EPA Region 9 Review of the TMDLs for the Klamath River in California Addressing Nutrients, Temperature, Organic Enrichment/Low Dissolved Oxygen December 2010

Introduction

On December 8, 2010, California's State Water Resources Control Board (State Board) submitted to Environmental Protection Agency (EPA) Region 9 for review under Section 303(d)(2) of the Clean Water Act (CWA) amendments to the North Coast Regional Water Quality Control Board (Regional Board) Water Quality Control Plan (Basin Plan) to establish the Klamath River Total Maximum Daily Loads (TMDLs) addressing temperature, dissolved oxygen (DO), nutrients, and microcystin impairments in the Klamath River in California.

These California TMDLs were developed concurrently with upstream TMDLs addressing the Klamath River in Oregon as part of a comprehensive multi-state analysis of impairments and loadings to the Klamath River Basin. Oregon Department of Environmental Quality (ODEQ), the Regional Board, and EPA Regions 9 and 10 worked together with EPA's contractor TetraTech, Inc., to develop TMDLs for the impaired waterbodies in the Klamath Basin, including the Lost River, the Klamath Straits Drain, and the Klamath River from Link River in Oregon to the Pacific Ocean in California. These entities formed a technical team to develop a uniform water quality model of the Klamath River basin and conduct joint analyses to ensure compatible TMDLs in Oregon and California. Additionally, the team worked closely and cooperatively, coordinating stakeholder and public meetings, jointly publishing Notice of Availability for public review drafts[1], and preparing responses to public comments.

A predictive water quality model was developed for use in the Klamath River TMDLs for both states, referred to as the Klamath TMDL model. The Klamath River TMDL model was run by Tetra Tech, Inc., but each phase of the work was carefully reviewed by program and technical staff from the three agencies - ODEQ, Regional Board, EPA Regions 9 and 10. Together, the agencies have made substantive improvements and corrections to the model in response to TMDL needs and peer review comments.

The model was used to:

- characterize background water quality conditions
- evaluate seasonal changes in pollutants and other variables
- establish targets
- establish loading capacity values for reaches of the river ; and
- calculate TMDL load and waste load allocations and responsibilities to meet water quality standards.

[1] EPA Region 9 and the Regional Board jointly published a Notice of Availability for Public Review for the December 2009 Public Review Draft TMDLs in the following papers: Eureka Times Standard (on 12/22/09, 12/23/09 and 12/24/09; Legal Notice No. 0003350368); Santa Rosa Press Democrat (on 12/24/09; #2448420); Klamath Falls Herald and News (on 12/26/09; public notice ID # 11684991.HTM); Sacramento Bee (on 12/22/09, 12/23/09 and 12/24/09; C.C.P. 2015.5); and the Siskiyou Daily News (on 12/23/09, 12/24/09 and 12/28/09).

The State has provided an overview of the application of the model and the model configuration documentation and the modeling scenarios used for TMDL development in the Final TMDL Report[2], Chapter 3 and Appendices 6 and 7, respectively.

Natural conditions baseline loading estimates were developed using the Klamath River TMDL model. Oregon allocations were developed to meet Oregon water quality standards. Further, these allocations resulted in compliance loads that are also sufficient to meet California water quality standards for the Klamath River immediately downstream of Stateline in California.

Loading capacity assumptions for the Klamath River in California are based on the implementation of TMDL allocations and responsibilities developed for the Klamath River in Oregon necessary to meet Oregon water quality standards at the most downstream point in Oregon (aka, the Oregon-California border, or Stateline). The Oregon TMDLs for Upper Klamath and Lost River sub-basins were approved by ODEQ on December 21, 2010, and have been submitted to EPA Region 10 for review.

The TMDL submittal also contains other elements required by California law, including an Implementation Plan for the Klamath and Lost River basins in California. (The Lost River TMDL was established by EPA in December 2008, addressing those segments identified on the State's 2006 Section 303(d) lists.) EPA has reviewed these other elements and that review has informed EPA's understanding and approval of the TMDLs. However, EPA is not in this approval taking any action on the Implementation Plan or other elements provided with the TMDL submittal.

EPA has reviewed the TMDL and supporting documents, and finds that the TMDLs satisfy the requirements of Section 303(d) of the Clean Water Act, 33 U.S.C. Section 1313(d), and EPA's regulations at 40 CFR Part 130. This decision document presents the rationale supporting EPA Region 9's decision to approve the TMDLs for the Klamath River in California.

[2] Where this document cites the "Final TMDL Report", it refers specifically to the portion of the State Board's submittal: Administrative Record for the State Board Resolution No, 2010-0043, pages 1371 through 3535, presenting a "Final Staff Report," which is the March 2010 "*Final Staff Report for the Klamath River Total Maximum Daily Loads (TMDLs) Addressing Temperature, Dissolved Oxygen, Nutrient, and Microcystin Impairments in California, the Proposed Site Specific Dissolved Oxygen Objectives for the Klamath River in California, and the Klamath River and Lost River Implementation Plans*" revised to incorporate minor edits from the Regional Board and the State Board approval processes.

TMDL Review Checklist

State: California

Waterbodies: Klamath River in California

Pollutant(s): Temperature, Dissolved Oxygen, Nutrients (including total phosphorus, total nitrogen and CBOD) and Microcystin

Date of Initial Submittal: October 21, 2010

Date Received By EPA: October 21, 2010

Dates of Supplemental Submittal(s) Received by EPA: October 28, 2010, December 8, 2010

EPA Reviewer: Susan Keydel

1. Submittal Letter: *State submittal letter indicates final TMDL(s) for specific water(s)/pollutant(s) were adopted by State and submitted to EPA for approval under Section 303(d).*

On October 21, 2010, EPA received the State Water Resources Control Board (State Board) submittal letter dated October 19, 2010, from Elizabeth Haven to Alexis Strauss, requesting approval under Clean Water Act (CWA) Section 303(d)(2) of amendments to the North Coast Regional Water Quality Control Board (Regional Board) Water Quality Control Plan (Basin Plan) to establish the Klamath River Total Maximum Daily Loads (TMDLs) addressing temperature, dissolved oxygen (DO), nutrients, and microcystin impairments in the Klamath River in California. The Regional Board adopted the proposed Basin Plan amendments on March 24, 2010, under Resolution Number R1-2010-0026. The State Board approved the Basin Plan amendments on September 7, 2010, under Resolution No. 2010-0043. The State Board simultaneously sent a request for approval to the California Office of Administrative Law (OAL) and EPA, and on December 8, 2010, EPA received the California OAL approval document, OAL File No. 2010.1021-02 S, dated December 7, 2010. EPA considers the State's submittal complete as of the date of receipt of the OAL approval document.

The State Board's submittal package includes: the submittal letter, the Regional Board's Resolution, the State Board's Notice of Opportunity for Public Comment on the Regional Board's Resolution, State Board response to public comments, the agenda for the State Board meeting addressing consideration of the Basin Plan amendment, the final agenda item including the State Board Draft Resolution, the final Basin Plan amendment language, the final State Board Resolution approving the Basin Plan amendment, and the Final TMDL Report including the Regional Board's responses to public comments, and incorporating minor editorial changes from the Regional Board and State Board approval processes.

2. TMDLs Included: *The submittal clearly identifies the water segments and pollutants or stressors for which TMDLs were developed. The submittal should include the water segment identifier (e.g., NHD code) for each segment addressed. The submittal should clearly identify the TMDLs adopted for currently Section 303(d) listed waterbody-pollutant combinations. It should also clarify if TMDLs were adopted for new impairment findings (by waterbody-pollutant combinations) that do not exist on the current Section 303(d) list. If appropriate, the submittal should describe any assessment decisions that may have resulted in non-impairment status for water/pollutant combinations that exist on State's most current 303(d) list.*

The State's submittal of TMDLs for EPA approval for areas in the Klamath River Hydrologic Unit (HU) includes the following Hydrologic Area (HA) segments:

- Middle HA - Oregon to Iron Gate;
- Middle HA - Iron Gate to Scott River;
- Middle/Lower HA - Scott River to Trinity River; and
- Lower HA - Klamath Glen

These waterbody segments and the associated pollutants or stressors are presented in Table 1, below. The Final TMDL Report addresses the waterbody segment and pollutant combinations included on the State's 2006 Section 303(d) lists of impaired waters; these are presented in Table 1.1 of the Final TMDL Report. Not addressed in these TMDLs are the sediment impairments for these Section 303(d) listed segments.

Table 1 – Klamath River HU Waterbody Segments and pollutants / stressors for which Klamath River TMDLs were developed

Waterbody	Segment	HSA or other descriptor	Waterbody ID
Pollutant/Stressors - ***Nutrients, Organic Enrichment/Low Dissolved Oxygen, and Temperature (water)***			
Middle HA	**Oregon to Iron Gate**	Iron Gate HSA 115.37 and Copco HSA 105.38.	CAR1053702220011219001110
Middle HA	**Iron Gate Dam to Scott River**	Beaver Creek HSA 105.35 Hornbrook HSA 105.36.	CAR1053505320011215015907
Middle HA and Lower HA	**Scott River to Trinity River**	Ukonom HSA 105.31, Happy Camp HSA 105.32, Seiad Valley HSA 105.33 and Orleans HSA 105.12	CAR1053107519990610152950
Lower HA		Klamath Glen HSA 105.11	CAR1051108619990608084033
Pollutant/Stressors - ***Cyanobacteria hepatotoxic microcystins***			
Middle HA	**Oregon to Iron Gate**	Klamath River Mainstem, excluding the riverine reach from the Oregon border downstream to the beginning of Copco 1 Reservoir. (part or all of: Copco Lake HSA 105.38, and Iron Gate HSA 105.37)	CAR1053702220011219001110
Middle HA	**Oregon to Iron Gate**	Copco I and II Reservoirs	CAL1053802120020720133912
Middle HA	**Oregon to Iron Gate**	Iron Gate Reservoir	CAL1053702320020720133707
Middle HA	**Iron Gate Dam to Scott River**	Klamath River Mainstem in (part or all of: Iron Gate HSA 105.37, Hornbrook HSA 105.36, Beaver Creek HSA 105.35, and Seiad Valley HSA 105.33)	CAR1053505320011215015907
Middle HA and Lower HA	**Scott River to Trinity River reach**	Klamath River Mainstem in Ukonom HSA 105.31, Happy Camp HSA 105.32, Seiad Valley HSA 105.33, and Orleans HSA 105.12	CAR1053107519990610152950

3. Water Quality Standards: *Submittal describes applicable water quality standards, including beneficial uses, applicable numeric and/or narrative criteria.*

The Klamath River in California is impaired and included on the State's 2006 CWA Section 303(d) list. It does not meet Basin Plan water quality objectives for the pollutant/stressors of temperature, organic enrichment/low DO, and nutrients. The reach of the Klamath River that includes Copco and Iron Gate Reservoirs is additionally impaired and on the State's 2006 Section 303(d) list for the cyanobacteria toxin, microcystin.

The State developed these TMDLs using the:

- Regional Board Basin Plan for water quality objectives for the segments of the Klamath River falling under the jurisdiction of the State, and
- Hoopa Valley Tribe's *Water Quality Control Plan for the Hoopa Valley Indian Reservation* for water quality criteria, as approved by EPA (Feb 14, 2008), for the portion of the Klamath River falling under the jurisdiction of the Hoopa Valley Tribe (HVT).

Additionally, three other tribes with land along the Klamath River (the Karuk Tribe, the Resighini Rancheria, and the Yurok Tribe) have adopted water quality standards. Although these tribal water quality standards have not been submitted to or approved by EPA under the CWA, they were used by the Regional Board as guidance in developing the TMDLs. The Karuk Tribe, the Resighini Rancheria, and the Yurok Tribe water quality objectives and criteria are presented in the Final TMDL Report, Section 2.2.2.4.

The Regional Board developed TMDLs to ensure allocations will lead to achievement of water quality standards, and protection of beneficial uses in the Klamath River. The TMDL submittal identifies 23 designated beneficial uses for the Klamath River Basin. Of the designated beneficial uses, 17 are identified as impaired: cold freshwater habitat (COLD); rare, threatened, and endangered species (RARE); migration of aquatic organisms (MIGR); spawning, reproduction, and/or early development of fish (SPWN); commercial and sport fishing (COMM); Native American cultural use (CUL); subsistence fishing (FISH); Water contact and noncontact water recreation (REC1 and REC2); Agricultural supply (AGR); Aquaculture (AQUA); Estuarine habitat (EST); Marine habitat (MAR); Municipal and domestic supply (MUN); Shellfish harvesting (SHELL); Warm freshwater habitat (WARM); and Wildlife habitat (WILD) (see Final TMDL Report, Section 2.2.1.1).

The Regional Board's water quality objectives and HVT water quality criteria used in developing these TMDLs are summarized below and presented in the Final TMDL Report Section 2.2.1.2.

3.1 Temperature

The HVT does not have temperature criteria for the Klamath River. The Regional Board Basin Plan includes two separate water quality objectives for temperature.

1. The intrastate temperature objective - a narrative objective with associated numeric criteria, applicable to all waters of the state.

   > *The natural receiving water temperature of intrastate waters shall not be altered unless it can be demonstrated to the satisfaction of the Regional Water Board that such alteration in temperature does not adversely affect beneficial uses.*
   >
   > *At no time or place shall the temperature of any COLD water be increased by more than 5°F above natural receiving water temperature.*
   >
   > *At no time or place shall the temperature of WARM intrastate waters be increased more than 5°F above natural receiving water temperatures.*

2. The interstate temperature objective contained in the State's *Water Quality Control Plan for Control of Temperature In the Coastal and Interstate Waters and Enclosed Bays and Estuaries of California* (Thermal Plan), which is incorporated by reference in Appendix 3 of the Basin Plan. The plan designates the Klamath River as a "Cold Interstate Water." The "Cold Interstate Waters" objective is as follows:

   > *Elevated temperature waste discharges into cold interstate waters are prohibited.*

   The interstate objective applies to waters that cross or define the state border. The interstate temperature objective augments, but does not supersede, the intrastate temperature objective.

3.2 Dissolved Oxygen

The Regional Board determined the existing site specific objectives (SSOs) for dissolved oxygen (DO) required revision for the mainstem Klamath River. Appendix 1 of the Final TMDL Report presents the *Staff Report for the Proposed Site Specific Dissolved Oxygen Objectives for the Klamath River in California*. The revised DO SSOs were amended to the Basin Plan (3/24/10), approved by State Board (9/7/10) and OAL (12/7/2010), and approved by EPA (12/21/2010).

The revised DO SSOs were applied in the development of the State's TMDLs. The DO SSOs, reproduced below in Table 2, are presented as percent saturation based on natural temperature conditions. (Source: Final Basin Plan Amendment Language, State Board Administrative Record, pages SB-692 and 693).

Table 2 - Dissolved Oxygen Site Specific Objectives

Table 3-1a[1]

Location[2]	**Percent DO saturation based on natural receiving water temperatures**[3]	**Time period**
Stateline to the Scott River	90%	October 1 through March 31
	85%	April 1 through September 30
Scott River to Hoopa	90%	Year round
Downstream of Hoopa-California boundary to Turwar	85%	June 1 through August 31
	90%	September 1 through May 31
Upper and Middle Estuary	80%	August 1 through August 31
	85%	September 1 through October 31 and June 1 through July 31
	90%	November 1 through May 31
Lower Estuary	For the protection of estuarine habitat (EST), the dissolved oxygen content of the lower estuary shall not be depressed to levels adversely affecting beneficial uses as a result of controllable water quality factors.	

1 - States may establish site specific objectives equal to natural background (USEPA, 1986. Ambient Water Quality Criteria for Dissolved Oxygen, EPA 440/5-86-033; USEPA Memo from Tudor T. Davies, Director of Office of Science and Technology, USEPA Washington, D.C. dated November 5, 1997). For aquatic life uses, where the natural background condition for a specific parameter is documented, by definition that condition is sufficient to support the level of aquatic life expected to occur naturally at the site absent any interference by humans (Davies, 1997). These DO objectives are derived from the T1BSR run of the Klamath TMDL model and described in Tetra Tech, December 23, 2009 *Modeling Scenarios: Klamath River Model for TMDL Development.* They represent natural DO background conditions due only to non-anthropogenic sources and a natural flow regime.

2 - These objectives apply to the maximum extent allowed by law. To the extent that the State lacks jurisdiction, the Site Specific Dissolved Oxygen Objectives for the Mainstem Klamath River are extended as a recommendation to the applicable regulatory authority.

3 - Corresponding DO concentrations are calculated as daily minima, based on site-specific barometric pressure, site-specific salinity, and natural receiving water temperatures as estimated by the T1BSR run of the Klamath TMDL model and described in Tetra Tech, December 23, 2009. Modeling Scenarios: Klamath River Model for TMDL Development. The estimates of natural receiving water temperatures used in these calculations may be updated as new data or method(s) become available. After opportunity for public comment, any update or improvements to the estimate of natural receiving water temperature must be reviewed and approved by Executive Officer before being used for this purpose."

HVT have DO criteria for the Klamath River that consist of three components: water column DO criteria, inter-gravel DO criteria, and a natural conditions clause. The water column DO criteria for the designated use COLD (year-round) require the 7-day moving average of the daily minimum DO in the water column to not drop below 8.0 mg/L. For the designated use SPWN (whenever spawning occurs, has occurred in the past or has potential to occur) the 7-day moving average of daily minimum DO in the water column may not drop below 11.0 mg/L, and the inter-gravel DO criteria requires the 7-day moving average of the daily minimum DO

in the inter-gravel water to not drop below 8.0 mg/L. The Natural Conditions component is applied if the HVT DO numeric criteria are not achievable due to natural conditions; in such cases, the COLD and SPWN standards instead are DO concentrations equivalent to 90% saturation under natural receiving water temperatures. The State's TMDLs achieve and utilize the HVT natural conditions DO criteria; these were used because the HVT DO numeric criteria are not achieved at all times by the natural baseline conditions (estimated using the Klamath River TMDL model). Specifically, the SPWN criteria are not achievable in late spring and early fall, and COLD criteria are not achievable for limited periods in the summer).

3.3 Nutrients

Regional Board Basin Plan water quality objectives and HVT criteria related to nutrients for the applicable reaches of the Klamath River consist of both narrative and numeric criteria.

For biostimulatory substances - the Basin Plan and the HVT *Water Quality Control Plan for the Hoopa Valley Indian Reservation* contain the same narrative text, which reads:

> *Waters shall not contain biostimulatory substances in concentrations that promote aquatic growths to the extent that such growths cause nuisance or adversely affect beneficial uses*.

For nutrients in the Klamath River, HVT also have narrative and numeric criteria.

- *The mean nutrient concentrations in any 30-day period from May - October shall not exceed the values shown in* ***Table 3.2*** [reproduced below]. *If total nitrogen and total phosphorus standards are not achievable due to natural conditions*[1]*, then the standards shall instead be the natural conditions for total nitrogen and total phosphorus.*
  ([1] Through consultation, the ongoing TMDL process for the Klamath River is expected to further define these natural conditions.)

Table 3.2 *– Klamath River Nutrient Criteria Standards*

Parameter	**Standard** (mg/L)
Total Nitrogen (TN)	0.2
Total Phosphorus (TP)	0.035

- Nitrate: [For all waterbodies except those designated with municipal or domestic supply use], the levels of nitrate shall not be increased by human related activity above the levels consistent with preservation of the specified beneficial uses.

- Nitrite: Levels of nitrites shall not be increased, in any body of water, by human related activity above the levels consistent with preservation of the specified beneficial use corresponding to that water body.

- Phosphates: In order to preserve the existing quality of water within the reservation boundaries from existing and to avoid potential eutrophication of phosphorus in any water body shall not be increased by human related activity above levels consistent with preservation of the specified beneficial uses. [sic]

- Periphyton: the maximum annual periphyton biomass shall not exceed 150 mg chlorophyll *a*/m^2 of streambed area.

The TMDL identifies additional nutrient related water quality objectives - pH, toxicity - that influence nutrient cycling and thus beneficial use impairment from biostimulation.

3.4 pH

The Basin Plan criteria for pH in the Klamath River specify that minimum pH levels shall not drop below 7.0 and maximum pH shall not be raised above 8.5. Similarly, HVT water quality criteria specify that pH in the Klamath River shall be maintained within 7.0 and 8.5 at all times.

3.5 Microcystins & *Microcystis*

With regard to microcystin, the toxin produced by species of cyanobacteria including *microcystis*, the Basin Plan includes a narrative objective for toxicity that reads: *All water shall be maintained free of toxic substances in concentrations that are toxic to, or that produce detrimental physiological responses in human, plant, animal, or aquatic life.*

HVT water quality criteria for the Klamath River specify that for *Microcystis aeruginosa* and microcystin criteria, waters "shall not exceed the values shown in ***Table 3.3***" (reproduced below), and include the following narrative criteria:

> *All waters shall be maintained free of toxic substances in concentrations that produce detrimental physiological responses in human, plant, animal, or aquatic life.*
>
> *There shall be no presence of cyanobacterial scums.*

Table 3.3 - Hoopa *Microcystis aeruginosa* and microcystin criteria for the Klamath River

Parameter	**Hoopa Standard**	**Rationale**
Microcystis aeruginosa cell density	<5,000 cells/mL for drinking water <40,000 cells/mL for recreational water	Combination of WHO and Oregon guidelines-- protection of public health
Microcystin toxin concentration	<1µg/L total microcystins for drinking water <8 µg/L total microcystins for recreational water	<1µg/L total microcystins for drinking water <8 µg/L total microcystins for recreational water
Total potentially toxigenic bluegreen algal species (1)	<100,000 cells/mL for recreational water	Oregon guidelines—protective of public health
1) Includes: *Anabaena*, *Microcystis*, *Planktothrix*, *Nostoc*, *Coelosphaerium*, *Anabaenopsis*, *Aphanizomenon*, *Gloeotrichia* and *Oscillatoria*.		

EPA finds the State's TMDL submittal has properly identified the applicable State and Tribal water quality standards for the Klamath River in California.

4. Numeric Target(s): *Submittal describes numeric water quality target(s) for TMDL, and adequate basis for target(s) as interpretation of water quality standards is provided.*

Numeric targets refer to quantified water quality conditions that represent attainment of the water quality standards, and serve as good indicators of progress towards TMDL compliance and beneficial use support. The TMDLs rely upon: (1) numeric water quality objectives and (2) numeric water quality target(s) as interpretations of conditions that meet a narrative water quality objective. Numeric targets used for temperature, DO and nutrients are summarized below.

4.1 Temperature

Numeric water temperature targets, expressed as monthly average temperatures, were calculated from the natural temperature regime for the riverine segments (estimated using the Klamath River TMDL model).

Location specific targets expressed as monthly average temperature are presented in the identified table for the following locations:

- Stateline - Table 5.3
- Copco and Iron Gate Reservoir tailraces – Table 5.4
- Iron Gate Hatchery – Table 5.6

Secondary targets were established for riparian shade (effective shade) and to address sediment related temperature impacts (via channel alteration, diversion potential at stream crossings, and road-related landslides). Stream temperature increases from human-caused discharges of sediment constitute an exceedance of the water quality objective for temperature.

Riparian shade targets are expressed as site-potential effective shade, and are a measure of the percentage of total daily direct beam solar radiation blocked by vegetation or topography before reaching the ground or stream surface, taking into account differences in solar intensity that occur throughout a day. The Final TMDL Report presents curves of percent effective shade values developed for July 21, the beginning of the period of peak water and air temperatures, and TMDL targets require the site-potential effective shade to meet the load allocation for excess solar radiation where natural factors affect site-potential effective shade. The Final TMDL Report Figures 5.4 through 5.9 present effective shade condition curves for six different types of vegetation, three aspect categories and various bankfull stream widths. These curves constitute the numeric targets for riparian shade with the Klamath River basin in California.

Temperature targets related to sedimentation include:

- an in-stream target - 0 miles of substantial human-caused sediment-related channel alteration;
- a target for road diversion or failure - <1% of all road-stream crossing diversions or failures as a result of a 100-year or smaller floods; and
- a target of a decreasing trend of road-related landslides.

4.2 Dissolved Oxygen

DO targets represent concentrations corresponding to the Klamath River TMDL model, California compliant conditions scenario. They are expressed as monthly mean and monthly minimum DO concentrations. These values meet, and at times are more stringent than, DO concentrations representative of the DO site specific objective for percent saturation (see Section 3, above). Location-specific DO targets are presented in the following tables of the Final TMDL Report:

- Stateline - Table 5.7
- Copco and Iron Gate Reservoir tailraces – Table 5.9
- Iron Gate Hatchery discharges – Table 5.11
- Klamath River Mainstem below the Salmon River – Table 5.13

4.3 Nutrients

Nutrient and organic matter effects are closely tied to DO, and thus nutrient impairments are partially addressed by TMDL allocations to attain DO targets. To further address nutrients (TN and TP) and organic matter (addressed as carbonaceous biochemical oxygen demand, CBOD), narrative biostimulatory and toxicity objectives were interpreted by developing numeric targets for benthic algae biomass, suspended algae chlorophyll-a, *Microcystis aeruginosa* cell density, and microcystin toxin concentration.

Nutrient targets for TN, TP and CBOD are expressed as monthly average concentrations. These targets reflect the nutrient reductions necessary to achieve water quality standards for both primary and the additional nutrient targets (e.g., chlorophyll-a), under the Klamath River TMDL model, California Compliant conditions scenario.

Numeric targets applicable to the specified locations for both water quality standards and the above algal targets addressing narrative biostimulatory objectives are presented in the following tables of the Final TMDL Report:

- Stateline - Table 5.8
- Copco and Iron Gate Reservoir, at the tailraces – Table 5.10.
- Iron Gate Hatchery – Table 5.12
- Klamath River Mainstem below the Salmon River – Table 5.14
- Major tributaries to Klamath River in CA– Table 5.15 (Shasta River TN, TP, and CBOD allocations are consistent with the existing Shasta River TMDL, approved by EPA in 2006)
- Minor tributaries to Klamath River in CA – Table 5.16

Biostimulatory and toxicity targets take into consideration reach-specific hydrodynamic characteristics. The Klamath River alternates between free-flowing riverine reaches and impounded conditions, and different water quality targets are required. The following are algal targets for each of these conditions.

- **Free-flowing reaches benthic algal biomass** = 150 mg chlorophyll-*a* /m^2, applied as a reach-average in the growing season (June - September). The TMDL specifies the growing season reach-average should be measured at a minimum of three points (in

close proximity to TMDL compliance points) and identifies protocols to be used. This target corresponds to the Hoopa Valley Tribe's water quality criterion for periphyton biomass.

- **Quiescent waters (Klamath River reservoirs, backwater eddies and estuary)** -
    - Suspended algae (phytoplankton) biomass = 10 ug/L chlorophyll-*a*, applied as a growing season (May to October) mean. Chlorophyll-*a* is a surrogate measure to assess nutrient biostimulatory narrative criteria for water quality pollutants (stressors).
    - Cyanobacteria targets correspond with *Microcystis aeruginosa* and microcystin toxin levels expected to result in low probabilities of adverse health effects per World Health Organization (WHO)[3]: *Microcystis aeruginosa* cell density ≤ 20,000 cells/mL and Microcystin Toxin concentration < 4 ug/L

  Monitoring requirements for each reservoir with recreational uses are identified in the Final TMDL Report.

EPA's review finds the State's approach to developing targets is reasonable and includes an environmentally protective approach to account for uncertainty in the relationship between pollutant loading levels and attainment of water quality standards, as required by CWA Section 303(d)(1)(C).

5. Source Analysis: *Point, non-point, and background sources of pollutants of concern are described, including the magnitude and location of sources. If point sources are present, submittal identifies existing NPDES permits by name and number. Submittal demonstrates all sources have been considered.*

The Final TMDL Report (Chapter 4) provides extensive analysis of sources of impairment; magnitudes were determined using empirical data and the Klamath River TMDL model.

Point sources:

The Iron Gate Hatchery is the only discrete point source for the Klamath River in California. It accounts for less than 1% of the total loads for TP, TN or CBOD. Iron Gate Hatchery operates under an existing NPDES permit and Waste Discharge Requirement (NPDES Permit No. CA0006688 and WDR No. R1-2000-17), described in the Final TMDL Report, Section 4.2.3

Three Statewide NPDES permits operable in the Klamath Basin include the California Department of Transportation Statewide Stormwater General Permit (NPDES Permit No. CAS000003), the California Construction General Stormwater Permit (NPDES Permit No. CAS000002), and the California Non-Construction General Stormwater Permit (NPDES Permit No. CAS000001).

[3] WHO 2003 Guidelines for Safe Recreational Water Environments, Volume 1, Coastal and Fresh Waters. Geneva, Switzerland.

Non-point sources and other inputs:

The Final TMDL Report identified the following geographic non-point source areas:

- Stateline waters entering California from Oregon. ODEQ's Klamath River TMDLs address sources for the Klamath River in Oregon.
- Klamath Hydroelectric Project Reservoirs in California created by: (a) Copco 1 and 2 dams (treated as a single source) and (b) Iron Gate dam.
- Tailrace waters from the Klamath Hydroelectric Project dams
- Four river tributaries (Shasta, Scott, Salmon, and Trinity Rivers)
- Six combined groups of smaller creeks (Stateline to Iron Gate reach tributaries, Iron Gate to Shasta, Shasta to Scott, Scott to Salmon, Salmon to Trinity, and Trinity to Turwar)

Additionally, sources of temperature impairments include effects of excess solar radiation and effects of excess sediment loads.

Quantitative load estimates for each of these areas were developed. Source areas for total phosphorus, total nitrogen, and organic matter (as CBOD) are identified in Table 4.2 of the Final TMDL Report. This table presents both annual loads and critical period (May through October) loads, for current and natural baseline conditions. This table also presents the relative magnitude of each source (as percent total annual loading). The sources with the greatest magnitude for TP, TN and CBOD loads are Klamath River at Stateline and the four California river tributaries. The Trinity River represents the largest contribution to Klamath River from a tributary, followed by the Scott River.

The TMDL submittal has further identified the Klamath Hydroelectric Project (KHP) dams in California as additional sources of temperature, DO and nutrient impairments, because river waters containing pollutants are impounded, and the resulting change in physical conditions (velocity, depth, etc.) create conditions in the reservoirs that lead to violations or increased violation of water quality standards in the reservoirs.

EPA finds that the TMDL submittal adequately considers all significant sources by examining relevant and available data, and sufficiently describes sources of impairments, and their magnitude and locations. EPA supports the State's approach, identifying the incremental impairment due to the dams as sources of temperature, DO and nutrient impairments.

6. Linkage Analysis: *Submittal describes relationship between numeric target(s) and identified sources of impairments.*

The State examined all relevant studies to provide an analysis of the linkage between source levels and water quality within the Klamath River. The Final TMDL Report (Section 2) includes detailed discussions of the relationships between water quality impairment parameters and numeric targets, and presents a conceptual model to convey the relationship of pollutants to the current water quality impairments.

To establish quantitative relationships between loadings and instream water quality responses, the Klamath TMDL model was used. This is an integrated hydrodynamic water quality modeling framework, incorporating several models. For flowing reaches of the river, the Resource Management Associates RMA-2 and RMA-11 models were applied; the U.S. Army Corps of Engineers' CE-QUAL-W2 model was applied to quiescent waters; and, the EPA Environmental Fluid Dynamics Code (EFDC) model was used for the estuary. The specific model applied to each segment of the Klamath River and estuary is presented in Table 3.1 of the Final TMDL Report. These models were optimized, calibrated and corroborated using available data collected over several years, and applied in series to the Klamath River from Upper Klamath Lake in Oregon to where the Klamath River discharges to the Pacific Ocean at the California coast. Tributaries to the river were represented as boundary conditions (i.e., they were not explicitly modeled), and existing TMDL allocations for tributaries were used in this analysis.

The Klamath River TMDL model linked water quality conditions for the Klamath River to source loading and the assimilative capacity of each reach, by continuously simulating changes in various parameters of concern for specific time increments and at specified locations. The model deterministically represents the cause-effect relationship between sources and water quality conditions throughout the Klamath's riverine, reservoir, and estuarine portions. By representing conditions in great spatial and temporal detail, the model effectively considers a spectrum of conditions that may be overlooked by simpler analyses.

The final water quality model (the Klamath River TMDL model) was calibrated using empirical data from 2000 and corroborated using data from 2002 to optimize the model's accuracy and predictive capabilities; the estuary segment was calibrated using data from 2004.

The model was used to:

- characterize background water quality conditions
- evaluate seasonal changes in parameters and impairment status
- establish targets
- establish loading capacity values for reaches of the river; and
- calculate TMDL load and waste load allocations and responsibilities (see Item 7 below) to meet water quality standards.

EPA finds the State's linkage analysis thoroughly addresses the relationship between water quality impairment parameters and numeric targets, considering seasonal variation, natural conditions estimation, and sources of anthropogenic loading that impact water quality conditions.

7. TMDL and Allocations: *Submittal identifies the total allowable load, waste load allocations for all point sources and load allocations for non-point sources. The TMDL must be set equal to or less than the loading capacity. If no point sources are present, waste load allocations are zero. If no non-point sources are present, load allocations are zero. TMDLs and allocations should be expressed in terms of daily time steps. If the TMDL and/or allocations are also expressed in terms other than mass loads per day, the submittal explains why it is reasonable and appropriate to express the TMDL in those terms.*

These TMDLs were developed concurrently with upstream TMDLs addressing the Klamath River in Oregon (by ODEQ), as part of a comprehensive multi-state effort to analyze water quality impairments to the Klamath River. TMDL loading capacities were developed to first meet Oregon water quality standards for the Klamath River down to the Oregon/California border, where compliance with California water quality standards was confirmed. For the Klamath River in California, loading capacities were then developed based on the available loading capacity and assuming water quality compliant conditions at Stateline (thus, assuming full compliance with the ODEQ Klamath River TMDLs). Allocations were developed for temperature, DO and nutrient impairments to meet loading capacities. Both loading capacity and allocations vary spatially (in the various river reaches or reservoir segments of the Klamath River) and temporally (e.g., seasonally).

7.1 TMDL Loading Capacity:

Temperature

For the riverine portions of the Klamath River in California, the applicable objectives do not allow for the discharge of elevated temperature waste (interstate objective) or increases over natural water temperatures unless a proposed increase is less than 5°F and doesn't adversely impact beneficial uses (intrastate objective). Existing water temperatures in the Klamath River and reservoirs in California already adversely affect beneficial uses during critical time periods. Thus, the temperature loading capacity equals the natural receiving water condition, and no increase is permissible. The loading capacity in all riverine reaches is zero.

There is no allowable temperature increase above natural conditions for riverine waters. The loading capacity for waters within Copco and Iron Gate Reservoirs is presented as the temperature condition of water as it enters the reservoirs with an allowance given for the reservoir reaches, calculated as the difference of downstream (at tailrace) and upstream (at inlet) daily maximum and daily average temperatures.

Dissolved Oxygen, Nutrients and Organic Matter

The Klamath River is often described as nitrogen limited; however, the loading capacity analysis addresses total phosphorus (TP), total nitrogen (TN), and organic matter (measured as CBOD) to comprehensively address the dominant nutrient stressors influencing biostimulatory and toxicity related impairments. The loading capacities for dissolved oxygen and nutrient-related water quality impairments are closely interrelated because of the strong relationship between biostimulatory conditions, decomposition of organic matter, and resulting dissolved oxygen conditions.

For the riverine reaches of the Klamath River in California, loading capacities for specific reaches were identified for nutrients (TP and TN) and organic matter (CBOD). Figures 5.1, 5.2, and 5.3 (for TP, TN and CBOD, respectively) of the Final TMDL Report graphically present annual cumulative loading capacity for the riverine reaches. The contribution of nutrient and organic matter natural background loads is incorporated into the load for each source area.

Loading capacity for the reservoir segments differ significantly from free flowing river reaches. For the reservoirs, the TMDL submittal describes the reduced loading capacity caused by dam-induced changes in hydrodynamics. Copco and Iron Gate dams decrease flow rates and thereby increase residence time, which results in DO and nutrient impairments (e.g., oxygen deficits found in the hypolimnion during the summer months) as well as biostimulatory condition impairments (e.g., high levels of chlorophyll-*a* and blue-green algae). By comparing the loading capacities under three conditions - current conditions, conditions demonstrating compliance without the presence of dams, and conditions representing compliance with the dams present - the reduced assimilative capacities due to the presence of the dams and reservoirs can be roughly estimated as greater than 35% (TP), greater than 25% (TN) and greater than 40% (CBOD). These comparisons are illustrated for TP, TN and CBOD in Figures 5.12, 5.13 and 5.14, respectively, of the Final TMDL Report.

7.2 TMDL Allocations

Wasteload Allocations

Wasteload allocations are identified for Iron Gate Hatchery, applicable to the NPDES permit for that facility:

- temperature - zero increase above natural temperature, based on California compliance conditions (Final TMDL Report Table 5.6).
- DO - allocations correspond to California compliance conditions (Final TMDL Report Table 5.11).
- nutrients and organic matter - zero net increase above California compliance conditions, expressed as monthly mean concentrations for TN, TP and CBOD (Final TMDL Report Table 5.12).

Wasteload allocations applicable to the relevant Statewide NPDES stormwater permits (see Section 5, above) corresponding to the watershed-wide allocations to address temperature impairments (see Basin Plan Table 4-15) are: zero temperature increase caused by substantial human-caused sediment-related channel alteration.

Load Allocations:

The State has also identified load allocations for non-point sources that are applicable watershed-wide and for specific locations in California waters.

Temperature

Watershed-wide allocations for temperature impairments apply to the Klamath River Middle and Lower Hydrologic Areas. These are identified in the Basin Plan Table 4-15, and include:

- Riparian Shade: the shade provided by topography and full potential vegetation conditions at a site, with an allowance for natural disturbances (e.g., floods, wind throw, disease, landslides, and fire).
- Human-caused discharges of sediment: zero temperature increase caused by substantial human-caused sediment-related channel alteration.

Major tributaries are not assigned any additional temperature allocations. The Scott, Shasta and Salmon River watersheds already have allocations through existing temperature TMDLs for those waters. The Lost and Trinity are not listed as impaired for temperature.

Location-specific riverine allocations developed for temperature impairments are:

- *zero increase above natural temperature conditions*.

During summer and fall months, the Klamath River is too hot to accommodate more heat without adversely affecting beneficial uses. While there are periods in the winter and spring when temperature increases of 2.8 °C (5 °F) or less may occur (as calculated using the Klamath River TMDL model, California allocation scenario) without beneficial uses of water being adversely affected, the exact timing of those periods varies year to year. Temperature targets, as natural temperature conditions (based on the California allocation scenario), are identified for the following locations within the Final TMDL Report: Stateline (Tables 5.3) and Iron Gate and Copco Reservoir Tailrace waters (Table 5.4).

Additionally, Copco and Iron Gate Reservoirs impact the natural temperature regime of the Klamath River downstream of the reservoirs in a manner that is detrimental to beneficial uses related to COLD and SPWN. Specifically, water released from the reservoirs is warmer than natural during the early fall, which can delay the onset of spawning. Therefore, the State took a conservative approach, allocating zero temperature increases year-round. The temperature allocation applicable to the reservoirs is the temperature increase expected to naturally occur in the river reach occupied by the reservoirs. Additional temperature allocations are identified for Copco and Iron Gate Reservoirs:

- In-reservoir waters - Temperature, together with dissolved oxygen, must meet compliance lens requirements (described below) or conditions that provide equal or better protection of COLD and MIGR beneficial uses.

The reservoirs stratify during the summer months, creating a situation where there is no location within the reservoirs where both dissolved oxygen and temperature conditions are suitable to support the COLD beneficial use. The allocation to address this condition requires creating a compliance lens where temperature and DO conditions co-exist during the critical summer period (May through October) to support all beneficial uses (e.g., COLD and MIGR). DO concentrations in the reservoirs must meet the DO objective while co-occurring with temperatures consistent with natural water temperatures (natural baseline summer mean is ~18.7°C). This applies from the river's point of entry into each reservoir throughout the width and length of each reservoir.

Dissolved Oxygen, Nutrient and Organic Matter

The State's TMDL allocations for nutrients, dissolved oxygen, and organic matter were designed to reduce the nutrient (TP and TN) and organic matter (measured as CBOD) loads, as well as reduce other stressors driving biostimulatory and toxicity related impairments (chlorophyll-a, *Microcystis aeruginosa*, and microcystin targets). Allocations were established to address loading capacity in the riverine reaches as well as dam-related reduced assimilative capacity in the reservoirs.

For the riverine reaches of the Klamath River in California, TMDL allocations expressed as daily loads are presented in Table 4-16 of the Basin Plan (and Table 5.2 of the Final TMDL Report). Allocations for specific compliance locations, expressed as monthly mean concentrations for nutrients (TP and TN) and organic matter (CBOD) correspond to targets (see Sections 4.2 and 4.3, above). Figures 5.1, 5.2, and 5.3 (for TP, TN and CBOD, respectively) of the Final TMDL Report graphically present annual allocations for the riverine reaches. These figures identify the loading capacities and allocations for the reaches of the Klamath River in California.

For the Reservoirs, allocations for nutrients (TP and TN) equal:

- 67,048 pounds TP/year and
- 1,025,314 pounds TN/year.

These allocations are assigned at the upstream end of Copco 1 Reservoir. The State identified that "alternative pollutant load reductions and/or alternative management measures or offsets may also result in achievement of the in-reservoir chlorophyll-a, *Microcystis aeruginosa*, and microcystin targets." These allocations for pollutant load reductions, alternative management measures, and/ or offsets are necessary to: meet the Basin Plan narrative toxicity objective (and the associated chlorophyll-a, *Microcystis aeruginosa*, and microcystin numeric targets); meet the narrative biostimulatory substances objective (and the associated TP and TN targets); and support the REC-1; REC-2, and CUL beneficial uses of the river system with Copco 1, Copco 2, and Iron Gate Dams and Reservoirs in place.

7.3 EPA Review of State's TMDL Allocations

As noted above, staff from the Regional Board, ODEQ, EPA R9 and R10 have been deeply engaged in the collaborative process of developing these TMDLs for a period of several years. EPA has participated in the development of modeling assumptions and refinements, reviewed administrative drafts and participated in soliciting and responding to comments on public review drafts. In addition, EPA has provided financial support to the collaborative effort, with an end goal of developing a broadly reviewed, technically justified TMDL.

Given our participation in the process, as well as our review of the final submittal package from the State Board, EPA finds that the technical basis for these TMDLs is sound, that it was developed using the best data available and was analyzed using a reasonable interpretation of the Klamath River TMDL models. EPA believes that the Final TMDL Report accurately identifies the sources of impairments and correctly assigns responsibility for those impairments.

Characterizing Impairments Caused by Klamath Dams

EPA is approving these TMDLs, but wants to clarify our understanding of how Section 303(d) of the CWA applies to river segments that are impacted by dams. At issue is how best to characterize a dam's contribution to impaired water quality due to the creation of a reservoir in what was otherwise a free-flowing water segment. An example of this kind of impairment is the decrease in DO levels caused by the impoundment of river waters. These decreased DO levels are not caused by the introduction into the reservoir of pollutants by the dam itself. Instead, this incremental DO deficit, which we will refer to as the "incremental impairment from a dam," occurs because river waters containing pollutants (usually nutrients) are impounded, and the resulting change in physical conditions (velocity, depth, etc.) can create conditions in the reservoir that lead to violations or increased violation of water quality standards in the reservoir.

States around the country have taken different approaches to characterizing these incremental impairments from dams. For example, in Washington's Spokane River Dissolved Oxygen (DO) TMDL recently approved by EPA (Spokane TMDL), the State first identified the incremental impairment from a dam[4] and then assigned that incremental impairment to the dam operator as a " responsibility" that would be implemented under the CWA 401 certification process. The TMDL load allocations and waste load allocations were then calculated for the remaining impairment. EPA's approval of the Spokane TMDL explicitly noted that the incremental impairment from the dam would be addressed in the 401 Certification process. California, in this TMDL, has taken a different approach. California has included the incremental impairments from the Klamath River dams in its load allocation to the dam owner. (See discussion above that summarizes the load allocations included in Chapter 5 of the TMDL).

EPA believes that the incremental impairments from a dam, as discussed above, are not properly characterized as a "load allocation" under CWA Section 303(d) or its implementing regulations at 40 CFR Part 130. Under CWA Section 303(d)(1)(C), a state is to develop TMDLs for "pollutants." [5] EPA does not believe it is appropriate to categorize the incremental impairments from a dam of the kind described in the Final TMDL Report for the Klamath River as a "load" or "wasteload" allocation because the dam is not contributing impairment-causing "pollutants" as defined in CWA Section 502(6).

[4] This calculation was complicated. The State first simulated the "natural" DO condition of the river by leaving the dam in place and assuming no other sources of pollution; this approach was used to represent the current critical condition (i.e., the dam is there, and there are no plans to remove it). Then the incremental impairment from the dam was calculated as the difference between the current critical condition DO conditions in the reservoir and the impairments that would occur in the reservoir when phosphorus concentrations entering the lake are at minimal levels of human impact, as represented by EPA's ecoregional criterion.

[5] See discussion in 64 FR 46012, 46022 (August 23, 1999). Although the proposed rule discussed in this Federal Register notice has been withdrawn, the discussion in the preamble of this particular issue still reflects EPA's position.

EPA notes that this difference in how we characterize the incremental impairments from a dam appears to have little effect on the regulatory response to these impairments under the federal CWA. As in the Spokane TMDL, the primary mechanism for addressing these impairments under the federal CWA is through the 401 Certification process related to the FERC dam relicensing. In addition, the states can address these impairments under their state law authority.

Similarly, EPA believes that characterizing the incremental impairments from the dams as something other than a TMDL "load allocation" does not affect the computation of other load or wasteload allocations in the TMDL. That is, no other load allocation or wasteload allocation changes by declining to characterize the incremental impairments from the dams as TMDL "load allocations." We believe that there is reasonable assurance that the incremental impairments from the dams will be addressed, and that load and wasteload computations have properly been made on the basis of that assumption. Specifically, on the Klamath River, we note the ongoing Klamath Hydropower Settlement Agreement (KHSA) process, the anticipated endpoint of which is the removal of four of the Klamath River dams. In the event that the KHSA process does not result in the removal of the dams, the States of California and Oregon still have the Section 401 Certification process and state regulatory mechanisms available for the regulation of the incremental impairments from the dams.

Finally, we note that this issue of incremental impairments from dams does not affect any analysis of temperature impairments. Section 502(6) explicitly includes heat as a "pollutant" under the statute, and TMDLs addressing temperature impairments are well established under the Clean Water Act.

Conditioned on this clarification of the characterization of the incremental impairments from dams, EPA concludes that the State Board's submittal meets the requirements of CWA Section 303 and the underlying regulations at 40 CFR Part 130.

8. Margin of Safety: *Submittal describes explicit and/or implicit margin of safety for each pollutant.*

The State's submittal incorporated an implicit margin of safety. Conservative assumptions that comprise the implicit margin of safety include:

- Allocating no temperature increases year-round represents a conservative approach.
- The Klamath TMDL model incorporates conservative assumptions into loading estimates and allocations, expressed in the predicted dissolved oxygen and chlorophyll-a levels.
- The numeric model used to predict the impact of allocations does not assume sediment oxygen demand (SOD) improvements will occur in the downstream riverine sections following upstream load reductions; however, the magnitude of SOD will likely decrease with the decrease of organic loading allocated by the TMDL, and result in increased DO concentrations over time. Thus, the model assumption regarding downstream SOD is conservative.

- The timing of achieving allocations in Upper Klamath Lake and the Klamath River in Oregon is assumed to be measured. The TMDL assumes the greatest loading from Upper Klamath Lake and allows the longest period of water quality not meeting numeric criteria. The magnitudes of the allocations are based on median loading conditions from Upper Klamath Lake. (The largest source of uncertainty in these TMDL analyses is in the characterization of loading from Upper Klamath Lake, which is highly variable, and those loads dominate much of the Klamath River system, even in California.) The assumption of delayed timing for achieving allocations is conservative because allocations are based on the difference from a baseline condition.
- An empirical analysis suggests that the TMDL model may underestimate nutrient loss and retention within the Klamath River. While the underestimate does not appear to be large, this potential underestimation results in more conservative allocations upstream.
- The year chosen for developing the water quality models and establishing the TMDL included periods of critical low flow and poor water quality conditions, which results in more stringent load allocations.
- Allocations to nonpoint sources are for all nutrients (TN, TP, and CBOD), not just the predicted limiting nutrient.
- Year 2000 flows are less than more recent flow requirements (i.e. USBR Klamath Project Operations and PacifiCorp Klamath Hydro Project Biological Opinion flows), which results in more stringent load allocations.

EPA finds the submittal adequately incorporates a margin of safety. An implicit margin of safety is used because natural background loads leave little to no assimilative capacity, and the Klamath River TMDL model uses conservative estimates to define natural conditions, identify loading capacity and develop allocations.

9. Seasonal Variations and Critical Conditions: *Submittal describes method for accounting for seasonal variations and critical conditions in the TMDL(s)*

The State's TMDL addresses seasonal changes in characterizing river and reservoir conditions, calculating loading inputs, and developing targets and corresponding allocations. Loads are identified for annual and critical season (May – October); and targets and allocations are presented as monthly or seasonal mean concentrations.

Flows, temperature, dissolved oxygen and nutrient loads all vary temporally in the river system.

- During the growing season, flows are lowest (low precipitation and high diversion rates) and temperatures highest. The impact of nutrient loading is more pronounced as a result of low flow conditions when nutrients become more concentrated.
- In the reservoirs, slow travel time enhances the warming of waters creating optimal conditions for algae growth. Algae blooms, elevated temperature and depressed dissolved oxygen are typical in summer and fall (June through October).
- The reservoirs' slow response to temporal changes cause delays in seasonal temperature changes in downstream waters; the river is cooler in the springtime when juvenile salmonids are migrating to the ocean and warmer in the fall when adults are migrating upstream and spawning.

The TMDL uses a modeling framework (as described above) capable of assessing changes in pollutant loads and other variables in very small time increments (e.g. hourly), by continuously predicting changes in various parameters of concern, including temperature, dissolved oxygen, and other parameters, at any given time or place for the simulation period. Seasonality is reflected in modeling output and calculation of loads, which are presented for time-steps throughout the year. DO allocations for the reservoirs are identified for critical periods (May 1st – October 31st). Targets and allocations are established for monthly time periods.

EPA finds the State's submittal adequately accounts for the seasonal variations by establishing loading capacities and allocations that attain water quality objectives during the critical conditions.

10. Public Participation: *Submittal documents provision of public notice and public comment opportunity, and explains how public comments were considered in the final TMDL(s).*

Public participation during development of the TMDLs for the Klamath River in California is documented in the State's submittal, Chapter 11 of the Final Staff Report. This describes many of the opportunities made available by the Regional Board for the public to comment on and participate in the development of the Klamath River TMDLs. These efforts included public meetings, workshops, presentations of updates and status reports to the Regional Water Board (open to the public), presentations given at organization's public meetings and conferences, updates and drafts made available on the Regional Board website for the Klamath TMDLs, the peer review processes for both the model development and the TMDL drafts, and public review periods for two (2) drafts of the TMDLs.

The Regional Board completed an initial public comment period (June 15, 2009 to August 27, 2009) on the Public Draft California Klamath TMDL. The TMDL document was subsequently revised based upon written and oral public comments received.

A second public comment period on the revised Public Draft California Klamath TMDL (aka, Dec. 2009 Public Review Draft) opened on December 23, 2009 and closed on February 9, 2010. Comments were specifically solicited on the revised text and substantive changes to the documents. The California Klamath TMDL documents were then modified and the *Responsiveness Summary* (response to comments received during the June-August 2009 as well as the Dec 2009-Feb 2010 comment periods) and the final California Klamath TMDL documents were prepared and made available for the March 24, 2010 Regional Water Board Hearing. Response to public comments is presented in Appendix 10 of the Final Staff Report.

The State Board comment period for review of the Regional Board-approved TMDL document opened on June 22, 2010 and closed on July 21, 2010. Public comments were received and responded to, and the public was provided notice of the State Board hearing.

EPA finds the State provided all stakeholders adequate opportunity to comment on the proposed TMDLs. The State demonstrated that it provided multiple and sufficient opportunities for public comments and considered public comments in its final decision by providing reasonably detailed responsiveness summaries.

11. Technical Analysis: *Submittal provides appropriate level of technical analysis supporting TMDL elements*.

This TMDL represents a very significant level of effort and understanding. The technical approach for the TMDLs includes the conceptual model, framing the inter-relation of pollutants and impairments (Final TMDL Figures 2.7 and 2.8), and the hydrodynamic water quality model used to quantitatively relate pollutant loads to loading capacity and allocations. EPA fully supports the TMDL development approach utilizing a set of hydrodynamic water quality models to characterize current conditions, define natural background conditions, and calculate reductions in pollutants necessary to achieve Klamath River water quality objectives for identified impairments: temperature, DO, nutrients and microcystin toxins.

The scientific foundation for the Klamath TMDLs is a system of linked water quality models developed by Tetra Tech, Inc., under contract to EPA. The Klamath River models have been subjected to a substantial level of peer review. The model was developed and run by Tetra Tech, Inc., and each phase of the work was carefully reviewed by program and technical staff from three agencies - ODEQ, California North Coast Water Board, EPA Regions 9 and 10. In addition to this inter-agency review, the models were reviewed by numerous outside experts. In 2005, peer reviews of the Klamath River TMDL models were completed by Dr. Scott Wells (Portland State University), Brown & Caldwell (for City of Klamath Falls, Oregon), and the Bureau of Reclamation. Between 2005 and 2007, the TMDL development team engaged in informal consultation with Watercourse Engineering, Inc. (consultant to PacifiCorp). The State of California later submitted its technical report for review to four external scientific peer reviewers in accordance with its regulations. Finally, under contract with the Bureau of Reclamation, the U.S. Geological Survey reviewed a portion of the Klamath model during the public comment period for the Klamath TMDL in California. Over time, the agencies have made substantive corrections and improvements to the model in response to peer review comments.

Modeling refinements were conducted in response to comments on the June 2009 Public Review draft. These refinements include rerunning of the model to support scenario reanalyses for TMDL development and increasing documentation for the model (presented in TMDL Appendix 6 – Modeling Configuration and Results, and Appendix 7 – Modeling Scenarios: Klamath River Model for TMDL Development). The Final TMDLs reflect the revised model output and updated allocations needed to meet identified water quality criteria and targets.

EPA concludes the State's technical analyses, including the revised allocations as calculated by the Regional Board following modeling refinements, form an appropriate and fully adequate scientific basis for these TMDLs.

12. Reasonable Assurances: *If wasteload allocations are made less stringent based on inclusion of load allocations that reflect nonpoint source reductions, then submittal describes how there are reasonable assurances that necessary nonpoint source reductions will occur.*

TMDLs for the Klamath River in California are based on the successful implementation of Klamath River TMDLs in Oregon. Under a Memorandum of Agreement (MOA), implementation will be coordinated under a framework for joint implementation of the Klamath and Lost River TMDLs between the Regional Board, ODEQ, and EPA Regions 9 and 10.[6]

For the Klamath River in California, waste load allocations are included for the existing point sources (with NPDES permits). The single discrete point source, Iron Gate Hatchery, accounts for less that 0.1% of the total loading capacity for nutrients. Nonpoint source load allocations address the vast majority of impairments for the Klamath River in California. Dam-related impairments in the reservoirs are the responsibility of the dam owner.

The threats to water quality from nonpoint source activities in the Klamath River basin are largely associated with timber harvest, roads, grazing, and irrigated agriculture on private and federal lands. The implementation plan focuses on reducing nutrient loading in the upper basin, controlling sediment discharges, and protecting riparian vegetation in the tributaries downstream of Iron Gate Dam in accordance with the technical TMDL allocations.

The Regional Board's Implementation Plan (Chapter 6 of the Final TMDL Report) identifies a number of mechanisms to address impairments from nonpoint sources and incremental dam impairments.

Under the authority established by California's Porter-Cologne Water Quality Control Act, the Regional Board may impose restrictions to achieve compliance with water quality standards. Implementation actions taken to achieve load allocations must be consistent with California's *Policy for Implementation and Enforcement of the Nonpoint Source Pollution Control Program* (State NPS Policy). This policy requires that "all current and proposed nonpoint source discharges must be regulated under waste discharge requirements (WDRs), waivers of WDRs, a Basin Plan prohibition, or some combination of these tools" (Regional Water Board 2007, p.4-33.00). For some pollutant sources, the method of compliance with this policy is already in place, and if it is determined to be sufficient, no further action by the Regional Water Board is necessary. However, if the source is currently unregulated, or the current permits, waivers and/or prohibitions are not sufficient to attain the TMDL, a means to comply with the State NPS Policy must be proposed as part of the implementation plan.

The Final TMDL Report, Table 6.1 provides an overview of Regional Water Board staff recommendations of regulatory mechanisms to implement the TMDL allocations in the Klamath River Basin in California. Also Table 4.18 of the Basin Plan Amendment identifies implementation actions and mechanisms by source, land use category and/or responsible party.

[6] Letter from Eric Nigg, Water Quality Manager, Eastern Region, ODEQ, to Catherine Kuhlman, Executive Officer, Regional Board, dated September 2, 2010.

EPA finds the State's TMDL submittal provides reasonable assurances that nonpoint source reductions will occur.

13. Other: *Table for clarifying submittal for TMDL waterbody-combinations for 303(d) listed water, new impairment findings or non-impairment findings.*

Not applicable.