
WATER QUALITY SURVEY SUMMARY
FOR THE
GILA & SAN FRANCISCO RIVER
AND SELECT TRIBUTARIES
2007



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PRINCIPAL INVESTIGATORS

Survey Leads

Water Chemistry:	Scott Hopkins
Biology/Habitat:	Gary Schiffmiller
Watershed Protection:	Dave Menzie
TMDLs:	Shelly Lemon
GIS/Mapping	Bill Skinner

Surface Water Quality Bureau Office: (505) 827-0187

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Cover Photo: USGS Gage 09341500: Gila River near Redrock, New Mexico

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LIST OF ACRONYMS

AP	Assessment Protocol
C	Celsius
cfs	cubic feet per second
CWA	Clean Water Act
DO	Dissolved Oxygen
GIS	Geographic Information Systems
MAS	Monitoring and Assessment Section
NMAC	New Mexico Administrative Code
NMED	New Mexico Environment Department
QAPP	Quality Assurance Project Plan
STORET	EPA's Storage and Retrieval System
SWQB	Surface Water Quality Bureau
TMDL	Total Maximum Daily Load
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
WPS	Watershed Protection Section
WQS	Water Quality Standards

EXECUTIVE SUMMARY

The Monitoring and Assessment Section ([MAS](#)) of the Surface Water Quality Bureau ([SWQB](#)) of the New Mexico Environment Department conducted a water quality survey of the Gila and San Francisco River Watersheds between March and October 2007. This survey focused on the mainstem of the Gila and San Francisco Rivers as well as several tributary streams including the East, Middle and West Forks of the Gila River, Blue Creek, Mangas Creek and Sapillo Creek ([Figures 1 & 2](#); [Table 1](#)). Water quality sampling methods were in accordance with the *Quality Assurance Project Plan for Water Quality Management Programs* ([NMED/SWQB 2007a](#)).

The primary purpose of this survey was to collect chemical, physical, and biological data to evaluate water quality within the watershed. The data collected are assessed against New Mexico Water Quality Standards ([WQS](#); [NMAC 2007](#)) and any impaired waters are summarized in the Integrated List portion of the biennial *State of New Mexico Integrated Clean Water Act §303(d)/305(b) Report* ([NMED/SWQB 2010](#)). It is important to note that both the assessment protocols and water quality standards are revised periodically to incorporate new information and refinements. Any assessment conclusions presented in this report are based on water quality standards and assessment protocols that existed at the time the report was developed. The U.S. Environmental Protection Agency ([USEPA](#)) uses the most recent state-developed assessment protocols and the most recent USEPA-approved water quality standards when deciding whether or not to approve impairment determinations on the biennial *New Mexico Integrated List of Impaired Waters* ([NMED/SWQB 2010](#)). Therefore, the current impairment conclusions in the Integrated List supersede assessment conclusions in this survey report if they should differ.

Water chemistry sampling occurred at 13 survey stations which were selected based on previous survey findings and proximity to potential sources. Chemical analyses included total nutrients, total and dissolved metals, major anions and cations, radionuclides, and microbiological collections. Data loggers were deployed at select stations to monitor diurnal trends in temperature, pH, and dissolved oxygen. Additional data on the physical habitat and biological communities were collected for this survey. Two qualitative assessments were performed to provide general information on the health of the habitat and structure of the stream: the Rapid Geomorphic Assessment ([Simon 1989](#)) and the Rapid Habitat Assessment ([Peck, et. al 2006](#)). These observational assessments combined with the quantitative canopy measurements provide an indication of riparian health.

Biological surveys collected benthic macroinvertebrate, periphyton, and fish community data. The macroinvertebrate community is generally the first to show a response to certain stressors such as the fine sediment suspended in the water column or settled on the bottom of the channel. Currently information is compiled on all identified species to create a stream condition index score (SCI) which expresses the amount of stress a macroinvertebrate community is encountering based on the diversity of species and the stress tolerance and feeding habitats of those taxa present in the stream reach. Macroinvertebrate data were assessed at 5 study sites as well as 3 reference sites; 2 study sites rated good and the other 3 study sites rated fair (refer to [Benthic-Macroinvertebrate Bioassessments](#) bullet on p. 6 for more information).

Water quality in the **Gila River and San Francisco watersheds** was found to be generally good. Primary findings of the surface water quality assessment are as follows:

- **Aluminum:** Available data from the East Fork Gila and Middle Fork Gila exceed the chronic aquatic life criterion of 87 µg/L.
- **Nutrients:** Assessment of available data indicate nutrient enrichment in Mangas Creek and the Gila River between Mangas Creek and Red Rock.
- **Temperature:** Available data indicate that temperature impairments are widespread throughout the Gila and San Francisco watersheds, although some of these impairments may be an artifact of improper aquatic life use designation and/or inappropriate water quality criteria. Stream reaches listed for temperature impairment include the mainstem of the Gila River, Middle Fork Gila, West Fork Gila from Cliff Dweller Canyon to headwaters, Mangas Creek, and San Francisco River from Centerfire Creek to the Arizona border.
- **Turbidity:** Current water quality data exceed the historic, segment specific criterion of 10 NTU in the Middle Fork Gila. Benthic macroinvertebrate data were not available to confirm the turbidity listing, but will hopefully be collected during the next scheduled water quality survey in 2012.
- **Benthic-Macroinvertebrate Bioassessments (Streams):** Based on macroinvertebrate sampling, the East Fork Gila, San Francisco River from Dry Creek to Whitewater Creek, and San Francisco River from Centerfire Creek to the Arizona border were found to have a biological assessment score signifying impaired conditions.

Water quality sampling in Sapillo Creek (Gila River to Lake Roberts) and San Francisco River (Dry Creek to Whitewater Creek) found no exceedences of applicable water quality criteria.

NMED collected **fish community** data in Sapillo Creek, East Fork Gila, and the San Francisco River. In Sapillo Creek, non-native species were far more abundant (85%) than native (15%). Most of the fish captured were cool water species (63%), followed by warm water species (31%), with relatively few cold water fish (6%) present.

In the East Fork Gila, native, cool water species were far more abundant (74%) than non-native, warm water species (23%). This stream (along with Sapillo Creek) is currently designated as a high quality cold water aquatic life use with a 32.2°C temperature criterion. These designations and criteria require revision.

In the San Francisco River (downstream of Glenwood), non-native, warm water species were far more abundant (91%) than native, cool water species (9%). Loach minnow (*Tiaroga cobitis*), a federally and State listed as a threatened species, was present, but not abundant. In the San Francisco River (upstream of Luna), native species were far more abundant (87%) than non-native (13%), with warm water species (73%) being numerically dominant to cool water species (27%).

1.0 INTRODUCTION

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. In 2007, surface water quality monitoring stations were selected to characterize water quality in the greater Gila River Basin of New Mexico. This includes the main stem of the Gila River from its headwaters to the New Mexico–Arizona border and the portion of the main stem of the San Francisco River occurring within New Mexico. Major tributaries to the Gila River include the East, Middle, and West forks of the Gila River, Sapillo Creek, Mogollon Creek, Duck Creek, Bear Creek, Mangas Creek, and Blue Creek. The San Francisco River is also 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.

Numerous species within this watershed are listed as either threatened or endangered by both State and Federal agencies. Federally listed threatened species of particular interest due to reliance on aquatic and riparian habitat in the watershed include the Gila trout, spikedace, loach minnow, Chiricahua leopard frog, and southwestern willow flycatcher (http://nhnm.unm.edu/query_bcd/bcd_watershed_query.php5).

1.1 Geography and Geology

The Gila River watershed contains approximately 8,288 square kilometers (3,200 square miles) at the furthest downstream gage within New Mexico (Gila below Blue Creek near Virden). The San Francisco River watershed contains approximately 4273 square kilometers (1,650 square miles) of watershed at the furthest downstream gage within New Mexico (San Francisco River near Glenwood). The greater Gila River watershed including the San Francisco River is located in Catron, Grant, and Hidalgo Counties (US Geological Survey Hydrologic Unit Codes 15040001, 15040002 and 15040004). Land management in the Gila River watershed is approximately: 56% US Forest Service, 15% US Bureau of Land Management, 7% State of NM, 21% private lands, and <1% National Park Service ([Figure 1](#)). Land management in the San Francisco River watershed is approximately 92% US Forest Service, <1% US Bureau of Land Management, <1% State of NM, and 7% private lands ([Figure 2](#)).

The Gila River watershed reaches its highest elevation of approximately 3,320 meters (10,892 feet) at Whitewater Baldy in the sub-watersheds of the West Fork and Middle Forks. The lowest elevation of approximately 1,131 meters (3,710 feet) is reached at the NM-AZ border. Average rainfall in the greater Gila River basin varies between less than 203 millimeters (8 inches) per year in the lower Basin and Range section of the watershed to more than 635 millimeters (25 inches) per year in the higher elevations. Approximately one half of the annual precipitation falls during the summer monsoon (thunderstorm) season from early July through mid-September. Summer precipitation from thunderstorms is derived from a seasonal shift in wind direction allowing a moist flow of air to enter New Mexico from the south. Winter precipitation as rain or snow from December through April is mostly derived from low-pressure storm systems originating in the Pacific or, on rare occasions, the Gulf of California.

Most of the greater Gila River watershed occurs within the southeast portion of the Transition Zone Physiographic Province ([Figures 3 & 4](#)). The Transition Zone is a vast area of Tertiary

extrusive and intrusive volcanic rocks which form a transition between relatively un-deformed Paleozoic and Mesozoic sediments that dominate in the Colorado Plateau Physiographic Province to the north and the Tertiary alluvial fill sediments that dominate the landscape in the tectonically active Basin and Range Physiographic Province south of the Transition Zone. Lower elevation areas in the southern part of the watershed are located within the Basin and Range Physiographic Province.

The greater Gila River watershed in the Transition Zone is dominated by Tertiary extrusive and intrusive volcanic rocks. Large volumes of rhyolite and ash flow tuff originating from the Bursum and Cliff Dwellings caldrons cover much of the landscape. Minor vents, flows, and domes also produced dacitic, andesitic, and basaltic rocks. The dominance of these types of alumino-silicate rocks is the most likely source of existing dissolved chronic aluminum exceedences of State water quality standards and the subsequent Total Maximum Daily Loads for chronic aluminum for Whitewater Creek, Mogollon Creek, Taylor Creek, and the East Fork of the Gila River. Tertiary and Quaternary valley fill, pediment gravels, talus, and alluvial deposits cover some areas of the widespread volcanic rock in the Transition Zone. Those parts of the Gila River watershed in the Transition Zone include most of the perennial surface waters. In the Basin and Range section of the greater Gila River basin, younger Tertiary and Quaternary deposits of sand, gravel, and conglomerate fill the basins. Some younger basaltic flows are interbedded in the basin-fill deposits and volcanic rocks also form the ranges adjacent to the basins.

The region's active and complex geology produced numerous economically valuable metal deposits. There are three significant mining districts in the greater Gila River basin. The Mogollon Mining District is located in the sub-watersheds of Mineral Creek and Silver Creek which are tributaries to the San Francisco River. The Tyrone and Steeple Rock Mining Districts are located in the sub-watersheds of Mangas Creek and Carlisle Creek which are tributaries to the Gila River. Although mining activity in all three districts is less than it was in the past, the Tyrone mine is still actively producing copper and new exploration is ongoing in the greater Gila River watershed.



Photo 1. Gila River
below the East Fork

Gila River 2007 Survey Stations

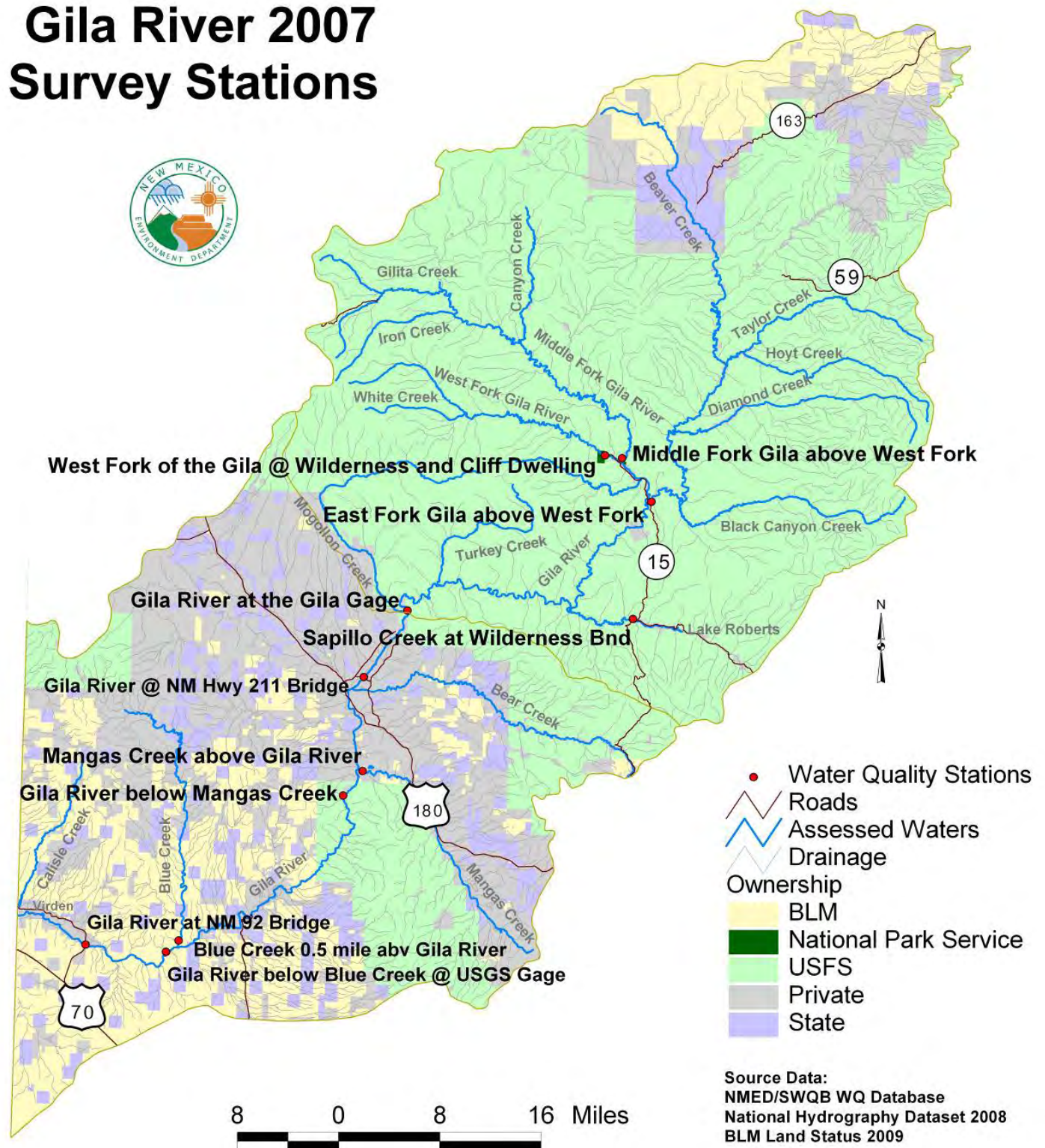


Figure 1. Gila River watershed stations and land ownership information



Figure 2. San Francisco River watershed stations and land ownership information

Gila River Surface Geology

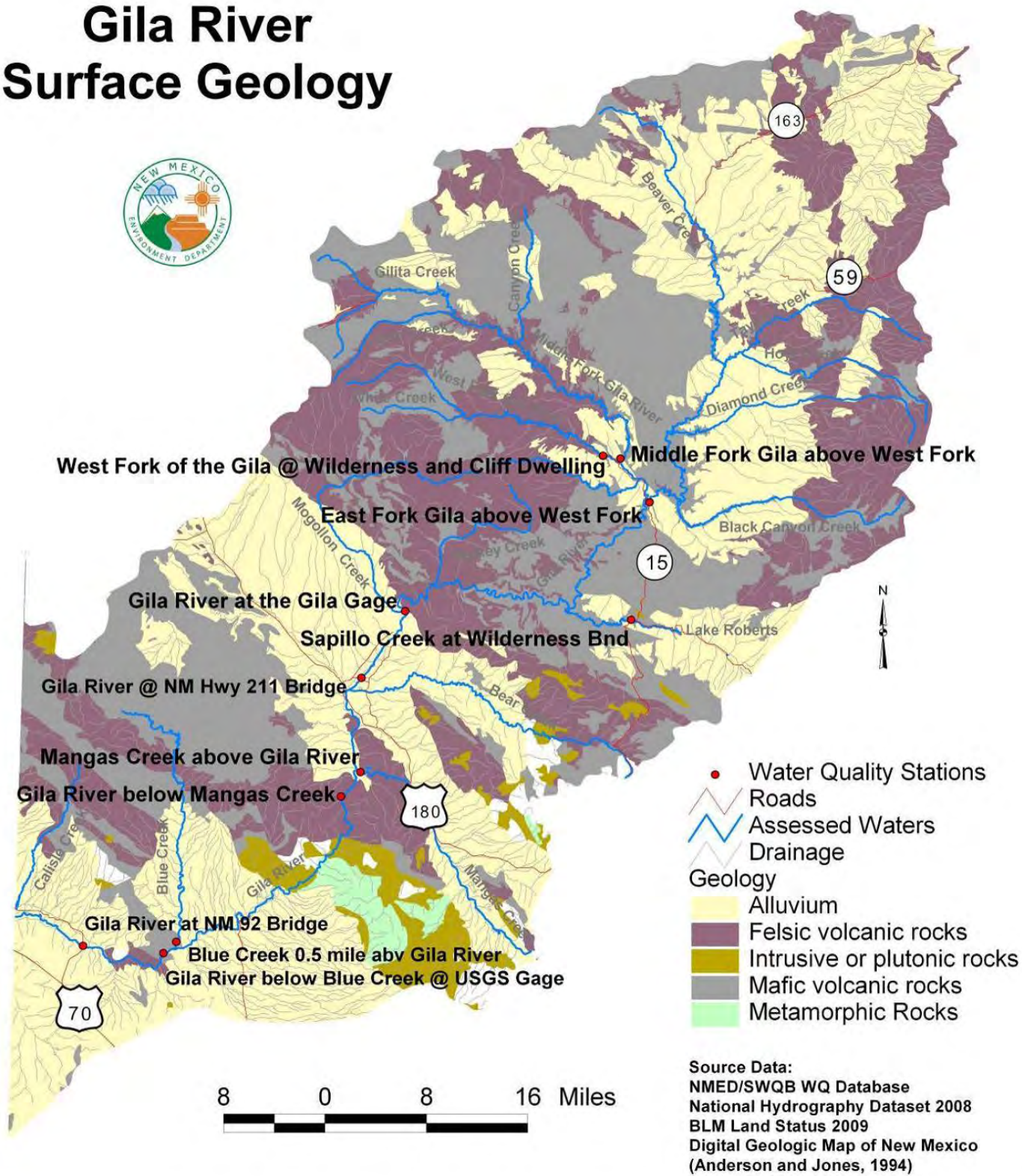


Figure 3. Gila Watershed Geology

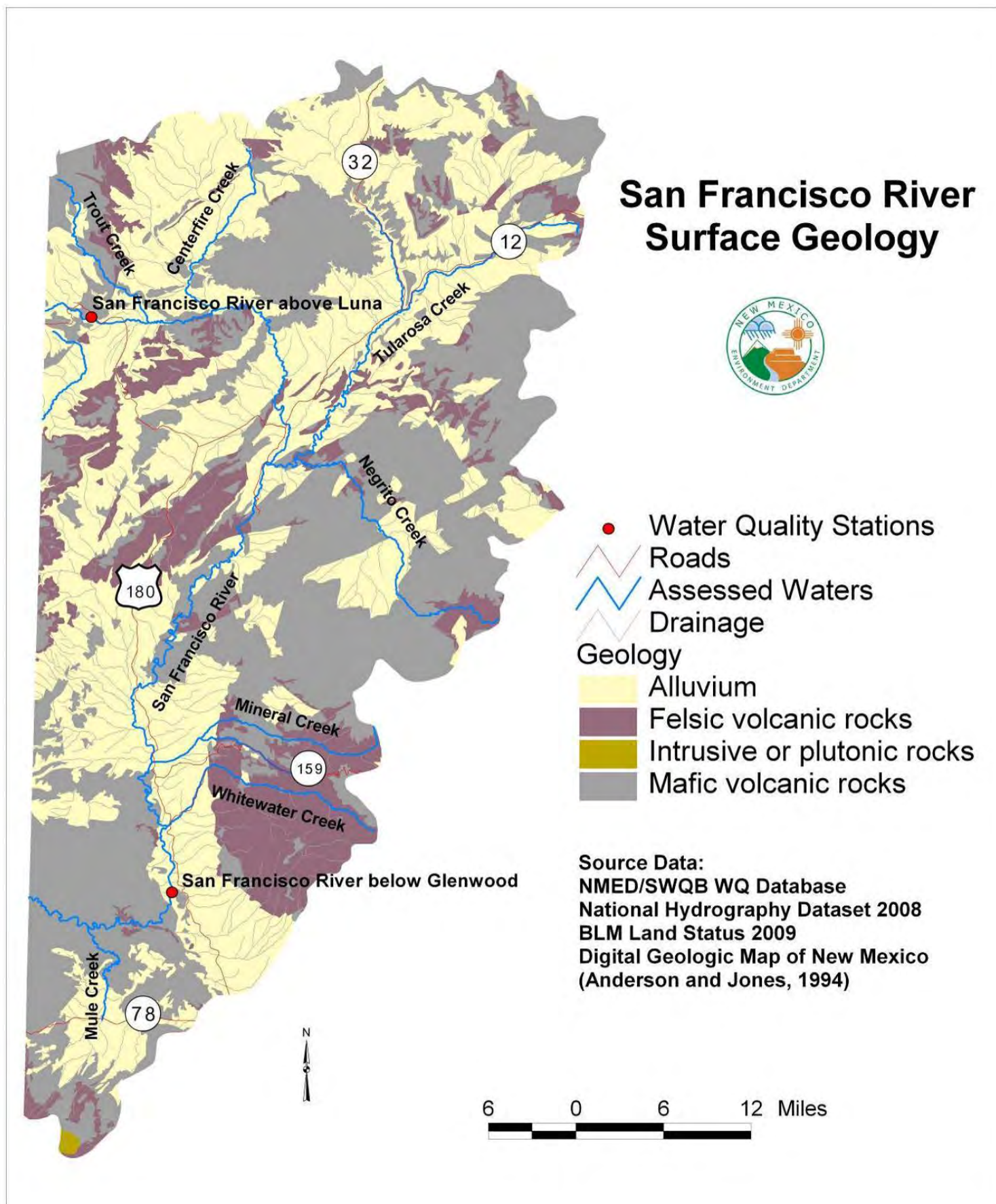


Figure 4. San Francisco Watershed Geology



Photo 2. San Francisco River looking downstream about 4 miles south of the Village of Reserve.

2.0 NEW MEXICO WATER QUALITY STANDARDS

The water quality standards for the Gila and San Francisco watersheds fall within segments 20.6.4.501, 20.6.4.502, 20.6.4.503, 20.6.4.601 and 20.6.4.602 NMAC ([NMAC 2007](#)). The use specific numeric criteria in 20.6.4.900 apply to all waters in the State. In addition the narrative standards water quality found in 20.6.4.13 apply to all waters in the State. For these segments, the WQS state:

20.6.4.501 GILA RIVER BASIN - The main stem of the Gila river from the New Mexico-Arizona line upstream to Redrock canyon and perennial reaches of streams in Hidalgo county.

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

B. Criteria:

(1) In any single sample: pH within the range of 6.6 to 9.0 and temperature 32.2°C (90°F) or less. The use-specific numeric criteria set forth in 20.6.4.900 NMAC are applicable to the designated uses listed above in Subsection A of this section.

(2) The monthly geometric mean of E. coli bacteria 126 cfu/100 mL or less; single sample 410 cfu/100 mL or less (see Subsection B of 20.6.4.14 NMAC).

[20.6.4.501 NMAC - Rp 20 NMAC 6.1.2501, 10-12-00; A, 05-23-05]

20.6.4.502 GILA RIVER BASIN - The main stem of the Gila river from Redrock canyon upstream to the confluence of the West Fork Gila river and East Fork Gila river and perennial reaches of tributaries to the Gila river below Mogollon creek.

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

B. Criteria:

(1) In any single sample: pH within the range of 6.6 to 9.0 and temperature 28°C (82.4°F) or less. The use-specific numeric criteria set forth in 20.6.4.900 NMAC are applicable to the designated uses listed above in Subsection A of this section.

(2) The monthly geometric mean of E. coli bacteria 126 cfu/100 mL or less; single sample 410 cfu/100 mL or less (see Subsection B of 20.6.4.14 NMAC).

[20.6.4.502 NMAC - Rp 20 NMAC 6.1.2502, 10-12-00; A, 05-23-05]

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 secondary contact.

B. Criteria:

(1) In any single sample: specific conductance 300 µmhos/cm or less for the main stem of the Gila river above Gila hot springs and 400 µmhos or less for other reaches, pH within the range of 6.6 to 8.8 and temperature 20°C (68°F) or less except 32.2°C (90°F) or less in the east fork of the Gila river and Sapillo creek below lake Roberts. The use-specific numeric criteria set forth in 20.6.4.900 NMAC are applicable to the designated uses listed above in Subsection A of this section. 20.6.4 NMAC 33

(2) The monthly geometric mean of E. coli bacteria 126 cfu/100 mL or less; single sample 235 cfu/100 mL or less (see Subsection B of 20.6.4.14 NMAC).

[20.6.4.503 NMAC - Rp 20 NMAC 6.1.2503, 10-12-00; A, 05-23-05]

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 secondary contact.

B. Criteria:

(1) In any single sample: pH within the range of 6.6 to 9.0 and temperature 32.2°C (90°F) or less. The use-specific numeric criteria set forth in 20.6.4.900 NMAC are applicable to the designated uses listed above in Subsection A of this section.

(2) The monthly geometric mean of E. coli bacteria 126 cfu/100 mL or less; single sample 410 cfu/100 mL or less (see Subsection B of 20.6.4.14 NMAC).

[20.6.4.601 NMAC - Rp 20 NMAC 6.1.2601, 10-12-00; A, 05-23-05]

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:

(1) In any single sample: pH within the range of 6.6 to 8.8 and temperature 25°C (77°F) or less. The use-specific numeric criteria set forth in 20.6.4.900 NMAC are applicable to the designated uses listed above in Subsection A of this section.

(2) The monthly geometric mean of E. coli bacteria 126 cfu/100 mL or less; single sample 410 cfu/100 mL or less (see Subsection B of 20.6.4.14 NMAC).

[20.6.4.602 NMAC - Rp 20 NMAC 6.1.2602, 10-12-00; A, 05-23-05]

3.0 METHODS

All biological, chemical, and geomorphological data were collected in accordance with the procedures set forth in the *SWQB Quality Assurance Project Plan* ([NMED/SWQB 2007a](#)) and the *SWQB Standard Operating Procedures for Data Collection* ([NMED/SWQB 2007b](#)). The data collected as part of this study were later combined with all other readily available or submitted data that meet state quality assurance/quality control requirements to form the basis of designated use attainment determinations. These data were assessed in accordance with protocols established in the *State of New Mexico Procedures for Assessing Standards Attainment for the Integrated §303(d)/§305(b) Water Quality Monitoring and Assessment Report [Assessment Protocols]* ([NMED/SWQB 2009](#)).

4.0 SAMPLING SUMMARY

The Monitoring and Assessment Section (MAS) of the Surface Water Quality Bureau (SWQB) conducted a water quality survey of the Gila and San Francisco watersheds between March and October, 2007. This water quality survey included 12 water quality stations ([Figures 1 & 2](#)). The unique station identification codes and sampling rationales are provided in **Table 1**. Sampling station locations are determined by the project team based on a targeted monitoring approach. All existing or potential point or nonpoint source pollution sources along the stream are determined through the use of United States Geological Survey (USGS) topographical maps, retrievals of data from external sources, historical data on file, and information from other agencies and local residents. Existing stations are reviewed to determine their continued relevance. A sampling location is selected to bracket perceived or potential pollution sources, allow access to the waterbody, and represent the assessment unit. Due to limited resources, there typically is only one sampling station within each assessment unit (AU). Since water flows downhill, the sampling station is often located at the bottom of the AU to account for any natural or anthropogenic inputs from the adjacent region. If a USGS gaging station is located in the reach under study, it is routinely selected as one of the sampling stations since long-term flow and water quality data are generally available for these stations.

Table 1. Sampling Stations and Rationales

STATION NAME	STATION ID	SAMPLING RATIONALE
Blue Creek 0.5 mile above Gila River	78BlueCr000.9	Reference site
East Fork Gila above West Fork	77EFkGil000.2	Only station on the East Fork; bottom of the AU
Gila River at NM 211 Bridge	78GilaR087.7	Requested by Gila – San Francisco Settlement Committee
Gila River at NM 92 bridge	78GilaRi011.5	Lowest AU on the Gila in NM; Gila – San Francisco Settlement Agreement
Gila River at the Gila gage	77GilaRi101.4	Near USGS gage
Gila River below Blue Creek at USGS gage	78GilaRi025.5	Reference site
Gila River below Mangas Creek	78GilaRi069.2	Below Mangas Creek
Mangas Creek above Gila River (FR 809)	78Mangas000.7	Bottom of the AU
Middle Fork Gila above West Fork	77MFkGil000.1	Bottom of the AU
Sapillo Creek at Wilderness Boundary	77Sapill012.0	Temperature criterion review
West Fork Gila abv Cliff Dwelling Cyn	77WFkGil010.0	Reference site; Below wilderness area
San Francisco R above Luna	80SanFra154.1	Upstream site; Background condition
San Francisco R blw Glenwood at Hot Springs	80SanFra028.6	Gila Settlement Agreement

Water samples were analyzed for plant nutrients, ions, total and dissolved metals, bacteria, radionuclides, and anthropogenic organic compounds. Parameters such as temperature, dissolved oxygen, pH, turbidity, and specific conductance were measured in the field and are included in the “field data” column. Physical habitat, benthic macroinvertebrate communities, and periphyton were surveyed to determine the impacts of excessive nutrients and settled sediment on aquatic life within a stream. The number of times each parameter (or suite of parameters) was monitored is summarized in **Table 2**. The type and number of samples collected at a given station was based on previous survey findings and proximity to potential sources. Monitoring these sites enabled an assessment of the cumulative influence of the physical habitat, water sources, and land management activities upstream from the sites.

Table 2. SWQB Gila River and San Francisco River sampling summary.

Assessment Unit / Station	Field Data	<i>E. coli</i> bacteria	Ions	Nutrients	Dissolved Metals	Total Metals	Radionuclides	Organics	Discharge	Habitat – EMAP	Fish Community	Macroinvertebrates	Periphyton	Thermograph	Sonde Deployment
Blue Creek (Gila River to headwaters)															
Blue Creek 0.5 mile abv Gila River	4	-	-	-	-	-	-	-	-	X	-	X	X	-	-
East Fork Gila River (Gila River to headwaters)															
East Fork Gila above West Fork	8	4	9	8	8	8	3	-	8	X	X	X	X	X	X
Gila River (Mangas Creek to Mogollon Creek)															
Gila River @ NM Hwy 211 Bridge	8	4	8	8	8	8	3	-	6	X	-	X	X	X	-
Gila River (AZ border to Red Rock)															
Gila River at NM 92 bridge	8	3	8	8	8	8	3	2	6	-	-	-	-	X	-
Gila River below Blue Creek at USGS gage	12	1	12	12	8	8	3	-	2	X	-	X	X	X	-
Gila River (Mogollon Creek to confl East and West Forks)															
Gila River at the Gila Gage	8	4	8	8	8	8	3	-	1	-	-	-	-	X	-
Gila River (Red Rock to Mangas Creek)															
Gila River below Mangas Creek	9	4	9	9	8	8	3	2	1	X	-	X	X	X	-
Mangas Creek (Gila River to Mangas Springs)															
Mangas Creek above Gila River (Forest Road 809)	8	4	8	8	8	8	3	-	8	-	-	-	-	X	-
Middle Fork Gila River (Gila River to headwaters)															
Middle Fork Gila above West Fork	8	4	8	8	8	8	3	-	8	-	-	-	-	X	-
Sapillo Creek (Gila River to Lake Roberts)															
Sapillo Creek at Wilderness Boundary	7	3	7	7	7	7	3	-	7	-	X	-	-	X	-
Sapillo Creek below Lake Roberts	3	-	-	-	-	-	-	-	-	-	-	-	-	X	-
West Fork Gila R (Cliff Dweller Cyn to headwaters)															
West Fork Gila abv Cliff Dwelling Cyn	11	4	11	11	8	8	3	-	8	X	-	X	X	X	X
San Francisco River (Centerfire Creek to AZ border)															

Assessment Unit / Station	Field Data	<i>E. coli</i> bacteria	Ions	Nutrients	Dissolved Metals	Total Metals	Radionuclides	Organics	Discharge	Habitat – EMAP	Fish Community	Macroinvertebrates	Periphyton	Thermograph	Sonde Deployment
San Francisco River above Luna	8	3	8	8	8	8	3	-	8	X	X	X	X	X	X
San Francisco River (Dry Creek to Whitewater Creek)															
San Francisco River below Glenwood at Hot Springs	8	3	8	8	8	8	3	-	2	X	X	X	X	X	X

5.0 WATER QUALITY IMPAIRMENTS

For many water quality analytes, the State of New Mexico maintains numeric water quality standards, whereas standards for other parameters such as plant nutrients and stream bottom deposits are narrative. Data are assessed for designated use attainment status for both numeric and narrative water quality standards by application of the *State of New Mexico Procedures for Assessing Standards Attainment for the Integrated §303(d)/§305(b) Water Quality Monitoring and Assessment Report [Assessment Protocols]* ([NMED/SWQB 2009](#)). When available, outside sources of data that meet quality assurance requirements are combined with data collected by SWQB during the watershed survey to determine final impairment status. Final designated use impairment status is housed in the Assessment Database (ADB) and is reported in the biennial *State of New Mexico CWA §303(d)/§305(b) Integrated Report* ([NMED/SWQB 2010](#)).

5.1 Water Quality Impairments For Numeric Criteria

5.1.1 Physicochemical Data

Water samples were analyzed for major ions, total and dissolved metals, bacteria, radionuclides, and anthropogenic organic compounds. Parameters such as dissolved oxygen (DO), pH, turbidity, and specific conductance were measured in the field. Results from the water quality data assessment indicated designated use impairments due to chronic aluminum and turbidity. [Table 3](#) provides a summary of the physicochemical assessment conclusions. A complete dataset can be obtained by contacting the SWQB.

Table 3. Summary of Physicochemical Assessment Conclusions

Assessment Unit / Station	Aluminum	Turbidity
Blue Creek (Gila River to headwaters)		
Blue Creek 0.5 mile abv Gila River		
East Fork Gila River (Gila River to headwaters)		
East Fork Gila above West Fork	NS	FS
Gila River (Mangas Creek to Mogollon Creek)		
Gila River @ NM Hwy 211 Bridge	FS	
Gila River (AZ border to Red Rock)		
Gila River at NM 92 bridge	FS	
Gila River below Blue Creek at USGS gage	FS	
Gila River (Mogollon Creek to confl East and West Forks)		
Gila River at the Gila Gage	FS	
Gila River (Red Rock to Mangas Creek)		
Gila River below Mangas Creek	FS	
Mangas Creek (Gila River to Mangas Springs)		
Mangas Creek above Gila River (Forest Road 809)	FS	
Middle Fork Gila River (Gila River to headwaters)		
Middle Fork Gila above West Fork	NS	NS*
Sapillo Creek (Gila River to Lake Roberts)		
Sapillo Creek at Wilderness Boundary	FS	FS
Sapillo Creek below Lake Roberts		FS
West Fork Gila R (Cliff Dweller Cyn to headwaters)		
West Fork Gila abv Cliff Dwelling Cyn	FS	FS
San Francisco River (Centerfire Creek to AZ border)		
San Francisco River above Luna	FS	
San Francisco River (Dry Creek to Whitewater Creek)		
San Francisco River below Glenwood at Hot Springs	FS	

NOTES:

If a cell is blank for a particular station or AU, it means that parameter was **not assessed** either due to lack of adequate data.

NS = **Not Supporting**; **FS** = Fully Supporting

* Macroinvertebrate data are needed to confirm turbidity impairment.

5.1.2 Data from Continuous Monitoring Devices

Temperature data loggers (thermographs) were deployed at selected stations ([Table 2](#)) within the study area. YSI multi-parameter sondes were also deployed at selected stations ([Table 2](#)) to examine pH and dissolved oxygen (DO). The thermographs and sondes were programmed to record temperature, DO, and/or pH once per hour over their respective collection intervals.

Large datasets generated from data loggers (i.e., sondes and thermographs) are assessed according to protocols developed specifically for such datasets (with few exceptions). This is because, unlike grab sample data, it is unreasonable to list as not supporting on the basis of one or a few exceedences out of several hundred or thousand data points.

Temperature (given in °C) and pH assessment criteria are tied to the criteria in the *State of New Mexico Standards for Interstate and Intrastate Surface Waters* ([NMAC 2007](#)). Dissolved oxygen assessment criteria are linked to the presence of sensitive aquatic organisms, *e.g.* early life stages, and designated use, *e.g.* marginal coldwater aquatic life use. SWQB's *Assessment Protocol* provides details of large dataset assessment procedures ([NMED/SWQB 2009](#)). **Table 4** summarizes the assessment conclusions based on thermograph and sonde data.

Table 4. Summary of Thermograph and Sonde Assessment Conclusions

Assessment Unit	Designated Use	Temperature Criterion (°C)	Temperature Assessment*	pH Criterion (SU)	pH Assessment	DO Criterion (mg/L)	DO Assessment
East Fork Gila River (Gila River to headwaters)	HQCWAL	≤ 32.2	FS	6.6 – 8.8	FS	≥ 6.0	FS
Middle Fork Gila River (Gila River to headwaters)	HQCWAL	≤ 20.0	NS	6.6 – 8.8	no data	≥ 6.0	no data
West Fork Gila River (Cliff Dweller Cyn to headwaters)	HQCWAL	≤ 20.0	NS	6.6 – 8.8	FS	≥ 6.0	FS
Gila River (AZ border to Redrock)	MWWAL	≤ 32.2	NS	6.6 – 9.0	no data	≥ 5.0	no data
Gila River (Redrock to Mangas Creek)	MCWAL	≤ 28.0	NS	6.6 – 9.0	no data	≥ 6.0	no data
Gila River (Mangas Creek to Mogollon Creek)	MCWAL	≤ 28.0	NS	6.6 – 9.0	no data	≥ 6.0	no data
Gila River (Mogollon Creek to confl E and W Forks)	MCWAL	≤ 28.0	NS	6.6 – 9.0	no data	≥ 6.0	no data
Sapillo Creek (Gila River to Lake Roberts)	HQCWAL	≤ 32.2	FS	6.6 – 8.8	no data	≥ 6.0	no data
Mangas Creek (Gila River to Mangas Springs)	MCWAL	≤ 28.0	NS	6.6 – 9.0	no data	≥ 6.0	no data
San Francisco River (Dry Creek to Whitewater Creek)	MWWAL & MCWAL	≤ 32.2	FS	6.6 – 9.0	FS	≥ 6.0	FS
San Francisco River (Centerfire Creek to AZ border)	CWAL	≤ 25.0	NS	6.6 – 8.8	FS	≥ 6.0	FS

NOTES:

NS = **Not Supporting** FS = Fully Supporting

HQCWAL = High quality coldwater aquatic life

MCWAL = Marginal coldwater aquatic life

* A revision of the water quality standards may be warranted.

no data = data not collected

CWAL = Coldwater aquatic life

MWWAL = Marginal warmwater aquatic life

5.2 Water Quality Impairments For Narrative Criteria

5.2.1 Physical Habitat

It is essential to characterize the physical habitat in order to relate stream biological condition to land use impacts and potential anthropogenic disturbances. The physical habitat components most directly impacting aquatic communities are the stream geomorphology (physical structure), the riparian corridor that supports and protects aquatic life, and the composition of the substrate where the aquatic communities live. Streams existing in similar landscapes express similar compositions of these three attributes and can be compared to a reference site within that group. A reference site is a stream reach that has been exposed to the least amount of human disturbance within a certain landscape.

Environmental Monitoring and Assessment Program ([EMAP](#); [Peck et al. 2006](#)) surveys were conducted to collect data for sedimentation/siltation impairment determinations. **Table 5** describes the watershed size, elevation, and ecoregion of each station where an EMAP survey was conducted. These are the minimal data necessary to categorize the sites by landscape, and the reference sites indicated were chosen as the least disturbed by the professional judgment of the Monitoring and Assessment Biology Team.

Table 5. Watershed Characteristics of Reference and Study Sites

Station Name <i>*Italics indicate reference site</i>	Watershed Area in km² (mi²)	Elevation in meters (feet)	Omernick Ecoregion
<i>West Fork Gila at Cliff Dwelling</i>	282 (109)	1740 (5709)	AZ/NM Mountains
East Fork Gila above West Fork Gila	2554 (986)	1692 (5551)	AZ/NM Mountains
Gila River at NM Hwy 211 bridge	5265 (2033)	1374 (4508)	Chihuahuan Desert
Gila River below Mangas Creek	7086 (2736)	1322 (4337)	Chihuahuan Desert
San Francisco R blw Glenwood at hot springs	4281 (1653)	1398 (4587)	Chihuahuan Desert
San Francisco R above Luna	176 (68)	2188 (7178)	AZ/NM Mountains
<i>Blue Creek 0.5 mile abv Gila River</i>	358.7 (138.5)	1208 (3963)	Chihuahuan Desert
<i>Gila River blw Blue Creek at USGS gage</i>	8280 (3197)	1190 (3904)	Chihuahuan Desert

Substrate Composition

The size of sediment within a stream system is one of the most important physical attributes in determining the health of aquatic communities. There are two components to sediment load that impact aquatic life: suspended load and bed load. Suspended load is quantified through the

measurement of turbidity and total suspended solids. Bed load describes the particles that settle to or roll along the bottom (saltation) of the channel. Larger bed load particles provide increased interstitial space between particles, thus allowing for different aquatic communities than those found among small particles with little or no space. The size of sediment within a stream has a natural progression from coarse, large particles in sections at high elevation with smaller watershed size gradually decreasing to sand in low elevation streams with large watersheds. Therefore, to determine whether a stream exhibits an unnaturally fine bed load, knowledge of the location of the stream segment within the watershed is necessary. Particles smaller than 2 millimeters are considered “fines”, and “percent fines” are considered for assessment of New Mexico’s narrative sediment standard (see [20.6.4.13\(A\) NMAC](#)). Percent fines is calculated by adding the % sand and % silt-clay fractions (**Table 6**). Other metrics in **Table 6** describe the size classes found in the reach, the size of the median of the cumulative frequency distribution (D50), and the mean embeddedness, which is how much of the particles were surrounded by fines.

Table 6. Substrate Composition Data from the Gila River and San Francisco River

Station Name <i>*Italics indicate reference site</i>	D50 (mm)	D84 (mm)	% Fines (>2mm)	Mean % Embeddedness
<i>West Fork Gila at Cliff Dwelling</i>	53	121	8%	37%
East Fork Gila above West Fork Gila	65	115	4%	32%
Gila River at NM Hwy 211 bridge	80	130	0%	30%
Gila River below Mangas Creek	34	63	5%	51%
San Francisco R blw Glenwood at hot springs	70	130	14%	28%
San Francisco R above Luna	80	30	17%	31%
<i>Blue Creek 0.5 mile abv Gila River</i>	4	116	43%*	60%
<i>Gila River blw Blue Creek at USGS gage</i>	10	126	36%*	58%

NOTES: * Higher percent fines is expected in this ecoregion and at this elevation.

Geomorphology

Quantitatively identifying the current structure of a stream channel allows for a determination of the amount and variation of habitat available for aquatic communities. A natural, undisturbed stream system maintains equilibrium with the amount of water and sediment that it transports, allowing that system to remain stable. Human impacts may alter the equilibrium of a stream, causing the stream to actively attempt to restore this balance. As the stream attempts to restore equilibrium, it may cause damage to the adjacent riparian habitat or the aquatic communities within the channel. [Table 7](#) provides a comparison of the geomorphic parameters collected at the reference reaches and study reaches during the 2006 and 2007 EMAP surveys.

Riparian Health

The riparian area is the corridor of vegetation surrounding the stream that provides many beneficial functions to the stream channel. Although there are many benefits to a diverse and healthy riparian area, the most direct effects are shade, soil stability, and organic inputs providing food for the aquatic communities. Two qualitative assessments were performed to provide general information on the health of the habitat and structure of the stream: the Rapid Geomorphic Assessment (RGA) and the Rapid Habitat Assessment (RHA). These observational assessments combined with the quantitative canopy measurements (**Table 8**) provide an indication of riparian health.

Table 7. Geomorphic Data for the Gila River and San Francisco River

Station Name <i>*Italics indicate reference site</i>	Slope (%)	Bankfull Width (m)	Bankfull Height (m)	Width-Depth Ratio
<i>West Fork Gila at Cliff Dwelling</i>	1.2	9.8	0.3	33.8
East Fork Gila above West Fork Gila	1.0	13.8	0.3	45.9
Gila River at NM Hwy 211 bridge	<1	25.1	0.6	41.2
Gila River below Mangas Creek	<1	22.2	0.6	35.4
San Francisco R blw Glenwood at hot springs	<1	13.1	0.5	25.2
San Francisco R above Luna	1.7	4.9	0.3	17.4
<i>Blue Creek 0.5 mile abv Gila River</i>	1.0	7.9	0.2	33.0
<i>Gila River blw Blue Creek at USGS gage</i>	< 1	14.4	0.6	23.0

Table 8. Riparian Cover and Qualitative Scores for the Gila River and San Francisco River

Station Name <i>*Italics indicate reference site</i>	Riparian Canopy Cover (% cover)	RGA¹ Stability Score (0-36)	RHA² Habitat Score (0-200)
<i>West Fork Gila at Cliff Dwelling</i>	57%	1	177
East Fork Gila above West Fork Gila	34%	5	164
Gila River at NM Hwy 211 bridge	14%	9	150
Gila River below Mangas Creek	19%	18.5	143
San Francisco R blw Glenwood at hot springs	30%	10	159

Station Name <i>*Italics indicate reference site</i>	Riparian Canopy Cover (% cover)	RGA¹ Stability Score (0-36)	RHA² Habitat Score (0-200)
San Francisco R above Luna	60%	6	159
<i>Blue Creek 0.5 mile abv Gila River</i>	<i>39%</i>	<i>11</i>	<i>133</i>
<i>Gila River blw Blue Creek at USGS gage</i>	<i>51%</i>	<i>8</i>	<i>158</i>

1. The Rapid Geomorphic Assessment is used to identify stable reaches and the destabilizing processes that are active in the reach. A channel stability score is determined by observing a number of channel characteristics and the stage of channel evolution based on the National Sedimentation Lab empirical model ([Simon 1989](#)). **Lower scores indicate a more stable channel.**
2. The Rapid Habitat Assessment ([Barbour, et al. 1999](#)) provides a qualitative aquatic habitat score that is based primarily on observation of the quality and diversity of in stream habitats. **Higher scores indicate better habitat quality.**

5.2.2 Macroinvertebrate Community and Sedimentation Data

Since the narrative standard for stream bottom deposits is dependent on biological condition, the assessment of this physically-based narrative sedimentation criterion should be determined using a biological response variable that will link excess settled sediment levels to designated use attainment. The macroinvertebrate community is generally the first to show a response to certain stressors such as the fine sediment that settles to the bottom of the channel. By collecting data on the macroinvertebrate communities that are present in a stream reach, SWQB can identify changes that indicate stress on the community. Depending on the ecoregion of the study site, this can be done by utilizing either the Rapid Bioassessment Protocol (RBP) or Mountain Stream Condition Index (M-SCI) as described in SWQB's main assessment protocol (NMED/SWQB 2009). The RBP or M-SCI score is a percentage comparison of the sum of selected metric scores derived from the macroinvertebrate communities and used to compare the study site to the selected reference site or reference condition in order to determine the degree of impairment. For example, when the macroinvertebrate community at a study site in ecoregion 23 (AZ/NM Mountains) has an M-SCI score less than 56.70% of the reference condition, it can be concluded that there is stress on that community and it would be deemed impaired (i.e. non-support) ([Table 9](#)).

Table 9. Biological Integrity Attainment Matrix ([Jacobi, et. al 2006](#))

Biological Index Score	Biological Condition Category ¹
> 78.36%	Very Good (Full Support)
78.35 – 56.70%	Good (Full Support)
56.69 – 37.20%	Fair (Non-Support)
37.19 – 18.90%	Poor (Non-Support)
< 18.89%	Very Poor (Non-Support)

1. New Mexico has combined the “very good” and “good” categories into “Full Support,” while the remaining categories define “Non-Support.”

Sedimentation/Siltation Assessment

In order to assess for excess sedimentation, the biological index score and the percent fines in the stream reach are assessed independently for their support of the aquatic life use. Reference sites are currently used to determine the amount of fines appropriate for each stream reach. If a low biological index score coincides with percent fines greater than 20% and this value exceeds a 28% increase from the associated reference site, excess fine sediment is indicated as a cause of impairment. If only the biological index score is low, excess fine sediment is not indicated as a cause of impairment.

Macroinvertebrate and sediment data were assessed at 5 sites. Three out of the five study sites had biological assessment scores in the “fair” range indicating the biological communities in those reaches are stressed. All 3 reaches exhibited low to moderate amounts of fine sediment; 4% fines in the East Fork Gila, 14% in the San Francisco River below Glenwood, and 17% in the San Francisco River above Luna ([Table 10](#)). According to [Appendix D](#) of the [Assessment Protocol](#), raw percent values of $\leq 20\%$ fine sediment at a study site should be evaluated as “Full Support” for sedimentation/siltation. However, because the macroinvertebrate communities scored low at these sites these streams were listed for benthic-macroinvertebrate bioassessments until the exact cause of the biological impairment is determined.

Table 10. Sediment Evaluations for the Gila River and San Francisco River watersheds

Station	Biological Index Score	% Fine Sediment ⁺	Sediment Assessment
East Fork Gila above West Fork Gila	53.37	4%	FS
Gila River at NM Hwy 211 bridge	64.70	0%	FS
Gila River below Mangas Creek	64.88	5%	FS
San Francisco R blw Glenwood at hot springs	55.50	14 %	FS
San Francisco R above Luna	51.37	17%	FS

+ = Raw percent values of $\leq 20\%$ fines at a study site should be evaluated as "Full Support."
 FS = Fully Supporting

5.2.3 Periphyton Community and Nutrient Assessment

The periphyton community is another biological indicator that can express aquatic ecosystem stress in ways that the macroinvertebrate community may not reveal. The use of periphyton community data is still in early stages of development and does not provide conclusive information on stream health at this time. Periphyton is collected in biological surveys for a community composition analysis and for the quantification of chlorophyll *a* for the second level of nutrient assessments. A Level 1 nutrient screen is performed at each survey station to determine if excess nutrients may be an issue for the reach. If necessary, a series of data is collected for the nutrient Level 2 survey to determine impairment status.

Nutrient Level 2 Assessment

Level 2 nutrient surveys were conducted at sites that were previously listed as impaired due to plant nutrients or that the Level 1 nutrient assessment indicated the possibility of nutrient impairment. For more information on this process refer to the *Nutrient Assessment Protocol for Wadeable, Perennial Streams* ([NMED/SWQB 2009](#)). The Level 2 nutrient survey consists of data collection on a number of indicators including total phosphorus, total nitrogen, dissolved oxygen, pH, and periphyton chlorophyll *a* concentration. Chlorophyll *a* is a quantitative measure of algal biomass which is the direct or indirect cause of most problems associated with nutrient impairment. The indicators are compared to the applicable criterion or threshold value to generate an exceedence ratio, or the number of exceedences divided by the total number of times the parameter was measured ([Table 11](#)). For total phosphorus, total nitrogen, and chlorophyll *a*, the threshold values are dependent on the ecoregion and designated aquatic life use.

Table 11. Nutrient Level 2 Assessment Data for Gila River and San Francisco River

Assessment Unit	Ecoregion – Aquatic Life Use	DO & pH – long term datasets	DO %Sat. – grab (# and % of exceedences)	DO conc – grab (# and % of exceedences)	pH – grab (# and % of exceedences)	Total Nitrogen (# and % of exceedences)	Total Phosphorus (# and % of exceedences)	Chlorophyll <i>a</i> exceedence?	Nutrient Assessment
East Fork Gila River (Gila River to headwaters)	AZ/NM Mountains - HCWAL	supports HCWAL	2/8 = 25%	0/8 = 0%	0/8 = 0%	3/8 = 38%	6/8 = 75%	no	FS
Gila River (Redrock to Mangas Creek)	Chihuahuan Desert - MCWAL	no data	3/9 = 33%	0/9 = 0%	1/9 = 11%	2/9 = 22%	8/9 = 89%	no	NS*
Gila River (Mangas Crk to Mogollon Creek)	Chihuahuan Desert - MCWAL	no data	2/8 = 25%	0/8 = 0%	1/8 = 13%	1/8 = 13%	7/8 = 88%	no	FS
Mangas Creek (Gila River to Mangas Springs)	Chihuahuan Desert - MCWAL	no data	4/8 = 50%	0/8 = 0%	1/8 = 13%	8/8 = 100%	4/8 = 50%	no data	NS*
San Francisco River (Dry Creek to Whitewater Creek)	Chihuahuan Desert – MCWAL	supports MCWAL	2/8 = 25%	0/8 = 0%	0/8 = 0%	1/8 = 13%	8/8 = 100%	no	FS
San Francisco River (Centerfire Creek to AZ border)	AZ/NM Mountains - CWAL	supports CWAL	1/8 = 13%	0/8 = 0%	0/8 = 0%	5/8 = 63%	8/8 = 100%	no	FS

NOTES:

Bolded Cells indicate parameters that exceed the threshold value.

HCWAL = High Quality Coldwater Aquatic Life CWAL = Coldwater Aquatic Life

MCWAL = Marginal Coldwater Aquatic Life

FS = Fully Supporting

NS = Not Supporting

* = Sonde (long-term) data needed to verify DO impairment.

5.2.4 Fish Community Data

Fish community data are collected for one or more of the following reasons:

- Development and/or refinement of water quality standards, particularly for designated aquatic life uses and/or temperature criteria.
- Development of fish-based biocriteria and/or bioassessment procedures. Once fish-based bioassessment procedures have been developed, fish community data will then be used as a basis for bioassessment.
- To document and characterize a given water's fish community for comparison with future or past records.

The characteristics and habits of fish species ([Table 12](#)) can be correlated with physical habitat to provide information about how changes may be impacting the fish community.

Fish community data were collected on four dates (all in 2007) at four locations: 15 October (Sapillo Creek, 77Sapill012.0), 17 October (San Francisco River, 80SanFra028.6), 18 October (San Francisco River, 80SanFra154.1), and 20 October (East Fork Gila, 77EFkGil000.2). All collections were performed in a single upstream pass using a Smith-Root backpack electroshocker (Model 12-B). Block nets were not used. [Table 13](#) provides the results of fish collection in the Gila and San Francisco watersheds.

At Sapillo Creek, a 150 m reach (mean width of approximately 2 m) was sampled. The reach was dominated by riffles (~45%) and pools (~45%), with few runs (~10%). Non-native species were far more abundant (85%) than native (15%), with Rio Grande sucker (*Catostomus (Pantosteus) plebeius*) being the most common species (there is some doubt as to whether Rio Grande sucker was introduced by people or native as a result of stream capture from the Mimbres basin; they are considered non-native in this report). Historical records indicate that longfin dace (*Agosia chrysogaster*) was among the most abundant of species, and in this collection was the second most common species (15%). Most of the fish captured were cool water species (63%), followed by warm water species (31%). Rainbow trout (*Oncorhynchus mykiss*) was the only cold water species (6%) present. This collection marks the first known population of goldfish (*Carassius auratus*) documented in this stream. The presence of rainbow trout, goldfish, and largemouth bass (*Micropterus salmoides*) can likely be attributed to the upstream impoundment (Lake Roberts) where several species have been introduced. Seepage of water through the dam is also the likely reason for the comparatively cold year-round water temperature of this reach.

At the San Francisco River (downstream of Glenwood), a 500 m reach (mean width of approximately 10 m) was sampled. Runs (~60%) were the most abundant habitat feature, with riffles fairly common (30%) and pools relatively sparse (10%). Non-native, warm water species were far more abundant (91%) than native, cool water species (9%). Common carp (*Cyprinus carpio*) were all greater than 500 mm total length (TL); channel catfish (*Ictalurus punctatus*) were all greater than 400 mm TL with the exception of one subadult. Flathead catfish (*Pylodictis olivaris*) comprised the other non-native present. Of the two native species present, loach minnow (*Tiaroga cobitis*) is federally and State listed as a threatened species, while Sonora sucker (*Catostomus insignis*) is typically common in the basin.

At the San Francisco River (upstream of Luna), a 200 m reach (mean width of approximately 4 m) was sampled. There were equal amounts of runs and riffles (40% each) with pools being less common (20%). Two of the three species collected were native with longfin dace (73%) being most abundant by far. This is the only location in this survey where speckled dace (*Rhinichthys osculus*) (15%) was collected. Rio Grande sucker (13%) was the only non-native species collected at this location.

A 150 m reach (mean width approximately 6 m) was sampled at the East Fork Gila, with runs being the dominant habitat feature (70%); riffles (20%) and pools (10%) were much less common. Despite the scarcity of pools, the great majority of fish, particularly Sonora sucker (69%), were found in pools. Western mosquitofish (14%) were found primarily in shallow, low velocity margins of the stream, as is typical. This reach was dominated numerically by native species (24 Sonora sucker; 2 desert sucker, *Catostomus (Pantosteus) clarki*), but 4 of 6 taxa

collected were non-native, including yellow bullhead (*Ameiurus natalis*), green sunfish (*Lepomis cyanellus*), and smallmouth bass (*Micropterus dolomieu*).

Table 12. Characteristics of Fish Species found in the Gila River and San Francisco River

Species	Common Name	Native	Temperature	Gravel Spawner	Feeding Guild	Water Quality Tolerance
<i>Agosia chrysogaster</i>	Longfin dace	Yes	Warm	No	Omnivore	Tolerant
<i>Ameiurus natalis</i>	Yellow bullhead	No	Warm	No	Omnivore, Piscivore	Tolerant
<i>Carassius auratus</i>	Goldfish	No	Warm	No	Omnivore	Tolerant
<i>Catostomus insignis</i>	Sonora sucker	Yes	Cool	Yes	Omnivore	Intermediate
<i>Catostomus (Pantosteus) clarki</i>	Desert sucker	Yes	Cool	Yes	Herbivore	Intermediate
<i>Catostomus (Pantosteus) plebeius</i>	Rio Grande sucker	No	Cool	Yes	Omnivore	Intermediate
<i>Cyprinus carpio</i>	Common carp	No	Warm	No	Omnivore	Tolerant
<i>Gambusia affinis</i>	Western mosquitofish	No	Warm	No	Insectivore	Tolerant
<i>Ictalurus punctatus</i>	Channel catfish	No	Warm	No	Insectivore, Piscivore	Tolerant
<i>Lepomis cyanellus</i>	Green sunfish	No	Warm	No	Insectivore, Piscivore	Tolerant
<i>Oncorhynchus mykiss</i>	Rainbow trout	No	Cold	Yes	Insectivore, Piscivore	Sensitive
<i>Micropterus dolomieu</i>	Smallmouth bass	No	Cool	No	Piscivore	Intermediate
<i>Micropterus salmoides</i>	largemouth bass	No	Warm	No	Piscivore	Tolerant
<i>Pylodictis olivaris</i>	Flathead catfish	No	Warm	No	Piscivore	Tolerant
<i>Rhinichthys osculus</i>	Speckled dace	Yes	Cool	Yes	Insectivore	Intermediate
<i>Tiaroga cobitis</i>	Loach minnow	Yes	Cool	Yes	Insectivore	Sensitive

Table 13. Fish Community Data from the Gila River and San Francisco River

Station:			East Fork Gila at Grapevine Campground	San Francisco River blw Glenwood	San Francisco River abv Luna	Sapillo Creek at wilderness boundary
Scientific name	Common name	Temperature				
<i>Agosia chrysogaster</i>	Longfin dace	Warm	0	0	45	19
<i>Ameiurus natalis</i>	Yellow bullhead	Warm	1	0	0	0
<i>Carassius auratus</i>	Goldfish	Warm	0	0	0	7
<i>Catostomus insignis</i>	Sonora sucker	Cool	24	2	0	0
<i>Catostomus (Pantosteus) clarki</i>	Desert sucker	Cool	2	0	0	0
<i>Catostomus (Pantosteus) plebeius</i>	Rio Grande sucker	Cool	0	0	8	78
<i>Cyprinus carpio</i>	Common carp	Warm	0	12	0	0
<i>Gambusia affinis</i>	Western mosquitofish	Warm	5	0	0	0
<i>Ictalurus punctatus</i>	Channel catfish	Warm	0	20	0	0
<i>Lepomis cyanellus</i>	Green sunfish	Warm	2	0	0	0
<i>Oncorhynchus mykiss</i>	Rainbow trout	Cold	0	0	0	8
<i>Micropterus dolomieu</i>	Smallmouth bass	Cool	1	0	0	0
<i>Micropterus salmoides</i>	largemouth bass	Warm	0	0	0	12
<i>Pylodictis olivaris</i>	Flathead catfish	Warm	0	7	0	0
<i>Rhinichthys osculus</i>	Speckled dace	Cool	0	0	9	0
<i>Tiaroga cobitis</i>	Loach minnow	Cool	0	2	0	0
		# of Individuals	35	43	62	124
		Total # of Taxa	6	5	3	5
		% Native	74	9	87	15
		% Non-native	26	91	13	85
		% Coldwater	0	0	0	6
		% Coolwater	77	9	27	63
		% Warmwater	23	91	73	31

6.0 DISCUSSION

Due to the large volume of data collected during this survey, it will not be included in this report. To acquire specific data, contact the SWQB or [search USEPA's STORET database](#). All of the monitoring that was conducting by the SWQB is summarized in [Table 2](#). Those parameters that exceeded the State's Water Quality Criteria are shown in [Tables 3 and 4](#) as well as [Tables 10 and 11](#). Data collected as part of this study were assessed for water quality impairment and the assessment results were included in the *2010-2012 State of New Mexico CWA §303(d)/§305(b) Integrated List and Report* ([NMED/SWQB 2010](#)).

The primary cause of exceedences of water quality standards in the Gila and San Francisco watersheds continues to be temperature. The southerly latitude, relatively low elevation and frequently sparse riparian cover render attainment of temperature criteria difficult. Impairment determinations of New Mexico water quality standards for **temperature** were documented for the West Fork, Middle Fork, Mangas Creek, upper San Francisco River, and the mainstem of the Gila River from the Arizona border all the way to the confluence of the East and West Forks. However, it is believed that some of these waterbodies are misclassified and that a revision of the water quality standards is warranted. Further data collection is needed to verify the appropriate criteria for assessment determinations.

Impairment of the narrative **plant nutrients** criterion was determined for Mangas Creek and the Gila River below Mangas Creek. It should be noted that Mangas Creek has long been listed for plant nutrients. Nitrate levels in Mangas Creek above the Gila River at Forest Road 809 ranged from 3.4 mg/L to 4.8 mg/L (mean = 4.01 mg/L, median = 4.05 mg/L, n = 8). Mangas Spring, a primary source of water for Mangas Creek, has produced very high nitrate levels (15 – 16 mg/L). Nitrate concentrations of this magnitude are normally associated with some sort of anthropogenic input. However, pending further investigation of this issue, the source(s) are unknown at this time. Probable sources of nitrate in Mangas Creek include historic to present day mining activities, septic systems, general agricultural sources, and/or natural causes (i.e. geology).

Furthermore, current water quality data exceeded the historic, segment specific **turbidity** criterion in the Middle Fork of the Gila River, however macroinvertebrate data were not available to verify the turbidity impairment. The Middle Fork also exceeded the **chronic aluminum** criterion. As noted in [Section 1.1](#), a likely source for the aluminum exceedences is the chemical weathering of alumino-silicate minerals found in the volcanic geology of the region. This effect may be exacerbated by the erosive after-effects of wildfires which are common in the area. The production of excess sediment after wildfires may also be a source, at least in part, for the turbidity listing.

Impairment of the **aquatic macro-invertebrate community** was determined in the East Fork Gila, the San Francisco River from Dry Creek to Whitewater Creek, and the San Francisco River from Centerfire Creek to the Arizona border. The reduction in the relative support level for the aquatic life use in these streams is probably not due to sediment because the percent fine sediment in all three streams was below 20%. The biological impairment is most likely the result of some other pollutant (temperature, D.O., pH, etc.), alone or in combination with

sediment. The reaches were listed for benthic-macroinvertebrate bioassessments until the exact cause of the biological impairment is determined.

Data from this study also supported the removal of several impairments from the 2010-2012 CWA §303(d) *List of Impaired Waterbodies* ([NMED/SWQB 2010](#)), meaning all data collected met current water quality criteria. These “de-listed” waters include:

- PLANT NUTRIENTS in the San Francisco River from Centerfire Creek to the Arizona border; and
- TURBIDITY in Sapillo Creek from the Gila River to Lake Roberts.

Fish community data were collected on four dates (all in 2007) at four locations. In general fish species collected were dominated by non-native warmwater species and native coolwater species. Although most of the non-native fish were warm water (with the exception of one smallmouth bass and rainbow trout), all of the native fish were cool water. Some of the sites sampled are designated as high quality cold water aquatic life use with a 32.2°C temperature criterion, however based on the fish species present these designations and criteria may require revision.

A number of assessment units could not be re-assessed due to insufficient data. These “old” impairments will remain on the Integrated List until additional data are available. Additional water quality data will be collected by the SWQB during the standard rotational period for water quality surveys. As a result, targets will be re-examined and potentially revised. When water quality standards have been achieved, the reach will be moved to the appropriate category on the CWA §303(d)/§305(b) Integrated List.

7.0 REFERENCES

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