WASHINGTON STATE
DEPARTMENT OF
ECOLOGY

Colville River Dissolved Oxygen Total Maximum Daily Load

Submittal Report

March 2003
Publication No. 03-10-029
Printed on Recycled Paper

Colville River Dissolved Oxygen Total Maximum Daily Load

Submittal Report

by
Dennis Murray
Greg Pelletier

Washington State Department of Ecology
Water Quality Program
Post Office Box 47600
Olympia, Washington 98504-7600

March 2003
Publication No. 03-10-029
Printed on Recycled Paper

For additional copies of this report, contact:
Department of Ecology
Publications
P.O. Box 47600
Olympia, WA 98504-7600
Telephone: (360) 407-7472

Table of Contents

List of Tables

List of Figures

Introduction

Section 303(d) of the federal Clean Water Act mandates that the state establish Total Maximum Daily Loads (TMDLs) for surface waters that do not meet standards after application of technology-based pollution controls. The U.S. Environmental Protection Agency (EPA) has established regulations (40 CFR 130) and developed guidance (EPA, 1991) for setting TMDLs.

Under the Clean Water Act, every state has its own water quality standards designed to protect, restore, and preserve water quality. Water quality standards consist of designated uses, such as cold water biota and drinking water supply, and criteria, usually numeric criteria, to achieve those uses. When a lake, river or stream fails to meet water quality standards after application of required technology-based controls, the Clean Water Act requires the state to place the water body on a list of "impaired" water bodies and to prepare an analysis called a **Total Maximum Daily Load (TMDL)**.

The goal of a TMDL is to ensure the impaired water will attain water quality standards. A TMDL includes a written, quantitative assessment of water quality problems and of the pollutant sources that cause them. The TMDL determines the amount of a given pollutant that can be discharged to the water body and still meet standards, called the **loading capacity,** and allocates that load among the various sources. If the pollutant comes from a discrete source (referred to as a **point source**) such as a distinct discharge to a water body from an industrial facility, that facility's share of the loading capacity is called a **wasteload allocation**. If it comes from a diffuse source (referred to as a **nonpoint source**) such as a farm, that facility's share is called a **load allocation**. The TMDL must also consider **seasonal variations** and include a **margin of safety** that takes into account any lack of knowledge about the causes of the water quality problem or its loading capacity. The sum of the individual allocations and the margin of safety must be equal to or less than the loading capacity.

The Washington State Department of Ecology (Ecology) is establishing a Total Maximum Daily Load (TMDL) for dissolved oxygen (DO) and ammonia in the Colville River. This TMDL will address impairments due to low dissolved oxygen levels in nine segments on the 1998 303(d) list of impaired surface waters. This TMDL will also address impairments due to high ammonia and chlorine levels in one segment on the 1998 303(d) list of impaired surface waters.

The five components of any TMDL, as required by the Clean Water Act (CWA), are defined as:

Loading Capacity: Loading capacity is the amount of pollutants that a water body can receive without violating water quality standards. The loading capacity of the Colville River TMDL was based on the critical conditions period of August through October when dissolved oxygen levels are the lowest. A water quality model was used to determine the amount of ammonia and oxygen demanding substances that could be discharged from point sources and meet the standard for dissolved oxygen. Existing loads from nonpoint sources were used in determining the loading capacity.

Wasteload Allocation: Wasteload allocation is the portion of a receiving water's loading capacity that is allocated to one of the existing or future point sources of pollution. Wasteload allocations (WLAs) for point sources are set as allowable effluent limits for biochemical oxygen demand (BOD_5) and ammonia nitrogen (N). The wasteload allocations will be implemented through issuance of discharge permits with effluent limitations.

Load Allocation: Load allocation is the portion of a receiving waters capacity that is attributed either to one of its existing or potential nonpoint sources of pollution or to natural background sources. No reductions in existing loading are proposed for nonpoint sources. The load allocations (LAs) for nonpoint sources are equal to the existing human-caused loads during critical conditions minus estimates of background.

Margin of Safety: Margin of Safety is the means by which the analysis for the uncertainty about the relationship between pollutant loads and the receiving water quality. The margin of safety can be explicit in the form of an allocation, or implicit in the use of conservative assumptions in the analysis. Several conservative assumptions were made in the model development and application that provide an inherent margin of safety. The model used critical low flows estimated to be the seven-day average low flow with a recurrence interval of once every 29 years (7Q29). Extreme of either the 90^{th} or 10^{th} percentile values were used to estimate critical variables in the model application. The mixing zone dilution factor used was based on river flow at the established critical conditions (seasonal 7Q29).

Seasonal Variation: Dissolved oxygen data collected from the Colville River show a definite pattern of seasonal variation. August through October is the critical period for dissolved oxygen in the Colville River, corresponding to lower flows and higher temperatures. Flow-based effluent limits provide protection to the river during the low flow season when water quality protection is needed most.

Background

Located in northeastern Washington State, the Colville River watershed shown in Figure 1, lies within the Selkirk Mountains between the Pend Oreille and Columbia rivers. The Colville watershed is about 50 miles long and 25 miles wide, with a north to south orientation. Basin elevations range from 1,290 feet around the river mouth to 6,700 feet near Calispell Peak. Headwater streams start in the area 19 miles north of Spokane, while discharge is about 30 miles from the Canadian border.

The Colville River begins at the confluence of Sheep Creek and Deer Creek in southern Stevens County, and meanders northerly for about 60 river miles. Along its course the river passes through the cities of Chewelah and Colville, eventually discharging near the town of Kettle Falls to Franklin D. Roosevelt Lake, an impoundment of the Columbia River behind Grand Coulee Dam. The Colville River watershed accounts for an entire Water Resource Inventory Area (WRIA 59).

The Colville River drains a 1,016 square mile area, with all but about eight square miles of the basin contained within Stevens County. The portion outside Stevens County is the headwater area of the Little Pend Oreille River drainage, along the northeastern divide, in Pend Oreille County. The Colville River drains 41% of the land area in Stevens County. Ranking 23rd in population of the 39 Washington counties, rural Stevens County has 40,066 residents, based on the 2000 Federal Census (OFM, 2002).

The Colville River basin generally has a warm and dry continental climate, due to the Cascade Mountains to the west acting as a barrier for eastward moving marine air. To the north and east of the basin, the Rocky Mountains shield the area from extreme cold moving south from Canada, but occasionally spilling into the basin for short periods during the winter months. Monthly average temperatures at Colville range from 24.3 °F in January to 68.4 °F in July. Precipitation averages 17.2 inches per year at Colville. The range for the period 1917 to 2000 was 8.22 inches to 29.02 inches (WRCC, 2002). About two-thirds of the total annual precipitation in the basin falls between October and March. Areal distributions of precipitation are affected by topography due to the relationship between precipitation and altitude. Significant differences in precipitation occur between the valley and uplands and from the windward side of the valley (east) to the leeward (west). The average seasonal snow fall is about 48 inches and covers the ground much of the winter.

Colville River discharge is driven by a snow-melt regime. The high-flow period is in the spring as a result of melting of the previous winter snow pack, in combination with spring rainfall. April is the highest month for discharge, while August is the lowest. The majority of the tributaries to the Colville River are small, generally averaging less than 20 cfs, except for Chewelah Creek, Little Pend Oreille River, and Mill Creek. These three large streams account for just over half of the Colville River discharge. Sheep Creek, a headwater stream, is the only other tributary accounting for more than 5% of the river volume, at about 5.9%.

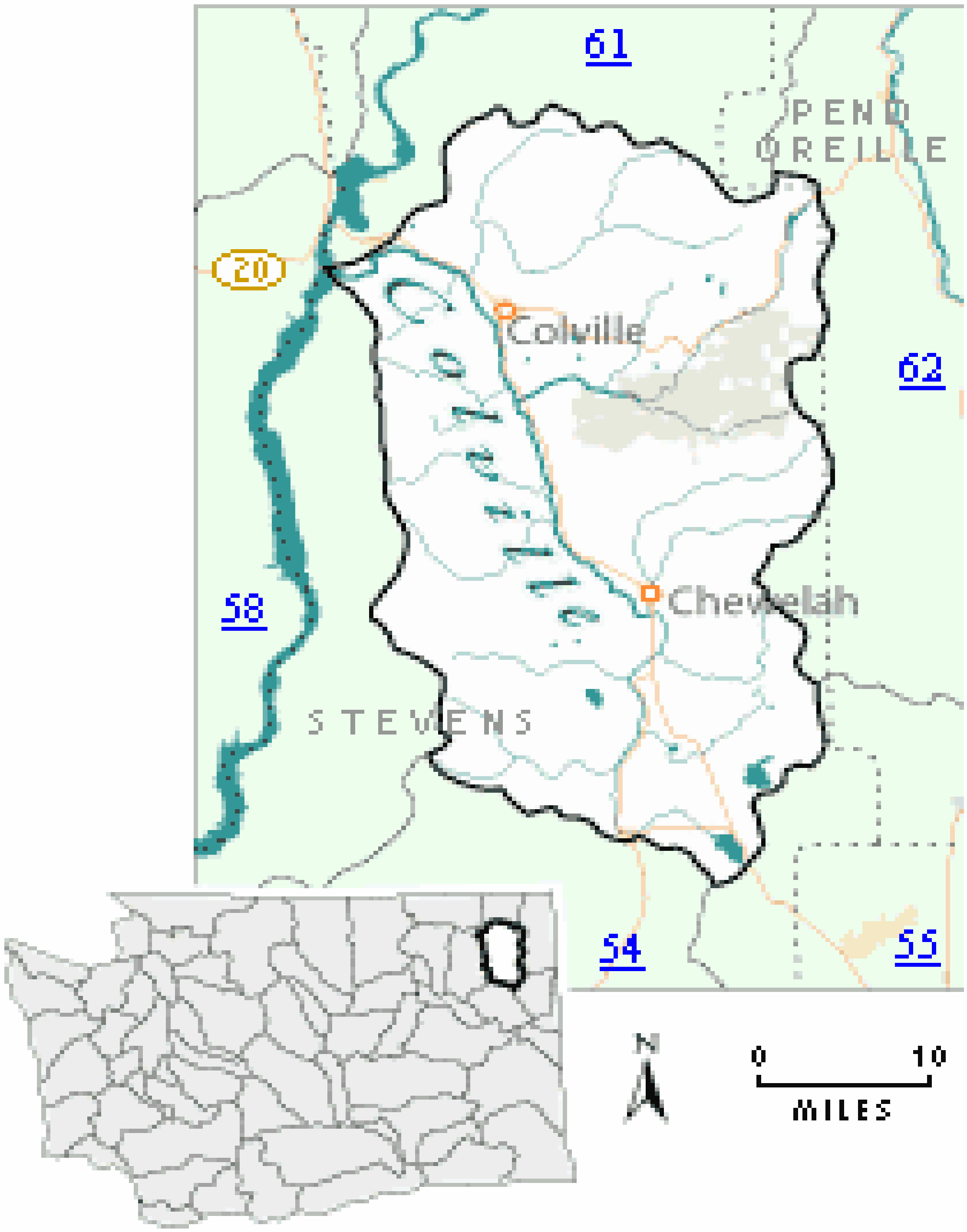

Figure 1. Map showing the Colville River watershed, WRIA 59.

Presented in Table 1 are the generalized land cover distributions for the Colville River watershed. Eighty-two percent of the land cover for the Colville River basin is within forest, shrub land, woody wetlands, and upland grasses. Most of the remainder is divided between agriculture and transitional/barren grounds. Less than 2% of the basin is covered by urban, residential, commercial/industrial, transportation, and recreational grasses. The urban/residential areas of the watershed are near the population centers of Chewelah, Colville, Kettle Falls, Springdale, and along portions of the highway corridors. The vast majority of the housing is single family residences. The sub-basins are rural/residential, with agriculture the predominant land use along the valley bottoms and on some terraces higher up. The uplands are dominated by evergreen forest, accounting for about 75% of the basin.

Table 1. Generalized land cover for the Colville River watershed (Coots, 2002).

Land Cover	Percent (%) of Watershed
Forests/Woody Wetlands/Shrub Land/Upland Grasses	82
Agriculture	10
Barren Ground	6
Urban/Residential/Commercial/Industrial/Transportation	1
Open Water/Herbaceous Wetlands	1

Description of Pollutant Sources

There are two permitted municipal wastewater treatment plants (WWTPs) that discharge to the Colville River. The city of Chewelah WWTP discharges to the mainstem at river mile (RM) 38, and the city of Colville discharges to the mainstem at RM 15. Although the major focus of the TMDL study is on point sources of pollution, nonpoint sources are considered, but only as loads from the headwaters and tributaries entering the Colville River.

Downstream from both Chewelah and Colville WWTPs, dissolved oxygen decreases rapidly during the summer months (SCCD, 1993). The TMDL study, *Colville River Water Quality:Pollutant Loading Capacity and Recommendations for TMDLs,* 96-349 (Pelletier, 1997), water quality monitoring data verified the dissolved oxygen decrease. The TMDL study is located in Appendix C of this report. The rapid decrease is influenced by sediment oxygen demand, BOD, ammonia, and algal respiration.

Ammonia concentrations in the river are highest immediately downstream from the Chewelah and Colville WWTP discharges. Modeled concentrations at the Colville WWTP mixing zone exceeded the acute water quality standards for ammonia and chlorine (Hoyle-Dodson, 1994). Ammonia concentrations decrease proceeding downstream from the WWTPs due to algal uptake and nitrification.

Applicable Criteria

Within the state of Washington, water quality standards are published pursuant to Chapter 90.48 of the Revised Code of Washington (RCW). Authority to adopt rules, regulations, and standards as are necessary to protect the environment is vested with the Department of Ecology. Under the federal Clean Water Act, the EPA Regional Administrator must approve the water quality standards adopted by the state (Section 303(c)(3)). Through adoption of these water quality standards, Washington has designated certain characteristic uses to be protected and the criteria necessary to protect these uses [Washington Administrative Code (WAC), Chapter 173-201A). These standards were last adopted in November 1997.

The TMDL is designed to address impairments of characteristic uses caused by low dissolved oxygen. The characteristic uses designated for protection of the Class A Colville River water are as follows:

> *"Characteristic uses. Characteristic uses shall include, but not be limited to, the following:*
> *(i) Water supply (domestic, industrial, agricultural).*
> *(ii) Stock watering.*
> *(iii) Fish and shellfish:*
> *Salmonid migration, rearing, spawning, and harvesting.*
> *Other fish migration, rearing, spawning, and harvesting.*
> *Clam and mussel rearing, spawning, and harvesting.*
> *Crayfish rearing, spawning, and harvesting.*
> *(iv) Wildlife habitat.*
> *(v) Recreation (primary contact recreation, sport fishing, boating, and aesthetic enjoyment).*
> *(vi) Commerce and navigation."*

[WAC 173-201A-030(1)(b)]

The water quality standards criteria for dissolved oxygen in Class A freshwaters is:

"Freshwater - dissolved oxygen shall exceed 8.0 mg/L."

[WAC 173-201A-030(2)(c)(ii)(A)]

In cases where natural background conditions exceed a standard, the water quality standards state the following:

> *"Whenever the natural conditions of said waters are of a lower quality than the criteria assigned, the natural conditions shall constitute the water quality criteria."*

[WAC 173-201A-070(2)]

Water Quality and Resource Impairments

Low dissolved oxygen levels in the Colville River are not supportive of aquatic life respiration. Relatively low dissolved oxygen concentrations were observed ten years ago during watershed water quality monitoring (SCCD 1993).

The Colville River has segments on both the 1996 and 1998 303(d) lists for not supporting beneficial uses due to dissolved oxygen violations (Ecology, 2000). The dissolved oxygen listed segment, at RM 14.7, is also listed for ammonia and chlorine. This segment is directly downstream of the Colville WWTP discharge. Ammonia is of concern as part of BOD (nitrogenous BOD) and because of toxicity criteria for protection of aquatic life. Chlorine is also a concern because of its toxicity to aquatic life.

The 1998 303(d) list is more specific as to the location of problem areas, by listing river segments roughly one mile in length upstream of where the samples were collected. The Colville River impaired segments on the 1996 and 1998 303(d) lists for dissolved oxygen, ammonia, and chlorine are shown in Table 2. Since the 1996 and 1998 dissolved oxygen listed river segments are downstream of the Chewelah and Colville WWTP discharges, all will be addressed with this TMDL.

Table 2. Colville River segments on the 1996 and 1998 303(d) lists list for dissolved oxygen, ammonia and chlorine.

Parameter	1998 Water Body ID	1996 Water body ID	Segment Location
Dissolved Oxygen	DH01PX 6.850		T36N-R38E-S26
Dissolved Oxygen	DH01PX 8.892	WA-59-1010	T36N-R38E-S29
Dissolved Oxygen	DH01PX12.712	WA-59-1010	T36N-R38E-S27
Dissolved Oxygen	DH01PX14.872		T36N-R38E-S26
Dissolved Oxygen	DH01PX16.882	WA-59-1010	T36N-R38E-S36
Dissolved Oxygen	DH01PX18.225		T36N-R38E-S31
Dissolved Oxygen	DH01PX22.274		T35N-R30E-S08
Dissolved Oxygen	DH01PX23.438	WA-59-1010	T35N-R38E-S17
Ammonia	DH01PX23.438	WA-59-1010	T35N-R38E-S17
Chlorine	DH01PX23.438	WA-59-1010	T35N-R38E-S17
Dissolved Oxygen	DH01PX54.306		T33N-R40E-S31

Technical Analysis

A steady-state model of dissolved oxygen and ammonia, based on EPA's QUAL2E, was 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 standards for dissolved oxygen and ammonia. Critical loads from nonpoint and tributary sources were estimated from sample survey data. The QUAL2E model of dissolved oxygen and ammonia was used to determine the potential to exceed water quality standards and recommend WLAs for the Chewelah and Colville WWTP discharges.

Three field water quality sampling surveys were conducted to provide data for the water quality models. Analyses of the data collected during the study and by prior investigators were used to calibrate and verify the dissolved oxygen and ammonia models of the Colville River. 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 the development of water quality models for the WWTP discharge permitting, which are seasonal low river flows. WLAs for establishing permit limits were expected to be applied seasonally using seasonal permit periods (e.g., dry season and wet season) or additional seasonal divisions. Therefore the dissolved oxygen and ammonia water quality models were calibrated and validated for seasonal low flows during all seasonal permit periods. Data from the USGS station at Kettle Falls, (station 12409000) shows that August through October are the months with the lowest flow during the dry season and November has the lowest flow of the wet season. Since the dry season was expected to have the most restrictive WLAs, two sampling surveys were conducted during the dry season to assure sufficient data for confirmation of model predictions in the dry season.

The sample sites were divided into six major groups of stations with two groups being sampled twice during each survey to measure total variability of lab parameters. Field measurements of temperature, pH, and dissolved oxygen 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 and the other sample collected in the late morning or early afternoon.

Modeling Approach

The water quality models were developed using QUAL2E combined with spreadsheet models. Model calibration and validation were based on recommendations by USEPA (1985) and Thomann and Mueller (1987).

QUAL2E was calibrated to the Colville River between RM 40.4 and 5.4 to simulate dissolved oxygen and ammonia at steady-state conditions. The mainstem was divided into 25 reaches for the QUAL2E modeling, using model notation documented in USEPA (1987). Each reach was further sub-divided into computational sections, with river lengths of 0.2 mile, which were assumed to have uniform steady-state concentrations of modeled constituents.

Hydrology data from three sources, conservation district (SCCD, 1993), Ecology, and USGS data, were summarized to estimate river flow in the QUAL2E reaches. Flow balance was used for calibration and verification of each reach for the QUAL2E modeling.

The effluents from the Chewelah and Colville WWTPs were included in the QUAL2E model as point loads. Tributary loads were also simulated as point loads based on measurements during the TMDL study. Residual inflows and outflows between sampling stations were calculated by mass balance between flow measurement stations and included in the QUAL2E model as incremental flows. Flow conditions in the river showed a wide range over the three surveys, which support the use of the model for seasonal analysis.

Results of the QUAL2E dissolved oxygen simulations for calibration and verification were compared with dissolved oxygen observed by Ecology during the August, October and November 1994 sample surveys. The model prediction uncertainty was estimated by the root-mean-squared-error (RMSE), which is a commonly used measure of model variability (Reckhow, *et al*., 1986). The QUAL2E model had an overall RMSE for dissolved oxygen of 0.4 to 0.8 mg/L for the three sample surveys. Results of the QUAL2E ammonia simulations for calibration and verification were also compared with ammonia observed by Ecology during the sample surveys. The QUAL2E model had an overall RMSE for ammonia of 0.01 to 0.05 mg/L as nitrogen (N).

WAC 173-201A-100 contains requirements for limiting mixing zones for permitted dischargers. Separate chronic and acute points of compliance are recognized. Dilution factors 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).

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. For various assumed effluent pH levels, the effluent limits for ammonia to meet criteria at mixing zone boundaries are presented in Table 3 for Chewelah and Colville WWTPs.

Table 3. Ammonia effluent limits for Chewelah and Colville WWTPs for various assumed effluent pH.

	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

Dissolved oxygen in the Colville River was found to be sensitive to effluent loads of carbonaceous BOD, ammonia, and dissolved oxygen. 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 dissolved oxygen in the river. For example, as effluent loading for carbonaceous BOD increases, effluent loading of ammonia must decrease to maintain the dissolved oxygen standard in the river.

Effluent dissolved oxygen 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 through October, the diurnal minimum dissolved oxygen in the river upstream from the WWTPs is predicted to be less than the Class A standard of 8 mg/L at critical conditions. Effluent dissolved oxygen of 3 mg/L was found to cause an additional depletion of about 1 mg/L downstream from each WWTP. Therefore, reaeration of effluent during June through October is recommended to meet the dissolved oxygen standard in the river. Reaeration of effluent is not necessary during November through May. The reaeration evaluation of the effect of effluent dissolved oxygen on in-stream dissolved oxygen is shown in Table 4.

Table 4. Reaeration evaluations 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 WWTP:				
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 WWTP (CH_2M-Hill estimates)				
flow (cfs)	1.64	1.64	3.31	3.31
DO (mg/L)	3	8	3	3
Complete mix diurnal DO below Chewelah WWTP	6.6	7.6	9.9	9.6
Colville WWTP:				
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 WWTP				
flow (cfs)	2.78	2.78	2.78	2.78
DO (mg/L)	3	8	3	3
Complete mix diurnal DO below Colville WWTP	6.2	7.2	8.7	8.4

Loading Capacity

Identification of the loading capacity is an important step in developing TMDLs. The loading capacity is the amount of pollutant a water body can receive and still meet water quality standards. By definition, a TMDL is the sum of the allocations. An allocation is defined as the portion of a receiving water's loading capacity that is assigned to a particular source. EPA defines the loading capacity as "the greatest amount of loading that a water can receive without violating water quality standards."

The loading capacity is often figured based on critical conditions. Critical conditions were evaluated in the model to estimate the effects of current waste loading to the river. Critical conditions are those possible physical, chemical, and biological characteristics of the receiving water and pollutant loading sources that can increase the adverse effects of a pollutant of concern (e.g., low river flow and increased temperature would increase the effect of a given biochemical oxygen demand load). For the Colville River, the critical period is August through October.

The analysis of field sampling data collected during the study and previous water quality monitoring, showed that the probable combined occurrence of high water temperature, low dissolved oxygen, and low river flow would be restricted to these months. The Colville River water quality critical condition values for river flow, temperature, background and nonpoint source loading, headwater and tributary concentrations, WWTP discharge characteristics, and model segment characteristics were used to determine the loading capacity and subsequent WLAs.

To estimate allowable biochemical oxygen demand (BOD) loading from the WWTPs, the dissolved oxygen standard was assumed to be met if: 1) the QUAL2E model predicted dissolved oxygen to be greater than 8 mg/L; or 2) WWTPs were predicted to cause an insignificant depletion when dissolved oxygen was less than 8 mg/L. Insignificant depletion was defined as less than 0.2 mg/L depletion below background conditions when predicted dissolved oxygen 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. Dissolved oxygen 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 dissolved oxygen depletion as no more than 0.2 mg/L also has precedent in the marine dissolved oxygen standards of WAC 173-201A and has been approved in NPDES permits to protect Washington's freshwater standards.

QUAL2E simulates BOD as ultimate carbonaceous BOD (CBODU). Relationships between CBODU, $CBOD_5$, BOD_5, and total organic carbon (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). Headwater and tributary loading of CBODU was estimated based on the average measured ratio of CBODU/TOC applied to the measured TOC.

In order to establish the loading capacity, the model was initially calibrated using data collected during the August 23-25 sampling survey. When an optimum calibration was reached for August it was then applied to the October surveys. After the best predictions and optimum calibration was achieved for both the August and October surveys, the model was applied to the November survey for verification. Comparison of the model results fit to the 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 dissolved oxygen and ammonia water quality standards.

The WWTP loads were estimated based on measured loading during the field study. Flow from incremental inflows was 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 summary of measured loads used for calibration of the QUAL2E model is shown in Appendix D.

Wasteload Allocations

The ultimate goal of a TMDL is to bring a water body into full compliance with applicable water quality standards. The Colville River is Class A according to WAC 173-201A, which requires a water quality criterion of 8 mg/L of dissolved oxygen at all times. Concentrations of dissolved oxygen less than 8 mg/L were frequently observed during August in the river downstream from the WWTP effluent discharges. The WWTP loads were estimated based on measured loading during the field study. A trial-and-error procedure was used to find WLAs for BOD and ammonia that produced an in-stream dissolved oxygen concentration that satisfied the water quality standard for dissolved oxygen (USEPA, 1983). No wasteload allocation was assigned for cholorine because disinfection using ultraviolet light will replace the chlorine system which will eliminate chlorine toxicity from the effluent.

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 through October
- November through February
- March through 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 WWTP 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 dissolved oxygen standard was met. These trial loads of ammonia would correspond to daily maximum loading limits according to Ecology policy for TMDL modeling. The dissolved oxygen standard was assumed to be met:

- if the diurnal minimum dissolved oxygen concentration was greater than 8.0 mg/L; or
- if the diurnal minimum dissolved oxygen concentration was less than 8.0 mg/L and the maximum depletion compared with zero discharge from the WWTP was less than 0.2 mg/L.

Wasteload allocations (WLAs) for point sources are set as allowable effluent limits for biological oxygen demand (BOD_5) and ammonia nitrogen as shown in Table 5. Effluent limits during June through October are the most restrictive.

Table 5. Wasteload allocations for the Chewelah and Colville WWTP discharges.

Season	Discharger	Daily Maximum BOD_5		Daily Maximum Ammonia	
		mg/L	pounds/day	mg/L as N	pounds/day
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

Seasonal Variation

Seasonal variations involve changes in stream flow as a result of hydrologic and climatologic patterns. In the Colville River mainstem seasonally high flows occur during the warmer period of late winter and in early spring from snow melt and spring rain, while seasonally low flows typically occur during the warmer summer and early fall dry periods.

Seasonal data were used whenever possible. Annual data were used to estimate variables which were not measured during some seasons (*e.g.* chlorophyll, organic nitrogen, organic phosphorus, and soluble reactive P during March through May). Seasonal 90th percentiles were estimated to represent critical temperature conditions. Data were pooled into three regions to represent spatial variability.

The U.S. Geological Survey (USGS) has operated the one long-term flow monitoring station collecting daily discharge information for the Colville River at the Kettle Falls gaging station (USGS 12409000) from 1923 to the present. A review of flow data from the USGS station shows that August through 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 sample surveys were scheduled for the dry season to assure sufficient data for confirmation of model predictions in the dry season.

Dissolved oxygen data collected from the Colville River show a definite pattern of seasonal variation coinciding with the river flow. Based on the review of the data collected during the study and by prior investigators, the critical period established for the TMDL was set to June through October. The recommended water quality-based discharge limits during June through October, November through February, and March through May vary according to seasonal changes in the assimilative capacity (e.g., river flows, temperature, etc.). The WLAs are most restrictive during June through October to meet the dissolved oxygen water quality standard.

Margin of Safety

The statute requires that a margin of safety be identified to account for uncertainty when establishing a TMDL. The margin of safety can be explicit in the form of an allocation, or implicit in the use of conservative assumptions in the analysis. Several conservative assumptions and critical conditions used in the modeling analysis of the Colville River dissolved oxygen TMDL provide an inherent margin of safety as required by the statute. These conservative assumptions and critical conditions are listed below:

- The sampling dates were chosen to represent seasonal low river flow critical conditions.
- The receiving water critical conditions were used in the modeling.
- 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). Since these are applied to the critical period of August through October, the flows are equivalent to the annual 7Q10 specified in the water quality standards (Ecology, 1991).
- Flow-based limits provide protection to the river during the low flow season when protection is needed.
- For water quality in headwaters and tributaries to the Colville River the 10^{th} or 90^{th} percentiles (whichever was more limiting) of seasonal data, or 5^{th} or 95^{th} percentiles of annual data were selected for critical conditions for modeling of WLAs.
- After calibration and verification with the Ecology water quality survey data the model was run at selected critical conditions to determine the amount of BOD and ammonia loading that would meet dissolved oxygen and ammonia standards. Model runs were conducted at critical conditions for the permit periods.
- The mixing zone dilution factor will be based on river flow at the established critical conditions (seasonal 7Q29).
- Disinfection using ultraviolet light will replace the chlorine system which will eliminate chlorine toxicity from the effluent.
- A review of USGS flow data shows that August through October are the months with the lowest flow. WLAs for establishing permit limits are to be applied seasonally. Therefore, the water quality models were calibrated and validated for seasonal low flows during all seasonal permit periods.
- WAC 173-201A-100 contains requirements for limiting mixing zones for NPDES dischargers. Separate chronic and acute points of compliance are recognized. Dilution factors 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).

Summary Implementation Strategy

Introduction

In accordance with the Memorandum of Agreement (MOA) between the Washington Department of Ecology (Ecology) and the Environmental Protection Agency (EPA), a Summary Implementation Strategy (SIS) must be included in the Total Maximum Daily Load (TMDL) submittal report to the EPA for approval of the TMDL. The SIS describes the activities conducted to date and the future activities planned that are required to implement the TMDL and achieve water quality standards.

Overview

The Colville River is presently listed as not supporting characteristic uses because of observed violations of dissolved oxygen (Ecology 1996; Ecology 2000). Ammonia and chlorine are also listed because of predicted violations of criteria at the mixing zone boundary for the Colville WWTP (Ecology, 1996).

The cities of Chewelah and Colville each operate a wastewater treatment plant (WWTP) that discharge treated wastewater to the Colville River. Both WWTPs are permitted under the Clean Water Act (CWA) National Pollutant Discharge Elimination System (NPDES). The NPDES permits are managed by Ecology's Eastern Regional Office (ERO) with an assigned permit manager.

A Colville WWTP receiving water study showed that permitted effluent loads would reduce dissolved oxygen concentrations downstream from the discharge under critical conditions in the river. Ammonia concentrations in the river were highest immediately downstream from the Chewelah and Colville WWTP discharges. Chlorine toxicity was also predicted to be a problem (Pelletier, 1989). Modeled concentrations at the Colville WWTP mixing zone boundary exceeded the acute water quality standards for ammonia and chlorine (Hoyle-Dodson, 1994). A TMDL study, the *Colville River Water Quality: Pollutant Loading Capacity and Recommendations for Total Daily Maximum Loads, 96-349* (Pelletier, 1997) was conducted to determine the capacity of the Colville River to assimilate pollutant loads and to recommend effluent limits for the Chewelah and Colville WWTPs. This study is bound separately as Ecology publication number 96-349. The web site link to this publication can be found in Appendix C, Technical Report.

A steady-state model of dissolved oxygen and ammonia, based on EPAs QUAL2E model was developed to evaluate the capacity of the river to assimilate waste loads from point and nonpoint sources and meet water quality standards. The QUAL2E model of dissolved oxygen and ammonia was used to determine the potential to violate water quality standards and recommend wasteload allocations (WLAs) for the Chewelah and Colville WWTP discharges. Critical loads from nonpoint and tributary sources were estimated from the study sampling survey data.

The success of the TMDL relies upon the upgrades of the level of treatment at the Chewelah and Colville WWTPs. Effluent limits and compliance schedules in the NPDES permits for the municipalities will result in the TMDL objective of meeting the target WLAs and achieving water quality standards by 2006.

Implementation Plan Development and Activities

Upgrading of the Chewelah and Colville WWTPs is required because of design flow exceedances, repeated failures to meet the minimum federal municipal standards, degraded downstream water quality in the Colville River, and TMDL compliance requirements. The WWTPs are being upgraded to activated sludge/extended aeration systems. Both WWTPs will have effluent reaeration capabilities. The discharge permits will be modified upon these upgrades.

The treatment plant upgrades will allow implementation of the recommended wasteload allocations (WLAs) for BOD_5 and ammonia to protect water quality standards in the Colville River. Applying Ecology's mixing zone policy for discharge permits will also benefit the attainment of ammonia levels for protection of aquatic life. In addition, the upgrades involve the replacement of the chlorine systems with ultraviolet light for disinfection, which will eliminate any chlorine toxicity from the effluent.

The city of Chewelah recently completed an upgrade of its wastewater treatment system and began operating in January 2002. The discharge permit was modified with new final effluent limitations that implement the recommended WLAs. Downstream of the Chewelah WWTP discharge, the 2002 river monitoring results have shown compliance with the TMDL requirements and the water quality standards for dissolved oxygen are being protected.

The city of Colville is in the process of upgrading its wastewater treatment system. An interim permit was issued in June 2001 with new compliance requirements and limits on new sewer connections until the new plant is completed. The WWTP upgrade is to meet the WLA requirements by July 31, 2006. The compliance schedule in the NPDES permit states that if site consolidation with preload is not required, the construction schedule shall be accelerated by one year and should be able to comply with TMDL requirements by July 31, 2005.

Summary of Public Involvement

The NPDES permits are managed by Ecology's Eastern Regional Office (ERO). ERO has staff personnel assigned as NPDES permit managers.

- Ecology's permit managers conducted numerous meetings with city officials from Chewelah and Colville and their consultants during the 1990's.

- Ecology conducted a public meeting, in March 2002, to discuss the Colville River water quality impairments, the bacteria TMDL study, and the developing Colville River dissolved oxygen TMDL.

- A Colville River watershed Water Cleanup Plan website (http://www.ecy.wa.gov/programs/wq/tmdl/watershed/colville/index.html) was introduced in June 2002. The website includes information concerning the dissolved oxygen TMDL and the recommended WLAs. The TMDL technical report is linked to the website.

- A Display Ad for a November 21, 2002 public meeting and an affidavit of its publication were issued in early November, 2002.

- The Nov. 21, 2002 meeting included a clarification that the two draft Colville River TMDL reports will be submitted to EPA as separate documents, and comments will be accepted for each during the 45-day public comment period. Discussion continued on the dissolved oxygen, ammonia, and chlorine water quality problems in the Colville River and how the WWTP discharges are a contributing source to these problems. The dissolved oxygen TMDL was discussed and how the completed Chewelah WWTP upgrade has addressed these problems and how the scheduled Colville WWTP upgrade will address these problems and protect the water quality of the river.

Please see Appendix A, Public Participation Materials, for more information concerning public involvement associated with this TMDL.

Monitoring Strategy

The upgraded Chewelah WWTP was in operation during 2002. The Discharge Monitoring Reports (DMRs) submitted from the city of Chewelah show the effluents have been well below the permit limits and in compliance with the TMDL requirements during the year 2002 low flow period. River water quality monitoring downstream of the Chewelah WWTP discharge is being conducted bi-monthly by the conservation district and the data are provided to Ecology. All of the 2002 monitoring data results show the TMDL targets are being met. This monitoring will continue through 2003. Beginning in 2004, Ecology's effectiveness monitoring conducted by the Eastern Regional Office Water Quality Program will sample once during the critical condition season to verify the TMDL requirements and that water quality standards are being met. In addition, the DMRs submitted to Ecology will be reviewed annually. The TMDL evaluation has shown the WWTP upgrade has been effective at maintaining the river dissolved oxygen levels within the water quality standards.

Since completion of the Colville WWTP upgrade will not be until July 2005 at the earliest and July 2006 at the latest, the dissolved oxygen levels downstream of the discharge will continue to violate water quality standards during the June through October critical period.

Upon the WWTP upgrade and modified permit discharge limits, the river will be monitored and evaluated for TMDL and implementation effectiveness. Interim compliance targets and WWTP effluents will be monitored through the monthly submittal of Discharge Monitoring Reports (DMRs).

Funding Sources

Chewelah received a 50 percent matching fund Centennial Clean Water grant, a state revolving fund loan, and a U.S. Department of Agriculture (USDA) Rural Development grant and loan to comply with the requirements of the TMDL. Colville has been using USDA and Rural Development funds for upgrading the collection system. Funding the new plant construction, the city of Colville is applying for Ecology grant and loan funds and possible local financing through general obligation bonds or revenue bonds, is being evaluated.

References Cited

Coots, Randy, 2002, *Colville River Fecal Coliform Total Maximum Daily Load Study*, July 2002. Washington State Department of Ecology, Olympia, WA. Pub. No. 02-03-036.

Ecology, 1991. *Guidance for Determination and Allocation of Total Maximum Daily Loads (TMDL) in Washington State.* Washington State Department of Ecology. EILS Program. Olympia, WA.

Ecology, 1996. *1996 List of Waters Requiring Establishment of Total Maximum Daily Loads (TMDLs).* May 29, 1996. Washington State Department of Ecology, Water Quality Program, Olympia, WA.

Ecology, 2000. *1998 List of Waters Requiring Establishment of Total Maximum Daily Loads (TMDLs).* January 1, 2000. Washington State Department of Ecology, Water Quality Program, Olympia, WA.

EPA. 1985. *Rates, constants, and kinetics formulations in surface water quality modeling* (second edition). EPA/600/3-85/040. U.S. Environmental Protection Agency. Environmental Research Laboratory. Athens, GA.

EPA. 1987. *The enhanced stream water quality models QUAL2E and QUAL2E-UNCAS: documentation and user model*. EPA/600/3-87/007. U.S. Environmental Protection Agency. Environmental Research Laboratory. Athens, GA.

EPA. 1991a. *Instruction materials for the workshop on the stream water quality and uncertainty model QUAL2E*. June 24-28, 1991. U.S. Environmental Protection Agency. Center for Exposure Assessment Modeling. Athens, GA.

Hoyle-Dodson, G., 1994. *Quality Assurance Project Plan for Colville POTW Class II Inspection*. Washington State Department of Ecology, EILS Program, Olympia, WA.

OFM, 2002. 2000 Federal Census Data. State of Washington, Office of Financial Management, Olympia, WA. http//www.ofm.wa.gov/census2000. Accessed January 4, 2002.

Pelletier, G.P., 1989. *Colville Wastewater Treatment Plan/Colville River Receiving Water Study*. Washington State Department of Ecology. EILS Program. Olympia, WA.

Pelletier, Greg, 1997. *Colville River Water Quality: Pollutant Loading Capacity and Recommendations for Total Maximum Daily Loads.* Washington State Department of Ecology, Olympia, WA. Pub. No. 96-349.

Reckhow, K.H., J.T. Clements, and R. Dodd. 1986. Statistical goodness-of-fit measures for wasteload allocation models. Work Assignment No. 33. EPA Contract No. 68-01-6904. September, 1986.

SCCD, 1993. *Water Quality Summary for Colville River Watershed Ranking and Plannin*g. Stevens County Conservation District, Colville, WA.

WRCC, 2002. Western Regional Climate Center. Period of Record General Climate Summary, Precipitation for Colville, Washington. http://www.wrcc.dri.edu/cgi-bin/cliGCStP.pl?wacolv Accessed January 10, 2002.

Appendix A

Public Participation Materials

Meeting Notice

WASHINGTON STATE DEPARTMENT OF ECOLOGY

More public comments sought on Colville River water cleanup plans

SPOKANE--In response to a request received at the Nov. 21, 2002, public meeting on the Colville River water-cleanup plans (sometimes called total maximum daily loads, or TMDLs), the Department of Ecology (Ecology) will hold another meeting on **Dec. 19** to take additional comments.

The meeting will take place from 6:30 to 8:30 p.m. on Thursday, Dec. 19, at the Colville Community College, 985 S. Elm St., Colville, in the Dominion Room. Please park in the east parking lot and use the east entrance.

Participants will be able to submit comments and questions on the water cleanup plans for fecal coliform bacteria and dissolved oxygen in the Colville River. The comments received at the meeting will be addressed and included in the final "submittal reports" that will go to the U.S. Environmental Protection Agency in January 2003.

Ecology will respond to questions and comments in writing to those who have signed in at the public meetings.

All comments must be submitted in writing by Jan. 4, 2003, to be included. Comments can be addressed to Dennis Murray, 4601 N. Monroe St., Spokane, Wash., 99205, or via e-mail at demu461@ecy.wa.gov.

For copies of the water cleanup plan reports or more information on the meeting, please contact Dennis Murray at 509-329-3493 or by e-mail.

News Release

FOR IMMEDIATE RELEASE – Nov. 7, 2002 02-2XX

Colville River water cleanup plans public review and comment

SPOKANE -- The state Department of Ecology (Ecology) is preparing two water cleanup plan reports that are to be submitted to the U.S. Environmental Protection Agency (EPA) in January 2003. These water cleanup plan reports show that the Colville River's beneficial uses, such as contact recreation (swimming), fishing and fish habitat are currently impaired by the presence of pollutants: fecal coliform bacteria, ammonia, dissolved oxygen and chlorine.

The reports establish maximum "limits" [Total Maximum Daily Loads (TMDLs)] on the amount of pollutants that can be discharged to the Colville River and still meet water quality standards. One water cleanup plan addresses fecal coliform bacteria and the second plan addresses ammonia, dissolved oxygen, and chlorine.

A public meeting to discuss these reports with Ecology will be held Thursday, Nov. 21, 2002 from 7:00 to 9:00 p.m. at the Stevens County Conservation District, 232 Williams Lake Rd., Colville, WA. This meeting kicks off a 45-day public-comment period on the reports prior to being submitted to EPA. A responsive summary to all comments will be included in the final TMDL submittal reports, in addition to the technical report and the implementation strategies.

Water quality experts will review the technical report that characterizes fecal coliform bacteria density and loads in the Colville River and its tributaries and sets reduction targets to achieve water quality standards. The summary implementation strategies (SISs) will also be reviewed. The SIS is an outline of the activities required to reduce the amount of pollution entering the Colville River and its tributaries.

Sources of fecal coliform bacteria pollution in the Colville River watershed include human (leaking septic systems), domestic animals (cattle, horses, and pets), birds, and wild animals. Downstream from the Chewelah and Colville POTWs dissolved oxygen was below water quality standards. The low dissolved oxygen is influenced by BOD and ammonia. Chewelah has upgraded its POTW and Colville is in the process of upgrading their POTW.

All comments must be submitted in writing by Jan 4, 2003 to be included. Comments can be addressed to **Dennis Murray**, 4601 N. Monroe St, Spokane, WA 99205 or via email demu461@ecy.wa.gov.

Contact: Jani Gilbert, public information, 509-456-4464; pager, 509-622-1289

For more information: See this Web page for more information on the Colville River TMDL: http://www.ecy.wa.gov/programs/wq/tmdl/watershed/colville/index.html

Department of Ecology seeks comments on

Two Draft Water Cleanup Plans for the Colville River Watershed

The state Department of Ecology has dra cleanup plans for the Colville River Watershed. One plan recommends actio cal coliform entering the Colville River and its tributaries to meet state water quality standards and protect the streams for recreation. The second cleanup plan addresses ammonia, chlorine and dissolved-oxygen problems in the river. The sources of these pollutants are primarily wastewater treatments plants, and work is already under way to resolve the problems.

The water clean up plans will be submitted to the Environmental Protection Agency (EPA) in January 2003 for their approval.

We welcome your comments and participation at our meeting on November 21st, and appreciate your interest in improving water quality in the Colville River watershed.

Public comment period Nov 21, 2002 to January 4, 2003

Section 1.01 Public meeting

November 21, 2002 from 7-9 p.m. at Stevens County Conservation District, 232 Williams Lake Road, Colville, WA

You can review the Water Cleanup Plans at:

- **http://www.ecy.wa.gov/programs/wq/tmdl/ watershed/colville/index.html**
- **Stevens County Conservation District (see address above)**
- **Call 509-456-4461 for a copy**

Please send comments by January 4, 2002, to Dennis Murray, Dept. of Ecology, 4601 N. Monroe St, Spokane, WA 99205 or email demu461@ecy.wa.gov

All comments must be submitted in writing to be documented in the submittal report to EPA and answered in the Response to Comments.

If you have special accommodation needs, please call Dennis Murray at (509) 456-4461 or (509) 458-2055 (TDD).

Colville River Watershed Water Quality
&
Water Cleanup Plans or TMDLs
Meeting Agenda
March 28, 2002; 7:00 pm – 8:30 pm

Steven's County Conservation District
232 Williams Lake Road, Colville, WA

7:00 Introductions & Purpose of Meeting

7:15 What is a TMDL? Why and How are they done?

7:45 Colville River Watershed Water Quality

- Colville River Bacteria Water Cleanup Plan (TMDL)
- Colville River Dissolved Oxygen, Ammonia and chlorine TMDLs
- Citizen Advisory Group (opportunity for citizen's to give input & be heard)

8:20 Comment Period and Q/A's

8:30 Adjourn

Appendix B

Responses to Comments

Comments regarding factual inaccuracies, improved wording, or that clarify policy positions by other government agencies have been directly incorporated into the text of the submittal report. All other comments are summarized below. In order to avoid redundant and/or repeated responses to similar or related comments, some comments may refer back to a previous response.

Comment #1 was recorded at the December 19, 2003 public meeting, so there is not a name associated with it as there is with the #2 and #3 written comments.

1. Comment: We (advisory committee) were told we weren't dealing with dissolved oxygen – just fecal coliform. We don't have any representation from anyone dealing with dissolved oxygen. The two documents will likely be combined and there they should be null and void since there was no representation.

Response: Ecology is submitting two separate TMDL submittal reports for the Colville River. One is the fecal coliform bacteria TMDL and the other is the dissolved oxygen TMDL. These TMDLs are two separate documents and will not be combined. The dissolved oxygen TMDL addresses the impaired river segments directly downstream from where the city of Colville and the city of Chewelah wastewater treatment plant (WWTP) discharge to the river. The strategies to meet the requirements of the dissolved oxygen TMDL will be addressed with new effluent discharge permits for these facilities. Ecology permit managers have been working directly with the appropriate city administrators for several years concerning treatment plant upgrades enabling the plant discharges to meet water quality standards.

2. Bob Playfair comments:

A. Comment: "…I feel the landowners were short-circuited in this process. The Conservation District, of which I'm a board supervisor, has operated a water quality testing program in the basin for nearly ten years. There has been an active citizens committee (WRIA Planning Unit) meeting monthly for a couple of years in this WRIA. Why then was this TMDL program singled out for the back door approach?...In the past Ecology has worked with the district to inform the landowners of a problem and help them search out a equitable solution. Only 2 inadequately advertised public meetings were held prior to announcing the rule. These were attended by a limited number of landowners. A larger audience could have been reached by involving the WRIA 59 team."

Response: A TMDL is not a rule but a planning process to meet water quality standards and therefore is not subject to the same public participation requirements for going through the rule making process. However, several methods were used to inform the watershed residents about the TMDL development:

- A news release by the Stevens County Conservation District (SCCD), *Colville River Water Quality monitoring will begin soon***,** was submitted in December 1999 to the Colville Statesman-Examiner, Chewelah Independent, and the Deer Park Tribune. This publicly announced news release made known that the TMDL water quality monitoring was to begin in March 2000 in the Colville River.

- In the June 2001 Conservation District's newsletter, an article announced the completion of Colville River bacteria monitoring and encouraged watershed residents to become involved in the water cleanup plan development. The article also stated that the newsletter would continue to keep watershed residents informed of plan progress.

- On March 7, 2002 Ecology presented a Colville River Fecal coliform bacteria TMDL briefing to the WRIA 59 Watershed Planning Unit. In addition, eight public meetings were announced and held between March and September 2002 prior to the public comment period for the TMDL submittal report. Please see the Public Participation Materials in Appendix A of the *Colville River Watershed Bacteria TMDL* submittal report for additional announcements and new releases concerning the TMDLs.

B. Comment: The Public participation approach was grossly deficient when compared with the rules imposed by the Eastern Washington Growth Management Hearings Board on the Stevens County government in their comprehensive resource planning efforts. Your efforts were short about 10 meetings and a similar number of news articles.

Response: Please see response to comment #2 A above.

C. Comment: "I also question the timing in release of the document. I just received notice that a new Rule making process is starting on the Water Quality Standards. Does this mean we will have to repeat the process in a few months?"

Response: The proposed modifications of Washington's Surface Water Quality Standards will not have an effect on the Colville River TMDL projects. It will not be necessary to repeat this TMDL process due to the proposed water quality modifications.

D. Comment: "Nowhere in the proposal documents do I find reference to the implementation of a Small Business Economic Impact study and statement provided for under the Regulatory Fairness Act (RFA), 19.85 RCW.

Response: The Washington State legislature enacted the Regulatory Fairness Act RCW 19.85, with the intent of reducing the disproportionate impact of state administrative rules on small business. The Clean Water Act (CWA) is a federal statute that requires states to cleanup their impaired water bodies. A TMDL is not a rule but a planning process to meet water quality standards and therefore is not subject to the Regulatory Fairness Act.

E. Comment: "In a couple of meetings I attended it was apparent by the comments about fencing that livestock grazing adjacent to the Colville River was the first thing to be addressed. This was apparently determined without re-looking at the original "hot spots", most of which residents know or suspect is domestic sanitation problems."

Response: This water quality project is at the beginning stages with only large geographical areas known for high fecal coliform levels or densities. The first part of the implementation plan will be additional fecal coliform water quality monitoring. This will be necessary prior to implementing appropriate site specific fecal coliform reducing BMPs. The next steps in determining the fecal coliform sources would be to: 1) focus on the river main stem segments and the tributaries that require the greatest fecal coliform reductions to meet water quality standards; 2) then decrease the geographical area of "where" the bacteria sources are; 3) then determine "what" the sources are. The upper basin of the Colville River watershed, as well as some tributaries will require additional bacteria water monitoring to determine where and what the sources are.

Landowners are not being required to fence off streams, however for those landowners who chose to construct fences on a portion of their property, federal and state cost-share funding is available through the Natural Resource Conservation Service (NRCS) or the conservation district to help off-set fencing costs. NRCS' continuous Conservation Reserve Program (CRP) does pay rental rates for the land that has been enrolled in the program. A take can also be considered the operation of a business or farm in a manner that fails to protect human health and water use, thereby denying the public's right to clean water.

F. **Comment:** **"**It has come to my attention that the state standards being imposed in this Okanogan Highlands WRIA are more restrictive than the federal requirements. If this is the case, it may explain why the Colville River today cannot always meet the state requirements."

Response: Any numerical value chosen for an indicator organism, such as fecal coliform bacteria, is associated with at least some theoretic level of risk to human health. These risks can be defined and reduced through setting water quality standards and taking control actions.

In setting standards, statistics are used to establish the level of illness expected based on the rates of illness actually observed among swimmers. The issue of setting a numerical limit at some defined level of potential illness suggests that there can be an acceptable level of risk. This means some number of illnesses in a given population is acceptable.

The Environmental Protection Agency (EPA) fecal coliform criterion of 200 cfu/100mL carries a theoretical risk level of 8 illnesses per 1,000 swimmers in freshwater (USEPA, 1986). These coliform criteria were initially described as being chosen specifically so as not to have a statistically discernable increase in illness (USEPA, 1986).

At the time Ecology established the existing fecal coliform water quality standards a discussion paper noted "it was desirable to have the fecal coliform level as low as possible to have the safest level of water to accommodate swimming" (Ecology, 1976). Ecology chose a standard that would result in a statistical discernable decrease in illness.

G. **Comment:** **"**Historically this River was a series of beaver dams with muskrats and large numbers of waterfowl. The river is cleaner today in both DO and fecals than it was when David Thompson first walked to Spokane."

Response: Neither historical nor current data on the abundance of beavers and their influence on Stevens county stream water quality is available. While we will never know what the bacteria levels were prior to settlement of the area, the current water quality standards are written to protect beneficial uses of the county water bodies.

H. **Comment:** "…I will…ask the Department to re-evaluate their [policies] and procedures bringing them in line with Stevens County Code Title 1 Public Participation Policy."

Response: Please see response to comment #2 A above.

3. Stevens County Conservation District comments:

A. **Comment:** "A steady-state model of DO, ammonia, and fecal coliform, based on EPA's QUAL2E model…." The District questions whether the model included fecal coliform. There is no other mention of fecal coliform in this report, and the draft fecal coliform TMDL submittal report does not mention the model. Please edit and/or elaborate as necessary.

   Response: Fecal coliform was simulated in QUAL2E and this was mentioned in the draft bacteria TMDL submittal report, but only in the Resource Impairments section. The 1997 Pelletier report did recommend a fecal coliform TMDL evaluation as stated in the draft report.

B. **Comment:** "This is in keeping with Ecology's watershed approach and will correspond to the Scoping year for the Colville River watershed." Ecology should elaborate by explaining the meaning and significance of the "Scoping year."

   Response: Ecology's Water Quality Program adopted the five-year, five-step "Watershed Approach to Water Quality Management" to meet the TMDL requirements of the federal CWA and Ecology's 1998 Memorandum of Agreement (MOA) with the Environmental Protection Agency. The five-year "Watershed Approach" includes these five-steps:

   - Prioritize the Listed waters in the watershed: **Year 1 "Scoping"**
   - Data Collection: **Years 2 & 3**
     &
   - Data Evaluation: **Years 2 & 3**
   - Develop Watershed Cleanup Plan (TMDL): **Year 4**
   - Implement Watershed Cleanup Plan with Effectiveness Monitoring: **Year 5**

C. **Comment:** Grammatical and editorial revisions concerning the draft submittal report.

   Response: Suggested revisions have been done.

Appendix C

Technical Report

Bound separately as Ecology Publication No. 96-349 - *Colville River Water Quality: Pollutant Loading Capacity and Recommendations for Total Maximum Daily Loads*

Website Link

http://www.ecy.wa.gov/biblio/96349.html

Appendix D

Measured Loads

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

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

Field ID	QUAL2E Point Load	Flow cfs	iDissolved Oxygen mg/L	Ultimate CBOD mg/L	Cond-uctivity umho/cm ®25 C°	Fecal Coliform col/100mL	Fecal Coliform #/day	Chloro-phyll a ug/L	Chloro-phyll a + phaeo phytin ug/L	Organic N mg/L	NH3-N mg/L	N02+ N03-N mg/L	Organic P mg/L	SRP mg/L	Total P mg/L	Total N mg/L	Kjeldahl N mg/L	Alk-alinity mg/L as CaCO3	Hard-ness mg/L as CaCO3	Chloride mg/L	N02-N mg/L	Total Organic C 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	5.70+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	0.61	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 Orville 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 P01W	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			21.0
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						1.5
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
Ctewelah 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
Stenagar 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	2.20+10			0.126	0.005	0.012	0.005	0.034	0.037	0.143				3		2.7
Little Pend Orville 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	0.1	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	319	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 I	1	0.00935			33700					19.0	253	45.5					210		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 P01W	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
StensgarCr	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	2.1	517	42	3.0E+09			0.166	0.005	0.236	0.005	0.025	0.027	0.407				3.9		3.8
Little Peed Orville k	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
Corbctt 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

I) 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 I and 1.
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.

Addendum

Colville River Dissolved Oxygen Total Maximum Daily Load Submittal Report March 2003 Ecology Publication No. 03-10-029

Ammonia TMDL

August 11, 2003

Applicable Criteria

Within the state of Washington, water quality standards are published pursuant to Chapter 90.48 of the Revised Code of Washington (RCW). Authority to adopt rules, regulations, and standards as are necessary to protect the environment is vested with the Department of Ecology. Under the federal Clean Water Act, the EPA Regional Administrator must approve the water quality standards adopted by the State (Section 303(c)(3)).

The following criteria shall be applied to all surface waters of the state of Washington for the protection of aquatic life. The ammonia criteria are a function of pH and temperature. [WAC 173-201A-040(3)]

Ammonia is listed in the Colville River downstream of the City of Colville's WWTP discharge and is addressed in this TMDL. The ammonia water quality standards are shown in Table 2.

Table 2. Numeric water quality standards for ammonia.

Freshwater acute	Freshwater chronic
0.52 ÷ (FT)(FPH)(2)	0.80 ÷ (FT)(FPH)(RATIO)

In the Colville River there is a significant seasonal difference in pH and temperature. Therefore, seasonal ammonia criteria were calculated and are shown in Table 6.

Wasteload Allocations

BOD is the amount of oxygen consumed by microorganisms while stabilizing or degrading carbonaceous and nitrogenous compounds under aerobic conditions. Ammonia is of concern as part of BOD (nitrogenous BOD). The DO is decreased in the receiving water upon nitrogen oxidation

The Colville River exhibits three distinct flow scenarios: 1) very low flows during the summer dry season of June through October; 2) moderate flows during the winter, November through February; and 3) high flow during the spring, March through May. By dividing the river into these three distinct seasons, the most flexibility for developing discharge limits that protected water quality was obtained.

The critical condition for each independent season of the Colville River was determined to be the seven day average low river flow with a recurrence interval of 29 years (7Q29). The permit discharge limits for ammonia are toxicity-based during the moderate and high flow seasons of the year. During the summer critical conditions the need to reduce effluent ammonia to the river's critical dissolved oxygen is more restrictive than toxicity-based limits for ammonia.

Very restrictive seasonal-based BOD and ammonia effluent limits are necessary to be protective of the river dissolved oxygen criterion during critical (7Q29) flows and therefore are imposed instead of the technology-based limitation. The Chewelah WWTP does not have effluent filtration to meet the extremely low BOD and ammonia concentrations required to meet the loading limits when the entire effluent flow is discharged to the river. To achieve the very low BOD and ammonia concentrations required to meet the summer maximum loading limits, the WWTP is required to divert a portion of the treated effluent to the storage lagoons to the mass loading limit for BOD and ammonia when the river flows are low. This volume management of the discharge allows flexibility for quick, incremental adjustment to the maximum loading while protecting river water quality using flow-based intervals for river flows above the 7Q29.

Table 3 in the TMDL submittal report shows the ammonia effluent limits for the Chewelah and Colville WWTPs for various assumed effluent pH. The permit limits the effluent pH to be: equal to or greater than 6.5 and less than or equal to 7.8 which lead to less restrictive limits for ammonia. Table 3 revision with pH of 7.8 effluent included is shown below.

Table 3. Ammonia effluent limits for Chewelah and Colville WWTPs for various assumed effluent pH.

		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
	7.8	2.8	3.9	1.4	2.0
	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
	7.8	9.4	9.5	4.7	4.8
	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
	7.8	4.8	14.2	2.4	7.2
	8.0	3.3	11	1.7	5.7
	8.5	2.2	7.8	1.1	3.9

The Chewelah WWTP permit limits for ammonia are:

June-October: 1.0 mg/L due to the river's critical dissolved oxygen is more restrictive than the ammonia toxicity-based limits (shown in Table 5 of the submittal report with a 15 mg/L BOD daily maximum)

November-February: 2.0 mg/L monthly average and a daily maximum of 4.0 mg/L

March-May: 2.0 mg/L monthly average and a daily maximum of 4.0 mg/L

Table 6. Ammonia wasteload allocations for the Chewelah and Colville WWTP discharges

Season	Discharger	Acute ammonia mg/L	Chronic ammonia mg/L
June-October	Chewelah	9.51	1.70
	Colville	10.08	2.85
November-February	Chewelah	11.03	6.17
	Colville	11.93	6.83
March-May	Chewelah	10.52	3.36
	Colville	15.88	21.72

The summaries of seasonal critical conditions for ammonia limits for Chewelah and Colville WWTPs in relation to pH are shown in the technical report Appendix C.