WATER QUALITY SURVEY SUMMARY
FOR THE
TULAROSA CLOSED BASIN WATERSHED
2004

Prepared by

Surface Water Quality Bureau
New Mexico Environment Department

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Acknowledgements

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AU	Assessment Unit
BLM	Bureau of Land Management
cfs	Cubic feet per second
CWA	Clean Water Act
^{o}C	Degrees Celsius
^{o}F	Degrees Fahrenheit
Ecoregion	Ecological regions based on geology, physiography, vegetation, climate, soils, land use, wildlife, and hydrology.
GIS	Geographic Information Systems
HUC	Hydrologic unit code
km^2	Square kilometer
mg/L	Milligrams per Liter
mi^2	Square miles
mL	Milliliters
mm	Millimeters
NM	New Mexico
NMAC	New Mexico Administrative Code
NMED	New Mexico Environment Department
STORET	EPA's Storage and Retrieval Database
SWQB	Surface Water Quality Bureau
USDA	U.S. Department of Agriculture
USEPA	U.S. Environmental Protection Agency
USFS	U.S. Forest Service
USGS	U.S. Geological Survey
WQCC	Water Quality Control Commission
WQS	Water quality standards (NMAC 20.6.4. as amended through July 17, 2005.)

1.0 EXECUTIVE SUMMARY

Water quality surveys and assessments are completed in fulfillment of Section 106 of the Clean Water Act (CWA) [33 USC 1251 et seq.], *Work Program for Water Quality Management.* The purpose of the survey is to collect water quality data to identify and prioritize water quality problems within a watershed and to evaluate the effectiveness of water quality based controls. The data collected as part of the survey are compared to New Mexico's current water quality standards, as approved by the United States Environmental Protection Agency (USEPA), to determine if the surveyed waterbodies are supporting their designated uses, such as the fishable and swimmable goals set forth in the CWA §102(a).

Water Quality Survey Summary Reports focus on information and data collected by the New Mexico Environment Department's (NMED) Surface Water Quality Bureau (SWQB) pertaining to stream reaches that were identified as NOT meeting water quality standards. All data collected as part of a survey are available upon request to the SWQB and can be downloaded from USEPA's computerized environmental storage and retrieval data system known as STORET. The data collected as part of this study are 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 summarized in the biennial *State of New Mexico Integrated CWA §303(d)/305(b) Report*.

During July through November 2004, SWQB conducted water chemistry sampling at 8 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. In addition, data loggers were deployed for roughly a week at select stations to collect temperature, pH, dissolved oxygen, conductivity, and turbidity data to monitor diurnal trends.

In general water quality in the Tularosa Closed Basin watershed was found to meet applicable criteria, with only two water quality standards criteria exceedences observed during the 2004 survey. Three Rivers Creek from the US Forest Service boundary to its headwaters exceeded the *E. coli* criterion. Dog Canyon Creek (Perennial portions) is exceeded the temperature criterion, however long-term thermograph data are needed to confirm this exceedence which was based on grab data.

2.0 INTRODUCTION

The Monitoring and Assessment Section of the Surface Water Quality Bureau (SWQB) conducted a water quality survey on the Tularosa Closed Basin watershed between July and November 2004. Depending on the presence of water, anywhere from two to nine sampling events, were conducted to capture different portions of the seasonal hydrograph (see Figure 1). A total of 8 sites were located throughout the basin. Figures 2, 3 and 4 illustrate the location of these sites in reference to land cover and land ownership, and geology respectively.

Water quality, physical habitat, and biota were studied to characterize the streams and determine impairment. Water samples were analyzed for plant nutrients, ions, total and dissolved metals and, on a more limited basis, *E. coli* bacteria, radionuclides, and anthropogenic organic compounds. Physical habitat was evaluated using geomorphological surveys and field parameters such as dissolved oxygen, temperature, specific conductance, turbidity and pH were measured.

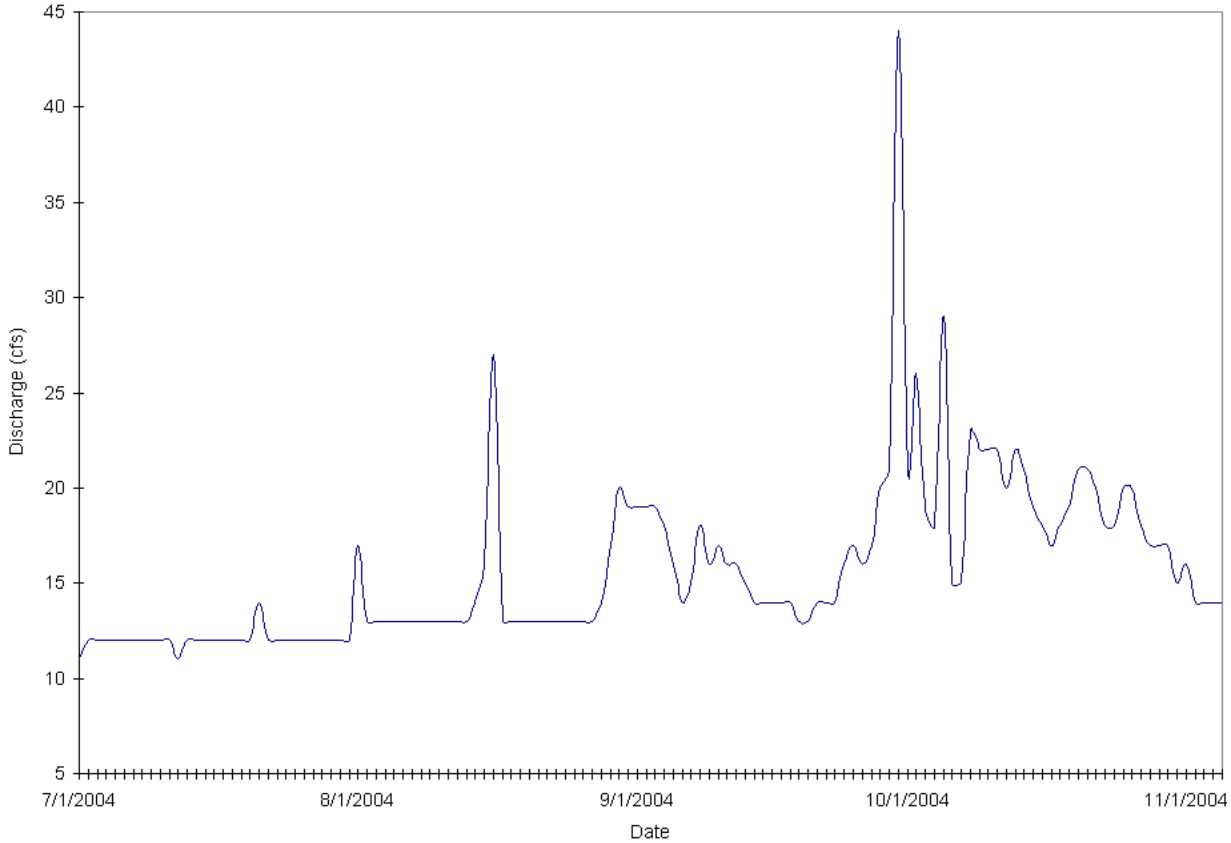

Figure 1. Discharge of the Rio Tularosa During the 2004 Survey.
Data from USGS gage number 08481500 TULAROSA CREEK NEAR BENT, NM.

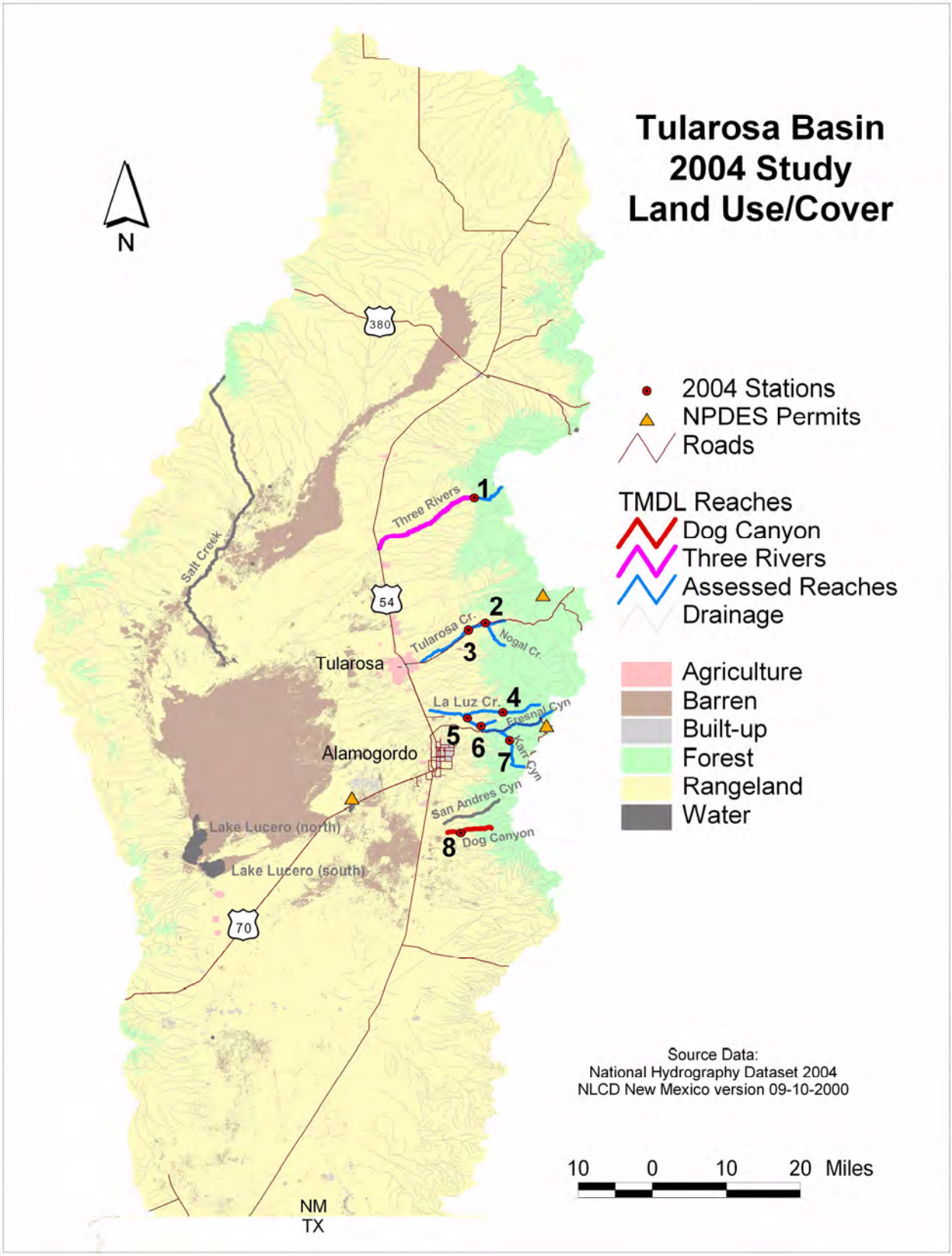

Figure 2. Tularosa Closed Basin Land Use/Land Cover and Sampling Stations

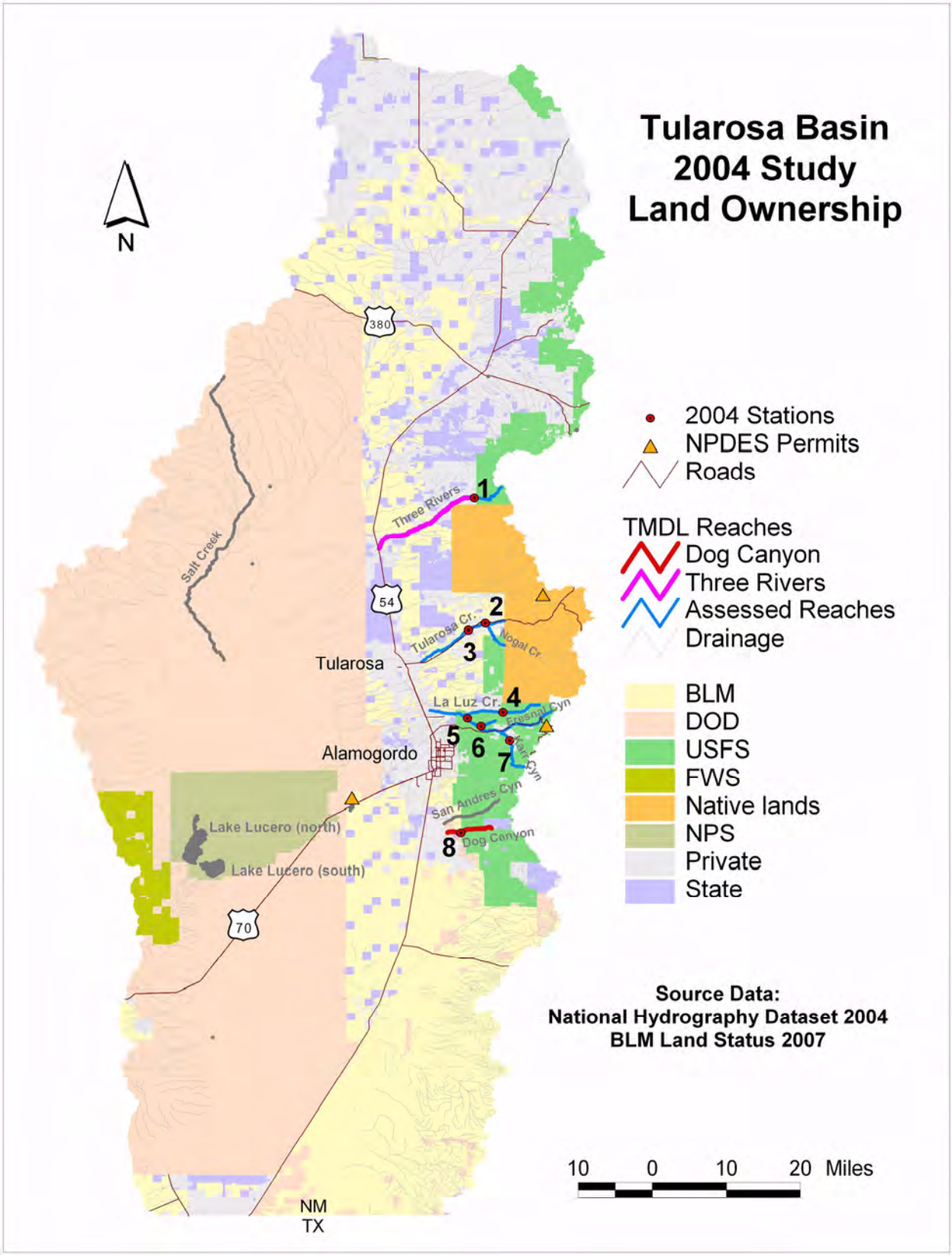

Figure 3. Tularosa Closed Basin Land Ownership and Sampling Stations

The geology of the Tularosa Closed Basin consists of a complex distribution of Tertiary igneous rock, felsic volcanic rock, intrusive rocks, and alluvium (Figure 4). The watershed lies along the east-southeast margin of the Río Grande Rift Soft upper Paleozoic, Mesozoic, and lower Cenozoic sedimentary strata dominantly characterize the geologic setting of the area. These units contain Permian through Tertiary age continental and marine sandstones, shales, mudstones, and carbonate rocks. Strata are generally flat lying, often faulted, and carved into broad valleys flanked by mesas and mountains. The mountainous areas along the margins of the northeast and west-central watershed are made up of intrusive igneous rocks (granitic plutonic rocks, gneiss, and schists). Younger Tertiary or Quaternary volcanic rocks intrude the sediments and occasionally cap high standing mesas. Tertiary and Quaternary valley fill, pediment gravels, talus, and alluvial deposits mantle the geologic section.

Like most of New Mexico, the climate of the Central Closed Basins, which includes the Tularosa, Salt and Jornada del Muerto Basins, varies with elevation. The lower areas of each basin are warm and dry, being around 4,000 feet in elevation. Potential evapotranspiration in these areas significantly exceeds annual precipitation. The mountainous rims of the four basins, in contrast, have a cooler and more humid climate, often with fewer than one hundred frost-free days and more than twenty-five inches of rainfall in an average year. The edges of these basins are generally at least 6,500 feet high while Sierra Blanca, on the rim of the Tularosa Sub-basin, is nearly 12,000 feet (3649 meters) in elevation. Wind patterns in the lowlands combine with sparse vegetation in these areas to cause localized cyclones, or “dust devils,” with heights up to 12,000 feet. As climate varies with elevation, so does vegetation. The study area lies within Level IV Ecoregions 23a Chihuahuan desert slopes, 23b Madrean lower montane woodlands and 23f Rocky Mountain conifer forests (Griffith, G.E. et al., 2006).

The major surface waters of the Tularosa Closed Basin are the Rio Tularosa and Three Rivers. Additional perennial streams flowing into the basin include Freznal Creek, La Luz Creek and numerous small springs including those in San Andres Canyon, Dog Canyon and Alamogordo Canyon. According to the New Mexico Office of the State Engineer in 2004, the City of Alamogordo has surface water rights to 17,000 acre feet per year, which constitutes approximately 72% of the city’s total water rights. Of that, 700 acre feet per year come from Bonito Lake in the Pecos River watershed. Holloman Air Force Base also utilizes 700 acre feet per year from Bonito Lake. Withdrawal points in La Luz, Freznal and Alamo Canyons provide 95.5% of the City of Alamogordo’s surface water rights.

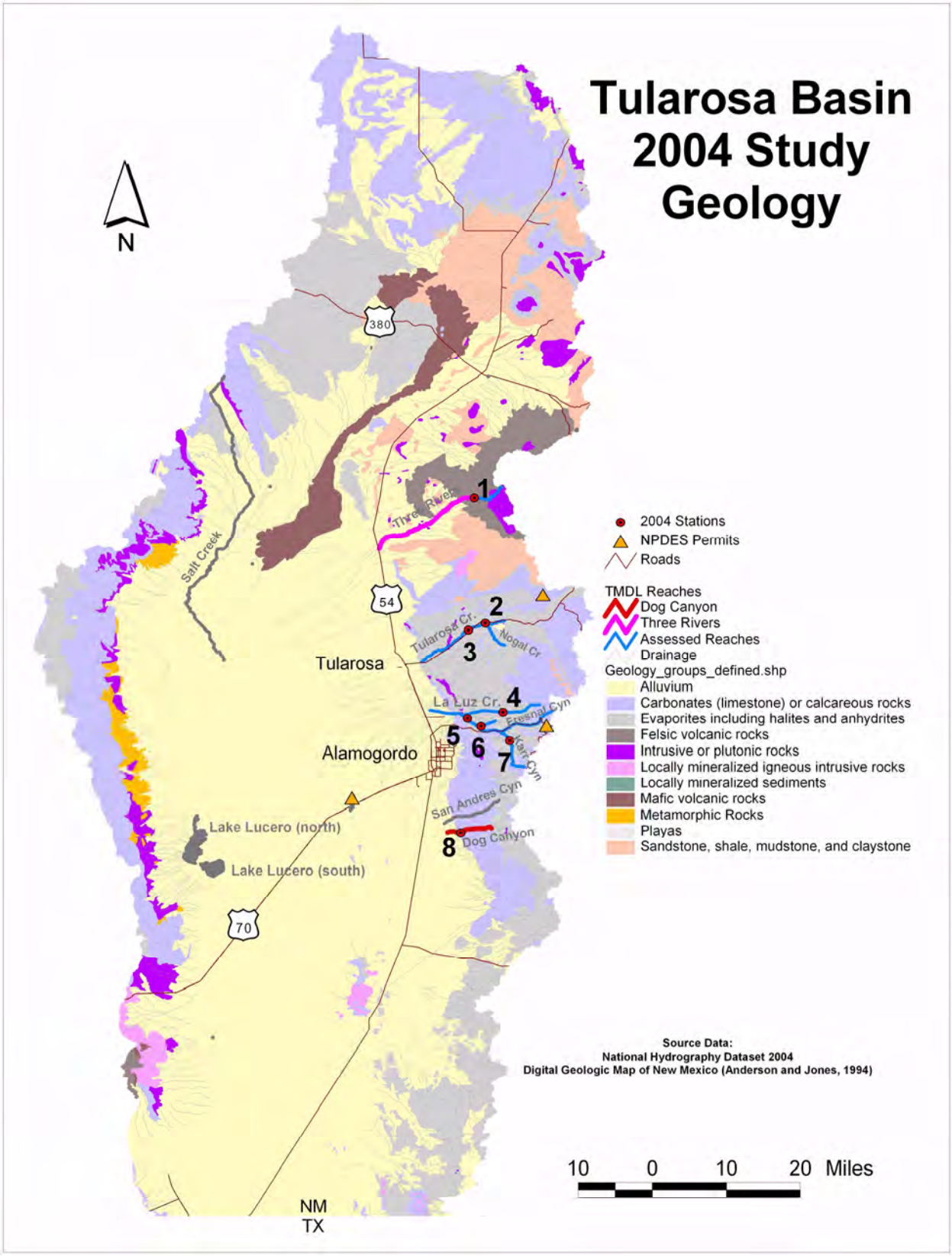

Figure 4. Tularosa Closed Basin Geology

3.0 NM WATER QUALITY STANDARDS

General water quality criteria and criteria applicable to attainable or designated uses for portions of the Tularosa Closed Basin watershed that were surveyed in this study are set forth in sections 20.6.4.13 and 20.6.4.900, of the *New Mexico Standards for Interstate and Intrastate Surface Waters* (NM Administrative Code [NMAC] 20.6.4. (as amended through July 17, 2005 at the time of data assessment for this survey). Segment specific standards for the Tularosa Closed Basin are set forth in Sections 20.6.4.801 and 20.6.4.802 and read as follows:

20.6.4.801 CLOSED BASINS - Rio Tularosa lying east of the old U.S. highway 70 bridge crossing east of Tularosa and all perennial tributaries to the Tularosa basin except Three Rivers.

A. Designated Uses: coldwater aquatic life, fish culture, irrigation, livestock watering, wildlife habitat, municipal and industrial water supply and secondary contact.

B. Criteria:

(1) In any single sample: pH within the range of 6.6 to 8.8 and temperature 20°C (68°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 235 cfu/100 mL or less (see Subsection B of 20.6.4.14 NMAC).

[20.6.4.801 NMAC - Rp 20 NMAC 6.1.2801, 10-12-00; A, 05-23-05]

20.6.4.802 CLOSED BASINS - Perennial reaches of Three Rivers.

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

B. Criteria:

(1) In any single sample: specific conductance 500 µmhos/cm or less, pH within the range of 6.6 to 8.8 and temperature 20°C (68°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 235 cfu/100 mL or less (see Subsection B of 20.6.4.14 NMAC).

[20.6.4.802 NMAC - Rp 20 NMAC 6.1.2802, 10-12-00; A, 05-23-05]

Additionally, standards set forth at 20.6.4.13, GENERAL STANDARDS, and 20.6.4.900, CRITERIA APPLICABLE TO ATTAINABLE OR DESIGNATED USES UNLESS OTHERWISE SPECIFIED IN 20.6.4.97 THROUGH 20.6.4.899 NMAC, apply.

Table 1 details the current listings on the *2008-2010 State of New Mexico Integrated Clean Water Act §303(d)/ §305(b) Report* (NMED/SWQB, 2008). To date, no TMDLs have been written for this watershed.

Table 1. Summary of Water Quality Impairments in the Tularosa Closed Basin, 2008-2010 Integrated List

Assessment Unit	2008-2010 Integrated List
Dog Canyon (Perennial portions)	temperature
Three Rivers (USFS bnd to headwaters)	*E. coli*

4.0 METHODS

The Tularosa Closed Basin was sampled by the SWQB in 2004. A brief summary of the survey and the hydrologic conditions during the sample period is provided in the following subsections.

4.1 Survey Design

Monitoring stations were selected to characterize water quality of various assessment units (i.e., stream reaches) throughout the closed basin watershed. The survey included 8 water quality sites (Figure 2-4, Table 2). Stations were located to evaluate the impact of tributary streams and to determine ambient and background water quality conditions. Monitoring these sites enabled an assessment of the cumulative influence of the physical habitat, water sources, and land management activities upstream from the sites and to characterize smaller tributaries, determine the influence of springs and wells, and examine changes in the character of the larger streams in the upstream reaches.

Table 2. SWQB 2004 Tularosa Closed Basin Sampling Stations

Site	Assessment Unit	Station Description	Latitude	Longitude	STORET ID	Rationale
1	Three Rivers (USFS bnd to headwaters)	Three Rivers at Forest Service Campground	33.402781	-105.885837	48ThreeR02 2.8	Station in 1987 study survey (Pierce, 1987a&b). Met standards at that time.
2	Nogal Creek* (Tularosa Creek to Mescalero Apache bnd)	Nogal Creek at County Road B-17	33.158059	-105.864449	48NogalC00 0.2	Station in 1987 survey (Pierce, 1987a&b). Met standards at that time.

Table 2. SWQB 2004 Tularosa Closed Basin Sampling Stations, cont.

Site	Assessment Unit	Station Description	Latitude	Longitude	STORET ID	Rationale
3	Rio Tularosa (Old US 70 crossing to Mescalero Apache bnd)	Rio Tularosa at USGS Gages – Old Hwy Crossing	33.145003	-105.897227	48RTular03 0.0	Station in 1987 survey (Pierce, 1987a&b). Met standards at that time. Stakeholders expressed concern about water quality in this area.
4	La Luz Creek*	La Luz Creek at County Road A-70 Crossing	32.98472	-105.82972	48LaLuzC0 14.2	La Luz is a water source for Alamogordo, NM, and historically had perennial reaches.
5	Fresnal Creek* (La Luz Creek to headwaters)	Fresnal Creek at Alamogordo Water Intake	32.972504	-105.899170	48FresCa00 1.0	Evaluate water quality at the intake.
6	Rio Salado	Rio Salado above Fresnal Canyon	32.956810	-105.872510	48Salado00 0.4	This tributary to Fresnal was flowing while Fresnal had no flow.
7	Karr Canyon (Fresnal Canyon to headwaters)	Karr Canyon above Raven Road	32.928870	-105.816730	48KarrCa00 2.9	Perennial reach from Fresnal Canyon to National Forest boundary.
8	Dog Canyon Creek(Perennial portions)	Dog Canyon at Nature Trail	32.749520	105.912370	48DogCan0 02.7	Dog Canyon has a small, spring fed, perennial stream.

*No flow observed during the survey

4.2 Hydrologic Conditions

The Tularosa Closed Basin contains only one active real-time USGS gage station (Gage number 08481500, Tularosa Creek near Bent, NM). The 2004 SWQB watershed survey was performed over varying flow conditions from July through November. No instantaneous stream-flow measurements were taken. As stated in the Assessment Protocol (NMED/SWQB 2006), data collected during all flow conditions, including low flow conditions (i.e., flows below the 4-day, 3-year low flow frequency [4Q3]), will be used to determine designated use attainment status during the assessment process. In terms of assessing designated use attainment in ambient surface waters, WQS apply at all times under all flow conditions.

5.0 SAMPLING SUMMARY

Surface water grab samples were analyzed for a variety of chemical/physical parameters. Surface water quality samples were collected monthly between July through November 2004. Data from grab samples and field measurements are housed in the SWQB provisional water quality database and were uploaded to USEPA's Storage and Retrieval (STORET) database.

Table 3 summarizes data collected in each assessment unit and at each station. The number of times each parameter (or suite of parameters) was sampled is indicated. Field data include temperature, specific conductance, pH, dissolved oxygen and turbidity.

All sampling and assessment techniques used during the 2004 SWQB survey are detailed in the *Quality Assurance Project Plan* (QAPP) (NMED/SWQB 2004) and assessment protocols (NMED/SWQB 2006) both of which are available online at http://www.nmenv.state.nm.us/SWQB/ or by contacting the SWQB directly.

Table 3. Sampling Summary

Stations	Field Data	Ions	Nutrients	Total Metals	Dissolved Metals	*Escherichia coli*	Fecal Coliforms	Organics	Sonde Deployment	Thermograph	Geomorphology
Three Rivers @ USFS Campground	5	6	6	3	2	5	4	1	X		X
Nogal Creek at County Road B-17 *											
Rio Tularosa at USGS Gage – Old Hwy Crossing	5	5	4	2	2	4	3	1	X		X
La Luz Creek at County Road A-70 *											
Fresnal Creek at Alamogordo Water Intake*											
Rio Salado above Fresnal Canyon	2	2	2	1	1						
Karr Canyon above Raven Road	4	4	4	2	2	2	2		X	X	X
Dog Canyon at Nature Trail	5	6	6	2	2	5	4	1	X		X

* Dry for entire survey

6.0 WATER QUALITY ASSESSMENT

6.1 Water Quality Standards Exceedences

For many water quality parameters, the State of New Mexico maintains numeric water quality standards. However, for several parameters e.g., plant nutrients and stream bottom deposits, only narrative standards exist. Data are assessed for designated use attainment status for both numeric and narrative water quality standards by application of the *Assessment Protocol* and associated appendices (NMED/SWQB 2006).

The following discussion includes information pertaining to all exceedences of water quality standards found during the 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 NMED/SWQB's *Assessment Protocol* for additional information on the assessment process, NMED/SWQB, 2006). When available, outside sources of data that meet quality assurance requirements are combined with data collected by SWQB during watershed surveys 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 Integrated Clean Water Act §303(d)/ §305(b) Report* (NMED/SWQB, 2008).

6.1.1 Physicochemical Data

As a result of the 2004 SWQB monitoring effort, two exceedences of the surface water standards were identified (Table 4). A complete data set can be obtained by contacting the SWQB.

Table 4. Physicochemical Water Quality Standards Exceedences

Assessment Unit	Temperature	*E. coli*	Station
Dog Canyon (Tularosa Creek to headwaters)	**CWAL - NS**	Secondary Contact - FS	Dog Canyon at Nature Trail
Three Rivers (USFS bnd to headwaters)	HQCWAL - FS	**Secondary Contact - NS**	Three Rivers @ USFS Campground

FS=Full Support, NS =Non Support

6.1.2 Data from Continuous Monitoring Devices

Large data sets generated from data loggers (i.e., multi-parameter sondes and thermographs) are assessed according to protocols developed specifically for such datasets. 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 several thousand data points.

Dissolved oxygen assessment criteria are based on season (i.e., if early life stages of fish are likely present) and designated use (coldwater or warmwater aquatic life use). pH assessment criteria are tied to the criteria in the *New Mexico Standards for Interstate and Intrastate Surface Waters* (NMAC, 2004). Details of large dataset assessment procedures are available in appendices C, F and G of the *Assessment Protocol* (NMED/SWQB 2006).

Table 5. Summary of Thermograph Data.

Station Name	Data Collection Interval	WQS Temperature Criterion (°C)	Maximum Recorded Temperature (°C)	Total # of Data Points	# / % of Exceedences
Karr Canyon abv Raven Rd	1 hr	20	18.2	2805	0/0

Table 6a. Summary of pH Data Collected from Sondes.

Station Name	Designated Use	Criterion SU	Deployment Dates (2004)	Min/Max SU	Number/% Exceedences	Magnitude Exceedence	Frequency Exceedence
Rio Tularosa @ USGS Gage - Old HWY Crossing	CWAL	6.6 – 8.8	8/19 – 8/26	7.98 / 8.32	0/0	0/0	0/0
Three Rivers at USFS Campground	CWAL	6.6 – 8.8	8/20 – 8/26	7.57 – 7.76	0/0	0/0	0/0
Karr Canyon above Raven Road	CWAL	6.6 – 8.8	8/19 – 8/26	7.82 – 8.20	0/0	0/0	0/0
Dog Canyon at Nature Trail	CWAL	6.6 – 8.8	8/19 – 8/26	7.82 – 7.98	0/0	0/0	0/0

Table 6b. Summary of DO Data Collected from Sondes.

Assessment Unit Station Name	Designated Use	WQS Criterion Mg/L	Deployment Dates 2004	Min/Max Concentration Mg/L	Min. Sat. % Local	Assessment Criterion	Combined Conc./Sat. exceedences #/%/>3 hrs	% Sat. Exceedences #/%/>3 hrshrs
Rio Tularosa At USGS Gage – Old HWY Crossing	**CWAL**	**6.0**	**8/19 – 8/26**	**7.74 – 8.90**	**101.3**	**6.0 mg/l – 90%**	**0/0/0**	**0/0/0**
Three Rivers at USFS Campground	**HQCWAL**	**6.0**	**8/20 – 8/26**	**6.95 – 8.52**	**98.1**	**6.0 mg/l – 90%**	**0/0/0**	**0/0/0**
Karr Canyon at Raven Road	**CWAL**	**6.0**	**8/19 – 8/26**	**7.77 – 9.11**	**101.8**	**6.0 mg/l – 90%**	**0/0/0**	**0/0/0**
Dog Canyon at Nature Trail	**CWAL**	**6.0**	**8/19 – 8/26**	**5.88 – 8.40**	**76.1**	**6.0 mg/l – 90%**	**4/2.4/0**	**0/0/0**

6.1.3 Riparian Health

The riparian area is the corridor of vegetation surrounding the stream and providing 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 stream 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 7**) provide an indication of riparian health.

Table 2. Riparian Cover and Qualitative Scores for the Tularosa Closed Basin Watershed, 2004.

Station Name	% Riparian Canopy Cover	RGA[1] Stability Score (0 – 36)	RHA[2] Habitat Score (0 – 200)
Three Rivers at USFS Campground	**83.33**	**5.0**	**140**
Karr Canyon at Raven Road	**21.41**	**7.0**	**171**
Dog Canyon at Nature Trail	**51.96**	**4.5**	**179**
Rio Tularosa At USGS Gage	**N/D**	**17.5**	**107**

1. 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. Rapid Habit 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

6.1.4 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 as displayed in Table 8. Other metrics in Table 8 describe the sizes 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 3. Substrate Composition Data from the Tularosa Closed Basin Watershed, 2004. Sites in bold are reference sites.

Station Name Bold indicates reference	D 50 mm	% Bedrock	% Boulder	% Cobble	% Gravel	% Sand	% Silt / Clay
Three Rivers at USFS Campground	1.2	0	17	9	36	30	8
Karr Canyon at Raven Road	0.8	2	0	3	44	24	28
Dog Canyon at Nature Trail	60	60	2	8	4	4	16

6.1.5 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, 2008). 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 9**). For total phosphorus, total nitrogen, and chlorophyll *a*, the threshold values are dependent on the ecoregion and designated aquatic life use.

Table 9. Nutrient Assessment Data from Tularosa Closed Basin Watershed, 2004. Shaded cells indicate an exceedence of the threshold value.

Assessment Unit Station ID	**Ecoregion**	**Designated Aquatic Life Use**	**DO & pH – long term datasets**	**DO %Saturation – grab** (# and % of exceedences)	**pH – grab** (# and % of exceedences)	**DO concentration – grab** (# and % of exceedences)	**Total Nitrogen** (# and % of exceedences)	**Total Phosphorus** (# and % of exceedences)	**Chlorophyll *a* exceedence?**
Tularosa Creek (Old US 70 crossing to Mescalero Apache bnd) Rio Tularosa at USGS Gage	AZ/NM Mountains	CWAL	Support CWAL	0/5 , 0%	0/5 , 0%	0/5 , 0%	4/4, 100%	0/4, 0%	No
Dog Canyon (Perennial portions) Dog Canyon at Nature Trail	Chihuahuan Desert	CWAL	Support CWAL	0/6 , 0%	0/5 , 0%	0/6, 0%	0/4 , 0%	0/4 , 0%	Yes

7.0 DISCUSSION

Due to the large volume of data collected during this survey, it will not be included in this report. Those persons requiring a complete dataset or data from a specific site should contact the Surface Water Quality Bureau or search EPA's STORET database. All of the monitoring that was conducted is summarized in **Table 3**. Those parameters that exceeded the State's Water Quality Standards are shown in **Table 4**. These data are organized by assessment unit, designated use or segment-specific criteria, parameter, and sample station in that order.

In general, water quality in the Tularosa Closed Basin watershed, where sampled in 2004, met applicable water quality standards criteria. Concentrations of dissolved metals were low, usually below the limit of detection. Analyses of over 200 volatile and semi-volatile organic compounds found nothing at levels above relevant EPA standards or guidance. Total Dissolved Solids (TDS) were at a level to be expected in desert streams. The only WQS exceedences leading to listings in the 2008-2010 Integrated List were for temperature in Dog Canyon Creek and *E. coli* in Three Rivers.

Changes in study design, analytical methods and target analytes over the years makes comparisons between the 1987 survey (Pierce, 1987a&b) and this 2004 survey difficult. There were only three stations, Three Rivers @ USFS Campground, Nogal Creek at County Road B-17 and Rio Tularosa at USGS Gage – Old Hwy Crossing, that were sampled in both surveys and of these Nogal Creek was dry for the entire 2004 survey. The timing of the sampling efforts at

those stations was very different, with multiple visits on three consecutive days in 1987 and a single day visit in each of four consecutive months in 2004. Changes to WQS criteria *e.g.*, from total metals to dissolved metals, caused changes to parameter suites sampled. In 2004, drought condition resulted in a lack of flow which prevented sampling at the downstream stations sampled in 1987 and rendered evaluation of the hydrologic and chemical degradation found there in 1987 impossible on Three Rivers.

References

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