

Water Segment: Crowley Lake, Mono County (HU No. 603.10)
Pollutant: Nitrogen and Phosphorus

Recommendation: De-list for nitrogen and phosphorous, and list for ammonia and dissolved oxygen. This recommendation is based on the evidence presented below (summarized from Lahontan Water Board, 2005) which indicate that water quality standards for the listed pollutants are not exceeded. However, water quality standards for ammonia and dissolved oxygen are exceeded.

LINES OF EVIDENCE

Matrix:
Water

Beneficial use(s):
MUN - Municipal and Domestic Supply
AGR - Agricultural Supply
NAV - Navigation
POW – Hydropower generation
REC-1 - Recreation 1 – water contact recreation
REC –2 - Recreation 2 – non-contact water recreation
COMM - Commercial and Sportfishing
COLD - Cold Freshwater Habitat
WILD - Wildlife Habitat
SPAWN - Spawning, Reproduction, and Development

Water Quality Objectives:

Applicable Numeric Objectives:

No numeric water quality objectives (WQOs) for total nitrogen (N) or phosphorus (P) are established for Crowley Lake.

The Water Quality Control Plan for the Lahontan Region (Basin Plan) includes numeric ammonia objectives that are a function of temperature and pH. Tables 3-1 and 3-4 in Basin Plan show one-hour average and four-day average concentration limits, respectively, for water bodies designated as COLD and COLD with SPWN. These limits are applicable to Crowley Lake.

The Basin Plan also includes numeric dissolved oxygen objectives. Table 3-6 in the Basin Plan shows 7-day mean and 1-day minimum dissolved oxygen concentration limits for water bodies designated as COLD with SPWN; these limits are applicable to Crowley Lake.

Applicable Narrative Objectives:

Biostimulatory Substances: Waters shall not contain biostimulatory substances in concentrations that promote aquatic growths to the extent that such growths cause nuisance or adversely affect the water for beneficial uses.

Taste and Odor: Waters shall not contain taste or odor-producing substances in concentrations that impart undesirable tastes or odors to fish or other edible products of aquatic origin, that cause nuisance, or that adversely affect the water for beneficial uses. For naturally high quality waters, the taste and odor shall not be altered.

Turbidity: Waters shall be free of changes in turbidity that cause nuisance or adversely affect the water for beneficial uses. Increases in turbidity shall not exceed natural levels by more than 10 percent.

Water Quality Guideline: NA

Data Used to Assess Water Quality:

Current Data: Nutrient concentrations, sources and limnological information are based on data collected under contract between the Sierra Nevada Aquatic Research Laboratory (SNARL) and the Lahontan RWQCB. SNARL submitted the results of their work in two reports (Jellison and Dawson 2003, Jellison et al., 2003), provided on compact disc with this memo. The sampling program consisted of lake and tributary sampling programs performed in 2000 and 2001.

Historic Data: Available historical information on Crowley Lake included that published in the late 1950s and early 1960s by E. P. Pister of the California Department of Fish and Game; the USEPA (1978), based on data collected in 1975; and a 1997 Fisheries Management Plan prepared by Department of Fish and Game.

Spatial Representation:

Current sampling included 6 in-lake stations and approximately 50 sampling locations on seven major tributaries to Crowley Lake.

Temporal Representation:

Historic (1950-1975: 1997) and current (2000-2001).

Water Body Specific Information:

Crowley Lake (Long Valley Reservoir) is located on the eastern slope of the Sierra Nevada in Southern Mono County at an elevation of 6,781 feet. It was created by the impoundment of the Upper Owens River in 1941 by the City of Los Angeles. The reservoir inundated large areas of meadowland and sagebrush flats. Information published in the late 1950s and early 1960s by E. P. Pister of the California Department of Fish and Game suggests that Crowley Lake has been eutrophic since its formation, primarily due to its natural meadow/wetland setting and high levels of naturally occurring P in tributary inflows to the reservoir.

Data Quality Assessment:

Historic information based on agency staff reports; current data collected and analyzed by Sierra Nevada Aquatic Research Laboratory (SNARL) of the UC Natural Reserve System. Particulate carbon and nitrogen analysis by the Marine Science Analytical Lab, UCSB.

RATIONALE FOR DELISTING FOR NITROGEN AND PHOSPHOROUS

At the time Crowley Lake was placed on the 303(d) list, it was considered impaired by nutrient inputs based on observations of seasonal algae blooms. Land uses such as grazing, fish hatcheries, and residential development were thought to have the potential to be contributing excess nutrients that caused the perceived impairment. Current studies and evaluation, however, reveal that the lake is naturally eutrophic and that controllable, man-induced nutrient inputs are not significantly affecting the trophic state of the lake and are not impairing beneficial uses. Therefore, Regional Board Staff recommends removing the nitrogen and phosphorous pollutant listings for Crowley Lake.

Source(s):

Phosphorus loading to Crowley Lake is due, almost entirely, to natural hot springs sources. The Big Springs complex, which is the headwaters of the Owens River, is naturally high in phosphorous. The Hot Creek springs are also naturally high in phosphorous. Therefore, Crowley Lake receives a relatively large annual load of phosphorous from uncontrollable, natural sources. Control of naturally occurring high levels of phosphorus is not feasible.

The high natural phosphorus load and low TN:TP loading ratio to Crowley Lake favors blue-green algae growth. A few genera of blue-green algae found in Crowley Lake can fix dissolved atmospheric N₂ gas. Therefore, sufficient nitrogen, as evidenced by summer plankton carbon:nitrogen ratios, is available and is essentially uncontrollable.

Water Quality Objective Attainment:

The narrative WQOs for Biostimulatory Substances, Taste and Odor, and Turbidity all prohibit nuisance conditions or adversely affecting the water for beneficial uses. Therefore, attainment of narrative WQOs is determined by the absence of nuisance conditions or adverse affects to beneficial uses.

Nuisance Condition Analysis:

A nuisance condition is defined in the Lahontan Basin Plan as a condition that "occurs during or as a result of the treatment or disposal of wastes" (Basin Plan, P. 3-15). Because the nitrogen and phosphorous loading to Crowley Lake is the result of natural conditions rather than associated with waste treatment or disposal, the resultant seasonal algal blooms do not cause nuisance conditions by definition.

Beneficial Use Attainment Analysis:

Crowley Lake is the largest reservoir in the LADWP aqueduct system and provides water for municipal and domestic supply, downstream irrigation, and hydroelectric power generation. Therefore, the MUN, AGR and POW beneficial uses are attained.

Crowley Lake is a very popular fishing and boating venue. While seasonal algal blooms might have an occasional negative effect on boating and swimming, Board Staff believe that algal blooms are sufficiently sporadic in time and space and, therefore, do not significantly impair the recreation and fishing beneficial uses. This is supported by results of a survey conducted as part of the Mono Basin Environmental Impact Report (Jones & Stokes, 1993), which showed that 188 of 243 respondents were "generally satisfied" or "very satisfied" with Crowley Lake recreation opportunities. Therefore, Regional Board staff concludes that the NAV, REC-1, REC-2 and COMM beneficial uses are attained.

Crowley Lake is, and has been since its creation, a very productive fishery. As excerpted from Milliron (1997):

" 'Of the many fishable waters in the Inyo-Mono area of eastern California, Crowley Lake is the largest and perhaps the most used (Pister, 1960).' This statement, made over three decades ago, remains true with anglers seeking sustained high catch rates of quality put-and-grow rainbow trout; fast action and trophy Sacramento perch angling; and trophy catch-and-release trout angling. High angler satisfaction, even under heavy angling pressure, has become the Crowley trademark." Therefore, Regional Board staff concludes that the COLD, WILD, COMM, and SPWN beneficial uses are attained in Crowley Lake.

Numerous websites may be found describing the recreational and fishing opportunities at the lake (e.g., http://www.monocounty.org/regions/index.php?region_id=9). Crowley Lake is heavily used for recreational purposes including seasonal water sports, fishing, bird watching and wildflower viewing. Based on the available information, Staff concludes that beneficial uses in Crowley Lake are attained, and nuisance conditions related to the listed pollutants are not present. Therefore, Regional Board staff concludes that narrative WQOs applicable to the listed pollutants in Crowley Lake are not exceeded.

Tributary Waters:

The numeric WQOs for the tributaries to Crowley Lake are summarized in Appendix B along with averaged results from Jellison and Dawson (2003). There are two exceedances of WQOs for the tributaries to Crowley Lake.

1. The 90th percentile value for orthophosphate at Sherwin Creek (0.10 mg/L) exceeded its WQO (0.08 mg/L) in 2001; this WQO was met in 2000. The annual average orthophosphate WQO for Sherwin Creek was achieved in both 2000 and 2001.
2. The 2001 annual average TN concentration (0.5 mg/L) in Hot Creek exceeded its WQO (0.3 mg/L). This WQO was met in 2000. The 90th percentile TN value at Hot Creek was met in 2000 and 2001.

Regional Board staff concludes that the waters tributary to Crowley Lake are in compliance with Basin Plan WQOs. The limited exceedances described above do not meet the minimum exceedance requirements for listing according to the State Board's Listing Policy. Board Staff believe this is further evidence that the eutrophic conditions at Crowley Lake are not related to anthropogenic causes from upland sources.

RATIONALE TO LIST FOR AMMONIA AND DISSOLVED OXYGEN

Regional Board staff recognizes that in order to completely remove a waterbody from 303(d) list, evidence must be presented that the waterbody is attaining WQOs applicable to the listed pollutant(s). While it is clear that the eutrophic conditions in Crowley Lake are due to natural inputs of phosphorous and nitrogen, it is equally clear that WQOs for ammonia and dissolved oxygen, established in the Basin Plan for all waters in the Lahontan Region, are not being attained in Crowley Lake at all times. These data are described further below.

Ammonia

Board Staff reviewed and summarized all the 2000-2001 ammonia data from Jellison and Dawson (2003). These data were edited to include only data that had corresponding temperature and pH measurements taken at the time of sample collection. This allowed Board Staff to calculate: (1) the unionized ammonia fraction of each sample, and (2) the 1-hour and 4-day unionized ammonia criteria for the specific temperature and pH at the time of sample collection. These data are tabulated in Appendix E (Lahontan 2005) and consist of 38 total ammonia samples from Crowley Lake and its outlet.

None of the samples exceeded the one-hour criteria. Every sample collected during the summer months exceed the 4-day criteria, for total of seven exceedances. These data characterize the summer season as the critical condition. The minimum number of measured exceedances to place a waterbody on the 303(d) list for conventional pollutants such as ammonia is 7 exceedances (based on a dataset of 37 to 42 samples); therefore, it is appropriate to list for this pollutant.

Dissolved Oxygen

The Basin Plan water quality criteria for dissolved oxygen in water bodies designated as COLD and SPWN is an instantaneous concentration minimum of 5 mg/L. Jellison and Dawson (2003) showed that during the summer months at depths below approximately 10 meters, Crowley Lake does not meet this criterion. These data are summarized in Appendix D (Lahontan 2005). Of 112 samples collected from various in-lake locations, 36 depth-averaged dissolved oxygen measurements were less than 5 mg/L. The minimum number of measured exceedances to place a waterbody on the 303(d) list for a conventional pollutant such as dissolved oxygen is 19 exceedances (based on a dataset of 110 to 115 samples); therefore, it is appropriate to list for this stressor.

The occurrence of elevated ammonia and depressed dissolved oxygen concentrations are associated with the natural eutrophic condition of Crowley Lake. Therefore, Board Staff recommend the preparation of site-specific objectives or other basin planning amendments that recognize and account for natural conditions. We do not anticipate preparing a TMDL for these constituents for Crowley Lake. Because this work is not currently in the Region's work plan, it is appropriate to list Crowley Lake for dissolved oxygen and ammonia until this issue is reconciled with the water quality standards in the Basin Plan.

REFERENCES

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- Jones & Stokes Associates. 1993. Environmental Impact Report for the Review of Mono Basin Water Rights of the City of Los Angeles. Draft. May. JSA 90-171. Sacramento, CA. Prepared for California State Water Resources Control Board, Division of Water Rights, Sacramento, CA.
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