A Department of Ecology Report

Groundwater Data Summary for the Wenatchee River Watershed Total Maximum Daily Load Study

Abstract

The Wenatchee River flows off the east side of the Cascade Mountain range in north-central Washington and eventually drains into the Columbia River near the city of Wenatchee.

The purpose of this study is to characterize the groundwater contribution to the Wenatchee River and its major tributaries including Icicle, Mission, Peshastin, Chumstick, Nason, and Brender creeks. Groundwater data from 54 mini-piezometers installed at selected sites were compared to surface water data to evaluate the dynamics of the groundwater and surface water system. Gaining and losing river reaches were identified using hydraulic gradient measurements and water temperature profiles. Additionally, historic groundwater quality data were evaluated; these data were from the state Department of Ecology, the state Department of Health, and the U.S. Geological Survey.

Overall, the groundwater quality is excellent in the Upper Wenatchee subbasin, deteriorates slightly in the Icicle Creek and Leavenworth areas, and continues to deteriorate downstream. Elevated nutrient concentrations are highest in the Peshastin and Cashmere areas. The nitrate standard of 10 mg N/l was exceeded seven times in the Lower Wenatchee subbasin, with a maximum detected value of 12.2 mg N/l. The elevated nutrient concentrations in groundwater may be contributing to low dissolved oxygen values in the river.

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This report was prepared by a licensed hydrogeologist. A signed and stamped copy of the report is available upon request.

Table of Contents

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Purpose

The purpose of this study is to define the hydraulic connection between groundwater and surface water in the Wenatchee River watershed. The data in this report were collected in support of the temperature and dissolved oxygen TMDL assessments. This project focuses on the Wenatchee River mainstem below Lake Wenatchee including the following tributaries: Icicle, Mission, Peshastin, Chumstick, Nason, and Brender creeks. Mini piezometers were installed at selected sites to monitor the hydraulic conductivity between surface water and groundwater, and to determine the quality of groundwater.

The major objectives of this study are to:

- Evaluate and describe the timing, and distribution of surface water and groundwater interchange for selected stream reaches within the Wenatchee River watershed.
- Characterize the temperature and chemical quality of the groundwater that naturally discharges to area streams.
- Identify gaining and losing reaches.
- Quantify hydraulic gradients and groundwater temperature profiles.

Background

Study Area

The Wenatchee River drains an area east of the Cascade Mountains in north-central Washington in Chelan County. The river flows in a southwesterly direction draining into the Columbia River at the city of Wenatchee. The Wenatchee River watershed (Water Resource Inventory Area 45) covers 1,371 square miles, and has 230 miles of major rivers and streams. The watershed originates high in the Cascade Mountains. The study area includes the area downgradient of Lake Wenatchee where the river descends rapidly through Tumwater Canyon, then drops into a lower gradient section near Leavenworth where Icicle Creek joins the mainstem. Other major tributaries that were evaluated as part of this study include Icicle, Mission, Peshastin, Chumstick, Nason, and Brender creeks (Figure 1).

Geology

The Wenatchee River is situated over the Chiwaukum graben, which is an erosional lowland developed on top of downdropped sandstone and shale. A graben is an elongated trench bounded by parallel normal faults, which was created when the block that forms the trench floor moved downward relative to the blocks that form the sides. The Chiwaukum graben is bordered by the Leavenworth fault to the west and the Entiat fault to the east (Gresens, 1983). The Wenatchee River flows through this structural feature until it reaches the Columbia River at the city of Wenatchee. Bordering the Chiwaukum graben, there are granitic and metamorphic rocks, which have been structurally altered.

During the Pleistocene Epoch, glaciers advanced and retreated over the area. These glaciers deposited significant unconsolidated sediments (Figure 2). There are four types of unconsolidated deposits (USGS, 1977).

1. Lacustrine deposits are silts and clays deposited as lake bottom sediments behind the glacial ice and moraine dams.
2. Outwash deposits were created during the advancing and retreating glaciers which deposited sand and gravel in front of the glacier from the glacier meltwater.
3. Till layers are a very dense, poorly sorted mixture of clay, silt, sand, and gravel which were deposited directly beneath the glacial ice.
4. Alluvial deposits were created as these unconsolidated deposits were reworked by the area rivers and streams, and were redeposited to create the uppermost alluvial aquifer which averages approximately 150 feet thick.

Hydrogeology

There are two major aquifers in the Wenatchee River watershed: (1) a lower bedrock aquifer, and (2) a overlying unconsolidated alluvial and outwash aquifer. Area well location and construction information is contained in Table 1.

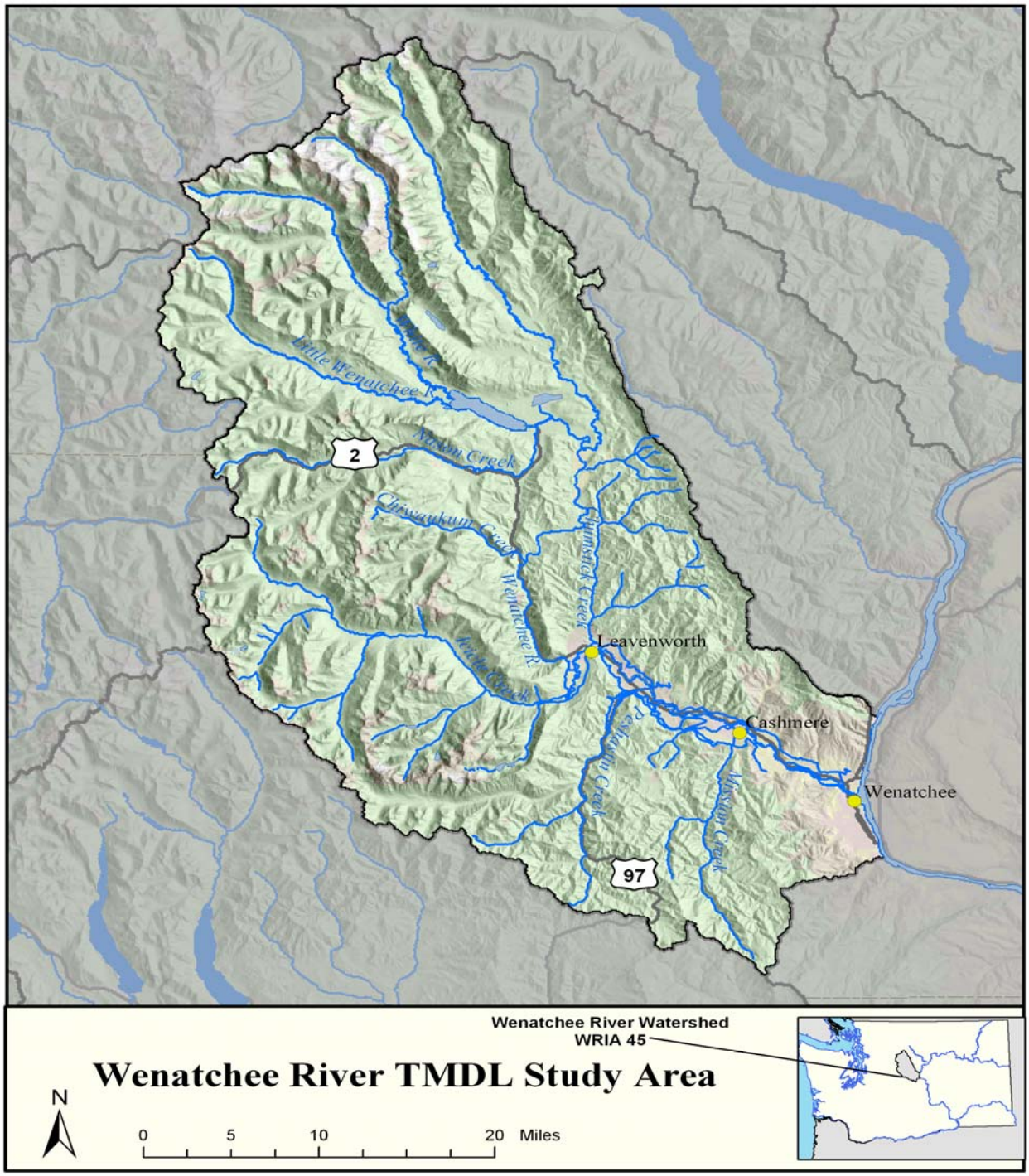

Figure 1. Wenatchee River TMDL Study Area.

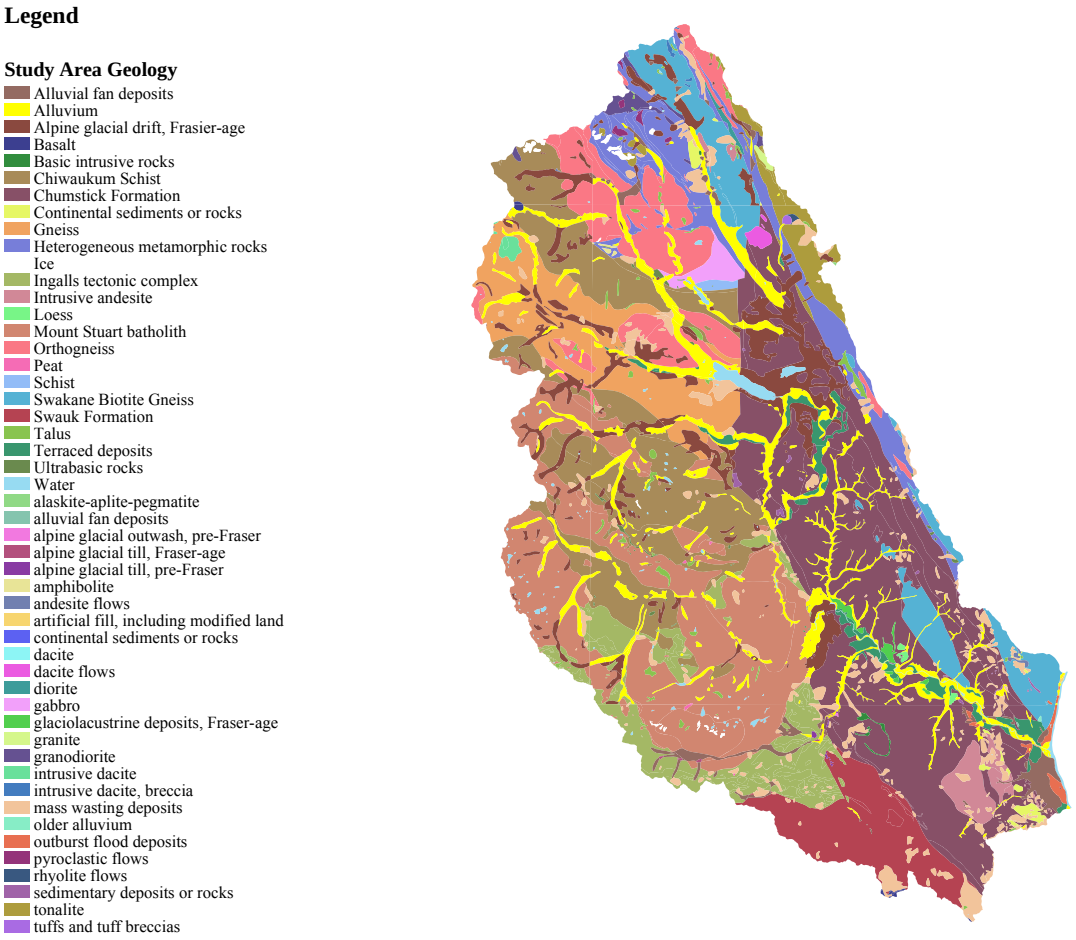

Figure 2. Surficial Geology of the Wenatchee River Watershed.

The bedrock aquifer is a low yielding aquifer typically producing less than 1 gallon per minute (gpm). This aquifer is not considered a reliable source sufficient to supply usable quantities of water for more than single domestic supplies. There are some areas of weathered bedrock where production averages approximately 15 gallons per minute (Ecology, 1995). Transmissivity is estimated to average approximately 25 square feet per day (ft^2/day) (Golder Associates, 1995).

The alluvial and glaciofluvial outwash aquifer is the main source of groundwater in the area. This aquifer, in many places, is in direct hydraulic connection to the Wenatchee River and its tributaries. The hydraulic connection between groundwater and surface water is dependent on the geologic conditions. The nature and extent of this aquifer is defined by the occurrence of fine-grained sediments which create localized confining units. The quality and quantity of groundwater in this aquifer is highly variable depending upon the local geology, the quality of the surface water, and the anthropogenic impacts. Well yields range from five gallons per minute to greater than 100 gallons per minute (Ecology, 1995). Transmissivity is estimated to average approximately 1720 ft^2/day (Golder Associates, 1995).

The Wenatchee River and Icicle Creek emerge from bedrock canyons. The alluvial aquifer is limited in extent by this graben which forms the bedrock canyon. The aquifer is isolated and receives recharge only from precipitation, runoff from the surrounding ridges, and losses from streamflow. The unconsolidated aquifer is segregated into two, sometimes indistinct, aquifers by a discontinuous confining unit. The lower alluvial aquifer is comprised mainly of the glaciofluvial sands and gravels. The uppermost alluvial aquifer is comprised mainly of silty sands deposited since the last glacial event by the erosion of the sandstones and shales on the bordering mountain ridges (Wildrick, 1979).

Methods

Piezometers

Instream piezometers were installed at 54 sites (Figure 3) along the mainstem Wenatchee River and selected tributaries: Icicle, Peshastin, Mission, Nason, Brender, and Chumstick creeks. The piezometers were monitored monthly over a period of 12 to 18 months to define hydraulic gradient relationships between area streams and groundwater, and to assess groundwater temperature and water quality.

The intention was to evenly distribute the piezometers within the watersheds. Stream temperature thermistors were located in conjunction with the piezometers. The piezometers consisted of a seven-foot length of one-inch diameter galvanized pipe, of which one end is crimped and slotted. The upper end of each piezometer was fitted with a standard pipe coupler to provide a robust strike surface and to enable the piezometers to be securely capped between sampling events. The piezometers were driven into the streambed within a few feet of the shoreline to a maximum depth of approximately five feet. After installation, the piezometers were developed with a peristaltic pump to ensure they had a good hydraulic connection with the streambed sediments. Table 2 describes the piezometer locations and construction details.

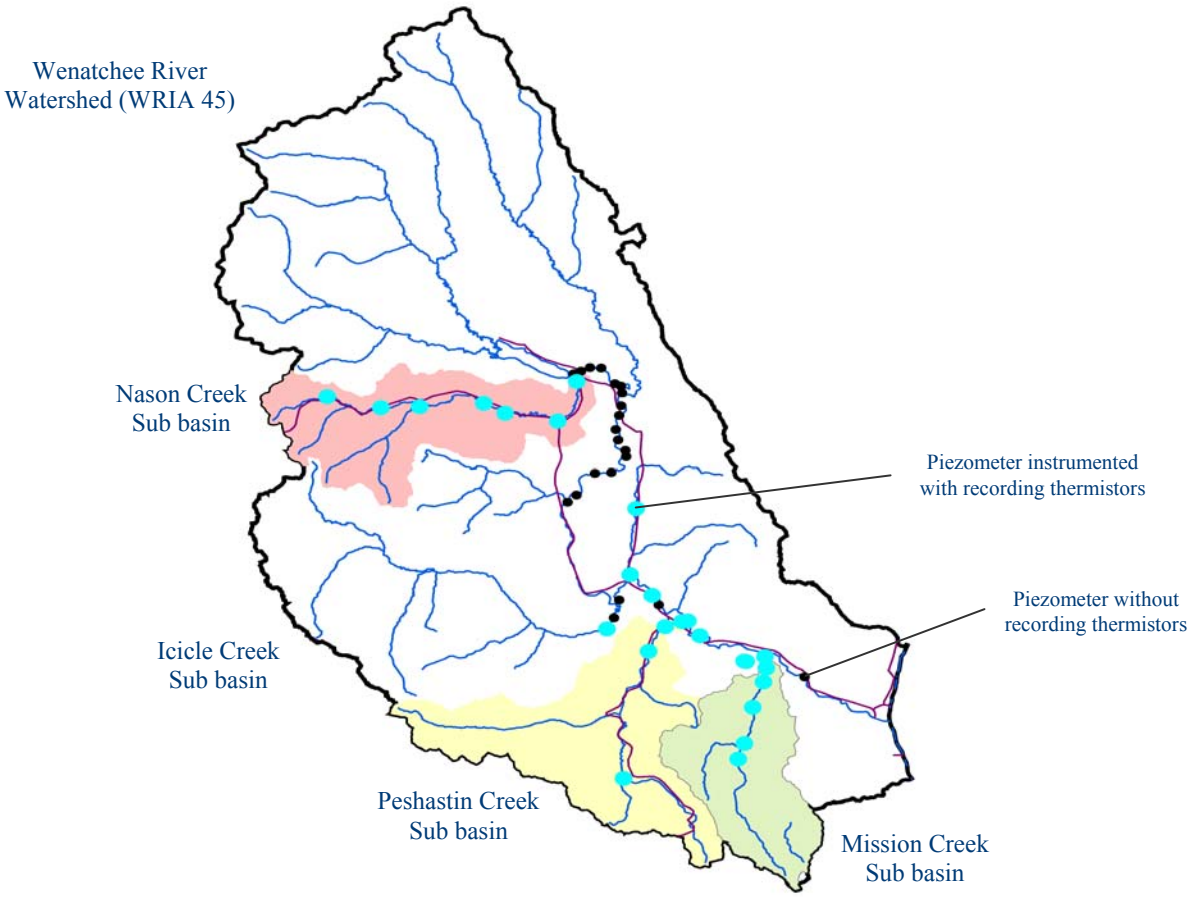

Figure 3. Location of Instream Piezometers.

Sample Collection

Three i-button® temperature thermistors, capable of continuous water temperature monitoring, were placed in each piezometer. The typical design included placing one thermistor near the bottom of the piezometer, one at a depth of approximately one foot below the streambed, and one midway between the upper and lower thermistors. The piezometers were accessed monthly from June through November to download data from the thermistors and to make in-situ measurements of stream and groundwater temperatures in order to compare with thermistor data and validate the accuracy of the measurements. The monthly in-situ measurements were made with properly maintained and calibrated field meters in accordance with standard Ecology methodology (MEL, 2000).

During the monthly site visits, surface water and groundwater head relationships were determined using a calibrated electric well probe, steel tape, or manometer board in accordance with standard USGS methodology (Stallman, 1983). The electric tape measurements are accurate to 0.1 foot, while the steel tape readings are considered accurate to 0.01 foot. The head difference between the internal piezometer water level and the external river stage provides an indication of the vertical hydraulic gradient and the direction of flow between the river and groundwater. When the piezometer head exceeds the river stage, groundwater discharge into the river is inferred and the river is considered a gaining reach. Similarly, when the river stage exceeds the head in the piezometer, loss of water from the river to groundwater storage can be inferred, and the river is considered a losing reach.

At piezometer sites where it was determined to be a gaining reach, the following groundwater quality parameters were also sampled: conductivity, pH, temperature, total suspended solids, alkalinity, chloride, total persulfate nitrogen, nutrients (ammonia, nitrate-nitrite, orthophosphate, and total phosphorus), dissolved organic carbon, total organic carbon, and total dissolved solids. Figure 4 illustrates the water quality sampling locations. All samples were collected, processed, and transported to the laboratory in accordance with standard Ecology methodology (MEL, 2000).

To ensure representative water quality values, the sampled wells were purged with a peristaltic pump and sampled using low-flow sampling techniques (purge rate approximately 500 ml per minute). Grab samples were collected at approximately three-minute intervals and monitored for pH, temperature, and specific conductance. Water quality values were considered stable when two successive grab samples yielded comparable results within a 10% difference. All meters were calibrated daily with known standards daily in accordance with the Quality Assurance Project Plan (Bilhimer, 2002).

Temperature and conductivity were measured for both surface water and groundwater during each of the piezometer surveys. Typically, stream reaches with significant groundwater input, especially during low-flow periods, should have similar water chemistry to area groundwater. Measurements were made with properly maintained and calibrated field meters in accordance with standard Ecology methodology (MEL, 2000).

Vertical Hydraulic Gradient

The vertical hydraulic gradient between the stream and the piezometers is calculated as follows:

$$i_v = dh/dl$$

where: i_v = vertical hydraulic gradient (L/L)
dh = difference between the stream stage and the piezometer water level
dl = distance from the streambed to the midpoint of the piezometer perforations

Negative values of i_v indicate loss of water from the stream to groundwater, which is classified as a losing reach. Positive values indicate groundwater discharge into the stream, which is classified as a gaining reach.

The piezometers and stream were also sampled for temperature and specific conductance during each monitoring event to provide an additional means of verifying the gradient relationships. Table 3 summarizes the field data collected, water level data, and hydraulic gradient data for instream piezometers within the Wenatchee River watershed. Piezometers exhibiting negative hydraulic gradients generally have water quality signatures that are quite similar to surface water, since the stream is losing water to groundwater at that location. Piezometers with positive hydraulic gradients typically have more stable temperatures (less annual variability) that diverge from the stream temperature seasonally. Water from such piezometers is generally warmer than the stream during the cool winter months and cooler than the stream during the warm summer months.

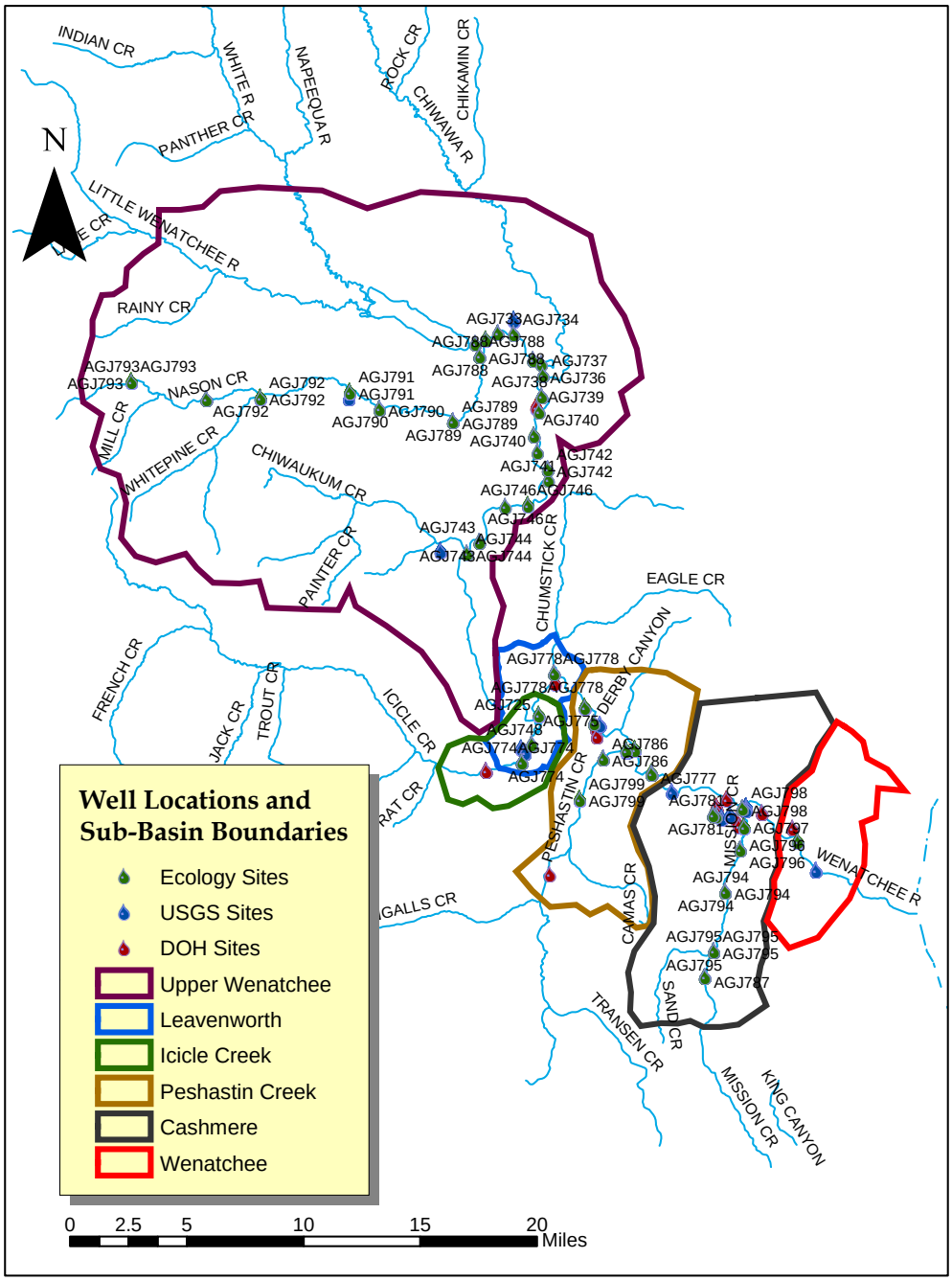

Figure 4. Groundwater Quality Sites in the Wenatchee Basin.

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Data Quality Objectives

The quality assurance statistical summary is described in Table 4 for the laboratory duplicate samples and the method blanks, and Table 5 describes the quality assurance for the field duplicate samples. Table 6 summarizes the statistics by parameter for laboratory and field quality assurance data. Accuracy is affected by both precision and bias. The targets for analytical precision are described in Table 14 of the Quality Assurance (QA) Project Plan (Bilhimer, 2002). Data that do not meet the data quality objectives specified in the QA Project Plan have been qualified in the data table. Overall the quality of data reported for this project is judged to be acceptable.

Duplicates

Analytical precision is estimated by laboratory duplicates. This entails analysis of duplicate aliquots from a single sample container.

Overall precision of the entire sampling and analytical process is measured by field duplicate samples. Field duplicates are two samples collected from the same location at the same time. Differences in the concentrations can be the result of variations in sample location, sample collection, containers, or the analytical procedure.

All project data were below the target percent relative standard deviation (%RSD) identified by Bilhimer (2002).

Blanks

Bias due to laboratory contamination is determined by method blanks. This is an analytical tool performed by the laboratory to measure the theoretical concentration of zero. The blanks are prepared and analyzed along with the samples to measure any impacts from the analytical process. No analytically significant levels of analytes were detected in the method blanks associated with these samples.

Field blanks were used during two of the four sampling events. During the week of August 19 through August 23, 2002, there were elevated concentrations of total suspended solids (13 mg/l) and total phosphorous (0.0329 mg/l) detected in the field blank. After careful analysis, it was determined that the most likely reason for these elevations was that the field blank bottles for inorganic analysis were mislabeled as sample bottles. All other quality assurance data meet the data quality objectives defined for this study (Bilhimer, 2002). Since it cannot be determined definitively which samples were mislabeled, all samples from that sampling event for those two parameters which are within the range of X – 5X (0.0329 mg/l TP – 0.1645 mg/l TP) are qualified with a "J" value. These values should only be used as an estimate of water quality concentrations. This designation affects five samples: one in the Peshastin Creek subbasin, and four in the Upper Wenatchee River subbasin. These five values were included in the results tables but were removed for the purposes of statistical analysis and conclusions.

Results

Groundwater quality was evaluated using data from the Washington State Department of Ecology (Ecology), Washington State Department of Health (DOH), and the U.S. Geological Survey (USGS). Table 7 summarizes the groundwater quality data, Table 8 consolidates the data statistics, and Table 9 summarizes the data by subbasin.

Ecology's data were collected to evaluate groundwater impacts to the Wenatchee River and its tributaries. These data were taken predominantly from instream piezometers that penetrated the uppermost aquifer. Historic data from other agencies were also compiled. DOH data were obtained from the SADIE database, which contains water quality information from public drinking water supply systems. USGS data reflects water quality samples taken from area wells.

Alkalinity

Groundwater alkalinity concentrations increase downstream within the basin for all the statistical evaluations. The upper 95% tolerance interval ranges from 119.08 mg/l in the Upper Wenatchee reaches, to 376.01 mg/l in the Cashmere reaches (Table 8). Not enough samples were taken to calculate the upper 95% tolerance interval in the Wenatchee area.

Chloride

Chloride concentrations in groundwater were highest in the Leavenworth and Icicle Creek reaches. The maximum value is 16.1 mg/l for both areas, and the upper 95% tolerance interval is 20.25 mg/l in the Leavenworth reaches and 26.63 mg/l in the Icicle Creek reaches (Table 8). The groundwater quality standard for chloride is established at 250 mg/l (Chapter 172-200 WAC). All groundwater values evaluated as part of this study are well below this standard.

Chloride is present in all natural waters, although the concentration is usually low. Chloride is one of the most conservative parameters moving through the subsurface with minimal retardation, making it a good groundwater tracer.

Conductivity

Conductivity generally increases downstream within the basin, although the highest mean and median values occur in the Cashmere reaches (Table 8).

There is a linear relationship between conductivity and the ionic concentration of the water (Hem, 1985), making conductivity a good general indicator of the relative salt concentration of the water.

Nitrate

Generally nitrate concentrations show an increasing trend downstream through the watershed. The maximum value of 12.2 mg N/l was detected in the Cashmere reach; the upper 95% tolerance interval and the 90th percentile were also greatest in this area (Table 8). Seven of the values evaluated in the watershed exceeded the groundwater quality standard of 10 mg N/l for nitrate (Chapter 173-200 WAC). All of these values were detected in the lower Wenatchee reaches.

Nitrate is extremely mobile due to its high solubility, anionic form, and non-reactive nature. It is the most mobile of the nitrogen species; it moves readily through the soils and travels at approximately the same rate as groundwater. Nitrate is one of the most prevalent groundwater contaminants. Sources of nitrate contamination include irrigated agriculture, confined animal feeding operations, wastewater treatment facilities, golf courses, lawn fertilizers, wastewater reuse facilities, and on-site sewage systems.

Nitrate poses an environmental and public health threat. Nitrate in elevated concentrations above the 10 mg N/l standard can cause methemoglobinemia in infants. There is also concern that excessive ingestion of nitrate could be a cancer-causing agent in adults. Nitrate is often used as an indicator of general groundwater quality and is useful in determining environmental degradation.

Phosphorus

There are no groundwater quality standards for orthophosphate or total phosphorus in Washington State. However, legally groundwater quality cannot contribute to an impairment of a surface waterbody. Orthophosphate values range from 0.0046 to 0.8410 mg/l in the study area. Total phosphorus values range from 0.0049 to 0.7380 mg/l in the study area.

Orthophosphate and total phosphorus concentrations in groundwater are highest in the Peshastin Creek area, with statistical values approximately an order of magnitude greater than all the other areas. Both the elevated orthophosphate and the total phosphorus values were taken from well AGJ727 on 10/10/2002 (Table 9). A field duplicate taken for the orthophosphate sample provides confidence in the validity of the concentration and indicates that this is not a sampling, laboratory, or reporting error.

Orthophosphate and total phosphorus are a major concern in the Wenatchee River watershed, since the presence of phosphorus in surface water can indirectly cause a decrease in the amount of dissolved oxygen. Phosphorus is a major cause of eutrophication in lakes. When too much phosphorus enters streams and lakes, algae and other aquatic plants may grow or bloom in amounts that cause toxic conditions. Algae blooms may cloud the water, cause odors, decrease the amount of dissolved oxygen, cause humans to become ill, kill fish, or kill other animals.

Phosphorus is one of the predominant nutrients added to watersheds from human activities. It enters the environment from sewage, animal wastes, fertilizers, and stormwater. Phosphorus is also a component of some household detergents, although the concentration has decreased dramatically since 1994 when a Washington State law limited the phosphorus content of household laundry detergents to 0.5% by weight and dishwashing detergents to 8.7% by weight.

Approximately 95% of the phosphorus is removed in the vadose zone. Saturated soil conditions or a coarse soil matrix may reduce the degree of phosphorus removal and lead to more rapid transport to groundwater. The USGS (Gilliom, 1982) estimates that 1% of the discharged phosphorus can migrate through groundwater and be transported into nearby lakes and rivers. EPA (2002) estimates that a typical on-site sewage system discharges between 6 to 12 mg/l of phosphorous. Using a median value of 9 mg/l, it is estimated that 90 ug/l of the total phosphorus discharged from on-site sewage systems migrate through the groundwater system into surface water. This concentration is great enough to impact surface waterbodies.

Conclusions

Following are the conclusions from this study:

- Overall groundwater quality is excellent in the Upper Wenatchee subbasin, then deteriorates slightly in the Icicle Creek and Leavenworth areas, and continues to deteriorate downstream. Elevated nutrient concentrations are highest in the Peshastin and Cashmere areas.

- Groundwater has the potential to impact surface water in the areas where there are gaining reaches and elevated contaminant concentrations in groundwater.

- Groundwater quality degrades downstream in the watershed for all parameters.

- The elevated nutrient concentrations may be contributing to oxygen depletion in the river, causing low dissolved oxygen values.

- The Wenatchee River exhibits interspersed gaining and losing stream reaches throughout its length.

- Individual piezometer sites show significant seasonal variability, with some sites transitioning between gaining and losing conditions.

- The piezometer sites on the tributary streams exhibit more seasonal consistency than on the mainstem.

- There is excellent agreement between total hydraulic head measurements taken with a manometer board and with the electrical tape.

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Tables

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Table 1. Wenatchee Area Well Location and Construction Information.

Owner	Local number	Well tag number	Latitude	Longitude	Water use*	Altitude (feet)	Well depth (feet)	Casing diameter (inches)	Static water level (feet below land surface)	Date
F. Lester	22N/19E-01-swse		472522	120233601	D	1600	150	6	10	10/24/1974
V. Fletcher	22N/19E-06-ne-se	ABL907	4726187	12029922	D	917	34.5	6	15.5	8/22/1994
M. Rowe	22N/20E-06				D		104	8	42	10/10/1970
R. Griffin	23N/18E-24	ACX058	474784	120.65528	D		58.5	6	25.5	6/21/1997
D. Dittrich	23N/18E-24	AHK811	4728.211	12039.322	D		150	6	10	9/21/1974
D. Dittrich	23N/17E-24	AKW731	4728.226	12039.313	D		52	6	17	2/17/2003
Valley High	23N/17E-24-nw-ne	ABR285	474814	1206512	M	1700	58	8	12	5/6/1986
J. Melcher	23N/18E-1-sw-sw				D		268	6	50	11/28/1974
J.B. Smith	23N/18E-6-swsw	AAJ539	4730.837	12037.71	D		239	6	33	3/24/1994
D. Huber	23N/18E-7-nesw	ACX075	4730.114	12037.886	D	1614	59.5	6	43	8/5/1997
G.J. Ezzy	23N/18E-18-sene	ABL519	4729.403	12037.683	D	1611	299	6	17	6/15/1994
J Lafer	23N/18E-18-nene	AFH415	4729.653	12037.942	D	1496	117	6	53.5	4/25/2000
P. Latimer	23N/18E-18-sene	ABL902	4729.587	12038.009	D	1531	179	6	35	8/25/1994
H. R. Haril	23N/19E-4-nwse	ALX577	4730.864	12027.424	D	842	219	6	57.5	4/13/1998
J. D. Kerr	23N/19E-4-swsw	ABL908	4730.611	12028.41	D	1550	41	6	18	8/3/1994
J.C. Merrit	23N/19E-4-nenw	ABT569	4731.31	12027.889		791	20	6	16	6/18/1996
D.G. Moody	23N/19E-4-nene	ABL661	4731.295	12027.331	D	824	39	6	17.5	1/11/1995
A. Person	23N/19E-4-swsw	AAI093	4730.606	12028.213	D	843	203	6	22	9/9/1994
Cashmere Fruit Growers	23N/19E-4-nwse						21		10	9/11/1956
F. J. Barnes	23N/19E-5						40	6	27	1/1/1944
A. Bye	23N/19E-5-sesw						43	6	38	6/1/1946
Cashmere S. Baptist Church	23N/19E-5-nwne				D		62	6	20	11/25/1975
Town of Cashmere	23N/19E-5-nwse						92	12	36	
R. Lewis	23N/19E-5-nesw				D/I		50	6	33	1/23/1974
F.L. Moore	23N/19E-5-swnw	ABL636	4731.051	12029.708	D	851	76.5	6	52	1/27/1995
L.E. Sheldon	23N/19E-5-sww	AAJ378	47030.727	12029.07	D	906	119	6	99	11/18/1973
J. Town	23N/19E-5						40	8.62	20	1/17/1962
R. Town	23N/19E-5-sese				D		50	8	25	10/27/1975
E. Von Grey	23N/19E-5-nwsw	AFH789	4730.923	12029.46	D	874	105	6	62	10/5/2000
J. L. Whitman	23N/19E-5-senw	ACX554	4731.23	12029.273	D	848	56.5	6	25.5	11/21/1997
A. Whitmire	23N/19E-5				D		42		38	1/1/1959
F. S. Wolfe	23N/19E-5-nwsw				D		65	8	45	2/8/1965
R. & J. Wohlers	23N/19E-5-nwsw	ACE371	4730.852	12029.546	D	988	94.5	6	64	3/26/1996
Chelan County Fair	23N/19E-5-nene	AGL830	4731.428	12029.78	D	925	76	6	29	7/16/2001
J. L. Flagel	23N/19E-6-sene	AFE479	4731.219	12029.928	D	940	75.5	6	43.5	11/5/1999
V. & L. Guzman	23N/19E-6-senw	AEM566	4731.122	12030.45	D	943	74.5	6	26.5	8/13/1998
A. Jones	23N/19E-6-nese	AGL816	4731.012	12029.952	D	947	76	6	21	6/15/2001
J. W. Jones	23N/19E-6-swsw	AFH438	4730.82	12030.879	D	1122	181	6	105	5/24/2000
R. G. Long	23N/19E-6-swsw	AKW726	4731.44	12030.392	D	1017	457	6	111	2/12/2003
D. E. Magnus	23N/19E-6-nwse	ACE551	4730.715	12029.915	D	986	118.5	6	32.5	5/21/1996
W. C. Warman	23N/19E-6-senw	AFE468	4731.185	12030.599	D	958	73.5	6	29.5	10/15/1999
B. C. Sutton	23N/19E-6-sene						92	6	15	4/17/1950
R. L. Knappert	23N/19E-8-nese	AEM583	4730.084	12028.316	D	1550	41	6	18.5	10/2/1998
R. L. Knappert	23N/19E-8-nese	AEM584	4730.084	12028.316	D	1550	38.5	6	15.5	10/5/1998
H. E. Radach	23N/19E-8-nene	ABL925	4730.487	12028.415	D		42	8	22.5	8/26/1994
J. L. Rankin	23N/19E-8-sese	AGM368	4729.737	12028.553	D	907	39.5	6	16	10/9/2001
P. & E. Walsh	23N/19E-8-sene	ABL503	4730.183	12028.49	D	933	38.5	6	16	7/7/1994
P. & E. Walsh	23N/19E-8-sene	ABL506	4730.215	12028.418	D	874	38.5	6	16	7/6/1994

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J. Bartelome	23N/19E-9-nwnw	AEC233	4730.384	12028.386	D	892	44	6	10	7/21/1999
S. R. Foster	23N/19E-9-swsw	ABL886	4729.77	12028.373	D	909	178	6	3	10/24/1994
S. R. Foster	23N/19E-9-swsw	ABL885	4729.768	12028.373	D	901	39	6	8	10/24/1994
Jones	23N/19E-9-nwnw	AGM383	4730.382	12028.179	D	884	48	6	19	11/15/2001
M. Waters	23N/19E-9-swnw	AHK816	4730.276	12028.354	D	879	42.5	6	22	10/11/2002
J. E. Dolman	23N/19E-9-nwnw				I		47	8	8	
J. & L. Griffith	23N/19E-9-nene	AFH798	4730.368	12026.026	D	817	85	6	67	10/24/2000
D. Collins	23N/19E-10-sese				D		95	6	40	4/23/1975
Roys Orchards	23N/19E-11-swnw	AAJ528	4729.748	12025.598	D	738	33.5	6	15.5	2/28/1994
J. Campbell	23N/19E-11-swnw				D		30	6	15	11/7/1975
L. R. Andrus	23N/19E-11-nwsw				D		40	6	15	2/28/1974
A. L. Weythman	23N/19E-11-swsw				D		18		10	3/1/1946
C. H. Quinn	23N/19E-11-sesw				D		15		5	6/15/1946
L. J. Bailey	23N/19E-13-sene	ABX249	4729.27	12023.776	D	773	257	6	90	4/3/1995
Mylius Brothers	23N/19E-13-sene						8		3	5/31/1963
East Monitor Water Assn.	23N/19E-13-nesw	ABR286	47.48421	120.39985			30		22	6/19/1964
R. Scott	23N/19E-13-senw						10		8	3/1/1964
Chelan County	23N/19E-13-swsw						38		13	7/30/1970
D. L. Brown	23N/19E-14-nwnw	AGM626	4729.078	12025.218	D	766	122.5	6	93	5/17/2002
F. H. Davis	23N/19E-14-nene	AGL802	4729.443	12025.581	D	743	67	6	44.5	5/11/2001
T. & W. Elias	23N/19E-14-nwse	ACE375	4729.059	12024.975	D	717	55	6	30.5	2/28/1996
T. E. King	23N/19E-14-nenw	AHK830	4729.601	12025.348	D	699	59	6	14.5	9/10/2002
Cashmere Fruit Exchange/ George Lehman	23N/19E-14-nesw	AFE477	4729.192	12025.066	D	763	46	8	15	11/3/1999
T. W. Stephens	23N/19E-14-nesw	AGL803	4729.045	12024.81	D	732	39	6	20	5/11/2001
L. M. Worley	23N/19E-14-sese	AFQ729			D		43	6	23	1/25/2001
S. E. Strutzel	23N/19E-14-senw	AFQ735	4729.414	12025.302	D	750	64	6	42.5	3/5/2001
Central Packers and Great Northern RR	23N/19E-14-swne						40	8	13	3/14/1950
I. Mckee jr.	23N/19E-14-nese				D		39	6	11.52	2/28/1974
B. Campbell	23N/19E-20-nwnw				D		95	6	13	12/3/1975
D. Holmberg	23N/19E-29-senw						35	6	15	1/1/1940
G. A. Miltner	23N/19E-31-sese	AKH862	4726.22	12029.924	D	1247	84	8	12	6/5/2003
R. H. Hartmann	23N/20E-16-sesw						32		28	6/7/1945
J. Johnson	23N/20E-18-swnw	ACX064	4729.272	12023.173	D	794	218	6	103	7/14/1997
G. Stone	23N/20E-18-nesw	AEQ738	4729.093	12022.739	D	794	258	6	163	8/2/1999
Veterans Administration	23N/20E-18-sesw	AKW732	4729.091	12022.592	D	789	104	6	94	2/21/2003
Pacific Pulp Molding Co.	23N/20E-22-swnw						64		35	12/16/1950
Wenatchee Water CO	23N/20E-28-nesw						30	30	24	2/1/1945
Wenatchee Wenoka Growers	23N/20E-30-sene				Industrial		83		40	9/9/1965
Leavenworth Fish Hatchery 1			4755.5	12067.4167			77.5		33	8/2/1989
Leavenworth Fish Hatchery 2			4755.2778	12067.4722			94.4		28	8/2/1989
Leavenworth Fish Hatchery 3			4755.1944	12067.6389			92		30.4	6/1/1989
Leavenworth Fish Hatchery 4	24N/17E-23-swse		4755.7222	12067.4444	I		237.5	16	24'11"	10/21/1996
Leavenworth Fish Hatchery 5	24N/17E-23-swsw		4755.9444	12067.4444	I		290	20	14	12/11/1979
Leavenworth Fish Hatchery 6	24N/17E-23-nwse		4755.8333	1267.6944	I		170	14	90	11/14/1979
Leavenworth Fish Hatchery 7	24N/17E-23-nwne		4755.2222	12067.4722	I		115	14	12	12/14/1979
R. Keene	24N/17E-1-swnw	AFH411	4736.355	12039.968	D		125	6	28	3/25/2000

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R. Keene	24N/17E-1-swnw	ABX104			D		116	6	32	6/23/1995
R. Keene	24N/17E-1-swnw	ACX077			D		477	6	27	3/25/2000
R. Kimmerly	24N/17E-1-nenw	ACX078	4736.798	12039.656	D		135	6	116	8/7/1997
R. Kimmerly	24N/17E-1-nenw	ACX079	4736.702	12039.651	D		136.5	6	133.5	8/12/1997
H. C. & D. R. Moore	24N/17E-1-swnw	AAJ379	4736.344	12039.974	D		84	6	34	11/19/1993
H. Moore	24N/17E-1-swnw	ABL873	4736.298	12039.997	D		98	6	24	9/29/1994
W. E. Morgan	24N/17E-1-nesw	ACX097	4736.225	12039.482	D		238	6	82	10/25/1997
J. & R. Plkinton	24N/17E-1-nese	AEL828	4736.316	120389.912	D		120	6	40	8/9/1999
L. R. Sarabia	24N/17E-1-nene	AFQ722	4736.658	12038.917	D		26	6	8	1/8/2001
Wheeler	24N/17E-1-swnw	ABX242			D		121.5	6	24.5	2/24/1995
K. W. Wilson	24N/17E-1-nwne	ABL914	4736.761	12012039.38	D		179	6	148	8/18/1994
R. & D. Wise	24N/17E-1-nwne				D		161	6	50	8/10/1978
R. Kimmerly	24N/17E-1-nenw				I		168	8	153	8/21/1978
B. H. Clennon	24N/17E-2-nesw	AEQ722	4736.544	12040.345	D		222	6	148	6/28/1999
B. Clennon	24N/17E-2-nene	ABX250	4736.544	12040.337	D		221.5	6	159	4/5/1995
A. Lampert	24N/17E-12-sene				D		102	6	40	11/9/1974
C. Chase	24N/17E-12-swsw						10	48	6	9/27/1951
B. W. Linderman	24N/17E-12-sesw						24.5	36	16.5	5/5/1948
B. L. Cowell	24N/17E-13-nwne				I		12	30	3.5	9/24/1967
E. Kyne	24N/17E-14				D		80	6	60	2/5/1970
J. Mallard, S. Mallas	24N/17E-23-nwne	AGL831	473405	1204050	D		151	6	116	7/17/2001
W. Hartl	24N/17E-23-senw		473347	1204057	D		138	6	106	9/24/1990
A. Prevost	24N/17E-23-senw	ABL635	473343	1204054	D		176.5	6	85	11/4/1994
R. L. Baker	24N/17E-23-senw	AFH450	473346	1204050	D		170	6	42.5	6/28/2000
Drake Family Partnership	24N/17E-23-sene	AGM351	473351	1204025	D		32	6	13.5	8/27/2001
S. Thornton	24N/17E-23-swne	AFH407			D		72.5	6	13	2/21/2000
O. Christensen	24N/17E-23-swsw		473314	1204103	D		98	6	72	4/3/1989
C. Bergren	24N/17E-23-swse		473320	1204030	D		85	6	37.5	6/28/1989
D. & D. Dailey	24N/17E-24-nene	AGM390	473405	1203858	D		230	6	74	12/10/2001
T. Beemer	24N/17E-24-swnw		473353	120955	D		55	6	15.5	4/24/1990
G. Lunz	24N/17E-24-nwsw		473336	1204001	D		139	6	15	4/23/1987
H. Bullitt	24N/17E-26-senw	ABL531	473258	1204044	D		25	6	12	7/12/1994
G. Griswold	24N/18E-6-swnw				D		80	8	25	11/6/1977
G. W. Fitzsimmons	24N/18E-6-sesw				D		90	6	77	6/10/1969
M. Osborn	24N/18E-6-nwse				D		70	6	30	12/11/1976
D. & P. Howerton	24N/18E-8-nesw	ACX087	4735.354	12037.151	D		548	6	102	9/11/1997
D. H. Mckellar	24N/18E-8-sese	ABL867	4735.061	12036.138	D		75	6	35.5	9/22/1994
J. O. Smith	24N/18E-8-swsw	AEM581	4735.065	12037.316	D		118	6	59.5	10/1/1998
E. G. Clark	24N/18E-8			group domestic/irrigation			66	6		8/24/1968
F. Pflugrath	24N/18E-17-nesw	ABL904	4734.517	12036.928	D		270	6	71	8/12/1994
Peshastin Forest Products	24N/18E-17-nesw				Industrial		60	12	40	
Peshastin Cooperative Growers	24N/18E-17-nese				D		88	8	36'6"	7/14/1953
D. Dittrich	24N/18E-21-sese	AGM389	4733.366	12035.059	D		73	6	46	12/7/2001
J. Russel & G. Pliss	24N/18E-21-nwnw	AGL819	4733.858	12036.236	D		199	6	53	6/19/2001
Big Y Café	24N/18E-21-sese	ABR283	473316	1203456	D		50	6	25	6/9/1984
R. L. Goehner	24N/18E-22-sese	ABX657	4733.395	12033.608	D		104.5	6	61	10/18/1995
Dryden Gun Club	24N/18E-22-nesw		4733.39	12034.834	D		82	6	50	8/1/1975

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J. Guthrie	24N/18E-26-nwnw	ABX245	4733.023	12033.283	D		157	6	57	3/30/1995
Haig Orchard	24N/18E-26-nwse	ACX289	4732.749	12032.875	I		111	6	22	7/26/2001
Miller Orchards	24N/18E-26-nenw	ABL405	4732.896	12033.217			157	8	28	4/22/1994
Mierman Orchards	24N/18E-26-nesw	AAJ535	4732.721	12033.257	D		135	6	96	3/18/1994
D. W. Soles	24N/18E-26-swse	ACX098	4732.34	12032.967	D		42	6	13	10/28/1997
D. Thies	24N/18E-26-nwse	ACL730	4732.722	12033.421	D		171	6	138.5	4/2/1997
PUD #1 of Chelan County	24N/18E-27-nese	ABR282	4754.315	12056.347	M		54.5	8	26	9/10/1982
D. Hansen	24N/18E-27-swse	ABQ443	4732.553	12034.097	D		80	6	14	10/7/1994
D. Knishka	24N/18E-27-senw	ABL910	4732.953	12034.258	D		38.5	6	14	8/2/1994
M. London	24N/18E-27-swse	ACR848	4732.388	12034.47	D		77	6	58	4/15/1998
L. & K. Myrick	24N/18E-27-swse	ACE377	4732.717	12034.267	D		39	6	5	2/19/1996
W. L. Reiman	24N/18E-27-nwsw	AFE473	4732.694	12033.992	D		59	6	31.5	10/28/1999
R. D. Talley	24N/18E-27-sesw	ACX553	4732.529	12034.522	D		649	6	129	11/14/1997
Dodrish	24N/18E-27-nwnw				D		81	6	68	6/15/1976
D. Johnson	24N/18E-32-swnw	ARI396	4731.929	12037.26	D		62.5	6	54	1/12/1994
H. D. Creger	24N/18E-32-nwnw				D		63	6	41	5/4/1975
T. M. Davis	24N/18E-35-nese	ABL512	4731.84	12032.545	D		49	6	17	6/22/1994
J. Krister	24N/18E-35-nese	ABL525	4731.906	12032.448	D		53.5	6	13	6/23/1994
Pearmount Inc.	24N/18E-35-nwse	ABL515	4731.831	12032.802	D		158	6	33	6/20/1994
A. Thompson	24N/18E-35-sese	AFH447	4731.671	12032.514	D		59	6	11	6/19/2000
A. L. Nelson	24N/18E-35-nwse						36.5	36	23	3/25/1951
F. Connery	24N/19E-27-swne						49	36	29.5	7/1/1936
K. Kirschner	24N/19E-31-nwsw	AKH869	4731.787	12030.806	D		219	6	104	6/26/2003
L. Hamilton	24N/19E-32-nesw	AFH422	4731.913	12029.41	D		87	6	54	4/20/2000
A. MCClendon & G. Bates	24N/19E-32-swsw	AFE454	4731.55	12029.739	D		229	6	17	9/14/1999
L. Scott	24N/19E-32-swnw	AFH416	4732.005	12029.68	D		145	6	110	4/6/2000
R. Steigmeyer	24N/19E-32-nwsw	AAJ370	4731.875	12029.69	D		80	6	57.5	12/17/1993
E. B. Sines	24N/19E-32-swsw						14	60	5	1/1/1930
J. M. Hughes	24N/19E-32-sesw						45	36	36	8/15/1947
Circle C Ranch	15N/17E-12-sw				D		135	6	60	6/13/1971
S. J. Schmoker					I		77	8	35	8/27/1977
G. Eldridge					D		95	6	10	6/21/1975
S. J. & J. L. Buckley	25N/18E-18-nese	ABL410	4739.833	12037.854	D		199	6	52	8/15/1994
W. Krieg	25N/18E-18-nenw	AFH431	4767.247	12063.974	D		81	6	1	5/10/2000
G. Cromwell	25N/18E-18-nese	AGL839			D		219	6	3	8/10/2001
R. Hinthorne	25N/18E-18-nese	ABL888			D		77.5	6	8	9/16/1994
J. B. Craig	25N/18E-18-sesw				D		49	6	30	7/18/1977
C. Hinthorne	25N/18E-18-swse				D		34	6	20	6/29/1977
J. M. Brazler	25N/18E-19-nesw	ABL659	4738.885	12038.693	D		78.5	6	11.5	11/2/1994
R. L. Bryan	25N/18E-19-senw	AGL840	4739.241	12038.615	D		57	6	16.5	8/13/2001
E. L. Nashek	25N/18E-19-swsw	ACL739	4738.699	12038.974	D		79.5	6	12	5/8/1997
R. Lyons	25N/18E-19-senw				D		74	6	25	3/25/1977
L. Brender	25N/18E-19-swsw				D		100	6	60	9/2/1971
E. Reynolds	25N/18E-22-sesw				I		93	8	10	8/13/1977
J. Schons	25N/18E-27-nwnw				I		93.5	8	30	8/6/1971
R. Hinthorne	25N/18E-29-s-sw				I		41	8	10	8/3/1977
A. L. Lockhart	25N/18E-30-sesw	AAJ553	4737.742	12038.697	D	1255	63	6	33	3/10/1994
G. Moll	25N/18E-30-swne	AKW745	4738.106	12038.812	D	1275	198	6	2.3	4/10/2003

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R. M. Raines	25N/18E-30-senw	ABL856	4738.33	12038.723	D	1262	58.5	6	13	9/26/1994
P. Burnett	25N/18E-30-senw				ID		72	6	22	7/28/1977
V. Brehm	25N/18E-30-nesw				I		77	6	30	9/8/1977
J. W. Salgado	25N/18E-30-sese				D		38	8	17	10/7/1977
T. A. Pearson	25N/18E-31-nesw	AET967	4737.166	12038.909	D	1185	78	6	12	2/25/1999
O. C. Pearson	25N/18E-31-nesw	AET966			D		79	6	5.5	2/24/1999
G. T. Witt	25N/18E-31-nenw	AGL843	4737.588	12038.627	D	1247	52.5	8	23.5	8/16/2001
O. Pearson	25N/18E-31-senw				D		75	6	75	9/18/1974
C. H. Conard	26N/17E-3-nw						95	6	62	3/21/1963
Alpine Acres	26N/17E-12						58		35	4/11/1969
Mountain Fir Lumber Co.	26N/17E-20-nese	AGJ079	4773.716	12074.308	D		183	6	18	10/5/1984
Primitive Park Company	26N/17E-24						61	10	27	5/27/1963
I. Fisk	26N/18E-17-nenw				D		214	6	28	8/26/1985
B. Silkinson	26N/18E-17-swsw				D		216	6	41	7/4/1978
P. Myhre	26N/18E-29-swsw				D		180	6	50	6/9/1975
N. T. Rose	26N/18E-30-ne				D		150	6	68	6/30/1978
R. Marshall	26N/18E-31-senw				D		90	6	10	8/24/1978
M. Scheibler	26N/18E-31-nwse				D		135	6	60	4/27/1978
USDA	27N/16W-13-nwsw	ABR430	4783.683	12079.922	D		234	8	16	1/21/1978
State of Washington Parks and Rec.	27N/17-28	AGJ089	4780.745	12072.699			167	10	10	4/8/1965
R. E. Strand	27N/17-36						10	36	8	10/31/1950

D = domestic well
I = irrigation well
M = municipal well
D/I = domestic and irrigation

Table 2. Piezometer Construction Details.

Well I.D. Tag No.	Piezometer location	Local number	Site latitude (dd.mm.ss)	Site longitude (ddd.mm.ss)	River mile (miles)	Site altitude (feet)	Piezometer stickup above streambed (feet)	Piezometer depth below streambed (feet)	Depth to midpoint of perforations (feet below streambed)	In-well thermistor depths (feet below streambed)				Hyporheic thermistor depth (feet below streambed)
										upper	middle	other middle	lower	
Wenatchee River														
AGJ731		27N/17E-28K	474833	1204312	53.8	1865	2	5	4.75					
AGJ732		27N/17E-27E	474843	1204238	53.4	1863	2.4	4.6	4.35					
AGJ733		27N/17E-27B	474856	1204157	52.8	1859	2.4	4.6	4.35					
AGJ734		27N/17E-26C	474855	1204105	52	1856	2.2	4.8	4.55					
AGJ735		27N/17E-36E	474757	1204001	50.6	1849	2.2	4.8	4.55					
AGJ736		27N/17E-36G	474748	1203934	50.1	1847	2.6	4.4	4.15					
AGJ737		27N/17E-36Q	474723	1203929	48.5	1839	4.8	2.2	1.95					
AGJ738		26N/17E-01Q	474636	1203332	47.5	1825	3.4	3.6	3.35					
AGJ739		26N/17E-12F	474601	1203941	46.4	1812	3	4	3.75					
AGJ740		26N/17E-13F	474509	1203957	45.4	1797	3.3	3.7	3.45					
AGJ741		26N/17E-24C	474431	1203946	44.4	1787	4.2	2.8	2.55					
AGJ742		26N/17E-24R	474353	1203912	43.2	1771	3.1	3.9	3.65					
AGJ743		25N/17E-03N	474110	1204257	36.9	1680	3.5	3.5	3.25					
AGJ744		25N/17E-09G	474044	1204338	35.9	1662	3.1	3.9	3.65					
AGJ745		26N/17E-25H	474330	1203909	42.6	1765	5	2	1.75					
AGJ746		26N/17E-36E	474233	1204017	40.3	1725	2.9	4.1	3.85					
AGJ747		26N/17E-35M	474229	1204132	39.4	1711	5.5	1.5	1.25					
AGJ726	Above Peshastin, 30 ft below USGS gaging station	24N/18E-08N	473502	1203708	21.5	1025	5	2	1.75					
AGJ726 (AGJ775)	Above Peshastin, 30 ft below USGS gaging station	24N/18E-08N	473502	1203708	21.5	1025	2.3	2.7	2.45	0.5 ft	1.7 ft		2.5 ft	0.40 ft
AGJ727	At Peshastin, about 100 ft above abandoned bldg @ PUD WWTP	24N/18E-17K	473427	1203638	20.6	1015	4.9	2.1	1.85					
AGJ728	Right bank 25 ft above Peshastin Ck confluence	24N/18E-22L	473328	1203424	17.9	975	3.3	3.7	3.45					
AGJ728 (AGJ776)	Right bank 25 ft above Peshastin Ck confluence	24N/18E-22L	473328	1203424	17.9	975	3	4	3.75	0.75 ft	1.6 ft		3.9 ft	
AGJ749		24N/18E-26M	473237	1203329	16	916	5.3	1.7	1.45					
AGJ729	Below dryden septic drainfield, right bank	24N/18E-26M	473234	1203328	15.9	915	2.7	4.3	4.05					
AGJ729 (AGJ777)	Below dryden septic drainfield, right bank	24N/18E-26M	473234	1203328	15.9	915	1	4	3.75	0.9 ft	1.5 ft	2.1 ft	3.8 ft	
AGJ730	About 100 ft below old monitor bridge	23N/19E-11L	473003	1202528	7.1	705	2.9	4.1	3.85					
Icicle Creek														
AGJ724	Leavenworth hatchery, 100 ft below new channel headworks	24N/17E-26G	473259	1204035	3.8	1135	3.6	3.4	3.15					
AGJ724 (AGJ774)	Leavenworth hatchery, 100 ft below new channel headworks	24N/17E-26G	473259	1204035	3.8	1135	3.7	3.3	3.05	0.3 ft	1.9 ft		3.1 ft	
AGJ748		24N/17E-23H	473339	1204003	2.4	1117	2.8	4.2	3.95					

Table 2. Piezometer Construction Details.

Well I.D. Tag No.	Piezometer location	Local number	Site latitude (dd.mm.ss)	Site longitude (ddd.mm.ss)	River mile (miles)	Site altitude (feet)	Piezometer stickup above streambed (feet)	Piezometer depth below streambed (feet)	Depth to midpoint of perforations (feet below streambed)	In-well thermistor depths (feet below streambed)				Hyporheic thermistor depth (feet below streambed)
										upper	middle	other middle	lower	
AGJ725	1/4 mile upstream of mouth, right bank on Martin's property	24N/17E-13C	473445	1203940	0.2	1095	2	5	4.75					
Chumstick Creek														
AGJ778	At lower gage	24N/17E-01J	473617	1203854			2.9	2.1	1.85					
AGJ779	At Sunitsch Rd.	25N/18E-18B	474020	1203827			2.1	4.9	4.65	1.3 ft	3.3 ft		4.7 ft	
Brender Creek														
AGJ780	At Hinman	23N/19E-06J	473100	1202956			2.4	4.6	4.35	0.3 ft	1.7 ft		4.4 ft	
AGJ781	At Pioneer	23N/19E-06K	473101	1203006			1.7	5.3	5.05	1.2 ft	3.2 ft		5.1 ft	
Mission Creek														
AGJ787	At FS boundary	22N/19E-07G	472501	1203033			2.9	2.1	1.85	0.45 ft	1.15 ft		2.0 ft	0.50 ft
AGJ794	At Shelton tree farm	23N/19E-20M	472811	1202926			3.7	3.3	3.05	0 ft	0.5 ft	1.05 ft	3.2 ft	0.40 ft
AGJ795	At Fletcher property	22N/19E-06H	472558	1203004			3.9	3.1	2.85	0.45 ft	1.2 ft		3.0 ft	0.50 ft
AGJ796	At Woodring Rd.	23N/19E-08R	472944	1202837			3.2	1.8	1.55	0.4 ft	0.8 ft		1.7 ft	0.50 ft
AGJ797	At Bindor Rd.	23N/19E-09D	473035	1202824			2.7	4.3	4.05	3.2 ft	3.7 ft		4.2 ft	0.50 ft
AGJ798	At Sunset Ave.	23N/19E-05A	473117	1202830			2.5	4.5	4.25	1.35 ft	2.55 ft		3.75 ft	0.40 ft
Peshastin Creek														
AGJ785	At lower gage	24N/18E-22N	473326	1203451			2.2	2.8	2	0.5 ft	1.8 ft		2.7 ft	0.50 ft
AGJ786	At Roller Coaster Rd	24N/18E-28D	473307	1203607			3.1	1.9	2.55	0.1 ft	0.9 ft		1.75 ft	0.40 ft
AGJ799	At white trailer	24N/18E-32N	473137	1203724			3.2	1.8	1.55	0.3 ft	0.8 ft		1.7 ft	
AGJ800	At upper site near bridge crossing	22N/17E-13F	472349	1203918			2.5	4.5	4.25	0.7 ft	3.15 ft		4.3 ft	0.50 ft
Nason Creek														
AGJ783	At DOT Berne Maintenance Facility	26N15E-03R	474625	1205804			2.3	2.7	2.45	-0.4 ft	1.1 ft		2.7 ft	0.50 ft
AGJ788	At Lk Wenatchee trailhead	27N/17E-33A	474805	1204257			3.4	3.6	3.35	-0.55 ft	0.2 ft	1.1 ft	3.4 ft	0.50 ft
AGJ789	At Hwy 59 diner	26N/17E-08R	474539	1204425			2.7	2.3	2.05	0.90 ft	1.65 ft		2.2 ft	0.40 ft
AGJ790	At Dardaniels Rd.	26N/16E-11H	474608	1204828			2.7	4.3	4.05	0.4 ft	1.3 ft	2.3 ft	4.25 ft	
AGJ791	At Lake Ethyl trailhead	26N/16E-03L	474644	1205006			3.1	3.9	3.65	0.05 ft	0.85 ft	1.95 ft	3.95 ft	
AGJ792	At White Pine	26N/15E-01P	474631	1205502			3.1	1.9	1.65	- 0.3 ft	0.4 ft	1.1 ft	1.9 ft	
AGJ793	At FS Rd 6700	26N/14E-01J	474705	1210208			3.3	1.7	1.45	0.0 ft	0.6 ft		1.65 ft	

Table 3. Summary of Field Data, Water Level Data, and Vertical Hydraulic Gradient for In-Stream Piezometers.

Well I.D. Tag No.	River mile	Sample date	Temperature (°C)		Specific conductance µS/cm@25°C		Electric tape readings (feet)			Average head difference measured with manometer (feet))	Vertical hydraulic gradient (dh/dl) (dimensionless)	Flow condition
			River water	Ground water	River water	Ground water	Ground water	Stream stage	Head difference			
Wenatchee River												
AGJ731	53.8	8/19/02	19.8	12.4	21	72 *	2.33	1.45	-0.88	NA	-0.185	GW recharge
AGJ732	53.4	8/19/02	21.4	16.2	24	28	1.89	1.83	-0.06	-0.03	-0.014	GW recharge
AGJ733	52.8	8/19/02	18	12.8	24	32	1.87	1.95	0.08	**0.09**	0.018	GW discharge
AGJ734	52	8/19/02	18.2	12.3	24	119	1.84	1.85	0.01	**0.005**	0.002	GW discharge
AGJ735	50.6	8/20/02	17	11.9	24	38	1.42	1.45	0.03	**0.03**	0.007	GW discharge
AGJ736	50.1	8/20/02	17.9	13.3	21	53	1.18	NA	NA	-0.01	-0.002	GW recharge
AGJ737	48.5	8/20/02	18.4	12.8	24	79	4.48	4.49	0.01	**0.015**	0.005	GW discharge
AGJ738	47.5	8/20/02	18.1	12.8	40	121	2.34	2.33	-0.01	**0.004**	-0.003	GW discharge
AGJ739	46.4	8/20/02	17.1	12	32	111	2.22	2.22	0	-0.0026	0.000	GW recharge
AGJ740	45.4	8/21/02	15.1	12.6	32	108	1.91	2	0.09	**0.09**	0.026	GW discharge
AGJ741	44.4	8/21/02	16.2	17.2	31	31	3.71	3.48	-0.23	-0.23	-0.090	GW recharge
AGJ742	43.2	8/21/02	17.3	12.5	32	217	2.49	2.49	0	**0.01**	0.003	GW discharge
AGJ743	36.9	8/21/02	18	11.2	32	43	3.04	3.09	0.05	**0.05**	0.015	GW discharge
AGJ744	35.9	8/21/02	16.8	11.8	32	31	1.72	1.89	0.17	**0.15**	0.047	GW discharge
AGJ745	42.6	8/22/02	17.7	16.4	31	34	NA	4.59	NA	**0.01**	0.006	GW discharge
AGJ746	40.3	8/22/02	17.3	14.1	32	86	NA	2.12	NA	**0.01**	0.003	GW discharge
AGJ747	39.4	8/22/02	18.4	16.3	32	34	NA	4.33	NA	**0.01**	0.008	GW discharge
AGJ726	21.5	7/30/02	15.1	NA	29	291	3.22	3.23	0.01	NA	0.006	GW discharge
		8/18/02	17.8	16.5	36	291	4.83	4.84	0.01	NA	0.006	GW discharge
		10/10/02	10.1	NA	49	351	5.97	NA	NA	NA		NA
		7/15/03	17.9	16.5	32	418	3.71	3.79	0.08	NA	0.046	GW discharge
		7/21/03	-	-	-	-	4.27	4.29	0.02	NA	0.011	GW discharge
AGJ726	21.5	7/15/03	17.9	15.2	32	372	-	1.03	NA	NA		
(AGJ775)*		7/21/03	19.6	14.9	35	433	1.53	1.51	-0.02	NA	-0.008	
		8/12/03	20.5	16.5	45	392	2.63	-	NA	NA		
		9/17/03	12.2	13.4	45	372	3.2	-	NA	0	0.000	
		10/20/03	11.7	10.8	35.7	418	0.95	0.94	-0.01	NA	-0.004	

Table 3. Summary of Field Data, Water Level Data, and Vertical Hydraulic Gradient for In-Stream Piezometers.

Well I.D. Tag No.	River mile	Sample date	Temperature (°C)		Specific conductance µS/cm@25°C		Electric tape readings (feet)			Average head difference measured with manometer (feet))	Vertical hydraulic gradient (dh/dl) (dimensionless)	Flow condition
			River water	Ground water	River water	Ground water	Ground water	Stream stage	Head difference			
AGJ727	20.6	7/30/02	15.5	15.4	29	236	2.9	NA	NA	-0.01	-0.005	GW recharge
		8/18/02	18.7	17.2	37	118	4.32	NA	NA	**0.01**	0.005	GW discharge
		10/10/02	9.9	12.8	49	73	5.48	NA	NA	**0.01**	0.005	GW discharge
AGJ728	17.9	7/30/02	16	16.6	32	47	1.15	1.04	-0.11	-0.09	-0.032	GW recharge
		8/18/02	18.7	17.9	51	124	2.31	2.46	0.15	**0.16**	0.043	GW discharge
		8/23/02	20.2	17.6	57	128	2.57	2.8	0.23	**0.3**	0.067	GW discharge
		10/10/02	11.5	10.6	72	153	3.09	3.21	0.12	**0.12**	0.035	GW discharge
		7/15/03	18.2	17.3	37	43	1.67	1.53	-0.14	NA	-0.041	GW recharge
		7/21/03	-	-	-	-	2.04	2.09	0.05	NA	0.014	GW discharge
		8/11/03	-	-	-	-	2.91	3.09	0.18	NA	0.052	GW discharge
AGJ728 (AJG776)*	17.9	7/15/03	18.2	18.1	37	44	1.05	0.92	-0.13	-0.13	-0.035	GW recharge
		7/21/03	20.3	16.9	40	95	1.47	1.42	-0.05	NA	-0.013	GW recharge
		8/11/03	21.6	19.6	55	118	2.31	2.47	0.16	NA	0.043	GW discharge
		9/15/03	15.4	13.8	59	116	2.62	2.7	0.08	NA	0.021	GW discharge
		11/17/03	5	5	53	56	1.94	1.68	-0.26	NA	-0.069	GW recharge
AGJ749	16	8/23/02	19.6	16.3	46	118	NA	4.1	NA	**0.035**	0.024	GW discharge
AGJ729	15.9	7/30/02	16.5	13.2	32	634	1.62	1.62	0	**0.018**	0.004	GW discharge
		8/18/02	18.8	15	43	601	3.55	NA	NA	**0.018**	0.004	GW discharge
		8/23/02	19.3	15.2	46	579	NA	NA	NA	**0.024**	0.006	GW discharge
		10/10/02	11.3	14.2	63	355	NA	NA	NA	**0.01**	0.002	GW discharge
AGJ729 (AGJ777)*	15.9	7/23/03	21.2	14.6	40	388	0.3	0.3	0	0	0.000	No measurable gradient
		8/14/03	17.1	16.1	55	430	1.84	-	NA	**0.04**	0.011	GW discharge
		8/19/03	20.2	16.2	56	428	1.94	-	NA	-		
		9/15/03	15.3	15.4	66	368	2.46	-	NA	0.09	0.024	GW discharge
		9/30/03	14	15	75	376	2.35	-	NA	-		
		11/17/03	5.2	8.8	48	478	0.56	0.58	0.02	-	0.005	GW discharge
AGJ730	7.1	7/30/02	17.6	13.9	36	44	1.14	NA	NA	NA	0.000	No measurable difference
		8/23/02	17.5	16.6	55	71	2.82	2.84	0.02	**0.01**	0.007	GW discharge
		10/10/02	12	NA	82	NA	NA	NA	NA	**NA**		NA
Icicle Creek												
AGJ724	3.8	7/30/02	13.4	11.1	35	48	1.95	1.99	0.04	**0.05**	0.013	GW discharge
		8/19/02	13.5	11.9	46	51	2.75	2.82	0.07	**0.09**	0.022	GW discharge
		10/9/02	NA	NA	NA	NA	6.57	Dry	NA	**NA**		NA
		7/15/03	14.6	13	36	64	2.11	2.14	0.03	-0.01	0.010	
		7/23/03	-	-	-	-	2.43	2.43	0	NA	0.000	No measurable gradient
		8/12/03	-	-	-	-	2.92	2.93	0.01	NA	0.003	

Table 3. Summary of Field Data, Water Level Data, and Vertical Hydraulic Gradient for In-Stream Piezometers.

Well I.D. Tag No.	River mile	Sample date	Temperature (°C)		Specific conductance µS/cm@25°C		Electric tape readings (feet)			Average head difference measured with manometer (feet))	Vertical hydraulic gradient (dh/dl) (dimensionless)	Flow condition
			River water	Ground water	River water	Ground water	Ground water	Stream stage	Head difference			
AGJ724	3.8	7/15/03	14.9	15.4	37	53	0.95	0.93	-0.02	-0.01	-0.007	
(AGJ774)*		7/23/03	15.8	13.4	39	62	1.26	1.23	-0.03	-0.01	-0.010	
		8/12/03	13.9	14.5	38	50	1.72	1.71	-0.01	-0.02	-0.003	
		9/16/03	Dry	14.7	Dry	76	5.1	Dry	NA	NA		
		10/22/03	10.9	10.4	33.9	51	0	0.01	0.01		0.003	
AGJ748	2.4	8/23/02	14.3	10.1	54	184	1.67	1.8	0.13	**0.13**	0.033	GW discharge
AGJ725	0.2	7/30/02	13.9	9.5	37	87	0.35	0.36	0.01	**0.02**	0.002	GW discharge
		8/23/02	NA	NA	NA	NA	NA	NA	NA	**0.01**	0.002	GW discharge
		10/10/02	8.8	10.7	55	52	1.34	1.28	-0.06	**-0.04**	-0.13	GW recharge
Chumstick Creek												
AGJ778		8/18/03	13.2	12.8	300	276	2.53	2.44	-0.09	NA	-0.049	GW recharge
		8/19/03	13.1	12.8	287	278	2.5	2.41	-0.09	NA	-0.049	GW recharge
		9/16/03	11.6	11.7	154	210	2.33	2.23	-0.1	NA	-0.054	GW recharge
		10/20/03	10.3	10.1	326	330	2.31	2.39	0.08	NA	0.043	GW discharge
AGJ779		8/18/03	15.6	12.4	306	231	-	1.55	NA	NA		
		8/19/03	15.1	12	305	238	1.55	1.5	-0.05	NA	-0.011	GW recharge
		9/17/03	7.5	11.3	268	207	1.71	1.44	-0.27	NA	-0.058	GW recharge
		9/30/03	9.4	11	314	244	1.53	1.49	-0.04	NA	-0.009	GW recharge
		10/20/03	9.9	10.1	308	238	1.21	1.2	-0.01	NA	-0.002	GW recharge
Brender Creek												
AGJ780		7/23/03	14.9	11.8	296	396	0.74	1.67	**0.93**	NA	0.214	GW discharge
		8/14/03	12.5	11.2	350	431	0.69	1.7	**1.01**	NA	0.232	GW discharge
		8/19/03	13.4	11.5	337	448	0.65	1.69	**1.04**	NA	0.239	GW discharge
		9/17/03	9.7	11.3	120	367	0.3	1.12	**0.82**	NA	0.189	GW discharge
		9/30/03	12.9	11.3	158	466	0.4	1.3	**0.9**	NA	0.207	GW discharge
		10/21/03	11.8	11.2	396	388	0.69	1.73	**1.04**	NA	0.239	GW discharge
AGJ781		7/23/03	14.7	12.6	262	391	1.15	0.97	-0.18	NA	-0.036	GW recharge
		8/14/03	12.8	12.1	300	445	1.18	1.02	-0.16	NA	-0.032	GW recharge
		8/18/03	14.1	12	288	448	1.14	0.94	-0.2	NA	-0.040	GW recharge
		9/17/03	10.1	11.9	108	375	0.9	0.75	-0.15	NA	-0.030	GW recharge
		9/30/03	12.7	12.3	132	449	0.98	0.75	-0.23	NA	-0.046	GW recharge
		10/21/03	11.6	11.9	343	451	1.23	1.11	-0.12	NA	-0.024	GW recharge
Mission Creek												
AGJ787		6/12/03	13.2	10.8	150	161	2.24	2.24	0	-0.01	-0.005	GW recharge
		7/14/03	15.3	13.2	175	205	2.45	2.44	-0.01	-0.005	-0.005	GW recharge
		7/22/03	13.8	13.8	179	209	2.48	2.47	-0.01	NA	-0.005	GW recharge
		8/11/03	17.2	14.3	195	222	2.55	2.54	-0.01	-0.01	-0.005	GW recharge
		9/15/03	11.6	11.1	183	195	2.62	2.61	-0.01	-0.02	-0.005	GW recharge
		10/21/03	10.6	9.8	167.2	228	2.29	2.29	0	NA	0.000	No measurable gradient

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Well I.D. Tag No.	River mile	Sample date	Temperature (°C)		Specific conductance µS/cm@25°C		Electric tape readings (feet)			Average head difference measured with manometer (feet))	Vertical hydraulic gradient (dh/dl) (dimensionless)	Flow condition
			River water	Ground water	River water	Ground water	Ground water	Stream stage	Head difference			
AGJ794		6/10/03	14	12.1	185	354	3.06	2.93	-0.13	-0.11	-0.043	GW recharge
		7/14/03	16.3	15	224	270	3.37	3.19	-0.18	-0.16	-0.059	GW recharge
		7/22/03	17.3	15.9	234	245	3.44	3.24	-0.2	NA	-0.066	GW recharge
		8/11/03	18.9	17	229	245	3.5	3.31	-0.19	NA	-0.062	GW recharge
		9/15/03	13.8	13.2	260	306	3.65	3.42	-0.23	-0.22	-0.075	GW recharge
		10/21/03	11.3	10.1	204	306	3.22	3.09	-0.13	NA	-0.043	GW recharge
AGJ795		6/10/03	12.9	9.5	173	418	3.2	3.2	0	**0.03**	0.011	
		7/14/03	16.5	11.4	203	380	3.46	3.46	0	**0**	0.000	
		7/22/03	14.4	11.6	208	392	3.5	3.5	0	**0.01**	0.004	
		8/11/03	18.1	12.6	196	334	3.58	3.59	0.01	**0**	0.004	
		9/15/03	11.6	11.2	206	309	3.64	3.65	0.01	**0**	0.004	
		10/21/03	10.7	10.1	185.6	353	3.32	3.35	0.03	**NA**	0.011	
AGJ796		6/10/03	15	10.1	196	352	2.47	2.55	0.08	**0.12**	0.052	GW discharge
		7/14/03	18.9	10.4	260	346	2.77	2.91	0.14	**0.14**	0.090	GW discharge
		7/22/03	21.3	10.4	274	346	2.93	3.05	0.12	NA	0.077	GW discharge
		8/11/03	14.4	11.3	379	340	3.16	3.22	0.06	NA	0.039	GW discharge
		8/19/03	12.9	13.2	412	390	3.24	Dry	NA	NA		
		9/15/03	Dry	13.8	Dry	383	3.99	Dry	NA	NA		
		9/30/03	Dry	14	Dry	425	4.15	Dry	NA	NA		
		10/21/03	11.7	11.1	223	395	2.57	2.61	0.04	NA	0.026	
AGJ797		6/10/03	15	14.8	197	192	4.4+	1.58	> -2.84	NA		GW recharge
		7/14/03	19.2	15.8	244	257	5.73	2.05	-3.68	NA	-0.909	GW recharge
		7/22/03	19.5	18.8	301	299	6.17	2.23	-3.94	NA	-0.973	GW recharge
		8/11/03	19.2	18.6	202	217	6.14	2.31	-3.83	NA	-0.946	GW recharge
		9/15/03	14.1	13	165	198	6.19	2.2	-3.99	NA	-0.985	GW recharge
		10/21/03	12.1	11.4	244	284	4.62	1.76	-2.86	NA	-0.706	GW recharge
AGJ798		6/10/03	14.8	10.7	192	594	1.93	1.86	-0.07	-0.06	-0.016	GW recharge
		7/14/03	19.1	14.1	262	549	2.64	2.17	-0.47	-0.37	-0.111	GW recharge
		7/22/03	18.7	14.6	277	539	2.83	2.4	-0.43	NA	-0.101	GW recharge
		8/11/03	Dry	14.4	Dry	531	3.3	Dry	NA	NA		NA
		9/15/03	14.4	14.2	182	600	2.84	2.32	-0.52	NA	-0.122	GW recharge
		10/21/03	12.5	12.9	256	603	2.68	2.02	-0.66	NA	-0.155	GW recharge
Peshastin Creek												
AGJ785		6/13/03	9.6	10.1	74	81	3.08	2.6	-0.48	-0.47	-0.240	GW recharge
		7/15/03	20.1	15.7	91	96	2.08	1.67	-0.41	-0.41	-0.205	GW recharge
		7/21/03	22.5	17.4	103	105	2.17	1.78	-0.39	NA	-0.195	GW recharge
		8/11/03	21	18.5	129	125	2.5	2.2	-0.3	NA	-0.150	GW recharge
		9/15/03	13.5	12.9	114	116	2.59	2.14	-0.45	NA	-0.225	GW recharge
		10/20/03	9.9	9.5	93.5	126.6	1.52	0.92	-0.6	NA	-0.300	GW recharge

Table 3. Summary of Field Data, Water Level Data, and Vertical Hydraulic Gradient for In-Stream Piezometers.

Well I.D. Tag No.	River mile	Sample date	Temperature (°C)		Specific conductance µS/cm@25°C		Electric tape readings (feet)			Average head difference measured with manometer (feet))	Vertical hydraulic gradient (dh/dl) (dimensionless)	Flow condition
			River water	Ground water	River water	Ground water	Ground water	Stream stage	Head difference			
AGJ786		6/13/03	9	9.3	66	71	NA	NA	NA	-0.06	-0.024	GW recharge
		7/15/03	18.1	14.9	81	81	2.01	1.98	-0.03	-0.03	-0.012	GW recharge
		7/21/03	21.2	16.9	103	104	2.13	2.11	-0.02	NA	-0.008	GW recharge
		8/11/03	18.5	16.7	135	134	2.38	2.35	-0.03	-0.05	-0.012	GW recharge
		9/15/03	12.4	12.2	125	124	2.58	2.38	-0.2	NA	-0.078	GW recharge
		10/20/03	9.7	9.7	95.4	105.6	1.35	1.24	-0.11	NA	-0.043	GW recharge
AGJ799		6/9/03	11	8.6	70	77	3.39	3.17	-0.22	-0.3	-0.142	GW recharge
		7/15/03	17.5	15.6	108	111	2.6	2.36	-0.24	-0.2	-0.155	GW recharge
		7/21/03	19.8	17.8	115	115	2.69	2.45	-0.24	NA	-0.155	GW recharge
		8/11/03	17	15.6	147	150	2.91	2.68	-0.23	-0.23	-0.148	GW recharge
		9/15/03	11.9	11.1	150	151	3.07	2.8	-0.27	NA	-0.174	GW recharge
		10/20/03	9.5	9.4	88.7	122.6	2.19	1.84	-0.35	NA	-0.226	GW recharge
AGJ800		6/9/03	13.6	NA	121	NA	NA	NA	NA	NA		NA
		7/9/03	16.4	10.1	155	371	6.03	2.3	-3.73	NA	-0.878	GW recharge
		7/21/03	19.4	11.4	158	414	5.93	2.29	-3.64	NA	-0.856	GW recharge
		8/11/03	14.9	12.6	171	532	5.78	2.38	-3.4	NA	-0.800	GW recharge
		9/15/03	8.2	11.1	153	-	6.72	2.39	-4.33	NA	-1.019	GW recharge
		10/20/03	9.5	8.8	160.2	-	6.7	2.16	-4.54	NA	-1.068	GW recharge
Nason Creek												
AGJ783		6/25/03	9.9	5	18	27	0.78	0.98	0.2	**0.16**	0.082	GW discharge
		7/10/03	14.1	5.5	23	28	1.25	1.4	0.15	NA	0.061	GW discharge
		7/22/03	17.9	6.8	27	56	1.69	1.78	0.09	NA	0.037	GW discharge
		8/12/03	12.9	9.8	28	25.4	NA	NA	NA	**0.02**	0.008	GW discharge
		9/16/03	8.4	10.3	-	-	1.97	1.94	-0.03	NA	-0.012	GW recharge
		10/22/03	7.9	7.9	21.3	41.6	0.62	0.6	-0.02	NA	-0.008	GW recharge
AGJ788		6/12/03	9.9	7.4	20	155	0.45	0.35	-0.1	NA	-0.030	GW recharge
		7/11/03	17	11.4	33	162	2.04	1.85	-0.19	NA	-0.057	GW recharge
		7/22/03	21.8	12.8	38	-	2.31	2.2	-0.11	NA	-0.033	GW recharge
		8/12/03	18.2	14.4	46	122	2.52	2.4	-0.12	-0.13	-0.036	GW recharge
		9/16/03	13	12.6	44	125	2.72	2.57	-0.15	-0.13	-0.045	GW recharge
		10/21/03	10.1	9.3	21.8	102.4	0.34	0.23	-0.11	NA	-0.033	GW recharge
AGJ789		6/12/03	7.4	8.1	19	22	1.04	0.96	-0.08	-0.08	-0.039	GW recharge
		7/15/03	12.9	13.4	33	32	4.47	4.32	-0.15	-0.14	-0.073	GW recharge
		7/22/03	19.8	16.1	37	49	2.66	2.48	-0.18	NA	-0.088	GW recharge
		8/12/03	17.8	16	39	37	2.8	NA	NA	-0.14	-0.068	GW recharge
		9/16/03	12.2	11.3	-	-	3.11	3.05	-0.06	NA	-0.029	GW recharge
		10/21/03	9.8	8.8	21.7	29.2	1.1	1.02	-0.08	NA	-0.039	GW recharge

Table 3. Summary of Field Data, Water Level Data, and Vertical Hydraulic Gradient for In-Stream Piezometers.

Well I.D. Tag No.	River mile	Sample date	Temperature (°C)		Specific conductance µS/cm@25°C		Electric tape readings (feet)			Average head difference measured with manometer (feet))	Vertical hydraulic gradient (dh/dl) (dimensionless)	Flow condition
			River water	Ground water	River water	Ground water	Ground water	Stream stage	Head difference			
AGJ790		6/11/03	9.9	7.3	20	24	0.53	0.53	0	NA	0.000	No measurable gradient
		7/11/03	12.2	10.9	30	29	2.55	2.56	0.01	NA	0.002	
		7/22/03	18.5	12.2	33	49	2.92	2.91	-0.01	NA	-0.002	
		8/12/03	16.1	12	38	38	3.14	3.15	0.01	NA	0.002	
		9/16/03	13.1	11.1	34.9	36.4	3.26	3.24	-0.02	-0.02	-0.005	
		10/22/03	9.3	10.5	25.1	35.3	1.69	1.71	0.02	NA	0.005	
AGJ791		6/11/03	9.2	5.8	20	35	1.52	1.58	**0.06**	NA	0.016	GW discharge
		7/10/03	15.2	9.3	29	33	2.7	2.71	**0.01**	NA	0.003	GW discharge
		7/22/03	18.3	12.3	34	62	2.92	2.89	-0.03	NA	-0.008	GW recharge
		8/12/03	14.4	13	34	36	3.09	3.08	-0.01	NA	-0.003	GW recharge
		9/16/03	10.4	10.6	-	-	3.21	3.16	-0.05	-0.4	-0.014	GW recharge
		10/22/03	8.9	7.8	25.4	38	2.19	2.18	-0.01	NA	-0.003	
AGJ792		6/11/03	8	7.3	15	17	NA	NA	NA	**0.04**	0.024	GW discharge
		7/10/03	13.2	11.5	22	26	2.24	2.26	0.02	NA	0.012	GW discharge
		7/22/03	17.7	16.5	26	29	2.56	2.53	-0.03	NA	-0.018	GW recharge
		8/12/03	13.1	13.1	26	27	2.74	2.73	-0.01	NA	-0.006	GW recharge
		9/16/03	9.2	9.2	-	-	2.87	2.83	-0.04	-0.06	-0.024	GW recharge
		10/22/03	8.4	8.4	20.1	23.4	1.36	1.36	NA	0	0.000	No measurable gradient
AGJ793		6/11/03	4.7	4.6	13	194	2.1	2.15	0.05	**0.08**	0.034	GW discharge
		7/10/03	10.6	6.9	21	174	2.87	3.05	0.18	NA	0.124	GW discharge
		7/22/03	16.4	9.5	25	139	3.13	3.26	0.13	NA	0.090	GW discharge
		8/12/03	12.4	12.8	46	71	3.27	3.36	0.09	NA	0.062	GW discharge
		9/16/03	7.8	9.6	32.4	-	3.29	3.36	0.07	NA	0.048	GW discharge
		10/22/03	7.6	7.8	18.1	161.7	2.03	2.18	0.15	NA	0.103	GW discharge

* - New install

Note: Head differences and sign convention for water level data calculated: SW head - GW head = difference.
Negative gradients indicate loss of water from the stream to groundwater, and positive gradients indicate groundwater discharge into the stream.

Table 4. Quality Assurance Review of Laboratory Duplicate Samples and Laboratory Method Blanks.

Sample Date		Total Nitrate+ Nitrite (as N) (mg/L)	Total Persulfate Nitrogen (mg/L)	Ammonia (mg/L)	Ortho-Phosphate (mg/L)	Total Phosphorus (mg/L)	Total Coliform (CFU/100mL)	Fecal Coliform (CFU/100mL)	Chloride (mg/L)	Total Alkalinity (mg/L)	Dissolved Organic Carbon (mg/L)
8/19-25/02	Value	0.03		0.010 U	0.0098				0.23	27.00	1.0 U
	Duplicate	0.029		0.010 U	0.0110				0.24	26.00	1.0 U
	StdDev	0.0007			0.0008				0.0071	0.7071	
	RPD (%)	3.39			*-11.54*				-4.26	3.77	
	%RSD	2.40			8.16				3.01	2.67	
	Blank	0.010 U		0	0.0030 U				0.1 U	5.0 U	1.0 U
09/04/02	Value	0.484	0.164				7	1 U	7.13		
	Duplicate	0.487	0.182				11	1 U	7.09		
	StdDev	0.0021	0.0127				2.8284		0.0283		
	RPD (%)	-0.62	*-10.40*				-44.44		0.56		
	%RSD	0.44	7.36				31.43		0.40		
10/10/2002	Value				0.841					35.00	1.0 U
	Duplicate				0.905					35.00	1.0 U
	StdDev				0.0453					0.0000	
	RPD (%)				-7.33					0.00	
	%RSD				5.18					0.00	
	Blank	0.010 U		0.010 U	0.0030 U				0.1 U	5.0 U	1.0 U
12/10/02	Value	0.133	0.243				1 U	1 U	1.4		
	Duplicate	0.132	0.24				1 U	1 U	1.34		
	StdDev	0.0007	0.0021						0.0424		
	RPD (%)	0.75	1.24						4.38		
	%RSD	0.53	0.88						3.10		
8/19/2003	Value			0.010 U				1 U	3.24	113.00	
	Duplicate			0.010 U				1.00	3.20	113.00	
	StdDev								0.0283	0.0000	
	RPD (%)								1.24	0.00	
	%RSD								0.88	0.00	
	Blank	0.010 U		0.010 U	0.0030 U				0.1 U	5.0 U	1.0 U
9/30/2003	Value			0.010 U	0.017			1.00			1.20
	Duplicate			0.010 U	0.017			1.00			1.30
	StdDev				0.0000			0.0000			0.0707
	RPD (%)				0.00			0.00			-8.00
	%RSD				0.00			0.00			5.66
	Blank	0.010 U		0.010 U	0.0030 U				0.10 U	5.0 U	1.0 U

Data in italics did not meet target for accuracy, precision or bias.

Result data qualifiers: U - The analyte was not detected at or above the reported value; J - The analyte was positively identified, and the reported value is an estimate;
UJ - The analyte was not detected at or above the reported estimated value.

RPD (%) - relative percent difference: The numeric difference between duplicate sample pairs divided by their mean, with the result expressed as a percentage.

%RSD - percent relative standard deviation: Calculated for a pair of results, x1 and x2, as 100*s/(average[x1 and x2]), where s is the standard deviation of the sample pair.

Table 5. Quality Assurance Review of Field Duplicate Samples.

Sample Date		Total Nitrate+ Nitrite (as N) (mg/L)	Total Persulfate Nitrogen (mg/L)	Ammonia (mg/L)	Ortho-Phosphate (mg/L)	Total Phosphorus (mg/L)	Total Coliform (CFU/100mL)	Fecal Coliform (CFU/100mL)	Chloride (mg/L)	Total Alkalinity (mg/L)	Total Dissolved Solids (mg/L)	Total Suspended Solids (mg/L)	Total Organic Carbon (mg/L)	Dissolved Organic Carbon (mg/L)	Total Iron (ug/L)	Total Manganese (ug/L)
8/19-25/02	Value	0.013	0.025 U	0.010 U	0.0076 J	0.0052			0.87	64.80	79.00	1 U	1.0 U	1.0 U		
	Duplicate	0.012	0.025 U	0.010 U	0.0072 J	0.0049			0.91	64.60	83.00	1 U	1.0 U	1.0 U		
	StdDev	0.0007				0.0002			0.0283	0.1414	2.8284					
	RPD (%)	8.00				5.94			-4.49	0.31	-4.94					
	%RSD	5.66				4.20			3.18	0.22	3.49					
	Blank	0.01 U	0.039	0.011	0.0033	0.0329			0.11	5.0 U	8	13	1.0 U	1		
09/04/02	Value	0.484J	0.451				1U	1U	1.35						50U	10U
	Duplicate	0.484J	0.514				1U	1U	1.33						50U	10U
	StdDev		0.0445						0.0141							
	RPD (%)		*-13.06*						1.49							
	%RSD		9.23						1.06							
10/10/2002	Blank	0.010 U	0.025 U	0.010 U	0.003 U	0.003 U			0.1 U	5.0 U	1 U	1 U	1.0 U	1.0 U		
12/10/02	Value		0.48				2	1 U	1.4						25U	5U
	Duplicate		0.464				2	1 U	1.38						25U	5U
	StdDev		0.0113				0.0000		0.0141							
	RPD (%)		3.39				0.00		1.44							
	%RSD		2.40				0.00		1.02							
8/19/2003	Value	3.49	3.24	0.010 U	0.244	0.252		1 U	6.87	182			1.4	1.4		
	Duplicate	3.46	3.39	0.010 U	0.243	0.252		1 U	7.04	181			1.7	1.4		
	StdDev	0.0212	0.1061		0.0007	0.0000			0.1202	0.7071			0.2121	0.0000		
	RPD (%)	0.86	-4.52		0.41	0.00			-2.44	0.55			*-19.35*	0.00		
	%RSD	0.61	3.20		0.29	0.00			1.73	0.39			13.69	0.00		
9/30/2003	Value	2.98	3.62	0.010 U	0.168	0.169		1 U	6.21	137			1	1.2		
	Duplicate	2.85	3.32	0.010 U	0.168	0.171		1 U	6.18	137			1	1.3		
	StdDev	0.0919	0.2121		0.0000	0.0014			0.0212	0.0000			0.0000	0.0707		
	RPD (%)	4.46	8.65		0.00	-1.18			0.48	0.00			0.00	-8.00		
	%RSD	3.15	6.11		0.00	0.83			0.34	0.00			0.00	5.66		

Data in italics did not meet target for accuracy, precision or bias.

Result data qualifiers: U - The analyte was not detected at or above the reported value; J - The analyte was positively identified, and the reported value is an estimate.
UJ - The analyte was not detected at or above the reported estimated value.

RPD (%) - relative percent difference: The numeric difference between duplicate sample pairs divided by their mean, with the result expressed as a percentage.

%RSD - percent relative standard deviation: Calculated for a pair of results, x1 and x2, as 100*s/(average[x1 and x2]), where s is the standard deviation of the sample pair.

Table 6. Summary Statistics by Parameter for Laboratory and Field Quality Assurance Data.

Sample Date		Total Nitrate+ Nitrite (as N)	Total Persulfate Nitrogen	Ortho-Phosphate	Total Phosphorus	Total Coliform	Fecal Coliform	Chloride	Total Alkalinity	Total Dissolved Solids	Total Suspended Solids	Total Organic Carbon	Dissolved Organic Carbon
Laboratory													
8/19-25/02	RPD (%)	3.39		*11.54*				4.26	3.77				
09/04/02	RPD (%)	0.62	*10.40*			44.44		0.56					
10/10/02	RPD (%)			7.33					0.00				
12/10/02	RPD (%)	0.75	1.24					4.38					
08/19/03	RPD (%)							1.24	0.00				
09/30/03	RPD (%)			0.00			0.00						8.00
	n	3	2	3		1	1	4	3				1
	min	0.62	1.24	0.00				0.56	0.00				
	max	3.39	10.40	11.54				4.38	3.77				
	mean	1.59	5.82	6.29				2.61	1.26				
Field													
8/19-25/02	RPD (%)	8.00			5.94			4.49	0.31	4.94			
09/04/02	RPD (%)		*13.06*					1.49					
10/10/02	RPD (%)												
12/10/02	RPD (%)		3.39			0.00		1.44					
08/19/03	RPD (%)	0.86	4.52	0.41	0.00			2.44	0.55			*19.35*	0.00
09/30/03	RPD (%)	4.46	8.65	0.00	1.18			0.48	0.00			0.00	8.00
	n	3	4	2	3	1		5	3	1		2	2
	min	0.86	3.39	0.00	0.00			0.48	0.00			0.00	0.00
	max	8.00	13.06	0.41	5.94			4.49	0.55			19.35	8.00
	mean	4.44	7.41	0.21	2.37			2.07	0.29			9.68	4.00

Data in italics did not meet target for accuracy, precision or bias.

RPD (%) - relative percent difference: The numeric difference between duplicate sample pairs divided by their mean, with the result expressed as a percentage.

Table 7. Groundwater Quality Data Summary.

Site ID	River	River mile	Sample date	Alkalinity (mg/l)	Ammonia (mg/l)	Chloride (mg/l)	Conductivity (mg/l)	DOC (mg/l)	Nitrate (mg/l)	TPN (mg/l)	Ortho-P (mg/l)	Total P (mg/l)	TOC (mg/l)
Ecology Instream Piezometers													
AGJ733	Wenatchee	52.8	8/19/02	51.4	0.01	0.36	32	1	0.01	0.025	0.0098	0.0675 *J*	1
AGJ734	Wenatchee	52	8/19/02	15	0.071	3.11	119	1.8	0.01	0.122	0.017	0.121 *J*	2.2
AGJ735	Wenatchee	50.6	8/20/02	37	0.01	0.47	38	1	0.141	0.135	0.0057	0.016	1
AGJ737	Wenatchee	48.5	8/20/02	54.7	0.01	0.77	79	1	0.17	0.167	0.011	0.021	1
AGJ738	Wenatchee	47.5	8/20/02	45	0.012	4.62	121	1.1	0.01	0.025	0.018	0.0679 *J*	1.6
AGJ740	Wenatchee	45.4	8/21/02	109	0.047	0.67	108	2.1	0.021	0.161	0.017	0.296	3.8
AGJ742	Wenatchee	43.2	8/21/02	39	0.01	3.6	217	1	0.254	0.251	0.0382	0.0346 *J*	1
AGJ743	Wenatchee	36.9	8/21/02	9.9	0.01	0.36	43	1	0.018	0.025	0.0054	0.026	1
AGJ744	Wenatchee	35.9	8/21/02	35	0.01	0.2	31	1	0.028	0.026	0.0046	0.018	1.1
AGJ746	Wenatchee	40.3	8/22/02	21	0.01	1.7	86	1	0.183	0.165	0.012	0.013	1
AGJ727	Wenatchee	20.6	10/10/02	64.7	0.046	0.68	73	1.8	0.012	0.113	0.8410		1.9
AGJ728	Wenatchee	17.9	8/23/02	86.7	0.01	0.89	128	1	0.0125	0.025	0.0074	0.0052	1
AGJ729	Wenatchee	15.9	8/23/02	136	0.063	7.43		2.5	2.02	2.23	0.1320	0.144 *J*	2.5
AGJ728	Wenatchee	17.9	10/10/02	264	0.01	1.32	153	1	0.01	0.025	0.0056	0.0079	1
AGJ729	Wenatchee	15.9	10/10/02	182	0.01	5.86	355	1.4	2.26	2.38	0.0798	0.0924	1.6
AGJ777	Wenatchee	15.9	8/19/03	137	0.01	6.96	428	1.4	3.47	3.31	0.2440	0.252	1.55
AGJ777	Wenatchee	15.9	9/30/03	115	0.01	6.19	376	1.25	2.91	3.47	0.1680	0.17	1
AGJ724	Icicle Creek	3.8	8/19/02	34	0.01	0.23	51	1	0.03	0.025	0.016	0.012	1
AGJ725	Icicle Creek	0.2	8/23/02	182	0.01	1.78		1.1	1.19	1.24	0.011	0.007	1
AGJ748	Icicle Creek	2.4	8/23/02	65.7	0.01	1.61	184	1	0.422	0.412	0.022	0.021	1
AGJ778	Chumstick	0.1	8/19/03	134	0.01	3.24	278	1.5	0.509	0.545	0.0349	0.0462	1.7
AGJ779	Chumstick	4.9	8/19/03	113	0.366	4.02	238	1.2	0.01	0.395	0.023	0.221	5.4
AGJ779	Chumstick	4.9	9/30/03	27	0.317	4.39	244	1.6	0.01	0.419	0.025	0.053	1.8
AGJ780	Brender	1.4	8/19/03	205	0.01	3.57	448	1	2.64	2.56	0.015	0.0179	1
AGJ781	Brender	1.6	8/19/03	206	0.018	4.24	448	1	3.75	3.97	0.018	0.0234	1
AGJ780	Brender	1.4	9/30/03	222	0.01	3.69	466	1	2.13	2.88	0.017	0.022	1
AGJ781	Brender	1.6	9/30/03	204	0.01	4.79	449	1	4.06	4.61	0.021	0.0176	1
AGJ796	Mission	2.3	8/19/03	200	0.01	4.31	390	1.5	1.49	1.59	0.014	0.0156	1.4
AGJ796	Mission	2.3	9/30/03	13	0.01	4.27	425	1.5	0.937	1.03	0.014	0.0142	1.3
Ecology Groundwater Wells													
23N19E11			10/6/04	420		11.500	908		11.900		0.104	0.122	
USGS Groundwater Wells													
472852120292201			7/13/79	130		2.900	290		1.700				
473054120293701			5/25/71	261		2.100	574		3.400				
473054120293701			10/20/71			2.200	671						
473101120291101			7/23/79	280		2.600	575		3.700				
473112120281801			7/13/79	180		7.400	505		3.700				

Table 7. Groundwater Quality Data Summary.

Site ID	River	River mile	Sample date	Alkalinity (mg/l)	Ammonia (mg/l)	Chloride (mg/l)	Conductivity (mg/l)	DOC (mg/l)	Nitrate (mg/l)	TPN (mg/l)	Ortho-P (mg/l)	Total P (mg/l)	TOC (mg/l)
473117120282501			1/24/39	207		2.600			0.530				
473145120322801			7/23/79	250		5.500	540		3.700				
473305120400001			11/9/70	57		0.600	117		1.000				
473305120400001			7/25/79	22		0.300	55		0.040				
473305120400001			9/6/91			0.300	68		0.050		0.010		
473305120400001			9/17/91				22						
473305120400001			9/27/91				77						
473330120341501			7/25/79	95		1.300	220		1.300				
473330120403701			9/6/91			1.100	126		0.540		0.010		
473330120403701			9/27/91				142						
473425120360501			7/25/79	120		4.200	300		2.700				
DOH Groundwater Wells													
11700			9/28/00						5.190				
11700			7/30/01						5.230				
12286			6/13/01						5.770				
12286			6/13/01						11.000				
12286			8/20/02						5.100				
12286			8/20/02						12.200				
12286			8/22/02						11.300				
12286			1/6/03						11.400				
12286			3/11/03						5.010				
12286			3/11/03						11.400				
12286			6/23/03						11.200				
12286			12/18/03						5.020				
46500			6/13/00						12.000				
77432			1/7/02						8.460				
77432			2/24/03						7.170				
77432			5/5/03						6.400				
77432			9/25/03						7.770				
77432			11/5/03						6.310				
77432			12/11/03						6.020				
88392			10/26/99						5.500				
88392			10/26/99						5.500				
88392			5/2/00						5.290				
88392			5/2/00						5.290				
88392			8/27/02						5.290				
88392			8/27/02						5.290				
88392			9/8/02						5.290				
88392			9/8/02						5.290				
88945			9/2/99						6.140				
88945			12/7/99						5.620				

Table 7. Groundwater Quality Data Summary.

Site ID	River	River mile	Sample date	Alkalinity (mg/l)	Ammonia (mg/l)	Chloride (mg/l)	Conductivity (mg/l)	DOC (mg/l)	Nitrate (mg/l)	TPN (mg/l)	Ortho-P (mg/l)	Total P (mg/l)	TOC (mg/l)

DOC - dissolved organic carbon
TPN - total persulfate nitrogen
Ortho-P - orthophosphate
Total P - total phosphorus
TOC - total organic carbon
J - estimated value

Ecology - Washington State Department of Ecology
USGS - U.S. Geological Survey
DOH - Washington State Department of Health

Table 8. Groundwater Quality Summary Statistics.

	Alkalinity (mg/l)	Chloride (mg/l)	Conductivity (mg/l)	Nitrate (mg/l)	Ortho-P (mg/l)	Total P (mg/l)	pH
Mean							
Upper Wenatchee	45.40	1.26	83.00	0.11	0.0139	0.0650	7.32
Leavenworth	56.67	2.96	112.68	0.48	0.0173	0.0216	7.56
Icicle Creek	41.20	3.36	76.94	0.47	0.0140	0.0130	7.56
Peshastin Creek	124.54	4.07	226.00	3.95	0.1896	0.1880	7.00
Cashmere	202.54	3.98	382.00	6.38	0.0170	0.0185	7.42
Wenatchee	275.00	7.20	328.25	7.07			
90th percentile							
Upper Wenatchee	82.00	3.03	153.00	0.27	0.0270		8.31
Leavenworth	110.01	9.92	225.10	1.04	0.0290	0.0440	7.94
Icicle Creek	65.90	11.40	118.72	1.09	0.0200	0.0220	7.94
Peshastin Creek	202.50	7.60	433.85	7.55	0.5100		7.18
Cashmere	285.81	5.86	542.98	11.11	0.0210	0.0240	7.78
Wenatchee	537.81	14.90	843.06	10.18			
50th percentile							
Upper Wenatchee	45.00	0.67	76.00	0.06	0.0115	0.0195	6.90
Leavenworth	45.50	0.85	72.00	0.47	0.0135	0.0165	7.40
Icicle Creek	34.00	0.85	63.00	0.42	0.0110	0.0120	7.40
Peshastin Creek	120.00	5.03	128.00	3.49	0.1500	0.1690	7.00
Cashmere	206.00	4.24	383.00	5.23	0.0170	0.0178	7.30
Wenatchee	275.00	7.20	180.50	7.17			
95% UTI							
Upper Wenatchee	119.08	4.80	212.00	0.43	0.0427		10.54
Leavenworth	211.16	20.25	318.82	1.89	0.0540	0.1100	8.58
Icicle Creek	122.37	26.63	176.29	2.10	0.0560		8.58
Peshastin Creek	286.45	11.70	558.81	10.50	0.9060		
Cashmere	376.01	7.90	638.68	14.04	0.0270	0.0340	8.59
Wenatchee				13.91			
Minimum							
Upper Wenatchee	10.00	0.20	28.00	0.01	0.0046	0.0130	6.60
Leavenworth	22.00	0.23	22.00	0.03	0.0100	0.0070	7.20
Icicle Creek	22.00	0.30	22.00	0.03	0.0100	0.0070	7.20
Peshastin Creek	35.00	0.68	43.00	0.01	0.0056	0.0049	6.90
Cashmere	10.00	2.10	161.00	0.53	0.0140	0.0142	7.20
Wenatchee	130.00	2.90	44.00	1.70			7.30
Maximum							
Upper Wenatchee	109.00	4.62	217.00	0.42	0.0382	0.2960	8.20
Leavenworth	134.00	16.10	330.00	1.19	0.0349	0.0462	7.90
Icicle Creek	66.00	16.10	184.00	1.19	0.0220	0.0210	7.90
Peshastin Creek	264.00	7.43	634.00	9.61	0.8410	0.7380	7.10
Cashmere	280.00	7.40	671.00	12.20	0.0210	0.0234	7.90
Wenatchee	420.00	11.50	908.00	11.90			7.30

Ortho-P = Orthophosphate
Total P = Total phosphorus
UTI = upper tolerance level

Table 9. Groundwater Quality Data and Statistical Summaries by Subbasin. See Figure 4 for boundary definition.

I.D. Number	Date	Alkalinity (mg/l)	Chloride (mg/l)	Conductivity (mg/l)	Nitrate (mg/l)	Ortho-P (mg/l)	Total P (mg/l)
Upper Wenatchee River							
AGJ733	8/19/2002	13.00	0.36	32.00	0.01	0.0098	
AGJ734	8/19/2002	51.00	3.11	119.00	0.01	0.0170	
AGJ735	8/20/2002	15.00	0.47	38.00	0.14	0.0057	0.0160
AGJ737	8/20/2002	37.00	0.77	79.00	0.17	0.0110	0.0210
AGJ738	8/20/2002	55.00	4.62	121.00	0.01	0.0180	
AGJ740	8/21/2002	45.00	0.67	108.00	0.02	0.0170	0.2960
AGJ742	8/21/2002	109.00	3.60	217.00	0.25	0.0382	
AGJ743	8/21/2002	21.00	0.36	43.00	0.02	0.0054	0.0260
AGJ744	8/21/2002	10.00	0.20	31.00	0.03	0.0046	0.0180
AGJ746	8/22/2002	39.00	1.70	86.00	0.18	0.0120	0.0130
474050120450501	3/24/1965	91.00	0.80	211.00	0.18		
474630120501001	10/20/1971	16.00	0.50	33.00	0.07		
474806120425801	5/22/1964	59.00	1.00	115.00	0.04		
474825120433001	11/9/1970	58.00	0.50	115.00	0.42		
474825120433001	5/25/1971	62.00	0.30	106.00			
50th percentile		45.00	0.67	75.50	0.06	0.0115	0.0195
90th percentile		82.00	3.03	153.39	0.27	0.0270	
upper 95% tolerance interval		119.08	4.80	212.40	0.43	0.0427	
mean		45.40	1.26	82.59	0.11	0.0139	0.0650
standard deviation		28.87	1.38	55.24	0.12	0.0099	0.1133
number of samples		15	15	22	14	10	6
minimum		10.00	0.20	28.00	0.01	0.0046	0.0130
maximum		109.00	4.62	217.00	0.42	0.0382	0.2960
Leavenworth							
AGJ724	8/19/2002	27.00	0.23	51.00	0.03	0.0160	0.0120
AGJ725	8/23/2002	34.00	1.78	87.00	1.19	0.0110	0.0070
AGJ748	8/23/2002	66.00	16.10	184.00	0.42	0.0220	0.0210
AGJ778	8/19/2003	134.00	3.24	278.00	0.51	0.0349	0.0462
473305120400001	11/9/1970	57.00	0.60	117.00	1.00		
473305120400001	7/25/1979	22.00	0.30	55.00	0.04		
473305120400001	9/6/1991		0.30	68.00	0.05	0.0100	
473330120403701	9/6/1991		1.10	126.00	0.54	0.0100	
50th percentile		45.50	0.85	72.00	0.47	0.0135	0.0165
90th percentile		110.01	9.92	225.10	1.04	0.0290	0.0440
upper 95% tolerance interval		211.16	20.25	318.82	1.89	0.0540	0.1100
mean		56.67	2.96	112.68	0.47	0.0173	0.0216
standard deviation		41.63	5.41	87.72	0.44	0.0098	0.0174
number of samples		6	8	22	8	6	4
minimum		22.00	0.23	22.00	0.03	0.0100	0.0070
maximum		134.00	16.10	330.00	1.19	0.0349	0.0462
Icicle Creek							
AGJ724	8/19/2002	27.00	0.23	51.00	0.03	0.0160	0.0120
AGJ725	8/23/2002	34.00	1.78	87.00	1.19	0.0110	0.0070
AGJ748	8/23/2002	66.00	16.10	184.00	0.42	0.0220	0.0210
473305120400001	11/9/1970	57.00	0.60	117.00	1.00		
473305120400001	7/25/1979	22.00	0.30	55.00	0.04		
473305120400001	9/6/1991		0.30	68.00	0.05	0.0100	
473330120403701	9/6/1991		1.10	126.00	0.54	0.0100	
50th percentile		34.00	0.85	63.00	0.42	0.0110	0.0120
90th percentile		65.90	11.40	118.72	1.09	0.0200	0.0220
upper 95% tolerance interval		122.37	26.63	176.29	2.10	0.0560	

Table 9. Groundwater Quality Data and Statistical Summaries by Subbasin. See Figure 4 for boundary definition.

I.D. Number	Date	Alkalinity (mg/l)	Chloride (mg/l)	Conductivity (mg/l)	Nitrate (mg/l)	Ortho-P (mg/l)	Total P (mg/l)
mean		41.20	3.36	76.94	0.47	0.0138	0.0133
standard deviation		19.28	6.27	40.50	0.48	0.0052	0.0071
number of samples		5	6	18	7	5	3
minimum		22.00	0.30	22.00	0.03	0.0100	0.0070
maximum		66.00	16.10	184.00	1.19	0.0220	0.0210
Peshastin Creek							
AGJ727	10/10/2002	35.00	0.68	73.00	0.01	0.8400	0.7380
AGJ728	8/23/2002	65.00	0.91	128.00	0.01	0.0076	0.0052
AGJ728	10/10/2002	87.00	1.32	153.00	0.01	0.0056	0.0079
AGJ729	8/23/2002	264.00	7.43	579.00	2.02	0.1320	
AGJ729	10/10/2002	136.00	5.86	355.00	2.26	0.0798	0.0924
AGJ777	8/19/2003	182.00	7.04	428.00	3.49	0.2440	0.2520
AGJ777	9/30/2003	137.00	6.21	376.00	2.98	0.1680	0.1710
473330120341501	7/25/1979	95.00	1.30	220.00	1.30		
473425120360501	7/25/1979	120.00	4.20	300.00	2.70		
50th percentile		120.00	5.03	128.00	3.49	0.1500	0.1690
90th percentile		202.50	7.60	433.85	7.55	0.5100	
upper 95% tolerance interval		286.45	11.70	558.81	10.50	0.9060	
mean		124.54	4.07	225.68	3.95	0.1896	0.1880
standard deviation		60.47	2.81	162.18	2.81	0.2465	0.2291
number of samples		13	12	53	23	10	6
minimum		35.00	0.68	43.00	0.01	0.0056	0.0049
maximum		264.00	7.43	634.00	9.61	0.8410	0.7380
Cashmere							
AGJ780	8/19/2003	205.00	3.57	448.00	2.64	0.0150	0.0179
AGJ780	9/30/2003	222.00	3.69	466.00	2.13	0.0170	0.0220
AGJ781	8/19/2003	206.00	4.24	448.00	3.75	0.0180	0.0234
AGJ781	9/30/2003	204.00	4.79	449.00	4.06	0.0210	0.0176
AGJ796	8/19/2003	182.00	4.31	390.00	1.49	0.0140	0.0156
AGJ796	9/30/2003	200.00	4.27	425.00	0.94	0.0140	0.0142
473117120282501	1/24/1939	207.00	2.60		0.53		
473119120282301	5/11/1961	226.00	4.50	447.00	0.68	0.0200	
473101120291101	7/23/1979	280.00	2.60	575.00	3.70		
473112120281801	7/13/1979	180.00	7.40	505.00	3.70		
473145120322801	7/23/1979	250.00	5.50	540.00	3.70		
473054120293701	5/25/1971	261.00	2.10	574.00	3.40		
473054120293701	10/20/1971		2.20	671.00			
50th percentile		206.00	4.24	383.00	5.23	0.0170	0.0178
90th percentile		285.81	5.86	542.98	11.11	0.0210	0.0240
upper 95% tolerance interval		376.01	7.90	638.68	14.04	0.0270	0.0340
mean		202.54	3.98	381.69	6.38	0.0170	0.0185
standard deviation		64.97	1.47	125.61	3.69	0.0028	0.0036
number of samples		13	13	55	39	7	6
minimum		10.00	2.10	161.00	0.53	0.0140	0.0142
maximum		280.00	7.40	671.00	12.20	0.0210	0.0234
Wenatchee							
472852120292201	7/13/1979	130.00	2.90	290.00	1.70		
77432	12/11/2003				6.02		
77432	11/5/2003				6.31		
77432	5/5/2003				6.40		
77432	5/5/2003				6.40		
77432	2/24/2003				7.17		

Table 9. Groundwater Quality Data and Statistical Summaries by Subbasin. See Figure 4 for boundary definition.

I.D. Number	Date	Alkalinity (mg/l)	Chloride (mg/l)	Conductivity (mg/l)	Nitrate (mg/l)	Ortho-P (mg/l)	Total P (mg/l)
77432	2/24/2003				7.17		
77432	9/25/2003				7.77		
77432	1/7/2002				8.46		
77432	1/7/2002				8.46		
AGJ730	7/30/2002			44.00			
AGJ730	8/23/2002			71.00			
23N19E11	10/6/2004	420.00	11.50	908.00	11.90	0.1040	0.1220
50th percentile		275.00	7.20	180.50	7.17		
90th percentile		537.81	14.90	843.06	10.18		
upper 95% tolerance interval					13.91		
mean		275.00	7.20	328.25	7.07		
standard deviation		205.06	6.08	401.89	2.43		
number of samples		2	2	4	11		
minimum		130.00	2.90	44.00	1.70		
maximum		420.00	11.50	908.00	11.90		
Lower Wenatchee River Basin							
50th percentile		120.00	1.60	46.50	2.48	0.0115	0.0200
90th percentile		291.00	7.59	300.19	8.03	0.2897	
upper 95% tolerance interval		393.78	10.26	402.87	10.42	0.4790	
mean		149.10	3.02	104.30	3.48	0.0625	0.0853
standard deviation		110.79	3.56	153.08	3.55	0.1773	0.1830
number of samples		31	53	86	85	22	17
minimum		16.00	0.20	21.00	0.01	0.0046	0.0049
maximum		420.00	16.10	908.00	12.20	0.8410	0.7380