US EPA-APPROVED
TOTAL MAXIMUM DAILY LOAD (TMDL)
FOR THE
Dry Cimarron River Watershed

JUNE 2, 2009

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COVER PHOTO*: Dry Cimarron River @ Folsom Falls, March 27, 2006.*

LIST OF ABBREVIATIONS AND DEFINITIONS

AU	Assessment Unit
BLM	Bureau of Land Management
BMP	Best management practices- effective, practical, structural or nonstructural methods which prevent or reduce the movement of pollutants from the land to surface water.
CFR	Code of Federal Regulations
cfs	Cubic feet per second
CGP	Construction general storm water permit
CWA	Clean Water Act
^{o}C	Degrees Celsius
^{o}F	Degrees Fahrenheit
Ecoregion	Ecological regions based on geology, physiography, vegetation, climate, soils, land use, wildlife, and hydrology.
EQIP	Environmental Quality Incentive Program
GIS	Geographic Information Systems
HUC	Hydrologic unit code- a way of identifying all of the drainage basins in the United States in a catalogued arrangement from largest (Regions) to smallest (Cataloging Units).
LA	Load allocation
mg/L	Milligrams per Liter
mi^2	Square miles
mL	Milliliters
MOS	Margin of safety
MOU	Memorandum 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-as authorized by the Clean Water Act, permit program controls water pollution by regulating point sources that discharge pollutants into waters of the United States.
NPS	National Park Service
%	Percent
QAPP	Quality Assurance Project Plan
RFP	Request for proposal
SBD	Stream bottom deposits
STORET	Storage and Retrieval Database- a repository for water quality, biological, and physical data and is used by state environmental agencies, EPA and other federal agencies, universities, private citizens, and others.
SWPPP	Storm Water Pollution Prevention Plan-a written document that describes the construction operator's activities to comply with the requirements in the construction general permit
SWQB	Surface Water Quality Bureau
TMDL	Total maximum daily load

TDS	Total dissolved solids
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- The commission is the state water pollution control agency for NM, and for all purposes of the federal Clean Water Act and the wellhead protection and sole source aquifer programs of the federal Safe Drinking Water Act.
WQS	Water quality standards (NMAC 20.6.4 as amended through 2002)
WRAS	Watershed Restoration Action Strategy
WWTP	Wastewater treatment plant

EXECUTIVE SUMMARY

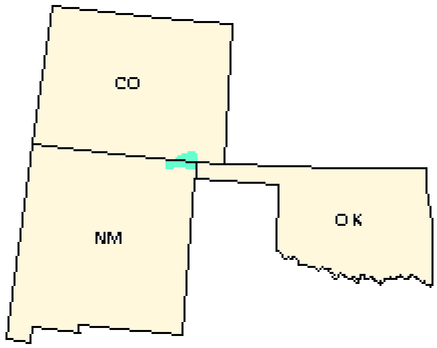
Section 303(d) of the Federal Clean Water Act requires states to develop Total Maximum Daily Load (TMDL) management plans for waterbodies determined to be water quality limited. A TMDL documents the amount of a pollutant a waterbody can assimilate without violating a state's water quality standard. It also allocates the 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).

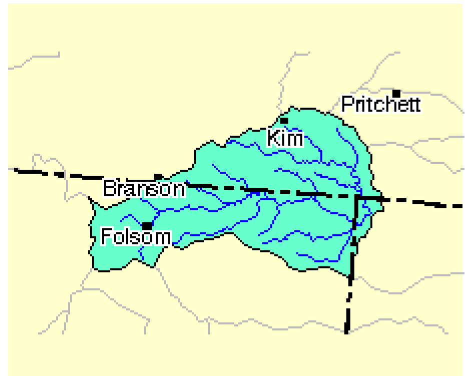
The Dry Cimarron River together with its tributaries and headwaters, define the Dry Cimarron River Watershed. The Surface Water Quality Bureau (SWQB) held pre-survey public meetings in Kenton, OK and Folsom, NM and conducted an surface water quality survey of the Dry Cimarron River watershed in 2006. Sampling stations were established along the streams in the watershed to evaluate the impact of tributary streams and to work toward establishing background conditions. As a result of assessing data generated during this monitoring effort, SWQB staff documented impairments of the New Mexico water quality standards for total dissolved solids (TDS) and sulfate on Dry Cimarron River (perennial reaches OK boundary to Long Canyon), *E.coli* and TDS on Dry Cimarron River (Long Canyon to Oak Creek), *E.coli* and selenium on Long Canyon (perennial reaches above Dry Cimarron), and *E.coli* and nutrients on Oak Creek (Dry Cimarron to headwaters). This TMDL document addresses the above noted impairments as summarized in the tables below. The data used to develop this TMDL were collected during the 2006 survey and follow-up collections in 2007 and 2008.

The 2006 Dry Cimarron Watershed study also identified other potential water quality impairments in this watershed which are not addressed in this document. Additional data needs for verification of those impairments are being identified and data collection will follow. Subsequent TMDLs will be prepared in the near future in a separate TMDL document.

Additional water quality data will be collected by New Mexico Environment Department during the standard rotational period for water quality 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 2008b).

TOTAL MAXIMUM DAILY LOAD FOR SULFATE AND TDS
DRY CIMARRON RIVER (PERENNIAL REACHES OK BND TO LONG CANYON)

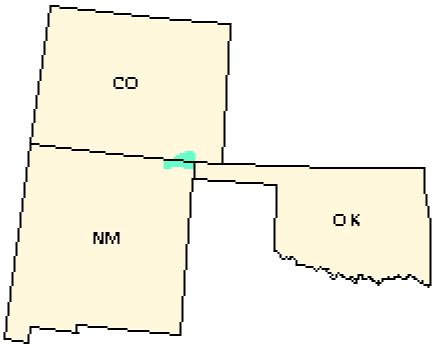


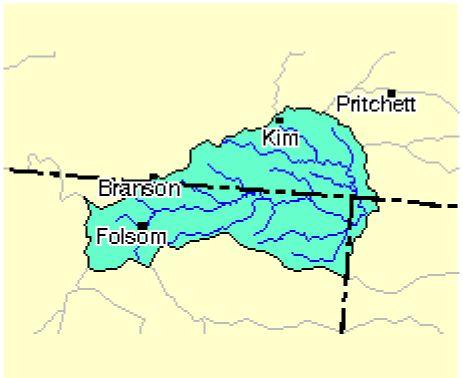


New Mexico Standards Segment	Dry Cimarron River Basin 20.6.4.701
Assessment Unit Identifier	Dry Cimarron River (perennial reaches OK bnd to Long Canyon) NM-2701_00 (formerly NM-DC1-10000)
Assessment Unit Length	56 miles
Parameters of Concern	Sulfate, total dissolved solids
Designated Uses Affected	Coldwater Aquatic Life
Geographic Location	Cimarron Headwaters USGS Hydrologic Unit Code 11040001
Scope/size of Watershed	980 square miles
Land Type	Southwestern Tablelands Ecoregion (26)
Land Use/Cover	Grassland (65%), Forest (25%), Shrubland (9%), Pasture/row crop (<1%)
Probable Sources	Drought-related impacts, flow alterations from water diversions, highway/road/bridge runoff (non-construction related), irrigation crop production, natural sources, waterfowl[a].
Land Management	Private (99%), State (<1%), BLM (<1%), NPS (<1%)
IR Category	5/5A
Priority Ranking	High
TMDL for:	**WLA + LA + MOS = TMDL**
Sulfate	0 + 880 + 220 = 1,100 lbs/day
TDS	0 + 1,906 + 476 = 2,382 lbs/day

[a] per public comment, this will be added to the 2010-2012 CWA Integrated §303(d)/§305(b) List.

TOTAL MAXIMUM DAILY LOAD FOR E.COLI AND TDS
DRY CIMARRON RIVER (LONG CANYON TO OAK CREEK)

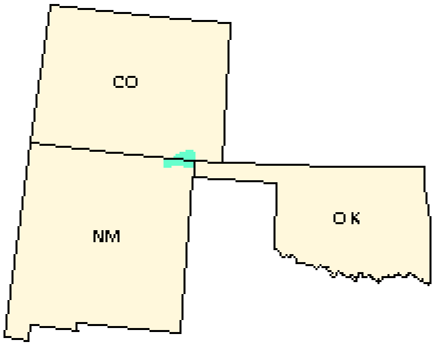


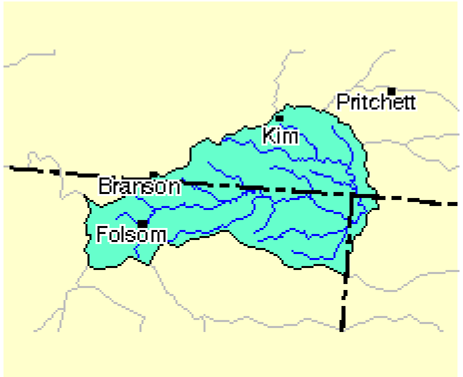


New Mexico Standards Segment	Dry Cimarron River Basin 20.6.4.701
Assessment Unit Identifier	Dry Cimarron River (Long Canyon to Oak Creek) NM-2701_02 (formerly NM-DC1-10000)
Assessment Unit Length	21.65 miles
Parameters of Concern	*E.coli*, Total dissolved solids
Designated Uses Affected	Coldwater Aquatic Life
Geographic Location	Cimarron Headwaters USGS Hydrologic Unit Code 11040001
Scope/size of Watershed	369.31square miles
Land Type	Southwestern Tablelands Ecoregion (26)
Land Use/Cover	Grassland (52%), Forest (30%), Shrubland (17%), Pasture/row crop (<1%), Developed (<1%)
Probable Sources	Drought-related impacts, flow alterations from water diversions, irrigated crop production, natural sources, on-site treatment systems (septic systems and similar decentralized systems), rangeland grazing, wildlife other than waterfowl, waterfowl[a].
Land Management	Private (81%), State (19%), BLM (<1%), NPS (<1%)
IR Category	5
Priority Ranking	High
TMDL for:	**WLA + LA + MOS = TMDL**
E.coli	0 + 7.30×10^8 + 8.11×10^7 = 8.11×10^8 cfu/day
TDS	0 + 1,361 + 340 = 1,701 lbs/day

[a] per public comment, this will be added to the 2010-2012 CWA Integrated §303(d)/§305(b) List.

TOTAL MAXIMUM DAILY LOAD FOR E.COLI, SELENIUM
LONG CANYON (PERENNIAL REACHES ABOVE DRY CIMARRON)

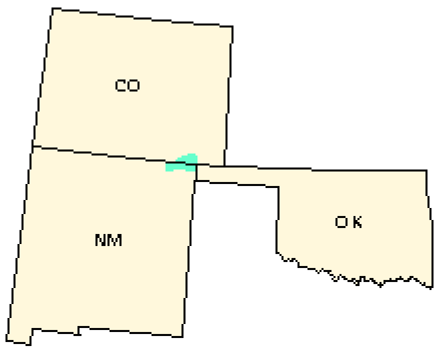


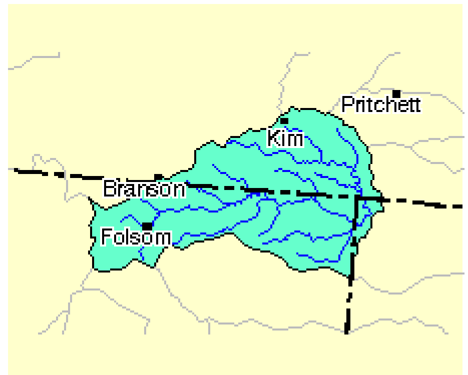


New Mexico Standards Segment	Dry Cimarron River Basin 20.6.4.701
Assessment Unit Identifier	Long Canyon (perennial reaches above Dry Cimarron), NM-2701_20 (formerly NM-DC1-10100)
Assessment Unit Length	8.21 miles
Parameters of Concern	*E.coli*, selenium
Designated Uses Affected	Coldwater Aquatic Life
Geographic Location	Cimarron Headwaters USGS Hydrologic Unit Code 11040001
Scope/size of Watershed	131.11 square miles
Land Type	Southwestern Tablelands Ecoregion (26)
Land Use/Cover	Grassland (69%),Forest (27%), Shrubland (4%)
Probable Sources	Drought-related impacts, highway/road/bridge runoff (non-construction related), natural sources, rangeland grazing, streambank modifications/destabilization, wildlife other than waterfowl, waterfowl[a].
Land Management	Private (77%), State (23%), BLM (<1%)
IR Category	5
Priority Ranking	High
TMDL for:	**WLA + LA + MOS = TMDL**
E.coli	0 + 5.93×10^8 + 6.59×10^7 = 6.59×10^8 cfu/day
Selenium	0 + 0.0046 + 0.0012 = 0.0058 lbs/day

[a] per public comment, this will be added to the 2010-2012 CWA Integrated §303(d)/§305(b) List.

TOTAL MAXIMUM DAILY LOAD FOR NUTRIENTS AND TEMPERATURE
OAK CREEK (DRY CIMARRON TO HEADWATERS)





New Mexico Standards Segment	Dry Cimarron River Basin 20.6.4.701
Assessment Unit Identifier	Oak Creek (Dry Cimarron to headwaters), NM-2701_10 (NM-DC1-30200)
Assessment Unit Length	11.72 miles
Parameters of Concern	Nutrients, *E.coli*
Designated Uses Affected	Coldwater Aquatic Life
Geographic Location	Cimarron Headwaters USGS Hydrologic Unit Code 11040001
Scope/size of Watershed	23 square miles
Land Type	Southwestern Tablelands Ecoregion (26)
Land Use/Cover	Forest (61%), Grassland (23%), Shrubland (16%)
Probable Sources	Crop production (crop land or dry land), drought-related impacts, flow alteration from water diversions, rangeland grazing, wildlife other than waterfowl, waterfowl[a].
Land Management	Private (99%), State (1%)
IR Category	5
Priority Ranking	High
TMDL for:	**WLA + LA + MOS = TMDL**
E.coli	0 + 2.01×10^9 + 2.23×10^8 = 2.23×10^9 cfu/day
Plant Nutrients *Total Phosphorus*	0 + 0.062 + 0.016 = 0.078 lbs/day
Total Nitrogen	0 + 0.779 + 0.195 = 0.974 lbs/day

[a] per public comment, this will be added to the 2010-2012 CWA Integrated §303(d)/§305(b) List.

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 standards 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 Dry Cimarron watershed that are 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 Dry Cimarron watershed, provides applicable water quality standards for the assessment units addressed in this document, and briefly discusses the water quality survey conducted in the Dry Cimarron in 2006. Section 3.0 presents individual watershed descriptions. Section 4.0 presents the TMDLs developed for *E.coli* in the Dry Cimarron River watershed. Section 5.0 presents the TMDLs for nutrients and Section 6.0 presents the TMDLs for selenium. Section 7.0 includes TMDLs for sulfate and Section 8.0 includes TMDLs for Total Dissolved Solids. Pursuant to Section 106(e)(1) of the Federal CWA, Section 9.0 provides a monitoring plan in which methods, systems, and procedures for data collection and analysis are discussed. Section 10.0 discusses implementation of TMDLs and the relationship between TMDLs and Watershed Restoration Action Strategies (WRAS). Section 11.0 discusses assurance, Section 12.0 public participation in the TMDL process, and Section 13.0 provides references.

2.0 BACKGROUND

The Dry Cimarron watershed was sampled by the Surface Water Quality Bureau (SWQB) from March to October 2006 with additional collections in 2007 and 2008. The Dry Cimarron Basin includes the Dry Cimarron from its headwaters to the Oklahoma border as well as its tributaries. Surface water quality monitoring stations were selected to characterize water quality of the stream reaches. Assessment units that will have a TMDL prepared in this document are discussed in their respective individual watershed sections. The 2006 Dry Cimarron Watershed study also identified other potential water quality impairments in this watershed which are not addressed in this document. Additional data needs for verification of those impairments are being identified and data collection will follow. Subsequent TMDLs will be prepared in the near future in a separate TMDL document.

2.1 Description and Land Ownership

The Dry Cimarron drainage extends from the eastern slopes of Johnson Mesa (elev. ~2500 m/8200 ft) for about 80 miles to the New Mexico/Oklahoma line (elev. ~1300 m/4200 ft) near Kenton, Oklahoma. The Dry Cimarron River watershed (US Geological Survey [USGS] Hydrologic Unit Codes[HUCs] 11040001) is located in Union County in northeastern New Mexico (NM).

The Cimarron Headwaters HUC (11040001) covers approximately 1,696 square miles (mi^2) in northeastern New Mexico (NM) as well as southeastern Colorado and western Oklahoma. Land use for the Cimarron Headwaters HUC includes 73% grassland, 19% forest, 7% shrubland, and less than 1% pasture and row crops (Figure 2.1). As presented in Figure 2.2, land ownership for the Cimarron Headwaters HUC is 99% private, and less than 1% State, National Park Service (NPS), and Bureau of Land Management (BLM) in New Mexico and 88% private, 6% U.S. Forest Service (USFS), and 6% State in Colorado.

Nine water quality sites were sampled during this survey (Figures 2.1 through 2.3). Table 2.1 details location descriptions of sampling stations in each assessment unit (AU), station numbers, and STORET identification codes.

Only one species within this watershed is listed as either threatened or endangered by either state and federal agencies. The state listed threatened species in HUC 11040001 is the Suckermouth Minnow (*Phenacobius mirabilis*). http://nhnm.unm.edu/query_bcd/bcd_watershed_results.php5

2.2 History and Geology

The Dry Cimarron drainage extends from the eastern slopes of Johnson Mesa (elev. ~2500 m/8200 ft) for about 80 miles to the New Mexico/Oklahoma line (elev. ~1300 m/4200 ft) near Kenton, Oklahoma. Much of the drainage is scenic, high relief canyon. Land uses include pasture and irrigated agriculture. The vegetation of Union County can be characterized as short grass prairie and high plains (NMGS 1987). The inability of the uplands to absorb precipitation and the lack of a functional floodplain cause the river to flood destructively on a fairly regular basis. The loss of the floodplain to downcutting has rendered the surrounding grasslands totally dependent on precipitation or irrigation for moisture. The New Mexico Department of Game and Fish stocks rainbow trout at Folsom Falls, near the village of Folsom in the upper watershed (NMED/SWQB, 2000).

In New Mexico, the bedrock of the Dry Cimarron watershed is mainly upper Triassic. (NMGS 1987). Raton Mesa is comprised of soft Cretaceous marine shale and the Cretaceous-Tertiary sandstones and shale of the Raton formation (Chronic 1987). An abundance of fossils have been found in the Morrison and Glencarin Formations in the area. The base of the Glencarin formation is a thin layer of fossiliferous sandstone and above this sandstone is marine shale, sandstone, and siltstone, also fossil-containing layers. There is a regional dip in the strata from Kenton, Oklahoma to Wedding Cake Butte in New Mexico from the Upper Jurassic Morrison Formation to the Upper Triassic Travesser Formation. The white sandstone at the New Mexico border is Entrada Sandstone over dark siltstones of the Sloan Canyon Formation. The Bell Ranch Formation in the Dry Cimarron River watershed is siltstone and fine-grained gypsiferous sandstone (NMGS 1987).

Stone spear points produced by early hunter-gatherers were found near Folsom, NM (Chronic 1987). The Santa Fe Trail roughly paralleled the present US Hwy 64 and old Conestoga wheel ruts can still be seen in places; a tribute to the slow erosion rate in this semi-arid, gravely area of the Great Plains (Chronic 1987). The Cimarron Cutoff branch of the Santa Fe Trail went through southwestern Kansas, the Oklahoma panhandle, and northeastern New Mexico (NMGS 1987). The first Anglo-Americans to enter the valley of the Dry Cimarron in the mid-nineteenth century were beaver trappers. The subsequent removal of the beaver, and the later arrival of large herds of livestock, initiated an episode of channel destabilization that has resulted in many of the hydro-geomorphic impacts seen today. (NMED-SWQB, 2000). The Kenton, Oklahoma area was settled by ranchers in the 1870's and the town itself was established in 1890 by homesteaders and miners seeking nearby copper (NMGS 1987). Copper mining occurred in the Dry Cimarron River valley from 1889 to 1956.

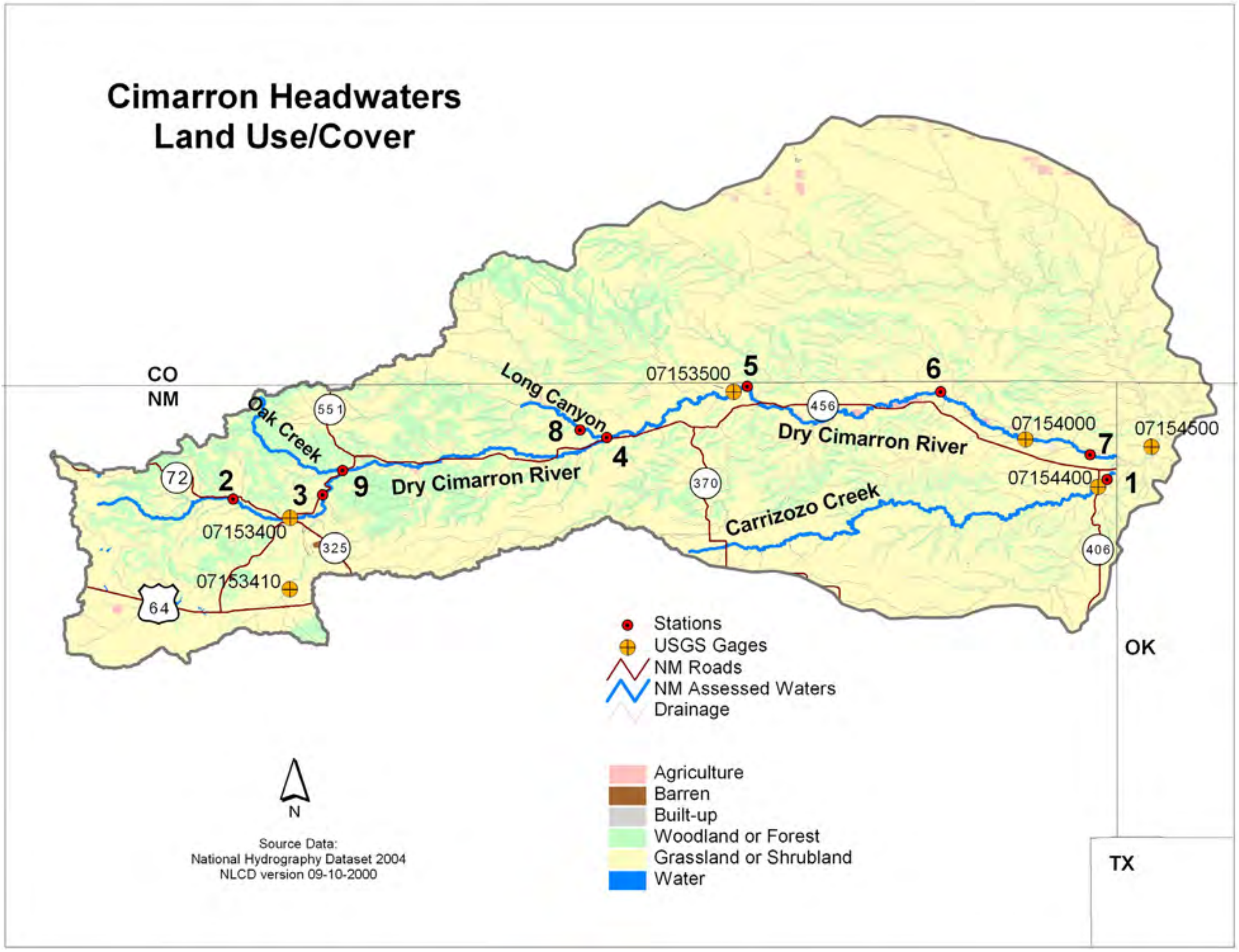


Figure 2.1 Dry Cimarron River Watershed Land Use/Land Cover

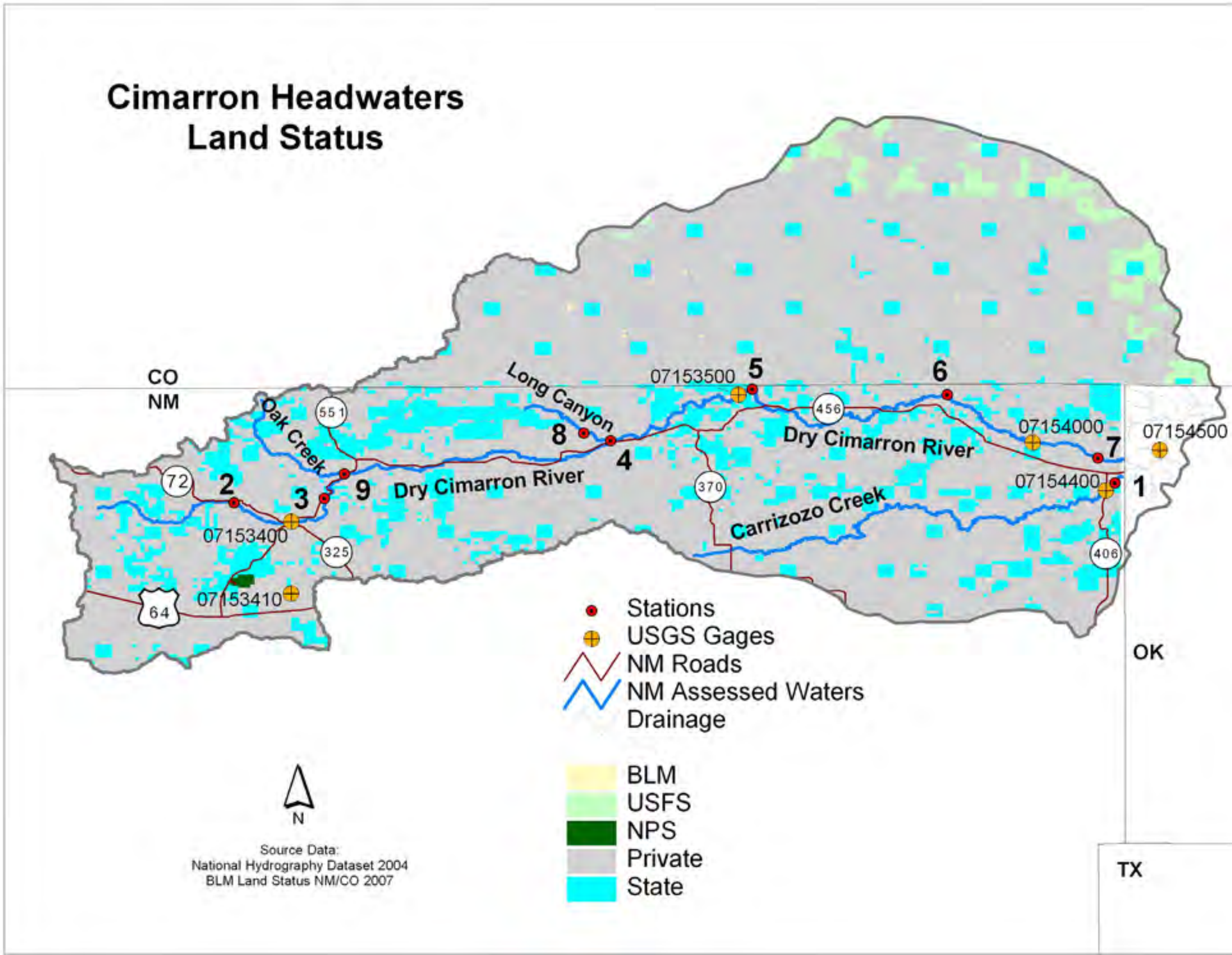


Figure 2.2 Dry Cimarron River Watershed Land Ownership

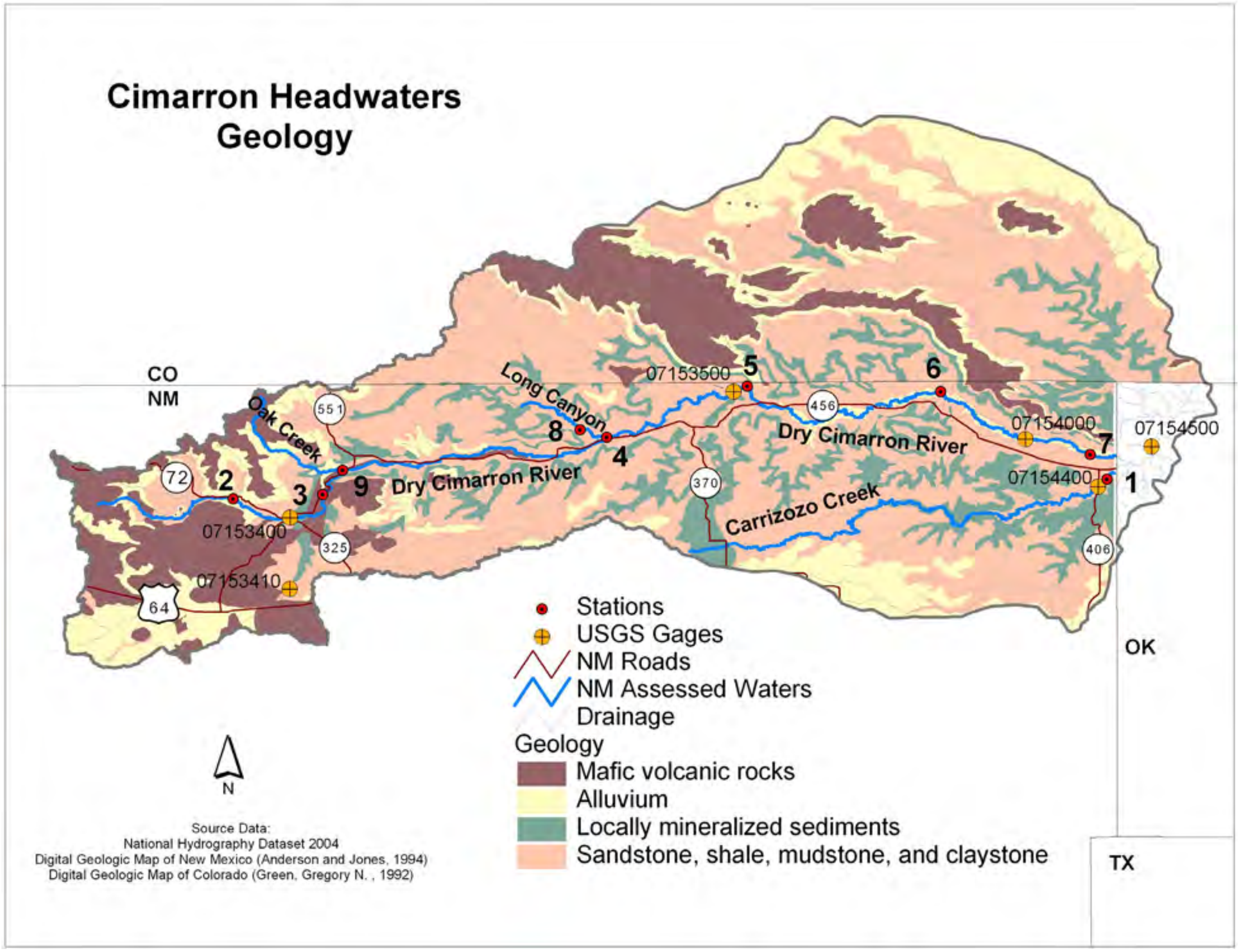


Figure 2.3 Dry Cimarron River Watershed Geology

2.3 Water Quality Standards

The EPA-approved water quality standards (WQS) currently applicable to the Dry Cimarron River are set forth in the following section of *New Mexico Standards for Interstate and Intrastate Surface Waters* (20.6.4 NMAC), effective October 12, 2002:

20.6.4.701 DRY CIMARRON RIVER - Perennial portions of the Dry Cimarron river in Union and Colfax counties and perennial reaches of Oak creek, Long canyon, and Corrumpa and Carrizozo creeks.

A. Designated Uses: coldwater fishery, irrigation, livestock watering, wildlife habitat, and secondary contact.

B. Criteria:

(1) In any single sample: pH shall be within the range of 6.6 to 8.8, temperature shall not exceed 25°C (77°F), TDS shall not exceed 1,200 mg/L, sulfate shall not exceed 600 mg/L, and chloride shall not exceed 40 mg/L. 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).

With the 2005 WQS amendments, Segment 701 was broken into Segments 701 and 702, modifications were made to the uses and criteria, and the fecal coliform criteria were changed to corresponding E. coli criteria. However, EPA did not approve the modifications. Therefore, This TMDL is based on the criteria listed in the 2002 WQS, except that the fecal coliform criteria are replaced with the corresponding E. coli criteria, as follows: the monthly geometric mean of 126 cfu/100 mL or less, single sample 235 cfu/100 mL or less.

2.4 Water Quality Sampling

The Dry Cimarron River watershed was sampled by the SWQB in 2006. A brief summary of the survey and the hydrologic conditions during the sample period is provided in the following subsections. A more detailed description of the Dry Cimarron River survey can be found in the pending *Water Quality Survey Summary for the Dry Cimarron River and Tributaries* (NMED/SWQB 2009). The survey summary for the 2000 survey of the Dry Cimarron River watershed is currently available on the SWQB website. Survey summary reports are also available by contacting SWQB at (505) 827-0187 or by emailing the contacts listed on the SWQB website at http://www.nmenv.state.nm.us/swqb.

2.4.1 Survey Design

Surface water quality samples were collected monthly between March and October during the 2006 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 2.1, 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 were analyzed for a variety of chemical/physical parameters. Data from grab samples and field measurements are housed in the SWQB provisional water quality database and were uploaded to USEPA's Storage and Retrieval (STORET) database.

Table 2.1 SWQB 2006 Dry Cimarron River Sampling Stations

Site Number	Assessment Unit	STORET ID	Station Description
1	Carrizozo Creek (Dry Cimarron River to headwaters)	02Carriz002.7	Carrizozo Creek near NM406 (DCR 12) [a]
2	Dry Cimarron River (Oak Creek to	02DryCim122.7	Dry Cimarron at Rainbow Ranch [t]
3	headwaters)	02DryCim108.2	Dry Cimarron River at Folsom Falls (above Oak Creek)
4	Dry Cimarron River (Perennial reaches Long Canyon to Oak Cr)	02DryCim074.5	Dry Cimarron River above Long Canyon [t]
5	Dry Cimarron River (Perennial reaches OK bnd to Long Canyon)	02DryCim047.2	Dry Cimarron River at Jesus Mesa Road (downstream of old USGS gage) [b, t]
6		02DryCim024.6	Dry Cimarron River at Wedding Cake Butte [c]
7		02DryCim003.2	Dry Cimarron River at Wiggins Road [t]
8	Long Canyon (Perennial reaches abv Dry Cimarron)	02LongCa004.1	Long Canyon about 2 miles above NM 456 [t]
9	Oak Creek (Dry Cimarron to headwaters)	02OakCre000.1	Oak Creek above Dry Cimarron River [t]

[a] Site visited, but no samples collected or field measurements taken, March –May 2006
[b] Field measurements (6/29/06), Radionuclides only (10/31/06), EMAP (11/2/06)
[c] No field measurements or sampling during regular survey. Radionuclides only (10/31/06)
[t] Water thermograph deployed (air thermograph also deployed at 02DryCim003.2)

All sampling and assessment techniques used during the 2006 SWQB survey are detailed in the *Quality Assurance Project Plan* (QAPP) (NMED/SWQB 2006) and assessment protocols (NMED/SWQB 2008a) both of which are available online or may be obtained by contacting the SWQB at 505-827-0187. As a result of the 2006 SWQB monitoring effort, several surface water impairments were verified. Accordingly, these impairments will remain and several new determined impairments were added to the 2008-2010 Integrated CWA §303 (d)/305(b) list (NMED/SWQB 2008b).

2.4.2 Hydrologic Conditions

There are no active, real-time U.S. Geological Survey (USGS) gaging stations in the Dry Cimarron River watershed in New Mexico. The nearest active USGS gage is at 07154500 Cimarron River near Kenton, OK. There are, however, two historic USGS gaging stations on the Dry Cimarron River in New Mexico. USGS gage 07153500 Dry Cimarron near Guy, NM has a period of record from 1942-1973 and USGS gage 07154000 Cimarron River near Folsom, NM has a period of record from 1927-1933. There is also a USGS gaging station at 07153410 Bennett Spring near Capulin, NM with a period of record from 1977-1981. The mean daily streamflow for the nearest, active gage is displayed in Figure 2.4.

The 2006 SWQB survey was performed over varying flow conditions from March to October. As stated in the Assessment Protocol (NMED/SWQB 2008a), data collected during all flow conditions, including low flow conditions (i.e., flows below the 4-day, 3-year low flow frequency [4Q3]), will be used to determine attainment status of designated or existing uses . In terms of assessing designated use attainment in ambient surface waters, WQS apply at all times under all flow conditions, unless the WQS specify a qualifier.

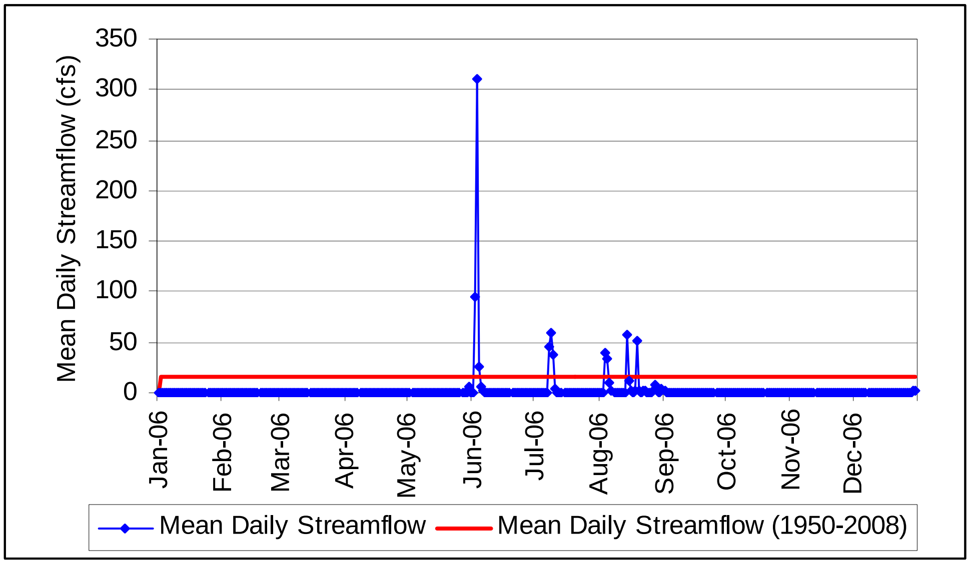


Figure 2.4 Daily Mean Streamflow: USGS 07154500 Cimarron River near Kenton, OK

3.0 INDIVIDUAL WATERSHED DESCRIPTIONS

TMDLs were developed for assessment units for which constituent (or pollutant) concentrations measured during the 2006 water quality survey indicated impairment. Because characteristics of each subwatershed, such as geology, land use, and land ownership provide insight into probable sources of impairment, they are presented in this section for the individual subwatersheds within the Dry Cimarron basin. In addition, the 2008-2010 Integrated CWA §303(d)/§305(b) list for waters within the Dry Cimarron River basin are discussed below (NMED/SWQB 2008b).

3.1 Dry Cimarron River Watershed

The headwaters of the 1696 mi^2 Dry Cimarron River watershed originate on Johnson Mesa. According to available Geographic Information System (GIS) coverages, the Dry Cimarron River watershed has an average elevation of 5,478 feet above sea level and receives approximately 16 inches of precipitation a year. As presented in Figure 2.1, land uses include 73% grassland, 19% forest, 7% shrubland, and less than 1% pasture and row crop. Land ownership is 82% private, 15% State, 3% USFS, and less than one percent NPS and BLM (Figure 2.2). The geology of the Dry Cimarron River watershed is predominantly comprised of mafic volcanic rocks as well as sandstones and shale(Figure 2.3).

Dry Cimarron River (perennial reaches Long Canyon to Oak Creek) is approximately 21 miles in length. SWQB established one station along this assessment unit and deployed one thermograph during the 2006 survey. Dry Cimarron River (perennial reaches Long Canyon to Oak Creek) was included on the 2008-2010 Integrated CWA §303(d)/§305(b) list for *E. coli* and total dissolved solids.

Dry Cimarron River (perennial reaches OK boundary to Long Canyon) is approximately 56 miles in length. SWQB established three stations along this assessment unit and deployed two water thermographs and one air thermograph during the 2006 water quality survey. Dry Cimarron River (perennial reaches OK bnd to Long Canyon) was included on the 2008-2010 Integrated CWA §303(d)/§305(b) list for dissolved oxygen (DO), sulfate, temperature, and total dissolved solids. However, according to the Basis for Change for 20.6.4.702 in the December 2008 Triennial Review Petition Proposed Amendments to the NM Water Quality Standards, "the segment warrants additional consideration, and it may be a good candidate for the new coolwater use." The coolwater designated use has proposed DO and temperature criteria associated with it that differ from those associated with the current coldwater designated use. Also, a full nutrient assessment was not able to be performed in this Assessment Unit. For these reasons, a TMDL for temperature and DO will not be written at this time and a change to IR Category 5B will be suggested for the upcoming 2010-2012 Integrated CWA §303(d)/§305(b) list.

No TMDLs have previously been established for Dry Cimarron River. Therefore, TMDLs were developed for inclusion in this document for the following assessment units in the Dry Cimarron River watershed:

- ***E.coli*, TDS:** Dry Cimarron River (perennial reaches Long Canyon to Oak Creek)
- **Sulfate, TDS:** Dry Cimarron River (perennial reaches OK bnd to Long Canyon)

Photo 3.1 Dry Cimarron River above Long Canyon (March 27, 2006)

Photo 3.2 Dry Cimarron River at Jesus Mesa (February 16, 2006)

3.2 Long Canyon Subwatershed

The Long Canyon subwatershed is 131 mi^2 . According to available GIS coverages, the Long Canyon watershed has an average elevation of 5,244 feet above sea level and receives approximately 16 inches of precipitation a year. As presented in Figure 2.1, land uses include 69% grasslands, 27% forest, and 4% shrubland. Land ownership is over 77% private, 23% State, and less than one percent BLM (Figure 2.2). The geology of the Long Canyon watershed is predominantly comprised of sandstones, shales, and mudstones as well as locally mineralized sediments (Figure 2.3).

Long Canyon (perennial reaches above Dry Cimarron) is approximately 8 miles in length. SWQB established one station along this assessment unit and deployed one thermograph during the 2006 water quality survey and subsequent 2008 thermograph redeployment. Long Canyon (perennial reaches above Dry Cimarron) was included on the 2008-2010 Integrated CWA §303(d)/§305(b) list for *E.coli*, selenium, and temperature.

No TMDLs have previously been established for Long Canyon. Long Canyon was listed for temperature prior to the 1998 CWA §303(d) list. One thermograph deployed in the reach from April 25- August 6, 2008 measured a maximum temperature of 25.5°C and a second thermograph deployed August 6, 2008-March 3, 2009 measured a maximum temperature of 26.28°C. Neither thermograph indicates a temperature impairment per SWQB temperature assessment protocol (NMED/SWQB 2008a). A letter describing the delisting rationale will be submitted to EPA Region 6 and the temperature listing will be removed from the 2010-2012 CWA §303(d)/§305(b) list. Therefore, TMDLs were developed for inclusion in this document for the following assessment unit in the Long Canyon subwatershed:

- ***E.coli, selenium*:** Long Canyon (perennial reaches above Dry Cimarron)

Photo 3.3 Long Canyon about 2 miles above NM 456 (March 27, 2006)

3.3 Oak Creek Subwatershed

The Oak Canyon subwatershed is 23 mi^2 . According to available GIS coverages, Oak Creek watershed has an average elevation of 6,668 feet above sea level and receives approximately 17 inches of precipitation a year. As presented in Figure 2.1, land uses include 61% forest, 23% grassland, and 16% shrubland. Land ownership is over 99% private and less than 1% State (Figure 2.2). The geology of the Oak Creek watershed is predominantly comprised of mafic volcanic rocks, alluvium, sandstones and shales, and locally mineralized sediments (Figure 2.3).

Oak Creek (Dry Cimarron to headwaters)is approximately 12 miles in length. SWQB established one station along this assessment unit and deployed one thermograph during the 2006 water quality survey. Oak Creek (Dry Cimarron to headwaters) was included on the 2008-2010 Integrated CWA §303(d)/§305(b) list for *E.coli* and nutrients.

No TMDLs have previously been established for Oak Creek. Therefore, TMDLs were developed for inclusion in this document for the following assessment unit in the Oak Creek subwatershed:

- ***E.coli, nutrients*:** Oak Creek (Dry Cimarron to headwaters)

Photo 3.4 Oak Creek above Dry Cimarron River (March 27, 2006)

4.0 BACTERIA

During the 2006 SWQB sampling monitoring effort in the Dry Cimarron River watershed, *E. coli* data showed several exceedences of the New Mexico water quality secondary contact use standard for several assessment units. As a result, three assessment units in the Dry Cimarron River watershed were determined to be impaired with *E. coli* as a pollutant of concern (see summary in Table 4.1). Presence of *E. coli* bacteria is an indicator of the possible presence of other bacteria that may limit beneficial uses and present human health concerns. There are probable nonpoint of *E. coli* bacteria throughout the basin that could be contributing to the *E. coli* levels. According to the New Mexico Water Quality Standards (WQS), the *E. coli* standard reads:

20.6.4.701 NMAC: The monthly geometric mean of E. coli bacteria 126 cfu/100 mL or less; single sample 235 cfu/100 mL or less.

20.6.4.702 NMAC: The monthly geometric mean of E. coli bacteria 126/100mL or less; single sample 235cfu/100 mL or less.

As noted in Section 2.3, the WQS effective October 2002 contain fecal coliform criteria. New Mexico has transitioned away from fecal coliform to *E.coli* criteria at the recommendation of USEPA. The proposed segments 701 and 702 contain *E.coli* criteria as noted above and presented in Table 4.1. When water quality standards have been achieved, the reach will be moved to the appropriate category on the Clean Water Act Integrated §303(d)/§305(b) List of assessed waters.

Table 4.1 Summary of Bacteria Data in the Dry Cimarron River Watershed

Assessment Unit	NM WQS segment	*E.coli* # exceedences/ total samples	*E. coli* [(a)] % exceedences
Carrizozo Creek (Dry Cimarron River to headwaters)	20.6.4.701 [(c)]	0/0	0% [(b)]
Dry Cimarron River (Oak Creek to headwaters)	20.6.4.701	0/12	0% [(b)]
Dry Cimarron River (perennial reaches Long Canyon to Oak Creek)	20.6.4.701 [(c)]	2/6	33%
Dry Cimarron River (perennial reaches OK bnd to Long Canyon)	20.6.4.701 [(c)]	0/6	0% [(b)]
Long Canyon (perennial reaches above Dry Cimarron)	20.6.4.701 [(c)]	4/6	67%
Oak Creek (Dry Cimarron to headwaters)	20.6.4.701	3/6	50%

[(a)] Exceedence rates ≥ 15% result in a determination of Non Support based on the assessment protocol (NMED/SWQB 2008a)
[(b)] There are no TMDL calculations for *E. coli* in this document because the exceedence rate was <15%. Thus, the determination would be Full Support.
[(c)] Assessment units that are proposed to be in WQS segment 20.6.4.702

4.1 Target Loading Capacity

Overall, the target values for bacteria 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 bacteria are based on the reduction in bacteria necessary to achieve numeric criteria. This TMDL is also consistent with New Mexico's antidegradation policy.

The segment-specific criteria leading to an assessment of use impairment for the Dry Cimarron River (perennial reaches Long Canyon to Oak Creek), Long Canyon, and Oak Creek assessment units are the proposed numeric *E. coli* criteria stating "The monthly geometric mean of *E. coli* bacteria 126cfu /100 mL or less; single sample 235cfu /100 mL or less" for the designated contact use.

Table 4.2 *E.coli* and flow data for Dry Cimarron (perennial reaches Long Canyon to Oak Creek)

Sample Date	*E.coli* (cfu/100 mL)	Flow (cfs)
Dry Cimarron above Long Canyon (02DryCim074.5)		
4/24/06	1986.3*	0.5
6/14/06	64.3	0.5
7/6/06	2419.6*	3
7/24/06	19.7	3
8/29/06	161.6	0.8
10/31/06	7.5	2

*denotes exceedence of *E.coli* criterion

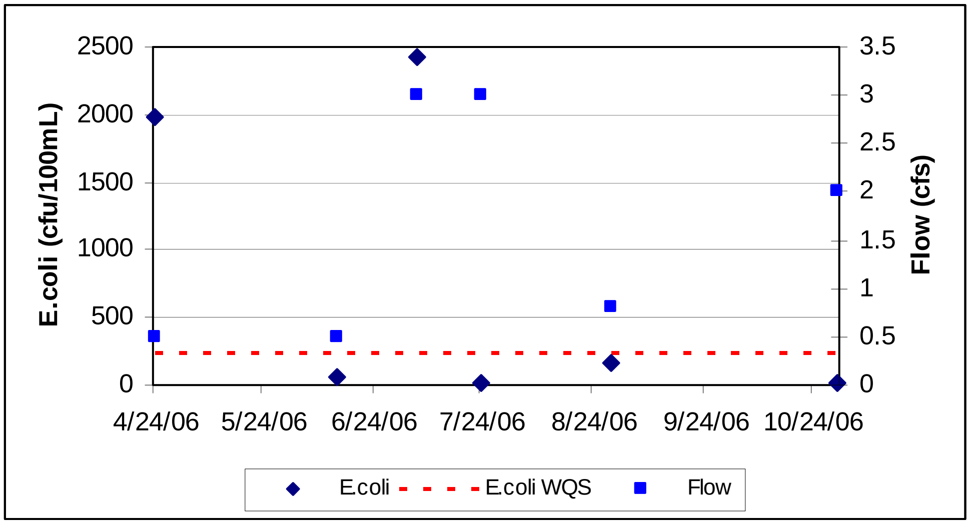


Figure 4.1 *E. coli* criterion exceedences at (02DryCim074.5)

Table 4.3 *E.coli* and flow data for Long Canyon (perennial reaches above Dry Cimarron)

Sample Date	*E.coli* (cfu/100mL)	Flow (cfs)
Long Canyon above DCR (02LongCa004.1)		
4/24/06	43.2	0.2
6/14/06	325.5*	0.25
7/6/06	2419.6*	1.25
7/24/06	435.2*	0.3
8/29/06	770.1*	0.3
10/31/06	29.5	<1.0

*denotes exceedence of *E.coli* criterion

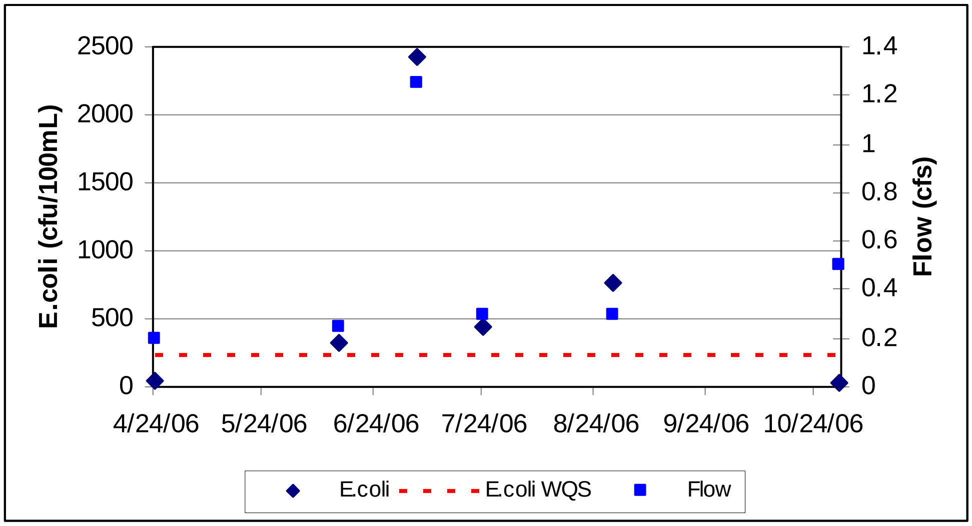


Figure 4.2 E.coli criterion exceedences at 02LongCa004.1

Table 4.4 *E.coli* and flow data for Oak Creek (Dry Cimarron to headwaters)

Sample Date	*E.coli* (cfu/100mL)	Flow (cfs)
Oak Creek above DCR (02OakCre000.1)		
4/24/06	1119.9*	0.2
6/14/06	980.4*	0.25
7/6/06	488.4*	0.2
7/24/06	43.1	0.2
8/29/06	201.4	0.3
10/31/06	9.8	<1.0

*denotes exceedence of *E.coli* criterion

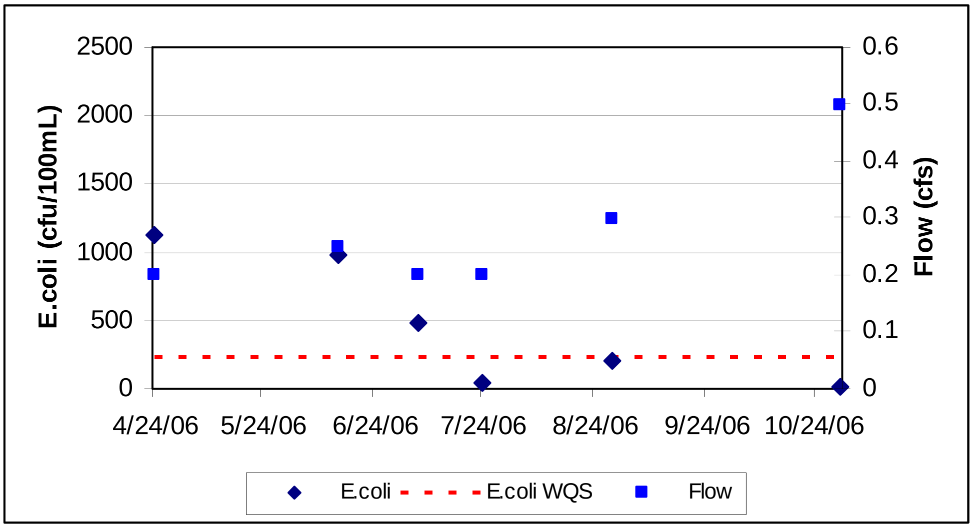


Figure 4.3 E.coli criterion exceedences at 02OakCre000.1

4.2 Flow

TMDLs are calculated at a specific flow. Bacteria numbers can vary as a function of flow. Typically, flow duration curves are developed for *E. coli* TMDLs, however, the lack of nearby USGS gages (Section 2.4.2) makes this unreasonable for this watershed. Exceedences of the criterion occurred at both high and low flows in the impaired assessment units in the Dry Cimarron River basin (Tables 4.2 – 4.4 and Figures 4.1 – 4.3). Therefore, the target flow values used to calculate the TMDLs for these stream reaches were obtained using a 4-day, 3-year low-flow frequency (4Q3) regression model. The 4Q3 is the annual lowest 4 consecutive day flow that occurs with a frequency of at least once every 3 years. When available, USGS gages are used to estimate flow. There are no active USGS gages on Long Canyon or Oak Creek and the nearest USGS gage on the Dry Cimarron is 59 miles downstream of the confluence with Long Canyon (see Section 2.4.2), therefore, gage data was not available for these TMDL calculations and 4Q3 flows were estimated.

It is often necessary to estimate a critical flow for a portion of a watershed where there is no active USGS flow gage. 4Q3 derivations for ungaged streams in the Dry Cimmaron watershed were based on analysis methods described by Waltemeyer (2002). In Waltemeyer's analysis, two regression equations for estimating 4Q3 were developed based on physiographic regions of NM (i.e., statewide and mountainous regions above 7,500 feet in elevation). None of the impaired AUs in this survey are above 7,500 feet in elevation, so the following statewide regression equation was used to calculate 4Q3 flows (Waltemeyer 2002):

$$4Q3 \quad = \quad 1.2856 \times 10^{-4} \; DA^{0.42} \; P_w^{\;3.16}$$

where,

4Q3 = Four-day, three-year low-flow frequency (cfs)
DA = Drainage area (mi^2)

P_w = Average basin mean winter precipitation (inches)

This regression equation is based on data from 50 gaging stations with non-zero discharge. The average standard error of estimate (SEE) and coefficient of determination are 126 and 48 percent, respectively (Waltemeyer 2002). The drainage areas and average basin mean winter precipitation for assessment units where this regression method was used are presented in the following table:

Table 4.5 Parameters for Estimating Flow using USGS Regression Model

Assessment Unit	**Regression Model**[(a)]	**Average Elevation for Assessment Unit (feet)** [(b)]	**Drainage Area (mi^2)**	**Mean Basin Winter Precipitation (inches)**	**Estimated 4Q3 (cfs)**	**Estimated 4Q3 (mgd)**
Dry Cimarron (Long Canyon to Oak Creek)	Statewide	5,572	369.31	5.09	0.263	0.170
Long Canyon	Statewide	5,245	131.11	5.47	0.214	0.138
Oak Creek	Statewide	6,668	22.73	10.15	0.723	0.467

Notes:
mi^2 = Square miles
[(a)] Waltemeyer (2002)
[(b)] Average elevation = average of elevations at bottom and top of AU

As shown in Figures 4.1-4.3 and Tables 4.1-4.3, flow measurements were taken alongside water quality samples in 2006. However, given that the flow meters used by SWQB are inaccurate below depths of 0.5 ft and velocities below 0.5 ft/s (NMED/SWQB 2007), visual flow estimations were often made during the 2006 survey. These flow estimations and measurements taken in the field are valuable when it comes to discussing during which flow regime the WQS exceedences occurred, but they will not be used in calculations of critical flow.

The critical flows in Table 4.5 were converted from cfs to units of million gallons per day (mgd) as follows:

$$4Q3\frac{ft^3}{\sec}\times 1{,}728\frac{in^3}{ft^3}\times 0.004329\frac{gal}{in^3}\times 86{,}400\,\frac{\sec}{day}\times 10^{-6} = 4Q3\,mgd$$

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. Meeting the calculated TMDL may be a difficult objective.

4.3 Calculations

Bacteria standards are expressed as colony forming units (cfu) per unit volume. The proposed *E. coli* criteria used to calculate the allowable stream loads for the impaired assessment units are listed in Table 4.6. Target loads for bacteria are calculated based on flow values, current and proposed WQS, and conversion factors (**Equation 1**). The more conservative monthly geometric mean criteria are utilized in TMDL calculations to provide an implicit MOS. In addition, if the single sample criteria were used as targets, the geometric mean criteria may not be achieved.

*C as cfu/100 mL * 1,000 mL/1 L * 1 L/ 0.264 gallons * Q in 1,000,000 gallons/day = cfu/day* (**Eq. 1**)

Where C = NM state water quality standard criterion for bacteria,
Q = stream flow in million gallons per day (mgd)

Table 4.6 Calculation of target loads for *E.coli*

Assessment Unit	Flow (mgd)	*E.coli* geometric mean criteria (cfu/100mL)	Conversion Factor [(a)]	Target Load Capacity (cfu/day)
Dry Cimarron (perennial reaches Long Canyon to Oak Creek)	0.170	126	3.79×10^{7}	8.11×10^{8}
Long Canyon (perennial reaches abv Dry Cimarron)	0.138	126	3.79×10^{7}	6.59×10^{8}
Oak Creek (Dry Cimarron to headwaters)	0.467	126	3.79×10^{7}	2.23×10^{9}

Notes: *values rounded to three significant figures
(a) Based on equation 1.

The measured loads for *E.coli* were similarly calculated. The arithmetic mean of the data used to determine the impairment was substituted for the criterion in Equation 1. The same conversion factor was used. Results are presented in Table 4.7.

Table 4.7 Calculation of measured loads for *E.coli*

Assessment Unit	Flow (mgd)	*E.coli* Arithmetic Mean (cfu/100mL)	Conversion Factor [(a)]	Measured Load (cfu/day)
Dry Cimarron (perennial reaches Long Canyon to Oak Creek)	0.170	2202.95	3.79×10^{7}	1.42×10^{10}
Long Canyon (perennial reaches abv Dry Cimarron)	0.138	987.6	3.79×10^{7}	5.16×10^{9}
Oak Creek (Dry Cimarron to headwaters)	0.467	862.9	3.79×10^{7}	1.53×10^{10}

Notes: *values rounded to three significant figures
(a) Based on equation 1.
(b) The measured concentration is the arithmetic mean of the measured values used to make the impairment determination.

4.4 Waste Load Allocations and Load Allocations

4.4.1 Waste Load Allocation

There are no National Pollutant Discharge Elimination System (NPDES) or Municipal Separate Storm Sewer System (MS4) storm water permits in these AUs. Sediment may be a component of some industrial and construction storm water discharges covered under General NPDES Permits, so the load from 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 sediment (TSS), turbidity, sedimentation, bacteria, etc.) and water 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 (WLA) 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 load allocation (LA), the WLA and margin of safety (MOS) were subtracted from the target capacity TMDL following **Equation 1**:

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

The MOS is estimated to be 10 percent of the target load calculated in Table 4.6. Results are presented in Table 4.8. Additional details on the MOS chosen are presented in Section 4.7.

Table 4.8 TMDL for *E.coli*

Location	WLA (cfu/day)	LA (cfu/day)	MOS (10%) (cfu/day)	TMDL (cfu/day)
Dry Cimarron (perennial reaches Long Canyon to Oak Creek)	0	7.30×10^{8}	8.11×10^{7}	8.11×10^{8}
Long Canyon (perennial reaches abv Dry Cimarron)	0	5.93×10^{8}	6.59×10^{7}	6.59×10^{8}
Oak Creek (Dry Cimarron to headwaters)	0	2.01×10^{9}	2.23×10^{8}	2.23×10^{9}

Notes: *values rounded to three significant figures

The extensive data collection and analyses necessary to determine background *E.coli* loads for the Dry Cimarron River watershed were beyond the resources available for this study. It is therefore assumed that a portion of the LA is made up of natural background loads.

The load reductions necessary to meet the target loads were calculated to be the difference between the calculated TMDL (Table 4.6) and the measured loads (Table 4.7), and are shown in Table 4.9. These load reduction tables are presented for informational purposes only. However, it is important to note that WLAs and LAs are estimates based on a specific flow condition (i.e., 4Q3 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, proposed *E. coli* water quality standards.

Table 4.9 Calculation of load reduction for *E.coli*

Assessment Unit	TMDL (cfu/day) *(a)*	Measured Load (cfu/day)	Load Reduction (cfu/day)	Percent Reduction*(b)*
Dry Cimarron (perennial reaches Long Canyon to Oak Creek)	7.30×10^{8}	1.42×10^{10}	1.35×10^{10}	95
Long Canyon (perennial reaches abv Dry Cimarron)	5.93×10^{8}	5.16×10^{9}	4.57×10^{9}	89
Oak Creek (Dry Cimarron to headwaters)	2.01×10^{9}	1.53×10^{10}	1.33×10^{10}	87

Note: 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 = TMDL - MOS
(b) Percent reduction is the percent the existing measured load must be reduced to achieve the TMDL, and is calculated as follows: (Measured Load – TMDL) / 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 4.10:

Table 4.10 Pollutant source summary for *E.coli*

Pollutant Sources	Magnitude[(a)]	Location	Probable Sources[(b)]
Point:			
E.coli	none	Dry Cimarron (perennial reaches Long Canyon to Oak Creek)	0%
	none	Long Canyon (perennial reaches abv Dry Cimarron)	0%
	none	Oak Creek (Dry Cimarron to headwaters)	0%
Nonpoint:			
E.coli	1.42×10^{10} cfu/day	Dry Cimarron (perennial reaches Long Canyon to Oak Creek)	100% Drought-related impacts, flow alterations from water diversions, irrigated crop production, natural sources, on-site treatment systems (septic systems and similar decentralized systems), rangeland grazing, wildlife other than waterfowl, wildlife, waterfowl. [(c)]
	5.16×10^{9} cfu/day	Long Canyon (perennial reaches abv Dry Cimarron)	100% Drought-related impacts, highway/road/bridge runoff (non-construction related), natural sources, rangeland grazing, streambank modifications/destabilization, wildlife other than waterfowl. [(c)]
	1.53×10^{10} cfu/day	Oak Creek (Dry Cimarron to headwaters)	100% Crop production (crop land or dry land), drought-related impacts, flow alterations from water diversions, rangeland grazing, wildlife other than waterfowl. [(c)]

Notes:
(a) Measured Load.
(b) From the 2008-2010 Integrated CWA 303(d)/305(b) list (NMED/SWQB 2008). 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) per public comment, "waterfowl" will be added to the 2010-2012 CWA Integrated §303(d)/§305(b) List.

Probable sources of *E.coli* for this assessment unit will be evaluated, refined, and changed as necessary through the Watershed Restoration Action Strategy (WRAS) process.

4.6 Linkage of Water Quality and Pollutant Sources

SWQB fieldwork includes an assessment of the probable sources of impairment (NMED/SWQB 2007). The sample Probable Sources field sheet in Appendix B 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 probable sources of impairment in this watershed. Table 4.10 displays probable sources of nonpoint source impairments along the reach as determined by field reconnaissance and assessment. Appendix C provides relevant excerpts from the 2008-2010 Integrated CWA 303(d)/305(b) List which includes the probable sources associated with each Assessment Unit in the Dry Cimarron River watershed.

Among the potential sources of bacteria are poorly maintained or improperly installed (or missing) septic tanks, livestock grazing of valley pastures and riparian areas, upland livestock grazing, and wildlife. Howell et. al. (1996) found that bacteria concentrations in underlying sediment increase when cattle (*Bos taurus*) have direct access to streams, such as the waters in the Dry Cimarron River watershed. Natural sources of bacteria are also present in the form of other wildlife such as elk, deer, and any other warm-blooded mammals. In addition to direct input from grazing operations and wildlife, *E. coli* concentrations may be subject to elevated levels as a result of resuspension of bacteria laden sediment during storm events. Temperature can also play a role in bacteria concentrations. Howell et. al. (1996) observed that bacteria growth increases as water temperature increases, which has the potential to occur in this watershed as well.

The bacteria loading from Dry Cimarron River, Long Canyon, and Oak Creek probably originate from a combination of drought-related impacts, septic systems and similar decentralized systems, and livestock and wildlife wastes that are transported downstream during runoff events. The list of Probable Sources (Appendix B) also identifies streambank modifications and road maintenance and runoff as potential sources of bacteria.

In order to determine exact sources and relative contributions, further study is needed. One method of characterizing sources of bacteria is a Bacterial, or Microbial, Source Tracking (BST) study. The extensive data collection and analyses necessary to determine bacterial sources were beyond the resources available for this study. However, sufficient data exist to support development of an *E.coli* TMDL to address the stream standards violations.

Photo 4.1 Livestock at Dry Cimarron River above Long Canyon sampling site (March 27, 2006)

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 these bacteria TMDLs, the MOS was developed using a combination of conservative assumptions and explicit recognition of potential errors in flow calculations. Therefore, this MOS is the sum of the following two elements:

- *Conservative Assumptions*
  Treating *E.coli* as a conservative pollutant, that is a pollutant that does not readily degrade in the environment, was used as a conservative assumption in developing these loading limits.

  A more conservative limit of the geometric mean value, rather than the current and proposed standards which allow for higher concentrations in individual grab samples, was used to calculate loading values.

- *Errors in calculating flow*
  4Q3s low flow values were determined based on calculations using Waltemeyer (2002). There is inherent error in all flow measurements. A conservative MOS for this element is therefore **10 percent**.

4.8 Consideration of Seasonal Variation

Federal regulations (40 CFR §130.7(c)(1)) require that TMDLs take into consideration seasonal variation in watershed conditions and pollutant loading. During the 2006 water quality survey, bacteria exceedences occurred during both high and low flow events. Based on this data, there is no single critical condition for bacteria. Higher flows may flush more nonpoint source runoff containing bacteria. It is possible the criterion may be exceeded under a low flow condition when there is insufficient dilution. Evaluation of seasonal variability for potential nonpoint sources is difficult due to limited available data. Data used in the calculation of this TMDL were collected during the spring, summer, and fall of 2006 in order to ensure coverage of any potential seasonal variation in the system.

4.9 Future Growth

Growth estimates by county are available from the New Mexico Bureau of Business and Economic Research. These estimates project growth to the year 2030. The population of Union County in 2005 was 4,213 and is projected to be 3,947 in 2030. According to the calculations, the overwhelming source of bacteria loading is from nonpoint sources. Estimates of future growth are not anticipated to lead to a significant increase in bacteria concentrations that cannot be controlled with BMP implementation in this watershed. However, it is imperative that BMPs continue to be utilized and improved upon in this watershed while continuing to improve road conditions and grazing allotments and adhering to SWPPP requirements related to construction and industrial activities covered under the general permit.

5.0 PLANT NUTRIENTS

The potential for excessive nutrients in Oak Creek and Dry Cimarron River (perennial reaches OK bnd to Long Canyon) were noted through site visits during the 2006 SWQB watershed survey. Assessment of various water quality parameters indicated nutrient impairment in these two Assessment Units. However, a nutrient TMDL will not be developed for the Dry Cimarron River AU as discussed in Section 3.1.

5.1 Target Loading Capacity

The target values for nutrient loads are determined based on 1) the presence of numeric and narrative 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 the target value for plant nutrients is based on both narrative and numeric translators. This TMDL is consistent with the New Mexico State antidegradation policy.

The New Mexico WQCC has adopted a narrative water quality criterion for plant nutrients to sustain and protect existing or attainable uses of the surface waters of the state. This general criterion applies to surface waters of the state at all times unless a specific criterion is provided elsewhere. The general water quality criteria require that a stream have water quality, streambed characteristics, and other attributes of habitat sufficient to protect and maintain coldwater aquatic life. The narrative plant nutrient criterion leading to an assessment of use impairment is as follows (Subsection E of 20.6.4.13 NMAC):

> ***Plant Nutrients:*** *Plant nutrients from other than natural causes shall not be present in concentrations which will produce undesirable aquatic life or result in the dominance of nuisance species in surface waters of the state.*

There are two potential constituents of nutrient enrichment in a given stream: excessive nitrogen and/or phosphorus. The reason for controlling plant growth is to preserve aesthetic and ecologic characteristics along the waterway. The intent of numeric criteria for phosphorus and nitrogen is to control the excessive growth of attached algae and higher aquatic plants that can result from the introduction of these plant nutrients into streams. Numeric criteria also are necessary to establish targets for total maximum daily loads (TMDLs), to develop water quality-based permit limits and source control plans, and to support designated uses within the watershed.

Nutrient criteria development in the State of New Mexico has taken place in three steps, thus far. First, the EPA compiled nutrient data from the national nutrient dataset, divided it by waterbody type, grouped it into nutrient ecoregions, and calculated the 25th percentiles for each aggregate and Level III ecoregion. EPA published these recommended water quality criteria to help states and tribes reduce problems associated with excess nutrients in waterbodies in specific areas of the country (USEPA 2000). Next a U.S. Geological Survey (USGS) employee, Evan Hornig, who assisted EPA Region 6 with nutrient criteria development, refined the recommended ecoregional nutrient criteria. Hornig used regional nutrient data from EPA's Storage and

Retrieval System (STORET), the USGS, and the SWQB to create a regional dataset for New Mexico. Threshold values were calculated based on EPA procedures and the median for each Level III ecoregion.

The third round of analysis was conducted by SWQB to produce nutrient threshold values for streams based on ecoregion and designated aquatic life use. For this analysis, total phosphorus (TP), total Kjeldahl nitrogen (TKN), and nitrate plus nitrite (N+N) data from the National Nutrient Dataset (1990-1997) was combined with Archival STORET data from 1998, and 1999-2006 data from the SWQB in-house database. The data were then divided by waterbody type, removing all rivers, reservoirs, lakes, wastewater treatment effluent, and playas. For all of the stream data, Level III and IV Omernik ecoregions (Omernik 2006) as well as the designated aquatic life use were assigned to all stream data using GIS coverages and the station's latitude and longitude. Medians were calculated for each ecoregion/aquatic life use group using Excel. For comparison purposes, values below the detection limit were estimated in two ways; using the substitution method (one half the detection limit) in Excel and using the nonparametric Kaplan-Meier method in Minitab. Interestingly, the results from the different analysis produced very similar results. However, the threshold values that will be incorporated into the SWQB Stream Nutrient Assessment Protocol were calculated using the Kaplan-Meier method and are shown in Table 5.1.

Table 5.1 SWQB's Recommended Nutrient Targets for streams (in mg/L)

	ECOREGION									
Parameter	21-Southern Rockies		23-AZ/NM Mountains		22-AZ/NM Plateau		24-Chihuahuan Desert	26-SW Tablelands		
TP	0.02		0.02		0.05		0.04	0.03		
TN	0.25		0.25		0.35		0.53	0.38		
ALU	CW	T/WW (volcanic)	CW	T/WW	CW	T/WW	T/WW	CW	T	WW
TP	0.02	0.02 (0.05)	0.02	0.05	0.04	0.09	0.04	0.02	0.03	0.03
TN	0.25	0.25	0.25	0.29	0.28	0.48	0.53	0.25	0.38	0.45

NOTES:
- TP = Total Phosphorus
- TN = Total Nitrogen
- ALU = Designated Aquatic Life Use
- CW = Coldwater (those water quality segments having only coldwater uses)
- T = Transitional (those water quality segments with marginal coldwater or both cold and warmwater uses)
- WW = Warmwater (those water quality segments having only warmwater uses)

Oak Creek (Dry Cimarron to headwaters) is located in Ecoregion 26 (Southwest Tablelands). In addition, this assessment unit is covered by the water quality standards in 20.6.4.701 NMAC, which has a coldwater aquatic life use designation. According to Table 5.1, Oak Creek (Dry Cimarron to headwaters) should have numeric nutrient targets of 0.02 mg/L for total phosphorus and 0.25 mg/L for total nitrogen.

Total Nitrogen is defined as the sum of Nitrate+Nitrite (N+N), and Total Kjeldahl Nitrogen (TKN). At the present time, there is no USEPA-approved method to test for Total Nitrogen, however a combination of USEPA method 351.2 (TKN) and USEPA method 353.2 (Nitrate + Nitrite) may be appropriate for monitoring Total Nitrogen.

Table 5.2 SWQB nutrient data

Sample Date	Total Phosphorus (mg/L)	Total Nitrogen (mg/L) [a]			Flow[(b)] (cfs)
		Nitrate + nitrite (mg/L)	TKN (mg/L)	TN	
3/27/2006	0.056*	0.1 [+]	0.26	0.31*	n/a
4/24/2006	0.058*	0.1 [+]	0.39	0.44*	0.2
5/22/2006	0.071*	0.1 [+]	0.33	0.38*	n/a
7/24/2006	0.034*	0.1 [+]	0.54	0.59*	0.2
8/29/2006	0.036*	0.1 [+]	0.35	0.4*	0.3
9/26/2006	0.016	0.1 [+]	0.17	0.22	< 1
10/24/2006	0.07*	0.1 [+]	0.63	0.68*	< 1

[a] Total Nitrogen = nitrate + nitrite + TKN
[b] visual flow estimations, too shallow to measure in most cases.
*denotes exceedence of nutrient targets of 0.02 mg/L TP and 0.25 mg/L TN.
[+] less than detection limit

5.2 Flow

The presence of plant nutrients in a stream can vary as a function of flow (Table 5.2). As flow decreases, the stream cannot effectively dilute its constituents, which causes the concentration of plant nutrients to increase. Thus, a TMDL is calculated for each assessment unit at a specific flow.

The *critical condition* can be thought of as the "worst case" scenario of environmental conditions in the waterbody in which the loading expressed in the TMDL for the pollutant of concern will continue to meet water quality standards. Critical conditions are the combination of environmental factors (e.g., flow, temperature, etc.) that results in attaining and maintaining the water quality criterion and has an acceptably low frequency of occurrence.

The critical flow condition for these TMDLs was obtained using a 4Q3 regression model. The 4Q3 is the minimum average four consecutive day flow that occurs with a frequency of at least once every 3 years. Low flow was chosen as the critical flow because of the negative effect decreasing, or low, flows have on nutrient concentrations and algal growth.

It is often necessary to calculate a critical flow for a portion of a watershed where there is no active USGS flow gage. The 4Q3 derivation for Oak Creek was based on analysis methods described by Waltemeyer (2002). In Waltemeyer's analysis, two regression equations for estimating 4Q3 were developed based on physiographic regions of New Mexico (i.e., statewide and mountainous regions above 7,500 feet in elevation). Oak Creek is not above 7,500 feet in elevation, so the the following statewide regression equation was used to calculate the 4Q3 flow (Waltemeyer 2002):

$$4Q3 \quad = \quad 1.2856 \times 10^{-4} \ DA^{0.42} \ P_w{}^{3.16}$$

where,

4Q3 = Four-day, three-year low-flow frequency (cfs)
DA = Drainage area (mi^2)
P_w = Average basin mean winter precipitation (inches)

This regression equation is based on data from 50 gaging stations with non-zero discharge. The average standard error of estimate (SEE) and coefficient of determination are 126 and 48 percent, respectively (Waltemeyer 2002). The drainage area and average basin mean winter precipitation for Oak Creek are presented in the following table:

Table 5.3 Calculation of 4Q3 Low-Flow Frequencies

Assessment Unit	Regression Model[(a)]	Average Elevation for Assessment Unit (feet) [(b)]	Drainage Area (mi^2)	Mean Basin Winter Precipitation (inches)	Estimated 4Q3 (cfs)	Estimated 4Q3 (mgd)
Oak Creek	Statewide	6,668	22.73	10.15	0.723	0.467

Notes:
mi^2 = Square miles
[(a)] Waltemeyer (2002)
[(b)] Average elevation = average of elevations at bottom and top of AU

The 4Q3 value in Table 5.3 was converted from cubic feet per second (cfs) to units of million gallons per day (MGD) as follows:

$$0.723 \ \frac{ft^3}{\sec} \times 1{,}728 \frac{in^3}{ft^3} \times 0.004329 \frac{gal}{in^3} \times 86{,}400 \ \frac{\sec}{day} \times 10^{-6} = 0.467 \ MGD \qquad \text{(Eq. 3)}$$

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 these systems the target load will vary based on the changing flow. Management of the load to improve stream water quality and meet water quality criteria should be a goal to be attained.

5.3 Calculations

This section describes the relationship between the numeric target and the allowable pollutant-level by determining the waterbody's total assimilative capacity, or loading capacity, for the pollutant. The loading capacity is the maximum amount of pollutant loading that a waterbody can receive while meeting its water quality objectives.

As a river flows downstream it has a specific carrying capacity for nutrients. This carrying capacity, or TMDL, is defined as the mass of pollutant that can be carried under critical low-flow conditions without violating the target concentration for that constituent. This TMDL was developed based on simple dilution calculations using 4Q3 flow, the numeric target, and a conversion factor. The specific carrying capacity of a receiving water for a given pollutant, may be estimated using **Equation 4**.

4Q3 (in MGD) x Numeric Target (in mg/L) x 8.34 = TMDL (pounds per day [lbs/day]) **(Eq. 4)**

The annual target loads for TP and TN are summarized in Table 5.4.

Table 5.4 Estimates of Annual Target Loads for TP & TN

Assessment Unit	Parameter	4Q3 Flow (MGD)	Numeric Target (mg/L)	Conversion Factor	Target Load (lbs/day)
Oak Creek (Dry Cimarron to headwaters)	Total Phosphorus	0.467	0.02	8.34	0.078
	Total Nitrogen	0.467	0.25	8.34	0.974

The measured loads for TP and TN were similarly calculated. In order to achieve comparability between the target and measured loads, the same flow value was used for both calculations. The arithmetic mean of the collected data that exceeded the numeric targets (Table 5.2) was substituted for the numeric target in **Equation 4**. The same conversion factor of 8.34 was used. The results are presented in Table 5.5.

Table 5.5 Estimates of Annual Measured Loads for TP and TN

Assessment Unit	Parameter	Flow (MGD)	Arithmetic Mean Conc. * (mg/L)	Conversion Factor	Measured Load (lbs/day)
Oak Creek (Dry Cimarron to headwaters)	Total Phosphorus	0.467	0.054	8.34	0.210
	Total Nitrogen	0.467	0.467	8.34	1.82

Notes:
* Arithmetic mean of TP and TN exceedences (See Table 5.2 for data).

5.4 Waste Load Allocations and Load Allocations

5.4.1 Waste Load Allocation

There are no individually permitted NPDES or MS4 storm water permits in this assessment unit.

Excess nutrient levels may be a component of some (primarily construction) storm water discharges 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) 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 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, turbidity, siltation, stream bottom deposits, etc.) and flow velocity during and after construction compared to preconstruction 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. Therefore, this TMDL does not include a specific WLA for storm water discharges for these assessment units.

5.4.2 Load Allocation

In order to calculate the LAs for phosphorus and nitrogen, the WLAs and MOSs were subtracted from the target capacity (TMDL) using the following equation:

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

The MOS was developed using a combination of conservative assumptions and explicit recognition of potential errors in flow calculations. Results using an explicit MOS of 20% (see Section 5.7 for details) are presented in Table 5.6.

Table 5.6 Calculation of Annual TMDL for TP and TN

Assessment Unit	Parameter	WLA (lbs/day)	LA (lbs/day)	MOS (20%) (lbs/day)	TMDL (lbs/day)
Oak Creek (Dry Cimarron to headwaters)	TP	0	0.062	0.016	0.078
	TN	0	0.779	0.195	0.974

The load reductions that would be necessary to meet the target loads were calculated to be the difference between the calculated target load allocation (Table 5.4) and the measured load (Table 5.5), and are shown in Table 5.7.

Table 5.7 Calculation of Load Reduction for TP and TN

Assessment Unit	Parameter	Target Load[(a)] (lbs/day)	Measured Load (lbs/day)	Load Reduction (lbs/day)	Percent Reduction [(b)]
Oak Creek (Dry Cimarron to headwaters)	TP	0.062	0.210	0.148	70%
	TN	0.779	1.82	1.04	57%

Note: 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 = TMDL - MOS
(b) Percent reduction is the percent the existing measured load must be reduced to achieve the target load, and is calculated as follows: (Measured Load – Target Load) / Measured Load x 100.

5.5 Identification and Description of Pollutant Sources

Probable sources of impairment for TP and TN that could contribute to Oak Creek are listed in Table 5.8.

Table 5.8 Pollutant Source Summary for Total Phosphorus and Total Nitrogen

Assessment Unit	Pollutant Sources	Magnitude (lbs/day)	Probable Sources* (% from each)
Oak Creek (Dry Cimarron to headwaters)	Point: none	0	0%
	Nonpoint:	0.062 TP 0.779 TN	100% Crop production (crop land or dry land), drought-related impacts, flow alterations from water diversions, rangeland grazing, wildlife other than waterfowl, waterfowl. [(a)]

Notes:
* From the 2008-2010 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.
[(a)] per public comment, "waterfowl" will be added to the 2010-2012 CWA Integrated §303(d)/§305(b) List.

5.6 Linkage Between Water Quality and Pollutant Sources

The source assessment phase of TMDL development identifies sources of nutrients that may contribute to both elevated nutrient concentrations and the stimulation of algal growth in a waterbody. 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.

Phosphorus and nitrogen generally drive the productivity of algae and macrophytes in aquatic ecosystems, therefore they are regarded as the primary limiting nutrients in freshwaters. The main reservoirs of natural phosphorus are rocks and natural phosphate deposits. Weathering, leaching, and erosion are all processes that breakdown rock and mineral deposits allowing phosphorus to be transported to aquatic systems via water or wind. The breakdown of mineral phosphorus produces inorganic phosphate ions ($H_2PO_4^-$, HPO_4^{2-}, and PO_4^{3-}) that can be absorbed by plants from soil or water (USEPA 1999). Phosphorus primarily moves through the food web as organic phosphorus (after it has been incorporated into plant or algal tissue) where it may be released as phosphate in urine or other waste by heterotrophic consumers and reabsorbed by plants or algae to start another cycle (Nebel and Wright 2000).

The largest reservoir of nitrogen is the atmosphere. About 80 percent of the atmosphere by volume consists of nitrogen gas (N_2). Although nitrogen is plentiful in the environment, it is not readily available for biological uptake. Nitrogen gas must be converted to other forms, such as ammonia (NH_3 and NH_4^+), nitrate (NO_3^-), or nitrite (NO_2^-) before plants and animals can use it. Conversion of gaseous nitrogen into usable mineral forms occurs through three biologically mediated processes of the nitrogen cycle: nitrogen fixation, nitrification, and ammonification (USEPA 1999). Mineral forms of nitrogen can be taken up by plants and algae and incorporated into plant or algal tissue. Nitrogen follows the same pattern of food web incorporation as phosphorus and is released in waste primarily as ammonium compounds. The ammonium compounds are usually converted to nitrates by nitrifying bacteria, making it available again for uptake, starting the cycle anew (Nebel and Wright 2000).

Rain, overland runoff, groundwater, drainage networks, and industrial and residential waste effluents transport nutrients to receiving waterbodies. Once nutrients have been transported into a waterbody they can be taken up by algae, macrophytes, and microorganisms either in the water column or in the benthos; they can sorb to organic or inorganic particles in the water column and/or sediment; they can accumulate or be recycled in the sediment; or they can be transformed and released as a gas from the waterbody (Figure 5.1).

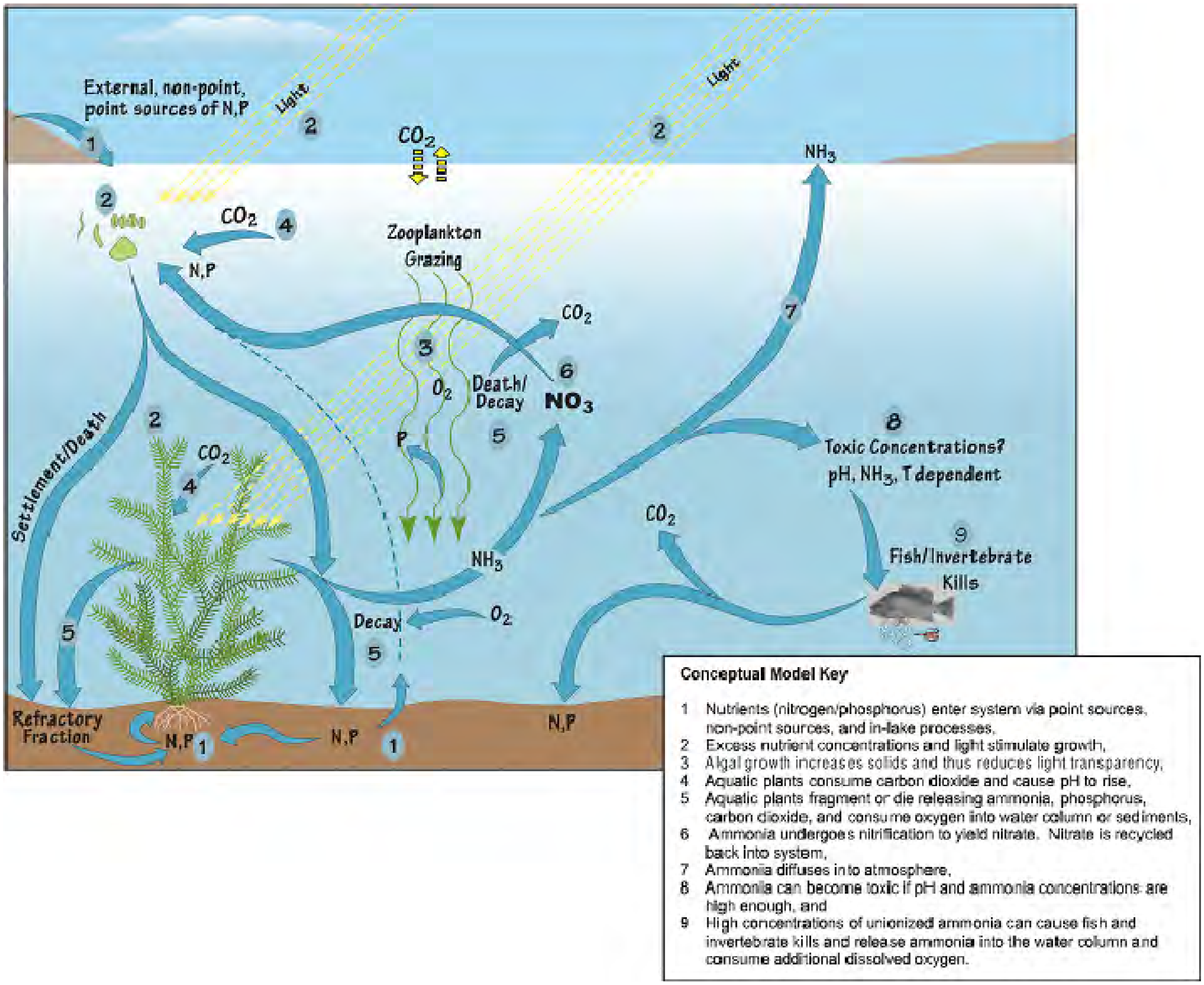


Figure 5.1 Nutrient Conceptual Model (USEPA 1999)

As noted above, phosphorus and nitrogen are essential for proper functioning of ecosystems. However, excess nutrients cause conditions unfavorable for the proper functioning of aquatic ecosystems. Nuisance levels of algae and other aquatic vegetation (macrophytes) can develop rapidly in response to nutrient enrichment when other factors (e.g., light, temperature, substrate, etc.) are not limiting (Figure 5.1). The relationship between nuisance algal growth and nutrient enrichment in stream systems has been well documented in the literature (Welch 1992; Van Nieuwenhuyse and Jones 1996; Dodds et al. 1997; Chetelat et al. 1999). Unfortunately, the magnitude of nutrient concentration that constitutes an "excess" is difficult to determine and varies by ecoregion.

As described in Section 5.2, the presence of plant nutrients in a stream can vary as a function of flow. As flow decreases through water diversions and/or drought-related stressors, the stream cannot effectively dilute its constituents, which causes the concentration of plant nutrients to increase. Nutrients generally reach the waterbody from land uses that are in close proximity to the stream because the hydrological pathways are shorter and have fewer obstacles than land uses located away from the riparian corridor. However, during the growing season (i.e. in agricultural return flow) and in storm water runoff, distant land uses can become hydrologically connected to the stream, thus transporting nutrients from the hillslopes to the stream during these time periods.

In addition to agriculture, there are several other human-related activities that influence nutrient concentrations in rivers and streams. Residential areas contribute nutrients from septic tank disposal systems, landscape maintenance, as well as backyard livestock (e.g. cattle, horses) and pet wastes. Urban development contributes nutrients by disturbing the land and consequently increasing soil erosion, by increasing the impervious area within the watershed, and by directly applying nutrients to the landscape. Recreational activities such as hiking and biking can also contribute nutrients to the stream by reducing plant cover and increasing soil erosion (e.g. trail network, streambank destabilization), direct application of human waste, campfires and/or wildfires, and dumping trash near the riparian corridor.

Undeveloped, or natural, landscapes also can deliver nutrients to a waterbody through decaying plant material, soil erosion, air deposition, and wild animal waste. Another geographically occurring nutrient source is atmospheric deposition, which adds nutrients directly to the waterbody through dryfall and rainfall. Atmospheric phosphorus and nitrogen can be found in both organic and inorganic particles, such as pollen and dust. The contributions from these natural sources are generally considered to represent background levels.

Water pollution caused by on-site septic systems is a widespread problem in New Mexico (McQuillan 2004). Septic system effluents have contaminated more water supply wells, and more acre-feet of ground water, than all other sources in the state combined. Groundwater contaminated by septic system effluent can discharge into streams gaining from groundwater inflow. Nutrients such as phosphorous and nitrogen released into gaining streams from aquifers contaminated by septic systems can contribute to eutrophic conditions.

SWQB fieldwork includes an assessment of the probable sources of impairment (NMED/SWQB 2007). The completed Pollutant Source(s) Documentation Protocol forms in Appendix B 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 probable sources of impairment in this watershed.

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 TMDLs. These nutrient TMDLs were calculated using the best available methods that were known at the time of calculation and may be revised in the future.

5.7 Margin of Safety (MOS)

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. The MOS can be expressed either implicitly or explicitly. An implicit MOS is incorporated by making conservative assumptions in the TMDL analysis, such as allocating a conservative load to background sources. An explicit MOS is applied by reserving a portion of the TMDL and not allocating it to any other sources.

For these nutrient TMDLs, the margin of safety was developed using a combination of conservative assumptions and explicit recognition of potential errors. Therefore, this margin of safety is the sum of the following two elements:

- *Conservative Assumptions*
  Treating phosphorus and nitrogen as conservative pollutants, that pollutants that do not readily degrade in the environment, was used as a conservative assumption in developing these loading limits.

  Using the 4Q3 critical low flow to calculate the allowable load.

- *Explicit recognition of potential errors*
  A level of uncertainty exists in sampling nonpoint sources of pollution. Accordingly, a conservative MOS decreases the TMDL by **10 percent**.

  A 4Q3 flow value for this ungaged stream was estimated based on regression equations from Waltemeyer (2002). There is inherent error in all flow calculations. A conservative MOS for this element is therefore **10 percent.**

5.8 Consideration of Seasonal Variability

Section 303(d)(1) of the CWA requires TMDLs to be "established at a level necessary to implement the applicable WQS with seasonal variation." Data used in the calculation of these TMDLs were collected during spring, summer, and fall in order to ensure coverage of any potential seasonal variation in the system. Exceedences were observed during all seasons, which captured flow alterations related to snowmelt, agricultural diversions, and summer monsoonal rains. Data that exceeded the target concentration for TP and TN were used in the calculation of the measured loads (Table 5.6) and can be found in Table 5.2.

The critical condition used for calculating the TMDL was low-flow. Calculations made at the critical low-flow (4Q3), in addition to using other conservative assumptions as described in the previous section on MOS, should be protective of the water quality standards designed to preserve aquatic life in the stream. It was assumed that if critical conditions were met during this time, coverage of any potential seasonal variation would also be met.

5.9 Future Growth

Growth estimates by county are available from the New Mexico Bureau of Business and Economic Research. These estimates project growth to the year 2030. The population of Union County in 2005 was 4,213 and is projected to be 3,947 in 2030. According to the calculations, the overwhelming source of metals loading is from nonpoint sources. Estimates of future growth are not anticipated to lead to a significant increase in metals concentrations that cannot be controlled with BMP implementation in this watershed. However, it is imperative that BMPs continue to be utilized and improved upon in this watershed while continuing to improve road conditions and grazing allotments and adhering to SWPPP requirements related to construction and industrial activities covered under the general permit.

6.0 SELENIUM

Assessment of the data from the 2006 SWQB water quality survey in the Dry Cimarron River watershed identified several exceedences of the New Mexico water quality standards for total recoverable selenium in Long Canyon (perennial reaches above Dry Cimarron). Consequently, this waterbody was listed on the 2008-2010 Integrated CWA §303(d)/§305(b) (NMED/SWQB 2008b) list for selenium.

6.1 Target Loading Capacity

A target value for this selenium 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.

According to the New Mexico water quality standards (20.6.4.900 NMAC), the total recoverable selenium criteria is 0.005 mg/L for chronic aquatic life and wildlife habitat uses. This criterion was exceeded 3 of 4 times on Long Canyon (perennial reaches above Dry Cimarron). These exceedences are presented in Table 6.1. Concurrently collected TSS and turbidity data reported in Table 6.1 will be discussed in the Linkage(s) section below.

Selenium is both an essential and detrimental naturally occurring trace element, predominantly found in black shale derived soils and landscapes. Selenium becomes bioavailable to aquatic biota through surface and groundwater interactions with surrounding geology. Selenium is also hypothesized as contributing to the decline of endangered fishes of the Colorado River Basin because it may inhibit recovery by adversely affecting reproduction and recruitment (USGS 2004). Due to the bioaccumulative properties of selenium, USEPA is currently proposing that one component of selenium criteria be expressed as a concentration of the pollutant in fish tissue rather than a concentration in the water (USEPA 2004).

Table 6.1 Total Recoverable Selenium and additional related data for Long Canyon

Sample Date	Total Recoverable Selenium (mg/L)	TSS (mg/L)	Turbidity (NTU)	Flow[(a)] (cfs)
3/27/2006	0.007*	31	29.7	0.4
4/24/2006	<0.005	15	n/a	0.2
7/24/2006	0.006*	5	5.4	0.3
10/24/2006	0.008*	12	7.1	1

*denotes exceedence of total recoverable selenium criterion.
[(a)] visual flow estimations, too shallow to measure in most cases.
NTU = Nephelometric turbidity units.
n/a = not available.

6.2 Flow

Selenium concentrations can vary as a function of flow, therefore TMDLs are calculated at a specific flow. The target flow value used to calculate the TMDL for this stream reach was obtained using a 4-day, 3-year low-flow frequency (4Q3) regression model. The 4Q3 is the annual lowest 4 consecutive day flow that occurs with a frequency of at least once every 3 years. When available, USGS gages are used to estimate flow. However, there are no active USGS gages in Long Canyon and the nearest gage on the Dry Cimarron is 59 miles downstream of the confluence with Long Canyon (see Section 2.4.2), therefore, gage data was not available for this TMDL calculation and the 4Q3 flow was estimated.

It is often necessary to estimate a critical flow for a portion of a watershed where there is no active USGS flow gage. 4Q3 derivations for ungaged streams in the Dry Cimmaron watershed were based on analysis methods described by Waltemeyer (2002). In Waltemeyer's analysis, two regression equations for estimating 4Q3 were developed based on physiographic regions of NM (i.e., statewide and mountainous regions above 7,500 feet in elevation). None of the impaired AUs in this survey are above 7,500 feet in elevation, so the following statewide regression equation was used to calculate 4Q3 flows (Waltemeyer 2002):

$$4Q3 \;=\; 1.2856 \times 10^{-4}\; DA^{0.42}\; P_w^{\;3.16}$$

where,

4Q3	= Four-day, three-year low-flow frequency (cfs)
DA	= Drainage area (mi^2)
P_w	= Average basin mean winter precipitation (inches)

This regression equation is based on data from 50 gaging stations with non-zero discharge. The average standard error of estimate (SEE) and coefficient of determination are 126 and 48 percent, respectively, for this regression equation (Waltemeyer 2002). The drainage areas and average basin mean winter precipitation for Long Canyon are presented in the following table:

Table 6.2 Parameters for Estimating Flow using USGS Regression Model

Assessment Unit	Regression Model[(a)]	Average Elevation for Assessment Unit (feet) [(b)]	Drainage Area (mi^2)	Mean Basin Winter Precipitation (inches)	Estimated 4Q3 (cfs)	Estimated 4Q3 (mgd)
Long Canyon (perennial reaches abv Dry Cimarron)	Statewide	5,245	131.11	5.47	0.214	0.138

Notes:
mi^2 = Square miles
[(a)] Waltemeyer (2002)
[(b)] Average elevation = average of elevations at bottom and top of AU

The critical flow in Table 6.2 was converted from cfs to units of mgd as follows:

$$0.214\frac{ft^3}{\sec}\times 1{,}728\frac{in^3}{ft^3}\times 0.004329\frac{gal}{in^3}\times 86{,}400\ \frac{\sec}{day}\times 10^{-6}\ = 0.138\,mgd$$

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. Meeting the calculated TMDL may be a difficult objective.

6.3 Calculations

A target load for total recoverable selenium is calculated based on a flow, the current water quality criterion, and a conversion factor (8.34) that is used to convert mg/L units to lbs/day (see Appendix A for Conversion factor derivation). The target loading capacity is calculated using **Equation 4**. The results are shown in Table 6.3.

Critical flow (mgd) x Criterion (mg/L) x 8.34 = Target Loading Capacity ***(Eq. 4)***

Table 6.3 Calculation of target loads for total recoverable selenium

Location	Flow (mgd)	Total Recoverable Selenium (mg/L)	Conversion Factor	Target Load Capacity (lbs/day)*
Long Canyon (perennial reaches abv Dry Cimarron)	0.138	0.005	8.34	0.0058

Notes: *values rounded to four significant figures

The measured loads for total recoverable selenium were similarly calculated. The arithmetic mean of the data used to determine the impairment was substituted for the criterion in Equation 4. The same conversion factor of 8.34 was used. Results are presented in Table 6.4.

Table 6.4 Calculation of measured loads for total recoverable selenium

Location	Flow (mgd)	Total Recoverable Selenium Arithmetic Mean (mg/L)	Conversion Factor	Measured Load (lbs/day)
Long Canyon (perennial reaches abv Dry Cimarron)	0.138	0.007	8.34	0.0081

Notes: *values rounded to four significant figures

6.4 Waste Load Allocations and Load Allocations

6.4.1 Waste Load Allocation

There are no NPDES or MS4 storm water permits in this Assessment Unit. Sediment may be a component of some industrial and construction storm water discharges covered under General NPDES Permits, so the load from 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., TSS, turbidity, siltation, SBDs, bacteria, etc.) and water 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 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.

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**:

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

The MOS is estimated to be 20 percent of the target load calculated in Table 6.5. Additional details on the MOS are presented in Section 6.7.

Table 6.5 TMDL for total recoverable selenium

Location	WLA (lbs/day)	LA (lbs/day)	MOS (20%) (lbs/day)	TMDL (lbs/day)
Long Canyon (perennial reaches abv Dry Cimarron)	0	0.0046	0.0012	0.0058

Notes: *values rounded to four significant figures

The extensive data collection and analyses necessary to determine background selenium loads for the Dry Cimarron River watershed were beyond the resources available for this study. It is therefore assumed that a portion of the LA is made up of natural background loads.

The load reductions necessary to meet the target loads were calculated to be the difference between the calculated TMDL (Table 6.3) and the measured loads (Table 6.4), and are shown in Table 6.6. These load reduction tables are presented for informational purposes only. However, it is important to note that WLAs and LAs are estimates based on a specific flow condition (i.e., 4Q3 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 water quality standards.

Table 6.6 Calculation of load reduction for Total Recoverable Selenium

Assessment Unit	TMDL (lbs/day) [(a)]	Measured Load (lbs/day)	Load Reduction (lbs/day)	Percent Reduction[(b)]
Long Canyon (perennial reaches abv Dry Cimarron)	0.0046	0.0081	0.0035	43%

Note: 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 = TMDL - MOS
(b) Percent reduction is the percent the existing measured load must be reduced to achieve the TMDL, and is calculated as follows: (Measured Load – TMDL) / Measured Load x 100

6.5 Identification and Description of Pollutant Source(s)

Probable nonpoint sources that may be contributing to the observed load are displayed in Table 6.7:

Table 6.7 Pollutant source summary for Selenium

Pollutant Sources	Magnitude[(a)]	Location	Probable Sources[(b)]
Point: Total recoverable selenium	none	Long Canyon (perennial reaches abv Dry Cimarron)	0%
Nonpoint: Total recoverable selenium	0.0081	Long Canyon (perennial reaches abv Dry Cimarron)	100% Drought-related impacts, highway/road/bridge runoff (non-construction related), natural sources, rangeland grazing, streambank modifications/destabilization, wildlife other than waterfowl, waterfowl.[(c)]

Notes:
(a) Measured Load.
(b) From the 2008-2010 Integrated CWA 303(d)/305(b) list (NMED/SWQB 2008b). 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) per public comment, "waterfowl" will be added to the 2010-2012 CWA Integrated §303(d)/§305(b) List.

Probable sources of total recoverable selenium for this assessment unit will be evaluated, refined, and changed as necessary through the Watershed Restoration Action Strategy (WRAS) process.

6.6 Linkage of Water Quality and Pollutant Sources

SWQB fieldwork includes an assessment of the probable sources of impairment (NMED/SWQB 2007). The sample Probable Sources field sheet in Appendix B 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 probable sources of impairment in this watershed. Table 4.6 displays probable sources of nonpoint source impairments along the reach as determined by field reconnaissance and assessment. Appendix C provides relevant excerpts from the 2008-2010 Integrated CWA 303(d)/305(b) List which includes the probable sources associated with each Assessment Unit in the Dry Cimarron River watershed.

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 stream. This does not appear to be the case for Long Canyon as evidenced by the fact that there is a very weak relationship between the total recoverable selenium and TSS concentrations according to the data used to determine the impairment (Figure 6.1). However, the degree to which sediment delivery and transport in these watershed 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 soils of the Dry Cimarron River Watershed are the primary source of sediment transport, the anthropogenic influence of the highway construction, channelization, land development, and historical rangeland grazing practices could be contributing to impairment, particularly in the Long Canyon sub-watershed. The geology in the watershed also contributes to the amount of sediment available for transport. In the western United States, selenium is most common in marine sedimentary deposits, such as shale. Selenium is highly mobile and biologically available in arid regions having alkaline soils. Rainfall infiltrating through these soils can leach selenium, which can then be transported to streams.

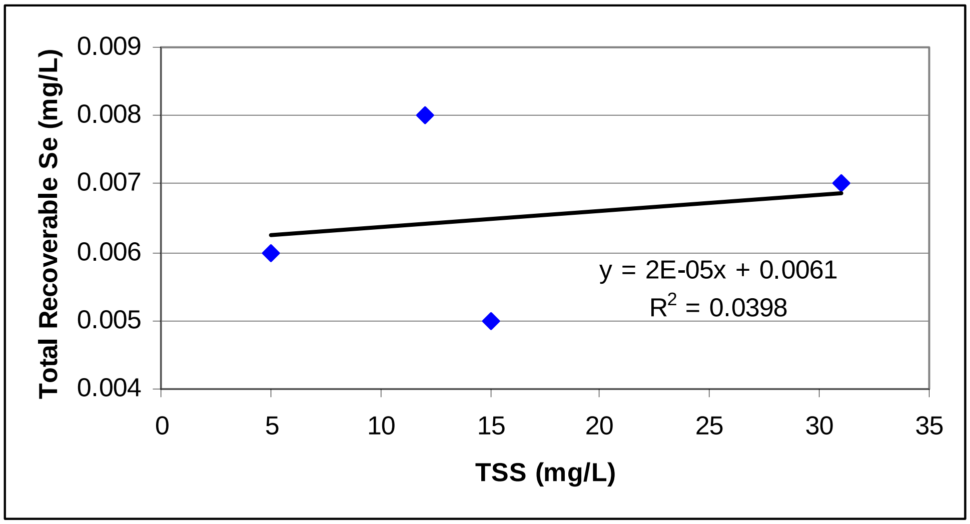


Figure 6.1 Relationship between total recoverable selenium and TSS

The geology of the Long Canyon watershed is comprised of a number of sedimentary formations (Figure 2.3). Specifically, the Middle Jurassic San Rafael Group and Upper Cretaceous Graneros and Greenhorn Formations found in the area of Long Canyon are comprised of shale. All of the shales of Cretaceous age consist at least in part of gray arid black shale and are potential sources of selenium (Blanchard *et al.* 1993). This type of shale is also the probable source of metals found in some mineral deposits. As such, many black shale sequences are nonpoint sources for potentially toxic elements such as arsenic, selenium, chromium, and mercury (USGS 2004). In a study conducted in the San Juan River watershed in northwestern New Mexico, concentrations of total selenium in bottom-sediment and soil samples, as well as in water samples, were greater for Cretaceous than for non-Cretaceous soil types. The study suggested that irrigation significantly increases the selenium concentrations in water samples when an irrigation project is present in selenium-rich sediments. The study also concluded that the primary variable affecting selenium accumulations in biota at aquatic habitats was the presence of Cretaceous soils (Thomas *et al*., 1998).

Normal aqueous chemical processes, enhanced by seepage from irrigated agriculture in the watershed, are capable of rendering some of the naturally-occurring selenium in the Cretaceous age layers in the watershed available to the stream system. However, it should be noted that exceedences occurred across most of the sampling season, including some sampling events which were outside of the traditional irrigation season. The list of Probable Sources (Appendix B) identifies a number of probable sources, including drought-related impacts, natural sources, highway/road-bridge runoff, and streambank modifications as probable sources of selenium.

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, 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 total recoverable selenium. This MOS incorporates several factors:

- *Errors in calculating nonpoint source loads*
  A level of uncertainity exists in sampling nonpoint sources of pollution. Techniques used for measuring concentrations in stream water can lead to inaccuracies in the data. Therefore, a conservative MOS for metals increases the TMDL by **10%.**

- *Errors in calculating flow*
  A 4Q3 flow value for this ungaged stream was estimated based on regression equations from Waltemeyer (2002). There is inherent error in all flow calculations. A conservative MOS for this element is therefore **10 percent.**

6.8 Consideration of Seasonal Variation

Federal regulations (40 CFR §130.7(c)(1)) require that TMDLs take into consideration seasonal variation in watershed conditions and pollutant loading. During the 2006 water quality survey, total recoverable selenium exceedences occurred across most sampling events. Higher flows may flush more nonpoint source runoff containing sediment and metals. It is possible the criterion may be exceeded under a low flow condition when there is insufficient dilution. Evaluation of seasonal variability for potential nonpoint sources is difficult due to limited available data. Data used in the calculation of this TMDL were collected during the spring, summer, and fall of 2006 in order to ensure coverage of any potential seasonal variation in the system.

6.9 Future Growth

Growth estimates by county are available from the New Mexico Bureau of Business and Economic Research. These estimates project growth to the year 2030. The population of Union County in 2005 was 4,213 and is projected to be 3,947 in 2030. According to the calculations, the overwhelming source of metals loading is from nonpoint sources. Estimates of future growth are not anticipated to lead to a significant increase in metals concentrations that cannot be controlled with BMP implementation in this watershed. However, it is imperative that BMPs continue to be utilized and improved upon in this watershed while continuing to improve road conditions and grazing allotments and adhering to SWPPP requirements related to construction and industrial activities covered under the general permit.

7.0 SULFATE

Assessment of the data from the 2006 SWQB water quality survey in the Dry Cimarron River watershed identified several exceedences of the New Mexico water quality standards for sulfate in Dry Cimarron River (perennial reaches OK boundary to Long Canyon). Consequently, this waterbody was listed on the 2008-2010 Integrated CWA §303(d)/§305(b) (NMED/SWQB 2008b) list for sulfate.

7.1 Target Loading Capacity

Target values for this sulfate 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.

According to the New Mexico water quality standards (20.6.4 NMAC), the segment-specific criteria for sulfate in water quality segment 20.6.4.701 is 600 mg/L. This criterion was exceeded 3 of 7 times in the Dry Cimarron River (OK boundary to Long Canyon). These exceedences are presented in Table 7.1. Concurrently collected TSS and turbidity data reported in Table 7.1 will be discussed in the Linkage(s) section below. Due to the fact that the Dry Cimarron River in New Mexico flows into Oklahoma, the WQS for the State of Oklahoma were also consulted. According to Appendix F (OMRB, 2006) and discussion with ODEQ staff, the NM WQS are at least as stringent as those in Oklahoma.

Sulfate is the oxidized form of sulfur and is mobile in soils. Common minerals that belong in the sulfate class include gypsum and anhydrite. Atmospheric deposition of sulfates can be a source to soils. Other sources of sulfates can include decomposition of organic matter, fertilizers, and natural sources (such as volcanoes and shales) (MPCA, 1999). Irrigation water that is high in sulfates often leads to lower crop yields (Papadopoulos, 1986). Excessive sulfate in drinking water available to cattle can decrease their feed consumption and therefore decrease their weight gain (Weeth and Capps, 1972).

Table 7.1 Sulfate and additional related data for Dry Cimarron River

Sample Date	Sulfate (mg/L)	TSS (mg/L)	Turbidity (NTU)	TDS (mg/L)	Flow[(a)] (cfs)
3/27/2006	687*	14	18.9	1330**	1.1
4/24/2006	637*	13	n/a	1450**	0.5
5/22/2006	642*	5	n/a	1450**	n/a
7/24/2006	285	9	15.6	754	0.75
8/29/2006	190	12	9	564	2
9/26/2006	516	115	7.4	1140	1
10/24/2006	585	3	2.5	1490**	1

*denotes exceedence of sulfate criterion.
** denotes exceedence of TDS criterion (See Section 9.0)
(a) visual flow estimations, too shallow to measure in most cases.

NTU = Nephelometric turbidity units.
n/a = not available.

7.2 Flow

Sulfate concentrations can vary as a function of flow, therefore TMDLs are calculated at a specific flow. The target flow value used to calculate the TMDL for this stream reach was obtained using a 4-day, 3-year low-flow frequency (4Q3) regression model. The 4Q3 is the annual lowest 4 consecutive day flow that occurs with a frequency of at least once every 3 years. When available, USGS gages are used to estimate flow. There are no active USGS gages on the Dry Cimarron River in New Mexico and the nearest gage on the Dry Cimarron is 7 miles downstream of this Assessment Unit (see Section 2.4.2). USGS gage data at Cimarron River near Kenton, OK (07154500) were used to estimate the 4Q3 flow for this TMDL. The 4Q3 was estimated using the USGS A193 calculation Log Pearson Type III distribution through DFLOW software, Version 3.1b (USEPA 2006). DFLOW 3.1b is a Windows-based tool developed to estimate user selected design stream flows for low flow analysis. However, the 4Q3 flow for the period of record is zero, so another tool for 4Q3 estimation had to be used.

It is often necessary to estimate a critical flow for a portion of a watershed where there is no active USGS flow gage. 4Q3 derivations for ungaged streams in the Dry Cimmaron watershed were based on analysis methods described by Waltemeyer (2002). In Waltemeyer's analysis, two regression equations for estimating 4Q3 were developed based on physiographic regions of NM (i.e., statewide and mountainous regions above 7,500 feet in elevation). The Dry Cimarron River (perennial reaches OK boundary to Long Canyon) is not higher than 7,500 feet in elevation, so the following statewide regression equation was used (Waltemeyer 2002):

$$4Q3 \quad = \quad 1.2856 \times 10^{-4} \ DA^{0.42} \ P_w^{\ 3.16}$$

where,

4Q3 = Four-day, three-year low-flow frequency (cfs)
DA = Drainage area (mi^2)
P_w = Average basin mean winter precipitation (inches)

This regression equation is based on data from 50 gaging stations with non-zero discharge. The average standard error of estimate (SEE) and coefficient of determination are 126 and 48 percent, respectively, for this regression equation (Waltemeyer 2002). The drainage area and average basin mean winter precipitation for the Dry Cimarron River are presented in the following table:

Table 7.2 Parameters for Estimating Flow using USGS Regression Model

Assessment Unit	Regression Model[(a)]	Average Elevation for Assessment Unit (feet) [(b)]	Drainage Area (mi^2)	Mean Basin Winter Precipitation (inches)	Estimated 4Q3 (cfs)	Estimated 4Q3 (mgd)
Dry Cimarron River (perennial reaches OK bnd to Long Canyon)	Statewide	4,746	980.23	4.97	0.368	0.238

Notes:
mi^2 = Square miles
[(a)] Waltemeyer (2002)
[(b)] Average elevation = average of elevations at bottom and top of AU

The critical flow in Table 7.2 was converted from cfs to units of mgd as follows:

$$0.368\frac{ft^3}{\sec}\times 1{,}728\frac{in^3}{ft^3}\times 0.004329\frac{gal}{in^3}\times 86{,}400\ \frac{\sec}{day}\times 10^{-6}\ = 0.238\,mgd$$

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. Meeting the calculated TMDL may be a difficult objective.
.

7.3 Calculations

A target load for sulfate is calculated based on a flow, the current water quality criterion, and a conversion factor (8.34) that is used to convert mg/L units to lbs/day (see Appendix A for Conversion factor derivation). The target loading capacity is calculated using **Equation 4**. The results are shown in Table 7.3.

Critical flow (mgd) x Criterion (mg/L) x 8.34 = Target Loading Capacity (Eq. 4)

Table 7.3 Calculation of target loads for sulfate

Location	Flow (mgd)	Sulfate (mg/L)	Conversion Factor	Target Load Capacity (lbs/day)*
Dry Cimarron River (perennial reaches OK bnd to Long Canyon)	0.238	600	8.34	1191

Notes: *values rounded to four significant figures

The measured loads for sulfate were similarly calculated. The arithmetic mean of the data used to determine the impairment was substituted for the criterion in Equation 4. The same conversion factor of 8.34 was used. Results are presented in Table 7.4.

Table 7.4 Calculation of measured loads for sulfate

Location	Flow (mgd)	Sulfate Arithmetic Mean (mg/L)	Conversion Factor	Measured Load (lbs/day)
Dry Cimarron River (perennial reaches OK bnd to Long Canyon)	0.238	655	8.34	1300

Notes: *values rounded to four significant figures

7.4 Waste Load Allocations and Load Allocations

7.4.1 Waste Load Allocation

There are no NPDES or MS4 storm water permits in this Assessment Unit. Sediment may be a component of some industrial and construction storm water discharges covered under General NPDES Permits, so the load from 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., TSS, turbidity, siltation, SBDs, bacteria, etc.) and water 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 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.

7.4.2 Load Allocation

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

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

The MOS is estimated to be 20 percent of the target load calculated in Table 7.5. Results are presented in Table 7.5. Additional details on the MOS are presented in Section 7.7.

Table 7.5 TMDL for sulfate

Location	WLA (lbs/day)	LA (lbs/day)	MOS (20%) (lbs/day)	TMDL (lbs/day)
Dry Cimarron River (perennial reaches OK bnd to Long Canyon)	0	880	220	1100

Notes: *values rounded to four significant figures

The extensive data collection and analyses necessary to determine background sulfate loads for the Dry Cimarron River watershed were beyond the resources available for this study. It is therefore assumed that a portion of the LA is made up of natural background loads.

The load reductions necessary to meet the target loads were calculated to be the difference between the calculated TMDL (Table 7.3) and the measured loads (Table 7.4), and are shown in Table 7.6. These load reduction tables are presented for informational purposes only. However, it is important to note that WLAs and LAs are estimates based on a specific flow condition (i.e., 4Q3 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 water quality standards.

Table 7.6 Calculation of load reduction for sulfate

Assessment Unit	TMDL (lbs/day) [(a)]	Measured Load (lbs/day)	Load Reduction (lbs/day)	Percent Reduction[(b)]
Dry Cimarron River (perennial reaches OK bnd to Long Canyon)	880	1300	420	32%

Note: 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 = TMDL - MOS
(b) Percent reduction is the percent the existing measured load must be reduced to achieve the TMDL, and is calculated as follows: (Measured Load – TMDL) / Measured Load x 100

7.5 Identification and Description of Pollutant Source(s)

Probable nonpoint sources that may be contributing to the observed load are displayed in Table 7.7:

Table 7.7 Pollutant source summary for Sulfate

Pollutant Sources	Magnitude[(a)]	Location	Probable Sources[(b)]
Point: Sulfate	none	Dry Cimarron River (perennial reaches OK bnd to Long Canyon)	0%
Nonpoint: Sulfate	1300 lbs/day	Dry Cimarron River (perennial reaches OK bnd to Long Canyon)	100% Drought-related impacts, flow alterations from water diversions, highway/road/bridge runoff (non-construction related), irrigated crop production, natural sources, waterfowl. [(c)]

Notes:
(a) Measured Load.
(b) From the 2008-2010 Integrated CWA 303(d)/305(b) list (NMED/SWQB 2008b). 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) per public comment, "waterfowl" will be added to the 2010-2012 CWA Integrated §303(d)/§305(b) List.

Probable sources of sulfate for this assessment unit will be evaluated, refined, and changed as necessary through the Watershed Restoration Action Strategy (WRAS) process

7.6 Linkage of Water Quality and Pollutant Sources

SWQB fieldwork includes an assessment of the probable sources of impairment (NMED/SWQB 2007). The sample Probable Sources field sheet in Appendix B 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 probable sources of impairment in this watershed. Table 7.7 displays probable sources of nonpoint source impairments along the reach as determined by field reconnaissance and assessment. Appendix C provides relevant excerpts from the 2008-2010 Integrated CWA 303(d)/305(b) List which includes the probable sources associated with each Assessment Unit in the Dry Cimarron River watershed.

In general, increased salinity-related parameters in the water column can commonly be linked to sediment transport and accumulation, where the parameter is a constituent part of the stream. This does not appear to be the case for Dry Cimarron River (perennial reaches OK bnd to Long Canyon) as evidenced by the fact that there is a very weak relationship between the sulfate and TSS concentrations according to the data used to determine the impairment (Figure 7.1). However, the degree to which sediment delivery and transport in these watershed 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 soils of the Dry Cimarron River Watershed are the primary source of sediment transport, the anthropogenic influence of the highway construction, channelization, irrigation, land development, and historical rangeland grazing practices could be contributing to impairment, particularly in the Dry Cimarron River watershed. The geology in the watershed contributes to the amount of sediment available for transport.

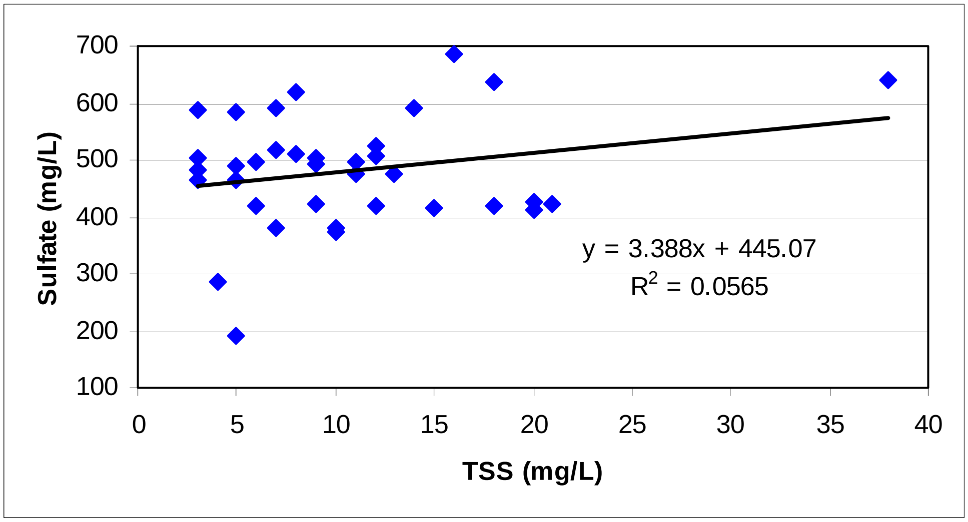


Figure 7.1 Relationship between sulfate and TSS

The highest sulfate values occurred in the spring, which is the beginning of the irrigation season. The elevated levels of sulfate could be linked to the spring wash-out of salts from the irrigated fields. In dry climates, water evaporates from the top layer of soil leaving a layer of salt that is toxic to crops and degrades the soil (Postel, 1999). The list of Probable Sources (Appendix B) identifies a number of probable sources, including drought-related impacts, natural sources, highway/road-bridge runoff, streambank modifications, and irrigated crop production as probable sources of sulfate.

7.7 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 sulfate. This MOS incorporates several factors:

- *Errors in calculating nonpoint source loads*
  A level of uncertainity exists in sampling nonpoint sources of pollution. Techniques used for measuring concentrations in stream water can lead to inaccuracies in the data. Therefore, a conservative MOS increases the TMDL by **10%.**

- *Errors in calculating flow*
  A 4Q3 flow value for this ungaged stream was estimated based on a regression equation from Waltemeyer (2002). There is inherent error in all flow calculations. A conservative MOS for this element is therefore **10 percent.**

7.8 Consideration of Seasonal Variation

Federal regulations (40 CFR §130.7(c)(1)) require that TMDLs take into consideration seasonal variation in watershed conditions and pollutant loading. During the 2006 water quality survey, sulfate exceedences occurred from March-May, but there were also high values in September and October. Higher flows may flush more nonpoint source runoff containing sediment. It is possible the criterion may be exceeded under a low flow condition when there is insufficient dilution. Evaluation of seasonal variability for potential nonpoint sources is difficult due to limited available data.

7.9 Future Growth

Growth estimates by county are available from the New Mexico Bureau of Business and Economic Research. These estimates project growth to the year 2030. The population of Union County in 2005 was 4,213 and is projected to be 3,947 in 2030. According to the calculations, the overwhelming source of sulfate loading is from nonpoint sources. Estimates of future growth are not anticipated to lead to a significant increase in sulfate concentrations that cannot be controlled with BMP implementation in this watershed. However, it is imperative that BMPs continue to be utilized and improved upon in this watershed while continuing to improve road conditions and grazing allotments and adhering to SWPPP requirements related to construction and industrial activities covered under the general permit.

8.0 TOTAL DISSOLVED SOLIDS

Assessment of the data from the 2006 SWQB water quality survey in the Dry Cimarron River watershed identified several exceedences of the New Mexico water quality standards for total dissolved solids (TDS) in Dry Cimarron River (perennial reaches OK boundary to Long Canyon) and Dry Cimarron River (Long Canyon to Oak Creek). Consequently, these waterbodies were listed on the 2008-2010 Integrated CWA §303(d)/§305(b) (NMED/SWQB 2008b) list for TDS.

8.1 Target Loading Capacity

Target values for this TDS 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.

According to the New Mexico water quality standards (20.6.4 NMAC), the segment-specific criteria for TDS in 20.6.4.701 is 1,200 mg/L. This criterion was exceeded 4 of 7 times on Dry Cimarron River (OK boundary to Long Canyon) and 3 of 7 times on Dry Cimarron (Long Canyon to Oak Creek). These exceedences are presented in Tables 8.1 and 8.2. Concurrently collected data reported in Tables 8.1 and 8.2 will be discussed in the Linkage(s) section below. Due to the fact that the Dry Cimarron River in New Mexico flows into Oklahoma, the WQS for the State of Oklahoma were also consulted. According to Appendix F (OMRB, 2006) and discussion with ODEQ staff, the NM WQS are at least as stringent as those in Oklahoma.

TDS is the total amount of solids remaining after a water sample is evaporated. It is the sum of all dissolved constituents, with bicarbonate converted to equivalent carbonate. Salinity can basically be defined as TDS (Drever, 1997). High sulfate levels are typically associated with high levels of TDS. This is the case with Dry Cimarron River (OK boundary to Long Canyon) as evidenced in Section 7 and Table 8.1.

Studies have shown that water with elevated TDS levels is detrimental to the growth and health of cattle. In one study, feed consumption decreased and water consumption increased (Patterson *et al*, 2003). Increased TDS can also affect aquatic organisms. TDS toxicity in freshwater organisms is due to osmotic stress and the impact on an organism's lack of the ability to continue osmoregulation (McCulloch *et al*, 1993).

Table 8.1 TDS and additional related data for Dry Cimarron River (OK boundary to Long Canyon)

Sample Date	TDS (mg/L)	TSS (mg/L)	Turbidity (NTU)	Sulfate (mg/L)	Flow[(a)] (cfs)
3/27/2006	1330*	14	18.9	687**	1.1
4/24/2006	1450*	13	n/a	637**	0.5
5/22/2006	1450*	5	n/a	642**	n/a
7/24/2006	754	9	15.6	285	0.75
8/29/2006	564	12	9	190	2
9/26/2006	1140	115	7.4	516	1
10/24/2006	1490*	3	2.5	585	1

*denotes exceedence of TDS criterion.
**denotes exceedence of sulfate criterion.
[(a)] visual flow estimations, too shallow to measure in most cases.
NTU = Nephelometric turbidity units.
n/a = not available.

Table 8.2 TDS and additional related data for Dry Cimarron River (Long Canyon to Oak Creek)

Sample Date	TDS (mg/L)	TSS (mg/L)	Turbidity (NTU)	Flow[(a)] (cfs)
3/27/2006	1190	58	90.1	1.3
4/24/2006	1260*	77	n/a	0.5
5/22/2006	1210*	44	47	n/a
7/24/2006	1240*	8	12.6	3
8/29/2006	612	26	13.1	0.8
9/26/2006	1200	8	19.8	n/a
10/24/2006	1150	17	12.8	2

*denotes exceedence of TDS criterion.
[(a)] visual flow estimations, too shallow to measure in most cases.
NTU = Nephelometric turbidity units.
n/a = not available.

8.2 Flow

TDS concentrations can vary as a function of flow, therefore TMDLs are calculated at a specific flow. The target flow value used to calculate the TMDL for this stream reach was obtained using a 4-day, 3-year low-flow frequency (4Q3) regression model. The 4Q3 is the annual lowest 4 consecutive day flow that occurs with a frequency of at least once every 3 years. When available, USGS gages are used to estimate flow. However, the nearest gage on the Dry Cimarron is 59 miles downstream of the confluence with Long Canyon (see Section 2.4.2), therefore, gage data was not available for this TMDL calculation and the 4Q3 flow was estimated.

It is often necessary to estimate a critical flow for a portion of a watershed where there is no active USGS flow gage. 4Q3 derivations for ungaged streams in the Dry Cimmaron watershed were based on analysis methods described by Waltemeyer (2002). In Waltemeyer's analysis, two regression equations for estimating 4Q3 were developed based on physiographic regions of NM (i.e., statewide and mountainous regions above 7,500 feet in elevation). None of the impaired AUs in this survey are above 7,500 feet in elevation, so the following statewide regression equation was used to calculate 4Q3 flows (Waltemeyer 2002):

$$4Q3 \quad = \quad 1.2856 \times 10^{-4} \; DA^{0.42} \; {P_w}^{3.16}$$

where,

4Q3 = Four-day, three-year low-flow frequency (cfs)
DA = Drainage area (mi^2)
P_w = Average basin mean winter precipitation (inches)

This regression equation is based on data from 50 gaging stations with non-zero discharge. The average standard error of estimate (SEE) and coefficient of determination are 126 and 48 percent, respectively, for this regression equation (Waltemeyer 2002). The drainage areas and average basin mean winter precipitation for assessment units where this regression method was used are presented in the following table:

Table 8.3 Parameters for Estimating Flow using USGS Regression Model

Assessment Unit	Regression Model[a]	Average Elevation for Assessment Unit (feet) [b]	Drainage Area (mi^2)	Mean Basin Winter Precipitation (inches)	Estimated 4Q3 (cfs)	Estimated 4Q3 (mgd)
Dry Cimarron River (OK bnd to Long Canyon)	Statewide	4,746	980.23	4.97	0.368	0.238
Dry Cimarron River (Long Canyon to Oak Creek)	Statewide	5,572	369.31	5.09	0.263	0.170

Notes:
mi^2 = Square miles
[a] Waltemeyer (2002)
[b] Average elevation = average of elevations at bottom and top of AU

The critical flow in Table 8.3 were converted from cfs to units of mgd as follows:

$$0.214 \frac{ft^3}{\sec} \times 1{,}728 \frac{in^3}{ft^3} \times 0.004329 \frac{gal}{in^3} \times 86{,}400 \frac{\sec}{day} \times 10^{-6} = 0.138\, mgd$$

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. Meeting the calculated TMDL may be a difficult objective.

8.3 Calculations

Target loads for TDS were calculated based on a flow, the current water quality criterion, and a conversion factor (8.34) that is used to convert mg/L units to lbs/day (see Appendix A for Conversion factor derivation). The target loading capacity is calculated using **Equation 4**. The results are shown in Table 8.4.

Critical flow (mgd) x Criterion (mg/L) x 8.34 = Target Loading Capacity ***(Eq. 4)***

Table 8.4 Calculation of target loads for Total Dissolved Solids

Location	Flow (mgd)	Total Dissolved Solids (mg/L)	Conversion Factor	Target Load Capacity (lbs/day)*
Dry Cimarron River (OK bnd to Long Canyon)	0.238	1,200	8.34	2,382
Dry Cimarron River (Long Canyon to Oak Creek)	0.170	1,200	8.34	1,701

Notes: *values rounded to four significant figures

The measured loads for TDS were similarly calculated. The arithmetic mean of the data used to determine the impairment was substituted for the criterion in Equation 4. The same conversion factor of 8.34 was used. Results are presented in Table 8.5.

Table 8.5 Calculation of measured loads for Total Dissolved Solids

Location	Flow (mgd)	Total Dissolved Solids Arithmetic Mean (mg/L)	Conversion Factor	Measured Load (lbs/day)
Dry Cimarron River (OK bnd to Long Canyon)	0.238	1,430	8.34	2,838
Dry Cimarron River (Long Canyon to Oak Creek)	0.170	1,240	8.34	1,758

Notes: *values rounded to four significant figures

8.4 Waste Load Allocations and Load Allocations

8.4.1 Waste Load Allocation

There are no NPDES or MS4 storm water permits in this Assessment Unit. Sediment may be a component of some industrial and construction storm water discharges covered under General NPDES Permits, so the load from 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., TSS, turbidity, sedimentation, bacteria, etc.) and water 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 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.

8.4.2 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 percent of the target load calculated in Table 8.4. Results are presented in Table 8.6. Additional details on the MOS are presented in Section 8.7.

Table 8.6 TMDL for Total Dissolved Solids

Location	WLA (lbs/day)	LA (lbs/day)	MOS (20%) (lbs/day)	TMDL (lbs/day)
Dry Cimarron River (OK bnd to Long Canyon)	0	1,906	476	2,382
Dry Cimarron River (Long Canyon to Oak Creek)	0	1,361	340	1,701

Notes: *values rounded to four significant figures

The extensive data collection and analyses necessary to determine background TDS loads for the Dry Cimarron River watershed were beyond the resources available for this study. It is therefore assumed that a portion of the LA is made up of natural background loads.

The load reductions necessary to meet the target loads were calculated to be the difference between the calculated TMDL (Table 8.4) and the measured loads (Table 8.5), and are shown in Table 8.7. These load reduction tables are presented for informational purposes only. However, it is important to note that WLAs and LAs are estimates based on a specific flow condition (i.e., 4Q3 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 water quality standards.

Table 8.7 Calculation of load reduction for Total Dissolved Solids

Assessment Unit	TMDL (lbs/day) [(a)]	Measured Load (lbs/day)	Load Reduction (lbs/day)	Percent Reduction[(b)]
Dry Cimarron River (OK bnd to Long Canyon)	1,906	2,838	932	33%
Dry Cimarron River (Long Canyon to Oak Creek)	1,361	1,758	397	23%

Note: 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 = TMDL - MOS
(b) Percent reduction is the percent the existing measured load must be reduced to achieve the TMDL, and is calculated as follows: (Measured Load – TMDL) / Measured Load x 100

8.5 Identification and Description of Pollutant Source(s)

Probable nonpoint sources that may be contributing to the observed load are displayed in Table 8.8:

Table 8.8 Pollutant source summary for TDS

Pollutant Sources	Magnitude[(a)]	Location	Probable Sources[(b)]
Point:			
Total Dissolved Solids	none	Dry Cimarron River (OK bnd to Long Canyon)	0%
	none	Dry Cimarron River (Long Canyon to Oak Creek)	0%
Nonpoint:			
Total Dissolved Solids	2,838 lbs	Dry Cimarron River (OK bnd to Long Canyon)	100% Drought-related impacts, flow alterations from water diversions, highway/road/bridge runoff (non-construction related), irrigated crop production, natural sources, waterfowl.[(c)]
	1,758 lbs	Dry Cimarron River (Long Canyon to Oak Creek)	100% Drought-related impacts, flow alterations from water diversions, irrigated crop production, natural sources, on-site treatment systems (septic systems and similar decentralized systems), rangeland grazing, wildlife other than waterfowl, waterfowl.[(c)]

Notes:
(a) Measured Load.
(b) From the 2008-2010 Integrated CWA 303(d)/305(b) list (NMED/SWQB 2008). 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) per public comment, "waterfowl" will be added to the 2010-2012 CWA Integrated §303(d)/§305(b) List.

Probable sources of TDS for these assessment units will be evaluated, refined, and changed as necessary through the Watershed Restoration Action Strategy (WRAS) process.

8.6 Linkage of Water Quality and Pollutant Sources

SWQB fieldwork includes an assessment of the probable sources of impairment (NMED/SWQB 2007). The sample Probable Sources field sheet in Appendix B 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 8.6 displays probable sources of nonpoint source impairments along the reach as determined by field reconnaissance and assessment. Appendix C provides relevant excerpts from the 2008-2010 Integrated CWA 303(d)/305(b) List which includes the probable sources associated with each Assessment Unit in the Dry Cimarron River watershed.

TDS refers to the total amount of all inorganic and organic substances – including minerals, salts, metals, anions, and cations – that are dispersed within a volume of water. Higher concentrations of TDS may occur during and after precipitation events. In the United States, elevated TDS has been due to natural environmental features such as mineral springs, carbonate deposits, salt deposits, and silt, the decomposition of leaves and plankton, and the weathering erosion of rocks. Other sources may include stormwater and agricultural runoff, mining operations, industrial wastewater, and sewage. Studies have shown that water with elevated TDS levels is detrimental to the growth and health of cattle. In studies, feed consumption decreased and water consumption increased (Patterson *et al*, 2003). Increased TDS can also affect aquatic organisms. TDS toxicity in freshwater organisms is due to osmotic stress and the impact on an organism's lack of the ability to continue osmoregulation (McCulloch *et al*, 1993).

The electrical conductivity of water is directly related to the concentration of dissolved solids in the water because TDS concentrations are equal to the sum of positively charged ions (cations) and negatively charged ions (anions) in the water. These relationships can be seen in Figures 8.1 and 8.2. These electrically charged dissolved particles make ordinary natural water a good conductor of electricity. Conversely, pure water has a high electrical resistance, and resistance is frequently used as a measure of its purity.

Conductivity in streams and rivers is affected primarily by the geology of the area through which the water flows. Streams that run through areas with granite bedrock tend to have lower conductivity because granite is composed of more inert materials that do not dissolve into ionic components when washed into the water. On the other hand, streams that run through areas with clay soils tend to have higher conductivity because of the presence of materials that ionize when washed into the water. Ground water inflows can have the same effects depending on the bedrock they flow through. In addition, discharges to streams can change the conductivity depending on their make-up. For example, a failing sewage system would raise the conductivity because of the presence of chloride, phosphate, and nitrate.

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.

Factors affecting TDS in a waterway include:

1. Increases or decreases in flow rates
   - heavy rains can pick up sand, silt, clay, and organic particles (such as leaves and soil) from the land and carry it to surface water destroying the aquatic habitat and harming and/or killing the aquatic life, but the actual concentration of TDS may decrease because of dilution by all that rainwater.
   - during low flow, there is not enough water in the stream for dilution to occur and TDS concentrations tend to increase. Therefore, sudden inputs of concentrated pollutant, especially during low flow periods, can cause significant negative impacts to aquatic organisms.

2. Soil erosion caused by disturbance of a land surface
   - increases TDS in the water
   - reduces transmission of sunlight needed for photosynthesis
   - interferes with animal behaviors dependent on sight (foraging, mating, and escape from predators)
   - impedes respiration (e.g., by gill abrasion in fish) and digestion
   - reduces oxygen in the water
   - destabilizes banks and promote erosion
   -

3. Clearing of trees and shrubs from shorelines
   - destabilizes banks and promote erosion
   - increases sedimentation and turbidity
   - reduces shade and increase water temperature which could disrupt fish metabolism
   - causes channels to widen and become more shallow, increasing temperatures

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 this TMDL. However, the degree to which sediment delivery and transport in these watershed 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 soils of the Dry Cimarron River Watershed are the primary source of sediment transport, the anthropogenic influence of the highway construction, channelization, land development, and historical rangeland grazing practices could be contributing to impairment, particularly in the Dry Cimarron River watershed.

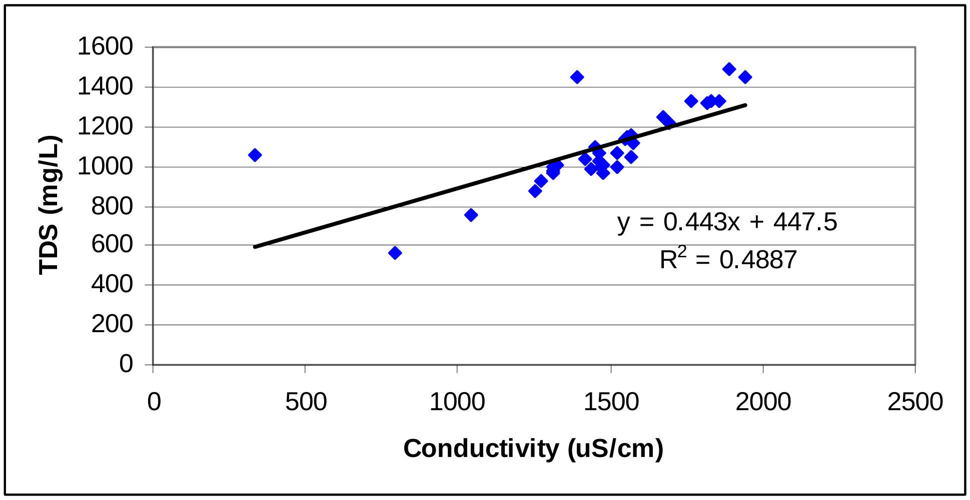


Figure 8.1 TDS and Conductivity for Dry Cimarron River (OK bnd to Long Canyon)

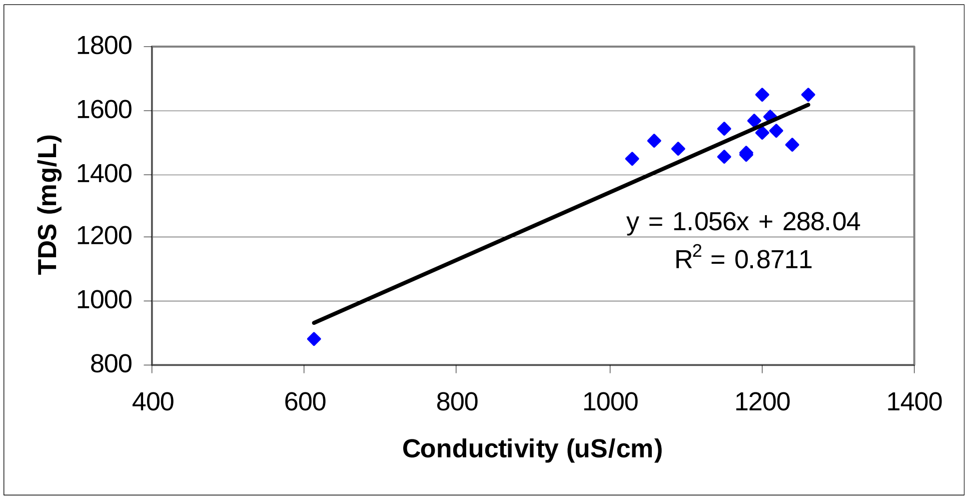


Figure 8.2 TDS and Conductivity for Dry Cimarron River (Long Canyon to Oak Creek)

8.7 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 TDS. This MOS incorporates several factors:

- *Errors in calculating nonpoint source loads*
  A level of uncertainity exists in sampling nonpoint sources of pollution. Techniques used for measuring concentrations in stream water can lead to inaccuracies in the data. Therefore, a conservative MOS for metals increases the TMDL by **10%.**

- *Errors in calculating flow*
  A 4Q3 flow value for this ungaged stream was estimated based on a regression equation from Waltemeyer (2002). There is inherent error in all flow calculations. A conservative MOS for this element is therefore **10 percent.**

8.8 Consideration of Seasonal Variation

Federal regulations (40 CFR §130.7(c)(1)) require that TMDLs take into consideration seasonal variation in watershed conditions and pollutant loading. During the 2006 water quality survey, TDS exceedences occurred at the beginning and the end of the sampling season. Higher flows may flush more nonpoint source runoff containing sediment. It is possible the criterion may be exceeded under a low flow condition when there is insufficient dilution. Evaluation of seasonal variability for potential nonpoint sources is difficult due to limited available data. Data used in the calculation of this TMDL were collected during the spring, summer, and fall of 2006 in order to ensure coverage of any potential seasonal variation in the system.

8.9 Future Growth

Growth estimates by county are available from the New Mexico Bureau of Business and Economic Research. These estimates project growth to the year 2030. The population of Union County in 2005 was 4,213 and is projected to be 3,947 in 2030. According to the calculations, the overwhelming source of TDS loading is from nonpoint sources. Estimates of future growth are not anticipated to lead to a significant increase in salinity concentrations that cannot be controlled with BMP implementation in this watershed. However, it is imperative that BMPs continue to be utilized and improved upon in this watershed while continuing to improve road conditions and grazing allotments and adhering to SWPPP requirements related to construction and industrial activities covered under the general permit.

9.0 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 methods for 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 monitored each year with an established return frequency of approximately every eight years. Based on an 8-year rotation throughout the state, the next tentatively scheduled monitoring date for the Dry Cimarron River watershed is 2015. 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 were directed toward those waters that are on the USEPA TMDL consent decree list (U.S. District Court for the District of New Mexico 1997), however NMED/SWQB completed the final remaining TMDL on the consent decree in December 2006 and USEPA approved this TMDL in August 2007. USEPA is currently working on officially closing out New Mexico's Consent Decree.

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, water quality 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 2008a).

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 routinely develops a 10-year monitoring strategy and submits it to USEPA. The strategy details 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 rotational cycle, which assumes the existing level of resources, the next time SWQB will sample the Dry Cimarron River watershed is during 2015.

It should be noted that a watershed would not be ignored during the years in between 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, 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 monitoring and short-term water quality surveys can both contribute to the State's Integrated §303(d)/§305(b) listing process for waters requiring TMDLs.

10.0 IMPLEMENTATION OF TMDLS

10.1 WRAS and BMP Coordination

Watershed public awareness and involvement will be crucial to the successful implementation of these plans to improve water quality. Staff from SWQB have work with stakeholders to develop a WRAS for the Dry Cimarron River Watershed. 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 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 as well as land owners, and other agencies in the implementation of this TMDL.

Implementation of BMPs within the watershed to reduce pollutant loading from nonpoint sources will be encouraged. Any reductions from point sources will be addressed in revisions to NPDES discharge permits. SWQB will communicate to designated federal land management agencies the intent of the TMDL and desire that BMPs be developed through the above coordination process.

10.2 Time Line

Table 10.1 details the proposed implementation timeline.

10.3 Clean Water Act §319(h) Funding Opportunities

The Watershed Protection Section of the SWQB manages a grant program of CWA §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 10.1 Proposed Implementation Timeline

Implementation Actions	Year 1 (2006)	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
TMDL Development				X				
WRAS Development						X		
Revise any NPDES permits as necessary (currently USEPA Region 6)				X				
Establish Performance Targets				X				
Secure Funding*								
Implement Management Measures (BMPs)							X	X
Monitor BMPs					X	X	X	X
Determine BMP Effectiveness					X	X	X	X
Reevaluate Performance Targets						X	X	X

*this item will depend on the 319(h) RFP process.

10.4 Other Funding Opportunities and Restoration Efforts in the Dry Cimarron River Basin

Several other sources of funding exist to address impairments discussed in this TMDL document. NMED's Construction Programs Bureau assists communities in need of funding for WWTP upgrades and improvements to septic tank configurations (such as the design of cluster systems). The Construction Programs Bureau can also provide matching funds for appropriate CWA §319(h) projects using state revolving fund monies. The United States Department of Agriculture (USDA) Environmental Quality Incentive Program (EQIP) program can provide assistance to private land owners in the basin. The USDA Forest Service aligns its mission to protect lands it manages with the TMDL process, and is another source of assistance. Also, the BLM has several programs in place to provide assistance to improve unpaved roads and grazing allotments.

11.0 ASSURANCES

New Mexico's Water Quality Act (Act) authorizes 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. (§74-6-10(A) NMSA 1978) 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 Subsection C of 20.6.4.62) (NMAC 2007) state:

> *Pursuant to Subsection A of Section 74-6-12 NMSA 1978, this part does not grant to the water quality control commission or to any other entity the power to 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. Proving causation by a nonpoint source of a violation of a water quality standard would be very difficult, and to date NMED has not brought an enforcement action on this basis. Instead, 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. NMED believes this is the best and most effective approach to addressing impairment of streams as a result of nonpoint source issues. 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 its efforts towards 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 previously established Memoranda of Understanding (MOUs) with various federal agencies, in particular the USFS and the Bureau of Land Management. MOUs in the past have also been developed with other State agencies, such as the New Mexico State Highway and Transportation Department. These MOUs provided 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 includes watershed projects that may not be starting immediately, and also contemplates response to earlier projects. This timeframe is intended to provide some measure of watershed response to projects but is not intended to be a fixed goal. Stakeholders in this process will include SWQB, and other stakeholders involved with the development and implementation of the WRAS. The cooperation of watershed stakeholders will be pivotal in the implementation of these TMDLs as well.

12.0 PUBLIC PARTICIPATION

Public participation was solicited in development of this TMDL (see Appendix D). Additional data was solicited via public notice July 30, 2007. The draft TMDL was made available for a 30-day comment period beginning on February 2, 2009 and ending on March 4, 2009 at 5pm MDT. Five sets of comments were received and formal Response to Comments are included as Appendix E of this document. The draft document notice of availability was extensively advertised via the SWQB email distribution list, webpage postings (www.nmenv.state.nm.us/swqb/DCR), and press releases to the Albuquerque Journal, Santa Fe New Mexican, and Raton Range. A public meeting was held on Thursday, February 19, 2009 in Folsom, NM at the Village Offices from 6-8pm with over 30 attendees.

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APPENDIX A
CONVERSION FACTOR DERIVATION

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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:

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

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APPENDIX B
PROBABLE SOURCE DOCUMENTATION

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Station ID:	Station Description:			
Field Crew: J. S. Hopkins	Comments:			
WQS Segment from 20.6.4 NMAC: 20.6.4.702		Assessment Unit: **Dry Cimarron River (Perennial reaches OK bnd to Long Canyon)**		
Ecoregion: 26f	Elevation: 4357'	Watershed Size: 1024	Latitude: 36.9175	Longitude: -103.027222
HQCW ALU	CW ALU	**WW ALU**	MWW ALU	L ALU
Is ALU correctly Identified?	**Yes**	No	What Should it be?	

Activity Checklist

Agriculture				
Permitted CAFOs	**0**	1	3	5
Crop Production (Cropland or Dry Land)	0	1	**3**	5
Drains 0		**1**	3	5
Irrigated Crop Production (Irrigation Equip)	0	1	3	**5**
Permitted Aquaculture	**0**	1 3		5
Other:	**0**	1 3		5

Rangeland				
Cattle/Livestock Use	0	1	3	**5**
Rangeland Grazing	0	1	3	**5**
Other:	0	1	3	5

Industrial/ Municipal				
Industrial Stormwater Discharge (permitted)	**0**	1 3		5
Storm water Runoff due to Construction	**0**	1 3		5
Industrial Point Source Discharge	**0**	1 3		5
Landfill	**0**	1 3		5
Municipal Point Source Discharge	**0**	1 3		5
On-Site Treatment Systems (Septic, etc.)	0	1	**3**	5
Pavement/ /Impervious Surfaces	**0**	1	3	5
Inappropriate Waste Disposal	**0**	1 3		5
RCRA/Superfund Site	**0**	1 3		5
Residences/Buildings	0	1	**3**	5
Sewage/Pipes/Outfalls	**0**	1	3	5
Site Clearance (Land Development)	**0**	1 3		5
Urban Runoff/Storm Sewers	**0**	1	3	5
Power Plants/ Atmospheric Deposition	**0**	1 3		5
Other: 0		1	3	5

Resource Extraction				
Abandoned Mines (Inactive)/Tailings	**0**	1 3		5
Acid Mine Drainage	**0**	1 3		5
Active Mines (Placer/Potash/Other -- circle)	**0**	1 3		5
Oil/Gas Activities (Permitted/Legacy – circle)	**0**	1 3		5
Reclamation of Inactive Mines	**0**	1 3		5
Other:	**0**	1 3		5

Roads				
Bridges/Culverts/RR Crossings	0	1	3	**5**
Low Water Crossing	0	1	3	**5**
Paved Roads	0	1	**3**	5
Gravel Roads	0	1	3	**5**
Dirt Roads	0	1	3	**5**
Other: 0		1	3	5

Silviculture				
Logging Ops – Active Harvesting	**0**	1 3		5
Logging Ops – Legacy	**0**	1 3		5
Fire Suppression (Thinning/Chemicals)	**0**	1 3		5
Other:				

Hydromodifications				
Channelization	0	1	3	**5**
Dams/Diversions 0		1	3	**5**
Draining/Filling Wetlands	**0**	1 3		5
Dredging	**0**	1 3		5
Irrigation Return Drains	0	1	3	**5**
Riprap/Wall/Dike/Jetty Jack -- circle	**0**	1 3		5
Flow Alteration (from Water Diversions/Dam Ops – circle)	0 1		3	**5**
Highway/Road/Bridge Runoff	0	1	3	**5**
Other:	0	1	3	5

Miscellaneous				
Angling Pressure	**0**	1 3		5
Dumping/Garbage/Trash/Litter	**0**	1 3		5
Exotic Plant Species	0	1	3	**5**
Fish Stocking	**0**	1 3		5
Hiking Trails	**0**	1 3		5
Campgrounds (Dispersed/Defined – circle)	**0**	1 3		5
Waste From Pets	**0**	1 3		5
Surface Films/Odors	**0**	1 3		5
Pesticide Application (Algaecide/Insecticide)	**0**	1 3		5
Other:	0	1	3	5

Habitat Modification				
Exotics Removal	**0**	1 3		5
Incised	0	1	3	**5**
Mass Wasting	0	1	3	**5**
Restoration	**0**	1 3		5
Other:	0	1	3	5

Natural Disturbance or Occurrence				
Waterfowl	0	1	3	**5**
Drought-related Impacts	0	1	3	**5**
Watershed Runoff Following Forest Fire	**0**	1 3		5
Bankfull Flows	0	1	3	**5**
Overbank Flows	0	1	3	**5**
Wildlife other than Waterfowl	0	1	3	**5**
Other Natural Sources:	0	1	3	5

Station ID:	Station Description:
Field Crew: J. S. Hopkins	Comments:

WQS Segment from 20.6.4 NMAC: 20.6.4.702	Assessment Unit: **Dry Cimarron River (Perennial reaches Long Canyon to Oak Cr)**

Ecoregion: 26f	Elevation: 5131'	Watershed Size: 419	Latitude: 36.936667	Longitude: -103.5650
HQCW ALU	CW ALU	**WW ALU**	MWW ALU	L ALU

Is ALU correctly Identified?	**Yes**	No	What Should it be?

Activity Checklist

Agriculture

Permitted CAFOs	**0**	1	3	5
Crop Production (Cropland or Dry Land)	0	1	**3**	5
Drains 0		1	3	**5**
Irrigated Crop Production (Irrigation Equip)	0	1	3	**5**
Permitted Aquaculture	**0**	1 3		5
Other:	**0**	1 3		5

Rangeland

Cattle/Livestock Use	0	1	3	**5**
Rangeland Grazing	0	1	3	**5**
Other:	0	1	3	5

Industrial/ Municipal

Industrial Stormwater Discharge (permitted)	**0**	1 3		5
Storm water Runoff due to Construction	**0**	1 3		5
Industrial Point Source Discharge	**0**	1 3		5
Landfill	**0**	1 3		5
Municipal Point Source Discharge	**0**	1 3		5
On-Site Treatment Systems (Septic, etc.)	0	1	**3**	5
Pavement/ /Impervious Surfaces	**0**	1	3	5
Inappropriate Waste Disposal	**0**	1 3		5
RCRA/Superfund Site	**0**	1 3		5
Residences/Buildings 0		1	**3**	5
Sewage/Pipes/Outfalls	**0**	1	3	5
Site Clearance (Land Development)	**0**	1 3		5
Urban Runoff/Storm Sewers	**0**	1	3	5
Power Plants/ Atmospheric Deposition	**0**	1 3		5
Other: 0		1	3	5

Resource Extraction

Abandoned Mines (Inactive)/Tailings	**0**	1 3		5
Acid Mine Drainage	**0**	1 3		5
Active Mines (Placer/Potash/Other -- circle)	**0**	1 3		5
Oil/Gas Activities (Permitted/Legacy – circle)	**0**	1 3		5
Reclamation of Inactive Mines	**0**	1 3		5
Other:	**0**	1 3		5

Roads

Bridges/Culverts/RR Crossings	0	1	3	**5**
Low Water Crossing	0	1	3	**5**
Paved Roads	**0**	1 3		5
Gravel Roads	0	1	3	**5**
Dirt Roads	0	1	3	**5**
Other: 0		1	3	5

Silviculture

Logging Ops – Active Harvesting	**0**	1 3		5
Logging Ops – Legacy	**0**	1 3		5
Fire Suppression (Thinning/Chemicals)	**0**	1 3		5
Other:				

Hydromodifications

Channelization	0	1	3	**5**
Dams/Diversions 0		1	3	**5**
Draining/Filling Wetlands	**0**	1 3		5
Dredging	**0**	1 3		5
Irrigation Return Drains	0	1	3	**5**
Riprap/Wall/Dike/Jetty Jack -- circle	**0**	1 3		5
Flow Alteration (from Water Diversions/Dam Ops – circle)	0 1		3	**5**
Highway/Road/Bridge Runoff	0	1	3	**5**
Other:	0	1	3	5

Miscellaneous

Angling Pressure	**0**	1 3		5
Dumping/Garbage/Trash/Litter	**0**	1 3		5
Exotic Plant Species	0	1	3	**5**
Fish Stocking	**0**	1 3		5
Hiking Trails	**0**	1 3		5
Campgrounds (Dispersed/Defined – circle)	**0**	1 3		5
Waste From Pets	**0**	1 3		5
Surface Films/Odors	**0**	1 3		5
Pesticide Application (Algaecide/Insecticide)	**0**	1 3		5
Other:	0	1	3	5

Habitat Modification

Exotics Removal	**0**	1 3		5
Incised	0	1	3	**5**
Mass Wasting	0	1	3	**5**
Restoration	**0**	1 3		5
Other:	0	1	3	5

Natural Disturbance or Occurrence

Waterfowl	0	1	3	**5**
Drought-related Impacts	0	1	3	**5**
Watershed Runoff Following Forest Fire	**0**	1 3		5
Bankfull Flows	0	1	3	**5**
Overbank Flows	0	1	3	**5**
Wildlife other than Waterfowl	0	1	3	**5**
Other Natural Sources:	0	1	3	5

Station ID:		Station Description:						
Field Crew: J. S. Hopkins		Comments: Deeply incised, interrupted stream.						
WQS Segment from 20.6.4 NMAC: 20.6.4.702				Assessment Unit: **Long Canyon (Perennial reaches abv Dry Cimarron)**				
Ecoregion: 26f	Elevation: 5177’	Watershed Size: 129		Latitude: 36.9450		Longitude: -103.59444		
HQCW ALU	CW ALU	**WW ALU**		MWW ALU		L ALU		
Is ALU correctly Identified?		**Yes**	No	What Should it be?				

Activity Checklist

Agriculture

Permitted CAFOs	**0**	1	3	5
Crop Production (Cropland or Dry Land)	**0**	1	3	5
Drains	**0**	1	3	5
Irrigated Crop Production (Irrigation Equip)	**0**	1 3		5
Permitted Aquaculture	**0**	1 3		5
Other:	**0**	1 3		5

Rangeland

Cattle/Livestock Use	0	1	3	**5**
Rangeland Grazing	0	1	3	**5**
Other:	0	1	3	5

Industrial/ Municipal

Industrial Stormwater Discharge (permitted)	**0**	1	3	5
Storm water Runoff due to Construction	**0**	1 3		5
Industrial Point Source Discharge	**0**	1 3		5
Landfill	**0**	1 3		5
Municipal Point Source Discharge	**0**	1 3		5
On-Site Treatment Systems (Septic, etc.)	**0**	1 3		5
Pavement/ /Impervious Surfaces	**0**	1	3	5
Inappropriate Waste Disposal	**0**	1 3		5
RCRA/Superfund Site	**0**	1 3		5
Residences/Buildings	**0**	**1**	3 5	
Sewage/Pipes/Outfalls	**0**	1	3	5
Site Clearance (Land Development)	**0**	1 3		5
Urban Runoff/Storm Sewers	**0**	1	3	5
Power Plants/ Atmospheric Deposition	**0**	1 3		5
Other: 0		1	3	5

Resource Extraction

Abandoned Mines (Inactive)/Tailings	**0**	1 3		5
Acid Mine Drainage	**0**	1 3		5
Active Mines (Placer/Potash/Other -- circle)	**0**	1 3		5
Oil/Gas Activities (Permitted/Legacy – circle)	**0**	1 3		5
Reclamation of Inactive Mines	**0**	1 3		5
Other:	**0**	1 3		5

Roads

Bridges/Culverts/RR Crossings	**0**	1 3		**5**
Low Water Crossing	0	1	3	**5**
Paved Roads	**0**	1 3		5
Gravel Roads	0	1	3	**5**
Dirt Roads	0	1	3	**5**
Other: 0		1	3	5

Silviculture

Logging Ops – Active Harvesting	**0**	1 3		5
Logging Ops – Legacy	**0**	1 3		5
Fire Suppression (Thinning/Chemicals)	**0**	1 3		5
Other:				

Hydromodifications

Channelization	**0**	1 3		5
Dams/Diversions	**0**	1 3		5
Draining/Filling Wetlands	**0**	1 3		5
Dredging	**0**	1 3		5
Irrigation Return Drains	**0**	1 3		5
Riprap/Wall/Dike/Jetty Jack -- circle	**0**	1 3		5
Flow Alteration (from Water Diversions/Dam Ops – circle)	**0**	1 3		5
Highway/Road/Bridge Runoff	0	1	3	**5**
Other:	0	1	3	5

Miscellaneous

Angling Pressure	**0**	1 3		5
Dumping/Garbage/Trash/Litter	**0**	1 3		5
Exotic Plant Species	0	1	3	**5**
Fish Stocking	**0**	1 3		5
Hiking Trails	**0**	1 3		5
Campgrounds (Dispersed/Defined – circle)	**0**	1 3		5
Waste From Pets	**0**	1 3		5
Surface Films/Odors	**0**	1 3		5
Pesticide Application (Algaecide/Insecticide)	**0**	1 3		5
Other:	0	1	3	5

Habitat Modification

Exotics Removal	**0**	1 3		5
Incised	0	1	3	**5**
Mass Wasting	0	1	3	**5**
Restoration	**0**	1 3		5
Other:	0	1	3	5

Natural Disturbance or Occurrence

Waterfowl	**0**	1 3		5
Drought-related Impacts	0	1	3	**5**
Watershed Runoff Following Forest Fire	**0**	1 3		5
Bankfull Flows	0	1	3	**5**
Overbank Flows	**0**	1 3		5
Wildlife other than Waterfowl	0	1	3	**5**
Other Natural Sources:	0	1	3	5

Station ID:	Station Description:
Field Crew: J. S. Hopkins	*Comments: Only a very short reach between the confluence with the Dry Cimarron and SR 456 can hold cold water species, and then only when beaver are present. No beaver in 2006.

WQS Segment from 20.6.4 NMAC: 20.6.4.701	Assessment Unit: **Oak Creek (Dry Cimarron to headwaters)**

Ecoregion: 26f	Elevation: 5997’	Watershed Size: 23	Latitude: 36.89986	Longitude: -103.85880
HQCW ALU	MCW ALU	**WW ALU**	MWW ALU	L ALU

Is ALU correctly Identified?	Yes	**No**	What Should it be? WWALU* See comment above

Activity Checklist

Agriculture				
Permitted CAFOs	**0**	1	3	5
Crop Production (Cropland or Dry Land)	0 1		**3**	5
Drains 0		1	3	**5**
Irrigated Crop Production (Irrigation Equip)	**0**	1 3		5
Permitted Aquaculture	**0**	1 3		5
Other:	**0**	1 3		5
Rangeland				
Cattle/Livestock Use	0	1	3	**5**
Rangeland Grazing	0	1	3	**5**
Other:	0	1	3	5
Industrial/ Municipal				
Industrial Stormwater Discharge (permitted)	**0**	1 3		5
Storm water Runoff due to Construction	**0**	1 3		5
Industrial Point Source Discharge	**0**	1 3		5
Landfill	**0**	1 3		5
Municipal Point Source Discharge	**0**	1 3		5
On-Site Treatment Systems (Septic, etc.)	**0**	1 3		5
Pavement/ /Impervious Surfaces	**0**	1	3	5
Inappropriate Waste Disposal	**0**	1 3		5
RCRA/Superfund Site	**0**	1 3		5
Residences/Buildings 0		**1**	3 5	
Sewage/Pipes/Outfalls	**0**	1	3	5
Site Clearance (Land Development)	**0**	1 3		5
Urban Runoff/Storm Sewers	**0**	1	3	5
Power Plants/ Atmospheric Deposition	**0**	1 3		5
Other: 0		1	3	5
Resource Extraction				
Abandoned Mines (Inactive)/Tailings	**0**	1 3		5
Acid Mine Drainage	**0**	1 3		5
Active Mines (Placer/Potash/Other -- circle)	**0**	1 3		5
Oil/Gas Activities (Permitted/Legacy – circle)	**0**	1 3		5
Reclamation of Inactive Mines	**0**	1 3		5
Other:	**0**	1 3		5
Roads				
Bridges/Culverts/RR Crossings	0	1	3	**5**
Low Water Crossing	0	1	3	**5**
Paved Roads	0	1	3	**5**
Gravel Roads	0	1	3	**5**
Dirt Roads	0	1	3	**5**
Other: 0		1	3	5

Silviculture				
Logging Ops – Active Harvesting	**0**	1 3		5
Logging Ops – Legacy	**0**	1 3		5
Fire Suppression (Thinning/Chemicals)	**0**	1 3		5
Other:				
Hydromodifications				
Channelization	0	1	3	**5**
Dams/Diversions 0		1	3	**5**
Draining/Filling Wetlands	**0**	1 3		5
Dredging	**0**	1 3		5
Irrigation Return Drains	**0**	1 3		5
Riprap/Wall/Dike/Jetty Jack -- circle	**0**	1 3		5
Flow Alteration (from Water Diversions/Dam Ops – circle)	0 1		3	**5**
Highway/Road/Bridge Runoff	0	1	3	**5**
Other:	0	1	3	5
Miscellaneous				
Angling Pressure	**0**	1 3		5
Dumping/Garbage/Trash/Litter	**0**	1 3		5
Exotic Plant Species	0	1	3	**5**
Fish Stocking	**0**	1 3		5
Hiking Trails	**0**	1 3		5
Campgrounds (Dispersed/Defined – circle)	**0**	1 3		5
Waste From Pets	**0**	1 3		5
Surface Films/Odors	**0**	1 3		5
Pesticide Application (Algaecide/Insecticide)	**0**	1 3		5
Other:	0	1	3	5
Habitat Modification				
Exotics Removal	**0**	1 3		5
Incised	**0**	1 3		5
Mass Wasting	**0**	1 3		5
Restoration	**0**	1 3		5
Other:	0	1	3	5
Natural Disturbance or Occurrence				
Waterfowl	0	1	3	**5**
Drought-related Impacts	0	1	3	**5**
Watershed Runoff Following Forest Fire	**0**	1 3		5
Bankfull Flows	0	1	3	**5**
Overbank Flows	0	1	3	**5**
Wildlife other than Waterfowl	0	1	3	**5**
Other Natural Sources:	0	1	3	5

Legend – Proximity Score

Activity Absent	0	Activity present in Watershed and within 15 km	3
Activity present in Watershed	1	Activity present < 10 m away, on banks or in channel	5

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APPENDIX C
SELECTIONS FROM 2008-2010 CWA §303 (d)/305(b) List

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2008 - 2010
State of New Mexico CWA 303(d)/305(b) Integrated List
of Assessed Surface Waters

HUC: 11040001 Cimarron Headwaters

Carrizozo Creek (Dry Cimarron to headwaters) Cimarron Headwaters

Assessment Unit ID:	Size (mi or ac):	WQS reference:	Monitoring Schedule:	Cycle Last Assessed:	IR Category:
NM-2701_40	44.79	20.6.4.701	2015	2008	3

Use Information:

Designated Use (s):	Attainment:
Coldwater Aquatic Life	Not Assessed
Irrigation	Not Assessed
Livestock Watering	Not Assessed
Secondary Contact	Not Assessed
Wildlife Habitat	Not Assessed

Assessment Information:

Assessment Unit Comments:

As of the date of this review (4/4/08), EPA Region 6 has not approved the 2005 triennial proposal to create WQ standard segment 20.6.4.702 under which this AU would fall. Therefore, this AU still falls under 20.6.4.701 and the associated designated uses to make 2008 impairment determinations. This AU may not be perennial.

Dry Cimarron R (Perennial reaches OK bnd to Long Canyon) Cimarron Headwaters

Assessment Unit ID:	Size (mi or ac):	WQS reference:	Monitoring Schedule:	Cycle Last Assessed:	IR Category:
NM-2701_00	56	20.6.4.701	2015	2008	5/5A

Use Information:

Designated Use (s):	Attainment:
Coldwater Aquatic Life	Not Supporting
Irrigation	Fully Supporting
Livestock Watering	Fully Supporting
Secondary Contact	Fully Supporting
Wildlife Habitat	Fully Supporting

Assessment Information:

Probable Causes of Impairment:	TMDL Schedule:
Oxygen, Dissolved	2008
Sulfates	2008
Temperature, water	2008
Total Dissolved Solids	2008

Probable Sources of Impairment:

Drought-related Impacts
Flow Alterations from Water Diversions
Highway/Road/Bridge Runoff (Non-construction Related)
Irrigated Crop Production
Natural Sources

Assessment Unit Comments:

As of the date of this review (4/4/08), EPA Region 6 has not approved the 2005 triennial proposal to create WQ standard segment 20.6.4.702 under which this AU would fall. Therefore, this AU still falls under 20.6.4.701 and the associated designated uses to make 2008 impairment determinations. Both the temperature and dissolved oxygen impairments were measured at station DCR at Wiggins Road which has wetland characteristics and may not be representative of the rest of the AU.

Dry Cimarron River (Long Canyon to Oak Ck) — Cimarron Headwaters

Assessment Unit ID:	Size (mi or ac):	WQS reference:	Monitoring Schedule:	Cycle Last Assessed:	IR Category:
NM-2701_02	21.65	20.6.4.701	2015	2008	5

Use Information:

Designated Use (s):	Attainment:
Coldwater Aquatic Life	Not Supporting
Irrigation	Fully Supporting
Livestock Watering	Fully Supporting
Secondary Contact	Not Supporting
Wildlife Habitat	Fully Supporting

Assessment Information:

Probable Causes of Impairment:	TMDL Schedule:
E. coli	2008
Total Dissolved Solids	2008

Probable Sources of Impairment:

Drought-related Impacts
Flow Alterations from Water Diversions
Irrigated Crop Production
Natural Sources
On-site Treatment Systems (Septic Systems and Similar Decencentralized Systems)
Rangeland Grazing
Wildlife Other than Waterfowl

Assessment Unit Comments:

As of the date of this review (4/4/08), EPA Region 6 has not approved the 2005 triennial proposal to create WQ standard segment 20.6.4.702 under which this AU would fall. Therefore, this AU still falls under 20.6.4.701 and the associated designated uses to make 2008 impairment determinations.

Dry Cimarron River (Oak Creek to headwaters) — Cimarron Headwaters

Assessment Unit ID:	Size (mi or ac):	WQS reference:	Monitoring Schedule:	Cycle Last Assessed:	IR Category:
NM-2701_01	15.16	20.6.4.701	2015	2008	1

Use Information:

Designated Use (s):	Attainment:
Coldwater Aquatic Life	Fully Supporting
Irrigation	Fully Supporting
Livestock Watering	Fully Supporting
Secondary Contact	Fully Supporting
Wildlife Habitat	Fully Supporting

Assessment Information:

Assessment Unit Comments: As of the date of this review (4/4/08), EPA Region 6 has not approved the 2005 triennial proposal to change the aquatic life use from CWAL to MCWAL and WWAL. Therefore, CWAL is still in effect and was the ALU used for the 2008 impairment determinations.

Long Canyon (Perennial reaches abv Dry Cimarron) **Cimarron Headwaters**

Assessment Unit ID:	Size (mi or ac):	WQS reference:	Monitoring Schedule:	Cycle Last Assessed:	IR Category:
NM-2701_20	8.21	20.6.4.701	2015	2008	5

Use Information:

Designated Use (s):	Attainment:
Coldwater Aquatic Life	Not Supporting
Irrigation	Fully Supporting
Livestock Watering	Fully Supporting
Secondary Contact	Not Supporting
Wildlife Habitat	Not Supporting

Assessment Information:

Probable Causes of Impairment:	TMDL Schedule:
E. coli	2008
Selenium	2008
Temperature, water	2008

Probable Sources of Impairment:

Drought-related Impacts
Highway/Road/Bridge Runoff (Non-construction Related)
Natural Sources
Rangeland Grazing
Streambank Modifications/destablization
Wildlife Other than Waterfowl

Assessment Unit Comments:

As of the date of this review (4/4/08), EPA Region 6 has not approved the 2005 triennial proposal to create WQ standard segment 20.6.4.702 under which this AU would fall. Therefore, this AU still falls under 20.6.4.701 and the associated designated uses to make 2008 impairment determinations.

Oak Creek (Dry Cimarron to headwaters) — Cimarron Headwaters

Assessment Unit ID:	Size (mi or ac):	WQS reference:	Monitoring Schedule:	Cycle Last Assessed:	IR Category:
NM-2701_10	11.72	20.6.4.701	2015	2008	5

Use Information:

Designated Use (s):	Attainment:
Coldwater Aquatic Life	Not Supporting
Irrigation	Fully Supporting
Livestock Watering	Fully Supporting
Secondary Contact	Not Supporting
Wildlife Habitat	Fully Supporting

Assessment Information:

Probable Causes of Impairment:	TMDL Schedule:
E. coli	2008
Nutrient/Eutrophication Biological Indicators	2008

Probable Sources of Impairment:

Crop Production (Crop Land or Dry Land)
Drought-related Impacts
Flow Alterations from Water Diversions
Rangeland Grazing
Wildlife Other than Waterfowl

Assessment Unit Comments:

As of the date of this review (4/4/08), EPA Region 6 has not approved the 2005 triennial proposal to change the aquatic life use from CWAL to MCWAL and WWAL. Therefore, CWAL is still in effect and was the ALU used for the 2008 impairment determinations.

APPENDIX D
PUBLIC PARTICIPATION FLOWCHART

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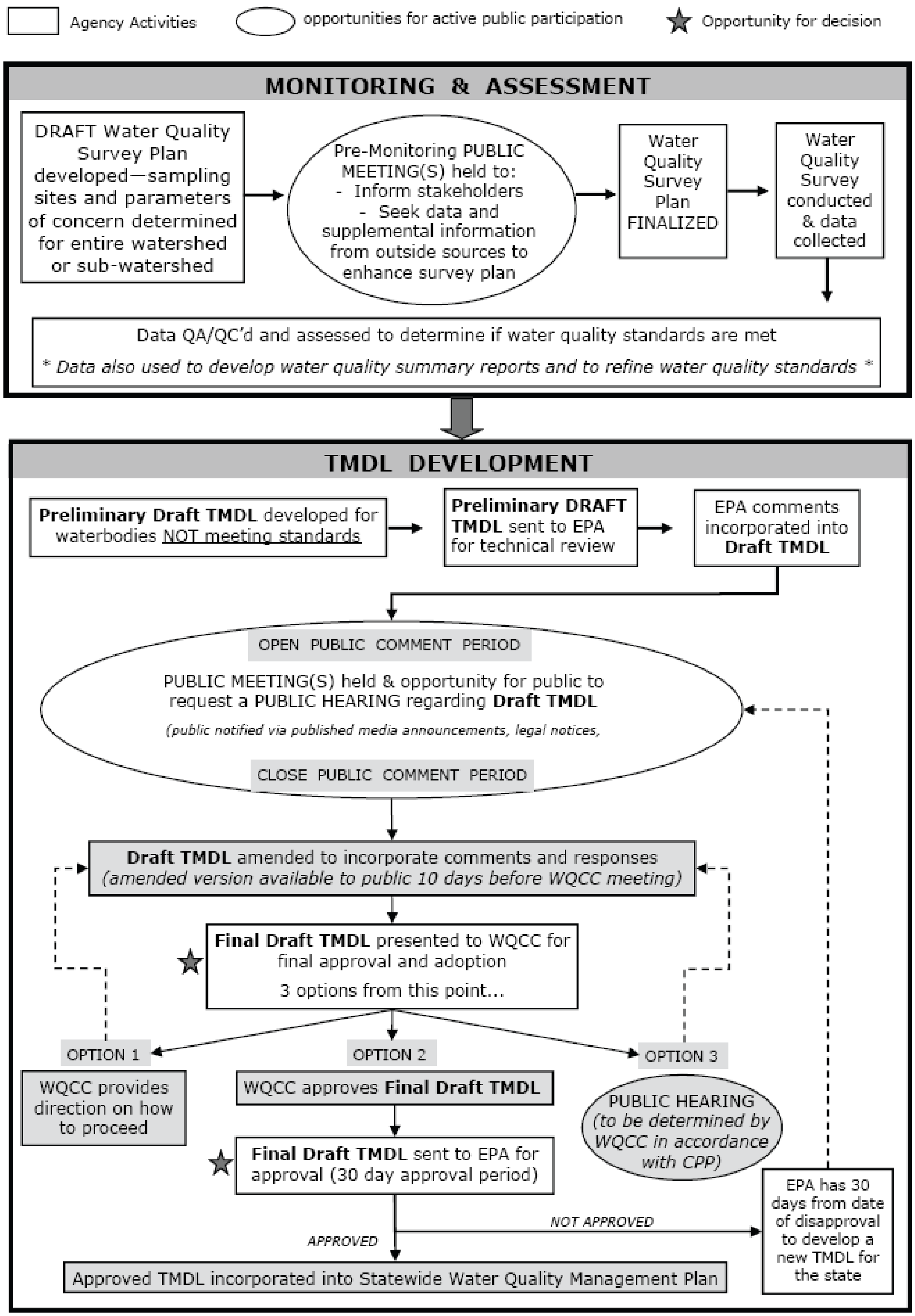
Monitoring, Assessment, & TMDL Development Process



NEW MEXICO
ENVIRONMENT DEPARTMENT

Surface Water Quality Bureau

Harold Runnels Building
1190 St. Francis Dr., Santa Fe, NM 87505
Phone (505) 827-0187 Fax (505) 827-0160
www.nmenv.state.nm.us

BILL RICHARDSON
Governor
DIANE DENISH
Lieutenant

RON CURRY
Secretary
JON GOLDSTEIN
Deputy Secretary

THE NEW MEXICO ENVIRONMENT DEPARTMENT, SURFACE WATER QUALITY BUREAU PROPOSES TOTAL MAXIMUM DAILY LOADS (TMDLs) FOR THE DRY CIMARRON RIVER WATERSHED

NOTICE OF A 30-DAY PUBLIC COMMENT PERIOD AND COMMUNITY MEETINGS

The New Mexico Environment Department's (NMED) Surface Water Quality Bureau (SWQB) is inviting the public to comment on the draft "total maximum daily load" (TMDL) document for the Dry Cimarron River Watershed. Draft TMDLs in this document include:

Bacteria- Dry Cimarron River (Long Canyon to Oak Creek)
Bacteria- Long Canyon (perennial reaches above Dry Cimarron)
Bacteria- Oak Creek (Dry Cimarron to headwaters),
Plant Nutrients- Oak Creek (Dry Cimarron to headwaters),
Selenium- Long Canyon (perennial reaches above Dry Cimarron),
Sulfate- Dry Cimarron River (perennial reaches OK bnd to Long Canyon)
Total Dissolved Solids- Dry Cimarron River (perennial reaches OK bnd to Long Canyon)
Total Dissolved Solids- Dry Cimarron River (Long Canyon to Oak Creek)

A TMDL is a planning document that establishes specific goals to meet water quality standards in waterbodies where pollutant limits are exceeded. It includes current pollution loadings, reduction estimates for pollutants, information on probable sources of pollution, and suggestions to restore or protect the health of the waterbody.

The 30-day comment period on this document will open February 2, 2009 and will close March 4, 2009 at 5:00 p.m. MST. Formal comments for inclusion in the public record must be submitted in writing, to **Heidi Henderson** mailing address **NMED SWQB, P.O. Box 26110, Santa Fe, NM, 87502; voice: 505-827-2901; fax number (505) 827-0160; or e-mail: heidi.henderson@state.nm.us** (if possible, please submit an electronic copy in addition to paper).

A public meeting will be held to summarize the information and to provide a forum for interested parties to ask questions and provide comments. The meeting date will allow the public time to review the document and generate questions or comments. The meeting will be held in Folsom, NM on Thursday, February 19th from 6-8pm at the Folsom Village Offices.

Following the close of the comment period, copies of the draft final document will be:

- mailed to all persons who submitted written comments by March 4, 2009 at 5pm and
- available electronically on the bureau's website or by contacting the bureau at the address above.

The SWQB plans to request approval of the draft final TMDLs at the Water Quality Control Commission's (WQCC) regularly scheduled meeting on April 14, 2009. WQCC agendas are available at: http://www.nmenv.state.nm.us/wqcc/index.html.

Persons having a disability and needing help in being a part of this hearing process should contact Judy Bentley at least 10 days before event, at the NMED, Human Resources Bureau, P.O. Box 26110, 1190 St. Francis Drive, Santa Fe, New Mexico, 87502, telephone 505-827-9872. TDY users please access her number via the New Mexico Relay Network at 1-800-659-8331.

For more information, please contact Heidi Henderson at the address or phone number provided above.

New Mexico Environment Department

Protecting Our Environment, Preserving The Enchantment

Surface Water Quality Bureau

1190 St. Francis Dr, Santa Fe, NM 87106 / 505-827-0187 / www.nmenv.state.nm.us/swqb

The NMED Surface Water Quality Bureau invites you to attend a:

COMMUNITY MEETING

Thursday, February 19, 2009
6:00 - 8:00 PM
Folsom, New Mexico
Village Offices

Dry Cimarron Watershed

♦♦♦♦♦♦♦♦♦♦♦♦♦♦♦♦♦♦♦♦♦♦♦♦♦♦♦♦♦♦♦♦♦

TMDL Document Presentation

DISCUSSION TOPICS

Total Maximum Daily Load (TMDL) development for the Dry Cimarron watershed

•

Discussion of survey results from 2006 water quality monitoring

•

Current and future water quality restoration projects in watershed.

For more information contact:
Heidi Henderson at 505-827-2901 heidi.henderson@state.nm.us

The State of Our Environment is up to You

APPENDIX E
RESPONSE TO COMMENTS

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Changes made during public comment period based on staff review:

1. Public participation information was updated in Section 12 based on the public meeting events that occurred after the Public Comment Draft TMDL was released for public comment.

2. EPA R6 requested that the "Priority Ranking" line in the Executive Summary tables be added back into the TMDL document template.

3. A thermograph was deployed at Long Canyon (02LongCa004.1) from April 25, 2008 through August 6, 2008. A second thermograph was deployed on August 6, 2008 and retrieved March 3, 2009. At the time of the release of the Public Comment Draft TMDL on February 2, 2009, only the data from the first thermograph was available. The second thermograph has since been retrieved and the additional data are included in Section 3.2 of the Final Draft TMDL.

4. Minor editorial changes noted by staff have been corrected.

Comment Set A:

From: Henry and Marlene Brown [brownmnh@bacavalley.com]
To: Heidi Henderson, NMENV
Subject: comments on Dry Cimarron TMDL
Sent: Wednesday 2/25/2009 9:31 AM

Attachment: tmdl comments (25 KB)

Please find attached comments concerning the draft Dry Cimarron TMDL.

I enjoyed the presentation in Folsom and found everything to be quite informative, I would like to be kept informed on this total process.

Thank you,
Henry Brown

Attachment:

T0: Surface Water Quality Bureau

Re: Comments on Dry Cimarron River TMDL's

From: Henry A. Brown
536 Long Canyon Road
Folsom, NM 88419
brownmnh@bacavalley.com

Most of my comments will concern the tributary, Long Canyon, as that is where I have lived and ranched all my life.

Long Canyon needs to be classified as a warm water body, or at the very least cool water. During the summer the daily temperatures can exceed 100 F, for most of July and August. Wildlife that I have observed in the creek include; Channel catfish, Snapping turtles, Soft shell turtles, Minnows, Muskrat, Ducks , Turkeys, Deer (white tail and mule), and Elk. Beaver have been present in the past but are not there now. Cattle ranching and wild hay production also occur in places.

I believe the excessive air temperatures and traditional low flow during the hot summer months will lead to exceedances of certain "pollutants".

It seems in Long Canyon that the exceedences come from natural sources as no point source pollution is observed. As more years of data are collected, comparisons and base line information will be available.

In conclusion, I agree with the designated uses and the approved testing procedures, but feel that the designation as cold water is incorrect, include waterfowl as a probable source of nutrients, and continue testing. As budgets allow we need to look further out in the watershed for answers instead of in the creek bottom itself.

Thank you for the opportunity to comment on the draft document.

SWQB Response: *Thank you for your written comments and attendance at the public meeting on February 19, 2009 in Folsom, NM. First, based on your comments and the overwhelming concern at the public meeting regarding waterfowl as a probable source in the watershed, the category "waterfowl" will be added to the upcoming 2010-2012 Integrated List as a probable source for Long Canyon. This change has also been noted in the "Identification and Description of Pollutant Sources" sections in the TMDL document as well as the Executive Summary. SWQB appreciates this local stakeholder input during the development of the list of probable sources.*

Second, you are correct that there are no observed point sources in the Long Canyon watershed to account for the E.coli or selenium impairments. It is not uncommon for the SWQB to develop TMDL documents for pollutants for which there are no point sources. You are also correct that more data is needed to effectively discuss the probable sources of these impairments and SWQB hopes to continue to work with the stakeholders in the Dry Cimarron River watershed in order compile a more complete dataset.

Lastly, SWQB recognizes that further discussion is needed regarding the appropriate temperature criteria and designated aquatic life uses for Long Canyon and the Dry Cimarron watershed as a whole. The current temperature criterion of 25ºC (77 ºF) has always been higher than the coldwater criterion of 20 ºC (68 ºF) applicable to most streams with a designated coldwater aquatic life use in the state, but it may nevertheless be too stringent for some portions of the DCR watershed. However, the warmwater criterion of 32.2ºC (90ºF) may be too warm to be fully protective. In order for EPA to approve a change to less stringent criteria, the state must demonstrate what conditions are "attainable" given natural conditions and the implementation of reasonable best management practices that could improve watershed conditions. SWQB is proposing a new "coolwater" aquatic life use as part of the current triennial review of water quality standards. If it is approved, SWQB will consider its application to various streams throughout the state, including appropriate portions of the DCR watershed. Whether or not the coolwater use is approved, SWQB is committed to working with stakeholders to acquire and analyze data and other information as needed to identify the attainable designated uses and temperature criteria for the watershed.

For more information on the triennial review, including SWQB's coolwater and other proposals related to the DCR, please see SWQB's water quality standards website at http://www.nmenv.state.nm.us/SWQB/Standards/index.html. You may also contact Pam Homer, SWQB's Water Quality Standards Coordinator, at 505-827-2822 or pamela.homer@state.nm.us.

Comment Set B:

FEB-26-2009 06:31 PM BERG 5052782438 P.01

Surface Water Quality Bureau
NEW MEXICO ENVIRONMENT DEPARTMENT

Public Comment Card

Meeting Date: 2/19/09

Comments Regarding: TMDL Dry Cimarron River Watershed

***OPTIONAL INFORMATION :**

*Name: Donald W. Berg *Affiliation: Landowner

*E-Mail: bergj@bacavalley.com

*Mailing Address: PO Box 354; Folsom, NM 88419

Comments must be submitted in writing in order to be included in the public record. Please provide comments in the space below (use back if necessary):

I have lived and ranched along the Dry Cimarron in the Oak Canyon area and, also, just above Folsom, since 1969. Below, I list (in no particular order) some observations.

1. The Dry Cimarron is not perennial from headwater to Oklahoma state line, but is, instead an intermittent stream that consists of perennial portions separated by dry portions. The pioneers named it the Dry Cimarron for a reason.
2. To my knowledge, the only portion of the stream, capable of supporting cold water fish, is a reach of about 3 miles in the Folsom Falls area.
3. Numerous ducks winter in ice free portions of the Dry Cimarron.
4. Huge flocks of turkeys winter in the Dry Cimarron and roost in cottonwood trees found along the stream.

Turn comment card in tonight or mail / fax:

TMDL Coordinator
Surface Water Quality Bureau, P. O. Box 26110. Santa Fe, NM 87502
Phone: (505) 827-0187; Fax: (505) 827-0160

<u>SWQB Response:</u> *Thank you for your written comments and attendance at the public meeting on February 19, 2009 in Folsom, NM. First, SWQB recognizes that the Dry Cimarron River has both perennial and intermittent portions along its course before reaching the Oklahoma state line. For example, SWQB noted during the 2006 survey that the DCR is often dry through the village of Folsom as well as downstream of Oak Creek. As far as fish, Table E.1 lists the fish collected during the 2000 water quality survey of the DCR:*

Table E.1- Fish collected by SWQB during 2000 water quality survey of DCR

Collection Site	*Scientific Name*	*Common Name*	*Number of fish caught*
Carrizozo Creek	*Fundulus zebrinus*	*plains killifish*	*105*
	Lepomis cyanellus	*green sunfish*	*5*
	Ameiurus melas	*black bullhead*	*3*
	Campostoma anomalum	*central stoneroller*	*15*
	Pimephales promelas	*fathead minnow*	*3*
DCR near Wedding Cake Butte	*Campostoma anomalum*	*central stoneroller*	*3*
	Ameiurus melas	*black bullhead*	*3*
	Platygobio gracilis	*fathead chub*	*4*
	Fundulus zebrinus	*plains killifish*	*4*
	Lepomis cyanellus	*green sunfish*	*9*
	Pimephales promelas	*fathead minnow*	*4*
DCR below Folsom Falls	*Campostoma anomalum*	*central stoneroller*	*332*
	Pimephales promelas	*fathead minnow*	*934*
DCR near Jesus Mesa	*Ameiurus melas*	*black bullhead*	*15*
	Platygobio gracilis	*flathead chub*	*26*
	Campostoma anomalum	*central stoneroller*	*16*
	Pimephales promelas	*fathead minnow*	*1*

Additionally, red shiner (Cyprinella lutensis), sand shiner (Notropis stramineus), and suckermouth minnow (Phenacobius mirabilis) have historically occurred in the New Mexico portions of the DCR. Arkansas River shiner (Notropis girardi) historically occurred just downstream of the NM-OK border in the DCR and is now federally listed as threatened under the Endangered Species Act. All of the above noted fish species and those in Table E.1 are considered to be warm water species, with the exception of central stoneroller and flathead chub which are considered to be cool water species.

Second, based on your comments and the overwhelming concern at the public meeting regarding waterfowl as a probable source in the watershed, the category "waterfowl" will be added to the upcoming 2010-2012 Integrated List as a probable source for the Dry Cimarron. This change has also been noted in the "Identification and Description of Pollutant Sources" sections in the TMDL document as well as the Executive Summary. SWQB appreciates this local stakeholder input during the development of the list of probable sources.

Comment Set C:

Surface Water Quality Bureau

NEW MEXICO ENVIRONMENT DEPARTMENT

Public Comment Card

Meeting Date: Feb 19, 09

Comments Regarding: Dry Cimarron River watershed

***OPTIONAL INFORMATION :**

*Name: Fred E. Daniel

*Affiliation: Resident + land owner along river

*E-Mail:

*Mailing Address: 42 Daniel Rd Folsom, NM 88419

Comments must be submitted in writing in order to be included in the public record.
Please provide comments in the space below (use back if necessary):

The Dry Cimarron River should be designated as a warm water river. It certainly isn't a cold water river, It might be a cool river at Folsom, but when it reaches the Okla line it is certainly a warm water river, I've lived on this river all my life (77 yrs) and I think I know more about the river than someone in Dallas, Tx.

RECEIVED

FEB 27 2009

SURFACE WATER
QUALITY BUREAU

Turn comment card in tonight or mail / fax:

TMDL Coordinator
Surface Water Quality Bureau, P. O. Box 26110. Santa Fe, NM 87502
Phone: (505) 827-0187; Fax: (505) 827-0160

<u>SWQB Response:</u> *Thank you for your written comments and attendance at the public meeting on February 19, 2009 in Folsom, NM. SWQB appreciates your local knowledge of the DCR watershed and your willingness to assist in the development of appropriate water quality standards. Your concerns are shared by a number of the other stakeholders who submitted comments on the DCR TMDL. A complete response to the issue regarding warmwater versus coldwater versus coolwater designated uses is documented following Comment Set A. The public comments included in this TMDL will be considered by the New Mexico Water Quality Control Commission as well as EPA Region 6 in Dallas, TX and will serve to demonstrate that there is a local concern regarding appropriate water quality standards. For more information on the triennial review, including SWQB's coolwater and other proposals related to the DCR, please see SWQB's water quality standards website at http://www.nmenv.state.nm.us/SWQB/Standards/index.html. You may also contact Pam Homer, SWQB's Water Quality Standards Coordinator, at 505-827-2822 or pamela.homer@state.nm.us.*

Comment Set D:

From: Brett Bannon [rio@bacavalley.com]
Sent: Sunday, March 01, 2009 5:51 PM
To: Henderson, Heidi, NMENV
Cc: Eib, Doug, NMENV; Hopkins, Scott, NMENV; trailnalong@yahoo.com; Brett D Bannon
Subject: Emailing: OakCreekisDry 001, OakCreekisDry 002, OakCreekisDry 003

Attachments: OakCreekisDry 001.jpg; OakCreekisDry 002.jpg; OakCreekisDry 003.jpg

Heidi

Thanks for your informational meetings at Folsom. I appreciate the work that you are doing, and a fascinated with your results. I thoroughly enjoy learning more about our river.

Below are three comments that I would like included in your draft. And hopefully they can be addressed. I also have included some photos that help document one of my concerns.

Also, I failed to add my name and E-mail to the list that was at the meeting in Folsom. I already receive E-mails from you department, but if needed please add it to any list that would let me continue being notified of events. Thanks.

Brett Bannon
4721 Dry Cimarron Hwy
Folsom, NM 88419
rio@bacavalley.com

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1. Oak Creek (Dry Cimarron River to headwaters)

I am of the opinion that the testing station at Oak Creek (DCR 03, 02OakCre000.1, Oak Creek above Dry Cimarron River) should be considered ephemeral and removed. Historically, this area will run for a season during high snowfall and rainfall times, but then will dry up. I feel that it is in error to include this area as being a part of the perennial flow of the Dry Cimarron. Attached I have photographs of this area on February 20, 2009 as being dry.

2. Warm water aquatic life and marginal coldwater aquatic life

   Historically no salmonids were indigenous to the Dry Cimarron, and though they have been introduced by the NM Game and Fish, they do not reproduce. Green sunfish (Lepomis cyanellus) are found 5 miles west of and upriver from Folsom. I feel that there should be more emphasis on Warm Water Aquatic life and even more emphasis on the “marginal” in Marginal Coldwater Aquatic life.

3. WATER QUALITY SURVEY SUMMARY (http://www.nmenv.state.nm.us/swqb/Surveys/DryCimarron2000.pdf) states:

> “The first Anglo-Americans to enter the valley of the Dry Cimarron in the mid-nineteenth century were beaver trappers. The subsequent removal of the beaver, and the later arrival of large herds of livestock, initiated an episode of channel destabilization that has resulted in many of the hydro-geomorphic impacts seen today.”

However, there is evidence in the pre-mid-nineteenth century flood plane alluvium, that there had been cyclical climatic events involving periods of drought and fire, with floods and the resultant channel destabilization (identified by light soils with chunks of charcoal interspersed with layers of larger sized river rock), and then periods of wet (identified by dark soils). All of these alluvial records occur before any Anglo-Americans entered the valley. Furthermore, locally collected Ponderosa Tree growth rings give further evidence of the climatic swings between periods of higher and lower rainfall.

OakCreekisDry 001.jpg


OakCreekisDry 002.jpg


OakCreekisDry 003.jpg

SWQB Response: *Thank you for your written comments and attendance at the public meeting on February 19, 2009 in Folsom, NM.*

First, SWQB appreciates the written and photographic evidence in regards to Oak Creek. In 2000, SWQB measured flow at 02OakCre000.1 in May, August, and November and found the flow to be less than one cfs. Similarly, in 2006, SWQB measured flow in April, June, July, August, September, and October and found the flow to be less than one cfs. However, in 2006, flowing water was available for sampling and sample collection occurred. Fish and macroinvertebrates were also observed at this site in 2006. SWQB will visit a site during a reconnaissance trip prior to a water quality survey and throughout the year as detailed in the sampling plan, samples will not be collected when and where there is no available water to be sampled.

Your concerns regarding the appropriate aquatic life use for the DCR are shared by a number of the other stakeholders who submitted comments on the DCR TMDL. A complete response to the issue regarding warmwater versus coldwater versus coolwater designated uses is documented following Comment Set A. Additionally, a discussion on the fish species in the DCR watershed is discussed in Comment Set B.

Your third comment is regarding the 2000 Survey Summary that was also discussed at the public meeting on February 19, 2008 in Folsom, NM by SWQB staff. Although the comment is not directly regarding the TMDL itself, portions of the Survey Summary were used in the development of the TMDL document. SWQB staff compiled a few thoughts on climate, fire, and land use changes to address your comment..

SWQB suggests the research paper by Henri Grissino-Mayer entitled "A 2129-Year Reconstruction of Precipitation for Northwestern New Mexico, USA" available online at: http://www.ncdc.noaa.gov/paleo/drought/drght_grissno.html. The paper contains the following graph (Figure E.1) detailing the precipitation record over the last 2100 years in northwestern New Mexico.

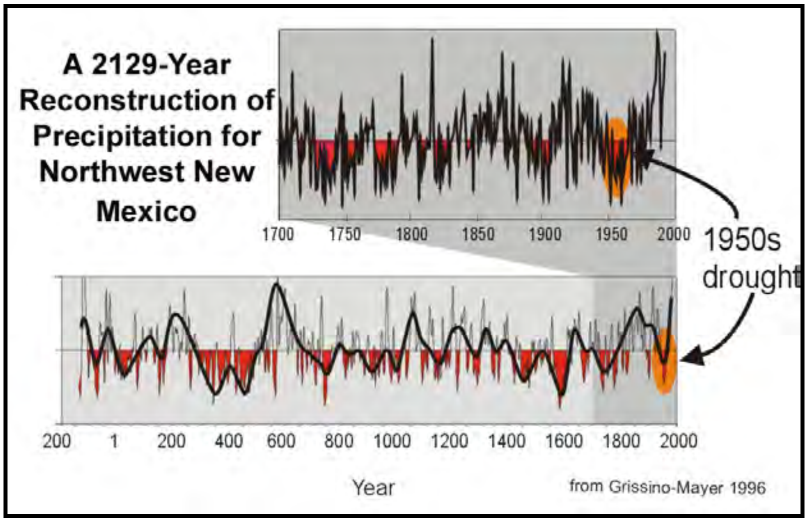

Figure E.1- A 2129-year Reconstruction of Precipitation for Northwest NM (Grissino-Mayer, 1996)

The graph indicates that the drought and/or wet conditions are more common than the "average" and supports your statement regarding tree ring data. Also, the arroyo cutting cycle of the late 1800s early 1900s is well documented. The fact that alternating soil horizons are now exposed on streambanks and arroyo walls could imply recent degradation. A number of active floodplains have the same strata as described in the comment and this can document a stream's movement across its floodplain. Alternating dark soils and alluvium does not necessarily mean alternating wet and dry conditions. It just documents where the stream bed was at various times. Stream incision and the subsequent loss of alluvial water storage have a negative effect on base flow. SWQB staff suggest the following articles for more information regarding fire regimes and climate effects:

Touchan, R., T.W. Swetnam, and H.D. Grissino-Mayer. Effects of Settlement Grazing on Pre-Settlement New Mexico, 1995. Symposium on Fire in Wilderness and Park Management: Past Lessons and Future Opportunities. v 380: 268-272. http://tree.ltrr.arizona.edu/~tswetnam/tws-pdf/livestockgrazing.pdf

Swetnam, T.W., and J.L. Betancourt. ENSO Phenomena and Forest Fires in the Southwestern United States, 1990. Science. Volume 249: 4972, 1017-1020. http://www.ltrr.arizona.edu/~tswetnam/tws-pdf/ENSO.pdf

Comment Set E:

From: Shari Morrow [trailnalong@yahoo.com]
Sent: Thursday, March 05, 2009 6:54 AM
To: Henderson, Heidi, NMENV
Cc: Brett and Jody Bannon; shari morrow
Subject: Dry Cimarron Water Study

Hello Heidi -

Concerning the Dry Cimarron and Oak Creek Water Study.

Thank you for your informative meeting at Folsom. I have a few follow up comments.

1. I disagree that the classification for the water is cold. Trout are unable to propagate in waters. Additionally the NM Game and Fish have trouble with the viablitiy of trout they stock in the Dry Cimarron River especially in the summer months. Mainly because of the warm temperature of the water. The classification of the Dry Cimarron River needs needs a hard look and in my opinion would have a warm classification.

2. Oak Creek waters run according to the snow and rain fall. A sample of water needs to take this into account. A small pool of water that is drying up, is not being fed fresh water, is going to become stagnant and putrid. Water samples need supporting data to establish some creditablity.

3. I think it is a good idea to involve the people that live here. Ideally, the local land owners need to be on board. Land owners are in a position to impact the quality of water and if there is a congenial and cooperative effort, obviously more gets done. No one likes a finger pointed at them. We who live here are concerned about every part of our environment and are good stewards for the most part.
   - Attempting to invovle the local people in a study would be most beneficial to all.

I hope I didn't miss the deadline for comments. Either way - please take my comments into consideration.

Thank you for your time.

Sincerely,
Shari Morrow
Dry Cimarron/Oak Creek land owner/manager

SWQB Response: *Thank you for your comments. Although your comments were technically received after the deadline, many of your comments have been reiterated by other local stakeholders and SWQB wishes to emphasize the extent to which these concerns are shared by the community.*

1. *SWQB appreciates your local knowledge of the DCR watershed and your willingness to assist in the development of appropriate water quality standards. Your concerns are shared by a number of the other stakeholders who submitted comments on the DCR TMDL. A complete response to the issue regarding warmwater versus coldwater versus coolwater designated uses is documented following Comment Set A. The public comments included in this TMDL will be considered by the New Mexico Water Quality Control commission as well as EPA Region 6 in Dallas, TX and will serve to demonstrate to these agencies that there is a local concern regarding appropriate water quality standards. Pam Homer can be contacted at 505-827-2822 or pamela.homer@state.nm.us with questions regarding the water quality standards or the Triennial Review process.*

2. *SWQB recognizes that portions of Oak Creek may not be perennial as indicated in the waterbody description in NMAC 20.6.4.701 that states "…perennial reaches of Oak Creek." Oak Creek was visited by SWQB staff eleven times and flow was measured eight times from March-October during the 2006 water quality survey. Table E.2 details the visits to site 02OakCre000.1 in 2006. Comment Set D also addresses the SWQB water quality survey of Oak Creek.*

Table E.2- Details of SWQB sampling events at 02OakCre000.1 in 2006

Date	*Samples Collected*	*Flow Measured*
3/27/2006	Field measurements, ions, metals, cyanide, radionuclides, nutrients	None
4/24/2006	Field measurements, metals, nutrients, ions, bacteria	0.2 cfs[1]
5/22/2006	Field measurements, nutrients, ions, radionuclides, cyanide	none
6/14/2006	Bacteria	0.25 cfs[1]
6/29/2006	Field measurements	None
7/6/2006	Bacteria	0.2 cfs[1]
7/24/2006	Field measurements, ions, metals, bacteria, nutrients	0.2 cfs[1]
8/29/2006	Field measurements, nutrients, ions, bacteria	0.3 cfs[1]
9/26/2006	Field measurements, ions, nutrients	<1.0 cfs[1]
10/24/2006	Field measurements, ions, nutrients, metals	<1.0 cfs[1]
10/31/2006	Bacteria	<1.0 cfs[1]

[1]*visual estimation*

3. *SWQB held a public meeting in Kenton, Oklahoma and Folsom, NM in February 2006 to solicit stakeholder input prior to the water quality survey and worked with landowners throughout the duration of the water quality survey. Stakeholder input is invaluable to the work performed by SWQB and public participation is encouraged. SWQB agrees that landowners are in the best position to maintain and improve the water quality in the Dry Cimarron River watershed. SWQB*

wishes to be able to provide stakeholders the additional tools to continue to be good stewards of their land. Following a water quality survey and the development of a TMDL, stakeholders can apply for §319*(h) funds to improve the health of their watersheds. Section 10 of the TMDL discusses this process.*