

## 5. Water Supply

This section provides an overview of the water supply in the Lower Rio Grande Water Planning Region, including climate conditions (Section 5.1), surface water and groundwater resources (Sections 5.2 and 5.3), water quality (Section 5.4), and the administrative water supply used for planning purposes in this regional water plan update (Section 5.5). Additional quantitative assessment of water supplies is included in Section 7, Identified Gaps between Supply and Demand.

The *Updated Regional Water Planning Handbook* (NMISC, 2013) specifies that each of the 16 regional water plans briefly summarize water supply information from the previously accepted plan and provide key new or revised information that has become available since submittal of the accepted regional water plan. The information in this section regarding surface and groundwater supply and water quality is thus drawn largely from the accepted *Lower Rio Grande Regional Water Plan* (Terracon et al., 2003) and, where appropriate, updated with more recent information and data from a number of sources, as referenced throughout this section.

The Lower Rio Grande region has both groundwater and surface water, and in some cases these supplies are closely linked and necessitate conjunctive management. Due to the flourishing agricultural community, supported in large measure by New Mexico State University, and the proximity of the Las Cruces, El Paso, and Ciudad Juarez metropolitan areas, competition for water supplies has been intense for over a century. In the late 1890s the Mexican government filed a claim for damages against the United States alleging that the water shortages in Juarez were due to increasing diversions upstream (West, 1995). Thus began a series of agreements that led to construction of the Rio Grande Project as it exists today and, ultimately, negotiation of the Rio Grande Compact. They include, but are not limited to, the 1896 Federal Embargo on water development, the 1929 Temporary Rio Grande Compact, the Rio Grande Canalization Project, and a number of associated investigations into the hydrology of the Rio Grande. Water supply shortages continue to be a major issue during extended drought.

Currently, some of the key water supply updates and issues impacting the Lower Rio Grande region are:

- The Rio Grande stream system is fully appropriated. In general, any new water uses that impact the flows of the Rio Grande must be offset through return flow, the transfer of existing water rights, and/or supplementation by a new source of water. No mechanism is presently in place to allow transfers of Rio Grande Project water from the Elephant Butte Irrigation District (EBID) to non-agricultural uses.
- Groundwater pumping and depletions in New Mexico and Texas impact the flows of the Rio Grande and affect the operations of the Rio Grande Project. This issue continues to be a source of controversy and conflict among New Mexico, Texas, the U.S. Bureau of Reclamation (USBR), and the two U.S. irrigation districts supplied by the Rio Grande Project (EBID in New Mexico and El Paso County Water Improvement District #1

[EPCWID#1] in Texas).

- In 2013 the State of Texas initiated a lawsuit in the U. S. Supreme Court over the Rio Grande Compact, specifically water management and water use by New Mexico below Elephant Butte Dam, and names New Mexico and Colorado as defendants. The United States has joined in this lawsuit. The outcome of this lawsuit, whether through settlement or court order, may have significant impacts on water management in the Lower Rio Grande region.
- An Operating Agreement for the Rio Grande Project, developed during settlement of litigation between EBID, EPCWID #1, and USBR in Texas Federal District Court, was implemented in 2008. Implementation of this agreement appears to have reduced EBID's allocation of Rio Grande Project water in full-supply years by more than 150,000 acre-feet, and this large decrease is likely to lead to increased dependence on groundwater for irrigation. Many questions persist regarding the fairness and sustainability of the Operating Agreement as it has been implemented. The New Mexico Attorney General sued the USBR in 2011 regarding this Operating Agreement and the USBR's unauthorized release of New Mexico Compact credit water to ECWID#1. The judge in the case has stayed, or suspended, any action in this lawsuit pending action by the U. S. Supreme Court. Continued conflict associated with this Agreement is likely.
- Recent drought and high levels of groundwater pumping may cause increased concentration of salts in the soils and aquifers of the Rincon and Mesilla Valleys, and increased groundwater salinity may limit the usefulness of this water for some applications in the future.
- The demand for water in the Lower Rio Grande region has increased through time due to increasing population and increasing cultivation of high-water-demand crops such as alfalfa and pecans.
  - The population of the Lower Rio Grande planning region is expected to expand from approximately 209,000 in 2010 to almost 350,000 in 2060. The increasing demand for municipal water is likely to result in water rights transfers from agriculture through willing seller-willing buyer agreements.
  - The great majority of water use in the Lower Rio Grande surface water basin is for irrigation, but fallowing otherwise irrigated lands during drought periods is complicated by the fact that about 30 percent of irrigated lands in the Lower Rio Grande basin are planted in permanent crops such as pecan orchards that would be severely stunted or lost if not irrigated.
- Salinity of Rio Grande Project water has long been a source of controversy between New Mexico and Texas. In 2008 the Rio Grande Compact Commission, together with NMISC and the New Mexico Environment Department (NMED), assisted in the formation of a multi-state Río Grande Project Salinity Management Coalition (Coalition). The Coalition

is composed of Texas, New Mexico, and Colorado state water agencies, irrigation districts, El Paso and Las Cruces water utilities, and university researchers (NMED, 2012a, 2012b; Crilley et al., 2013; Hogan et al., 2007). The overall objectives of the Coalition are to reduce salinity concentrations and impacts in the Río Grande Project area in order to increase usable water supplies for agricultural, urban, and environmental purposes in the critical Texas-New Mexico border region. On behalf of the Coalition, NMISC, NMED, the Texas Commission on Environmental Quality, Texas Water Development Board, and the U.S. Army Corps of Engineers are working on a Water Resources Development Act Section 729 project to bring together existing information and develop a recommended strategy for moving forward with salinity management projects.

- The Lower Rio Grande stream system adjudication—the largest ongoing adjudication in the state—is underway, with close to 45 percent of the 13,979 water right subfiles now adjudicated (Knowles, 2015). Major water rights issues are now before the adjudication court or in the process of implementation pursuant to an earlier order from the court. See Section 4.1.2.5 for additional discussion.
- Given the growing population in the region, there is likely to be an increased municipal and commercial market for water rights. Transfer of irrigation water rights associated with the Rio Grande Project into non-irrigation uses will involve coordination with USBR and EBID and development of a transfer mechanism and set of rules for such transfers. Special water user associations have been created in anticipation of future use of Rio Grande Project water for drinking supplies and other non-irrigation uses.
- The risk of flooding from the Rio Grande and its tributaries is a key concern in the region. Much of the original flood control infrastructure was installed decades ago and requires maintenance and upgrades. Recently, the International Boundary and Water Commission (IBWC) completed improvements on over 200 miles of infrastructure including Rio Grande levees, floodwalls, floodgates, and ancillary structures (USBR, 2016). However, full implementation of all the necessary flood control improvements is expected to be very expensive, due in part to required removal of sediment deposited within the Rio Grande channel and issues associated with aging infrastructure.
- Endangered species and environmental restoration issues may increase in importance. Large populations of southwestern willow flycatcher and yellow billed cuckoo, both listed species under the federal Endangered Species Act, reside in the dry portion of the reservoir pool of Elephant Butte Reservoir. Operations of Elephant Butte and Caballo Reservoirs may be impacted by habitat protection for these species. Furthermore, a number of non-governmental organizations have taken an interest in the potential for aquatic and related wetland restoration in and along the main channel of the Rio Grande within the EBID and Lower Rio Grande basin.
- Under the National Environmental Policy Act (NEPA), the Bureau of Reclamation is

currently drafting an Environmental Impact Statement (EIS) on the 2008 Operating Agreement, which is discussed in more detail in Section 4.3.1. Depending on the outcome of the EIS process, Rio Grande Project operations may be affected.

- The Jornada del Muerto Basin is primarily an alluvial basin that is being mined through groundwater pumping of its finite freshwater supply, and demand is tending to outpace supply in parts of the southernmost extent of the basin, where population growth and development have increased rapidly in recent years. Other parts of the Jornada del Muerto Basin are also the subject of keen interest, including the central area in which the newly constructed Spaceport America resides.
- High levels of E. coli in the Rio Grande exceed total maximum daily load (TMDL) criteria (Section 5.4) and are a threat to public health.
- Under Section 72-12-25 NMSA, notices of intent to drill deep wells in the eastern Mimbres Basin, within Doña Ana County and about 15 miles from the Rio Grande, for the withdrawal of 25,000 acre-feet per year of nonpotable water have been filed, including a notice to drill five deep wells for the withdrawal of 5,000 acre-feet per year filed by the City of Las Cruces prior to changes in state law.
- The many small rural drinking water systems within the region face challenges in financing infrastructure maintenance and upgrades and complying with water quality monitoring and training standards. Though the source water for these systems is generally good-quality groundwater, the maintenance, upgrades, training, operation, and monitoring that is required to ensure delivery of water that meets drinking water quality standards is a financial and logistical challenge for these small systems. The water systems in Garfield, Hatch, and Mesilla recently received New Mexico Water Trust Board funding for upgrading waterlines and other infrastructure improvements for fiscal year 2015.

## **5.1 Summary of Climate Conditions**

The 2003 regional water plan (Terracon et al., 2003) included an analysis of historical temperature and precipitation in the region. This section provides an updated summary of temperature, precipitation, snowpack conditions, and drought indices pertinent to the region (Section 5.1.1). Studies relevant to climate change and its potential impacts to water resources in New Mexico and the Lower Rio Grande region are discussed in Section 5.1.2.

### **5.1.1 Temperature, Precipitation, and Drought Indices**

Table 5-1 lists the periods of record for weather stations in Doña Ana County and identifies two stations that were used for analysis of weather trends. These stations were selected based on location, how well they represented conditions in their respective counties, and completeness of their historical records. The locations of the climate stations for which additional data were analyzed are shown in Figure 5-1.

Long-term minimum, maximum, and average temperatures for the two climate stations are detailed in Table 5-2, and average summer and winter temperatures for each year of record are shown on Figure 5-2.

The average precipitation distribution across the entire region is shown on Figure 5-3, and Table 5-2 lists the minimum, maximum, and long-term average annual precipitation (rainfall and snowmelt) at the two representative stations in the planning region. Total annual precipitation for the selected climate stations is shown in Figure 5-4. Average annual precipitation ranges from 8 inches in the valley to 23 inches in the Organ Mountains.

Another way to review long-term variations in climate conditions is through drought indices. A drought index consists of a ranking system derived from the assimilation of data—including rainfall, snowpack, streamflow, and other water supply indicators—for a given region. The Palmer Drought Severity Index (PDSI) was created by W.C. Palmer (1965) to measure the variations in the moisture supply and is calculated using precipitation and temperature data as well as the available water content of the soil. Because it provides a standard measure that allows comparisons among different locations and months, the index is widely used to assess the weather during any time period relative to historical conditions. The PDSI classifications for dry to wet periods are provided in Table 5-3.

There are considerable limitations when using the PDSI, as it may not describe rainfall and runoff that varies from location to location within a climate division and may also lag in indicating emerging droughts by several months. Also, the PDSI does not consider groundwater or reservoir storage, which can affect the availability of water supplies during drought conditions. However, even with its limitations, many states incorporate the PDSI into their drought monitoring systems, and it provides a good indication of long-term relative variations in drought conditions, as PDSI records are available for more than 100 years.

The PDSI is calculated for climate divisions throughout the United States. Doña Ana County falls primarily within New Mexico Climate Division 8 (the Southern Desert Climate Division) with a portion of Division 5 (the Central Valley Climate Division) extending about halfway into the eastern side of the region (Figure 5-1). Figure 5-6 shows the long-term PDSI for these two regions. Of interest are the large variations from year to year in both divisions, which are similar in pattern though not necessarily in magnitude.

The chronological history of drought, as illustrated by the PDSI, indicates that the most severe droughts in the last century occurred in the early 1900s, the 1950s, the early 2000s, and in recent years (2011 to 2013) (Figures 5-6a and 5-6b).

The likelihood of drought conditions developing in New Mexico is influenced by several weather patterns:

- *El Niño/La Niña*: El Niño and La Niña are characterized by a periodic warming and cooling, respectively, of sea surface temperatures across the central and east-central

equatorial Pacific. Years in which El Niño is present are more likely to be wetter than average in New Mexico, and years with La Niña conditions are more likely to be drier than average, particularly during the cool seasons of winter and spring.

- *The Pacific Decadal Oscillation (PDO)*: The PDO is a multi-decadal pattern of climate variability caused by shifting sea surface temperatures between the eastern and western Pacific Ocean that cycle approximately every 20 to 30 years. Warm phases of the PDO (shown as positive numbers on the PDO index) correspond to El Niño-like temperature and precipitation anomalies (i.e., wetter than average), while cool phases of the PDO (shown as negative numbers on the PDO index) correspond to La Niña-like climate patterns (drier than average). It is believed that since 1999 the planning region has been in the cool phase of the PDO.
- *The Atlantic Multidecadal Oscillation (AMO)*: The AMO refers to variations in surface temperatures of the Atlantic Ocean which, similarly to the PDO, cycle on a multi-decade frequency. The pairing of a cool phase of the PDO with the warm phase of the AMO is typical of drought in the southwestern United States (McCabe et al., 2004; Stewart, 2009). The AMO has been in a warm phase since 1995. It is possible that the AMO may be shifting to a cool phase but the data are not yet conclusive.
- *The North American Monsoon* is characterized by a shift in wind patterns in summer, which occurs as Mexico and the southwest U.S. warm under intense solar heating. As this happens, the flow reverses from dry land areas to moist ocean areas. Low-level moisture is transported into the region primarily from the Gulf of California and eastern Pacific. Upper-level moisture is transported into the region from the Gulf of Mexico by easterly winds aloft. Once the forests of the Sierra Madre Occidental green up from the initial monsoon rains, evaporation and plant transpiration can add additional moisture to the atmosphere that will then flow into the region. If the Southern Plains of the U.S. are unusually wet and green during the early summer months, that area can also serve as a moisture source. This combination causes a distinct rainy season over large portions of western North America (NWS, 2015).

### 5.1.2 Recent Climate Studies

New Mexico's climate has historically exhibited a high range of variability. Periods of extended drought, interspersed with relatively short-term, wetter periods, are common. Historical periods of high temperature and low precipitation have resulted in high demands for irrigation water and higher open water evaporation and riparian evapotranspiration. In addition to natural climatic cycles (i.e., el Niño/la Niña, PDO, AMO [Section 5.1.1]) that affect precipitation patterns in the southwestern United States, there has been considerable recent research on potential climate change scenarios and their impact on the Southwest and New Mexico in particular.

The consensus on global climate conditions is represented internationally by the work of the Intergovernmental Panel on Climate Change (IPCC), whose Fifth Assessment Report, released in

September 2013, states, “Warming of the climate system is unequivocal, and since the 1950s many of the observed changes are unprecedented over decades to millennia. The atmosphere and ocean have warmed, the amounts of snow and ice have diminished, sea level has risen, and the concentrations of greenhouse gases have increased” (IPCC, 2013). Atmospheric concentrations of greenhouse gases are rising so quickly that all current climate models project significant warming trends over continental areas in the 21st century.

In the United States, regional assessments conducted by the U.S. Global Change Research Program (USGCRP) have found that temperatures in the southwestern United States have increased and are predicted to continue to increase, and serious water supply challenges are expected. Water supplies are projected to become increasingly scarce, calling for trade-offs among competing uses and potentially leading to conflict (USGCRP, 2009). Most of the major river systems of the southwestern U.S. are expected to experience reductions in streamflow and other limitations to water availability (Garfin et al., 2013).

Although there is consensus among climate scientists that global temperatures are warming, there is considerable uncertainty regarding the specific spatial and temporal impacts that can be expected. To assess climate trends in New Mexico, the NMOSE and NMISC (2006) conducted a study of observed climate conditions over the past century and found that observed wintertime average temperatures had increased statewide by about 1.5°F since the 1950s. Predictions of annual precipitation are subject to greater uncertainty “given poor representation of the North American monsoon processes in most climate models” (NMOSE/NMISC, 2006).

A number of other studies predict temperature increases in New Mexico from 5° to 10°F by the end of the century (Forest Guild, 2008; Hurd and Coonrod, 2008; USBR, 2011). Predictions of annual precipitation are subject to greater uncertainty, particularly regarding precipitation during the summer monsoon season in the southwestern U.S.

Based on these studies, the effects of climate change that are likely to occur in New Mexico and the planning region include (NMOSE/NMISC, 2006):

- Temperature is expected to continue to rise.
- Higher temperatures will result in a longer and warmer growing season, resulting in increased water demand on irrigated lands and increased evapotranspiration from riparian areas, grasslands and forests, and thus less recharge to aquifers.
- Reservoir and other open water evaporation are expected to increase. Soil evaporation will also increase.
- Precipitation is expected to be more concentrated and intense, leading to increased projected frequency and severity of flooding.
- Streamflows in major rivers across the Southwest are projected to decrease substantially during this century (e.g., Christensen et al., 2004; Hurd and Coonrod, 2008; USBR,

2011, 2013) due to a combination of diminished cold season snowpack in headwaters regions and higher evapotranspiration in the warm season. The seasonal distribution of streamflow is projected to change as well: flows could be somewhat higher than at present in late winter, but peak runoff will occur earlier and be diminished. Late spring/early summer flows are projected to be much lower than at present, given the combined effects of less snow, earlier melting, and higher evaporation rates after snowmelt.

To minimize the impact of these changes, it is imperative that New Mexico plan for dealing with variable water supplies, including focusing on drought planning and being prepared to maximize storage from extreme precipitation events while minimizing their adverse impacts.

## **5.2 Surface Water Resources**

Surface water supplies approximately 60 percent of the water currently diverted in the Lower Rio Grande Water Planning Region, with its primary uses being for irrigated agriculture. The dominant waterway flowing in the region is the Rio Grande.

Major surface drainages (including both perennial and intermittent streams) and watersheds in the planning region are shown on Figure 5-7. The water planning region consists of parts of four distinct drainage basins, but only one of these, the Rio Grande, has a through-flowing river. The other three basins—the Jornada del Muerto, Tularosa, and Mimbres—are closed basins. When evaluating surface water information, it is important to note that streamflow does not represent available supply, as there are also water rights and interstate compact limitations. The administrative water supply discussed in Section 5.5 is intended to represent supply considering both physical and legal limitations, but excluding potential compact limitations. The information provided in this section is intended to illustrate the variability and magnitude of streamflow, and particularly the relative magnitude of streamflow in recent years.

Tributary flow is not monitored in every subwatershed in the planning region. However, streamflow data are collected by the USGS and various cooperating agencies at stream gage sites in the planning region. Table 5-4a lists the locations and periods of record for data collected at stream gages in the region, as well as the drainage area and estimated irrigated acreage for surface water diversions upstream of the station. Table 5-4b provides the minimum, median, and maximum annual yield for all gages that have 10 or more years of record. In addition to the large variability in annual yield, streamflow also varies from month to month within a year, and monthly variability or short-term storms can have flooding impacts, even when annual yields are low. Table 5-5 provides monthly summary statistics for each of the stations with 10 or more years of record.

For this water planning update, two stream gages, Rio Grande at Elephant Butte and Rio Grande below Caballo, shown on Figure 5-8, were analyzed in more detail. These stations were chosen because of their locations in the hydrologic system, completeness of record, and

representativeness as key sources of supply. Figure 5-8 shows the minimum and median annual water yield for these gages. Figure 5-9 shows the annual water yield from the beginning of the period of record through 2013 for the two gages. As shown in these figures, the gages are both upstream of Lower Rio Grande planning region and measure flow from Elephant Butte and Caballo Reservoirs; thus the annual flow is controlled by dam operations, except in years when the reservoirs spilled (1942, 1985, 1986, 1987, 1988, 1997 and 1995 (USBR, 2009)). The minimum flow of 168,757 acre-feet was recorded in 2013 at the gage below Elephant Butte dam and the average is 652,400 acre-feet per year (ac-ft/yr).

Several small lakes are present in the planning region (Figure 5-7) but the two main reservoirs on the Rio Grande (Elephant Butte and Caballo Reservoirs) are outside of the region and not shown on Figure 5-7. The NMOSE *Water Use by Categories* reports track usage in the larger lakes and reservoirs (i.e., storage capacity greater than 5,000 acre-feet), although Lake Lucero, an intermittent playa lake in the planning region (Figure 5-7) with an area of 5,500 acres, is not included in the latest report (Longworth et al., 2013).

Within the Lower Rio Grande Basin, a number of drainages channel storm runoff, snowmelt, and minor spring flow from both sides of the river to the Rio Grande. In addition, the 2002 water plan estimated that an average of about 11,000 acre-feet, or 10 million gallons per day (mgd), of treated wastewater is discharged to the Rio Grande from wastewater treatment systems in Doña Ana County (Table 5-9; Terracon et al., 2003). This water originated as groundwater pumped from wells in the Lower Rio Grande and southern Jornada del Muerto basins by municipal supply systems.

Rio Grande Project water is the primary supply of surface water to the Lower Rio Grande region. It is the basis of the agricultural sector in this part of New Mexico, Texas, and northern Mexico and serves both flood control and power generation purposes as well. USBR releases water from the Rio Grande Project reservoirs to furnish, through the EBID and EPCWID #1, stored water to downstream irrigable land in New Mexico and Texas and delivers up to 60,000 acre-feet of water annually to the Republic of Mexico. At this time, the Rio Grande Project water allocated to EBID is used for primarily irrigation purposes. The primary reservoirs of the Rio Grande Project, Elephant Butte Reservoir and Caballo Reservoir, are located in the Socorro-Sierra planning region but are described here because the water that is stored in the reservoirs is primarily for the benefit of water users within the Lower Rio Grande planning region.

- Elephant Butte Dam and Reservoir (originally called Engle Dam), 125 miles north of El Paso, Texas, currently can store about 2,024,586 acre-feet of water to provide irrigation and year-round power generation. The dam was completed in 1916, but storage operation began in 1915. The power system consists of a 24,300-kilowatt hydroelectric power plant at Elephant Butte Dam. Elephant Butte Reservoir is the delivery point for New Mexico's Rio Grande Compact annual delivery obligation.
- Caballo Reservoir has a maximum capacity of 324,934 acre-feet (determined in 2007 survey), which includes space for conservation storage and floodwater. It is about 25

miles downstream from Elephant Butte Dam, and the operations of the two are coordinated for hydroelectric power generation and irrigation releases.

In addition to these reservoirs, the Lower Rio Grande contains a number of smaller reservoirs used primarily for either flood control or recreation; information on these smaller reservoirs was included in the accepted plan (Terracon et al., 2003).

During the summer months, water is released at Elephant Butte Dam, within certain limits, to generate electricity, and the released water is stored farther downstream behind Caballo Dam until it is needed for irrigation. Little or no water is released from either reservoir during the winter months.

The USBR controls the operation of Elephant Butte and Caballo Dams. The U.S. Section of the IBWC maintains the river floodway and levees of the Rio Grande from the Percha diversion dam south to the borders with Texas and Mexico.

The NMOSE conducts periodic inspections of non-federal dams in New Mexico to assess dam safety issues. Dams that equal or exceed 25 feet in height that impound 15 acre-feet of storage or dams that equal or exceed 6 feet in height and impound at least 50 acre-feet of storage are under the jurisdiction of the State Engineer. These non-federal dams are ranked as being in good, fair, poor, or unsatisfactory condition. Dams with unsatisfactory conditions are those that require immediate or remedial action. Dams identified in recent inspections as being deficient, with high or significant hazard potential, are summarized in Table 5-7. The 40 dams listed in this table are primarily for operation of the EBID or are used for flood control.

### **5.3 Groundwater Resources**

In the Lower Rio Grande region groundwater accounted for about 40 percent of all water diversions in the year 2010 (Longworth et al., 2013). Groundwater not only supplies all the water demands for public, domestic, commercial, power, mining and industry, it also supplies a significant, but variable percent of the irrigated agriculture water demands.

#### **5.3.1 Regional Hydrogeology**

The geology that controls groundwater occurrence and movement within the planning region was described in the accepted *Lower Rio Grande Regional Water Plan* (Terracon et al., 2003), based on studies by Conover (1954), Leggat et al. (1962), King et al. (1971), Hawley (1984), Wilson and White (1984), Nickerson (1986), Hawley and Lozinski (1992), Weeden and Maddock (1999). A map illustrating the surface geology of the planning region, derived from a geologic map of the entire state of New Mexico by the New Mexico Bureau of Geology & Mineral Resources (2003), is included as Figure 5-10.

Two physiographic regions exist within the planning region (Hawley, 1986). From the west to the east, these are:

- Basin and Range (Mexican Highland, Rio Grande Subsection)
- Basin and Range (Mexican Highland Section)

Figure 5-10 shows the approximate extents of these areas within the planning region.

Groundwater resources for the Lower Rio Grande region include parts of six UWBs (Figure 4-1): the Lower Rio Grande, Tularosa (western portion), Nutt Hockett (eastern portion), Hueco, Mount Riley, and Mimbres (eastern portion). The Lower Rio Grande UWB is characterized according to location into two sub-basins: the Rincon Valley and Mesilla. In addition, the NMOSE has developed a groundwater model for the Jornada del Muerto hydrogeologic basin, the southern portion of which falls in the planning region.

The *Rincon Valley* of the Lower Rio Grande UWB is the narrow valley of the Rio Grande from Caballo Dam (just upstream of the planning region) to Selden Canyon. The primary aquifer in the Rincon Valley is a narrow band of alluvium that follows the present channel of the Rio Grande. This alluvial aquifer (Rio Grande alluvium) is highly transmissive; well yields over 1,000 gallons per minute (gpm) have been reported for many irrigation wells, with some as high as 2,500 gpm (Terracon et al., 2003). Groundwater pumped from the Rio Grande alluvium is replaced quickly with seepage of surface water from the Rio Grande and irrigated farmland (Terracon et al., 2003). In most situations pumping from the Rio Grande alluvium probably has a greater effect on surface flow in the Rio Grande than on groundwater levels (Terracon et al., 2003).

The major geologic unit underlying the Rio Grande alluvium in the Rincon Valley is the Santa Fe Group, with the Upper and Middle Santa Fe Group forming the bulk of exposed deposits adjacent to the valley. Unlike many parts of the state, the Santa Fe Group in the Rincon Valley is composed predominantly of fine-grained particles, and as a result, it does not serve as a major aquifer in this area.

The primary use of groundwater in the Rincon Valley is for irrigation. To a much lesser extent, groundwater is also used to supply municipal uses, including Hatch and Rincon, and domestic wells.

The *Mesilla Basin* is in the southern portion of the Lower Rio Grande Basin and encompasses about 1,110 square miles. It extends south from near Leasburg into the Republic of Mexico. The major aquifers of the Mesilla Basin are the unconsolidated basin-fill sediments of the Santa Fe Group and the alluvial valley fill in the channel and floodplain of the Rio Grande (Terracon et al., 2003). The alluvial aquifer is also highly transmissive and is connected to the surface water system, although in areas where considerable groundwater pumping has occurred, such as near Las Cruces, cones of depression have formed, and in those areas groundwater flows toward the

pumping wells. Water quality in the upper part of the alluvial aquifer is strongly influenced by surface water, including river infiltration and irrigation return flows.

A complex sequence of stratigraphy beneath the valley fill in the Santa Fe Group, described in detail by Hawley and Kennedy (2004), is a source of recharge to the alluvial aquifer and wells. The most productive unit is the upper Santa Fe hydrostratigraphic subdivision. It consists primarily of the sand and gravel deposited by the ancestral Rio Grande.

Groundwater in the Mesilla Basin is used primarily for agricultural purposes in and near the EBID service area. Additionally, the basin supplies a wide range of municipal and industrial users, including the City of Las Cruces, New Mexico State University, Mesilla, and Santa Teresa, and to a much lesser extent, mutual domestic water association and domestic wells.

The *southern Jornada del Muerto Basin*, about 600 square miles in area, is located in the northern and east-central parts of the planning region. The Jornada del Muerto Basin is one of several topographically closed basins in the central part of New Mexico, although some groundwater discharges into other basins, in particular the Mesilla Basin; little or no groundwater is thought to discharge from the basin at the surface. Variability in well yields can be significant, ranging from a few gallons per minute (gpm) to 1,160 gpm in the vicinity of Highway 70 (Wilson et al., 1981). Water quality at the southern end of the basin is generally good with dissolved solids of less than 500 milligrams per liter (mg/L). In 1975 saturated thicknesses of the freshwater zone were estimated to be up to 2,000 feet near Highway 70 in the vicinity of the town of Organ (Wilson et al., 1981).

Current groundwater pumping (about 13,535 acre-feet in 2010 [(Longworth et al., 2013)]) represents a significant outflow from the southern Jornada del Muerto Basin. The majority of that water supplies users in the Lower Rio Grande Basin. The Jornada del Muerto Basin has become an important additional source of groundwater supply for the planning region. Because of its limited connection with the Rio Grande, stream offsets are much lower than they would be within the Rincon or Mesilla valleys. Stream offsets, which are difficult to obtain, can also be met with return flow of treated wastewater.

The *western Tularosa Basin* is present on the east side of the planning region. Quaternary-age alluvial, piedmont, aeolian, and pluvial deposits cover the basin surface and are underlain by the Santa Fe Group sediments, all considered basin fill deposits. The basin fill is highly mineralized and yields low quantities, of groundwater very high in total dissolved solids (TDS), particularly within the central portion of the basin. However, alluvial deposits along the mountain front contain freshwater (Orr and Myers, 1986) and high yields. The sediments are coarse-grained near the mountain front, with yields up to 1,000 gpm (Livingston and JSAI, 2002) and become finer-grained toward the center of the basin where the wells have low yields. Orr and Myers

(1986) report thicknesses of these freshwater zones in the western Tularosa Basin of as much as 1,500 feet.

The *Hueco Basin*, in the southeastern corner of the water planning region, is part of the Hueco Bolson, which extends into Otero County and into Texas and Mexico where it forms the El Paso Valley. The Tertiary to Pleistocene-age Santa Fe Group fills the basin, with aquifer thicknesses up to 8,000 feet. The aquifer characteristics of the Hueco Bolson vary greatly: coarser-grained sediments (such as alluvial fan deposits) near the mountain fronts have higher hydraulic conductivity than the finer-grained lake deposits at the center of the basin (Orr and Risser, 1992). Orr and Risser (1992) show freshwater in the western portion of the basin, primarily where it is recharged by runoff from the Franklin and Organ mountains.

The eastern portion of the *Nutt-Hockett UWB*, located in the western part of the planning region, is within the Mimbres surface water basin, a closed basin. The basin fill consists of Quaternary alluvium and contains groundwater of good quality at depths ranging from 130 to 220 feet below land surface (NMOSE, 1998). This groundwater is used for domestic and stock water and for irrigation. Relatively high rates of decline have been observed in some parts of the basin.

The *Mount Riley UWB* was declared two years after the 2003 water plan was prepared and is located in the southwestern portion of the Lower Rio Grande planning region. Very little is published on the hydrology of the Mount Riley UWB. Only two wells in the basin are in the NMOSE WATERS database, one of which has a depth of 510 feet (a depth is not reported for the other); these wells are associated with Laredo Farms, a dairy operation. King et al. (1969) list details of several ranch wells in the area including a well in the center of Mount Riley UWB that penetrates over 500 feet of basalt, with a 7-foot layer of sand at the bottom of the well.

The eastern side of the *Mimbres UWB* falls within southwestern Doña Ana County. The aquifer within the Mimbres Basin is composed primarily of Quaternary and upper Tertiary sediments and interbedded basalts (Hanson et al., 1994). The aquifer is recharged by Mason Draw, which flows during intense thunderstorms.

### 5.3.2 Aquifer Conditions

As reported in the accepted regional water plan (Terracon et al., 2003), basin fill sediments, primarily from the Santa Fe Group and overlying Rio Grande alluvium, supply water to wells in the Rincon Valley and Mesilla sub-basins. Water levels are shallow near the Rio Grande (10 to 25 feet below ground surface [ft bgs]) and more than 300 ft bgs near the basin fill boundaries (Terracon et al., 2003). In general, groundwater flows from higher elevations to lower elevations and then roughly parallels the Rio Grande in the Rincon Valley and Mesilla sub-basins. Basin-fill sediments in the closed basins are primarily derived from erosion and deposition from the mountains that surround the basins.

In order to evaluate changes in water levels over time, the USGS monitors groundwater wells throughout New Mexico (Figure 5-11). Hydrographs illustrating groundwater levels versus time, as compiled by the USGS (2014b), were selected for seven monitor wells with longer periods of record and are shown on Figure 5-12. In the Rincon Valley and Mesilla sub-basins, groundwater is hydrologically connected to surface water such that seepage from the Rio Grande and irrigation return flows recharge the aquifer and groundwater pumping can deplete surface flows in drains and the Rio Grande. Thus water levels in wells near the Rio Grande fluctuate with the irrigation seasons and availability of streamflow (Figure 5-12). Water levels in these wells and most of the wells near the Rio Grande (Figure 5-11) show a decline from the recent drought and increased pumping from farm wells in EBID. In the other basins that are not stream connected, groundwater is slowly replenished through recharge from intermittent flows in arroyos and mountain-front recharge. The hydrographs for the wells in the Hueco and Nutt-Hockett UWBs show a steady decline in water levels. Water levels are declining at a high rate in the Nutt-Hockett (average 3 feet per year [ft/yr] in three USGS wells), Jornada (average 2.7 ft/yr in 18 wells) and Hueco (1.1 ft/yr in 5 wells) basins (USGS, 2014b).

The aquifers in the planning region are recharged naturally through mountain front recharge, irrigation return flow, seepage from the Rio Grande, and seepage from ephemeral streams channels during precipitation events and inter-basin flow. The accepted regional water plan provided ten published estimates of recharge in the region:

- Mountain-front recharge to the Mesilla Basin (Frenzel and Kaehler, 1990):  
11,084 ac-ft/yr
- Mountain-front recharge to the Mesilla Basin (Weeden and Maddock (1999):  
12,967 ac-ft/yr
- Mountain-front recharge to the Rincon Valley (Frenzel and Kaehler, 1990): 4,542  
ac-ft/yr
- Seepage from the Rio Grande between Las Cruces and Anthony (Wilson et al., 1981):  
20,300-97,400 ac-ft/yr
- Mountain-front recharge in the Jornada del Muerto Basin (Shomaker and Finch, 1996):  
5,200 ac-ft/yr
- Seepage from arroyos to the Hueco Basin (Orr and Risser, 1992):  
4,300 ac-ft/yr
- Inflow from the Tularosa Basin to the Hueco Basin (Meyer, 1976):  
5,600 ac-ft/yr

- Recharge from the West Potrillo Mountains to the Mimbres Basin (Hanson et al., 1994): 3,400 ac-ft/yr
- Seepage from Mason Draw to the Mimbres Basin (Hanson et al., 1994): 500 ac-ft/yr
- Seepage from arroyos to the Western Tularosa Basin (Livingston and JSAI, 2002): 9,291 ac-ft/yr

More recently, the OSE's administrative model for the Lower Rio Grande (SSPA, 2007) includes three recharge components: mountain-front, slope-front, and deep percolation of applied irrigation water. For the mountain-front and slope-front recharge estimates S.S. Papadopulos & Associates, Inc. (SSPA) used two precipitation-based methods for estimating the annual recharge (the Maxey-Eakin and Hearne-Dewey methods) by sub-basins. Using the Maxey-Eakin method, recharge is estimated to be 71,700 ac-ft/yr, while the Hearne-Dewey method resulted in an estimate of about 24,000 ac-ft/yr. SSPA applied the Hearne-Dewey method to the model input in the Rincon Valley and Mesilla sub-basins and reduced the rate in specific locations to obtain a calibrated model. Calibrated values for mountain-front and slope front recharge within the modeled area are:

- West Rincon Valley: 8,822 ac-ft/yr
- East Rincon Valley: 1,055 ac-ft/yr
- West Mesilla near Selden Canyon: 70 ac-ft/yr
- West Mesilla outside Selden Canyon: 1,566 ac-ft/yr
- East Mesilla – Jornada: 880 ac-ft/yr
- East Mesilla outside Jornada: 1,888 ac-ft/yr
- Slope front: 440 ac-ft/yr
- Franklin Mountains: 542 ac-ft/yr

The major public water supply well fields in the planning region, along with the basins they draw from, are:

- Lake Section Water Company (Hueco Basin)
- White Sands Missile Range Well Field (western Tularosa Basin, completed in the western edge of the valley fill and yielding approximately 100 to 1,000 gpm [Livingston and JSAI, 2002]).
- Anthony Water & Sanitation (Mesilla sub-basin)

- Dona Ana Mutual Domestic Water Consumers Association (MDWCA) (Mesilla sub-basin)
- Las Cruces Municipal Water System (Mesilla sub-basin and Jornada del Muerto Basin)
- Lower Rio Grande Public Water Works Authority (Mesilla sub-basin)
- Moongate Water System (Jornada del Muerto Basin)
- Sunland Park Water System (Mesilla sub-basin)
- Jornada Water Co (Jornada del Muerto Basin)

#### **5.4 Water Quality Assessment**

Assurance of ability to meet future water demands requires not only water in sufficient quantity, but also water that is of sufficient quality for the intended use. This section summarizes the water quality assessment that was provided in the 2003 regional water plan and updates it to reflect new studies of surface and groundwater quality and current databases of contaminant sources. The identified water quality concerns should be a consideration in the selection of potential projects, programs, and policies to address the region's water resource issues.

Surface water quality in the Lower Rio Grande Water Planning Region is evaluated through periodic monitoring and comparison of sample results to pertinent water quality standards. Several reaches of the Rio Grande have been listed on the 2012-2014 New Mexico 303(d) list (NMED, 2014a). This list is prepared by NMED to comply with Section 303(d) of the federal Clean Water Act, which requires each state to identify surface waters within its boundaries that are not meeting or not expected to meet water quality standards. E.coli levels top 560,000 colony-forming units per 100 milliliters (cfu/100 mL) (PdNWC\_WBP, 2014) in surface water samples. Sources of contamination were identified by NMED to be

- Impervious surface/parking lot runoff
- Municipal point source discharges
- Urbanized high density areas
- On-site treatment systems
- Permitted runoff from confined animal feeding operations
- Rangeland grazing
- Waste from pets
- Waste from waterfowl

- Waste from wildlife other than waterfowl

Section 303(d) further requires the states to prioritize their listed waters for development of total maximum daily load (TMDL) management plans, which document the amount of a pollutant a waterbody can assimilate without violating a state water quality standard and allocates that load capacity to known point sources and nonpoint sources at a given flow. Figure 5-13 shows the locations of lakes and stream reaches with impaired water quality. Table 5-8 provides details of impairment for those reaches.

In evaluating the impacts of the 303(d) list on the regional water planning process, it is important to consider the nature of water quality impairment and its effect on potential use. Problems such as stream bottom deposits and turbidity will not necessarily make the water unusable for irrigation or even for domestic water supply (if the water is treated prior to use). However, the presence of the impaired reaches illustrates the degradation that can occur in the water supply, and some of these impairments can be very disruptive to a healthy aquatic community.

Although it is not on New Mexico's 303(d) list, salinity in the Rio Grande has long been a source of concern and controversy within the Rio Grande Project in both New Mexico and Texas. Rio Grande salinity is discussed in 5.4.2.

Generally the quality of groundwater in the planning region is excellent, except in the central portions of the closed basins where minerals are concentrated in the groundwater through evaporation and in the Rio Grande Valley where salinity is high due to natural and man-made conditions. Water quality in the eastern Mimbres Basin is generally suitable for irrigation, with the best quality in the northern portion by Mason Draw (Hanson et al., 1994).

In the Mesilla Valley, many of the domestic wells and sewage disposal systems have been poorly constructed. In some areas, the depth to water is less than 4 feet and residents can cheaply obtain water through hand dug wells that have little or no protection at the surface. The shallow depth to water and poorly constructed wells combined with the lack of proper sanitation create a serious set of circumstances that may not only cause aquifer contamination, but may also promote the spread of disease. Yet unlike municipal systems that are sampled quarterly for a full suite of parameters, the quality of domestic well water is not monitored unless the user can afford to have it tested.

Because of these conditions, the Border Health Office contracted with DBS&A (1996) to sample 135 shallow domestic wells throughout the Mesilla and Rincon Valleys to determine the impact of agriculture and other sources of pollution on water quality. Water samples collected from the 135 shallow wells, mostly in the Mesilla Valley, indicate that the water quality is generally moderate to poor due to high concentrations of TDS and sulfate. Health concerns related to the water quality arise from five factors: (1) naturally high levels of uranium, arsenic, and selenium, (2) high levels of lead, most likely from household plumbing, (3) possible fecal and nitrate

contamination due either to poorly constructed wells or septic systems, (4) nitrate and enterococci contamination, possibly from dairy lagoons and chicken farms, and (5) organic contamination from pesticides and solvents.

Specific sources that have the potential to impact either surface or groundwater quality in the future are discussed below. Sources of contamination are considered as one of two types: (1) point sources (Section 5.4.1), if they originate from a single location, or (2) nonpoint sources (Section 5.4.2), if they originate over a more widespread or unspecified location. Information on both types of sources is provided below.

#### 5.4.1 Point Sources

Point source discharges to surface water must comply with the Clean Water Act and the New Mexico Water Quality Standards (20 NMAC 6.4.1) by obtaining a National Pollutant Discharge and Elimination System (NPDES) permit to discharge. NPDES-permitted discharges in the planning region are summarized in Table 5-9 and shown on Figure 5-14.

The NMED Ground Water Bureau regulates facilities with wastewater discharges that have a potential to impact groundwater quality. These facilities must comply with the New Mexico Water Quality Act (NMSA 1978, §§ 74-6-1 through 74-6-17) and New Mexico Water Quality Control Commission (NMWQCC) regulations (NMWQCC, 2002) and obtain approval of a discharge plan, which provides for measures needed to prevent and detect groundwater contamination. A variety of facilities fall under the discharge plan requirements, including mines, sewage dischargers, dairies, food processors, sludge and septage disposal facilities, and other industries. The NMWQCC regulations contain requirements for cleanup of any groundwater contamination detected under discharge plan monitoring requirements. Until such cleanup is complete, these facilities may impact the availability of water supplies of sufficient quality for intended uses. Thirty abatement sites in Dona Ana County are undergoing cleanups. Details indicating the status, waste type, and treatment for individual discharge plans can be obtained from the NMED Ground Water Bureau website (<http://www.nmenv.state.nm.us/gwb/>). A summary list of current discharge plans in the planning region is provided in Table 5-10; their locations are shown in Figure 5-14.

The 2003 regional water plan (Terracon et al., 2003) identified one Superfund site in the planning region that was listed on the National Priorities List by the U.S. EPA (2004). Information regarding this site is provided in Table 5-11. The Griggs & Walnut Groundwater Plume is on the National Priorities List due to a perchloroethylene plume that contaminated City of Las Cruces wells (U.S. EPA, 2014).

Leaking underground storage tank (UST) sites present a potential threat to groundwater, and the NMED maintains a database of registered USTs. Many of the facilities included in the NMED UST database are not leaking, and even leaking USTs may not necessarily have resulted in

groundwater contamination or water supply well impacts. These USTs could, however, potentially impact groundwater quality in and near the population centers in the future. UST sites in the Lower Rio Grande region are identified on Figure 5-14. Many of the UST sites listed in the NMED database require no further action and are not likely to pose a water quality threat. Sites that are being investigated or cleaned up by the state or a responsible party, as identified on Table 5-12, should be monitored for their potential impact on water resources. Additional details regarding any groundwater impacts and the status of site investigation and cleanup efforts for individual sites can be obtained from the NMED database, which is accessible on the NMED website (<http://www.nmenv.state.nm.us/ust/ustbtop.html>).

Landfills used for disposal of municipal and industrial solid waste can contain a variety of potential contaminants that may impact groundwater quality. Landfills operated since 1989 are regulated under the New Mexico Solid Waste Management Regulations. Many small landfills throughout New Mexico, including landfills in the planning region, closed before the 1989 regulatory enactment to avoid more stringent final closure requirements. Other landfills have closed as new solid waste regulations became effective in 1991 and 1995. Within the planning region, there are three operating landfills and six closed landfills (Table 5-13, Figure 5-14).

#### 5.4.2 Nonpoint Sources

As noted above, a primary surface water quality concern in the planning region is the increase in salinity that has historically been observed in the downstream direction. In the early 2000s, Texas threatened to sue New Mexico in the U.S. Supreme Court, stating in part that the salinity of the water it receives from the Rio Grande Project had increased. Review of data collected and analyzed by a number of entities indicates that the salinity, while variable, has not changed significantly from historical conditions (Crilley et al., 2013, Hogan et al., 2007).

Historically, the salinity increase was attributed to various mechanisms, including (1) evaporation and concentration during reservoir storage, irrigation, and subsequent reuse, (2) displacement of shallow saline groundwater during irrigation, (3) erosion and dissolution of natural deposits, and/or (4) inflow of deep saline and/or geothermal groundwater (groundwater with elevated water temperature). Relatively recent studies (Witcher et al., 2004; DBS&A, 2010; Dadakis et al., 2004; Phillips et al., 2003) have identified natural sources as the most significant contributor to observed salinity increases. Anthropogenic sources such as agricultural return flows and municipal wastewater discharges also contribute, but play a lesser role. Observed salinity increases are generally localized and are correlated with contributions to the river from such sources as hydrothermal areas and upwelling and discharge of deep, saline groundwater at the terminus of the groundwater basin.

Salinity levels within the Rio Grande Project area are exacerbated in non-irrigation months when there are no reservoir releases and saline inputs from groundwater constitute a greater proportion

of river flow. These higher salinity levels during low-flow periods preclude use of Rio Grande water for municipal supply and can adversely impact agricultural and environmental uses (DBS&A, 2010).

The multi-state Rio Grande Project Salinity Management Coalition, under the framework of the Rio Grande Compact Commission, was established in 2008 to address salinity issues from San Acacia, New Mexico to Fort Quitman, Texas. The USGS prepared a report for the Coalition in 2009 that summarized the existing salinity data and information in the basin (Moyer et al., 2009). The report indicates that the concentration of dissolved solids in the Rio Grande doubles (from approximately 500 mg/L to 1,000 mg/L) from below Elephant Butte to El Paso and is commonly twice as high during the non-irrigation season. The USGS study identified natural sources such as the upwelling of deep-circulating groundwater and geothermal waters as the principal contributors of salinity in the region. These natural salinity inputs appear to be localized, suggesting that source control and treatment may be feasible. Phillips et al. (2003) showed that salinity increases from about 40 milligrams per liter (mg/L) to about 2,000 mg/L over a 750-mile stretch of the Rio Grande; the increases occur in a series of steps, with large observed salinity increases localized at the southern ends of sedimentary sub-basins, for example, at San Acacia, Elephant Butte (Truth or Consequences), Selden Canyon, and the El Paso Narrows.

Other nonpoint sources of pollutants that are concerns for surface water quality in the planning region include *E. coli* contamination, which reaches maximal levels in the Rio Grande during the late summer monsoon season. Testing for the source of *E. coli* found that birds were the main contributor (32 percent of the total), with wildlife contributing 17 percent, cattle and other livestock 16 percent, horses 8 percent, pets 9 percent, and sewage 6 percent, with another 13 percent unidentified (PdNWC\_WBP, 2014). *E. coli* exceedance in the reach above Leasburg Cable is primarily related to stormwater runoff, whereas the *E. coli* exceedance in the reach from Anthony to the international boundary with Mexico is primarily related to non-stormwater flows (PdNWC\_WBP, 2014).

Another nonpoint source of pollutants that is a concern for both groundwater and groundwater-connected surface water in the planning region is contamination of groundwater due to septic tanks. In areas with shallow water tables or in karst terrain, septic system discharges can percolate rapidly to the underlying aquifer and increase concentrations of (NMWQCC, 2002):

- Total dissolved solids (TDS)
- Iron, manganese, and sulfides (anoxic contamination)
- Nitrate
- Potentially toxic organic chemicals
- Bacteria, viruses, and parasites (microbiological contamination)

Because septic systems are generally spread out over rural areas, they are considered a nonpoint source. Collectively, septic tanks and other on-site domestic wastewater disposal systems constitute the single largest known source of groundwater contamination in New Mexico (NMWQCC, 2002), with many of these occurrences in areas with shallow water tables. Concentrations of septic tanks and domestic wells near shallow groundwater along the Rio Grande corridor are found in several parts of the region, including the rural areas within the Rincon and Mesilla Valleys and the border region in southern Doña Ana County. The domestic wells in these areas generally serve homes that are outside municipal water and wastewater system service areas and have the potential to be impacted by septic tank effluent. The NMED periodically conducts water fairs at locations around the state, including Las Cruces, to allow domestic well owners to bring samples of their water to be tested.

One approach to addressing nonpoint source pollution is through Watershed Based Planning or other watershed restoration initiatives that seek to restore riparian health and to address sources of contamination. In the Lower Rio Grande region, the Paso Del Norte Watershed Council has identified needed restoration projects in the Lower Rio Grande watershed (<http://www.pdnwc.org>) to investigate, develop, and recommend projects and activities that address issues related to the establishment and maintenance of a viable watershed, including approximately 430 river miles between Elephant Butte Reservoir in southern New Mexico to the confluence of the Rio Conchos in Presidio County, Texas. These include promoting projects to improve water quality and quantity, ecosystem integrity, the quality of life, and economic sustainability in the Paso del Norte watershed.

The Paso del Norte Watershed Council was awarded a watershed restoration grant to develop a Watershed Based Plan to protect and improve water quality in the reach of the lower Rio Grande from Percha Dam (below Caballo Reservoir) downstream to the American Dam (near the New Mexico, Texas, and international border) that has been impaired by *E.coli* bacteria. Funding has been provided by the U.S. EPA through the NMED under the authority of the Clean Water Act Section 319(h) nonpoint source grant program. The two year grant funded a water quality sampling program to determine the bacterial source (described above) and recommended projects to address the problems (PdNWC\_WBP, 2014).

## **5.5 Administrative Water Supply**

The *Updated Regional Water Planning Handbook* (NMISC, 2013) describes a common technical approach (referred to there as a *platform*) for analyzing the water supply in all 16 water planning regions in a consistent manner. As discussed in the handbook (NMISC, 2013), many methods can be used to account for supply and demand, but some of the tools for implementing these analyses are available for only parts of New Mexico, and resources for developing them for all regions are not currently available. Therefore, the state has developed a simple method that can be used consistently across all regions to assess supply and demand for planning purposes. The

use of this consistent method will facilitate efficient development of a statewide overview of the balance between supply and demand in both normal and drought conditions, so that the state can move forward with planning and funding water projects and programs that will address the regions' and state's pressing water issues.

To assess the available water supply, the common technical approach considers legal and physical constraints on the supply and a range of conditions from severe drought to normal supply. The method to estimate this supply, hereafter referred to as *administrative water supply*, is based on recent diversions, which provide a measure of supply that considers both physical supply and legal restrictions (i.e., the diversion is physically available, permitted, and in compliance with water rights policies) and thus, in most instances, reflects the amount of water that can actually be used by a region. For the Lower Rio Grande Planning Region, the surface water component of the administrative water supply has been reduced due to diminished allocations of Rio Grande Project water to EBID farmers resulting from the 2008 Operating Agreement (Section 5.5.1). The recent diversion data are also adjusted to reflect drought supplies, as discussed in Section 5.5.2.

#### 5.5.1 2010 and 2060 Administrative Water Supply

The total diversions (i.e., administrative water supply) in 2010 for the Lower Rio Grande region, as reported by Longworth et al. (2013), were about 450,000 acre-feet. Of this total, 271,700 acre-feet were surface water diversions and 178,300 acre-feet were groundwater. The breakdown of the reported 2010 diversions among the various sectors of use detailed in the NMOSE water use report is discussed in Section 6.1.

It is important to note that the administrative supply numbers for 2010 are impacted by the 2008 Operating Agreement, which is the subject of litigation discussed in Section 4.3.1. The Operating Agreement allocates the Rio Grande Project surface water supply between EBID and EPCWID #1. Accordingly, it affects the amount of surface water supply available in the region. Since the Operating Agreement was entered into, EBID's surface water supply has been reduced. This surface water supply reduction, in turn, impacts groundwater use in the region. Nevertheless, the 2010 numbers discussed above are reflective of the system under the Operating Agreement. However, if the Operating Agreement is adjusted based on the pending litigation, these numbers may change to reflect an accurate water supply in the region.

For regions such as the Lower Rio Grande planning region, where the aquifers in closed basins (such as the Tularosa, Jornada del Muerto, Nutt-Hockett, Mimbres, Mount Riley, and Hueco) are being depleted, the administrative water supply may not be sustainable in the future. In these non-stream-connected basins, where the estimated groundwater diversions are currently about 21,600 ac-ft/yr, the future available supply was estimated as described below.

Existing wells with water level hydrographs in these closed basins were used to predict the future decline of the saturated thickness and thus the available supply. This decline rate was compared to the available saturated thickness in existing wells. Using the average rate of water level decline calculated from USGS monitor wells within the non-stream-connected groundwater basins and assuming that this rate will continue, the water level decline to 2060 was predicted as shown in Table 5-14. The percentage of impacted wells was estimated by comparing the predicted drawdown to the available water column in existing wells, and the percentage of impacted wells was assumed to represent the reduction in supply by 2060.

The predicted water level decline in each of the six closed-basin basin fill aquifers ranges from 10 to about 150 feet in 2060, assuming an average water level decline rate between 0.2 and 3.1 feet per year. Depending on the available median water column and predicted decline, between 2 and 76 percent of the wells could be impacted. Assuming that the percentage of impacted wells results in an equal impact on water supply, then the estimated supply in 2060 is reduced by 39 percent of the 2010 diversions. Thus the amount of groundwater withdrawn would be 8,300 acre-feet less than the 2010 administrative supply of 21,600 ac-ft/yr, or 13,300 ac-ft/yr for the six closed basins within the Lower Rio Grande planning region.

This approach represents an approximation of the impact on existing wells by 2060. Factors that may affect the accuracy of these predictions include:

- The water columns may not represent the available supply because existing wells could possibly be drilled deeper.
- The shallowest wells that are most impacted may not proportionally represent the distribution of pumping (the deeper wells most likely pump more than the shallow wells).
- New wells could be drilled in other parts of the aquifer, although doing so would require a water right permit.
- The groundwater diversions are estimated and involve a high degree of uncertainty, particularly for irrigation wells that are not metered. No diversion data were available for the Mount Riley UWB, and the 2010 Census shows no population within this subregion. Review of aerial photography shows what appears to be a dairy, but the water use is unknown.

Ideally, the aquifers should be modeled to determine the longevity of wells and to estimate the best distribution of pumping to prolong the supply. NMOSE's existing models could be used if the modeled pumping rate reflects actual use and observed drawdowns.

## 5.5.2 Drought Supply

The variability in surface water supply from year to year is a better indicator of how vulnerable a planning region is to drought in any given year or multi-year period than is the use of long-term averages. As discussed in Section 5.1.1, in the Lower Rio Grande region, 2010 was a year with below average rainfall (Figure 5-4), but in the headwaters of the Rio Grande and for the Rio Grande Project, which supply the primary source of surface water to the planning region, 2010 was an above average and full supply year, respectively. Further, according to the PDSI for the two main climate divisions present in the Rio Grande region (Figure 5-6), 2010 was a near normal year in Climate Division 5 and an incipient wet spell (slightly wetter than normal) in Climate Division 8. As discussed in Section 5.1, the PDSI is an indicator of whether drought conditions exist and if so, what the relative severity of those conditions is. Given that the water use data for 2010 represent a near normal to slightly above normal year for the two climate divisions present in the region, it cannot be assumed that this supply will be available in all years; it is important that the region also consider potential water supplies during drought periods.

While 2010 was a full-supply year for the Rio Grande Project, EBID's water allocation was smaller than in previous years due to the accounting under the 2008 Operating Agreement. As noted above (Section 5.5.1), the Operating Agreement is a primary reason for the decrease in surface water diversion and increase in groundwater use in 2010 in the planning region. Depending upon the outcome of the litigation regarding the Operating Agreement (Section 4.3.1), it may be necessary to make changes to the calculation of the drought supply. There is no established method or single correct way of quantifying a drought supply given the complexity associated with varying levels of drought and constantly fluctuating water supplies. For purposes of having an estimate of drought supplies for regional and statewide water planning, the state has developed and applied a method for regions with both stream-connected and non-stream-connected aquifers. The method adopted for stream-connected aquifers is described below:

- The drought adjustment is applied only to the portion of the administrative water supply that derives from surface water, as it is assumed that groundwater supplies will be available during drought due to the relatively stable thicknesses of groundwater aquifers that are continuously recharged through their connection to streams. While individual wells may be depleted due to long-term drought, this drought adjustment does not include an evaluation of diminished groundwater supplies.
- The minimum annual yield for key stream gages on mainstem drainages (Table 5-4b) was compared to the 2010 yield, and the gage with the lowest ratio of minimum annual yield to 2010 yield was selected.

- The 2010 administrative surface water supply for the region was then multiplied by that lowest ratio to provide an estimate of the surface water supply adjusted for the maximum drought year of record.

For the Lower Rio Grande region, the gage with the minimum ratio of annual yield to 2010 yield is the Rio Grande below Caballo Dam, with a ratio of 0.23 for minimum annual yield (168,757 acre-feet in 2013) to 2010 yield (722,230 acre-feet) (USGS, 2014c). Based on the region's total administrative surface water supply of 271,717 acre-feet (Section 5.5.1), the drought-adjusted surface water supply is 62,495 acre-feet.

Though the adjustment is based on the minimum year of streamflow recorded to date, it is possible that drought supplies could be even lower in the future. Additionally, water supplies downstream of reservoirs may be mitigated by reservoir releases in early drought phases, while longer-term droughts can potentially have greater consequences. This approach does not evaluate mitigating influences of reservoir storage in early phases of a drought when storage is available or potential development of new groundwater supplies. Nonetheless, the adjusted drought supply provides a rough estimate of what may be available during a severe to extreme drought year.

In addition to the variability in surface water supply from year to year, in non-stream-connected basins the change in recharge during a drought is also important, possibly even more so. To estimate the vulnerability of the closed basins within a planning region to a prolonged drought, OSE administrative models for other areas of the state were used to predict the potential impact by 2060 of a 20-year drought.

The method adopted by the state for estimating drought supplies for non-stream connected aquifers is as follows:

- The drought adjustment is applied only to the portion of the administrative water supply that derives water from the mined aquifer.
- In basins for which NMOSE has an administrative model, the simulation period is from 2010 to 2060 as described above, with no recharge from 2020 to 2040.
- For a conservative approximation, the drawdown predicted during the drought period is derived from a model cell in a heavily stressed area at the end of the simulation period (2060) to represent the water column that will be lost due to drought and pumping (Table 5-15). Where no model is available, the percentage impact on the water supply for the modeled area is applied to the other basins.

- This adjusted predicted drawdown is then compared to the median available water column in 2010 (as described in Section 5.5.1) to determine the percentage of wells that are impacted by the 20-year drought and continued pumping.
- This percentage represents the reduction in supply due to drought. The drought supply will be estimated by multiplying the percentage by the 2060 administrative supply.

For the Lower Rio Grande calculations, six OSE administrative models—Estancia, Tularosa, Lea County, Mimbres, and Lordsburg—were run. Among these six models the average impact on water columns in the six closed basins was 12 percent (Table 5-15).

The estimated reduction in administrative supply in the six closed basins due to continued pumping and one 20-year drought with no recharge over the 50-year planning period, is 51 percent, resulting in an available water supply for the six closed basins of about 10,600 acre-feet per year (Table 5-15) out of the 2010 pumping of 21,570.

The total projected available supply in 2060 during a prolonged drought is equal to the total groundwater supplies plus drought-impacted surface water supplies:

- Closed basin supply of 10,600 acre-feet
- Groundwater supply in the Rincon and Mesilla valleys (that is assumed by this method to not be impacted by drought) of 156,700 acre-feet
- Drought impacted surface supply of 62,500 acre-feet

The resulting estimated total drought supply in 2060 is about 229,800 acre-feet, or about 51 percent of a normal year administrative water supply.