FINAL-APPROVED
TOTAL MAXIMUM DAILY LOAD (TMDL)
FOR THE
RED RIVER WATERSHED

RIO GRANDE RIVER TO HEADWATERS

MARCH 17, 2006

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LIST OF ABBREVIATIONS

AU	Assessment Unit
ADB	Assessment Database version 2
BLM	Bureau of Land Management
BMP	Best management practices
CFR	Code of Federal Regulations
cfs	Cubic feet per second
cfu	Colony forming units
CGP	Construction general storm water permit
CWA	Clean Water Act
^{o}C	Degrees Celsius
^{o}F	Degrees Fahrenheit
DP	Discharge permit
EPT	Ephemeroptera/Plecoptera/Tricoptera
EQIP	Environmental Quality Incentive Program
GIS	Geographic Information Systems
HBI	Hilsenhoff's Biotic Index
HQCWF	High Quality Coldwater Fishery
HUC	Hydrologic unit code
km^2	Square kilometer
LA	Load allocation
lbs/day	Pounds per Day
mgd	Million gallons per day
mg/L	Milligrams per Liter
mi^2	Square miles
mL	Milliliters
mm	Millimeters
MOS	Margin of safety
MOU	Memoranda of Understanding
MS4	Municipal Separate Storm Sewer System
MSGP	Multi Sector General Storm Water Permit
NM	New Mexico
NMAC	New Mexico Administrative Code
NMED	New Mexico Environment Department
NPDES	National Pollutant Discharge Elimination System
NTU	Nephelometric turbidity units
%	Percent
QAPP	Quality Assurance Project Plan
RBP	Rapid bioassessment protocol
RFP	Request for proposal
RI/FS	Remedial Investigation/Feasibility Study
SBD	Stream bottom deposits
STORET	Storage and Retrieval Database
SWPPP	Storm Water Pollution Prevention Plan
SWQB	Surface Water Quality Bureau

TMDL	Total maximum daily load
TSS	Total suspended solids
USDA	U.S. Department of Agriculture
USEPA	U.S. Environmental Protection Agency
USFS	U.S. Forest Service
USGS	U.S. Geological Survey
WLA	Waste load allocation
WQCC	Water Quality Control Commission
WQS	Water quality standards (NMAC 20.6.4 as amended through October 11, 2002)
WRAS	Watershed Restoration Action Strategy
WWTP	Waste water treatment plant
μmhos	Micromhos

EXECUTIVE SUMMARY

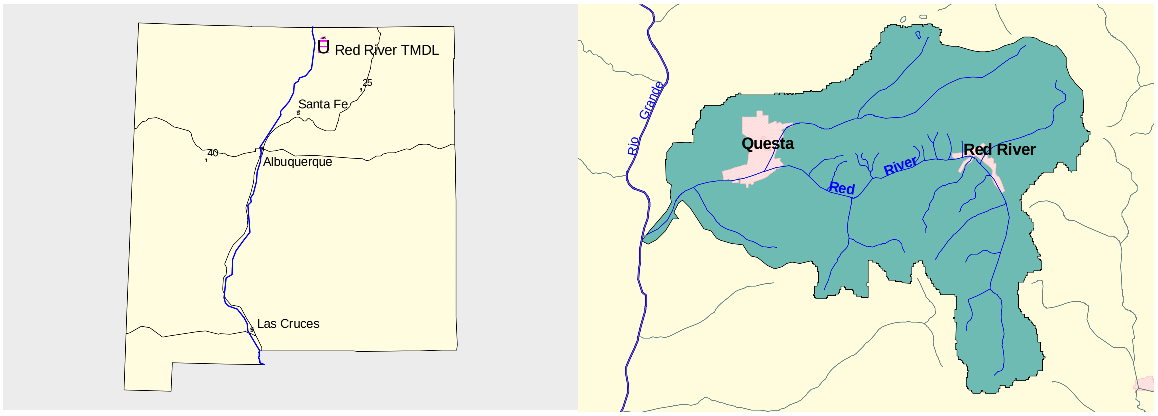
Section 303(d) of the Federal Clean Water Act requires states to develop Total Maximum Daily Load (TMDL) management plans for water bodies determined to be water quality limited. A TMDL documents the amount of a pollutant a water body can assimilate without violating a state's water quality standards. It also allocates that load capacity to known point sources and nonpoint sources at a given flow. Total maximum daily loads are defined in 40 Code of Federal Regulations Part 130 as the sum of the individual Waste Load Allocations (WLAs) for point sources and Load Allocations (LAs) for nonpoint sources and background conditions, and includes a Margin of Safety (MOS).

The Red River (from its confluence with the Rio Grande), together with its tributaries and headwaters (upstream from the confluence of the main and west forks of the Red River), define the Red River Watershed of northern New Mexico. The Surface Water Quality Bureau (SWQB) conducted an intensive surface water quality survey of the Red River watershed in 1999. Sampling stations were established along the course of the river to evaluate the impact of tributary streams and to establish background conditions. As a result of assessing data generated during this monitoring effort, combined with data from outside sources that met SWQB quality assurance requirements, impairment determinations of New Mexico water quality standards for metals (aluminum) were documented in the Red River (Rio Grande to Placer Creek), Bitter Creek, and Placer Creek. Pioneer Creek was found to be impaired with respect to turbidity and Bitter Creek is impaired with respect to sedimentation/siltation (i.e. stream bottom deposits). This TMDL document addresses the above noted impairments, except for chronic aluminum, as summarized in the tables below. Draft TMDLs for the Red River Watershed were previously prepared in 2002 by Daniel B. Stephens & Associates, Inc. for the SWQB. Those TMDLs were not finalized and are replaced by the TMDLs contained in this document.

Chronic aluminum TMDLs for the main stem Red River, Bitter Creek, and Placer Creek are not included in this document due to potential changes in the *New Mexico Standards for Interstate and Intrastate Surface Waters* for chronic aluminum in the Red River Watershed. Naturally occurring aluminum levels in the Red River Watershed are typically high and often exceed the chronic aluminum standard of 0.087 milligrams per liter (mg/L). The future development of chronic aluminum TMDLs for the Red River will be dependent on the development of appropriate segment specific chronic aluminum standards.

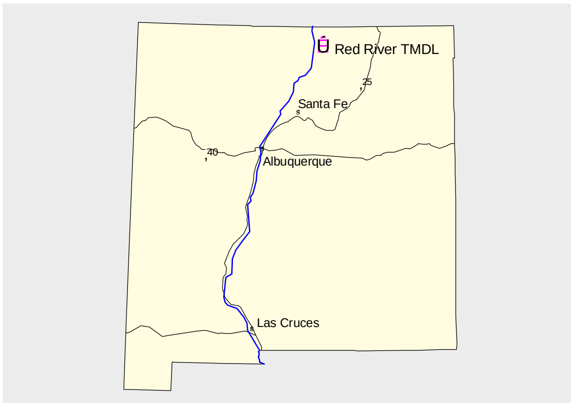
Additional water quality data will be collected by New Mexico Environment Department during the standard rotational period for intensive stream surveys. As a result, targets will be re-examined and potentially revised as this document is considered to be an evolving management plan. In the event that new data indicate that the targets used in this analysis are not appropriate and/or if new standards are adopted, the load capacity will be adjusted accordingly. When water quality standards have been achieved, the reach will be moved to the appropriate attainment category on the Clean Water Act Integrated §303(d)/§305(b) list of waters (NMED/SWQB 2004a).

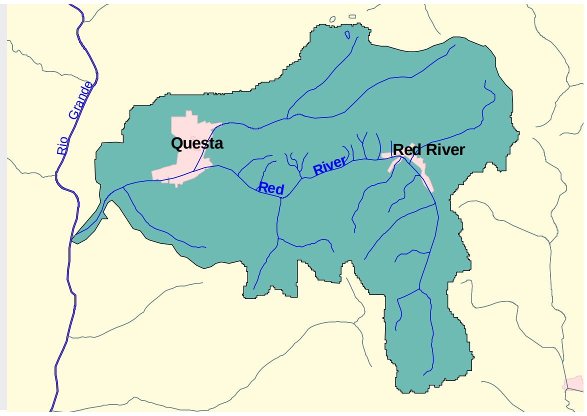
TOTAL MAXIMUM DAILY LOAD FOR ALUMINUM
RED RIVER (RIO GRANDE TO PLACER CREEK)



New Mexico Standards Segment	Rio Grande Basin 20.6.4.122
Assessment Unit Identifier	Red River (Rio Grande to Placer Creek), NM-2119_10 (formerly NM-URG1-20400)
Assessment Unit Length	20.2 miles
Parameters of Concern	Acute Aluminum
Designated Uses Affected	Coldwater Fishery
Geographic Location	Upper Rio Grande USGS Hydrologic Unit Code 13020101
Scope/size of Watershed	147 mi^2
Land Type	Southern Rockies Ecoregion (21)
Land Use/Cover	Forest (78%), Grassland (10%), Shrubland (8%), Mining (2.5%), Agriculture (0.5%), Built-up (0.4%), Barren (0.3%), Water (0.05%)
Identified Sources	Highway/Road/Bridge Runoff (Non-construction related), Impacts from Abandoned Mine Lands (Inactive), Mill Tailings, Mine Tailings, Natural Sources
Land Management	U.S. Forest Service (83%), Private (12.8%), BLM (4%), State (0.1%), Tribal (<0.1%)
Priority Ranking	High
TMDL for: Acute Aluminum	**WLA (3.90) + LA (578) + MOS (194) = 776**

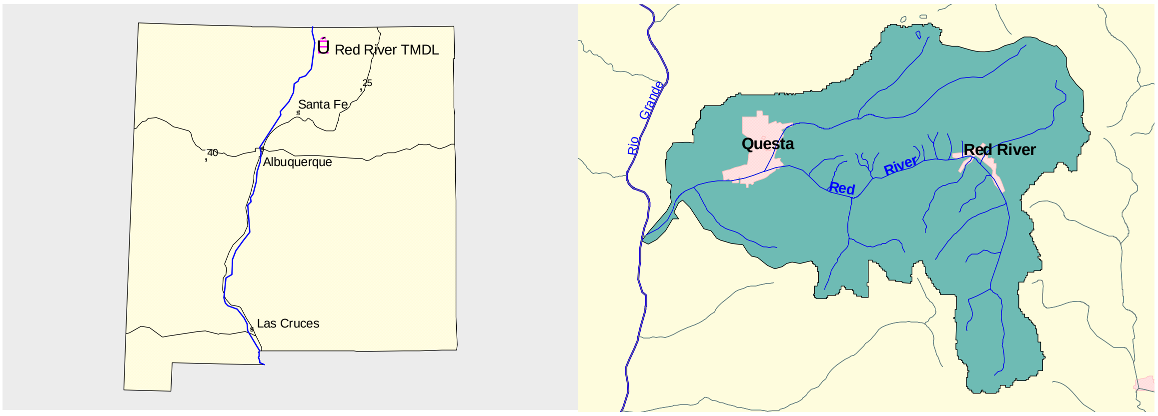
TOTAL MAXIMUM DAILY LOAD FOR ACUTE ALUMINUM AND SEDIMENTATION/SILTATION
BITTER CREEK (RED RIVER TO THE HEADWATERS)





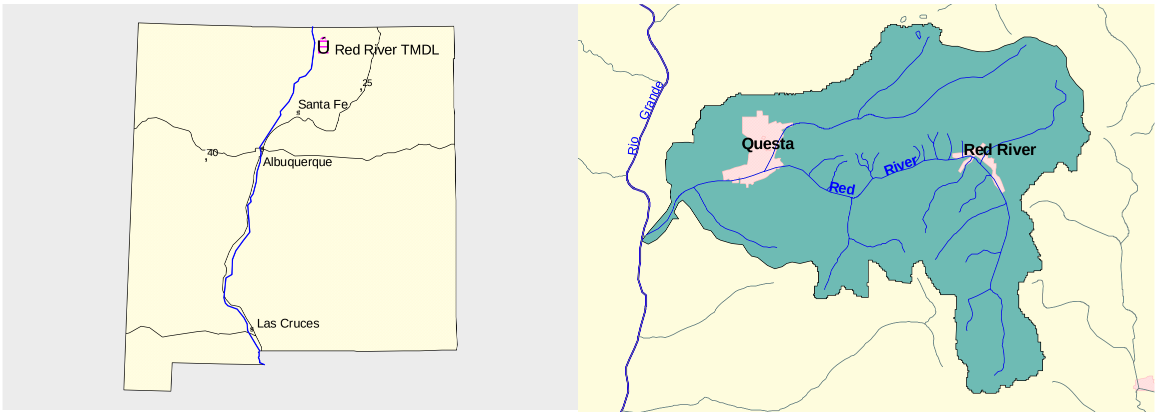
New Mexico Standards Segment	Rio Grande Basin 20.6.4.123
Assessment Unit Identifier	Bitter Creek (Red River to the headwaters), NM-2120.A_705 (formerly NM-URG1-20450)
Assessment Unit Length	7.1 miles
Parameters of Concern	Acute Aluminum, Sedimentation/Siltation
Designated Uses Affected	High Quality Coldwater Fishery
Geographic Location	Upper Rio Grande USGS Hydrologic Unit Code 13020101
Scope/size of Watershed	10 mi^2
Land Type	Southern Rockies Ecoregion (21)
Land Use/Cover	Forest (84%), Shrubland (9%), Grassland (7%), Commercial (<1%), Residential (<1%), Water (<1%)
Identified Sources	Acid Mine Drainage, Highway/Road/Bridge Runoff (Non-construction related), Natural Sources, Other Recreational Pollution Sources, Surface Mining
Land Management	U.S. Forest Service (97%), Private (3%)
Priority Ranking	High
TMDL for: Acute Aluminum Sedimentation/Siltation	 **WLA (0) + LA (31.4) + MOS (10.5) = 41.9** **WLA (0) + LA (16) + MOS (4.0) = 20**

TOTAL MAXIMUM DAILY LOAD FOR TURBIDITY
PIONEER CREEK (RED RIVER TO THE HEADWATERS)



New Mexico Standards Segment	Rio Grande Basin 20.6.4.123
Assessment Unit Identifier	Pioneer Creek (Red River to the headwaters), NM-2120.A_703 (formerly NM-URG1-20430)
Assessment Unit Length	4.3 miles
Parameters of Concern	Turbidity
Designated Uses Affected	High Quality Coldwater Fishery
Geographic Location	Upper Rio Grande USGS Hydrologic Unit Code 13020101
Scope/size of Watershed	5.3 mi^2
Land Type	Southern Rockies Ecoregion (21)
Land Use/Cover	Forest (90%), Grassland (5.3%), Shrubland (4.8%), Commercial (<1%), Residential (<1%)
Identified Sources	Resource Extraction, Recreation, Loss of Riparian Habitat, Streambank Modification/Destabilization
Land Management	U.S. Forest Service (92%), Private (8%)
Priority Ranking	High
TMDL for: Turbidity	**WLA (0) + LA (517) + MOS (129) = 646**

TOTAL MAXIMUM DAILY LOAD FOR ACUTE ALUMINUM PLACER CREEK (RED RIVER TO THE HEADWATERS)



New Mexico Standards Segment	Rio Grande Basin 20.6.4.123
Assessment Unit Identifier	Placer Creek (Red River to the headwaters), NM-2120.A_706 (formerly NM-URG1-20510)
Assessment Unit Length	1.3 miles
Parameters of Concern	Acute Aluminum
Designated Uses Affected	High Quality Coldwater Fishery
Geographic Location	Upper Rio Grande USGS Hydrologic Unit Code 13020101
Scope/size of Watershed	2.4 mi^2
Land Type	Southern Rockies Ecoregion (21)
Land Use/Cover	Forest (93%), Shrubland (4.5%), Grassland (2.5%)
Identified Sources	Habitat Modification (other than Hydromodification), Loss of Riparian Habitat, Natural Sources, Placer Mining
Land Management	U.S. Forest Service (92%), Private (8%)
Priority Ranking	High
TMDL for: Acute Aluminum	**WLA (0) + LA (7.50) + MOS (2.50) = 10.0**

1.0 INTRODUCTION

Under Section 303 of the Clean Water Act (CWA), states establish water quality standards, which are submitted and subject to approval of the U.S. Environmental Protection Agency (USEPA). Under Section 303(d)(1) of the CWA, states are required to develop a list of waters within a state that are impaired and establish a total maximum daily load (TMDL) for each pollutant. A TMDL is defined as "*a written plan and analysis established to ensure that a waterbody will attain and maintain water quality standard including consideration of existing pollutant loads and reasonably foreseeable increases in pollutant loads*" (USEPA 1999). A TMDL documents the amount of a pollutant a waterbody can assimilate without violating a state's water quality standards. It also allocates that load capacity to known point sources and nonpoint sources at a given flow. TMDLs are defined in 40 Code of Federal Regulations (CFR) Part 130 as the sum of the individual Waste Load Allocations (WLAs) for point sources and Load Allocations (LAs) for nonpoint sources and natural background conditions, and includes a margin of safety (MOS). This document provides TMDLs for assessment units within the Red River watershed that have been determined to be impaired based on a comparison of measured concentrations and conditions with water quality criteria and numeric translators for narrative standards.

This document is divided into several sections. Section 2.0 provides background information on the location and history of the Red River watershed, provides applicable water quality standards for the assessment units addressed in this document, and briefly discusses the intensive water quality survey conducted in the Red River watershed in 1999. Section 3.0 provides detailed descriptions of the individual watersheds for which TMDLs were developed. Section 4.0 presents the TMDL developed for sedimentation/siltation (previously referred to as stream bottom deposits) in the Red River watershed. Section 5.0 presents the TMDLs developed for turbidity in the Red River watershed. Section 6.0 presents a TMDL developed for acute aluminum. Pursuant to Section 106(e)(1) of the Federal CWA, Section 7.0 provides a monitoring plan in which methods, systems, and procedures for data collection and analysis are discussed. Section 8.0 discusses implementation of TMDLs (phase two) and the relationship between TMDLs and Watershed Restoration Action Strategies (WRAS). Section 9.0 discusses assurance, Section 10.0 public participation in the TMDL process, and Section 11.0 provides references.

2.0 RED RIVER WATERSHED BACKGROUND

2.1 Description and Land Ownership

The Red River, which originates in the Sangre de Cristo Range among New Mexico's highest peaks, including the 13,161-foot Wheeler Peak, is an important tributary to the Rio Grande. The river's sources are fed by relatively consistent patterns of orographic precipitation, including snowmelt and summer season convective storms.

The Red River Watershed covers approximately 187 square miles (mi^2) in northern New Mexico. It is dominated by conifer forest, but includes rangeland, agricultural and mining areas, barren lands, and built-up areas (Figure 2.1). Most of the land is managed by the United States Department of Agriculture (USDA) Forest Service (USFS). A much smaller area (4 percent[%]) is under the purview of the Bureau of Land Management (BLM) (Figure 2.2). The watershed consists almost entirely of Federal lands, with approximately 8% privately held land.

2.2 Geology

The watershed has two distinct characters, owing to an abrupt change in geology along its course. Along its upper and middle reaches, in the high mountains of the Carson National Forest, the Red River is a freestone stream flowing across wide meadows and through narrow canyons (Figure 2.3). The gradient along this reach ranges from approximately 70 to 130 feet per mile, decreasing downstream. The terrain is derived from erosion and the river's downcutting into Precambrian igneous and metamorphic basement rocks and Tertiary volcanic intrusives (altered and unaltered). Cabresto Creek joins the Red River in the lower part of this section and is its largest tributary. During the irrigation season, which usually lasts from May through September, essentially the entire flow of Cabresto creek is diverted, disconnecting it from the Red River. A significant portion of the Cabresto Creek watershed is encompassed by the Latir Peak Wilderness area, which includes the northernmost reaches of the Red River Basin (Figure 2.2).

As it nears the Rio Grande Gorge, the Lower Red River has carved a deep canyon through the Quaternary alluvial deposits and Tertiary conglomerates and volcanic flows of the Rio Grande rift system (Figure 2.3). The average gradient along this reach is approximately 150 feet per mile. In this section, the river flows through boulder-choked pockets of water and is similar in character to the Rio Grande itself. The lowermost section of the river is included in the Rio Grande Wild and Scenic River area.

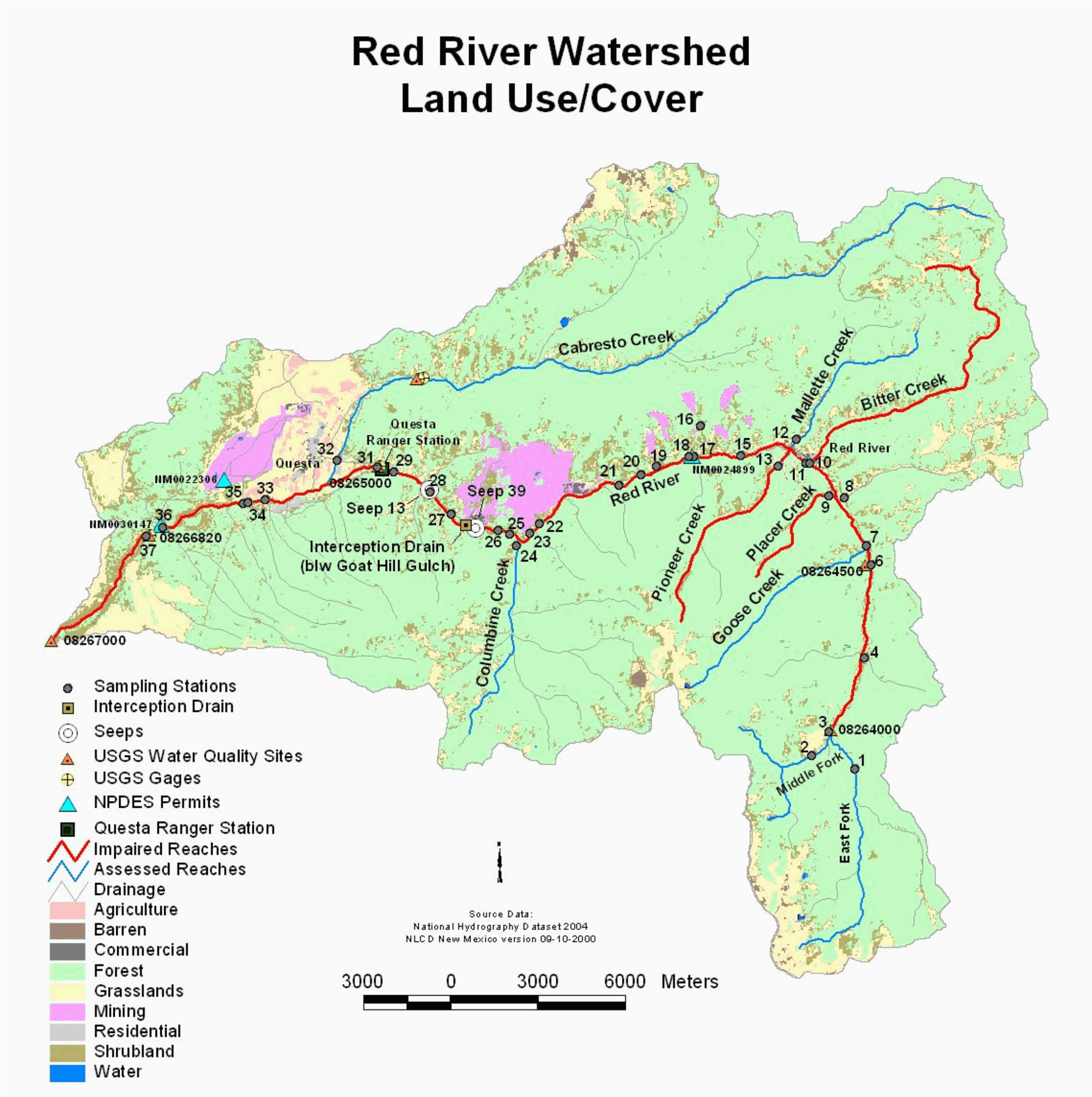


Figure 2.1 Red River Watershed Land Use/Land Cover and Sampling Stations

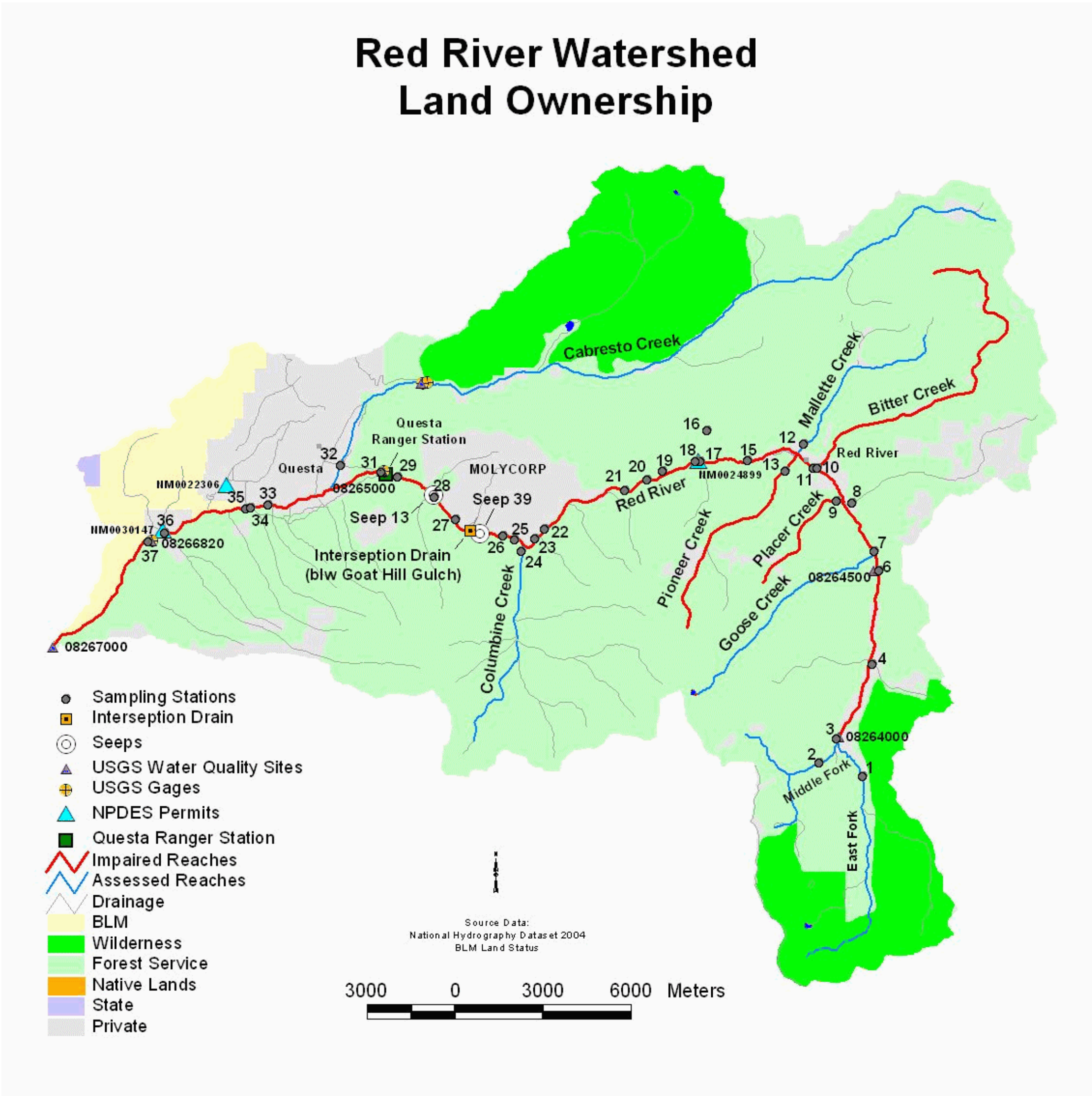


Figure 2.2 Red River Watershed Land Ownership and Sampling Stations

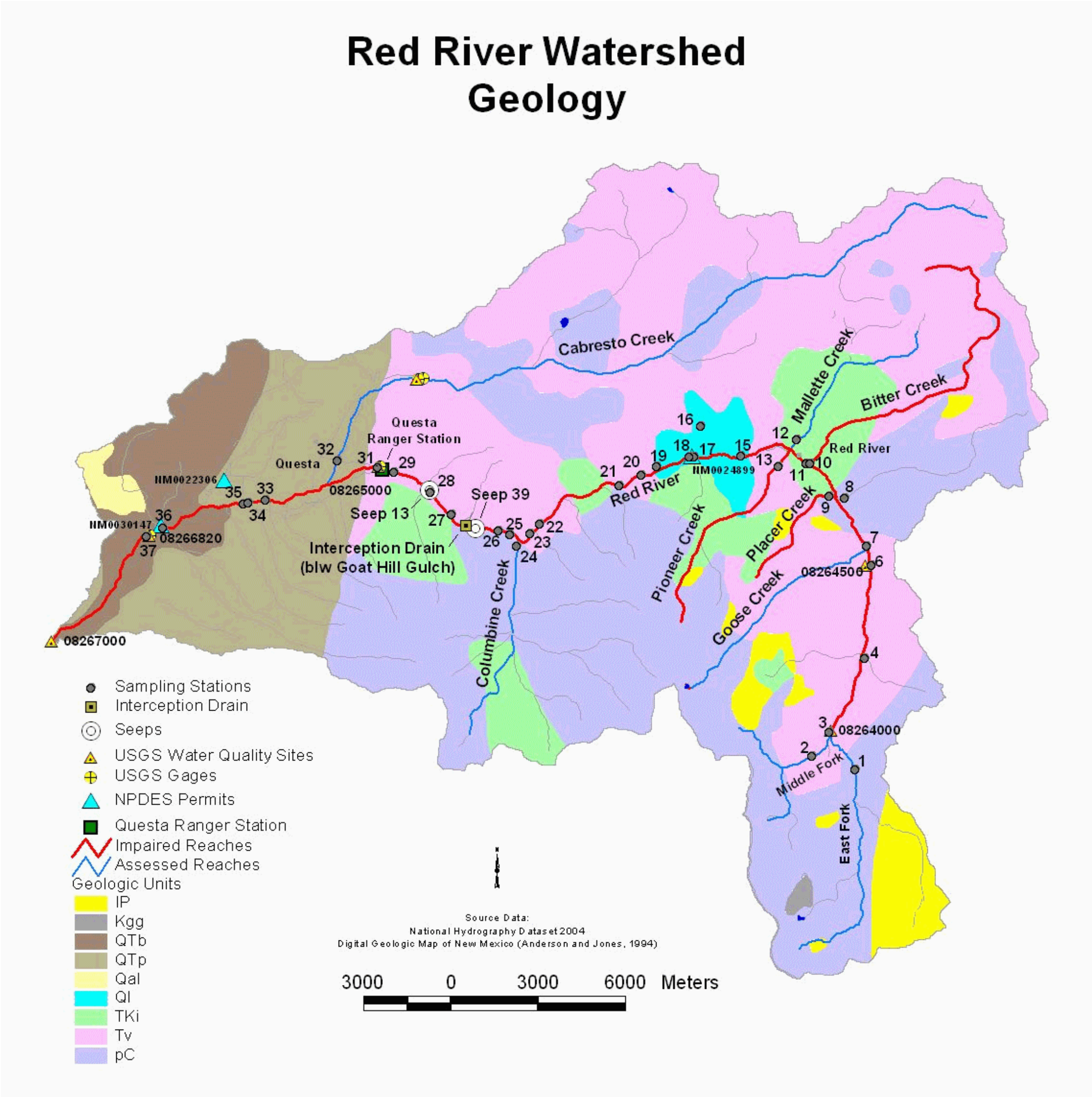


Figure 2.3 Red River Watershed Geology

Table 2.1 Geologic Unit Definitions for the Red River Basin (see Figure 2.3)

Geologic Unit Code	Definition
IP	Pennsylvanian (age) rocks
K_{gg}	Graneros Shale and Greenhorn Formation; limited to northeastern area; lower Turonian and Cenomanian
QT_b	Basaltic and andesitic volcanics interbedded with Pleistocene and Pliocene sedimentary units
QT_p	Older Piedmont alluvial deposit and shallow basin fill
Q_{al}	Alluvium, Q_a
Q_l	Landslide deposits and colluvium
TK_i	Paleogene and Upper Cretaceous intrusive rocks
Tv	Middle Tertiary volcanic rocks, undifferentiated
pC	Precambrian

2.2.1 Alteration Scars

In the Red River drainage basin, there are approximately 25 distinct alteration scar areas that range in size from < 0.1 square kilometers (km^2) (<24.7 acres) to approximately 0.5 km^2 (123.6 acres). These areas collectively encompass approximately 600 acres, which amounts to 0.5% of the basin's area. Alteration scars are landforms characterized by steep slopes, a lack of soil, iron oxide staining and clay formation, rapid erosion, and common slumping and landsliding (Meyer and Leonardson 1990). Runoff from the highly visible scars in the Red River valley contains elevated concentrations of iron oxides and clay minerals that turn the water orange, giving the Red River its name. The scars are thought to develop as a result of landslides and erosion in areas that become susceptible to mass wasting. Areas of faulting, fracturing, supergene alteration (weathering), and hydrothermal alteration are prone to landslides and scar development due to diminished shear strength of the affected rock mass (Meyer and Leonardson 1990). In addition, anthropogenic activity, such as mining, roads, etc, in the Red River area aggravates scar development and the associated effects on water quality (RGI 2000).

The scars are found mostly on the north side of the river and are aligned along two parallel, east to west trends (Meyer and Leonardson 1990) that follow the trend of mineralization (Figure 2.4). The south-facing slopes have a lower density of stabilizing forest cover and other vegetation than the north-facing slopes (Meyer and Leonardson 1990). The majority of the erosional scars are located east of the Molycorp Mine, but natural scars are also located within the mine's property.

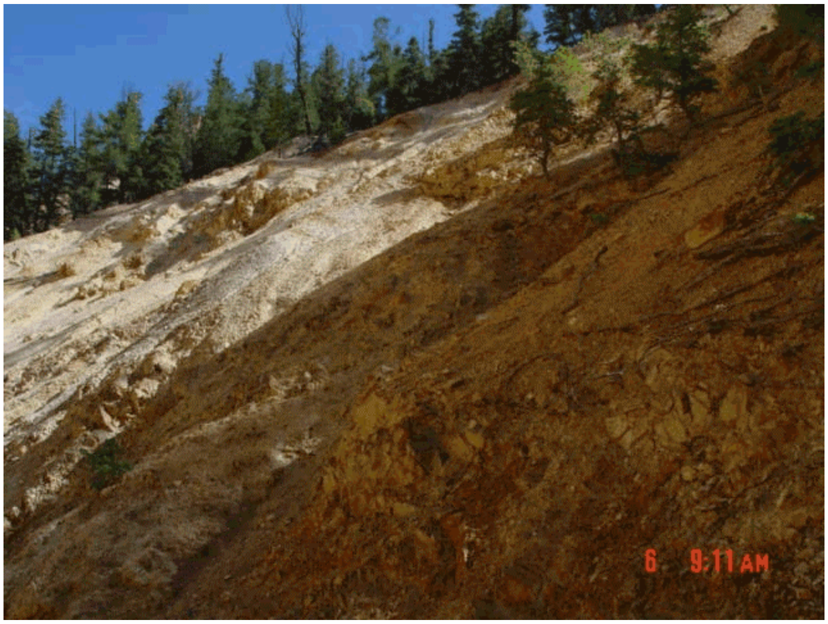


Photo 2.1 Alteration Scar in the Straight Creek Watershed

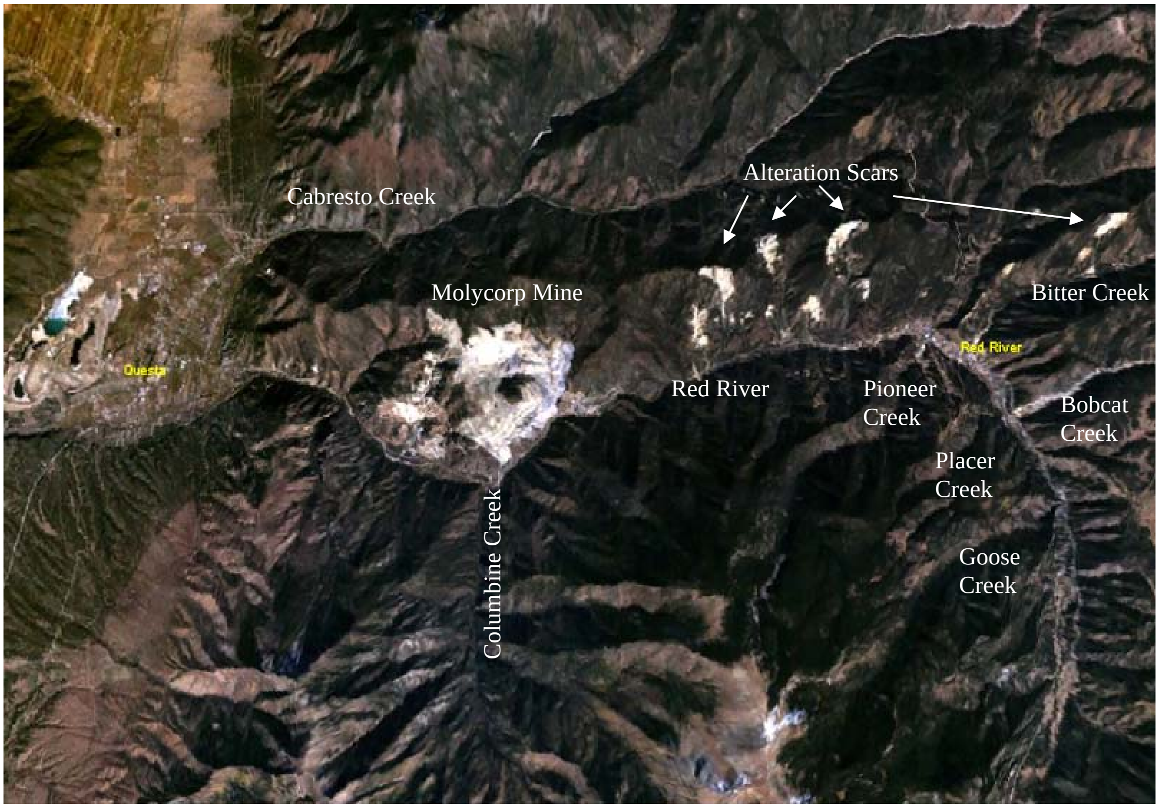


Figure 2.4 Satellite Image of the Red River Watershed, showing the Molycorp Mine Site and Alteration Scars along the North Side of the Red River

A high pyrite content of 3 to 5% is common in scar areas, while a lower pyrite content of 1% or less is typical throughout most of the region in nonmineralized zones and 1 to 3% in mineralized zones. Samples taken from scar areas have yielded acidic-paste pH measurements as low as 0.8 (RGI 2000) due to pyrite oxidation and acidic water generation, but typically range between 2-4 s.u. This indicates that weathering scars can also contribute to acid rock drainage, dissolved constituent loads in ephemeral overland flow that follows the steep drainage systems, and acidic groundwater recharge that eventually seeps or flows into the river (NMED 1996). Because the scars are also highly erosive and are the source of sediment; debris flows often wash across State Highway 38 and into the Red River during periods of heavy precipitation or snowmelt.

2.2.2 Molybdenum Mining

A molybdenum mine owned by Molycorp, Inc. is located north of the Red River between the Village of Questa and the Town of Red River (Figure 2.4). The mine occupies an almost three-square-mile area that is surrounded by the Carson National Forest (NMED 1996). Mining operations at the property have been carried out in three phases (historic underground, open pit, and block-caving methods) since 1919 (URS 2001). Over 100 million tons of tailing material that was generated in the open pit mining process were transported in slurry form by a 8-mile pipeline, and deposited in two unlined tailings ponds that are located west of Questa (Figure 2.1). Numerous spills have originated from the pipeline. Some of these spills have entered the Red River at various times since the construction of the pipelines. Currently, pursuant to Discharge Permit 933, Molycorp is investigating historic spills and the impact that those spills have to the environment. Also, during pit development, a series of waste rock piles (approximately 320 million tons) were placed in Capulin Canyon, Goathill Gulch, Sulpher Gulch, Spring Gulch, Blind Gulch, and many unnamed drainages located within the Molycorp property boundary along Highway 38, which parallels the Red River. The waste rock piles consist of mineralized rocks that contain pyrite, and non-mineralized rocks. The reaction between air and water with pyrite produces an acidic solution that leach metals such as aluminum. Presently, the acidic leachate reaches the Red River either through seeps and springs, or the interaction between groundwater and the Red River.

The mine is currently developing and refining plans for operational and closure conditions to protect surface and ground water quality pursuant to Discharge Permit (DP)-1055, DP-933 and the National Pollutant Discharge Elimination System (NPDES) permit. One of the conditions in DP-1055 is to determine pre-mining background ground water concentrations at the Molycorp mine site. A study of background conditions was conducted in 2001 and 2002 by the United States Geological Survey (USGS) in conjunction with the New Mexico Environment Department (NMED), Molycorp and a local environmental group. Pertinent results from the USGS study are incorporated into this TMDL document.

2.3 Water Quality Standards

Water quality standards (WQS) for all assessment units in this document are set forth in the following various sections of *New Mexico Standards for Interstate and Intrastate Surface Waters* (NM Administrative Code [NMAC] 20.6.4) (NMAC 2002):

20.6.4.122 RIO GRANDE BASIN - The main stem of the Rio Grande from Taos Junction bridge upstream to the New Mexico-Colorado line, the Red river from its mouth on the Rio Grande upstream to the mouth of Placer creek, and the Rio Pueblo de Taos from its mouth on the Rio Grande upstream to the mouth of the Rio Grande del Rancho.

A. **Designated Uses**: coldwater fishery, fish culture, irrigation, livestock watering, wildlife habitat, and primary contact.

B. **Standards**:

(1) In any single sample: pH shall be within the range of 6.6 to 8.8, temperature shall not exceed 20°C (68°F), and turbidity shall not exceed 50 NTU. The use-specific numeric standards set forth in 20.6.4.900 NMAC are applicable to the designated uses listed above in Subsection A of this section.

(2) The monthly geometric mean of fecal coliform bacteria shall not exceed 100/100 mL; no single sample shall exceed 200/100 mL (see Subsection B of 20.6.4.13 NMAC).

20.6.4.123 RIO GRANDE BASIN - The Red river upstream of the mouth of Placer creek, all tributaries to the Red river, and all other perennial reaches of tributaries to the Rio Grande in Taos and Rio Arriba counties unless included in other segments.

A. **Designated Uses**: domestic water supply, fish culture, high quality coldwater fishery, irrigation, livestock watering, wildlife habitat, and secondary contact.

B. **Standards**:

(1) In any single sample: conductivity shall not exceed 400 µmhos (500 µmhos for the Rio Fernando de Taos), pH shall be within the range of 6.6 to 8.8, temperature shall not exceed 20°C (68°F), and turbidity shall not exceed 25 NTU. The use-specific numeric standards set forth in 20.6.4.900 NMAC are applicable to the designated uses listed above in Subsection A of this section.

(2) The monthly geometric mean of fecal coliform bacteria shall not exceed 100/100 mL; no single sample shall exceed 200/100 mL (see Subsection B of 20.6.4.13 NMAC).

NMAC 20.6.4.900 provides standards applicable to attainable or designated uses unless otherwise specified in 20.6.4.101 through 20.6.4.899. This section includes the dissolved aluminum chronic and acute criterion of 0.087 and 0.75 milligrams per liter (mg/L), respectively, for Aquatic Life Habitat uses discussed in Section 6.0 of this document. NMAC 20.6.4.12 lists general standards that apply to all surface waters of the state at all times, unless a specified standard is provided elsewhere in NMAC.

NMED proposed several modifications to the New Mexico WQS during the February 2004 triennial review hearings. Changes that will potentially affect the Red River watershed are:

- Changing the criteria related to contact uses from fecal coliform to *E. coli* (monthly geometric mean of 126 colony forming units (cfu)/100 mL or less and single sample 235 cfu/100 mL).

- The addition of a total phosphorus criteria of 0.1 mg/L in NMAC 20.6.4.123.
- The segment-specific turbidity criteria has been replaced with the following language applicable to all surface waters:

> **Turbidity**: Turbidity attributable to other than natural causes shall not reduce light transmission to the point that the normal growth, function or reproduction of aquatic life is impaired or that will cause substantial visible contrast with the natural appearance of the water. Turbidity shall not exceed 10 NTU over background turbidity when the background turbidity is 50 NTU or less, or increase more than 20 percent when the background turbidity is more than 50 NTU. Background turbidity shall be measured at a point immediately upstream of the turbidity-causing activity. However, limited-duration activities necessary to accommodate dredging, construction or other similar activities and that cause the criterion to be exceeded may be authorized provided all practicable turbidity control techniques have been applied and all appropriate permits and approvals have been obtained.

Proposed changes to the standards have been approved by the New Mexico Water Quality Control Commission (WQCC), but are still under review and have not been approved by USEPA at the time of this writing. Accordingly, this TMDL document was prepared using the existing WQS (NMAC 2002). The approval of the proposed WQS changes for the Red River watershed by USEPA will not affect the TMDLs included in this document.

2.4 Intensive Water Quality Sampling

The Red River watershed was intensively sampled by the SWQB in 1999, with additional geomorphic and biological data collected in the Fall of 2001. A brief summary of the survey and the hydrologic conditions during the intensive sample period is provided in the following subsections. A more detailed description of the Red River intensive survey can be found in the *Water Quality Survey Summary for the Red River and Tributaries* available online at http://www.nmenv.state.nm.us/swqb/Surveys/RedRiver1999.pdf (NMED/SWQB 2004b).

2.4.1 Survey Design

Surface water quality samples were collected on a seasonal basis between May and October for the 1999 intensive SWQB study. Surface water quality monitoring stations were selected to characterize water quality of various assessment units (i.e., stream reaches) throughout the watershed (Table 2.2, Figures 2.1 through 2.3). Stations were located to evaluate the impact of tributary streams and to determine ambient and background water quality conditions. Surface water grab samples stations were analyzed for a variety of chemical/physical parameters. Data results from grab sampling are housed in the SWQB provisional water quality database and were uploaded to USEPA's Storage and Retrieval (STORET) database.

Table 2.2 SWQB 1999 Red River Sampling Stations

Station	Location Description
1	East Fork Red River at Ditch cabin
2	Middle Fork Red River
3	Red River below confluence of East and Middle forks
4	Black Copper Canyon
5	Bear Creek – visual assessment only
6	Red River at Zwergle Dam
6a	Red River at upper recreation crossing (QA duplicate)
7	Red River below Goose Creek
8	Bobcat Creek
9	Placer Creek
10	Bitter Creek
11	Red River below Bitter Creek
12	Mallette Creek
13	Pioneer Creek
14	Haut-N-Taut Creek (ephemeral)
15	Red River at Junebug Campground
16	Straight Creek (ephemeral)
17	Red River above Red River WWTP
18	Red River below Red River WWTP
19	Hansen Creek (ephemeral)
20	Red River below Hansen Creek
21	Red River at upper Molycorp boundary
22	Red River above Molycorp mine seep #2
23	Red River at Columbine Creek
24	Columbine Creek
25	Red River above Molycorp mine seep #3
26	Red River between seeps #3 and #4
27	Red River at Goat Hill Gulch campground
28	Red River above Capulin Creek
29	Red River below Capulin Creek
29a	Red River at picnic area (QA duplicate)
30	Not used – merged with 29
31	Red River at Questa USGS gage
32	Cabresto Creek at Hwy 38
33	Red River at Hwy 522 bridge
34	Red River below Questa WWTP
35	Red River below Molycorp outfall 002
36	Red River above hatchery (biology and geomorphology)
37	Red River below hatchery
37a	Red River above canyon mouth (QA duplicate)

All sampling and assessment techniques used during the 1999 intensive SWQB survey are detailed in the *Quality Assurance Project Plan* (QAPP) (NMED/SWQB 1999a) and assessment protocols (NMED/SWQB 2004c). As a result of the 1999 SWQB monitoring efforts and subsequent sampling by Molycorp, Inc, several surface water impairments were determined. Accordingly, these impairments remained on New Mexico's 2004-2006 Integrated CWA §303 (d)/305(b) list (NMED/SWQB 2004a).

Additional water quality data has been collect by Molycorp, Inc. as part of the Remedial Investigation/Feasibility Study (RI/FS) process currently being conducted at Molycorp's Questa Mine and as part of DP-1055 and DP-933. This additional data was used in the assessment process to determine impairments within the Red River. This data was not included in the determination of measured load (Section 6.0) of this document because it was not collected during the critical period for the aluminum TMDL.

In April 2001, the USGS and NMED began a cooperative study at the Molycorp Questa mine site to determine pre-mining or natural background water chemistry concentrations for the Questa site. USGS has published the results of several of these extensive studies on their USGS website at http://wwwbrr.cr.usgs.gov/projects/GWC_chemtherm/questa.htm. The results of these studies were used in this TMDL to assist in the determination of the aluminum loads in the Red River.

2.4.2 Hydrologic Conditions

There are two active, real-time USGS gaging stations in the Red River watershed associated with the reaches presented in this document. USGS gage locations are presented in Figures 2.1 through 2.3. Daily stream flow for these USGS gages are presented graphically in Figures 2.5 and 2.6 for the 1999-2002 calendar years.

The Red River is fed by numerous springs and shallow alluvial ground water discharges rendering it a gaining stream over a large portion of its length (Smolka and Tague, 1989). Numerous ephemeral/intermittent seeps and springs were identified along the Red River between the town of Red River and the gaging station near Questa during the USGS low-flow and snowmelt tracer studies (McCleskey *et al* 2003).

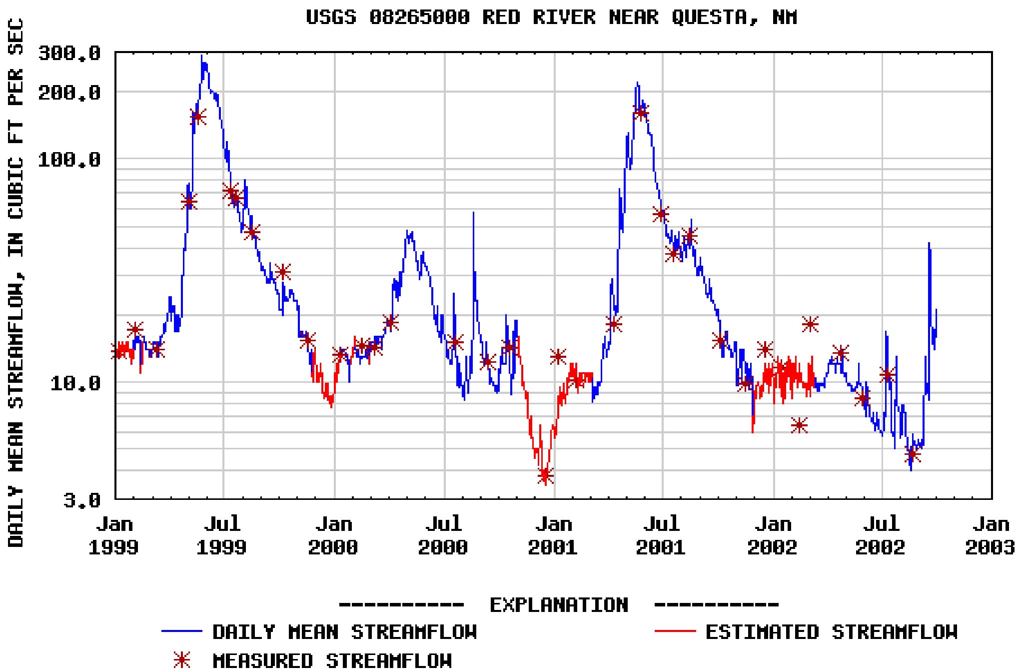


Figure 2.5 January 1999 - December 2002 USGS Average Daily Streamflow, Red River near Questa, NM

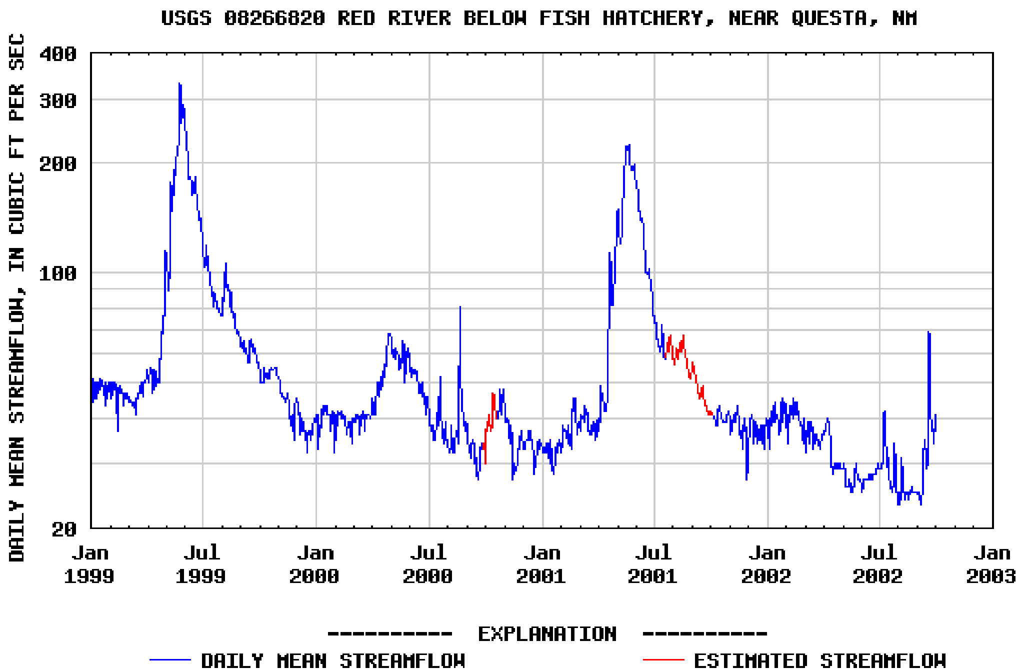


Figure 2.6 January 1999 – December 2002 USGS Average Daily Streamflow, Red River below Fish Hatchery near Questa, NM

The 1999 SWQB intensive survey was performed over varying flow conditions from May to October. During the spring of 1999, the Red River snow melt occurred earlier than usual, peaking at least twice before the sampling effort began. The studies performed by the USGS were carried out during low-flow conditions in August 2001 and snowmelt conditions in March 2002. Flows during 2001 and 2002 were below average based on the period of record, but the flows recorded in 1999 were slightly above average with a very good snow pack. In terms of assessing designated use attainment in ambient surface waters, WQS apply at all times under all flow conditions.

3.0 INDIVIDUAL WATERSHED DESCRIPTIONS & IMPAIRMENTS

TMDLs were developed for assessment units for which constituent (or pollutant) concentrations measured during the 1999 water quality survey, as combined with quality outside data, indicated impairment. Because characteristics of each watershed, such as geology, land use, and land ownership provide insight into probable sources of impairment, they are presented in this section for each of stream reaches. In addition, the 2004-2006 Integrated §303(d)/§305(b) listings within the Red River watershed are discussed (NMED/SWQB 2004a).

3.1 Red River

The headwaters of the 187 mi^2 Red River watershed originate in the Sangre de Cristo Range. The Red River has several perennial and ephemeral tributaries. As presented in Figure 2.2, land ownership is approximately 83% USFS, 8% Private, 4% BLM, 0.1% State, and <0.1% Tribal. Land use/land cover includes approximately 78% forest, 10% grassland, 8% shrubland, 2.5% mining, 0.5% agriculture, 0.4% built-up land, 0.3% barren land, and 0.05% water (Figure 2.1). The geology of the Red River watershed is predominantly comprised of Precambrian igneous and metamorphic basement rocks and Tertiary volcanic intrusives (Figure 2.3, see Section 2.2 for a more detailed description of the Red River Watershed geology).

Photo 3.1 Red River below Molycorp Mine

The Red River was divided into two assessment units (AUs). SWQB established several stations in each AU. Data from these stations were combined with readily available data from other sources that met quality control objectives, and assessed using established assessment protocols to determine whether or not designated uses were being met. As a result, the Red River (Rio

Grande to Placer Creek) was included on the 2004-2006 Integrated CWA §303(d)/§305(b) list for aluminum, and "sediment and water bioassays – chronic toxicity", and the Red River (Placer Creek to Headwaters) was included on the 2004-2006 Integrated CWA §303(d)/§305(b) list for aluminum (NMED/SWQB 2004a). The chronic aluminum TMDLs for both AUs will be prepared after a segment specific chronic aluminum is developed for the Red River. No TMDLs have previously been established for the Red River. Therefore, TMDLs were developed for inclusion in this document for the following assessment unit:

- ***Acute Aluminum***: Red River (Rio Grande to Placer Creek)

3.2 Bitter Creek

According to available Geographic Information System (GIS) coverages, the Bitter Creek watershed is approximately 10.6 mi^2 and there are no perennial tributaries or named ephemeral drainages along Bitter Creek. As represented in Figure 2.2, land ownership is approximately 97% USFS and 3% Private. Land use includes approximately 84% forest, 9% shrubland, 7% grassland, <1% commercial, <1% residential, and <1% water (Figure 2.1). The geology of the Bitter Creek watershed is consistent with the middle/upper portions of the Red River Watershed (Figure 2.3), and is comprised mainly of Precambrian igneous and metamorphic basement rocks and Tertiary volcanic intrusives. The lower portion of the canyon has an area with hydrothermal scars and a large associated debris apron which is contributing acid rock drainage and sediment to Bitter Creek. There were 20 historical mine sites identified within the Bitter Creek drainage *Preliminary Assessment/Site Inspection Bitter Creek Watershed* (Ecology and Environment, Inc. 2002a).

Photo 3.2 Bitter Creek near the Headwaters

One AU was established for Bitter Creek with a sampling station upstream of the confluence with the Red River (Figure 2.1). Data from this station was assessed using established assessment protocols to determine whether or not designated uses were being met. As a result, Bitter Creek (Red River to Headwaters) was included on the 2004-2006 Integrated CWA §303(d)/§305(b) list for sedimentation/siltation (stream bottom deposits) and aluminum. No TMDLs have previously been established for this AU. Therefore, the following TMDLs were developed for this document:

- ***Acute Aluminum***: Bitter Creek (Red River to Headwater)
- ***Sedimentation/siltation***: Bitter Creek (Red River to Headwater)

3.3 Pioneer Creek

According to available GIS coverages, the Pioneer Creek watershed is approximately 5.3 mi^2 and there are no perennial tributaries or named ephemeral drainages along Pioneer Creek. As represented in Figure 2.2, land ownership is 92% USFS and 8% Private. Land use includes approximately 90% forest, 5.3% grassland, 4.8% shrubland, <1% commercial, and <1% residential (Figure 2.1). The geology of the Pioneer Creek watershed is consistent with the middle/upper portions of the Red River Watershed (Figure 2.3), and is comprised mainly of Precambrian igneous and metamorphic basement rocks and Tertiary volcanic intrusives. There were 24 historical mines identified in the *Preliminary Assessment/Site Inspection Pioneer Creek Watershed* (Ecology and Environment, Inc. 2002b). Potential impacts from these historical mines could include erosion of soil and mining waste and sedimentation of the creek.

Pioneer Creek was moved from its natural channel on the Red River floodplain and extended west along the valley slope. This extension of the channel has decreased the stream's gradient, reducing stream power, and caused the deposition of large amounts of sediment that would otherwise have flushed to the Red River. The loss of hydrologic competency brought about by this excess deposition causes Pioneer Creek to flood frequently; endangering the homes built near the new channel. These sediment deposits significantly contribute to the turbidity problem in Pioneer Creek.

One AU was established for Pioneer Creek with a sampling station near the confluence with Red River (Figure 2.1). Data from this station was assessed using established assessment protocols to determine whether or not designated uses were being met. As a result, Pioneer Creek (Red River to Headwaters) was included on the 2004-2006 Integrated CWA §303(d)/§305(b) list for turbidity. No TMDLs have previously been established for this AU. Therefore, the following TMDL was developed for this document:

- ***Turbidity***: Pioneer Creek (Red River to Headwater)

Photo 3.3 Pioneer Creek in the Town of Red River (10/20/05)

3.4 Placer Creek

According to available GIS coverages, the Placer Creek watershed is approximately 2.0 mi^2 and there are no perennial tributaries or named ephemeral drainages along Placer Creek. As represented in Figure 2.2, land ownership is 92% USFS and 8% Private. Land use includes approximately 93% forest, 4.5% shrubland, and 2.6% grassland (Figure 2.1). The geology of the Placer Creek watershed is consistent with the middle/upper portions of the Red River Watershed (Figure 2.3), and is comprised mainly of Precambrian igneous and metamorphic basement rocks and Tertiary volcanic intrusives. Historical mineral exploration is visible throughout the Placer Creek watershed in the form of waste piles, adits/shafts, trails, and remnants of structures such as cabins and mills. There were 17 historical mines identified in the *Preliminary Assessment/Site Inspection Placer Creek Watershed* (Ecology and Environment, Inc. 2002c).

One AU was established for Placer Creek with a sampling station near the confluence with the Red River (Figure 2.1). Data from this station was assessed using established assessment protocols to determine whether or not designated uses were being met. As a result, Placer Creek (Red River to Headwaters) was included on the 2004-2006 Integrated CWA §303(d)/§305(b) list for aluminum. No TMDLs have previously been established for this AU. Therefore, the following TMDL was developed for this document:

- ***Acute Aluminum***: Placer Creek (Red River to Headwater)

Photo 3.4 Placer Creek near the Confluence with the Red River (10/20/05)

4.0 SEDIMENTATION/SILTATION (STREAM BOTTOM DEPOSITS)

Based on additional sampling performed in the Fall of 2001, impairment due to excessive Sedimentation/Siltation (previously listed as impairment due to Stream Bottom Deposits, [SBD]) was documented for Bitter Creek (Red River to the headwaters) (NMED/SWQB 2004c). Consequently, this assessment unit was listed on the 2004-2006 Integrated CWA §303(d)/§305(b) list for Sedimentation/Siltation (NMED/SWQB 2004a).

4.1 Target Loading Capacity

Target values for this Sedimentation/Siltation TMDL will be determined based on 1) the presence of numeric criteria or appropriate numeric translator to a narrative standard, 2) the degree of experience in applying the indicator, and 3) the ability to easily monitor and produce quantifiable and reproducible results. This TMDL is also consistent with New Mexico's antidegradation policy.

The state of New Mexico has developed and adopted a narrative "bottom deposit" standard. The current general narrative standard for the deposition of material on the bottom of a stream channel is specifically found in Section 20.6.4.12(A) of the State of New Mexico Standards for Interstate and Intrastate Surface Waters (NMAC 2002):

> ***Bottom Deposits****: Surface waters of the State shall be free of water contaminants from other than natural causes that will settle and damage or impair the normal growth, function, or reproduction of aquatic life or significantly alter the physical or chemical properties of the bottom.*

Clean stream bottom substrates are essential for optimum habitat for many fish and aquatic insect communities. The impact of fine sediment deposits is well documented in the literature. Impairment occurs when critical habitat components, such as spawning gravels and cobble surfaces, are physically covered by fines thereby decreasing intergravel oxygen and reducing or eliminating the quality and quantity of habitat for fish, macroinvertebrates, and algae (Chapman and McLeod 1987, Lisle 1989, Waters 1995). An increased sediment load is often the most important adverse effect of activities on streams, according to a monitoring guidelines report (USEPA 1991). This impact is largely a mechanical action that severely reduces the available habitat for macroinvertebrates and fish species that utilize the streambed in various life stages. Minshall (1984) cited the importance of substratum size to aquatic insects and found that substratum is a primary factor influencing the abundance and distribution of insects. Aquatic detritivores also can be affected when their food supply either is buried under sediments or diluted by increased inorganic sediment load and by increasing search time for food (Relyea et al. 2000). In addition, sediment loads that exceed a river's sediment transport capacity often trigger changes in stream morphology (Leopold and Wolman 1964). Streams that become overwhelmed with sediment often go through a period of accelerated channel widening and streambank erosion before returning to a stable form (Schumm 1977, Knighton 1984). These morphological changes tend to accelerate erosion, thereby reducing habitat diversity and placing additional stress on designated aquatic life uses.

The SWQB Sediment Workgroup evaluated a number of methods described in the literature that would provide information allowing a direct assessment of the impacts to the stream bottom substrate. In order to address the narrative criteria for bottom deposits, SWQB compiled techniques to measure the level of sedimentation of a stream bottom. These procedures are presented in Appendix D of the *State of New Mexico Procedures for Assessing Standards Attainment for the Integrated §303(d)/§305(b) Water Quality Monitoring and Assessment Report* (NMED/SWQB 2004c). The purpose of the protocol is to provide a reproducible quantification of the narrative criteria for bottom deposits in small wadeable streams. A final set of monitoring procedures was implemented at a wide variety of sites during the 2001 monitoring season. These procedures included conducting pebble counts (to determine percent fines), stream bottom cobble embeddedness, geomorphologic measurements, and the collection and enumeration of benthic macroinvertebrates.

The target levels involved the examination of developed relationships between percent fines and biological score as compared to a reference site. Using existing data from New Mexico, a relationship (r^2=0.75) was established between embeddedness and the biological scores using data collected in 1998 (NMED/SWQB 2004c). A correlation (r^2= 0.719) was also found when relating embeddedness to percent fines. Although these correlations were based on a limited data set, TMDL studies on other reaches, including those in the Cimarron Basin, the Jemez Basin, and the Rio Guadalupe, have shown this relationship to be consistent. These relationships show that at the desired biological score of at least 79, the target embeddedness for fully supporting a designated use would be 45% and the target percent fines would be 20% (NMED/SWQB 2004c). Since this relationship is based on New Mexico streams, 20% was utilized for the target value for percent fines in previous TMDLs for small wadeable streams in New Mexico.

The Columbine Creek at Columbine Camp Ground was chosen as the benthic macroinvertebrate reference station for Bitter Creek about 100 meters above Red River (SWQB Station 10). They are both in ecoregion 21 and have similar geomorphic characteristics. Benthic macroinvertebrate samples and pebble counts were collected at both stations (Barbour et al. 1999, Wohlman 1954).

Collection of benthic macroinvertebrates involved the compositing of three individual kick net samples taken from a riffle at each sampling location. Each kick involved the disturbance of approximately one-third of a square meter of substrate for one minute into a 500-micron mesh net. The rapid bioassessment protocol (RBP) metrics were applied to a 300-organism subsample of the composite sample at each site (Barbour et al. 1999). Selection of those metrics that are particularly suited to the delineation of sediment impacts highlights the degree of impairment. Ephemeroptera/Plecoptera/Tricoptera (EPT) taxa, the number of sediment adapted organisms, taxa richness, and Hilsenhoff's Biotic Index (HBI) all indicate some degree of impairment attributable to sedimentation (Table 4.1). Select results of the pebble count and benthic macroinvertebrate surveys are shown in Table 4.1.

Table 4.1 Pebble Count and Benthic Macroinvertebrate Results

Results	Reference Site[a]	Study Site[b]	Percent of Reference
Pebble count			
% Fines (< 2 mm)	4%	81%	2,025%
D50	66 mm	—	—
D84	155 mm	5 mm	—
Benthic metrics			
Standing Crop (number/square meter)	2,035	2,395	—
Ephemeroptera/ Plecoptera/ Tricoptera Taxa	21	3	—
Taxa Richness	35	10	—
Hilsenhoff's Biotic Index	2.96	5.70	—
Total Biologic Score	66	30	45%

Notes:
[a] Reference Site = Columbine Creek at Columbine Camp Ground
[b] Study Site = Bitter Creek about 100 meters above Red River
mm = Millimeters
— = Not applicable

4.2 Flow

No streamflow data are necessary because all loads are specified in percent fines.

4.3 Calculations

No calculations were necessary because all loads are specified in percent fines. The target loads for sedimentation are shown in Table 4.2.

Table 4.2 Calculation of Target Loads for Sedimentation/Siltation

Location	Sedimentation Standard[a] (% fines)	Sedimentation Target Load Capacity (% fines)
Bitter Creek (Red River to Headwaters)	20	20

Notes:
(a) This value is based on a narrative standard. The background values for bottom deposits were taken from the Stream Bottom Deposit Assessment Protocol (NMED/SWQB 2004d).

It is important to remember that the TMDL itself is a value calculated at a defined critical condition, and is calculated as part of planning process designed to achieve WQSs. Since flows vary throughout the year in these systems, the actual load at any given time will vary based on the changing flow. Management of the load to improve stream water quality should be a goal to be attained.

Measured load was determined by a pebble count as described in the Stream Bottom Deposit Assessment Protocol (NMED/SWQB 2004d). Fines are defined as particles less than 2 millimeters (mm) in diameter. Results are displayed in Table 4.3 .

Table 4.3 Calculation of Measured Loads for Sedimentation/Siltation

Location	Sedimentation/ Siltation Measured Load (% fines)
Bitter Creek (Red River to Headwaters)	81

4.4 Waste Load Allocations and Load Allocations

4.4.1 Waste Load Allocation

There are no Municipal Separate Storm Sewer System (MS4) storm water permits in this AU. Sediment may be a component of some industrial and construction storm water discharges covered under General Permits, so these discharges should be addressed. In contrast to discharges from other industrial storm water and individual process wastewater permitted facilities, storm water discharges from construction activities are transient because they occur mainly during the construction itself, and then only during storm events. Coverage under the NPDES construction general storm water permit (CGP) for construction sites greater than one acre requires preparation of a Storm Water Pollution Prevention Plan (SWPPP) that includes identification and control of all pollutants associated with the construction activities to minimize impacts to water quality. In addition, the current CGP also includes state specific requirements to implement best management practices (BMPs) that are designed to prevent to the maximum extent practicable, an increase in sediment, or a parameter that addresses sediment (e.g., total suspended solids [TSS], turbidity, siltation, SBDs, etc.) and flow velocity during and after construction compared to pre-construction conditions. In this case, compliance with a SWPPP that meets the requirements of the CGP is generally assumed to be consistent with this TMDL.

Other industrial storm water facilities are generally covered under the current NPDES Multi Sector General Storm Water Permit (MSGP). This permit also requires preparation of an SWPPP that includes identification and control of all pollutants associated with the industrial activities to minimize impacts to water quality. In addition, the current MSGP also includes state specific requirements to further limit (or eliminate) pollutant loading to water quality impaired/water quality limited waters from facilities where there is a reasonable potential to contain pollutants for which the receiving water is impaired. In this case, compliance with a SWPPP that meets the requirements of the MSGP is generally assumed to be consistent with this TMDL.

Individual wasteload allocations for the General Permits were not possible to calculate at this time in this watershed using available tools. Loads that are in compliance with the General Permits from facilities covered are therefore currently calculated as part of the watershed load allocation.

4.4.2 Load Allocation

In order to calculate the LA, the WLA and MOS were subtracted from the target capacity TMDL following **Equation 1**:

$$WLA + LA + MOS = TMDL \qquad \text{(Eq. 1)}$$

The MOS is estimated to be 20 percent of the target load calculated in Table 4.2. Results are presented in Table 4.4. Additional details on the MOS chosen are presented in Section 4.7.

Table 4.4 TMDL for Sedimentation/Siltation

Location	WLA (% fines)	LA (% fines)	MOS (20%) (% fines)	TMDL (% fines)
Bitter Creek (Red River to Headwaters)	0	16	4.0	20

The extensive data collection and analyses necessary to determine background sedimentation loads for these AUs was beyond the resources available for this study. Therefore, it is assumed that a portion of the load allocation is made up of natural background loads. The nonpoint source and background load reductions necessary to meet the target load was calculated to be the difference between the target load (Table 4.4) and the measured load (Table 4.3). This load reduction table (Table 4.5) is presented for informational purposes only.

Table 4.5 Calculation of Load Reduction for Sedimentation/Siltation

Location	Target Load$^{(a)}$ (% fines)	Measured Load (% fines)	Load Reduction (% fines)	Percent Reduction$^{(b)}$
Bitter Creek (Red River to Headwaters)	16	81	65	80%

Notes: The MOS is not included in the load reduction calculations because it is a set aside value which accounts for any uncertainty or variability in TMDL calculations and therefore should not be subtracted from the measured load.
(a) Target Load = LA + WLA
(b) Percent reduction is the percent the existing measured load must be reduced to achieve the TMDL, and is calculated as follows: (Measured Load – Target Load) / Measured Load x 100.

4.5 Identification and Description of Pollutant Source(s)

Probable nonpoint sources that may be contributing to the observed load are displayed in Table 4.6:

Table 4.6 Pollutant source summary for Sedimentation/Siltation

Pollutant Sources	**Magnitude[(a)]**	**Location**	**Potential Sources[(b)]**
Point:			
None	0%	--------	0%
Nonpoint:			
Sedimentation	81.0%	Bitter Creek (Red River to Headwaters)	100% Acid Mine Drainage Highway/Road/Bridge Runoff (non-construction related) Natural Sources Other Recreational Pollution Sources Surface Mining

Notes:
(a) Measured Load expressed as % fines.
(b) From the 2004-2006 Integrated CWA 303(d)/305(b) list (NMED/SWQB 2004a). This list of probable sources is based on staff observation and known land use activities in the watershed. These sources are not confirmed or quantified at this time.

4.6 Linkage of Water Quality and Pollutant Sources

SWQB fieldwork includes an assessment of the potential sources of impairment (NMED/SWQB 1999b). The *Pollutant Source(s) Documentation Protocol* form and summary in Appendix A. provide documentation of a visual analysis of probable sources along an impaired reach. Although this procedure is subjective, SWQB feels that it provides the best available information for the identification of potential sources of impairment in this watershed. Staff completing these forms identify and quantify potential sources of nonpoint source impairments along each reach as determined by field reconnaissance and assessment. It is important to consider not only the land directly adjacent to the stream, which is predominantly privately held, but also to consider upland and upstream areas in a more holistic watershed approach to implementing these TMDLs.

New Mexico's existing bottom deposits narrative WQS includes the phrase " …*from other than natural causes*…" Therefore, the degree to which sediment delivery and transport from the alteration scars is a natural phenomenon, has been exacerbated by human activities, or is the result of a combination of both should be considered. Even though the alteration scars are the primary source of excessive fine sediment loads and storm events during the summer and fall are the primary source of sediment transport, the anthropogenic influence of the forest road, land development, and the sand and gravel operation are contributing to impairment in Bitter Creek. Therefore, it cannot be stated that sediment impairment in Bitter Creek is completely due to natural causes. The geology in the watershed contributes to the amount of sediment available for transport. The Bitter Creek sediment load originates from the highly erodible alteration scars. This large, active sediment load in the lower canyon plays an important role in the formation and maintenance of instream habitat. Spring snowmelt and intense summer and fall precipitation events contribute to the amount of sediment transported into Bitter Creek and ultimately into Red River.

4.7 Margin of Safety

TMDLs should reflect a MOS based on the uncertainty or variability in the data, the point and nonpoint source load estimates, and the modeling analysis. For this TMDL, there will be no MOS for point sources since none were accounted for in the TMDL calculation. However, the MOS is estimated to be 20% for sedimentation. This MOS is based on the uncertainty in the relationship between embeddedness and percent fines. In this case, the percent fines numeric target was determined to interpret the narrative standard. There are also potential errors in measurement of nonpoint source and background loads due to sampling technique, time of sampling, and other factors. Accordingly, a conservative MOS for sedimentation accounts for **20%** of the TMDL.

4.8 Consideration of Seasonal Variation

Data used in the calculation of this TMDL were collected during the fall, which is a biological index period; meaning fall is a critical time in the life cycle stages of aquatic biota. Fall is also generally the low-flow period of the mean annual hydrograph in New Mexico when bottom deposits are most likely to settle and cause impairment, after the summer monsoon season but before annual spring runoff. It is assumed that if critical conditions are met during this time, coverage of any potential seasonal variation will also be met.

4.9 Future Growth

Estimations of future growth are not anticipated to lead to a significant increase for sedimentation that cannot be controlled with BMP implementation in the watershed, continued improvement of road conditions, and proper operation of the sand and gravel operations.

5.0 TURBIDITY

During the 1999 SWQB sampling monitoring effort in the Red River watershed, turbidity data showed several exceedences of the New Mexico WQS for the assessment unit Pioneer Creek (Red River to Headwaters). As a result, this assessment unit is listed on the 2004-2006 Integrated CWA §303(d)/§305(b) list (NMED/SWQB 2004a) with turbidity as a pollutant of concern (see summary in Table 5.1 and data in Appendix B).

5.1 Target Loading Capacity

Overall, the target values for turbidity TMDLs will be determined based on (1) the presence of numeric criteria, (2) the degree of experience in applying the indicator and (3) the ability to easily monitor and produce quantifiable and reproducible results. For this TMDL document, target values for turbidity are based on numeric criteria. This TMDL is also consistent with New Mexico's antidegradation policy.

According to the New Mexico Water Quality Standards (20.6.4 NMAC), the general narrative standard for turbidity reads:

> ***Turbidity***: *Turbidity attributable to other than natural causes shall not reduce light transmission to the point that the normal growth, function, or reproduction of aquatic life is impaired or that will cause substantial visible contrast with the natural appearance of the water.*

According to the New Mexico WQS the segment specific standards for turbidity reads:

> *20.6.4.123 NMAC: In any single sample: turbidity shall not exceed 25 NTU.*

The TSS analytical method is a commonly used measurement of suspended material in surface water. This method was originally developed for use on wastewater samples, but has widely been used as a measure of suspended materials in stream samples because it is acceptable for regulatory purposes and is an inexpensive laboratory procedure. Since there are no wastewater treatment plants discharging into Pioneer Creek, it is assumed that TSS measurements in these ambient stream samples are representative of erosional activities and thus comprised primarily of suspended sediment versus any potential biosolids from wastewater treatment plant effluent.

Turbidity levels can be inferred from studies that monitor suspended sediment concentrations. Extrapolation from these studies is possible when a site-specific relationship between concentrations of suspended sediments and turbidity is confirmed. Activities that generate varying amounts of suspended sediment will proportionally change or affect turbidity (USEPA 1991). The impacts of suspended sediment and turbidity are well documented in the literature. An increased sediment load is often the most important adverse effect of activities on streams, according to a monitoring guidelines report (USEPA 1991). This impact is largely a mechanical action that severely reduces the available habitat for macroinvertebrates and fish species that utilize the streambed in various life stages. An increase in suspended sediment concentration will reduce the penetration of light, decreases the ability of fish or fingerlings to capture prey, and reduce primary production (USEPA 1991). As stated in Relyea *et al* (2000) "increased turbidity by sediments can reduce stream primary production by reducing photosynthesis, physically abrading algae and other plants, and preventing attachment of autotrouphs to substrate surfaces".

TSS and turbidity were measured in Pioneer Creek (Table 5.1) during the 1999 survey. The TSS target was derived using a regression equation developed using measured turbidity as the independent variable and measured TSS dependent variable. The equation and regression statistics are displayed below in Figure 5.1. A correlation of $r^2 = 0.58$ was found between TSS and turbidity for Pioneer Creek.

Table 5.1 TSS and Turbidity Data for Pioneer Creek

Sample Date	TSS (mg/L)	Turbidity (NTU)
Pioneer Creek about 400 yards above Red River		
5/10/1999	17	30.3*
5/11/1999	35	26.5*
5/12/1999	12	13.6
5/13/1999	4	10.3
5/28/1999	7	5.65
8/17/1999	16	8.52
8/18/1999	<3.0	3.4
10/25/1999	<3.0	2.76
10/26/1999	8	6.36
10/27/1999	8	1.69
10/28/1999	<3.0	9.11

Notes: *Exceedence of turbidity water quality criterion.
NTU = Nephelometric turbidity units

5.2 Flow

Sediment transport in a stream varies as a function of flow. As flow increases, the amount of sediment being transported increases. Exceedences of the criterion occurred only during high flows in Pioneer Creek. Therefore, the target flow was set at high flow conditions. There is no USGS gage station on this reach and flow was not recorded during the 1999 sampling events, therefore flow had to be estimated for May from the Red River Watershed flow model developed by Daniel B. Stephens & Associates, Inc. (Appendix C). The estimated flow value for May 1999 based on this model is 3.60 million gallons per day (mgd).

It is important to remember that the TMDL itself is a value calculated at a defined critical condition, and is calculated as part of planning process designed to achieve water quality standards. Since flows vary throughout the year in these systems, the actual load at any given time will vary based on the changing flow. Management of the load to improve stream water quality should be a goal to be attained.

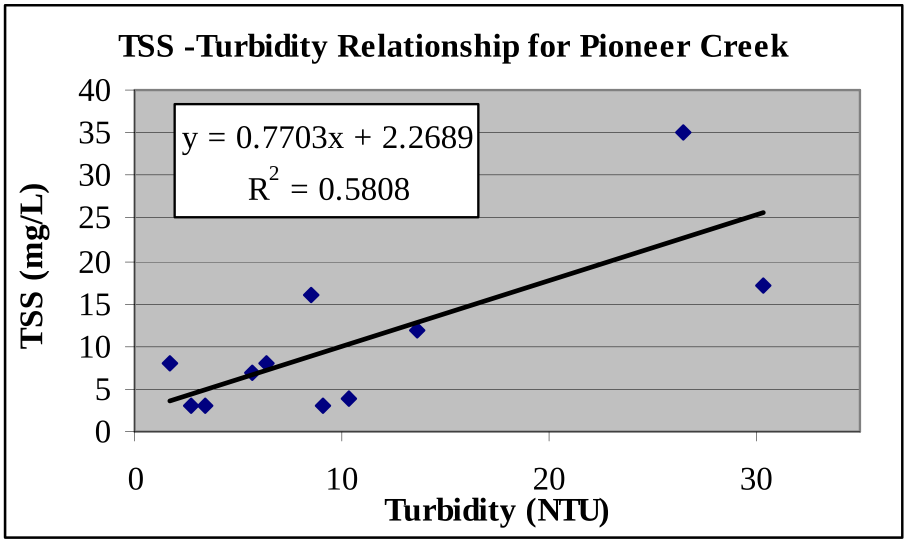


Figure 5.1 Relationship between TSS and Turbidity at Pioneer Creek

5.3 Calculations

Target loads for turbidity (expressed as TSS) are calculated based on a flow, the current water quality standards, and a conversion factor (8.34) that is a used to convert mg/L units to pounds per day (lbs/day) (see Appendix D for Conversion Factor Derivation). The target loading capacity is calculated using **Equation 1**. The results are shown in Table 5.2.

Critical Flow (mgd) x Standard (mg/L) x 8.34 = Target Loading Capacity (Eq. 1)

Table 5.2 Calculation of target loads for turbidity (expressed as TSS)

Location	Flow (mgd)	TSS (mg/L)	Conversion Factor	Target Load Capacity (lbs/day)
Pioneer Creek (Red River to Headwaters	3.60	21.5+*	8.34	646*

Notes:
+ The TSS value was calculated using the relationship established between TSS and turbidity in Figure 5.1 (y=0.7703x + 2.2689, R^2=0.58) using the turbidity standard of 25 NTU for the X variable.
*Values rounded to three significant figures.

Measured loads were also calculated using **Equation 1**. The arithmetic mean of corresponding TSS values when turbidity exceeded the standard was substituted for the standard in **Equation 1**. In order to achieve comparability between the target capacity (i.e., TMDL values) and measured loads, the same flow rates were used for both calculations. The same conversion factor of 8.34 was used. Results are presented in Table 5.3.

Table 5.3 Calculation of Measured Loads for Turbidity

Location	Flow (mgd)	TSS Arithmetic Mean+ (mg/L)	Conversion Factor	Measured Load Capacity (lbs/day)
Pioneer Creek (Red River to Headwaters)	3.60	26.0	8.34	781*

Notes: + = Arithmetic mean of TSS values when measured turbidity exceeded the standard (see Table 5.1).
* Values rounded to three significant figures.

5.4 Waste Load Allocations and Load Allocations

5.4.1 Waste Load Allocation

There are no individually permitted point source facilities or MS4 storm water permits in this assessment unit. Sediment may be a component of some (primarily construction) storm water discharges that contribute to suspended sediment impacts, and should be addressed.

In contrast to discharges from other industrial storm water and individual process wastewater permitted facilities, storm water discharges from construction activities are transient because they occur mainly during the construction itself, and then only during storm events. Coverage under the NPDES CGP for construction sites greater than one acre requires preparation of a SWPPP that includes identification and control of all pollutants associated with the construction activities to minimize impacts to water quality. In addition, the current CGP also includes state specific requirements to implement BMPs that are designed to prevent to the maximum extent practicable, an increase in sediment, or a parameter that addresses sediment (e.g., TSS, turbidity, siltation, stream bottom deposits, etc.) and flow velocity during and after construction compared to pre-construction conditions. In this case, compliance with a SWPPP that meets the requirements of the CGP is generally assumed to be consistent with this TMDL.

Other industrial storm water facilities are generally covered under the current NPDES MSGP. This permit also requires preparation of an SWPPP that includes identification and control of all pollutants associated with the industrial activities to minimize impacts to water quality. In addition, the current MSGP also includes state specific requirements to further limit (or eliminate) pollutant loading to water quality impaired/water quality limited waters from facilities where there is a reasonable potential to contain pollutants for which the receiving water is impaired. In this case, compliance with a SWPPP that meets the requirements of the MSGP is generally assumed to be consistent with this TMDL.

Individual WLAs for the General Permits were not possible to calculate at this time in this watershed using available tools. Loads that are in compliance with the General Permits from facilities covered are therefore currently calculated as part of the watershed load allocation.

5.4.2 Load Allocation

In order to calculate the LA, the WLA and MOS were subtracted from the target capacity (TMDL) following **Equation 2**.

$$WLA + LA + MOS = TMDL \qquad \text{(Eq. 2)}$$

The MOS is estimated to be 20% of the target load calculated in Table 5.2. Results are presented in Table 5.4. Additional details on the MOS chosen are presented in Section 5.7 below.

Table 5.4 Calculation of TMDL for turbidity

Location	WLA (lbs/day)	LA (lbs/day)	MOS (20%) (lbs/day)	TMDL (lbs/day)
Pioneer Creek (Red River to Headwaters	0	517	129*	646

* Values rounded to three significant figures.

The extensive data collection and analyses necessary to determine background turbidity loads for Pioneer Creek was beyond the resources available for this study. It is therefore assumed that a portion of the load allocation is made up of natural background loads.

The nonpoint source and background load reductions necessary to meet the target loads were calculated to be the difference between the target load (Table 5.4) and the measured load (Table 5.3), and are shown in Table 5.5. These load reduction tables are presented for informational purposes only.

Table 5.5 Calculation of Load Reduction for Turbidity (expressed as TSS)

Assessment Unit	Target Load*(a)* (lbs/day)	Measured Load (lbs/day)	Load Reduction (lbs/day)	Percent Reduction*(b)*
Pioneer Creek (Red River to Headwaters	517	781	264	34%

Notes: The MOS is not included in the load reduction calculations because it is a set aside value which accounts for any uncertainty or variability in TMDL calculations and therefore should not be subtracted from the measured load.
(a) Target Load = LA + WLA
(b) Percent reduction is the percent the existing measured load must be reduced to achieve the TMDL, and is calculated as follows: (Measured Load – Target Load) / Measured Load x 100.
* Values rounded to three significant figures.

It is important to note that load allocations are estimates based on a specific flow condition (i.e., high flow in this case). Under differing hydrologic conditions, the loads will change. For this reason the load allocations given here are less meaningful than are the relative percent reductions. Successful implementation of this TMDL will be determined based on achieving the current turbidity water quality standards.

5.5 Identification and Description of Pollutant Sources

Based on measured loads, probable nonpoint pollutant sources that may be contributing to observed turbidity loads are displayed in Table 5.6.

Table 5.6 Pollutant Source Summary for Turbidity

Pollutant Sources	Magnitude[(a)] (lbs/day)	Assessment Unit	Potential Sources[(b)]
Point: None	0	--------	0%
Nonpoint: Turbidity	781	Pioneer Creek (Red River to Headwaters)	100% Acid Mine Drainage Highway/Road/Bridge Runoff (non-construction related) Natural Sources Streambank modifications/destabilization Loss of Riparian Habitat Channelization Urbanized High Density Area Ski Slope Runoff Recreational Pollution Sources (Off Highway vehicles (OHV)

Notes:
(a) Measured load expressed as TSS in lbs/day
(b) From the 2004-2006 Integrated CWA 303(d)/305(b) list. This list of probable sources is based on staff observation and known land use activities in the watershed. These sources are not confirmed or quantified at this time.

5.6 Linkage Between Water Quality and Pollutant Sources

SWQB fieldwork includes an assessment of the potential sources of impairment (NMED/SWQB 1999b). The Pollutant Source(s) Documentation Protocol form and Potential Sources Summary Table in Appendix A provides an approach for a visual analysis of a pollutant source along an impaired reach. Although this procedure is subjective, SWQB feels that it provides the best available information for the identification of potential sources of impairment in this watershed. Table 5.6 (Pollutant Source Summary) identifies and quantifies potential sources of nonpoint source impairments along the reach as determined by field reconnaissance and assessment.

Turbidity is an expression of the optical property in water that causes incident light to be scattered or absorbed rather than transmitted in straight lines. It is the condition resulting from suspended solids in the water, including silts, clays, and plankton. Such particles absorb heat in the sunlight, thus raising water temperature, which in turn lowers dissolved oxygen levels. It also prevents sunlight from reaching plants below the surface. This decreases the rate of photosynthesis, so less oxygen is produced by plants. Turbidity may harm fish and their larvae. Turbidity exceedences, historically, are generally attributable to soil erosion, excess nutrients, various wastes and pollutants, and the stirring of sediments up into the water column during high flow events. Turbidity increases, as observed in SWQB monitoring data, show turbidity values along these reaches that exceed the State Standards for the protection of aquatic habitat, High Quality Coldwater Fishery (HQCWF) designed uses. Through monitoring, and pollutant source documentation, it has been observed that the most probable cause for these exceedences are due to the alteration of the stream's hydrograph and natural causes. Alterations can be historical or current in nature.

The components of a watershed continually change through natural ecological processes such as vegetation succession, erosion, and evolution of stream channels. Intrusive human activity often affects watershed function in ways that are inconsistent with the natural balance. These changes, often rapid and sometimes irreversible, occur when people:

- cut forests
- clear and cultivate land
- remove stream-side vegetation
- alter the drainage of the land
- channelize watercourses
- withdraw water for irrigation
- build towns and cities
- discharge pollutants into waterways.

Possible effects of these practices on aquatic ecosystems include:

1. Increased amount of sediment carried into water by soil erosion which may

    - increase turbidity of the water
    - reduce transmission of sunlight needed for photosynthesis
    - interfere with animal behaviors dependent on sight (foraging, mating, and escape from predators)
    - impede respiration (e.g., by gill abrasion in fish) and digestion
    - reduce oxygen in the water
    - cover bottom gravel and degrade spawning habitat
    - cover eggs, which may suffocate or develop abnormally; fry may be unable to emerge from the buried gravel bed

2. Clearing of trees and shrubs from shorelines which may

    - destabilize banks and promote erosion
    - increase sedimentation and turbidity
    - reduce shade and increase water temperature which could disrupt fish metabolism
    - cause channels to widen and become more shallow

3. Land clearing, constructing drainage ditches, straightening natural water channels which may

- create an obstacle to upstream movement of fish and suspend more sediment in the water due to increased flow
- strand fish upstream and dry out recently spawned eggs due to subsequent low flows
- reduce baseflows

Where data gaps exist or the level of uncertainty in the characterization of sources is large, the recommended approach to TMDL assignments requires the development of allocations based on estimates utilizing the best available information.

Additional turbidity and TSS sampling would need to be conducted to more fully characterize probable sources of turbidity in Pioneer Creek. However, sufficient data exist to support development of a turbidity TMDL to address the stream standards violations.

5.7 Margin of Safety

TMDLs should reflect a MOS based on the uncertainty or variability in the data, the point and nonpoint source load estimates, and the modeling analysis. For the Pioneer Creek TMDLs, there will be no MOS for point sources since there are none. However, for the nonpoint source TMDLs, the MOS is estimated to be **20%** of the TMDL. This MOS incorporates several factors:

•*Errors in calculating nonpoint source loads*

A level of uncertainty does exist in the relationship between TSS and turbidity. In this case, the TSS measure does not include bedload and therefore does not account for a complete measure of sediment load. This does not influence the MOS because we need only be concerned with the turbidity portion of the sediment load, which is the basis for the standard. However, there is a potential to have errors in measurements of nonpoint source loads due to equipment accuracy, time of sampling, etc. Accordingly, a conservative MOS accounts for **10%** the TMDL.

•*Errors in calculating flow*

Flow estimates were based on USGS gages and modeling calculations. There is a potential to have errors in measurements of flow due to equipment accuracy, time of sampling, etc. To be conservative, an additional MOS of **10%** will be included to account for accuracy of flow computations.

5.8 Consideration of Seasonal Variability

Data used in the calculation of this TMDL were collected during spring, summer, and fall in order to ensure coverage of any potential seasonal variation in the system. Since the critical condition is set to estimate high stream discharge, only data that exceeded the water quality criterion were used in determining the target capacities. Therefore, it is assumed that if critical conditions are met, coverage of any potential seasonal variation will also be met.

5.9 Future Growth

Based on the lack of point sources in Pioneer Creek, the overwhelming source of turbidity loading is from nonpoint sources. Estimates of future growth are not anticipated to lead to a significant increase in turbidity concentrations that cannot be controlled with BMP implementation in this watershed.

6.0 ALUMINUM

During the 1999 SWQB intensive water quality survey in the Red River basin, there were several exceedences of the New Mexico water quality standards for dissolved aluminum documented in Bitter Creek, Placer Creek, and Red River. Consequently, these three waterbodies were listed on the 2004-2006 Integrated CWA §303(d)/§305(b) list for aluminum.

6.1 Target Loading Capacity

Target values for these aluminum TMDLs will be determined based on 1) the presence of numeric criteria, 2) the degree of experience in applying the indicator, and 3) the ability to easily monitor and produce quantifiable and reproducible results. For this TMDL document, target values for dissolved aluminum are based on numeric criteria. This TMDL is also consistent with New Mexico's antidegradation policy.

According to the current New Mexico water quality standards (20.6.4.900.M NMAC), the dissolved aluminum chronic criterion is 0.087 mg/L and the dissolved aluminum acute criterion is 0.75 mg/L for aquatic life uses. According to the SWQB assessment protocol, impairment is determined by comparing the arithmetic mean of the measured concentrations of consecutive-day samples to the chronic criterion of 0.087 mg/L. The measured concentrations are also compared to the acute criterion of 0.75 mg/L; and more than one exceedence is considered not supporting. The acute criterion was exceeded 9 times in the lower Red River assessment unit (i.e. Red River [Rio Grande to Placer Creek]), 3 times in Bitter Creek, and 4 times in Placer Creek during the 1999 survey (see Appendix B). All of these acute criterion exceedences occurred in May 1999 during spring runoff. Average dissolved aluminum concentrations for the SWQB Red River stations are presented in Figure 6.1. Concurrently collected TSS and turbidity data reported in the tables in Appendix B will be discussed in the Linkage(s) section below.

The SWQB and other states are currently reviewing the appropriateness of the chronic aluminum criterion of 0.087 mg/L and SWQB is considering proposing changes to this criterion for the Red River Watershed. This area has very high naturally occurring levels of aluminum and exceedences of the chronic criterion were measured during spring runoff in the upstream background site (SWQB Site 3). Because this review is ongoing SWQB has decided to postpone the preparation of chronic aluminum TMDLs for the Red River Watershed until a new chronic standard is developed. This document therefore contains acute aluminum TMDLs for Red River (Rio Grande to Placer Creek), Bitter Creek (Red River to headwaters), and Placer Creek (Red River to headwaters). When a new standard is in place then the Red River data will reassessed and any necessary chronic aluminum TMDLs will be prepared. SWQB recognizes that acute aluminum TMDLs are not protective of the water quality of the Red River against chronic effects of aluminum and every effort will be made to develop new chronic aluminum standards and resulting TMDLs in a timely manner.

One of the studies conducted by the USGS, *Low-Flow (2001) and Snowmelt (2002) Synoptic/Tracer Water Chemistry for the Red River, New Mexico* (McCleskey *et al* 2003), reported water analyses for 259 samples collected from the Red River and tributaries during periods of both low-flow and snowmelt. Aluminum results from this study are included in

Appendix B. The goal of the 2002 snowmelt synoptic study "was to obtain information about metal and acid loading to the Red River from snowmelt draining altered areas on the north side of the basin and from the mine area" (McCleskey *et al* 2003). However it is important to remember that snowpack and snowmelt in 2002 was well below average and the 1999 snowmelt sampled by SWQB. The total and dissolved aluminum concentrations from stream samples collected during the 2002 snowmelt tracer study are presented in Figure 6.2. USGS also collected water samples from surface inflows (tributaries, springs, and seeps) the aluminum concentrations from these samples are presented in Figure 6.3. Figures 6.2 shows the total aluminum concentrations in the Red River are higher than the dissolved aluminum concentrations. The dissolved aluminum concentrations increase slightly from the top of the study, which is just above the Town of Red River (i.e., RR-0), downstream to below the mine site. All of the dissolved aluminum 2002 snowmelt samples were below the acute aluminum criteria, but the majority of the concentrations were above the chronic aluminum criteria (Appendix B). The increase in the total aluminum concentrations from upstream to downstream is much greater than the increase observed in the dissolved aluminum concentrations, especially within and below the Molycorp Mine (i.e. >10,000 meters downstream from RR-0).

High chronic levels of dissolved aluminum can be toxic to fish, benthic invertebrates, and some single-celled plants. Aluminum concentrations from 0.1 to 0.3 mg/L increase mortality, retard growth, gonadal development, and egg production of fish (http://www.bae.ncsu.edu/programs/extension/wqg/). High acute levels of dissolved aluminum can be especially detrimental to aquatic life increasing mortality rates for many species of fish and benthic macroinvertebrates.

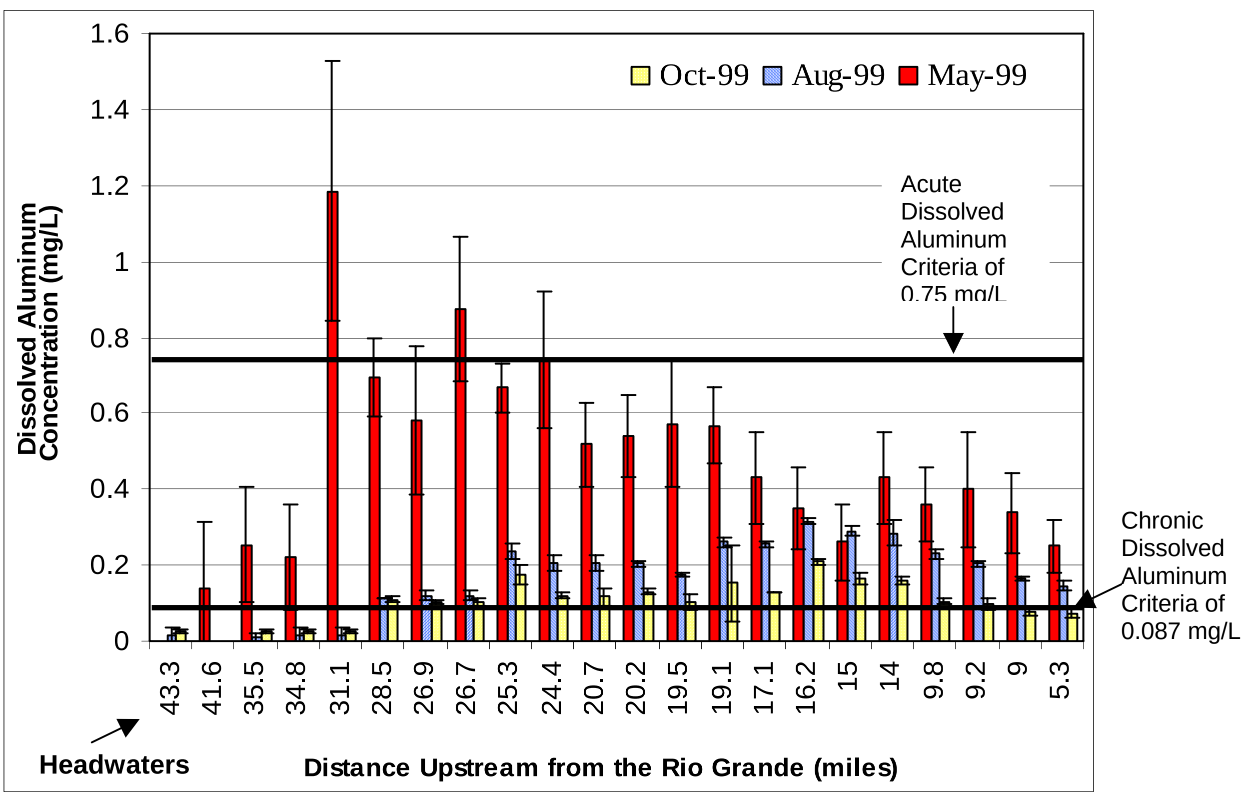


Figure 6.1 SWQB 1999 Average Dissolved Aluminum Concentrations from the Headwaters to the Confluence with the Rio Grande

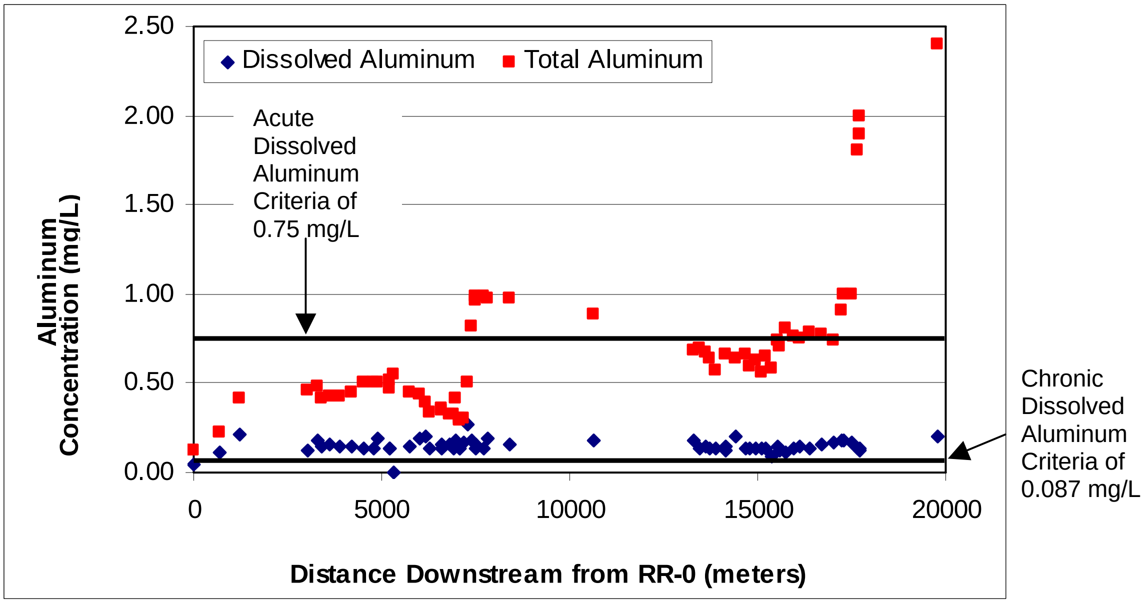


Figure 6.2 USGS 2002 In-stream Snowmelt Tracer Study Aluminum Concentrations

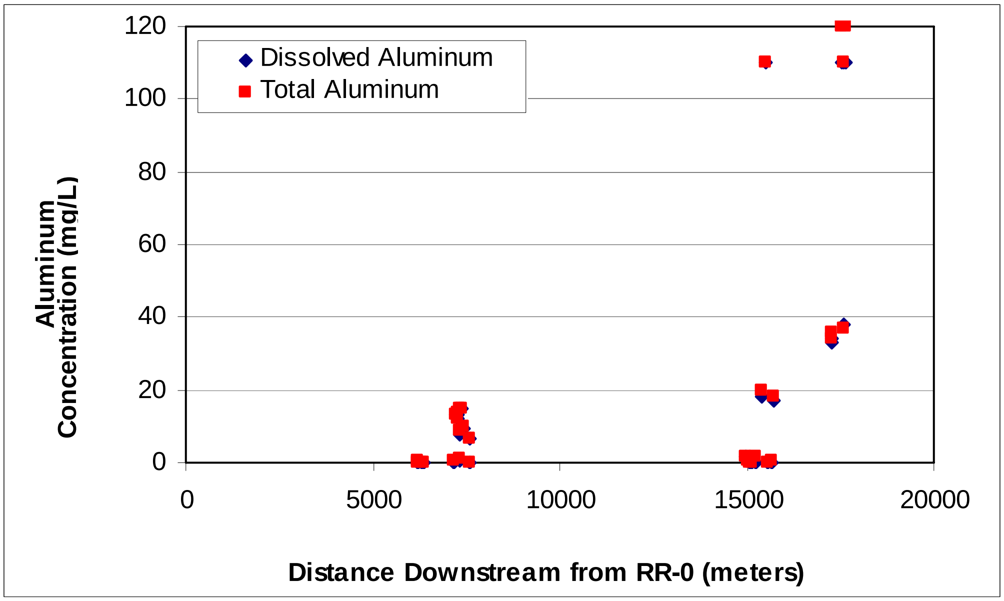


Figure 6.3 USGS 2002 Bank (i.e. Tributaries, Seeps, and Springs) Snowmelt Tracer Study Aluminum Concentrations

6.2 Flow

TMDLs are calculated for the Red River Watershed at a specific flow. Metal concentrations in a stream vary as a function of flow. As flow increases the concentration of metals can increase. When available, USGS gages are used to estimate flow. Where gages are absent, geomorphologic cross section field data are collected at each site and flows are modeled or actual flow measurements are taken. There are two active USGS gages on the Red River, both of which are located in the lower Red River assessment unit. Since all of the exceedences of the acute aluminum criterion were measured during spring runoff, the average flow for May 1999 at the furthest downstream USGS gage (i.e. 08266820, Red River below Fish Hatchery, near Questa, NM) will be used. Therefore, the flow value for the Red River (Rio Grande to Placer Creek) used in this TMDL is 192 cubic feet per second (cfs).

This flow value for the Red River was converted from cfs to units of mgd as follows:

$$192\,\frac{ft^3}{\sec} \times 7.48\,\frac{gal}{ft^3} \times 86{,}400\,\frac{\sec}{day} \times 10^{-6} = 124\,mgd$$

There are no USGS gage stations for either Bitter Creek or Placer Creek and flow was not recorded during the 1999 sampling events, therefore flow had to be estimated for May from the Red River Watershed flow model developed by Daniel B. Stephens & Associates, Inc. (Appendix C). The estimated May 1999 flow values for Bitter Creek and Placer Creek based on this model are 6.7 and 1.6 mgd, respectively.

It is important to remember that the TMDL is a planning tool to be used to achieve water quality standards. Since flows vary throughout the year in all natural surface water systems, the target load will vary based on the changing flow. Management of the load to improve stream water quality should be a goal to be attained.

6.3 Calculations

A target load for dissolved aluminum is calculated based on a flow, the current water quality criterion, and a conversion factor (8.34) that is a used to convert mg/L units to lbs/day (see Appendix D for Conversion Factor Derivation). The target loading capacity is calculated using **Equation 1**. The results are shown in Table 6.1.

Critical Flow (mgd) x Standard (mg/L) x 8.34 = Target Loading Capacity (Eq. 1)

Table 6.1 Calculation of target loads for dissolved aluminum

Location	**Flow (mgd)**	**Dissolved Aluminum (mg/L)**	**Conversion Factor**	**Target Load Capacity (lbs/day)**
Red River (Rio Grande to Placer Creek)	124	0.750	8.34	776*
Bitter Creek (Red River to Headwaters)	6.70+	0.750	8.34	41.9*
Placer Creek (Red River to Headwaters)	1.60+	0.750	8.34	10.0*

NOTES: + Since USGS gages were unavailable and direct measurements were not obtained, flow was estimated using a model (see Appendix C).
* Values rounded to three significant figures.

The measured loads for dissolved aluminum were similarly calculated. The arithmetic mean of the data used to determine the impairment (see Appendix B) was substituted for the standard in **Equation 1**. The same conversion factor of 8.34 was used. Results are presented in Table 6.2.

Table 6.2 Calculation of Measured Loads for Dissolved Aluminum

Location	Flow (mgd)	Dissolved Aluminum Arithmetic Mean+ (mg/L)	Conversion Factor	Measured Load (lbs/day)
Red River (Rio Grande to Placer Creek)	124	1.13	8.34	1,170*
Bitter Creek (Red River to Headwaters)	6.70	1.27	8.34	71.0*
Placer Creek (Red River to Headwaters)	1.60	1.08	8.34	14.4*

Notes: + Arithmetic mean of May 1999 dissolved aluminum concentrations (see Appendix B).
* Values rounded to three significant figures.

6.4 Waste Load Allocations and Load Allocations

6.4.1 Waste Load Allocation

There are no point source contributions associated with the TMDLs for Bitter Creek and Placer Creek, therefore the WLA for both of these streams is zero. There are three point sources on the Red River (Rio Grande to Placer Creek). From upstream to downstream they are the wastewater treatment plant (WWTP) for the Town of Red River, the Molycorp Mine, and the Red River Fish Hatchery. The outfall locations for these sources are shown on Figure 2.1. The Town of Questa operates WWTP lagoons along the Red River, but this facility does not have a discharge permit and does not discharge into the Red River, therefore no WLA will be assigned to the Questa WWTP. The Red River WWTP and the fish hatchery have one outfall each. The Molycorp Mine has four permitted outfalls (#1, #2, #4, and #5); however, only outfall #2 has continuous discharge (from the tailings interceptor system). The other three outfalls are intermittent, containing process water and storm water. Monitoring records indicate that Molycorp has not discharged from outfall #1 since 1990 and has never discharged water from outfalls #4 and #5.

As an additional BMP in the Molycorp Questa Mine's NPDES permit, Molycorp was required to "install seepage interception systems to prevent discharges of process-related groundwater to the Red River at Spring 13 and Spring 39. The permittee shall also install a ground water withdrawal well below the toe of the Sugar Shack South deposit at a location approximately 100 yards south west of the old mill site." (USEPA 2000). The locations of Springs 13 and 39 and the seepage interception system are shown in Figure 2.1. Photo 6.1 shows the Spring 13 area and white aluminum precipitation in the Red River before installation of the interception system.

Molycorp's permit states "the permittee shall install the following seepage interception and management system to comply with the prohibition against discharge to the Red River of pollutants traceable to point source mine operations except in trace amounts." Therefore, no WLA is assigned to Springs 13 and 39 or any other springs or seeps located along the Red River. If future studies determine there are additional point sources attributable to the Molycorp Questa Mine or other entities then this TMDL will be revisited and the WLAs will be adjusted accordingly.

The monthly average discharge limits for total aluminum at the Red River WWTP, the Molycorp Mine outfalls, and the fish hatchery are listed in Table 6.3. The current permit for the fish hatchery does not include a discharge limit for total aluminum. Since the fish hatchery uses water obtained from the Red River in their operations, water discharged from the fish hatchery will contain aluminum concentrations similar to ambient river concentrations. No reduction in aluminum concentrations from the fish hatchery discharge is required in their permit or this TMDL.

The monthly average aluminum loading allowable under the Molycorp permit is 2.075 lbs/day for outfall #1 and 0.169 lb/day from outfall #2 after the first two years of the five-year permit. The total aluminum discharge limit for the Red River WWTP permit has interim and final limits based on a compliance schedule, with the highest limit being 2.63 lbs/day during the first two years (2001 through 2002), but decreasing to 0.305 lbs/day after 2002.

The discharge limit for each of the permitted point sources is well below the target loads for aluminum, and impairment of the Red River from these sources is assumed to be negligible. Therefore, the WLAs for the Red River will be the discharge limits as set in the NPDES permits. To account for potential permitted discharges from Molycorp's outfalls #4 and #5 the WLA was increased by 1.35 lb/day, which corresponds to a combined flow value of 0.5 cfs. This portion of the WLA is not directly allocated to outfalls #4 and #5, but is a set-aside value to allow for permitted discharges without violating the TMDL.

Table 6.3 NPDES Permitted Point Source Discharge Limits for Total Aluminum

<table>
<tr><th>Outfall</th><th>Permit No.</th><th>Effective Date</th><th>Expiration Date</th><th>Discharge Limit (monthly average)</th></tr>
<tr><td>Red River WWTP</td><td>NM0024899</td><td>9/1/2000</td><td>8/31/2005*</td><td>0.305 lbs/day</td></tr>
<tr><td>Molycorp Mine #1</td><td rowspan="4">NM0022306</td><td rowspan="4">2/1/2001</td><td rowspan="4">1/31/2006</td><td>2.075 lbs/day</td></tr>
<tr><td>Molycorp Mine #2</td><td>0.169 lbs/day</td></tr>
<tr><td>Molycorp Mine #4</td><td>0.5 mg/L+</td></tr>
<tr><td>Molycorp Mine #5</td><td>0.5 mg/L+</td></tr>
<tr><td>Fish Hatchery</td><td>NM0030147</td><td>11/1/2001</td><td>9/30/2005*</td><td>no limit specified</td></tr>
</table>

+ There is no flow value in the NPDES permit associated with Outfalls 4 and 5, therefore a loading valve is not included in the permit. Since there has been no discharge measured for Outfalls 4 and 5 and the potential flow is unknown, a WLA could not be calculated for these outfalls.

* These NPDES permits are currently in the process of being reissued by the USEPA Region 6.

Photo 6.1. Spring 13 Area Before Installation of the Interception System (note white aluminum precipitation in the River).

6.4.2 Load Allocation

In order to calculate the LA, the WLA and MOS were subtracted from the target capacity (TMDL) following **Equation 2**.

$$WLA + LA + MOS = TMDL \qquad \text{(Eq. 2)}$$

The MOS is estimated to be 25% of the target load calculated in Table 6.1. Results are presented in Table 6.4. Additional details on the MOS chosen are presented in Section 6.7 below.

Table 6.4 Calculation of TMDL for Dissolved Aluminum

Location	WLA (lbs/day)	LA (lbs/day)	MOS (25%) (lbs/day)	TMDL (lbs/day)
Red River (Rio Grande to Placer Creek)	3.90*	578*	194	776*
Bitter Creek (Red River to Headwaters)	0	31.4	10.5	41.9*
Placer Creek (Red River to Headwaters)	0	7.50	2.50	10.0*

* Values rounded to three significant figures.

The extensive data collection and analyses necessary to determine background dissolved aluminum for the Bitter Creek and Placer Creek watersheds was beyond the resources available for this study. There are several ongoing studies being conducted in the Red River to determine the amount of aluminum coming from background, nonpoint source, and point sources, but exact values were not available at the time this TMDL was prepared. It is therefore assumed that a portion of the load allocation for Red River, Bitter Creek, and Placer Creek is made up of natural background loads and potentially also includes presently unidentified or uncontrolled point sources for the Red River.

The nonpoint source and background load reductions that would be necessary to meet the target loads were calculated to be the difference between the target load (Table 6.4) and the measured load (Table 6.2), and are shown in Table 6.5. These load reduction tables are presented for informational purposes only.

Table 6.5 Calculation of Load Reduction for Dissolved Aluminum

Location	**Target Load*(a)* (lbs/day)**	**Measured Load (lbs/day)**	**Load Reduction (lbs/day)**	**Percent Reduction*(b)***
Red River (Rio Grande to Placer Creek)	582*	1,170*	588	50.3%
Bitter Creek (Red River to Headwaters)	31.4*	71.0*	39.6	55.8%
Placer Creek (Red River to Headwaters)	7.50*	14.4*	6.90	47.9%

Notes: The MOS is not included in the load reduction calculations because it is a set aside value which accounts for any uncertainty or variability in TMDL calculations and therefore should not be subtracted from the measured load.
(a) Target Load = LA + WLA
(b) Percent reduction is the percent the existing measured load must be reduced to achieve the TMDL, and is calculated as follows: (Measured Load – Target Load) / Measured Load x 100.
* Values rounded to three significant figures.

6.5 Identification and Description of Pollutant Source(s)

Probable nonpoint pollutant sources that may be contributing to observed dissolved aluminum loads are displayed in Table 6.6.

A variety of potential point and nonpoint sources of pollutants are located in the Red River watershed. The area includes three point-source dischargers regulated through NPDES permits issued by the USEPA:

- The Town of Red River wastewater treatment plant discharges its treated effluent near the Elephant Rock Campground (NPDES Permit NM0024899).

Table 6.6 Pollutant Source Summary for Dissolved Aluminum

Pollutant Sources	Magnitude[a] (lbs/day)	Assessment Unit	Potential Sources[b]
Point:			
Aluminum	3.90[c]	Red River (Rio Grande to Placer Creek)	0.3%[c] Mill Tailings Mine Tailings Acid Mine Drainage
	None	Bitter Creek (Red River to Headwaters)	0%
	None	Placer Creek (Red River to Headwaters)	0%
Nonpoint:			
Aluminum	1,166.1[c]	Red River (Rio Grande to Placer Creek)	99.6%[c] Highway/Road/Bridge Runoff (Non-construction Related) Impacts from Abandoned Mine Lands (Inactive) Natural Sources Acid Mine Drainage
	71.0	Bitter Creek (Red River to Headwaters)	100% Acid Mine Drainage Highway/Road/Bridge Runoff (Non-construction Related) Natural Sources Other Recreational Pollution Sources Surface Mining
	14.4	Placer Creek (Red River to Headwaters)	100% Habitat Modification – other than Hydromodification Loss of Riparian Habitat Natural Sources Placer Mining Recreational Pollution Sources (Off Highway vehicles (OHV)

Notes:
(a) Measured load.
(b) From the 2004-2006 Integrated CWA 303(d)/305(b) list. This list of probable sources is based on staff observation and known land use activities in the watershed. These sources are not confirmed or quantified at this time.
(c) The exact amount of the measured load for the Red River attributed to point sources, background, and nonpoint sources is yet to be determined, studies currently being conducted are attempting to resolve this issue.

- The Red River Fish Hatchery is located near the confluence of the Rio Grande. The hatchery discharges return water from its raceways (NPDES Permit NM0030147).

- A large molybdenum (Molycorp) mine operates along the middle 10 miles of the river. The mill tailings from the mine are deposited in tailing ponds located just west of the town of Questa. There are four permitted discharge points, but only one has continual discharge of collected tailing dam seepage (NPDES Permit NM0022306). Also, a series of waste rock piles have been placed in drainages located within the Molycorp property boundary along Highway 38, which parallels the Red River.

Based on the relatively low allowable discharge limits and compliance monitoring, it seems likely that the nonpoint source areas within the watershed are the primary cause of aluminum impacts to the Red River. The following nonpoint sources have been identified:

- Natural alteration scars are located along the river from the Molycorp Mine upstream to the town of Red River. The scar areas contribute to decreased water quality in the Red River under two conditions. During runoff events, large amounts of sediment and acidic runoff are released from these areas, often coloring the river a mustard yellow. The scar areas also release acid rock drainage that enters the Red River as groundwater seepage. This groundwater seepage has low pH, elevated aluminum content and a suite of other metals, and appears to be a major factor in the impairment of the river.

- There are also several scar areas located within the Molycorp Mine property land holdings that contribute to nonpoint source pollution. These areas are adjacent to mineralized rocks exposed and/or disturbed during the mining process. Some of the scar material was placed in a series of waste rock piles. The *Molycorp Questa Mine Site-Wide Comprehensive Hydrologic Characterization Report* (URS 2001) describes the potential nonpoint source pollution source areas at the Molycorp Mine.

- Road maintenance along Highway 38 has led to changes in the course of the Red River, resulting in increased sediment erosion in certain areas.

- The Red River Ski Area and the Town of Red River are located upstream of the mine; the township stretches for 1.5 miles along the river downstream from Placer Creek. The ski area is developed on mineralized rock and soil.

- Numerous access roads have been constructed on the steep slopes that adjoin the river and its tributaries. Some road cuts expose mineralized bedrock and acidic scar debris. In addition, dwellings with individual septic systems are also located along these roads.

6.6 Link Between Water Quality and Pollutant Sources

Where data gaps exist or the level of uncertainty in the characterization of sources is large, the recommended approach to TMDL assignments requires the development of allocations based on estimates utilizing the best available information.

SWQB fieldwork includes an assessment of the potential sources of impairment (NMED/SWQB 1999b). The Pollutant Source(s) Documentation Protocol form and Potential Sources Summary Table in Appendix A provide documentation of a visual analysis of probable sources along an impaired reach. Although this procedure is subjective, SWQB feels that it provides the best available information for the identification of potential sources of impairment in this watershed. Table 6.6 (Pollutant Source Summary) identifies and quantifies potential sources of nonpoint source impairments along each reach as determined by field reconnaissance and assessment. It is important to consider not only the land directly adjacent to the impaired assessment unit, but also on the upland and upstream areas in a more holistic watershed approach to implementing this TMDL.

In general, increased metals in the water column can commonly be linked to sediment transport and accumulation, where the metals are a constituent part of the sediment. This does not appear to be the case for either the Red River or Bitter Creek as evidenced by the fact that there is a very weak relationship between dissolved aluminum and TSS concentrations according to the data used to determine the impairment (Figures 6.4 and 6.5). There appears to be a correlation between TSS and dissolved aluminum in Placer Creek (Figure 6.6) with an R^2 value of 0.57.

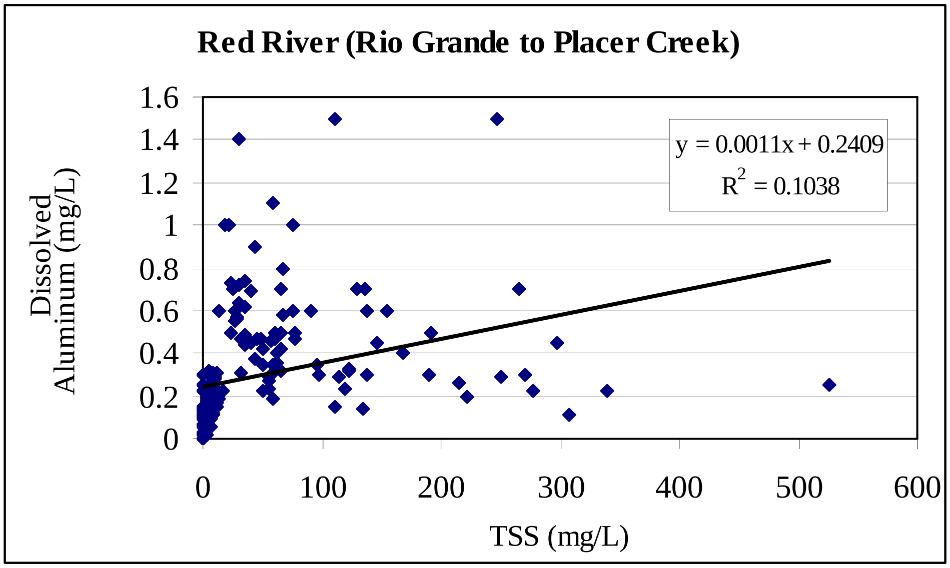


Figure 6.4 Relationship between Dissolved Aluminum and TSS in the Red River

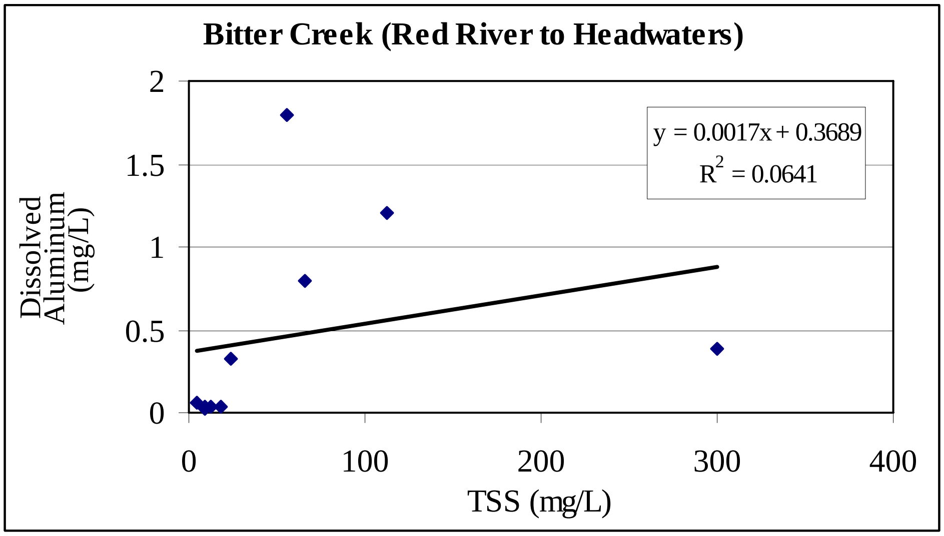


Figure 6.5 Relationship between Dissolved Aluminum and TSS in Bitter Creek

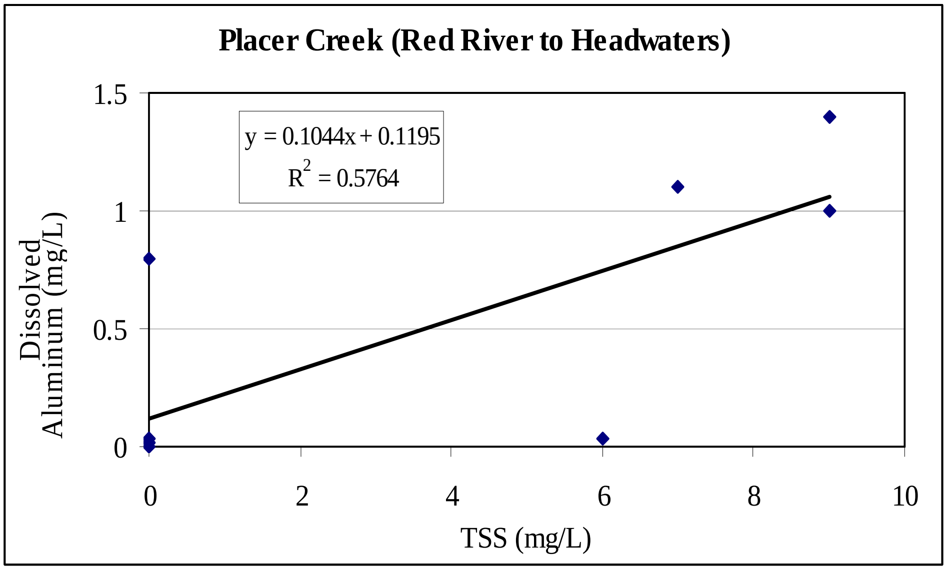


Figure 6.6 Relationship between Dissolved Aluminum and TSS in Placer Creek

Extremely high aluminum is characteristic of the spring snowmelt/runoff period and is not pronounced during baseflow conditions in the Red River, Bitter Creek, or Placer Creek. Normal aqueous chemical processes, enhanced by the slight natural acidity of snow and rain, are capable of rendering some of this abundant, naturally-occurring aluminum available to the stream system. The fact that dissolved aluminum concentrations above the acute aluminum criterion were measured during the spring sampling run as opposed to lower concentrations during fall sampling runs are indicative of a landscape source. Acidic anions as well as carbonic acid carried in snow are released into the soil as the snow melts and bring aluminum species into solution. Thus, aluminum concentrations are often high during spring runoff in many areas in New Mexico despite the expected diluting effects of high flow.

There are several known existing and historic mines in this watershed which are also contributing to the high levels of aluminum during baseflow. The most likely source for the higher aluminum concentrations in Bitter Creek and the Red River during spring runoff/snowmelt are the large alterations scars located along Bitter Creek (Figure 2.4). All of the exceedences of the acute aluminum criterion were in samples collected below Bitter Creek (SWQB Station 11) downstream to the sampling location below Columbine Creek (SWQB Station 25). These alteration scars are naturally occurring geological features, but the amount of eroded material being washed into Bitter Creek during snowmelt and other runoff events has been accelerated in areas by Bitter Creek Road which runs along the creek, a sand and gravel operation, and land development along the creek.

The source of the acute aluminum exceedences in Placer Creek are likely caused by the channelization/alteration of the creek channel in the Town of Red River. The bottom ½ mile of Placer Creek runs parallel to a National Forest Service road and eventually the creek runs down the middle of the road delivering high sediment loads to the Red River. There are also several historic abandoned mines with exposed waste rock piles and acid rock drainage in the Placer Creek Watershed which may be releasing aluminum to surface water.

6.7 Margin of Safety

TMDLs should reflect a MOS based on the uncertainty or variability in the data, the point and nonpoint source load estimates, and the modeling analysis. For this TMDL the MOS is estimated to be an addition of **25%** for the Red River, Bitter Creek, and Placer Creek. This MOS incorporates several factors:

- *Errors in calculating nonpoint source loads*

  A level of uncertainty exists in sampling nonpoint sources of pollution. Techniques used for measuring metals concentrations in stream water can lead to inaccuracies in the data. Therefore, a conservative MOS for metals increases the TMDL by **15%.**

- *Errors in calculating flow*

  Flow estimates were based on USGS gages and modeling calculations. There is a potential to have errors in measurements of flow due to equipment accuracy, time of sampling, etc. To be conservative, an additional MOS of **10%** will be included to account for accuracy of flow computations.

6.8 Consideration of Seasonal Variation

Data used in the calculation of this TMDL were collected during the spring, summer, fall, and winter between 1999 and 2002 in order to ensure coverage of any potential seasonal variation in the system. Critical condition was set to the flow estimate determined during snowmelt in May 1999.

6.9 Future Growth

Based on the lack of point sources in Placer Creek and Bitter Creek, the overwhelming source of aluminum loading in these two creeks is from nonpoint sources The point sources located on the Red River are contributing only a very minor portion of the acute aluminum load during the critical flow period. Therefore, estimates of future growth are not anticipated to lead to a significant increase in aluminum concentrations that cannot be controlled with BMP implementation in this watershed. Since future projections indicate the potential that nonpoint sources will increase as this region continues to grow and develop, it is imperative that BMPs continue to be utilized and improved upon in this watershed while continuing to improve road conditions and adhering to SWPPP requirements related to construction activities for sites greater than one acre.

7.0 MONITORING PLAN

Pursuant to Section 106(e)(1) of the Federal CWA, the SWQB has established appropriate monitoring methods, systems and procedures in order to compile and analyze data on the quality of the surface waters of New Mexico. In accordance with the New Mexico Water Quality Act, the SWQB has developed and implemented a comprehensive water quality monitoring strategy for the surface waters of the State.

The monitoring strategy establishes the methods of identifying and prioritizing water quality data needs, specifies procedures for acquiring and managing water quality data, and describes how these data are used to progress toward three basic monitoring objectives: to develop water quality-based controls, to evaluate the effectiveness of such controls, and to conduct water quality assessments.

The SWQB utilizes a rotating basin system approach to water quality monitoring. In this system, a select number of watersheds are intensively monitored each year with an established return frequency of approximately every eight years. The next scheduled monitoring date for the Red River watershed is 2008. The SWQB maintains current quality assurance and quality control plans for the respective sample year to cover all monitoring activities. This document, called the QAPP, is updated and certified annually by USEPA Region 6. In addition, the SWQB identifies the data quality objectives required to provide information of sufficient quality to meet the established goals of the program. Current priorities for monitoring in the SWQB are driven by the CWA Section 303(d) list of streams requiring TMDLs. Short-term efforts will be directed toward those waters that are on the USEPA TMDL consent decree list (U.S. District Court for the District of New Mexico 1997).

Once assessment monitoring is completed, those reaches showing impacts and requiring a TMDL will be targeted for more intensive monitoring. The methods of data acquisition include fixed-station monitoring, intensive surveys of priority assessment units (including biological assessments), and compliance monitoring of industrial, federal, and municipal dischargers, as specified in the SWQB assessment protocols (NMED/SWQB 2004c).

Long-term monitoring for assessments will be accomplished through the establishment of sampling sites that are representative of the waterbody and which is revisited approximately every eight years. This information will provide time relevant information for use in CWA Section 303(d) listing and 305(b) report assessments and to support the need for developing TMDLs. The approach provides:

- a systematic, detailed review of water quality data which allows for a more efficient use of valuable monitoring resources;
- information at a scale where implementation of corrective activities is feasible;
- an established order of rotation and predictable sampling in each basin which allows for enhanced coordinated efforts with other programs; and
- program efficiency and improvements in the basis for management decisions.

SWQB recently developed a 10-year monitoring strategy submitted to USEPA on September 30, 2004. Once the 10-year monitoring plan is reviewed and approved by the USEPA, it will be available at the SWQB website: http://www.nmenv.state.nm.us/swqb/swqb.html. The strategy will detail both the extent of monitoring that can be accomplished with existing resources plus expanded monitoring strategies that could be implemented given additional resources. According to the draft proposed rotational cycle, which assumes the existing level of resources, the next time SWQB will intensively sample the Red River watershed is during 2008.

It should be noted that a watershed would not be ignored during the years in between intensive sampling. The rotating basin program will be supplemented with other data collection efforts such as the funding of long-term USGS water quality gaging stations for long-term trend data, the Molycorp sampling, and on-going studies being performed by USGS and USEPA. Data will be analyzed and field studies will be conducted to further characterize acknowledged problems and TMDLs will be developed and implemented accordingly. Both long-term and intensive field studies can contribute to the State's Integrated §303(d)/§305(b) listing process for waters requiring TMDLs.

8.0 IMPLEMENTATION OF TMDLS

8.1 Coordination

In this watershed public awareness and involvement will be crucial to the successful implementation of these plans and improved water quality. Staff from SWQB have worked with stakeholders to develop a Draft WRAS for the Red River Basin (RRWG 2003). The WRAS is a written plan intended to provide a long-range vision for various activities and management of resources in a watershed. It details opportunities for private landowners and public agencies to reduce and prevent impacts to water quality. This long-range strategy will become instrumental in coordinating and achieving constituent levels consistent with New Mexico's WQS, and will be used to prevent water quality impacts in the watershed. The WRAS is essentially the Implementation Plan, or Phase Two of the TMDL process. The completion of the TMDLs and WRAS leads directly to the development of on-the-ground projects to address surface water impairments in the watershed.

SWQB staff will continue to assist with any technical assistance such as selection and application of BMPs needed to meet WRAS goals. Stakeholder public outreach and involvement in the implementation of this TMDL will be ongoing. Stakeholders in this process will include SWQB and other members of the Red River Watershed Group.

Implementation of BMPs within the watershed to reduce pollutant loading from nonpoint sources will be encouraged. Reductions from point sources will be addressed in revisions to NPDES discharge permits.

8.2 Time Line

The Red River watershed is atypical in that a watershed group was formed in 1998 during the planning stage for the 1999 intensive survey, and thus prior to any impairment determinations/verifications or TMDL development. As a result, the WRAS was developed and finalized before preparation of these TMDLs. The modified general implementation timeline is detailed below (Table 8.1).

8.3 Clean Water Act §319(h) Funding Opportunities

The Watershed Protection Section of the SWQB provides USEPA §319(h) funding to assist in implementation of BMPs to address water quality problems on reaches listed as category 4 or 5 waters on the Integrated CWA §303(d)/§305(b) list. These monies are available to all private, for profit and nonprofit organizations that are authenticated legal entities, or governmental jurisdictions including: municipalities, counties, tribal entities, Federal agencies, or agencies of the State. Proposals are submitted by applicants at least once a year through a Request for Proposal (RFP) process and require a non-federal match of 40% of the total project cost consisting of funds and/or in-kind services. Funding is available for both watershed group formation (which includes WRAS development) and on-the-ground projects to improve surface water quality and associated habitat. Further information on funding from the CWA §319 (h) can be found at the SWQB website: http://www.nmenv.state.nm.us/swqb/.

Table 8.1 Proposed Implementation Timeline

Implementation Actions	Year 1 (1998)	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8
Public Outreach and Involvement	X	X	X	X	X	X	X	X
Form watershed groups	X	X						
TMDL Development					X	X	X	X
WRAS Development				X	X	X		
Revise any NPDES permits as necessary (currently USEPA Region 6)			X					X
Establish Performance Targets				X				
Secure Funding			X	X				
Implement Management Measures (BMPs)			X	X	X	X	X	X
Monitor BMPs						X	X	X
Determine BMP Effectiveness					X	X	X	X
Reevaluate Performance Targets						X	X	X

8.4 Other Funding Opportunities and Restoration Efforts in the Red River Basin

Several other sources of funding existing to address impairments discussed in this TMDL document. The Red River WRAS lists the following as potential funding sources.

Potential federal sources for watershed restoration funding include:

- 319 nonpoint source grants from EPA
- EPA watershed initiative grants
- Collaborative Forest Restoration Program grants
- U.S. Natural Resources Conservation Service assistance
- USFS and possible Abandoned Hardrock Mines Restoration Act funding for abandoned mine reclamation and Acid Rock Drainage remediation

Potential state and local sources for watershed restoration funding include:

- New Mexico State Legislature

• Taos Soil and Water Conservation District
• Village of Questa
• Town of Red River

9.0 ASSURANCES

New Mexico's Water Quality Act (Act) does authorize the WQCC to "promulgate and publish regulation to prevent or abate water pollution in the state" and to require permits. The Act authorizes a constituent agency to take enforcement action against any person who violates a water quality standard. Several statutory provisions on nuisance law could also be applied to nonpoint source water pollution. The Water Quality Act also states in §74-6-12(a):

> *The Water Quality Act (this article) does not grant to the commission or to any other entity the power to take away or modify the property rights in water, nor is it the intention of the Water Quality Act to take away or modify such rights.*

In addition, the State of New Mexico Surface Water Quality Standards (see NMAC 20.6.4.10.C) (NMAC 2002) states:

> *These water quality standards do not grant the Commission or any other entity the power to create, take away or modify property rights in water.*

New Mexico policies are in accordance with the federal Clean Water Act §101(g):

> *It is the policy of Congress that the authority of each State to allocate quantities of water within its jurisdiction shall not be superseded, abrogated or otherwise impaired by this Act. It is the further policy of Congress that nothing in this Act shall be construed to supersede or abrogate rights to quantities of water which have been established by any State.*
>
> *Federal agencies shall co-operate with State and local agencies to develop comprehensive solutions to prevent, reduce and eliminate pollution in concert with programs for managing water resources.*

New Mexico's 319 Program has been developed in a coordinated manner with the State's 303(d) process. All 319 watersheds that are targeted in the annual RFP process coincide with the State's biennial impaired waters list as approved by USEPA. The State has given a high priority for funding, assessment, and restoration activities to these watersheds.

As a constituent agency, NMED has the authority under Chapter 74, Article 6-10 NMSA 1978 to issue a compliance order or commence civil action in district court for appropriate relief if NMED determines that actions of a "person" (as defined in the Act) have resulted in a violation of a water quality standard including a violation caused by a nonpoint source. The NMED nonpoint source water quality management program has historically strived for and will continue to promote voluntary compliance to nonpoint source water pollution concerns by utilizing a voluntary, cooperative approach. The State provides technical support and grant monies for implementation of BMPs and other nonpoint source prevention mechanisms through §319 of the Clean Water Act. Since portions of this TMDL will be implemented through nonpoint source control mechanisms, the New Mexico Watershed Protection Program will target efforts to this and other watersheds with TMDLs.

In order to obtain reasonable assurances for implementation in watersheds with multiple landowners, including Federal, State and private land, NMED has established Memoranda of Understanding (MOUs) with various Federal agencies, in particular the USFS and the Bureau of Land Management. MOUs have also been developed with other State agencies, such as the New Mexico State Highway and Transportation Department. These MOUs provide for coordination and consistency in dealing with nonpoint source issues.

The time required to attain standards for all reaches is estimated to be approximately 10-20 years. This estimate is based on a five-year time frame implementing several watershed projects that may not be starting immediately or may be in response to earlier projects. Stakeholders in this process will include SWQB, and other members of the WRAS. The cooperation of watershed stakeholders will be pivotal in the implementation of these TMDLs as well.

10.0 PUBLIC PARTICIPATION

Public participation was solicited in development of this TMDL (see Appendix E). The draft TMDL was made available for a 30-day comment period on November 16, 2005. Response to Comments are included as Appendix F of this document. The draft document notice of availability was extensively advertised via newsletters, email distribution lists, webpage postings (http://www.nmenv.state.nm.us/), and press releases to area newspapers. A public meeting in the Red River Watershed was held November 29, 2005 from 6-7 p.m. at the US Forest Service Questa Ranger District office (1 mile east of Questa, State Route 38) .

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APPENDIX A
SOURCE DOCUMENTATION SHEET AND SOURCES SUMMARY TABLE

Red River TMDL Probable Sources Summary

<table>
<tr><th>Reach</th><th>Parameter</th><th>Probable Sources (ADB v.2 terminology)</th></tr>
<tr><td>Red River (Rio Grande to Placer Creek)</td><td>Acute Aluminum</td><td>Highway/Road/Bridge Runoff (Non-construction Related)
Impacts from Abandoned Mine Lands (Inactive)
Mill Tailings
Mine Tailing
Natural Sources</td></tr>
<tr><td>Bitter Creek (Red River to headwaters)</td><td>Sedimentation/ Siltation and Acute Aluminum</td><td>Acid Mine Drainage
Highway/Road/Bridge Runoff (non-construction related)
Natural Sources
Other Recreational Pollution Sources
Surface Mining</td></tr>
<tr><td>Pioneer Creek (Red River to headwaters)</td><td>Turbidity</td><td>Acid Mine Drainage
Highway/Road/Bridge Runoff (non-construction related)
Natural Sources
Streambank modifications/destabilization
Loss of Riparian Habitat
Channelization</td></tr>
<tr><td>Placer Creek (Red River to headwaters)</td><td>Acute Aluminum</td><td>Habitat Modification – other than Hydromodification
Loss of Riparian Habitat
Natural Sources
Placer Mining</td></tr>
</table>

APPENDIX B
WATER QUALITY DATA

Table B.1 SWQB Red River (Rio Grande to Placer Creek) Water Quality Data

Station ID	Date	Dissolved Aluminum (mg/L)	TSS (mg/L)	Turbidity (NTU)
28REDRIV005.3	5/10/99	0.3	271	
28REDRIV005.3	5/10/99*	0.11	307	203
28REDRIV005.3	5/11/99	0.2	222	149
28REDRIV005.3	5/11/99*	0.26	215	
28REDRIV005.3	5/12/99	0.31	59	47.9
28REDRIV005.3	5/12/99*	0.32	66	
28REDRIV005.3	5/13/99	0.23	56	39.7
28REDRIV005.3	5/13/99*	0.27	55	
28REDRIV005.3	8/17/99	0.14	7	4.3
28REDRIV005.3	8/17/99*	0.13	4	
28REDRIV005.3	8/18/99	0.16	8	4.16
28REDRIV005.3	8/18/99*	0.15	6	
28REDRIV005.3	10/25/99	0.07	<3	4.4
28REDRIV005.3	10/25/99*	0.07	<3	
28REDRIV005.3	10/26/99	0.06	6	3.64
28REDRIV005.3	10/26/99*	0.06	<3	
28REDRIV005.3	10/27/99	0.07	<3	3.65
28REDRIV005.3	10/27/99*	0.07	3	
28REDRIV005.3	10/28/99	0.1	<3	2.89
28REDRIV005.3	10/28/99*	0.09	5	
28REDRIV009.0	5/10/99	0.3	97	208
28REDRIV009.0	5/11/99	0.22	340	221
28REDRIV009.0	5/12/99	0.36	62	40.4
28REDRIV009.0	5/13/99	0.47	60	38.7
28REDRIV009.0	8/17/99	0.17	10	19.3
28REDRIV009.0	8/18/99	0.16	4	5.89
28REDRIV009.0	10/25/99	0.08	5	4.45
28REDRIV009.0	10/26/99	0.07	4	3.03
28REDRIV009.0	10/27/99	0.07	<3	5.38
28REDRIV009.0	10/28/99	0.09	6	9.38
28REDRIV009.2	5/10/99	0.22	277	301
28REDRIV009.2	5/11/99	0.45	298	201
28REDRIV009.2	5/12/99	0.58	68	38.3
28REDRIV009.2	5/13/99	0.35	58	43.4
28REDRIV009.2	8/17/99	0.21	11	4.82
28REDRIV009.2	8/18/99	0.2	8	6.45
28REDRIV009.2	10/25/99	0.11	4	8.06
28REDRIV009.2	10/26/99	0.08	5	4.47
28REDRIV009.2	10/27/99	0.09	4	5.59
28REDRIV009.2	10/28/99	0.11	8	5.21
28REDRIV009.8	5/10/99	0.3	190	279
28REDRIV009.8	5/11/99	0.29	250	158
28REDRIV009.8	5/12/99	0.35	95	48.8

Station ID	Date	Dissolved Aluminum (mg/L)	TSS (mg/L)	Turbidity (NTU)
28REDRIV009.8	5/13/99	0.5	65	43.3
28REDRIV009.8	8/17/99	0.24	9	5.68
28REDRIV009.8	8/18/99	0.22	9	5.79
28REDRIV009.8	10/25/99	0.11	5	4.52
28REDRIV009.8	10/26/99	0.1	6	4.18
28REDRIV009.8	10/27/99	0.1	<3	4.38
28REDRIV009.8	10/28/99	0.11	8	5.8
28REDRIV014.0	5/10/99	0.33	123	141
28REDRIV014.0	5/11/99	0.6	91	82
28REDRIV014.0	5/12/99	0.42	65	38.2
28REDRIV014.0	5/13/99	0.37	43	38.6
28REDRIV014.0	8/17/99	0.31	11	6.68
28REDRIV014.0	8/18/99	0.26	9	6.42
28REDRIV014.0	10/25/99	0.17	12	6.02
28REDRIV014.0	10/26/99	0.15	4	4.94
28REDRIV014.0	10/27/99	0.15	<3	4.84
28REDRIV014.0	10/28/99	0.17	9	5.02
28REDRIV015.0	5/10/99	0.15	111	147
28REDRIV015.0	5/10/99*	0.29	114	
28REDRIV015.0	5/11/99	0.14	134	87
28REDRIV015.0	5/11/99*	0.32	123	
28REDRIV015.0	5/12/99	0.19	59	36.9
28REDRIV015.0	5/12/99*	0.42	51	
28REDRIV015.0	5/13/99	0.35	51	39.8
28REDRIV015.0	5/13/99*	0.22	50	
28REDRIV015.0	8/17/99	0.29	10	6.07
28REDRIV015.0	8/17/99*	0.28	9	
28REDRIV015.0	8/18/99	0.28	10	6.64
28REDRIV015.0	8/18/99*	0.31	8	
28REDRIV015.0	10/25/99	0.17	6	6.53
28REDRIV015.0	10/25/99*	0.16	5	
28REDRIV015.0	10/26/99	0.15	11	6.82
28REDRIV015.0	10/26/99*	0.15	7	
28REDRIV015.0	10/27/99	0.15	6	6.19
28REDRIV015.0	10/27/99*	0.16	7	
28REDRIV015.0	10/28/99	0.19	7	5.68
28REDRIV015.0	10/28/99*	0.18	8	
28REDRIV016.2	5/10/99	0.23	119	142
28REDRIV016.2	5/11/99	0.29	55	77
28REDRIV016.2	5/12/99	0.4	62	37.1
28REDRIV016.2	5/13/99	0.47	49	31.9
28REDRIV016.2	8/17/99	0.31	7	4.89
28REDRIV016.2	8/18/99	0.32	5	6.11
28REDRIV016.2	10/25/99	0.22	<3	2.81
28REDRIV016.2	10/26/99	0.21	3	4.11

Station ID	Date	Dissolved Aluminum (mg/L)	TSS (mg/L)	Turbidity (NTU)
28REDRIV016.2	10/27/99	0.2	4	4.5
28REDRIV016.2	10/28/99	0.21	5	3.41
28REDRIV017.1	5/10/99	0.5	191	130
28REDRIV017.1	5/11/99	0.25	526	187
28REDRIV017.1	5/12/99	0.5	61	35
28REDRIV017.1	5/13/99	0.47	45	30.8
28REDRIV017.1	8/17/99	0.25	<3	6.1
28REDRIV017.1	8/18/99	0.26	9	6.68
28REDRIV017.1	10/25/99	0.13	<3	4.89
28REDRIV017.1	10/26/99	0.13	<3	2.93
28REDRIV017.1	10/27/99	0.13	3	2.99
28REDRIV017.1	10/28/99	0.13	6	2.92
28REDRIV019.1	5/10/99	0.7	130	147
28REDRIV019.1	5/11/99	0.46	57	88.8
28REDRIV019.1	5/12/99	0.56	28	40.4
28REDRIV019.1	5/13/99	0.55	27	41.8
28REDRIV019.1	8/17/99	0.25	6	3.98
28REDRIV019.1	8/18/99	0.27	8	4.95
28REDRIV019.1	10/25/99	0.11	<3	2.95
28REDRIV019.1	10/26/99	0.09	5	2.46
28REDRIV019.1	10/27/99	0.11	<3	2.82
28REDRIV019.1	10/28/99	0.3	<3	3.19
28REDRIV019.5	5/10/99	0.45	147	128
28REDRIV019.5	5/11/99	0.8[+]	68	69
28REDRIV019.5	5/12/99	0.44	35	39.6
28REDRIV019.5	5/13/99	0.6	27	42
28REDRIV019.5	8/17/99	0.17	4	4.67
28REDRIV019.5	8/18/99	0.18	5	6.52
28REDRIV019.5	10/25/99	0.09	<3	3.26
28REDRIV019.5	10/26/99	0.09	<3	2.69
28REDRIV019.5	10/27/99	0.1	4	3.06
28REDRIV019.5	10/28/99	0.13	3	3.8
28REDRIV020.2	5/10/99	0.7	136	185
28REDRIV020.2	5/11/99	0.5	78	92.7
28REDRIV020.2	5/12/99	0.47	32	51.8
28REDRIV020.2	5/13/99	0.49	35	48.6
28REDRIV020.2	8/17/99	0.2	7	6.56
28REDRIV020.2	8/18/99	0.21	10	6.99
28REDRIV020.2	10/25/99	0.13	6	5.16
28REDRIV020.2	10/26/99	0.12	9	3.76
28REDRIV020.2	10/27/99	0.13	<3	3.65
28REDRIV020.2	10/28/99	0.14	<3	3.67
28REDRIV020.7	5/10/99	0.4	168	154
28REDRIV020.7	5/11/99	0.6	75	NS
28REDRIV020.7	5/12/99	0.45	40	52.2

Station ID	Date	Dissolved Aluminum (mg/L)	TSS (mg/L)	Turbidity (NTU)
28REDRIV020.7	5/13/99	0.62	36	47.7
28REDRIV020.7	8/17/99	0.19	14	7.38
28REDRIV020.7	8/18/99	0.22	9	6.21
28REDRIV020.7	10/25/99	0.12	4	4.54
28REDRIV020.7	10/26/99	0.1	<3	3.66
28REDRIV020.7	10/27/99	0.1	<3	3.6
28REDRIV020.7	10/28/99	0.15	5	3.75
28REDRIV024.4	5/10/99	0.6	138	132
28REDRIV024.4	5/11/99	1^{+}	76	81.2
28REDRIV024.4	5/12/99	0.72	31	43.5
28REDRIV024.4	5/13/99	0.64	31	41.9
28REDRIV024.4	8/17/99	0.19	6	7.3
28REDRIV024.4	8/18/99	0.22	6	6.02
28REDRIV024.4	10/25/99	0.12	3	11.2
28REDRIV024.4	10/26/99	0.11	<3	3.7
28REDRIV024.4	10/27/99	0.12	4	4.64
28REDRIV024.4	10/28/99	0.13	<3	3.71
28REDRIV025.3	5/10/99	0.7	266	129
28REDRIV025.3	5/11/99	0.7	66	73.4
28REDRIV025.3	5/12/99	0.7	26	40.7
28REDRIV025.3	5/13/99	0.57	29	43.5
28REDRIV025.3	8/17/99	0.22	16	18.1
28REDRIV025.3	8/18/99	0.25	9	4.39
28REDRIV025.3	10/25/99	0.18	4	2.24
28REDRIV025.3	10/26/99	0.19	7	2.42
28REDRIV025.3	10/27/99	0.14	<3	2.83
28REDRIV025.3	10/28/99	0.19	3	2.46
28REDRIV026.7	5/10/99	0.6	154	92.2
28REDRIV026.7	5/11/99	0.9^{+}	44	66.5
28REDRIV026.7	5/12/99	1^{+}	22	26.3
28REDRIV026.7	5/13/99	1^{+}	19	41.5
28REDRIV026.7	8/17/99	0.11	9	5.82
28REDRIV026.7	8/18/99	0.13	<3	2.99
28REDRIV026.7	10/25/99	0.11	<3	2.11
28REDRIV026.7	10/26/99	0.09	<3	3.09
28REDRIV026.7	10/27/99	0.1	<3	2.33
28REDRIV026.7	10/28/99	0.11	<3	2.15
28REDRIV026.9	5/10/99	0.3	137	104
28REDRIV026.9	5/11/99	0.69	41	57.4
28REDRIV026.9	5/12/99	0.6	14	22.1
28REDRIV026.9	5/13/99	0.73	24	32.4
28REDRIV026.9	8/17/99	0.11	6	5.46
28REDRIV026.9	8/18/99	0.13	6	3.2
28REDRIV026.9	10/25/99	0.11	<3	1.86
28REDRIV026.9	10/26/99	0.1	<3	2.91

Station ID	Date	Dissolved Aluminum (mg/L)	TSS (mg/L)	Turbidity (NTU)
28REDRIV026.9	10/27/99	0.1	<3	1.88
28REDRIV026.9	10/28/99	0.1	<3	2.41
28REDRIV028.5	5/10/99	1.5+	111	100
28REDRIV028.5	5/11/99	0.47	78	52
28REDRIV028.5	5/12/99	0.31	32	22
28REDRIV028.5	5/13/99	0.5	24	23.6
28REDRIV028.5	8/17/99	0.1	6	7.93
28REDRIV028.5	8/17/99*	0.1	<3	
28REDRIV028.5	8/18/99	0.13	3	2.08
28REDRIV028.5	8/18/99*	0.13	3	
28REDRIV028.5	10/25/99	0.11	<3	1.64
28REDRIV028.5	10/25/99*	0.11	3	
28REDRIV028.5	10/26/99	0.1	<3	1.92
28REDRIV028.5	10/26/99*	0.1	<3	
28REDRIV028.5	10/27/99	0.14	<3	2.18
28REDRIV028.5	10/27/99*	0.1	<3	
28REDRIV028.5	10/28/99	0.11	<3	3.18
28REDRIV028.5	10/28/99*	0.11	3	
28REDRIV031.1	5/10/99	1.5+	247	122
28REDRIV031.1	5/11/99	1.1+	59	61
28REDRIV031.1	5/12/99	1.4+	31	22.5
28REDRIV031.1	5/13/99	0.74	36	27
28REDRIV031.1	8/17/99	0	<3	1.72
28REDRIV031.1	8/18/99	0.03	<3	1.39
28REDRIV031.1	10/25/99	0.02	3	1.11
28REDRIV031.1	10/26/99	0.02	<3	0.63
28REDRIV031.1	10/27/99	0.03	<3	0.68
28REDRIV031.1	10/28/99	0.03	<3	0.48

* Duplicate sample.
+ Exceedence of the acute aluminum standard of 0.75 mg/L.

Table B.2 SWQB Bitter Creek (Red River to headwaters) Water Quality Data

Station ID	Date	Dissolved Aluminum (mg/L)	TSS (mg/L)	Turbidity (NTU)
28BITTER000.1	5/10/99	0.39	300	231
28BITTER000.1	5/10/99*		292	
28BITTER000.1	5/11/99	1.2+	112	85.2
28BITTER000.1	5/12/99	1.8+	56	40.3
28BITTER000.1	5/13/99	0.8+	66	48.3
28BITTER000.1	8/17/99	0.04	9	15.5
28BITTER000.1	8/18/99	0.06	4	6.91
28BITTER000.1	10/25/99	0.04	18	15
28BITTER000.1	10/26/99	0.33	24	15.3
28BITTER000.1	10/27/99	0.04	13	8.34
28BITTER000.1	10/28/99	0.03	9	16

* Duplicate sample.
+ Exceedence of the acute aluminum standard of 0.75 mg/L.

Table B.3 SWQB Placer Creek (Red River to headwaters) Water Quality Data

Station ID	Date	Dissolved Aluminum (mg/L)	TSS (mg/L)	Turbidity (NTU)
28PLACER000.2	5/10/99	1.1+	7	21.8
28PLACER000.2	5/11/99	1+	9	18.3
28PLACER000.2	5/12/99	1.4+	9	15.4
28PLACER000.2	5/13/99	0.8+	<3	12.8
28PLACER000.2	8/17/99	0	<3	3.15
28PLACER000.2	8/18/99	0.03	6	1.79
28PLACER000.2	10/25/99	0.02	<3	1.47
28PLACER000.2	10/26/99	0.03	<3	2.74
28PLACER000.2	10/27/99	0.03	<3	0.45
28PLACER000.2	10/28/99	0.02	<3	3.1

Table B.4 SWQB Pioneer Creek (Red River to headwaters) Water Quality Data

Station ID	Date	Dissolved Aluminum (mg/L)	TSS (mg/L)	Turbidity (NTU)
28PIONEE000.7	5/10/99	0.08	17	30.3
28PIONEE000.7	5/11/99		35	26.5
28PIONEE000.7	5/12/99		12	13.6
28PIONEE000.7	5/13/99		4	10.3
28PIONEE000.7	5/25/99	0.09		16.9
28PIONEE000.7	5/26/99	0.08		7.92
28PIONEE000.7	5/27/99	0.1		5.44
28PIONEE000.7	5/28/99	0.08	7	5.65
28PIONEE000.7	8/17/99	0.05	16	8.52
28PIONEE000.7	8/18/99	0.07	3	3.4
28PIONEE000.7	10/25/99	0.06	3	2.76
28PIONEE000.7	10/26/99	0.05	8	6.36
28PIONEE000.7	10/27/99	0.07	8	1.69
28PIONEE000.7	10/28/99	0.05	3	9.11

Table B.5 USGS Instream Water Analyses for the March 30 – April 1, 2001 Low-Flow Tracer Study (McCleskey et al 2003)

Sample Identification	Dissolved Aluminum (mg/L)	Total Aluminum (mg/L)	Sample Identification	Dissolved Aluminum (mg/L)	Total Aluminum (mg/L)
RRU-0	0.011	0.050	RRM-7500A	0.22	0.58
RRU-200	0.013	0.054	RRM-7500B	0.20	0.40
RRU-324	0.020	0.055	RRM-7800	0.23	0.61
RRU-375	0.011	0.052	RRM-8100	0.22	0.65
RRU-518	0.024	0.071	RRM-8400	0.23	0.66
RRU-700	0.087	0.21	RRM-8700	0.22	0.68
RRU-800A	0.12	0.26	RRM-9000	0.23	0.61
RRU-800B	0.12	0.26	RRM-9300	0.23	0.63
RRU-900	0.12	0.23	RRM-9600	0.22	0.62
RRU-1040	0.14	0.28	RRM-9900	0.21	0.62
RRU-1100	0.13	0.32	RRM-10200	0.21	0.66
RRU-1200	0.14	0.34	RRM-10300	0.20	0.62
RRU-1300	0.16	0.33	RRM-10500	0.21	0.64
RRU-1640	0.14	0.33	RRM-10644	0.17	0.64
RRU-1765	0.14	0.34	RRM-10800	0.17	0.62
RRU-1975	0.14	0.36	RRM-11000	0.18	0.65
RRU-2184	0.14	0.37	RRM-11300	0.18	0.62
RRU-2404	0.13	0.36	RRM-11600	0.19	0.67
RRU-2693	0.14	0.33	RRM-11963	0.17	0.68
RRU-3052A	0.12	0.39	RRM-12200	0.17	0.66
RRU-3052B	0.15	0.35	RRM-12515A	0.18	0.69
RRU-3350A	0.15	0.35	RRM-12515B	0.18	0.73
RRU-3350B	0.15	0.33	RRM-12600	0.19	0.69
RRU-3638	0.15	0.32	RRM-12900	0.18	0.75
RRU-3900	0.16	0.34	RRM-13194	0.19	0.75
RRU-4200	0.14	0.31	RRL-12515	0.21	0.88
RRU-4500	0.14	0.31	RRL-12600	0.23	1.1
RRU-4800	0.14	0.33	RRL-12900	0.21	0.90
RRU-4900	0.15	0.33	RRL-13194	0.23	0.87
RRU-5200	0.14	0.30	RRL-13300	0.20	0.83
RRU-5300	0.15	0.31	RRL-13600	0.22	0.92
RRU-5735	0.14	0.32	RRL-13700A	0.23	0.91
RRM-5756	0.12	0.36	RRL-13700B	0.26	0.88
RRM-6000	0.13	0.33	RRL-13900	0.26	1.2
RRM-6175	0.13	0.32	RRL-14142	0.24	1.1
RRM-6300	0.14	0.32	RRL-14400	0.26	1.2
RRM-6600	0.11	0.31	RRL-14700	0.26	1.2
RRM-6819	0.12	0.61	RRL-14790	0.26	1.2
RRM-7100	0.13	0.34	RRL-14958	0.25	1.3
RRM-7200	0.10	0.32	RRL-15221	0.23	1.3
RRM-7295	0.21	0.40	RRL-15295	0.20	1.2
RRM-7395	0.21	0.57	RRL-15373	0.19	1.3

Table B.5 USGS Instream Water Analyses for the March 30 – April 1, 2001 Low-Flow Tracer Study (McCleskey et al 2003) (continued)

Sample Identification	Dissolved Aluminum (mg/L)	Total Aluminum (mg/L)
RRL-15600	0.15	1.4
RRL-15765	0.15	1.7
RRL-16100	0.22	1.8
RRL-16400	0.20	2.1
RRL-16700	0.19	2.2
RRL-17012	0.19	2.2
RRL-17300	0.22	1.9
RRL-17480	0.13	2.1
RRL-17655	0.20	2.2
RRL-17700A	0.16	2.0
RRL-17700B	0.15	2.3
RRL-18000	0.19	1.7
RRL-18300	0.19	1.8
RRL-18600	0.18	1.8
RRL-18900	0.22	1.8
RRL-19170	0.22	1.9
RRL-19500	0.22	1.9
RRL-19780	0.21	1.8

RRU – Red River Upper
RRM – Red River Middle
RRL – Red River Lower

Table B.6 USGS Bank Water Analyses for the March 30 – April 1, 2001 Low-Flow Tracer Study (McCleskey et al 2003)

Sample Identification	Description	Dissolved Aluminum (mg/L)	Total Aluminum (mg/L)	Sample Identification	Description	Dissolved Aluminum (mg/L)	Total Aluminum (mg/L)
RRU-275	RBI	0.010	0.023	RRM-7352	RBI	0.31	0.71
RRU-340	LBI	0.007	0.13	RRM-7400	LBI	12	12
RRU-380	RBI	0.009	0.034	RRM-7457	RBI	1.8	3.9
RRU-487	RBI	0.009	1.0	RRM-7588	LBI	0.31	0.90
RRU-511	RBI	0.32	0.33	RRM-7615	RBI	9.3	9.0
RRU-530	RBI	6.9	6.9	RRM-10360	RBI	0.35	0.63
RRU-542	RBI	3.3	7.6	RRM-10519	RBI	0.28	0.28
RRU-570	RBI	6.8	7.8	RRM-10572	LBI	0.044	0.051
RRU-572	RBI	6.6	6.8	RRM-12287	LBI	2.5	3.3
RRU-705	RBI	5.7	8.6	RRM-12308	RBI	8.6	8.6
RRU-750	LBI	0.35	1.4	RRM-13210	LBI	0.031	0.042
RRU-758	RBI	8.7	11	RRL-13675	RBI	39	39
RRU-834	RBI	0.36	1.8	RRL-13750	LBI	31	31
RRU-1050	RBI	0.038	1.6	RRL-13751	RBI	42	43
RRU-1117	RBI	0.039	0.053	RRL-14570	RBI	5.0	5.5
RRU-1463	RBI	0.017	0.73	RRL-14800	RBI	2.6	6.6
RRU-1510	RBI	4.6	5.9	RRL-14973	RBI	1.5	1.5
RRU-1658	RBI	0.014	0.031	RRL-15000	LBI	0.70	1.6
RRU-2195	LBI	0.060	0.33	RRL-15044	RBI	0.45	0.49
RRU-2406	RBI	0.025	0.32	RRL-15264	RBI	<0.06	0.10
RRU-2830	RBI	0.033	0.16	RRL-15331	LBI	0.029	0.21
RRU-4100	LBI	0.27	0.47	RRL-15356	RBI	0.057	0.084
RRU-5652	LBI	0.096	0.21	RRL-15408	RBI	15	15
RRM-6214	RBI	0.013	0.021	RRL-15500	LBI	0.098	1.1
RRM-6343	LBI	0.009	0.010	RRL-15687	RBI	0.36	0.37
RRM-6971	RBI	98	98	RRL-17574	RBI	33	34
RRM-7010	Inflow	0.034	0.11	RRL-17595	RBI	90	90
RRM-7240	RBI	14	14	RRL-17670	RBI	100	100
RRM-7255	LBI	0.093	2.1	RRL-17749	LBI	0.072	0.32
RRM-7270	RBI	13	14	RRL-18160	LBI	11	12
RRM-7300	LBI	9.5	10	RRL-19040	RBI	28	29

RBI – Right-band Inflow
LBI – Left-bank Inflow
RRU – Red River Upper
RRM – Red River Middle
RRL – Red River Lower

Table B.7 USGS Instream Water Analyses for the August 17 – 24, 2002 Snowmelt Tracer Study (McCleskey et al 2003)

Sample Identification	Dissolved Aluminum (mg/L)	Total Aluminum (mg/L)	Sample Identification	Dissolved Aluminum (mg/L)	Total Aluminum (mg/L)
RRH-0	0.050	0.12	RRF-7800	0.19	0.98
RRH-700	0.11	0.22	RRF-8400	0.16	0.98
RRH-1200	0.21	0.42	RRF-10644	0.18	0.89
RRH-3052	0.12	0.46	RRC-13300	0.18	0.68
RRH-3300	0.18	0.48	RRC-13465	0.14	0.70
RRH-3380	0.15	0.42	RRC-13595	0.15	0.67
RRH-3638	0.16	0.43	RRC-13700	0.14	0.64
RRH-3900	0.15	0.43	RRC-13900	0.13	0.57
RRH-4200	0.15	0.45	RRC-14142A	0.12	0.66
RRH-4500	0.14	0.50	RRC-14142B	0.15	0.66
RRH-4800	0.14	0.51	RRC-14400	0.20	0.64
RRH-4900	0.19	0.51	RRC-14700	0.13	0.66
RRH-5200A	0.14	0.52	RRC-14790	0.14	0.59
RRH-5200B	0.14	0.47	RRC-14958	0.14	0.63
RRH-5300	---	0.55	RRC-15084	0.14	0.56
RRF-5735	0.15	0.45	RRC-15221	0.13	0.65
RRF-6000	0.19	0.44	RRC-15373	0.092	0.58
RRF-6175	0.20	0.39	RRC-15547	0.15	0.74
RRF-6300	0.14	0.34	RRC-15600	0.12	0.71
RRF-6600A	0.16	0.36	RRC-15765	0.11	0.81
RRF-6600B	0.13	0.35	RRC-15950	0.14	0.76
RRF-6819	0.16	0.33	RRC-16100	0.15	0.75
RRF-6940	0.14	0.33	RRC-16400	0.13	0.79
RRF-6948	0.18	0.42	RRC-16700	0.16	0.77
RRF-7100A	0.14	0.30	RRC-17012	0.17	0.74
RRF-7100B	0.14	0.29	RRC-17230	0.18	0.91
RRF-7200	0.17	0.30	RRC-17300	0.18	1.0
RRF-7295	0.27	0.51	RRC-17480	0.17	1.0
RRF-7377	0.18	0.82	RRC-17655	0.13	1.8
RRF-7500A	0.14	0.96	RRC-17700A	0.12	2.0
RRF-7500B	0.16	0.99	RRC-17700B	0.13	1.9
RRF-7700	0.13	0.99	RRC-19780	0.20	2.4

RRH – Red River at Hottentot Creek
RRF – Red River at Fawn Lakes
RRC – Red River at Columbine Creek

Table B.8 USGS Bank Water Analyses for the August 17 – 24, 2002 Snowmelt Tracer Study (McCleskey et al 2003)

Sample Identification	Description	Dissolved Aluminum (mg/L)	Total Aluminum (mg/L)
RRF-6209	LBI	0.069	0.80
RRF-6214	RBI	0.046	0.13
RRF-6301	RBI	0.067	0.12
RRF-6343	LBI	0.052	0.070
RRF-7150	RBI	0.10	0.42
RRF-7240	RBI	13	13
RRF-7270	RBI	12	12
RRF-7297	RBI	13	14
RRF-7300	LBI	7.8	8.6
RRF-7320	RBI	15	15
RRF-7352	RBI	0.49	0.97
RRF-7383	LBI	15	15
RRF-7457	RBI	9.4	9.9
RRF-7588	RBI	0.11	0.15
RRF-7615	RBI	6.4	6.5
RRC-14973	RBI	1.6	1.6
RRC-15044	RBI	0.31	0.74
RRC-15087	LBI	0.089	0.12
RRC-15141	LBI	0.033	0.14
RRC-15264	RBI	0.12	1.4
RRC-15408	RBI	18	20
RRC-15507	RBI	110	110
RRC-15567	LBI	0.029	0.022
RRC-15687	RBI	0.17	0.41
RRC-15737	RBI	17	18
RRC-17270	RBI	33	34
RRC-17288	LBI	34	36
RRC-17525	RBI	110	120
RRC-17574	RBI	38	37
RRC-17595	RBI	110	110
RRC-17670	RBI	110	120

RBI – Right-band Inflow
LBI – Left-bank Inflow
RRH – Red River at Hottentot Creek
RRF – Red River at Fawn Lakes
RRC – Red River at Columbine Creek

APPENDIX C
RED RIVER WATERSHED FLOW MODEL

Flow Modeling Methodology

The mass loading during a specified time interval (e.g., day) of any constituent is related to flow through the following equation:

Equation B1. Mass Load (mass units) = Q x C

Where Q = Discharge (volumetric units) and C = Concentration (mass per unit volume). Therefore, the discharge for each designated segment (natural or artificial) must be estimated in order to determine the TMDL.

Background

The following describes the approach applied to estimate ungaged inflows to the Red River between the USGS gage station/SWQB established flow measurement site below the Zwergle dam site near Red River, New Mexico, and the confluence of the Red River with the Rio Grande. Estimation of ungauged inflows is one of the most difficult, and common, tasks in hydrology. All approaches take into account contributing area. Some approaches add other variables such as precipitation, elevation of the gage site, and/or land use patterns. Many approaches use the "transfer" method whereby information from similar gauged sites is "transferred" to the site of interest. In sparsely gauged areas, this transfer can be problematic, as the gauged sites may be dissimilar in area, elevation, or land use and the information may not be reliably transferred.

Furthermore, groundwater flow in the watershed is controlled by fractures and faults, preferred channels within debris flow material, and differences in hydraulic conductivity between bedrock, mine waste rock piles (near Molycorp), and valley fill/alluvium. Hydrogeologic units include a Pre-Cambrian aquitard, volcanic and sedimentary rock aquifers, and valley fill alluvial or debris flow aquifers. Groundwater gradients are toward the Red River, except for the cone of depression created by mine dewatering. Fan delta deposits at the mouths of tributary canyons are the principal hydraulic connection between the river and upgradient sources.

The Red River watershed is sparsely gauged. Some information has been collected from contributing streams and from points of seepage. This information, although not definitive, does allow a "reality" check on estimated values.

Methods

The Red River flow model stations were positioned below major tributaries, NPDES outfalls, and known acidic seepage locations. All stations lie between the former Zwergle gage station, which is located just above the town of Red River, and the mouth on the Rio Grande. The flow stations also coincide with SWQB and biological stations when present. Automated measurement tools within ArcView were used to determine sub-basin areas for significant tributaries to the Red River and the watershed areas above each of the flow stations.

Model development involved matching, as closely as possible, measured streamflows at the current and former gage stations. Streamflow records for these stations were downloaded from the National Water Information System web site (USGS, 2001). Data from the last 50 years at the Questa gage station was used to estimate the missing flows for the same time period at the remaining gage stations. This was accomplished for the three months of interest by developing a relationship between the data collected at the Questa station with each of the remaining stations. The result was a target average daily streamflow value for May, August, and October (Table B1) that the flow model attempted to match at each of the USGS stations on the Red River.

Table B1. Target Streamflows for USGS Gage Locations

Location	**Flow Model Station**	**Target Streamflow (cfs)**		
		May	August	October
Near Red River Gage	N/A	35.0	16.0	7.15
Zwergle Gage	1	49.6	20.6	11.0
Questa Gage	14	118	38.8	22.0
Fish Hatchery Gage	17	164	64.7	48.8
Mouth Gage	18	169	79.8	60.7

The average daily streamflows at the remaining model stations were simulated based on the area-weighted gains between the Zwergle and Questa gage stations, and between the Questa and fish hatchery gage stations. These gains were apportioned among the tributaries and groundwater seepage areas as described below.

Area-Weighting Approach

The approach used in the Red River TMDL study relies on measured river flows and various point measurements of tributary and seepage flows to estimate the ungaged flows. The approach will be described using the river reach between the gage sites at Questa (Red River near Questa, NM) and Zwergle. The contributing area to the river flow at Zwergle is 25.7 square miles. At Questa, the area is 113 square miles. Therefore, the intervening contributing area is 87.3 square miles, 44.5 square miles of which is assigned to tributaries and the remaining 42.8 square miles is assigned to non-tributaries, or seeps in this usage. The river distance between the Zwergle and Questa is 14 miles allowing direct (not time-lagged) comparisons between the average daily flows at the two sites. The gains or losses in the average daily flows can be calculated as:

Equation B2. $dQ = Q_Q - Q_Z$

Where dQ is the difference in the average daily flow (for a specific measurement day such as May 5, 1970, for example) between Questa and Zwergle, Q_Q is the average daily flow at Questa and Q_Z is the average daily flow at Zwergle for the same day. The value of dQ can be either positive (gains) or negative (losses). The period of overlapping measurements for the two sites or stations is from May 1, 1963 through December 31, 1973, or 3,898 days. The gain or loss on a daily basis is calculated as:

Equation B3. $q = dQ/dA$

Where q is the contributing flow in cfs per square mile and dA is the change in area between the stations. Rearranging and expanding equation (B3) yields:

$$\textit{Equation B4.}\quad dQ = q_t A_t + q_s A_s$$

Where q_t and A_t are the contributing flow and area from the designated tributaries and q_s and A_s are the same measures for the non-tributaries, or seeps. The total change of area is:

$$\textit{Equation B5.}\quad dA = A_t + A_s$$

Equation (B4) can be modified to:

$$\textit{Equation B6.}\quad dQ = q_s (K A_t + A_s)$$

Where $K = q_t / q_s$. The problem is to assign values to q_t, q_s, and/or K. These values are dynamic, i.e. they change with time, and vary from source to source. However, without detailed and prolonged measurements, only general values can be used.

Estimating Values

Because there are more unknowns than equations, the K factor was introduced to relate q_t and q_s. The range in K, based on the small number of point samples, is between 1 and 3, with 1 appropriate for the low flow months of August and October and 3 appropriate for the high flow month of May (the three months chosen for detailed analyses). Once a value of K was selected, then an optimum value of q_s could be calculated that yielded a minimum least squared errors summation or:

$$\textit{Equation B7.}\quad \text{Min} \sum (dQ \text{ measured} - dQ \text{ estimated})^2$$

Where dQ measured is from equation (B2) and dQ estimated is from equation (B6). It should be obvious that the best estimate is the one that will yield a dQ equal to the average of the dQ values found from equation (B2). This optimal value is static over the time period from which it is derived, such as the May flows. Because q_s is a really a dynamic value, a refinement was developed. A linear regression model was developed for q_s as:

$$\textit{Equation B8.}\quad q_s = a + b\, Q_Z$$

Where a and b are regression parameters. The value of q_s was related to the flow at Zwergle because that flow was the known upstream boundary condition. The individual values of q_s were back calculated by rearranging equation (B6) with an assumed K value and the difference in daily flows found from equation (B2). The relationships for the Zwergle to Questa reach for the months of May, August, and October were reasonable and were incorporated into the flow estimation model. The final form of the estimation equation for the Zwergle to Questa reach is:

$$\textit{Equation B9.}\quad Q_Q = Q_Z + (a + b\, Q_Z) \text{ x } (K A_t + A_s)$$

Equation (B9) was used to estimate the daily flows at Questa based on the flow at Zwergle and the estimated inflows. The results were reasonable. This comparison was made for all three detailed months and for the entire period of overlapping record.
Similarly, the reach between Questa and the Red River below Fish Hatchery near Questa, NM, site was also analyzed. It this reach, the K value was set to 0.0 (no tributary inflows, i.e. A_t was 0.0 as well) and only q_s was considered. The linear relationships, in the form of equation (B8), were poor, so only the optimum value of q_s was employed in the flow estimation procedure.

Flow Model Results

The gains were estimated for each reach as described above and were then summed to the Zwergle station target flow value to calculate a flow at each of the downstream model locations. Flow model results for May are shown in Table B2. The model sites corresponding to the Questa, Fish Hatchery, and Red River at Mouth gage stations have estimated average daily streamflows that are within 10 percent of the target flow values shown in Table B1.

Table B2. Flow Model Results for May

Model Station	Location	Area (m^2)	Q/A cfs per m^2	Flow cfs
1	Zwergle Gage	25.7		49.6
	Goose Creek	5.5	1.039	5.7
	Placer Creek	2.4	1.039	2.5
	Bobcat Creek	5.8	1.039	6.0
	seepage	5	0.346	1.8
2	Above town of Red River	44.6		65.6
	Bitter Creek	10	1.039	10.4
	seepage	1.9	0.346	0.7
3	Below Bitter Creek	56.5		76.7
	Pioneer Creek	5.3	1.039	5.5
	seepage	8.9	0.346	3.1
4	Below town of Red River	70.7		85.3
	Haut n Taut Creek			0.0
	seepage	1.6	0.346	0.6
5	Junebug Campground	72.3		85.8
	Straight Creek			0.0
	Red River WWTP outfall			0.98
	seepage	1.9	0.346	0.7
6	Elephant Rock Camp	74.2		87.5
	Hansen Creek			0.0
	seepage	2.3	0.346	0.8
7	Below Hansen Creek	76.5		88.3
	seep#1	2.1	0.346	0.7
8	At Mine Boundary	78.6		89.0
	seepage	7.5	0.346	2.6

Table B2. Flow Model Results for May

Model Station	Location	Area (m^2)	Q/A cfs per m^2	Flow cfs
9	Above Portal	86.1		91.6
	seep#2	0.6	0.346	0.2
10	Above Columbine Creek	86.7		91.8
	Columbine Creek	15.5	1.039	16.1
	seep#3	1.5	0.346	0.5
11	Below Columbine Creek	103.7		108.4
	seep#4	3	0.346	1.0
12	Above Goathill Gulch	106.7		109.5
	seep#5	5.9	0.346	2.0
13	Eagle Rock Campground	112.6		111.5
	seep#6	0.4	0.346	0.1
14	Questa Gage	113		111.7
	Cabresto Creek	36.7		33.8
	seepage	6	0.395	2.4
15	Below Cabresto Creek	155.7		147.8
	Mine outfall			0.54
	seepage	19.6	0.395	7.7
16	Below Mine Outfall	175.3		156.1
	Fish Hatchery outfall			14.5
	seepage	9.7	0.395	3.8
17	Fish Hatchery Gage	185		174.4
	seepage	5	0.395	2.0
18	Mouth Gage	190		176.4

The estimated average daily streamflows for May (high flow) were used to calculate the TMDL for the Red River. Streamflow samples taken during the spring runnoff period of 1999 showed the highest aluminum and sediment loadings. Therefore, an implicit MOS, with respect to average conditions, is provided in the loading allowances.

References

U.S. Geological Survey. 2001. Surface-Water Data for USA. <http://water.usgs.gov/nwis/sw>

APPENDIX D
CONVERSION FACTOR DERIVATION

Flow (as million gallons per day [MGD]) and concentration values (milligrams per liter [mg/L]) must be multiplied by a conversion factor in order to express the load in units "pounds per day." The following expressions detail how the conversion factor was determined:

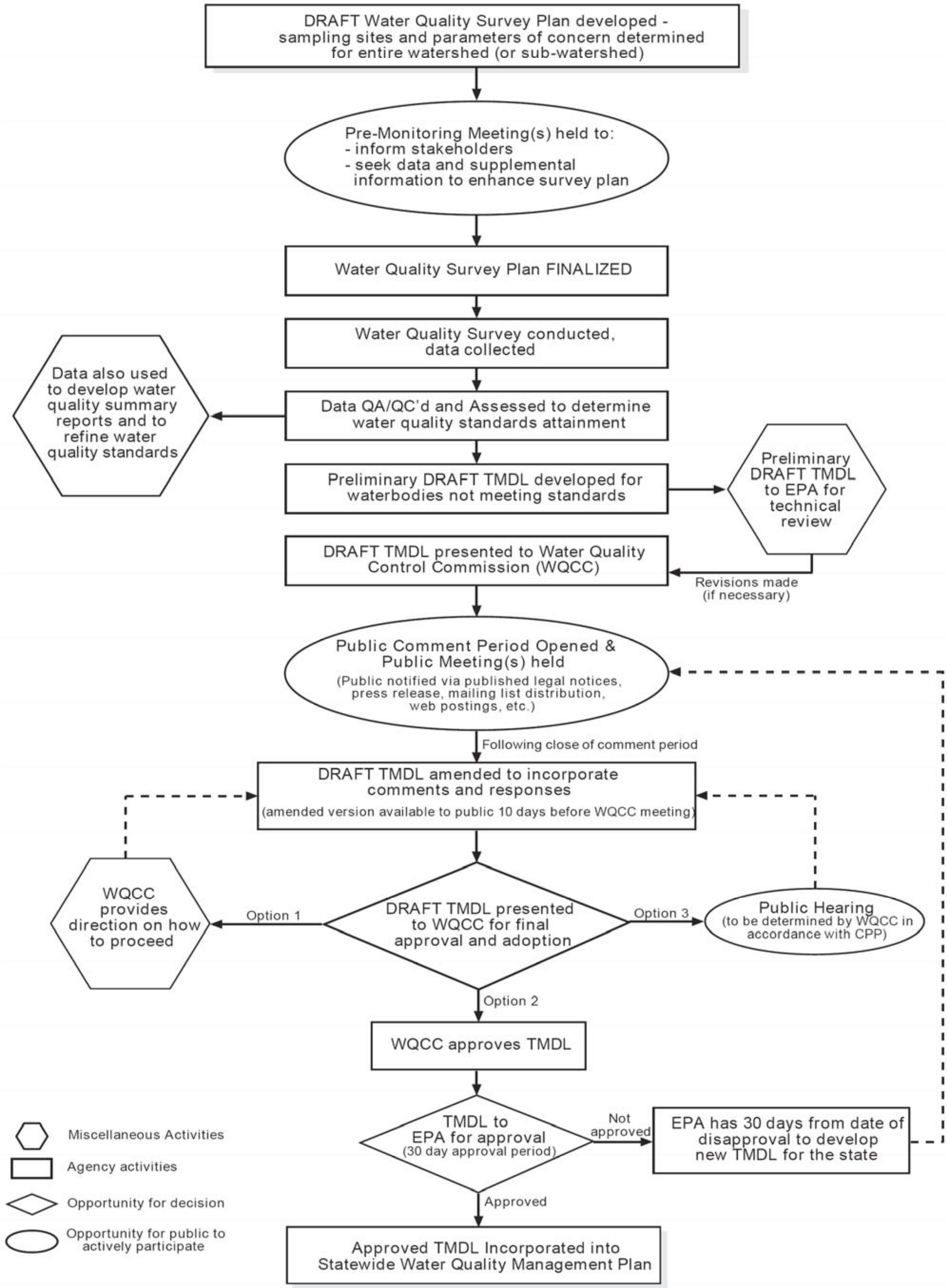
TMDL Calculation:

$$Flow\left(MGD\right)\times Concentration\left(\frac{mg}{L}\right)\times CF\left(\frac{L-lb}{gal-mg}\right)=Load\left(\frac{lb}{day}\right)$$

Conversion Factor Derivation:

$$CF = 10^6 \times \frac{3.785\,L}{gal}\times\frac{1\,lb}{454{,}000\,mg}=8.34\,\frac{L-lb}{gal-mg}$$

APPENDIX E
PUBLIC PARTICIPATION PROCESS FLOWCHART


DRAFT Water Quality Survey Plan developed - sampling sites and parameters of concern determined for entire watershed (or sub-watershed)
Pre-Monitoring Meeting(s) held to: - inform stakeholders - seek data and supplemental information to enhance survey plan
Water Quality Survey Plan FINALIZED
Water Quality Survey conducted, data collected
Data also used to develop water quality summary reports and to refine water quality standards
Data QA/QC'd and Assessed to determine water quality standards attainment
Preliminary DRAFT TMDL developed for waterbodies not meeting standards
Preliminary DRAFT TMDL to EPA for technical review
DRAFT TMDL presented to Water Quality Control Commission (WQCC)
Revisions made (if necessary)
Public Comment Period Opened & Public Meeting(s) held
(Public notified via published legal notices, press release, mailing list distribution, web postings, etc.)
Following close of comment period
DRAFT TMDL amended to incorporate comments and responses
(amended version available to public 10 days before WQCC meeting)
WQCC provides direction on how to proceed
Option 1
DRAFT TMDL presented to WQCC for final approval and adoption
Option 3
Public Hearing
(to be determined by WQCC in accordance with CPP)
Option 2
WQCC approves TMDL
TMDL to EPA for approval
(30 day approval period)
Not approved
EPA has 30 days from date of disapproval to develop new TMDL for the state
Approved
Approved TMDL Incorporated into Statewide Water Quality Management Plan
Miscellaneous Activities
Agency activities
Opportunity for decision
Opportunity for public to actively participate

APPENDIX F
RESPONSES TO COMMENTS

Comment Set A:
Molycorp

(PDF of letter received inserted)

Molycorp, Inc.
Questa Division
P.O. Box 469
Questa, NM 87556
Telephone (505) 586-7642
Facsimile (281) 276-9216

Molycorp

Scott Honan
Supervisor, Environmental Compliance

December 15, 2005

Ms. Jennifer Ickes
New Mexico Environment Department
Surface Water Quality Bureau
P.O. Box 26110
Santa Fe, NM 87502

RE: Comments on the Draft TMDL for the Red River Watershed

Dear Ms. Ickes:

Molycorp has reviewed the Draft TMDL for the Red River Watershed dated October 31, 2005. In general, this draft represents a substantial improvement over previous efforts, and Molycorp is in agreement with the conclusions reached in the document. Attached to this letter are comments on the draft TMDL that have been prepared by Chadwick Ecological Consultants, Inc. These comments are being provided in the spirit of assisting NMED to produce a stronger and more defensible final TMDL.

Molycorp has additional suggestions that might improve the report, but we are not sure they are of sufficient significance to state them at this time. Please contact myself (505.586.7642) or Mr. Steven Canton of Chadwick (303.794.5530) should you have any questions regarding this submission.

Sincerely,

Scott Honan

Scott Honan

C: Anne Wagner, Molycorp

Chadwick Ecological Consultants, Inc.
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☎ (303) 794-5530, Fax: (303) 794-5041, e-mail: Chadeco@aol.com

December 15, 2005

TECHNICAL MEMORANDUM

REVIEW OF OCTOBER 31, 2005 RED RIVER TMDL

Chadwick Ecological Consultants, Inc. (CEC) was asked to review 2005 Draft Total Maximum Daily Load (TMDL) for the Red River Watershed document on behalf of Molycorp, concentrating on the acute aluminum (Al) portion of the TMDL document. Before we present our comments, we would like to recognize the considerable effort that the Surface Water Quality Bureau (SWQB) of the New Mexico Environment Department (NMED) spent on this TMDL, which we believe can serve as an excellent starting point for guiding future efforts to improve water quality in the Red River.

Aluminum TMDL-Red River, Bitter Creek, and Placer Creek

Overall, the report presents a reasonable and generally complete picture of the complexities of the Red River Watershed in a straightforward and understandable manner, including discussion of the numerous non-point sources adding acute Al loads to the Red River. There are a few changes that we believe could improve the acute Al TMDL, based on general EPA TMDL practice and our knowledge of the river, including:

- Providing an estimate of the relative contributions of specific non-point sources;
- Providing a discussion on non-anthropogenic or "background" concentrations or conditions for each of the pollutants (which would be useful, given the complexity of the watershed); and
- Using only acute Al sources and loads in the document.

Again, these comments are being submitted to improve and strengthen the final document.

Acute aluminum approach

Because of the decision to propose an acute Al TMDL, rather than a chronic TMDL, it is important that data used in the TMDL analysis only reflect the portions of each river segment that are acutely impaired by Al and describe only the sources that contribute to acute aluminum exceedances.

Response: *The SWQB does not feel it is possible to determine exactly which sources are contributing to only the acute aluminum exceedences and which contribute to only the chronic aluminum exceedences. Since exceedences are determine based on a concentration of aluminum in water grab samples all sources would be contributing to that aluminum concentration.*

Assigning acute aluminum exceedances to entire river

Multiple Al sources and sinks exist within the Red River watershed due to the unique geology and its contribution to ambient water quality characteristics that effect Al transport. The draft TMDL document contains acute Al TMDLs for Red River, Bitter Creek, and Placer Creek: The separation of Bitter Creek and Placer Creek for individual TMDL analyses is appropriate. However, we are concerned that using the entire reach of the Red River from Placer Creek to the Rio Grande results in an inaccurate estimate of acute Al loads at the confluence with the Rio Grande River.

Specifically, multiplying the arithmetic mean of acute Al exceedances in the Red River upstream of the confluence by the mean high flow at the base of the watershed generates an incorrect estimate of the actual measured load for the portions of the Red River that exceed the acute standard since it is a gaining watershed. This is especially true since exceedance locations are all ≥ 24 km upstream of the confluence with the Rio Grande River (See Figure 6.1).[1]

Matched site flow data and dissolved Al concentrations that exceed the acute standard should be used to determine the relative contribution to acute exceedances from different reaches within the Red River. This approach would probably result in sectioning the river into acutely impaired and unimpaired segments, thus identifying different areas of concern throughout the watershed. The toxicity reference value of 0.75 mg dissolved Al/L would remain the same for each segment, yet the target load and measured loads will vary throughout the watershed with flow and instream Al concentrations.

According to Figure 6.1, the Red River is acutely impaired by Al only in the reaches more than approximately 24 river km upstream from the confluence with the Rio Grande River. The remainder of the river is chronically impaired and as such should not be included (via flow or river miles) in the acute TMDL analysis.

Thus, one approach would be to split the river based on portions exceeding acute Al concentrations, while also incorporating the geologic and hydrologic characteristics that reflect acute Al sources and impacts. Such sub-segmentation could include splitting the Placer Creek to the Rio Grande segment into at least two segments, with Columbine Creek being a reasonable hydrologic break. Based on the NMED data,

[1] We should note that Figure 6.1 appears to have mislabeled units. The values in the x-axis appear to be distance in kilometers – based on our knowledge of the river – but the units are reported as miles.

only the potential sub-segment from Placer Creek to Columbine Creek would be listed for acute impairment for Al. Columbine Creek is located approximately 13.4 miles (21.5 km) upstream of the confluence with the Rio Grande River. Al concentrations below Columbine Creek do not contribute to acute exceedences.

Using this alternative approach, the calculation of target loads and measured loads (and, subsequent load reductions necessary to meet the acute Al standard) would change (see Table 1). Given the flows modeled above Columbine Creek of 91.8 cfs or 59.3 mgd (Appendix C of the report, May 1999) and the same mean dissolved Al concentrations of 1.13 mg/L (based on acute exceedances in May 1999), measured loads contributing to acute Al would be 559 lbs/day, rather than the 1,170 lbs/day used in the report. The resulting TMDL would be 371 lbs/day, instead of 776 lbs/day in the report, resulting in a load reduction of 188 lbs/day.

Table 1: An example recalculation of target loads and measured loads for the segment of the Red River with dissolved Al concentrations that exceed the acute criterion of 0.75 mg/L.

Location	Flow[a] (mgd)	Acute Criterion (mg/L)	Target Load Capacity (lbs/day)	Mean dissolved Al[b] (mg/L)	Measured Load (lbs/day)
Placer Creek to Columbine Creek	59.3	0.75	371	1.13	559

[a] flow = model station 10-above of Columbine Creek, from TMDL, Appendix C.
[b] mean of aluminum concentrations exceeding the acute criterion in May 1999.

Response: *The Red River (Rio Grande to Placer Creek) is covered by one assessment unit and one water quality standard segment (20.6.4. NMAC); therefore we feel that one TMDL is appropriate. Splitting this assessment unit will be considered by SWQB staff for future SWQB intensive surveys and TMDLs, but at this time we do not believe it is necessary to split it in this TMDL document.*

Seasonal TMDL

Additionally, it should be more clearly stated the derived acute Al TMDLs are specifically for spring runoff conditions – and, as such, constitute a seasonal TMDL. Such a designation is common, especially with regard to nutrient TMDLs.

Response: *NMED has prepared seasonal TMDLs for other watersheds when the point source contributors have variable flow based on recreation levels. We do not believe it is necessary to designated this TMDL as a seasonal TMDL; therefore this change will not be made.*

Other Suggested Corrections to the Aluminum TMDL Analysis

Waste Load Allocations

Report Table 6.3 states the point source waste load allocations (WLA) were derived from the monthly average discharge limit, whereas the text states these values are the maximum Al loads. Since these values are used in acute TMDL calculations, we believe the loads set to meet daily max limits (based on acute standards), rather than loads set to meet the monthly average limit, would be more appropriate to determine the WLA for this TMDL. Loads set to meet chronic standards would not be expected to contribute to an acute Al exceedance.

Response: It is SWQB's standard practice to use monthly average values in TMDLs and not daily maximum levels. The reference in the text has been modified to clarify this point.

Incorporation of the Margin of Safety

The footnote to Table 6.5 notes "the MOS is not included in the load reduction calculation because it is a set aside value which accounts for any uncertainty or variability in TMDL calculation and therefore should not be subtracted from the measured load." Although data presented in the report were for informational purposes only, it appears that the statement in the footnote was not followed. Specifically, load reduction was calculated in the document as:

Load Reduction = Measured Load-Target Load

Where: **Target Load = WLA + LA.**
However, this is actually: **Target Load = WLA + [TMDL - (WLA+MOS)]** (since no measurements were available for the load allocation [LA]).

Therefore, the load reduction equation would be:

Load Reduction = Measured Load –TMDL + MOS

As such, it appears the MOS was considered in the determination of load reduction, as it was included in the target load. However, if the MOS were not included, the actual percentage load reduction necessary to meet the proposed TMDLs would be much less for each location than the percentages presented in the report (Table 2). If this was not the report's intent, this footnote and percentages in the table should be modified accordingly.

Table 2: Calculated percent reductions when removing the MOS from load reduction calculations.

Location	Al TMDL	Measured Al Load	Al Load Reduction	% Reduction
Red River (Rio Grande to Placer Creek	776	1,170	394	33.7%
Bitter Creek (Red River to Headwaters)	41.9	71	29.1	41.0%
Placer Creek (Red River to Headwaters)	10.0	14.4	4.4	30.5%

[a] Load Reduction = Measured Load - TMDL

Response: *We feel you have misinterpreted the footnote for Table 6.5. It is included only to clarify why the MOS is not being subtracted from the Measured Load to determine the load reduction needed to meet the TMDL. The Target Load is equal to the WLA + LA, which is a different value from the TMDL.*

Summary of Sources

Report Table 6.6 presents the pollutant source summary for dissolved Al. Potential sources are broken into point and non point sources. We believe a distinction should be made as to whether a source is contributing to <u>acute</u> Al exceedances or not, since this is an acute Al TMDL. It doesn't appear that this distinction is made.

The LA was derived from the calculated TMDL, MOS and WLA. These values actually represent the *target load* for this segment, not the "measured load" contributed by non-point sources as described by the text and Footnote (a) to Table 6.6. Although the TMDL document states that the exact amount of these values are still to be determined, the magnitude of non-point source contributions to the Red River, using the TMDL values, should be 1,166 lbs/day (= measured load – WLA), to be consistent with the other segments presented. Percent contributions of the potential sources to the Red River are correct and were likely based on this value.

Response: *It is not possible to designate pollutant sources to just the acute or chronic aluminum impairments since all sources contribute to the aluminum concentration in the Red River. The magnitude of the nonpoint source contributions was wrong and has been corrected to reflect the measured load.*

Flow conversion from cfs to mgd

The equation presented results in a measurement that's actually 10-times the reported value. We think the last conversion factor should be 10^{-7}, not 10^{-6}.

Response: We believe the conversion factor of 10^{-6} in the following equation is correct to convert from gallons per day to million gallons per day.

$$192\,\frac{ft^3}{\sec} \times 7.48\,\frac{gal}{ft^3} \times 86{,}400\,\frac{\sec}{day} \times 10^{-6} = 124\,mgd$$

Link between water quality and pollutant sources: Relationship between dissolved Al and TSS in the Red River

It was stated in the TMDL: that only a very weak relationship between dissolved Al and TSS exists for Red River and Bitter Creek (R^2 = 0.10 and 0.064 respectively) and that a stronger relationship exists for Placer Creek (R^2=0.57). This difference could be due to the differential range of TSS values. Placer Creek TSS data used for this analysis range from approximately 0-9 mg/L. Red River and Bitter Creek TSS data range from 0 to >500 and 300 mg/L respectively. Looking strictly at the low TSS concentrations (perhaps < 75 mg/L TSS), it seems that a relationship between TSS and dissolved Al may also exist for these sites. [Note: All of the above statements were generated from a visual analysis of the data. No raw data were used to draw these conclusions.]

Sediment/Siltation TMDL - Bitter Creek

Because no data were available, target loads were determined from relationships between percent fines and biological scores of the study site and a reference site (Columbine Creek). According to the satellite image provided, minimal or no alteration scars exist within the Columbine Creek watershed. This raises the question of whether Columbine Creek is an appropriate reference site given the differences in geology between the sites. Likely, background load between these two sites differ, which would generate different expected conditions.

The percent reduction necessary to meet the derived sediment TMDL is 81%. The report suggests that the majority of the Bitter Creek sediment load originates from the highly erodible alteration scars. The NMED SWQB 1999 sampling (NMED 2004) indicated that sand and gravel operations and development have led to the very high sediment loads in Bitter Creek. It would be helpful if these seemingly contradictory statements could be reconciled and a percentage approximation made between the contributions of natural and man-made sources.

Response: *Reference sites are picked based on the best available sites for a watershed. Columbine Creek was considered by field staff to be the best available site in this watershed based on the lack of other relatively non-impaired streams in this watershed.*

These two statements are not contradictory. In the NMED SWQB 1999 survey report was discussing potential nonpoint source contributions to the impairment and the TMDL is also including potential background sources. The sand and gravel operation and development are definitely contributing to the impairments in Bitter Creek.

Comment Set B:

Amigos Bravos

Friends of the Wild Rivers
P.O.Box 238, Taos, NM 87571
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December 16th, 2005

Sent Via and Electronic Mail

Jennifer A. Ickes
TMDL and Outreach Team
Surface Water Quality Bureau
NM Environment Department
1190 St. Francis Dr.
Santa Fe, NM 87505
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RE: Red River TMDL

Dear Ms. Ickes:

Introduction

As a statewide river conservation organization based in Taos, Amigos Bravos, Friends of the Wild Rivers, would like to submit the following comments on the draft TMDL document for the Red River. In New Mexico, issues of water quality and quantity are integral to all aspects of life. The cultural and ecological survival of the communities of New Mexico is intricately tied to our rivers, acequias and other water bodies and we strongly support efforts to curb pollution to our waters through strong TMDL documents with enforceable implementation plants. We have organized our comments into a number of general topic areas:

Implementation Plan

Where are the guarantees that this TMDL document is not merely a paper exercise? Amigos Bravos holds that TMDLS, including their implementation plans, should be written as enforceable documents. On page 57 the TMDL states "Implementation of BMPs within the watershed to reduce pollutant loading from NPS will be encouraged." How will the Environment Department encourage BMPs? The implementation plan should include detailed plans as to what types of BMPs will be encouraged, and ideally required, to meet water quality standards.

TMDLs, should be written with equal focus on presenting data on current conditions *and* implementing plans to clean up the river. Most TMDL documents are heavy on data on the current conditions and the target conditions but lack detail on how to get to that target. Two pages out of sixty-four is not giving TMDL implementation adequate attention.

Response: *The NMED nonpoint source water quality management program has historically strived for and will continue to promote voluntary compliance to nonpoint source water pollution concerns by utilizing a voluntary, cooperative approach. In addition, other compliance remedies are outlined in Section 9.0, page 59, of this TMDL document. NMED does not include detailed implementation plans in our TMDL documents because we contend that Watershed Restoration Action Strategies (WRAS) written on a local level by stakeholder groups in cooperation with the SWQB are in essence TMDL implementation plans. SWQB provides Clean Water Act Section 319 funding to watershed groups for WRAS development. Also, EPA does not review implementation plans included in TMDL documents because they are not a required element. We contend it is confusing to the public, staff, and EPA to have one document that is only partially EPA-approved, so we believe the TMDL implementation portion is more clearly presented in the WRAS format.*

Potential versus Actual Sources of Pollution

The one area that the TMDL can make a strong statement is in identifying sources of pollution. Amigos Bravos believes that there is definitive proof that many of the sources labeled "potential" sources of pollution in all of New Mexico's TMDL documents, including the Red River TMDL are actual sources of pollution and should be labeled as such. The impacts from recreation, highway and road runoff and impacts from mining activities in the Red River should all be labeled as "sources of pollution" rather than "potential sources."

Response: *Intensive surveys completed by the SWQB are not designed to determine the exact sources of pollution in each waterbody and therefore we do not feel it would be appropriate to label these sources as definitely contributors to the pollution problems. We are continually improving our monitoring and assessment methods and working towards intensive studies that will better target sources of pollution.*

Recreation – Potential Source of Pollution

Recreation should be added as a source of pollution for turbidity on Pioneer Creek (page 37) and for Aluminum on Placer Creek (page 49). Amigos Bravos has been working on a project to address pollution from OHV abuse in the upper Red River and during this project we have inventoried impacts to water quality from OHV abuse in almost all of the tributaries to the Red River including Pioneer and Placer Creeks. The Questa Ranger District of the US Forest Service has a detailed map with GPS points of the most impacted places from OHV abuse in the watershed – many of these places can be found on Placer and Pioneer Creeks.

Response: *Agreed. "Off-road vehicles" has been added as potential source of pollution for both Pioneer Creek and Placer Creek.*

Mining Activities

Current mining activities should be listed as a current source of pollution in the Red River (Rio Grande to Placer Creek). There is some indication that seeps from the Molycorp mine site are still contributing to Aluminum levels in the Red River – this would be an illegal waste load allocation. Runoff from the mine site is definitely contributing to the load allocation for sediment and aluminum and should be listed as a source on page 49.

Response: *Agreed. Current mining activities has been added as a potential source of pollution in the Red River.*

Red River (Rio Grande to Placer Creek) – impaired for sediment and water bioassays
On page 21 the TMDL states that the Red River from the Rio Grande to Placer Creek is impaired for sediment and water bioassays yet a TMDL has not been prepared for these constituents for this part of the watershed.

Response: *It is not possible to prepare TMDLs for Sediment and Water Bioassay listings because the actual constituent(s) causing the toxicity is not identified by these listings. EPA encourages states to document impairment based on the results of toxicity testing (see our Assessment Protocols for the listing process at: http://www.nmenv.state.nm.us/swqb/protocols/index.html). States then need to identify the actual parameter(s) of concern in order to develop TMDLs. In this portion of the Red River, it is reasonable to assume that elevated aluminum is the cause of toxicity.*

Chronic Aluminum
Since this TMDL was written for Acute Aluminum with no regard for chronic standards the TMDL for Aluminum is somewhat meaningless. TMDLs must be written to protect the most sensitive use in the water resource for aluminum, which would be coldwater aquatic life. To protect coldwater aquatic life, chronic standards as well as acute standards must be met. This TMDL only addresses acute standards for aluminum and thus gives an inadequate picture of the watershed and is ultimately a waste of time and resources.

Response: *The NMED understands that this TMDL may not be protective of the coldwater aquatic life use since it does not address the chronic aluminum impairments. We are working to rectify this by proposing more appropriate chronic aluminum standards for the Red River Watershed and develop any required chronic aluminum TMDLs.*

Waste Load Allocation
Since the only way that TMDLs have any true weight, in terms of enforcement, to protect the watershed is by assigning and enforcing proper waste load allocations, Amigos Bravos thinks that it would be appropriate to prohibit any waste load allocation in the impaired segment for any impaired constituents until target loads are met. This would be a first step in protecting the many impaired watersheds in the state. This may force watershed residents and industries to address the load allocation sources more effectively. This is especially appropriate since the point source dischargers are often closely connected to the land-use activities in the watershed that are causing the non-point source pollution.

Response: *While NMED understands your point, we cannot prohibit WLAs in the TMDLs. WLAs are a required element.*

Stormwater Impacts

The TMDL does not account for the potentially substantial impacts from stormwater running off of construction and industrial sites. Storm Water Pollution Prevention Plans (SWPPPs) developed under the General Storm Water Permits and referred to in the TMDL are *not*, as suggested by the TMDL, adequate for controlling all pollution from construction sites. The TMDL itself states that the Storm Water Pollution Prevention Plans (SWPPPs) developed under the General Storm Water Permits (CGP and MSGP) "minimize" impacts to water quality. Coverage under the CGP and MSGP and the related SWPPPs do not *eliminate* impacts to water quality. Therefore, the TMDL should allocate at least some waste load allocation to pollution from stormwater running off construction sites that are covered under the General Construction Storm Water Permit, and some load allocation to construction sites not covered under the general permit. The same should hold true for industrial sites. The TMDL also states "compliance with a SWPPP that meets the requirements of the MSGP is generally assumed to be consistent with this TMDL" (page 35). Does the Environment Department inspect these construction and industrial sites to make sure that there is a SWPPP and that it is indeed being complied to? How is the public to know if stormwater runoff from these sites is, in fact, being controlled? At the very least the TMDL should identify sites and facilities that are covered under these general stormwater permits in the watershed.

Response: *Since these various permits require BMPs in order decrease or eliminate any discharge from the sites, we do not believe it is appropriate to assign a waste load allocation or load allocation to these permits. The SWQB has considered adding information on construction permits to the TMDLs, but these sites are generally very transient and change dramatically from the time of the study to the time when the TMDLs are prepared. General permits do not have the information necessary to determine potential loading in TMDLs. In future TMDLs we will add a list of stormwater permits that are active when intensive surveys are completed and the TMDLs are prepared.*

Previous Comments

Amigos Bravos commented on the first draft of TMDLs for the Red River back in 2002. We have attached our comments (only available in hard copy by fax) from that comment period and hope that these concerns will be addressed as well.

Response: *We have reviewed this comment set as well with respect to the revised draft. We believe the concerns have been addressed in the revised TMDL.*

Thank you for the opportunity to comment on the draft TMDL. We look forward to your response to our comments.

Thank you and happy holidays,

Rachel Conn
Clean Water Circuit Rider
Amigos Bravos

Comment Set C:
Taos County Soil and Water Conservation District

December 29, 2005

New Mexico Environment Department
SWQB, Room N2109
P.O. Box 26110,
Santa Fe, NM 87502

Attn: Ms. Jennifer Ickes

Subject: Comments on Draft (TMDL), RED RIVER WATERSHED

Dear Ms Ickes;

The following comments are submitted on behalf of the Taos County Soil and Water Conservation District. The Comments refer to the version of the Draft TMDL for the Red River Watershed that was available on the New Mexico Environment Department, Surface Water Quality Bureau's web site on December 16, 2005. The general concern of the District is that watersheds or stream segments be listed based on best scientific data and that impairment decisions and eventual TMDL implementation actions be based on clear links between data and causes of impairments. This relates to the specific concern that any proposed TMDL implementation actions that affect District actions or policies be in the overall best interest of the health of the target watershed.

The Red River (from its confluence with the Rio Grande), together with its tributaries and headwaters (upstream from the confluence of the main and west forks of the Red River), define the Red River Watershed of northern New Mexico. In general, it seems that development of a TMDL strategy for this watershed is premature at this time. Some impairments are not addressed due to consideration of pending changes in water quality criteria, other portions of loads are not assessed since the resources and data are not available at this time, and the USGS has ongoing studies of this watershed that are not available for review by the general public.

The review and comments submitted herein are preliminary based on the lack of time to review all of the information supporting the proposed actions, especially the USGS studies of the Red River watershed. The review has identified several areas of concern:

- For example the determination that Pioneer Creek is impaired for turbidity is based on only 11 measurements, only two of which exceed the New Mexico turbidity criteria;

- Less than 20% of the measurements exceed the turbidity standard of 50 NTU, and the two measurements that exceed the standard occurred in a spring and may represent "background" conditions for spring runoff;

Response: *According to the SWQB's Assessment Protocols, an assessment unit is considered impaired if greater than 15% of the measurements exceed the turbidity criterion.*

- Flow rates tributaries are estimated from Red River flow based on a watershed model. This may be an acceptable method, but the MOS and uncertainty factors in all calculations should be increased to address this added source of potential error and uncertainty;

Response: *The MOS was increased by 10% to account for an uncertainty in this flow model.*

- The relationship between the discussion of the development of a TMDL for aluminum in the Executive summary and the discussion in Chapter 6 is confusing. Is it the intent to develop a TMDL for aluminum in this document or wait for a revised chronic criterion? ;

Response: *The acute TMDLs were prepared in this document and chronic TMDLs will be prepared if necessary after an appropriate revised chronic criterion is adopted..*

- The assessment is almost totally dependent upon the judgment of NMED staff, since no clear statistical criteria for determining what percentage of samples that exceed a standard indicate impairment or what volume and frequency of data collection data is adequate to determine an impairment: and,

Response: *Data assessments performed by NMED staff on done using our documented Assessment Protocol which are available on our website at:* *http://www.nmenv.state.nm.us/swqb/protocols/index.html* *and have been reviewed by the USEPA in Region 6.*

- It is unclear how impairments based on bio-assessment or other means are to be related to be specific to a specific impairing condition, such as elevated turbidity.

Response: *In this TMDL document bioassessments where used only in relation to the stream bottom deposit impairments; not for turbidity or aluminum impairments. The SWQB is in the process of developing biocriteria assessment protocols, but those protocols are not in place at this time.*

Thank you for your consideration of these comments.

Sincerely,

Peter A. Vigil
Taos SWCD – District Manager