Little Tucannon River, Panjab Creek, Sheep Creek, and Bear Creek.

The Tucannon River subbasin has a significant elevation change ranging from 540 feet at the confluence of the Tucannon and Snake Rivers to 6,400 feet at Oregon Butte in the Wenaha-Tucannon Wilderness located in the Umatilla National Forest. The steep topography limits cultivation to the non-forested land with slopes of 45 percent in the middle to lower portions of the subbasin.

As described further in Section 7, the geology of the Tucannon River subbasin consists of basaltic rocks, flows of the Columbia River Basalt Group, overlain by fine-grained loess soils. The loess ranges in thickness from 200 to 300 feet, while average basalt flow thickness is about 90 to 120 feet. One of the most notable geologic features in the Tucannon subbasin is the Hite Fault. This fault crosses the Tucannon River and continues beneath Pataha Creek at right angles. The Hite Fault is still active and may be the cause of elevated ground water temperatures well above the standard geothermal gradient recorded in local wells (Covert *et al.* 1995).

Major land uses in the Tucannon River watershed are related to agricultural purposes. Crop, forest, rangeland, pasture, and hay comprise over 90 percent of the watershed, with approximately 40 percent being grazed rangeland. Dry and irrigated cropland produces winter wheat, barley, peas, and bluegrass. There are eight constructed lakes along the Tucannon River; six are filled from the Tucannon River and two are fed by springs. The mouth and lower 2 miles of the Tucannon River has become a marshland as a result of the reservoir formed by Lower Monumental Dam, 20 miles downstream on the Snake River (Kelley *et al*. 1982)

Approximately 75 percent of the Tucannon subbasin is in private ownership, primarily in the lower reaches. Significant areas are managed by WDFW along the mid-reaches of the Tucannon River. The headwaters of the Tucannon River is managed by the USFS.

6.2 Surface Water Resources

The Tucannon Implementation Area is located in Columbia and Garfield Counties. The Tucannon River mainstem and Pataha Creek are the major stream reaches located within this area.

The Tucannon River headwaters begin at Oregon Butte in the Blue Mountains and drains into the Snake River at RM 62.2, near the Palouse River, and 20 miles upstream of the Lower Monumental Dam (Convert, et. al, 1995 and Gephart, et. al., 2001, unpublished work). The major tributaries of the Tucannon River include Pataha Creek, Willow Creek, Kellogg Creek, Tumalum Creek, Cumming Creek, Little Tucannon River, Panjab Creek, Sheep Creek, and Bear Creek.

Pataha Creek enters the Tucannon River at RM 11.2. Its major tributaries include Dry Pataha Creek, Sweeney Gulch, Balmaier Gulch, Linville Creek, Tatman Gulch, and Dry Hollow. Pataha Creek is discussed in further detail in Section 5.

This section provides an analysis of available gauging station data, a description of the available instream flow studies for the Tucannon Implementation Area, a discussion of instream flow legal requirements, and identification of instream flow needs.

6.2.1 Gauging Data and Stream Flows

Measurement of stream flows with gauging stations has been occurring in the Tucannon Implementation Area since 1913 when a gauging station was installed on the Tucannon River near Marengo, Washington.

The data most useful to watershed planning efforts has been compiled by the United States Geological Survey (USGS). Historically, USGS has operated gauging stations recording stream flows on a daily basis or peakflows over various time periods in this area.

Since September 1998, the Washington State University (WSU) Department of Biological Systems and Center for Environmental Education has been working with the Columbia Conservation District to monitor water quality in the Tucannon River and Pataha Creek in order to evaluate the effectiveness of conservation practices. As part of the monitoring program, spot stream flow measurements were collected at various locations along the Tucannon River. These spot measurements can be useful for specific research or management activities, and in the long run provide a fairly representative record of stream flow even though the record is not continuous.

In support of the watershed planning efforts in the Middle Snake River Basin, the Washington Department of Ecology (Ecology) and the Asotin County Public Utility District proposed to install additional gauging locations in WRIA 35. These monitoring stations are either telemetry or manual stage height stations. Telemetry stations record the stage height every fifteen minutes and data is then imported into Ecology's stream flow database, providing a continuous record of stream flow. Manual stage height stations record the river stage height 6 to 8 times a year, which can then be converted to instantaneous stream flow using a rating table or flow curve.

Ecology also operates water quality monitoring station that are either long-term or basin stations. Long-term stations are monitored every water year (October 1 till September 30), whereas basin stations are monitored for one water year and sometimes returning every five years. Grab samples are taken usually once or twice a month and stream flow, when recorded, is either

estimated or measured. Ecology water quality monitoring stations do not provide a continuous record of stream flow.

General Stream Gauging Locations

Historically, the USGS has operated five (5) stream flow gauging stations in the Tucannon River Implementation Area over various time periods (see Table 6.2-1). Two (2) stations are located on Tucannon River, USGS gauges 13344000 and 13344500, and have recorded stream flow on a daily basis. Of these, only gauge 13344500 is still in operation. The remaining three (3) gauging stations, USGS gauges 13344506, 13344508, and 13344510 are located on Kellogg Creek, and recorded only peak flows; none of these remain in operation today. The locations of the gages are shown on Exhibit 6-1.

The WSU Monitoring Program collected stream flow data at three locations on Tucannon River. The locations are shown on Exhibit 6-1 and listed in Table 6.2-2.

Ecology has proposed one telemetry stream flow gauging location in the Tucannon Implementation Area that has been installed on Tucannon River near Marengo (35B150), Washington. A conversion table has not yet been developed for this site (Jim Peterson, personal communication, 2003). This station is also a basin water quality monitoring station that collected stream flow data for the 1997 water year.

INSERT EXHIBIT 6-1 (Map showing all gauges/monitoring stations.)

Table 6.2-1
USGS Gauging Stations[1]

Site Number	Site Name	Period of Record	Data Type	Count
13344000	TUCANNON RIVER NEAR POMEROY, WASH. (Marengo)	1914 – 1930 1913 – 1930	Peak stream flow Daily stream flow	8 3,043
13344500	TUCANNON RIVER NEAR STARBUCK, WASH. (Smith Hollow)	1915 – 2002 1914 – 1917; 1928 – 1931; 1958 – 1990; 1994 - Current 1964 – 1970	Peak stream flow Real-time, Daily Water Quality	46 16,894 11
13344506	KELLOGG CREEK TRIBUTARY NO. 2 NEAR STARBUCK, WASH.	1970 – 1978	Peak stream flow	9
13344508	KELLOGG CREEK TRIBUTARY NEAR STARBUCK, WASH.	1964 – 1969	Peak stream flow	5
13344510	KELLOGG CREEK AT STARBUCK, WASH.	1963 – 1964	Peak stream flow	3

[1] Source: USGS, 2003.

Table 6.2-2
Washington State University Monitoring Stations[1]

Site ID	Location	Period of Record	Count
Tucannon 4	TUCANNON RIVER AT MARENGO	1999 – 2001	19
Tucannon 6	TUCANNON RIVER JUST DOWNSTREAM OF CUMMINGS CREEK	1999 – 2001	19
Tucannon 9	TUCANNON RIVER AT HEADWATERS	1999 – 2001	24

[1] Sources: Washington State University Center for Environmental Education, 2001.

Ecology also operates a long-term water quality monitoring station, 35B060, on the Tucannon River near Starbuck, Washington. Spot data was collected periodically from 1974 to 2002, often on a monthly basis. The location of the Ecology gages are shown on Exhibit 6-1 and listed in Table 6.2-3.

Table 6.2-3
Washington Department of Ecology Monitoring Stations[1]

Station	Station Type	Site Name	River Mile	Period of Record	Data Type	Count
35B060	Water Quality	TUCANNON RIVER AT POWERS	2.3	1973 – 1974; 1978 – 1992; 1994 – 2002	Long-term	289
35B150	Stream flow Water Quality	TUCANNON RIVER NEAR MARENGO	24.8	2003 1997	Telemetry Basin	71[2] 12

[1] Source: Ecology, 2003.
[2] Count as of 12/9/03.

Although the data collected from the Ecology and WSU sites are limited at this time, the period of record will continue to expand for these sites. These will be useful in monitoring and evaluating flow enhancement activities under an adaptive management approach.

Summary of Existing Data

USGS gauge 13344000, WSU site Tucannon 4, and Ecology station 35B150 are located near Marengo, Washington. Of the 3 sites, only USGS recorded data continuously, and also recorded the most data; however, the records from this gauge are from 1930 and prior. The WSU site collected stream flow almost monthly for just under 2 years, but did not record flows in the month of July. The Ecology site collected monthly flows for the 1997 water year, and recently began recording stage height continuously. For the purposes of this analysis, only data from USGS gauge 13344000 will be summarized below. However, once a conversion table has been developed for the Ecology telemetry site, that data will provide a better idea of stream flow conditions.

In addition, once the stage height recorded by Ecology 35B150 has been converted to flow, a comparison can be made between the flows at Marengo and downstream at Starbuck. This will provide a better understanding of the actual volume of water withdrawals in the area, since the majority of surface water withdrawals occur in this reach. At this time, since USGS gauge 13344000 only recorded stream flow until 1930, a comparison cannot be made with the data collected at USGS gauge 13344500 and Ecology 35B060.

Within the Tucannon Implementation Area, the most useful data for analyzing stream flow is summarized in Table 6.2-4:

- USGS, WSU and Ecology monitoring stations with stream flow data
- Potential value and limitations of these data for characterizing stream flows
- Volume of stream flow passing this gage in an average year based on available data

The complete stream flow records for Tucannon River are summarized in Exhibits 6-2 through 6-6. The USGS monitoring locations are daily readings of stream flow, whereas Ecology recorded stream flow data once a month over the period of record.

The average monthly stream flows observed for the USGS and Ecology monitoring stations for Tucannon River over the period of record, and calculated 10% and 90% exceedance flows are summarized in Exhibits 6-7 through 6-11.

The exceedance flows were calculated from the average monthly flows for the full period of record. The 10% exceedance flow represents the flow that would be exceeded an average of only 10% of the time, and the 90% exceedance flow would be exceeded an average of 90% of the time. The 10% exceedance flow could be considered to represent average high flows and the 90% exceedance flow to be low average flows.

Table 6.2-4
Stream Flow Data: Tucannon Implementation Area

Gauge	Type of data	Site Name and Potential Planning Value	Period of Record	Volume[4] (afy)
TUCANNON RIVER MAINSTEM				
WSU[1] Tucannon 9	Spot data	TUCANNON RIVER AT HEADWATERS	1999 – 2001	-
WSU[1] Tucannon 6	Spot data	TUCANNON RIVER JUST DOWNSTREAM OF CUMMINGS CREEK	1999 – 2001	-
USGS 13344000	Daily	TUCANNON RIVER NEAR POMEROY, WASH.	1913 – 1930	90,520
USGS 13344500	Daily	TUCANNON RIVER NEAR STARBUCK, WASH.	1914 – 1917; 1928 – 1931; 1958 – 1990; 1994 – 2002	123,823
Ecology 35B060	Spot data	TUCANNON RIVER AT POWERS	1973 – 1974; 1977 – 1992; 1994 – 2002	118,880
KELLOGG CREEK				
USGS 13344506	Peakflow	KELLOGG CREEK TRIBUTARY NO. 2 NEAR STARBUCK, WASH.	1970 – 1978	-
USGS 13344508	Peakflow	KELLOGG CREEK TRIBUTARY NEAR STARBUCK, WASH.	1964 – 1969	-
USGS 13344510	Peakflow	KELLOGG CREEK AT STARBUCK, WASH.	1963 – 1964	-

[1] Sources: Washington State University Center for Environmental Education, 2001.
[2] Source: USGS, 2003.
[3] Source: Ecology, 2003.
[4] Total volume of stream flow passing the gage in an average flow year in acre-feet/yr.

Insert Exhibit 6-2

Insert Exhibit 6-3

Insert Exhibit 6-4

Insert Exhibit 6-5

Insert Exhibit 6-6

Insert Exhibit 6-7

Insert Exhibit 6-8

Insert Exhibit 6-9

Insert Exhibit 6-10

Insert Exhibit 6-11

The following summarizes the data available, and seasonal and long-term trends suggested by the data, for each of the streams in the Implementation Area:

Tucannon River:

The general stream flow pattern of Tucannon River suggested by the WSU monitoring data and USGS gauging stations coincides with winter precipitation and spring snowmelt in the lower elevations, and spring snowmelt in the higher elevations. The long-term trend cannot be determined since the period of record at most locations are short. However, from existing data, peak flows generally occur mostly in the late spring, varying from year to year. The following summarizes the available data for each of reach of Tucannon River:

Tucannon River from Headwaters to Panjab Creek Confluence

- No stream flow data is available for this stream reach.

Tucannon River from Panjab Creek Confluence to Little Tucannon Confluence

- The records from WSU monitoring site Tucannon 9 (Exhibits 6-2 and 6-7) indicate a mean annual flow of about 88.4 cfs, a normal low flow of 42.7 – 49.3 cfs between August and October, and a normal high flow of 158to 242 cfs between April and June. Average late summer flows are about 23 percent of the average spring flows. The total annual stream flow volume in this reach is about 64,000 acre-feet per year.

Tucannon River from Little Tucannon Confluence to Cummings Creek Confluence

- No stream flow data is available for this stream reach.

Tucannon River from Cummings Creek Confluence to Tumalum Creek Confluence

- The records from WSU monitoring site Tucannon 6 (Exhibits 6-3 and 6-8) indicate a mean annual flow of about 115.6 cfs, a normal low flow of 50 – 60.5 cfs between August and October, and a normal high flow of 150.5 – 283.5 cfs between April and June. Average late summer flows are about 26 percent of the average spring flows. Flows were not recorded in July. The total annual stream flow volume in this reach is about 76,800 acre-feet per year.

Tucannon River from Tumalum Creek Confluence to Willow Creek Confluence

- The records from USGS gauge 13344000 (Exhibits 6-4 and 6-9) indicate a mean annual flow of about 125.3 cfs, a normal low flow of 53.3 to 72.4 cfs between August and October, and a normal high flow of 129.2 – 234.1 cfs between March and June. Average late summer flows are about 33 percent of the average spring flows. The total annual stream flow volume in this reach is about 90,520 acre-feet per year.

- The flows measured by Ecology station 35B150 in the 1997 water year ranged from 62 cfs in October 1996 to 805 cfs in February 1997. The flows measured at WSU Tucannon 4 between September 1998 and March 2001 have ranged from 35 cfs (Gephart, et. al., 2001, unpublished work) to 454 cfs measured in May 1999 (WSU, 2001).

Tucannon River from Willow Creek Confluence to Pataha Creek Confluence

- No stream flow data is available for this stream reach.

Tucannon River from Pataha Creek Confluence to Kellogg Creek Confluence

- The records from USGS gauge 13344500 (Exhibits 6-5 and 6-10) indicate a mean annual flow of about 171.8 cfs, a normal low flow of 60.7 to 83.2 cfs between August and October, and a normal high flow of 202 to 296 cfs between March and June. Average late summer flows are about 28 percent of the average spring flows. The total annual stream flow volume in this reach is about 123,900 acre-feet per year.

Tucannon River from Kellogg Creek Confluence to Snake River

- The records from Ecology monitoring site 35B060 (Exhibits 6-6 and 6-11) indicate a mean annual flow of about 164.7 cfs, a normal low flow of 66.6 – 79.6 cfs between August and October, and a normal high flow of 230 to – 278 cfs between April and June. Average late summer flows are about 29 percent of the average spring flows. Flows were not recorded in July. The total annual stream flow volume in this reach is about 118,900 acre-feet per year.

Panjab Creek:

Limited stream flow data is available for this creek. Flows were measured in early August 1986 by WDFW at 2.9 cfs (trail #3127) and 6.7 cfs (0.9 above Camp 13 Bridge) (Kuttel, 2002).

Kellogg Creek:

Limited stream flow data is available for this creek. USGS gauges 13344506, 13344508, and 13344510 recorded peak stream flows on Kellogg Creek for some winter months between 1963 and 1978. The flows recorded near Starbuck, Washington at USGS gauge 13344510 ranged from 130 cfs on January 24, 1964 to 4,000 cfs on December 22, 1964. Just upstream at USGS gauge 13344508, winter flows ranged from 35 cfs to 1,010 cfs between 1965 and 1969. A spring flow of 5 cfs was estimated on April 18, 1967, and the lowest flow recorded was less than 0.5 cfs in 1968 at this location. Further upstream at USGS gauge 13344506, winter and spring flows ranged from 36 cfs to 106 cfs between 1970 and 1978. Summer flows were recorded at 44 cfs on September 24, 1977 and 169 cfs on July 8, 1978 at this location.

Pataha Creek:

Pataha Creek is discussed in further detail in Section 5.

Willow Creek, Cummings Creek, Little Tucannon River and tributaries:

No stream flow data is available for these streams.

(NOTE: From conversation with Glen Mendel, a draft report will be completed in January 2005 that may have additional stream flow information pertinent to this Implementation Area.)

Adequacy of Existing Data

The following summarizes the usefulness of the available data for quantifying the stream flow entering or originating within the Implementation Area:

Tucannon River:

Tucannon River from Headwaters to Panjab Creek Confluence

- No stream flow gauging stations have been installed in this stream reach. In 1983 the United States Forest Service (USFS) established a stream gauge on Tucannon River at Panjab Creek, however this gauge was damaged in 1996 by flooding. The gauge was reinstalled in 1997 but was later discontinued because there were problems maintaining the site. A stage discharge rating was never developed for the gauge and records have not been analyzed. (Umatilla National Forest and Pomeroy Ranger District, 2002).

Tucannon River from Panjab Creek Confluence to Little Tucannon Confluence

- Instantaneous stream flow in this reach can be estimated using WSU monitoring site Tucannon 9 on Tucannon River just downstream of Panjab Creek. Contributions from Panjab Creek are not known.

Tucannon River from Little Tucannon Confluence to Cummings Creek Confluence

- No stream flow gauging stations have been installed in this stream reach.

Tucannon River from Cummings Creek Confluence to Tumalum Creek Confluence

- Instantaneous stream flow in this reach can be estimated using WSU monitoring site Tucannon 6 on Tucannon River just downstream of Cummings Creek. Individual contributions from Cummings Creek and Little Tucannon River are not known. Total contribution can be estimated by taking the difference between WSU monitoring sites Tucannon 9 and Tucannon 6.

Tucannon River from Tumalum Creek Confluence to Willow Creek Confluence

- The stream flow in this reach can be estimated using USGS gauge 13344000 prior to 1930. An Ecology telemetry station (35B150) has been installed near Marengo, Washington. More recent continuous stream flow records will be available as more data is collected and a conversion table is developed to convert the manual stage height data collected.

Tucannon River from Willow Creek Confluence to Pataha Creek Confluence

- No stream flow gauging stations have been installed in this stream reach.

Tucannon River from Pataha Creek Confluence to Kellogg Creek Confluence

- The stream flow in this reach can be estimated using USGS gauge 13344500. Contributions from Pataha Creek can be estimated from WSU monitoring site Pataha 1 and Ecology station 35F050.

Tucannon River from Kellogg Creek Confluence to Snake River

- The stream flow in this reach can be estimated using stream flow data collected at Ecology water quality monitoring station 35B060. Instantaneous contributions from Kellogg Creek can be estimated from USGS peakflow gauge 13344510 located near Starbuck, Washington.

Kellogg Creek:
USGS gauges 13344506, 13344508, and 13344510 recorded peak stream flows on Kellogg Creek.

Pataha Creek:

Pataha Creek is discussed in further detail in Section 5.

Willow Creek, Tumalum Creek, Cummings Creek, Little Tucannon River and Panjab Creek and tributaries:
No stream flow gauging stations have been installed in these streams.

6.2.2 Instream Flow Requirements

A listing of specific stream flow requirements is presented in this subsection. The general discussion on instream flows and instream flow studies are presented in Section 9. The Tucannon River subbasin currently has no instream flow requirements adopted as a regulation or rule. However, there have been instream flow recommendations developed for the Tucannon River in the past that Ecology considers for conditioning water rights applications. Two of the most recent recommendations are based on findings from IFIM instream flow studies. These instream flow recommendations are summarized in Table 6.2-5. Application of these recommendations is discussed further in Section 9. The most recent IFIM instream flow study was conducted in 2003 by the Washington State University. The results of this study are also discussed further in Section 9.

Table 6.2-5
Historical Instream Flow Recommendations for Tucannon River Subbasin

Time Period	Recommended Flow	Measurement Point	Basis for Flow
Year round	50 cfs low flow	Confluence of Tucannon and Snake Rivers	Letter from Dept. of Fisheries, Dec. 12, 1972
Year Round	Closure	Above Cummings Creek	Letter from Dept. of Fisheries, Dec. 12, 1972
Oct. 1 – Feb. 28 Mar. 1 – Jun. 14 Jun. 15 – Aug. 14 Aug. 15 – Sep. 30	65 cfs 100 cfs 65 cfs 70 cfs	Starbuck Dam	Letter from WDFW, Aug. 24, 1993 based on IFIM study
Jun. 15 – Aug. 14 Aug. 15 – Nov. 30 Dec. 1 – Feb. 28/29 Mar. 1 – Jun 14	75 cfs 85 cfs 75 cfs 105 cfs	Starbuck Dam	Letter from WDFW, April 12, 1995 based on IFIM study.

Furthermore, two surface water source limitations (SWSL) have been established on the Tucannon River. A description of the SWSLs is shown in Table 6.2-6.

Table 6.2-6
Surface Water Source Limitations in the Tucannon River Subbasin

Stream Name	Type	Location	Documentation Basis
Tucannon River	Closure	Township 10N, Range 41E, Section 22	Letter from Fisheries, Dec. 12, 1972; Oct. 28, 1974
Tucannon River	Low Flow - 50 cfs	Township 12N, Range 39E, Section 33	Letter from Fisheries, Dec. 12, 1972; Oct. 28, 1974

6.3 Water Demand Projections

This section includes the demand projections for the Tucannon River subbasin. A general discussion of water use is included in Section 2. In general, there are five major categories of water users identified in the Tucannon River subbasin. These are: (i) major public water systems (City of Starbuck); (ii) small public water systems (Group B systems); (iii) self-supplied commercial/industrial users; (iv) individual household wells; and (v) agricultural water users. Starbuck is a small community, while pasture and rangeland, cropland, and forestland are the predominant land uses within the Tucannon River subbasin. Thus, the most significant water use is associated with agricultural use (including stock watering and pastures).

A summary of principal water demands for municipal and rural residential needs, along with agricultural demands are outlined in the subsections below.

6.3.1 Municipal and Rural Residential Use

Planning for future water supply needs requires projection of long-term demand to quantify probable water resource requirements. For watershed planning, quantifying current and projected diversions for domestic, commercial, and industrial uses is essential to determine the distribution of instream and out-of-stream water resources and demands. For municipalities, such forecasts guide the sizing and identification of long-range supply facilities.

The method for conducting the demand projections is described in the Asotin Creek Implementation Area section under Section 3.3.1. As described in that section, the demand projection is based on the population and per capita demand derived from the DOH formula. The population forecasts described in Section 2.4 is used as the basis for the demand projections. For convenience the population projections for Tucannon River subbasin is repeated below in Table 6.3-1 and the per capita demand is repeated in Table 6.3-2.

Table 6.3-1 Population Projection for Tucannon Subbasin			
	City of Starbuck	**Rural Columbia Co.**	**Rural Garfield Co.**
1990	170	-	-
1995	165	-	-
2000	165	479	815
2005	165	470	819
2010	165	470	819
2015	165	470	819
2020	165	470	819
2025	165	470	819

Table 6.3-2 Average Rainfall and Per Capita Residential Demand					
	Asotin County	**City of Asotin**	**Columbia County**	**Garfield County**	**Whitman County**
Average Rainfall (inches/year)(1)	14.4	13.3	25.3	16.3	18.1
Average per Capita Demand (gallons) (1)	300.9	320.6	206.7	276.3	257.3

(1) Rounded to the nearest tenth.

Using sub-basin populations forecasts shown in Table 6.3-1 and per capita demand shown in Table 6.3-2 the planning unit projected average day demand for residential connections through 2025. The results of this calculation for the Tucannon River subbasin are provided in Table 6.3-3 in gallons per day and in Table 6.3-4 in acre feet per year.

Table 6.3-3 Average Day Demand Projections for Tucannon River Subbasin			
Year	**City of Starbuck**	**Rural Columbia Co.**	**Rural Garfield Co.**
1990	35,145	-	-
1995	34,111	-	-
2000	34,111	79,105	16,983
2005	34,111	77,621	17,080
2010	34,111	77,621	17,080
2015	34,111	77,621	17,080
2020	34,111	77,621	17,080
2025	34,111	77,621	17,080

Units in Gallons per day

Table 6.3-4 Average Annual Volume Projections for Tucannon River Subbasin (acre feet per year)			
	City of Starbuck	**Rural Columbia Co.**	**Rural Garfield Co.**
1990	39	-	-
1995	38	-	-
2000	38	89	19
2005	38	87	19
2010	38	87	19
2015	38	87	19
2020	38	87	19
2025	38	87	19

Units in acre feet per year

As discussed with the Asotin subbasin (Section 3.3.1), the portion of the projected demand associated with surface water versus ground water was not done for the Level 1 assessment. However, based on a comparison of the water rights for non-irrigation purposes (see Section 6.4), ground water use is higher on annual basis than surface water use in the subbasin. This is because Starbuck relies on ground water as their source, and most of the large agricultural irrigation also utilizes ground water as the source of water. Furthermore, most individual household users use wells for water supply. Based strictly on the water rights ratios, it is estimated that ground water use accounts for over 90 percent of the source of water for non-irrigation use in the Tucannon River subbasin.

6.3.2 Agricultural Demand

A general discussion on agricultural water use and measurement is provided in Section 3.3.2. That section also includes a description of the methods used to estimate agricultural water use in the basin. This section includes the findings of that analysis for the Tucannon River subbasin.

Of the four Subbasins described in this Assessment, the Tucannon Subbasin is most significantly impacted by agricultural land and water use. A 1995 study completed by the Natural Resources Conservation Service documented 1,941 acres of irrigated cropland located in the Subbasin[1]. Primary crops include grass hay, alfalfa hay, pasture, wheat and fallow land. Diversions generally take place from early May through August[2]. Most water used for irrigation is derived from surface water sources, though groundwater is more commonly used for irrigation in the Tucannon than in other Subbasins. As in other Subbasins, most diversions are not metered, so it is difficult to determine the amount of water being diverted for agricultural use. There is potential for stock watering from exempt wells in the Subbasin, but the extent and impact of this water use is unknown.

Table 6.3-1 estimates surface and ground water diversions for agricultural irrigation in the Tucannon Subbasin. Values of acreage by crop were documented the 1995 study conducted by the Natural Resources Conservation Service. Annual irrigation values were calculated based on the estimated amount of water required for each crop and an average 65% irrigation efficiency[3]. Annual surface and ground diversions were estimated based on water rights data for the acreage being irrigated. Of the 1941 irrigated acres documented, 1,588 (81.8%) held surface water rights[4]. The water rights data were not correlated to crop type in the 1995 study; therefore surface and ground diversion estimates are general in nature and should be treated as such.

Table 6.3-5
Agricultural Water Use by Crop in the Tucannon Subbasin[1]

Irrigated Crop	Acreage	Estimated Peak Flow[2] (cfs)	Total Annual Irrigation (afy)	Estimated Annual Surface Diversions (afy)	Estimated Annual Ground Diversions (afy)
Hay (Grass)	115.4	2.68	464.8	380.2	84.6
Hay (Alfalfa)	834.6	20.38	3,167.2	2,590.8	576.4
Pasture	377.8	8.75	1,521.9	1,244.9	277
Wheat	596.2	7.66	1,222.9	1,000.3	222.6
Fallow	17.3	0.22	35.5	29	6.5
TOTALS	1,941.3	39.69	6,412.3	5,245.3	1,167

[1] *Data provided by Natural Resources Conservation Service (1995)*
[2] *Estimated peak flow based on crop demands and acreage during peak irrigation period (NRCS 1995)*

[1] NRCS, April 1995, Memo: Tucannon River Planning – Water to Irrigation
[2] NRCS, May 1995, Report: Flow Dedicated to Irrigation on Tucannon River
[3] NRCS, May 1995, Report: Flow Dedicated to Irrigation on Tucannon River
[4] NRCS, April 1995, Memo: Tucannon River Planning – Water to Irrigation

Irrigation systems predominantly consist of hand and wheel lines (1,549.4 acres), and to a lesser degree center pivot (313.5 acres) and big gun systems (78.4 acres)[5]. These are relatively simplistic irrigation systems, with an estimated average 65% field application efficiency[6]. A recalculation of water use including a 5% increase in irrigation efficiency resulted in a reduction of 3.2 cfs and 458 afy in seasonal volume of water withdrawal[7]. Future upgrades of irrigation practices to increase efficiency, changes in irrigation timing, or use of storage to collect water for use during the dry summer months could potentially impact stream flows in the Subbasin.

Due to the uncertainty of agricultural crop markets and in an effort to include conservative estimates in this Level 1 Assessment, it is anticipated that agricultural water use in the Tucannon Subbasin will remain constant.

6.4 Water Rights and Claims

Section 2.9 includes a general discussion of the water rights and claims status for the WRIA 35 watershed as a whole. This section includes a subbasin-specific summary of the types of use and the estimated quantities of water rights for the Tucannon River subbasin.

In order to derive the subbasin-specific water rights, all of the water rights were mapped based on their location per the township-range-section description in the WRATS database (refer to Section 2.9). The same analysis as conducted to prepare Tables 2.8-1 and 2.8-3 was used, except that only those water rights within the Tucannon River subbasin were included in the evaluation. Tables 6.4-1 and 6.4-2 include summaries of the types of use and associated quantities for surface and ground water permitted and certificated water rights, respectively. Water rights with irrigation being one of the purposes of use accounts for almost 70 percent of the total annual water rights allocated, in terms of total annual quantities. Ground water and surface water are approximately equally appropriated as the source of water in terms of annual volume allocated by water rights.

[5] NRCS, April 1995, Memo: Tucannon River Planning – Water to Irrigation
[6] Washington State University, 1985, Washington State Irrigation Guide
[7] NRCS, April 1995, Memo: Tucannon River Planning – Water to Irrigation

Table 6.4-1 Summary of Surface Water Rights[1] for Tucannon River Subbasin			
Purpose of Use	**Number of Records**	**Annual Quantity, Qa (afy)**	**Instantaneous Quantity, Qi (cfs)**
IR	7	2,250.00	16.408
ST WL	3	6.50	0.0616
IR ST	2	849.00	1.33
DM	1	17.00	0.1
DS	1	1.00	0.01
DS ST WL	1	9.00	0.1831
FR IR	1	40.00	0.2

NOTES:

1 The detailed summary by Purpose of Use only includes data pertaining only to water right permits and certificates, as listed in the Department of Ecology Water Rights Application Tracking System (WRATS) database (February 4, 2004). Quantities of water associated with claims and water right applications are not included in this table. There are no annual or instantaneous quantities associated with water right applications.

- ***DM**--Domestic Multiple (more than one dwelling none of which are under municipal control)*
- ***DS**--Domestic Single (one dwelling with lawn and garden, up to one-half acre)*
- ***FR**--Fire Protection*
- ***IR**--Irrigation*
- ***ST**--Stock Watering*
- ***WL**--Wildlife Propagation*

Table 6.4-2 Summary of Ground Water Rights[1] for Tucannon River Subbasin			
Purpose of Use	**Number of Records**	**Annual Quantity, Qa (afy)**	**Instantaneous Quantity, Qi (gpm)**
DS IR	2	161	155
FS	2	1440	900
MU	2	566	370
CI DM	1	18	158
IR	1	43	100
IR ST	1	779	1500
RW	1	6.14	100

NOTES:

(1) The detailed summary by Purpose of Use only includes data pertaining only to water right permits and certificates, as listed in the Department of Ecology Water Rights Application Tracking System (WRATS) database (February 4, 2004). Quantities of water associated with claims and water right applications are not included in this table. There is no feasible means of evaluating the validity, or documenting the amount of, water associated with claims. There are no annual or instantaneous quantities associated with water right applications, because they are not appropriated rights, since they have not been approved.

- ***CI**--Commercial and Industrial Manufacturing*
- ***DM**--Domestic Multiple*
- ***DS**--Domestic Single (one dwelling with lawn and garden, up to one-half acre)*
- **FS**--Fish Propagation
- ***IR**--Irrigation*
- ***MU**--Domestic Municipal*
- ***RW**--Railway (use of water to serve railway equipment and facilities)*
- ***ST**--Stock Watering*

6.5 Water Quality

Various degrees of water quality impairment can restrict the beneficial uses of surface and ground water for the purposes of recreational, drinking, industrial, and agricultural uses, as well as for fish habitat. This section includes a discussion of surface water quality in the Tucannon River Implementation Area. Water quality parameters and regulations are discussed in Sections 3.5.1 and 3.5.2 respectively. Ground water quality is discussed basin-wide in the ground water section (Section 7.6) since it is impractical to describe ground water strictly within the boundaries of individual subbasins.

6.5.1 Surface Water Quality Criteria and 303(d) List

The State of Washington recently adopted revised surface water quality standards on June 25, 2003. However, the changes must be reviewed and adopted by EPA and other federal agencies

before they go into effect. Key changes applicable to the study area include a focus on pollution prevention, targeting (1) temperature requirements, (2) new criteria for ammonia, and (3) classifying fresh waters by actual use rather than by class. While these revisions do not change the general process to achieve water quality standards, the mechanics of that process and the goals for specific water bodies will change.

Under the revised water quality standards for Washington, surface waters of the state are assigned to be protected for certain designated uses and the water quality criteria associated with them, as described in WAC 173-201A-200. Use designation for waters of the state are described in WAC 173-201A-600. The designated uses and water quality standard assigned to waterbodies in the Tucannon Implementation Area are described in Table 6.5-1.

The 1998 and 2002 303(d) listed streams and impaired waters within the Tucannon Implementation Area are summarized in Table 6.5-2 and are illustrated in Exhibit 6.5-1 and 6.5-2, respectively. Elevated stream temperature is the primary water quality concern in the Implementation Area, thought to be due to lack of riparian vegetation (Kuttel 2001). The 303(d) lists are developed based on monitoring data collected by Ecology as well as information and data submitted to Ecology by other entities. All data is checked for accuracy and compliance with established QA/QC procedures prior to establishing the listings.

Table 6.5-1
Water Quality Standards for waterbodies: Tucannon Implementation Area

Waterbody	Designated Uses	Water Quality Standards[5]	
All waters including tributaries of the following that are not in or above the Umatilla National Forest: ▪ Cummings Creek ▪ Tumalum Creek: above the junction of Tumalum Creek and unnamed tributary at longitude –117.6488 and latitude 46.3594 All waters including tributaries above the junction of Willow Creek and the unnamed tributary at longitude –117.8314 and latitude 46.4182. Tucannon River's unnamed tributaries at above longitude –117.7756, latitude 46.3877 and longitude –117.7449, latitude 46.3769	▪ Char ▪ Primary Contact Recreation ▪ Domestic, Industrial, Agricultural and Stock water supply ▪ Wildlife habitat, harvesting, commerce/ navigation, boating and aesthetics	**Temperature**, 7-day average of daily max.	12°C (53.6°)
		Dissolved Oxygen, 1-day min.	9.5 mg/L
		Turbidity[1] Background Turbidity ≤ 50 NTU: Background Turbidity > 50 NTU:	 < 5 NTU over background < 10% increase
		Total Dissolved Gas[2]	< 110% saturation
		pH[3]	6.5 – 8.5, variation of < 0.2
		Fecal coliform[4]	< 100 colonies/100mL
All waters including tributaries of the following that are in the Umatilla National Forest: ▪ Cummings Creek ▪ Tumalum Creek: Above the junction of Tumalum Creek and unnamed tributary at longitude –117.6488 and latitude 46.3594 Panjab Creek and all tributaries Grub Canyon and all tributaries Hixon Canyon and all tributaries Little Tucannon River and all tributaries	▪ Char ▪ Extraordinary Primary Contact Recreation ▪ Domestic, Industrial, Agricultural and Stock water supply ▪ Wildlife habitat, harvesting, commerce/ navigation, boating and aesthetics	**Temperature**, 7-day average of daily max.	12°C (53.6°)
		Dissolved Oxygen, 1-day min.	9.5 mg/L
		Turbidity[1] Background Turbidity ≤ 50 NTU: Background Turbidity > 50 NTU:	 < 5 NTU over background < 10% increase
		Total Dissolved Gas[2]	< 110% saturation
		pH[3]	6.5 – 8.5, variation of < 0.2
		Fecal coliform[4]	< 50 colonies/100mL

Source: WAC 173-201A.

Table 6.5-1 continued Water Quality Standards for waterbodies: Tucannon Implementation Area			
Waterbody	**Designated Uses**	**Water Quality Standards[5]**	
• Tucannon River Mainstem • From headwaters to Panjab Creek	▪ Char ▪ Extraordinary Primary Contact Recreation ▪ Domestic, Industrial, Agricultural and Stock water supply ▪ Wildlife habitat, harvesting, commerce/ navigation, boating and aesthetics	**Temperature**, 7-day average of daily max.	12°C (53.6°)
		Dissolved Oxygen, 1-day min.	9.5 mg/L
		Turbidity[1] Background Turbidity ≤ 50 NTU: Background Turbidity > 50 NTU:	 < 5 NTU over background < 10% increase
		Total Dissolved Gas[2]	< 110% saturation
		pH[3]	6.5 – 8.5, variation of < 0.2
		Fecal coliform[4]	< 50 colonies/100mL
• Tucannon River Mainstem • from Panjab Creek to Umatilla National Forest boundary (RM 38.1)	▪ Salmon and trout spawning, core rearing, and migration ▪ Extraordinary Primary Contact Recreation ▪ Domestic, Industrial, Agricultural and Stock water supply ▪ Wildlife habitat, harvesting, commerce/ navigation, boating and aesthetics	**Temperature**, 7-day average of daily max.	16°C (60.8°F)
		Dissolved Oxygen, 1-day min.	9.5 mg/L
		Turbidity[1] Background Turbidity ≤ 50 NTU: Background Turbidity > 50 NTU:	 < 5 NTU over background < 10% increase
		Total Dissolved Gas[2]	< 110% saturation
		pH[3]	6.5 – 8.5, variation of < 0.2
		Fecal coliform[4]	< 50 colonies/100mL

Source: WAC 173-201A.

Table 6.5-1 continued
Water Quality Standards for waterbodies: Tucannon Implementation Area

Waterbody	Designated Uses	Water Quality Standards[5]	
• Tucannon River Mainstem All waters including tributaries, unless otherwise listed in this table, not in or above the Umatilla National Forest. •	▪ Salmon and trout spawning, non-core rearing, and migration ▪ Primary Contact Recreation ▪ Domestic, Industrial, Agricultural and Stock water supply ▪ Wildlife habitat, harvesting, commerce/ navigation, boating and aesthetics	**Temperature**, 7-day average of daily max.	17.5°C (63.5°F)
		Dissolved Oxygen, 1-day min.	8.0 mg/L
		Turbidity[1] Background Turbidity ≤ 50 NTU: Background Turbidity > 50 NTU:	 < 5 NTU over background < 10% increase
		Total Dissolved Gas[2]	< 110% saturation
		pH[3]	6.5 – 8.5, variation of < 0.5
		Fecal coliform[4]	< 100 colonies/100mL

Source: WAC 173-201A.

Notes:

[1] *Turbidity is measured in Nephelometric Turbidity Units (NTU). Ecology may allow modification of the turbidity criteria to allow a temporary area of mixing during and immediately after necessary in-water construction activities.*

[2] *Total dissolved gas criteria does not apply when the stream flow exceeds the 7-day, 10-year frequency flood.*

[3] *pH variation is for human caused variations within the given range.*

[4] *Not more than 10% of all samples obtained for calculating the geometric mean value may exceed the fecal coliform organism levels shown in the table.*

[5] *Toxic, radioactive, or deleterious material concentrations, and aesthetic values are not shown in this table. Toxic, radioactive, or deleterious material concentrations shall be below the potential to adversely affect characteristic water uses, cause acute or chronic conditions to the most sensitive biota dependent upon those waters, or adversely affect public health as determined by Ecology; and 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.*

Table 6.5-2
303(d) Listed and Impaired Stream Segments: Tucannon Implementation Area[1]

Segment Description [Stream ID; Listing ID(s)]	Parameter(s) Exceeding Standards	1998 List (#)	2002 List[2]		Comments
			4	5	
Tucannon River near Panjab Creek confluence [KL66VJ; 21222]	Fish Habitat		X		based on Kuttel 2002, factors limiting salmon uses: pools
Tucannon River between Little Tucannon River confluence and Cummings Creek confluence [KL66VJ; 13984, 13983, 13982]	Temperature			X	based on WDFW unpublished data
Tucannon River downstream of Cummings Creek confluence [KL66VJ; 13864]	Temperature			X	based on WDFW unpublished data
Tucannon River downstream of Tumalum Creek confluence [KL66VJ; 13859, 13857]	Temperature			X	based on WDFW unpublished data
Tucannon River near Marengo bridge [KL66VJ; 13856, 21223]	Temperature			X	based on WDFW unpublished data and Ecology data
	Fish Habitat		X		based on Kuttel 2002, factors limiting salmon uses: riparian, streambank condition, pools
Tucannon River [KL66VJ; 13855, 13853]	Temperature			X	based on WDFW unpublished data
Tucannon River near confluence with Willow Creek [KL66VJ; 13850, 21224]	Temperature			X	based on WDFW unpublished data
	Fish Habitat		X		based on Kuttel 2002, factors limiting salmon uses: riparian, streambank condition, floodplain connectivity
Tucannon River near confluence with Smith Hollow [KL66VJ; 13849]	Temperature			X	based on WDFW unpublished data
Tucannon River upstream of confluence with Snake River [KL66VJ; 15918, 16800, 3725]	Turbidity			X	based on Ecology data
	Fecal Coliform			X	
	Temperature	X		X	
Tucannon River [KL66VJ; 16934, 11144]	pH			X	based on USACE unpublished data and Ecology data
Tucannon River near mouth [KL66VJ; 13848, 21225]	Temperature			X	based on WDFW unpublished data
	Fish Habitat		X		based on Kuttel 2002, factors limiting salmon uses: riparian, streambank condition, floodplain connectivity

[1] *Source: Ecology 2004b.*
[2] *The 2002/2004 Categories 4 and 5 are shown in the table.*

Table 6.5-2 continued
303(d) Listed and Impaired Stream Segments: Tucannon Implementation Area[1]

Segment Description [Stream ID; Listing ID(s)]	Parameter(s) Exceeding Standards	1998 List (#)	2002 List[2]		Comments
			4	5	
Tucannon River Hatchery Intake [EJ00TL; 13865]	Temperature			X	based on WDFW unpublished data
Cummings Creek at confluence with Tucannon River [BG41HE; 22432]	Temperature			X	based on Umatilla National Forest unpublished data

[1] *Source: Ecology 2004b.*
[2] *The 2002/2004 Categories 4 and 5 are shown in the table.*

6.5.2 Existing Surface Water Quality Monitoring

Water quality monitoring stations in the Tucannon Implementation area have been present since the mid 1960's. Historical water quality data in the Implementation Area is available from federal and state agencies such as the EPA STORET database, Ecology, USGS, and U.S. Forest Service (USFS) and illustrated in Exhibit 6.5-3.

Ecology has operated five basin and one long-term (Ecology 35B060) water quality monitoring stations in the Implementation Area as part of their long-term Ambient Water Quality Monitoring Program. Long-term stations are monitored every water year (October 1 through September 30 the following year), whereas basin stations generally monitors for one water year and sometimes returning again every five years. Grab samples are usually taken once or twice a month. Water quality parameters typically measured include: dissolved oxygen, pH, temperature, total suspended solids, turbidity, fecal coliform bacteria, soluble reactive phosphorus, total phosphorus, ammonia, nitrate plus nitrite, and total nitrogen. Numeric water quality standards associated with each of these parameters are presented in detail in WAC 173-201A. The Pomeroy Ranger District of the Umatilla National Forest, USFS, has also been monitoring water quality within the area in recent years as part of the requirements under the National Forest Management Act. Station locations and years of record for Ecology, USGS and USFS monitoring stations in the Tucannon Implementation Area are listed in Table 6.5-3.

In addition, the Washington State University (WSU), in conjunction with the Columbia Conservation district (CCD), has been monitoring water quality in the Tucannon River at nine locations (Table 6.5-4) to determine the effectiveness of agricultural conservation practices and have prepared the "Tucannon River Water Quality Monitoring Report April 1999-March 2001 (CEEd 2001).

WDFW and the CCD have also collected limited water quality data at numerous locations along the Tucannon River (Table 6.5-5) in order to assess fisheries and their habitats. These have been documented in the progress reports for the Tucannon River Instream Habitat Alteration Projects (Bumgarner 2001, 2002a and 2002b).

The stations with the most recent information in the Tucannon River include Ecology 35B060, USFS 14030001, USFS 14030003, USFS 14030005, USFS 14030009, USFS 14030014, USFS 14030015, USFS 14030017, the WSU stations and the WDFW/CCD stations. Ecology 35B060 is a long-term station with monthly grab samples over the last 10 water years. The USFS, WSU, and WDFW/CCD stations have monitored various water quality parameters at various times from 1999 through 2003.

Table 6.5-3
Historical Water Quality Monitoring Stations: Tucannon Implementation Area[1]

Agency	Station Number	Description	Years of Record for Water Quality Data
Ecology	35B060	**Tucannon River at Powers**	1974; 1978-1992; 1995-current
	35B090	Tucannon River at Smith Hollow	2003 (3 days)
	35B100	Tucannon River at Territorial Rd.	2003 (3 days)
	35B110	Tucannon River near Delaney	1959-1960
	35B120	Tucannon River at Brines Rd.	2003 (3 days)
	35B150	**Tucannon River near Marengo**	1997
USGS	13344500	Tucannon River near Starbuck	1964-1970
	13344520	Tucannon River at Powers	1973-1980
USFS 113FORS6 (Umatilla National Forest)	**14030001**	**Panjab Creek above Panjab Campground**	1970-1975; 1980; 2003
	14030002	Tucannon River above Panjab Creek Confluence	1971-1978
	14030003	**Tucannon River at Panjab Bridge, FR-47**	1970-1978; 1980; 1999-2001; 2003
	14030004	Tucannon River downstream of Big Four Canyon Confluence	1970-1978; 1980
	14030005	**Tucannon River at Forest Serivce Boundary**	1970-1978; 1980-1998; 1999-2002
	14030006	Tucannon River at Marengo Bridge	1972-1978; 1980
	14030009	**Little Tucannon River at Mouth**	1973-1978; 1980; 2003
	14030010	Little Tucannon River at FR N-902	1973; 1976; 1980 (3 days)
	14030011	Little Tucannon River at Headwaters	1973 (1 day)
	14030012	Cummings Creek at Highway 12	1973-1978
	14030013	Tucannon River at Highway 12	1974; 1980 (3 days)
	14030014	**Tucannon River above Sheep Creek**	1980; 1983-1995; 2003
	14030015	**Meadow Creek**	1971; 1974; 1976-1977; 1980; 2003
	14030017	**Cummings Creek**	1978-1995; 2003

[1] Sources: Ecology 2004a; EPA STORET 2004; Umatilla National Forest 2002; and unpublished data Umatilla National Forest 2004.

Table 6.5-4
WSU Water Quality Monitoring Stations: Tucannon Implementation Area[1]

Agency	Station Number	Description	Years of Record for Water Quality Data
WSU	**Tucannon 1**	Tucannon River at SR-261 Bridge near Starbuck	1999-2001
	Tucannon 2	Tucannon River downstream of Pataha Creek Confluence	1999-2001
	Tucannon 3	Tucannon River at Territorial Bridge	1999-2001
	Tucannon 4	Tucannon River at Marengo Bridge	1999-2001
	Tucannon 5	Tucannon River at Bridge 14	1999-2001
	Tucannon 6	Tucannon River at Cummings Creek Bridge	1999-2001
	Tucannon 7	Tucannon River at Hatchery Bridge	1999-2001
	Tucannon 8	Tucannon River at Camp Wooten Bridge	1999-2001
	Tucannon 9	Tucannon River at Panjab Creek Bridge	1999-2001

[1] Sources: CEEd 2001.

Table 6.5-5
WDFW/CCD Water Quality Monitoring Stations: Tucannon Implementation Area[1]

Agency	Location Description	Years of Record for Water Quality Data
WDFW	Tucannon River below Big 4 Lake	2000-2002
	Tucannon River at Cummings Creek Bridge	2000-2002
	Tucannon River at Bridge 14	2000-2002
	Tucannon River at Marengo Bridge	2000-2002
	Tucannon River at Enrich Bridge	2000; 2002
	Tucannon River at Territorial Bridge	2002
	Tucannon River at Ducharme Property	2002
	Tucannon River at Smith Hollow Bridge	2000; 2002
	Tucannon River at SR-261 Bridge	2000-2002
Columbia Conservation District	Tucannon River at Lady Bug Flat Campground	2000-2002
	Tucannon River above Panjab Creek Confluence	2000-2002
	Tucannon River below Little Tucannon River	2000-2002
	Tucannon River at Camp Wooten	2000-2002
	Tucannon River at Beaver/Watson Lake Intake	2000
	Tucannon River above Beaver/Watson Lake Intake	2000
	Tucannon River at Forest Service Sign	2000-2002
	Tucannon River at Tucannon Hatchery Intake	2000-2002
	Tucannon River above Rainbow Lake Outlet	2000
	Tucannon River below Rainbow Lake Outlet	2000
	Tucannon River at Bridge 12	2000-2002
	Tucannon River at Bridge 10	2000-2002
	Tucannon River at King Grade Bridge	2000-2002
	Tucannon River at Highway 12 Bridge	2000-2002

[1] Sources: Bumgarner 2001, 2002a and 2002b.

6.5.3 Areas of Impacted Water Quality

The following is a discussion of the specific water quality parameters that impact each of the streams in this Implementation Area.

Tucannon River Mainstem

The primary concerns in the Tucannon River are elevated stream temperature along the entire length and excessive fecal coliform concentrations near the mouth, as can be seen from the water quality monitoring data and the 303(d) lists. In addition, total suspended solids concentrations, turbidity, and high pH levels are also of concern as potential limiting factors to salmonid rearing in the lower portions the Tucannon River near the mouth.

- **Tucannon River from Headwaters to Panjab Creek Confluence:** Water quality information for this reach was collected by USFS 14030014 above the Sheep Creek confluence, and by WDFW/CCD at the Lady Bug Campground. USFS monitored temperature, turbidity and total suspended solids concentration between 1980 and 1995, and daily temperatures in the summer of 2003. The WDFW/CCD monitored daily temperatures for the summers of 2000, 2001 and 2002. There was no water quality data available on fecal coliform bacteria concentrations, pH, dissolved oxygen concentrations, turbidity or nutrients for this stream reach. Table 6.5-6 summarizes the current water quality conditions in this reach.

  Temperature: Umatilla National Forest and WDFW/CCD have recorded water temperatures in this reach. Exhibits 6.5-4 and 6.5-5 show the mean, minimum, and maximum water temperatures recorded by CCD in 2001 and 2002; and Exhibit 6.5-6 shows the mean, minimum, and maximum water temperatures recorded by USFS 14030014 in 2003. Although this reach of the Tucannon River is not listed on the 303(d) list, the maximum designated use temperature standard of 12°C (53.6°F) for char spawning and rearing was exceeded every summer of 2001, 2002 and 2003, mostly in July and August. The 7-day mean of daily maximum values recorded in 2003 by USFS range from 46ºF to 58ºF (7.8ºC to 14.4ºC). The data collected at all stations were consistent.

  Turbidity: USFS 14030014 monitored turbidity from 1980 to 1995; however, data was recorded in Jackson Candle Units (JTU).

  Suspended Solids: Umatilla National Forest recorded total suspended solids concentration in this reach from 1983 to 1995. Exhibit 6.5-7 shows the mean monthly total suspended solids concentrations recorded at USFS 14030014. The mean monthly total suspended solids concentration recorded were well below the USFS recommended standard of 80mg/L. Only 5 out of 3,499 samples exceeded the recommended standard for total suspended solids concentration.

Insert Table 6.5-6

- **Tucannon River from Panjab Creek Confluence to Little Tucannon River Confluence:** Water quality information for this reach was collected by USFS 14030003, WSU Tucannon 9, and WDFW/CCD, all located at Panjab Creek bridge. USFS monitored temperature between 1970 and 1994, and in the summer of 2003l; fecal coliform bacteria concentration, pH levels, dissolved oxygen concentration were monitored for various periods between 1970 and 1980; and turbidity and total suspended solids concentrations were monitored daily between 1999 and 2001. WSU Tucannon 9 monitored temperature, fecal coliform bacteria and total suspended solids concentrations, and nutrients between 1999 and 2001. The WDFW/CCD monitored daily temperatures for the summers of 2000, 2001 and 2002. Table 6.5-7 summarizes the current water quality conditions in this reach.

  Temperature: Umatilla National Forest, WDFW/CCD, and WSU have recorded water temperatures in this reach. Exhibits 6.5-8 and .5-9 show the mean, minimum, and maximum water temperatures recorded by CCD in 2001 and 2002; and Exhibit 6.5-10 shows the mean, minimum, and maximum water temperatures recorded by USFS 14030003 in 2002 and 2003. Exhibit 6.5-11 shows the mean monthly temperatures recorded by WSU in comparison to USFS 14030003 for the period of record. The data collected at all stations were consistent. The 7-day mean of daily maximum values recorded in 2003 by USFS range from 37ºF to 60ºF (2.8ºC to 15.6ºC). The maximum designated use temperature standard of 16°C (60.8°F) for salmon and trout rearing, core rearing and migration was not exceeded in 2001, 2002 or 2003.

  Fecal Coliform Bacteria: WSU Tucannon 9 monitored fecal coliform concentrations from 1999 to 2001. Exhibit 6.5-12 shows that the mean monthly fecal coliform concentrations recorded by WSU Tucannon 9. The recorded mean fecal coliform concentrations ranged from 0 to 11 colonies/100mL, which is well below the the designated use criteria for extraordinary primary contact recreation of 50 colonies/100mL for fecal coliform concentrations.

  pH: pH concentrations were infrequently recorded by USFS 14030003 between 1970 and 1980. During the period of record, the pH concentrations ranged from 6.5 to 9.1, with 5 out of 29 samples exceeding the maximum limit of 8.5. All samples had pH levels greater than 6.5.

  Dissolved Oxygen: Dissolved oxygen concentrations were infrequently recorded by USFS 14030003 between 1970 and 1980. The dissolved oxygen concentration recorded during the period of record ranged from 9 mg/L to 13 mg/L. 7 out of 25 of the samples collected were below the minimum 9.5 mg/L standard for char.

  Turbidity: USFS 14030003 monitored turbidity from 1970 to 2001. However, from 1970 to 1989, data was recorded in Jackson Candle Units (JTU). Only in 1999 did USFS begin recording turbidity in Nephelometric Turbidity Units (NTU). Exhibit 6.5-13 shows that the mean monthly turbidity recorded by USFS from 1999 to 2001 generally ranged from 1 NTU to 15 NTU, with the exception of a peak turbidity of 101 NTU that was recorded on September 30, 2000.

Insert Table 6.5-7

Suspended Solids: Umatilla National Forest and WSU have recorded total suspended solids concentration in this reach. Exhibit 6.5-14 shows the mean monthly total suspended solids concentrations recorded at these two stations. The mean monthly total suspended solids concentration recorded were well below the USFS recommended standard of 80mg/L.

Nutrients: WSU Tucannon 9 collected some data on ammonia, nitrate, total Kjeldahl nitrogen (TKN) and total phosphorous from 1999 to early 2001. During the period of record, ammonia concentrations ranged from 0.06 mg/L to 0.75 mg/L, with a mean concentration of 0.25 mg/L. Nitrate concentrations ranged from 0.01 mg/L to 0.01 mg/L, with a mean concentration of 0.05 mg/L, and TKN concentrations ranged from 0.14 mg/L to 0.94 mg/L, with a mean concentration of 0.41 mg/L. The total phosphorous concentration recorded ranged from 0.03 mg/L to 0.17 mg/L, with a mean of 0.06 mg/L, which is within the USFWS recommended range of 0.01 mg/L to 0.3 mg/L for trout.

- **Tucannon River from Little Tucannon Confluence to Forest Service Boundary:** Table 6.5-8 summarizes the current water quality conditions in this reach.

  Temperature: Umatilla National Forest, WDFW/CCD, and WSU have recorded water temperatures in this reach. However, the most recent data is available through WDFW/CCD and WSU; Umatilla National Forest data is prior to 1994. Exhibits 6.5-15 through 6.5-18 show the mean, minimum, and maximum water temperatures recorded by WDFW/CCD in 2001 and 2002; and Exhibit 6.5-19 shows the mean, minimum, and maximum water temperatures recorded by WSU Tucannon 9 from 1999 to 2001. The data collected at all stations were generally consistent. The maximum designated use temperature standard of 16°C (60.8°F) for salmon and trout rearing, core rearing and migration was exceeded in the summers of 2001 and 2002. These have resulted in the placement of this reach on the 2002 303(d) list for temperature (see Table 6.5-2).

  Fecal Coliform Bacteria: Fecal coliform concentrations was monitored by WSU Tucannon 8 from 1999 to 2001. Exhibit 6.5-20 shows that the mean monthly fecal coliform concentrations recorded by WSU Tucannon 9. The mean fecal coliform concentrations recorded range from 0 colonies/100mL to 5 colonies/100mL, which is well below the the designated use criteria for extraordinary primary contact recreation of 50 colonies/100mL for fecal coliform concentrations.

  pH: pH concentrations were recorded by USFS 14030005 between 1970 and 1980. During the period of record, the pH concentrations ranged from 6.6 to 9.1, with 3 out of 27 samples exceeding the maximum limit of 8.5. All samples had pH levels greater than 6.5.

  Dissolved Oxygen: Dissolved oxygen concentrations were recorded by USFS 14030005 between 1970 and 1980. The dissolved oxygen concentration recorded during the period of record ranged from 0 mg/L to 13 mg/L. 9 out of 24 of the samples collected were below the minimum 9.5 mg/L standard for char.

Insert Table 6.5-8

Turbidity: USFS 14030005 monitored turbidity from 1970 to 2002; however from 1970 to 1989, data was recorded in Jackson Candle Units (JTU). Only in 1999 did USFS begin recording turbidity in Nephelometric Turbidity Units (NTU). Exhibit 6.5-21 shows that the mean monthly turbidity recorded by USFS from 1999 to 2001 ranged from 1 NTU to 7.2 NTU.

Suspended Solids: Umatilla National Forest and WSU have recorded total suspended solids concentration in this reach. Exhibit 6.5-22 shows the mean monthly total suspended solids concentrations recorded at these two stations. The mean monthly total suspended solids concentration recorded were well below the USFS recommended standard of 80mg/L.

Nutrients: WSU Tucannon 8 collected some data on ammonia, nitrate, total Kjeldahl nitrogen (TKN) and total phosphorous from 1999 to early 2001. During the period of record, ammonia concentrations ranged from 0.03 mg/L to 0.36 mg/L, with a mean concentration of 0.17 mg/L. Nitrate concentrations ranged from 0.02 mg/L to 0.09 mg/L, with a mean concentration of 0.04 mg/L, and TKN concentrations ranged from 0.10 mg/L to 1.84 mg/L, with a mean concentration of 0.68 mg/L. The total phosphorous concentration recorded ranged from 0 to 0.11 mg/L, with a mean of 0.05 mg/L. Only 1 out of 13 samples was outside the USFWS recommended range of 0.01 mg/L to 0.3 mg/L for trout.

- **Tucannon River from Forest Service Boundary to Cummings Creek Confluence:** There was no water quality data available on pH, dissolved oxygen concentrations or turbidity for this stream reach. Table 6.5-9 summarizes the current water quality conditions in this reach.

  Temperature: WDFW/CCD and WSU have recorded water temperatures in this reach. Exhibits 6.5-23 through 6.5-26 show the mean, minimum, and maximum water temperatures recorded by WDFW/CCD in 2001 and 2002; and Exhibit 6.5-27 shows the mean, minimum, and maximum water temperatures recorded by WSU Tucannon 7 from 1999 to 2001. The data collected at all stations were generally consistent. The maximum designated use temperature standard of 17.5°C (63.5°F) for salmon and trout rearing, non-core rearing and migration was exceeded in the summers of 2001 and 2002. These have resulted in the placement of this reach on the 2002 303(d) list for temperature (see Table 6.5-2).

  Fecal Coliform Bacteria: Fecal coliform concentrations was monitored by WSU Tucannon 8 from 1999 to 2001. Exhibit 6.5-28 shows that the mean monthly fecal coliform concentrations recorded by WSU Tucannon 7. The mean fecal coliform concentrations recorded range from 0 colonies/100mL to 57 colonies/100mL, which is well below the the designated use criteria for primary contact recreation of 100 colonies/100mL for fecal coliform concentrations.

Insert Table 6.5-9

Suspended Solids: Total suspended solids concentration was monitored by WSU Tucannon 7 from 1999 to 2001. Exhibit 6.5-29 shows the mean monthly total suspended solids concentrations recorded by WSU Tucannon 7. The mean monthly total suspended solids concentration recorded were well below the USFS recommended standard of 80mg/L.

Nutrients: WSU Tucannon 7 collected some data on ammonia, nitrate, total Kjeldahl nitrogen (TKN) and total phosphorous from 1999 to early 2001. During the period of record, ammonia concentrations ranged from 0.08 mg/L to 0.58 mg/L, with a mean concentration of 0.26 mg/L. Nitrate concentrations ranged from 0.01 mg/L to 1.66 mg/L, with a mean concentration of 0.16 mg/L, and TKN concentrations ranged from 0 mg/L to 1.27 mg/L, with a mean concentration of 0.60 mg/L. The total phosphorous concentration recorded ranged from 0 mg/L to 0.13 mg/L, with a mean of 0.06 mg/L. Only 1 out of 13 samples was outside the USFWS recommended range of 0.01 mg/L to 0.3 mg/L for trout.

- **Tucannon River from Cummings Creek Confluence to Marengo:** There was no water quality data available on pH, dissolved oxygen concentrations or turbidity for this stream reach. Table 6.5-10 summarizes the current water quality conditions in this reach.

  Temperature: WDFW/CCD and WSU have recorded water temperatures in this reach. Exhibits 6.5-30 through 6.5-37 show the mean, minimum, and maximum water temperatures recorded by WDFW/CCD in 2001 and 2002; and Exhibit 6.5-38 shows the mean monthly water temperatures recorded by WSU Tucannon 5 and Tucannon 6 from 1999 to 2001. The data collected at all stations were generally consistent. The maximum designated use temperature standard of 17.5°C (63.5°F) for salmon and trout rearing, non-core rearing and migration was exceeded in the summers of 2001 and 2002. These have resulted in the placement of this reach on the 2002 303(d) list for temperature (see Table 6.5-2).

  Fecal Coliform Bacteria: Fecal coliform concentrations was monitored by WSU Tucannon 5 and Tucannon 6 from 1999 to 2001. Exhibit 6.5-39 shows that the mean monthly fecal coliform concentrations recorded by both WSU stations. The mean fecal coliform concentrations for the period of record ranged from 1 colonies/100mL to 24 colonies/100mL at WSU Tucannon 6, located at Cummings Creek Bridge. At WSU Tucannon 5, located downstream of Tumalum Creek confluence, the fecal coliform concentrations for the period of record ranged from 0 to 104 colonies/100mL. None of the samples at WSU Tucannon 6, and only 1 out of 13 samples at WSU Tucannon 5 exceeded the designated use criteria for primary contact recreation of 100 colonies/100mL for fecal coliform concentrations.

Insert Table 6.5-10

Suspended Solids: Total suspended solids concentration was monitored by WSU Tucannon 5 and 6 from 1999 to 2001. Exhibit 6.5-40 shows the mean monthly total suspended solids concentrations recorded by both WSU stations. The mean monthly total suspended solids concentration recorded were well below the USFS recommended standard of 80mg/L.

Nutrients: WSU Tucannon 5 and Tucannon 6 collected some data on ammonia, nitrate, total Kjeldahl nitrogen (TKN) and total phosphorous from 1999 to early 2001. At Cummings Creek Bridge (WSU Tucannon 6), ammonia concentrations ranged from 0.06 mg/L to 0.39 mg/L, with a mean concentration of 0.20 mg/L between 1999 and 2001. Nitrate concentrations ranged from 0.02 mg/L to 1.21 mg/L, with a mean concentration of 0.13 mg/L, and TKN concentrations ranged from 0 mg/L to 1.78 mg/L, with a mean concentration of 0.68 mg/L. The total phosphorous concentration recorded ranged from 0 mg/L to 0.13 mg/L, with a mean of 0.06 mg/L.

Downstream of Tumalum Creek confluence (WSU Tucannon 5), ammonia concentrations ranged from 0.06 mg/L to 0.63 mg/L, with a mean of 0.23 mg/L. Nitrate concentrations ranged from 0.02 mg/L to 0.80 mg/L, with a mean concentration of 0.10 mg/L, and TKN concentrations ranged from 0.1 mg/L to 0.83 mg/L, with a mean concentration of 0.49 mg/L. The total phosphorous concentration recorded ranged from 0.01 mg/L to 0.12 mg/L, with a mean of 0.06 mg/L.

- **Tucannon River from Marengo to Willow Creek Confluence:** Table 6.5-11 summarizes the current water quality conditions in this reach.

  Temperature: WDFW/CCD, WSU and Ecology have recorded water temperatures in this reach. Exhibits 6.5-41 through 6.5-45 show the mean, minimum, and maximum water temperatures recorded by WDFW/CCD in 2001 and 2002; and Exhibit 6.5-46 shows the mean monthly water temperatures recorded by WSU Tucannon 4 from 1999 to 2001 and by Ecology 35B150 for the 1997 water year. The data collected at all stations were generally consistent. The maximum designated use temperature standard of 17.5°C (63.5°F) for salmon and trout rearing, non-core rearing and migration was exceeded in the summers of 2001 and 2002. These have resulted in the placement of this reach on the 2002 303(d) list for temperature (see Table 6.5-2).

  Fecal Coliform Bacteria: Fecal coliform concentrations was monitored by WSU Tucannon 4 from 1999 to 2001 and by Ecology 35B150 for the 1997 water year. Exhibit 6.5-47 shows the mean monthly fecal coliform concentrations recorded by WSU and Ecology. The mean fecal coliform concentrations recorded by Ecology 35B150 ranged from 4 colonies/100mL to 100 colonies/100mL in 1997, while at WSU Tucannon 4 concentrations ranged from 0 to 208 colonies/100mL. None of the samples at Ecology 35B150 and only 2 out of 51 samples at WSU Tucannon 4 exceeded the designated use criteria for primary contact recreation of 100 colonies/100mL for fecal coliform concentrations.

Insert Table 6.5-11

pH: pH concentrations were recorded by Ecology 35B150 for the 1997 water year (Exhibit 6.5-48). During the period of record, the pH concentrations ranged from 7.1 to 8.7, with 3 out of 12 samples exceeding the maximum limit of 8.5. All samples had pH levels greater than 6.5.

Dissolved Oxygen: Dissolved oxygen concentrations were recorded by Ecology 35B150 for the 1997 water year (Exhibit 6.5-49). The dissolved oxygen concentration recorded during the period of record ranged from 8.3 mg/L to 12.6 mg/L. All samples collected were above the minimum 8.0 mg/L standard for salmon and trout spawning, non-core rearing and migration.

Turbidity: Ecology 35B150 monitored turbidity for the 1997 water year. Exhibit 6.5-50 shows that the mean monthly turbidity ranged from 1.3 NTU to 85 NTU.

Suspended Solids: WSU Tucannon 4 and Ecology 35B150 have recorded total suspended solids concentration in this reach. Exhibit 6.5-51 shows the mean monthly total suspended solids concentrations recorded at these two stations. All mean monthly total suspended solids concentration recorded were below the USFS recommended standard of 80mg/L, except for a high record of 175mg/L in Febrauary 1997.

Nutrients: WSU Tucannon 4 collected some data on ammonia, nitrate, total Kjeldahl nitrogen (TKN) and total phosphorous from 1999 to early 2001, and Ecology 35B150 monitored ammonia and total phosporous for the 1997 water year. Ammonia concentrations recorded by Ecology in the 1997 water year ranged from 0.01 mg/L to 0.019 mg/L, with a mean concentration of 0.011 mg/L, and records by WSU from 1999 to 2001 ranged from 0.1 mg/L to 0.44 mg/L, with a mean of 0.26 mg/L. Nitrate concentrations recorded by WSU ranged from 0.01 mg/L to 0.80 mg/L, with a mean concentration of 0.12 mg/L, and TKN concentrations ranged from 0.11 mg/L to 1.22 mg/L, with a mean concentration of 0.68 mg/L. The total phosphorous concentration recorded by Ecology in the 1997 water year ranged from 0.05 mg/L to 0.42 mg/L, with a mean of 0.13 mg/L, and records by WSU ranged from 0.01 mg/L to 0.22 mg/L, with a mean of 0.07 mg/L. 1 out of 12 samples collected by Ecology was outside the USFWS recommended range of 0.01 mg/L to 0.3 mg/L for trout, whereas none of the samples collected by WSU was outside the recommended range.

- **Tucannon River from Willow Creek Confluence to Pataha Creek Confluence:** There was no water quality data available on dissolved oxygen concentrations and very little data on pH concentrations or turbidity for this stream reach. Table 6.5-12 summarizes the current water quality conditions in this reach.

Insert Table 6.5-12

Temperature: WDFW/CCD and WSU have recorded water temperatures in this reach. Exhibits 6.5-52 through 6.5-54 show the mean, minimum, and maximum water temperatures recorded by WDFW/CCD in 2001 and 2002; and Exhibit 6.5-55 shows the mean monthly water temperatures recorded by WSU Tucannon 3 from 1999 to 2001. The data collected at all stations were generally consistent. The maximum designated use temperature standard of 17.5°C (63.5°F) for salmon and trout rearing, non-core rearing and migration was exceeded in the summers of 2001 and 2002. These have resulted in the placement of this reach on the 2002 303(d) list for temperature (see Table 6.5-2).

Fecal Coliform Bacteria: Fecal coliform concentrations was monitored by WSU Tucannon 3 from 1999 to 2001. Exhibit 6.5-56 shows that the mean monthly fecal coliform concentrations recorded by WSU exceeded the fecal coliform standard of 100colonies/100mL for primary contact recreation 2 out of 51 samples. The highest fecal coliform concentration was 440colonies/100mL recorded on May 31, 2000.

pH: Ecology 35B100 and Ecology 35B120 recorded very limited data on pH concentrations in 2003. pH concentrations of 7.61 and 7.58 (March 21, 2003), and 7.98 and 7.91 (May 2, 2003) were recorded in Tucannon River at Brines Road (Ecology 35B120) and a little further downstream atTerritorial Road (Ecology 35B100). All four samples were within the acceptable pH range of 6.5 and 8.5.

Turbidity: Ecology 35B100 and Ecology 35B120 recorded very limited data on turbidity in 2003. Turbidity of 8.81 NTU and 11.3 NTU (March 21, 2003), 2.64 NTU and 3.41 NTU (April 9, 2003), and 3.4 NTU and 2.2 NTU (May 2, 2003) were recorded in Tucannon River at Brines Road (Ecology 35B120) and a little further downstream atTerritorial Road (Ecology 35B100).

Suspended Solids: WSU Tucannon 3 recorded total suspended solids concentration in this reach. Exhibit 6.5-57 shows the mean monthly total suspended solids concentrations recorded at WSU Tucannon 3. All total suspended solids concentration recorded were well below the USFS recommended standard of 80mg/L.

Nutrients: WSU Tucannon 3 collected some data on ammonia, nitrate, total Kjeldahl nitrogen (TKN) and total phosphorous from 1999 to early 2001. Ammonia concentrations ranged from 0.10 mg/L to 0.80 mg/L, with a mean concentration of 0.275 mg/L. Nitrate concentrations ranged from 0.01 mg/L to 0.65 mg/L, with a mean concentration of 0.12 mg/L, and TKN concentrations ranged from 0.08 mg/L to 1.56 mg/L, with a mean concentration of 0.88 mg/L. The total phosphorous concentration ranged from 0.031 mg/L to 0.415 mg/L, with a mean of 0.093 mg/L. 1 out of 13 samples collected was outside the USFWS recommended range of 0.01 mg/L to 0.3 mg/L for trout.

- **Tucannon River from Pataha Creek Confluence to Kellogg Creek Confluence:** There was no water quality data available on dissolved oxygen concentrations and very little data on pH concentrations or turbidity for this stream reach. Table 6.5-13 summarizes the current water quality conditions in this reach.

Insert Table 6.5-13

Temperature: WDFW/CCD and WSU have recorded water temperatures in this reach. Exhibits 6.5-58 through 6.5-59 show the mean, minimum, and maximum water temperatures recorded by WDFW/CCD in 2002; and Exhibit 6.5-60 shows the mean monthly water temperatures recorded by WSU Tucannon 2 from 1999 to 2001. The data collected at all stations were generally consistent. The maximum designated use temperature standard of 17.5°C (63.5°F) for salmon and trout rearing, non-core rearing and migration was exceeded in the summer of 2002. This has resulted in the placement of this reach on the 2002 303(d) list for temperature (see Table 6.5-2).

Fecal Coliform Bacteria: Fecal coliform concentrations was monitored by WSU Tucannon 2 from 1999 to 2001. Exhibit 6.5-61 shows that the mean monthly fecal coliform concentrations recorded by WSU exceeded the fecal coliform standard of 100colonies/100mL for primary contact recreation 5 out of 50 samples. The highest fecal coliform concentration was 770colonies/100mL recorded on May 31, 2000.

pH: Ecology 35B090 recorded very limited data on pH concentrations in 2003. pH concentrations of 7.63, and 8.03 were recorded in Tucannon River at Smith Hollow on March 21, 2003 and May 2, 2003. Both samples were within the acceptable pH range of 6.5 and 8.5.

Turbidity: Ecology 35B090 recorded very limited data on turbidity in 2003. Turbidity of 3.4 NTU and 19.2 NTU were recorded in Tucannon River at Smith Hollow on March 21, 2003 and May 2, 2003.

Suspended Solids: WSU Tucannon 2 recorded total suspended solids concentration in this reach. Exhibit 6.5-62 shows the mean monthly total suspended solids concentrations recorded at WSU Tucannon 2. All total suspended solids concentration recorded were well below the USFS recommended standard of 80mg/L.

Nutrients: WSU Tucannon 2 collected some data on ammonia, nitrate, total Kjeldahl nitrogen (TKN) and total phosphorous from 1999 to early 2001. Ammonia concentrations ranged from 0.090 mg/L to 0.443 mg/L, with a mean concentration of 0.255 mg/L. Nitrate concentrations ranged from 0.015 mg/L to 0.57 mg/L, with a mean concentration of 0.136 mg/L, and TKN concentrations ranged from 0.10 mg/L to 2.27 mg/L, with a mean concentration of 0.60 mg/L. The total phosphorous concentration ranged from 0.006 mg/L to 0.464 mg/L, with a mean of 0.095 mg/L. 1 out of 13 samples collected was outside the USFWS recommended range of 0.01 mg/L to 0.3 mg/L for trout.

- **Tucannon River from Kellogg Creek Confluence to Snake River:** Table 6.5-14 summarizes the current water quality conditions in this reach.

Insert Table 6.5-14

Temperature: WDFW/CCD, WSU and Ecology have recorded water temperatures in this reach. The station with the most information is Ecology 35B060, from 1974 to 2002. Exhibits 6.5-63 through 6.5-64 show the mean, minimum, and maximum water temperatures recorded by WDFW/CCD in 2001 and 2002; and Exhibit 6.5-65 shows the mean monthly water temperatures recorded by WSU Tucannon 1 from 1999 to 2001 and by Ecology 35B060 for the period of record. The data collected at all stations were generally consistent. The maximum designated use temperature standard of 17.5°C (63.5°F) for salmon and trout rearing, non-core rearing and migration was exceeded in the summers of 2001 and 2002. These have resulted in the placement of this reach on the 2002 303(d) list for temperature (see Table 6.5-2).

Fecal Coliform Bacteria: Fecal coliform concentrations was monitored by WSU Tucannon 1 from 1999 to 2001 and by Ecology 35B060 from 1974 to 2002. Exhibit 6.5-66shows the mean monthly fecal coliform concentrations recorded by WSU and Ecology. Exhibit 6.5-67 shows the fecal coliform concentrations recorded by Ecology 35B060 for the period of record. The fecal coliform standard of 100colonies/100mL for primary contact recreation was exceeded 23 out of 91 samples between 1995 and 2002 at Ecology 35B060, and 8 out of 50 samples between 1999 and 2001 at WSU Tucannon 1. These have resulted in the placement of this reach on the 2002 303(d) list for fecal coliform bacteria (see Table 6.5-2).

pH: pH concentrations were recorded by Ecology 35B060 from 1974 to 2002 (Exhibit 6.5-68). The mean monthly pH concentrations were within the acceptable pH range of 6.5 to 8.5. However, from 1995 to 2002, 19 out of 96 samples exceeded the maximum limit of 8.5. All samples had pH levels greater than 6.5. This has resulted in the placement of this reach on the 2002 303(d) list for pH (see Table 6.5-2).

Dissolved Oxygen: Dissolved oxygen concentrations were recorded by Ecology 35B060 from 1974 to 2002 (Exhibit 6.5-69). The mean dissolved oxygen concentration ranged from 9.1 mg/L to 12.2 mg/L. Only 1 out of 92 samples collected between 1995 and 2002 was below the minimum 8.0 mg/L standard for salmon and trout spawning, non-core rearing and migration.

Turbidity: Ecology 35B060 monitored turbidity from 1978 to 2002. Exhibit 6.5-70 shows that the mean monthly turbidity ranged from 5.52 NTU to 80.6 NTU. This reach has been placed on the 2002 303(d) list for turbidity (see Table 6.5-2).

Suspended Solids: WSU Tucannon 1 and Ecology 35B060 have recorded total suspended solids concentration in this reach. Exhibit 6.5-71 shows the mean monthly total suspended solids concentrations recorded at these two stations. All mean monthly total suspended solids concentration recorded by WSU Tucannon 1 were below the USFS recommended standard of 80mg/L, however, the mean total suspended solids concentration recorded by Ecology 35B060 exceeded the recommended standard 4 out of 12 months.

Nutrients: Ecology 35B060 collected the data on ammonia and total phosphorous concentrations between 1974 and 2002, while WSU Tucannon 1 collected some data on ammonia, nitrate, total Kjeldahl nitrogen (TKN) and total phosphorous from 1999 to early 2001. Ammonia concentrations recorded by Ecology from 1995 to 2002 ranged from 0.01 mg/L to 0.121 mg/L, with a mean concentration of 0.015 mg/L, and records by WSU from 1999 to 2001 ranged from 0.052 mg/L to 0.498 mg/L, with a mean of 0.222 mg/L. Nitrate concentrations recorded by WSU ranged from 0.038 mg/L to 0.511 mg/L, with a mean concentration of 0.196 mg/L, and TKN concentrations ranged from 0.14 mg/L to 1.33 mg/L, with a mean concentration of 0.66 mg/L. The total phosphorous concentration recorded by Ecology from 1995 to 2002 ranged from 0.04 mg/L to 0.484 mg/L, with a mean of 0.106 mg/L, and records by WSU ranged from 0.006 mg/L to 0.619 mg/L, with a mean of 0.119 mg/L. 4 out of 92 samples collected by Ecology was outside the USFWS recommended range of 0.01 mg/L to 0.3 mg/L for trout, and 1 out of 12 samples collected by WSU was outside the range.

Sheep Creek

The Umatilla National Forest recorded temperature in Sheep Creek from 1997 to 2003. The annual summer maximum temperatures shown in Table 6.5-15 indicate that the 7-day mean of daily maximum values ranged from 48ºF to 60ºF (8.8ºC to 15.6ºC) between 1997 and 2003. Exhibit 6.5-72 shows the mean, minimum, and maximum water temperatures recorded by USFS at the mouth of Sheep Creek in 2003. The designated use temperature standard of 12°C (53.6°F) for char was only exceeded in the summer of 1998.

Table 6.5-15
Annual Summer Maximum Temperatures: Sheep Creek[1]
Umatilla National Forest Data

Station	7-day moving average of the daily maximum Temperature, °F (°C)						
	1997	1998	1999	2000	2001	2002	2003
Sheep Creek @ mouth	48 (8.8)	60 (15.6)	49 (9.4)	49 (9.4)	49 (9.4)	-	50 (10.0)

[1] Source: Umatilla National Forest 2002 and unpublished data Umatilla National Forest 2004.

Panjab Creek and Tributaries

- **Panjab Creek:** The Umatilla National Forest recorded water quality data for Panjab Creek (USFS 14030001 and USFS 14030002) from the 1970 to 1980. The data collected include temperature, fecal coliform concentrations, pH concentrations, dissolved oxygen concentrations, turbidity, suspended solids concentrations, and nutrients. Temperatures in the summers have also been recorded in recent years from 1992 to 2003 at the mouth of Panjab Creek. The annual summer maximum temperatures shown in Table 6.5-16 indicate that the 7-day mean of daily maximum values ranged from 57ºF to 63ºF (13.9ºC to 17.2ºC) between 1992 and 2003. Exhibit 6.5-73 shows the mean, minimum, and maximum water temperatures recorded by USFS at the mouth of Panjab Creek in 2003. The designated use

temperature standard of 12°C (53.6°F) for char was exceeded every summer between 1992 and 2003; however, this reach is not listed on the 1998 or 2002 303(d) lists.

Table 6.5-16
Annual Summer Maximum Temperatures: Panjab Creek[1]
Umatilla National Forest Data

Station	7-day moving average of the daily maximum Temperature, °F (°C)											
	'92	'93	'94	'95	'96	'97	'98	'99	'00	'01	'02	'03
USFS 14030001 Panjab Creek @ mouth	63 (17.2)	59 (15)	63 (17.2)	59 (15)	57 (13.9)	58 (14.4)	60 (15.6)	60 (15.6)	60 (15.6)	60 (15.6)	-	61 (16.1)

[1] Source: Umatilla National Forest 2002 and unpublished data Umatilla National Forest 2004.

- **Meadow Creek:** The Umatilla National Forest recorded temperature for Meadow Creek (USFS 14030015) from the 1971 to 1980, and in the summers from 1992 to 2003. The annual summer maximum temperatures shown in Table 6.5-17 indicate that the 7-day mean of daily maximum values ranged from 53ºF to 59ºF (11.7ºC to 15ºC) between 1992 and 2003. Exhibit 6.5-74 shows the mean, minimum, and maximum water temperatures recorded by USFS at the mouth of Meadow Creek in 2003. The designated use temperature standard of 12°C (53.6°F) for char was exceeded every summer with the exception of 1997; however, this reach is not listed on the 1998 or 2002 303(d) lists.

Table 6.5-17
Annual Summer Maximum Temperatures: Meadow Creek[1]
Umatilla National Forest Data

Station	7-day moving average of the daily maximum Temperature, °F (°C)											
	'92	'93	'94	'95	'96	'97	'98	'99	'00	'01	'02	'03
Meadow Creek @ mouth	57 (13.9)	-	57 (13.8)	-	-	53 (11.7)	56 (13.3)	54 (12.2)	56 (13.3)	59 (15)	-	57 (13.9)

[1] Source: Umatilla National Forest 2002 and unpublished data Umatilla National Forest 2004.

Little Tucannon River

The Umatilla National Forest recorded some water quality data for Little Tucannon River (USFS 14030009, USFS 14030010 and USFS 14030011) from the 1973 to 1980. The data collected include temperature, fecal coliform concentrations, pH concentrations, dissolved oxygen concentrations, turbidity, suspended solids concentrations, and nutrients. Temperatures in the summers have also been recorded in recent years from 1992 to 2003 at the mouth of Little Tucannon River. The annual summer maximum temperatures shown in Table 6.5-18 indicate that the 7-day mean of daily maximum values ranged from 57ºF to 61ºF (13.9ºC to 16.1ºC) between 1992 and 2003. Exhibit 6.5-75 shows the mean, minimum, and maximum water temperatures recorded by USFS at the mouth of Little Tucannon River in 2003. The designated

use temperature standard of 12°C (53.6°F) for char was exceeded every summer between 1992 and 2003; however, this reach is not listed on the 1998 or 2002 303(d) lists.

Table 6.5-18
Annual Summer Maximum Temperatures: Little Tucannon River[1]
Umatilla National Forest Data

Station	7-day moving average of the daily maximum Temperature, °F (°C)											
	'92	'93	'94	'95	'96	'97	'98	'99	'00	'01	'02	'03
Little Tucannon @ mouth	61 (16.1)	57 (13.9)	61 (16.1)	58 (14.4)	-	58 (14.4)	61 (16.1)	58 (14.4)	59 (15)	59 (15)	-	61 (16.1)

[1] Source: Umatilla National Forest 2002 and unpublished data Umatilla National Forest 2004.

Hixon Creek

The Umatilla National Forest recorded temperature in Hixon Creek from 1997 to 2003. The annual summer maximum temperatures shown in Table 6.5-19 indicate that the 7-day mean of daily maximum values ranged from 54ºF to 58ºF (12.2ºC to 14.4ºC) between 1997 and 2003. Exhibit 6.5-76 shows the mean, minimum, and maximum water temperatures recorded by USFS at the mouth of Hixon Creek in 2003. The designated use temperature standard of 12°C (53.6°F) for char was exceeded every summer with the exception of 1997; however, this reach is not listed on the 1998 or 2002 303(d) lists.

Table 6.5-19
Annual Summer Maximum Temperatures: Hixon Creek[1]
Umatilla National Forest Data

Station	7-day moving average of the daily maximum Temperature, °F (°C)						
	1997	1998	1999	2000	2001	2002	2003
Hixon Creek	54 (8.8)	-	58 (14.4)	57 (13.9)	57 (13.9)	-	57 (13.9)

[1] Source: Umatilla National Forest 2002 and unpublished data Umatilla National Forest 2004.

Cummings Creek

The Umatilla National Forest recorded some water quality data for Cummings Creek from 1973 to 2003. USFS 14030012, located near the mouth at Highway 12, collected temperature, fecal coliform concentrations, pH concentrations, dissolved oxygen concentrations, turbidity, suspended solids concentrations, and nutrients from 1973 to 1978. USFS 14030017, located at the lower end of Cummings timber sale, collected temperature, turbidity and suspended solids concentrations from 1978 to 1995. Summer temperatures have also been recorded from 1997 to 2003 at the mouth of Cummings Creek.

Temperature: The annual summer maximum temperatures shown in Table 6.5-20 indicate that the 7-day mean of daily maximum values ranged from 55ºF to 66ºF (12.8ºC to 18.9ºC) between 1997 and 2003. Exhibit 6.5-77 shows the mean, minimum, and maximum water temperatures recorded by USFS at the mouth of Cummings Creek in 2003. The designated use temperature standard of 12°C (53.6°F) for char was exceeded every summer between 1997 and 2003. This has resulted in the placement of this reach on the 2002 303(d) list for temperature (see Table 6.5-2).

Table 6.5-20
Annual Summer Maximum Temperatures: Cummings Creek[1]
Umatilla National Forest Data

Station	7-day moving average of the daily maximum Temperature, °F (°C)						
	1997	1998	1999	2000	2001	2002	2003
Hixon Creek	55 (12.8)	66 (18.9)	64 (17.8)	Missing	66 (18.9)	-	64 (17.8)

[1] Source: Umatilla National Forest 2002 and unpublished data Umatilla National Forest 2004.

Turbidity: USFS 14030017 monitored turbidity from 1978 to 1995. However, data was recorded in Jackson Candle Units (JTU). No recent data is available.

Suspended Solids: USFS 14030017 recorded total suspended solids concentration in this reach. Exhibit 6.5-78 shows the mean monthly total suspended solids concentrations recorded by USFS. The mean monthly total suspended solids concentration recorded were well below the USFS recommended standard of 80mg/L.

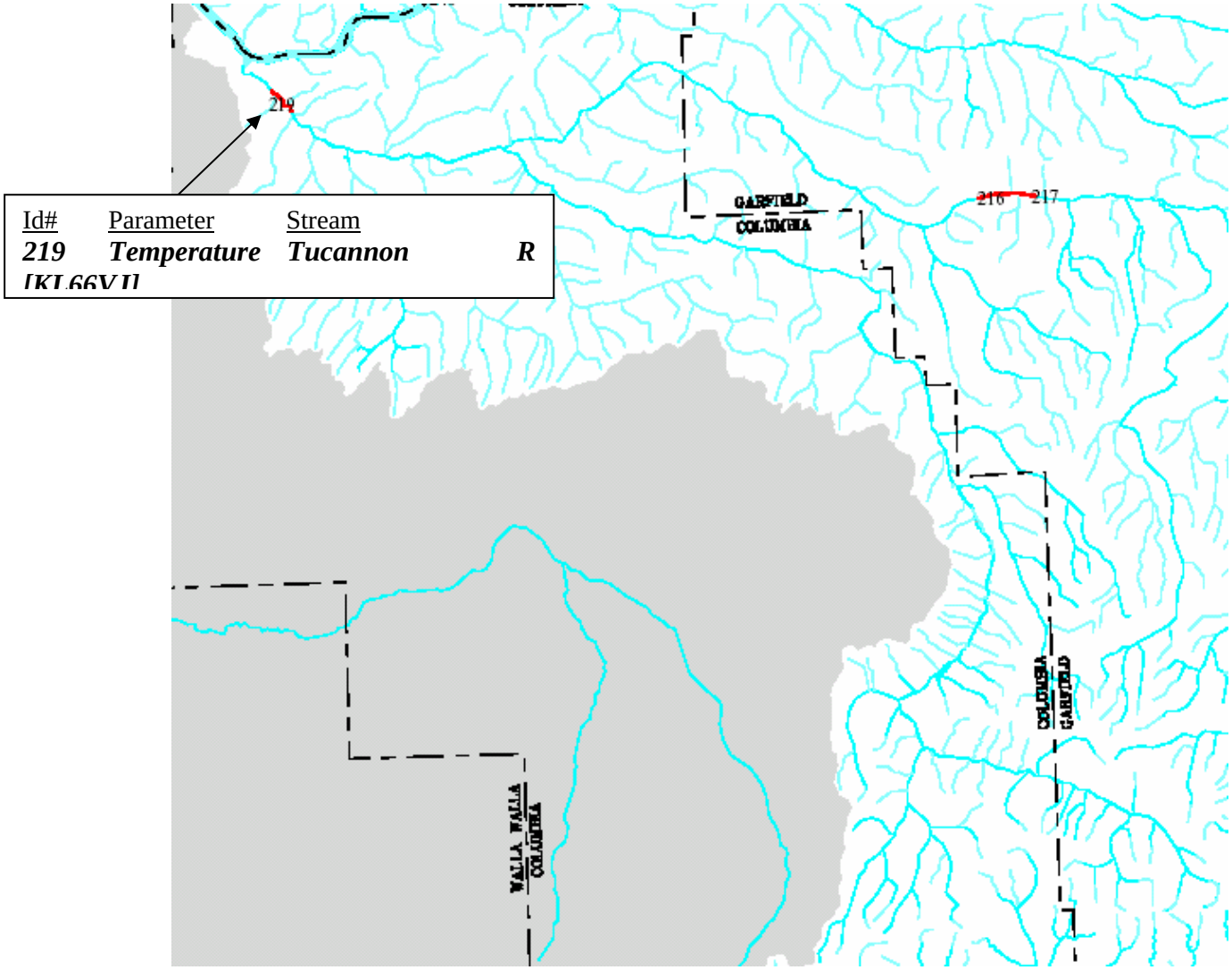
Pataha Creek

Water quality of Pataha Creek is discussed in further detail in Section 5.5.

All other Tributaries to Tucannon River

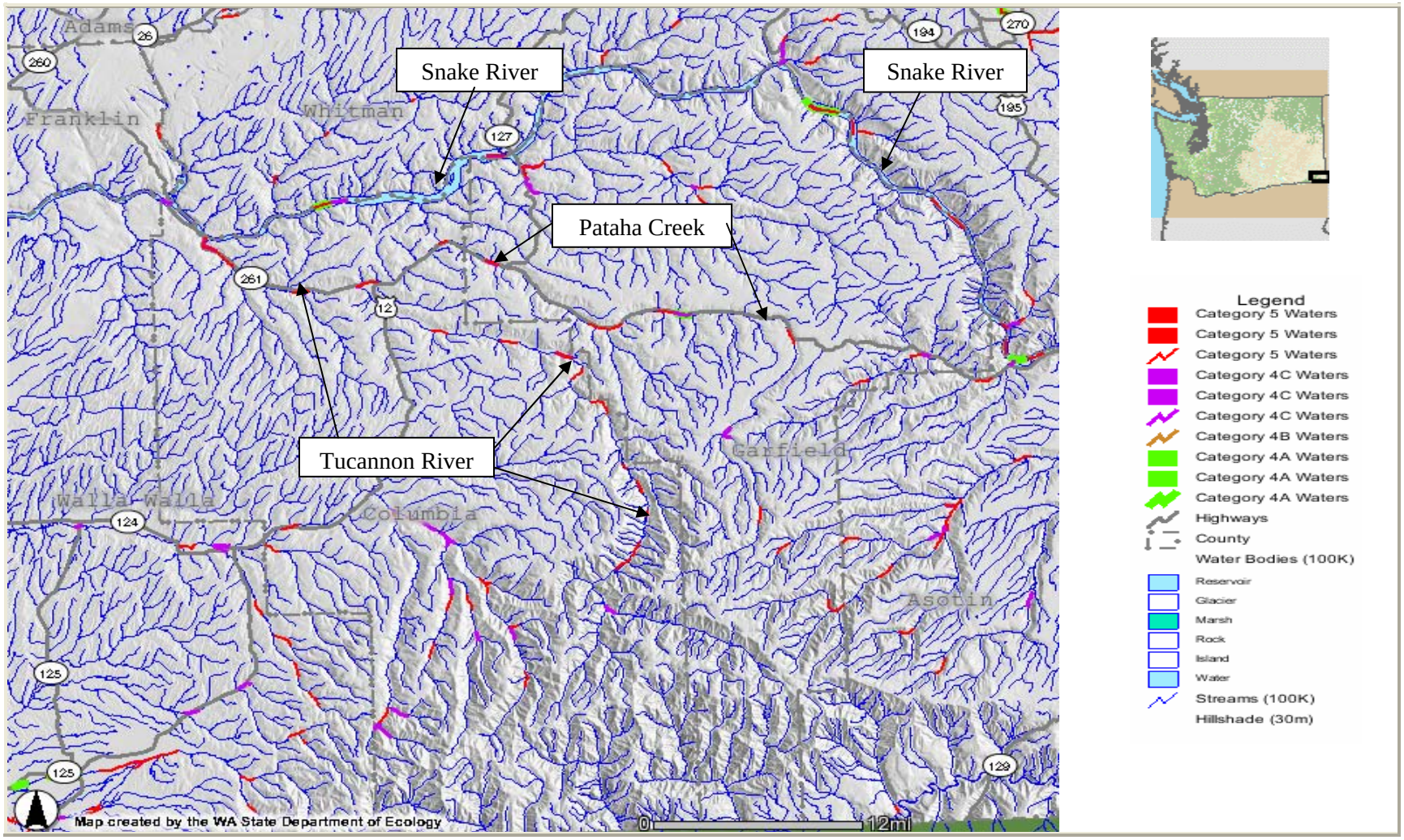
No water quality data is available on Tumalum, Willow, and Kellog Creeks.

Exhibit 6.5-1
1998 303(d) Listed Stream Segments: Tucannon Implementation Area



Source: Ecology, 2004. WRIA 35 - Middle Snake webpage

Exhibit 6.5-2
2002 303(d) Listed and Impaired Stream Segments: Tucannon Implementation Area



Source: Water Quality Assessment of Washington webpage (Ecology 2004b).