ATTACHMENT A

PRELIMINARY ENGINEERING REPORT - WATER SYSTEM IMPROVEMENTS

CHUPADERO WATER - SEWAGE CORPORATION
SANTA FE COUNTY, NEW MEXICO

Martin/Martin, Inc. Project No.: 25.0216

August 2025

MARTIN/MARTIN
CONSULTING ENGINEERS

PRELIMINARY ENGINEERING REPORT

WATER SYSTEM IMPROVEMENTS

Chupadero Water - Sewage Corporation
Santa Fe County, New Mexico

August 2025

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This Preliminary Engineering Report (PER) was prepared by Martin/Martin, Inc. as per the U.S. Department of Agriculture Rural Utilities Service Bulletin 1780-2: *Preliminary Engineering Reports for the Water and Wastewater Disposal Program* (April 4, 2013).

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EXECUTIVE SUMMARY

The Chupadero Water and Sewage Corporation (Chupadero) is located approximately 11 miles north of the City of Santa Fe in Santa Fe County, New Mexico, along State Highway 592 and County Road 78.

Chupadero currently owns and operates a public water system, constructed in 1976, which generally consists of a 20,000-gallon water storage tank, one groundwater supply well, a packaged ion exchange adsorptive media treatment system for alpha particles, 3-inch PVC water main, 2-inch PVC laterals, a single pressure-reducing valve, isolation valves, and radio read water meters.

Chupadero completed a new groundwater well, Well #5 in 2019. The new well is expected to provide a level of sustainability and use to serve the corporation's existing customers as well as allow new members to join. Previously, the corporation had not accepted new members since 2012. Prior to the construction of Well #5, the system used two privately owned wells. After the new well was constructed, the previously used Wells #2 and #4 were returned to their private owners. Water samples collected during drilling showed Well #5 had concentrations of alpha particles above the regulatory levels, and a packaged ion exchange adsorptive treatment system was designed and constructed in 2024. No other analytes exceeded the regulatory levels.

Due to the aging members of the Chupadero Board, and their operator, and the lack of interest in the community for younger members to take over these roles, Chupadero requested that Santa Fe County take over their water system. On July 23, 2012, the Chupadero Board approved incorporating their service area into the County Utility's water service area. On September 25, 2012, Santa Fe County approved a resolution to incorporate the Chupadero service area into the County's as well as committing to execute the proper legal instrument for transfer of water assets and infrastructure to the County. The final transfer is planned to take place upon completion of the needed water system improvements identified in this report.

The purpose of this preliminary engineering report (PER) is to evaluate feasible and cost-effective water system improvement alternatives for the existing Chupadero system. Multiple alternatives were evaluated for this PER. They may generally be categorized as storage, disinfection, and transmission/distribution.

The recommended project, based on the life cycle cost analysis and evaluation of non-monetary factors, is a combination of three alternatives for improvements to disinfection, storage and transmission/distribution. The estimated capital cost of the recommended project is $4,917,475 and the present worth 20-year life cycle cost is $5,269,414.

For any water system improvements projects, Chupadero will pursue funding for design and construction. To receive project funding, Chupadero will need to submit this PER to funding agencies as part of the project funding process. Future engineering design of the project must comply with the New Mexico Environment Department Construction Programs Bureau (NMED CPB) 2006 Recommended Standards for Water Facilities. Since Santa Fe County will eventually be taking over ownership of the water system, design must also comply with the 2012 Santa Fe County Water Utility Customer Service Policies and the forthcoming Santa Fe County Utility Standards (currently in draft stage).

This PER was prepared under the responsible charge of a registered New Mexico professional engineer per the guidelines and format published in U.S. Department of Agriculture (USDA) RUS (Rural Utility Services) Bulletin 1780-2: Preliminary Engineering Reports for the Water and Wastewater Disposal Program (April 4, 2013). The planning period for this PER is 20 years.

1.0 PROJECT PLANNING

1.1 PROJECT LOCATION

The proposed water system improvements included in this report are located within the Chupadero Water and Sewage Corporation (Chupadero) public water system; NMED Water System No. 3566026. Chupadero is located approximately 11 miles north of the City of Santa Fe in Santa Fe County, New Mexico, along State Highway 592 and County Road 78. A site vicinity map, using a USGS topographic map of the area, is provided as Figure 1 in Appendix A.

The Chupadero water system service area includes residences located along both State and County intersecting roadways as well as several side roads that connect to County Road 78. A map of the service area is provided as Figure 2 in Appendix A. The elevation across the system ranges approximately from 6,990 ft. above mean sea level (AMSL) at the storage tank site to 6,700 ft. AMSL at the lowest service connection. The ephemeral Rio Chupadero passes through the southern portion of the service area. Outcrops of the Tesuque Formation are located just north of the service area.

1.2 ENVIRONMENTAL RESOURCES PRESENT

1.2.1 HYDROLOGY

Since the area of the Rio Chupadero has the lowest elevations, surface water from precipitation migrates towards the Rio Chupadero.

Groundwater in the area, from which Chupadero obtains its potable water, was documented in a technical memo prepared by Daniel B. Stephens & Associates, Inc. (DBS) in July 2016; Hydrogeologic Survey of Chupadero Area. The numerous faults located to the north of Rio Chupadero can act as barriers to lateral groundwater flow. This can limit the long-term production capability of groundwater supply wells located within the faults area. Historically, Chupadero has had four groundwater supply wells (see Section 2.0 – Existing Facilities). Historically, fluoride and uranium concentrations have been detected in two of the wells (Well #1 and Well #3) which has prevented use of these wells in the past. Many of the residences in Chupadero still have private groundwater supply wells. They are used for individual potable supply or for irrigation. According to the DBS technical memo, shallow wells in the area produce 5 to 80 gpm and depth to water varies from 10 to hundreds of feet. The thickness of the coarse-grained materials in the aquifer can also affect well productivity. This thickness in the shallow wells varies from 50 to 300 ft., per the DBS technical memo. Groundwater flow is predominately to the southwest.

Chupadero's water supply wells are located in the Nambe-Pojoaque, which has been closed by the Office of the State Engineer as part of the regional March 2016 Aamodt Settlement with area tribes. During a drought in 2012, Chupadero's shallow Well #2 went dry and their deeper Well #4 only produced an average of 3,000 gallons per day (gpd). A new well, Well #5, was drilled in 2019 on the northern end of the service area. Wells #2 and #4 are privately owned wells that were allowed to be used by Chupadero. After Well #5 was installed, these wells were returned to their private owners and are no longer used by Chupadero.

1.2.2 GEOLOGY

The upper 8 ft. of surface geology can be identified by a Soil Resource Report obtained from USDA Natural Resource Conservation Service (NRCS). This report is provided in Appendix B. The NRCS report indicates that the area of the existing water system is comprised primarily of loams, which can include very fine sandy loam and very cobbly sandy loam. At depths greater than 7 ft., the loams can change to sands.

The surface geology of the area has been documented in a study conducted in 2003 by Claudia I. Borchert et al, Geologic Map of the Tesuque Quadrangle, Santa Fe County, New Mexico, published by the New Mexico Bureau of Geology and Mineral Resources for open file digital Geologic Map 47. The geologic map and a blowup of Geologic Map 47, that more clearly shows the Chupadero area, is provided in Appendix B. Soils in the immediate area of the Rio Chupadero are identified as Quaternary Alluvium (Qal) consisting of poorly sorted sands and silts. To the north of the Rio Chupadero, the soils change to Tertiary Tesuque formations consisting of Lithosome A (Ttan, Nambe member of the Tesuque formation Santa Fe Group) and Basalt (Ttnb) in the lower Nambe member. Numerous fault lines have been identified in this formation. To the south of Rio Chupadero exists the same Tertiary Tesuque formations consisting of Lithosome A (Ttan) and smaller areas of Quaternary Gravel of ancestral Rio Chupadero (Qgc) Pleistocene era and also of the assumed Upper Pleistocene era (Qgc2).

1.2.3 WETLANDS

A wetlands inventory map was obtained (provided in Appendix B) from the U.S. Fish & Wildlife Service National Wetlands Inventory. Rio Chupadero is identified as a riverine habitat, and several freshwater forested/shrub wetlands have been identified along Rio Chupadero. Proposed work that crosses Rio Chupadero will take place in previously disturbed lands along existing roadways.

1.2.4 FLOODPLAINS

A FEMA Flood Insurance Rate Map (FIRM) of the Chupadero area was obtained and is provided in Appendix B. The map indicates that the area of the Rio Chupadero is prone to flooding by 100-year storms. Any future improvements and construction work that occurs in the area identified on the FIRM will need to consider the potential for flooding.

1.2.5 BIOLOGICAL CONSIDERATIONS

A list of endangered and threatened species for Santa Fe County, New Mexico was downloaded from the U.S. Fish & Wildlife Service (provided in Appendix B). Potential endangered species in the area includes the New Mexico Jumping Mouse and the Southwest

Willow Flycatcher. Potential threatened species includes the Mexican Spotted Owl and the Yellow Billed Cuckoo. Potential critical habitats were not identified in the list. Migratory birds are protected under several historical acts and treaties. The majority of the identified migratory birds breed from March to September. Construction work occurring during this period of time would need to be cognizant of the potential for nesting migratory birds identified in the list.

1.2.6 CULTURAL CONSIDERATIONS

Some homes in Chupadero date back over 150 years. The list of historic sites was reviewed at the New Mexico Preservation Division Cultural Resources website. There were no historic sites identified in Chupadero.

1.3 POPULATION TRENDS

Demographic data for the Chupadero area was estimated using the American Community Survey (ACS), the U.S. Census Bureau, and the University of New Mexico Bureau of Business and Economic Research. Population data for 2000, when Chupadero became a Census Designated Place (CDP), is from the U.S. Census Bureau. Population data for 2010 and 2020 was estimated using the ACS 5-year estimate of average household size in the Chupadero CDP. Population data for Chupadero is provided in Table 1 and a graph of the estimated population is provided in Figure 1.

The ACS 5-year estimate of population showed a decrease in population in Chupadero between 2010 and 2020 despite a steady increase in the number of households from 2000 to 2020. This estimate does not appear to be correct as Chupadero has indicated there has not been a loss in population in the community. Additionally, the ACS reported that Chupadero had 236 households in 2023, an increase of 88 households over only three years. This almost 60% increase in households over three years is substantially greater than the population growth reported over previous decades. Because of this, the number of households in 2025 was instead estimated by averaging the yearly percent increase in households in the Chupadero CDP, or 0.88% per year. The estimated capita per household was calculated using the average reported value of 2.33 persons per household based on reported values for 2000, 2010, and 2020. These estimates in household growth and capita per household were used to project population growth for 2035 and 2045. Since Chupadero is located within a closed water basin and Chupadero stopped accepting new members in 2012 (due to lack of sustainable water sources), population growth is not anticipated to be at a higher rate.

Table 1: Chupadero Census Designated Place Population Information

Year	Population	No. of Households	Capita/Household
2000	318[1]	125[1]	2.54[1]
2010	372[2]	137[3]	2.71[3]
2020	257[2]	148[3]	1.73[3]
2025	361	155	2.33
2035	394	169	2.33[4]
2045	429	184	2.33[4]

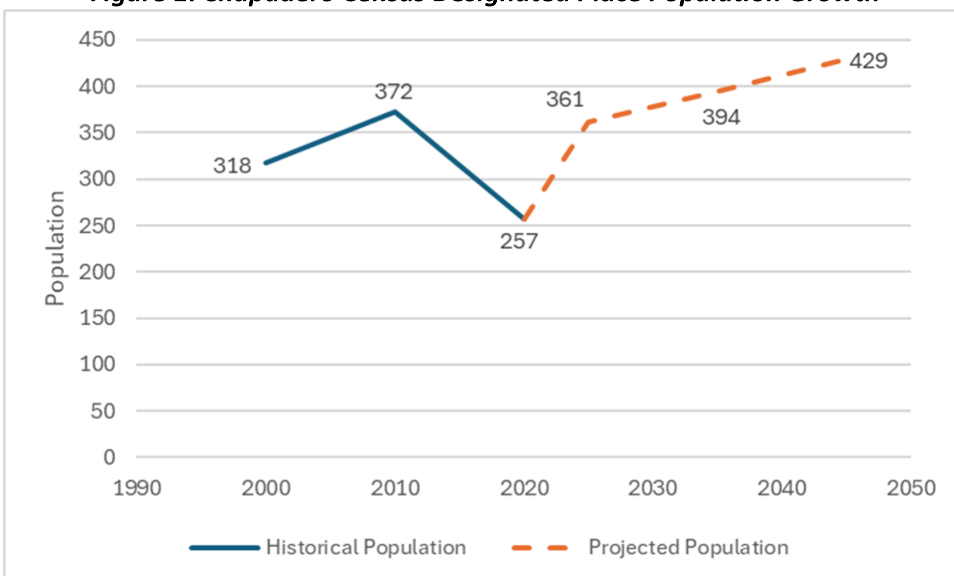
[1] Estimated using the 2000 U.S. Census report

[2] Estimated using the number of households and capita per household reported in the ACS 5-year estimate for the respective year in the Chupadero CDP

[3] As reported in the ACS 5-year estimate for the respective year in the Chupadero CDP

[4] Average capita per household for 2000 – 2023

Figure 1: Chupadero Census Designated Place Population Growth



2.0 EXISTING FACILITIES

Chupadero currently owns and operates a public water system (NMED System No. NM3566026), which was originally constructed in 1976. The water system consists of one 20,000-gallon water storage tank, one groundwater supply well, an alpha particle treatment system and one master meter/electrical vault, one well house, 3-inch PVC water main, 2-inch PVC laterals, a single pressure reducing valve, isolation valves and radio read water meters. There are currently 54 active connections with 56 active customers (some meters currently shared). The Board believes there may be as many as 10 additional illegal connections. A map of the service area and a map of the existing and historical water system is provided as Figures 2 and 3, respectively, in Appendix A.

2.1 HISTORY

The Chupadero Board was formed in 1974 and the water system was first constructed in 1976. It originally consisted of the storage tank, piping and most of the 54 service connections noted above. Well #1 was constructed in 1977. Well #1 developed a reportable concentration of fluoride and production reportedly dropped off.

In 1986, the New Mexico State Health Department requested in writing that Well #1 be shut down even though the concentration of fluoride was apparently just above the State standard (4.22 mg/L vs. 4.0 mg/L). In 1987, Chupadero drilled a shallow (65 ft.) replacement well (current Well #2) under a private permit at the property of David Roybal, a historical Chupadero Board member.

In May 2002, a PER for Chupadero was prepared by DBS. In the PER DBS indicated that Well #2 had decreased in production in recent years and that in 2002 the water level dropped below the pump intake and the pump burned out. The 2002 PER recommended the following alternatives:

- Drill new well.
- Provide chlorination for disinfection.
- Add a second water storage tank.
- Move water main outside of paved roadway.
- Use C900 PVC for new water main.
- Replace water meters.

Public concerns identified in the 2002 PER included:

- Water quality and quantity.
- Firefighting capability.
- Water rate increases.
- Loss of members and decreased revenues.

A proposed project from the 2002 PER was a new well that was eventually funded and constructed in 2003. Non-funded proposed tasks in the 2002 PER were new water storage tank, improvements to storage tank access road, replacement of distribution piping and appurtenances, installation of a disinfection system and installation of new system-wide metering.

In May 2002, DBS prepared preliminary design plans for a new supply well and improvements to the existing water storage tank site. A new well (Well #3), with well house, was subsequently constructed in 2003 (under emergency status) to a depth of 530 ft. Well #3 was used for approximately 3 months when uranium was detected, and production dropped dramatically. Well #3 was taken offline and shallow private Well #2 again became the sole source of supply for Chupadero. A new well (Well #4) was subsequently drilled beside Well #2 to a depth of 300 ft.

In May 2002, Chupadero filed an application to the OSE to discontinue use of 39.7 acre-ft. per year (AFY) from 21 private domestic wells and transfer those rights to Chupadero. In 2007 OSE partially approved the application by granting 12.59 AFY for Wells #2 and #3. Chupadero subsequently filed a grievance letter and in 2008 dispute mediation was stayed.

Chupadero's water supply wells are located in the Nambe-Pojoaque Basin, which was closed by the OSE as part of the regional March 2016 Aamodt Settlement with area tribes. During a drought in 2012, Chupadero's shallow well went dry and their deeper well was only producing 3,000 gpd. At this time, Chupadero stopped accepting new members.

Due to the aging of members of the Chupadero Board and their operator, and the lack of interest in the community for younger members to take over these roles, Chupadero requested that Santa Fe County take over their water system. On July 23, 2012, the Chupadero Board approved incorporating their service area into the County utility's water service area. On September 25, 2012, Santa Fe County approved a resolution to incorporate the Chupadero service area into the County's as well as committing to execute the proper legal instrument for transfer of water assets and infrastructure to the County. The final transfer is planned to take place upon completion of the needed water system improvements identified in this report.

In July 2013, a Chupadero Water System Analysis and Water Right Evaluation was prepared for Santa Fe County by Southwest Water Consultants, Inc. to analyze the system and to estimate the monetary value of Chupadero's water rights.

In 2013, Chupadero negotiated a water rights settlement of 20.096 AFY (equivalent to an average of 17,939 gpd) with the OSE. An extension of time must be filed every three years with OSE until that volume is pumped in one calendar year. That volume has not been able to be pumped by the system since that time due to low production from Wells #2 and #4.

In 2014, the water supply situation in Wells #2 and #4 improved and members have been on a voluntary water use reduction program since that time. New members are still not allowed to date.

In 2018, a PER was prepared for Chupadero by Martin/Martin Inc. The report identified many of the same concerns as identified in the 2002 PER. Despite the emergency construction of Well #3 in 2002, low production and the presence of uranium meant Chupadero had returned to relying on

Wells #2 and #4 as the primary source of water for the community. The 2018 PER recommended the following alternatives:

- Installation of a new well on the Jiminez property on the western end of the service area.
- Installation of a sodium hypochlorite disinfection system at the storage tank site.
- Storage tank improvements including refurbishment and installation of a ladder safety cage and locking cage door
- Rehabilitation, transport and installation of the 20,000 gallon offsite water storage tank.
- Purchase and installation of a third 20,000 gallon water storage tank.
- Installation of a dedicated 3-inch diameter PVC or HDPE dedicated fill line from the wells to the storage tanks.
- Installation of an 8-inch PVC or HDPE water main and 3-inch PVC or HDPE water laterals.
- Installation of an 8-inch PRV station with a 4-inch PRV bypass line.
- Installation of fire hydrants along the distribution main and at the Tesuque Fire Department building.
- Installation of flush hydrants at the ends of the distribution main and/or laterals.

In 2019 a new well, Well # 5, was dug on the northern end of the Chupadero service area. Analytical samples were collected, and showed the only analyte exceeding drinking water standards was alpha particles. A packaged alpha particle treatment system using ion exchange adsorptive media for uranium was constructed on the easement to treat the water from Well #5. Treatment building construction was completed in 2024. Well #5 is currently serving as the primary water source for Chupadero and use of Wells #2 and #4 was discontinued for the Chupadero service area.

2.2 CONDITION OF EXISTING FACILITIES

Martin/Martin, Inc. met on-site with Chupadero and Santa Fe County on December 27, 2017 to discuss and observe the existing facilities.

<u>Groundwater Supply Wells</u>

Groundwater supply Wells #2 and #4 have previously been used as the water source for Chupadero. Both these wells were originally private wells that were provided to Chupadero for community use. An Agreement is in place that once Santa Fe County takes over the Chupadero system these two wells will be returned to the original owners along with 0.5 ac. ft./yr. water rights. Well #1 is no longer owned by Chupadero and Well #3 is not in use because of low production and the presence of uranium.

Groundwater supply well #5, which was completed in 2019, is now being used as the water source for Chupadero. The well is located on the northern side of the service area off Los Jiminez Rd; the site also houses a treatment building constructed in 2024. The well was dug to a depth of 420 ft and has a depth to water of 84 ft. A 5 HP pump capable of producing 20 gpm was installed. Water is pumped from the well, through the alpha particle treatment system housed in the treatment building, and then down to Don Filomeno Road where it connects to the water main. There is not a dedicated fill line to the water storage tank on the eastern side of the service area. The wellhead is surrounded by a 6 foot security fence. Photo 1 shows Well #5, the security fence enclosure and the treatment building in the background.

Photo 1: Well #5

With the completion of Well #5, Wells #2 and #4 were returned to the original owners and no longer serve as a water source for the Chupadero system.

<u>Well Production/Water Demand</u>

Well #5 has a 5 HP pump and a production rate of 20 gpm.

Chupadero provided well diversion readings that have been submitted to OSE. The monthly reported readings were used to calculate an average day demand for the system for 2014 through 2017. The highest average day demand in that time period was 10,666 gpd in October 2017. The lowest average day demand in that time period was 3,154 gpd in March 2017. Please note an average daily demand of 16,658 was calculated for September 2015 but this value is suspect and was not used as it differs considerably from all the other well diversion data. The above reported demands appear similar to other calculated average day system demands and is typical of water systems, with lowest demand in the winter months and highest demand in the summer months.

<u>Water Storage Tank</u>

The existing 20,000-gallon water storage tank is located near the top of a hill to the east and above State Highway 592. The access road to the tank is steep and limits the access of large vehicles. The original tank and pipeline easement date back to 1977. The tank was not built in the location provided in the easement; it was constructed further to the west. In 2014, the current owners of the property applied to Santa Fe County to vacate the current easement and create a new easement that incorporates the existing location of the tank and pipeline. The application was approved by the County in 2014. It is understood that the new tank and pipeline easement prepared in 2014 has not yet been finalized and recorded with the County.

During the 2017 site visit, it was observed that the exterior of the tank appeared in good condition. At the time, the tank did not have adequate security measures in place. Since the visit, it is reported that the security measures recommended in the 2018 PER have been installed. These measures included a safety cage with improved fall protection apparatus for the exterior ladder, a locking ladder access hatch, and the completion of the security fence around the tank site. The tank does not have markings for its external level reader. The tank is equipped with a float level sensor that communicates via radio with groundwater supply pumps to fill the tank. Photographs of the existing tank taken during the 2017 site visit are provided below:

Photo 2: Water Storage Tank (2017)

Photo 3: Tank Access Road (2017)

Chupadero provided a video of an internal tank inspection conducted by Inland Potable Services, Colorado. Chupadero thinks the inspection was over 10 years old when provided to Martin/Martin in 2018. The tank inspection video viewed by Martin/Martin, Inc. indicates that the paint on the inside of the tank is peeling off in multiple places, there is some corrosion and rust spots on the floors and walls and paint "blisters" were visible on the tank floor. Select photographs of the video are provided below.

Photo 4: Old Tank Inspection Fill Pipe

Photo 5: Old Tank Inspection Interior Paint

Since the previous tank inspection videos indicated there are items of concern within the tank, a new tank inspection was conducted as part of the PER prepared in 2018. CW Divers Farmington, New Mexico, were contracted to perform an inspection of the existing 20,000-gallon tank. The new inspection was performed on February 1, 2018. The results of the 2018 inspection indicate:

- Tank interior requires sandblasting and repainting with NSF 61 approved paint.
- Corrosion is uniform and measurable corrosion not identified therefore interior welding repairs not anticipated.
- Interior ladder has some corrosion that can be repaired by repainting.
- Exterior ladder requires safety cage and improved fall arrest.
- Vegetation around tank foundation will be removed.

Select photographs of the 2018 tank inspection are provided below:

Photo 6: Tank Inspection Interior Ceiling (2018)

Photo 7: Tank Inspection Interior Wall at Floor (2018)

A video of the tank has not been taken since 2018, so there are not updated photos of the tank's condition. It is assumed the tank is in no better condition than observed in 2018 and may be in worse condition.

Chupadero purchased a used 20,000-gallon storage tank in 2009. The tank is located at D&R Tank in Albuquerque. D&R provided a quote of $24,000 in 2009 to rehabilitate the tank and move it to a new location. Martin/Martin, Inc. contacted D&R Tank in April 2025 to confirm the tank is still stored at their yard and to obtain a revised quote for rehabilitation, transport and erection. After coordination with D&R Tank, they have not confirmed that they still have the previously purchased tank or provided an updated quote for rehabilitating the tank and installing it at Chupadero.

Distribution System

The distribution system consists of 3-inch PVC pipe that starts at the existing storage tank, travels approximately 320 ft. down a hill to the east side of State Highway 592, travels approximately 270 ft. north on the east side of State Highway 592, crosses the State Highway to the west at the intersection of County Road 78 and then travels west within the north side of County Road 78 to Los Jimenez Road (see Figure 3, Appendix A). This total route is estimated to be approximately 7,300 ft. long. There are three 2-inch PVC laterals that branch off the water main to the west at Abs Road (Wells #2 and #4 connection to main), Florencio Road and Camino de Pastores. The estimated length of the 2-inch laterals is 2,600 ft. There is a pressure reducing valve (PRV) located in the middle of County Road 78 just east of the intersection of Florencio Road. An isolation valve is located on the east side of the PRV. Main and lateral isolation valves are also located at the intersections of County Road 78 and Abs Road and Camino de Pastores. There are three 2-inch flush hydrants located within the system (see Figure 3, Appendix A). One flush hydrant is located beside Tesuque Fire Department Station No. 2. The other two flush hydrants are located within the water system, not at the ends of the water main or laterals as would normally be the case in order to flush entire pipe segments. There is also a lateral that connects at the Tesuque Fire Department building and travels south approximately 930 ft. to service two homes. It is assumed this lateral is 2 inches in diameter and is PVC as is the rest of the piping system.

Photographs of the water main appurtenances are provided below:

Photo 8: Pressure Reducing Valve Station

Photo 9: Water Main/Lateral Isolation Valves

Photo 10: Flush Valve at Tesuque Fire Station No. 2

County Road 78 pavement ends just west of the intersection with Camino de Pastores. At that point the County Road ends and becomes a private gated dirt road. The beginning of Abs Road, Florencio Road and Camino de Pastores are paved approximately 50 ft. or less and then the roads become dirt/gravel.

Chupadero has reported a number of leaks occurring in their water main and at some of their isolation valves. An assumed leak (wetted surface extending approximately 20 ft.) was observed by Martin/Martin, Inc. on Camino de Pastores Road during the field reconnaissance conducted on December 27, 2017. In 2024, it was reported that the leak is no longer present. Chupadero has also reported that there may be as many as 10 illegal connections and laterals on their water main.

A 2018 photograph of the suspected leak is provided below:

Photo 11: Observed Apparent Leak on Camino de Pastores (2018)

Chupadero does not have utility easement permits with either NMDOT or Santa Fe County for the water main. A 20-foot-wide pipeline easement was granted to Chupadero in 1977 by landowners for two roads located within the community. According to the named landowners in the easement these roads are assumed to be Camino de Pastores and Florencio Road.

In 2018 Santa Fe County hired a surveyor, Morris Surveying Engineering, Santa Fe, New Mexico, in an effort to document private properties and easements in Chupadero with respect to the water main and laterals. The results of the survey indicate that properties are not consistent for utility or roadway easements. It appears portions of roads are at times are located within private properties and at other times portions of roads are not included within any property and may have no legal owner.

<u>Service Meters</u>

Prior to the 2018 PER, Chupadero replaced old water meters with new radio read meters. Chupadero uses a set monthly rate for customer billing. A photograph of one of the new water meters is provided below.

Photo 12: Water Service Meter (2018)

2.3 FINANCIAL STATUS OF ANY EXISTING FACILITIES

The 2024-year end financial statement for Chupadero was provided by their accountant and is provided in Appendix D. As indicated in the statement:

- The income from water bills was $47,044.97.
- Well repairs expenditure was $15,680.43
- Operations and maintenance cost was $13,394
- Electricity cost was $1,128.30
- The net income for 2024 was a negative $7,351.98.

The 2025 budget projects:

- Revenues - $141,338
- Expenditures - $141,160
- Ending balance - $66,072
- Reserves - $61,000
- Ending cash balance - $5,072

Chupadero does not have any debt reserve or required reserve accounts. The 2025 reserve budget is for operations, emergency and capital improvements. The current monthly service billing flat rate is approximately $70/month.

2.4 WATER/ENERGY/WASTER AUDITS

Chupadero has indicated that a water/energy/waste audit has been completed since 2018, however, the audit information was not provided to Martin/Martin at the time of this PER. Water audits have been conducted in the area by the OSE in determining water rights and beneficial use as part of the Aamodt Settlement with area tribes and the closure of the Nambe-Pojoaque water basin to new water right appropriations.

3.0 PROJECT PURPOSE AND NEED

3.1 HEALTH, SANITATION, AND SECURITY

Health and sanitation needs for the project includes:

- A disinfection system to provide a compliant and safe potable water supply for distribution.
- A dedicated water supply pipe and water distribution system.
- Large enough water storage, water main and fire hydrants for fire flow.

Addition of a disinfection system is expected to provide sustainable safe drinking water for the community. Chupadero does not currently disinfect their potable water supply and although still in regulatory compliance, one non-compliant water sample could instigate the requirement for a disinfection system.

Separation of the supply pipe and water distribution system into dedicated pipes is expected to improve the capability of the water system. A dedicated supply pipe between Well #5 and the water storage tank is expected to promote water turnover in the water storage tank and mitigate concerns with water age. Installation of isolation valves on the supply pipe and distribution system allows for the isolation of lines for O&M purposes. Separation of the systems allows for O&M to be completed on the supply line without impacting the distribution system, increasing resilience and water security of the system.

Tesuque Fire Department Station No. 2 is located along State Hwy 592 just below the Chupadero water storage tank site. A 2-inch flush hydrant is located on the water transmission pipe beside the fire station. Having fire storage, pipe fire flow capability and a fire hydrant located beside the fire station will greatly benefit Chupadero, as well as the surrounding communities that are served by the fire station.

The Chupadero water system is inspected annually by the NMED Drinking Water Bureau (DWB). The latest NMED DWB Sanitary Survey Report, dated April 2024, indicated six significant deficiencies and one recommendation for a minor deficiency. The identified significant deficiencies were:

- Lack of or inadequate system maps.
- Lack of or inadequate written sampling plans for regulated constituents. Failure to follow a sampling plan.
- No water level indicator for storage facility.
- Lack of an Emergency Response Plan.
- Lack of or inadequate operations and maintenance plan or operational policies.
- No inspection of the storage facility (recommended every three years).

A copy of the referenced 2024 NMED DWB Sanitary Survey Report has been requested from Chupadero, but was not received at the time of this report.

Establishing documented and recorded legal easements and acquiring utility permits from NMDOT, and potentially Santa Fe County, for the water main and laterals is necessary for Chupadero to have legal access to property and public right-of-way for future water system improvements construction and operation and maintenance.

3.2 AGING INFRASTRUCTURE

The Chupadero water system is over 45 years old. In recent years there have been multiple water leaks and the water system has trouble keeping up with the current needs and demand. Water main isolation valves are leaking and/or inoperable. Based on review of the over 17-year-old storage tank video, the storage tank will require interior re-painting and repair of the tank level indicator. In 2018, inoperable water service meters were replaced as part of a total water service meter replacement project, in collaboration with Santa Fe County. Continual aging of the existing infrastructure over the 20-year PER planning period will most likely increase the level of operation and maintenance required as well as pose greater health and sanitation risks to the community.

3.3 REASONABLE GROWTH

Recent growth in the Chupadero community has been hindered by the OSE closure of the Nambe-Pojoaque water basin as well as Chupadero's need to prohibit new memberships in 2012 due to drought and unsustainable water supply. As indicated in Section 1.3 – Population Trends of this report, population growth in Chupadero and Santa Fe County is anticipated to be fairly flat over the next 20 years, when compared to historical population growth for the past 40 years. Future population growth in Chupadero will be limited by the available water supply. Chupadero has indicated that as many as five additional residences have shown interest in becoming members of the water system and as many as 10 illegal connections to the water system may exist. It is very likely that some other existing residences, and potentially 10 to 20 new residences, will apply for new memberships once Chupadero is able to accept new customers. Ten additional members added after completion of an improvements project would increase the total number of customers by 18% and would help support future system financial requirements.

4.0 ALTERNATIVES ASSESSMENT

There are multiple alternatives to consider for improving the Chupadero water system. Alternatives evaluated include:

- Improving disinfection and treatment.
- Improving water storage.
- Improving transmission and distribution.

4.1 ALTERNATIVE NO. 1 – GROUNDWATER SUPPLY WELLS

4.1.1 DESCRIPTION

Well #5 is meeting the needs of the corporation at this time. If population growth continues as discussed in Section 1.3, a supplemental well could be investigated. However, a supplemental well is not planned at the time of this report.

4.2 ALTERNATIVE NO. 2 – DISINFECTION AND TREATMENT

Disinfection of a water supply prior to storage is required when a periodic required analytical test result indicates the presence of coliforms in the water supply. Most water systems do not wait for a failed coliform test to disinfect the water supply. It is recommended to add disinfection, using sodium hypochlorite, to the water system.

A packaged alpha particle treatment system was constructed in 2024 following the detection of alpha particles in the newly constructed Well #5. No other analytes of concern were detected at regulatory levels in Well #5.

4.2.1 DESCRIPTION

Disinfection of the stored water supply using sodium hypochlorite can be accomplished with a packaged system that includes a small storage tank and peristaltic pump system. The disinfection system would need to be installed after the wells and before the storage tanks. Therefore, due to the locations of the multiple existing and future wells, it is recommended to install the disinfection system at the storage tank site. Installing the disinfection system in an underground vault is expected to be more cost effective than a small heated building. As the existing tank level control radio system obtains electrical power from the Tesuque Fire Department building, it is assumed the low power requirement for a pump and light for the disinfection system can also be obtained from the fire department building; otherwise solar power may be utilized. A flow switch can be installed in the well supply piping at the storage tank site such that the disinfection system only operates when new water is pumped to the storage tanks.

4.2.2 DESIGN CRITERIA

The design criteria for this alternative includes NMED DWB and Santa Fe County regulations and standards.

4.2.3 MAP

A map of this alternative is provided as Figure 5 in Appendix A.

4.2.4 ENVIRONMENTAL IMPACTS

Environmental impacts are not anticipated for this alternative since construction would take place in previously disturbed locations that has regular foot and vehicle traffic.

4.2.5 POTENTIAL CONSTRUCTION PROBLEMS

There are no apparent potential construction problems with this alternative.

4.2.6 LAND REQUIREMENTS

Additional land is not expected to be required for this alternative.

4.2.7 SUSTAINABILITY CONSIDERATIONS

4.2.7.a WATER EFFICIENCY

This alternative does not provide additional water efficiencies.

4.2.7.b ENERGY EFFICIENCY

The disinfection and treatment systems described in this alternative use very little power to operate, thus providing energy efficiency for their use.

4.2.8 COST ESTIMATES

The engineer’s cost estimate for this alternative is provided in the following table. A summary of this cost alternative, including both a disinfection and uranium treatment system, is provided below.

Construction Cost: $84,950
Non-Construction Cost: $28,018
Present Value 20 Year O&M Cost: $35,076
Total Life Cycle Cost: $148,043

Table 2: Disinfection and Treatment Alternative Cost Estimate

Planning Period = 20 yr.			**Federal Discount Interest Rate=**		2.50%
Construction Cost					
Item	**Description**	**Unit**	**Qty**	**Unit Cost**	**Total Cost**
1	Mobilization/Demobilization	LS	1	$ 6,000	$ 6,000
2	Testing Allowance	Allow	1	$ 5,000	$ 5,000
3	Chlorination Pump, Tank, Vault, Electrical	LS	1	$ 50,000	$ 50,000
				Subtotal	$ 61,000
		Contingency[1]		30%	$ 18,300
		NMGRT		7.125%	$ 5,650
				Construction Cost Total	**$ 84,950**
Non-Construction Cost					
Engineering Design, Bid & Construction Services				25%	$ 21,238
Geotechnical Study					$ 5,000
		NMGRT		6.785%	$ 1,780
				Non-Construction Cost Total	**$ 28,018**
				Total Capital Cost	**$ 112,968**
Annual O&M Cost					
Sodium Hypochlorite					$ 500
Utilities - Electrical					$ 1,750
				Total Annual O&M cost	$ 2,250
20 Yr. Present Value of O&M Cost					$ 35,076
				Total Life Cycle Cost	**$ 148,043**

[1] A Contingency of 30% was applied due to uncertainty in cost increases from inflation and tariffs

4.2.9 ADVANTAGES/DISADVANTAGES

Advantages:

- Disinfection allows Chupadero to provide a safe supply of potable water for its customers.
- If Chupadero decides not to disinfect their potable water at this time this alternative, if implemented, would still allow Chupadero to start the disinfection system whenever they desired.

Disadvantages:

- Customers may object to the taste of disinfected water if the chlorine residual concentration is maintained at too high a level.
- Additional operator time will be required to monitor and maintain disinfection system.
- Disinfection system requires long term O&M costs which typically results in increased customer rates.

4.3 ALTERNATIVE NO. 3 – WATER STORAGE

Chupadero has planned to add additional water storage for over 16 years. They purchased a matching storage tank in 2009 and received a quote at that time from D&R Tank to refurbish the tank and move it to their site. In April 2025, Martin/Martin requested confirmation from D&R that the tank is stored on their lot as well as obtain an updated quote for tank rehabilitation and installation on site. At the time of this report, D&R has not confirmed the tank is stored on their lot or provided an updated quote.

In order to provide service for 75 connections at 200 gpd per connection, store 2 days of demand and 30,000 gal. for fire flow, a total of 60,000 gal. of storage is required. Chupadero would require a 40,000 gal. tank. Chupadero may be able to purchase another used tank for refurbishing but at this time it is assumed a new 40,000 gal. storage will be required.

4.3.1 Description

The easement for the existing storage tank site and access road needs to be finalized and executed for this alternative. The existing 20,000 gal. storage tank will be rehabilitated by sandblasting and re-painting the interior. A new 40,000 gal. storage tank will be erected on site beside the existing tank. The new tank will be sized such that it has the same height as the existing tank. A new ring foundation, set at the same elevation as the existing tank foundation, will be required for the new tank. A geotechnical study will be required for the new tank foundation. The tank site and access road will be regraded to remove vegetation and to control stormwater and erosion. A rip rap stormwater swale will be constructed on the north side of the access road from the tank site to State Highway 592 where it would discharge to an existing drainage channel. After re-grading the tank site will be provided with a geotextile fabric overlain with a gravel surface to control vegetation on the site. The new tank would be piped to the existing tank such that both tanks fill and empty in unison. Both tank overflows and drains will be valved and piped to the new stormwater swale. The existing security fence will be extended to surround the new water storage tank. The existing radio-controlled tank level sensor will remain. The water level in both tanks will be maintained such that 30,000 gal. of fire flow is available at all times. The second tank will be erected onsite and placed in operation prior to improvements to the existing tank taking place.

4.3.2 Design Criteria

Design criteria for this alternative includes American Water Works Association (AWWA), NMED DWB and Santa Fe County regulations, standards and recommendations.

4.3.3 Map

A map of this alternative is provided as Figure 6, Appendix A.

4.3.4 Environmental Impacts

Environmental impacts are not anticipated for this alternative as construction would take place on previously disturbed areas.

4.3.5 Land Requirements

There are no additional land requirements for this alternative.

4.3.6 Potential Construction Problems

Transporting the additional tanks up the steep dirt access road for erection on the existing tank site may require that the additional tanks be brought in pieces and re-welded onsite during erection.

4.3.7 Sustainability Considerations

4.3.7.a Water Efficiency

Utilizing a second tank to double the available storage volume and provide fire flow storage for Chupadero provides for a more efficient and sustainable water system.

4.3.7.b Energy Efficiency

Filling tanks in the nighttime hours can be planned as the cost of power is less during these hours.

4.3.7.c Other

There are no other efficiencies associated with this alternative.

4.3.8 Cost Estimates

The engineer's cost estimate of this alternative is provided in the table below and is summarized as follows:

Construction Cost: $773,716
Non-Construction Cost: $273,828
Present Value 20 Year O&M Cost: $38,973
Total Life Cycle Cost: $1,086,517

Table 3: Storage Tanks Alternative Cost Estimate

Planning Period = 20 yr.			**Federal Discount Interest Rate=**		2.50%
Construction Cost					
Item	**Description**	**Unit**	**Qty**	**Unit Cost**	**Total Cost**
1	Mob/Demob	LS	1	$ 55,000	$ 55,000
2	Testing Allowance	ALLOW	1	$ 15,000	$ 15,000
3	Rehab Onsite Tank	LS	1	$ 75,000	$ 75,000
5	New 40K gal. Storage Tank, CIP	GAL	40,000	$ 7	$ 280,000
7	New Tank Foundation	CY	46	$ 1,600	$ 73,600
8	Tank Interconnection Piping & Appurtenances, CIP	LF	200	$100	$ 20,000
9	Regrade Site & Road	LS	1	$ 18,750	$ 18,750
10	Geotextile Fabric/Gravel Surface Tank Site	LS	1	$ 2,500	$ 2,500
11	Rip Rap Swale	LF	350	$ 50	$ 17,500
				Subtotal	$ 557,350
		Contingency[1]		30%	$ 167,205
		NMGRT		6.785%	$ 49,161
				Construction Cost Total	**$ 773,716**
Non-Construction Cost					
	Engineering Design, Bid & Construction Services			25%	$ 193,429
	Geotechnical Study				$ 8,000
	Private Property Easement Coordination				$ 25,000
	Survey				$ 30,000
		NMGRT		6.785%	$ 17,399
				Non-Construction Cost Total	**$ 273,828**
				Total Capital Cost	**$ 1,047,544**
Annual O&M Cost					
Maintenance					$ 2,500
		Total Annual O&M cost			$ 2,500
	20 Yr. Present Value of O&M Cost				$ 38,973
				Total Life Cycle Cost	**$ 1,086,517**

[1] A Contingency of 30% was applied due to uncertainty in cost increases from inflation and tariffs

4.3.9 Advantages/Disadvantages

Advantages:

- Increased volume of available potable water.
- Provides fire flow storage capacity which is expected to lower homeowner fire insurance rates.
- Matching tanks aids in O&M.

Disadvantages:

- The water system must maintain 30,000 gal. fire flow capacity at all times.
- In order to provide two days of demand and fire flow storage, only 75 connections can be served (at a demand of 200 gpd/connection) with a 60,000 gal. storage system.

4.4 ALTERNATIVE NO. 4 – TRANSMISSION AND DISTRIBUTION

The existing single water transmission/distribution pipe will be replaced with a dedicated fill pipe and a separate transmission distribution main to improve its capabilities as well as to improve its operation and longevity.

4.4.1 Description

The existing single 3-inch water main/transmission pipe will be replaced with a 3 inch high density polyethylene (HDPE) dedicated fill pipe from wells to storage tanks and a new 8 inch HDPE water main will be provided for water transmission and distribution. Both pipes will be provided with new isolation valves so segments of the pipe can be isolated for O&M purposes. The existing PRV will be replaced and will include two PRVs, one 8-inch diameter. for large flows and one 4-inch diameter for smaller flows. New piping will be placed under the northern edge of County Road 78. The Santa Fe County Public Works Dept. has indicated that 4 ft. of the northernmost edge of County Road 78 may be used for placement of the new piping. The new piping is unable to be installed outside of the pavement due to both the lack of individual property easements and physical constraints located along the roadway. New piping installed by drilling beneath State Highway 592 will need to be encased in a steel sleeve and a NMDOT District 5 right-of-way utility permit will be required prior to construction. It is also anticipated that a utility easement will also be required from Santa Fe County for County Road 78. Easements from property owners along County Road 78 may also be required in the case of historical prescriptive easements that extend into the limits of County Road 78. Existing County Road 78 pavement will be demolished and replaced as part of the construction process. Piping laterals installed on side roads will include replacement of gravel disturbed during construction activities. The use of directional drilling along County Road 78 is not anticipated to provide a cost savings over pavement demolition and replacement due to the number of short curves in the roadway, the lack of physical space to setup drilling equipment and the short length of the project. New fire hydrants will be spaced at 1,000 ft. maximum intervals along the distribution main on

County Road 78 and will also be located at the Tesuque Fire Dept. building. Flush hydrants will be installed at piping lateral ends. Existing customer water service connections will be connected to the new water main and laterals. A geotechnical study will be conducted along County Road 78 for the PRV vault foundation and to aid in identification of potential subsurface anomalies that could affect construction, such as caliche, boulders and bedrock. Traffic control and control plans will be required for State Highway 592 and County Road 78.

4.4.2 Design Criteria

Design criteria for this alternative includes NMED DWB and Santa Fe County regulations, standards and guidelines. Permits required will include Santa Fe County and NMDOT traffic control plans and a stormwater pollution prevention plan (SWPPP) due to the disturbance of more than one acre of land.

4.4.3 Map

A map of this alternative is provided as Figure 7 Appendix A.

4.4.4 Environmental Impacts

Environmental impacts are not anticipated for this alternative as construction will take place in active highways and roads.

4.4.5 Land Requirements

This is no additional land requirement expected for this alternative other than the easements that will need to be obtained prior to construction.

4.4.6 Potential Construction Problems

Potential construction problems for this alternative include subsurface conditions that could hinder construction progress. A geotechnical study conducted for the new piping routes would assist in the determination of potential problems.

4.4.7 Sustainability Considerations

4.4.7.a Water Efficiency

A new 6-inch water main will hold a volume four times greater than the existing 3-inch pipe that is currently in use. It will also hold a volume equal to approximately 80% of the estimated daily use of the system. This alternative will provide a more efficient means of storing and using water.

4.4.7.b Energy Efficiency

Using a dedicated fill pipe is anticipated to provide a more efficient means of filling storage tanks and is expected to be more energy efficient.

4.4.8 Cost Estimates

The engineer's cost estimate for this alternative is provided in the following table. A summary of this estimate is provided as follows:

Construction Cost: $2,945,771
Non-Construction Cost: $811,192
Present Value 20 Year O&M Cost: $277,891
Total Life Cycle Cost: $4,034,854

Table 4: Transmission/Distribution Alternative Cost Estimate

Planning Period = 20 yr.			**Federal Discount Interest Rate =**		2.50%
Construction Cost					
Item	**Description**	**Unit**	**Qty**	**Unit Cost**	**Total Cost**
1	Mob/Demob	LS	1	$ 200,000	$ 200,000
2	Testing Allowance	ALLOW	1	$ 15,000	$ 15,000
3	Traffic Control/SWPPP	LS	1	$ 75,000	$ 75,000
4	3 in. HDPE Laterals & Dedicated Fill	LF	10,600	$ 50	$ 530,000
5	8 in. HDPE Water Main	LF	6,000	$ 88	$ 525,000
6	Import Pipe Bedding Material	CY	3,500	$ 45	$ 157,500
7	3 in. Gate Valve	EA	6	$ 6,250	$ 37,500
8	8 in Gate Valve	EA	4	$ 10,000	$ 40,000
9	1 in. Air Valve	EA	4	$ 12,500	$ 50,000
10	6 in. Fire Hydrant	EA	4	$ 10,000	$ 40,000
11	2 in. Flush Hydrant	EA	4	$ 8,000	$ 32,000
12	8 in. PRV Station	LS	1	$ 82,500	$ 82,500
13	Asphalt Pavement Demo and Replace	SY	2,500	$ 125	$ 312,500
14	Gravel Road Repair	SY	1,000	$ 25	$ 25,000
				Subtotal	$ 2,122,000
			Contingency[1]	30%	$ 636,600
			NMGRT	6.785%	$ 187,171
			Construction Cost Total		**$ 2,945,771**
Non-Construction Cost					
	Engineering Design, Bid & Construction Services			25%	$ 689,650
	Survey				$ 50,000
	Easements				$ 20,000
			NMGRT	6.785%	$ 51,542
			Non-Construction Cost Total		**$ 811,192**
			Total Capital Cost		**$ 3,756,963**
Annual O&M Cost					
	Misc. annual repair reserve				$ 2,000
	Operations				$ 15,826
			Total Annual O&M cost		$ 17,826
	20 Yr. Present Value of O&M Cost				$ 277,891
			Total Life Cycle Cost		**$ 4,034,854**

[1] A Contingency of 30% was applied due to uncertainty in cost increases from inflation and tariffs

4.4.9 Advantages/Disadvantages

Advantages:

- Dedicated fill pipe will allow better control over entire water system.
- Providing fire flow and fire hydrants will help reduce community fire insurance rates as well as provide fire flow volume to the Tesuque Fire Department.
- New engineered piping is expected to greatly minimize the number of leaks experienced by the water system.

Disadvantages:

- Traffic will be impacted along the community roadways during construction activities.
- Issues may arise within the community if and when illegal system taps are discovered during construction.
- Increases in user rates to help support the capital and future O&M costs of a new water system may not bode well with customers.

5.0 SELECTION OF AN ALTERNATIVE

Each of the three alternatives evaluated is a much needed individual component of the overall Chupadero water system. As such, each of these three components is selected for alternative implementation at Chupadero.

5.1 LIFE CYCLE COST ANALYSIS

Most of the new items installed in the three alternatives are not expected to have an appreciable salvage value at the end of a 20 year life cycle as they have a life expectancy greater than 20 years and are required for use by the water system and could not be sold for salvage value. The federal "real discount" interest rate from Appendix C of OMB Circular A-94 used for calculations is 2.50%.

The 20 year life cycle cost analysis estimate for all three alternatives is a total of $5,269,414. Capital cost of alternatives implementation is estimated to be $4,917,475 and the estimated 20 year present cost of O&M is $351,939. Considering a 20 year plan, this equates to $17,759 per year, in present worth 2025 dollars, for O&M costs.

5.2 NON-MONETARY FACTORS

5.2.1 ENVIRONMENTAL ASPECTS

As previously identified for the improvements project alternatives, each alternative is considered to be sustainable as well as pose little potential threat to the environment during its construction and implementation.

5.2.2 PERMITS

Permits required for the implementation of the alternatives include a

- NMED DWB Public Water System Construction Permit

5.2.3 OPERATION REQUIREMENTS

Annual operation requirements are expected to be overall less with the implementation of new or fully refurbished equipment and materials designated for the alternatives.

6.0 PROPOSED PROJECT (RECOMMENDED ALTERNATIVE)

6.1 PRELIMINARY PROJECT DESIGN

A new disinfection system is required for the water system. Because wells in multiple locations may be used, it is most cost effective to install one sodium hypochlorite disinfection system at the storage tank site. It can be housed in an underground vault to avoid the cost of a building and heating system.

The current 56 connections used by the 2020 estimated 148 households indicates 37% of the households are served by the water system. Using this same ratio for the projected 169 households in 2035 results in an estimated 62 connections in 2028. Assuming another 10 connections from existing households results in a total of 72 connections. The recommended 60,000 gal. of storage can serve 75 connections, based on a 200 gpd demand per household, 2 days of storage and 2 hrs. of 250 gpm (30,000 gal.) fire storage.

Storage tank improvements will include refurbishing the existing tank by sandblasting and painting the interior. A new 40,000 gal. tank will also be installed at the tank site. The tanks will a require new foundation as well as interconnecting piping with the existing tank such that the tanks can operate in tandem. The tank site and dirt access road will be regraded for stormwater control and a new riprap swale will be installed to collect and transport stormwater to a natural drainage channel located at State Hwy. 592. The overflow and drain pipes from the tanks will be routed to the stormwater swale. Maintaining a minimum of 30,000 gal. in the two storage tanks is expected to allow Chupadero to provide ISO Category 8 fire flow (250 gpm for 2 hours). The existing security fence at the tank site will be extended to surround the new water storage tank.

A new 3 inch diameter HDPE dedicated fill pipe from Well #5 will be placed on the north side of County Road 78 in a 4 ft. wide maximum trench, be bored and cross under State Hwy. 592 within a steel pipe sleeve and then travel up the tank access road to the storage tanks. A new 8 inch diameter HDPE pipe for stored water transmission and distribution will be installed in the same trench as the dedicated fill pipe. Distribution laterals from the new 8 inch water main will be 3 inch diameter HDPE pipes. A new 8 inch PRV station with 4 inch PRV bypass will replace the existing 3 inch PRV station. Fire hydrants will be placed along the 8 inch water main and at the Tesuque Fire Department building. Flush hydrants will be placed at the end of the distribution main and/or laterals. The demolished asphalt pavement along County Road 78 for placement of the new pipes will be replaced. The existing 3 inch water pipe will be abandoned in place where located outside of the new pipe trench.

A map of the recommended project is provided as Figure 8 in Appendix A.

Due to the estimated total capital cost of the three alternatives recommended for the improvements project, it is anticipated that the project will be constructed in phases as funding becomes available. The recommended order of phasing is:

1. Disinfection/Treatment.

2. Storage Tank Improvements.
3. Transmission/Distribution Improvements.

6.2 PROJECT SCHEDULE

The estimated design, permitting and construction schedule for each of the alternatives is as follows:

- Disinfection/Treatment – 7 months.
- Storage Tank Improvements – 4 months
- Transmission/Distribution Improvements – one year.

6.3 PERMIT REQUIREMENTS

The anticipated permits required for each phase of the project includes:

- Disinfection/Treatment – NMED DWB, Santa Fe County Building Permit
- Storage Tank Improvements – NMED DWB
- Transmission/Distribution Improvements – NMED DWB, EPA SWPPP, Santa County ROW Utility and Traffic Control Permits and NMDOT ROW Utility and Traffic Control Permits.

6.4 SUSTAINABILITY CONSIDERATIONS

6.4.1 WATER EFFICIENCY

Water efficiency components for the recommended project include:

- Utilizing a second water storage tank to double the available storage volume and provide fire flow storage for Chupadero provides for a more efficient and sustainable water system.
- A new 6-inch water main will hold a volume four times greater than the existing 3-inch pipe volume, is equal to approximately 80% of the estimated daily use of the system and is a more efficient means of storing and using water.

6.4.2 ENERGY EFFICIENCY

Energy efficiency components for the recommended project include:

- Filling the storage tanks during nighttime hours when electrical cost is cheapest.
- Planned disinfection system uses very little or no electrical power.
- Use of a dedicated tank fill pipe is expected to be more energy efficient for well pump operation.

6.5 TOTAL PROJECT COST ESTIMATE

The estimated cost of the recommended phased project is the summation of each of the three alternatives cost estimates. The cost contingency used for both construction and non-construction costs is 20%. The total estimated recommended project cost estimate is summarized as follows:

Total Capital Cost: $4,917,475 (construction and non-construction)

Total 20-Year Life Cycle Present Worth Cost: $5,269,414

- Construction Cost: $3,804,437
- Non-Construction Cost: $1,113,038
- 20 Year Life Cycle Present Worth O&M Cost: $351,939

6.6 ANNUAL OPERATING BUDGET

The following annual operating budget is from the end of year 2024 accountant's financial statement (provided in Appendix D).

6.6.1 INCOME

The total 2024 income, from water bills, was $47,044.97 for unmetered flow. Moving forward with the recommended project will require additional income for funding matches, increased annual O&M cost and a reserve fund for future equipment O&M requirements. The following table shows the recommended project broken down into three phases with the associated cost scenarios for a variety of loan and grant ratios.

As can be seen in the following table, with the limited number of connections and the estimated expense of the Recommended Project, Chupadero could likely at best financially support a 90% grant/10% loan funded project.

Table 5: Recommended Project Income for Various Funding Scenarios

Connections:	56	Interest Rate:	2.50%	Term:	20		yrs.
Current Monthly Base Rates:		Residential	Commercial				
		$70.00	N/A				
Phase/Est. Cost	**Loan (%)**	**Loan Monthly Payment ($)**	**Service Connection Monthly Rate Increase**				
Disinfection/ Treatment	100%	$599	$10.69				
	75%	$449		$8.02			
	50%	$299			$5.34		
	25%	$150				$2.67	
$112,968	10%	$60					$1.07
Storage Tanks	100%	$5,551	$99.12				
	75%	$4,163		$74.34			
	50%	$2,775			$49.56		
	25%	$1,388				$24.78	
$1,047,544	10%	$555					$9.91
Water Distribution System Improvements	100%	$19,908	$355.50				
	75%	$14,931		$266.63			
	50%	$9,954			$177.75		
	25%	$4,977				$88.88	
$3,756,963	10%	$1,992					$35.58
Estimated Project Rate Increase Totals			**$465**	**$349**	**$233**	**$116**	**$47**
Required Monthly Base Rate		Loan %	100%	75%	50%	25%	10%
		Residential	$535	$419	$303	$186	$117
		Commercial	--	--	--	--	--
Chupadero 2024 MHI:			**$99,828**				
Annual Future Residential Base Rate as % of MHI:			6.43%	5.04%	3.64%	2.24%	1.40%

6.6.2 ANNUAL O&M COSTS

The 2024 cost for O&M and electricity was $15,063. The anticipated annual O&M budget for the recommended project is approximately $17,597 (in 2025 dollars). The bulk of the annual O&M cost is for an operator since it is anticipated that Chupadero in the future will no longer receive low cost volunteer operator services from their community. In order for Chupadero to cover the anticipated improvements project annual O&M costs the monthly billing rate for the current 56 customers would need to be an additional $27/month.

6.6.3 DEBT REPAYMENTS

Chupadero does not currently have any debt repayments. Future debt repayments may be required for the funding agency(s) used for the project.

6.6.4 RESERVES

Chupadero does not currently have any loan debt reserves. Future debt reserves (as much as 10% of the loan value) may be required for the funding agency(s) used for the project.

7.0 CONCLUSIONS AND RECOMMENDATIONS

Chupadero is in need of a number of water system improvements to provide a safe, reliable and sustainable water system for its customers. The cost of the recommended improvements is beyond Chupadero's financial capability and funding assistance will be necessary. The estimated cost for disinfection/treatment and storage tanks improvements is expected to be able to be funded by a number of funding agencies, however, it is anticipated that these improvements will occur over a several year period due to the amount of funding required. The Transmission/distribution improvements project will likely require funding from agencies that specialize in higher cost projects, such as the NM Water Trust Board or USDA Rural Development. This alternative could also be broken down into smaller phases in order to be more amenable to a variety of funding agencies, however, additional cost could be incurred from multiple construction bids and the cost escalation that occurs over time.

Funding constraints and availability may require the proposed project to be broken down into smaller phases. Recommended project phases and tasks in order of importance and required phasing are:

1) Secure all necessary easements.
2) Topographic survey of project area.
3) Relocate the main PRV for the most opportune location and such that all wells can connect upstream of the PRV in the existing single 3-inch water pipe used for tank filling and distribution
4) Rehab and install new storage tanks.
5) Install new transmission/distribution and dedicated fill pipes from storage tank site to east end of County Road 78, crossing under St. Hwy. 592.
6) Install remainder of transmission/distribution and dedicated fill pipes on County Road 78.
7) Install new 3-inch distribution laterals.

APPENDIX A

Figures

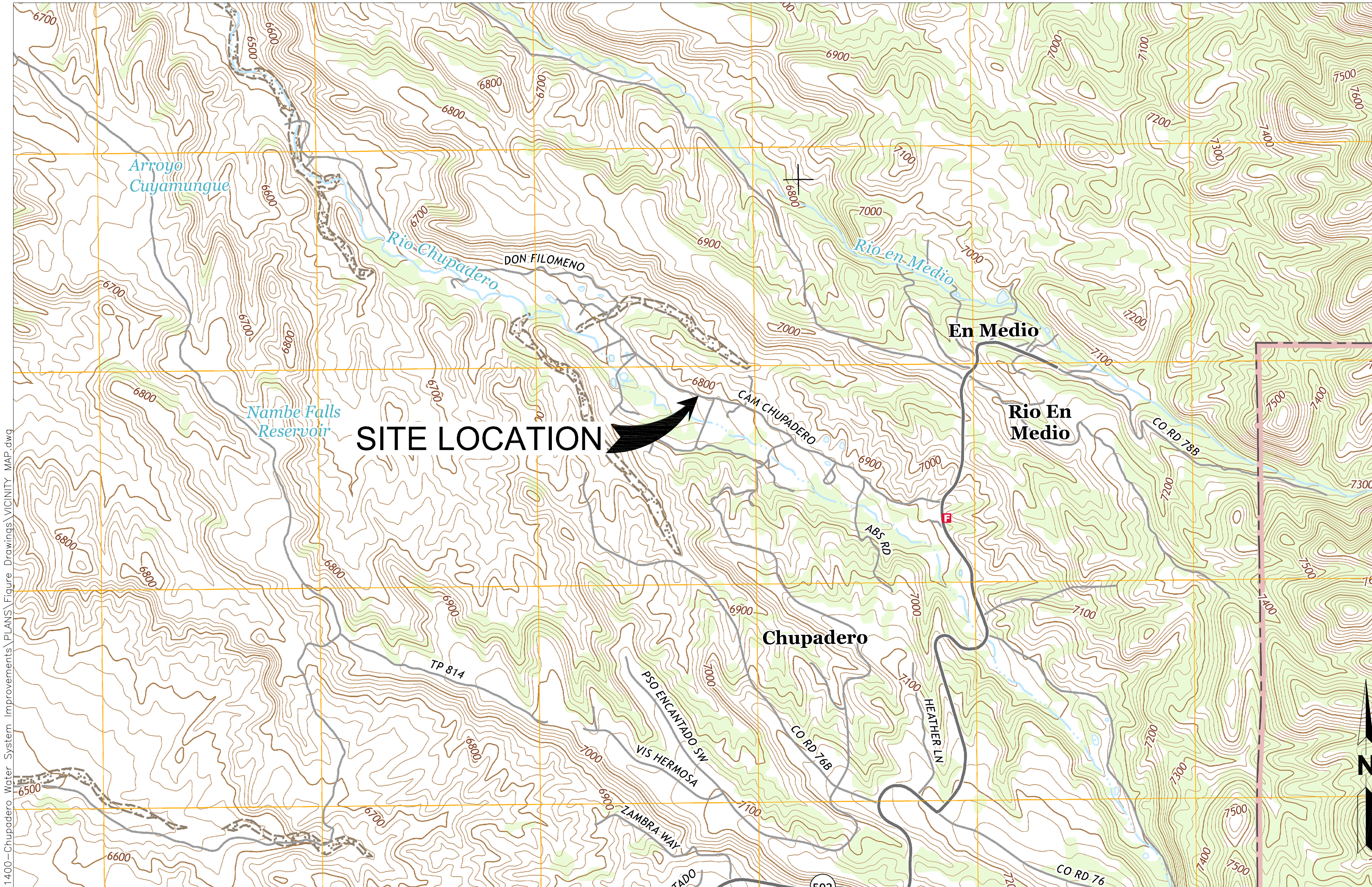


FIGURE 1 – SITE VICINITY MAP

CHUPADERO WATER AND SEWER CORP

0 1000 2000

SCALE: 1"=2000'
ALL DIMENSIONS ARE
U.S. SURVEY FEET

SOURCE:
USGS 7.5' TOPOGRAPHIC MAP. TESUQUE, NEW MEXICO,
DATED: 2017.

MARTIN/MARTIN
CONSULTING ENGINEERS
6100 INDIAN SCHOOL RD NE # 225, ALBUQUERQUE, NM 87110
505.242.4435 MARTINMARTIN.COM

DRAWING LOCATION: G:\MAY\17.1400-Chupadero Water System Improvements\PLANS\Figure Drawings\VICINITY MAP.dwg

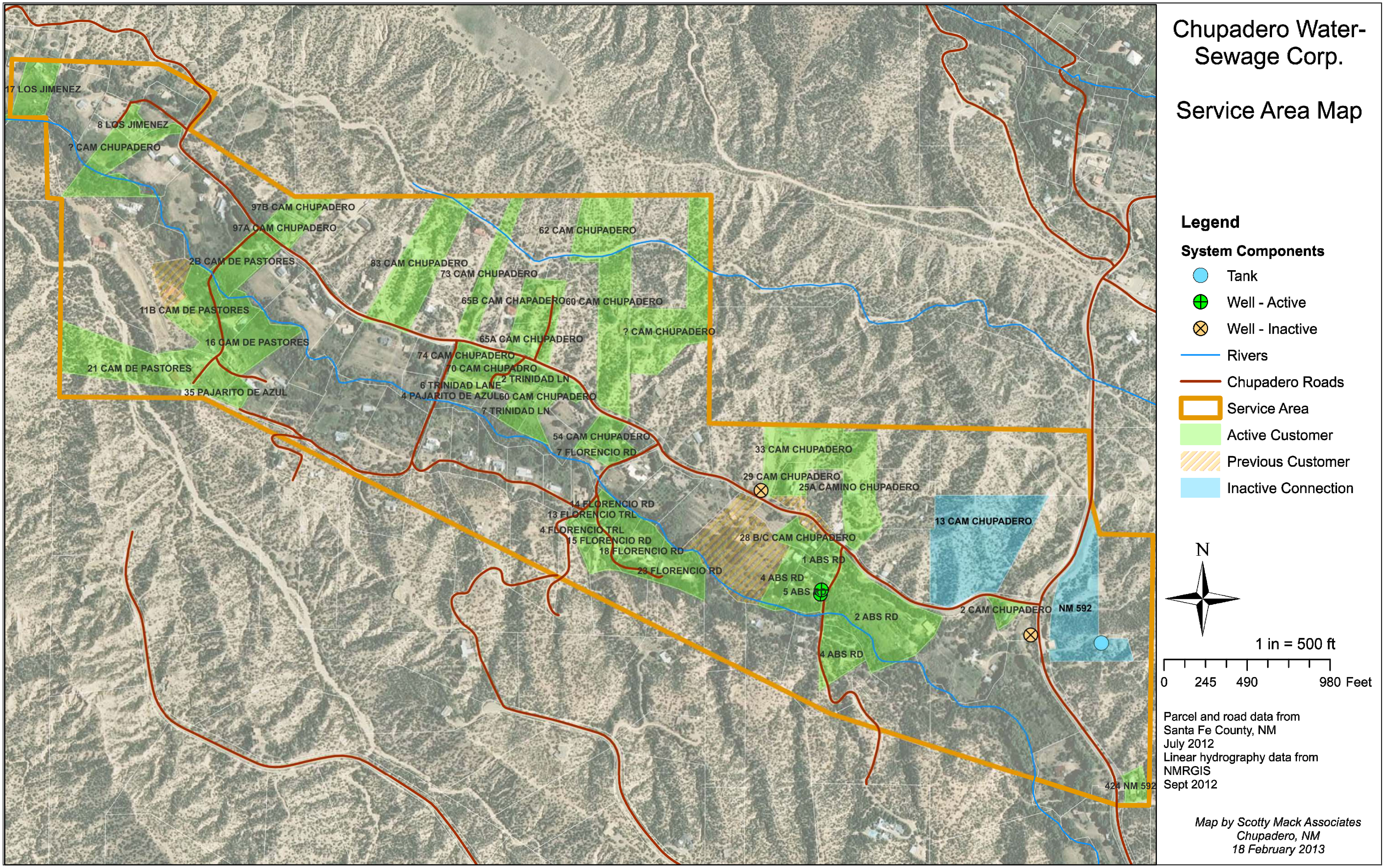


FIGURE 2 – SERVICE AREA MAP
CHUPADERO WATER AND SEWER CORP

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CONSULTING ENGINEERS
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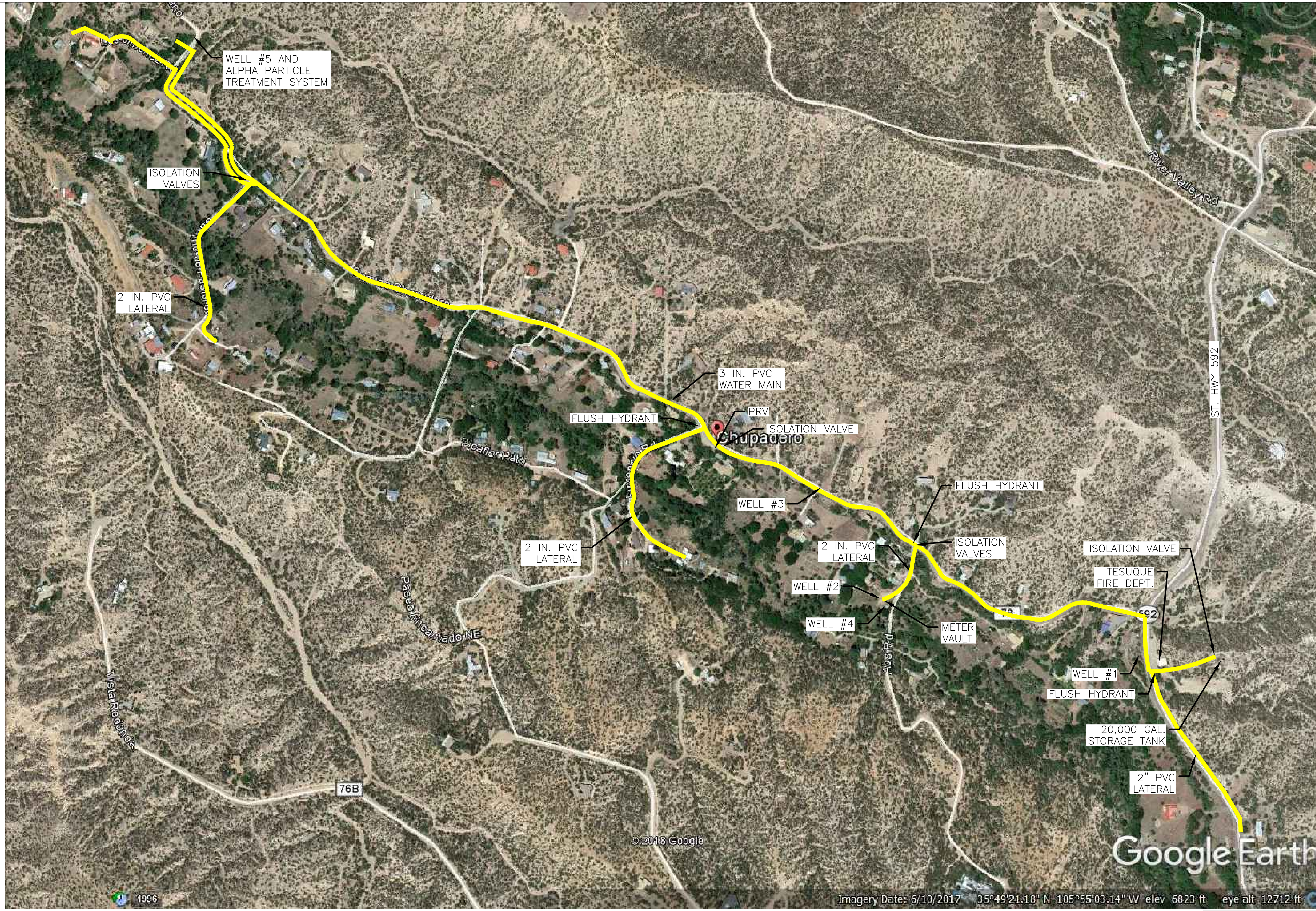
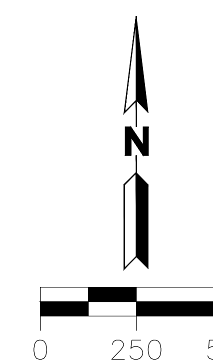
505.242.4435 MARTINMARTIN.COM

DRAWING LOCATION: G:\SULLIVAN\25.0216-Chupadero - PER Update\PLANS\Figure Drawings\SERVICE AREA MAP.dwg



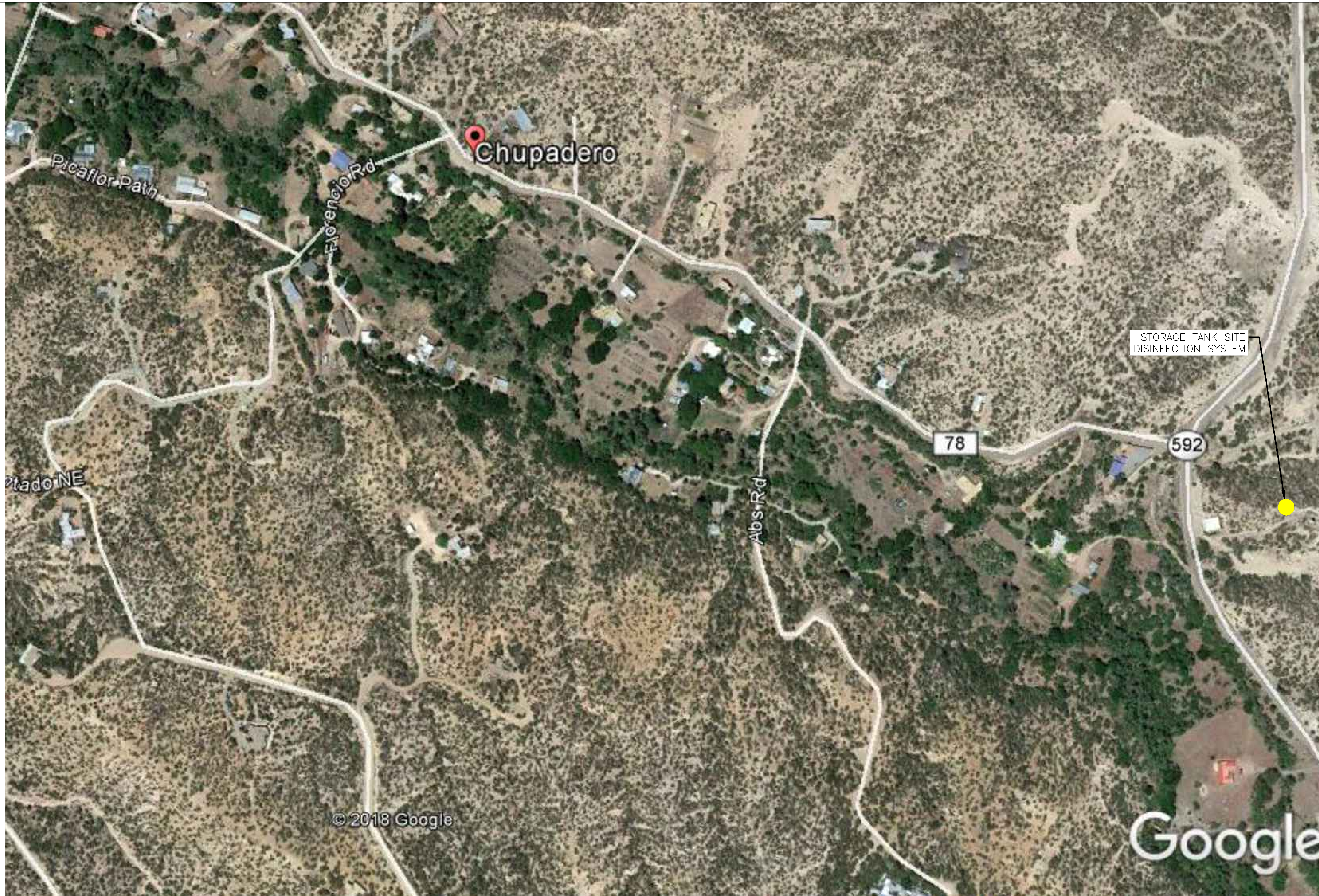


SCALE: 1"=500'
ALL DIMENSIONS ARE U.S. SURVEY FEET

FIGURE 3 – EXISTING WATER SYSTEM
CHUPADERO WATER AND SEWER CORP

MARTIN/MARTIN
CONSULTING ENGINEERS
6100 INDIAN SCHOOL RD NE # 225, ALBUQUERQUE NM 87110
505.242.4435 MARTINMARTIN.COM

DRAWING LOCATION: G:\SULLIVAN\25.0216-Chupadero – PER Update\PLANS\Figure Drawings\EX WATER SYSTEM.dwg



N

0 250 500

SCALE: 1"=500'
ALL DIMENSIONS ARE
U.S. SURVEY FEET

FIGURE 4 – DISINFECTION–TREATMENT ALTERNATIVE
CHUPADERO WATER AND SEWER CORP

MARTIN/MARTIN
CONSULTING ENGINEERS

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505.242.4435 MARTINMARTIN.COM

DRAWING LOCATION: G:\SULLIVAN\25.0216–Chupadero – PER Update\PLANS\Figure Drawings\DIFINFECTION TREATMENT.dwg

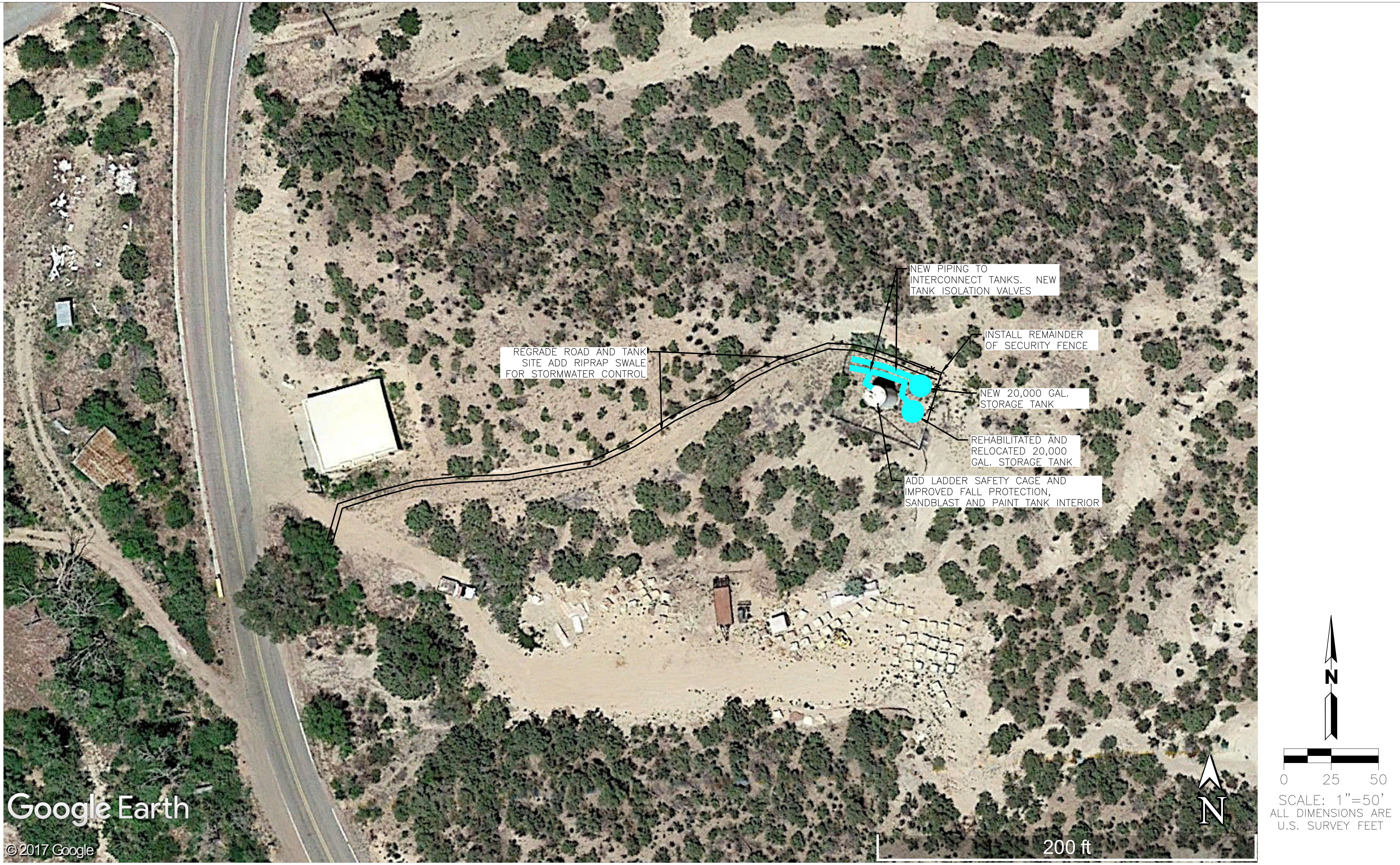

FIGURE 5 – WATER STORAGE TANK IMPROVEMENTS ALTERNATIVE
CHUPADERO WATER AND SEWER CORP

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CONSULTING ENGINEERS
6100 INDIAN SCHOOL RD NE # 225, ALBUQUERQUE NM 87110
505.242.4435 MARTINMARTIN.COM

DRAWING LOCATION: G:\SULLIVAN\25.0216–Chupadero – PER Update\PLANS\Figure Drawings\WATER STORAGE TANK.dwg

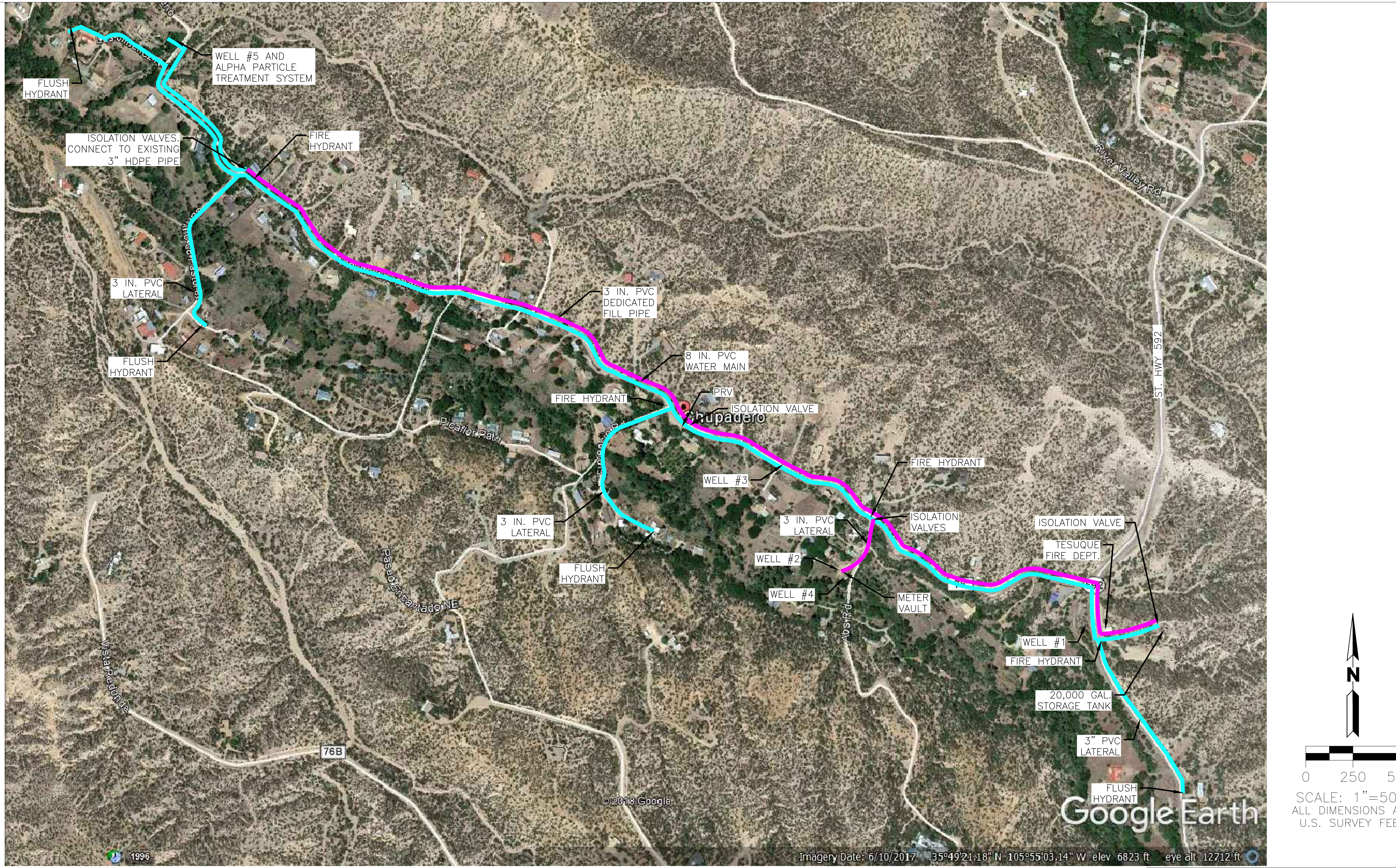

FIGURE 6 – WATER TRANSMISSION–DISTRIBUTION SYSTEM IMPROVEMENTS ALTERNATIVES
CHUPADERO WATER AND SEWER CORP

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CONSULTING ENGINEERS
6100 INDIAN SCHOOL RD NE # 225, ALBUQUERQUE NM 87110
505.242.4435 MARTINMARTIN.COM

DRAWING LOCATION: G:\SULLIVAN\25.0216-Chupadero – PER Update\PLANS\Figure Drawings\WATER TRANSMISSION.dwg

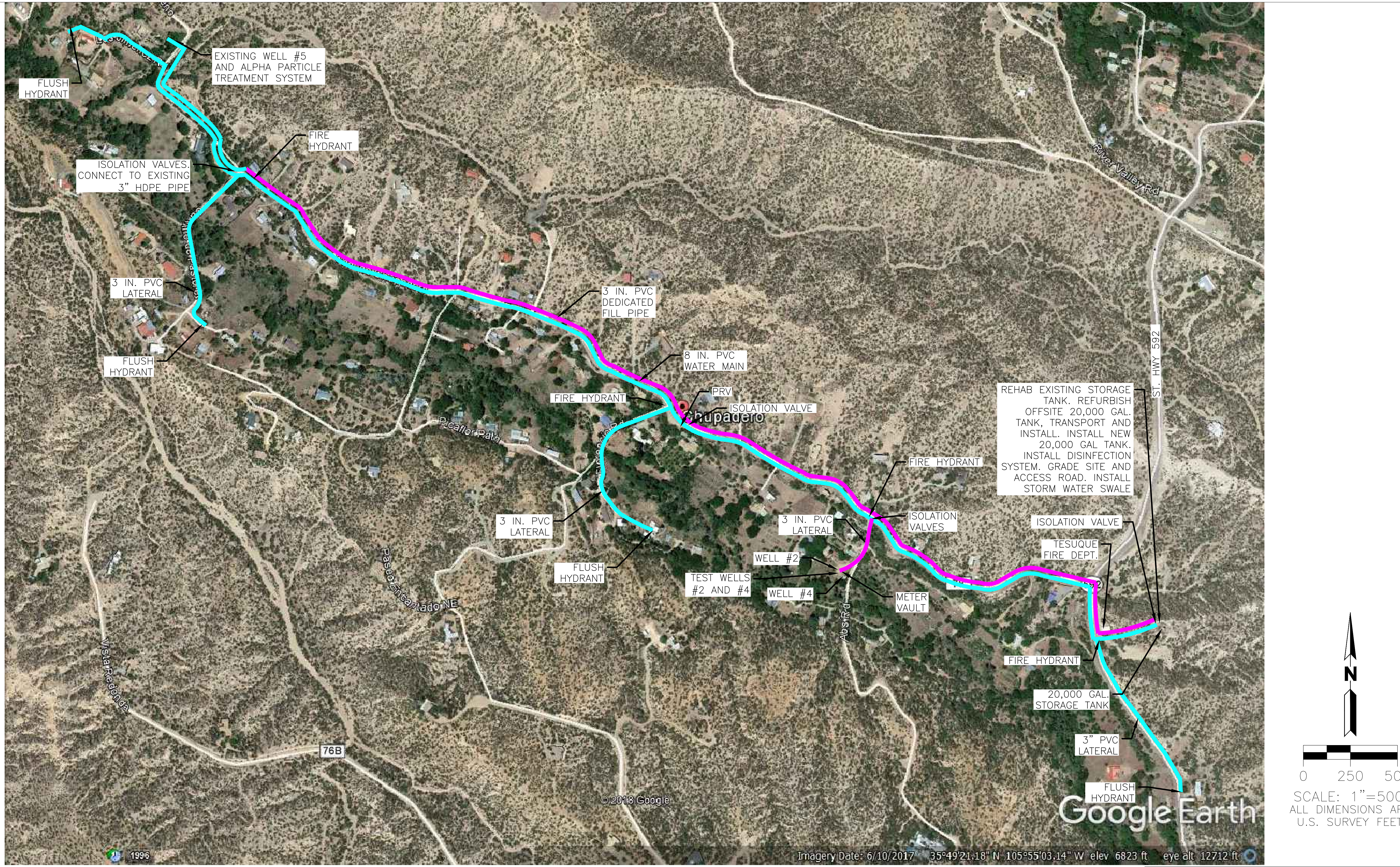


FIGURE 7 – RECOMMENDED PROJECT
CHUPADERO WATER AND SEWER CORP

MARTIN/MARTIN
CONSULTING ENGINEERS
6100 INDIAN SCHOOL RD NE #225, ALBUQUERQUE NM 87110
505.242.4435 MARTINMARTIN.COM

DRAWING LOCATION: G:\SULLIVAN\25.0216-Chupadero – PER Update\PLANS\Figure Drawings\RECOMMENDED PROJECT.dwg

APPENDIX B

Environmental Resource Documentation

IPaC **U.S. Fish & Wildlife Service**

IPaC resource list

This report is an automatically generated list of species and other resources such as critical habitat (collectively referred to as *trust resources*) under the U.S. Fish and Wildlife Service's (USFWS) jurisdiction that are known or expected to be on or near the project area referenced below. The list may also include trust resources that occur outside of the project area, but that could potentially be directly or indirectly affected by activities in the project area. However, determining the likelihood and extent of effects a project may have on trust resources typically requires gathering additional site-specific (e.g., vegetation/species surveys) and project-specific (e.g., magnitude and timing of proposed activities) information.

Below is a summary of the project information you provided and contact information for the USFWS office(s) with jurisdiction in the defined project area. Please read the introduction to each section that follows (Endangered Species, Migratory Birds, USFWS Facilities, and NWI Wetlands) for additional information applicable to the trust resources addressed in that section.

Location

Santa Fe County, New Mexico

Local office

New Mexico Ecological Services Field Office

(505) 346-2525
(505) 346-2542

2105 Osuna Road Ne
Albuquerque, NM 87113-1001

Endangered species

This resource list is for informational purposes only and does not constitute an analysis of project level impacts.

The primary information used to generate this list is the known or expected range of each species. Additional areas of influence (AOI) for species are also considered. An AOI includes areas outside of the species range if the species could be indirectly affected by activities in that area (e.g., placing a dam upstream of a fish population even if that fish does not occur at the dam site, may indirectly impact the species by reducing or eliminating water flow downstream). Because species can move, and site conditions can change, the species on this list are not guaranteed to be found on or near the project area. To fully determine any potential effects to species, additional site-specific and project-specific information is often required.

Section 7 of the Endangered Species Act **requires** Federal agencies to "request of the Secretary information whether any species which is listed or proposed to be listed may be present in the area of such proposed action" for any project that is conducted, permitted, funded, or licensed by any Federal agency. A letter from the local office and a species list which fulfills this requirement can **only** be obtained by requesting an official species list from either the Regulatory Review section in IPaC (see directions below) or from the local field office directly.

For project evaluations that require USFWS concurrence/review, please return to the IPaC website and request an official species list by doing the following:

1. Draw the project location and click CONTINUE.
2. Click DEFINE PROJECT.
3. Log in (if directed to do so).
4. Provide a name and description for your project.
5. Click REQUEST SPECIES LIST.

Listed species[1] and their critical habitats are managed by the Ecological Services Program of the U.S. Fish and Wildlife Service (USFWS) and the fisheries division of the National Oceanic and Atmospheric Administration (NOAA Fisheries[2]).

Species and critical habitats under the sole responsibility of NOAA Fisheries are **not** shown on this list. Please contact NOAA Fisheries for species under their jurisdiction.

---

1. Species listed under the Endangered Species Act are threatened or endangered; IPaC also shows species that are candidates, or proposed, for listing. See the listing status page for more information. IPaC only shows species that are regulated by USFWS (see FAQ).
2. NOAA Fisheries, also known as the National Marine Fisheries Service (NMFS), is an office of the National Oceanic and Atmospheric Administration within the Department of Commerce.

The following species are potentially affected by activities in this location:

Mammals

NAME	STATUS
New Mexico Meadow Jumping Mouse *Zapus hudsonius luteus* Wherever found There is **final** critical habitat for this species. Your location does not overlap the critical habitat. https://ecos.fws.gov/ecp/species/7965	Endangered

Birds

NAME	STATUS
Mexican Spotted Owl *Strix occidentalis lucida* Wherever found There is **final** critical habitat for this species. Your location does not overlap the critical habitat. https://ecos.fws.gov/ecp/species/8196	Threatened
Southwestern Willow Flycatcher *Empidonax traillii extimus* Wherever found There is **final** critical habitat for this species. Your location does not overlap the critical habitat. https://ecos.fws.gov/ecp/species/6749	Endangered
Yellow-billed Cuckoo *Coccyzus americanus* There is **final** critical habitat for this species. Your location does not overlap the critical habitat. https://ecos.fws.gov/ecp/species/3911	Threatened

Insects

NAME	STATUS
Monarch Butterfly *Danaus plexippus* Wherever found There is **proposed** critical habitat for this species. Your location does not overlap the critical habitat. https://ecos.fws.gov/ecp/species/9743	Proposed Threatened
Suckley's Cuckoo Bumble Bee *Bombus suckleyi* No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/10885	Proposed Endangered

Critical habitats

Potential effects to critical habitat(s) in this location must be analyzed along with the endangered species themselves.

There are no critical habitats at this location.

You are still required to determine if your project(s) may have effects on all above listed species.

Bald & Golden Eagles

Bald and Golden Eagles are protected under the Bald and Golden Eagle Protection Act [2] and the Migratory Bird Treaty Act (MBTA) [1]. Any person or organization who plans or conducts activities that may result in impacts to Bald or Golden Eagles, or their habitats, should follow appropriate regulations and consider implementing appropriate avoidance and minimization measures, as described in the various links on this page.

Additional information can be found using the following links:

- Eagle Management https://www.fws.gov/program/eagle-management
- Measures for avoiding and minimizing impacts to birds https://www.fws.gov/library/collections/avoiding-and-minimizing-incidental-take-migratory-birds
- Nationwide avoidance and minimization measures for birds https://www.fws.gov/sites/default/files/documents/nationwide-standard-conservation-measures.pdf
- Supplemental Information for Migratory Birds and Eagles in IPaC https://www.fws.gov/media/supplemental-information-migratory-birds-and-bald-and-golden-eagles-may-occur-project-action

There are Bald Eagles and/or Golden Eagles in your project area.

Measures for Proactively Minimizing Eagle Impacts
For information on how to best avoid and minimize disturbance to nesting bald eagles, please review the National Bald Eagle Management Guidelines. You may employ the timing and activity-specific distance recommendations in this document when designing your project/activity to avoid and minimize eagle impacts. For bald eagle information specific to Alaska, please refer to Bald Eagle Nesting and Sensitivity to Human Activity.

The FWS does not currently have guidelines for avoiding and minimizing disturbance to nesting

Golden Eagles. For site-specific recommendations regarding nesting Golden Eagles, please consult with the appropriate Regional Migratory Bird Office or Ecological Services Field Office.

If disturbance or take of eagles cannot be avoided, an incidental take permit may be available to authorize any take that results from, but is not the purpose of, an otherwise lawful activity. For assistance making this determination for Bald Eagles, visit the Do I Need A Permit Tool. For assistance making this determination for golden eagles, please consult with the appropriate Regional Migratory Bird Office or Ecological Services Field Office.

Ensure Your Eagle List is Accurate and Complete
If your project area is in a poorly surveyed area in IPaC, your list may not be complete and you may need to rely on other resources to determine what species may be present (e.g. your local FWS field office, state surveys, your own surveys). Please review the Supplemental Information on Migratory Birds and Eagles, to help you properly interpret the report for your specified location, including determining if there is sufficient data to ensure your list is accurate.

For guidance on when to schedule activities or implement avoidance and minimization measures to reduce impacts to bald or golden eagles on your list, see the "Probability of Presence Summary" below to see when these bald or golden eagles are most likely to be present and breeding in your project area.

Review the FAQs
The FAQs below provide important additional information and resources.

NAME	BREEDING SEASON
Bald Eagle Haliaeetus leucocephalus This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities.	Breeds Dec 1 to Aug 31
Golden Eagle Aquila chrysaetos This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities. https://ecos.fws.gov/ecp/species/1680	Breeds Dec 1 to Aug 31

Probability of Presence Summary

The graphs below provide our best understanding of when birds of concern are most likely to be present in your project area. This information can be used to tailor and schedule your project activities to avoid or minimize impacts to birds. Please make sure you read "Supplemental Information on Migratory Birds and Eagles", specifically the FAQ section titled "Proper

Interpretation and Use of Your Migratory Bird Report" before using or attempting to interpret this report.

Probability of Presence (■)

Each green bar represents the bird's relative probability of presence in the 10km grid cell(s) your project overlaps during a particular week of the year. (A year is represented as 12 4-week months.) A taller bar indicates a higher probability of species presence. The survey effort (see below) can be used to establish a level of confidence in the presence score. One can have higher confidence in the presence score if the corresponding survey effort is also high.

How is the probability of presence score calculated? The calculation is done in three steps:

1. The probability of presence for each week is calculated as the number of survey events in the week where the species was detected divided by the total number of survey events for that week. For example, if in week 12 there were 20 survey events and the Spotted Towhee was found in 5 of them, the probability of presence of the Spotted Towhee in week 12 is 0.25.
2. To properly present the pattern of presence across the year, the relative probability of presence is calculated. This is the probability of presence divided by the maximum probability of presence across all weeks. For example, imagine the probability of presence in week 20 for the Spotted Towhee is 0.05, and that the probability of presence at week 12 (0.25) is the maximum of any week of the year. The relative probability of presence on week 12 is 0.25/0.25 = 1; at week 20 it is 0.05/0.25 = 0.2.
3. The relative probability of presence calculated in the previous step undergoes a statistical conversion so that all possible values fall between 0 and 10, inclusive. This is the probability of presence score.

To see a bar's probability of presence score, simply hover your mouse cursor over the bar.

Breeding Season (■)
Yellow bars denote a very liberal estimate of the time-frame inside which the bird breeds across its entire range. If there are no yellow bars shown for a bird, it does not breed in your project area.

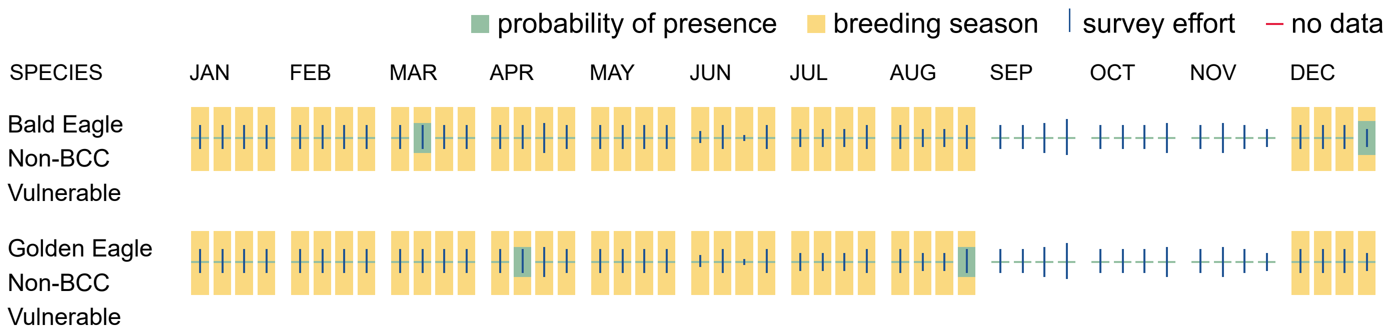
Survey Effort (|)
Vertical black lines superimposed on probability of presence bars indicate the number of surveys performed for that species in the 10km grid cell(s) your project area overlaps. The number of surveys is expressed as a range, for example, 33 to 64 surveys.

To see a bar's survey effort range, simply hover your mouse cursor over the bar.

No Data (–)
A week is marked as having no data if there were no survey events for that week.

Survey Timeframe
Surveys from only the last 10 years are used in order to ensure delivery of currently relevant information. The exception to this is areas off the Atlantic coast, where bird returns are based on

all years of available data, since data in these areas is currently much more sparse.



Bald & Golden Eagles FAQs

What does IPaC use to generate the potential presence of bald and golden eagles in my specified location?

The potential for eagle presence is derived from data provided by the Avian Knowledge Network (AKN). The AKN data is based on a growing collection of survey, banding, and citizen science datasets and is queried and filtered to return a list of those birds reported as occurring in the 10km grid cell(s) which your project intersects, and that have been identified as warranting special attention because they are an eagle (Bald and Golden Eagle Protection Act requirements may apply).

Proper interpretation and use of your eagle report

On the graphs provided, please look carefully at the survey effort (indicated by the black vertical line) and for the existence of the "no data" indicator (a red horizontal line). A high survey effort is the key component. If the survey effort is high, then the probability of presence score can be viewed as more dependable. In contrast, a low survey effort line or no data line (red horizontal) means a lack of data and, therefore, a lack of certainty about presence of the species. This list is not perfect; it is simply a starting point for identifying what birds have the potential to be in your project area, when they might be there, and if they might be breeding (which means nests might be present). The list and associated information help you know what to look for to confirm presence and helps guide you in knowing when to implement avoidance and minimization measures to eliminate or reduce potential impacts from your project activities or get the appropriate permits should presence be confirmed.

How do I know if eagles are breeding, wintering, or migrating in my area?

To see what part of a particular bird's range your project area falls within (i.e. breeding, wintering, migrating, or resident), you may query your location using the RAIL Tool and view the range maps provided for birds in your area at the bottom of the profiles provided for each bird in your results. If an eagle on your IPaC migratory bird species list has a breeding season associated with it (indicated by yellow vertical bars on the phenology graph in your “IPaC PROBABILITY OF PRESENCE SUMMARY” at the top of your results list), there may be nests present at some point within the timeframe specified. If "Breeds elsewhere" is indicated, then the bird likely does not breed in your project area.

Interpreting the Probability of Presence Graphs

Each green bar represents the bird's relative probability of presence in the 10km grid cell(s) your project overlaps during a particular week of the year. A taller bar indicates a higher probability of species presence. The survey effort can be used to establish a level of confidence in the presence score.

How is the probability of presence score calculated? The calculation is done in three steps:
The probability of presence for each week is calculated as the number of survey events in the week where the species was detected divided by the total number of survey events for that week. For example, if in week 12 there were 20 survey events and the Spotted Towhee was found in 5 of them, the probability of presence of the Spotted Towhee in week 12 is 0.25.

To properly present the pattern of presence across the year, the relative probability of presence is calculated. This is the probability of presence divided by the maximum probability of presence across all weeks. For example, imagine the probability of presence in week 20 for the Spotted Towhee is 0.05, and that the probability of presence at week 12 (0.25) is the maximum of any week of the year. The relative probability of presence on week 12 is 0.25/0.25 = 1; at week 20 it is 0.05/0.25 = 0.2.

The relative probability of presence calculated in the previous step undergoes a statistical conversion so that all possible values fall between 0 and 10, inclusive. This is the probability of presence score.

Breeding Season ()
Yellow bars denote a very liberal estimate of the time-frame inside which the bird breeds across its entire range. If there are no yellow bars shown for a bird, it does not breed in your project area.

Survey Effort ()
Vertical black lines superimposed on probability of presence bars indicate the number of surveys performed for that species in the 10km grid cell(s) your project area overlaps.

No Data ()
A week is marked as having no data if there were no survey events for that week.

Survey Timeframe
Surveys from only the last 10 years are used in order to ensure delivery of currently relevant information. The exception to this is areas off the Atlantic coast, where bird returns are based on all years of available data, since data in these areas is currently much more sparse.

Migratory birds

The Migratory Bird Treaty Act (MBTA) [1] prohibits the take (including killing, capturing, selling, trading, and transport) of protected migratory bird species without prior authorization by the Department of Interior U.S. Fish and Wildlife Service (Service). The incidental take of migratory birds is the injury or death of birds that results from, but is not the purpose, of an activity. The Service interprets the MBTA to prohibit incidental take.

---

1. The Migratory Birds Treaty Act of 1918.
2. The Bald and Golden Eagle Protection Act of 1940.

Additional information can be found using the following links:

- Eagle Management https://www.fws.gov/program/eagle-management

- Measures for avoiding and minimizing impacts to birds https://www.fws.gov/library/collections/avoiding-and-minimizing-incidental-take-migratory-birds
- Nationwide avoidance and minimization measures for birds
- Supplemental Information for Migratory Birds and Eagles in IPaC https://www.fws.gov/media/supplemental-information-migratory-birds-and-bald-and-golden-eagles-may-occur-project-action

Measures for Proactively Minimizing Migratory Bird Impacts

Your IPaC Migratory Bird list showcases birds of concern, including Birds of Conservation Concern (BCC), in your project location. This is not a comprehensive list of all birds found in your project area. However, you can help proactively minimize significant impacts to all birds at your project location by implementing the measures in the Nationwide avoidance and minimization measures for birds document, and any other project-specific avoidance and minimization measures suggested at the link Measures for avoiding and minimizing impacts to birds for the birds of concern on your list below.

Ensure Your Migratory Bird List is Accurate and Complete

If your project area is in a poorly surveyed area, your list may not be complete and you may need to rely on other resources to determine what species may be present (e.g. your local FWS field office, state surveys, your own surveys). Please review the Supplemental Information on Migratory Birds and Eagles document, to help you properly interpret the report for your specified location, including determining if there is sufficient data to ensure your list is accurate.

For guidance on when to schedule activities or implement avoidance and minimization measures to reduce impacts to migratory birds on your list, see the "Probability of Presence Summary" below to see when these birds are most likely to be present and breeding in your project area.

Review the FAQs

The FAQs below provide important additional information and resources.

NAME	BREEDING SEASON
Bald Eagle Haliaeetus leucocephalus This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities.	Breeds Dec 1 to Aug 31
Black Swift Cypseloides niger This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/8878	Breeds Jun 15 to Sep 10

Broad-tailed Hummingbird Selasphorus platycercus — Breeds May 25 to Aug 21
This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.

Cassin's Finch Haemorhous cassinii — Breeds May 15 to Jul 15
This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.
https://ecos.fws.gov/ecp/species/9462

Clark's Nutcracker Nucifraga columbiana — Breeds Jan 15 to Jul 15
This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA

Evening Grosbeak Coccothraustes vespertinus — Breeds May 15 to Aug 10
This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.

Golden Eagle Aquila chrysaetos — Breeds Dec 1 to Aug 31
This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities.
https://ecos.fws.gov/ecp/species/1680

Grace's Warbler Setophaga graciae — Breeds May 20 to Jul 20
This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA

Lesser Yellowlegs Tringa flavipes — Breeds elsewhere
This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.
https://ecos.fws.gov/ecp/species/9679

Lewis's Woodpecker Melanerpes lewis — Breeds Apr 20 to Sep 30
This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.
https://ecos.fws.gov/ecp/species/9408

Olive-sided Flycatcher Contopus cooperi — Breeds May 20 to Aug 31

This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.
https://ecos.fws.gov/ecp/species/3914

Pinyon Jay Gymnorhinus cyanocephalus — Breeds Feb 15 to Jul 15

This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.
https://ecos.fws.gov/ecp/species/9420

Virginia's Warbler Leiothlypis virginiae — Breeds May 1 to Jul 31

This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.
https://ecos.fws.gov/ecp/species/9441

Western Grebe aechmophorus occidentalis — Breeds Jun 1 to Aug 31

This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.
https://ecos.fws.gov/ecp/species/6743

Probability of Presence Summary

The graphs below provide our best understanding of when birds of concern are most likely to be present in your project area. This information can be used to tailor and schedule your project activities to avoid or minimize impacts to birds. Please make sure you read "Supplemental Information on Migratory Birds and Eagles", specifically the FAQ section titled "Proper Interpretation and Use of Your Migratory Bird Report" before using or attempting to interpret this report.

Probability of Presence (■)

Each green bar represents the bird's relative probability of presence in the 10km grid cell(s) your project overlaps during a particular week of the year. (A year is represented as 12 4-week months.) A taller bar indicates a higher probability of species presence. The survey effort (see below) can be used to establish a level of confidence in the presence score. One can have higher confidence in the presence score if the corresponding survey effort is also high.

How is the probability of presence score calculated? The calculation is done in three steps:

1. The probability of presence for each week is calculated as the number of survey events in the week where the species was detected divided by the total number of survey events for that week. For example, if in week 12 there were 20 survey events and the Spotted Towhee was found in 5 of them, the probability of presence of the Spotted Towhee in week 12 is 0.25.
2. To properly present the pattern of presence across the year, the relative probability of

presence is calculated. This is the probability of presence divided by the maximum probability of presence across all weeks. For example, imagine the probability of presence in week 20 for the Spotted Towhee is 0.05, and that the probability of presence at week 12 (0.25) is the maximum of any week of the year. The relative probability of presence on week 12 is 0.25/0.25 = 1; at week 20 it is 0.05/0.25 = 0.2.

3. The relative probability of presence calculated in the previous step undergoes a statistical conversion so that all possible values fall between 0 and 10, inclusive. This is the probability of presence score.

To see a bar's probability of presence score, simply hover your mouse cursor over the bar.

Breeding Season (■)

Yellow bars denote a very liberal estimate of the time-frame inside which the bird breeds across its entire range. If there are no yellow bars shown for a bird, it does not breed in your project area.

Survey Effort (|)

Vertical black lines superimposed on probability of presence bars indicate the number of surveys performed for that species in the 10km grid cell(s) your project area overlaps. The number of surveys is expressed as a range, for example, 33 to 64 surveys.

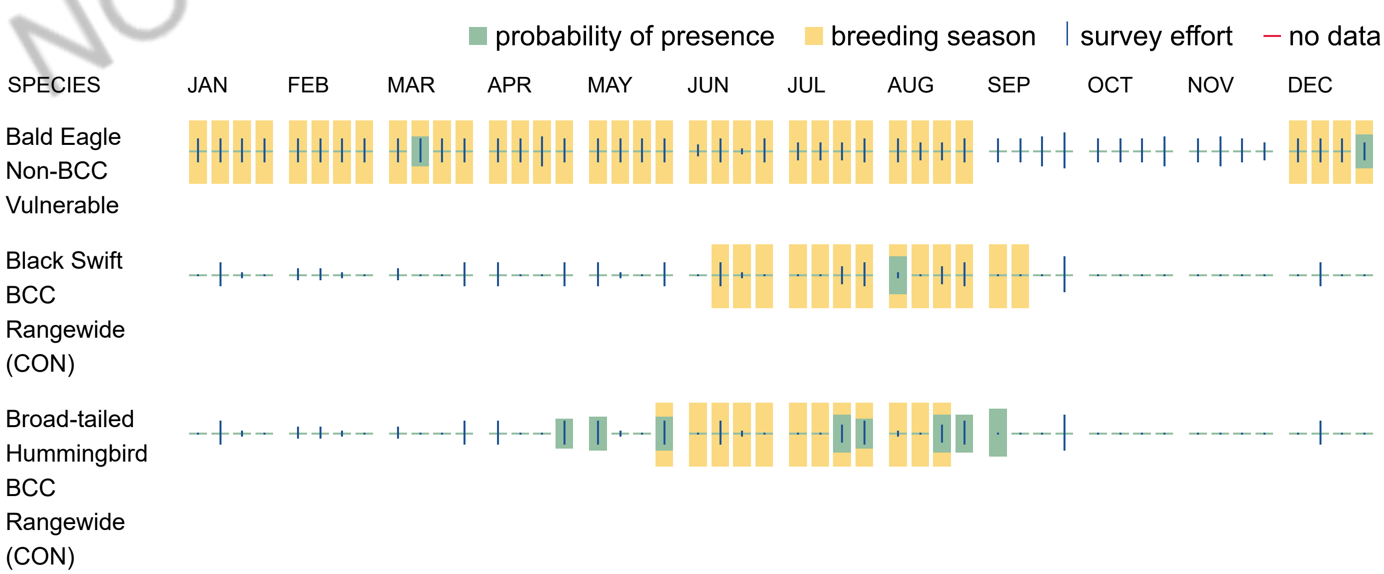
To see a bar's survey effort range, simply hover your mouse cursor over the bar.

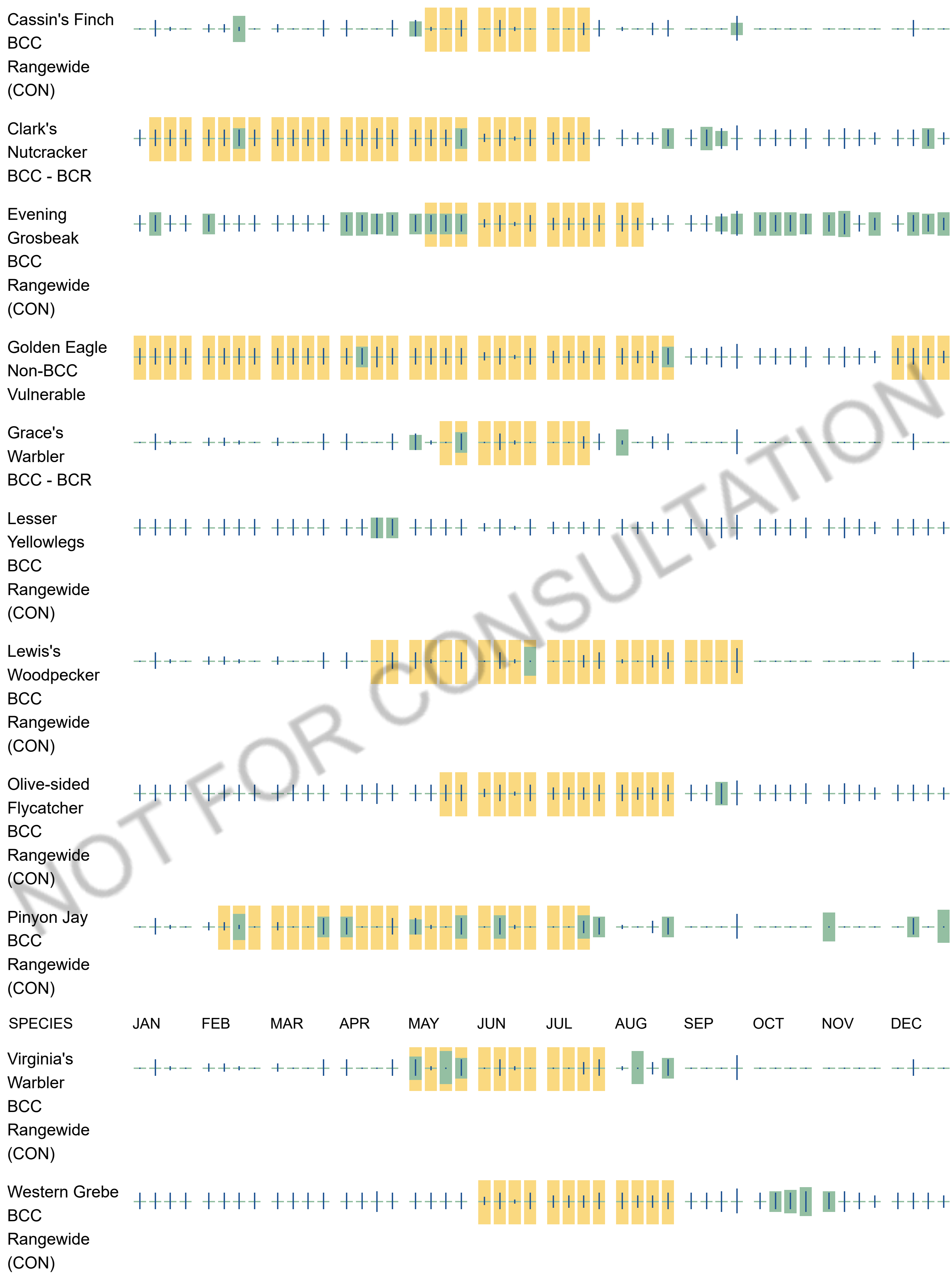
No Data (–)

A week is marked as having no data if there were no survey events for that week.

Survey Timeframe

Surveys from only the last 10 years are used in order to ensure delivery of currently relevant information. The exception to this is areas off the Atlantic coast, where bird returns are based on all years of available data, since data in these areas is currently much more sparse.




Cassin's Finch
BCC Rangewide (CON)
Clark's Nutcracker
BCC - BCR
Evening Grosbeak
BCC Rangewide (CON)
Golden Eagle
Non-BCC Vulnerable
Grace's Warbler
BCC - BCR
Lesser Yellowlegs
BCC Rangewide (CON)
Lewis's Woodpecker
BCC Rangewide (CON)
Olive-sided Flycatcher
BCC Rangewide (CON)
Pinyon Jay
BCC Rangewide (CON)
SPECIES
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
Virginia's Warbler
BCC Rangewide (CON)
Western Grebe
BCC Rangewide (CON)
NOT FOR CONSULTATION

Migratory Bird FAQs

Tell me more about avoidance and minimization measures I can implement to avoid or minimize impacts to migratory birds.

Nationwide Avoidance & Minimization Measures for Birds describes measures that can help avoid and minimize impacts to all birds at any location year-round. When birds may be breeding in the area, identifying the locations of any active nests and avoiding their destruction is one of the most effective ways to minimize impacts. To see when birds are most likely to occur and breed in your project area, view the Probability of Presence Summary. Additional measures or permits may be advisable depending on the type of activity you are conducting and the type of infrastructure or bird species present on your project site.

What does IPaC use to generate the list of migratory birds that potentially occur in my specified location?

The Migratory Bird Resource List is comprised of Birds of Conservation Concern (BCC) and other species that may warrant special attention in your project location, such as those listed under the Endangered Species Act or the Bald and Golden Eagle Protection Act and those species marked as “Vulnerable”. See the FAQ “What are the levels of concern for migratory birds?” for more information on the levels of concern covered in the IPaC migratory bird species list.

The migratory bird list generated for your project is derived from data provided by the Avian Knowledge Network (AKN). The AKN data is based on a growing collection of survey, banding, and citizen science datasets and is queried and filtered to return a list of those birds reported as occurring in the 10km grid cell(s) with which your project intersects. These species have been identified as warranting special attention because they are BCC species in that area, an eagle (Bald and Golden Eagle Protection Act requirements may apply), or a species that has a particular vulnerability to offshore activities or development.

Again, the Migratory Bird Resource list includes only a subset of birds that may occur in your project area. It is not representative of all birds that may occur in your project area. To get a list of all birds potentially present in your project area, and to verify survey effort when no results present, please visit the Rapid Avian Information Locator (RAIL) Tool.

Why are subspecies showing up on my list?

Subspecies profiles are included on the list of species present in your project area because observations in the AKN for **the species** are being detected. If the species are present, that means that the subspecies may also be present. If a subspecies shows up on your list, you may need to rely on other resources to determine if that subspecies may be present (e.g. your local FWS field office, state surveys, your own surveys).

What does IPaC use to generate the probability of presence graphs for the migratory birds potentially occurring in my specified location?

The probability of presence graphs associated with your migratory bird list are based on data provided by the Avian Knowledge Network (AKN). This data is derived from a growing collection of survey, banding, and citizen science datasets.

Probability of presence data is continuously being updated as new and better information becomes available. To learn more about how the probability of presence graphs are produced and how to interpret them, go to the Probability of Presence Summary and then click on the "Tell me about these graphs" link.

How do I know if a bird is breeding, wintering, or migrating in my area?

To see what part of a particular bird's range your project area falls within (i.e. breeding, wintering, migrating, or resident), you may query your location using the RAIL Tool and view the range maps provided for birds in your area at the bottom of the profiles provided for each bird in your results. If a bird on your IPaC migratory bird species list has a breeding season associated with it (indicated by yellow vertical bars on the phenology graph in your "IPaC PROBABILITY OF PRESENCE SUMMARY" at the top of your results list), there may be nests present at some point within the timeframe specified. If "Breeds elsewhere" is indicated, then the bird likely does not breed in your project area.

What are the levels of concern for migratory birds?

Migratory birds delivered through IPaC fall into the following distinct categories of concern:

1. "BCC Rangewide" birds are Birds of Conservation Concern (BCC) that are of concern throughout their range anywhere within the USA (including Hawaii, the Pacific Islands, Puerto Rico, and the Virgin Islands);
2. "BCC - BCR" birds are BCCs that are of concern only in particular Bird Conservation Regions (BCRs) in the continental USA; and
3. "Non-BCC - Vulnerable" birds are not BCC species in your project area, but appear on your list either because of the Bald and Golden Eagle Protection Act requirements (for eagles) or (for non-eagles) potential susceptibilities in offshore areas from certain types of development or activities (e.g. offshore energy development or longline fishing).

Although it is important to avoid and minimize impacts to all birds, efforts should be made, in particular, to avoid and minimize impacts to the birds on this list, especially BCC species. For more information on avoidance and minimization measures you can implement to help avoid and minimize migratory bird impacts, please see the FAQ "Tell me more about avoidance and minimization measures I can implement to avoid or minimize impacts to migratory birds".

Details about birds that are potentially affected by offshore projects

For additional details about the relative occurrence and abundance of both individual bird species and groups of bird species within your project area off the Atlantic Coast, please visit the Northeast Ocean Data Portal. The Portal also offers data and information about other taxa besides birds that may be helpful to you in your project review. Alternately, you may download the bird model results files underlying the portal maps through the NOAA NCCOS Integrative Statistical Modeling and Predictive Mapping of Marine Bird Distributions and Abundance on the Atlantic Outer Continental Shelf project webpage.

Proper interpretation and use of your migratory bird report

The migratory bird list generated is not a list of all birds in your project area, only a subset of birds of priority concern. To learn more about how your list is generated and see options for identifying what other birds may be in your project area, please see the FAQ "What does IPaC use to generate the migratory birds potentially occurring in my specified location". Please be aware this report provides the "probability of presence" of birds within the 10 km grid cell(s) that overlap your project; not your exact project footprint. On the graphs provided, please look carefully at the survey effort (indicated by the black vertical line) and for the existence of the "no data" indicator (a red horizontal line). A high survey effort is the key component. If the survey effort is high, then the probability of presence score can be viewed as more dependable. In contrast, a low survey effort bar or no data bar means a lack of data and, therefore, a lack of certainty about presence of the species. This list does not represent all birds present in your project area. It is simply a starting point for identifying what birds of concern have the potential to be in your project area, when they might be there, and if they might be breeding (which means nests might be present). The list and associated information help you know what to look for to confirm presence and helps guide implementation of avoidance and minimization measures to eliminate or reduce potential impacts from your project activities, should presence be confirmed. To learn more about avoidance and minimization measures, visit the FAQ "Tell me about avoidance and minimization measures I can implement to avoid or minimize impacts to migratory birds".

Interpreting the Probability of Presence Graphs
Each green bar represents the bird's relative probability of presence in the 10km grid cell(s) your project overlaps during a particular week of the year. A taller bar indicates a higher probability of species presence. The survey effort can be used to establish a level of confidence in the presence score.

How is the probability of presence score calculated? The calculation is done in three steps:
The probability of presence for each week is calculated as the number of survey events in the week where the species was detected divided by the total number of survey events for that week. For example, if in week 12 there were 20 survey events and the Spotted Towhee was found in 5 of them, the probability of presence of the Spotted Towhee in week 12 is 0.25.

To properly present the pattern of presence across the year, the relative probability of presence is calculated. This is the probability of presence divided by the maximum probability of presence across all weeks. For example, imagine the probability of presence in week 20 for the Spotted Towhee is 0.05, and that the probability of presence at week 12 (0.25) is the maximum of any week of the year. The relative probability of presence on week 12 is 0.25/0.25 = 1; at week 20 it is 0.05/0.25 = 0.2.

The relative probability of presence calculated in the previous step undergoes a statistical conversion so that all possible values fall between 0 and 10, inclusive. This is the probability of presence score.

Breeding Season ()
Yellow bars denote a very liberal estimate of the time-frame inside which the bird breeds across its entire range. If there are no yellow bars shown for a bird, it does not breed in your project area.

Survey Effort ()
Vertical black lines superimposed on probability of presence bars indicate the number of surveys performed for that species in the 10km grid cell(s) your project area overlaps.

No Data ()
A week is marked as having no data if there were no survey events for that week.

Survey Timeframe
Surveys from only the last 10 years are used in order to ensure delivery of currently relevant information. The exception to this is areas off the Atlantic coast, where bird returns are based on all years of available data, since data in these areas is currently much more sparse.

Facilities

National Wildlife Refuge lands

Any activity proposed on lands managed by the National Wildlife Refuge system must undergo a 'Compatibility Determination' conducted by the Refuge. Please contact the individual Refuges to discuss any questions or concerns.

There are no refuge lands at this location.

Fish hatcheries

There are no fish hatcheries at this location.

Wetlands in the National Wetlands Inventory (NWI)

Impacts to NWI wetlands and other aquatic habitats may be subject to regulation under Section 404 of the Clean Water Act, or other State/Federal statutes.

For more information please contact the Regulatory Program of the local U.S. Army Corps of Engineers District.

Please note that the NWI data being shown may be out of date. We are currently working to update our NWI data set. We recommend you verify these results with a site visit to determine the actual extent of wetlands on site.

This location overlaps the following wetlands:

FRESHWATER FORESTED/SHRUB WETLAND

- PSS1A
- PFO1A

FRESHWATER POND

- PUBF
- PUS2Jx
- PUS3Cx
- PUS2Ax

RIVERINE

- R4SBJ
- R4SBA
- R4SBC

R5UBH
R4SB7A
R4SBJx

A full description for each wetland code can be found at the National Wetlands Inventory website

NOTE: This initial screening does **not** replace an on-site delineation to determine whether wetlands occur. Additional information on the NWI data is provided below.

Data limitations

The Service's objective of mapping wetlands and deepwater habitats is to produce reconnaissance level information on the location, type and size of these resources. The maps are prepared from the analysis of high altitude imagery. Wetlands are identified based on vegetation, visible hydrology and geography. A margin of error is inherent in the use of imagery; thus, detailed on-the-ground inspection of any particular site may result in revision of the wetland boundaries or classification established through image analysis.

The accuracy of image interpretation depends on the quality of the imagery, the experience of the image analysts, the amount and quality of the collateral data and the amount of ground truth verification work conducted. Metadata should be consulted to determine the date of the source imagery used and any mapping problems.

Wetlands or other mapped features may have changed since the date of the imagery or field work. There may be occasional differences in polygon boundaries or classifications between the information depicted on the map and the actual conditions on site.

Data exclusions

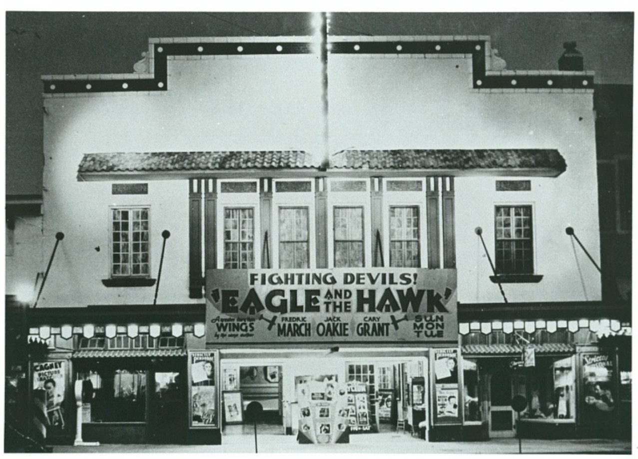
Certain wetland habitats are excluded from the National mapping program because of the limitations of aerial imagery as the primary data source used to detect wetlands. These habitats include seagrasses or submerged aquatic vegetation that are found in the intertidal and subtidal zones of estuaries and nearshore coastal waters. Some deepwater reef communities (coral or tuberficid worm reefs) have also been excluded from the inventory. These habitats, because of their depth, go undetected by aerial imagery.

Data precautions

Federal, state, and local regulatory agencies with jurisdiction over wetlands may define and describe wetlands in a different manner than that used in this inventory. There is no attempt, in either the design or products of this inventory, to define the limits of proprietary jurisdiction of any Federal, state, or local government or to establish the geographical scope of the regulatory programs of government agencies. Persons intending to engage in activities involving modifications within or adjacent to wetland areas should seek the advice of appropriate Federal, state, or local agencies concerning specified agency regulatory programs and proprietary jurisdictions that may affect such activities.

New Mexico's
Rich Cultural Heritage

Listed State and National Register Properties `w Ams I rw



March 2012

Pictured clockwise: Acoma Curio Shop, Cibola County (1934);); Belen Harvey House, Valencia County (888); Gate, Fence, and Hollow Tree Shelter Designed by Dionicio Rodriguez for B.C. Froman, Union County (1927); and Lyceum Theater, Curry County (1897).

Section 2: Arranged by County

HPD	County	City	Name Of Property	SR Date	NR Date
957	Sandoval	Ponderosa	LA 46341	10/25/1983	5/21/1984
959	Sandoval	Ponderosa	LA 5920	10/25/1983	5/21/1984
973	Sandoval	Ponderosa	Wahajhamka Ruin	10/25/1983	5/21/1984
1383	Sandoval	Rio Rancho	Corrales North Archeological District	5/15/1987	
22	Sandoval	San Antonito	Sandia Cave NHL		10/15/1966
236	Sandoval	San Felipe Puebl	San Felipe Pueblo	2/1/1972	
1237	Sandoval	Santa Ana Puebl	Canjillon Pueblo (LA 2049)	2/28/1986	
165	Sandoval	Santa Ana Puebl	Santa Ana, Pueblo of	3/13/1972	11/1/1974
237	Sandoval	Santo Domingo	Santo Domingo Pueblo	2/1/1972	12/12/1973
347	Sandoval	Zia Pueblo	Ko-ah'-sai-ya Ruin	9/18/1974	
232	Sandoval	Zia Pueblo	Zia, Pueblo of	12/30/1971	4/3/1973
1973	Santa Fe		Santa Fe Trail: Canada de los Alamos Site	2/17/2012	
1256	Santa Fe	Canoncito	Nuestra Senora de Luz Church and Cemetery	5/9/1986	12/14/1995
316	Santa Fe	Cerrillos	Cerrillos Opera House	3/29/1974	

HPD	County	City	Name Of Property	SR Date	NR Date
273	Santa Fe	Cerrillos	Los Cerrillos Mining District	2/9/1973	
566	Santa Fe	Cerrillos	Mount Chalchihuitl Turquoise Mine	1/20/1978	
114	Santa Fe	Cerrillos	San Marcos, Pueblo of	9/12/1969	3/26/1982
746	Santa Fe	Cerrillos	Waldo Coke Ovens	8/24/1979	
188	Santa Fe	Chimayo	El Santuario de Chimayo NHL	5/22/1970	4/15/1970
188	Santa Fe	Chimayo	El Santuario de Chimayo NHL	12/20/1968	4/15/1970
71	Santa Fe	Chimayo	Oratorio de San Buenaventura	5/23/1969	
75	Santa Fe	Chimayo	Plaza del Cerro	5/23/1969	7/17/1972
576	Santa Fe	Chimayo	Santa Cruz Dam	1/20/1978	
195	Santa Fe	Cundiyo	Cundiyo	6/26/1970	
271	Santa Fe	Espanola	La Iglesia y la Plaza de Santa Cruz de la Canada	2/9/1973	8/17/1973
129	Santa Fe	Galisteo	Galisteo Historic District	10/17/1969	
801	Santa Fe	Galisteo	Pueblo Blanco (LA 40)	4/3/1981	
107	Santa Fe	Galisteo	Pueblo Colorado (North)	9/12/1969	

HPD	County	City	Name Of Property	SR Date	NR Date
113	Santa Fe	Galisteo	San Lazaro Puebo NHL	9/12/1969	10/15/1966
49	Santa Fe	Glorieta	Glorieta Pass Battlefield NHL	3/21/1969	10/15/1966
192	Santa Fe	Glorieta	Pigeon's Ranch	5/22/1970	
1977	Santa Fe	Glorieta	Santa Fe Trail: Apache Canyon Bridge Site	4/13/2012	
535	Santa Fe	Jacona Plaza	Roybal, Ignacio, House	11/4/1977	2/13/1986
1776	Santa Fe	Jaconita	Lujan/Ortiz House	3/26/1999	1/14/2000
914	Santa Fe	La Bajada	La Bajada Mesa Agricultural Site	1/14/1983	1/15/1984
384	Santa Fe	La Bajada	La Bajada Ruin (LA 7)	6/20/1975	
1822	Santa Fe	La Bajada Villag	Route 66 and National Old Trails Road Historic District at La Bajada	12/6/2002	7/30/2005
387	Santa Fe	La Cienega	Cienega Village Museum, Old	8/24/1979	
199	Santa Fe	La Cienega	Cieneguilla Pueblo (LA 16) (aka Tzeguma)	8/10/1970	
1778	Santa Fe	La Cienega	Jackson, J. B., House	3/26/1999	6/4/1999
219	Santa Fe	La Cienega	Las Golondrinas Ranch Site and Acequia System	8/6/1971	2/1/1980
541	Santa Fe	Lamy	Apache Canyon Railroad Bridge	12/9/1977	4/27/1979

HPD	County	City	Name Of Property	SR Date	NR Date
97	Santa Fe	Lamy	Colina Verde Ruin	9/12/1969	
111	Santa Fe	Lamy	Galisteo, Pueblo of	9/12/1969	
1230	Santa Fe	Lamy	Pflueger, John General Merchandise & Annex Saloon	2/28/1986	6/23/1987
110	Santa Fe	Lamy	Pueblo Largo	9/12/1969	
112	Santa Fe	Lamy	San Cristobal, Pueblo of, Archeological District	9/12/1969	
115	Santa Fe	Lamy	She, Pueblo of	9/12/1969	
1949	Santa Fe	Lamy	The Mission Chapel of Our Lady of Light	8/13/2010	
1901	Santa Fe	Lamy, vic. Of	Arroyo Hondo Pueblo	10/13/2006	7/13/2007
56	Santa Fe	Los Alamos	Bandelier National Monument (2 portions) NHL and CCC National Register Historic District	5/21/1971	5/28/1987
56	Santa Fe	Los Alamos	Bandelier National Monument (2 portions) NHL and CCC National Register Historic District	5/21/1971	10/15/1966
1871	Santa Fe	Los Alamos	Coalition and Classic Period Cultural Properties of the Pajarito Plateau, AD 1200-1600	9/13/2004	
454	Santa Fe	Madrid	Madrid Boarding House	7/30/1976	
356	Santa Fe	Madrid	Madrid Historic District	12/6/1974	11/9/1977
1954	Santa Fe	Multiple	Camino Real - Canon de Las Bocas Section	12/10/2010	4/8/2011

HPD	County	City	Name Of Property	SR Date	NR Date
1953	Santa Fe	Multiple	Camino Real - La Bajada Mesa Section	12/10/2010	4/8/2011
1955	Santa Fe	Multiple	Camino Real - Los Alamitas Section	12/10/2010	
327	Santa Fe	Nambe Pueblo	Nambe Archeological District	5/17/1974	
241	Santa Fe	Nambe Pueblo	Nambe, Pueblo of	3/13/1972	1/21/1974
212	Santa Fe	Pojoaque	Bouquet Ranch	5/21/1971	
888	Santa Fe	Pojoaque	Bouquet, Jean, Historic/Archaeological District	10/1/1982	1/5/1983
1490	Santa Fe	Rio Chiquito	Trujillo, Jose Raphael, House	9/9/1988	
346	Santa Fe	San Ildefonso Pu	Black Mesa (Tunyo)	9/27/1974	
295	Santa Fe	San Ildefonso Pu	Otowi Bridge Historic District	8/20/1973	12/4/1975
1670	Santa Fe	San Ildefonso Pu	Otowi Suspension Bridge	5/9/1997	7/15/1997
230	Santa Fe	San Ildefonso Pu	San Ildefonso, Pueblo of	12/30/1971	6/20/1974
1905	Santa Fe	Sanata Fe	Dodge-Bailey House	12/8/2006	5/18/2007
205	Santa Fe	Santa Fe	Acequia Madre (east portion)	12/18/1970	
1903	Santa Fe	Santa Fe	Acequia Madre Elementary School	12/8/2006	

HPD	County	City	Name Of Property	SR Date	NR Date
815	Santa Fe	Santa Fe	Agua Fria Street, 518	4/3/1981	
805	Santa Fe	Santa Fe	Agua Fria Street, 532-538	4/3/1981	
821	Santa Fe	Santa Fe	Agua Fria Street, 714	4/3/1981	
813	Santa Fe	Santa Fe	Agua Fria Street, 733	4/3/1981	
354	Santa Fe	Santa Fe	Alarid, Jose, House	12/6/1974	
1022	Santa Fe	Santa Fe	Alarid, Ricardo, House	6/8/1984	8/30/1984
1026	Santa Fe	Santa Fe	Allison Dormitory	8/17/1984	11/29/1984
819	Santa Fe	Santa Fe	Alto Street, 508	4/3/1981	
1395	Santa Fe	Santa Fe	Archbishop Lamy's Chapel	7/17/1987	8/19/1988
827	Santa Fe	Santa Fe	Atchison, Topeka & Santa Fe Railway Depot	5/15/1981	
367	Santa Fe	Santa Fe	Atchison, Topeka & Santa Fe Railway Loco. 5030	2/28/1975	
1918	Santa Fe	Santa Fe	Baca-McElvain Residence	10/5/2007	
4	Santa Fe	Santa Fe	Barrio de Analco National Register Historic District NHL		11/24/1968
355	Santa Fe	Santa Fe	Bergere, A. M., House	12/6/1974	10/1/1975

HPD	County	City	Name Of Property	SR Date	NR Date
81	Santa Fe	Santa Fe	Borrego, House	7/18/1969	
82	Santa Fe	Santa Fe	Boyle, House	7/18/1969	
1112	Santa Fe	Santa Fe	Camino del Monte Sol Historic District	8/17/1984	7/11/1988
1904	Santa Fe	Santa Fe	Carlos Gilbert Elementary School	12/8/2006	
823	Santa Fe	Santa Fe	Catanach House	4/3/1981	
213	Santa Fe	Santa Fe	Chapel of San Miguel and Collections	5/21/1971	
803	Santa Fe	Santa Fe	Chavez, Trinidad, House	4/3/1981	
806	Santa Fe	Santa Fe	Conklin Estate	4/3/1981	
1470	Santa Fe	Santa Fe	Connor Hall (NMSD)	7/8/1988	9/22/1988
1563	Santa Fe	Santa Fe	Cooper, Bruce, House and Shop	9/17/1993	
249	Santa Fe	Santa Fe	Crespin, Gregorio, House	7/5/1972	5/29/1975
83	Santa Fe	Santa Fe	Davey, Randall, House	7/18/1969	7/9/1970
58	Santa Fe	Santa Fe	Delgado, Felipe, House	5/23/1969	
812	Santa Fe	Santa Fe	Dendahl House	4/3/1981	

HPD	County	City	Name Of Property	SR Date	NR Date
658	Santa Fe	Santa Fe	Digneo-Valdez House	7/28/1978	11/21/1978
1820	Santa Fe	Santa Fe	Don Gaspar Bridge	8/16/2002	10/16/2002
891	Santa Fe	Santa Fe	Don Gaspar Historic District	12/1/1982	7/21/1983
752	Santa Fe	Santa Fe	Dorman House	10/26/1979	
822	Santa Fe	Santa Fe	Dudrow House	4/3/1981	
826	Santa Fe	Santa Fe	Dunlap Street, 715	4/3/1981	
834	Santa Fe	Santa Fe	El Patio Building	9/4/1981	
545	Santa Fe	Santa Fe	El Puente de Los Hidalgos	1/20/1978	7/25/2001
545	Santa Fe	Santa Fe	El Puente de Los Hidalgos	1/20/1978	
84	Santa Fe	Santa Fe	El Zaguan	7/18/1969	
1873	Santa Fe	Santa Fe	Fairview Cemetery	10/8/2004	1/20/2005
874	Santa Fe	Santa Fe	Federal Building, Old	6/4/1982	8/15/1974
302	Santa Fe	Santa Fe	Field, Mr. & Mrs. William N. Residence	10/27/1973	
707	Santa Fe	Santa Fe	First Ward School	12/15/1978	

HPD	County	City	Name Of Property	SR Date	NR Date
379	Santa Fe	Santa Fe	Fort Marcy Officer's Residence	5/3/1975	6/20/1975
87	Santa Fe	Santa Fe	Fort Marcy Ruins	7/18/1969	4/14/1975
1002	Santa Fe	Santa Fe	Gallegos, Hilario, House	2/17/1984	
62	Santa Fe	Santa Fe	Gallegos, Padre, House	5/23/1969	
817	Santa Fe	Santa Fe	Guadalupe Street, 110	4/3/1981	
809	Santa Fe	Santa Fe	Gutierrez, Marcos and Nicolasa, House	4/3/1981	
377	Santa Fe	Santa Fe	Hayt-Wientge Mansion	3/27/1975	5/6/1977
259	Santa Fe	Santa Fe	Hesch House	9/29/1972	
65	Santa Fe	Santa Fe	Hinojos, Francisca, House	5/23/1969	
1802	Santa Fe	Santa Fe	Historic and Architectural Resources of the Santa Fe, NM Public Schools	7/20/2001	
919	Santa Fe	Santa Fe	Holmes, Juan, House	3/4/1983	
1471	Santa Fe	Santa Fe	Hospital Building (NMSD)	7/8/1988	9/22/1988
1978	Santa Fe	Santa Fe	Jane and Gustave Baumann House and Studio	4/13/2012	
1978	Santa Fe	Santa Fe	Jane and Gustave Baumann House and Studio	4/13/2012	

HPD	County	City	Name Of Property	SR Date	NR Date
1840	Santa Fe	Santa Fe	Jones, Everret Residence	8/8/2003	1/15/2004
1869	Santa Fe	Santa Fe	Kelly, Daniel T., Residence	6/11/2004	10/19/2005
1003	Santa Fe	Santa Fe	Kopp, Andreas, House	2/17/1984	
1916	Santa Fe	Santa Fe	LA 2	10/5/2007	
88	Santa Fe	Santa Fe	La Conquistadora	7/18/1969	
141	Santa Fe	Santa Fe	La Conquistadora Chapel	1/9/1970	
890	Santa Fe	Santa Fe	Laboratory of Anthropology	12/1/1982	7/12/1983
816	Santa Fe	Santa Fe	Larragoite Residence	4/3/1981	
1920	Santa Fe	Santa Fe	Las Acequias	12/7/2007	
67	Santa Fe	Santa Fe	Lobato, Roque, House	5/23/1969	
1922	Santa Fe	Santa Fe	Manderfield Elementary School	12/7/2007	
808	Santa Fe	Santa Fe	Manhatten Avenue, 701 West	4/3/1981	
1303	Santa Fe	Santa Fe	McKibbin, Dorothy S., House	10/24/1986	
1909	Santa Fe	Santa Fe	Molino Barela de Truchas	6/8/2007	

HPD	County	City	Name Of Property	SR Date	NR Date
807	Santa Fe	Santa Fe	Montezuma Avenue, 418	4/3/1981	
217	Santa Fe	Santa Fe	Museum of New Mexico, Collections at the	5/20/1971	
144	Santa Fe	Santa Fe	National Park Service Southwest Regional Office NHL	5/21/1971	10/6/1970
1821	Santa Fe	Santa Fe	New Mexico Public Welfare Building	10/7/2002	
1795	Santa Fe	Santa Fe	New Mexico State Supreme Court Building	7/21/2000	1/18/2002
1908	Santa Fe	Santa Fe	Old Santa Fe Armory	6/8/2007	
468	Santa Fe	Santa Fe	Oldest House, The	8/27/1976	
828	Santa Fe	Santa Fe	Ortiz y Ortiz Residence	5/15/1981	
1517	Santa Fe	Santa Fe	Ortiz y Pino, House	12/8/1989	
16	Santa Fe	Santa Fe	Ortiz, Nicholas and Antonio Jose, Houses		
72	Santa Fe	Santa Fe	Our Lady of Guadalupe Church	5/23/1969	
218	Santa Fe	Santa Fe	Our Lady of Light Chapel	6/20/1971	
1511	Santa Fe	Santa Fe	Palace Avenue, 525 East	9/29/1989	
17	Santa Fe	Santa Fe	Palace of the Governors NHL		10/15/1966

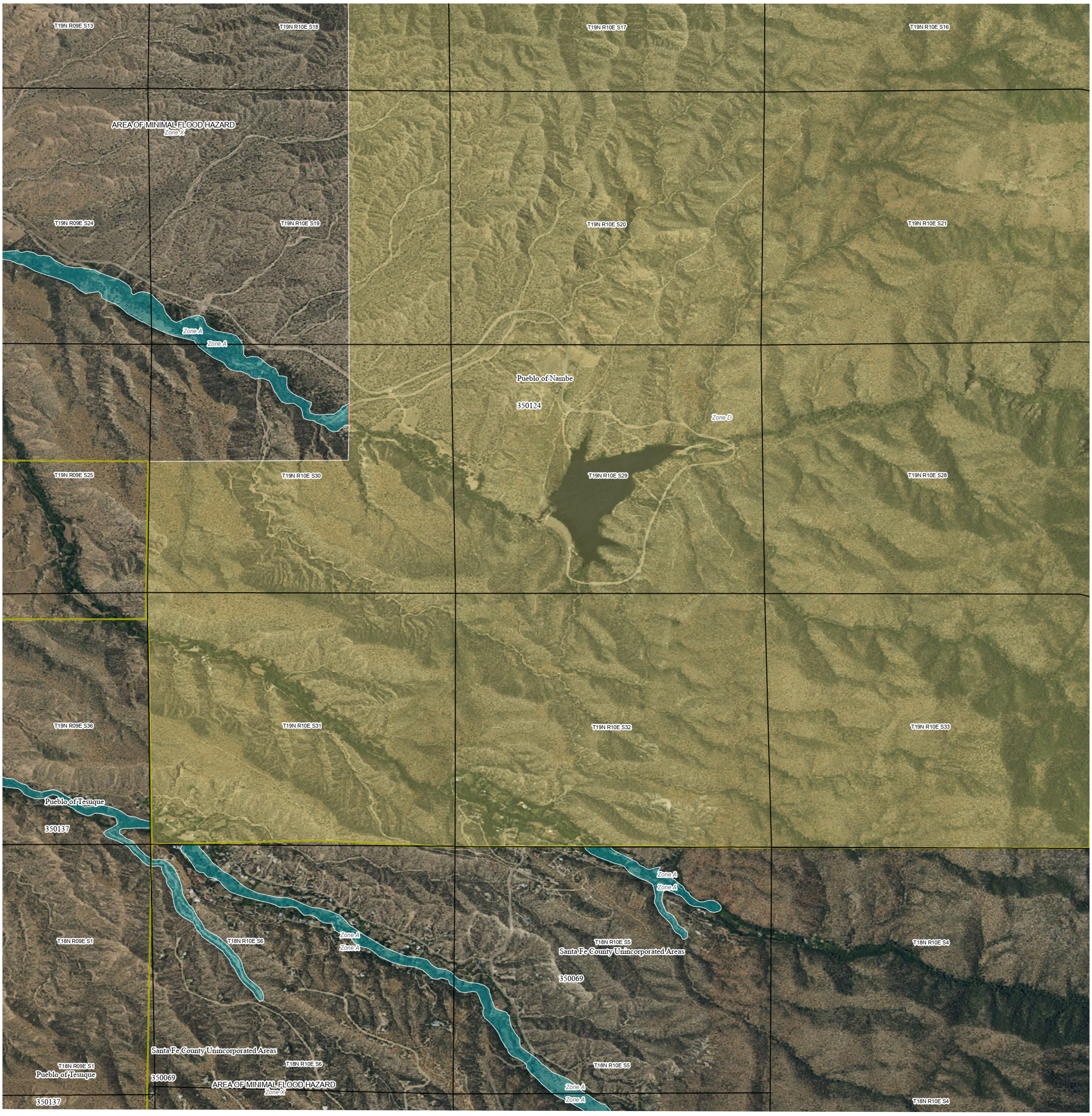
HPD	County	City	Name Of Property	SR Date	NR Date
253	Santa Fe	Santa Fe	Prada, Juan Jose, House	7/5/1972	
375	Santa Fe	Santa Fe	Preston, George Cuyler, House	3/27/1975	
211	Santa Fe	Santa Fe	Prince Plaza	4/23/1971	
950	Santa Fe	Santa Fe	Read, Benjamin M., House	10/25/1983	
89	Santa Fe	Santa Fe	Reredos of Our Lady of Light	7/20/1979	9/4/1970
350	Santa Fe	Santa Fe	Rio Grande Depot, Santa Fe	9/27/1974	
76	Santa Fe	Santa Fe	Rodriguez, Juan, House	5/23/1969	
90	Santa Fe	Santa Fe	Rosario Chapel and Cemetery	7/18/1969	
814	Santa Fe	Santa Fe	Roybal, Jose Rafael, House	4/3/1981	
303	Santa Fe	Santa Fe	Rush, Olive Studio	10/27/1973	
804	Santa Fe	Santa Fe	San Francisco Street, 406 West	4/3/1981	
818	Santa Fe	Santa Fe	San Francisco Street, 447 West	4/3/1981	
811	Santa Fe	Santa Fe	San Francisco Street, 450 West	4/3/1981	
810	Santa Fe	Santa Fe	San Francisco Street, 637.5 West	4/3/1981	

HPD	County	City	Name Of Property	SR Date	NR Date
825	Santa Fe	Santa Fe	Sandoval House	4/3/1981	
820	Santa Fe	Santa Fe	Santa Fe Builders Supply Company (SANBUSCO) Bldg.	4/3/1981	
1279	Santa Fe	Santa Fe	Santa Fe County Courthouse	5/9/1986	
260	Santa Fe	Santa Fe	Santa Fe Historic District	9/29/1972	7/23/1973
27	Santa Fe	Santa Fe	Santa Fe Plaza NHL		10/15/1966
1931	Santa Fe	Santa Fe	Santa Fe River Park Channel	8/8/2008	12/10/2008
200	Santa Fe	Santa Fe	Santa Fe River Sites (16/2,16/3,16/4,16/8,16/9)	8/10/1970	
577	Santa Fe	Santa Fe	Santa Fe Waterworks Reservoir	1/20/1978	
1469	Santa Fe	Santa Fe	School Building Number 2 (NMSD)	7/8/1988	9/22/1988
924	Santa Fe	Santa Fe	Scottish Rite Temple	7/8/1983	3/13/1987
516	Santa Fe	Santa Fe	Second Ward School	7/15/1977	3/30/1978
91	Santa Fe	Santa Fe	Sena Plaza	7/18/1969	
824	Santa Fe	Santa Fe	Sena, Jose D., House	4/3/1981	
119	Santa Fe	Santa Fe	Seton Castle NHL	5/18/1973	10/15/1966

HPD	County	City	Name Of Property	SR Date	NR Date
320	Santa Fe	Santa Fe	Shonnard, Eugenie, House	3/1/1974	9/5/1975
615	Santa Fe	Santa Fe	Sol y Sombra	2/24/1978	
289	Santa Fe	Santa Fe	Spanish & Mexican Period Documentary Collections	6/29/1973	
256	Santa Fe	Santa Fe	Spanish Log Cabin	7/5/1972	
223	Santa Fe	Santa Fe	Spiegelberg-Spitz House	11/20/1971	5/25/1973
1804	Santa Fe	Santa Fe	St. Catherine's Industrial Indian School	9/28/2001	
261	Santa Fe	Santa Fe	Stone Warehouse	9/29/1972	
1472	Santa Fe	Santa Fe	Superintendent's Residence (NMSD)	7/8/1988	9/22/1988
831	Santa Fe	Santa Fe	Supreme Body Shop	6/26/1981	
258	Santa Fe	Santa Fe	Tudesqui, Roque, House	7/5/1972	
79	Santa Fe	Santa Fe	Tully, Pinckney R., House	5/23/1969	11/5/1974
244	Santa Fe	Santa Fe	United States Courthouse, Santa Fe	3/13/1972	5/25/1973
835	Santa Fe	Santa Fe	Van Dresser, Peter, House	9/4/1981	
712	Santa Fe	Santa Fe	Vierra, Carlos, House	2/9/1979	8/3/1979

HPD	County	City	Name Of Property	SR Date	NR Date
80	Santa Fe	Santa Fe	Vigil, Donaciano, House	5/23/1969	6/28/1972
1533	Santa Fe	Santa Fe	Wheelwright Museum of the American Indian	10/5/1990	12/18/1990
851	Santa Fe	Santa Fe	Wood, Professor J. A., House	3/12/1982	
282	Santa Fe	Seton Village	Seton Village NHL (REMOVED SR)	9/1/1969	10/15/1966
245	Santa Fe	Stanley	West Otto Site	3/13/1972	
270	Santa Fe	Tesuque	El Rancho Viejo (REMOVED SR)	2/9/1973	
1823	Santa Fe	Tesuque	Schmidt, Albert, Residence and Studio	12/6/2002	7/25/2003
222	Santa Fe	Tesuque Pueblo	Tesuque, Pueblo of (Tatunge)	11/22/1971	7/16/1973
857	Santa Fe	White Rock	Navawi	3/12/1982	12/8/1982
1195	Sierra	Arrey	LA 50751	9/20/1985	
1207	Sierra	Arrey	LA 517	9/20/1985	12/16/1989
570	Sierra	Arrey	Percha Diversion Dam	1/20/1978	4/6/1979
1206	Sierra	Caballo	LA 1119	9/20/1985	12/16/1989
1203	Sierra	Caballo	Longbottom Canyon Ruin (LA 49033)	9/20/1985	12/16/1989

105°56'15.89"W 35°52'40.96"N



105°52'29.18"W 35°48'29.6"N

FLOOD HAZARD INFORMATION

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR DRAFT FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS	Without Base Flood Elevation (BFE) *Zone A, V, A99*
	With BFE or Depth *Zone AE, AO, AH, VE, AR*
	Regulatory Floodway
OTHER AREAS OF FLOOD HAZARD	0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
	Future Conditions 1% Annual Chance Flood Hazard *Zone X*
	Area with Reduced Flood Risk due to Levee See Notes *Zone X*
	Area with Flood Risk due to Levee *Zone D*
	NO SCREEN Area of Minimal Flood Hazard *Zone X*
	Effective LOMRs
OTHER AREAS	Area of Undetermined Flood Hazard *Zone D*
GENERAL STRUCTURES	Channel, Culvert, or Storm Sewer
	Levee, Dike, or Floodwall
OTHER FEATURES	B 20.2 Cross Sections with 1% Annual Chance
	17.5 Water Surface Elevation
	8 Coastal Transect
	Coastal Transect Baseline
	Profile Baseline
	Hydrographic Feature
	513 Base Flood Elevation Line (BFE)
	Limit of Study
	Jurisdiction Boundary

NOTES TO USERS

For information and questions about this Flood Insurance Rate Map (FIRM), available products associated with this FIRM, including historic versions, the current map date for each FIRM panel, how to order products, or the National Flood Insurance Program (NFIP) in general, please call the FEMA Map Information eXchange at 1-877-FEMA-MAP (1-877-336-2627) or visit the FEMA Flood Map Service Center website at https://msc.fema.gov. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. Many of these products can be ordered or obtained directly from the website.

Communities annexing land on adjacent FIRM panels must obtain a current copy of the adjacent panel as well as the current FIRM Index. These may be ordered directly from the Flood Map Service Center at the number listed above.

For community and countywide map dates, refer to the Flood Insurance Study Report for this jurisdiction.

To determine if flood insurance is available in this community, contact your Insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

Basemap information shown on this FIRM was provided in digital format by USDA, Farm Service Agency (FSA). This information was derived from NAIP, dated April 11, 2018.

This map was exported from FEMA's National Flood Hazard Layer (NFHL) on **3/23/2025 10:37 PM** and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time. For additional information, please see the Flood Hazard Mapping Updates Overview Fact Sheet at https://www.fema.gov/media-library/assets/documents/118418

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards. This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date.

SCALE

Map Projection:
GCS, Geodetic Reference System 1980;
Vertical Datum:
For information about the specific vertical datum for elevation features, datum conversions, or vertical monuments used to create this map, please see the Flood Insurance Study (FIS) Report for your community at https://msc.fema.gov

N

1 inch = 1,000 feet 1:12,000

0 500 1,000 2,000 3,000 4,000 Feet

0 105 210 420 630 840 Meters

FEMA

National Flood Insurance Program

NATIONAL FLOOD INSURANCE PROGRAM

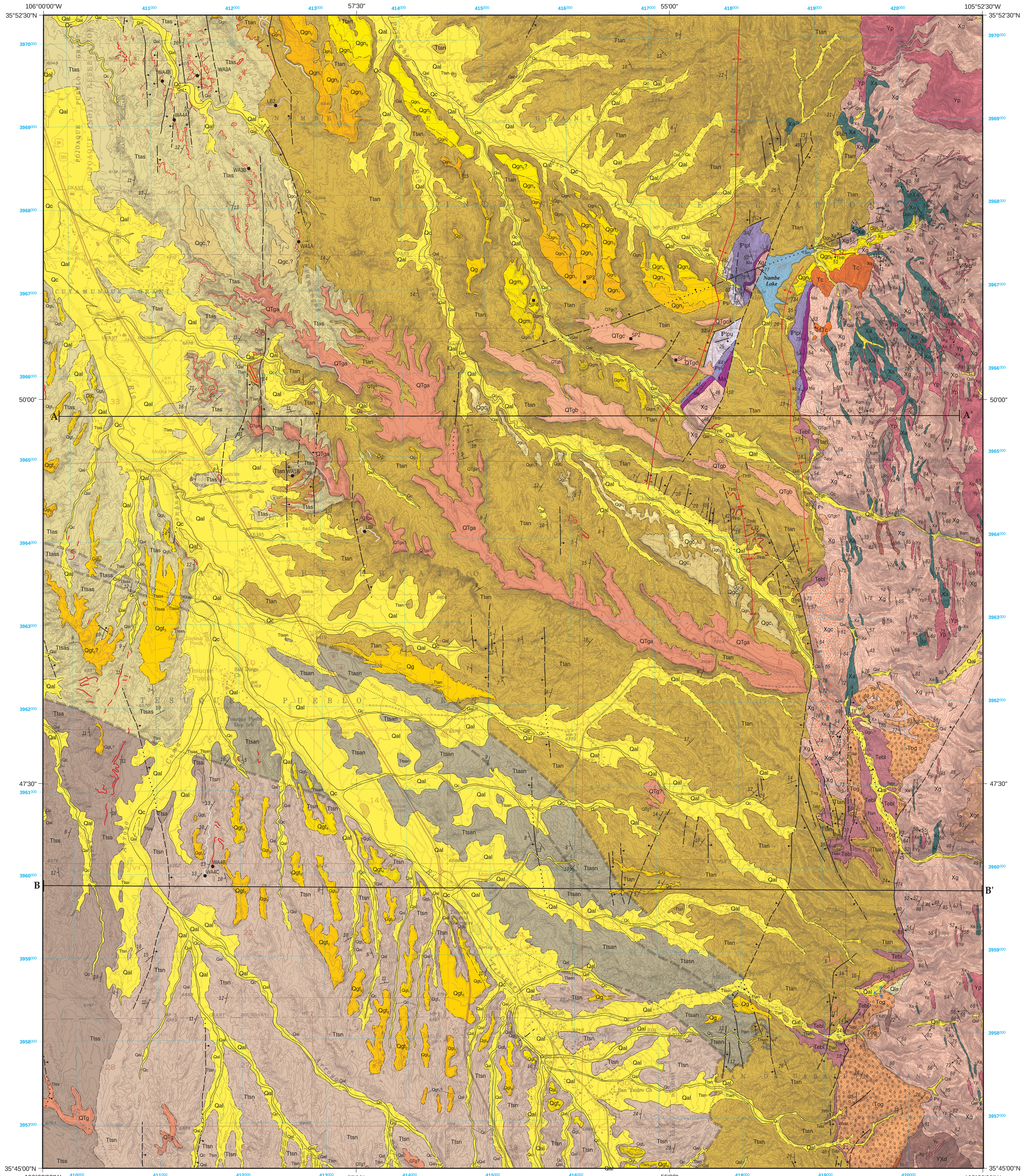
FLOOD INSURANCE RATE MAP

PANEL **285** OF **1100**

Panel Contains:

COMMUNITY	NUMBER	PANEL
PUEBLO OF NAMBE	350124	0285
SANTA FE COUNTY UNINCORPORATED AREAS	350069	0285
PUEBLO OF TESUQUE	350137	0285

MAP NUMBER
35049C0285E
EFFECTIVE DATE
December 04, 2012



MAP UNITS

(Partial description of units; complete descriptions are found in the accompanying report.)

CENOZOIC

Quaternary

Qc — **Modern channels (streams and arroyos) and associated active floodplain alluvium (Holocene)** — Tan, poorly-sorted, gravelly sand and silt. Most deposits occur within 2 m elevation of the present channel. Floodplain may contain vegetation. Only channels >3 m in width are identified on map. Thickness unknown.

Qal — **Alluvium, undifferentiated (Pleistocene? - Holocene)** — Tan, poorly-sorted sand and silt, with minor amounts of subrounded gravel (mostly granite and granitic gneiss); surface soils may have been inflated by addition of eolian material. Grades to 2-10 m above modem channel (base level) of current main-stem stream (Rio Tesuque or Rio Nambé). Unit includes at least four undifferentiated terraces, such as the inhabited and cultivated terraces along the Rio Tesuque, Rio en Medio, and Rio Chupadero. Alluvial deposits, estimated <2 m thick, are not included within this map unit. Likely equivalent to *Qal* of the Santa Fe quadrangle geologic map by Kottlowski and Baldwin (1963). Thickness is unknown, but estimated to be less than 25 m on the basis of regional well logs.

Qls — **Landslide deposits (Pleistocene)** — Unconsolidated, disturbed sediment consisting of angular to subangular granitic clasts and sand.

Qg — **Gravel, undifferentiated (Pleistocene)** — Dominantly subrounded gravel and tan sand with lesser silt. Gravel clasts are dominantly pinkish granite and granitic gneiss (70%), with some quartz and quartzite and sparse limestone, amphibolite, and quartz-mica schist. Clasts are as much as 0.4 m in diameter and generally smaller than the *QTg* gravel deposits. A 1-2 m thick silt deposit, which has largely been pedogenically altered, overlies the gravels and is attributed to eolian dust influx. Deposits are set into existing valleys (most commonly the south and west side) and unconformably overlie the gently dipping beds of the Tesuque Formation. Unit is sufficiently isolated to make correlation to other gravel deposits or to ancestral stream difficult. *Qg* deposits are not correlative to one another. Deposits typically 2-10 m thick.

Gravel of the ancestral Rio Nambé (Pleistocene) — Gravel deposits inset into the southwestern flanks Rio Nambé drainage basin:

- **Qgn_5** — **Lowermost terrace of the ancestral Rio Nambé (middle to upper(?) Pleistocene)** — Terrace tread is approximately 30-45 m above modem channel. 4-10 m thick.
- **Qgn_4** — **Lower terrace of the ancestral Rio Nambé (middle to upper(?) Pleistocene)** — Terrace tread is approximately 45-56 m above modem channel. 2-10 m thick.
- **Qgn_3** — **Middle terrace of the ancestral Rio Nambé (middle Pleistocene)** — Terrace tread is approximately 60-73 m above modem channel. Deposit may correlate to Qt2 Rio del Oso terrace of Dethier and Demsey (1984) with an estimated age of 160 ka. 2-3 m thick.
- **Qgn_2** — **Upper terrace of the ancestral Rio Nambé (middle Pleistocene)** — Terrace tread is approximately 75-83 m above modem channel. 2-5 m thick.
- **Qgn_1** — **Uppermost terrace of the ancestral Rio Nambé (lower Pleistocene)** — Terrace tread is approximately 85-92 m above modem channel. Includes a well-developed soil with a 0.5 m-thick Bt horizon and a 1 m thick Stage II calcium carbonate horizon (Borchert and Wisniewski, unpublished). Soil age is estimated to be >330 ka using the method outlined in Machette (1982, using a constant dust influx rate of 0.25 g cm^{-1} ka^{-1}). Actual age may be significantly older, since observations of soil profile horizon suggest at least two soil-stripping events. 2-10 m thick.

Gravel of the ancestral Rio en Medio (Pleistocene) — Gravel deposits inset into the southwestern flanks Rio en Medio drainage basin:

- **Qgm_2** — **Lower terrace of the ancestral Rio en Medio (upper(?) Pleistocene)** — Terrace tread is approximately 24-31 m above modem channel. Includes a well-developed soil with a 0.52 m thick Bt horizon and a 0.5 m thick Stage II calcium carbonate horizon (Borchert and Wisniewski, unpublished). Soil age is estimated to be >120 ka using the method outlined in Machette (1982, using a constant dust influx rate of 0.25 g cm^{-1} ka^{-1}). Actual age may be significantly older, since observations of soil profile horizon suggest at least two soil-stripping events. This deposit may correlate to *Qt2* Rio del Oso terrace of Dethier and Demsey (1984) with an estimated age of 160 ka. 2-6 m thick.
- **Qgm_1** — **Upper terrace of the ancestral Rio en Medio (middle to upper Pleistocene)** — Terrace tread is approximately 43-61 m above modem channel. 2-8 m thick.

Gravel of the ancestral Rio Chupadero (Pleistocene) — Gravel deposits inset into the southwestern flanks Rio Chupadero drainage basin:

- **Qgc_2** — **Lower terrace of the ancestral Rio Chupadero (late(?) Pleistocene)** — Terrace tread is approximately 22-28 m above modem channel. This deposit may correlate to the *Qt3* Rio del Oso terrace of Dethier and Demsey (1984), whose age is estimated to be 51 ka. 1-5 m thick.
- **Qgc_1** — **Upper terrace of the ancestral Rio Chupadero (middle to late Pleistocene)** — Terrace tread is approximately 36-49 m above modem channel. 2-5 m thick.

Gravel of the ancestral Rio Tesuque (Pleistocene) — Gravel deposits inset into the southwestern flanks Rio Tesuque drainage basin:

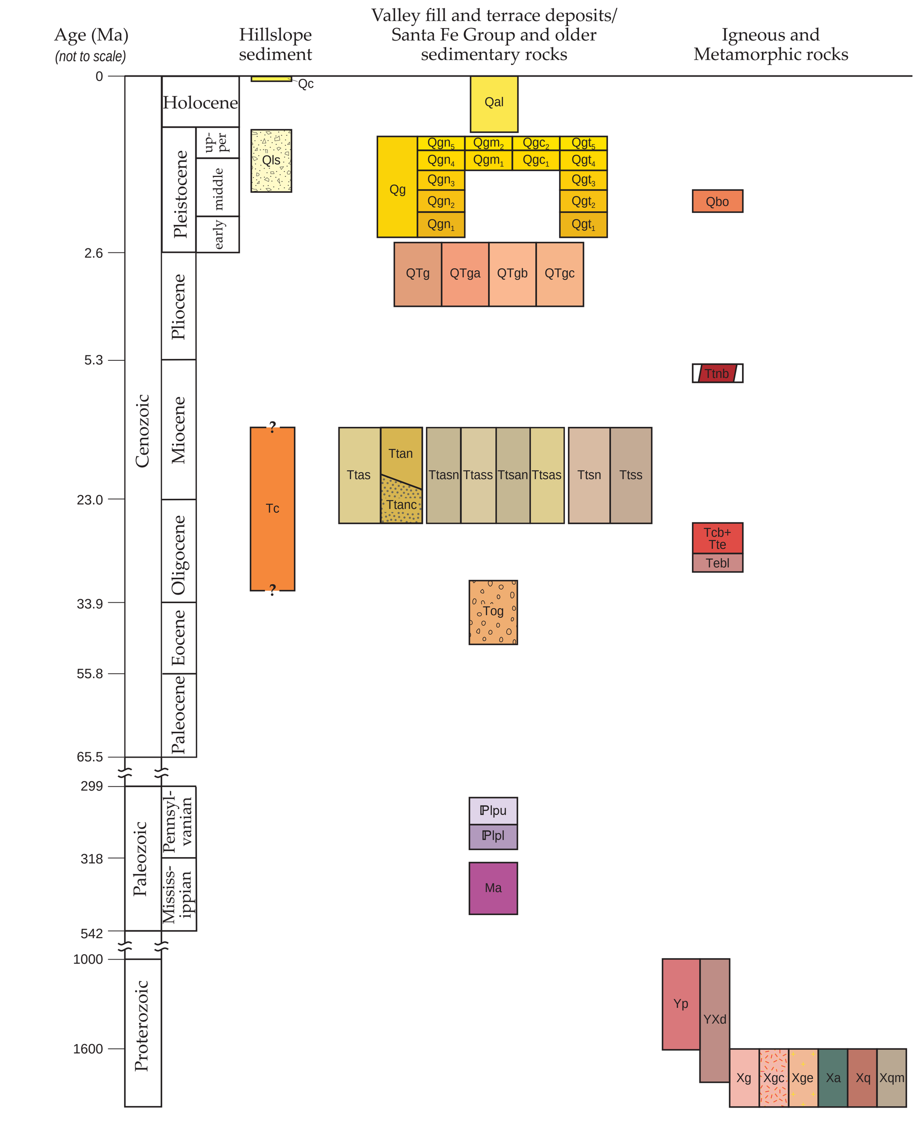
- **Qgt_5** — **Lowermost terrace of the ancestral Rio Tesuque (upper(?) Pleistocene)** — Terrace tread is approximately 20-28 m above modem channel. 1-4 m thick.
- **Qgt_4** — **Lower terrace of the ancestral Rio Tesuque (middle to upper Pleistocene)** — Terrace tread is approximately 30-35 m above modem channel. This deposit may correlate to the *Qt3* Rio del Oso terrace of Dethier and Demsey (1984), whose age is estimated to be 51 ka. 1-5 m thick.
- **Qgt_3** — **Middle terrace of the ancestral Rio Tesuque (middle to upper Pleistocene)** — Terrace tread is approximately 45-55 m above modem channel. 2-5 m thick.
- **Qgt_2** — **Upper terrace of the ancestral Rio Tesuque (middle Pleistocene)** — Terrace tread is approximately 60-65 m above modem channel. 2-6 m thick.
- **Qgt_1** — **Uppermost terrace of the ancestral Rio Tesuque (middle Pleistocene)** — Terrace tread is approximately 75-85 m above modem channel. 2-8 m thick.

Qbo — **Guaje pumice bed of the Otowi Member, Bandelier Tuff (lower Pleistocene; *ca*. 1.61 ± 0.01 Ma (Izett and Obradovich, 1994)** — White pumice clasts generally less than 1 cm long with rare clasts as much as 7 cm long derived from the Valles caldera. Pumice includes quartz and sanidine phenocrysts. Lies within upper 3 m of a 4-12 m fill terrace, *QTga*, and is visible from Hwy 285/84 in the cliffs east of Camel Rock Casino (T18N, R9E, Sec. 2; Plate 1). Constrains age of *QTga* as late Pliocene to early Pleistocene. 1-1.5 m thick.

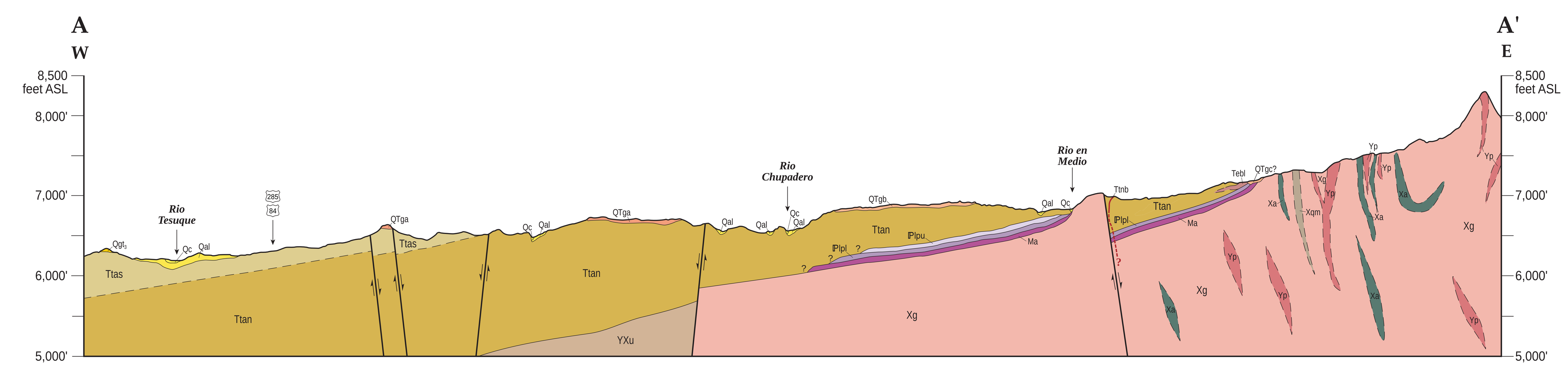
Late Pliocene to early Pleistocene

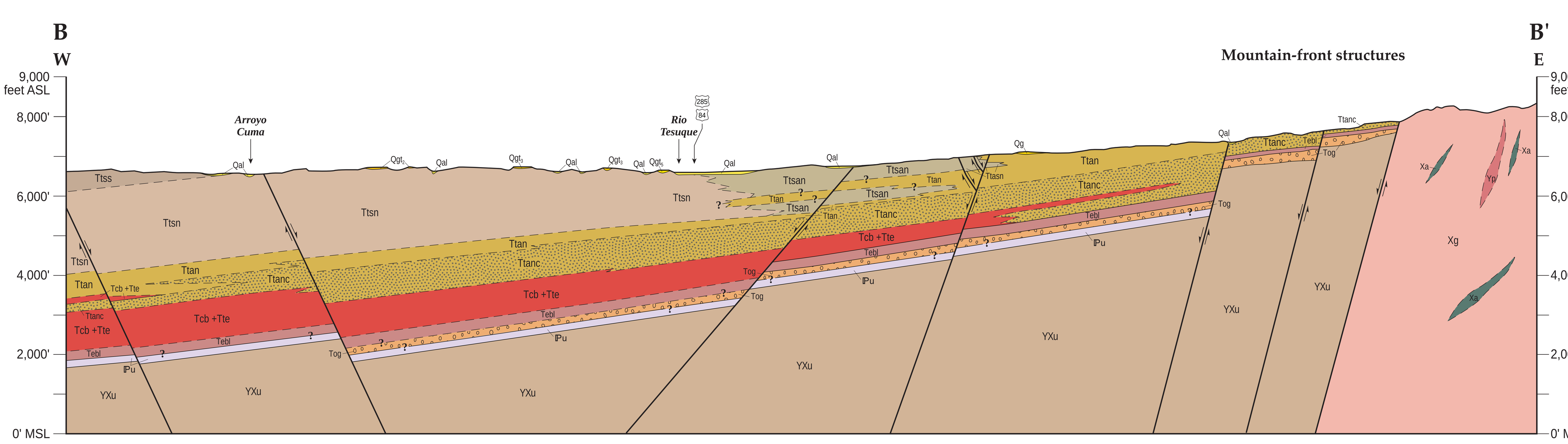
Stream gravel (late Pliocene to early Pleistocene) — Nearly flat-lying, bedded, sub-rounded to subangular gravel and sand (with some ...

CORRELATION OF MAP UNITS



GEOLOGIC CROSS SECTIONS





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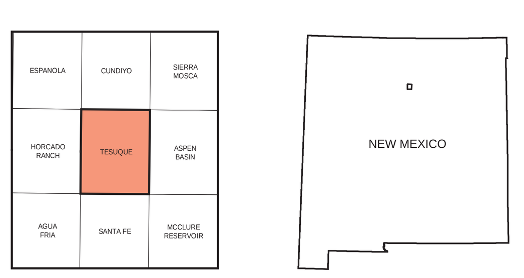
QUADRANGLE LOCATION



New Mexico Bureau of Geology and Mineral Resources
New Mexico Tech
801 Leroy Place
Socorro, New Mexico
87801-4796

[575] 835-5490

This and other STATEMAP quadrangles are available for free download in both PDF and ArcGIS formats at:

http://geoinfo.nmt.edu

1:24,000

CONTOUR INTERVAL 20 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929

New Mexico Bureau of Geology and Mineral Resources
Open-file Geologic Map 47

Mapping of this quadrangle was funded by a matching-funds grant from the STATEMAP program of the National Cooperative Geologic Mapping Act, administered by the U. S. Geological Survey, and by the New Mexico Bureau of Geology and Mineral Resources, (Dr. Peter A. Scholle, *Director and State Geologist*, Dr. J. Michael Timmons, *Geologic Mapping Program Manager*).

Geologic map of the Tesuque quadrangle, Santa Fe County, New Mexico

February 2003

by

Claudia I. Borchert[1], Steven J. Skotnicki[2], Adam S. Read[3], Daniel J. Koning[3], and David J. McCraw[3]

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[2] 281 W. Amoroso Dr., Gilbert, AZ 85233
[3] New Mexico Bureau of Geology and Mineral Resources, 801 Leroy Place, Socorro, NM 87801

MAP SYMBOLS

COMMENTS TO MAP USERS

Geologic Map of the Tesuque Quadrangle, Santa Fe County, New Mexico

By

Claudia I. Borchert, Steven J. Skotnicki, Adam S. Read, Daniel J. Koning, and David J. McCraw

February, 2003

New Mexico Bureau of Geology and Mineral Resources
Open-file Digital Geologic Map OF-GM 72

Scale 1:24,000

This work was supported by the U.S. Geological Survey, National Cooperative Geologic Mapping Program (STATEMAP) under USGS Cooperative Agreement 06HQPA0003 and the New Mexico Bureau of Geology and Mineral Resources.

New Mexico Bureau of Geology and Mineral Resources
801 Leroy Place, Socorro, New Mexico, 87801-4796

EXPLANATION TO THE GEOLOGIC MAP OF THE TESUQUE QUADRANGLE, SANTA FE COUNTY, NEW MEXICO

Claudia I. Borchert, Steven J. Skotnicki, Adam S. Read, Daniel J. Koning, and David J. McCraw

Field mapping was conducted by Claudia Borchert (formerly of the University of New Mexico, now with the City of Santa Fe) as part of her Master thesis. The effort was supervised by Dr. Gary Smith (University of New Mexico) and assisted by Susan Hoffman, Aaron Cavosie, and Mike Gaud. Proterozoic mapping was done by Dr. Steven Skotnicki (private consultant) and Adam Read (New Mexico Bureau of Geology and Mineral Resources); Adam also mapped Paleozoic rocks around Nambé Dam. Terrace-related soil studies were performed by C. Borchert and Paul Wisniewski. Daniel Koning updated the Tertiary basin deposits in 2009-2010 (Koning and Read, 2010). David McCraw synthesized the disparate contributions that have occurred since 2003 into the final map product.

Description of Map Units

CENOZOIC

QUATERNARY

Qc **Modern channels (streams and arroyos) and associated active floodplain alluvium (Holocene)** — Tan, poorly-sorted, gravelly sand and silt. Most deposits occur within 2 m elevation of the present channel. Floodplain may contain vegetation. Only channels >3 m in width are identified on map. Thickness unknown.

Qal **Alluvium, undifferentiated (Pleistocene (?) - Holocene)** — Tan, poorly-sorted sand and silt, with minor amounts of subrounded gravel (mostly granite and granitic gneiss); surface soils may have been inflated by addition of eolian material. Grades to 2-10 m above modem channel (base level) of current mainstem stream (Rio Tesuque or Rio Nambé). Unit includes at least four undifferentiated terraces, such as the inhabited and cultivated terraces along the Rio Tesuque, Rio en Medio, and Rio Chupadero. Alluvial deposits, estimated <2 m thick, are not included within this map unit. Likely equivalent to *Qal* of the Santa Fe quadrangle geologic map by Kottlowski and Baldwin (1963). Thickness is unknown, but estimated to be less than 25 m on the basis of regional well logs.

Qls Landslide deposits (Pleistocene) — Unconsolidated, disturbed sediment consisting of angular to subangular granitic clasts and sand.

Quaternary terrace gravels

Dominantly subrounded gravel and tan sand with lesser silt. Gravel clasts are dominantly pinkish granite and granitic gneiss (70%), with some quartz and quartzite and sparser limestone, amphibolite, and quartz-mica schist. Clasts are as much as 0.4 m in diameter and generally smaller than the *QTg* gravel deposits. A 1-2 m silt deposit, which has largely been pedogenically altered, overlies the gravels and is attributed to eolian dust influx. Deposits are set into existing valleys (most commonly the south and west side) and unconformably overlie the gently dipping beds of the Tesuque Formation. Deposits are typically between 2-10 m thick.

Terrace deposits are correlated by field observation and tread and strath positions and not by clast composition or soil profiles. Map units bear the letter of the drainage system they are within (*Qgn* for Rio Nambé-Pojoaque River, *Qgm* for Rio en Medio, Qgc for Rio Chupadero, and *Qgt* for Rio Tesuque) and are labeled from oldest and highest elevation (Qgn_1, Qgm_1, Qgc_1, and Qgt_1) to youngest and lowest in elevation (Qgn_5, Qgm_2, Qgc_2, and Qgt_5), but described below from youngest to oldest. Since the number of terraces per stream system varies (from two within the Rio Chupadero valley to five within the Rio Nambé), the units which bear the same numeral subscript are not necessarily correlative. Where stream-gravel boundaries are covered by a colluvial apron shed from an older, higher terrace (e.g., Qgn_3, Qgt_4, and Qgn_5 in T19N, R10E, Sec. 30), the boundary between deposits has been placed midpoint between the two terrace treads. Where no field outcrops were found, the assumption was made that each tread represents a distinct terrace-forming deposit. The alternative, in which several strath terrace treads have been carved into a larger cut-and-fill stream deposit, is also plausible. Ages for deposits are approximate.

Qg Gravel, undifferentiated (Pleistocene) — Gravel unit that is sufficiently isolated to make correlation to other gravel deposits or to ancestral stream difficult. *Qg* exposures are not correlative to one another.

Qgn Gravel of ancestral Rio Nambé (Pleistocene) — Gravel deposits inset into the southwestern flanks Rio Nambé drainage basin:

Qgn_5 (middle to upper(?) Pleistocene) — Terrace tread is approximately 30-45 m above modem channel. 4-10 m thick.

Qgn_4 (**middle to upper (?) Pleistocene)** — Terrace tread is approximately 45-56 m above modem channel. 2-10 m thick.

Qgn_3 **(middle Pleistocene)** — Terrace tread is approximately 60-73 m above modem channel. Deposit may correlate to *Qt_2* Rio del Oso terrace of Dethier and Demsey (1984) with an estimated age of 160 ka. 2-3 m thick.

Qgn_2 **(middle Pleistocene)** — Terrace tread is approximately 75-83 m above modem channel. 2-5 m thick.

Qgn_1 **(lower Pleistocene)** — Terrace tread is approximately 85-92 m above modem channel. Includes a well-developed soil with a 0.5 m-thick Bt horizon and a 1 m thick Stage II calcium carbonate horizon (Borchert and Wisniewski, unpublished). Soil age is estimated to be >330 ka using the method outlined in Machette (1982, using a constant dust influx rate of 0.25 g cm^{-1} ka^{-1}). Actual age may be significantly older, since observations of soil profile horizon suggest at least two soil-stripping events. 2-10 m thick.

Qgm **Gravel of ancestral Rio en Medio (Pleistocene)** — Gravel deposits inset into the southwestern flanks of the Rio en Medio drainage basin:

Qgm_2 **(upper (?) Pleistocene)** — Terrace tread is approximately 24-31 m above modem channel. Includes a well-developed soil with a 0.52 m thick Bt horizon and a 0.5 m thick Stage II calcium carbonate horizon (Borchert and Wisniewski, unpublished). Soil age is estimated to be >120 ka using the method outlined in Machette (1982, using a constant dust influx rate of 0.25 g cm^{-1} ka^{-1}). Actual age may be significantly older, since observations of soil profile horizon suggest at least two soil-stripping events. This deposit may correlate to *Qt2* Rio del Oso terrace of Dethier and Demsey (1984) with an estimated age of 160 ka. 2-6 m thick.

Qgm_1 **(middle to upper Pleistocene)** — Terrace tread is approximately 43-61 m above modem channel. 2-8 m thick.

Qgc **Gravel of ancestral Rio Chupadero (Pleistocene)** — Gravel deposits inset into the southwestern flanks of the Rio Chupadero drainage basin:

Qgc_2 **(upper (?) Pleistocene)** — Terrace tread is approximately 22-28 m above modem channel. This deposit may correlate to the *Qt3* Rio del Oso terrace of Dethier and Demsey (1984), whose age is estimated to be 51 ka. 1-5 m thick.

Qgc_1 **(middle to upper Pleistocene)** — Terrace tread is approximately 36-49 m above modem channel. 2-5 m thick.

Qgt **Gravel of ancestral Rio Tesuque (Pleistocene)** — Gravel deposits inset into the southwestern flanks of the Rio Tesuque drainage basin:

Qgt_5 **(upper (?) Pleistocene)** — Terrace tread is approximately 20-28 m above modem channel. 1-4 m thick.

Qgt_4 **(middle to upper Pleistocene)** — Terrace tread is approximately 30-35 m above modem channel. This deposit may correlate to the *Qt3* Rio del Oso terrace of Dethier and Demsey (1984), whose age is estimated to be 51 ka. 1-5 m thick.

Qgt_3 **(middle to upper Pleistocene)** — Terrace tread is approximately 45-55 m above modem channel. 2-5 m thick.

Qgt_2 **(middle Pleistocene)** — Terrace tread is approximately 60-65 m above modem channel. 2-6 m thick.

Qgt_1 **(middle Pleistocene)** — Terrace tread is approximately 75-85 m above modem channel. 2-8 m thick.

Qbo **Guaje pumice bed of the Otowi Member, Bandelier Tuff (lower Pleistocene; *ca.* 1.61 ± 0.01 Ma (Izett and Obradovich, 1994)** — White pumice clasts generally less than 1 cm long with rare clasts as much as 7 cm long derived from the Valles caldera. Pumice includes quartz and sanidine phenocrysts. Lies within upper 3 m of a 4-12 m fill terrace, *QTga,* and is visible from Hwy 285/84 in the cliffs east of Camel Rock Casino (T18N, R9E, Sec. 2; Plate 1). Constrains age of *QTga* as late Pliocene to early Pleistocene. 1-1.5 m thick.

Upper Pliocene to lower Pleistocene

QTg **Stream gravel (upper Pliocene to lower Pleistocene)** — Nearly flat-lying, bedded, subrounded to subangular gravel and sand (with some silt) unconformably overlying the gently dipping Tesuque Formation. Basal unit is commonly rusty yellow, subrounded gravel with tan sand and silt. Clasts are dominantly pinkish granitic gneiss (40-60%) and granite (10-20%), with some quartzite (10-30%), limestone (5-15%), amphibolite <10%), and schist <10%). Limestone clasts are present in greater number and larger size at high elevations close to the mountain front. The gravel varies from 2 mm to 80 cm in diameter and is commonly imbricated to the east, conforming to the east to west transport direction near the eastern margin of the basin. These coarse-grained, fluvial deposits are overlain by 1+ m of silt and fine sand, which we attribute to eolian deposition. Deposits are divided into *QTga-c* based on their interfluve position and not by clast composition. Age approximations for stream gravel are rough at best. Some of the gravel highest in the landscape has been previously named Ancha Formation by Speigel and Baldwin (1963) and piedmont gravels by Kelley (1978). Deposits range from 2-18 m thick.

QTg — Gravel units of small aerial extent in interfluve positions.

QTga — Fill terrace. Caps the interfluve south of Rio Chupadero. Includes the 1.61 Ma Guaje Pumice bed of the Otowi Member of the Bandelier Tuff (*Qbo*, age from Izett and Obradovich, 1994) within the upper 3 m of the fill terrace. Well exposed behind the Camel Rock Casino (T18N R9E, Sec. 3) and along County Road 592, where it underlies the Vista Redondo subdivision. As much as 18 m thick.

QTgb — Fill terrace. Caps the interfluve south of Rio en Medio. As much as 20 m thick.

QTgc — Fill terrace. Caps the interfluve south of Rio Nambé. As much as 15 m thick.

TERTIARY

Tesuque Formation

Proposed by Baldwin (1963), the Tesuque Formation consists of relatively arkosic sandstone and silty sandstone intercalated with variable gravelly channel-fills and subordinate mudstone and siltstone. Strong cementation is not common and its characteristic colors are tan to pink, with minor reddish brown. Galusha and Blick (1971) subdivided the Tesuque Formation in the eastern Española Basin into three stacked members (listed in ascending order, but note the Pojoaque Member is not present on this quadrangle): the Nambé, Skull Ridge, and Pojoaque Members. Later, Cavazza (1986) subdivided the Tesuque Formation into two lithosomes (lithosomes A and B) based on composition, paleocurrents, and provenance considerations; note that lithosome B is not exposed on this quadrangle. Following up on this approach, Koning et al. (2004) recognized another lithosome, called lithosome S, in the Santa Fe area. The map units on the Tesuque quadrangle reflect a combination of the nomenclature of both Cavazza (1986) and Galusha and Blick (1971), with primary emphasis on the former.

Lithosome A interfingers and grades laterally southward into lithosome S (described below). Smith (2000b) and Kuhle and Smith (2001) have interpreted correlative sediment to the north as alluvial slope deposits. Lithosome A is subdivided into the Skull Ridge and Nambé Members, following Galusha and Blick (1971). [description modified from Koning and Read, 2010].

Tta **Lithosome A, Tesuque Formation, Santa Fe Group (upper Oligocene to middle Miocene)** — Pink-tan alluvial slope deposits composed of sandstone, silty-clayey very fine- to medium-grained sandstone, and subordinate mudstone; these are intercalated with minor, coarse-grained channel-fills. Colors of the sandy sediment range from very pale brown, light yellowish brown, pink, to light brown (most common to least common). Sandstone outside of the coarse channel-fills is generally very fine- to medium-grained, mostly moderately to well consolidated, weakly cemented, and in very thin to thick (mostly medium to thick), tabular beds. Coarse channel-fills consist of medium- to very coarse-grained sandstone, pebbly sandstone, and sandy conglomerate. The coarse channel-fills are clast-supported, weakly to strongly cemented by calcium carbonate, and ribbon- to lenticular-shaped. The proportion of coarse channel-fills increases near (within 5 km) the modern mountain front, where gravelly sediment dominates. Conglomerate includes pebbles with minor cobbles. Clasts are poorly to moderately sorted, subrounded to angular (larger clasts are rounded to subrounded), and composed of granite with trace to 5% quartzite, 1-5% amphibolite, and minor intraformational clasts of cemented sandstone. Sand is subangular to subrounded, moderately to well sorted, and an arkose.

Ttas Lithosome A, Skull Ridge Member of the Tesuque Formation, Santa Fe Group (middle Miocene) — Pinkish, interbedded sandstone and siltstone, with lenses of conglomerate and mudstone. Sedimentary structures include cross bedding, ripple lamination, channel scour-and-fill, and bioturbation (burrows). Distinguished from other members by its numerous tephra layers. Approximately 200-230 m (650-750 ft) thick (Galusha and Blick, 1971).

Tephras of the Skull Ridge Member in lithosome A

The Skull Ridge Member contains as many as 37 ash beds whose color, texture and thickness may vary laterally. Tephra beds are thicker than original ash fall as a consequence of fluvial reworking of the ash. Some pure fallout ash may locally remain at the base. Four prominent, white tephra horizons, labeled as the No. 1, 2, 3, and 4 white ashes by Galusha and Blick (1971), are specified on the map where identified. The "lower light blue", a useful horizon marker between the No. 1 and No. 2 white ashes, is also identified. All other white tephra are marked as "undifferentiated white tephra."

Ashes were identified in the field generally by stratigraphic context (especially in relation to other non-white ashes) rather than internal characteristics (e.g. mineralogy). Galusha and Blick (1971) use the No. 1 white ash to mark the contact between the Skull Ridge and the Nambé Members. In absence of the No. 1 white ash, the contact between the Skull Ridge and Nambé Members is not stratigraphically identifiable; hence where the No. 1 white ash is covered or not present in the Tesuque quadrangle (approximately 90% of the quadrangle), the basal contact has been approximated (dashed on the map) using local bedding orientation. Magnetostratigraphy (Barghoorn; 1981), biostratigraphy (Tedford and Barghoorn; 1993), and $^{40}Ar/^{39}Ar$ geochronology (McIntosh and Quade, 1995; McIntosh, unpub. *in* Kuhle, 1997, Izett and Obradovich, 2001) establish the age of the Skull Ridge between 14.5 and 16 Ma (middle Miocene).

White tephra, undifferentiated – White to very light-gray, vitric tephra. May include quartz, sanidine, biotite, hornblende, and/or pyroxene. Variably indurated and weathered. 0.3-3.3 m thick.

No. 1 white ash – 15.86 ± 0.03 Ma (Perkins, *personal communication*, by tephra-stratigraphic correlation, in Kuhle, 1997). Blocky white, fine-grained, vitric, stuctureless tephra. Includes sparse quartz and lithic fragments. Base weathers to bentonite locally. Constitutes the contact between the Skull Ridge and Nambé Members. Visible from U.S. Hwy. 285/84 north of Camel Rock Casino (T19N, R9E, Sec. 34). 1-2 m thick.

Lower light blue ash – White, fine-grained tephra. Typically capped by a 0.2-0.5 m-thick, cemented sandstone ledge. Visible from U.S. Hwy. 285/84 north of Camel Rock Casino (T19N, R9E, Sec. 34). 0.2-0.5 m thick.

No. 2 white ash – 15.5 ± 0.07 Ma (Izett and Obradovich, 2001) and 15.59 ± 0.07 Ma (MacIntosh, *personal communication*, in Kuhle, 1997) – White, fine-grained, vitric tephra. Contains quartz, sanidine, plagioclase, and little biotite. Occurs 41 m (stratigraphic distance) above the No. 1 white ash. Encircles the base of a hill east of U.S. Hwy. 285/84, 1.5 km northwest of Camel Rock Casino (T19N, R9E, Sec. 34). 0.2-0.8 m thick.

Ashes slightly above the No. 2 white ash (Nos. 2A, 2B, or 2C of Galusha and Blick, 1971) – Thin ashes that lie within 7-10 m above the No. 2 white ash. Not described.

No. 3 white ash – 15.4 ± 0.08 Ma (Izett and Obradovich, 2001) – White, fine-grained, vitric, structureless tephra. Locally found stratigraphically below a highly bioturbated bed. Occurs 58 m (stratigraphic distance) above the No.1 white ash. Crops out east of Cuyamungue (T19N, R9E, Sec. 34). 0.4-1.0 m thick.

No. 4 white ash – 15.3 ± 0.05 Ma (Izett and Obradovich, 2001) and 15.42 ± 0.06 Ma (MacIntosh and Quade, 1995) – White, fine-grained, vitric, structureless tephra. Contains quartz, sanidine, plagioclase, and sparse biotite. Occurs 157 m (stratigraphic distance) above the No. 1 white ash. Crops out approximately 5 m below a distinct blue ash (T19N, R9E, Sec. 21).

Ttan Lithosome A, Nambé Member of the Tesuque Formation, Santa Fe Group (upper Oligocene to lower Miocene) — Light gray, tan and pinkish, coarse-grained sandstone interbedded with conglomerate, siltstone, and sparse mudstone layers. The upper section is tan and pink silty sandstone with more mudstone in than the lower and middle sections. Galusha and Blick (1971) named the upper 120 m the "fossiliferous part" of the member. The section is well exposed in an arroyo with a road east of Rio Tesuque (T18N, R9E, section 12).

The reddish brown, coarse-grained, lower-middle 305-345 m (1000-1100 ft) section (called the 'lower conglomeratic portion' by Galusha and Blick, 1971, depicted in cross section B-B′ as *Ttanc*) varies in grain size, sorting, and rock fragment composition. Outcrops exhibit 80-90% poorly-sorted, sub-angular, arkosic sandstone and conglomerate in beds as much as 40 cm thick; clasts are commonly between 2-10 cm (and as much as 35 cm) in diameter and compsed of granite and granitic gneiss. A distinctive interval in the lower-middle section commonly overlies outcrops of the Bishop's Lodge Member (now of the Espinaso Formation). It consists of angular to sub-rounded, moderately sorted, medium to coarse-grained, quartz-rich (60-75%) gravelly sandstone and conglomerate; this interval is commonly cemented by a white, calcium-carbonate-rich matrix and bedded on the cm to dm scale. This cemented interval crops out discontinuously in many places in the Tesuque quadrangle and is reminiscent of quartz grus visible on modern transport-limited granite or granite gneiss hill slopes. 400-450 m thick (Galusha and Blick, 1971); 500-550 m thick from the cross sections.

Tephras of the Nambé Member in lithosome A

Multiple white and gray tephra exist within the Nambé Member. As many as three white tephras have been identified. The upper tephra was called the Nambé Ash by Galusha and Blick (1971). The lower tephra is herein named the Chupadero Ash, because of its locality within the Chupadero valley (T18N, R9E, Sec. 1); it may possibly correlate with an ash dated by Izett and Obradovich (2001) at 16.4 ± 0.13 Ma.

White ash, undifferentiated – White tephra that was not described in detail. Variably indurated and weathered. 0.3-1 m thick.

"Upper" Nambé white ash – A white, fine ash bed located 10-13 m stratigraphically above the Nambé white ash and lithologically similar to it. Located near the northern quadrangle boundary (T19 N, R9E, Sec. 15 and 22).

Nambé white ash – White, fine-grained, vitric, structureless tephra. Contains quartz, sanidine, plagioclase, and sparse biotite. 0.6-1.2 m thick. Located approximately 35 m (stratigraphic distance) below the contact between the Nambé and Skull Ridge Members.

Chupadero ash – A white, fine ash located in the Chupadero valley (T18N, R9E, Sec. 1).

Gabaldon tephra – A 0.2-100 cm-thick, white tephra bed consisting of fluvially reworked coarse ash and fine lapilli; the latter consists of felsic (latite?) clasts. Tephra is mixed with subordinate arkose sand. Located approximately 18 m (stratigraphic distance) above the basal contact (below which lies the Bishops Lodge Member of the Espinaso Formation). $^{40}Ar/^{39}Ar$ analyses on sanidine crystals returned an age of 25.52 ± 0.07 Ma (Koning *et al*., 2013).

Tts **Lithosome S of the Tesuque Formation, Skull Ridge Member (upper Oligocene(?) to middle Miocene)** — Pebbly sand channel-fill deposits and fine sandstone, siltstone, and mudstone floodplain deposits associated with a large drainage exiting the Sangre de Cristo Mountains near the modern Santa Fe River. Lithosome S is recognized by its clast composition (35-65% granite, 3-40% Paleozoic clasts, 5-30% quartzite, including a distinctive black quartzite, and 1-8% chert), reddish color (particularly compared to the browner, distal alluvial slope facies of lithosome A), and high-energy-flow deposits in very broad, thick channel complexes that possess very thin to medium, planar to lenticular internal bedding. Channel-fill conglomerate is commonly clast-supported, poorly to moderately sorted, and mostly subrounded (but granitic clasts may be subangular). The sand fraction is arkosic and is composed of quartz, 10-30% potassium feldspar, trace to 7% yellowish Paleozoic siltstone, sandstone, or limestone grains, and trace to 5% chert and dark quartzite grains. Channel-fill sand is commonly light brown (7.5YR 6/3), fine- to very coarse-grained, poorly to well sorted, and subrounded to subangular. Cementation of channel-fills is variable. Finer-grained strata of lithosome S are in very thin to medium, tabular beds with horizontal-planar to wavy laminations; locally, this sediment is structureless. Overbank sediment consists of light brown to reddish yellow and pink to very pale brown siltstone, very fine- to coarse-grained (generally fine-grained) sandstone, and silty to clayey sandstone. Within the fine sediment are local very thin to medium, lenticular channel-fills. There are also variable amounts of reddish brown to yellowish red to light reddish brown mudstone and sandy mudstone. Lithosome S interfingers and grades northwards into lithosome A. Lithosome S is subdivided into the Skull Ridge and Nambé Members, following Galusha and Blick (1971) [description modified from Koning and Read, 2010].

Ttss Lithosome S, Skull Ridge Member of the Tesuque Formation, Santa Fe Group (lower to middle Miocene) — Sediment as described above. Unit overlies the inferred, approximate projection of White Ash No. 1. Approximately 200-230 m (650-750 ft) thick (Galusha and Blick, 1971).

Ttsn Lithosome S, Nambé Member of the Tesuque Formation, Santa Fe Group (upper Oligocene to lower Miocene) — Sediment as described above. This unit gradationally overlies a 350(?) m-thick tongue of lower lithosome A sediment. 380-400 m thick.

Ttsas Gradational zone between lithosomes S and A of the Skull Ridge Member, slightly more lithologically similar to lithosome S (upper to middle Miocene) — Fine-grained lateral gradation between lithosomes A and S; unit is laterally closer to lithosome S than lithosome A; predominantly fine sandstone, silty sandstone, and mudstone. Approximately 200-230 m (650-750 ft) thick, similar to the thickness of the Skull Ridge Member to the north.

Ttsan Gradational zone between lithosomes S and A of the Nambé Member, slightly more lithologically similar to lithosome S (upper Oligocene to lower Miocene) — Fine-grained lateral gradation between lithosomes A and S; unit is laterally closer to lithosome S than lithosome A; predominantly fine sandstone, silty sandstone, and mudstone. Approximately 380-400 m thick.

Ttass Gradational zone between lithosomes S and A of the Skull Ridge Member, slightly more lithologically similar to lithosome A (lower to middle Miocene) — Fine-grained lateral gradation between lithosomes A and S; unit is laterally closer to lithosome A than lithosome S; predominantly fine sandstone, silty sandstone, and mudstone. Approximately 200-230 m (650-750 ft) thick, similar to the thickness of the Skull Ridge Member to the north.

Ttasn Gradational zone between lithosomes S and A of the Nambé Member, slightly more lithologically similar to lithosome A (upper Oligocene to lower Miocene) — Fine-grained lateral gradation between lithosomes A and S; unit is laterally closer to lithosome A than lithosome S; predominantly fine sandstone, silty sandstone, and mudstone. Approximately 390-400 m thick.

Ttnb Basalt in the lower Nambé Member (upper Oligocene to lower Miocene(?)) — Dark-green to dark gray, weathered, olivine basalt with a coarse-crystalline texture. Vesicles and calcite amygdules are concentrated near the top of the flows. Outcrops tend to weather spheroidally. Five separate basalt flows have been identified in a relatively unaltered outcrop in an arroyo north of the Chupadero fire station. Basalt is overlain by a 1-2 m greenish siltstone within the lower Nambé Member. Basalt crops out near faults in several locations northeast of the Rio Chupadero, close to the mountain front. May be correlative to a basalt dated at 24.9 ± 0.6 Ma (K-Ar age-determination by Baldridge *et al*., 1980; sample UAKA-77-80) located 5 km east-northeast of Nambé Pueblo. 1-3 m thick.

Tcb+

Tte Cieneguilla basanite flows interbedded with lithosome E, Tesuque Formation (Oligocene) — Cieneguilla basanite flows interbedded with sandstone and pebbly sandstone of lithosome E of the Tesuque Formation (Koning and Read, 2010; Koning and Johnson, 2006). The flows correlate in part with the basalt in the lower Nambé Member (unit *Ttnb*). They consist of gray, porphyritic, mafic volcanic rocks -- probably basanite but may also include nephelinite and basalt. Cuttings from correlative strata in the Yates No. 2 La Mesa well, located 8.1 km southwest of the southwestern corner of this quadrangle, indicates that these flows contain a dark groundmass composed of fine-grained pyroxene and plagioclase; phenocrysts include clinopyroxene, iddingsite-replaced olivine, and plagioclase (Myer and Smith, 2006, unit 2). These cuttings also indicate that the sand is grayish in color and composed of altered basalt, variable percentages of latite, and 1-5% greenish, granular grains of unknown composition. Very fine to fine sand has minor quartz and lesser (about 3%) potassium feldspar and granitic grains. Sand grains are very fine- to very coarse, poorly sorted, and angular to subrounded. Note that some of the sand grains are likely slough from strata higher in the well. Locally there are minor (10-15%) very fine pebbles of basalt. At least one tuff interval. Description of volcaniclastic sediment is from observations of the Yates No. 2 La Mesa well cuttings (Daniel Koning and David Sawyer, unpublished data). Cross section B-B′ only.

Tebl Bishop's Lodge Member of the Espinaso Formation (late Oligocene to early Miocene(?)) — Light gray to white, tuffaceous (?) siltstone and sandstone with gray pumiceous, porphyritic (plagioclase and pyroxene), and andesitic to latitic clasts. Pumice clasts reached 45 cm, whereas latite rock clasts are as much as 18 cm in diameter. At the type-section near The Bishop's Lodge within the Santa Fe quadrangle, Smith (2000) has distinguished at least two volcaniclastic intervals that are each 10-60 m thick: an older, coarser-grained interval that includes latitic and pumaceous clasts and a finer-grained upper interval.

The member is differentiated from the Nambé Member by the presence of volcanic clasts and its characteristically whitish-gray, fine-grained sandy silt. Contact with the pinker, more granitic Nambé Member is interfingered and both erosional and gradational, likely because the sediment of a volcanic apron was shed intermittently and mixed with sediment derived from the mountains to the east. Any mappable thicknesses of fine-grained material (tuffaceous sand and silt) that may have very little in the way of volcanic pebbles, but may include volcanic granules or small pumice lapilli, have been included in the Bishop's Lodge Member, as well as fine-grained silts exhibiting the characteristic light-gray Bishop's Lodge Member color. The Bishop's Lodge Member crops out discontinuously, close to the mountain front (e.g. west and south of Pacheco Canyon road and along the National Forest Boundary in Secs. 17 and 22, T10N, R8E) and commonly fills valley floors. Smith (2000) reports a 30.45 ± 0.16 Ma tephra ($^{40}Ar/^{39}Ar$ date on biotite,) from within the member. Although this member was named by Baldwin (1963), who included it within the Tesuque Formation, Galusha and Blick (1971) call the member the Picuris Formation. Ingersoll, *et al.* (1990) consider it contemporaneous with deposition of the upper Abiquiu and middle Picuris Formations, which are late Oligocene to early Miocene age. Typically 2-25 m thick.

Tc Colluvium (Oligocene? to early Miocene?) — Buff and yellowish poorly-exposed, limestone boulder-rich deposit overlying basal Nambé Member adjacent to the contact between the basement rock and basin fill. Probably >10 m thick.

Tog **Older gravels (Eocene to lower Oligocene)** — Limestone- and granite-bearing pebbly sandstone and conglomerate that underlies the Bishops Lodge Member (Espinaso Formation) at and north of Santa Fe. At the mouth of Pacheco Canyon, 10-30 m of limestone-rich gravel overlies the Bishops Lodge Member and is assigned to this unit. Beds are commonly medium and tabular to lenticular. Gravel clasts are subangular to subrounded, commonly clast-supported, moderately to poorly sorted, and consist of pebbles with varying amounts of cobbles (but cobbles are generally subordinate). Clasts are composed of granite, granitic gneiss, and yellowish Paleozoic limestone and siltstone. Sand is light yellowish brown to light gray, mostly medium- to very coarse-grained, subrounded to subangular, poorly to moderately sorted, and an arkose in its upper part. Strong cementation is common. [modified from Koning and Read, 2010].

This unit correlates to a >400-m section of limestone-rich strata below the Bishop's Lodge Member that Smith (2000) included in the Nambé Member. Following Koning and Read (2010), we have elected to informally call this interval as an "older gravel unit (*Tog*)," in part because the lower part of this unit may be correlative with the Laramide-age Galisteo Formation. At least three distinct intervals, whose heterogeneity are perhaps influenced by local basin characteristics (such as drainage basin size, location within drainage basin, and proximity to faults) are present in the *Tog* unit near its basal contact with the basement rock. One is a 25+ m exposure of a quartz-rich interval visible in the footwall along a near-vertical fault surface (State Plane coordinates: x=605000, y=1732000). The fault juxtaposes the quartz-rich strata in the footwall against pink, arkosic, gravelly, sub-angular sand and silt beds in the hanging wall; the hanging wall arkosic beds interfinger with the light gray, tuffaceous, volcaniclastic Bishop's Lodge Member. The second interval comprises a very light tan sand and/or silt, which does not contain volcanic clasts but may represent a mixing of volcanic ash with granitic source material. The strata are rich in limestone (25-40% limestone cobbles) and more visible in the Tesuque quadrangle as lag deposit than in outcrop. The third interval is a pink to dark reddish brown, coarse, angular sand and gravel much like the 'lower-middle' unit of the Nambé Member described previously. >400 m thick (Smith, 2000).

PALEOZOIC

Pennsylvanian

IPlp La Pasada Formation (Desmoinesian) — Gray, fossiliferous limestone (weathering buff to tan) with some gray shale and red to maroon, subrounded, sandstone and conglomerate. Exposed in an unnamed drainage 0.5 km south the Nambé Lake Dam (northwest comer of T19N, R10E, Sec. 32). Approximately 30-50 m thick.

IPs Sandia Formation (Morrowan) — Gray, highly fossiliferous limestone (weathering buff to tan) with some green to black mudstone, gray, green and buff shale, and green, red, maroon and brown, poorly sorted sandstone and conglomerate. Overlies the Arroyo Peñasco Group (Mississippian) along western boundary of Nambé Lake (T19N, R10E, Sec. 29). Outcrops may include Arroyo Peñasco Group locally at base. Approximately 60 m thick.

Mississippian

Ma Arroyo Peñasco Group — Predominantly gray, crinkly-laminated dolomitic limestone (~0.5 m-thick beds) interbedded with lesser amounts of platy mudstone, blocky limestone, and reddish sandstone. Basal unit is a greenish, very fine to fine-grained, silty sandstone. Unconformably overlies the Proterozoic rocks west of Nambé Lake Dam. Approximately 12 m thick.

PROTEROZOIC

YXu Proterozoic undifferentiated — Strongly foliated granitic gneiss with lesser amounts of amphibolite, quartzite, and quartz-muscovite schist (likely Paleoproterozoic). Cross sections only.

Yp Pegmatite (Middle Proterozoic?) — Very coarse-grained, anhedral to subhedral pink, locally perthitic K-feldspar, light gray to clear-gray quartz, and locally variable amounts of either muscovite or biotite. Muscovite is much more common. Crystals range up to 6 or more cm across. Some bodies contain abundant anhedral to euhedral bi-pyramidally shaped magnetite crystals. Red garnet is rare. Some exposures reveal K-feldspar and quartz intergrown in graphic textures several tens of cm across. These rocks form thin veins less than a meter wide to thick dikes and irregularly shaped bodies. The pegmatites tend to erode into coarse debris that commonly mantles slopes and creates the illusion of a much thicker body. Hence in many areas contacts are very difficult to identify and dashed contacts on the map should be regarded as best guesses.

YXd Diorite (Middle Proterozoic?) — Medium-grained, equigranular, non-foliated intrusive rocks containing roughly equal parts amphibole, biotite, and plagioclase, with subordinate quartz. Exposures are poor and rock weathers into sandy grus-covered slopes in the extreme southeastern corner of the Tesuque 7.5′ quadrangle. Weathers dark green.

Xg **Fine- to medium-grained granite—"Embudo Granite" (Early Proterozoic)** — Locally heterogeneous, predominantly fine-to medium-grained granite. This equigranular rock contains pink K-feldspar, light gray plagioclase, clear-gray quartz, and very minor biotite (1-3%). Many exposures are light tan to pink and contain coarser-grained muscovite crystals and a preponderance of K-feldspar over plagioclase. The coarse muscovite is probably not primary, but was likely created during metamorphism by the reaction between K-feldspar and quartz. The excess(?) K-feldspar suggests that some of these rocks may have undergone addition of potassium during an episode of potassium metasomatism. The axial plane of rare isoclinal folds are sub-parallel to S_2. The dominant foliation, S_2, and stretching lineation, L_2 (indicated on the map), may represent a secondary tectonic fabric, overprinting an earlier tectonic stress history (with an associated S_1 and L_1). The Embudo granite has been dated by Register and Brookins (1979) in the Nambé Falls area at 1412 and 1372 Ma and in Pacheco Canyon at 1534 and 1492 Ma.

Miller and others (1963) described a separate gneissic variety as well as a coarse-grained variety and a quartz-dioritic phase. Mapping has shown that the gneissic variety grades into rock where foliation is weak to nonexistent and is clearly recognizable as fine-grained granite. Hence, the gniessic and fine-grained rocks are probably the same granite. Exposed very locally south of Rio Nambe is a medium-gray, strongly foliated, fine- to medium-grained rock containing very little recognizable K-feldspar and abundant (~10%) biotite. This rock, though not mapped separately, is adjacent to a large band of quartz-muscovite schist/ quartzite. The rock may be equivalent to the quartz diorite variety described by Miller and others (1963). However, they interpret the variety as having originated from the partial assimilation of amphibolite, but here the rock is not immediately in contact with any amphibolite.

Map unit *Xg* may be equivalent to 'tonalite' mapped in the northeast part of the Chimayo 7.5′ quadrangle (Koning, 2003). This unit contains some areas that are coarse-grained.

Xgc **Coarse-grained granite - "Embudo Granite" (Early Proterozoic)** — Coarse-grained granite containing obvious pink K-feldspar phenocrysts up to about 1.5 cm across. Biotite is abundant (5-10%) and is characteristically fresh, anhedral, and relatively large (1-3 mm) compared to biotite crystals in the fine-grained granite (map unit *Xg*). This unit, as mapped, is everywhere foliated. Miller and others (1963) describe a coarse-grained variety of the Embudo granite. However, at the time of their study, few accurate age-dates were available and the significance of the later pulse of ~1.4 Ga plutonism was not fully recognized. Hence, it is possible that this coarse-grained granite may either be part of the early Proterozoic Embudo pluton or it may be a younger ~1.4 Ga intrusion. Comparison of these exposures with coarse-grained granites presumably to the east may help to resolve this problem.

Xge Medium- to coarse-grained, equigranular granite - "Embudo Granite" (Early Proterozoic) — This unit is tentatively separated from map unit Xg on the basis of homogeneous and apparently widespread (at least locally) exposures of this granite variety exposed in the high, steep face on the north side of Pacheco Canyon, in the southern part of the Tesuque 7.5′ quadrangle. Here it approaches coarse-grained, is equigranular, and forms very bold cliffs with subangular to rounded, bouldery outcrops.

Xa Amphibolite (Early Proterozoic) — Amphibole-rich gniess, biotite schists, and all gradations in between. Outcrops are rather heterogeneous and contain highly variable amounts of amphibole, feldspar (mostly plagioclase), biotite, and quartz. Biotite schists commonly contain abundant light gray feldspar and quartz, and are approximately granodioritic in composition. The biotite schists generally appear slightly lighter gray than the dark greenish gray amphibolites. Amphibolites range from fine-grained to relatively coarse-grained and contain tabular subhedral amphibole phenocrysts locally up to 1 cm long, that appear as though they formed both during and after metamorphism. The percentage of feldspar is highly variable. Some rocks contain only amphibole and quartz. The amphibolites and biotite schists together may have originally been either intermediate to mafic igneous rocks or intermediate-composition pelitic rocks, or both.

Xq Quartzite (Early Proterozoic) — These discontinuous, lens-shaped bluish gray exposures are composed of quartz and thin laminae of darker iron oxides. No bedding is obvious. Exposures are foliated.

Xqm Quartz-Muscovite Schist (Early Proterozoic) — Composed of quartz and medium- to coarse grained muscovite. Commonly strongly foliated. This unit was likely a sedimentary protolith that contained abundant quartz and finer material that included some clay.

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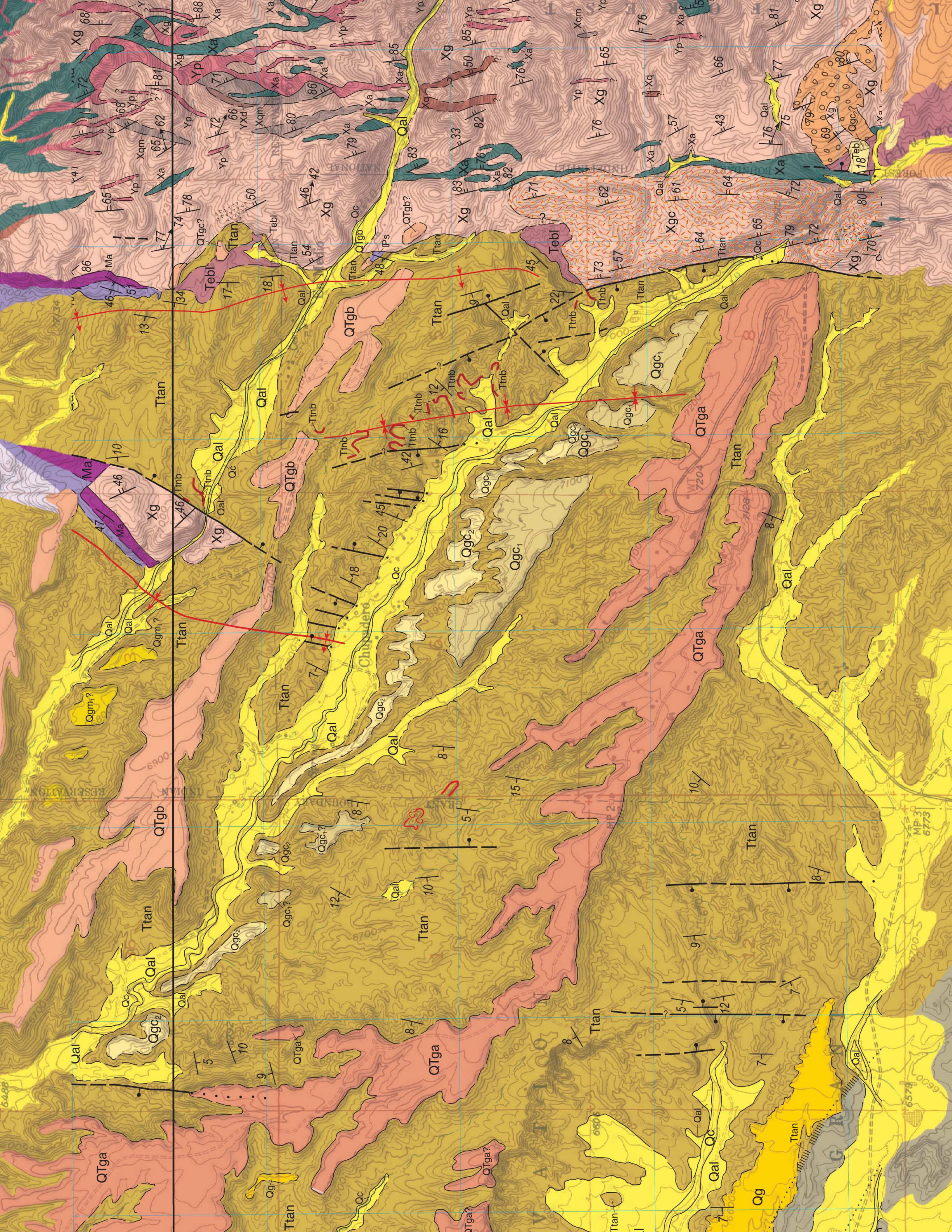

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United States Department of Agriculture

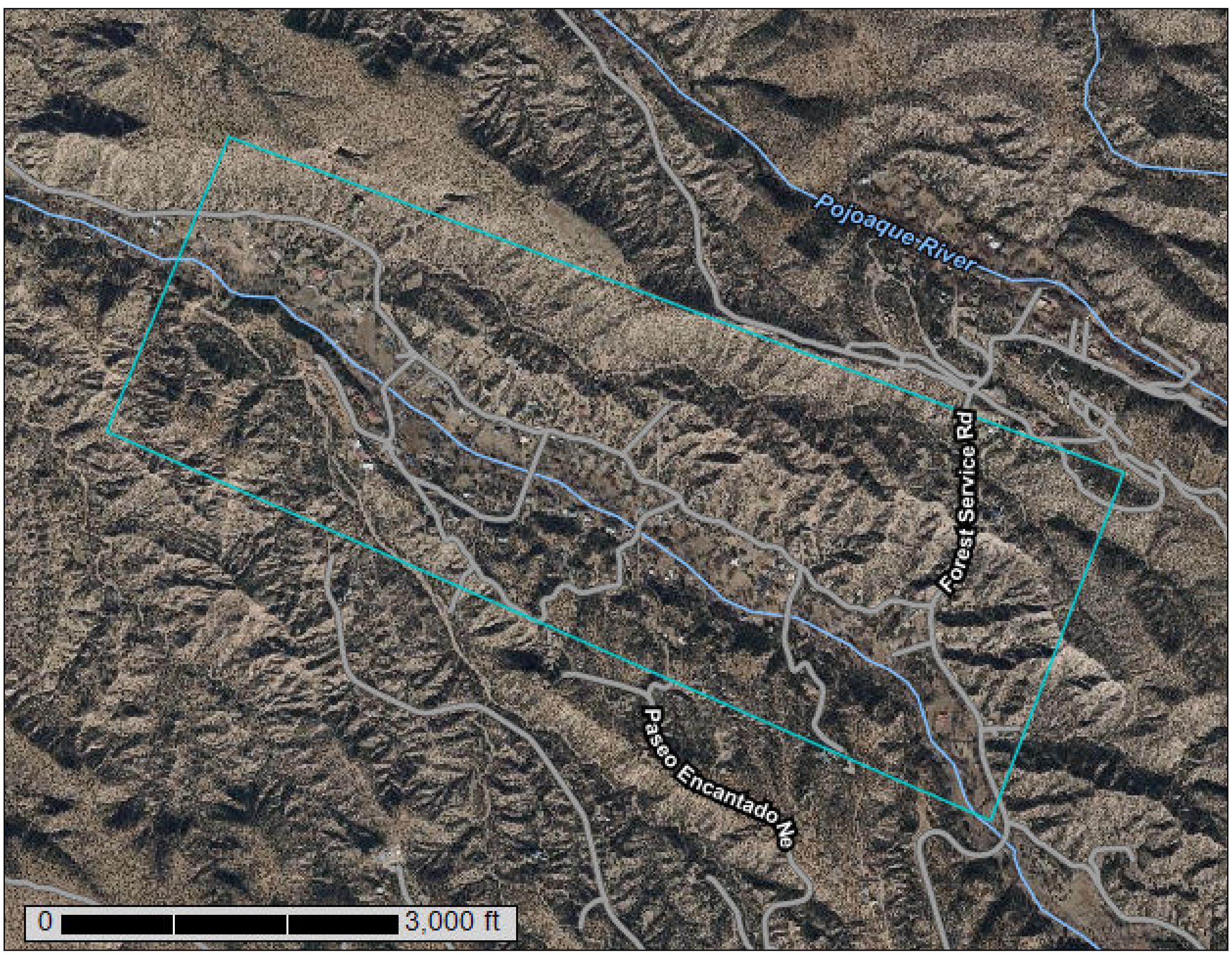
NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for

Santa Fe County Area, New Mexico



March 27, 2025

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

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Contents

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

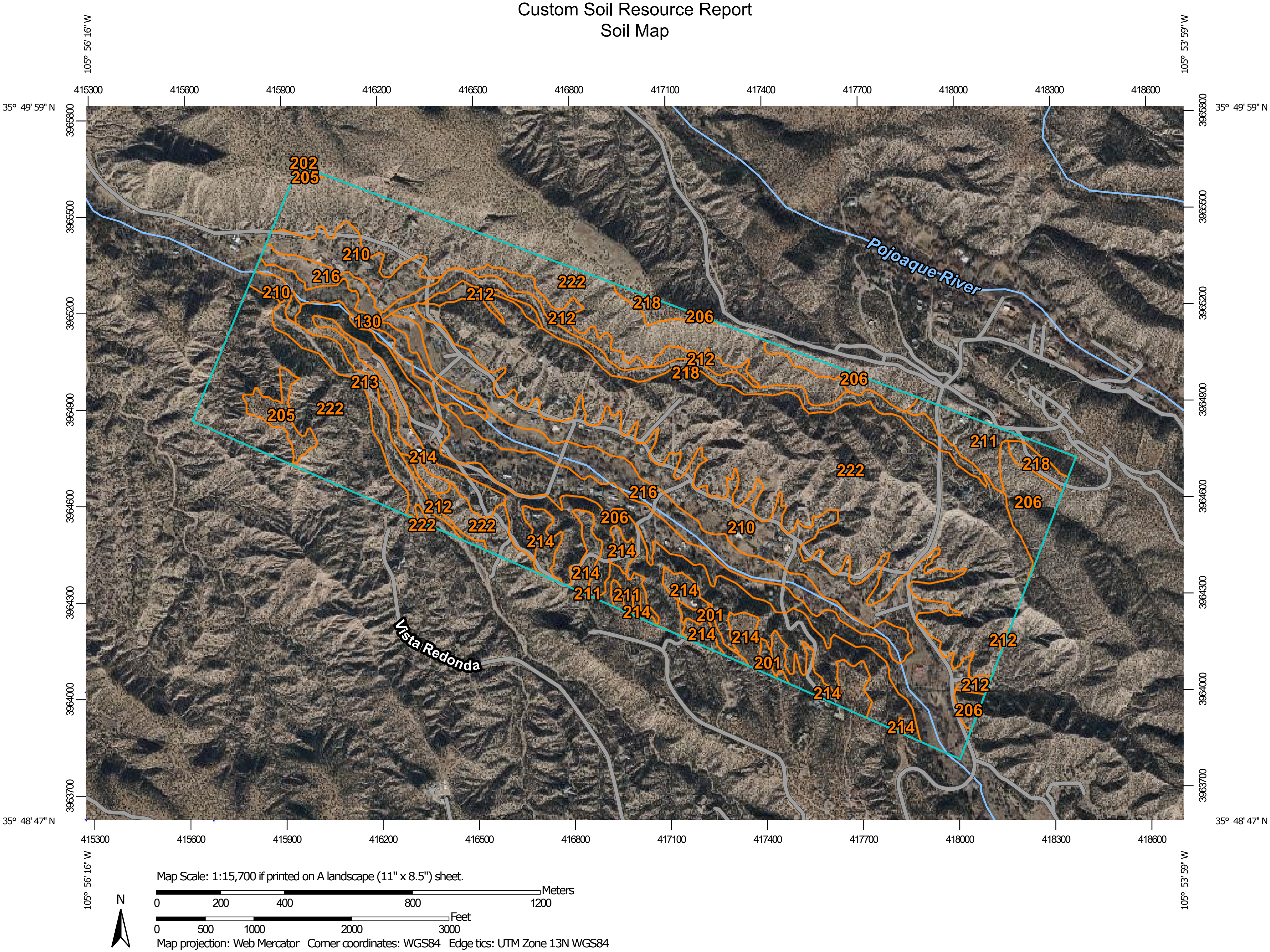
Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Soil Map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Map Scale: 1:15,700 if printed on A landscape (11" x 8.5") sheet.
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Feet
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2000
3000
Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 13N WGS84

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features

- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background

- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Santa Fe County Area, New Mexico
Survey Area Data: Version 16, Sep 3, 2024

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Nov 15, 2021—Dec 11, 2021

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
130	Jaralosa very fine sandy loam, 0 to 2 percent slopes, flooded	8.1	1.3%
201	Tanoan-Encantado complex, 5 to 25 percent slopes	3.1	0.5%
202	Alire loam, 2 to 6 percent slopes	0.3	0.0%
205	Nazario gravelly loam, 2 to 8 percent slopes	5.3	0.9%
206	Encantado very cobbly sandy loam, 25 to 45 percent slopes	74.2	12.3%
210	Urban land-Buckhorse-Altazano complex, 2 to 8 percent slopes	111.0	18.4%
211	Tanoan-Encantado-Urban land complex, 5 to 25 percent slopes	13.1	2.2%
212	Junebee gravelly sandy loam, 5 to 15 percent slopes	14.8	2.5%
213	Levante-Riverwash complex, 1 to 3 percent slopes, flooded	10.6	1.8%
214	Nazario-Urban land complex, 2 to 8 percent slopes	33.3	5.5%
216	Dondiego loam, 1 to 3 percent slopes	34.8	5.8%
218	Pedregal very gravelly loam, 2 to 15 percent slopes	23.2	3.8%
222	Sipapu-Yuzarra-Kachina complex, 5 to 65 percent slopes	271.8	45.0%
Totals for Area of Interest		**603.6**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class.

Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Santa Fe County Area, New Mexico

130—Jaralosa very fine sandy loam, 0 to 2 percent slopes, flooded

Map Unit Setting

National map unit symbol: drbg
Elevation: 5,400 to 6,900 feet
Mean annual precipitation: 9 to 14 inches
Mean annual air temperature: 47 to 52 degrees F
Frost-free period: 140 to 170 days
Farmland classification: Not prime farmland

Map Unit Composition

Jaralosa and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Jaralosa

Setting

Landform: Flood-plain steps on valley floors
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from micaceous sandstone and siltstone over alluvium derived from granite, gneiss, or schist

Typical profile

A - 0 to 1 inches: very fine sandy loam
AC1 - 1 to 6 inches: loamy very fine sand
AC2 - 6 to 10 inches: very fine sandy loam
ACnz - 10 to 16 inches: very fine sandy loam
Cnz1 - 16 to 22 inches: loamy very fine sand
Cnz2 - 22 to 35 inches: stratified very fine sandy loam to loamy very fine sand
2C1 - 35 to 42 inches: gravelly sand, gravelly coarse sand
2C2 - 42 to 53 inches: stratified very gravelly coarse sand to very gravelly coarse sand
2C3 - 53 to 84 inches: very gravelly coarse sand

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: 20 to 39 inches to strongly contrasting textural stratification
Drainage class: Moderately well drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: Occasional
Frequency of ponding: None
Calcium carbonate, maximum content: 3 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum: 4.0
Available water supply, 0 to 60 inches: Low (about 4.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4c
Hydrologic Soil Group: A
Ecological site: F036XA005NM - Riverine Riparian
Hydric soil rating: No

Minor Components

Bosquecito

Percent of map unit: 6 percent
Hydric soil rating: No

Innacutt

Percent of map unit: 4 percent
Hydric soil rating: No

Cuyamungue

Percent of map unit: 3 percent
Hydric soil rating: No

Urban land

Percent of map unit: 2 percent
Hydric soil rating: No

201—Tanoan-Encantado complex, 5 to 25 percent slopes

Map Unit Setting

National map unit symbol: drc2
Elevation: 5,500 to 7,500 feet
Mean annual precipitation: 13 to 15 inches
Mean annual air temperature: 47 to 50 degrees F
Frost-free period: 140 to 160 days
Farmland classification: Not prime farmland

Map Unit Composition

Tanoan and similar soils: 45 percent
Encantado and similar soils: 40 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Tanoan

Setting

Landform: Eroded fan remnants
Landform position (two-dimensional): Shoulder
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Alluvium derived from granite, gneiss, schist, and loess over residuum weathered from basaltic tuff or granitic sandstone

Typical profile

A - 0 to 3 inches: gravelly sandy loam
Bk1 - 3 to 7 inches: loam
Bk2 - 7 to 24 inches: loam
Bk3 - 24 to 32 inches: sandy loam
Bkq - 32 to 57 inches: loam
BCk1 - 57 to 70 inches: gravelly loamy coarse sand
BCk2 - 70 to 84 inches: gravelly coarse sandy loam

Properties and qualities

Slope: 5 to 15 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat excessively drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 15 percent
Maximum salinity: Nonsaline (0.0 to 1.0 mmhos/cm)
Sodium adsorption ratio, maximum: 4.0
Available water supply, 0 to 60 inches: Low (about 5.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4c
Hydrologic Soil Group: A
Ecological site: F036XA136NM - Pinyon-Utah juniper/Apache plume
Hydric soil rating: No

Description of Encantado

Setting

Landform: Eroded fan remnants
Landform position (two-dimensional): Backslope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Colluvium and slope alluvium derived from granite, gneiss, and schist over residuum weathered from granitic fanglomerate and sandstone

Typical profile

ABk - 0 to 3 inches: very gravelly sandy loam
Bk1 - 3 to 9 inches: very gravelly loam
Bk2 - 9 to 22 inches: very gravelly coarse sandy loam
BCk1 - 22 to 33 inches: gravelly loamy coarse sand
BCk2 - 33 to 45 inches: very gravelly loamy coarse sand
BCk3 - 45 to 54 inches: very gravelly loamy coarse sand
C1 - 54 to 63 inches: gravelly loamy sand
C2 - 63 to 85 inches: very gravelly loamy sand

Properties and qualities

Slope: 10 to 25 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat excessively drained
Runoff class: Medium

Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 30 percent
Maximum salinity: Nonsaline to slightly saline (0.0 to 4.0 mmhos/cm)
Sodium adsorption ratio, maximum: 4.0
Available water supply, 0 to 60 inches: Very low (about 2.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4s
Hydrologic Soil Group: A
Ecological site: F036XA136NM - Pinyon-Utah juniper/Apache plume
Hydric soil rating: No

Minor Components

Nazario

Percent of map unit: 4 percent
Hydric soil rating: No

Buckhorse

Percent of map unit: 3 percent
Hydric soil rating: No

Altazano

Percent of map unit: 3 percent
Hydric soil rating: No

Encantado

Percent of map unit: 2 percent
Hydric soil rating: No

Urban land

Percent of map unit: 2 percent
Hydric soil rating: No

Riverwash

Percent of map unit: 1 percent
Hydric soil rating: No

202—Alire loam, 2 to 6 percent slopes

Map Unit Setting

National map unit symbol: drc3
Elevation: 6,100 to 7,400 feet
Mean annual precipitation: 13 to 15 inches
Mean annual air temperature: 47 to 50 degrees F
Frost-free period: 140 to 160 days

Farmland classification: Not prime farmland

Map Unit Composition

Alire and similar soils: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Alire

Setting

Landform: Eroded fan remnants
Landform position (two-dimensional): Summit
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived granite, gneiss, schist, loess, and volcanic ash

Typical profile

A - 0 to 2 inches: loam
Bt - 2 to 8 inches: clay loam
Btk1 - 8 to 15 inches: clay loam
Btk2 - 15 to 28 inches: clay loam
Bk1 - 28 to 45 inches: loam
Bk2 - 45 to 57 inches: gravelly loam
BCk - 57 to 71 inches: gravelly sandy loam
BCkq - 71 to 105 inches: gravelly sandy loam

Properties and qualities

Slope: 2 to 6 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 40 percent
Gypsum, maximum content: 1 percent
Maximum salinity: Very slightly saline to moderately saline (2.0 to 8.0 mmhos/cm)
Sodium adsorption ratio, maximum: 13.0
Available water supply, 0 to 60 inches: High (about 9.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4c
Hydrologic Soil Group: C
Ecological site: R035XA112NM - Loamy
Hydric soil rating: No

Minor Components

Encantado

Percent of map unit: 5 percent
Hydric soil rating: No

Predawn

Percent of map unit: 2 percent

Hydric soil rating: No

Tanoan

Percent of map unit: 2 percent
Hydric soil rating: No

Urban land

Percent of map unit: 1 percent
Hydric soil rating: No

205—Nazario gravelly loam, 2 to 8 percent slopes

Map Unit Setting

National map unit symbol: f3gw
Elevation: 6,200 to 7,400 feet
Mean annual precipitation: 13 to 15 inches
Mean annual air temperature: 47 to 50 degrees F
Frost-free period: 140 to 160 days
Farmland classification: Not prime farmland

Map Unit Composition

Nazario and similar soils: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Nazario

Setting

Landform: Eroded fan remnants
Landform position (two-dimensional): Summit
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Alluvium derived from granite, gneiss, schist, and loess over residuum weathered from granitic fanglomerate and sandstone

Typical profile

ABk - 0 to 2 inches: gravelly loam
Bk1 - 2 to 7 inches: gravelly loam
Bk2 - 7 to 15 inches: gravelly loam
Bk3 - 15 to 24 inches: gravelly loam
2BCk1 - 24 to 43 inches: very gravelly loamy coarse sand
2BCk2 - 43 to 52 inches: gravelly loamy coarse sand
2C1 - 52 to 67 inches: coarse sand
2C2 - 67 to 94 inches: gravelly coarse sand

Properties and qualities

Slope: 2 to 8 percent
Depth to restrictive feature: 20 to 28 inches to strongly contrasting textural stratification
Drainage class: Well drained
Runoff class: Low

Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 30 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum: 4.0
Available water supply, 0 to 60 inches: Very low (about 2.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4c
Hydrologic Soil Group: B
Ecological site: F036XA136NM - Pinyon-Utah juniper/Apache plume
Hydric soil rating: No

Minor Components

Alire

Percent of map unit: 3 percent
Hydric soil rating: No

Tanoan

Percent of map unit: 3 percent
Hydric soil rating: No

Encantado

Percent of map unit: 2 percent
Hydric soil rating: No

Urban land

Percent of map unit: 2 percent
Hydric soil rating: No

206—Encantado very cobbly sandy loam, 25 to 45 percent slopes

Map Unit Setting

National map unit symbol: f3gx
Elevation: 5,700 to 7,600 feet
Mean annual precipitation: 13 to 15 inches
Mean annual air temperature: 47 to 50 degrees F
Frost-free period: 140 to 160 days
Farmland classification: Not prime farmland

Map Unit Composition

Encantado and similar soils: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Encantado

Setting

Landform: Eroded fan remnants
Landform position (two-dimensional): Backslope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Colluvium derived from granite, gneiss, and schist over residuum weathered from granitic fanglomerate and sandstone

Typical profile

ABk - 0 to 2 inches: very cobbly sandy loam
Bk1 - 2 to 8 inches: gravelly sandy loam
Bk2 - 8 to 12 inches: gravelly coarse sandy loam
Bk3 - 12 to 24 inches: very gravelly coarse sandy loam
BCk - 24 to 31 inches: gravelly loamy sand
BCk1 - 31 to 56 inches: very gravelly loamy coarse sand
BCk2 - 56 to 67 inches: gravelly loamy sand
C - 67 to 82 inches: gravelly loamy coarse sand

Properties and qualities

Slope: 25 to 45 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat excessively drained
Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 30 percent
Maximum salinity: Nonsaline to slightly saline (0.0 to 4.0 mmhos/cm)
Sodium adsorption ratio, maximum: 4.0
Available water supply, 0 to 60 inches: Very low (about 2.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: A
Ecological site: F036XA136NM - Pinyon-Utah juniper/Apache plume
Hydric soil rating: No

Minor Components

Nazario

Percent of map unit: 4 percent
Hydric soil rating: No

Encantado

Percent of map unit: 3 percent
Hydric soil rating: No

Urban land

Percent of map unit: 2 percent
Hydric soil rating: No

Rock outcrop

Percent of map unit: 1 percent

Hydric soil rating: No

210—Urban land-Buckhorse-Altazano complex, 2 to 8 percent slopes

Map Unit Setting

National map unit symbol: f5r5
Elevation: 5,700 to 7,500 feet
Mean annual precipitation: 13 to 15 inches
Mean annual air temperature: 47 to 50 degrees F
Frost-free period: 140 to 160 days
Farmland classification: Not prime farmland

Map Unit Composition

Urban land: 60 percent
Buckhorse and similar soils: 20 percent
Altazano and similar soils: 10 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Urban Land

Setting

Landform: Eroded fan remnants
Down-slope shape: Linear
Across-slope shape: Linear

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8s
Hydric soil rating: No

Description of Buckhorse

Setting

Landform: Eroded fan remnants
Landform position (two-dimensional): Toeslope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Slope alluvium derived from granite, gneiss, schist, granitic sandstone, fanglomerate, and mudstone

Typical profile

A - 0 to 4 inches: coarse sandy loam
Bt - 4 to 11 inches: coarse sandy loam
Btk1 - 11 to 22 inches: loam
Btk2 - 22 to 37 inches: loam
Bk - 37 to 49 inches: fine sandy loam
BCk - 49 to 61 inches: sandy loam
C - 61 to 83 inches: gravelly coarse sand

Properties and qualities

Slope: 2 to 8 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 15 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum: 4.0
Available water supply, 0 to 60 inches: Moderate (about 6.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4c
Hydrologic Soil Group: B
Ecological site: R035XA112NM - Loamy
Hydric soil rating: No

Description of Altazano

Setting

Landform: Inset fans on eroded fan remnants
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Slope alluvium derived from granite, gneiss, schist, granitic sandstone, fanglomerate, and mudstone

Typical profile

AC - 0 to 2 inches: gravelly sandy loam
C1 - 2 to 8 inches: gravelly coarse sandy loam
C2 - 8 to 19 inches: very gravelly loamy coarse sand
C3 - 19 to 29 inches: gravelly sandy loam
Btkb1 - 29 to 46 inches: loam
Btkb2 - 46 to 65 inches: loam
BCkb - 65 to 74 inches: gravelly coarse sandy loam
Ckb - 74 to 90 inches: gravelly loamy coarse sand

Properties and qualities

Slope: 2 to 8 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: Frequent
Frequency of ponding: None
Calcium carbonate, maximum content: 20 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum: 4.0
Available water supply, 0 to 60 inches: Low (about 5.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4w
Hydrologic Soil Group: B
Ecological site: R035XG114NM - Gravelly
Hydric soil rating: No

Minor Components

Levante

Percent of map unit: 7 percent
Hydric soil rating: No

Riverwash

Percent of map unit: 3 percent
Hydric soil rating: No

211—Tanoan-Encantado-Urban land complex, 5 to 25 percent slopes

Map Unit Setting

National map unit symbol: f5r9
Elevation: 5,500 to 7,500 feet
Mean annual precipitation: 13 to 15 inches
Mean annual air temperature: 47 to 50 degrees F
Frost-free period: 140 to 160 days
Farmland classification: Not prime farmland

Map Unit Composition

Tanoan and similar soils: 35 percent
Encantado and similar soils: 30 percent
Urban land: 25 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Tanoan

Setting

Landform: Eroded fan remnants
Landform position (two-dimensional): Shoulder
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Alluvium derived from granite, gneiss, schist, and loess over residuum weathered from basaltic tuff or granitic sandstone

Typical profile

A - 0 to 3 inches: gravelly sandy loam
Bk1 - 3 to 7 inches: loam
Bk2 - 7 to 24 inches: loam

Bk3 - 24 to 32 inches: sandy loam
Bkq - 32 to 57 inches: loam
BCk1 - 57 to 70 inches: gravelly loamy coarse sand
BCk2 - 70 to 84 inches: gravelly coarse sandy loam

Properties and qualities

Slope: 5 to 15 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat excessively drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 15 percent
Maximum salinity: Nonsaline (0.0 to 1.0 mmhos/cm)
Sodium adsorption ratio, maximum: 4.0
Available water supply, 0 to 60 inches: Low (about 5.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4c
Hydrologic Soil Group: A
Ecological site: F036XA136NM - Pinyon-Utah juniper/Apache plume
Hydric soil rating: No

Description of Encantado

Setting

Landform: Eroded fan remnants
Landform position (two-dimensional): Backslope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Colluvium and slope alluvium derived from granite, gneiss, and schist over residuum weathered from granitic fanglomerate and sandstone

Typical profile

ABk - 0 to 3 inches: very gravelly sandy loam
Bk1 - 3 to 9 inches: very gravelly loam
Bk2 - 9 to 22 inches: very gravelly coarse sandy loam
BCk1 - 22 to 33 inches: gravelly loamy coarse sand
BCk2 - 33 to 45 inches: very gravelly loamy coarse sand
BCk3 - 45 to 54 inches: very gravelly loamy coarse sand
C1 - 54 to 63 inches: gravelly loamy sand
C2 - 63 to 85 inches: very gravelly loamy sand

Properties and qualities

Slope: 10 to 25 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat excessively drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None

Calcium carbonate, maximum content: 30 percent
Maximum salinity: Nonsaline to slightly saline (0.0 to 4.0 mmhos/cm)
Sodium adsorption ratio, maximum: 4.0
Available water supply, 0 to 60 inches: Very low (about 2.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4s
Hydrologic Soil Group: A
Ecological site: F036XA136NM - Pinyon-Utah juniper/Apache plume
Hydric soil rating: No

Description of Urban Land

Setting

Landform: Eroded fan remnants
Down-slope shape: Linear
Across-slope shape: Linear

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8
Hydric soil rating: No

Minor Components

Altazano

Percent of map unit: 4 percent
Hydric soil rating: No

Junebee

Percent of map unit: 3 percent
Hydric soil rating: No

Nazario

Percent of map unit: 2 percent
Hydric soil rating: No

Alire

Percent of map unit: 1 percent
Hydric soil rating: No

212—Junebee gravelly sandy loam, 5 to 15 percent slopes

Map Unit Setting

National map unit symbol: f5rb
Elevation: 6,100 to 7,800 feet
Mean annual precipitation: 13 to 15 inches
Mean annual air temperature: 47 to 50 degrees F
Frost-free period: 140 to 160 days

Farmland classification: Not prime farmland

Map Unit Composition

Junebee and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Junebee

Setting

Landform: Eroded fan remnants
Landform position (two-dimensional): Toeslope
Down-slope shape: Concave
Across-slope shape: Linear
Parent material: Slope alluvium derived from granitic sandstone, fanglomerate, and mudstone

Typical profile

A - 0 to 3 inches: gravelly sandy loam
Btk1 - 3 to 14 inches: sandy loam
Btk2 - 14 to 29 inches: sandy loam
Btk3 - 29 to 38 inches: sandy loam
Btk4 - 38 to 48 inches: gravelly coarse sandy loam
Btk5 - 48 to 58 inches: gravelly coarse sandy loam
Bk1 - 58 to 72 inches: gravelly coarse sandy loam
Bk2 - 72 to 88 inches: gravelly coarse sandy loam
BCk - 88 to 112 inches: gravelly loamy coarse sand
C - 112 to 122 inches: gravelly loamy coarse sand

Properties and qualities

Slope: 5 to 15 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat excessively drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 10 percent
Maximum salinity: Nonsaline (0.0 to 1.0 mmhos/cm)
Sodium adsorption ratio, maximum: 1.0
Available water supply, 0 to 60 inches: Low (about 4.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4c
Hydrologic Soil Group: A
Ecological site: R035XA115NM - Deep Sand
Hydric soil rating: No

Minor Components

Altazano

Percent of map unit: 6 percent
Hydric soil rating: No

Levante

Percent of map unit: 5 percent
Hydric soil rating: No

Riverwash

Percent of map unit: 4 percent
Hydric soil rating: No

213—Levante-Riverwash complex, 1 to 3 percent slopes, flooded

Map Unit Setting

National map unit symbol: f5rc
Elevation: 5,600 to 7,700 feet
Mean annual precipitation: 13 to 15 inches
Mean annual air temperature: 47 to 50 degrees F
Frost-free period: 140 to 160 days
Farmland classification: Not prime farmland

Map Unit Composition

Levante and similar soils: 55 percent
Riverwash: 35 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Levante

Setting

Landform: Flood plains on valley floors
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from granite, gneiss, schist, and granitic sandstone

Typical profile

AC - 0 to 4 inches: loamy sand
C1 - 4 to 17 inches: coarse sand
C2 - 17 to 32 inches: gravelly coarse sand
C3 - 32 to 45 inches: stratified gravelly loamy coarse sand to gravelly coarse sand
C4 - 45 to 58 inches: gravelly loamy coarse sand
C5 - 58 to 86 inches: very gravelly coarse sand
C6 - 86 to 122 inches: very gravelly coarse sand

Properties and qualities

Slope: 1 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Excessively drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): High to very high (6.00 to 19.98 in/hr)
Depth to water table: More than 80 inches

Frequency of flooding: Occasional
Frequency of ponding: None
Calcium carbonate, maximum content: 10 percent
Maximum salinity: Nonsaline (0.0 to 1.0 mmhos/cm)
Sodium adsorption ratio, maximum: 1.0
Available water supply, 0 to 60 inches: Very low (about 2.8 inches)

Interpretive groups
Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4c
Hydrologic Soil Group: A
Ecological site: R035XA113NM - Sandy
Hydric soil rating: No

Description of Riverwash

Setting
Landform: Channels on flood plains
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from mixed

Typical profile
C1 - 0 to 10 inches: gravelly coarse sand
C2 - 10 to 50 inches: very gravelly coarse sand
C3 - 50 to 65 inches: gravelly sandy clay loam
C4 - 65 to 85 inches: gravelly coarse sand

Properties and qualities
Slope: 0 to 1 percent
Drainage class: Excessively drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Frequency of flooding: Frequent
Calcium carbonate, maximum content: 3 percent
Gypsum, maximum content: 3 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum: 4.0
Available water supply, 0 to 60 inches: Very low (about 3.0 inches)

Interpretive groups
Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8
Hydric soil rating: No

Minor Components

Altazano
Percent of map unit: 5 percent
Hydric soil rating: No

Dondiego
Percent of map unit: 3 percent
Hydric soil rating: No

Urban land
Percent of map unit: 2 percent

Hydric soil rating: No

214—Nazario-Urban land complex, 2 to 8 percent slopes

Map Unit Setting

National map unit symbol: f5rf
Elevation: 6,200 to 7,400 feet
Mean annual precipitation: 13 to 15 inches
Mean annual air temperature: 47 to 50 degrees F
Frost-free period: 140 to 160 days
Farmland classification: Not prime farmland

Map Unit Composition

Nazario and similar soils: 55 percent
Urban land: 30 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Nazario

Setting

Landform: Eroded fan remnants
Landform position (two-dimensional): Summit
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Alluvium derived from granite, gneiss, schist, and loess over residuum weathered from granitic fanglomerate and sandstone

Typical profile

ABk - 0 to 2 inches: gravelly loam
Bk1 - 2 to 7 inches: gravelly loam
Bk2 - 7 to 15 inches: gravelly loam
Bk3 - 15 to 24 inches: gravelly loam
2BCk1 - 24 to 43 inches: very gravelly loamy coarse sand
2BCk2 - 43 to 52 inches: gravelly loamy coarse sand
2C1 - 52 to 67 inches: coarse sand
2C2 - 67 to 94 inches: gravelly coarse sand

Properties and qualities

Slope: 2 to 8 percent
Depth to restrictive feature: 20 to 28 inches to strongly contrasting textural stratification
Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None

Calcium carbonate, maximum content: 30 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum: 4.0
Available water supply, 0 to 60 inches: Very low (about 2.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4c
Hydrologic Soil Group: B
Ecological site: F036XA136NM - Pinyon-Utah juniper/Apache plume
Hydric soil rating: No

Description of Urban Land

Setting

Landform: Eroded fan remnants
Down-slope shape: Linear
Across-slope shape: Linear

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8
Hydric soil rating: No

Minor Components

Alire

Percent of map unit: 8 percent
Hydric soil rating: No

Encantado

Percent of map unit: 4 percent
Hydric soil rating: No

Tanoan

Percent of map unit: 3 percent
Hydric soil rating: No

216—Dondiego loam, 1 to 3 percent slopes

Map Unit Setting

National map unit symbol: f5rk
Elevation: 6,100 to 7,400 feet
Mean annual precipitation: 13 to 15 inches
Mean annual air temperature: 47 to 50 degrees F
Frost-free period: 140 to 160 days
Farmland classification: Not prime farmland

Map Unit Composition

Dondiego and similar soils: 85 percent
Minor components: 15 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Dondiego

Setting

Landform: Stream terraces on valley floors
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from granite, gneiss, schist, and loess

Typical profile

A - 0 to 2 inches: loam
Bt1 - 2 to 9 inches: loam
Bt2 - 9 to 22 inches: loam
Btk - 22 to 28 inches: loam
BCk - 28 to 36 inches: sandy loam
Btb1 - 36 to 48 inches: loam
Btb2 - 48 to 59 inches: loam
BCb - 59 to 69 inches: gravelly sandy loam
Cb1 - 69 to 85 inches: gravelly loamy coarse sand
Cb2 - 85 to 102 inches: stratified gravelly loamy coarse sand to sandy loam

Properties and qualities

Slope: 1 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: Very rare
Frequency of ponding: None
Calcium carbonate, maximum content: 3 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum: 1.0
Available water supply, 0 to 60 inches: Moderate (about 8.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4c
Hydrologic Soil Group: B
Ecological site: R035XA112NM - Loamy
Hydric soil rating: No

Minor Components

Ohke

Percent of map unit: 7 percent
Hydric soil rating: No

Urban land

Percent of map unit: 4 percent
Hydric soil rating: No

Altazano

Percent of map unit: 4 percent
Hydric soil rating: No

218—Pedregal very gravelly loam, 2 to 15 percent slopes

Map Unit Setting

National map unit symbol: f5rq
Elevation: 5,900 to 7,600 feet
Mean annual precipitation: 13 to 15 inches
Mean annual air temperature: 47 to 50 degrees F
Frost-free period: 140 to 160 days
Farmland classification: Not prime farmland

Map Unit Composition

Pedregal and similar soils: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Pedregal

Setting

Landform: Eroded fan remnants
Landform position (two-dimensional): Summit, shoulder
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Alluvium derived from granite, gneiss, and schist over residuum weathered from granitic sandstone, siltstone, and fanglomerate

Typical profile

A - 0 to 2 inches: very gravelly loam
Bt1 - 2 to 5 inches: very gravelly clay loam
Bt2 - 5 to 8 inches: very gravelly clay loam
Btk - 8 to 12 inches: very gravelly sandy clay loam
Bk1 - 12 to 22 inches: very gravelly sandy loam
Bk2 - 22 to 45 inches: extremely gravelly coarse sandy loam
BCk - 45 to 62 inches: extremely gravelly coarse sand
C1 - 62 to 81 inches: gravelly loamy sand
2C2 - 81 to 92 inches: silt loam
2C3 - 92 to 104 inches: silt loam

Properties and qualities

Slope: 2 to 15 percent
Depth to restrictive feature: 2 to 4 inches to abrupt textural change
Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 45 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)

Sodium adsorption ratio, maximum: 4.0
Available water supply, 0 to 60 inches: Very low (about 0.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4s
Hydrologic Soil Group: C
Ecological site: F035XG135NM - Steep Gravelly - Woodland
Hydric soil rating: No

Minor Components

Predawn

Percent of map unit: 4 percent
Hydric soil rating: No

Alire

Percent of map unit: 2 percent
Hydric soil rating: No

Urban land

Percent of map unit: 2 percent
Hydric soil rating: No

Encantado

Percent of map unit: 1 percent
Hydric soil rating: No

Nazario

Percent of map unit: 1 percent
Hydric soil rating: No

222—Sipapu-Yuzarra-Kachina complex, 5 to 65 percent slopes

Map Unit Setting

National map unit symbol: f5rx
Elevation: 5,600 to 7,800 feet
Mean annual precipitation: 12 to 14 inches
Mean annual air temperature: 48 to 50 degrees F
Frost-free period: 140 to 160 days
Farmland classification: Not prime farmland

Map Unit Composition

Sipapu and similar soils: 45 percent
Yuzarra and similar soils: 30 percent
Kachina and similar soils: 15 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Sipapu

Setting

Landform: Ridges, hills
Landform position (two-dimensional): Backslope
Down-slope shape: Convex
Across-slope shape: Linear, convex
Parent material: Colluvium derived from granite and gneiss over residuum weathered from granitic sandstone, siltstone, and mudstone

Typical profile

A - 0 to 1 inches: gravelly sandy loam
Bk - 1 to 3 inches: sandy loam
2BCk - 3 to 8 inches: very paragravelly fine sandy loam
2Cr - 8 to 18 inches: cemented bedrock

Properties and qualities

Slope: 20 to 65 percent
Depth to restrictive feature: 6 to 10 inches to paralithic bedrock
Drainage class: Somewhat excessively drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.20 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 15 percent
Maximum salinity: Nonsaline (0.0 to 1.0 mmhos/cm)
Sodium adsorption ratio, maximum: 1.0
Available water supply, 0 to 60 inches: Very low (about 1.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: D
Ecological site: F035XG135NM - Steep Gravelly - Woodland
Hydric soil rating: No

Description of Yuzarra

Setting

Landform: Ridges, hills
Landform position (two-dimensional): Summit
Down-slope shape: Convex
Across-slope shape: Convex, linear
Parent material: Alluvium derived from granite, gneiss, and schist over residuum weathered from granitic sandstone and fanglomerate

Typical profile

ABk - 0 to 3 inches: very gravelly sandy loam
Bk1 - 3 to 10 inches: gravelly sandy loam
2Bk2 - 10 to 22 inches: very gravelly coarse sand
2Bk3 - 22 to 26 inches: gravelly sand
2Bk4 - 26 to 34 inches: very gravelly coarse sand
2Cr - 34 to 44 inches: cemented bedrock

Properties and qualities

Slope: 5 to 15 percent
Depth to restrictive feature: 20 to 39 inches to paralithic bedrock
Drainage class: Somewhat excessively drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.60 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 35 percent
Maximum salinity: Nonsaline (0.0 to 1.0 mmhos/cm)
Sodium adsorption ratio, maximum: 1.0
Available water supply, 0 to 60 inches: Very low (about 1.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4s
Hydrologic Soil Group: B
Ecological site: F035XG135NM - Steep Gravelly - Woodland
Hydric soil rating: No

Description of Kachina

Setting

Landform: Ridges, hills
Landform position (two-dimensional): Toeslope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Slope alluvium derived from micaceous sandstone, siltstone, mudstone, and fanglomerate

Typical profile

A - 0 to 3 inches: fine sandy loam
Bk1 - 3 to 13 inches: fine sandy loam
Bk2 - 13 to 24 inches: sandy clay loam
Bk3 - 24 to 44 inches: loam
BCk1 - 44 to 53 inches: sandy loam
BCk2 - 53 to 73 inches: gravelly sandy loam
BCk3 - 73 to 81 inches: gravelly sandy clay loam
2BCk4 - 81 to 93 inches: very paragravelly silty clay loam
2Cr - 93 to 103 inches: cemented bedrock

Properties and qualities

Slope: 5 to 15 percent
Depth to restrictive feature: 79 to 98 inches to paralithic bedrock
Drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 10 percent
Maximum salinity: Very slightly saline to slightly saline (2.0 to 4.0 mmhos/cm)
Sodium adsorption ratio, maximum: 4.0

Available water supply, 0 to 60 inches: High (about 9.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4c
Hydrologic Soil Group: B
Ecological site: F035XG135NM - Steep Gravelly - Woodland
Hydric soil rating: No

Minor Components

Junebee

Percent of map unit: 3 percent
Hydric soil rating: No

Badland

Percent of map unit: 2 percent
Hydric soil rating: No

Dondiego

Percent of map unit: 2 percent
Hydric soil rating: No

Levante

Percent of map unit: 1 percent
Hydric soil rating: No

Urban land

Percent of map unit: 1 percent
Hydric soil rating: No

Rock outcrop

Percent of map unit: 1 percent
Hydric soil rating: No

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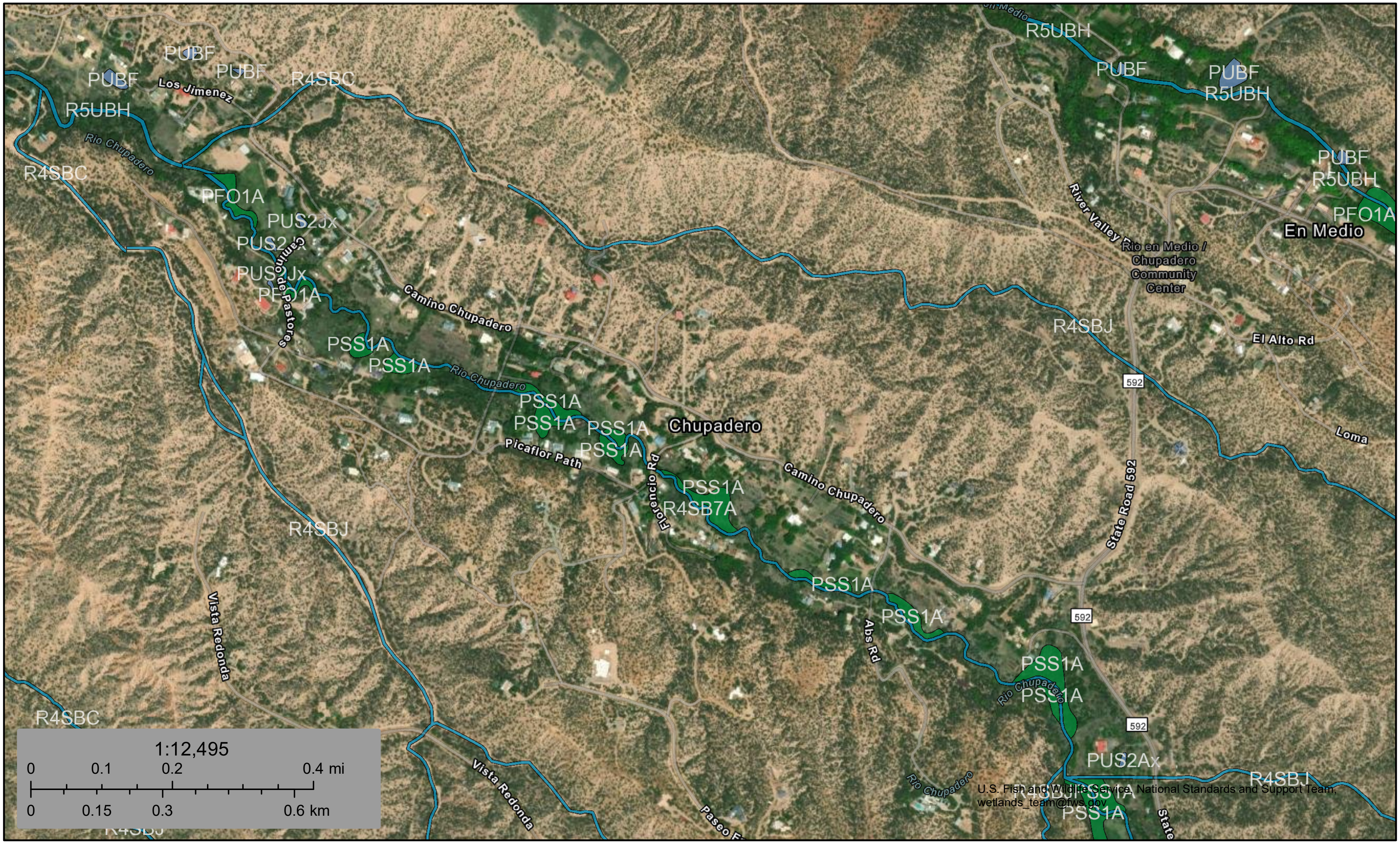
U.S. Fish and Wildlife Service
National Wetlands Inventory

Chupadero PER Update



March 23, 2025

Wetlands

Estuarine and Marine Deepwater	Freshwater Emergent Wetland	Lake
Estuarine and Marine Wetland	Freshwater Forested/Shrub Wetland	Other
	Freshwater Pond	Riverine

This map is for general reference only. The US Fish and Wildlife Service is not responsible for the accuracy or currentness of the base data shown on this map. All wetlands related data should be used in accordance with the layer metadata found on the Wetlands Mapper web site.

APPENDIX C

Regulatory Correspondence

State of New Mexico
E RONMENT DEPARTMEN
Drinking Water Bureau
525 Camino de los Marquez, Suite 4
Santa Fe, New Mexico 87505-1816
Telephone (505) 827-7536
Fax (505) 827-7545

BILL RICHARDSON
GOVERNOR

RON CURRY
SECRETARY

DERRITH WATCHMAN-MOORE
DEPUTY SECRETARY

ANNE MARIE ORTIZ
DIRECTOR

February 8, 2005

Chupadero MDWCA
Mr. Jack Miller, Operator
RT 4 P.O. Box 60A (01 AB-S RD SF)
Santa Fe, New Mexico 87506

RE: **Well #3, Violation of the Maximum Contaminant Level (MCL) for Gross Alpha**
Well #3, Advisory for Uranium MCL for Federal Safe Drinking Water Act Regulations or Future State Drinking Water Regulations Uranium MCL (Effective Enforcement Date of January, 2007)
Chupadero MDWCA, WSS #660-26

Dear Mr. Miller:

Pursuant to 20.7.10.100 NMAC of the New Mexico Drinking Water Regulations (NMDWR), which incorporates federal regulation 40 CFR §141.15(b), indicates that the Chupadero MDWCA exceeded the MCL of 15.0 pCi/L for gross alpha particle activity (including Radium 226 but excluding radon and uranium) for Well #3 in their drinking water. This was based on an annual composite baseline water sample consisting of four (4) consecutive quarterly sampling events during 2004. This was for the system's new well put on-line back on January 14, 2005 by the Drinking Water Bureau (DWB) staff's site visit.

The Chupadero MDWCA water system's Well #3 had a final laboratory result of 19.518 pCi/L for gross alpha particle activity calculations pursuant to a final laboratory report completed on January 10, 2005 and received by the DWB oversight staff on February 3, 2005. The final gross alpha particle activity result is due to the natural occurring radioactive decay process that is primarily present from the Uranium element found in underlying basement igneous and metamorphic rocks, formations and volcanic tuff of the immediate Nambe, Pojoaque and Tesuque areas.

The Uranium mass concentrations detected in the drinking water from Well #3 was reported at 53.50 ug/L when compared with the current federal drinking water standard of 30 ug/L. The actual State Drinking Water Regulations for the Uranium MCL of 30 ug/L will be effective in 2007. This will allow State Drinking Water Programs to complete their regulatory compliance requirements for the standardized monitoring framework for radionuclides effectively from January 1, 2004 through December 31, 2006 for all applicable regulated water systems and work with systems on corrective action plans.

Pursuant to 20.7.10.100 NMAC of the New Mexico Drinking Water Regulations (NMDWR), which incorporates federal regulation 40 CFR §141.201, the Chupadero MDWCA water system must now post **Public Notice** for exceeding the MCL running annual average composite result in 2004 for gross alpha particle activity in Well #3 (according to the State's laboratory chain of custody). The public notification also includes information for the elevated Uranium mass concentrations. Enclosed is a Public Notice for your use. Please make the necessary changes to the Public Notice and comply with the notification requirements. The water system is also required to sign the public notice and return a copy to the Department.

The water systems Well #3 will remain on quarterly monitoring by the DWB for radionuclides for as long as the gross alpha MCL exists and due to the elevated Uranium mass concentrations (future State Drinking Water Standard MCL in 2007) for this active well. The water system has received funding to drill and install a new Well #4 by this spring. This well is being installed due to the lack of water production at the Well #3. The water system is also now faced unfortunately with elevated drinking water results for radionuclides. This was based on the recently made available aforementioned laboratory results for an annual "baseline" composite sampling event that occurred in consecutive quarters of 2004.

As required, the State DWB staff is always available toward assisting the water system on a possible corrective action plan for fixing their current water quality issues of radionuclides at Well #3 or other possible options. If you have any further questions, please contact me at our toll free number 1-877-654-8720, or at (505) 827-7536, extension 1026 or email at chris_serazio@nmenv.state. nm.us.

Sincerely,

Chris Serazio
Environmental Specialist
District II, System Oversight
NMED Drinking Water Bureau

Enclosure: Public Notice for Gross Alpha Particle Activity and Uranium Information
Radionuclides Rule Fact Sheet Reference Guide

CC: Michael Huber, Manager, DWB-DII
Joe Chavez, Sampling Manger, DWB
Santa Fe Field Office
Central File
System File

SANITARY SURVEY REPORT

For

Chupadero MDWCA
NM3566026

Este informe contiene información importante acerca de su agua potable. Haga que alguien lo traduzca para usted, o hable con alguien que lo entienda.

Prepared by: Chris Cudia
New Mexico Environment Department
1190 St. Francis
PO Box 5469
Santa Fe, NM 87502-5469
505.476.8636

Date December 1, 2016

State of New Mexico
Environment Department
Water Protection Division
Drinking Water Bureau
1190 St Francis Drive
Santa Fe, NM 87505

RECORD OF INSPECTION

This Sanitary Survey Report fulfills the requirements of New Mexico Administrative Code 20.7.10.100 incorporating 40 Code of Federal Regulations 141.21(d) (ii) (2) and 142.16(o)(2) for completing a State approved survey. The information and data was prepared by Chris Cudia North Region Compliance Supervisor.

NMED APPROVING AUTHORITY: [signature] Date: 12-1-16
Chris Cudia North Region Compliance Supervisor

Introduction

A sanitary survey enables the NMED Drinking Water Bureau Water (DWB) to provide a comprehensive and accurate review of the components of a water system, to assess the operating condition and adequacy of the water system, and to determine if past recommendations have been implemented effectively. The Sanitary Survey encompasses eight specific elements that are evaluated during the survey. Those eight elements are:

- Source (Protection, Physical Components, and Condition);
- Treatment
- Distribution System
- Finished Water Storage
- Pumps/Pump Facilities and Controls
- Monitoring/Reporting/Data Verification
- Water System Management/Operations
- Operator Compliance with State Requirements

Each element may not be specifically mentioned within this report, however, a significant deficiency or recommendation will be noted if any issues are discovered with any of these eight (8) elements.

As part of a sanitary survey the DWB conducted a site inspection of the Chupadero MDWCA water system on June 14, 2016. The site inspection was conducted by Chris Cudia, DWB North Region Compliance Supervisor and accompanied by Jack and Linda Miller, Chupadero MDWCA water system operator and administrative contacts. David Roybal, Major Domo for the local Acequia Association was also consulted during the Survey. In addition to the site inspection, DWB reviewed various operational, managerial, and financial documents submitted by the Chupadero MDWCA water system and conducted a review of DWB compliance files for the water system.

System Description

The Chupadero MDWCA water system has 56 service connections, serves approximately 131 year-round customers[1], and is classified as a Community Water System according to the New Mexico Drinking Water Regulations 20.7.10 NMAC. The water system consists of two wells (Well #2 & Well #4), a 20,000 gallon storage tank (Storage Tank #1) and distribution. Each well is metered individually. The tank floats in distribution and all distribution lines consists of PVC pipe.

Water from Wells 2 and 4 enters a meter pit before being delivered to the floating storage tank. During periods of high demand, water can be delivered to customers before supplying the tank. Pressure is reduced to 60 PSI with a single pressure reducing valve.

Survey Findings

Sanitary surveys serve as a proactive public health measure and can provide important information on a water system's design and operations, can identify minor and significant deficiencies for correction before they become major problems, and can improve overall system compliance. The following significant and minor deficiencies were identified during the sanitary survey.

[1] Pursuant to 20.7.10.9(A) NMAC; U.S. States Census Bureau indicates average persons per household in Santa Fe County (2010-2014) = 2.34. Water System reports 56 connections. (http://www.census.gov/quickfacts/table/HSD310214/35049).

SUSANA MARTINEZ
Governor

JOHN A. SANCHEZ
Lt. Governor

**NEW MEXICO
ENVIRONMENT DEPARTMENT**

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BUTCH TONGATE
Acting Cabinet Secretary

J. C. BORREGO
Acting Deputy Secretary

12/1/2016

Linda Miller
Chupadero MDWCA, NM3566026
01 Ab's Road
SANTA FE, NM 87506

RE: 2016 Sanitary Survey Report

Dear Linda Miller:

Enclosed is the Sanitary Survey Report for the Chupadero MDWCA water system, conducted on June 14, 2016 by Chris Cudia of the New Mexico Environment Department Drinking Water Bureau (DWB).

During the survey three (3) significant deficiencies were identified and one (1) recommendation was provided. Chupadero MDWCA water system must consult with the DWB within 30 days of the date of this letter and take corrective action on the three (3) significant deficiencies no later than 120 days after the date of this letter, or be in compliance with a DWB-approved schedule and plan for correcting these deficiencies within the same 120 day period. Failure to correct any significant deficiency will result in a treatment technique violation of NMAC 20.7.10.100 incorporating 40 C.F.R. 141 Subpart S.

If you have any questions or need additional clarification concerning this report please call 505-476-8648 or e-mail chris.cudia@state.nm.us.

Respectfully,

Chris Cudia, North Region Complaince Supervisor
Drinking Water Bureau
Water Protection Division

cc: Area Supervisor (electronic)
Chupadero MDWCA water system Area Office file
Electronic Central File

Significant Deficiencies:

A significant deficiency is defined as any deficiency that is causing or has the potential to cause a threat to public health [New Mexico Administrative Code (NMAC) 20.7.10.100 incorporating 40 Code of Federal Regulations (CFR) §141.403(a)(4)]. Water systems must consult with DWB within 30 days and take corrective action for any significant deficiencies found during the sanitary survey no later than 120 days after receiving written notification of such deficiencies, or be in compliance with a DWB-approved schedule and plan for correcting these deficiencies within the same 120 day period [NMAC 20.7.10.100 incorporating 40 CFR §141.403(a)(4) and §141.403(a)(5)(i)-(ii)]. Failure to remedy any significant deficiency will result in a treatment technique violation of NMAC 20.7.10.100 incorporating 40 CFR Part 141 Subpart S.

A total of three (3) significant deficiencies were identified at the Chupadero MDWCA water system during the survey.

1. ***Deficiency:*** **(004B) Inadequate or lack of Emergency Response Plan (ERP)**

Regulatory Citation: **40 CFR 141.403 (a)(4)**

Concern/Description: **Operation/Management.** Lack of an adequate Emergency Plan could lead to extended delays in supplying safe potable drinking water during minor or major emergencies. Public Water Systems that assess their vulnerabilities and adopt thorough emergency response plans are minimizing the likelihood of major delays in supplying safe and potable drinking water to their customers.

Corrective Action: Submit adequate Emergency Response Plan specific to the Barranco MDWCA water system to DWB Compliance Officer.

2. ***Deficiency:*** **(004K) Inadequate Overflow Splash Pad.**

Regulatory Citation: **40 CFR 141.403(a)(4)**

Concern/Description: **Finished Water Storage.** Erosion of the facility site can result in a collapse of storage facilities which can cause a water outage.

Corrective Action: Implement erosion control measures to mitigate erosion at the storage facility. (See Figures 1 & 2).

Figure 1. Significant Deficiency #2. Erosion near storage tank facility.

Figure 2. Significant Deficiency #2. Erosion near storage facility.

3. Deficiency **(001S) Inadequate Site Security at storage facility**

Regulatory Citation: 20.7.10.400.D NMAC

Concern/Description: Unauthorized access can result in water system being contaminate and key components being compromised which could result in a water Outage.

Corrective Action: Reinstall/repair breaks in the perimeter fence around the storage tank. (See Figure 3)

Figure 3. Significant Deficiency #3. Perimeter fence at storage tank is down.

Minor Deficiencies:

The following are minor deficiencies which DWB recommends be corrected before the next sanitary survey to ensure the deficiencies do not become significant.

1. Deficiency: Brush Growing Around Foundation of Storage Tank

Recommendation: Remove vegetation (Siberian Elm) from around the storage tank. Vegetation could compromise the integrety of the tank foundation and the tank. See Figure 4.

Figure 4. Siberian Elm and other woody plants should be cleared from around the tank to maintain the structural integrity of the facility.

Conclusion

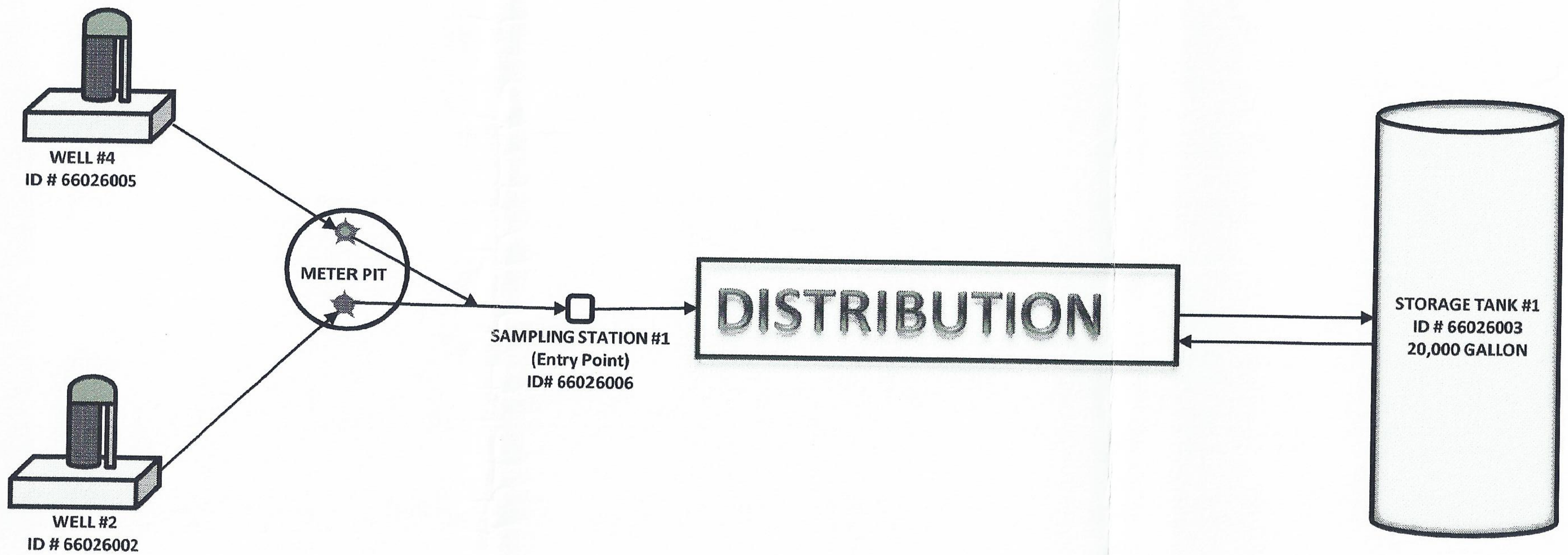
The sanitary survey for the Chupadero MDWCA water system was completed on June 14m, 2016. Based upon the onsite inspection and review of various operational and managerial documents and of DWB compliance files, three (3) significant deficiencies were identified and one (1) minor deficiencies was identified. The Chupadero MDWCA water system must comply with the following in the correction of these deficiencies.

- Upon receipt of this report, the Chupadero MDWCA water system must consult with the DWB within 30 days for all significant deficiencies (i.e., provide written documentation to DWB within 30 days of receipt of this report stating how and when each significant deficiency will be addressed).
- Failure to consult with DWB within 30 days on all significant deficiencies will result in a monitoring and reporting violation of NMAC 20.7.10.100 incorporating 40 CFR Par 141 Subpart S.
- The Chupadero MDWCA water system must take corrective action on all significant deficiencies no later than 120 days after receiving written notification of such deficiencies, OR be in compliance with a DWB approved schedule and plan for correcting these deficiencies within 120 days.
- Failure to correct any significant deficiency in accordance with the previous bullet will result in a treatment technique violation of NMAC 20.7.10.100 incorporating 40 CFR Part 141 Subpart S.

- In addition, the Chupadero MDWCA must provide written documentation to the DWB within 30 days of completing corrective action for each significant deficiency. Failure to submit documentation within 30 days will result in a monitoring and reporting violation of NMAC 20.7.10.100 incorporating 40 CFR Part 141 Subpart S.

If you have any questions or need additional clarification concerning this report please call 505-476-8636 or e-mail chris.cudia@state.nm.us.

NMED - Drinking Water Bureau
System Schematic
CHUPADERO MDWCA
NM 3566026



APPENDIX D

Financial Information

Chupadero Water and Sewage Corp
Profit & Loss
January through December 2024

		Jan - Dec 24
Ordinary Income/Expense		
Income		
Water bills		47,044.97
Total Income		47,044.97
Expense		
Accounting		54.09
Corporate filing fees		10.00
Donations		140.97
Dues		157.00
Insurances		
Insurance	3,499.00	
Total Insurances		3,499.00
Line locates		145.90
Meeting space rental		205.56
Office expenses		
Bookkeeping Services	12,822.66	
Office supplies	730.07	
PO Box rental	200.00	
Postage	774.00	
Total Office expenses		14,526.73
Operations $ Maintenance		
Maintenance	135.00	
Water master	13,799.70	
Total Operations $ Maintenance		13,934.70
Professional fees		
Lawyer	1,484.63	
Total Professional fees		1,484.63
Scada system		1,126.80
Security for meeting		0.00
Software support		528.41
Utilities		
Electricity	1,128.30	
Total Utilities		1,128.30
Water master helper		1,565.24
Water testing		714.64
Well repairs		15,680.43
Total Expense		54,902.40
Net Ordinary Income		-7,857.43
Other Income/Expense		
Other Income		
Interest		5.45
Transfer fee		500.00
Total Other Income		505.45
Net Other Income		505.45
Net Income		**-7,351.98**

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-
-
-

Chupadero Water-Sewage Corp
PO Box 24051 Santa Fe NM 87502
afcwa@msn.com
505-490-2128

Calendar Year
2025 Interim Budget

	APPROVED BUDGET	1st QR: Jan - Mar	2nd QR: Apr - Jun	3rd QR: Jul - Sept	4th QR: Oct -Dec	Year to Date(YTD) Totals	YTD (over)/under BUDGET	% of Budget
Beginning balances: Cash	11,526							
Savings	54,368							
CDs								
Investments								
Beginning Balance TOTAL	**$ 65,894**							
REVENUES								
Water Sales (Water Use Fees)	47,000	0	0	0		0	47,000	0%
Connection/Reconnection Charges						0	0	-
Membership and Meter Sales (Utility Service Fees)	500		0			0	500	0%
Late Fees and Penalties (Other Fines and Forfeits)						0	0	-
Gross Receipts Tax (Other State shared taxes)						0	0	-
Other Operating Revenue (miscellaneous - other)	93,838	0	0	0		0	93,838	0%
TOTAL	**$ 141,338**	-	-	-	-	-	**141,338**	0%
EXPENDITURES								
Salaries - Operator, Bookkeeper, etc.	28,660	0	0	0		0	28,660	0%
Employee Benefits and Expenses						0	0	-
Electricity	2,400	0	0	0		0	2,400	0%
Other Utilities - Gas, Water, Sewer, Telephone						0	0	-
System Parts and Supplies	3,000	0				0	3,000	0%
System Repairs and Maintenance	3,000	0	0	0		0	3,000	0%
Vehicle Expenses						0	0	-
Office and Administrative Expenses	1,500	0	0	0	0	0	1,500	0%
Professional Services - Accounting, Engineering, Legal	2,800	0				0	2,800	0%
Insurance	3,600	0		0		0	3,600	0%
Dues, Fees, Permits and Licenses	200	0	0	0		0	200	0%
Taxes - Gross Receipts Tax, Water Conservation Fee	-		0			0	0	-
Training						0	0	-
Miscellaneous	96,000	0	0	0		0	96,000	0%
Loans								
Annual debt service - Loan 1						0	0	-
Annual debt service - Loan 2						0	0	-
TOTAL	**$ 141,160**	-	-	-	-	-	**141,160**	0%
Ending Balance	66,072					65,894		
LESS: Operating Reserve	25,000							
Emergency Reserve	20,000							
Capital Improvement Reserve	16,000							
Debt Reserve								
Ending Available Cash Balance	**$ 5,072**					**$ 65,894**		

I HEREBY CERTIFY THE CONTENTS IN THIS REPORT ARE TRUE AND CORRECT TO THE BEST OF MY KNOWLEDGE AND THAT THIS REPORT DEPICTS ALL

Renee Roybal
President/Chairperson

Date

APPENDIX E

JSAI Hydrogeologic Evaluation

February 20, 2018

Jerry A. May, P.E., Principal
Martin/Martin, Inc., Consulting Engineers
5353 Wyoming Blvd. NE, Suite 2A
Albuquerque, New Mexico 87109 jmay@martinmartin.com

Re: Hydrogeologic evaluation for Chupadero Water & Sewage Corporation (CWSC)

Dear Jerry:

John Shomaker & Associates, Inc. (JSAI) has performed a review of "Hydrogeologic Survey of Chupadero Area" by Daniel B. Stephens & Associates, Inc. (DBSA) completed on June 22, 2016 and provided to JSAI in November of 2017. The objective of the DBSA (2016) memo was to give Santa Fe County and the Chupadero Water & Sewage Corporation (CWSC) scientific information to make decisions regarding the location of a future water supply well considering hydrogeologic conditions in the CWSC service area.

Supplemental Information

Supplemental data were provided on January 2, 2018 that changed the conclusions of the above DBSA (2016) report. The supplemental information consisted of the following:

1. "Water System Analysis & Water Rights Valuation" of the CWSC completed in 2013 for Santa Fe County by Southwest Water Consultants.
2. "Supply Well Construction Specification Standard" with a proposed well diagram approved by a NM-licensed Professional Engineer on August 2, 2017.
3. New Mexico Environmental Department (NMED) "Notice of Violation and Public Notice Advisory" dated February 8, 2005 concerning gross alpha and uranium concentration results from CWSC Well 3.
4. Well Records for CWSC Wells 3 and 4, and water well meter readings for these wells for the period 2005-2014.
5. "Well Installation Report" dated February 21, 2014, concerning the borehole completion, well construction, and pumping tests for CWSC Well 3 performed in 2003.
6. Correspondence between Martin/Martin and Santa Fe County detailing a revised recommended well location for CWSC.
7. Three maps detailing the new chosen CWSC well site at the Jiminez property, and a hand-drawn DBSA cross-section sketch centered on this property dated May 25, 2017.
8. CWSC "Service Area Map" dated February 18, 2013.

Review

The DBSA (2016) memo is limited primarily due to the limited scope of study, which includes the lack of water-quality data, and the lack of integration of supplemental information listed above. The memo summarizes data for domestic wells on file with New Mexico Office of the State Engineer (NMOSE) and concludes that the ideal well site for CWSC lies in thicker sequences of the Tesuque Formation to the south and west of the Village of Chupadero. However, significant data gaps exist, and the data available through NMOSE are not extremely reliable and should be interpreted cautiously as the memo states.

The DBSA (2016) memo did not include a comprehensive evaluation of local water-quality results. Additional water-quality data for Chupadero wells, and not contained in the DBSA (2016) memo, are contained in Johnson et al. (2008), the NMED (2018), and contained in Manning (2008). These omissions are problematic, as groundwater with elevated uranium concentrations has been documented in the area, and CWSC Wells 1 and 3 are currently not utilized due to elevated fluoride and uranium. An NMED letter dated February 8, 2005 indicates that the relatively deep completion of CWSC Well 3 sources uranium "found in underlying igneous and metamorphic rock (…) of the Tesuque area."

Elevated uranium concentrations have also been documented for the Vista Redonda Subdivision, located about a quarter-mile south of the Village of Chupadero (NMED, 2018). Elevated uranium concentrations in the Tesuque aquifer have been attributed to the granite bedrock (Johnson et al., 2008), volcanic ash layers in the aquifer (McQuillan and Montes, 1998), and oxidation of sulfide minerals (McQuillan et al., 2010). McQuillan et al. (2010) also suggested that uranium concentrations tend to be higher near the mountain front where deeper groundwater is close to the surface and recharge waters are ephemeral and scarce. There is some documentation suggesting that wells completed deeper in the Tesuque Formation in the area may have higher average uranium concentrations. However, uranium concentrations can vary considerably within individual wells in the area, depending on factors including the age of the well, declining well efficiency, sampling protocol, and how the well is (and has been) operated in terms of pumping rates and durations (JSAI, 2013).

The DBSA (2016) study aimed to select a location for a future water supply well based on the following criteria: "maximize saturated thickness of the aquifer," "maximize the coarsest sediments," and "maximize the distance from the nearest fault(s)." The DBSA (2016) study utilized NMOSE domestic Well Records to gain an understanding of the sediments coarseness and by proxy possible well yields; however, drillers' logs submitted with domestic Well Records should be interpreted cautiously, as they may not provide adequate detail or accuracy to provide reliable information on coarseness of sediments. The DBSA (2016) memo concluded that "well sites located in the western parts of the study area will … penetrate the greatest saturated thickness" (p. 12) and western and southern areas the "greatest thicknesses" of "saturated coarse-grained aquifer materials" (p. 11), where "lesser to no indication of faulting" and "higher reported production capacities" (p. 12) are found. JSAI generally agrees, and in addition, would caution that deeper wells completed near the base of the Tesuque Formation should also be avoided as water quality near the bedrock is problematic. The DBSA (2016) memo favored a hilltop site in close proximity to the Vista Redonda Wells 4 and 7; however, JSAI would not recommend a new CWSC well in this location, as the greater depth to water would add to drilling costs, and fail to consider potential well interference and drawdown effects from nearby Vista Redonda wells. In addition, Vista Redonda might be expected to protest.

Lack of available saturated thickness and potentially low specific capacity are problematic for the three CWSC-proposed sites described in the DBSA (2016) memo. Additionally, the DBSA (2016) memo fails to point out that based on a design pumping rate of about 20 gallons per minute (gpm) and conservative specific capacity of 0.10 gpm/ft (based on CWSC Well 3), drawdown could be in excess of 200 ft. If a 200-ft vertical buffer is to be maintained above bedrock due to water-quality issues, and a 300-ft screen interval is desired for the well (DBSA proposed well diagram dated 8/2/2017; and pumping water levels are to be maintained above the screen interval), a location with Tesuque Formation saturated thickness greater than 700 ft would be needed. The three CWSC proposed sites do not meet this criterion; locally as little as 100 ft saturated thickness may be available due to a geologically complex basin accommodation zone (Koning and Read, 2010). A well completed at any of the three above mentioned CWSC proposed sites would also likely have unacceptable water-quality parameters as these areas intercept very little recharge, and likely have elevated uranium, fluoride, or arsenic concentrations (cf. Manning, 2008). The well would likely also experience the effects of regional groundwater declines, exacerbated by aquifer compartmentalization further reducing well yield and longevity.

Additional Information Considered: Basin Structure and Sediments

In the area of interest, a shallowing Española Basin is filled with sediments abutting the Sangre de Cristo Mountains, consisting mostly of granites. The basin is a half graben, and its eastern side is defined by thin Miocene-age Tesuque Formation consisting of red coarse-cemented sandstone and angular conglomerate with generally poor permeability. The aquifer becomes more fine-grained with depth and correspondingly hydraulic conductivity also decreases (Hearne, 1985; Borchert et al., 2003; Koning and Read, 2010).

Total Tesuque Formation thickness increases rapidly along the Rio Chupadero to the west according to Grauch et al. (2009), from about 400 ft in the northeastern part of the CWSC service area to about 1,000 ft in the southwestern part of the CWSC service area. The eastern two-thirds of the CWSC service area is structurally complex, characterized by an intra-basin bedrock uplift, a dozen closely spaced faults, an accommodation zone, and several folds, as well as total Tesuque Formation thicknesses of less than 700 ft. The western end of the CWSC service area is characterized by a monocline indicative of a rapidly thickening basin (>700 ft thick), and an area Grauch et al. (2009) characterized as "underlain by magnetic sediments," which are explained as likely indicating coarse-grain size, or less likely "magnetic lithic detritus, such as volcanic clasts."

Additional Information Considered: Well Completion Data and Aquifer Properties

Domestic wells completed locally in the Tesuque Formation have depths ranging from 12 to 950 ft based on wells in the NMOSE NMWRRS database (DBSA, 2016; table 1). These wells average 280 ft in depth, although since 2000, the average well depth has increased, possibly as a result of declining water levels, or possibly as a result of newer homes being developed on mesas away from riparian areas. Wells tend to be completed relatively shallow near the riparian areas as depths to water are shallow, ranging from 0 to 103 ft below ground level (bgl), and averaging 41 ft bgl (DBSA, 2016; table 1). Depth to water in all areas range up to 305 ft bgl, and average 110 ft bgl (200 ft bgl over the last 17 years; DBSA, 2016). Groundwater generally flows westward or northwestward in the study area.

Data on aquifer transmissivity for the Tesuque Formation are summarized in the DBSA memo (2016; table 2), but the transmissivity value for CWSC Well 3 is low for the area, 8 ft^2/day, compared with a local median value of 50 ft^2/day (DBSA, 2016). The Well 3 recovery curve of its constant-rate pumping test is characteristic of a fractured rock aquifer. The database compiled by DBSA (2016; table 2) almost exclusively consists of deep wells with depth to water exceeding 229 ft bgl. Shallow wells completed locally within the alluvium have reported transmissivities of 1,600 ft^2/day, whereas Tesuque Formation wells average 160 ft^2/day in the Pojoaque and Tesuque drainages (Koopman, 1975). Specific-capacity values range locally from 0.1 to 1.1 gallons per minute per foot (gpm/ft) of drawdown, with a median value of 0.42 gpm/ft (no shallow wells). CWSC Well 3 had a specific capacity of 0.10 gpm/ft of drawdown after 3 hours of pumping, and as DBSA (2016) points out, its location close to a fault is likely the reason for the excessive drawdown and limited saturated thickness.

Additional Information Considered: Groundwater Quality

Groundwater produced from the Tesuque Formation within the CWSC service area appears to be of poor to moderate quality based on water-quality data contained in NMED (1980). Johnson et al. (1980) and Manning (2008) contain additional water-quality results for the area some of which corroborate the 1980 published data, some of which include a better water quality for wells. Water-quality results for CWSC Well 3 (NMED letter dated February 8, 2005) list a uranium concentration of 0.0535 mg/L, and a gross alpha concentration of 19.52 pCi/L, both exceeding the current primary drinking water standards of the NMED/DWB. CWSC Well 1 water quality results from 1979 list arsenic, cadmium, fluoride, lead, uranium, and gross alpha concentrations that exceed the current NMED/DWB National Primary Drinking Water Regulations (Table 1); whereas, pH exceeds the National Secondary Drinking Water Regulations. The high pH suggests caustic groundwater that is corrosive to the well casing, which may be the reason for elevated metals such as cadmium and lead. See Table 1 for CWSC Well 1 water-quality data. CWSC Well 4 uranium concentrations reviewed online (NMED, 2018) range from 0.013 to 0.021 mg/L (2014-2015), or below the NMED/DWB standard.

Just south of the CWSC, the Vista Redonda MDWCA operates seven wells all of which, completed to depths between 405 and 950 ft bgl (and lying at elevations between 7,160 and 6,920 ft above mean sea level; amsl), have at times exceeded the uranium standards of the NMED/DWB. Uranium concentrations have generally varied from about 0.01 to 0.05 mg/L (JSAI, 2013). Water quality results for the nearby Rio En Medio community wells in NMED (1980) show no exceedance in any water-quality constituents, suggesting that these wells may not have the same problems or are taking in mostly surface water, which is almost certainly lower in pH and hence would ameliorate problems with deeper caustic groundwater, which are common in the Española Basin (e.g., Manning, 2008). Nothing is known about the Rio En Medio well completions, or whether these wells are still in existence.

JSAI also briefly reviewed potential contamination in the CWSC area associated with leaking underground petroleum storage tanks, landfills, and other sites. Based on a review of the NMED, Petroleum Storage Tank Bureau's (NMED, 2018) inventories of active leaking petroleum sites and no further action sites, accessed on January 2, 2018, there are no sites within a 1-mile radius of the CWSC service area.

Table 1. Summary of water-quality data,
CWSC Well 1, Santa Fe County, New Mexico

constituent	unit	Chupadero Water & Sewage Corporation (CWSC) Well 1	NMED-DWB MCL standard
color	CU	5	15[a]
odor	TON	0	3[a]
surfactants	mg/L	<0.05	0.5[a]
pH	pH units	**8.65**	6.5 to 8.5[a]
hardness	mg/L	8	no standard
alkalinity	mg/L	216	no standard
bicarbonate	mg/L	248.2	no standard
carbonate	mg/L	7.8	no standard
specific conductance	µmhos/cm	497	no standard
total dissolved solids (TDS)	mg/L	271	500[a]
turbidity	NTU	4.6	5
chloride	mg/L	5.2	250[a]
fluoride	mg/L	**4.22**	2[a] to 4
nitrate	mg/L	0.02	10
nitrite	mg/L		1
sulfate	mg/L	26.7	250[a]
arsenic (total)	mg/L	**0.021**	0.010
barium	mg/L	<0.10	2.0
cadmium	mg/L	**0.015**	0.005
calcium	mg/L	3.2	no standard
chromium	mg/L	<0.005	0.1
iron	mg/L	<0.25	0.3[a]
lead	mg/L	**0.017**	0.015
magnesium	mg/L	0.0	no standard
manganese	mg/L	<0.05	0.05[a]
mercury	mg/L	-	0.002
potassium	mg/L	0.78	no standard
selenium	mg/L	<0.005	0.05
silver	mg/L	<0.005	no standard
sodium	mg/L	108.1	no standard
gross alpha	pCi/L	**40.6±2.7**	15
gross beta	pCi/L	22.4±3.8	50[b]
radium-226	pCi/L	<0.04	5 (combined)
radium-228	pCi/L	<1.0	

[a] - national secondary drinking water standard (non-enforceable guidelines)
[b] - NMED-DWB defined level below which the equivalent radiation is below EPA mandated radiation threshold of 4 mrem/year
[c] - not officially reported by laboratory due to QC problem, result is provisional
NMED-DWB MCL – NMED-Drinking Water Bureau maximum contaminant level

bold indicates exceedance of the MCL
mg/L - milligrams per liter
pCi/L - picoCuries per liter
CU – color unit
µmhos/cm – micromhos per centimeter

Additional Information Considered: Groundwater Availability and Declines

Water levels in U.S. Geological Survey (USGS) monitored wells in the area have declined between the 1960s and present, showing yearly changes of <10 ft, and an average decline of about 0.5 ft/yr over the period of record (see Fig. 1). JSAI (2013) documented average water-level declines of 0.4 to 2.2 ft/yr in the area. Long-term water-level declines are another reason that a future water-supply well for CWSC should be placed to take advantage of the greatest possible thickness of the Tesuque Formation within close proximity to areas of potential surface-water recharge. In contrast, areas of limited saturated thickness, and at higher elevations, distant from areas of recharge would only limit water production. Artesian conditions could locally be present in the Tesuque Formation aquifer.

Additional Information Considered: Assessment of Existing Wells

Some important observations can be made based on the CWSC well completions and the age of the CWSC wells. Available well completion data for CWSC wells are summarized in Table 2, along with average values for domestic wells in the area for comparison.

CWSC Well 1 with NMOSE file number RG-28780 and completion date 1977 has steel well casing that has likely corroded, resulting in the production of poor quality water. According to its NMOSE Well Record, it only has a 10-ft screen from 435 to 445 ft bgl, and according to your email of January 2, 2018, the CWSC has lost ownership of this well. Your email also suggests it’s a “good producer,” contrary to the SWC (2013) report, which lists “water quantity concerns,” which could be caused by its short screen interval.

CWSC Well 2 data were not found, as the NMOSE file number (RG-45650) given in the SWC (2013) report is for another well. The SWC (2013) report gives CWSC Well 2’s completion year as 1987, its NMOSE file number as RG-78029-S (amended), and a completion depth of 67 ft bgl. The NMOSE well database (table 1; DBSA, 2016) has only one well completed in 1987 (RG-47074), a well with steel casing, completed to 80 ft bgl with 20 ft of screen from 58 to 78 ft bgl and a depth to water of 28 ft bgl. This well is currently in service.

CWSC Well 3, a well with PVC casing, is completed to 530 ft bgl with 220 ft of screen and according to your email of January 2, 2018, was “not producing very well.” The NMOSE Well Record, with file number RG-78029, indicates it was completed in 2003 with an estimated yield of 40 gpm. This well is not currently in service.

CWSC Well 4, with NMOSE file number RG-84262 (subsequently amended by the NMOSE to RG-78029-S2) has PVC casing, and was completed in 2005 to a depth of 300 ft bgl with screen from 220 to 280 ft bgl and a depth to water of 22 ft bgl. According to its NMOSE Well Record, the well produced 20 gpm when built. Currently, CWSC Wells 2 and 4 are the only wells in service to supply the CWSC system. Individual well efficiencies, or decreases in well efficiencies, for CWSC wells are unknown, and it is not known if well video surveys have ever been performed for any of these wells.

Table 2. Summary of available data for CWSC wells, Santa Fe County, New Mexico

well name	NMOSE file number	year completed	total depth (ft)	screen interval (ft bgl)	depth to water (ft bgl)	reported test yield / current yield (gpm)	reported specific capacity (gpm/ft)
CWSC Well 1 [1]	RG-28780	1977	445	435-445	17 (7/1977)	not operational	-
CWSC Well 2 [2,3]	RG-78029-S	1987	67 (?)	-	dry (2012)	- / 5 (?)	-
CWSC Well 3 [1]	RG-78029	2003	530	300-520	140 (4/2003)	40 / 22	0.10 (4/2003)
CWSC Well 4 [1]	RG-84262 (old) RG-78029-S2 (new)	2005	300	220-280	22 (2/2005)	20 / 3	-
average of domestic wells [2]	various	various	282	various	107	2 to 115 (average 22)	0.47 [4]

[1] NMOSE NMWRRS, 2018
[2] NMOSE listed domestic well within 1-mile radius (DBSA, 2016)
[3] SWC, 2013
[4] DBSA, 2016; table 2
CWSC - Chupadero Water & Sewage Corporation

ft/bgl - feet below ground level
gpm - gallons per minute
mg/L - milligrams per liter
gpm/ft - gallons per minute per foot of drawdown
NMOSE - New Mexico Office of the State Engineer

Recommendations

Local water-quality considerations are very important in locating potential well sites for a future water supply well for CWSC. A potential well location near the western end of the service area in the lower Chupadero valley, where depth to water is 50 ft bgl or less, and saturated thicknesses exceed 1,000 ft, has a greater likelihood of achieving acceptable water quality and a production capacity that averages 20 gpm. Regarding the conclusions reached in the revised DBSA (2016) report, JSAI generally agrees with siting the new CWSC well at the southwest corner of the Jiminez property (closest to the arroyo bottom); JSAI has the following (additional) recommendations:

1. As the Jiminez property is the preferred location for CWSC water supply (DBSA cross-section, 2016), JSAI suggests that a water-quality sample is collected from a well close to Jiminez property as an alternative to open-borehole zone water-quality sampling.

2. Drill an exploratory borehole to about 500 ft bgl where a final well design (total well depth and placement of screen interval) are based on the interpretation of lithologic and geophysical logs (and take into account an estimated specific capacity of 0.2 gpm/ft and about 100 ft of drawdown at 20 gpm).

3. Run geophysical logs in the open borehole, including temperature (logged down, first log run), caliper, spontaneous potential, resistivity (8”, 16”, 32”, and 64”), neutron, sonic and gamma-ray logs.

4. Construct the well with PVC well casing and PVC factory-slot screen, rather than HSLA steel casing due to water-quality concerns.

5. Exploratory well drilling, well construction, and pumping tests should be supervised by an experienced Hydrogeologist to interpret drill cuttings and prepare a detailed lithologic log (at 10-ft intervals), determine screen setting (at least 200 ft interval suggested), supervising proper development, and adequate quality data gathering. Geophysical logs would be reviewed by the Hydrogeologist in combination with the lithologic log to determine total depth and placement of screen interval(s) for the well.
6. All well construction materials, including blank casing and screen and annular materials, must be on-site upon completion of drilling the borehole, so that the well may be constructed promptly following geophysical logging and interpretation of logs.
7. Only potential well locations west of 108 Camino Chupadero should be considered, as Tesuque Formation thickness is limited to the east.
8. The well should be located as close to the surface drainages associated with the Rio Chupadero as possible to take advantage of local recharge (and minimize depth to water).
9. Septic set-back regulations should be observed per NMED regulations.
10. Sanitary seals should extend to at least 50 ft bgl.

Additionally, the CWSC should ascertain why the current wells (CWSC Wells 2 and 4) are inadequate for their needs. This ideally should include a step-drawdown pumping test, video survey, water-quality determination, and bacteriological analysis including iron-related, sulfate-reducing, and slime-forming bacteria (BART test kit) to provide an accurate determination of the condition of CWSC wells, what they are capable of producing, and baseline capacity. Note that a well video survey requires that the pump be removed from the well. The results of the video survey and the qualitative bacteriological analysis should be analyzed to determine if rehabilitation should be considered for the CWSC wells. It should be understood that older wells, particularly if they are constructed of mild steel, can be irreparably damaged during rehabilitation. A post-rehabilitation step-drawdown pumping test should also be performed at the same pumping rates as the initial test to determine the effectiveness of rehabilitation efforts.

Please let me know if you have any questions or comments.

Sincerely,

JOHN SHOMAKER & ASSOCIATES, INC.

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Senior Hydrogeologist

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Enc: References
Figure 1. Hydrographs for USGS-monitored wells 354738105553901 and 354555105564501.

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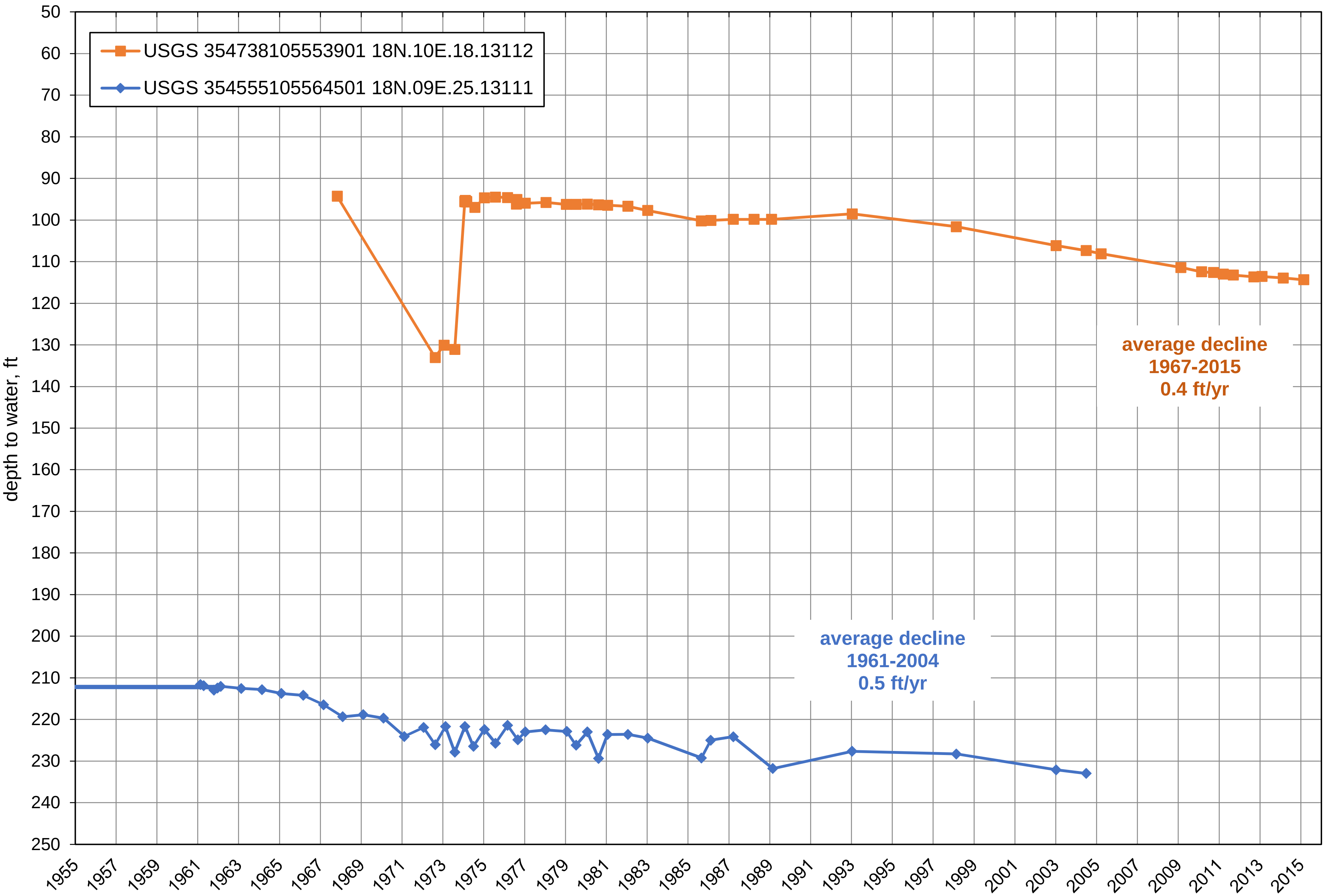

Figure 1. Hydrographs for USGS-monitored wells 354738105553901 and 354555105564501, near Chupadero, Santa Fe County, New Mexico.

JOHN SHOMAKER & ASSOCIATES, INC.