WATER QUALITY SURVEY SUMMARY

FOR THE

SAN JUAN AND ANIMAS WATERSHEDS
(Navajo Nation at Hogback to the Colorado border)
2010

Prepared by

Surface Water Quality Bureau
New Mexico Environment Department
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LIST OF ACRONYMS

ALU	Aquatic Life Use
AU	Assessment Unit
DO	Dissolved Oxygen
MAS	Monitoring and Assessment Section
NMAC	New Mexico Administrative Code
SCI	Stream Condition Index
SFNF	Santa Fe National Forest
STORET	Storage and Retrieval System
SWQB	Surface Water Quality Bureau
TMDL	Total Maximum Daily Load
USEPA	United States Environmental Protection Agency
WWTP	Wastewater Treatment Plant
WQS	Water Quality Standards

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EXECUTIVE SUMMARY

The Surface Water Quality Bureau conducted a water quality survey of the San Juan-Animas watersheds between March and October, 2010. The project area includes the San Juan River and its tributaries from Navajo Reservoir to the Navajo Nation at Hogback and the Animas River from the Colorado border to its confluence with the San Juan River (Figure 1). Tributaries included in this study are the Navajo River, La Plata River, and Stevens Arroyo.

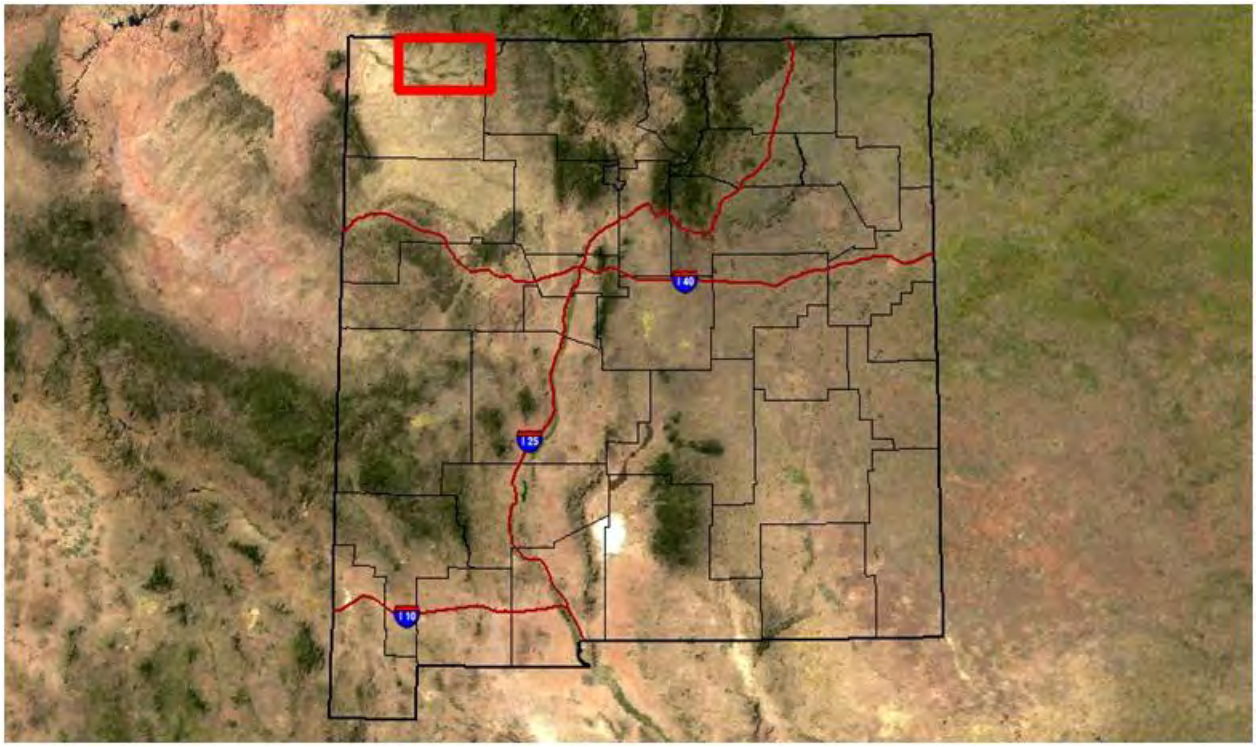


Figure 1. San Juan/Animas watershed location within Northwestern NM.

The primary purpose of this survey was to collect chemical, physical, and biological data to evaluate water quality within the watershed. Data collected are assessed against New Mexico Water Quality Standards (WQS; NMWQCC 2011) and impaired waters are summarized in the WQCC-Approved 2012-2014 Integrated List portion of the biennial *State of New Mexico Clean Water Act §303(d)/305(b) Integrated Report* (NMED/SWQB 2012). It is important to note that both the assessment protocols and water quality standards are revised periodically to incorporate new information and refinements. Any assessment conclusions presented in this report are based on water quality standards and assessment protocols that existed at the time the report was developed. The U.S. Environmental Protection Agency (USEPA) uses the most recent state-developed assessment protocols and the most recent USEPA-approved water quality standards when deciding whether or not to approve impairment determinations on the biennial *New Mexico Integrated List of Impaired Waters*. Therefore, the impairment conclusions in the most recent Integrated List will supersede assessment conclusions in this survey report if they should differ.

Water chemistry, physical habitat, and biological sampling occurred at stations that were selected based on previous survey findings, proximity to potential sources, and input from various interested parties outside of NMED SWQB. Chemical analyses included total nutrients, total and dissolved metals, total dissolved solids, total suspended solids, radionuclides, organics, and microbiological collections. In addition, data loggers were deployed at selected stations to collect temperature, pH, dissolved oxygen, conductivity, and turbidity data to monitor diel trends over days, weeks, and months. Biological (macroinvertebrates, periphyton, fish community) and physical habitat surveys were also conducted at selected sites.

Based on the results from this survey, water quality in the San Juan-Animas watersheds was found to exceed several water quality criteria.

- **Dissolved Oxygen:** Lower La Plata River.
- ***E. coli*:** Upper Animas River, Lower Animas River, Upper La Plata River, Lower La Plata River, Lower San Juan.
- **Nutrient/Eutrophication Biological Indicators:** Lower Animas River, Upper La Plata River.
- **Total Phosphorus:** Upper Animas River.
- **Sedimentation/Siltation:** Upper Animas River, Lower La Plata River, Middle San Juan River, Lower San Juan (additional data required before TMDL development).
- **Temperature:** Navajo Reservoir, Lake Farmington, Navajo River/Upper Animas River (water quality standards reviews are needed), Lower Animas River.
- **Turbidity:** Upper Animas River.

1.0 INTRODUCTION

The Monitoring and Assessment Section (MAS) of the Surface Water Quality Bureau (SWQB) conducted a water quality survey of the San Juan River watershed between March and November, 2010. This survey included 31 sampling sites (Figure 2; Table 1). Data collected were assessed against New Mexico WQS (WQCC 2011) to determine if the waterbodies in this survey were meeting their designated uses (Table 2). SWQB staff presented the monitoring plan at a public meeting on February 23, 2010 in Farmington, NM.

Historic and current land uses in the San Juan River watershed include mineral extraction, forestry, farming, ranching, and recreational activities. Land use/cover for the entire watershed above the Hogback (Station 31) includes 67% forest, 29% rangeland, 2% barren soil, 2% agriculture, and <1% urban/residential. Land use/cover above the Hogback within New Mexico includes 56% forest, 42% rangeland, 1% agriculture, <1% urban/residential and <1% barren soil. Land ownership within the New Mexico portion of the watershed is 46% tribal, 27% BLM, 14% private, 8% USFS, and 5% State (Figure 1). The San Juan River watershed is located in Omernick Level III Ecoregions 21 (Southern Rockies) and 23 (Arizona/New Mexico Mountains) in the headwaters and Level III Ecoregions 20 (Colorado Plateau) and 22 (Arizona/New Mexico Plateau) in the lowlands. The elevation range for the various sampling sites in the survey spanned from 1,532 (Hogback) to 2,083 (Navajo River) meters above mean sea level. Annual precipitation ranges from 175 mm at Farmington to 321 mm at Durango, CO. Mean maximum July temperatures range from 34.3 (Farmington) to 30.8°C (Durango, CO) while the average January minimum temperatures range from -6.6 (Farmington) to -11.4°C (Durango, CO) (WRCC 2012). Several species within this watershed are listed as either threatened or endangered by both state and federal agencies. Federally threatened and endangered species in the San Juan River watershed that are reliant on aquatic and riparian habitat include southwestern willow flycatcher (*Empidonax traillii extimus*), Colorado pikeminnow (*Ptychocheilus lucius*), and razorback sucker (*Xyrauchen texanus*). Bonytail chub (*Gila elegans*), federally listed as endangered, is native to the San Juan but extirpated in New Mexico (Sublette, et al. 1990). Roundtail chub (*Gila robusta*), listed by the State of New Mexico and the Navajo Nation as endangered, is also native to the San Juan.

Water quality monitoring included measurement of field parameters (dissolved oxygen (DO), pH, temperature, turbidity, and conductivity) as well as sampling for ions, total dissolved solids, total suspended solids, total nutrients, total and dissolved metals, and *E. coli*. Radionuclides, organics, and cyanide were monitored at the lowest stations of the subwatersheds. Data loggers were deployed at select stations to collect long-term datasets for temperature, pH, DO, specific conductance, and turbidity. Data on physical habitat and biological communities were also collected. Habitat surveys included measurement of channel dimensions such as cross-sectional profiles, longitudinal profiles, bankfull width and depth, and slope, as well as canopy cover and large woody debris estimations. Biological surveys included the collection of benthic macroinvertebrates, periphyton, and fish. Monitoring conducted at each site is summarized in Table 3.

Figure 2. San Juan water quality survey map (2010)

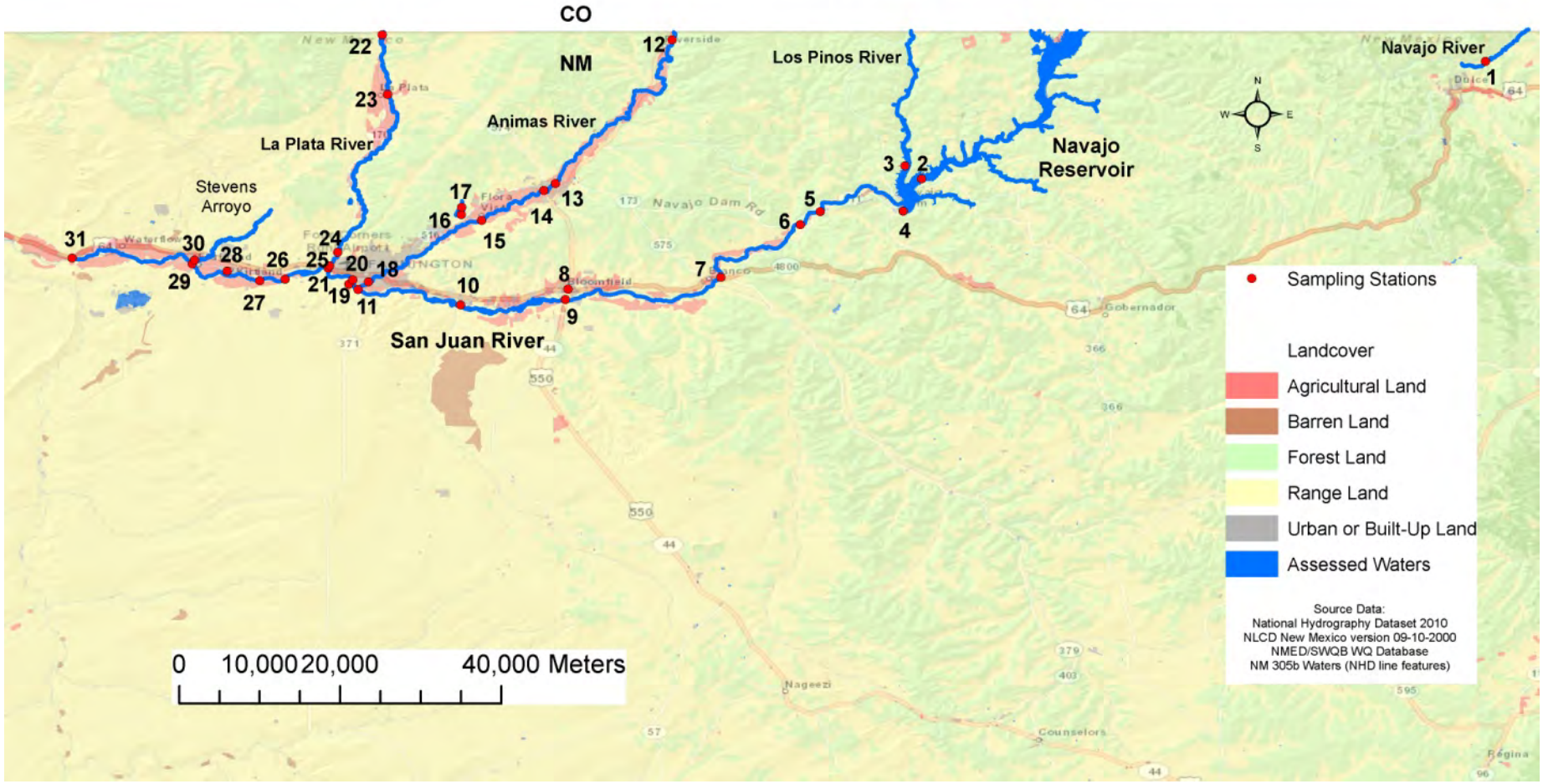


Table 1. San Juan watershed sampling stations.

Station Number	Station Name	Station ID	Sampling Rationale
1	Navajo River upstream of Jicarilla Bnd	64Navajo022.1	Bottom of AU; no historical data
2	Navajo Lake at Sims Mesa Marina	64NavajoLkSim	Lake station
3	Navajo Reservoir at Gooseneck	64NavajoLkGoo	Lake station
4	Navajo Reservoir towards the dam	64NavajoLkDam	Lake station
5	San Juan River near Navajo Dam	64SanJua162.4	Upper station above most likely inputs
6	San Juan River at Soaring Eagle	64SanJua154.8	Thermograph only station
7	San Juan River at bridge near Blanco	64SanJua144.8	Bottom of AU
8	Bloomfield WWTP outfall	NM0020770	Point source monitoring; TMDL needs
9	San Juan River at Bloomfield Bridge	64SanJua126.2	Above Bloomfield WWTP
10	San Juan River at McGee Park	64SanJua113.5	Below Bloomfield WWTP
11	San Juan River above Animas	66SanJua101.6	Bottom of AU; Above Farmington WWTP and Animas River
12	Animas River downstream of state line	66Animas055.8	Monitor inflow from CO
13	Animas River above Estes Arroyo	66Animas028.1	Bottom of AU; Above Aztec WWTP
14	Aztec WWTP	NM0020168	Point source monitoring; TMDL needs
15	Animas at CR 350 Bridge	66Animas017.4	Below Aztec WWTP
16	Lake Farmington Deep	66LkFarmiDeep	Lake station
17	Lake Farmington Shallow	66LkFarmiShal	Lake station
18	Animas River at Farmington	66Animas001.7	Bottom of AU; Above Farmington WWTP
19	Farmington WWTP	NM0020583-M	Point source monitoring; TMDL needs
20	San Juan River at Bisti Bridge	66SanJua100.2	Below Farmington WWTP
21	San Juan R above La Plata R confluence	67SanJua096.3	Bracket La Plata and Harper Valley WWTP
22	La Plata R at NM-CO state line	67LaPlat033.8	Monitor inflow from CO
23	La Plata R at La Plata , NM	67LaPlat024.8	Bottom of AU
24	La Plata at Farmington City Park	67LaPlat002.3	Good access for sampling habitat - longer reach w/less influence from road and culvert
25	La Plata R near Farmington	67LaPlat000.3	Bottom of AU
26	Harper Valley WWTP	NM0029025	Point source monitoring; TMDL needs
27	San Juan River at Lions Park near Kirtland	67SanJua088.1	Bracket Harper WWTP and Central Consolidated WWTP
28	Central Consolidated School District No. 22	NM0029319	Point source monitoring; TMDL needs

Station Number	Station Name	Station ID	Sampling Rationale
29	San Juan River near Kirtland	67SanJua082.6	Below Central Consolidated WWTP
30	Stevens Arroyo below CR 6100	66SteveArroyo	*E. coli* only station
31	San Juan River at Hogback	67SanJua065.3	Bottom of AU

2.0 NEW MEXICO WATER QUALITY STANDARDS

State water quality standards (WQS) are codified in the New Mexico Administrative Code (NMAC) as *Standards for Interstate and Intrastate Surface Waters* (20.6.4 NMAC) (WQCC 2011). The WQS set water quality goals by designating uses and establishing criteria to protect those uses, and they are periodically updated by the New Mexico Water Quality Control Commission. Water quality in the San Juan River watershed was evaluated against the WQS, as amended through January 14, 2011, to determine if waterbodies are supporting their designated uses. The applicable WQS for the San Juan River watershed covered in this report are:

20.6.4.98 INTERMITTENT WATERS - All non-perennial unclassified waters of the state, except those ephemeral waters included under 20.6.4.97 NMAC.

A. **Designated Uses:** livestock watering, wildlife habitat, marginal warmwater aquatic life and primary contact.

B. **Criteria:** the use-specific criteria in 20.6.4.900 NMAC are applicable to the designated uses, except that the following site-specific criteria apply: the monthly geometric mean of E. coli bacteria 206 cfu/100 mL or less, single sample 940 cfu/100 mL or less.

20.6.4.99 PERENNIAL WATERS - All perennial unclassified waters of the state.

A. **Designated Uses:** warmwater aquatic life, livestock watering, wildlife habitat and primary contact.

B. **Criteria:** the use-specific criteria in 20.6.4.900 NMAC are applicable to the designated uses, except that the following site-specific criteria apply: the monthly geometric mean of E. coli bacteria 206 cfu/100 mL or less, single sample 940 cfu/100 mL or less.

20.6.4.401 SAN JUAN RIVER BASIN - The main stem of the San Juan river from the Navajo Nation boundary at the Hogback upstream to its confluence with the Animas river. Some waters in this segment are under the joint jurisdiction of the state and the Navajo Nation.

A. Designated Uses: public water supply, industrial water supply, irrigation, livestock watering, wildlife habitat, primary contact, marginal coldwater aquatic life and warmwater aquatic life.

B. Criteria: the use-specific numeric criteria set forth in 20.6.4.900 NMAC are applicable to the designated uses, except that the following segment-specific criterion applies: temperature 32.2°C (90°F) or less.

20.6.4.402 SAN JUAN RIVER BASIN - La Plata river from its confluence with the San Juan river upstream to the New Mexico-Colorado line.

A. Designated Uses: irrigation, marginal warmwater aquatic life, marginal coldwater aquatic life, livestock watering, wildlife habitat and primary contact.

B. Criteria: the use-specific numeric criteria set forth in 20.6.4.900 NMAC are applicable to the designated uses, except that the following segment-specific criterion applies: temperature 32.2°C (90°F) or less.

20.6.4.403 SAN JUAN RIVER BASIN - The Animas river from its confluence with the San Juan upstream to Estes Arroyo.

A. Designated Uses: public water supply, industrial water supply, irrigation, livestock watering, wildlife habitat, marginal coldwater aquatic life, primary contact and warmwater aquatic life.

B. Criteria: the use-specific numeric criteria set forth in 20.6.4.900 NMAC are applicable to the designated uses.

20.6.4.404 SAN JUAN RIVER BASIN - The Animas river from Estes Arroyo upstream to the New Mexico-Colorado line.

A. Designated Uses: coldwater aquatic life, irrigation, livestock watering, wildlife habitat, public water supply, industrial water supply and primary contact.

B. Criteria: the use-specific numeric criteria set forth in 20.6.4.900 NMAC are applicable to the designated uses, except that the following segment-specific criterion applies: phosphorus (unfiltered sample) 0.l mg/L or less.

20.6.4.405 SAN JUAN RIVER BASIN - The main stem of the San Juan river from Canyon Largo upstream to the Navajo dam.

A. Designated Uses: high quality coldwater aquatic life, irrigation, livestock watering, wildlife habitat, public water supply, industrial water supply and primary contact.

B. Criteria: the use-specific numeric criteria set forth in 20.6.4.900 NMAC are applicable to the designated uses, except that the following segment-specific criteria apply: specific conductance 400 μS/cm or less; the monthly geometric mean of E. coli bacteria 126 cfu/100 mL or less, single sample 235 cfu/100 mL or less.

20.6.4.406 SAN JUAN RIVER BASIN - Navajo reservoir in New Mexico.

A. Designated Uses: coldwater aquatic life, warmwater aquatic life, irrigation storage, livestock watering, wildlife habitat, public water supply, industrial water supply and primary contact.

B. Criteria: the use-specific numeric criteria set forth in 20.6.4.900 NMAC are applicable to the designated uses, except that the following segment-specific criteria apply: phosphorus (unfiltered sample) 0.1 mg/L or less; the monthly geometric mean of E. coli bacteria 126 cfu/100 mL or less, single sample 235 cfu/100 mL or less.

20.6.4.407 SAN JUAN RIVER BASIN - Perennial reaches of the Navajo river from the Jicarilla Apache reservation boundary to the Colorado border and perennial reaches of Los Pinos river in New Mexico.

A. Designated Uses: coldwater aquatic life, irrigation, livestock watering, public water supply, wildlife habitat and primary contact.

B. Criteria: the use-specific numeric criteria set forth in 20.6.4.900 NMAC are applicable to the designated uses, except that the following segment-specific criteria apply: phosphorus (unfiltered sample) 0.1 mg/L or less; the monthly geometric mean of E. coli bacteria 126 cfu/100 mL or less, single sample 235 cfu/100 mL or less.

20.6.4.408 SAN JUAN RIVER BASIN - The main stem of the San Juan river from its confluence with the Animas river upstream to its confluence with Canyon Largo.

A. Designated Uses: public water supply, industrial water supply, irrigation, livestock watering, wildlife habitat, primary contact, marginal coldwater aquatic life and warmwater aquatic life.

B. Criteria: the use-specific numeric criteria set forth in 20.6.4.900 NMAC are applicable to the designated uses, except that the following segment-specific criterion applies: temperature 32.2°C (90°F) or less.

20.6.4.409 SAN JUAN RIVER BASIN - Lake Farmington.

A. Designated Uses: public water supply, wildlife habitat, livestock watering, primary contact, coldwater aquatic life and warmwater aquatic life.

B. Criteria: the use-specific numeric criteria set forth in 20.6.4.900 NMAC are applicable to the designated uses, except that the following segment-specific criterion applies: temperature 25°C (77°F) or less.

Subsection J of Section 20.6.4.900 NMAC, as referenced in the above site-specific criteria, provides a list of water chemistry analytes and their respective criteria. The table of numeric criteria provided in Section 900 is used for assessing water quality to determine if the water is supporting its designated uses (e.g., irrigation, livestock watering, human health, etc). Narrative criteria for sedimentation/siltation, plant nutrients, turbidity, and biological integrity are also addressed in this report and found in 20.6.4.13 NMAC, subsections A, E, J, and M, respectively.

Impairments for the San Juan watershed are listed in Table 2 and may be found in Appendix A of the most recent version of the *State of New Mexico Integrated Clean Water Act §303(d)/§305(b) Report* (303(d) List; NMED/SWQB 2012). The 303(d) List is a catalog of all assessment units (AUs) with a summary of their current status (i.e. assessed/not assessed and impaired/not impaired). Once an AU is determined to be impaired, a total maximum daily load (TMDL) guidance document for stream restoration is developed specifically for that AU. AU names and WQS may change over time and the history of these changes is tracked in the Record of Decision (ROD) associated with this report. Use attainment determinations supported by data collected from this survey were included in the 2012-2014 §303(d) List.

Table 2. Causes of impairment in the San Juan watershed.

Assessment Unit	Impairments*	WQS (January 2011)
Gallegos Canyon (San Juan River to Navajo bnd)	Selenium	20.6.4.99
Los Pinos River (Navajo Reservoir to CO border)	None (not assessed)	20.6.4.407
Navajo Reservoir	Mercury in fish tissue, temperature	20.6.4.406
Navajo River (Jicarilla Apache Nation to CO border)	Temperature	20.6.4.407
San Juan River (Navajo bnd at Hogback to Animas River)	*E. coli*, sedimentation/siltation~~, turbidity~~	20.6.4.401
San Juan River (Animas River to Cañon Largo)	Sedimentation/siltation~~, turbidity~~	20.6.4.408
San Juan River (Cañon Largo to Navajo Reservoir)	None (fully supporting)	20.6.4.405
Animas River (San Juan River to Estes Arroyo)	*E. coli*, nutrients, temperature~~, turbidity~~	20.6.4.403
Animas River (Estes Arroyo to So. Ute Indian Tribe bnd)	*E. coli*, total phosphorus, sedimentation/siltation, temperature, turbidity	20.6.4.404
Lake Farmington	Mercury in fish tissue, temperature	20.6.4.409
Jackson Lake	None (not assessed)	20.6.4.99
La Plata River (San Juan River to McDermott Arroyo)	*E. coli*, dissolved oxygen, sedimentation/siltation~~, turbidity~~	20.6.4.402
La Plata River (McDermott Arroyo to So. Ute Indian Tribe bnd)	*E. coli*, nutrients	20.6.4.402
Shumway Arroyo (San Juan River to Ute Mtn Ute bnd)	None (fully supporting)	20.6.4.98
Stevens Arroyo (Perennial prts San Juan R to headwaters)	None (fully supporting for primary contact; other uses not assessed)	20.6.4.99

* From the 2012-2014 State of New Mexico CWA §303(d) / §305(b) Integrated List and Report (NMED/SWQB 2012), with the exception of four turbidity listings for Assessment Units in WQS segments 20.6.4.401, 20.6.4.402, 20.6.4.403, and 20.6.4.408 NMAC. The 2012 assessment protocol was not designed to assess turbidity in stream segments that have both coldwater and warmwater aquatic life uses, such as those designated in the WQS segments listed above. Therefore, the four invalid turbidity listings will be removed on the draft 2014-2016 Integrated List.

3.0 METHODS

All data were collected in accordance with procedures documented in the *SWQB Quality Assurance Project Plan* (QAPP; NMED/SWQB 2010a) and the *SWQB Standard Operating Procedures for Data Collection* (SOPs; NMED/SWQB 2007). Data collected during this study

were combined with all other submitted data that met SWQB quality assurance requirements for assessment according to the most recent edition of the Assessment Protocol (AP). Final designated use impairment status is housed in the assessment database.

4.0 SAMPLING SUMMARY

A map of the study area is provided in Figure 1. The station numbers, station identification codes, and sampling rationale of the stations selected for this survey are provided in Table 1. Stations were mostly chosen because they were at the downstream end of an assessment unit or to bracket potential pollutant sources. Several wastewater treatment plant (WWTP) effluents were also sampled to estimate pollutant loading into the receiving stream.

Water samples were analyzed for total dissolved solids (TDS), total suspended solids (TSS), hardness (Ca + Mg), anions and cations (lakes only), total nutrients, total and dissolved metals, *E. coli*, cyanide, radionuclides, and synthetic organic compounds. Instantaneous measurements ("grab" data) for temperature, dissolved oxygen (DO), pH, turbidity, and specific conductance were taken in the field. Data loggers (thermographs and sondes) were deployed to collect temperature, pH, DO, conductivity, and turbidity data over extended periods of time. Physical habitat, benthic macroinvertebrate communities, and fish communities were also surveyed. Physical habitat surveys were conducted by boat in several reaches of the Animas and San Juan rivers. Fish communities were sampled only in the smaller, wadeable streams (Navajo and La Plata rivers). The specific types and number of sampling events conducted at each site are summarized in Table 3.

Table 3. San Juan watershed sampling summary.

Station Number	Station Name	Field Data[1]	TSS, TDS, and/or anions/cations	Nutrients	Total Metals (Hg, Se, Al)	Dissolved Metals	E. coli	Total Residual Chlorine	Flow	Cyanide	Radionuclides	Organics	Thermograph	Sonde Deployment	Habitat Survey[2]	Macroinvertebrates[2]	Periphyton[2]	Fish Community
1	Navajo River upstream of Jicarilla Bnd	9	8	7	4	4	8	-	8	1	2	2	✓	✓	-	-	-	✓
2	Navajo Lake at Sims Mesa Marina	3	3	3	3	3	-	-	-	-	-	-	-	-	-	-	-	-
3	Navajo Reservoir at Gooseneck	3	3	3	3	3	-	-	-	-	-	-	-	-	-	-	-	-
4	Navajo Reservoir towards the dam	3	3	3	3	3	3	-	-	2	2	2	-	-	-	-	-	-
5	San Juan River near Navajo Dam	8	8	8	4	4	8	-	-	-	-	-	-	-	-	-	-	-
6	San Juan River at Soaring Eagle	-	-	-	-	-	-	-	-	-	-	-	✓	-	-	-	-	-
7	San Juan River at bridge near Blanco	10	8	9	4	4	9	-	-	-	-	-	✓	✓	✓	✓	✓	-
8	Bloomfield WWTP outfall	8	4	8	-	1	8	1	-	-	-	-	-	-	-	-	-	-
9	San Juan River at Bloomfield Bridge	8	8	8	4	4	8	-	-	1	-	-	-	-	-	-	-	-
10	San Juan River at McGee Park	8	8	8	4	4	8	-	-	-	-	-	-	✓	✓	✓	✓	-
11	San Juan River above Animas	9	8	9	4	4	8	-	-	-	-	-	✓[3]	-	-	-	-	-

Station Number	Station Name	Field Data[1]	TSS, TDS, and/or anions/cations	Nutrients	Total Metals (Hg, Se, Al)	Dissolved Metals	E. coli	Total Residual Chlorine	Flow	Cyanide	Radionuclides	Organics	Thermograph	Sonde Deployment	Habitat Survey[2]	Macroinvertebrates[2]	Periphyton[2]	Fish Community
12	Animas River downstream of state line	8	8	8	4	4	8	-	-	-	-	-	✓	-	-	-	-	-
13	Animas River above Estes Arroyo	9	8	9	4	4	8	-	-	-	-	-	✓	✓	✓	✓	✓	-
14	Aztec WWTP	8	4	8	-	1	8	1	-	-	-	-	-	-	-	-	-	-
15	Animas at CR 350 Bridge	8	8	8	4	4	8	-	-	-	-	-	-	-	-	-	-	-
16	Lake Farmington Deep	3	3	3	3	3	3	-	-	2	2	2	-	-	-	-	-	-
17	Lake Farmington Shallow	3	3	3	3	3	-	-	-	-	-	1	-	-	-	-	-	-
18	Animas River at Farmington	9	8	9	4	4	8	-	-	1	2	3	✓	✓	✓	✓	✓	-
19	Farmington WWTP	8	4	8	-	1	8	1	-	-	-	-	-	-	-	-	-	-
20	San Juan River at Bisti Bridge	8	8	8	4	4	8	-	-	-	-	-	-	-	-	-	-	-
21	San Juan R above La Plata R confluence	8	8	8	4	4	8	-	-	-	-	-	-	-	-	-	-	-
22	La Plata R at NM-CO state line	8	8	8	4	4	8	-	-	-	-	-	✓	-	-	-	-	-
23	La Plata R at La Plata , NM	9	9	8	4	4	8	-	-	-	-	-	✓	✓	-	-	-	-
24	La Plata at Farmington City Park	2	1	-	-	-	-	-	-	-	-	-	-	✓	-	-	-	✓
25	La Plata R near Farmington	8	8	8	4	4	8	-	-	1	2	3	✓	-	-	-	-	-
26	Harper Valley WWTP	7	3	7	-	-	7	1	-	-	-	-	-	-	-	-	-	-
27	San Juan River at Lions Park near Kirtland	8	8	8	4	4	8	-	-	-	-	-	-	-	-	-	-	-
28	Central Consolidated School District No. 22	7	4	7	-	1	7	-	-	-	-	-	-	-	-	-	-	-
29	San Juan River near Kirtland	9	8	9	4	4	8	-	-	-	-	-	-	-	✓	✓	✓	-
30	Stevens Arroyo below CR 6100	8	-	-	-	-	8	-	8	-	-	-	-	-	-	-	-	-
31	San Juan River at Hogback	8	8	8	4	4	8	-	-	1	2	3	✓	✓	-	-	-	-

1 Field data include instantaneous measurements of temperature, specific conductivity, dissolved oxygen, pH, and turbidity
2 Habitat, macroinvertebrate, and periphyton data were collected by boat in a representative reach of the assessment unit
3 Logger was deployed but unrecoverable

5.0 WATER QUALITY SAMPLING RESULTS

5.1 Water Quality Exceedences of Numeric Criteria

5.1.1 Grab Data

Grab (instantaneous) data refers to samples or measurements collected from individual visits to survey stations and are distinct from data obtained with continuous monitoring devices over an extended period of time. Exceedences of numeric criteria identified during this survey using grab data are documented in Table 4. Results indicate designated use impairments due to *E. coli* in the Animas River (Estes Arroyo to CO border), Animas River (San Juan River to Estes Arroyo), San Juan River (Navajo bnd at Hogback to Animas River), La Plata River (McDermott Arroyo to CO border), and La Plata River (San Juan River to McDermott Arroyo); due to total phosphorus in

the Animas River (Estes Arroyo to CO border); and due to total gross alpha radioactivity in the La Plata River (San Juan River to McDermott Arroyo).

Assessment and listing procedures can be found in the Assessment Protocol. A complete dataset can be obtained by contacting SWQB.

Table 4. Exceedences* of WQS criteria using grab data

Station Number	Station Name*	Aluminum, Dissolved	Aluminum, Total	*E.coli*	Phosphorus, Total	Total Gross alpha radioactivity
1	Navajo River upstream of Jicarilla Bnd	1/4	1/4	1/8	1/7	
12	Animas River downstream of state line			1/8	**2/8**	
13	Animas River above Estes Arroyo			**3/8**	**2/9**	
15	Animas at CR 350 Bridge			1/8		
18	Animas River at Farmington			**2/8**		
20	San Juan River at Bisti Bridge			**2/8**		
21	San Juan River above La Plata River confluence			1/8		
23	La Plata River at La Plata , NM			**5/8**		
25	La Plata River near Farmington			**4/8**		**1/2**
27	San Juan River at Lions Park near Kirtland			**3/8**		
29	San Juan River near Kirtland			**2/8**		
30	Stevens Arroyo below CR 6100			1/8		
31	San Juan River at Hogback			**4/8**		

Exceedences are expressed as the ratio of the number of exceedences divided by the total number of samples for that parameter at that station. **BOLDED** ratios indicate designated use impairments. Blank cells indicate that the parameter (e.g., aluminum, phosphorus, etc.) was not detected in concentrations exceeding the applicable criterion.

* Stations not included on this list did not have any grab data that exceeded WQS criteria.

5.1.2 Data from Continuous Monitoring Devices

Temperature data loggers (thermographs) were deployed at strategic locations within the study area. Multi-parameter data loggers (sondes) were deployed at stations in each assessment unit primarily to examine diel fluxes in pH and dissolved oxygen (DO). Thermographs (temperature only) and sondes (temperature, DO concentration, DO percent saturation, conductivity, turbidity, and pH) were programmed to record hourly while deployed.

Large datasets generated from data loggers are assessed according to protocols developed specifically for such datasets (NMED/SWQB 2011a). This is because it is not reasonable to list as not supporting on the basis of one or a few exceedences out of several hundred or thousand

data points. Temperature, DO, and pH numeric criteria have default values that are typically associated with designated uses (20.6.4.900 NMAC); however, occasionally there are segment-specific criteria that differ from the default value of use-specific criteria. Assessment conclusions based on long-term thermograph and sonde data sets are summarized below (Table 5).

Table 5. Assessment summary of long-term thermograph and sonde datasets.

Station Number	Station Name	Aquatic Life Use	Temperature Criterion (°C)	Temperature Assessment	pH Criterion (SU)	pH Assessment	DO Criterion (mg/L)	DO Assessment
1	Navajo River upstream of Jicarilla Bnd	CW	20	**NS**	6.6-8.8	FS	6	FS
6	San Juan River at Soaring Eagle	HQCW	20	FS	6.6-8.8	N/A	6	N/A
7	San Juan River at bridge near Blanco	HQCW	20	FS	6.6-8.8	FS	6	FS
10	San Juan River at McGee Park	MCW	32.2	N/A	6.6-9.0	FS	6	FS
11	San Juan River abv Animas	MCW	32.2	N/A[1]	6.6-9.0	N/A	6	N/A
12	Animas River downstream of state line	CW	20	**NS**	6.6-8.8	N/A	6	N/A
13	Animas River above Estes Arroyo	CW	20	**NS**	6.6-8.8	FS	6	FS
18	Animas River at Farmington	MCW	25	**NS**	6.6-9.0	FS	6	FS
22	La Plata R at NM-CO state line	MCW	32.2	FS	6.6-9.0	N/A	6	N/A
23	La Plata R at La Plata , NM	MCW	32.2	FS	6.6-9.0	FS	6	**NS**
24	La Plata at Farmington City Park	MCW	32.2	N/A	6.6-9.0	FS	6	N/A[2]
25	La Plata R near Farmington	MCW	32.2	FS	6.6-9.0	N/A	6	N/A
31	San Juan River at Hogback	MCW	32.2	FS	6.6-9.0	FS	6	FS

1 Thermograph was deployed but unrecoverable

2 Equipment failure

CW = Coldwater Aquatic Life

HQCW = High Quality Coldwater Aquatic Life

MCW = Marginal Coldwater Aquatic Life

FS = Fully supporting its designated uses

NS = Not supporting its designated uses

5.2 Water Quality Exceedences of Narrative Criteria

The EMAP boatable method was used to collect biological and habitat data in the San Juan and Animas Rivers because these rivers are too large to effectively wade. This method entails floating a length of river in each assessment unit. The length of river sampled is calculated as

approximately 40 times the average width of the river. Average width of a representative reach in each assessment unit was estimated from satellite imagery obtained from Google™ Earth. Sampling was conducted at the beginning of the sampled reach and again at each tenth of the sampled reach for a total of 11 transects.

5.2.1 Sedimentation Assessment

During the 2010 San Juan River Basin survey, SWQB staff characterized substrate ("pebble count") at three sites in each river assessment unit utilizing, to the extent possible, the sampling techniques used during the 2002 USDA National Sedimentation Lab (NSL) study (Heins, et al. 2004) (see Appendix A for data). SWQB staff also performed large river EMAP-style pebble counts in each assessment unit; however these results were not used in the median calculation used for assessment purposes because the sampling methods were not comparable to the NSL study (NMED/SWQB 2011b). Similar to the process used for the development of the 2004-2006 Integrated List, the median value for percent sand and fines was determined for each assessment unit of concern. The median values were then compared to a fine sediment benchmark to determine potential impairment (Table 6). The 75th percentile of the percent sand and fines measured at reference sites from the 2002 NSL study was used as the **fine sediment benchmark** (NSL 2002; NMED/SWQB 2004).

Table 6. Aquatic Life Use support in San Juan and Animas Rivers

Assessment Unit	%Fine Sediment Median[1]	Fine Sediment Benchmark (NSL 2002)[2]	Aquatic Life Use Support for Sedimentation
Reach 1 – San Juan River (Navajo Nation boundary at Hogback to Animas River)	56%	< 29.5%	Not Supporting
Reach 2 – San Juan River (Animas River to Cañon Largo)	57%	< 29.5%	Not Supporting
Reach 3 – San Juan River (Cañon Largo to Navajo Dam)	29%	< 29.5%	Fully Supporting
Reach 4 – Animas River (San Juan River to Estes Arroyo)	19%	< 29.5%	Fully Supporting
Reach 5 – Animas River (Estes Arroyo to Colorado border)	62%	< 29.5%	Not Supporting (IR Category 5C[3])

1 Medians were calculated using all sites in the assessment unit (vs. only coarse-dominated sites).

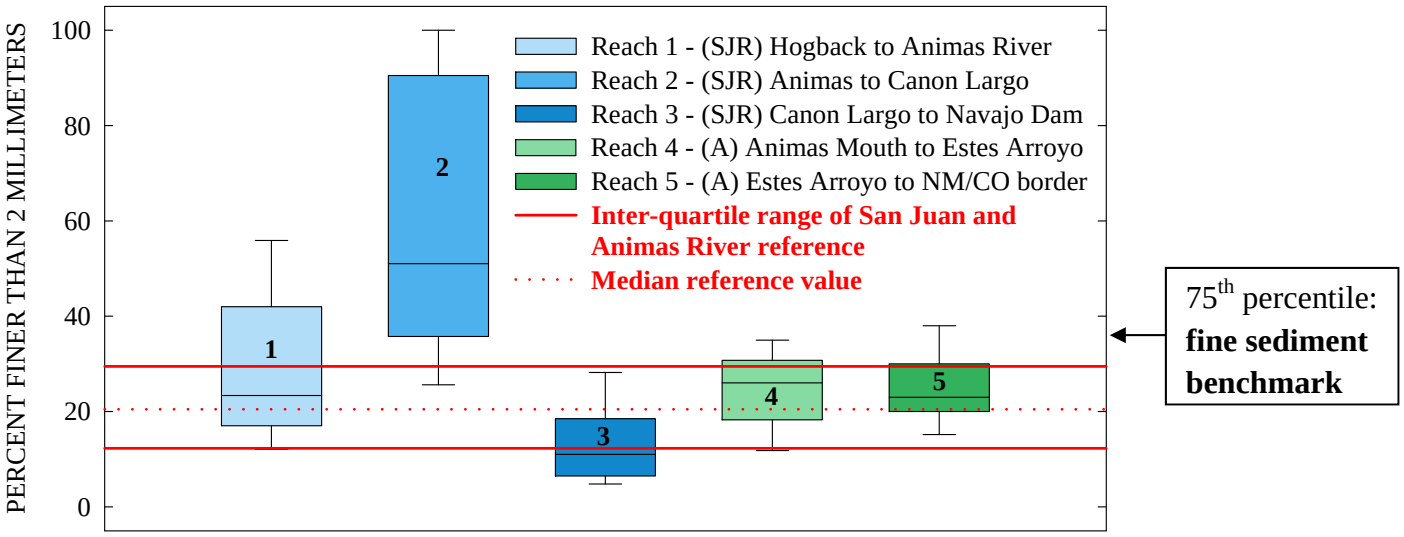
2 Reference condition for San Juan and Animas Rivers determined using all stable (stage I or VI) coarse-dominated sites except those within 5km of Navajo Dam (NMED/SWQB 2004)

3 Integrated Report (IR) Category 5C – Assessment Units (AUs) are listed in this category if there are not enough data to determine the pollutant of concern or there are not adequate data to develop a TMDL.

Percent sand and fines data collected in 2010 generally fell within the previously collected range of data from the 2002 NSL study as presented in Figure 3, with the exception of the upper portion of the Animas River. In this reach, there was close to an order of magnitude difference

between two of the three % sand and fine values measured in 2010. Given this discrepancy, SWQB believes collection of additional data is warranted to confirm the impairment before proceeding with TMDL development for this reach. Therefore, the sediment listing for the Animas River (Estes Arroyo to Colorado border) is noted as "Category 5C" on the 2012-2014 Integrated List.

Figure 3. Percent (%) sand and fines box plots for all study sites in the 2002 NSL study and fine sediment benchmark based on coarse-material sites (adapted from Heins, et al. 2004)



5.2.2 Macroinvertebrate Community

In 2010, the New Mexico Water Quality Control Commission adopted the following narrative criterion (20.6.4.13 Subsection M):

> *Biological integrity: Surface waters of the state shall support and maintain a balanced and integrated community of aquatic organisms with species composition, diversity and functional organization comparable to those of natural or minimally impacted water bodies of a similar type and region.*

To date, benthic macroinvertebrate sampling has been the primary form of biomonitoring utilized by SWQB, followed by periphyton and fish. The macroinvertebrate community responds to stressors such as fine sediment, therefore information regarding the macroinvertebrate community is important to determine the overall integrity of the stream.

Macroinvertebrate Sampling

By collecting data on the macroinvertebrate community composition, characteristics that indicate stress on the community can be identified. Depending on the ecoregion of the study site, this is done by utilizing either the Mountain Stream Condition Index (M-SCI; Jacobi, et al. 2006) or the Rapid Bioassessment Protocol (RBP; Plafkin, et al. 1989; Barbour, et al. 1999). The M-SCI or RBP score is based on a comparison of selected metric scores obtained from macroinvertebrate community composition to the reference site or reference condition. This index or score is then used to determine impairment. Threshold values for M-SCI and RBP scores appear in Table 7.

Benthic macroinvertebrates were collected in the San Juan and Animas rivers (the sampling design is explained at the beginning of Section 5.2), but because assessment methods for benthic macroinvertebrate communities are under development for large rivers, no assessments of these data were conducted. Macroinvertebrate data were assessed at only one wadeable site in this study, Navajo River upstream of the Jicarilla Apache boundary. Because this station is within Ecoregion 21f (Southern Rockies), the M-SCI threshold of 56.70 was used to determine the biological integrity of the stream; therefore an M-SCI score less than 56.70 would indicate a biological community that is stressed. Navajo River had an M-SCI score of 58.6 indicating no impairment.

Table 7. M-SCI and RBP thresholds and assessment conclusions

M-SCI Index[1]	RBP % of reference site[2]	Resulting Aquatic Life Use Support Determination
>56.7	>83	Full Support
≤56.7-37.2	≤83-79	Indeterminate[3]
≤37.2	≤79	Not Supporting

1 The M-SCI is used for Ecoregions 21 and 23.
2 RBP scores (as % of reference site) are used for Ecoregions 22, 24, 25, and 26.
3 SWQB will list as Not Supporting if a second sample within a 5-year period confirms value in this range.

5.2.3 Periphyton Chlorophyll-a and Nutrient Assessment

Periphyton Sampling

The periphyton community is a biological indicator that can express system stress in ways that the macroinvertebrate community may not reveal. Use of periphyton community data is still in early stages of development and does not yet provide conclusive information on stream health. Periphyton is collected during biological surveys for the quantification of chlorophyll *a* (Table 8) and, on a more limited basis, for community composition analysis.

Table 8. Chlorophyll a results

Station Number	Station	Station ID	Candidate Threshold[1] (µg/cm^2)	Chlorophyll *a* (µg/cm^2)
7	San Juan River at bridge near Blanco	64SanJua144.8	10	1.95
10	San Juan River at McGee Park	64SanJua113.5	10	**14.54**
13	Animas River above Estes Arroyo	66Animas028.1	7.4 - 7.8	5.76
18	Animas River at Farmington	66Animas001.7	7.4 - 7.8	**8.79**
29	San Juan River near Kirtland	67SanJua082.6	10	**13.09**

1. A threshold value of 10 µg/cm^2 was used for the San Juan River because the sample size is less than 10 (Barbour, et al. 1999). The threshold range for the Animas River is from the Nutrient Assessment Protocol for Wadeable Streams (NMED/SWQB 2011a).

BOLDED values signify exceedence of candidate threshold and indicate potential for nutrient impairment.

Periphyton chlorophyll *a* was not collected in the La Plata because of storm flows/scouring immediately prior to the scheduled sampling event.

Nutrient Assessments

In most watersheds, a Level 1 nutrient assessment is performed at each wadeable stream station to determine if excess nutrients may be impacting the reach. If the Level 1 assessment indicates a potential impairment, data are collected for the Level 2 nutrient assessment to determine impairment status.

The Level 2 nutrient assessment consists of evaluating data for a number of indicators including total phosphorus, total nitrogen, dissolved oxygen, pH, and periphyton chlorophyll *a* concentration in order to perform a weight-of-evidence based impairment determination. Chlorophyll *a* is a quantitative measure of algal biomass which is the direct or indirect cause of most problems associated with nutrient impairment. Typically, indicators are compared to the applicable criteria or threshold values to determine if an exceedence occurred (Table 9). Threshold values for total phosphorus, total nitrogen, and chlorophyll *a* are dependent on the ecoregion and designated aquatic life use of the stream. However, as is the case with benthic macroinvertebrates, the nutrient assessment protocol for large, non-wadeable rivers is currently under development, therefore non-wadeable sites (i.e., San Juan River) were not assessed for nutrient impairment. Data collected from the San Juan River will be added to the nutrient dataset and used for threshold development and refinement.

Table 9. Nutrient Assessments

Assessment Unit	Ecoregion – Aquatic Life Use	DO & pH – Long term datasets	DO %Sat. – grab (# of exceedences)	DO conc – grab (# of exceedences)	pH – grab (# of exceedences)	Total Nitrogen (# of exceedences)	Total Phosphorus (# of exceedences)	Chlorophyll *a* exceedence?	Nutrient Assessment
Animas River (Estes Arroyo to CO border)	AZ/NM Plateau - CWAL	DO is FS pH is FS	0/17	0/17	0/17	**10/17**	**8/17**	no	FS[1]
Animas River (San Juan River to Estes Arroyo)	AZ/NM Plateau - MCWAL	DO is FS pH is FS	2/17	0/17	0/17	**5/17**	**6/17**	**YES**	**NS[1]**
La Plata River (McDermott Arroyo to CO Border)	AZ/NM Plateau - MCWAL	**DO is NS** pH is FS	**2/8**	0/8	0/8	**2/8**	1/8	no data	**NS**
La Plata River (San Juan River to McDermott Arroyo)	AZ/NM Plateau - MCWAL	*DO probe failure* pH is FS	0/8	0/8	0/8	**3/7**	**4/7**	no data	FS
Navajo River (Jicarilla to CO bnd)	Southern Rockies - CWAL	no data	0/8	0/8	1/8	**4/7**	**6/7**	no data	FS

1 The Animas River is borderline between the "wadeable stream" and "non-wadeable river" categories used for assessment, therefore it was reassessed using the Nutrient AP for Wadeable Streams.

NS = Not Supporting; FS = Fully Supporting

CWAL = coldwater aquatic life; MCWAL = marginal coldwater aquatic life

Bolded cells indicate parameters that exceeded thresholds or allowed exceedence ratios.

5.3 Fish Community Data

Human activities near streams and rivers can reduce the quality of aquatic habitat necessary for fish survival and reproduction. To prevent unintended effects of human actions, it is important to know something about fish and their needs (Table 10). Fish community data are collected for development and refinement of water quality standards, development of fish-based biocriteria and bioassessment procedures, and to document and characterize the fish community for comparison with future or past records.

Fish community composition can be correlated with physical habitat to provide information about how changes may be impacting the fish community. Cold-water fish, such as trout and salmon, require aquatic habitats with abundant insects or small fish as a food source, clear cold water with year-round temperatures that do not exceed 20ºC (68ºF) for extended time periods, high levels of dissolved oxygen, and a stony or gravelly channel substrate for spawning. Warm-water fish can tolerate higher temperatures of up to 32.2ºC (90ºF), as well as lower oxygen levels and some species can also tolerate or require muddy or sandy substrates. Characteristics of fish community composition can offer clues as to if and how a particular habitat has been degraded. For example, if one would expect a robust community of gravel spawners at a particular location, but they are not abundant, it may be indicative of sedimentation issues. Fish collection data for wadeable streams in the San Juan watershed appear below (Table 11). Included in Tables 10 and 11 are all species of native and non-native fish that have been documented at or near the collection locations, regardless of whether they were encountered during our collection efforts.

In La Plata River adjacent to the Farmington City Park, the fish community was dominated by native cool water fish, particularly flannelmouth sucker (*Catostomus latipinnis*). All native fish encountered were cool water species; all non-native fish encountered were warm water species. All native fish were also gravel spawners, but all suckers encountered were sub-adult, as this location lacked habitat to support adult-sized suckers. Although the very shallow water at this location tended to get warmer than most cool water habitats, these particular cool water species tend to exhibit wide temperature tolerances. Dominance of cool water species suggests that revision of the current marginal warm water aquatic life use designation in favor of cool water should be considered.

The Navajo River upstream of the Jicarilla Apache boundary was dominated by native, cool water species. Only two cold water individuals, brown trout (*Salmo trutta*), probably washed downstream during flood events, were captured. Temperatures recorded during the summer months at this station would not support a resident cold water fish population and historic fish records do not indicate that a cold water community has existed there. Although this river has a designated cold water aquatic life use according to New Mexico water quality standards, this designation should be reconsidered and possibly revised to cool water. Under a cool water aquatic life use, this assessment unit would not be listed as impaired for temperature. Two-thirds of the individuals encountered were mottled sculpin (*Cottus bairdi*), a native, cool water species, found in New Mexico only in the San Juan basin. The San Juan basin population is disjunct from all other populations of this species, which is widespread in North America, ranging from Labrador to Georgia to the Columbia River basin (Lee, et al. 1980). Speckled dace (*Rhinichthys osculus*), another native, cool water species, comprised 26% of the individuals encountered. Unlike mottled sculpin, this species is a gravel spawner. It is widespread west of the continental divide in New Mexico and North America (Lee, et al. 1980).

Table 10. Characteristics of fish species found in wadeable streams in the San Juan watershed

Scientific Name	Common Name	Native	Temperature	Gravel Spawner	Primary Feeding Guild	Water Quality Tolerance
Salmo trutta	brown trout	No	Cold	Yes	Invertivore/Insectivore	Intermediate
Cyprinella lutrensis	red shiner	No	Warm	No	Omnivore	Tolerant
Gila robusta	roundtail chub	Yes	Cool	No	Omnivore	Sensitive
Rhinichthys osculus	speckled dace	Yes	Cool	Yes	Invertivore/Insectivore	Intermediate
Pimephales promelas	fathead minnow	No	Warm	No	Omnivore	Tolerant
Catostomus commersoni	white sucker	No	Cool	Yes	Omnivore	Tolerant
Catostomus (Pantosteus) discobolus	bluehead sucker	Yes	Cool	Yes	Herbivore	Tolerant
Catostomus latipinnis	flannelmouth sucker	Yes	Cool	Yes	Omnivore	Intermediate
Ameiurus melas	black bullhead	No	Warm	No	Invertivore/Insectivore	Tolerant
Fundulus zebrinus	plains killifish	No	Warm	No	Invertivore/Insectivore	Tolerant
Lepomis machrochirus	bluegill	No	Warm	No	Invertivore/Insectivore	Tolerant
Cottus bairdi	mottled sculpin	Yes	Cool	No	Invertivore/Insectivore	Intermediate

Table 11. Fish community data from wadeable sites in the San Juan watershed

Scientific Name	Common Name	La Plata at Farmington City Park	Navajo River upstream of Jicarilla bnd
Salmo trutta	brown trout	0	2
Cyprinella lutrensis	red shiner	2	0
Gila robusta	roundtail chub	0	0
Rhinichthys osculus	speckled dace	3	67
Pimephales promelas	fathead minnow	0	0
Catostomus commersoni	white sucker	0	3
Catostomus (Pantosteus) discobolus	bluehead sucker	1	14
Catostomus latipinnis	flannelmouth sucker	15	0
Ameiurus melas	black bullhead	0	0
Fundulus zebrinus	plains killifish	4	0
Lepomis machrochirus	bluegill	0	0
Cottus bairdi	mottled sculpin	0	171
	# of Individuals	25	257
	Total # of Taxa	5	5
	% Native	76	98
	% Non-native	24	2
	% Coldwater	0	<1
	% Coolwater	76	>99
	%Warmwater	24	0

5.4 Water Quality Assessment Specific to Lake Sampling

5.4.1 Lake Background Information

Navajo Reservoir

Navajo Reservoir is New Mexico's second largest lake with a capacity of more than 15,000 surface acres and offers a variety of recreational opportunities including fishing, boating, camping, water skiing, and wildlife viewing. Navajo Reservoir is located in the Arizona/New Mexico Plateau region of the San Juan watershed in northwestern New Mexico and southwestern Colorado approximately 40 miles east of Farmington via NM 64 and NM 511. The reservoir is over 40 kilometers (25 miles) long and sits astride the New Mexico-Colorado border at an elevation of 1,859 meters (6,100 feet) above sea level. Creeks and drainages that contribute to the reservoir include Frances Creek, La Jara Creek, the Piedra River, Sambrito Creek, Los Pinos River, Spring Creek, and numerous other canyons resulting in an 8,365 km^2 (3,230 mi^2) drainage area. Maximum storage capacity is 1.709 million acre-feet at a corresponding elevation of 6,085 ft (NMED/SWQB 2002). During the length of this water quality survey, the storage pool volume varied from 1.232 to 1.551 million acre-feet (BOR 2012).

Photo 1. Looking towards the dam on Navajo Reservoir 3/23/2010.

Lake Farmington

Lake Farmington serves as the primary water supply for the city of Farmington and offers some limited boating and fishing opportunities. Lake Farmington is located just northeast of Farmington off Highway 516 in the Arizona/New Mexico Plateau region of the San Juan watershed of northwestern New Mexico. The reservoir has a capacity of approximately 250 surface acres and is at an elevation of 1,692 meters (5,550 feet) above sea level, and is an off-channel reservoir fed by the Animas River as well as a pump station. Lake levels during 2010 were down due to construction around the inlet with lake surface area varying from 150 to 170 acres during the SWQB survey.

Photo 2. Looking north at Lake Farmington from overlook near dam 3/22/2010.

5.4.2 Chemical/Physical Data Evaluations

Chemical/Physical data for Navajo Reservoir were collected only down to 75 m (246 ft) due to the limitations of the sampling equipment (the deepest part of the reservoir exceeds 100 m depth). There were no chemical exceedences in either lake, but both lakes stratified during the warmer months. Lake Farmington exhibited an anoxic hypolimnion (DO < 0.5 mg/L) during October sampling, but did not exceed the DO criterion (Figures 4 and 5; Tables 12 and 13). Both lakes exceeded the cold water aquatic life temperature criterion; however, they both were found to support the warm water aquatic life temperature criterion.

Table 12. Depth profile data results.

Station	Sampling Date	Time	Temperature (°C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% saturation)	Dissolved Oxygen at Bottom (mg/L)	pH (SU)	Conductivity (µS/cm)	Turbidity (NTU)
Navajo Reservoir Deep	3/23/2010	1000	5.24	9.79	96.5	NA	7.89	227	2.44
	6/29/2010	1100	**20.44**	6.40	87.7	NA	8.18	239	2.59
	10/19/2010	0930	16.78	6.86	87.3	NA	7.88	224	1.14
Navajo Reservoir Gooseneck	3/23/2010	1400	7.28	10.27	106.5	10.10	8.12	226	2.51
	6/29/2010	1230	**21.17**	6.46	89.8	6.52	8.05	240	2.30
	10/19/2010	1300	17.75	6.66	86.5	6.68	7.88	228	1.79
Navajo Near Sims Marina	3/23/2010	1300	5.53	9.93	98.7	9.84	7.97	227	2.61
	6/29/2010	1300	**20.47**	6.51	89.3	6.10	7.85	237	2.67
	10/19/2010	1500	17.64	6.77	87.9	6.62	7.88	222	1.38
Lake Farmington Deep	3/22/2010	1500	7.73	10.27	106.5	9.84	8.08	582	5.13
	6/28/2011	1300	**21.78**	6.87	97.6	2.16	8.14	390	3.88
	10/18/2011	1430	16.92	7.17	91.6	0.25	7.26	496	2.80
Lake Farmington Shallow	3/22/2010	1630	8.57	10.28	108.9	10.23	8.13	581	4.79
	6/28/2011	1330	**24.59**	7.02	104.4	6.80	7.99	391	3.09
	10/18/2011	1630	17.82	7.54	98.2	7.47	8.04	495	3.40

According to Subsection C Paragraph (3) of 20.6.4.14 NMAC, water quality measurements taken at intervals in the entire water column at a sampling station *shall be averaged* for the epilimnion, or in the absence of an epilimnion for the upper one-third of the water column of the lake to determine attainment of criteria (WQCC 2011).
Bold values indicate an exceedence of the WQS criterion

Table 13. Physical data results.

Station	Sampling Date	Time	Integrated sample surfaces to depth (m)	Maximum Depth (m)	Secchi Depth (m)	Forel Ule Color	Euphotic Zone Depth (m)	Thermocline? (no or at depth in meters)	Anoxic hypolimnion? (no or at depth in meters)
Navajo Reservoir Deep	3/23/2010	1000	10.0	94.5	3.0	8	8.0	no	NA
	6/29/2010	1100	45.0	95.0	4.8	11	15.0	(9-10)	NA
	10/19/2010	0930	30.0	110.0	5.3	12	17.0	(18-19)	NA
Navajo Reservoir Gooseneck	3/23/2010	1400	5.0	7.8	3.0	8	9.6	(2-3)	no
	6/29/2010	1230	5.0	5.8	4.0	11	13.0	no	no
	10/19/2010	1300	5.0	6.5	4.0	14	6.5	no	no
Navajo Near Sims Marina	3/23/2010	1300	5.0	6.0	2.5	8	8.0	no	no
	6/29/2010	1300	13.0	14.5	4.2	11	13.5	(9-10)	no
	10/19/2010	1500	0.5	6.5	5.7	12	6.6	no	no
Lake Farmington Deep	3/22/2010	1500	5.0	19.3	1.0	8	3.2	no	no
	6/28/2011	1300	20.0	21.0	3.0	11	10.0	(8-9)	no
	10/18/2011	1430	21.0	21.9	3.6	11	11.0	(14-15)	(15)
Lake Farmington Shallow	3/22/2010	1630	0.5	6.5	1.5	8	4.8	no	no
	6/28/2011	1330	4.0	5.0	2.5	8	5.0	(2-3)	no
	10/18/2011	1630	1.0	4.6	2.7	8	8.5	no	no

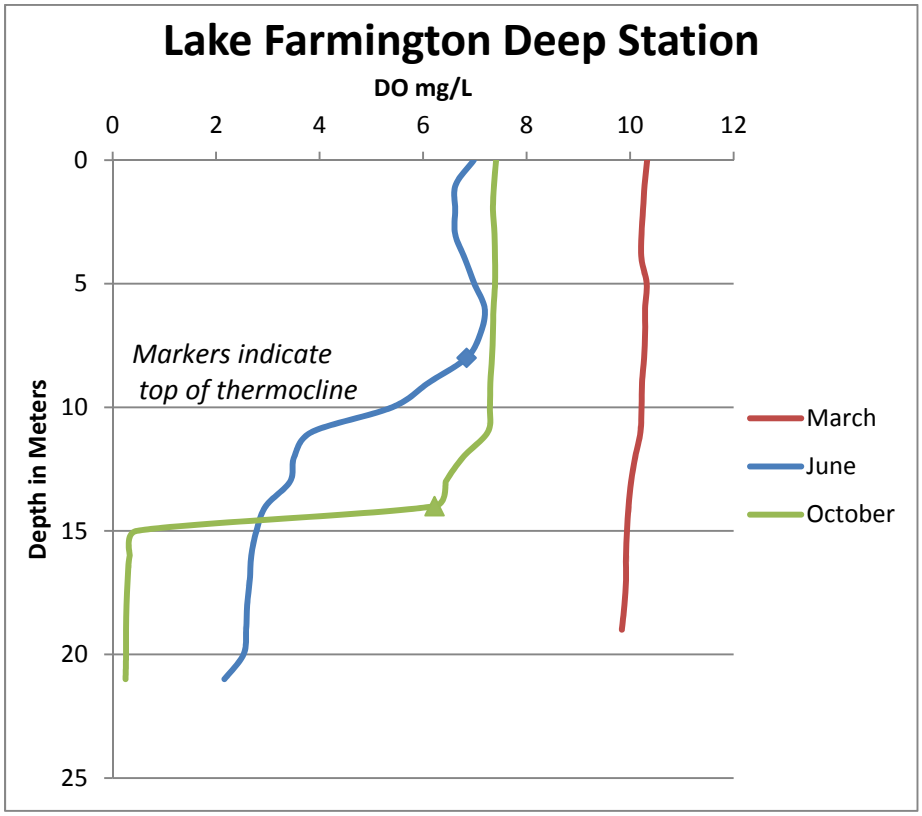


Figure 4. Lake Farmington dissolved oxygen depth profiles.

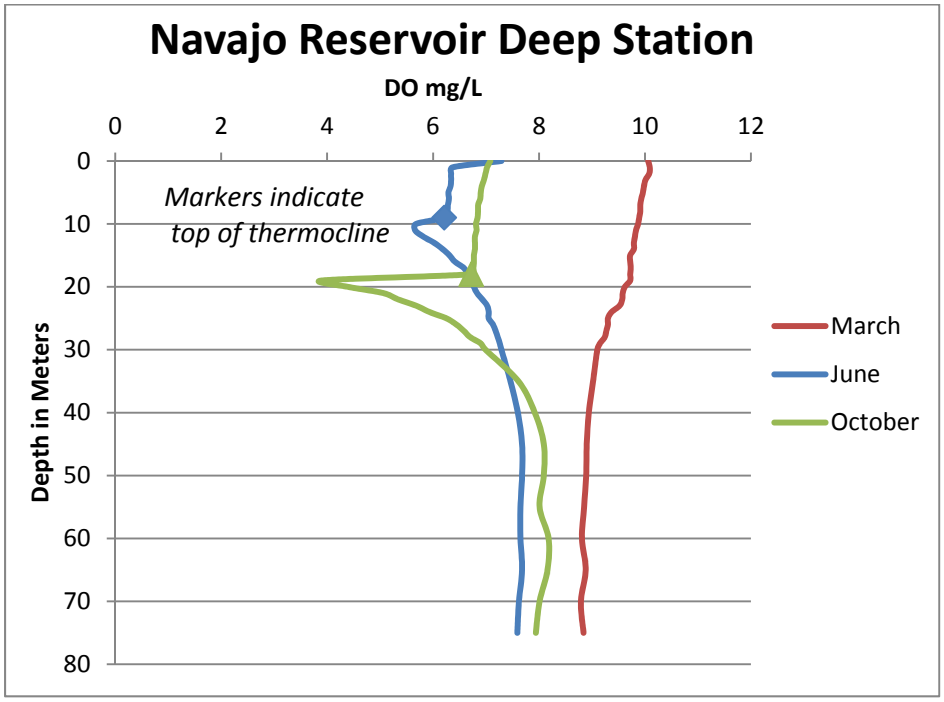


Figure 5. Navajo Reservoir dissolved oxygen depth profiles.

Note: profiles include only the first 75 meters due to equipment limitations.

5.4.3 Nutrient and Biological Data Evaluation

A draft Nutrient Assessment Protocol for Lakes and Reservoirs (draft AP) (NMED/SWQB 2010b) has been developed by SWQB to implement the narrative criterion for plant nutrients at 20.6.4.13 NMAC; however further analyses on impairment thresholds are being conducted. Until these analyses are complete and thresholds are identified, nutrient assessment should be considered provisional.

Sampling results from Navajo Reservoir and Lake Farmington were compared to the thresholds identified in the draft AP (Table 14). Referring to the seasonal thresholds in the draft AP, Lake Farmington exceeded 2 of 6 secchi depth measurements and 1 of 6 DO depth profiles. However, Lake Farmington was still in support for nutrients as it did not exceed 3 or more of the threshold groups in the draft AP. Navajo Reservoir did not have any exceedences of nutrient indicators.

Phytoplankton samples were collected at the deep stations and the community was identified and enumerated, including the percent cyanobacteria – an indicator of nutrient enrichment. Cyanobacteria (blue-green algae) were not found in Lake Farmington and were found only in small amounts in Navajo Reservoir and then only in October. Cyanobacteria comprised less than 2% of the October phytoplankton community in Navajo Reservoir, which is below the impairment threshold of 50% of the total phytoplankton community. The October community consisted of 1.4% *Microcystis aeruginosa* and 0.3 % *Woronichinia*. *Microcystis aeruginosa* has been known to produce harmful toxins associated with algae blooms; however the amount of *Microcystis aeruginosa* observed was low and there were no observations or reports of large blooms in Navajo Reservoir during this survey.

Table 14. Nutrient related indicators.

Station	Sampling Date	Chlorophyll *a* (µg/L)	Limiting Nutrient (N = Nitrogen; P = Phosphorus)	Total Phosphorus (mg/L)	Total Nitrogen (mg/L)	Secchi Depth (m)	% of Profile Below D.O. Criterion	Cyanobacteria (% Bluegreen Algae)	Trophic State [2] (Carlson 1977)
Navajo Deep	3/23/2010	2.62	P	0.038	0.11	3	0[1]	0	Meso
	6/29/2010	1.12	P	0.006	0.13	4.75	4[1]	0	OligoMeso
	10/19/2010	MDP	P	0.005	0.18	5.25	8[1]	1.7	OligoMeso
Navajo at Gooseneck	3/23/2010	1.78	N	0.004	0	3	0	NA	OligoMeso
	6/29/2010	1.73	P	0.005	0.15	4	0	NA	OligoMeso
	10/19/2010	MDP	P	0.006	0.17	4	0	NA	OligoMeso
Navajo Near Sims	3/23/2010	2.43	N	0.019	0.13	2.5	0	NA	OligoMeso
	6/29/2010	1.36	P	0.006	0.29	4.2	7	NA	OligoMeso
	10/19/2010	MDP	P	0.004	0.13	5.7	0	NA	Oligo

Station	Sampling Date	Chlorophyll *a* (µg/L)	Limiting Nutrient (N = Nitrogen; P = Phosphorus)	Total Phosphorus (mg/L)	Total Nitrogen (mg/L)	Secchi Depth (m)	% of Profile Below D.O. Criterion	Cyanobacteria (% Bluegreen Algae)	Trophic State [2] (Carlson 1977)
Lake Farmington Deep Station	3/22/2010	0.19	N	0.027	0	**1**	0	0	OligoMeso
	6/28/2011	1.21	P	0.008	0.19	3	**55**	0	OligoMeso
	10/18/2011	MDP	P	0.004	0.18	3.6	33	0	OligoMeso
Lake Farmington Shallow Station	3/22/2010	0.28	P	0.003	0.11	**1.5**	0	NA	Oligo
	6/28/2011	1.12	P	0.005	0.14	2.5	0	NA	OligoMeso
	10/18/2011	MDP	P	0.005	0.22	2.7	0	NA	OligoMeso

1. % of the profile at the deep station only includes the first 75 meters due to equipment limitations.
2. Oligo = Oligotrophic – low productivity, low nutrient content. Meso = Mesotrophic – Intermediate level of productivity and nutrients.

Bold values indicate an exceedence of the nutrient impairment thresholds for reservoirs recommended in the draft AP.
MDP – Missing data point.
NA – Not applicable because phytoplankton only collected at the deep station

5.5 Water Quality Sampling Results for Permitted Point Sources

Data collected from permitted discharges are used to inform development of TMDLs and management of NPDES permits, but are not directly used in assessments. They also do not represent compliance monitoring and cannot be used for enforcement actions. Values in **bold type** represent exceedences of permit limits. These data are included in Table 15 for public information.

Table 15. Results from Wastewater Treatment Plant (WWTP) discharges

Site No.	Facility	Sample Date	TDS (mg/L)	TSS (mg/L)	*E. coli* (cfu/ 100 mL)	Total Residual Chlorine (mg/L)	Ammonia (mg/L)	pH	N+N (mg/L)	TKN (mg/L)	TP (mg/L)
8	Bloomfield WWTP	3/17/2010			**235.9**		14.2	7.51	4.5	17	0.935
		4/13/2010	526		4.1		2.52	6.95	9.3	4.8	0.291
		5/11/2010		7	8.4		0.804	7.05	9.4	2.7	0.325
		6/15/2010			2		2.36	7.64	10	5.1	1.44
		7/20/2010	526		**180.6**		< 0.1	7.15	12	1.7	0.72
		8/17/2010			3.1		2	7.14	5.8	3.6	0.653
		10/13/2010	482		**435.2**	0.05	1.26	7.16	9	2.9	0.637
		11/1/2010			20.6		12.5	7.46	0.5	15	0.709

Site No.	Facility	Sample Date	TDS (mg/L)	TSS (mg/L)	*E. coli* (cfu/ 100 mL)	Total Residual Chlorine (mg/L)	Ammonia (mg/L)	pH	N+N (mg/L)	TKN (mg/L)	TP (mg/L)
14	Aztec WWTP	3/16/2010			1		< 0.1	7.66	**2.8**	1.4	0.361
		4/13/2010	660		3		< 0.1	7.41	**3.3**	1.3	**3.6**
		5/11/2010		7	41		0.165	7.42	1.5	1.9	**3.23**
		6/15/2010			1		< 0.1	7.73	**4.4**	1.1	0.557
		7/20/2010	550		64.5		0.331	7.64	**3.9**	1.5	**4.56**
		8/17/2010			> 2419.6		2.71	7.45	**3.9**	4.8	**3.78**
		10/13/2010	580		12.2	< 0.01	< 0.1	7.65	< 0.1	1.3	0.557
		11/1/2010			**165.8**		1.34	7.67	0.44	3.5	**4.76**
19	Farmington WWTP	3/16/2010			< 1		18.36	7.16	7.3	19	3.09
		4/14/2010	768		< 1		13.5	7.2	7.2	15	0.991
		5/11/2010		8	< 1		3.24	6.93	20	5.3	2.64
		6/16/2010			3.1		1.4	7.66	17	2.8	2.21
		7/21/2010	664		1		1.2	6.82	17	3.4	2.03
		8/18/2010			8.6		2.4	6.93	18	3.7	2.05
		10/14/2010	718		1	0.04	0.998	7.18	18	2.4	2.04
		11/2/2010			1		1.03	7.34	17	2.5	1.32
26	Harper Valley WWTP	3/17/2010			**> 2419.6**		41.1	7.41	< 0.1	49	7.04
		4/14/2010	704		**> 2419.6**		32.5	7.31	< 0.1	44	4.82
		6/16/2010			**> 2419.6**		7.51	7.6	0.1	13	3.63
		7/21/2010	712		**> 2419.6**		3.31	7.31	5	10	2.72
		8/18/2010			**> 2419.6**		4.07	7.29	9.5	6.9	3.33
		10/14/2010	824		**236**	0.13	1.69	7.56	19	5.6	3.65
		11/2/2010			**> 2419.6**		1.16	7.83	14	3.01	2.58
28	Central Consolidated School District WWTP	3/17/2010			5.2		< 0.1	6.99	29	1.1	6.07
		4/14/2010	786		2		< 0.1	6.99	32	0.99	5.82
		5/11/2010		7	4.1		< 0.1	6.91	25	1.9	6.12
		6/16/2010			< 0.1		< 0.1		30	0.43	6.12
		7/21/2010	706		< 0.1		< 0.1	7.06	13	0.98	2.04
		8/18/2010			**> 2419.6**		1.61	6.97	20	2.5	2.75
		10/14/2010	810		28.1		< 0.1	6.99	< 0.1	0.73	4.79

TDS = Total Dissolved Solids
TSS = Total Suspended Solids
N+N = Nitrate plus Nitrite
TKN = Total Kjeldahl Nitrogen
TP = Total Phosphorus

6.0 CONCLUSIONS

The 2010 San Juan water quality survey included the San Juan River from the Navajo Nation boundary at the Hogback upstream to Navajo Dam, the Animas River from its confluence with the San Juan upstream to the Colorado border, La Plata River from its confluence with the San Juan upstream to the Colorado border, Stevens Arroyo, five permitted wastewater treatment plants, the Navajo River upstream of the Jicarilla Apache Nation, Lake Farmington, and Navajo Reservoir.

Documented exceedences of numeric criteria from this survey include:

- Total and dissolved **aluminum** criteria were exceeded at only one station (Navajo River), only on one occasion in April. It is not uncommon for spring runoff flows to exhibit exceedences of this type. The lack of further exceedences suggests this is not a chronic condition.

- A segment-specific numeric criterion for total **phosphorus** exists in the upper Animas (Estes Arroyo to Colorado border), Navajo River, and Navajo Reservoir. Other waters in the San Juan basin do not have numeric limits for total phosphorus, although all waters are covered under the narrative nutrient criterion found at 20.6.4.13(E) NMAC. The total phosphorus segment-specific numeric criterion was exceeded twice at each of two stations (a total of four exceedences) in the upper Animas and once in the Navajo River. There were no other exceedences of the total phosphorus numeric criterion.

- **Dissolved oxygen** data recorded by a logger indicate an exceedence of that criterion in La Plata River at La Plata, NM. Dissolved oxygen exceedences are typically indicative of excessive nutrient loading and dissolved oxygen data are a component of the assessment of narrative nutrient criterion (see below).

- The total **gross alpha** criterion was exceeded once on the lower La Plata.

- The greatest number of exceedences by far was for ***E. coli***. Exceedences were reported in the San Juan, Animas, La Plata, and Navajo rivers, as well as Stevens Arroyo. No exceedences were reported in the San Juan above its confluence with the Animas. Five stations had one exceedence each and eight stations had multiple exceedences.

- The only substantial exceedences of **temperature** criteria were recorded with data loggers in the Navajo and Animas rivers. However, this may be an artifact of inappropriate criteria that require revision. Navajo River is designated as a cold water aquatic life use, but the fish community (including historical records) suggests that a cool water designation may be more appropriate. Similarly, a cold water designation for the upper Animas may be unrealistically stringent. A marginal warm water designation with its associated 32.2°C criterion for La Plata may be inappropriately lenient.

The San Juan, from Cañon Largo upstream to Navajo Dam, has an aquatic life use designation of high quality cold water. The temperature criterion (20°C) was not exceeded at any of the stations within this segment at any time. This is a result of the release of very cold hypolimnetic water

from Navajo Reservoir. Prior to the construction of Navajo Dam, this reach of the San Juan would have supported a cool water fish community, rather than the very popular trout sport fishery that now exists. The trout fishery represents an important economic and recreational resource. However, it should be noted that this is due to a completely artificial alteration of the native aquatic ecosystem. Thermal and hydrologic alterations resulting from the operation of Navajo Dam are major contributing factors in the decline of native fishes, particularly Colorado pikeminnow (*Ptychocheilus lucius*) and razorback sucker (*Xyrauchen texanus*), that once existed in far greater numbers in the San Juan and are now listed as endangered under federal, State and/or Navajo Nation statutes. While removal of Navajo Dam is not a realistic option now or in the foreseeable future, it is appropriate to acknowledge that the native aquatic ecosystem is impacted.

General criteria related to stream bottom deposits and suspended or settleable solids (sedimentation), plant nutrients, and biological integrity were also assessed. The following was determined based on SWQB's data evaluation:

- Data collected on **sedimentation** were consistent with previous data, with the exception of the upper Animas and represents an outlier. Further data collection will be necessary to confirm the results from the upper Animas. The San Juan River below Cañon Largo exhibited excessive sedimentation.

- **Nutrients** were determined to be excessive (through a weight-of-evidence assessment procedure) in the lower Animas and upper La Plata. The lower Animas assessment was based on excess nitrogen, phosphorus, and chlorophyll *a*. In the La Plata, the basis was large fluctuations in dissolved oxygen saturation and excess nitrogen.

- **Benthic macroinvertebrate** data were collected and assessed only for the Navajo River, as protocols for large, non-wadeable river assessment are under development. Navajo River exhibited a healthy (i.e., non-impaired) macroinvertebrate community.

- **Fish** community data were collected only in the Navajo River and lower La Plata River. Results of these fish surveys (and a review of historical fish data) indicate that a cold water designation for Navajo River should be reconsidered in favor of a cool water designation. In contrast, the marginal warm water designation for the La Plata should be reconsidered in favor of a cool water designation, particularly for the upper reaches, and possibly for the lower reaches as well. All native fish in these streams at these locations are classified as cool water species. The failure of some La Plata locations to meet cool water temperature criteria may be due to habitat degradation.

The cold water aquatic life temperature criterion was exceeded in Lake Farmington and Navajo Reservoir. There were no exceedences of water chemistry criteria in either lake. Under the provisional lake nutrient assessment protocol, both lakes were in support, although Lake Farmington exhibited exceedences of secchi depth (both deep and shallow stations) and dissolved oxygen (deep station only).

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