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DEPARTMENT OF
ECOLOGY

Colville River Water Quality

Pollutant Loading Capacity and Recommendations
for Total Maximum Daily Loads

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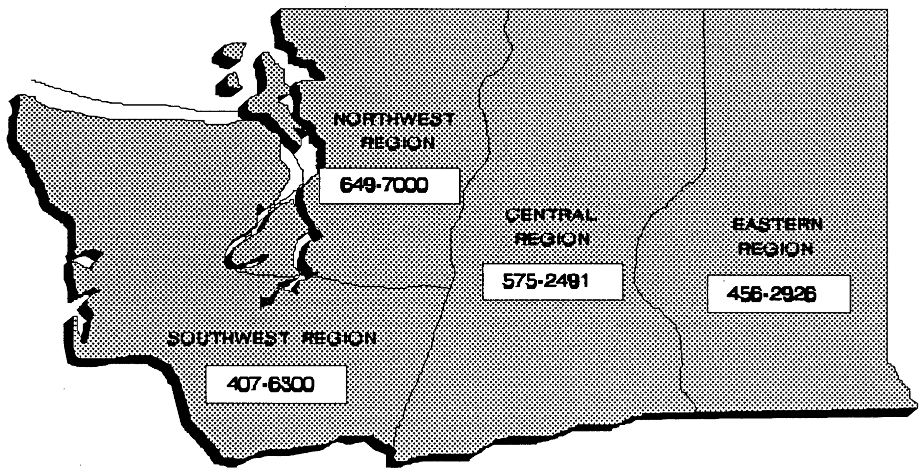

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Colville River Water Quality

Pollutant Loading Capacity and Recommendations
for Total Maximum Daily Loads

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Abstract

The capacity of the Colville River to assimilate pollutant loads from point and nonpoint sources was investigated. Dissolved oxygen downstream from the publicly-owned treatment works (POTWs) operated by the cities of Chewelah and Colville decreases rapidly during summer. The rapid decrease is influenced by sediment oxygen demand, biochemical oxygen demand (BOD), ammonia, and algal respiration. Dissolved oxygen was observed below the 8 mg/L Class A standard at several locations. Ammonia concentrations in the river are highest immediately downstream from the Chewelah and Colville POTWs. Ammonia concentrations decrease proceeding downstream from the POTWs due to algal uptake and nitrification. Fecal coliform concentrations exceed standards over the entire length of the Colville River and in most tributaries.

EPA's QUAL2E model was used to simulate dissolved oxygen, ammonia, and fecal coliform in the Colville River. The model was used to determine the potential to violate water quality criteria and recommend waste load allocations for point sources (Colville POTW, Chewelah POTW, and L-Bar).

Project Description

Setting

The Colville River watershed is approximately 1,020 square miles in area and is located in northeastern Washington (Figure 1). The basin is almost entirely in Stevens County with only a small portion of the Little Pend Oreille sub-watershed in Pend Oreille County. The Colville River flows northward for approximately 53 miles until it flows into the Columbia River south of Kettle Falls. A river mile index is presented in Appendix A with the locations of major tributaries, bridge crossings, municipalities, and miscellaneous landmarks along with pertinent drainage area and water surface elevation data.

The headwater of the Colville River at the confluence of Sheep Creek and Deer Creek has an elevation of 1,680 feet (SCCD, 1993). At the confluence of the Colville with the Columbia River, the water level is about 1,309 feet. The basin is bordered by mountains ranging in elevation from about 5,000 to 7,000 feet.

The land uses in the watershed include urban/municipal, rural residential, agriculture, forestry, mining, and industrial. There are approximately 30 dairies, 5 municipalities, 4 lumber mills, and 3 major industrial complexes located adjacent to the Colville River or its tributaries (SCCD, 1993).

Average annual precipitation in the watershed is approximately 18 inches. About forty percent of the annual precipitation typically falls between April and September. Average seasonal snowfall is approximately 47 inches. Snow covers the ground in many areas of the watershed for much of the winter, but warm, dry chinook winds may occur during the winter and early spring and cause a rapid reduction in snow cover.

Stream flows in the Colville River typically peak in April or May. Lowest flows usually occur during July-October. The lowest and highest 7-day average flows with recurrence intervals of once every 10 years range from about 20 cfs to 2,200 cfs at the U.S. Geological Survey (USGS) station at Kettle Falls, located at river mile (RM) 5.0, which represents about 99 percent of the watershed area.

Wastewater Discharges

Two publicly-owned treatment works (POTWs) discharge treated wastewater to the Colville River: Chewelah POTW at river mile (RM) 38 and Colville POTW at RM 15. Both POTWs are permitted under the National Pollutant Discharge Elimination System (NPDES). The NPDES permits are managed by Ecology's Eastern Regional Office (ERO). The Colville POTW includes three lagoons (two are aerated), a chlorine contact pond, a v-notch weir effluent measuring device, and a discreet conveyance ditch to the Colville River. The Colville POTW currently serves

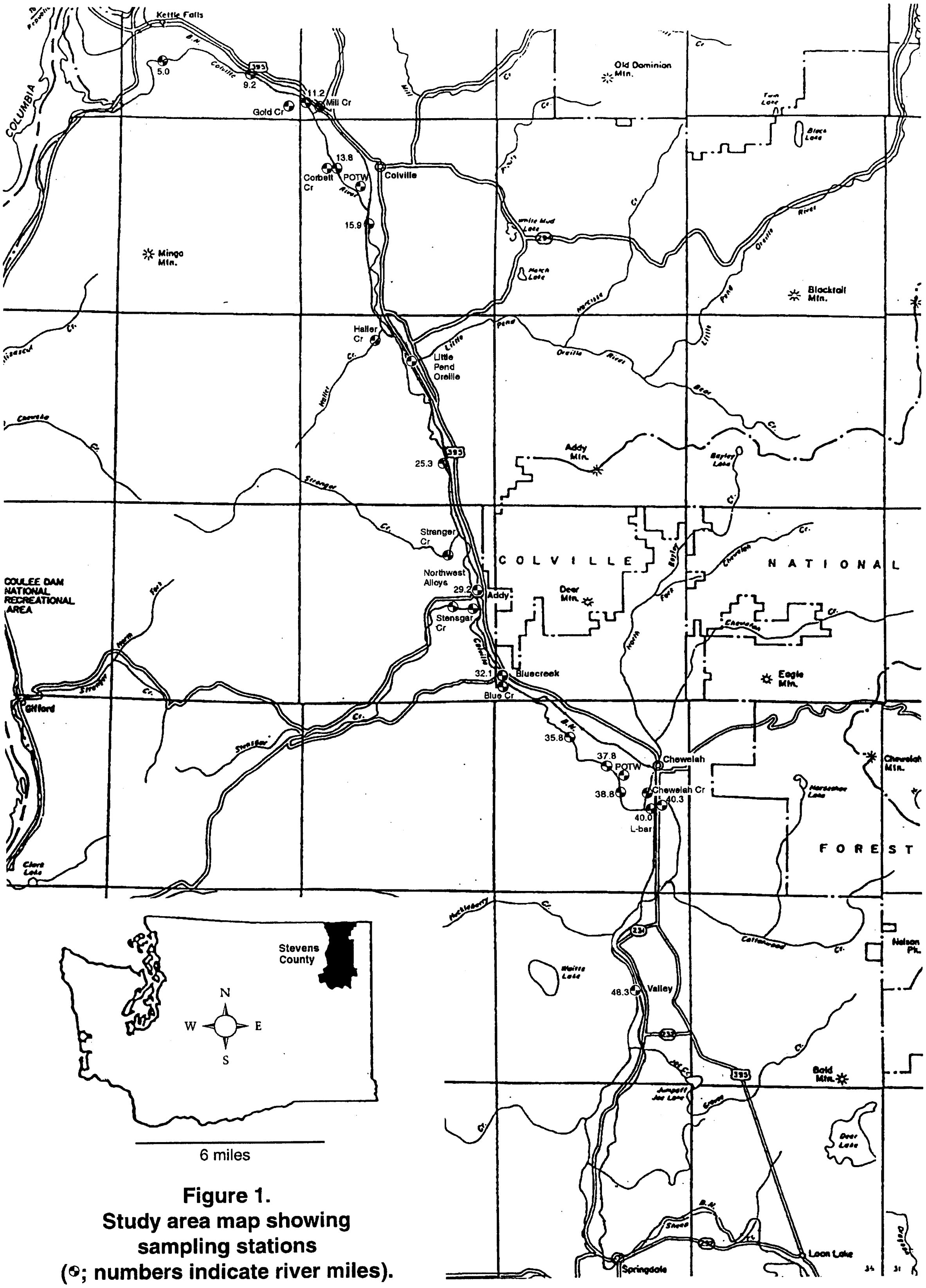

Figure 1.
Study area map showing sampling stations (⊗; numbers indicate river miles).

about 4,500 people and has a maximum monthly average design flow of 1.2 mgd. The Chewelah POTW includes three lagoons (two are aerated), a chlorine contact chamber, a rectangular weir for effluent flow measurement, and an underground pipe to the bank of the Colville River. The Chewelah POTW currently serves about 1,970 people and has a maximum monthly average design flow of 0.45 mgd. Chewelah's facilities plan is currently being revised, and the maximum monthly average design flows are expected to increase to 0.71 mgd during June-October and 1.2 mgd during November-May (CH2M-Hill, 1996a).

Northwest Alloys, Inc. owns and operates a magnesium extraction plant located near RM 29 in the town of Addy in Stevens County. Ecology's Industrial Section has regulatory responsibility for the Northwest Alloys plant. Northwest Alloys produces magnesium by extraction from dolomite, which is mined at the north end of the plant site. Ammonia is generated as a by-product of the magnesium reduction process. All wastewater is recycled and the facility is considered to be a zero wastewater discharge facility by Ecology's Industrial Section. However, ERO considers the facility to be discharging to ground and would require a state waste discharge permit because of the use of unlined lagoons for wastewater holding ponds at the south end of the site. The difference in regulatory application is being reviewed by ERO and the Industrial Section. The proximity of the unlined lagoons to the Colville River has prompted the question of whether seepage from the site has the potential to increase ammonia concentrations in the river during critical conditions.

The L-Bar site is located upstream from the town of Chewelah at RM 40. The L-Bar site was a magnesium recovery facility owned and operated by L-Bar Products, Inc., a wholly owned subsidiary of Reserve Products, Inc. L-Bar Products, Inc. closed down operations in 1991 and is now undergoing reorganization under Chapter 11 in the United States Bankruptcy Court. The major operation at the plant was to recover magnesium trapped in granular form within sludge bars. The sludge bars were a waste product of magnesium reduction facilities and were mostly supplied by Northwest Alloys, Inc. from the plant in Addy. Past operating practices and inadequate storage of sludge bars and sludge bar residues have resulted in known contamination of groundwater, soil, and air.

The L-Bar site was under an Emergency Enforcement Order by Ecology's Toxics Cleanup Program at ERO to address controlling surface water discharge from a leachate collection ditch to the Colville River. As a result of the Enforcement Order, water from the main ditch is no longer allowed to be discharged to the river. Water level in the main ditch is maintained by pumping excess water to a storage pond. Management options for this waste water are currently being studied. The study to determine the extent of contamination as well as some interim actions are currently being conducted under a MTCA Agreed Order. Determination of final cleanup alternatives is expected during 1997. One of the options being considered is a point source discharge to the river under a NPDES permit on a seasonal basis. The possibility of land-applying this water to the adjacent agricultural field is also being studied. The major pollutant of concern at L-Bar is ammonia because of observed concentrations as high as 620 mg/L in surface water draining the site. Heavy metal concentrations in surface waters sampled on the site have also been observed near or above water quality criteria for the river.

Beneficial Uses

The Colville River is classified as Class A for water quality standards (WAC 173-201A). Class A waters are required to meet or exceed the requirements for all or substantially all of the following characteristic uses: domestic, industrial, and agricultural water supply; stock watering; salmonid and other fish migration, rearing, spawning, and harvesting; wildlife habitat; recreation (primary contact recreation, sport fishing, boating, and aesthetic enjoyment); and commerce and navigation.

The Colville River is presently listed as not supporting characteristic uses because of observed violations of dissolved oxygen (DO), temperature, pH, and fecal coliform criteria (Ecology, 1994a; Ecology, 1996). Ammonia and chloride are also listed because of predicted violations of criteria at the mixing zone boundary for the Colville POTW (Ecology, 1996).

Historical Data Review

Existing water quality data were summarized by Joy (1993) as part of Ecology's "Needs Assessment for the Upper Columbia Watershed" (Cornett, 1994). The following indented paragraphs present information summarized by Joy (1993) for the Colville River basin:

> A Colville POTW receiving water study was written by Pelletier (1989). That study showed that permitted effluent loads would reduce DO concentrations downstream from the outfall under critical conditions in the river. Chlorine toxicity was also predicted to be a problem. A seasonal reduction in biochemical oxygen demand (BOD) and chlorine residual was recommended. Further studies of effluent and receiving water metals concentrations were recommended. Macroinvertebrate diversity upstream and downstream from the outfall indicated moderately polluted conditions.
>
> Stevens County Conservation District (SCCD) obtained a Centennial Clean Water Fund (CCWF) grant from Ecology and produced the Colville River Watershed Ranking Plan (SCCD, 1992; SCCD, 1993). Water quality monitoring was conducted from January to December 1992, at 25 locations in the Colville River basin. Sub-watersheds were ranked based on riparian land and water quality conditions, and potential success with local owners' involvement. The top six sub-watersheds requiring nonpoint management were: Chewelah Creek, Jump-Off-Joe Creek, Mill Creek, Little Pend Oreille River, City of Colville, and Stensgar Creek. Additional water quality monitoring is being conducted in the Chewelah Creek sub-watershed by Stevens County and is planned for Jump-Off-Joe Creek. SCCD intends to intensively investigate water quality and implement action plans for water quality protection for the top four sub-watersheds. Sedimentation, bacterial

> contamination, pH and temperature criteria violations, and elevated nutrient concentrations were among the most common water quality problems reported, and are the focus of follow-up studies and action plans being conducted by SCCD.
>
> Deer and Loon Lakes were part of a limnological investigation by EILS in the 1970s (Singleton *et al.*, 1980; Bishop, 1973). Deer Lake was found to be mesotrophic and was considered to be the most stable and least threatened by shoreline and watershed development. Loon Lake had the most severe DO depletion in the hypolimnion, and had declining transparency. Sewer system construction was not recommended for any of the lakes, but reevaluation of their trophic status was recommended at five-year intervals. Stevens County Public Utilities District conducted a water quality assessment of Deer Lake under a CCWF grant.

The Industrial Section of the Department of Ecology conducted a survey of the Colville River and Stensgar Creek upstream and downstream from suspected seepage from the Northwest Alloys plant in May 1994 (Oie, 1994). River flow typically peaks during April and May and was 435 cfs at the USGS station at Kettle Falls on the day of the survey by the Industrial Section. Samples were analyzed for pH, conductivity, hardness, chloride, cyanide, ammonia, nitrate plus nitrite, calcium, magnesium, and sodium. No significant differences were observed between upstream and downstream stations, which suggests that seepage from Northwest Alloys is undetectable at high river flows or not significant.

Water samples were collected from surface waters at the L-Bar site and in the Colville River upstream and downstream in October 1993 for determination of nutrients, heavy metals, and other tracers of leachate from the site (Bala, 1994). Surface waters on the site were found to be several orders of magnitude higher in leachate than in river water for several parameters, including ammonia and chloride. Heavy metals were found to be near or above criteria for protection of aquatic life in surface waters in on-site ditches which contained leachate draining from the site. Northwest Alloys, Inc. has been monitoring the river upstream and downstream from the site and also sampling surface water on-site at monthly to bimonthly intervals since March 1994 for flow, temperature, pH, conductivity, chloride, and ammonia as a condition of an Emergency Enforcement Order by Ecology.

Project Goals

The capacity of the Colville River to assimilate wastewater from the Colville and Chewelah POTWs and from the L-Bar site is presently not well understood. The major pollutants of concern for NPDES permits are biochemical oxygen demand (BOD), ammonia, chlorine, and trace metals. Ammonia is of concern as part of BOD (nitrogenous BOD) and because of toxicity criteria for protection of aquatic life.

The ERO has requested a study to determine loading capacities for ammonia and BOD discharges to the Colville River. The ERO is also interested in characterizing potential pollutant loads to the Colville River from the L-Bar and Northwest Alloys sites as well as nonpoint and natural sources during critical conditions in the river. The combined effects of various sources in the basin need to be evaluated to determine the need for establishing a Total Daily Maximum Load (TMDL) for the basin as required under Section 303(d) of the Federal Clean Water Act.

If water quality standards are not being met or are threatened by existing pollutant sources, then a TMDL may be established to regulate acceptable pollutant loads. The TMDL may be apportioned between point sources (waste load allocations or WLAs) and nonpoint or background sources (load allocations or LAs). The allocations (WLAs and LAs) are implemented through NPDES permits, state waste discharge permits, grant projects, and nonpoint source controls.

In addition to evaluating the need for WLAs and LAs to achieve DO and ammonia criteria, the ERO is also interested in investigating potential problem areas documented by the Stevens County Conservation District during basin-wide water quality monitoring in 1992 (SCCD, 1992). Relatively low DO and high fecal coliform concentrations were observed by Stevens County near the headwater of the Colville River (RM 48). ERO is interested in obtaining fecal coliform data from the Colville River and tributaries to supplement existing data for prioritizing inspection and management of nonpoint sources.

Project Objectives

Major objectives of the present study are as follows:

- Conduct water quality sampling investigations for calibration and verification of a DO and ammonia model of the Colville River. A steady-state model of DO and ammonia will be developed in the Colville River to evaluate the capacity of the river to assimilate waste loads from point and nonpoint sources and meet water quality criteria for DO and ammonia.
- Use the steady state model of DO and ammonia to determine the potential to violate water quality criteria and recommend WLAs for point sources (Colville POTW, Chewelah POTW, and L-Bar) and LAs for nonpoint and background sources to meet water quality standards.
- Conduct supplementary water quality sampling to provide documentation of fecal coliform concentrations in the Colville River and tributaries between the municipality of Chewelah and the Ecology ambient monitoring station at RM 4.8.
- Conduct water quality sampling of metals in effluents and river water for use in evaluating the need for water quality-based limits in NPDES permitting of the Colville and Chewelah POTWs and the L-Bar site according to Ecology policies outlined in the Permit Writer's Manual (Ecology, 1994b).

- Conduct water quality sampling to determine if seepage from the Northwest Alloys site increases ammonia concentrations in the Colville River at critical river conditions.
- Document water quality conditions in the Colville River at RM 48 to supplement existing data which show relatively low DO and high fecal coliform concentrations.
- Review available data and make recommendations regarding possible TMDLs or alternative management strategies to address parameters on the 303(d) list.

Methods

Study Design

The project objectives were met through a combination of field sampling, analysis of data collected during the study and by prior investigators, and development and use of water quality models.

Field Surveys

Three field surveys were conducted during 1994 to provide data for meeting the project objectives. The sampling dates were as follows:

- August 23-25, 1994
- October 4-6, 1994
- November 15-17, 1994

The sampling dates were chosen to represent critical conditions for development of water quality models for NPDES permitting, which are seasonal low river flows. WLAs for establishing NPDES permit limits are expected to be applied seasonally using semi-annual permit periods (e.g. dry season and wet season) or additional seasonal divisions. Therefore, water quality models will need to be calibrated and validated for seasonal low flows during all seasonal permit periods. A preliminary review of flow data from the USGS station at Kettle Falls, (station 12409000) shows that August-October are the months with lowest flow during the dry season and November has the lowest flow of the wet season. The dry season is expected to be the most restrictive (lowest WLAs). Therefore, two surveys were scheduled for the dry season to assure sufficient data for confirmation of model predictions in the dry season.

Sampling Stations and Schedule

Locations of sampling stations are presented in Figure 1 and Table 1. The project was divided into six major groups of stations to meet the project objectives. Samples for groups 1 and 2 in Table 1 were collected on Tuesday and Wednesday of each survey week and delivered to the lab within approximately 24 hours of collection. All stations for groups 1 and 2 were sampled twice during each survey to measure total variability of lab parameters. Field measurements of temperature, pH, and DO were made four times during each survey over two consecutive days to measure diurnal variability, with one sample collected each day in the early morning (between sunrise and 1000) and the other sample collected in the late morning or early afternoon (between approximately 1100 and 1900).

Table 1. Groups of sampling stations for the Colville River study.

1. Colville POTW Loading Capacity Study

Colville POTW final effluent

Colville R	RM 15.9	(SCCD site 20, Mantz-Rickey Rd)
	RM 13.8	(SCCD site 21, Oakshot Rd bridge)
	RM 11.2	(SCCD site 23, Gold Cr Rd bridge)
	RM 9.2	(SCCD site 24, Greenwood Loop Rd bridge)
	RM 5.0	(Ecology ambient station 59A070 Kettle Falls)
Corbett Cr		(Oakshot Rd bridge)
Mill Cr	mile 0.3	(395 bridge)
Gold Cr	mile 0.3	(road bridge if flowing)

2. Chewelah POTW Loading Capacity Study

Chewelah POTW final effluent

Colville R	RM 38.8	(SCCD site 11, Alm Lane)
	RM 37.8	(road bridge)
	RM 35.8	(road bridge)
	RM 32.1	(SCCD site 12)

3. Tributaries between Chewelah and Colville study areas

SCCD Site 10: Chewelah Cr at Alm Lane
SCCD Site 13: Blue Cr at Blue Creek Rd
SCCD Site 14: Stensgar Cr at its mouth (Ott property off Zimmer Rd)
SCCD Site 15: Stranger Cr at Marble Valley Basin Rd
SCCD Site 17: Little Pend Oreille R at US 395
SCCD Site 19: Haller Cr adjacent to Skidmore Rd (Andrews property)

4. L-Bar Upstream/Downstream Survey

Colville R upstream from L-Bar (RM 40.3 at Rt. 395)
Colville R 300 feet downstream from L-Bar
L-Bar Ditch 1 (main ditch)
L-Bar Ditch 2 (west ditch)

5. Northwest Alloys Upstream/Downstream Survey

Colville R upstream from Stensgar Creek (RM 29.8 from Ott property)
Colville R downstream from NW Alloys (RM 29.2 at Addy bridge)
Colville R downstream from NW Alloys (RM 25.3-26.6 road bridge)
Stensgar Cr at Road bridge above NW Alloys

6. Water quality sampling at RM 48.3 (SCCD site 6, Waitts Lake Rd at Valley)

Colville R at Waitts Lake Road at Valley (RM 48.3)

Samples for groups 3, 4, 5, and 6 in Table 1 were collected on Thursday of each sample week and delivered to the lab within approximately 24 hours of collection. Field replicates at selected stations were sampled approximately 15-60 minutes apart to measure total field and lab variability.

The sampling schedule for November was different than during August and October because of shorter day length. All samples scheduled for the November survey were collected between Tuesday and Thursday of the survey week. August through November sampling schedules also varied depending on the occurrence of surface water during dry weather (*i.e.* some creeks were not flowing during dry weather).

Data Analysis and Modeling

All project data were entered in Lotus 1-2-3 or Microsoft Excel spreadsheets. Statistical calculations were made using the database spreadsheets and by importing the data from the spreadsheets to either SYSTAT or WQHYDRO (Aroner, 1992) statistical software. Models of water quality were developed using QUAL2E (USEPA, 1987) combined with spreadsheet models. Model calibration and validation were based on recommendations by USEPA (1983 and 1985) and Thomann and Mueller (1987).

Data from other sources (e.g. Stevens County Conservation District and the USGS) were also analyzed to meet the project objectives. Stevens County data were imported into Lotus 1-2-3 or Microsoft Excel spreadsheets and analyzed using spreadsheets and SYSTAT or WQHYDRO statistical software. The USGS data were obtained in text files from USGS or Hydrodata CD-ROM and analyzed using spreadsheets and WQHYDRO statistical software.

Data Quality Objectives and Analytical Procedures

Analytical methods and the detection or precision limits for field measurements and lab analyses of conventional and biological parameters are listed in Table 2. The laboratory's data quality objectives and quality control procedures are documented in the Manchester Environmental Laboratory Lab Users Manual (MEL, 1994).

Metals were measured as total recoverable (effluent and river water) and dissolved (river water only). Field replicate samples and field filter blanks were analyzed with each day's samples. Standard reference materials (SRMs), matrix spikes, and spike duplicates were also analyzed by the lab in each batch of samples.

Water samples were analyzed for dissolved and total recoverable metals using methods listed in Table 3, except mercury was measured in total recoverable form only. The lab followed all quality control (QC) procedures required by the analytical methods listed in Table 3. Analytical data quality objectives were met if QC results met the relevant criteria established by MEL.

Table 2. Summary of field and laboratory measurements, target detection limits, and methods.

	Sensitivity or Reporting Limit	Method[a]
Velocity	± 0.05 feet/second	Current meter
pH	± 0.1 standard units	Field Meter/Electrode
Temperature	± 0.2 °C	Red Liquid Thermometer
Dissolved Oxygen	± 0.06 mg/L	Gas Probe/Winkler Titration
Specific Conductivity	1 mmhos/cm	Conductivity Bridge
Fecal coliform	2/100 ml	SM18 Membrane Filter 9222D
Ammonia nitrogen	0.01 mg/L	EPA 350.1
Nitrate + nitrite nitrogen	0.01 mg/L	EPA 353.2
Total persulfate nitrogen	0.01 mg/L	SM 4500 NO3-F Modified
Orthophosphate	0.01 mg/L	EPA 365.3
Total phosphorus	0.01 mg/L	EPA 365.3
Chloride	0.1 mg/L	EPA 330.0
Hardness	1 mg/L	EPA 130.2
Total organic carbon	1 mg/L	EPA 415.1
5-day BOD	2 mg/L	EPA 405.1
Ultimate Carbonaceous BOD	2 mg/L	NCASI (1987)
Phytoplankton ID/Biovolume	--	SM18 10200F; Sweet (1987)
Chlorophyll *a*	0.05 ug/L	fluorometer, SM 10200H(3)

[a]SM = Standard methods for the examination of water and wastewater. Eighteenth edition (1992). American Public Health Association, American Water Works Association, and Water Environment Federation. Washington, D.C.

EPA = Methods for the chemical analysis of water and wastes. Environmental Monitoring Supply Laboratory. U.S. Environmental Protection Agency. Cincinnati, OH. EPA-600/4-74-020. 1983.

NCASI = A procedure for the estimation of ultimate oxygen demand (biochemical). National Council of the Paper Industry for Air and Stream Improvement, Inc. Special Report No. 87-06. May 6, 1987.

Sweet (1987) = Phytoplankton of selected northwest lakes and rivers. Final report prepared for the Environmental Protection Agency, Region X, Seattle, WA. Project officer: Dave Terpening. Prepared by J.W. Sweet. June 1987.

Table 3. Metals analyzed for the Colville River study and the proposed methods and reporting limits compared with criteria.

Parameter	Chronic Criteria at Hardness of 134 mg/L CaCO3	Reporting Limits for Various Methods by Manchester Lab: ICP-MS Dissolved (2)	ICP-MS Total Recoverable (2)	GFAA Total Recoverable (3)	ICAP Total Recoverable (4)	CVAF Total Recoverable (5)	CVAA Total Recoverable (6)	Proposed Method (7): River Samples	Effluent/ Leachate Samples
Cadmium (Cd)	1.2	0.04	0.04	0.1	2	NA	NA	ICP-MS	GFAA
Copper (Cu)	13	0.05	0.2	1	3	NA	NA	ICP-MS	ICAP
Lead (Pb)	3.2	0.02	0.092	1	20	NA	NA	ICP-MS	GFAA
Silver (Ag)	3.6	0.03	0.03	0.5	3	NA	NA	ICP-MS	GFAA
Zinc (Zn)	121	1	1	NA	4	NA	NA	ICAP (8)	ICAP
Mercury (Hg)	0.012 (1)	NA	NA	NA	NA	0.001	0.05	CVAF	CVAF

1) not a hardness-dependent criteria
2) ICP-MS = inductively coupled plasma mass spectrometry
3) GFAA = graphite furnace atomic absorbtion
4) ICAP = inductively coupled argon plasma (also referred to as ICP)
5) CVAF = cold vapor atomic fluorescence
6) CVAA = cold vapor atomic absorption
7) dissolved and total recoverable for river samples; total recoverable only for effluent and leachate samples
8) ICP-MS may be substituted for ICAP for Zn in river samples

Total recoverable metals samples collected from the Colville River were digested in a class 100 clean hood. A special cleaning protocol using teflon beakers and post-digestion storage containers was used as follows to minimize contamination during analysis (Kammin, 1993):

- normal cleaning of the teflon beakers in a Labconco dishwasher
- soaking of the beakers in a 1:1 deionized water/re-distilled nitric acid mixture for 18 hours prior to use
- subsequent storage of the beakers in closed polyethylene plastic containers until use
- 72 hour soaking of post-digestion polyethylene bottles
- copious rinsing of post-digestion polyethylene bottles with 18 megohm deionized water followed by air drying in a class 100 clean hood and storage capped and sealed in PVC zip-lock bags.

To confidently determine violations of water quality criteria, metals results should ideally be reported to approximately an order of magnitude below the criteria. This objective was achieved for surface water samples by the use of special sample preparation and analytical protocols and by using method detection limits (MDLs) as reporting limits for metals. Analytical methods for metals in POTW effluents and leachate from L-Bar were different from methods used for surface waters because of matrix interference and expected higher concentrations. If analytical blanks, field transfer blanks, or field filter blanks were greater than the MDL, then sample results that were less than 10 times the highest appropriate blank were identified with a data qualifier to indicate potential contamination during analysis or field sampling and handling.

Sampling Procedures

The sampling procedures used during this study followed protocols described by WAS (1992). All surface water samples (river, tributary, and L-Bar ditch) were collected directly into pre-cleaned containers supplied by MEL and described by MEL (1994), except DO samples were collected in bottles prepared by WAS and processed as described by WAS (1992) for the modified Winkler method. Effluent samples collected from Colville and Chewelah POTWs were collected in pre-cleaned ISCO 24-hour composite samplers except for fecal coliform and field measurements parameters, which were taken by grab samples. Effluent sampling was conducted according to standard operating procedures for Class II inspections by Ecology as documented in Glenn (1994), Hoyle-Dodson (1994), and Golding (1994).

Field measurements in surface water stations included flow, temperature, and pH. Field measurements of POTW effluent included temperature, pH, DO (YSI meter), and residual chlorine. All field measurements followed protocols described by WAS (1992), Glenn (1994), Hoyle-Dodson (1994), and Golding (1994).

Quality Control Procedures

Total variation for field sampling and analytical variation was assessed by collecting replicate samples as described above in the "Study Design" section. More than 50 percent of the sample stations were sampled at least twice during each survey to measure total variability. Quality control procedures by the lab followed standard operating procedures described in MEL (1994).

Metals were measured as total recoverable and dissolved form as described above. In addition to replicate samples, three reference materials were analyzed by the lab. A field filter blank was also submitted for dissolved metals during each survey. MEL's quality control procedures for metals also included analysis of a spike and spike duplicate with each batch of samples. Lab duplicates were also analyzed with each batch of samples for special clean analysis described above and normal sample preparation methods for metals. An equipment blank from the composite samplers used for effluent monitoring was prepared and submitted for total recoverable metals analysis during each sampling survey.

Field sampling and measurements followed protocols described in the WAS protocols manual (WAS, 1992). All meters were calibrated and post-calibrated according to the manufacturer's instructions. DO measurements were made either using the modified Winkler method or *in situ* using meters. Samples for laboratory analysis were stored on ice and delivered to MEL within 24 hours of collection according to the schedule described above.

Data Assessment Procedures

Data reduction, review, and reporting followed the procedures as outlined in MEL's Lab Users Manual (MEL, 1994). The principal investigator ensured that all data were validated before preparing a final project database. Validation involved review of 100 percent of the data for possible transcription errors, missing data, and improbable values when importing data from MEL submittals to the project database (Appendix B).

Results and Discussion

QUAL2E Model Calibration and Verification

Model Structure and Approach

QUAL2E is a one-dimensional, steady-state numerical model capable of simulating a variety of conservative and non-conservative water quality parameters (USEPA, 1987). QUAL2E was calibrated to the Colville River between RM 40.4 and 5.4 to simulate DO and ammonia at steady-state conditions. The major constituent interactions modeled in the Colville River are shown in Figure 2.

The receiving water system was divided into 25 reaches for QUAL2E modeling. A schematic of reaches and loading sources is presented in Table 4 using model notation documented in USEPA (1987). Each reach was divided into computational elements with lengths of 0.2 mile, which were assumed to have uniform steady-state concentrations of modeled constituents.

The model was calibrated using data collected during the August 23-25, 1994 sampling survey by Ecology. Kinetic coefficients calibrated to the August 23-25 survey were then applied to the October 1994 surveys. The first step during calibration was an iterative adjustment of model coefficients to achieve the best predictions for the August and October surveys. Goodness of fit was measured using the root-mean-square-error of predicted versus observed values. After an optimum calibration was reached for August and October, the model was applied to the November 1994 survey for verification. Comparison of the results of the model fit to the Ecology surveys tested the validity of the model over a wide range of conditions during the summer and fall seasons. After calibration and verification, the model was run at selected critical conditions to determine the amount of BOD and ammonia loading that would meet DO and ammonia standards. Printouts of the QUAL2E input files for calibration with the Ecology survey data and model runs at critical conditions for NPDES permit periods are presented in Appendices C and D. The following sections explain selection of model parameters during calibration, verification, and analysis of critical conditions.

Flow, Velocity, and Depth

Hydrology data from three sources — Stevens County Conservation District (SCCD, 1993), Ecology surveys during this study, and USGS data — were summarized to estimate velocity and depth in QUAL2E reaches (Table 5). The flow-exponent equations relating velocity (V in ft/sec), depth (D in feet), and width (W in feet) with flow (Q in cfs) are written as follows (McCutcheon, 1989):

$$V = a\,Q^{b} \qquad D = c\,Q^{d} \qquad W = e\,Q^{f} \qquad \text{(equation 1)}$$

Figure 2. Major constituent interactions in the QUAL2E model.

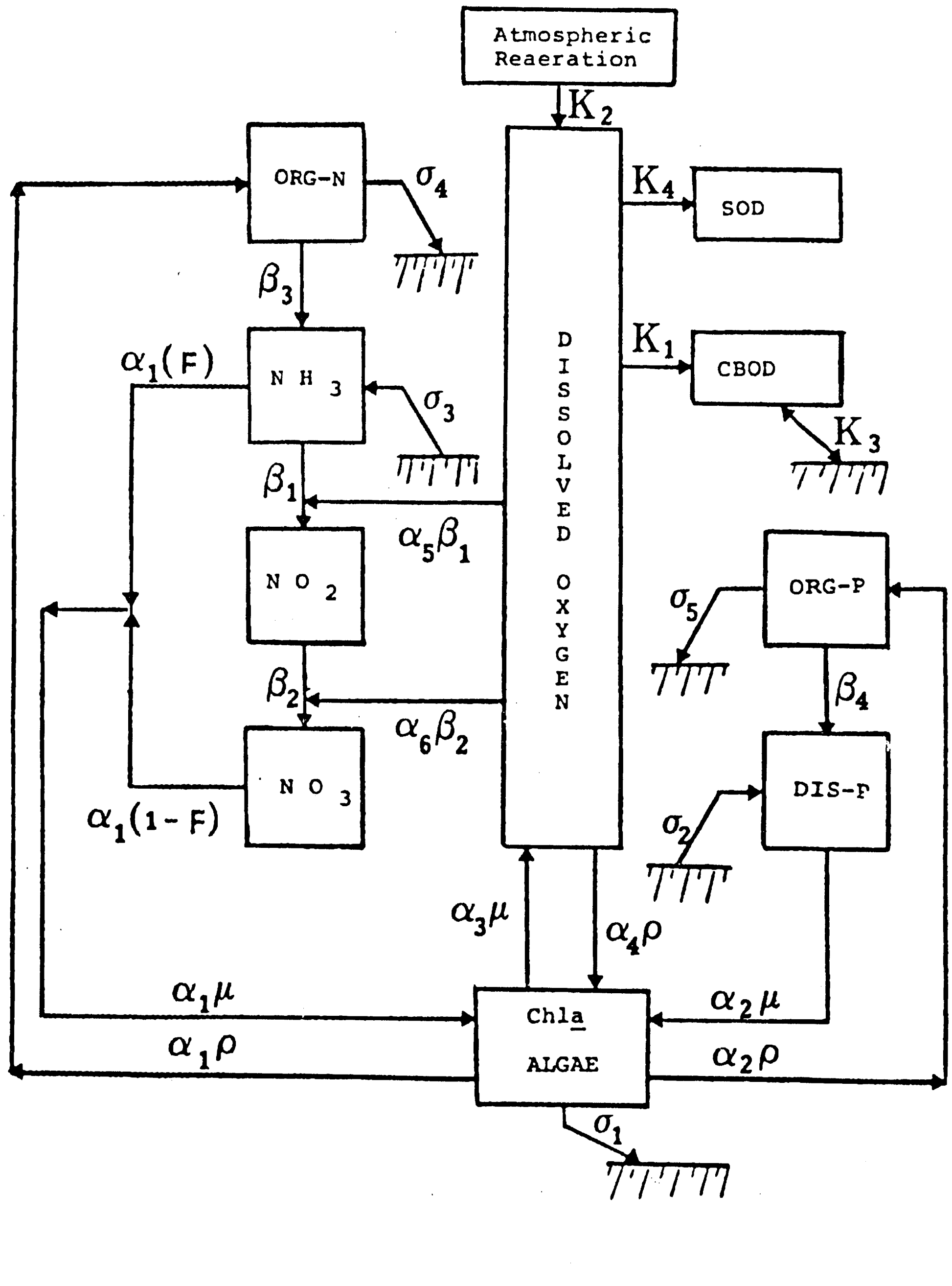

Table 4. Schematic of QUAL2E reaches and hydraulics coefficients.

Upstream River Mile (mile)	Downstream River Mile (mile)	Ecology/ Stevens Co. Mainstem Sampling Station	Ecology Tributary Sampling Station	*QUAL2E Reaches, Elements, and PointLoads* Reach Number	Element Number	Reach Element Number	Data Type 4 Flag	Pointload Number	*QUAL2E Hydraulics Coefficients* V = aQ^b and D = cQ^d for Q in cfs, V in fps, and D in ft *a*	*b*	*c*	*d*
40.4	40.2	RM40.3		1	1	1	1					
40.2	40.0	RM40.1	L-Bar	2	2	1	6	1	0.0605	0.719	0.61	0.271
40.0	39.8				3	2	2					
39.8	39.6		Chewelah Cr		4	3	6	2				
39.6	39.4			3	5	1	2		0.0605	0.719	0.61	0.271
39.4	39.2				6	2	2					
39.2	39.0				7	3	2					
39.0	38.8	RM38.8/SCCD11			8	4	2					
38.8	38.6			4	9	1	2		0.0605	0.719	0.61	0.271
38.6	38.4				10	2	2					
38.4	38.2		Chewelah POTW	5	11	1	6	3	0.0742	0.747	0.877	0.132
38.2	38.0				12	2	2					
38.0	37.8	RM37.8			13	3	2					
37.8	37.6			6	14	1	2		0.0742	0.747	0.877	0.132
37.6	37.4				15	2	2					
37.4	37.2				16	3	2					
37.2	37.0				17	4	2					
37.0	36.8				18	5	2					
36.8	36.6				19	6	2					
36.6	36.4				20	7	2					
36.4	36.2				21	8	2					
36.2	36.0				22	9	2					
36.0	35.8	RM35.8			23	10	2					
35.8	35.6			7	24	1	2		0.0742	0.747	0.877	0.132
35.6	35.4				25	2	2					
35.4	35.2				26	3	2					
35.2	35.0				27	4	2					
35.0	34.8			8	28	1	2		0.361	0.432	0.207	0.412
34.8	34.6				29	2	2					
34.6	34.4				30	3	2					
34.4	34.2				31	4	2					
34.2	34.0				32	5	2					
34.0	33.8				33	6	2					
33.8	33.6				34	7	2					
33.6	33.4				35	8	2					
33.4	33.2				36	9	2					
33.2	33.0				37	10	2					
33.0	32.8				38	11	2					
32.8	32.6				39	12	2					
32.6	32.4				40	13	2					
32.4	32.2		Blue Cr		41	14	6	4				
32.2	32.0	RM32.1/SCCD12			42	15	2					
32.0	31.8			9	43	1	2		0.361	0.432	0.207	0.412
31.8	31.6				44	2	2					
31.6	31.4				45	3	2					
31.4	31.2				46	4	2					
31.2	31.0				47	5	2					
31.0	30.8				48	6	2					
30.8	30.6				49	7	2					
30.6	30.4			10	50	1	2		0.062	0.719	0.477	0.301
30.4	30.2				51	2	2					
30.2	30.0				52	3	2					
30.0	29.8	RM29.8			53	4	2					
29.8	29.6		Stensgar Cr		54	5	6	5				
29.6	29.4				55	6	2					

Table 4. Schematic of QUAL2E reaches and hydraulics coefficients.

Upstream River Mile (mile)	Downstream River Mile (mile)	Ecology/ Stevens Co. Mainstem Sampling Station	Ecology Tributary Sampling Station	*QUAL2E Reaches, Elements, and PointLoads* Reach Number	Element Number	Reach Element Number	Data Type 4 Flag	Pointload Number	*QUAL2E Hydraulics Coefficients* V = aQ^b and D = cQ^d for Q in cfs, V in fps, and D in ft *a*	*b*	*c*	*d*
29.4	29.2	RM29.2			56	7	2					
29.2	29.0			11	57	1	2		0.062	0.719	0.477	0.301
29.0	28.8				58	2	2					
28.8	28.6				59	3	2					
28.6	28.4				60	4	2					
28.4	28.2				61	5	2					
28.2	28.0				62	6	2					
28.0	27.8				63	7	2					
27.8	27.6				64	8	2					
27.6	27.4				65	9	2					
27.4	27.2				66	10	2					
27.2	27.0			12	67	1	2		0.0456	0.669	0.716	0.29
27.0	26.8				68	2	2					
26.8	26.6		Stranger Cr		69	3	6	6				
26.6	26.4				70	4	2					
26.4	26.2				71	5	2					
26.2	26.0				72	6	2					
26.0	25.8				73	7	2					
25.8	25.6				74	8	2					
25.6	25.4				75	9	2					
25.4	25.2	RM25.3/SCCD16			76	10	2					
25.2	25.0			13	77	1	2		0.0456	0.669	0.716	0.29
25.0	24.8				78	2	2					
24.8	24.6				79	3	2					
24.6	24.4				80	4	2					
24.4	24.2				81	5	2					
24.2	24.0				82	6	2					
24.0	23.8				83	7	2					
23.8	23.6				84	8	2					
23.6	23.4				85	9	2					
23.4	23.2				86	10	2					
23.2	23.0				87	11	2					
23.0	22.8			14	88	1	2		0.056	0.648	0.622	0.27
22.8	22.6				89	2	2					
22.6	22.4				90	3	2					
22.4	22.2				91	4	2					
22.2	22.0				92	5	2					
22.0	21.8				93	6	2					
21.8	21.6				94	7	2					
21.6	21.4				95	8	2					
21.4	21.2				96	9	2					
21.2	21.0				97	10	2					
21.0	20.8	SCCD18	L Pend Oreille R	15	98	1	6	7	0.056	0.648	0.622	0.27
20.8	20.6				99	2	2					
20.6	20.4				100	3	2					
20.4	20.2				101	4	2					
20.2	20.0				102	5	2					
20.0	19.8				103	6	2					
19.8	19.6		Haller Cr		104	7	6	8				
19.6	19.4				105	8	2					
19.4	19.2				106	9	2					
19.2	19.0				107	10	2					
19.0	18.8				108	11	2					
18.8	18.6				109	12	2					
18.6	18.4				110	13	2					

Table 4. Schematic of QUAL2E reaches and hydraulics coefficients.

Upstream River Mile (mile)	Downstream River Mile (mile)	Ecology/ Stevens Co. Mainstem Sampling Station	Ecology Tributary Sampling Station	*QUAL2E Reaches, Elements, and PointLoads* Reach Number	Element Number	Reach Element Number	Data Type 4 Flag	Pointload Number	*QUAL2E Hydraulics Coefficients* V = aQ^b and D = cQ^d for Q in cfs, V in fps, and D in ft *a*	*b*	*c*	*d*
18.4	18.2			16	111	1	2		0.278	0.322	0.113	0.599
18.2	18.0				112	2	2					
18.0	17.8				113	3	2					
17.8	17.6				114	4	2					
17.6	17.4				115	5	2					
17.4	17.2				116	6	2					
17.2	17.0				117	7	2					
17.0	16.8				118	8	2					
16.8	16.6				119	9	2					
16.6	16.4				120	10	2					
16.4	16.2				121	11	2					
16.2	16.0				122	12	2					
16.0	15.8	RM15.9/SCCD20			123	13	2					
15.8	15.6			17	124	1	2		0.278	0.322	0.113	0.599
15.6	15.4				125	2	2					
15.4	15.2				126	3	2					
15.2	15.0				127	4	2					
15.0	14.8				128	5	2					
14.8	14.6		Colville POTW	18	129	1	6	9	0.159	0.478	0.18	0.502
14.6	14.4				130	2	2					
14.4	14.2				131	3	2					
14.2	14.0				132	4	2					
14.0	13.8	RM13.8/SCCD21			133	5	2					
13.8	13.6			19	134	1	2		0.159	0.478	0.18	0.502
13.6	13.4				135	2	2					
13.4	13.2		Corbett Cr		136	3	6	10				
13.2	13.0				137	4	2					
13.0	12.8				138	5	2					
12.8	12.6				139	6	2					
12.6	12.4			20	140	1	2		0.0673	0.584	0.324	0.35
12.4	12.2				141	2	2					
12.2	12.0				142	3	2					
12.0	11.8				143	4	2					
11.8	11.6				144	5	2					
11.6	11.4		Mill Cr		145	6	6	11				
11.4	11.2	RM11.2/SCCD23			146	7	2					
11.2	11.0			21	147	1	2		0.0673	0.584	0.324	0.35
11.0	10.8				148	2	2					
10.8	10.6				149	3	2					
10.6	10.4				150	4	2					
10.4	10.2				151	5	2					
10.2	10.0			22	152	1	2		0.0975	0.563	0.309	0.373
10.0	9.8				153	2	2					
9.8	9.6				154	3	2					
9.6	9.4				155	4	2					
9.4	9.2	RM09.2/SCCD24			156	5	2					
9.2	9.0			23	157	1	2		0.0975	0.563	0.309	0.373
9.0	8.8				158	2	2					
8.8	8.6				159	3	2					
8.6	8.4				160	4	2					
8.4	8.2				161	5	2					
8.2	8.0				162	6	2					
8.0	7.8				163	7	2					
7.8	7.6				164	8	2					
7.6	7.4				165	9	2					

Table 4. Schematic of QUAL2E reaches and hydraulics coefficients.

Upstream River Mile (mile)	Downstream River Mile (mile)	Ecology/ Stevens Co. Mainstem Sampling Station	Ecology Tributary Sampling Station	*QUAL2E Reaches, Elements, and PointLoads* Reach Number	Element Number	Reach Element Number	Data Type 4 Flag	Pointload Number	*QUAL2E Hydraulics Coefficients* V = aQ^b and D = cQ^d for Q in cfs, V in fps, and D in ft *a*	*b*	*c*	*d*
7.4	7.2			24	166	1	2		0.0488	0.563	0.618	0.373
7.2	7.0				167	2	2					
7.0	6.8				168	3	2					
6.8	6.6				169	4	2					
6.6	6.4				170	5	2					
6.4	6.2				171	6	2					
6.2	6.0				172	7	2					
6.0	5.8				173	8	2					
5.8	5.6				174	9	2					
5.6	5.4	(waterfall)			175	10	2					
5.4	5.2			25	176	1	2		0.0975	0.563	0.309	0.373
5.2	5.0	RM05.0			177	2	2					

Table 5. Flow balance for calibration and validation of QUAL2E.

Upstream RM (mile)	Dnstream RM (mile)	Reach Number	Ecology/SCCD Mainstem Sampling Station	Ecology Tributary Sampling Station	August 23-25, 1994 Measured Mainstem Flow (cfs)	August 23-25, 1994 Measured Tributary Flow (cfs)	August 23-25, 1994 Pro-rated Incremental Inflow/ Outflow for reach (cfs)	August 23-25, 1994 Calculated Element Outflow (cfs)	October 4-6, 1994 Measured Mainstem Flow (cfs)	October 4-6, 1994 Measured Tributary Flow (cfs)	October 4-6, 1994 Pro-rated Incremental Inflow/ Outflow for reach (cfs)	October 4-6, 1994 Calculated Element Outflow (cfs)	November 15-17, 1994 Measured Mainstem Flow (cfs)	November 15-17, 1994 Measured Tributary Flow (cfs)	November 15-17, 1994 Pro-rated Incremental Inflow/ Outflow for reach (cfs)	November 15-17, 1994 Calculated Element Outflow (cfs)
40.4	40.2	1	RM40.3		12.8		0.650	12.80	19.5		1.800	19.50	34.6		6.400	34.60
40.2	40.0	2	RM40.1	L-Bar		0		12.11		0		19.61		0.05935		34.69
40.0	39.8							11.43				19.73				34.73
39.8	39.6			Chewelah Cr		6.3	-2.057	17.04		10.2	0.343	30.04		13.3	0.103	48.06
39.6	39.4	3						16.36				30.16				48.10
39.4	39.2							15.67				30.27				48.13
39.2	39.0							14.99				30.39				48.17
39.0	38.8		RM38.8/SCCD11		14.3		-2.743	14.30	30.5		0.457	30.50	48.2		0.138	48.20
38.8	38.6	4						14.61				30.80				48.93
38.6	38.4						0.627	14.93			0.607	31.11			1.460	49.66
38.4	38.2	5		Chewelah POTW		0.433		15.67		0.433		31.84		0.551		50.94
38.2	38.0							15.99				32.15				51.67
38.0	37.8		RM37.8		16.3		0.940	16.30	32.45		0.910	32.45	52.4		2.190	52.40
37.8	37.6	6						16.22				32.54				52.42
37.6	37.4							16.14				32.63				52.44
37.4	37.2							16.06				32.72				52.47
37.2	37.0							15.98				32.81				52.49
37.0	36.8							15.90				32.90				52.51
36.8	36.6							15.82				32.99				52.53
36.6	36.4							15.74				33.08				52.55
36.4	36.2							15.66				33.18				52.58
36.2	36.0							15.58				33.27				52.60
36.0	35.8		RM35.8		15.5		-0.800	15.50			0.907	33.36			0.221	52.62
35.8	35.6	7						15.33				33.45				52.64
35.6	35.4							15.16				33.54				52.66
35.4	35.2							14.98				33.63				52.69
35.2	35.0						-0.688	14.81			0.363	33.72			0.088	52.71
35.0	34.8	8						14.64				33.81				52.73
34.8	34.6							14.47				33.90				52.75
34.6	34.4							14.30				33.99				52.78
34.4	34.2							14.12				34.08				52.80
34.2	34.0							13.95				34.17				52.82
34.0	33.8							13.78				34.26				52.84
33.8	33.6							13.61				34.35				52.86
33.6	33.4							13.43				34.45				52.89
33.4	33.2							13.26				34.54				52.91
33.2	33.0							13.09				34.63				52.93
33.0	32.8							12.92				34.72				52.95
32.8	32.6							12.75				34.81				52.97
32.6	32.4							12.57				34.90				53.00
32.4	32.2			Blue Cr		0.67		13.07		0.47		35.46		0.56		53.58
32.2	32.0		RM32.1/SCCD12		12.9		-2.582	12.90	35.55		1.360	35.55	53.6		0.331	53.60
32.0	31.8	9						12.96				35.41				53.93
31.8	31.6							13.03				35.27				54.26
31.6	31.4							13.09				35.14				54.59
31.4	31.2							13.16				35.00				54.91
31.2	31.0							13.22				34.86				55.24

Table 5. Flow balance for calibration and validation of QUAL2E.

Upstream RM	Dnstream RM	Reach Number	Ecology/SCCD Mainstem Sampling Station	Ecology Tributary Sampling Station	August 23-25, 1994 Measured Mainstem Flow	August 23-25, 1994 Measured Tributary Flow	August 23-25, 1994 Pro-rated Incremental Inflow/ Outflow for reach	August 23-25, 1994 Calculated Element Outflow	October 4-6, 1994 Measured Mainstem Flow	October 4-6, 1994 Measured Tributary Flow	October 4-6, 1994 Pro-rated Incremental Inflow/ Outflow for reach	October 4-6, 1994 Calculated Element Outflow	November 15-17, 1994 Measured Mainstem Flow	November 15-17, 1994 Measured Tributary Flow	November 15-17, 1994 Pro-rated Incremental Inflow/ Outflow for reach	November 15-17, 1994 Calculated Element Outflow
(mile)	(mile)				(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)
31.0	30.8							13.29				34.72				55.57
30.8	30.6						0.450	13.35			-0.965	34.58			2.300	55.90
30.6	30.4	10						13.41				34.45				56.23
30.4	30.2							13.48				34.31				56.56
30.2	30.0							13.54				34.17				56.89
30.0	29.8		RM29.8					13.61				34.03				57.21
29.8	29.6			Stensgar Cr		0		13.67		0.38		34.28		2.8		60.34
29.6	29.4							13.74				34.14				60.67
29.4	29.2		RM29.2		13.8		0.450	13.80	34		-0.965	34.00	61		2.300	61.00
29.2	29.0	11						13.83				34.07				60.84
29.0	28.8							13.86				34.15				60.68
28.8	28.6							13.89				34.22				60.52
28.6	28.4							13.92				34.30				60.36
28.4	28.2							13.95				34.37				60.20
28.2	28.0							13.98				34.45				60.04
28.0	27.8							14.01				34.52				59.88
27.8	27.6							14.04				34.60				59.72
27.6	27.4							14.07				34.67				59.56
27.4	27.2						0.300	14.10			0.745	34.74			-1.597	59.40
27.2	27.0	12						14.13				34.82				59.24
27.0	26.8							14.16				34.89				59.08
26.8	26.6			Stranger Cr		0.1		14.29		0.61		35.58		2.9		61.82
26.6	26.4							14.32				35.65				61.66
26.4	26.2							14.35				35.73				61.50
26.2	26.0							14.38				35.80				61.34
26.0	25.8							14.41				35.88				61.19
25.8	25.6							14.44				35.95				61.03
25.6	25.4							14.47				36.03				60.87
25.4	25.2		RM25.3/SCCD16		14.5		0.300	14.50	36.1		0.745	36.10			-1.597	60.71
25.2	25.0	13						14.45				36.15				60.55
25.0	24.8							14.40				36.19				60.39
24.8	24.6							14.35				36.24				60.23
24.6	24.4							14.30				36.28				60.07
24.4	24.2							14.25				36.33				59.91
24.2	24.0							14.20				36.38				59.75
24.0	23.8							14.15				36.42				59.59
23.8	23.6							14.09				36.47				59.43
23.6	23.4							14.04				36.51				59.27
23.4	23.2							13.99				36.56				59.11
23.2	23.0						-0.557	13.94			0.506	36.61			-1.757	58.95
23.0	22.8	14						13.89				36.65				58.79
22.8	22.6							13.84				36.70				58.63
22.6	22.4							13.79				36.74				58.47
22.4	22.2							13.74				36.79				58.31
22.2	22.0							13.69				36.84				58.15
22.0	21.8							13.64				36.88				57.99
21.8	21.6							13.59				36.93				57.83

Table 5. Flow balance for calibration and validation of QUAL2E.

Upstream RM (mile)	Dnstream RM (mile)	Reach Number	Ecology/SCCD Mainstem Sampling Station	Ecology Tributary Sampling Station	August 23-25, 1994 Measured Mainstem Flow (cfs)	August 23-25, 1994 Measured Tributary Flow (cfs)	August 23-25, 1994 Pro-rated Incremental Inflow/Outflow for reach (cfs)	August 23-25, 1994 Calculated Element Outflow (cfs)	October 4-6, 1994 Measured Mainstem Flow (cfs)	October 4-6, 1994 Measured Tributary Flow (cfs)	October 4-6, 1994 Pro-rated Incremental Inflow/Outflow for reach (cfs)	October 4-6, 1994 Calculated Element Outflow (cfs)	November 15-17, 1994 Measured Mainstem Flow (cfs)	November 15-17, 1994 Measured Tributary Flow (cfs)	November 15-17, 1994 Pro-rated Incremental Inflow/Outflow for reach (cfs)	November 15-17, 1994 Calculated Element Outflow (cfs)
21.6	21.4							13.54				36.97				57.67
21.4	21.2							13.49				37.02				57.51
21.2	21.0						-0.506	13.44			0.460	37.07			-1.597	57.35
21.0	20.8	15	SCCD18	L Pend Oreille R		9.2		22.59		12.9		50.01		18.9		76.09
20.8	20.6							22.54				50.06				75.93
20.6	20.4							22.48				50.10				75.77
20.4	20.2							22.43				50.15				75.61
20.2	20.0							22.38				50.19				75.45
20.0	19.8							22.33				50.24				75.29
19.8	19.6			Haller Cr		0.08		22.36		0.19		50.48		1.8		76.93
19.6	19.4							22.31				50.52				76.77
19.4	19.2							22.26				50.57				76.61
19.2	19.0							22.21				50.61				76.46
19.0	18.8							22.16				50.66				76.30
18.8	18.6							22.11				50.71				76.14
18.6	18.4						-0.658	22.06			0.597	50.75			-2.076	75.98
18.4	18.2	16						22.01				50.80				75.82
18.2	18.0							21.96				50.84				75.66
18.0	17.8							21.91				50.89				75.50
17.8	17.6							21.86				50.94				75.34
17.6	17.4							21.81				50.98				75.18
17.4	17.2							21.75				51.03				75.02
17.2	17.0							21.70				51.07				74.86
17.0	16.8							21.65				51.12				74.70
16.8	16.6							21.60				51.17				74.54
16.6	16.4							21.55				51.21				74.38
16.4	16.2							21.50				51.26				74.22
16.2	16.0							21.45				51.30				74.06
16.0	15.8		RM15.9/SCCD20		21.4		-0.658	21.40	51.35		0.597	51.35	73.9		-2.076	73.90
15.8	15.6	17						21.30				51.33				74.28
15.6	15.4							21.21				51.30				74.66
15.4	15.2							21.11				51.28				75.04
15.2	15.0							21.01				51.26				75.42
15.0	14.8						-0.486	20.91			-0.116	51.23			1.894	75.79
14.8	14.6	18		Colville POTW		1.071		21.89		1.331		52.54		1.012		77.18
14.6	14.4							21.79				52.52				77.56
14.4	14.2							21.69				52.50				77.94
14.2	14.0							21.60				52.47				78.32
14.0	13.8		RM13.8/SCCD21		21.5		-0.486	21.50	52.45		-0.116	52.45	78.7		1.894	78.70
13.8	13.6	19						21.45				52.42				78.50
13.6	13.4							21.39				52.39				78.29
13.4	13.2			Corbett Cr		0		21.34		0		52.37		0.29		78.38
13.2	13.0							21.28				52.34				78.17
13.0	12.8							21.23				52.31				77.97
12.8	12.6						-0.323	21.18			-0.170	52.28			-1.223	77.77
12.6	12.4	20						21.12				52.25				77.56
12.4	12.2							21.07				52.22				77.36

Table 5. Flow balance for calibration and validation of QUAL2E.

Upstream RM (mile)	Dnstream RM (mile)	Reach Number	Ecology/SCCD Mainstem Sampling Station	Ecology Tributary Sampling Station	August 23-25, 1994 Measured Mainstem Flow (cfs)	August 23-25, 1994 Measured Tributary Flow (cfs)	August 23-25, 1994 Pro-rated Incremental Inflow/ Outflow for reach (cfs)	August 23-25, 1994 Calculated Element Outflow (cfs)	October 4-6, 1994 Measured Mainstem Flow (cfs)	October 4-6, 1994 Measured Tributary Flow (cfs)	October 4-6, 1994 Pro-rated Incremental Inflow/ Outflow for reach (cfs)	October 4-6, 1994 Calculated Element Outflow (cfs)	November 15-17, 1994 Measured Mainstem Flow (cfs)	November 15-17, 1994 Measured Tributary Flow (cfs)	November 15-17, 1994 Pro-rated Incremental Inflow/ Outflow for reach (cfs)	November 15-17, 1994 Calculated Element Outflow (cfs)
12.2	12.0							21.02				52.20				77.15
12.0	11.8							20.96				52.17				76.95
11.8	11.6							20.91				52.14				76.75
11.6	11.4			Mill Cr		5.3		26.15		10.25		62.36		15.5		92.04
11.4	11.2		RM11.2/SCCD23		26.1		-0.377	26.10			-0.198	62.33			-1.427	91.84
11.2	11.0	21						25.99				62.30				91.64
11.0	10.8							25.88				62.28				91.43
10.8	10.6							25.77				62.25				91.23
10.6	10.4							25.66				62.22				91.02
10.4	10.2						-0.550	25.55			-0.141	62.19			-1.020	90.82
10.2	10.0	22						25.44				62.16				90.62
10.0	9.8							25.33				62.13				90.41
9.8	9.6							25.22				62.11				90.21
9.6	9.4							25.11				62.08				90.00
9.4	9.2		RM09.2/SCCD24		25		-0.550	25.00	62.05		-0.141	62.05	89.8		-1.020	89.80
9.2	9.0	23						25.21				62.37				90.37
9.0	8.8							25.42				62.69				90.94
8.8	8.6							25.63				63.01				91.51
8.6	8.4							25.84				63.34				92.09
8.4	8.2							26.05				63.66				92.66
8.2	8.0							26.26				63.98				93.23
8.0	7.8							26.47				64.30				93.80
7.8	7.6							26.68				64.62				94.37
7.6	7.4						1.886	26.89			2.893	64.94			5.143	94.94
7.4	7.2	24						27.10				65.26				95.51
7.2	7.0							27.30				65.59				96.09
7.0	6.8							27.51				65.91				96.66
6.8	6.6							27.72				66.23				97.23
6.6	6.4							27.93				66.55				97.80
6.4	6.2							28.14				66.87				98.37
6.2	6.0							28.35				67.19				98.94
6.0	5.8							28.56				67.51				99.51
5.8	5.6							28.77				67.84				100.09
5.6	5.4		(waterfall)				2.095	28.98			3.214	68.16			5.714	100.66
5.4	5.2	25						29.19				68.48				101.23
5.2	5.0		RM05.0		29.4		0.419	29.40	68.8		0.643	68.80	101.8		1.143	101.80

Flows in the Colville River during the August-November 1994 surveys are presented in Figure 3. The conditions in the river span a wide range over the three surveys, which supports the use of the model for seasonal analysis.

Headwaters, Point Loads, and Incremental Inflows/Outflows

QUAL2E refers to loading from sources at the upstream end of the model network as headwater loads. Headwater loads at RM 40.4 in the Colville River model were estimated during calibration and validation from flow and water quality data at RM 38.8. Therefore, calibration of the model actually began at the head of the fourth reach. The model network was extended upstream to RM 40.4 to allow for later simulation of loading alternatives from the L-Bar site.

Direct discharges to the model system are referred to as point loads. The effluents from Colville and Chewelah POTWs were included in the QUAL2E model as a point loads. Tributary loads were also included as point loads based on measurements during the 1994 surveys. Residual inflows and outflows between sampling stations were calculated by mass balance between flow measurement stations and included in the QUAL2E model as incremental inflows.

The POTW loads were estimated based on measured loading during the field study. Flow from incremental inflows were estimated based on differences in estimated flow between stations. Pollutant loading from incremental inflows was estimated by applying the flow-weighted average tributary concentrations to the estimated incremental inflow. The estimated headwater loads, point load inputs, and incremental inflows for calibration and validation of the QUAL2E model are presented in Tables 5 and 6.

Coefficients for Oxygen, Nutrient, and Algae Calibration

Tables 7 and 8 show the calibration coefficients selected to fit observed conditions during the August and October, 1994 surveys. The coefficients shown in Tables 7 and 8 were also applied to the November 1994 sampling to test the performance of the model under a range of seasonal conditions. The constants and kinetic coefficients were selected during model calibration to simulate the DO, nitrogen, phosphorus, and algae interactions shown in Figure 2. All first-order rate constants used in QUAL2E were specified in units of day^{-1} at 20 degrees C using the base of natural logarithms. Temperature correction of rate constants was performed internally as discussed below.

Benthic Uptake of Nutrients

The model terms for benthic source or loss of ammonia and dissolved phosphorus were adjusted to account for benthic uptake in the river. Benthic uptake of nutrients was found to vary seasonally with changes in productivity. Benthic uptake of nutrients was correlated with diurnal changes in DO, which indicates uptake by attached algae and plants is significant. The rate of

Figure 3. Flows in the Colville River during the 1994 Study

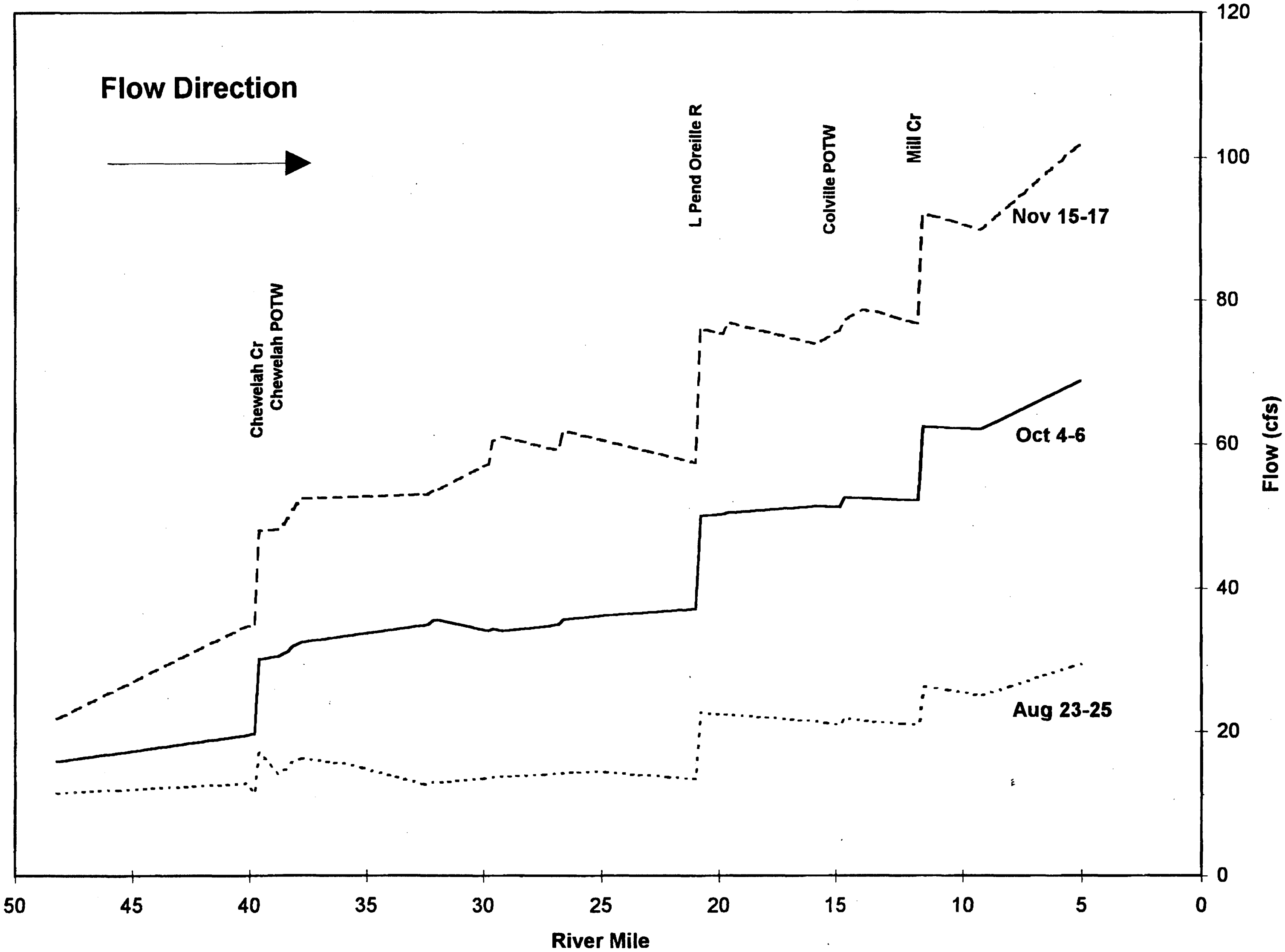

Table 6. Summary of measured loads used for calibration of the QUAL2E model of the Colville River.

Field ID	QUAL2E Point Loa	Flow	Dissolved Oxygen	Ultimate CBOD	Cond-uctivity umho/cm @25 C	Fecal Coliform	Fecal Coliform	Chloro-phyll *a*	Chloro-phyll *a* + phaeo-phytin	Organic N	NH3-N	NO2+NO3-N	Organic P	SRP	Total P	Total N	Kjeldahl N	Alk-alinity	Hard-ness	Chloride	NO2-N	Total Organic C
		cfs	mg/L	mg/L		#/100mL	#/day	ug/L	ug/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L as CaCO3	mg/L as CaCO3	mg/L	mg/L	mg/L
August 23-25, 1994 (week 34):																						
Incremental Inflow (1)			9.5	2.0	460	963				0.132	0.005	0.066	0.005	0.052	0.046	0.204						2.8
RM 40.3 Headwater (2)		12.8			404						0.005	0.005										
RM 38.8 Headwater (2)		14.3	13.3	2.0	353	163	5.7E+10	8.3	11.7	0.159	0.005	0.063	0.011	0.005	0.017	0.227						2.8
Point Loads:																						
Chewelah Cr	2	6.3	10.4	1.3	281	360	5.5E+10			0.245	0.005	0.525	0.005	0.017	0.01	0.775					0.01 U	1.9
Chewelah POTW	3	0.433	2.4	32.4	998	29	3.1E+08	115	282	0.005	18.2	0.072	0.005	3.31	1.42		18.25		328			29.7
Blue Cr	4	0.67	9.5	1.8	459	570	9.3E+09			0.129	0.005	0.065	0.005	0.056	0.053	0.199					0.01 U	2.6
Stranger Cr	6	0.1	9.1	2.8	510	3900	9.5E+09			0.179	0.005	0.085	0.005	0.043	0.031	0.269				3.6	0.01 U	3.9
Little Pend Oreille R	7	9.2	10.0	1.8	204	120	2.7E+10			0.071	0.005	0.005	0.005	0.005	0.005	0.081					0.01 U	2.5
Haller Cr	8	0.08	9.8	1.9	404	580	1.1E+09			0.102	0.005	0.053	0.005	0.033	0.01	0.16					0.01 U	2.7
Colville POTW	9	1.071	3.6	29.7	1125	18	4.7E+08	92.4	163	3.42	1.34	0.049	0.005	1.27	0.771		8		362			21
Mill Cr	11	5.25	11.0	1.2	453	220	2.8E+10			0.04	0.005	0.467	0.005	0.005	0.005	0.512						1.65
October 4-6, 1994 (week 40):																						
Incremental Inflow (1)			11.1	1.8	495	1140				0.143	0.005	0.063	0.005	0.048	0.046	0.212						2.5
RM 40.3 Headwater (2)		19.5			397					0.125	0.005	0.203	0.005	0.015	0.016	0.333						
RM 38.8 Headwater (2)		30.5	11.3	1.3	351	33	2.5E+10	1.1	3.6	0.078	0.005	0.236	0.005	0.014	0.015	0.319						1.9
Point Loads:																						
Chewelah Cr	2	10.2	11.6	1.2	268	60	1.5E+10			0.059	0.005	0.466	0.005	0.016	0.019	0.53						1.7
Chewelah POTW	3	0.433	3.5	34.1	1015	3275	3.5E+10	156	227	11.4	11.7	0.100	0.665	3.34	4		23	423	312			32.1
Blue Cr	4	0.47	11.0	1.4	468	260	3.0E+09			0.164	0.005	0.005	0.005	0.043	0.041	0.174						2
Stensgar Cr	5	0.38	11.0	2.1	503	2150	2.0E+10			0.163	0.005	0.247	0.005	0.084	0.076	0.415				4.7		3
Stranger Cr	6	0.61	11.1	1.9	535	1500	2.2E+10			0.126	0.005	0.012	0.005	0.034	0.037	0.143				3		2.7
Little Pend Oreille R	7	12.9	12.0	1.8	210	170	5.4E+10			0.078	0.005	0.005	0.005	0.005	0.005	0.088						2.6
Haller Cr	8	0.19	11.6	1.7	416	140	6.5E+08			0.109	0.005	0.005	0.005	0.036	0.027	0.119						2.4
Colville POTW	9	1.331	1.8	17.7	1190	41.2	1.3E+09	12.5	32.9	3.83	9.18	0.050	0.155	2.97	3.13		13	387	357.5			18.7
Corbett Cr	10					19																
Mill Cr	11	10.25	11.9	0.7	437	49	1.2E+10			0.035	0.005	0.409	0.005	0.005	0.0095	0.449						1.05
November 14-16, 1994 (week 46):																						
Incremental Inflow (1)			12.5	2.5	454	62				0.181	0.009	0.129	0.006	0.027	0.032	0.320						3.5
RM 40.3 Headwater (2)		34.6			405.5					0.214	0.005	0.391	0.026	0.026	0.05	0.609						
RM 38.8 Headwater (2)		48.2	11.8	1.8	379	58	6.8E+10	1.9	4.1	0.158	0.027	0.433	0.01	0.024	0.036	0.617						2.6
Point Loads:																						
L-Bar Ditch 1	1	0.00935			33700					19.0	253	45.5					270		7362	11650		
L-Bar Ditch 2	1	0.05			4740					1.037	0.526	21.4					1.3		1435	919		
L-Bar Ditch 1+2 (3)	1	0.0594			9302					3.87	40.30	25.2					43.63		2369	2610		
Chewelah Cr	2	13.3	11.8	2.0	259	79	2.6E+10			0.092	0.005	0.469	0.005	0.019	0.028	0.566						2.8
Chewelah POTW	3	0.551	4.6	32.4		1110	1.5E+10	21.9	39.4	7.05	14.0	0.0435	0.005	2.94	0.959		21	359.5	255.5			26.3
Blue Cr	4	0.56	12.1	2.3	481	430	5.9E+09			0.295	0.066	0.269	0.005	0.052	0.045	0.63						3.3
Stensgar Cr	5	2.8	12.8	2.3	431.5	30	2.1E+09			0.164	0.005	0.071	0.008	0.026	0.036	0.240				5.3		3.3
Stranger Cr	6	2.9	12.0	2.7	517	42	3.0E+09			0.166	0.005	0.236	0.005	0.025	0.027	0.407				3.9		3.8
Little Pend Oreille R	7	18.9	13.3	2.0	197	74	3.4E+10			0.107	0.005	0.046	0.005	0.005	0.005	0.158						2.8
Haller Cr	8	1.8	13.0	2.5	378	31	1.4E+09			0.197	0.005	0.005	0.005	0.023	0.029	0.207						3.5
Colville POTW	9	1.012	11.0	47.8		173	4.3E+09	570	779	7.36	9.64	0.281	0.335	2	1.60		17	373	333			31.0
Corbett Cr	10	0.29	13.3	2.4	236	1	7.1E+06			0.157	0.005	0.109	0.005	0.018	0.025	0.271						3.4
Mill Cr	11	15.5	12.5	0.5	436	84	3.2E+10			0.027	0.005	0.475	0.005	0.005	0.005	0.507						0.75

1) Incremental inflow was estimated as the flow-weighted average concentration of Haller, Blue, Stensgar, and Stranger Creeks (Excel file all.xls\TribAvg). Flows vary by reach and are calculated in Excel file q2e-rch.xls.
2) RM 38.8 was used as the headwater for calibration.
3) Loading from L-Bar was estimated as the sum of measured loads at ditches 1 and 2.
4) Ultimate CBOD was estimated from TOC based on the average ratio of 0.708 for CBODU/TOC from RM 15.9 and 38.8. CBODU of POTWs was estimated based on sample measurements of CBODU.

Table 7. QUAL2E data type 1A: global algae, nitrogen, phosphorus, and light parameters for calibration and verification of August-November 1994 conditions.

QUAL2E Coefficient	Description	Units	Value Used
α_5	O_2 uptake per NH_3 oxidized	mg O/mg N	3.43
α_6	O_2 uptake per NO_2 oxidized	mg O/mg N	1.14
α_3	O_2 production per unit algae	mg O/mg A	1.6
α_4	O_2 respiration per unit algae	mg O/mg A	2.0
α_1	N content of algae	mg N/mg A	0.08
α_2	P content of algae	mg P/mg A	0.011
μ_{max}	algal maximum growth rate	day^{-1}	3.0
ρ	algal respiration rate	day^{-1}	0.12
K_N	N half-saturation concentration	mg N /L	0.015
K_P	P half-saturation concentration	mg P /L	0.003
λ_1	linear algal light extinction	(ft^{-1})/(ug/L chl *a*)	0.013
--	light function option	--	1
K_L	light saturation coefficient	$BTU/ft^2/min$	0.092
LAVOPT	daily averaging option for light	--	2
AFACT	light averaging factor	dimensionless	1.0
--	number of daylight hours	hours	13.9, 11.5, 9.3 [1]
--	total daily solar radiation	$BTU/ft^2/day$	2100, 1450, 800 [1]
--	algal growth limitation option	--	2
F or P_N	algal preference for ammonia	dimensionless	0.9
KNITRF	nitrification inhibition constant	day^{-1}	0.6

[1] August 23-25, October 4-6, and November 14-16, 1994, respectively

Table 8. QUAL2E data types 6, 6A, and 6B: BOD, algae, nitrogen, phosphorus, and fecal coliform parameters for calibration and verification of August-November 1994 conditions.

QUAL2E Coefficient	Description	Units[1]	Value Used
K_1	CBOD decay rate constant	day^{-1}	0.065, 0.123, 0.066 [2]
K_2	reaeration rate constant	day^{-1}	QUAL2E Option 8[3]
β_3	rate constant for hydrolysis of organic N to NH_3	day^{-1}	0.1
σ_4	organic N settling rate	day^{-1}	0.4
β_1	rate constant for biological oxidation of NH_3 to NO_2	day^{-1}	2
β_2	rate constant for biological oxidation of NO_2 to NO_3	day^{-1}	2
β_4	organic P decay rate	day^{-1}	0.1
σ_5	organic P settling rate	day-1	0.4
α_0	ratio of chlorophyll *a* / algae	ug chl *a* / mg A	15
σ_1	algal settling rate	feet/day	2.0
λ_0	non-algal light extinction	ft^{-1}	0.01
K_5	coliform decay coefficient	day^{-1}	4

1 all units in day^{-1} are expressed at 20 degrees C.
2 Reach 4 (average of data from RM 15.9 and RM 38.8); reaches 5-17 (average of data from the Chewelah POTW); and reaches 18-25 (average for the Colville POTW).
3 QUAL2E option 8 except for reach 25. Reach 25 was estimated during calibration to be 10 day^{-1} at 20 degrees C.

uptake was estimated to be related to the plant productivity as measured by ranges in diurnal DO (Thomann and Mueller, 1987). The estimated benthic nutrient uptake rates for each sampling survey are presented in Table 9.

Sediment Oxygen Demand

Sediment Oxygen Demand (SOD) was estimated during model calibration to achieve the best prediction of DO profiles. Goodness of fit was determined using the root-mean-squared-error (RMSE) between observed and predicted DO. The estimates of SOD are presented in Table 10. SOD rates for the October and November surveys and seasonal critical conditions were calculated from the August calibration data by assuming that SOD rates were proportional to velocity and depth of river reaches (Hatcher, 1986; USEPA, 1985).

Oxygen demand by benthic sediments and organisms was found to be significant downstream from Chewelah and Colville. Benthal deposits that demand oxygen are the result of transportation and deposition of organic material. The material may be from a source such as wastewater particulate BOD, or it may be generated inside the river such as through plant growth. The location of the observed SOD downstream from the POTWs suggests that the wastewater discharges may be influencing SOD either through deposition of particulate BOD or stimulation of algae and plant growth and subsequent settling.

Reaeration

Reaeration rates used in the QUAL2E model were estimated based on empirical equations recommended by USEPA (1985; 1987) and recommendations of Thomann and Mueller (1987). The Tsivoglou and Wallace option (QUAL2E option 8) was considered to be most representative of conditions in the Colville River based on velocity and depth. Reaeration in reach 25 was estimated during calibration to be 10 day^{-1} at 20 degrees C to account for Meyer Falls.

Relationship Between CBODU, $CBOD_5$, BOD_5, and TOC

QUAL2E simulates BOD as ultimate carbonaceous BOD (CBODU). Relationships between CBODU, $CBOD_5$, BOD_5, and TOC were based on laboratory tests using methods recommended by USEPA and the National Council of the Paper Industry for Air and Stream Improvement (USEPA, 1985; NCASI, 1987a and 1987b). The relationships between CBODU and other parameters in effluent and surface water samples collected by Ecology are presented in Table 11. Headwater and tributary loading of CBODU was estimated based on the average measured ratio of CBODU/TOC applied to the measured TOC (Table 6).

Table 9. Estimated benthic uptake rates of ammonia and dissolved phosphorus for the Ecology surveys during August-November, 1994.

Sampling Survey	Benthic Ammonia Uptake[1] (mg/ft^2-day)	Benthic Dissolved P Uptake[1] (mg/ft^2-day)
August 23-25, 1994	11	1.6
October 4-6	4.8	0.68
November 14-16	2.0	0.28

[1]The rate of ammonia uptake was estimated to be 200 mg/ft^2-day in reach 5 during August 23-25 to account for the rapid loss observed.

Table 10. Estimated rates of sediment oxygen demand (SOD) for model calibration and validation, and seasonal critical conditions (all SOD rates are expressed as mg/ft^2/day at 20 degrees C.)

	Normalized Rates for Velocity and Depth				
Qual2e Reach	Aug 23-25, 1994 Calibration	October 4-6, 1994 Validation	November 15-17, 1994 Validation	June-October Critical Conditions	November-May Critical Conditions
4	0.1	0.2	0.3	0.044	0.12
5	0.2	0.4	0.6	0.092	0.23
6	0.3	0.6	0.9	0.13	0.34
7	0.5	1.0	1.5	0.19	0.60
8	0.5	1.1	1.6	0.19	0.66
9	0.2	0.5	0.7	0.10	0.28
22	0.1	0.2	0.3	0.053	0.15
23	0.1	0.2	0.3	0.050	0.14
24	0.2	0.4	0.6	0.088	0.26

Table 11. Summary of BOD data and relationships between CBODU and other variables.

Station	Ultimate CBOD (mg/L)	5-day CBOD (mg/L)	5-day BOD (mg/L)	CBOD Rate Constant (1/day)	TOC (mg/L)	Ratio of CBODU/BOD5	Ratio of CBODU/TOC
August 23-25, 1994 survey:							
RM 15.9	1.9	0.6	0.6	0.0711	3.7	3.33	0.530
RM 38.8	2.3	0.8	0.9	0.0902	2.8	2.76	0.833
Colville POTW	29.7	7.6	7.8	0.0544	21.0	3.74	1.41
Chewelah POTW	32.4	11.1	12.4	0.0794	29.7	3.17	1.10
October 4-6, 1994 survey:							
RM 15.9	1.6	0.4	0.4	0.0549	2.5	4.10	0.648
RM 38.8	1.3	0.4	0.5	0.0776	1.9	2.65	0.696
Colville POTW	17.7	4.2	4.2	0.0666	--	4.03	--
Chewlah POTW	34.1	19.4	20.1	0.1728	--	1.75	--
November 15-17, 1994 survey:							
RM 15.9	1.6	--	--	0.0410	2.7	--	0.585
RM 38.8	2.4	--	--	0.0546	2.7	--	0.904
Colville POTW	47.8	--	--	0.0774	31.0	--	1.54
Chewelah POTW	32.4	--	--	0.1166	26.3	--	1.24
Average of August-November surveys (bold values indicate key values used for model calibration as explained in text and tables).							
RM 15.9	1.7	0.5	0.5	0.0557	3.0	3.71	0.617
RM 38.8	2.0	0.6	0.7	0.0741	2.4	2.70	0.800
Colville POTW	31.7	5.9	6.0	**0.0661**	26.0	3.89	--
Chewelah POTW	33.0	15.3	16.3	**0.123**	28.0	2.46	--
Average of RM 15.9 and RM 38.8	1.9	0.6	0.6	**0.0649**	2.7	3.21	**0.708**
Average of Colville and Chewelah POTWs	32.3	10.6	11.2	0.0945	27.0	3.17	--
Average of River and POTWs Combined	17.1	5.6	5.9	0.0797	14.8	3.19	--

Algae, Nitrogen, and Phosphorus Cycles

The coefficients α_5 and α_6 represent the oxygen uptake per unit of ammonia and nitrite oxidized. The values selected represent the stoichiometric amounts of oxygen required as recommended by USEPA (Table 7; USEPA, 1985).

The rate constants for biological oxidation of nitrite to nitrate (β_2) and hydrolysis of organic-N to ammonia (β_3) were specified from the range of typical reported values to achieve the best comparison between observed and simulated nitrogen (Table 8; USEPA, 1985). The value of β_2 was selected from near the high end of reported values to approximate a single-stage process of nitrification controlled by the rate of oxidation of ammonia to nitrate (β_1).

The remaining kinetic coefficients listed in Tables 7 and 8 were selected from the mid-range of typical values summarized by USEPA (1985). Recommendations from USEPA (1991a) and Thomann and Mueller (1987) were also used to select appropriate values for various coefficients. Coefficients for algae, nitrogen, and phosphorus cycles were not varied from initially selected values for model calibration.

The phytoplankton species observed in the Colville River are typical of streams and rivers (Appendix B). There were no unusual algae present, with the possible exception of *Oscillatoria* at RM 13.8 on August 23, 1994. However, it only comprised less than 2 percent of the total density. This bluegreen alga is most often associated with enriched waters. Phytoplankton abundance was highest in August; October and November were similar. Algae were more abundant downstream from Chewelah (RM 37.8) than downstream from Colville (RM 13.8) during August, but, both sites were similar in October and November.

Fecal Coliform Calibration

Fecal coliforms are simulated in QUAL2E using a first-order die-off function. The fecal coliform die-off rate, which depends on temperature, is the only coefficient for model calibration. A die-off rate of 4 day^{-1} at 20 degrees C was selected to provide the best fit during model calibration. The selected die-off rate is within the range of normal reported values (USEPA, 1987).

Temperature and Correction of Coefficients

Reaction coefficients in Tables 7 and 8 are reported at 20 degrees C using base e of the natural logarithms. The QUAL2E model allows correction of actual reaction rates from the rate at 20 degrees C to the ambient temperature of the receiving water during simulations. The temperature corrections used were commonly accepted values from the scientific literature (USEPA, 1985; USEPA, 1991a) using the formula:

$$X_T = X_{20}\,\theta^{(T-20)} \qquad \text{(equation 3)}$$

where

X_T = the value of the coefficient at the local temperature (T in degrees C)

X_{20} = the value of the coefficient at the standard temperature of 20 degrees C

θ = an empirical constant from literature for each reaction coefficient.

The values used for the empirical constants for temperature correction are shown in Table 12. Temperatures used in the QUAL2E model of the Colville River were based on measured temperatures during the August-November 1994 surveys. Average reach temperatures (degrees F) during each survey are presented in the QUAL2E input files in Appendix C (QUAL2E data type 7).

Comparison of Observed and Simulated Water Quality

Dissolved Oxygen

Results of the QUAL2E simulations for calibration and verification are compared with DO observed by Ecology during August-November 1994 in Figure 4. The uncertainty of model prediction was estimated by the root-mean-squared-error (RMSE), which is a commonly used measure of model variability (Reckhow, *et al.*, 1986). The RMSE is a measure of the difference between model predictions and measured daily average values. The QUAL2E model had an overall RMSE for DO of 0.4 to 0.8 mg/L for the August-November surveys. Model performance was slightly better for the verification data set from November compared with summer calibration results. Variability during summer was influenced by wide diurnal ranges caused by algae and macrophyte productivity.

DO downstream from the Chewelah POTW decreases rapidly until approximately RM 32 (Figure 4). The rapid decrease in DO from RM 38 to 32 is influenced by sediment oxygen demand, in addition to CBOD, NBOD, and algal respiration. DO was observed below the 8 mg/L Class A standard at several locations below Chewelah during the August 1994 survey. The expected location of critical sag below the Chewelah POTW is approximately RM 32.

DO proceeding downstream from the Colville POTW also shows a pattern of decreasing average concentrations and decreasing diurnal ranges. Diurnal minimum concentrations are similar from RM 15 to 5, although the diurnal average tends to decrease downstream. DO was observed below the 8 mg/L Class A standard at several locations below Colville during the August 1994 survey. The expected location of critical sag below the Colville POTW is immediately upstream from Meyer Falls at approximately RM 5.4.

Table 12. Constants for temperature correction of QUAL2E model coefficients.

	QUAL2E Coefficient (Table 7 and 8)	Temperature Constant θ
algal maximum growth	μ_{max}	1.047
algal respiration	ρ	1.047
ammonia oxidation	β_1	1.080
nitrite oxidation	β_2	1.047
organic N hydrolysis	β_3	1.047
organic P decay	β_4	1.047
CBOD decay	K_1	1.047
reaeration	K_2	1.024
sediment oxygen demand	K_4	1.080
coliform decay	K_5	1.047

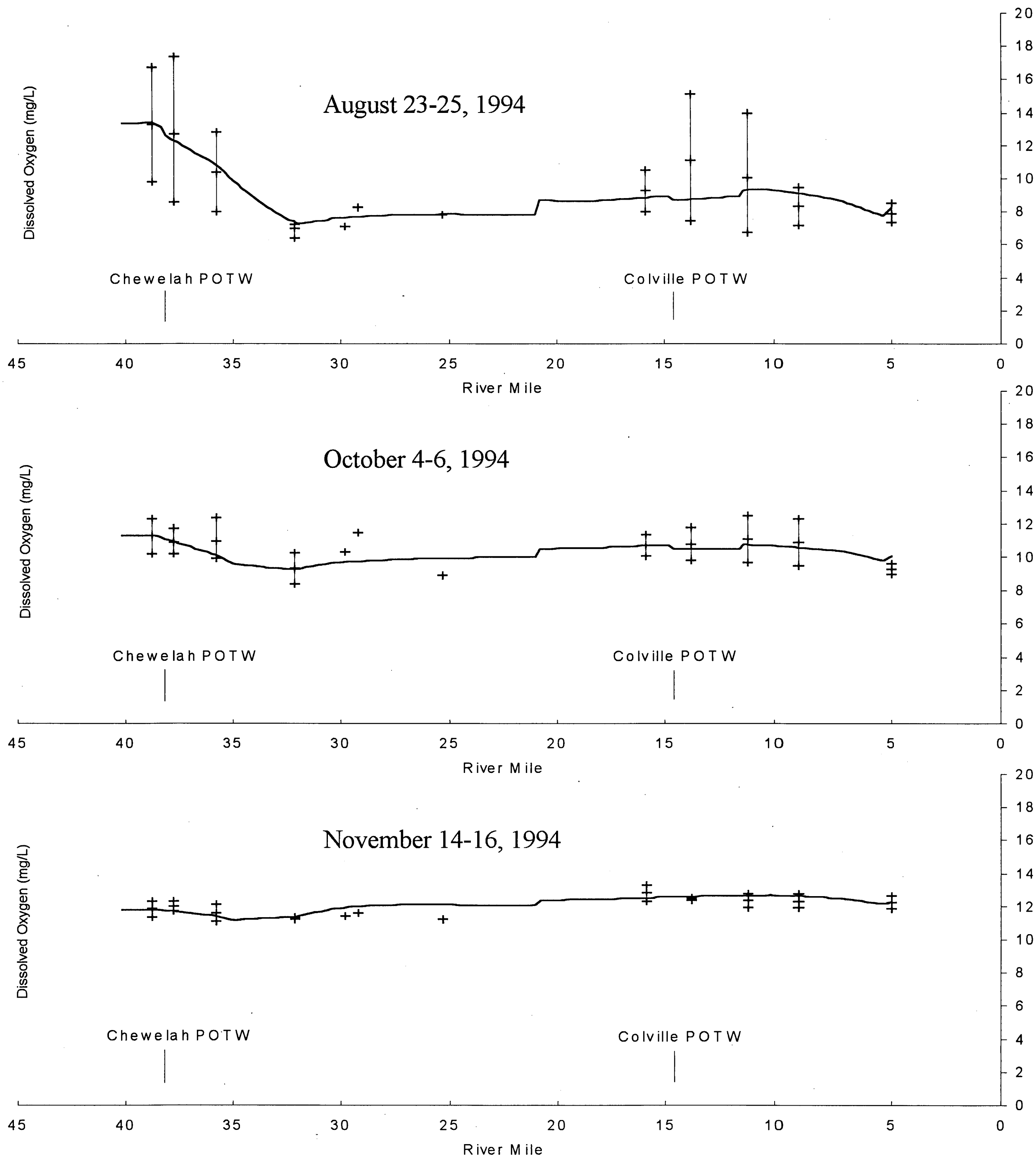

Figure 4. Calibration and validation of QUAL2E for prediction of dissolved oxygen in the Colville River during August-November 1994 (vertical lines are observed means and ranges.)

Wastewater discharges of nutrients appear to stimulate algal and plant productivity. The diurnal range in DO is greatest immediately downstream from effluent discharges. Effluent loading of nutrients was greater than headwater and tributary loading during August and October. Diurnal ranges at the locations of the critical sags are similar to or less than the ranges occurring upstream from effluent discharges. The regions of the critical sags of minimum DO at RM 32 and RM 5.4 are downstream from the greatest stimulation of productivity and exhibit relatively little diurnal range in DO. Therefore, steady-state model predictions for the critical sag locations are expected to be fairly precise for prediction of critical conditions. Minimum DO at the critical sag locations may not be greatly exacerbated by increased productivity caused by nutrient loading.

Ammonia

Results of the QUAL2E simulations for calibration and verification are compared with ammonia observed by Ecology during August-November 1994 in Figure 5. The QUAL2E model had an overall RMSE for ammonia of 0.01 to 0.05 mg/L as N.

Ammonia concentrations exhibit spikes and rapid decreases proceeding downstream from both POTWs (Figure 5). The loading of ammonia from Chewelah POTW was found to minimally affect concentrations immediately upstream from the Colville POTW because of rapid instream loss. Ammonia uptake by benthic algae and plants was found to be very important, as was nitrification, to represent the rapid loss rates that were observed.

Fecal Coliform

Results of the QUAL2E simulations for calibration and verification are compared with fecal coliform observed by Ecology during November 1994 in Figure 6. The QUAL2E model had an overall RMSE for fecal coliform of 16 organisms/100 mL for the November calibration. The calibrated model was applied to the August and September data as shown in Figure 7. November was chosen for model calibration because of variability and unexplained sources of fecal coliform suspected during the August and October surveys. Measured loads of fecal coliform from tributaries could not explain the concentrations observed in the river during August and October.

Nonpoint sources of fecal coliform were found to be very significant to explain the high fecal coliform concentrations observed during the August and October 1994 surveys. The amount of unmeasured nonpoint loading was estimated by trial using the calibrated model. Approximately 10^{12} fecal coliform organisms per day were estimated to originate from unmeasured nonpoint discharges directly to the river along most of its length, which is equivalent to the amount of direct loading from approximately 100 cows (Crane *et al.*, 1983; Moore *et al.*, 1988) or 400 people (Brandes *et al.*, 1978). The QUAL2E model results shown in Figure 7 suggests that concentrations of fecal coliform in the river may have met Class A standards if the direct nonpoint loading had not been present.

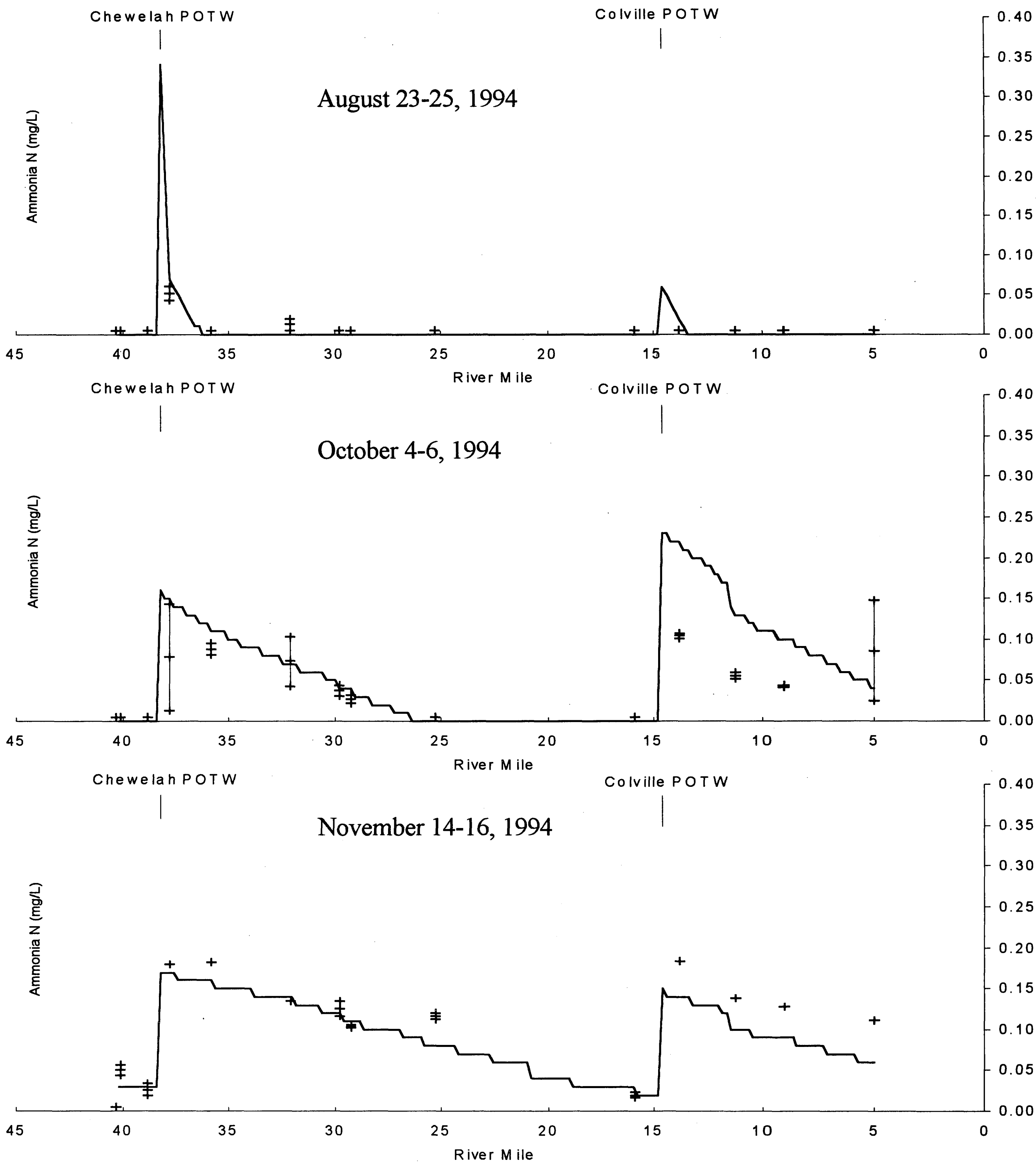

Figure 5. Calibration and validation of QUAL2E for prediction of ammonia in the Colville River during August-November 1994 (vertical lines are observed means and ranges.)

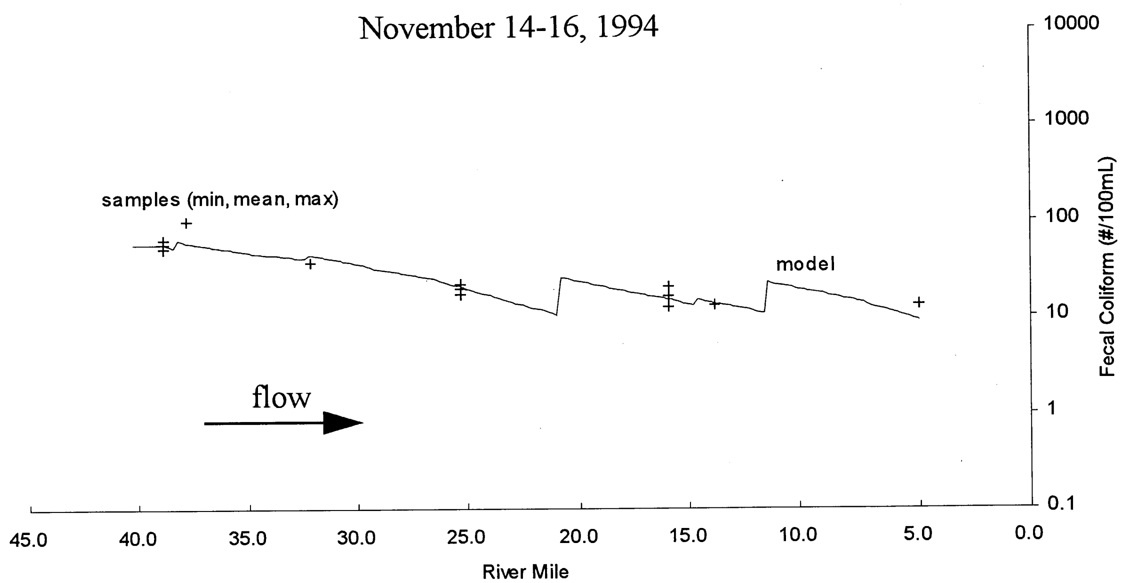

Figure 6. Comparison of observed and simulated fecal coliform in the Colville River during November 1994 survey.

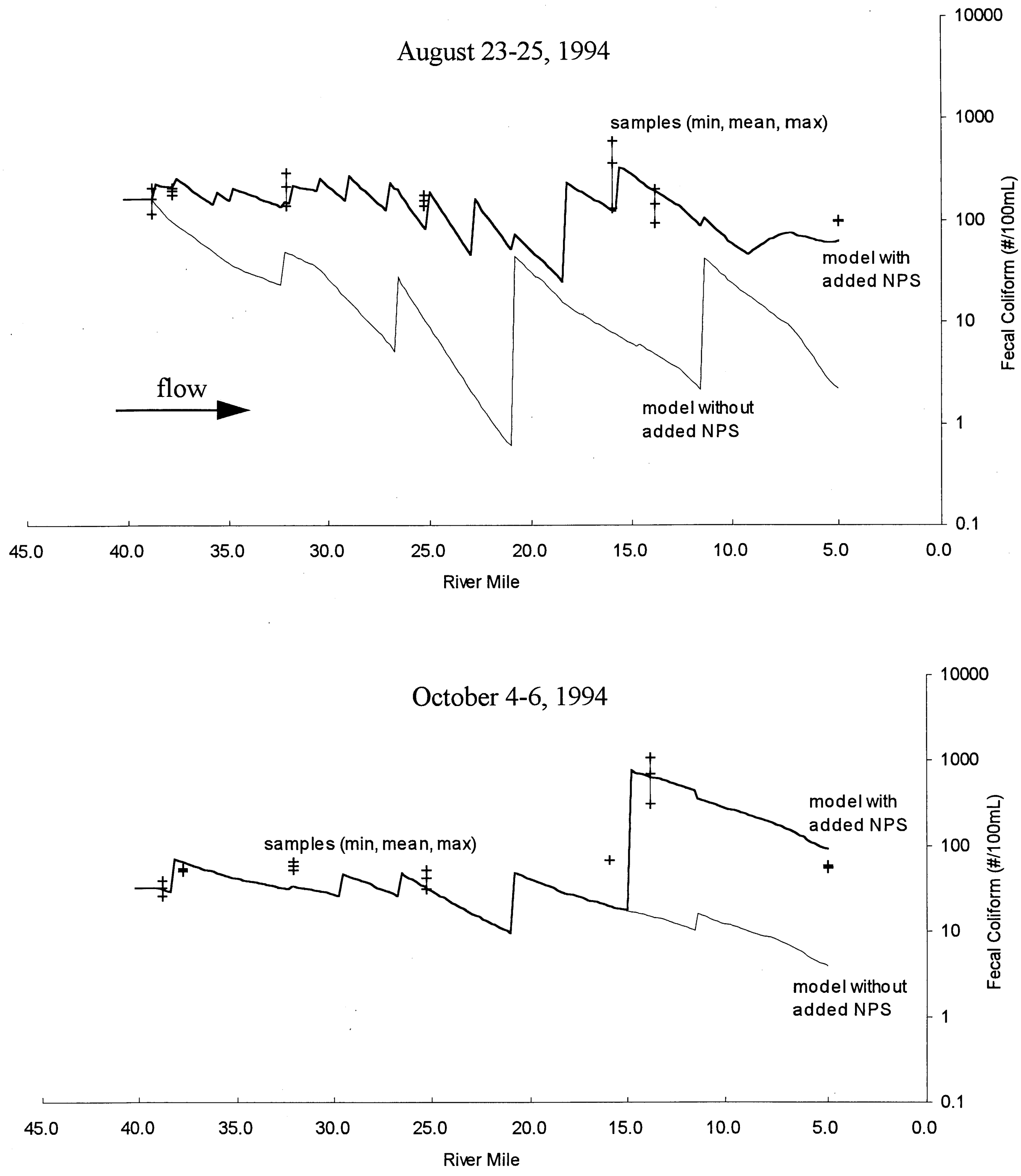

Figure 7. Comparison of observed and simulated fecal coliform in the Colville River during August and October 1994 surveys with and without estimated nonpoint sources.

Numerous cattle and dairy operations are present in the watershed (SCCD, 1992), and direct access to the stream bank for watering of cows was observed at several locations in the river. Failing septic systems have also been suspected of discharging to the river. Other nonpoint sources of fecal coliform may also be significant. Further investigations would be needed to identify the sources of the estimated nonpoint loading.

Waste Load Allocations for BOD and Ammonia

Seasonal Permit Periods

Three seasonal permit periods were chosen to allow dischargers to efficiently use the assimilative capacity of the river. Separate WLAs were estimated for each season. The seasons were chosen to maximize the available river flow during the high flow season and to minimize the length of the most restrictive period. The following three seasons were selected based on analysis of low river flows at the USGS gage at RM 5:

- June-October
- November-February
- March-May

DO Standard and Targets for QUAL2E Modeling

The Colville River is Class A according to Chapter 173-201A WAC, which requires a water quality criterion of 8 mg/L of DO at all times. Concentrations of DO less than 8 mg/L were frequently observed during August 1994 in the river downstream from the effluent discharges. Sediment oxygen demand, relatively high river temperatures during summer, and algal respiration are probably major contributors to excursions below the DO criterion of 8 mg/L.

To estimate allowable BOD loading from POTWs, the DO standard was assumed to be met if: 1) the QUAL2E model predicted DO to be greater than 8 mg/L; or 2) POTWs were predicted to cause an insignificant depletion when DO was less than 8 mg/L. Insignificant depletion was defined as less than 0.2 mg/L depletion below background conditions when predicted DO was less than 8 mg/L using the QUAL2E model. This definition was assumed to be consistent with the anti-degradation requirements of WAC 173-201A-070, which specify that when natural conditions are of a lower quality than the criteria assigned, the natural conditions constitute the water quality criteria. DO depletion of no more than 0.2 mg/L below background conditions is assumed to be small enough to prevent interference with existing beneficial uses. Defining insignificant DO depletion as no more than 0.2 mg/L also has precedent in the marine DO standards of WAC 173-201A and has been approved in NPDES permits to protect Washington's freshwater standards (e.g. EPA Permit No. ID-000116-3; Potlatch Corporation, Lewiston, Idaho; discharge to the Snake River at the state line).

Critical Conditions for WLA Modeling of DO and Ammonia

When a steady-state water quality model such as QUAL2E is used to derive a WLA, the pollutant loading is introduced into the model under a given set of assumed water quality conditions (*e.g.* receiving water flows, temperature, background, and nonpoint source loading). A trial-and-error procedure was used to find WLAs for BOD and ammonia that produced an in-stream DO concentration that satisfied the water quality standard for DO (USEPA, 1983). The receiving water conditions that were used in WLA modeling are called critical conditions. Input files for QUAL2E for critical conditions for each season are presented in Appendix D.

River Flows, Velocity, and Depth

Critical river flows for the three permit periods were estimated as the 7-day average low flows with a recurrence interval of once every 29 years (7Q29) according to Ecology policy for seasonal WLAs (Ecology, 1991). The 7Q29 flows shown in Table 13 were estimated for each seasonal period using the log-Pearson type III distribution as implemented in WQHYDRO (Aroner, 1992).

7Q29 flows were estimated for river mile 5.0 (USGS station 12409000) based on a long period of record (1922-1995). Critical flows at various other locations were estimated based on regression analysis of daily flows from river mile 5 (USGS data at station 12409000) compared with flows at other river mile and tributary locations on the same day or lagged one or two days (Stevens County and Ecology data). The selected best-fitting regression equations are presented in Table 13. The regression equations were used to estimate critical flows at other locations from the estimated 7Q29 flows at river mile 5.

Velocity and depth of flow in each model reach were estimated using the same power curve equations presented above for model calibration. Incremental inflows were estimated based on continuity using differences between flows at river mile and tributaries shown in Table 13.

Headwater and Tributary Loading, River Temperature, Diurnal DO

Critical conditions for water quality in headwaters and tributaries to the Colville River are presented in Table 14. The 10th or 90th percentiles (whichever was more limiting) of seasonal data, or 5th or 95th percentiles of annual data were selected for critical conditions for modeling of WLAs. Seasonal data were used whenever possible. Annual data were used to estimate variables which were not measured during some seasons (*e.g.* chlorophyll, organic N, organic P, and soluble reactive P during March-May).

Critical temperatures in the Colville River are presented in Table 15. Seasonal 90th percentiles were estimated to represent critical conditions. Data were pooled into three regions to represent spatial variability.

Table 13. Summary of regression equations and predicted river and tributary flows for critical conditions.

	Power Curve Parameters Q = a Q4090 ^ b (1) a	b	Annual 7Q10 (cfs)	Seasonal 7Q29 (cfs) Jun-Oct	Nov-Feb	Mar-May
Mainstem River Mile:						
5 (1)	--	--	20.4	11.2	36.8	88.7
9.2	1.319	0.9381	22.3	12.7	38.8	88.6
11.2	1.506	0.9011	22.8	13.3	38.8	85.7
13.8	1.276	0.9064	19.6	11.4	33.5	74.4
15.9	1.326	0.8908	19.5	11.4	32.9	72.1
20.8	1.020	0.9263	16.7	9.6	28.8	65.0
25.3	0.7983	0.9028	12.1	7.1	20.7	45.8
32.1	0.3736	1.096	10.2	5.3	19.4	51.0
38.8	0.8702	0.8367	10.8	6.6	17.8	37.1
Creeks/POTWs:						
Chewelah Cr	0.06686	1.144	2.1	1.1	4.1	11.3
Chewelah POTW (2)	--	--	(2)	(2)	(2)	(2)
Blue Cr	11.73	-0.7565	1.2	1.9	0.8	0.4
Stensgar Cr	8.365E-11	5.399	0.001	0.000	0.02	2.7
Stranger Cr	5.932E-08	3.963	0.009	0.001	0.1	3.1
Little Pend Oreille R	0.2230	1.015	4.8	2.6	8.7	21.2
Haller Cr	5.492E-05	2.257	0.05	0.01	0.2	1.4
Colville POTW (3)	--	--	(3)	(3)	(3)	(3)
Mill Cr	0.1145	1.070	2.9	1.5	5.4	13.9

1) power curves for prediction of flow (Q in cfs) at various mainstem river miles or tributaries from flow (Q4090 in cfs) at USGS gage 12409000 (river mile 5). 7Q29 flows at river mile 5 are from log-Pearson type III analysis of USGS data.
2) Chewelah POTW- Critical flows from CH2M-Hill (1996a). June-October maximum monthly average of 0.71 mgd, maximum daily average of 1.06 mgd. November-May: maximum monthly average of 1.2 mgd, maximum daily average of 2.14 mgd.
3) Colville POTW: maximum monthly average of 1.2 mgd, maximum daily average of 1.8 mgd.

Table 14. Selected critical conditions for headwater and tributary quality for QUAL2E modeling, based on 90th percentiles of data collected by SCCD, Ecology, and NW Alloys.

Season	Location	Critical Flow (4) (cfs)	Dissolved Oxygen (5) (mg/L)	Ultimate CBOD (6) (mg/L)	Fecal Coliform (#/100 ml)	Chlorophyll *a* (ug/L)	Organic N (mg/L as N)	Ammonia (mg/L as N)	Nitrate +Nitrite (mg/L as N)	Organic P (mg/L as P)	Soluble Reactive P (mg/L as P)
June-October (10th/90th %tiles)	RM 40.3 headwater (1)	5.5	11.2	3.2	14	13	0.37	0.10	0.67	0.02	0.02
	L-Bar Ditch 1	--	--	--	--	--	1	457	41.3	--	--
	L-Bar Ditch 2	--	--	--	--	--	1	14.8	20.5	--	--
	Chewelah Cr	1.1	9.2	1.4	353	--	0.44	0.05	0.55	0.01	0.02
	Chewelah POTW (2)	1.640	(2)	(2)	(2)	205	30.5	(2)	0.14	1.78	3.35
	Blue Cr	1.9	8.2	2.0	1210	--	0.18	0.12	0.47	0.01	0.06
	Stensgar Cr	0	9.5	2.1	5320	--	0.18	0.19	0.34	0.01	0.08
	Stranger Cr	0.001	8.8	3.2	3410	--	0.21	0.19	0.32	0.01	0.05
	Little Pend Oreille R	2.6	8.9	1.9	418	--	0.08	0.04	0.22	0.01	0.005
	Haller Cr	0.01	9.2	2.0	620	--	0.11	0.05	0.31	0.01	0.04
	Colville POTW (2)	2.79	(2)	(2)	(2)	147	7.18	(2)	0.06	0.26	3.65
	Mill Cr	1.5	8.8	1.4	459	--	0.06	0.08	0.53	0.01	0.005
	Incremental Inflows (3)	--	8.2	2.0	1208	--	0.18	0.12	0.47	0.01	0.06
November-February (10th/90th %tiles)	RM 40.3 headwater (1)	13.7	12.2	3.6	47	1.9	0.24	0.17	1.16	0.05	0.03
	L-Bar Ditch 1	--	--	--	--	--	12.3	634	63.1	--	--
	L-Bar Ditch 2	--	--	--	--	--	2.00	21.3	22.9	--	--
	Chewelah Cr	4.1	10.2	4.0	135	--	0.18	0.06	0.79	0.02	0.04
	Chewelah POTW (2)	3.311	(2)	(2)	(2)	22.1	7.14	(2)	0.06	0.01	3.02
	Blue Cr	0.8	10.5	4.7	531	--	0.59	0.18	0.58	0.02	0.10
	Stensgar Cr	0.02	10.8	2.3	431	--	0.19	0.21	0.48	0.01	0.03
	Stranger Cr	0.1	11	5.4	117	--	0.33	0.40	0.97	0.02	0.05
	Little Pend Oreille R	8.7	11.4	4.0	112	--	0.21	0.05	0.31	0.02	0.01
	Haller Cr	0.2	10.6	5.0	94	--	0.39	0.10	1.65	0.02	0.05
	Colville POTW (2)	2.79	(2)	(2)	(2)	624	7.39	(2)	0.29	3.66	2.01
	Mill Cr	5.4	10.5	1.1	98	--	0.05	0.17	0.61	0.02	0.01
	Incremental Inflows (3)	--	10.6	4.7	414	--	0.52	0.19	0.80	0.02	0.09
March-May (10th/90th %tiles)	RM 40.3 headwater (1)	25.8	11.4	--	54	--	--	0.06	1.02	--	--
	L-Bar Ditch 1	--	--	--	--	--	--	334	--	--	--
	L-Bar Ditch 2	--	--	--	--	--	--	10.9	--	--	--
	Chewelah Cr	11.3	9.2	--	249	--	--	0.05	0.50	--	--
	Chewelah POTW (2)	3.311	(2)	(2)	(2)	--	--	(2)	--	--	--
	Blue Cr	0.4	8.1	--	5110	--	--	0.10	0.30	--	--
	Stensgar Cr	2.7	9.7	--	3200	--	--	0.07	0.27	--	--
	Stranger Cr	3.1	9.4	--	489	--	--	0.11	0.5	--	--
	Little Pend Oreille R	21.2	9.5	--	72	--	--	0.08	0.2	--	--
	Haller Cr	1.4	9.5	--	127	--	--	0.06	0.37	--	--
	Colville POTW (2)	2.79	(2)	(2)	(2)	--	--	(2)	--	--	--
	Mill Cr	13.9	9.1	--	493	--	--	0.05	0.34	--	--
	Incremental Inflows (3)	--	9.5	--	1629	--	--	0.09	0.38	--	--
All Seasons (5th/95th %tiles)	RM 40.3 headwater (1)	5.5	--	3.0	75	12	0.65	0.1	1.63	0.02	0.04
	L-Bar Ditch 1	--	--	--	--	--	49.5	680	60.9	--	--
	L-Bar Ditch 2	--	--	--	--	--	2.0	33.0	39.7	--	--
	Chewelah Cr	1.1	9	2.3	533	--	0.36	0.07	0.68	0.01	0.02
	Chewelah POTW (2)	1.640	(2)	(2)	(2)	348	30.3	(2)	0.15	1.4	3.5
	Blue Cr	1.9	8	2.8	3180	--	0.37	0.2	0.92	0.01	0.06
	Stensgar Cr	0	9.3	2.4	8920	--	0.19	0.22	0.42	0.01	0.14
	Stranger Cr	0.001	8.9	3.4	2470	--	0.21	0.3	0.81	0.01	0.05
	Little Pend Oreille R	2.6	9	2.0	557	--	0.12	0.08	0.45	0.01	0.005
	Haller Cr	0.01	9.1	2.8	912	--	0.24	0.08	0.91	0.01	0.04
	Colville POTW (2)	2.79	(2)	(2)	(2)	1470	9.9	(2)	0.39	0.97	3.7
	Mill Cr	1.5	8.7	1.5	567	--	0.06	0.12	0.65	0.01	0.005
	Incremental Inflows (3)	--	8.0	2.8	3168	--	0.37	0.20	0.92	0.01	0.06

1) Chlorophyll *a* was based on data from RM 38.8. Dissolved oxygen was based on observations of 124% of saturation during June-October, 95% of saturation during November-February, and 116% of saturation during March-May (ALL-WQ.XLS\RM38.8).
2) Critical conditions for POTWs are presented elswehere for consideration of various treatment alternatives for WLA modeling.
3) Incremental inflows were estimated as the flow-weighted average concentrations of Haller, Blue, Stensgar, and Stranger Creeks.
4) Critical flows were estimated as low 7Q29 flows for headwater and tributaries, and seasonal design flows for treatment plants.
5) Headwater dissolved oxygen was assumed to start at saturation (at 90th %tile temperatures of 20.2, 4.8, and 16.1 degrees C during Jun-Oct, Nov-Feb, and Mar-May.)
6) Ultimate CBOD of tributary sites was estimated from TOC based on the average of measured ratios of CBODU/TOC (0.708).

Table 15. Critical temperatures (seasonal 90th percentiles) in the Colville River for Waste Load Allocation modeling using QUAL2E.

RM	QUAL2E Reaches	June-October Temperature (deg C)	November-February Temperature (deg C)	March-May Temperature (deg C)
40.3-32.1	1-9	20.2	4.8	16.1
32.1-15.9	10-17	18.5	5.9	14.5
15.9-5.0	18-25	17.5	5.4	12.9

Diurnal ranges in DO measured during 1994 are presented in Table 16. The 1994 studies by Ecology are the most comprehensive data set available. Critical seasonal conditions for WLA modeling were estimated as follows: the June-October season was represented by data from the August 23-25 survey; the November-February and March-May seasons were represented by data from the November 15-17, 1994, survey.

Critical Conditions for Mixing Zones for Effluent Discharge of Ammonia

Chapter 173-201A-100 WAC contains requirements for limiting mixing zones for NPDES dischargers. Separate chronic and acute points of compliance are recognized. Dilution factors (DF) based on maximum allowable dilution flows were calculated from discharger design flow (maximum monthly average for chronic and maximum daily average for acute criteria) and river flow (seasonal 7Q29).

WLAs for ammonia for individual dischargers were calculated based on the critical conditions presented in Appendix E using a simple mass balance equation. Each mixing zone WLA (acute and chronic) was calculated from water quality standards (acute and chronic WQS), background ambient constituent concentrations (CA), and dilution factors (acute and chronic DF) as follows:

$$\text{Mixing Zone WLA} = (WQS * DF) - (CA * (DF - 1))$$

The effluent limits for ammonia to meet criteria at mixing zone boundaries are presented in Table 17 for Chewelah and Colville POTWs. The mixture of effluent and river water reduces instream temperature and pH, which results in increased limits for ammonia. Effluent temperature, pH, and alkalinity were assumed to modify the temperature and pH at the mixing zone boundary for calculation of ammonia limits. Temperature at the mixing zone boundary was estimated by dilution calculation for the mixture of upstream and effluent waters. The pH at the mixing zone boundary was calculated from the mixture of river pH and alkalinity using the spreadsheet PHMIX (Ecology, 1994b). Instream temperature and pH continues to increase as dilution proceeds downstream from the mixing zone boundary. However, effluent limits were found to be most restrictive at the mixing zone boundary.

Effluent temperature and alkalinity were assumed to be representative of extended air activated sludge treatment processes designed for nitrification, which would have cooler temperatures and lower alkalinity than the existing lagoon systems. Effluent alkalinity for Chewelah was estimated by CH2M-Hill (1996b). Effluent alkalinity for Colville for a nitrification treatment process was estimated based on the 10th percentile alkalinity for the lagoon system minus 7.14 mg/L as $CaCO_3$ for each mg/L of ammonia-N oxidized based on the 90th percentile of existing ammonia-N. Critical effluent temperature was assumed to be 18 °C during June-October, 10 °C during November-February, and 15 °C during March-May (personal communication with Ken Merrill, Department of Ecology, Eastern Regional Office). Effluent limits for various effluent pH were estimated.

Table 16. Diurnal DO range (mg/L) during 1994 sampling surveys (difference between maximum and minimum DO.)

Station	August 23-25	October 4-6	November 15-17
RM 38.8	6.93	2.10	0.95
RM 37.8	8.80	1.50	0.60
RM 35.8	4.80	2.45	1.00
RM 32.1	0.85	1.85	0.10
RM 15.9	2.50	1.30	1.00
RM 13.8	7.65	2.00	0.15
RM 11.2	7.30	2.80	0.80
RM 9.2	2.30	2.80	0.85
RM 5.0	1.10	0.60	0.80

Table 17. Summary of effluent limits for ammonia for Chewelah and Colville POTWs for various assumed effluent pH (see Appendix E for list of all assumptions for calculations.)

		Daily Maximum Ammonia Concentration (mg/L as N)		Monthly Average Ammonia Concentration (mg/L as N)	
	Effluent pH	Chewelah	Colville	Chewelah	Colville
June-October					
	7.5	3.7	6.1	1.9	3.0
	8.0	1.4	2.5	0.7	1.3
	8.5	0.6	1.1	0.3	0.6
November-February					
	7.5	11	13	5.6	6.7
	8.0	6.9	7.1	3.4	3.5
	8.5	3.1	2.9	1.5	1.4
March-May					
	7.5	7.0	19	3.5	9.4
	8.0	3.3	11	1.7	5.7
	8.5	2.2	7.8	1.1	3.9

The City of Chewelah is currently in the process of designing a new extended air activated sludge treatment system to incorporate nitrification. Ammonia limits for new treatment systems designed for nitrification will probably be less restrictive than for the existing lagoon systems because of reduced temperature, pH, and alkalinity. The existing permits allow a maximum effluent pH of 8.5. However, effluent from the extended air activated sludge process is likely to be substantially lower than 8.5, which would lead to less restrictive limits for ammonia.

Potential effluent limits for a surface discharge from L-Bar were also estimated (Table 18). Accurate estimates of effluent flows from L-Bar are not currently available. Effluent limits based on meeting criteria at mixing zone boundaries were estimated two ways in Table 18:

- assume that effluent flows will equal the maximum observed flows during each season; or

- assume that effluent flows are negligible compared with river flows.

Both methods result in similar mass loading limits because maximum observed effluent flows are much lower than river flows.

Alternatives for NPDES Discharge Limits for BOD_5,, Ammonia, and DO

DO in the Colville River was found to be sensitive to effluent loads of carbonaceous BOD, ammonia, and DO. Alternative combinations of these three variables were evaluated using the QUAL2E model to predict a variety of effluent conditions which could meet the water quality standard for DO in the river. For example, as effluent loading for carbonaceous BOD increases, effluent loading of ammonia must decrease to maintain the DO standard in the river.

Effluent DO of 3 mg/L was assumed to represent effluent from an activated sludge plant, and 8 mg/L was assumed to represent the same effluent after reaeration (CH2M-Hill, 1996c). During June-October, the diurnal minimum DO in the river upstream from the POTWs is predicted to be less than the Class A standard of 8 mg/L at critical conditions. Effluent DO of 3 mg/L was found to cause an additional depletion of about 1 mg/L downstream from each POTW. Therefore, reaeration of effluent during June-October is recommended to meet the DO standard in the river (Table 19). Reaeration of effluent is not necessary during November-May.

Effluent BOD_5 concentrations of 45, 30, and 15 mg/L were evaluated using the QUAL2E model. Loads of BOD_5 were calculated from maximum monthly average POTW design flows and were converted to ultimate CBOD using the ratio measured during the August-November 1994 surveys (ratio of ultimate $CBOD/BOD_5 = 3.17$). The maximum allowable effluent ammonia load for each assumed BOD_5 load was estimated by systematically trying different values until the DO standard was met. These trial loads of ammonia would correspond to daily maximum loading limits according to Ecology policy for TMDL modeling. The DO standard was assumed to be met:

- if the diurnal minimum DO concentration was greater than 8.0 mg/L; or

Table 18. Summary of seasonal critical conditions for ammonia criteria for mixing zones for the proposed L-Bar discharge in the Colville River.

Variable	Units	Jun-Oct	Nov-Feb	Mar-May	Jun-Oct	Nov-Feb	Mar-May
		L-Bar flow/concentration-based limits based on seasonal maximum reported flow; all other ammonia units are concentration in mg/L)			*L-Bar load-based limits assuming that effluent flow is negligible compared with river flow*		
upstream river flow	cfs	5.50	13.70	25.80	5.50	13.70	25.80
upstream temperature	degrees C	21.4	3.90	16.60	21.4	3.9	16.6
upstream pH	std units	8.50	8.30	8.60	8.5	8.3	8.6
upstream alkalinity	mg/L as CaCO3	176	176	176	176	176	176
upstream ammonia	mg/L as total NH3-N	0.12	0.16	0.10	0.120	0.160	0.100
effluent acute design flow	mgd	0.046	0.058	0.24	(1)	(1)	(1)
effluent chronic design flow	mgd	0.046	0.058	0.24	(1)	(1)	(1)
effluent temperature	degrees C	21.4	3.9	16.6	(1)	(1)	(1)
effluent pH	std units	8.5	8.3	8.6	(1)	(1)	(1)
effluent alkalinity	mg/L as CaCO3	176	176	176	(1)	(1)	(1)
acute DF	dimensionless	2.93	4.82	2.74	(1)	(1)	(1)
chronic DF	dimensionless	20.32	39.17	18.37	(1)	(1)	(1)
acute mixing zone temperature	degrees C	21.40	3.90	16.60	21.40	3.90	16.60
acute mixing zone pH	std units	8.50	8.30	8.60	8.50	8.30	8.60
chronic mixing zone temperature	degrees C	21.40	3.90	16.60	21.40	3.90	16.60
chronic mixing zone pH	std units	8.50	8.30	8.60	8.50	8.30	8.60
acute ammonia criteria	mg/L as total NH3-N	1.750	3.152	1.543	1.750	3.152	1.543
chronic ammonia criteria	mg/L as total NH3-N	0.282	0.718	0.315	0.282	0.718	0.315
acute ammonia WLA	mg/L as total NH3-N	4.90	14.57	4.05	--	--	--
chronic ammonia WLA	mg/L as total NH3-N	3.42	22.03	4.05	--	--	--
acute ammonia WLA	pounds/day as total NH3-N	--	--	--	1.21	5.53	5.02
chronic ammonia WLA	pounds/day as total NH3-N	--	--	--	1.20	10.31	7.48
daily max ammonia limit	mg/L as total NH3-N	4.9	14.6	4.0	--	--	--
monthly average ammonia limit	mg/L as total NH3-N	1.9	5.8	1.6	--	--	--
daily max load limit	pounds/day as total NH3-N	1.9	7.1	8.1	1.2	5.5	5.0
monthly avg load limit	pounds/day as total NH3-N	0.75	2.8	3.2	0.48	2.2	2.0

(1) Estimates for future effluent discharge from L-Bar are not available; effluent flow was assumed to be negligible compared with river flow for WLA and limit calculations. WLAs assuming negligible effluent flow were estimated as follows:

Acute WLA lbs/day = 0.025 (Upstream Flow cfs) (Acute Criteria - Upstream Concentration mg/L) (5.394)

Chronic WLA lbs/day = 0.25 (Upstream Flow cfs) (Chronic Criteria - Upstream Concentration mg/L) (5.394)

Table 19. Seasonal critical conditions for evaluation of the effect of effluent dissolved oxygen on in-stream dissolved oxygen.

	June-October (without effluent reaeration)	June-October (with effluent reaeration)	November-February (without effluent reaeration)	March-May (without effluent reaeration)
Chewelah POTW:				
Colville RM 38.8				
flow (cfs)	6.6	6.6	17.8	37.1
diurnal average DO from QUAL2E (mg/L)	11.0	11.0	11.7	10.7
diurnal DO range	6.93	6.93	0.95	0.95
diurnal minimum	7.56	7.56	11.2	10.2
Chewelah POTW (CH2M-Hill estimates)				
flow (cfs)	1.64	1.64	3.31	3.31
DO (mg/L)	3	8	3	3
Complete mix diurnal minimum DO below Chewelah POTW	6.6	7.6	9.9	9.6
Colville POTW:				
Colville RM 15.9				
flow (cfs)	11.4	11.4	32.9	72.1
diurnal average DO from QUAL2E (mg/L)	8.27	8.27	9.69	9.09
diurnal DO range	2.50	2.50	1.00	1.00
diurnal minimum	7.02	7.02	9.19	8.59
Colville POTW				
flow (cfs)	2.78	2.78	2.78	2.78
DO (mg/L)	3	8	3	3
Complete mix diurnal minimum DO below Colville POTW	6.2	7.2	8.7	8.4

- if the diurnal minimum DO concentration was less than 8.0 mg/L and the maximum depletion compared with zero discharge from the POTW was less than 0.2 mg/L.

Ammonia loading from L-Bar was assumed to occur from groundwater and surface water. The groundwater load of ammonia was estimated to be 0.2 Kg/day (CH2M-Hill, 1996d). The surface water load of ammonia was assumed to be the daily maximum load limit derived in Table 18 (flow and concentration-based). Allowable effluent loads from Chewelah and Colville POTWs were estimated with and without surface loading from L-Bar.

QUAL2E Model Results for WLAs

Table 20 presents the allowable combinations of effluent limits for BOD_5 and ammonia that meet the DO standard. Effluent limits during June-October are the most restrictive. The estimated loading limits during June-October are probably lower than technology-based limits for an extended air activated sludge process with nitrification without effluent filtration (Metcalf and Eddy, 1991). Loading limits during November-February and March-May are probably achievable by this process.

Effluent limits for BOD_5 and ammonia of 10 and 1 mg/L as a monthly average and 15 and 2 mg/L as a daily maximum may be achievable by the extended air activated sludge process proposed by CH2M-Hill for Chewelah. The QUAL2E model was used to estimate the amount of DO depletion that would result from this amount of BOD_5 and ammonia loading. The maximum monthly average loading (10 mg/L of BOD_5, 1 mg/L of ammonia as N, and maximum monthly average design flow) would result in less than 0.2 mg/L of DO depletion compared with no NPDES discharge during June-October. However, the daily maximum load (15 mg/L of BOD_5, 2 mg/L of ammonia as N, and maximum daily average design flow) is predicted to cause a 0.5 mg/L DO depletion downstream from Chewelah and 0.8 mg/L depletion below Colville.

Addition of a surface discharge from L-Bar would reduce the loading limits allowed for Chewelah (Table 20). Limits for Colville would not be significantly affected by loading from L-Bar because of the long travel time and instream oxidation of ammonia upstream from Colville. Ammonia loading from L-Bar during June-October should be limited to 1.8 pounds/day (Table 20) to meet the DO standard, which is more restrictive than the limits required to meet the ammonia standard (Table 18).

Recommended Implementation of WLAs in NPDES Permit Limits

The WLAs presented in the previous section are recommended as maximum daily average loads for BOD_5 and ammonia. Since the DO criterion is a single value that is to be exceeded at all times, the WLAs would be protective of the standard if only daily maximum limits of BOD_5 and ammonia are included in the permit. If a maximum average monthly limit is also required for the permit, the statistical procedure described in the USEPA Technical Support Document would be

Table 20. Summary of effluent limits for NPDES permits to meet dissolved oxygen standards in the Colville River.

Season	Discharger	Daily Maximum BOD5		Daily Maximum Ammonia	
		mg/L	pounds/day	mg/L as N	pounds/day
Without Surface Discharge from L-Bar:					
June-October	Chewelah	10	59	1.7	15
		15	89	0	0
	Colville	10	100	0.8	12
		15	150	0.4	6
November-February	Chewelah	15	150	5.7	102
		30	300	4.6	82
		45	451	3.7	66
	Colville	15	150	7.5	113
		30	300	6.8	102
		45	451	6.0	90
March-May	Chewelah	15	150	10	179
		30	300	9.6	171
		45	451	8.6	154
	Colville	15	150	13	195
		30	300	12	180
		45	451	11	165
With Surface Discharge from L-Bar:					
June-October	L-Bar	--	--	--	1.8
	Chewelah	10	59	0.5	4
		15	89	0	0
	Colville	10	100	1.0	15
		15	150	0.4	6
November-February	L-Bar	--	--	--	7.1
	Chewelah	15	150	5.3	95
		30	300	4.3	77
		45	451	3.2	57
	Colville	15	150	7.5	113
		30	300	6.8	102
		45	451	6.0	90
March-May	L-Bar	--	--	--	8.1
	Chewelah	15	150	9.9	177
		30	300	8.7	155
		45	451	7.9	141
	Colville	15	150	12	180
		30	300	12	180
		45	451	11	165

appropriate (USEPA, 1991b). The maximum average monthly limit, if included, would vary depending on the variability of effluent BOD and ammonia concentrations.

The statistical procedure described by USEPA (1991b) can be used to calculate a multiplier which can be applied to the maximum 1-day average WLAs to estimate maximum average monthly limits. The following formula relates maximum average monthly limits (AML) to the WLA:

$$AML = WLA * \exp[0.5s^2 - 2.326s] * \exp[1.645s_n - 0.5s_n^2]$$

where:

s^2 $= \ln(CV^2 + 1)$

CV = long-term (seasonal) coefficient of variation of effluent BOD_5
= standard deviation/mean

s_n^2 $= \ln((CV^2/n) + 1)$

n = number of samples per month for compliance monitoring.

For example, if the coefficient of variation is 0.6 and four samples per month are required, then the average monthly permit limit would be approximately half of the daily maximum limit (0.498*WLA).

Ammonia in the Vicinity of Northwest Alloys

Water quality in the Colville River, Stensgar Creek, and Stranger Creek in the vicinity of Northwest Alloys is presented in Table 21. No significant increases in ammonia, chloride, or any other constituent concentrations were observed in downstream stations compared with upstream stations. This finding is consistent with results of a May 1994 sampling survey by Ecology (Oie, 1994). These results suggest that seepage of wastewater from Northwest Alloys is not causing a detectable change in the quality of Stensgar Creek, Stranger Creek, or the Colville River.

Tributary and Nonpoint Fecal Coliform

Fecal coliform concentrations throughout the study area frequently exceed water quality standards (Table 22). Most river and tributary stations did not meet Class A standards. Five tributaries and two Colville River stations exceeded both the geometric mean and upper 10th percentile standard: Blue Creek, Chewelah Creek, Haller Creek, Stensgar Creek, Stranger Creek, Colville RM 37.8, and Colville RM 13.8. Little Pend Oreille River, Mill Creek, Colville RM 48.3, Colville RM 32.1, and Colville RM 15.9 exceeded either the geometric mean or upper 10th percentile standard, but not both. Also, fecal coliform samples collected by Ecology in effluent from the Chewelah POTW exceeded effluent limits during the October and November, 1994 surveys.

Table 21. Water quality in the vicinity of Northwest Alloys near the town of Addy, WA during August-November

Station (River Mile)	Date	Flow (cfs)	Chloride (mg/L)	Conductivity (umho/cm @ 25C)	Ammonia (mg/L as N)	Nitrate +Nitrite (mg/L as N)	Total Persulfate N (mg/L as N)
Upstream from Northwest Alloys:							
Colville RM29.8	8/25/94	--	7.2	377	0.010 U	0.056	--
	8/25/94	--	7.2	376	0.010 U	0.053	--
	10/6/94	--	2.8	376	0.044	0.309	0.496
	10/6/94	--	2.9	375	0.031	0.292	0.455
	11/17/94	--	6.0	384	0.134	0.513	0.901
	11/17/94	--	5.9	384	0.116	0.502	0.786
Stensgar Cr 1 (upstream)	10/6/94	0.45	4.4	482	0.010 U	0.240	0.695
	10/6/94	--	4.4	481	0.010 U	0.237	0.630
	11/17/94	--	5.2	429	0.010 U	0.079	0.275
	11/17/94	--	5.2	428	0.010 U	0.078	0.229
Downstream from Northwest Alloys:							
Colville RM29.2	8/25/94	13.8	7.1	379	0.010 U	0.027	--
	8/25/94	--	7.1	379	0.010 U	0.026	--
	10/6/94	34.0	2.9	376	0.032	0.302	0.500
	10/6/94	--	2.9	376	0.022	0.299	0.497
	11/17/94	61.0	6.0	384	0.102	0.476	0.804
	11/17/94	--	5.9	386	0.106	0.486	0.774
Colville RM25.3	8/25/94	14.5	7.0	376	0.010 U	0.010 U	--
	8/25/94	--	7.2	376	0.010 U	0.010 U	--
	10/6/94	36.1	2.9	375	0.010 U	0.010 U	0.418
	10/6/94	--	2.9	375	0.010 U	0.010 U	0.400
	11/17/94	--	5.4	382	0.113	0.463	0.743
	11/17/94	--	5.4	383	0.121	0.451	0.764
Stensgar Cr 2 (downstream)	10/6/94	0.38	4.7	503	0.010 U	0.248	0.426
	10/6/94		4.7	503	0.010 U	0.246	0.404
	11/17/94	2.8	5.3	432	0.010 U	0.070	0.223
	11/17/94		5.3	431	0.010 U	0.072	0.256
Stranger Cr	8/25/94	0.10	3.6	510	0.010 U	0.085	0.269
	10/6/94	0.61	3.0	535	0.010 U	0.012	0.143
	11/17/94	2.9	3.9	517	0.010 U	0.236	0.407

Table 22. Summary of fecal coliform concentrations in the Colville River and tributaries during August-November 1994 surveys (bold type indicates values greater than Class A standards.)

Station (River Mile)	Fecal Coliform (colony forming units per 100 mL)				
	number of samples	minimum	maximum	geometric mean	upper 10th percentile
Colville RM 48.3	3	14	190	45	**250**
Colville RM 38.8	6	26	210	66	170
Colville RM 37.8	5	51	210	**100**	**230**
Colville RM 32.1	5	37	290	88	**250**
Colville RM 25.3	6	17	180	50	180
Colville RM 15.9	6	12.5	600	67	**390**
Colville RM 13.8	5	13	1100	**150**	**1300**
Colville RM 5.0	5	13	100	53	150
Blue Cr	3	260	570	**400**	**670**
Chewelah Cr	3	60	360	**120**	**410**
Corbett Cr	2	1	19	4	63
Haller Cr	3	31	580	**140**	**890**
Little Pend Oreille R	3	74	170	**110**	200
Mill Cr	5	31	250	96	**280**
Stensgar Cr (near mouth)	4	26	2300	**250**	**6000**
Stranger Cr	3	42	3900	**630**	**13000**

In addition to excessive concentrations in tributaries, nonpoint loading from land areas adjacent to the river are also suspected of contributing to high concentrations in the Colville River. Nonpoint sources of fecal coliform other than sampled tributaries were found to be very significant to explain the high fecal coliform concentrations observed during the August and October 1994 surveys. Approximately 10^{12} fecal coliform organisms per day were estimated to originate from unmeasured nonpoint discharges directly to the river along most of its length. The estimated direct loading was approximately 5 times greater than the total loading from tributary and headwater sources (Table 6; approximately $2X10^{11}$ organisms/day occurred from all tributary and headwater sources). Therefore, direct loading of fecal coliform may be much more significant than tributary loading. Concentrations in the river may be reduced below Class A standards if direct nonpoint sources are controlled. Total fecal coliform loading from headwaters and tributaries was relatively constant for August, October, and November 1994 surveys even though flows varied by about a factor of three, which suggests that loading to tributaries may also be occurring mainly from constant localized sources.

Numerous cattle and dairy operations are present in the watershed (SCCD, 1992), and direct access to the stream bank for watering of cows was observed at several locations in the river. Failing septic systems have also been suspected of discharging to the river. Other nonpoint sources of fecal coliform may also be significant. Further investigations are warranted to identify the sources of nonpoint loading.

Critical Conditions for Metals in NPDES Permits

Table 23 presents recommended critical conditions for metals for NPDES permits for Chewelah and Colville POTWs, and L-Bar. The following equation is recommended for derivation of acute and chronic WLAs for permit limits for total recoverable Ag, Cd, Cu, Pb and Zn:

$$WLA = [(WQC_{dis} * DF) - (CB_{dis} * (DF - 1))] / f_d$$

where WQC_{dis} are acute and chronic water quality criteria for dissolved metals, DF are acute and chronic dilution factors at the mixing zone boundary, and f_d is the fraction of dissolved metals. Water quality-based effluent limits should be calculated by the two-value WLA process as described by USEPA (1991b) and Ecology (1994b).

For total recoverable Hg, acute and chronic WLAs should be calculated from the following equation:

$$WLA = (WQC_{trec} * DF) - (CB_{trec} * (DF - 1))$$

where WQC_{trec} and CB_{trec} are total recoverable water quality criteria and background concentrations.

Table 23. Recommended critical conditions for evaluation of metals for NPDES permits for Chewelah, Colville, and L-Bar.

	Ag	Cd	Cu	Hg	Pb	Zn
Chewelah POTW						
Upstream dissolved concentration (ug/L)	0.03 U	0.04 U	0.77	--	0.069	1.1 J
Upstream total recoverable concentration (ug/L)	--	--	--	0.001 U	--	--
Fraction of dissolved metals (acute/chronic)	0.85	0.944/0.909	0.991	--	0.438	0.978/0.986
Acute criteria (ug/L) for dissolved Ag, Cd, Cu, Pb, Zn and total recoverable Hg (hardness = 178 mg/L as CaCO3)	9.3	6.9	29.3	2.4	120	187
Chronic criteria (ug/L) for dissolved Ag, Cd, Cu, Pb, Zn and total recoverable Hg	--	1.6	444.4	0.012	4.7	170
Maximum effluent total recoverable concentration	0.5 UN	0.1 U	4.5 P	0.013 P	1 UN	19 J
Number of effluent samples	4	4	4	4	4	4
Colville POTW						
Upstream dissolved concentration (ug/L)	0.03 U	0.04 U	0.88	--	0.057	1 UJ
Upstream total recoverable concentration (ug/L)	--	--	--	0.0013 P	--	--
Fraction of dissolved metals (acute/chronic)	0.85	0.944/0.909	0.997	--	0.326	0.978/0.986
Acute criteria (ug/L) for dissolved Ag, Cd, Cu, Pb, Zn and total recoverable Hg (hardness = 155 mg/L as CaCO3)	7.3	6.0	25.7	2.4	104	166
Chronic criteria (ug/L) for dissolved Ag, Cd, Cu, Pb, Zn and total recoverable Hg	--	1.4	16.5	0.012	4.0	152
Maximum effluent total recoverable concentration	0.71 P	0.13 PJ	9.2 P	0.015	1 UN	11.9 J
Number of effluent samples	4	4	4	4	4	4
L-Bar						
Upstream dissolved concentration (ug/L)	0.03 U	0.04 U	0.75	--	0.056	1 U
Upstream total recoverable concentration (ug/L)	--	--	--	0.00105 P	--	--
Fraction of dissolved metals (acute/chronic)	0.85	0.944/0.909	0.857	--	0.431	0.978/0.986
Acute criteria (ug/L) for dissolved Ag, Cd, Cu, Pb, Zn and total recoverable Hg (hardness = 206 mg/L as CaCO3)	12.0	8.1	33.6	2.4	140	211
Chronic criteria (ug/L) for dissolved Ag, Cd, Cu, Pb, Zn and total recoverable Hg	--	1.8	21.0	0.012	5.5	193
Maximum effluent total recoverable concentration	0.5 U	0.89 P	51	0.0287	2 UJ	32.6 J
Number of effluent samples	4	4	4	4	4	4

Critical conditions were estimated as follows:

- for upstream Ag, Cd, Hg, and Zn, the maximum value was used because most samples were below detection.
- for upstream Cu and Pb, the critical value was assumed to be 2X geometric mean.
- for fractions of dissolved Cu and Pb, the 90th percentile was calculated from the z-statistic using an arcsine square root transformation
- for fractions of dissolved Ag, Cd, and Zn, the default fraction of dissolved metals was based on the conversion factors in the EPA's Interim Final Rule (40CFR131; Federal Register, May 4, 1995, Volume 60, Number 86).

Data Qualifiers:
U = the analyte was not detected at or above the reported result
J = the analyte was positively identified and the associated numerical result is an estimate
UJ = the analyte was not detected at or above the reported estimated result
N = the spike sample recovery was not within control limits
P = the analyte was detected above the instrument detection limit but below the quantitation limit

Conclusions and Recommendations

- A steady-state model of DO, ammonia, and fecal coliform, based on EPA's QUAL2E model, was developed to evaluate the capacity of the river to assimilate waste loads from point and nonpoint sources and meet water quality criteria.

- DO downstream from the Chewelah and Colville POTWs decreases rapidly during summer. The rapid decrease is influenced by sediment oxygen demand, BOD, ammonia, and algal respiration. DO was observed below the 8 mg/L Class A standard at several locations.

- Ammonia concentrations in the river are highest immediately downstream from the Chewelah and Colville POTWs. Ammonia concentrations decrease proceeding downstream from the POTWs due to algal uptake and nitrification.

- Nonpoint sources of fecal coliform explained the high concentrations observed in the river during summer. Nonpoint loading along the shoreline of the river was equivalent to direct loading from approximately 100 cows or 400 people. The estimated direct loading was approximately 5 times greater than the total loading from tributary and headwater sources. Numerous cattle and dairy operations are present in the watershed and direct access to the stream bank for watering of cows was observed at several locations. Failing septic systems have also been suspected of discharging to the river. Other nonpoint sources of fecal coliform may also be significant. Concentrations in the river may be reduced below Class A standards if direct nonpoint sources are controlled. Further investigations of potential loading sources along the riparian corridor and in tributary sub-watersheds are warranted.

- The QUAL2E model of DO and ammonia was used to determine the potential to violate water quality criteria and recommend WLAs for point sources (Colville POTW, Chewelah POTW, and L-Bar). Critical loads from nonpoint and tributary sources were estimated from monitoring data. Major findings and recommendations for effluent DO, BOD, and ammonia are as follows:

  ◊ Reaeration of effluent is recommended during June-October.

  ◊ Effluent loading from the existing Chewelah and Colville POTWs is not predicted to protect the DO standard in the river at assumed critical conditions.

  ◊ If the Chewelah and Colville POTWs are each replaced with an extended air activated sludge process with nitrification (without effluent filtration), then the DO standard may be protected during June-October at potential monthly average loads, but, may not be protected at potential maximum daily loads. The DO standard could be met during November-May with potential maximum daily BOD and ammonia loading from hypothetical extended air plants.

◊ Effluent limits for BOD and ammonia that are more restrictive than normal technology-based limits for secondary treatment are recommended year-round. Proposed limits during June-October, November-February, and March-May vary according to seasonal changes in the assimilative capacity (e.g. river flows, temperature, etc.). Limits are most restrictive during June-October and least restrictive during March-May.

◊ Potential effluent limits for ammonia from L-Bar may affect effluent limits for Chewelah. Loading limits for Colville POTW are not predicted to be affected by potential discharge from L-Bar. Effluent ammonia limits for L-Bar should be restricted to approximately 1.8 pounds/day during June-October to meet the DO standard in the river.

- Metals were sampled to evaluate water quality-based effluent limits. Recommendations were made for critical conditions for the Colville and Chewelah POTWs and the L-Bar site according to Ecology policies outlined in the Permit Writer's Manual.

- Water quality sampling was conducted to determine if seepage from the Northwest Alloys site increases ammonia concentrations in the Colville River at critical river conditions. Seepage of wastewater from Northwest Alloys did not cause a detectable change in the quality of Stensgar Creek, Stranger Creek, or the Colville River.

- Data were collected to document water quality conditions in the Colville River at RM 48.3 to supplement previous studies which show relatively low DO and high fecal coliform concentrations. Fecal coliform and pH were higher than Class A standards during the 1994 surveys.

- The following recommendations address issues related to TMDLs or alternative management strategies for parameters on the 303(d) list:

◊ *DO, Ammonia, and Chloride*. Implementation of the recommended waste load allocations for BOD_5 and ammonia for the Chewelah and Colville POTWs is recommended to protect water quality criteria for DO in the Colville River. Application of Ecology's mixing zone policy for NPDES permits is expected to result in attainment of ammonia and chloride criteria, as well as other criteria for protection of aquatic life (*e.g.* metals).

◊ *Fecal Coliform, pH, and Temperature*. Further investigations of potential loading sources of fecal coliform along the riparian corridor and in tributary sub-watersheds are warranted. Nonpoint loading of nutrients is probably also contributing to high pH and large diurnal ranges of DO from algal productivity. Control of nonpoint loading sources for fecal coliform is likely to also reduce nutrient loading. Riparian projects to decrease water temperature also should be considered. Centennial Clean Water funded projects and Farm Plans should be considered as surrogates for TMDLs to address attainment of fecal coliform, pH, and temperature criteria.

◊ *Centennial Clean Water Funded Projects*. Ecology provides grants from the Centennial fund to local governments and state agencies to complete a wide variety of water pollution control projects. Projects within the Colville River basin should be considered a high priority for funding if they will result in improvement of parameters on the Section 303(d) list. Funded projects should also be required to meet the major requirements for TMDL approval, including problem formulation, TMDL calculations and supporting studies, control actions and implementation schedules, public participation, and follow-up monitoring.

◊ *Farm Plans*. The state's local conservation districts work with individual farmers to develop water quality management (farm) plans. Development of these plans may be voluntary, required under the statewide NPDES Dairy Waste General Discharge Permit, or initiated by an agricultural water quality complaint to Ecology. These plans may be included as part of a basin-wide TMDL. A single farm plan or set of plans could also contain all of the components of a complete TMDL.

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Appendix A

River Mile Index of the Colville River

(Source: Pacific Northwest River Basins Commission.
Hydrology and Hydraulics Committee.
River Mile Index: Moses Coulee, Crab and Foster Creeks,
Okanogan (Okanagan), Sanpoil, Colville, and Kettle Rivers.
August, 1968).

RIVER MILE INDEX
COLVILLE RIVER (2ND ORDER)

River Mile Location miles	Description	Drainage Area sq.miles	Water Elev. ft.
0.0	Mouth of Colville River at river mile 695.0 at center line of Columbia River (L. bank)		
0.5	Former road crossing	1,020	
1.4	State Highway 22 bridge - KETTLE FALLS		
3.2	Upper end Franklin D. Roosevelt Lake		
5.0	Overhead transmission line BPA 115 kv. (Republic tap to Bell-Metaline Falls)		
5.0	Road bridge - MEYER FALLS		
5.00	Gaging Station USGS #4090, Colville River at KETTLE FALLS	1,007	1,506
5.1	Powerplant - Washington Water Power Co.		
8.1	Overhead transmission line, Wash.Wat.Pwr. 34.5 kv.		
9.2	Road bridge		
11.0	Gold Creek (L. bank)		
11.1	Bonanza Lead Mill		
11.2	Road bridge	978	
11.6	Mill Creek (R. bank, 3rd order)		
	0.0 Mouth		
	0.3 G.N. RR bridge		
	0.30 U.S. Hwy. 395 and State Hwy. 3 bridge		
	0.4 Gage 4087 Mill Creek at mouth nr. COLVILLE	146	1,542
	0.9 Road bridge		
	2.5 Echo Valley Road bridge		
	4.2 Clugston Creek (R. bank) at mouth	32.8	
	4.3 Mill Creek above Clugston Creek	104	
	5.1 Gillette Creek (R. bank)		

River Mile Location miles	Description	Drainage Area sq.miles	Water Elev. ft.
	Mill Creek (Continued)		
	6.5 Douglas Falls		
	9.8 Road bridge		
	10.0 Aladdin Road bridge		
	10.9 Gage 4085 Mill Creek nr. COLVILLE	83.0	1,950
	12.1 Road bridge		
	14.2 Road bridge		
	14.5 Grevit Creek (R. bank)		
	14.7 Hull Creek (L. bank)		
	15.7 Road bridge - Gage 4084.5 Mill Creek below Forks	67.0	
	16.2 North Fork Mill Creek (R. bank) 3/4 mi.up	23.5	
	16.7 Mill Creek 0.5 mi. above North Fork	42.2 N	
	17.3 South Fork Mill Creek and Middle Fork Mill Creek		
11.9	Overhead transmission line BPA 115 kv. (Republic tap to Bell-Metaline Falls)		
13.4	Corbett Creek (L. bank)		
13.8	Fay Road bridge - COLVILLE		
15.4	G.N. RR bridge		
15.9	Road bridge		
18.6	Road bridge - ORIN	784	
19.3	Logging RR bridge		
19.7	G.N. RR bridge		
19.8	Haller Creek (L. bank, 3rd order)		
	0.0 Mouth		
	0.8 Gage 4084.2, Haller Creek nr. ARDEN	37.0	1,601
21.0	Little Pend Oreille River (R. bank, 3rd order)		
	0.0 Mouth		
	0.2 G.N. RR bridge		

River Mile Location mile		Description	Drainage Area sq.miles	Water Elev. ft.
Little Pend Oreille River (Continued)				
	0.5	U.S. Hwy. 395 and State Hwy. 3 bridge ARDEN	171	
	1.2	Logging RR bridge		
	2.0	Logging RR bridge		
	3.2	Logging RR bridge and road bridge		
	4.5	Road bridge		
	5.2	Narcisse Creek (R. bank)		
	7.0	Gage 4083 L. Pend Oreille River near COLVILLE	132	2,011
	7.5	Bear Creek (L. bank) at mouth	34.6	
	8.3	Road bridge		
	10.3	Road bridge		
	10.8	Logging RR bridge		
	11.5	Road bridge		
	12.8	Prospect Creek (L. bank)		
	13.0	Road bridge		
	13.8	Road bridge		
	14.1	Cedar Creek (L. bank)		
	14.8	State Highway 6A bridge	66.0	
	15.0	Camp Creek (R. bank)		
	15.5	State Highway 6A bridge		
	18.3	Olsen Creek (L. bank)		
	18.5	Road bridge		
	18.7	Floodelle Creek (L. bank)		
	20.8	Coffin Lake	30.5	
	23.2	Lake Sherry		
	24.2	Lake Thomas - MIDDLEPORT	16.3	
23.7		Road bridge		
25.0		Twelvemile Creek (R. bank)		
25.3		G.N. RR bridge and road bridge	544	
26.7		Stranger Creek (R. bank) at mouth	43.3	
27.8		G.N. RR bridge		
29.2		State Highway bridge - ADDY		

River Mile Location miles	Description	Drainage Area sq.miles	Water Elev. ft.
Colville River (Continued)			
29.8	Mill Creek (L. bank)		
	0.8 Road crossing	53.0	
32.0	G.N. RR bridge		
32.1	Gage 4080, Colville River at BLUE CREEK	428	1,622
32.2	Blue Creek (L. bank)		
32.20	State Highway bridge - BLUE CREEK		
32.5	G.N. RR bridge		
33.6	Road bridge		
35.8	Road bridge		
37.8	Road bridge		
38.8	Road bridge		
39.7	Chewelah Creek (R. bank, 3rd order)		
	0.0 Mouth		
	0.5 Road bridge		
	0.6 Road bridge		
	1.0 CHEWELAH		
	2.0 Gage 4077, Chewelah Creek at CHEWELAH	94.1	1,662
	2.2 South Fork Chewelah Creek		
	0.0 at mouth	33.8	
	2.3 North Fork Chewelah Creek at mouth	59.6 N	
40.3	G.N. RR bridge and U.S. Highway 395, State Highway 3 bridge	295	
43.1	Road bridge		
43.8	Cottonwood Creek (R. bank)		
	1.2 Road crossing near mouth	34.1	
44.2	Road bridge		
44.4	U.S. Highway 395 and State Highway 3 bridge		

River Mile Location miles	Description	Drainage Area sq.miles	Water Elev. ft.
Colville River (Continued)			
44.7	Overhead transmission line - BPA 115 kv. (Deer Park tap to Bell-Metaline Falls)		
44.8	Overhead transmission line, Was. Water Pwr.,69 kv.		
44.9	G.N. RR bridge		
45.7	Road bridge		
46.3	Huckleberry Creek (L. bank)		
	1.5 above mouth	41.8	
47.5	Outlet from Watts Lake (L. bank)		
48.3	Road bridge - VALLEY	161	
50.1	Jumpoff Creek (R. bank)		
50.1	Overhead transmission line - Wash. Water Pwr.,69 kv.		
50.10	Road bridge		
52.9	Deer Creek (L. bank, 3rd order)		
	0.0 Mouth		
	0.3 Road bridge		
	0.4 Overhead transmission line, Wash. Wtr.Pwr. 69 kv.		
	0.8 Road bridge		
	2.0 Gage 4075.2, Deer Creek near VALLEY	36.0	2,061
52.90	Sheep Creek (R. bank, 3rd order)		
	0.0 Mouth		
	0.3 Road bridge	91.8	
	1.3 Road bridge		
	1.4 Grouse Creek (R. bank)		
	0.2 Road crossing	23.6	
	1.9 Road bridge		
	4.4 State Highway bridge		
	4.9 G.N. RR bridge and U.S. Highway 395, State Highway 3 bridge		
	4.90 Gage 4075, Sheep Creek at SPRINGDALE	48.2	1,981
	5.4 SPRINGDALE		
	--- Loon Lake	35.8	2,380

Appendix B.

Project database.

B1. Field measurements.
B2. Conventional lab data.
B3. BOD data.
B4. Metals data.
B5. Metals QA-QC data.
B6. Phytoplankton data.

Appendix B1: Colville River field data from August-November 1994 (shading indicates criteria not met)

Date	Station (River Mile)	Time	Flow (cfs)	Average Velocity (ft/sec)	Average Depth (ft)	Temp (deg C)	pH (SU)	Winkler DO (mg/L)
25-Aug-94	RM48.3	1334	11.5	0.27	2.19	14.6	8.5	13.7
06-Oct-94	RM48.3	1402	15.9	0.63	1.02	11.0	8.6	13.9
17-Nov-94	RM48.3	1404	21.8	0.79	1.12	4.9		13.4
25-Aug-94	RM40.3	1231	12.8	0.74	0.87	16.3	8.5	10.9
06-Oct-94	RM40.3	1303	19.5	0.89	1.06	9.0	8.5	13.1
17-Nov-94	RM40.3	1306	34.6	1.32	1.25	4.4		12.4
25-Aug-94	RM40.1	1053				16.2	8.4	8.5
06-Oct-94	RM40.1	1203				8.0	8.4	11.4
17-Nov-94	RM40.1	1123				3.6		11.6
23-Aug-94	RM38.8	848				14.5	8.5	10.9
23-Aug-94	RM38.8	1642	12.5	0.35	1.39	17.8	9.0	16.8
24-Aug-94	RM38.8	841				13.2	8.4	9.8
24-Aug-94	RM38.8	1616	16.0	0.41	1.37	17.7	9.0	15.7
04-Oct-94	RM38.8	939				8.5	8.3	10.3
04-Oct-94	RM38.8	1704	31.9	0.83	1.29	10.9	8.5	12.3
05-Oct-94	RM38.8	933				7.5	8.5	10.2
05-Oct-94	RM38.8	1647	29.1	0.80	1.25	9.4	8.5	12.3
16-Nov-94	RM38.8	807				3.3		11.4
16-Nov-94	RM38.8	1256	48.2	1.06	1.51	3.8		12.3
23-Aug-94	RM37.8	837				14.1	8.2	8.9
23-Aug-94	RM37.8	1555	14.6	0.55	1.26	18.5	9.1	17.4
24-Aug-94	RM37.8	830				12.8	8.2	8.6
24-Aug-94	RM37.8	1540	17.9	0.64	1.30	17.8	9.0	15.9
04-Oct-94	RM37.8	927				8.1	8.3	10.3
04-Oct-94	RM37.8	1631	35.8	1.07	1.46	11.4	8.5	11.7
05-Oct-94	RM37.8	921				7.0	8.5	10.2
05-Oct-94	RM37.8	1613	29.1	0.93	1.28	9.8	8.4	11.5
16-Nov-94	RM37.8	749				3.4		11.7
16-Nov-94	RM37.8	1213	52.4	1.43	1.49	3.8		12.3
23-Aug-94	RM35.8	816				14.4	8.2	8.0
23-Aug-94	RM35.8	1522	12.4	0.85	0.97	19.1	8.8	12.8
24-Aug-94	RM35.8	812				13.0	8.2	8.0
24-Aug-94	RM35.8	1508	18.6	0.95	0.85	18.7	8.8	12.8
04-Oct-94	RM35.8	911				7.7	8.2	10.0
04-Oct-94	RM35.8	1610				11.9	8.5	11.5
05-Oct-94	RM35.8	908				7.2	8.5	10.1
05-Oct-94	RM35.8	1556				10.1	8.4	12.4
16-Nov-94	RM35.8	734				3.5		11.1
16-Nov-94	RM35.8	1148				3.7		12.1
23-Aug-94	RM32.1	751				17.0	8.3	7.3
23-Aug-94	RM32.1	1447	10.0	0.18	1.39	17.2	8.3	6.4
24-Aug-94	RM32.1	759				15.9	8.3	7.2
24-Aug-94	RM32.1	1409	15.7	0.69	0.93	15.9	8.5	7.2
04-Oct-94	RM32.1	857				9.3	8.1	8.4
04-Oct-94	RM32.1	1534	35.2	1.18	1.20	9.2	8.4	10.3
05-Oct-94	RM32.1	854				8.5	8.4	8.7
05-Oct-94	RM32.1	1500	35.9	1.16	1.22	8.4	8.4	10.3
16-Nov-94	RM32.1	707				3.4		11.4
16-Nov-94	RM32.1	1047	53.6	1.41	1.41	3.5		11.3
25-Aug-94	RM29.8	856				15.1	8.5	7.1
06-Oct-94	RM29.8	1028				8.5	8.4	10.4
17-Nov-94	RM29.8	936				3.2		11.4

Appendix B1: Colville River field data from August-November 1994 (shading indicates criteria not met)

Date	Station (River Mile)	Time	Flow (cfs)	Average Velocity (ft/sec)	Average Depth (ft)	Temp (deg C)	pH (SU)	Winkler DO (mg/L)
25-Aug-94	RM29.2	921	13.8	0.40	1.07	15.8	8.5	8.3
06-Oct-94	RM29.2	1053	34.0	0.83	1.32	8.6	8.5	11.5
17-Nov-94	RM29.2	956	61.0	1.15	1.69	3.4		11.6
25-Aug-94	RM25.3	733	14.5	0.32	1.26	16.2	8.7	7.8
06-Oct-94	RM25.3	847	36.1	0.68	1.46	8.3	8.2	8.9
17-Nov-94	RM25.3	730				3.1		11.2
22-Aug-94	RM15.9	1730	19.5	0.54	1.01			
23-Aug-94	RM15.9	726				15.4	8.2	8.0
23-Aug-94	RM15.9	1323	21.2	0.85	0.60	18.6	8.5	10.5
24-Aug-94	RM15.9	734				14.1	8.2	8.3
24-Aug-94	RM15.9	1315	23.5	0.87	0.64	18.0	8.5	10.3
04-Oct-94	RM15.9	815				8.7	8.4	10.1
04-Oct-94	RM15.9	1409	50.0	1.22	0.96	12.3	8.5	11.2
05-Oct-94	RM15.9	819				8.3	8.5	10.3
05-Oct-94	RM15.9	1358	52.7	1.30	0.93	11.8	8.5	11.4
15-Nov-94	RM15.9	932				3.2		12.3
15-Nov-94	RM15.9	1430	73.9	1.42	1.16	3.6		13.3
23-Aug-94	RM13.8	708				14.8	8.1	7.5
23-Aug-94	RM13.8	1246	20.3	0.54	1.01	18.5	8.9	15.1
24-Aug-94	RM13.8	709				14.0	8.1	7.5
24-Aug-94	RM13.8	1233	22.7	0.60	1.00	18.3	8.9	14.4
04-Oct-94	RM13.8	802				8.3	8.3	9.8
04-Oct-94	RM13.8	1327	51.9	1.22	1.11	12.4	8.5	11.8
05-Oct-94	RM13.8	803				8.1	8.5	10.0
05-Oct-94	RM13.8	1306	53.0	1.05	0.99	10.8	8.5	11.6
15-Nov-94	RM13.8	911				3.2		12.4
15-Nov-94	RM13.8	1328	78.7	1.28	1.22	3.5		12.5
23-Aug-94	RM11.2	648				14.2	8.1	6.8
23-Aug-94	RM11.2	1204	25.5	0.36	1.30	16.2	8.6	12.7
24-Aug-94	RM11.2	654				13.6	8.1	6.7
24-Aug-94	RM11.2	1202	26.6	0.34	1.54	16.9	8.7	14.0
04-Oct-94	RM11.2	745				8.7	8.3	9.7
04-Oct-94	RM11.2	1303				11.4	8.5	12.5
05-Oct-94	RM11.2	750				7.6	8.4	9.8
05-Oct-94	RM11.2	1249				10.1	8.6	12.4
15-Nov-94	RM11.2	852				3.2		12.0
15-Nov-94	RM11.2	1309				3.7		12.8
23-Aug-94	RM09.2	635				15.0	8.2	7.4
23-Aug-94	RM09.2	1130	23.9	0.53	1.26	16.0	8.3	9.3
24-Aug-94	RM09.2	638				15.1	8.3	7.2
24-Aug-94	RM09.2	1130	26.1	0.52	1.31	16.0	8.3	9.5
04-Oct-94	RM09.2	731				8.3	8.3	9.5
04-Oct-94	RM09.2	1232	63.6	1.14	1.29	10.5	8.5	12.3
05-Oct-94	RM09.2	742				7.8	8.3	9.7
05-Oct-94	RM09.2	1222	60.5	1.10	1.28	9.4	8.5	12.2
15-Nov-94	RM09.2	842				3.1		11.9
15-Nov-94	RM09.2	1234	89.8	1.37	1.61	3.6		12.8
23-Aug-94	RM05.0	609				17.9	8.4	7.4
23-Aug-94	RM05.0	1055				18.8	8.4	8.0
24-Aug-94	RM05.0	617				17.2	8.5	7.8
24-Aug-94	RM05.0	1100	29.4	1.10	0.63	17.9	8.4	8.5
04-Oct-94	RM05.0	713				10.9	8.7	9.0
04-Oct-94	RM05.0	1145	52.9	1.29	0.88	11.9	8.3	9.6
05-Oct-94	RM05.0	702				10.4	8.9	9.1

Appendix B1: Colville River field data from August-November 1994 (shading indicates criteria not met)

Date	Station (River Mile)	Time	Flow (cfs)	Average Velocity (ft/sec)	Average Depth (ft)	Temp (deg C)	pH (SU)	Winkler DO (mg/L)
05-Oct-94	RM05.0	1139	84.7	1.81	1.02	10.2	8.3	9.6
15-Nov-94	RM05.0	748				3.2		11.9
15-Nov-94	RM05.0	1147	101.8	1.74	1.22	3.7		12.7
25-Aug-94	Stranger Cr	822	0.10	0.25	0.16	11.6	8.5	9.1
06-Oct-94	Stranger Cr	924	0.61	0.34	0.45	6.1	8.5	11.1
17-Nov-94	Stranger Cr	813	2.9	0.98	0.64	2.5		12.0
06-Oct-94	Stensgar 2 (dn)	1008	0.38	0.42	0.19	6.5	8.2	11.0
17-Nov-94	Stensgar 2 (dn)	904	2.8	0.63	0.60	2.6		12.8
06-Oct-94	Stensgar 1 (up)	946	0.45	1.31	0.16	7.4	8.2	10.9
17-Nov-94	Stensgar 1 (up)	837				2.4		13.1
23-Aug-94	Mill Cr	940	5.4	0.71	0.49	12.6	8.4	11.0
24-Aug-94	Mill Cr	940	5.1	0.68	0.45	12.3	8.4	11.0
04-Oct-94	Mill Cr	1053	10.1	1.23	0.44	8.6	8.7	11.8
05-Oct-94	Mill Cr	1044	10.4	1.26	0.45	7.7	8.7	12.0
15-Nov-94	Mill Cr	1056	15.5	1.25	0.63	4.7		12.5
25-Aug-94	LPendOr R	630	9.2	0.47	0.89	12.3	8.5	10.0
06-Oct-94	LPendOr R	733	12.9	0.63	0.89	5.9	8.4	12.0
16-Nov-94	LPendOr R	931	18.9	0.90	0.91	2.5		13.3
17-Nov-94	LbarD2	1200	0.05					
17-Nov-94	LbarD1	1215	0.00935					
25-Aug-94	Haller Cr	700	0.08	0.03	0.25	11.1	8.6	9.8
06-Oct-94	Haller Cr	803	0.19	0.22	0.14	5.2	8.4	11.6
16-Nov-94	Haller Cr	905	1.8	0.62	0.36	2.5		13.0
15-Nov-94	Corbett Cr	1405	0.29	0.10	0.39	4.1		13.3
25-Aug-94	Chewelah Cr	1012	6.3	0.87	0.50	11.6	8.5	10.4
06-Oct-94	Chewelah Cr	1128	10.2	1.19	0.52	7.4	8.5	11.6
16-Nov-94	Chewelah Cr	1351	13.3	1.34	0.62	4.3		11.8
24-Aug-94	Blue Cr	1445	0.67	2.03	0.16	13.5	8.4	9.5
05-Oct-94	Blue Cr	1521	0.47	1.31	0.12	8.2	8.3	11.0
16-Nov-94	Blue Cr	1123	0.56	1.36	0.14	3.6		12.1
23-Aug-94	Colville POTW (Grab)	830-950	0.45			18.8	8.04	2.5
23-Aug-94	Colville POTW (Grab)	1635-1725				21.6	8.2	5.55
24-Aug-94	Colville POTW (Grab)	845-1100	0.354			18.9	7.98	2.5
24-Aug-94	Colville POTW (Grab)	1730				21.7	8.04	4.65
25-Aug-94	Colville POTW (Grab)	1110-1220				19	7.92	4.1
4-Oct-94	Colville POTW (Grab)	800				8.5	7.82	1.4
4-Oct-94	Colville POTW (Grab)	1405				14.9	7.64	2.25
6-Oct-94	Colville POTW (Grab)	850						1.4
14-Nov-94	Colville POTW (Grab)	1600-1710				4	8.17	11.3
16-Nov-94	Colville POTW (Grab)	717-850				3.3	8.18	10.85
16-Nov-94	Colville POTW (Grab)	1420-1440				3.4	8.15	11
17-Nov-94	Colville POTW (Grab)	740-905				2.8	8.01	10.7
24-Aug-94	Chewelah POTW (Grab)	1245-1445				18.6	7.83	2.4
25-Aug-94	Chewelah POTW (Grab)	1310-1440				18.1	7.84	2.3
4-Oct-94	Chewelah POTW (Grab)	1135				11.3	7.8	
4-Oct-94	Chewelah POTW (Grab)	1645				14.6	7.7	4.25

Date	Station (River Mile)	Time	Flow (cfs)	Average Velocity (ft/sec)	Average Depth (ft)	Temp (deg C)	pH (SU)	Winkler DO (mg/L)
5-Oct-94	Chewelah POTW (Grab)	655				10.4	8.1	2.85
5-Oct-94	Chewelah POTW (Grab)	1750				12.4	8	4.4
6-Oct-94	Chewelah POTW (Grab)	720				9.7	8	2.3
15-Nov-94	Chewelah POTW (Grab)	940-1100				3.4	7.69	3.7
16-Nov-94	Chewelah POTW (Grab)	1015-1130				3	7.75	4.25
16-Nov-94	Chewelah POTW (Grab)	1525-1540				3.2	7.81	5.3
17-Nov-94	Chewelah POTW (Grab)	1010-1200				2.4	7.7	5.2

Appendix B2. Colville River lab data from August-November 1994 sampling.

Station (River Mile)	Date	Alkalinity (mg/L as CaCO3)	Hardness (mg/L as CaCO3)	Chloride (mg/L)	Conductivity (umho/cm @ 25C)	Ammonia (mg/L as N)	Nitrate +Nitrite (mg/L as N)	Total Per-sulfate N (mg/L as N)	Total Kjeldahl N (mg/L as N)	Ortho-P (mg/L as P)	Total P (mg/L as P)	Total Organic C (mg/L)	Chloro-phyll a (ug/L)	Fecal Coliform (#/100mL)
RM48.3	8/25/94				383	0.010 U	0.061			0.011	0.010 U	2.0	2.3	190
RM48.3	10/6/94				388	0.010 U	0.224	0.360		0.014	0.017	1.7	3.4	34
RM48.3	11/17/94				390	0.010 U	0.420	0.607		0.019	0.124	2.5	1.2	14
RM40.3	8/25/94		206	1.9	404	0.010 U	0.010 U							
RM40.3	8/25/94		207	1.9	404	0.010 U	0.010 U							
RM40.3	10/6/94		207	1.9	397	0.010 U	0.204	0.327		0.015	0.016			
RM40.3	10/6/94		207	1.9	397	0.010 U	0.202	0.338		0.014	0.015			
RM40.3	11/17/94		208	3.0	406	0.010 U	0.390	0.582		0.026	0.027			
RM40.3	11/17/94		209	2.7	405	0.010 U	0.391	0.636		0.026	0.074			
RM40.1	8/25/94		217	7.9	432	0.010 U	0.010 U							
RM40.1	8/25/94		218	7.4	431	0.010 U	0.010 U							
RM40.1	10/6/94		206	2.1	398	0.010 U	0.198	0.295		0.012	0.016			
RM40.1	10/6/94		207	2.1	400	0.010 U	0.198	0.298		0.012	0.014			
RM40.1	11/17/94		213	8.3	434	0.044	0.467	0.721		0.028	0.046			
RM40.1	11/17/94		217	8.2	433	0.057	0.456	0.702		0.029	0.047			
RM38.8	8/23/94	182	178		349	0.010 U	0.068	0.201		0.010 U	0.012	2.9	5.6	210
RM38.8	8/24/94	188	183		356	0.010 U	0.058	0.252		0.010 U	0.021	2.7	10.9	115
RM38.8	10/4/94	190	183		352	0.010 U	0.231	0.302		0.013	0.016	1.8	1.3	26
RM38.8	10/5/94	187	183		350	0.010 U	0.241	0.335		0.014	0.014	1.9	1.0	39
RM38.8	11/16/94	182	185		375	0.034	0.431	0.619		0.023	0.038	2.6	1.8	64
RM38.8	11/16/94	183	183		383	0.019	0.435	0.615		0.024	0.033	2.7	1.9	51
RM37.8	8/23/94				344	0.061	0.099	0.328		0.063	0.029	3.4	5.4	180
RM37.8	8/24/94				358	0.043	0.080	0.308		0.048	0.043	2.9	5.8	210
RM37.8	10/4/94				362	0.144	0.248	0.550		0.060	0.074	2.2	3.7	51
RM37.8	10/5/94				360	0.013	0.010 U	0.587		0.063	0.080	2.3	5.3	55
RM37.8	11/16/94				381	0.181	0.471	0.926		0.060	0.072	3.5	2.8	100
RM35.8	8/23/94				361	0.010 U	0.118	0.252		0.051	0.012	3.6	2.3	
RM35.8	8/24/94				371	0.010 U	0.094	0.268		0.040	0.042	3.1	2.5	
RM35.8	10/4/94				361	0.096	0.309	0.570		0.066	0.082	2.3	4.9	
RM35.8	10/5/94				365	0.081	0.290	0.550		0.057	0.068	2.2	3.9	
RM35.8	11/16/94				378	0.183	0.490	0.892		0.060	0.095	3.2	2.4	
RM32.1	8/23/94			7.5	380	0.020	0.075	0.254		0.050	0.010 U	3.7	1.1	140
RM32.1	8/24/94			7.2	372	0.010 U	0.074	0.283		0.048	0.040	3.0	1.3	290
RM32.1	10/4/94			3.3	370	0.104	0.317	0.609		0.069	0.083	2.3	2.7	66
RM32.1	10/5/94			2.8	374	0.043	0.273	0.469		0.055	0.058	2.1	1.1	53
RM32.1	11/16/94			6.2	378	0.135	0.450	0.748		0.051	0.054	2.7	2.2	37
RM29.8	8/25/94			7.2	377	0.010 U	0.056							
RM29.8	8/25/94			7.2	376	0.010 U	0.053							
RM29.8	10/6/94			2.8	376	0.044	0.309	0.496						
RM29.8	10/6/94			2.9	375	0.031	0.292	0.455						

Appendix B2. Colville River lab data from August-November 1994 sampling.

Station (River Mile)	Date	Alkalinity (mg/L as CaCO3)	Hardness (mg/L as CaCO3)	Chloride (mg/L)	Conductivity (umho/cm @ 25C)	Ammonia (mg/L as N)	Nitrate +Nitrite (mg/L as N)	Total Per-sulfate N (mg/L as N)	Total Kjeldahl N (mg/L as N)	Ortho-P (mg/L as P)	Total P (mg/L as P)	Total Organic C (mg/L)	Chloro-phyll a (ug/L)	Fecal Coliform (#/100mL)
RM29.8	11/17/94			6.0	384	0.134	0.513	0.901						
RM29.8	11/17/94			5.9	384	0.116	0.502	0.786						
RM29.2	8/25/94			7.1	379	0.010 U	0.027							
RM29.2	8/25/94			7.1	379	0.010 U	0.026							
RM29.2	10/6/94			2.9	376	0.032	0.302	0.500						
RM29.2	10/6/94			2.9	376	0.022	0.299	0.497						
RM29.2	11/17/94			6.0	384	0.102	0.476	0.804						
RM29.2	11/17/94			5.9	386	0.106	0.486	0.774						
RM25.3	8/25/94			7.0	376	0.010 U	0.010 U			0.035	0.010 U	3.0	1.1	140
RM25.3	8/25/94			7.2	376	0.010 U	0.010 U			0.037	0.010 U	3.0	1.3	180
RM25.3	10/6/94			2.9	375	0.010 U	0.010 U	0.418		0.037	0.043	2.1	0.8	53
RM25.3	10/6/94			2.9	375	0.010 U	0.010 U	0.400		0.038	0.041	2.1	1.0	32
RM25.3	11/17/94			5.4	382	0.113	0.463	0.743		0.046	0.071	2.7	2.1	17
RM25.3	11/17/94			5.4	383	0.121	0.451	0.764		0.048	0.072	2.9	2.2	21.5
RM15.9	8/23/94	161	156	4.2	320	0.010 U	0.010 U	0.134		0.029	0.016	3.4	0.7	600
RM15.9	8/24/94	160	155		319	0.010 U	0.010 U	0.152		0.018	0.030	4.0	0.7	130
RM15.9	10/4/94	248	165		333	0.010 U	0.131	0.271		0.033	0.037	2.5	1.3	67.5
RM15.9	10/5/94	174	170		333	0.010 U	0.097	0.234		0.026	0.028	2.5	2.8	68
RM15.9	11/15/94	173	168		343	0.017	0.303	0.442		0.027	0.038	2.7	3.8	20.5
RM15.9	11/15/94	171	169		343	0.023	0.305	0.468		0.028	0.037	2.7	3.2	12.5
RM13.8	8/23/94				352	0.010 U	0.018	0.205		0.081	0.031	4.4	8.8	92
RM13.8	8/24/94				350	0.010 U	0.012	0.271		0.061	0.092	3.7	8.7	200
RM13.8	10/4/94				352	0.108	0.146	0.453		0.081	0.089	2.8	2.1	1100
RM13.8	10/5/94				350	0.101	0.112	0.406		0.074	0.074	2.6	1.8	310
RM13.8	11/15/94				359	0.184	0.311	0.670		0.061	0.083	3.1	10.1	13
RM11.2	8/23/94				388	0.010 U	0.068	0.252		0.047	0.005	3.5	4.2	
RM11.2	8/24/94				381	0.010 U	0.057	0.278		0.029	0.048	3.2	6.6	
RM11.2	10/4/94				369	0.060	0.218	0.419		0.064	0.061	2.7	4.3	
RM11.2	10/5/94	186			368	0.052	0.199	0.443		0.060	0.062	2.4	4.6	
RM11.2	11/15/94				371	0.138	0.354	0.634		0.050	0.064	2.6	10.3	
RM09.2	8/23/94				400	0.010 U	0.065	0.230		0.034	0.024	3.8	2.6	
RM09.2	8/24/94				395	0.010 U	0.040	0.241		0.018	0.033	3.2	3.0	
RM09.2	10/4/94				372	0.044	0.227	0.387		0.061	0.056	2.6	4.9	
RM09.2	10/5/94				371	0.042	0.215	0.441		0.058	0.069	2.3	6.0	
RM09.2	11/15/94				372	0.128	0.355	0.633		0.047	0.067	2.7	9.8	
RM05.0	8/23/94				393	0.010 U	0.037	0.248		0.037	0.036	4.2	2.8	95
RM05.0	8/24/94				395	0.010 U	0.042	0.262		0.021	0.044	3.2	1.5	100
RM05.0	10/4/94				376	0.147	0.167	0.336		0.048	0.047	2.7	2.2	60
RM05.0	10/5/94				375	0.024	0.196	0.353		0.048	0.046	2.6	2.4	55
RM05.0	11/15/94				375	0.111	0.370	0.621		0.044	0.064	2.7	6.2	13

Appendix B2. Colville River lab data from August-November 1994 sampling.

Station (River Mile)	Date	Alkalinity (mg/L as CaCO3)	Hardness (mg/L as CaCO3)	Chloride (mg/L)	Conductivity (umho/cm @ 25C)	Ammonia (mg/L as N)	Nitrate +Nitrite (mg/L as N)	Total Per-sulfate N (mg/L as N)	Total Kjeldahl N (mg/L as N)	Ortho-P (mg/L as P)	Total P (mg/L as P)	Total Organic C (mg/L)	Chloro-phyll a (ug/L)	Fecal Coliform (#/100mL)
Blue Cr	8/24/94				459	0.010 U	0.065	0.199		0.056	0.053	2.6		570
Blue Cr	10/5/94				468	0.010 U	0.010 U	0.174		0.043	0.041	2.0		260
Blue Cr	11/16/94				481	0.066	0.269	0.630		0.052	0.045	3.3		430
Chewelah Cr	8/25/94				281	0.010 U	0.525	0.775		0.017	0.010	1.9		360
Chewelah Cr	10/6/94				268	0.010 U	0.466	0.530		0.016	0.019	1.7		60
Chewelah Cr	11/16/94				259	0.010 U	0.469	0.566		0.019	0.028	2.8		79
Corbett Cr	10/5/94													19
Corbett Cr	11/15/94				236	0.010 U	0.109	0.271		0.018	0.025	3.4		1
Haller Cr	8/25/94				404	0.010 U	0.053	0.160		0.033	0.010	2.7		580
Haller Cr	10/6/94				416	0.010 U	0.010 U	0.119		0.036	0.027	2.4		140
Haller Cr	11/16/94				378	0.010 U	0.010 U	0.207		0.023	0.029	3.5		31
Little Pend Oreille R	8/25/94				204	0.010 U	0.010 U	0.081		0.010 U	0.010 U	2.5		120
Little Pend Oreille R	10/6/94				210	0.010 U	0.010 U	0.088		0.010 U	0.010 U	2.6		170
Little Pend Oreille R	11/16/94				197	0.010 U	0.046	0.158		0.010 U	0.010 U	2.8		74
Mill Cr	8/23/94				451	0.010 U	0.475	0.511		0.010 U	0.010 U	1.2		250
Mill Cr	8/24/94				454	0.010 U	0.459	0.513		0.010 U	0.010 U	2.1		190
Mill Cr	10/4/94				437	0.010 U	0.400	0.451		0.010 U	0.010 U	1.1		31
Mill Cr	10/5/94				437	0.010 U	0.417	0.446		0.010 U	0.014	1.0 U		67
Mill Cr	11/15/94				436	0.010 U	0.475	0.507		0.010 U	0.010 U	0.8		84
Stensgar Cr 1 (up)	10/6/94			4.4	482	0.010 U	0.240	0.695						
Stensgar Cr 1 (up)	10/6/94			4.4	481	0.010 U	0.237	0.630						
Stensgar Cr 1 (up)	11/17/94			5.2	429	0.010 U	0.079	0.275						
Stensgar Cr 1 (up)	11/17/94			5.2	428	0.010 U	0.078	0.229						
Stensgar Cr 2 (dn)	10/6/94			4.7	503	0.010 U	0.248	0.426		0.084	0.072	3.0		2000 J
Stensgar Cr 2 (dn)	10/6/94			4.7	503	0.010 U	0.246	0.404		0.084	0.080	3.0		2300 J
Stensgar Cr 2 (dn)	11/17/94			5.3	432	0.010 U	0.070	0.223		0.026	0.035	3.3		26
Stensgar Cr 2 (dn)	11/17/94			5.3	431	0.010 U	0.072	0.256		0.025	0.036	3.3		34
Stranger Cr	8/25/94			3.6	510	0.010 U	0.085	0.269		0.043	0.031	3.9		3900 J
Stranger Cr	10/6/94			3.0	535	0.010 U	0.012	0.143		0.034	0.037	2.7		1500
Stranger Cr	11/17/94			3.9	517	0.010 U	0.236	0.407		0.025	0.027	3.8		42
Chewelah Effluent (24h comp)	8/24/94		326		995	11.9	0.102	1.41		3.29	0.739	30.7	153	
Chewelah Effluent (24h comp)	8/25/94		330		1000	24.4	0.041		18	3.32	2.11	28.6	77	
Chewelah Effluent (24h comp)	10/5/94	423	310		1010	10.2	0.1		22	3.35	3.86	32.3	143	
Chewelah Effluent (24h comp)	10/6/94	423	314		1010	13.1	0.1		24	3.32	4.14	31.9	169	
Chewelah Effluent (24h comp)	11/16/94	362	258			14.0	0.052	11.9	21	2.98	1.14	26.7	22	
Chewelah Effluent (24h comp)	11/17/94	357	253			13.9	0.035	17	21	2.89	0.778	25.8	22	
Chewelah Effluent (grab)	8/24/94													15

Station (River Mile)	Date	Alkalinity (mg/L as CaCO3)	Hardness (mg/L as CaCO3)	Chloride (mg/L)	Conductivity (umho/cm @ 25C)	Ammonia (mg/L as N)	Nitrate +Nitrite (mg/L as N)	Total Per-sulfate N (mg/L as N)	Total Kjeldahl N (mg/L as N)	Ortho-P (mg/L as P)	Total P (mg/L as P)	Total Organic C (mg/L)	Chloro-phyll a (ug/L)	Fecal Coliform (#/100mL)
Chewelah Effluent (grab)	8/25/94													43
Chewelah Effluent (grab)	10/4/94				1020									3000
Chewelah Effluent (grab)	10/4/94				1020									3550
Chewelah Effluent (grab)	11/15/94													130
Chewelah Effluent (grab)	11/16/94													1200
Chewelah Effluent (grab)	11/17/94													2000
Colville Effluent (24h comp)	8/24/94		360		1120	1.51	0.045	0.862		1.32	0.431	21.3	125	
Colville Effluent (24h comp)	8/25/94		364		1130	1.17	0.052		8	1.22	1.11	20.7	60	
Colville Effluent (24h comp)	10/5/94	388	354		1190	7.95	0.060		12	2.96	3.02	18.8	10.5	
Colville Effluent (24h comp)	10/6/94	386	361		1190	10.4	0.039		14	2.98	3.23	18.5	14.4	
Colville Effluent (24h comp)	11/16/94	374	336			9.63	0.276	11.10	17	2.00	2.66	30.5	541	
Colville Effluent (24h comp)	11/17/94	372	330			9.65	0.286	14.10	17	2.01	0.530	31.4	599	
Colville Effluent (grab)	8/23/94													7 O
Colville Effluent (grab)	8/24/94													11.5
Colville Effluent (grab)	8/25/94													35.5
Colville Effluent (grab)	10/4/94				1190									120 J
Colville Effluent (grab)	10/4/94				1190									1 U
Colville Effluent (grab)	10/6/94													2.5
Colville Effluent (grab)	11/14/94													120
Colville Effluent (grab)	11/15/94													200
Colville Effluent (grab)	11/16/94													200
Lbar Ditch 1	8/25/94		9420 J	14560	41400	350	55.7		350					
Lbar Ditch 1	8/25/94		9170 J	13704	41400	318	57.0		290					
Lbar Ditch 1	11/17/94		7310 J	11500 J	33700	232 J	42.2 J		270					
Lbar Ditch 1	11/17/94		7414 J	11800 J	33700	274 J	48.8 J		270					
Lbar Ditch 2	11/17/94		1440	906 J	4740		21.4		1.2					
Lbar Ditch 2	11/17/94		1430	932 J	4740	0.526	21.4		1.4					

1994 Lab Sample #	Station	Sampling Date	Ultimate BOD Test Results 5-day BOD (mg/L)	5-day CBOD (mg/L)	Ultimate CBOD (mg/L)	CBOD Rate Constant base e (1/day)
34-8237	RM15.9	23-Aug-94	0.7	0.7	2.0	0.0682
34-8241	RM38.8	23-Aug-94	1.0	0.9	2.5	0.0889
34-8248	RM15.9	24-Aug-94	0.5	0.5	1.9	0.0741
34-8253	RM38.8	24-Aug-94	0.8	0.7	2.2	0.0915
34-8290	Colville POTW	24-Aug-94	8.7	8.4	32.7	0.0533
34-8291	Colville POTW	25-Aug-94	7.0	6.8	26.6	0.0555
34-8294	Chewelah POTW	24-Aug-94	14.3	12.8	28.9	0.1130
34-8295	Chewelah POTW	25-Aug-94	10.6	9.5	36.0	0.0458
40-8407	RM15.9	04-Oct-94	0.4	0.3	1.5	0.0565
40-8411	RM38.8	04-Oct-94	0.5	0.4	1.3	0.0770
40-8418	RM15.9	05-Oct-94	0.4	0.4	1.8	0.0533
40-8423	RM38.8	05-Oct-94	0.5	0.4	1.3	0.0783
40-8244	Chewelah POTW	05-Oct-94	19.3	18.7	32.5	0.1830
40-8264	Colville POTW	05-Oct-94	4.5	4.5	18.6	0.0775
40-8470	Colville POTW	06-Oct-94	4.0	4.0	16.8	0.0556
40-8473	Chewlah POTW	06-Oct-94	21.0	20.1	35.7	0.1625
46-8400	RM15.9	15-Nov-94	--	--	1.5	0.0507
46-8408	RM15.9	15-Nov-94	--	--	1.7	0.0313
46-8409	RM38.8	16-Nov-94	--	--	2.9	0.0268
46-8417	RM38.8	16-Nov-94	--	--	1.9	0.0823
46-8460	Colville POTW	16-Nov-94	--	--	45.7	0.0702
46-8461	Colville POTW	17-Nov-94	--	--	49.8	0.0845
46-8464	Chewelah POTW	16-Nov-94	--	--	32.3	0.1022
46-8465	Chewelah POTW	17-Nov-94	--	--	32.6	0.1310

Averages For Stations and Sampling Surveys:

Station	5-day BOD (mg/L)	5-day CBOD (mg/L)	Ultimate CBOD (mg/L)	CBOD Rate Constant base e (1/day)
August 23-25, 1994 survey:				
RM15.9	0.6	0.6	1.9	0.0711
RM38.8	0.9	0.8	2.3	0.0902
Colville POTW	7.8	7.6	29.7	0.0544
Chewelah POTW	12.4	11.1	32.4	0.0794
Average of RM15.9 and RM 38.8	0.7	0.7	2.1	0.0807
Average of Colville and Chewelah POTWs	10.1	9.4	31.0	0.0669
Average of River and POTWs Combined	5.4	5.0	16.6	0.0738
October 4-6, 1994 survey:				
RM15.9	0.4	0.4	1.6	0.0549
RM38.8	0.5	0.4	1.3	0.0776
Colville POTW	4.2	4.2	17.7	0.0666
Chewlah POTW	20.1	19.4	34.1	0.1728
Average of RM15.9 and RM 38.8	0.4	0.4	1.5	0.0663
Average of Colville and Chewelah POTWs	12.2	11.8	25.9	0.1197
Average of River and POTWs Combined	6.3	6.1	13.7	0.0930
November 15-17, 1994 survey:				
RM15.9	--	--	1.6	0.0410
RM38.8	--	--	2.4	0.0546
Colville POTW	--	--	47.8	0.0774
Chewelah POTW	--	--	32.4	0.1166
Average of RM15.9 and RM 38.8	--	--	2.0	0.0478
Average of Colville and Chewelah POTWs	--	--	40.1	0.0970
Average of River and POTWs Combined	--	--	21.0	0.0724
Average of All Surveys (August, October, and November 1994)				
RM15.9	0.4	0.4	1.7	0.0557
RM38.8	0.5	0.4	2.0	0.0741
Colville POTW	4.2	4.2	31.7	0.0661
Chewelah POTW	20.1	19.4	33.0	0.1229
Average of RM15.9 and RM 38.8	0.4	0.4	1.9	0.0649
Average of Colville and Chewelah POTWs	12.2	11.8	32.3	0.0945
Average of River and POTWs Combined	6.3	6.1	17.1	0.0797

Appendix B4. Colville River metals data from August-November 1994 sampling.

Sampling Station	Sampling Date	Sampling Time	Total Recoverable Metals (ug/L)						Dissolved Metals (ug/L)				
			Ag	Cd	Cu	Hg	Pb	Zn	Ag	Cd	Cu	Pb	Zn
RM15.9	23-Aug-94	13:23	0.03 U	0.04 U	0.627	0.001 P	0.189 P	2 J	0.03 U	0.04 U	0.5715	0.0495 P	1 UJ
RM15.9	24-Aug-94	13:15	0.03 U	0.04 U	0.623	0.001 U	0.174 P	1.2 J	0.03 U	0.04 U	0.567	0.049 P	1 UJ
RM15.9	04-Oct-94	14:09	0.1 U	0.1 U	0.882 P	0.0013 P	0.4 P	5.86 J	0.03 U	0.04 U	0.368 P	0.033 P	1 U
RM15.9	05-Oct-94	13:58	0.1 U	0.1 U	0.548 P	0.001 U	0.31 P	5.1 J	0.03 U	0.04 U	0.352 P	0.03 P	1 U
RM15.9	15-Nov-94	9:32	0.1 U	0.1 U	0.52 P	0.001 U	0.26 P	4.3 J	0.03 U	0.04 U	0.33 P	0.03 U	1 U
RM15.9	15-Nov-94	14:30	0.1 U	0.1 U	0.49 P	0.001 U	0.15 P	1.9 J	0.03 U	0.04 U	0.521	0.03 U	1 U
RM38.8	23-Aug-94	16:42	0.03 U	0.04 U	0.53	0.001 U	0.103 P	1.8 J	0.03 U	0.04 U	0.503	0.037 P	1 UJ
RM38.8	24-Aug-94	16:16	0.03 U	0.04 U	0.519	0.001 U	0.1 P	1 UJ	0.03 U	0.04 U	0.519	0.041 P	1.1 J
RM38.8	04-Oct-94	17:04	0.1 U	0.1 U	0.612 P	0.001 U	0.2 P	4.1 J	0.03 U	0.04 U	0.31 P	0.02 U	1 U
RM38.8	05-Oct-94	16:47	0.1 U	0.1 U	0.57 P	0.001 U	0.27 P	4.4 J	0.03 U	0.04 U	0.321 P	0.062 P	1 U
RM38.8	16-Nov-94	8:07	0.1 U	0.1 U	0.64 P	0.001 U	0.4 P	6.5 J	0.03 U	0.04 U	0.32 P	0.03 P	1 U
RM38.8	16-Nov-94	12:56	0.1 U	0.1 U	0.57 P	0.001 U	0.44 P	2.3 J	0.03 U	0.04 U	0.39 P	0.058 P	1 U
RM40.1	25-Aug-94	10:53	0.03 U	0.04 U	0.561	0.001 U	0.19 P	1 UJ	0.03 U	0.04 U	0.494 P	0.066 P	1 UJ
RM40.1	25-Aug-94	11:13	0.03 U	0.04 U	0.594	0.001 U	0.228	1.8 J	0.03 U	0.04 U	0.438 P	0.036 P	1 UJ
RM40.1	06-Oct-94	12:03	0.1 U	0.1 U	0.43 P	0.001 U	0.25 P	2.2 J	0.03 U	0.04 U	0.28 P	0.037 P	1 U
RM40.1	06-Oct-94	12:23	0.1 U	0.1 U	0.46 P	0.001 U	0.16 P	2.6 J	0.03 U	0.04 U	0.275 P	0.021 P	1 U
RM40.1	17-Nov-94	11:23	0.1 U	0.1 U	0.775 P	0.001 U	0.375 P	2.55 J	0.03 U	0.04 U	0.46 P	0.03 U	1 U
RM40.1	17-Nov-94	11:43	0.1 U	0.1 U	0.86 P	0.001 U	0.35 P	4.6 J	0.03 U	0.04 U	0.62	0.14 P	1 U
RM40.3	25-Aug-94	12:31	0.03 U	0.04 U	0.566	0.00105 P	0.175 P	4.07 J	0.03 U	0.04 U	0.496 P	0.032 P	1 UJ
RM40.3	25-Aug-94	12:51	0.03 U	0.04 U	0.542	0.001 U	0.168 P	1.8 J	0.03 U	0.04 U	0.418 P	0.076 P	1 UJ
RM40.3	06-Oct-94	13:03	0.1 U	0.1 U	0.435 P	0.001 U	0.115 P	2.85 J	0.03 U	0.04 U	0.316 P	0.0245 P	1 U
RM40.3	06-Oct-94	13:23	0.1 U	0.1 U	0.39 P	0.001 U	0.23 P	2.7 J	0.03 U	0.04 U	0.267 P	0.02 U	1 U
RM40.3	17-Nov-94	13:06	0.1 U	0.1 U	0.68 P	0.001 U	0.45 P	3 J	0.03 U	0.04 U	0.41 P	0.052 P	1 U
RM40.3	17-Nov-94	13:26	0.1 U	0.1 U	0.79 P	0.001 U	0.34 P	6.86 J	0.03 U	0.04 U	0.39 P	0.03 U	1 U
L-bar D1	25-Aug-94	12:00	0.5 UN	0.7 P	51	0.0287	2 UJ	26 J	--	--	--	--	--
L-bar D1	25-Aug-94	12:20	0.5 UN	0.89 P	42.7	0.0271	1 U	24 J	--	--	--	--	--
L-bar D1	17-Nov-94	12:30	0.5 U	0.555 P	29.7 P	0.0058 P	1 UJ	32.6 J	--	--	--	--	--
L-bar D1	17-Nov-94	12:45	0.5 U	0.68 P	26 P	0.0057 P	1.5 UJ	12 J	--	--	--	--	--
L-bar D2	17-Nov-94	12:00	0.5 U	0.16 P	3 U	0.001 U	1 UN	6 J	--	--	--	--	--
L-bar D2	17-Nov-94	12:15	0.5 U	0.16 P	3 U	0.001 U	1 UN	8.5 J	--	--	--	--	--
Colville Effluent	24-Aug-94	24hr	0.59 J	0.1 U	7.1 P	0.0145 P	1 U	7.9 J	--	--	--	--	--
Colville Effluent	25-Aug-94	24hr	0.605 J	0.125 PJ	9.2 P	0.015 P	1 U	11.9 J	--	--	--	--	--
Colville Effluent	16-Nov-94	24hr	0.71 P	0.1 U	8.1 P	0.0115	1 UN	9.4 J	--	--	--	--	--
Colville Effluent	17-Nov-94	24hr	0.59 P	0.1 U	7.4 P	0.0113	1 UN	8.8 J	--	--	--	--	--
Chewelah Effluent	24-Aug-94	24hr	0.5 UN	0.1 U	4.5 P	0.013 P	1 U	8.8 J	--	--	--	--	--
Chewelah Effluent	25-Aug-94	24hr	0.5 UN	0.1 U	4.4 P	0.012 P	1 U	4 U	--	--	--	--	--
Chewelah Effluent	16-Nov-94	24hr	0.5 U	0.1 U	3 U	0.0102	1 J	19 J	--	--	--	--	--
Chewelah Effluent	17-Nov-94	24hr	0.5 U	0.1 U	3 U	0.0094 P	1 UN	14 J	--	--	--	--	--

DATA QUALIFIERS:
U = the analyte was not detected at or above the reported result
J = the analyte was positively identified and the associated numerical result is an estimate
UJ = the analyte was not detected at or above the reported estimated result
N = the spike sample recovery was not within control limits
P = the analyte was detected above the instrument detection limit but below the quantitation limit

Appendix B5. QA data for metals samples from the Colville River study, August-November, 1994.

Sample Number	Sample ID	Sampling Date	QC Sample	Total Recoverable Metals (ug/L) Ag	Cd	Cu	Hg	Pb	Zn	Dissolved Metals (ug/L) Ag	Cd	Cu	Pb	Zn
94-348283	QC-4	23-Aug-94	0.3 ppb standard	0.288 P	0.33 P	0.296 P	--	0.398	0.485 P	--	--	--	--	--
94-408466	QC-6	04-Oct-94	0.3 ppb standard	0.3 P	0.28 P	0.3 P	--	0.3 P	1 UJ	0.283 P	0.259 P	0.444 P	0.35	1 U
94-468446	QC-6 (ICP-MS)	15-Nov-94	0.3 ppb standard	0.29 P	0.31 P	0.28 P	--	0.3 P	1 U	0.295 P	0.31 P	0.28 P	0.303	1 U
94-348284	QC-5	23-Aug-94	NIST 1641c	--	--	--	0.0315	--	--	--	--	--	--	--
94-408467	QC-7	04-Oct-94	NIST 1641c	--	--	--	0.0308	--	--	--	--	--	--	--
94-468447	QC-7	15-Nov-94	NIST 1641c	--	--	--	0.0242	--	--	--	--	--	--	--
94-348282	QC-3	23-Aug-94	NIST 1643c	1.91	11.7	20.8	--	35.8	82.2	2.22	12.2	20.5	35.6	109
94-408465	QC-5	04-Oct-94	NIST 1643c	2.19	11.5	19	--	29.8	61	1.7	12.9	22.7	39.6	81.6
94-468445	QC-5 (ICP-MS)	15-Nov-94	NIST 1643c	2.06	11.4	20.2	--	31.9	59.3 J	2.1	11.5	20.5	32.7	61.8
94-468445	QC-5 (ICP,AA)	15-Nov-94	NIST 1643c	2 P	10.8	19 P	--	34.2 N	71.7 J	--	--	--	--	--
94-408463	QC-3	04-Oct-94	bottle blank- HDPE	0.1 U	0.1 U	0.1 P	0.001 U	0.1 U	2.8 J	--	--	--	--	--
94-468443	QC-3	15-Nov-94	bottle blank- HDPE	0.5 U	0.1 U	3 U	0.001 U	1 UN	4 UJ	--	--	--	--	--
94-348280	QC-1	23-Aug-94	bottle blank- teflon	0.03 U	0.04 U	0.2 P	0.001 U	0.092 P	5.68 J	0.03 U	0.04 U	0.05 U	0.02 U	1 UJ
94-408461	QC-1	04-Oct-94	bottle blank- teflon	0.1 U	0.1 U	0.15 P	0.001 U	0.12 P	6.67 J	0.03 U	0.04 U	0.05 U	0.02 U	1 U
94-468441	QC-1 (ICP-MS)	15-Nov-94	bottle blank- teflon	0.1 U	0.1 U	0.1 U	--	0.23 P	3.1 J	0.03 U	0.04 U	0.05 U	0.03 U	1 U
94-468441	QC-1 (ICP,AA,CVAF)	15-Nov-94	bottle blank- teflon	0.5 U	0.1 U	3 U	0.001 U	1 UN	4 UJ	--	--	--	--	--
94-348298	EQUBLANK	23-Aug-94	equipment blank	0.5 UN	0.1 U	3.6 P	0.002 U	1 U	4 U	--	--	--	--	--
94-468468	CHE-EFF1	15-Nov-94	equipment blank	0.5 U	0.1 U	3 U	0.001 U	1 UN	4 UJ	--	--	--	--	--
94-348281	QC-2	23-Aug-94	field filter blank	--	--	--	--	--	--	0.03 U	0.04 U	0.05 U	0.02 U	1.4 J
94-408462	QC-2	04-Oct-94	field filter blank	0.1 U	0.1 U	0.2 P	--	0.16 P	5.94 J	0.03 U	0.04 U	0.05 U	0.02 U	1 U
94-468442	QC-2 (ICP-MS)	15-Nov-94	field filter blank	0.1 U	0.1 U	0.1 U	--	0.1 U	1 UJ	0.03 U	0.04 U	0.14 P	0.03 U	1 U
94-468442	QC-2 (ICP,AA)	15-Nov-94	field filter blank	0.5 U	0.1 U	3 U	--	1 UN	4 UJ	--	--	--	--	--
94-34XXXX	BLANK	23-Aug-94	lab method blank	--	--	--	--	--	--	0.03 U	0.04 U	0.05 U	0.02 U	1 UJ
94-34XXXX	EWPB34.04	23-Aug-94	lab method blank	0.03 U	0.04 U	0.2 U	--	0.092 U	1 U	--	--	--	--	--
94-34XXXX	EWPB36.09	23-Aug-94	lab method blank	0.5 U	0.1 U	3 U	--	1 U	13 P	--	--	--	--	--
94-34XXXX	BLANK(348237)	23-Aug-94	lab method blank	--	--	--	0.001 U	--	--	--	--	--	--	--
94-40XXXX	BLANK(408407)	04-Oct-94	lab method blank	0.1 U	0.1 U	0.1 U	--	0.1 U	3.5 J	--	--	--	--	--
BLNK4771	HG-BLNK	15-Nov-94	lab method blank	--	--	--	0.001 U	--	--	--	--	--	--	--
BLNK4809	HG-BLNK	15-Nov-94	lab method blank	--	--	--	0.001 U	--	--	--	--	--	--	--
	EWPB0204	15-Nov-94	lab method blank	--	--	3 U	--	--	4 U	--	--	--	--	--
	EWPB4745	15-Nov-94	lab method blank	0.5 U	0.1 U	--	--	1 U	--	--	--	--	--	--
	EWPB4746	15-Nov-94	lab method blank	0.5 U	0.1 U	3 U	--	1 U	4.7 P	--	--	--	--	--
	ICBICPMS	15-Nov-94	lab method blank	--	--	--	--	--	--	0.03 U	0.04 U	0.05 U	0.03 U	1 U
BLNK5051	WPB47.45	15-Nov-94	lab method blank	0.1 U	0.1 U	0.1 U	--	0.1 U	5.7 P	--	--	--	--	--

DATA QUALIFIERS:
U = the analyte was not detected at or above the reported result
J = the analyte was positively identified and the associated numerical result is an estimate
UJ = the analyte was not detected at or above the reported estimated result
N the spike sample recovery was not within control limits
P = the analyte was detected above the instrument detection limit but below the quantitation limit

January 24, 1995

Stuart Magoon
Dept of Ecology, Manchester Lab
7411 Beach Drive East
Port Orchard, WA 98366-8204

Stuart,

I've enclosed the results of the 8 river phytoplankton samples that were collected in 1994 from the Colville River.

A table of Similarity Indices (SI's) are included. These SI's range from 0 for totally dissimilar samples, to 100 for identical samples. They are calculated from the relative density of each alga present.

The highest SI was 80, at RM 13.8 for the Aug 23 and Aug 24 samples (makes sense). The lowest was 28, between RM 37.8 on Aug 23 and RM 13.8 on Aug 24. Most SI's were fairly high, indicating a general similarity of algal species composition between all sites on all dates. In general, samples were more similar at given sites / different dates than with given dates / different sites.

The species observed are typical of streams and rivers. As far as generalizations go, Nitzschia seem to prefer more enriched waters, Navicula somewhat less, and Gomphonema still less. Achnanthes and Cymbella are usually found in fairly clean flowing waters. Cocconeis is intermediate. Cyclotella meneghiniana is usually associated with enriched waters.

There were no unusual algae present, with the possible exception of Oscillatoria at RM 13.8 on Aug 23. But it only comprised less than 2% of the density. This bluegreen alga is most often associated with enriched waters.

The abundances were highest in August at both stations; October and November were similar. Algae were more abundant at RM 37.8 than RM 13.8 in August, but both sites were similar in October and November.

I appreciate the opportunity to analzye your algae samples. Please let me know if you would like further interpretations, or if you have any questions.

Best regards,

Jim Sweet
Aquatic Analysts

SIMILARITY INDICES FOR ALGAE SAMPLES.

	DB69	DB70	DB71	DB72	DB73	DB74	DB98	DB99
DB69	....	14	20	15	16	20	15	16
DB70	30	....	14	16	16	17	15	18
DB71	80	28	....	17	17	22	14	14
DB72	42	35	47	....	23	25	19	20
DB73	32	47	35	58	....	23	19	19
DB74	50	46	51	62	51	....	19	20
DB98	34	37	37	55	60	44	....	19
DB99	31	39	31	54	49	47	59	....

CODE	SAMPLE
DB69	Colville R, RM 13.8, 94-08-23
DB70	Colville R, RM 37.8, 94-08-23
DB71	Colville R, RM 13.8, 94-08-24
DB72	Colville R, RM 13.8, 94-10-04
DB73	Colville R, RM 37.8, 94-10-04
DB74	Colville R, RM 13.8, 94-10-05
DB98	Colville R, RM 37.8, 94-11-16
DB99	Colville R, RM 13.8, 94-11-15

Similarity indices are given at the lower left.
Number of species common between samples are at upper right.

PHYTOPLANKTON SAMPLE ANALYSIS

SAMPLE: Colville R, RM 13.8 / 348236 &

SAMPLE DATE: 94-08-23

TOTAL DENSITY (#/ml): 1443

TOTAL BIOVOLUME (cu.uM/ml): 423815

TROPHIC STATE INDEX: 43.7

DIVERSITY INDEX: 3.77

	SPECIES	DENSITY	PCT	BIOVOL	PCT
1	Nitzschia paleacea	486	33.7	47598	11.2
2	Achnanthes minutissima	125	8.7	6245	1.5
3	Gomphonema angustatum	125	8.7	22481	5.3
4	Ankistrodesmus falcatus	97	6.7	2428	0.6
5	Cocconeis placentula	69	4.8	31917	7.5
6	Diatoma vulgare	69	4.8	135994	32.1
7	Cryptomonas erosa	56	3.8	28864	6.8
8	Nitzschia fonticola	42	2.9	1748	0.4
9	Chlamydomonas sp.	42	2.9	13530	3.2
10	Achnanthes linearis	28	1.9	5495	1.3
11	Cocconeis pediculus	28	1.9	14432	3.4
12	Oscillatoria sp.	28	1.9	27754	6.5
13	Cyclotella meneghiniana	28	1.9	10546	2.5
14	Melosira varians	14	1.0	18040	4.3
15	Navicula cryptocephala veneta	14	1.0	1318	0.3
16	Nitzschia palea	14	1.0	2498	0.6
17	Gomphonema tenellum	14	1.0	2914	0.7
18	Navicula pupula	14	1.0	3747	0.9
19	Amphora perpusilla	14	1.0	2304	0.5
20	Rhodomonas minuta	14	1.0	278	0.1
21	Unidentified flagellate	14	1.0	278	0.1
22	Hannaea arcus	14	1.0	24285	5.7
23	Nitzschia frustulum	14	1.0	1665	0.4
24	Synedra sp.	14	1.0	3886	0.9
25	Nitzschia amphibia	14	1.0	1332	0.3
26	Nitzschia microcephala	14	1.0	1388	0.3
27	Navicula cryptocephala	14	1.0	2567	0.6
28	Rhoicosphenia curvata	14	1.0	1624	0.4
29	Navicula capitata	14	1.0	6661	1.6

PHYTOPLANKTON SAMPLE ANALYSIS

SAMPLE: Colville R, RM 37.8 / 348240 dm

SAMPLE DATE: 94-08-23

TOTAL DENSITY (#/ml): 2481

TOTAL BIOVOLUME (cu.uM/ml): 1066062

TROPHIC STATE INDEX: 50.3

DIVERSITY INDEX: 3.64

	SPECIES	DENSITY	PCT	BIOVOL	PCT
1	Cyclotella meneghiniana	636	25.6	241490	22.7
2	Cymbella minuta	349	14.0	128945	12.1
3	Navicula cryptocephala	267	10.7	49303	4.6
4	Cymbella affinis	246	9.9	442800	41.5
5	Nitzschia paleacea	144	5.8	14063	1.3
6	Ankistrodesmus falcatus	123	5.0	3075	0.3
7	Cocconeis placentula	123	5.0	56580	5.3
8	Achnanthes minutissima	103	4.1	5125	0.5
9	Nitzschia frustulum	62	2.5	7380	0.7
10	Nitzschia palea	62	2.5	11070	1.0
11	Selenastrum minutum	62	2.5	1230	0.1
12	Navicula tripunctata	41	1.7	45920	4.3
13	Navicula pupula	41	1.7	11070	1.0
14	Gomphonema angustatum	41	1.7	7380	0.7
15	Cocconeis pediculus	21	0.8	10660	1.0
16	Navicula minima	21	0.8	902	0.1
17	Achnanthes lanceolata	21	0.8	3690	0.3
18	Gomphonema olivaceum	21	0.8	4613	0.4
19	Amphora perpusilla	21	0.8	3403	0.3
20	Achnanthes linearis	21	0.8	2706	0.3
21	Navicula sp.	21	0.8	3075	0.3
22	Chlamydomonas sp.	21	0.8	6663	0.6
23	Scenedesmus acuminatus	21	0.8	4920	0.5

PHYTOPLANKTON SAMPLE ANALYSIS

SAMPLE: Colville R, RM 13.8 /348247

SAMPLE DATE: 94-08-24

TOTAL DENSITY (#/ml): 1651

TOTAL BIOVOLUME (cu.uM/ml): 532837

TROPHIC STATE INDEX: 45.3

DIVERSITY INDEX: 3.63

--	SPECIES	DENSITY	PCT	BIOVOL	PCT
1	Nitzschia paleacea	520	31.5	50940	9.6
2	Gomphonema angustatum	229	13.9	41278	7.7
3	Achnanthes minutissima	199	12.0	9937	1.9
4	Cocconeis placentula	76	4.6	35163	6.6
5	Diatoma vulgare	76	4.6	179788	33.7
6	Chlamydomonas sp.	61	3.7	19875	3.7
7	Cryptomonas erosa	46	2.8	23849	4.5
8	Achnanthes linearis	46	2.8	6054	1.1
9	Cyclotella meneghiniana	46	2.8	17428	3.3
10	Navicula minima	31	1.9	1345	0.3
11	Amphora perpusilla	31	1.9	5076	1.0
12	Cocconeis pediculus	31	1.9	15900	3.0
13	Hannaea arcus	31	1.9	53508	10.0
14	Navicula cryptocephala veneta	31	1.9	2905	0.5
15	Ankistrodesmus falcatus	31	1.9	764	0.1
16	Nitzschia fonticola	15	0.9	642	0.1
17	Amphora ovalis	15	0.9	8837	1.7
18	Gomphonema tenellum	15	0.9	3211	0.6
19	Navicula cryptocephala	15	0.9	2828	0.5
20	Cymbella minuta	15	0.9	5657	1.1
21	Nitzschia frustulum	15	0.9	1835	0.3
22	Oscillatoria sp.	15	0.9	15288	2.9
23	Pleurosigma delicatulum	15	0.9	13759	2.6
24	Scenedesmus quadricauda	15	0.9	3975	0.7
25	Gomphonema sp.	15	0.9	3058	0.6
26	Melosira varians	15	0.9	9937	1.9

PHYTOPLANKTON SAMPLE ANALYSIS

SAMPLE: Colville R, RM 13.8 /408406

SAMPLE DATE: 94-10-04

TOTAL DENSITY (#/ml): 639

TOTAL BIOVOLUME (cu.uM/ml): 198427

TROPHIC STATE INDEX: 38.2

DIVERSITY INDEX: 4.60

	SPECIES	DENSITY	PCT	BIOVOL	PCT
1	Nitzschia paleacea	61	9.5	5937	3.0
2	Achnanthes linearis	61	9.5	7997	4.0
3	Achnanthes minutissima	47	7.4	2356	1.2
4	Cocconeis placentula	47	7.4	21675	10.9
5	Cocconeis pediculus	47	7.4	24502	12.3
6	Navicula cryptocephala	34	5.3	6226	3.1
7	Navicula cryptocephala veneta	34	5.3	3197	1.6
8	Achnanthes lanceolata	27	4.2	4847	2.4
9	Gomphonema angustatum	27	4.2	4847	2.4
10	Amphora perpusilla	27	4.2	4470	2.3
11	Nitzschia dissipata	20	3.2	5432	2.7
12	Cymbella minuta	20	3.2	7472	3.8
13	Navicula minima	13	2.1	592	0.3
14	Fragilaria construens venter	13	2.1	969	0.5
15	Epithemia sorex	13	2.1	23021	11.6
16	Navicula viridula	13	2.1	6058	3.1
17	Ankistrodesmus falcatus	13	2.1	841	0.4
18	Chlamydomonas sp.	13	2.1	4375	2.2
19	Diatoma vulgare	13	2.1	26387	13.3
20	Scenedesmus quadricauda	7	1.1	1750	0.9
21	Melosira varians	7	1.1	8751	4.4
22	Navicula capitata	7	1.1	3231	1.6
23	Fragilaria pinnata	7	1.1	404	0.2
24	Cymbella sinuata	7	1.1	942	0.5
25	Diploneis puella	7	1.1	1750	0.9
26	Navicula gregaria	7	1.1	1178	0.6
27	Navicula anglica	7	1.1	2423	1.2
28	Nitzschia sp.	7	1.1	808	0.4
29	Nitzschia communis	7	1.1	303	0.2
30	Navicula sp.	7	1.1	1010	0.5
31	Nitzschia palea	7	1.1	1212	0.6
32	Gomphonema sp.	7	1.1	1346	0.7
33	Cymbella affinis	7	1.1	12116	6.1

PHYTOPLANKTON SAMPLE ANALYSIS

SAMPLE: Colville R, RM 37.8/408410

SAMPLE DATE: 94-10-04

TOTAL DENSITY (#/ml): 789

TOTAL BIOVOLUME (cu.uM/ml): 313332

TROPHIC STATE INDEX: 41.5

DIVERSITY INDEX: 4.30

	SPECIES	DENSITY	PCT	BIOVOL	PCT
1	Navicula cryptocephala	129	16.3	23839	7.6
2	Cocconeis placentula	121	15.3	55570	17.7
3	Achnanthes minutissima	56	7.1	2819	0.9
4	Cymbella affinis	48	6.1	86979	27.8
5	Cyclotella meneghiniana	48	6.1	18362	5.9
6	Navicula cryptocephala veneta	48	6.1	4591	1.5
7	Achnanthes lanceolata	40	5.1	7248	2.3
8	Cymbella minuta	32	4.1	11919	3.8
9	Amphora perpusilla	32	4.1	5348	1.7
10	Ankistrodesmus falcatus	16	2.0	403	0.1
11	Achnanthes linearis	16	2.0	2126	0.7
12	Diatoma vulgare	16	2.0	31570	10.1
13	Cocconeis pediculus	16	2.0	8376	2.7
14	Nitzschia paleacea	16	2.0	1578	0.5
15	Nitzschia palea	8	1.0	1450	0.5
16	Navicula tripunctata	8	1.0	9020	2.9
17	Scenedesmus abundans	8	1.0	1611	0.5
18	Gomphonema sp.	8	1.0	1611	0.5
19	Cymbella sinuata	8	1.0	1128	0.4
20	Achnanthes clevei	8	1.0	1208	0.4
21	Navicula minima	8	1.0	354	0.1
22	Navicula cascadensis	8	1.0	483	0.2
23	Fragilaria construens	8	1.0	1804	0.6
24	Fragilaria pinnata	8	1.0	483	0.2
25	Gomphonema angustatum	8	1.0	1450	0.5
26	Melosira varians	8	1.0	10470	3.3
27	Navicula viridula	8	1.0	3624	1.2
28	Fragilaria construens venter	8	1.0	387	0.1
29	Gomphonema tenellum	8	1.0	1691	0.5
30	Nitzschia communis	8	1.0	362	0.1
31	Nitzschia acicularis	8	1.0	2255	0.7
32	Rhoicosphenia curvata	8	1.0	942	0.3
33	Nitzschia linearis	8	1.0	12274	3.9

PHYTOPLANKTON SAMPLE ANALYSIS

SAMPLE: Colville R, RM 13.8 / 408417

SAMPLE DATE: 94-10-05

TOTAL DENSITY (#/ml): 781

TOTAL BIOVOLUME (cu.uM/ml): 220637

TROPHIC STATE INDEX: 39

DIVERSITY INDEX: 4.75

--	SPECIES	DENSITY	PCT	BIOVOL	PCT
1	Nitzschia paleacea	112	14.3	10936	5.0
2	Navicula cryptocephala	74	9.5	13762	6.2
3	Cocconeis placentula	56	7.1	25665	11.6
4	Ankistrodesmus falcatus	37	4.8	930	0.4
5	Nitzschia frustulum	37	4.8	4464	2.0
6	Diatoma vulgare	28	3.6	54678	24.8
7	Achnanthes linearis	28	3.6	3682	1.7
8	Cymbella sinuata	28	3.6	3906	1.8
9	Cocconeis pediculus	28	3.6	14506	6.6
10	Achnanthes minutissima	28	3.6	1395	0.6
11	Gomphonema angustatum	19	2.4	3348	1.5
12	Gomphonema tenellum	19	2.4	3906	1.8
13	Cymbella minuta	19	2.4	6881	3.1
14	Amphora perpusilla	19	2.4	3087	1.4
15	Cyclotella meneghiniana	19	2.4	7067	3.2
16	Nitzschia palea	19	2.4	3348	1.5
17	Nitzschia dissipata	19	2.4	5003	2.3
18	Achnanthes lanceolata	19	2.4	3348	1.5
19	Navicula minima	9	1.2	409	0.2
20	Fragilaria construens	9	1.2	2083	0.9
21	Nitzschia communis	9	1.2	418	0.2
22	Navicula cascadensis	9	1.2	558	0.3
23	Navicula cryptocephala veneta	9	1.2	883	0.4
24	Cryptomonas erosa	9	1.2	4835	2.2
25	Navicula anglica	9	1.2	3348	1.5
26	Nitzschia fonticola	9	1.2	391	0.2
27	Fragilaria pinnata	9	1.2	1116	0.5
28	Amphora ovalis	9	1.2	5375	2.4
29	Nitzschia volcanica	9	1.2	1488	0.7
30	Scenedesmus quadricauda	9	1.2	2418	1.1
31	Synedra parasitica	9	1.2	1302	0.6
32	Melosira varians	9	1.2	6044	2.7
33	Chlamydomonas sp.	9	1.2	3022	1.4
34	Selenastrum minutum	9	1.2	186	0.1
35	Navicula capitata	9	1.2	4464	2.0
36	Navicula decussis	9	1.2	1785	0.8
37	Epithemia sorex	9	1.2	10601	4.8

PHYTOPLANKTON SAMPLE ANALYSIS

SAMPLE: Colville R, RM 37.8 / 468416

SAMPLE DATE: 94-11-16

TOTAL DENSITY (#/ml): 648

TOTAL BIOVOLUME (cu.uM/ml): 205180

TROPHIC STATE INDEX: 38.4

DIVERSITY INDEX: 4.45

--	SPECIES	DENSITY	PCT	BIOVOL	PCT
1	Achnanthes minutissima	76	11.8	3811	1.9
2	Cocconeis placentula	76	11.8	35064	17.1
3	Navicula cryptocephala	51	7.8	9401	4.6
4	Achnanthes lanceolata	51	7.8	9147	4.5
5	Navicula cryptocephala veneta	51	7.8	4828	2.4
6	Nitzschia dissipata	32	4.9	8544	4.2
7	Cymbella minuta	32	4.9	11751	5.7
8	Gomphonema angustatum	32	4.9	5717	2.8
9	Ochromonas sp.	25	3.9	2700	1.3
10	Navicula tripunctata	19	2.9	21343	10.4
11	Cymbella affinis	19	2.9	34301	16.7
12	Navicula minuscula	13	2.0	572	0.3
13	Nitzschia acicularis	13	2.0	3557	1.7
14	Chlamydomonas sp.	13	2.0	4129	2.0
15	Cymbella sinuata	13	2.0	1779	0.9
16	Navicula gregaria	13	2.0	2223	1.1
17	Ankistrodesmus falcatus	13	2.0	318	0.2
18	Nitzschia paleacea	13	2.0	1245	0.6
19	Achnanthes linearis	13	2.0	1677	0.8
20	Nitzschia linearis	6	1.0	9681	4.7
21	Amphora perpusilla	6	1.0	1054	0.5
22	Surirella ovata	6	1.0	1842	0.9
23	Fragilaria leptostauron	6	1.0	1169	0.6
24	Cyclotella meneghiniana	6	1.0	2414	1.2
25	Navicula decussis	6	1.0	1220	0.6
26	Gyrosigma sp.	6	1.0	3176	1.5
27	Cocconeis pediculus	6	1.0	3303	1.6
28	Unidentified flagellate	6	1.0	127	0.1
29	Navicula mournei	6	1.0	1493	0.7
30	Synedra socia	6	1.0	2096	1.0
31	Diatoma vulgare	6	1.0	12450	6.1
32	Navicula capitata	6	1.0	3049	1.5

PHYTOPLANKTON SAMPLE ANALYSIS

SAMPLE: Colville R, RM 13.8 468407

SAMPLE DATE: 94-11-15

TOTAL DENSITY (#/ml): 699

TOTAL BIOVOLUME (cu.uM/ml): 280536

TROPHIC STATE INDEX: 40.7

DIVERSITY INDEX: 4.51

	SPECIES	DENSITY	PCT	BIOVOL	PCT
1	Navicula cryptocephala veneta	88	12.6	8376	3.0
2	Nitzschia dissipata	81	11.7	21892	7.8
3	Navicula cryptocephala	54	7.8	10037	3.6
4	Cocconeis placentula	47	6.8	21838	7.8
5	Achnanthes lanceolata	41	5.8	7325	2.6
6	Nitzschia paleacea	34	4.9	3323	1.2
7	Chlamydomonas sp.	27	3.9	8817	3.1
8	Navicula tripunctata	27	3.9	30383	10.8
9	Gomphonema angustatum	27	3.9	4883	1.7
10	Synedra ulna	20	2.9	40488	14.4
11	Cymbella minuta	20	2.9	7528	2.7
12	Cymbella affinis	20	2.9	36623	13.1
13	Achnanthes minutissima	20	2.9	1017	0.4
14	Rhodomonas minuta	20	2.9	407	0.1
15	Unidentified flagellate	20	2.9	407	0.1
16	Diatoma vulgare	14	1.9	26585	9.5
17	Navicula viridula	14	1.9	6104	2.2
18	Gomphonema olivaceum	14	1.9	3052	1.1
19	Nitzschia frustulum	14	1.9	1628	0.6
20	Amphora perpusilla	14	1.9	2252	0.8
21	Nitzschia palea	7	1.0	1221	0.4
22	Navicula minima	7	1.0	298	0.1
23	Nitzschia sigmoidea	7	1.0	5765	2.1
24	Nitzschia linearis	7	1.0	10336	3.7
25	Navicula capitata	7	1.0	3255	1.2
26	Euglena sp.	7	1.0	3934	1.4
27	Cocconeis pediculus	7	1.0	3527	1.3
28	Cymbella sinuata	7	1.0	949	0.3
29	Navicula sp.	7	1.0	1017	0.4
30	Fragilaria construens	7	1.0	1519	0.5
31	Navicula pupula	7	1.0	1831	0.7
32	Amphora ovalis	7	1.0	3920	1.4

Appendix C.

QUAL2E Input Files for Calibration and Validation to August-November 1994 Survey Data

```
TITLE01              Calibration for August 23-25, 1994 survey
TITLE02              File WK34.IN
TITLE03  YES         CONSERVATIVE MINERAL I      CCON      uS
TITLE04   NO         CONSERVATIVE MINERAL II
TITLE05   NO         CONSERVATIVE MINERAL III
TITLE06   NO         TEMPERATURE
TITLE07  YES         BIOCHEMICAL OXYGEN DEMAND
TITLE08  YES         ALGAE AS CHL-A IN UG/L
TITLE09  YES         PHOSPHORUS CYCLE AS P IN MG/L
TITLE10                (ORGANIC-P, DISSOLVED-P)
TITLE11  YES         NITROGEN CYCLE AS N IN MG/L
TITLE12                (ORGANIC-N, AMMONIA-N, NITRITE-N, NITRITE-N)
TITLE13  YES         DISSOLVED OXYGEN IN MG/L
TITLE14  YES         FECAL COLIFORMS IN NO./100 ML
TITLE15   NO         ARBITRARY NON-CONSERVATIVE
ENDTITLE
LIST DATA INPUT
WRITE OPTIONAL SUMMARY
NO FLOW AUGMENTATION
STEADY STATE
DISCHARGE COEFFICIENTS
NO PRINT SOLAR/LCD DATA
NO PLOT DO AND BOD
FIXED DNSTM COND (YES=1)=   0.00000         5D-ULT BOD CONV K COEF  =    0.00000
INPUT METRIC (YES=1)    =   0.00000         OUTPUT METRIC (YES=1)   =    0.00000
NUMBER OF REACHES       =  25.00000         NUMBER OF JUNCTIONS     =    0.00000
NUM OF HEADWATERS       =   1.00000         NUMBER OF POINT LOADS   =   11.00000
TIME STEP (HOURS)       =                   LNTH  COMP  ELEMENT (DX)=    0.20000
MAXIMUM ITERATIONS      =  100.0000         TIME INC. FOR RPT2 (HRS)=
ENDATA1
O UPTAKE BY NH3 OXID(MG O/MG N)= 3.4300  O UPTAKE BY NO2 OXID(MG O/MG N)= 1.1400
O PROD  BY ALGAE (MG O/MG A)    = 1.6000  O UPTAKE BY ALGAE (MG O/MG A)   = 2.0000
N CONTENT OF ALGAE (MG N/MG A) = 0.0800  P CONTENT OF ALGAE (MG P/MG A) = 0.0110
ALG MAX SPEC GROWTH RATE(1/DAY)= 3.0000  ALGAE RESPIRATION RATE (1/DAY) = 0.1200
N HALF SATURATION CONST (MG/L) = 0.0150  P HALF SATURATION CONST  (MG/L)= 0.0030
LIN ALG EXCO (1/FT)/(UGCHLA/L) = 0.0130  NLINCO (1/FT)/(UGCHLA/L)**(2/3)= 0.0000
LIGHT FUNCTION OPTION (LFNOPT) = 1.0000  LIGHT SAT'N COEFF (BTU/FT2/MIN)= 0.0920
DAILY AVERAGING OPTION (LAVOPT)=      2  LIGHT AVERAGING FACTOR (AFACT) = 1.0000
NUMBER OF DAYLIGHT HOURS (DLH) = 13.900  TOTAL DAILY SOLR RAD (BTU/FT2) = 2100.0
ALGY GROWTH CALC OPTION(LGROPT)= 2.0000  ALGAL PREF FOR NH3-N (PREFN)    = 0.9000
ALG/TEMP SOLR RAD FACTOR(TFACT)= 0.4500  NITRIFICATION INHIBITION COEF  = 0.6000
ENDATA1A
THETA     BOD SETT    1.000
THETA     SOD RATE    1.080
THETA     ORGN SET    1.000
THETA     NH3 DECA    1.080
THETA     NH3 SRCE    1.000
THETA     PORG SET    1.000
THETA     DISP SRC    1.000
THETA     ALG SETT    1.000
ENDATA1B
STREAM REACH      1.RCH= Headwater          FROM         40.4      TO           40.2
STREAM REACH      2.RCH= L-bar/Chew Cr      FROM         40.2      TO           39.6
STREAM REACH      3.RCH= To SCCD 11         FROM         39.6      TO           38.8
STREAM REACH      4.RCH= Abv Chew POTW      FROM         38.8      TO           38.4
STREAM REACH      5.RCH= Blw Chew POTW      FROM         38.4      TO           37.8
STREAM REACH      6.RCH= Blw Chew POTW      FROM         37.8      TO           35.8
STREAM REACH      7.RCH= Blw Chew POTW      FROM         35.8      TO           35.0
STREAM REACH      8.RCH= To Blue Cr         FROM         35.0      TO           32.0
STREAM REACH      9.RCH= Blw Blue Cr        FROM         32.0      TO           30.6
STREAM REACH     10.RCH= To Addy            FROM         30.6      TO           29.2
STREAM REACH     11.RCH= Below Addy         FROM         29.2      TO           27.2
STREAM REACH     12.RCH= To SCCD 16         FROM         27.2      TO           25.2
STREAM REACH     13.RCH= Abv LPendOr R      FROM         25.2      TO           23.0
STREAM REACH     14.RCH= To  LPendOr R      FROM         23.0      TO           21.0
STREAM REACH     15.RCH= Blw LPendOr R      FROM         21.0      TO           18.4
STREAM REACH     16.RCH= To SCCD 20         FROM         18.4      TO           15.8
STREAM REACH     17.RCH= Abv Colvil POTW    FROM         15.8      TO           14.8
STREAM REACH     18.RCH= Blw Colvil POTW    FROM         14.8      TO           13.8
STREAM REACH     19.RCH= Blw Colvil POTW    FROM         13.8      TO           12.6
STREAM REACH     20.RCH= To Blw Mill Cr     FROM         12.6      TO           11.2
STREAM REACH     21.RCH= Blw Mill Cr        FROM         11.2      TO           10.2
STREAM REACH     22.RCH= To SCCD 24         FROM         10.2      TO            9.2
STREAM REACH     23.RCH= Abv Backwater      FROM          9.2      TO            7.4
STREAM REACH     24.RCH= Above Falls        FROM          7.4      TO            5.4
STREAM REACH     25.RCH= Below Falls        FROM          5.4      TO            5.0
ENDATA2
ENDATA3
FLAG FIELD RCH=   1.          1            1
FLAG FIELD RCH=   2.          3            6 2 6
FLAG FIELD RCH=   3.          4            2 2 2 2
FLAG FIELD RCH=   4.          2            2 2
FLAG FIELD RCH=   5.          3            6 2 2
FLAG FIELD RCH=   6.         10            2 2 2 2 2 2 2 2 2 2
FLAG FIELD RCH=   7.          4            2 2 2 2
FLAG FIELD RCH=   8.         15            2 2 2 2 2 2 2 2 2 2 2 2 2 6 2
FLAG FIELD RCH=   9.          7            2 2 2 2 2 2 2
FLAG FIELD RCH=  10.          7            2 2 2 2 6 2 2
FLAG FIELD RCH=  11.         10            2 2 2 2 2 2 2 2 2 2
FLAG FIELD RCH=  12.         10            2 2 6 2 2 2 2 2 2 2
FLAG FIELD RCH=  13.         11            2 2 2 2 2 2 2 2 2 2 2
FLAG FIELD RCH=  14.         10            2 2 2 2 2 2 2 2 2 2
FLAG FIELD RCH=  15.         13            6 2 2 2 2 2 6 2 2 2 2 2 2
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FLAG FIELD RCH=  16.         13            2 2 2 2 2 2 2 2 2 2 2 2 2
FLAG FIELD RCH=  17.          5            2 2 2 2 2
FLAG FIELD RCH=  18.          5            6 2 2 2 2
FLAG FIELD RCH=  19.          6            2 2 6 2 2 2
FLAG FIELD RCH=  20.          7            2 2 2 2 2 6 2
FLAG FIELD RCH=  21.          5            2 2 2 2 2
FLAG FIELD RCH=  22.          5            2 2 2 2 2
FLAG FIELD RCH=  23.          9            2 2 2 2 2 2 2 2 2
FLAG FIELD RCH=  24.         10            2 2 2 2 2 2 2 2 2 2
FLAG FIELD RCH=  25.          2            2 5
ENDATA4
HYDRAULICS RCH=   1.                0.161      0.588      0.353      0.360      0.03
HYDRAULICS RCH=   2.               0.0605      0.719      0.610      0.271      0.03
HYDRAULICS RCH=   3.               0.0605      0.719      0.610      0.271      0.03
HYDRAULICS RCH=   4.        5.93   0.0605      0.719      0.610      0.271      0.03
HYDRAULICS RCH=   5.        5.93   0.0742      0.747      0.877      0.132      0.03
HYDRAULICS RCH=   6.        5.93   0.0742      0.747      0.877      0.132      0.03
HYDRAULICS RCH=   7.        5.93   0.0742      0.747      0.877      0.132      0.03
HYDRAULICS RCH=   8.        5.93    0.361      0.432      0.207      0.412      0.03
HYDRAULICS RCH=   9.        5.93    0.361      0.432      0.207      0.412      0.03
HYDRAULICS RCH=  10.        5.93   0.0620      0.719      0.477      0.301      0.03
HYDRAULICS RCH=  11.        5.93   0.0620      0.719      0.477      0.301      0.03
HYDRAULICS RCH=  12.        5.93   0.0456      0.669      0.716      0.290      0.03
HYDRAULICS RCH=  13.        5.93   0.0456      0.669      0.716      0.290      0.03
HYDRAULICS RCH=  14.        5.93   0.0560      0.648      0.622      0.270      0.03
HYDRAULICS RCH=  15.        5.93   0.0560      0.648      0.622      0.270      0.03
HYDRAULICS RCH=  16.        5.93    0.278      0.322      0.113      0.599      0.03
HYDRAULICS RCH=  17.        5.93    0.278      0.322      0.113      0.599      0.03
HYDRAULICS RCH=  18.        5.93    0.159      0.478      0.180      0.502      0.03
HYDRAULICS RCH=  19.        5.93    0.159      0.478      0.180      0.502      0.03
HYDRAULICS RCH=  20.        5.93   0.0673      0.584      0.324      0.350      0.03
HYDRAULICS RCH=  21.        5.93   0.0673      0.584      0.324      0.350      0.03
HYDRAULICS RCH=  22.        5.93   0.0975      0.563      0.309      0.373      0.03
HYDRAULICS RCH=  23.        5.93   0.0975      0.563      0.309      0.373      0.03
HYDRAULICS RCH=  24.        5.93   0.0488      0.563      0.618      0.373      0.03
HYDRAULICS RCH=  25.        5.93   0.0975      0.563      0.309      0.373      0.03
ENDATA5
ENDATA5A
REACT COEF RCH=    1.                                1       0.
REACT COEF RCH=    2.                                1       0.
REACT COEF RCH=    3.                                1       0.
REACT COEF RCH=    4.   0.065    0.00   0.100    8              0.054
REACT COEF RCH=    5.   0.123    0.00   0.200    8              0.054
REACT COEF RCH=    6.   0.123    0.00   0.300    8              0.054
REACT COEF RCH=    7.   0.123    0.00   0.500    8              0.054
REACT COEF RCH=    8.   0.123    0.00   0.500    8              0.054
REACT COEF RCH=    9.   0.123    0.00   0.200    8              0.054
REACT COEF RCH=   10.   0.123    0.00   0.000    8              0.054
REACT COEF RCH=   11.   0.123    0.00   0.000    8              0.054
REACT COEF RCH=   12.   0.123    0.00   0.000    8              0.054
REACT COEF RCH=   13.   0.123    0.00   0.000    8              0.054
REACT COEF RCH=   14.   0.123    0.00   0.000    8              0.054
REACT COEF RCH=   15.   0.123    0.00   0.000    8              0.054
REACT COEF RCH=   16.   0.123    0.00   0.000    8              0.054
REACT COEF RCH=   17.   0.123    0.00   0.000    8              0.054
REACT COEF RCH=   18.   0.066    0.00   0.000    8              0.054
REACT COEF RCH=   19.   0.066    0.00   0.000    8              0.054
REACT COEF RCH=   20.   0.066    0.00   0.000    8              0.054
REACT COEF RCH=   21.   0.066    0.00   0.000    8              0.054
REACT COEF RCH=   22.   0.066    0.00   0.100    8              0.054
REACT COEF RCH=   23.   0.066    0.00   0.100    8              0.054
REACT COEF RCH=   24.   0.066    0.00   0.200    8              0.054
REACT COEF RCH=   25.   0.066    0.00   0.000    1      10.
ENDATA6
N AND P COEF    RCH=   1.
N AND P COEF    RCH=   2.
N AND P COEF    RCH=   3.
N AND P COEF    RCH=   4.    0.10  0.400   2.00  -11.0   2.00   0.10   0.40 -1.600
N AND P COEF    RCH=   5.    0.10  0.400   2.00  -200.   2.00   0.10   0.40 -1.600
N AND P COEF    RCH=   6.    0.10  0.400   2.00  -11.0   2.00   0.10   0.40 -1.600
N AND P COEF    RCH=   7.    0.10  0.400   2.00  -0.00   2.00   0.10   0.40 -1.600
N AND P COEF    RCH=   8.    0.10  0.400   2.00  -0.00   2.00   0.10   0.40 -0.000
N AND P COEF    RCH=   9.    0.10  0.400   2.00  -0.00   2.00   0.10   0.40 -0.000
N AND P COEF    RCH=  10.    0.10  0.400   2.00  -0.00   2.00   0.10   0.40 -0.000
N AND P COEF    RCH=  11.    0.10  0.400   2.00  -0.00   2.00   0.10   0.40 -0.000
N AND P COEF    RCH=  12.    0.10  0.400   2.00  -0.00   2.00   0.10   0.40 -0.000
N AND P COEF    RCH=  13.    0.10  0.400   2.00  -0.00   2.00   0.10   0.40 -0.000
N AND P COEF    RCH=  14.    0.10  0.400   2.00  -0.00   2.00   0.10   0.40 -0.000
N AND P COEF    RCH=  15.    0.10  0.400   2.00  -0.00   2.00   0.10   0.40 -0.000
N AND P COEF    RCH=  16.    0.10  0.400   2.00  -0.00   2.00   0.10   0.40 -0.000
N AND P COEF    RCH=  17.    0.10  0.400   2.00  -0.00   2.00   0.10   0.40 -0.000
N AND P COEF    RCH=  18.    0.10  0.400   2.00  -11.0   2.00   0.10   0.40 -1.600
N AND P COEF    RCH=  19.    0.10  0.400   2.00  -11.0   2.00   0.10   0.40 -1.600
N AND P COEF    RCH=  20.    0.10  0.400   2.00  -0.00   2.00   0.10   0.40 -0.000
N AND P COEF    RCH=  21.    0.10  0.400   2.00  -0.00   2.00   0.10   0.40 -0.000
N AND P COEF    RCH=  22.    0.10  0.400   2.00  -0.00   2.00   0.10   0.40 -0.000
N AND P COEF    RCH=  23.    0.10  0.400   2.00  -0.00   2.00   0.10   0.40 -0.000
N AND P COEF    RCH=  24.    0.10  0.400   2.00  -0.00   2.00   0.10   0.40 -0.000
N AND P COEF    RCH=  25.    0.10  0.400   2.00  -0.00   2.00   0.10   0.40 -0.000
ENDATA6A
ALG/OTHER COEF RCH=   1.     15.    2.00    0.01
ALG/OTHER COEF RCH=   2.     15.    2.00    0.01
ALG/OTHER COEF RCH=   3.     15.    2.00    0.01
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ALG/OTHER COEF RCH=   4.    15.   2.00   0.01   4.00
ALG/OTHER COEF RCH=   5.    15.   2.00   0.01   4.00
ALG/OTHER COEF RCH=   6.    15.   2.00   0.01   4.00
ALG/OTHER COEF RCH=   7.    15.   2.00   0.01   4.00
ALG/OTHER COEF RCH=   8.    15.   2.00   0.01   4.00
ALG/OTHER COEF RCH=   9.    15.   2.00   0.01   4.00
ALG/OTHER COEF RCH=  10.    15.   2.00   0.01   4.00
ALG/OTHER COEF RCH=  11.    15.   2.00   0.01   4.00
ALG/OTHER COEF RCH=  12.    15.   2.00   0.01   4.00
ALG/OTHER COEF RCH=  13.    15.   2.00   0.01   4.00
ALG/OTHER COEF RCH=  14.    15.   2.00   0.01   4.00
ALG/OTHER COEF RCH=  15.    15.   2.00   0.01   4.00
ALG/OTHER COEF RCH=  16.    15.   2.00   0.01   4.00
ALG/OTHER COEF RCH=  17.    15.   2.00   0.01   4.00
ALG/OTHER COEF RCH=  18.    15.   2.00   0.01   4.00
ALG/OTHER COEF RCH=  19.    15.   2.00   0.01   4.00
ALG/OTHER COEF RCH=  20.    15.   2.00   0.01   4.00
ALG/OTHER COEF RCH=  21.    15.   2.00   0.01   4.00
ALG/OTHER COEF RCH=  22.    15.   2.00   0.01   4.00
ALG/OTHER COEF RCH=  23.    15.   2.00   0.01   4.00
ALG/OTHER COEF RCH=  24.    15.   2.00   0.01   4.00
ALG/OTHER COEF RCH=  25.    15.   2.00   0.01   4.00
ENDATA6B
INITIAL COND-1 RCH=   1.   60.4
INITIAL COND-1 RCH=   2.   60.4
INITIAL COND-1 RCH=   3.   60.4
INITIAL COND-1 RCH=   4.   60.4
INITIAL COND-1 RCH=   5.   60.4
INITIAL COND-1 RCH=   6.   60.9
INITIAL COND-1 RCH=   7.   61.5
INITIAL COND-1 RCH=   8.   61.5
INITIAL COND-1 RCH=   9.   61.7
INITIAL COND-1 RCH=  10.   61.7
INITIAL COND-1 RCH=  11.   61.7
INITIAL COND-1 RCH=  12.   61.7
INITIAL COND-1 RCH=  13.   61.7
INITIAL COND-1 RCH=  14.   61.7
INITIAL COND-1 RCH=  15.   61.7
INITIAL COND-1 RCH=  16.   61.7
INITIAL COND-1 RCH=  17.   61.6
INITIAL COND-1 RCH=  18.   61.6
INITIAL COND-1 RCH=  19.   60.5
INITIAL COND-1 RCH=  20.   60.5
INITIAL COND-1 RCH=  21.   59.7
INITIAL COND-1 RCH=  22.   59.7
INITIAL COND-1 RCH=  23.   62.1
INITIAL COND-1 RCH=  24.   62.1
INITIAL COND-1 RCH=  25.   62.1
ENDATA7
INITIAL COND-2 RCH=   1.
INITIAL COND-2 RCH=   2.
INITIAL COND-2 RCH=   3.
INITIAL COND-2 RCH=   4.
INITIAL COND-2 RCH=   5.
INITIAL COND-2 RCH=   6.
INITIAL COND-2 RCH=   7.
INITIAL COND-2 RCH=   8.
INITIAL COND-2 RCH=   9.
INITIAL COND-2 RCH=  10.
INITIAL COND-2 RCH=  11.
INITIAL COND-2 RCH=  12.
INITIAL COND-2 RCH=  13.
INITIAL COND-2 RCH=  14.
INITIAL COND-2 RCH=  15.
INITIAL COND-2 RCH=  16.
INITIAL COND-2 RCH=  17.
INITIAL COND-2 RCH=  18.
INITIAL COND-2 RCH=  19.
INITIAL COND-2 RCH=  20.
INITIAL COND-2 RCH=  21.
INITIAL COND-2 RCH=  22.
INITIAL COND-2 RCH=  23.
INITIAL COND-2 RCH=  24.
INITIAL COND-2 RCH=  25.
ENDATA7A
INCR INFLOW-1  RCH=   1.
INCR INFLOW-1  RCH=   2. -2.057
INCR INFLOW-1  RCH=   3. -2.743
INCR INFLOW-1  RCH=   4.  0.627          9.5   2.0  460.
INCR INFLOW-1  RCH=   5.  0.940          9.5   2.0  460.
INCR INFLOW-1  RCH=   6. -0.800
INCR INFLOW-1  RCH=   7. -0.688
INCR INFLOW-1  RCH=   8. -2.582
INCR INFLOW-1  RCH=   9.  0.450          9.5   2.0  460.
INCR INFLOW-1  RCH=  10.  0.450          9.5   2.0  460.
INCR INFLOW-1  RCH=  11.  0.300          9.5   2.0  460.
INCR INFLOW-1  RCH=  12.  0.300          9.5   2.0  460.
INCR INFLOW-1  RCH=  13. -0.557
INCR INFLOW-1  RCH=  14. -0.506
INCR INFLOW-1  RCH=  15. -0.658
INCR INFLOW-1  RCH=  16. -0.658
INCR INFLOW-1  RCH=  17. -0.486
INCR INFLOW-1  RCH=  18. -0.486
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INCR INFLOW-1   RCH=  19. -0.323
INCR INFLOW-1   RCH=  20. -0.377
INCR INFLOW-1   RCH=  21. -0.550
INCR INFLOW-1   RCH=  22. -0.550
INCR INFLOW-1   RCH=  23.  1.886          9.5    2.0  460.
INCR INFLOW-1   RCH=  24.  2.095          9.5    2.0  460.
INCR INFLOW-1   RCH=  25.  0.419          9.5    2.0  460.
ENDATA8
INCR INFLOW-2   RCH=   1.         0.132  0.005  0.000  0.066  0.005  0.052
INCR INFLOW-2   RCH=   2.
INCR INFLOW-2   RCH=   3.
INCR INFLOW-2   RCH=   4.         0.132  0.005  0.000  0.066  0.005  0.052
INCR INFLOW-2   RCH=   5.         0.132  0.005  0.000  0.066  0.005  0.052
INCR INFLOW-2   RCH=   6.
INCR INFLOW-2   RCH=   7.
INCR INFLOW-2   RCH=   8.
INCR INFLOW-2   RCH=   9.         0.132  0.005  0.000  0.066  0.005  0.052
INCR INFLOW-2   RCH=  10.         0.132  0.005  0.000  0.066  0.005  0.052
INCR INFLOW-2   RCH=  11.         0.132  0.005  0.000  0.066  0.005  0.052
INCR INFLOW-2   RCH=  12.         0.132  0.005  0.000  0.066  0.005  0.052
INCR INFLOW-2   RCH=  13.
INCR INFLOW-2   RCH=  14.
INCR INFLOW-2   RCH=  15.
INCR INFLOW-2   RCH=  16.
INCR INFLOW-2   RCH=  17.
INCR INFLOW-2   RCH=  18.
INCR INFLOW-2   RCH=  19.
INCR INFLOW-2   RCH=  20.
INCR INFLOW-2   RCH=  21.
INCR INFLOW-2   RCH=  22.
INCR INFLOW-2   RCH=  23.         0.132  0.005  0.000  0.066  0.005  0.052
INCR INFLOW-2   RCH=  24.         0.132  0.005  0.000  0.066  0.005  0.052
INCR INFLOW-2   RCH=  25.         0.132  0.005  0.000  0.066  0.005  0.052
ENDATA8A
ENDATA9
HEADWTR-1 HDW=   1. RM 38.8            12.8        13.3   2.3  353.
ENDATA10
HEADWTR-2  HDW=   1.        163.   8.3 0.159 0.005 0.000 0.063 0.011 0.005
ENDATA10A
POINTLD-1 PTL=   1. RM 38.8            0.00
POINTLD-1 PTL=   2. RM 38.8            6.30        13.3   2.3  353.
POINTLD-1 PTL=   3. Chewel POTW       0.433         2.4  32.4  998.
POINTLD-1 PTL=   4. Blue Cr            0.67        9.50   1.8  459.
POINTLD-1 PTL=   5. Stensgar Cr        0.00
POINTLD-1 PTL=   6. Stranger Cr        0.10        9.10   2.8  510.
POINTLD-1 PTL=   7. LPendOr R          9.20        9.95   1.8  204.
POINTLD-1 PTL=   8. Haller Cr          0.08        9.80   1.9  404.
POINTLD-1 PTL=   9. Colvil POTW        1.07         3.6  29.7 1125.
POINTLD-1 PTL=  10. Corbett Cr         0.00
POINTLD-1 PTL=  11. Mill Cr            5.25        11.0   1.2  453.
ENDATA11
POINTLD-2  PTL=   1.
POINTLD-2  PTL=   2.        163.   8.3 0.159 0.005 0.000 0.063 0.011 0.005
POINTLD-2  PTL=   3.         29.  115. 0.005  18.2 0.000 0.072 0.005  1.42
POINTLD-2  PTL=   4.        570.       0.129 0.005 0.000 0.065 0.005 0.056
POINTLD-2  PTL=   5.
POINTLD-2  PTL=   6.       3900.       0.179 0.005 0.000 0.085 0.005 0.043
POINTLD-2  PTL=   7.        120.       0.071 0.005 0.000 0.005 0.005 0.005
POINTLD-2  PTL=   8.        580.       0.102 0.005 0.000 0.053 0.005 0.033
POINTLD-2  PTL=   9.         18.  92.4  3.42  1.34 0.000 0.049 0.005  0.77
POINTLD-2  PTL=  10.
POINTLD-2  PTL=  11.        220.       0.040 0.005 0.000 0.467 0.005 0.005
ENDATA11A
DAM DATA       DAM=   1.   25.   1.  1.60  0.80 1.000     0.
ENDATA12
ENDATA13
ENDATA13A
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TITLE01             Confirmation for October 4-6, 1994 survey
TITLE02             File WK40.IN
TITLE03  YES        CONSERVATIVE MINERAL I      CCON      uS
TITLE04   NO        CONSERVATIVE MINERAL II
TITLE05   NO        CONSERVATIVE MINERAL III
TITLE06   NO        TEMPERATURE
TITLE07  YES        BIOCHEMICAL OXYGEN DEMAND
TITLE08  YES        ALGAE AS CHL-A IN UG/L
TITLE09  YES        PHOSPHORUS CYCLE AS P IN MG/L
TITLE10               (ORGANIC-P, DISSOLVED-P)
TITLE11  YES        NITROGEN CYCLE AS N IN MG/L
TITLE12               (ORGANIC-N, AMMONIA-N, NITRITE-N, NITRITE-N)
TITLE13  YES        DISSOLVED OXYGEN IN MG/L
TITLE14  YES        FECAL COLIFORMS IN NO./100 ML
TITLE15   NO        ARBITRARY NON-CONSERVATIVE
ENDTITLE
LIST DATA INPUT
WRITE OPTIONAL SUMMARY
NO FLOW AUGMENTATION
STEADY STATE
DISCHARGE COEFFICIENTS
NO PRINT SOLAR/LCD DATA
NO PLOT DO AND BOD
FIXED DNSTM COND (YES=1)=   0.00000         5D-ULT BOD CONV K COEF  =   0.00000
INPUT METRIC (YES=1)    =   0.00000         OUTPUT METRIC (YES=1)   =   0.00000
NUMBER OF REACHES       =  25.00000         NUMBER OF JUNCTIONS     =   0.00000
NUM OF HEADWATERS       =   1.00000         NUMBER OF POINT LOADS   =  11.00000
TIME STEP (HOURS)       =                   LNTH  COMP  ELEMENT (DX)=   0.20000
MAXIMUM ITERATIONS      =  100.0000         TIME INC. FOR RPT2 (HRS)=
ENDATA1
O UPTAKE BY NH3 OXID(MG O/MG N)= 3.4300  O UPTAKE BY NO2 OXID(MG O/MG N)= 1.1400
O PROD  BY ALGAE (MG O/MG A)   = 1.6000  O UPTAKE BY ALGAE (MG O/MG A)   = 2.0000
N CONTENT OF ALGAE (MG N/MG A) = 0.0800  P CONTENT OF ALGAE (MG P/MG A) = 0.0110
ALG MAX SPEC GROWTH RATE(1/DAY)= 3.0000  ALGAE RESPIRATION RATE (1/DAY) = 0.1200
N HALF SATURATION CONST (MG/L) = 0.0150  P HALF SATURATION CONST  (MG/L)= 0.0030
LIN ALG EXCO (1/FT)/(UGCHLA/L) = 0.0130  NLINCO (1/FT)/(UGCHLA/L)**(2/3)= 0.0000
LIGHT FUNCTION OPTION (LFNOPT) = 1.0000  LIGHT SAT'N COEFF (BTU/FT2/MIN)= 0.0920
DAILY AVERAGING OPTION (LAVOPT)=      2  LIGHT AVERAGING FACTOR (AFACT) = 1.0000
NUMBER OF DAYLIGHT HOURS (DLH) = 11.500  TOTAL DAILY SOLR RAD (BTU/FT2) = 1450.0
ALGY GROWTH CALC OPTION(LGROPT)= 2.0000  ALGAL PREF FOR NH3-N (PREFN)   = 0.9000
ALG/TEMP SOLR RAD FACTOR(TFACT)= 0.4500  NITRIFICATION INHIBITION COEF  = 0.6000
ENDATA1A
THETA     BOD SETT    1.000
THETA     SOD RATE    1.080
THETA     ORGN SET    1.000
THETA     NH3 DECA    1.080
THETA     NH3 SRCE    1.000
THETA     PORG SET    1.000
THETA     DISP SRC    1.000
THETA     ALG SETT    1.000
ENDATA1B
STREAM REACH      1.RCH= Headwater          FROM         40.4      TO             40.2
STREAM REACH      2.RCH= L-bar/Chew Cr      FROM         40.2      TO             39.6
STREAM REACH      3.RCH= To SCCD 11         FROM         39.6      TO             38.8
STREAM REACH      4.RCH= Abv Chew POTW      FROM         38.8      TO             38.4
STREAM REACH      5.RCH= Blw Chew POTW      FROM         38.4      TO             37.8
STREAM REACH      6.RCH= Blw Chew POTW      FROM         37.8      TO             35.8
STREAM REACH      7.RCH= Blw Chew POTW      FROM         35.8      TO             35.0
STREAM REACH      8.RCH= To Blue Cr         FROM         35.0      TO             32.0
STREAM REACH      9.RCH= Blw Blue Cr        FROM         32.0      TO             30.6
STREAM REACH     10.RCH= To Addy            FROM         30.6      TO             29.2
STREAM REACH     11.RCH= Below Addy         FROM         29.2      TO             27.2
STREAM REACH     12.RCH= To SCCD 16         FROM         27.2      TO             25.2
STREAM REACH     13.RCH= Abv LPendOr R      FROM         25.2      TO             23.0
STREAM REACH     14.RCH= To  LPendOr R      FROM         23.0      TO             21.0
STREAM REACH     15.RCH= Blw LPendOr R      FROM         21.0      TO             18.4
STREAM REACH     16.RCH= To SCCD 20         FROM         18.4      TO             15.8
STREAM REACH     17.RCH= Abv Colvil POTW    FROM         15.8      TO             14.8
STREAM REACH     18.RCH= Blw Colvil POTW    FROM         14.8      TO             13.8
STREAM REACH     19.RCH= Blw Colvil POTW    FROM         13.8      TO             12.6
STREAM REACH     20.RCH= To Blw Mill Cr     FROM         12.6      TO             11.2
STREAM REACH     21.RCH= Blw Mill Cr        FROM         11.2      TO             10.2
STREAM REACH     22.RCH= To SCCD 24         FROM         10.2      TO              9.2
STREAM REACH     23.RCH= Abv Backwater      FROM          9.2      TO              7.4
STREAM REACH     24.RCH= Above Falls        FROM          7.4      TO              5.4
STREAM REACH     25.RCH= Below Falls        FROM          5.4      TO              5.0
ENDATA2
ENDATA3
FLAG FIELD RCH=   1.          1            1
FLAG FIELD RCH=   2.          3            6 2 6
FLAG FIELD RCH=   3.          4            2 2 2 2
FLAG FIELD RCH=   4.          2            2 2
FLAG FIELD RCH=   5.          3            6 2 2
FLAG FIELD RCH=   6.         10            2 2 2 2 2 2 2 2 2 2
FLAG FIELD RCH=   7.          4            2 2 2 2
FLAG FIELD RCH=   8.         15            2 2 2 2 2 2 2 2 2 2 2 2 2 6 2
FLAG FIELD RCH=   9.          7            2 2 2 2 2 2 2
FLAG FIELD RCH=  10.          7            2 2 2 2 6 2 2
FLAG FIELD RCH=  11.         10            2 2 2 2 2 2 2 2 2 2
FLAG FIELD RCH=  12.         10            2 2 6 2 2 2 2 2 2 2
FLAG FIELD RCH=  13.         11            2 2 2 2 2 2 2 2 2 2 2
FLAG FIELD RCH=  14.         10            2 2 2 2 2 2 2 2 2 2
FLAG FIELD RCH=  15.         13            6 2 2 2 2 2 6 2 2 2 2 2 2
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FLAG FIELD RCH=  16.        13          2 2 2 2 2 2 2 2 2 2 2 2 2
FLAG FIELD RCH=  17.         5          2 2 2 2 2
FLAG FIELD RCH=  18.         5          6 2 2 2 2
FLAG FIELD RCH=  19.         6          2 2 6 2 2 2
FLAG FIELD RCH=  20.         7          2 2 2 2 2 6 2
FLAG FIELD RCH=  21.         5          2 2 2 2 2
FLAG FIELD RCH=  22.         5          2 2 2 2 2
FLAG FIELD RCH=  23.         9          2 2 2 2 2 2 2 2 2
FLAG FIELD RCH=  24.        10          2 2 2 2 2 2 2 2 2 2
FLAG FIELD RCH=  25.         2          2 5
ENDATA4
HYDRAULICS  RCH=   1.              0.161      0.588     0.353     0.360       0.03
HYDRAULICS  RCH=   2.             0.0605      0.719     0.610     0.271       0.03
HYDRAULICS  RCH=   3.             0.0605      0.719     0.610     0.271       0.03
HYDRAULICS  RCH=   4.     5.93    0.0605      0.719     0.610     0.271       0.03
HYDRAULICS  RCH=   5.     5.93    0.0742      0.747     0.877     0.132       0.03
HYDRAULICS  RCH=   6.     5.93    0.0742      0.747     0.877     0.132       0.03
HYDRAULICS  RCH=   7.     5.93    0.0742      0.747     0.877     0.132       0.03
HYDRAULICS  RCH=   8.     5.93     0.361      0.432     0.207     0.412       0.03
HYDRAULICS  RCH=   9.     5.93     0.361      0.432     0.207     0.412       0.03
HYDRAULICS  RCH=  10.     5.93    0.0620      0.719     0.477     0.301       0.03
HYDRAULICS  RCH=  11.     5.93    0.0620      0.719     0.477     0.301       0.03
HYDRAULICS  RCH=  12.     5.93    0.0456      0.669     0.716     0.290       0.03
HYDRAULICS  RCH=  13.     5.93    0.0456      0.669     0.716     0.290       0.03
HYDRAULICS  RCH=  14.     5.93    0.0560      0.648     0.622     0.270       0.03
HYDRAULICS  RCH=  15.     5.93    0.0560      0.648     0.622     0.270       0.03
HYDRAULICS  RCH=  16.     5.93     0.278      0.322     0.113     0.599       0.03
HYDRAULICS  RCH=  17.     5.93     0.278      0.322     0.113     0.599       0.03
HYDRAULICS  RCH=  18.     5.93     0.159      0.478     0.180     0.502       0.03
HYDRAULICS  RCH=  19.     5.93     0.159      0.478     0.180     0.502       0.03
HYDRAULICS  RCH=  20.     5.93    0.0673      0.584     0.324     0.350       0.03
HYDRAULICS  RCH=  21.     5.93    0.0673      0.584     0.324     0.350       0.03
HYDRAULICS  RCH=  22.     5.93    0.0975      0.563     0.309     0.373       0.03
HYDRAULICS  RCH=  23.     5.93    0.0975      0.563     0.309     0.373       0.03
HYDRAULICS  RCH=  24.     5.93    0.0488      0.563     0.618     0.373       0.03
HYDRAULICS  RCH=  25.     5.93    0.0975      0.563     0.309     0.373       0.03
ENDATA5
ENDATA5A
REACT COEF RCH=   1.                                 1      0.
REACT COEF RCH=   2.                                 1      0.
REACT COEF RCH=   3.                                 1      0.
REACT COEF RCH=   4.   0.065     0.00    0.200   8          0.054
REACT COEF RCH=   5.   0.123     0.00    0.400   8          0.054
REACT COEF RCH=   6.   0.123     0.00    0.600   8          0.054
REACT COEF RCH=   7.   0.123     0.00    1.000   8          0.054
REACT COEF RCH=   8.   0.123     0.00    1.100   8          0.054
REACT COEF RCH=   9.   0.123     0.00    0.500   8          0.054
REACT COEF RCH=  10.   0.123     0.00    0.000   8          0.054
REACT COEF RCH=  11.   0.123     0.00    0.000   8          0.054
REACT COEF RCH=  12.   0.123     0.00    0.000   8          0.054
REACT COEF RCH=  13.   0.123     0.00    0.000   8          0.054
REACT COEF RCH=  14.   0.123     0.00    0.000   8          0.054
REACT COEF RCH=  15.   0.123     0.00    0.000   8          0.054
REACT COEF RCH=  16.   0.123     0.00    0.000   8          0.054
REACT COEF RCH=  17.   0.123     0.00    0.000   8          0.054
REACT COEF RCH=  18.   0.066     0.00    0.000   8          0.054
REACT COEF RCH=  19.   0.066     0.00    0.000   8          0.054
REACT COEF RCH=  20.   0.066     0.00    0.000   8          0.054
REACT COEF RCH=  21.   0.066     0.00    0.000   8          0.054
REACT COEF RCH=  22.   0.066     0.00    0.200   8          0.054
REACT COEF RCH=  23.   0.066     0.00    0.200   8          0.054
REACT COEF RCH=  24.   0.066     0.00    0.400   8          0.054
REACT COEF RCH=  25.   0.066     0.00    0.000   1     10.
ENDATA6
N AND P COEF    RCH=   1.
N AND P COEF    RCH=   2.
N AND P COEF    RCH=   3.
N AND P COEF    RCH=   4.   0.10  0.400   2.00  -4.80   2.00   0.10   0.40 -0.680
N AND P COEF    RCH=   5.   0.10  0.400   2.00  -4.80   2.00   0.10   0.40 -0.680
N AND P COEF    RCH=   6.   0.10  0.400   2.00  -4.80   2.00   0.10   0.40 -0.680
N AND P COEF    RCH=   7.   0.10  0.400   2.00  -4.80   2.00   0.10   0.40 -0.680
N AND P COEF    RCH=   8.   0.10  0.400   2.00  -4.80   2.00   0.10   0.40 -0.680
N AND P COEF    RCH=   9.   0.10  0.400   2.00  -4.80   2.00   0.10   0.40 -0.680
N AND P COEF    RCH=  10.   0.10  0.400   2.00  -4.80   2.00   0.10   0.40 -0.680
N AND P COEF    RCH=  11.   0.10  0.400   2.00  -4.80   2.00   0.10   0.40 -0.680
N AND P COEF    RCH=  12.   0.10  0.400   2.00  -4.80   2.00   0.10   0.40 -0.680
N AND P COEF    RCH=  13.   0.10  0.400   2.00  -0.00   2.00   0.10   0.40 -0.680
N AND P COEF    RCH=  14.   0.10  0.400   2.00  -0.00   2.00   0.10   0.40 -0.680
N AND P COEF    RCH=  15.   0.10  0.400   2.00  -0.00   2.00   0.10   0.40 -0.680
N AND P COEF    RCH=  16.   0.10  0.400   2.00  -0.00   2.00   0.10   0.40 -0.680
N AND P COEF    RCH=  17.   0.10  0.400   2.00  -0.00   2.00   0.10   0.40 -0.680
N AND P COEF    RCH=  18.   0.10  0.400   2.00  -4.80   2.00   0.10   0.40 -0.680
N AND P COEF    RCH=  19.   0.10  0.400   2.00  -4.80   2.00   0.10   0.40 -0.680
N AND P COEF    RCH=  20.   0.10  0.400   2.00  -4.80   2.00   0.10   0.40 -0.680
N AND P COEF    RCH=  21.   0.10  0.400   2.00  -4.80   2.00   0.10   0.40 -0.680
N AND P COEF    RCH=  22.   0.10  0.400   2.00  -4.80   2.00   0.10   0.40 -0.680
N AND P COEF    RCH=  23.   0.10  0.400   2.00  -4.80   2.00   0.10   0.40 -0.680
N AND P COEF    RCH=  24.   0.10  0.400   2.00  -4.80   2.00   0.10   0.40 -0.680
N AND P COEF    RCH=  25.   0.10  0.400   2.00  -4.80   2.00   0.10   0.40 -0.680
ENDATA6A
ALG/OTHER COEF RCH=   1.    15.    1.00   0.01
ALG/OTHER COEF RCH=   2.    15.    1.00   0.01
ALG/OTHER COEF RCH=   3.    15.    1.00   0.01
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ALG/OTHER COEF RCH=   4.    15.   2.00   0.01   4.00
ALG/OTHER COEF RCH=   5.    15.   2.00   0.01   4.00
ALG/OTHER COEF RCH=   6.    15.   2.00   0.01   4.00
ALG/OTHER COEF RCH=   7.    15.   2.00   0.01   4.00
ALG/OTHER COEF RCH=   8.    15.   2.00   0.01   4.00
ALG/OTHER COEF RCH=   9.    15.   2.00   0.01   4.00
ALG/OTHER COEF RCH=  10.    15.   2.00   0.01   4.00
ALG/OTHER COEF RCH=  11.    15.   2.00   0.01   4.00
ALG/OTHER COEF RCH=  12.    15.   2.00   0.01   4.00
ALG/OTHER COEF RCH=  13.    15.   2.00   0.01   4.00
ALG/OTHER COEF RCH=  14.    15.   2.00   0.01   4.00
ALG/OTHER COEF RCH=  15.    15.   2.00   0.01   4.00
ALG/OTHER COEF RCH=  16.    15.   2.00   0.01   4.00
ALG/OTHER COEF RCH=  17.    15.   2.00   0.01   4.00
ALG/OTHER COEF RCH=  18.    15.   2.00   0.01   4.00
ALG/OTHER COEF RCH=  19.    15.   2.00   0.01   4.00
ALG/OTHER COEF RCH=  20.    15.   2.00   0.01   4.00
ALG/OTHER COEF RCH=  21.    15.   2.00   0.01   4.00
ALG/OTHER COEF RCH=  22.    15.   2.00   0.01   4.00
ALG/OTHER COEF RCH=  23.    15.   2.00   0.01   4.00
ALG/OTHER COEF RCH=  24.    15.   2.00   0.01   4.00
ALG/OTHER COEF RCH=  25.    15.   2.00   0.01   4.00
ENDATA6B
INITIAL COND-1 RCH=   1.   48.3
INITIAL COND-1 RCH=   2.   48.3
INITIAL COND-1 RCH=   3.   48.3
INITIAL COND-1 RCH=   4.   48.3
INITIAL COND-1 RCH=   5.   48.3
INITIAL COND-1 RCH=   6.   48.5
INITIAL COND-1 RCH=   7.   48.3
INITIAL COND-1 RCH=   8.   48.3
INITIAL COND-1 RCH=   9.   49.2
INITIAL COND-1 RCH=  10.   49.2
INITIAL COND-1 RCH=  11.   49.2
INITIAL COND-1 RCH=  12.   49.2
INITIAL COND-1 RCH=  13.   49.2
INITIAL COND-1 RCH=  14.   49.2
INITIAL COND-1 RCH=  15.   49.2
INITIAL COND-1 RCH=  16.   49.2
INITIAL COND-1 RCH=  17.   50.2
INITIAL COND-1 RCH=  18.   50.2
INITIAL COND-1 RCH=  19.   49.4
INITIAL COND-1 RCH=  20.   49.4
INITIAL COND-1 RCH=  21.   48.6
INITIAL COND-1 RCH=  22.   48.6
INITIAL COND-1 RCH=  23.   49.9
INITIAL COND-1 RCH=  24.   49.9
INITIAL COND-1 RCH=  25.   49.9
ENDATA7
INITIAL COND-2 RCH=   1.
INITIAL COND-2 RCH=   2.
INITIAL COND-2 RCH=   3.
INITIAL COND-2 RCH=   4.
INITIAL COND-2 RCH=   5.
INITIAL COND-2 RCH=   6.
INITIAL COND-2 RCH=   7.
INITIAL COND-2 RCH=   8.
INITIAL COND-2 RCH=   9.
INITIAL COND-2 RCH=  10.
INITIAL COND-2 RCH=  11.
INITIAL COND-2 RCH=  12.
INITIAL COND-2 RCH=  13.
INITIAL COND-2 RCH=  14.
INITIAL COND-2 RCH=  15.
INITIAL COND-2 RCH=  16.
INITIAL COND-2 RCH=  17.
INITIAL COND-2 RCH=  18.
INITIAL COND-2 RCH=  19.
INITIAL COND-2 RCH=  20.
INITIAL COND-2 RCH=  21.
INITIAL COND-2 RCH=  22.
INITIAL COND-2 RCH=  23.
INITIAL COND-2 RCH=  24.
INITIAL COND-2 RCH=  25.
ENDATA7A
INCR INFLOW-1  RCH=   1.
INCR INFLOW-1  RCH=   2.  0.343         11.1   1.8  495.
INCR INFLOW-1  RCH=   3.  0.457         11.1   1.8  495.
INCR INFLOW-1  RCH=   4.  0.607         11.1   1.8  495.
INCR INFLOW-1  RCH=   5.  0.910         11.1   1.8  495.
INCR INFLOW-1  RCH=   6.  0.907         11.1   1.8  495.
INCR INFLOW-1  RCH=   7.  0.363         11.1   1.8  495.
INCR INFLOW-1  RCH=   8.  1.360         11.1   1.8  495.
INCR INFLOW-1  RCH=   9. -0.965
INCR INFLOW-1  RCH=  10. -0.965
INCR INFLOW-1  RCH=  11.  0.745         11.1   1.8  495.
INCR INFLOW-1  RCH=  12.  0.745         11.1   1.8  495.
INCR INFLOW-1  RCH=  13.  0.506         11.1   1.8  495.
INCR INFLOW-1  RCH=  14.  0.460         11.1   1.8  495.
INCR INFLOW-1  RCH=  15.  0.597         11.1   1.8  495.
INCR INFLOW-1  RCH=  16.  0.597         11.1   1.8  495.
INCR INFLOW-1  RCH=  17. -0.116
INCR INFLOW-1  RCH=  18. -0.116
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INCR INFLOW-1  RCH=  19. -0.170
INCR INFLOW-1  RCH=  20. -0.198
INCR INFLOW-1  RCH=  21. -0.141
INCR INFLOW-1  RCH=  22. -0.141
INCR INFLOW-1  RCH=  23.  2.893         11.1   1.8  495.
INCR INFLOW-1  RCH=  24.  3.214         11.1   1.8  495.
INCR INFLOW-1  RCH=  25.  0.643         11.1   1.8  495.
ENDATA8
INCR INFLOW-2  RCH=   1.
INCR INFLOW-2  RCH=   2.         0.143  0.005  0.000  0.063  0.005  0.048
INCR INFLOW-2  RCH=   3.         0.143  0.005  0.000  0.063  0.005  0.048
INCR INFLOW-2  RCH=   4.         0.143  0.005  0.000  0.063  0.005  0.048
INCR INFLOW-2  RCH=   5.         0.143  0.005  0.000  0.063  0.005  0.048
INCR INFLOW-2  RCH=   6.         0.143  0.005  0.000  0.063  0.005  0.048
INCR INFLOW-2  RCH=   7.         0.143  0.005  0.000  0.063  0.005  0.048
INCR INFLOW-2  RCH=   8.         0.143  0.005  0.000  0.063  0.005  0.048
INCR INFLOW-2  RCH=   9.
INCR INFLOW-2  RCH=  10.
INCR INFLOW-2  RCH=  11.         0.143  0.005  0.000  0.063  0.005  0.048
INCR INFLOW-2  RCH=  12.         0.143  0.005  0.000  0.063  0.005  0.048
INCR INFLOW-2  RCH=  13.         0.143  0.005  0.000  0.063  0.005  0.048
INCR INFLOW-2  RCH=  14.         0.143  0.005  0.000  0.063  0.005  0.048
INCR INFLOW-2  RCH=  15.         0.143  0.005  0.000  0.063  0.005  0.048
INCR INFLOW-2  RCH=  16.         0.143  0.005  0.000  0.063  0.005  0.048
INCR INFLOW-2  RCH=  17.
INCR INFLOW-2  RCH=  18.
INCR INFLOW-2  RCH=  19.
INCR INFLOW-2  RCH=  20.
INCR INFLOW-2  RCH=  21.
INCR INFLOW-2  RCH=  22.
INCR INFLOW-2  RCH=  23.         0.143  0.005  0.000  0.063  0.005  0.048
INCR INFLOW-2  RCH=  24.         0.143  0.005  0.000  0.063  0.005  0.048
INCR INFLOW-2  RCH=  25.         0.143  0.005  0.000  0.063  0.005  0.048
ENDATA8A
ENDATA9
HEADWTR-1 HDW=   1. RM 38.8           19.5        11.3   1.3  351.
ENDATA10
HEADWTR-2  HDW=   1.         33.   1.1 0.078 0.005 0.000 0.236 0.005 0.014
ENDATA10A
POINTLD-1 PTL=   1. RM 38.8           0.00
POINTLD-1 PTL=   2. RM 38.8          10.20        11.3   1.3  351.
POINTLD-1 PTL=   3. Chewel POTW      0.433         3.5  34.1 1015.
POINTLD-1 PTL=   4. Blue Cr           0.47        11.0   1.4  468.
POINTLD-1 PTL=   5. Stensgar Cr       0.38        11.0   2.1  503.
POINTLD-1 PTL=   6. Stranger Cr       0.61        11.1   1.9  535.
POINTLD-1 PTL=   7. LPendOr R         12.9        12.0   1.8  210.
POINTLD-1 PTL=   8. Haller Cr         0.19        11.6   1.7  416.
POINTLD-1 PTL=   9. Colvil POTW      1.331         1.8  17.7 1190.
POINTLD-1 PTL=  10. Corbett Cr        0.00
POINTLD-1 PTL=  11. Mill Cr          10.25        11.9   0.7  437.
ENDATA11
POINTLD-2  PTL=   1.
POINTLD-2  PTL=   2.         33.   1.1 0.078 0.005 0.000 0.236 0.005 0.014
POINTLD-2  PTL=   3.       3275.  156.  11.4  11.7 0.000 0.100 0.665  3.34
POINTLD-2  PTL=   4.        260.       0.164 0.005 0.000 0.005 0.005 0.043
POINTLD-2  PTL=   5.       2150.       0.163 0.005 0.000 0.247 0.005 0.084
POINTLD-2  PTL=   6.       1500.       0.126 0.005 0.000 0.012 0.005 0.034
POINTLD-2  PTL=   7.        170.       0.078 0.005 0.000 0.005 0.005 0.005
POINTLD-2  PTL=   8.        140.       0.109 0.005 0.000 0.005 0.005 0.036
POINTLD-2  PTL=   9.         41.  12.5  3.83  9.18 0.000 0.050 0.155  2.97
POINTLD-2  PTL=  10.
POINTLD-2  PTL=  11.         49.       0.035 0.005 0.000 0.409 0.005 0.005
ENDATA11A
DAM DATA       DAM=   1.   25.    1.  1.60  0.80 1.000    0.
ENDATA12
ENDATA13
ENDATA13A
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TITLE01             Confirmation for November 15-17, 1994 survey
TITLE02             File WK46.IN
TITLE03  YES        CONSERVATIVE MINERAL I     CCON      uS
TITLE04   NO        CONSERVATIVE MINERAL II
TITLE05   NO        CONSERVATIVE MINERAL III
TITLE06   NO        TEMPERATURE
TITLE07  YES        BIOCHEMICAL OXYGEN DEMAND
TITLE08  YES        ALGAE AS CHL-A IN UG/L
TITLE09  YES        PHOSPHORUS CYCLE AS P IN MG/L
TITLE10               (ORGANIC-P, DISSOLVED-P)
TITLE11  YES        NITROGEN CYCLE AS N IN MG/L
TITLE12               (ORGANIC-N, AMMONIA-N, NITRITE-N, NITRITE-N)
TITLE13  YES        DISSOLVED OXYGEN IN MG/L
TITLE14  YES        FECAL COLIFORMS IN NO./100 ML
TITLE15   NO        ARBITRARY NON-CONSERVATIVE
ENDTITLE
LIST DATA INPUT
WRITE OPTIONAL SUMMARY
NO FLOW AUGMENTATION
STEADY STATE
DISCHARGE COEFFICIENTS
NO PRINT SOLAR/LCD DATA
NO PLOT DO AND BOD
FIXED DNSTM COND (YES=1)=    0.00000        5D-ULT BOD CONV K COEF  =    0.00000
INPUT METRIC (YES=1)     =   0.00000        OUTPUT METRIC (YES=1)   =    0.00000
NUMBER OF REACHES        =  25.00000        NUMBER OF JUNCTIONS     =    0.00000
NUM OF HEADWATERS        =   1.00000        NUMBER OF POINT LOADS   =   11.00000
TIME STEP (HOURS)        =                  LNTH  COMP  ELEMENT (DX)=    0.20000
MAXIMUM ITERATIONS       =  100.0000        TIME INC. FOR RPT2 (HRS)=
ENDATA1
O UPTAKE BY NH3 OXID(MG O/MG N)= 3.4300  O UPTAKE BY NO2 OXID(MG O/MG N)= 1.1400
O PROD  BY ALGAE (MG O/MG A)   = 1.6000  O UPTAKE BY ALGAE (MG O/MG A)   = 2.0000
N CONTENT OF ALGAE (MG N/MG A) = 0.0800  P CONTENT OF ALGAE (MG P/MG A) = 0.0110
ALG MAX SPEC GROWTH RATE(1/DAY)= 3.0000  ALGAE RESPIRATION RATE (1/DAY) = 0.1200
N HALF SATURATION CONST (MG/L) = 0.0150  P HALF SATURATION CONST  (MG/L)= 0.0030
LIN ALG EXCO (1/FT)/(UGCHLA/L) = 0.0130  NLINCO (1/FT)/(UGCHLA/L)**(2/3)= 0.0000
LIGHT FUNCTION OPTION (LFNOPT) = 1.0000  LIGHT SAT'N COEFF (BTU/FT2/MIN)= 0.0920
DAILY AVERAGING OPTION (LAVOPT)=      2  LIGHT AVERAGING FACTOR (AFACT) = 1.0000
NUMBER OF DAYLIGHT HOURS (DLH) =  9.300  TOTAL DAILY SOLR RAD (BTU/FT2) =  800.0
ALGY GROWTH CALC OPTION(LGROPT)= 2.0000  ALGAL PREF FOR NH3-N (PREFN)   = 0.9000
ALG/TEMP SOLR RAD FACTOR(TFACT)= 0.4500  NITRIFICATION INHIBITION COEF  = 0.6000
ENDATA1A
THETA     BOD SETT    1.000
THETA     SOD RATE    1.080
THETA     ORGN SET    1.000
THETA     NH3 DECA    1.080
THETA     NH3 SRCE    1.000
THETA     PORG SET    1.000
THETA     DISP SRC    1.000
THETA     ALG SETT    1.000
ENDATA1B
STREAM REACH       1.RCH= Headwater          FROM          40.4      TO            40.2
STREAM REACH       2.RCH= L-bar/Chew Cr      FROM          40.2      TO            39.6
STREAM REACH       3.RCH= To SCCD 11         FROM          39.6      TO            38.8
STREAM REACH       4.RCH= Abv Chew POTW      FROM          38.8      TO            38.4
STREAM REACH       5.RCH= Blw Chew POTW      FROM          38.4      TO            37.8
STREAM REACH       6.RCH= Blw Chew POTW      FROM          37.8      TO            35.8
STREAM REACH       7.RCH= Blw Chew POTW      FROM          35.8      TO            35.0
STREAM REACH       8.RCH= To Blue Cr         FROM          35.0      TO            32.0
STREAM REACH       9.RCH= Blw Blue Cr        FROM          32.0      TO            30.6
STREAM REACH      10.RCH= To Addy            FROM          30.6      TO            29.2
STREAM REACH      11.RCH= Below Addy         FROM          29.2      TO            27.2
STREAM REACH      12.RCH= To SCCD 16         FROM          27.2      TO            25.2
STREAM REACH      13.RCH= Abv LPendOr R      FROM          25.2      TO            23.0
STREAM REACH      14.RCH= To  LPendOr R      FROM          23.0      TO            21.0
STREAM REACH      15.RCH= Blw LPendOr R      FROM          21.0      TO            18.4
STREAM REACH      16.RCH= To SCCD 20         FROM          18.4      TO            15.8
STREAM REACH      17.RCH= Abv Colvil POTW    FROM          15.8      TO            14.8
STREAM REACH      18.RCH= Blw Colvil POTW    FROM          14.8      TO            13.8
STREAM REACH      19.RCH= Blw Colvil POTW    FROM          13.8      TO            12.6
STREAM REACH      20.RCH= To Blw Mill Cr     FROM          12.6      TO            11.2
STREAM REACH      21.RCH= Blw Mill Cr        FROM          11.2      TO            10.2
STREAM REACH      22.RCH= To SCCD 24         FROM          10.2      TO             9.2
STREAM REACH      23.RCH= Abv Backwater      FROM           9.2      TO             7.4
STREAM REACH      24.RCH= Above Falls        FROM           7.4      TO             5.4
STREAM REACH      25.RCH= Below Falls        FROM           5.4      TO             5.0
ENDATA2
ENDATA3
FLAG FIELD RCH=   1.          1            1
FLAG FIELD RCH=   2.          3            6 2 6
FLAG FIELD RCH=   3.          4            2 2 2 2
FLAG FIELD RCH=   4.          2            2 2
FLAG FIELD RCH=   5.          3            6 2 2
FLAG FIELD RCH=   6.         10            2 2 2 2 2 2 2 2 2 2
FLAG FIELD RCH=   7.          4            2 2 2 2
FLAG FIELD RCH=   8.         15            2 2 2 2 2 2 2 2 2 2 2 2 2 6 2
FLAG FIELD RCH=   9.          7            2 2 2 2 2 2 2
FLAG FIELD RCH=  10.          7            2 2 2 2 6 2 2
FLAG FIELD RCH=  11.         10            2 2 2 2 2 2 2 2 2 2
FLAG FIELD RCH=  12.         10            2 2 6 2 2 2 2 2 2 2
FLAG FIELD RCH=  13.         11            2 2 2 2 2 2 2 2 2 2 2
FLAG FIELD RCH=  14.         10            2 2 2 2 2 2 2 2 2 2
FLAG FIELD RCH=  15.         13            6 2 2 2 2 2 6 2 2 2 2 2 2
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FLAG FIELD RCH=  16.        13          2 2 2 2 2 2 2 2 2 2 2 2 2
FLAG FIELD RCH=  17.         5          2 2 2 2 2
FLAG FIELD RCH=  18.         5          6 2 2 2 2
FLAG FIELD RCH=  19.         6          2 2 6 2 2 2
FLAG FIELD RCH=  20.         7          2 2 2 2 2 6 2
FLAG FIELD RCH=  21.         5          2 2 2 2 2
FLAG FIELD RCH=  22.         5          2 2 2 2 2
FLAG FIELD RCH=  23.         9          2 2 2 2 2 2 2 2 2
FLAG FIELD RCH=  24.        10          2 2 2 2 2 2 2 2 2 2
FLAG FIELD RCH=  25.         2          2 5
ENDATA4
HYDRAULICS RCH=   1.              0.161     0.588     0.353     0.360      0.03
HYDRAULICS RCH=   2.             0.0605     0.719     0.610     0.271      0.03
HYDRAULICS RCH=   3.             0.0605     0.719     0.610     0.271      0.03
HYDRAULICS RCH=   4.      5.93   0.0605     0.719     0.610     0.271      0.03
HYDRAULICS RCH=   5.      5.93   0.0742     0.747     0.877     0.132      0.03
HYDRAULICS RCH=   6.      5.93   0.0742     0.747     0.877     0.132      0.03
HYDRAULICS RCH=   7.      5.93   0.0742     0.747     0.877     0.132      0.03
HYDRAULICS RCH=   8.      5.93    0.361     0.432     0.207     0.412      0.03
HYDRAULICS RCH=   9.      5.93    0.361     0.432     0.207     0.412      0.03
HYDRAULICS RCH=  10.      5.93   0.0620     0.719     0.477     0.301      0.03
HYDRAULICS RCH=  11.      5.93   0.0620     0.719     0.477     0.301      0.03
HYDRAULICS RCH=  12.      5.93   0.0456     0.669     0.716     0.290      0.03
HYDRAULICS RCH=  13.      5.93   0.0456     0.669     0.716     0.290      0.03
HYDRAULICS RCH=  14.      5.93   0.0560     0.648     0.622     0.270      0.03
HYDRAULICS RCH=  15.      5.93   0.0560     0.648     0.622     0.270      0.03
HYDRAULICS RCH=  16.      5.93    0.278     0.322     0.113     0.599      0.03
HYDRAULICS RCH=  17.      5.93    0.278     0.322     0.113     0.599      0.03
HYDRAULICS RCH=  18.      5.93    0.159     0.478     0.180     0.502      0.03
HYDRAULICS RCH=  19.      5.93    0.159     0.478     0.180     0.502      0.03
HYDRAULICS RCH=  20.      5.93   0.0673     0.584     0.324     0.350      0.03
HYDRAULICS RCH=  21.      5.93   0.0673     0.584     0.324     0.350      0.03
HYDRAULICS RCH=  22.      5.93   0.0975     0.563     0.309     0.373      0.03
HYDRAULICS RCH=  23.      5.93   0.0975     0.563     0.309     0.373      0.03
HYDRAULICS RCH=  24.      5.93   0.0488     0.563     0.618     0.373      0.03
HYDRAULICS RCH=  25.      5.93   0.0975     0.563     0.309     0.373      0.03
ENDATA5
ENDATA5A
REACT COEF RCH=   1.                            1      0.
REACT COEF RCH=   2.                            1      0.
REACT COEF RCH=   3.                            1      0.
REACT COEF RCH=   4.   0.065    0.00    0.300   8           0.054
REACT COEF RCH=   5.   0.123    0.00    0.600   8           0.054
REACT COEF RCH=   6.   0.123    0.00    0.900   8           0.054
REACT COEF RCH=   7.   0.123    0.00    1.500   8           0.054
REACT COEF RCH=   8.   0.123    0.00    1.600   8           0.054
REACT COEF RCH=   9.   0.123    0.00    0.700   8           0.054
REACT COEF RCH=  10.   0.123    0.00    0.000   8           0.054
REACT COEF RCH=  11.   0.123    0.00    0.000   8           0.054
REACT COEF RCH=  12.   0.123    0.00    0.000   8           0.054
REACT COEF RCH=  13.   0.123    0.00    0.000   8           0.054
REACT COEF RCH=  14.   0.123    0.00    0.000   8           0.054
REACT COEF RCH=  15.   0.123    0.00    0.000   8           0.054
REACT COEF RCH=  16.   0.123    0.00    0.000   8           0.054
REACT COEF RCH=  17.   0.123    0.00    0.000   8           0.054
REACT COEF RCH=  18.   0.066    0.00    0.000   8           0.054
REACT COEF RCH=  19.   0.066    0.00    0.000   8           0.054
REACT COEF RCH=  20.   0.066    0.00    0.000   8           0.054
REACT COEF RCH=  21.   0.066    0.00    0.000   8           0.054
REACT COEF RCH=  22.   0.066    0.00    0.300   8           0.054
REACT COEF RCH=  23.   0.066    0.00    0.300   8           0.054
REACT COEF RCH=  24.   0.066    0.00    0.600   8           0.054
REACT COEF RCH=  25.   0.066    0.00    0.000   1     10.
ENDATA6
N AND P COEF    RCH=   1.
N AND P COEF    RCH=   2.
N AND P COEF    RCH=   3.
N AND P COEF    RCH=   4.   0.10  0.400   2.00  -2.00   2.00   0.10   0.40 -0.280
N AND P COEF    RCH=   5.   0.10  0.400   2.00  -2.00   2.00   0.10   0.40 -0.280
N AND P COEF    RCH=   6.   0.10  0.400   2.00  -2.00   2.00   0.10   0.40 -0.280
N AND P COEF    RCH=   7.   0.10  0.400   2.00  -2.00   2.00   0.10   0.40 -0.280
N AND P COEF    RCH=   8.   0.10  0.400   2.00  -2.00   2.00   0.10   0.40 -0.280
N AND P COEF    RCH=   9.   0.10  0.400   2.00  -2.00   2.00   0.10   0.40 -0.280
N AND P COEF    RCH=  10.   0.10  0.400   2.00  -2.00   2.00   0.10   0.40 -0.280
N AND P COEF    RCH=  11.   0.10  0.400   2.00  -2.00   2.00   0.10   0.40 -0.280
N AND P COEF    RCH=  12.   0.10  0.400   2.00  -2.00   2.00   0.10   0.40 -0.280
N AND P COEF    RCH=  13.   0.10  0.400   2.00  -2.00   2.00   0.10   0.40 -0.280
N AND P COEF    RCH=  14.   0.10  0.400   2.00  -2.00   2.00   0.10   0.40 -0.280
N AND P COEF    RCH=  15.   0.10  0.400   2.00  -2.00   2.00   0.10   0.40 -0.280
N AND P COEF    RCH=  16.   0.10  0.400   2.00  -2.00   2.00   0.10   0.40 -0.280
N AND P COEF    RCH=  17.   0.10  0.400   2.00  -2.00   2.00   0.10   0.40 -0.280
N AND P COEF    RCH=  18.   0.10  0.400   2.00  -2.00   2.00   0.10   0.40 -0.280
N AND P COEF    RCH=  19.   0.10  0.400   2.00  -2.00   2.00   0.10   0.40 -0.280
N AND P COEF    RCH=  20.   0.10  0.400   2.00  -2.00   2.00   0.10   0.40 -0.280
N AND P COEF    RCH=  21.   0.10  0.400   2.00  -2.00   2.00   0.10   0.40 -0.280
N AND P COEF    RCH=  22.   0.10  0.400   2.00  -2.00   2.00   0.10   0.40 -0.280
N AND P COEF    RCH=  23.   0.10  0.400   2.00  -2.00   2.00   0.10   0.40 -0.280
N AND P COEF    RCH=  24.   0.10  0.400   2.00  -2.00   2.00   0.10   0.40 -0.280
N AND P COEF    RCH=  25.   0.10  0.400   2.00  -2.00   2.00   0.10   0.40 -0.280
ENDATA6A
ALG/OTHER COEF RCH=   1.     15.    1.00    0.01
ALG/OTHER COEF RCH=   2.     15.    1.00    0.01
ALG/OTHER COEF RCH=   3.     15.    1.00    0.01
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ALG/OTHER COEF RCH=   4.     15.    2.00    0.01    4.00
ALG/OTHER COEF RCH=   5.     15.    2.00    0.01    4.00
ALG/OTHER COEF RCH=   6.     15.    2.00    0.01    4.00
ALG/OTHER COEF RCH=   7.     15.    2.00    0.01    4.00
ALG/OTHER COEF RCH=   8.     15.    2.00    0.01    4.00
ALG/OTHER COEF RCH=   9.     15.    2.00    0.01    4.00
ALG/OTHER COEF RCH=  10.     15.    2.00    0.01    4.00
ALG/OTHER COEF RCH=  11.     15.    2.00    0.01    4.00
ALG/OTHER COEF RCH=  12.     15.    2.00    0.01    4.00
ALG/OTHER COEF RCH=  13.     15.    2.00    0.01    4.00
ALG/OTHER COEF RCH=  14.     15.    2.00    0.01    4.00
ALG/OTHER COEF RCH=  15.     15.    2.00    0.01    4.00
ALG/OTHER COEF RCH=  16.     15.    2.00    0.01    4.00
ALG/OTHER COEF RCH=  17.     15.    2.00    0.01    4.00
ALG/OTHER COEF RCH=  18.     15.    2.00    0.01    4.00
ALG/OTHER COEF RCH=  19.     15.    2.00    0.01    4.00
ALG/OTHER COEF RCH=  20.     15.    2.00    0.01    4.00
ALG/OTHER COEF RCH=  21.     15.    2.00    0.01    4.00
ALG/OTHER COEF RCH=  22.     15.    2.00    0.01    4.00
ALG/OTHER COEF RCH=  23.     15.    2.00    0.01    4.00
ALG/OTHER COEF RCH=  24.     15.    2.00    0.01    4.00
ALG/OTHER COEF RCH=  25.     15.    2.00    0.01    4.00
ENDATA6B
INITIAL COND-1 RCH=   1.    38.4
INITIAL COND-1 RCH=   2.    38.4
INITIAL COND-1 RCH=   3.    38.4
INITIAL COND-1 RCH=   4.    38.5
INITIAL COND-1 RCH=   5.    38.5
INITIAL COND-1 RCH=   6.    38.5
INITIAL COND-1 RCH=   7.    38.4
INITIAL COND-1 RCH=   8.    38.4
INITIAL COND-1 RCH=   9.    38.2
INITIAL COND-1 RCH=  10.    38.2
INITIAL COND-1 RCH=  11.    38.2
INITIAL COND-1 RCH=  12.    38.2
INITIAL COND-1 RCH=  13.    38.2
INITIAL COND-1 RCH=  14.    38.2
INITIAL COND-1 RCH=  15.    38.2
INITIAL COND-1 RCH=  16.    38.2
INITIAL COND-1 RCH=  17.    38.1
INITIAL COND-1 RCH=  18.    38.1
INITIAL COND-1 RCH=  19.    38.1
INITIAL COND-1 RCH=  20.    38.1
INITIAL COND-1 RCH=  21.    38.1
INITIAL COND-1 RCH=  22.    38.1
INITIAL COND-1 RCH=  23.    38.1
INITIAL COND-1 RCH=  24.    38.1
INITIAL COND-1 RCH=  25.    38.1
ENDATA7
INITIAL COND-2 RCH=   1.
INITIAL COND-2 RCH=   2.
INITIAL COND-2 RCH=   3.
INITIAL COND-2 RCH=   4.
INITIAL COND-2 RCH=   5.
INITIAL COND-2 RCH=   6.
INITIAL COND-2 RCH=   7.
INITIAL COND-2 RCH=   8.
INITIAL COND-2 RCH=   9.
INITIAL COND-2 RCH=  10.
INITIAL COND-2 RCH=  11.
INITIAL COND-2 RCH=  12.
INITIAL COND-2 RCH=  13.
INITIAL COND-2 RCH=  14.
INITIAL COND-2 RCH=  15.
INITIAL COND-2 RCH=  16.
INITIAL COND-2 RCH=  17.
INITIAL COND-2 RCH=  18.
INITIAL COND-2 RCH=  19.
INITIAL COND-2 RCH=  20.
INITIAL COND-2 RCH=  21.
INITIAL COND-2 RCH=  22.
INITIAL COND-2 RCH=  23.
INITIAL COND-2 RCH=  24.
INITIAL COND-2 RCH=  25.
ENDATA7A
INCR INFLOW-1  RCH=   1.
INCR INFLOW-1  RCH=   2.  0.103         12.5   2.5  454.
INCR INFLOW-1  RCH=   3.  0.138         12.5   2.5  454.
INCR INFLOW-1  RCH=   4.  1.460         12.5   2.5  454.
INCR INFLOW-1  RCH=   5.  2.190         12.5   2.5  454.
INCR INFLOW-1  RCH=   6.  0.221         12.5   2.5  454.
INCR INFLOW-1  RCH=   7.  0.088         12.5   2.5  454.
INCR INFLOW-1  RCH=   8.  0.331         12.5   2.5  454.
INCR INFLOW-1  RCH=   9.  2.300         12.5   2.5  454.
INCR INFLOW-1  RCH=  10.  2.300         12.5   2.5  454.
INCR INFLOW-1  RCH=  11. -1.597
INCR INFLOW-1  RCH=  12. -1.597
INCR INFLOW-1  RCH=  13. -1.757
INCR INFLOW-1  RCH=  14. -1.597
INCR INFLOW-1  RCH=  15. -2.076
INCR INFLOW-1  RCH=  16. -2.076
INCR INFLOW-1  RCH=  17.  1.894         12.5   2.5  454.
INCR INFLOW-1  RCH=  18.  1.894         12.5   2.5  454.
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INCR INFLOW-1  RCH=  19. -1.223
INCR INFLOW-1  RCH=  20. -1.427
INCR INFLOW-1  RCH=  21. -1.020
INCR INFLOW-1  RCH=  22. -1.020
INCR INFLOW-1  RCH=  23.  5.143          12.5   2.5  454.
INCR INFLOW-1  RCH=  24.  5.714          12.5   2.5  454.
INCR INFLOW-1  RCH=  25.  1.143          12.5   2.5  454.
ENDATA8
INCR INFLOW-2  RCH=   1.
INCR INFLOW-2  RCH=   2.           0.181  0.009  0.000  0.129  0.006  0.027
INCR INFLOW-2  RCH=   3.           0.181  0.009  0.000  0.129  0.006  0.027
INCR INFLOW-2  RCH=   4.           0.181  0.009  0.000  0.129  0.006  0.027
INCR INFLOW-2  RCH=   5.           0.181  0.009  0.000  0.129  0.006  0.027
INCR INFLOW-2  RCH=   6.           0.181  0.009  0.000  0.129  0.006  0.027
INCR INFLOW-2  RCH=   7.           0.181  0.009  0.000  0.129  0.006  0.027
INCR INFLOW-2  RCH=   8.           0.181  0.009  0.000  0.129  0.006  0.027
INCR INFLOW-2  RCH=   9.           0.181  0.009  0.000  0.129  0.006  0.027
INCR INFLOW-2  RCH=  10.           0.181  0.009  0.000  0.129  0.006  0.027
INCR INFLOW-2  RCH=  11.
INCR INFLOW-2  RCH=  12.
INCR INFLOW-2  RCH=  13.
INCR INFLOW-2  RCH=  14.
INCR INFLOW-2  RCH=  15.
INCR INFLOW-2  RCH=  16.
INCR INFLOW-2  RCH=  17.           0.181  0.009  0.000  0.129  0.006  0.027
INCR INFLOW-2  RCH=  18.           0.181  0.009  0.000  0.129  0.006  0.027
INCR INFLOW-2  RCH=  19.
INCR INFLOW-2  RCH=  20.
INCR INFLOW-2  RCH=  21.
INCR INFLOW-2  RCH=  22.
INCR INFLOW-2  RCH=  23.           0.181  0.009  0.000  0.129  0.006  0.027
INCR INFLOW-2  RCH=  24.           0.181  0.009  0.000  0.129  0.006  0.027
INCR INFLOW-2  RCH=  25.           0.181  0.009  0.000  0.129  0.006  0.027
ENDATA8A
ENDATA9
HEADWTR-1 HDW=   1. RM 38.8           34.6         11.8   1.8  379.
ENDATA10
HEADWTR-2  HDW=   1.         58.   1.9 0.158 0.027 0.000 0.433 0.010 0.024
ENDATA10A
POINTLD-1 PTL=   1. RM 38.8          0.0594        11.8   1.8  379.
POINTLD-1 PTL=   2. RM 38.8            13.3        11.8   1.8  379.
POINTLD-1 PTL=   3. Chewel POTW       0.551         4.6  32.4 1015.
POINTLD-1 PTL=   4. Blue Cr            0.56        12.1   2.3  481.
POINTLD-1 PTL=   5. Stensgar Cr         2.8        12.8   2.3  432.
POINTLD-1 PTL=   6. Stranger Cr         2.9        12.0   2.7  517.
POINTLD-1 PTL=   7. LPendOr R          18.9        13.3   2.0  197.
POINTLD-1 PTL=   8. Haller Cr           1.8        13.0   2.5  378.
POINTLD-1 PTL=   9. Colvil POTW       1.012        11.0  47.8 1190.
POINTLD-1 PTL=  10. Corbett Cr         0.29        13.3   2.4  236.
POINTLD-1 PTL=  11. Mill Cr            15.5        12.5   0.5  436.
ENDATA11
POINTLD-2  PTL=   1.         58    1.9 0.158 0.027 0.000 0.433 0.010 0.024
POINTLD-2  PTL=   2.         58.   1.9 0.158 0.027 0.000 0.433 0.010 0.024
POINTLD-2  PTL=   3.       1110.  21.9  7.05  14.0 0.000 0.044 0.005  2.94
POINTLD-2  PTL=   4.        430.       0.295 0.066 0.000 0.269 0.005 0.052
POINTLD-2  PTL=   5.         30.       0.164 0.005 0.000 0.071 0.008 0.026
POINTLD-2  PTL=   6.         42.       0.166 0.005 0.000 0.236 0.005 0.025
POINTLD-2  PTL=   7.         74.       0.107 0.005 0.000 0.046 0.005 0.005
POINTLD-2  PTL=   8.         31.       0.197 0.005 0.000 0.005 0.005 0.023
POINTLD-2  PTL=   9.        173.  570.  7.36  9.64 0.000 0.281 0.335  2.00
POINTLD-2  PTL=  10.          1.       0.157 0.005 0.000 0.109 0.005 0.018
POINTLD-2  PTL=  11.         84.       0.027 0.005 0.000 0.475 0.005 0.005
ENDATA11A
DAM DATA       DAM=   1.    25.    1.  1.60  0.80 1.000     0.
ENDATA12
ENDATA13
ENDATA13A
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Appendix D.

QUAL2E Input Files for Critical Conditions
for WLA Modeling
(loads for POTWs were estimated by trial for various alternative combinations of BOD and ammonia loading as described in the report.)

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TITLE01              June-October critical conditions
TITLE02              zero NPDES discharge
TITLE03   NO         CONSERVATIVE MINERAL I      CCON       uS
TITLE04   NO         CONSERVATIVE MINERAL II
TITLE05   NO         CONSERVATIVE MINERAL III
TITLE06   NO         TEMPERATURE
TITLE07  YES         BIOCHEMICAL OXYGEN DEMAND
TITLE08  YES         ALGAE AS CHL-A IN UG/L
TITLE09  YES         PHOSPHORUS CYCLE AS P IN MG/L
TITLE10                (ORGANIC-P, DISSOLVED-P)
TITLE11  YES         NITROGEN CYCLE AS N IN MG/L
TITLE12                (ORGANIC-N, AMMONIA-N, NITRITE-N, NITRITE-N)
TITLE13  YES         DISSOLVED OXYGEN IN MG/L
TITLE14   NO         FECAL COLIFORMS IN NO./100 ML
TITLE15   NO         ARBITRARY NON-CONSERVATIVE
ENDTITLE
LIST DATA INPUT
WRITE OPTIONAL SUMMARY
NO FLOW AUGMENTATION
STEADY STATE
DISCHARGE COEFFICIENTS
NO PRINT SOLAR/LCD DATA
NO PLOT DO AND BOD
FIXED DNSTM COND (YES=1)=    0.00000        5D-ULT BOD CONV K COEF   =   0.00000
INPUT METRIC (YES=1)     =   0.00000        OUTPUT METRIC (YES=1)    =   0.00000
NUMBER OF REACHES        =  25.00000        NUMBER OF JUNCTIONS      =   0.00000
NUM OF HEADWATERS        =   1.00000        NUMBER OF POINT LOADS    =  11.00000
TIME STEP (HOURS)        =                  LNTH  COMP  ELEMENT (DX)=    0.20000
MAXIMUM ITERATIONS       =  100.0000        TIME INC. FOR RPT2 (HRS)=
ENDATA1
O UPTAKE BY NH3 OXID(MG O/MG N)= 3.4300  O UPTAKE BY NO2 OXID(MG O/MG N)= 1.1400
O PROD  BY ALGAE (MG O/MG A)    = 1.6000  O UPTAKE BY ALGAE (MG O/MG A)   = 2.0000
N CONTENT OF ALGAE (MG N/MG A) = 0.0800  P CONTENT OF ALGAE (MG P/MG A) = 0.0110
ALG MAX SPEC GROWTH RATE(1/DAY)= 3.0000  ALGAE RESPIRATION RATE (1/DAY) = 0.1200
N HALF SATURATION CONST (MG/L) = 0.0150  P HALF SATURATION CONST  (MG/L)= 0.0030
LIN ALG EXCO (1/FT)/(UGCHLA/L) = 0.0130  NLINCO (1/FT)/(UGCHLA/L)**(2/3)= 0.0000
LIGHT FUNCTION OPTION (LFNOPT) = 1.0000  LIGHT SAT'N COEFF (BTU/FT2/MIN)= 0.0920
DAILY AVERAGING OPTION (LAVOPT)=      2  LIGHT AVERAGING FACTOR (AFACT) = 1.0000
NUMBER OF DAYLIGHT HOURS (DLH) = 16.000  TOTAL DAILY SOLR RAD (BTU/FT2) = 2700.0
ALGY GROWTH CALC OPTION(LGROPT)= 2.0000  ALGAL PREF FOR NH3-N (PREFN)    = 0.9000
ALG/TEMP SOLR RAD FACTOR(TFACT)= 0.4500  NITRIFICATION INHIBITION COEF  = 0.6000
ENDATA1A
THETA     BOD SETT    1.000
THETA     SOD RATE    1.080
THETA     ORGN SET    1.000
THETA     NH3 DECA    1.080
THETA     NH3 SRCE    1.000
THETA     PORG SET    1.000
THETA     DISP SRC    1.000
THETA     ALG SETT    1.000
ENDATA1B
STREAM REACH      1.RCH= Headwater         FROM          40.4      TO           40.2
STREAM REACH      2.RCH= L-bar/Chew Cr     FROM          40.2      TO           39.6
STREAM REACH      3.RCH= To SCCD 11        FROM          39.6      TO           38.8
STREAM REACH      4.RCH= Abv Chew POTW     FROM          38.8      TO           38.4
STREAM REACH      5.RCH= Blw Chew POTW     FROM          38.4      TO           37.8
STREAM REACH      6.RCH= Blw Chew POTW     FROM          37.8      TO           35.8
STREAM REACH      7.RCH= Blw Chew POTW     FROM          35.8      TO           35.0
STREAM REACH      8.RCH= To Blue Cr        FROM          35.0      TO           32.0
STREAM REACH      9.RCH= Blw Blue Cr       FROM          32.0      TO           30.6
STREAM REACH     10.RCH= To Addy           FROM          30.6      TO           29.2
STREAM REACH     11.RCH= Below Addy        FROM          29.2      TO           27.2
STREAM REACH     12.RCH= To SCCD 16        FROM          27.2      TO           25.2
STREAM REACH     13.RCH= Abv LPendOr R     FROM          25.2      TO           23.0
STREAM REACH     14.RCH= To  LPendOr R     FROM          23.0      TO           21.0
STREAM REACH     15.RCH= Blw LPendOr R     FROM          21.0      TO           18.4
STREAM REACH     16.RCH= To SCCD 20        FROM          18.4      TO           15.8
STREAM REACH     17.RCH= Abv Colvil POTW   FROM          15.8      TO           14.8
STREAM REACH     18.RCH= Blw Colvil POTW   FROM          14.8      TO           13.8
STREAM REACH     19.RCH= Blw Colvil POTW   FROM          13.8      TO           12.6
STREAM REACH     20.RCH= To Blw Mill Cr    FROM          12.6      TO           11.2
STREAM REACH     21.RCH= Blw Mill Cr       FROM          11.2      TO           10.2
STREAM REACH     22.RCH= To SCCD 24        FROM          10.2      TO            9.2
STREAM REACH     23.RCH= Abv Backwater     FROM           9.2      TO            7.4
STREAM REACH     24.RCH= Above Falls       FROM           7.4      TO            5.4
STREAM REACH     25.RCH= Below Falls       FROM           5.4      TO            5.0
ENDATA2
ENDATA3
FLAG FIELD RCH=   1.          1            1
FLAG FIELD RCH=   2.          3            6 2 6
FLAG FIELD RCH=   3.          4            2 2 2 2
FLAG FIELD RCH=   4.          2            2 2
FLAG FIELD RCH=   5.          3            6 2 2
FLAG FIELD RCH=   6.         10            2 2 2 2 2 2 2 2 2 2
FLAG FIELD RCH=   7.          4            2 2 2 2
FLAG FIELD RCH=   8.         15            2 2 2 2 2 2 2 2 2 2 2 2 2 6 2
FLAG FIELD RCH=   9.          7            2 2 2 2 2 2 2
FLAG FIELD RCH=  10.          7            2 2 2 2 6 2 2
FLAG FIELD RCH=  11.         10            2 2 2 2 2 2 2 2 2 2
FLAG FIELD RCH=  12.         10            2 2 6 2 2 2 2 2 2 2
FLAG FIELD RCH=  13.         11            2 2 2 2 2 2 2 2 2 2 2
FLAG FIELD RCH=  14.         10            2 2 2 2 2 2 2 2 2 2
FLAG FIELD RCH=  15.         13            6 2 2 2 2 2 6 2 2 2 2 2 2
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FLAG FIELD RCH=  16.        13          2 2 2 2 2 2 2 2 2 2 2 2 2
FLAG FIELD RCH=  17.         5          2 2 2 2 2
FLAG FIELD RCH=  18.         5          6 2 2 2 2
FLAG FIELD RCH=  19.         6          2 2 6 2 2 2
FLAG FIELD RCH=  20.         7          2 2 2 2 2 6 2
FLAG FIELD RCH=  21.         5          2 2 2 2 2
FLAG FIELD RCH=  22.         5          2 2 2 2 2
FLAG FIELD RCH=  23.         9          2 2 2 2 2 2 2 2 2
FLAG FIELD RCH=  24.        10          2 2 2 2 2 2 2 2 2 2
FLAG FIELD RCH=  25.         2          2 5
ENDATA4
HYDRAULICS RCH=   1.       5.93     0.161      0.588      0.353      0.360       0.03
HYDRAULICS RCH=   2.       5.93    0.0605      0.719      0.610      0.271       0.03
HYDRAULICS RCH=   3.       5.93    0.0605      0.719      0.610      0.271       0.03
HYDRAULICS RCH=   4.       5.93    0.0605      0.719      0.610      0.271       0.03
HYDRAULICS RCH=   5.       5.93    0.0742      0.747      0.877      0.132       0.03
HYDRAULICS RCH=   6.       5.93    0.0742      0.747      0.877      0.132       0.03
HYDRAULICS RCH=   7.       5.93    0.0742      0.747      0.877      0.132       0.03
HYDRAULICS RCH=   8.       5.93     0.361      0.432      0.207      0.412       0.03
HYDRAULICS RCH=   9.       5.93     0.361      0.432      0.207      0.412       0.03
HYDRAULICS RCH=  10.       5.93    0.0620      0.719      0.477      0.301       0.03
HYDRAULICS RCH=  11.       5.93    0.0620      0.719      0.477      0.301       0.03
HYDRAULICS RCH=  12.       5.93    0.0456      0.669      0.716      0.290       0.03
HYDRAULICS RCH=  13.       5.93    0.0456      0.669      0.716      0.290       0.03
HYDRAULICS RCH=  14.       5.93    0.0560      0.648      0.622      0.270       0.03
HYDRAULICS RCH=  15.       5.93    0.0560      0.648      0.622      0.270       0.03
HYDRAULICS RCH=  16.       5.93     0.278      0.322      0.113      0.599       0.03
HYDRAULICS RCH=  17.       5.93     0.278      0.322      0.113      0.599       0.03
HYDRAULICS RCH=  18.       5.93     0.159      0.478      0.180      0.502       0.03
HYDRAULICS RCH=  19.       5.93     0.159      0.478      0.180      0.502       0.03
HYDRAULICS RCH=  20.       5.93    0.0673      0.584      0.324      0.350       0.03
HYDRAULICS RCH=  21.       5.93    0.0673      0.584      0.324      0.350       0.03
HYDRAULICS RCH=  22.       5.93    0.0975      0.563      0.309      0.373       0.03
HYDRAULICS RCH=  23.       5.93    0.0975      0.563      0.309      0.373       0.03
HYDRAULICS RCH=  24.       5.93    0.0488      0.563      0.618      0.373       0.03
HYDRAULICS RCH=  25.       5.93    0.0975      0.563      0.309      0.373       0.03
ENDATA5
ENDATA5A
REACT COEF RCH=   1.   0.065     0.00   0.000   8      4.   0.110
REACT COEF RCH=   2.   0.065     0.00   0.000   8      4.   0.110
REACT COEF RCH=   3.   0.065     0.00   0.000   8      4.   0.110
REACT COEF RCH=   4.   0.065     0.00   0.044   8      4.   0.110
REACT COEF RCH=   5.   0.123     0.00   0.092   8      4.   0.110
REACT COEF RCH=   6.   0.123     0.00   0.130   8      4.   0.110
REACT COEF RCH=   7.   0.123     0.00   0.190   8      4.   0.110
REACT COEF RCH=   8.   0.123     0.00   0.190   8      4.   0.110
REACT COEF RCH=   9.   0.123     0.00   0.100   8      4.   0.110
REACT COEF RCH=  10.   0.123     0.00   0.000   8      4.   0.110
REACT COEF RCH=  11.   0.123     0.00   0.000   8      4.   0.110
REACT COEF RCH=  12.   0.123     0.00   0.000   8      4.   0.110
REACT COEF RCH=  13.   0.123     0.00   0.000   8      4.   0.110
REACT COEF RCH=  14.   0.123     0.00   0.000   8      4.   0.110
REACT COEF RCH=  15.   0.123     0.00   0.000   8      4.   0.110
REACT COEF RCH=  16.   0.123     0.00   0.000   8      4.   0.110
REACT COEF RCH=  17.   0.123     0.00   0.000   8      4.   0.110
REACT COEF RCH=  18.   0.066     0.00   0.000   8      4.   0.110
REACT COEF RCH=  19.   0.066     0.00   0.000   8      4.   0.110
REACT COEF RCH=  20.   0.066     0.00   0.000   8      4.   0.110
REACT COEF RCH=  21.   0.066     0.00   0.000   8      4.   0.110
REACT COEF RCH=  22.   0.066     0.00   0.053   8      4.   0.110
REACT COEF RCH=  23.   0.066     0.00   0.050   8      4.   0.110
REACT COEF RCH=  24.   0.066     0.00   0.088   8      4.   0.110
REACT COEF RCH=  25.   0.066     0.00   0.000   1     10.
ENDATA6
N AND P COEF    RCH=   1.   0.10  0.400   2.00  -4.80   2.00   0.10   0.40 -0.680
N AND P COEF    RCH=   2.   0.10  0.400   2.00  -4.80   2.00   0.10   0.40 -0.680
N AND P COEF    RCH=   3.   0.10  0.400   2.00  -4.80   2.00   0.10   0.40 -0.680
N AND P COEF    RCH=   4.   0.10  0.400   2.00  -4.80   2.00   0.10   0.40 -0.680
N AND P COEF    RCH=   5.   0.10  0.400   2.00  -4.80   2.00   0.10   0.40 -0.680
N AND P COEF    RCH=   6.   0.10  0.400   2.00  -4.80   2.00   0.10   0.40 -0.680
N AND P COEF    RCH=   7.   0.10  0.400   2.00  -4.80   2.00   0.10   0.40 -0.680
N AND P COEF    RCH=   8.   0.10  0.400   2.00  -4.80   2.00   0.10   0.40 -0.680
N AND P COEF    RCH=   9.   0.10  0.400   2.00  -4.80   2.00   0.10   0.40 -0.680
N AND P COEF    RCH=  10.   0.10  0.400   2.00  -4.80   2.00   0.10   0.40 -0.680
N AND P COEF    RCH=  11.   0.10  0.400   2.00  -4.80   2.00   0.10   0.40 -0.680
N AND P COEF    RCH=  12.   0.10  0.400   2.00  -4.80   2.00   0.10   0.40 -0.680
N AND P COEF    RCH=  13.   0.10  0.400   2.00  -4.80   2.00   0.10   0.40 -0.680
N AND P COEF    RCH=  14.   0.10  0.400   2.00  -4.80   2.00   0.10   0.40 -0.680
N AND P COEF    RCH=  15.   0.10  0.400   2.00  -4.80   2.00   0.10   0.40 -0.680
N AND P COEF    RCH=  16.   0.10  0.400   2.00  -4.80   2.00   0.10   0.40 -0.680
N AND P COEF    RCH=  17.   0.10  0.400   2.00  -4.80   2.00   0.10   0.40 -0.680
N AND P COEF    RCH=  18.   0.10  0.400   2.00  -4.80   2.00   0.10   0.40 -0.680
N AND P COEF    RCH=  19.   0.10  0.400   2.00  -4.80   2.00   0.10   0.40 -0.680
N AND P COEF    RCH=  20.   0.10  0.400   2.00  -4.80   2.00   0.10   0.40 -0.680
N AND P COEF    RCH=  21.   0.10  0.400   2.00  -4.80   2.00   0.10   0.40 -0.680
N AND P COEF    RCH=  22.   0.10  0.400   2.00  -4.80   2.00   0.10   0.40 -0.680
N AND P COEF    RCH=  23.   0.10  0.400   2.00  -4.80   2.00   0.10   0.40 -0.680
N AND P COEF    RCH=  24.   0.10  0.400   2.00  -4.80   2.00   0.10   0.40 -0.680
N AND P COEF    RCH=  25.   0.10  0.400   2.00  -4.80   2.00   0.10   0.40 -0.680
ENDATA6A
ALG/OTHER COEF RCH=   1.    15.   2.00   0.01   4.00
ALG/OTHER COEF RCH=   2.    15.   2.00   0.01   4.00
ALG/OTHER COEF RCH=   3.    15.   2.00   0.01   4.00
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ALG/OTHER COEF RCH=   4.     15.    2.00    0.01    4.00
ALG/OTHER COEF RCH=   5.     15.    2.00    0.01    4.00
ALG/OTHER COEF RCH=   6.     15.    2.00    0.01    4.00
ALG/OTHER COEF RCH=   7.     15.    2.00    0.01    4.00
ALG/OTHER COEF RCH=   8.     15.    2.00    0.01    4.00
ALG/OTHER COEF RCH=   9.     15.    2.00    0.01    4.00
ALG/OTHER COEF RCH=  10.     15.    2.00    0.01    4.00
ALG/OTHER COEF RCH=  11.     15.    2.00    0.01    4.00
ALG/OTHER COEF RCH=  12.     15.    2.00    0.01    4.00
ALG/OTHER COEF RCH=  13.     15.    2.00    0.01    4.00
ALG/OTHER COEF RCH=  14.     15.    2.00    0.01    4.00
ALG/OTHER COEF RCH=  15.     15.    2.00    0.01    4.00
ALG/OTHER COEF RCH=  16.     15.    2.00    0.01    4.00
ALG/OTHER COEF RCH=  17.     15.    2.00    0.01    4.00
ALG/OTHER COEF RCH=  18.     15.    2.00    0.01    4.00
ALG/OTHER COEF RCH=  19.     15.    2.00    0.01    4.00
ALG/OTHER COEF RCH=  20.     15.    2.00    0.01    4.00
ALG/OTHER COEF RCH=  21.     15.    2.00    0.01    4.00
ALG/OTHER COEF RCH=  22.     15.    2.00    0.01    4.00
ALG/OTHER COEF RCH=  23.     15.    2.00    0.01    4.00
ALG/OTHER COEF RCH=  24.     15.    2.00    0.01    4.00
ALG/OTHER COEF RCH=  25.     15.    2.00    0.01    4.00
ENDATA6B
INITIAL COND-1 RCH=   1.   68.4
INITIAL COND-1 RCH=   2.   68.4
INITIAL COND-1 RCH=   3.   68.4
INITIAL COND-1 RCH=   4.   68.4
INITIAL COND-1 RCH=   5.   68.4
INITIAL COND-1 RCH=   6.   68.4
INITIAL COND-1 RCH=   7.   68.4
INITIAL COND-1 RCH=   8.   68.4
INITIAL COND-1 RCH=   9.   68.4
INITIAL COND-1 RCH=  10.   65.3
INITIAL COND-1 RCH=  11.   65.3
INITIAL COND-1 RCH=  12.   65.3
INITIAL COND-1 RCH=  13.   65.3
INITIAL COND-1 RCH=  14.   65.3
INITIAL COND-1 RCH=  15.   65.3
INITIAL COND-1 RCH=  16.   65.3
INITIAL COND-1 RCH=  17.   65.3
INITIAL COND-1 RCH=  18.   63.5
INITIAL COND-1 RCH=  19.   63.5
INITIAL COND-1 RCH=  20.   63.5
INITIAL COND-1 RCH=  21.   63.5
INITIAL COND-1 RCH=  22.   63.5
INITIAL COND-1 RCH=  23.   63.5
INITIAL COND-1 RCH=  24.   63.5
INITIAL COND-1 RCH=  25.   63.5
ENDATA7
INITIAL COND-2 RCH=   1.
INITIAL COND-2 RCH=   2.
INITIAL COND-2 RCH=   3.
INITIAL COND-2 RCH=   4.
INITIAL COND-2 RCH=   5.
INITIAL COND-2 RCH=   6.
INITIAL COND-2 RCH=   7.
INITIAL COND-2 RCH=   8.
INITIAL COND-2 RCH=   9.
INITIAL COND-2 RCH=  10.
INITIAL COND-2 RCH=  11.
INITIAL COND-2 RCH=  12.
INITIAL COND-2 RCH=  13.
INITIAL COND-2 RCH=  14.
INITIAL COND-2 RCH=  15.
INITIAL COND-2 RCH=  16.
INITIAL COND-2 RCH=  17.
INITIAL COND-2 RCH=  18.
INITIAL COND-2 RCH=  19.
INITIAL COND-2 RCH=  20.
INITIAL COND-2 RCH=  21.
INITIAL COND-2 RCH=  22.
INITIAL COND-2 RCH=  23.
INITIAL COND-2 RCH=  24.
INITIAL COND-2 RCH=  25.
ENDATA7A
INCR INFLOW-1  RCH=   1.  0.000
INCR INFLOW-1  RCH=   2.  0.000
INCR INFLOW-1  RCH=   3.  0.000
INCR INFLOW-1  RCH=   4. -0.213
INCR INFLOW-1  RCH=   5. -0.319
INCR INFLOW-1  RCH=   6. -1.064
INCR INFLOW-1  RCH=   7. -0.426
INCR INFLOW-1  RCH=   8. -1.596
INCR INFLOW-1  RCH=   9.  0.370            8.2   2.0
INCR INFLOW-1  RCH=  10.  0.370            8.2   2.0
INCR INFLOW-1  RCH=  11.  0.529            8.2   2.0
INCR INFLOW-1  RCH=  12.  0.529            8.2   2.0
INCR INFLOW-1  RCH=  13. -0.052
INCR INFLOW-1  RCH=  14. -0.048
INCR INFLOW-1  RCH=  15.  0.895            8.2   2.0
INCR INFLOW-1  RCH=  16.  0.895            8.2   2.0
INCR INFLOW-1  RCH=  17. -0.410
INCR INFLOW-1  RCH=  18. -0.410
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INCR INFLOW-1  RCH=  19.  0.185          8.2   2.0
INCR INFLOW-1  RCH=  20.  0.215          8.2   2.0
INCR INFLOW-1  RCH=  21. -0.300
INCR INFLOW-1  RCH=  22. -0.300
INCR INFLOW-1  RCH=  23. -0.643
INCR INFLOW-1  RCH=  24. -0.714
INCR INFLOW-1  RCH=  25. -0.143
ENDATA8
INCR INFLOW-2  RCH=   1.
INCR INFLOW-2  RCH=   2.
INCR INFLOW-2  RCH=   3.
INCR INFLOW-2  RCH=   4.
INCR INFLOW-2  RCH=   5.
INCR INFLOW-2  RCH=   6.
INCR INFLOW-2  RCH=   7.
INCR INFLOW-2  RCH=   8.
INCR INFLOW-2  RCH=   9.        0.180  0.120  0.000  0.470  0.010  0.060
INCR INFLOW-2  RCH=  10.        0.180  0.120  0.000  0.470  0.010  0.060
INCR INFLOW-2  RCH=  11.        0.180  0.120  0.000  0.470  0.010  0.060
INCR INFLOW-2  RCH=  12.        0.180  0.120  0.000  0.470  0.010  0.060
INCR INFLOW-2  RCH=  13.
INCR INFLOW-2  RCH=  14.
INCR INFLOW-2  RCH=  15.        0.180  0.120  0.000  0.470  0.010  0.060
INCR INFLOW-2  RCH=  16.        0.180  0.120  0.000  0.470  0.010  0.060
INCR INFLOW-2  RCH=  17.
INCR INFLOW-2  RCH=  18.
INCR INFLOW-2  RCH=  19.        0.180  0.120  0.000  0.470  0.010  0.060
INCR INFLOW-2  RCH=  20.        0.180  0.120  0.000  0.470  0.010  0.060
INCR INFLOW-2  RCH=  21.
INCR INFLOW-2  RCH=  22.
INCR INFLOW-2  RCH=  23.
INCR INFLOW-2  RCH=  24.
INCR INFLOW-2  RCH=  25.
ENDATA8A
ENDATA9
HEADWTR-1 HDW=   1. RM 40.3            5.5        11.2   3.2
ENDATA10
HEADWTR-2  HDW=   1.         14.   13. 0.370 0.100 0.000 0.670 0.020 0.020
ENDATA10A
POINTLD-1 PTL=   1. L-bar           0.000000
POINTLD-1 PTL=   2. Chewelah Cr          1.1         9.2   1.4
POINTLD-1 PTL=   3. Chewel POTW        0.000         2.0  143.
POINTLD-1 PTL=   4. Blue Cr              1.9         8.2   2.0
POINTLD-1 PTL=   5. Stensgar Cr         0.00         9.5   2.1
POINTLD-1 PTL=   6. Stranger Cr        0.001         8.8   3.2
POINTLD-1 PTL=   7. LPendOr R            2.6         8.9   1.9
POINTLD-1 PTL=   8. Haller Cr           0.01         9.2   2.0
POINTLD-1 PTL=   9. Colvil POTW         0.00         2.0  143.
POINTLD-1 PTL=  10. Corbett Cr
POINTLD-1 PTL=  11. Mill Cr              1.5         8.8   1.4
ENDATA11
POINTLD-2  PTL=   1.                     1.0  133.        41.3
POINTLD-2  PTL=   2.         353.      0.440 0.050 0.000 0.550 0.010 0.020
POINTLD-2  PTL=   3.         400.  205.  30.5   25. 0.000 0.140 1.780  3.35
POINTLD-2  PTL=   4.        1210.      0.180 0.120 0.000 0.470 0.010 0.060
POINTLD-2  PTL=   5.        5320.      0.180 0.190 0.000 0.340 0.010 0.080
POINTLD-2  PTL=   6.        3410.      0.210 0.190 0.000 0.320 0.010 0.050
POINTLD-2  PTL=   7.         418.      0.080 0.040 0.000 0.220 0.010 0.005
POINTLD-2  PTL=   8.         620.      0.110 0.050 0.000 0.310 0.010 0.040
POINTLD-2  PTL=   9.         400.  147.  7.18   25. 0.000 0.060 0.260  3.65
POINTLD-2  PTL=  10.
POINTLD-2  PTL=  11.         459.      0.060 0.080 0.000 0.530 0.010 0.005
ENDATA11A
DAM DATA      DAM=   1.   25.    1.  1.60  0.80 1.000     0.
ENDATA12
ENDATA13
ENDATA13A
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TITLE01              November-February critical conditions
TITLE02              zero NPDES discharges
TITLE03    NO        CONSERVATIVE MINERAL I     CCON      uS
TITLE04    NO        CONSERVATIVE MINERAL II
TITLE05    NO        CONSERVATIVE MINERAL III
TITLE06    NO        TEMPERATURE
TITLE07   YES        BIOCHEMICAL OXYGEN DEMAND
TITLE08   YES        ALGAE AS CHL-A IN UG/L
TITLE09   YES        PHOSPHORUS CYCLE AS P IN MG/L
TITLE10                (ORGANIC-P, DISSOLVED-P)
TITLE11   YES        NITROGEN CYCLE AS N IN MG/L
TITLE12                (ORGANIC-N, AMMONIA-N, NITRITE-N, NITRITE-N)
TITLE13   YES        DISSOLVED OXYGEN IN MG/L
TITLE14    NO        FECAL COLIFORMS IN NO./100 ML
TITLE15    NO        ARBITRARY NON-CONSERVATIVE
ENDTITLE
LIST DATA INPUT
WRITE OPTIONAL SUMMARY
NO FLOW AUGMENTATION
STEADY STATE
DISCHARGE COEFFICIENTS
NO PRINT SOLAR/LCD DATA
NO PLOT DO AND BOD
FIXED DNSTM COND (YES=1)=   0.00000       5D-ULT BOD CONV K COEF  =    0.00000
INPUT METRIC (YES=1)     =   0.00000       OUTPUT METRIC (YES=1)   =    0.00000
NUMBER OF REACHES        =  25.00000       NUMBER OF JUNCTIONS     =    0.00000
NUM OF HEADWATERS        =   1.00000       NUMBER OF POINT LOADS   =   11.00000
TIME STEP (HOURS)        =                 LNTH  COMP  ELEMENT (DX)=    0.20000
MAXIMUM ITERATIONS       =  100.0000       TIME INC. FOR RPT2 (HRS)=
ENDATA1
O UPTAKE BY NH3 OXID(MG O/MG N)= 3.4300  O UPTAKE BY NO2 OXID(MG O/MG N)= 1.1400
O PROD  BY ALGAE (MG O/MG A)   = 1.6000  O UPTAKE BY ALGAE (MG O/MG A)   = 2.0000
N CONTENT OF ALGAE (MG N/MG A) = 0.0800  P CONTENT OF ALGAE (MG P/MG A) = 0.0110
ALG MAX SPEC GROWTH RATE(1/DAY)= 3.0000  ALGAE RESPIRATION RATE (1/DAY) = 0.1200
N HALF SATURATION CONST (MG/L) = 0.0150  P HALF SATURATION CONST  (MG/L)= 0.0030
LIN ALG EXCO (1/FT)/(UGCHLA/L) = 0.0130  NLINCO (1/FT)/(UGCHLA/L)**(2/3)= 0.0000
LIGHT FUNCTION OPTION (LFNOPT) = 1.0000  LIGHT SAT'N COEFF (BTU/FT2/MIN)= 0.0920
DAILY AVERAGING OPTION (LAVOPT)=      2  LIGHT AVERAGING FACTOR (AFACT) = 1.0000
NUMBER OF DAYLIGHT HOURS (DLH) =  11.00  TOTAL DAILY SOLR RAD (BTU/FT2) = 1350.0
ALGY GROWTH CALC OPTION(LGROPT)= 2.0000  ALGAL PREF FOR NH3-N (PREFN)   = 0.9000
ALG/TEMP SOLR RAD FACTOR(TFACT)= 0.4500  NITRIFICATION INHIBITION COEF  = 0.6000
ENDATA1A
THETA     BOD SETT    1.000
THETA     SOD RATE    1.080
THETA     ORGN SET    1.000
THETA     NH3 DECA    1.080
THETA     NH3 SRCE    1.000
THETA     PORG SET    1.000
THETA     DISP SRC    1.000
THETA     ALG SETT    1.000
ENDATA1B
STREAM REACH      1.RCH= Headwater          FROM        40.4      TO          40.2
STREAM REACH      2.RCH= L-bar/Chew Cr      FROM        40.2      TO          39.6
STREAM REACH      3.RCH= To SCCD 11         FROM        39.6      TO          38.8
STREAM REACH      4.RCH= Abv Chew POTW      FROM        38.8      TO          38.4
STREAM REACH      5.RCH= Blw Chew POTW      FROM        38.4      TO          37.8
STREAM REACH      6.RCH= Blw Chew POTW      FROM        37.8      TO          35.8
STREAM REACH      7.RCH= Blw Chew POTW      FROM        35.8      TO          35.0
STREAM REACH      8.RCH= To Blue Cr         FROM        35.0      TO          32.0
STREAM REACH      9.RCH= Blw Blue Cr        FROM        32.0      TO          30.6
STREAM REACH     10.RCH= To Addy            FROM        30.6      TO          29.2
STREAM REACH     11.RCH= Below Addy         FROM        29.2      TO          27.2
STREAM REACH     12.RCH= To SCCD 16         FROM        27.2      TO          25.2
STREAM REACH     13.RCH= Abv LPendOr R      FROM        25.2      TO          23.0
STREAM REACH     14.RCH= To  LPendOr R      FROM        23.0      TO          21.0
STREAM REACH     15.RCH= Blw LPendOr R      FROM        21.0      TO          18.4
STREAM REACH     16.RCH= To SCCD 20         FROM        18.4      TO          15.8
STREAM REACH     17.RCH= Abv Colvil POTW    FROM        15.8      TO          14.8
STREAM REACH     18.RCH= Blw Colvil POTW    FROM        14.8      TO          13.8
STREAM REACH     19.RCH= Blw Colvil POTW    FROM        13.8      TO          12.6
STREAM REACH     20.RCH= To Blw Mill Cr     FROM        12.6      TO          11.2
STREAM REACH     21.RCH= Blw Mill Cr        FROM        11.2      TO          10.2
STREAM REACH     22.RCH= To SCCD 24         FROM        10.2      TO           9.2
STREAM REACH     23.RCH= Abv Backwater      FROM         9.2      TO           7.4
STREAM REACH     24.RCH= Above Falls        FROM         7.4      TO           5.4
STREAM REACH     25.RCH= Below Falls        FROM         5.4      TO           5.0
ENDATA2
ENDATA3
FLAG FIELD RCH=   1.          1            1
FLAG FIELD RCH=   2.          3            6 2 6
FLAG FIELD RCH=   3.          4            2 2 2 2
FLAG FIELD RCH=   4.          2            2 2
FLAG FIELD RCH=   5.          3            6 2 2
FLAG FIELD RCH=   6.         10            2 2 2 2 2 2 2 2 2 2
FLAG FIELD RCH=   7.          4            2 2 2 2
FLAG FIELD RCH=   8.         15            2 2 2 2 2 2 2 2 2 2 2 2 2 6 2
FLAG FIELD RCH=   9.          7            2 2 2 2 2 2 2
FLAG FIELD RCH=  10.          7            2 2 2 2 6 2 2
FLAG FIELD RCH=  11.         10            2 2 2 2 2 2 2 2 2 2
FLAG FIELD RCH=  12.         10            2 2 6 2 2 2 2 2 2 2
FLAG FIELD RCH=  13.         11            2 2 2 2 2 2 2 2 2 2 2
FLAG FIELD RCH=  14.         10            2 2 2 2 2 2 2 2 2 2
FLAG FIELD RCH=  15.         13            6 2 2 2 2 2 6 2 2 2 2 2 2
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FLAG FIELD RCH=  16.        13          2 2 2 2 2 2 2 2 2 2 2 2 2
FLAG FIELD RCH=  17.         5          2 2 2 2 2
FLAG FIELD RCH=  18.         5          6 2 2 2 2
FLAG FIELD RCH=  19.         6          2 2 6 2 2 2
FLAG FIELD RCH=  20.         7          2 2 2 2 2 6 2
FLAG FIELD RCH=  21.         5          2 2 2 2 2
FLAG FIELD RCH=  22.         5          2 2 2 2 2
FLAG FIELD RCH=  23.         9          2 2 2 2 2 2 2 2 2
FLAG FIELD RCH=  24.        10          2 2 2 2 2 2 2 2 2 2
FLAG FIELD RCH=  25.         2          2 5
ENDATA4
HYDRAULICS RCH=   1.      5.93     0.161      0.588      0.353      0.360       0.03
HYDRAULICS RCH=   2.      5.93    0.0605      0.719      0.610      0.271       0.03
HYDRAULICS RCH=   3.      5.93    0.0605      0.719      0.610      0.271       0.03
HYDRAULICS RCH=   4.      5.93    0.0605      0.719      0.610      0.271       0.03
HYDRAULICS RCH=   5.      5.93    0.0742      0.747      0.877      0.132       0.03
HYDRAULICS RCH=   6.      5.93    0.0742      0.747      0.877      0.132       0.03
HYDRAULICS RCH=   7.      5.93    0.0742      0.747      0.877      0.132       0.03
HYDRAULICS RCH=   8.      5.93     0.361      0.432      0.207      0.412       0.03
HYDRAULICS RCH=   9.      5.93     0.361      0.432      0.207      0.412       0.03
HYDRAULICS RCH=  10.      5.93    0.0620      0.719      0.477      0.301       0.03
HYDRAULICS RCH=  11.      5.93    0.0620      0.719      0.477      0.301       0.03
HYDRAULICS RCH=  12.      5.93    0.0456      0.669      0.716      0.290       0.03
HYDRAULICS RCH=  13.      5.93    0.0456      0.669      0.716      0.290       0.03
HYDRAULICS RCH=  14.      5.93    0.0560      0.648      0.622      0.270       0.03
HYDRAULICS RCH=  15.      5.93    0.0560      0.648      0.622      0.270       0.03
HYDRAULICS RCH=  16.      5.93     0.278      0.322      0.113      0.599       0.03
HYDRAULICS RCH=  17.      5.93     0.278      0.322      0.113      0.599       0.03
HYDRAULICS RCH=  18.      5.93     0.159      0.478      0.180      0.502       0.03
HYDRAULICS RCH=  19.      5.93     0.159      0.478      0.180      0.502       0.03
HYDRAULICS RCH=  20.      5.93    0.0673      0.584      0.324      0.350       0.03
HYDRAULICS RCH=  21.      5.93    0.0673      0.584      0.324      0.350       0.03
HYDRAULICS RCH=  22.      5.93    0.0975      0.563      0.309      0.373       0.03
HYDRAULICS RCH=  23.      5.93    0.0975      0.563      0.309      0.373       0.03
HYDRAULICS RCH=  24.      5.93    0.0488      0.563      0.618      0.373       0.03
HYDRAULICS RCH=  25.      5.93    0.0975      0.563      0.309      0.373       0.03
ENDATA5
ENDATA5A
REACT COEF RCH=   1.   0.065    0.00   0.000   8           0.110
REACT COEF RCH=   2.   0.065    0.00   0.000   8           0.110
REACT COEF RCH=   3.   0.065    0.00   0.000   8           0.054
REACT COEF RCH=   4.   0.065    0.00   0.120   8           0.054
REACT COEF RCH=   5.   0.123    0.00   0.230   8           0.054
REACT COEF RCH=   6.   0.123    0.00   0.340   8           0.054
REACT COEF RCH=   7.   0.123    0.00   0.600   8           0.054
REACT COEF RCH=   8.   0.123    0.00   0.660   8           0.054
REACT COEF RCH=   9.   0.123    0.00   0.280   8           0.054
REACT COEF RCH=  10.   0.123    0.00   0.000   8           0.054
REACT COEF RCH=  11.   0.123    0.00   0.000   8           0.054
REACT COEF RCH=  12.   0.123    0.00   0.000   8           0.054
REACT COEF RCH=  13.   0.123    0.00   0.000   8           0.054
REACT COEF RCH=  14.   0.123    0.00   0.000   8           0.054
REACT COEF RCH=  15.   0.123    0.00   0.000   8           0.054
REACT COEF RCH=  16.   0.123    0.00   0.000   8           0.054
REACT COEF RCH=  17.   0.123    0.00   0.000   8           0.054
REACT COEF RCH=  18.   0.066    0.00   0.000   8           0.054
REACT COEF RCH=  19.   0.066    0.00   0.000   8           0.054
REACT COEF RCH=  20.   0.066    0.00   0.000   8           0.054
REACT COEF RCH=  21.   0.066    0.00   0.000   8           0.054
REACT COEF RCH=  22.   0.066    0.00   0.150   8           0.054
REACT COEF RCH=  23.   0.066    0.00   0.140   8           0.054
REACT COEF RCH=  24.   0.066    0.00   0.260   8           0.054
REACT COEF RCH=  25.   0.066    0.00   0.000   1      10.
ENDATA6
N AND P COEF     RCH=   1.    0.10  0.400   2.00   -2.00    2.00    0.10    0.40 -0.280
N AND P COEF     RCH=   2.    0.10  0.400   2.00   -2.00    2.00    0.10    0.40 -0.280
N AND P COEF     RCH=   3.    0.10  0.400   2.00   -2.00    2.00    0.10    0.40 -0.280
N AND P COEF     RCH=   4.    0.10  0.400   2.00   -2.00    2.00    0.10    0.40 -0.280
N AND P COEF     RCH=   5.    0.10  0.400   2.00   -2.00    2.00    0.10    0.40 -0.280
N AND P COEF     RCH=   6.    0.10  0.400   2.00   -2.00    2.00    0.10    0.40 -0.280
N AND P COEF     RCH=   7.    0.10  0.400   2.00   -2.00    2.00    0.10    0.40 -0.280
N AND P COEF     RCH=   8.    0.10  0.400   2.00   -2.00    2.00    0.10    0.40 -0.280
N AND P COEF     RCH=   9.    0.10  0.400   2.00   -2.00    2.00    0.10    0.40 -0.280
N AND P COEF     RCH=  10.    0.10  0.400   2.00   -2.00    2.00    0.10    0.40 -0.280
N AND P COEF     RCH=  11.    0.10  0.400   2.00   -2.00    2.00    0.10    0.40 -0.280
N AND P COEF     RCH=  12.    0.10  0.400   2.00   -2.00    2.00    0.10    0.40 -0.280
N AND P COEF     RCH=  13.    0.10  0.400   2.00   -2.00    2.00    0.10    0.40 -0.280
N AND P COEF     RCH=  14.    0.10  0.400   2.00   -2.00    2.00    0.10    0.40 -0.280
N AND P COEF     RCH=  15.    0.10  0.400   2.00   -2.00    2.00    0.10    0.40 -0.280
N AND P COEF     RCH=  16.    0.10  0.400   2.00   -2.00    2.00    0.10    0.40 -0.280
N AND P COEF     RCH=  17.    0.10  0.400   2.00   -2.00    2.00    0.10    0.40 -0.280
N AND P COEF     RCH=  18.    0.10  0.400   2.00   -2.00    2.00    0.10    0.40 -0.280
N AND P COEF     RCH=  19.    0.10  0.400   2.00   -2.00    2.00    0.10    0.40 -0.280
N AND P COEF     RCH=  20.    0.10  0.400   2.00   -2.00    2.00    0.10    0.40 -0.280
N AND P COEF     RCH=  21.    0.10  0.400   2.00   -2.00    2.00    0.10    0.40 -0.280
N AND P COEF     RCH=  22.    0.10  0.400   2.00   -2.00    2.00    0.10    0.40 -0.280
N AND P COEF     RCH=  23.    0.10  0.400   2.00   -2.00    2.00    0.10    0.40 -0.280
N AND P COEF     RCH=  24.    0.10  0.400   2.00   -2.00    2.00    0.10    0.40 -0.280
N AND P COEF     RCH=  25.    0.10  0.400   2.00   -2.00    2.00    0.10    0.40 -0.280
ENDATA6A
ALG/OTHER COEF RCH=   1.    15.    2.00    0.01    4.00
ALG/OTHER COEF RCH=   2.    15.    2.00    0.01    4.00
ALG/OTHER COEF RCH=   3.    15.    2.00    0.01    4.00
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ALG/OTHER COEF RCH=   4.     15.   2.00   0.01   4.00
ALG/OTHER COEF RCH=   5.     15.   2.00   0.01   4.00
ALG/OTHER COEF RCH=   6.     15.   2.00   0.01   4.00
ALG/OTHER COEF RCH=   7.     15.   2.00   0.01   4.00
ALG/OTHER COEF RCH=   8.     15.   2.00   0.01   4.00
ALG/OTHER COEF RCH=   9.     15.   2.00   0.01   4.00
ALG/OTHER COEF RCH=  10.     15.   2.00   0.01   4.00
ALG/OTHER COEF RCH=  11.     15.   2.00   0.01   4.00
ALG/OTHER COEF RCH=  12.     15.   2.00   0.01   4.00
ALG/OTHER COEF RCH=  13.     15.   2.00   0.01   4.00
ALG/OTHER COEF RCH=  14.     15.   2.00   0.01   4.00
ALG/OTHER COEF RCH=  15.     15.   2.00   0.01   4.00
ALG/OTHER COEF RCH=  16.     15.   2.00   0.01   4.00
ALG/OTHER COEF RCH=  17.     15.   2.00   0.01   4.00
ALG/OTHER COEF RCH=  18.     15.   2.00   0.01   4.00
ALG/OTHER COEF RCH=  19.     15.   2.00   0.01   4.00
ALG/OTHER COEF RCH=  20.     15.   2.00   0.01   4.00
ALG/OTHER COEF RCH=  21.     15.   2.00   0.01   4.00
ALG/OTHER COEF RCH=  22.     15.   2.00   0.01   4.00
ALG/OTHER COEF RCH=  23.     15.   2.00   0.01   4.00
ALG/OTHER COEF RCH=  24.     15.   2.00   0.01   4.00
ALG/OTHER COEF RCH=  25.     15.   2.00   0.01   4.00
ENDATA6B
INITIAL COND-1 RCH=   1.   40.6
INITIAL COND-1 RCH=   2.   40.6
INITIAL COND-1 RCH=   3.   40.6
INITIAL COND-1 RCH=   4.   40.6
INITIAL COND-1 RCH=   5.   40.6
INITIAL COND-1 RCH=   6.   40.6
INITIAL COND-1 RCH=   7.   40.6
INITIAL COND-1 RCH=   8.   40.6
INITIAL COND-1 RCH=   9.   40.6
INITIAL COND-1 RCH=  10.   42.6
INITIAL COND-1 RCH=  11.   42.6
INITIAL COND-1 RCH=  12.   42.6
INITIAL COND-1 RCH=  13.   42.6
INITIAL COND-1 RCH=  14.   42.6
INITIAL COND-1 RCH=  15.   42.6
INITIAL COND-1 RCH=  16.   42.6
INITIAL COND-1 RCH=  17.   42.6
INITIAL COND-1 RCH=  18.   41.7
INITIAL COND-1 RCH=  19.   41.7
INITIAL COND-1 RCH=  20.   41.7
INITIAL COND-1 RCH=  21.   41.7
INITIAL COND-1 RCH=  22.   41.7
INITIAL COND-1 RCH=  23.   41.7
INITIAL COND-1 RCH=  24.   41.7
INITIAL COND-1 RCH=  25.   41.7
ENDATA7
INITIAL COND-2 RCH=   1.
INITIAL COND-2 RCH=   2.
INITIAL COND-2 RCH=   3.
INITIAL COND-2 RCH=   4.
INITIAL COND-2 RCH=   5.
INITIAL COND-2 RCH=   6.
INITIAL COND-2 RCH=   7.
INITIAL COND-2 RCH=   8.
INITIAL COND-2 RCH=   9.
INITIAL COND-2 RCH=  10.
INITIAL COND-2 RCH=  11.
INITIAL COND-2 RCH=  12.
INITIAL COND-2 RCH=  13.
INITIAL COND-2 RCH=  14.
INITIAL COND-2 RCH=  15.
INITIAL COND-2 RCH=  16.
INITIAL COND-2 RCH=  17.
INITIAL COND-2 RCH=  18.
INITIAL COND-2 RCH=  19.
INITIAL COND-2 RCH=  20.
INITIAL COND-2 RCH=  21.
INITIAL COND-2 RCH=  22.
INITIAL COND-2 RCH=  23.
INITIAL COND-2 RCH=  24.
INITIAL COND-2 RCH=  25.
ENDATA7A
INCR INFLOW-1  RCH=   1.  0.000
INCR INFLOW-1  RCH=   2.  0.000
INCR INFLOW-1  RCH=   3.  0.000
INCR INFLOW-1  RCH=   4.  0.006          10.6   4.7
INCR INFLOW-1  RCH=   5.  0.009          10.6   4.7
INCR INFLOW-1  RCH=   6.  0.031          10.6   4.7
INCR INFLOW-1  RCH=   7.  0.012          10.6   4.7
INCR INFLOW-1  RCH=   8.  0.046          10.6   4.7
INCR INFLOW-1  RCH=   9.  0.243          10.6   4.7
INCR INFLOW-1  RCH=  10.  0.243          10.6   4.7
INCR INFLOW-1  RCH=  11.  0.347          10.6   4.7
INCR INFLOW-1  RCH=  12.  0.347          10.6   4.7
INCR INFLOW-1  RCH=  13. -0.314
INCR INFLOW-1  RCH=  14. -0.286
INCR INFLOW-1  RCH=  15.  1.950          10.6   4.7
INCR INFLOW-1  RCH=  16.  1.950          10.6   4.7
INCR INFLOW-1  RCH=  17. -0.218
INCR INFLOW-1  RCH=  18. -0.218
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INCR INFLOW-1  RCH=  19. -0.046
INCR INFLOW-1  RCH=  20. -0.054
INCR INFLOW-1  RCH=  21.  0.000
INCR INFLOW-1  RCH=  22.  0.000
INCR INFLOW-1  RCH=  23. -0.857
INCR INFLOW-1  RCH=  24. -0.952
INCR INFLOW-1  RCH=  25. -0.190
ENDATA8
INCR INFLOW-2  RCH=   1.
INCR INFLOW-2  RCH=   2.
INCR INFLOW-2  RCH=   3.
INCR INFLOW-2  RCH=   4.         0.520  0.190  0.000  0.800  0.020  0.090
INCR INFLOW-2  RCH=   5.         0.520  0.190  0.000  0.800  0.020  0.090
INCR INFLOW-2  RCH=   6.         0.520  0.190  0.000  0.800  0.020  0.090
INCR INFLOW-2  RCH=   7.         0.520  0.190  0.000  0.800  0.020  0.090
INCR INFLOW-2  RCH=   8.         0.520  0.190  0.000  0.800  0.020  0.090
INCR INFLOW-2  RCH=   9.         0.520  0.190  0.000  0.800  0.020  0.090
INCR INFLOW-2  RCH=  10.         0.520  0.190  0.000  0.800  0.020  0.090
INCR INFLOW-2  RCH=  11.         0.520  0.190  0.000  0.800  0.020  0.090
INCR INFLOW-2  RCH=  12.         0.520  0.190  0.000  0.800  0.020  0.090
INCR INFLOW-2  RCH=  13.
INCR INFLOW-2  RCH=  14.
INCR INFLOW-2  RCH=  15.         0.520  0.190  0.000  0.800  0.020  0.090
INCR INFLOW-2  RCH=  16.         0.520  0.190  0.000  0.800  0.020  0.090
INCR INFLOW-2  RCH=  17.
INCR INFLOW-2  RCH=  18.
INCR INFLOW-2  RCH=  19.
INCR INFLOW-2  RCH=  20.
INCR INFLOW-2  RCH=  21.
INCR INFLOW-2  RCH=  22.
INCR INFLOW-2  RCH=  23.
INCR INFLOW-2  RCH=  24.
INCR INFLOW-2  RCH=  25.
ENDATA8A
ENDATA9
HEADWTR-1 HDW=   1. RM 38.8          13.7        12.2   3.6
ENDATA10
HEADWTR-2  HDW=   1.                1.9 0.240 0.170 0.000 1.160 0.050 0.030
ENDATA10A
POINTLD-1 PTL=   1. Lbar           0.0000
POINTLD-1 PTL=   2. Chewelah Cr       4.1        10.2   4.0
POINTLD-1 PTL=   3. Chewel POTW     0.000
POINTLD-1 PTL=   4. Blue Cr           0.8        10.5   4.7
POINTLD-1 PTL=   5. Stensgar Cr       0.02       10.8   2.3
POINTLD-1 PTL=   6. Stranger Cr       0.1        11.0   5.4
POINTLD-1 PTL=   7. LPendOr R         8.7        11.4   4.0
POINTLD-1 PTL=   8. Haller Cr         0.2        10.6   5.0
POINTLD-1 PTL=   9. Colvil POTW     0.000
POINTLD-1 PTL=  10. Corbett Cr
POINTLD-1 PTL=  11. Mill Cr           5.4        10.5   1.1
ENDATA11
POINTLD-2  PTL=   1.                12.3              63.1
POINTLD-2  PTL=   2.                0.180 0.060 0.000 0.790 0.020 0.040
POINTLD-2  PTL=   3.           22.1  7.14       0.000 0.060 0.010  3.02
POINTLD-2  PTL=   4.                0.590 0.180 0.000 0.580 0.020 0.100
POINTLD-2  PTL=   5.                0.190 0.210 0.000 0.480 0.010 0.030
POINTLD-2  PTL=   6.                0.330 0.400 0.000 0.970 0.020 0.050
POINTLD-2  PTL=   7.                0.210 0.050 0.000 0.310 0.020 0.010
POINTLD-2  PTL=   8.                0.390 0.100 0.000 1.650 0.020 0.050
POINTLD-2  PTL=   9.           624.  7.39       0.000 0.290 3.660  2.01
POINTLD-2  PTL=  10.
POINTLD-2  PTL=  11.                0.050 0.170 0.000 0.610 0.020 0.010
ENDATA11A
DAM DATA       DAM=   1.   25.   1.  1.60  0.80 1.000    0.
ENDATA12
ENDATA13
ENDATA13A
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TITLE01              March-May critical conditions
TITLE02              zero NPDES discharges
TITLE03   NO         CONSERVATIVE MINERAL I      CCON      uS
TITLE04   NO         CONSERVATIVE MINERAL II
TITLE05   NO         CONSERVATIVE MINERAL III
TITLE06   NO         TEMPERATURE
TITLE07  YES         BIOCHEMICAL OXYGEN DEMAND
TITLE08  YES         ALGAE AS CHL-A IN UG/L
TITLE09  YES         PHOSPHORUS CYCLE AS P IN MG/L
TITLE10                (ORGANIC-P, DISSOLVED-P)
TITLE11  YES         NITROGEN CYCLE AS N IN MG/L
TITLE12                (ORGANIC-N, AMMONIA-N, NITRITE-N, NITRITE-N)
TITLE13  YES         DISSOLVED OXYGEN IN MG/L
TITLE14   NO         FECAL COLIFORMS IN NO./100 ML
TITLE15   NO         ARBITRARY NON-CONSERVATIVE
ENDTITLE
LIST DATA INPUT
WRITE OPTIONAL SUMMARY
NO FLOW AUGMENTATION
STEADY STATE
DISCHARGE COEFFICIENTS
NO PRINT SOLAR/LCD DATA
NO PLOT DO AND BOD
FIXED DNSTM COND (YES=1)=    0.00000        5D-ULT BOD CONV K COEF  =    0.00000
INPUT METRIC (YES=1)     =   0.00000        OUTPUT METRIC (YES=1)   =    0.00000
NUMBER OF REACHES        =  25.00000        NUMBER OF JUNCTIONS     =    0.00000
NUM OF HEADWATERS        =   1.00000        NUMBER OF POINT LOADS   =   11.00000
TIME STEP (HOURS)        =                  LNTH  COMP  ELEMENT (DX)=    0.20000
MAXIMUM ITERATIONS       =  100.00000       TIME INC. FOR RPT2 (HRS)=
ENDATA1
O UPTAKE BY NH3 OXID(MG O/MG N)= 3.4300  O UPTAKE BY NO2 OXID(MG O/MG N)= 1.1400
O PROD  BY ALGAE (MG O/MG A)   = 1.6000  O UPTAKE BY ALGAE (MG O/MG A)  = 2.0000
N CONTENT OF ALGAE (MG N/MG A) = 0.0800  P CONTENT OF ALGAE (MG P/MG A) = 0.0110
ALG MAX SPEC GROWTH RATE(1/DAY)= 3.0000  ALGAE RESPIRATION RATE (1/DAY) = 0.1200
N HALF SATURATION CONST (MG/L) = 0.0150  P HALF SATURATION CONST  (MG/L)= 0.0030
LIN ALG EXCO (1/FT)/(UGCHLA/L) = 0.0130  NLINCO (1/FT)/(UGCHLA/L)**(2/3)= 0.0000
LIGHT FUNCTION OPTION (LFNOPT) = 1.0000  LIGHT SAT'N COEFF (BTU/FT2/MIN)= 0.0920
DAILY AVERAGING OPTION (LAVOPT)=      2  LIGHT AVERAGING FACTOR (AFACT) = 1.0000
NUMBER OF DAYLIGHT HOURS (DLH) =  15.70  TOTAL DAILY SOLR RAD (BTU/FT2) = 2650.0
ALGY GROWTH CALC OPTION(LGROPT)= 2.0000  ALGAL PREF FOR NH3-N (PREFN)   = 0.9000
ALG/TEMP SOLR RAD FACTOR(TFACT)= 0.4500  NITRIFICATION INHIBITION COEF  = 0.6000
ENDATA1A
THETA    BOD SETT   1.000
THETA    SOD RATE   1.080
THETA    ORGN SET   1.000
THETA    NH3 DECA   1.080
THETA    NH3 SRCE   1.000
THETA    PORG SET   1.000
THETA    DISP SRC   1.000
THETA    ALG SETT   1.000
ENDATA1B
STREAM REACH      1.RCH= Headwater         FROM         40.4     TO           40.2
STREAM REACH      2.RCH= L-bar/Chew Cr     FROM         40.2     TO           39.6
STREAM REACH      3.RCH= To SCCD 11        FROM         39.6     TO           38.8
STREAM REACH      4.RCH= Abv Chew POTW     FROM         38.8     TO           38.4
STREAM REACH      5.RCH= Blw Chew POTW     FROM         38.4     TO           37.8
STREAM REACH      6.RCH= Blw Chew POTW     FROM         37.8     TO           35.8
STREAM REACH      7.RCH= Blw Chew POTW     FROM         35.8     TO           35.0
STREAM REACH      8.RCH= To Blue Cr        FROM         35.0     TO           32.0
STREAM REACH      9.RCH= Blw Blue Cr       FROM         32.0     TO           30.6
STREAM REACH     10.RCH= To Addy           FROM         30.6     TO           29.2
STREAM REACH     11.RCH= Below Addy        FROM         29.2     TO           27.2
STREAM REACH     12.RCH= To SCCD 16        FROM         27.2     TO           25.2
STREAM REACH     13.RCH= Abv LPendOr R     FROM         25.2     TO           23.0
STREAM REACH     14.RCH= To  LPendOr R     FROM         23.0     TO           21.0
STREAM REACH     15.RCH= Blw LPendOr R     FROM         21.0     TO           18.4
STREAM REACH     16.RCH= To SCCD 20        FROM         18.4     TO           15.8
STREAM REACH     17.RCH= Abv Colvil POTW   FROM         15.8     TO           14.8
STREAM REACH     18.RCH= Blw Colvil POTW   FROM         14.8     TO           13.8
STREAM REACH     19.RCH= Blw Colvil POTW   FROM         13.8     TO           12.6
STREAM REACH     20.RCH= To Blw Mill Cr    FROM         12.6     TO           11.2
STREAM REACH     21.RCH= Blw Mill Cr       FROM         11.2     TO           10.2
STREAM REACH     22.RCH= To SCCD 24        FROM         10.2     TO            9.2
STREAM REACH     23.RCH= Abv Backwater     FROM          9.2     TO            7.4
STREAM REACH     24.RCH= Above Falls       FROM          7.4     TO            5.4
STREAM REACH     25.RCH= Below Falls       FROM          5.4     TO            5.0
ENDATA2
ENDATA3
FLAG FIELD RCH=   1.         1            1
FLAG FIELD RCH=   2.         3            6 2 6
FLAG FIELD RCH=   3.         4            2 2 2 2
FLAG FIELD RCH=   4.         2            2 2
FLAG FIELD RCH=   5.         3            6 2 2
FLAG FIELD RCH=   6.        10            2 2 2 2 2 2 2 2 2 2
FLAG FIELD RCH=   7.         4            2 2 2 2
FLAG FIELD RCH=   8.        15            2 2 2 2 2 2 2 2 2 2 2 2 2 6 2
FLAG FIELD RCH=   9.         7            2 2 2 2 2 2 2
FLAG FIELD RCH=  10.         7            2 2 2 2 6 2 2
FLAG FIELD RCH=  11.        10            2 2 2 2 2 2 2 2 2 2
FLAG FIELD RCH=  12.        10            2 2 6 2 2 2 2 2 2 2
FLAG FIELD RCH=  13.        11            2 2 2 2 2 2 2 2 2 2 2
FLAG FIELD RCH=  14.        10            2 2 2 2 2 2 2 2 2 2
FLAG FIELD RCH=  15.        13            6 2 2 2 2 2 6 2 2 2 2 2 2
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FLAG FIELD RCH=  16.         13           2 2 2 2 2 2 2 2 2 2 2 2 2
FLAG FIELD RCH=  17.          5           2 2 2 2 2
FLAG FIELD RCH=  18.          5           6 2 2 2 2
FLAG FIELD RCH=  19.          6           2 2 6 2 2 2
FLAG FIELD RCH=  20.          7           2 2 2 2 2 6 2
FLAG FIELD RCH=  21.          5           2 2 2 2 2
FLAG FIELD RCH=  22.          5           2 2 2 2 2
FLAG FIELD RCH=  23.          9           2 2 2 2 2 2 2 2 2
FLAG FIELD RCH=  24.         10           2 2 2 2 2 2 2 2 2 2
FLAG FIELD RCH=  25.          2           2 5
ENDATA4
HYDRAULICS RCH=   1.       5.93     0.161      0.588      0.353      0.360       0.03
HYDRAULICS RCH=   2.       5.93    0.0605      0.719      0.610      0.271       0.03
HYDRAULICS RCH=   3.       5.93    0.0605      0.719      0.610      0.271       0.03
HYDRAULICS RCH=   4.       5.93    0.0605      0.719      0.610      0.271       0.03
HYDRAULICS RCH=   5.       5.93    0.0742      0.747      0.877      0.132       0.03
HYDRAULICS RCH=   6.       5.93    0.0742      0.747      0.877      0.132       0.03
HYDRAULICS RCH=   7.       5.93    0.0742      0.747      0.877      0.132       0.03
HYDRAULICS RCH=   8.       5.93     0.361      0.432      0.207      0.412       0.03
HYDRAULICS RCH=   9.       5.93     0.361      0.432      0.207      0.412       0.03
HYDRAULICS RCH=  10.       5.93    0.0620      0.719      0.477      0.301       0.03
HYDRAULICS RCH=  11.       5.93    0.0620      0.719      0.477      0.301       0.03
HYDRAULICS RCH=  12.       5.93    0.0456      0.669      0.716      0.290       0.03
HYDRAULICS RCH=  13.       5.93    0.0456      0.669      0.716      0.290       0.03
HYDRAULICS RCH=  14.       5.93    0.0560      0.648      0.622      0.270       0.03
HYDRAULICS RCH=  15.       5.93    0.0560      0.648      0.622      0.270       0.03
HYDRAULICS RCH=  16.       5.93     0.278      0.322      0.113      0.599       0.03
HYDRAULICS RCH=  17.       5.93     0.278      0.322      0.113      0.599       0.03
HYDRAULICS RCH=  18.       5.93     0.159      0.478      0.180      0.502       0.03
HYDRAULICS RCH=  19.       5.93     0.159      0.478      0.180      0.502       0.03
HYDRAULICS RCH=  20.       5.93    0.0673      0.584      0.324      0.350       0.03
HYDRAULICS RCH=  21.       5.93    0.0673      0.584      0.324      0.350       0.03
HYDRAULICS RCH=  22.       5.93    0.0975      0.563      0.309      0.373       0.03
HYDRAULICS RCH=  23.       5.93    0.0975      0.563      0.309      0.373       0.03
HYDRAULICS RCH=  24.       5.93    0.0488      0.563      0.618      0.373       0.03
HYDRAULICS RCH=  25.       5.93    0.0975      0.563      0.309      0.373       0.03
ENDATA5
ENDATA5A
REACT COEF RCH=   1.   0.065    0.00   0.000   8           0.054
REACT COEF RCH=   2.   0.065    0.00   0.000   8           0.054
REACT COEF RCH=   3.   0.065    0.00   0.000   8           0.054
REACT COEF RCH=   4.   0.065    0.00   0.120   8           0.054
REACT COEF RCH=   5.   0.123    0.00   0.230   8           0.054
REACT COEF RCH=   6.   0.123    0.00   0.340   8           0.054
REACT COEF RCH=   7.   0.123    0.00   0.600   8           0.054
REACT COEF RCH=   8.   0.123    0.00   0.660   8           0.054
REACT COEF RCH=   9.   0.123    0.00   0.280   8           0.054
REACT COEF RCH=  10.   0.123    0.00   0.000   8           0.054
REACT COEF RCH=  11.   0.123    0.00   0.000   8           0.054
REACT COEF RCH=  12.   0.123    0.00   0.000   8           0.054
REACT COEF RCH=  13.   0.123    0.00   0.000   8           0.054
REACT COEF RCH=  14.   0.123    0.00   0.000   8           0.054
REACT COEF RCH=  15.   0.123    0.00   0.000   8           0.054
REACT COEF RCH=  16.   0.123    0.00   0.000   8           0.054
REACT COEF RCH=  17.   0.123    0.00   0.000   8           0.054
REACT COEF RCH=  18.   0.066    0.00   0.000   8           0.054
REACT COEF RCH=  19.   0.066    0.00   0.000   8           0.054
REACT COEF RCH=  20.   0.066    0.00   0.000   8           0.054
REACT COEF RCH=  21.   0.066    0.00   0.000   8           0.054
REACT COEF RCH=  22.   0.066    0.00   0.150   8           0.054
REACT COEF RCH=  23.   0.066    0.00   0.140   8           0.054
REACT COEF RCH=  24.   0.066    0.00   0.260   8           0.054
REACT COEF RCH=  25.   0.066    0.00   0.000   1      10.
ENDATA6
N AND P COEF    RCH=   1.    0.10  0.400   2.00  -2.00    2.00   0.10   0.40 -0.280
N AND P COEF    RCH=   2.    0.10  0.400   2.00  -2.00    2.00   0.10   0.40 -0.280
N AND P COEF    RCH=   3.    0.10  0.400   2.00  -2.00    2.00   0.10   0.40 -0.280
N AND P COEF    RCH=   4.    0.10  0.400   2.00  -2.00    2.00   0.10   0.40 -0.280
N AND P COEF    RCH=   5.    0.10  0.400   2.00  -2.00    2.00   0.10   0.40 -0.280
N AND P COEF    RCH=   6.    0.10  0.400   2.00  -2.00    2.00   0.10   0.40 -0.280
N AND P COEF    RCH=   7.    0.10  0.400   2.00  -2.00    2.00   0.10   0.40 -0.280
N AND P COEF    RCH=   8.    0.10  0.400   2.00  -2.00    2.00   0.10   0.40 -0.280
N AND P COEF    RCH=   9.    0.10  0.400   2.00  -2.00    2.00   0.10   0.40 -0.280
N AND P COEF    RCH=  10.    0.10  0.400   2.00  -2.00    2.00   0.10   0.40 -0.280
N AND P COEF    RCH=  11.    0.10  0.400   2.00  -2.00    2.00   0.10   0.40 -0.280
N AND P COEF    RCH=  12.    0.10  0.400   2.00  -2.00    2.00   0.10   0.40 -0.280
N AND P COEF    RCH=  13.    0.10  0.400   2.00  -2.00    2.00   0.10   0.40 -0.280
N AND P COEF    RCH=  14.    0.10  0.400   2.00  -2.00    2.00   0.10   0.40 -0.280
N AND P COEF    RCH=  15.    0.10  0.400   2.00  -2.00    2.00   0.10   0.40 -0.280
N AND P COEF    RCH=  16.    0.10  0.400   2.00  -2.00    2.00   0.10   0.40 -0.280
N AND P COEF    RCH=  17.    0.10  0.400   2.00  -2.00    2.00   0.10   0.40 -0.280
N AND P COEF    RCH=  18.    0.10  0.400   2.00  -2.00    2.00   0.10   0.40 -0.280
N AND P COEF    RCH=  19.    0.10  0.400   2.00  -2.00    2.00   0.10   0.40 -0.280
N AND P COEF    RCH=  20.    0.10  0.400   2.00  -2.00    2.00   0.10   0.40 -0.280
N AND P COEF    RCH=  21.    0.10  0.400   2.00  -2.00    2.00   0.10   0.40 -0.280
N AND P COEF    RCH=  22.    0.10  0.400   2.00  -2.00    2.00   0.10   0.40 -0.280
N AND P COEF    RCH=  23.    0.10  0.400   2.00  -2.00    2.00   0.10   0.40 -0.280
N AND P COEF    RCH=  24.    0.10  0.400   2.00  -2.00    2.00   0.10   0.40 -0.280
N AND P COEF    RCH=  25.    0.10  0.400   2.00  -2.00    2.00   0.10   0.40 -0.280
ENDATA6A
ALG/OTHER COEF RCH=   1.     15.    2.00   0.01    4.00
ALG/OTHER COEF RCH=   2.     15.    2.00   0.01    4.00
ALG/OTHER COEF RCH=   3.     15.    2.00   0.01    4.00
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ALG/OTHER COEF RCH=   4.    15.   2.00   0.01   4.00
ALG/OTHER COEF RCH=   5.    15.   2.00   0.01   4.00
ALG/OTHER COEF RCH=   6.    15.   2.00   0.01   4.00
ALG/OTHER COEF RCH=   7.    15.   2.00   0.01   4.00
ALG/OTHER COEF RCH=   8.    15.   2.00   0.01   4.00
ALG/OTHER COEF RCH=   9.    15.   2.00   0.01   4.00
ALG/OTHER COEF RCH=  10.    15.   2.00   0.01   4.00
ALG/OTHER COEF RCH=  11.    15.   2.00   0.01   4.00
ALG/OTHER COEF RCH=  12.    15.   2.00   0.01   4.00
ALG/OTHER COEF RCH=  13.    15.   2.00   0.01   4.00
ALG/OTHER COEF RCH=  14.    15.   2.00   0.01   4.00
ALG/OTHER COEF RCH=  15.    15.   2.00   0.01   4.00
ALG/OTHER COEF RCH=  16.    15.   2.00   0.01   4.00
ALG/OTHER COEF RCH=  17.    15.   2.00   0.01   4.00
ALG/OTHER COEF RCH=  18.    15.   2.00   0.01   4.00
ALG/OTHER COEF RCH=  19.    15.   2.00   0.01   4.00
ALG/OTHER COEF RCH=  20.    15.   2.00   0.01   4.00
ALG/OTHER COEF RCH=  21.    15.   2.00   0.01   4.00
ALG/OTHER COEF RCH=  22.    15.   2.00   0.01   4.00
ALG/OTHER COEF RCH=  23.    15.   2.00   0.01   4.00
ALG/OTHER COEF RCH=  24.    15.   2.00   0.01   4.00
ALG/OTHER COEF RCH=  25.    15.   2.00   0.01   4.00
ENDATA6B
INITIAL COND-1 RCH=   1.   61.0
INITIAL COND-1 RCH=   2.   61.0
INITIAL COND-1 RCH=   3.   61.0
INITIAL COND-1 RCH=   4.   61.0
INITIAL COND-1 RCH=   5.   61.0
INITIAL COND-1 RCH=   6.   61.0
INITIAL COND-1 RCH=   7.   61.0
INITIAL COND-1 RCH=   8.   61.0
INITIAL COND-1 RCH=   9.   61.0
INITIAL COND-1 RCH=  10.   58.1
INITIAL COND-1 RCH=  11.   58.1
INITIAL COND-1 RCH=  12.   58.1
INITIAL COND-1 RCH=  13.   58.1
INITIAL COND-1 RCH=  14.   58.1
INITIAL COND-1 RCH=  15.   58.1
INITIAL COND-1 RCH=  16.   58.1
INITIAL COND-1 RCH=  17.   58.1
INITIAL COND-1 RCH=  18.   55.2
INITIAL COND-1 RCH=  19.   55.2
INITIAL COND-1 RCH=  20.   55.2
INITIAL COND-1 RCH=  21.   55.2
INITIAL COND-1 RCH=  22.   55.2
INITIAL COND-1 RCH=  23.   55.2
INITIAL COND-1 RCH=  24.   55.2
INITIAL COND-1 RCH=  25.   55.2
ENDATA7
INITIAL COND-2 RCH=   1.
INITIAL COND-2 RCH=   2.
INITIAL COND-2 RCH=   3.
INITIAL COND-2 RCH=   4.
INITIAL COND-2 RCH=   5.
INITIAL COND-2 RCH=   6.
INITIAL COND-2 RCH=   7.
INITIAL COND-2 RCH=   8.
INITIAL COND-2 RCH=   9.
INITIAL COND-2 RCH=  10.
INITIAL COND-2 RCH=  11.
INITIAL COND-2 RCH=  12.
INITIAL COND-2 RCH=  13.
INITIAL COND-2 RCH=  14.
INITIAL COND-2 RCH=  15.
INITIAL COND-2 RCH=  16.
INITIAL COND-2 RCH=  17.
INITIAL COND-2 RCH=  18.
INITIAL COND-2 RCH=  19.
INITIAL COND-2 RCH=  20.
INITIAL COND-2 RCH=  21.
INITIAL COND-2 RCH=  22.
INITIAL COND-2 RCH=  23.
INITIAL COND-2 RCH=  24.
INITIAL COND-2 RCH=  25.
ENDATA7A
INCR INFLOW-1   RCH=   1.  0.000
INCR INFLOW-1   RCH=   2.  0.000
INCR INFLOW-1   RCH=   3.  0.000
INCR INFLOW-1   RCH=   4.  0.747             9.5   2.8
INCR INFLOW-1   RCH=   5.  1.120             9.5   2.8
INCR INFLOW-1   RCH=   6.  3.734             9.5   2.8
INCR INFLOW-1   RCH=   7.  1.494             9.5   2.8
INCR INFLOW-1   RCH=   8.  5.601             9.5   2.8
INCR INFLOW-1   RCH=   9. -2.265
INCR INFLOW-1   RCH=  10. -2.265
INCR INFLOW-1   RCH=  11. -3.235
INCR INFLOW-1   RCH=  12. -3.235
INCR INFLOW-1   RCH=  13. -1.048
INCR INFLOW-1   RCH=  14. -0.952
INCR INFLOW-1   RCH=  15.  2.850             9.5   2.8
INCR INFLOW-1   RCH=  16.  2.850             9.5   2.8
INCR INFLOW-1   RCH=  17.  0.562             9.5   2.8
INCR INFLOW-1   RCH=  18.  0.562             9.5   2.8
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INCR INFLOW-1   RCH=   19.  -1.200
INCR INFLOW-1   RCH=   20.  -1.400
INCR INFLOW-1   RCH=   21.   1.450           9.5    2.8
INCR INFLOW-1   RCH=   22.   1.450           9.5    2.8
INCR INFLOW-1   RCH=   23.   0.043           9.5    2.8
INCR INFLOW-1   RCH=   24.   0.048           9.5    2.8
INCR INFLOW-1   RCH=   25.   0.010           9.5    2.8
ENDATA8
INCR INFLOW-2   RCH=    1.
INCR INFLOW-2   RCH=    2.
INCR INFLOW-2   RCH=    3.
INCR INFLOW-2   RCH=    4.          0.370  0.090  0.000  0.380  0.010  0.060
INCR INFLOW-2   RCH=    5.          0.370  0.090  0.000  0.380  0.010  0.060
INCR INFLOW-2   RCH=    6.          0.370  0.090  0.000  0.380  0.010  0.060
INCR INFLOW-2   RCH=    7.          0.370  0.090  0.000  0.380  0.010  0.060
INCR INFLOW-2   RCH=    8.          0.370  0.090  0.000  0.380  0.010  0.060
INCR INFLOW-2   RCH=    9.
INCR INFLOW-2   RCH=   10.
INCR INFLOW-2   RCH=   11.
INCR INFLOW-2   RCH=   12.
INCR INFLOW-2   RCH=   13.
INCR INFLOW-2   RCH=   14.
INCR INFLOW-2   RCH=   15.          0.370  0.090  0.000  0.380  0.010  0.060
INCR INFLOW-2   RCH=   16.          0.370  0.090  0.000  0.380  0.010  0.060
INCR INFLOW-2   RCH=   17.          0.370  0.090  0.000  0.380  0.010  0.060
INCR INFLOW-2   RCH=   18.          0.370  0.090  0.000  0.380  0.010  0.060
INCR INFLOW-2   RCH=   19.
INCR INFLOW-2   RCH=   20.
INCR INFLOW-2   RCH=   21.          0.370  0.090  0.000  0.380  0.010  0.060
INCR INFLOW-2   RCH=   22.          0.370  0.090  0.000  0.380  0.010  0.060
INCR INFLOW-2   RCH=   23.          0.370  0.090  0.000  0.380  0.010  0.060
INCR INFLOW-2   RCH=   24.          0.370  0.090  0.000  0.380  0.010  0.060
INCR INFLOW-2   RCH=   25.          0.370  0.090  0.000  0.380  0.010  0.060
ENDATA8A
ENDATA9
HEADWTR-1 HDW=    1. RM 38.8            25.8         11.4    3.0
ENDATA10
HEADWTR-2  HDW=    1.                 12. 0.650 0.060 0.000 1.020 0.020 0.040
ENDATA10A
POINTLD-1 PTL=    1. Lbar              0.0000
POINTLD-1 PTL=    2. Chewelah Cr         11.3         9.2    2.3
POINTLD-1 PTL=    3. Chewel POTW        0.000         3.0
POINTLD-1 PTL=    4. Blue Cr              0.4         8.1    2.8
POINTLD-1 PTL=    5. Stensgar Cr          2.7         9.7    2.4
POINTLD-1 PTL=    6. Stranger Cr          3.1         9.4    3.4
POINTLD-1 PTL=    7. LPendOr R.          21.2         9.5    2.0
POINTLD-1 PTL=    8. Haller Cr            1.4         9.5    2.8
POINTLD-1 PTL=    9. Colvil POTW        0.000         3.0
POINTLD-1 PTL=   10. Corbett Cr
POINTLD-1 PTL=   11. Mill Cr             13.9         9.1    1.5
ENDATA11
POINTLD-2  PTL=    1.                    49.5              60.9
POINTLD-2  PTL=    2.                   0.360 0.050 0.000 0.500 0.010 0.020
POINTLD-2  PTL=    3.             348.   30.3       0.000 0.150   1.4   3.5
POINTLD-2  PTL=    4.                   0.370 0.100 0.000 0.300 0.010 0.060
POINTLD-2  PTL=    5.                   0.190 0.070 0.000 0.270 0.010 0.140
POINTLD-2  PTL=    6.                   0.210 0.110 0.000 0.500 0.010 0.050
POINTLD-2  PTL=    7.                   0.120 0.080 0.000 0.200 0.010 0.005
POINTLD-2  PTL=    8.                   0.240 0.060 0.000 0.370 0.010 0.040
POINTLD-2  PTL=    9.            1470.    9.9       0.000 0.390 0.970   3.7
POINTLD-2  PTL=   10.
POINTLD-2  PTL=   11.                   0.060 0.050 0.000 0.340 0.010 0.005
ENDATA11A
DAM DATA        DAM=    1.    25.    1.  1.60   0.80 1.000     0.
ENDATA12
ENDATA13
ENDATA13A
```

Appendix E.

Critical conditions for calculation of ammonia limits for Chewelah and Colville POTWs.

E1. Ammonia limits for effluent pH of 7.5.
E2. Ammonia limits for effluent pH of 8.0.
E3. Ammonia limits for effluent pH of 8.5.

Appendix E1. Summary of seasonal critical conditions for ammonia limits for Colville and Chewelah POTWs assuming effluent pH of 7.5 (design flows for Chewelah are per CH2M-Hill, 1996a)

		June-October		November-February		March-May	
		Chewelah	Colville	Chewelah	Colville	Chewelah	Colville
upstream river flow	cfs	6.60	11.4	17.80	32.9	37.10	72.1
upstream temperature	degrees C	20.7	18.3	6.0	5.7	17.2	13.8
upstream pH	std units	9.1	8.7	7.9	8.2	8.7	7.7
upstream alkalinity	mg/L as CaCO3	176	190	176	190	176	190
upstream ammonia	mg/L as total NH3-N	0.020	0.029	0.073	0.120	0.063	0.076
effluent acute design flow	mgd	1.06	1.8	2.14	1.8	2.14	1.8
effluent chronic design flow	mgd	0.71	1.2	1.20	1.2	1.20	1.2
effluent temperature	degrees C	18	18	10	10	15	15
effluent pH	std units	7.5	7.5	7.5	7.5	7.5	7.5
effluent alkalinity	mg/L as CaCO3	107	283	157	283	157	283
fraction of river flow for acute DF	dimensionless	0.025	0.025	0.025	0.025	0.025	0.025
fraction of river flow for chronic DF	dimensionless	0.25	0.25	0.25	0.25	0.25	0.25
acute DF	dimensionless	1.10	1.10	1.13	1.30	1.28	1.65
chronic DF	dimensionless	2.50	2.54	3.40	5.43	6.00	10.71
acute mixing zone temperature	degrees C	18.25	18.03	9.53	9.02	15.48	14.53
acute mixing zone pH	std units	7.56	7.53	7.54	7.57	7.61	7.55
chronic mixing zone temperature	degrees C	19.62	18.18	7.18	6.49	16.83	13.91
chronic mixing zone pH	std units	8.00	7.78	7.76	7.91	8.18	7.67
acute ammonia criteria	mg/L as total NH3-N	11.129	11.683	12.181	11.734	10.623	11.491
chronic ammonia criteria	mg/L as total NH3-N	0.918	1.486	2.064	1.600	0.762	2.134
acute ammonia WLA	mg/L as total NH3-N	12.25	12.88	13.81	15.16	13.58	18.88
chronic ammonia WLA	mg/L as total NH3-N	2.27	3.72	6.84	8.16	4.25	22.12
daily max ammonia concentration limit	mg/L as total NH3-N	3.72	6.11	11.23	13.40	6.98	18.88
monthly average ammonia concentration limit	mg/L as total NH3-N	1.86	3.05	5.60	6.68	3.48	9.41
daily max ammonia load limit	pounds/day as total NH3-N	32.9	91.8	200.5	201.3	124.7	284
monthly average ammonia load limit	pounds/day as total NH3-N	11.0	30.5	56.0	66.9	34.9	94.2

Appendix E2. Summary of seasonal critical conditions for ammonia limits for Colville and Chewelah POTWs assuming effluent pH of 8.0 (design flows for Chewelah are per CH2M-Hill, 1996a)

		June-October		November-February		March-May	
		Chewelah	Colville	Chewelah	Colville	Chewelah	Colville
upstream river flow	cfs	6.60	11.4	17.80	32.9	37.10	72.1
upstream temperature	degrees C	20.7	18.3	6.0	5.7	17.2	13.8
upstream pH	std units	9.1	8.7	7.9	8.2	8.7	7.7
upstream alkalinity	mg/L as CaCO3	176	190	176	190	176	190
upstream ammonia	mg/L as total NH3-N	0.020	0.029	0.073	0.120	0.063	0.076
effluent acute design flow	mgd	1.06	1.8	2.14	1.8	2.14	1.8
effluent chronic design flow	mgd	0.71	1.2	1.20	1.2	1.20	1.2
effluent temperature	degrees C	18	18	10	10	15	15
effluent pH	std units	8.0	8.0	8.0	8.0	8.0	8.0
effluent alkalinity	mg/L as CaCO3	107	283	157	283	157	283
fraction of river flow for acute DF	dimensionless	0.025	0.025	0.025	0.025	0.025	0.025
fraction of river flow for chronic DF	dimensionless	0.25	0.25	0.25	0.25	0.25	0.25
acute DF	dimensionless	1.10	1.10	1.13	1.30	1.28	1.65
chronic DF	dimensionless	2.50	2.54	3.40	5.43	6.00	10.71
acute mixing zone temperature	degrees C	18.25	18.03	9.53	9.02	15.48	14.53
acute mixing zone pH	std units	8.06	8.02	7.98	8.03	8.09	7.88
chronic mixing zone temperature	degrees C	19.62	18.18	7.18	6.49	16.83	13.91
chronic mixing zone pH	std units	8.45	8.23	7.92	8.15	8.49	7.73
acute ammonia criteria	mg/L as total NH3-N	4.919	5.338	6.050	5.494	4.638	6.942
chronic ammonia criteria	mg/L as total NH3-N	0.348	0.625	1.571	0.989	0.391	2.041
acute ammonia WLA	mg/L as total NH3-N	5.41	5.88	6.85	7.08	5.92	11.39
chronic ammonia WLA	mg/L as total NH3-N	0.84	1.54	5.16	4.84	2.03	21.11
daily max ammonia concentration limit	mg/L as total NH3-N	1.38	2.53	6.85	7.08	3.33	11.39
monthly average ammonia concentration limit	mg/L as total NH3-N	0.69	1.26	3.42	3.53	1.66	5.68
daily max ammonia load limit	pounds/day as total NH3-N	12.2	38.0	122.4	106.4	59.5	171
monthly average ammonia load limit	pounds/day as total NH3-N	4.1	12.6	34.2	35.3	16.6	56.8

Appendix E1. Summary of seasonal critical conditions for ammonia limits for Colville and Chewelah POTWs assuming effluent pH of 8.5 (design flows for Chewelah are per CH2M-Hill, 1996a)

		June-October		November-February		March-May	
		Chewelah	Colville	Chewelah	Colville	Chewelah	Colville
upstream river flow	cfs	6.60	11.4	17.80	32.9	37.10	72.1
upstream temperature	degrees C	20.7	18.3	6.0	5.7	17.2	13.8
upstream pH	std units	9.1	8.7	7.9	8.2	8.7	7.7
upstream alkalinity	mg/L as CaCO3	176	190	176	190	176	190
upstream ammonia	mg/L as total NH3-N	0.020	0.029	0.073	0.120	0.063	0.076
effluent acute design flow	mgd	1.06	1.8	2.14	1.8	2.14	1.8
effluent chronic design flow	mgd	0.71	1.2	1.20	1.2	1.20	1.2
effluent temperature	degrees C	18	18	10	10	15	15
effluent pH	std units	8.5	8.5	8.5	8.5	8.5	8.5
effluent alkalinity	mg/L as CaCO3	107	283	157	283	157	283
fraction of river flow for acute DF	dimensionless	0.025	0.025	0.025	0.025	0.025	0.025
fraction of river flow for chronic DF	dimensionless	0.25	0.25	0.25	0.25	0.25	0.25
acute DF	dimensionless	1.10	1.10	1.13	1.30	1.28	1.65
chronic DF	dimensionless	2.50	2.54	3.40	5.43	6.00	10.71
acute mixing zone temperature	degrees C	18.25	18.03	9.53	9.02	15.48	14.53
acute mixing zone pH	std units	8.55	8.51	8.35	8.43	8.54	8.08
chronic mixing zone temperature	degrees C	19.62	18.18	7.18	6.49	16.83	13.91
chronic mixing zone pH	std units	8.83	8.59	7.99	8.26	8.66	7.75
acute ammonia criteria	mg/L as total NH3-N	1.725	1.863	2.708	2.253	1.748	4.754
chronic ammonia criteria	mg/L as total NH3-N	0.168	0.290	1.393	0.773	0.273	1.974
acute ammonia WLA	mg/L as total NH3-N	1.90	2.05	3.06	2.88	2.22	7.78
chronic ammonia WLA	mg/L as total NH3-N	0.39	0.69	4.56	3.66	1.32	20.41
daily max ammonia concentration limit	mg/L as total NH3-N	0.64	1.13	3.06	2.88	2.18	7.78
monthly average ammonia concentration limit	mg/L as total NH3-N	0.32	0.57	1.53	1.44	1.08	3.88
daily max ammonia load limit	pounds/day as total NH3-N	5.7	17.0	54.7	43.3	38.8	117
monthly average ammonia load limit	pounds/day as total NH3-N	1.9	5.7	15.3	14.4	10.9	38.8