WATER QUALITY SURVEY SUMMARY
FOR THE
LOWER RIO GRANDE TRIBUTARIES
2004

Prepared by
New Mexico Environment Department
Surface Water Quality Bureau
November 2009

This page left intentionally blank.

PRINCIPLE INVESTIGATORS

Survey Leads		**Contact information**
Water Chemistry:	Seva Joseph	seva.joseph@state.nm.us
	Scott Hopkins	scott.hopkins@state.nm.us
Watershed Protection:	Dave Menzie	david.menzie@state.nm.us
Report Author:	Shelly Drinkard	shelly.drinkard@state.nm.us
GIS/Mapping	Bill Skinner	bill.skinner@state.nm.us
Surface Water Quality Bureau Office:		(505) 827-0187

Water quality surveys and assessments conducted by the New Mexico Environment Department Surface Water Quality Bureau are completed to fulfill Section 106 of the Clean Water Act [33 USC 1251 et seq.], *Work Program for Water Quality Management.* This project was funded by a grant from the U.S. Environmental Protection Agency.

This page left intentionally blank.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ACRONYMS

ADB	Assessment Database
ºC	Degrees Celsius
CWA	Clean Water Act
DO	Dissolved Oxygen
EMAP	Environmental Monitoring and Assessment Program
ºF	Degrees Fahrenheit
GIS	Geographic Information Systems
MCWAL	Marginal Coldwater Aquatic Life
mi^2	square miles
NMAC	New Mexico Administrative Code
NMED	New Mexico Environment Department
QAPP	Quality Assurance Project Plan
STORET	Storage and Retrieval System
SWQB	Surface Water Quality Bureau
EPA	United States Environmental Protection Agency

1.0 EXECUTIVE SUMMARY

During 2004, the Monitoring and Assessment Section of the Surface Water Quality Bureau (SWQB) conducted water quality and biological assessment surveys of the Lower Rio Grande and its perennial tributaries from the international boundary with Mexico to Elephant Butte Reservoir. Tributaries of the Lower Rio Grande sampled during the survey included Alamosa Creek, Las Animas Creek, Palomas Creek, and Percha Creek. Sampling at the tributary stream stations was conducted on a monthly basis from June through October when water was present at the stations. Information on the water quality of the main-stem sites can be found in the *Water Quality Survey Summary for the Lower Rio Grande 2004* (NMED/SWQB 2006a).

The primary purpose of this survey was to collect chemical, physical, and biological data to identify water quality impairments within the watershed. The results of this study are summarized in the Integrated List portion of the biennial *State of New Mexico Integrated Clean Water Act §303(d)/305(b) Report.* Any assessment conclusions presented in this report are based on water quality standards and assessment protocols that existed at the time the survey was conducted. It is important to note that both the assessment protocols and water quality standards are revised periodically to incorporate new information and refinements. 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 Assessed Surface Waters*. Therefore, the impairment conclusions in the most recent Integrated List supersede assessment conclusions in this survey report if they should differ.

Water quality monitoring at survey stations included total nutrients, total and dissolved metals, major anions and cations, and microbiological collections as determined by proximity to potential sources and/or previous survey findings. Data loggers were deployed at select stations to collect temperature, pH, dissolved oxygen (DO), conductivity, and turbidity data for an extended period of time to monitor diurnal fluctuations. Biological surveys, which included the monitoring of fecal coliform and *E. coli* as well as the collection of macroinvertebrates and physical habitat characteristics, were conducted at select stations.

Water quality in the Lower Rio Grande tributaries was found to be good. Water quality sampling at tributary stream stations found no exceedences of water quality criteria for total nutrients, total and dissolved metals, major anions and cations, bacteria, and field parameters such as dissolved oxygen, pH, and temperature. However, Percha Creek and Alamosa Creek were listed as Partially Supporting on the 1998 §303(d) list with stream bottom deposits as the cause. Additional data were collected in 2007 to confirm the historic sedimentation/siltation listings. These data were assessed according to SWQB's *Appendix D: Sedimentation/Siltation Assessment Protocol for Wadeable, Perennial Streams* (NMED/SWQB 2009). Based on the assessment, it was determined that Alamosa and Percha Creeks were fully supporting their aquatic life uses with respect to sedimentation/siltation. Consequently, NMED/SWQB intends to remove the sedimentation/siltation impairment listings for Alamosa and Percha Creeks in the 2010-2012 State of New Mexico CWA §303(d)/§305(b) Integrated Report.

2.0 INTRODUCTION

The Rio Grande originates in the San Juan Mountains of southern Colorado and follows a 1,885-mile course before flowing into the Gulf of Mexico. Along the way, the river and its tributaries drain 182,200 square miles of land. This drainage encompasses a widely varied landscape in the United States and Mexico, including mountains, forests, and deserts. The basin is home to diverse native plants and wildlife as well as some 10 million people. For approximately two-thirds of its course, the river also serves as the boundary between the United States and Mexico.

The Lower Rio Grande offers a 247-day growing season where temperatures can soar to 111 degrees Fahrenheit (°F) and plummet to –16 °F. Two-thirds of the annual precipitation (7.8 inches) is packed into the late summer and early fall (La Mar 1984). Historic and current land uses in the watershed include agriculture, recreation, and municipal related activities of Las Cruces and El Paso. At present, ranching and irrigated agriculture are major components of the economy in the basin.

Much of the land ownership adjacent to the river is private with the exception of state parks near Elephant Butte Reservoir, Caballo Reservoir, Percha Dam, and Leasburg Dam. The Bureau of Land Management and the State of New Mexico also own and manage sizable tracts of public lands in the upland portions of the watershed. The various state parks and reservoirs located along the river support activities such as hiking, mountain biking, camping, and fishing as well as water skiing and other recreational sports.

The surrounding geology was shaped by the Rio Grande Rift system. The Rio Grande Rift system is a series of grabens (fault-bounded basins) that extend from central Colorado southward through New Mexico and into western Texas and Mexico. Continental rifting was associated with crustal stretching and uplift of the southwestern United States. Grabens dropped down thousands of meters relative to adjacent uplifts, and alluvial sediment accumulated to great thickness in the basins. Intrusions and volcanic eruptions also took place within the rift valleys and throughout the surrounding region.

The Monitoring and Assessment Section (MAS) of the SWQB conducted a water quality survey of the Lower Rio Grande tributaries between June 2004 and October 2004 with additional data collections in 2007. Surface water quality monitoring stations were selected to characterize water quality of the stream reaches and determine impairment. The water quality survey for the Lower Rio Grande and its tributaries included 22 sampling sites encompassing the geographic area from Elephant Butte Reservoir to the International Boundary with Mexico (**Figure 1 and Table 1**). 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 1** lists the location of sampling stations in each assessment unit (AU) of the Lower Rio Grande tributaries along with the station numbers, STORET identification codes, the current listings on the Integrated Clean Water Act (CWA) §303(d)/§305(b) Report, and the associated water quality segment number. Information on the water quality of the main-stem sites can be found in the *Water Quality Survey Summary for the Lower Rio Grande 2004* (NMED/SWQB 2006a).

Figure 1. Lower Rio Grande Survey Area and 2004 Sampling Stations

Table 1. Lower Rio Grande Tributaries and Associated Sampling Stations

Assessment Unit	Station No.	STORET Code	Sampling Station	Historic Impairment Listing(s)	WQS (August 2007) reference
Percha Creek (Perennial reaches Caballo Res. to M Fork)	16	41Percha025.3	Percha Creek at Percha Box	Sedimentation/ Siltation	20.6.4.103
Las Animas Creek (perennial portion R Grande to headwaters)	17	41LAnima018.6	Las Animas Creek at Rd Crossing	---	20.6.4.103
	18	41LAnima029.3	Las Animas Creek above box		
	19	41LAnima038.3	Las Animas Creek near Dunn		
Palomas Creek (perennial portion R Grande to headwaters)	20	41SPalom019.1	South Fork Palomas Creek near Hermosa	---	20.6.4.103
	21	41Paloma036.7	South Fork Palomas Creek above North Fork		
Alamosa Creek (Perennial reaches abv Monticello diversion)	22	40Alamos058.5	Alamosa Creek below USGS Gage 8360000	Sedimentation/ Siltation	20.6.4.103

3.0 NM WATER QUALITY STANDARDS

United States Environmental Protection Agency (EPA) approved water quality standards were used to determine if waterbodies throughout the watershed are supporting their designated uses. The *State of New Mexico Standards for Interstate and Intrastate Surface Waters*, which include fishable and swimmable goals set forth in the Clean Water Act §102(a), were consulted for this determination. General standards and standards applicable to attainable or designated uses for portions of the Lower Rio Grande tributaries that were surveyed in this study are set forth in sections 20.6.4.13, 20.6.4.97, 20.6.4.98, 20.6.4.99, and 20.6.4.900 of the *State of New Mexico Standards for Interstate and Intrastate Surface Waters* (NMAC 2007). Segment specific standards for the Lower Rio Grande tributaries are set forth in section 20.6.4.103, which reads as follows:

20.6.4.103 RIO GRANDE BASIN - The main stem of the Rio Grande from the headwaters of Caballo reservoir upstream to Elephant Butte dam and perennial reaches of tributaries to the Rio Grande in Sierra and Socorro counties.

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

B. Criteria:

(1) In any single sample: pH within the range of 6.6 to 9.0 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 548 cfu/100 mL or less, single sample 2507 cfu/100 mL or less (see Subsection B of 20.6.4.14 NMAC).

C. Remarks: Flow in this reach of the Rio Grande main stem is dependent upon release from Elephant Butte dam. [20.6.4.103 NMAC - Rp 20 NMAC 6.1.2103, 10-12-00; A, 05-23-05]

4.0 METHODS

Water quality sampling methods were in accordance with the approved *Quality Assurance Project Plan (QAPP) for Water Pollution Control Programs* (NMED/SWQB 2004) and the *SWQB Standard Operating Procedures for Data Collection*. These data were assessed in accordance with protocols established in the *Procedures for Assessing Water Quality Standards Attainment for the State of New Mexico CWA §303(d)/§305(b) Integrated Report: Assessment Protocol* (NMED/SWQB 2006b).

5.0 SAMPLING SUMMARY

A map of the study area is provided in **Figure 1**. The station numbers, STORET identification codes, and location descriptions of sampling stations selected for this survey are provided in **Table 1**. The rational for selecting each tributary station is as follows:

Percha Creek at Percha Box was selected because it is a perennial reach of a Rio Grande tributary.
Las Animas Creek at Rd Crossing was selected because it is a perennial reach of a Rio Grande tributary.
Las Animas Creek above box was selected because it is minimally impacted site above ranch headquarters and associated activities and is considered an ecoregional reference site.
Las Animas Creek near Dunn was selected at the request of the US Forest Service because it is located near the USFS boundary.
Alamosa Creek below USGS Gage 8360000 was selected because it is a perennial reach of a Rio Grande tributary and is a possible ecoregional reference station.
South Fork Palomas Creek near Hermosa was selected at the request of the US Forest Service because it is located near the USFS boundary.
South Fork Palomas Creek above North Fork was selected because it is a perennial reach of a Rio Grande tributary and is a possible ecoregional reference station.

Water samples were analyzed for plant nutrients, ions, total and dissolved metals, fecal coliform bacteria, radionuclides, and anthropogenic organic compounds. Variables such as dissolved oxygen (DO), pH, turbidity, and specific conductance were measured in the field. Physical habitat and benthic macroinvertebrate communities were surveyed to determine the impacts of excessive nutrients and settled sediment on aquatic life within a stream. The type of monitoring done at each site is summarized in **Table 2**. The number of times each parameter (or suite of parameters) was sampled for is indicated.

Table 2. SWQB Sampling Summary

Assessment Unit / Stations	Field Data+	Ions (full suite)	Total Nutrients	Total Metals	Dissolved Metals	Fecal Coliform	E. Coli	Sonde Deployment	Thermograph Deployment
Percha Creek (Perennial reaches Caballo R to M Fork)									
Percha Creek at Percha Box	5	3	5	5	5	1	1	Yes	**
Las Animas Creek (perennial portion R Grande to headwaters)									
Las Animas Creek at Rd Crossing	5	3	3	3	3	1	1	Yes	Yes
Las Animas Creek above box	5	2	4	2	2	-	-	Yes	-
Las Animas Creek near Dunn	1	-	1	-	-	-	-	Yes	-
Alamosa Creek (Perennial reaches abv Monticello diversion)									
Alamosa Creek below USGS Gage 8360000	6	6	6	5	5	4	4	Yes	**
Palomas Creek (perennial portion R Grande to headwaters)									
South Fork Palomas Creek near Hermosa	3	-	1	1	1	-	-	-	-
South Fork Palomas Creek above North Fork	1	3	3	3	3	1	1	Yes	**

+ *Field data include dissolved oxygen (DO), pH, temperature, turbidity, specific conductance, and salinity.*
*** Thermographs were deployed but lost due to flood events.*

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 bottom deposits are narrative. Data are assessed for designated use attainment status for both numeric and narrative water quality standards by application of the *Assessment Protocol* (NMED/SWQB 2009). A complete dataset can be obtained by contacting the SWQB.

6.0 WATER QUALITY CRITERIA EXCEEDENCES

The following discussion includes information pertaining to exceedences of water quality standards found during the SWQB watershed survey. The purpose of this section of the report is to provide the reader with information on where current water quality standards are being exceeded within the watershed. These exceedences are used to determine designated use impairment status. Final assessment determinations as to whether or not a stream reach is considered to be meeting its designated uses depend on the overall amount and type of data available during the assessment process (Refer to SWQB's *Assessment Protocol* for additional information on the assessment process, 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 2008).

6.1 Water Quality Exceedences For Numeric Criteria

6.1.1 Physicochemical Data

Physicochemical water quality samples and sampling frequencies are provided in **Table 2**. It should be noted that an exceedence of a given criterion may not generate a violation of standards, triggering a listing on the 303(d) list. Details of assessment and listing procedures are available in the *Assessment Protocol* (NMED/SWQB 2006b).

Sampling for major ions, nutrients, total and dissolved metals, bacteria, and field parameters found no exceedences of water quality criteria.

6.1.2 Data from Continuous Monitoring Devices

Temperature data loggers (thermographs) were deployed at selected stations within the study area. **Table 3** summarizes temperature data from thermographs in degrees Celsius (°C). YSI multi-parameter sondes were also deployed at selected stations to examine pH and dissolved oxygen (DO). **Tables 4a and 4b** summarize sonde data collected from the Lower Rio Grande tributaries. 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 (e.g., 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 not reasonable to list as not supporting on the basis of one or a few exceedences out of several hundred or thousand data points.

Temperature (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, *i.e.* early life stages, aquatic organisms and designated use, *i.e.* marginal coldwater aquatic life use. Details of large dataset assessment procedures are available in the *Assessment Protocol* (NMED/SWQB 2006b).

Table 3. Summary of Thermograph Data

Station	Data Collection Interval	WQS Temperature Criterion (°C)	Maximum Recorded Temperature (°C)	Total # of data points (n)	# / % Exceedences
Las Animas Creek at road crossing	July 8, 2004 – October 19, 2004	25 °C	19.9 °C	2022	0 / 0%

NOTES: Thermographs were deployed but lost due to flood events on Palomas, Alamosa, and Percha Creeks.

Table 4a. Summary of pH Data Collected from Sondes

Station	Data Collection Interval	Designated Use	Criterion SU	Min / Max SU	# / % Exceedences	Magnitude Violation	Frequency Violation
Las Animas Creek at road crossing	July 7-12, 2004	MCWAL	6.6-9.0	6.95/7.09	0 / 0%	No	No
Las Animas Creek above the box	October 18-27, 2006	MCWAL	6.6-9.0	7.30/7.41	0 / 0%	No	No
Las Animas Creek near Dunn	Aug 27-Sep 6, 2004	MCWAL	6.6-9.0	6.18/6.67	0 / 0%	No	No
Alamosa Creek blw USGS Gage 8360000	July 8-12, 2004	MCWAL	6.6-9.0	7.64/8.24	0 / 0%	No	No
South Fork Las Palomas abv North Fork	July 7-12, 2004	MCWAL	6.6-9.0	7.40/8.13	0 / 0%	No	No
Percha Creek at Percha Box	July 7-12, 2004	MCWAL	6.6-9.0	7.43/7.62	0 / 0%	No	No

NOTES: MCWAL = Marginal Coldwater Aquatic Life

Table 4b. Summary of Dissolved Oxygen Data Collected from Sondes

Station	Data Collection Interval	Designated Use	WQS Criterion (mg/L)	Min/Max Conc. (mg/L)	Min Sat. (% local)	Assessment Criterion	Combined Conc./Sat. Exceedences (# / %)	% Sat. Exceedences (# / %)
Las Animas Creek at road crossing*	July 7-12, 2004	MCWAL	6.0	1.69 / 2.43	20.8	OLS	121 / 100%	121 / 100%
Las Animas Creek above the box	Oct 18-27, 2006	MCWAL	6.0	8.21 / 9.64	101.7	OLS	0 / 0%	0 / 0%
Las Animas Creek near Dunn*	Aug 27-Sep 6, 2004	MCWAL	6.0	0.14 / 5.17	1.8	OLS	241 / 100%	241 / 100%
Alamosa Creek blw USGS Gage 8360000	July 8-12, 2004	MCWAL	6.0	5.88 / 7.09	87	OLS	8 / 7.6%	0 / 0%
South Fork Las Palomas abv North Fork^	July 7-12, 2004	MCWAL	6.0	---	---	---	---	---
Percha Creek at Percha Box*	July 7-12, 2004	MCWAL	6.0	4.72 / 7.49	68.1	OLS	77 / 62.6%	54 / 43.9%

NOTES: MCWAL = Marginal Coldwater Aquatic Life
OLS refers to Other Life Stages, as opposed to the more sensitive ELS, Early Life Stages
* Low dissolved oxygen results are likely the result of significant groundwater input.
^ DO probe malfunction.

As noted in **Table 4b** above, several streams have low dissolved oxygen (DO) values below the DO water quality standard. Natural inflows of groundwater often have low concentrations of DO and can therefore result in lower DO concentrations in surface waters. One way to help determine if a stream is dominated by groundwater inflows is to look at the water temperature over a period of time. Groundwater is often colder and does not exhibit the typical diurnal swings of temperature as that observed in surface waters (**Figures 2 and 3**). That is, over a period of 24 hours the temperature of a groundwater-fed stream is relatively stable. The results of this analysis indicated that the low DO values documented in Las Animas and Percha Creeks are likely the result of a significant groundwater input and therefore these sites were determined to be Fully Supporting its aquatic life use with respect to DO.

Figure 2. Example of relatively stable stream temperatures indicative groundwater input

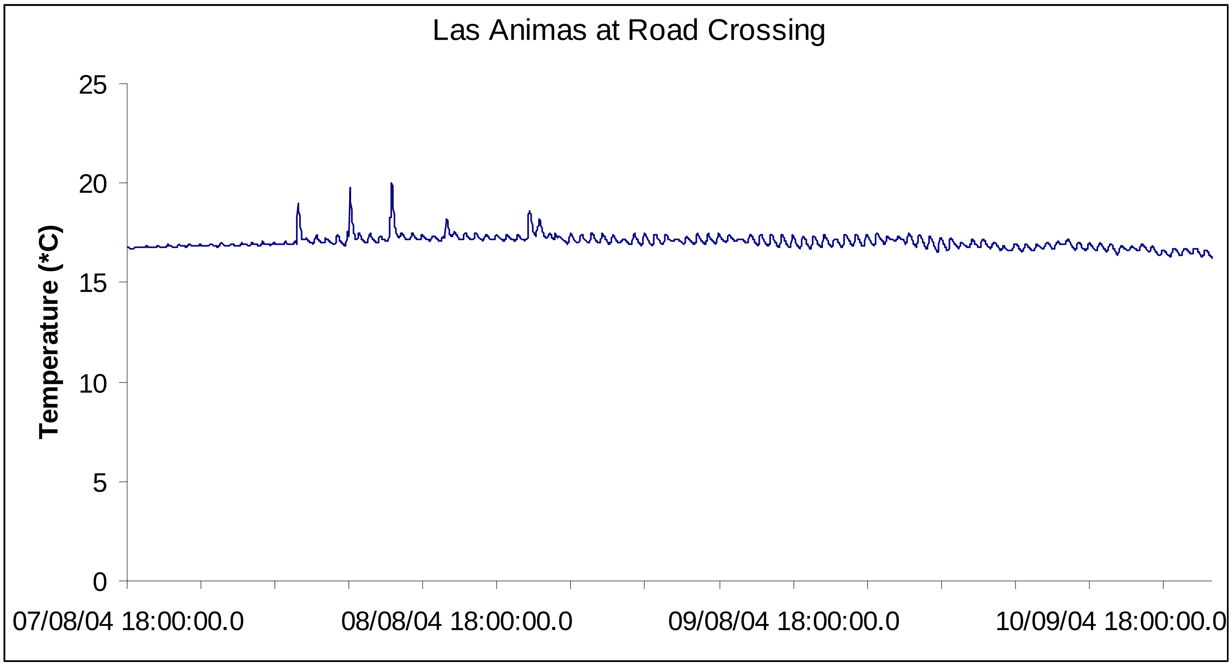
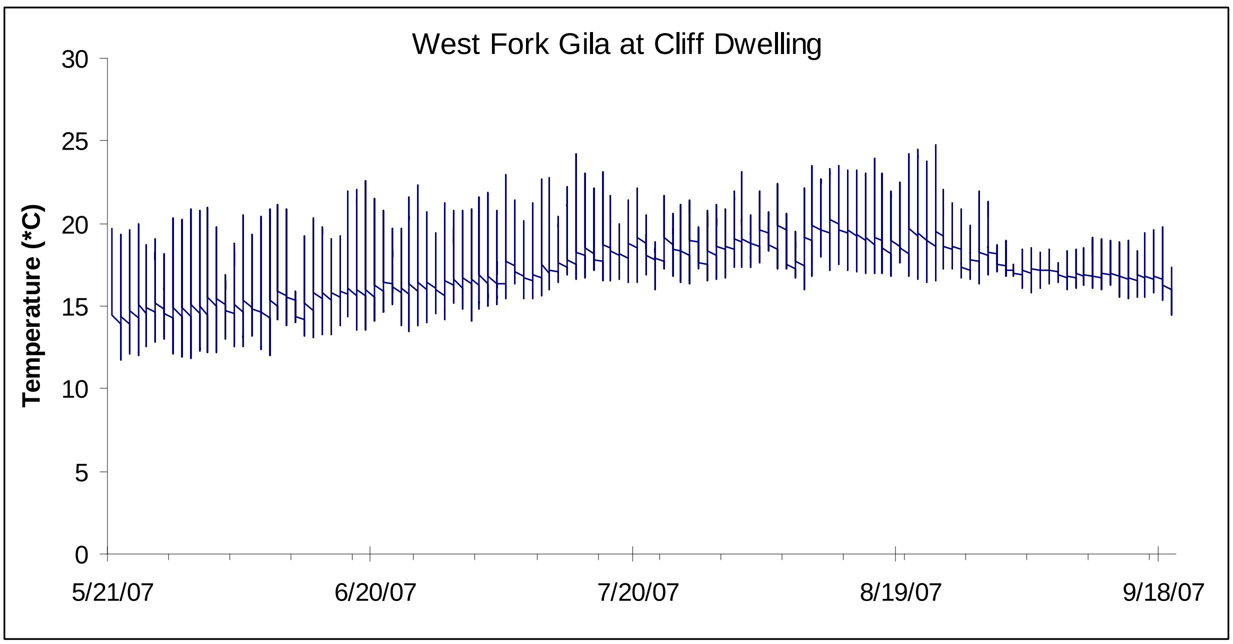


Figure 3. Example of typical diurnal fluctuations of temperature in surface water



6.2 Water Quality Exceedences For Narrative Criteria

6.2.1 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 biological 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. **Table 5** describes the watershed size, ecoregion, and elevation of each station within the biological survey of the Lower Rio Grande Tributaries. 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.

Percha Creek and Alamosa Creek were previously listed for stream bottom deposits. Environmental Monitoring and Assessment Program (EMAP; Peck *et al.* 2003) surveys were conducted on these streams in 2007 to collect data in order to verify the historic sedimentation/siltation listings.

Table 5. Watershed Characteristics of Reference and Study Sites

Station	Latitude	Longitude	Watershed Area	Elevation	Ecoregion
West Fork Gila abv Cliff Dweller Cyn (reference)	33.2293	108.266	109 mi^2	5709 feet	AZ/NM Mountains
Alamosa Creek below USGS Gage 8360000	33.5687	107.590	401 mi^2	6181 feet	AZ/NM Mountains
Blue Creek 0.5 mile abv Gila River (reference)	32.6627	108.830	138.5 mi^2	3963 feet	Chihuahuan Desert
Percha Creek at Percha Box	32.9179	107.529	85.5 mi^2	5003 feet	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 course, 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 2mm are considered “fines”, and “percent fines” are considered for assessment purposes (See 20.6.4.13(A) NMAC). The percent fines is calculated by adding the % sand and % silt-clay.

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.

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 provide an indication of riparian health.

Table 6 provides a comparison of the physical habitat parameters collected at the reference reaches and study reaches during the 2007 EMAP surveys. In both cases the geomorphic and measures of riparian health are comparable with reference site conditions.

Table 6. Comparison of Physical Habitat Results between Reference Sites and Study Sites

Results	West Fork Gila (Reference)	Alamosa Creek	Blue Creek (Reference)	Percha Creek
Substrate Composition				
% Fines (< 2 mm)	8%	22%	43%	16%
D50	53 mm	18.5 mm	4.5 mm	24.5 mm
D84	121.5 mm	42.5 mm	119.5 mm	62 mm
Mean % Embeddedness	41.9%	46.6%	60.2%	49.5%
Geomorphic Data				
Slope	1.15%	1.10%	0.95%	0.83%
Width-to-Depth Ratio	47.1	29.3	33.3	26.5
Riparian Health				
Rapid Geomorphic Assessment[1] (0 – 36)	1.0	14.0	11.0	16.5
Rapid Habitat Assessment[2] (0 – 200)	177	151	133	138

NOTES: mm = millimeters

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). **Higher scores indicate a more unstable 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**.

6.2.2 Macroinvertebrate Community and Sedimentation Data

Since the narrative standard for bottom deposits is dependent on biological condition, the assessment of this physically-based narrative sedimentation criteria 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. Application of the biological assessment or degree of impairment is a percentage comparison of the sum of selected metric scores at the study site compared to a reference site or condition. For example, a study site in ecoregion 24 (Chihuahuan Desert) achieving a RBP score greater than 83 percent of the reference site would be deemed non-impaired (**Table 7**). Similarly, when the macroinvertebrate community at a study site in ecoregion 23 (AZ/NM Mountains) has an M-SCI score < 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 8**).

Table 7. Biological Integrity Attainment Matrix using the Rapid Bioassessment Protocol Index[1] for Chihuahuan Desert Sites

% Comparison to Reference Site(s)	Biological Condition Category[2]	Attributes[1]
> 83%	Non-impaired (Full Support)	Comparable to best situation to be expected within ecoregion (watershed reference site). Balanced trophic structure. Optimum community structure (composition & dominance) for stream size and habitat quality.
79 – 54%	Slightly Impaired (Non-Support)	Community structure less than expected. Composition (species richness) lower than expected due to loss of some intolerant forms. Percent contribution of tolerant forms increases.
50 – 21%	Moderately Impaired (Non-Support)	Fewer species due to loss of most intolerant forms. Reduction in EPT index.
< 17%	Severely Impaired (Non-Support)	Few species present. Densities of organisms dominated by one or two taxa.

1. RBP Index, percentages, and biological attributes are taken from Plafkin *et al.*, 1989. Percentage values obtained that are in between the above ranges will require best professional judgment as to the correct placement.
2. New Mexico has combined all but the "Non-impaired" category into "Non-Support" per USEPA Region 6 suggestion.

Table 8. Biological Integrity Attainment Matrix using M-SCI[1] for AZ/NM Mountain Sites

% Comparison to Reference Condition	Biological Condition Category[2]
> 78.35%	Very Good (Full Support)
78.35 – 56.70%	Good (Full Support)
56.70 – 37.20%	Fair (Non-Support)
37.20 – 18.90%	Poor (Non-Support)
> 18.90%	Very Poor (Non-Support)

1. M-SCI Index and percentages based on Jacobi, *et al.* (2006)
2. 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 (RBP or M-SCI depending on ecoregion) 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 a percent fines that is 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.

Alamosa Creek had an M-SCI score in the "good" range indicating the biological community is not impaired or stressed even though the percent fine sediment in Alamosa Creek exhibited a 175% increase over the reference site (**Table 9**) and was slightly above the 20% fine threshold defined in Appendix D of the Assessment Protocol. Therefore, Alamosa Creek was determined to be Fully Supporting its aquatic life use with respect to sedimentation/siltation.

Percha Creek had a RBP score in the "moderately impaired" range indicating the biological community is stressed, however the percent fine sediment in Percha Creek was only 16% almost three times lower than the 43% fines found at its reference site (**Table 9**). According to Appendix D of the Assessment Protocol, raw percent values of ≤ 20% fines at a study site should be evaluated as "Full Support" regardless of the percent attained at the reference site. Therefore Percha Creek was determined to be Fully Supporting its aquatic life use with respect to sedimentation/siltation.

Table 9. Sedimentation Evaluations for the Lower Rio Grande Tributaries

Stations	Biological Index Score	% of Reference	% Fine Sediment	% increase over Reference
Alamosa Creek below USGS Gage 8360000	61.7*	N/A	22	175%
Percha Creek at Percha Box	46^	96%	16+	- 63%

* Mountain – Stream Condition Index (M-SCI) is used to assess AZ/NM Mountain sites.
^ Rapid Bioassessment Protocol (RBP) Index is used to assess Chihuahuan Desert sites.
+ Raw percent values of ≤20% fines at a study site should be evaluated as "Full Support" regardless of the percent attained at the reference site.

6.2.3 Periphyton Community and Nutrient Data

The periphyton community is another biological indicator that can express system stress in ways that the macroinvertebrate or fish 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.

Nutrient Level 2 Assessment

The primary question to be answered during a Nutrient Assessment is: **Is this reach impaired due to nutrient enrichment?** Nutrient impairment occurs where algal and/or macrophyte growth interferes with designated uses, thus preventing the reach from supporting these uses. Algal biomass is the most important indicator of nutrient enrichment, as algae cause most problems related to excessive nutrient enrichment. Algae and macrophytes may be a nuisance when 1) there are large amounts of rotting algae and macrophytes in the stream; 2) the stream substrate is choked with algae; 3) large diurnal fluctuations in DO and pH occur; and/or 4) there is a release of sediment-bound toxins.

The Assessment Protocol uses a two-tiered approach to nutrient assessment. The two levels of assessment are used in sequential order to determine if there is excessive nutrient enrichment. Level 2 nutrient surveys were conducted at the Lower Rio Grande tributary sites that the Level 1 nutrient assessment indicated the possibility of nutrient impairment or that were previously listed as impaired due to plant nutrients. 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. For total phosphorus, total nitrogen, and chlorophyll *a*, the threshold values are dependent on the ecoregion and designated aquatic life use.

According to the *Nutrient Assessment Protocol for Wadeable, Perennial Streams* (NMED/SWQB 2009), a stream is determined to be not supporting if **three or more** indicators exceed their respective threshold values. Total phosphorus was the only indicator that exceeded its threshold value for Las Animas Creek (**Table 10**) resulting in a determination of "Full Support" for Las Animas Creek. Total phosphorus and total nitrogen exceeded their respective threshold values in both Alamosa Creek and Percha Creek, however the long term DO and pH datasets from these creeks did not exceed the criteria (**Table 10**), which resulted in a determination of "Full Support" for nutrients in both creeks. Nevertheless, since chlorophyll *a* data were not available for these streams, chlorophyll *a* data should be collected on Alamosa Creek and Percha Creek to verify the "full support" determination.

Table 10. Summary of Nutrient Data

Assessment Unit Station ID	**Ecoregion**	**Designated Aquatic Life Use**	**DO & pH – long term datasets**	**Total Nitrogen** (# and % of exceedences)	**Total Phosphorus** (# and % of exceedences)	**Chlorophyll *a* exceedence?**
Las Animas Creek (perennial portion R Grande to headwaters) Las Animas abv the box	Chihuahuan Desert	MCWAL	support MCWAL	0 / 0%	1 / 25%	N/A
Alamosa Creek (Perennial reaches abv Monticello diversion) Alamosa Creek below USGS Gage 8360000	Chihuahuan Desert	MCWAL	support MCWAL	1 / 17%	2 / 33%	N/A
Percha Creek (Perennial reaches Caballo R to M Fork) Percha Creek at Percha Box	Chihuahuan Desert	MCWAL	support MCWAL	5 / 100%	2 / 40%	N/A

NOTES: MCWAL = Marginal Coldwater Aquatic Life
N/A = not applicable because data not collected

7.0 CONCLUSIONS

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**.

Sampling for major ions, nutrients, total and dissolved metals, bacteria, and field parameters found no exceedences of water quality criteria. Additionally, according to SWQB's thermograph and sonde data, there were no criteria exceedences for temperature or pH within the Lower Rio Grande's perennial tributaries. There were exceedences of the DO criteria, however these exceedences were determined to be most likely the result of significant groundwater input along the stream reach. Natural inflows of groundwater often have low concentrations of DO and will therefore lower DO concentrations in surface waters. Additional data were collected in 2007 to confirm the historic sedimentation/siltation listings on Percha Creek and Alamosa Creek. These data were assessed according to SWQB's *Appendix D: Sedimentation/Siltation Assessment Protocol For Wadeable, Perennial Streams* (NMED/SWQB 2009). Based on this assessment, it was determined that Alamosa and Percha Creeks were fully supporting their aquatic life uses with respect to sedimentation/siltation. Consequently, the sedimentation/siltation impairment listings for Alamosa and Percha Creeks will be removed in the 2010-2012 State of New Mexico CWA §303(d)/§305(b) Integrated Report.

8.0 REFERENCES

Barbour, M.T., J. Gerritsen, B.D. Snyder, and J.B. Stribling. 1999. *Rapid bioassessment protocols for use in streams and wadeable rivers: Periphyton, benthic macroinvertebrates and fish*, Second Edition. EPA 841-B-99-002. USEPA, Office of Water; Washington, D.C.

Jacobi G.Z., M.D. Jacobi, M.T. Barbour, E.W. Leppo. 2006. *Benthic macroinvertebrate stream condition indices for New Mexico wadeable streams.* Jacobi and Associates and Tetra Tech, Inc. for New Mexico Environment Department, Surface Water Quality Bureau. Santa Fe, NM.

La Mar, Barbel. 1984. *Water and Land in the Mesilla Valley, New Mexico: Reclamation and its Effects on Property Ownership and Agricultural Land Use*. Ph.D. diss., University of Oregon, Eugene. 21 p.

New Mexico Administrative Code (NMAC). 2007. *State of New Mexico Standards for Interstate and Intrastate Surface Waters*. 20.6.4. New Mexico Water Quality Control Commission. As amended through August 1, 2007. (20.6.4 NMAC)

New Mexico Environment Department/Surface Water Quality Bureau (NMED/SWQB). 2004. *Quality Assurance Project Plan (QAPP) for Water Quality Management Programs, 2004*. NMED/SWQB EPA QAPP QTRCK Number 04-088.

NMED/SWQB. 2006a. *Water Quality Survey Report for the Lower Rio Grande (from the International Boundary with Mexico to Elephant Butte Dam) 2004*. Santa Fe, NM.

NMED/SWQB. 2006b. *Procedures for Assessing Water Quality Standards Attainment for the State of New Mexico CWA §303(d)/§305(b) Integrated Report: Assessment Protocol*. Santa Fe, NM. Revised January 24, 2006.

NMED/SWQB. 2008. *2008-2010 State of New Mexico Clean Water Act §303(d)/§305(b) Integrated Report*. Santa Fe, NM.

NMED/SWQB. 2009. *Procedures for Assessing Water Quality Standards Attainment for the State of New Mexico CWA §303(d)/§305(b) Integrated Report: Assessment Protocol*. Santa Fe, NM. June 19, 2009.

Peck, D.V., J.M. Lazorchak, and D.J. Klemm (editors). 2003. *Environmental Monitoring and Assessment Program -Surface Waters: Western Pilot Study Field Operations Manual for Wadeable Streams*. EPA/XXX/X-XX/XXXX. U.S. Environmental Protection Agency, Washington, D.C.

Plafkin, J.L., M.T. Barbour, K.D. Porter, S.K. Gross, and R.M. Hughs. 1989. *Rapid bioassessment protocols for use in streams and rivers.* USEPA. Office of Water Regulations and Standards. EPA/444/4-89-001. Washington, D.C.

Simon A. 1989. A model of channel response in disturbed alluvial channels. *Earth Surface Processes and Landforms* 14*(*1*):*11-26.