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WATER QUALITY ASSESSMENTS FOR SELECTED NEW MEXICO LAKES

1999

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LAKE WATER QUALITY MONITORING, TROPHIC STATE EVALUATION, AND STANDARDS ASSESSMENT'S FOR:

Abiquiu Reservoir, Danny R. Davis
Hopewell Lake, S. J. Joseph

1999

EXECUTIVE SUMMARY

Water quality surveys and assessments were completed in fulfillment of work-plan commitments of the *FY 1999-2000 section 106 Work Program for Water Quality Management.* This program was partially funded by a grant from the U.S. Environmental Protection Agency.

Abiquiu Reservoir

During 1999 the Surveillance and Standards Section of the Surface Water Quality Bureau of the New Mexico Environment Department conducted water quality and biological assessment surveys of two lacustrine systems. Abiquiu Reservoir and Hopewell Lake were studied concurrently with an intensive Total Maximum Daily Load (TMDL) stream study conducted within the respective watershed. Studying lakes in this way helps to insure a timely return to the lake system as watersheds are revisited, and also add to the understanding of surface waters within the drainage basin. Water quality sampling methods were in accordance with the "Quality Assurance Project Plan for Water Quality Management Programs" (NMED 1999).

The following assessments provide information pertaining to water quality, biological integrity, trophic state, limiting nutrients, water quality criteria exceedences and water quality standards specific to existing, attainable or designated uses in the State of New Mexico Standards for Interstate and Intrastate Surface Waters, (1995).

Hopewell Lake

Water chemistry sampling at lake stations include total and dissolved nutrients, total and dissolved metals, major ions including TDS, hardness and alkalinity, radionuclides, organic scans, cyanide, and microbiological collections. Phytoplankton and benthic diatom samples were collected for analysis. The following assessments do not include all data results, except for those specifically related to general physical nature, trophic state, limiting nutrient or criteria exceedances and consequent standards violations. All data are available upon request.

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LAKE SURVEYS

Water Quality and Biological Assessment Survey of Abiquiu Reservoir, Rio Arriba County, April 28, September 2 and November 3, 1999.
Danny R. Davis, Principal Investigator

Abiquiu Reservoir

Abiquiu Reservoir was built by the U.S. Army Corps of Engineers and began impounding Chama River water in 1963. Also contributing to the lake are the Rio Puerco, Canjilon Creek and Canones Creek, in total creating a 5,562 km^2 (2,148 mi^2) watershed area. Maximum storage capacity is 1.372 million acre-feet at a corresponding elevation of 6,362 feet above mean sea level, however, the storage pool varied from .172 to .178 million acre-feet during the study. The Reservoir is within the Arizona/New Mexico Plateau ecoregion (Omernik, 1987) and receives an average of 24.5 cm (9.63 in.) of precipitation per year. Abiquiu Reservoir is classified in New Mexico Water Quality Standards for Interstate and Intrastate Surface Waters (1995), where uses of irrigation storage, livestock watering, wildlife habitat, primary contact, coldwater fishery, and warmwater fishery are designated. Principal fish species consist of rainbow, cutthroat, brown trout, kokanee salmon, crappie, walleye, and channel catfish.

Table 1.

Physical Characteristics	Deep Station		Shallow Station	
Secchi (m)	Sp	3.60	Sp	1.60
	Su	5.0	Su	3.0
	Fall	0.8	Fall	1.4
Forel Ule Color	Sp	6	Sp	6
	Su	12	Su	11
	Fall	11	Fall	12
Maximum Depth (m)	Sp	32	Sp	10.5
	Su	39	Su	5.5
	Fall	39.6	Fall	5.5
Euphotic Zone (m)	Sp	6.25	Sp	4.6
	Su	8.4	Su	>5.5
	Fall	3.3	Fall	3.75
Surface Area (Acres)	Sp	3,890	Sp	3,890
	Su	3,938	Su	3,938
	Fall	3,918	Fall	3,918
Storage Capacity (Ac. Ft.)	Sp	172,458	Sp	172,458
	Su	177,155	Su	177,155
	Fall	175,113	Fall	175,113

Table 1. con't.

Physical Characteristics		Deep Station		Shallow Station
Anoxic Hypolimnion (Y/N)	Sp	No	Sp	No
	Su	No	Su	No
	Fall	No	Fall	No
Stratified (Y/N) @ depth (m)	Sp	No	Sp	No
	Su	Yes @ 8 meters	Su	No
	Fall	No	Fall	No
PH (SUs)	Sp	8.0	Sp	8.06
	Su	8.16	Su	8.12
	Fall	7.92	Fall	8.04
Conductivity (µS)	Sp	330	Sp	340
	Su	335	Su	328
	Fall	338	Fall	339
Turbidity (NTUs)	Sp	2.88	Sp	5.57
	Su	1.71	Su	1.86
	Fall	9.26	Fall	6.92
Integrated Sample surface to (m)	Sp	6.25	Sp	4.6
	Su	30	Su	5.0
	Fall	3.5	Fall	3.5
Dissolved Oxygen Surface (mg/L)	Sp	8.6	Sp	8.65
	Su	6.3	Su	7.71
	Fall	7.4	Fall	8.2
Dissolved Oxygen Bottom (mg/L)	Sp	8.6	Sp	8.7
	Su	3.0	Su	7.61
	Fall	6.0	Fall	7.3
Temperature Surface (°C)	Sp	11.7	Sp	11.0
	Su	21.7	Su	23.4
	Fall	13.4	Fall	13.9
Temperature Bottom (°C)	Sp	9.0	Sp	8.7
	Su	15.0	Su	22.0
	Fall	13.3	Fall	13.0
Chlorophyll *a* (µg/L)	Sp	1.17	Sp	1.24
	Su	0.09 (Q)	Su	1.03
	Fall	1.40	Fall	MDP

MDP = missing data point; (Q) = questionable result.

Table 2.

Trophic State (Carlson, 1977)		Deep Station		Shallow Station
Secchi depth	Sp	Mesotrophic	Sp	Eutrophic
	Su	Oligomeso	Su	Mesotrophic
	Fall	Eutrophic	Fall	Eutrophic
Chlorophyll *a*	Sp	Oligomeso	Sp	Oligomeso
	Su	Oligotrophic	Su	Oligomeso
	Fall	Oligomeso	Fall	MDP
Total Phosphorus	Sp	Oligotrophic	Sp	Oligotrophic
	Su	Oligotrophic	Su	Oligotrophic
	Fall	Oligotrophic	Fall	Oligotrophic

Overall Trophic Condition	Oligomesotrophic

Table 3.

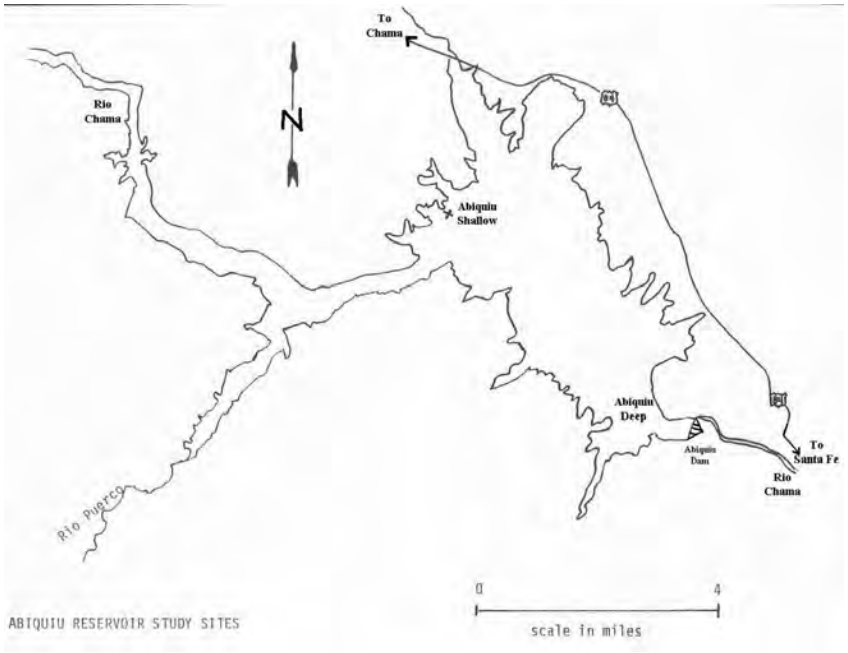
Nitrogen/Phosphorus Ratio		Deep Station		Shallow Station
Limiting Nutrient	Sp	N	Sp	P
	Su	P	Su	P
	Fall	P	Fall	P

Table 4.

Designated or Attainable Use	Criteria Exceedence	Attainment Status
Primary Contact	None	Fully Supporting
Coldwater Fishery	2 Temp Summer Epi	Fully Supporting
Warmwater Fishery	None	Fully Supporting
Wildlife Habitat	None	Fully Supporting
Livestock Watering	None	Fully Supporting
Irrigation Storage	None	Fully Supporting
Human Health	None	Fully Supporting

Water Quality Assessment

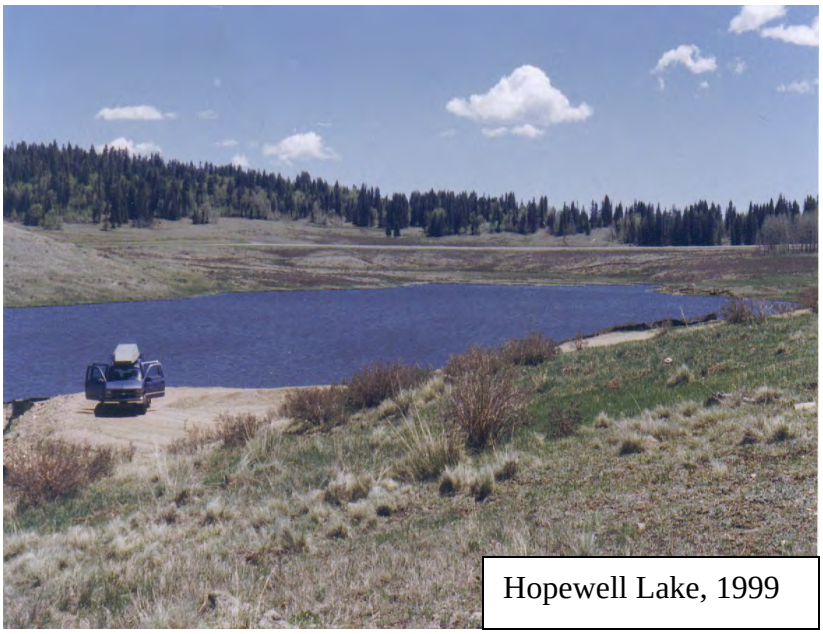
Lake chemistry sampling consists of total, dissolved and calculated nutrients, anions and cations, total and dissolved heavy metals, synthetic organics, radionuclides, and cyanide, which cover all standards criteria pertinent to the protection of all designated uses. These data are available upon request, though any criteria exceedences will be discussed below. Abiquiu Reservoir may be classified as oligomesotrophic according to Carlson's (1977) indices, and algal community composition (Likens 1975). Table 2 shows the variation observed seasonally and between stations for secchi depth, chlorophyll *a*, and total phosphorus. Phytoplankton community composition consisted mostly of members of the Cryptophyceae and Bacillariophyceae, resulting in relatively low species richness and moderately high diversity. Benthic diatom community composition consisted of 33 species, with a high diversity according to Shannon-Wiener. *Diatoma vulagre* var. *linearis* V.H., was the most common member of the diatom community and is a diatom, which generally prefers waters of moderate to high nutrient content.



Abiquiu Reservoir was not stratified during either the spring or fall sampling runs, however a pronounced thermocline was present at both the deep and shallow stations during the summer visit. At both stations water temperature exceeded the fisheries criteria above the thermocline, and dissolved oxygen fell below the 6.0-mg/L criterion below the thermocline. The low dissolved oxygen below the thermocline does not constituted an exceedence because criteria only apply to the epilimnetic layer or upper 1/3 of the water column. Similarly, the average temperature from epilimnetic measurements at both the deep and shallow stations did not exceed the 20° C criteria when averaged for all sampling events, resulting in full support of the coldwater fishery use. There were no other exceedences of water quality criteria observed from water chemistry samples collected during the study. All designated and attainable uses were fully attained during the study.

Water Quality and Biological Assessment Survey of Hopewell Lake,
Rio Arriba County, June 8, 1999.

Seva J. Joseph, Principal Investigator



Hopewell Lake, 1999

Hopewell Lake, in north-central New Mexico was completed in 1930, and is located 26 km (16 mi.) west of Tres Piedres, New Mexico via US 64. The 14-acre lake was named after a gold and silver mining camp that existed on Placer Creek from 1894 to 1906. The lake is located in Rio Arriba County within the Carson National Forest at an elevation of 2,765 meters (9,765 ft.) above sea level. The New Mexico Department of Game and Fish (NMDG&F) owns the water rights and earth dam and has a special use permit obtained from the USFS for the use of the surrounding land. Reproducing brook trout inhabit Placer Creek and the lake, and rainbow trout are stocked by the NMDG&F for the recreating public. Potter (NMEID, 1982) reported maximum depth to be 4.6 meters (15 ft.) with a mean depth of 1.74 m (5.71 ft.) and maximum volume was calculated to be 80.2 ac. ft. at the spillway elevation. The watershed is generally characterized as Southern Rocky Mountain ecoregion (Omernik, 1987), where mean annual rainfall averages 47 cm (18.5 in.) per year (Gabin and Lesperance 1977). Water quality standards for Hopewell Lake are set forth in sections 2112 and 3101 of the New Mexico water quality standards (NMWQCC 1995). Designated uses include domestic water supply, irrigation, high quality coldwater fishery, livestock watering, wildlife habitat, and secondary contact.

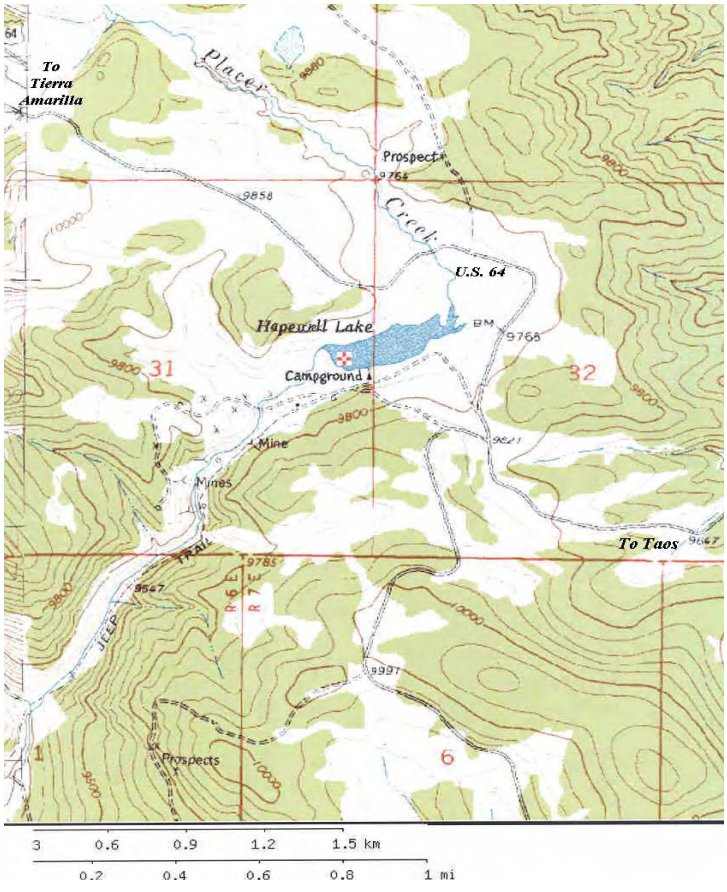


Table 1. Physical characteristics for Hopewell Lake.

Physical Characteristics	Hopewell Lake
Secchi Depth (m)	1.15
Forel Ule Color	13
Maximum Depth (m)	4.75
Euphotic Zone (m)	2.3
Surface Area (Acres)	14
Anoxic Hypolimnion (Y/N)	N
Stratified (Y/N) @ (m)	N
Ph units (SUs) Surface	7.22
Conductivity (μS) (Surface)	44
Turbidity (NTUs)	7.73
Integrated sample surface to (m)	4.0
Dissolved Oxygen Surface (mg/L)	8.1
Dissolved Oxygen Bottom (mg/L)	6.8
Temperature Surface (°C)	12.5
Temperature Bottom (°C)	10.3
Chlorophyll *a* (μg/L)	7.85

Table 2. Trophic State (Carlson, 1977)

Trophic State Indices	Deep Station	
Secchi depth	Su	Eutrophic
Chlorophyll *a*	Su	Oligotrophic
Total Phosphorus / Total Nitrogen	Su	Eutrophic / Mesotrophic

Overall Trophic Condition	Mesotrophic

Table 3. Nitrogen/Phosphorus Ratio

	Deep Station
Limiting Nutrient	**N**

Table 4. Use Attainment

Designated or Attainable Use	Criteria Exceedence	Attainment Status
Domestic Water Supply	None	Fully Supporting
Irrigation	None	Fully Supporting
High Quality Coldwater Fishery	None	Fully Supporting
Livestock watering	None	Fully Supporting
Wildlife Habitat	None	Fully Supporting
Secondary Contact	None	Fully Supporting

FS = Full Support; FSIO = Full Support Impacts Observed; PS = Partial Support; NS = Not Supported.

Water Quality Assessment

Lake chemistry sampling consisted of total and dissolved nutrients, anions and cations, total and dissolved heavy metals, synthetic organics, radionuclides, and cyanide, which covers all standards criteria pertinent to the protection of all designated uses. Phytoplankton, diatom and chlorophyll analyses were also performed. These data are available upon request, though any criteria exceedences will be discussed below.

Hopewell Lake may be classified as mesotrophic according to Carlson's (1977) indices, and algal community composition (Likens 1975). Table 2 shows trophic variation observed during the single summer visit for Secchi depth, chlorophyll *a*, and total phosphorus. The N/P ratio indicated nitrogen to be the limiting nutrient on the day of sampling. Of the ten phytoplankton genera identified from the sample, over 90 percent were members of the Chrysophyta and Cryptophyta. The dominance of these members of the community supports the mesotrophic determination. Benthic diatom community composition consisted of 48 species, with a high diversity according to Shannon-Weaver (1949). The diatom community consisted of common members, many of which preferred waters of moderate to high nutrient enrichment with moderate mineral content.

During the study visit, the day use facility associated with Hopewell Lake was closed by the U.S. Forest Service which was conducting road maintenance at the lake. This improvement was the first phase of a major project at the lake, which included the construction of 39 for use camping units. The area also has running water and restrooms for users, trash bins; and is located away from the lake and Placer Creek. Fencing around the lake and stream areas excludes livestock from these areas.

There were no exceedances of criteria and all designated uses were fully attained during the sampling visit. Continued management of the public use areas and exclusion of livestock from riparian areas should insure that Hopewell Lake remains a nutrient stable, high mountain lake.

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