US EPA-APPROVED

TOTAL MAXIMUM DAILY LOAD

FOR THE

UPPER GILA, SAN FRANCISCO, AND MIMBRES WATERSHEDS

SEPTEMBER 11, 2014

Prepared by

New Mexico Environment Department, Surface Water Quality Bureau

Monitoring, Assessments, and Standards Section

Public Draft Released June 23, 2014

Water Quality Control Commission Approval Date: September 9, 2014

U.S. EPA Approval Date: September 11, 2014

Effective Date:

Revision Date(s): ______________________________

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Cover Photo: Tularosa River, SWQB 2011

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4Q3	4-Day, 3-year low-flow frequency
Act	New Mexico Water Quality Act
ADB	Assessment database
AU	Assessment unit
BLM	Bureau of Land Management
BMP	Best management practices
CFR	Code of Federal Regulations
cfs	Cubic feet per second
cfu	Colony forming units
CGP	Construction general stormwater permit
CWA	Clean Water Act
CWAL	Cold Water Aquatic Life
^{o}C	Degrees Celsius
EQIP	Environmental Quality Incentive Program
^{o}F	Degrees Fahrenheit
GIS	Geographic information system
HQCWAL	High Quality Cold Water Aquatic Life
HUC	Hydrologic unit code
ISC	Interstate Stream Commission
km^2	Square kilometers
LA	Load allocation
lbs/day	Pounds per day
MASS	Monitoring, Assessment and Standards Section
MGD	Million gallons per day
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 stormwater permit
µS	Microsiemen
NM	New Mexico
NMAC	New Mexico Administrative Code
NMED	New Mexico Environment Department
NPDES	National Pollutant Discharge Elimination System
NPS	Nonpoint source
NTU	Nephelometric turbidity units
QAPP	Quality Assurance Project Plan
RFP	Request for proposal
§	Section
SEV	Severity of ill effect
sMS4	Small Municipal Separate Storm Sewer
SWPPP	Stormwater pollution prevention plan
SWQB	Surface Water Quality Bureau
TMDL	Total Maximum Daily Load
TSS	Total Suspended Solids
UAA	Use Attainability Analysis
ug/L	Micrograms per Liter

USDA	U.S. Department of Agriculture
USEPA	U.S. Environmental Protection Agency
USFS	U.S. Forest Service
USGS	U.S. Geological Survey
USNPS	U.S. National Park Service
WBP	Watershed-based plan
WLA	Waste load allocation
WQCC	Water Quality Control Commission
WQS	Water quality standards (NMAC 20.6.4 as amended through June 5, 2013)
WQX	Water quality exchange
WRAS	Watershed restoration action strategies
wt %	Weight percent
WWTP	Wastewater treatment plant

EXECUTIVE SUMMARY

Section 303(d) of the Federal Water Pollution Control Act , a.k.a., Clean Water Act, 33 U.S.C. §1313[1], requires states to develop Total Maximum Daily Load ("TMDL") management plans for water bodies determined to be impaired. A TMDL defines the amount of a pollutant that a waterbody can assimilate without exceeding the state's water quality standard for that waterbody and allocates loads to known point sources and nonpoint sources. It further identifies potential methods, actions, or limitations that could be implemented to achieve water quality standards. "Total Maximum Daily Load" is defined as the sum of the individual Waste Load Allocations ("WLA") for point sources and Load Allocations ("LA") for nonpoint source and background conditions; see 40 C.F.R. §130.2(i)[2]. TMDLs also include a Margin of Safety ("MOS"), a required component that acknowledges and counteracts uncertainty.

The New Mexico Environment Department ("NMED") Surface Water Quality Bureau ("SWQB") conducted water quality surveys of the Mimbres watershed of south-central New Mexico in 2009 and the Gila River Basin in 2011. Water quality monitoring stations were located within the watersheds to evaluate ambient water quality conditions and the impact of tributary streams. As a result of assessing data generated during these monitoring efforts, the following impairments[3] of water quality standards were found:

- Cadmium and lead in Cold Springs Creek in the Mimbres watershed, Closed Basin;
- *E. coli* in Centerfire Creek, San Francisco River, South Fork Negrito Creek, and Tularosa River of the San Francisco River watershed, Gila River Basin; and Mimbres River in the Mimbres watershed, Closed Basin;
- Turbidity in Centerfire Creek, San Francisco River, and Tularosa River in the San Francisco River watershed, Gila River Basin; and
- Chronic aluminum in Willow Creek in the Upper Gila watershed, Gila River Basin.

This TMDL addresses the above impairments as summarized in Tables ES-1 – ES-8. The 2009 and 2011 field studies identified other potential water quality impairments that are not addressed in this document due to additional data needs, assessment protocol revisions or re-application, or impending use attainability analyses. If additional impairments are verified or found, subsequent TMDLs will be developed for those impairments. The SWQB has previously prepared TMDLs for portions of these watersheds including: TMDLs for conductivity and plant nutrients on Centerfire Creek (2001); a temperature TMDL for South Fork Negrito Creek (2001); TMDLs for temperature and plant nutrients on San Francisco River (2001); and a TMDL for conductivity on Tularosa River (2001).

The SWQB's Monitoring, Standards, and Assessment Section ("MASS") is scheduled to collect water quality data in the Mimbres watershed in 2015 and the Gila River Basin in 2019. TMDLs will be re-examined and potentially revised at those times as this document is considered to be an evolving management plan. In the event that the new data indicate that the targets used in the

[1] http://www.epw.senate.gov/water.pdf
[2] http://www.gpo.gov/fdsys/pkg/CFR-2002-title40-vol18/pdf/CFR-2002-title40-vol18-part130.pdf
[3] http://water.epa.gov/lawsregs/lawsguidance/cwa/tmdl/overview.cfm

analyses are not appropriate and/or if new standards are adopted, the TMDLs will be adjusted accordingly. When attainment of applicable water quality standards has been achieved, the impairment will be removed from New Mexico's CWA §303(d) List of Impaired Waters ("§303(d) List").

SWQB's Watershed Protection Section will continue to work with watershed groups to develop Watershed-Based Plans ("WBPs") to implement strategies that attempt to correct the water quality impairments detailed in this document. Implementation of items detailed in the WBP will be done with participation of all interested and affected parties. Further information on WBPs is in Section 11.

ES-1 Summary for Centerfire Creek (San Francisco River to Headwaters)

New Mexico Standards Segment	20.6.4.603				
Waterbody Identifier	NM-2603.A_50				
Segment Length	16.1 miles				
Parameters of Concern	*E. coli*, turbidity				
Uses Affected	High Quality Coldwater Aquatic Life, Primary Contact				
Geographic Location	San Francisco River USGS Hydrologic Unit Code 15040004				
Scope/size of Watershed	136.9 mi^2				
Land Type	Arizona/New Mexico Mountains (Ecoregion 23c)				
Probable Sources*	Drought-related impacts, gravel or dirt roads, grazing, low water crossings, stream channel incision				
IR Category	5/5A				
Priority Ranking	High				
TMDL for:	**WLA_{TOTAL} + LA + MOS = TMDL**				
E. coli	**0 + $1.62x10^9$ + $2.87x10^8$ = $1.91x10^9$ cfu/day**				
Turbidity	**Duration (consecutive hrs)**	**WLA (lbs/day)**	**LA (lbs/day)**	**MOS (lbs/day)**	**TMDL (lbs/day)**
	720	0	26.99	4.76	31.75
	336	0	43.98	7.76	51.74
	168	0	61.53	10.86	72.39
	144	0	65.98	11.64	77.62
	120	0	74.94	13.23	88.17
	96	0	83.99	14.82	98.81
	72	0	97.68	17.24	114.92

** Additional Probable Sources noted during the 2011 water quality survey are listed in Tables 5.9 and 9.16*

ES-2 Summary for Cold Springs Creek (Hot Springs Creek to headwaters)

New Mexico Standards Segment	20.6.4.803
Waterbody Identifier	NM-2803_11
Segment Length	7.6 miles
Parameters of Concern	Cadmium, lead
Uses Affected	Coldwater Aquatic Life
Geographic Location	Mimbres (Closed) Basin USGS Hydrologic Unit Code 13030202
Scope/size of Watershed	21.3 mi^2
Land Type	Arizona/New Mexico Mountains (Ecoregion 23b)
Probable Sources*	Abandoned mines, low water crossings, mass wasting, road runoff
IR Category	5/5A
Priority Ranking	High
TMDL for:	**WLA_{TOTAL} + LA + MOS = TMDL**
Cadmium	**0 + 6.74×10^{-4} + 1.68×10^{-4} = 8.42×10^{-4} lbs/day**
Lead	**0 + 5.79×10^{-3} + 1.45×10^{-3} = 7.24×10^{-3} lbs/day**

** Additional Probable Sources noted during the 2009 water quality survey are listed in Tables 7.7 and 8.7.*

ES-3 Summary for Mimbres R (Perennial reaches downstream of Willow Springs)

New Mexico Standards Segment	20.6.4.803
Waterbody Identifier	NM-2803_00
Segment Length	25.18mi
Parameters of Concern	*E. coli*
Uses Affected	Primary Contact
Geographic Location	Mimbres (Closed) Basin USGS Hydrologic Unit Code 13030202
Scope/size of Watershed	457.2mi^2
Land Type	Arizona/New Mexico Mountains (Ecoregion 23b)
Probable Sources*	Low water crossings, road runoff, waste from pets, waterfowl, wildlife other than waterfowl
IR Category	5/5B
Priority Ranking	High
TMDL for:	**WLA_{TOTAL} + LA + MOS = TMDL**
E. coli	**0 + 3.78×10^{9} + 4.20×10^{8} = 4.20×10^{9} cfu/day**

** Additional Probable Sources noted during the 2009 water quality survey are listed in Table 5.9*

ES-4 Summary for San Francisco River (NM 12 at Reserve to Centerfire Creek)

New Mexico Standards Segment	20.6.4.602
Waterbody Identifier	NM-2602_10
Segment Length	16.0 miles
Parameters of Concern	*E. coli*, turbidity
Uses Affected	Coldwater Aquatic Life, Primary Contact
Geographic Location	San Francisco River USGS Hydrologic Unit Code 15040004
Scope/size of Watershed	306.7 mi^2
Land Type	Arizona/New Mexico Mountains (Ecoregions 23c and 23e)
Probable Sources*	Grazing, low water crossings, residences/buildings, runoff following forest fire
IR Category	5/5A
Priority Ranking	High
TMDL for:	**WLA_{TOTAL} + LA + MOS = TMDL**
E. coli	**0 + $4.43x10^9$ + $4.92x10^8$ = $4.92x10^9$ cfu/day**
Turbidity	(see table below)

Turbidity

Duration (consecutive hrs)	WLA (lbs/day)	LA (lbs/day)	MOS (lbs/day)	TMDL (lbs/day)
720	0	68.49	7.61	76.10
336	0	95.94	10.66	106.60
168	0	124.16	13.80	137.96
144	0	131.27	14.59	145.86
120	0	145.73	16.19	161.92
96	0	160.42	17.82	178.24
72	0	182.76	20.31	203.07

** Additional Probable Sources noted during the 2011 water quality survey are listed in Tables 5.9 and 9.16*

ES-5 Summary for San Francisco River (Willow Springs Cyn to NM 12 at Reserve)

New Mexico Standards Segment	20.6.4.601
Waterbody Identifier	NM-2602_22
Segment Length	10.4 miles
Parameters of Concern	*E. coli*
Uses Affected	Primary Contact
Geographic Location	San Francisco River USGS Hydrologic Unit Code 15040004
Scope/size of Watershed	1058.8 mi^2
Land Type	Arizona/New Mexico Mountains (Ecoregions 23b and 23e)
Probable Sources*	Drought-related impacts, flow alteration from diversions, grazing, municipal point source discharges, onsite treatment systems, runoff following forest fire
IR Category	5/5A
Priority Ranking	High
TMDL for: *E. coli*	**WLA_{TOTAL} + LA + MOS = TMDL** **3.58×10^{8} + 8.30×10^{9} + 1.53×10^{9} = 1.02×10^{10} cfu/day**

** Additional Probable Sources noted during the 2011 water quality survey are listed in Table 5.9*

ES-6 Summary for South Fork Negrito Creek (Negrito Creek to headwaters)

New Mexico Standards Segment	20.6.4.603
Waterbody Identifier	NM-2603.A_43
Segment Length	14.5 miles
Parameters of Concern	*E. coli*
Uses Affected	Primary Contact
Geographic Location	San Francisco River USGS Hydrologic Unit Code 15040004
Scope/size of Watershed	49.6 mi^2
Land Type	Arizona/New Mexico Mountains (Ecoregion 23c)
Probable Sources*	Drought-related impacts, grazing, hiking trails, onsite treatment systems, removal of riparian vegetation
IR Category	5/5B
Priority Ranking	High
TMDL for: *E. coli*	**WLA_{TOTAL} + LA + MOS = TMDL** **0 + 6.71×10^{9} + 1.18×10^{9} = 7.89×10^{9} cfu/day**

** Additional Probable Sources noted during the 2011 water quality survey are listed in Tables 5.9*

ES-7 Summary for Tularosa River (San Francisco River to Apache Creek)

New Mexico Standards Segment	20.6.4.603
Waterbody Identifier	NM-2603.A_40
Segment Length	22.0 miles
Parameters of Concern	*E. coli*, turbidity
Uses Affected	High Quality Coldwater Aquatic Life, Primary Contact
Geographic Location	San Francisco River USGS Hydrologic Unit Code 15040004
Scope/size of Watershed	645.0 mi^2
Land Type	Arizona/New Mexico Mountains (Ecoregion 23e)
Probable Sources*	Channelization, drought-related impacts, grazing, low water crossings, onsite treatment systems, hiking trails
IR Category	5/5B
Priority Ranking	High
TMDL for:	**WLA_{TOTAL} + LA + MOS = TMDL**
E. coli	**0 + $6.38x10^9$ + $1.13x10^9$ = 7.51×10^9 cfu/day**

Turbidity

Duration (consecutive hrs)	WLA (lbs/day)	LA (lbs/day)	MOS (lbs/day)	TMDL (lbs/day)
720	0	159.15	28.09	187.24
336	0	221.59	39.10	260.69
168	0	283.92	50.10	334.02
144	0	299.61	52.87	352.48
120	0	330.77	58.37	389.14
96	0	361.94	63.87	425.81
72	0	408.79	72.14	480.93

** Additional Probable Sources noted during the 2011 water quality survey are listed in Tables 5.9 and 9.16*

ES-8 Summary for Willow Creek (Gilita Creek to headwaters)

New Mexico Standards Segment	20.6.4.503
Waterbody Identifier	NM-2503_47
Segment Length	7.21 miles
Parameters of Concern	Aluminum - chronic
Uses Affected	High Quality Coldwater Aquatic Life
Geographic Location	San Francisco River USGS Hydrologic Unit Code 15040004
Scope/size of Watershed	14.9 mi^2
Land Type	Arizona/New Mexico Mountains (Ecoregions 23c and 23d)
Probable Sources*	Gravel or dirt roads, low water crossings, stream channel incision
IR Category	5/5B
Priority Ranking	High
TMDL for: Aluminum - chronic	**WLA_{TOTAL} + LA + MOS = TMDL** **0 + 5.14 + 1.29 = 6.43 lbs/day**

** Additional Probable Sources noted during the 2011 water quality survey are listed in Table 6.7*

1.0 INTRODUCTION

Under Section ("§") 303 of the CWA, individual states establish water quality standards, which are subject to the approval of the U.S. Environmental Protection Agency ("USEPA"). Under §303(d)(1) of the CWA (33 U.S.C. §1313(d)[4]), states are required to develop a list of waters within a state that are impaired and establish a TMDL for each pollutant. A TMDL is defined as "*a written plan and analysis established to ensure that a waterbody will attain and maintain water quality standard including consideration of existing pollutant loads and reasonably foreseeable increases in pollutant loads* (USEPA, 1999)." A TMDL documents the amount of a pollutant a waterbody can assimilate without violating a state's water quality standard. It also allocates that load capacity to known point sources and nonpoint sources ("NPS") at a given flow. TMDLs are defined in the Code of Federal Regulations (40 C.F.R. §130[5]) as the sum of the individual Waste Load Allocations ("WLA") for point sources and Load Allocations ("LA") for NPS and natural background conditions, and include a margin of safety ("MOS"). This document provides TMDLs for assessment units ("AUs") within the Gila River and Closed Basin that have been determined to be impaired based on a comparison of measured concentrations and conditions with water quality criteria.

This document is divided into several sections. Section 2.0 provides background information on the Gila River Basin and Closed Basin. Section 3.0 provides information on the water quality surveys performed in the basin in 2009 and 2011. Section 4.0 provides detailed information on the sub-basins and watersheds and their impairments. Section 5.0 presents TMDLs developed for bacteria; Section 6.0 presents a TMDL developed for chronic total recoverable Aluminum; Section 7.0 presents a TMDL developed for cadmium; Section 8.0 presents a TMDL for lead; and Section 9.0 presents TMDLs developed for turbidity. Pursuant to CWA §106(e)(1), Section 10.0 provides a monitoring plan in which methods, systems, and procedures for data collection and analysis are discussed. Section 11.0 discusses implementation of TMDLs and the relationship between TMDLs and Watershed Restoration Action Strategies ("WRAS"); Section 12.0 discusses assurance; Section 13.0 discusses public participation in the TMDL process; and Section 14.0 provides references for this document. Appendices are referenced throughout and are found at the end of the document.

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[4] http://www.epw.senate.gov/water.pdf
[5] http://www.gpo.gov/fdsys/pkg/CFR-2002-title40-vol18/pdf/CFR-2002-title40-vol18.pdf

2.0 BASIN BACKGROUND

2.1 Description and Land Ownership

The Gila River is a large tributary to the Colorado River Basin, with its headwaters located in the Gila Wilderness and Gila National Forest of southwestern New Mexico. The greater Gila River Basin encompasses portions of New Mexico and Arizona. The New Mexico portion of the basin extends into Grant, Catron, and Hidalgo counties, and includes the main stem of the Gila River, the NM portion of the San Francisco River, and several tributaries. Major tributaries to the Gila River include, but are not limited to, the East, Middle, and West forks of the Gila, Sapillo Creek, Mogollon Creek, and Mangas Creek. The San Francisco River is a major tributary to the Gila River, but its confluence with the Gila River is in Arizona. Major tributaries to the San Francisco River in New Mexico include the Tularosa River and Whitewater Creek. Land ownership and management in the New Mexico portion of the greater Gila River Basin includes US Forest Service ("USFS"), US Bureau of Land Management ("BLM"), US National Park Service ("USNPS"), State, and Private (Figure 2.1).

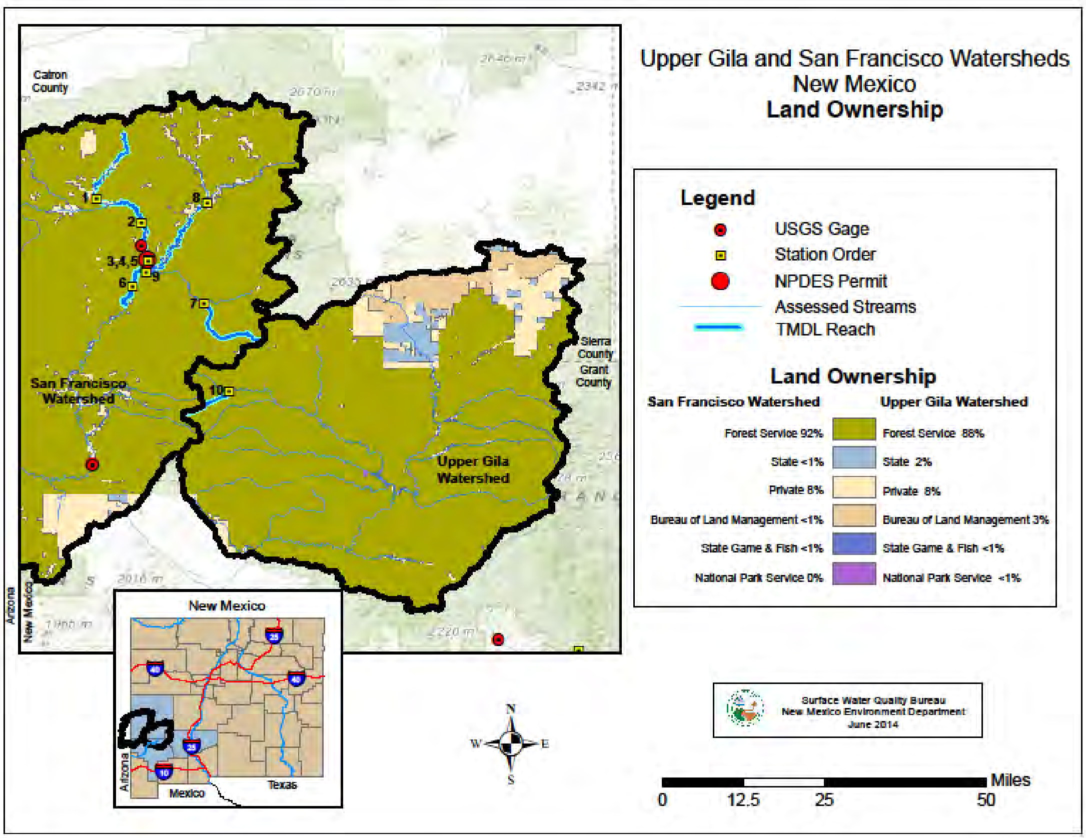

Figure 2.1 Land Ownership in the Upper Gila and San Francisco River watersheds

The Mimbres River watershed is classified in 20.6.4.803 New Mexico Administrative Code[6] ("NMAC") and 20.6.4.804 NMAC as a part of the Closed Basins. This is a result of the endorheic, or closed, nature of the watershed. An endorheic basin is one in which there is no outflow from the basin. The Closed Basin that includes the Mimbres River watershed reaches from the northeast portions of Luna and Sierra counties into Grant and Doña Ana counties, and into northern Chihuahua, Mexico. Tributaries to the Mimbres River in New Mexico include San Vicente Arroyo, Gallinas River, East fork Mimbres (McKnight Canyon), and Hot Springs Creek. Land ownership and management responsibilities in the Mimbres watershed include USFS, BLM, Department of Defense ("DOD"), State, and Private jurisdictions (Figure 2.2).

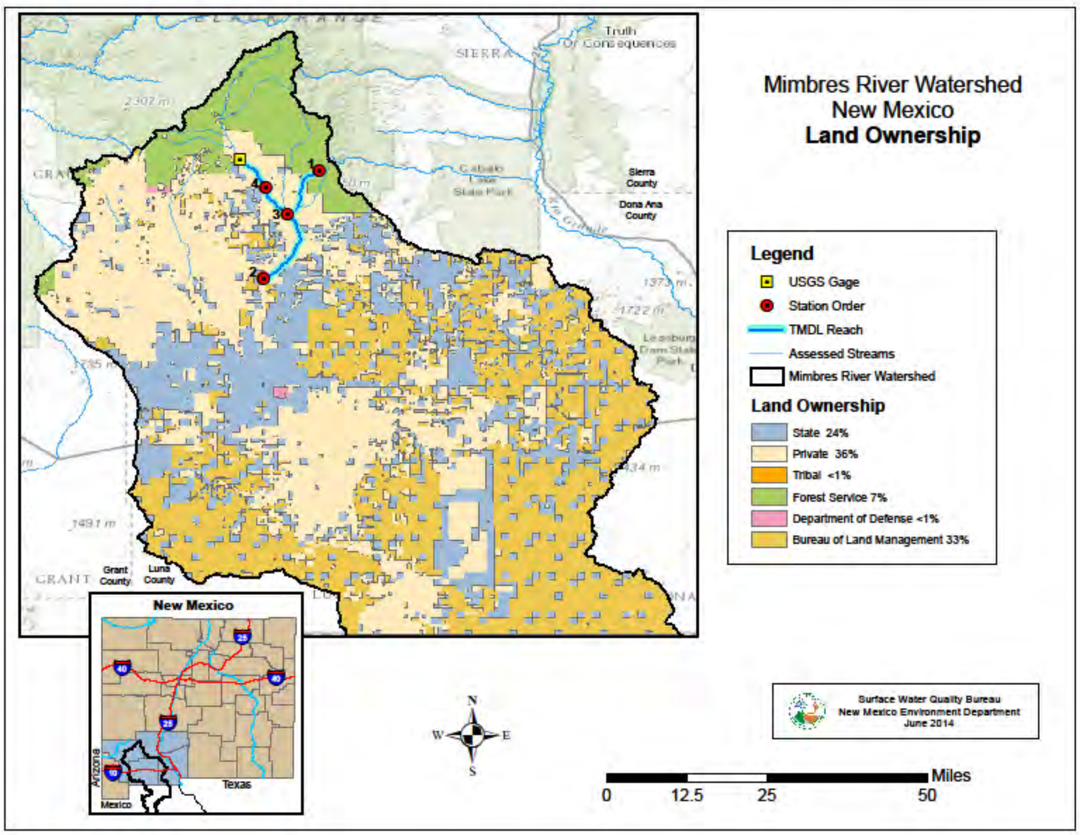

Figure 2.2 Land ownership in the Mimbres Watershed

2.2 Geology

Most of the greater Gila River watershed occurs within the southeastern portion of the Transition Zone Physiographic Province. The Transition Zone is an extensive area of extrusive and intrusive volcanic rocks that lies between the Paleozoic and Mesozoic sediments of the Colorado Plateau to the north and the Tertiary alluvial sediments of the Basin and Range to the south. The lower elevation areas in the southern part of the Gila watershed are located within the Basin and Range province.

[6] http://www.nmcpr.state.nm.us/nmac/parts/title20/20.006.0004.pdf

The greater Gila River watershed within the Transition Zone is dominated by alumino-silicate igneous rocks including rhyolite, tuff, dacite, andesite, and basalt that formed as part of the Mogollon-Datil volcanic field. Eruptions of lava and ash flows covered approximately 40,000 km^2 of southwestern New Mexico and southeastern Arizona between 40-24 million years ago (NMBGMR, 2014)[7]. The volcanic field in the greater Gila River Basin is bounded on the east by the Rio Grande Rift. In addition to igneous rocks, Tertiary and Quaternary sedimentary deposits are widespread, including valley fill, pediment gravels, talus, and alluvial deposits. The portion of the watershed that lies in the Basin and Range province is dominated by younger Tertiary and Quaternary sedimentary deposits of sand, gravel, and conglomerate, interbedded with basalts in the basins, and volcanic rocks that are present in the parallel ranges (Figure 2.3).

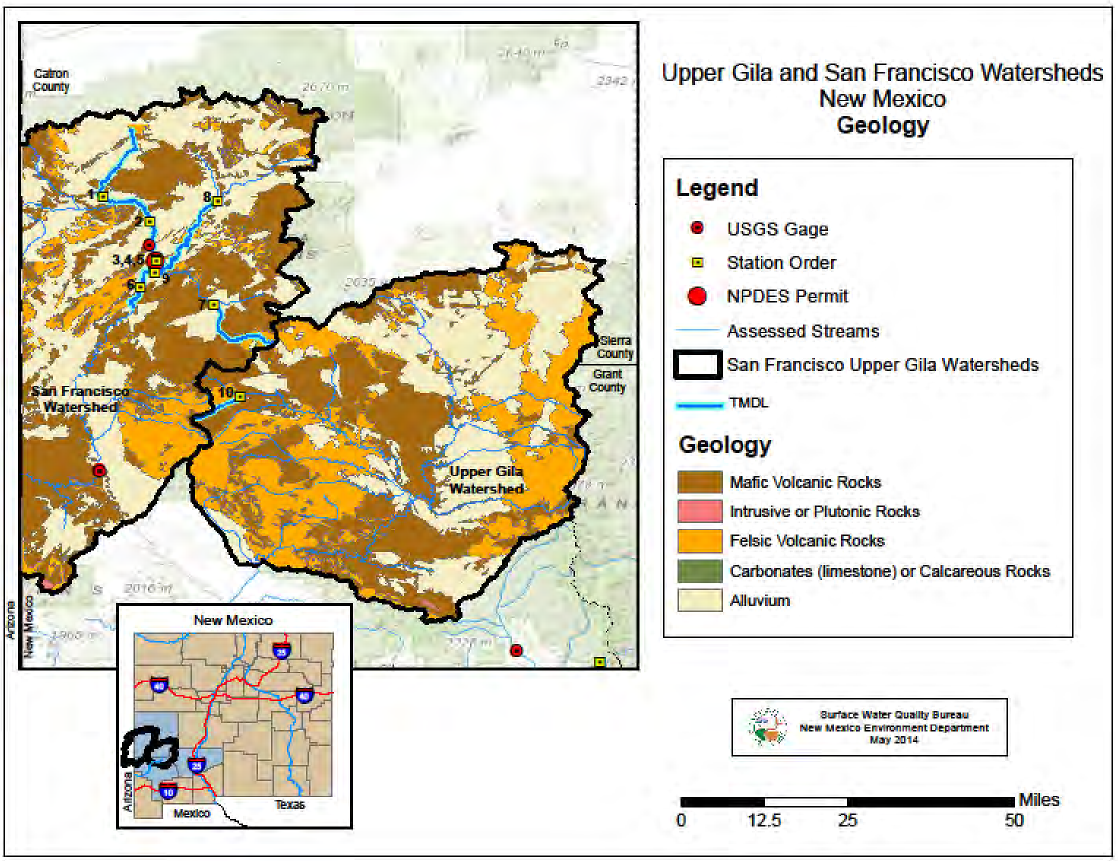

Figure 2.3 Generalized geology of the Upper Gila and San Francisco Watersheds.

The region's complex geologic history has resulted in numerous economically viable ore deposits. There are three major mining districts in the greater Gila River Basin. The Mogollon Mining District is located in the Mineral Creek and Silver Creek watersheds; the Tyrone and

[7] http://geoinfo.nmt.edu/tour/provinces/mogollon_datil_volcanic_field/home.html

Steeple Rock Mining Districts are located in the Mangas Creek and Carlisle Creek watersheds. While mining activity has decreased, there is active copper production and ongoing exploration.

Soils in the greater Gila River Basin are highly complex and variable. Valley soils are typically derived from igneous, metamorphic, and sedimentary parent material, range from low to moderately high permeability, and are generally well-drained (Soil Survey Staff, 2014)[8].

The geology of the Mimbres watershed in the north is similar to that of the greater Gila River Basin, with elevations ranging from nearly 10,000 ft above mean sea level at the headwaters to below 4,000 ft above mean sea level in the lower desert. The basin within New Mexico is dominated by the volcanics of the Mogollon-Datil volcanic field in the northern Transition Zone and the deep sedimentary deposits associated with the Basin and Range province in the southern watershed (Figure 2.4). There are many mining districts, both metals and industrial minerals, including the Carpenter District near the town of Mimbres (McLemore *et al.*, 2005)[9].

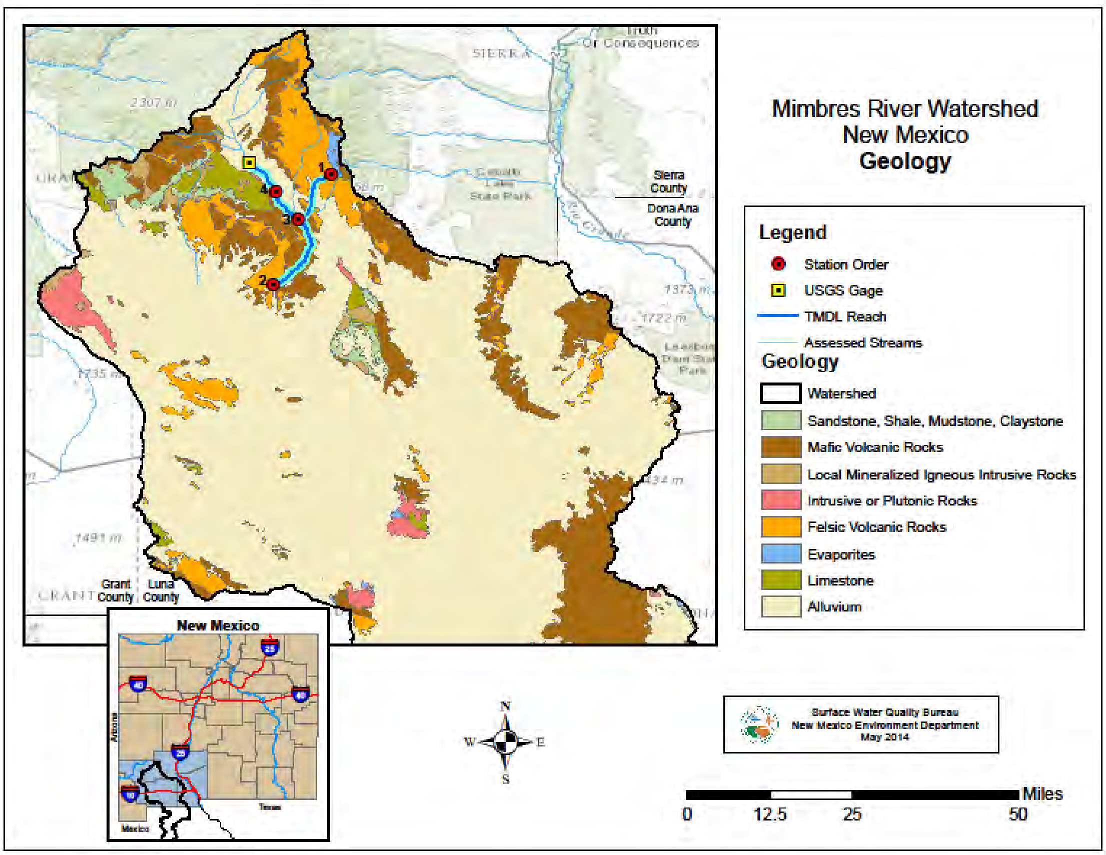

Figure 2.4 Generalized geology of the Mimbres watershed

[8] http://websoilsurvey.nrcs.usda.gov/
[9] https://geoinfo.nmt.edu/publications/openfile/details.cfml?Volume=494

Soils in the Mimbres watershed are highly variable and range from very shallow, cobbly clay soils to deep, gently sloping loamy or clayey soils and include Farmland of Statewide Importance, as classified by the USDA. Similar to the greater Gila Basin, soils in the Mimbres watershed are typically derived from igneous, metamorphic, and sedimentary parent material (Soil Survey Staff, 2014)[10].

2.3 Water Quality Standards and Designated Uses

Water quality standards ("WQS") for all assessment units in this document are set forth in sections 20.6.4.503, 20.6.4.602, 20.6.4.603, and 20.6.4.803 of the *Standards for Interstate and Intrastate Surface Waters*, 20.6.4 New Mexico Administrative Code ("NMAC"), as amended through June 5, 2013 (NMAC, 2013)[11]. These standards have been approved by USEPA for CWA purposes. The following are the relevant NMAC code sections:

20.6.4.503 GILA RIVER BASIN – All perennial tributaries to the Gila river above and including Mogollon creek.

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

B. Criteria: the use-specific numeric criteria set forth in 20.6.4.900 NMAC are applicable to the designated uses, except that the following segment-specific criteria apply: specific conductance 300 µS/cm or less for the main stem of the Gila river above Gila hot springs and 400 µS/cm or less for other reaches; 32.2°C (90°F) or less in the east fork of the Gila river and Sapillo creek below Lake Roberts; the monthly geometric mean of *E. coli* bacteria 126 cfu/100mL or less, single sample 235 cfu/100mL or less.

20.6.4.601 SAN FRANCISCO RIVER BASIN – The main stem of the San Francisco river from the New Mexico-Arizona line upstream to state highway 12 at Reserve and perennial reaches of Mule Creek.

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

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

20.6.4.602 SAN FRANCISCO RIVER BASIN – The main stem of the San Francisco river from state highway 12 at Reserve upstream to the New Mexico-Arizona line.

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

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

20.6.4.603 SAN FRANCISCO RIVER BASIN – All perennial reaches of tributaries to the San Francisco river above the confluence of Whitewater creek and including Whitewater creek.

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

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[10] http://websoilsurvey.nrcs.usda.gov/
[11] http://www.nmcpr.state.nm.us/nmac/parts/title20/20.006.0004.pdf

B. Criteria: the use-specific numeric criteria set forth in 20.6.4.900 NMAC are applicable to the designated uses, except that the following segment-specific criteria apply: specific conductance 400 µS/cm or less; the monthly geometric mean of *E. coli* bacteria 126 cfu/100mL or less, single sample 235 cfu/100mL or less; and temperature 25°C (77°F) or less in Tularosa creek.

20.6.4.803 CLOSED BASINS – Perennial reaches of the Mimbres river downstream of the confluence with Willow Springs canyon and all perennial reaches of tributaries thereto.

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

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

3.0 INTENSIVE WATER QUALITY SURVEYS

SWQB intensively surveyed the Gila and San Francisco Rivers in 2011, and the Mimbres River watershed in 2009. Brief summaries of the surveys and hydrologic conditions during the sample periods are provided in the following subsections.

The 2009 Water Quality Survey Summary for the Mimbres River Watershed can be found online at: http://www.nmenv.state.nm.us/swqb/documents/swqbdocs/MAS/Surveys/Mimbres2009.pdf.[12]

The 2011 Water Quality Survey Summary for the Upper Gila and San Francisco River Watersheds has not been finalized but will be available at the Surface Water Quality Website upon its completion.

3.1 Survey Design

Surface water quality samples were collected monthly between March and November for the 2009 and 2011 SWQB field surveys. Surface water quality monitoring stations were selected to characterize water quality of stream reaches throughout the basin. Stations in the 2009 Mimbres study are in Table 3.1 and shown on Figure 2.1, and stations from the 2011 Gila study are in Table 3.2 and shown on Figure 2.2. Stations were located to evaluate the impact of tributary streams and to determine ambient water quality conditions. Surface water grab sample from these stations were analyzed for a variety of chemical and physical parameters. Data from grab samples are housed in the SWQB Surface Water Quality Information Database ("SQUID") and uploaded to USEPA's Water Quality Exchange ("WQX") database.

In 2013, additional sampling was initiated by SWQB on Centerfire Creek to augment data from the 2011 survey in order to better understand the watershed. The approved 2013 field sampling plan included the intention to collect nutrient, sediment, and biological habitat information. Sampling is ongoing at that location, and results will be assessed during the next listing cycle. It is not expected that results of this sampling effort would alter the Centerfire Creek TMDLs in this document.

[12] http://www.nmenv.state.nm.us/swqb/documents/swqbdocs/MAS/Surveys/Mimbres2009.pdf

All sampling and assessment techniques used during the surveys are detailed in the *Quality Assurance Project Plan* ("QAPP")[13] (NMED/SWQB, 2012a) and Assessment Protocol[14] (NMED/SWQB, 2013), as well as the U.S. Department of Agriculture ("USDA") National Sedimentation Lab study (Heins *et al.*, 2004). As a result of the monitoring efforts, several surface water impairments were found or confirmed. Accordingly, these impairments were either added to or remained on New Mexico's CWA §303(d)/305(b) Integrated List and Report, the most recent of which was approved for the 2012-2014 cycle. Approval of the 2014-2016 version is pending as of August 2014[15].

Table 3.1 SWQB 2009 Mimbres watershed sampling stations

Station Number	**Station ID**	**Station Name**
1	45ColdSp009.3	Cold Springs above Mimbres
2	45Mimbre062.7	Mimbres below Dwyer at Ranch del Rio
3	45Mimbre085.7	Mimbres River abv confl with Gallinas River nr Royal John Bridge
4	45Mimbre094.6	Mimbres River at State Highway 90 bridge (aka NM 152) near San Lorenzo

[13] http://www.nmenv.state.nm.us/swqb/QAPP/
[14] http://www.nmenv.state.nm.us/swqb/protocols/2014/
[15] http://www.nmenv.state.nm.us/swqb/

Table 3.2 SWQB 2011 Upper Gila and San Francisco River sampling stations

Station Number	Station ID	Station Name
1	80Center002.1	Centerfire Creek abv San Francisco River
2	80SanFra124.2	San Francisco River at Upper Box
3	80SanFra109.7	San Francisco River above Reserve WWTP
4	NM0024163	Reserve WWTP - NM0024163
5	80SanFra109.6	San Francisco River below Reserve WWTP
6	80SanFra105.7	San Francisco River above Reserve
7	80SNegri000.1	South Negrito Creek
8	80Tularo035.8	Tularosa River above Apache Creek
9	80Tularo001.3	Tularosa River above San Francisco River
10	77Willow000.1	Willow Creek above Gilita Creek

3.2 Hydrologic Conditions

There are several active United States Geological Survey ("USGS") gaging stations in the watersheds in this document, and three gages which were considered for flow information. USGS 09442680 - San Francisco River near Reserve, NM is located on the San Francisco River (NM 12 at Reserve to Centerfire Creek) AU, with a period of record ranging from 1960 to the present. Gage location is represented in Figure 2.1. Daily stream flow at the gage is presented graphically in Figure 3.1 for the 2011 calendar year.

USGS 09444000 - San Francisco River near Glenwood, NM is located on the San Francisco River (Box Canyon to Whitewater Creek) AU, downstream of the San Francisco River AUs addressed in this document. The gage has a period of record ranging from 1927 to the present. Gage location is represented in Figure 2.1. Daily stream flow at the gage is presented graphically in Figure 3.2 for the 2011 calendar year. Flows at both San Francisco River gages during the 2011 survey year were typically below the median annual discharge since the beginning of gage operation, as recorded at relevant USGS gage stations, with the exception of strong monsoon events in late summer and early fall.

USGS 08477110 - Mimbres River at Mimbres, NM is located in the Mimbres River (Perennial reaches downstream of Willow Springs). The period of record for USGS 08477110 is 1978-2013. Gage location is represented in Figure 2.2. Daily stream flow for USGS 08477110 is presented graphically in Figure 3.3 for the 2009 calendar year. Flows during the 2009 survey year were typically below the median annual discharge since the beginning of gage operation, as recorded at relevant USGS gage station. 2009 flows were particularly divergent from the annual median during the spring snowmelt and late summer to fall monsoon periods.

As stated in the SWQB Assessment Protocol (NMED/SWQB, 2013), data collected during all flow conditions, including low flow (i.e., flows below the 4Q3), were used to determine designated use attainment status during the assessment process. The 4Q3 is the annual lowest four (4) consecutive day flow that occurs with a frequency of at least once every three (3) years. In terms of assessing designated use attainment in ambient surface waters, WQS apply at all times under all flow conditions.

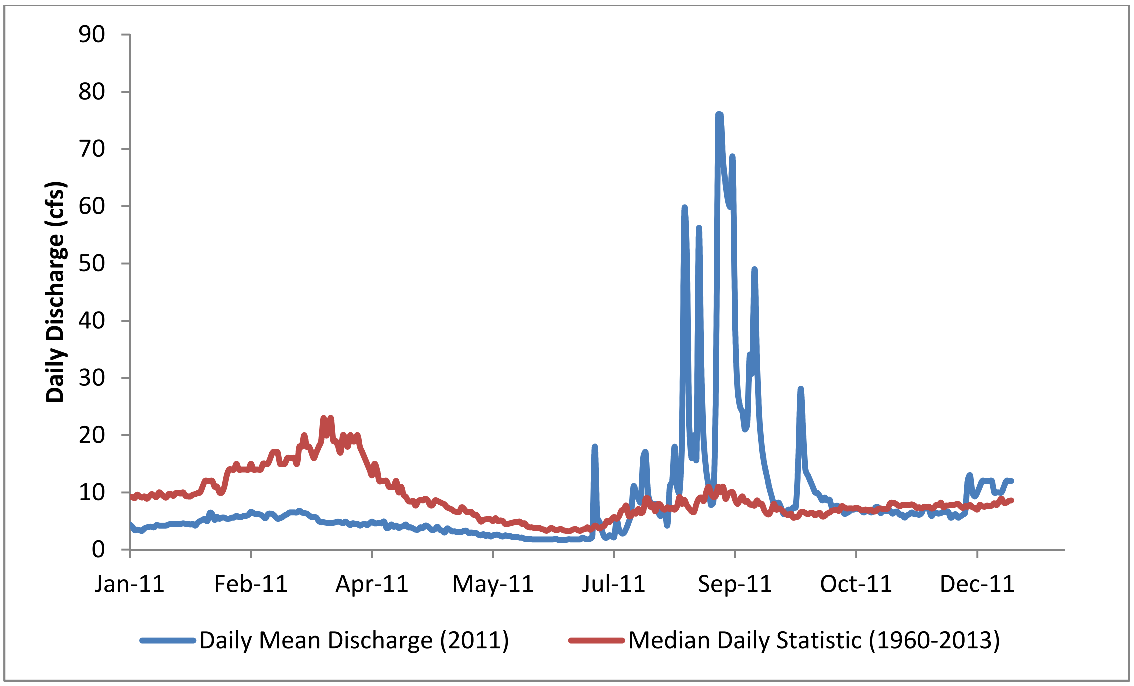

Figure 3.1 USGS 09442680 San Francisco River near Reserve, NM

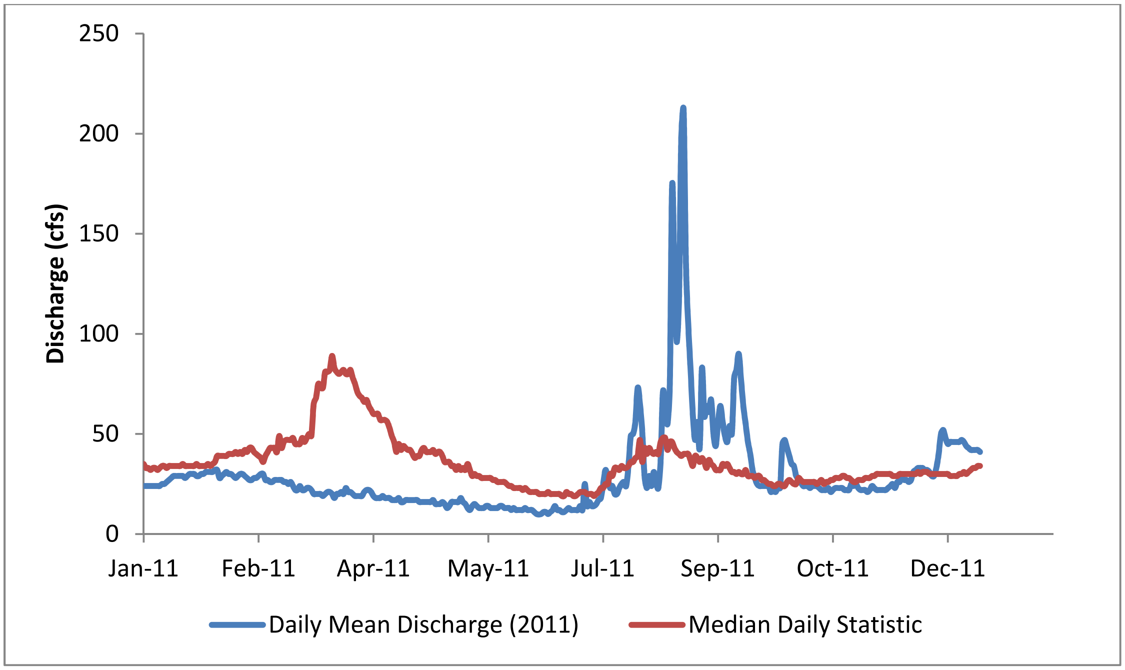

Figure 3.2 USGS 09444000 San Francisco River near Glenwood, NM

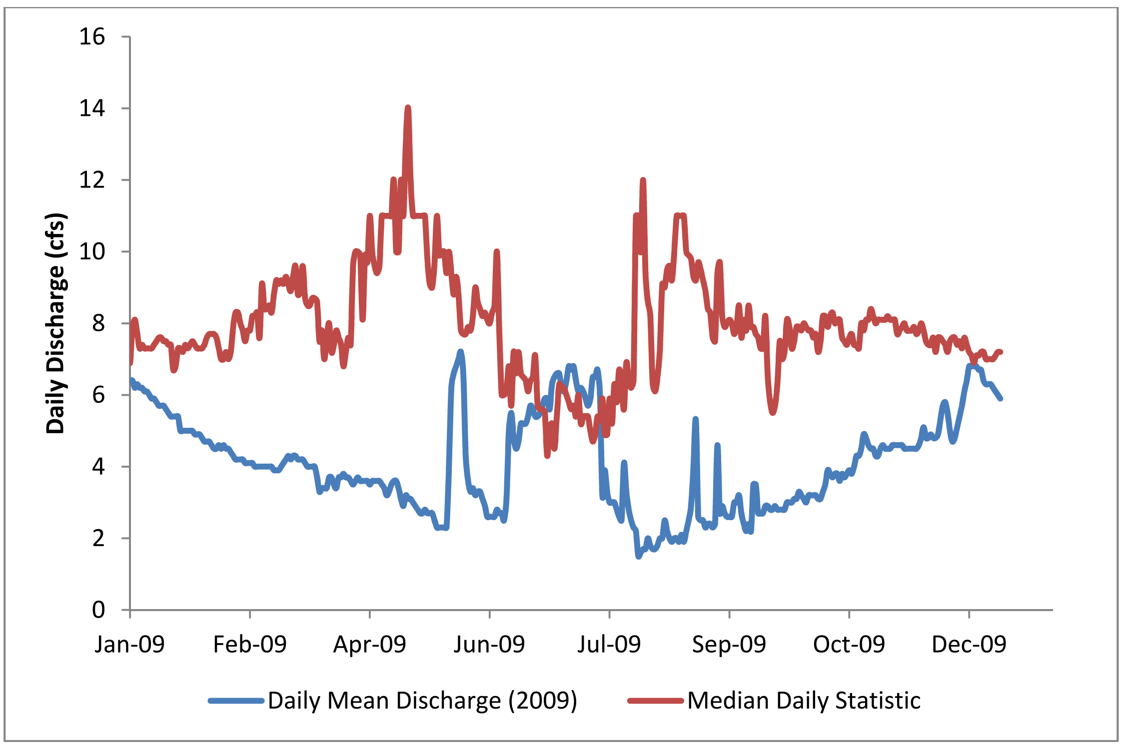

Figure 3.3 USGS 08477110 Mimbres River at Mimbres, NM

4.0 INDIVIDUAL WATERSHED DESCRIPTIONS AND IMPAIRMENTS

TMDLs have been developed for assessment units in which constituent or pollutant concentrations measured during the 2009 and 2011 water quality surveys, as combined with data from outside sources that meet NMED's data quality requirements, indicate impairment. Because characteristics of each watershed, such as geology, land use, and land ownership provide insight into probable sources of impairment, they are presented in this section for the individual 8-digit hydrologic unit code ("HUC") watersheds within the Gila River Basin and Closed Basin that are included in this document. In addition, impairments included in the 2014-2016 CWA §303(d) List within the watersheds are discussed (NMED/SWQB, 2014).

4.1 Mimbres Watershed (HUC 13030202)

The headwaters of the approximately 5,140 square mile (mi^2) Mimbres watershed originate on U.S. Forest Service land on the southwestern slopes of the Black Range, a north-south trending mountain range in west-central New Mexico. The watershed extends into Doña Ana, Grant, Luna, and Sierra counties and includes several tributaries, including Gallinas and Cold Springs creeks and continues into Chihuahua, Mexico. As presented in Figure 2.2, land ownership in New Mexico is 36% private, 33% BLM, 24% State, 7% USFS, <1% DOD, and <1% Tribal. Land use includes 87% rangeland, 8% forest, 3% agriculture, 1% built up, and <1% each of barren soil, mining, water, and wetland (Figure 4.1).

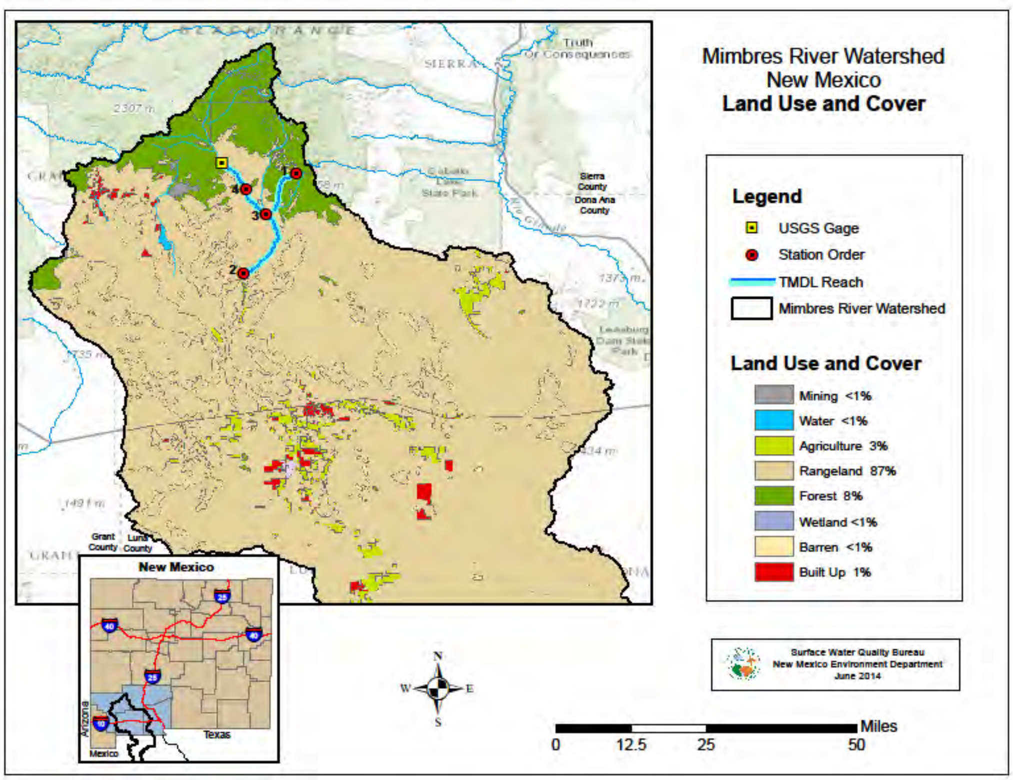

Figure 4.1 Land use in the Mimbres Watershed

The New Mexico portion of the watershed spans six Level IV Ecoregions: the Montane Conifer Forests (23b); the Madrean Lower Montane Woodlands (23c); the Chihuahuan Basins and Playas (24a); Chihuahua Desert Grasslands (24b); Low Mountains and Bajadas (24c); and the

Chihuahuan Montane Woodlands (24d) (Griffith G.E. *et al.*, 2006)). In the Mimbres Watershed, streams typically travel from headwaters through deep incised canyons to downstream locations where the stream adopts a more meandering and/or braided morphology. SWQB sampling locations range in elevation from 5,052 ft to 7,152 ft above mean sea level. Annual precipitation ranges from 30 in at higher elevations to 10 in at lower elevations.

The soils in the Mimbres watershed range from very shallow, cobble-rich clay soils to deep, gently sloping loamy or clayey soils, typically formed from alluvium derived from mixed sources. Soils are generally well-drained with variable water capacity and rapid permeability.

The Mimbres watershed is classified by NM WQS as an endorheic, or closed, basin which may have had greater connectivity within the Guzman basin of the U.S. and Mexico in the past. It is located in the Mexican Highlands section of the Basin and Range physiographic province, and is characterized by high relief in the northern portion and moderate to low relief in the central and southern portions. Neogene volcanics dominate the headwaters of the Mimbres watershed, including basaltic andesites and tuffs. Other geologic materials in the watershed include Quaternary-aged conglomerates, piedmont alluvium and basin fill, and recent alluvial sediments. A wide variety of bedrock is present in the area, ranging from sedimentary rocks including limestone, sandstone, and shale, to igneous rocks of granite, granodiorite, and monzonite and metamorphic rocks including gneiss, schist, and quartzite (NRCS, 2014)[16].

Waterbodies in the Mimbres watershed were included in the 2014-2016 CWA §303(d) List for nutrients, temperature, and *E. coli*. Cold Springs Creek (Hot Springs Creek to headwaters) was included on the CWA §303(d) List in 1996 for undetermined metals. In 1998, copper and zinc were added to the CWA §303(d) List, impairments which were then removed in 2004. Cadmium and lead were first listed as impairments for Cold Springs Creek on the 2012-2014 CWA §303(d) List.

The following TMDLs are presented in this document for the Mimbres watershed:

- Cold Springs Creek (Hot Springs Creek to headwaters): Cadmium, Lead
- Mimbres R (Perennial reaches downstream of Willow Springs)[17]: *E. coli*

4.2 Upper Gila Watershed (HUC 15040001)

The headwaters of the Upper Gila Watershed are located in the Tertiary igneous Mogollon Mountains in south-central New Mexico. The watershed drains approximately 1,985 mi^2 in southwest New Mexico. The watershed extends into Catron, Grant, and Sierra Counties and includes several perennial and ephemeral tributaries. Land ownership is 88% USFS, 8% private, 3% BLM, 2% state, and <1% each of USNPS and State Game and Fish. Land use in the watershed is 67% forest, 30% rangeland, 1% agriculture, and <1% each of built up, barren, wetland, water, and mining (Figure 4.2).

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[16] http://www.nrcs.usda.gov/wps/portal/nrcs/detail/nm/technical/?cid=nrcs144p2_068851

[17] Mimbres R (Perennial reaches downstream of Willow Springs) is the official AU name for Mimbres River (Perennial reaches downstream of Willow Springs).

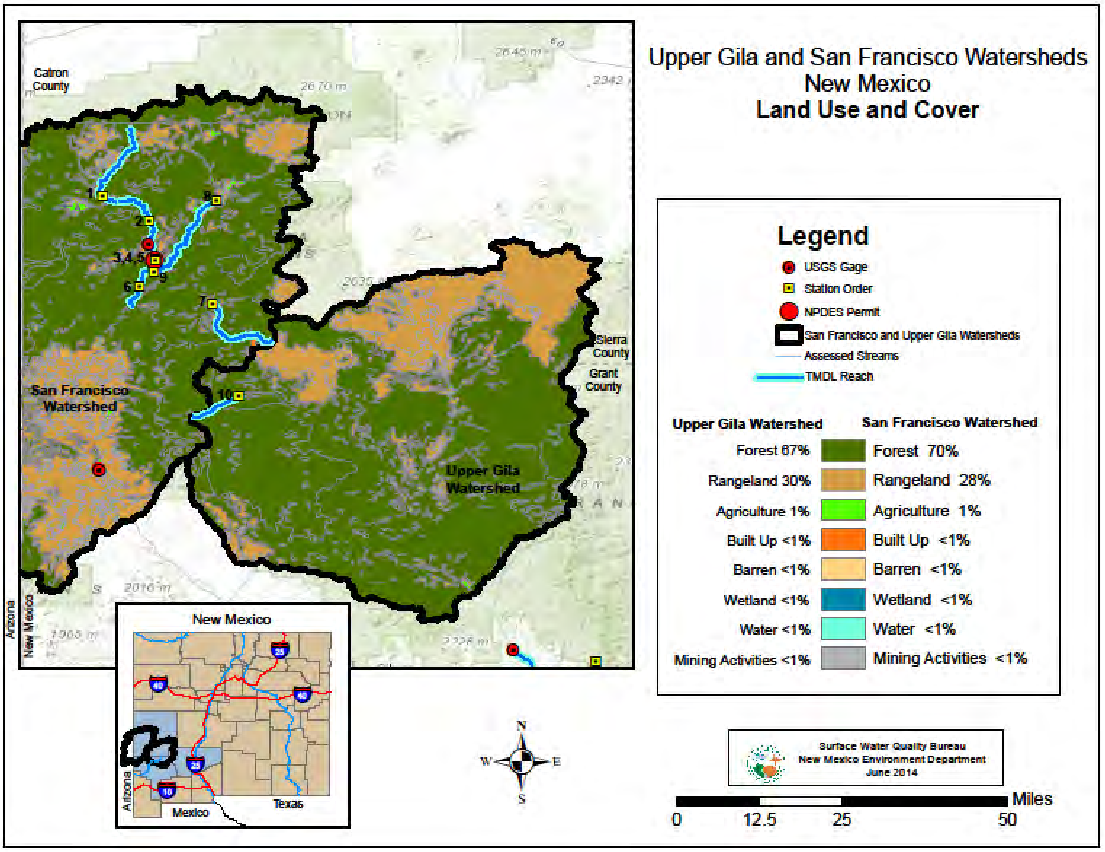

Figure 4.2 Land use and land cover in the Upper Gila and San Francisco watersheds

The watershed spans three Level IV Ecoregions: the Montane Conifer Forests (23c), the Arizona/New Mexico Subalpine Forests (23d), and the Conifer Woodlands and Savannas (23e) (Griffith G.E. *et al.*, 2006). Elevation in the watershed ranges from greater than 10,800 ft to approximately 4,600 ft above mean sea level. Annual precipitation in the watershed ranges from 41in at the highest elevations to 15 in in the northeastern portion of the watershed (NRCS, 2014)[18]. A soil survey has not been published for the majority of the Upper Gila Watershed.

The Upper Gila watershed lies on the Mogollon Plateau at the southern end of the Transition Zone described in Section 2.2. Geology of the watershed is characterized by extensive volcanic activity resulting from both the Mogollon-Datil volcanic events in the Paleogene and concurrent and more recent crustal extension. Normal faults trending northwest are also present in the watershed. Rocks are typically Tertiary rhyolitic ash-flow tuffs, basaltic andesites, and andesites. The Quaternary Gila Formation is also present in the watershed, comprised of conglomerate, sandstone, and interbedded basalt flows.

The Willow Creek (Gilita Creek to headwaters) assessment unit was included on the 2014-2016 CWA §303(d) List for chronic aluminum (total recoverable). The assessment unit has not been

[18] http://www.nrcs.usda.gov/wps/portal/nrcs/detail/nm/technical/?cid=nrcs144p2_068851

previously listed for aluminum impairment but was previously listed for plant nutrients. The reach was removed from the CWA §303(d) List in 1998.

The following TMDLs are presented in this document for the Upper Gila watershed:

- Willow Creek (Gilita Creek to headwaters): Aluminum

4.3 San Francisco Watershed (HUC 15040004)

The headwaters of the San Francisco Watershed are located in the Mogollon and San Francisco Mountains in west central New Mexico. The watershed drains approximately 2,809 mi^2 in west central-southwest New Mexico and southeast Arizona. The New Mexico portion of the watershed extends into Catron and Grant Counties, and is approximately 1,867 mi^2, or 70% of the total watershed.

Land ownership of the New Mexico portion of the watershed, is 92% USFS, 8% private, and <1% each BLM, State, and State Game and Fish. Land use and cover in the watershed is 70% forest, 28% rangeland, 1% agriculture, and <1% each of built up, barren, wetland, water, and mining (Figure 4.2).

The watershed spans four Level IV Ecoregions: the Madrean Lower Montane Woodlands (23b), the Montane Conifer Forests (23c), the Arizona/New Mexico Subalpine Forests (23d), and the Conifer Woodlands and Savannas (23e) (Griffith G.E. *et al.*, 2006). Similar to other watersheds in the Gila River Basin, the headwaters of the watershed's streams begin at high elevation and travel through incised canyons prior to leveling and widening at lower elevations. Elevations in the watershed range from 10,800 ft to less than 3,300 ft above mean sea level. Annual precipitation ranges from 13 in to 41 in. A soil survey has not been published for the majority of the San Francisco River watershed.

Geology in the San Francisco watershed is similar to that described for the watersheds above. Surface geology is dominated by the igneous rocks of the Mogollon-Datil Volcanic Field. Extrusive felsic and mafic units are ubiquitous, and Quaternary alluvium in the form of the Gila Formation, as well as late Pleistocene and Holocene alluvial deposits are common throughout.

Centerfire Creek (San Francisco River to headwaters) was first included in the CWA §303(d)/§305(b) Integrated List and Report prior to 1996 for temperature, conductivity, and plant nutrients, followed by specific conductivity and pH in 2002, and *E. coli*, sediment, and turbidity in 2014. TMDLs were developed for plant nutrients and conductivity in 2002. The water quality criterion for temperature is under review.

San Francisco River (NM 12 at Reserve to Centerfire Creek) was first included on the CWA §303(d)/§305(b) Integrated List and Report prior to 1996 under the assessment unit San Francisco River from Largo Canyon to the New Mexico-Arizona border; the assessment unit was listed for temperature, pH, total ammonia, and plant nutrients. The assessment unit was divided into its current state in the 2014-2016 CWA §303(d) List and was included for temperature, *E. coli*, and turbidity.

San Francisco River (Willow Springs Canyon to NM 12 at Reserve) was first included on the CWA §303(d)/§305(b) Integrated List and Report in 2014. It was previously included in the San Francisco River (Whitewater to NM 12 at Reserve) AU. *E. coli* is the only listed source of impairment.

South Fork Negrito (Negrito Creek to headwaters) was included on the CWA §303(d)/§305(b) Integrated List and Report prior to 1996 under the AU name Negrito Creek (South Fork). Temperature was added as a cause of impairment in 2000 and *E. coli* was to the 2014-2016 303(d) List. A temperature TMDL was written in 2002, however the temperature water quality standards are currently under review.

The Tularosa River (San Francisco R to Apache Creek) was initially listed for temperature and turbidity prior to 1996. An *E. coli* impairment was added in 2014.

The following TMDLs are presented in this document for the San Francisco River watershed:

- Centerfire Creek (San Francisco River to headwaters): *E. coli*, turbidity
- San Francisco River (NM 12 at Reserve to Centerfire Creek): *E. coli*, turbidity
- San Francisco River (Willow Springs Cyn to NM 12 at Reserve): *E. coli*
- South Fork Negrito Creek (Negrito Creek to headwaters): *E. coli*
- Tularosa River (San Francisco R to Apache Creek): *E. coli*, turbidity

4.4 Wildfire

The occurrence of wildfire in the TMDL survey areas has been frequent. Between 2011 and 2014, wildfires have impacted the Mimbres watershed, the San Francisco River watershed, and the Upper Gila watershed (Figure 4.3).

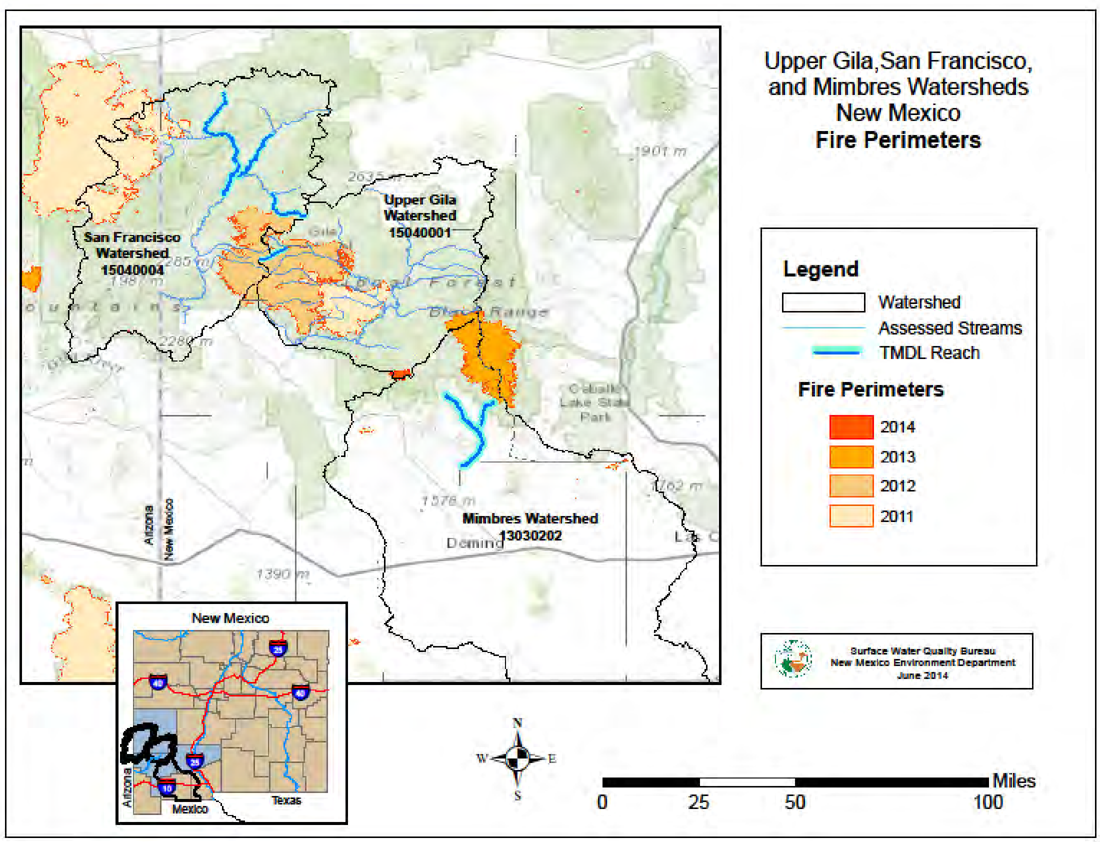

Figure 4.3 Recent fire perimeters in the study area

Several wildfires have burned portions of the Mimbres watershed since the 2009 SWQB survey, including the Silver Fire in 2013 and the Signal Fire in 2014. Cumulatively, these two fires resulted in over 144,000 acres burned, although not entirely within the Mimbres watershed. According to the New Mexico Incident Management Team, the Silver Fire burned 138,705 acres near Kingston, NM between June 7 and late July, 2013. The Signal Fire burned 5,484 acres between May 11 and May 22, 2014. Appendix D includes the final incident reports on the fires.

There have been numerous wildfires in the vicinity of the 2011 Upper Gila and San Francisco River survey. Fires include the 2011 Wallow Fire, the 2012 Whitewater-Baldy Complex, and the 2013 Signal Fire discussed above. The Whitewater Baldy Complex consumed 297,845 acres, the entirety in New Mexico. Final incident reports on the fires are included in Appendix D. Any collected data that were deemed to be impacted by wildfire were not used in the assessment of impairment designation.

4.5 Arizona Water Settlement Act

The Arizona Water Settlement Act of 2004, Pub. L. 108-451 ("AWSA"), adopted by the U.S. Congress, has several purposes, including:

- To provide for adjustments to the Central Arizona Project in Arizona;
- To authorize the Gila River Indian Community water rights settlement; and
- To reauthorize and amend the Southern Arizona Water Rights Settlement Act of 1982.

As part of AWSA, New Mexico has been allocated an annual average of 14,000 acre-feet of additional water from the Gila River Basin and potential federal funding of $128 million to meet water supply demands. New Mexico has the option to receive funding by constructing a New Mexico Unit of the Central Arizona Project, a large-scale diversion and storage project, or through non-diversion water projects. Funds can only be used in the southwestern New Mexico region (Grant, Luna, Hidalgo, and Catron counties), and the additional water must be consumed in the state; it cannot be leased or marketed outside of the state.

As a component of AWSA, the New Mexico Interstate Stream Commission ("ISC") must approve all uses of both the water and the funding. ISC began evaluating proposals from stakeholders in May 2011 and expects to have made its final selections by December 31, 2014. As of August 2014, the only proposal which may impact an AU in this TMDL is a watershed restoration and ditch improvement proposal in the San Francisco River watershed.

4.5 Antidegradation

NM's *Standards for Interstate and Intrastate Surface Waters* (20.6.4 NMAC)[19] establish surface water quality standards that consist of designated uses of surface waters of the State, the water quality criteria necessary to protect the uses, and an antidegradation policy. NM's antidegradation policy, which is based on the requirements of 40 CFR Part 131.12[20], describes how waters are to be protected from degradation (Subsection A of 20.6.4.8 NMAC) while the *Antidegradation Policy Implementation Procedures* establish the process for implementing the

[19] http://www.nmcpr.state.nm.us/nmac/parts/title20/20.006.0004.pdf
[20] http://www.gpo.gov/fdsys/pkg/CFR-2002-title40-vol18/pdf/CFR-2002-title40-vol18.pdf

antidegradation policy (NMED/SWQB, 2011). At a minimum, the policy mandates that "the level of water quality necessary to protect the existing uses shall be maintained and protected in all surface waters of the state." In addition, whether or not a segment is impaired, the State's antidegradation policy requirements, as detailed in the *Antidegradation Policy Implementation Procedures* (NMED/SWQB, 2011) must be met. TMDLs are consistent with the policy because implementation of a TMDL restores water quality so that existing uses are protected and water quality criteria are achieved. The *Antidegradation Policy Implementation Procedure* can be found in Appendix A of the *Statewide Water Quality Management Plan and Continuing Planning Process* document[21].

[21] http://www.nmenv.state.nm.us/swqb/Planning/WQMP-CPP/

5.0 BACTERIA - E. COLI

Assessment of the data from 2011 SWQB water quality survey in the Gila and San Francisco River watersheds identified exceedences of the New Mexico water quality standard criteria for *E. coli* bacteria in the Centerfire Creek (San Francisco River to headwaters), San Francisco River (Willow Springs Canyon to NM 12 at Reserve), San Francisco River (NM 12 at Reserve to Centerfire Creek), South Fork Negrito Creek (Negrito Creek to headwaters), and Tularosa River (San Francisco River to Apache Creek) AUs. Assessment of the 2009 data identified exceedences of the *E. coli* criteria in the Mimbres R (Perennial reaches downstream of Willow Springs) AU. Bacteria data collected and used for assessment of the AUs can be found in Appendix C.

As a result, these assessment units are listed on the 2014-2016 CWA §303(d)/ §305(b) Integrated Report and List with *E. coli* as an impairment (NMED/SWQB, 2014)[22]. Mimbres R (Perennial reaches downstream of Willow Springs) was initially listed for fecal coliform in 2004 and *E. coli* on the 2012-2014 CWA §303(d)/§305(b) Integrated Report and List (NMED/SWQB, 2012b). If and when water quality criteria have been met, the reach will be moved to the appropriate category on the CWA §303(d) List.

5.1 Target Loading Capacity

Bacteria standards are expressed as colony forming units ("cfu") per unit volume, typically cfu per 100 milliliter ("mL") (cfu/100mL). Target values for bacteria in the San Francisco River AUs are based on the reduction in bacteria necessary to achieve the numeric criterion associated with the primary contact designated use in 20.6.4.900 NMAC of 126 cfu/100 mL *E. coli* monthly geometric mean and 410 cfu/100 mL *E. coli* single sample. Target values for bacteria for Centerfire Creek, Mimbres River, South Fork Negrito Creek, and Tularosa Creek are based on attainment of the monthly geometric mean of 126 cfu/100 mL and a segment specific *E. coli* single sample criterion of 235 cfu/100 mL.

The criterion for the primary contact designated use was used for the San Francisco River AUs as it is the most stringent criteria for the designated uses identified for the AUs. The presence of *E. coli* bacteria is an indicator of the possible presence of other pathogens that may limit beneficial uses and present human health concerns. Samples were assessed by comparing the *E. coli* results to the single sample criterion. Exceedences are presented in Table 5.1; data are located in Appendix C.

[22] http://www.nmenv.state.nm.us/swqb/303d-305b/

Table 5.1 Exceedences of *E. coli*

Assessment Unit	Criteria (single sample)	Number of Exceedences	Number of Samples
Centerfire Creek (San Francisco River to headwaters)	235 cfu/100mL	6	7
Mimbres R (Perennial reaches downstream of Willow Springs)	235 cfu/100mL	8	18
San Francisco River (NM 12 at Reserve to Centerfire Creek)	410 cfu/100mL	2	7
San Francisco River (Willow Springs Canyon to NM 12 at Reserve)	410 cfu/100mL	7	23
South Fork Negrito Creek (Negrito Creek to headwaters)	235 cfu/100mL	2	4
Tularosa River (San Francisco River to Apache Creek)	235 cfu/100mL	5	15

5.2 Flow

TMDLs are calculated at a specific flow and bacteria concentrations can vary as a function of flow. SWQB determined streamflow either by using the active USGS gage network or by taking direct flow measurements utilizing standard procedures (NMED/SWQB, 2013)[23]. Water quality standard exceedences for all impaired reaches occurred during low and moderate flows. Therefore, for these reaches, the critical flow value used to calculate the TMDLs 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. According to the New Mexico Water Quality Standards, 20.6.4.11.B.2 NMAC[24], the low flow critical condition is defined as 4Q3 for numeric criteria set in 20.6.4.97 through 20.6.4.900 NMAC, as well as Subsection F of 20.6.4.13 NMAC. Bacteria criteria are found in these sections of the regulations and are therefore bound by this critical condition. Critical low flow was determined on an annual basis utilizing all available daily flow values rather than on a seasonal basis for these TMDLs because exceedences occurred across flow conditions and flow in the gage record was typically non-zero.

SWQB determined streamflow and critical flows using available data from active USGS gages in the study area (Table 5.2) as input for DFLOW 3.1a software, developed by the USGS (USEPA, 2006)[25]. DFLOW allows the user to specify seasonal components that may impact low flow. For example, AUs at higher elevations may have little to no flow during the winter months as a result of freezing conditions, which could result in a 4Q3 of zero. Using a 4Q3 of zero is not a valid

[23] http://www.nmenv.state.nm.us/swqb/SOP/
[24] http://www.nmcpr.state.nm.us/nmac/parts/title20/20.006.0004.pdf
[25] http://water.epa.gov/scitech/datait/models/dflow/

input into the equation and would result in a null threshold value. Also, if a stream isn't flowing, its support of designated uses cannot be accurately assessed. In the case of the Mimbres gage, flows of zero were recorded for 16 of the 17 days between June 16, 2002 and July 2, 2002. Upon examination, it is likely that the portion of the AU located at the USGS gaging station was dry due to drought. Because drought is a natural occurrence and does not appear to have occurred regularly during the gaged period, each zero data point was changed to 0.01 cfs in order to retain the presence of those extreme low flows in the 4Q3 calculation without resulting in an invalid result.

Table 5.2 USGS gages in study area

Gage	Name	Start Date	End Date	4Q3 (cfs[b])	4Q3 (MGD[c])
09442680	San Francisco River near Reserve, NM	March 1, 1959	April 3, 2014	1.60	1.03
09444000	San Francisco River near Glenwood, NM	April 1, 1928	April 1, 2013	10.3	6.7
08477110	Mimbres River at Mimbres, NM	March 1, 1978	June 2, 2013	1.36	0.88

[b]cfs = cubic feet per second
[c]MGD = Million Gallons per Day

The calculated 4Q3s using DFLOW software and assumptions noted above are:

- San Francisco River (NM 12 at Reserve to Centerfire Creek) = 1.03 MGD
- Mimbres R (Perennial reaches downstream of Willow Springs) = 0.88 MGD

The San Francisco River (Willow Springs Canyon to NM 12) AU does not contain an active gage, but is located on an actively gaged stream. USGS Gage 09442680 is located in the San Francisco River (NM 12 at Reserve to Centerfire Creek) AU and USGS Gage 09444000 is located in the San Francisco River (Box Canyon to Whitewater Creek) AU; gage information is located in the above Table 5.2. However, because the ratio of the gaged to ungaged drainage areas is not between 0.5 and 1.5, the critical flow could not be calculated using the gage data (Table 5.3). This ratio is identified in Thomas *et al.*, 1997 as part of a method of estimating the 4Q3 of an ungaged station located on a gaged stream. Applying the Thomas method outside of the ratio identified above would be inappropriate. Please see *Methods for estimating magnitude and frequency of floods in the southwestern United States*, USGS Water-Supply Paper 2433 (Thomas *et al*., 1997)[26] for details.

[26] http://pubs.usgs.gov/wsp/2433/report.pdf

Table 5.3 Drainage areas and ratios of selected gages on San Francisco River

Gage	Name	Drainage Area (mi^2)	Ratio of Gaged to Ungaged
09442680	San Francisco River near Reserve, NM	303.55	0.29
09444000	San Francisco River near Glenwood, NM	1628.69	1.54
-	San Francisco River (Willow Springs Cyn to NM 12 at Reserve, NM)	1058.81	-

In the case of ungaged streams, an analysis method developed by Waltemeyer (2002) can be used to estimate flow. 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 ft in elevation). Because the average elevation of the watersheds of Tularosa River (San Francisco River to Apache Creek), Centerfire Creek (San Francisco River to headwaters), South Fork Negrito Creek (Negrito Creek to headwaters), and San Francisco River (Willow Springs Cyn to NM 12 at Reserve) are above 7,500 ft, the decision was made to use the mountainous regions regression equation.

The following mountainous regions regression equation (Equation 5.1) is based on data from 40 gaging stations located above 7,500 ft in elevation with non-zero discharge (Waltemeyer 2002):

Equation 5.1

$$4Q3 = 7.3287 \times 10^{-5} DA^{0.70} {P_w}^{3.58} S^{1.35}$$

Where:

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

For details and development of this equation, please see *Analysis of the Magnitude and Frequency of the 4-Day Annual Low Flow and Regression Equations for Estimating the 4-Day, 3-Year Low-Flow Frequency at Ungaged Sites on Unregulated Streams in New Mexico*, USGS Water-Resources Investigations Report 01-4271 (Waltemeyer, 2002)[27].

4Q3 values calculated using Waltemeyer's methods are presented in Table 5.4. Parameters used in the calculation were determined using Weasel, a Geographic Information System ("GIS") application. The 4Q3 result from Equation 5.1 is in cubic feet per second ("cfs"). Conversion to

[27] http://nm.water.usgs.gov/publications/abstracts/wrir01-4271.html

million gallons per day ("MGD") was calculated using the unit conversion provided in Appendix A.

Table 5.4 Calculation of 4Q3

Assessment Unit	Average Elevation (ft)	Drainage Area (mi^2)	Mean Winter Precipitation (in)	Average Basin Slope (percent)	4Q3 (cfs)	4Q3 (MGD)
Centerfire Creek (San Francisco River to headwaters)	7592	136.85	9.45	0.163	0.62	0.40
San Francisco River (Willow Springs Canyon to NM 12 at Reserve)	7556	1058.81	9.46	0.195	3.30	2.13
South Fork Negrito (Negrito Creek to headwaters)	8064	49.58	16.16	0.191	2.56	1.65
Tularosa River (San Francisco River to Apache Creek)	7579	645.02	9.57	0.195	2.43	1.57

5.3 Calculations

The *E. coli* geometric monthly mean criterion (126 cfu/100 mL) was used to calculate the allowable stream loads for the impaired assessment units because it is the most conservative applicable criterion. TMDLs, or target loading capacities, for bacteria are calculated with the following equation, based on flow values, WQS, and a conversion factor (Equation 5.2):

Equation 5.2

$$C\ as\ \frac{cfu}{100mL} * 1000\frac{mL}{L} * \frac{L}{0.264\ gallons} * Q\ in\ 1{,}000{,}000\frac{gallons}{day} = cfu/day$$

Where:

C = water quality criterion for bacteria
Q = the critical stream flow in million gallons per day (MGD)

The more conservative monthly geometric mean criterion is utilized in TMDL calculations to provide an implicit Margin of Safety ("MOS"). Furthermore, if the higher value single sample criterion was used and achieved as a target, the geometric mean criterion may still not be achieved. The calculated target loads are located in Table 5.5. The measured load was calculated using the arithmetic mean of the data. Because the arithmetic mean of a dataset is always greater than the geometric mean (Muirhead, 1903), the arithmetic mean acts as a component of the implicit MOS.

Table 5.5 TMDL/target *E. coli* loads

Assessment Unit	Critical Flow (MGD)	*E. coli* geometric mean criteria (cfu/100mL)	Conversion Factor[b]	TMDL[a] (cfu/day)
Centerfire Creek (San Francisco River to headwaters)	0.40	126	3.79×10^{7}	1.91×10^{9}
Mimbres R (Perennial reaches downstream of Willow Springs)	0.88	126	3.79×10^{7}	4.20×10^{9}
San Francisco River (NM 12 at Reserve to Centerfire Creek)	1.03	126	3.79×10^{7}	4.92×10^{9}
San Francisco River (Willow Springs Canyon to NM 12 at Reserve)	2.13	126	3.79×10^{7}	1.02×10^{10}
South Fork Negrito Creek (Negrito Creek to headwaters)	1.65	126	3.79×10^{7}	7.89×10^{9}
Tularosa River (San Francisco River to Apache Creek)	1.57	126	3.79×10^{7}	7.50×10^{9}

[a]TMDL values are equivalent to the target load
[b] Details can be found in Appendix A. The conversion factor converts flow and concentration into loading units, in this case cfu/day.

The measured loads for *E. coli* were similarly calculated as the target loads. The arithmetic mean of the data used to determine the impairment was substituted for the criterion in Equation 5.1. The same conversion factor was used. Results are presented in Table 5.6.

The samples collected and the resulting impairment determinations are based on exceedences of the State's single sample criterion, and the TMDL is written to address the monthly geometric mean standard. As such, any simple comparison of these numbers is fraught with challenge and, in this case, will result in an over-estimation of the actual reduction necessary. Furthermore, neither CWA §303 nor 40 CFR Part 130.7 requires states to include discussions of percent reductions in TMDL documents. Although NMED believes that it is often useful to discuss the magnitude of water quality exceedences in the TMDL, the "percent reduction" value can be calculated in multiple ways and as a result can often be misinterpreted, therefore a percent reduction is not presented for *E. coli*.

Table 5.6 Measured *E. coli* load

Assessment Unit	Critical Flow (MGD)	*E. coli* Arithmetic Mean (cfu/100mL)	Conversion Factor[(a)]	Measured Load (cfu/day)
Centerfire Creek (San Francisco River to headwaters)	0.40	826.07	3.79×10^{7}	1.25×10^{10}
Mimbres R (Perennial reaches downstream of Willow Springs)	0.88	276.14	3.79×10^{7}	9.21×10^{9}
San Francisco River (NM 12 at Reserve to Centerfire Creek)	1.03	538.39	3.79×10^{7}	2.10×10^{10}
San Francisco River (Willow Springs Canyon to NM 12 at Reserve)	2.13	657.23	3.79×10^{7}	5.31×10^{10}
South Fork Negrito Creek (Negrito Creek to headwaters)	1.65	674.38	3.79×10^{7}	4.22×10^{10}
Tularosa River (San Francisco River to Apache Creek)	1.57	295.03	3.79×10^{7}	1.76×10^{10}

[(a)] Details can be found in Appendix A. The conversion factor converts flow and concentration into loading units, in this case cfu/day.

5.4 Waste Load Allocations and Load Allocations

5.4.1 Waste Load Allocation

There is one existing point source with an individual NPDES permit in these AUs. The Village of Reserve Mutual Sewer Association holds a permit (NM0024163) for a municipal wastewater treatment plant (WWTP) with one outfall that is authorized to discharge to an unnamed tributary and wetland then to the San Francisco River (Willow Springs Canyon to NM 12 at Reserve) AU. The wetland has been delineated and is filed in the National Wetlands Inventory, although it has not undergone jurisdictional delineation. The unnamed tributary is classified as "Intermittent Waters" (NMAC 20.6.4.98) in the New Mexico Water Quality Standards. Waters with this classification are subject to segment-specific *E. coli* criterion of 206 cfu/100 mL geometric mean and 940 cfu/100 mL single sample, and thus the WWTP has been provided an *E. coli* effluent limit of 206 cfu/100 mL in its NPDES permit. Table 5.7 details the existing effluent *E. coli* permit limits for the Village of Reserve Mutual Sewer Association WWTP. This differs from the *E. coli* criteria identified for San Francisco River (Willow Springs Cyn to NM 12 at Reserve), which was found to be impaired in the 2014-2016 CWA list. Because the WWTP is now discharging, albeit indirectly, to a waterbody which is impaired for *E. coli*, the WLA assigned to the facility in this TMDL reflects the more stringent *E. coli* criterion of the receiving water, 126 cfu/100 mL. Table 5.8 details the WLA.

No permittees have been identified in the watersheds by the USEPA as Phase II small Municipal Separate Storm Sewer Systems ("sMS4").

Table 5.7 Existing NPDES permit effluent limits for *E. coli*

Assessment Unit	Facility	Design Capacity Flow (MGD)	*E. coli* Effluent Limits (cfu/100mL)
San Francisco River (Willow Springs Cyn to NM 12 at Reserve)	Village of Reserve Mutual Sewer Association NPDES No. NM0024163, expiration: August 31, 2018	0.075	206[a]

(a) The Village of Reserve Mutual Sewer Association WWTP effluent permit limits are based on the water quality criteria for NMAC 20.6.4.98 as the outfall discharges to an unnamed tributary and wetlands before reaching the AU.

Excess bacteria concentrations may be a component of some stormwater discharges covered by general NPDES permits, so the load for these dischargers will be addressed in this document as a component of the Load Allocation.

Stormwater discharges from construction activities are transient because they occur mainly during the construction itself, and then only during storm events. Coverage under the National Pollutant Discharge Elimination System ("NPDES") Construction General 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. The current CGP also includes state-specific requirements to implement site-specific interim and permanent stabilization, managerial, and structural solids, erosion, and sediment control Best Management Practices ("BMPs"), and/or other controls. BMPs are designed to prevent to the maximum extent practicable an increase in sediment load to the water body or an increase in a sediment-related parameter, such as total suspended solids, turbidity, siltation, stream bottom deposits, etc. BMPs also include measures to reduce flow velocity during and after construction compared to pre-construction conditions to assure that waste load allocations and/or applicable water quality standards, including the antidegradation policy, are met. Compliance with a SWPPP that meets the requirements of the CGP is generally assumed to be consistent with this TMDL.

Stormwater discharges from active industrial facilities are generally covered under the current NPDES Multi-Sector General Permit ("MSGP"). This permit also requires preparation of an SWPPP, which includes specific requirements to limit (or eliminate) pollutant loading associated with the industrial activities in order to minimize impacts to water quality. Compliance with a SWPPP that meets the requirements of the MSGP is generally assumed to be consistent with this TMDL.

It is not possible to calculate individual WLAs for facilities covered by the MSGP at this time using the available tools. The discharges from these permits are typically transitory and enforcement is complex as permittees are temporary. Loads that are in compliance with the MSGP are therefore currently included as part of the LA. While these sources are not given individual allocations, they are addressed through other means, including BMPs, stormwater pollution prevention conditions, and other requirements.

Table 5.8 Assigned *E. coli* WLA

Assessment Unit	Facility	Design Capacity Flow (MGD)	*E. coli* criterion of receiving water[(a)] (cfu/100mL)	Conversion Factor	WLA (cfu/day)
San Francisco River (Willow Springs Cyn to NM 12 at Reserve)	Village of Reserve Mutual Sewer Association NPDES No. NM0024163, expiration: August 31, 2018	0.075	126[(a)]	3.79×10^7	3.58×10^8

(a) The monthly geometric mean *E. coli* criterion for San Francisco River (Willow Springs Cyn to NM 12 at Reserve) is 126 cfu/100mL.

5.4.2 Load Allocation

In order to calculate the LA, the WLA and MOS were subtracted from the target capacity TMDL using the equation below.

Equation 5.3

$$WLA + LA + MOS = TMDL$$

or

$$LA = TMDL - MOS - WLA$$

For the *E. coli* TMDLs presented in this document, the WLA is 0 with the exception of San Francisco River (Willow Springs Cyn to NM 12 at Reserve). In this TMDL document, a WLA of 0 is due to the lack of NPDES permitted dischargers in the relevant AUs. The MOS is estimated to be 15% of the target load calculated in Table 5.5 for ungaged AUs; an MOS of 10% has been assigned to gaged AUs. Results of the TMDL calculations are presented in Table 5.9. Additional details on the MOS are presented in Section 5.7.

The extensive data collection and analyses necessary to determine background *E. coli* loads for the watersheds in this section 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. SWQB is involved in an ongoing study in the Centerfire Creek watershed to better understand its impairments and provide more insight into probable.

Table 5.9 TMDL for *E. coli*

Assessment Unit	WLA (cfu/day)	LA (cfu/day)	MOS (15%) (cfu/day)	TMDL[a] (cfu/day)
Centerfire Creek (San Francisco River to headwaters)	0	1.62×10^{9}	2.87×10^{8}	1.91×10^{9}
Mimbres R (Perennial reaches downstream of Willow Springs)	0	3.78×10^{9}	4.20×10^{8}[b]	4.20×10^{9}
San Francisco River (NM 12 at Reserve to Centerfire Creek)	0	4.43×10^{9}	4.92×10^{8}[b]	4.92×10^{9}
San Francisco River (Willow Springs Canyon to NM 12 at Reserve)	3.58×10^{8}	8.30×10^{9}	1.53×10^{9}	1.02×10^{10}
South Fork Negrito Creek (Negrito Creek to headwaters)	0	6.71×10^{9}	1.18×10^{9}	7.89×10^{9}
Tularosa River (San Francisco River to Apache Creek)	0	6.38×10^{9}	1.13×10^{9}	7.50×10^{9}

[a] TMDL values are equivalent to the target load capacity; these values are displayed in Table 5.5.
[b] Margin of Safety for San Francisco River (NM 12 at Reserve to Centerfire Creek) AU and Mimbres R (Perennial reaches downstream of Willow Springs) AU are 10%. See Section 5.7 for details.

5.5 Identification and Description of Pollutant Sources

SWQB fieldwork includes an assessment of the probable sources of impairment, an example of which may be found in Appendix B. The approach for identifying probable sources of impairment was modified by SWQB in 2010 to include additional input from a variety of stakeholders including landowners, watershed group, and local, state, tribal, and federal agencies. Probable source sheets are filled out by SWQB staff during watershed surveys and watershed restoration activities. The draft probable source list was reviewed and modified as necessary with watershed group/stakeholder input during the TMDL public meeting and comment period.

Although this procedure includes subjective and qualitative elements, SWQB has concluded that it provides the best available information for the identification of probable sources of impairment in a watershed given current resources available for this effort. The list of probable sources is not intended to single out any single land owner or particular land management activity and generally includes several sources per impairment. Table 5.10 displays pollutant sources that may contribute to each AU as determined by field reconnaissance and evaluation. Probable sources of *E. coli* impairments will be evaluated, refined, and changed as necessary through the Watershed-Based Plan (“WBP”).

Table 5.10 Probable Source Summary for *E. coli*

Pollutant Sources	Magnitude[a]	AU	Probable Sources[b]
Point:			
	3.58×10^8	San Francisco River (Willow Springs Canyon to NM 12)	Village of Reserve WWTP - NM0024163
Nonpoint:			
	1.25×10^{10}	Centerfire Creek (San Francisco River to headwaters)	Dispersed rangeland grazing, *drought-related impacts, gravel or dirt roads, low water crossings, recent bankful or overbank events*
	9.21×10^9	Mimbres R (Perennial reaches downstream of Willow Springs)	*Livestock grazing[c], pavement/impervious surfaces, bridges/culverts/rr crossings, low water crossings, paved roads, gravel or dirt roads, highway/road/bridge runoff, waste from pets, waterfowl, wildlife other than waterfowl*
	2.10×10^{10}	San Francisco River (NM 12 at Reserve to Centerfire Creek)	*Dispersed rangeland grazing, residences/buildings, low water crossings, gravel or dirt roads, watershed runoff following forest fire*
	8.30×10^9	San Francisco River (Willow Springs Canyon to NM 12 at Reserve)	*Irrigation return drains, flow alteration from water diversions, onsite treatment systems, residences /buildings, dispersed rangeland grazing, low water crossings, gravel or dirt roads, waterfowl, drought-related impacts, watershed runoff*

			following forest fire
	4.22×10^{10}	South Fork Negrito (Negrito Creek to headwaters)	Removal of riparian vegetation, *defined campgrounds, dispersed rangeland grazing, drought-related impacts, gravel or dirt roads, highway/road/bridge runoff, hiking trails, low water crossings, onsite treatment systems, residences/ buildings*
	1.76×10^{10}	Tularosa River (San Francisco River to Apache Creek)	*Bridges/culverts/RR crossings, defined campgrounds,* dispersed rangeland grazing, *drought-related impacts, gravel or dirt roads, highway/ road/bridge runoff, hiking trails, inappropriate waste disposal, low water crossings, onsite treatment systems, paved roads, residences /buildings, waterfowl*

(a) The magnitudes of point source probable sources are based on the NPDES permit and WLA assigned in the TMDL. The nonpoint source probable source magnitude is calculated by subtracting the point source load from the measured load.
(b) Probable sources in italics have not been previously noted in the 303(b)/305(d) Integrated List; they were noted on Probable Source Sheets, an example of which is identified in **Appendix B**.
(c) Source noted at most downstream station in AU only.

5.6 Linkage of Water Quality and Pollutant Sources

In the San Francisco River (Willow Springs Cyn to NM 12) AU, the Village of Reserve Mutual Sewer Association WWTP is a potential source of bacteria. Among nonpoint source probable sources of bacteria in the greater Gila River and Closed basins are livestock grazing of uplands and riparian areas, in addition to wastes from pets, waterfowl, and other wildlife. Howell *et al.* (1996) found that bacteria concentrations in underlying sediment increase when cattle have direct access to streams. Natural sources of bacteria are also present in the form of other wildlife such as elk, deer, and any other warm-blooded mammals. In particular, waterfowl and wildlife other than waterfowl were noted during probable source assessment of the Mimbres R (Perennial reaches downstream of Willow Springs).

In addition to direct input from grazing operations and wildlife, *E. coli* concentrations may be subject to elevated levels as a result of re-suspension of bacteria-laden sediment during storm events. While the highest concentrations of *E. coli* may occur during storm events rather than when flow is at 4Q3 levels, these events are rare, and the dilution of stormwater by the baseflows, combined with the transitory nature of the events, the 4Q3 is considered a more conservative estimate of the long-term stream condition. Habitat modifications, including loss of riparian habitat, road maintenance and runoff, and land development and redevelopment, as well as other recreational pollution sources, appear to also be important contributors of bacteria in the relevant watersheds. While sufficient data currently exist to support development of *E. coli* TMDLs, further study is necessary to better determine sources and their relative contributions.

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

- *Conservative Assumptions:*
  - *E. coli* bacteria are able to survive in the freshwater environment (Wcisło and Chróst 2000);
  - Basing the target load capacity on the geometric mean criterion rather than the higher-concentration single sample criterion; and
  - Calculating the measured load with the arithmetic mean rather than the geometric mean of the sample results produces a greater mean and therefore a more conservative load estimate.
- *Explicit recognition of potential errors:*
  - Uncertainty exists in sampling nonpoint sources of pollution. A conservative MOS for this element is therefore **5%**.
  - The critical flow value for the ungaged streams was estimated based on a regression equation from Waltemeyer (2002). There is inherent error in all flow calculations, including those based on gage data. A conservative MOS for this element for AUs which used the regression equation is therefore **10%**.
  - There is inherent error in all flow measurements; a conservative MOS for this element in gaged streams is **5%**.

5.8 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. Data used in the calculation of these TMDLs were collected during the spring, summer, and fall in order to ensure coverage of any potential seasonal variation in the system. Bacteria exceedences occurred during flows throughout the sampling season, although more exceedences were recorded during sampling events between June and August. Higher flows may generate more nonpoint source runoff containing bacteria. It is also possible that higher concentrations are observed under a low flow condition when there is insufficient dilution. Because there were exceedences throughout the sampling timeframe, seasonality was not considered a factor in development of *E. coli* TMDLs in this document.

5.9 Future Growth

Growth estimates by county are available from the New Mexico Bureau of Business and Economic Research[28]. These estimates project growth to the year 2040. Table 5.11 displays the 2010 population, projected 2040 population, and the associated percent change for the counties relevant to the *E. coli* TMDLs in this document.

According to SWQB data and a limited number of permitted NPDES permittees with a reasonable potential to discharge *E. coli*, bacterial loading is primarily due to diffuse nonpoint sources. Estimates of future growth in Catron, Grant, Hidalgo, Luna, and Sierra Counties are not anticipated to lead to a significant increase in bacteria that cannot be controlled with BMPs. However, it is imperative that BMPs continue to be utilized to improve road conditions and grazing allotments and adhere to SWPPP requirements related to construction and industrial activities covered under the general permit.

Table 5.11 Projected population by county

County	2010 Population	Projected 2040 Population	Percent Change
Catron	3,725	4,012	7.7%
Grant	29,371	29,102	-0.9%
Hidalgo	4,894	4,403	-10%
Luna	25,095	35,595	41.8%
Sierra	11,988	12,737	6.2%

Through the Arizona Water Settlement Act of 2004 (P.L. 108-451)[29], New Mexico has been allocated an additional annual average of 14,000 acre-feet of water from the Gila River Basin and potential federal funding to meet water supply demands in the region. As of August 2014, the only proposal which may impact an AU in this TMDL is a watershed restoration and ditch improvement proposal in the San Francisco River watershed, which would be unlikely to substantially change flow in the AUs.

Because proposals have not yet been selected and must undergo environmental impact analysis, statements regarding potential changes to future flow conditions and growth as a result of these projects are not appropriate at this time. Any resulting future growth would be considered part of the existing load allocation, assuming persistence of the hydrologic conditions used to develop these TMDLs.

[28] http://bber.unm.edu/demograp2.htm
[29] http://www.gpo.gov/fdsys/pkg/PLAW-108publ451/pdf/PLAW-108publ451.pdf

6.0 ALUMINUM

Assessment of the data from the 2011 SWQB intensive water quality survey in the Upper Gila watershed identified exceedences of the New Mexico water quality standards for total recoverable aluminum in Willow Creek (Gilita Creek to headwaters). Consequently, this waterbody was listed on the 2014-2016 CWA §303(d) List (NMED/SWQB, 2014)[30] for total recoverable aluminum-chronic.

6.1 Target Loading Capacity

For this TMDL document, target values for aluminum are based on the reduction in aluminum necessary to achieve the numeric criterion associated with the high quality cold water aquatic life (HQCWAL) use. The New Mexico water quality standards identify chronic aluminum as a hardness-dependent criterion (20.6.4.900.I NMAC); its numeric criterion is based on concurrent hardness data. Using Equation 6.1, the numeric chronic criterion for each sample date was calculated and is presented in Table 6.1.

Equation 6.1

$$exp(m_c \times [ln(hardness)] + b_c)$$

Where,

m_C = 1.3695
b_C = 0.9161

High chronic levels of aluminum can be toxic to fish, benthic invertebrates, and some single-celled plants. Aluminum concentrations from 0.1 to 0.3 mg/L (100 to 300 ug/L) increase mortality and retard growth, gonadal development, and egg production of fish.

[30] http://www.nmenv.state.nm.us/swqb/303d-305b/

Table 6.1 Calculated hardness-dependent aluminum criteria – Chronic

Sample Date	Hardness (mg/L CaCO3)	Aluminum Concentration (ug/L)	Calculated Criterion (ug/L)	Measured Flow (cfs)
April 13, 2011	24.04	124.55	194.34	0.91
May 18, 2011	27.34	255.60[b]	232.03	1-2[a]
June 22, 2011	32.72	103.14	296.75	2.5[a]
July 27, 2011	31.33	574.99[b]	279.62	0.55
August 24, 2011	25.26	498.46[b]	208.20	12.57
September 21, 2011	32.27	167.46	291.18	NA[c]
October 25, 2011	30.27	80.00	266.75	2[a]
Arithmetic Mean	29.03	257.74	251.90	-

[a] Flow based on a visual estimate
[b]Indicates exceedence of the calculated criterion
[c]Flow was not measured

6.2 Flow

TMDLs are calculated at a specific flow, and aluminum concentrations can vary as a function of flow. SWQB determined streamflow by taking direct flow measurements utilizing standard procedures or visual estimates (NMED/SWQB, 2011)[31]. All of the aluminum samples were collected at moderate to low flows, ranging from 0.55 cfs to 12.57 cfs, with an estimated average of 4.87 cfs, and exceedences reported at a variety of flows. For this parameter, the critical flow value used to calculate the TMDLs was obtained using a 4-day, 3-year low-flow frequency (4Q3) regression model. The 4Q3 is the annual lowest four (4) consecutive day flow that occurs with a frequency of at least once every three (3) years. According to the New Mexico Water Quality Standards[32], the low flow critical condition is defined as 4Q3 (20.6.4.11.B.2 NMAC) for numeric criteria set in 20.6.4.97 through 20.6.4.900 NMAC, as well as Subsection F of 20.6.4.13 NMAC. Aluminum criteria are defined in Subsection I, 20.6.4.900 NMAC. Critical low flow was determined on an annual basis utilizing all available daily flow values rather than on a seasonal basis for these TMDLs because exceedences occurred during both lower and higher flow conditions.

Because Willow Creek is an ungaged stream, an analysis method developed by Waltemeyer (2002) was used to estimate flow. 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 ft in elevation). The average elevation of the Willow Creek

[31] http://www.nmenv.state.nm.us/swqb/SOP/
[32] http://www.nmcpr.state.nm.us/nmac/parts/title20/20.006.0004.pdf

watershed is above 7,500 ft, the decision was made to use the mountainous regions regression equation.

The following mountainous regions regression equation (Equation 6.2) is based on data from 40 gaging stations located above 7,500 ft in elevation with non-zero discharge (Waltemeyer 2002):

Equation 6.2

$$4Q3 = 7.3287 \times 10^{-5} DA^{0.70} {P_w}^{3.58} S^{1.35}$$

Where:

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

For details and development of this equation, please see *Analysis of the Magnitude and Frequency of the 4-Day Annual Low Flow and Regression Equations for Estimating the 4-Day, 3-Year Low-Flow Frequency at Ungaged Sites on Unregulated Streams in New Mexico*, USGS Water-Resources Investigations Report 01-4271 (Waltemeyer, 2002)[33].

The 4Q3 value calculated using Waltemeyer's method is presented in Table 6.2. Parameters used in the calculation were determined using Weasel, a GIS application. The 4Q3 result from Equation 6.2 is in cfs. Conversion to MGD was calculated using the unit conversion provided in Appendix A.

It is important to remember that the TMDL itself is a value calculated at a defined critical condition as part of a 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 is the goal.

Table 6.2 Calculation of 4Q3

Assessment Unit	Average Elevation (ft)	Drainage Area (mi^2)	Mean Winter Precipitation (in)	Average Basin Slope (percent)	4Q3 (cfs)	4Q3 (MGD)
Willow Creek (Gilita Creek to headwaters)	8970	14.94	20.60	0.295	4.73	3.06

6.3 Calculations

This section describes the relationship between the numeric target and the allowable pollutant load by determining the total assimilative capacity of a waterbody, or loading capacity, for aluminum. The loading capacity is the maximum amount of pollutant that a waterbody can

[33] http://nm.water.usgs.gov/publications/abstracts/wrir01-4271.html

receive at a given flow while meeting its water quality objectives. This TMDL was developed based on simple dilution calculations using the 4Q3 flow, a criterion, and a unit conversion factor (Equation 6.3, Table 6.3). Because the water quality criterion for aluminum is hardness dependent, the average of the hardness values measured in Willow Creek during the 2011 SWQB survey was used to calculate the numeric criterion for this TMDL (Table 6.3). Additionally, the WQS criterion and arithmetic mean concentration values have been converted from micrograms per liter ("ug/L") to milligrams per liter in order to maintain proper unit conversion in the TMDL calculation (Appendix A).

Equation 6.3

$$Critical\ Flow\ \times WQS \times Unit\ Conversion\ Factor = Target\ Loading\ Capacity\ (TMDL)$$

Table 6.3 TMDL / target load for aluminum

Assessment Unit	Critical Flow (MGD)	WQS Criterion (mg/L)	Unit Conversion Factor	TMDL[(a)] (lbs/day)
Willow Creek (Gilita Creek to headwaters)	3.06	0.252	8.34	6.43

(a) TMDL = Target Load Capacity

By applying Equation 6.3 to aluminum, it is determined that Willow Creek can transport approximately 6.43 lbs/day of aluminum during critical flow condition and instream concentrations will not exceed 251.90 ug/L, at a hardness of 29.03 mg/L $CaCO_3$.

The measured load for aluminum was similarly calculated. In order to achieve comparability between the target and measured loads, the same flow value was used for both calculations, although measured flow was typically lower than the calculated 4Q3. The arithmetic mean of the collected data was substituted for the numeric target in Equation 6.3. The same unit conversion factor was utilized. The calculated measured load is in Table 6.4.

Table 6.4 Calculated measured aluminum load

Assessment Unit	Critical Flow (MGD)	Arithmetic Mean Concentration (ug/L)	Unit Conversion Factor	Measured Load (lbs/day)
Willow Creek (Gilita Creek to headwaters)	3.06	0.258	8.34	6.58

6.4 Waste Load Allocations and Load Allocations

6.4.1 Waste Load Allocation

There are no existing point sources along this assessment unit, nor any identified sMS4 or Municipal Separate Storm Sewer ("MS4") areas in the watershed.

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

Stormwater discharges from active industrial facilities are generally covered under the current NPDES MSGP. This permit also requires preparation of an SWPPP, which includes specific requirements to limit (or eliminate) pollutant loading associated with the industrial activities in order to minimize impacts to water quality. Compliance with a SWPPP that meets the requirements of the MSGP is generally assumed to be consistent with this TMDL.

It is not possible to calculate individual WLAs for facilities covered by the MSGP at this time using readily available tools. The discharges from these permits are typically transitory and enforcement is complex as permittees are temporary. Loads that are in compliance with the MSGP are therefore currently included as part of the LA. While these sources are not given individual allocations, they are addressed through other means, including BMPs, stormwater pollution prevention conditions, and other requirements.

6.4.2 Load Allocation

In order to calculate the LA for aluminum, the MOS was subtracted from the target load (TMDL) using Equation 6.4:

Equation 6.4

$$LA + MOS = TMDL$$

or

$$LA = TMDL - MOS$$

The MOS was developed using a combination of conservative assumptions and explicit recognition of potential errors. The explicit MOS is 20%; see Section 6.7 for details.

The TMDL was allocated per Equation 6.4. Table 6.5 presents how the TMDL was allocated between nonpoint sources and the MOS.

Table 6.5 TMDL for aluminum

Assessment Unit	LA (lbs/day)	MOS (20%) (lbs/day)	TMDL [(a)] (lbs/day)
Willow Creek (Gilita Creek to headwaters)	5.14	1.29	6.43

[(a)] TMDL value is equivalent to the target load capacity, displayed in Table 6.3

The load reduction necessary to meet the target load was calculated to be the difference between the calculated Target Load (Table 6.3) and the measured load (Table 6.4), as shown in Table 6.6. As discussed previously, the aluminum criterion is hardness-dependent, thus the actual load reduction required will vary with hardness at any given time.

Table 6.6 Percent reduction for aluminum

Assessment Unit	Target Load (lbs/day)	Measured Load (lbs/day)	Load Reduction (lbs/day)	Percent Reduction (%)[(a)]
Willow Creek (Gilita Creek to headwaters)	6.43	6.58	0.15	2.27

(a) Percent reduction is the amount that 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 Sources

SWQB fieldwork includes an assessment of the probable sources of impairment (Appendix B). The approach for identifying probable sources of impairment was recently modified by SWQB to include additional input from a variety of stakeholders including landowners, watershed groups, and local, state, tribal, and federal agencies. Probable source sheets are filled out by SWQB staff during watershed surveys and watershed restoration activities. The draft probable source list was reviewed and modified as necessary with watershed group/stakeholder input during the TMDL public meeting and comment period.

Although this procedure includes subjective and qualitative elements, SWQB has concluded that it provides the best available information for the identification of probable sources of impairment in a watershed. The list of probable sources is not intended to single out any individual land owner or particular land management activity and generally includes several sources per impairment. Pollutant sources that may contribute to each segment were determined by field reconnaissance and evaluation (Table 6.7). Probable sources of aluminum impairments will be evaluated, refined, and changed as necessary through the WBP.

Table 6.7 Probable source summary for aluminum

Pollutant Sources	Magnitude[a]	AU	Probable Sources[b]
<u>*Nonpoint:*</u>			
	6.58 lbs/day	Willow Creek (Gilita Creek to headwaters)	*Campgrounds; geologic input; highway/bridge/road runoff; gravel or dirt roads; hiking trails; low water crossings; stream channel incision*

[a] Because there are no waste load allocations in this TMDL, the magnitude of the nonpoint source probable sources is equivalent to the measured load.
[b] Probable sources in italics have not been previously noted in the 303(b)/305(d) Integrated List; they were noted on probable source field sheets.

6.6 Linkage between Water Quality and Pollutant Sources

Aluminum is the third most common element in the Earth's crust, and the most common metal. It is a major component of the geology in the greater Gila River basin, as evidenced by the predominance of alumino-silicate volcanic rocks in the region. In general, increased metals in the water column can be linked to sediment transport. This may be the case in Willow Creek, as there is a slight positive correlation between TSS and aluminum concentrations that exceed standards, as measured during the 2011 SWQB survey. Normal aqueous chemical processes, enhanced by the slight natural acidity of snow and rain, are fully capable of rendering some of this abundant, naturally-occurring aluminum available to the river system, and one would expect to see higher aluminum concentrations during the spring sampling events, as a result of snowmelt. Instead, the dataset indicates that exceedences occurred during both the spring and summer months, suggesting that the presence of it in surface water may be result of land disturbance in the watershed in addition to natural erosion and transport.

The pH at the sampling station during the 2011 discrete sampling events averaged 7.88, with a low of 7.73 and a high of 8.11; there does not appear to be a relationship between exceedences of the calculated criteria and the pH (Figure 6.1). pH measurements recorded using a sonde deployed from September 21 to September 28, 2011 recorded an average value of 7.47, with a minimum reading of 7.36 and a maximum value of 7.73. The pH recorded during both types of events is within the acceptable range of 6.6-9 which is identified for application of the Assessment Protocol (NMED/SWQB, 2014) and the hardness-dependent criteria equation (NMAC, 2013).

Within the observed pH range, one would expect to see aluminum hydroxides such as gibbsite [$Al(OH)_3$] in both oxidizing or reducing conditions (Takeno, 2005). Gibbsite is not particularly soluble at the pH range observed in Willow Creek, and its toxicity is debated, assuming that the Al source is related to local lithology. It is not expected that pH will vary substantially in the AU, assuming the continuation of flow conditions and land management activities.

As discussed above, probable source sheets indicate that various types of ground disturbance are the most commonly observed probable sources of surface water contamination in the watershed. During the probable source identification process, it was noted that Willow Creek may still be impacted by 2006 Bear Fire; this probable source was given a 1 out of 5, and is thus not considered to be a major probable source. However, it may be contributing to the aluminum concentrations observed in the AU.

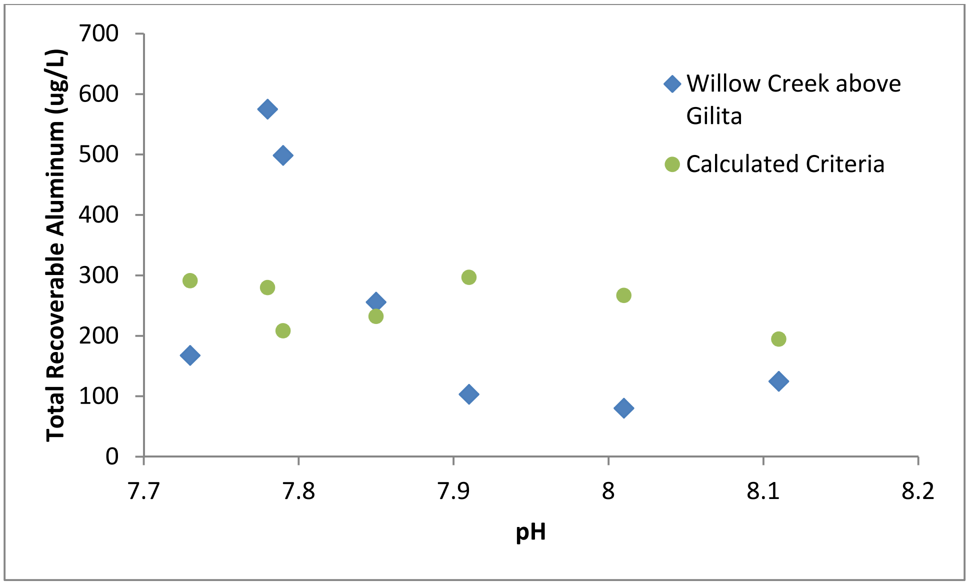

Figure 6.1 pH and total recoverable aluminum in Willow Creek as measured during 2011 SWQB survey

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 aluminum TMDL, the MOS was developed using a combination of conservative assumptions and inputs and explicit recognition of potential errors in flow calculations. Therefore, the MOS is the sum of the following assumptions:

- Conservative Assumptions:
  - Aluminum does not readily degrade in the environment.
  - Calculating the measured load with the arithmetic mean rather than the geometric mean of the sample results produces a greater mean and therefore a more conservative load estimate.
- Explicit recognition of potential errors:
  - Uncertainty exists in sampling nonpoint sources of pollution. A conservative MOS for this element is therefore **5%**.
  - Critical flow was determined using a regression equation based on sites statewide. There is inherent error in using this equation, including uncertainty in the winter precipitation, as well as changes in precipitation patterns; a conservative MOS for this element is **10%**.
  - The criterion used to develop the TMDL is based on the average hardness measurement of the stream during the 2011 SWQB survey of Willow Creek; a conservative MOS for this element is **5%**.

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. Data used in the calculation of these TMDLs were collected during the spring, summer, and fall of 2011 in order to ensure coverage of any potential seasonal variation in the system. Aluminum exceedences were observed in the late spring and summer, and as such, seasonality is not considered a factor in this aluminum TMDL.

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 2040. Catron County population is projected to increase in population by 7.7% over the 2010-2040 period, from 3,725 to 4,012 (NMBBER, 2012)[34].

The estimate of future growth in Catron County is not anticipated to lead to a significant increase in aluminum that cannot be controlled with BMPs. However, it is imperative that BMPs continue to be utilized to avoid, minimize, and mitigate land disturbance, improve roads and low water crossings, and adhere to SWPPP requirements related to construction and industrial activities covered under the general permit.

Any future growth would be considered part of the existing load allocation, assuming persistence of the hydrologic conditions used to develop these TMDLs.

[34] http://bber.unm.edu/demograp2.htm

7.0 CADMIUM

Assessment of the data from the 2009 SWQB water quality survey in the Mimbres River watershed identified exceedences of the New Mexico water quality standards for dissolved cadmium in Cold Springs Creek (Hot Springs Creek to headwaters). Consequently, this waterbody was listed on the 2012-2014 Integrated CWA §303(d) List (NMED/SWQB, 2012)[35] for cadmium.

7.1 Target Loading Capacity

For this TMDL document, target values for cadmium are based on the reduction in cadmium necessary to achieve the numeric criterion associated with the cold water aquatic life ("CWAL") use. The New Mexico water quality standards identify chronic cadmium as a hardness-dependent criterion (NMAC 20.6.4.900.I); its numeric criterion is based on concurrent hardness data. Using Equation 7.1, the numeric chronic criterion for each sample date was calculated and is presented in Table 7.1.

Equation 7.1

$$exp(m_c \times [ln(hardness)] + b_c) \times CF$$

Where,

m_C = 0.7647
b_C = -4.2180
CF = 1.101672-[ln(hardness)*0.041838]

Table 7.1 Calculated hardness-dependent cadmium criteria - Chronic

Sample Date	Hardness (mg/L CaCO3)	Cadmium Concentration (ug/L)	Calculated Criterion (ug/L)
March 23, 2009	321	1.00	1.05
July 20, 2009	316	2.21[b]	1.03
August 24, 2009	328	2.00[b]	1.05
November 17, 2009	435	2.00[b]	1.22[a]
Arithmetic Mean	350	1.80	1.10

[a]NMAC 20.6.4.90.I indicates that for dissolved hardness concentrations greater than 400 mg/L CaCO3, the criteria for 400 mg/L $CaCO_3$ apply
[b] Exceedence of the calculated criterion

Cadmium is a relatively rare element that is classified as a heavy metal and that occurs mainly as a component of the earth's crust. Cadmium can be toxic to aquatic life at higher concentrations and through accumulation in the body (USEPA, 2001). Cadmium may enter the aquatic environment from various anthropogenic sources, including as a by-product of zinc refining, coal

35 http://www.nmenv.state.nm.us/swqb/303d-305b/

combustion, mine wastes, fertilizers and pesticides. These TMDLs were drafted for chronic cadmium and should therefore also be protective against any acute exceedences.

Data was collected from Cold Springs Creek above the Mimbres River four times between March 23 and November 17, 2009. Dissolved cadmium concentrations exceeded the calculated criterion three of four times.

7.2 Flow

TMDLs are calculated at a specific flow, and cadmium concentrations can vary as a function of flow. SWQB determined streamflow by taking direct flow measurements utilizing standard procedures (NMED/SWQB, 2011)[36]. All of the cadmium samples were collected at low flows, ranging from an estimated 0.01 cfs to 0.25 cfs, and exceedences were reported at a variety of flows. For this parameter, the critical flow value used to calculate the TMDLs was obtained using a 4-day, 3-year low-flow frequency (4Q3) regression model. The 4Q3 is the annual lowest four (4) consecutive day flow that occurs with a frequency of at least once every three (3) years. According to the New Mexico Water Quality Standards[37], the low flow critical condition is defined as 4Q3 (20.6.4.11.B.2 NMAC) for numeric criteria set in 20.6.4.97 through 20.6.4.900 NMAC, as well as Subsection F of 20.6.4.13 NMAC. Critical low flow was determined on an annual basis utilizing all available daily flow values rather than on a seasonal basis for these TMDLs because exceedences occurred across both low and high flow conditions.

Because Cold Springs Creek is an ungaged stream, an analysis method developed by Waltemeyer (2002) can be used to estimate flow. 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 ft in elevation). The average elevation of the Cold Springs Creek watershed is below 7,500 ft, the decision was made to use the statewide, non-mountainous regions regression equation (Equation 7.2):

Equation 7.2

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

Where:

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

For details and development of this equation, please see *Analysis of the Magnitude and Frequency of the 4-Day Annual Low Flow and Regression Equations for Estimating the 4-Day, 3-Year Low-Flow Frequency at Ungaged Sites on Unregulated Streams in New Mexico*, USGS Water-Resources Investigations Report 01-4271 (Waltemeyer 2002)[38].

4Q3 values calculated using Waltemeyer's methods are presented in Table 7.2. Parameters used in the calculation were determined using Weasel, a GIS application. The 4Q3 result from

[36] http://www.nmenv.state.nm.us/swqb/SOP/
[37] http://www.nmcpr.state.nm.us/nmac/parts/title20/20.006.0004.pdf
[38] http://nm.water.usgs.gov/publications/abstracts/wrir01-4271.html

Equation 7.2 is in cfs; conversion to MGD was calculated using the unit conversion provided in Appendix A.

It is important to remember that the TMDL itself is a value calculated at a defined critical condition as part of a 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 is the goal.

Table 7.2 Parameters used in calculation of 4Q3

Assessment Unit	Average Elevation (ft)	Drainage Area (mi^2)	Mean Winter Precipitation (in)	Average Basin Slope (%)	4Q3 (cfs)	4Q3 (MGD)
Cold Springs Creek (Hot Springs Creek to headwaters)	6683	21.27	6.10	0.312	0.141	0.091

7.3 Calculations

This section describes the relationship between the numeric target and the allowable pollutant load by determining the total assimilative capacity of a waterbody, or loading capacity, for cadmium. The loading capacity is the maximum amount of pollutant that a waterbody can receive at a given flow while meeting its water quality objectives. This TMDL was developed based on simple dilution calculations using the 4Q3 flow, a criterion, and a unit conversion factor (Equation 7.3, Table 7.3). Because the water quality criterion for cadmium is hardness dependent, the average of the hardness values measured in Cold Springs Creek during the 2009 SWQB survey was used to calculate the numeric criterion for this TMDL (Table 6.3). Additionally, the WQS criterion and arithmetic mean concentration values have been converted from micrograms per liter to milligrams per liter in order to maintain proper unit conversion in the TMDL calculation (Appendix A).

Equation 7.3

$$Critical\ Flow\ (4Q3) \times WQS \times Unit\ Conversion\ Factor = Target\ Loading\ Capacity\ (TMDL)$$

Table 7.3 TMDL / target load for cadmium

Assessment Unit	4Q3 (MGD)	WQS Criterion (mg/L)	Unit Conversion Factor	TMDL[a] (lbs/day)
Cold Springs Creek (Hot Springs Creek to headwaters)	0.091	1.11×10^{-3}	8.34	8.42×10^{-4}

(a) TMDL = Target Load Capacity

By applying Equation 7.3 to cadmium, it is determined that Cold Springs Creek can transport approximately 8.42×10^{-4} lbs/day of cadmium during critical low-flow conditions during which instream concentrations should not exceed 1.11 ug/L, at an average hardness of 350 mg/L $CaCO_3$.

The measured load for cadmium was 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 was substituted for the numeric target in Equation 7.3. The same unit conversion factor was utilized. The calculated measured load is in Table 7.4.

Table 7.4 Calculated measured cadmium load

Assessment Unit	4Q3 (MGD)	Arithmetic Mean Concentration[a] (mg/L)	Unit Conversion Factor	Measured Load (lbs/day)
Cold Springs Creek (Hot Springs Creek to headwaters)	0.091	1.80×10^{-3}	8.34	1.37×10^{-3}

[a] Arithmetic mean concentration comprises all SWQB cadmium data collected in AU

7.4 Waste Load Allocations and Load Allocations

7.4.1 Waste Load Allocation

There are no existing point sources along this assessment unit, nor are identified sMS4 or MS4 areas in the watershed.

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

Stormwater discharges from active industrial facilities are generally covered under the current NPDES MSGP. This permit also requires preparation of an SWPPP, which includes specific requirements to limit (or eliminate) pollutant loading associated with the industrial activities in order to minimize impacts to water quality. Compliance with a SWPPP that meets the requirements of the MSGP is generally assumed to be consistent with this TMDL.

It is not possible to calculate individual WLAs for facilities covered by the MSGP at this time using readily available tools. The discharges from these permits are typically transitory and enforcement is complex as permittees are temporary. Loads that are in compliance with the MSGP are therefore currently included as part of the LA. While these sources are not given individual allocations, they are addressed through other means, including BMPs, stormwater pollution prevention conditions, and other requirements.

7.4.2 Load Allocation

In order to calculate the LA for cadmium, the MOS was subtracted from the target load (TMDL) using Equation 7.4

Equation 7.4

$$LA + MOS = TMDL$$

Or

$$LA = TMDL - MOS$$

The MOS was developed using a combination of conservative assumptions and explicit recognition of potential errors. The explicit MOS is 20%; see Section 7.7 for details.

The TMDL was allocated per Equation 7.4. Table 7.5 presents how the TMDL was allocated between nonpoint sources and the MOS.

The load reductions that would be necessary to meet the target loads were calculated to be the difference between the calculated Target Load (Table 7.3) and the measured load (Table 7.4) are shown in Table 7.6. As discussed previously, the cadmium criterion is hardness-dependent, thus the actual load reduction required will vary depending on hardness at any given time.

Table 7.5 TMDL for cadmium

Assessment Unit	LA (lbs/day)	MOS (20%) (lbs/day)	TMDL [a] (lbs/day)
Cold Springs Creek (Hot Springs Creek to headwaters)	6.74×10^{-4}	1.68×10^{-4}	8.42×10^{-4}

[a] TMDL value is equivalent to the target load capacity, displayed in Table 6.3.

Table 7.6 Cadmium load reduction

Assessment Unit	Target Load (lbs/day)	Measured Load (lbs/day)	Load Reduction (lbs/day)	Percent Reduction (%)[a]
Cold Springs Creek (Hot Springs Creek to headwaters)	8.42×10^{-4}	1.37×10^{-3}	5.24×10^{-4}	62.16

[a] Percent reduction is the amount that 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 Sources

SWQB fieldwork includes an assessment of the probable sources of impairment (Appendix B). The approach for identifying probable sources of impairment was modified by SWQB in 2010 to include additional input from a variety of stakeholders including landowners, watershed group, and local, state, tribal, and federal agencies. Because the SWQB survey took place in 2009, the new approach to include outside stakeholders was not followed. Probable Source Sheets were filled out by SWQB staff during the watershed survey. The draft probable source list will be reviewed and modified, as necessary, with watershed group/stakeholder input during the TMDL public meeting and comment period.

Although this procedure includes subjective and qualitative elements, SWQB has concluded that it provides the best available information for the identification of probable sources of impairment in a watershed given current resources available for this effort. The list of probable sources is not intended to single out any single land owner or particular land management activity and generally includes several sources per impairment. Table 7.7 displays pollutant sources that may contribute to each AU as determined by field reconnaissance and evaluation. Probable sources of cadmium impairments will be evaluated, refined, and changed as necessary through the WBP.

Table 7.7 Probable source summary for cadmium

Pollutant Sources	Magnitude[a]	AU	Probable Sources[b]
Nonpoint:			
	1.37×10^{-3} lbs/day	Cold Springs Creek (Hot Springs Creek to headwaters)	*Abandoned mines (tailings), geologic input, gravel or dirt roads, incision, low water crossings, mass wasting, road runoff*

(a) Because there are no waste load allocations in this TMDL, the magnitude of the nonpoint source probable sources is equivalent to the measured load.
(b) Probable sources in italics have not been previously noted in the 303(b)/305(d) Integrated List; they were noted on probable source field sheets.

7.6 Linkage between Water Quality and Pollutant Sources

Among the probable sources of cadmium in the Cold Springs Creek watershed are the abandoned mine workings located in the watershed, as well as geologic input. Additionally, conditions in the watershed, including low water crossings, runoff from roads, incision, and mass wasting may facilitate transport of cadmium into the stream.

In general, increased metals in the water column can commonly be linked to sediment transport and accumulation, where the metals are a constituent part of the sediment. Heavy metals are often present in stormwater runoff in dissolved phases, but a large fraction of most metals are bound to suspended solids, although cadmium actually has relatively low potential to adsorb in comparison to others. Additionally, heavy metals do not degrade in the environment, so cadmium in soil will persist until it is transported into the stream (Pitt *et al*., 1996; Weiss *et al*., 2008) through land disturbance or natural processes.

The Cold Springs Creek watershed is located within the Carpenter mining district on the west slope of the Black Range. Base metal ores were discovered in the district in the 1880s, and the Royal John Mines, also referred to historically as the Grand Central Mines were operated on a non-continuous basis between 1927 and an ambiguous date in the latter half of the 20th century. Ore typical of that found in the Cold Springs watershed contains 1,500 parts per million ("ppm") of cadmium, with key minerals of sphalerite, pyrite, galena, and chalcopyrite (Hedlund, 1985). While cadmium was not mined economically, it is likely present in tailings and in the abandoned workings that are present just 0.5 miles upstream of SWQB's sampling station and would be a component of runoff from the area. Cold Springs Creek is also impaired for lead; lead and cadmium often concomitant within ore deposits, further suggesting that a potential source for cadmium in Cold Springs Creek is historical mining operations and exposure of the ore to the elements via anthropogenic and natural processes. It is possible that cadmium is being contributed to the stream by spring water; however, data were not readily available to determine the potential input. SWQB and USFS completed a restoration project at the site in the mid-1990s with little success.

The pH at the sampling station during the 2009 sampling events averaged 8.14, with a low of 7.71 and a high of 8.77 (Figure 7.1); the recorded pH is within the acceptable range of 6.6-9 which is identified for application of the Assessment Protocol (NMED/SWQB, 2014) and the hardness-dependent criteria equation (NMAC, 2013), although it does near the upper pH limit of applicability.

Within the observed pH range, one would expect to see Cd^{2+} in both oxidizing and reducing conditions (Takeno, 2005). It is not expected that pH will vary substantially in the AU, assuming the continuation of flow conditions and land management activities. It may be advisable to place a sonde in the AU during the next survey year in order to have a clearer picture of pH in the waterbody.

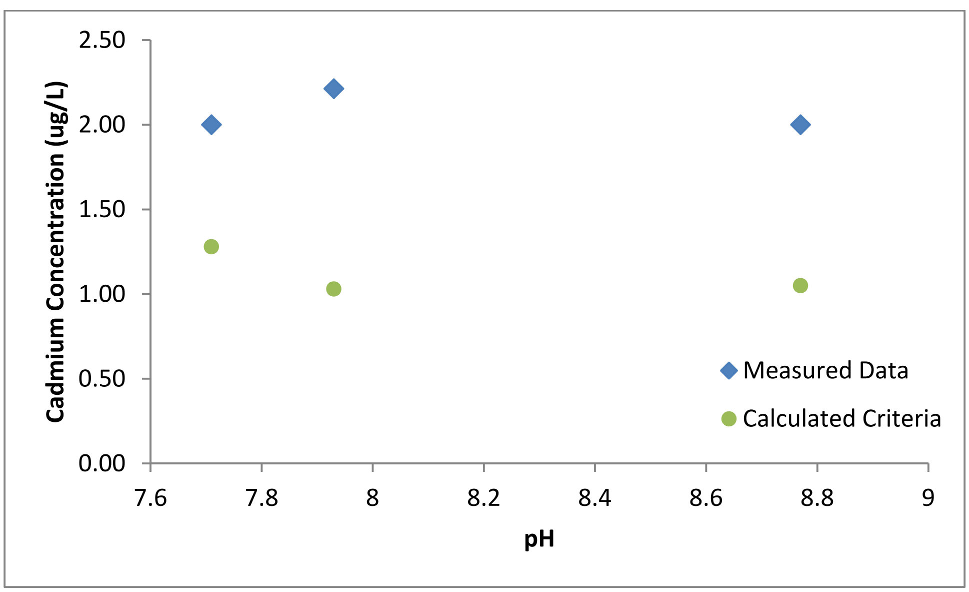

Figure 7.1 pH and dissolved Cadmium in Cold Springs Creek as measured during 2009 SWQB survey

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 cadmium TMDL, the MOS was developed using a combination of conservative assumptions and inputs and explicit recognition of potential errors in flow calculations. Therefore, the MOS is the sum of the following assumptions:

- Conservative Assumptions:
  - Cadmium does not readily degrade in the environment.
  - Calculating the measured load with the arithmetic mean rather than the geometric mean of the sample results produces a greater mean and therefore a more conservative load estimate.
- Explicit recognition of potential errors:
  - Uncertainty exists in sampling nonpoint sources of pollution. A conservative MOS for this element is therefore **5%**.
  - Critical flow was determined using a regression equation based on sites statewide. There is inherent error in using this equation; a conservative MOS for this element is **10%**.
  - The criterion used to develop the TMDL is based on the average hardness measurement of the stream during the 2009 SWQB survey of Cold Springs Creek; a conservative MOS for this element is **5%**.

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. Data used in the calculation of these TMDLs were collected during the spring, summer, and fall of 2009 in order to ensure coverage of any potential seasonal variation in the system. Cadmium exceedences occurred during the summer and fall sampling events, and as such, seasonality is not considered a factor in this TMDL.

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 2040. Grant County population is projected to decrease in population by an estimated 0.9% over the 2010-2040 period, from 29,371 to 29,102 (NMBBER, 2012)[39]. The Cold Springs Creek watershed itself is sparsely populated, with the majority of the county's population residing in Silver City.

The estimate of future growth in Grant County is not anticipated to lead to a significant increase in cadmium that cannot be controlled with BMPs. However, it is imperative that BMPs continue to be utilized to minimize land disturbance and adhere to SWPPP requirements related to construction and industrial activities covered under the general permit.

Any future growth would be considered part of the existing load allocation, assuming persistence of the hydrologic conditions used to develop these TMDLs.

[39] http://bber.unm.edu/demograp2.htm

8.0 LEAD

Assessment of the data from the 2009 water quality survey in the Mimbres River watershed identified exceedences of the New Mexico water quality standards for dissolved lead in Cold Springs Creek (Hot Springs Creek to headwaters). Consequently, this waterbody was listed on the 2012-2014 Integrated CWA §303(d) List (NMED/SWQB, 2012)[40] for lead.

8.1 Target Loading Capacity

For this TMDL document, target values for lead are based on the reduction in lead necessary to achieve the numeric criterion associated with the cold water aquatic life (CWAL) use. The New Mexico water quality standards identifies the chronic lead as hardness-dependent (NMAC 20.6.4.900.I); its numeric criterion is based on concurrent hardness data. Using Equation 8.1, the numeric chronic criterion for each sample date was calculated and is presented in Table 8.1.

Equation 8.1

$$exp(m_c \times [ln(hardness)] + b_c) \times CF$$

Where,

m_C = 1.273
b_C = -4.705
CF = 1.46203-[ln(hardness)*0.145712]

Table 8.1 Calculated hardness-dependent lead criteria - Chronic

Sample Date	Hardness (mg/L CaCO3)	Lead Concentration (ug/L)	Calculated Criterion (ug/L)
March 23, 2009	321	12.00[(b)]	8.72
July 20, 2009	316	17.59[(b)]	9.00
August 24, 2009	328	15.00[(b)]	8.92
November 17, 2009	435	14.00[(b)]	11[(a)]
Arithmetic Mean	350	14.65	9.54

[(a)]NMAC 20.6.4.900(I) indicates that for dissolved hardness concentrations greater than 400 mg/L CaCO3, the criteria for 400 mg/L CaCO3 apply
[(b)] Exceedence of the calculated criterion

Lead is a naturally occurring heavy metal that has been mined by humans for more than 6,000 years. It is rarely found in its pure form, and is more likely to be found as part of a compound with other elements. In the past it and its alloys have been used for pipes, glazes, and paint; in more modern times, it has been used as an additive to raise the octane level of gasoline, as well as in plumbing, cable sheathing, car batteries, and in some solders (Royal Society of Chemistry,

[40] http://www.nmenv.state.nm.us/swqb/303d-305b/

2014) and is still widely used in some developing countries. Lead may reach surface water by release from mining activities, atmospheric deposition, and inappropriate disposal of lead-bearing materials (ATSDR, 2007). Lead exposure to humans can negatively impact most systems, but particularly the nervous system in adults and more widespread effects in children (ATSDR, 2007). Chronic exposure to lead by aquatic life decreases survival, growth, and reproduction, as well as increasing spinal deformities (USEPA, 1984).

Data were collected from Cold Springs Creek above the Mimbres River four times between March 23 and November 17, 2009. Dissolved lead concentrations exceeded the calculated criterion four times out of the four sampling events.

8.2 Flow

TMDLs are calculated at a specific flow, and lead concentrations can vary as a function of flow. SWQB determined streamflow by taking direct in-stream flow measurements utilizing standard procedures (NMED/SWQB, 2011)[41]. All of the lead samples were collected at low flows. For this parameter, the critical flow value used to calculate the TMDLs was obtained using a 4-day, 3-year low-flow frequency (4Q3) regression model. The 4Q3 is the annual lowest four (4) consecutive day flow that occurs with a frequency of at least once every three (3) years. According to the New Mexico Water Quality Standards[42], the low flow critical condition is defined as 4Q3 (20.6.4.11.B.2 NMAC) for numeric criteria set in 20.6.4.97 through 20.6.4.900 NMAC, as well as Subsection F of 20.6.4.13 NMAC. Critical low flow was determined on an annual basis utilizing all available daily flow values rather than on a seasonal basis for these TMDLs because exceedences occurred across the sampling season.

Because Cold Springs Creek is an ungaged stream, an analysis method developed by Waltemeyer (2002) can be used to estimate flow. 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 ft in elevation). The average elevation of the Cold Springs Creek watershed is below 7,500 ft, the decision was made to use the statewide, non-mountainous regions regression equation (Equation 8.2).

For details and development of Equation 8.2, please see *Analysis of the Magnitude and Frequency of the 4-Day Annual Low Flow and Regression Equations for Estimating the 4-Day, 3-Year Low-Flow Frequency at Ungaged Sites on Unregulated Streams in New Mexico*, USGS Water-Resources Investigations Report 01-4271 (Waltemeyer, 2002)[43].

4Q3 values calculated using Waltemeyer's methods are presented in Table 8.2. Parameters used in the calculation were determined using Weasel, a GIS application. The 4Q3 result from Equation 8.2 is in cfs; conversion to MGD was calculated using the unit conversion provided in Appendix A.

[41] http://www.nmenv.state.nm.us/swqb/SOP/
[42] http://www.nmcpr.state.nm.us/nmac/parts/title20/20.006.0004.pdf
[43] http://nm.water.usgs.gov/publications/abstracts/wrir01-4271.html

Equation 8.2

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

Where:

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

Table 8.2 Calculation of 4Q3

Assessment Unit	Average Elevation (ft)	Drainage Area (mi^2)	Mean Winter Precipitation (inches)	Average Basin Slope (%)	4Q3 (cfs)	4Q3 (MGD)
Cold Springs Creek (Hot Springs Creek to headwaters)	6,683	21.27	6.10	0.312	0.141	0.091

It is important to remember that the TMDL itself is a value calculated at a defined critical condition as part of a 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 is the goal.

8.3 Calculations

This section describes the relationship between the numeric target and the allowable pollutant load by determining the total assimilative capacity of a waterbody, or loading capacity, for lead. The loading capacity is the maximum amount of pollutant that a waterbody can receive at a given flow while meeting its water quality objectives. This TMDL was developed based on simple dilution calculations using the critical flow, a criterion, and a unit conversion factor (Equation 8.3, Table 8.3).

Because the water quality criterion for lead is hardness dependent, the average of the hardness values measured in Cold Springs Creek during the 2009 SWQB survey was used to calculate the numeric criterion for this TMDL (Table 8.3). Additionally, the WQS criterion and arithmetic mean concentration values have been converted from micrograms per liter to milligrams per liter in order to maintain proper unit conversion in the TMDL calculation (Appendix A).

Equation 8.3

$$Critical\ Flow \times WQS \times Unit\ Conversion\ Factor = Target\ Loading\ Capacity\ (TMDL)$$

Table 8.3 TMDL / target load for lead

Assessment Unit	Critical Flow (MGD)	WQS Criterion (mg/L)	Unit Conversion Factor	TMDL[(a)] (lbs/day)
Cold Springs Creek (Hot Springs Creek to headwaters)	0.091	9.54×10^{-3}	8.34	7.24×10^{-3}

(a) TMDL is equivalent to the target load capacity

By applying Equation 8.2 to lead, it is determined that Cold Springs Creek can transport approximately 7.24×10^{-3} lbs/day of lead during critical low-flow conditions, and instream concentrations will not exceed 9.54 ug/L, at an average hardness of 350 mg/L $CaCO_3$.

The measured load for lead was 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 was substituted for the numeric target in Equation 8.2. The same unit conversion factor was utilized. Measured load results are in Table 8.4

Table 8.4 Calculated measured lead load

Assessment Unit	4Q3 (MGD)	Arithmetic Mean Concentration[(a)] (mg/L)	Unit Conversion Factor	Measured Load (lbs/day)
Cold Springs Creek (Hot Springs Creek to headwaters)	0.091	1.47×10^{-2}	8.34	1.11×10^{-2}

(a) Arithmetic mean concentration comprises all SWQB lead data collected in AU

8.4 Waste Load Allocations and Load Allocations

8.4.1 Waste Load Allocation

There are no existing point sources identified in this assessment unit, or identified sMS4 or MS4 areas in the watershed.

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

Stormwater discharges from active industrial facilities are generally covered under the current NPDES MSGP. This permit also requires preparation of an SWPPP, which includes specific requirements to limit (or eliminate) pollutant loading associated with the industrial activities in order to minimize impacts to water quality. Compliance with a SWPPP that meets the requirements of the MSGP is generally assumed to be consistent with this TMDL.

It is not possible to calculate individual WLAs for facilities covered by the MSGP at this time using readily available tools. The discharges from these permits are typically transitory and enforcement is complex as permittees are temporary. Loads that are in compliance with the MSGP are therefore currently included as part of the LA. While these sources are not given individual allocations, they are addressed through other means, including BMPs, stormwater pollution prevention conditions, and other requirements.

8.4.2 Load Allocation

In order to calculate the LA for lead, MOS was subtracted from the target load (TMDL) using Equation 8.4

Equation 8.4

$$LA + MOS = TMDL$$

or

$$LA = TMDL - MOS$$

The MOS was developed using a combination of conservative assumptions and explicit recognition of potential errors. The explicit MOS is 20%; see Section 8.7 for details.

The TMDL was allocated per Equation 8.3. The TMDL allocations are presented in Table 8.5.

Table 8.5 TMDL for lead

Assessment Unit	LA (lbs/day)	MOS (20%) (lbs/day)	TMDL [(a)] (lbs/day)
Cold Springs Creek (Hot Springs Creek to headwaters)	5.79×10^{-3}	1.45×10^{-3}	7.24×10^{-3}

[(a)] TMDL value is equivalent to the target load capacity, displayed in Table 8.3

The load reductions that would be necessary to meet the target loads were calculated to be the difference between the calculated Target Load (Table 8.3) and the measured load (Table 8.4) are shown in Table 8.6. As discussed previously, the lead criterion is hardness-dependent, thus the actual load reduction required will vary depending on hardness at any given time.

Table 8.6 Lead load reduction

Assessment Unit	Target Load (lbs/day)	Measured Load (lbs/day)	Load Reduction (lbs/day)	Percent Reduction (%)[a]
Cold Springs Creek (Hot Springs Creek to headwaters)	7.24×10^{-3}	1.11×10^{-2}	3.88×10^{-3}	34.88

(a) Percent reduction is the amount that 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 Sources

SWQB fieldwork includes an assessment of the probable sources of impairment (Appendix B). The approach for identifying probable sources of impairment was modified by SWQB in 2010 to include additional input from a variety of stakeholders including landowners, watershed group, and local, state, tribal, and federal agencies. Because the SWQB survey took place in 2009, the new approach to include outside stakeholders was not followed. Probable source sheets were filled out by SWQB staff during the watershed survey. The draft probable source list will be reviewed and modified, as necessary, with watershed group/stakeholder input during the TMDL public meeting and comment period.

Although this procedure includes subjective and qualitative elements, SWQB has concluded that it provides the best available information for the identification of probable sources of impairment in a watershed given current resources available for this effort. The list of “Probable Sources” is not intended to single out any single land owner or particular land management activity and generally includes several sources per impairment. Table 8.7 displays pollutant sources that may contribute to each AU as determined by field reconnaissance and evaluation. Probable sources of cadmium impairments will be evaluated, refined, and changed as necessary through the Watershed-Based Plan (WBP).

Table 8.7 Probable source summary for lead

Pollutant Sources	Magnitude[a]	AU	Probable Sources[b]
<u>*Nonpoint:*</u>			
	1.11×10^{-2} lbs/day	Cold Springs Creek (Hot Springs Creek to headwaters)	*Abandoned mines (tailings), low water crossings, geologic input, gravel or dirt roads, incision, mass wasting, road runoff*

(a) Because there are no waste load allocations in this TMDL, the magnitude of the nonpoint source probable sources is equivalent to the measured load.
(b) Probable sources in italics have not been previously noted in the 303(b)/305(d) Integrated List; they were noted on probable source field sheets

8.6 Linkage between Water Quality and Pollutant Sources

Among the probable sources of lead in the Cold Springs Creek watershed are the abandoned mine workings located in the watershed, as well as geologic input. Additionally, conditions in the watershed, including low water crossings, runoff from roads, incision, and mass wasting may facilitate transport of lead into the stream.

In general, increased metals in the water column can commonly be linked to sediment transport and accumulation, where the metals are a constituent part of the sediment. Heavy metals are often present in stormwater runoff in dissolved phases, but a large fraction of most metals are bound to suspended solids. Additionally, heavy metals do not degrade in the environment, so lead in soil will persist until it is transported into the stream (Pitt *et al*., 1996; Weiss *et al*., 2008) as a result of land disturbance.

The Cold Springs Creek watershed is located within the Carpenter mining district on the west slope of the Black Range. Base metal ores were discovered in the district in the 1880s, and the Royal John Mines were operated on a non-continuous basis between 1927 and an unknown date in the latter half of the 20th century. Analysis of ore typical of that found in the Cold Springs watershed include greater than 10 weight percent (wt %) lead, with key minerals being sphalerite, pyrite, galena, and chalcopyrite. Production figures for the Royal John mine group, including the Royal John mine located just 0.5 mi upstream of SWQB's sampling station, state that over 2,000,000 lbs of lead were mined as of 1946 (Hedlund, 1985). Therefore, it is likely to be present in tailings and in the abandoned workings upstream of SWQB's sampling station and would be a component in runoff from the area. In addition to drainage from tailings, it is likely that land disturbance resulting from legacy mining and roads is a contributing factor in lead concentrations in surface water. Additionally, lead has been observed in stream-sediment concentrates throughout the Carpenter district (Hedlund, 1985). A watershed restoration project was undertaken by SWQB, in conjunction with USFS in the mid-1990s. For a variety of reasons, the project did not meet its intended goals.

The pH at the sampling station during the 2009 sampling events averaged 8.14, with a low of 7.71 and a high of 8.77 (Figure 8.1); the recorded pH is within the acceptable range of 6.6-9 which is identified for application of the Assessment Protocol (NMED/SWQB, 2014) and the hardness-dependent criteria equation (NMAC, 2013), although it does near the upper pH limit of applicability. Exceedences of the hardness-dependent criteria occurred at both ends of the pH range.

Within the observed pH range, one would expect to see $PbOH^{+}$ or Pb^{2+} in both oxidizing and reducing conditions (Takeno, 2005). It is not expected that pH will vary substantially in the AU, assuming the continuation of flow conditions and land management activities. It may be advisable to place a sonde in the AU during the next survey year in order to have a clearer picture of pH in the waterbody.

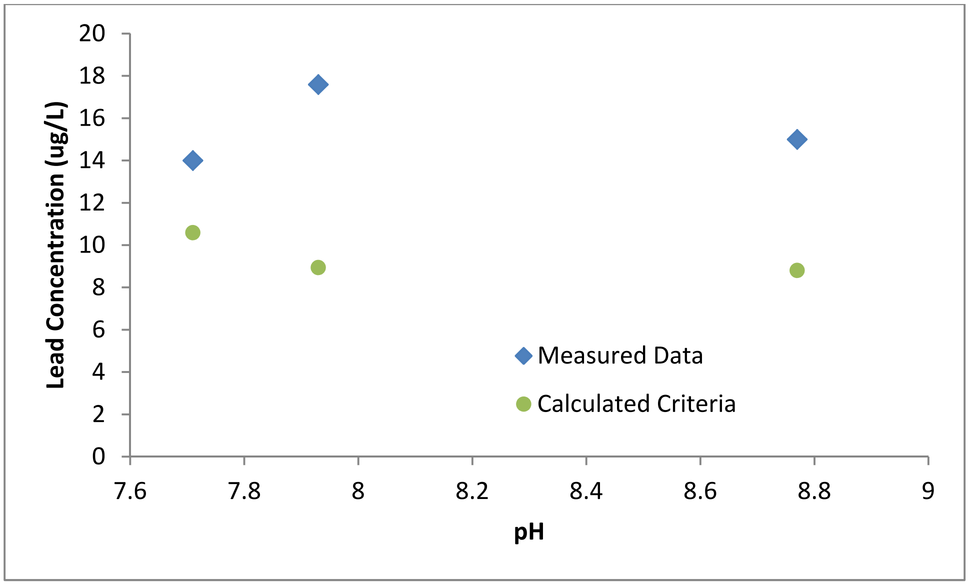

Figure 8.1 pH and dissolved lead in Cold Springs Creek as measured during 2009 SWQB survey

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 lead TMDL, the MOS was developed using a combination of conservative assumptions and inputs and explicit recognition of potential errors in flow calculations. Therefore, the MOS is the sum of the following assumptions:

- Conservative Assumptions:
  - Lead does not readily degrade in the environment.
  - Calculating the measured load with the arithmetic mean rather than the geometric mean of the sample results produces a greater mean and therefore a more conservative load estimate.
- Explicit recognition of potential errors:
  - Uncertainty exists in sampling nonpoint sources of pollution. A conservative MOS for this element is therefore **5%**.
  - Critical flow was determined using a regression equation based on sites statewide. There is inherent error in using this equation; a conservative MOS for this element is **10%**.
  - The criterion used to develop the TMDL is based on the average hardness measurement of the stream during the 2009 SWQB survey of Cold Springs Creek; a conservative MOS for this element is **5%**.

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. Data used in the calculation of these TMDLs were collected during the spring, summer, and fall of 2009 in order to ensure coverage of any potential seasonal variation in the system. Lead exceedences were observed through all three seasons, and as such, seasonality is not considered a factor in this TMDL.

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 2040. Grant County population is projected to decrease in population by an estimated 0.9% between 2010 and 2040, from 29,371 to 29,102 (NMBBER, 2012)[44]. The Cold Springs Creek watershed itself is sparsely populated, with the majority of the county's population residing in Silver City.

The estimate of future growth in Grant County is not anticipated to lead to a significant increase in lead in the Cold Springs Creek watershed that cannot be controlled with BMPs. However, it is imperative that BMPs continue to be utilized to minimize and mitigate land disturbance, improve road conditions, and adhere to SWPPP requirements related to construction and industrial activities covered under the general permit.

Any future growth would be considered part of the existing load allocation, assuming persistence of the hydrologic conditions used to develop these TMDLs.

[44] http://bber.unm.edu/demograp2.htm

9.0 TURBIDITY

During the 2011 survey, exceedences of the numeric turbidity thresholds resulting in an impairment of the narrative criterion for turbidity in 20.6.4.13 NMAC were documented in three AUs: Centerfire Creek (San Francisco River to headwaters); San Francisco River (NM 12 at Reserve to Centerfire Creek); and Tularosa River (San Francisco River to Apache Creek).

9.1 Target Loading Capacity

Target values for this turbidity TMDL were based on the turbidity thresholds identified in the NMED 2013 Assessment Protocol[45].

According to the New Mexico WQS, 20.6.4 NMAC[46], the general narrative standard for turbidity reads:

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

The assessment approach used to determine turbidity impairments relies upon the use of biotranslators to derive numeric thresholds from the narrative standard above (NMED/SWQB, 2013). A biotranslator is a physical or chemical water quality parameter that has been isolated and effects an impairment of a quantifiable attribute of an indicator organism. In some cases, the quantifiable attribute may be the lethal dose or concentration of the parameter. In the case of turbidity, the attribute is typically based upon observed behavior and the Severity of Ill Effects ("SEV") index, described in more detail in the 2013 Assessment Protocol (NMED/SWQB, 2013).

The three AUs for which turbidity TMDLs have been developed in this document are designated as either coldwater or high quality cold water. The most representative fish to use in determining the appropriate turbidity thresholds for coldwater aquatic life ("CWAL") and high quality coldwater aquatic life ("HQCWAL") stream segments are salmonids, as a majority of studies on turbidity in fish have been conducted with them. According to the Assessment Protocol, the numeric thresholds have been supported with studies of turbidity and benthic macroinvertebrates (NMED/SWQB, 2013).

An SEV index of 3.5 was selected to develop thresholds for turbidity impairment in New Mexico. This SEV index value corresponds to the boundary between conditions that effect changes to feeding in aquatic organisms and conditions that have been found to reduce growth rate and habitat size. The relationship between turbidity, duration, and an SEV of 3.5 is given in Equation 9.1, where x is duration in hours and y is the turbidity in Nephelometric Turbidity Units ("NTUs") for durations from 7 hours to 720 hours. Shorter-term turbidity excursions are unlikely to impair the growth, function, and reproduction of aquatic life as required by New Mexico's narrative turbidity water quality criterion, while thresholds for durations longer than 720 consecutive hours result in turbidity values that are lower than supported by literature available at the time of the assessment protocol development. The Assessment Protocol (NMED/SWQB, 2013) provides a series of turbidity thresholds and durations which are listed in Table 9.1.

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[45] http://www.nmenv.state.nm.us/swqb/protocols/2014/
[46] http://www.nmcpr.state.nm.us/nmac/parts/title20/20.006.0004.pdf

Equation 9.1

$$x = 37{,}382y^{-1.9887}$$

Where:

x = duration (hours)
y = turbidity (NTU)
Applicable for durations between 7 and 720 hours

Table 9.1 Turbidity impairment thresholds and durations appearing in the SWQB Assessment Protocol

Turbidity Threshold (NTU)	Allowable Duration (consecutive hours)	Allowable Duration (consecutive days)
23	72	3
20	96	4
18	120	5
16	144	6
15	168	7
11	336	14
7	720	30

NTU = Nephelometric Turbidity Units

Because a TMDL requires a numeric loading component which is not congruous with turbidity, Total Suspended Solids ("TSS") has been used in previous SWQB TMDLs as a turbidity surrogate since prior to the year 2000. TSS is a commonly-used measurement of suspended material in surface water. This method was originally developed for use on wastewater samples, but has widely been used as a measure of suspended materials in stream samples because it is acceptable for regulatory purposes and is an inexpensive laboratory procedure. Since there are no wastewater treatment plants with NPDES permits discharging into or upstream of the AUs targeted for a turbidity TMDL, it is assumed that TSS measurements in these ambient stream samples are representative of erosional activities, re-suspension of bedded sediments, or biosolids from livestock or wildlife, and thus comprised primarily of suspended sediment versus any potential biosolids from WWTP effluent.

A relationship can typically be found between turbidity and TSS in a watershed or waterbody. Hence, suspended sediment levels may be inferred from turbidity studies; alternatively, turbidity levels may be inferred from studies that monitor suspended sediment concentrations. Extrapolation from these studies is possible when a site-specific relationship between concentrations of suspended sediments and turbidity is confirmed. Activities that generate varying amounts of suspended sediment will proportionally change or affect turbidity (USEPA, 1991). The impacts of suspended sediment and turbidity are well documented in the literature. An increased sediment load is often the most important adverse effect of activities on streams, according to a monitoring guidelines report (USEPA, 1991). An increase in suspended sediment concentration will reduce the penetration of light, decreases the ability of fish or fingerlings to capture prey, and reduce primary production (USEPA, 1991). As stated in Relyea *et al.* (2000), "increased turbidity by sediments can reduce stream primary production by reducing photosynthesis, physically abrading algae and other plants, and preventing attachment of autotrophs to substrate surfaces."

TSS and turbidity data were collected in the San Francisco watershed (Table 9.2) during the 2011 survey. Turbidity impairment was determined based on long-term data that was also collected in 2011. The TSS target was derived using a regression equation developed with turbidity and TSS data obtained from grab samples. Because the turbidity – TSS relationship is unique to each watershed, different types of regression equations were found to offer the best fit for each AU based on both the R^2 value (coefficient of determination) and the appropriateness of the resulting TSS values. For example, a linear regression applied to Centerfire Creek and San Francisco River resulted in negative TSS values at the lower end of the turbidity spectrum. The R^2 value is essentially a measure of how well a dataset fits the applied model; R^2 values approaching one are considered better fits than R^2 values approaching zero. The equation and regression statistics are displayed in Table 9.3 and Figures 9.1-9.3.

Table 9.2 Discrete (grab) turbidity and TSS data

Assessment Unit and Station	Date	Turbidity (NTU)	TSS (mg/L)	Flow (cfs)
Centerfire Creek (San Francisco River to headwaters) - Centerfire Creek above San Francisco River 80Center002.1	March 8, 2011	2.3	8	<1[(a)]
	April 15, 2011	11	5	<0.5[(a)]
	May 17, 2011	11.9	20	<1[(a)]
	July 26, 2011	76	89	<<1[(a)]
	August 25, 2011	697.1	1,090	8.3
	September 15, 2011	1,197.8	5,060	NA
	September 21, 2011	20.8	32	1.3
	October 26, 2011	18.9	22	NA
San Francisco River (NM 12 at Reserve to Centerfire Creek) - San Francisco River at Upper Box 80SanFra124.2	March 8, 2011	0	5	6.5
	April 15, 2011	5.4	4	4.6
	May 17, 2011	12.1	10	3.1
	June 23, 2011	5.2	19	1.8
	July 26, 2011	121.2	150	4.8
	August 25, 2011	439.8	952	32

	September 20, 2011	35.9	32	15
	October 26, 2011	5.9	6	7.0
Tularosa River (San Francisco River to Apache Creek) - Tularosa above San Francisco 80Tularo001.3	March 9, 2011	1.8	12	3.5
	April 14, 2011	0	3	3.66
	May 17, 2011	13.3	16	2.8
	June 23, 2011	2.8	14	0.26
	July 28, 2011	215.4	309	4.47
	August 24, 2011	75.9	113	21.18
	September 21, 2011	18.9	25	8.85
	October 26, 2011	5.5	6	5
Tularosa River (San Francisco River to Apache Creek) - Tularosa above Apache 80Tularo035.8	April 15, 2011	5	16	<1[a]
	May 17, 2011	0.2	22	<1[a]
	June 23, 2011	11.2	23	<1[a]
	July 26, 2011	19.5	36	<1[a]
	August 25, 2011	28.5	43	1-2[a]
	September 15, 2011	30.6	30.6	NA
	September 20, 2011	17.5	24	NA
	October 26, 2011	3.5	NA	NA

[a] Flow based on a visual estimate

Table 9.3 Regression equations and R^2 values for turbidity and TSS[b]

Assessment Unit	**Equation Type**	**Regression Equation**[a]	**R^2 Value**
Centerfire Creek (San Francisco River to headwaters)	Power	$y = 1.1595x^{1.0817}$	$R^2 = 0.9242$
San Francisco River (NM 12 at Reserve to Centerfire Creek)	Polynomial	$y = 0.003x^2 + 0.8333x + 2.8823$	$R^2 = 0.9997$
Tularosa River (San Francisco River to Apache Creek)	Linear	$y = 1.4017x + 4.4881$	$R^2 = 0.9899$

(a) y = TSS target (mg/L), x = given turbidity (NTU)
(b) These relationships are based on a limited dataset. The uncertainty associated with the relationships is included in the MOS (Section 9.7).

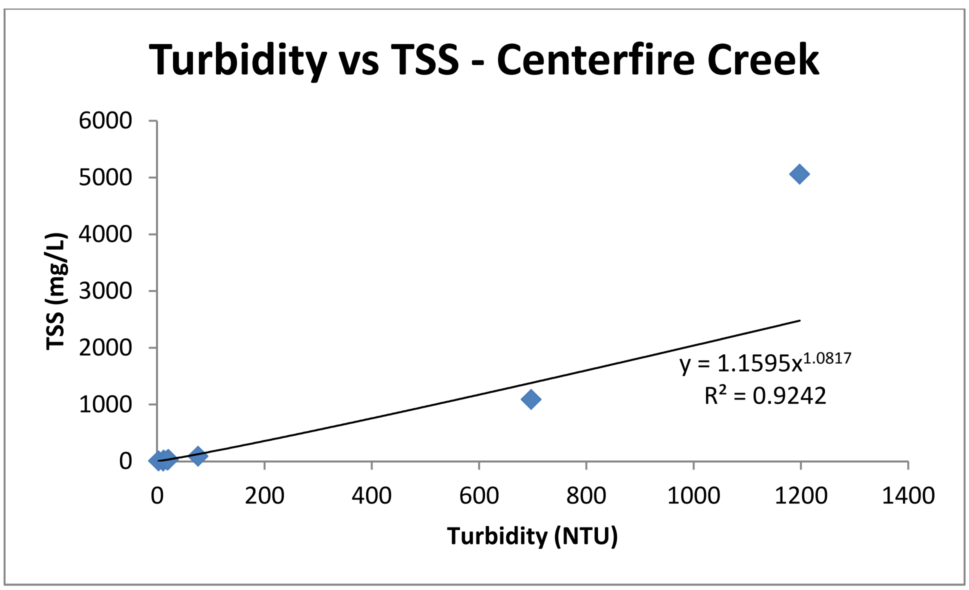

Figure 9.1 Turbidity – TSS relationship in Centerfire Creek (San Francisco River to headwaters)

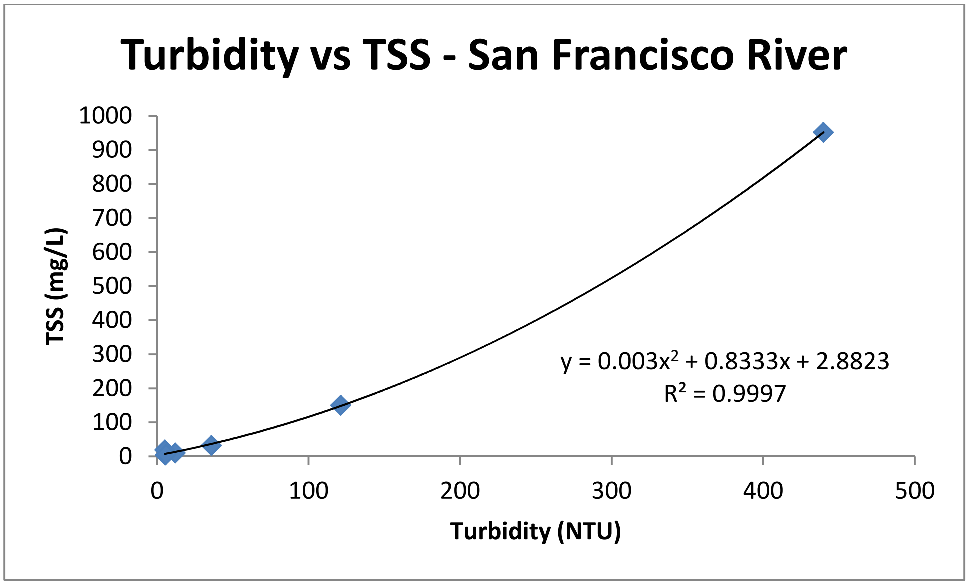

Figure 9.2 Turbidity – TSS relationship in San Francisco River (NM 12 at Reserve to Centerfire Creek)

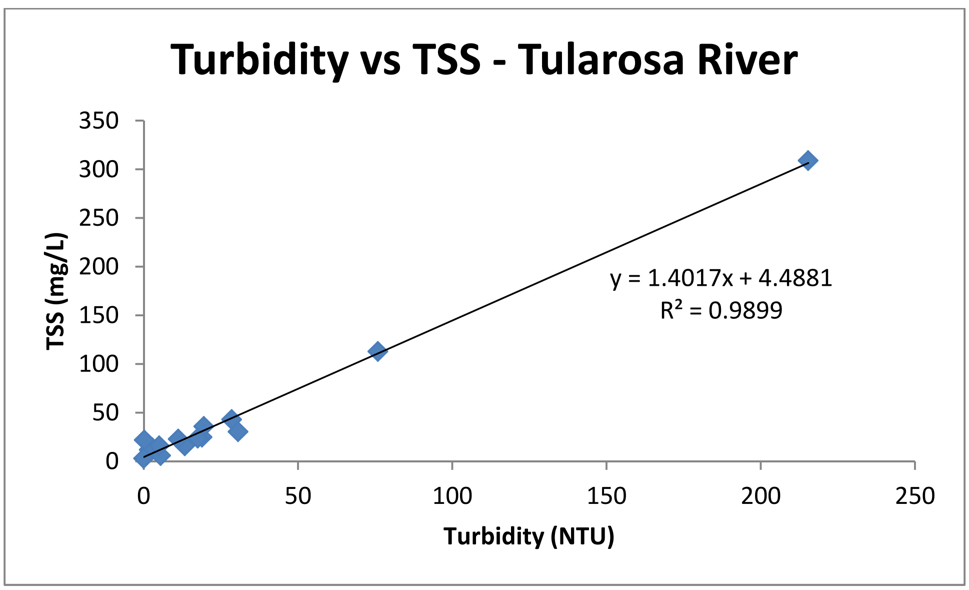

Figure 9.3 Turbidity – TSS relationship in Tularosa River (San Francisco River to Apache Creek)

Sonde data were collected in all three AUs in 2011 and used to determine impairment. The average, maximum, and minimum turbidity measurements based on sonde data are listed in Table 9.4. The sonde data for Centerfire Creek and the downstream station of Tularosa Creek indicate that turbidity exceeded the short-duration threshold of 23 NTU for 72 hours, as well as the 20 NTU for 96 hour threshold and the 18 NTU for 120 hour threshold. The San Francisco River AU exceeded the longer duration, lower NTU thresholds of 20 NTU for 96 hours, 18 NTU for 120 hours, 16 NTU for 144 hours, and 15 NTU for 168 hours (Table 9.5).

Table 9.4 Sonde deployments and turbidity statistics

Assessment Unit	Station	Sonde deployment	Duration of Deployment (hours)	Average (NTU)	Maximum (NTU)	Minimum (NTU)
Centerfire Creek (San Francisco River to headwaters)	80Center002.1	Sept 15-21, 2011	141	378.71	1,242.8	34.9
San Francisco River (NM 12 at Reserve to Centerfire Creek)	80SanFra124.2	Sept 26-Oct 11, 2011	360	76.91	1,705.4	0
Tularosa River (San Francisco River to Apache Creek)	80Tularo001.3	Sept 15-21, 2011	150	63.46	740.9	30
	80Tularo035.8	Sept 15-20, 2011	118	203.64	1,294.9	6.3

Table 9.5 Exceedences of numeric turbidity thresholds

Assessment Unit	23 NTU / 72 hrs	20 NTU / 96 hrs	18 NTU / 120 hrs	16 NTU / 144 hrs	15 NTU / 168 hrs	11 NTU / 336 hrs	7 NTU / 720 hrs
Centerfire Creek (San Francisco River to headwaters)	Exceeds	Exceeds	Exceeds	NA[a]	NA[a]	NA[a]	NA[a]
San Francisco River (NM 12 at Reserve to Centerfire Creek)	Exceeds	Exceeds	Exceeds	Exceeds	Exceeds	Does not exceed	NA[a]
Tularosa River (San Francisco River to Apache Creek)	Exceeds	Exceeds	Exceeds	NA[a]	NA[a]	NA[a]	NA[a]

[a] NA indicates that the sonde was not deployed for the column’s duration

It seems likely duration deployments longer than what was collected in 2011 would result in more threshold exceedences. The upstream station of Tularosa River (San Francisco River to Apache Creek), 80Tularo035.8, does not indicate an exceedence of the thresholds. This may be a result of the relatively short-term deployment or suggest a turbidity input downstream of the station.

9.2 Flow

The 4Q3 is the annual lowest four (4) consecutive day flow that occurs with a frequency of at least once every three (3) years. According to the New Mexico Water Quality Standards, the low flow critical condition is defined as 4Q3 (NMAC 20.6.4.11.B.2) for numeric criteria set in 20.6.4.97 through 20.6.4.900 NMAC, as well as Subsection F of 20.6.4.13 NMAC . There is a gage located on the San Francisco River (NM 12 at Reserve to Centerfire Creek) AU (Table 9.6), thus flow was determined using a 4-day, 3-year low-flow frequency (4Q3) regression model. Critical low flow was determined on an annual basis utilizing all available daily flow values rather than on a seasonal basis for these TMDLs because exceedences occurred across both low and high flow conditions and all flow in the gage record was non-zero.

Table 9.6 USGS gages in study area

Gage	Name	Start Date	End Date	4Q3 (cfs[c])	4Q3 (MGD[b])
09442680	San Francisco River near Reserve, NM	March 1, 1959	Present	1.60	1.03

The calculated 4Q3s using DFLOW software and assumptions noted above are:

- San Francisco River (NM 12 at Reserve to Centerfire Creek) = 1.03 MGD

In the case of ungaged streams, an analysis method developed by Waltemeyer (2002) can be used to estimate flow. 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 ft in elevation). Because the average elevation of the watersheds of Tularosa River (San Francisco River to Apache Creek) and Centerfire Creek (San Francisco River to headwaters) are above 7,500 ft, the decision was made to use the mountainous regions regression equation.

The following mountainous regions regression equation (Equation 9.2) is based on data from 40 gaging stations located above 7,500 ft in elevation with non-zero discharge (Waltemeyer, 2002):

Equation 9.2

$$4Q3 = 7.3287 \times 10^{-5} DA^{0.70} {P_w}^{3.58} S^{1.35}$$

Where:

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

For details and development of this equation, please see *Analysis of the Magnitude and Frequency of the 4-Day Annual Low Flow and Regression Equations for Estimating the 4-Day, 3-Year Low-Flow Frequency at Ungaged Sites on Unregulated Streams in New Mexico*, USGS Water-Resources Investigations Report 01-4271 (Waltemeyer, 2002)[47].

4Q3 values calculated using Waltemeyer's methods are presented in Table 9.7. Parameters used in the calculation were determined using Weasel, a GIS application. The 4Q3 result from Equation 9.2 is in cfs; conversion to MGD was calculated using the unit conversion provided in Appendix A.

[47] http://nm.water.usgs.gov/publications/abstracts/wrir01-4271.html

Table 9.7 Calculation of 4Q3

Assessment Unit	Average Elevation (ft)	Drainage Area (mi^2)	Mean Winter Precipitation (in)	Average Basin Slope (%)	4Q3 (cfs)	4Q3 (MGD)
Centerfire Creek (San Francisco River to headwaters)	7,592	136.85	9.45	0.163	0.62	0.40
Tularosa River (San Francisco River to Apache Creek)	7,579	645.02	9.57	0.195	2.43	1.57

It is important to remember that the TMDL itself is a value calculated at a defined critical condition as part of a 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.

Because impairment of a waterbody is dependent on the duration of elevated turbidity, a separate TMDL has been determined for each NTU/duration threshold identified in the turbidity assessment protocol for each assessment unit.

9.3 Calculations

This section describes the relationship between the numeric target and the allowable pollutant load by determining the total assimilative capacity of a waterbody, or loading capacity, for turbidity at each threshold. The loading capacity is the maximum amount of pollutant that a waterbody can receive, at a specific flow, while meeting its water quality objectives. This TMDL was developed using the turbidity/duration thresholds identified in the SWQB turbidity assessment protocol, the site-specific relationships between turbidity and TSS, the 4Q3 flow condition, and a unit conversion factor to translate the target value into pounds per day (lbs/day). Using the regression equations provided in Table 9.3, TSS values for each turbidity threshold were calculated for each assessment unit (Tables 9.8-9.10).

Table 9.8 Calculated TSS threshold values for Centerfire Creek (San Francisco River to headwaters)

Turbidity (NTU)	TSS (mg/L)	Duration (consecutive hrs)
7	9.52	720
11	15.51	336
15	21.70	168
16	23.27	144
18	26.43	120
20	29.62	96
23	34.45	72

Table 9.9 Calculated TSS threshold values for San Francisco River (NM 12 at Reserve to Centerfire Creek)

Turbidity (NTU)	TSS (mg/L)	Duration (consecutive hrs)
7	8.86	720
11	12.41	336
15	16.06	168
16	16.98	144
18	18.85	120
20	20.75	96
23	23.64	72

Table 9.10 Calculated TSS threshold values for Tularosa Creek (San Francisco River to Apache Creek)

Turbidity (NTU)	TSS (mg/L)	Duration (consecutive hrs)
7	14.30	720
11	19.91	336
15	25.51	168
16	26.92	144
18	29.72	120
20	32.52	96
23	36.73	72

Because impairment of a waterbody is dependent on the duration of elevated turbidity, a separate TMDL has been determined for each turbidity/duration threshold identified in the SWQB turbidity assessment protocol. The TSS values calculated in Tables 9.7-9.9 were substituted into

Equation 9.3 to determine the target loading capacity for each assessment unit at each turbidity/duration threshold (Tables 9.11-9.13).

Equation 9.3

$$Critical\ Flow\ \times WQS \times Unit\ Conversion\ Factor = Target\ Loading\ Capacity\ (TMDL)$$

Note that the target load is the TMDL for an assessment unit for a particular turbidity/duration pairing. It should not be extrapolated to longer or shorter durations.

Table 9.11 Turbidity-TSS/Duration TMDLs for Centerfire Creek (San Francisco River to headwaters)

Duration (consecutive hrs)	Duration (consecutive days)	TSS Target (mg/L)	4Q3 (MGD)	Conversion Factor	Target Load (lbs/day)
720	30	9.52	0.40	8.34	31.75
336	14	15.51	0.40	8.34	51.74
168	7	21.7	0.40	8.34	72.39
144	6	23.27	0.40	8.34	77.62
120	5	26.43	0.40	8.34	88.17
96	4	29.62	0.40	8.34	98.81
72	3	34.45	0.40	8.34	114.92

Table 9.12 Turbidity-TSS/Duration TMDLs for San Francisco River (NM 12 at Reserve to Centerfire Creek)

Duration (consecutive hrs)	Duration (consecutive days)	TSS Target (mg/L)	4Q3 (MGD)	Conversion Factor	Target Load (lbs/day)
720	30	8.86	1.03	8.34	76.10
336	14	12.41	1.03	8.34	106.60
168	7	16.06	1.03	8.34	137.96
144	6	16.98	1.03	8.34	145.86
120	5	18.85	1.03	8.34	161.92
96	4	20.75	1.03	8.34	178.24
72	3	23.64	1.03	8.34	203.07

Table 9.13 Turbidity-TSS/Duration TMDLs for Tularosa River (San Francisco River to Apache Creek)

Duration (consecutive hrs)	Duration (consecutive days)	TSS Target (mg/L)	4Q3 (MGD)	Conversion Factor	Target Load (lbs/day)
720	30	14.3	1.57	8.34	187.24
336	14	19.91	1.57	8.34	260.69
168	7	25.51	1.57	8.34	334.02
144	6	26.92	1.57	8.34	352.48
120	5	29.72	1.57	8.34	389.14
96	4	32.52	1.57	8.34	425.81
72	3	36.73	1.57	8.34	480.93

9.4 Waste Load Allocations and Load Allocations

9.4.1 Waste Load Allocation

There are no individually permitted point source facilities or MS4/sMS4 stormwater permits in this assessment unit. Sediment may be a component of some (primarily construction) stormwater discharges that contribute to suspended sediment impacts, and should be addressed.

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

Other industrial stormwater facilities are generally covered under the current NPDES MSGP. This permit also requires the preparation of a 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. It is not possible to calculate individual WLAs for facilities covered by the MSGP at this time using available tools. The discharges from the MSGP are typically transitory and enforcement is complex as permittees are temporary. Loads that are in compliance with the General Permits are therefore currently included as part of the LA. While these sources are not given individual allocations, they are addressed through other means, including BMPs, stormwater pollution prevention conditions, and other requirements.

9.4.2 Load Allocation

In order to calculate the LA for turbidity, the MOS was subtracted from the target load (TMDL) using the following Equation 9.4:

Equation 9.4

$$LA + MOS = TMDL$$

Or

$$LA = TMDL - MOS$$

The MOS was developed using a combination of conservative assumptions and explicit recognition of potential errors. The explicit MOS is estimated to be 15% of the target load calculated in Table 9.10-9.12 for ungaged AUs. An MOS of 10% has been assigned to the gaged AU; see Section 9.7 for details.

The TMDLs were allocated per Equation 9.3 and the resulting allocations are listed in Tables 9.14 – 9.16.

Table 9.14 TMDL for Turbidity in Centerfire Creek (San Francisco River to headwaters)

Duration (consecutive hrs)	WLA (lbs/day)	LA (lbs/day)	MOS (15%) (lbs/day)	TMDL (lbs/day)
720	0.00	26.99	4.76	31.75
336	0.00	43.98	7.76	51.74
168	0.00	61.53	10.86	72.39
144	0.00	65.98	11.64	77.62
120	0.00	74.94	13.23	88.17
96	0.00	83.99	14.82	98.81
72	0.00	97.68	17.24	114.92

Table 9.15 TMDL for Turbidity in San Francisco River (NM 12 at Reserve to Centerfire Creek)

Duration (consecutive hrs)	WLA (lbs/day)	LA (lbs/day)	MOS (10%) (lbs/day)	TMDL (lbs/day)
720	0.00	68.49	7.61	76.10
336	0.00	95.94	10.66	106.60
168	0.00	124.16	13.80	137.96
144	0.00	131.27	14.59	145.86
120	0.00	145.73	16.19	161.92
96	0.00	160.42	17.82	178.24
72	0.00	182.76	20.31	203.07

Table 9.16 TMDL for Turbidity in Tularosa River (San Francisco River to Apache Creek)

Duration (consecutive hrs)	WLA (lbs/day)	LA (lbs/day)	MOS (15%) (lbs/day)	TMDL (lbs/day)
720	0.00	159.15	28.09	187.24
336	0.00	221.59	39.10	260.69
168	0.00	283.92	50.10	334.02
144	0.00	299.61	52.87	352.48
120	0.00	330.77	58.37	389.14
96	0.00	361.94	63.87	425.81
72	0.00	408.79	72.14	480.93

9.5 Identification and Description of Pollutant Sources

SWQB fieldwork includes an assessment of the probable sources of impairment (Appendix B). The approach for identifying probable sources of impairment was recently modified by SWQB to include additional input from a variety of stakeholders including landowners, watershed groups, and local, state, tribal, and federal agencies. Probable source sheets are filled out by SWQB staff during watershed surveys and watershed restoration activities. The draft probable source list is then reviewed and modified, as necessary, with watershed group and other stakeholder input during the TMDL public meeting and comment period.

Although this procedure includes subjective and qualitative elements, SWQB has concluded that it provides the best available information for the identification of probable sources of impairment in a watershed. The list of probable sources is not intended to single out a particular land owner or land management activity and generally includes several potential sources per impairment. Table 9.17 displays pollutant sources that may contribute to each segment as determined by field reconnaissance and evaluation. Probable sources of turbidity impairments will be evaluated, refined, and changed as necessary through the WBP.

Table 9.17 Probable Source Summary for Turbidity

Pollutant Sources	AU	Probable Sources[b]
Nonpoint:		
	Centerfire Creek (San Francisco River to headwaters)	Dispersed rangeland grazing, *legacy logging operations, gravel or dirt roads, low water crossings,* stream bank destabilization, *stream channel incision*
	San Francisco River (NM 12 at Reserve to Centerfire Creek)	*Dispersed rangeland grazing, low water crossings, gravel or dirt roads, watershed runoff following forest fire*
	Tularosa River (San Francisco River to Apache Creek)	*Channelization, highway/road/bridge runoff, dispersed rangeland grazing, bridges/culverts/RR crossings, low water crossings, gravel or dirt roads, hiking trails, defined campgrounds, drought-related impacts*

(a) Because there are no waste load allocations in this TMDL, the magnitude of the nonpoint source probable sources is equivalent to the measured load.
(b) Probable sources in italics have not been previously noted in the 303(b)/305(d) Integrated List; they were noted on probable source field sheets.

9.6 Linkage between Water Quality and Pollutant Sources

Turbidity is an expression of the optical property in water that causes incident light to be scattered and absorbed rather than transmitted in straight lines. It is the condition resulting from suspended solids in the water, including silts, clays, and plankton. Such particles absorb heat in the sunlight, thus raising water temperature, which in turn lowers dissolved oxygen levels. It also prevents sunlight from reaching plants below the surface. This decreases the rate of photosynthesis, so less oxygen is produced by plants. Turbidity may harm fish and their larvae. Turbidity exceedences have historically been attributed to soil erosion, excess nutrients, various wastes and pollutants, and the re-suspension of sediments up into the water column during high flow events.

As observed in SWQB data turbidity values along these reaches exceed the applicable standards for the protection of designated uses. Through monitoring, and pollutant source documentation, it has been observed that the most probable causes for these exceedences are increased land disturbance and changing land use. Disturbances may be historical or current in nature.

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

- Cut forests
- Clear and cultivate land
- Remove stream-side vegetation
- Alter the drainage of the land

- Channelize watercourses
- Withdraw water for irrigation
- Build towns and cities
- Discharge pollutants into waterways

Possible effects of these practices on aquatic ecosystems include:

- Increased amount of sediment carried into water by soil erosion, which may:
  - Increase turbidity of the water;
  - Reduce transmission of sunlight needed for photosynthesis;
  - Interfere with animal behaviors dependent on sight (foraging, reproduction, and escape from predators);
  - Impede respiration (e.g., by gill abrasion and congestion in fish) and digestion; and
  - Reduce oxygen in the water.
- Clearing of trees and shrubs from shorelines, which may:
  - Destabilize banks and promote erosion;
  - Increase sedimentation and turbidity;
  - Reduce shade and increase water temperature which could disrupt fish metabolism; and
  - Cause channels to widen and become shallower.
- Land clearing, constructing drainage ditches, straightening natural water channels, which may:
  - Create an obstacle to upstream movement of fish and suspend more sediment in the water due to increased flow;
  - Strand fish upstream and dry out recently spawned eggs due to subsequent low flows; and
  - Reduce base flows.

Where data gaps exist or the level of uncertainty in the characterization of sources is large, the recommended approach to TMDL assignments requires the development of allocations based on estimates utilizing the best available information. Additional turbidity and TSS sampling are needed in the referenced reaches to more fully characterize probable sources of turbidity. However, sufficient data exist to support development of turbidity TMDLs to address the stream standards exceedences. As described in Section 3.1, a more focused study is ongoing in Centerfire Creek, and it is expected that results will aid in watershed planning and restoration.

During the 2011 SWQB intensive survey, a wildfire occurred in the San Francisco watershed. While the presence of fire debris was noted during the August 25, 2011 sampling event in the San Francisco River (NM 12 at Reserve to Centerfire Creek) AU, it was not noted during other sampling events, during sonde deployment, or at other sampling locations.

9.7 Margin of Safety

TMDLs should reflect a MOS based on the uncertainty or variability in the data, the point and nonpoint source loading estimates, and the modeling analysis. The MOS can be expressed implicitly, explicitly, or a combination of the two. 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 the turbidity TMDLs presented in this document, there are no permitted point sources on the reaches, so there will be no MOS associated with point sources. The MOS for the TMDLs was developed using a combination of conservative assumptions and allocating an explicit portion of the TMDL in recognition of potential errors. Therefore, this MOS is the sum of the following two elements:

- Conservative Assumptions:
  - TSS is a conservative parameter that does not settle out of the water column.
- Explicit Recognition of Potential Errors:
  - Uncertainty exists in the relationship between TSS and turbidity. A conservative MOS for this element is **5%**.
  - The critical flow value for the ungaged streams was estimated based on a regression equation from Waltemeyer (2002). There is inherent error in all flow calculations. A conservative MOS for this element for AUs which used the regression equation is therefore **10%**.
  - There is inherent error in all flow measurements; a conservative MOS for this element in gaged streams is **5%**.

9.8 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. Data used in the calculation of these TMDLs were collected during the spring, summer, and fall of 2011 in order to ensure coverage of any potential seasonal variation in the system. Higher turbidity values are typically associated with higher flows, which were noted in the SWQB dataset during the fall monsoon season. However, as monsoonal storm events are infrequent and transitory in nature, the 4Q3 is considered a more conservative estimate of the long-term stream condition. Since the critical flow condition is set to estimate critical low flow discharge, it is assumed that if critical conditions are met, coverage of any potential seasonal variation will also be met.

9.9 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 2040. The Catron County population is projected to grow by 7.7% over the 2010-2040 time period. The 2010 Census population is 3,725; the projected 2040 population is 4,012 (NMBBER, 2012)[48].

Due to the lack of known point sources in the watersheds, it is likely that turbidity is primarily due to diffuse nonpoint sources. Estimates of future growth in Catron County are not anticipated to lead to a significant increase in turbidity that cannot be controlled with BMPs. However, it is imperative that BMPs continue to be utilized to improve road conditions and grazing allotments and adhere to SWPPP requirements related to construction and industrial activities covered under the general permit.

Any future growth would be considered part of the existing load allocation, assuming persistence of the hydrologic conditions used to develop these TMDLs.

[48] http://bber.unm.edu/demograp2.htm

10.0 MONITORING PLAN

Pursuant to CWA §106(e)(1), 33 U.S.C. §1251[49], 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, §74-6-1 et seq., NMSA 1978[50], the SWQB has developed and implemented a comprehensive water quality monitoring strategy for the surface waters of the State.

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

The SWQB utilizes a rotating basin system approach to water quality monitoring. In this system, a select number of watersheds are intensively monitored each year with an established return frequency of approximately every eight years. The next scheduled monitoring year for the Mimbres Watershed is 2015; the Upper Gila and San Francisco Watersheds are 2019. The SWQB maintains current quality assurance and quality control plans to cover all monitoring activities. This document, called the QAPP, is updated and certified annually by USEPA Region 6 (NMED/SWQB, 2013). 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 §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. The U.S. District Court dismissed the Consent Decree on April 21, 2009.

Once assessment monitoring is completed, those reaches showing impacts and requiring a TMDL will be targeted for more intensive monitoring. The methods of data acquisition include fixed-station monitoring, intensive surveys of priority assessment units (including biological assessments), and compliance monitoring of industrial, federal, and municipal dischargers, as specified in the SWQB Standard Operating Procedures (NMED/SWQB, 2013). Long-term monitoring for assessments will be accomplished through the establishment of sampling sites that are representative of the waterbody and which can be revisited approximately every seven years. This information will provide time relevant information for use in CWA §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 foundations for management decisions.

[49] http://www.epw.senate.gov/water.pdf
[50] http://public.nmcompcomm.us/nmpublic/gateway.dll/?f=templates&fn=default.htm

Outside of years of intensive survey, the rotating basin program will be supplemented with other data collection efforts such as on-going studies being performed by the USGS, USEPA, and other programs within NMED. Data will be analyzed and field studies will be conducted to further characterize acknowledged problems, and TMDLs will be developed and implemented accordingly. Both long-term and intensive field studies can contribute to the State’s Integrated §303(d)/ §305(b) listing process for waters requiring TMDLs.

11.0 IMPLEMENTATION OF TMDLS

11.1 Point Sources – NPDES Permitting

There is one existing point source with an individual NPDES permit with potential impacts to the San Francisco River (Willow Springs Canyon to NM 12 at Reserve). The Village of Reserve Mutual Sewer Association holds a permit (NM0024163) for a municipal wastewater treatment plant (WWTP) with one outfall to the San Francisco River (Willow Springs Canyon to NM 12 at Reserve) AU via an unnamed tributary and wetlands. The distance between outfall and confluence with the river is approximately 40 ft. The *E. coli* WLA that has been assigned to the point source is 3.58×10^8 cfu/day, which is based upon the more stringent *E. coli* criteria of the San Francisco River (Willow Springs Canyon to NM 12 at Reserve) AU.

The current NPDES permit effluent limits are based on the water quality criteria for the unnamed tributary to which the WWTP directly discharges. The unnamed tributary is classified in the water quality standards in 20.6.4.98 NMAC as an "Intermittent Water" with a monthly geometric mean *E. coli* criterion of 206 cfu/100 mL and a single sample criterion of 940 cfu/100 mL. It is expected that upon NPDES permit renewal, the effluent permit limits for *E. coli* will be revised to include a monthly geometric mean criterion of 126 cfu/100 mL and a single sample criterion of 410 cfu/100 mL.

11.2 Nonpoint Sources – WBP and BMP Coordination

Public awareness and involvement will be crucial to the successful implementation of these plans and improved water quality. A WBP is a written plan intended to provide a long-range vision for various activities and management of resources in a watershed. It includes opportunities for private landowners and public agencies in reducing and preventing nonpoint source impacts to water quality. This long-range strategy will become instrumental in coordinating efforts to achieve water quality standards in the watershed. The WBP is essentially the Implementation Plan, or Phase Two of the TMDL process. The completion of the TMDLs and WBP leads directly to the development of on-the-ground projects to address surface water impairments in the watershed.

Several of the stream reaches discussed in this document have TMDLs already in place, and watershed restoration is ongoing in some AUs. A WBP exists for the Gila watershed that was approved by USEPA Region 6 and updated in 2009; a draft Watershed Restoration Action Strategy from 2006 is available for the Mimbres watershed. If necessary, updated planning documents should be drafted to meet the requirements and includes identified impairments and the new TMDLs.

SWQB staff will provide technical assistance such as selection and application of BMPs needed to meet WBP goals. Stakeholder public outreach and involvement in the implementation of this TMDL will be ongoing. Stakeholders in this process are likely to include the Upper Gila Watershed Alliance and the Gila Conservation Coalition, in addition to private landowners, USFS, and other interested parties.

11.3 Clean Water Act §319(h) Funding

The Watershed Protection Section of the SWQB can potentially provide USEPA §319(h) funding to assist in implementation of BMPs to address water quality problems on reaches listed as Category 4 or 5 waters on the CWA §303(d) List. These monies are available to all private, for-profit, and non-profit organizations that are authenticated legal entities, or governmental jurisdictions including: cities, counties, tribal entities, Federal agencies, or agencies of the State. Proposals are submitted by applicants through a Request for Proposal ("RFP") process. Selected projects require a non-federal match of 40% of the total project cost consisting of funds and/or in-kind services. Funding is potentially available, generally annually, for both watershed-based planning and on-the-ground projects to improve surface water quality and associated habitat. Further information on funding from the CWA Section 319(h) can be found at the SWQB website: http://www.nmenv.state.nm.us/swqb/.

11.4 Other Funding Opportunities and Restoration Efforts

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. They can also provide matching funds for appropriate CWA Section 319(h) projects using state revolving fund monies. The USDA Environmental Quality Incentive Program ("EQIP") program can provide assistance to private land owners in the basin. The USFS, a major land owner in the watersheds discussed in this document, aligns their mission to protect the lands that they manage with the TMDL process and are another source of assistance. The BLM has several programs in place to provide assistance to improve unpaved roads and grazing allotments.

On August 15, 2013 the intention for a new state-funded stream restoration program called the River Stewardship Program was announced. The River Stewardship Program has the overall goal of addressing the root causes of poor water quality and stream habitat. Objectives of the River Stewardship Program include: restoring or maintaining hydrology of streams and rivers to better handle overbank flows and thus reduce flooding downstream; enhancing economic benefits of healthy river systems such as improved opportunities to hunt, fish, float or view wildlife; and providing state matching funds required for federal CWA grants." The New Mexico Legislature provided $2.3 million in the state FY2015 budget to support this initiative. Responsibility for the program will be assigned to NMED, and staff will develop and administer the program.

12.0 APPLICABLE REGULATIONS AND STAKEHOLDER ASSURANCES

New Mexico's Water Quality Act ("Act") authorizes the WQCC to "promulgate and publish regulations to prevent or abate water pollution in the state" (NMSA 1978, § 74-6-4 (E)) and to require permits. The Act authorizes a constituent agency to take enforcement action against any person who violates a water quality standard. Several statutory provisions on nuisance law could also be applied to NPS water pollution. The Water Quality Act also provides that:

> "[t]he Water Quality Act 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."

NMSA 1978, §74-6-12 (A). In addition, the State of New Mexico Surface Water Quality Standards, Subsection C of 20.6.4.4 NMAC also provides:

> "C. 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."

20.6.4.4 (C) NMAC. New Mexico policies are in general accord with the federal Clean Water Act Section 101 (g), 33 U.S.C. §1251 (g), goals:

> "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 chapter. It is the further policy of Congress that nothing in this chapter 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."

33 U.S.C. §1251 (g). New Mexico's CWA Section 319 program has been developed in a coordinated manner with the State's 303(d) process. All Section 319 watersheds that are targeted in the annual RFP process coincides with the State's preparation of the biennial impaired waters listing as approved by the USEPA. The State has given a high priority for funding, assessment, and restoration activities to these impaired/listed watersheds.

As a constituent agency, NMED has the authority pursuant to NMSA 1978, Section 74-6-10, 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 NPS. The NMED NPS water quality management program has historically strived for and will continue to promote voluntary compliance to NPS water pollution concerns by utilizing a voluntary, cooperative approach. The State provides technical support and grant monies for implementation of BMPs and other NPS prevention mechanisms through Section 319 of the Clean Water Act (33 U.S.C. § 1329). Since portions of this TMDL will be implemented through NPS control mechanisms, the New Mexico Watershed Protection Program will target efforts to this and other watersheds with TMDLs.

In order to obtain reasonable assurances for implementation in watersheds with multiple landowners, including federal, state, and private entities, NMED has established Memoranda of Understanding ("MOU") with various federal agencies, in particular the USFS and the BLM. A MOU has also been developed with other state agencies, such as the New Mexico Department of Transportation. These MOUs provide for coordination and consistency in dealing with NPS issues.

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

13.0 PUBLIC PARTICIPATION

Public participation was solicited in development of this TMDL. The draft Upper Gila, San Francisco, and Mimbres TMDL was first made available for a 30-day comment period beginning June 23, 2014 and ending on July 22, 2014. The draft document notice of availability was extensively advertised via email distribution lists, webpage postings, and press releases to area newspapers. A public meeting was held on July 10th, 2014 at the City Hall Annex in the Town of Silver City from 6-8pm. No comments were received during the public comment period.

The TMDL was approved by the Water Quality Control Commission on September 9, 2104. Upon approval by USEPA Region 6, the next step for public participation is development of a WBP, as described in Section 11.2, and participation in watershed protection projects including those that may be funded by Clean Water Act §319(h) grants. The WBP development process is open to any member of the public who wants to participate.

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APPENDIX A

CONVERSION FACTOR DERIVATIONS

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FLOW

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:

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

Conversion Factor Derivation for milligrams:

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

Conversion Factor Derivation for micrograms:

$$CF = 10^6 \times \frac{3.785\ L}{gal} \times \frac{1\ lb}{453{,}592{,}370\ ug} = 0.008\left(\frac{L - lb}{gal - ug}\right)$$

Flow is converted from cfs to MGD by the following equation:

$$\left(\frac{ft^3}{s}\right) * \left(\frac{86{,}400\ s}{1\ day}\right) * \left(\frac{7.48\ gal}{ft^3}\right) * \left(\frac{1\ Million\ gal}{1{,}000{,}000\ gal}\right) = MGD$$

APPENDIX B

SOURCE DOCUMENTATION SHEET AND SOURCES

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"Sources" are defined as activities that may contribute pollutants or stressors to a water body (USEPA 1997). The list of "Probable Sources of Impairment" in the Integrated 303(d)/305(b) List, Total Maximum Daily Load documents (TMDLs), and WBPs is intended to include any and all activities that could be contributing to the identified cause of impairment. Data on Probable Sources is routinely gathered by Monitoring and Assessment Section staff and Watershed Protection Section staff during water quality surveys and watershed restoration projects and is housed in the Assessment Database ("ADB") (ADB version 2). ADB was developed by USEPA to help states manage information on surface water impairment and to generate §303(d)/ §305(b) reports and statistics. More specific information on Probable Sources of Impairment is provided in individual watershed planning documents (e.g., TMDLs, WBPs, etc.) as they are prepared to address individual impairments by assessment unit.

USEPA through guidance documents strongly encourages states to include a list of Probable Sources for each listed impairment. According to the 1998 305(b) report guidance, "…, states must always provide aggregate source category totals…" in the biennial submittal that fulfills CWA section 305(b)(1)(C) through (E) (USEPA 1997). The list of "Probable Sources" is not intended to single out any particular land owner or single land management activity and has therefore been labeled "Probable" and generally includes several sources for each known impairment.

The approach for identifying "Probable Sources of Impairment" was recently modified by SWQB. Any new impairment listing will be assigned a Probable Source of "Source Unknown." Probable Source Sheets will continue to be filled out during watershed surveys and watershed restoration activities by SWQB staff. Information gathered from the Probable Source Sheets will be used to generate a draft Probable Source list in consequent TMDL planning documents. These draft Probable Source lists will be finalized with watershed group/stakeholder input during the pre-survey public meeting, TMDL public meeting, WBP development, and various public comment periods. The final Probable Source list in the approved TMDL will be used to update the subsequent Integrated List.

Literature Cited:

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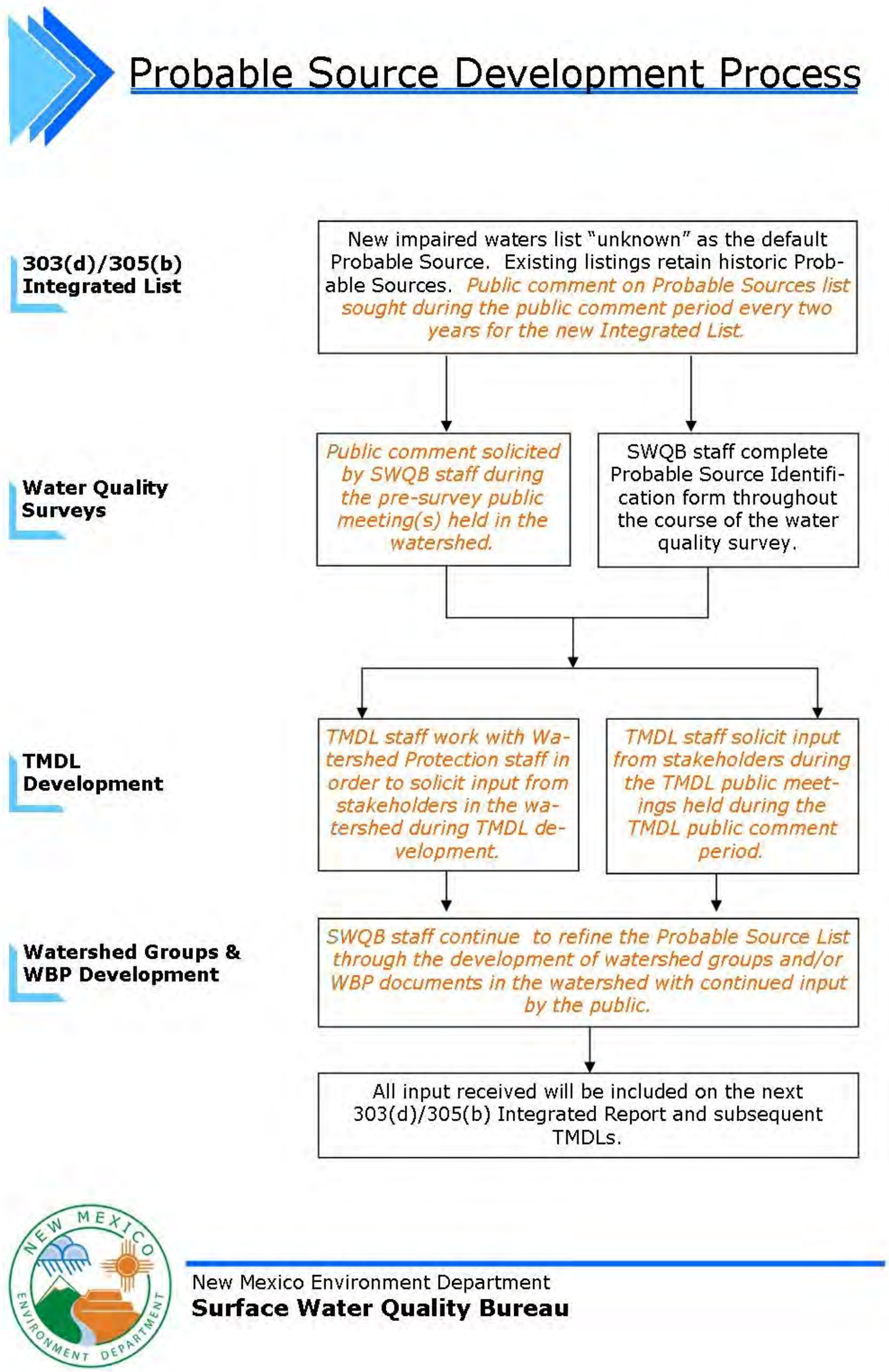

Figure B1. Probable Source Development Process and Public Participation Flowchart

Help Us Identify Probable Sources of Impairment

Name:
Phone Number (optional):
Email or Mailing Address (optional):
Date:
Waterbody or site description (example - Fish Creek near HWY 34 crossing):

From the list below, please check activities known to exist that you are concerned may be contributing to surface water quality impairment. Please score items you check based on distance to or occurrence on or near the waterbody of concern.

(1 = Low occurrence or not near waterbody)
(3 = Moderate occurrence or within ½ mile of waterbody)
(5 = High occurrence or right next to water body)

✓	ACTIVITY	Score			✓	ACTIVITY	Score		
☐	Feedlots	1	3	5	☐	Pavement and Other Impervious Surfaces	1	3	5
☐	Livestock Grazing	1	3	5	☐	Roads/Bridges/Culverts	1	3	5
☐	Agriculture	1	3	5	☐	Habitat Modification(s)	1	3	5
☐	Flow Alterations (water withdrawal)	1	3	5	☐	Mining/Resource Extraction	1	3	5
☐	Stream/River Modification(s)	1	3	5	☐	Logging/Forestry Operations	1	3	5
☐	Storm Water Runoff	1	3	5	☐	Housing or Land Development	1	3	5
☐	Drought Related	1	3	5	☐	Habitat Modification	1	3	5
☐	Landfill(s)	1	3	5	☐	Waterfowl	1	3	5
☐	Industry/Wastewater Treatment Plant	1	3	5	☐	Wildlife other than Waterfowl	1	3	5
☐	Inappropriate Waste Disposal	1	3	5	☐	Recreational Use	1	3	5
☐	Improperly maintained Septic Systems	1	3	5	☐	Natural Sources	1	3	5
☐	Waste from Pets	1	3	5	☐	Other: *(please describe)*	1	3	5

Comments/additional information:

Revised 02Aug12

Figure B2. Probable Source Identification Sheet for the Public

28 Jun 2011
Ver. 5

Probable Source(s) & Site Condition Class Field Form

Station ID:	Station Name/Description:
AU ID:	AU Description:
Field Crew:	Comments:
Date:	Watershed protection staff reviewer: Date of WPS review:

Score the proximity, intensity and/or certainty of occurrence of the following activities in the AU upstream of the site. Consult with the appropriate staff at NMED and other agencies to score "*" cells if needed.

Activity Checklist

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
Habitat Modification				
Active Exotics Removal	0	1	3	5
Stream Channel Incision	0	1	3	5
Mass Wasting	0	1	3	5
Active Restoration	0	1	3	5
Other:	0	1	3	5
Industrial/ Municipal				
Storm Water Runoff due to Construction	0	1	3	5
Landfill	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
Residences/Buildings	0	1	3	5
Site Clearance (Land Development)	0	1	3	5
Urban Runoff/Storm Sewers	0	1	3	5
Power Plants	0	1	3	5
* Industrial Storm Water Discharge (permitted)	0	1	3	5
* Industrial Point Source Discharge	0	1	3	5
* Municipal Point Source Discharge	0	1	3	5
* RCRA/Superfund Site	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
* Active Mine Reclamation	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:	0	1	3	5
Rangeland				
Livestock Grazing or Feeding Operation	0	1	3	5
Rangeland Grazing (dispersed)	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 or Dirt Roads	0	1	3	5
Agriculture				
Crop Production (Cropland or Dry Land)	0	1	3	5
Irrigated Crop Production (Irrigation Equip)	0	1	3	5
* Permitted CAFOs	0	1	3	5
* Permitted Aquaculture	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 Species (describe in comments)	0	1	3	5
Hiking Trails	0	1	3	5
Campgrounds (Dispersed/Defined – circle)	0	1	3	5
Surface Films/Odors	0	1	3	5
Pesticide Application (Algaecide/Insecticide)	0	1	3	5
Waste From Pets (high concentration)	0	1	3	5
* Fish Stocking	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
Recent Bankfull or Overbank Flows	0	1	3	5
Wildlife other than Waterfowl	0	1	3	5
Other Natural Sources (describe in	0	1	3	5

Figure B2. Probable Source Identification Sheet for Internal Use

APPENDIX C

CHEMICAL DATA – 2009, 2011

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E. coli - Centerfire Creek (San Francisco River to headwaters)		
Date	**Concentration (cfu/100 mL)**	**Sampling Station**
3/8/2011	1	80Center002.1
4/15/2011	1,119.9	80Center002.1
5/17/2011	261.3	80Center002.1
7/26/2011	1,986.3	80Center002.1
8/25/2011	1,299.7	80Center002.1
9/21/2011	727	80Center002.1
10/26/2011	387.3	80Center002.1
***E. coli* - Mimbres R (Perennial reaches downstream of Willow Springs)**		
Date	**Concentration (cfu/100 mL)**	**Sampling Station**
3/23/2009	3	45Mimbre062.7
4/22/2009	16	45Mimbre062.7
6/23/2009	70	45Mimbre062.7
7/20/2009	67	45Mimbre062.7
8/24/2009	435	45Mimbre062.7
9/28/2009	152	45Mimbre062.7
11/19/2009	165	45Mimbre062.7
3/23/2009	107	45Mimbre085.7
4/22/2009	273	45Mimbre085.7
6/22/2009	48	45Mimbre085.7
7/20/2009	240	45Mimbre085.7
8/24/2009	435	45Mimbre085.7
9/28/2009	155	45Mimbre085.7
11/17/2009	816	45Mimbre085.7
3/24/2009	276	45Mimbre094.6
7/20/2009	240	45Mimbre094.6
8/25/2009	1414	45Mimbre094.6
11/17/2009	59	45Mimbre094.6

E. coli - San Francisco River (Willow Springs Cyn to NM 12 at Reserve)		
Date	**Concentration (cfu/100 mL)**	**Sampling Station**
3/9/2011	52.9	80SanFra105.7
4/14/2011	12.2	80SanFra105.7
5/17/2011	17.3	80SanFra105.7
6/22/2011	90.5	80SanFra105.7
7/28/2011	1,413.6	80SanFra105.7
8/24/2011	2420	80SanFra105.7
9/21/2011	67.7	80SanFra105.7
10/26/2011	37.3	80SanFra105.7
3/9/2011	14.5	80SanFra109.6
4/14/2011	34.5	80SanFra109.6
5/17/2011	22.6	80SanFra109.6
6/22/2011	579.4	80SanFra109.6
7/28/2011	2420	80SanFra109.6
8/24/2011	2420	80SanFra109.6
9/21/2011	119.8	80SanFra109.6
10/26/2011	21.6	80SanFra109.6
3/9/2011	23.1	80SanFra109.7
4/14/2011	68.3	80SanFra109.7
5/17/2011	26.2	80SanFra109.7
6/22/2011	290.9	80SanFra109.7
7/28/2011	2420	80SanFra109.7
8/24/2011	2420	80SanFra109.7
9/21/2011	125.9	80SanFra109.7

E. coli - San Francisco River (NM 12 at Reserve to Centerfire Creek)		
Date	**Concentration (cfu/100 mL)**	**Sampling Station**
3/8/2011	2	80SanFra124.2
4/15/2011	17.3	80SanFra124.2
5/17/2011	260.3	80SanFra124.2
7/26/2011	980.4	80SanFra124.2
8/25/2011	2,419.6	80SanFra124.2
9/20/2011	75.9	80SanFra124.2
10/26/2011	13.2	80SanFra124.2

E. coli - South Fork Negrito (Negrito Creek to headwaters)		
Date	**Concentration (cfu/100 mL)**	**Sampling Station**
6/22/2011	2,419.6	80SNegri000.1
8/24/2011	238.2	80SNegri000.1
9/28/2011	31.3	80SNegri000.1
10/25/2011	8.4	80SNegri000.1
E. coli **- Tularosa River (San Francisco River to Apache Creek)**		
Date	**Concentration (cfu/100 mL)**	**Sampling Station**
3/9/2011	18.9	80Tularo001.3
4/14/2011	8.6	80Tularo001.3
5/17/2011	93.3	80Tularo001.3
6/23/2011	1,413.6	80Tularo001.3
7/28/2011	816.4	80Tularo001.3
8/24/2011	579.4	80Tularo001.3
9/21/2011	32.3	80Tularo001.3
10/26/2011	24.3	80Tularo001.3
4/15/2011	17.1	80Tularo035.8
5/17/2011	90.5	80Tularo035.8
6/23/2011	579.4	80Tularo035.8
7/26/2011	547.5	80Tularo035.8
8/25/2011	18.5	80Tularo035.8
9/20/2011	13.5	80Tularo035.8
10/26/2011	172.2	80Tularo035.8

Aluminum - Willow Creek (Gilita Creek to headwaters)		
Date	**Al Concentration (ug/L)**	**Hardness ($CaCO_3$ mg/L)**
4/13/2011	124.55	24.04
5/18/2011	255.6	27.34
6/22/2011	103.14	32.72
7/27/2011	574.99	31.33
8/24/2011	498.46	25.26
9/21/2011	167.46	32.27
10/25/2011	80	30.27

Cadmium - Cold Springs Creek (Hot Springs Creek to headwaters)		
Date	**Concentration (ug/L)**	**Hardness ($CaCO_3$ mg/L)**
3/23/2009	1.00	321
7/20/2009	2.21	316
8/24/2009	2.00	328
11/17/2009	2.00	435

Lead - Cold Springs Creek (Hot Springs Creek to headwaters)		
Date	**Concentration (ug/L)**	**Hardness ($CaCO_3$ mg/L)**
3/23/2009	12.00	321
7/20/2009	17.59	316
8/24/2009	15.00	328
11/17/2009	14.00	435

APPENDIX D

FINAL FIRE INCIDENT REPORTS

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InciWeb - Incident Information System

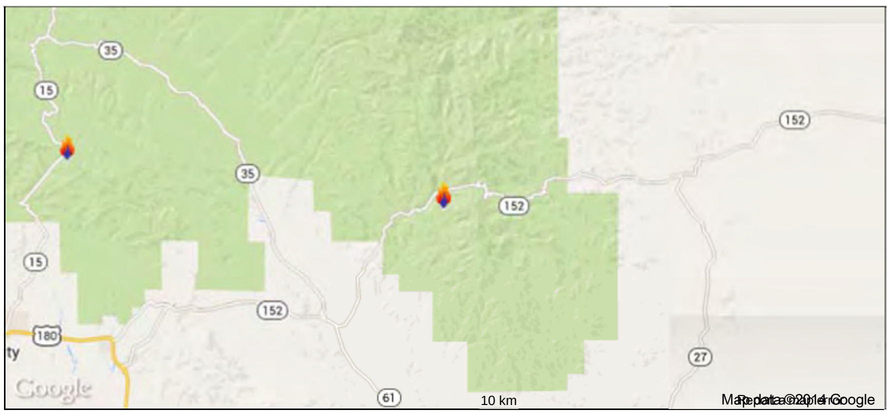
Silver Fire

This incident is no longer being updated.

INCIDENT UPDATED 5/17/2014

Approximate Location

32.893 latitude, -107.81 longitude



Incident Overview

Priorities continue to be rehabilitation of the burned area. Personnel will work this spring on restoring and repairing areas impacted by fire suppression activities. Please check here for updates about ongoing work in the fire area.

Basic Information

Current as of	Wednesday, May 21, 2014 9:09:02 PM
Incident Type	Wildfire
Cause	Lightning
Date of Origin	Friday June 07th, 2013 approx. 03:00 PM
Location	Vicinity of Kingston, NM

Current Situation

Size	138,705 Acres
Percent of Perimeter	100%
Fuels Involved	Timber (litter and understory).Highly varied fuels ranging from dry mixed conifer at high elevations. Fuel is high due to lack of fire disturbance in past century.

Outlook

Content posted to this website is for information purposes only.

InciWeb - Incident Information System

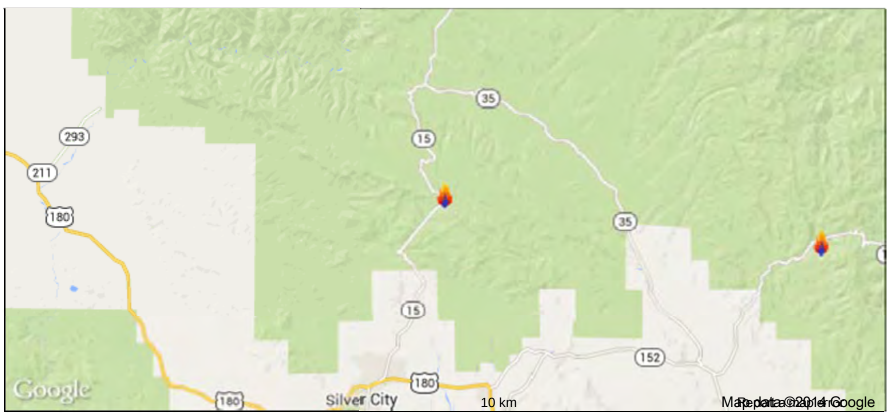
Signal Fire

NEWS RELEASE
Post Signal Fire Work Begins The Burned Area Emergency Response (BAER) funding request for the Signal Fire was recently approved and work is scheduled to begin to stabilize and restore areas impacted by the fire. The first... more

INCIDENT UPDATED 6/3/2014

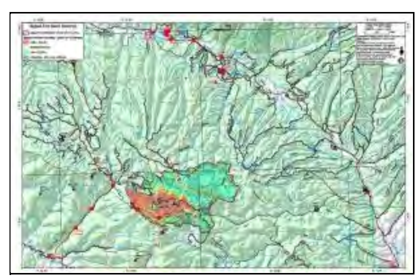
Approximate Location

32.934 latitude, -108.195 longitude



Incident Overview

The Signal Fire was reported by the Signal Peak Lookout Tower Sunday afternoon. The fire is located approximately 10 miles north of Silver City. It is estimated at 5,484 acres and is fully contained.



Basic Information

Current as of	Wednesday, May 28, 2014 10:02:11 AM
Incident Type	Wildfire
Cause	Human
Date of Origin	Sunday May 11th, 2014 approx. 03:00 PM
Location	10 miles north of Silver City
Incident Commander	Richards

Current Situation

Total Personnel	10
Size	5,484 Acres
Percent of Perimeter Contained	100%
Estimated Containment Date	Thursday May 22nd, 2014 approx. 12:00 AM
Fuels Involved	Timber, grass, understory

Outlook

Planned Actions	
	Monitor and patrol firelines

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InciWeb - Incident Information System

Wallow

This incident is no longer being updated.

INCIDENT UPDATED 7/21/2011

Approximate Location

33.602 latitude, -109.449 longitude

Incident Overview

Final Wallow Fire Update Day 35 July 4, 2011

Since the Wallow fire started on May 29, 2011 the fire suppression and repair activities have been managed by a series of fire teams from throughout the United States. Due to the great work these teams and all of the other resources assigned to the fire have done, the fire was previously turned back to the White Mountain Apache Tribe and will be turned back to the Apache- Sitgreaves National Forest on July 5, 2011 to continue patrolling, mopping up and repairing areas of the fire damaged by fire suppression activities. For further information contact:

- Apache-Sitgreaves National Forest at 928-333-6263 or go to their web site at http://tinyurl.com/6fzvyax.

- White Mountain Apache Tribe at 928-338 2502 or go to their web site at http://www.wmat.us.

Giving the management responsibilities back to the forests does not mean the fire is completely out. Smoke may continue to be visible from interior fuels burning until a season ending rain event occurs.

Today both Burned Area Emergency Response (BAER) crews and fire crews continue to remove woody debris from the East and West forks of the Little Colorado River. Hazard tree removal continues on FR 81 in Auger Canyon, which was severely burned. "Feller-buncher" machinery and saw teams are removing dead trees that could fall across the road. The trees are placed in piles for removal at a later time.

High pressure over the area will continue to feed moisture into the region. Moisture is moving over southern Apache and Navajo counties and will have the best chance for thunderstorm activity. These thunderstorms may create localized flash flooding particularly within or adjacent to the burn area. Take appropriate precautions if a thunderstorm occurs in your vicinity. Today's temperatures will range from 76-85 degrees with 4-8 mph southwest wind. Relative humidity will be near 20%. There is a 50% chance of showers and thunderstorms in the afternoon.

Special Information:

- Fourth of July fireworks at Sunrise Ski Area and Resort are cancelled.
- Though the sale of ground and hand-held fireworks and their use in some locations is now legal in Arizona, please remember, fireworks are not permitted on public lands at any time.
- The July 4th weekend is upon us and besides the hazards presented by elk and other wildlife on the roads and highways be aware of heavy holiday traffic in the area. Watch your speed and drive defensively. Remember that the Apache-Sitgreaves National Forest is asking that speed be held down to a maximum of 50 mph during dusk to dawn and at night.
- An Individual Assistance Service Center (IASC) is available for all evacuated Arizonans to access information to assist in their personal recovery from the fire. It is located at the Round Valley Public Library, 179 S Main, Eagar, Ariz. The hours of operation are: Tuesday through Thursday, July 5-7th 10 a.m.- 4 p.m. and July 8th, 10 a.m. - 2 p.m. The facility will be closed Monday, July 4th.

Fire Facts:

Location: - Apache, Navajo, Graham, and Greenlee, Counties, Arizona; Catron County, New Mexico Fort Apache Indian Reservation,

San Carlos Apache Indian Reservation

Date Started:

05/29/2011

Cause: Human - under investigation

Size: 538,049 acres total; 15,407 acres in N.M. Percent Contained: 95%

Total Personnel: 579

Includes: 8 handcrews Injuries to Date: 16 Resources: 2 Helicopter;

26 Engines; 10 Water Tenders; 9 Dozers

Residences: 32 destroyed; 5 damaged Commercial Property: 4 destroyed Outbuildings: 36 destroyed; 1 damaged

Vehicles: 1 destroyed

Road Closures - Due to heavy fire suppression and repair activities the following roads are closed to the public:

- US 191 (the Coronado Trail) is closed between Alpine to north of Clifton (milepost 176-253).
- SR 261 (to Big Lake) and SR 273 (between Big Lake and Reservation Lake), remain closed.
- Forest Road 281 is closed two miles south of its junction with US 180 but is open beyond this point to residences only.

Closures and Restrictions:

- All Forest Service and private commercial facilities inside the road closures are not available to the public.
- **San Carlos Apache Indian Reservation**: Fire Restrictions and area closures remain in effect.
- **Apache-Sitgreaves National Forests** Closures and Open Areas. Due to continued fire activity and the unprecedented levels of dry forest fuel along with dry weather, conditions exist for extreme fire danger necessitating closure of most of the Apache-Sitgreaves National Forest. Please go to the following web site for the most complete information: http://tinyurl.com/6yflpfu.
- For information on closures and restrictions for all public lands in Arizona go to the Public Lands Information Center web site at http://www.publiclands.org/firenews/AZ.php or call their hotline at (877) 864-6985.
- **Gila National Forest:** A closure is in effect for the western portion of the Gila National Forest. Call (575) 388-8201, TTY (575) 388-8497 or see http://www.fs.usda.gov/gila.
- **Fort Apache Indian Reservation:** Partial area closures are in effect for the eastside of the Fort Apache Indian Reservation. See http://www.wmat.nsn.us/.

Public Safety: Please be aware that flooding is likely in those areas adjacent to high severity burned areas. This may affect many of the same people who evacuated their homes in the early days of the Wallow Fire. There is concern about roads, bridges, and culverts holding up through flooding events. It is important to be alert and keep informed on what you can do to protect your homes and property. While private land issues are within the County's purview, here are some links that could be helpful to begin preparations:

- NOAA National Weather Service: http://tinyurl.com/29fnj35 - for monitoring for flooding predictions and sign up to get

- e-mail alerts
- County emergency information: http://593info.org - this web site is applicable for southern Apache and Navajo Counties.
- For county specific information go the following web sites: http://www.co.apache.az.us/ (Apache Co., Ariz.), http://www.co.greenlee.az.us/ (Greenlee Co., Ariz.), and https://mylocalgov.com/catroncountynm/ (Catron Co., N.Mex.)
- Occupational Health and Safety Administration: http://tinyurl.com/3uuxu3h - information on how to fill, and carry sandbags in a safe manner.
- Information on flood property protection: http://tinyurl.com/6hfues3
- A Crisis Intervention Line (928) 333-2683 is available for residents suffering from the stress of living with fire danger.
- For more safety information see: http://tinyurl.com/6zvcrck.
- Apache County and local fire departments have begun identifying locations for staging of sandbags in anticipation of the monsoon season. More information will be provided as locations are confirmed.
- Information and assistance for damaged homes and small businesses can be accessed at this link: http://tinyurl.com/6a94bk5.

Basic Information

Current as of	Monday, March 03, 2014 2:11:58 PM
Incident Type	Wildfire
Cause	Under Investigation
Date of Origin	Sunday May 29th, 2011 approx. 01:30 PM
Location	Eastern AZ near Alpine, Nutrioso, and Springerville
Incident Commander	Area Comm Bill Waterbury

Current Situation

Total Personnel	579
Size	538,049 Acres
Percent of Perimeter Contained	100%
Fuels Involved	10 Timber and Grass (litter and understory)
Significant Events	Mop-up, patrols and supressions repair efforts continue as does removal of excess equipment and supplies from the firelines, The fire area was patrolled by air resources

Outlook

Planned Actions	Patrol, mop up, back haul equipment and continue suppression repair activities. Significant rain fell in some areas of the fire
Projected Incident	Low
Remarks	Hwy 191 remains closed from Alpine mile marker 176 to north of Clifton mile marker 253. Forest Road 281, two miles south of US 180, is open to residences only. Due to extremely steep and inaccessible terrain, the portion of the fireline from Hwy 281 to Red Hill Road will be left open however suppression objectives of the fire will be met. This area has rocky steep terrain, is inaccessible, and not safe to fire fighters on the ground.

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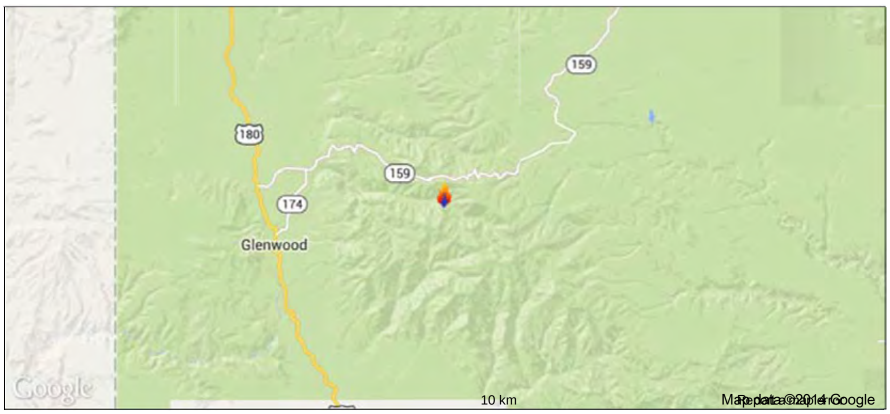
Whitewater Baldy Complex

This incident is no longer being updated.

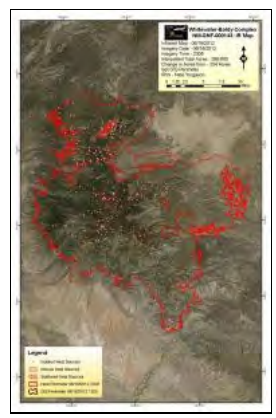
INCIDENT UPDATED 10/4/2012

Approximate Location

33.345 latitude, -108.71 longitude



Incident Overview



As the burned area rehabilitation for the Whitewater-Baldy fire comes to an end, Forest officials, in cooperation with the New Mexico Department of Game and Fish, have lifted the area closure for most of the fire area. Public safety remains a high priority and selected trails will remain closed until a thorough assessment of trail conditions can be completed.

AREA DESCRIBED: Campgrounds and Facilities closed: • Gilita Campground • Ben Lilly Campground • Willow Creek Campground and Trailhead • Gilita Campground Road (FR 28E) • o parking or overnight camping is authorized on either side of Catron County Road CAT-C073, (formerly known as FR 507), on Forest System Lands

Trails closed: • West Fork Corral Trail (FT 814) is closed

• West Fork Tmil (FT 151) is closed from Willow Creek Trailhead to the junction with Forest Trail 30

• Whitewater Baldy Trail (FT 172) is closed from the junction with West Fork Trail (FT 151) west to the junction with the Crest Trail (FT 182)

• Mogollon Baldy Trail (FT 152) is closed from the junction with Crest Trail (FT 182) to the junction with Gobbler Canyon Trail (FT 221)

- Gobble Canyon Trail (FT 221) is closed from the junction with Mogollon Baldy Trail (FT 152) to the junction with Mogollon Trail (FT 153)
- Crest Trail (FT 182) is closed
- Redstone Trail (FT 206) is closed
- Deloche Trail (FT 179) is closed • Whitewater Creek Trail (FT207 is closed from the Wilderness Boundary to the junction with FT182 at Hummingbird Saddle

South Fork Whitewater Trail (FT 212 is closed from the Wilderness Boundacy to the junction with FT 181 at Camp Creek Saddle

- East Fork Whitewater Trail (FT213) is closed
- Little Whitewater Creek Trail (FT 214) is closed
- Holt Gulch Trail (FT 217) is closed
- Straight Up Trail (FT215) is closed
- Holt Apache Trail (FT 181) is closed
- North Fork Big Dry Creek Trail (FT 225) is closed
- Little Dry Creek Trail (FT 180) is closed
- Rain Creek 74 Mountain Trail (FT 189) is closed from the Rain Creek trailhead north and east to the junction with Mogollon Trail (FT153)
- West Fork Mogollon Trail (FT 224) is closed
- Golden Link Trail (FT 218) is closed
- Grouse Mountain Trail (FT 781) is closed
- Bead Spring Trail (FT 138) is closed
- Gilita/Middle Fork Trail (FT 157) from the trailhead near Willow Creek, easterly to the Middle Fork Gila River, just below Snow Lake is closed
- Mogollon Creek Trail FT 153 is closed from Trail Canyon westerly to the junction with Rain Creek Trail FT 189
- Turkeyfeather Mtn. Trail FT 102 is closed

Portions of the Catwalk Recreation Trail will reopen on 10/6/2012. For more information visit www.fs.usda.gov/gila/

Basic Information

Current as of	Thursday, May 23, 2013 8:50:46 AM
Incident Type	Wildfire
Cause	Lightning
Date of Origin	Wednesday May 16th, 2012 approx. 10:25 AM
Location	East of Glenwood, New Mexico

Current Situation

Size	297,845 Acres
Percent of Perimeter	100%
Fuels Involved	10 Timber (litter and understory) Mixed Conifer, Ponderosa Pine, Pinyon/Juniper and Grass fuels are within the fire perimeter along with heavy concentrations of down and dead fuels.
Significant Events	Inactive

Outlook

Planned Actions	Monitor
Projected Incident	Low

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