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1. Introduction

The Lower Rio Grande Water Planning Region, which includes all of Doña Ana County (Figure 1-1), is one of 16 water planning regions in the State of New Mexico. Regional water planning was initiated in New Mexico in 1987, its primary purpose being to protect New Mexico water resources and to ensure that each region is prepared to meet future water demands. Between 1987 and 2008, each of the 16 planning regions, with funding and oversight from the New Mexico Interstate Stream Commission (NMISC), developed a plan to meet regional water needs over the ensuing 40 years. The *New Mexico Lower Rio Grande Regional Water Plan* (RWP) (Terracon et al., 2003) was completed and accepted by the NMISC in December 2003.

The purpose of this document is to update the 2003 RWP to reflect new and changed information related to water planning in the Lower Rio Grande region, as listed in the bullets below, and to evaluate projections of future water supply and demand for the region using a common technical approach applied to all 16 planning regions statewide. Accordingly, the following sections summarize key information in the 2003 plan and provide updated information regarding changed conditions and additional data that have become available. Specifically, this update:

- Identifies significant new research or data that provide a better understanding of current water supplies and demands in the Lower Rio Grande region.
- Presents recent water use information and develops updated projections of future water use using the common technical approach developed by NMISC, in order to facilitate incorporation into the New Mexico State Water Plan.
- Identifies strategies, including infrastructure projects, conservation programs, watershed management policies, or other strategies that will help to balance supplies and projected demands and address the Lower Rio Grande region's future water management needs and goals.
- Discusses other goals or priorities as identified by stakeholders in the region.

The water supply and demand information in this RWP update is based on current published studies and data and information supplied by water stakeholders in the region.

The organization of this update follows the template provided in the *Updated Regional Water Planning Handbook: Guidelines to Preparing Updates to New Mexico Regional Water Plans* (NMISC, 2013):

- Information regarding the public involvement process followed during development of this RWP update and entities involved in the planning process is provided in Section 2.

- Section 3 provides background information regarding the characteristics of the Lower Rio Grande planning region, including an overview of updated population and economic data.

- The legal framework and constraints that affect the availability of water are briefly summarized in Section 4, with recent developments and any new issues discussed in more detail.

- The physical availability of surface water and groundwater and water quality constraints was discussed in detail in the 2003 RWP; key information from that plan is summarized in Section 5, with new information that has become available since 2003 incorporated as applicable. In addition, Section 5 presents updated monitoring data for temperature, precipitation, drought indices, streamflow, groundwater levels, and water quality, and an estimate of the administrative water supply including an estimate of drought supply.

- The information regarding historical water demand in the planning region, projected population and economic growth, and projected future water demand was discussed in detail in the 2003 RWP. Section 6 provides updated population and water use data, which are then used to develop updated projections of future water use.

- Based on the current water supply and demand information discussed in Sections 5 and 6, Section 7 updates the projected gap between supply and demand of the planning region.

Common Technical Approach

To prepare both the regional water plans and the state water plan, the state has developed a set of methods for assessing the available supply and projected demand that can be used consistently in all 16 planning regions in New Mexico. This *common technical approach* outlines the basis for defining the available water supply and specifies methods for estimating future demand in all categories of water use:

- The method to estimate 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 reflects the amount of water that can actually be used by a region. An estimate of supply during future droughts is also developed by adjusting the recent diversion data based on physical supplies available during historical droughts.
- Projections of future demands in nine categories of water use are based on demographic and economic trends and population projections using methods for each category that are applied consistently across all planning regions.

The objective of applying this common technical approach is to be able to efficiently develop 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 state's pressing water issues.

- Section 8 outlines new strategies (water programs, projects, or policies) identified by the region as part of this update, including additional water conservation measures

Water supply and demand information (Sections 5 through 7) is assessed in accordance with a common technical approach, as identified in the Handbook (NMISC, 2013) (where it is referred to as a common technical *platform*). This common technical approach is a simple method that can be used consistently across all regions to assess supply and demand, with the objective of efficiently developing a statewide overview of the balance between supply and demand for planning purposes.

2. Public Involvement in the Planning Process (Prepared by the Region)

Preliminary Draft. This is an outline of the public involvement section of the updated Regional Water Plan (RWP). The purpose of this section is to document the public involvement process that has taken place during the update of the RWPs. The table below lists the first two sets of meetings that took place by region:

- Meeting 1: Kick-off meeting
- Meeting 2: Technical components of the regional water plan, presentation of data to the regions

ISC Planning Region		Meeting #1		Meeting #2	
		Date	**Location**	**Date**	**Location**
1	Northeast New Mexico	Jun 30, 2014	Grady	Oct 20, 2014	Tucumcari
2	San Juan Basin	Jul 17, 2014	Farmington	Dec 4, 2014	Farmington
3	Jemez y Sangre	Mar 4, 2014	Santa Fe	Nov 13, 2014	Santa Fe
4	Southwest New Mexico	Aug 13, 2014	Silver City	Mar 12, 2015	Deming
5	Tularosa-Sacramento-Salt Basins	Jul 24, 2014	Tularosa	Jan 14, 2015	Alamogordo
6	Northwest New Mexico	Mar 19, 2014	Grants	Dec 5, 2014	Gallup
7	Taos	Mar 31, 2014	Taos	Oct 30, 2014	Taos
8	Mora-San Miguel-Guadalupe	Feb 27, 2014	Las Vegas	Oct 27, 2014	Las Vegas
9	Colfax	Apr 23, 2014	Cimarron	Oct 29, 2014	Cimarron
10	Lower Pecos Valley	May 9, 2014	Artesia	Feb 13, 2015	Artesia
11	Lower Rio Grande	May 21, 2014	Las Cruces	Jan 13, 2015	Las Cruces
12	Middle Rio Grande	Apr 2, 2014	Albuquerque	Jan 23, 2015	Albuquerque
13	Estancia Basin	Apr 17, 2014	Moriarty	Feb 19, 2015	Estancia
14	Rio Chama	Mar 31, 2014	Española	Nov 13, 2014	Hernandez
15	Socorro-Sierra	May 21, 2014	Truth or Consequences	Oct 28, 2014	Truth or Consequences
16	Lea County	May 8, 2014	Lovington	Feb 12, 2015	Hobbs

2. Public Involvement in the Planning Process *(Prepared by the Region with ISC contractor assistance)*

As specified in the *Updated Regional Water Planning Handbook* (NMISC, 2013), the regional water plan update shall include participation of a representative group of stakeholders, referred to in this document as a steering committee, to guide the public involvement during the update and to identify strategies for addressing water issues and needs in the region. This section documents the steering committee and public involvement process used in the update of the plan.

2.1 Identification of Regional Steering Committee Members and Stakeholders

The RWP Update Handbook (NMISC, 2013) specifies that the steering committee membership include representatives from multiple water user groups. Some of the categories may not be applicable to the specific region, and the regions could add other categories as appropriate to their specific region. The steering committee representation listed in the Handbook includes:

- Agricultural – surface water user
- Agricultural – groundwater user
- Municipal government
- Rural water provider
- Extractive industry
- Environmental interest
- County government
- Local (retail) business
- Tribal entity
- Watershed interest
- Federal agency
- Other groups as identified by the steering committee

Steering committee members were recruited from interviews, public meetings, and recommendations. Through this outreach, the Lower Rio Grande Water Planning Region established a representative steering committee, the members of which are listed in Table 2-1.

Table 2-1. Steering Committee Members, Lower Rio Grande Water Planning Region

Water User Group [a]	Name [b]	Organization / Representation
Agricultural – groundwater user	Greg Daviet	Head of Agriculture Workgroup - Pecan Farmer
Agricultural – surface water user	Ryan Ward	NM Department of Agriculture
County government	Billy Garret	Dona Ana County Commissioner
County government	Angela Roberson	Dona Ana County
County government	Marmolejo Luis	Dona Ana County
Environmental interest	Kevin Bixby	Southwest Environmental Center - Head of Environmental Workgroup
Environmental interest	Beth Bardwell	Audubon
Extractive industry		
Federal agency		
State agency	Chris Canavan	NMED
Local (retail) business	Steve Chavira	Las Cruces Home Builders Association
Municipal government	Leslie Kryder	Las Cruces Utilities – Head of Technical Advisory Workgroup
Municipal government	Adrienne Widmer	Las Cruces Utility and LRGWD
Municipal government	Gill Sorg	Las Cruces City Council
Quality of Life	Wayne Miller	Steering Committee Chair – Earthwise Corp (Green Business Develop)
Rural water provider	Kurt Anderson	Dona Ana Mutual Domestic Water Consumers Association
Rural water provider	Josh Orozco	Camino Real Regional Utility Authority
Watershed interest	Conrad Keyes	
Watershed interest	Sam Fernald	Water Resources Research Institute

[a] *Updated Regional Water Planning Handbook: Guidelines to Preparing Updates to New Mexico Regional Water Plans* (NM ISC, 2013), Section C.

[b] Regions may appoint multiple representatives in each category, as desired and appropriate.

The Lower Rio Grande determined that subcommittees/workgroups would be a useful means of enhancing the planning effort and ensuring implementation of the RWP, and several subcommittees were formed, including: technical advisory, agricultural users, domestic & civic, commercial & industrial, environmental use, quality of life & big picture, and public engagement. The heads of these working groups then comprised the steering committee. The steering committee identified Wayne Miller as the Chair.

In addition to the steering committee, the water planning effort included developing a list of stakeholders to facilitate outreach to individuals and entities interested in the water planning update; the list is on file with the ISC. Invitations to the meetings were e-mailed to this stakeholder list for the Round 1 and Round 2 meetings. Steering committee members were asked to share information about the process with stakeholders in the region for the Round 3 meetings.

2.2 Description of the Public Involvement Process

The public involvement process was centered on developing a representative steering committee, informing the regions about the process for updating the RWPs, and revitalizing interest in regional water planning. All steering committee meetings were open to the public and interested stakeholders. Meetings were announced to the steering committee list by e-mail, and participation from all meeting attendees was encouraged. Steering committee members served as a conduit of information to others and through their own organizational communications with other agencies to encourage participation in the process.

2.2.1 Regional Water Plan Update Kick Off Meeting (Round 1)

An initial kick off meeting for the Regional Water Plan Update was held in the Lower Rio Grande region on May 21, 2014. In preparation for this meeting, a master stakeholder list was developed building from the previous plan, and extensive efforts were made to begin identifying the representatives from the water user groups who should be invited to the meetings. These individuals were identified through research, communication with other water user group representatives in the region, contacting local organizations and entities, and making phone calls. Other individuals and entities that have an interest in water were also added to the master stakeholder list. The meeting was announced through e-mails and by telephonic communication with the preliminary stakeholder list.

The purpose of the initial meeting was to present the regional water planning update process to the region and continue to conduct outreach to begin building the steering committee. Many of the meeting attendees were not on the master stakeholder list, and those individuals were added to the list. Representatives from many of the water user groups attended the meeting and were instrumental in identifying other individuals as potential representatives for a particular group.

2.2.2 Presentation of the Technical Information to the Water Planning Region (Round 2)

A second meeting was held for the Lower Rio Grande region on January 13, 2105. The purpose of the meeting was to present the technical data compiled and synthesized for the region. The data presented included population and economic trends through a series of tables, the administrative water supply, the projected future water demand, and the gap between supply and demand for both normal and drought years. In addition, the presentation reaffirmed the development of a steering committee to guide the process as outlined in the RWP Handbook.

2.2.3 Development of the Public Involvement Process and List of Projects, Programs, and Policies in the Water Planning Region (Round 3)

Several meetings were held in the region to begin working with the steering committee and working groups on the public involvement process and on identifying the projects, programs, and policies the regions want to include in the regional water plan update, as well as continued refinement of the steering committee, subcommittees and leadership of the subcommittees, and locations, dates, and times for future meetings. Several new people attended each meeting, and it was important to reaffirm the goals for the plan update and discuss the process and purpose for developing a list of future projects. Therefore, each of the Round 3 meetings included a brief review of the update process and timeline.

Meeting # 3 – Las Cruces: The steering committee and interested stakeholders met in the Las Cruces Utilities Building on February 12, 2105. The group reviewed the update process and the timeline for updating the RWP. The group reviewed the survey of past and future projects, policies, programs that would be used as a template for gathering new/updated information. The group further discussed guiding principles for developing the plan. Concerns over the proposed timeline and minimal data supplied in the Round 2 meeting were also discussed. A doodle-poll was used to determine the best meeting time for the next meeting.

Meeting # 4 – Las Cruces The steering committee and interested stakeholders met in the Women's Improvement Association on April 8, 2015. The group reviewed the steering committee makeup and made suggestions for new members. The steering committee discussed the difficulty of planning in this region due to ongoing court cases, severely limiting agricultural members such as EBID from participating. Subcommittees had been developed at a previous meeting, and for those that had met, subcommittee chairs reported on ideas generated relative to programs, policies, projects, or other issues. The steering committee agreed to a strategy proposed by the public engagement committee to gather input from several constituencies not actively participating in the regional water planning process. The public engagement committee conducted surveys and one-on-one interviews around the county with members of several constituencies: water-intensive businesses, colonias, farmers and agricultural experts, the general public at the Las Cruces Farmers Market and via online survey. Complete information on these surveys and interviews will be contained in their own appendix.

Meeting # 5 – Las Cruces The steering committee and interested stakeholders met in the Las Cruces Community Enterprise Center Classroom on April 23, 2015. The group developed a work plan to complete the update in the ISC timeline. The group reviewed the alternatives developed in the previous plan and discussed any potential updates or revisions.

Meeting # 6 – Las Cruces The steering committee and interested stakeholders met at Las Cruces City Hall on May 7, 2015. The group continued to review the alternatives from the previous plan. The group further discussed potential collaborative projects such as agriculture/acequia projects, water system regionalization/cooperation, monitoring/data collect ion, watershed restoration, drought contingency planning, municipal conservation and reuse, local and state water policy recommendations, endangered species projects, and water quality protection.

Meeting # 7 – Las Cruces The steering committee and interested stakeholders met at Las Cruces City Hall on May 27, 2015. The group continued to review the new project, policy and program ideas that were developed by the working groups. The timeline for completion and the public involvement plan were discussed.

Meeting # 8 – Las Cruces: The steering committee and interested stakeholders held their final meeting in of the 2014-2015 fiscal year (FY) at Las Cruces City Hall on June 10. The group discussed elements that would be included in the public involvement chapter and ideas for FY 2015-2016 outreach. A deadline for sending information to the consultants was confirmed. The group participated in a brainstorming activity that helped to identify overarching concerns with the planning process and how to make the process as beneficial as possible. The consultants affirmed the next steps for the RWP update effort and a general idea for meeting again in FY 2015-2016.

2.3 Public Involvement in Lower Rio Grande Water Planning Region in Fiscal Year 2015-2016

During the Round 3 meetings in the spring of 2015, the steering committee worked with the technical contractors to begin identifying the best approach to develop a public involvement plan and the identification of the projects, programs, and policies to include in the plan. During FY 2015-2016, this process will continue, with the ISC contractors working with the regions to complete the two regional tasks (Sections 2 and 8 of the Updated Regional Water Plan). The ISC contractor is responsible for working with the steering committee to obtain the information necessary to draft both sections. The steering committee is not responsible for drafting the text of these sections; however, they will provide much of the information to be included by the contractor in these sections of the plan. The outcome of the process in 2016 will be completed

Public Involvement in Planning Process and *Implementation of Strategies to Meet Future Water Demand* sections.

The ISC contractors will facilitate three meetings with the Steering Committee between October 2015 and May 2016 to continue working on identifying projects, programs, and policies, as well as an approach to implementation. The first meeting will be held once the ISC has released a draft of the technical sections of the updated regional water plan. Subcommittees will continue to meet as needed to work on the projects, programs, and policies that pertain to their area of interest. ISC contractors will not facilitate these meetings. The subcommittee will provide the ISC contractors additional information as needed on the projects, programs, and policies reviewed in the subcommittees.

2.3.1 Meeting Locations and Times

The steering committee made the following recommendations regarding meeting times and locations:

- Location: Las Cruces
- Meeting space: Las Cruces City Hall works for Steering Committee, but a bigger place would be needed for public meetings
- Timing: Weekends and evenings were encouraged for increased participation
- Chairs of each subcommittee will organize meetings with subcommittee members. These meetings will not be facilitated by the ISC contractors.
- Steering committee members will continue to assist with outreach.

2.3.2 Public Outreach

The regional water planning process will continue to be an open and inclusive process. This region in particular conducted over 200 public surveys to educate the community about the planning process and to hear their concerns. The steering committee will continue to keep all water planning meetings open to the general public and to forward the invitation e-mails at their discretion. Generally, steering committee members ensure that other concerned or interested individuals receive the announcement and have communicated key contacts to add to the stakeholder list throughout the planning process. At the present time, it is not anticipated that the ISC will initiate or ask the regions to hold a general public meeting to present the planning process to the public at large. Because public outreach has been inclusive throughout the update process, members of the public who have an interest in water have either been invited directly or indirectly through the steering committee representative. The contractors will continue to encourage the steering committee members to communicate with interested stakeholders about the planning process.

1. Description of the Planning Region

This section provides a general overview of the Lower Rio Grande Water Planning Region. Detailed information, including maps illustrating the land use and general features of the region, was provided in the 2003 RWP (except for some of the region's declared underground water basins [UWBs]); that information is briefly summarized and updated as appropriate here, including a description of the other declared UWBs in the planning region . Additional detail on the climate, water resources, and demographics of the region is provided in Sections 5 and 6.

3.1 General Description of the Planning Region

The Lower Rio Grande Water Planning Region is located in south-central New Mexico and includes all of Doña Ana County. The region is bounded on the north by Sierra County, on the west by Sierra and Luna counties, on the south by the international border with Mexico and the Texas state line, and on the east by Otero County (Figure 1-1). The total area of the planning region is approximately 3,814 square miles.

The current area of the Lower Rio Grande Water Planning Region differs somewhat from the area addressed in the accepted plan (Terracon et al., 2003). For the 2003 plan, the region coincided with NMOSE's Lower Rio Grande surface water basin, which extends to Elephant Butte Dam, and the previously drawn region therefore included the area within Sierra County downstream of Elephant Butte Reservoir. The northern boundary of the current water planning region is the Dona Aña County-Sierra County line. The region includes a number of areas outside the Lower Rio Grande surface water basin that provide water to users in Doña Ana County.

Agriculture is the predominant land use in the Lower Rio Grande region. Las Cruces is the major city. There has been a small amount of historical mining in the region, primarily in the Organ Mountains. New Mexico State University in Las Cruces is also an important asset to the region.

3.2 Climate

The climate of the Lower Rio Grande region is arid continental, characterized by low annual precipitation (8 to 10 inches) in the valleys and more than 20 inches in the higher terrain. Precipitation falls mostly as rain during the summer monsoon season, but winter temperatures are low enough for occasional snowfall events. Average annual temperatures are around 61 to 75 degrees Fahrenheit (°F).

3.3 Major Surface Water and Groundwater Sources

The predominant water supply in the Lower Rio Grande region is the Rio Grande, which flows through the center of the planning region and provides 60 percent of the water supply, predominantly for irrigation. Groundwater is derived primarily from the alluvial and basin fill aquifers that have formed in the rift valleys of the Lower Rio Grande and the non-stream connected aquifers of the Tularosa, Jornada, Hueco, Nutt-Hockett, Mimbres and Mount Riley groundwater basins. The Nutt-Hockett Basin is stream-connected, but it is treated as non-stream connected for planning purpose due to the relatively high rates of drawdown observed in this basin.

The Lower Rio Grande Water Planning Region overlies parts of the Tularosa, Lower Rio Grande, Nutt-Hockett, Hueco, Mimbres, and Mount Riley Declared Underground Water Basins (UWBs). (A declared UWB is an area of the state proclaimed by the State Engineer to be underlain by a groundwater source having reasonably ascertainable boundaries. By such proclamation the State Engineer assumes jurisdiction over the appropriation and use of groundwater from the source.) These basins are shared with the following water planning regions:

- Tularosa: Estancia Basin, Socorro-Sierra, and Tularosa-Salt-Sacramento Basins
- Lower Rio Grande: Socorro-Sierra
- Nutt-Hockett: Socorro-Sierra, Southwest New Mexico
- Mimbres: Southwest New Mexico, Socorro-Sierra

The Hueco UWB falls almost entirely within the Lower Rio Grande region, with just a small section extending into the Tularosa-Salt-Sacramento Basins region, and the Mount Riley UWB falls entirely within the Lower Rio Grande region. A map showing the UWBs in the region is provided in Section 4.7.2.

Additional information on administrative basins and surface and groundwater resources of the region is included in Section 4 and Sections 5.2 and 5.3, respectively.

3.4 Demographics, Economic Overview, and Land Use

The Lower Rio Grande Water Planning Region is composed of one county, Doña Ana, located in south-central New Mexico. The federal government owns 75 percent of the land in the planning region. Most of the County's private land is located in the agricultural valley along the Rio Grande and within the City of Las Cruces (Viva Doña Ana, 2013).

Doña Ana County is the second most populous county in New Mexico; the total 2013 population of the county was 213,460 (U.S. Census Bureau, 2014a). As shown in Table 3-1, between 2010 and 2013 the population of Doña Ana County increased by 2.0 percent.

The largest employment categories in Doña Ana County are education/healthcare, retail trade, arts, entertainment, recreation, accommodation, professional, scientific, and management, construction, and government. Current statistics on the economy and land use in the county, compiled from the U.S. Census Bureau and the New Mexico Department of Workforce Solutions, are summarized in Table 3-1. Additional detail on demographics and economics within the region is provided in Section 6.

1. Legal Issues

4.1 Relevant Water Law

4.1.1 State of New Mexico Law

Since the accepted regional water plan for the Lower Rio Grande Water Planning Region was published in 2003, there have been significant changes in New Mexico water law through case law, statutes, and regulations. These changes address statewide issues including, but not limited to, domestic well permitting, the State Engineer's authority to regulate water rights, administrative and legal review of water rights matters, use of settlements to allocate water resources, the rights appurtenant to a water right, and acequia water rights. New law has also been enacted to address water project financing and establish a new strategic water reserve. These general state law changes are addressed by topic area below. State law more specific to the Lower Rio Grande region is discussed in Section 4.1.2.

4.1.1.1 Regulatory Powers of the OSE

In 2003, the New Mexico Legislature enacted NMSA 1978, § 72-2-9.1, relating to the administration of water rights by priority date. The legislature recognized that "the adjudication process is slow, the need for water administration is urgent, compliance with interstate compacts is imperative and the state engineer has authority to administer water allocations in accordance with the water right priorities recorded with or declared or otherwise available to the state engineer" (§ 72-2-9.1(A)). The statute authorized the State Engineer to adopt rules for priority administration in a manner that does not interfere with future or pending adjudications, creates no impairment of water rights other than what is required to enforce priorities, and creates no increased depletions.

Based on Section 72-2-9.1, the State Engineer promulgated the Active Water Resource Management (AWRM) regulations in December 2004. The regulation's stated purpose is to establish the framework for the State Engineer to "to carry out his responsibility to supervise the physical distribution of water to protect senior water right owners, to assure compliance with interstate stream compacts and to prevent waste by administration of water rights" (19.25.1.6 NMAC). In order to carry out this purpose, the AWRM regulations provide the framework for the promulgation of specific water master district rules and regulations. No district-specific AWRM regulations have been promulgated at the time of writing.

The general AWRM regulations set forth the duties of a water master to administer water rights in the specific district under the water master's control. Before the water master can take steps to manage the district, AWRM requires the OSE to determine the "administrable water rights" for purposes of priority administration. The State Engineer determines the elements, including priority date, of each user's administrable water right using a hierarchy of the best available evidence, in the following order: (1) a final decree or partial final decree from an adjudication, (2) a subfile order from an adjudication, (3) an offer of judgment from an adjudication, (4) a hydrographic survey, (5) a license issued by the State Engineer, (6) a permit issued by the State Engineer along with proof of beneficial use, and (7) a determination by the State Engineer using "the best available evidence" of historical, beneficial use. Once determined, this list of administrable water rights is published and subject to appeal (19.25.13.27 NMAC), and once the list is finalized, the water master may evaluate the available water supply in the district and manage that supply according to users' priority dates.

The general AWRM regulations also allow for the use of replacement plans to offset the depletions caused by out-of-priority water use. The development, review, and approval of replacement plans will be based on a generalized hydrologic analysis developed by the State Engineer.

The general AWRM regulations were unsuccessfully challenged in court in *Tri-State Generation and Transmission Ass'n, Inc. v. D'Antonio,* 2012-NMSC-039. In this case the New Mexico Supreme Court analyzed whether Section 72–2–9.1 provided the State Engineer with the authority to adopt regulations allowing it to administer water rights according to interim priority determinations developed by the OSE.

In *Tri-State* the Court held that (1) the Legislature delegated lawful authority to the State Engineer to promulgate the AWRM regulations, and (2) the regulations are not unconstitutional on separation of powers, due process, or vagueness grounds. Specifically, the Court found that establishing such regulations does not violate the constitutional separation of powers because AWRM regulations do not go beyond the broad powers vested in the State Engineer, including the authority vested by Section 72–2–9.1. The Court further found that the AWRM regulations did not violate the separation of powers between the executive and the judiciary despite the fact that the regulations allow priorities to be administered prior to an *inter se* adjudication of priority. Rather, the Legislature chose to grant the OSE quasi-judicial authority in administering priorities prior to final adjudication, which was well within its discretion to do.

The Court further held that the AWRM regulations do not violate constitutional due process because they do not deprive the party challenging the regulations of a property right. As explained by the Court, a water right is a limited, usufructuary right providing only a right to use a certain amount of water established through beneficial use. As such, based on the long-standing principle that a water right entitles its holder to the use of water according to priority, regulation of that use by the state does not amount to a deprivation of a property right.

In addition to *Tri-State*, several other cases that address other aspects of the regulatory powers of the OSE have been decided recently. Priority administration was addressed in a case concerning the settlement agreement entered into by the United States, New Mexico (State), the Carlsbad Irrigation District (CID), and the Pecos Valley Artesian Conservancy District (PVACD) related to the use of the waters of the Pecos River (*State ex rel. Office of the State Engineer v. Lewis*, 2007-NMCA-008, 140 N.M). The issues in the case revolved around (1) the competing claims of downstream, senior surface water users in the Carlsbad area and upstream, junior groundwater users in the Roswell Artesian Basin and (2) the competing claims of New Mexico and Texas users. Through the settlement agreement, the parties sought to resolve these issues through public funding, without offending the doctrine of prior appropriation and without resorting to a priority call.

The settlement agreement was, in essence, a water conservation plan designed to augment the surface flows of the lower Pecos River in order to (1) secure the delivery of water within the CID, (2) meet the State's obligations to Texas under the Pecos River Compact (Compact), and (3) limit the circumstances under which the United States and CID would be entitled to make a call for the administration of water right priorities. The agreement included the development of a well field to facilitate the physical delivery of groundwater directly into the Pecos River under certain conditions, the purchase and transfer to the well field of existing groundwater rights in the Roswell UWB by the State, and the purchase and retirement of irrigated land within PVACD and CID.

The Court of Appeals framed the issue as whether the priority call procedure is the exclusive means under the doctrine of prior appropriation to resolve existing and projected future water shortage issues. The Court held that Article XVI, Section 2 of the Constitution, which states that "[p]riority of appropriation shall give the better right," and Article IX of the Compact, which states that "[i]n maintaining the flows at the New Mexico-Texas state line required by this compact, New Mexico shall in all instances apply the principle of prior appropriation within New Mexico," do not require a priority call as the sole response to water shortage concerns. The Court found it reasonable to construe these provisions to permit flexibility within the prior appropriation doctrine in attempting to resolve longstanding water issues. Thus, the more flexible approach pursued by the settling parties through the settlement agreement was not ruled out in the Constitution, the Compact, or case precedent.

In relation to the OSE's regulatory authority over supplemental wells, in *Herrington v. State of New Mexico ex rel. State Engineer,* 2006-NMSC-014, 139 N.M. 368, the New Mexico Supreme Court clarified certain aspects of the *Templeton* doctrine. The *Templeton* doctrine allows senior surface water appropriators impaired by junior wells to drill a supplemental well to offset the impact to their water right (see *Templeton v. Pecos Valley Artesian Conservancy District,* 1958-NMSC-131, 65 N.M. 59). According to *Templeton,* drilling the supplemental well allows the senior surface right owner to keep their surface water right whole by drawing upon groundwater that originally fed the surface water supply. Although the New Mexico prior appropriation doctrine theoretically does not allow for sharing of water shortages, the *Templeton* doctrine permits both the aggrieved senior surface appropriator and the junior user to divert their full share of water. The requirements for a successful *Templeton* supplemental well include (1) a valid surface water right, (2) surface water fed in part by groundwater (baseflow), (3) junior appropriators intercepting that groundwater by pumping, and (4) a proposed well that taps the same groundwater source of the applicant's original appropriation.

In *Herrington* the Court clarified that the well at issue would meet the *Templeton* requirements if it was dug into the same aquifer that fed the surface water. The Court also clarified whether a *Templeton* well could be drilled upstream of the surface point of diversion. The Court determined that the proper placement of a *Templeton* well must be considered on a case-by-case basis, and that these supplemental wells are not necessarily required to be upstream in all cases.

Lastly, the Court addressed the difference between a *Templeton* supplemental well and a statutory supplemental well drilled under NMSA 1978, Sections 72–5–23, -24 (1985). The Court found that a statutory transfer must occur within a continuous hydrologic unit, which differs from the narrow *Templeton* same-source requirement. Although surface to groundwater transfers require a hydrologic connection, this may be a more general determination than the *Templeton* baseflow source requirement. Further, *Templeton* supplemental wells service the original parcel, while statutory transfers may apply to new uses of the water, over significant distances.

Also related to the OSE's regulatory authority, the Court of Appeals addressed unperfected water rights in *Hanson v. Turney*, 2004-NMCA-069, 136 N.M. 1. In *Hanson*, a water rights permit holder who had not yet applied the water to beneficial use sought to transfer her unperfected water right from irrigation to subdivision use. The State Engineer denied the application because the water had not been put to beneficial use. The permit holder argued that pursuant to NMSA 1978, Section 72-12-7(A) (1985), which allows the owner of a "water right" to change the use of the water upon application to the State Engineer, the State Engineer had wrongly rejected her application. The Court upheld the denial of the application, finding that under western water law the term "water right" does not include a permit to appropriate water when no water has been put to beneficial use. Accordingly, as used in Section 72-12-7(A) the term "water right" requires the perfection of a water right through beneficial use before a transfer can be allowed.

4.1.1.2 Legal Review of OSE Determinations

In *Lion's Gate Water v. D'Antonio*, 2009-NMSC-057, 147 N.M. 523, the Supreme Court addressed the scope of the district court's review of the State Engineer's determination that no water is available for appropriation. In *Lion's Gate*, the applicant filed a water rights application, which the State Engineer rejected without publishing notice of the application or holding a hearing, finding that no water was available for appropriation. The rejected application was subsequently reviewed in an administrative proceeding before the State Engineer's hearing examiner. The hearing examiner upheld the State Engineer's decision on the grounds that there was no unappropriated water available for appropriation.

This ruling was appealed to the district court, which determined that it had jurisdiction to hear all matters either presented or which might have been presented to the State Engineer, as well as new evidence developed since the administrative hearing. The OSE disagreed, arguing that only the issue of whether there was water available for appropriation was properly before the district court. The Supreme Court agreed with the OSE. The Court found that the comprehensive nature of the water code's administrative process, its mandate that a hearing must be held prior to any appeal to district court, and the broad powers granted to the State Engineer clearly express the Legislature's intent that the water code provide a complete and exclusive means to acquire water rights. Accordingly, the OSE was correct that the district court's *de novo* review was limited in its review of the application to what the State Engineer had already addressed administratively, in this case whether unappropriated water was available.

The Court also held that the water code does not require publication of an application for a permit to appropriate if the State Engineer determines no water is available for appropriation, because no third-party rights are implicated unless water is available. If water is deemed to be available, the State Engineer must order notice by publication in the appropriate form.

Based in large part on the holding in *Lion's Gate*, the New Mexico Court of Appeals in *Headon v. D'Antonio*, 2011-NMCA-058, 149 N.M. 667, held that a water rights applicant is required to proceed through the administrative process when challenging a decision of the State Engineer. In *Headon* the applicant challenged the OSE's determination that his water rights were forfeited. To do so, he filed a petition seeking declaratory judgment as to the validity of his water rights in district court, circumventing the OSE administrative hearing process (2011-NMCA-058, ¶¶ 2-3). The Court held that the applicant must proceed with the administrative hearing, along with its *de novo* review in district court, to challenge the findings of the OSE.

Legal review of OSE determinations was also an issue in *D'Antonio v. Garcia*, 2008-NMCA-139,145 N.M. 95, where the Court of Appeals made several findings related to OSE administrative review of water rights matters. *Garcia* involved an OSE petition to the district court for enforcement of a compliance order after the OSE hearing examiner had granted a motion for summary judgment affirming the compliance order (2008-NMCA-139, ¶¶ 2-5) . The Court first found that the right to a hearing granted in NMSA 1978, Section 72-2-16 (1973), did not create an absolute right to an administrative hearing. Rather, the OSE hearing contemplated in Section 72-2-16 could be waived if a party did not timely request such a hearing (2008-NMCA-139, ¶ 9). In *Garcia* the defendant had not made such a timely request and therefore was not entitled to a full administrative hearing prior to issuance of an order by the district court.

The Court also examined the regulatory powers of the OSE hearings examiner, specifically, whether 19.25.2.32 NMAC allows the hearing examiner to issue a final order without the express written consent of the state engineer (2008-NMCA-139, ¶¶ 11-15). The Court held that the regulation allowed the hearing examiner to dismiss a case without the express approval of the State Engineer (2008-NMCA-139, ¶ 14). Finally, the Court held that the OSE hearing examiner may dismiss a case without full hearing when a party willfully fails to comply with the hearing examiner's orders (2008-NMCA-139, ¶¶ 17-18). Accordingly, the Court in *Garcia* upheld the OSE hearing examiner's action to issue a compliance order without a full administrative hearing or final approval by the State Engineer. As such, the district court had the authority to enforce that compliance order.

4.1.1.3 Beneficial Use of Water – Non-Consumptive Use

Carangelo v. Albuquerque-Bernalillo County Water Utility Authority, 2014-NMCA-032, addressed whether a non-consumptive use of water qualifies as a beneficial use under New Mexico law and, accordingly, can be the basis for an appropriation of such water. In *Carangelo*, the OSE granted the Albuquerque-Bernalillo County Water Utility Authority's (Authority's) application to divert approximately 45,000 acre-feet per year of Rio Grande surface water, to which the Authority had no appropriative right. The Authority intended to use the water for the non-consumptive purpose of "carrying" the Authority's own San Juan-Chama Project water, Colorado River Basin water to which the Authority had contracted for use of, to a water treatment plant for drinking water purposes. The Court of Appeals found the OSE erred in granting the application because the application failed to seek a new appropriation. The Authority's application sought to divert water, to which the Authority asserted no prior appropriative right, which required a new appropriation. Moreover, the Authority affirmatively asserted no beneficial use of the water. The Court remanded the matter to the OSE to issue a corrected permit.

The Court's decision included the following legal conclusions:

- A new non-consumptive use of surface water in a fully appropriated system requires a new appropriation of water. A "non-consumptive use" is a type of water use where either there is no diversion from a source body or there is no diminishment of the source. Neither the New Mexico Constitution nor statutes governing the appropriation of water distinguishes between diversion of water for consumptive and non-consumptive uses. Because both can be beneficial uses, New Mexico's water law applies equally to either.

- The Authority did not need to file for a change in place or purpose of use for the diversion of its San Juan-Chama Project water. The Court stated that the San Juan-Chama Project water does not come from the Rio Grande Basin, and the Authority's entitlement to its beneficial use is not within the administrative scope of the Rio Grande Basin. Accordingly, the Authority already had an appropriative right to that water and did not need to file an application with the OSE for its use.

4.1.1.4 Impairment

Montgomery v. Lomos Altos, Inc., 2007-NMSC-002, 141 N.M. 21, involved applications to transfer surface water rights to groundwater points of diversion in the fully appropriated Rio Grande stream system. In order for a transfer to be approved, an applicant must show, among other factors, that the transfer will not impair existing water uses at the move-to location. In *Lomos Altos*, several parties protested the OSE's granting of the applications, arguing that surface depletions at the move-to location caused by the applications should be considered *per se* impairment of existing rights. The Court found that questions of impairment are factual and cannot be decided as a matter of law, but must be determined on a case-by-case basis. In doing so, the Court held that surface depletions in a fully appropriated stream system do not result in *per se* impairment, but the Court noted that, under some circumstances, even *de minimis* depletions can lead to a finding of impairment. The Court further found that in order to determine impairment, all existing water rights at the "move-to" location must be considered.

4.1.1.5 Rights Appurtenant to Water Rights

The Supreme Court has issued three recent opinions dealing with appurtenancy. *Hydro Resources Corp. v. Gray,* 2007-NMSC-061, 143 N.M. 142, involved a dispute over ownership of water rights developed by a mining lessee in connection with certain mining claims owned by the lessor. The Supreme Court held that under most circumstances, including mining, water rights are not considered appurtenant to land under a lease. The sole exception to the general rule that water rights are separate and distinct from the land is water used for irrigation. Therefore, a lessee can acquire water rights on leased land by appropriating water and placing it to beneficial use. Those developed rights remain the property of the lessee, not the lessor, unless stipulated otherwise in an agreement.

In a case examining whether irrigation water rights were conveyed with the sale of land, or severed prior to the sale (*Turner v. Bassett,* 2005-NMSC-009, 137 N.M. 381), the Supreme Court examined New Mexico's transfer statute, NMSA 1978, Section 72-5-23 (1941), along with the OSE regulations addressing the change of place or purpose of use of a water right, 19.26.2.11(B) NMAC. The Court found that the statute, coupled with the applicable regulations and OSE practice, requires consent of the landowner and approval of the transfer application by the State Engineer for severance to occur. The issuance of a permit gives rise to a presumption that the water rights are no longer appurtenant to the land. A landowner who holds water rights and follows the statutory and administrative procedures to effect a severance and initiate a transfer may convey the land severed from its former water rights, without necessarily reserving those water rights in the conveyance documents.

In *Walker v. United States,* 2007-NMSC-038, 142 N.M. 45, the New Mexico Supreme Court examined the issue of whether a water right includes an implicit right to graze. After the United States Forest Service cancelled the Walkers' grazing permits, the Walkers filed a complaint arguing that the United States had taken their property without just compensation in violation of the Fifth Amendment to the United States Constitution. The Walkers asserted a property right to the allotments under New Mexico state law, arguing that the revocation of the federal permit resulted in the loss of "water, forage, and grazing" rights based on New Mexico state law and deprived them of all economically viable use of their cattle ranch.

The Court found that a stock watering right does not include an appurtenant grazing right. In doing so, the Court addressed in depth the long understood principle in western water law that water rights, unless used for irrigation, are not appurtenant to the land on which they are used. The Court also clarified that the beneficial use for which a water right is established does not guarantee the water right owner an interminable right to continue that same beneficial use. The Walkers could have transferred their water right to another location or another use if they could not continue with the original uses. For these reasons, the Court rejected the Walkers attempt to make an interest in land incident or appurtenant to a water right.

4.1.1.6 Domestic Wells

New Mexico courts have decided several significant cases addressing domestic well permitting recently and the OSE also recently amended its regulations governing domestic wells.

In *Bounds v. State ex. rel D'Antonio,* 2013-NMSC-037, the New Mexico Supreme Court upheld the constitutionality of New Mexico's Domestic Well Statute (DWS), NMSA 1978, Section 72-12–1.1 (2003). Bounds, a rancher and farmer in the fully appropriated and adjudicated Mimbres basin, and the New Mexico Farm and Livestock Bureau (Petitioners), argued that the DWS was facially unconstitutional. The DWS states that the OSE "shall issue" domestic well permits, without determining the availability of unappropriated water or providing other water rights owners in the area the ability to protest the well. The Petitioners argued this practice violated the New Mexico constitutional doctrine of prior appropriation to the detriment of senior water users, as well as due process of law. The Court held that the DWS does not violate the doctrine of prior appropriation set forth in the New Mexico Constitution. The Court also held that Petitioners failed to adequately demonstrate any violation of their due process rights.

In addressing the facial constitutional challenge, the Court rejected the Petitioners' argument that the New Mexico Constitution mandates that the statutory requirements of notice, opportunity to be heard, and a prior determination of unappropriated waters or lack of impairment be applied to the domestic well application and permitting process. The Court reasoned that the DWS creates a different and more expedient permitting procedure for domestic wells and the constitution does not require a particular permitting process, or identical permitting procedures, for all appropriations. While holding that the DWS was valid in not requiring the same notice, protest, and water availability requirements as other water rights applications, the court confirmed that domestic well permits can be administered in the same way as all other water rights. In other words, domestic wells do not require the same rigors as other water rights when permitted, but when domestic wells are administered, constitutionally mandated priority administration still applies. Thus the DWS, which deals solely with permitting and not with administration, does not conflict with the priority administration provisions of the New Mexico Constitution.

The Court also found that the Petitioners failed to prove a due process violation because they did not demonstrate how the DWS deprived them of their water rights. Specifically, Bounds failed to show any actual impairment, or imminent future impairment, of his water rights. Bounds asserted that any new appropriations must necessarily cause impairment in a closed and fully appropriated basin, and therefore, granting any domestic well permit had the potential to impair his rights. The Court rejected this argument, finding that impairment must be proven using scientific analysis, not simply conclusory statements based on a bright line rule that impairment always occurs when new water rights are permitted in fully appropriated basins.

Two other significant domestic well decisions addressed domestic well use within municipalities. In *Smith v. City of Santa Fe*, 2007-NMSC-055, 142 N.M. 786, the Supreme Court examined the authority of the City of Santa Fe to enact an ordinance restricting the drilling of domestic wells. The Court held that under the City's home rule powers, it had authority to prohibit the drilling of a domestic well within the municipal boundaries and that this authority was not preempted by existing state law.

Then in *Stennis v. City of Santa Fe,* 2008-NMSC-008, 143 N.M. 320, Santa Fe's domestic well ordinance was tested when a homeowner (Stennis) applied for a domestic well permit with the OSE, but did not apply for a permit from the City. In examining the statute allowing municipalities to restrict the drilling of domestic wells, the Court found that municipalities must strictly comply with NMSA 1978, Section 3–53–1.1(D) (2001) , which requires cities to file their ordinances restricting the drilling of domestic water wells with the OSE. On remand, the Court of Appeals held that Section 3-53-1.1(D) does not allow for *substantial* compliance (*Stennis v. City of Santa Fe*, 2010-NMCA-108, 149 N.M. 92). Rather, strict compliance is required and the City must have actually filed a copy of the ordinance with the OSE.

In addition to the cases addressing domestic wells, the regulations governing the use of groundwater for domestic use were substantially amended in 2006 to clarify domestic well use pursuant to NMSA 1978, Section 72-12-1.1. (19.27.5.1 et seq. NMAC). The regulations:

1. Limit the amount of water that can be used pursuant to a domestic well permit to:

   - 1.0 acre feet per year (ac-ft/yr) for a single household use (can be increased to up to 3.0 ac-ft/yr if the applicant can show that the combined diversion from domestic wells will not impair existing water rights).

   - 1.0 ac-ft/yr for each household served by a well serving more than one household, with a cap of 3.0 ac-ft/yr if the well serves three or more households.

   - 1.0 ac-ft/yr for drinking and sanitary purposes incidental to the operations of a governmental, commercial, or non-profit facility as long as no other water source is available. The amount of water so permitted is subject to further limitations imposed by a court or a municipal or county ordinance.

   The amount of water that can be diverted from a domestic well can also be increased by transferring an existing water right to the well (19.27.5.9 NMAC).

2. Require mandatory metering of all new domestic wells under certain conditions, such as when wells are permitted within a domestic well management area, when a court imposes a metering requirement, when the water use is incidental to the operations of a governmental, commercial, or non-profit facility, and when the well serves multiple households (19.27.5.13(C) NMAC).

3. Allow for the declaration of domestic well management areas when hydrologic conditions require added protections to prevent impairment to valid, existing surface water rights. In such areas, the maximum diversion from a new domestic well cannot exceed, and may be less than, 0.25 ac-ft/yr for a single household and up to 3.0 ac-ft/yr for a multiple household

well, with each household limited to 0.25 ac-ft/yr. The State Engineer has not declared any domestic well management areas in the planning region.

4.1.1.7 Water Project Financing

The Water Project Finance Act, Chapter 72, Article 4A NMSA 1978, outlines different mechanisms for funding water projects in water planning regions. The purpose of the Act is to provide for water use efficiency, resource conservation, and the protection, fair distribution, and allocation of New Mexico's scarce water resources for beneficial purposes of use within the State. The Water Project Finance Act creates two funds: the Water Project Fund, NMSA 1978, Section 72-4A-9 (2005), and the Acequia Project Fund, NMSA 1978, Section 72-4A-9.1 (2004). Both funds are administered by the New Mexico Finance Authority. The Water Trust Board recommends projects to the Legislature to be funded from the Water Project Fund.

The Water Project Fund may be used to make loans or grants to qualified entities (broadly defined to include public entities and Indian tribes and pueblos). To qualify for funding, the project must be approved by the Water Trust Board for one of the following purposes: (1) storage, conveyance or delivery of water to end users, (2) implementation of federal Endangered Species Act of 1973 collaborative programs, (3) restoration and management of watersheds, (4) flood prevention, or (5) water conservation or recycling, treatment, or reuse of water as provided by law (NMSA 1978, § 72-4A-5(B) (2011)). The Water Trust Board must give priority to projects that (1) have been identified as being urgent to meet the needs of a regional water planning area that has a completed regional water plan accepted by the ISC, (2) have matching contributions from federal or local funding sources, and (3) have obtained all requisite state and federal permits and authorizations necessary to initiate the project (NMSA 1978, § 72-4A-5). The Acequia Project Fund may be used to make grants to acequias for any project approved by the Legislature.

The Water Project Finance Act directed the Water Trust Board to adopt regulations governing the terms and conditions of grants and loans recommended by the Board for appropriation by the Legislature from the Water Project Fund. The Board promulgated implementing regulations (19.25.10.1 et seq. NMAC) in 2008. The regulations set forth the procedures to be followed by the Board and New Mexico Finance Authority for identifying projects to recommend to the Legislature for funding. The regulations also require that financial assistance be made only to entities that agree to certain conditions set forth in the regulations.

4.1.1.8 The Strategic Water Reserve

In 2005, the New Mexico Legislature enacted legislation to establish a Strategic Water Reserve, NMSA 1978, Section 72-14-3.3 (2007). Regulations implementing the Strategic Water Reserve statute were also implemented in 2005 (19.25.14.1 et seq. NMAC).

The statute authorizes the Commission to acquire water rights or storage rights to compose the reserve (Section 72-14-3.3(A)). Water in the Strategic Water Reserve can be used for two purposes: (1) to comply with interstate stream compacts and (2) to manage water for the benefit of endangered or threatened species or to avoid additional listing of species (Section 72-14-3.3(B)). The ISC may only acquire water rights that have sufficient seniority and consistent, historical beneficial use to effectively contribute to the purpose of the Reserve. The ISC must annually develop river reach or groundwater basin priorities for the acquisition of water rights for the Strategic Water Reserve. The Lower Rio Grande basin has been designated as a priority basin.

4.1.1.9 Water Conservation

Guidelines for drafting and implementing water conservation plans are set forth in NMSA 1978, Section 72-14-3.2 (2003). By statute, neither the Water Trust Board nor the New Mexico Finance Authority may accept an application from a covered entity (defined as municipalities, counties and any other entities that supply at least 500 acre-feet per annum of water to its customers, but excluding tribes and pueblos) for financial assistance to construct any water diversion, storage, conveyance, water treatment, or wastewater treatment facility unless the entity includes a copy of its water conservation plan.

The water conservation statute primarily supplies guidance to covered entities, as opposed to mandating any particular action. For example, the statute provides that the covered entity determines the manner in which it will develop, adopt, and implement a water conservation plan. The statute further states that a covered entity "shall consider" either adopting ordinances or codes to encourage conservation, or otherwise "shall consider" incentives to encourage voluntary compliance with conservation guidelines. The statute then states that covered entities "shall consider, and incorporate in its plan if appropriate, . . . a variety of conservation measures," including, in part, water-efficient fixtures and appliances, water reuse, leak repairs, and water rate structures encouraging efficiency and reuse (Section 72-14-3.2(D)).

4.1.1.10 Municipal Condemnation

NMSA 1978, Section 3-27-2 (2009) was amended in 2009 to prohibit municipalities from condemning water sources used by, water stored for use by, or water rights owned or served by an acequia, community ditch, irrigation district, conservancy district, or political subdivision of the state.

4.1.2 State Water Laws and Administrative Policies Affecting the Region

In New Mexico, water is administered generally by the State Engineer, who has the "general supervision of waters of the state and of the measurement, appropriation, distribution thereof and such other duties as required" (NMSA 1978, § 72-2-1 (1982)). To administer water throughout the state the State Engineer has several tools at its disposal, including designation of water masters, declaration of UWBs, and use of the Active Water Resource Management rules, all of which are discussed below along with other tools used to manage water within regions.

4.1.2.1 Water Masters

The State Engineer has the power to create water master districts or sub-districts by drainage area or stream system and to appoint water masters for such districts or sub-districts (NMSA 1978, § 72-3-1 (1919)). Water masters have the power to apportion the waters in the water master's district under the general supervision of the State Engineer and to appropriate, regulate, and control the waters of the district to prevent waste (NMSA 1978, § 72-3-2 (2007)). Currently, two water masters and two assistant water masters are assigned to the Lower Rio Grande.

4.1.2.2 Groundwater Basin Guidelines

The OSE has declared UWBs and implements guidelines in those basins for the purpose of carrying out the provisions of the statutes governing underground waters (see NMAC 19.27.48.6). There are six UWBs in the Lower Rio Grande region (Figure 4-1): the Hueco, Lower Rio Grande, Mimbres, Mount Riley, Nutt Hockett, and Tularosa. The Lower Rio Grande Underground Water Basin is the largest basin in the region and is governed by the *Mesilla Valley Administrative Guidelines for Review of Water Right Applications* (NMOSE, 1999). These guidelines were discussed at length in the 2003 plan, Section 5.6.1. There are no specific basin guidelines for the Hueco, Mimbres, Mount Riley, and Nutt Hockett UWBs.

For the Lower Rio Grande UWB, two State Engineer Orders on administration were issued in 2004. One order creates a Water Master District located in Sierra and Doña Ana counties for the administration of groundwater in the Lower Rio Grande UWB. The water master has the power to appropriate, regulate, and control the waters of the District to prevent impairment of senior water right owners and the waste of water (*In the Matter of the Creation of the Lower Rio Grande Water Master District for the Administration of Rights to the Use of Ground Water from the Lower Rio Grande Groundwater Basin of New Mexico*, December 3, 2004).

The second order requires the metering and reporting by March 1, 2006 of all groundwater withdrawals except for domestic and livestock uses. The order included metering of all lands within the Lower Rio Grande, Hot Springs, and Las Animas Creek UWBs (*In the Matter of the Requirements for Metering Groundwater Withdrawals in the Lower Rio Grande Watermaster District,* December 3, 20040.

The Tularosa UWB was extended in 2005 (19.27.64.1 et seq. NMAC). In 2014, the OSE put forth an *Update to the Alamogordo-Tularosa Administrative Guidelines for Review of Water Right Applications* (NMOSE, 2014a). The update provides guidelines on the procedures for processing pending and future water rights applications filed within the Alamogordo-Tularosa

Administrative Area, a portion of which is within the Region. The updated guidelines replace the Tularosa Basin Administrative Criteria adopted by the OSE in 1997.

4.1.2.3 AWRM Implementation in the Basin

Although the Lower Rio Grande Basin has been designated a priority basin for Active Resource Water Management, AWRM regulations have not yet been issued for the basin.

4.1.2.4 Special Districts in the Basin

Special districts are various districts within the region having legal control over the use of water in that district. All are subject to specific statutes concerning their organization and operation, found in Chapter 73 of the New Mexico Statutes. In the Lower Rio Grande region, special districts include the Doña Ana and Caballo Soil and Water Conservation Districts, the Elephant Butte Irrigation District (EBID), and the Town of Mesilla Special Water Users Association. Because of its size, the EBID and its water management practices are particularly important to the region.

4.1.2.5 State Court Adjudications in the Basin

The Lower Rio Grande stream system adjudication, *State of New Mexico ex rel. State Engineer v. Elephant Butte Irrigation Dist., et al.,* No. CV-96-888 (3rd Jud. Dist.), is an ongoing adjudication with close to 45 percent of the 13,979 water right subfiles now adjudicated (NMOSE, 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. The parties currently are litigating the interests of the United States in the Rio Grande Project. To date, the court has determined the source and the amount of water for the Project. It next will decide the Project's priority date, after a two-week trial held in September 2015.

In August 2011, the adjudication court set the irrigation water requirements for all crops in the LRG. That ruling is now being applied in adjudicating subfiles. The court established a basin-wide farm delivery requirement (FDR) of 4.5 acre-feet per acre per year, but allowed claimants to prove an FDR up to 5.5 acre-feet based on evidence showing greater historical use. Evidence from more than 600 claimants is now being evaluated.

In addition, two major expedited *inter se* proceedings are in progress, one to adjudicate claims to water rights associated with the Copper Flat mine and the other to adjudicate claims to pre-1906 water rights derivative of the Rio Grande Dam and Irrigation Company.

4.1.3 Federal Water Laws

The law of water appropriation has been developed primarily through decisions made by state courts. Since the accepted plan was published in 2003 several federal cases have been decided examining various water law questions. These cases are too voluminous to include here, and many of the issues in the cases will not apply directly to the region. However, New Mexico is a party to one original jurisdiction case in the U.S. Supreme Court involving the Rio Grande Compact and waters of the Lower Rio Grande.

In *Texas v. New Mexico and Colorado*, No. 141 Original (United States Supreme Court, 2014), Texas alleges that New Mexico has violated the Rio Grande Compact by intercepting water Texas is entitled to under the Compact through groundwater pumping and surface water diversions downstream of Elephant Butte Reservoir but upstream of the New Mexico-Texas state line. Colorado is also a defendant in the lawsuit as a signatory to the Rio Grande Compact. The United States has intervened as a Plaintiff in the case. EBID and El Paso County Water Improvement District Number One (EPCWID #1)have both sought to intervene in the case as well, claiming that their interests are not fully represented by the named parties. The motions to intervene along with a motion to dismiss filed by New Mexico are currently pending.

Another federal court case, *State of New Mexico v. U.S. Bureau of Reclamation, et al.,* No. 1:2011-cv-00691-JB-ACT (D.N.M. filed August 8, 2011), also has the potential to greatly impact water planning for the region. It is summarized in Section 4.3.1.

4.1.3.1 Federal Reservations

The doctrine of federally reserved water rights was developed over the course of the 20th Century. Simply stated, federally reserved rights are created when the United States sets aside land for specific purposes, thereby withdrawing the land from the general public domain. In doing so, there is an implied, if not expressed, intent to reserve an amount of water necessary to fulfill the purpose for which the land was set aside. Federally reserved water rights are not created, or limited, by State law.

On federal lands (e.g., Forest Service, Park Service), water rights are reserved by the United States for use on those lands. The priority date of federally reserved water rights is the date the United States reserved the land for the particular use. In some cases, the United States may have State law rights under the prior appropriation system, for instance, if the United States acquires lands with existing water rights. Federally reserved lands with the Lower Rio Grande planning region include the following:

- Jornada Experimental Range
- Fort Bliss
- Organ Mountain National Recreation Area
- Organ Mountain Desert Peaks National Monument
- Prehistoric Trackways National Monument
- San Andreas National Wildlife Refuge

- White Sands National Monument
- White Sands Missile Range

4.1.3.2 Interstate Stream Compacts

Interstate compacts become federal law once ratified by Congress. The Rio Grande Compact is important in the Lower Rio Grande region. Signed in 1938, with Colorado, New Mexico, and Texas as parties, and approved by Congress in 1939, the Rio Grande Compact apportions among the three states the waters of the Rio Grande above Fort Quitman, Texas. The Compact is discussed in depth in the 2003 plan, Section 5.1.2. The Compact is the topic of the above-discussed case currently pending before the Unites States Supreme Court, *Texas v. New Mexico and Colorado*, No. 141 Original (United States Supreme Court, 2014).

4.1.3.3 Treaties

The 1906 Convention between the United States and Mexico distributes the waters of the Rio Grande between the two nations in the international reach of the river between the El Paso-Juárez Valley and Fort Quitman, Texas. Under the Convention, Mexico is entitled to 60,000 acre feet of water a year at El Paso, adjusted for drought conditions. The International Boundary and Water Commission is the international agency charged with upholding the convention's terms. The terms of the 1906 Convention were expanded on in the Mexican Water Treaty of 1944 (*Utilization of the Waters of Colorado and Tijuana Rivers and of the Rio Grande*, Feb. 3, 1944, U.S.-Mexico, T.S. No. 994).

4.1.3.4 Federal Water Projects

The Rio Grande Project is a federal water project in the Lower Rio Grande region. The project is extremely important to the region and furnishes irrigation water to approximately 178,000 acres of land and electric power for communities and industries in New Mexico and Texas. Project lands occupy the river bottom land of the Rio Grande Valley in south-central New Mexico and west Texas. Water is also provided for diversion to Mexico by the International Boundary and Water Commission-United States Section to irrigate about 25,000 acres in the Juarez Valley. The project includes Elephant Butte and Caballo Dams. The project has been the source of conflict over the years between EBID, EPCWID #1, and the U.S. Bureau of Reclamation (USBR). Much of the past conflict is discussed in Section 5.2 of the 2003 plan.

Currently, the Rio Grande Project is the subject of litigation again between the State of New Mexico and the USBR, as discussed in Section 4.3.1.

The Rio Grande Canalization Project was authorized by Congress in 1936 to facilitate compliance with the 1906 Mexican Water Treaty, which provided for the equitable division of the waters of the Rio Grande between the U.S. and Mexico, and to regulate and control the water supply for use in the two countries. The project was constructed between 1938 and 1943 and includes a normal-flow rectified river channel within a floodway bordered by levees on either side. The Project extends 105.6 miles (170 km) along the Rio Grande from the Percha Diversion Dam at Caballo (located 2.0 miles downstream of Caballo Dam) to the American Dam in El Paso, Texas. The normal flow channel has a depth of 3 to 5 feet, a width ranging from 110 to 500 feet and a capacity ranging from 2,500 cubic feet per second (cfs) above Leasburg Dam to 1,200 cfs at El Paso. The floodway varies between 50 and 2,100 feet in width. The bordering levees range from 3 to 15 feet in height and have a total length of 130 miles—57 miles on the west side and 73 miles on the east side. In some areas, the floodway is bounded by natural high ground, and in the section near Canutillo, Texas, a railroad embankment forms the east levee. The Project provides flood protection against a 100-year flood and assures releases of waters to Mexico from the upstream reservoirs.

4.1.3.5 Federal Adjudications in the Basin

Not applicable.

4.1.4 Tribal Law

Not applicable.

4.1.5 Local Law

Local laws addressing water use have been implemented by both municipalities and counties within the planning region.

4.1.5.1 Doña Ana County

Water use in Doña Ana County is guided by two planning documents and its ordinances.

One Valley, One Vision 2040, Doña Ana County, New Mexico Regional Plan (Vision 2040, 2011) is the comprehensive planning document guiding growth in the County. The Plan outlines the regional water goals of (1) ensuring the availability of a safe, dependable, affordable, and sustainable water supply to meet or exceed the needs of all reasonable beneficial uses and (2) protecting existing surface and groundwater from pollution and ensuring that it meets or exceeds water quality standards. The Plan then sets forth strategies to meet these goals including, but not limited to, ensuring that 40-year water plans are updated, promoting green infrastructure and low-impact development, planning and creating additional water supplies, encouraging low-water use industry and development, and encouraging the installation of systems to help track water usage as a way to conserve water and prevent over-appropriation

The *Doña Ana Snapshot Report*, Doña Ana County, 2013, identifies key issues related to water supply and consumption in the County, including an increase in municipal water demand and a decline in groundwater levels, a need for additional storage or supply to provide for a buffer supply during drought, the ongoing adjudication process, competing demands on the watershed, the impact of climate change on long-term water supply, and an ongoing need to address groundwater pollutants. The goal of the report is to improve livability in the county.

The Doña Ana County Code and related Water Supply Guidelines regulate water use for developments in the County. All new developments in the County must have a water supply plan that quantifies the water demand for the development and requires conservation measures (Section 300.22). Pursuant to the County's water rights acquisition policy, developers must provide water rights in sufficient quantity and quality to supply developments for 40 years (Section 324-46), with the maximum amount of water that can be allocated per lot limited to 0.75 acre-foot per year (Section 157.33). The Water Supply Guidelines also address water conservation measures. The County also has the power to restrict the drilling of new domestic wells within its designated service area.

4.1.5.2 City of Las Cruces

Water use in City of Las Cruces is guided by several planning documents and its ordinances.

The City of Las Cruces *Comprehensive Plan: Administrative Update 2040* (City of Las Cruces, 2013) outlines several goals relating to water use, including promoting water conservation and reuse of resources (such as treated wastewater) through innovation and best practices, and providing an adequate and reliable supply of safe, clean drinking water at an affordable cost. The plan encourages sustainable growth and a sustainable water supply through identification of new sources of water, wellhead protection, and water conservation.

The *Las Cruces Utilities Water Conservation Plan* (City of Las Cruces, 2012), was adopted primarily for regulatory compliance; the Office of the State Engineer requires the City to develop and implement a water conservation plan as a permit condition. However, the plan recognizes additional benefits of water conservation, such as benefits to customers and the environment, cost savings, and reliability of supply. The plan provides a framework for the development of measures to achieve water conservation. Goals outlined in the plan include:

- Evaluate current water usage.
- Evaluate mandatory, voluntary, and other conservation measures for the plan.
- Determine resource levels for the plan.
- Determine sources of funding for the water conservation program.
- Develop priorities.
- Set measured goals and criteria for evaluation of these goals.
- Improve baseline information on City's usage and update annually.

- Develop appropriate ordinances from the plan.
- Increase enforcement of the water conservation ordinances.
- Develop a summer month surcharge for users exceeding some multiplier of the average delivery amount in each rate class.
- Establish indoor and outdoor water audits for each rate class.

The City of Las Cruces also regulates water use by ordinance and regulations. Ordinance No. 2722 (August 18, 2014) enacted a revised water conservation ordinance (Section 28-301 *et seq*.) which mandates that the City's Utilities Board submit a water conservation plan and develop and approve regulations to enforce that plan. The Ordinance further specifies that the Utilities Board update the City's *Drought and Emergency Management Plan* to provide for a number of factors, including measurable criteria for determining the severity of a water emergency and response measures for each level of water emergency. Water conservation regulations passed by the Utility Board pursuant to the ordinance specify outdoor watering restrictions, including time of day and day of the week watering restrictions, water wasting restrictions, and violation compliance procedures.

4.1.5.3 Camino Real Regional Water Utility Authority

The Camino Real Regional Water Utility Authority (CRRWUA) serves southern Doña Ana County. It regulates water use through its Water Ordinance No. 2011-01, which mandates that new developments within the CRRWUA service area connect to the system and that developers provide CRRWUA with water rights for new developments. The ordinance also allows CRRWUA to restrict the drilling of domestic wells.

4.1.5.4 City of Sunland Park

Water use in the City of Sunland Park is guided by the CRRWUA regulations and the *One Valley, One Vision 2040, Doña Ana County, New Mexico Regional Plan* discussed in Section 4.1.5.1.

4.1.5.5 Village of Hatch

Water use in the Village of Hatch is governed by regulations. Section 13.04.030 of the Hatch Village Code is the Village's water conservation ordinance, and it prohibits the waste of water, imposes time of day and day of the week outdoor watering restrictions, and outlines water emergency stages with various restrictions for water use during each stage. Water use in the Village is also guided by the *One Valley, One Vision 2040, Doña Ana County, New Mexico Regional Plan* discussed in Section 4.1.5.1.

4.1.5.6 City of Anthony

Water use in the City of Anthony is guided by the *One Valley, One Vision 2040, Doña Ana County, New Mexico Regional Plan* discussed in Section 4.1.5.1.

4.1.5.7 Town of Mesilla

Water use in the Town of Mesilla is governed by regulations. Section 13.26.020 of the Mesilla Town Code requires the conveyance of water rights as a prerequisite for land development. The Town's water conservation ordinance is found at Chapter 13.25 of the Code and prohibits the waste of water, imposes time of day and day of the week outdoor watering restrictions, and allows for the declaration of a water emergency and implementation of water restrictions during an emergency. Water use in the Village is also guided by the *One Valley, One Vision 2040, Doña Ana County, New Mexico Regional Plan,* discussed in Section 4.1.5.1.

4.2 Relevant Environmental Law

4.2.1 Species Protection Laws

The Endangered Species Act (ESA) can have a tremendous influence on the allocation of water, especially of stream and river flows (16 U.S. C. §§ 1531 to 1544). The ESA was enacted in 1973 and, with limited exceptions, has remained in its current form since then. The goal of the Act is to protect threatened and endangered species and the habitat on which they depend (16 U.S.C. § 1531(b)). The Act's ultimate goal is to "recover" species so that they no longer need protection under the Act.

The ESA provides several mechanisms for accomplishing these goals. It authorizes the U.S. Fish and Wildlife Service (USFWS) to list "threatened" or "endangered" species, which are then protected under the Act, and to designate "critical habitat" for those species. The Act makes it unlawful for anyone to "take" a listed species unless an "incidental take" permit or statement is first obtained from the Department of the Interior (16 U.S.C. §§ 1538, 1539). To "take" is defined as "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect or to attempt to engage in any such conduct" (16 U.S.C. § 1532(19)).

In addition, federal agencies must use their authority to conserve listed species (16 U.S.C. § 1536(a)(1)). They must make sure, in consultation with USFWS, that their actions do not jeopardize the continued existence of listed species or destroy or harm habitat that has been designated as critical for such species (16 U.S.C. § 1536(a)(2)). This requirement applies whenever a private or public entity undertakes an action that is "authorized, funded, or carried out," wholly or in part by a federal agency (16 U.S.C. § 1536(a)(2)). As part of the consultation process, federal agencies must usually prepare a biological assessment to identify endangered or threatened species and determine the likely effect of the federal action on those species and their critical habitat (16 U.S.C. § 1536(c)). At the end of the consultation process, the USFWS prepares a biological opinion stating whether the proposed action will jeopardize the species or destroy or adversely modify its critical habitat (16 U.S.C. § 1536(c)(4)). USFWS may also recommend reasonable alternatives that do not jeopardize the species (16 U.S.C. § 1536(c)(4)).

The species in the planning region that are subject to protection under the ESA are as follows:

- Southwestern willow flycatcher (endangered)
- Yellow-billed cuckoo (threatened)
- Northern aplomado falcon (experimental population, non-essential)
- Least tern (endangered, final recovery plan)
- Sprague's pipit (candidate)

Of the threatened and endangered species found in the Lower Rio Grande region, the protection and recovery of the Southwestern willow flycatcher and yellow-billed cuckoo are most likely to affect water planning within the region. Both birds rely on riparian habitat for survival. Any actions that are likely to harm the habitat used by these species will be subject to strict review and possible limitation.

4.2.1.1 New Mexico Wildlife Conservation Act

The New Mexico Wildlife Conservation Act, enacted in 1974, provides for the listing and protection of threatened and endangered wildlife species in the State (NMSA 1978, §§ 17-2-37 to 17-2-46). In enacting the law, the Legislature found that indigenous New Mexico species that are threatened or endangered "should be managed to maintain and, to the extent possible, enhance their numbers within the carrying capacity of the habitat" (NMSA 1978, § 17-2-39(A)).

The Act authorizes the New Mexico Department of Game and Fish to conduct investigations of indigenous New Mexico wildlife species suspected of being threatened or endangered to determine if they should be listed (NMSA 1978, § 17-2-40(A)). Based on the investigation, the director then makes listing recommendations to the Game and Fish Commission (NMSA 1978, § 17-2-40(A)). The Act authorizes the Commission to issue regulations listing wildlife species as threatened or endangered based on the investigation and recommendations of the Department (NMSA 1978, § 17-2-41(A)). Once a species is listed, the Department of Game and Fish, "to the extent practicable," is to develop a recovery plan for that species (NMSA 1978, § 17-2-40.1). The act makes it illegal to "take, possess, transport, export, process, sell or offer for sale[,] or ship" any listed endangered wildlife species (NMSA 1978, § 17-2-41(C)). However, enforcement of this provision of the Act is very limited.

Pursuant to the Act, the Commission has listed over 100 wildlife species—mammals, birds, fish, reptiles, amphibians, crustaceans, and mollusks—as endangered or threatened (19.33.6.8 NMAC). As of August 2014, 62 species were listed as threatened, and 56 species were listed as endangered (19.33.6.8 NMAC). In the Lower Rio Grande region, all of the federally listed species discussed above are also protected under the Act, along with several others.

4.2.2 Water Quality Laws

4.2.2.1 Clean Water Act

The most significant federal law addressing water quality is the Clean Water Act (CWA), 33 U.S.C. §§ 1251 to 1387, which Congress enacted in its modern form in 1972, overriding President Nixon's veto. The stated objective of the CWA is to "restore and maintain the chemical, physical and biological integrity" of the waters of the United States (33 U.S.C. § 1251(a)).

4.2.2.1.1 NPDES Permit Program (Section 402)

The CWA makes it unlawful for any person to discharge any pollutant into waters of the United States without a permit (33 U.S.C. § 1311(a)). Generally, a "water of the United States" is a navigable water, a tributary to a navigable water, or an adjacent wetland, although the scope of the term has been the subject of considerable controversy as described below.

The heart of the CWA regulatory regime is the National Pollutant Discharge Elimination System (NPDES) permitting program under Section 402 of the Act. Any person—including a corporation, partnership, state, municipality, or other entity—that discharges a pollutant into waters of the United States from a point source must obtain an NPDES permit from EPA or a delegated state (33 U.S.C. § 1342). A point source is defined as "any discernible, confined, and discrete conveyance," such as a pipe, ditch, or conduit (33 U.S.C. § 1362(14)). NPDES permits include conditions setting effluent limitations based on available technology and, if needed, effluent limitations based on water quality.

The CWA provides that each NPDES permit issued for a point source must impose effluent limitations based on application of the best practicable, and in some cases the best available, pollution control technology (33 U.S.C. § 1311(b)). The Act also requires more stringent effluent limitations for newly constructed point sources, called new source performance standards (33 U.S.C. § 1316(b)). EPA has promulgated technology-based effluent limitations for dozens of categories of new and existing industrial point source dischargers (40 C.F.R. pts. 405-471). These regulations set limits on the amount of specific pollutants that a permittee may discharge from a point source.

The CWA requires the states to develop water quality standards for individual segments of surface waters (33 U.S.C. § 1313). Water quality standards have three components. First, states must specify designated uses for each body of water, such as public recreation, wildlife habitat, water supply, fish propagation, or agriculture (40 C.F.R. § 131.10). Second, they must establish water quality criteria for each body of water, which set a limit on the level of various pollutants that may be present without impairing the designated use of the water body (40 C.F.R. § 131.11). And third, states must adopt an antidegradation policy designed to prevent the water body from becoming impaired such that it cannot sustain its designated use (40 C.F.R. § 131.12).

Surface water segments that do not meet the water quality criteria for the designated uses must be listed as "impaired waters" (33 U.S.C. § 1313(d)(l)(C)). For each impaired water segment, states must establish "total maximum daily loads" (TMDLs) for those pollutants causing the water to be impaired, allowing a margin of safety (33 U.S.C. § 1313(d)(1)). The states must submit to EPA for approval the list of impaired waters and associated TMDLs (33 U.S.C. § 1313(d)(2)). The TMDL process, in effect, establishes a basin-wide budget for pollutant influx to a surface water. The states must then develop a continuing planning process to attain the standards, including effluent limitations for individual point sources (33 U.S.C. § 1313(e)).

New Mexico has taken steps to implement these CWA requirements. As discussed in Section 4.2.2.3, the New Mexico Water Quality Control Commission has adopted water quality standards for surface waters. The standards include designated uses for specific bodies of water, water quality criteria, and an antidegradation policy (20.6.4 NMAC). The New Mexico Environment Department has prepared a report listing impaired surface waters throughout the State (NMED, 2014). In the Lower Rio Grande planning region, numerous segments of the Rio Grande, Las Animas Creek, and both Elephant Butte and Caballo reservoirs are on the impaired list.

EPA can delegate the administration of the NPDES program to individual states (33 U.S.C. § 1251(b)). New Mexico is one of only a handful of states that has neither sought nor received delegation to administer the NPDES permit program. Accordingly, EPA administers the NPDES program in New Mexico.

4.2.2.1.2 Dredge and Fill Permit Program (Section 404)

The CWA establishes a second important permitting program under Section 404, regulating discharges of "dredged or fill material" into waters of the United States (33 U.S.C. § 1344). Although the permit requirement applies to discharges of such material into all waters of the United States, most permits are issued for the filling of wetlands. The program is administered primarily by the Army Corps of Engineers, although EPA has the authority to veto permits, and it shares enforcement authority with the Corps.

Like the Section 402 NPDES permit program, the CWA allows the Section 404 permit program to be delegated to states (33 U.S.C. § 1344(g)). Again, New Mexico has not received such delegation, and the program is implemented in New Mexico by the Corps and EPA.

4.2.2.1.3 Waters of the United States

The term "waters of the United States" delineates the scope of CWA jurisdiction, both for the Section 402 NPDES permit program, and for the Section 404 dredge and fill permit program. The term is not defined in the CWA, but is derived from the definition of "navigable waters," which means "waters of the United States including the territorial seas" (33 U.S.C. § 1362(7)). In 1979, EPA promulgated regulations defining the term "waters of the United States" (see 40 C.F.R. § 230.3(s) (2014)) (between 1979 and 2014, the term remained substantially the same). This definition, interpreted and implemented by both EPA and the Corps, remained settled for many years.

In 2001, however, the Supreme Court began to cast doubt on the validity of the definition as interpreted by EPA and the Corps. The Court took up a case in which the Corps had asserted CWA jurisdiction over an isolated wetland used by migratory birds, applying the Migratory Bird Rule. The Court ruled that the Corps had no jurisdiction under the CWA, emphasizing that the CWA refers to "navigable waters," and that the isolated wetland had no nexus to any navigable-in-fact water (*Solid Waste Agency of Northern Cook County v. U.S. Army Corps of Engineers,* 531 U.S.159 (2001)).

The Court muddied the waters further in its 2006 decision in *Rapanos v. United States,* 547 U.S. 715 (2006) (consolidated with *Carabell v. U.S. Army Corps of Engineers*). Both these cases challenged the Corps' assertion of CWA jurisdiction over wetlands separated from traditional navigable waters by a man-made ditch. In a fractured 4-1-4 decision, the Court ruled that the Corps did not have CWA authority to regulate these wetlands. The plurality opinion, authored by Justice Scalia, held that CWA jurisdiction extends only to relatively permanent standing or flowing bodies of water that constitute rivers, streams, oceans, and lakes (*Rapanos v. United States,* 547 U.S. 739 (2006)). Nevertheless, jurisdiction extends to streams or lakes that occasionally dry up, and to streams that flow only seasonally (*Rapanos v. United States,* 547 U.S. 732, n.3 (2006)). And jurisdiction extends to wetlands with a continuous surface connection to such water bodies (*Rapanos v. United States,* 547 U.S. 742 (2006)). The concurring opinion, written by Justice Kennedy, stated that CWA jurisdiction extends to waters having a "significant nexus" to a navigable water, such nexus the Corps had failed to show in either case (*Rapanos v. United States,* 547 U.S. 779-80 (2006)). In dissent, Justice Stevens would have found CWA jurisdiction in both cases (*Rapanos v. United States,* 547 U.S. 787 (2006)).

There has been considerable confusion over the proper application of these opinions. Based on this confusion, EPA and the Corps recently amended the regulatory definition of "waters of the United States" to conform to the *Northern Cook County* and *Rapanos* decisions (Final Rule, 80 Fed. Reg. 37054 (June 29, 2015) codified at 33 C.F.R. pt 328; 40 C.F.R. pts 110, 112, 116, 117, 122, 230, 232, 300, 302, and 401). The new definition covers (1) waters used for interstate or foreign commerce, (2) interstate waters, (3) the territorial seas, (4) impounded waters otherwise meeting the definition, (5) tributaries of the foregoing waters, (6) waters, including wetlands, adjacent to the foregoing waters, (7) certain specified wetlands having a significant nexus to the foregoing waters, and (8) waters in the 100-year floodplain of the foregoing waters (40 C.F.R. § 302.3).

Several states and industry groups have challenged the new definition in federal district courts and courts of appeal. In one such challenge, the district court granted a preliminary injunction temporarily staying the rule (*North Dakota v. EPA*, 2015 WL 5060744 (Aug. 27, 2015)) Because the New Mexico Environment Department and the New Mexico Office of the State Engineer are plaintiffs in this case, the stay is effective—and the new definition does not now apply—in New Mexico. The United States is likely to appeal the decision.

4.2.2.2 Safe Drinking Water Act

Enacted in 1974, the Safe Drinking Water Act (SDWA) regulates the provision of drinking water in the United States (42 U.S.C. §§ 300f to 300j-26). The act's overriding purpose is "to insure the quality of publicly supplied water" (*Arco Oil & Gas Co. v. EPA*, 14 F.3d 1431, 1436 (10th Cir. 1993)). The SDWA requires EPA to promulgate national primary drinking water standards for protection of public health and national secondary drinking water standards for protection of public welfare (42 U.S.C. § 300g-1). To provide this protection, the SDWA requires EPA, as part of the national primary drinking water regulations, to establish maximum contaminant level goals (MCLGs) and maximum contaminant levels (MCLs) for drinking water contaminants (42 U.S.C. § 300g-1(b)(1)). The regulations apply to all "public water systems" (42 U.S.C. § 300g).

EPA has promulgated primary and secondary drinking water regulations (40 C.F.R. pts. 141, 143). Most significantly, the agency has set MCLGs and MCLs for a number of drinking water contaminants, including 16 inorganic chemicals, 53 organic chemicals, turbidity, 6 microorganisms, 7 disinfectants and disinfection byproducts, and 4 radionuclides (40 C.F.R. §§ 141.11, 141.13, 141.61-66). As noted above, New Mexico has incorporated these primary and secondary regulations into the State regulations (20.7.10.100 NMAC, 20.7.10.101 NMAC).

4.2.2.3 New Mexico Water Quality Act

The most important New Mexico law addressing water quality is the New Mexico Water Quality Act (WQA), NMSA 1978, §§ 74-6-1 to 74-6-17. The New Mexico Legislature enacted the WQA in 1967. The purpose of the WQA is "to abate and prevent water pollution" (*Bokum Res. Corp. v. N.M. Water Quality Control Comm'n*, 93 N.M. 546, 555, 603 P.2d 285, 294 (1979)).

The WQA created the Water Quality Control Commission to implement many of its provisions (NMSA 1978, § 74-6-3). The WQA authorizes the Commission to adopt State water quality standards for surface and ground waters and to adopt regulations to prevent or abate water pollution (NMSA 1978, § 74-6-4(C) and (D)). The WQA also authorizes the Commission to adopt regulations requiring persons to obtain from the New Mexico Environment Department a permit for the discharge into groundwater of any water contaminant (NMSA 1978, § 74-6-5(A)). The Department must deny a discharge permit if the discharge would cause or contribute to contaminant levels in excess of water quality standards "at any place of withdrawal of water for present or reasonably foreseeable future use" (NMSA 1978, § 74-6-5(E)(3)). The WQA also authorizes the Commission to adopt regulations relating to monitoring and sampling, record keeping, and Department notification regarding the permit (NMSA 1978, § 74-6-5(I)). Permit terms are generally limited to five years (NMSA 1978, § 74-6-5(H)).

Accordingly, the Commission has adopted groundwater quality standards, regulations requiring discharge permits, and regulations requiring abatement of groundwater contamination (20.6.2 NMAC). The water quality standards for ground water are published at Sections 20.6.2.3100 through 3114 NMAC and the regulations for discharge permits are published at Sections 20.6.2.3101 to 3114 NMAC.

An important part of these regulations are those addressing abatement (20.6.2.4101 - .4115 NMAC). The purpose of the abatement regulations is to "[a]bate pollution of subsurface water so that all groundwater of the state of New Mexico which has a background concentration of 10,000 milligrams per liter or less total dissolved solids is either remediated or protected for use as domestic or agricultural water supply" (20.6.2.4101.A(1) NMAC). The regulations require that groundwater pollution must be abated to conform to the water quality standards (20.6.2.4103.B NMAC). Abatement must be conducted pursuant to an abatement plan approved by the Department, 20.6.2.4104.A NMAC, or pursuant to a discharge permit, 20.6.2.3109.E NMAC.

In addition, the Commission has adopted standards for surface water (20.6.1 NMAC). The objective of these standards, consistent with the federal Clean Water Act (Section 4.2.2.1) is "to establish water quality standards that consist of the designated use or uses of surface waters of the [S]tate, the water quality criteria necessary to protect the use or uses[,] and an antidegradation policy" (20.6.4.6.A NMAC). The standards include designated uses for specific bodies of water within the State (20.6.4.50 to 20.6.4.806 NMAC). The standards also include general water quality criteria (20.6.4.13 NMAC), water quality criteria for specific designated uses (20.6.4.900 NMAC), and water quality criteria for specific bodies of water (20.6.4.50 to 20.6.4.806 NMAC). The standards also include an antidegradation policy, applicable to all surface waters of the State, to protect and maintain water quality (20.6.4.8 NMAC). The antidegradation policy sets three levels of protection, closely matched to the federal regulations.

Lastly, the Commission has also adopted regulations limiting the discharge of pollutants into surface waters (20.6.2.2100 to 2202 NMAC).

Because copper mining occurs in the basin it is also important to note that in 2009 the Legislature amended the WQA to require the Commission to adopt regulations particular to the copper industry that would specify the measures to be taken to prevent water pollution and to monitor water quality (NMSA 1978, § 74-6-4(K)). Effective December 2013, the Commission adopted the Copper Mine Rule (20.6.7 NMAC). The stated purpose of the Copper Mine Rule is "to control discharges of water contaminants specific to copper mine facilities and their operations to prevent water pollution" (20.6.7.6 NMAC). However, the rule also allows for contamination of groundwater at copper mines in excess of groundwater quality standards (*e.g.*, 20.6.7.17 NMAC, 20.6.7.20 NMAC, 20.6.7.21 NMAC, 20.6.7.22 NMAC, 20.6.7.28 NMAC). The legality of these provisions has been questioned. For example, the New Mexico Attorney General has challenged the Copper Mine Rule in an appeal. Although the Court of Appeals upheld the rule (*Gila Res, Info. Project v. N.M. Water Quality Control Comm'n*, 2015-NMCA-076, 355 P.3d 36), the New Mexico Supreme Court granted *certiorari* on July 13, 2015 (Nos. S-1-SC-35,279, 35,289, & 35,290).

4.2.2.4 New Mexico Drinking Water Standards

The New Mexico Environmental Improvement Act created an Environmental Improvement Board, and it authorizes the Board to promulgate rules and standards for water supply (NMSA 1978, § 74-1-8(A)(2)). The Board has accordingly adopted State drinking water standards for all public water systems (20.7.10 NMAC). The State regulations incorporate by reference the federal primary and secondary drinking water standards (40 C.F.R. parts 141 and 143) established by the U.S. Environmental Protection Agency (EPA) under the Safe Drinking Water Act (Section 4.2.2.2) (20.7.10.100 NMAC, 20.7.10.101 NMAC).

4.3 Legal Issues Unique to the Region and Local Conflicts Needing Resolution

4.3.1 Ongoing or Threatened Litigation that May Affect Water Management

State of New Mexico v. U.S. Bureau of Reclamation, et al., No. 1:2011-cv-00691-JB-ACT (D.N.M. filed August 8, 2011) involves the 2008 Operating Agreement for the Rio Grande Project as well unauthorized releases under the Rio Grande Compact. The Operating Agreement was developed during settlement of litigation between the EBID, EPCWID #1, and the USBR. The State of New Mexico asserts that implementation of this agreement, to which the State is not a party, appears to have reduced EBID's allocation of Rio Grande Project water in full-supply years by more than 150,000 acre-feet. Furthermore, the State of New Mexico asserts that the USBR illegally took New Mexico Credit Water as allocated and accounted under the Rio Grande Compact and violated the National Environmental Policy Act in implementing the agreement. The case is currently stayed pending action by the U.S. Supreme Court in *Texas v. New Mexico and Colorado*, No. 220141 Original (Section 4.1.3). The Operating Agreement in its present form will continue to cause water management issues.

4.3.2 Local Conflicts Needing Resolution

There continues to be conflict among EBID, other local farmers, and the State of New Mexico regarding issues related both to the Lower Rio Grande adjudication and the 2008 Operating Agreement for the Rio Grande Project. These issues will continue to evolve as the related lawsuits move forward and will have a large impact on water management in the region.

4.3.3 Legal Issues Unique to the Region

The outcome of *Texas v. New Mexico and Colorado,* No. 220141 Original may greatly impact the region because it deals with water allocation and groundwater pumping in the Lower Rio Grande.

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 the1989 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.

6. Water Demand

To effectively plan for meeting future water resource needs, it is important to understand current use trends as well as future changes that may be anticipated. This section includes an evaluation of current water use by sector (Section 6.1), an evaluation of population and economic trends and projections of future population (Sections 6.2 and 6.3), a discussion of the approach used to incorporate water conservation in projecting future demand (Section 6.4), and projections of future water demand (Section 6.5).

6.1 Present Uses

The most recent assessment of water use in the region was compiled by OSE for 2010, as discussed in Section 5.5. The OSE Water Use report (Longworth et al., 2013) provides information on total withdrawals for nine categories of water use:

- Public water supply
- Domestic (self-supplied)
- Irrigated agriculture
- Livestock (self-supplied)
- Commercial (self-supplied)
- Industrial (self-supplied)
- Mining (self-supplied)
- Power (self-supplied)
- Reservoir evaporation

The total surface water and groundwater withdrawals for each category of use, for each county, and for the entire region, are shown on Table 6-1 and Figure 6-1.

The predominant water use in 2010 in the Lower Rio Grande region was for irrigated agriculture, which uses 87 percent of the nearly 450,000 ac-ft/yr of diverted surface and groundwater. Nearly all of the surface water diverted in the region is for irrigated agriculture with a very small fraction for livestock watering.

Most of the groundwater use in the Lower Rio Grande region is also for irrigated agriculture, with 68 percent of the 178,300 ac-ft/yr applied to crops. Groundwater also supplies public water systems and self-supplied commercial, domestic, industrial, livestock, mining, and power. About40 percent of the total withdrawals in the region are supplied by groundwater. Groundwater points of diversion are shown in Figure 6-2.

The categories included in the OSE Water Use Report and shown on Figure 6-1 and Table 6-1 represent the major demands in the planning region. There are also some unquantified additional categories of water use, including riparian evapotranspiration and instream flow.

- *Riparian evapotranspiration:* Some research and estimates have been made for riparian evapotranspiration in selected areas, such as along the middle and lower Rio Grande (Thibault and Dahm, 2011; Coonrod and McDonnell, Undated; Bawazir et al., 2009), but riparian evapotranspiration has not been quantified statewide. The New Mexico Water Resources Research Institute is currently developing those estimates but the results are not yet available. Though riparian evapotranspiration is anticipated to consume a relatively large quantity of water statewide, it is not a large use in the planning region. It will not affect the calculation of the gap between supply and demand using the method in this report, because the gap reflects the difference between future anticipated demands and present uses, and if both present and future uses do not include the riparian evapotranspiration category, then the difference will not be affected. The only impact to the gap calculation would be if evapotranspiration significantly changes in the future. There is potential for such a change due to warming temperatures, but anticipated changes have not been quantified and would be subject to considerable uncertainty. Anticipated changes in riparian and stream evapotranspiration are areas that should be considered in future regional and state water plan updates.

- *Instream flow:* The analysis of the gap between supply and demand relies on the largest use categories that reflect withdrawals for human use or reservoir storage that allows for withdrawals downstream upon release of the stored water. It is recognized that there is also value in preserving instream water for ecosystem and habitat and tourism purposes. Though this value has not been quantified in the supply/demand gap calculation, it may still be an important use in the region, and if the region chooses, it may recommend instream flow protections in its policy, program, and project recommendations.

In addition to the special conditions listed above, the 2010 NMOSE data are available for diversions only; depletions have not been quantified. In many cases, some portion of diverted water returns to surface or groundwater, for example from agricultural runoff or seepage or discharge from a wastewater treatment plant. In those locations where there is such return flow, the use of diversion data for planning purposes will add a margin of safety; thus the use of diversion data is a conservative approach for planning purposes.

6.2 Demographic and Economic Trends

To project future water demands in the region, it is important to first understand demographics, including population growth and economic and land use trends as detailed below. This section provides specific information regarding the population and economic trends in the Lower Rio Grande region. This information was obtained primarily from telephone interviews with government officials and other parties with knowledge of demographic and economic trends in Doña Ana County; the list of interviewees is provided in Appendix 6-A. The information in this section was used to project population, economic growth, and future water demand, as presented in Sections 6.3 and 6.5.

As shown in Table 3-1, between 2010 and 2013 the population of Doña Ana County increased from 209,233 to 213,460, an increase of 2.0 percent (U.S. Census Bureau, 2014a). The City of Las Cruces, with a 2013 population of 101,324, comprises 47.5 percent of total county population. Doña Ana County has a younger population profile than most other counties in the state, with a higher percentage of people under the age of 18 (25.9 in 2013, compared with 24.3 percent for the state) and a lower percentage of people over 65 years of age (13.6 percent vs. 14.7 percent statewide). Another difference is the percentage of Hispanic population: 66.6 percent in Doña Ana, compared with 47.3 percent for the entire state (U.S. Census Bureau, 2014c). The county has a substantially higher poverty rate than the state as a whole, 25.8 percent compared with 19.5 percent (U.S. Census Bureau, 2014c).

The Doña Ana County economy is heavily dependent on business from contractors and military personnel at the nearby White Sands Missile Range, which comprises 25 percentof the local economy. The Range straddles both Doña Ana and Otero Counties, but the residential portion, where most military personnel and their dependents live, is in Doña Ana County. The White Sands Missile Range has its own zip code and the population is roughly 1,730.

Approximately 11,000 commuters travel from Doña Ana County to El Paso for work. In 2010 they represented 16.5 percent of the Doña Ana workforce. Conversely, 8,000 El Paso residents commute to Las Cruces for work (U.S. Census Bureau, 2015). Although Doña Ana County residents held 15,066 more jobs in 2010 than in 2002, 10,952 or 73 percent of them were in El Paso or outside the main urbanized areas of Doña Ana County (Viva Doña Ana, 2013).

Doña Ana County is undergoing a shift from an agricultural community to an industrial economy. One factor that could hold back this change is lack of a skilled workforce. Doña Ana County Community College is offering specialized training to match skills with the needs of the new industries.

Doña Ana County has approved a $2.75 million incentive package for CN Wire, a Turkish company that intends to use the funds to purchase land and renovate an existing manufacturing facility in Santa Teresa for copper wire manufacturing. The plant will create 195 full-time jobs by mid-2017 (Soular, 2014). However another local wire manufacturer is suing the City of Anthony over the City's plan to provide an additional $70 million in bond-funded incentives to the new competitor in Santa Teresa.

A German company, CertoPlast, manufactures tapes for automotive wire harnesses and plans to open its first U.S. manufacturing plant in the new West Mesa Industrial Park in Las Cruces, which is part of the Doña Ana County Foreign Trade Zone. The company may hire as many as 100 employees.

Santa Teresa is a 2,200-acre master planned community that will eventually accommodate industrial, residential, and open space uses. Currently there are over 2,000 residential lots in Santa Teresa, with the possibility of several thousand more. In the first half of 2014, 11 new subdivisions were approved in the County, twice as many as in all of 2013.

In April 2014 the Union Pacific Railroad opened a $400 million inter-modal logistics and warehouse facility in Santa Teresa. When fully operational, the facility will employ 600 permanent workers, all of which should be hired by 2020. However, since the facility is replacing a facility in El Paso, it is expected that the El Paso workers will keep their jobs and commute to Santa Teresa, 13 miles away, so that only a limited number of new jobs will be available in the short-term; 200 of those workers have already transferred. Most of the jobs at the facility will be semi-skilled and pay a minimum of $35,000 a year. The intermodal facility will transfer goods from train to trucks for delivery and will also service trains with a diesel-fueling operation. The site offers border access to imported goods from Mexico that can be trucked elsewhere. At least 10 companies have left El Paso for Santa Teresa since 2011, some because of the new rail facility. In 2014 Franco Whole Foods opened a tortilla-processing center in Las Cruces that brought 160 new jobs.

Two major interstate highways pass through Doña Ana County: I-10 and I-25. With the addition of the Santa Teresa rail hub and the border crossing, there is a good opportunity for the County to become a distribution and logistics hub. Land along the highway corridors that are now devoted to dairies and cattle grazing will become more valuable and will likely be converted to industrial uses.

Many of the jobs created since 2010 have been construction jobs that are temporary. For instance, 3,000 temporary construction jobs were created during the build-out of the Union Pacific facility. Despite new businesses locating in the County, private sector employment is growing slowly. From September 2013 through September 2014, the private sector added 400 jobs, an increase of 0.8 percent. Between 2012 and 2022, total employment is projected to increase by 9,387 jobs, an annual average percentage change of 1.18 percent. The fastest growing job categories will be professional, scientific, and technical services, healthcare and social assistance, wholesale trade, and accommodation and food services (New Mexico Department of Workforce Solutions, 2014b).

Doña Ana County contains 37 rural communities located within 150 miles of the Mexican border, called colonias, that lack adequate infrastructure such as paved roads, sanitary sewers, housing that meets codes, and basic services. The imbalance between revenues and needs in the colonias impedes the ability to make improvements.

The size of the under 25 population in the county is due to the presence of New Mexico State University (NMSU). However, most college graduates leave the area due to a lack of professional job opportunities.

In the City of Las Cruces, both residential and commercial development is flat. In 2013, 395 residential permits were issued, down considerably from the 1,200 that were the norm before 2008. The City was hoping to get an increase in tourism from the Spaceport north of the region as Las Cruces has upscale hotels that are lacking in Sierra County. However, those prospects are dimming due to the lack of space flights to date and potential future delays. The City has implemented water conservation measures and has a reclamation plant. The Las Cruces economy is stable, but without growth.

The residential real estate supply exceeds demand and loans were down by 14 percent in 2014 from 2013. Commercial loan demand is flat as well.

Doña Ana County is the fourth largest milk producer in New Mexico, although the number of producers has decreased, from 30 in 2003 to 19 in 2013 (NMSU Dairy Extension, 2014). In 2012, there were 43,395 milk cows (84 percent of the cattle inventory) in the County and 8,175 beef cows (USDA NASS, 2014).

In 2012 there were 2,184 farms and ranches in Doña Ana County, a 24 percent increase over 2007. The number of acres increased by 12 percent, from 589,373 to 659,970 acres. Between 2007 and 2012 irrigated acreage declined slightly, from 79,019 acres to 76,347 acres, a decrease of 3.4 percent. Government payments to farmers participating in agricultural support programs declined by 38 percent in the same time frame. The market value of crops fell by 10 percent from 2007 to 2012. The top crop in 2012 was pecans (USDA NASS, 2012).

While Doña Ana County, particularly Hatch, is known for its chiles, increased competition from China has affected how much land is devoted to this crop. Furthermore, the County has too many small (under 50-acre) chile farms. Mechanization is believed to be necessary to lower costs and save the chile industry in New Mexico; however, a minimum of 500 acres is needed to use automated harvesting. On the other hand, pecans are in high demand in foreign markets, especially China, and more acreage is being devoted to this crop. As industrial uses in the County increase, agriculture is likely to become a smaller part of the overall economy.

6.3 Projected Population Growth

The population projections for the 2003 regional water plan encompassed three forecasts, a low, medium, and high, each covering the period from 2000 through 2040. These projections reflected an overly optimistic economic perspective. For 2010, the forecasts were 220,692 for the low, 243,425 for the medium, and 266,252 for the high projection (Table 6-2). Even the low projection exceeded the actual 2010 population of 209,233.

Due to its large population and the anticipated growth, more data are available for Doña Ana County than for other more rural counties, and several population forecasts exist:

- Forecasts by Woods & Poole, reported in the *Border Area Economic Development Strategy* (AECOM and BE, 2014) project a 2020 population of about 260,000 and a 2030 population of approximately 355,000, based on an annual growth rate of 2.2 percent.

- The January 2012 *One Valley, One Vision 2040*, *Doña Ana County Regional Plan* offers several population projections for consideration, but settles on a projection of 325,000 for

2040 (Doña Ana County and City of Las Cruces, 2012).

- One of the forecasts in the regional plan was provided by the NMSU Arrowhead Center, which forecasted a 2020 population of 240,000 and a 2040 population of about 310,000. This forecast was lower than another one provided by the University of Texas, El Paso (UTEP), which projected a population of about 350,000 in 2040.

For this regional water planning update cycle, the Bureau of Business and Economic Research (BBER) at the University of New Mexico (UNM) prepared county-level population forecasts through 2040 using data and historical trends from 1960 through to the 2000 Census (Appendix B). The projections for this plan are based in part on the BBER projections, moderated by the continuing recession, expected number of new jobs, and actual population growth rates between 2010 and 2013.

The population projections through 2060 (Table 6-3) encompass two population forecasts: one based on a more optimistic projection of the economy and one on the premise that not all expected new economic development will occur. The population of the County is projected to grow in both the high and low scenarios through 2060 (Table 6-3). Both the high and low projections are below the BBER projections, which are believed to be too optimistic.

The BBER's 2012 population projections for Doña Ana County are used as the basis for the high population growth rates in this plan for the period 2020 through 2060, although BBER’s forecast for 2020 was reduced to take into account the slower rate of growth that has occurred since 2010. Whereas the BBER projected an average growth of almost 3,400 residents a year between 2010 and 2020, the actual average growth per year between 2010 and 2013 was 1,409.

Between 2020 and 2040, the growth rates shown in Table 6-3a agree with those in the BBER projections. Growth rates are lower for the low projections and take into account the possible closure of White Sands Missile Range after 2020 (although the U.S. government does not discuss military base closures until they are placed on a list, the government has publicly stated that it wishes to reduce the number of bases, and over a 45-year period, it is likely that some New Mexico bases may close). The northern part of Doña Ana County is rural and the only endeavor that could create an economic and population uplift is the Spaceport, which is now in peril due to the lack of a mix of tenants and the postponement of flights by Virgin Galactic.

6.4 Water Conservation

Water conservation is often a cost-effective and easily implementable measure that a region may use to help balance supplies with demands. The State of New Mexico is committed to water conservation programs that encourage wise use of our limited water resources. In support of that commitment, the NMOSE, when evaluating water rights transfers or 40-year water development plans that hold water rights for future use, considers whether adequate conservation measures are in place. It is therefore important when planning for meeting future water demand to consider the potential for conservation.

To develop demand projections for the region, some simplifying assumptions regarding conservation have been made. These assumptions were made only for the purpose of developing an overview of the future supply-demand balance in the region and are not intended to guide policy regarding conservation for individual water users. The approach to considering conservation in each sector for developing water demand projections is discussed below. Specific recommendations for conservation programs and policies for the Lower Rio Grande region, as identified by the regional steering committee, are provided in Section 8.

Public water supply. Public water suppliers that have large per capita usage have a greater potential for conservation than those that are already using water more efficiently. Through a cooperative effort with seven public water suppliers, the NMOSE developed a GPCD (gallons per capita per day) calculation to be used statewide, thereby standardizing the methods for calculating populations, defining categories of use, and analyzing use within these categories. The GPCD calculator was used to arrive at the per capita uses for public water systems in the region, shown in Table 6-4. These rates are provided to assist the regional steering committee in considering specific conservation measures.

The system-wide per capita usage for each water supplier includes uses such as golf courses, parks, and commercial enterprises that are supplied by the system. Hence there can be large variability among the systems. For purposes of developing projections, a county-wide per capita rate was calculated as the total public supply use in the county divided by the total county population (or portion of the county within the region), excluding those served by domestic wells. For future projections (Section 6.5), a consistent method is being used statewide that assumes that conservation would reduce future per capita demand in each county by the following amounts:

- For current average per capita use greater than 300 gpcd, assume a reduction in future per capita demand to 180 gpcd.
- For current average per capita use between 200 and 300 gpcd, assume a reduction in future per capita demand to 150 gpcd.
- For current average per capita use between 130 and 200 gpcd, assume a reduction in future per capita demand to 130 gpcd.
- For current average per capita use less than 130 gpcd, no reduction in future per capita demand is assumed.

Current per capita use in Doña Ana County is 182 gpcd (Table 6-4), so future per capita demand is assumed to be reduced to 130 gpcd. In the projections, these reductions are phased in over time.

Self-supplied domestic. Homeowners with private wells can achieve water savings through household conservation measures. These wells are not metered, and current water use estimates were developed based on a relatively low per capita use assumption (Table 6-4; Longworth et al., 2013). Therefore, no additional conservation savings were assumed in developing the water demand projections. For purposes of developing projections, a county-wide per capita rate was calculated as the total self-supplied domestic use in the county divided by the total county population (or portion of the county within the region), excluding those served by a public water system.

Irrigated agriculture. As the largest water use in the region, conservation in this sector could be beneficial if it reduced actual water consumption. However, doing so is not simple and it is important when considering the potential for improved efficiency in agricultural irrigation systems to consider how potential conservation measures may affect the overall water balance in the region.

Irrigation withdrawals include both consumptive and non-consumptive uses and incidental losses:

- Consumptive uses are permanently removed from the stream system and are due to a crop's potential for evapotranspiration (i.e., evaporation and transpiration), which is determined by factors that include crop variety, soil type, climate and growing season, on-farm management, and irrigation practices.
- Additional water is used non-consumptively for conveyance requirements and is returned to the surface or groundwater system from which it was withdrawn without loss.
- Incidental losses are permanently removed from the stream system and occur through both seepage and evapotranspiration during conveyance through the irrigation system.
    - Seepage losses occur when water leaks through the conveyance channel or below the root zone after application to the field but does not return to the shallow groundwater or stream system.
    - Evapotranspiration occurs as a result of (1) evaporation during water conveyance in canals or with some irrigation methods (e.g., flood, spray irrigation) and (2) transpiration by ditch-side vegetation.

Some agricultural water use efficiency improvements (commonly referred to as agricultural water conservation) reduce the amount of water diverted, but may not reduce depletions or may even have the effect of increasing consumptive use per acre on farms and ultimately within a stream system. These efforts can result in economic benefits, such as increased crop yield, but have the adverse effect of reducing return flows and therefore downstream water supply. For example, methods such as canal lining or piping may result in reduction of seepage losses associated with conveyance, but that seepage will no longer provide return flow to other users. Other techniques such as drip irrigation and center pivots may reduce the amount of water diverted, but if the water saved from such reductions is applied to on-farm crop demands, water supplies for downstream uses will be reduced.

Due to the complexities in agricultural irrigation efficiency, no quantitative estimates of savings are included in the projections. However, the regions are encouraged to explore strategies for agricultural conservation, especially those that result in consumptive use savings through changes in crop type or fallowing of land while concentrating limited supplies for greater economic value on smaller parcels. Section 8 outlines strategies developed by the Lower Rio Grande steering committee to achieve savings in agricultural water use within the region.

Self-supplied commercial, industrial, livestock, mining, and power. Conservation programs can be applicable to these sectors, but since uses are very low in these categories within the region, no additional conservation savings are assumed in the water demand projections.

Reservoir evaporation. In many parts of New Mexico, reservoir evaporation is one of the highest consumptive water uses, but no reservoir evaporation is estimated for the Lower Rio Grande region. Elephant Butte and Caballo Reservoirs have high evaporation rates, which have been factored into the water delivery requirements under the Rio Grande Compact. To reduce usage in this category, some areas outside of the region have considered aquifer storage and recovery to replace some reservoir storage, and it may also be possible in some circumstances to gain some reduction in evaporation by storing more water at higher elevations or constructing deeper reservoirs with less surface area for evaporation. However, due to the legal, financial, and other complexities of implementing these techniques, no conservation savings are assumed in developing the reservoir evaporation demand projections for this region.

6.5 Projections of Future Water Demand for the Planning Horizon

To develop projections of future water demand a consistent method was used statewide, as described in Section 6.5.1. The discussion in Section 6.5.1 is a comprehensive one that includes the methods applied consistently throughout the state to project water demand in all the categories reported in the NMOSE *Water Use by Categories* reports, and some of the categories may not be applicable to the Lower Rio Grande region. The projections of future water demand determined using this consistent method, as applicable, for the Lower Rio Grande region are discussed in Section 6.5.2.

6.5.1 Water Demand Projection Methods

The *Updated Regional Water Planning Handbook* (NMISC, 2013) provides the time frame for the projections; that is, they should begin with 2010 data and be developed in 10-year increments (2020, 2030, 2040, 2050, and 2060). Projections will be for diversions in each of the nine categories included in the 2010 OSE *Water Use by Categories* (Longworth et al., 2013) report and listed in Section 6.1.

To assist in bracketing the uncertainty of the projections, low- and high-water demand estimates were developed for each category in which growth is anticipated, based on demographic and economic trends (Section 6.2) and population projections (Section 6.3), unless otherwise noted. The projected growth in population and economic trends will affect water demand in eight of the nine water use categories; the reservoir evaporation water use category is not driven by these factors.

The 2010 administrative water supply (Section 5.5.1) was used as a base supply from which water demand was projected forward. (See Section 5.5 for more information on the 2010 administrative supply for the region.) Surface water supplies may be considerably lower in drought years, as discussed in Section 5.5.2, but the demand for water does not necessarily decrease when the supply is diminished (i.e., if water were to be available, there is demand and it would be applied to beneficial use). For example, some water right holders may not have put all their rights to beneficial use in some years due to drought or economic conditions. However, as water becomes available in future wet years or the economic climate improves, these existing rights may once again be exercised. Therefore, for planning purposes, it is assumed that existing rights, reflected in the administrative water supply, will be exercised by the owner when needed or may be leased to other users.

The assumptions and methods used statewide to develop the projections for each category follow. Not all of these categories are applicable to every planning region. The specific methods applied in the Lower Rio Grande region are discussed in Section 6.5.2.

Public water supply includes community water systems that rely on surface water and groundwater diversions other than from domestic wells permitted under 72-12-1.1 NMSA 1978 and that consist of common collection, treatment, storage, and distribution facilities operated for the delivery of water to multiple service connections. This definition includes municipalities (which may serve residential, commercial, and industrial water users), mutual domestic water user associations, prisons, residential and mixed-use subdivisions, and mobile home parks.

For regions with anticipated population increases, the increase in projected population (high and low) was multiplied by the per capita use from the 2010 Water Use report (reduced for conservation as specified above), times the portion of the population that was publicly supplied in 2010 (calculated from Longworth et al., 2013); the resulting value was then added to the 2010 public water supply withdrawal amount. Current surface water withdrawals were not allowed to increase above the 2010 withdrawal amount unless there is a new source of available supply (i.e., water project or settlement). Both the high and low projections incorporated conservation for counties with per capita use above 130 gpcd, as discussed in Section 6.4, on the assumption that some of the new demand would be met through reduction of per capita demand.

In counties where a decline in population is anticipated (in either the high or low scenario or both), it was assumed that public water supply would continue at 2010 rates. In regions where the population growth is initially positive but later shows a decline, the water demand projection was kept at the higher rate for the remainder of the planning period. Water rights used for public water supply have value and are not likely to be lost through forfeiture or abandonment proceedings; therefore, constant use is assumed even as population declines slightly, as public water suppliers may serve additional customers through annexation or regionalization, or because communities outside the municipal boundaries will request service from the municipal system.

The *domestic (self-supplied)* category includes self-supplied residences with well permits issued by the NMOSE under 72-12-1.1 NMSA 1978 (Longworth et al., 2013). Such residences may be single-family or multi-family dwellings. High and low projections were calculated as the 2010 domestic withdrawal amount plus a value determined by multiplying the projected change in population (high and low) times the domestic self-supplied per capita use from the 2010 Water Use report, times the calculated proportion of the population that was self-supplied in 2010 (calculated from Longworth et al., 2013). In counties where the high and/or low projected growth rate is negative, the projection was set equal to the 2010 domestic withdrawal amount. This allows for continuing use of existing domestic wells, which is anticipated, even when there are population declines in a county. In regions where the population growth is initially positive but later shows a decline, the water demand projection was kept at the higher level for the remainder of the planning period, based on the assumption that domestic wells will continue to be used, even if there are later population declines.

The *irrigated agriculture* category includes all withdrawals of water for the irrigation of crops grown on farms, ranches, and wildlife refuges (Longworth et al., 2013). To understand trends in the agricultural sector, interviews were held with farmers, farm agency employees, and others with extensive knowledge of agriculture practices and trends in each county. Additionally, the New Mexico agriculture census data for 2007 and 2012 were reviewed and provided helpful agricultural data such as principal crops, irrigated acreage, farm size, farm subsidies, and age of farmers (USDA NASS, 2014). Comparison of the two data sets shows a downward trend in the agricultural sector across New Mexico. This decline was in all likelihood related at least in part to the lack of precipitation in 2012: in most of New Mexico 2007 was a near normal precipitation year (ranging from mild drought to incipient wet spell across the state), while in 2012 the PDSI for all New Mexico climate divisions indicated extreme to severe drought conditions. Based on the interviews, economic factors are also thought to be a cause of the decline as aquifers go dry.

In much of the state, recent drought and recession are thought to be driving a decline in agricultural production. However, that does not necessarily indicate that there is less demand for water. In areas where the irrigation is supplied by surface water, there are frequent supply limitations, with many ditches having no or limited supply later in the season. This results in large fluctuations in agricultural water use and productivity from year to year. While it is possible that drought will continue over a longer term, it is also likely that drought years will be interspersed with wetter years, and there is some potential for renewed agricultural activity as a result. With infrastructure and water rights in place, there is a demand for water if it becomes available.

The 2010 administrative supply (surface water and groundwater diversions combined) was used as the starting point for the irrigation projections. For the 2020 through 2060 projections, it was assumed that the surface water demand is equal to the 2010 demand for both the high and low scenarios. Even if some farmers cease operations or plant less acreage, the water is expected to be used elsewhere due to surface water shortages. Conversely, if increased agricultural activity is anticipated, water demand in this sector was still projected to stay at 2010 levels unless there is a new source of available supply (i.e., water project or settlement). As noted in Section 5.5.1, the administrative supply numbers used here may need to be modified based on the 2008 Operating Agreement litigation.

In areas where 10 percent or more of groundwater withdrawals are for agriculture and there are projected declines in agricultural acreage, the low projection assumes that there will be a reduced demand in this sector. The amount of decline projected is based on interviews with individuals knowledgeable about the agricultural economy in each county (Section 6.2). However, a reduction in demand does not mean additional water would be available for appropriation. Water that has been applied to beneficial use represents a valid water right that may be licensed or adjudicated. As demand shifts over time, transfers between water use sectors may occur through sales and leases. Even in areas where the data indicate a decline in the agricultural economy, the high projection assumes that overall water uses will remain at 2010 levels since water rights have economic value and will continue to be used.

The *livestock* category includes water used to raise livestock, maintain self-supplied livestock facilities, and support on-farm processing of poultry and dairy products (Longworth et al., 2013). High and low projections for percentage growth or declines in the livestock sector were developed based on interviews with ranchers, farm agency employees, and others with extensive knowledge of livestock trends in each county (Section 6.2). The growth or decline rates were then multiplied by the 2010 water use to calculate future water demand.

The *commercial (self-supplied)* category includes self-supplied businesses (e.g., motels, restaurants, recreational resorts, and campgrounds) and public and private institutions (e.g., public and private schools and hospitals) involved in the trade of goods or provision of services

(Longworth et al., 2013). This category pertains only to commercial enterprises that supply their own water; commercial businesses that receive water through a public water system are not included. To develop the commercial self-supplied projections, it was assumed that commercial development is proportional to other growth, and the high and low projections were calculated as the 2010 commercial water use multiplied by the projected high and low population growth rates. In regions where the growth rate is negative, both the high and low projections were assumed to stay at the 2010 amount, based on the assumption that water rights applied to beneficial use would have value and would continue to be used, even though there are economic declines. In regions where the population growth is initially positive but later shows a decline, the water demand projection will remain at the higher level for the remainder of the planning period, based on the assumption that if the water is put to beneficial use in the future it will continue to have value and will be used even if there are later economic declines. This method may be modified in some regions to consider specific information regarding plans for large commercial development or increased use by existing commercial water users.

The *industrial (self-supplied)* category includes self-supplied water used by enterprises that process raw materials or manufacture durable or nondurable goods and water used for the construction of highways, subdivisions, and other construction projects (Longworth et al., 2013). To collect information on factors affecting potential future water demand, economists conducted interviews with industrial users and used information from the New Mexico Department of Workforce Solutions (2014) to determine if growth is expected in this sector. Based on these interviews and information, high and low scenarios were developed to reflect ranges of possible growth. If water use in this category is low and limited additional use is expected, both the high and low projections are the same.

The *mining* category includes self-supplied enterprises that extract minerals occurring naturally in the earth's crust, including solids (e.g., potash, coal, and smelting ores), liquids (e.g., crude petroleum), and gases (e.g., natural gas). Anticipated changes in water use in this category were based on interviews with individuals involved in or knowledgeable about the mining sector. If water use in this category is low and limited additional use is expected, both the high and low projections are the same.

The *power* category includes all self-supplied power generating facilities and water used in conjunction with coal-mining operations that are directly associated with a power generating facility that owns and/or operates the coal mines. Anticipated changes in water use in this category were based on interviews with individuals involved in or knowledgeable about the power sector. If water use in this category is low and limited additional use is expected, both the high and low projections are the same.

Reservoir evaporation includes estimates of open water evaporation from man-made reservoirs with a storage capacity of approximately 5,000 acre-feet or more. No large reservoirs are present in Doña Ana County; therefore, no water use is projected for the reservoir evaporation category.

6.5.2 Lower Rio Grande Projected Water Demand

Table 6-5 summarizes the projections for each water use category for each of the three counties that were developed by applying the methods discussed in Section 6.5.1. As discussed in Section 6.3, population is projected to increase under both the high and low growth scenarios.

Projected water demand in the *public water supply* and *self-supplied domestic* and *commercial* categories is projected to increase in Doña Ana County under both the high and low scenarios, proportional to the increasing population projections.

Water use in Doña Ana County occurs primarily in the *agricultural* category, and interviews (Section 6.2) indicated that the sector is relatively stable overall. For the high scenario, the amount of water devoted to irrigated agriculture in Doña Ana County is projected to remain at the 2010 level. The low scenario anticipates a drop in groundwater use to 80 percent of the 2010 level in 2020, with a rebound to 85 percent in the next two decades. By 2050, groundwater usage is projected to be at 90 percent of 2010 levels and remain there through 2060. Under the low scenario, no decline is expected in surface water use, which under the 2008 Operating Agreement was already reduced from historical normal levels.

Livestock in Doña Ana County is expected to be at 80 percent of 2010 levels in 2020 under the high scenario but to decrease over the next 40 years as dairies and cattle ranching give way to industrial and commercial land uses. In the low scenario, water usage is projected to drop to 75 percent of 2010 use in 2020, decline to 70 percent in 2030, and then level off at 65 percent as land uses change

Industrial water use is projected to increase minimally, as most of the new industries use relatively small amounts of water.

Doña Ana County has a few aggregate *mines* that use a small amount of water; this water use is expected to remain steady throughout the forecast period.

Water use in the *power* industry is expected to increase modestly through 2020. The Afton power plant operated by PNM will increase water use in 2020 and then level off. El Paso Electric intends to retire three electricity-generating units within the forecast period, but may install two new plants. The high projection anticipates that the two new plants will be located in Doña Ana County, while the low projection excludes them. In both scenarios, water usage is projected to level off after 2030.

No large reservoirs are present in Doña Ana County; therefore, no water use is projected for the *reservoir evaporation* category.

5. Identified Gaps between Supply and Demand

Estimating the balance between supply and demand requires consideration of several complex issues, including:

- Both supplies and demands vary considerably over time, and although long-term balanced supplies may be in place, the potential for drought or, conversely, high flows and flooding must be considered. In general, storage, including the capture of extreme flows for future use, is an important aspect of allowing surface water supplies to be used when needed to meet demand during drought periods (i.e., reservoir releases may sustain supplies during times when surface water supplies are inadequate).
- In wet years when more water is available than in 2010, irrigators can increase surface water diversions up to their water right and reservoirs will fill when inflow exceeds downstream demand, provided that compact requirements are satisfied to increase storage for subsequent years. Thus, though not quantified, the diversions in wet years may be greater than the high projection.
- Supplies in one part of the region may not necessarily be available to meet demands in other areas, particularly in the absence of expensive infrastructure projects. Therefore comparing the supplies to the demands for the entire region without considering local issues provides only a general picture of the balance.
- As discussed in Section 4, there are considerable legal limitations on the development of new surface and groundwater resources, given that surface and surface-connected groundwater supplies are fully appropriated, which affects the ability of the region to prepare for shortages by developing new supplies.
- Besides quantitative estimates of supply and demand, numerous other challenges affect the ability of a region to have adequate water supplies in place. Water supply challenges include the need for adequate funding and resources for infrastructure projects, water quality issues, location and access to water resources, limited productivity of certain aquifers, and protection of source water.

Despite these limitations, it is useful to have a general understanding of the overall balance of the supply and demand. Figure 7-1 illustrates the total projected regional water demand under the high and low demand scenarios, and also show the administrative water supply and the drought - adjusted water supply. Future water demand projections reflect substantial growth in water demand (Figure 7-1), due to the optimistic economic forecasts discussed in Sections 3 and 6.

However, even without significant growth in demand, major supply shortages are indicated in drought years.

The Lower Rio Grande Planning region includes several mined basins that could be impacted by reductions to recharge resulting from long-term drought.. The region also relies on surface water supplies that are vulnerable to drought. Also important is the predicted decline of the aquifers in these closed basins due to continued pumping. As discussed in Section 6.5, the water level decline rates were examined to estimate the future supply with and without a 20-year drought where no recharge occurred in the mined basins. This analysis indicated that future water availability may be only 51 percent of the 2010 supply (Table 7-1), and the estimated shortage in drought years is expected to range from 218,000 to 244,200 acre-feet. Consequently, increasing storage, developing shortage-sharing agreements, protecting watershed health for the region's surface water supplies, and identifying alternative groundwater supplies are high priorities for the region.

6. Implementation of Strategies to Meet Future Water Demand (Prepared by the Regions)

8.1 Water Conservation

8.2 Implementation of Strategies Identified in Previously Accepted Regional Water Plan

8.3 Proposed Strategies (Water Programs, Projects, or Policies)

8.4 Evaluations

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DRAFT

Regional Water Planning Update

Projects, Programs, and Policies

Water Planning Region:______Lower Rio Grande Region 11______________________

Planning Region	County	Regional or System Specific (R), (SS)	Strategy Type (Project, Program or Policy)	Strategy Approach (What issue does strategy address)	Subcategory	Project Name	Source of Project Information	Description	Project lead (Entity or Organization)	Partners (other entities or participants)	Timeframe (Fiscal Year)	Planning Phase	Cost	Need or reason for the project, program, or policy	Comments
Lower Rio Grande	Dona Ana	R	Policy	Increase Water Supply	Reduce Demand	**Rainwater Harvesting for City Landscaping**	Community Engagement Workgroup	Promote and provide funding for harvesting of stormwater and rainwater (to the extent allowed by the law) for City landscaping. Modify City policies to support stormwater and rainwater harvesting through educational programs and incentives							
Lower Rio Grande	Dona Ana	R	Policy	Increase Water Supply	Reduce Demand	**Rainwater Harvesting**	Chris Canavan - NMED	Facilitate EBID ideas of capturing stormwater in their drainage system including creating small linear impoundments for direct infiltration and to use for irrigation. Includes constructed wetlands that capture stormwater while also creates habitat and reduces pollutant loads to the river							
Lower Rio Grande	Dona Ana	R	Policy	Improve System Efficiency	Reduce Demand	**Water-wise designs for indoor and outdoor infrastructure**	Community Engagement Workgroup	Require water conserving designs and infrastructure (both indoor and outdoor) in al lnew development or create a point system for assessing the water-efficiency of the proposed new development						Developers have a tendency to continue to use technology that they are familiar with and require little change in design. However, there are ways to design buildings to take advantage of rainwater, stormwater, and low-water infrastructure (both indoor and outdoor). Policies requiring specific designs, infrastructure, or levels of efficiency can level the playing field for all developers while promoting water efficiency	Municipalities in other parts of the country use a point system to assess building designs for a variety of conservation and efficiency measures and award permits to those desings that meet a certain score
Lower Rio Grande	Dona Ana	R	Policy	Improve System Efficiency	Reduce Demand	**Promote LID (Low Impact Design) for the homeowner and commerical developer**	Chris Canavan - NMED	Encompass techniques such as rain gardens/bioswales, permeable pavement, cisterns, curb cuts in medians, parking lots, etc, small detention basin-parks						These techniques are currently exist and proven to work	
Lower Rio Grande	Dona Ana	R	Policy	Protect Exisiting Water Supplies		**Review well permit regulations**	Community Engagement Workgroup	Review and implement regualtions regarding wells, both commercial and residential						The threats addressed by the proposals are around water access and availability. The results is a multi-faceted approach to water conservation	
Lower Rio Grande	Dona Ana	R	Policy	Protect Exisiting Water Supplies		**Public Education**	Community Engagement Workgroup	Increase public relations campaigns on water conservation						The threats addressed by the proposals are around water access and availability. The results is a multi-faceted approach to water conservation	
Lower Rio Grande	Dona Ana	R	Policy	Protect Exisiting Water Supplies		**Ensure compliance with existing policies and regulations**	Community Engagement Workgroup	Enforce the exisiting policies on water quality and well head protection						Smaller communities and individuals with private domestic wells often have concerns with contamination from Ag or Commerical neighbors. They want stronger enforcement of well head protection and stricter dumping regulations	

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Lower Rio Grande	Dona Ana	R	Policy	Improve System Efficiency		**Landscaping meters**	Community Engagement Workgroup	Require separate landscape meters on all new development in Las Cruces						Separate landscape meters make it possible to determine how much water is being used on landscape. This provides the opportunity to more easily detect leaks and other irrigation inefficiencies. As a side benefit, in Las Cruces customers are not charged for sewer services on landscape water where there is a separate meter	
Lower Rio Grande	Dona Ana	R	Policy	Improve System Efficiency, and Reduce Demand		**Irrigation Audits**	Community Engagement Workgroup	Optimize irrigation systems and landscapes throughout Las Crues by subsidizing irrigation audits, irrigation system adjustments and educating the public about the need for optimization						Outdoor irrigation accounts for about 1/3 (33%) of total water use in Las Cruces. With a growing population, Las Cruces' water needs are expected to increase; this rpogram can help keep the total water use down	Older irrigation systems are often inefficient and require application of excess water in order to supply sufficient water to all areas of the landscape. Poorly maintained systems with broken sprinkler heads or with leaks will waste water. Irrigation schedules are often set too long.
Lower Rio Grande	Dona Ana	R	Program	Improve system efficiency	Reduce Demand	**Low-flow conversion incentive**	Community Engagement Workgroup	Replace indoor residential and commercial water infrastructure such as toilets and showerheads with low-water used models in the region. Make the program accessible especially to low and moderate income households						Older infrastructure uses significantly more water than newer, water-efficient models. Research has shown that toliets and showers are the two highest indoor water uses. Replacement of older infrastructure will reduce water consumption, improving overall system efficiency. This program needs to reach the low-income communities, which typically have the oldest infrastructure and lack the income to replace old and leaking equipment.	Both the Cities of Santa Fe and Albuquerque have had similar programs, which led to reduction in indoor water use in these areas.
Lower Rio Grande	Dona Ana	S	Program	Improve system efficiency	Reduce Demand	**Water leak detection program**	Community Engagement Workgroup	Fund the purchase or rental of leak detection equipment and personel to inspect the City of Las Cruces water distribution system. As water distribution infrastructure ages, real losses rise. The loss represents a waste of both water and energy used to treat and deliver water						Like many water systems, real losses in the City of Las Cruces distribution systemm accound for some unknown portion of the total unaccounted for water loss in the system. In 2014, total unaccounted for water loss was 16.8% of the total water provided. Reduction in real losses will help to keep the City of Las Cruces' total water need down as the population grows	
Lower Rio Grande	Dona Ana	S	Program	Reduce Demand		**Expansion of water reclamation system in Las Cruces**	Community Engagement Workgroup	Fund the expansion of the water reclamation and delivery system in Las Cruces. The existing system has a maximum capacity of 1M gallons per day. More of the City's wastewater could be treated and reused on landscapes. In addition to more treatment capacity at the reclamation plant, more purple pipe distribution system needs to be installed to deliver the treated water where it is needed. Require purple pipe on all new development in the City Utilitiy's service area.						water which can be reused effectively reduces overall demand	

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Lower Rio Grande	Dona Ana	R	Policy	Reduce Demand	Protect Existing Water Supplies	**Limit water use throughout the Mesilla Basin at the renewable supply limit**	Community Engagement Workgroup	Work with the regional stakeholders to cap water use at the calculated renewable supply (calculated over a annual or other appropriate timeframe).						If the current trend of mining aquifers continues, the reliable supply of water will dimish with many associated problems, not least of which is to make the area more susceptible to drought, reduce the capacity of the area to sustain people and agriculture, and degrade natural enviroment	
Lower Rio Grande	Dona Ana	R	Project	Protect Existing Water Supplies		**Floodplain Management**	Chris Canavan - NMED	Shave the floodplain to capture stormflows. Use gage data to determine flood frequency and flow volume. Overbank should occur as close to just above irrigation delivery as possible/practicable..						This would reduce flood severity, increase flood capacity, infiltrate water, mitigate pollution, and create floodplain habitat	
Lower Rio Grande	Dona Ana	R	Project	Protect Existing Water Supplies		**Watershed Restoration**	Chris Canavan - NMED	Watershed restoration that reduces runoff while increasing infiltration							
Lower Rio Grande	Dona Ana	R	Project	Improve system efficiency		**Irrigation App**	Chris Canavan - NMED	Develop an app for farmers to use to assist in determining irrigation needs - such as when and how much to apply etc							Possibly in development already at NMSU
Lower Rio Grande	Dona Ana	R	Policy	Improve system efficiency	Environmental Protection	**Fund climate research**	Chris Canavan - NMED	The research on our climate (such as WRRI or USGS gage data) should be supported (financially), complied, and disseminated.						There is a growing need for good hydrologic data. Increased data facilitates regional water planning.	
Lower Rio Grande	Dona Ana	R	Program	Protect Existing Water Supplies	Environmental Protection	**Restore Fish Habitat**	Kevin Bixby - Enviroment Work Group	Develop a plan to reestablich self-sustaining populations of native fish in the Rio Grande below Caballo.	Plan could be done by scientists at NMSU or UNM, in partnership with others	Potential partners: NMSU, UNM, UTEP, U.S. Fish and Wildlife Service, NM Dept. of Game and Fish, U.S. Bureau of Reclamation, International Boundary and Water Commission —U.S. Section				The Rio Grande has lost two thirds of its native dish species due to a century of dam building, channelization and dewatering. The disapperance of these species is an indication that the river ecosystem has been severly degraded	Restoring all or a significant number of extirpated native fish species would represent major progress towards restoring the Rio Grande to ecological health since it would require a comprehensive approach by necessity, addressing a host of factors that have caused native fish to disappear. Most of these species are not currently listed as threatened or endangered under the U.S. Endangered Species Act, but their current depleted status suggests that listing could become warranted at some point in the future. Their listing could result in serious constraints on existing Rio Grande management, as it has for the middle Rio Grande of New Mexico with the Rio Grande silvery minnow. Taking a proactive approach to conserving native fish by developing a plan for their recovery before they are listed will minimize disruptions to water users while providing greater flexibility in the choice of conservation measures
Lower Rio Grande	Dona Ana	R	Program	Protect Existing Water Supplies	Environmental Protection	**Environmental Water Needs Assesment**	Kevin Bixby - Enviroment Work Group	Develop an Environmental Water Needs Assessment for the lower Rio Grande that will: 1) determine the amount of water needed to restore and maintain a healthy river/floodplain ecosystem, including water needed for year-round base flows to sustain native fish, peak flows, floodplain vegetation and open water features, river-associated wildlife, and recreational boating; 2) include a 3-year flow study to document the relationship between water deliveries and river conditions; 3) include scenario planning to support environmental water allocation decisions with varying water supplies.						Currently there is no allocated water supply for the environment. The river floodplain ecosystem has been severely degraded due to more than a century of dam building, channelization and dewatering. Two thirds of native fish species have disappeared from this reach. The proposed assessment is needed to determine how much water would be needed to restore and sustain a healthy river floodplain ecosystem.	

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Lower Rio Grande	Dona Ana	R	Program	Protect Existing Water Supplies	Environmental Protection	**Living River Program**	Kevin Bixby - Enviroment Work Group	Establish a Living River Program to encourage water conservation among urban water users and raise money to acquire water rights for river restoration.						1) Some urban water users do not like to reduce water usage because they are concerned the saved water will go towards more urban growth. This program would give them an incentive to conserve. 2) Money is needed to purchase or lease water for restoring the river. This program would generate funds for this purpose	Similar programs have been implemented in Arizona and Santa Fe. See http://conserve2enhance.org/ for more information about the Arizona programs.
Lower Rio Grande	Dona Ana	R	Policy	Protect Existing Water Supplies, Improve System Efficiency		**Farm Delivery Metering (Previous Plan Section 8.2.1.5.2)**	2003 Regional Water Plan with Comments from 2015 Steering Committee	Increase metering of ground water and surface water withdrawals for AG purposes					Cost $1050 per turnout using EBID fabricated pressure transducers (but other prices can range from $700-$2500 each)		Metering of deomestic wells is very important as there are cases of abuse where the domestic well is used for other purposes. Some of this has definitely been implemented, it is an ongoing program required by the State Engineer and paid for by water rights holders. The reporting system (for both domestic and AG meteres) needs to be improved, with farmers sometimes falling behind on reporting their meter readings to the ISC.
Lower Rio Grande	Dona Ana	R	Program	Improve System Efficiency		**Laser Leveling (Previous Plan Section 8.2.1.5.2)**	2003 Regional Water Plan with Comments from 2015 Steering Committee	Improve irrigation efficiency by precision grading the field. Reduces the amount of water needed to be delivered for the same amount of crop delivery. Less ET and more consumption					$350 per acre with $200 -$250 retouch leveling every 3-5 years		In the last 10 years there has a been a push for laser leveling and costs have decreased. Annual crops require laser leveling of the field every year, but perennial crops such as pecans don't need to be leveled as often. Since water rights are administered by diversion, this increase in efficiency allows for greater production with the same water delivery. The downside of this is that increased production from the same delivery will in turn decrease the returns (via seepage or drainage back to canals) so the net depletion increases.
Lower Rio Grande	Dona Ana	R	Program	Improve System Efficiency		**Drip Irrigation (Previous Plan Section 8.2.1.5.2)**	2003 Regional Water Plan with Comments from 2015 Steering Committee	Replace flood irrigation with more efficient drip irrigation					lots of varied prices for drip and sprinkler irrigation		This sprinkler option was described as limited in this area due to high salt content and winds which decrease sprinkler efficiency. Drip system is hampered by sediment rich surface water causing system clogs. Both are still options worth considering if system maintenance allows.
Lower Rio Grande	Dona Ana		Program	Improve System Efficiency		**High Flow Turnouts (Previous Plan Section 8.2.1.5.2)**	2003 Regional Water Plan with Comments from 2015 Steering Committee	Increase turnout flow from 2 cfs to 25 cfs which results in more uniform infiltration					$1,200 to $2,000 per high flow turnout		The difficulty with this alternative is that the high flow turnouts are often designed to only work correctly at high flow rates. When the water supply is low this is problematic.
Lower Rio Grande	Dona Ana		Program	Reduce Demand	Build System Resiliance	**Low Water Use Crops (Previous Plan Section 8.2.1.5.2)**	2003 Regional Water Plan with Comments from 2015 Steering Committee	Switch from high water use crops (alfalfa and pecans) to low water use crops					No specific costs discussed, feasibility depends on market demand for the lower water use crops		The difficulty with low water use crops is that there isn't a market to purchase these goods (typically sorghum, cotton, corn, hemp). Other low water consumption crops (they require frequent irrigation, but have a small consumption) include: chile, lettuce, onion, and cabbage.
Lower Rio Grande	Dona Ana	R	Program	Improve System Efficiency		**Deficit Irrigation (Previous Plan Section 8.2.1.5.2)**	2003 Regional Water Plan with Comments from 2015 Steering Committee	Apply less water than required to fully replenish root zone					No specific costs discussed, feasibility depends on market demand for the lower water use crops		This practice already occurs in the region, and there are not many new crops that could be introduced that also survive this technique. Not much room for growth with this conservation measure in this region.

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Lower Rio Grande	Dona Ana	R	Program	Reduce Demand	Build System Resiliance	**Cultural Practices (Previous Plan Section 8.2.1.5.2)**	2003 Regional Water Plan with Comments from 2015 Steering Committee	Farmers often develop unique irrigation schemes to save water, such as, irrigating every other furrow					No specific costs discussed, feasibility depends on market demand for the lower water use crops		
Lower Rio Grande	Dona Ana	R	Program	Improve System Efficiency		**Canal Lining (Previous Plan Section 8.2.1.5.2)**	2003 Regional Water Plan with Comments from 2015 Steering Committee	Concrete line irrigation canals to reduce seepage					$20 to $115 per linear ft. of canal (depending on canal geometry)		Reduced diversion is attractive, however reduced seepage canal means less return flows or GW recharge
Lower Rio Grande	Dona Ana	R	Policy	Improve System Efficiency	Reduce demand	**Irrigation Rate Structure (Previous Plan Section 8.2.1.5.3)**	2003 Regional Water Plan with Comments from 2015 Steering Committee	Increase the cost of water to discourage water wasting					Current water rates based on market value and not for profit		The steering committee felt that this alternative was not approriate for AG water users (they pay a flat fee to help maintain the system, they don't pay based on volume of water used/diverted). If water costs did increase for AG they would be more inclined to sell their water rights to developers rather than conserve. The steering committee would like to see this alternative retained for muncipal and domestic users however.
Lower Rio Grande	Dona Ana	R	Policy	Improve System Efficiency	out	**Charge to Constituents (Previous Plan Section 8.2.1.5.3)**	2003 Regional Water Plan with Comments from 2015 Steering Committee	Charge customers who order a water delivery but then refuse water at delivery time					no costs discussed		The steering committee would like to see this alternative removed. This issue is handled internally with EBID
Lower Rio Grande	Dona Ana	R	Policy	Improve System Efficiency		**Manage water releases to maximize efficiency (Previous Plan Section 8.2.1.5.3)**	2003 Regional Water Plan with Comments from 2015 Steering Committee	Change water delivery patterns to increase delivery efficiency		There are lots of players involved with this option (irrigation districts, BoR, Compact Commissioners from CO, NM, TX)			no costs discussed		The steering committee indicated that significant work had happened on this alternative since the plan was written, an Operations Agreement is now in place. Unfortunately there is concern that this alternative does not take into account the water needs of wildlife and the river.
Lower Rio Grande	Dona Ana	R	Program	Protect Existing Supplies	Environmental Protection	**Remove invasive plants (Previous Plan Section 8.2.2.1)**	2003 Regional Water Plan with Comments from 2015 Steering Committee	Remove invasive or non native plants from the river					no costs discussed		The steering committee would like to see this alternative renamed to IBWC Conceptual Restoration. Replacing invasive species with native plants doesn't increase waer savings, but it does have other beneficial environmental impacts. The habitat areas would have to be carefully replanted with care and detail to endangered species needs.
Lower Rio Grande	Dona Ana	R	Program	Increase Water Supply		**Rainfall Augmentation (Previous Plan Section 8.2.2)**	2003 Regional Water Plan with Comments from 2015 Steering Committee	Add salt or ice crystals to "seed" clouds to increase precipitation formation					no costs discussed		It could be modestly expected to increase rainfall by 5-20%. However, sufficient cloud formation must already occur to have seeding opportunity.
Lower Rio Grande	Dona Ana	R	Program	Increase Water Supply		**Desalination (Previous Plan Section 8.2.3)**	2003 Regional Water Plan with Comments from 2015 Steering Committee	Desalinate brackish groundwater					no costs discussed		There are deeper, brackish groundwater aquifers in the basin which could be treated. Brine waste disposal would need to be considered and is one of the biggest hurdles for this alternative.
Lower Rio Grande	Dona Ana	R	Program	Protect Existing Supplies	build system resilience	**Aquifer Storage and Recovery (Previous Plan Section 8.2.4)**	2003 Regional Water Plan with Comments from 2015 Steering Committee	Store water in underground aquifers for future withdrawal					no costs discussed		Potential sources of injection water are treated waste-water, storm water runoff, purchased surface water
Lower Rio Grande	Dona Ana	R	Program	Increase Water Supply		**Storm Water Capture (Previous Plan Section 8.2.5)**	2003 Regional Water Plan with Comments from 2015 Steering Committee	Capture water during storm events in detention and infiltration ponds					no costs discussed		Storm water capture in urban areas but will be limited by regulations (and the regulations vary by location within the basin - below Elephant Butte the rules are different). Another complication is that storm water comes when irrigators do not need it (fields already flooded with rain are not going to divert additional water).

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Lower Rio Grande	Dona Ana	R	Policy	Protect Existing Supplies	build system resilience, allocate water supplies equitably and efficiently	**Water Right Lease and Transfer Policies (Previous Plan Section 8.2.2.6.1)**	2003 Regional Water Plan with Comments from 2015 Steering Committee	EBID was in the process of establishing regulations to implement SWUA allowing lease of EBID water for municipal use. The SWUA concept is described on pgs. 188-193 of the previous water plan.					no costs discussed		Water policy could be developed to control water use for municipal, agricultural and environmental/biological habitat reasons
Lower Rio Grande	Dona Ana	R	Policy	Mitigate Drought		**Purchase of Water Rights (Previous Plan Section 8.2.2.6.1)**	2003 Regional Water Plan with Comments from 2015 Steering Committee	Obtain water rights by direct purchase					Price depends on market value. $4.5k in Rincon Valley to $10k per acre in Las Cruces area		City of Las Cruces' preference is to lease water rather than purchase the land and water - which means the City does not own the water right
Lower Rio Grande	Dona Ana	R	Program	Protect Existing Supplies	Environmental Protection	**Passive Use of Water for Restoration (Previous Plan Section 8.2.2.6.1)**	2003 Regional Water Plan with Comments from 2015 Steering Committee	Not all restoration needs will have water allocated to them					no costs discussed		EIS studies conducted on restoration of canalized sections of the river
Lower Rio Grande	Dona Ana	SS	Project		watershed restoration, increase water supply	**Las Cruces Sustainable Water Project (Previous Plan Section 8.2.2.7)**	2003 Regional Water Plan with Comments from 2015 Steering Committee	Augment ground water supply for the Mesilla Rincon Basin with surface water					no costs discussed		This surface water would be obtained through the SWUA process. The alternative is not complete - in progress. The plan was to have year round releases, but it is based on available water supply in reservoirs
Lower Rio Grande	Dona Ana	SS	Project		watershed restoration, increase water supply	**Hatch Area Water Treatment Plant (Previous Plan Section 8.2.2.7.1)**	2003 Regional Water Plan with Comments from 2015 Steering Committee	Proposed treatment plant with a capacity of 3.5 MGD in 2007 and 4.5 MGD in 2015					no costs discussed		Plant would serve Dona Ana County's North Planning Area (Hatch, Salem, Garfield, Rincon, and the spaceport)
Lower Rio Grande	Dona Ana	SS	Project		watershed restoration, increase water supply	**Las Cruces Area SWTP (Previous Plan Section 8.2.2.7.2)**	2003 Regional Water Plan with Comments from 2015 Steering Committee	Proposed treatment plant with a capacity off 20 MGD in 2005 and 34 MGD in 2020-2030					no costs discussed		Plant would serve the City of Las Cruces and some mutual domestics
Lower Rio Grande	Dona Ana	SS	Project		watershed restoration, increase water supply	**Anthony Area SWTP (Previous Plan Section 8.2.2.7.3)**	2003 Regional Water Plan with Comments from 2015 Steering Committee	Proposed treatment plant with a capacity of 4 MGD in 2005 and increasing to 16 MGD in phase 3 (2030?)					no costs discussed		Plant would serve Dona Ana County's South Planning area (Anthony, Vado, Berino, Chamberino, La Mesa). This project is still ongoing
Lower Rio Grande	Dona Ana	R	Project		increase water supply	**Importation of Water (Previous Plan Section 8.2.2.8)**	2003 Regional Water Plan with Comments from 2015 Steering Committee	Import water from (1) Gila Project, (2) Nutt-Hockett Basin, (3) Salt Basin					no costs discussed		This is a contriversial alternative. Many steering committee members are strongly against taking water from other regions. This would just be a delay of the real problem and stealing water from other regions. However, this alternative might be considered under dire circumstances.
Lower Rio Grande	Dona Ana	R	Program			**Public Education (Previous Plan Section 8.2.1.1)**	2003 Regional Water Plan with Comments from 2015 Steering Committee								Outreach is critical for all of these alternatives.
Lower Rio Grande	Dona Ana	R	Project			**Update the LRG Hydrologic Model**	Domestic & Civic Users Group	Update the existing LRG Hydrologic Model to incorporate drought conditions, the relationship between ground and surface water, estimation of the quantity, quality, and availability of water. This project will be useful for numerous programs and policy development or revision.	WRRI	Partnerships between ground and surface water users, the OSE, State Legislature for potential statutory/regulatory/policy modifications. Potential funding sources include State Legislature Monies, EPA Funds, In-kind funds, Bureau of Reclamation, NMFA, NSF, Water Trust Board.	Recurring funding will be required to keep the model up to date. During Phase I, estimates for yearly updates can be developed.		Initial estimate $1,000,000 and can be phased.	This project will define the quantity, quality and availability of water for current and future use. This project will provide sufficient information for the OSE to complete adjudication in addition allow all water right holders to plan for the current and future needs.	Lower Rio Grande Water Users Organization has already requested funding previously where Water Resources Research Institute agreed to be the fiscal and project lead. The model will require periodic maintenance and update. Monitoring can be accomplished through the LRGWO, Office of the State Engineer and the Interstate Stream Commission.

Planning Region	County	Regional or System Specific (R), (SS)	Strategy Type (Project, Program or Policy)	Strategy Approach (What issue does strategy address)	Subcategory	Project Name	Source of Project Information	Description	Project lead (Entity or Organization)	Partners (other entities or participants)	Timeframe (Fiscal Year)	Planning Phase	Cost	Need or reason for the project, program, or policy	Comments
Lower Rio Grande	Dona Ana	R	Project	Protect Existing Water Supplies		**Priority Call Impact Study**	Domestic & Civic Users Group	Conduct an economic impact study associated with a call for water based on water right priority date.	NM ISC / OSE	Partnerships between ground and surface water users, the OSE, State Legislature for potential statutory/regulatory/policy modifications. Potential funding sources include State Legislature Monies, EPA Funds, In-kind funds, Bureau of Reclamation, NMFA, NSF, Water Trust Board. Lower Rio Grande Water Users Organization would be			Initial estimate $300,000.	This project will define what the potential economic effects would be if the OSE made water calls.	A similar study was conducted for the Pecos Basin.
Lower Rio Grande	Dona Ana	R	Program			**Increased Funding for Planning**	Domestic & Civic Users Group	Provide funding for domestic and civic users past, current and future master plans, preliminary engineering reports, feasibility studies, infrastructure capital improvement projects, asset management plans, and 40-year water development plans, rate studies, etc.						To improve each specific water provider to meet any of the strategic objectives, new development, manage growth, address aging infrastructure, utilize updated and new technologies to become more efficient and water conscience.	Each water system is responsible for their own system with specific needs. The plans, reports, studies and projects can be found at each of the water system main offices, as requested or provided.
Lower Rio Grande	Dona Ana	R	Program	Improve System Efficiency		**Enhanced SCADA Monitoring**	Domestic & Civic Users Group	Implement enhanced SCADA system monitoring to include measuring two-way flows and pressures at critical system distribution points in combination with radio-read meter networks to better monitor and identify "lost" water and optimize system operation. Intent would be to achieve <3% unaccounted for water usage and reduce power consumption.	Best application would be to start with the larger users/networks (City of Las Cruces, Dona Ana MDWCA, Anthony, LRGPWWA, Garfield and Village of Hatch).	Funding sources will be variable but could include WTB, appropriations, colonias and USDA.			Cost would be variable but likely into the $100k-$200k for the largest users	Water systems often have water losses >15%, sometimes approaching as much as 50%. The costs from these losses can be significant (lost revenue and pumping expense) while simultaneously depleting potable water aquifers. Intended result is significantly higher system efficiency and lessened depletion of potable aquifers.	Enhanced SCADA has been proven in the Middle East (particularly Israel) to very significantly contribute to reduced water loss. Technique utilizes a combination of metering tools (primarily flow and pressure) in combination with analysis software to identify leaks in real time and at small volumes. Each community would need to complete their own implementation. Monitoring and evaluation of success would be fairly easy as the software would monitor successful decline of losses. Ultimate development and integration could result in a 911-style system with central monitoring and dispatch of coordinated response crews across the entire LRG project area.

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Lower Rio Grande	Dona Ana	SS	Project	Increase Water Supply		**Evaluate Potential New Water Sources for the Percha Creek Area**	Domestic & Civic Users Group	Evaluate/quantify and develop new water source (aquifer) in the Percha Creek area for use by domestic users immediately south of Caballo Reservoir. Utilize this study to establish water rights availability prior to excessive claims. A relatively undeveloped artesian aquifer is known to exist immediately west of Caballo Reservoir roughly in the area of Percha Creek. The extent north and south of this source and the specifics of its source/headwaters has not yet been determined except that it likely is not fed by LRG waters. This project would determine the reserve potential of the aquifer, likelihood of exploitation and potential threats.	Users near Caballo Reservoir would stand to benefit most greatly although conveyance may be possible all the way south to the Rincon area (or perhaps Spaceport USA) if resources are proven available. Funding sources would likely include legislative appropriation, NMBM&MR, WRRI and/or USGS.	Local domestic water providers could manage the project; however, to promote impartiality it would likely best be managed through NMBM&MR or OSE, and could use in-house resources and/or consultants.			Depending on the level of study, estimated costs could range from $50,000 (for basic pump testing, literature review and presentation and sampling) to $500,000 (if including seismic delineation of the aquifer extents).	The good quality artesian aquifer has been accessed for some farming and domestic use in Percha Creek, but its true potential has not yet been evaluated. Recent interest in the area for commercial agriculture water supply and/or mining suggests that this resource may be in jeopardy.	Aquifer studies have been common in NM and the LRG region. However, getting a study completed prior to large-scale exploitation would be an opportunity.
Lower Rio Grande	Dona Ana		Project			**ANTHONY 4TH ST DRAINAGE POND IMPROVE**	2015 Capital Outlay Bill SB159		Anthony				150000		1233
Lower Rio Grande	Dona Ana		Project			**ANTHONY WSD WATER LINE IMPROVE GADSDEN HIGH SCHL**	2015 Capital Outlay Bill SB159		Anthony				250000		1358
Lower Rio Grande	Dona Ana		Project			**BERINO DRAINAGE IMPROVEMENTS DONA ANA CO**	2015 Capital Outlay Bill SB159		Berino				50000		1286
Lower Rio Grande	Dona Ana		Project			**DONA ANA CO EAST MESA FLOOD CONTROL STRUCTURE**	2015 Capital Outlay Bill SB159						400000		1470
Lower Rio Grande	Dona Ana		Project			**DONA ANA CO SANTA TERESA AUTO WEATHER OBSERV SYS**	2015 Capital Outlay Bill SB159						262000		1289
Lower Rio Grande	Dona Ana		Project			**ELEPHANT BUTTE ID DISCHARGE PIPELINE DONA ANA CO**	2015 Capital Outlay Bill SB159						300000		1685
Lower Rio Grande	Dona Ana		Project			**MCDOWELL RD WWATER COLLECTION SYS MESILLA**	2015 Capital Outlay Bill SB159		Mesilla				250000		1990
Lower Rio Grande	Dona Ana		Project			**Storm drain mulit-purpose recreational flood control facility**	2015 Water Trust Board Application		Anthony, City of				190000		760
Lower Rio Grande	Dona Ana		Project			**Supplemental Well No. 2**	2015 Water Trust Board Application		Chamberino MDWC&SA				125000		841
Lower Rio Grande	Dona Ana		Project			**Water system improvements**	2015 Water Trust Board Application		Desert Aire MDW&SWA				1477563		799
Lower Rio Grande	Dona Ana		Project			**Upgrading waterlines**	2015 Water Trust Board Application		Garfield MDWC&MSWA				2416308		743
Lower Rio Grande	Dona Ana		Project			**Water transmission pipeline**	2015 Water Trust Board Application		Hatch, Village of				458654		798
Lower Rio Grande	Dona Ana		Project			**Water System Improvements Project**	2015 Water Trust Board Application		Mesilla, Town of				144000		809
Lower Rio Grande	Dona Ana		Project		Airports	**Automated Weather Observation System (AWOS)**	2016-2020 ICIP				2016		180000		18523
Lower Rio Grande	Dona Ana		Project		Storm/Surface Water Control	**Placitas Arroyo**	2016-2020 ICIP				2016-2020		4500000		21129
Lower Rio Grande	Dona Ana		Project		Storm/Surface Water Control	**Dragonfly Channel**	2016-2020 ICIP				2016-2020		8404000		26085
Lower Rio Grande	Dona Ana		Project		Storm/Surface Water Control	**Brahman Dam**	2016-2020 ICIP				2016-2019		3625000		26079
Lower Rio Grande	Dona Ana		Project		Storm/Surface Water Control	**Brown Farm Flood Control**	2016-2020 ICIP				2016-2020		5100000		19953
Lower Rio Grande	Dona Ana		Project		Storm/Surface Water Control	**Hatch Flood Control Project**	2016-2020 ICIP				2016-2020		6191420		26131

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Lower Rio Grande	Dona Ana		Project		Storm/Surface Water Control	**Longhorn Drive Area Drainage Improvements**	2016-2020 ICIP				2016-2017		300000		30043
Lower Rio Grande	Dona Ana		Project		Storm/Surface Water Control	**Radium Springs Drainage Master Plan**	2016-2020 ICIP				2016		100000		30045
Lower Rio Grande	Dona Ana		Project		Storm/Surface Water Control	**Hill Area Drainage Plan**	2016-2020 ICIP				2016-2017		275000		30136
Lower Rio Grande	Dona Ana		Project		Wastewater	**Chaparal WW Project Phase 1C**	2016-2020 ICIP				2016		3450000		28684
Lower Rio Grande	Dona Ana		Project		Wastewater	**South Central WW Collection Improvments**	2016-2020 ICIP				2016-2018		1500000		26235
Lower Rio Grande	Dona Ana		Project		Wastewater	**South Central Wastewater Treatment Plant Improv.**	2016-2020 ICIP				2016-2018		3500000		26263
Lower Rio Grande	Dona Ana		Project		Wastewater	**South Central Asset Management Plan**	2016-2020 ICIP				2016		250000		30039

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Table 3-1. Summary of Demographic and Economic Statistics for the Lower Rio Grande Water Planning Region

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a. Population

County	2000	2010	2013
Doña Ana	174,690	209,233	213,460
Total Region	174,690	209,233	213,460

Source: U.S. Census Bureau, 2014a

b. Income and Employment

County	2012 Income [a]		Labor Force Annual Average 2013 [b]		
	Per Capita ($)	Percentage of State Average	Number of Workers	Number Employed	Unemployment Rate (%)
Doña Ana	19,517	82.2	92,830	85,859	7.5

[a] U.S. Census Bureau, 2014c

[b] New Mexico Department of Workforce Solutions, 2014

c. Business Environment

County	Industry	Number Employed	Number of Businesses
	2008-2012 [a]		*2012* [b]
Doña Ana	Education/Healthcare	27,395	3,567
	Retail trade	10,201	
	Arts, entertainment, recreation, accommodation	8,026	
	Professional, scientific, management	7,451	
	Construction	7,368	
	Government	5,649	

[a] U.S. Census Bureau, 2014b

[b] U.S. Census Bureau, 2014c

Table 3-1. Summary of Demographic and Economic Statistics for the Lower Rio Grande Water Planning Region
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d. Agriculture

County [a]	Farms / Ranches			Most Valuable Agricultural Commodities
	Number	Acreage		
		Total	Average	
Doña Ana	2,184	659,970	302	Milk from cows Fruits, tree nuts, berries Vegetables, melons Other crops and hay

[a] USDA NASS, 2014 (some sales data withheld to avoid disclosure for individual operations)

Table 5-1. Lower Rio Grande Climate Stations

Climate Stations [a]	Latitude	Longitude	Elevation	Precipitation		Temperature	
				Data Start	Data End	Data Start	Data End
Dona Ana County							
Afton 6 NE	32.12	–106.87	4,189	7/1/1942	5/31/1999	9/1/1987	9/30/1987
Garfield	32.75	–107.27	4,104	1/1/1920	6/30/1948	1/1/1920	9/30/1942
Hatch 2 W	32.67	–107.18	4,051	4/1/1894	4/30/2008	3/1/1894	4/30/2008
Jornada Exp Range	32.62	–106.74	4,266	6/1/1914	Present	6/1/1914	Present
Las Cruces	32.30	–106.77	—	11/1/1944	Present	11/1/1944	Present
State University [b]	32.28	–106.76	3,881	1/1/1892	Present	1/1/1892	Present

Source: WRCC, 2014 — = Information not available

[a] Stations in **bold** type were selected for detailed analysis.

[b] Station formerly called “Agricultural College” from 1892 to 1959.

Table 5-2. Temperature and Precipitation for Selected Climate Stations Lower Rio Grande Water Planning Region

Station Name	Precipitation (inches)				Temperature			
	Average Annual [a]	Minimum [b]	Maximum [b]	% of Possible Observations [c]	Average (°F) Annual [d]	Average (°F) Minimum [e]	Average (°F) Maximum [e]	% of Possible Observations [c]
Jornada Exp Range, NM	9.77	3.10	19.97	90.4	75.3	40.0	76.5	60.2
State University, NM	9.28	3.44	14.83	99.6	61.8	46.3	77.4	99.6

Source: Statistics computed by Western Regional Climate Center (2014)

ft amsl = Feet above mean sea level

°F = Degrees Fahrenheit

[a] Average of annual precipitation totals for the period of record at each station.

[b] Minimum and maximum recorded annual precipitation amounts for each station.

[c] Amount of completeness in the daily data set that was recorded at each station (e.g., 99% complete means there is a 1% data gap).

[d] Average of the daily average temperatures calculated for each station.

[e] Average of the daily minimum (or maximum) temperature recorded daily for each station.

Table 5-3. Palmer Drought Severity Index Classifications

PDSI Classification	Description
+ 4.00 or more	Extremely wet
+3.00 to +3.99	Very wet
+2.00 to +2.99	Moderately wet
+1.00 to +1.99	Slightly wet
+0.50 to +0.99	Incipient wet spell
+0.49 to –0.49	Near normal
–0.50 to –0.99	Incipient dry spell
–1.00 to –1.99	Mild drought
–2.00 to –2.99	Moderate drought
–3.00 to –3.99	Severe drought
–4.00 or less	Extreme drought

Table 5-4a. USGS Stream Gage Stations

USGS Station [a]							Period of Record	
Name [b]	Number	Latitude	Longitude	Elevation (ft amsl)	Drainage Area (sq mi)	Irrigated Upstream Land [c] (acres)	Start Date	End Date
Dona Ana County								
Las Cruces Arr near Las Cruces, NM	08363600	32.3153714	–106.750559	4,035	14	—	10/1/1958	9/30/1966
Tularosa Valley Tr near White Sands, NM	08486250	32.4031472	–106.479994	4,230	17	—	10/1/1965	6/30/1974
Tularosa Valley Tr at White Sands, NM	08486260	32.3681480	–106.479438	4,230	21	—	10/1/1965	6/30/1974
Selected Streams Outside of Region								
Rio Grande below Elephant Butte Dam, NM	08361000	33.1485111	–107.206783	4,241	29,450	800,000	10/1/1916	Present
Rio Grande below Caballo Dam, NM [d]	08362500	32.8849111	–107.292697	4,141	30,700	800,000	1/1/1938	Present
Rio Grande at Courchesne	—	31.802778 [e]	– 106.54000[e]	3,760 [e]	—	—	1/1/1889 [f]	Present

Source: USGS, 2014c (unless otherwise noted)

[a] Only those USGS stream gages with daily data are shown.
[b] **Bold** indicates gages in key locations selected for additional analysis.
[c] Source: Terracon et al., 2003; USGS, 2014a
[d] U.S. Bureau of Reclamation gaging station (data provided byUSGS [2014c]).
[e] Source: TCEQ, 2013
[f] Source: NMISC, 2016

USGS = U.S. Geological Survey
ft amsl = Feet above mean sea level
sq mi = Square miles
— = Data not available from current source(s).

Table 5-4b. USGS Stream Gage Annual Statistics for Stations with 10 or More Years of Record

USGS Station Name [a]	Annual Yield [b] (acre-feet)			Number of Years [c]
	Minimum	Median	Maximum	
Selected Streams Outside of Region				
Rio Grande below Elephant Butte Dam, NM	168,757	692,402	1,818,605	97
Rio Grande below Caballo Dam, NM [d]	205,534	651,606	1,395,808	46
Rio Grande at Courchesne, NM [e,f]	50,749	453,635	2,011,847	124

Source: USGS, 2014c

[a] Stations with complete years of data only
Bold indicates gages in key locations selected for additional analysis.
[b] Based on calendar years;
[c] Number of years used in calculation of annual yield statistics
[d] U.S. Bureau of Reclamation gaging station (data provided by USGS [2014c]).
[e] Data points from years 1894-1896 showed zero flow and were excluded from this analysis
[f] Source: NMISC, 2016

Table 5-5. USGS Stream Gage Average Monthly Streamflow for Stations with 10 or More Years of Record

USGS Station [a]	Complete Years [b]	Average Monthly Streamflow [c] (acre-feet)											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Selected Streams Outside of Region													
Rio Grande below Elephant Butte Dam, NM	97	17,962	38,488	71,919	89,739	95,111	108,679	105,489	84,591	45,436	19,671	13,366	16,448
Rio Grande below Caballo Dam, NM [d]	46	5,877	15,357	95,491	72,462	78,019	109,612	115,023	97,229	53,066	12,404	2,041	3,404

Source: USGS, 2014c

[a] **Bold** indicates gages in key locations selected for additional analysis.

[b] Monthly statistics are for complete months with locations where 10 or more years of complete data were available.

[c] Data from USGS monthly statistics averaged over the entire period of record, converted to acre-feet (from cubic feet per second) and rounded to the nearest acre-foot.

[d] U.S. Bureau of Reclamation gaging station (data provided by USGS [2014c]).

USGS = U.S. Geological Survey

Table 5-6. Reservoirs and Lakes (greater than 5,000 acre-feet) Supplying the Lower Rio Grande Water Planning Region

River	Reservoir [a]	Primary Purpose	Operator	Date Completed	Total Storage Capacity (acre-feet)	Surface Area (acres)	Dam Height (feet)	Dam Length (feet)
Sierra County								
Rio Grande	Elephant Butte Reservoir	Conservation storage (irrigation)	Bureau of Reclamation	1915	2,024,586	36,643	301	1,674
	Caballo Reservoir	Re-regulation for irrigation	Bureau of Reclamation	1937	324,934	9,353	96	4,558

Source: USBR, 2012

[a] Reservoirs are upstream of Lower Rio Grande region, but are included because of their relevance to the region.

Table 5-7. Dams with Dam Safety Deficiency Rankings
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Dam	Condition Assessment [a]	Deficiency	Hazard Potential [b]	Estimated Cost to Repair ($)
Doña Ana County				
Anthony Arroyo Dam No. 1	Poor	Spillway capacity 88% of required flood Severe erosion on embankment Lack of design information	High	100,000
Apache Brazito Mesquite Dam No. 1	Poor	Spillway capacity 50% of required flood Severe erosion on embankment Lack of design information	High	2,500,000
Apache Brazito Mesquite Dam No. 2	Poor	Spillway capacity 64% of required flood Erosion of spillway slopes Lack of design information	High	2,500,000
Apache Brazito Mesquite Dam No. 3	Poor	Spillway capacity ~43% of required flood Erosion of slopes Lack of design information	High	2,500,000
Apache Brazito Mesquite Dam No. 4	Poor	Erosion of slopes Lack of design information	High	2,500,000
Apodaca Arroyo Dam	Poor	Spillway capacity 50% of required flood Maintenance needed Severe erosion	Significant	2,500,000
Breedlove Flood Control Dam	Poor	Lack of design information	High	100,000
Caballo Arroyo Dam No. 2	Poor	Spillway capacity 82% of required flood Partially plugged outlet Lack of design information	High	100,000
Caballo Arroyo Dam No. 3	Poor	Spillway capacity 60% of required flood Lack of design information	High	2,500,000
Caballo Arroyo Dam No. 4	Poor	Spillway capacity 48% of required flood Cracks on dam crest Lack of design information	Significant	2,500,000
Caballo Arroyo Dam No. 5	Poor	Spillway capacity 58% of required flood Lack of design information	Significant	2,500,000
Crow Broad Placitas Dam No. 1	Poor	Spillway capacity 35% of required flood Lack of design information	High	2,500,000
Crow Broad Placitas Dam No. 2A	Poor	Spillway capacity ~20% of required flood Lack of design information	High	2,500,000

Source: NMOSE, 2014b

[a] Assessment criteria are attached at the end of this table.
[b] Hazard potential classifications are attached at the end of this table.

PMP = Probable maximum precipitation

Table 5-7. Dams with Dam Safety Deficiency Rankings
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Dam	Condition Assessment [a]	Deficiency	Hazard Potential [b]	Estimated Cost to Repair ($)
Dona Ana Site 1	Fair	Spillway capacity 72% of required flood Portion of downstream toe removed Homes in flood pool	High	150,000
Fillmore Site 1 Dam	Poor	Spillway capacity 20% of required flood Erosion Conduit joints	High	2,500,000
Fillmore Site 2 Dam	Poor	Spillway capacity 48% of required flood Lack of design information	Significant	2,500,000
Fillmore Site 3 Dam	Poor	Spillway capacity 64% of required flood Lack of design information	Significant	2,500,000
Gardner Dam	Unsatisfactory	No spillway or outlet Severe erosion Woody vegetation Excessive seepage	High	2,500,000
Hatch Valley Arroyo Dam No. 1	Poor	Spillway capacity ~75% of required flood Lack of design info	High	200,000
Hatch Valley Arroyo Dam No. 2	Poor	Spillway capacity 45% of required flood Lack of design information	High	2,500,000
Hatch Valley Arroyo Dam No. 6	Poor	Spillway capacity 85% of required flood Lack of design info	High	150,000
Hatch Valley Arroyos Dam No. 3	Poor	Spillway capacity ~80% of required flood Lack of design information	High	
Hatch Valley Arroyos Dam No. 4	Poor	Lack of design information	High	100,000
Hatch Valley Arroyos Dam No. 5	Poor	Lack of design information	High	100,000
Kight Flood Retard Dam	Poor	Lack of design information Inoperable outlet gate	High	200,000
Lauson Arroyo Flood Detention Dam	Poor	Lack of design information	High	200,000
Leasburg Arroyo Dam	Poor	Lack of design information	Significant	200,000
Lucero Detention Dike	Poor	Spillway capacity 20% of required flood Maintenance needed	High	2,500,000

Source: NMOSE, 2014b

[a] Assessment criteria are attached at the end of this table.
[b] Hazard potential classifications are attached at the end of this table.

PMP = Probable maximum precipitation

Table 5-7. Dams with Dam Safety Deficiency Rankings
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Dam	Condition Assessment [a]	Deficiency	Hazard Potential [b]	Estimated Cost to Repair ($)
McClernon Dam	Poor	No maintenance Spillway headcut Woody vegetation Scour near outlet	Low	500,000
McLead Flood Control Dam	Poor	Spillway capacity ~15% of required flood Maintenance needed Lack of design information	Significant	3,000,000
North Fork Dam	Poor	Maintenance needed Woody vegetation Potential sediment in outlet Lack of design information	Low	2,500,000
Picacho North Dam	Poor	Spillway capacity 18% of required flood Poor intake design Erosion Lack of design information	High	2,500,000
Picacho South Dam	Poor	Spillway capacity 5% of required flood Poor intake design Erosion Lack of design information	High	2,500,000
Porter Whisenhunt Dam	Poor	Severe headcut on downstream slope Susceptible to breach	Significant	200,000
Rhodes Arroyo Retard Dam	Poor	Maintenance needed Lack of design information	Significant	200,000
Sand Hill Arroyo Dam	Poor	Spillway capacity ~65% of COE envelope curve PMF Lack of design information	High	2,500,000
South Fork Dam	Poor	Maintenance needed Outlet headcut Clogged inlet Lack of design information	Low	2,500,000
Spring Canyon Dam	Poor	Spillway capacity 83% of required flood Lack of design information	High	200,000
Tortugas Site 1 Dam	Poor	Severe erosion Woody vegetation Lack of design information	High	50,000
Tortugas Site 2 Dam	Poor	Lack of design information	High	100,000

Source: NMOSE, 2014b

[a] Assessment criteria are attached at the end of this table.

[b] Hazard potential classifications are attached at the end of this table.

PMP = Probable maximum precipitation

Table 5-7. Dams with Dam Safety Deficiency Rankings
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[a] Condition assessment:

	2008 US Army Corps of Engineers Criteria (adopted by NM OSE in FY09)	*NMOSE Spillway Risk Guidelines*
Fair:	No existing dam safety deficiencies are recognized for normal loading conditions. Rare or extreme hydrologic and/or seismic events may result in a dam safety deficiency. Risk may be in the range [for the owner] to take further action.	Spillway capacity < 70% but ≥ 25% of the SDF.
Poor:	A dam safety deficiency is recognized for loading conditions, which may realistically occur. Remedial action is necessary. A poor condition is also used when uncertainties exist as to critical analysis parameters, which identify a potential dam safety deficiency. Further investigations and studies are necessary.	Spillway capacity < 25% of the SDF.
Unsatisfactory:	A dam safety deficiency is recognized that requires immediate or emergency remedial action for problem resolution.	

[b] Hazard Potential Classifications:

High: Dams where failure or mis-operation would likely result in loss of human life.

Significant: Dams where failure or mis-operation would likely not result in loss of human life but could cause economic loss, environmental damage, disruption of lifeline facilities, or could impact other concerns. Significant hazard potential classification dams are often located in predominantly rural or agricultural areas but may be located in populated areas with significant infrastructure.

Low: Dams where failure or mis-operation would likely not result in loss of life but may result in minimal economic or environmental losses. Losses would be principally limited to the dam owner's property

Table 5-8. Total Maximum Daily Load Status of Streams in the Lower Rio Grande Water Planning Region

Waterbody Name (basin, segment)	Assessment Unit ID	Affected Reach (miles [a])	Probable Sources of Pollutant	Uses Not Fully Supported [b]	Specific Pollutant	IR Category [c]
Doña Ana County						
Burn Lake (Dona Ana)	NM-9000.B_024	7 [d]	Source unknown	WWAL	Aluminum	5/5A
Davies Tank	NM-9000.B_034	1280 [d]	Not assessed	—	—	3/3A
Lake Lucero (North)	NM-9000.B_068	3420.7 [d]	Not assessed	—	—	3/3A
Lake Lucero (South)	NM-9000.B_069	1988.27 [d]	Not assessed	—	—	3/3A
Rio Grande (Anthony Bridge to NM192 bridge W of Mesquite)	NM-2101_01	13.32	Municipal point source discharges Waterfowl On-site treatment systems (septic) Confined animal feeding operations (CAFOs) Wildlife other than waterfowl Wastes from pets Municipal (high density area) Impervious surface/parking lot runoff Rangeland grazing	PC	Escherichia coli	4A
Rio Grande (International Mexico bnd to Anthony Bridge)	NM-2101_00	8.71	Municipal point source discharges Waterfowl On-site treatment systems (septic) Source unknown Confined animal feeding operations (CAFOs) Wildlife other than waterfowl Wastes from pets Municipal (high density area) Impervious surface/parking lot runoff Rangeland grazing	PC IRR	Boron Escherichia coli	5/5A

Source: NMED, 2014a

[a] Unless otherwise noted.

[b] PC = Primary contact
IRR = Irrigation
WWAL = Warm water aquatic life

[c] Impairment (IR) category definitions are provided at the end of this table.

[d] Acres

— = No information provided (reach was not assessed).

Table 5-8. Total Maximum Daily Load Status of Streams in the Lower Rio Grande Water Planning Region
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Waterbody Name (basin, segment)	Assessment Unit ID	Affected Reach (miles [a])	Probable Sources of Pollutant	Uses Not Fully Supported [b]	Specific Pollutant	IR Category [c]
Rio Grande (Leasburg Dam to one mile below Percha Dam)	NM-2101_10	42.22	Municipal point source discharges Waterfowl On-site treatment systems (septic) Confined animal feeding operations (CAFOs) Wildlife other than waterfowl Wastes from pets Impervious surface/parking lot runoff Rangeland grazing	PC	Escherichia coli	4A
South Fork Las Cruces Arroyo (Las Cruces Arroyo to hwtrs)	NM-98.A_013	6.5	Not assessed	—	—	3/3A

Source: NMED, 2014a

[a] Unless otherwise noted.

— = No information provided (reach was not assessed).

[b] PC = Primary contact
IRR = Irrigation
WWAL = Warm water aquatic life

[c] Impairment (IR) categories are determined for each assessment unit (AU) by combining individual designated use support decisions. The applicable unique assessment categories for New Mexico (NMED, 2013b) are described as follows:

Category 3: No reliable monitored data and/or information to determine if any designated or existing use is attained. AUs are listed in this category where data to support an attainment determination for any use are not available, consistent with requirements of the assessment and listing methodology.

Category 3A:

Category 4A: Impaired for one or more designated uses, but does not require development of a TMDL because TMDL has been completed. AUs are listed in this subcategory once all TMDL(s) have been developed and approved by USEPA that, when implemented, are expected to result in full attainment of the standard. Where more than one pollutant is associated with the impairment of an AU, the AU remains in IR Category 5A (see below) until all TMDLs for each pollutant have been completed and approved by USEPA.

Category 5A: Impaired for one or more designated or existing uses and a TMDL is underway or scheduled. AUs are listed in this category if the AU is impaired for one or more designated uses by a pollutant. Where more than one pollutant is associated with the impairment of a single AU the AU remains in Category 5A until TMDLs for all pollutants have been completed and approved by U.S. EPA.

Table 5-9. Municipal and Industrial NPDES Permittees in the Lower Rio Grande Water Planning Region

Permit No	Municipality/Industry [a]	Permit Type
Dona Ana County		
NM0029629	Anthony Water And Sanitation District/WWTP [b]	Municipal (POTW)
NM0029483	CRRUA -Sunland Park WWTP	Municipal (POTW)
NM0030457	Dona Ana County Salem WWTP [b]	Municipal (POTW)
NM0030490	Dona Ana County South Central Regional WWTP	Municipal (POTW)
NM0000108	El Paso Electric Company [c]	Utility
NM0028487	Gadsden Independent School District	Private domestic
NM0020010	Hatch, Village of/WWTP	Municipal (POTW)
NM0030872	Las Cruces, City of/East Mesa Water Reclamation Facility [b]	Municipal (POTW)
NM0023311	Las Cruces, City of/Jacob Hands WWTP [b]	Municipal (POTW)

Source: NMED, 2014d

[a] Names appear as listed in the NMED database.

[b] Major discharger, classified as such by the Regional Administrator, or in the case of approved state programs, the Regional Administrator in conjunction with the State Director. Major municipal dischargers include all facilities with design flows of greater than 1 million gallons per day and facilities with U.S. EPA/State approved industrial pretreatment programs. Major industrial facilities are determined based on specific ratings criteria developed by U.S. EPA/State.

[c] NMED lists multiple outfall locations

NPDES = National Pollutant Discharge and Elimination System
WWTP = Wastewater treatment plant
POTW = Publicly owned treatment works

Table 5-10. Groundwater Discharge Permits in the Lower Rio Grande Water Planning Region
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County	Facility Name [a]	Permit No.	Status	Permitted Discharge Amount (gpd)
Dona Ana	Admiral Beverage Industrial Park	DP-38	Active	10,000
	Adobe Acres North Mobile Home Park	DP-6	Active	5,250
	Afton Generating Station	DP-1345	Active	79,200
	Aldershot of New Mexico	DP-807	Active	25,000
	Alex R Masson Inc	DP-500	Active	39,000
	Anthony Water and Sanitation District	DP-450	Active	980,000
	Biad Chili LTD Co - Mesilla	DP-671	Active	90,000
	Biad Chili LTD Co.-Leasburg	DP-423	Active	90,000
	Big Sky Dairy	DP-833	Active	80,000
	Border Foods	DP-436	Active	860,000
	Bright Star Dairy	DP-340	Active	60,000
	Buena Vista 2	DP-74	Active	55,000
	Casa de Oro Care Center	DP-247	Active	16,875
	Casuco	DP-1392	Active	1,000
	Centennial High School	DP-1819	Pending	150,000
	Cervantes Enterprises Inc	DP-1152	Active	9,123
	Chaparral Wastewater Treatment Plant	DP-1602	Active	750,000
	Cottonbloom Adult Living Facility	DP-1124	Active	5,000
	Del Norte Dairy	DP-126	Active	40,000
	Del Oro Dairy	DP-692	Active	20,000
	Desert Hills Mobile Home Park	DP-303	Active	7,200

Source: NMED, 2014b gpd = Gallons per day
[a] Names appear as listed in the NMED database.

Table 5-10. Groundwater Discharge Permits in the Lower Rio Grande Water Planning Region

County	Facility Name [a]	Permit No.	Status	Permitted Discharge Amount (gpd)
Dona Ana (cont.)	Dominguez Dairy	DP-624	Active	33,200
	Dominguez Dairy #2	DP-42	Active	60,000
	Dona Ana (County of) - Las Cruces Animal Shelter	DP-678	Active	2,300
	Dona Ana County Airport	DP-1637	Pending	
	Dona Ana County Fairgrounds	DP-1687	Active	3,300
	Dona Ana Elementary School	DP-1137	Active	9,436
	Dos Lagos Golf Course	DP-1823	Pending	400,000
	East Picacho Elementary School	DP-293	Active	15,000
	Escalera Mobile Home Park	DP-1588	Pending	
	F and A Dairy Products	DP-1008	Active	400,000
	HORVAC Environmental	DP-1355	Active	175,000
	Johnny's Septage Disposal Facility	DP-1762	Active	10,000
	Johnson's Mobile Home Park	DP-682	Active	12,500
	Johnson's Mobile Home Park	DP-1427	Pending	
	Kit Carson Farms, Inc.	DP-471	Active	35,000
	Las Cruces (City of) - East Mesa Water Reclamation Facility	DP-1536	Active	1,400,000
	Las Cruces (City Of) - International Airport	DP-1652	Active	6,015
	Las Cruces (City of) - West Mesa Industrial Park Wastewater Treatment Facility	DP-1174	Active	400,000
	Las Cruces KOA Campground	DP-634	Active	4,000
	Las Cruces National Guard Armory	DP-1431	Active	3,054

Source: NMED, 2014b

gpd = Gallons per day

[a] Names appear as listed in the NMED database.

Table 5-10. Groundwater Discharge Permits in the Lower Rio Grande Water Planning Region

County	Facility Name [a]	Permit No.	Status	Permitted Discharge Amount (gpd)
Dona Ana (cont.)	Las Uvas Valley Dairies	DP-967	Active	108,000
	Las Uvas Valley Dairies	DP-342	Active	265,000
	Lou's Mobile Home Park	DP-1663	Active	4,500
	Masson's Southwest Greenhouse	DP-930	Active	4,000
	Mcanally Enterprises Inc	DP-1140	Active	2,500
	Mesa Development Center	DP-957	Active	2,500
	Lower Rio Grande Public Water Works Authority-Mesquite Wastewater Treatment Facility	DP-1036	Active	88,000
	Miller Mobile Manor	DP-754	Active	15,000
	Mini-mobile Village	DP-961	Active	4,500
	Mountain View Dairy	DP-70	Active	60,000
	NASA - White Sands Test Facility	DP-697	Active	25,000
	NASA - White Sands Test Facility	DP-1255	Active	1,872,000
	NASA - White Sands Test Facility	DP-1170	Active	16,805
	NASA - White Sands Test Facility	DP-392	Active	33,360
	NASA - White Sands Test Facility	DP-584	Active	8,000
	Organ Water and Sewer Association	DP-915	Active	31,500
	Patricio Tellez Trailer Park	DP-479	Active	2,200
	Picacho Hills Utility Company	DP-47	Active	150,000
	Rezolex Ltd Co	DP-832	Active	5,000
	Rincon Wastewater Treatment Plant	DP-1209	Active	33,000

Source: NMED, 2014b

gpd = Gallons per day

[a] Names appear as listed in the NMED database.

Table 5-10. Groundwater Discharge Permits in the Lower Rio Grande Water Planning Region
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County	Facility Name [a]	Permit No.	Status	Permitted Discharge Amount (gpd)
Dona Ana (cont.)	River Oaks Mobile Home Park	DP-1721	Active	4,082
	River Valley Dairy	DP-167	Active	35,000
	R-Qubed Energy, Inc.	DP-86	Active	60,000
	San Mateo Enterprises	DP-1525	Active	7,000
	Santa Teresa Wastewater Treatment Plant	DP-1076	Active	532,500
	Sapphire Energy - NM R&D Facility	DP-1718	Active	405,000
	Sonoma Ranch Golf Course	DP-1735	Active	950,000
	St John Mobile Home Park	DP-1015	Active	11,340
	Summerwind Associates MHP LLC	DP-504	Active	49,500
	Sun Valley Dairy LLC	DP-170	Active	35,000
	Sunset Dairy	DP-257	Active	45,000
	Tallmon Dairy	DP-1208	Active	16,945
	Tellbrook Subdivision Wastewater System	DP-203	Active	4,650
	Tellbrook/Las Alturas Convenience Store	DP-1470	Active	2,020
	The Lords Ranch	DP-1619	Active	9,880
	Tyson Prepared Foods	DP-1438	Active	21,000
	Vado Travel City	DP-9	Active	4,500
	Vegetable Products Inc	DP-495	Active	57,000
	Villa del Sol Mobile Home Park	DP-1083	Active	50,000
	Vista Middle School	DP-430	Active	4,400
	Vista Real Mobile Home Park	DP-1298	Active	11,640

Source: NMED, 2014b

gpd = Gallons per day

[a] Names appear as listed in the NMED database.

Table 5-10. Groundwater Discharge Permits in the Lower Rio Grande Water Planning Region
Page 5 of 5

County	Facility Name [a]	Permit No.	Status	Permitted Discharge Amount (gpd)
Dona Ana (cont.)	Watson Lane Mobile Home Park	DP-1678	Active	24,000
	West Mesa/Santa Teresa Area	DP-1281	Active	300,000
	Western Skies RV Park	DP-45	Active	8,000
	White Sands Missile Range	DP-976	Active	630,000
	Young Guns Inc	DP-1810	Pending	68,000

Source: NMED, 2014b gpd = Gallons per day
[a] Names appear as listed in the NMED database.

Table 5-11. Superfund Sites in the Lower Rio Grande Water Planning Region

Site Location	Site Name [a]	Site ID	EPA ID	Status [b]
Dona Ana County				
Las Cruces, NM	Griggs & Walnut Groundwater Plume	605116	NM0002271286	NPL

Source: U.S. EPA, 2014a
NMED, 2014f

[a] Names appear as listed in the NMED database.
[b] NPL = National Priorities List

Table 5-12. Leaking Underground Storage Tank Sites in the Lower Rio Grande Water Planning Region

City [a]	Release/Facility Name [b,c]	Release ID	Facility ID	Physical Address [c]	Status [d]
Dona Ana County					
Garfield	Pat Crisouthwestell Store	3720	29865	8980 Hwy 187	Cleanup, Responsible Party
Hatch	Halsell's Groc	287	6053	112 School Street	Cleanup, State Lead With CAF
	Hatch Exxon (B&M)	430	28485	481 W Hall St	Cleanup, State Lead With CAF
	Hatch Valley Public School	3405	28489	407 A North Main Street	Cleanup, Responsible Party
	Pic Quik #234	2627	1647	205 North Franklin Street	Pre-Investigation, Suspected Release
	Sharp Hatch Bulk Plant	4044	52267	Clinic St	Cleanup, Responsible Party
Fairacres	Former Fairacres Post Office	3997	27959	3940 W Picacho Ave	Cleanup, Responsible Party
	Lovelace Property	3506	29164	4050 W Picacho	Aggr Cleanup Completed, Resp Party
	NM 1310 Fairacres Co	4679	1227	20000 Corralitos Rd	Pre-Investigation, Confirmed Release
White Sands Missile Range	HELSTF	904	28500	Environmental Office B 26145	Referred To Hazardous Waste Bureau
	NASA Radar Site	2684	31715	Unknown	Referred To Hazardous Waste Bureau
	Timing Station	2624	31380	R5ET 225 511 QSE	Investigation Federal Facility
	WSMR Bldg 270-2	3684	31696	Stews El N	Investigation Federal Facility
Las Cruces	All About Cars	1665	26475	1695 W Picacho	Investigation, Responsible Party
	Bar F 20/Earls Buy N Fly B	417	27611	901 S Valley Dr	Cleanup, Responsible Party
	Bradley Food Mart	3155	27040	1206 El Paseo Rd	Aggr Cleanup Completed, Resp Party

Source: NMED, 2014e

[a] Determined according to latitude/longitude information in NMED database. In some cases this information was inconsistent with the facility address, and where such an inconsistency was identified, county and city were instead determined based on the facility address.

[b] Sites with No Further Action status (release considered mitigated) are not included. Information regarding such sites can be found on the NMED website (http://www.nmenv.state.nm.us/ust/lists.html

[c] Information appears as listed in the NMED database.

[d] Pre-Investigation, Suspected Release: Release not confirmed by definition
Pre-Investigation, Confirmed Release: Confirmed release as by definition
Investigation: Ongoing assessment of environmental impact
Cleanup: Physical removal of contamination ongoing
CAF: Corrective action fund
Aggressive Cleanup Completed (Aggr Cleanup Completed): Effective removal of contamination complete
Responsible Party (Resp Party): Owner/Operator responsible for mitigation of release
State Lead: State has assumed responsibility for mitigation of release
Federal Facility: Responsibility under the Federal Govt

Table 5-12. Leaking Underground Storage Tank Sites in the Lower Rio Grande Water Planning Region

City [a]	Release/Facility Name [b,c]	Release ID	Facility ID	Physical Address [c]	Status [d]
Dona Ana County (cont.)					
Las Cruces (cont.)	Chucky's Gas For Less Food Mart, Quik Chek	3128	30095	161 E Madrid	Investigation, Responsible Party
	Dona Ana Cty Trans Dept	2685	27759	2025 E Griggs Ave	Cleanup, Responsible Party
	Fenns Mini Mart	4048	29862	3985 South Main Street	Cleanup, Responsible Party
	Food And Fuel Stores , Midtown Chevron	3515	28069	750 S Main	Cleanup, Responsible Party
	Gene Peugh (Aamco)	2709	29944	1885 W Picacho	Referred To Hazardous Waste Bureau
	Guacamole Cafe	4461	53744	Unknown	Cleanup, Responsible Party
	Highway Texaco	976	28537	400 S Valley Dr	Aggr Cleanup Completed, Resp Party
	Johnson Park	2579	28783	888 N Main	Cleanup, State Lead With CAF
	Lantern Texaco	841	31083	1311 Avenida De Mesilla	Aggr Cleanup Completed, Resp Party
	Las Cruces Travel Center, Truckstps of Am	40	31213	202 N Motel Blvd	Cleanup, Responsible Party
	Lohman Food Mart, Shell	3513	29123	926 E Lohman	Cleanup, Responsible Party
	Pic Quick 1135	4431	1641	3916 W Picacho	Investigation, Responsible Party
	Pic Quik Stores Inc No 21, Pic Quik 1121	3036	1639	1250 N Valley Dr	Cleanup, Responsible Party

Source: NMED, 2014e

[a] Determined according to latitude/longitude information in NMED database. In some cases this information was inconsistent with the facility address, and where such an inconsistency was identified, county and city were instead determined based on the facility address.

[b] Sites with No Further Action status (release considered mitigated) are not included. Information regarding such sites can be found on the NMED website (http://www.nmenv.state.nm.us/ust/lists.html

[c] Information appears as listed in the NMED database.

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Table 5-12. Leaking Underground Storage Tank Sites in the Lower Rio Grande Water Planning Region

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City [a]	Release/Facility Name [b,c]	Release ID	Facility ID	Physical Address [c]	Status [d]
Dona Ana County (cont.)					
Las Cruces (cont.)	Picacho Shell	2669	1651	1196 W Picacho	Cleanup, Responsible Party
	Pilot Oil / Travel Center 266	4074	29969	2681 W Amador	Pre-Investigation, Confirmed Release
	Porter Oil, Inc.	4656	30037	306 S Motel Blvd	Pre-Investigation, Confirmed Release
	Porter Oil, Inc.	258	30037	306 S Motel Blvd	Pre-Investigation, Confirmed Release
	QVS Mobile Homes	2779	30108	1600 W Picacho	Aggr Cleanup Completed, Resp Party
	R C Sanders Trucking	2782	30116	1880 W Picacho	Cleanup, Responsible Party
	Sanco Oil Co, Sierra Ice & Water	1185	30604	2855 B West Picacho Ave	Cleanup, Responsible Party
	Sandia Fina	4036	30429	1802 S Espina	Cleanup, Responsible Party
	Sav-O-Mat B	2135	30492	920 El Paseo Rd	Pre-Investigation, Suspected Release
	Sav-O-Mat B	4474	30492	920 El Paseo Rd	Cleanup, Responsible Party
	Sav-O-Mat B	4596	30492	920 El Paseo Rd	Pre-Investigation, Confirmed Release
	Scotts Auto Sales	2675	30518	1835 N Main	Cleanup, Responsible Party
	Silva Sanitation	4661	30611	County B-53	Pre-Investigation, Confirmed Release
	Speedys 121, North Main Self Serve	2662	30717	1875 N Main	Cleanup, Responsible Party
	Southwest Indulgence Cafe	4099	53502	1701 El Paseo Road	Investigation, Responsible Party
	University Chevron	3234	1974	1600 S Solano	Pre-Investigation, Confirmed Release
	Valley Pic Quik	3481	29963	3810 Valley Dr	Cleanup, State Lead With CAF

Source: NMED, 2014e

[a] Determined according to latitude/longitude information in NMED database. In some cases this information was inconsistent with the facility address, and where such an inconsistency was identified, county and city were instead determined based on the facility address.

[b] Sites with No Further Action status (release considered mitigated) are not included. Information regarding such sites can be found on the NMED website (http://www.nmenv.state.nm.us/ust/lists.html

[c] Information appears as listed in the NMED database.

[d] Pre-Investigation, Suspected Release: Release not confirmed by definition
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Federal Facility: Responsibility under the Federal Govt

Table 5-12. Leaking Underground Storage Tank Sites in the Lower Rio Grande Water Planning Region

City [a]	Release/Facility Name [b,c]	Release ID	Facility ID	Physical Address [c]	Status [d]
Dona Ana County (cont.)					
Mesilla	Alvarez Garage	3836	26555	Hwy 292	Cleanup, Responsible Party
	Shorty's of Mesilla, Mesilla 66	3102	29390	2920 S NM 28	Cleanup, Responsible Party
San Miguel	City Market, Eg Borunda	339	27395	19116 South Highway 28	Cleanup, State Lead With CAF
La Mesa	Eagle Grocery	4684	28997	108 Corpening Street	Cleanup, Responsible Party
	Eagle Grocery	2419	28997	108 Corpening Street	Pre-Investigation, Confirmed Release
	La Mesa Chevron	934	28996	16205 & Hwy 28	Cleanup, Responsible Party
	La Mesa Mercantile	2173	28997	108 Corpening Street	Pre-Investigation, Confirmed Release
Mesquite	Hwy 478 and Hannah Ct	4665	54778	12600 Highway 478	Pre-Investigation, Confirmed Release
Vado	Chrome Outlet dba National Truck Stop	4457	29572	16320 Stern Dr	Aggr Cleanup Completed, Resp Party
	National Truck	947	29572	16320 Stern Dr	Cleanup, Responsible Party
Berino	Berino Mini Mart, Four D Country Stores	3161	28146	4500 Hwy 478	Aggr Cleanup Completed, Resp Party
Chaparral	Dona Ana Range, Base Camp	1549	27760	Building 8170	Investigation Federal Facility
Anthony	Boone Transportation	3691	27008	2102 W Washington	Cleanup, Responsible Party
	Boone Transportation	4436	27008	2102 W Washington	Cleanup, Responsible Party
	Border Cowboy Trkstp	2528	27012	20201 Las Alturas	Cleanup, Responsible Party

Source: NMED, 2014e

[a] Determined according to latitude/longitude information in NMED database. In some cases this information was inconsistent with the facility address, and where such an inconsistency was identified, county and city were instead determined based on the facility address.

[b] Sites with No Further Action status (release considered mitigated) are not included. Information regarding such sites can be found on the NMED website (http://www.nmenv.state.nm.us/ust/lists.html

[c] Information appears as listed in the NMED database.

[d] Pre-Investigation, Suspected Release: Release not confirmed by definition
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Responsible Party (Resp Party): Owner/Operator responsible for mitigation of release
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Federal Facility: Responsibility under the Federal Govt

Table 5-12. Leaking Underground Storage Tank Sites in the Lower Rio Grande Water Planning Region
Page 5 of 5

City [a]	Release/Facility Name [b,c]	Release ID	Facility ID	Physical Address [c]	Status [d]
Dona Ana County (cont.)					
Anthony (cont.)	Gadsden Independent School District	4645	54702	1325 W Washington Street	Investigation, Responsible Party
Santa Teresa	Charter Hospital of Santa Teresa	3382	27314	100 Charter Lane	Referred To Ground Water Quality Bureau

Source: NMED, 2014e

[a] Determined according to latitude/longitude information in NMED database. In some cases this information was inconsistent with the facility address, and where such an inconsistency was identified, county and city were instead determined based on the facility address.

[b] Sites with No Further Action status (release considered mitigated) are not included. Information regarding such sites can be found on the NMED website (http://www.nmenv.state.nm.us/ust/lists.html

[c] Information appears as listed in the NMED database.

[d] Pre-Investigation, Suspected Release: Release not confirmed by definition
Pre-Investigation, Confirmed Release: Confirmed release as by definition
Investigation: Ongoing assessment of environmental impact
Cleanup: Physical removal of contamination ongoing
CAF: Corrective action fund
Aggressive Cleanup Completed (Aggr Cleanup Completed): Effective removal of contamination complete
Responsible Party (Resp Party): Owner/Operator responsible for mitigation of release
State Lead: State has assumed responsibility for mitigation of release
Federal Facility: Responsibility under the Federal Govt

Table 5-13. Landfills in the Lower Rio Grande Water Planning Region

County	Landfill Name [a]	Landfill Operating Status	Landfill Closure Date
Doña Ana	Camino Real Environmental Center	Open	NA
	Chaparral	Closed	—
	Corralitos Regional Landfill	Open	NA
	Hatch Landfill	Closed	—
	Las Cruces Foothills Landfill	Closed	—
	New Mexico State University	Closed	—
	Nu-Mex Landfill-Camino Real Investment, Camino Real environmental Landfill [b]	Closed	—
	White Sands (Main Post)	Open	NA
	White Sand Missile Range	Closed	—

Sources: Terracon et al., 2003; NMED, 2000, 2013a, 2014c

[a] Names appear as listed in the NMED database.

[b] USA.com, 2014

NA = Not applicable

— = Information not available

Table 5-14. Projected Groundwater Supply in Closed Basins within Doña Ana County in 2060, Based on Observed Rate of Decline

Row	Calculation Step	Underground Water Basin						Explanation/Source
		Mimbres	Nutt-Hockett	Jornada del Muerto [a]	Tularosa	Hueco	Mount Riley	
1	Estimated ground-water diversions in 2010 (ac-ft/yr)	1,433	1,100	13,535	1,544	3,961	0	Longworth et al., 2013
2	Median water column (feet)	87	140	194	292	365	510	Difference between water level at the top of the well and total depth of the well, based on 1 well in the Mimbres, 4 wells in the Nutt-Hockett, 31 wells in the Jornada del Muerto, 11 wells in the Tularosa, 16 wells in the Hueco, and 2 wells in the Mount Riley UWBs from WATERS database with post-1997 water level
3	Available water column	61	98	136	204	255	357	NMISC Handbook (2013) guideline (70% of median water column)
4	Rate of water level decline (ft/yr)	0.20	3.00	2.74	0.50	1.09	0.31	Using the water level data for USGS monitor wells within the non-stream-connected groundwater basin with decreasing water levels (Figure 5-11), the change in water level from the 1980s to the most recent measurement date was calculated and divided by the elapsed time. The results were averaged to determine a single rate.

[a] Jornado Draw portion of Lower Rio Grande Underground Water Basin

ac-ft/yr = Acre-feet per year
UWB = Underground Water Basin

Table 5-14. Projected Groundwater Supply in Closed Basins within Doña Ana County in 2060, Based on Observed Rate of Decline
Page 2 of 2

Row	Calculation Step	Underground Water Basin						Explanation/Source
		Mimbres	Nutt-Hockett	Jornada del Muerto [a]	Tularosa	Hueco	Mount Riley	
5	Estimated decline in 50 years (feet)	9.80	150	137	25	55	15	The average rate of water level decline was multiplied by 50 years to predict the average drawdown by 2060.
6	Percentage of wells impacted	8%	76%	50%	6%	12%	2%	Row 5 divided by Row 3 and multiplied by 50%
7	Groundwater supply from mined sub-basins in 2060 (ac-ft/yr)	1,318	259	6,717	1,450	3,488	0	Row 1 reduced by Row 6

[a] Jornado Draw portion of Lower Rio Grande Underground Water Basin

ac-ft/yr = Acre-feet per year
UWB = Underground Water Basin

Table 5-15. Projected Drought Groundwater Supply in the Closed Basins of the Lower Rio GrandeWater Planning Region in 2060

Row	Calculation Step	Underground Water Basin						Explanation/Source
		Mimbres	Nutt-Hockett	Jornada del Muerto [a]	Tularos a	Hueco	Mount Riley	
1	Estimated groundwater diversions in 2010 (ac-ft/yr)	1,433	1,100	13,535	1,544	3,961	0	Longworth et al., 2013
2	Reduction in supply due to drought	12%	12%	12%	12%	12%	12%	Average impact estimated from OSE models
3	Revised supply by 2060 with 20-year drought (ac-ft/yr)	1,143	125	5,063	1,261	3,004	0	Row 7 of Table 14 reduced by the product of Row 1 and Row 2.

[a] Jornado Draw portion of Lower Rio Grande Underground Water Basin

ac-ft/yr = Acre-feet per year
UWB = Underground Water Basin

Table 6-1. Total Diversions in the Lower Rio Grande Water Planning Region in 2010

Water Use Category	Diversions (acre-feet)		
	Surface Water	Groundwater	Total
Commercial (self-supplied)	0	7,875	7,875
Domestic (self-supplied)	0	653	653
Industrial (self-supplied)	0	120	120
Irrigated agriculture	271,569	121,911	393,480
Livestock (self-supplied)	148	4,245	4,393
Mining (self-supplied)	0	74	74
Power (self-supplied)	0	1,966	1,966
Public water supply	0	41,434	41,434
Reservoir evaporation	0	0	0
Total	271,717	178,279	449,996

Source: Longworth et al., 2013

Table 6-2. Comparison of Projected and Actual 2010 Population

County	2003 Regional Water Plan [a]			2010 U.S. Census [b]
	High	Medium	Low	
Doña Ana	266,252	243,425	220,692	209,233
Total Region	266,252	243,425	220,692	209,233

[a] Terracon et al, 2003

[b] U.S. Census Bureau, 2014a

Table 6-3. Lower Rio Grande Water Planning Region Population Projections July 1, 2010 to July 1, 2060

a. Annual Growth Rate

County	Projection	Growth Rate (%)				
		2010-2020	2020-2030	2030-2040	2040-2050	2050-2060
Doña Ana	High	0.92	1.29	1.08	1.04	0.81
	Low	0.56	0.56	0.56	0.53	0.45

b. Projected Population

County	Projection	Population					
		2010	2020	2030	2040	2050	2060
Doña Ana	High	209,233	229,250	260,500	290,100	321,630	348,730
	Low	209,233	221,150	233,845	247,350	260,850	272,730

Source: Poster Enterprises, 2014

Table 6-4. 2010 Water Withdrawals for Drinking Water Supply Systems and Rural Self-Supplied Homes

OSE Declared Groundwater Basin(s) [a]	Water Supplier	Population	Per Capita Use (gpcd)	Withdrawals (acre-feet)	
				Surface Water	Groundwater
Doña Ana County					
Hueco	CBG Water Company	993	203	0	226
	Desert Aire	1,000	76	0	85
	Lake Section Water Company	7,980	254	0	2,267
Hueco Tularosa	White Sands Missile Range	1,503	758	0	1,277
Lower Rio Grande	Alameda Mobile Home Park	285	112	0	36
	Alto de Las Flores MDWCA	772	92	0	80
	Anthony Water & Sanitation	8,700	114	0	1,115
	Brazito MDWCA	485	177	0	96
	Camino Real/Summer Winds	551	76	0	47
	Chamberino MDW & SA	485	89	0	48
	Country Mobile Manor	222	113	0	28
	Covered Wagon Mobile Home Park	101	122	0	14
	De La Te Mobile Manor	157	100	0	18
	Dona Ana MDWCA	10,780	124	0	1,502
	Dove Canyon LLC0	157	100	0	18
	El Patio Mobile Home Park #2	86	100	0	10
	Fairview Estates Water System	152	148	0	25
	Fort Selden Water Company	1,000	193	0	217
	Garfield MDWCA	2,268	112	0	285
	High Valley Water Users	71	136	0	11
	La Union MDWCA	568	71	0	45
	Las Cruces Mobile Home Park	174	100	0	19

Source: Longworth et al., 2013, unless otherwise noted.

[a] Determined based on NMED Drinking Water Bureau water supply source locations (NMOSE water use database doesn't distinguish groundwater basin).

gpcd = Gallons per capita per day

DRAFT

OSE Declared Groundwater Basin(s) [a]	Water Supplier	Population	Per Capita Use (gpcd)	Withdrawals (acre-feet)	
				Surface Water	Groundwater
Doña Ana County (cont.)					
Lower Rio Grande (cont.)	Las Cruces Municipal Water System	94,398	186	0	19,713
	Leasburg MDWCA	903	116	0	117
	Lower Rio Grande Public Water Works Authority	12,834	99	0	1,424
	Mesa Development Center	900	99	0	100
	Mesilla Water System	2,180	123	0	301
	Miller's Mobile Manor	116	107	0	14
	Moongate Water System	6,840	263	0	2,014
	Picacho Hills Water System	2,183	123	0	301
	Picacho MDWCA	1,200	76	0	102
	Rancho Vista Mobile Home Park	120	107	0	14
	Rincon Water Consumers Co-Op	550	159	0	98
	Santa Teresa Water System [b]	4,335	276	0	1,341
	Silver Spur Mobile Home Park	132	104	0	15
	St John's Mobile Home Park	476	100	0	53
	Summer Wind Mobile Home Park	476	100	0	53
	Sunland Park Water System [b]	14,234	217	0	3,452
	Talavera Water Co-Op	160	115	0	21
	University Estates/San Pablo MDWCA	3,970	210	0	934
	Val Verde Mobile Home Park	188	100	0	21
	Valle de Rio Water System	243	272	0	74
	Villa Del Sol Mobile Home Park	516	143	0	83
	Vista Del Rey Estates MDWCA	42	309	0	15

Source: Longworth et al., 2013, unless otherwise noted.

[a] Determined based on NMED Drinking Water Bureau water supply source locations (NMOSE water use database doesn't distinguish groundwater basin).

[b] Groundwater basin assumed based on geographic location of water supplier.

gpcd = Gallons per capita per day
NA = Information not available

Table 6-4 2010 Water Withdrawals for Drinking Water Supply Systems and Rural Self-Supplied Homes

OSE Declared Groundwater Basin(s) [a]	Water Supplier	Population	Per Capita Use (gpcd)	Withdrawals (acre-feet)	
				Surface Water	Groundwater
Doña Ana County (cont.)					
Lower Rio Grande (cont.)	Vista Real Mobile Home Park	131	88	0	13
	West Mesa System	1,930	240	0	518
	West Mesa Water Company Inc	255	147	0	42
	Winterhaven MDWA	163	100	0	18
Lower Rio Grande Nutt-Hockett	Hatch Water Supply	2,172	177	0	431
NA	Billy Moreno Water System	59	96	0	6
	Butterfield Park MDWCA	1,132	362	0	459
	Caballo Lake MDWA	83	138	0	13
	CDS Rainmakers Util LLC Rancho Ruidoso	1,000	175	0	196
	Charles Madrid Mobile Home Park	72	101	0	8
	Cielo Dorado Estates Homeowners Assoc	263	158	0	47
	Delara Estates MDWCA	1,320	152	0	225
	Dona Ana County Utilities-Border Region	610	189	0	129
	Evergreen Mobile Home Park	113	539	0	68
	Johnson, Floyd-MHP	250	113	0	32
	Jornada Water Co	7,741	167	0	1,446
	Skoshi Mobile Home Park	171	100	0	19
	Summit Gardens LLC	440	66	0	33
	Terrace Mobile Home Park	10	156	0	2
	Doña Ana County public water supply totals	203,401		0	41,434
	County-wide public water supply per capita use		182		

Source: Longworth et al., 2013, unless otherwise noted.

[a] Determined based on NMED Drinking Water Bureau water supply source locations (NMOSE water use database doesn't distinguish groundwater basin).
[b] Groundwater basin assumed based on geographic location of water supplier.

gpcd = Gallons per capita per day
NA = Information not available

DRAFT

Table 6-4 2010 Water Withdrawals for Drinking Water Supply Systems and Rural Self-Supplied Homes

OSE Declared Groundwater Basin(s) [a]	Water Supplier	Population	Per Capita Use (gpcd)	Withdrawals (acre-feet)	
				Surface Water	Groundwater
Doña Ana County (cont.)					
Hueco Lower Rio Grande Mimbres Mount Riley Nutt-Hockett Tularosa	Rural self-supplied homes (Rio Grande) [c]	5,832	100	0	653
	Doña Ana County domestic self-supplied totals	5,832		0	653
	County-wide domestic self-supplied per capita use		100		

Source: Longworth et al., 2013, unless otherwise noted.

[a] Determined based on NMED Drinking Water Bureau water supply source locations (NMOSE water use database doesn't distinguish groundwater basin).

[c] Rural self-supplied homes are located in the river basin specified in parentheses.

gpcd = Gallons per capita per day

Table 6-5. Projected Water Demand, 2020 through 2060 Lower Rio Grande Water Planning Region

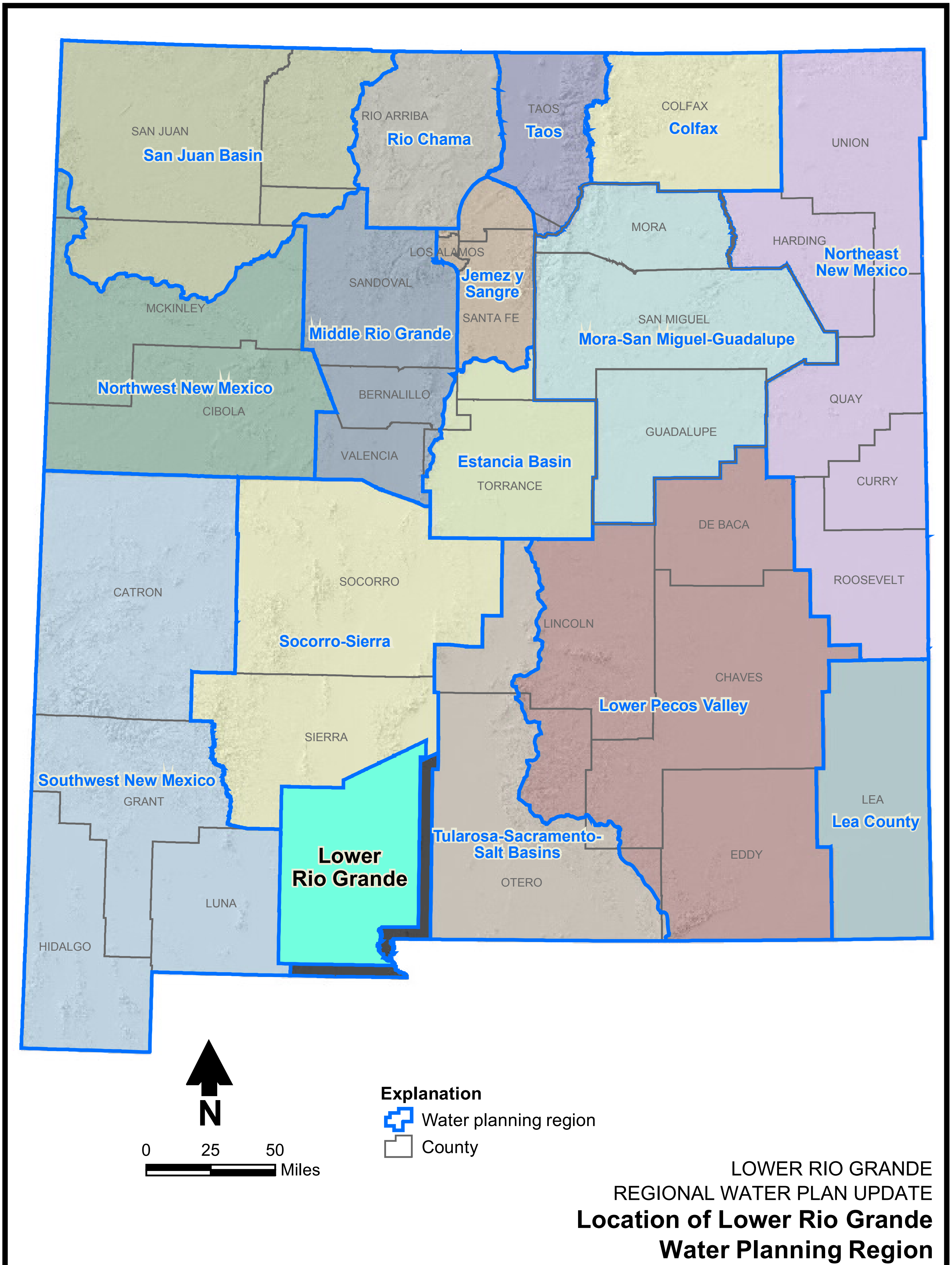
Use Sector	Projection	Water Demand (acre-feet)					
		2010 [a]	2020	2030	2040	2050	2060
Doña Ana County							
Public water supply	High	41,434	45,115	50,137	54,019	57,338	61,172
	Low	41,434	43,626	45,612	47,366	48,738	50,419
Domestic (self-supplied)	High	653	716	813	906	1,004	1,089
	Low	653	690	730	772	814	852
Irrigated agriculture	High	393,480	393,480	393,480	393,480	393,480	393,480
	Low	393,480	369,084	375,183	375,183	381,282	381,282
Livestock (self-supplied)	High	4,393	3,514	3,295	3,295	3,295	3,075
	Low	4,393	3,295	3,075	2,855	2,855	2,855
Commercial (self-supplied)	High	7,875	8,494	9,556	10,582	11,674	12,593
	Low	7,875	8,147	8,576	9,023	9,501	9,913
Industrial (self-supplied)	Low/High	120	130	160	160	160	160
Mining (self-supplied)	Low/High	74	74	74	74	74	74
Power (self-supplied)	High	1,966	2,370	2,370	2,370	2,370	2,370
	Low	1,966	2,185	2,185	2,185	2,185	2,185
Reservoir evaporation	High	0	0	0	0	0	0
	Low	0	0	0	0	0	0
Total regional demand	High	449,996	453,894	459,886	464,886	469,395	474,013
	Low	449,996	427,230	435,595	437,619	445,610	447,739

[a] Actual withdrawals (Longworth et al., 2013)

Table 7-1. Water Use and Estimated Availability in the Lower Rio Grande Water Planning Region

Source Type	Basin Area	2010 Estimated Water Use (ac-ft/yr)	2060 Estimated Water Availability (ac-ft/yr)	
			No Drought	One 20-Year Drought
Non stream-connected	Mimbres	1,433	1,318	1,143
	Nutt-Hockett	1,100	259	125
	Jornada del Muerto	13,535	6,717	5,063
	Tularosa	1,544	1,450	1,261
	Hueco	3,961	3,488	3,004
	Mount Riley	0	0	0
Stream-connected	Rio Grande surface water	271,717	271,717	62,495
	Groundwater connected to Rio Grande	156,706	156,706	156,706
	Total	449,996	441,654	229,796
	Water use as a percentage of 2010 use		98%	51%

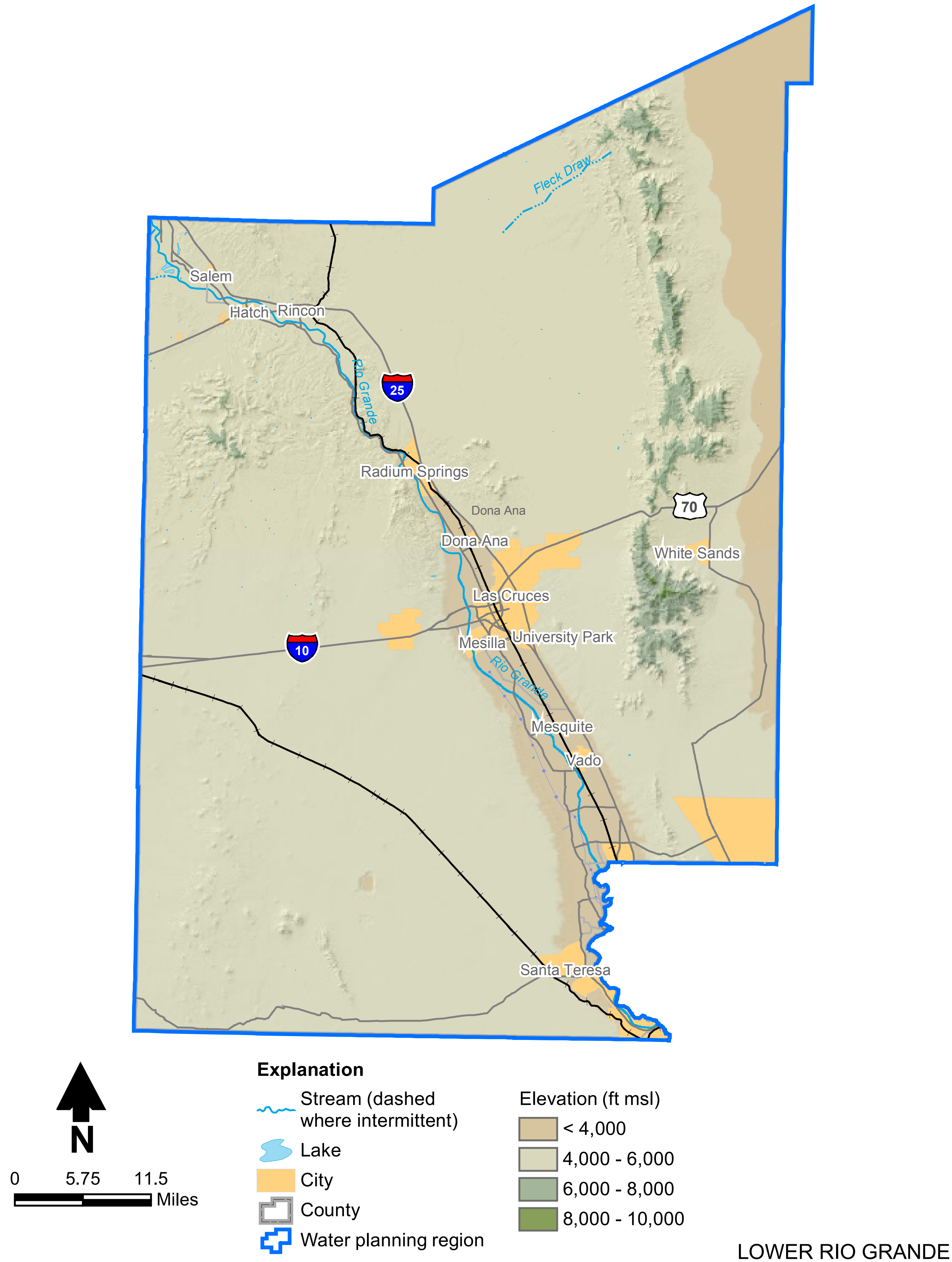
ac-ft/yr = Acre-feet per year



LOWER RIO GRANDE
REGIONAL WATER PLAN UPDATE

Location of Lower Rio Grande Water Planning Region

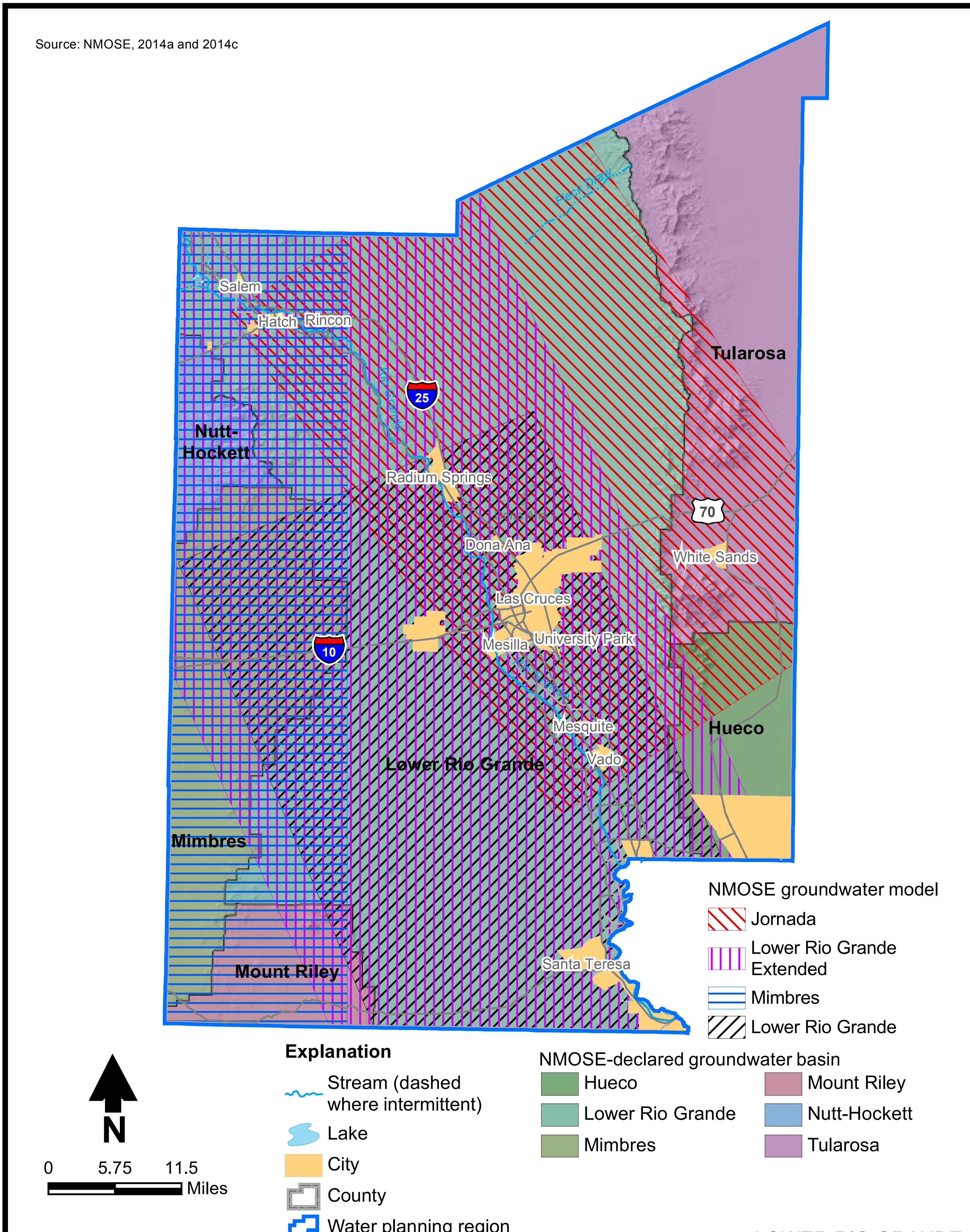
Figure 1-1



LOWER RIO GRANDE
REGIONAL WATER PLAN UPDATE
Regional Map

Figure 3-1

S:\PROJECTS\WR12.0165_STATE_WATER_PLAN_2012\GIS\MXDS\FIGURES_NO_LOGO\LOWER_RIO_GRANDE\FIG3-1_REGIONAL_MAP.MXD 12/18/2015

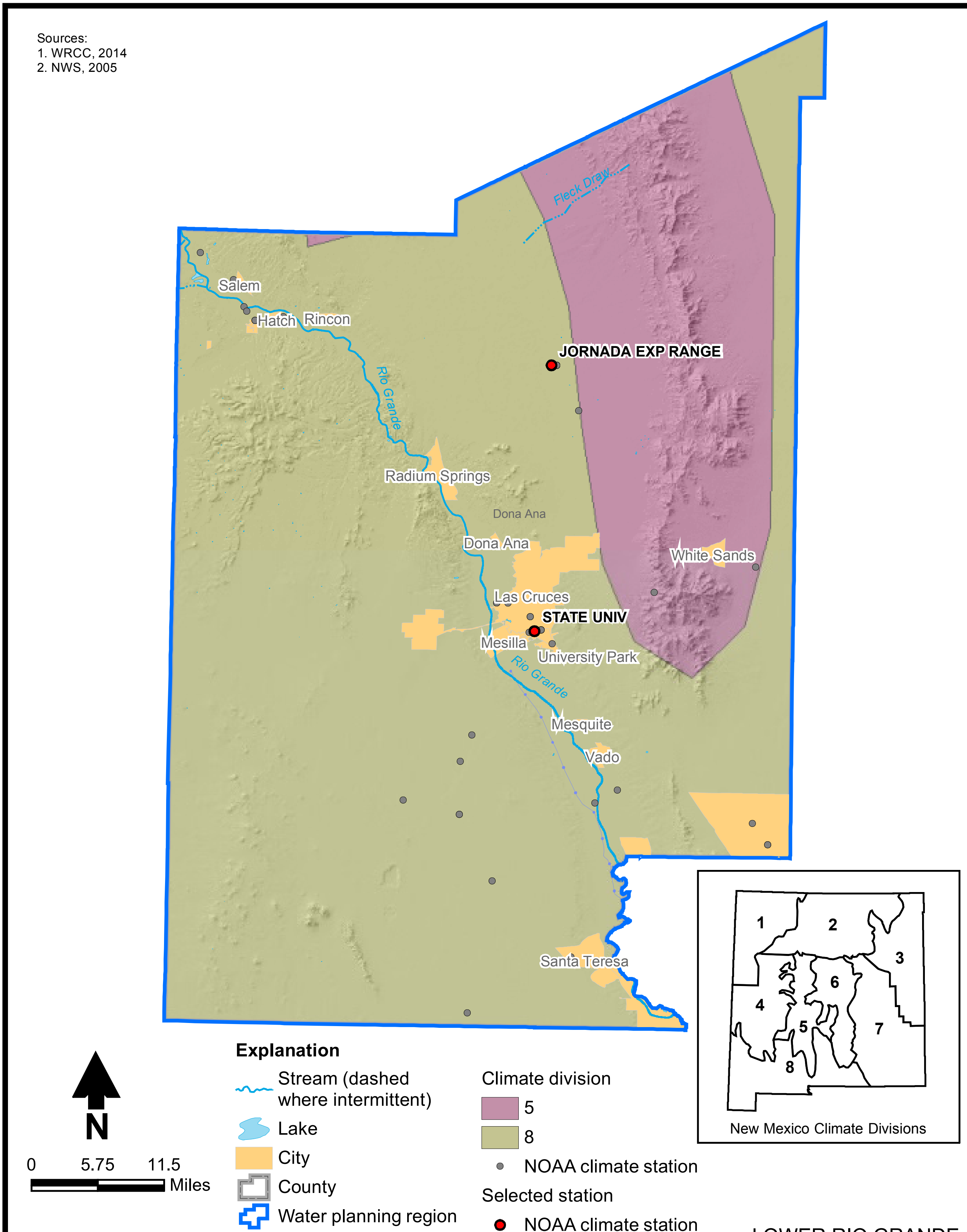


LOWER RIO GRANDE
REGIONAL WATER PLAN UPDATE

NMOSE-Declared Groundwater Basins and Groundwater Models

Figure 4-1

S:\PROJECTS\WR12.0165_STATE_WATER_PLAN_2012\GIS\MXDS\FIGURES_NO_LOGO\LOWER_RIO_GRANDE\FIG4-1_GW_BASINS_MODELS.MXD 12/18/2015

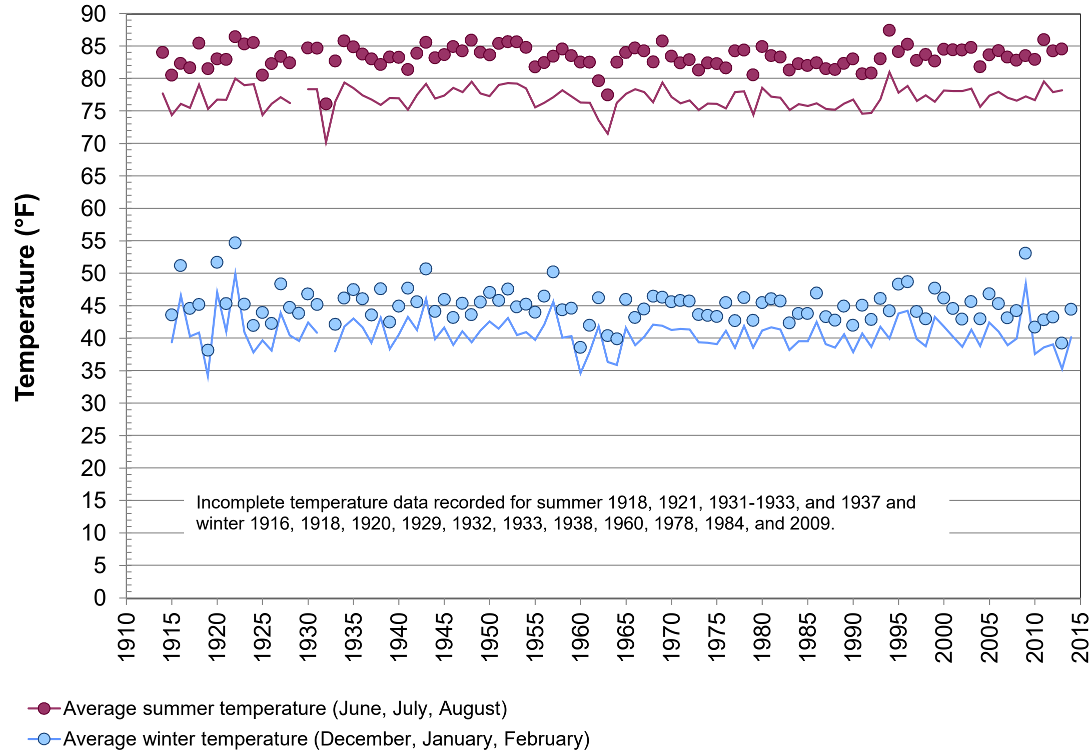


LOWER RIO GRANDE
REGIONAL WATER PLAN UPDATE
Climate Stations

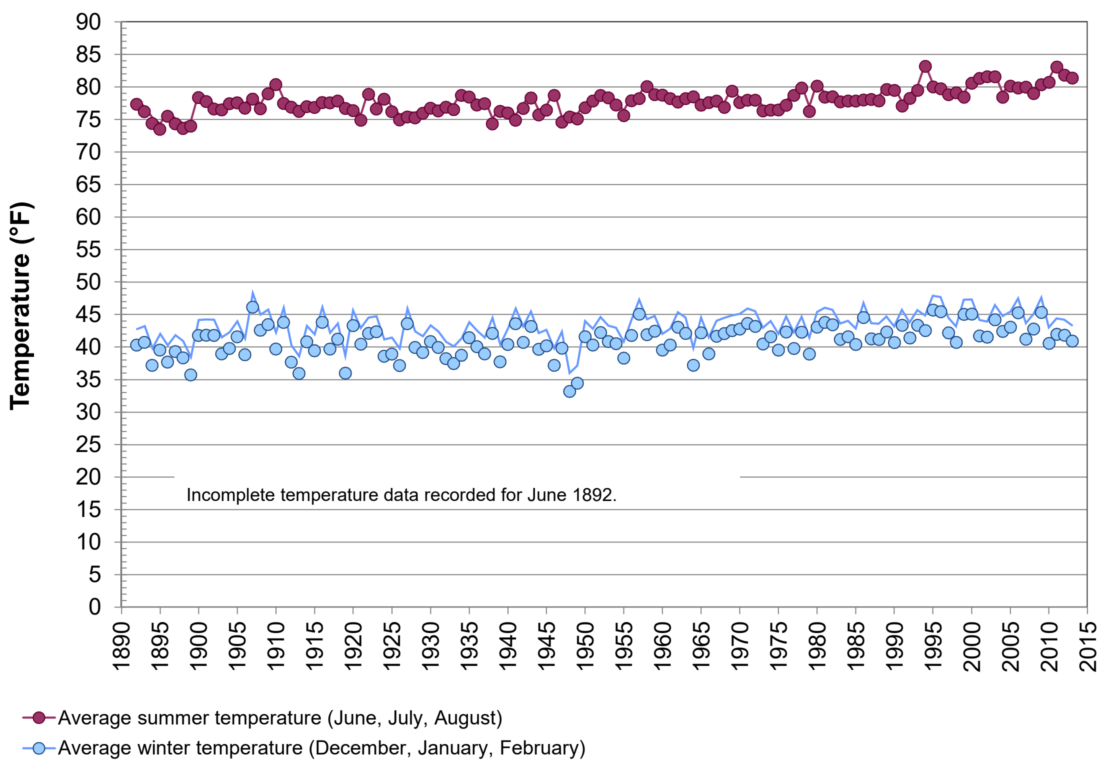
Figure 5-1

S:\PROJECTS\WR12.0165_STATE_WATER_PLAN_2012\GIS\MXDS\FIGURES_NO_LOGO\LOWER_RIO_GRANDE\FIG5-1_CLIMATE_STATIONS.MXD 12/18/2015

Jornada Exp Range, NM



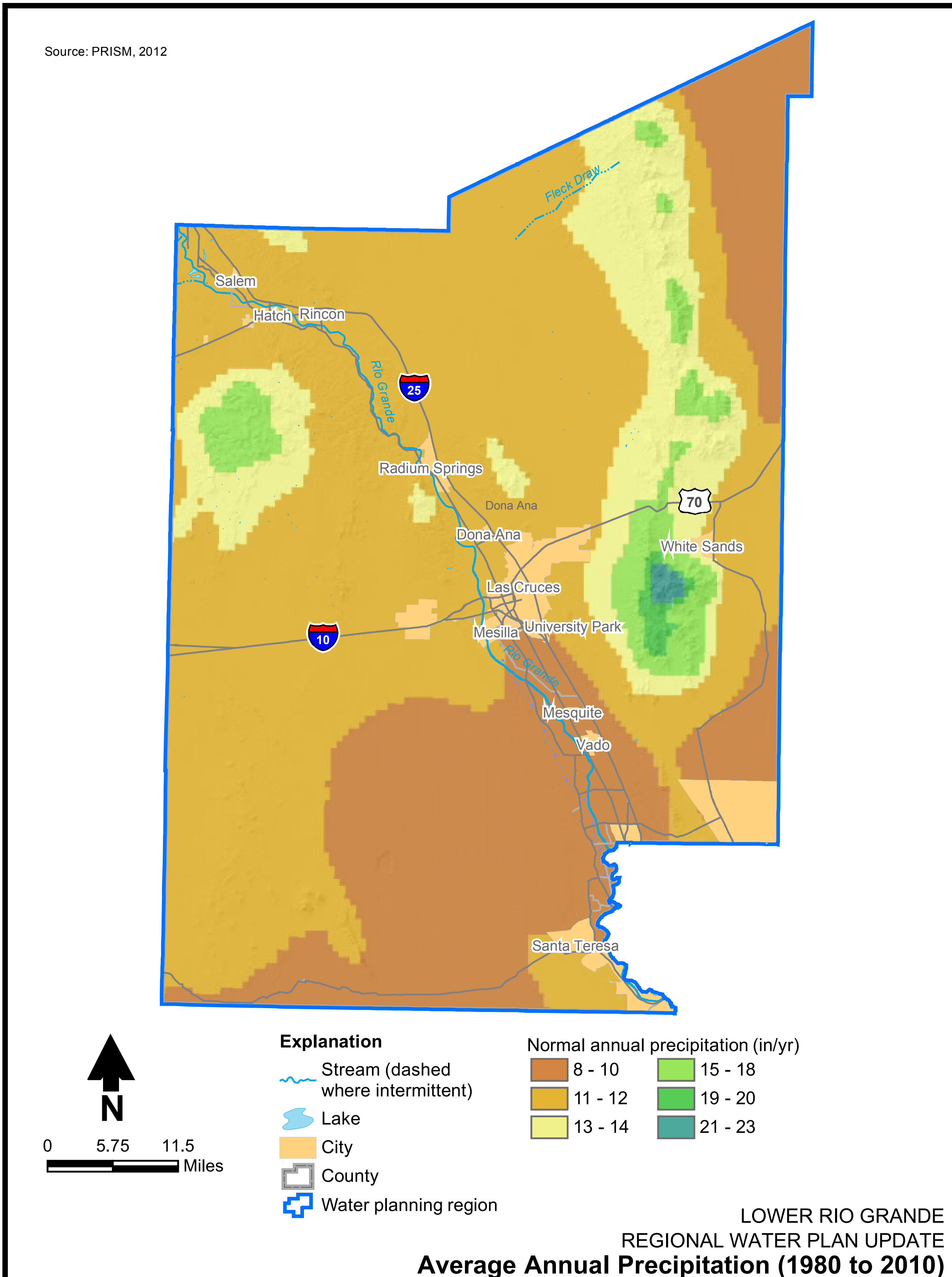
State University, NM



LOWER RIO GRANDE
REGIONAL WATER PLAN UPDATE

Average Temperature, Jornada Exp Range and State University Climate Stations

Figure 5-2



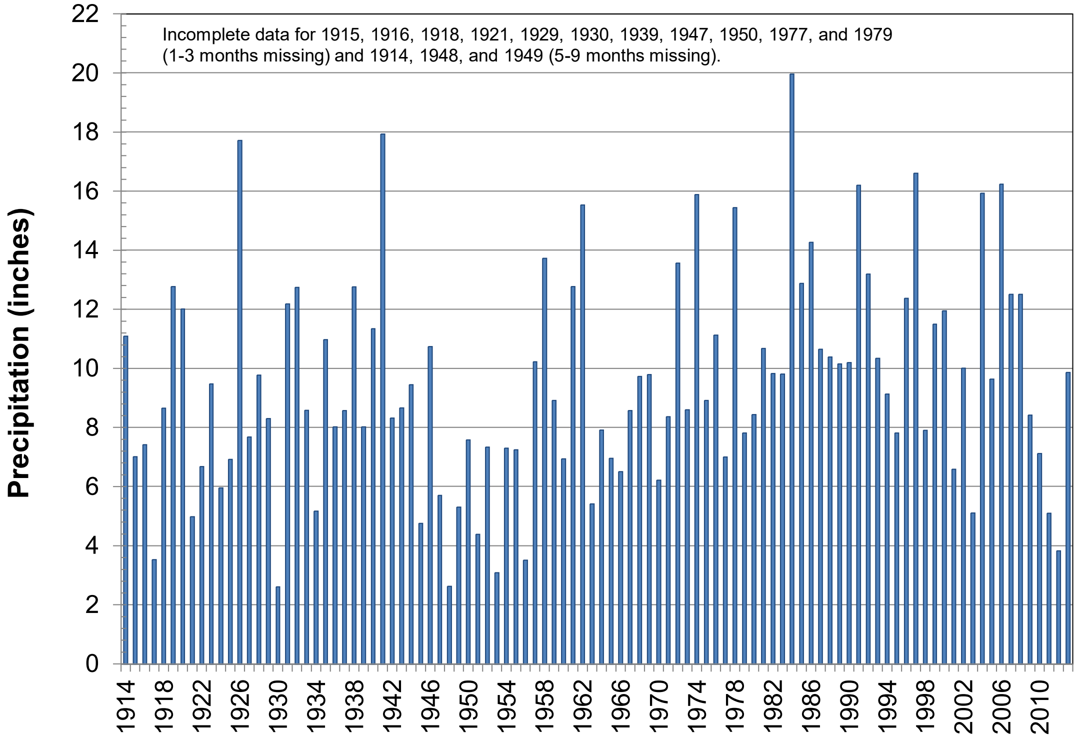
S:\PROJECTS\WR12.0165_STATE_WATER_PLAN_2012\GIS\MXDS\FIGURES_NO_LOGO\LOWER_RIO_GRANDE\FIG5-3_PRECIP.MXD 12/18/2015

LOWER RIO GRANDE
REGIONAL WATER PLAN UPDATE

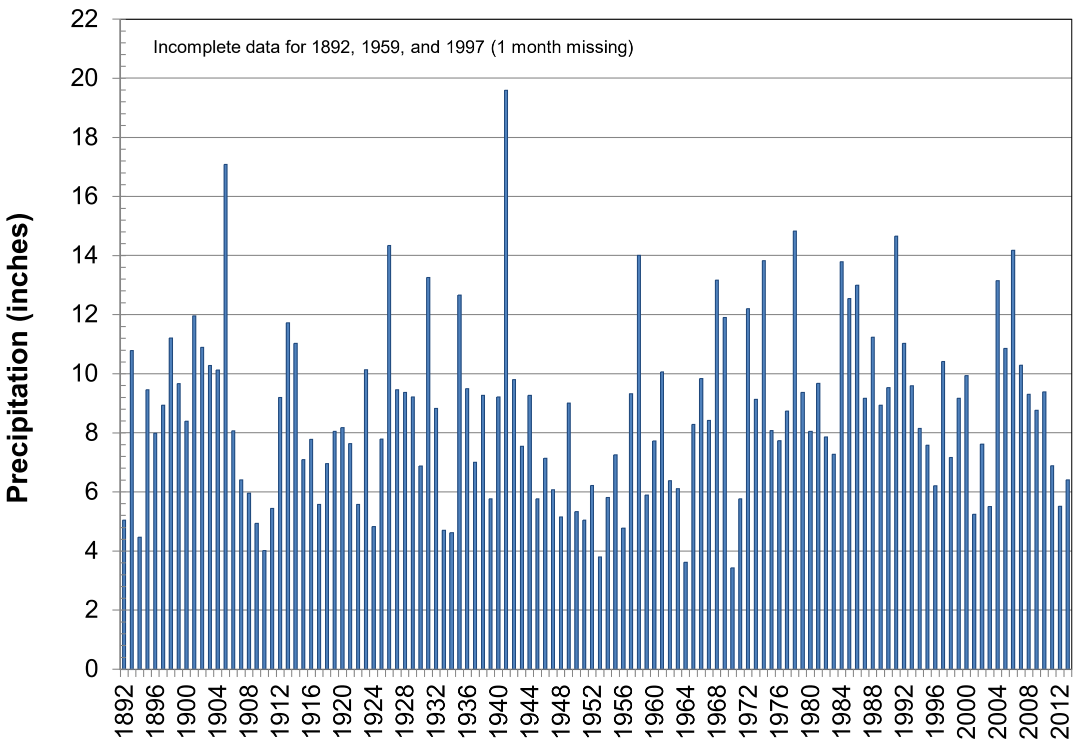
Average Annual Precipitation (1980 to 2010)

Figure 5-3

Jornada Exp Range, NM



State University, NM

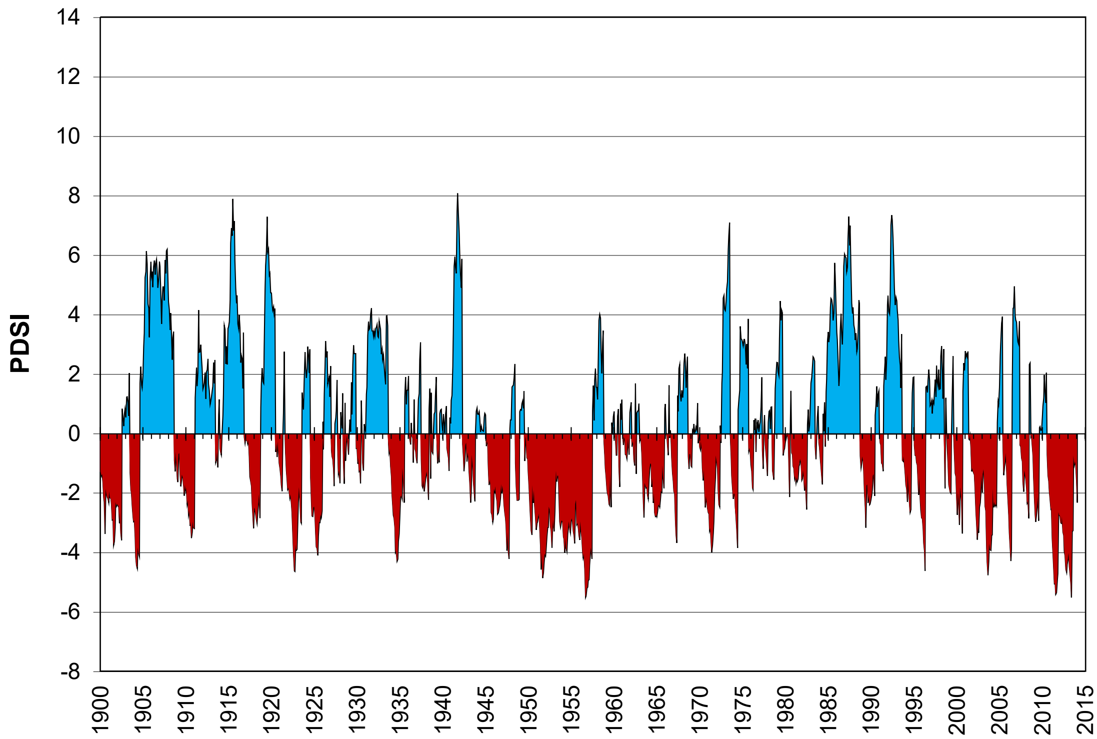


LOWER RIO GRANDE
REGIONAL WATER PLAN UPDATE

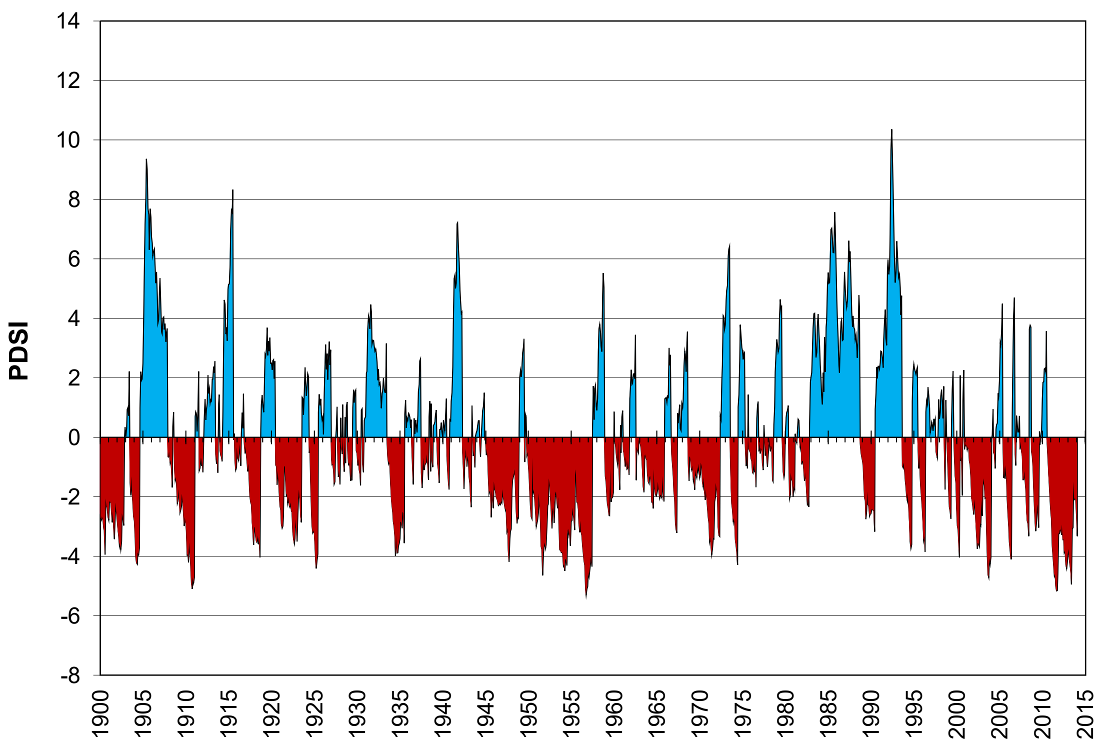
Annual Precipitation, Jornada Exp Range and State University Climate Stations

Figure 5-4

Climate Division 5



Climate Division 8



Note: Blue indicates wetter than average conditions and red indicates drier than average conditions, as described on Table 5-3.

LOWER RIO GRANDE
REGIONAL WATER PLAN UPDATE

Palmer Drought Severity Index
New Mexico Climate Divisions 5 and 8

Figure 5-6

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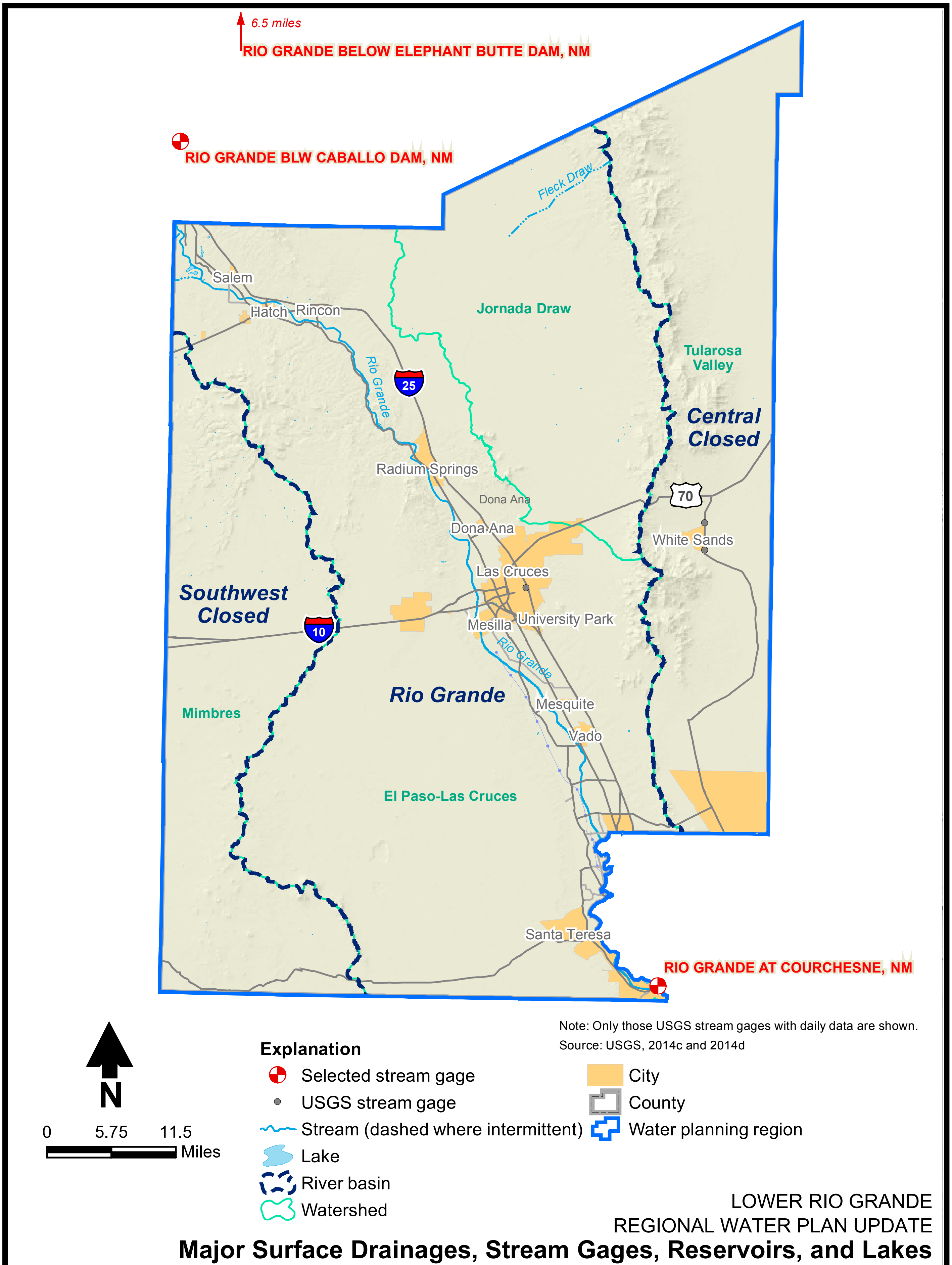


Note: Only those USGS stream gages with daily data are shown.
Source: USGS, 2014c and 2014d

S:\PROJECTS\WR12.0165_STATE_WATER_PLAN_2012\GIS\MXDS\FIGURES_NO_LOGO\LOWER_RIO_GRANDE\FIG5-7_SURFACE_WATER.MXD 1/27/2016

LOWER RIO GRANDE
REGIONAL WATER PLAN UPDATE
Major Surface Drainages, Stream Gages, Reservoirs, and Lakes

Figure 5-7

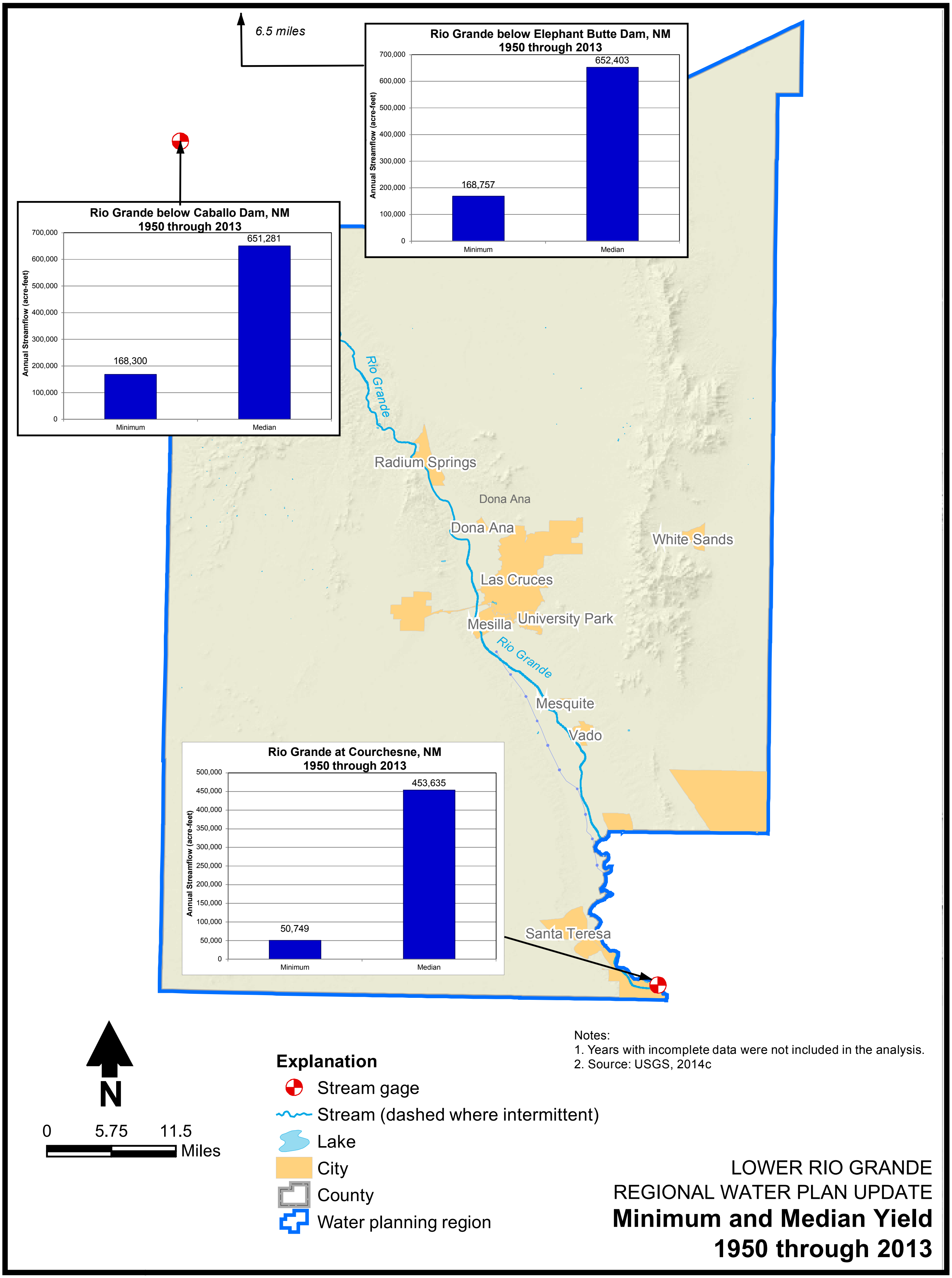
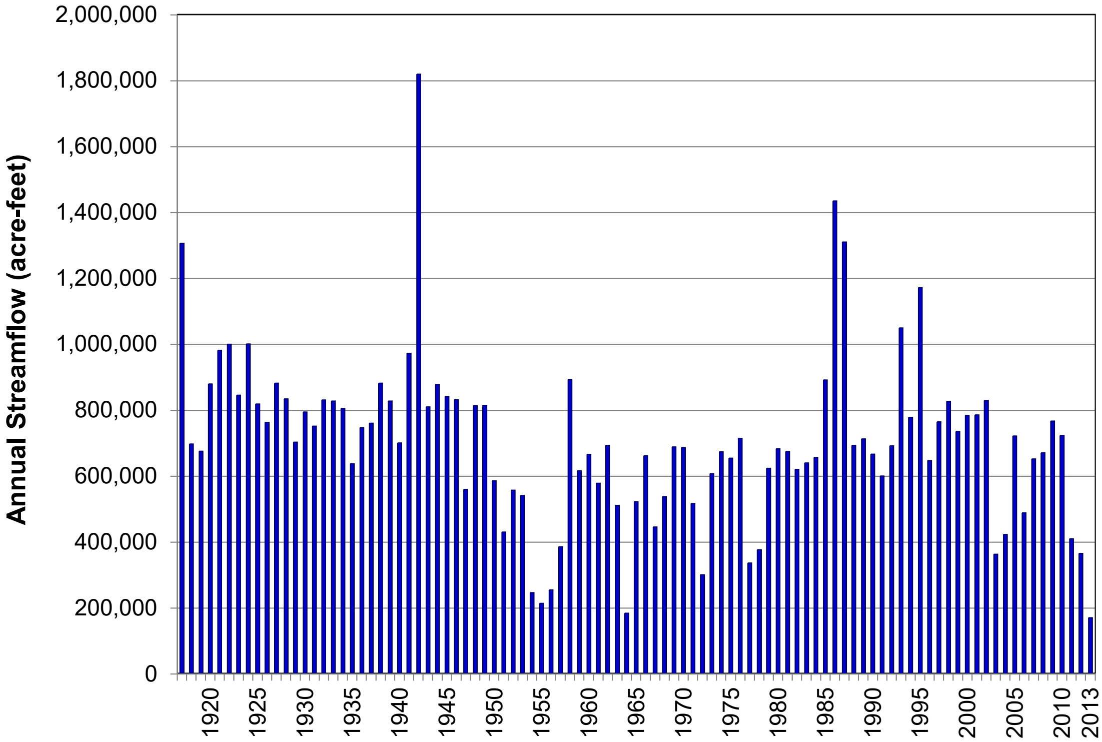


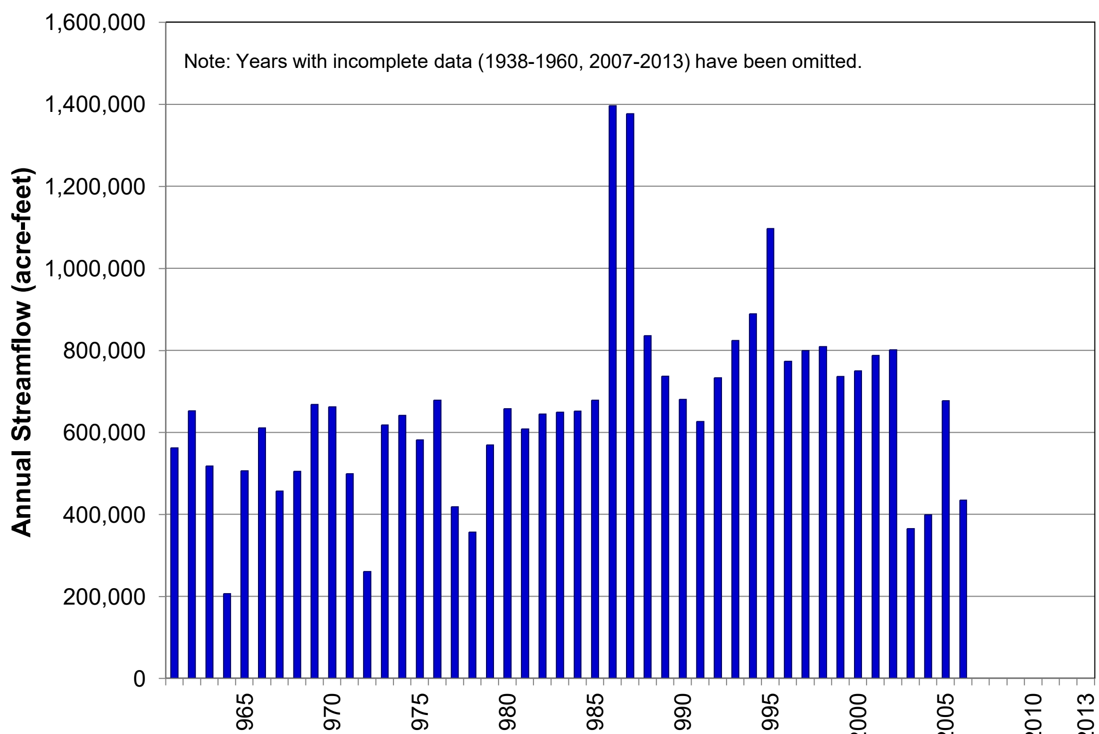
Figure 5-8

S:\PROJECTS\WR12.0165_STATE_WATER_PLAN_2012\GIS\MXDS\FIGURES_NO_LOGO\LOWER_RIO_GRANDE\FIG5-8_STREAMFLOW.MXD 1/28/2016

Rio Grande below Elephant Butte Dam, NM



Rio Grande below Caballo Dam, NM



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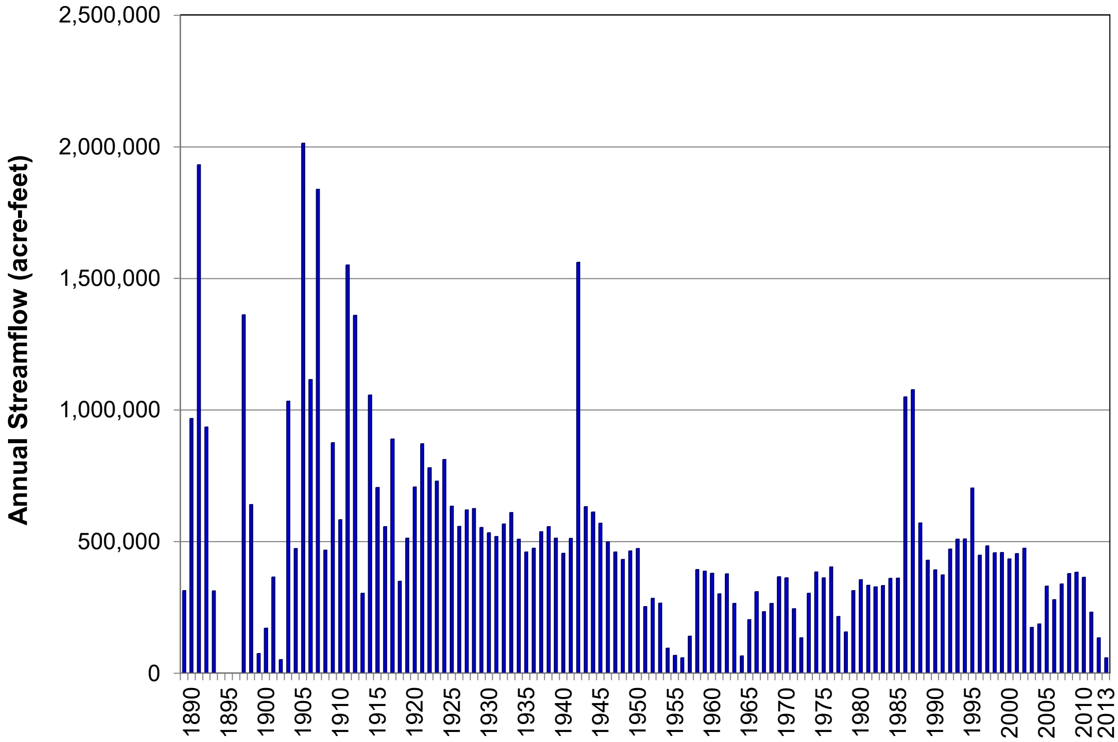
LOWER RIO GRANDE
REGIONAL WATER PLAN UPDATE

Annual Streamflow for Selected Gaging Stations on the Rio Grande

Figure 5-9a

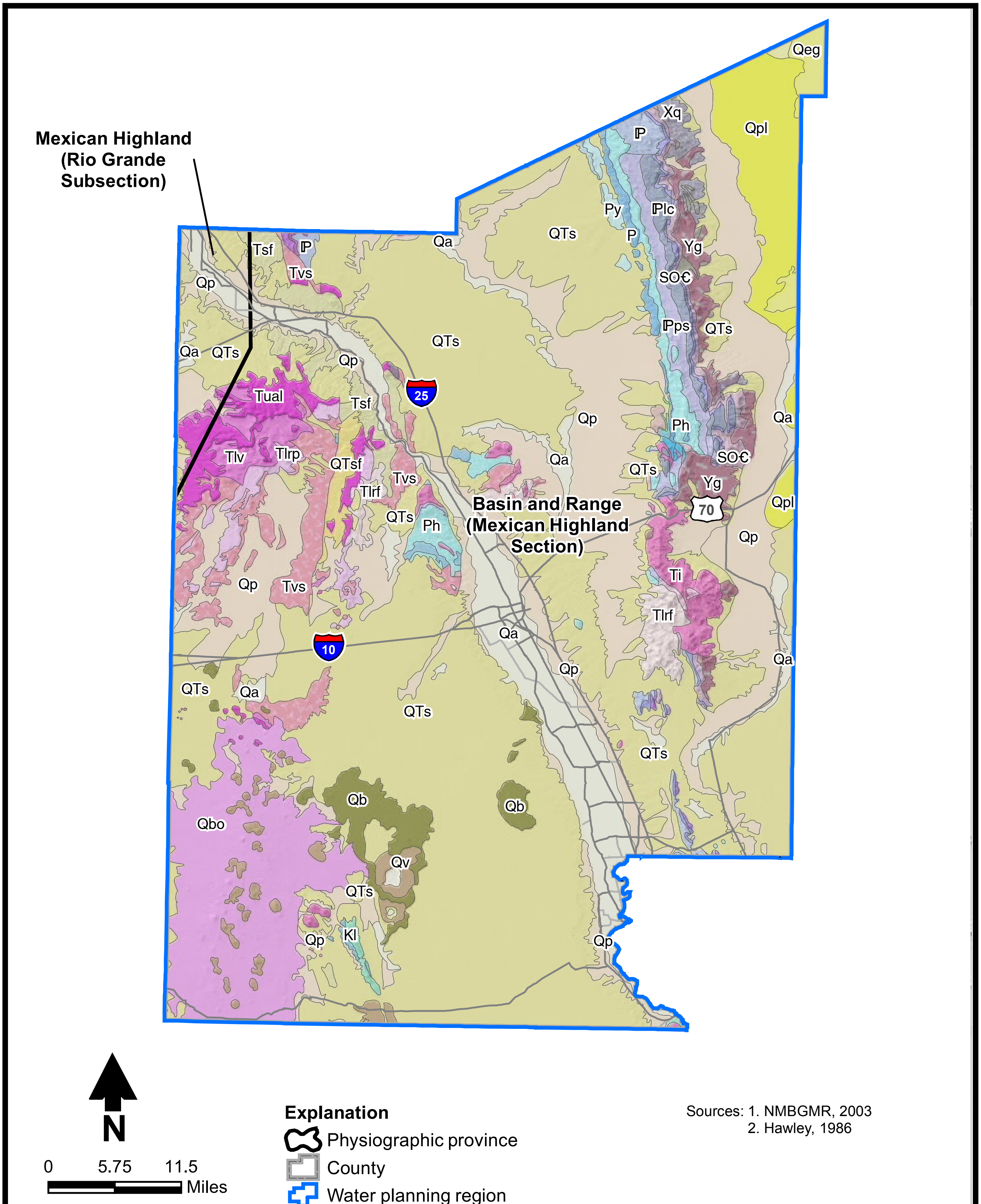
Rio Grande at Courchesne, NM



LOWER RIO GRANDE
REGIONAL WATER PLAN UPDATE

Annual Streamflow for Selected Gaging Stations on the Rio Grande

Figure 5-9b



Explanation
- Physiographic province
- County
- Water planning region

Sources: 1. NMBGMR, 2003
2. Hawley, 1986

LOWER RIO GRANDE
REGIONAL WATER PLAN UPDATE
Geology and Physiographic Provinces

Figure 5-10a

S:\PROJECTS\WR12.0165_STATE_WATER_PLAN_2012\GIS\MXDS\FIGURES_NO_LOGO\LOWER_RIO_GRANDE\FIG5-10A_GEOLOGY.MXD 12/18/2015

Geology Explanation

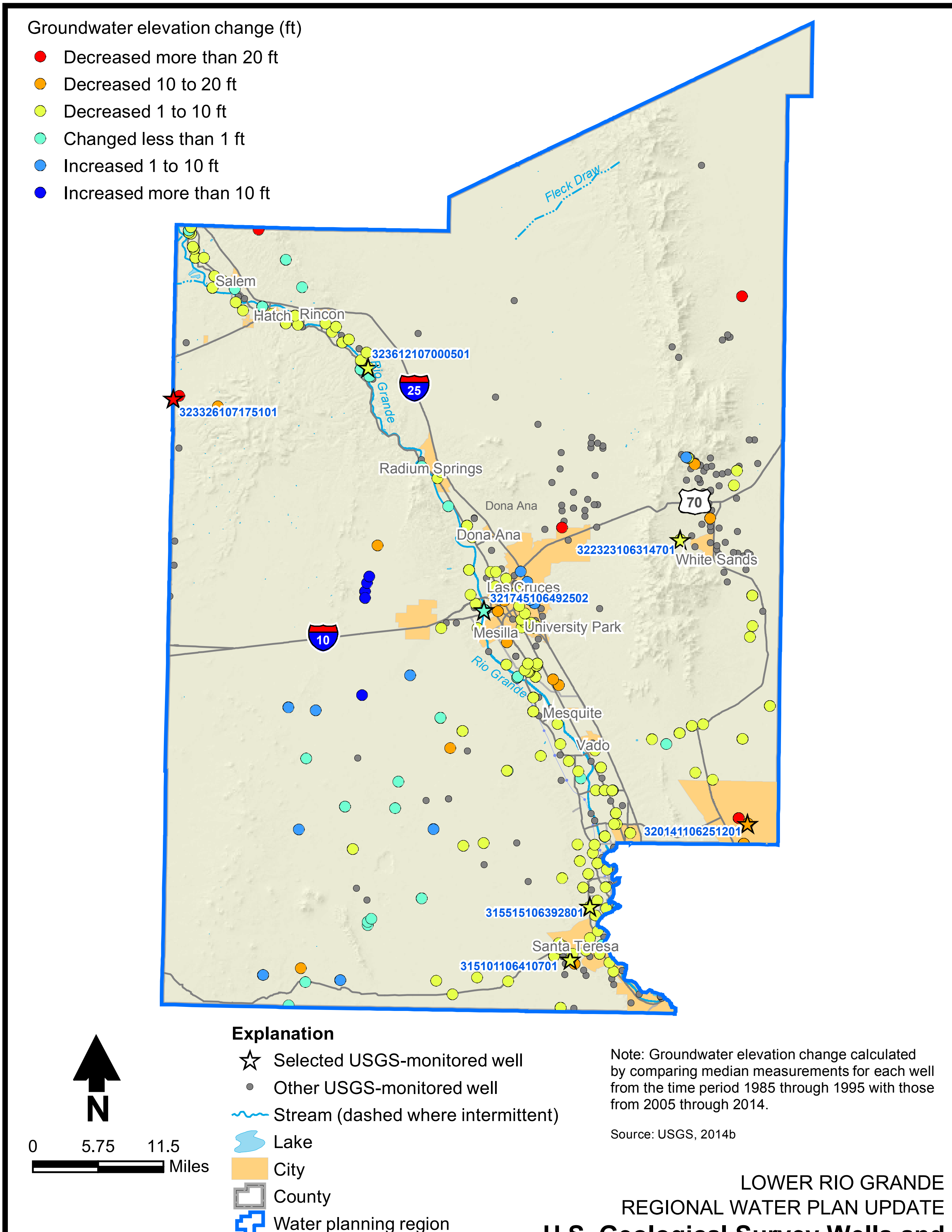
- ℙ - Pennsylvanian rocks undivided
- ℙlc - Lead Camp Formation
- ℙps - Panther Seep Formation
- K - Cretaceous rocks, undivided
- Kl - Lower Cretaceous, undivided
- MD - Mississippian and Devonian rocks, undivided
- O€ - Ordovician and Cambrian rocks, undivided
- P - Permian rocks, undivided
- Pa - Abo Formation
- Ph - Hueco Formation (or Group)
- Psa - San Andres Formation
- Psy - San Andres, Glorieta, and Yeso Formations, undivided
- Py - Yeso Formation
- Pya - Yeso and Abo Formations, undivided (Lower Permian)
- Pz - Paleozoic rocks, undivided
- QTs - Upper Santa Fe Group
- QTsf - Santa Fe Group, undivided
- Qa - Alluvium
- Qb - Basaltic to andesitic lava flows
- Qbo - Basaltic to andesitic lava flows
- Qe - Eolian deposits
- Qeg - Gypsiferous eolian deposits
- Qp - Piedmont alluvial deposits
- Qpl - Lacustrine and playa deposits
- Qv - Basaltic tephra and lavas near vents
- SO - Silurian and Ordovician rocks, undivided
- SO€ - Silurian through Cambrian rocks, undivided
- Ti - Tertiary intrusive rocks of intermediate to silicic composition
- Tla - Lower middle Tertiary andesitic to dacitic lavas and pyroclastic flow breccias
- Tlrf - Lower middle Tertiary rhyolitic lavas and local tuffs
- Tlrp - Lower middle Tertiary rhyolitic to dacitic pyroclastic rocks of the Datil Group, ash-flow tuffs
- Tlv - Lower middle Tertiary volcanic rocks
- Tps - Paleogene sedimentary units
- Tsf - Lower Santa Fe Group
- Tual - Lower-upper middle Tertiary basaltic andesites and andesites of the Mogollon Group
- Turf - Upper middle Tertiary rhyolitic lavas and local tuffs
- Tv - Middle Tertiary volcanic rocks
- Tvs - Middle Tertiary volcaniclastic sedimentary units
- Xg - Paleoproterozoic granitic plutonic rocks
- Xq - Paleoproterozoic quartzite
- Xvf - Paleoproterozoic rhyolite and felsic volcanic schist
- Xvm - Paleoproterozoic mafic metavolcanic rocks with subordinate felsic metavolcanic rocks
- Yg - Mesoproterozoic granitic plutonic rocks

Source: NMBGMR, 2003

S:\PROJECTS\WR12.0165_STATE_WATER_PLAN_2012\GIS\MXDS\FIGURES_NO_LOGO\LOWER_RIO_GRANDE\FIG5-10B_GEOLOGY_EXPLANATION.MXD 12/18/2015

LOWER RIO GRANDE
REGIONAL WATER PLAN UPDATE
Geology Explanation

Figure 5-10b



LOWER RIO GRANDE
REGIONAL WATER PLAN UPDATE

U.S. Geological Survey Wells and Recent Groundwater Elevation Change

S:\PROJECTS\WR12.0165_STATE_WATER_PLAN_2012\GIS\MXDS\FIGURES_NO_LOGO\LOWER_RIO_GRANDE\FIG5-11_USGS_WELLS.MXD 12/18/2015

Figure 5-11

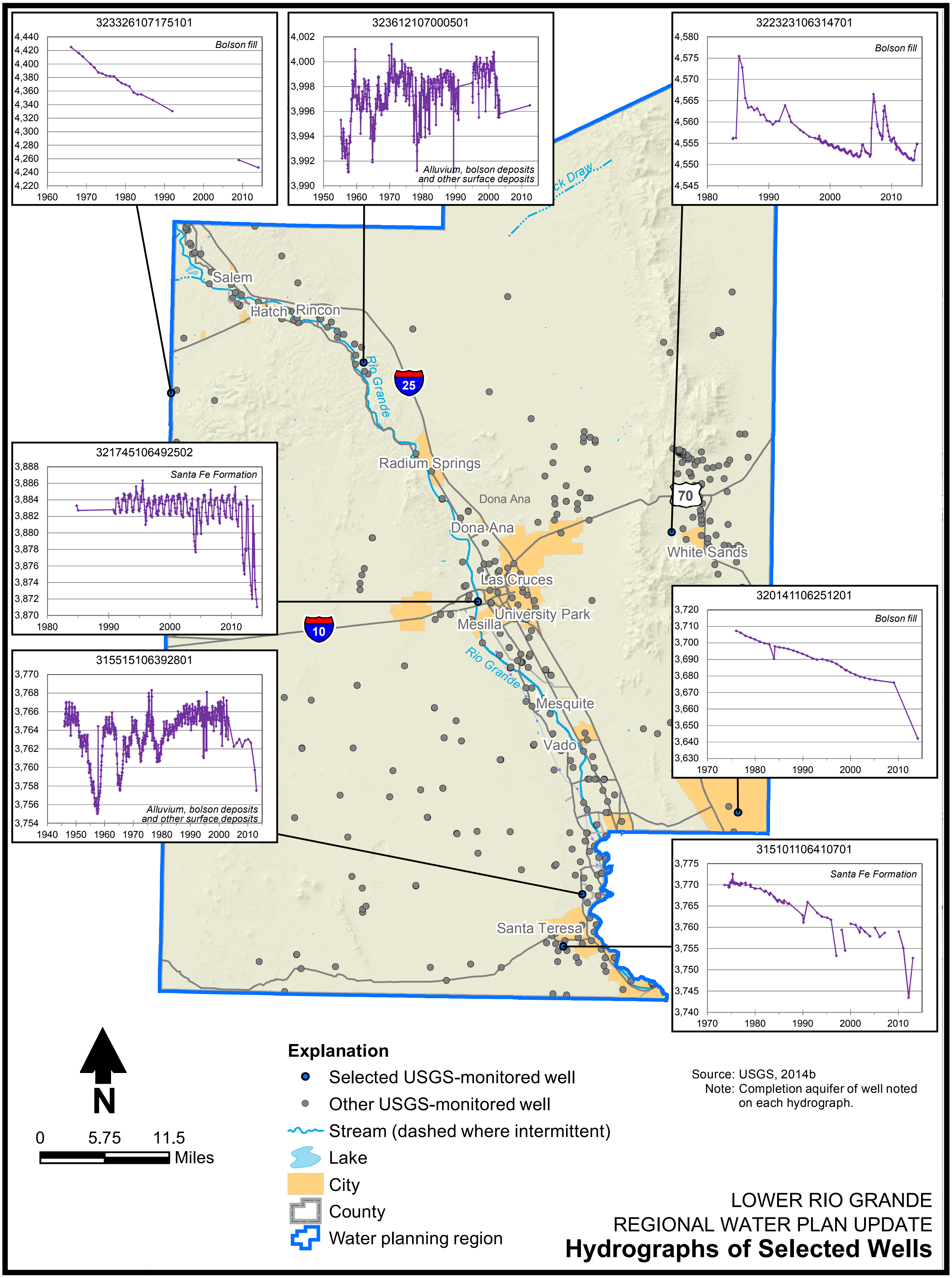


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Figure 5-12

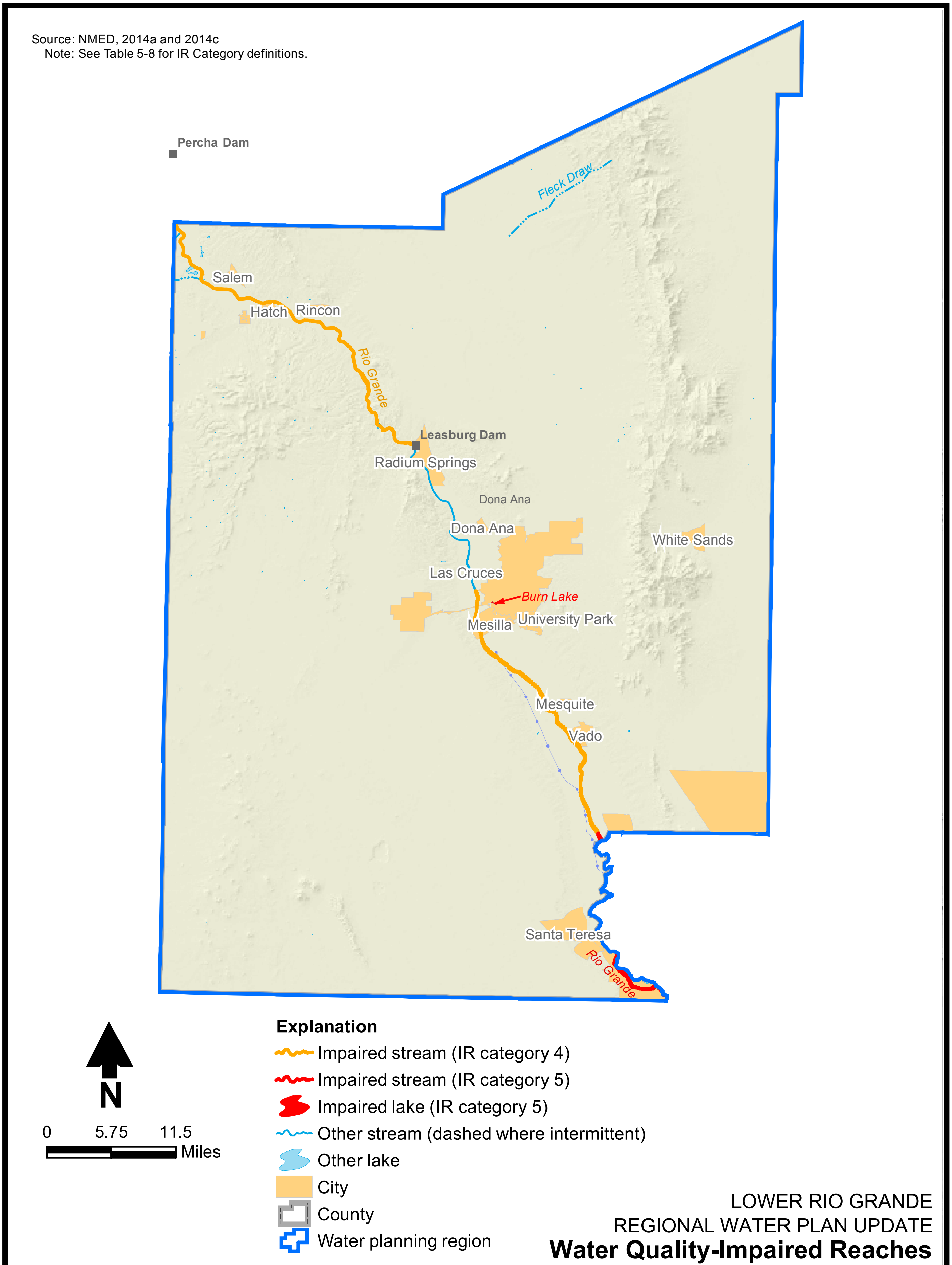
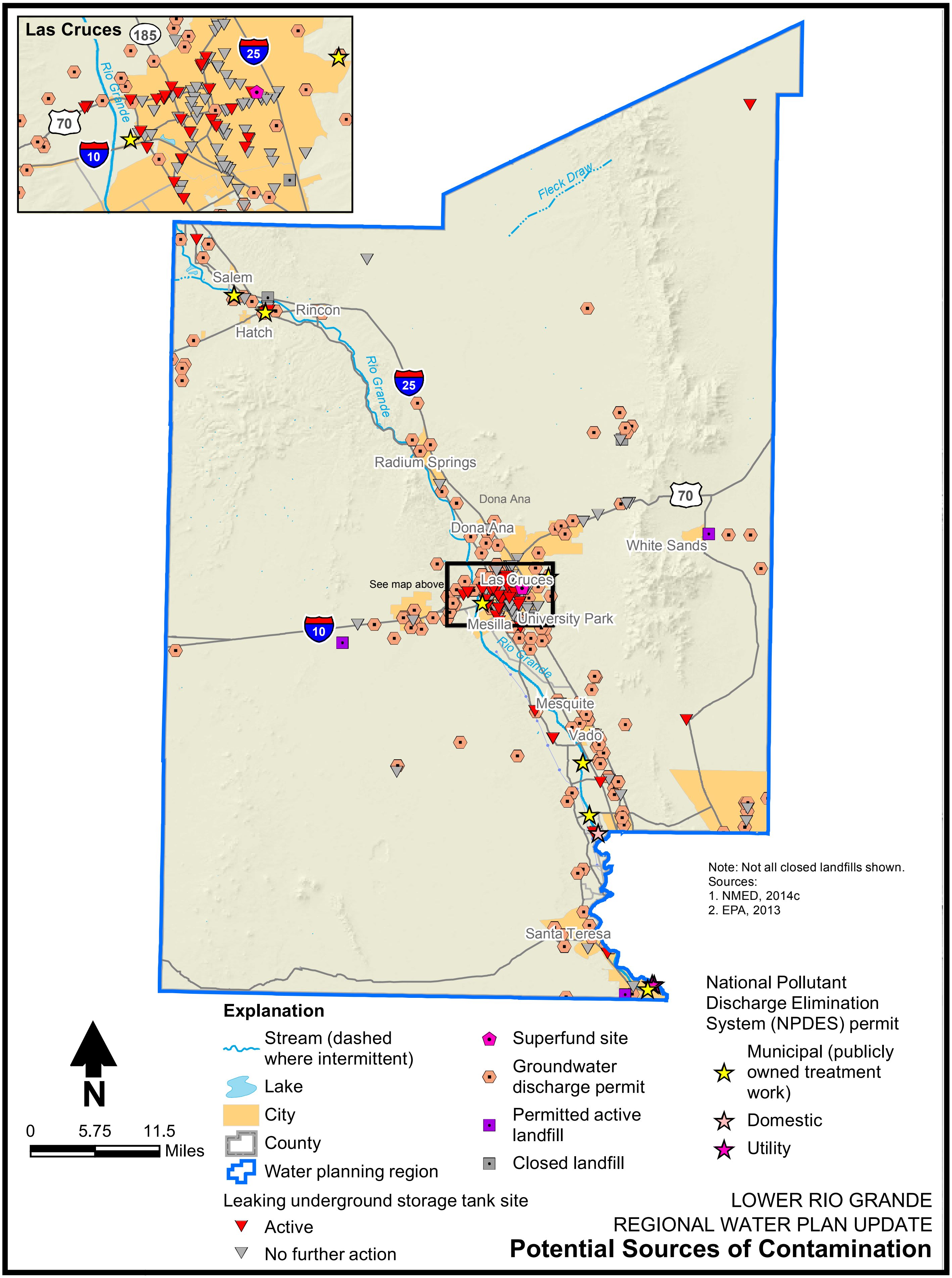


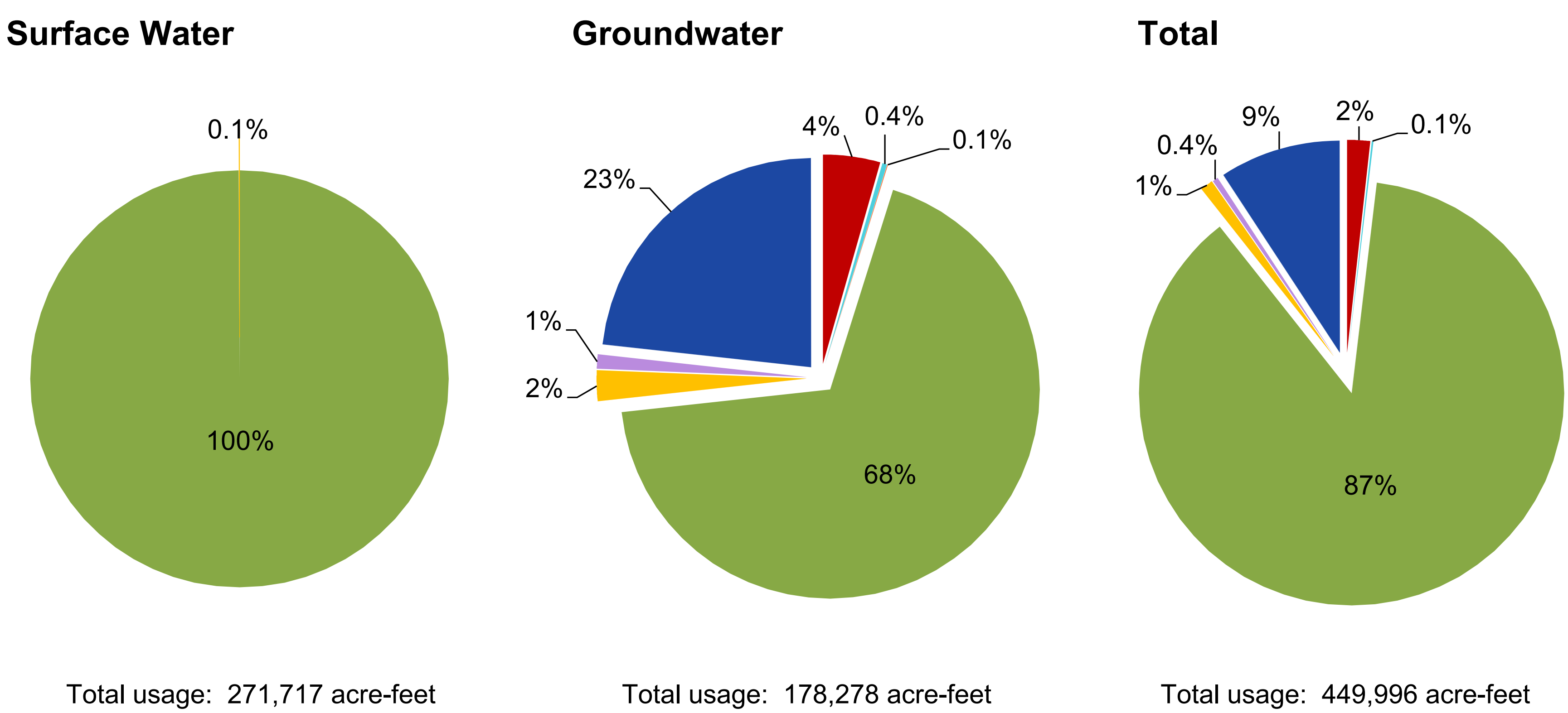
Figure 5-13

S:\PROJECTS\WR12.0165_STATE_WATER_PLAN_2012\GIS\MXDS\FIGURES_NO_LOGO\LOWER_RIO_GRANDE\FIG5-13_WQ_IMPAIRED_REACHES.MXD 12/18/2015



S:\PROJECTS\WR12.0165_STATE_WATER_PLAN_2012\GIS\MXDS\FIGURES_NO_LOGO\LOWER_RIO_GRANDE\FIG5-14_CONTAM_SOURCES.MXD 1/13/2016

Figure 5-14



Explanation

- Commercial (self-supplied)
- Domestic (self-supplied)
- Industrial (self-supplied)
- Irrigated agriculture
- Livestock (self-supplied)
- Mining (self-supplied)
- Power (self-supplied)
- Public water supply
- Reservoir evaporation

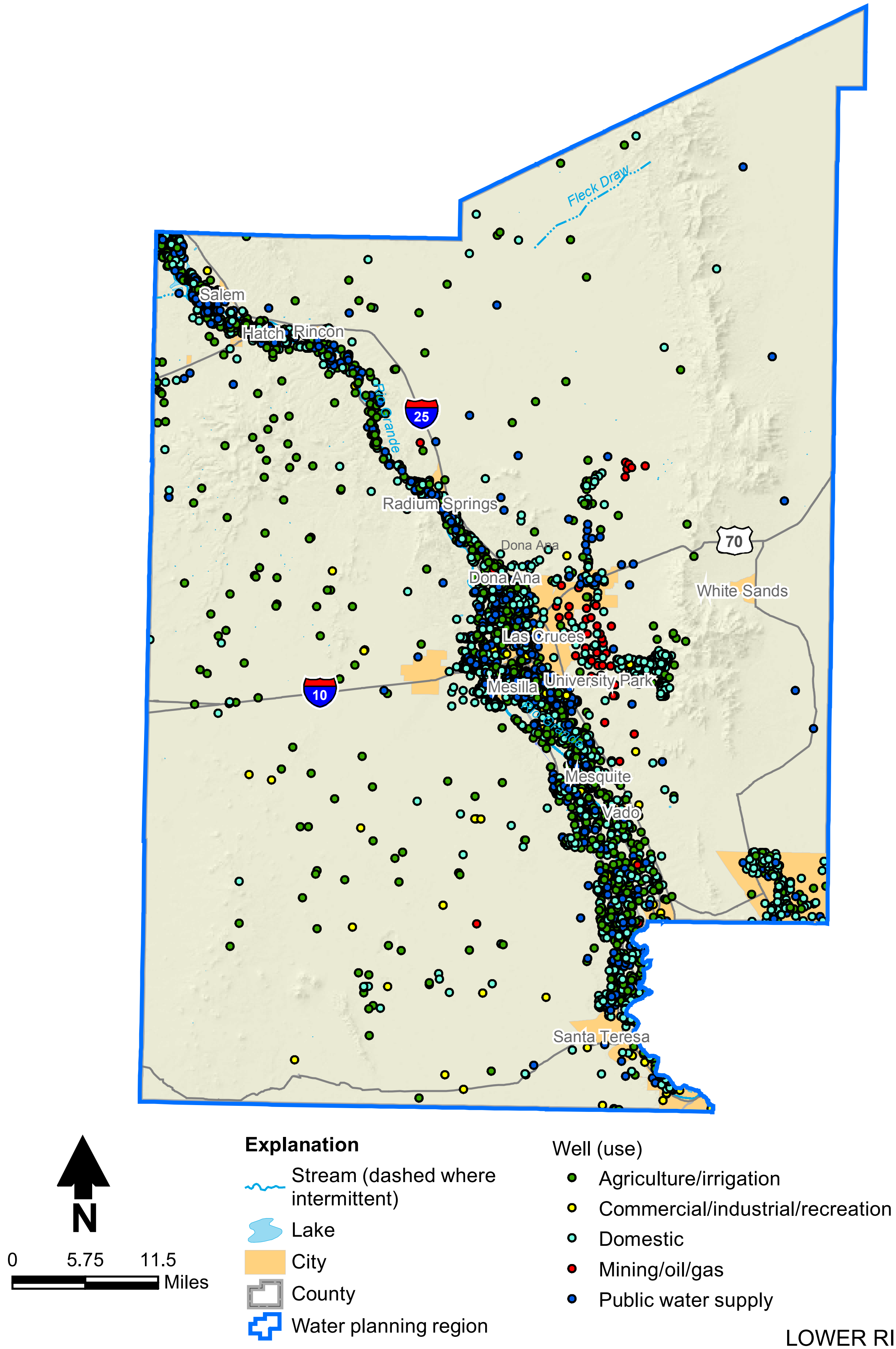
Source: NMOSE, 2013

Note: Only categories with usage above 0.1% are shown.

LOWER RIO GRANDE
REGIONAL WATER PLAN UPDATE

Total Regional Water Demand by Sector, 2010

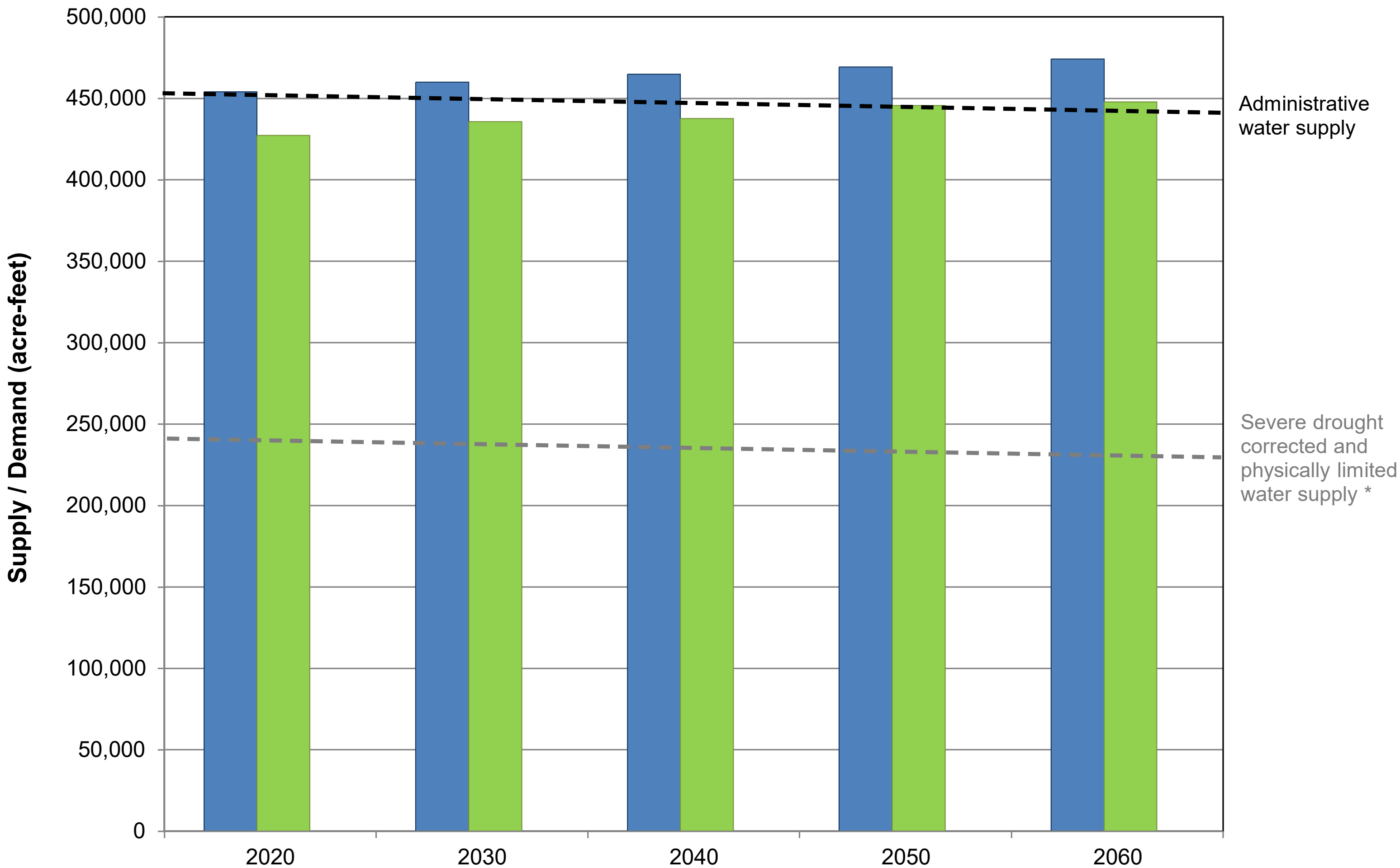
Figure 6-1



LOWER RIO GRANDE
REGIONAL WATER PLAN UPDATE
Groundwater Points of Diversion

Figure 6-2

S:\PROJECTS\WR12.0165_STATE_WATER_PLAN_2012\GIS\MXDS\FIGURES_NO_LOGO\LOWER_RIO_GRANDE\FIG6-2_POINTS_OF_DIVERSION.MXD 12/18/2015



High demand projection

Low demand projection

* Based on the ratio of the minimum streamflow of record to the 2010 administrative water supply and modeling conducted by the New Mexico Office of the State Engineer.

LOWER RIO GRANDE
REGIONAL WATER PLAN UPDATE

Available Supply and Projected Demand

Figure 7-1