July 24, 2018

Mr. Clinton Chisler, Reclamation Soil Scientist
Mining Act Reclamation Program
Mining and Minerals Division
1220 South St. Francis Drive
Santa Fe, NM 87505

Ms. Amber Rheubottom, Geologist
Ground Water Quality Bureau
New Mexico Environment Department
1190 S. St. Francis Drive
P.O. Box 5469
Santa Fe, NM 87502-5469

RE: Addendum to Roca Honda Mine Baseline Data Report; Permit Nos. MK-025RN, DP-1717

Dear Clinton and Amber:

As a follow up to our recent meeting, attached is Addendum 1 to the Baseline Data Report (BDR) and supplements previously submitted for the Roca Honda Mine project. As discussed during the meeting, this Addendum compiles the results of various studies completed for the planned expansion of the Roca Honda Mine permit area and the southern reuse pipeline. Roca Honda Resources (RHR) described plans for conducting the studies of the reuse pipeline corridor in a 12/24/14 letter to the Cibola National Forest (CNF) with copies to the Mining & Minerals Division (MMD), New Mexico Environment Department (NMED), and the New Mexico Department of Game and Fish (NMDG&F), all signatory agencies to the Roca Honda Mine MOU, as well as to the State Land Office and State Engineer's Office. All studies for the proposed Section 17/8 mine expansion area were performed pursuant to previously approved RHR Sampling and Analysis Plans (SAP) except as noted in the attached reports.

As you will see, the BDR Addendum does not include the results of the archaeological surveys that were completed for the pipeline route and Section 17. As discussed during our meeting, those reports are in preparation, pending further input from the Tribes participating in the Section 106 consultation process. In order to protect potentially culturally sensitive information, full reports will be provided on a confidential basis to the New Mexico Historic Preservation Department and the CNF while a summary version will be provided to other agencies as requested. We expect those reports to be completed in two to three months.

RHR
ROCA HONDA RESOURCES LLC

Hard and disk copies of this Addendum are being provided to MMD, NMED, NM G&F and to CNF as signatory to the MOU. If other recipients of this letter would like hard or disk copies please advise and they will be provided as well.

Please contact me at 208-354-0588 or Scott Bakken at 303-389-4132 if there are any questions.

Sincerely,

Michael Neumann

Michael Neumann
Sr. Project Consultant

cc:Diane Tafoya, Cibola National Forest
Ron Kellermueller, NM Game and Fish Department
Jack Yates, NM State Land Office
Michelle Ensy, NM Historic Preservation Department
Gary Funkhouser, NM Department of Transportation
Jeff Peterson, NM Office of State Engineer
Scott Bakken, Energy Fuels, Inc.

ROCA HONDA MINE
BASELINE DATA REPORT
ADDENDUM

July 2018 Addendum 1

Submitted To:

New Mexico Mining and Minerals Division
U.S. Forest Service (Cibola National Forest)
New Mexico Environment Department
New Mexico Department of Game and Fish

Prepared by:

Roca Honda Resources, LLC
225 Union Blvd, Suite 600
Lakewood, CO 80228

Contents

Appendices

Figures

1.0 Introduction

NMAC 19.10.6.602 D.(13)

The level of detail required for environmental baseline information may vary depending on the location, size, scope and type of mining operation and site-specific characteristics. Baseline data shall describe the environment of the proposed permit area and, to the extent practicable, the affected area. Data gathered or available to the applicant for other purposes, such as a site assessment previously submitted, may be used in part to meet the requirements of this Part. Baseline data shall be collected over a period of at least 12 months for evaluation of water quality and quantity, wildlife and wildlife habitat and vegetation. The Director may require studies of longer duration than 12 months to address unique, site-specific factors.

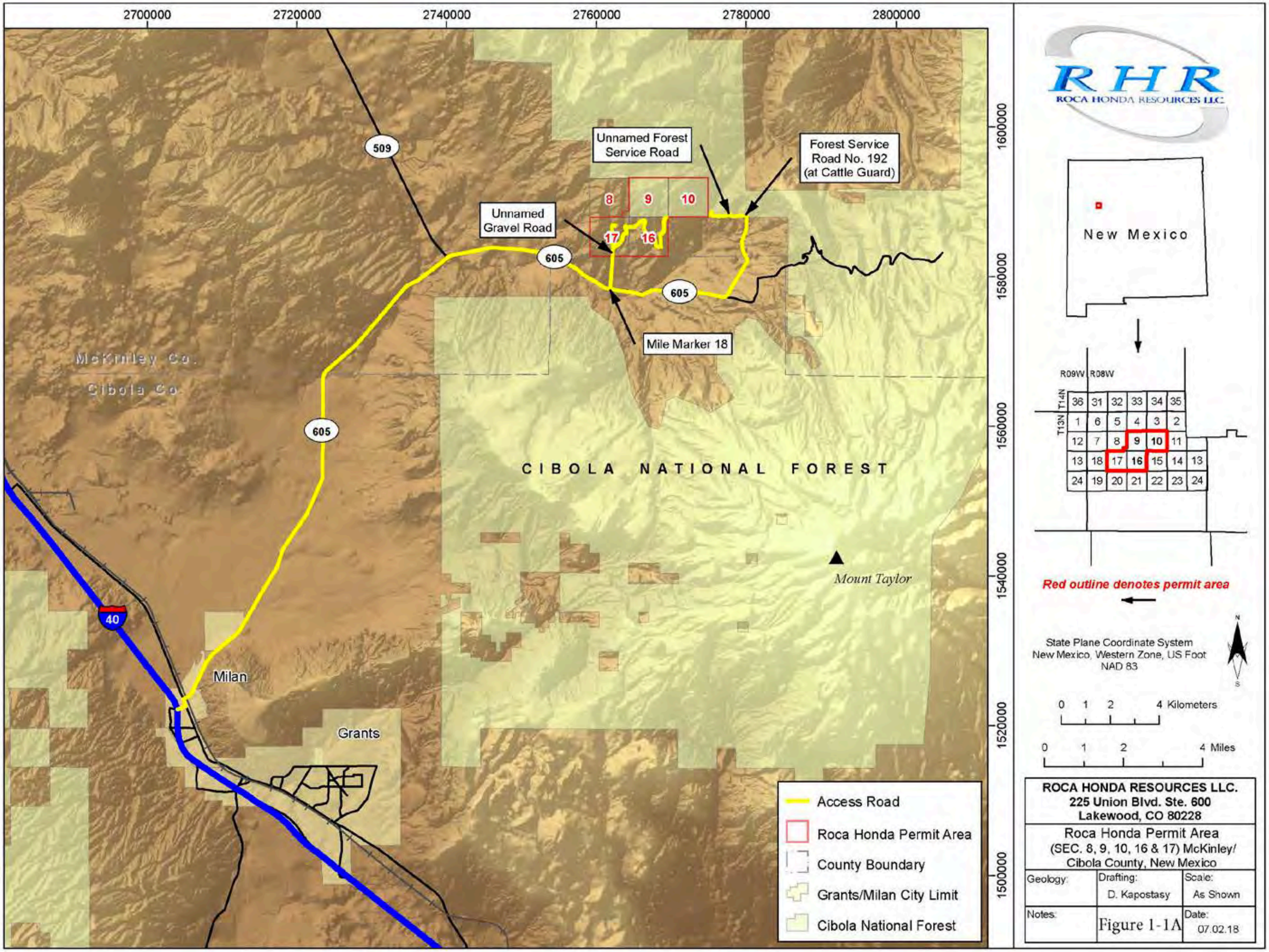
1.1 Background

Roca Honda Resources, LLC (RHR) submitted an application for a new mine permit to the New Mexico Mining and Minerals Division (NM MMD) for its proposed Roca Honda uranium mine in 2009. Since that time the proposed mine permit area has been expanded to include an additional section (Section 17) and one quarter-quarter section (Section 8) of private land in Township 13 North, Range 8 West (T13N R8W), in McKinley County, New Mexico. Figure 1-1A is a map showing the proposed expanded Roca Honda Mine permit area. In addition, the proposed water reuse pipeline is now planned to convey treated mine discharge water to the Rio San Jose near Milan, New Mexico, rather than northerly to San Lucas Draw as previously planned. Figure 1-2A shows the southern reuse pipeline route and discharge zone options. This addendum presents the results of baseline studies conducted of the mine expansion areas and along the length of the planned southern reuse pipeline route. The proposed mine permit area now includes approximately 2,600 acres; all of Sections 9, 10, 16, 17 and the SE1/4 SE1/4 of Section 8.

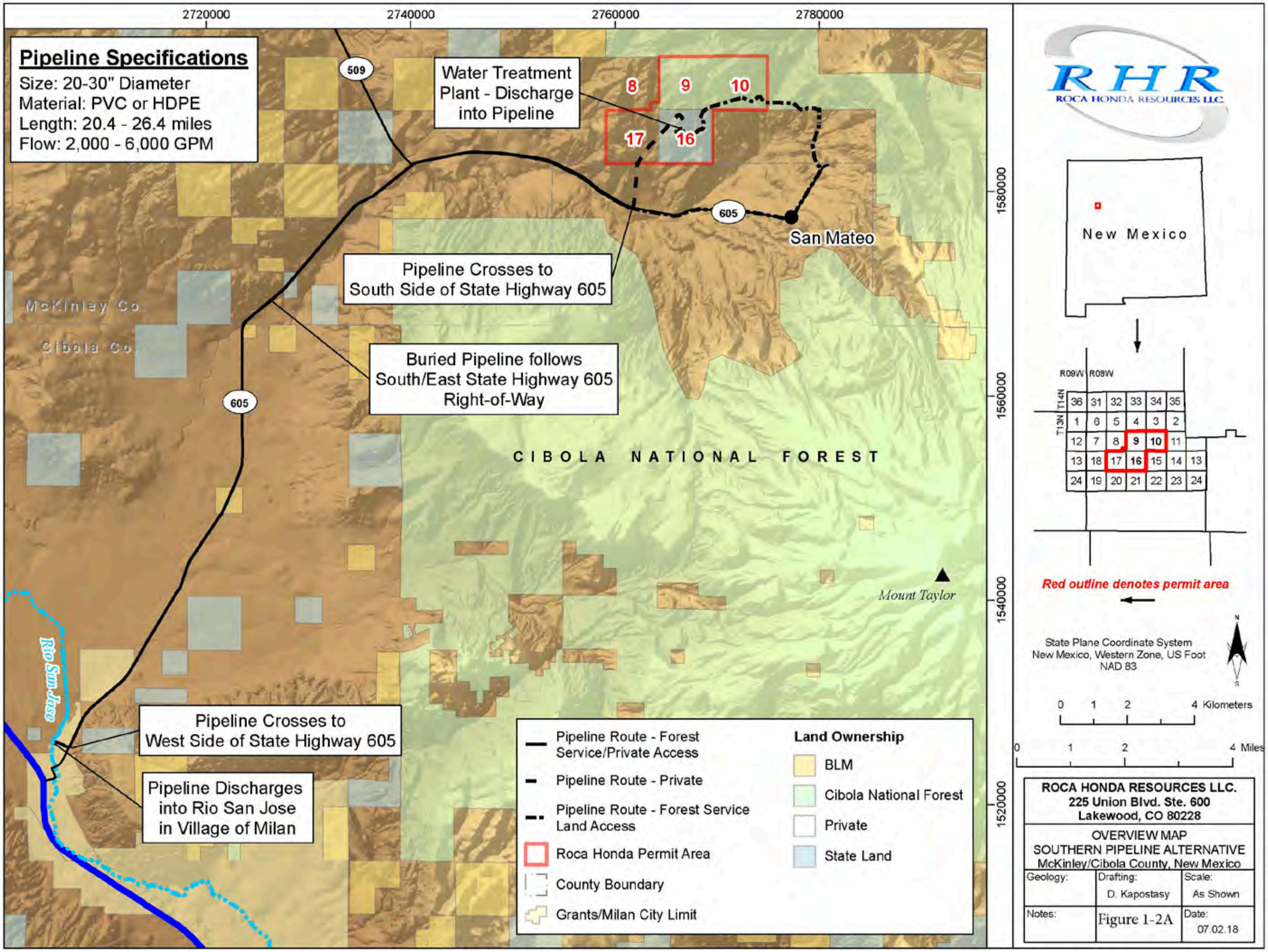
1.2 Baseline Data Collection

The information presented in this Addendum provides a baseline against which to evaluate and quantify the effects of planned mining activities, identify mitigation measures for construction and operation activities, and develop plans for reclamation of the disturbed areas. The methodologies used for the resource studies completed for the expansion areas in Sections 17 and 8, and along the pipeline route, were consistent with those used in previously approved Roca Honda Sampling and Analysis Plans (SAPs) unless otherwise noted in the reports.

In addition to the studies presented herein, Class III archaeology surveys of the proposed mine expansion areas and southern reuse pipeline routes have been completed in accordance with procedures approved by the USFS. Reports describing the methodologies and results of those surveys are in process and will be submitted to the USFS and State Historic Preservation Office upon completion.



2700000
2720000
2740000
2760000
2780000
2800000
1600000
1580000
1560000
1540000
1520000
1500000
509
605
Unnamed Forest Service Road
Forest Service Road No. 192 (at Cattle Guard)
Unnamed Gravel Road
8
9
10
17
16
Mile Marker 18
McKinley Co.
Cibola Co.
CIBOLA NATIONAL FOREST
Mount Taylor
40
Milan
Grants
Access Road
Roca Honda Permit Area
County Boundary
Grants/Milan City Limit
Cibola National Forest
RHR
ROCA HONDA RESOURCES LLC
New Mexico
R09W
R08W
T14N
T13N
Red outline denotes permit area
State Plane Coordinate System
New Mexico, Western Zone, US Foot
NAD 83
0 1 2 4 Kilometers
0 1 2 4 Miles
ROCA HONDA RESOURCES LLC.
225 Union Blvd. Ste. 600
Lakewood, CO 80228
Roca Honda Permit Area
(SEC. 8, 9, 10, 16 & 17) McKinley/
Cibola County, New Mexico
Geology:
Drafting:
D. Kapostasy
Scale:
As Shown
Notes:
Figure 1-1A
Date:
07.02.18



2720000
2740000
2760000
2780000
Pipeline Specifications
Size: 20-30" Diameter
Material: PVC or HDPE
Length: 20.4 - 26.4 miles
Flow: 2,000 - 6,000 GPM
509
Water Treatment Plant - Discharge into Pipeline
8
9
10
17
16
605
San Mateo
Pipeline Crosses to South Side of State Highway 605
McKinley Co.
Cibola Co.
Buried Pipeline follows South/East State Highway 605 Right-of-Way
605
CIBOLA NATIONAL FOREST
Mount Taylor
Rio San Jose
Pipeline Crosses to West Side of State Highway 605
Pipeline Discharges into Rio San Jose in Village of Milan
Pipeline Route - Forest Service/Private Access
Pipeline Route - Private
Pipeline Route - Forest Service Land Access
Roca Honda Permit Area
County Boundary
Grants/Milan City Limit
Land Ownership
BLM
Cibola National Forest
Private
State Land
1580000
1560000
1540000
1520000
RHR
ROCA HONDA RESOURCES LLC
New Mexico
R09W R08W
T14N
T13N
Red outline denotes permit area
State Plane Coordinate System
New Mexico, Western Zone, US Foot
NAD 83
0 1 2 4 Kilometers
0 1 2 4 Miles
ROCA HONDA RESOURCES LLC.
225 Union Blvd. Ste. 600
Lakewood, CO 80228
OVERVIEW MAP
SOUTHERN PIPELINE ALTERNATIVE
McKinley/Cibola County, New Mexico
Geology:
Drafting: D. Kapostasy
Scale: As Shown
Notes:
Figure 1-2A
Date: 07.02.18

There are no perennial surface water occurrences within the mine expansion area, hence no baseline water quality data is presented. A hydrologic analysis of runoff characteristics within the drainage basin containing Sections 17 and 8 was done as part of the civil design work completed for the proposed Section 17 mine facilities area and was previously provided to the reviewing agencies.

Existing environmental and geomorphologic characteristics of the Rio San Jose within the proposed discharge zone and for a distance of several miles downstream were evaluated pursuant to Work Plans approved by the New Mexico Environment Department and documented in an October 2017 report submitted to the NMED, NMMMD, the USFS (CNF), NM Department of Game and Fish, NM State Land Office and the NM Office of the State Engineer.

That document also contained a summary of all publicly available water quality and flow data for the Rio San Jose and the results of archaeological and biological surveys performed for the Village of Milan in conjunction with a Rio San Jose channel re-alignment project completed in 2017 pursuant to an Army Corps of Engineers Section 404 permit.

1.3 Reuse Pipeline Survey and Design

The proposed southern pipeline alignment was surveyed in 2015 using GPS equipment at intervals of 50 feet or less, where significant topographic changes were encountered. Pre-construction design drawings were then generated and a hydraulic analysis performed to determine pipeline sizing requirements using a discharge flow rate of 4,500 gpm. Results of the analysis and detailed route maps are presented in Appendix C.

Because the bulk of the pipeline route lies within state highway right-of-ways (ROW), the NM Department of Transportation NMDOT) was consulted prior to conducting any of the baseline studies and surveying the proposed alignment. NMDOT required that new archaeological and biological surveys of the entire ROW be completed in accordance with an Environmental Clearance permit, a copy of which is provided in Appendix D of this report. Note that RHR consulted with both the Bureau of Land Management and the NM State Land Office prior to performing the surveys as recommended by NMDOT. Both agencies deferred to the USFS, MMD and NMED regarding the scope and methodologies for the surveys to be completed.

As noted previously, detailed Class III inventories of cultural resources along the entire pipeline route were completed and a report describing the surveys, which identified a few small sites that can be readily avoided or mitigated, is in process. Results of the biological surveys are described in the reports presented in Appendix A.

2.0 Probable Hydrologic Consequences

Following acquisition of the mineral rights in Sections 17 and 8, RHR determined that it was more feasible to initiate mining activities on Section 17 rather than Section 16 as previously planned by utilizing a partially completed shaft in Section 17. Under this scenario, RHR would complete the Section 17 shaft, begin underground mine development there and progress toward Sections 16 and 10. Utilization of the existing mine shaft in Section 17 will require dewatering of the shaft initially and shifting mine dewatering operations into Section 16 over time. As a result the mine dewatering period will be approximately 18 months longer and require additional points of diversion not considered in the existing groundwater impact model. In order to assess the potential for groundwater impacts greater than previously predicted by modeling, RHR retained INTERA Inc. to update the previously approved groundwater flow model using the same hydrologic parameters as agreed upon by the Roca Honda Groundwater Working Group for the initial modeling effort. The results of the expanded mine dewatering analysis and overview of the model are presented in Appendix E.

Appendix E-1 is a Technical Memorandum that describes how the dewatering impact assessment was performed, based upon the most current iteration of the expanded mine plan for Roca Honda. This includes the assumptions that were used in the model, and the results of the modeling. Appendix E-2 is an overview of the groundwater flow model itself that was presented to the cooperating agencies at an April 2017 meeting. Both documents were previously provided to the cooperating agencies and are included herein for the purpose of completeness and ready reference.

APPENDIX A-1

Biological Survey of Proposed Section 17 Expansion Area

February 2018, Marron and Associates

Biological Survey

Proposed Section 17 Expansion Area
Cibola and McKinley Counties, New Mexico

Prepared for
Roca Honda Resources

February 2018

An NV5 Company

CONTENTS

APPENDIXES

LIST OF ILLUSTRATIONS

FIGURES

TABLES

1. INTRODUCTION AND PROJECT DESCRIPTION

In 2015, Marron and Associates Inc. completed a detailed pedestrian biological survey of approximately 262 acres of land located on private property in portions of southern McKinley County on the San Mateo US Geological Service 7.5' quadrangle maps (Figures 1 and 2). These surveys were designed to: identify and document all species of plants and animals present in the study area; develop a detailed vegetation map of the area, documenting not only the plant communities, but also previously disturbed areas; identify special or unique plant or animal habitats; identify potential or occupied habitats for threatened, endangered, proposed, and candidate species; identify migratory bird nests including raptors; identify potential wetland areas. In addition, Marron completed surveys for golden eagle during the 2015 season and identified potential nesting habitat for peregrine falcon, gray vireo, and western burrowing owl.

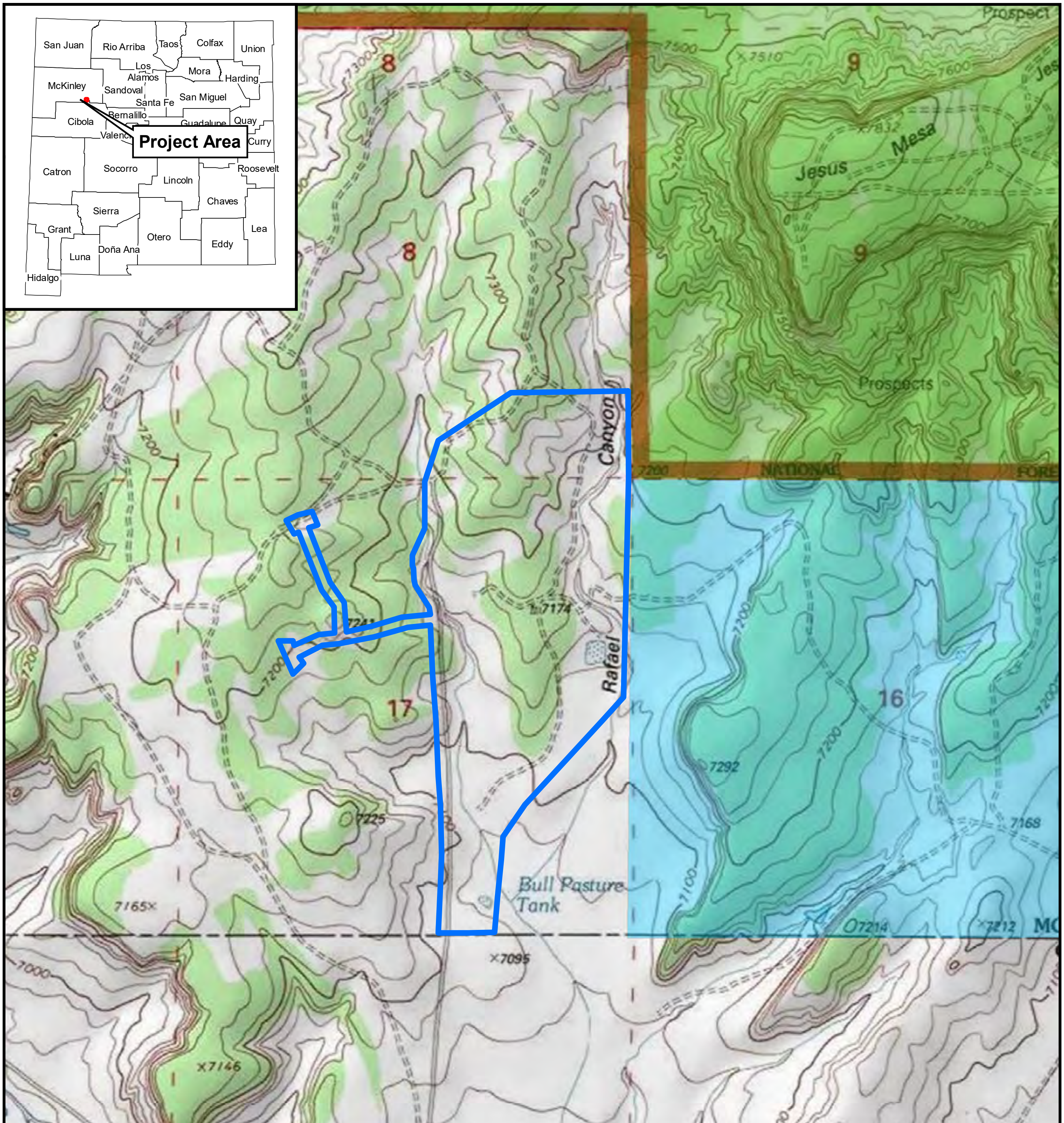
The purpose of this report is to document the existing conditions of biological resources found within the study area. This report provides descriptions of soils and geology, general vegetation and plant communities, wildlife, wetlands, protected species of plants and animals, migratory birds, and birds of prey. This report does not provide effect determinations or mitigation measures for rare, threatened, or endangered species.

1.1 Study Area History

In 2015, Energy Fuels Resources acquired the mineral rights to properties adjacent to the Roca Honda Project that contain known uranium resources and an existing mine shaft. The privately-owned properties, Sections 8 and 17, T13N, R08W, are part of the Lee Ranch. Both of these sections were extensively explored in the 1970s and early 1980s when more than 200 holes were drilled on Section 8 and over 500 holes were drilled on Section 17. The results of that drilling program led Kerr-McGee to sink a concrete-lined shaft to 1,469 feet below ground surface in the early 1980s. This shaft currently flooded to 750 feet below ground surface. No development into the ore body from the shaft was ever completed. Surface facilities were constructed in support of the shaft sinking project, resulting in the disturbance of approximately 22 acres around the mine shaft and a haul road to the shaft site. The disturbed area was never reclaimed and has been used for ranching operations since abandonment of the shaft. Additional wide-spread surface disturbance throughout the section resulted from the extensive exploration drilling program as well as current ranching operations. Due to uneconomical conditions for uranium mining development, the project was discontinued in 1982. At that time, the mine entrance was blocked with a 5-foot thick concrete plug with an access opening. Currently, the access opening is covered with a steel plate. The shaft is used by the landowner as a livestock and domestic water well.

1.2 Proposed Action

Energy Fuels intends to confirm the structural integrity of the shaft and incorporate it into the Roca Honda mine plan. Assuming that it is suitable for re-use with relatively little rehabilitation required, the shaft will be deepened up to an additional 200 feet for a total depth of 1,669 feet (Figures 3a and 3b). The Section 17 shaft will be used primarily to access ore located on Section 17 and on the western half of Section 16. A drift (tunnel) will be driven to connect the Section 17 mine workings to the planned Section 16 shaft. The shaft connection drift is approximately 6,600 feet long and will be used for underground mine ventilation, transport of workers and materials between the shafts, and to access ore zones that occur between the two shafts.



Study Area

Land Ownership

USFS

Private

State

Milan, Grants, Dos Lomas, and San Mateo,NM USGS 7.5' Quadrangles

Private, State and BLM Lands McKinley County, New Mexico

0 0.125 0.25 0.5 Miles

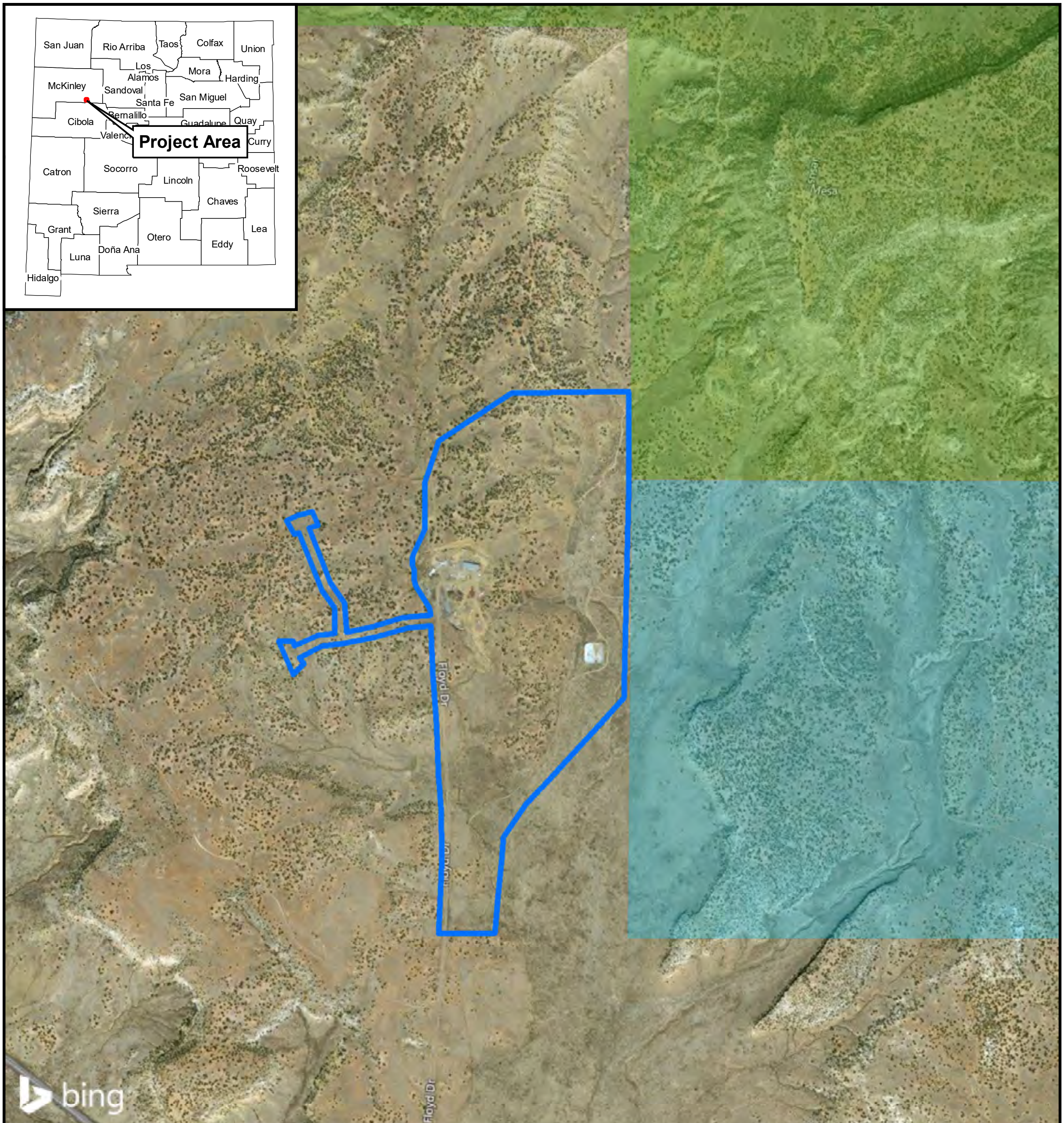
0 0.25 0.5 1 Kilometers

N

1:24,000

Figure 1 Project Location Map

Biological Survey of the Proposed Section 17 Expansion Area, McKinley County, New Mexico



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Milan, Grants, Dos Lomas, and San Mateo,NM USGS 7.5' Quadrangles

Private, State and BLM Lands McKinley County, New Mexico

0 0.125 0.25 0.5 Miles

0 0.25 0.5 1 Kilometers

N

1:24,000

Figure 2
Project Location Map on Aerial Background

Biological Survey of the Proposed Section 17 Expansion Area, McKinley County, New Mexico


Surface Facilities:
Hoist House & Shop
Ranch Hand's House
Section 17 Shaft
21.1 acres
Haul Road
Lined Pond
(1.3 acres)
Section 17
Section 16
Figure 3a
Section 17 Facilities Reference Map
1 inch = 200 feet
N
0
100
200
400 Feet
Section 17 Existing Disturbance

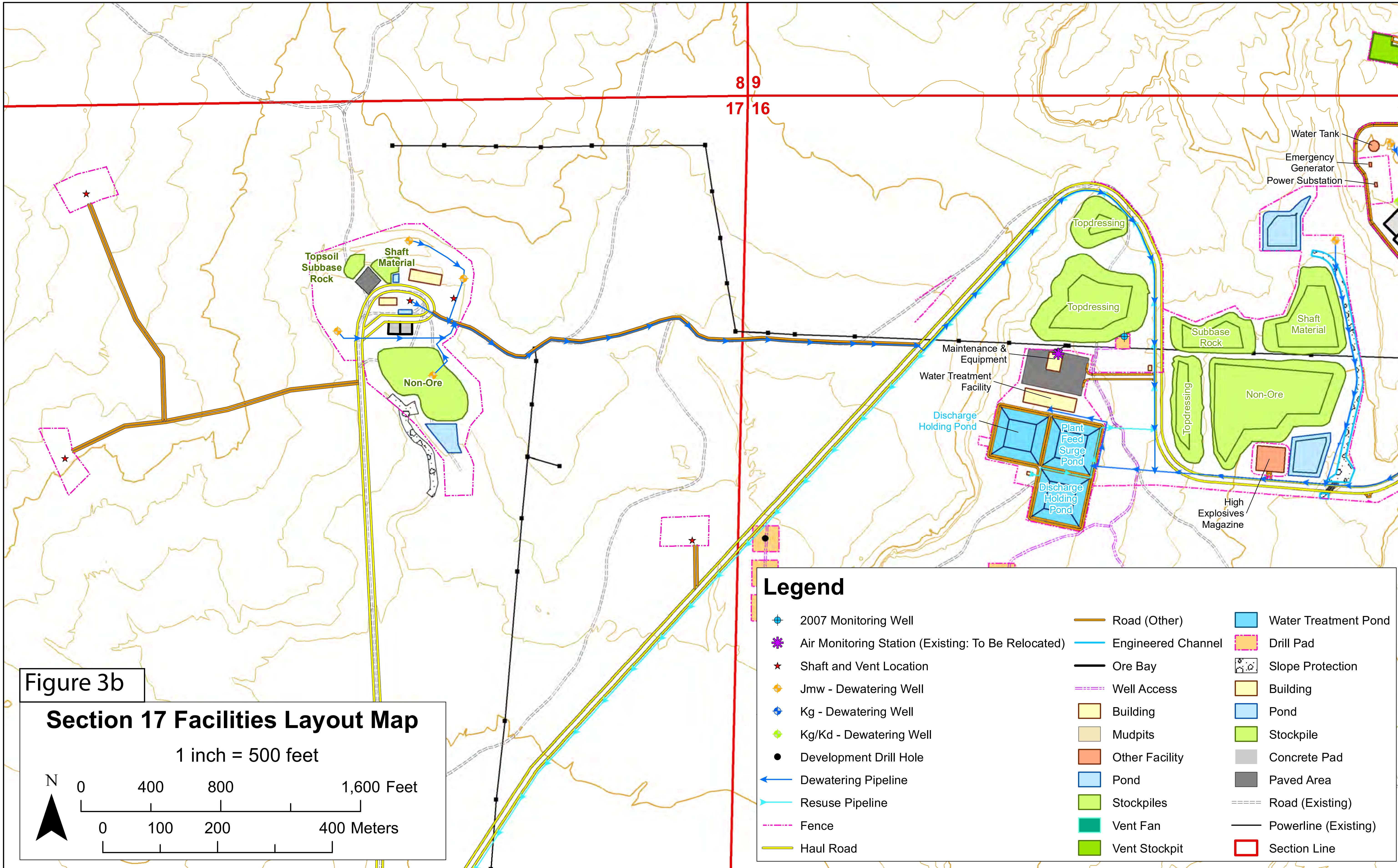


Figure 3b

Section 17 Facilities Layout Map

Ventilation raises needed to supply air and act as exhausts along the shaft connection drift are included in this plan. Rock excavated during underground development and operations will be hoisted up the Section 17 shaft to the surface and placed in temporary stockpiles located primarily on the existing disturbed areas adjacent to the shaft. Stockpiles will be constructed in lifts with 3:1 side slopes, to a maximum height that will not be visible from Highway 605. The non-ore stockpiles on Section 17 have been sized to accommodate the maximum volume of material that will be excavated during underground mine development and initial production areas before reaching steady-state ore production. After reaching steady-state ore production in the Section 17 area, the majority of non-ore material generated underground will stay underground and will be used as backfill. As underground mining progresses, non-ore material stockpiled on surface will be transferred underground and used as backfill. Prior to final reclamation, all excavated material will be returned underground as backfill.

A new headframe will be installed over the existing shaft to hoist material to the surface. There is a topographic barrier between the site and Highway 605, so very little of the headframe will be visible from the highway.

In addition to the non-ore stockpile, new facilities in Section 17 will be limited to a headframe and hoist house, mine office, small maintenance shop, subsoil stockpile(s), ore storage bays, and a stormwater retention pond or ponds. While the layout of facilities within the Section 17 disturbed boundary may change, the size and location of the disturbed area will stay as shown. Additional small disturbances would be necessary to expand the mine footprint, improve access roads to the proposed ventilation raise locations, construct the ventilation raises, and perform confirmation drilling. Each ventilation raise will require a temporary disturbance of approximately 1.5 acres for the drill pad and mudpits associated with the ventilation facilities. Each of five planned confirmation drill pads will be approximately one-half acre in size and will be reclaimed immediately after the drill holes are sealed and plugged. Table 1 details the proposed disturbance associated with adding the Section 17 mine site.

The total new disturbance area is approximately 20.6 acres. During final reclamation, the Section 17 production shaft and ventilation raises will be capped and reclaimed in the same manner as the Section 16 shaft and raises. All other surface facilities will be removed or retained at the direction of the land owner. Any disturbed areas not needed for approved post-mining land use would be reclaimed as described in the existing Mining & Reclamation Plan.

Table 1. Disturbed Areas Within the Proposed Section 17 Expansion Area

AREA	SECTION	ACRES	COMMENT
Sec. 17 Mine Site	17	25.7	Note that 18.6 acres are existing disturbed areas
Drill Pad	17	0.5	Reclaimed following drilling
Haul Road & Vent	17	4.6	2.5 acres are an existing disturbed area
Maintenance Road	17	0.4	
Maintenance Road	17	0.5	
Drill Access Roads	17	0.8	2,900 linear feet of the 12-foot wide road. Note most of these are existing two-track roads
Vent	17	0.0	Sliver of Section 8 Vent area
Road and Vents	17	5.4	
Channel Armoring	17	0.5	
Drill Pad	17	0.5	This area will be drilled and reclaimed before

			mining
Drill Pad	17	0.5	This area will be drilled and reclaimed before mining
Drill Pad	17	0.5	This area will be drilled and reclaimed before mining
Road and Vent	8	1.5	
Road and Pipeline	16	0.3	This is the only new disturbance in Sections 9/10/16
Total Disturbance		41.7	Includes 18.6 acres of existing disturbance
Total New Disturbance Area		20.6	18.6 acres at the mine site and 2.5-acre haul road
Total New Sec. 17 Disturbance		18.8	
Total New Sec. 8 Disturbance		1.5	
Total New Sec. 16 Disturbance		0.3	

The Section 17 disturbance is within a 614-acre drainage basin. The majority of runoff from this basin is already diverted around the western side of the existing shaft site in a well-established drainage feature. An allowance has been made for a new diversion structure that could be constructed above the shaft site to further divert all runoff around the site and stabilize the drainage features adjacent to and below the mine site (if necessary). The disturbed Section 17 surface facilities area would then be the only area draining into the stormwater pond(s).

1.3 Overview of Survey Area

The Lee Ranch study area consists of an irregular polygon aligned on a north/south axis about 6250-feet long and about 2300-feet wide on the north end, tapering to a narrow neck about 900-feet wide on the south end. There is also a narrow-branched corridor of land extending about 1650-feet westward from the overall western boundary of the study area, with a branch that extends northward about 1300 feet (Figures 1 and 2). In total, the study area covers approximately 262 acres. A large ephemeral waterway (Rafael Canyon) extends from the northeast corner southward along the eastern edge of the study area. Remnants of a historic floodplain flank both sides of this drainage providing a flat to gently sloping habitat. The land rises abruptly both east and west of this drainage forming rolling gentle ridges within the northern two-thirds of the study area. The narrow neck within the southern portion of the study area consists of a floodplain from an unnamed tributary of Rafael Canyon extending down the eastern half of the neck, rising to gently sloping uplands west of this unnamed drainage. The dominant vegetation across the study area varies from Desert Grassland, lowland shrub communities, Juniper Savanna, and Coniferous Woodland (Pinyon-Juniper Woodland). The study area occurs between approximately 7090 to 7320 feet in elevation above mean sea level. Most of the study area is accessible via a series of dirt roads that extend from the main north/south road leading to the ranch house.

2.0 METHODS

2.1 General Overview

The project activities began with a review of all existing resource databases, including: the NM Department of Game and Fish (NMDGF) Biota Information System of New Mexico (BISON) database; the US Fish and Wildlife Service (USFWS) Information, Planning and Conservation System (IPaC) database; the USFWS migratory bird list; the NM State Forest Endangered Plant Species list; as well as existing collections and literature concerning the distribution of plants and animals within or near the study area, and prior biological surveys of the area. The data gathered in this review were used to develop a list of rare, threatened, endangered, proposed, candidate, and sensitive species potentially occurring within the study limits. A classification system for vegetation, based on Dick-Peddie’s treatment of New Mexico vegetation (1993), was implemented to characterize vegetation within the study area. Climate data were derived from the National Climatic Data Center and other sources. Soil data were extracted from the Natural Resources Conservation Service’s soil mapper database for McKinley County, New Mexico. Geological data were derived primarily from the New Mexico Geological Society Guidebooks for areas within McKinley County, and the NM Geology database. Aerial imagery used in the analysis of habitats was derived from Google Earth and Environmental Systems Research Institute (ESRI) map layers. Upon review of all data sources, the ground surveys of the study area began.

2.2 Survey Strategy

Field work on the project began in late August 2015 during which a 100 percent cover pedestrian biological survey of the area was completed. From this survey, a detailed list of plant and animal species present in the survey area at the time of the survey was developed. Additionally, the plant communities found within and adjacent to the survey area were mapped and all waterways and potential wetlands were examined and mapped.

The field survey was completed at the end of the nesting season for most birds expected in the area and the beginning of the fall migration. Although the survey documented on any active nests present, it also was directed at identifying any inactive nests that might have been used in the recent past. The presence of fall migration birds contributed to the diverse lists of birds found in the area.

The survey also included a detailed examination of any potential or suitable habitat for protected species of plants or animals. A separate survey for potential raptor nest sites or use areas were completed across the study area and within a half- mile zone around the area. This included a late season golden eagle survey.

2.3 Survey Dates

The ground survey of the study area was completed between August 25 and27, 2015. The raptor and golden eagle survey of the area was completed between August 26 and27, 2015.

2.4 Survey Personnel

The following three team members participated in biological resources field surveys:

Paul Knight
M.S. Biology (Botany, Plant taxonomy, Ecology, Wetlands, and Endangered Species Studies)

Reggie Fletcher
M.S. Biology (Botany, Ecology, and Endangered Species Studies)

Nancy Cox
M.S. Biology (Ornithology, General Zoology, and Endangered Species Studies)

2.5 Regulatory Authority

The Study area occurs on private land. It falls under the regulatory authority of several federal agencies and, via the involvement of the state, several state laws including, but are not limited to, the following:

- Endangered Species Act
- Migratory Bird Treaty Act
- Bald and Golden Eagle Protection Act
- Clean Water Act Sections 404, 401, 402
- Executive Order 11990 (Protection of Wetlands)
- Executive Order 11988 (Floodplain Management)
- New Mexico Wildlife Conservation Act
- New Mexico Endangered Plant Species Act
- New Mexico Noxious Weed Management Act

3.0 EXISTING CONDITIONS

3.1 Geology, Topography, and Climate

The Lee Ranch study area ranges from approximately 7090 feet to 7320 feet in elevation. The lowest elevation occurs at the southern end of the study area within the bottom of an unnamed tributary of San Rafael Canyon. From there the elevation climbs steadily northward up into a series of low rolling ridges near the northern terminus of the study area. The higher ridges in the northern portion of the study area drop steadily downward to the east where the toe slopes of these uplands meet the floodplain of San Rafael Canyon. The channel and floodplain of San Rafael Canyon dominates the eastern edge of the study area. Much higher terrain occurs to the north and east of the study area. The southern edge of San Mateo Mesa spreads across the northern horizon of the study area rising to over 8000 feet in elevation. Immediately east of San Rafael Canyon (just outside the study area) lies Jesus Mesa, which climbs to over 7800 feet in elevation. These mesas and associated cliffs along their edges contribute to wildlife habitat and diversity as well as the plant diversity noted in the study area.

The geology within the study area is a mixture of Cretaceous and Quaternary strata. The lowlands within the drainages are dominated by Quaternary alluvial and aeolian deposits and the lower slopes of the ridges in the southwestern portion of the study area were composed of Saprolite, a decomposed and porous rock derived from chemical weathering of a parent rock, in this case sandstone. The ridgetops throughout the study area are compose of Upper Cretaceous rocks mostly affiliated with Mancos Shale. Within the central and southern portion of the study area, the ridgetops are composed of sandstones of the Crevasse Canyon Formation, in particular the Dilco Coal Member. This interbedded member of the Crevasse Canyon Formation is composed of a mixture of sandstone, siltstone, shale, and occasionally coal bed. The ridgetops along the northern boundary of the study area are composed of the Mulatto Tongue of the Mancos Shale. The Mulatto Tongue is a pale yellowish brown fine-grained silty sandstone. It contains sedimentary deposits from the Quaternary, Mesozoic, Jurassic, and Cretaceous. (Geology Map of New Mexico. 2003; USGS Geologic Quadrangle Map, 1966).

On average, the survey area is arid to semi-arid. Annual precipitation averages about 8.6 inches per year near San Mateo, a village located approximately 3.5 miles southeast of the survey area. Overall evaporation is high, ranging from 40 to 60 inches per year depending upon aspect and location. The winters across the survey area are cool and usually wet, receiving precipitation from frontal storms. However, the highest precipitation level is expected in the summer and early fall when monsoon moisture enters the area from the south. The average annual low temperatures are almost identical (approximately 33° to 34° Fahrenheit between the northern and southern portion of the survey area, but the average highs are about 6° cooler at the northern versus the southern end of the survey area (NM Climate Summaries, 2017).

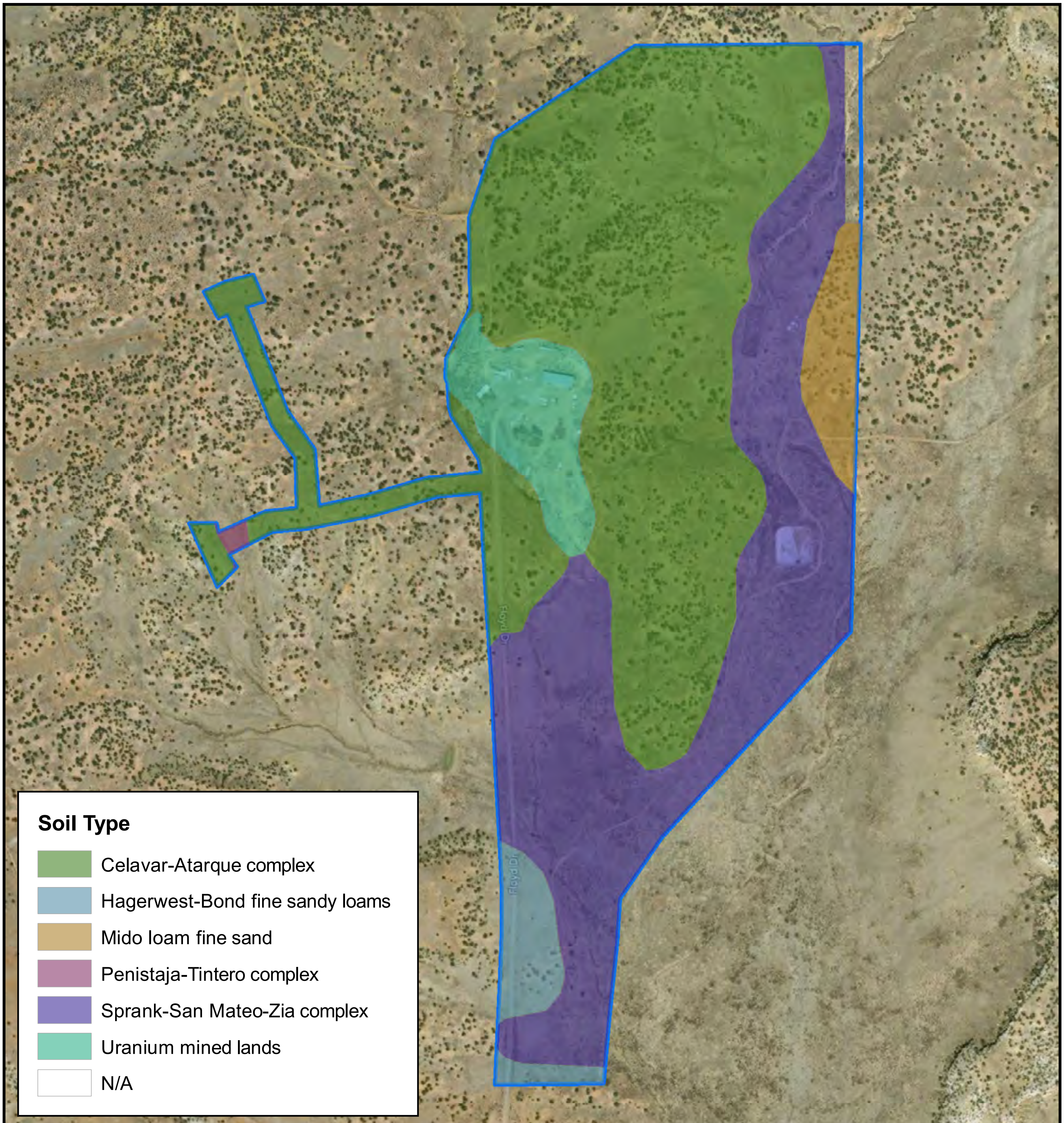
3.2 Soils

The National Resource Conservation Service (NRCS) lists 6 soil types within the study area. A full list of these soil types and their identification numbers appears in Table 1. Figure 4 depicts the location of each soil type in the survey area. The numbers found on each polygon within Figure 4 corresponds to the identification numbers in Table 1.

Table 2. NRCS Soil Types Identified within the Study Area

Soil Type #	Soil Name
205	Penistaja-Tintero complex, 1 to 10 percent slopes
220	Hagerwest-Bond fine sandy loams, 1 to 8 percent slopes
230	Sprank-San Mateo-Zia complex, 0 to 3 percent slopes
265	Uranium mined lands
305	Celavar-Atarque complex, 1 to 8 percent slopes
353	Mido loam fine sand, 1 to 6 percent slopes

The 6 soil types identified by the NRCS in the area vary from fine sand, sandy loams to soils previously disturbed by uranium mining (Table 1). The most abundant soil type within the study area was Celavar-Atarque complex, which consists mostly of sandy clay loams with bedrock as shallow as 31 inches. The next most abundant was Sprank-San Mateo-Zia complex, which is principally a clay soil type. In aggregate, the Celavar-Atarque complex and the Sprank-San Mateo-Zia complex constitute 89.7 percent of the soils within the study area. Aside from being more of a clay soil the Sprank-San Mateo-Zia complex differs from the Celavar-Atarque Complex in that it generally has deeper bedrock below it. In the typical profile for this soil, the bedrock is below 65 inches from the surface. The Sprank-San Mateo-Zia Complex soils dominate the bottom of the Rafael Canyon Drainage, which runs the entire length of the study area from the northeast corner southward to the southern boundary. There was no indication of rocks or bedrock along the floodplain of Rafael Canyon in the Sprank-San Mateo-Zia soil complex. The remaining soils in the study area, which constitute in aggregate about 10 percent of the study area, are mostly fine sands or sandy loams.



MARRON and ASSOCIATES

Figure 4
NRCS Soil Map on Aerial Background

Study Area

Milan, Grants, Dos Lomas, and San Mateo,NM USGS 7.5' Quadrangles

Private, State and BLM Lands McKinley County, New Mexico

0 0.075 0.15 0.3 Miles

0 0.125 0.25 0.5 Kilometers

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3.3 Vegetation

3.3.1 General Overview

A total of 153 species representing 43 families of common vascular plants were identified within the survey area. For such a small study area, the overall plant diversity was high. If the spring flora were added to the species list, we anticipate that more than 200 vascular plant species could be present in the study area. A full list of these species observed at the site during the late August survey is presented in Appendix A. There were no rare or protected plant species found within the survey area.

The study area supported six major natural vegetation types: lower Coniferous Woodland (pinyon-Juniper Woodland), Juniper Savanna, Great Basin Desert Scrub, Plains Mesa Grassland, Arroyo Riparian, and a transitional community where diffuse pinyon-juniper woodland is interspersed with extensive blue grama grassland. We termed this community Pinyon/Juniper Savanna (Dick-Peddie 1993). In addition to these native plant communities, there is a large patch of land in the center of the study area that has been heavily disturbed by past mining activities. Table 3 presents the approximate acreage of each of these communities within the study area, and Figure 5 is a map showing their distribution in the area. Essentially, all upland habitats in excess of 7200 feet in elevation are dominated either by Coniferous Woodland, Pinyon/Juniper Savanna, or Juniper Savanna. The shrubland habitats are confined to the flat floodplain lowlands along San Rafael Canyon, as is the small portion Arroyo Riparian community that occurs within the study area (Table 2).

Table 3.
Abundance and Coverage of Vegetation Types within the Study Area

Vegetation Type	Total Acres in the Study Area	Percent of Total Acres
Coniferous Woodland	17.13	6.53%
Coniferous Woodland/Savanna	74.77	28.53%
Juniper Savanna	37.34	14.24%
Great Basin Desert Scrub	76.26	29.09%
Plains/Mesa Grassland	19.50	7.44%
Arroyo Riparian	4.41	1.68%
Disturbed/Disclimax	32.64	12.45%
	262.07 Acres	

3.3.2 Vegetation Communities

Coniferous Woodland (Pinyon-Juniper Woodland)

Overall the distribution of these communities follows elevation and topography. Lower Coniferous Woodland dominates the upper elevations of the study area. The Coniferous Woodland (Pinyon-juniper Woodland) areas are restricted to the tops of the ridges above 7000 feet in elevation in the northern quarter of the study area. This community is found mostly in Section 8, but some extending southward into Section 17. Within the survey area, lower Coniferous Woodland was dominated by scattered pinyon (*Pinus edulis*) intermixed with denser stands of one-seed juniper (*Juniperus monosperma*) with a scattered ground cover of blue grama (*Bouteloua gracilis*) intermixed with false buffalo grass (*Munroa squarrosa*) and widely scattered ring muhly (*Muhlenbergia torreyi*), four-wing saltbush (*Atriplex canescens*), and four-o'-clock (*Mirabilis multiflora*). This community type covers approximately 17.13 acres, or about 6.53 percent of the study area (Figure 5).

Coniferous Woodland/Savanna

The Pinyon/Juniper Savanna community occurs adjacent to the polygons of Coniferous woodland in Sections 8 and 17, but was also found within the 2 lobes of the study area that extend out westward from the main study area in the northwest quarter of Section 17. This community varies from typical Coniferous Woodland in that it has much lower density of pinyon and juniper trees and a much higher percentage of grass ground cover (usually blue grama) often intermixed with galleta (*Pleuraphis jamesii*). The grass cover occurs as large pockets within the woodland community and does not take on the full aspect of savanna. If it were not for the abundance of pinyon trees present, this community could be considered Juniper Savanna. It is in effect a transition zone between the woodland and savanna communities and tends to occur on flats between the ridgetops and the upper slopes of the ridges. This community type covers approximately 74.77 acres or approximately 28.53 percent of the study area. In aggregate, the typical Coniferous Woodland combined with this community covers approximately 91.9 acres or about 35.06 percent of the study area.

Juniper Savanna

Savanna vegetation covers large portions of New Mexico at the transition zone between woodlands and grasslands and scrub zones. A thinning tree density and an overall increase in grasses characterize this zone. If the topographic conditions are suitable, this boundary zone can be quite large and support extensive stands of savanna. Vegetation is usually called savanna if there are fewer than 320 juniper trees per hectare (Dick-Peddie, 1993); however, in most cases the tree density is far fewer than 50 per hectare. Juniper Savanna is a widespread and common community in the study area, which is scattered along the transition zone between the woodland and grassland or shrub communities. It flanks most of the western edge of San Rafael Canyon and occurs along the western edge of the drainage that eventually discharges into San Rafael Canyon in the southern half of the study area. It is dominated by one-seed juniper intermixed with stands of grasses such as blue grama and galleta (*Pleuraphis jamesii*) with varying amounts of four-wing saltbush and rubber rabbitbrush (*Ericameria nauseosa*) present. The overall density of trees within this community varies widely from less than a dozen to more than a hundred per acre. This community type covers approximately 37.34 acres or approximately 14.24 percent of the study area.

Great Basin Desert Scrub

Great Basin Desert Shrub and Four-wing Saltbush communities cover most of the floodplain of San Rafael Canyon throughout the entire eastern edge of the study area. It also occurs along much smaller north/south trending drainage along the western portion of the study area. This small drainage eventually discharges into San Rafael Canyon. The dominant vegetation consists of four-wing-saltbush, Russian thistle (*Salsola tragus*), snakeweed (*Gutterezia sarothrae*), scattered rubber rabbitbrush, with patches of summer cypress (*Bassia scoparia*), false buffalo grass, and ring muhly. In some areas, there are even isolated pockets of blue grama as well as occasional pale wolfberry (*Lycium pallidum*). This community type is generally on heavier clay and clay loam soils. This community type covers approximately 76.26 acres or approximately 29.09 percent of the study area. Singularly, it is the largest vegetation community in the study area.

Plains Mesa Grassland

The Plains Mesa Grassland Community is the second smallest community in the study area. It is confined to a few areas around the periphery of the study area where the soil, topography and elevation are suitable to support grassland conditions. These grasslands are dominated by blue grama usually intermixed with rabbitbrush (*Ericameria nauseosa*), winterfat (*Krascheninnikovia lanata*), and snakeweed (Gutierrezia sarothrae). These pockets of grassland are generally found at the lower elevations of the study area, and usually within sandy soils. This community type covers approximately 19.50 acres or approximately 7.44 percent of the study area.

Arroyo Riparian

Within the study area the Arroyo Riparian community is best developed within the bottom of incised portions of San Rafael Canyon. San Rafael Canyon flows from north to south along the eastern edge of the study area. The incised channel of the drainage is most clearly defined in the northeastern corner of the study area, but flowing southward the channel begins to widen. At Universal Transverse Mercator (UTM) Zone 13 E254581/N3916483 (North American Datum [NAD] 83 approximately), the incised channel disappears, and the water begins to sheet flow across an area about 250-feet wide for a distance of nearly 900 feet. This broad sheet flow area disappears at approximately UTM Zone 13 E254645/N3916229 (NAD 83), where the flows of San Rafael Canyon abruptly spill back into a well-defined and deeply incised channel.

The other primary location of Arroyo Riparian vegetation is a smaller tributary canyon to San Rafael Canyon that occurs along the southwestern edge of the study area. The Arroyo Riparian community was dominated by rubber rabbitbrush, four-wing saltbush, western wheatgrass (*Agropyron cristatum*) and scattered snakeweed and Russian thistle. In aggregate, the various segments of Arroyo Riparian vegetation cover approximately 4.41 acres or approximately 1.68 percent of the study area. None of the habitat within the Arroyo Riparian zones met wetland criteria. However, there was an area near a well where extensive wetlands have developed. This area will be discussed in the wetland section of this report.

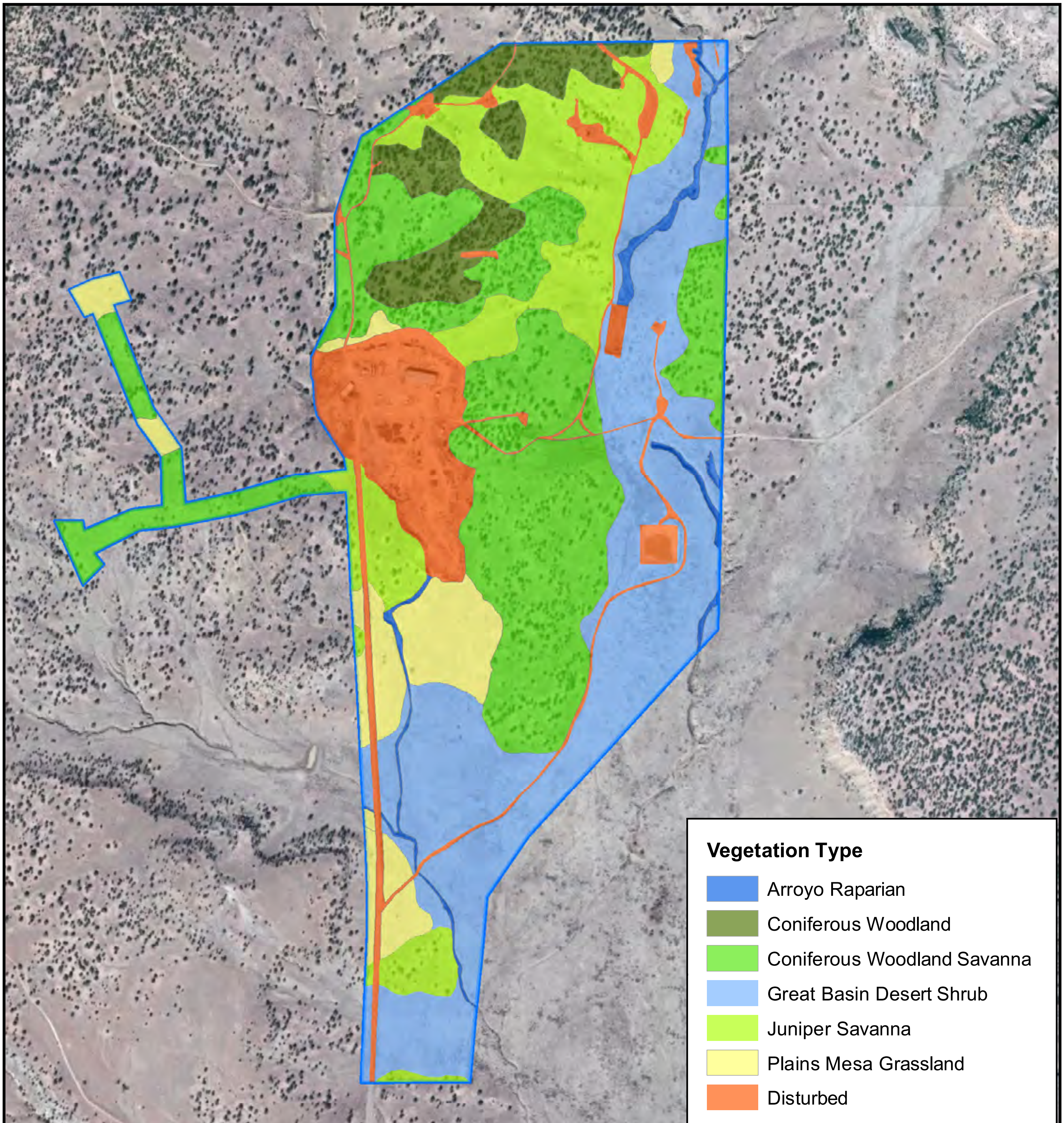

Figure 5
Vegetation Map of Study Area

Study Area

Milan, Grants, Dos Lomas, and San Mateo,NM USGS 7.5' Quadrangles

Private, State and BLM Lands McKinley County, New Mexico

0 0.1 0.2 0.4 Miles

0 0.125 0.25 0.5 Kilometers

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Disturbed Areas

In addition to these natural plant communities, there are disturbed areas where the climax native vegetation has been removed creating habitat for principally invasive or successional species. The main portion of these disturbed area is located in the west-central portion of the study area and consists of building, storage areas for piping and other construction materials, and a general work area. However, there are a variety of other disturbed areas that include dirt roadways, corrals, stock tanks, and ancillary work or storage areas spread across the property. In aggregate, these disturbed areas cover approximately 32.64 acres or approximately 12.45percent of the study area. These disturbed areas are mostly on flat, lower-elevation habitats where the dominant community is shrubland, grassland, or savanna. The vegetation within these areas varies dependent upon the abundance of surface water. In general, these areas are vegetated by stands of Russian thistle, summer cypress, scattered patches of ring muhly, tall rubber rabbitbrush, and four-wing saltbush. Moving outward from the edges of the disturbed zones, the vegetation begins to transition into native grasses, shrubs, and herbaceous species.

Summary of Vegetation

There are 6 vegetation types composed of native species, as well as a disclimax community composed of a mixture of annual exotic weeds intermixed with native species. Aside from San Rafael Canyon where the communities are more continuous along the waterway, the upland areas support a patchwork of pocket communities that vary from woodland, Savanna, and grasslands. The woodland communities are confined to the higher ridgetops along the northern boundary of the study area. The savanna communities occur on lower slopes of the ridgetops, and grasslands are intermixed on the tops of ridges, on benches, and across the non-riparian portions of the lowlands. We attribute the intermixing and diversity of community types to the topography of the area where the ridges, draws, and canyons produce variable aspects. This topographic variability also produces many microhabitats, which account for the relative high number of native plant species that were documented in the study area.

3.3.3 Noxious Weeds

Five (5) species of NM State noxious weeds were encountered within the survey area. These were the 'Class A' Scotch thistle (*Onopordum acanthium),* and the Class C tree-of-heaven (*Ailanthus atlissima*), Siberian elm (*Ulmus pumila*), salt cedar (*Tamarix* sp.) and Russian olive (*Elaeagnus angustifolia)*. Generally, treatment is not required for the Class C weeds. The Siberian elm, salt cedar, and Russian olive are not abundant, and do not occur within areas that threaten surface water or water tables. The tree-of-heaven was identified at one location within the study area at UTM Zone 13 E254168/N3915419 NAD 83. The trees are clustered at the location where one ranch road crosses the tributary drainage to San Rafael Arroyo within the southwest corner of the study area. They would be easy to remove if they come into the activity zone of the potential project. The Scotch thistle is clustered within a manmade wetland area where the water from a well spills onto the ground. This site is located approximately 1000-feet east of the ranch building in the center of the study area. Specifically, the site is located at UTM Zone 13 E254388/N3916202 NAD 83 and covers approximately 1652 square feet in area (Figure 6). The Scotch thistle is tightly contained in an area adjacent to an existing road and could be easily removed, if necessary. General, Class A and B noxious weeds require removal or treatment if the project activities overlap with their locations.

3.4 Wildlife

3.4.1 General Overview

A total of 62 vertebrate animals were encountered during the biological survey, including 43 species of birds, 13 species of mammals, 4 species of reptiles and 2 amphibian species (Appendix B). There was no suitable habitat for fish in the study area. Surveys were conducted in late summer and most species of migratory birds were still present contributing to the high diversity of observed bird species. This combined with the variation in habitats contributed to present a relatively high diversity of vertebrate species considering there is no intermittent or perennial riparian component present.

3.4.2 Birds

The most abundant birds observed during the survey were Cassin's kingbird (*Tyrannus vociferans*), Say's phoebe (*Sayornis saya*), vesper sparrow *(Pooecetes gramineus)*, chipping sparrow (*Spizella passerina*), scrub jay (*Aphelocoma californica*), American robin (*Turdus migratorius*), Juniper titmouse (*Baeolophus ridgwayi*), and larger birds such as the American crow *(Corvus brachyrhynchos)*, common raven *(Corvus corax), and* turkey vulture (*Cathartes aura*). There were many other small birds within their microhabitats but not necessarily across the entire study area.

3.4.3 Birds of Prey

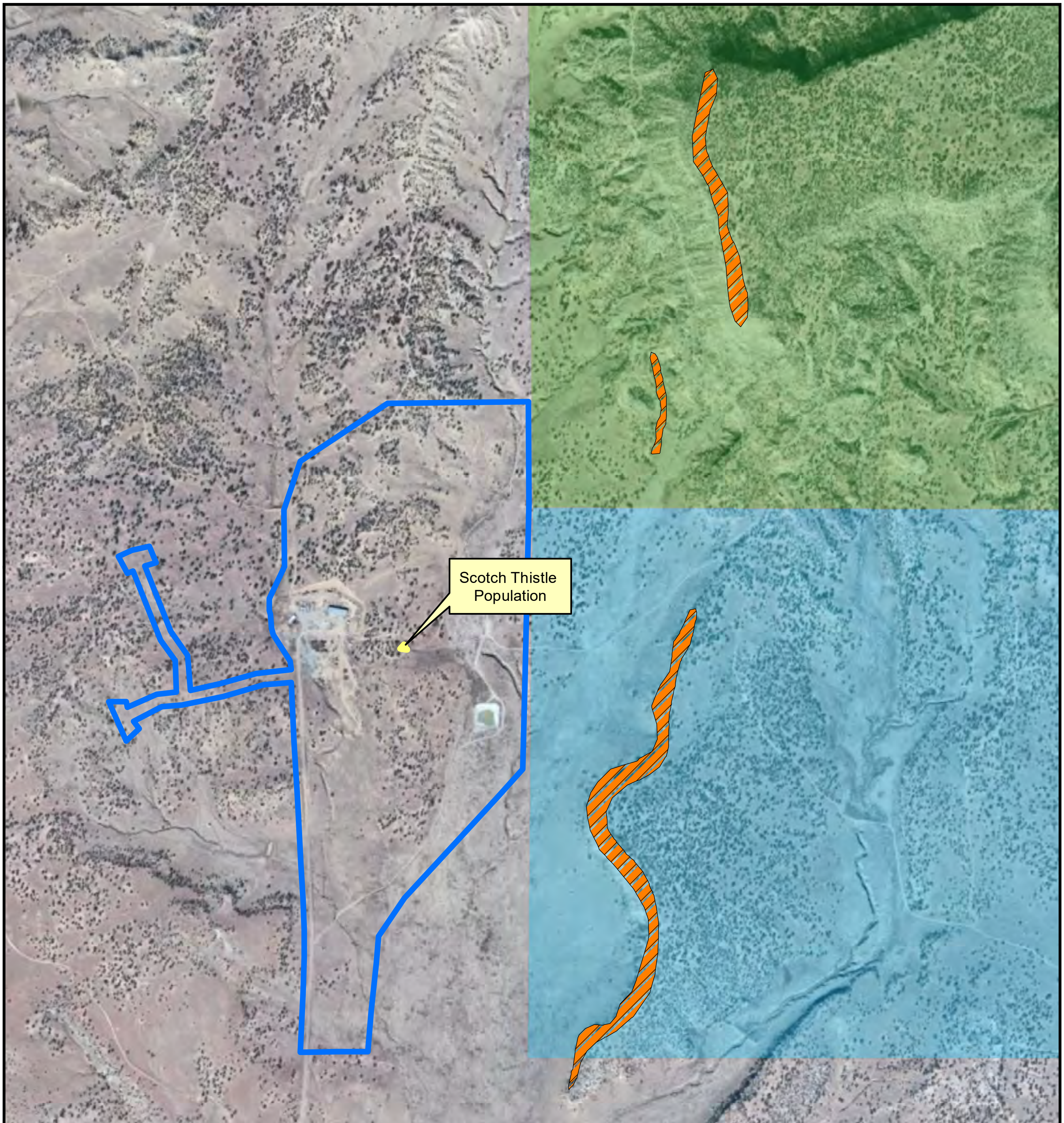
Four (4) species of raptors were observed from locations within the survey area. These included golden eagle (*Aquila chrysaetos*), red-tailed hawk *(Buteo jamaicensis)*, sharp-shinned hawk (*Accipiter striatus*), and American kestrel *(Falco sparverius).* Red-tailed hawks were observed at multiple locations across the study area. All the observations were flyovers but there were no indications of red-tailed hawk nests or roosts within the study area.

A solitary sharp-shinned hawk was observed flying over the woodland habitat near the northern boundary of the study area. All trees within that area were examined and there were no indications of raptor nests.

American kestrels were observed multiple times flying over the southern portion of the study area within the more open grassy and shrubby areas. These birds were also observed flying over the cliff faces located east of the southern third of the study area, but no nests were present.

At least 2 different golden eagles were observed flying over the southern portion of the study area and 1 was observed perching on top of the large cliffs located approximately 0.15-miles east of the eastern boundary of the study area (Figure 6). These cliffs were examined with the use of a spotting scope, and there were no potential eagle nests evident, but the surveys were completed late enough in the summer that golden eagle chicks would have fledged and left the nest. However, these cliffs are suitable nesting habitat for golden eagle, and they could be used for nesting any time in the future.

Although peregrine falcons were not observed during the survey, they were noted along portions of NM 605 only a few miles southeast of the study area. The cliff faces where the golden eagles were observed are also suitable habitat for falcons, and if future activity is anticipated in the study area, then these cliffs should be reevaluated for use by birds of prey.



Study Area
Weed Population
Potential Raptor Nesting Areas

Land Ownership

USFS
Private
State

Milan, Grants, Dos Lomas, and San Mateo,NM USGS 7.5' Quadrangles

Private, State and BLM Lands McKinley County, New Mexico

0 0.125 0.25 0.5 Miles

0 0.25 0.5 1 Kilometers

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Figure 6 Location of Noxious Weeds and Birds of Prey Potential Nesting Areas

Biological Survey of the Proposed Section 17 Expansion Area, McKinley County, New Mexico

3.4.4 Migratory Bird Nests

Suitable habitat for migratory birds occurs throughout the study area. The woodland habitats within the northern half of the study area provide excellent habitat for a variety of small and medium birds and several of the birds of prey. Burrows within the side walls of San Rafael Canyon (particularly in the northern half of the study area) provide nesting habitat for western burrowing owl. The shrubby areas in the central and southern portions of the study area provide nesting habitat for small birds (sparrows, finches, and loggerhead shrike). Finally, the cliff faces that extend in a north-south line east of the study area provide nesting habitat for a variety of birds of prey in particular, golden eagle, peregrine falcon, and buteos such as red-tailed hawk. These cliffs also provide nesting habitat for corvids such as crows and ravens, and colonial nesting species such as cliff swallow and barn swallows. Although suitable nesting habitat occurred throughout the study area, a detailed inspection of all , these areas failed to uncover a single nest within the study limits. However, current absence of nests is no indication of potential future presence. Migratory bird nests could turn up in every habitat in the study area, and for future construction, the proposed areas of disturbance should be cleared and grubbed outside the nesting season, or a migratory bird nest survey should be completed prior to construction.

3.4.5 Mammals

Tracks and scat of large mammals such as mule deer (*Odocoileus hemionus*), and elk (*Cervus elaphus*) were widespread particularly in the northern half study area. However, most elk tracks and droppings were old and appeared to be from the last season. Mule deer appear to be year-round residents but elk may move into the area in heavier concentrations during the winter months and move out in the growing season. Coyote tracks (*Canis latrans*) and scat were also widespread and abundant throughout the study area.

Smaller mammals found in the study area included: white-throated woodrat (*Neotoma albigula*), which was confined to woody areas in the northern third of the study area; Botta's pocket gopher (*Thomomys bottae*), which occurred in great abundance in slightly disturbed areas in the central portion of the study area; and both Ord's kangaroo rat (*Dipodomys ordii*) and banner-tailed kangaroo rat (*Dipodomys spectabilis*). Ord's kangaroo rat burrows were widespread at lower elevations in open grassy areas. Banner-tailed kangaroo rat mounds were uncommon and widely scattered in open grassy areas in the southern half of the study area. Also uncommon were rock squirrel (*Spermophilus variegatus*) and white-tailed antelope squirrel (*Ammospermophilus leucurus*). Desert cottontail rabbits (*Sylvilagus auduboni*) were uncommon but widespread, and black-tailed jackrabbits (*Lepus californicus*) were only noted in the southern half of the study area. There were no indications of bats within the study area but it is possible that there could be scattered use of the trees by some bats, and the cracks and fissures in the cliff faces east of the study area provide potential roosting habitat for bats.

3.4.6 Reptiles and Amphibians

Four (4) species of reptiles and 2 amphibian species were found within the study area. The reptiles observed were all lizards. Although there are undoubtedly several species of snakes in the area, none were present during the surveys. The most common lizards in the area were the southwestern lizard (*Sceloporus cowlesi*), which was abundant in the more wooded locations in the northern portion of the study area. The Plateau striped whiptail (*Aspidoscelis velox*) was abundant in the open grassy and shrubby area. An additional whiptail lizard was noted near the southern end of the study area, but it proved difficult to get close enough to a specimen for species-level identification. Less common was the short-horned lizard. A solitary specimen of this species was noted in the open woodland habitat near the northern terminus of the study area. There were no frogs present, but Woodhouse's toad (*Anaxyrus woodhousii*) was observed in shrubby lowlands in the northeast corner of the study area, and a solitary barred tiger salamander was found in a manmade wetland created by water leaking from a pump located just east of the ranch headquarters near the center of the study area.

3.5 Wetlands and Waterways

3.5.1 Waterways

Two (2) ephemeral waterways were examined within the survey area (Figure 7). The larger of the 2 is called San Rafael Canyon, and it drains from highlands north of the study area southward along the eastern edge of the study area. The upper portions of this drainage are deeply cut into the surrounding landscape leaving vertical banks that are sometimes 10- to 15-feet high. Further down the drainage towards the middle of the study area. its flows are hardly channelized, rather they appear to sheet flow over a large area eventually recombining to form a more defined channel near the southern end of the study area.

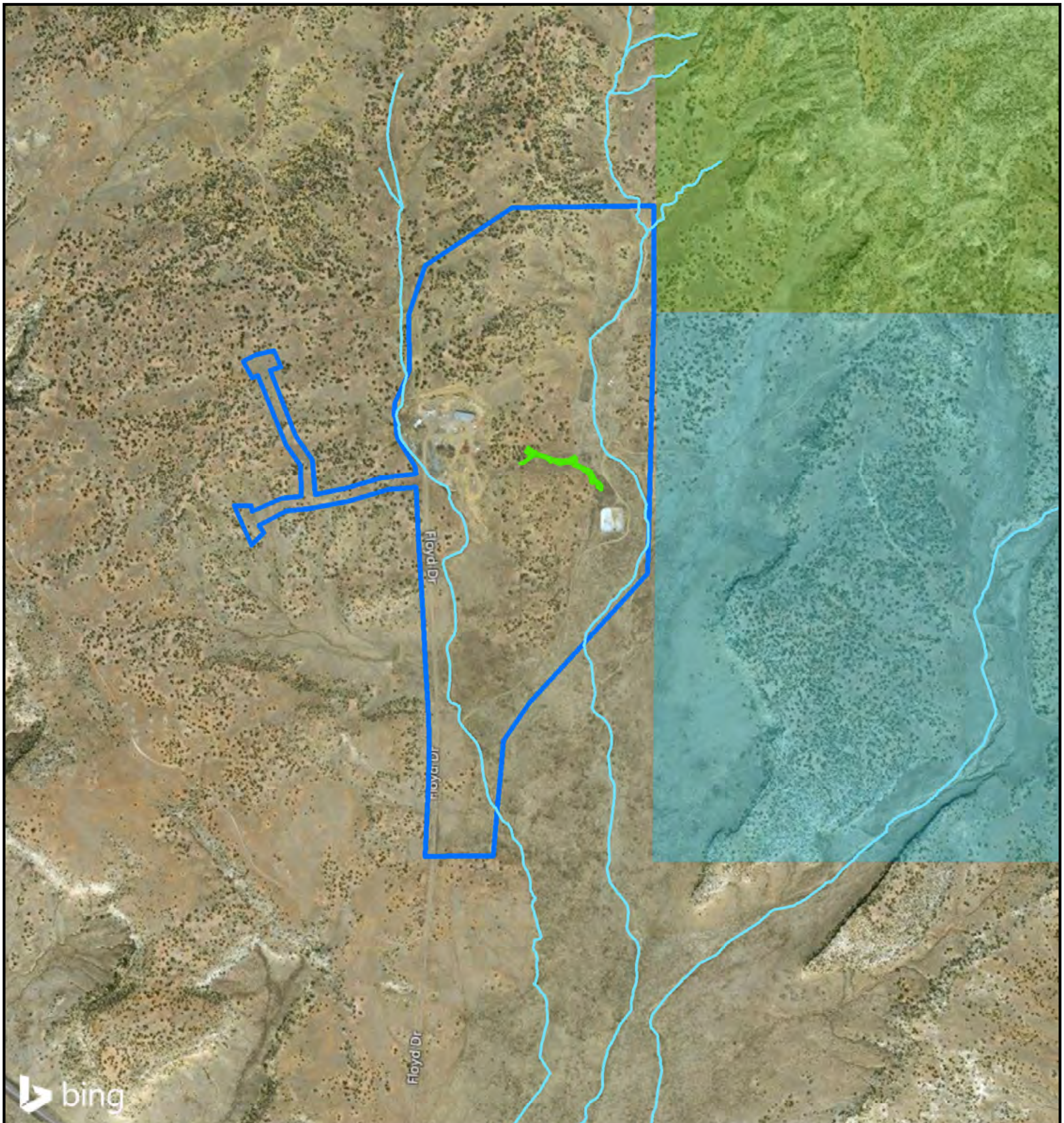
The second drainage in the study area is a tributary of San Rafael Canyon. It also drains from highlands located northwest of the study and flows southward through the western side of the study area combining with San Rafael Canyon at about 1.2 miles south of the northernmost reach of this drainage. This tributary drainage is generally shallow, with sloping banks, and in some locations, it is almost indistinct. The junction of this tributary drainage and San Rafael Canyon occurs in the southern part of the study area. The combined flows of these 2 waterways continue to flow southward, but a review of aerial photograph shows that the channel of these combined drainages dissipates, and the bed and bank disappear before reaching NM 605. The topographic map for this area also shows that the combined drainages of San Rafael Canyon and its tributary disappear south of the study area not reaching San Mateo Creek. To complicate matters, there is an additional unnamed drainage (located outside the study area) that sweeps down from the northeast, curves southwest, and approaches San Rafael Canyon south of the study area. However, there is no indication on aerial photography that these 2 drainages connect. This unnamed drainage does continue flowing southward via a culvert that passes under NM 605 and ultimately discharging into San Mateo Creek. From a biological point of view, the connectivity of the drainages in the study area to San Mateo Creek is not of great importance. However, from the standpoint of the US Army Corps of Engineers (and potential jurisdiction status of San Rafael Canyon), it may be important to ground verify whether the San Rafael Canyon drainage dissipates before reaching San Mateo Creek, or somehow discharges flow into the unnamed drainage area that ultimately does flow into San Mateo Creek.

3.5.2 Wetlands

The 2 natural waterways in the study area are both ephemeral. There are indications that after large flow events water may temporarily pool in low spots in the bottom of San Rafael Canyon, but none of these areas had water present long enough to develop wetland vegetation or soil characteristics. Long-term leaking from a pump and associated tank has led to the development of a palustrine wetland on top of a hill in the east-central portion of the study area east of the ranch headquarters located at UTM Zone 13 E254388/N3916202 NAD 83 (Figure 7), approximately. From the water source on top of the hill, this wetland extends eastward flowing down the slope for over 800 feet and covering an area of approximately 0.5 acres. Near its source at the top of the hill, shallow standing water is present dominated by a mixture of FACW (Facultative Wetland) and some OBL (Obligate) species.

The species composition changes along the length of this wetland. Near the top the dominant vegetation consists of herbaceous wetland indicator species such as annual rabbitfoot grass (*Polypogon monspeliensis*) OBL, spikerush (*Eleocharis sp*.) OBL, Baltic rush (*Juncus balticus*) FACW, meadow barley (*Hordeum brachyantherum*) FACW, foxtail barley (*Hordeum jubatum*)

Facultative (FAC), common three-square (*Schoenoplectus pungens*) OBL, scratchgrass (*Muhlenbergia asperifolia*) FACW, alkali buttercup (*Ranunculus cymbalaria*) FACW, and some small scattered pockets of cattail (*Typha latifolia*) OBL. Further down the slope as the wetland begins to dry, species such as scratchgrass and Baltic rush intermixed with barnyard grass (*Echinochloa crus-galii*) FACW, cocklebur (*Xanthium strumarium*) FAC, knotweed (*Polygonum aviculare*) FAC, and sweet clover (*Melilotus officinalis*) FACU are more common. Although this is a well-developed wetland, its hydrological source is from pumped groundwater, and it is not affiliated with any waterway. Consequently, it likely will not meet the qualifications of a jurisdictional wetland with the US Army Corps of Engineers (USACE).



MARRON and ASSOCIATES

Figure 7
Wetlands and Waterways

Study Area
Wetland
Roca Honda Drainages

Land Ownership

USFS
Private
State

Milan, Grants, Dos Lomas, and San Mateo,NM
USGS 7.5' Quadrangles

Private, State and BLM Lands
McKinley County, New Mexico

0 0.1 0.2 0.4 Miles

0 0.2 0.4 0.8 Kilometers

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Biological Survey of the Proposed Section 17 Expansion Area, McKinley County, New Mexico

4 THREATENED, ENDANGERED, and PROTECTED SPECIES

The study area occurs on private lands, but it falls under the regulatory authority of several agencies and laws that protect rare, threatened, and endangered species. These include the UUSFWS; the New Mexico Department of Game and Fish; and New Mexico State Forestry. Fifteen (15) species with protection status in these agencies are known to occur in McKinley County (Table 4). The following is a discussion of each, and the species on their lists that could occur in the survey area.

Table 4. Plant and Animal Species with Agency Status that Occur within McKinley County

Plants	
Pecos sunflower (*Helianthus paradoxus*)	USFWS, NMSF
Goodding's onion (*Allium gooddingii*)	NMSF
Parish's alkali grass(*Pucinellia parishii*)	NMSF
Zuni fleabane (*Erigeron rhizomatus*)	USFWS, NMSF
Birds	
Bald eagle (*Haliaeetus leucocephalus*)	NMDGF, USFWS (EPA)
Golden eagle (*Aquila chrysaetos)*	USFWS (EPA)
Yellow-billed cuckoo (*Coccyzus americanus*)	USFWS
Peregrine falcon (*Falco peregrinus anatum and tundrius*)	NMDGF
Southwestern willow flycatcher (*Empidonax traillii extimus*)	USFWS, NMDGF
Costa's hummingbird (*Calypte costae*)	NMDGF
Least tern (*Sternula antillarum)*	NMDGF
Gray vireo (*Vireo vicinior*)	NMDGF
Mexican spotted owl (*Strix occidentalis lucida*)	USFWS
Mammals	
Spotted bat (*Euderma maculatum*)	NMDGF
Fish	
Zuni bluehead sucker (*Catostomus discobolus yarrowi*)	NMDGF, USFWS

Key EPA-Eagle Protection Act, **NMSF**-NM State Forestry- **NMDGF**-NM Department of Game and Fish, **USFWS** –US Fish and Wildlife Service

4.1 US Fish and Wildlife Service (Endangered Species Act, Migratory Bird Treaty Act and Eagle Protection Act)

The Endangered Species Act not only provides protection for individual species locations, but in many cases also protects designated critical habitat. Consultation with the USFWS IPaC identified 5 species with federal or threatened or endangered status that should be considered in McKinley County. These are the Mexican spotted owl, southwestern willow flycatcher, yellow-billed cuckoo, Pecos sunflower, Zuni fleabane and Zuni bluehead sucker.

There was no suitable forest habitat for the spotted owl, nor was there sufficiently developed riparian habitat in the survey area for the yellow-billed cuckoo or southwestern willow flycatcher. Zuni fleabane occurs on Mesozoic Jurassic and Cenozoic Baca Formation strata west and southwest of the Grants/Milan area, but there were no suitable geological substrates for this species in the survey area. Pecos sunflower is known to occur along the Rio San Jose drainage south and southeast of the study area, but there were no natural wetlands or mesic, or riparian habitats suitable for the Pecos Sunflower in the study area.

The only species with designated critical habitat near the study area is the Mexican spotted owl. Spotted owl is known to occur on the upper slopes of Mount Taylor east of the survey area. However, these Protected Activity Center (PAC) locations and the associated critical habitat are far from the survey area and would be unaffected by the proposed study activities. The Pecos sunflower does not have any designated critical habitat, but its known locations near Grants, but again these are far from the study area and would be unaffected by proposed study activities.

The Bald and Golden Eagle Protection Act provides protections against take or harm to bald and golden eagles and their nesting locations. Although bald eagles are not likely to reside in the survey area, golden eagles are known to occur in the southern half of the study area. Golden eagles were previously discussed under the raptor and migratory bird sections of this report.

4.2 NM Department of Game and Fish (NM Wildlife Conservation Act)

The NMDGF BISON database containing information on the habitat requirements and general locations of state-threatened and -endangered species. The BISON database identified 8 species with state-threatened or-endangered species status for McKinley County, which were: Zuni bluehead sucker, bald eagle, peregrine falcon, Arctic peregrine falcon, southwestern willow flycatcher, least tern, gray vireo, and spotted bat (Table 5).

There are no waterways in the study area, and the Zuni bluehead sucker has no suitable habitat near the study area. The southwestern willow flycatcher has already been discussed and has no suitable riparian habitat in the survey area. Bald eagles could certainly fly over the survey area, but there is no suitable roosting or nesting habitat for them within or adjacent to the survey area. Costa's hummingbird could occur in the more mesic canyons of Mount Taylor east of the study area, but there was no suitable habitat in the study area. Least tern is extremely rare in the state records, and past sightings normally occurred along the larger river systems. This species can also use playa habitats, and there are some playa habitats about 10 miles southwest of the study area, but there is no suitable habitat for this species within or near the study area.

Peregrine falcon including the arctic subspecies could potentially use the cliff faces located east of the eastern edge of the study area. They were not observed during this survey but have been observed in other surveys of the general area in recent years. There are some rocky outcrops in the northeastern portion of the study area, which could provide potential roost habitat for spotted bat. Gray vireos were documented from the study area. The species, which have suitable habitat or were observed, are addressed in more detail in upcoming sections of this report.

4.3 New Mexico State Forestry (NM Endangered Plant List)

New Mexico State Forestry maintains a list of 37 species of state endangered plants. Four (4) species (Goodding's onion, Parish's alkali grass, Pecos sunflower, and Zuni fleabane) are presented in the NM Endangered Plant List as occurring in McKinley County(Table 4). Pecos sunflower has already been discussed. Goodding's onion occurs in high elevation meadows and wet areas in habitats far more mesic and cooler than the study area. Zuni fleabane has previously been discussed under the USFWS listings. Parish's alkali grass could potentially occur in palustrine wetland habitats similar in structure to the one found in the study area. However, the one in the study area was derived from a leaking pump and storage tank. It is wholly fed by surface flows and lacks the groundwater component usually associated with Parish's alkali grass. Additionally, the water from the well feeding the wetland is not alkaline, and there was no trace of salt deposition or alkali soils anywhere in the area. It is unlikely Parish's alkali grass would be present in the study area.

4.4 Species with Potential Habitat in the Roca Honda Survey Area

Although there are 15 species with USFWS, NM State Forestry, or NMDGF status within McKinley County, only 5 had potential habitat within the study area. These species (golden eagle, peregrine falcon [including American and Arctic varieties] spotted bat, and gray vireo) are all keyed into habitats, such as, cliffs and rock faces, or woodland areas (Table 5). Two (2) of these species (golden eagle and gray vireo) were found either in or adjacent to the study area. Although the golden eagle was discussed within the bird-of-prey section of this report, a more detailed discussion will be presented within this section.

Table 5. Threatened, Endangered, and Protected Species that Could Occur in the Survey Area

SPECIES	USFWS Federal Status	NM Department of Game and Fish Status	NM STATE Forestry Status
Golden eagle (*Aquila chrysaetos*)	EPA*	--	NA
American and Arctic peregrine falcon (*Falco peregrinus* varieties *anatum* and *tundris*)	--	T	NA
Gray vireo (*Vireo vicinior*)	--	T	NA
Spotted bat (*Euderma maculatum*)	--	T	NA

Key: **EPA** = Bald and Golden Eagle Protection Act; **E** = endangered; **T** = threatened

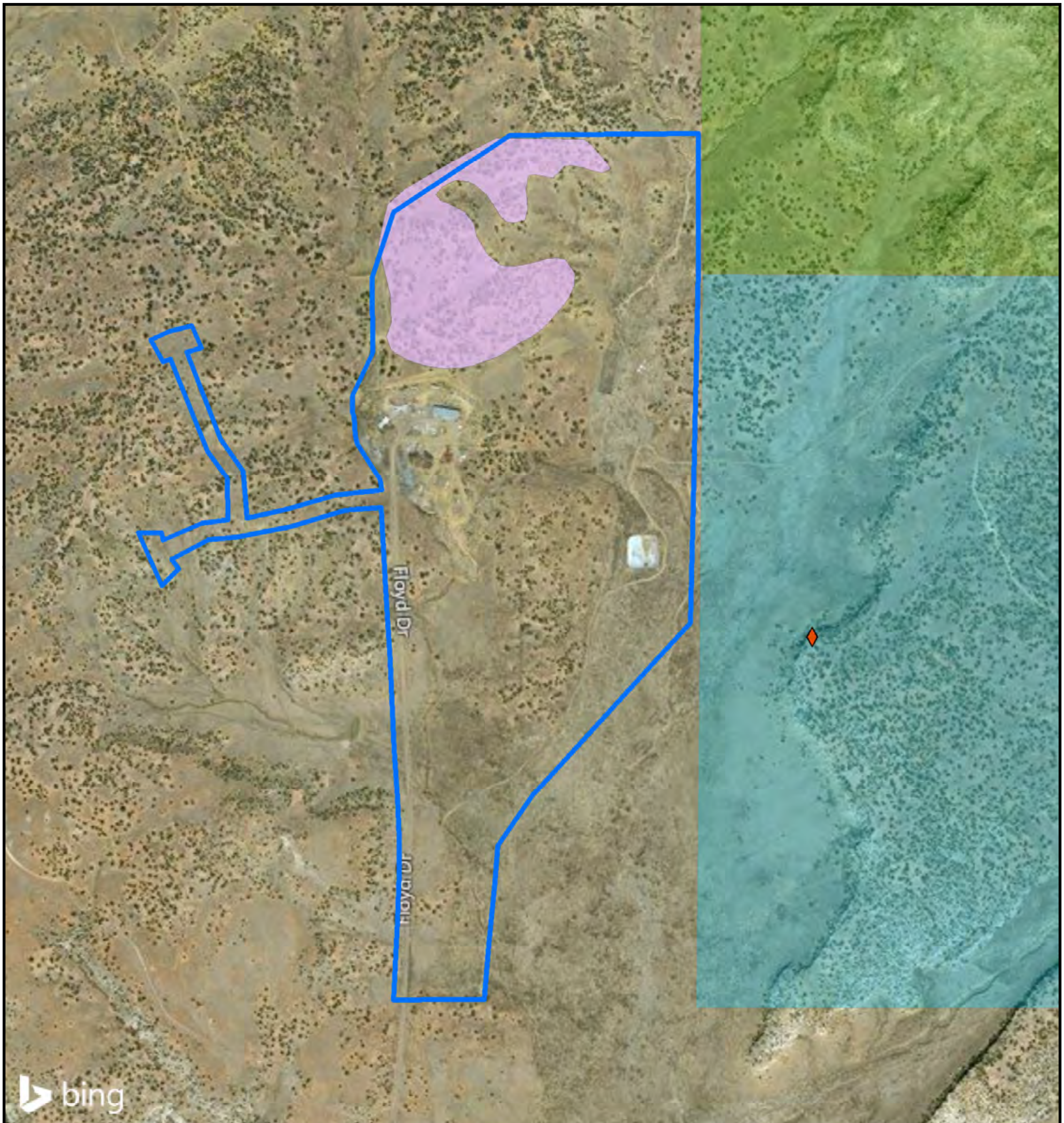
4.5.1 Golden eagle (Aquila chrysaetos)

Golden eagle is a large dark brown bird of prey with a wingspan of up to 71-inches. Their breeding range extends throughout Canada and through much of the western United States. They occur in open areas at lower to middle elevations throughout New Mexico. Preferred nesting sites are cavities within ledges and cliffs of mountainsides, mesa escarpments, and canyon walls. The cliffs that golden eagles typically use are greater than 30 meters in height, although they infrequently use cliffs of only 10 meters in height. The nesting cliffs are normally directly adjacent to suitable foraging habitats. The golden eagle is not listed (or under consideration for listing) under the Endangered Species Act or the New Mexico Wildlife Protection Act. However, Bald and Golden Eagle Protection Act and the Migratory Bird Treaty Act protect this species. Golden eagles in New Mexico can start breeding behavior in February and will often be on eggs by March.

A protocol survey for golden eagles was completed on August 26 and 27, 2015. There are several rock-outcrop cliffs located east of the study area that provide suitable perch, roost, and, in some areas, nesting habitat for golden eagles (Figure 8). The most promising of these are located east of the southern portion of the study area. During the area survey, 2 different golden eagles were observed flying over the south half of the study area. These eagles approached from the east and ultimately extended their flight across the study area to the west. During the two-day observations of the potential golden eagle habitat, a solitary golden eagle was observed briefly perching on top of the cliff face approximately 0.15 miles east of the study area at approximately UTM Zone 13 E254999/N3915792. All cliff faces near the study area were examined with a spotting scope, and there were no raptor nests evident. However, golden eagles, red-tailed hawks, and several other small birds of prey are known to occur in the area and could nest, perch, or roost on any cliff and rock outcrop areas in the future.

4.5.2 American and Arctic peregrine falcons *(Falco peregrinus* varieties *anatum* and *tundris*)

In New Mexico, this species breeds in mountainous areas and occurs essentially statewide, except during winter. During summer, peregrine falcons nest on tall, steep, rocky cliffs associated with forest or woodland near water. Peregrines take virtually all their prey on the



MARRON and ASSOCIATES

Figure 8
Protected Species Use Areas

Study Area
Golden Eagle Perch
Gray Vireo Habitat

Land Ownership
USFS
Private
State

Milan, Grants, Dos Lomas, and San Mateo,NM
USGS 7.5' Quadrangles

Private, State and BLM Lands
McKinley County, New Mexico

0 0.075 0.15 0.3 Miles

0 0.15 0.3 0.6 Kilometers

N
1:15,000

Biological Survey of the Proposed Section 17 Expansion Area, McKinley County, New Mexico

wing, typically after a stoop or dive from above. Prey consists almost entirely of birds ranging in size from swallows to ducks and large shorebirds such as Jays, woodpeckers, swifts,

The species is known to breed in northwestern New Mexico in areas where cliff habitat is available.

Peregrine falcons were not observed during the study survey, but suitable habitat occurs at the same location as previously described for the golden eagle. As with the golden eagle, there is no suitable nesting habitat within the boundary of the study area. Although peregrine falcons were not present during the survey, it is possible they could be present in suitable habitat areas during upcoming breeding seasons.

4.5.3 Gray vireo (*Vireo vicinor*)

Gray vireo is found throughout much of the western United States and northern Mexico. It is usually found breeding from southern California to western Oklahoma, and southward to northern Baja California, southern Arizona, southern New Mexico, western Texas, and northern Coahuila, Mexico. In New Mexico, gray vireos summer west of the eastern plains, from the San Juan Valley, Santa Fe area, southward to the southern New Mexico border (NMDGF, 2017). In New Mexico, gray vireo (an insectivore) is only found during the months of April through September when insects are most abundant. It generally nests from May through August. Gray vireos are found in Coniferous Woodland including lower pinyon-juniper woodland down into upper Juniper Savanna. The gray vireo is known to nest in McKinley County. Their breeding season generally extends from May through August. Gray vireo appears to be somewhat intolerant of human presence and activity. When development moves into occupied habitat, they tend to leave the area. A mixture of Juniper Woodland and open lower Pinyon Juniper Woodland dots the tops and slopes of the ridges in the northern half of the study area. There are scattered patches of woodland further south in the study area, but none of these appeared suitable for gray vireo.

The late summer survey of the area was at the very end of the nesting season for gray vireo when they are beginning to migrate south for the winter. There were no indications of gray vireo nests in the study area, but during the survey several gray vireos were heard calling along the ridgetops in the northern half of the study area. Figure 8 depicts the area where gray vireo was heard calling. A gray vireo tape was played, but none responded. We did not see any gray vireo nests in this area, but the territories of gray vireos can cover several hundred yards across and their nests could easily be located immediately outside the survey boundaries. Another possibility is that the gray vireo observed were just migrating through the area. The absence or presence of nesting gray vireos can only be resolved by protocol surveys for this species, which would need to be completed in May and June during the peak of the breeding season.

4.5.4 Spotted bat (Euderma maculatum)

The spotted bat is both a BLM-sensitive species as well as a NM state-threatened species. They can be found in arid regions ranging from desert scrub upward to forest biomes. They roost on cliffs and are usually associated with a nearby water source. Most of the study area lacks either the cliff or rock faces and the presence of surface water. However, the east central portion of the study area contains a large man-made wetland, with some small rock outcrops nearby in the study area and much larger cliffs located just about 0.2 miles east. Spotted bat could hunt over the previously described wetland area (See Figure 7), and they could roost in the rock outcrops located east of the study area. All rocky sites within the study area were examined, and there were no bat droppings. It does not appear that spotted bats were roosting in the study area. The only way to verify whether they are hunting in the study area would be with the use of either =mist netting to trap and identify specimens or an Anabat device for passive bat detection to examine the calls of the bats in the area.

5 SUMMARY AND CONCLUSIONS

The Roca Honda Section 17 Expansion area ranges in elevation from approximately 7090 feet upward to approximately 7320 feet. The geology composition of the survey area includes sedimentary deposits from the Quaternary and Cretaceous strata. The lowlands are dominated by Quaternary alluvium, and the hills and ridgetops are dominated by Upper Cretaceous strata. Precipitation in the survey area averages approximately 8.6 inches per year. The National Resource Conservation Service lists 6 soil types within the survey area. Most of these are sand or sandy loams, but a large portion of the area is classified as Uranium Mined Lands.

A total of 153 species representing 43 families of common vascular plants were identified within the survey area. There were no rare or protected plant species found within the survey area. The study area supported 6 major natural vegetation types—lower Coniferous Woodland (pinyon-Juniper Woodland), Juniper Savanna, Great Basin Desert Scrub, Plains/Mesa Grassland, Arroyo Riparian, and a transitional community with diffuse Coniferous Woodland intermixed with Juniper Savanna and Plains Mesa Grassland that we named Pinyon/Juniper Savanna (Dick-Peddie 1993). In addition to these native communities there were large patches of lands that were heavily disturbed by past mining activities that supported a weedy disclimax plant association.

The most abundant of these communities within the survey area were Great Basin Desert Scrub and the Pinyon/Juniper Savanna community which together covered nearly two-thirds of the study area. Juniper Savanna covered another 14 percent and all the remaining natural communities had fewer than 10 percent overall coverage.

Five (5) species of NM State Noxious Weeds were encountered within the survey area. These included the Class B Russian knapweed (*Onopordum acanthium),* and the Class C Siberian elm (*Ulmus pumila*), salt cedar (*Tamarix* sp.), Russian olive (*Elaeagnus angustifolia*), and tree of heaven (*Ailanthus altissima*).

A total of 62 vertebrate animal species were encountered during the biological survey, including 43 species of birds, 13 species of mammals, and 4 species of reptiles. There was no suitable habitat for fish.

Four (4) species of raptors were observed within the survey area. These included: Golden eagle (*Aquila chrysaetos*), red-tailed hawk *(Buteo jamaicensis)*, sharp-shinned hawk (*Accipiter stratus*), and American kestrel *(Falco sparverius).* At least 2 golden eagles were observed flying over the southern portion of the study area and 1 of these birds was observed perched on cliffs located approximately 0.15 miles east of the study area. Although not observed in the area, peregrine falcons could also be present. Suitable nesting habitat for a variety of avian species was present, but no migratory bird nests were found during the survey. In particular, there were burrows within the sidewalls of the upper portion of San Rafael Canyon that could provide suitable nesting habitat for western burrowing owl. A variety of small mammals were present including kangaroo rats, woodrats, and pocket gophers, but there were no prairie dogs present. Potential habitat for bats occurred in trees and in the cracks and fissures on cliff faces and rock outcrops, but there was no indication of bat roosts. Common species of whiptail and fence lizards were present, as well as Woodhouse's toad and barred tiger salamander, but there were no frogs present, and the salamander was confined to a wetland habitat created by a leaking pump and tank system.

Two (2) ephemeral waterways were present, San Rafael Canyon being the largest. There were no natural wetlands, but only wetland that formed at a leaking well and storage tank facility.

Fifteen (15) species with protection status by the USFWS, NMDGF or NM State Forestry are known to occur in McKinley County. Only 4 of these species had potential habitat within the survey area (golden eagle, peregrine falcon [American and Arctic varieties], gray vireo, and spotted bat). As previously mentioned, 2 golden eagles were observed flying over the area, and 1 roosting on nearby cliffs. Peregrine falcons have been previously observed in the general area and could also make use of the cliffs located east of the southern portion of the study area. Spotted bats could use the rocky outcrops and small cliffs in the northeastern portion of the study area but there was no indication of bat roosts. Species of bats hunting in the area could be identified with Anabat passive bat detection technology or mist netting if necessary. Gray vireo calls were heard during the survey. These vireos did not respond to taped calls, but it was at the end of nesting season and these birds might have been getting ready to migrate. Western burrowing owl within this land jurisdiction fall under the Migratory Bird Treaty Act and were previously discussed.

The study area contained a surprising diversity of both plants and animals. Sixty-three (63) species of vertebrates were documented, most of these were birds. This may have been due to the time of the survey, which was at the onset of the migration season. There were no indications of golden eagle nests near the study area, but there is structurally suitable nesting, roosting, and perching habitat for golden eagle use on cliffs east of the southern portion. Prior to any construction activities these cliffs should be examined as potential golden eagle and peregrine falcon nest sites. These cliffs, some smaller rock outcrops, and larger trees in the area also provide habitat for other species of raptors. Burrows along the banks of San Rafael Canyon should also be examined for potential use by western burrowing owl. Gray vireo surveys should be conducted within the woodland and savanna habitats in the study area. It is uncertain if the gray vireos identified during the survey were summer residents of the area or merely migrants . The wetland found within the study area, although sustaining lush palustrine vegetation, appears to be wholly derived from leaking pipes associated with a pump and storage tank. This wetland is not part of any waterway and does not appear to be a natural spring or seep. It is believed that this wetland is not a water of the United States. However, the USACE and US Environmental Protection Agency are the final sources for the approved jurisdictional determination..

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APPENDIX A

PLANT SPECIES OBSERVED WITHIN THE PROPOSED SECTION 17 EXPANSION SURVEY AREA

Species are organized by Families. At the end of each species appears a letter referring to its abundance. F=Few, I=Infrequent, O=Occasional, C=Common *Noxious Weed

AGAVACEAE (Agave Family)

Yucca angustissima Engelm. Ex Trel (Narrowleaf yucca) O
Yucca bacatta Torr. (Banana yucca) O

AMARANTHACEAE (Amaranth Family)

Acanthochiton wrightii Torr. (Greenstripe) I
Amaranthus sp. L. (Amaranth) C

ASTERACEAE (Sunflower Family)

Ambrosia acanthicarpa Hook (Flatspine bur ragweed) C
Amauriopsis dissecta (A.Gray) Britton (Ragleaf bahia) C
Artemisia bigelovii Gray (Bigelow's sage) F
Artemisia dracunculus Pursh (Taragon) I
Artemisia filifolia Torr. (Sand sage) F
Artemisia frigida Willd. (Fringed sage) O
Artemisia ludoviciana Nutt. (White sagebrush) I
Brickellia chlorolepis Wooton and Standley (Bricklebush) I
Chaetopappa ericoides (Torr.) Nesom (Rose heath) F
Chrysothamnus pulchellus (A.Gray) Greene (Southwestern rabbitbrush) I
Conyza canadensis (L.) Cronq. (Canadian horseweed) I
Cirsium orchrocentrum A. Gray (Yellowspine thistle) F
Dyssodia papposa (Vent.) Hitch. (Fetid marigold) I
Ericameria nauseosa (Pallas ex Pursh) Nesom & Baird (Rubber rabbitbrush) C
Grindelia nuda Wood var. aphanactis (Rydb.) Nesom (Gumweed) C
Gutierrezia sarothrae (Pursh) Britt. & Rusby (Broom snakeweed) C
Helianthus annuus L. (Common sunflower) F
Helianthus petiolaris Nutt. (Prairie sunflower) C
Heterotheca canescens (DC.) Shinners (Hoary false golden aster) C
Hymenopappus filifolius Hook. (Fineleaf hymenopappus) I
Krascheninnikovia lanata (Pursh) A. Meeuse & Smit (Winterfat) O
Lactuca seriola L. (Prickly lettuce) O
Machaeranthera canescens (Pursh) Gray (Hoary aster) C
Machaeranthera pinnatifida (Hook.) Shinners (Lace tansy aster) C
Machaeranthera tanecitifolia 9Kunth) Ness (Tansyleaf aster) C
**Onopordum acanthium* L. (Scotch cottonthistle) F
Picradeniopsis oppositifolia (Nutt.) Rydb. Ex Britton (Opposite leaf bahia) C
Psilostrophe tagetina (Nutt.) ex Greene (Wooly paperflower) C
Sanvitalia aberti A. Gray (Abert's creeping zinnia) I
Senecio flaccidus Less. (Threadleaf groundsel) F
Senecio riddellii Torr. & A.Gray (Riddell's ragwort) F

Stephanomeria exigua Nutt. (Small wire lettuce) O
Taraxicum officinale L. (Dandelion) F
Tetradymia canescens D.C. (Spineless horsebush) O
Thelesperma megapotamicum (Spreng) Kuntze (Navajo tea) I
Townsendia fendleri A. Gray (Fendler's Townsend daisy) F
Tragopogon dubius Scop. (Yellow salsify) I
Xanthium strumarium L. (Cocklebur) F

BORAGINACEAE (Borage Family)

Cryptantha micrantha (Torr.) I.M. Johnst. (Redroot crytantha) I
Cryptantha sp. Lehm. ex G. Don (Hidden flower) O

BRASSICACEAE (Mustard Family)

Arabis fendleri (S. Watson) Greene (Fendler's rockcress) I
Descurainia sophia (L.) Webb ex Prantl (Tansy mustard) I
Dimorphocarpa wislizeni (Engelm.) Rollins (Spectacle pod) F
Schoenocrambe linearifolia (A.Gray) Rollins (Slimleaf plainsmustard)

CACTACEAE (Cactus Family)

Escobaria vivipara (Nutt.) Buxbaum (Pincushion cactus) O
Echinocereus coccineus Engelm. (Scarlet hedgehog cactus) I
Echinocereus triglochidiatus Engelm. (Kingcup cactus) I
Opuntia phaeacantha Engelmann (NM prickly pear) I
Opuntia polyacantha Haw. (Plains prickly pear) I

CAPPARIDACEAE (Caper Family)

Cleome serrulata Pursh. (Rocky Mt. beeplant) F

CHENOPODIACEAE (Goosefoot Family)

Atriplex canescens (Pursh) Nutt. (Four-wing saltbush) C
Chenopodium L. sp. (Goosefoot) F
Dysphania graveolens (Willd.) Mosyakin&Clemants (Fetid goosefoot)
Kochia scoparia (L.) Schrad. (Summer cypress) C
Krascheninnikovia lanata (Pursh) A.D.J. Meeuse & Smit (Winterfat) I
Salsola tragus L. (Russian thistle) C
Sarcobatus vermiculatus (Hook.) Torr. (Greasewood) I

COMMELINACEAE (Spiderwort Family)

Tradescantia sp. L. (Spiderwort) F

CONVOLVULACEAE (Morning Glory Family)

Convolvulus arvensis L.(Field bindweed) I

CUPRESSACEAE (Cypress Family)

Juniperus monosperma (Engelm.) Sarg (One-seed juniper) C

CUSCUTACEAE (Dodder Family)

Cuscuta sp. L. (Dodder) I

CYPERACEAE (Sedge Family)

Eleocharis parishii Britton (Parish's spikerush) F
Juncus articus Willd. ssp. littorais Hulten (Baltic rush) F
Juncus torreyi Covelle (Torrey's rush) F
Schoenoplectus americanus (Pers.) Vokart ex. Schinz &R. Keller (Chairmaker's bulrush) F

ELAEAGNACEAE (Oleaster Family)

**Elaeagnus angustifolia* L. (Russian olive) F

EPHEDRACEAE (Joint Fir Family)

Ephedra torreyana S. Watson (Torrey jointfir) I

EUPHORBIACEAE (Spurge Family)

Chamaesyce fendleri (Torr. & Gray) Small (Fendler's sandmat) I
Chamaesyce serpyllifolia (Pers.) Small (Spurge) F

FABACEAE (Bean Family)

Astragalus humistratus L. (Milkvetch) F
Dalea candida Mishx. Ex. Willd. (Dalea) F
Dalea sp. L. (Dalea) F
Lupinus kingii S. Watson (King's lupine) I
Melilotus officinalis (L.) Lam. (Yellow sweetclover) I

FAGACEAE (Oak Family)

Quercus gambelii Nutt. (Gambel oak) C

HYDROPHYLLACEAE (Waterleaf Family)

Phacelia integrifolia Torr. (Gypsum phacelia) I

LAMIACEAE (Mint Family)

Salvia subincisa Benth. (Sawtooth sage) F
Monarda punctata L. (Spotted beebalm) I

LILIACEAE (Lily Family)

Allium sp. L. (Onion) I

LINACEAE (Flax Family)

Linum australe Heller (Southern flax) F
Linum neomexicanum Greene (New Mexico yellow flax) I
Linum vernale Wooton (Chihuahuan flax) I

LOASACEAE (Loasa Family)

Mentzelia multiflora (Nutt.) A. Gray (Adonis Blazing star) I

MALVACEAE (Mallow Family)

Sphaeralcea coccinea (Nutt.) Rydb. (Scarlet globemallow) O
Sphaeralcea incana Torr. ex Gray (Gray globemallow) C

NYCTAGINACEAE (Four-o'clock Family)

Abronia fragans A. Nelson (Sand Verbena) I
Mirabilis multiflora (Torr.) Gray (Four-o'clock) I
Mirabilis oxybaphoides (A.Gray) A. Gray (Spreading four o'clock) I

ONAGRACEAE (Evening Primrose Family)

Epilobium sp. L. (Willoweed) F
Gaura coccinea Nutt. ex Pursh (Scarlet gaura) F
Oenothera laciniata Hill (Cutleaf evening primrose) I

OROBANCHACEAE (Broomrape Family)

Orobanche multiflora Nutt. (Many-flower broom rape) F

PINACEAE (Pine Family)

Pinus edulis Engelm. (Pinyon pine) C

PLANTAGINACEAE (Plantain Family)

*Plantago sp.*L. (Plantain) I
Plantago patagonica Jacq. (Wooly plaintain) O

POACEAE (Grass Family)

Achnatherum hymenoides (Roemer & J.A. Schultes) Barkworth (Indian ricegrass) C
Agropyron sp. L. (Wheat grass)
Aristida adscensionis L. (Sixweeks threeawn)I
Aristida divaricata Humb.&Bonpl. Ex. Willd. (Poverty threeawn)F
Aristida arizonica Vassey (Arizona threeawn) I
Aristida purpurea Nutt. (Purple threeawn) C
Aristida purpurea Nutt. var. longiseta (Steud.) Vasey (Red threeawn) C
Bouteloua curtipendula (Michx) Torr. (Side-oats grama) C
Bouteloua gracilis (Willd. ex Kunth) Lag. ex Griffiths (Blue grama) C
Bouteloua simplex Lag. (Matted grama) C
Echinochloa muricata (P. Beauv.) Fernald (Rough barnyard grass)
Elymus elymoides (Raf.) Swezey (Squirreltail) I
Eragrostis sp Von Wolf (Lovegrass) F
Heterostipa comata (Trin. & Rupr.) Barkworth (Needle and thread grass) I
Heterotheca canescens (DC.) Shinner (False goldenaster)
Hordeum jubatum L. (Foxtail barley) I
Lycurus setosus C.G. Reeder (Bristly wolfstail) I
Muhlenbergia asperifolia (Nees & Meyen ex. Trin) Parodi (Scratchgrass) F
Muhlenbergia depauperata Scribn. (Sixweeks muhly) I
Muhlenbergia pungens thurb. (Sandy muhly) I
Muhlenbergia torreyi (Kunth) A.S. Hitchc. ex Bush (Ring muhly) C
Munroa squarrosa (Nutt.) Torr. (False Buffalograss) I
Pascopyrum smithii (Rydb.) A. Lˆve (Pubescent wheatgrass) C
Pleuraphis jamesii Torr. (Galleta) C
Polypogon monospliensis (L.) Desf. (Annual rabbitsfoot grass) F
Schedonnardus paniculatus (Nutt.) Trel. (Tumblegrass) F
Sporobolus airoides (Torr.) Torr. (Alkali sacaton) C
Sporobolus cryptandrus (Torr.) Gray (Sand dropseed) C
Sporobolus contractus Hitch (Spike dropseed) C

POLEMONIACEAE (Gilia Family)

Ipomopsis longiflora (Torr.) V.E. Grant (Flax-flowered ipomopsis) F

POLYGONACEAE (Buckwheat Family)

Eriogonum jamesii Benth. (James buckwheat) I
Eriogonum annum Nutt. (Annual buckwheat) I
Eriogonum cernuum Nutt. (Nodding buckwheat) I
Eriogonum microthecum Nutt. (Slender buckwheat) I
Polygonum aviculare L. (Knotweed) F

PORTULACEAE (Purselane Family)

Portulaca oleraceae L. (Little hogweed) I
Portulaca sp. L. (Hogweed) I

RANCULUACEAE (Buttercup Family)

Ranunculus cymbalaria Pursh (Alkali buttercup) F

ROSACEAE (Rose Family)

Cercocarpus montanus Raf. (Mountain mahogany)

SALICACEAE (Willow Family)

Populus deltoides W. Bartram ex Marshall ssp. *wislizenii* (Rio Grande cottonwood) F

SCROPHULARIACEAE (Figwort Family)

Castilleja integra A. Gray (Indian paintbrush) F
Cordylanthus wrightii A. Gray Wright's bird's beak F
Penstemon sp. L (Beardtongue) F
Verbascum thapsus L. (Miners candle) F

SIMAROUBACEAE (Quassia Family)

**Ailanthus atlissima* (Milll.) Swingle (Tree of heaven) F

SOLANACEAE (Nightshade Family)

Lycium pallidum Miers (Wolfberry) O
Physalis sp.L. (Groundcherry) F
Solanum elaeagnifolium Cav. (Silverleaf nightshade) F
Solanum jamesii Torr. (Wild potato) F

TAMARICACEAE (Tamarisk Family)

**Tamarix chinensis* Lour. (Salt cedar) I

TYPHACEAE (Cattail Family)

Typha angustifolia L. (Narrowleaf cattail) F

ULMACEAE (Elm Family)

**Ulmus pumila* L. (Siberian elm) O

VERBENACEAE (Vervain Family)

Verbena macdouagallii A. Heller (MacDougal verbena) F
Verbena perennis Wooton (Pinleaf verbena) O

APPENDIX B

VERTEBRATE ANIMAL SPECIES OBSERVED WITHIN THE PROPOSED SECTION 17 EXPANSION SURVEY AREA

BIRDS

CATHARTIDAE

Turkey vulture (*Cathartes aura*)

ACCIPITRIDAE

Golden eagle (*Aquila chrysaetos*)
Red-tailed hawk (*Buteo jamaicensis)*
Sharp-shinned hawk (*Accipiter striatus*)

FALCONIDAE

American kestrel (*Falco sparverius*)

COLUMBIDAE

Mourning dove (*Zenaida macroura*)
White-winged dove (*Zenaida asiatica*)

TYRANNIDAE

Say's phoebe (*Sayornis saya*)
Eastern phoebe (*Sayornis phoebe*)
Cassin's kingbird (*Tyrannus vociferans*)
Western kingbird (*Tyrannus verticalis*)
Ash-throated flycatcher (*Myiarchus cinerascens*)

LANIIDAE

Loggerhead shrike (*Lanius ludovicianus*)

CORVIDAE (Jay, Crow and Magpie Family)

American crow (*Corvus brachyrhynchos*)
Common raven (*Corvus corax*)
Pinyon jay (*Gymnorhinus cyanodephalus*)
Scrub jay (*Aphelocoma californica*) F

HIRUNDINIDAE

Violet-green swallow (*Tachycineta thalassina*)
Cliff swallow (*Petrochelidon pyrrhonota*)

PICIDAE

Red-shafted flicker (*Colaptes auratus*) F

PARIDAE

Juniper titmouse (*Baeolophus ridgwayi*)

TROGLODYTIDAE

Rock wren (*Salpinctes obsoletus*)

TURIDADAE

Western bluebird (*Sialia mexicana*)
American robin (*Turdus migratorius*)
Townsend's solitare (*Myadestes townsendi*)

MIMIDAE

Curved-billed thrasher (*Toxostoma curvirostre*)
Bendire's thrasher (*Toxostoma bendirei*)

VIREONIDAE

Gray vireo (*Vireo vicinior*)

EMBERIZIDAE

Vesper sparrow (*Pooecetes gramineus)*
Savannah sparrow (*Passerculus sandwichensis*)
Western meadowlark (*Sturnella neglecta*)
Black-chinned sparrow (*Spizella atrogularis*)
Lincoln's sparrow (*Melospiza lincolnii*)
Lark sparrow (*Chondestes grammacus*)
Brewer's sparrow (*Spizella breweri*)
Chipping sparrow (*Spizella passerina*)
Canyon towhee (*Melozone fusca*) I
Grace's warbler (*Setophaga graciae*)
Yellow-rumped warbler (*Setophaga coronata*)
Bullock's oriole (*Icterus bullockii*)

FRINGILLIDAE

House finch (*Carpodacus mexicanus*)
Lesser goldfinch (*Spinus psaltria*)
Cassin's finch (*Haemorhous cassinii*)

REPTILES AND AMPHIBIANS

PHRYNOSOMATIDAE

Sceloporus cowlesi (Southwestern lizard)
Phrynosoma douglasii (Short-horned lizard)

TEIIDAE

Aspidoscelis sp. (Whiptail)
Aspidoscelis velox (Plateau striped whiptail)

BUFONIDAE

Anaxyrus woodhousii (Woodhouse's toad)

AMBYSTOMATIDAE

Ambystoma mavortium (Barred tiger salamander)

MAMMALS

CANIDAE

Canis latrans (Coyote)

CERVIDAE

Odocoileus hemionus (Mule deer)
Cervus elaphus (Elk)

CRICETIDAE

Neotoma albigula (White-throated woodrat)

GEOMYIDAE

Thomomys bottae (Botta's pocket gopher)

HETEROMYIDAE

Dipodomys ordii (Ord's kangaroo rat)
Dipodomys spectabilis (Banner-tailed kangaroo rat)

ERETHIZONTIDAE

Erethizon dorsatum (Porcupine)

LEPORIDAE

Sylvilagus audubonii (desert cottontail)
Lepus californicus (Black-tailed jackrabbit)

MUSTELIDAE

Mephitis mephitis (Striped skunk)

SCIURIDAE

Spermophilus variegatus (Rock squirrel)
Ammospermophilus leucurus (White-tailed antelope squirrel)

APPENDIX C

AGENCY SPECIES LIST

USFWS IPAC

NM Department of Game and Fish

NM State Forestry

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

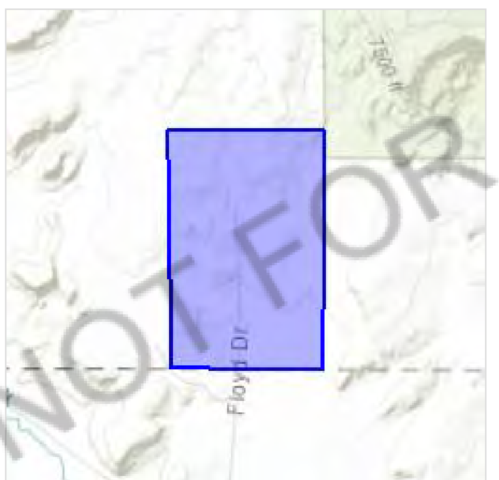
IPaC resource list

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

Cibola and McKinley counties, New Mexico



Local office

New Mexico Ecological Services Field Office

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

2105 Osuna Road Ne
Albuquerque, NM 87113-1001

http://www.fws.gov/southwest/es/NewMexico/
http://www.fws.gov/southwest/es/ES_Lists_Main2.html

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] are managed by the Ecological Services Program of the U.S. Fish and Wildlife Service.

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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.

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

Birds

NAME	STATUS
Mexican Spotted Owl *Strix occidentalis lucida* There is **final** critical habitat for this species. Your location is outside the critical habitat. https://ecos.fws.gov/ecp/species/8196	Threatened

Southwestern Willow Flycatcher Empidonax traillii extimus There is **final** critical habitat for this species. Your location is outside the critical habitat. https://ecos.fws.gov/ecp/species/6749	Endangered
Yellow-billed Cuckoo Coccyzus americanus There is **proposed** critical habitat for this species. Your location is outside the critical habitat. https://ecos.fws.gov/ecp/species/3911	Threatened

Fishes

NAME	STATUS
Zuni Bluehead Sucker Catostomus discobolus yarrowi There is **final** critical habitat for this species. Your location is outside the critical habitat. https://ecos.fws.gov/ecp/species/3536	Endangered

Flowering Plants

NAME	STATUS
Pecos (=puzzle, =paradox) Sunflower Helianthus paradoxus There is **final** critical habitat for this species. Your location is outside the critical habitat. https://ecos.fws.gov/ecp/species/7211	Threatened
Zuni Fleabane Erigeron rhizomatus No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/5700	Threatened

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.

Migratory birds

Certain birds are protected under the Migratory Bird Treaty Act[1] and the Bald and Golden Eagle Protection Act[2].

Any person or organization who plans or conducts activities that may result in impacts to migratory birds, eagles, and their habitats should follow appropriate regulations and consider implementing appropriate conservation measures, as described below.

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:

- Birds of Conservation Concern http://www.fws.gov/birds/management/managed-species/birds-of-conservation-concern.php
- Measures for avoiding and minimizing impacts to birds http://www.fws.gov/birds/management/project-assessment-tools-and-guidance/conservation-measures.php
- Nationwide conservation measures for birds http://www.fws.gov/migratorybirds/pdf/management/nationwidestandardconservationmeasures.pdf

The birds listed below are birds of particular concern either because they occur on the USFWS Birds of Conservation Concern (BCC) list or warrant special attention in your project location. To learn more about the levels of concern for birds on your list and how this list is generated, see the FAQ below. This is not a list of every bird you may find in this location, nor a guarantee that every bird on this list will be found in your project area. To see maps of where birders and the general public have sighted birds in and around your project area, visit E-bird tools such as the E-bird data mapping tool (search for the name of a bird on your list to see specific locations where that bird has been reported to occur within your project area over a certain timeframe) and the E-bird Explore Data Tool (perform a query to see a list of all birds sighted in your county or region and within a certain timeframe). For projects that occur off the Atlantic Coast, additional maps and models detailing the relative occurrence and abundance of bird species on your list are available. Links to additional information about Atlantic Coast birds, and other important information about your migratory bird list can be found below.

For guidance on when to schedule activities or implement avoidance and minimization measures to reduce impacts to migratory birds on your list, click on the PROBABILITY OF PRESENCE SUMMARY at the top of your list to see when these birds are most likely to be present and breeding in your project area.

NAME	BREEDING SEASON (IF A BREEDING SEASON IS INDICATED FOR A BIRD ON YOUR LIST, THE BIRD MAY BREED IN YOUR PROJECT AREA SOMETIME WITHIN THE TIMEFRAME SPECIFIED, WHICH IS A VERY LIBERAL ESTIMATE OF THE DATES INSIDE WHICH THE BIRD BREEDS ACROSS ITS ENTIRE RANGE. "BREEDS ELSEWHERE" INDICATES THAT THE BIRD DOES NOT LIKELY BREED IN YOUR PROJECT AREA.)

Bald Eagle Haliaeetus leucocephalus — 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/1626

Bendire's Thrasher Toxostoma bendirei — Breeds Mar 15 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/9435

Black-chinned Sparrow Spizella atrogularis — Breeds Apr 15 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/9447

Brewer's Sparrow Spizella breweri — Breeds May 15 to Aug 10

This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA
https://ecos.fws.gov/ecp/species/9291

Burrowing Owl Athene cunicularia — Breeds Mar 15 to Aug 31

This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA
https://ecos.fws.gov/ecp/species/9737

Chestnut-collared Longspur Calcarius ornatus — Breeds elsewhere

This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.

Clark's Grebe Aechmophorus clarkii — Breeds Jan 1 to Dec 31

This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.

Golden Eagle Aquila chrysaetos — Breeds Jan 1 to Aug 31

This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA
https://ecos.fws.gov/ecp/species/1680

Grace's Warbler Dendroica 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

Gray Vireo Vireo vicinior — Breeds May 10 to Aug 20
This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.
https://ecos.fws.gov/ecp/species/8680

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

Long-billed Curlew Numenius americanus — Breeds Apr 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/5511

Long-eared Owl asio otus — Breeds Mar 1 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/3631

Marbled Godwit Limosa fedoa — 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/9481

Mountain Plover Charadrius montanus — Breeds Apr 15 to Aug 15
This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.
https://ecos.fws.gov/ecp/species/3638

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

Rufous Hummingbird selasphorus rufus — 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/8002

Virginia's Warbler Vermivora 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

Willet Tringa semipalmata — Breeds elsewhere

This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.

Willow Flycatcher Empidonax traillii — Breeds May 20 to Aug 31

This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA
https://ecos.fws.gov/ecp/species/3482

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.

Probability of Presence (■)

Each green bar represents the bird's relative probability of presence in your project's counties 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 counties of your project area. 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.

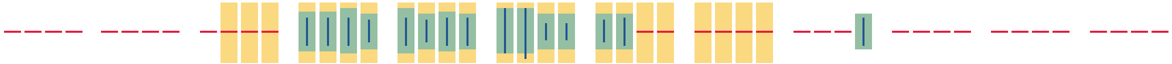
No Data (–)

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

Survey Timeframe

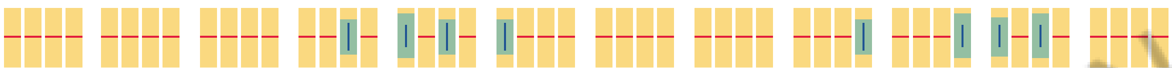
Surveys from only the last 10 years are used in order to ensure delivery of currently relevant information.

Burrowing Owl
BCC - BCR (This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA)

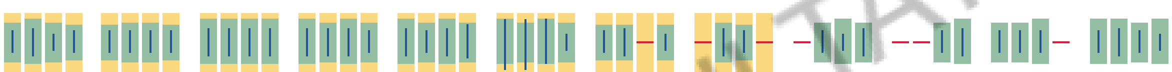


Chestnut-collared Longspur
BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)

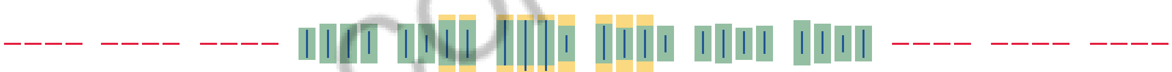
Clark's Grebe
BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)



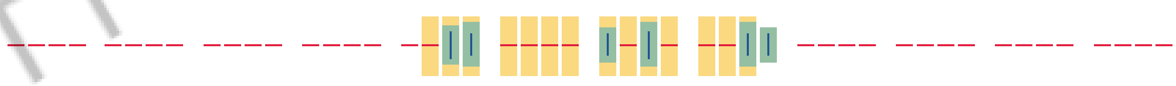
Golden Eagle
BCC - BCR (This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA)



Grace's Warbler
BCC - BCR (This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA)

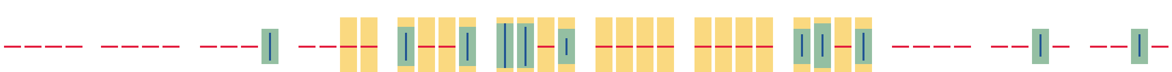


Gray Vireo
BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)

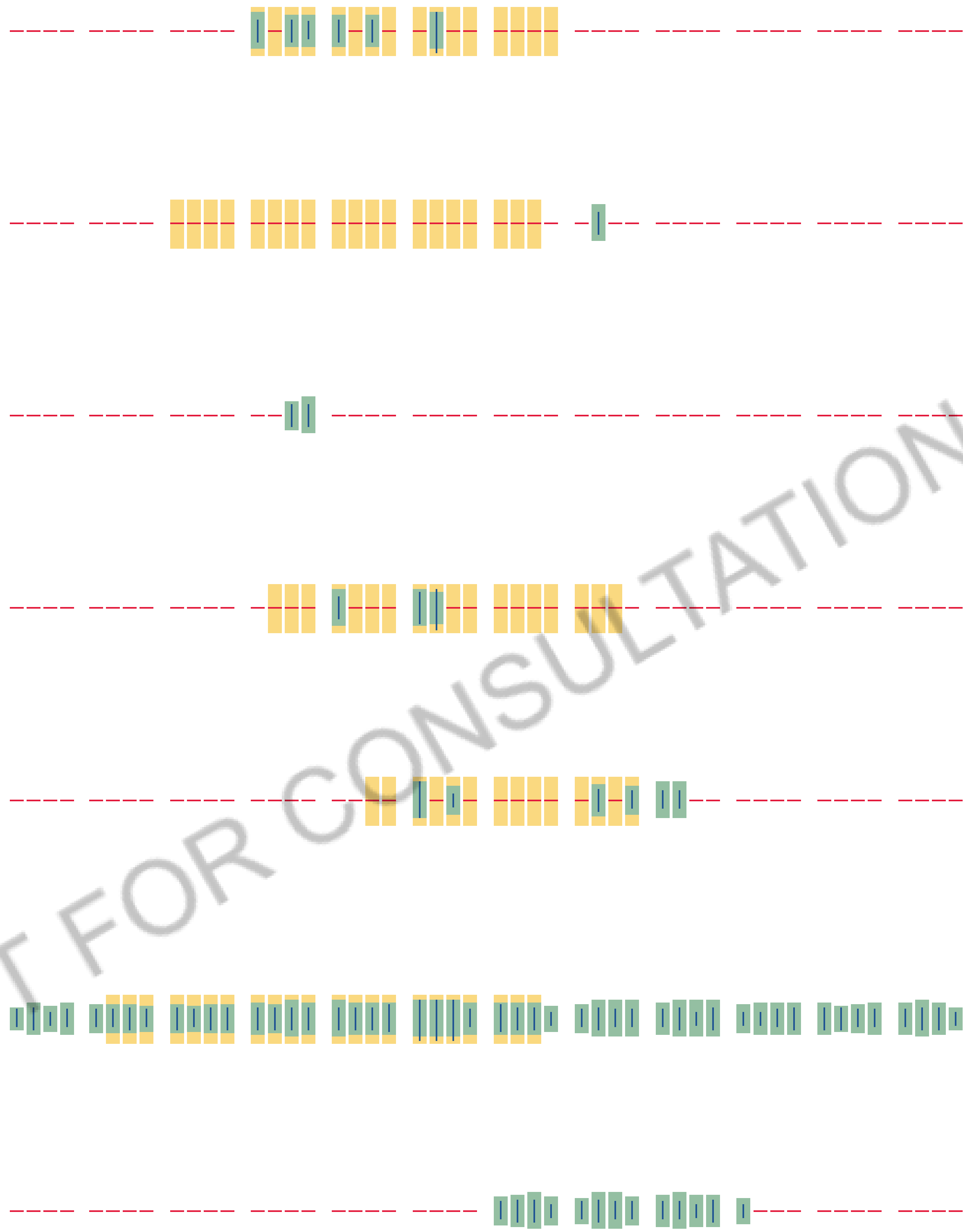


Lesser Yellowlegs
BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)

Lewis's Woodpecker
BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)



SPECIES JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC



Long-billed Curlew
BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)

Long-eared Owl
BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)

Marbled Godwit
BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)

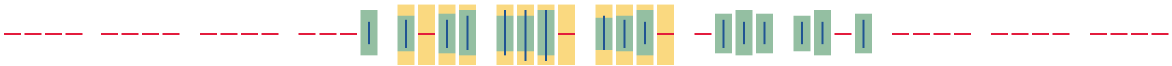
Mountain Plover
BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)

Olive-sided Flycatcher
BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)

Pinyon Jay
BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)

Rufous Hummingbird
BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)

Virginia's Warbler
BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)



Willet
BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)

Willow Flycatcher
BCC - BCR (This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA)

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

Nationwide Conservation Measures describes measures that can help avoid and minimize impacts to all birds at any location year round. Implementation of these measures is particularly important when birds are most likely to occur in the project area. When birds may be breeding in the area, identifying the locations of any active nests and avoiding their destruction is a very helpful impact minimization measure. To see when birds are most likely to occur and be breeding in your project area, view the Probability of Presence Summary. Additional measures and/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 migratory birds potentially occurring in my specified location?

The Migratory Bird Resource List is comprised of USFWS Birds of Conservation Concern (BCC) and other species that may warrant special attention in your project location.

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 counties which your project intersects, and that have been identified as warranting special attention because they are a BCC species in that area, an eagle (Eagle 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, please visit the E-bird Explore Data Tool.

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 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, migrating or present year-round in my project area?

To see what part of a particular bird's range your project area falls within (i.e. breeding, wintering, migrating or year-round), you may refer to the following resources: The The Cornell Lab of Ornithology All About Birds Bird Guide, or (if you are unsuccessful in locating the bird of interest there), the Cornell Lab of Ornithology Neotropical Birds guide. If a bird entry on your migratory bird species list indicates a breeding season, it is probable that the bird breeds in your project's counties 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 Eagle 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 try 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 eagles and BCC species of rangewide concern. For more information on conservation measures you can implement to help avoid and minimize migratory bird impacts and requirements for eagles, please see the FAQs for these topics.

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.

Bird tracking data can also provide additional details about occurrence and habitat use throughout the year, including migration. Models relying on survey data may not include this information. For additional information on marine bird tracking data, see the Diving Bird Study and the nanotag studies or contact Caleb Spiegel or Pam Loring.

What if I have eagles on my list?

If your project has the potential to disturb or kill eagles, you may need to obtain a permit to avoid violating the BGEPA should such impacts occur.

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

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.

This location overlaps the following wetlands:

FRESHWATER POND

- PUB

RIVERINE

- R4SBC

A full description for each wetland code can be found at the National Wetlands Inventory website: https://ecos.fws.gov/ipac/wetlands/decoder

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.

Login Contact

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Disclaimer Policy

Print Page

Database Query

Your search terms were as follows:

County Name
McKinley

Status
State NM: Endangered
State NM: Threatened

8 species returned.

Taxonomic Group	# Species	Taxonomic Group	# Species
Fish	1	Birds	7

Export to Excel

Species ID	Common Name	Scientific Name	Photo	USGS Distribution Map	County	Status
040370	Bald Eagle	Haliaeetus leucocephalus			McKinley	State NM: Threatened
040384	Peregrine Falcon	Falco peregrinus		no map	McKinley	State NM: Threatened
040385	Arctic Peregrine Falcon	Falco peregrinus tundrius	no photo	no map	McKinley	State NM: Threatened
042070	Least Tern	Sternula antillarum			McKinley	State NM: Endangered
040925	Costa's Hummingbird	Calypte costae			McKinley	State NM: Threatened
040521	Southwestern Willow Flycatcher	Empidonax traillii extimus		no map	McKinley	State NM: Endangered
042200	Gray Vireo	Vireo vicinior			McKinley	State NM: Threatened
010496	Zuni Bluehead Sucker	Catostomus discobolus yarrowi		no map	McKinley	State NM: Endangered

Close Window

NEW MEXICO STATE ENDANGERED PLANT SPECIES (19.21.2.8 NMAC)

Detailed information and images of many of these and other rare plants can be found at the New Mexico Rare Plants website (http://nmrareplants.unm.edu/index.html) (plants marked with an * are not listed on the NMRPTC website)

Botanical Name	Common Name	New Mexico Counties
Aliciella formosa	Aztec gilia	San Juan
Allium gooddingii	Goodding's onion	San Juan, McKinley, Catron, Lincoln, Santa Fe
Amsonia tharpii	Tharp's bluestar	Eddy
Argemone pleiacantha subsp. pinnatisecta (A. pinnatisecta)	Sacramento prickly poppy	Otero
Astragalus humillimus	Mancos milkvetch	San Juan
Cirsium vinaceum	Sacramento Mountains thistle	Otero
Cirsium wrightii	Wright's marsh thistle	Chaves, Grant, Guadalupe, Otero, Sierra, Socorro
Cleome multicaulis (Peritoma multicaulis)	slender spiderflower	Grant, Hidalgo
Coryphantha scheeri var. scheeri	Scheer's pincushion cactus	Chavez, Eddy
Cylindropuntia viridiflora	Santa Fe cholla	Santa Fe
Cypripedium parviflorum var. pubescens *	golden lady's slipper	San Juan, Grant, San Miguel
Echinocereus fendleri var. kuenzleri	Kuenzler's hedgehog cactus	Chavez, Eddy, Lincoln, Otero
Erigeron hessii	Hess' fleabane	Catron
Erigeron rhizomatus	Zuni fleabane	Catron, McKinley, San Juan
Eriogonum gypsophilum	gypsum wild buckwheat	Eddy
Escobaria duncanii	Duncan's pincushion cactus	Sierra
Escobaria organensis	Organ Mountain pincushion cactus	Doña Ana
Escobaria sneedii var. leei	Lee's pincushion cactus	Eddy

Escobaria sneedii var. sneedii	Sneed's pincushion cactus	Doña Ana
Escobaria villardii	Villard's pincushion cactus	Doña Ana, Otero
Hedeoma todsenii	Todsen's pennyroyal	Otero, Sierra
Helianthus paradoxus	Pecos sunflower	Cibola, Valencia, Socorro, Guadalupe, Chavez
Hexalectris nitida	shining coralroot	Eddy, Otero
Hexalectris spicata *	crested coralroot	Sierra, Otero, Hidalgo
Ipomopsis sancti-spiritus	Holy Ghost ipomopsis	San Miguel
Lepidospartum burgessii	gypsum scalebroom	Otero
Lilium philadelphicum *	wood lily	Otero, Los Alamos, Sandoval, San Miguel, Santa Fe
Mammillaria wrightii var. wilcoxii *	Wilcox pincushion cactus	Hidalgo, Grant, Doña Ana, Luna
Opuntia arenaria	sand prickly pear	Doña Ana, Luna, Socorro
Pediocactus knowltonii	Knowlton's cactus	San Juan
Pediomelum pentaphyllum	Chihuahua scurfpea	Hidalgo
Peniocereus greggii	night-blooming cereus	Doña Ana, Grant, Hidalgo, Luna
Polygala rimulicola var. mescalerorum	San Andres milkwort	Doña Ana
Puccinellia parishii	Parish's alkali grass	Catron, Cibola, Grant, Hidalgo, McKinley, Sandoval, San Juan
Sclerocactus cloveriae subsp. brackii	Brack's cactus	San Juan, Rio Arriba, Sandoval
Sclerocactus mesae-verdae	Mesa Verde cactus	San Juan
Spiranthes magnicamporum *	lady tresses orchid	Bernalillo, Santa Fe, Guadalupe, Rio Arriba

APPENDIX A-2

Addendum to 2014 Biology Report

2015 Protocol and Raptor Surveys: Pipeline Corridor

September 2015, Marron and Associates

Addendum to the 2014 Biology Report

2015 Protocol and Raptor Surveys

Proposed Roca Honda Pipeline Corridor

Cibola and McKinley Counties, New Mexico

Prepared for

Roca Honda Resources

4002 Office Court Drive Suite 107

Santa Fe, New Mexico 87507

MARRON and ASSOCIATES

September 2015

Table of Contents

Figures

Tables

Appendices

1.0 Introduction

During October and November 2014, Marron and Associates, Inc. completed biological surveys of the Roca Honda proposed reuse pipeline corridor, which is approximately 23.7 miles long situated along portions of County Road 75 and NM 605 within Cibola and McKinley Counties, NM. During these surveys, Marron identified suitable habitat for several species with agency status that required surveys within the breeding and flowering seasons for birds and plants to determine their presence or absence. To verify whether these species were present in the project area, a series of protocol surveys were completed within the Roca Honda project area in the spring and summer of 2015. These were surveys for golden eagle, peregrine falcon, gray vireo, western burrowing owl, Bendire's thrasher (on Bureau of Land Management [BLM] lands), Parish's alkali grass, and Pecos sunflower. The following is a summary of the findings of these surveys.

2.0 Methods, Survey Dates, and Personnel

Surveys were scheduled to meet protocol requirements for each species anticipated in the project area. Surveys for golden eagle and peregrine falcon were completed March 9 and May 12, 2015. Surveys for gray vireo were completed May 14 and July 9, 2015. Surveys for western burrowing owl and Bendire's thrasher were conducted May 21 and June 24, 2015. Surveys for Parish's alkali grass within wetland habitats in the project area were completed May 21, 2015. Preliminary surveys for Pecos sunflower were completed June 24, 2015, but the sunflowers were not in flower at that time. On August 25, a large known population of Pecos sunflower within designated critical habitat was examined near Grants, NM. The plants within this population were in full flower at that time, and the potential habitat for this species within the Roca Honda project area was subsequently surveyed the same day.

Survey Personnel

The following biologists participated in the field surveys:

- **Paul Knight**
  M.S. Biology (Botany, Plant Taxonomy, Ecology, Wetlands, and Endangered Species Studies)—Completed the surveys for Parish's alkali grass, Pecos sunflower, western burrowing owl, and Bendire's thrasher.

- **Nancy Cox**
  M.S. Biology (Ornithology, General Zoology, and Endangered Species Studies)—Completed the surveys for golden eagle, peregrine falcon, and gray vireo.

3.0 Findings

Target Species of Birds Found Within the Project Area

Three of the five birds under study (golden eagle, peregrine falcon, and gray vireo) were observed in the project area. However, only one of these (gray vireo) is likely to be nesting near the proposed pipeline corridor. The following is a detailed discussion of the observations of each of these species within the project area.

Golden eagle (Aquila chrysaetos)

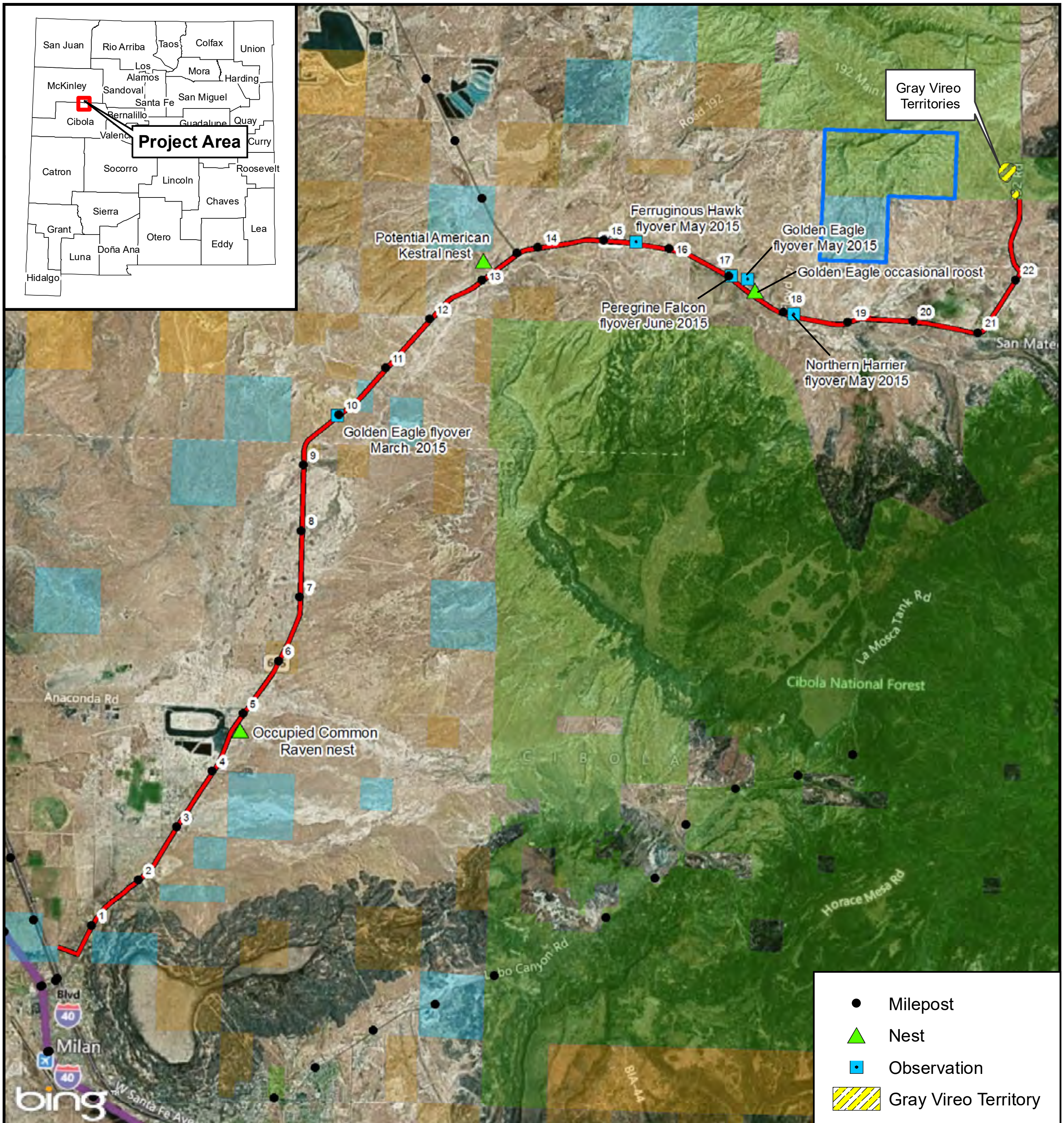
During the fall 2014 survey of the project area, a pair of golden eagles were observed perching on top of a cliff north of NM 605 near milepost (MP) 17.25. At that time, a potential nest site was also noted on a cliff face about 585 meters north/northwest of NM 605 near MP 17.16. To ascertain whether these eagles are nesting near the project area, the aforementioned protocol surveys for this species were completed in spring 2015. Appendix A contains a more detailed summary survey report of the methods and ancillary observations of both eagles and other raptor species in the area. One golden eagle was observed between MP 17 and 18 in March 2015. A solitary golden eagle was also observed briefly perched on cliffs near MP 10 during the March survey. During the May 2015 surveys, a pair of adult golden eagles was observed between MP 17 and 18 (Figure 1). There were no observations of golden eagles at MP 10 during the May survey. Although golden eagles were present at the MPs 17 and 18 locations during both surveys, there was no indication that they were nesting near the roadway. The potential nest site near MP 17.16 that was discovered in 2014 was not used by golden eagles or any other birds in 2015. Although golden eagles are using the area between MP 17 and 18, they are not nesting near the roadway and pipeline corridor, and no golden eagle nests were visible from the roadway anywhere in the project area. Golden eagles have very large daily activity areas. Recent studies of golden eagle behavior in the California Mohave and Sonoran Desert environments using VHF telemetry systems (Katzner et. al. 2012) found that the distance from the nest to the edge of home range of golden eagles varied from 6.2 (nearest)-17.3 miles (farthest) for males, and 3.4 (nearest) to 32.3 (farthest) miles for females.

American and Arctic peregrine falcons *(Falco peregrinus* varieties *anatum* and *tundris*)

Peregrine falcons were not observed during the 2014 survey of the project area, but suitable habitat for them does occur adjacent to NM 605 between MPs 9 and 18. Potential peregrine falcon nest sites were examined in 2015 during the same periods of the aforementioned golden eagle surveys. Peregrine falcons were not observed in the project area during the protocol March and May survey windows. However, during the June surveys for gray vireo, a peregrine falcon was noted flying over the project area near milepost MP 17. This bird never perched or roosted in the project area. Peregrine falcons are potentially nesting in the general area, but no indication of a nest site occurs anywhere near the pipeline project area.

Gray vireo (*Vireo vicinor*)

The fall 2014 survey of the project area was too late in the season to detect gray vireo, which by that time had migrated south for the winter. However, suitable habitat for this species occurred at a number of locations along NM 605. Much of this habitat was situated in uplands adjacent to the NM 605 corridor. The only portion of this habitat that actually extended into the NM 605 right-of-way occurred from MP 20.9 northward to the end of the survey area. In May and again in June 2015, all potential habitat for gray vireo was surveyed within the project area. Appendix B contains the summary field reports from these surveys. During May 20, 2015, two gray vireos were located along NM 605 at MP 23.6; one was singing northwest of this location and the second was singing southwest. These gray vireos are probably breeding in the area, but both observations of the birds were outside the project limits and the NM 605 right-of-way, and access to any nest sites was not available. However, both these sites are immediately adjacent to the Roca Honda project area (Figures 1 and 2). There were no other indications of gray vireo present at any other potential habitat areas along NM 605 during either the May or June surveys of the project area.



Project Area

Roca Honda Permit Area

Land Ownership

- BLM
- USFS
- Tribal
- Private
- State

Milan, Grants, Dos Lomas, and San Mateo, NM USGS 7.5' Quadrangles

Private, State and BLM Lands McKinley and Cibola Counties, New Mexico

0 0.75 1.5 3 Miles

0 1.75 3.5 7 Kilometers

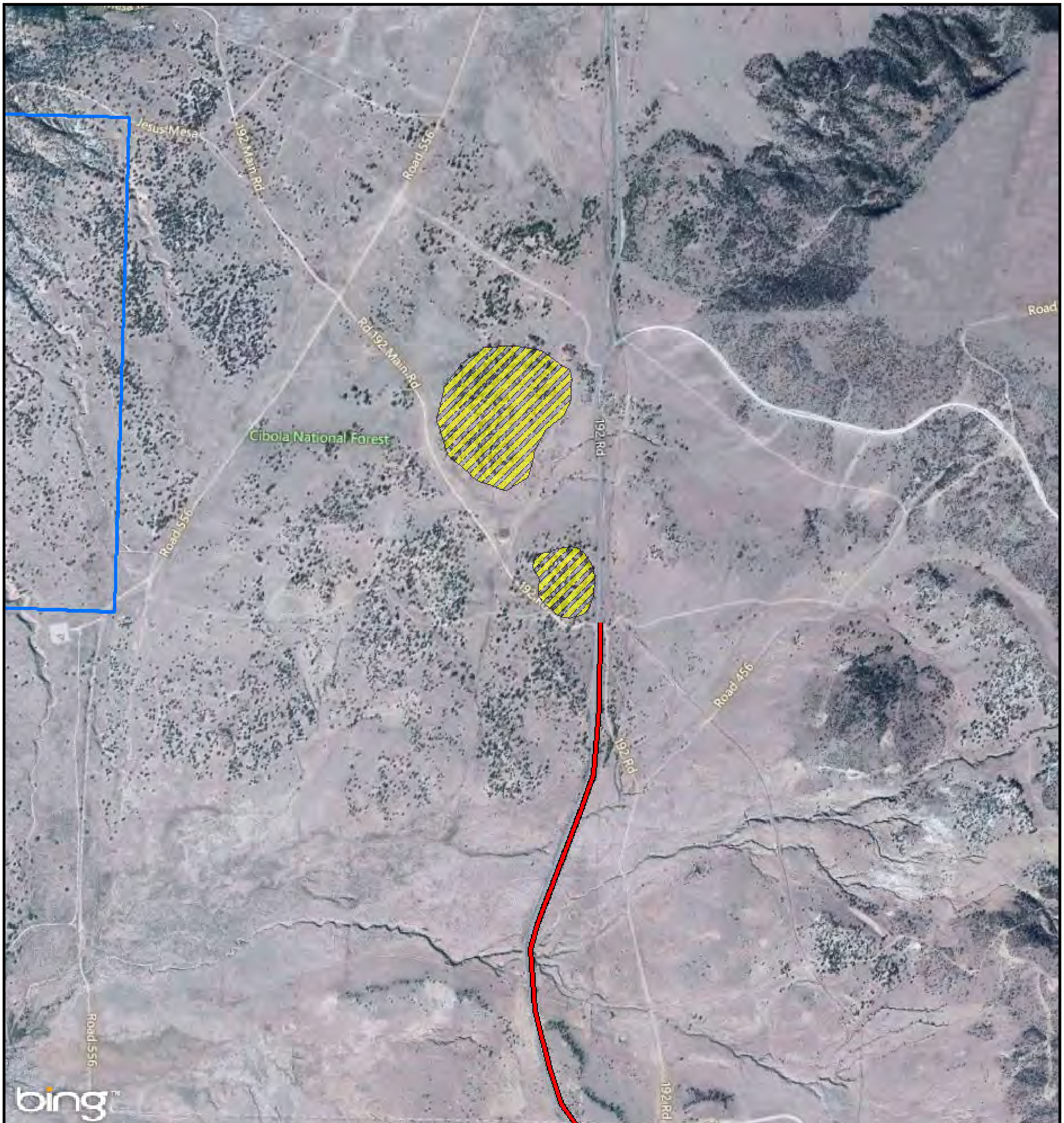
N

1:135,000

MARRON and ASSOCIATES

Figure 1
General Location of Golden Eagle Observations, Gray Vireo Territories, and Other Raptor Observations

Roca Honda Project, McKinley and Cibola Counties, New Mexico



Project Area
Roca Honda Permit Area
Gray Vireo Territory

Milan, Grants, Dos Lomas, and San Mateo,NM USGS 7.5' Quadrangles

Private, State and BLM Lands McKinley and Cibola Counties, New Mexico

0 0.125 0.25 0.5 Miles

0 0.25 0.5 1 Kilometers

N

1:18,000

Figure 2 Gray Vireo Territories

Roca Honda Project, McKinley and Cibola Counties, New Mexico

Target Species of Birds Absent from the Project Area

Western burrowing owl (*Athene cunicularia hypugea*)
During the fall 2014 surveys of the project area, a small prairie dog colony was discovered within the Roca Honda project limits at the southern terminus of the project area. This colony was located at Universal Transverse Mercator (UTM) Zone 13 E623126/N3898287 NAD 83 and the size and abundance of the prairie dog holes present was sufficient to provide suitable habitat for western burrowing owl. During the fall 2014 survey, every prairie dog hole in the project area was examined for evidence of past use by burrowing owl (ie. feathers, whitewash, or pellets). At that time, there was no indication of prior use of any burrow by western burrowing owl. This prairie dog colony was revisited in May and June 2015, and during those surveys every prairie dog burrow in the colony was observed and examined for use by western burrowing owl. There were no western burrowing owls present, nor was there any indication of any recent past use of these burrows by burrowing owls.

Bendire's Thrasher (*Toxostoma bendirei*)
Bendire's thrasher is a BLM sensitive species within the Rio Puerco District. Marginal suitable habitat for this species occurred within the two BLM parcels in the survey area. This is a migratory species and would have migrated southward. During the spring of 2015, the two BLM parcels within the Roca Honda project area were surveyed for any potential use by Bendire's thrasher (Partners in Flight, 2015). There were neither Bendire's thrasher, nor was there any indication of past or current nests for this species within the project area.

Plants Species Absent from the Project Area
Suitable habitat for two species of plants with agency status occurred within the project area. These were Pecos sunflower and Parish's alkali grass. Both of these species are associated with shallow groundwater and wetland habitats. Weather conditions related to rainfall were extremely favorable in the spring of 2015 contributing to the likelihood that if either species were present within the project area they would be readily visible. The following is a discussion of potential habitat and surveys for each species within the project area.

Parish's alkali grass (*Puccinellia parishii*)
Parish's alkali grass is a shorted-lived annual grass that is often less than 10 centimeters in height but has been known to grow upwards of 30 centimeters tall. This grass begins growing in early spring and is often stops by early to mid June. Potential habitat for this species occurred around MP 19.2 where shallow groundwater moves to the surface via capillary action depositing a salt crust across the area. Surveys for this species were completed in May 2015 to catch this species at peak growth when it is most visible. Although suitable habitat for Parish's alkali grass occurred at and around San Mateo Creek near MP 19.2, this species was not present.

Pecos sunflower (Helianthus paradoxus)

Pecos sunflower is an annual wetland plant that is normally 1 to 3 meters in height. Pecos sunflower is wholly a wetland species and prefers shallow ground water. Suitable habitat for this species occurred at the wetlands located immediately north of NM 605 within San Mateo Creek at MP 19.2, as well as seeps located along the north side of NM 605 east of San Mateo Creek. In late fall 2014, the only sunflowers noted along San Mateo Creek were the common sunflower (*Helianthus annuus*). In July 2015, it was noted that several small sunflowers were growing in a seep area along the north side of NM 605 immediately east of San Mateo Creek. These sunflowers were too young to ascribe to any species, but the alkali shallow groundwater habitat along this portion of NM 605 is the preferred habitat condition for this species. In late August 2015, a large known population of Pecos sunflower near Grants, NM (within designated critical habitat) was examined to ascertain the proper time to resurvey the potential habitat for this species near San Mateo Creek. The Pecos sunflower population near Grants, NM was thriving and in full flower on August 25, 2015. At that time all potential habitat for Pecos sunflower within the Roca Honda project area was examined. Pecos sunflower was not present within the project area.

4.0 Birds of Prey

Between 2014 and 2015, seven species of raptors were observed from locations within the survey area. In 2014, golden eagle (*Aquila chrysaetos*), prairie falcon (*Falco mexicanus),* red-tailed hawk *(Buteo jamaicensis)*, northern harrier (*Circus cyaneus*), and American kestrel *(Falco sparverius)* were observed in the project area. On May 12 and May 21, 2015, raptor surveys of the Roca Honda project area were completed. Two additional birds of prey (peregrine falcon (*Falco peregrinus*) and ferruginous hawk (*Buteo regalis*) were found within the project area (Table 1, Figure 1) and additional observations of species were noted in 2014. The location of the peregrine falcon was previously discussed. The ferruginous hawk was observed near MP 15.5 flying over the project area. There were no indications that this ferruginous hawk was nesting anywhere near the project area. The ferruginous hawk observed in the project area may have been hunting small prairie dogs located outside the project area near MP 15.5.

A female American Kestrel (*Falco sparverius*) was observed entering a cavity and remained in the cavity for most of the two-hour observation period on a cliff face west of mile MP 13. This is likely a nest site for the kestrel. It is located approximately 0.25 miles west of NM 605.

Table 1 Observations of Bird-of-Prey and Related Features 2015

Mile Post	Nest/Whitewash/ Flyover	Species	Direction from road	Distance from road (meters)	Comments
9.5	Flyover	Peregrine falcon		Above	Flying through the project area
10.0	Perched and flyover	Golden eagle	West	400	Briefly perched then flew over the project area
13.00	Possible Nest in Rock Cavity	American kestrel	West	400	Female American kestrel entered rock cavity and remained
15.5	Flyover	Ferruginous hawk	North	Above	Flying around the project area
17.25	Perched and Flyovers Throughout this General Area	Golden eagle	North	200	Perched on top of a cliff
18.1	Flyover	Northern harrier	North	100	Flying to the east

In addition to the bird observations, two stick nests were located near the project area during the 2014 survey season at MPs 4.5 (122 m east of road) and 4.75 (166 meters east of road). Both these nests were examined in the spring of 2015, and the nest at MP 4.75 being used was occupied by common ravens that successfully raised chicks. The other nest was empty.

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Appendix A

Golden Eagle and Peregrine Falcon Survey Report

Second Raptor Survey Memorandum For the Milan Roca Honda Project (Cibola and McKinley Counties)

Prepared by Nancy Cox, Southwestern Ornithological Research & Adventures
Consultant Task No. 15022.110

22 May 2015

INTRODUCTION

A second set of raptor surveys was conducted on 12 May 2015 as part of a project for a proposed water line along New Mexico 605 between Milan and San Mateo, New Mexico. The project area is in Cibola and McKinley Counties, New Mexico. The main target species were Golden Eagle (*Aquila chrysaetos*) and Peregrine Falcon (*Falco peregrinus*) looking for evidence of breeding activity. The first set of surveys was conducted on 9 March 2015.

METHODOLOGY

The surveys were conducted between 7:30 am and 2:30 pm on 12 May 2015. The surveyor scanned the escarpments and the sky in three locations along New Mexico 605. The surveyor watched from the highway for two hours in each of these locations. These areas are near mile markers 10, 13 and 17. Photo 1 shows the area surveyed near mile marker 13. Photo 2 shows the area surveyed near mile marker 17. The photo above shows the area surveyed near mile marker 10.

RESULTS

A pair of adult Golden Eagles was observed in the area between mile marker 17 and mile marker 18. They were not seen at a nest during the two-hour observation period. It is not known if they have a nest within a mile of the project area. One Golden Eagle was observed in this same area on the first survey in March 2015.

A female American Kestrel (*Falco sparverius*) was observed entering a cavity and remained in the cavity for most of the two-hour observation period in the area of mile marker 13.

No raptors were seen in the vicinity of mile marker 10 during the May survey. A single eagle had been observed in this area in March.

Photo 1 showing area surveyed near mile marker 13.

Photo 2 showing area surveyed near mile marker 17.

Photo 3 showing favorite Golden Eagle perch near mile marker 17.

No Peregrine Falcons were observed during either survey. However, one was seen during a Gray Vireo survey conducted on 9 June 2015.

A Ferruginous Hawk (*Buteo regalis*) was observed near mile marker 15.5. There is a prairie dog colony in this area. No nest was observed near this area.

A total of 18 additional bird species were seen or heard during this survey. All birds encountered are listed in Table 1.

Table 1. List of avian species encountered during the raptor surveys for the Milan Roca Honda Project conducted on 12 May 2015.

Common name	Scientific name
Turkey Vulture	*Cathartes aura*
Mourning Dove	*Zenaida macroura*
Broad-tailed Hummingbird	*Selasphorus platycercus*
Say's Phoebe	*Sayornis saya*
Loggerhead Shrike	*Lanius ludovicianus*
Pinyon Jay	*Gymnorhinus cyanocephalus*
Western Scrub-Jay	*Aphelocoma californica*
Common Raven	*Corvus corax*
Violet-green Swallow	*Tachycineta thalassina*
Cliff Swallow	*Petrochelidon pyrrhonota*
Rock Wren	*Salpinctes obsoletus*
Canyon Wren	*Catherpes mexicanus*
Blue-gray Gnatcatcher	*Polioptila caerulea*
Northern Mockingbird	*Mimus polyglottos*
MacGillivray's Warbler	*Geothlypis tolmiei*
Brewer's Sparrow	*Spizella breweri*
Lark Sparrow	*Chondestes grammacus*
Western Meadowlark	*Sturnella neglecta*

CONCLUSION

Golden Eagles are using the area between mile marker 17 and mile marker 18. It is not known if they are nesting within a mile of the project area. No active nests were visible from the highway.

Peregrine Falcons are in this area. However, no active nests were visible from the highway.

Appendix B

Gray Vireo
Survey Reports

Gray Vireo Survey Memorandum
For the Milan Roca Honda Project
(Cibola and McKinley Counties)

Prepared by Nancy Cox, Southwestern Ornithological Research & Adventures
Consultant Task No. 15022.110

20 May 2015

INTRODUCTION

A Gray Vireo (*Vireo vicinior*) survey was conducted on 14 May 2015 as part of a project for a proposed water line along New Mexico 605 between Milan and San Mateo, New Mexico. The project area is in Cibola and McKinley Counties, New Mexico.

METHODOLOGY

The survey was conducted between 6:17 am and 9:37 on 14 May 2015. The surveyor would stop every one-third mile for five minutes in appropriate habitat. The surveys began at sunrise and continued throughout the day. The observer would first listen at each stop for 1 - 2 minutes. Then the observer would play a taped call of the Gray Vireo for 30 seconds to elicit a response from nearby Gray Vireos. The surveyor would then listen for another 1 - 2 minutes. The tape would be played one more time for 20 to 30 seconds, then listen for one minute before continuing to the next point. Photo 1 shows the area surveyed near mile marker 13. Photo 2 shows the area surveyed near mile marker 17. The photo above shows the area surveyed near mile marker 23.6.

RESULTS

Two Gray Vireos were heard in the area of mile marker 23.6. One was singing from the northwest of this location and one was singing from the southwest. No other Gray Vireos were detected.

A total of 30 additional bird species were seen or heard during this survey. All birds encountered are listed in Table 1.

Photo 1 showing area to northwest of mile marker 23.6 from which a Gray Vireo was singing.

Photo 2 showing area to southwest of mile marker 23.6 from which a second Gray Vireo was singing.

Table 1. List of avian species encountered during the Gray Vireo survey for the Milan Roca Honda Project conducted on 14 May 2015.

Common name	Scientific name
Turkey Vulture	*Cathartes aura*
Ferruginous Hawk	*Buteo regalis*
Eurasian Collared-Dove	*Streptopelia decaocto*
Greater Roadrunner	*Geococcyx californianus*
Broad-tailed Hummingbird	*Selasphorus platycercus*
American Kestrel	*Falco sparverius*
Say's Phoebe	*Sayornis saya*
Ash-throated Flycatcher	*Myiarchus cinerascens*
Western Kingbird	*Tyrannus verticalis*
Loggerhead Shrike	*Lanius ludovicianus*
Pinyon Jay	*Gymnorhinus cyanocephalus*
Common Raven	*Corvus corax*
Cliff Swallow	*Petrochelidon pyrrhonota*
Barn Swallow	*Hirundo rustica*
Juniper Titmouse	*Baeolophus ridgwayi*
Rock Wren	*Salpinctes obsoletus*
Canyon Wren	*Catherpes mexicanus*
Blue-gray Gnatcatcher	*Polioptila caerulea*
Western Bluebird	*Sialia mexicana*
Mountain Bluebird	*Sialia currucoides*
Northern Mockingbird	*Mimus polyglottos*
Audubon's Warbler	*Dendroica coronata auduboni*
Canyon Towhee	*Pipilo fuscus*
Chipping Sparrow	*Spizella passerina*
Brewer's Sparrow	*Spizella breweri*
Vesper Sparrow	*Pooecetes gramineus*
Lark Sparrow	*Chondestes grammacus*
White-crowned Sparrow	*Zonotrichia leucophrys*
Western Meadowlark	*Sturnella neglecta*
House Finch	*Haemorhous mexicanus*

CONCLUSION

Gray Vireos probably breed in this area. A second survey will be conducted in June in areas where no Gray Vireos were detected during this survey.

Second Gray Vireo Survey Memorandum
For the Milan Roca Honda Project
(Cibola and McKinley Counties)

Prepared by Nancy Cox, Southwestern Ornithological Research & Adventures
Consultant Task No. 15022.110

16 July 2015

INTRODUCTION

A second Gray Vireo (*Vireo vicinior*) survey was conducted on 9 June 2015 as part of a project for a proposed water line along New Mexico 605 between Milan and San Mateo, New Mexico. The project area is in Cibola and McKinley Counties, New Mexico.

METHODOLOGY

The survey was conducted between 5:51 am and 8:15 am on 9 June 2015. The surveyor would stop every one-third mile for five minutes in appropriate habitat. The surveys began at sunrise and continued throughout the day. The observer would first listen at each stop for 1 - 2 minutes. Then the observer would play a taped call of the Gray Vireo for 30 seconds to elicit a response from nearby Gray Vireos. The surveyor would then listen for another 1 - 2 minutes. The tape would be played one more time for 20 to 30 seconds, then listen for one minute before continuing to the next point. Photo 1 shows the area surveyed near mile marker 13. Photo 2 shows the area surveyed near mile marker 17. The photo above shows the area surveyed near mile marker 23.6.

RESULTS

No Gray Vireos were detected during this survey. The area where two Gray Vireos had been heard in May was not included in this survey.

A total of 27 bird species were seen or heard during this survey. All birds encountered during the two surveys are listed in Table 1. All birds encountered during the second survey are also listed in Table 1.
A total of 40 birds were encountered during the two surveys and are listed in Table 2.

CONCLUSION

Gray Vireos probably breed in this area. However, they seem to be restricted to the northeastern end of the project.

Table 1. List of avian species encountered during the two Gray Vireo surveys for the Milan Roca Honda Project conducted on 9 June 2015.

Common name	Scientific name
Scaled Quail	*Callipepla squamata*
Red-tailed Hawk	*Buteo jamaicensis*
Eurasian Collared-Dove	*Streptopelia decaocto*
Mourning Dove	*Zenaida macroura*
Common Nighthawk	*Chordeiles minor*
American Kestrel	*Falco sparverius*
Peregrine Falcon	*Falco peregrinus*
Say's Phoebe	*Sayornis saya*
Ash-throated Flycatcher	*Myiarchus cinerascens*
Cassin's Kingbird	*Tyrannus vociferans*
Loggerhead Shrike	*Lanius ludovicianus*
Pinyon Jay	*Gymnorhinus cyanocephalus*
Common Raven	*Corvus corax*
Cliff Swallow	*Petrochelidon pyrrhonota*
Rock Wren	*Salpinctes obsoletus*
Bewick's Wren	*Thryomanes bewickii*
Blue-gray Gnatcatcher	*Polioptila caerulea*
Western Bluebird	*Sialia mexicana*
Northern Mockingbird	*Mimus polyglottos*
Canyon Towhee	*Pipilo fuscus*
Chipping Sparrow	*Spizella passerina*
Brewer's Sparrow	*Spizella breweri*
Lark Sparrow	*Chondestes grammacus*
Black-throated Sparrow	*Amphispiza bilineata*
Western Meadowlark	*Sturnella neglecta*
Scott's Oriole	*Icterus parisorum*
House Finch	*Haemorhous mexicanus*

Table 2. List of avian species encountered during the two Gray Vireo surveys for the Milan Roca Honda Project conducted on 14 May 2015 and 9 June 2015.

Common name	Scientific name
Scaled Quail	*Callipepla squamata*
Turkey Vulture	*Cathartes aura*
Red-tailed Hawk	*Buteo jamaicensis*
Ferruginous Hawk	*Buteo regalis*
Eurasian Collared-Dove	*Streptopelia decaocto*
Mourning Dove	*Zenaida macroura*
Common Nighthawk	*Chordeiles minor*
Greater Roadrunner	*Geococcyx californianus*
Broad-tailed Hummingbird	*Selasphorus platycercus*
American Kestrel	*Falco sparverius*
Peregrine Falcon	*Falco peregrinus*
Say's Phoebe	*Sayornis saya*
Ash-throated Flycatcher	*Myiarchus cinerascens*
Cassin's Kingbird	*Tyrannus vociferans*
Western Kingbird	*Tyrannus verticalis*
Loggerhead Shrike	*Lanius ludovicianus*
Gray Vireo	*Vireo vicinior*
Pinyon Jay	*Gymnorhinus cyanocephalus*
Common Raven	*Corvus corax*
Cliff Swallow	*Petrochelidon pyrrhonota*
Barn Swallow	*Hirundo rustica*
Juniper Titmouse	*Baeolophus ridgwayi*
Rock Wren	*Salpinctes obsoletus*
Canyon Wren	*Catherpes mexicanus*
Bewick's Wren	*Thryomanes bewickii*
Blue-gray Gnatcatcher	*Polioptila caerulea*
Western Bluebird	*Sialia mexicana*
Mountain Bluebird	*Sialia currucoides*
Northern Mockingbird	*Mimus polyglottos*
Audubon's Warbler	*Dendroica coronata auduboni*
Canyon Towhee	*Pipilo fuscus*
Chipping Sparrow	*Spizella passerina*
Brewer's Sparrow	*Spizella breweri*
Vesper Sparrow	*Pooecetes gramineus*
Lark Sparrow	*Chondestes grammacus*

Black-throated Sparrow	*Amphispiza bilineata*
White-crowned Sparrow	*Zonotrichia leucophrys*
Western Meadowlark	*Sturnella neglecta*
Scott's Oriole	*Icterus parisorum*
House Finch	*Haemorhous mexicanus*

APPENDIX A-3

Wetland Determination and Delineation

Proposed Roca Honda Pipeline Corridor

September 2015, Marron and Associates

Wetland Determination and Delineation

Proposed Roca Honda Pipeline Corridor
Cibola and McKinley Counties, New Mexico

Prepared for
Roca Honda Resources
4002 Office Court Drive Suite 107
Santa Fe, New Mexico 87507

MARRON and ASSOCIATES

September 2015

Table of Contents

Appendices:

Appendix A: Photographs of Potential Wetland Sites Identified on the National Wetland Inventory Maps
Appendix B. San Mateo Creek Wetland Data Sheets
Appendix C. Arroyo del Puerto Wetland Data Sheets

Figures:

Tables:

1.0 INTRODUCTION AND PROJECT DESCRIPTION

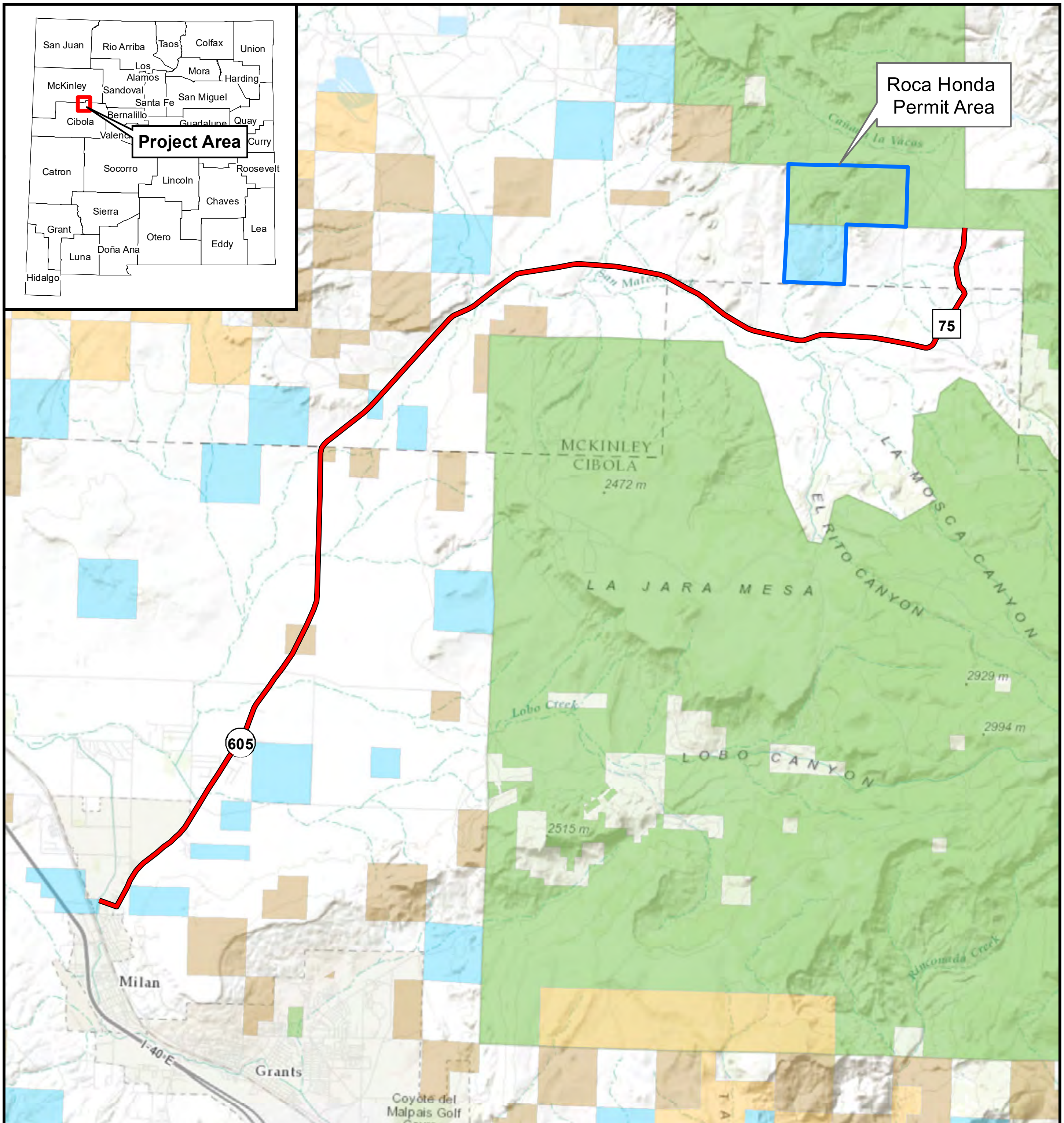
Roca Honda Resources (RHR) is proposing to construct an underground uranium mine near Grants, New Mexico within Cibola and McKinley counties. As part of the planned mine development, a reuse pipeline will need to be constructed to convey treated water from mine dewatering to a point or points of downstream use. The construction of the reuse pipeline will occur along County Road 75 and NM 605 from the Roca Honda Mine southward toward the Village of Milan. This project corridor is approximately 23.7 miles long and is located both within Cibola and McKinley counties (Figures 1 and 2a-2c). The existing roadway corridor in which the pipeline will be placed is mostly flanked by private land and two small parcels of Bureau of Land Management (BLM) and NM State Land. The pipeline will be placed within the right-of-way of county roads, NM Department of Transportation (NMDOT) right-of-way, or in the case of Stanley Avenue in Milan, a residential street. The project corridor is located on the *Milan, Grants, Dos Lomas, and San Mateo* US Geological Service 7.5' quadrangle maps.

The proposed pipeline would cross numerous ephemeral waterways, at least two intermittent waterways. In late 2014, a detailed review of each waterway was conducted in the project area. In the spring of 2015 Marron and Associates, Inc., (Marron) completed wetland determinations and delineations within those waterways where wetland characteristics were present. These determinations were completed using the format and data forms presented in the U.S. Army Corps of Engineers (USACE) *Arid West Region Wetland Delineation Manual*. This report presents the findings of those determinations and delineations. During the initial review of the project area 16 waterways, with channels evident in the project limits, were examined within the project area (Table 1, Figure 2a-2c). Three of these areas (Arroyo del Puerto at milepost [MP] 15.35, upper San Mateo Creek at MP 19.2, and a tributary of San Mateo Creek located at MP 21.25) had wetland characteristics. Ultimately, it was determined that the waterway at MP 21.25 would not be impacted by the project and a wetland determination was not performed at this site. However wetland determinations were completed at San Mateo Creek (MP 19.2) and Arroyo del Puerto (MP 15.35) and both these sites supported wetland. The US Fish and Wildlife Wetland Mapper classifies Arroyo del Puerto and San Mateo Creek as Riverine Intermittent Streambed that is Seasonally Flooded Wetland.

Description of the Environment

__General Overview__

The Roca Honda Pipeline survey area is generally aligned on a north to northeast axis with some sections aligned due north and others due east (Figures 2a-2c). Nearly all the corridor occurs on NMDOT right-of-way surrounded by private lands. Only a few small pieces occur on NM State Lands and BLM lands. The study area is mostly open and flat with a gentle ascending grade to the north. The dominant vegetation across most of the survey area is Desert Grassland, except a few areas along the project corridor that support Juniper Savanna or Coniferous Woodland. All portions of this pipeline corridor occur between approximately 6500 to 7300 feet in elevation above mean sea level (AMSL). All portions of the survey area are immediately accessible via existing NM 605 or connected county roads or residential streets. During the initial research for the project area the U.S. Fish and Wildlife Service (USFWS) Wetland Mapper program was used to determine whether any prior wetlands had been documented in the project area. Surprisingly, 22 locations appeared on wetland mapper as wetlands. The vast majority of these were classified as Riverine Intermittent Streambed (seasonally flooded) wetlands. A few were classified as playa wetlands. All 22 of these drainages and playas were evaluated in the spring of 2015. Appendix A provides a map of their location and photographs of each. The source of the original data which identified these areas as wetlands is uncertain; however, all but three of these reported wetlands lacked any wetland characteristics, and several had no identifiable bank or bed in the project area or culverts under NM 605.



MARRON and ASSOCIATES

Figure 1
Project Location Map

Project Area

Land Ownership

- BLM
- USFS
- Tribal
- Private
- State

Milan, Grants, Dos Lomas, and San Mateo,NM USGS 7.5' Quadrangles

Private, State and BLM Lands McKinley and Cibola Counties, New Mexico

0 1 2 4 Miles

0 2 4 8 Kilometers

N

1:150,000

Roca Honda Project, McKinley and Cibola Counties, New Mexico

Table 1. Location and Status of Waterways Identified With Defined Channels in the Survey Area

#	Name	MP	UTM NAD 83 Zone 13	Channel Width (Feet)	Channel Depth Within OHWM (Feet])	Jurisdictional
1	Irrigation ditch	Stanley Road	E236157/ N3898281	20	1.16)	Y
2	San Mateo Creek	9.1	E242181/ N3910228	31	1.0	Y
3	Unnamed Drainage	10.5	E243605/ N3911800	4	1. ft	Y
4	Unnamed Drainage	11.52	E244893/ N3912983	31	1.25 ft	Y
5	Unnamed Drainage	12.15	E245374/ N3913749	9	8 ft	Y
6	Arroyo del Puerto	12.6	E246040/ N3914231	25	1.91 ft	Y
7	Unnamed Drainage Wide Sheet Flow	15.35	E250001/ N3915451	249	0.25 ft	Y
8	Unnamed Drainage Ditch?	16.15	E251217/ N3915243	10	0.83	Y
9	Unnamed Drainage	18.63	E254796/ N3913538	35	0.25	Y
10	San Mateo Creek (Upper Crossing)	19.2	E255703/ N3913623	30	1.16	Y
11	Unnamed Drainage Plus Ditch?	21.25	E258799/ N3913542	25	1.0	Y
12	Unnamed Drainage	21.67	E259172/ N3914115	34	1.66	Y
13	Unnamed Drainage	21.73	E259218/ N3914176	27	0.83	Y
14	Unnamed Drainage	21.8	E259286/ N3914284	27	1.0	Y
15	San Mateo Creek Trib.	0.48 Lee Ranch Commino Rd CR 75	E259344/ N3915423	26	1.0	Y
16	San Mateo Creek Trib.	0.75 Lee Ranch Commino Rd CR 75	E259367/ N3915823	27	1.0	Y

Figure 2a
Waterways and Wetlands

Project Area
Milepost
Drainage/Waterway

Milan, Grants, Dos Lomas, and San Mateo,NM USGS 7.5' Quadrangles

Private, State and BLM Lands
McKinley and Cibola Counties, New Mexico

0 0.25 0.5 1 Miles
0 0.5 1 2 Kilometers

N
1:55,000

Roca Honda Project, McKinley and Cibola Counties, New Mexico

Figure 2b
Waterways and Wetlands

Project Area
Milepost
Drainage/Waterway

Milan, Grants, Dos Lomas, and San Mateo,NM USGS 7.5' Quadrangles

Private, State and BLM Lands McKinley and Cibola Counties, New Mexico

0 0.375 0.75 1.5 Miles

0 0.5 1 2 Kilometers

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1:55,000

Roca Honda Project, McKinley and Cibola Counties, New Mexico

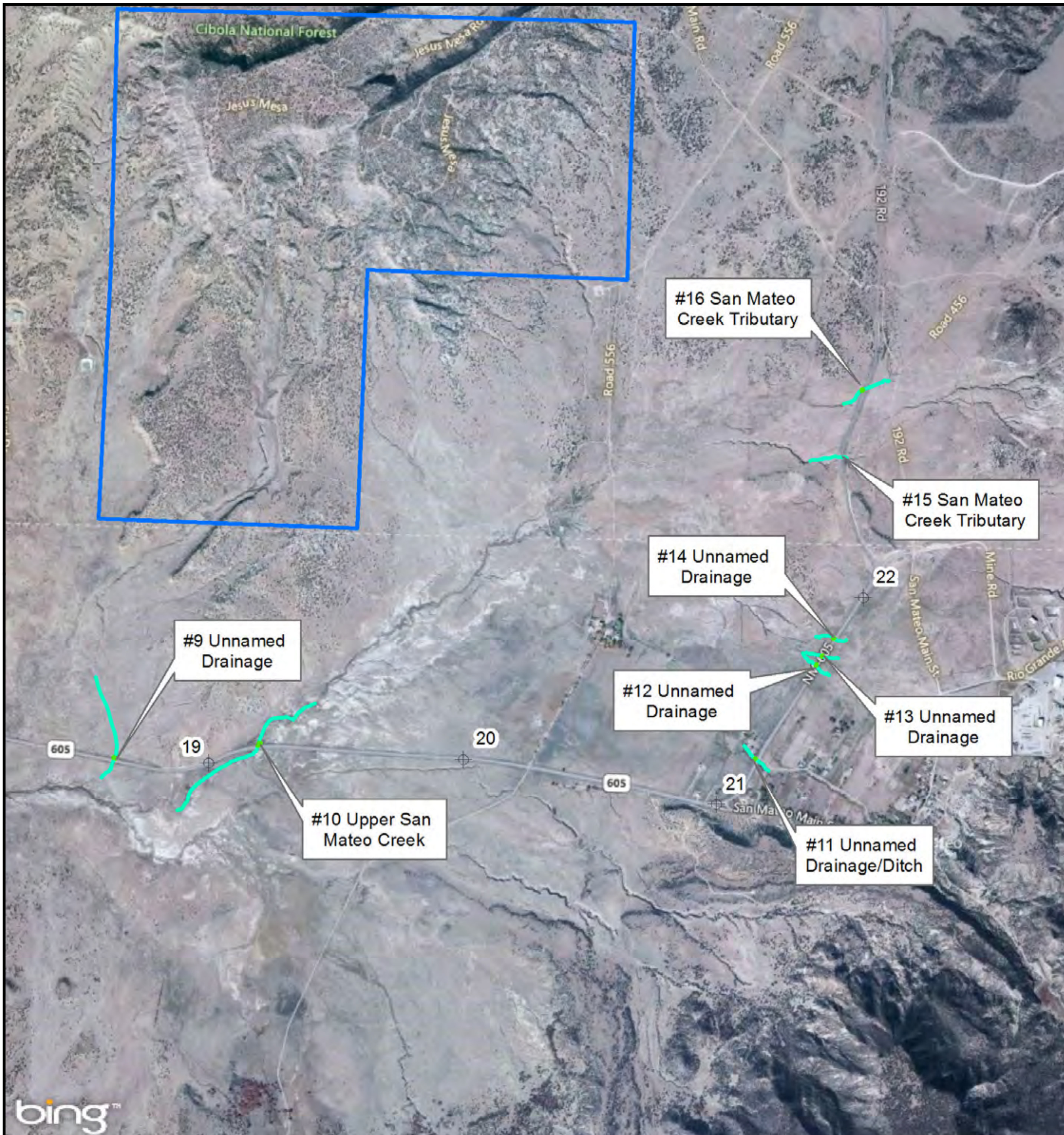


Figure 2c
Waterways and Wetlands

Project Area
Milepost
Drainage/Waterway
Roca Honda Permit Area

Milan, Grants, Dos Lomas, and San Mateo,NM USGS 7.5' Quadrangles

Private, State and BLM Lands McKinley and Cibola Counties, New Mexico

0 0.25 0.5 1 Miles

0 0.375 0.75 1.5 Kilometers

N

1:35,000

Roca Honda Project, McKinley and Cibola Counties, New Mexico

The three waterways that did support wetland characteristics are previously described locations at Arroyo del Puerto, upper San Mateo Creek, and the tributary of San Mateo Creek.

Soils
One soil type occurs around the San Mateo Creek Wetland, this is Sparank Sandy Clay Loam. This is a saline, sodic soil with 1 to 3 percent slopes. These are strongly saline soils that consist of sandy clay loams in the upper 5 inches of the soil profile and silty clay loams in the lower profiles. They fit the general consistency of the soils encountered in the wetland.

All the soils around Arroyo del Puerto are classified as Sparank-San Mateo-Zia Complex, 0 to 3 percent slopes. These soils generally have silty clay loam soils in the upper 2 inches of the profile and clay soils from 2-25 inches below the surface. They are somewhat sodic and their parent material consists of stream alluvium derived from calcareous limestone. The soils within the upper profile at the Arroyo del Puerto wetland fit the general description. Those in the lower profile were more typical of Sandy Clay Loams rather that pure clay. Neither the Sparank Sandy Clay Loam nor the Sparank-San Mateo-Zia Complex are considered hydric soils.

Climate
On average, the survey area is arid to semi-arid where annual precipitation averages 10.3 inches near Milan at the southern end of the survey area, and surprisingly declines to about 8.6 inches per year near San Mateo at the northern portion of the survey area. Overall evaporation is high, ranging from 40 to 60 inches per year depending upon aspect and location. The winters across the survey area are cool and usually wet, receiving precipitation from frontal storms. However, the highest precipitation level is expected in the summer and early fall when monsoon moisture enters the area from the south. The average annual low temperatures are almost identical (approximately 33 to 34 degrees Fahrenheit (°F) between the northern and southern portion of the survey area, but the average highs are about 6 degrees cooler at the northern versus the southern end of the survey area.

Vegetation
The project corridor supported four major natural vegetation types: lower Coniferous Woodland (pinyon-Juniper Woodland), Juniper Savanna, Desert Grassland (or shrub-steppe), and Arroyo Riparian (Dick-Peddie 1993). The most abundant of these communities within the survey area was Desert Grassland that Dick-Peddie classifies as the Shrub-Alkali Sacaton Series. The two wetlands where determinations and delineations were completed (San Mateo Creek and Arroyo del Puerto) both occur in within Arroyo Riparian Zones in areas surrounded by Desert Grasslands.

General Hydrology and Drainages
As previously discussed, 16 waterways were identified in the survey area. These included: natural flows that had been channeled within a man-made ditch structure; 2 crossings of San Mateo Creek; one crossing of Arroyo del Puerto; and 12 crossings of unnamed arroyos, many of which are tributaries of San Mateo Creek. Vegetative composition within these waterways varies dependent principally by availability of water. The drainages with localized watershed convey water sporadically and supported only marginal riparian vegetation. The southernmost drainage located along Stanley Avenue in Milan was dominated by annual weedy species such as summer cypress (*Kochia scoparia*), Russian thistle (*Salsola tragus*), and ragweed (*Ambrosia acanthicarpa*) within the low flow channel. However, the upper banks of this drainage supported coyote willow (*Salix exigua*) and Siberian elm (*Ulmus pumila*). The coyote willow is a Facultative Wetland (FACW) wetland indicator species and requires far more consistent water than the other species present. It appears that this drainage is subject to protracted surface water flows during at least portions of the growing

season followed by periods of intermittent and possibly scouring flows in the channel bottom, but overall the dominant vegetation and soils fail to meet the criteria of a wetland.

Lower San Mateo Creek was dominated by salt cedar (*Tamarix* sp.), alkali sacaton (*Sporobolus airoides*), and four-wing saltbush (*Atriplex canescens*) outside the right-of-way, but was dominated by Russian thistle, common sunflower (*Helianthus annuus*), and four-wing-saltbush within the NM 605 right-of-way.

Arroyo del Puerto supported a cohesive community of perennial vegetation including salt grass (*Distichlis spicata*), and alkali sacaton, with scattered four-wing saltbush. Initially in 2014, this site appeared to lack wetland soils, but after the late summer rainfalls of 2015 and the wet spring of 2015, this site met all the criteria of a wetland.

The upper San Mateo Creek was dominated by salt grass, and alkali sacaton, combined with foxtail barley (*Hordeum jubatum),* three-square rush (*Scirpus americanus*), and greasewood (*Sarcobatus vermiculatus*). A large seep area east of the drainage was dominated by mountain rush (*Juncus articus*) and salt grass. All these species are wetland indicators.

The tributary drainage of San Mateo Creek located at MP 21.15 supported an overstory of Siberian elm, some coyote willow, and other wetland indicator species and appeared to have sufficient hydrology to qualify as a wetland.

All the remaining 10 waterways lacked cohesive Arroyo Riparian vegetation. They often had either scoured, vegetation-free channels or were populated by ephemeral weedy species such as ragweed (*Ambrosia*), Russian thistle, and summer cypress (*Kochia scoparia*) intermixed with the occasional four-wing saltbush, galleta (*Pleuraphis jamesii*), and alkali sacaton. In aggregate, all these drainages intercept approximately 0.09 miles of the pipeline corridor, or less than one percent (0.38 percent) of the survey area.

With the exception of San Mateo Creek, ephemeral surface water is the primary source of hydrology for these waterways. San Mateo Creek has flowing surface water, but there was also substantial evidence of groundwater perched above the east side of San Mateo Creek. In the spring and summer of 2015, small pockets of standing water occurred in the bottom of the roadside borrow ditch east of San Mateo Creek cut on the north side of NM 605 at this location. There had been no rainfall at the site prior to the observation of this water. Additionally, much of the soil in the area has an alkali crust suggesting capillary movement of alkali groundwater to the surface. In addition, aerial photography of this area shows an expansive area of surface alkali crust located extending east of San Mateo Creek for at least two thousand feet and northward of the project area for more than a mile. Most importantly was the vegetation that dominated the bottom of the roadside borrow ditch. The dominants were mountain rush and salt grass occasionally intermixed with three-square rush and even a few small pockets of cattails (*Typha latifolia*). In 2014, this seep area was completely dry and the wetland vegetation was mostly browned and inconspicuous, but the wet spring of 2015 appears to have rejuvenated the area, and lush wetland vegetation was growing along a substantial length of this ditch east of San Mateo Creek.

Agency Coordination

Biological studies of the project area have been underway since 2014. These studies have included surveys for any species that appear on the USFWS list. No federal listed species occur in the project area, nor is there any designated critical habitat for protected species within or adjacent to the project area.

2.0 HYDROLOGY DESCRIPTION IN THE SAN MATEO CREEK AND ARROYO DEL PUERTO STUDY AREAS

The development of wetland is dependent upon hydrology. The wetland hydrology in both Arroyo del Puerto and San Mateo Creek wetlands appear to have surface water present on an ephemeral basis and San Mateo Creek has groundwater present. There is evidence that groundwater is present across a large area near San Mateo. Direct observation of alkali crust and scattered FACW wetland plants were noted in areas west of San Mateo both within and north of the N 605 right-of-way. We also noted that the NM 605 roadway construction in this area appears to have small boulders beneath the roadway prism suggesting a possible French drain configuration to allow groundwater to move beneath the roadway. Additionally, a very deep borrow ditch was cut along the north side of the roadway at this location draining directly into San Mateo Creek. Based on the distribution of alkali crust and general topography of the area it appears that this groundwater may be moving northeast to southwest. There are at least five known springs along San Mateo Creek north of the San Mateo Creek wetland that appear on the U.S. Geological Survey (USGS) topographic map for this area. These springs probably provide much of the surface water that appears within the channel of San Mateo Creek during the dry season. This groundwater appears to be the primary source of hydrology for a long borrow ditch-/trench-like area located north of NM 605 and east of San Mateo Creek. The entire length of this trench supports wetland vegetation. In addition to groundwater and surface flows associated with it, the San Mateo Creek watershed is of sufficient size to convey large stormwater surges as evidenced by drift lines and debris along the edge of the channel far above the elevation of the groundwater influenced habitat.

Further west of San Mateo Creek near Arroyo del Puerto, there was no evidence of groundwater. If groundwater existed at the site in the past, it likely dried up during the recent drought and has not resurfaced. Arroyo del Puerto appears to flow far less regularly than San Mateo Creek, and there was no saturated soil at or near the surface, although there was no indication of protracted surface water flows during the fall 2014 and spring 2015 surveys at this location. There is ample evidence that brief large surface water flows occur within this waterway after storm events. These ephemeral surface flows, combined with the configuration of the channel bottom downstream of the bridge have provided enough hydrology to support the establishment of a small patch of FAC (Facultative) and FACW (Facultative Wetland) wetland vegetation in the channel bottom. It appears that after storm events, water pools downstream of the bridge in the channel bottom. The soils in the profile are sandy and silty clay loams with enough clay content to hold the water and result in some soil reduction. This wetland probably disappeared during the drought years of 2010-2014. For example, the same site was studied in 2014, and there was insufficient hydrology to result in reduction of the soil. However, in 2015 there were sufficient redox concentrations to just meet the soil criteria for a wetland. It is likely that this site switches back and forth between non-wetland and wetland dependent upon long-term weather conditions, but in 2015 it marginally met the criteria for a wetland.

3.0 DESCRIPTION OF WETLANDS DELINEATED IN THE PROJECT AREA

San Mateo Creek Wetland (MP 19.2) Overview
The San Mateo Creek Wetland (MP 19.2) occurs on the north side of NM 605. This wetland includes the channel of San Mateo Creek as well as a linear ditch-like feature that extends from the east bank of San Mateo Creek (parallel to the north side of NM 605) eastward over 1,000 linear feet (Figures 3, 4, 5a and 5b). The lower reach of San Mateo Creek that crosses the project area near MP 9.1 is an ephemeral waterway, and in the last two years of study along NM 605 we have never seen it flow. However, the portion of San Mateo Creek at MP 19.2 has had surface water present consistently from the fall of 2014 through the summer of 2015. This area appears to receive some of its hydrology from surface flows that originate on the west flank of Mount Taylor, but the more important hydrology for the site is derived from groundwater perched north of NM 605 between MPs 19 and21. The extent of this groundwater can be inferred from aerial photographs of the region that show extensive salt deposition on the soil surface north of NM 605. This salt is being conveyed to the surface via capillary movement of groundwater upward. These salt deposits are concentrated principally east of San Mateo Creek near MP 19.2. Topographic maps of the area identify 5 known springs (commonly referred to as the Bridge Springs Complex) that occur along San Mateo Creek between 800-2900 feet north of the NM 605 bridge at MP 19.2 (Figure 3). All but 1 of these is also located on the east side of the San Mateo Creek. The locations of these springs on the east side of the creek, coupled with the distribution of salt encrusted on the surface of the soil, and the topography of the area, suggests that the groundwater flow and hydrological gradient is from the east to the west. We believe groundwater from the northwest base of Mount Taylor flows from east to west past the town of San Mateo and is intercepted by the north/south flowing portion of San Mateo Creek located immediately north of NM 605 at MP 19.2. The springs along the edge of the creek and shallow groundwater east of the creek are the product of this groundwater movement.

Aerial photography of the area also shows that riparian vegetation along the edge of the creek nearly disappears about 2 miles north of NM 605 at nearly the same location that the clearly defined surface salt crusts disappears. This also contributes credence to the idea that the primary source of hydrology for vegetation along San Mateo Creek is the movement of groundwater surfacing along the cut channel of the creek. These data have lead us to the conclusion that the majority of wetland hydrology noted at the San Creek Wetland at MP 19.2 is derived from groundwater. The presence of this groundwater is important not only to the wetland within the channel of San Mateo Creek, but also the wetland habitat noted in the borrow ditch along the north side of NM 605 east of San Mateo Creek. In 2014, this borrow ditch area was dry, and wetland vegetation was not thriving. By the spring of 2015, the actively growing wetland vegetation within this ditch extended over a 1000 feet east of San Mateo Creek. A more careful examination of this area in the bottom of this ditch found the old stems of cattails that apparently occurred along this ditch prior to 2014. Based on the salt crusting, the presence of surface water at a few locations along the ditch in the spring of 2015, and the presence of the old stems of obligate wetland plants such as cattails, we believe that this ditch area supported a much better developed wetland in the recent past. It is possible that the drought conditions over the last decade affected the groundwater in this area that led to this wetland drying up. The borrow ditch along NM 605 at this location is in perfect position to intercept groundwater flows from the east. During the wetland delineation of the borrow ditch we found large cobbles and small boulders along the base of the toe slope of the north side of the roadway where the borrow ditch occurs. We believe that when the road was installed, this area was wet enough to pose a potential problem. The designers may have placed a layer of cobbles and boulders beneath the road prism to allow groundwater to flow beneath the road like a French drain. They also installed the borrow ditch to intercept as much water as possible and convey it eastward to discharge into San Mateo Creek. In 2005, most of this borrow ditch has sufficient wetland vegetation and soil reduction to qualify as a wetland but lacked the hydrology. Only a few portions of this ditch currently have sufficient hydrology indicators to meet wetland criteria. However, with the end of the drought and the possibility of groundwater recharging in the area, the borrow ditch along the north side of NM 605 may eventually support emergent wetland along most of its length.

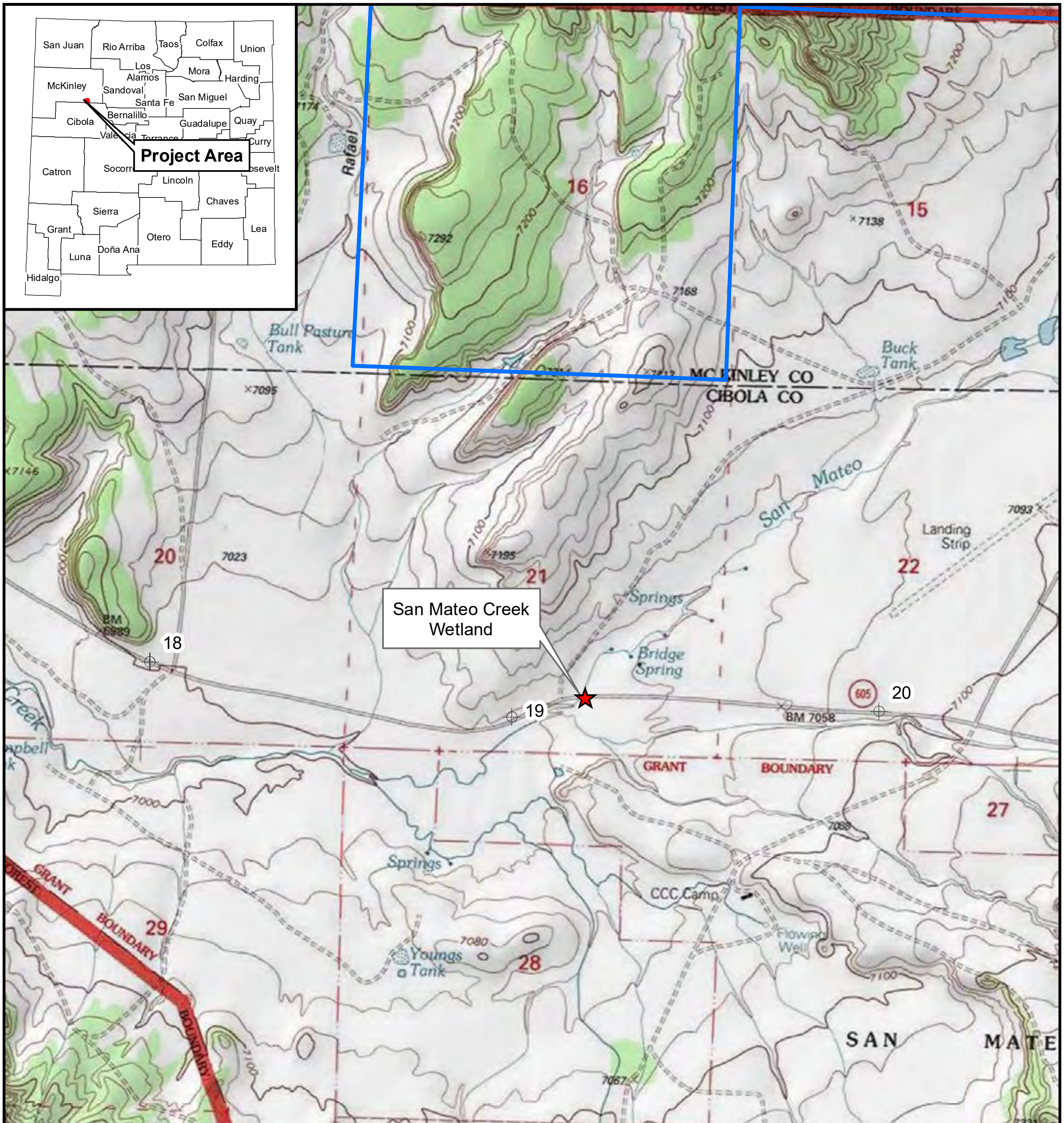
Determinations and Delineations for the San Mateo Creek Wetland (MP 19.2)

The San Mateo Creek Wetland occurs along the north side of NM 605 at MP 19.2. The site occurs within the southeast quarter of Section 21 in Township 13 N, Range 8W. The road crossing of San Mateo creek occurs at approximately Universal Transverse Mercator (UTM) Zone 13 E255703/ N3913623 NAD 83. The wetland appears on the San Mateo 7.5' USGS topographic map 35107 (Figures 3 and 4). The San Mateo Creek channel portion of the wetland appears on the National Wetland Inventory mapping as R4SBC (Riverine Intermittent Occasionally Flooded), but the wetland in the borrow ditch along NM 605 does not appear on the inventory.

Nine wetland study sites were required to delineate the San Mateo Creek Wetland (Figure 4). The wetland area consists of the bottom of the channel of San Mateo Creek, the borrow ditch channel that discharges into San Mateo Creek within the project area, and a portion of an old cutoff creek channel located west of the existing channel. It appears that historically a side channel of the creek occurred at this location, curving west of the existing active channel. During high flow events water probably flowed through this channel. However, when the NM 605 roadway was constructed, the flow of this side channel appears to have been cut off. There is no culvert at this location and no way for water to get through the road prism. There was no indication of recent standing water in this side channel. It appears that during very large flow events water may spill into this channel and probably pool before evaporating. The San Mateo Creek wetland study sites were placed to best delineate this complicated mixture of active flow channels, old channels, and groundwater fed ditches. The position of these sites is presented in Figure 4 and described in the paragraphs that follow.

- Site 1 was placed within the bottom of the channel of San Mateo Creek just north of the NM 605 bridge within the ordinary high water mark (OHWM).
- Site 2 was placed on the upper bank of San Mateo Creek just north of the NM 605 bridge, above the OHWM.
- Site 3 was placed within the bottom of the old cut off creek channel west of San Mateo Creek and north of NM 605.
- Site 4 was placed in the bottom of the borrow ditch north of NM 605 and approximately 310 feet east of San Mateo Creek.
- Site 5 was placed in the bottom of the borrow ditch north of NM 605 and approximately 485 feet east of San Mateo Creek.
- Site 6 was placed in the bottom of the borrow ditch north of NM 605 and approximately 654 feet east of San Mateo Creek.
- Site 7 was placed on the upland bench above the north side of the borrow ditch and north of NM 605 and approximately 654 feet east of San Mateo Creek.
- Site 8 was placed in the bottom of the borrow ditch north of NM 605 and approximately 793 feet east of San Mateo Creek
- Site 9 was placed in the bottom of the borrow ditch north of NM 605 and approximately 1007 feet east of San Mateo Creek.

Photographs of this wetland appear in Figures 5a and 5b, and wetland data sheets for each of the study sites appear in Appendix B.



★ Wetland

Roca Honda Permit Area

Milepost

Milan, Grants, Dos Lomas, and San Mateo,NM USGS 7.5' Quadrangles

Private, State and BLM Lands McKinley and Cibola Counties, New Mexico

0 0.125 0.25 0.5 Miles

0 0.25 0.5 1 Kilometers

N

1:24,000

MARRON and ASSOCIATES

Figure 3
San Mateo Creek Wetland on USGS 7.5 Minute Quadrangle

Roca Honda Project, McKinley and Cibola Counties, New Mexico

Wetlands

Wetland Pits

Figure 4
Close up of
San Mateo
Creek Wetland

Milan, Grants, Dos Lomas,
and San Mateo,NM
USGS 7.5' Quadrangles

Private, State
and BLM Lands
McKinley and Cibola
Counties, New Mexico

0 50 100 200 Feet

0 20 40 80 Meters

N

1:1,700

Roca Honda Project, McKinley and Cibola Counties, New Mexico

Figure 5a.(Above)Channel of San Mateo Creek dominated by herbaceous wetland vegetation. (Below) Surface water pooled in the San Mateo Creek Channel at the NM 605 bridge. (Photos taken June 24, 2015)

Figure 5b. (Above) Wetland area near Site 6 within the borrow ditch north of NM 605. (Below) A drier part of the borrow ditch between near Site 5 that does not currently qualify as wetland. (Photos taken June 24, 2015)

Wetland Criteria

Hydrology

As previously discussed, the hydrology for the San Mateo Creek wetland is derived from groundwater and intermittent surface water flows. A large area of perched groundwater occurs immediately east and northeast of the San Mateo Creek Wetland. The ultimate source for this groundwater is uncertain. However, the north slopes of the Mount Taylor lay immediately east of the project area and infiltration of snow on these slopes is a potential candidate for the hydrological source of this aquifer. Surface water flows do occur within the project area as evidenced by drift line and sediment on the vegetation, but they do not appear to be the source of the day-to-day hydrology evidenced by pools of standing water in the channel of the creek near NM 605. The lobe of wetland habitat that occurs within the borrow ditch along the north side of San Mateo Creek derives its hydrology wholly from groundwater. Based on repeated observation of the area, most of the wetland documented would not be present without the extensive groundwater in the area, as described in the paragraphs that follow.

- Site 1 had saturated soil at 4 inches below the surface and groundwater in the pit at 11 inches below the surface. There were also riparian drift lines on the vegetation and riparian sediment deposits on the wall of the culvert. This site meets the hydrology requirement for a wetland.
- Site 2 lacked any primary or secondary hydrology indicators and fails to meet the hydrology requirement for a wetland.
- Site 3 lacked any primary or secondary hydrology indicators and fails to meet the hydrology requirement for a wetland.
- Site 4 had saturated soil at 12 inches below the surface. There was also pooled surface water in low spots nearby. Additionally, there were non-riverine sediment deposits on the vegetation from periods of pooled surface water at the site. This site meets the hydrology requirement for a wetland.
- Site 5 did not have water present, but there was a salt crust that indicates past shallow groundwater that moved to the surface by capillary actions. This site meets the hydrology requirement for wetlands.
- Site 6 did not currently have water present, but was very damp 4 inches below the surface. There was a salt crust that indicates past shallow groundwater that moved to the surface by capillary actions. This site meets the hydrology requirement for wetlands.
- Site 7 has no water present, nor were there any indications of past hydrology indicators. It fails to meet the hydrology requirement for wetlands.
- Site 8 did not have water present, but based on the vegetation it is likely that wetlands have occurred in this area in the past and will likely occur there again. However, at this time it fails to meet the hydrology requirement.
- Site 9 did not have water present, but based on the vegetation it is likely that wetlands have occurred in this area in the past and will likely occur there again. However, at this time it fails to meet the hydrology requirement.

Based on the data collected Sites 1, 4, 5, and 6 meet the hydrology requirements for a wetland.

Soils

One soil type occurs at the San Mateo Creek wetland area. This is the Sprank sandy clay loam, Saline, sodic, 1-3 percent slopes. This soil type occurs in stream alluvium derived from sandstone and shales. These soils usually have a thin layer 0-2 inches thick of silt loam at the surface subtended by thick layers of clay, clay loam or sandy loam. This soil type does not appear on the NM hydric soil list. The various soils found within the project area include 10YR 4/2 clay loam, 10YR 5/2 clay loam, 10YR 4.3 sandy loam, 10YR 3/3, clay loams, 10yr 3/2 and 10YR 4/2 clay and clay loams with redox concentration. These soil types fit within the general description for the Sprank sandy clay loam soils.

The following is a brief description of the soils at each wetland study site.

- Site 1 had uniform chroma 2 soils throughout the profile with both redox concentrations and redox depletion zone. It meets the soil criteria for a wetland.
- Site 2 had chroma 2 soils throughout the profile but lacked any redoxymorphic features. This site fails to meet the soil criteria for a wetland.
- Site 3 had low chroma soils in the upper and mid profile and a very small amount of oxidized root channels in the upper profile (less than 1%). There were many more in the mid profile. Those in the upper profile are too few to meet hydric soil criteria, and those in the middle are too deep. This site fails to meet the soil requirement for a wetland.
- Site 4 had low chroma soils in the upper profile and had very oxidized root channels present meeting the Redox Dark Surface Criteria. It also had saturated soil present at 12 inches below the surface marginally meeting the aquic soil criteria. This site meets the hydric soil criteria for a wetland.
- Site 5 had low chroma soils and some redox present in the lower profile, but these redox features were too deep to meet hydric soil criteria.
- Site 6 had low chroma soils throughout the profile with Redox concentrations in the form of oxidized root channels in all areas except the root zone. This site meets the soil criteria for a wetland.
- Site 7 had high chroma values in the upper profile and lacked any redox features. It fails to meet the soil requirement for a wetland.
- Site 8 had low chroma soils throughout the profile with Redox concentrations in the form of oxidized root channels in all areas except the root zone. This site meets the soil criteria for a wetland.
- Site 9 had low chroma soils throughout the profile but lacked Redox features. This site fails to meet the soil criteria for a wetland.

Based on the data collected Sites 1, 4, 6 and 8 meet the hydric soil requirements for a wetland.

Vegetation

The San Mateo Creek Wetland included riparian vegetation lining the creek edge as well as vegetation developing along the seep area located east of the creek. The vegetation along the creek was dominated by *Sarcobagus vermiculatus* (FAC-Facultative) (greasewood) along the upper bank of the creek, with *Hordeum jubatum* (FAC) (foxtail barley), *Scirpus americanus* (OBL-Obligate) (chairmakers rush), and *Distichlis spicata* (FACW-Facultative Wetland) (salt grass) on the active floodplain of the creek. The areas just above the creek supported a mixture of mainly upland shrubby species including *Sarcobatus vermiculatus*, *Atriplex canescens* (NL-Not Listed) (four-wing saltbush), and *Ericameria nauseosa* (NL) (rabbitbrush). There were also some dense stands of *Tamarix chinensis* (FAC) (salt cedar) surround the edges of the creek. The borrow ditch seep area along the north side of NM 605 east of San Mateo Creek supported a mixture of *Sarcobatus vermiculatus*, *Juncus articus* (FACW), *Carex* sp. (FACW) (sedge), and *Sporobolus ariodes* (FAC) (alkali sacaton) within the ditch channel. The top of the banks above the ditch were dominated principally by *Ericameria nauseosa*, but intermixed with *Sarcobatus vermiculatus*. There were also scattered patches of *Sporobolus airoides* and *Juncus articus* present.

The following are brief descriptions of the vegetation at each of the study sites within the San Mateo Creek Wetland.

- Site 1 occurs within the channel bottom of San Mateo Creek and all plant species encountered at and around the site were wetland indicator species. This site meets both the dominance test and prevalence index and meets the vegetation requirements for a wetland.
- Site 2 occurs on the slope above the channel bottom of San Mateo Creek. It was dominated by a mixture of upland shrubs and a hydrophytic grass. However, there were not enough wetland plants present to meet either the dominance test or prevalence index. This site fails to meet the vegetation requirements for a wetland.
- Site 3 occurs within a large depression that looks like may have historically been part of the San Mateo Creek channel but was cut off when the road was installed. It was dominated by salt cedar (a FAC species) and meets both the dominance test and prevalence index for a wetland.
- Site 4 occurs within a shallow depression that parallels the NM 605 roadway. It may have been an old borrow ditch which intercepts groundwater flow and conveys it to San Mateo Creek. It was dominated by wetland vegetation and meets both the dominance test and prevalence index.
- Site 5 occurs within a shallow depression that parallels the NM 605 roadway. It may have been an old borrow ditch which intercepts groundwater flow and conveys it to San Mateo Creek. It was dominated by wetland vegetation and meets both the dominance test and prevalence index.
- Site 6 occurs within a shallow depression that parallels the NM 605 roadway. It may have been an old borrow ditch which intercepts groundwater flow and conveys it to San Mateo Creek. It was dominated by wetland vegetation and meets both the dominance test and prevalence index.
- Site 7 occurs on top of the bank above the borrow ditch depression. It was dominated by a mixture of wetland and non-wetland species but meets the dominance test for wetland vegetation.
- Site 8 occurs within a shallow depression that parallels the NM 605 roadway. It may have been an old borrow ditch, which intercepts groundwater flow and conveys it to San Mateo Creek. It was dominated by wetland vegetation and meets both the dominance test and prevalence index.
- Site 9 occurs within a shallow depression that parallels the NM 605 roadway. It may have been an old borrow ditch, which intercepts groundwater flow and conveys it to San Mateo Creek. It was dominated by wetland vegetation and meets both the dominance test and prevalence index.

Based on the data collected Sites 1, 3, 4, 5, 6, 7, 8, and 9 meet the vegetation requirement for a wetland.

Wetland Determination and Delineation for the San Mateo Creek Wetland
This section is a summary of the data pertinent to the determination of a wetland. The data forms used in the determination of each site are presented in Appendix B.

Determination
Table 2 presents a summary of the findings of wetland determinations at the San Mateo Creek Wetland.

Table 2. **Findings of Wetland Determination at the San Mateo Creek Wetland**

Site Name	Vegetation	Hydrology	Soils	Meets All Criteria
Site 1	Yes	Yes	Yes	**Yes**
Site 2	No	No	No	No
Site 3	Yes	No	No	No
Site 4	Yes	Yes	Yes	**Yes**
Site 5	Yes	Yes	No	No
Site 6	Yes	Yes	Yes	**Yes**
Site 7	Yes	No	No	No
Site 8	Yes	No	Yes	No
Site 9	Yes	No	No	No

Sites 1, 4, and 6 met all the criteria for a wetland. Site 2 lacked any wetland characteristics. Sites 3 had wetland vegetation present but lacked both hydric soils and wetland hydrology. Sites 5, 7, 8, and 9 all occur within the borrow ditch north of NM 605; although all met the vegetation criteria, they lacked either wetland hydrology or soils (or both). Site 5 also meet the hydrology criteria based on the presence of a salt crust, but lacked hydric soils near the surface. Site 8 had wetland soils present, but lacked current wetland hydrology. Sites 7 and 9 lacked both hydric soils and wetland hydrology. Based on the data acquired, the area along the banks and channel bottom of San Mateo Creek and portions of the borrow ditch along the along the north side of NM 605 qualify as wetland. However, there were indications that the borrow ditch had much more water in the past, and those portions of the ditch that failed to meet either the soil or hydrology criteria in 2015 could meet both criteria in the future if shallow groundwater returned to the area.

Delineation

Most habitat along the bottom of San Mateo Creek qualifies as wetland. Approximately 0.011 acres of wetland occurs in the area between the bridge and the north NM 605 right-of-way fence. An additional 0.024 acres of wetland occurs in two distinct polygons in the borrow ditch north of the roadway and east of San Mateo Creek. However, it should be noted that with the passing of the drought, this area could get much wetter in the future. In total, about 0.035 acres of wetland or approximately 1525 square feet of wetland occur in the project area (Figure 4). It is currently unknown if this wetland will be impacted by the project.

Function

The San Mateo Creek wetland provides sufficient vegetative cover for sediment removal and may also provide the potential for nutrient and toxicant removal. The combined palustrine emergent vegetation, scrub/shrub salt cedar patches provides wildlife habitat for nesting birds. Similarly, this wetland provides general habitat for wildlife and seasonal use by avian species during migration.

Determinations and Delineations for the Arroyo del Puerto Wetland (MP 19.2)

The Arroyo del Puerto Wetland occurs along the south side of NM 605 at MP 15.35. The site occurs within the Section 21 in Township 13N, Range 8W. The road crossing of San Mateo creek occurs at approximately UTM Zone 13 E246039/ N3914233 NAD 83. The wetland appears on the San Mateo 7.5' USGS topographic map 35107 (Figures 6, 7, and 8). The Arroyo del Puerto Wetland appears as R4SBC Riverine Intermittent Occasionally flooded on the National Inventory Wetland Map.

Two wetland study sites were required to delineate the Arroyo del Puerto (Figure 7). The wetland area consists of a small portion at the bottom of the channel or Arroyo del Puerto where water briefly pools after storm events. In recent years this channel has been mostly dry during the growing season. It is uncertain how wet it was prior to the drought, but the presence of FACW species such as *Distichlis spicata* suggests there must have been more than casual water present. Only a small portion of the arroyo downstream of the bridge had enough wetland vegetation present to warrant a wetland determination. One pit was placed within this vegetation, the other on top of the adjacent bank. The position of these sites is shown in Figure 7 and described in the paragraphs that follow.

- Site 1 was placed within the bottom of the channel of Arroyo del Puerto just south of the NM 605 bridge within the OHWM.
- Site 2 was placed on the low bank of Arroyo del Puerto just south of the NM 605 bridge above the OHWM.

Photographs of this wetland appear in Figure 8 and wetland data sheets for each of the study sites appear in Appendix C.

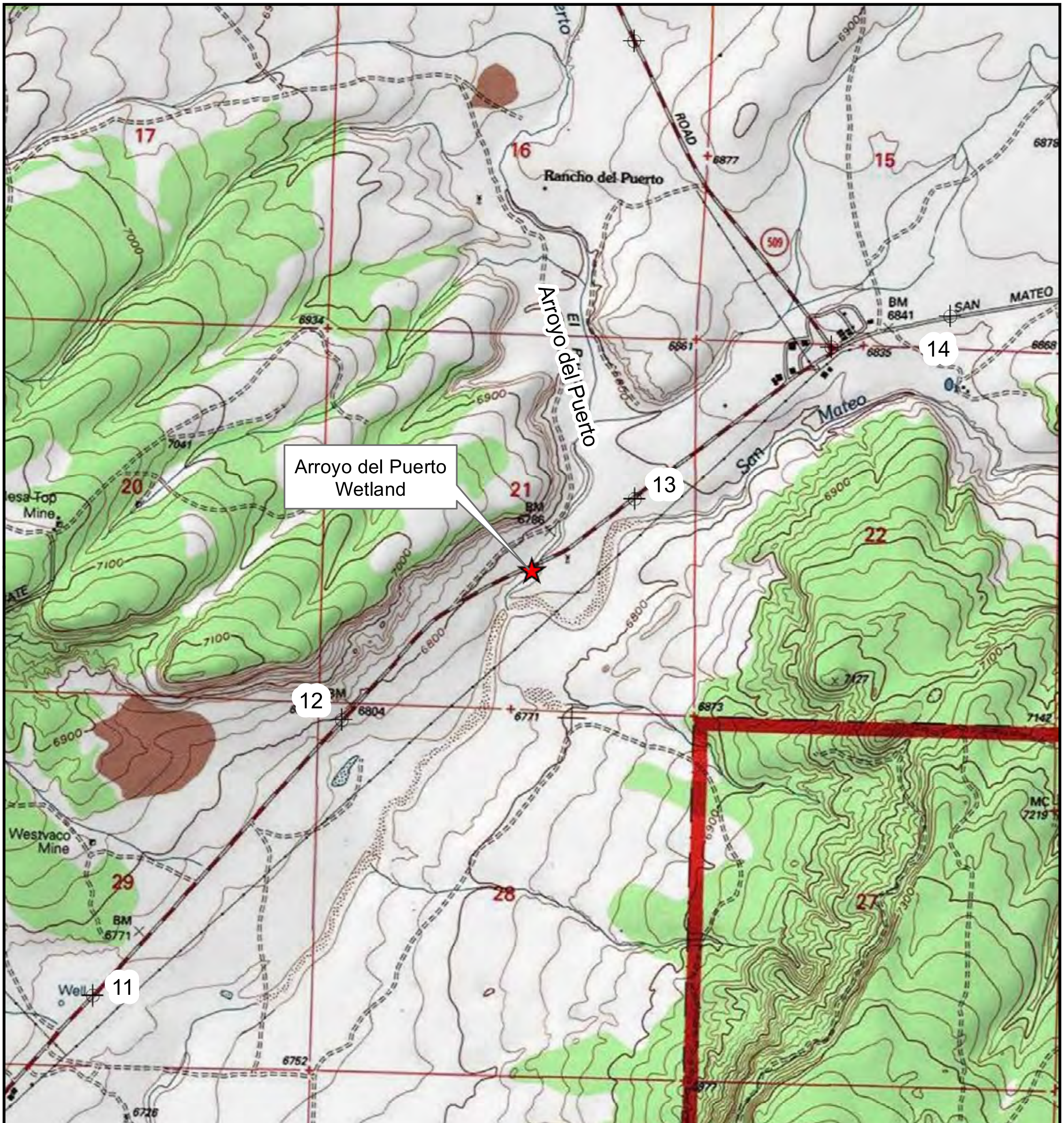


Figure 6
Arroyo del Puerto
Wetland on USGS
7.5 Minute Quadrangle

★ Wetland

⌖ Milepost

Milan, Grants, Dos Lomas, and San Mateo,NM USGS 7.5' Quadrangles

Private, State and BLM Lands McKinley and Cibola Counties, New Mexico

0 0.25 0.5 Miles

0 0.25 0.5 1 Kilometers

N

1:24,000

Roca Honda Project, McKinley and Cibola Counties, New Mexico

Wetland

Wetland Pit

Milan, Grants, Dos Lomas, and San Mateo,NM USGS 7.5' Quadrangles

Private, State and BLM Lands McKinley and Cibola Counties, New Mexico

0 20 40 80 Feet

0 5 10 20 Meters

N

1:700

Figure 7
Close up of Arroyo del Puerto Wetland

Roca Honda Project, McKinley and Cibola Counties, New Mexico

Figure 8. (Above)Channel of Arroyo del Puerto—note the green patch of vegetation just inside the fenceline on the channel bottom. (Below) A view of the dense green vegetation in a small portion of the channel bottom of Arroyo del Puerto. The density and composition of this vegetation changes from year to year dependent upon rainfall.

Wetland Criteria

Hydrology

There is no indication of ground water at Arroyo del Puerto. It appears that currently the sole source of hydrology at this site is surface water flows. There is evidence (drift lines, debris, sediment bands on the bridge piers) that brief large surface water flows occur within this waterway after storm events. These ephemeral surface flows combined with the configuration of the channel bottom downstream of the bridge have provided enough hydrology to support the establishment of a small patch of FAC and FACW wetland vegetation in the channel bottom. Some from the storm events temporarily pools downstream of the NM 605 bridge. The soils at that location are sandy and silty clay loams with enough clay content to hold the water and result in some soil reduction. The hydrology for this wetland is very tenuous. This wetland probably disappeared during the drought years between 2010 and 2014. For example, the same site was studied in 2014, and there was insufficient hydrology to result in reduction of the soil. However, in 2015 there were sufficient redox concentrations to just meet the soil criteria for a wetland. It is likely that this site switches between non-wetland and wetland dependent upon long-term weather conditions, but in 2015 it marginally met the criteria for a wetland. The following paragraphs describe of the hydrological conditions noted at the study sites at Arroyo del Puerto.

- Site 1 was dry at the time of the survey and has been dry during past visits. But there were drift deposits and sediment deposits on some vegetation. The right-of-way fence south of the roadway appears to be catching some debris at the base. During storm flows, it appears that a shallow pool of water forms in the channel bottom upstream of the fence. This water is sufficient to leave sediment on vegetation as it dries and there are drift deposits along the edge of the OHWM. This site meets secondary riverine criteria for a wetland.
- Site 2 is located above the ordinary high-water-mark and lacked any primary or secondary wetland hydrology indicators. It fails to meet the hydrology criteria for a wetland.

Based on the data collected only Site 1 met the hydrology requirements for a wetland.

Soils

One soil type occurs at the Arroyo del Puerto within the project area. This is the Sprank San Mateo-Zia Complex, 0-3 percent slopes. This soil type occurs in stream alluvium derived from calcareous sandstone. These soils usually have a thin layer 0-2 inches thick of silt loam at the surface subtended by thick layers of clay, clay loam, or sandy loam. The soils within the channel of Arroyo del Puerto fit the general description of this soil type. Those in the adjacent upland were similar but lacked the silty clay loam layer in the upper profile.

The following is a brief description of the soils at each wetland study site.

- Site 1 had chroma 2 soils with both redox concentrations. The layer with the redox concentrations is 5 inches thick and wholly within 10 inches of the surface. It meets the Redox Dark Surface criteria.
- Site 2 had chroma 3 or 4 soils throughout the profile and fails to meet any of the hydric soil criteria.

Based on the data collected Site 1 met the hydric soil requirements for a wetland.

Vegetation

There was very little shrubby vegetation along Arroyo del Puerto. Aside from a few scattered *Atriplex canescens* (not listed) the dominant vegetation was principally weedy annual species intermixed with some perennial grasses. The dominant species in the channel of the arroyo were *Kochia scoparia* (FAC) (summer cypress) and *Distichlis spicata* (FACW). There were also scattered *Grindellia nuda* (not listed) and *Agropyron* *cristatum* (not Listed) (Western wheat grass). The adjacent uplands along the edge of the channel were also dominated by *Kochia scoparia* intermixed with very scattered *Atriplex canescens*. In dry years, the *Kochia scoparia* is probably not present leaving only *Distchilis spicata* as the sole wetland plant in the drainage.

The following are brief descriptions of the vegetation at each study site within the Arroyo del Puerto Wetland:

- Site 1 occurs within the channel bottom of Arroyo del Puerto. The dominant vegetation is the annual *Kochia scoparia*, which is a FAC indicator. The codominant at the site is *Distichlis spicata*, which is a FACW indicator. This site meets both the dominance test and prevalence index and meets the vegetation requirements for a wetland
- Site 2 was dominated by the annual *Kochia scoparia* (FAC). There was *Atriplex canescens* (not listed) present, but it was not a dominant. It meets the dominance test for wetland vegetation and meets the vegetation requirements for a wetland.

Based on the data collected Sites 1 and 2 meet the vegetation requirement for a wetland.

Wetland Determination and Delineation for the Arroyo del Puerto Wetland

This section is a summary of the data pertinent to the determination of a wetland. The data forms used in the determination of each site are presented in Appendix C.

Determination

Table 3 presents a summary of the findings of wetland determinations at the Arroyo del Puerto Wetland.

Table 3. Findings of Wetland Determination at the Arroyo del Puerto Wetland

Site Name	Vegetation	Hydrology	Soils	Meets All Criteria
Site 1	Yes	Yes	Yes	**Yes**
Site 2	Yes	No	No	No

Sites 1 meets all criteria for a wetland, but as previously discussed this is an extremely marginal wetland. It could easily switch from a wetland to non-wetland from year to year dependent upon the type and density of vegetation cover. It could also be modified by a high velocity flow that would remove the shallow wetland soils just beneath the surface. However, in 2015 it did meet the requirements for a wetland.

Delineation

Only a small portion of the channel bottom of Arroyo del Puerto qualifies as wetland. Approximately 320 square feet or 0.007 acres of wetland occur on the channel bottom downstream of the NM 605 bridge. (Figure 7). It is currently unknown if this wetland will be impacted by the project.

Function

The Arroyo del Puerto wetland has very little wetland function. It does have the potential to remove some sediment during low velocity flows, but little else can be expected of it.

4.0 SUMMARY OF WETLANDS AND POTENTIAL FOR MITIGATION

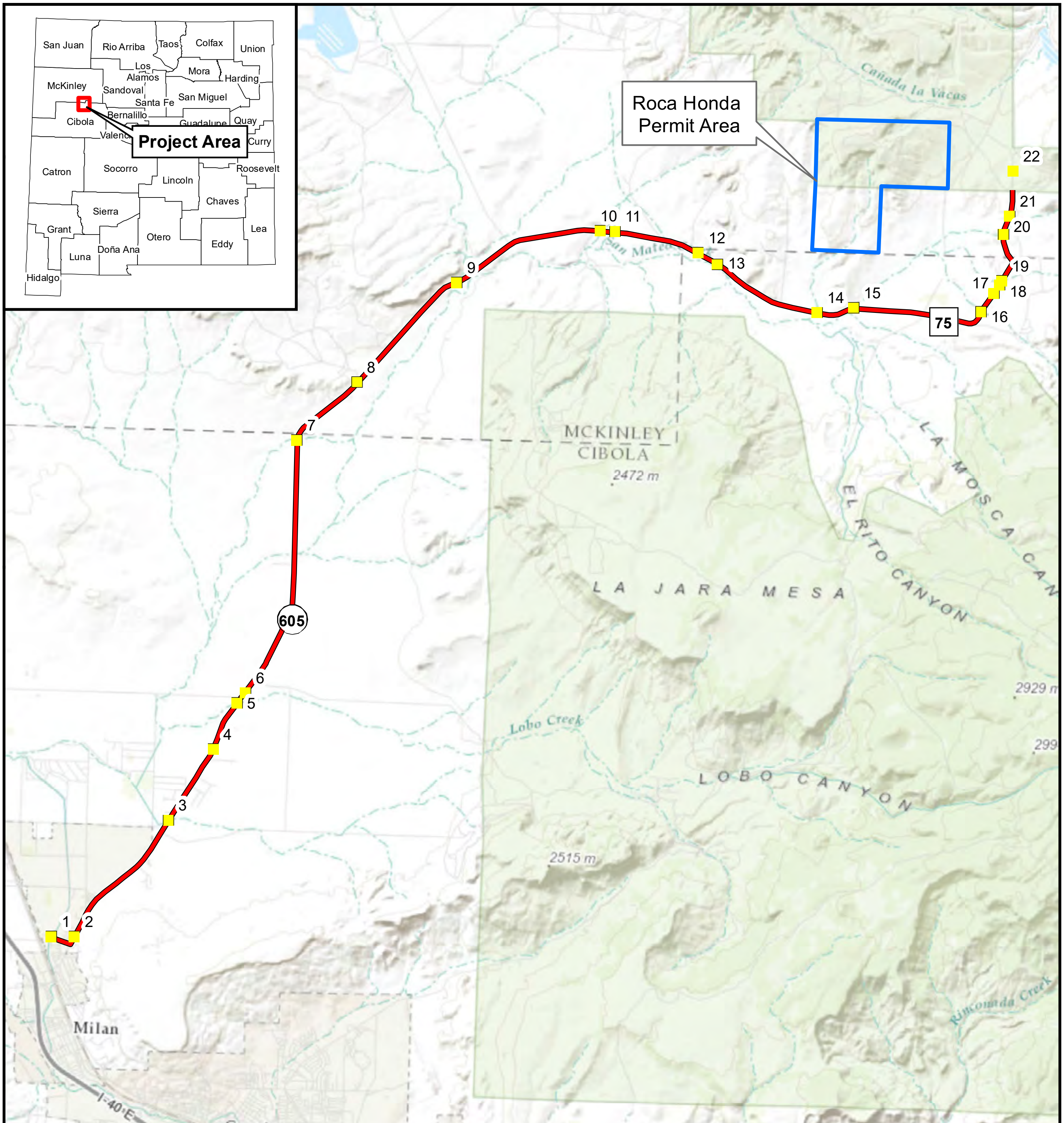
Two Wetlands were found within the proposed construction limits of the project area. The first occurred at San Mateo Creek near MP 19.2. This wetland derives its hydrology principally from groundwater that surfaces along the eastern edge of San Mateo Creek immediately upstream of the NM 605, as well as within a borrow ditch along the north side of NM 605 east of San Mateo Creek. This wetland appears to extend to San Mateo Creek from the project area, but only approximately 0.035 acres occurs within the potential project limits. This wetland has the potential to expand along the north side of NM 605 dependent upon climactic conditions. There was ample evidence that in the recent past the wetland habitat along the north side of the roadway was much more extensive and developed. There were even the remains of obligate wetland species present. However, the wetlands in the channel bottom probably did not change much during the recent drought conditions as the groundwater is augmented by periodic surface flows. In combination, this dual hydrology appears to be sufficient to maintain this portion of the wetland even in extremely dry conditions.

The Arroyo del Puerto wetland is substantially different than San Mateo Creek. Arroyo del Puerto appears to lack groundwater within the proposed construction limits. Consequently, it relies wholly on surface water flows that were probably nonexistent during the drought. In 2014 when we first looked at this site, it failed to meet the soil criteria, but sufficient redox concentrations had developed in the chroma 2 soils by the spring of 2015 to meet the soil conditions marginally. Additionally, annual wetland species thrived in the spring of 2015 further meeting the vegetation criteria. Only about 0.007 acres of wetland was present at the time of the 2015 survey, and depending upon how favorable the moisture conditions area this wetland could expand or disappear on a yearly basis.

The proposed project activities involve the placement of a water pipeline. This type of activity should not result in permanent take of wetlands. However, if by chance wetland are taken by project activities there may be the potential for wetland mitigation along San Mateo Creek. Since groundwater is present it is theoretically possible to tap into this groundwater and expand the current footprint of wetland at that location.

APPENDIX A

MAP OF LOCATIONS AND PHOTOGRAPHS OF WATERWAYS IDENTIFIED BY THE NATIONAL WETLAND INVENTORY AS WETLANDS



Project Area

National Wetland Inventory Wetlands

Milan, Grants, Dos Lomas, and San Mateo,NM USGS 7.5' Quadrangles

Private, State and BLM Lands McKinley and Cibola Counties, New Mexico

Appendix A National Wetland Inventory Wetlands Map

0 0.75 1.5 3 Miles

0 1.25 2.5 5 Kilometers

N

1:135,000

Roca Honda Project, McKinley and Cibola Counties, New Mexico


Site 1: Dry and no indication of recent flows, no wetland vegetation.


Site 2: No indication of clear cut channel and not dominated by wetland vegetation.


Site 3: No indication of a channel, no wetland vegetation and no wetland hydrology.

Site 4: No clear-cut channel, no wetland hydrology and not dominated by wetland vegetation.

Site 5: No clear-cut drainage, no wetland hydrology, no wetland vegetation.

Site 6: Playa just outside of right-of-way no wetland hydrology in right-of-way.


Site 7: Lower San Mateo Creek-The main channel of San Mateo Creek, but no indication of recent flows and not dominated by wetland vegetation.


Site 8: Small drainage without recent hydrological indicators and not dominated by wetland vegetation.

Figure 9. Clear-cut waterway with marginal wetlands present.

Figure 10. No defined channel. No indication of surface flows, and not dominated by wetland vegetation.

Site 11: Large sheet flow area with many culverts not dominated by wetland vegetation.

Site 12: Drainage intercepted by berms north of the roadway and no longer any flow within the project area.

Site 13: Curve of San Mateo Creek just outside of right-of-way does not enter project area.

Site 14. Shallow drainage, steep grade, no indication of recent flow, and not dominated by wetland vegetation.

Site 15: San Mateo Creek (upper) major drainage with pools of perennial water and wetland.

Site 16: Tributary of San Mateo Creek with flowing and pooled water. Likely a wetland but outside of project limits.

Site 17: Tiny drainage dominated by non-wetland species. No indication of recent flows and no channel in the ROW.

Site 18: Small ephemeral waterway dominated by non-wetland vegetation.


Site 19: Small ephemeral waterway dominated by non-wetland vegetation.

Site 20: Large deeply incised ephemeral drainage lacking any wetland vegetation.


Site 21: Ephemeral waterway nearly lacking any vegetation. No wetland vegetation present.


Site 22: Ephemeral waterway. No wetland vegetation present.

APPENDIX B

SAN MATEO CREEK WETLAND DATA SHEETS

WETLAND DETERMINATION DATA FORM - Arid West Region

Project/Site: San Mateo Creek/ Site 1 City/County: San Mateo/Cibola Sampling Date: 6/24/15

Applicant/Owner: NMDOT State: NM Sampling Point: Site 1

Investigator(s): Paul Knight Section, Township, Range: Unplatted

Landform (hillslope, terrace, etc.): Channel bottom Local relief (concave, convex, none): concave Slope (%): 1

Subregion (LRR): D - Interior Deserts Lat: 35° 20' 9.655" Long: 107° 41' 8.330" Datum: NAD 83

Soil Map Unit Name: Sprank sandy clay loam, Saline, sodic, 1-3 percent slopes NWI classification: R4SBC

Are climatic / hydrologic conditions on the site typical for this time of year? Yes (●) No ( ) (If no, explain in Remarks.)

Are Vegetation ☐ Soil ☐ or Hydrology ☐ significantly disturbed? Are "Normal Circumstances" present? Yes (●) No ( )

Are Vegetation ☐ Soil ☐ or Hydrology ☐ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS - Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes (●)	No ( )
Hydric Soil Present?	Yes (●)	No ( )
Wetland Hydrology Present?	Yes (●)	No ( )

Is the Sampled Area within a Wetland? Yes (●) No ( )

Remarks: This site is located on a terrace below the top of the bank of the river. It was dominated by wetland vegetation and had reduced soils present. There were some secondary hydrology indicators in the form of drift lines and sediment. Saturated soil was at 14 inches below the surface, but flow data indicates that during most of the spring growing season saturated soil is likely well within 12 inches of the surface.

VEGETATION

Tree Stratum (Use scientific names.)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
Total Cover:	%		
Sapling/Shrub Stratum			
1. *Sarcobatus vermiculatus*	10	Yes	FAC
2.			
3.			
4.			
5.			
Total Cover:	10 %		
Herb Stratum			
1. *Hordeum jubatum*	50	Yes	FAC
2. *Scirpus americanus*	5	No	OBL
3. *Distichlis spicata*	2	No	FACW
4.			
5.			
6.			
7.			
8.			
Total Cover:	57 %		
Woody Vine Stratum			
1.			
2.			
Total Cover:	%		

% Bare Ground in Herb Stratum 43 % % Cover of Biotic Crust 0 %

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 2 (A)

Total Number of Dominant Species Across All Strata: 2 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100.0 % (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	5	x 1 =	5
FACW species	2	x 2 =	4
FAC species	60	x 3 =	180
FACU species		x 4 =	0
UPL species		x 5 =	0
Column Totals:	67 (A)		189 (B)

Prevalence Index = B/A = 2.82

Hydrophytic Vegetation Indicators:

- ☒ Dominance Test is >50%
- ☒ Prevalence Index is ≤3.0[1]
- ☐ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ☐ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present.

Hydrophytic Vegetation Present? Yes (●) No ( )

Remarks: The site occurs within the channel bottom of San Mateo Creek and all of the vegetation encountered at and around the site were wetland indicator species. This site meets both the dominance test and prevalence index and meets the vegetation requirements for a wetland

SOIL

Sampling Point: Site 1

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type[1]	Loc[2]	Texture[3]	Remarks
0-6	10YR 4/2	98	10YR 3/6	2	C	M	Clay Loam	
6-8	10YR 4/2	90	Gley 2.5/N	10	D	M	Clay Loam	
8-16	10YR 5/2	100					Clay	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix. [2]Location: PL=Pore Lining, RC=Root Channel, M=Matrix.
[3]Soil Textures: Clay, Silty Clay, Sandy Clay, Loam, Sandy Clay Loam, Sandy Loam, Clay Loam, Silty Clay Loam, Silt Loam, Silt, Loamy Sand, Sand.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Stratified Layers (A5) (**LRR C**)
- ☐ 1 cm Muck (A9) (**LRR D**)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Loamy Mucky Mineral (F1)
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☒ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)
- ☐ Vernal Pools (F9)

Indicators for Problematic Hydric Soils[4]:

- ☐ 1 cm Muck (A9) (**LRR C**)
- ☐ 2 cm Muck (A10) (**LRR B**)
- ☐ Reduced Vertic (F18)
- ☐ Red Parent Material (TF2)
- ☒ Other (Explain in Remarks)

[4]Indicators of hydrophytic vegetation and wetland hydrology must be present.

Restrictive Layer (if present):

Type:

Depth (inches):

Hydric Soil Present? Yes ◉ No ○

Remarks: This site had low chroma soils with both redox concentrations and gley depletion zones present. It meets the Redox Dark Surface criteria. It also had persistent saturated soil at 4-5 inches below the surface meeting aquic soil criteria.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (any one indicator is sufficient)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☐ Saturation (A3)
- ☐ Water Marks (B1) (**Nonriverine**)
- ☐ Sediment Deposits (B2) (**Nonriverine**)
- ☐ Drift Deposits (B3) (**Nonriverine**)
- ☐ Surface Soil Cracks (B6)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Water-Stained Leaves (B9)
- ☐ Salt Crust (B11)
- ☐ Biotic Crust (B12)
- ☐ Aquatic Invertebrates (B13)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres along Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Plowed Soils (C6)
- ☒ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ☐ Water Marks (B1) (**Riverine**)
- ☒ Sediment Deposits (B2) (**Riverine**)
- ☒ Drift Deposits (B3) (**Riverine**)
- ☐ Drainage Patterns (B10)
- ☐ Dry-Season Water Table (C2)
- ☐ Thin Muck Surface (C7)
- ☐ Crayfish Burrows (C8)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Shallow Aquitard (D3)
- ☐ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present?	Yes ○	No ◉	Depth (inches):
Water Table Present?	Yes ◉	No ○	Depth (inches): 11
Saturation Present? (includes capillary fringe)	Yes ◉	No ○	Depth (inches): 4

Wetland Hydrology Present? Yes ◉ No ○

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks: The pit had saturated soil at 4 inches below the surface and groundwater in the pit at 11 inches below the surface. There were also riparian drift lines on the vegetation and riparian sediment deposits on the wall of the culvert. This site meets the hydrology requirement for a wetland.

WETLAND DETERMINATION DATA FORM - Arid West Region

Project/Site: San Mateo Creek/ Site 2 City/County: San Mateo/Cibola Sampling Date: 6/24/15

Applicant/Owner: NMDOT State: NM Sampling Point: Site 2

Investigator(s): Paul Knight Section, Township, Range: Unplatted

Landform (hillslope, terrace, etc.): Bank Slope Local relief (concave, convex, none): concave Slope (%): 10

Subregion (LRR): D - Interior Deserts Lat: 35° 20' 9.818" Long: 107° 41' 16.587" Datum: NAD 83

Soil Map Unit Name: Sprank sandy clay loam, Saline, sodic, 1-3 percent slopes NWI classification: None

Are climatic / hydrologic conditions on the site typical for this time of year? Yes (●) No ( ) (If no, explain in Remarks.)

Are Vegetation ☐ Soil ☐ or Hydrology ☐ significantly disturbed? Are "Normal Circumstances" present? Yes (●) No ( )

Are Vegetation ☐ Soil ☐ or Hydrology ☐ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS - Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ( )	No (●)
Hydric Soil Present?	Yes ( )	No (●)
Wetland Hydrology Present?	Yes ( )	No (●)

Is the Sampled Area within a Wetland? Yes ( ) No (●)

Remarks: This site on the slopes above San Mateo Creek although there was some wetland vegetation present it was no abundant enough to meet the vegetation requirement for a wetland. Additionally, the site lacked any hydric soil or hydrology indicators. This site fails to meet the criteria for a wetland.

VEGETATION

Tree Stratum (Use scientific names.)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
Total Cover:	%		
Sapling/Shrub Stratum			
1. *Atriplex canescens*	10	Yes	Not Listed
2. *Ericameria nauseosa*	5	No	Not Listed
3. *Sarcobatus vermiculatus*	5	No	FAC
4.			
5.			
Total Cover:	20 %		
Herb Stratum			
1. *Sporobolus airoides*	20	Yes	FAC
2.			
3.			
4.			
5.			
6.			
7.			
8.			
Total Cover:	20 %		
Woody Vine Stratum			
1.			
2.			
Total Cover:	%		

% Bare Ground in Herb Stratum 80 % % Cover of Biotic Crust 0 %

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC:	1	(A)
Total Number of Dominant Species Across All Strata:	2	(B)
Percent of Dominant Species That Are OBL, FACW, or FAC:	50.0 %	(A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species		x 1 =	0
FACW species		x 2 =	0
FAC species	25	x 3 =	75
FACU species		x 4 =	0
UPL species	15	x 5 =	75
Column Totals:	40 (A)		150 (B)

Prevalence Index = B/A = 3.75

Hydrophytic Vegetation Indicators:

- ☐ Dominance Test is >50%
- ☐ Prevalence Index is ≤3.0[1]
- ☐ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ☐ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present.

Hydrophytic Vegetation Present? Yes ( ) No (●)

Remarks: The site occurs on the slope above the channel bottom of San Mateo Creek. It was dominated by a mixture of upland shrubs, and a hydrophytic grass. However, there were not enough wetland plants present to meet either the dominance test or prevalence index. This site fails to meet a the vegetation requirements for a wetland

SOIL

Sampling Point: Site 2

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Type[1]	Loc[2]	Texture[3]	Remarks
0-2	10YR 4/3	100					Sandy Loam	
2-16	10YR 4/2	100					Clay	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix. [2]Location: PL=Pore Lining, RC=Root Channel, M=Matrix.
[3]Soil Textures: Clay, Silty Clay, Sandy Clay, Loam, Sandy Clay Loam, Sandy Loam, Clay Loam, Silty Clay Loam, Silt Loam, Silt, Loamy Sand, Sand.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Stratified Layers (A5) (**LRR C**)
- ☐ 1 cm Muck (A9) (**LRR D**)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Loamy Mucky Mineral (F1)
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)
- ☐ Vernal Pools (F9)

Indicators for Problematic Hydric Soils[4]:

- ☐ 1 cm Muck (A9) (**LRR C**)
- ☐ 2 cm Muck (A10) (**LRR B**)
- ☐ Reduced Vertic (F18)
- ☐ Red Parent Material (TF2)
- ☐ Other (Explain in Remarks)

[4]Indicators of hydrophytic vegetation and wetland hydrology must be present.

Restrictive Layer (if present):

Type: ____________

Depth (inches): ____________

Hydric Soil Present? Yes ○ No ●

Remarks: This site had no hydric soil indicators present and failed to meet the soil requirement for a wetland.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (any one indicator is sufficient)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☐ Saturation (A3)
- ☐ Water Marks (B1) (**Nonriverine**)
- ☐ Sediment Deposits (B2) (**Nonriverine**)
- ☐ Drift Deposits (B3) (**Nonriverine**)
- ☐ Surface Soil Cracks (B6)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Water-Stained Leaves (B9)
- ☐ Salt Crust (B11)
- ☐ Biotic Crust (B12)
- ☐ Aquatic Invertebrates (B13)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres along Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Plowed Soils (C6)
- ☐ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ☐ Water Marks (B1) (**Riverine**)
- ☐ Sediment Deposits (B2) (**Riverine**)
- ☐ Drift Deposits (B3) (**Riverine**)
- ☐ Drainage Patterns (B10)
- ☐ Dry-Season Water Table (C2)
- ☐ Thin Muck Surface (C7)
- ☐ Crayfish Burrows (C8)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Shallow Aquitard (D3)
- ☐ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present?	Yes ○	No ●	Depth (inches):
Water Table Present?	Yes ○	No ●	Depth (inches):
Saturation Present? (includes capillary fringe)	Yes ○	No ●	Depth (inches):

Wetland Hydrology Present? Yes ○ No ●

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks: The site lacked any primary or secondary hydrology indicators and fails to meet the hydrology requirement for a wetland.

WETLAND DETERMINATION DATA FORM - Arid West Region

Project/Site: San Mateo Creek/ Site 3 City/County: San Mateo/Cibola Sampling Date: 6/24/15

Applicant/Owner: NMDOT State: NM Sampling Point: Site 3

Investigator(s): Paul Knight Section, Township, Range: Unplatted

Landform (hillslope, terrace, etc.): Depression Local relief (concave, convex, none): Concave Slope (%): 1

Subregion (LRR): D - Interior Deserts Lat: 35° 20' 9.090" Long: 107° 41' 18.240" Datum: NAD 83

Soil Map Unit Name: Sprank sandy clay loam, Saline, sodic, 1-3 percent slopes NWI classification: None

Are climatic / hydrologic conditions on the site typical for this time of year? Yes (●) No ( ) (If no, explain in Remarks.)

Are Vegetation ☐ Soil ☐ or Hydrology ☐ significantly disturbed? Are "Normal Circumstances" present? Yes (●) No ( )

Are Vegetation ☐ Soil ☐ or Hydrology ☐ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS - Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes (●)	No ( )
Hydric Soil Present?	Yes ( )	No (●)
Wetland Hydrology Present?	Yes ( )	No (●)

Is the Sampled Area within a Wetland? Yes ( ) No (●)

Remarks: This site occurs within a large depression that looks like historically may have been part of the San Mateo Creek channel but was cut off when the road was installed. It did have some chroma 2 soils with a few oxidized root channel in the upper profile but these were to few to meet requirements. It was dominated by salt cedar a wetland indicator plant, but it lacked any indicator of wetland hydrology. The redox features are probably old. This site fails to meet the criteria for a wetland.

VEGETATION

Tree Stratum (Use scientific names.)	Absolute % Cover	Dominant Species?	Indicator Status
1. *Tamarix chinensis*	60	Yes	FAC
2.			
3.			
4.			
Total Cover:	60 %		
Sapling/Shrub Stratum			
1.			
2.			
3.			
4.			
5.			
Total Cover:	%		
Herb Stratum			
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
Total Cover:	%		
Woody Vine Stratum			
1.			
2.			
Total Cover:	%		

% Bare Ground in Herb Stratum 0 % % Cover of Biotic Crust 0 %

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC:	1	(A)
Total Number of Dominant Species Across All Strata:	1	(B)
Percent of Dominant Species That Are OBL, FACW, or FAC:	100.0 %	(A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species		x 1 =	0
FACW species		x 2 =	0
FAC species	60	x 3 =	180
FACU species		x 4 =	0
UPL species		x 5 =	0
Column Totals:	60 (A)		180 (B)

Prevalence Index = B/A = 3.00

Hydrophytic Vegetation Indicators:

- ☒ Dominance Test is >50%
- ☒ Prevalence Index is ≤3.0[1]
- ☐ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ☐ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present.

Hydrophytic Vegetation Present? Yes (●) No ( )

Remarks: The site occurs within a large depression that looks like historically may have been part of the San Mateo Creek channel but was cut off when the road was installed. It was dominated by salt cedar a FAC species and meets both the dominance test and prevalence index for a wetland.

SOIL

Sampling Point: Site 3

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox %	Type[1]	Loc[2]	Texture[3]	Remarks
0-2	10YR 3/2	99.5	10YR 4/6	0.5	C	RC	Sandy Loam	
2-10	10YR 4/3	100					Sandy Loam	
10-14	10 YR 3/2	90	10YR 5/6	10	C	M	Clay Loam	
14-16	10YR 4/3	100					Sandy Loam	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix. [2]Location: PL=Pore Lining, RC=Root Channel, M=Matrix.
[3]Soil Textures: Clay, Silty Clay, Sandy Clay, Loam, Sandy Clay Loam, Sandy Loam, Clay Loam, Silty Clay Loam, Silt Loam, Silt, Loamy Sand, Sand.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Stratified Layers (A5) (**LRR C**)
- ☐ 1 cm Muck (A9) (**LRR D**)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Loamy Mucky Mineral (F1)
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)
- ☐ Vernal Pools (F9)

Indicators for Problematic Hydric Soils[4]:

- ☐ 1 cm Muck (A9) (**LRR C**)
- ☐ 2 cm Muck (A10) (**LRR B**)
- ☐ Reduced Vertic (F18)
- ☐ Red Parent Material (TF2)
- ☐ Other (Explain in Remarks)

[4]Indicators of hydrophytic vegetation and wetland hydrology must be present.

Restrictive Layer (if present):

Type:

Depth (inches):

Hydric Soil Present? Yes ○ No ◉

Remarks: This site had low chroma soils in the upper and mid profile, and had a very small amount of oxidized root channels in the upper profile (less than 1%). There were many more in the mid profile. Those in the upper profile are to few to meet hydric soil criteria, and those in the middle are to deep. This site just fails to meet the soil requirement for a wetland.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (any one indicator is sufficient)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☐ Saturation (A3)
- ☐ Water Marks (B1) (**Nonriverine**)
- ☐ Sediment Deposits (B2) (**Nonriverine**)
- ☐ Drift Deposits (B3) (**Nonriverine**)
- ☐ Surface Soil Cracks (B6)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Water-Stained Leaves (B9)
- ☐ Salt Crust (B11)
- ☐ Biotic Crust (B12)
- ☐ Aquatic Invertebrates (B13)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres along Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Plowed Soils (C6)
- ☐ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ☐ Water Marks (B1) (**Riverine**)
- ☐ Sediment Deposits (B2) (**Riverine**)
- ☐ Drift Deposits (B3) (**Riverine**)
- ☐ Drainage Patterns (B10)
- ☐ Dry-Season Water Table (C2)
- ☐ Thin Muck Surface (C7)
- ☐ Crayfish Burrows (C8)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Shallow Aquitard (D3)
- ☐ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present?	Yes ○	No ◉	Depth (inches):
Water Table Present?	Yes ○	No ◉	Depth (inches):
Saturation Present? (includes capillary fringe)	Yes ○	No ◉	Depth (inches):

Wetland Hydrology Present? Yes ○ No ◉

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks: The site lacked any primary or secondary hydrology indicators and fails to meet the hydrology requirement for a wetland.

WETLAND DETERMINATION DATA FORM - Arid West Region

Project/Site: San Mateo Creek/ Site 4 City/County: San Mateo/Cibola Sampling Date: 5/21/15

Applicant/Owner: NMDOT State: NM Sampling Point: Site 4

Investigator(s): Paul Knight Section, Township, Range: Unplatted

Landform (hillslope, terrace, etc.): Depression Local relief (concave, convex, none): Concave Slope (%): 1

Subregion (LRR): D - Interior Deserts Lat: 35.33611" Long: 107.6868" Datum: NAD 83

Soil Map Unit Name: Sprank sandy clay loam, Saline, sodic, 1-3 percent slopes NWI classification: None

Are climatic / hydrologic conditions on the site typical for this time of year? Yes (●) No ( ) (If no, explain in Remarks.)

Are Vegetation ☐ Soil ☐ or Hydrology ☐ significantly disturbed? Are "Normal Circumstances" present? Yes (●) No ( )

Are Vegetation ☐ Soil ☐ or Hydrology ☐ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS - Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes (●)	No ( )
Hydric Soil Present?	Yes (●)	No ( )
Wetland Hydrology Present?	Yes (●)	No ( )

Is the Sampled Area within a Wetland? Yes (●) No ( )

Remarks: This site occurs within a long narrow depression that parallels NM 605 and may have been an old ditch. It appears to have been installed to intercept groundwater before it hits the road prism, and convey this groundwater west to San Mateo Creek. It had saturated soil present. It was dominated by wetland vegetation and had low chroma soils with redox concentrations. It meets all of the criteria of a wetland.

VEGETATION

(Use scientific names.)	Absolute % Cover	Dominant Species?	Indicator Status
Tree Stratum			
1.			
2.			
3.			
4.			
Total Cover:	%		
Sapling/Shrub Stratum			
1. *Sarcobatus vermiculatus*	10	Yes	FAC
2.			
3.			
4.			
5.			
Total Cover:	10 %		
Herb Stratum			
1. *Juncus articus*	40	Yes	FACW
2. *Carex sp.*	20	Yes	FACW
3. *Sporobolus airoides*	10	Yes	FAC
4.			
5.			
6.			
7.			
8.			
Total Cover:	70 %		
Woody Vine Stratum			
1.			
2.			
Total Cover:	%		

% Bare Ground in Herb Stratum 30 % % Cover of Biotic Crust 0 %

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC:	4	(A)
Total Number of Dominant Species Across All Strata:	4	(B)
Percent of Dominant Species That Are OBL, FACW, or FAC:	100.0 %	(A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species		x 1 =	0
FACW species	60	x 2 =	120
FAC species	20	x 3 =	60
FACU species		x 4 =	0
UPL species		x 5 =	0
Column Totals:	80 (A)		180 (B)

Prevalence Index = B/A = 2.25

Hydrophytic Vegetation Indicators:

- ☒ Dominance Test is >50%
- ☒ Prevalence Index is ≤3.0[1]
- ☐ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ☐ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present.

Hydrophytic Vegetation Present? Yes (●) No ( )

Remarks: The site occurs within a shallow depression that parallels the NM 605 roadway. It may have been an old bar ditch which intercepts groundwater flow and conveys it to San Mateo Creek. It was dominated by wetland vegetation and meets both the dominance test and prevalence index.

SOIL

Sampling Point: Site 4

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox %	Type[1]	Loc[2]	Texture[3]	Remarks
0-7	10YR 3/2	98	10YR 4/6	2	C	RC	Clay	
7-8.5	10YR 3/3	100					Sand	
8.5-16	10 YR 3/2						Clay Loam	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix. [2]Location: PL=Pore Lining, RC=Root Channel, M=Matrix.
[3]Soil Textures: Clay, Silty Clay, Sandy Clay, Loam, Sandy Clay Loam, Sandy Loam, Clay Loam, Silty Clay Loam, Silt Loam, Silt, Loamy Sand, Sand.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- [ ] Histosol (A1)
- [ ] Histic Epipedon (A2)
- [ ] Black Histic (A3)
- [ ] Hydrogen Sulfide (A4)
- [ ] Stratified Layers (A5) (**LRR C**)
- [ ] 1 cm Muck (A9) (**LRR D**)
- [ ] Depleted Below Dark Surface (A11)
- [ ] Thick Dark Surface (A12)
- [ ] Sandy Mucky Mineral (S1)
- [ ] Sandy Gleyed Matrix (S4)
- [ ] Sandy Redox (S5)
- [ ] Stripped Matrix (S6)
- [ ] Loamy Mucky Mineral (F1)
- [ ] Loamy Gleyed Matrix (F2)
- [ ] Depleted Matrix (F3)
- [x] Redox Dark Surface (F6)
- [ ] Depleted Dark Surface (F7)
- [ ] Redox Depressions (F8)
- [ ] Vernal Pools (F9)

Indicators for Problematic Hydric Soils[4]:

- [ ] 1 cm Muck (A9) (**LRR C**)
- [ ] 2 cm Muck (A10) (**LRR B**)
- [ ] Reduced Vertic (F18)
- [ ] Red Parent Material (TF2)
- [ ] Other (Explain in Remarks)

[4]Indicators of hydrophytic vegetation and wetland hydrology must be present.

Restrictive Layer (if present):
Type:
Depth (inches):

Hydric Soil Present? Yes (●) No ( )

Remarks: This site had low chroma soils in the upper profile, and had a very some oxidized root channels present meeting the Redox Dark Surface Criteria. It also had saturated soil present at 12 inches below the surface marginally meeting the aquic soil criteria. This site meets the hydric soil criteria for a wetland.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (any one indicator is sufficient)

- [x] Surface Water (A1)
- [ ] High Water Table (A2)
- [x] Saturation (A3)
- [ ] Water Marks (B1) (**Nonriverine**)
- [x] Sediment Deposits (B2) (**Nonriverine**)
- [ ] Drift Deposits (B3) (**Nonriverine**)
- [ ] Surface Soil Cracks (B6)
- [ ] Inundation Visible on Aerial Imagery (B7)
- [ ] Water-Stained Leaves (B9)
- [ ] Salt Crust (B11)
- [ ] Biotic Crust (B12)
- [ ] Aquatic Invertebrates (B13)
- [ ] Hydrogen Sulfide Odor (C1)
- [ ] Oxidized Rhizospheres along Living Roots (C3)
- [ ] Presence of Reduced Iron (C4)
- [ ] Recent Iron Reduction in Plowed Soils (C6)
- [ ] Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- [ ] Water Marks (B1) (**Riverine**)
- [ ] Sediment Deposits (B2) (**Riverine**)
- [ ] Drift Deposits (B3) (**Riverine**)
- [ ] Drainage Patterns (B10)
- [ ] Dry-Season Water Table (C2)
- [ ] Thin Muck Surface (C7)
- [ ] Crayfish Burrows (C8)
- [ ] Saturation Visible on Aerial Imagery (C9)
- [ ] Shallow Aquitard (D3)
- [ ] FAC-Neutral Test (D5)

Field Observations:

Surface Water Present?	Yes ( )	No (●)	Depth (inches):
Water Table Present?	Yes ( )	No (●)	Depth (inches):
Saturation Present? (includes capillary fringe)	Yes (●)	No ( )	Depth (inches): 12

Wetland Hydrology Present? Yes (●) No ( )

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks: The site had saturated soil at 12 inches below the surface. There was also pooled surface water in low spots nearby. Additionally, there were non-riverine sediment deposits on the vegetation from periods of pooled surface water at the site. This site meets the hydrology requirement for a wetland.

WETLAND DETERMINATION DATA FORM - Arid West Region

Project/Site: San Mateo Creek/ Site 5 City/County: San Mateo/Cibola Sampling Date: 6/24/15

Applicant/Owner: NMDOT State: NM Sampling Point: Site 5

Investigator(s): Paul Knight Section, Township, Range: Unplatted

Landform (hillslope, terrace, etc.): Depression Local relief (concave, convex, none): Concave Slope (%): 1

Subregion (LRR): D - Interior Deserts Lat: 35° 20' 9.952" Long: 107° 41' 10.398" Datum: NAD 83

Soil Map Unit Name: Sprank sandy clay loam, Saline, sodic, 1-3 percent slopes NWI classification: None

Are climatic / hydrologic conditions on the site typical for this time of year? Yes (●) No ( ) (If no, explain in Remarks.)

Are Vegetation ☐ Soil ☐ or Hydrology ☐ significantly disturbed? Are "Normal Circumstances" present? Yes (●) No ( )

Are Vegetation ☐ Soil ☐ or Hydrology ☐ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS - Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes (●)	No ( )
Hydric Soil Present?	Yes ( )	No (●)
Wetland Hydrology Present?	Yes (●)	No ( )

Is the Sampled Area within a Wetland? Yes ( ) No (●)

Remarks: This site was dominated by wetland vegetation and had a salt crust indicating past shallow groundwater. However, currently it did not have sufficient soil reduction to meet the hydric soils criteria. However, if in the future this soils has shallow saturated soil (in early spring) it may meet the soil criteria via Aquic soil conditions. Currently it fails to meet the wetland requirements.

VEGETATION

Tree Stratum (Use scientific names.)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
Total Cover:	%		
Sapling/Shrub Stratum			
1.			
2.			
3.			
4.			
5.			
Total Cover:	%		
Herb Stratum			
1. *Juncus articus*	15	Yes	FACW
2. *Sporobolus airoides*	3	Yes	FAC
3. *Melilotus officinalis*	1	No	FACU
4. *Gaura villosa*	1	No	Not Listed
5.			
6.			
7.			
8.			
Total Cover:	20 %		
Woody Vine Stratum			
1.			
2.			
Total Cover:	%		

% Bare Ground in Herb Stratum 80 % % Cover of Biotic Crust 0 %

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC:	2	(A)
Total Number of Dominant Species Across All Strata:	2	(B)
Percent of Dominant Species That Are OBL, FACW, or FAC:	100.0 %	(A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species		x 1 =	0
FACW species	15	x 2 =	30
FAC species	3	x 3 =	9
FACU species	1	x 4 =	4
UPL species	1	x 5 =	5
Column Totals:	20 (A)		48 (B)

Prevalence Index = B/A = 2.40

Hydrophytic Vegetation Indicators:

- ☒ Dominance Test is >50%
- ☒ Prevalence Index is ≤3.0[1]
- ☐ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ☐ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present.

Hydrophytic Vegetation Present? Yes (●) No ( )

Remarks: The site occurs within a shallow depression that parallels the NM 605 roadway. It may have been an old bar ditch which intercepts groundwater flow and conveys it to San Mateo Creek. It was dominated by wetland vegetation and meets both the dominance test and prevalence index.

SOIL

Sampling Point: Site 5

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type[1]	Loc[2]	Texture[3]	Remarks
0-3.5	10YR 4/2	100					Clay loam	
3.5-8	10YR 2.5/2	100					Sandy Loam	
8.0-14	10 YR 4/2	98	2.5YR 4/5	2	C	RC	Sandy Loam	
14-16	2.5YR 4/2	90	2.5YR 4/5	5	C	RC	Clay Loam	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix. [2]Location: PL=Pore Lining, RC=Root Channel, M=Matrix.
[3]Soil Textures: Clay, Silty Clay, Sandy Clay, Loam, Sandy Clay Loam, Sandy Loam, Clay Loam, Silty Clay Loam, Silt Loam, Silt, Loamy Sand, Sand.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Stratified Layers (A5) (**LRR C**)
- ☐ 1 cm Muck (A9) (**LRR D**)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Loamy Mucky Mineral (F1)
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)
- ☐ Vernal Pools (F9)

Indicators for Problematic Hydric Soils[4]:

- ☐ 1 cm Muck (A9) (**LRR C**)
- ☐ 2 cm Muck (A10) (**LRR B**)
- ☐ Reduced Vertic (F18)
- ☐ Red Parent Material (TF2)
- ☐ Other (Explain in Remarks)

[4]Indicators of hydrophytic vegetation and wetland hydrology must be present.

Restrictive Layer (if present):

Type:

Depth (inches):

Hydric Soil Present? Yes ○ No ●

Remarks: Although there were low chroma soils and some redox present, these redox features were to deep to meet hydric soil criteria.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (any one indicator is sufficient)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☐ Saturation (A3)
- ☐ Water Marks (B1) (**Nonriverine**)
- ☐ Sediment Deposits (B2) (**Nonriverine**)
- ☐ Drift Deposits (B3) (**Nonriverine**)
- ☐ Surface Soil Cracks (B6)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Water-Stained Leaves (B9)
- ☒ Salt Crust (B11)
- ☐ Biotic Crust (B12)
- ☐ Aquatic Invertebrates (B13)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres along Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Plowed Soils (C6)
- ☐ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ☐ Water Marks (B1) (**Riverine**)
- ☐ Sediment Deposits (B2) (**Riverine**)
- ☐ Drift Deposits (B3) (**Riverine**)
- ☐ Drainage Patterns (B10)
- ☐ Dry-Season Water Table (C2)
- ☐ Thin Muck Surface (C7)
- ☐ Crayfish Burrows (C8)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Shallow Aquitard (D3)
- ☐ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present?	Yes ○	No ●	Depth (inches):
Water Table Present?	Yes ○	No ●	Depth (inches):
Saturation Present? (includes capillary fringe)	Yes ○	No ●	Depth (inches):

Wetland Hydrology Present? Yes ● No ○

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks: The site currently did not have water present, but there was a salt crust which indicates past shallow groundwater that moved to the surface by capillary actions. This site meets the hydrology requirement for wetlands.

WETLAND DETERMINATION DATA FORM - Arid West Region

Project/Site: San Mateo Creek/ Site 6 City/County: San Mateo/Cibola Sampling Date: 6/24/15

Applicant/Owner: NMDOT State: NM Sampling Point: Site 6

Investigator(s): Paul Knight Section, Township, Range: Unplatted

Landform (hillslope, terrace, etc.): Depression Local relief (concave, convex, none): Concave Slope (%): 1

Subregion (LRR): D - Interior Deserts Lat: 35° 20' 9.875" Long: 107° 41' 8.348" Datum: NAD 83

Soil Map Unit Name: Sprank sandy clay loam, Saline, sodic, 1-3 percent slopes NWI classification: None

Are climatic / hydrologic conditions on the site typical for this time of year? Yes (●) No ( ) (If no, explain in Remarks.)

Are Vegetation ☐ Soil ☐ or Hydrology ☐ significantly disturbed? Are "Normal Circumstances" present? Yes (●) No ( )

Are Vegetation ☐ Soil ☐ or Hydrology ☐ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS - Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes (●)	No ( )
Hydric Soil Present?	Yes (●)	No ( )
Wetland Hydrology Present?	Yes (●)	No ( )

Is the Sampled Area within a Wetland? Yes (●) No ( )

Remarks: This site was dominated by wetland vegetation and had a salt crust indicating past shallow groundwater. The site had chroma 2 soils and redox features throughout the mid and lower profile, and was dominated by wetland vegetation. Although it lacked current ground or surface water it meets the wetland requirements.

VEGETATION

Tree Stratum (Use scientific names.)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
Total Cover:	%		
Sapling/Shrub Stratum			
1.			
2.			
3.			
4.			
5.			
Total Cover:	%		
Herb Stratum			
1. *Juncus articus*	5	Yes	FACW
2. *Distichlis spicata*	30	Yes	FACW
3. *Ericameria nauseosa*	1	No	Not Listed
4.			
5.			
6.			
7.			
8.			
Total Cover:	36 %		
Woody Vine Stratum			
1.			
2.			
Total Cover:	%		

% Bare Ground in Herb Stratum 64 % % Cover of Biotic Crust 0 %

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 2 (A)

Total Number of Dominant Species Across All Strata: 2 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100.0 % (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species		x 1 =	0
FACW species	35	x 2 =	70
FAC species		x 3 =	0
FACU species		x 4 =	0
UPL species	1	x 5 =	5
Column Totals:	36 (A)		75 (B)

Prevalence Index = B/A = 2.08

Hydrophytic Vegetation Indicators:

- ☒ Dominance Test is >50%
- ☒ Prevalence Index is ≤3.0[1]
- ☐ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ☐ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present.

Hydrophytic Vegetation Present? Yes (●) No ( )

Remarks: The site occurs within a shallow depression that parallels the NM 605 roadway. It may have been an old bar ditch which intercepts groundwater flow and conveys it to San Mateo Creek. It was dominated by wetland vegetation and meets both the dominance test and prevalence index.

SOIL

Sampling Point: Site 6

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox %	Type[1]	Loc[2]	Texture[3]	Remarks
0-4	10YR 3/2	100					Clay loam	Root Zone very little soil
4-8	10YR 4/2	93	10YR 4/6	5	C	RC	Clay Loam	
			10YR 4/1.5	2	D	M	ClayLoam	
8-12	10 YR 4/2	95	10YR 4/6	5	C	RC	Clay Loam	
12-16	10YR 4/2	95	10YR 4/6	5	C	RC	Clay	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix. [2]Location: PL=Pore Lining, RC=Root Channel, M=Matrix.
[3]Soil Textures: Clay, Silty Clay, Sandy Clay, Loam, Sandy Clay Loam, Sandy Loam, Clay Loam, Silty Clay Loam, Silt Loam, Silt, Loamy Sand, Sand.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Stratified Layers (A5) (**LRR C**)
- ☐ 1 cm Muck (A9) (**LRR D**)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Loamy Mucky Mineral (F1)
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☒ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)
- ☐ Vernal Pools (F9)

Indicators for Problematic Hydric Soils[4]:

- ☐ 1 cm Muck (A9) (**LRR C**)
- ☐ 2 cm Muck (A10) (**LRR B**)
- ☐ Reduced Vertic (F18)
- ☐ Red Parent Material (TF2)
- ☐ Other (Explain in Remarks)

[4]Indicators of hydrophytic vegetation and wetland hydrology must be present.

Restrictive Layer (if present):
Type:
Depth (inches):

Hydric Soil Present? Yes ◉ No ○

Remarks: This site had low chroma soils throughout the profile with Redox concentrations in the form of oxidized root channels in all areas except the root zone. This site meets the soil criteria for a wetland.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (any one indicator is sufficient)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☐ Saturation (A3)
- ☐ Water Marks (B1) (**Nonriverine**)
- ☐ Sediment Deposits (B2) (**Nonriverine**)
- ☐ Drift Deposits (B3) (**Nonriverine**)
- ☐ Surface Soil Cracks (B6)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Water-Stained Leaves (B9)
- ☒ Salt Crust (B11)
- ☐ Biotic Crust (B12)
- ☐ Aquatic Invertebrates (B13)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres along Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Plowed Soils (C6)
- ☐ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ☐ Water Marks (B1) (**Riverine**)
- ☐ Sediment Deposits (B2) (**Riverine**)
- ☐ Drift Deposits (B3) (**Riverine**)
- ☐ Drainage Patterns (B10)
- ☐ Dry-Season Water Table (C2)
- ☐ Thin Muck Surface (C7)
- ☐ Crayfish Burrows (C8)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Shallow Aquitard (D3)
- ☐ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present?	Yes ○	No ◉	Depth (inches):
Water Table Present?	Yes ○	No ◉	Depth (inches):
Saturation Present? (includes capillary fringe)	Yes ○	No ◉	Depth (inches):

Wetland Hydrology Present? Yes ◉ No ○

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks: The site currently did not have water present, but was very damp below 4 inches from the surface. There was a salt crust which indicates past shallow groundwater that moved to the surface by capillary actions. This site meets the hydrology requirement for wetlands.

WETLAND DETERMINATION DATA FORM - Arid West Region

Project/Site: San Mateo Creek/ Site 7 City/County: San Mateo/Cibola Sampling Date: 6/24/15

Applicant/Owner: NMDOT State: NM Sampling Point: Site 7

Investigator(s): Paul Knight Section, Township, Range: Unplatted

Landform (hillslope, terrace, etc.): Top of bank Local relief (concave, convex, none): Flat Slope (%): 0

Subregion (LRR): D - Interior Deserts Lat: 35° 20' 10.016" Long: 107° 41' 8.297" Datum: NAD 83

Soil Map Unit Name: Sprank sandy clay loam, Saline, sodic, 1-3 percent slopes NWI classification: None

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ◉ No ◯ (If no, explain in Remarks.)

Are Vegetation ☐ Soil ☐ or Hydrology ☐ significantly disturbed? Are "Normal Circumstances" present? Yes ◉ No ◯

Are Vegetation ☐ Soil ☐ or Hydrology ☐ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS - Attach site map showing sampling point locations, transects, important features, etc.

	Yes	No
Hydrophytic Vegetation Present?	◉	◯
Hydric Soil Present?	◯	◉
Wetland Hydrology Present?	◯	◉

Is the Sampled Area within a Wetland? Yes ◯ No ◉

Remarks: This site marginally meets the vegetation requirement for a wetland but lacks both soil and hydrology indicators. It fails to meet the criteria for a wetland.

VEGETATION

Tree Stratum (Use scientific names.)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
Total Cover:	%		
Sapling/Shrub Stratum			
1. *Ericameria nauseosa*	3	Yes	Not Listed
2. *Sarcobatus vermiculatus*	5	Yes	FAC
3.			
4.			
5.			
Total Cover:	8 %		
Herb Stratum			
1. *Sporobolus airoides*	20	Yes	FAC
2. *Juncus articus*	1	No	FACW
3.			
4.			
5.			
6.			
7.			
8.			
Total Cover:	21 %		
Woody Vine Stratum			
1.			
2.			
Total Cover:	%		

% Bare Ground in Herb Stratum 79 % % Cover of Biotic Crust 0 %

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 2 (A)

Total Number of Dominant Species Across All Strata: 3 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 66.7 % (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species		x 1 =	0
FACW species	1	x 2 =	2
FAC species	25	x 3 =	75
FACU species		x 4 =	0
UPL species	3	x 5 =	15
Column Totals:	29 (A)		92 (B)

Prevalence Index = B/A = 3.17

Hydrophytic Vegetation Indicators:

- ☒ Dominance Test is >50%
- ☐ Prevalence Index is ≤3.0[1]
- ☐ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ☐ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present.

Hydrophytic Vegetation Present? Yes ◉ No ◯

Remarks: The site occurs on top of the bank above the bar ditch depression. It was dominated by a mixture of wetland and non wetland species but meets the dominance test for wetland vegetation.

SOIL

Sampling Point: Site 7

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox %	Type[1]	Loc[2]	Texture[3]	Remarks
0-8	10YR 4/3	100					Clay loam	
8-16	10YR 3/2	100					Clay	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix. [2]Location: PL=Pore Lining, RC=Root Channel, M=Matrix.
[3]Soil Textures: Clay, Silty Clay, Sandy Clay, Loam, Sandy Clay Loam, Sandy Loam, Clay Loam, Silty Clay Loam, Silt Loam, Silt, Loamy Sand, Sand.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Stratified Layers (A5) (**LRR C**)
- ☐ 1 cm Muck (A9) (**LRR D**)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Loamy Mucky Mineral (F1)
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)
- ☐ Vernal Pools (F9)

Indicators for Problematic Hydric Soils[4]:

- ☐ 1 cm Muck (A9) (**LRR C**)
- ☐ 2 cm Muck (A10) (**LRR B**)
- ☐ Reduced Vertic (F18)
- ☐ Red Parent Material (TF2)
- ☐ Other (Explain in Remarks)

[4]Indicators of hydrophytic vegetation and wetland hydrology must be present.

Restrictive Layer (if present):
Type:
Depth (inches):

Hydric Soil Present? Yes ○ No ◉

Remarks: This site had high chroma values in the upper profile and lacked any redox features. It fails to meet the soil requirement for a wetland.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (any one indicator is sufficient)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☐ Saturation (A3)
- ☐ Water Marks (B1) (**Nonriverine**)
- ☐ Sediment Deposits (B2) (**Nonriverine**)
- ☐ Drift Deposits (B3) (**Nonriverine**)
- ☐ Surface Soil Cracks (B6)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Water-Stained Leaves (B9)
- ☐ Salt Crust (B11)
- ☐ Biotic Crust (B12)
- ☐ Aquatic Invertebrates (B13)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres along Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Plowed Soils (C6)
- ☐ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ☐ Water Marks (B1) (**Riverine**)
- ☐ Sediment Deposits (B2) (**Riverine**)
- ☐ Drift Deposits (B3) (**Riverine**)
- ☐ Drainage Patterns (B10)
- ☐ Dry-Season Water Table (C2)
- ☐ Thin Muck Surface (C7)
- ☐ Crayfish Burrows (C8)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Shallow Aquitard (D3)
- ☐ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes ○ No ◉ Depth (inches):
Water Table Present? Yes ○ No ◉ Depth (inches):
Saturation Present? (includes capillary fringe) Yes ○ No ◉ Depth (inches):

Wetland Hydrology Present? Yes ○ No ◉

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks: The site has no water present, nor were there any indications of past hydrology indicators. It fails to meet the hydrology requirement for wetland.

WETLAND DETERMINATION DATA FORM - Arid West Region

Project/Site: San Mateo Creek/ Site 8 | City/County: San Mateo/Cibola | Sampling Date: 6/24/15

Applicant/Owner: NMDOT | State: NM | Sampling Point: Site 8

Investigator(s): Paul Knight | Section, Township, Range: Unplatted

Landform (hillslope, terrace, etc.): Depression | Local relief (concave, convex, none): Concave | Slope (%): 1

Subregion (LRR): D - Interior Deserts | Lat: 35° 20' 9.875" | Long: 107° 41' 8.348" | Datum: NAD 83

Soil Map Unit Name: Sprank sandy clay loam, Saline, sodic, 1-3 percent slopes | NWI classification: None

Are climatic / hydrologic conditions on the site typical for this time of year? Yes (●) No ( ) (If no, explain in Remarks.)

Are Vegetation ☐ Soil ☐ or Hydrology ☐ significantly disturbed? Are "Normal Circumstances" present? Yes (●) No ( )

Are Vegetation ☐ Soil ☐ or Hydrology ☐ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS - Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes (●)	No ( )
Hydric Soil Present?	Yes (●)	No ( )
Wetland Hydrology Present?	Yes ( )	No (●)
Is the Sampled Area within a Wetland?	Yes ( )	No (●)

Remarks: This site was dominated by wetland vegetation and wetland soils but it currently lacks hydrology. Based on the vegetation present it was likely a wetland in the recent past and with return of hydrology may be so again.

VEGETATION

Tree Stratum (Use scientific names.)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
Total Cover:	%		
Sapling/Shrub Stratum			
1. *Ericameria nauseosa*	5	Yes	FACW
2.			
3.			
4.			
5.			
Total Cover:	5 %		
Herb Stratum			
1. *Juncus articus*	10	Yes	FACW
2. *Distichlis spicata*	20	Yes	FACW
3. *Sporobolus airoides*	5	Yes	FAC
4.			
5.			
6.			
7.			
8.			
Total Cover:	35 %		
Woody Vine Stratum			
1.			
2.			
Total Cover:	%		

% Bare Ground in Herb Stratum 65 % | % Cover of Biotic Crust 0 %

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC:	4	(A)
Total Number of Dominant Species Across All Strata:	4	(B)
Percent of Dominant Species That Are OBL, FACW, or FAC:	100.0 %	(A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species		x 1 =	0
FACW species	35	x 2 =	70
FAC species	5	x 3 =	15
FACU species		x 4 =	0
UPL species		x 5 =	0
Column Totals:	40 (A)		85 (B)

Prevalence Index = B/A = 2.12

Hydrophytic Vegetation Indicators:

- [x] Dominance Test is >50%
- [x] Prevalence Index is ≤3.0[1]
- [ ] Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- [ ] Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present.

Hydrophytic Vegetation Present? Yes (●) No ( )

Remarks: The site occurs within a shallow depression that parallels the NM 605 roadway. It may have been an old bar ditch which intercepts groundwater flow and conveys it to San Mateo Creek. It was dominated by wetland vegetation and meets both the dominance test and prevalence index.

SOIL

Sampling Point: Site 8

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox %	Type[1]	Loc[2]	Texture[3]	Remarks
0-4	10YR 3/2	100					Clay loam	Root Zone very little soil
4-8	10YR 4/2	93	10YR 4/6	5	C	RC	Clay Loam	
			10YR 4/1.5	2	D	M	ClayLoam	
8-12	10 YR 4/2	95	10YR 4/6	5	C	RC	Clay Loam	
12-16	10YR 4/2	95	10YR 4/6	5	C	RC	Clay	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix. [2]Location: PL=Pore Lining, RC=Root Channel, M=Matrix.
[3]Soil Textures: Clay, Silty Clay, Sandy Clay, Loam, Sandy Clay Loam, Sandy Loam, Clay Loam, Silty Clay Loam, Silt Loam, Silt, Loamy Sand, Sand.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Stratified Layers (A5) (**LRR C**)
- ☐ 1 cm Muck (A9) (**LRR D**)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Loamy Mucky Mineral (F1)
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☒ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)
- ☐ Vernal Pools (F9)

Indicators for Problematic Hydric Soils[4]:

- ☐ 1 cm Muck (A9) (**LRR C**)
- ☐ 2 cm Muck (A10) (**LRR B**)
- ☐ Reduced Vertic (F18)
- ☐ Red Parent Material (TF2)
- ☐ Other (Explain in Remarks)

[4]Indicators of hydrophytic vegetation and wetland hydrology must be present.

Restrictive Layer (if present):
Type:
Depth (inches):

Hydric Soil Present? Yes ◉ No ○

Remarks: This site had low chroma soils throughout the profile with Redox concentrations in the form of oxidized root channels in all areas except the root zone. This site meets the soil criteria for a wetland.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (any one indicator is sufficient)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☐ Saturation (A3)
- ☐ Water Marks (B1) (**Nonriverine**)
- ☐ Sediment Deposits (B2) (**Nonriverine**)
- ☐ Drift Deposits (B3) (**Nonriverine**)
- ☐ Surface Soil Cracks (B6)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Water-Stained Leaves (B9)
- ☐ Salt Crust (B11)
- ☐ Biotic Crust (B12)
- ☐ Aquatic Invertebrates (B13)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres along Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Plowed Soils (C6)
- ☐ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ☐ Water Marks (B1) (**Riverine**)
- ☐ Sediment Deposits (B2) (**Riverine**)
- ☐ Drift Deposits (B3) (**Riverine**)
- ☐ Drainage Patterns (B10)
- ☐ Dry-Season Water Table (C2)
- ☐ Thin Muck Surface (C7)
- ☐ Crayfish Burrows (C8)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Shallow Aquitard (D3)
- ☐ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present?	Yes ○	No ◉	Depth (inches):
Water Table Present?	Yes ○	No ◉	Depth (inches):
Saturation Present? (includes capillary fringe)	Yes ○	No ◉	Depth (inches):

Wetland Hydrology Present? Yes ○ No ◉

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks: The site currently did not have water present, but based on the vegetation it is likely that wetlands have occurred in this area in the past and will likely occur there again. However, at this time it fails to meet the hydrology requirement.

WETLAND DETERMINATION DATA FORM - Arid West Region

Project/Site: San Mateo Creek/ Site 9 City/County: San Mateo/Cibola Sampling Date: 6/24/15

Applicant/Owner: NMDOT State: NM Sampling Point: Site 9

Investigator(s): Paul Knight Section, Township, Range: Unplatted

Landform (hillslope, terrace, etc.): Flat ground end of ditch Local relief (concave, convex, none): Flat Slope (%): 0

Subregion (LRR): D - Interior Deserts Lat: 35° 20' 9.875" Long: 107° 41' 8.348" Datum: NAD 83

Soil Map Unit Name: Sprank sandy clay loam, Saline, sodic, 1-3 percent slopes NWI classification: None

Are climatic / hydrologic conditions on the site typical for this time of year? Yes (●) No ( ) (If no, explain in Remarks.)

Are Vegetation ☐ Soil ☐ or Hydrology ☐ significantly disturbed? Are "Normal Circumstances" present? Yes (●) No ( )

Are Vegetation ☐ Soil ☐ or Hydrology ☐ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS - Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes (●)	No ( )
Hydric Soil Present?	Yes (●)	No ( )
Wetland Hydrology Present?	Yes ( )	No (●)

Is the Sampled Area within a Wetland? Yes ( ) No (●)

Remarks: This site was dominated by wetland vegetation and wetland soils but it currently lacks hydrology. Based on the vegetation present it was likely a wetland in the recent past and with return of hydrology may be so again.

VEGETATION

Tree Stratum (Use scientific names.)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
Total Cover:	%		
Sapling/Shrub Stratum			
1. *Ericameria nauseosa*	1	No	Not Listed
2.			
3.			
4.			
5.			
Total Cover:	1 %		
Herb Stratum			
1. *Juncus articus*	5	Yes	FACW
2. *Distichlis spicata*	30	Yes	FACW
3.			
4.			
5.			
6.			
7.			
8.			
Total Cover:	35 %		
Woody Vine Stratum			
1.			
2.			
Total Cover:	%		

% Bare Ground in Herb Stratum 65 % % Cover of Biotic Crust 0 %

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 2 (A)

Total Number of Dominant Species Across All Strata: 2 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100.0 % (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:
OBL species		x 1 = 0
FACW species	35	x 2 = 70
FAC species		x 3 = 0
FACU species		x 4 = 0
UPL species	1	x 5 = 5
Column Totals:	36 (A)	75 (B)

Prevalence Index = B/A = 2.08

Hydrophytic Vegetation Indicators:

- ☒ Dominance Test is >50%
- ☒ Prevalence Index is ≤3.0[1]
- ☐ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ☐ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present.

Hydrophytic Vegetation Present? Yes (●) No ( )

Remarks: The site occurs within a shallow depression that parallels the NM 605 roadway. It may have been an old bar ditch which intercepts groundwater flow and conveys it to San Mateo Creek. It was dominated by wetland vegetation and meets both the dominance test and prevalence index.

SOIL

Sampling Point: Site 9

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox %	Type[1]	Loc[2]	Texture[3]	Remarks
0-6	10YR 2/2	100					Sandy Loam	
6-12	10YR 4/2	100					Sandy Loam	
12-16	10YR 4/2	100					ClayLoam	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix. [2]Location: PL=Pore Lining, RC=Root Channel, M=Matrix.
[3]Soil Textures: Clay, Silty Clay, Sandy Clay, Loam, Sandy Clay Loam, Sandy Loam, Clay Loam, Silty Clay Loam, Silt Loam, Silt, Loamy Sand, Sand.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Stratified Layers (A5) (**LRR C**)
- ☐ 1 cm Muck (A9) (**LRR D**)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Loamy Mucky Mineral (F1)
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)
- ☐ Vernal Pools (F9)

Indicators for Problematic Hydric Soils[4]:

- ☐ 1 cm Muck (A9) (**LRR C**)
- ☐ 2 cm Muck (A10) (**LRR B**)
- ☐ Reduced Vertic (F18)
- ☐ Red Parent Material (TF2)
- ☐ Other (Explain in Remarks)

[4]Indicators of hydrophytic vegetation and wetland hydrology must be present.

Restrictive Layer (if present):
Type:
Depth (inches):

Hydric Soil Present? Yes ◉ No ○

Remarks: This site had low chroma soils throughout the profile but it lacked Redox features This site fails to meet the soil criteria for a wetland.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (any one indicator is sufficient)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☐ Saturation (A3)
- ☐ Water Marks (B1) (**Nonriverine**)
- ☐ Sediment Deposits (B2) (**Nonriverine**)
- ☐ Drift Deposits (B3) (**Nonriverine**)
- ☐ Surface Soil Cracks (B6)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Water-Stained Leaves (B9)
- ☐ Salt Crust (B11)
- ☐ Biotic Crust (B12)
- ☐ Aquatic Invertebrates (B13)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres along Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Plowed Soils (C6)
- ☐ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ☐ Water Marks (B1) (**Riverine**)
- ☐ Sediment Deposits (B2) (**Riverine**)
- ☐ Drift Deposits (B3) (**Riverine**)
- ☐ Drainage Patterns (B10)
- ☐ Dry-Season Water Table (C2)
- ☐ Thin Muck Surface (C7)
- ☐ Crayfish Burrows (C8)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Shallow Aquitard (D3)
- ☐ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present?	Yes ○	No ◉	Depth (inches):
Water Table Present?	Yes ○	No ◉	Depth (inches):
Saturation Present? (includes capillary fringe)	Yes ○	No ◉	Depth (inches):

Wetland Hydrology Present? Yes ○ No ◉

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks: The site currently did not have water present, but based on the vegetation it is likely that wetlands have occurred in this area in the past and will likely occur there again. However, at this time it fails to meet the hydrology requirement.

APPENDIX C

ARROYO DEL PUERTO WETLAND DATA SHEETS

WETLAND DETERMINATION DATA FORM - Arid West Region

Project/Site: Arroyo del Puerto/ Site 1 City/County: San Mateo/Cibola Sampling Date: 5/21/15

Applicant/Owner: NMDOT State: NM Sampling Point: Site 1

Investigator(s): Paul Knight Section, Township, Range: Unplatted

Landform (hillslope, terrace, etc.): Channel Bottom Local relief (concave, convex, none): concave Slope (%): 1

Subregion (LRR): D - Interior Deserts Lat: 35° 20' 20.526" Long: 107° 47' 39.584" Datum: NAD 83

Soil Map Unit Name: Sprank - San Mateo-Zia Complex 0-3 percent slopes NWI classification: R4SBC

Are climatic / hydrologic conditions on the site typical for this time of year? Yes (●) No ( ) (If no, explain in Remarks.)

Are Vegetation ☐ Soil ☐ or Hydrology ☐ significantly disturbed? Are "Normal Circumstances" present? Yes (●) No ( )

Are Vegetation ☐ Soil ☐ or Hydrology ☐ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS - Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes (●)	No ( )
Hydric Soil Present?	Yes (●)	No ( )
Wetland Hydrology Present?	Yes (●)	No ( )

Is the Sampled Area within a Wetland? Yes (●) No ( )

Remarks: This is an extremely marginal wetland and in 2014 did not meet all of the criteria. Because some of the wetland indicator plants are annuals there may be dry years when the vegetation criteria is not wet. Additionally, during dry years the secondary hydrology that qualified the hydrology may not be year. It makes it as a wetland but barely.

VEGETATION

Tree Stratum (Use scientific names.)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
Total Cover:	%		
Sapling/Shrub Stratum			
1.			
2.			
3.			
4.			
5.			
Total Cover:	%		
Herb Stratum			
1. *Distichlis spicata*	10	Yes	FACW
2. *Bassia scoparia*	25	Yes	FAC
3. *Agropyron cristatum*	2	No	Not Listed
4. *Grindellia nuda*	2	No	Not Listed
5.			
6.			
7.			
8.			
Total Cover:	39 %		
Woody Vine Stratum			
1.			
2.			
Total Cover:	%		

% Bare Ground in Herb Stratum 61 % % Cover of Biotic Crust 0 %

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC:	2	(A)
Total Number of Dominant Species Across All Strata:	2	(B)
Percent of Dominant Species That Are OBL, FACW, or FAC:	100.0 %	(A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species		x 1 =	0
FACW species	10	x 2 =	20
FAC species	25	x 3 =	75
FACU species		x 4 =	0
UPL species	4	x 5 =	20
Column Totals:	39 (A)		115 (B)

Prevalence Index = B/A = 2.95

Hydrophytic Vegetation Indicators:

- ☒ Dominance Test is >50%
- ☒ Prevalence Index is ≤3.0[1]
- ☐ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ☐ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present.

Hydrophytic Vegetation Present? Yes (●) No ( )

Remarks: The site occurs on the bottom of the channel of Arroyo del Puerto. The site supported a mixture of wetland and upland vegetation but the wetland vegetation was abundant enough to meet both the dominance test and prevalence index. This site meets the vegetation requirements for a wetland

SOIL

Sampling Point: Site 1

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox %	Type[1]	Loc[2]	Texture[3]	Remarks
0-1.5	10YR 4/3	100					Fine sand /silt	
2-6	10YR 3/2	98	10YR 4/6	2	C	RC	Sandy Clay Loam	
6-16	10YR 3/2	99	10YR 4/6	1	C	RC	Silty Clay Loam	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix. [2]Location: PL=Pore Lining, RC=Root Channel, M=Matrix.
[3]Soil Textures: Clay, Silty Clay, Sandy Clay, Loam, Sandy Clay Loam, Sandy Loam, Clay Loam, Silty Clay Loam, Silt Loam, Silt, Loamy Sand, Sand.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Stratified Layers (A5) (**LRR C**)
- ☐ 1 cm Muck (A9) (**LRR D**)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Loamy Mucky Mineral (F1)
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☒ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)
- ☐ Vernal Pools (F9)

Indicators for Problematic Hydric Soils[4]:

- ☐ 1 cm Muck (A9) (**LRR C**)
- ☐ 2 cm Muck (A10) (**LRR B**)
- ☐ Reduced Vertic (F18)
- ☐ Red Parent Material (TF2)
- ☐ Other (Explain in Remarks)

[4]Indicators of hydrophytic vegetation and wetland hydrology must be present.

Restrictive Layer (if present):

Type: ________

Depth (inches): ________

Hydric Soil Present? Yes ◉ No ○

Remarks: This site had chroma 2 soils with redox concentrations in the upper profile. This site just meets the conditions for the Redox Dark Surface criteria.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (any one indicator is sufficient)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☐ Saturation (A3)
- ☐ Water Marks (B1) (**Nonriverine**)
- ☐ Sediment Deposits (B2) (**Nonriverine**)
- ☐ Drift Deposits (B3) (**Nonriverine**)
- ☐ Surface Soil Cracks (B6)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Water-Stained Leaves (B9)
- ☐ Salt Crust (B11)
- ☐ Biotic Crust (B12)
- ☐ Aquatic Invertebrates (B13)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres along Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Plowed Soils (C6)
- ☐ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ☐ Water Marks (B1) (**Riverine**)
- ☒ Sediment Deposits (B2) (**Riverine**)
- ☒ Drift Deposits (B3) (**Riverine**)
- ☐ Drainage Patterns (B10)
- ☐ Dry-Season Water Table (C2)
- ☐ Thin Muck Surface (C7)
- ☐ Crayfish Burrows (C8)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Shallow Aquitard (D3)
- ☐ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present?	Yes ○	No ◉	Depth (inches):
Water Table Present?	Yes ○	No ◉	Depth (inches):
Saturation Present? (includes capillary fringe)	Yes ○	No ◉	Depth (inches):

Wetland Hydrology Present? Yes ◉ No ○

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks: The site lacked any primary wetland indicators but had drift lines on the nearby fence and had sediment on the vegetation meeting the two secondary riverine indicators. It just meets the requirement for wetland hydrology.

WETLAND DETERMINATION DATA FORM - Arid West Region

Project/Site: Arroyo del Puerto/ Site 2 City/County: San Mateo/Cibola Sampling Date: 5/21/15

Applicant/Owner: NMDOT State: NM Sampling Point: Site 2

Investigator(s): Paul Knight Section, Township, Range: Unplatted

Landform (hillslope, terrace, etc.): Bench above channel Local relief (concave, convex, none): convex Slope (%): 3

Subregion (LRR): D - Interior Deserts Lat: 35° 20' 20.544" Long: 107° 47' 39.450" Datum: NAD 83

Soil Map Unit Name: Sprank - San Mateo-Zia Complex 0-3 percent slopes NWI classification: None

Are climatic / hydrologic conditions on the site typical for this time of year? Yes (●) No ( ) (If no, explain in Remarks.)

Are Vegetation ☐ Soil ☐ or Hydrology ☐ significantly disturbed? Are "Normal Circumstances" present? Yes (●) No ( )

Are Vegetation ☐ Soil ☐ or Hydrology ☐ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS - Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes (●)	No ( )	
Hydric Soil Present?	Yes ( )	No (●)	Is the Sampled Area
Wetland Hydrology Present?	Yes ( )	No (●)	within a Wetland? Yes ( ) No (●)

Remarks: This site has annual wetland vegetation present, but lacks both wetland soils and wetland hydrology. It fails to meet the criteria for a wetland.

VEGETATION

Tree Stratum (Use scientific names.)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
Total Cover:	%		
Sapling/Shrub Stratum			
1.			
2.			
3.			
4.			
5.			
Total Cover:	%		
Herb Stratum			
1. *Bassia scoparia*	40	Yes	FAC
2. *Atriplex canescens*	1	No	Not Listed
3.			
4.			
5.			
6.			
7.			
8.			
Total Cover:	41 %		
Woody Vine Stratum			
1.			
2.			
Total Cover:	%		

% Bare Ground in Herb Stratum 61 % % Cover of Biotic Crust 0 %

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC:	1	(A)
Total Number of Dominant Species Across All Strata:	1	(B)
Percent of Dominant Species That Are OBL, FACW, or FAC:	100.0 %	(A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species		x 1 =	0
FACW species		x 2 =	0
FAC species	40	x 3 =	120
FACU species		x 4 =	0
UPL species	1	x 5 =	5
Column Totals:	41 (A)		125 (B)

Prevalence Index = B/A = 3.05

Hydrophytic Vegetation Indicators:

- ☒ Dominance Test is >50%
- ☐ Prevalence Index is ≤3.0[1]
- ☐ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ☐ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present.

Hydrophytic Vegetation Present? Yes (●) No ( )

Remarks: Although this site is on a dry slope it was still dominated by Bassia scoparia which is a FAC indicator in the Arid Land West. It meets the dominance test for wetland vegetation.

SOIL

Sampling Point: Site 2

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Type[1]	Loc[2]	Texture[3]	Remarks
0-8	10YR 4/4	100					Sandy Loam	
8-16	10YR 3/3	100					Sandy Loam	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix. [2]Location: PL=Pore Lining, RC=Root Channel, M=Matrix.
[3]Soil Textures: Clay, Silty Clay, Sandy Clay, Loam, Sandy Clay Loam, Sandy Loam, Clay Loam, Silty Clay Loam, Silt Loam, Silt, Loamy Sand, Sand.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Stratified Layers (A5) (**LRR C**)
- ☐ 1 cm Muck (A9) (**LRR D**)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Loamy Mucky Mineral (F1)
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)
- ☐ Vernal Pools (F9)

Indicators for Problematic Hydric Soils[4]:

- ☐ 1 cm Muck (A9) (**LRR C**)
- ☐ 2 cm Muck (A10) (**LRR B**)
- ☐ Reduced Vertic (F18)
- ☐ Red Parent Material (TF2)
- ☐ Other (Explain in Remarks)

[4]Indicators of hydrophytic vegetation and wetland hydrology must be present.

Restrictive Layer (if present):

Type: ______

Depth (inches): ______

Hydric Soil Present? Yes ○ No ●

Remarks: This site had high chroma soils that lacked any redox features. It fails to meet the hydric soil criteria for a wetland

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (any one indicator is sufficient)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☐ Saturation (A3)
- ☐ Water Marks (B1) (**Nonriverine**)
- ☐ Sediment Deposits (B2) (**Nonriverine**)
- ☐ Drift Deposits (B3) (**Nonriverine**)
- ☐ Surface Soil Cracks (B6)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Water-Stained Leaves (B9)
- ☐ Salt Crust (B11)
- ☐ Biotic Crust (B12)
- ☐ Aquatic Invertebrates (B13)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres along Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Plowed Soils (C6)
- ☐ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ☐ Water Marks (B1) (**Riverine**)
- ☐ Sediment Deposits (B2) (**Riverine**)
- ☐ Drift Deposits (B3) (**Riverine**)
- ☐ Drainage Patterns (B10)
- ☐ Dry-Season Water Table (C2)
- ☐ Thin Muck Surface (C7)
- ☐ Crayfish Burrows (C8)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Shallow Aquitard (D3)
- ☐ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present?	Yes ○	No ●	Depth (inches):
Water Table Present?	Yes ○	No ●	Depth (inches):
Saturation Present? (includes capillary fringe)	Yes ○	No ●	Depth (inches):

Wetland Hydrology Present? Yes ○ No ●

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks: The site is located above the OHWM and lacked any hydrology indicators. It fails to meet the hydrology requirement for a wetland.

APPENDIX A-4

Pecos Sunflower Survey, Southern Pipeline Route

Proposed Roca Honda Pipeline Corridor

October 2015, Marron and Associates

Michael Neumann

From:	Paul Knight <paul@marroninc.com>
Sent:	Thursday, October 29, 2015 8:27 AM
To:	Michael Neumann
Subject:	Helianthus paradoxus survey along portions of the Rio San Jose on Acoma Pueblo.
Attachments:	Surveyed for Pecos Sunflower.kmz; Unsurveyd Potential Habitat for Pecos Sunflower.kmz

Mike:

On September 30, 2015 Paul Knight (MS Botany), and Reggie Fletcher (MS Botany) completed a survey for *Helianthus paradoxus* (Pecos sunflower) along approximately 5 miles of the Rio San Jose on Acoma Pueblo. This survey began approximately 1.3 miles east of the junction of NM 117 and Interstate 40 at approximately UTM Zone 13 E 249092/N3884767 NAD 83 and extended eastward along the channel of the river to just west of the Santa Maria Mission on Acoma Pueblo at approximately E 255529/N3883555 NAD 83 (A kmz file showing the extent of the survey has been attached to this email). Not only was the river channel surveyed, but also any adjacent meadows were included in the survey, particularly if seep areas or alkali soils were present. The most suitable habitat for Pecos sunflower that we found in the project area occurred along the edge of the river just south of Interstate 40 and north of NM 124 within an open area along the Rio San Jose. This area had saturated soil near the surface and the soil was topped with an alkali crust on the surface. This area extended along about 0.25 miles of the river centered around UTM Z 13 E252922/N3883341 NAD 83. Although there were large stands of *Helianthus annuus* (common sunflower), present at this location, there were no Pecos sunflowers present. Three other areas of suitable habitat were identified in the general area but outside of our survey corridor. These include two areas where surfacing groundwater sustains palustrine emergent marshy meadows that are separated and remote from the Rio San Jose, and a large marshy and that extends outward several hundred meters on both sides of the Rio San Jose. All three of these areas are mapped in an attached kmz file. There was not enough time to investigate these areas during this survey but they should be surveyed in the future. Prior to the onset of this survey a known population of Pecos sunflower located just east of Grants, NM was visited. This population occurs along the north and south side of Interstate 40 approximately 0.75 miles east of Exit 85 on Interstate 40. This population is part of the designated critical habitat for this species. This site is not part of the project area but it was close enough to the project area to ascertain the phonological status of *Helianthus paradoxus* at the time of the survey. This site was first visited on August 25, 2015, and at that time there were many thousands of Pecos sunflowers present in flower. The following two photos are of this known population along Interstate 40 taken on August 25, 2015.

(Above and Below) Helinathus paradoxus in full flower along the north side of Interstate 40 about 0.75 miles east of Exit 85.

We revisited this *Helianthus paradoxus* population on September 30, 2015. At that time the entire population had completed flowering and the head had browned, died back, and seeds were falling from them. Although many of the upper leaves had browned and shriveled, most of the lower leaves were still green. The dried heads were substantially smaller than those of *Helianthus annus*, and *H. petiolaris*, (the two other sunflowers common in the area) and the receptacle was noticeably flatter than either. It was anticipated that these traits combined with the leaf shape could be used to separate them from *H. annuus* and *H. petiolaris* within the survey area. As it turned out there was no problem in separating the dried H. *paradoxus* plants from either H. *annuus* or *H. petiolaris*, as the both of the later were still fully green, and most were still in flower. The *H. paradoxus* population appeared to have much more synchronous flowering, and a shorter flowering period than either *H. annuus* or *H. petiolaris* populations in the area. Both *Helianthus annuus* and *H. petiolaris* were still flowering in the area well into late October. Below are photographs of the *H. paradoxus* population just east of exit 85 along Interstate 40 near Grants as observed on September 30, 2015.

Helianthus paradoxus population along Intersate 40 near Exit 85 as observed on September 30, 2015.

(Above) lower stems of *Helianthus paradoxus* on September 30 showing the green leaves still visible. (Below) Dried heads of Helianthus paradoxus showing chaff and residual seeds.

Head of *Helianthus paradoxus* where the chaff has fallen off revealing the receptacle

Summary and Conclusion

With sufficient information collected to accurately determine if *Helianthus paradoxus* was present along the Rio San Jose we began the survey at about 9:00 AM on September 30, 2015 and continued to late afternoon. We concentrated the survey on the river channel area, but any wet meadows or marshes adjacent to the river were also examined. *Helianthus paradoxus* was not present anywhere along the five miles of the Rio San Jose on Acoma Pueblo that were surveyed on September 30, 2015. We believe that the primary reason for its absence is the average depth that the river channel along that reach of the Rio San Jose is generally far below the elevation of the surrounding uplands. In most places that we examined the surface water elevation in the river was close to three feet below the bank, and in some places as deep as five feet below the adjacent uplands. In these locations the average surface water level in the channel was far enough down below the bank that any groundwater associated with the river level would be several feet below the surface, and likely to deep to sustain the shallow groundwater and alkali soils this species prefers. The best likelihood of finding *Helianthus paradoxus* in the area would be to look within seeps, cienega areas or marshes far enough from the edge of the incised river channel to maintain their own perched water tables, or within areas where the river channel is close enough to the surface that the groundwater is shallow enough to sustain a water table close to the surface.

Paul Knight

Your Vision
Our Expertise
Exceptional Results

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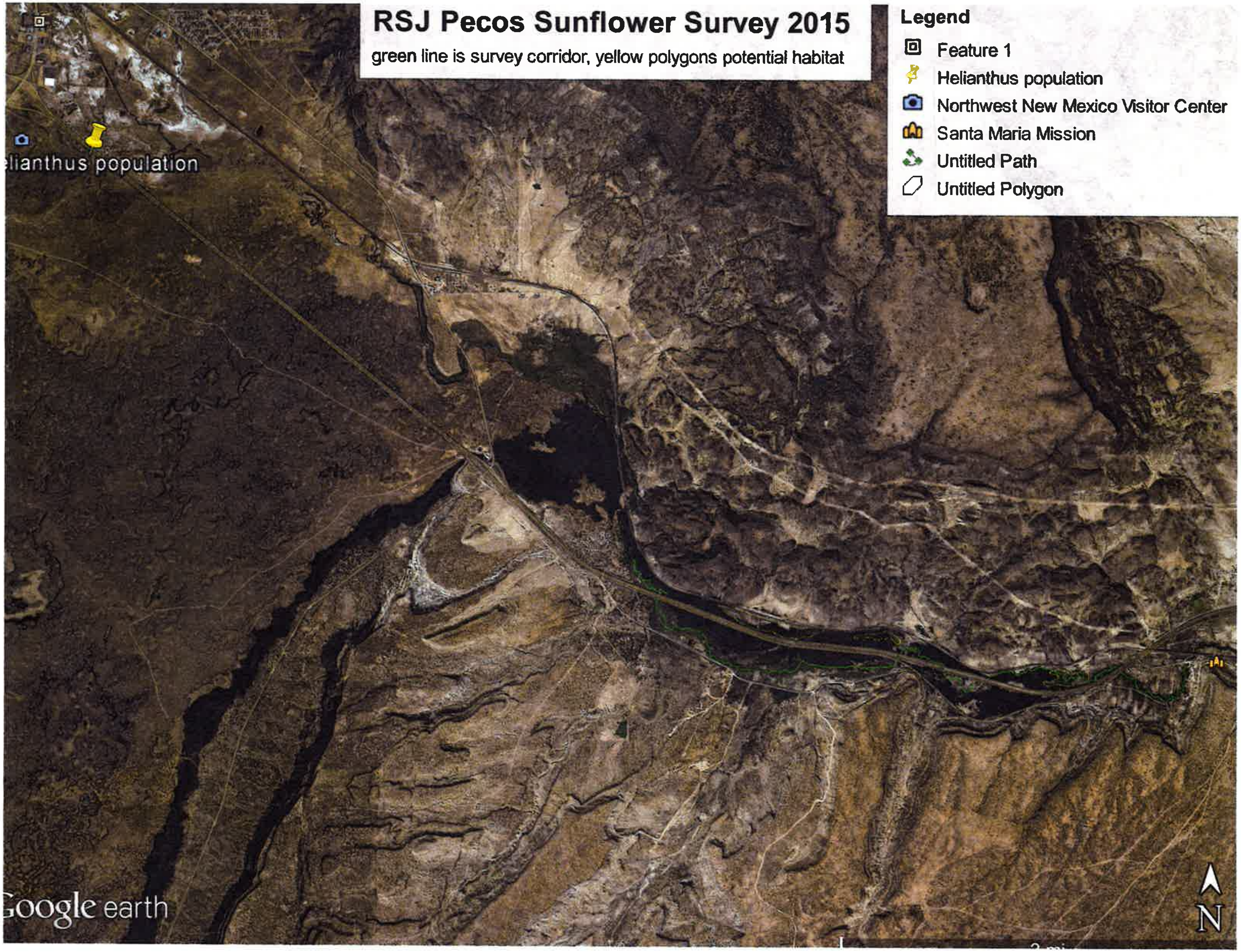

RSJ Pecos Sunflower Survey 2015
green line is survey corridor, yellow polygons potential habitat
Legend
Feature 1
Helianthus population
Northwest New Mexico Visitor Center
Santa Maria Mission
Untitled Path
Untitled Polygon
lianthus population
Google earth
N

APPENDIX B-1

SAP for Supplemental Radiological Survey at the Roca Honda Mine

August 2015, Environmental Restoration Group Inc.

Sampling and Analysis Plan for Supplemental Radiological Baseline Surveys at the Roca Honda Mine

Mine Permit No. MK025RN
Sections 8 and 17, McKinley County, New Mexico

Prepared for:

Roca Honda Resources, LLC.
4001 Office Court, Suite 107
Santa Fe, NM 87507

Prepared by:

Environmental Restoration Group, Inc.
8809 Washington St. NE, Suite 150
Albuquerque, NM 87113

August 26, 2015

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FIGURES

1. INTRODUCTION

On behalf of Roca Honda Resources, LLC. (RHR), Environmental Restoration Group, Inc. (ERG) has prepared this sampling and analysis plan (SAP) for supplemental radiological baseline surveys at the Roca Honda Mine in McKinley County, New Mexico (Site). These surveys will be conducted across portions of Sections 8 and 17 as depicted in Figure 1, which include newly expanded mineral properties adjacent to the original Roca Honda mining permit area (Mine Permit No. MK025RN). The total area to be surveyed is approximately 180 acres. The data generated will further supplement updated radiological baseline data for the Project as previously developed as an Addendum to Section 13 of the Roca Honda Mine Reclamation Plan (SENES, 2013a), as well as new data collected more recently along an alternate reuse water pipeline corridor (ARCADIS-SENES, 2014).

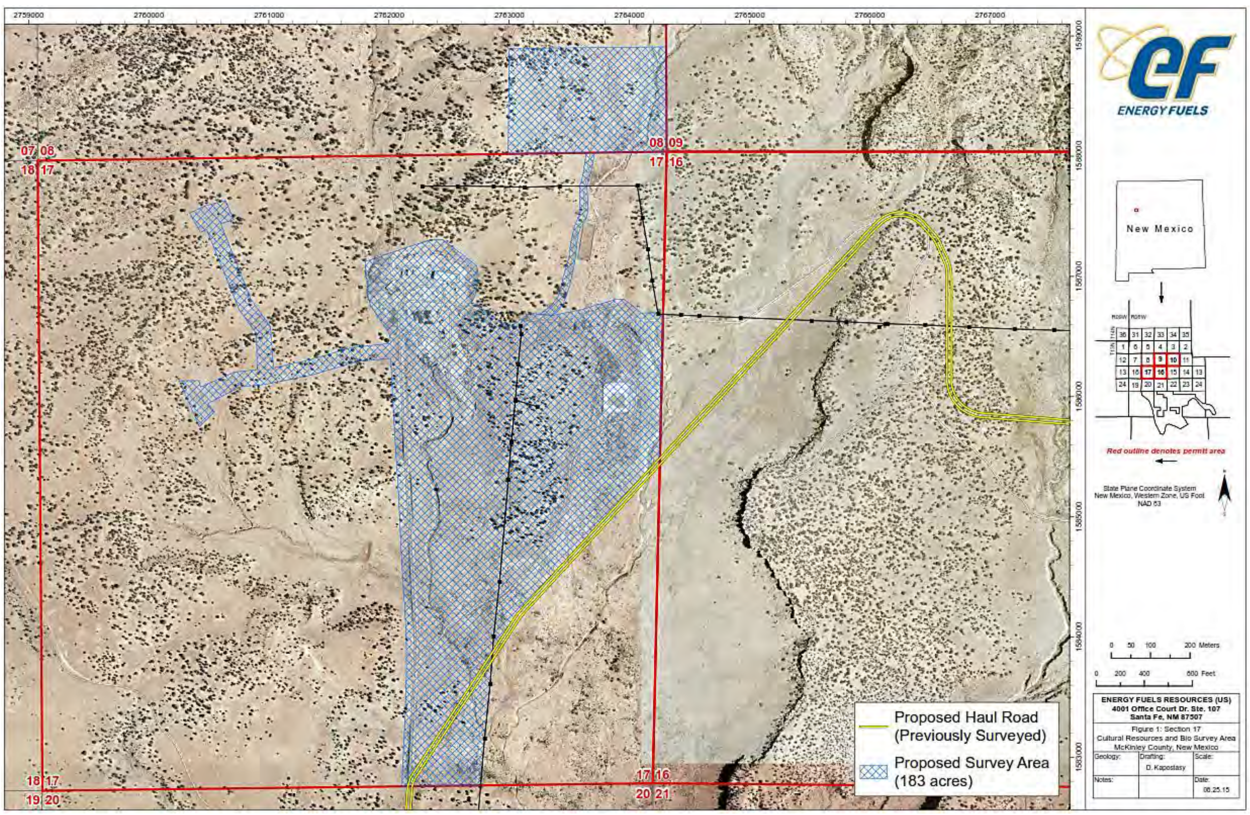

Figure 1: Proposed supplemental survey areas adjacent to the Roca Honda Mine permit area.

This SAP has been designed for general consistency with applicable draft guidance from the New Mexico Mining and Minerals Division (MMD) regarding radiation criteria at new uranium mining operations (MMD, 2014), as well as specific consistency with previous or planned radiological baseline surveys and related reports associated with relatively recent mine permitting activities for the Site (SENES, 2013a and 2013b; ARCADIS-SENES, 2014).

2. REGULATORY GUIDANCE

Key elements of applicable MMD guidance regarding radiological reclamation standards and baseline characterization for new mines (MMD, 2014) can generally be summarized as follows:

- The goal of reclamation is to return post-mining gamma radiation levels to pre-mining conditions. Residual mine materials having radionuclide concentrations in excess of MMD criteria must be removed to an approved offsite facility, or covered onsite with sufficient quantities of acceptable materials.
- Any residual mine waste materials due to mining operations that exceed an average radium-226 (Ra-226) concentration of 5 pCi/g above baseline concentrations in the first 15 cm below the ground surface, or exceed subsurface baseline Ra-226 concentrations by more than 15 pCi/g when averaged over subsequent 15 cm-thick layers, must be addressed by removal or covering as indicated above.
- Reclamation of radiation will be considered adequate if the Post-Reclamation Radiation Level (PRRL) is equal to or less than the 95th percentile on baseline gamma radiation readings, and if the concentration of Ra-226 (Ra-226) in any cover soils utilized in reclamation is less than 5 pCi/g above baseline Ra-226 soil concentrations.
- Pre- and post-radiation surveys are critical in determining whether or not post-reclamation radiation criteria have been met. The radiological baseline survey must adequately define pre-mine conditions within the permit area, including the nature and extent of any pre-existing contamination from NORM or TENORM materials.
- Both horizontal and vertical baseline radiological conditions must be characterized. Acceptable characterization parameters for each include the following:

  Horizontal characterization:

  - A gamma radiation survey (gamma survey), with the detector positioned 1 meter above ground surface, and with a minimum number of "samples" (measurements) taken to ensure statistical representativeness. A formula is provided in the MMD guidance for the number of gamma measurements needed, under an implied assumption that the gamma survey will be performed using widely spaced discrete point measurements (e.g. at nodes of a rectangular sampling grid). The location of each "sampling point" should be obtained using global positioning system (GPS) measurements and these data should be included in the report so that these points can be revisited in the future.
  - Gamma radiation measurements at the ground surface (shielded and unshielded) are also indicated, though the purpose of these measurements is not stated. Consistency of approach between the baseline and post-reclamation gamma surveys is stressed as a key element of demonstrating acceptable remedial performance with respect to external gamma radiation. The 95th percentile on baseline gamma radiation readings will be calculated and utilized after reclamation to demonstrate compliance with the PRRL criterion as indicated above.

- Surface soil sampling (0-6 inch depth increment) is required, with laboratory analysis for concentrations of Ra-226, natural uranium (U-nat) and natural thorium (Th-232). The guidance does not specify the number of soil samples needed.
- A statistical correlation (linear regression analysis) between baseline gamma radiation readings (x-axis) and soil Ra-226 concentrations (y-axis) is required to permit estimates of Ra-226 levels in soil based on gamma readings.

Vertical characterization:

- Subsurface soil sampling (6-12 inch depth increment) is also called for, with same analytes as indicated above for surface soils. Subsurface soil sampling need not be rigorous, but should be sufficient to give some idea of vertical radiological baseline conditions.

This SAP has been designed to meet the basic objectives of the above regulatory guidance, though there are some differences to also maintain consistency with previous radiological baseline surveys that have been performed at the Site. For example, the gamma survey will be performed using automated GPS-based scanning systems which will collect geospatial gamma radiation data at a measurement density and ground coverage that is orders of magnitude greater than that specified in the guidance, and the data will be mapped to provide clear definition of the spatial distribution of terrestrial gamma radiation across the entire survey area.

A correlation between gamma readings and soil Ra-226 concentrations has already been established for the Site, as has a cross-calibration between raw gamma readings and true exposure rates as measured with a high-pressure ionization chamber (HPIC). Limited soil sampling will be performed to compare average Ra-226 results against average gamma-based estimates converted with the existing gamma/soil Ra-226 correlation, and to also generate average estimates of uranium and thorium concentrations.

3. BASELINE GAMMA RADIATION SURVEY

The field work will consist of a comprehensive GPS-based baseline gamma survey at a scan coverage on the order of 8% (approximately 50-meter scan transects), and with readings collected every one-second while scanning along each transect. This coverage is consistent with the original baseline gamma surveys conducted across Roca Honda Mine permit areas, and easily meets minimum requirements indicated in the MMD guidance. Previous instrument cross-calibration relationships and correlations between gamma readings and soil Ra-226 concentrations as developed for the Site (SENES, 2013a) will be used to normalize all new supplemental data with existing radiological baseline data.

3.1 Survey Instruments and Methods

ERG will employ 2-inch by 2-inch Ludlum Model 44-10 sodium iodide (NaI) gamma-radiation detectors, each coupled to a Ludlum Model 2221 ratemeter/scaler which is, in turn, coupled to a Trimble sub-meter accuracy GPS unit with a handheld datalogger. All areas will be surveyed at typical walking speeds (between 0.5 to 1.5 meters per second, depending on terrain), with the detectors positioned at approximately 1 meter above the ground surface. Gamma radiation count rate and paired coordinates will be recorded every one second.

Field personnel will walk survey transects with GPS receivers and detectors mounted on backpacks, and with ratemeters housed inside of the backpacks. The Trimble dataloggers will be carried by hand and will have shape files of pre-determined scan transects loaded on the screen such that the surveyors' can follow the planned transects with general accuracy (depending on terrain and obstructions such as tall vegetation, structures, etc.).

3.2 Quality Assurance / Quality Control

The response characteristics of each NaI detector/ratemeter pairing will be evaluated in advance of the survey and only units with comparable response will be selected for use during the survey. Each instrument pairing will have been properly calibrated within one year prior to the survey in accordance with American National Standards Institute (ANSI) method ANSI N323A (1997), which includes use of a National Institute of Standards and Technology (NIST)-traceable cesium-137 check source.

For each detector/ratemeter pairing to be used in the field, quality control (QC) measurements will be performed before at the beginning and end of each work day in a consistent staging area to be determined in the field. These daily QC measurements will be taken at a fixed location and geometry, and will include readings of background as well as a check source. Initial QC measurements prior to the survey will include a series of repeated measurements to develop control limits with which to evaluate proper function of the instrument pairing throughout the survey, which is expected to take several days to complete. All QC data will be documented for later analysis, which will include developing estimates of data uncertainty.

4. BASELINE SOIL SAMPLING

Baseline soil sampling locations will be based on the results of the gamma survey, with grab samples collected to be uniformly representative of the range of gamma readings found across the survey area. The number of samples to be taken is based on statistical calculation of that necessary to provide an unbiased estimate of the mean at the 95% confidence level, using the EPA's ProUCL statistical package (EPA, 2015). This calculation was based on the degree of variability observed for existing natural background soils across the vast majority of the Rocha Honda permit area (standard deviation ≈ 1.5 pCi/g), along with a specified limit of ± 1 pCi/g for the allowable amount of uncertainty on the estimated mean.

A total of 11 grab samples of surface soils will be collected to a depth of 0-6 inches. At four of these locations, a subsurface sample (6-12 inches) will also be collected. At each soil sampling location, unshielded gamma radiation readings at the ground surface will be recorded. Shielded readings at the ground surface will not be taken as such measurements are dependent on shield characteristics, are not representative of ambient baseline gamma radiation conditions, and shielded measurements have not previously be taken at the Site. All samples will be sent to a qualified/accredited laboratory for analysis of Ra-226, U-nat and Th-232 concentrations using the same analytical methods previously used for soil samples from the Site.

5. REPORTING

The radiological baseline survey report for the areas depicted in Figure 1 will be developed in a manner consistent with the previous radiological survey reports for the Site as cited in this SAP. Final normalized data sets will be merged with existing data sets as may be required.

6. REFERENCES

Environmental Protection Agency (EPA). 2015. ProUCL Version 5.0. Statistical Software for Environmental Applications for Data Sets with and without Non-detect Observations.

Mining and Minerals Division (MMD). 2014. Guidance for Meeting Radiation Criteria Levels and Reclamation at New Uranium Mining Operations. Title 19, Chapter 10, Part 3 and Part 6, New Mexico Administrative Code. Energy, Minerals & Natural Resources Department, Mining and Minerals Division, 1220 South St. Francis Drive, Santa Fe, NM 87505. April, 2014.

SENES Consultants (SENES). 2013a. Supplemental Radiological Baseline Surveys, Addendum to Section 13 of the Roca Honda Mine Reclamation Plan (Rev. 1). Mine Permit No. MK0205RN, McKinley County, NM. August 2013.

SENES Consultants (SENES). 2013b. Post Mine Radiological Surveys, Addendum to Roca Honda Mine Reclamation Plan (Rev. 1), Mine Permit No. MK0205RN, McKinley County, NM. March 2013.

ARCADIS-SENES. 2014. Baseline Radiological Survey of Pipeline Corridor and Reuse Water Discharge Area. Mine Permit No. MK025RN. January, 2014.

Supplemental Radiological Baseline Surveys for Expanded Permit Areas at the Roca Honda Mine Site

Mine Permit No. MK025RN
McKinley County, New Mexico

Prepared for:

Roca Honda Resources, LLC
4001 Office Court, Suite 102
Santa Fe, NM 87505

Prepared by:

ERG
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Albuquerque, NM 87113

January 2016

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FIGURES

TABLES

1. INTRODUCTION

On behalf of Roca Honda Resources, LLC (RHR), Environmental Restoration Group, Inc. (ERG) has prepared this supplemental report detailing existing radiological baseline conditions across a proposed expansion to the Roca Honda uranium mine permit area, hereafter referred to as the "Site", in McKinley County, New Mexico. The original mine permit area boundaries and proposed mine permit expansion are shown in Figure 1.

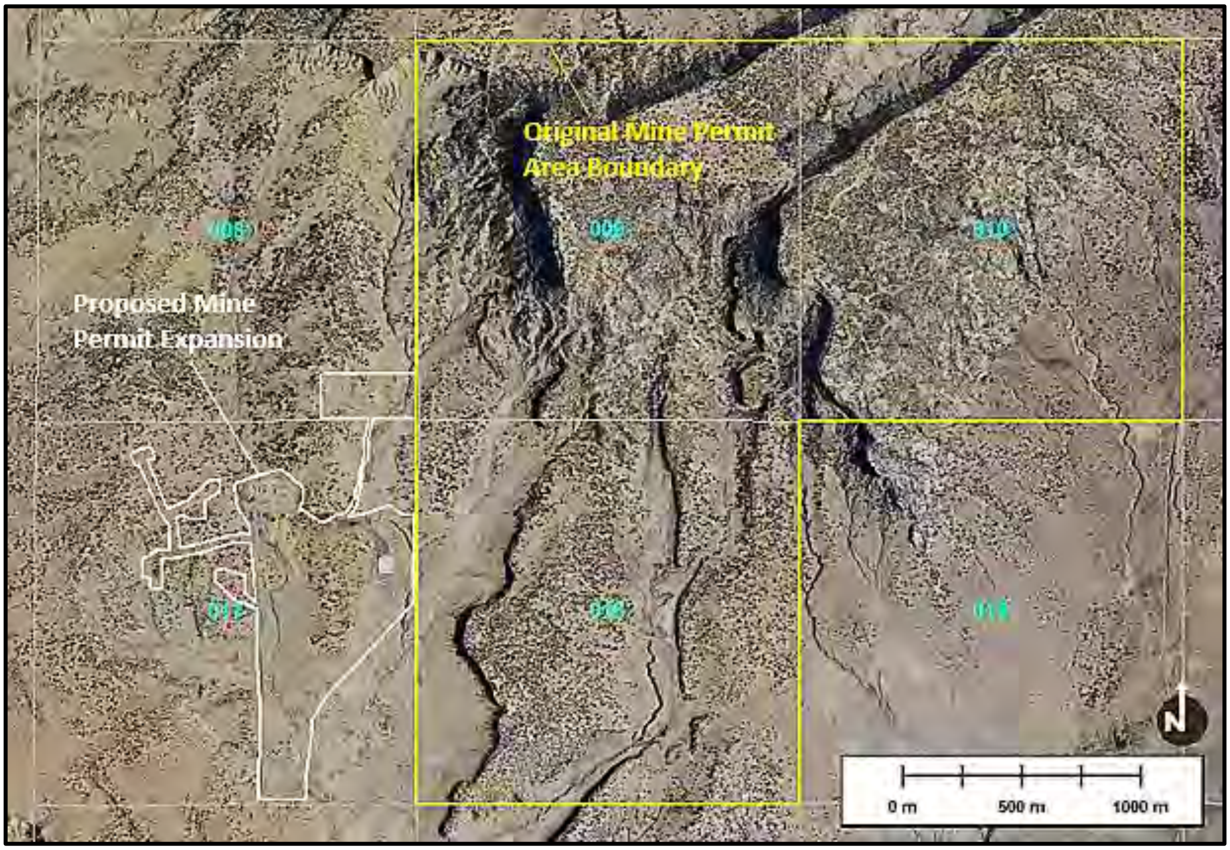


Figure 1: Mine permit area map.

Gamma radiation surveys and soil sampling were conducted in the fall of 2015 to characterize pre-operational baseline gamma exposure rates and associated concentrations of radionuclides in soil across the Site. Baseline radiological surveys at the Site followed a sampling and analysis plan (SAP) developed for consistency with methods previously used at the Roca Honda Mine which generally meet or exceed recent applicable guidance from the New Mexico Minerals and Mining Division (MMD) (MMD, 2014). The SAP is provided as Attachment A to this report.

2. METHODS

Gamma survey instrumentation included Ludlum Model 44-10 sodium iodide detectors (2 x 2 inch crystal dimensions) coupled to Ludlum Model 2221 ratemeter/scalers. Detectors were mounted externally on backpacks about 1 meter above the ground surface and scanning was conducted at typical walking speeds (0.5-1.5 m/s). The target scan coverage was 50-meter spacing between adjacent scan transects. Geospatial coordinates for each individual gamma reading were obtained with a Trimble ProXH global positioning systems (GPS) receiver and data logging system. Paired gamma/GPS data were recorded electronically every second with Trimble TerraSync software. Data were downloaded using Trimble Pathfinder GIS software for subsequent mapping and geostatistical/spatial analysis.

All NaI detector/ratemeter instrument pairings were properly calibrated according to instrument manufacturer and/or ANSI N323A 1997 specifications within one year prior to use on this project. This included (as applicable) high voltage plateau and count/exposure rate calibration against a National Institute of Standards and Technology (NIST)-traceable cesium-137 (Cs-137) source. Daily instrument quality control (QC) measurements were performed in the field at a designated onsite location for each NaI detector in accordance with standard ERG procedures. The purpose was to verify proper instrument response to ambient background and a Cs-137 check source, and to quantify the consistency of readings within and between individual scanning detectors under field conditions (i.e. site-specific measurement precision). The results of these field QC measurements are evaluated in Section 4.

As indicated in the SAP, a site-specific cross-calibration between Ludlum 44-10 detectors and a high-pressure ionization chamber (HPIC) was previously established at the Roca Honda Mine for converting recorded gamma radiation count rate data into estimates of true exposure rate (SENES, 2013a). This statistical relationship (Figure 2, left) was applied to the supplemental gamma survey data to obtain baseline exposure rate results for the expanded permit area in units of micro-roentgen per hour (µR/h). In addition, statistical correlations between gamma exposure rate and radium-226 (Ra-226) concentrations in soil were also previously developed for Roca Honda (SENES, 2013a). These correlations (Figure 2, right) were used to convert exposure rate results into predicted Ra-226 concentrations in surface soils (0-6 inch depth).

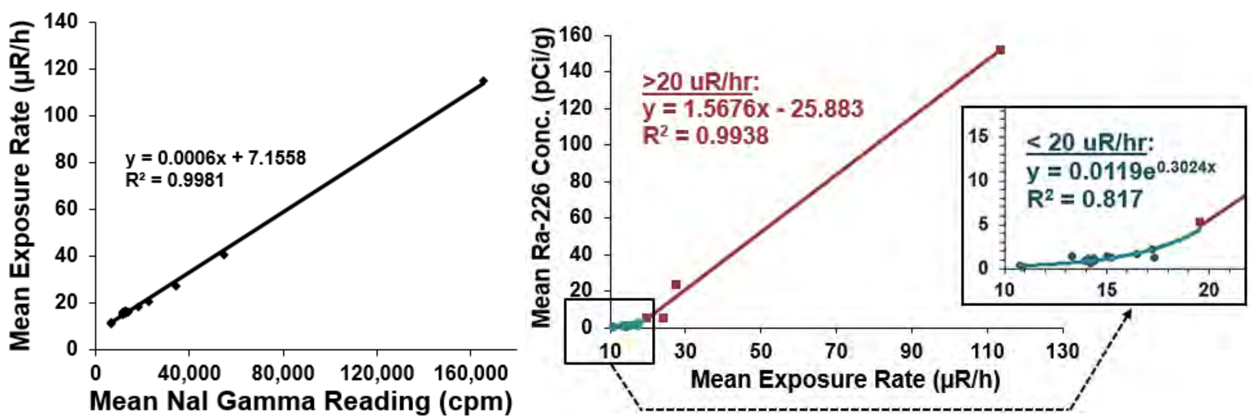


Figure 2: Site-specific instrument cross-calibration between NaI detector readings and HPIC exposure rate readings (left), and correlations between soil Ra-226 concentrations and gamma exposure rate (right) (adapted from SENES, 2013a).

The survey data described above, along with previous baseline gamma survey data for the adjacent Roca Honda permit area, were collectively mapped and geostatistically interpolated (kriged) using the Geostatistical Analyst program in ArcGIS to provide a unified characterization of pre-mining baseline gamma radiation exposure rates and associated Ra-226 concentrations in surface soils across the entire permit area. Final spatial renderings of these data were generated with another GIS program (Global Mapper®; BMG, 2014) which permits continuous interpolation of colors between discrete legend values to portray small quantitative/spatial variations in the data.

Soil sampling locations were chosen to represent the range of baseline gamma radiation levels based on initial survey results. Additional gamma scanning was performed during soil sampling activities to better characterize the spatial extent of certain areas of elevated gamma radiation. When necessary, gamma scanning went beyond planned permit area boundaries in order to adequately characterize pre-mining radiological baseline conditions in such areas.

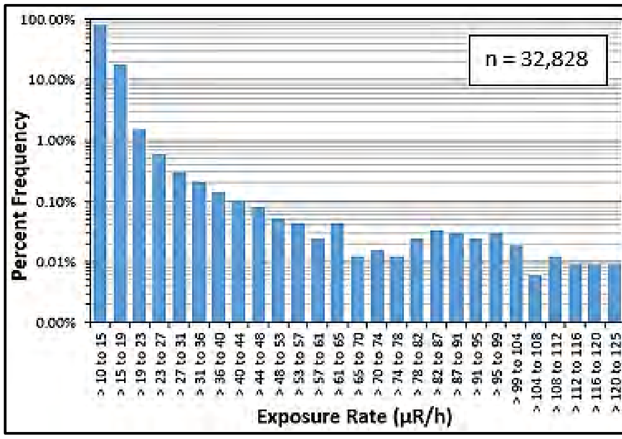
Soil samples were taken at 12 locations. In accordance with the SAP (Attachment A), surface soil at each location was sampled to a depth of 6 inches (15 cm) and at 4 of these locations, subsurface soil samples (6-12 inches) were also collected. Static gamma radiation measurements were taken at each soil sampling location in accordance with the SAP. These data were not used for correlating gamma radiation with measured soil radionuclide concentrations because a discrete sampling/measurement strategy can produce poor correlation results, and such correlations have already been established for the Roca Honda mine permit area (Figure 2, right) using a more appropriate method (SENES, 2013a). Instead, these static gamma measurements were used to evaluate uncertainty in kriged gamma survey data.

Soil samples were placed in sealable plastic bags and shipped to Energy Laboratories, Inc. (ELI) for analysis of Ra-226 by gamma spectroscopy (EPA Method 901.1 Modified). Estimates of Th-232 were also obtained by Method 901.1, indirectly, based on analysis of Ac-228 (a surrogate for Th-232 and its decay products, including Ra-228, based on an assumption of secular equilibrium). Natural uranium analysis was performed by inductively coupled plasma mass spectroscopy (ICP-MS) (Method SW6020).

3. RADIOLOGICAL BASELINE SURVEY RESULTS

3.1 Gamma Survey Results

The gamma survey covered the proposed mine permit expansion areas shown in Figure 1. Additional coverage was obtained in certain adjacent areas to characterize elevated gamma radiation discovered during initial survey efforts. A total of 32,828 individual gamma survey measurements were collected across the area. Descriptive statistics for exposure rate data generated from the gamma survey are shown in Figure 3. The data distribution is highly skewed due to a number of relatively small areas of significantly elevated sources of terrestrial gamma radiation to the east of southern portions of the proposed permit area expansion (Figure 4). These elevated areas are located in the vicinity of several alluvial runoff channels that drain from a mesa to the north and low hills to the west.



Central Tendency (µR/h)		Percentiles (µR/h)		
Mean	14.1	100.00%	maximum	124.7
Std Dev	5.1	99.50%		43.8
Std Err Mean	0.03	97.50%		20.5
Upper 95% Mean	14.17	90.00%		15.5
Lower 95% Mean	14.06	75.00%	quartile	14.3
Median	13.4	50.00%	median	13.4
		25.00%	quartile	12.7
Shape		10.00%		12.0
Skewness	11.7	2.50%		11.3
Kurtosis	176.7	0.50%		10.9
		0.00%	minimum	10.3

Figure 3: Descriptive statistics for gamma survey data.

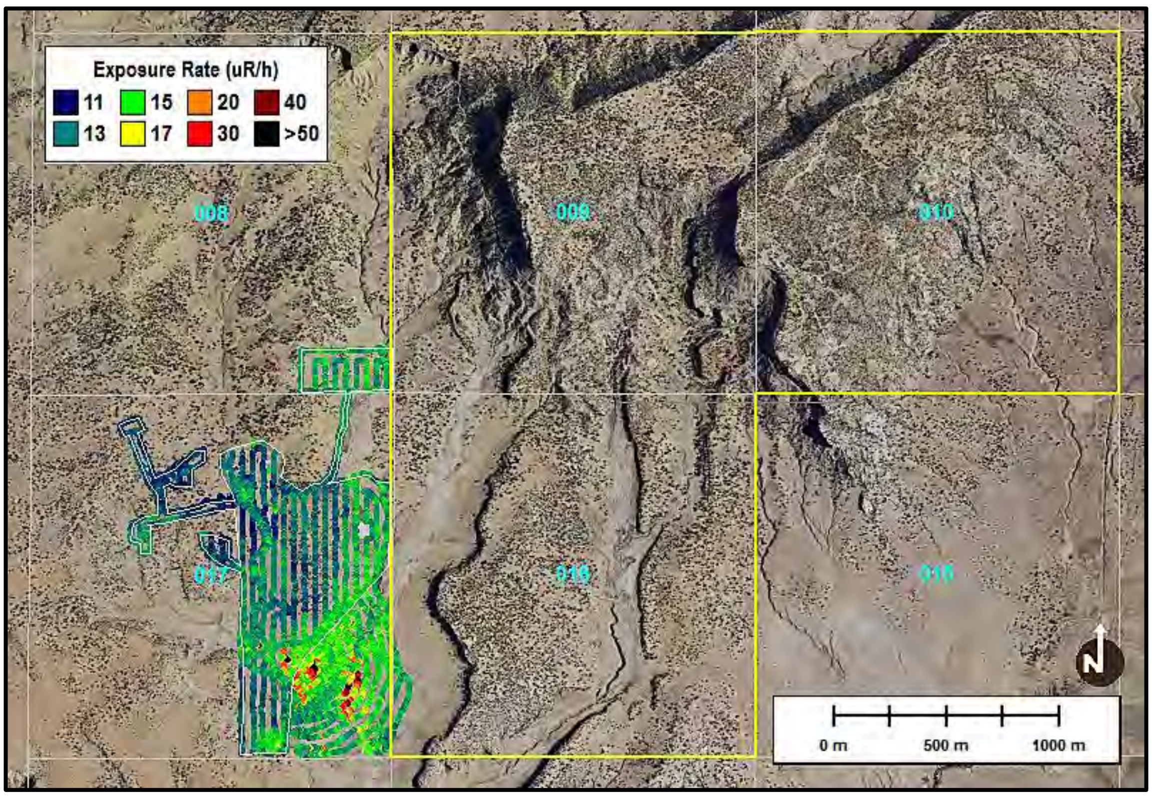


Figure 4: Pre-mining baseline gamma exposure rates across the expanded permit area based on raw gamma survey data.

To better characterize the spatial distribution of baseline gamma exposure rates at the Site, the data were combined with adjacent gamma survey data for the original mine permit area as presented in previous radiological baseline reports (SENES, 2013a and 2013b), and the unified data set was kriged as shown in Figure 5. The same was done with predicted Ra-226 concentrations in surface soils based on gamma survey data (Figure 6) and the applicable relationships shown in Figure 2.

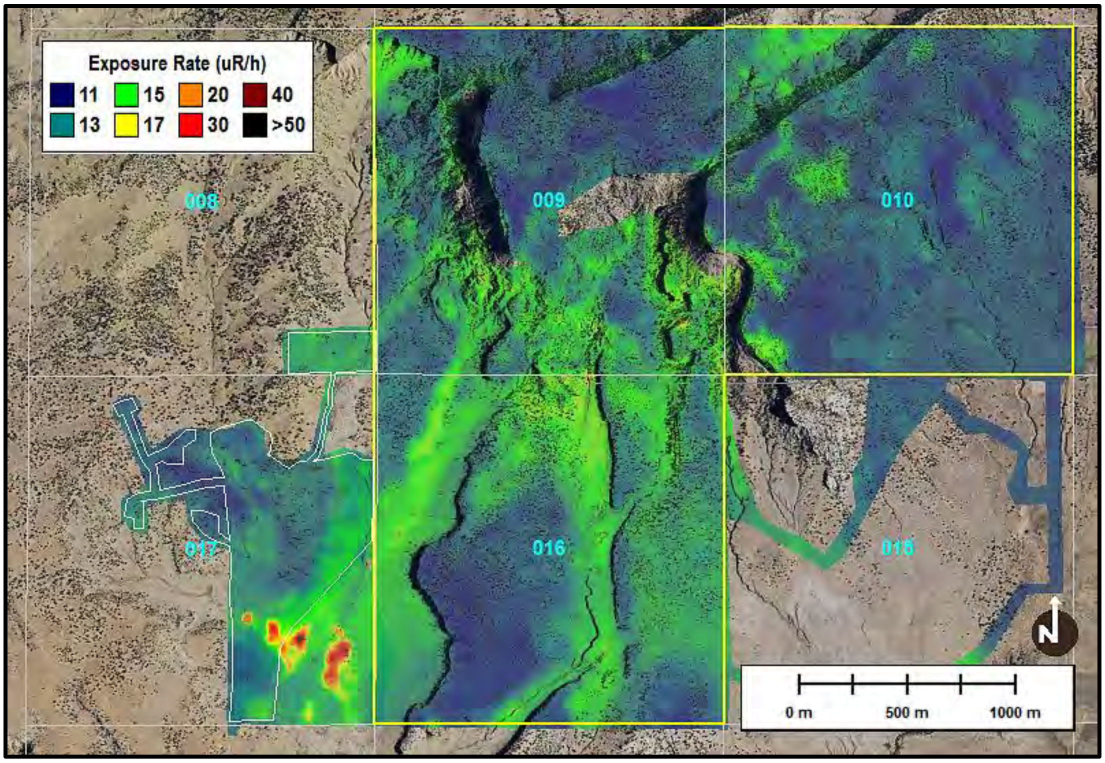


Figure 5: Continuously interpolated (kriged) rendering of pre-mining baseline gamma exposure rates across original and expanded Roca Honda mine permit areas based on raw gamma survey data.

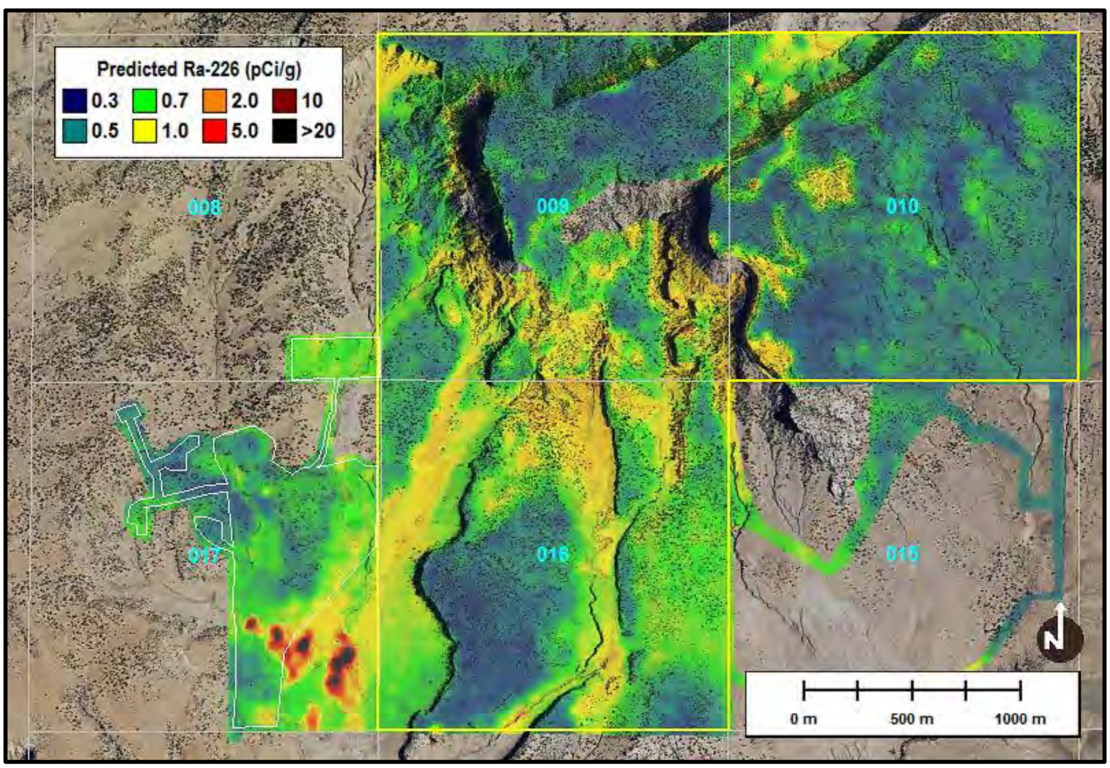


Figure 6: Predicted pre-mining baseline Ra-226 concentrations in surface soil across original and expanded Roca Honda mine permit areas based on raw gamma survey data.

3.2 Soil Sampling Results

Soil sampling data and associated summary statistics are provided in Table 1 and Figure 7. The analytical laboratory report is provided in Attachment C. Soil sampling locations are shown in Figure 8 with annotated "RHW" ID prefixes and color-coded circular symbols representing Ra-226 soil concentration values, overlain on the kriged map of predicted Ra-226 values based on the gamma survey. Pertinent soil sampling locations and Ra-226 results from a previous baseline study ("C" ID prefixes from SENES, 2013a) are also shown to further illustrate the degree of spatial/quantitative agreement between direct analysis of Ra-226 concentrations in surface soil samples relative to gamma-based predictions at corresponding locations. Important analytical data for previous sampling locations C6 and C7 are also shown Table 1.

Table 1: Analytical results for soil samples from the expanded Roca Honda Mine permit area.

Sample ID	Easting[1]	Northing[1]	Depth Interval (in)	Gamma Count Rate (cpm)	Calculated Eposure Rate (μR/hr)	Ra-226 (pCi/g)	Precision (± pCi/g)	Th-232[2] (pCi/g)	Precision (± pCi/g)	U-Nat (mg/kg)	U-Nat[3] (pCi/g)
RHW-01-0006	2760056	1586136	0 to 6	7,949	11.9	0.7	0.1	0.8	0.1	0.5	0.3
RHW-02-0006	2759356	1586760	0 to 6	9,285	12.7	0.8	0.1	1.0	0.2	0.9	0.6
RHW-03-0006	2759474	1585350	0 to 6	10,649	13.5	0.8	0.1	1.0	0.2	0.6	0.4
RHW-04-0006	2762015	1587562	0 to 6	10,444	13.4	0.9	0.1	1.1	0.2	0.9	0.6
RHW-05-0006	2762910	1587410	0 to 6	11,749	14.2	0.8	0.1	1.0	0.1	0.8	0.5
RHW-06-0006	2760968	1586001	0 to 6	12,059	14.4	1.1	0.1	1.8	0.2	1.1	0.7
RHW-06-0612	"	"	6 to 12	"	"	0.9	0.1	1.3	0.2	1.1	0.7
RHW-07-0006	2761432	1585629	0 to 6	14,746	16.0	1.3	0.1	0.8	0.1	0.7	0.5
RHW-08-0006	2762614	1585781	0 to 6	11,413	14.0	1.2	0.1	1.7	0.2	1.3	0.9
RHW-09-0006	2762766	1584819	0 to 6	12,073	14.4	1.0	0.1	1.4	0.2	1	0.7
RHW-09-0612	"	"	6 to 12	"	"	1.0	0.1	1.4	0.1	1.6	1.1
RHW-10-0006	2761871	1584709	0 to 6	7,546	11.7	0.3	0.1	0.4	0.1	0.4	0.3
RHW-10-0612	"	"	6 to 12	"	"	0.3	0.1	0.4	0.1	0.2	0.1
RHW-11-0006	2760977	1583696	0 to 6	11,584	14.1	0.9	0.1	1.1	0.2	1.5	1.0
RHW-12-0006	2761243	1585390	0 to 6	9,321	12.7	0.6	0.1	0.6	0.1	0.5	0.3
RHW-12-0612	"	"	6 to 12	"	"	0.6	0.1	0.6	0.1	0.6	0.4
C6*	2761747	1583241	0 to 6	33,804	27.4	23.8	1.6	1.3	0.9	9.9	6.7
C7*	2761598	1583525	0 to 6	177,429	114	152	3.8	2.6	1.8	21.8	14.8

[1]Coordinate system: State Plane, NAD 83 New Mexico West (FIPS 3003), U.S. Feet.

[2]Based on analysis of Ac-228 and assumption of equilibrium with Th-232 and Ra-228.

[3]Converted based on a factor of 0.677 pCi/g per mg/kg.

*Data adapted from a previous survey at Roca Honda (SENES, 2013a)

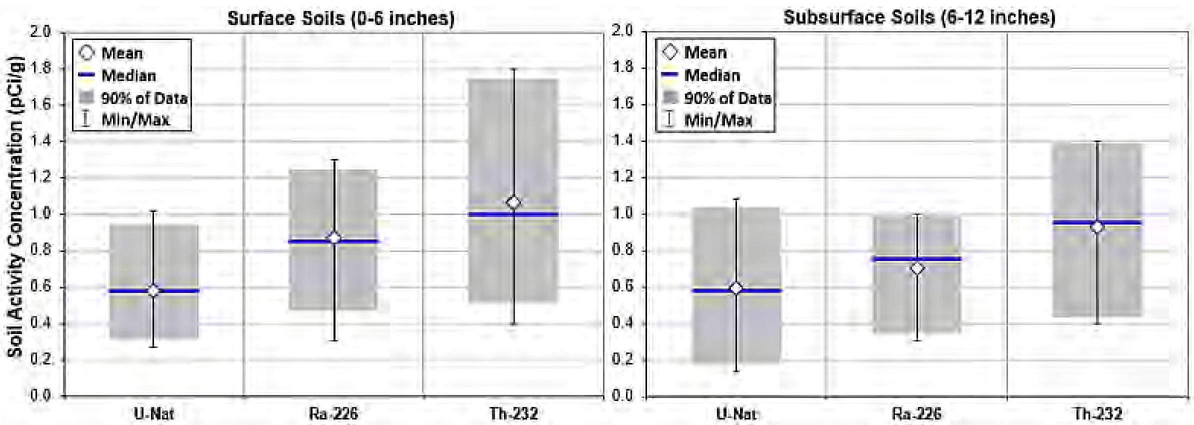


Figure 7: Graphical summary statistics for baseline radionuclides in soil samples (from Table 1, excluding atypically elevated baseline data from previous sampling locations C6 and C7).

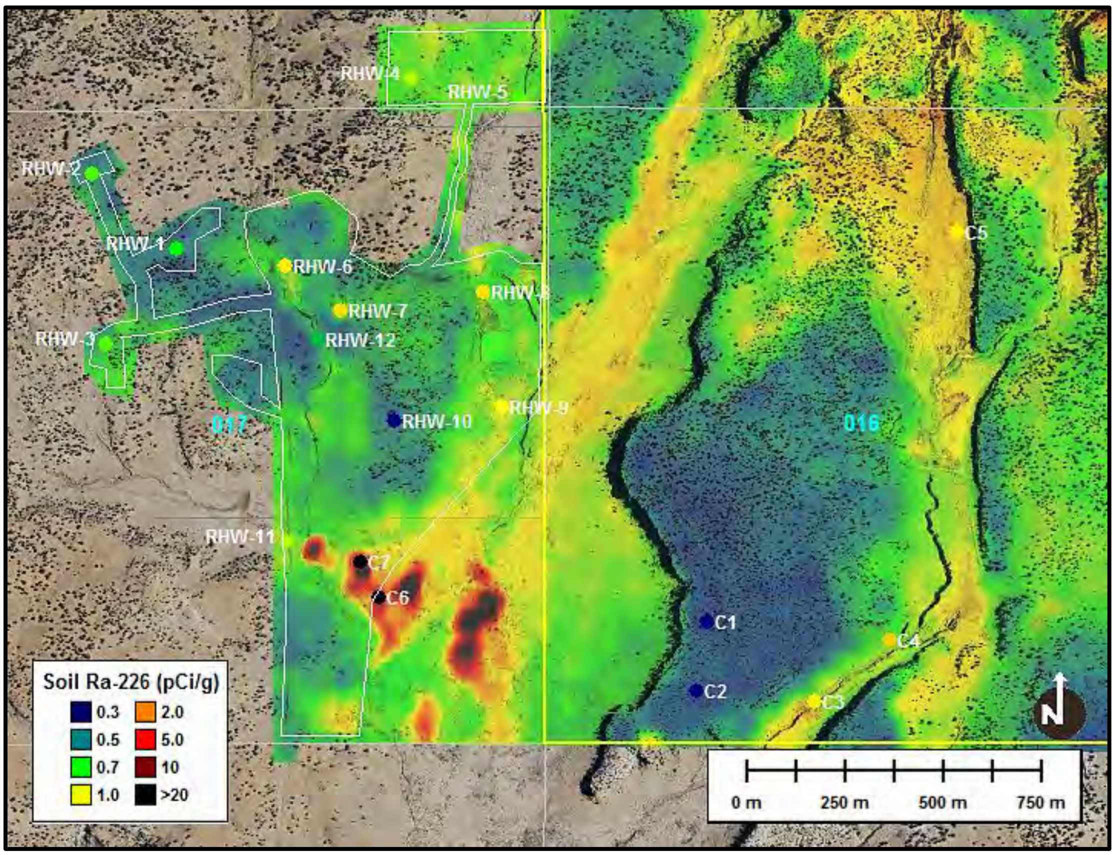


Figure 8: Annotated soil sampling locations for the expanded Roca Honda Mine permit area west of the original permit areas, along with color-coded circular symbols representing direct laboratory analysis results for Ra-226 in soil samples for comparison against kriged gamma-based predictions at corresponding locations. Pertinent sampling locations/results from a previous baseline study (SENES, 2013a) are also shown.

4. DATA QUALITY

All supplemental gamma surveys, supporting radiological measurements, soil sampling and data analysis included in this report were conducted in a manner consistent with the data QA/QC program described in the Post Mine Radiological Surveys plan (SENES, 2013b). The purpose of this program is to provide confidence in the results and to ensure that the data generated are reliable, with a minimal amount of uncertainty introduced by variability in instruments and field survey methods. The program is designed to help quantify data uncertainty due to these sources of variability, as well as those associated with natural environmental factors (e.g. changes in soil moisture, barometric pressure, etc.). In general, quality assurance (QA) includes qualitative factors that provide confidence in the results, while quality control (QC) includes quantitative evidence that enables estimation of data uncertainty (accuracy and precision).

Data QA protocols/factors for this supplemental radiological baseline survey included the following:

- The radiological survey design was developed and implemented by qualified environmental health physicists with specialized experience and expertise in radiological surveys and related spatial analysis techniques.
- The methods and data QA/QC protocols used for this survey followed the SAP and were consistent with previous radiological baseline surveys at the site.

Data QC protocols/factors included the following:

- All instruments were calibrated according to instrument manufacturer and/or ANSI N323A 1997 specifications within one year prior to use on this project (calibration certificates are provided in Attachment B).
- QC measurements were performed daily in the field to ensure proper instrument performance and to help quantify data precision/reproducibility.

The results of data QC protocols/factors are discussed in the following section.

4.1 Data Uncertainty

Each day during the survey, function checks and QC measurements were performed for each detector/ratemeter combination prior to use and at the end of use for the day. The function check ensured that the ratemeter was in calibration, the high voltage settings were appropriate for the calibration, and that the batteries were adequately charged. In accordance with the Post Mine Radiological Surveys Plan for the Roca Honda site (SENES, 2013b), the results of QC measurements (Figure 9) indicate that the detector response to both background and a Cs-137 check source was within acceptable tolerance limits (within ± 3 standard deviations of overall average readings for either ambient background or the Cs-137 check source).

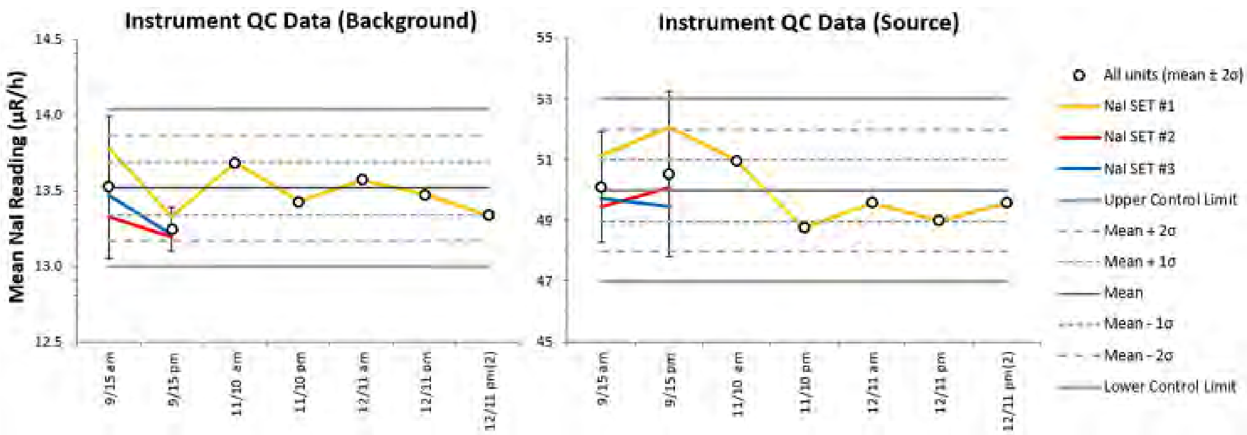


Figure 9: Gamma survey instrument QC charts with controlled static measurement results for each day of survey activities (denoted by month/day and general time of day, a.m. or p.m.).

The background QC chart suggests that total data uncertainty due to natural temporal variations in ambient gamma radiation and variability in response between different instruments is in the range of ± 0.6 µR/h when measuring gamma radiation levels in the range of average or median exposure rates recorded across the Site (in the range of 13 – 14 µR/h). However, for reasons described in detail in the Post Mine Radiological Surveys Plan (SENES, 2013b), this data uncertainty may be somewhat higher when actual gamma survey data are considered (e.g. ± 3 µR/h), particularly in areas with significantly elevated terrestrial gamma radiation levels (note that such areas represent only a small fraction of all areas surveyed).

Another measure of data uncertainty was obtained for kriged survey results based on statistical comparisons of direct, static measurements of gamma radiation versus kriged estimates at corresponding locations, as well as direct laboratory measurements of Ra-226 levels in soil samples versus kriged gamma-based predictions of Ra-226 levels at corresponding locations (Figure 10). The locations from which data were obtained for these comparisons are represented by the soil sampling locations shown in Figure 8. Parametric t-tests and non-parametric Wilcoxon Rank Sum (WRS) tests indicate that the relatively small numerical differences in in mean or median values for measured versus predicted data are not statistically significant (p-values > 0.05).

These statistical tests suggest that kriged predictions of gamma exposure rates and associated Ra-226 concentrations in surface soils based on gamma survey data are generally reliable, however, individual data comparisons indicate that in areas with significantly elevated baseline levels of ambient gamma radiation (e.g. near soil sampling locations C6 and C7 in Figure 8), predicted values tend to significantly underestimate measured values. This is a normal artifact of kriging because predicted values are based on interpolation with a number of distant values that tend to be much lower than those situated directly over small sources of elevated terrestrial radiation. In these areas, individual gamma survey measurements and soil sampling results will provide a better indication of true baseline Ra-226 concentrations and associated gamma exposure rates across these small areas. Note in Figure 10 that maximum values for these parameters are 152 pCi/g and 114 µR/h respectively – these values occur at location C7 as shown in Figure 8. Analytical results for individual baseline gamma radiation measurements and laboratory analysis of radionuclides in soil samples from locations C6 and C7 are provided in Table 1 (adapted from SENES, 2013a). These values are expected to be more characteristic of true baseline soil concentrations and terrestrial gamma exposure rates in other elevated areas in the general vicinity of these two sampling locations.

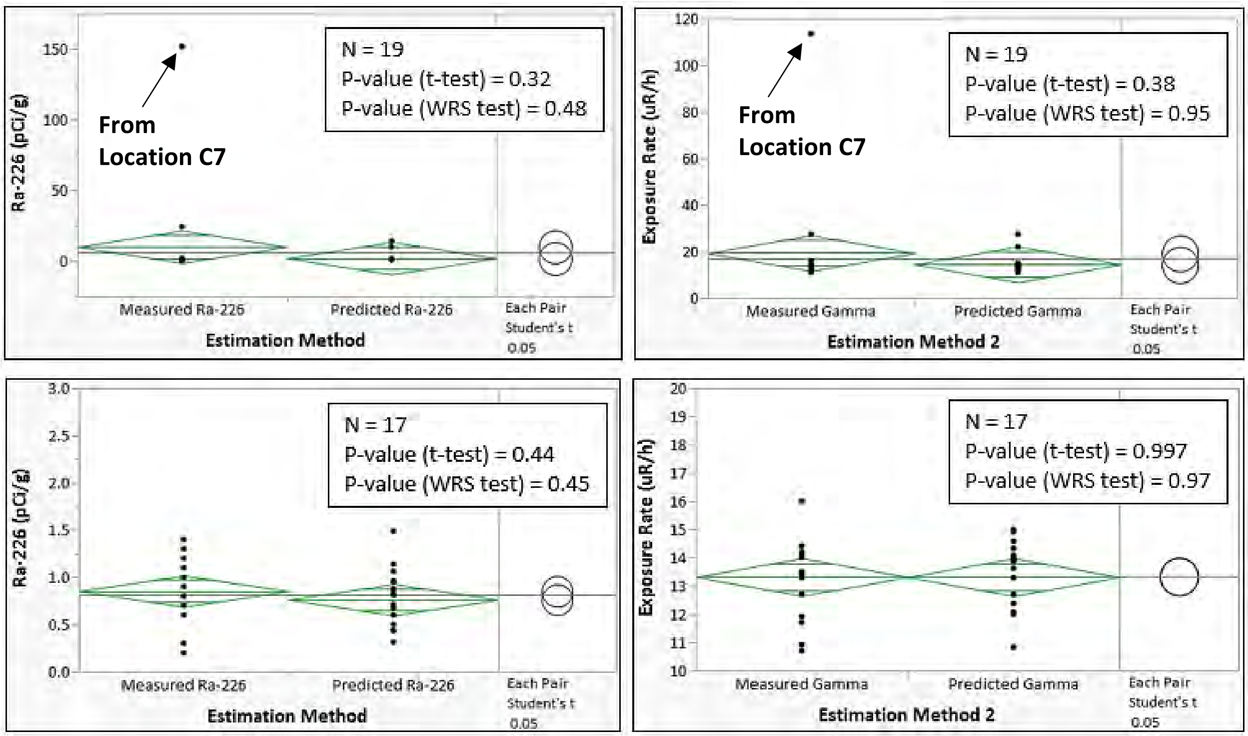


Figure 10: Statistical comparisons of measured versus predicted values at corresponding locations for all soil sampling locations (top) shown in Figure 8 (n = 19 locations), and (bottom) for all locations except the two situated in areas of significantly elevated gamma radiation (omitting locations C6 and C7, n = 17).

5. SUMMARY AND CONCLUSIONS

Supplemental radiological baseline data for a proposed permit area expansion at the Roca Honda Mine were generated in the fall of 2015 with additional gamma radiation surveys, soil sampling, and laboratory analysis of soil samples. The methods used were consistent with previous radiological baseline surveys at the Roca Honda Mine (SENES, 2013a), as well as with recent guidance from the New Mexico Minerals and Mining Division (MMD, 2014). Raw gamma survey count rate data were converted to estimates of true exposure rates and predicted Ra-226 activity concentrations in soil.

A majority of Ra-226 concentrations in surface soils and associated gamma radiation exposure rates across the Site are consistent with corresponding radiological baseline conditions across the vast majority of original permit areas at the Roca Honda Mine, which are typical of natural, undisturbed sites. However, in southern portions of the survey area these radiological parameters are anomalously and significantly elevated over what would normally be expected for a natural, undisturbed site.

Estimation uncertainty for baseline Ra-226 concentrations in surface soils and associated terrestrial gamma radiation is generally expected to be relatively small in most areas, though it will be relatively large in areas of significantly elevated radiological baseline conditions. Individual gamma survey measurement data and soil sampling results in these areas are expected to better reflect actual radiological baseline conditions in these small areas.

6. REFERENCES

Blue Marble Geographics (BMG). 2014. Global Mapper v. 16.0.3. Hallowell, Maine. USA.

Environmental Restoration Group Inc. (ERG). 2015. Sampling and Analysis Plan for Supplemental Radiological Baseline Surveys at the Roca Honda Mine. Mine Permit No. MK0205RN. Sections 8 and 17, McKinley County, NM. August, 2015.

Mining and Minerals Division (MMD). 2014. Guidance for Meeting Radiation Criteria Levels and Reclamation at New Uranium Mining Operations. Title 19, Chapter 10, Part 3 and Part 6, New Mexico Administrative Code. Energy, Minerals & Natural Resources Department, Mining and Minerals Division, 1220 South St. Francis Drive, Santa Fe, NM 87505. April, 2014.

SENES Consultants (SENES). 2013a. Supplemental Radiological Baseline Surveys, Addendum to Section 13 of the Roca Honda Mine Reclamation Plan (Rev. 1). Mine Permit No. MK0205RN, McKinley County, NM. August 2013.

SENES Consultants (SENES). 2013b. Post Mine Radiological Surveys, Addendum to Roca Honda Mine Reclamation Plan (Rev. 1), Mine Permit No. MK0205RN, McKinley County, NM. March 2013.

Attachment A – Sampling and Analysis Plan

(see previous document)

Attachment B – Instrument Calibration and QC Forms

Certificate of Calibration

Calibration and Voltage Plateau

Environmental Restoration Group, Inc.
8809 Washington St NE, Suite 150
Albuquerque, NM 87113
(505) 298-4224
www.ERGoffice.com

Meter:	Manufacturer:	Ludlum	Model Number:	2221r	Serial Number:	190206
Detector:	Manufacturer:	Ludlum	Model Number:	44-10	Serial Number:	PR288465

✔ Mechanical Check ✔ THR/WIN Operation
✔ F/S Response Check ✔ Reset Check
✔ Geotropism ✔ Audio Check
✔ Meter Zeroed ✔ Battery Check (Min 4.4 VDC)

HV Check (+/- 2.5%): ✔ 500 V ✔ 1000 V ✔ 1500 V
Cable Length: 39-inch ✔ 72-inch ☐ Other:

Source Distance: ☐ Contact ✔ 6 inches ☐ Other:
Source Geometry ✔ Side ☐ Below ☐ Other:

Threshold: 10 mV
Window:

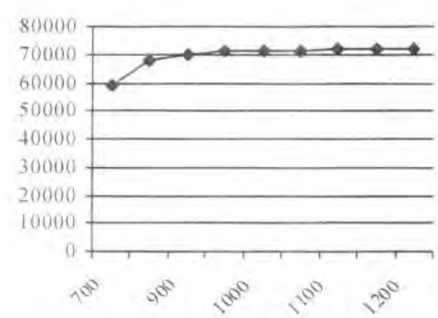
Barometric Pressure: 24.69 inches Hg
Temperature: 74 °F
Relative Humidity: 20 %

Instrument found within tolerance: ✔ Yes ☐ No

Range/Multiplier	Reference Setting	"As Found Reading"	Meter Reading	Integrated 1-Min. Count	Log Scale Count
x 1000	400	400	400	399242	400
x 1000	100	100	100		100
x 100	400	400	400	39923	400
x 100	100	100	100		100
x 10	400	400	400	3993	400
x 10	100	100	100		100
x 1	400	400	400	400	400
x 1	100	100	100		100

High Voltage	Source Counts	Background
700	59004	
800	68068	
900	70084	
950	71019	
1000	71450	9213
1050	71254	
1100	71727	
1150	71766	
1200	72142	

Voltage Plateau



Comments: HV Plateau Scaler Count Time = 1-min. Recommended HV = 1000

Reference Instruments and/or Sources:

Ludlum pulser serial number: ☐ 97743 ✔ 201932
Fluke multimeter serial number: ☐ 8749012
☐ Alpha Source: Th-230 @ 12,800 dpm (1/4/12) sn: 4098-03
✔ Gamma Source Cs-137 @ 5.2 uCi (1/4/12) sn: 4097-03
☐ Beta Source: Tc-99 @ 17,700 dpm (1/4/12) sn: 4099-03
☐ Other Source:

Calibrated By: [signature] Calibration Date: 9-8-15 Calibration Due 9-8-16

Reviewed By: [signature] Date: 9/9/15

ERG Form ITC. 101.A

This calibration conforms to the requirements and acceptable calibration conditions of ANSI N323A - 1997

ERG

Certificate of Calibration

Calibration and Voltage Plateau

Environmental Restoration Group, Inc.
8809 Washington St NE, Suite 150
Albuquerque, NM 87113
(505) 298-4224
www.ERGoffice.com

Meter:	Manufacturer:	Ludlum	Model Number:	2221r	Serial Number:	254772
Detector:	Manufacturer:	Ludlum	Model Number:	44-10	Serial Number:	PR303727

- ✔ Mechanical Check
- ✔ F/S Response Check
- ✔ Geotropism
- ✔ Meter Zeroed
- ✔ THR/WIN Operation
- ✔ Reset Check
- ✔ Audio Check
- ✔ Battery Check (Min 4.4 VDC)

HV Check (+/- 2.5%): ✔ 500 V ✔ 1000 V ✔ 1500 V

Cable Length: ☐ 39-inch ✔ 72-inch Other:

Barometric Pressure: 24.72 inches Hg

Source Distance: ☐ Contact ✔ 6 inches ☐ Other:

Threshold: 10 mV

Temperature: 74 °F

Source Geometry ✔ Side ☐ Below ☐ Other:

Window:

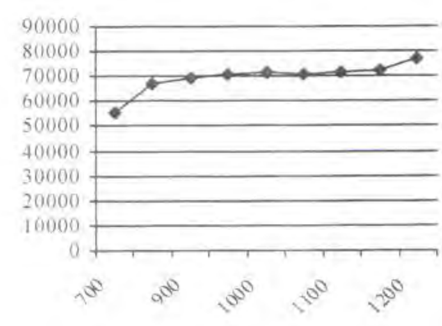
Relative Humidity: 20 %

Instrument found within tolerance: ✔ Yes ☐ No

Range/Multiplier	Reference Setting	"As Found Reading"	Meter Reading	Integrated 1-Min. Count	Log Scale Count
x 1000	400	400	400	397626	400
x 1000	100	100	100		100
x 100	400	400	400	39764	400
x 100	100	100	100		100
x 10	400	400	400	3976	400
x 10	100	100	100		100
x 1	400	400	400	397	400
x 1	100	100	100		100

High Voltage	Source Counts	Background
700	55381	
800	67100	
900	69724	
950	70714	
1000	71971	
1050	71157	
1100	71644	10299
1150	72244	
1200	76769	

Voltage Plateau



Comments: HV Plateau Scaler Count Time = 1-min. Recommended HV = 1100

Reference Instruments and/or Sources:

Ludlum pulser serial number: ☐ 97743 ✔ 201932

Fluke multimeter serial number: ☐ 8749012

☐ Alpha Source: Th-230 @ 12,800 dpm (1/4/12) sn: 4098-03

✔ Gamma Source Cs-137 @ 5.2 uCi (1/4/12) sn: 4097-03

☐ Beta Source: Tc-99 @ 17,700 dpm (1/4/12) sn: 4099-03

☐ Other Source:

Calibrated By: [signature] Calibration Date: 9-8-15 Calibration Due 9-8-16

Reviewed By: [signature] Date: 9/9/15

This calibration conforms to the requirements and acceptable calibration conditions of ANSI N323A - 1997

ERG

Certificate of Calibration

Calibration and Voltage Plateau

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8809 Washington St NE, Suite 150
Albuquerque, NM 87113
(505) 298-4224
www.ERGoffice.com

Meter:	Manufacturer:	Ludlum	Model Number:	2221r	Serial Number:	196086
Detector:	Manufacturer:	Ludlum	Model Number:	44-10	Serial Number:	PR295014

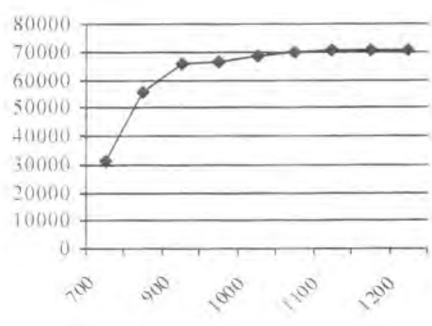
✓ Mechanical Check ✓ THR/WIN Operation HV Check (+/-2.5%): ✓ 500 V ✓ 1000 V ✓ 1500 V
✓ F/S Response Check ✓ Reset Check Cable Length: 39-inch ✓ 72-inch Other:
✓ Geotropism ✓ Audio Check
✓ Meter Zeroed ✓ Battery Check (Min 4.4 VDC) Barometric Pressure: 24.72 inches Hg
Source Distance: Contact ✓ 6 inches Other: Threshold: 10 mV Temperature: 74 °F
Source Geometry ✓ Side Below Other: Window: Relative Humidity: 20 %

Instrument found within tolerance: ✓ Yes No

Range/Multiplier	Reference Setting	"As Found Reading"	Meter Reading	Integrated 1-Min. Count	Log Scale Count
x 1000	400	500	400	399179	400
x 1000	100	100	100		100
x 100	400	400	400	39921	400
x 100	100	100	100		100
x 10	400	400	400	3992	400
x 10	100	100	100		100
x 1	400	400	400	399	400
x 1	100	100	100		100

High Voltage	Source Counts	Background
700	31402	
800	55513	
900	66006	
950	66597	
1000	68438	
1050	69511	
1100	70224	9705
1150	70279	
1200	70523	

Voltage Plateau



Comments: HV Plateau Scaler Count Time = 1-min. Recommended HV = 1100

Reference Instruments and/or Sources:

Ludlum pulser serial number: 97743 ✓ 201932
Alpha Source: Th-230 @ 12,800 dpm (1/4/12) sn: 4098-03
Beta Source: Tc-99 @ 17,700 dpm (1/4/12) sn: 4099-03
Fluke multimeter serial number: 8749012
✓ Gamma Source Cs-137 @ 5.2 uCi (1/4/12) sn: 4097-03
Other Source:

Calibrated By: [signature] Calibration Date: 9-14-15 Calibration Due 9-14-16
Reviewed By: [signature] Date: 9/14/15

ERG Form ITC. 101.A

This calibration conforms to the requirements and acceptable calibration conditions of ANSI N323A - 1997

(1)

ERG

Single-Channel Function Check Log

Environmental Restoration Group, Inc
8809 Washington St. NE, Suite 150
Albuquerque, NM 87113
(505) 298-4224

METER	
Manufacturer:	LUDLUM
Model:	2221
Serial No.:	254772
Cal. Due Date:	9/8/16

DETECTOR	
Manufacturer:	LUDLUM
Model:	44-10
Serial No.:	PR303727
Cal. Due Date:	9/8/16

Comments:
ROCA HONDA

Source: Cs-137 Activity: 4.94 uCi Source Date: 8/7/03 Distance to Source: ERG JIG ~5"

Serial No.: 1697-03 ~~Emission Rate:~~ ~~cpm/emissions~~

Date	Time	Battery	High Voltage	Source Counts	BKG Counts	Net Counts	Initials	Note(s):
9/15/15	0910	5.4	1100	73296	11044	62252	TA	THR: 100
9/15/15	1307	4.9	1099	74807	10289	64518	TA	THR: 100
9/15/15	1555	5.3	1099	69395	6951	62444	TA	Thr: 98 @ HMC office PARKING LOT
11/10/15	09:15	6.2	1104	73002	10811	62191	CF*	* TRANSCRIBED FOR DAVE ADAMS
11/10/15	11:30	6.1	1103	69322	10448	58874	CF*	BY CHUCK FARR.
~~11/10/15~~								
10/27/15	10:14	5.6	1102	78494	10962	67532 (A)	CF*	(A) NOT USING ERG JIG * TRANSCRIBED FOR DAVE ADAMS BY CHUCK FARR
10/27/15	15:42	5.5	1101	78616	10412	68204 (A)	CF*	~6" FROM DETECTOR TO SOURCE.
12/11/15	09:15	6.1	1107	70965	10691	60274	CF*	* TRANSCRIBED FOR DAVE A.
12/11/15	12:37	6.1	1107	69712	10526	59186	CF*	BY CHUCK FARR.

Reviewed by: T. [signature] Review Date: 12/21/15

(2)

ERG

Single-Channel Function Check Log

Environmental Restoration Group, Inc.
8809 Washington St. NE, Suite 150
Albuquerque, NM 87113
(505) 298-4224

METER	
Manufacturer:	LUDLUM
Model:	2221
Serial No.:	196086
Cal. Due Date:	9/14/15

DETECTOR	
Manufacturer:	LUDLUM
Model:	44-10
Serial No.:	PR295014
Cal. Due Date:	9/14/15

Comments:
ROCA HONDA

Source: Cs-137
Serial No.: 1697-03

Activity: 4.94 uCi
~~Emission Rate:~~ — ~~cpm/emissions.~~

Source Date: 8/7/03

ERG JIG Distance to Source: ~ 5"

Date	Time	Battery	High Voltage	Source Counts	BKG Counts	Net Counts	Initials	Note(s):
9/15/15	0850	6.0	1100	70904	10513	60391	TA	THR: 100
9/15/15	1315	5.9	1096	70449	10090	60359	TA	THR: 99
9/15/15	1557	5.9	1097	68621	6685	61936	TA	Thr: 99 @ HMC office PARKING LOT
10/27/15	10:13	6.0	1101	80116	10213	69906 (A)	CF*	NOT USING ERG JIG *TRANSCRIBED FOR DAVE
10/27/15	15:40	5.9	1100	79050	10378	68672 (A)	CF*	~6" FROM DETECTOR TO SOURCE ADAMS BY CHUCK FARR
								(A) SET 1 & 2 VERY GOOD AGREEMENT
								FOR THIS DAY/CAL SETUP.

Reviewed by: [signature]

Review Date: 12/21/15

(3)

ERG

Single-Channel Function Check Log

Environmental Restoration Group, Inc
8809 Washington St. NE, Suite 150
Albuquerque, NM 87113
(505) 298-4224

METER	
Manufacturer:	LUDLUM
Model:	2221
Serial No.:	190206
Cal. Due Date:	9/8/15

DETECTOR	
Manufacturer:	LUDLUM
Model:	44-10
Serial No.:	PR288465
Cal. Due Date:	9/8/15

Comments:
ROCA HONDA

Source: Cs-137 Activity: 4.94 uCi Source Date: 8/7/03 Distance to Source: ~ 5"

Serial No.: 1697-03 ~~Emission Rate: cpm/emissions~~

Date	Time	Battery	High Voltage	Source Counts	BKG Counts	Net Counts	Initials	Note(s):
9/15/15	0845	5.6	1000	70495	10280	60215	TA	THR: 100
9/15/15	1307	5.5	1000	71544	10066	61478	TA	THR: 100
9/15/15	1558	5.5	998	70602	6887	63,715	TA	Thr: 100 @ HMC office PARKING LOT

Reviewed by: [signature] Review Date: 12/21/15

Attachment C – Analytical Laboratory Reports

ANALYTICAL SUMMARY REPORT

December 03, 2015

Environmental Restoration Group Inc
8809 Washington St NE
Albuquerque, NM 87113

Work Order: C15110017

Project Name: Not Indicated

Energy Laboratories, Inc. Casper WY received the following 16 samples for Environmental Restoration Group Inc on 11/2/2015 for analysis.

Lab ID	Client Sample ID	Collect Date	Receive Date	Matrix	Test
C15110017-001	RHW-1-0006	10/27/15 15:15	11/02/15	Soil	Uranium, Total Percent Moisture Digestion, Total Metals Gamma Sample Preparation Gross Gamma
C15110017-002	RHW-2-0006	10/27/15 15:00	11/02/15	Soil	Same As Above
C15110017-003	RHW-3-0006	10/27/15 14:45	11/02/15	Soil	Same As Above
C15110017-004	RHW-4-0006	10/27/15 14:25	11/02/15	Soil	Same As Above
C15110017-005	RHW-5-0006	10/27/15 14:10	11/02/15	Soil	Same As Above
C15110017-006	RHW-6-0006	10/27/15 11:20	11/02/15	Soil	Same As Above
C15110017-007	RHW-6-0612	10/27/15 11:20	11/02/15	Soil	Same As Above
C15110017-008	RHW-7-0006	10/27/15 11:35	11/02/15	Soil	Same As Above
C15110017-009	RHW-8-0006	10/27/15 13:30	11/02/15	Soil	Same As Above
C15110017-010	RHW-9-0006	10/27/15 13:00	11/02/15	Soil	Same As Above
C15110017-011	RHW-9-0612	10/27/15 13:00	11/02/15	Soil	Same As Above
C15110017-012	RHW-10-0006	10/27/15 12:45	11/02/15	Soil	Same As Above
C15110017-013	RHW-10-0612	10/27/15 12:45	11/02/15	Soil	Same As Above
C15110017-014	RHW-11-0006	10/27/15 12:15	11/02/15	Soil	Same As Above
C15110017-015	RHW-12-0006	10/27/15 11:50	11/02/15	Soil	Same As Above
C15110017-016	RHW-12-0612	10/27/15 11:50	11/02/15	Soil	Same As Above

The results as reported relate only to the item(s) submitted for testing. The analyses presented in this report were performed at Energy Laboratories, Inc., 2393 Salt Creek Hwy., Casper, WY 82601, unless otherwise noted. Radiochemistry analyses were performed at Energy Laboratories, Inc., 2325 Kerzell Lane, Casper, WY 82601, unless otherwise noted. Any exceptions or problems with the analyses are noted in the Laboratory Analytical Report, the QA/QC Summary Report, or the Case Narrative.

If you have any questions regarding these test results, please call.

Report Approved By:

LABORATORY ANALYTICAL REPORT

Prepared by Casper, WY Branch

Client:	Environmental Restoration Group Inc	**Report Date:**	12/03/15
Project:	Not Indicated	**Collection Date:**	10/27/15 15:15
Lab ID:	C15110017-001	**DateReceived:**	11/02/15
Client Sample ID:	RHW-1-0006	**Matrix:**	Soil

Analyses	Result	Units	Qualifiers	RL	MDL	Method	Analysis Date / By
PHYSICAL CHARACTERISTICS							
Moisture	5.7	wt%		0.2		D2974	11/03/15 16:27 / sf
METALS - TOTAL							
Uranium	0.5	mg/kg-dry	D	0.2	0.0002	SW6020	11/04/15 15:54 / smm
RADIONUCLIDES - GAMMA							
Radium 226	0.7	pCi/g-dry				E901.1	12/01/15 11:29 / plj
Radium 226 precision (±)	0.08	pCi/g-dry				E901.1	12/01/15 11:29 / plj
Radium 226 MDC	0.08	pCi/g-dry				E901.1	12/01/15 11:29 / plj
Radium 228	0.8	pCi/g-dry				E901.1	12/01/15 11:29 / plj
Radium 228 precision (±)	0.1	pCi/g-dry				E901.1	12/01/15 11:29 / plj
Radium 228 MDC	0.2	pCi/g-dry				E901.1	12/01/15 11:29 / plj

Report Definitions:
RL - Analyte reporting limit.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.
D - RL increased due to sample matrix.
MDL - Method detection limit
QCL - Quality control limit.
MDC - Minimum detectable concentration

LABORATORY ANALYTICAL REPORT

Prepared by Casper, WY Branch

Client:	Environmental Restoration Group Inc	**Report Date:**	12/03/15
Project:	Not Indicated	**Collection Date:**	10/27/15 15:00
Lab ID:	C15110017-002	**DateReceived:**	11/02/15
Client Sample ID:	RHW-2-0006	**Matrix:**	Soil

Analyses	Result	Units	Qualifiers	RL	MDL	Method	Analysis Date / By
PHYSICAL CHARACTERISTICS							
Moisture	10.5	wt%		0.2		D2974	11/03/15 16:27 / sf
METALS - TOTAL							
Uranium	0.9	mg/kg-dry	D	0.2	0.0002	SW6020	11/04/15 15:55 / smm
RADIONUCLIDES - GAMMA							
Radium 226	0.8	pCi/g-dry				E901.1	12/01/15 11:29 / plj
Radium 226 precision (±)	0.09	pCi/g-dry				E901.1	12/01/15 11:29 / plj
Radium 226 MDC	0.08	pCi/g-dry				E901.1	12/01/15 11:29 / plj
Radium 228	1.0	pCi/g-dry				E901.1	12/01/15 11:29 / plj
Radium 228 precision (±)	0.2	pCi/g-dry				E901.1	12/01/15 11:29 / plj
Radium 228 MDC	0.2	pCi/g-dry				E901.1	12/01/15 11:29 / plj

Report Definitions:

RL - Analyte reporting limit.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.
D - RL increased due to sample matrix.

MDL - Method detection limit
QCL - Quality control limit.
MDC - Minimum detectable concentration

LABORATORY ANALYTICAL REPORT

Prepared by Casper, WY Branch

Client:	Environmental Restoration Group Inc		**Report Date:**	12/03/15
Project:	Not Indicated		**Collection Date:**	10/27/15 14:45
Lab ID:	C15110017-003		**DateReceived:**	11/02/15
Client Sample ID:	RHW-3-0006		**Matrix:**	Soil

Analyses	Result	Units	Qualifiers	RL	MDL	Method	Analysis Date / By
PHYSICAL CHARACTERISTICS							
Moisture	4.8	wt%		0.2		D2974	11/03/15 16:27 / sf
METALS - TOTAL							
Uranium	0.6	mg/kg-dry	D	0.2	0.0002	SW6020	11/04/15 15:57 / smm
RADIONUCLIDES - GAMMA							
Radium 226	0.8	pCi/g-dry				E901.1	12/01/15 11:29 / plj
Radium 226 precision (±)	0.1	pCi/g-dry				E901.1	12/01/15 11:29 / plj
Radium 226 MDC	0.1	pCi/g-dry				E901.1	12/01/15 11:29 / plj
Radium 228	1.0	pCi/g-dry				E901.1	12/01/15 11:29 / plj
Radium 228 precision (±)	0.2	pCi/g-dry				E901.1	12/01/15 11:29 / plj
Radium 228 MDC	0.2	pCi/g-dry				E901.1	12/01/15 11:29 / plj

Report Definitions:

RL - Analyte reporting limit.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.
D - RL increased due to sample matrix.
MDL - Method detection limit
QCL - Quality control limit.
MDC - Minimum detectable concentration

LABORATORY ANALYTICAL REPORT

Prepared by Casper, WY Branch

Client:	Environmental Restoration Group Inc	**Report Date:**	12/03/15
Project:	Not Indicated	**Collection Date:**	10/27/15 14:25
Lab ID:	C15110017-004	**DateReceived:**	11/02/15
Client Sample ID:	RHW-4-0006	**Matrix:**	Soil

Analyses	Result	Units	Qualifiers	RL	MDL	Method	Analysis Date / By
PHYSICAL CHARACTERISTICS							
Moisture	8.3	wt%		0.2		D2974	11/03/15 16:27 / sf
METALS - TOTAL							
Uranium	0.9	mg/kg-dry	D	0.2	0.0002	SW6020	11/04/15 15:58 / smm
RADIONUCLIDES - GAMMA							
Radium 226	0.9	pCi/g-dry				E901.1	12/01/15 11:29 / plj
Radium 226 precision (±)	0.1	pCi/g-dry				E901.1	12/01/15 11:29 / plj
Radium 226 MDC	0.09	pCi/g-dry				E901.1	12/01/15 11:29 / plj
Radium 228	1.1	pCi/g-dry				E901.1	12/01/15 11:29 / plj
Radium 228 precision (±)	0.2	pCi/g-dry				E901.1	12/01/15 11:29 / plj
Radium 228 MDC	0.3	pCi/g-dry				E901.1	12/01/15 11:29 / plj

Report Definitions:

RL - Analyte reporting limit.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.
D - RL increased due to sample matrix.
MDL - Method detection limit
QCL - Quality control limit.
MDC - Minimum detectable concentration

LABORATORY ANALYTICAL REPORT

Prepared by Casper, WY Branch

Client:	Environmental Restoration Group Inc	**Report Date:**	12/03/15
Project:	Not Indicated	**Collection Date:**	10/27/15 14:10
Lab ID:	C15110017-005	**DateReceived:**	11/02/15
Client Sample ID:	RHW-5-0006	**Matrix:**	Soil

Analyses	Result	Units	Qualifiers	RL	MDL	Method	Analysis Date / By
PHYSICAL CHARACTERISTICS							
Moisture	9.1	wt%		0.2		D2974	11/03/15 16:27 / sf
METALS - TOTAL							
Uranium	0.8	mg/kg-dry	D	0.2	0.0002	SW6020	11/04/15 16:00 / smm
RADIONUCLIDES - GAMMA							
Radium 226	0.8	pCi/g-dry				E901.1	12/01/15 11:29 / plj
Radium 226 precision (±)	0.1	pCi/g-dry				E901.1	12/01/15 11:29 / plj
Radium 226 MDC	0.09	pCi/g-dry				E901.1	12/01/15 11:29 / plj
Radium 228	1.0	pCi/g-dry				E901.1	12/01/15 11:29 / plj
Radium 228 precision (±)	0.1	pCi/g-dry				E901.1	12/01/15 11:29 / plj
Radium 228 MDC	0.2	pCi/g-dry				E901.1	12/01/15 11:29 / plj

Report Definitions:

RL - Analyte reporting limit.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.
D - RL increased due to sample matrix.
MDL - Method detection limit
QCL - Quality control limit.
MDC - Minimum detectable concentration

LABORATORY ANALYTICAL REPORT

Prepared by Casper, WY Branch

Client:	Environmental Restoration Group Inc		**Report Date:**	12/03/15
Project:	Not Indicated		**Collection Date:**	10/27/15 11:20
Lab ID:	C15110017-006		**DateReceived:**	11/02/15
Client Sample ID:	RHW-6-0006		**Matrix:**	Soil

Analyses	Result	Units	Qualifiers	RL	MDL	Method	Analysis Date / By
PHYSICAL CHARACTERISTICS							
Moisture	14.1	wt%		0.2		D2974	11/03/15 16:27 / sf
METALS - TOTAL							
Uranium	1.1	mg/kg-dry	D	0.2	0.0002	SW6020	11/04/15 16:09 / smm
RADIONUCLIDES - GAMMA							
Radium 226	1.1	pCi/g-dry				E901.1	12/01/15 11:29 / plj
Radium 226 precision (±)	0.1	pCi/g-dry				E901.1	12/01/15 11:29 / plj
Radium 226 MDC	0.1	pCi/g-dry				E901.1	12/01/15 11:29 / plj
Radium 228	1.8	pCi/g-dry				E901.1	12/01/15 11:29 / plj
Radium 228 precision (±)	0.2	pCi/g-dry				E901.1	12/01/15 11:29 / plj
Radium 228 MDC	0.3	pCi/g-dry				E901.1	12/01/15 11:29 / plj

Report Definitions:

RL - Analyte reporting limit.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.
D - RL increased due to sample matrix.
MDL - Method detection limit
QCL - Quality control limit.
MDC - Minimum detectable concentration

LABORATORY ANALYTICAL REPORT

Prepared by Casper, WY Branch

Client:	Environmental Restoration Group Inc	**Report Date:**	12/03/15
Project:	Not Indicated	**Collection Date:**	10/27/15 11:20
Lab ID:	C15110017-007	**DateReceived:**	11/02/15
Client Sample ID:	RHW-6-0612	**Matrix:**	Soil

Analyses	Result	Units	Qualifiers	RL	MDL	Method	Analysis Date / By
PHYSICAL CHARACTERISTICS							
Moisture	7.8	wt%		0.2		D2974	11/03/15 16:27 / sf
METALS - TOTAL							
Uranium	1.1	mg/kg-dry	D	0.2	0.0002	SW6020	11/04/15 16:11 / smm
RADIONUCLIDES - GAMMA							
Radium 226	0.9	pCi/g-dry				E901.1	12/01/15 11:29 / plj
Radium 226 precision (±)	0.1	pCi/g-dry				E901.1	12/01/15 11:29 / plj
Radium 226 MDC	0.08	pCi/g-dry				E901.1	12/01/15 11:29 / plj
Radium 228	1.3	pCi/g-dry				E901.1	12/01/15 11:29 / plj
Radium 228 precision (±)	0.2	pCi/g-dry				E901.1	12/01/15 11:29 / plj
Radium 228 MDC	0.3	pCi/g-dry				E901.1	12/01/15 11:29 / plj

Report Definitions:

RL - Analyte reporting limit.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.
D - RL increased due to sample matrix.
MDL - Method detection limit
QCL - Quality control limit.
MDC - Minimum detectable concentration

LABORATORY ANALYTICAL REPORT

Prepared by Casper, WY Branch

Client:	Environmental Restoration Group Inc		**Report Date:**	12/03/15
Project:	Not Indicated		**Collection Date:**	10/27/15 11:35
Lab ID:	C15110017-008		**DateReceived:**	11/02/15
Client Sample ID:	RHW-7-0006		**Matrix:**	Soil

Analyses	Result	Units	Qualifiers	RL	MDL	Method	Analysis Date / By
PHYSICAL CHARACTERISTICS							
Moisture	7.4	wt%		0.2		D2974	11/03/15 16:27 / sf
METALS - TOTAL							
Uranium	0.7	mg/kg-dry	D	0.2	0.0002	SW6020	11/04/15 16:13 / smm
RADIONUCLIDES - GAMMA							
Radium 226	1.3	pCi/g-dry				E901.1	12/01/15 11:29 / plj
Radium 226 precision (±)	0.1	pCi/g-dry				E901.1	12/01/15 11:29 / plj
Radium 226 MDC	0.08	pCi/g-dry				E901.1	12/01/15 11:29 / plj
Radium 228	0.8	pCi/g-dry				E901.1	12/01/15 11:29 / plj
Radium 228 precision (±)	0.1	pCi/g-dry				E901.1	12/01/15 11:29 / plj
Radium 228 MDC	0.2	pCi/g-dry				E901.1	12/01/15 11:29 / plj

Report Definitions:

RL - Analyte reporting limit.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.
D - RL increased due to sample matrix.
MDL - Method detection limit
QCL - Quality control limit.
MDC - Minimum detectable concentration

LABORATORY ANALYTICAL REPORT

Prepared by Casper, WY Branch

Client:	Environmental Restoration Group Inc	**Report Date:**	12/03/15
Project:	Not Indicated	**Collection Date:**	10/27/15 13:30
Lab ID:	C15110017-009	**DateReceived:**	11/02/15
Client Sample ID:	RHW-8-0006	**Matrix:**	Soil

Analyses	Result	Units	Qualifiers	RL	MDL	Method	Analysis Date / By
PHYSICAL CHARACTERISTICS							
Moisture	8.0	wt%		0.2		D2974	11/03/15 16:28 / sf
METALS - TOTAL							
Uranium	1.3	mg/kg-dry	D	0.2	0.0002	SW6020	11/04/15 16:14 / smm
RADIONUCLIDES - GAMMA							
Radium 226	1.2	pCi/g-dry				E901.1	12/01/15 11:29 / plj
Radium 226 precision (±)	0.1	pCi/g-dry				E901.1	12/01/15 11:29 / plj
Radium 226 MDC	0.1	pCi/g-dry				E901.1	12/01/15 11:29 / plj
Radium 228	1.7	pCi/g-dry				E901.1	12/01/15 11:29 / plj
Radium 228 precision (±)	0.2	pCi/g-dry				E901.1	12/01/15 11:29 / plj
Radium 228 MDC	0.4	pCi/g-dry				E901.1	12/01/15 11:29 / plj

Report Definitions:

RL - Analyte reporting limit.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.
D - RL increased due to sample matrix.
MDL - Method detection limit
QCL - Quality control limit.
MDC - Minimum detectable concentration

LABORATORY ANALYTICAL REPORT

Prepared by Casper, WY Branch

Client:	Environmental Restoration Group Inc		**Report Date:**	12/03/15
Project:	Not Indicated		**Collection Date:**	10/27/15 13:00
Lab ID:	C15110017-010		**DateReceived:**	11/02/15
Client Sample ID:	RHW-9-0006		**Matrix:**	Soil

Analyses	Result	Units	Qualifiers	RL	MDL	Method	Analysis Date / By
PHYSICAL CHARACTERISTICS							
Moisture	6.6	wt%		0.2		D2974	11/03/15 16:28 / sf
METALS - TOTAL							
Uranium	1.0	mg/kg-dry	D	0.2	0.0002	SW6020	11/04/15 16:16 / smm
RADIONUCLIDES - GAMMA							
Radium 226	1.0	pCi/g-dry				E901.1	12/01/15 11:29 / plj
Radium 226 precision (±)	0.1	pCi/g-dry				E901.1	12/01/15 11:29 / plj
Radium 226 MDC	0.1	pCi/g-dry				E901.1	12/01/15 11:29 / plj
Radium 228	1.4	pCi/g-dry				E901.1	12/01/15 11:29 / plj
Radium 228 precision (±)	0.2	pCi/g-dry				E901.1	12/01/15 11:29 / plj
Radium 228 MDC	0.3	pCi/g-dry				E901.1	12/01/15 11:29 / plj

Report Definitions:

RL - Analyte reporting limit.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.
D - RL increased due to sample matrix.
MDL - Method detection limit
QCL - Quality control limit.
MDC - Minimum detectable concentration

LABORATORY ANALYTICAL REPORT

Prepared by Casper, WY Branch

Client:	Environmental Restoration Group Inc		**Report Date:**	12/03/15
Project:	Not Indicated		**Collection Date:**	10/27/15 13:00
Lab ID:	C15110017-011		**DateReceived:**	11/02/15
Client Sample ID:	RHW-9-0612		**Matrix:**	Soil

Analyses	Result	Units	Qualifiers	RL	MDL	Method	Analysis Date / By
PHYSICAL CHARACTERISTICS							
Moisture	5.2	wt%		0.2		D2974	11/04/15 10:43 / sf
METALS - TOTAL							
Uranium	1.6	mg/kg-dry	D	0.2	0.0002	SW6020	11/04/15 16:17 / smm
RADIONUCLIDES - GAMMA							
Radium 226	1	pCi/g-dry				E901.1	12/01/15 11:29 / plj
Radium 226 precision (±)	0.1	pCi/g-dry				E901.1	12/01/15 11:29 / plj
Radium 226 MDC	0.1	pCi/g-dry				E901.1	12/01/15 11:29 / plj
Radium 228	1.4	pCi/g-dry				E901.1	12/01/15 11:29 / plj
Radium 228 precision (±)	0.1	pCi/g-dry				E901.1	12/01/15 11:29 / plj
Radium 228 MDC	0.3	pCi/g-dry				E901.1	12/01/15 11:29 / plj

Report Definitions:

RL - Analyte reporting limit.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.
D - RL increased due to sample matrix.

MDL - Method detection limit
QCL - Quality control limit.
MDC - Minimum detectable concentration

LABORATORY ANALYTICAL REPORT

Prepared by Casper, WY Branch

Client:	Environmental Restoration Group Inc	**Report Date:**	12/03/15
Project:	Not Indicated	**Collection Date:**	10/27/15 12:45
Lab ID:	C15110017-012	**DateReceived:**	11/02/15
Client Sample ID:	RHW-10-0006	**Matrix:**	Soil

Analyses	Result	Units	Qualifiers	RL	MDL	Method	Analysis Date / By
PHYSICAL CHARACTERISTICS							
Moisture	2.9	wt%		0.2		D2974	11/03/15 16:35 / sf
METALS - TOTAL							
Uranium	0.4	mg/kg-dry	D	0.2	0.0002	SW6020	11/04/15 16:19 / smm
RADIONUCLIDES - GAMMA							
Radium 226	0.3	pCi/g-dry				E901.1	12/01/15 11:29 / plj
Radium 226 precision (±)	0.06	pCi/g-dry				E901.1	12/01/15 11:29 / plj
Radium 226 MDC	0.07	pCi/g-dry				E901.1	12/01/15 11:29 / plj
Radium 228	0.4	pCi/g-dry				E901.1	12/01/15 11:29 / plj
Radium 228 precision (±)	0.09	pCi/g-dry				E901.1	12/01/15 11:29 / plj
Radium 228 MDC	0.1	pCi/g-dry				E901.1	12/01/15 11:29 / plj

Report Definitions:

RL - Analyte reporting limit.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.
D - RL increased due to sample matrix.
MDL - Method detection limit
QCL - Quality control limit.
MDC - Minimum detectable concentration

LABORATORY ANALYTICAL REPORT

Prepared by Casper, WY Branch

Client: Environmental Restoration Group Inc
Project: Not Indicated
Lab ID: C15110017-013
Client Sample ID: RHW-10-0612

Report Date: 12/03/15
Collection Date: 10/27/15 12:45
DateReceived: 11/02/15
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MDL	Method	Analysis Date / By
PHYSICAL CHARACTERISTICS							
Moisture	1.3	wt%		0.2		D2974	11/03/15 16:35 / sf
METALS - TOTAL							
Uranium	0.2	mg/kg-dry	D	0.2	0.0002	SW6020	11/04/15 16:20 / smm
RADIONUCLIDES - GAMMA							
Radium 226	0.3	pCi/g-dry				E901.1	12/01/15 11:29 / plj
Radium 226 precision (±)	0.05	pCi/g-dry				E901.1	12/01/15 11:29 / plj
Radium 226 MDC	0.06	pCi/g-dry				E901.1	12/01/15 11:29 / plj
Radium 228	0.4	pCi/g-dry				E901.1	12/01/15 11:29 / plj
Radium 228 precision (±)	0.09	pCi/g-dry				E901.1	12/01/15 11:29 / plj
Radium 228 MDC	0.2	pCi/g-dry				E901.1	12/01/15 11:29 / plj

Report Definitions:
RL - Analyte reporting limit.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.
D - RL increased due to sample matrix.
MDL - Method detection limit
QCL - Quality control limit.
MDC - Minimum detectable concentration

LABORATORY ANALYTICAL REPORT

Prepared by Casper, WY Branch

Client:	Environmental Restoration Group Inc		**Report Date:**	12/03/15
Project:	Not Indicated		**Collection Date:**	10/27/15 12:15
Lab ID:	C15110017-014		**DateReceived:**	11/02/15
Client Sample ID:	RHW-11-0006		**Matrix:**	Soil

Analyses	Result	Units	Qualifiers	RL	MDL	Method	Analysis Date / By
PHYSICAL CHARACTERISTICS							
Moisture	8.8	wt%		0.2		D2974	11/03/15 16:35 / sf
METALS - TOTAL							
Uranium	1.5	mg/kg-dry	D	0.2	0.0002	SW6020	11/04/15 16:22 / smm
RADIONUCLIDES - GAMMA							
Radium 226	0.9	pCi/g-dry				E901.1	12/01/15 11:29 / plj
Radium 226 precision (±)	0.1	pCi/g-dry				E901.1	12/01/15 11:29 / plj
Radium 226 MDC	0.1	pCi/g-dry				E901.1	12/01/15 11:29 / plj
Radium 228	1.1	pCi/g-dry				E901.1	12/01/15 11:29 / plj
Radium 228 precision (±)	0.2	pCi/g-dry				E901.1	12/01/15 11:29 / plj
Radium 228 MDC	0.2	pCi/g-dry				E901.1	12/01/15 11:29 / plj

Report Definitions:

RL - Analyte reporting limit.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.
D - RL increased due to sample matrix.

MDL - Method detection limit
QCL - Quality control limit.
MDC - Minimum detectable concentration

LABORATORY ANALYTICAL REPORT

Prepared by Casper, WY Branch

Client:	Environmental Restoration Group Inc	**Report Date:**	12/03/15
Project:	Not Indicated	**Collection Date:**	10/27/15 11:50
Lab ID:	C15110017-015	**DateReceived:**	11/02/15
Client Sample ID:	RHW-12-0006	**Matrix:**	Soil

Analyses	Result	Units	Qualifiers	RL	MDL	Method	Analysis Date / By
PHYSICAL CHARACTERISTICS							
Moisture	3.2	wt%		0.2		D2974	11/03/15 16:35 / sf
METALS - TOTAL							
Uranium	0.5	mg/kg-dry	D	0.2	0.0002	SW6020	11/04/15 16:31 / smm
RADIONUCLIDES - GAMMA							
Radium 226	0.6	pCi/g-dry				E901.1	12/01/15 11:29 / plj
Radium 226 precision (±)	0.07	pCi/g-dry				E901.1	12/01/15 11:29 / plj
Radium 226 MDC	0.07	pCi/g-dry				E901.1	12/01/15 11:29 / plj
Radium 228	0.6	pCi/g-dry				E901.1	12/01/15 11:29 / plj
Radium 228 precision (±)	0.09	pCi/g-dry				E901.1	12/01/15 11:29 / plj
Radium 228 MDC	0.2	pCi/g-dry				E901.1	12/01/15 11:29 / plj

Report Definitions:

RL - Analyte reporting limit.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.
D - RL increased due to sample matrix.
MDL - Method detection limit
QCL - Quality control limit.
MDC - Minimum detectable concentration

LABORATORY ANALYTICAL REPORT

Prepared by Casper, WY Branch

Client:	Environmental Restoration Group Inc	**Report Date:**	12/03/15
Project:	Not Indicated	**Collection Date:**	10/27/15 11:50
Lab ID:	C15110017-016	**DateReceived:**	11/02/15
Client Sample ID:	RHW-12-0612	**Matrix:**	Soil

Analyses	Result	Units	Qualifiers	RL	MDL	Method	Analysis Date / By
PHYSICAL CHARACTERISTICS							
Moisture	2.9	wt%		0.2		D2974	11/03/15 16:36 / sf
METALS - TOTAL							
Uranium	0.6	mg/kg-dry	D	0.2	0.0002	SW6020	11/06/15 17:38 / smm
RADIONUCLIDES - GAMMA							
Radium 226	0.6	pCi/g-dry				E901.1	12/01/15 11:29 / plj
Radium 226 precision (±)	0.07	pCi/g-dry				E901.1	12/01/15 11:29 / plj
Radium 226 MDC	0.07	pCi/g-dry				E901.1	12/01/15 11:29 / plj
Radium 228	0.6	pCi/g-dry				E901.1	12/01/15 11:29 / plj
Radium 228 precision (±)	0.1	pCi/g-dry				E901.1	12/01/15 11:29 / plj
Radium 228 MDC	0.2	pCi/g-dry				E901.1	12/01/15 11:29 / plj

Report Definitions:

RL - Analyte reporting limit.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.
D - RL increased due to sample matrix.

MDL - Method detection limit
QCL - Quality control limit.
MDC - Minimum detectable concentration

QA/QC Summary Report

Prepared by Casper, WY Branch

Client: Environmental Restoration Group Inc **Report Date:** 12/03/15

Project: Not Indicated **Work Order:** C15110017

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: E901.1										Batch: 46183
Lab ID: MB-R207005	7	Method Blank				Run: GAM-HPGE_151201A				12/01/15 11:29
Radium 226		0.1	pCi/g-dry							
Radium 226 precision (±)		0.05	pCi/g-dry							
Radium 226 MDC		0.06	pCi/g-dry							
Radium 228		0.1	pCi/g-dry							
Radium 228 precision (±)		0.04	pCi/g-dry							
Radium 228 MDC		0.1	pCi/g-dry							
Radon 222 precision (±)		0.05	pCi/g-dry							
Lab ID: LCS-R207005		Laboratory Control Sample				Run: GAM-HPGE_151201A				12/01/15 11:29
Radium 226		52	pCi/g-dry		106	70	130			
Lab ID: C15110017-016ADUP	7	Sample Duplicate				Run: GAM-HPGE_151201A				12/01/15 11:29
Radium 226		0.67	pCi/g-dry					19	20	
Radium 226 precision (±)		0.085	pCi/g-dry							
Radium 226 MDC		0.061	pCi/g-dry							
Radium 228		0.75	pCi/g-dry					16	20	
Radium 228 precision (±)		0.11	pCi/g-dry							
Radium 228 MDC		0.088	pCi/g-dry							
Radon 222 precision (±)		0.085	pCi/g-dry							

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

MDC - Minimum detectable concentration

QA/QC Summary Report

Prepared by Casper, WY Branch

Client: Environmental Restoration Group Inc **Report Date:** 12/03/15

Project: Not Indicated **Work Order:** C15110017

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: SW6020							Analytical Run: ICPMS2-C_151104A			
Lab ID: ICV		Initial Calibration Verification Standard								11/04/15 15:15
Uranium		0.0486	mg/L	0.00030	97	90	110			
Lab ID: ICSA		Interference Check Sample A								11/04/15 15:16
Uranium		0.000155	mg/L	0.00030						
Lab ID: ICSAB		Interference Check Sample AB								11/04/15 15:18
Uranium		1.65E-05	mg/L	0.00030						
Method: SW6020									Batch: 46119	
Lab ID: MB-46119		Method Blank				Run: ICPMS2-C_151104A				11/04/15 15:31
Uranium		0.01	mg/kg	0.0008						
Lab ID: LFB-46119		Laboratory Fortified Blank				Run: ICPMS2-C_151104A				11/04/15 15:33
Uranium		25	mg/kg	0.052	102	80	120			
Lab ID: LCS3-46119		Laboratory Control Sample				Run: ICPMS2-C_151104A				11/04/15 15:34
Uranium		110	mg/kg	0.13	88	80	120			
Lab ID: C15090985-015ADIL		Serial Dilution				Run: ICPMS2-C_151104A				11/04/15 15:39
Uranium		18	mg/kg-dry	0.32				12	10	R
Lab ID: C15090985-016AMS3		Sample Matrix Spike				Run: ICPMS2-C_151104A				11/04/15 15:49
Uranium		1100	mg/kg-dry	0.062		75	125			A
Lab ID: C15090985-016AMSD		Sample Matrix Spike Duplicate				Run: ICPMS2-C_151104A				11/04/15 15:51
Uranium		980	mg/kg-dry	0.062		75	125	8.9	20	A
Lab ID: C15110017-015BMS3		Sample Matrix Spike				Run: ICPMS2-C_151104A				11/04/15 16:32
Uranium		26.2	mg/kg-dry	0.15	100	75	125			
Lab ID: C15110017-015BMSD		Sample Matrix Spike Duplicate				Run: ICPMS2-C_151104A				11/04/15 16:34
Uranium		24.2	mg/kg-dry	0.15	92	75	125	8.2	20	

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

R - RPD exceeds advisory limit.

A - The analyte level was greater than four times the spike level. In accordance with the method % recovery is not calculated.

MDC - Minimum detectable concentration

QA/QC Summary Report

Prepared by Casper, WY Branch

Client: Environmental Restoration Group Inc **Report Date:** 12/03/15

Project: Not Indicated **Work Order:** C15110017

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: SW6020										Analytical Run: ICPMS2-C_151106A
Lab ID: ICV		Initial Calibration Verification Standard								11/06/15 15:14
Uranium		0.0455	mg/L	0.00030	91	90	110			
Lab ID: ICSA		Interference Check Sample A								11/06/15 15:16
Uranium		6.84E-05	mg/L	0.00030						
Lab ID: ICSAB		Interference Check Sample AB								11/06/15 15:19
Uranium		3.90E-06	mg/L	0.00030						
Method: SW6020										Batch: 46136
Lab ID: MB-46136		Method Blank				Run: ICPMS2-C_151106A				11/06/15 17:26
Uranium		0.03	mg/kg	2E-05						
Lab ID: LFB-46136		Laboratory Fortified Blank				Run: ICPMS2-C_151106A				11/06/15 17:31
Uranium		23.5	mg/kg	0.15	95	75	125			
Lab ID: LCS3-46136		Laboratory Control Sample				Run: ICPMS2-C_151106A				11/06/15 17:33
Uranium		112	mg/kg	0.37	89	80	120			
Lab ID: C15110017-016BDIL		Serial Dilution				Run: ICPMS2-C_151106A				11/06/15 17:50
Uranium		0.652	mg/kg-dry	0.77					10	
Lab ID: C15100911-017AMS3		Sample Matrix Spike				Run: ICPMS2-C_151106A				11/06/15 17:54
Uranium		26.6	mg/kg-dry	0.16	91	75	125			
Lab ID: C15100911-017AMSD		Sample Matrix Spike Duplicate				Run: ICPMS2-C_151106A				11/06/15 17:57
Uranium		27.3	mg/kg-dry	0.16	93	75	125	2.6	20	

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

MDC - Minimum detectable concentration

Work Order Receipt Checklist

Environmental Restoration Group Inc C15110017

Login completed by: Ralph Stanley
Reviewed by: BL2000\cwagner
Reviewed Date: 11/3/2015

Date Received: 11/2/2015
Received by: res
Carrier name: FedEx

Shipping container/cooler in good condition?	Yes ☑	No ☐	Not Present ☐
Custody seals intact on all shipping container(s)/cooler(s)?	Yes ☐	No ☐	Not Present ☑
Custody seals intact on all sample bottles?	Yes ☐	No ☐	Not Present ☑
Chain of custody present?	Yes ☑	No ☐	
Chain of custody signed when relinquished and received?	Yes ☑	No ☐	
Chain of custody agrees with sample labels?	Yes ☑	No ☐	
Samples in proper container/bottle?	Yes ☑	No ☐	
Sample containers intact?	Yes ☑	No ☐	
Sufficient sample volume for indicated test?	Yes ☑	No ☐	
All samples received within holding time? (Exclude analyses that are considered field parameters such as pH, DO, Res Cl, Sulfite, Ferrous Iron, etc.)	Yes ☑	No ☐	
Temp Blank received in all shipping container(s)/cooler(s)?	Yes ☐	No ☐	Not Applicable ☑
Container/Temp Blank temperature:	N/A°C		
Water - VOA vials have zero headspace?	Yes ☐	No ☐	Not Applicable ☑
Water - pH acceptable upon receipt?	Yes ☑	No ☐	Not Applicable ☐

Standard Reporting Procedures:

Lab measurement of analytes considered field parameters that require analysis within 15 minutes of sampling such as pH, Dissolved Oxygen and Residual Chlorine, are qualified as being analyzed outside of recommended holding time.

Solid/soil samples are reported on a wet weight basis (as received) unless specifically indicated. If moisture corrected, data units are typically noted as –dry. For agricultural and mining soil parameters/characteristics, all samples are dried and ground prior to sample analysis.

Contact and Corrective Action Comments:

None

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Chain of Custody & Analytical Request Record

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Account Information (Billing information)

Company/Name	ERG
Contact	David Adams
Phone	970 420 3750
Mailing Address	8809 Washington St NE, Ste. 150
City, State, Zip	Albuquerque, NM, 87113
Email	daveadams@ergoffice.com
Receive Invoice ☑ Hard Copy ☑ Email	Receive Report ☑ Hard Copy ☑ Email
Purchase Order	Quote

Report Information (if different than Account Information)

Company/Name	
Contact	
Phone	
Mailing Address	
City, State, Zip	
Email	
Receive Report ☐ Hard Copy ☐ Email	
Special Report/Formats: ☐ LEVEL IV ☐ NELAC ☐ EDD/EDT (contact laboratory) ☐ Other	

Comments

Project Information

Project Name, PWSID, Permit, etc.	
Bottle Order	
Sample Origin State	EPA/State Compliance ☐ Yes ☐ No
Sampler Name Dave Adams	Sampler Phone 970 420 3750

Matrix Codes
A - Air
W - Water
S - Soils/Solids
V - Vegetation
B - Bioassay
O - Other
DW - Drinking Water

All turnaround times are standard unless marked as RUSH.

Energy Laboratories MUST be contacted prior to RUSH sample submittal for charges and scheduling – See Instructions Page

	Sample Identification (Name, Location, Interval, etc.)	Collection Date	Collection Time	Number of Containers	Matrix (See Codes Above)	Analysis Requested: Ra-226 901.1	U-nat	Ra/Ac-228 901.1	See Attached	RUSH TAT	ELI LAB ID Laboratory Use Only
1	RHW-1 -0006	10/27/15	1515	1	S	✓	✓	✓			
2	RHW-2 -0006	10/27/15	1500	1	S	✓	✓	✓			C15110017
3	RHW-3 -0006	10/27/15	1445	1	S	✓	✓	✓			
4	RHW-4 -0006	10/27/15	1425	1	S	✓	✓	✓			C50
5	RHW-5 -0006	"	1410	1	S	✓	✓	✓			
6	RHW-6 -0006	"	1120	1	S	✓	✓	✓			
7	RHW-6 -0612	"	1120	1	S	✓	✓	✓			
8	RHW-7 -0006	"	1135	1	S	✓	✓	✓			
9	RHW-8 -0006	"	1130	1	S	✓	✓	✓			
10	RHW-9 -0006	"	1300	1	S	✓	✓	✓			

Custody Record MUST be signed	Relinquished by (print)	Date/Time	Signature	Received by (print)	Date/Time	Signature
	David Adams	10/28/15 1537	[signature]			
	Relinquished by (print)	Date/Time	Signature	Received by Laboratory (print) Energy Labs	Date/Time 11/2/15 11:25	Signature [signature]

LABORATORY USE ONLY

Sample Disposal	Shipped By	Cooler ID(s)	Custody Seals	Intact	Receipt Temp	Temp Blank	On Ice	Payment Type	Amount	Receipt Number (cash/check only)
Client Lab	FedEx-Exp RS-N		Y (N) C B	Y N	NA °C	Y N	Y (N)	CC Cash Check	$	

In certain circumstances, samples submitted to Energy Laboratories, Inc. may be subcontracted to other certified laboratories in order to complete the analysis requested. This serves as notice of this possibility. All subcontracted data will be clearly notated on your analytical report.

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Chain of Custody & Analytical Request Record

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Account Information (Billing information)

Company/Name	ERG
Contact	David Adams
Phone	970 420 3750
Mailing Address	8809 Washington St. NE, Ste. 150
City, State, Zip	Albuquerque, NM, 87113
Email	daveadams@ergoffice.com
Receive Invoice ☑Hard Copy ☑Email	Receive Report ☑Hard Copy ☑Email
Purchase Order	Quote

Report Information (if different than Account Information)

Company/Name	
Contact	
Phone	
Mailing Address	
City, State, Zip	
Email	
Receive Report ☐Hard Copy ☐Email	
Special Report/Formats: ☐ LEVEL IV ☐ NELAC ☐ EDD/EDT (contact laboratory) ☐ Other ______	

Comments

Project Information

Project Name, PWSID, Permit, etc.	
Bottle Order	
Sample Origin State	EPA/State Compliance ☐ Yes ☐ No
Sampler Name	Sampler Phone

Matrix Codes
A - Air
W - Water
S - Soils/Solids
V - Vegetation
B - Bioassay
O - Other
DW - Drinking Water

All turnaround times are standard unless marked as RUSH.

Energy Laboratories MUST be contacted prior to RUSH sample submittal for charges and scheduling – See Instructions Page

#	Sample Identification (Name, Location, Interval, etc.)	Collection Date	Collection Time	Number of Containers	Matrix (See Codes Above)	Ra-226 901E	U-NAT	Ra/Ac-228 901.1E							See Attached	RUSH TAT	ELI LAB ID Laboratory Use Only
1	RHW-9-0612	10/27/15	1300	1	S	✓	✓	✓									
2	RHW-10-0006	〃	1245	1	S	✓	✓	✓									
3	RHW-10-0612	〃	1245	1	S	✓	✓	✓									
4	RHW-11-0006	〃	1215	1	S	✓	✓	✓									
5	RHW-12-0006	〃	1150	1	S	✓	✓	✓									
6	RHW-12-0612	〃	1150	1	S	✓	✓	✓									
7																	
8																	
9																	
10																	

Custody Record MUST be signed	Relinquished by (print)	Date/Time	Signature	Received by (print)	Date/Time	Signature
	David Adams	10/28/15 1538	D. W. Adams			
	Relinquished by (print)	Date/Time	Signature	Received by Laboratory (print)	Date/Time	Signature

LABORATORY USE ONLY

Sample Disposal	Shipped By	Cooler ID(s)	Custody Seals	Intact	Receipt Temp	Temp Blank	On Ice	Payment Type	Amount	Receipt Number (cash/check only)
Client Lab			Y N C B	Y N	°C	Y N	Y N	CC Cash Check ______	$	

In certain circumstances, samples submitted to Energy Laboratories, Inc. may be subcontracted to other certified laboratories in order to complete the analysis requested. This serves as notice of this possibility. All subcontracted data will be clearly notated on your analytical report.

APPENDIX B-3

Baseline Radiological Survey of Pipeline Corridor and Reuse Water Discharge Area

January 2014, ARCADIS-SENES

SENES Consultants
AN ARCADIS COMPANY

Baseline Radiological Survey of Pipeline Corridor And Reuse Water Discharge Area

Mine Permit No. MK025RN
McKinley County, New Mexico

Prepared for:

Roca Honda Resources
c/o Energy Fuels Resources (USA) Inc.
225 Union Blvd, Suite 600
Lakewood, CO 80228

Prepared by:

ARCADIS-SENES
8310 South Valley Highway, Suite 135
Englewood, CO USA 80112

January, 2014

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LIST OF FIGURES

INTRODUCTION

In May 2013, SENES Consultants performed a radiological survey of the Roca Honda site as a supplement to a large area gamma survey previously completed. The supplement included measurements to standardize the results of the prior gamma survey to any future study. Additionally, the SENES 2013 survey evaluated a potential pipeline route with multiple discharge locations for treated minewater. The results of the 2013 radiological baseline survey, which included an originally planned pipeline corridor and three potential discharge locations, were submitted to RHR in a report entitled "Supplemental Radiological Baseline Surveys: Addendum to Section 13 of the Roca Honda Mine Reclamation Plan (Rev. 1)" (SENES, August 2013)[1]. In October 2014, SENES performed a radiological baseline survey of extended corridor areas for a planned reuse water pipeline that will convey treated mine water to an alternate discharge location. SENES conducted a comprehensive gamma radiation survey and characterization of associated soil radionuclide concentrations along the new pipeline corridor route and discharge location as specified in the RFP. The data was normalized to previous baseline gamma survey data per the methodologies developed in the Supplemental Radiological Baseline Surveys report (SENES, August 2013). These methodologies established a standard analytical basis of gamma radiation measurements for the Roca Honda Mine Permit in accordance with the "Post Mine Radiological Surveys" plan submitted to MMD.

PROJECT AREA

The pipeline corridor areas are indicated along green route segments shown in Figure 1 (reproduced from the RFP). The gamma scans were conducted only on the south or east side of the highway right of way as indicated in the RFP.

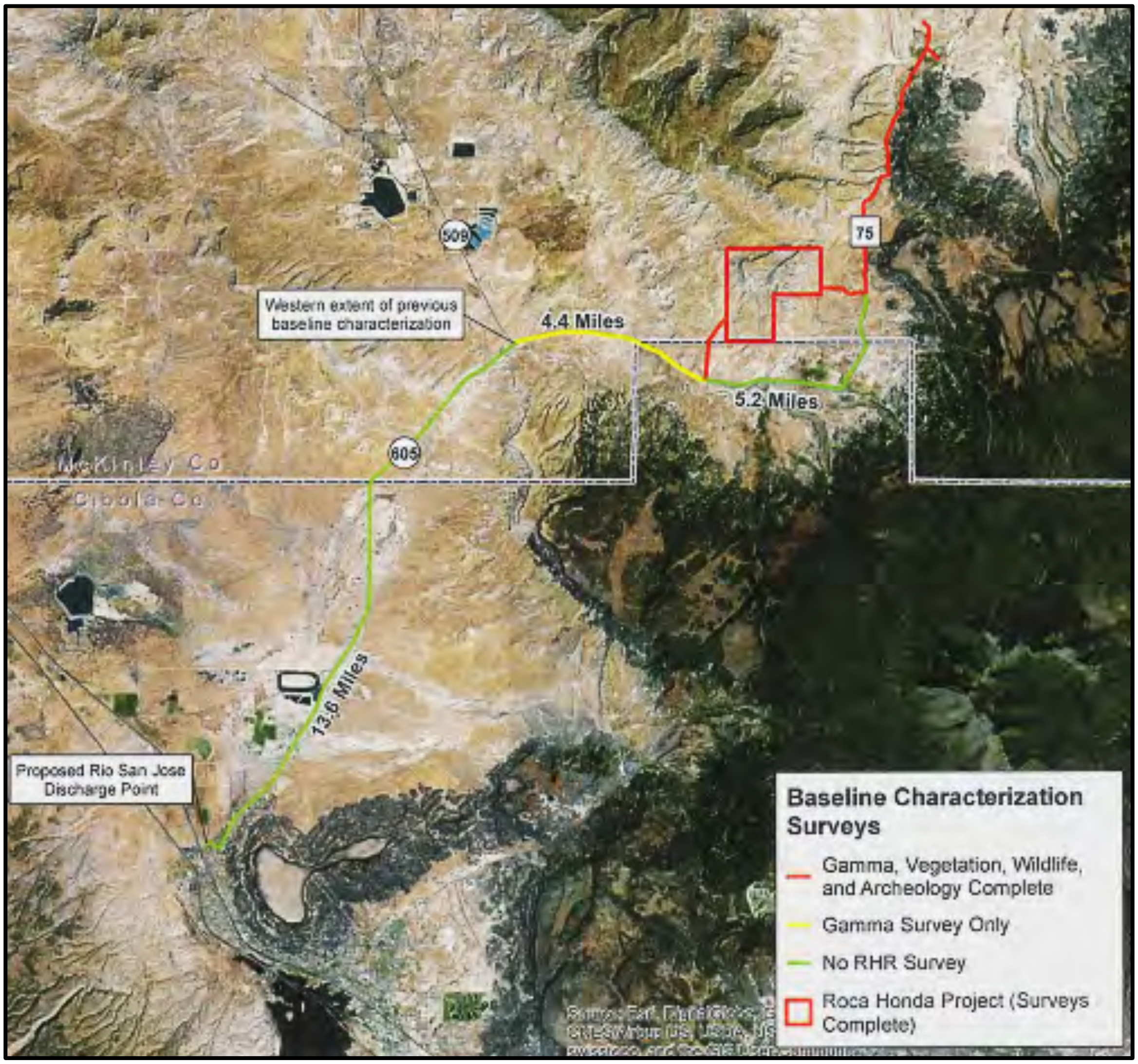
SCOPE OF WORK SUMMARY

The basic Scope of Work (SOW) is summarized as follows:

1. Baseline gamma survey of a total of 18.8 miles of pipeline corridor (along south or east highway right of way) and alternate discharge location as indicated in green in Figure 1.
2. Representative soil sampling with laboratory analysis of U-nat, Ra-226 and Th-232, and application of previously developed gamma/soil ^{226}Ra correlation.
3. Development and delivery of respective data and reports to RHR as indicated in the RFP.

[1] Field work performed and report developed by SENES Consultants, report submitted to RHR in August 2013.

Figure 1: **Extent of the proposed survey area as shown in green (reproduced from the RFP)**



SURVEY METHODOLOGY

SCANNING PROTOCOLS, INSTRUMENTATION AND SYSTEM SPECIFICATIONS

As with previous baseline gamma surveys associated with the Roca Honda mine, Ludlum 44-10 sodium iodide (NaI)-based scintillation detectors were used for gamma scanning. Each detector was paired with a Model 2221 scaler/rate meter, equipped with RS232 data output capability. Each detector/meter system integrated gamma counts every second and provided corresponding readings in units of counts per minute (cpm) as data output through the RS232 serial port. Each detector/meter pairing was been properly calibrated within one year prior to use. Instrument readings of local background and a Cs-137 check source were evaluated to ensure that instruments are working properly and that readings for each detector/meter pairing are consistent with one another.

Two gamma detectors were mounted on a four-wheel drive pickup truck, extending two to three feet beyond each side of the vehicle approximately five feet above ground surface[2]. Certain calibration / soil sampling location surveys were completed with a single-detector backpack-mounted scan system. Scan speeds were approximately three to five mph depending on terrain.

Each scanning system utilized a small, wide area augmentation system (WAAS)-enabled GPS receiver to provide GPS readings (latitude, longitude) every second to pair with each individual gamma reading. GPS receivers were mounted within two feet of the corresponding detectors with a clear view of the sky during scanning. Data acquisition for paired gamma/GPS readings utilized SENES-developed software installed on a portable field computer.

Aerial imagery with GIS shape file layers showing the pipeline route and relevant site features helped guide the scanning and ensured attainment of intended coverage. Scan data was plotted on a preliminary field map to assess adequacy of scan coverage and to help identify any problems that may have occurred with data acquisition. This information was used to select sampling and data normalization measurement locations.

Data Normalization and Gamma/Ra-226 Correlations

Normalization of gamma survey data to a common basis of measurement with previous baseline gamma survey data was accomplished using the same methods described in the Supplemental Radiological Baseline Surveys report (SENES, August 2013), including use of the previously developed cross-calibration equation to convert NaI scan data to estimates of true total exposure rate as measured by the HPIC (Figure 2).

[2] Five foot truck mounts were necessary due to truck clearance needs, however it was determined via measurement that data collected at three feet vs. five feet was approximately equivalent.

Similarly, the gamma/Ra-226 correlation relationship provided in the Supplemental Radiological Baseline Surveys report (SENES, August 2013; reproduced here as Figure 3) was used to convert HPIC-equivalent gamma survey data into estimates of soil Ra-226 concentrations.

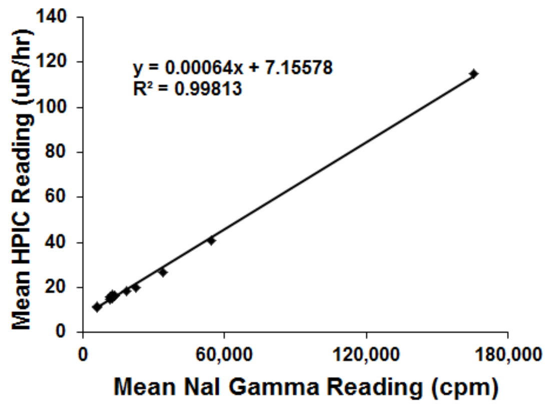


Figure 2 NaI/HPIC cross-calibration equation based on data generated for the Roca Honda mine site and surrounding environs.

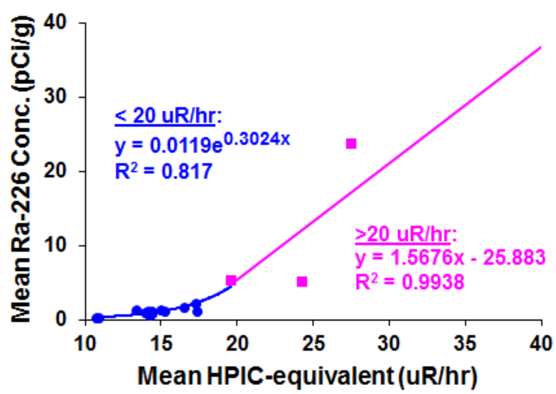


Figure 3 Gamma/soil ^{226}Ra correlation equations based on data generated for the Roca Honda Mine site and surrounding environs.

SURVEY EXECUTION

The survey was completed over the course of three days in the vicinity of the Roca Honda Site. The results of the survey are shown below in multiple maps as the inclusion of all results on one map would make it difficult to view the variation of gamma exposure rate across the entire length of the pipeline. The maps provided as Figures 4 to 8 begin at the location of the proposed drainage on the southern end of the proposed pipeline (Figure 4) and follow the pipeline as it travels to the northeast.

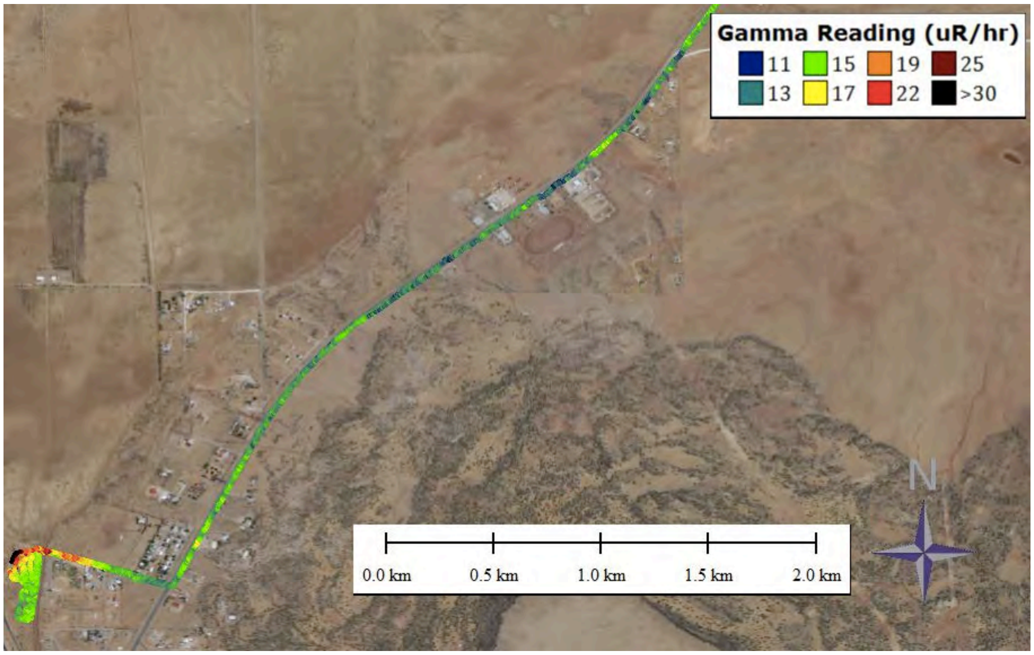


Figure 4 Proposed discharge area and south pipeline portion

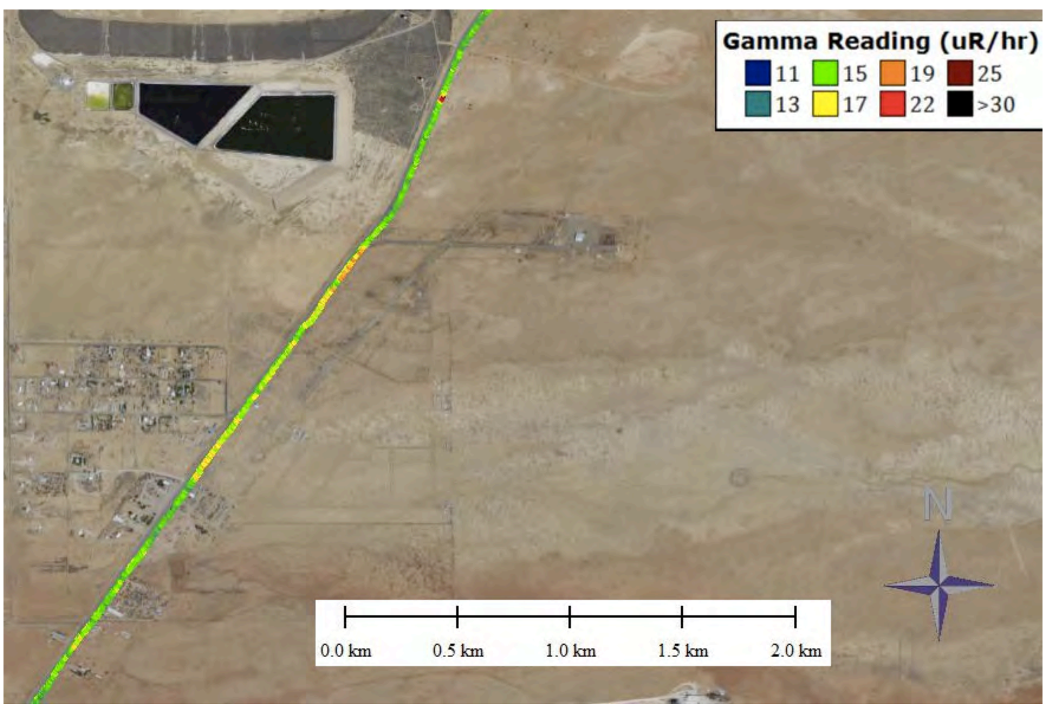


Figure 5 Midsection of Proposed Pipeline (1)

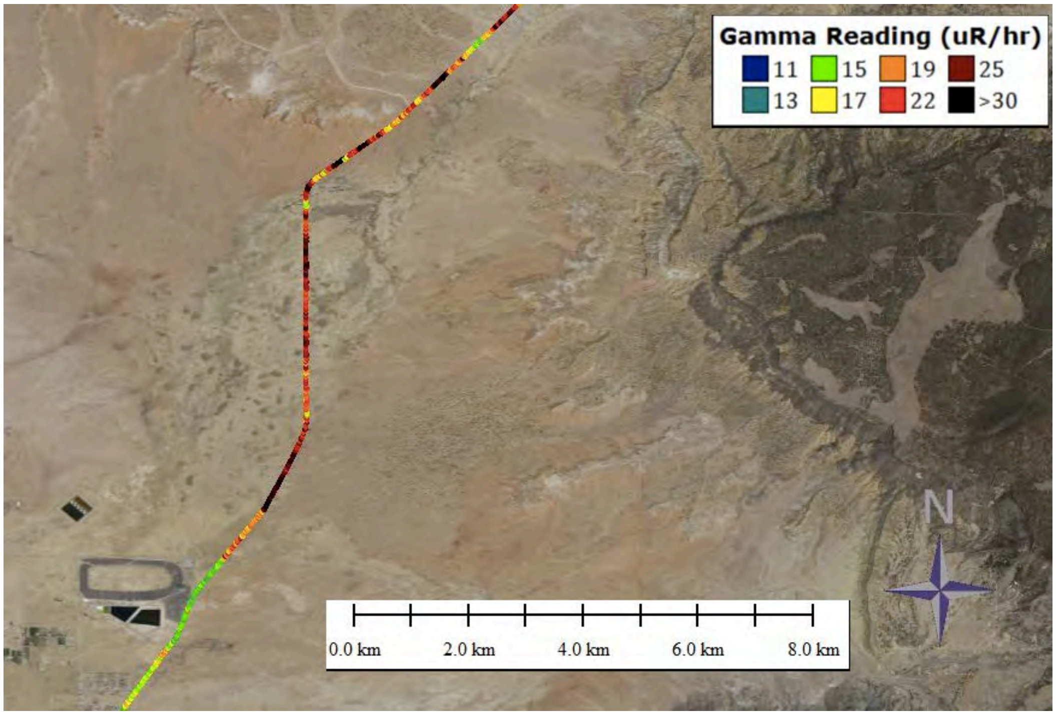


Figure 6 Midsection of proposed pipeline (2)

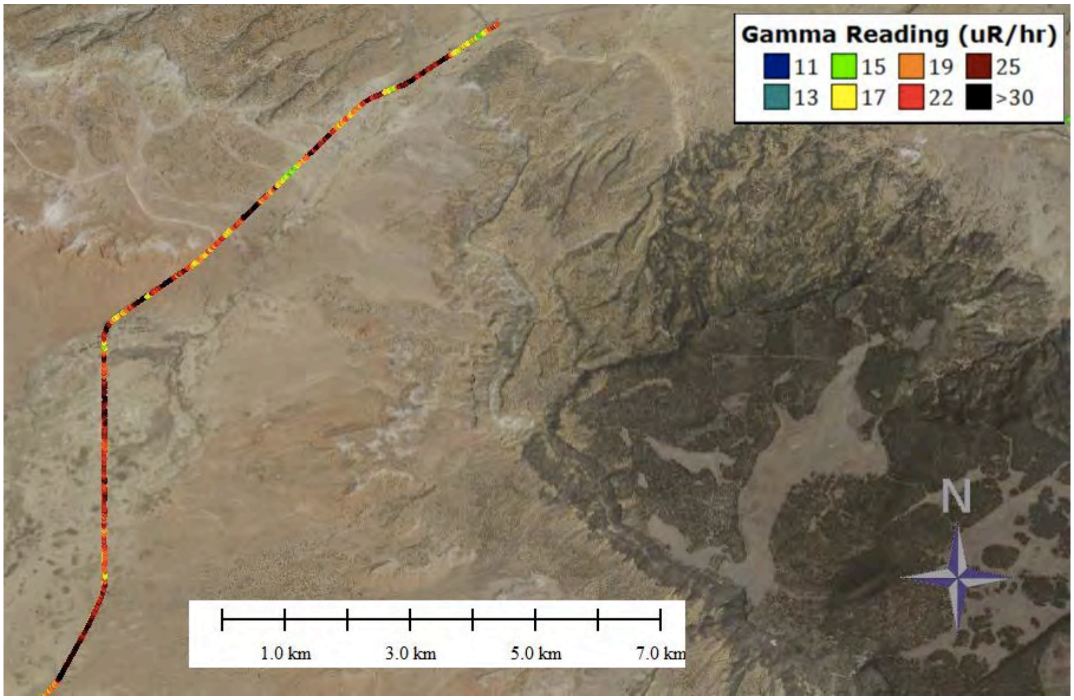


Figure 7 Midsection of Propose Pipeline (3)

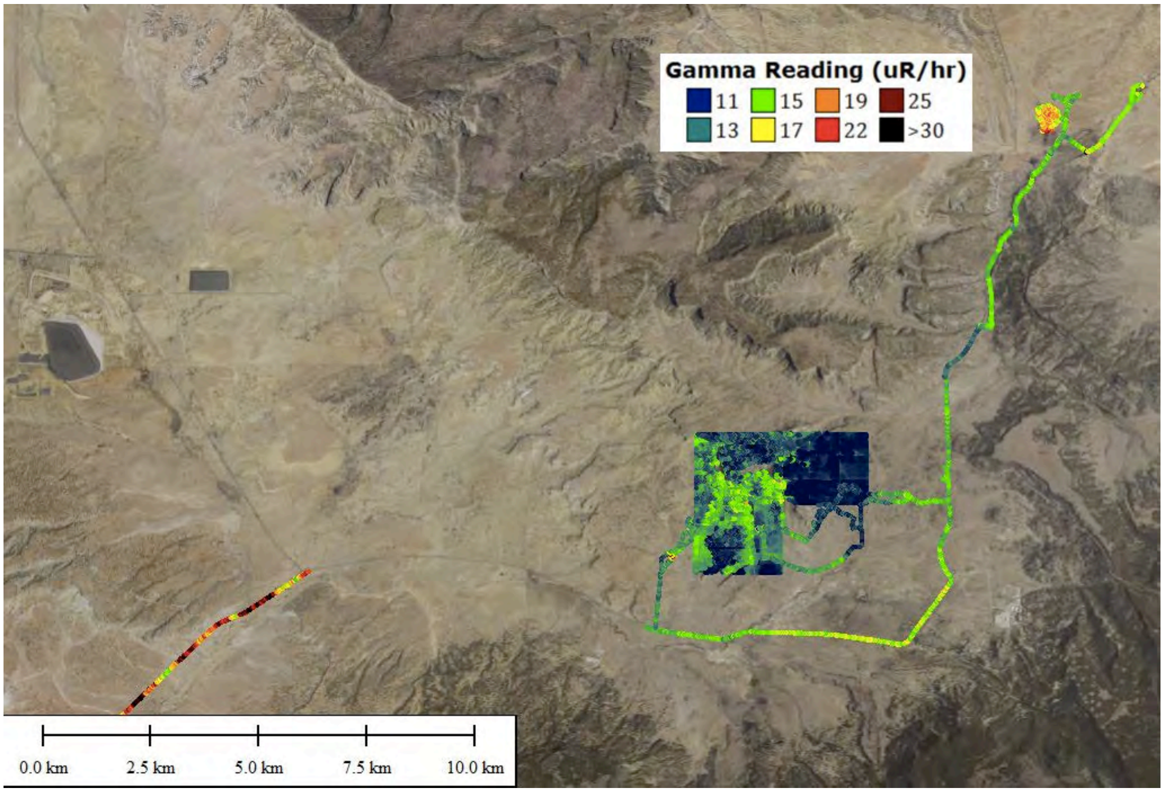


Figure 8 Last section of pipeline measurements (inclusive of previously collected mine site data for reference)

The southernmost and northernmost sections of the survey were fairly consistent with previously collected data. Anomalously elevated results were noted in the regions north of the tailings management area (visible on Figures 5 and 6) when compared to other roadway pipeline data, as well as relative to background across the Roca Honda mine site. These areas have potentially been impacted by the historic uranium recovery operations that have taken place over a period of many years in this region. This should be documented prior to future RHR mining operations in these areas since these areas have evidence of previous radiological impacts. Additionally, the proposed drainage area included areas of elevated gamma exposure rate, likely as a result of impacts from the historic uranium industry in the area (see additional detail in the soil sampling results section). Discharge into this area may be problematic relative to potential liability for impact after operations are completed. It may be advisable to avoid this section of the discharge area and only use the east/south portions where exposure rates are closer to the general background. However, the majority of the proposed discharge area recorded exposure rates in the 15-17 μR/hr range, which is only slightly above background as measured across the Roca Honda mine site. This is close to the gamma exposure rate ranges found at other proposed discharge areas to the northeast, with the exception of the Playa area, which was significantly higher than general background exposure rates measured in the mine site area.

SOIL SAMPING RESULTS

Five soil samples were collected during the supplemental pipeline survey: Three samples in the discharge area as required by the project scope and two samples along the potential pipeline route. While it was initially determined that soil sampling would not be required along the potential pipeline route, as an adequate number of samples had been collected in the previous survey to create a correlation between gamma exposure rates and ^{226}Ra concentrations in soil, the additional samples were collected in areas with anomalously elevated gamma exposure rates. Samples from Location 1 and Location 2 were collected along the pipeline route. The locations of these samples are shown below in Figure 9. Location 1 was collected within close proximity to a former uranium tailings management area in the region. Gamma exposure readings elevated from background indicated that windblown tailings or other former uranium industry related circumstances may have impacted this area. Location 2 was not in as close proximity to the uranium tailings area, however gamma exposure readings in this area were also well above general background based on previous surveys. Accordingly, it was deemed prudent to sample in this area as well. Roadways in this region may have been subject to impact from trucking of uranium ore / transferred tailings.

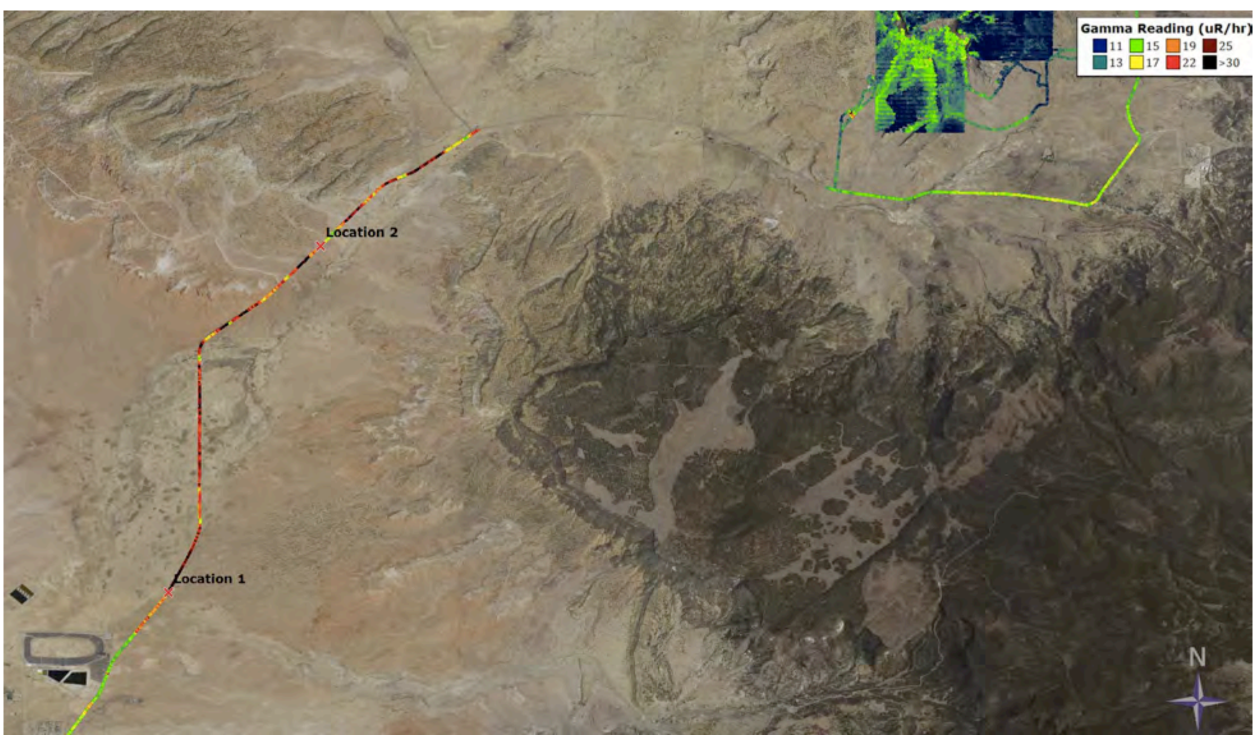


Figure 9 Locations of sampling points 1 and 2 along the pipeline route

Three sampling locations were selected within the proposed discharge area. As the diversity of gamma exposure readings thoughout this area was greater than expected, a range of gamma exposure readings were available for selecting sampling locations. These locations are shown in Figure 10 below.

Figure 10 Soil sampling locations 3, 4 and 5 at the proposed drainage area

Soils were analyzed for ^{40}K, ^{226}Ra, ^{228}Ra, ^{230}Th, and natural uranium. The mix of radionuclides chosen are used to support the quality of the data and to assist in indicating the possible origin of areas of elevated gamma exposure. The soil sampling data is provided in Table 1.

Table 1 Radionuclide Analysis for All Locations (all values in pCi/g)

Radionuclide Analyzed	Location 1 N' 35.254968 W' 107.84208	Location 2 N'35.32504 W' 107.81135	Location 3 N' 35.19286 W' 107.89899	Location 4 N' 35.19213 W' 107.89865	Location 5 N' 35.19271 W' 107.89855
^{40}K	13.0 ± 0.8	10.6 ± 0.8	8.0 ± 2.4	14.2 ± 0.8	12.9 ± 0.7
^{226}Ra	18.8	32.4 ± 0.4	580 ± 1.8	1.9 ± 0.1	1.6 ± 0.1
^{228}Ra	0.8 ± 0.2	0.5 ± 0.2	0.4 ± 0.7	0.9 ± 0.1	0.8 ± 0.1
^{230}Th	17.2 ± 1.8	28.6 ± 2.9	418 ± 39.2	4.0 ± 0.6	1.8 ± 0.3
U-nat	8.3	24.8	870	6.7	3.0

Soil samples from locations 1 and 2 suggest that contamination from historic uranium recovery operations in the region has impacted this portion of the road. Elevated ^{226}Ra and ^{230}Th with respect to natural uranium at location 1 may possibly be the result of wind blown tailings from the nearby tailings management area. Relative concentrations at Location 2, however, do not appear to be consistent with tailings materials as uranium is not significantly depleted with respect to its progeny but nonetheless, the results for this location indicate elevated levels of radionuclides are unlikely to have been caused just by natural variations in background at the site. Characterization of these areas is useful for the potential pipeline route, such that an established "baseline" indicates potential contamination prior to the placement and use of the pipeline. Further sampling at these potentially impacted locations is recommended to more fully characterize the area prior to RHR use.

Location 3 was selected because of gamma exposure readings significantly above background at this location in the proposed discharge area. The soils at this site appeared to have some strata that were yellowish in color (perhaps being a uranium bearing mineral), which was not seen at other soil sampling locations. In addition, this site was located next to an old wooden platform (that had not been used in some time) by the railroad tracks. It is possible that this location represents a loading area that was used for train cars carrying uranium ore and that there is contamination in this area as a result of uranium ore spillage at the loading platform. The elevated values of both ^{226}Ra, ^{230}Th, and (more importantly) natural uranium at this location, and only at this location to such a degree, support the notion that there is likely an impact from previous ore hauling activities at this site.

Static gamma exposure rate readings were made at all five sampling locations directly above the grab sample location. Exposure rates at these locations were made with the RadEye instrument, as well as with an NaI detector. The previous survey effort completed by SENES in 2013 provided conversions for both NaI detector and RadEye data to correct to exposure rates as normalized to the HPIC. The conversion for NaI data was provided in Figure 2, while RadEye data can be converted to normalized HPIC data as provided below in Figure 11. A comparison of measured exposure rates by instrument is presented in Table 2.

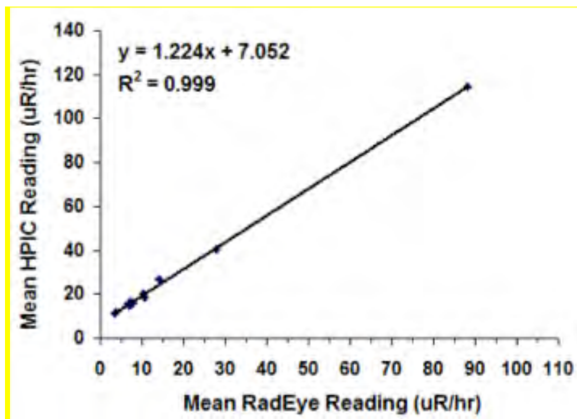


Figure 11: RadEye to HIPC Corrected Values

Table 2 Comaprisons of Gamma Exposure Rates by Instrument Type

Value	Location 1	Location 2	Location 3	Location 4	Location 5
Average RadEye Observed Exposure Rate - μR/hr	20.40	43.00	156.40	9.50	9.80
HPIC Corrected Value[1]- μR/hr	32.02	59.68	198.49	18.68	19.05
Average NaI Observed Exposure Rate – cps	38960	73514	231379	18618	18944
HPIC Corrected Value[2]- μR/hr	32.09	54.20	155.24	19.07	19.28

1 Corrected using formula provided in Figure 11
2 Predicted using formal provided in Figure 2

It is important to note that soil sampling locations chosen during this project were not subject to a rigorous selection and sampling scrutiny that locations chosen for correlation are generally subject to. These samples were collected as grab samples to verify radionuclide concentrations at gamma survey “hot spots”. To have used the previously developed gamma exposure ^{226}Ra correlation for these soil sample results , they would have had to have been collected as proper calibration samples, as described in Section 2.4 of the SENES 2013 report.

QA/QC FOR SOIL SAMPLING

Location ID numbers, date, and GPS coordinates for each sampling location were recorded in the field log book, along with notes of any field observations that could potentially affect the data or related data interpretations. After samples were collected, they were maintained under proper chain-of custody (COC) protocols. Field sampling personnel completed a COC form for each shipping container of soil samples delivered to the laboratory for analysis. COC/analytical request forms were provided by the laboratory (IML, Sheridan WY).

Each sample was thoroughly homogenized in accordance with the lab’s standard sample preparation protocols. For samples analyzed for Ra-226 by HPGe gamma spectroscopy, aliquots of homogenized samples were weighed and placed into counting tins, then sealed for a minimum of 21 days prior to counting to allow ingrowth of short-lived Ra-226 progeny and approximate equilibrium conditions to become established. Separate aliquots of the homogenized samples were used for analysis of U-nat by inductively coupled plasma mass spectrometry (ICP-MS).

The contract laboratory (Intermountain Laboratories, Inc.) has fully qualified radiochemistry capabilities including appropriate accreditations (e.g. NLAP, EPA, etc.). Each batch of laboratory analyses included Laboratory QC data that were reviewed for data quality verification purposes and all reported results were within EPA and the laboratory’s acceptance criteria. QC measurements (e.g. sample spikes, method blanks, duplicate analyses, etc.) and QC results were provided with each data report to provide indications of measurement accuracy and precision. The laboratory uses NIST certified standards for instrument calibrations, and for gamma spectroscopy, utilizes NIST or EPA certified soil radionuclide reference material standards for such calibrations.

SUMMARY AND CONCLUSIONS

The extended pipeline survey was completed in October of 2014 and provided generally consistent results with the previous gamma exposure rate survey effort at the site (SENES 2013). While many sections of the pipeline corridor are located along what appears to be areas of natural background conditions, some areas along the length of the pipeline corridor indicated elevated levels of naturally occurring radionuclides in the soil and associated elevated gamma exposure rates. It appears that areas in the potential discharge area may have been radiologically impacted from previous historical uranium recovery related activities. This information should be documented prior to initiation of Roca Honda mine related construction to minimize the potential for future liabilities associated with claims of environmental impact and associated with future decommissioning of the mine. It is further suggested that some modest additional characterization (gamma surveys and soil sampling, e.g.) be conducted at and in the vicinity of the identified impacted areas to further identify the potential for inherited radiological impacts at this site.

APPENDIX C-1

Reuse Pipeline Route Design Criteria

Roca Honda Mine Dewatering Discharge Pipeline

June 2015, Wilson & Company

WILSON
&COMPANY

June 29, 2015

Roca Honda
Mine Dewatering Discharge Pipeline

Introduction

The purpose of the proposed pipeline will be to transport wastewater from the Roca Honda mine site to the discharge point in the town of Milan, NM approximately 19 miles away. The pipeline will originate at the outfall of the discharge holding ponds at the mine site. The alignment of the pipeline will follow the mine access road to Highway 605 and be directional drilled under Highway 605. The pipeline will follow Highway 605 on the south/east side until reaching Milan. In Milan, the pipeline will be bored under Highway 605 at Stanley Ave. and continue westward until discharging at the drainage channel which crosses under Stanley Ave and flows south through Milan and connects with the San Rio Jose River.

The proposed alignment of the pipeline was surveyed using GPS equipment at intervals of at least every 50 feet. The survey data was overlaid in AutoCAD and compared to an existing topographical surface created by Wilson & Company using LIDAR mapping technology. Additionally, USGS Quadrangle maps were examined for the area surrounding the project for understanding of the topography of this region. The designers Brian Ambrogi and Kyle Sewell drove the project length taking special note of any unusual conditions and potential challenges to following a basic offset alignment on the south/east side of Highway 605. The majority of grade changes in this area were slight and there are some possible conflicts that must be avoided such as electric utility poles. There are several incline sections and an arroyo near Sta. 668+50 which must be passed under.

Hydraulic Analysis

Design Parameters	
Total pipeline length	108,431 ft
Pipe Material	HDPE 4710 DR-11
Hazen Williams Coefficient, C	150
Starting Elevation	High Elev = 7,265 ±
Discharge Elevation	6,526.94 ft
Elevation Difference	728.06 ft
Discharge Flow Rate, min.	4,500 gpm

We used the survey alignment data to create a profile of the proposed pipeline in AutoCAD. Using the profile and horizontal alignment we created a series of nodes to capture the elevation and lateral changes to have a linearized approximation of the proposed pipeline. These junctions were transferred to WaterCAD to create a pipeline model for the hydraulic analysis. In total there were 77 junctions created in WaterCAD of which 30 were modeled as air release/vacuum valves. The junctions do not have a physical meaning except to define the geometry of the pipe. Joint types will be water tight bell and spigot or fuse welded joints. Joint fittings will be an appropriate polyethylene fitting compatible with the selected pipe manufacturer's pipe system. A WaterCAD map is included with this report showing the node labels and pipeline alignment.

The start node of the pipeline was modeled as a reservoir, which in WaterCAD has unlimited water storage and a fixed water surface elevation. The source reservoir simulates the discharge dewatering lagoon with a fixed head and gravity flow into the pipeline. A note about the design assumptions in WaterCAD is that it uses the Hazen-Williams equation for turbulent flow and assumes the pipes are flowing full.

The discharge at the creek was modeled as a junction with a flow emitter. The flow emitter is a device that models the flow through a nozzle or orifice. The flow rate through the emitter is $Q=kP^n$, where k is the emitter coefficient (gpm/psi^n), and P^n is pressure (psi), and n is 0.5. The emitter coefficient, k was selected as 2,000 gpm/psi^n which is sufficiently large so the junction discharges water in the presence of a positive pressure at a rate restricted only be the pipe diameter.

The discharge is assumed to be above the water level of the drainage channel. When the channel is flowing full, backwater may be experienced which will reduce the discharge rate by the head pressure of the channel water and should be considered when designing the outlet location of the pipe.

After the pipeline was modeled with a defined source and flow emitter, analysis was run on the pipe to determine the hydraulic capacity of the line and determine the pipe diameter needed to meet the discharge flow rate of 4,500 gal/min. High density polyethylene pipe (HDPE, PE 4710) was used for the discharge line. Due to the use of HDPE pipe above-grade, service factors have been used to compensate for the effect of higher temperatures. The selected pressure class of pipe is DR-11 (202 PSI @ 73°f). The table below summarizes the results from analysis of 14", 16", 18", 20", and 24" pipe diameter.

Pipeline Diameter Sizing Table (HDPE 4710, DIPS, DR-11)

Nominal Pipe Diameter, in	Avg. Inner Diameter (in)	Flow Capacity, gal/min	Flow Velocity, ft/s
14	12.351	2,118	5.67
16	14.047	2,965	6.14
18	15.742	3,989	6.58
20	17.437	5,196	6.98
24	20.828	8,149	7.67

A 20" DR-11 HDPE pipe has sufficient capacity to transport the dewatering effluent since the flow capacity is 5,196 gal/min and exceeds the required minimum. The terrain characteristic of the line at the south end results in a negative pressure condition in the line which means a syphon effect is created to overcome the lower hill between J-1 and AV-5. As the pipe flows and fills to equilibrium, the water will flow at full or near full up the lower segment and head pressure in the line will back up enough to overcome the hill. After cresting the hill, the water in the pipe will increase in velocity making an air pocket in the pipe that would result in suction in the pipe without sufficient air release/suction valves. This is not desirable for gravity pipes since the pipe and joints are not designed for suction pressure.

To resolve this issue of suction pressure forming in the lower end of the pipe we propose a Flow Control Valve (FCV) just upstream from the discharge junction, J-88. An FCV with a maximum setting of 4,500 gpm will restrict discharge to the design flow level. This serves two purposes: one it reduces the discharge velocity and two it reduces the flow rate. The FCV solves this problem and allows the pipe to flow full with the help of upstream water in the pipe pushing against the FCV to keep the discharge flow at a constant 4,500 gpm. The FCV can be design to allow a range of flows above or below this design threshold if desired by the Owner.

Since this is a gravity pipeline over hilly terrain, some portions will hold water and not fully drain when the flow from the dewatering lagoons is shut off. Should this be undesirable, an alternate system with a pump and pressure pipeline would allow the line to be fully drained but will increase the cost of pipe from thinner walled gravity pipe to thicker pressure pipe.

The Appendix attached to this report include the coordinates of all elements in the model, pressures, analysis features, and output showing the WaterCAD results.

Conclusions

Our recommendation for the pipeline is as follows:

- 20" HDPE PE 4710 DIPS DR-11
  - 3 feet minimum cover
- Gravity Fed
- Flow Control Valve (4,500 gpm) at the south end or pumped system

The technical material and data contained in this report were prepared under the supervision and direction of the undersigned, whose seal as a Professional Engineer, licensed to practice in the State of New Mexico is affixed below.

BRIAN J. AMBROGI
NEW MEXICO
17610
LICENSED PROFESSIONAL ENGINEER

Brian J Ambrogi, PE

6-29-15

NM PE # 17610

Scenario: Base

Project Inventory: Discharge Pipeline.wtg

Title	
Engineer	
Company	
Date	3/18/2015
Notes	

Scenario Summary

ID	1
Label	Base
Notes	
Active Topology	Base Active Topology
Physical	Base Physical
Demand	Base Demand
Initial Settings	Base Initial Settings
Operational	Base Operational
Age	Base Age
Constituent	Base Constituent
Trace	Base Trace
Fire Flow	Base Fire Flow
Energy Cost	Base Energy Cost
Transient	Base Transient
Pressure Dependent Demand	Base Pressure Dependent Demand
Failure History	Base Failure History
User Data Extensions	Base User Data Extensions
Steady State/EPS Solver Calculation Options	Base Calculation Options
Transient Solver Calculation Options	Base Calculation Options

Network Inventory

Pipes	79	PRV's	0
Junctions	48	PSV's	0
Hydrants	0	PBV's	0
Tanks	0	FCV's	1
Reservoirs	1	TCV's	0
Pumps	0	GPV's	0
Pump Stations	0	Isolation Valves	0
Variable Speed Pump Batteries	0	Spot Elevations	0

Transient Network Inventory

Turbines	0	Surge Valves	0
Periodic Head-Flows	0	Check Valves	0
Air Valves	30	Rupture Disks	0
-Double Acting	30	Discharges to Atmosphere	0
-Slow Closing	0	Orifices Between Pipes	0
-Triple Acting	0	Valves With Linear Area Change	0
-Vacuum Breaker	0	Surge Tanks	0
Hydropneumatic Tanks	0		

Project Inventory: Discharge Pipeline.wtg

Pressure Pipes Inventory			
17.4 (in)	108,431 ft	All Diameters	108,431 ft

FlexTable: Reservoir Table

Current Time: 0.000 hours

ID	Label	Elevation (ft)	Zone	Hydraulic Grade (ft)
186	R-1	7,255.00	<None>	7,255.00

FlexTable: Pipe Table

Current Time: 0.000 hours

Label	Length (ft)	Start Node	Stop Node	Internal Diameter (in)	Material	Hazen-Williams C	Minor Loss Coefficient (Local)	Flow (gpm)	Velocity (ft/s)	Headloss Gradient (ft/ft)	Status (Initial)
P-2	793	J-1	AV-1	17.4	HDPE	150.0	0.000	-4,500	6.05	0.005	Open
P-3	1,568	AV-1	J-2	17.4	HDPE	150.0	0.000	-4,500	6.05	0.005	Open
P-4	839	J-2	AV-2	17.4	HDPE	150.0	0.000	-4,500	6.05	0.005	Open
P-5	514	AV-2	J-3	17.4	HDPE	150.0	0.000	-4,500	6.05	0.005	Open
P-6	585	J-3	J-4	17.4	HDPE	150.0	0.000	-4,500	6.05	0.005	Open
P-7	550	J-4	AV-3	17.4	HDPE	150.0	0.000	-4,500	6.05	0.005	Open
P-8	850	AV-3	J-5	17.4	HDPE	150.0	0.000	-4,500	6.05	0.005	Open
P-9	1,933	J-5	AV-4	17.4	HDPE	150.0	0.000	-4,500	6.05	0.005	Open
P-10	1,563	AV-4	J-6	17.4	HDPE	150.0	0.000	-4,500	6.05	0.005	Open
P-11	750	J-6	AV-5	17.4	HDPE	150.0	0.000	-4,500	6.05	0.005	Open
P-18	2,548	AV-9	J-7	17.4	HDPE	150.0	0.000	-4,500	6.05	0.005	Open
P-19	500	J-7	AV-10	17.4	HDPE	150.0	0.000	-4,500	6.05	0.005	Open
P-20	2,399	AV-10	AV-11	17.4	HDPE	150.0	0.000	-4,500	6.05	0.005	Open
P-21	2,923	AV-11	J-8	17.4	HDPE	150.0	0.000	-4,500	6.05	0.005	Open
P-22	2,473	J-8	AV-12	17.4	HDPE	150.0	0.000	-4,500	6.05	0.005	Open
P-23	1,450	AV-12	J-9	17.4	HDPE	150.0	0.000	-4,500	6.05	0.005	Open
P-24	950	J-9	J-10	17.4	HDPE	150.0	0.000	-4,500	6.05	0.005	Open
P-25	298	J-10	J-11	17.4	HDPE	150.0	0.000	-4,500	6.05	0.005	Open
P-26	202	J-11	J-12	17.4	HDPE	150.0	0.000	-4,500	6.05	0.005	Open
P-27	699	J-12	AV-13	17.4	HDPE	150.0	0.000	-4,500	6.05	0.005	Open
P-28	6,199	AV-13	AV-14	17.4	HDPE	150.0	0.000	-4,500	6.05	0.005	Open
P-29	6,201	AV-14	AV-15	17.4	HDPE	150.0	0.000	-4,500	6.05	0.005	Open
P-30	346	AV-15	J-13	17.4	HDPE	150.0	0.000	-4,500	6.05	0.005	Open
P-32	396	J-13	J-14	17.4	HDPE	150.0	0.000	-4,500	6.05	0.005	Open
P-33	352	J-14	J-15	17.4	HDPE	150.0	0.000	-4,500	6.05	0.005	Open
P-34	2,219	J-15	AV-16	17.4	HDPE	150.0	0.000	-4,500	6.05	0.005	Open
P-35	1,879	AV-16	J-16	17.4	HDPE	150.0	0.000	-4,500	6.05	0.005	Open
P-36	1,368	J-16	J-17	17.4	HDPE	150.0	0.000	-4,500	6.05	0.005	Open
P-37	377	J-17	AV-28	17.4	HDPE	150.0	0.000	-4,500	6.05	0.005	Open
P-38	3,606	AV-28	J-18	17.4	HDPE	150.0	0.000	-4,500	6.05	0.005	Open

FlexTable: Pipe Table

Current Time: 0.000 hours

Label	Length (ft)	Start Node	Stop Node	Internal Diameter (in)	Material	Hazen-Williams C	Minor Loss Coefficient (Local)	Flow (gpm)	Velocity (ft/s)	Headloss Gradient (ft/ft)	Status (Initial)
P-39	156	J-18	J-19	17.4	HDPE	150.0	0.000	-4,500	6.05	0.005	Open
P-40	546	J-19	AV-29	17.4	HDPE	150.0	0.000	-4,500	6.05	0.005	Open
P-41	657	AV-29	J-20	17.4	HDPE	150.0	0.000	-4,500	6.05	0.005	Open
P-42	669	J-20	AV-17	17.4	HDPE	150.0	0.000	-4,500	6.05	0.005	Open
P-43	1,460	AV-17	J-21	17.4	HDPE	150.0	0.000	-4,500	6.05	0.005	Open
P-44	898	J-21	J-22	17.4	HDPE	150.0	0.000	-4,500	6.05	0.005	Open
P-45	916	J-22	AV-30	17.4	HDPE	150.0	0.000	-4,500	6.05	0.005	Open
P-46	539	AV-30	J-23	17.4	HDPE	150.0	0.000	-4,500	6.05	0.005	Open
P-47	952	J-23	AV-18	17.4	HDPE	150.0	0.000	-4,500	6.05	0.005	Open
P-48	521	AV-18	J-24	17.4	HDPE	150.0	0.000	-4,500	6.05	0.005	Open
P-52	121	J-24	J-25	17.4	HDPE	150.0	0.000	-4,500	6.05	0.005	Open
P-53	137	J-25	J-26	17.4	HDPE	150.0	0.000	-4,500	6.05	0.005	Open
P-54	87	J-26	J-27	17.4	HDPE	150.0	0.000	-4,500	6.05	0.005	Open
P-55	596	J-27	AV-19	17.4	HDPE	150.0	0.000	-4,500	6.05	0.005	Open
P-56	928	AV-19	J-28	17.4	HDPE	150.0	0.000	-4,500	6.05	0.005	Open
P-57	2,029	J-28	J-29	17.4	HDPE	150.0	0.000	-4,500	6.05	0.005	Open
P-58	2,018	J-29	AV-20	17.4	HDPE	150.0	0.000	-4,500	6.05	0.005	Open
P-59	1,723	AV-20	J-30	17.4	HDPE	150.0	0.000	-4,500	6.05	0.005	Open
P-60	784	J-30	J-31	17.4	HDPE	150.0	0.000	-4,500	6.05	0.005	Open
P-61	795	J-31	J-32	17.4	HDPE	150.0	0.000	-4,500	6.05	0.005	Open
P-62	2,187	J-32	AV-27	17.4	HDPE	150.0	0.000	-4,500	6.05	0.005	Open
P-63	547	AV-27	J-33	17.4	HDPE	150.0	0.000	-4,500	6.05	0.005	Open
P-64	346	J-33	J-34	17.4	HDPE	150.0	0.000	-4,500	6.05	0.005	Open
P-65	2,406	J-34	AV-21	17.4	HDPE	150.0	0.000	-4,500	6.05	0.005	Open
P-66	3,896	AV-21	J-35	17.4	HDPE	150.0	0.000	-4,500	6.05	0.005	Open
P-67	799	J-35	AV-22	17.4	HDPE	150.0	0.000	-4,500	6.05	0.005	Open
P-68	797	AV-22	J-36	17.4	HDPE	150.0	0.000	-4,500	6.05	0.005	Open
P-69	2,089	J-36	AV-23	17.4	HDPE	150.0	0.000	-4,500	6.05	0.005	Open
P-70	796	AV-23	J-37	17.4	HDPE	150.0	0.000	-4,500	6.05	0.005	Open
P-71	903	J-37	AV-24	17.4	HDPE	150.0	0.000	-4,500	6.05	0.005	Open

FlexTable: Pipe Table

Current Time: 0.000 hours

Label	Length (ft)	Start Node	Stop Node	Internal Diameter (in)	Material	Hazen-Williams C	Minor Loss Coefficient (Local)	Flow (gpm)	Velocity (ft/s)	Headloss Gradient (ft/ft)	Status (Initial)
P-72	1,138	AV-24	J-38	17.4	HDPE	150.0	0.000	-4,500	6.05	0.005	Open
P-73	1,185	J-38	AV-25	17.4	HDPE	150.0	0.000	-4,500	6.05	0.005	Open
P-74	1,259	AV-25	J-39	17.4	HDPE	150.0	0.000	-4,500	6.05	0.005	Open
P-75	339	J-39	J-40	17.4	HDPE	150.0	0.000	-4,500	6.05	0.005	Open
P-76	541	J-40	J-41	17.4	HDPE	150.0	0.000	-4,500	6.05	0.005	Open
P-77	194	J-41	J-42	17.4	HDPE	150.0	0.000	-4,500	6.05	0.005	Open
P-80	335	J-43	J-42	17.4	HDPE	150.0	0.000	4,500	6.05	0.005	Open
P-82	2,041	J-44	J-43	17.4	HDPE	150.0	0.000	4,500	6.05	0.005	Open
P-84	1,422	J-45	J-44	17.4	HDPE	150.0	0.000	4,500	6.05	0.005	Open
P-86	633	AV-26	J-45	17.4	HDPE	150.0	0.000	4,500	6.05	0.005	Open
P-88	1,258	J-46	AV-26	17.4	HDPE	150.0	0.000	4,500	6.05	0.005	Open
P-89	5,239	R-1	J-47	17.4	HDPE	150.0	0.000	4,500	6.05	0.005	Open
P-90	3,245	J-47	J-46	17.4	HDPE	150.0	0.000	4,500	6.05	0.005	Open
P-91	2,473	AV-8	AV-7	17.4	HDPE	150.0	0.000	-4,500	6.05	0.005	Open
P-92	2,174	AV-7	AV-9	17.4	HDPE	150.0	0.000	-4,500	6.05	0.005	Open
P-93	2,858	AV-5	AV-6	17.4	HDPE	150.0	0.000	-4,500	6.05	0.005	Open
P-94	2,586	AV-6	AV-8	17.4	HDPE	150.0	0.000	-4,500	6.05	0.005	Open
P-104	103	J-88	FCV-6	17.4	HDPE	150.0	0.000	-4,500	6.05	0.005	Open
P-105	781	FCV-6	J-1	17.4	HDPE	150.0	0.000	-4,500	6.05	0.005	Open

FlexTable: Junction Table

Current Time: 0.000 hours

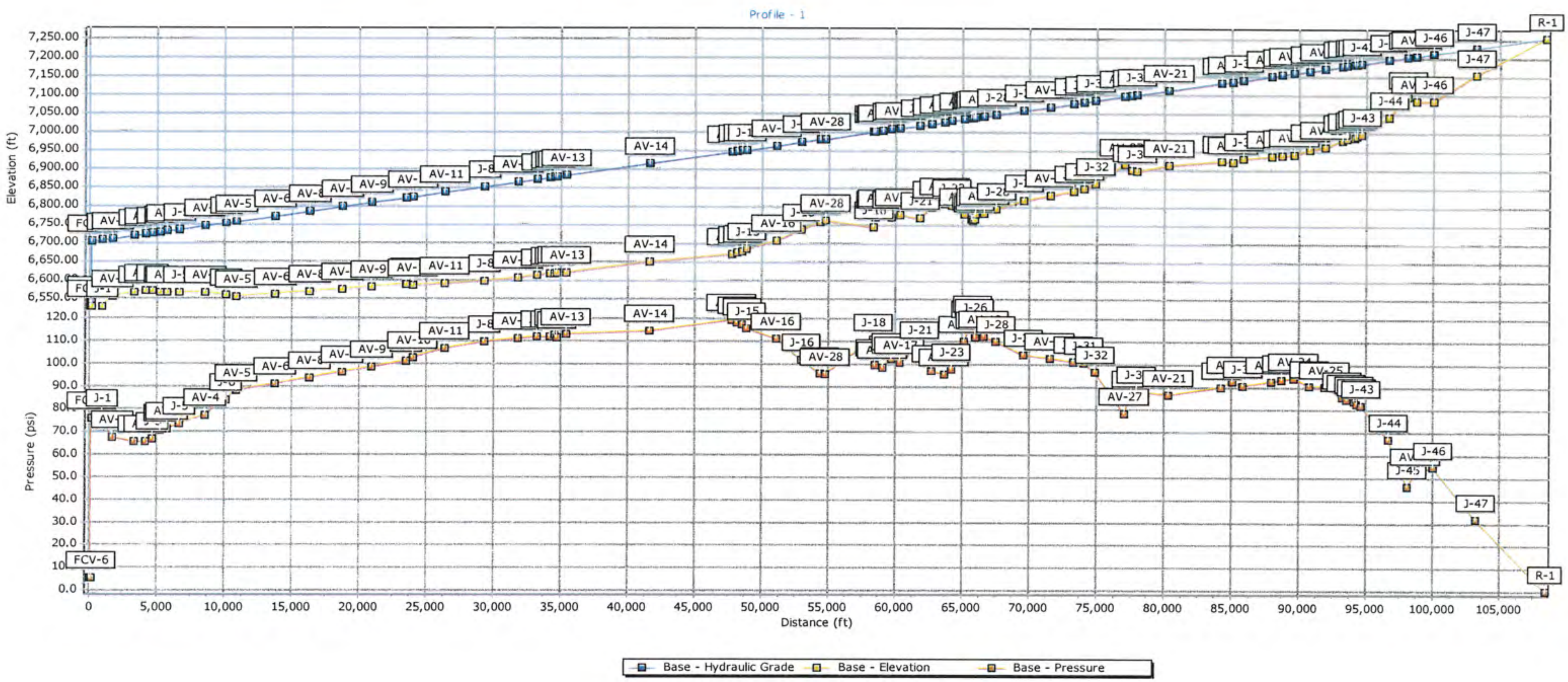
ID	Label	Elevation (ft)	Hydraulic Grade (ft)	Pressure (psi)
29	J-1	6,527.99	6,705.92	77.0
31	J-2	6,565.86	6,717.97	65.8
194	J-3	6,570.77	6,724.88	66.7
34	J-4	6,565.31	6,727.86	70.3
36	J-5	6,565.54	6,735.01	73.3
38	J-6	6,558.76	6,752.86	84.0
197	J-7	6,587.80	6,821.21	101.0
45	J-8	6,597.18	6,850.94	109.8
47	J-9	6,612.55	6,870.97	111.8
48	J-10	6,617.50	6,875.82	111.8
49	J-11	6,617.44	6,877.34	112.4
50	J-12	6,620.60	6,878.37	111.5
54	J-13	6,673.82	6,947.01	118.2
55	J-14	6,677.56	6,949.04	117.5
56	J-15	6,683.81	6,950.84	115.5
58	J-16	6,736.74	6,971.76	101.7
59	J-17	6,757.00	6,978.74	95.9
61	J-18	6,743.39	6,999.08	110.6
62	J-19	6,769.80	6,999.88	99.5
64	J-20	6,770.09	7,006.02	102.1
66	J-21	6,768.57	7,016.89	107.4
67	J-22	6,797.55	7,021.47	96.9
69	J-23	6,802.77	7,028.90	97.8
71	J-24	6,766.64	7,036.42	116.7
72	J-25	6,761.85	7,037.04	119.1
73	J-26	6,766.09	7,037.73	117.5
74	J-27	6,779.81	7,038.18	111.8
76	J-28	6,792.11	7,045.96	109.8
77	J-29	6,815.47	7,056.32	104.2
79	J-30	6,841.88	7,075.42	101.0
80	J-31	6,846.82	7,079.42	100.6
81	J-32	6,860.52	7,083.48	96.5
83	J-33	6,898.15	7,097.44	86.2
84	J-34	6,895.73	7,099.20	88.0
86	J-35	6,923.45	7,131.38	90.0
88	J-36	6,930.06	7,139.52	90.6
90	J-37	6,938.35	7,154.25	93.4
92	J-38	6,954.88	7,164.67	90.8
94	J-39	6,978.57	7,177.16	85.9
95	J-40	6,983.55	7,178.89	84.5
96	J-41	6,987.41	7,181.65	84.0
97	J-42	6,991.10	7,182.64	82.9
198	J-43	6,995.00	7,184.35	81.9
201	J-44	7,040.00	7,194.78	67.0
204	J-45	7,095.00	7,202.04	46.3
210	J-46	7,085.00	7,211.69	54.8
213	J-47	7,155.00	7,228.25	31.7
262	J-88	6,526.94	6,538.64	5.1

FlexTable: FCV Table

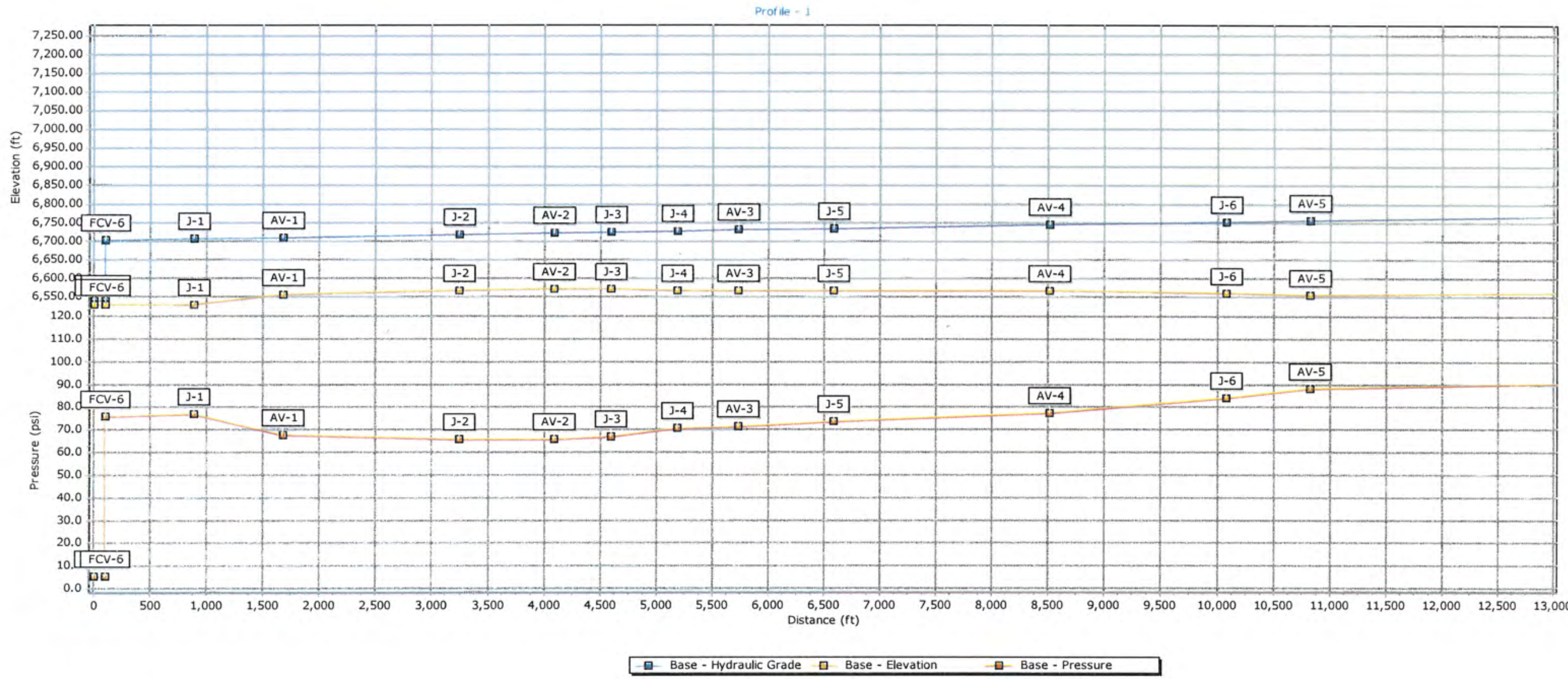
Current Time: 0.000 hours

ID	Label	Elevation (ft)	Diameter (Valve) (in)	Flow Setting (Initial) (gpm)
274	FCV-6	6,527.06	18.0	4,500

Minor Loss Coefficient (Local)	Flow (gpm)	Hydraulic Grade (From) (ft)	Hydraulic Grade (To) (ft)	Headloss (ft)
0.000	4,500	6,701.93	6,539.17	162.76



Profile - 1
Elevation (ft)
Pressure (psi)
Distance (ft)
Base - Hydraulic Grade
Base - Elevation
Base - Pressure



Profile - 1
Elevation (ft)
Pressure (psi)
Distance (ft)
FCV-6
J-1
AV-1
J-2
AV-2
J-3
J-4
AV-3
J-5
AV-4
J-6
AV-5
Base - Hydraulic Grade
Base - Elevation
Base - Pressure

APPENDIX C-2

Reuse Pipeline Route Survey and Construction Plans

Roca Honda Mine Dewatering Discharge Pipeline

June 2015, Wilson & Company

ROCA HONDA RESOURCES L.L.C.

CONSTRUCTION PLANS FOR

ROCA HONDA URANIUM MINE REUSE WATER PIPELINE IMPROVEMENTS

INDEX

NOTE:

PLAN AND PROFILE (P&P'S) DRAWINGS HAVE ONLY BEEN PROVIDED FOR CRITICAL LOCATIONS. SHEET NUMBERING HAS BEEN ORGANIZED TO ALLOW P&P'S FOR THE ENTIRE ALIGNMENT UPON REQUEST AT A LATER DATE.

Roca Honda Resources LLC.
4001 Office Court Drive Suite 102
Santa Fe, NM 87507

WILSON & COMPANY
4900 Lang Avenue Ne
Albuquerque, NM 87109
Phone: (505) 348-4000

SEAL

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PROJECT NAME

ENERGY FUELS
ROCA HONDA MINES
REUSE WATER PIPELINE
IMPROVEMENTS

REV.	DATE	DESCRIPTION	BY

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PROJECT NO:	1560001000
DESIGNED BY:	DDB
DRAWN BY:	STAFF
CHECKED BY:	DDB
DATE:	JUNE, 2015

SHEET TITLE

COVER SHEET

SHEET NO:

C-001

GENERAL NOTES

A1 PROJECT CONTROL PLAN AND SHEET LAYOUT

SCALE: 1"=3500'

0 1750' 3500'

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SHEET TITLE

OVERALL SHEET LAYOUT

SHEET NO:

C-101

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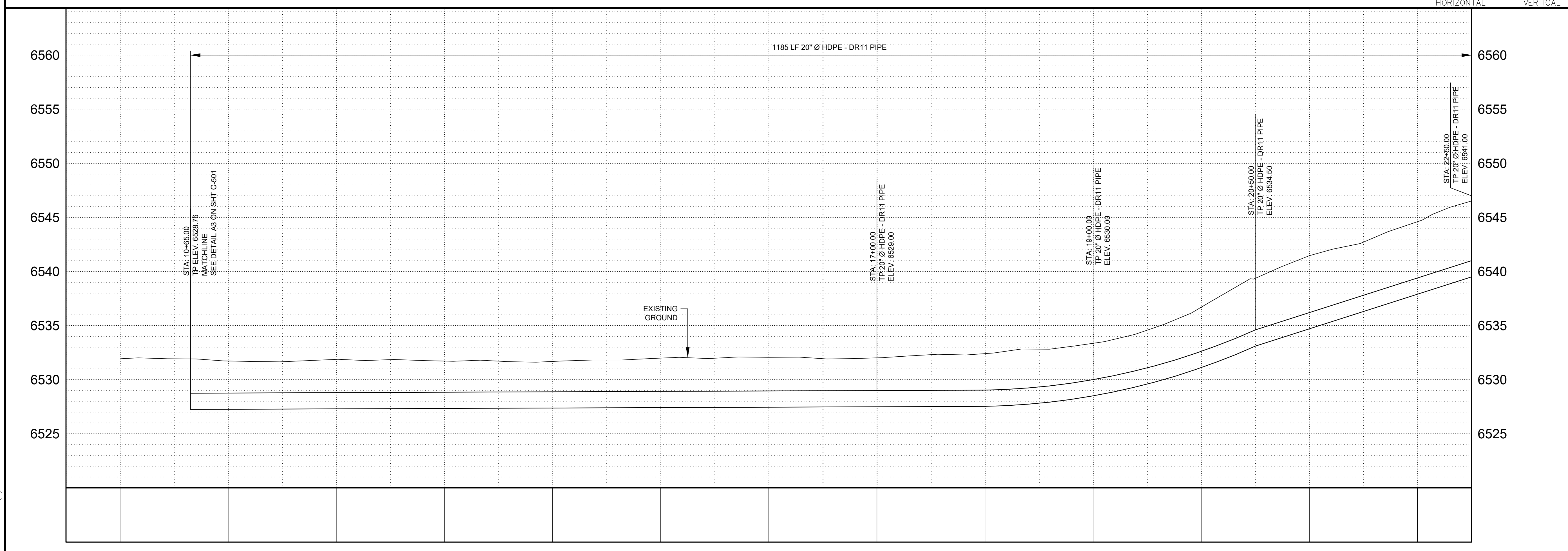
7/7/15



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CU-201

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2/16/12

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CU-202

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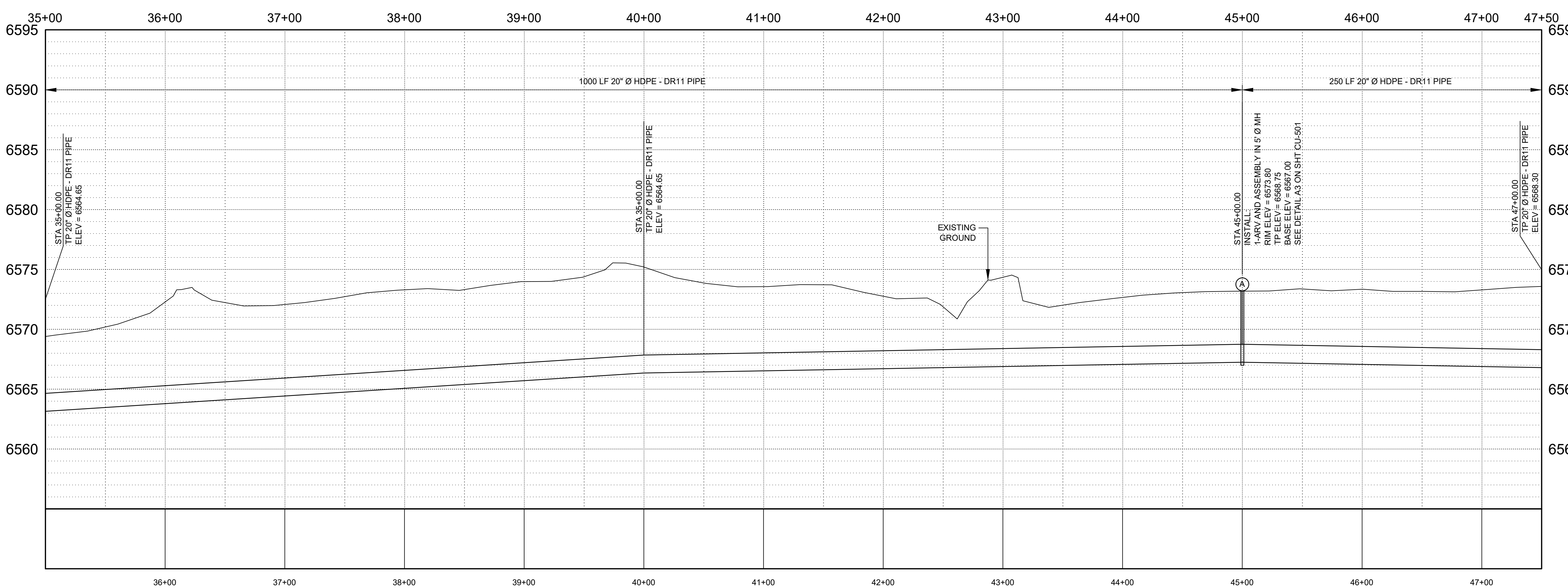

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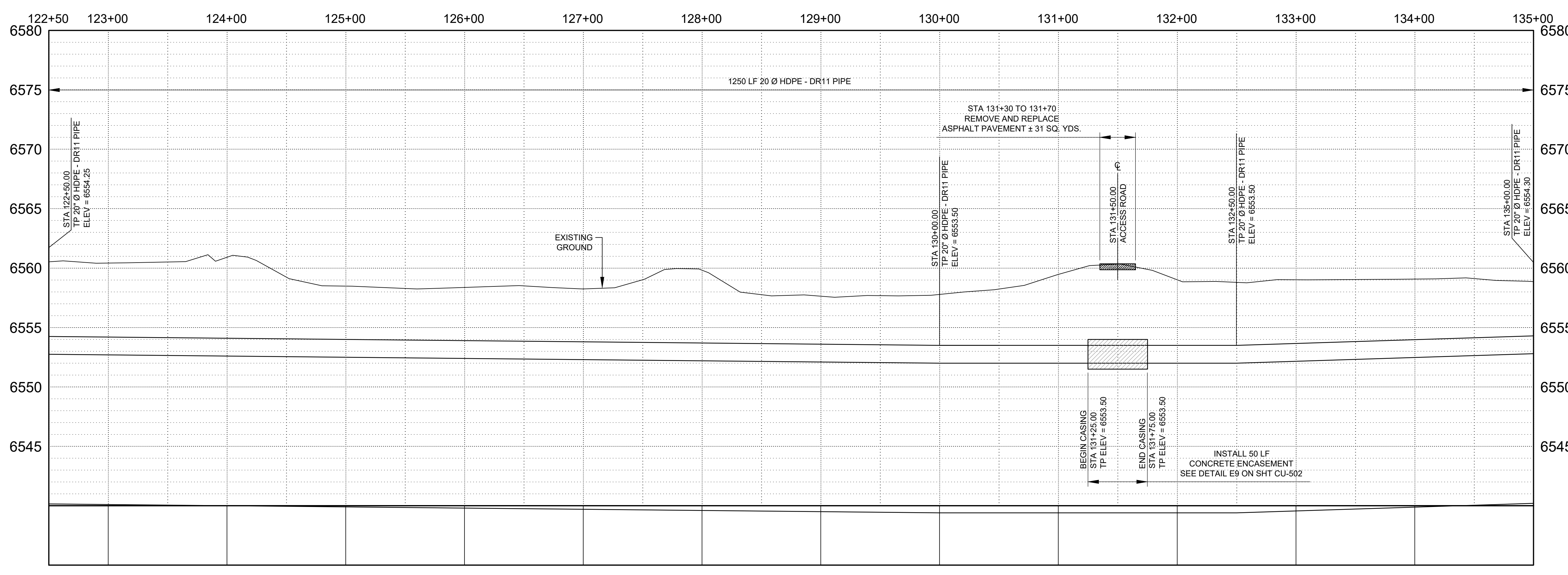
REUSE PLAN & PROFILE

SHEET NO:
CU-203



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CU-210

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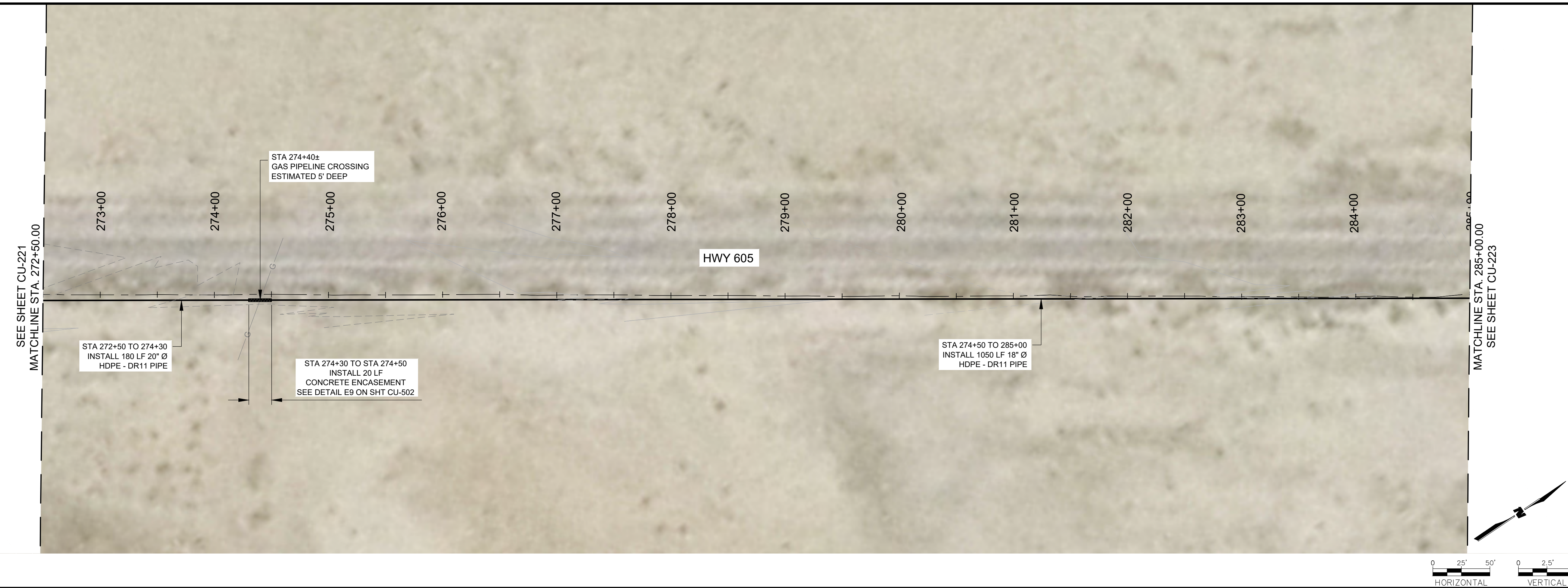

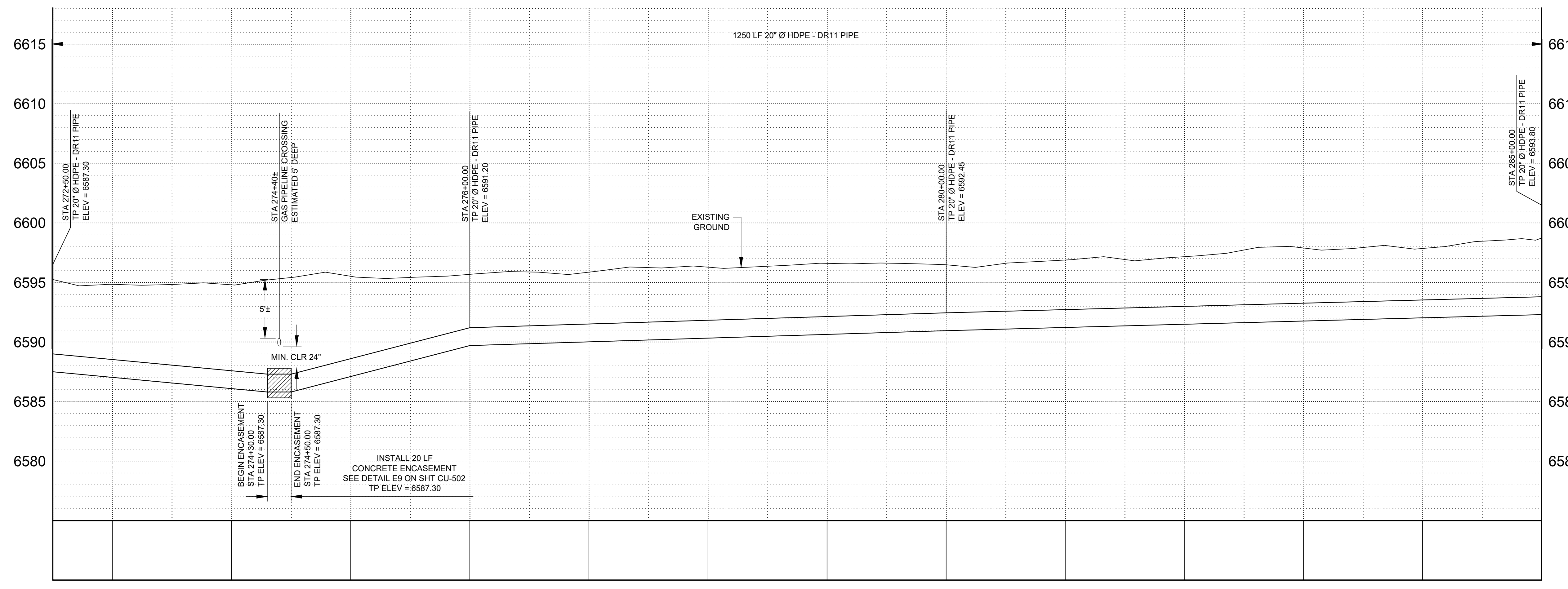

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REUSE PLAN & PROFILE

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CU-222

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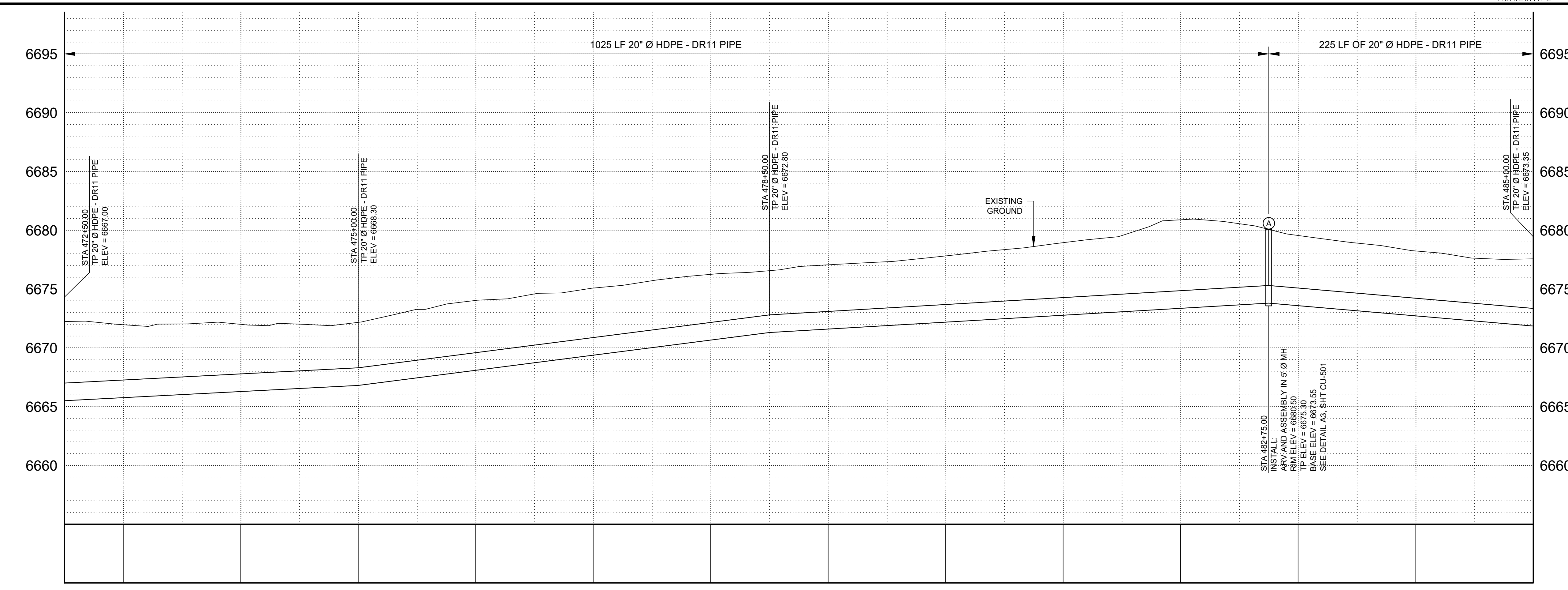

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REUSE WATER PIPELINE
IMPROVEMENTS

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SHEET TITLE

REUSE PLAN & PROFILE

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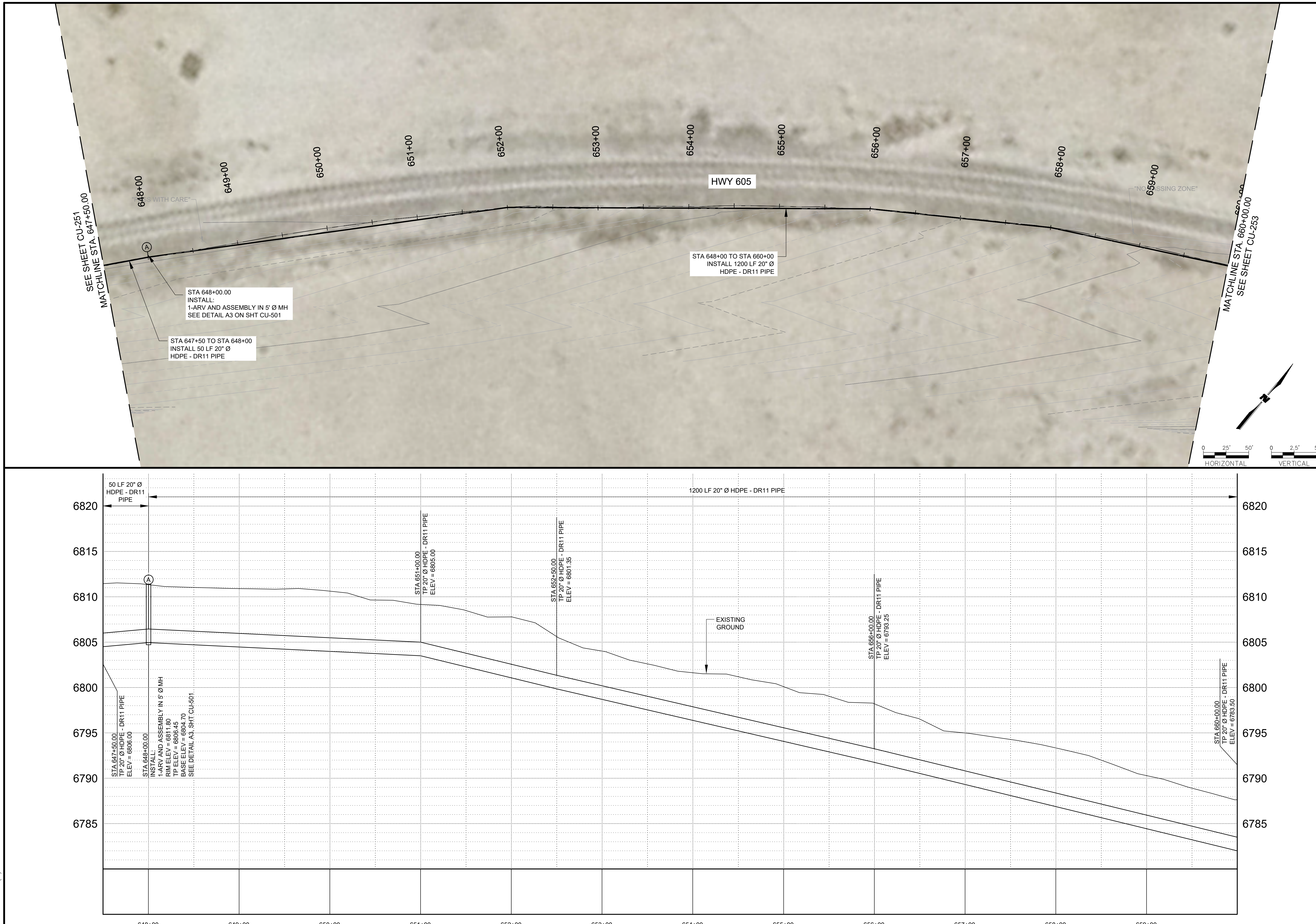
CU-238



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REUSE WATER PIPELINE
IMPROVEMENTS

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REUSE PLAN & PROFILE

SHEET NO:

CU-252

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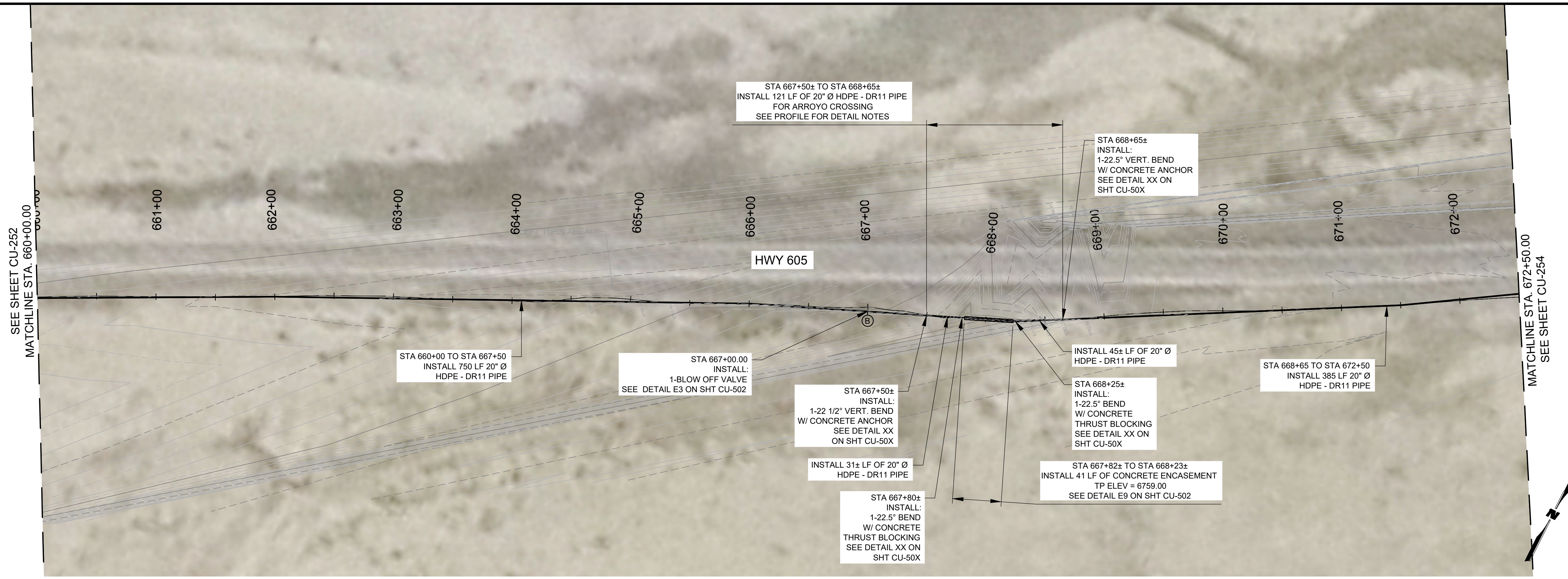

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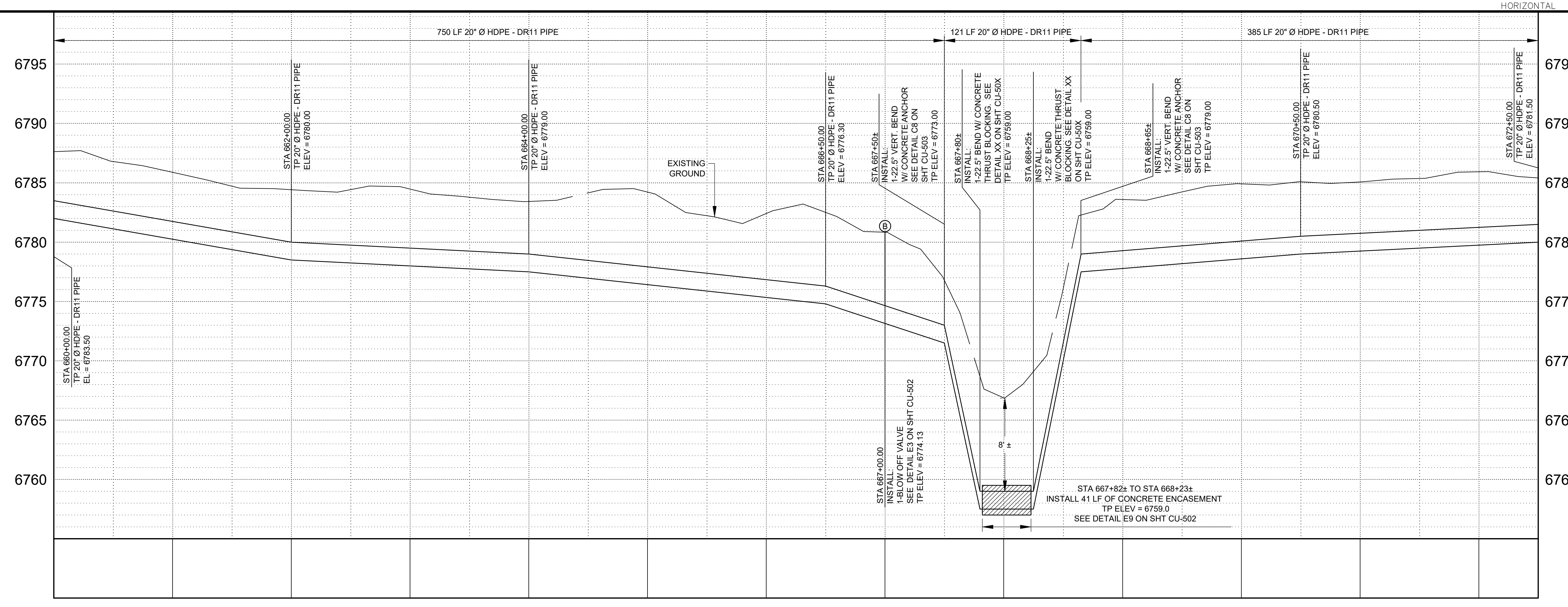

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Santa Fe, NM 87507

WILSON & COMPANY
4900 Lang Avenue Ne
Albuquerque, NM 87109
Phone: (505) 348-4000

SEAL
30% SUBMITTAL
NOT FOR
CONSTRUCTION

PROJECT NAME
ENERGY FUELS
ROCA HONDA MINES
REUSE WATER PIPELINE
IMPROVEMENTS

REV.	DATE	DESCRIPTION	BY

This Information is Confidential and Restricted from Public Disclosure Under 36 CFR 296.18

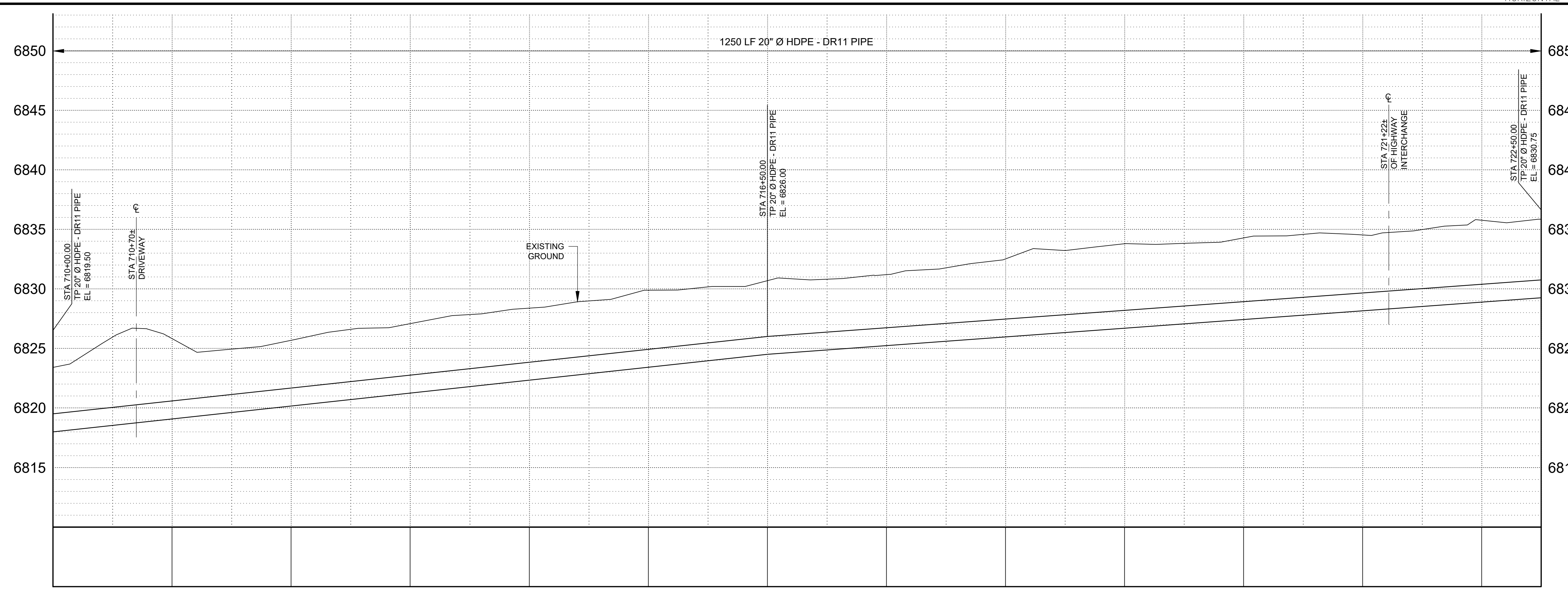
PROJECT NO:	1560001000
DESIGNED BY:	DDB
DRAWN BY:	STAFF
CHECKED BY:	DDB
DATE:	JUNE, 2015

SHEET TITLE
REUSE PLAN & PROFILE

SHEET NO:
CU-253

M:\MSD\15-600-010-00\2_DISCIPLINES_SHEETS\8_SHEETS - UTILITIES\02_CIVIL\P&P'S\REUSE PNP - (3).DWG
2/16/12

0 25' 50' HORIZONTAL
0 2.5' 5' VERTICAL



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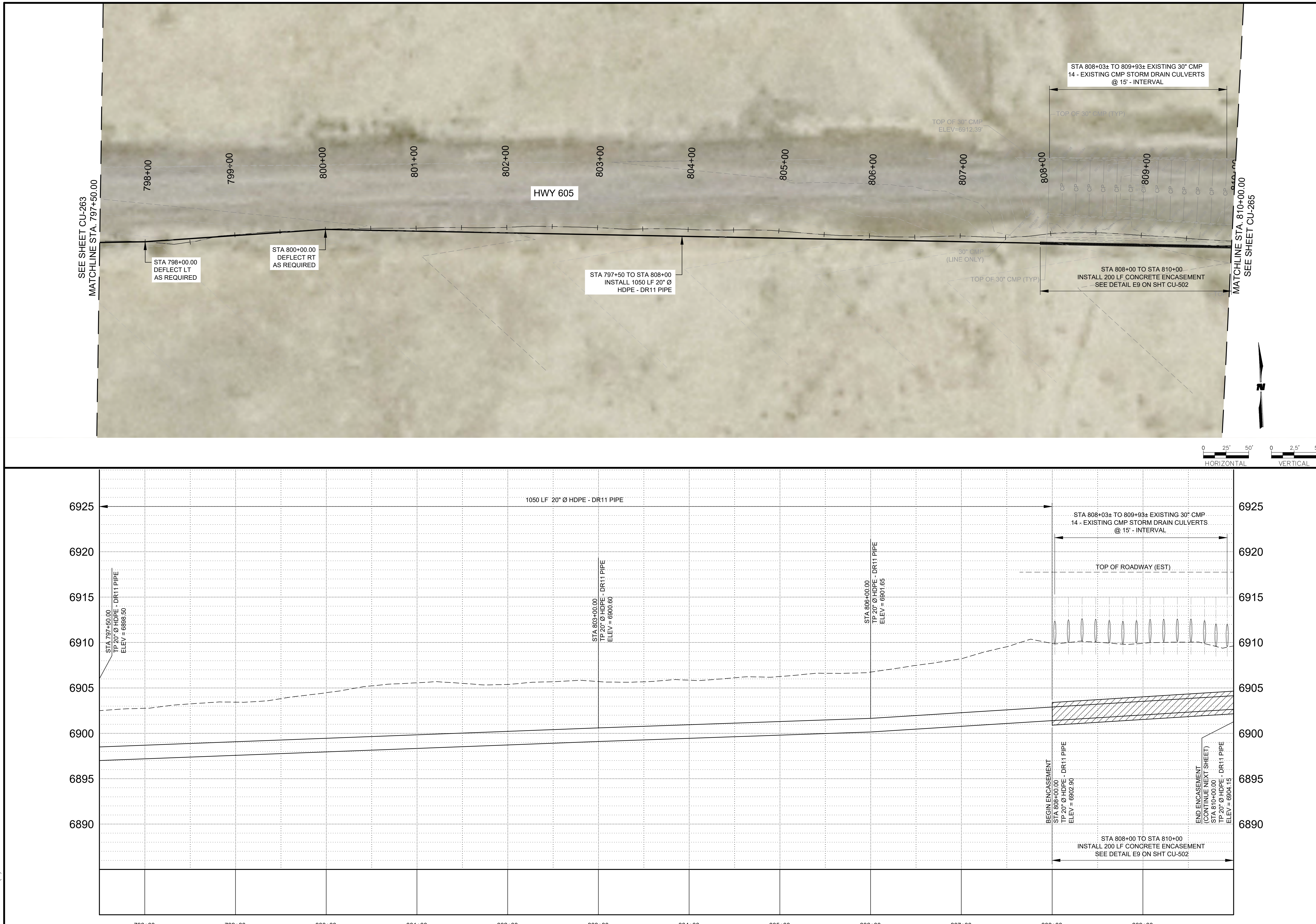
SHEET TITLE
REUSE PLAN & PROFILE

SHEET NO:
CU-257



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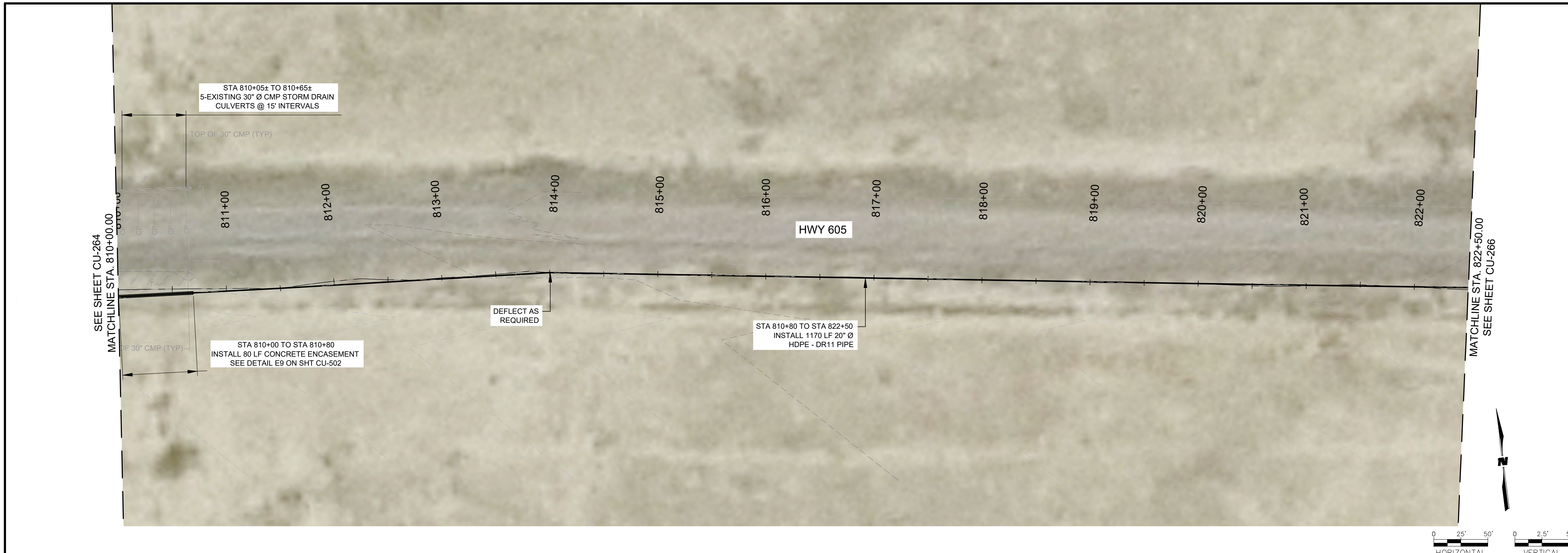
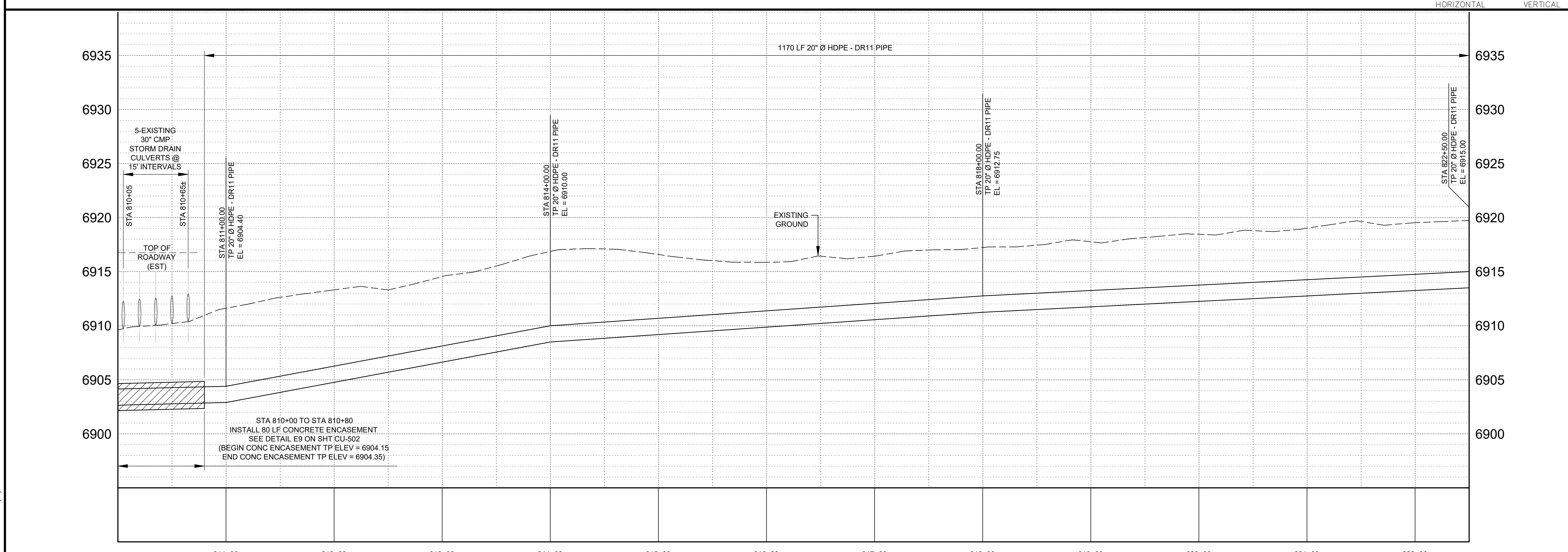
SHEET TITLE
REUSE PLAN & PROFILE

SHEET NO:
CU-264

M:\MSD\15-600-010-00\2_DISCIPLINES_SHEETS\8_SHEETS - UTILITIES\02_CIVIL\P&P'S\REUSE PNP - (4).DWG
2/16/12





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SHEET TITLE

REUSE PLAN & PROFILE

SHEET NO:

CU-265

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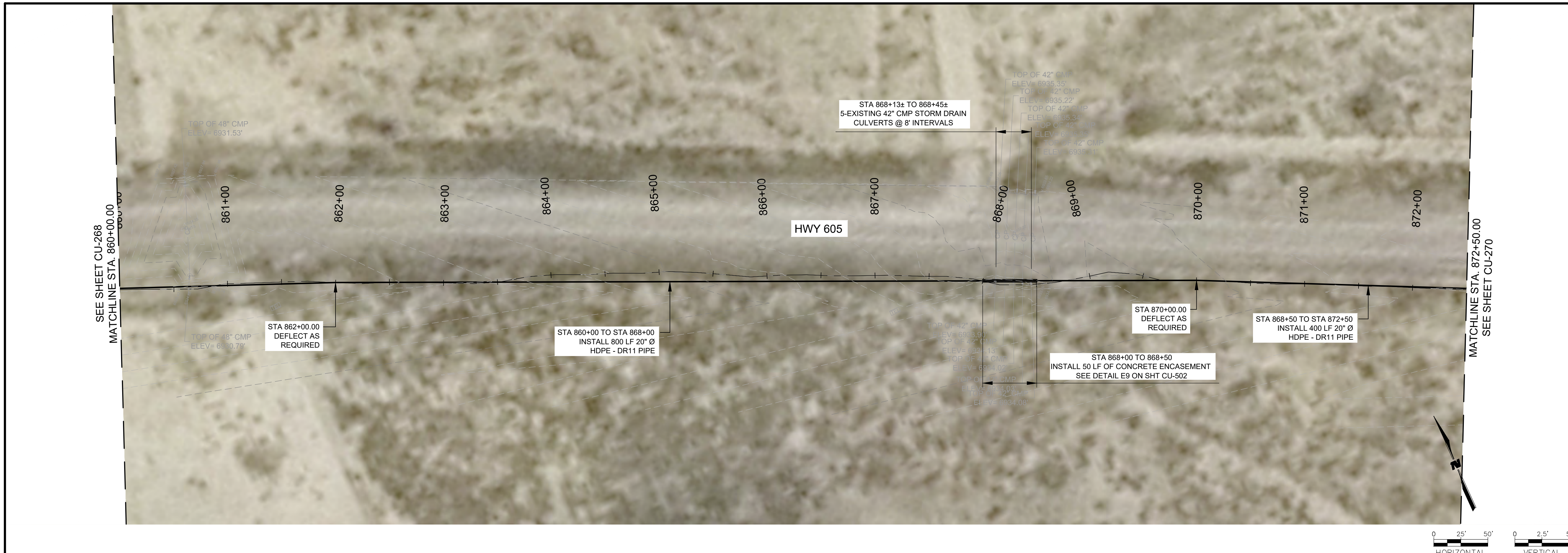
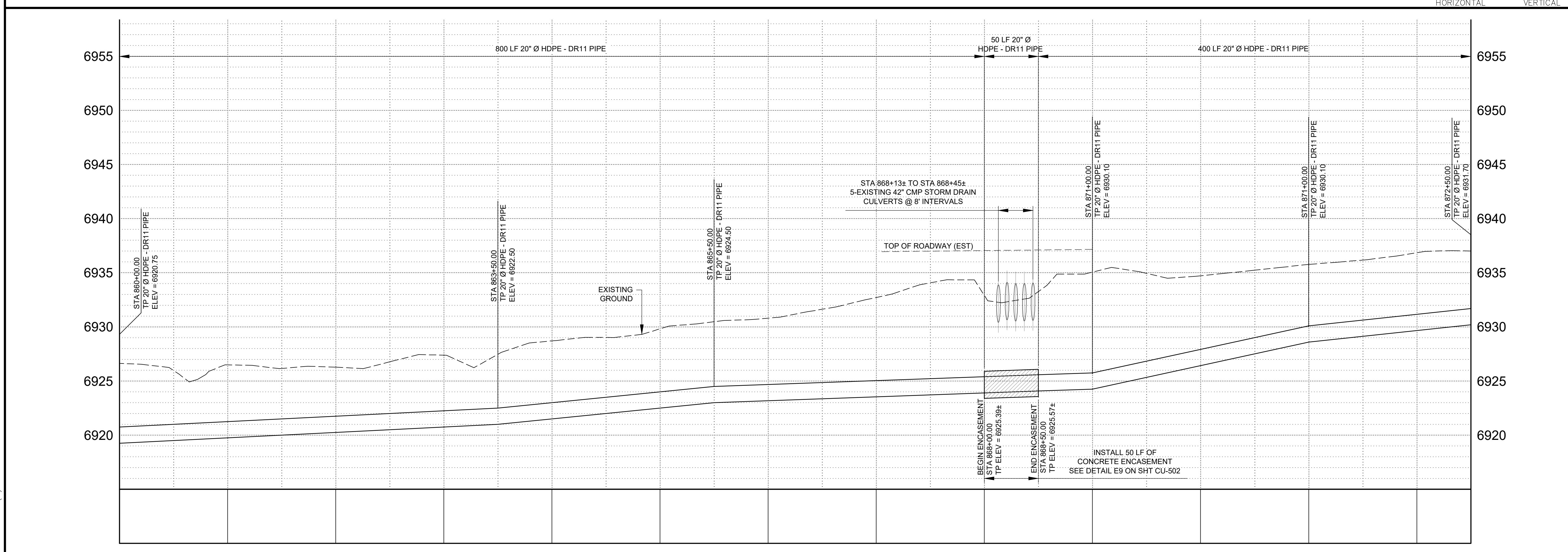
2/16/12





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SHEET TITLE

REUSE PLAN & PROFILE

SHEET NO:

CU-269

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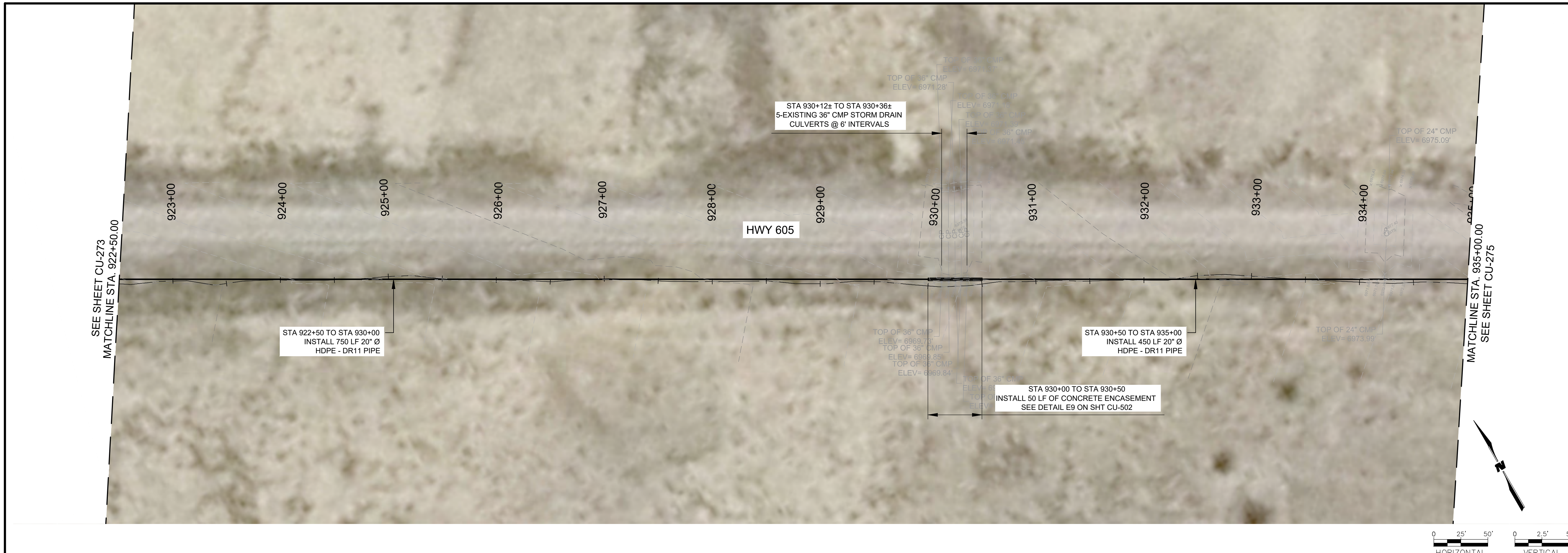
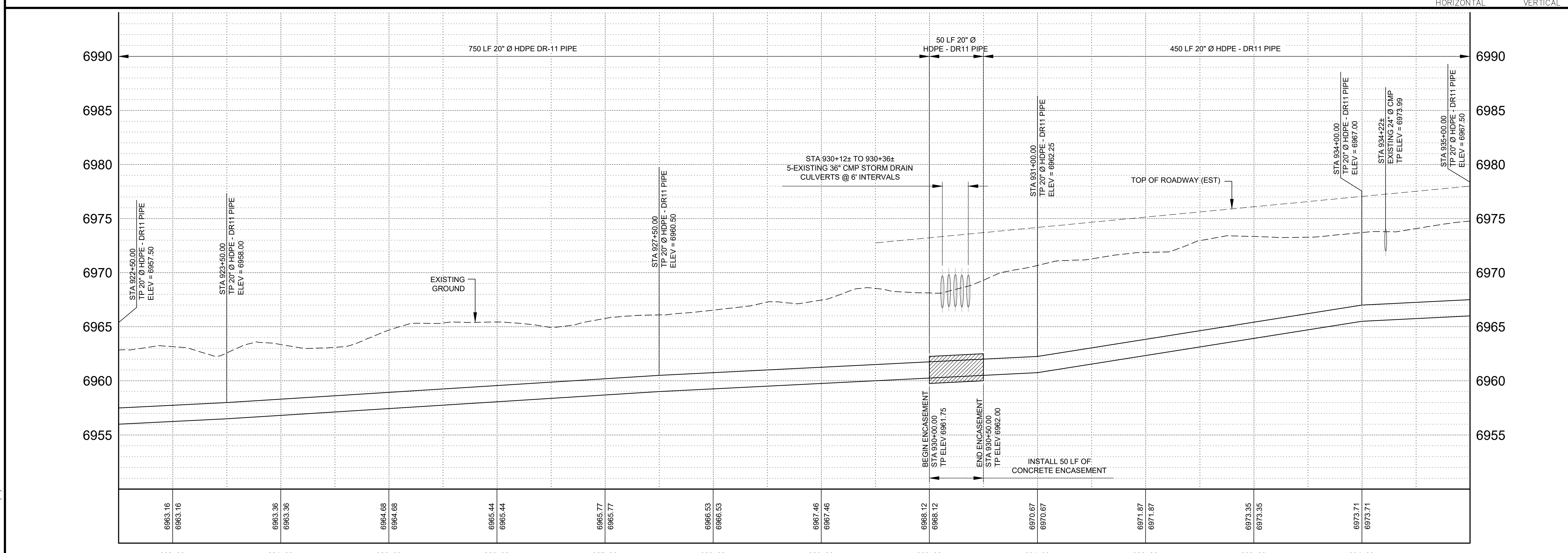
2/16/12





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2/16/12

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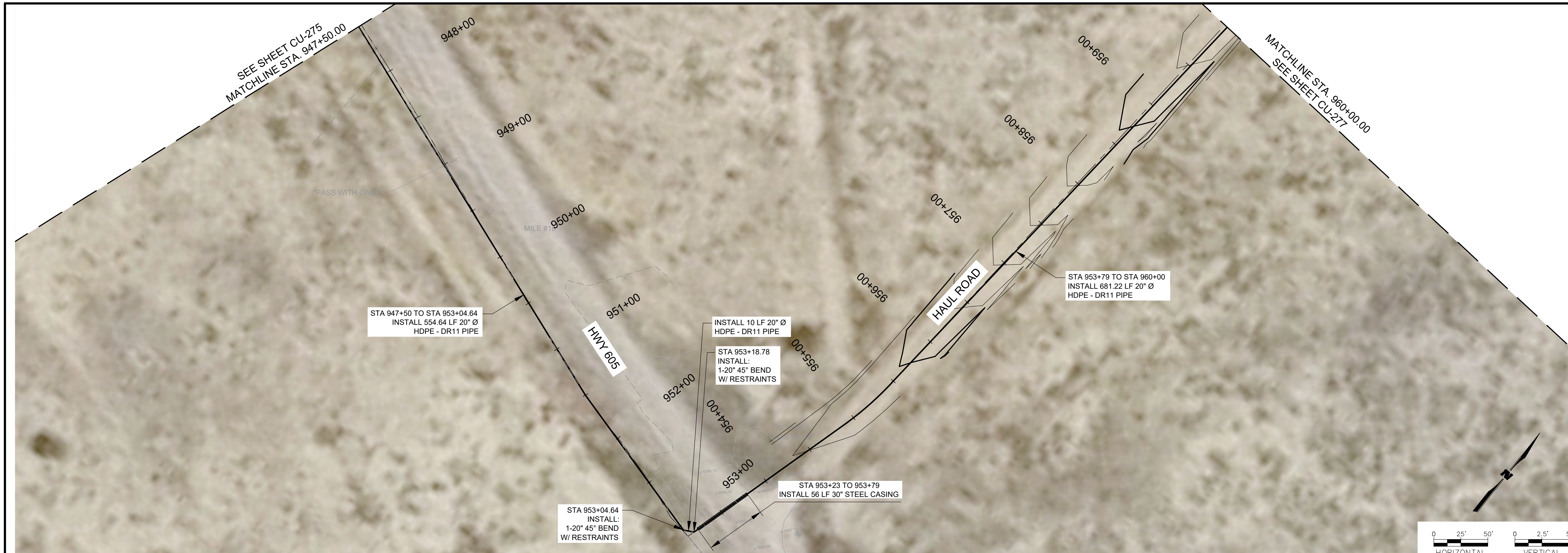
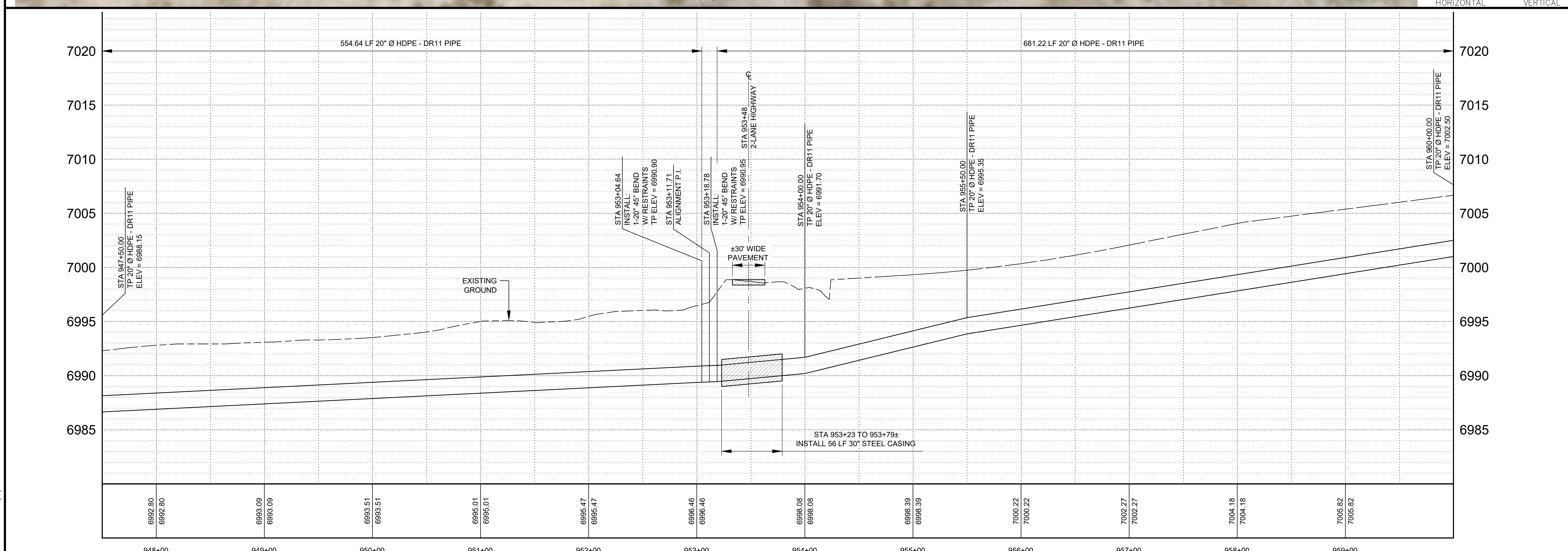
SHEET TITLE

REUSE PLAN & PROFILE

SHEET NO:

CU-274





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SHEET TITLE

REUSE PLAN & PROFILE

SHEET NO:

CU-276

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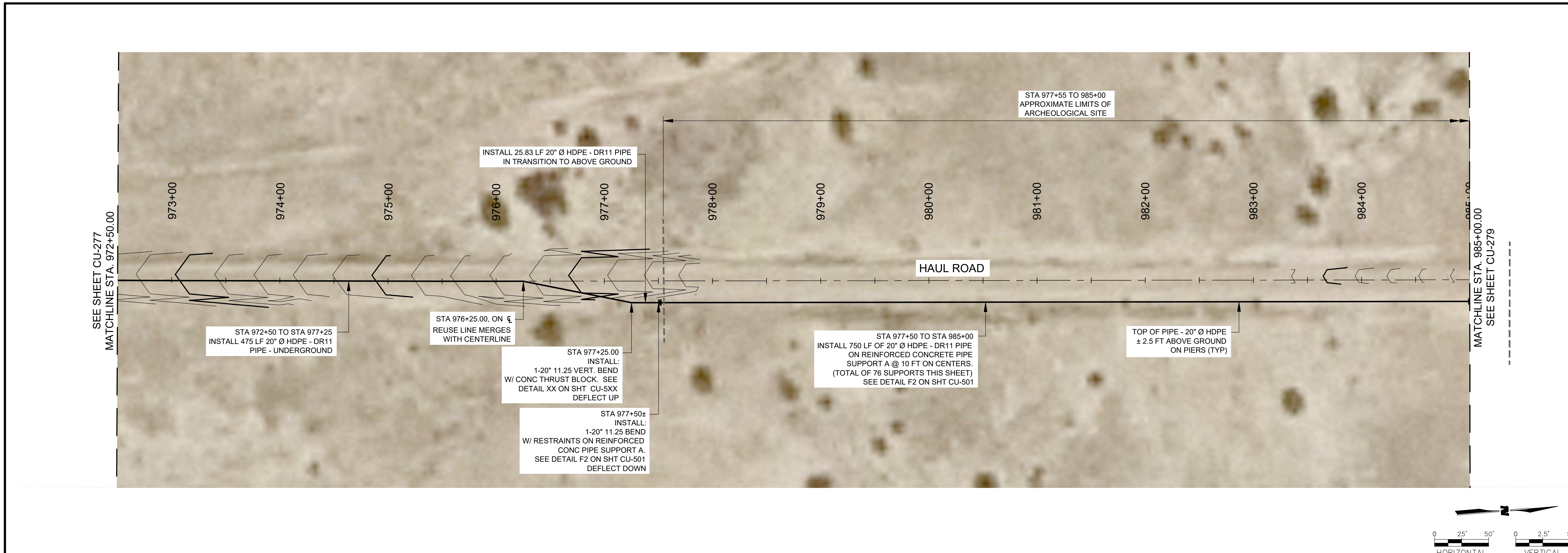
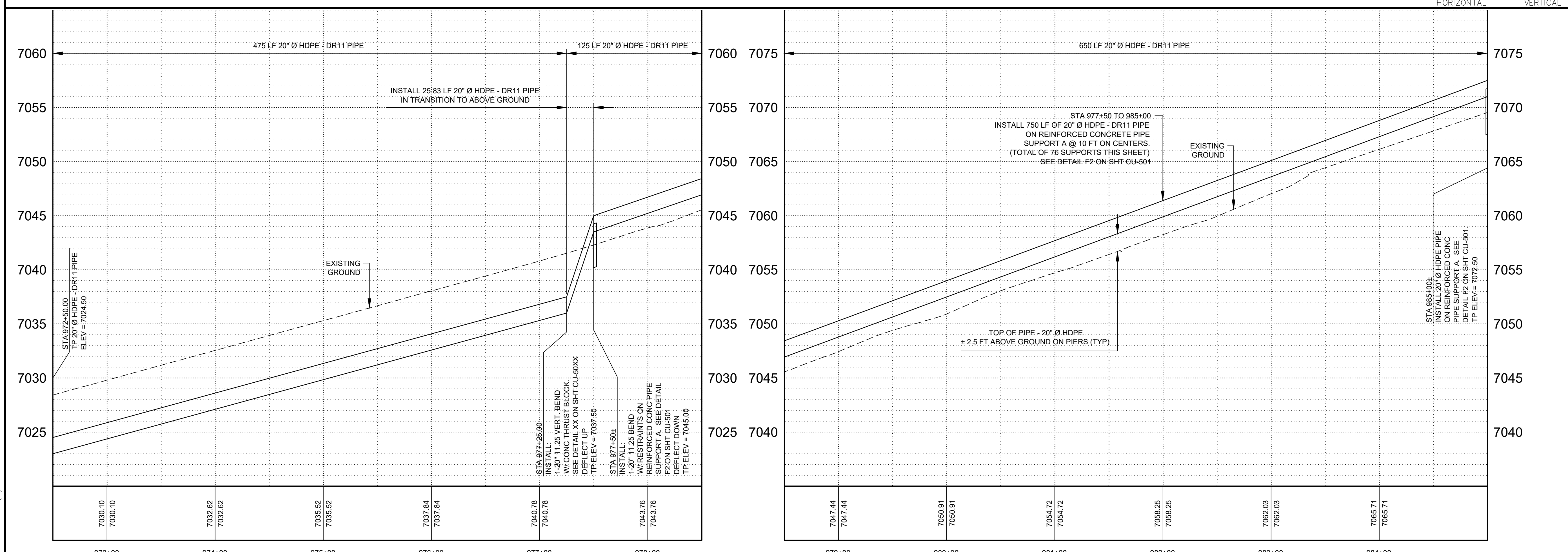
2/16/12





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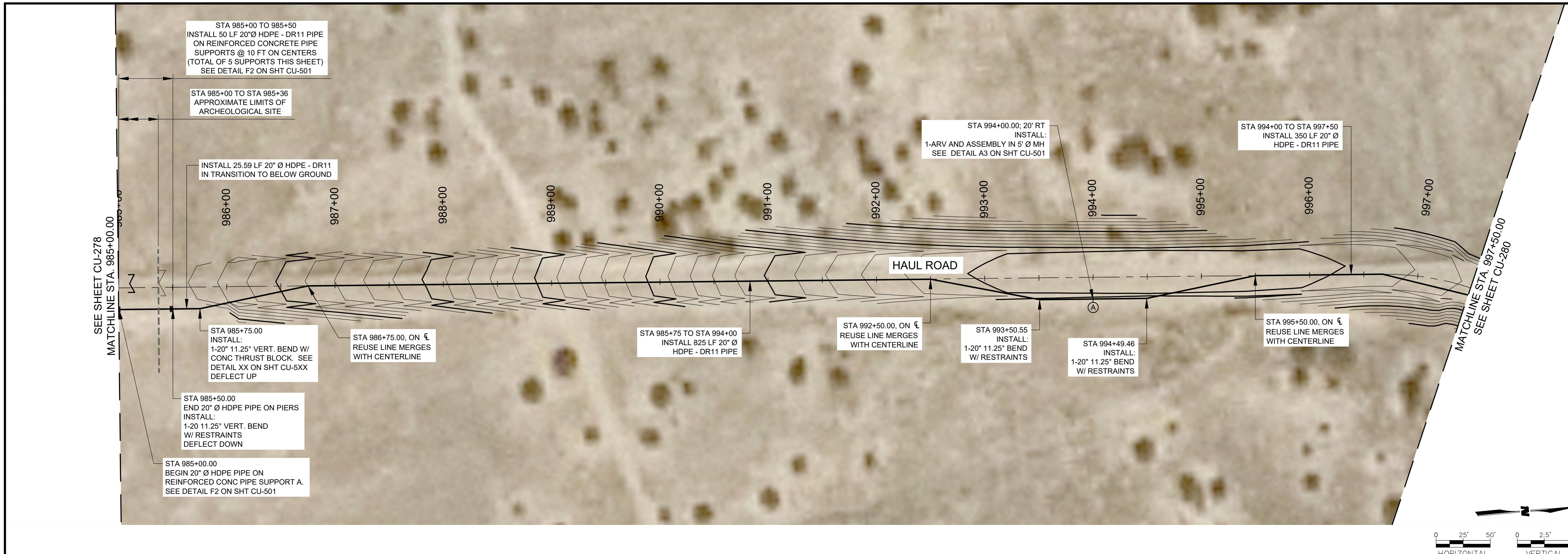
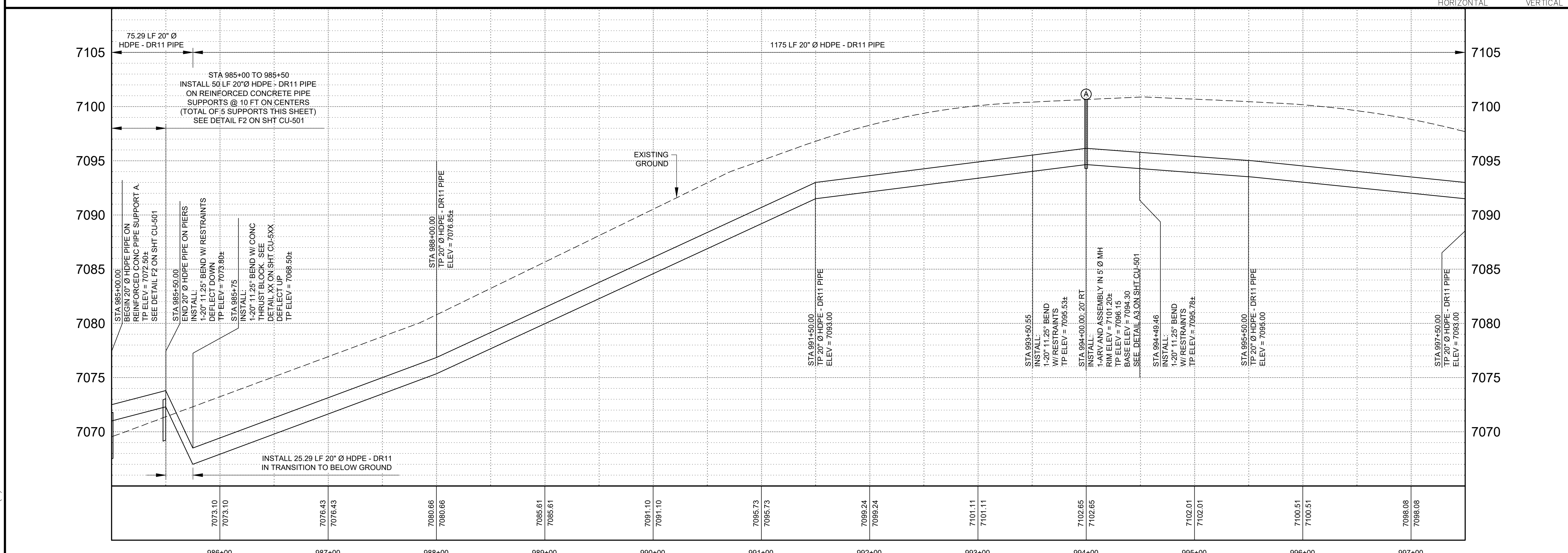
SHEET TITLE

REUSE PLAN & PROFILE

SHEET NO:

CU-278





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SHEET TITLE

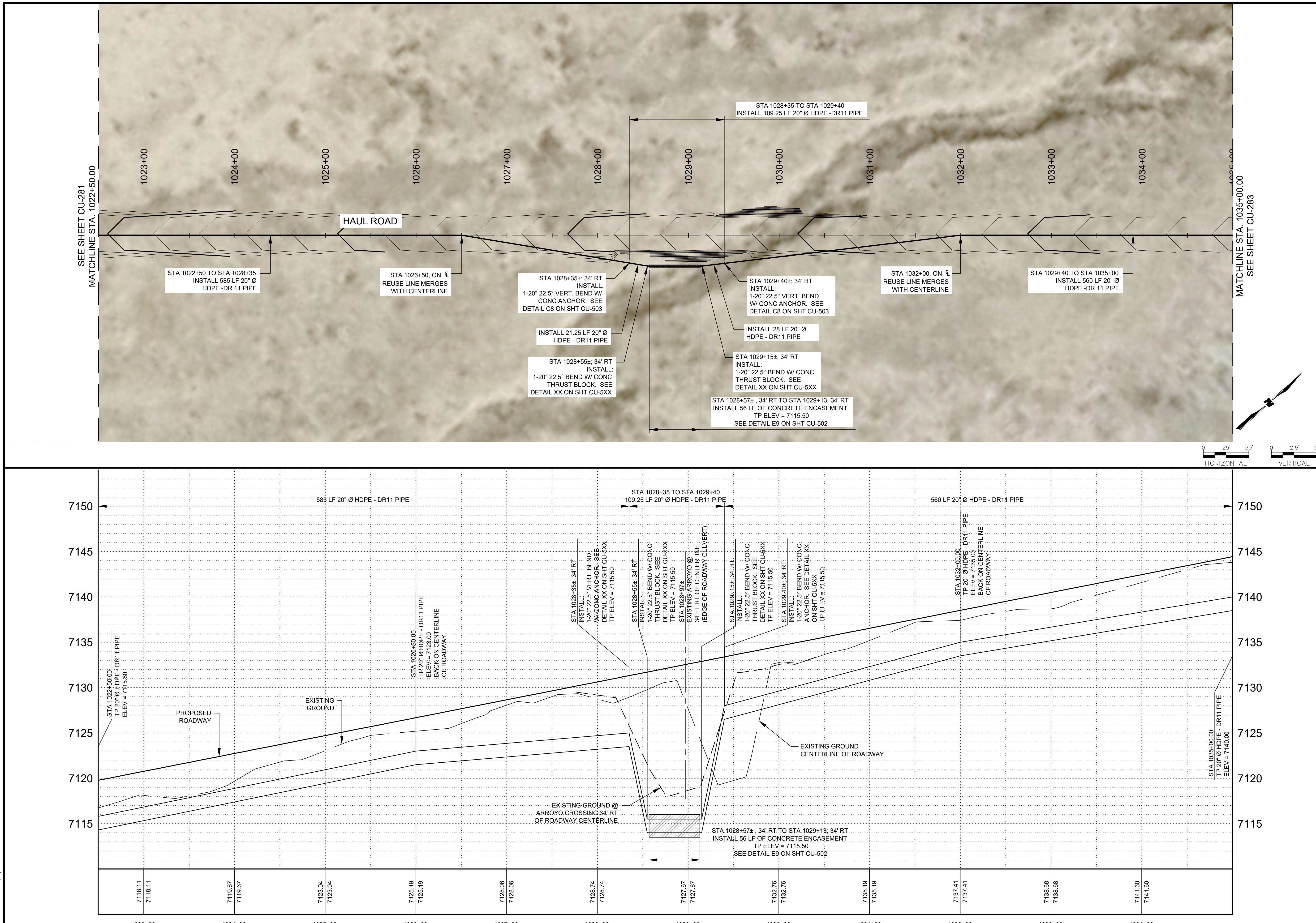
REUSE PLAN & PROFILE

SHEET NO:

CU-279

M:\MSD\15-600-010-00\2_DISCIPLINES_SHEETS\8_SHEETS – UTILITIES\02_CIVIL\P&P'S\REUSE PNP – (4).DWG

2/16/12



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2/16/12

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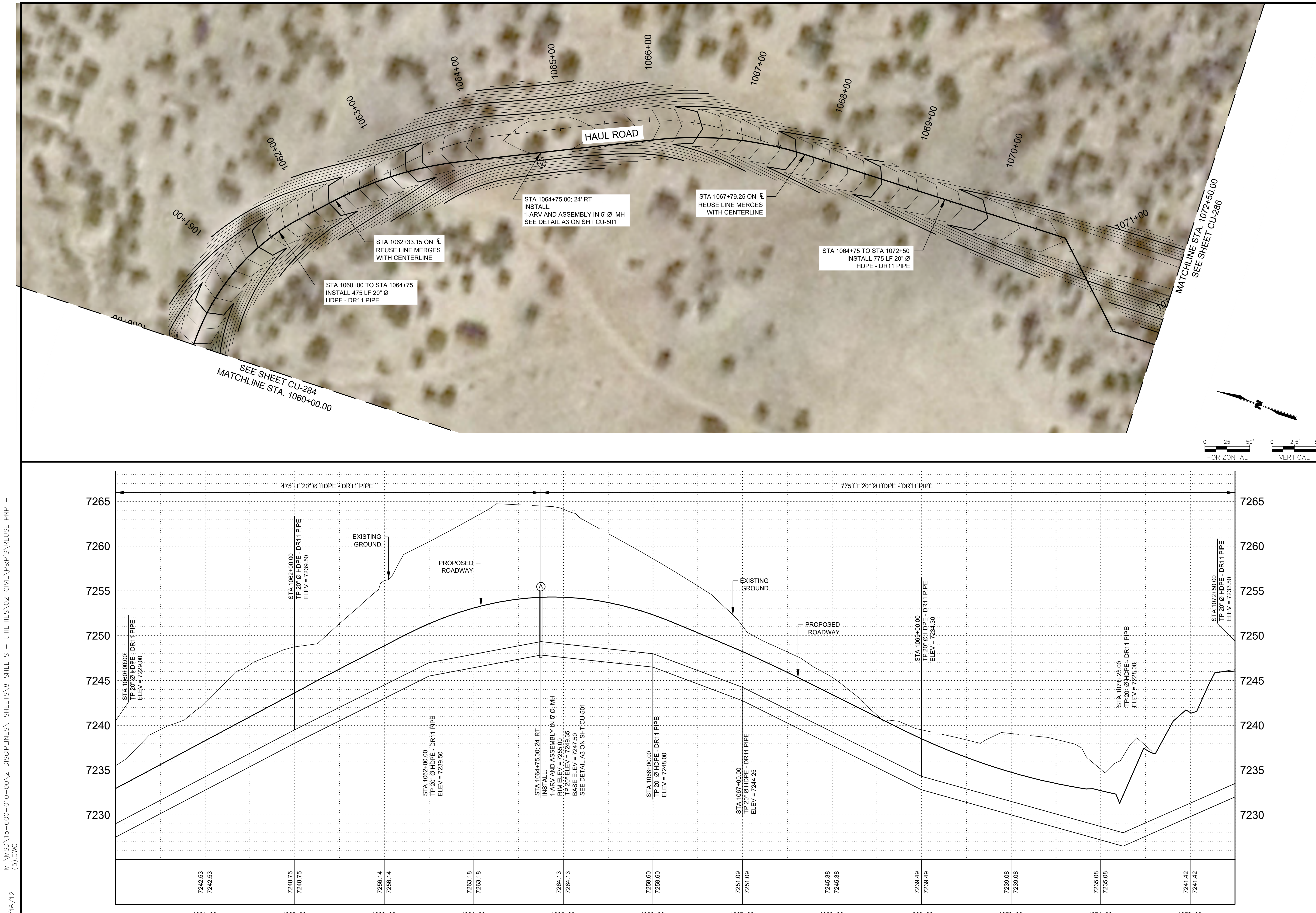
SHEET TITLE

REUSE PLAN & PROFILE

SHEET NO:

CU-282



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2/16/12

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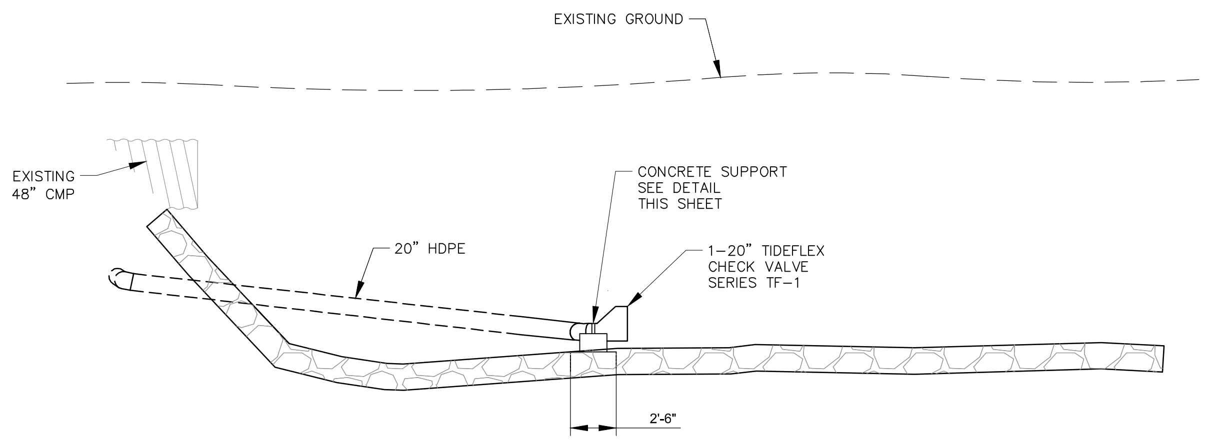
SHEET TITLE

REUSE PLAN & PROFILE

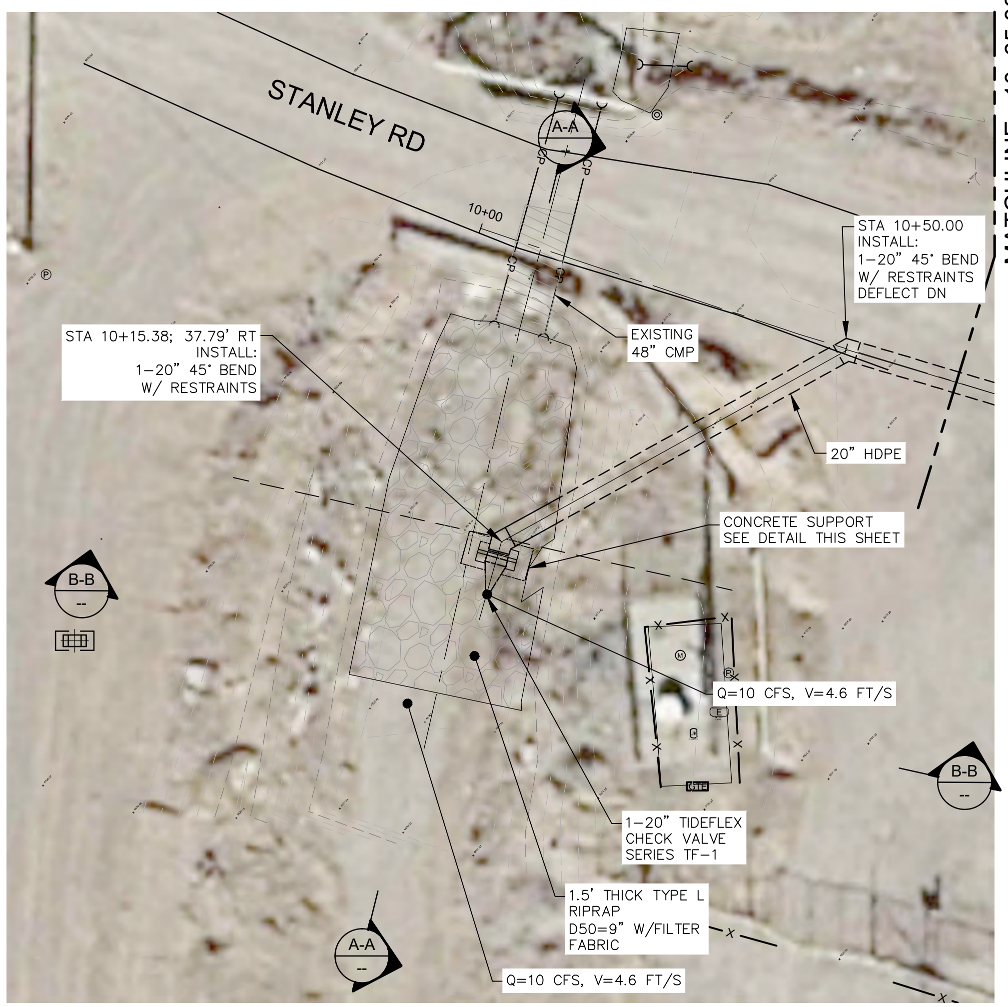
SHEET NO:

CU-285



A-A SECTION AT ARROYO

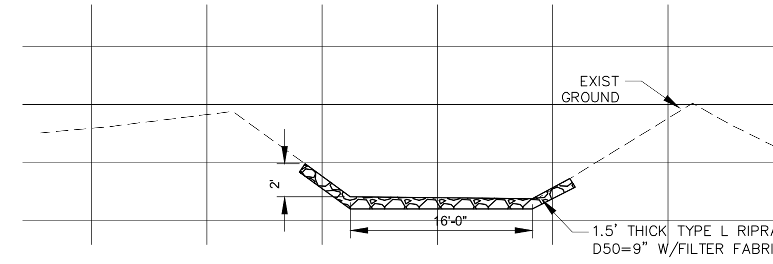
NOT TO SCALE



MATCHLINE - 10+65.00 SEE SHEET CU-201 FOR CONTINUATION

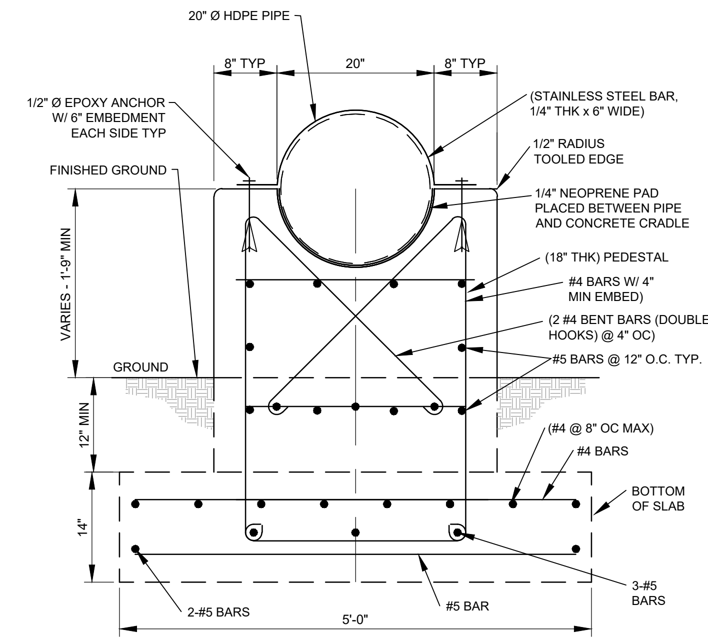
PLAN VIEW AT ARROYO

NOT TO SCALE



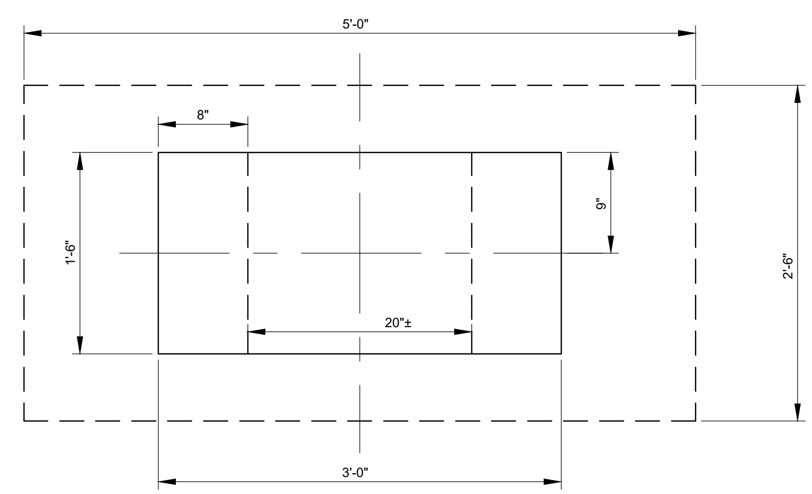
B-B SECTION AT ARROYO

NOT TO SCALE



SECTION C-C

CONCRETE f'c = 4000 psi
STEEL REINF. fy = 60 ksi



PLAN VIEW

CONCRETE PIPE SUPPORT AT ARROYO

GENERAL NOTES

1. DISTANCES BETWEEN SUPPORTS ARE DEPENDENT UPON TERRAIN.

NOTES:

1. ABOVE GROUND FLXFL CONNECTIONS SHALL HAVE RING FLANGE-TYTE GASKET.
2. RIP RAP STONE PAD SHALL BE CONSTRUCTED IN ACCORDANCE WITH SECTION 109 RIPRAP STONE AND SECTION 603 RIPRAP SURFACE TREATMENT OF THE NEW MEXICO STANDARD SPECIFICATIONS FOR PUBLIC WORKS CONSTRUCTION, 2006 EDITION, AS PUBLISHED BY THE NEW MEXICO CHAPTER OF APWA. ALL REQUIREMENTS OF SECTIONS 109 AND 603 SHALL APPLY EXCEPT:
   A). ONLY RIPRAP STONE MEETING THE SPECIFICATIONS OF THESE PLANS, OR AS APPROVED BY THE ENGINEER SHALL BE ACCEPTABLE;
   B). STONE PAD CONSTRUCTION SHALL MEET THE DETAILS AS DESCRIBED ON THESE PLAN DRAWINGS.

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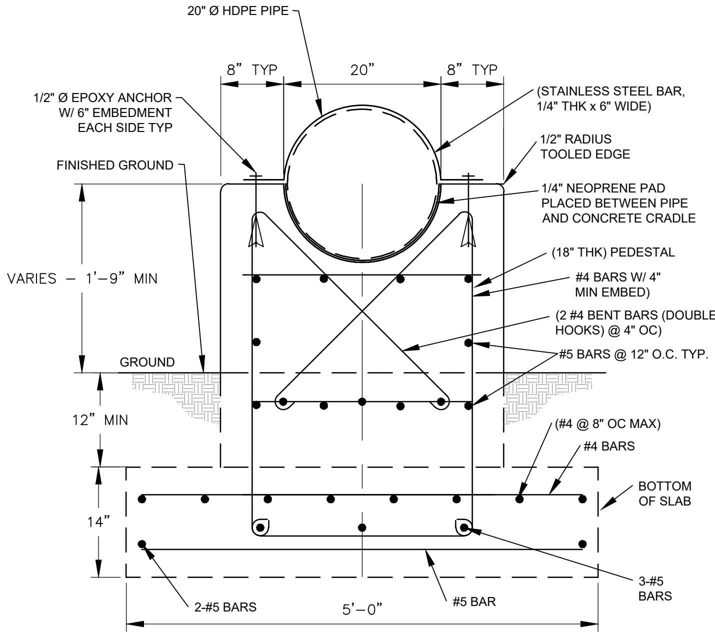
SHEET TITLE
ARROYO DISCHARGE AT STANLEY RD

SHEET NO:
C-501

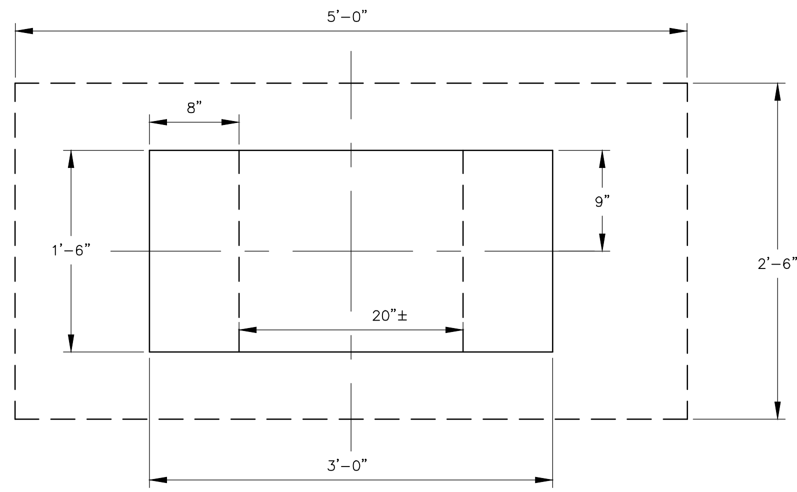
M:\MSD\15-600-010-00\2_DISCIPLINES_SHEETS\8_SHEETS - UTILITIES\03_TYP\1560100_C-501.DWG
7/1/15



CONCRETE PIPE SUPPORT A (FOR ABOVE-GROUND PIPE RUNS)

F2 — NOT TO SCALE

CONCRETE f'c = 4000 psi
STEEL REINF. fy = 60 ksi

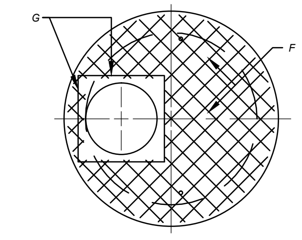


CONCRETE PIPE SUPPORT A

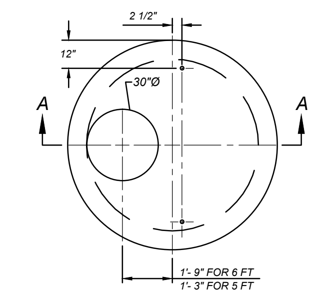
G5 — NOT TO SCALE

GENERAL NOTES

1. DISTANCES BETWEEN SUPPORTS ARE DEPENDENT UPON TERRAIN.

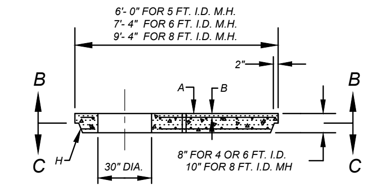


SECTION C-C BOTTOM MAT



5' OR 6' I.D. MH

PLAN



SECTION A-A

CONSTRUCTION NOTES:

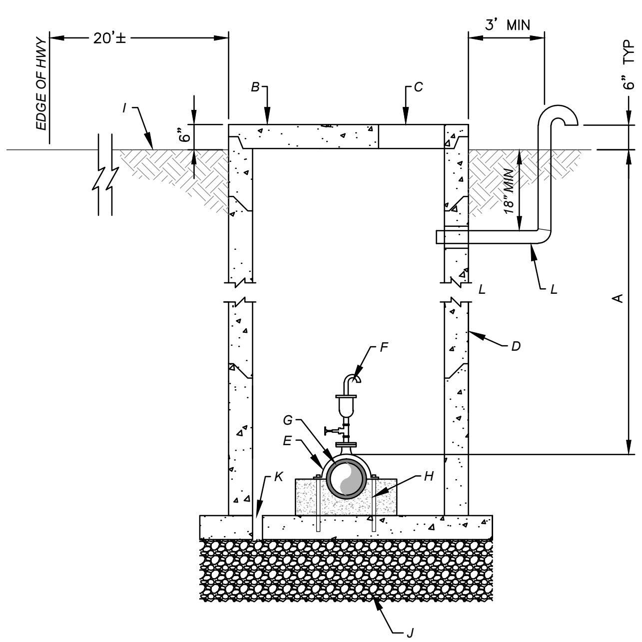
A. PRECAST REINF. CONC. MH COVER.
B. ALL BARS TO HAVE 1 1/2" MIN. COVER.
C. 2" PIPE SLEEVE VERTICALLY THROUGH COVER.
D. TOP MAT NO. 4 BARS AT 6" O.C. EA. WAY FOR 4, 6 & 8 FT. I.D. MH.
E. NO. 4 BARS.
F. BOTTOM MAT NO. 4 BARS 6 " O.C. EA. WAY FOR 4 & 6 FT. I.D. MH, NO.
G. 8 BARS 8" EA. WAY FOR 8 FT. I..D. MH.
H. NO. 4 BARS FOR 4 & 6 FT. I.D. MH. NO. 8 BARS FOR 8 FT. I.D. MH.
I. WHEN PRECAST M.H. SECTIONS ARE USED,COVER SHALL BE MODIFIED TO SHAPE OF APPROPRIATE SIZE T AND G JOINT.

CONSTRUCTION NOTES:

1. ALL MANHOLES 20' DEEP OR DEEPER WILL REQUIRE A INTERMEDIATE LANDING IN THE MANHOLE BARREL.

SEWER MANHOLE TOP

E8 — NOT TO SCALE



AIR RELEASE VALVE - WATER

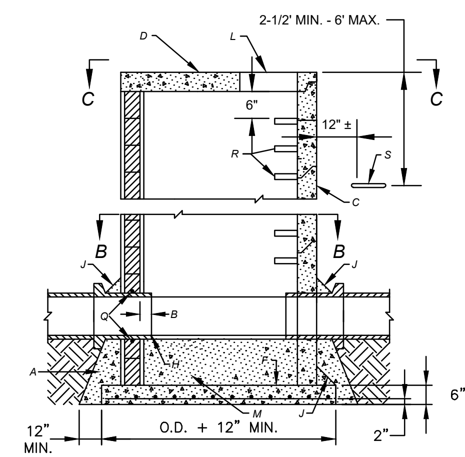
A3 — NOT TO SCALE — (IN 5' DIA MH)

GENERAL NOTES:

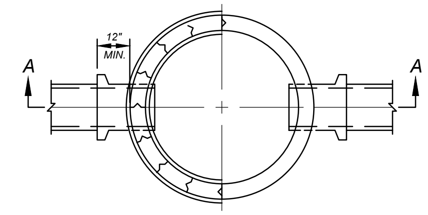
1. APPROXIMATE DISTANCE FROM NM HWY 605.
2. LOCATION AND OFFSETS FOR ARV VALVES AND MANHOLES ALONG THE PRIVATE ACCESS ALIGNMENT (HAUL ROAD) VARIES.
3. ALL COMPACTION FOR THE INSTALLATION OF ARV MANHOLE TO BE 95% OF THE MAXIMUM DRY DENSITY PER ASTM D 1557.
4. INTERIOR OF MANHOLE SHALL BE COATED IN ACCORDANCE WITH SECTION XX OF THE SPECIFICATIONS.

CONSTRUCTION NOTES:

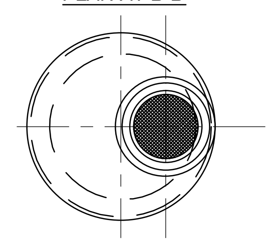
A. VARIES - SEE CONSTRUCTION PLANS FOR THE DEPTH REQUIRED
B. MANHOLE TOP, TYPE C, PER NMAPWA. WHERE MH IS INSTALLED. MH IS 5'-0" DIAMETER RCC.
C. CAST IRON FRAME AND LID, FOR TYPE C PER NMAPWA. INSERTED FLUSH WITH TOP SLAB. NEENAH R-6606 OR EQUAL.
D. CONCRETE MANHOLE, TYPE C PER NMAPWA. SEE DETAIL XX.
E. STAINLESS STEEL TIE-DOWN BAR 1/4" THK x 6" WIDE, FORMED TO HALF-MOON FOR PIPE HOLD-DOWN. (2-REQUIRED)
F. AIR VALVE ASSEMBLY COMPLETE, INCLUDING 3" COMBINATION AIR-RELEASE VALVE, VALMATIC MODEL No. 203C, WITH 3" NTP, 3" BALL/ GATE VALVE AND DOWNTURN ON DRAIN/ AIR EXHAUST, WITH 20" x 4" TEE AND BLIND FLANGE OR APPROVED EQUAL.
G. 20" HDPE REUSE WATER MAIN LINE BOTH WAYS FROM VALVE ASSEMBLY.
H. REINFORCED CONCRETE SUPPORT PAD W/ DRILLED ANCHORS INTO BASE. (1' x 2'-10" x 3'-0" PAD.)
I. FINISH GRADE IN UN-PAVED AREAS.
J. 12" DEEP 3/4" GRAVEL, ASTM C33, NO. 57 GRAVEL.
K. 3" PVC PIPE DRAIN
L. 4" DI AIR DISCHARGE PIPE ASSEMBLY



CROSS SECTION A-A



PLAN AT B-B



PLAN AT C-C

NOTES:

1. INSTALL NEOPRENE "O" RING ON PVC PIPE AND MORTAR TO MANHOLE FOR TIGHT SEAL.
2. FOR PRESSURE TYPE MANHOLE COVER USE SAME AS SHOWN WITH EIGHT (8) 1#2"X2" BOLTS AND NEOPRENE GASKET. BOLT HOLES SHALL BE PREDRILLED IN COVER AND TAPPED IN FRAME.
3. SAS SERVICES MAY BE CONSTRUCTED INTO CONCRETE MANHOLE BASES WHERE NEEDED.
4. IF SEWER MAIN AT A MANHOLE IS TO BE CONTINUED TO A FUTURE STREET, A 20' STUB-OUT TO BE INSTALLED WITH CAP AND WITH 1% MIN. SLOPE.
5. IN UNIMPROVED AND UNPAVED ROADS, MANHOLE RIMS AND CONCRETE COLLARS ARE TO BE INSTALLED AT EXISTING ROAD GRADE.
6. IN OFF-SITE AREAS, ELEVATIONS OF MANHOLE RIMS AND CONCRETE SHALL BE INSTALLED 6" ABOVE NATURAL GROUND.
7. 12" MAXIMUM OF ADJUSTMENST RINGS TO BE USED ON MANHOLES.
8. NON-SHRINK MORTAR INSIDE AND OUTSIDE OF MANHOLE JOINTS.
9. USE JOINT COMPOUND IN ALL MANHOLE BARREL JOINTS.

STANDARD CONCRETE MANHOLE - TYPE C

A6 — NOT TO SCALE

GENERAL NOTES:

1. M.H. GREATER THAN 18' IN DEPTH SHALL BE OF PRECAST CONC. SECTIONS ONLY.
2. DETAILS SHOW ONLY 4' AND 6' DIA MANHOLES, BUT DESIGN STANDARDS APPLY TO 4' THRU 10' DIAMETER MANHOLES.
3. USE NON-SHRINK GROUT FOR JOINTS, FILLETS & PIPE PENETRATIONS.
4. COMPACT ALL BACKFILL AROUND M.H. TO 95%.
5. POSITION M.H. OPENING OVER THE UPSTREAM SIDE OF MAIN LINE, UNLESS OTHERWISE NOTED.
6. FLAT-TOP TYPE MANHOLES SHALL BE USED FOR ALL WATER AIR VALVES, SEWER AIR-VAC VALVES, SEWER LIFT STATIONS, SEWER METER ASSEMBLY, AND ANY MH LESS THAN 6ft DEPTH.

CONSTRUCTION NOTES:

A. CONCRETE PIPE SUPPORTS SHALL EXTEND OUTSIDE OF M.H. TO BELL OF FIRST JOINT AND SHALL CRADLE PIPE TO SPRING LINE.
B. PIPE PENETRATION INTO MANHOLE SHALL BE FLUSH TO 2" MAX., MEASURED AT SPRINGLINE OF PIPE.
C. MANHOLE MAY BE CONSTRUCTED OF CONCRETE BLOCK, GR. MS BRICK, POURED CONCRETE OR PRECAST REINFORCED CONCRETE, IF BLOCK OR BRICK PLASTER INSIDE AND OUT WITH 1/2" MORTAR.
D. PRECAST CONCRETE COVER PER DETAIL THIS SHEET.
F. BASE TO BE POURED IN PLACE USING NO. 4 BARS AT 6" O.C. EA. WAY FOR M.H. DEPTH OF 16' OR GREATER. NO. 4 BARS AT 12" O.C. EA. WAY FOR M.H. LESS THAN 16' DEEP.
H. INV. ELEV. OF STUB OR LATERAL AS SHOWN ON PLANS.
J. 6" GROUT FILLET ON UPPER HALF OF PIPE AND AROUND BASE.
L. M.H. FRAME AND COVER, VARIES PER USE.
M. CONCRETE FILL, 3000 PSI.
Q. APPROVED WATERSTOP TO BE WITH TYPE OF PIPE.
R. STEPS TO BE INSTALLED AS SPECIFIED. (OPTIONAL PER HIGHWAY DEPT.)
S. EMD (IN UNPAVED AREAS).
T. IN UNPAVED AREAS SET FRAME TO GRADE AND SLOPE TOP OF PAD.
U. EPOXY COATING:
INTERIOR SURFACE - REQUIRED WHEN SPECIFIED ON CONSTRUCTION PLANS.
EXTERIOR SURFACE - REQUIRED WHEN GROUND WATER IS PRESENT.

Roca Honda Resources LLC.
4001 Office Court Drive Suite 102
Santa Fe, NM 87507

WILSON & COMPANY
4900 Lang Avenue Ne
Albuquerque, NM 87109
Phone: (505) 348-4000

SEAL: 30% SUBMITTAL NOT FOR CONSTRUCTION

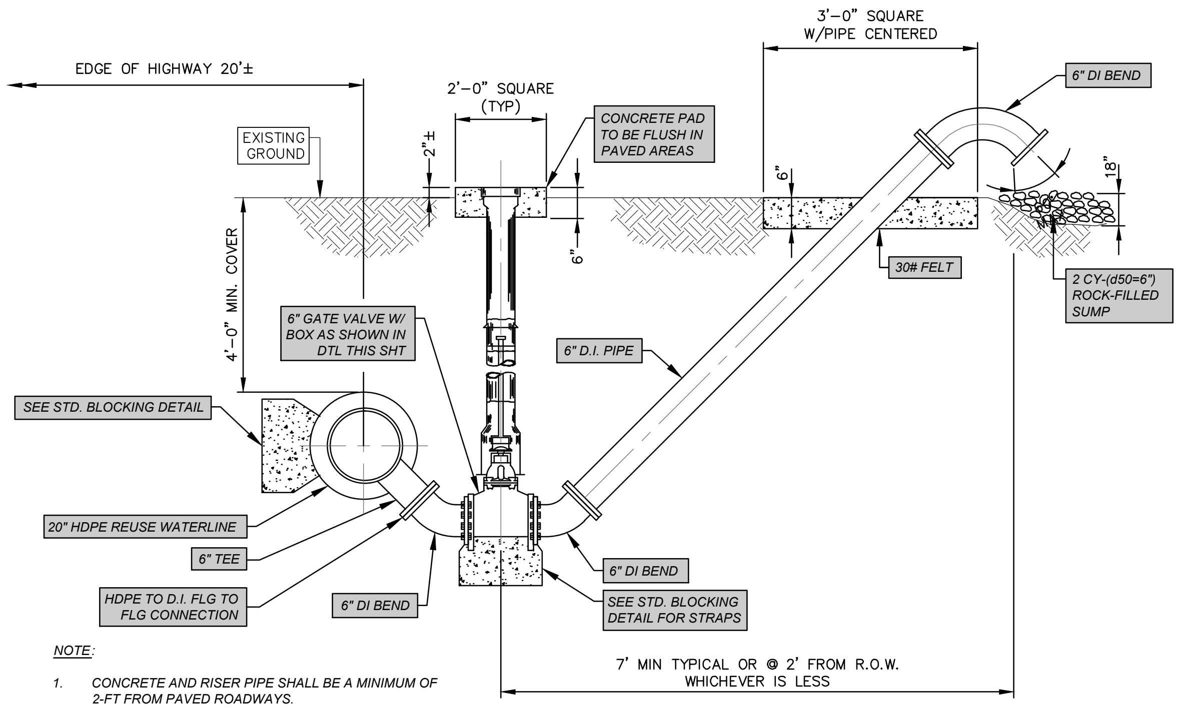
PROJECT NAME: ENERGY FUELS ROCA HONDA MINES REUSE WATER PIPELINE IMPROVEMENTS

REV.	DATE	DESCRIPTION	BY

This Information is Confidential and Restricted from Public Disclosure Under 36 CFR 296.18

PROJECT NO:	1560001000
DESIGNED BY:	DDB
DRAWN BY:	STAFF
CHECKED BY:	DDB
DATE:	JUNE, 2015
SHEET TITLE	
SHEET NO:	CU-501

M:\WSD\15-600-010-00\2_DISCIPLINES_SHEETS\8_SHEETS – UTILITIES\03_TYP\1560100_CU-501_CU-503.DWG
6/25/15

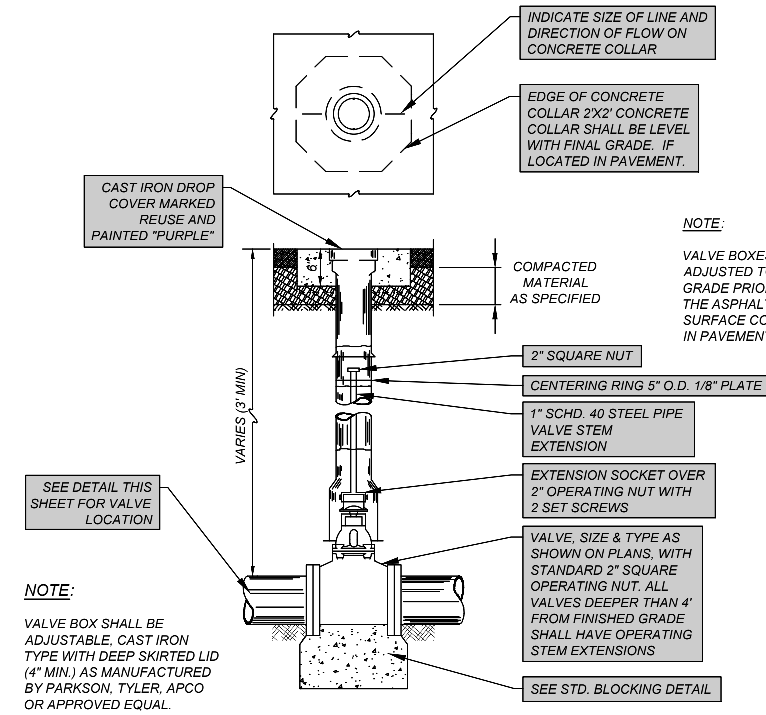


NOTE:

1. CONCRETE AND RISER PIPE SHALL BE A MINIMUM OF 2-FT FROM PAVED ROADWAYS.
2. LOCATION OF ANY BLOW OFF VALVE ON NM HWY IS APPROXIMATELY 25 FT FROM ROADWAY.
3. LOCATION OF ANY BLOWOFF VALVE ON PRIVATE HAUL ROAD VARIES IN LOCATION.

E3 BLOW-OFF DETAIL

NOT TO SCALE



NOTE:

VALVE BOXES SHALL BE ADJUSTED TO THE FINISHED GRADE PRIOR TO PLACING OF THE ASPHALTIC CONCRETE SURFACE COURSE. IF PLACED IN PAVEMENT.

NOTE:

VALVE BOX SHALL BE ADJUSTABLE, CAST IRON TYPE WITH DEEP SKIRTED LID (4" MIN.) AS MANUFACTURED BY PARKSON, TYLER, APCO OR APPROVED EQUAL.

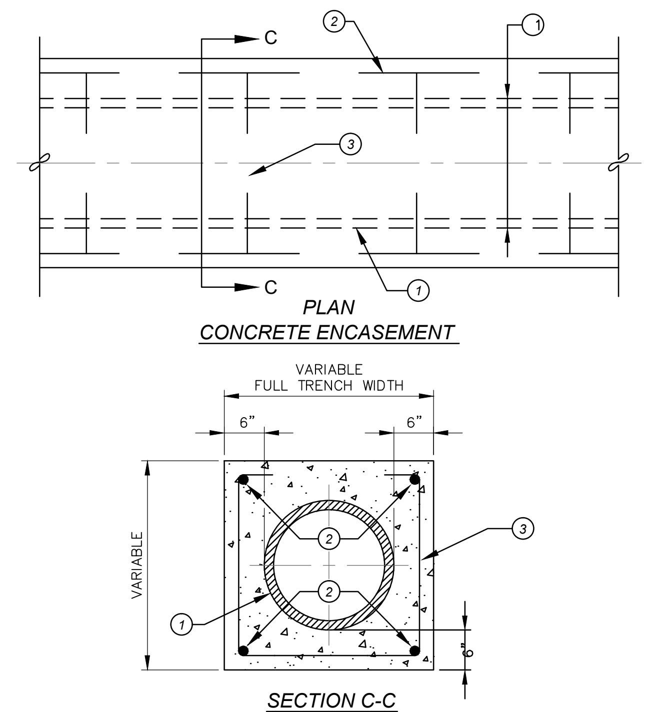
MECHANICAL RESTRAINTS REQUIRED ON ALL FITTINGS AND VALVES

NOTES:

1. ALL FITTINGS SHALL USE MEGA LUG RESTRAINTS.
2. GATE VALVE AND BOXES IN UNIMPROVED ROADS OR EASEMENTS SHALL HAVE A 2'X2' CONCRETE COLLAR INSTALLED AT EXISTING GRADE OR NATURAL GRADE.
3. A MECHANICAL RESTRAINT SYSTEM SHALL BE UTILIZED ON FITTINGS AND PIPING FOR THRUST RESTRAINT. CONCRETE THRUST BLOCKING TO BE USED ONLY FOR SPECIAL CONDITIONS, (SUCH AS, CAPS WHERE MAIN WILL BE EXTENDED IN THE FUTURE) OR AS SPECIFIED IN PLAN. .
4. FOR ALL MAIN LINE VALVES UP TO AND INCLUDING 12" USE GATE VALVES PER AWWA C509.

E6 VALVE & VALVE BOX ASSEMBLY

NOT TO SCALE



CONSTRUCTION NOTES:

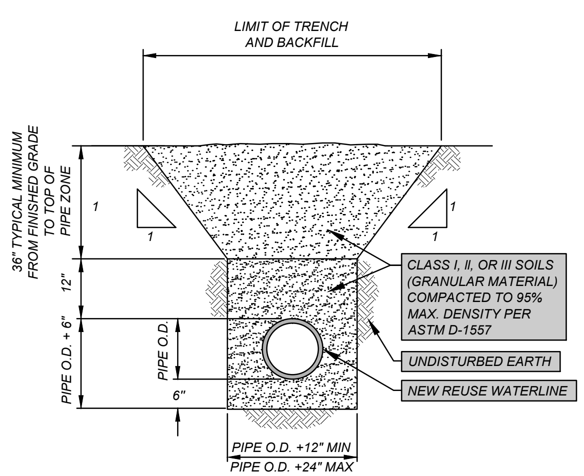
1. 20" Ø HDPE REUSE WATERLINE AS SHOWN ON PLANS
2. 4-NO. 4 BARS, CONT. WITH 3" CLEARANCE.
3. NO. 4 BARS, AT 36" O.C. (LENGTH WISE)

GENERAL NOTES:

1. CONCRETE ENCASEMENT TO BE PROVIDED WHEN REQUIRED FOR DRAINAGE , OR TO PROTECT BETWEEN REUSE LINE AND OTHER UTILITIES.

E9 CONCRETE ENCASEMENT

NOT TO SCALE

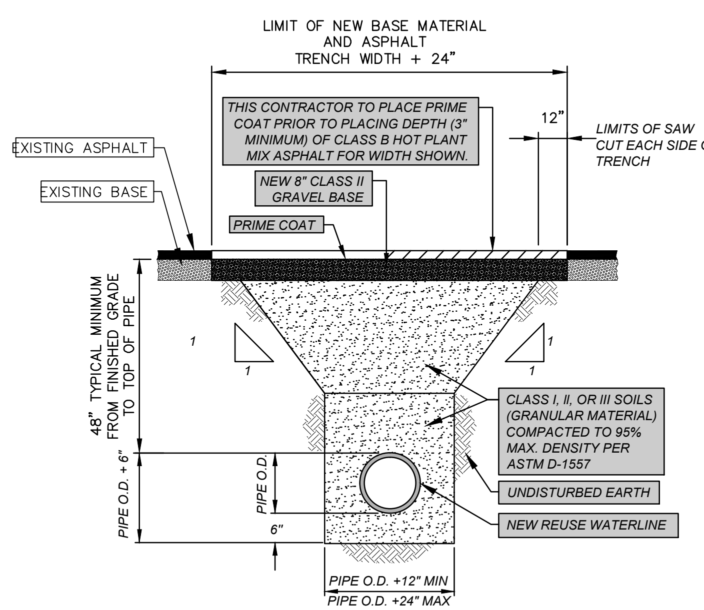


NOTE:

UPON COMPLETION OF PIPELINE CONSTRUCTION ALL ALIGNMENTS IN ALL DIRT AREAS SHALL HAVE THE SURFACE COMPACTED SMOOTHED AND BLADED TO PROVIDE SUITABLE MAINTENANCE ACCESS FOR VEHICLES.

A2 TYPICAL TRENCH DETAIL-1

NOT TO SCALE (IN UNPAVED AREAS)

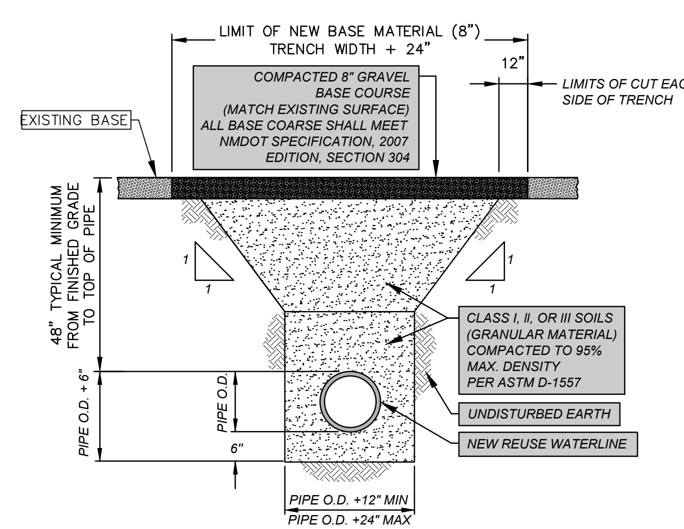


NOTES FOR MATCHING EXISTING PAVEMENT: DRIVEWAY OR STREETS

1. TRENCH-WIDTH ASPHALT SHALL HAVE A MINIMUM THICKNESS OF 3", REGARDLESS OF STREET ASPHALT THICKNESS, SEE TRENCH DETAIL" AND "TYPICAL LIMITS OF RESURFACING WORK" DETAIL THIS SHEET.

A4 TYPICAL TRENCH DETAIL-2

NOT TO SCALE (IN PAVED AREAS)



A5 TYPICAL TRENCH DETAIL-3

NOT TO SCALE (IN GRAVEL AREAS)

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Santa Fe, NM 87507

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Phone: (505) 348-4000

SEAL

30% SUBMITTAL NOT FOR CONSTRUCTION

PROJECT NAME

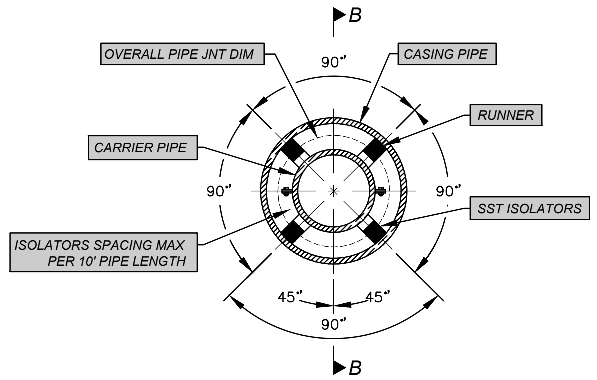
ENERGY FUELS
ROCA HONDA MINES
REUSE WATER PIPELINE
IMPROVEMENTS

REV.	DATE	DESCRIPTION	BY
		This Information is Confidential and Restricted from Public Disclosure Under 36 CFR 296.18	

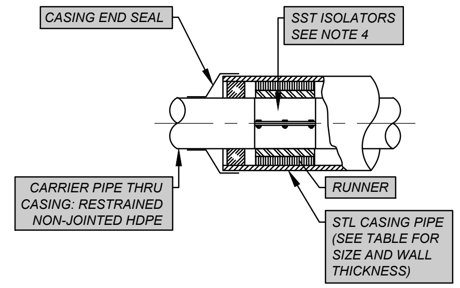
PROJECT NO:	1560001000
DESIGNED BY:	DDB
DRAWN BY:	STAFF
CHECKED BY:	DDB
DATE:	JUNE, 2015

SHEET TITLE

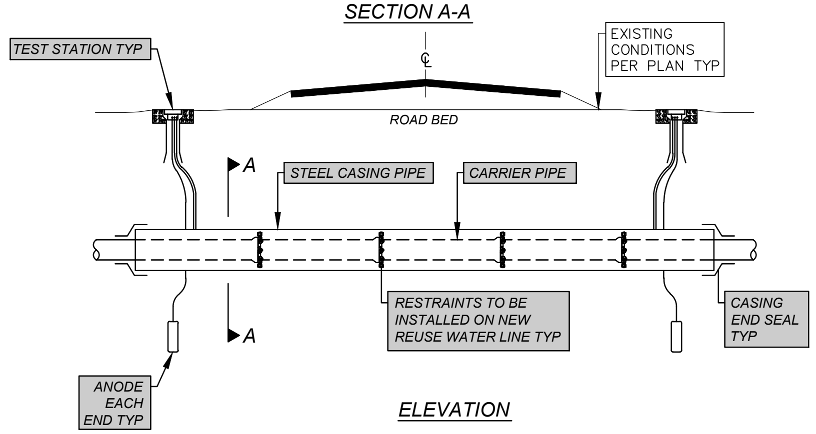
SHEET NO: CU-502



SECTION A-A



SECTION B-B



ELEVATION

STEEL CASING WALL THICKNESS CHART

MINIMUM THICKNESS		DIAMETER OF CASING PIPE
.2500"	1/4"	12" OR LESS
.3125"	5/16"	OVER 12"-18"
.3750"	3/8"	OVER 18"-22"
.4375"	7/16"	OVER 22"-28"
.5000"	1/2"	OVER 28"-34"
.5625"	9/16"	OVER 34"-42"
.6250"	5/8"	OVER 42"-48"

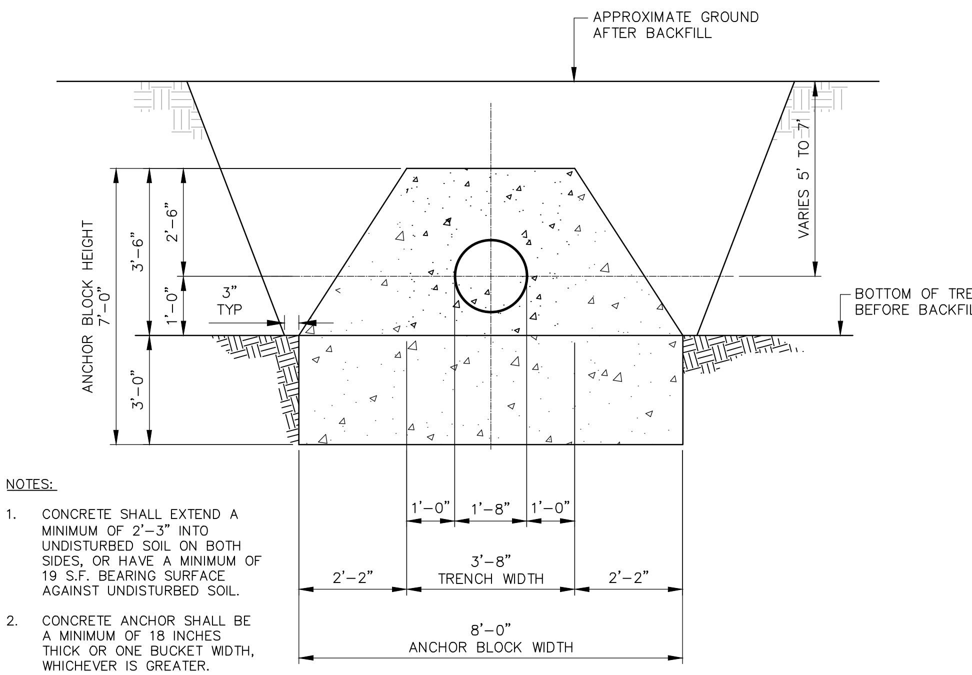
NOTE: THIS CHART IS ONLY FOR SMOOTH STEEL CASING PIPES WITH MINIMUM YIELD STRENGTH OF 35,000 PS1.

NOTES:

FOR HIGHWAY CROSSINGS AND ROADWAY CROSSINGS

1. ALL HORIZONTAL DISTANCES TO BE MEASURED AT RIGHT ANGLES FROM ℄ PAVING OF HWY.
2. CASING TO EXTEND BEYOND THE ℄ OF HIGHWAY AT RIGHT ANGLES AS SHOWN ON PLANS
3. CASING AND CARRIER PIPE MUST BE PLACED A MINIMUM OF 2 FEET BELOW EXISTING FIBER OPTIC CABLE IF ANY EXISTS. ANY EXCAVATION REQUIRED WITHIN 5 FEET OF ANY EXISTING FIBER OPTIC CABLE MUST BE HAND DUG.
4. MANUFACTURED ISOLATORS SHALL BE STAINLESS STEEL SHELL FOR DI CARRIER PIPE WITH ULTRA HIGH MOLECULAR WEIGHT POLYETHYLENE (UHMW PE) RUNNERS BY CASCADE, OR ENGINEER APPROVED EQUAL.
5. CARRIER AND CASING PIPE LOCATION AND DEPTHS PER PLAN AND PROFILES.
6. NOTES ON PLANS INDICATE WHICH LENGTHS OF CASING ARE TO BE PLACED BY BORE AND JACKING AND WHICH LENGTHS OF CASING ARE TO BE INSTALLED BY PLACING IN TRENCH AND BACKFILLED IN PLACE.

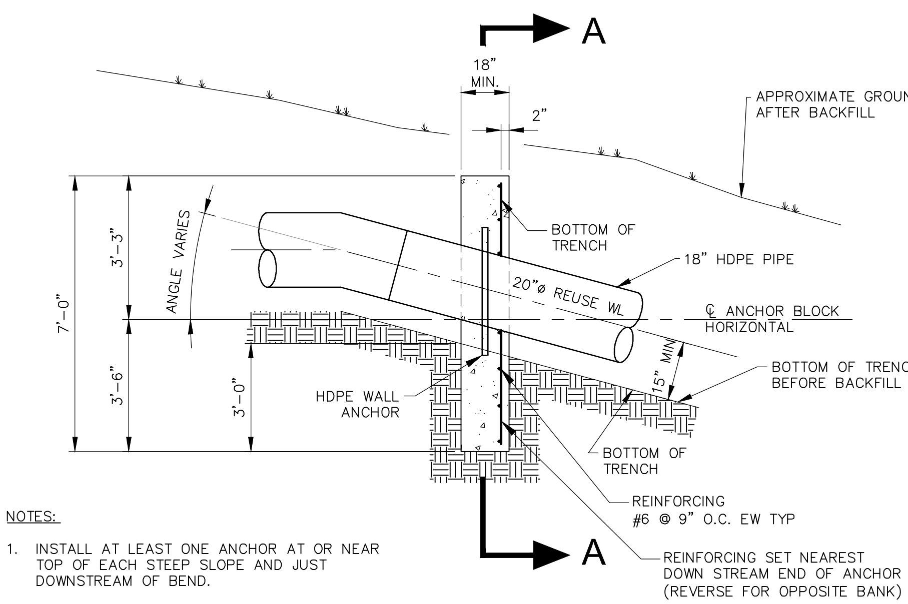
D3 REUSE WATER LINE CASING DETAIL
NOT TO SCALE



NOTES:

1. CONCRETE SHALL EXTEND A MINIMUM OF 2'-3" INTO UNDISTURBED SOIL ON BOTH SIDES, OR HAVE A MINIMUM OF 19 S.F. BEARING SURFACE AGAINST UNDISTURBED SOIL.
2. CONCRETE ANCHOR SHALL BE A MINIMUM OF 18 INCHES THICK OR ONE BUCKET WIDTH, WHICHEVER IS GREATER.

SECTION A-A



NOTES:

1. INSTALL AT LEAST ONE ANCHOR AT OR NEAR TOP OF EACH STEEP SLOPE AND JUST DOWNSTREAM OF BEND.
2. CONCRETE TO EXTEND 4'-0" EACH SIDE OF ℄ OF PIPE. SEE PIPE ANCHOR DETAIL #1.

C8 CONCRETE PIPE ANCHOR SUPPORT B (FOR STEEP SLOPED CONDITION)
NOT TO SCALE

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Phone: (505) 348-4000

30% SUBMITTAL NOT FOR CONSTRUCTION

SEAL

PROJECT NAME
ENERGY FUELS ROCA HONDA MINES REUSE WATER PIPELINE IMPROVEMENTS

REV.	DATE	DESCRIPTION	BY

PROJECT NO:	1560001000
DESIGNED BY:	DDB
DRAWN BY:	STAFF
CHECKED BY:	DDB
DATE:	JUNE, 2015

SHEET TITLE

SHEET NO: CU-503

M:\MSD\15-600-010-00\2_DISCIPLINES_SHEETS\8_SHEETS - UTILITIES\03_TYP\1560100_CU-501_CU-503.DWG
6/25/15

APPENDIX D

New Mexico Department of Transportation Correspondence and Environmental Clearance

Re: Roca Honda Mine Dewatering Reuse Pipeline

December 2013, NM DOT Environmental Development Section

Environmental Development Section

TO: Mike Neumann, Roca Honda Resources LLC

PROJECT: NM 605 from approximately MM 0 to MM 22;
Crossing east-to-west MM 0 and crossing north-to-south at MM 18;
McKinley and Cibola Counties

DATE: December 6, 2013

FROM: Genevieve Head

Land status maps indicate that some locations of your project within the NM 605 right-of-way are on Bureau of Land Management (BLM) and New Mexico State Land Office (SLO) lands. The New Mexico Department of Transportation (NMDOT) cannot provide environmental clearance for permitted projects on federal and State Trust lands. NMDOT has easements with the BLM and SLO for right of way on BLM and SLO lands, and NMDOT does issue permits to work within our easements; however, NMDOT cannot speak for the BLM or SLO regarding their environmental requirements.

You need to consult with the BLM and SLO regarding their procedures for environmental and cultural resources clearance.

For those areas of the proposed project that are within NMDOT right-of-way acquired from private sources, the NMDOT Environmental Development Section is requiring both cultural resource and environmental surveys.

Thank you for notifying the NMDOT Environmental Development Section of this project. Please attach a copy of this memo and correspondence from the BLM and SLO to your permit application.

If you have any questions, please don't hesitate to call me at 505-827-5356.

CULTURAL RESOURCE INVENTORY
REQUIRED
NMDOT, ENVIRONMENTAL SECTION

New Mexico DEPARTMENT OF TRANSPORTATION
MOBILITY FOR EVERYONE

REVIEWED
By Gary Funkhouser at 1:49 pm, Oct 24, 2014

Environmental Clearance for Undertakings within NMDOT Rights-o

ENVIRONMENTAL SURVEY
REQUIRED
NMDOT, ENVIRONMENTAL SECTION

In order to receive environmental clearance for permitted projects in highway rights-of-way the fi submitted to the NMDOT Environmental Development Section. Submittals (usually) are reviewe Submittals received on Tuesday will not be reviewed until the following Tuesday. Emergency re basis.

1. **Purpose** and **Nature** of undertaking. Describe the undertaking along with width, length and depth of ground disturbance. Include the methods

For those areas of the proposed project that are within NMDOT right-of-way acquired from private sources, the NMDOT Environmental Development Section is requiring both cultural resource and environmental surveys.

The undertaking will consist of surveys of cultural re conditions along a proposed buried pipeline route in 605 from approximately MP 22 on Hwy 605 to MP 0 (see Figure 1). The pipeline would convey treated w

2. **Is your project resulting from a NMDOT project?** If so, provide the control and/or project number.

No.

3. **Funding source.** Is the funding private, state, or federal? If state and/or federal, list agency(s).

Entirely private funding.

4. **Land status.** Is the project on right of way owned by BLM, Forest Service, Tribal land, or State Trust land? (NMDOT does not own all highway rights of way!)

A short portion of the ROW crosses BLM land near MP 5.7 on Highway 605 for a distance of about a half mile as shown on Figure 1.

5. **Permitting agencies.** List other permitting agencies involved besides NMDOT.

USFS (Cibola National Forest), NM Environment Department, and the NM Mining and Minerals Division of the Energy, Minerals and Natural Resources Department.

6. **County**. List the county or counties in which the project is located.

McKinley and Cibola Counties.

7. **Highway number.** Indicate the highway the project will cross or parallel.

State Highway 605 as shown on Figures 1 and 2.

8. **BOP and EOP.** Provide the milepost locations for the beginning of the project area (BOP) and the end of the project area (EOP). If highway crossing only, list the milepost location. Indicate BOP

and EOP on quadrangle maps as well.

See Figures 1and 2; BOP is approximately MP 0.5 and EOP is approximately MP 22.

9. **Side(s)** of the road. Indicate on which side of the road the project will be located using cardinal directions (north, south, east, west). List all project crossings of the highway by milepost.

The two proposed highway crossings are at approximately MP 0.5 and MP 18, as shown on Figures 1 and 2.

10. **Length** of the project. Indicate the length of the project within NMDOT right of way in terms of feet and/or miles.

The length of the project is approximately 22 miles.

11. **Provide the legal description** of the project area: Township, Range, and Section(s).

As shown on Figure 2, the proposed pipeline would run through portions of Sections 13,14,15,21,22,28,29,31 and 32 in T. 13N, R.9W.; Sections 18,19,20,21,22,23,24,26 in T. 13N, R. 8W; Sections 6,7,18, in T.12N,R.9W; and Sections 2,3, 9 and 10 in T.11N,R10W.

12. **USGS 1:24,000 (7.5') Quadrangle map.** List the name(s) of the USGS quadrangle map(s) on which the project is located.

San Mateo, Dos Lomas, Grants and Milan as shown on Figure 2.

13. Include the appropriate portion of the **USGS 1:24,000 (7.5') Quadrangle map(s)** with the project area indicated by an **X** if a crossing, or **BOP** and **EOP** if linear**.** Quad map images can be printed at no charge from the map locator/downloader page at the USGS store at: http://store.usgs.gov/
Google Maps of the project location are also acceptable **if** the background image is the satellite photo and **if** you are sending your request electronically: http://maps.google.com/

Please see attached Figures 2a-2h.

14. **Include you**r:

Name: *Mike Neumann*

Company (if applicable): *Roca Honda Resources LLC*

Phone #: *505-428-6370*

Fax #:

Email address (if you use one): *mneumann@energyfuels.com*

15. **Do not** send photos (including aerial photos or photo maps) unless they are scanned or sent via US Mail. Faxed photos come out entirely black.

16. Submit your requests by email, by fax, **OR** by mail.
Send in one format only – Please **do not** send in multiple formats.

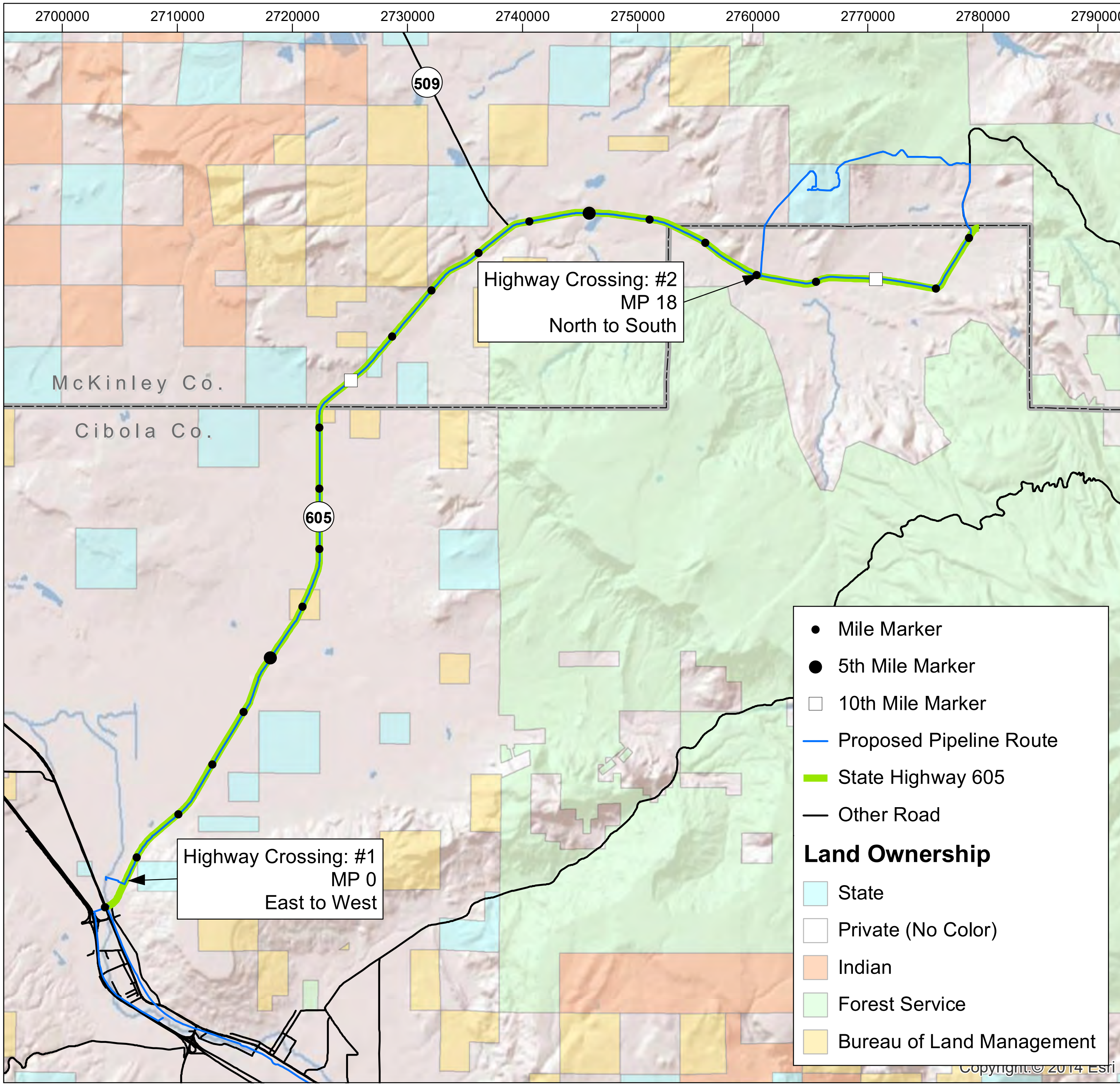
Send clearance requests to:

Gary Funkhouser, NMDOT - Environmental Development

P.O. Box 1149
Santa Fe, NM 87504-1149

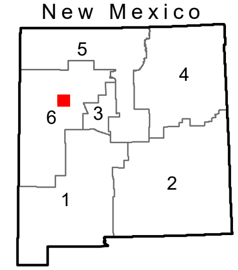
Physical address:
1120 Cerrillos Road, Room 206
Santa Fe, NM 87505-1842
(for FedEx or UPS the ZIP code is 87505)

Fax: 505-827-3243; **Phone**: 505-827-5692; **Email**: gary.funkhouser@state.nm.us



ROCA HONDA RESOURCES LLC.

New Mexico



NM DOT District Boundary

Red square denotes area of detail to left

County Boundary

State Plane Coordinate System
New Mexico, Western Zone, US Foot
NAD 83

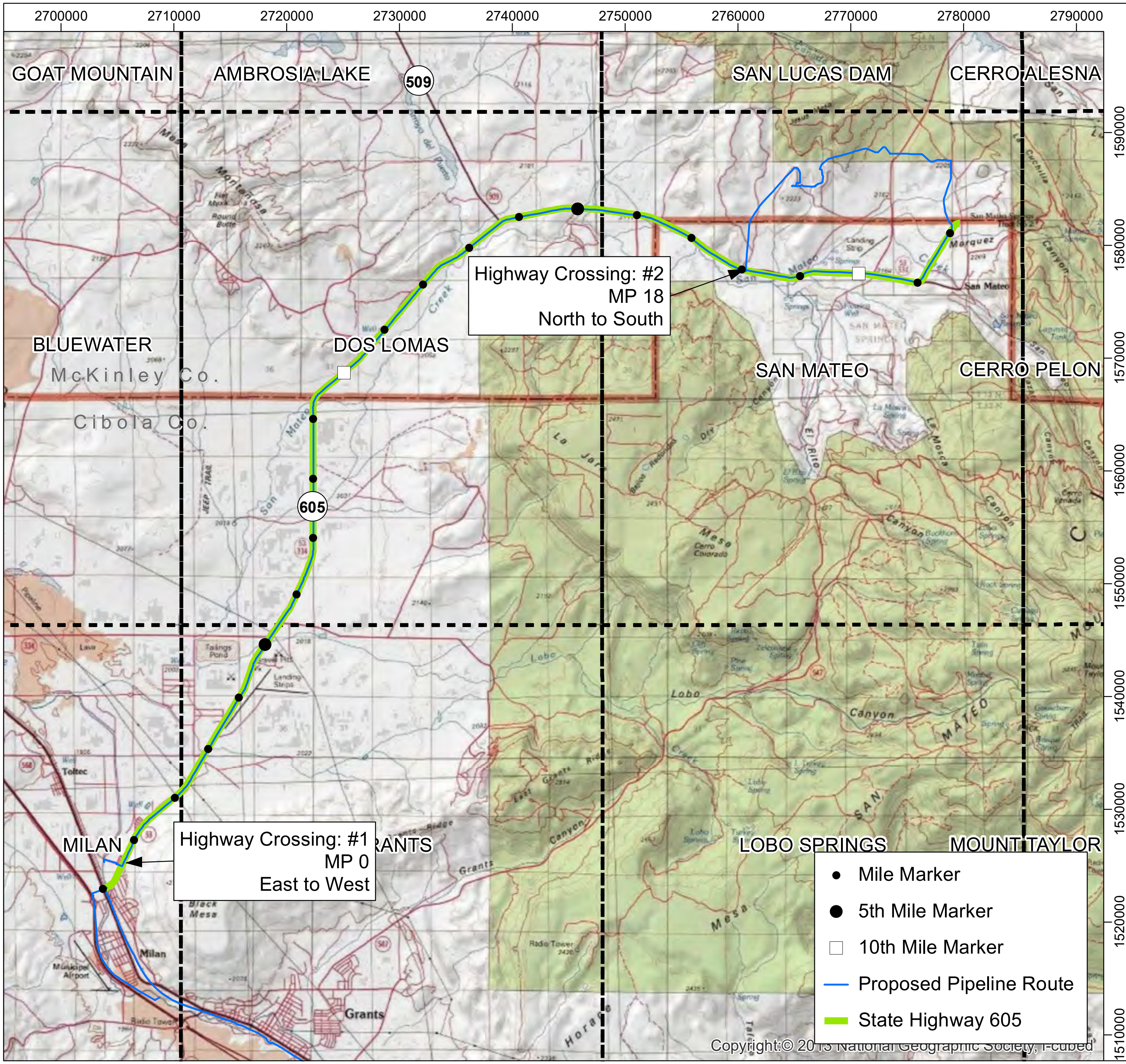
0 0.5 1 2
Miles

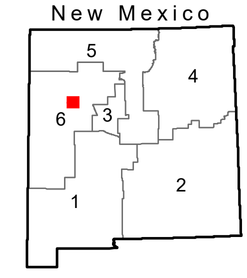
0 1 2 4
Kilometers

ROCA HONDA RESOURCES LLC.
4001 Office Court Dr. Ste. 107
Santa Fe, NM 87507

FIGURE 1
STATE HIGHWAY 605 MAP
Cibola & McKinley County, New Mexico

Geology:	Drafting: D. Kapostasy	Scale: 1:150,000
Notes:		Date: 10.22.14





Red square denotes area of detail to left

State Plane Coordinate System
New Mexico, Western Zone, US Foot
NAD 83

0 0.5 1 2
Miles

0 1 2 4
Kilometers

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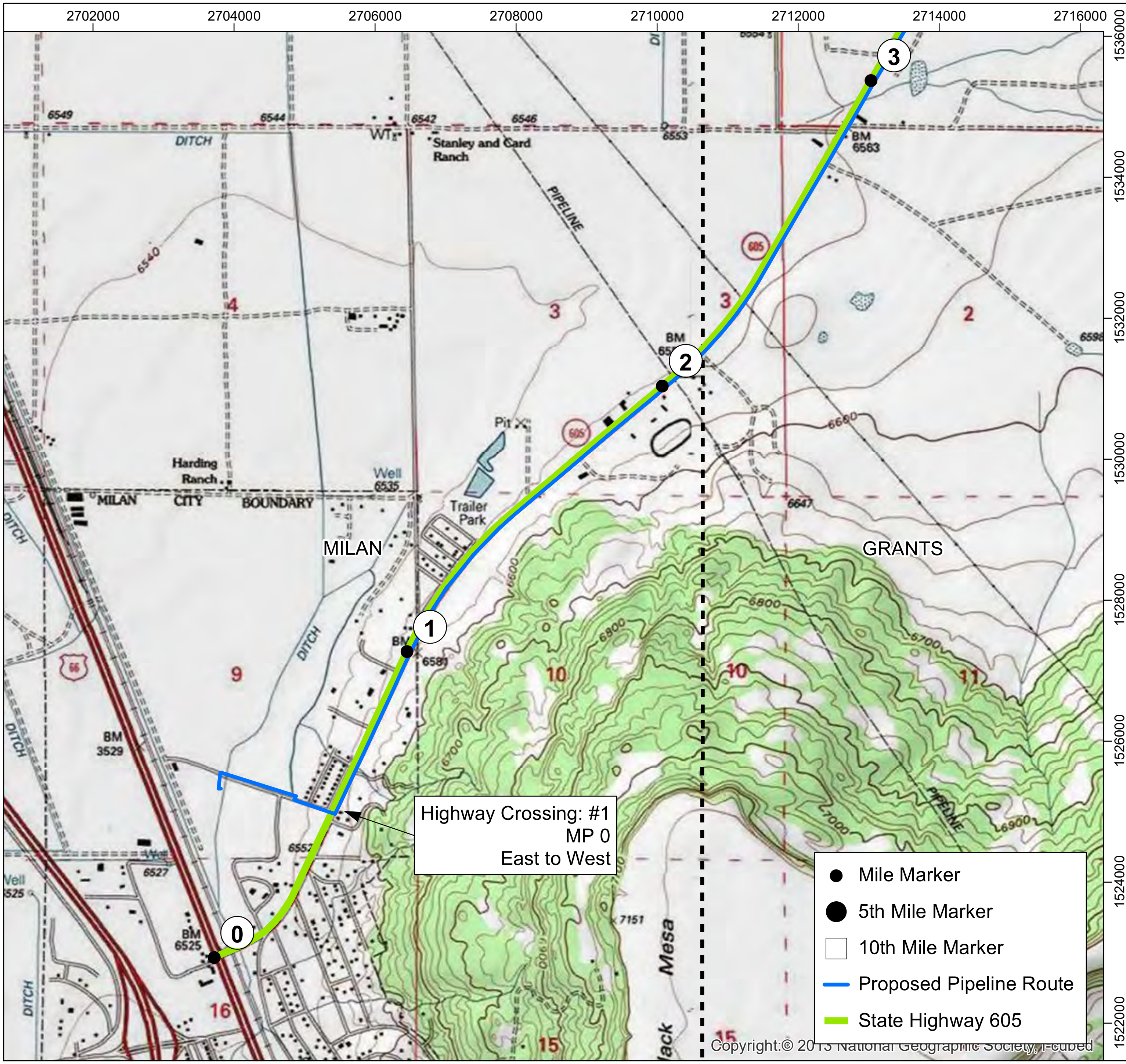
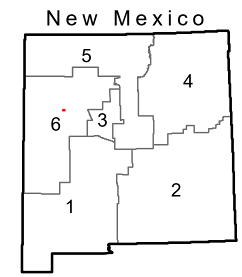
4001 Office Court Dr. Ste. 107
Santa Fe, NM 87507

FIGURE 2 - OVERVIEW MAP
STATE HIGHWAY 605 MAP - TOPO
Cibola & McKinley County, New Mexico

Geology:	Drafting: D. Kapostasy	Scale: 1:150,000
Notes:		Date: 10.22.14





USGS Quad

State Plane Coordinate System
New Mexico, Western Zone, US Foot
NAD 83

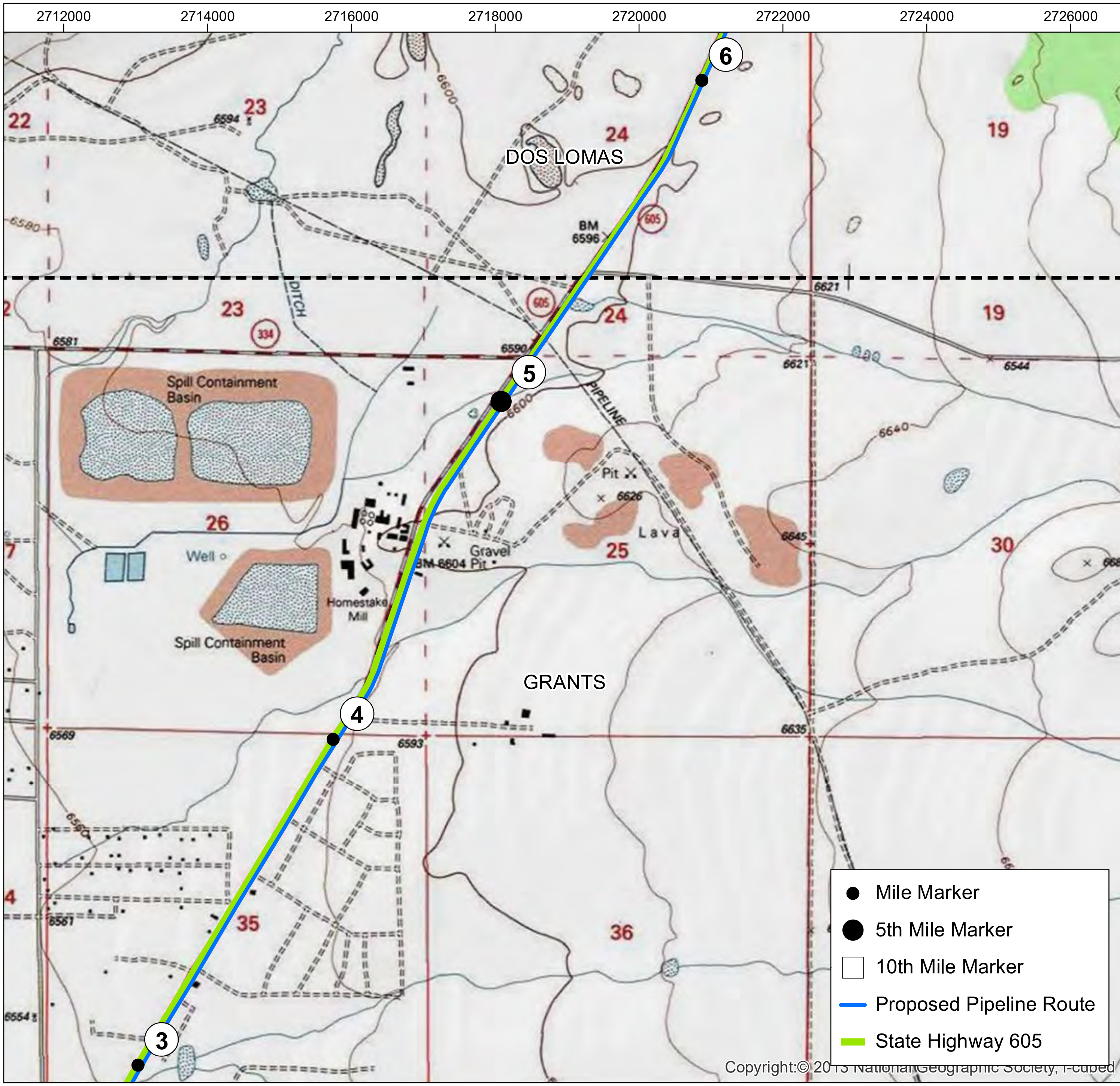
0 500 1,000 2,000
Feet

0 200 400 800
Meters

ROCA HONDA RESOURCES LLC.
4001 Office Court Dr. Ste. 107
Santa Fe, NM 87507

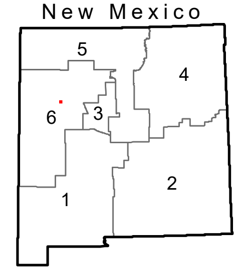
FIGURE 2a: MP 0 - MP 3
STATE HIGHWAY 605 MAP - TOPO
Cibola & McKinley County, New Mexico

Geology:	Drafting: D. Kapostasy	Scale: 1:24,000
Notes:		Date: 10.22.14



ROCA HONDA RESOURCES LLC.

New Mexico



NM DOT District Boundary

Red square denotes area of detail to left

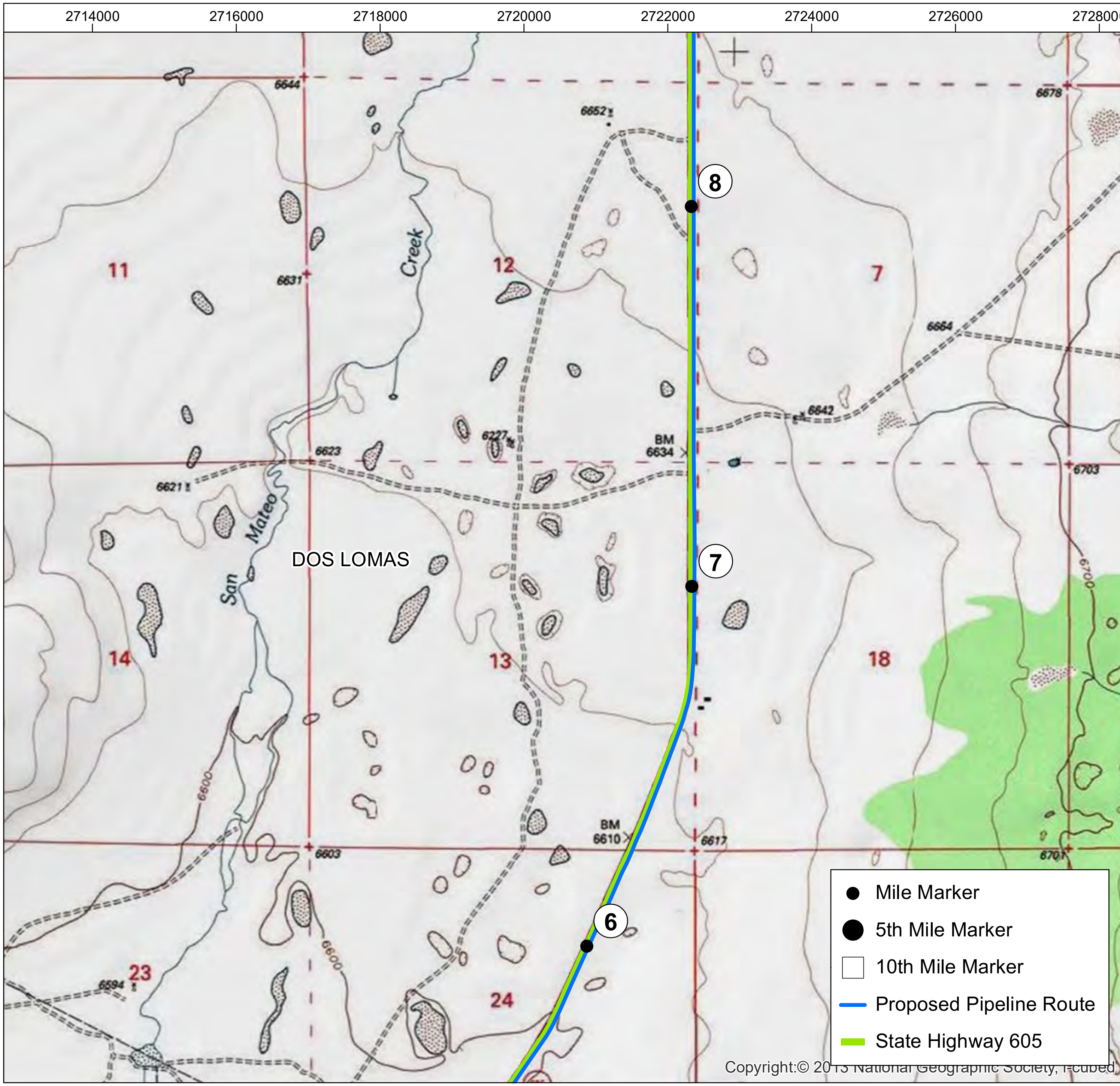
USGS Quad

State Plane Coordinate System
New Mexico, Western Zone, US Foot
NAD 83

0 500 1,000 2,000
Feet

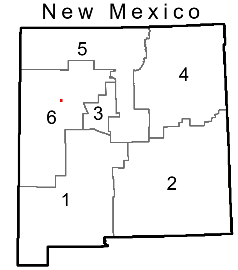
0 200 400 800
Meters

ROCA HONDA RESOURCES LLC. **4001 Office Court Dr. Ste. 107** **Santa Fe, NM 87507**		
FIGURE 2b: MP 3 - MP 6 STATE HIGHWAY 605 MAP - TOPO Cibola & McKinley County, New Mexico		
Geology:	Drafting: D. Kapostasy	Scale: 1:24,000
Notes:		Date: 10.22.14



ROCA HONDA RESOURCES LLC.

New Mexico



NM DOT District Boundary

Red square denotes area of detail to left

USGS Quad

State Plane Coordinate System
New Mexico, Western Zone, US Foot
NAD 83

N
S

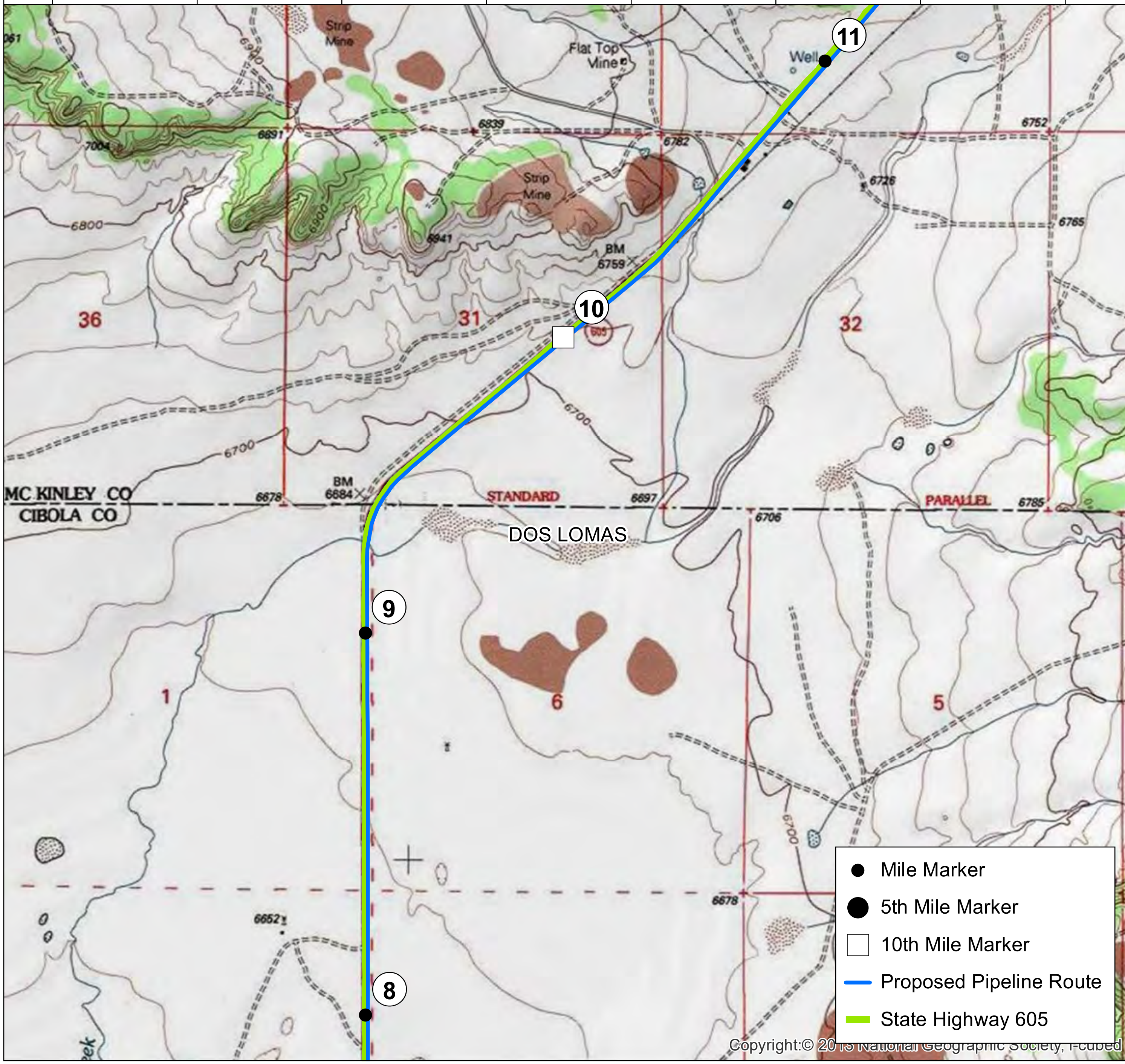
0 500 1,000 2,000
Feet

0 200 400 800
Meters

ROCA HONDA RESOURCES LLC.
4001 Office Court Dr. Ste. 107
Santa Fe, NM 87507

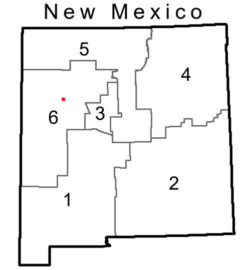
FIGURE 2c: MP 6 - MP 8
STATE HIGHWAY 605 MAP - TOPO
Cibola & McKinley County, New Mexico

Geology:	Drafting: D. Kapostasy	Scale: 1:24,000
Notes:		Date: 10.22.14



ROCA HONDA RESOURCES LLC.

New Mexico



NM DOT District Boundary

Red square denotes area of detail to left

USGS Quad

State Plane Coordinate System
New Mexico, Western Zone, US Foot
NAD 83

0 500 1,000 2,000
Feet

0 200 400 800
Meters

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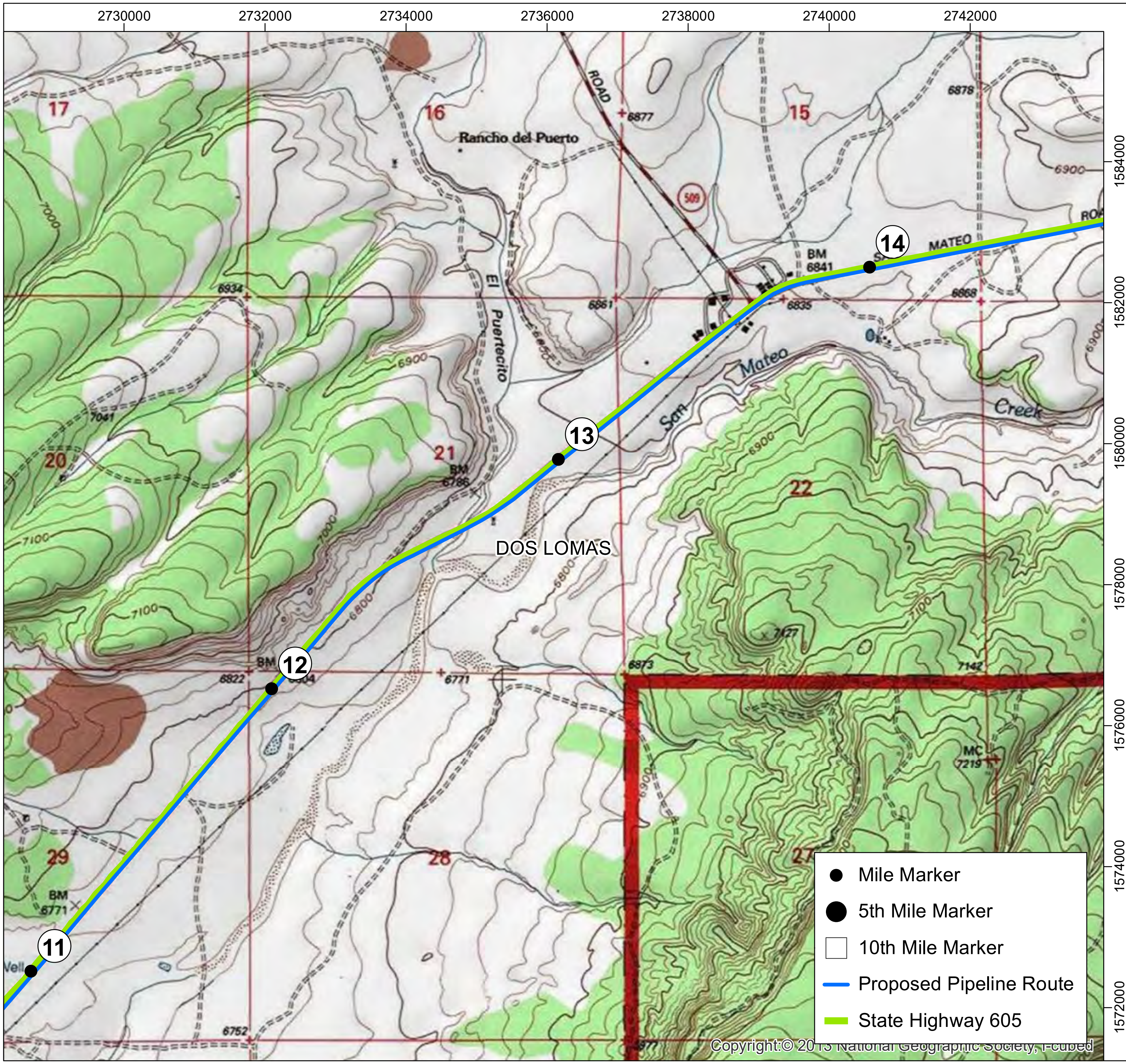
Santa Fe, NM 87507

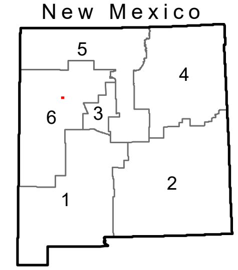
FIGURE 2d: MP 8 - MP 11
STATE HIGHWAY 605 MAP - TOPO
Cibola & McKinley County, New Mexico

Geology:	Drafting: D. Kapostasy	Scale: 1:24,000
Notes:		Date: 10.22.14



ROCA HONDA RESOURCES LLC.

New Mexico



NM DOT District Boundary

Red square denotes area of detail to left

USGS Quad

State Plane Coordinate System
New Mexico, Western Zone, US Foot
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Feet

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Meters

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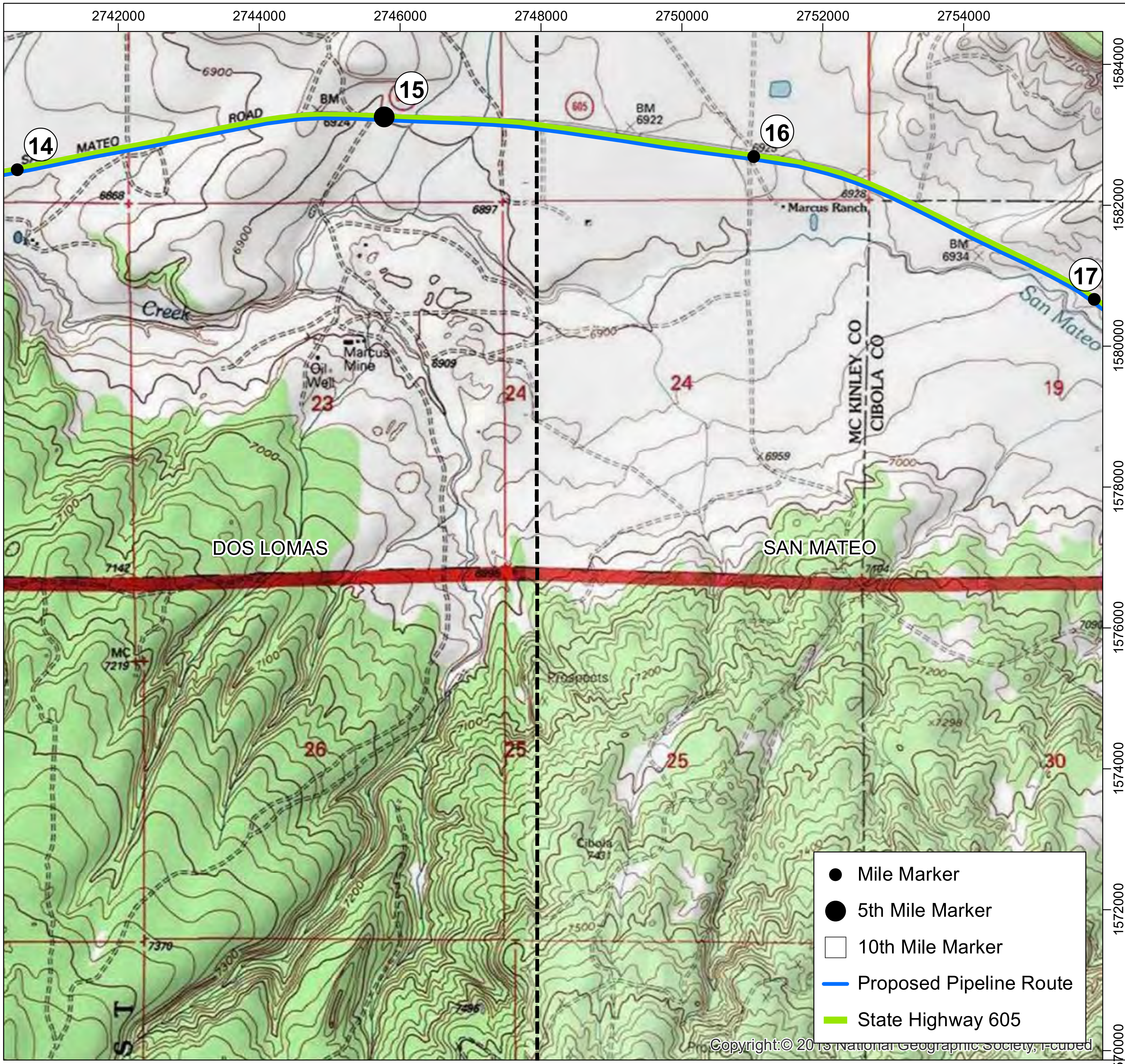
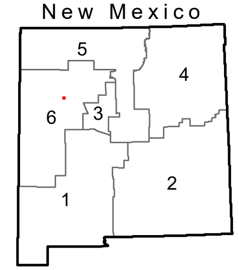
FIGURE 2e: MP 11 - MP 14
STATE HIGHWAY 605 MAP - TOPO
Cibola & McKinley County, New Mexico

Geology:	Drafting: D. Kapostasy	Scale: 1:24,000
Notes:		Date: 10.22.14



ROCA HONDA RESOURCES LLC.

New Mexico



NM DOT District Boundary

Red square denotes area of detail to left

USGS Quad

State Plane Coordinate System
New Mexico, Western Zone, US Foot
NAD 83

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Feet

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Meters

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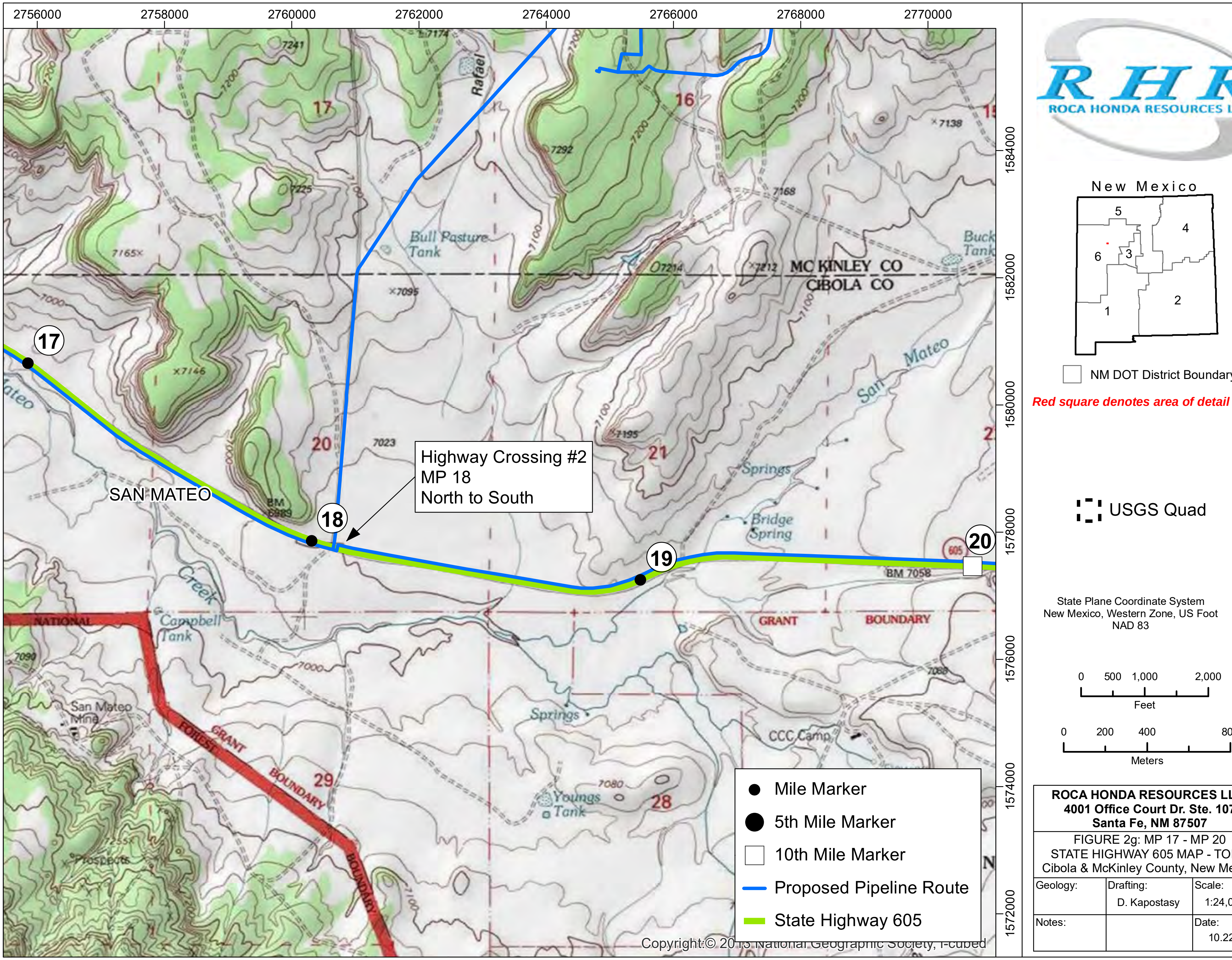
FIGURE 2f: MP 14 - MP 17
STATE HIGHWAY 605 MAP - TOPO
Cibola & McKinley County, New Mexico

Geology:	Drafting: D. Kapostasy	Scale: 1:24,000
Notes:		Date: 10.22.14

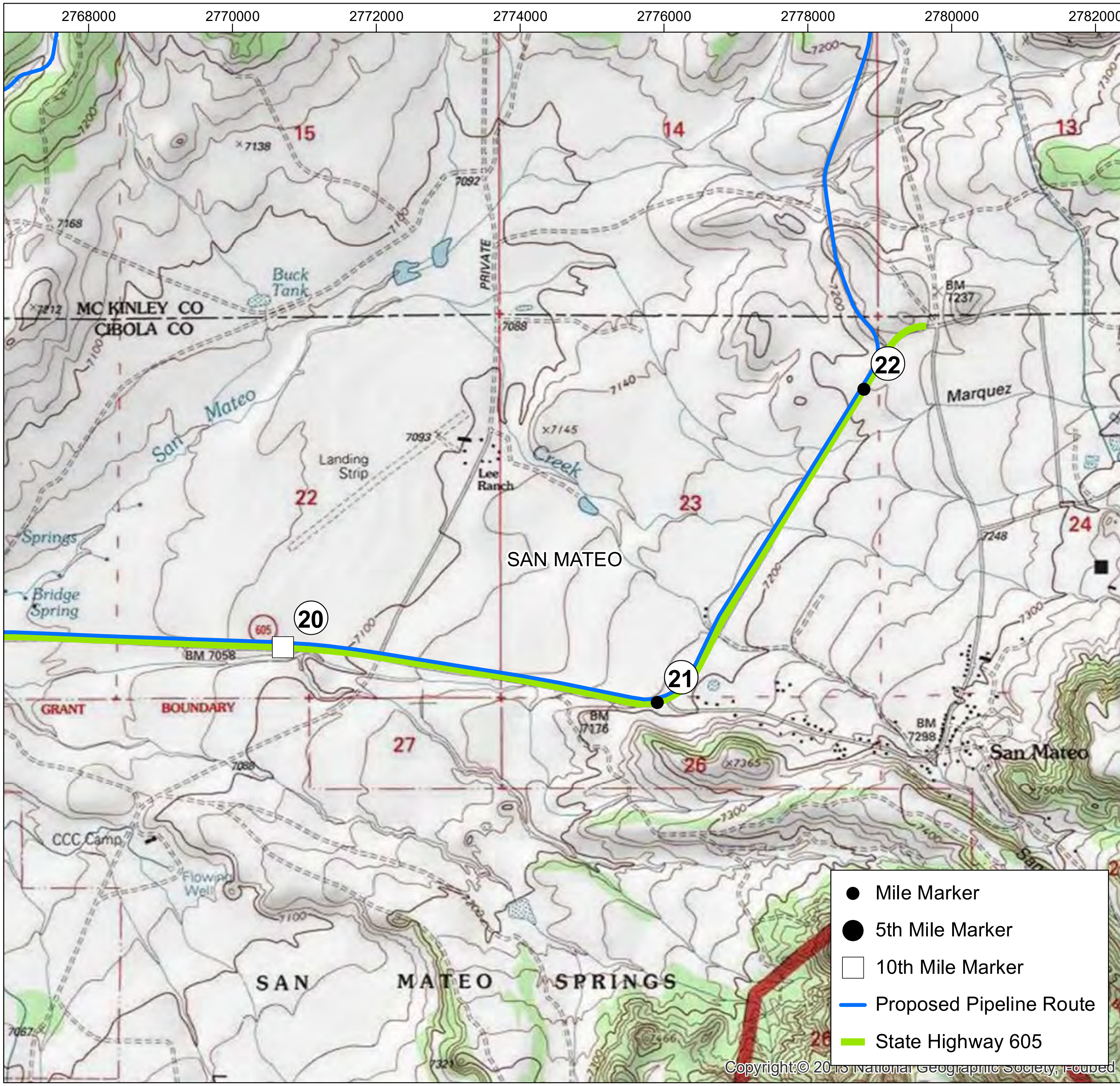


RHR
ROCA HONDA RESOURCES LLC.

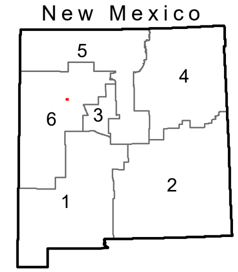
ROCA HONDA RESOURCES LLC.
4001 Office Court Dr. Ste. 107
Santa Fe, NM 87507

FIGURE 2g: MP 17 - MP 20
STATE HIGHWAY 605 MAP - TOPO
Cibola & McKinley County, New Mexico

Geology:	Drafting: D. Kapostasy	Scale: 1:24,000
Notes:		Date: 10.22.14



ROCA HONDA RESOURCES LLC.



NM DOT District Boundary

Red square denotes area of detail to left

USGS Quad

State Plane Coordinate System
New Mexico, Western Zone, US Foot
NAD 83

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Feet

0 200 400 800
Meters

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Santa Fe, NM 87507

FIGURE 2h: MP 20 - MP 22
STATE HIGHWAY 605 MAP - TOPO
Cibola & McKinley County, New Mexico

Geology:	Drafting: D. Kapostasy	Scale: 1:24,000
Notes:		Date: 10.22.14

APPENDIX E-1

Technical Memorandum:

Assessment of Potential Impacts from Dewatering at the Roca Honda Mine

INTERA Inc., April 20, 2017

INTERA Incorporated
6000 Uptown Boulevard NE, Suite 220
Albuquerque, New Mexico 87110 USA
505.246.1600

TECHNICAL MEMORANDUM

DATE: **April 20, 2017**

FROM: **John Sigda and Cheng Cheng, INTERA Inc.**

TO: **Michael Neumann and Daniel Kapostasy, Energy Fuels Resources Inc.**
Maryann Wasiolek, Hydroscience Associates Inc.

SUBJECT: **Assessment of Potential Impacts from Dewatering at the Roca Honda Mine**

1.0 INTRODUCTION

In 2014, the New Mexico Office of the State Engineer (NMOSE) granted Roca Honda Resources (RHR) a permit to dewater an underground mine to be completed in Sections 9, 10, and 16 of Township 13 North, Range 8 West in McKinley County, New Mexico. Since that time, RHR has acquired adjacent Section 17, and has modified the original mine plan to include that area. Energy Fuel Resources Inc. (EFRI), as the successor in interest to Strathmore Minerals who previously owned the Roca Honda claims, engaged INTERA Inc. (INTERA) to evaluate potential impacts from mine dewatering in Sections 9, 10, 16, and 17 over time using the mine plan and schedule for the Roca Honda mine plan dated late June 2016 and updated in November 2016. The proposed underground mine is located approximately 23 miles northeast of the City of Grants and 2.5 miles northwest of the community of San Mateo, New Mexico. Mine workings will be developed at depths between 2,100 and 2,800 feet (ft) below ground surface within the Westwater Canyon Member of the Jurassic Morrison Formation (Westwater). The mine workings include two production shafts, declines, stopes, and associated underground workings.

Strathmore submitted a proposed Roca Honda mine plan and schedule to the federal and state regulators in 2012, and INTERA (2012) developed the Roca Honda three-dimensional numerical groundwater flow model (2012 RHR model) to assess the potential impacts for that mine plan. The proposed Roca Honda mine plan in 2012 included a production shaft, declines, and underground workings in Sections 9, 10, and 16. The modeling results (INTERA, 2012) supported Strathmore's application for a mine dewatering permit from the NMOSE, and formed the basis for the section of "Affected Environment and Environmental Consequences" in the draft Environmental Impact

Statement (USDA, 2013). However, under the 2016 revised mine plan and schedule, underground mine workings are proposed in Section 17, as well as Sections 9, 10, and 16, necessitating an update to the 2012 assessment of potential impacts.

Under the November 2016 mine plan developed by EFRI, mining will begin in Section 17 and advance into Sections 16, 9, and 10 over a 13-year period with production from all four sections occurring over a 10-year period. In Section 17, renovation of the existing production shaft, construction of the underground workings and stopes, and mining will take 13 years. Construction of a production shaft in Section 16 is projected to take nearly three years, passing through three aquifer units: Gallup Sandstone (Gallup), Dakota Sandstone (Dakota), and Westwater. After that, construction of underground workings and mining of the Westwater in Sections 9, 10, and 16 will last another ten years.

The mine workings will be the primary means of dewatering the mine so that mining can occur safely and efficiently. Dewatering wells will be completed in the Gallup, Dakota, and Westwater aquifer units as needed. A well in the Gallup will supply the mine with drinking water.

We updated the 2012 RHR groundwater flow model (INTERA, 2012) to estimate the dewatering inflows and assess potential hydrologic impacts to springs, wells, and surface water resources from Roca Honda dewatering proposed under the 2016 mine plan. We continued the approach used for the 2012 RHR model impact assessment and applied the maximum estimated average annual dewatering rate in the Westwater to each of the 13 years of mine operation to conservatively assess potential impacts for the most recent mine plan and schedule. As discussed in Section 4.1 below, this rate is only expected to occur at the 7th year of the mine plan in reality; therefore, application of this rate to each year is very conservative and will lead to more drawdown than expected for the November 2016 mine plan.

2.0 OBJECTIVE

The objective of this assessment is to estimate the potential impacts caused by Roca Honda mine dewatering proposed under the 2016 revised mine plan. The potential impacts include changes in groundwater levels in the Gallup, Dakota, and Westwater aquifers, changes in groundwater levels in springs and regional water supply systems, changes in groundwater flow to major rivers, and changes in water balances for the Westwater aquifer. This memorandum describes the updates to the 2012 RHR model required for the assessment of potential impacts and presents the resulting estimated impacts to springs, wells, and surface water resources for the November 2016 Roca Honda mine plan in Sections 9, 10, 16, and 17.

3.0 POTENTIAL IMPACTS FROM 2012 ROCA HONDA MINE PLAN

As described in INTERA (2012), the 2012 RHR model was developed and used to evaluate the impacts on groundwater levels, springs, groundwater flow to rivers, and water balance for the 2012 Roca Honda mine plan for workings in Sections 9, 10, and 16. The 2012 RHR model was successfully calibrated to both pre-development and transient 1930 to 2012 conditions, which made it the most reliable and accurate tool available for estimating the effects of proposed mine dewatering. The assessment results revealed that dewatering at the Roca Honda mine is conservatively predicted to cause:

1. Negligible drawdown at springs, including Horace Spring;
2. Negligible impacts on groundwater discharge to the San Juan River, Rio Puerco, Rio San Jose, and Puerco Rivers;
3. No adverse effects to the water resources of the Village of Milan, Acoma Pueblo, Laguna Pueblo, the City of Grants, the community of San Mateo, the Crownpoint area, or the City of Gallup; and
4. Enough drawdown at wells B-1104 and B-1115, which are located within the model domain and relatively close to the Roca Honda mine, such that Strathmore agreed to plans of replacement for them (Stipulated Facts and Conclusions, 2013).

Based on a Theis drawdown calculation, NMOSE also identified well B-1636 as potentially having significant drawdown. This well lies outside of the Westwater aquifer in the RHR conceptual model and RHR numerical model; however as directed by NMOSE, Strathmore agreed to provide a plan of replacement for this well (Stipulated Facts and Conclusions, 2013).

The 2012 RHR model was accepted as part of the draft Environmental Impact Statement for the 2012 mine plan and formed the basis for the mine dewatering permit granted by the NMOSE in 2014. At the request of the US Forest Service, the sensitivity of results from the 2012 RHR model was tested for a tenfold increase in the vertical hydraulic conductivity of the Brushy Basin aquitard and for dewatering at the Gulf Mt. Taylor mine. Results from these “hard-look” simulations, as there were called by the US Forest Service, showed negligible changes in impacts from RHR mine dewatering, thus reinforcing the original findings of the 2012 RHR groundwater flow modeling.

4.0 ASSESSMENT APPROACH FOR 2016 ROCA HONDA MINE PLAN

We adopted the same approach used to assess potential impacts from the 2012 Roca Honda mine plan to assess potential impacts from the 2016 mine plan. We compared the results from predictive simulations of groundwater flow without and with Roca Honda dewatering to estimate potential impacts to springs, wells, and rivers.

As for the 2012 impact assessment, the two predictive simulations are called Scenarios 1 and 2 and are defined as:

- Scenario 1 – Pumping occurs at the Crownpoint and City of Gallup public water supplies and dewatering occurs at the Lee Ranch coal mine but no dewatering at Roca Honda mine. This scenario estimates the effects on future groundwater levels from current pumping stresses and represents current and future "baseline" conditions.

- Scenario 2 – Pumping occurs at the Crownpoint and City of Gallup public water supplies with dewatering at the Lee Ranch coal mine and dewatering at the proposed Roca Honda mine. This scenario estimates the effects on future groundwater levels from current pumping stresses plus Roca Honda mine dewatering.

In order to create the predictive simulations for impact assessment, we first updated the 2012 Roca Honda groundwater flow model to represent the November 2016 mine plan by making changes in the locations and timing of dewatering stresses. These changes are described in the sub-sections below.

4.1 Dewatering for 2016 Roca Honda Mine Plan

Mining under the 2016 mine plan will occur beneath four sections during a 13-year period. The locations of the underground mine workings are shown in **Figure 1**. Renovation of the existing shaft in Section 17, construction of stopes and underground workings in Section 17 will occur over a 13-year period beginning in year 1 (**Table 1**). Shaft construction in Section 16 will begin in year 1 with dewatering wells completed in the Gallup aquifer, then continue in the Dakota and Westwater aquifers, and will take nearly 3 years to complete (**Table 1**). After the shaft is completed, declines and underground workings in Sections 9, 10, and 16 will be constructed over a 10-year period from year 4 through year 13 (**Table 1**). Groundwater will be withdrawn by means of wells and sumps around the production shaft and along the main mine tunnel and mine workings, then treated and discharged. Water for the mine will be supplied by pumping at 30 gallons per minute (gpm) from a well in the Gallup aquifer during the life of the mine. When mining is complete, all Roca Honda pumping from the Westwater and Gallup will end.

We estimated the dewatering inflows for each year of the 2016 mine plan by modifying the 2012 RHR model to represent the new mine workings. INTERA (2017) provides a detailed description of all modifications made. In brief, modifications to the 2012 RHR model included

1. Changes to the horizontal discretization of the model grid so that spacing was consistent across mine workings;

2. Changes to the vertical discretization to better represent the available geologic information;

3. Changes to model stress periods to follow the 2016 mine schedule; and

4. Placing and configuring drain boundary conditions in model cells intercepted by mine workings to represent opening of workings according to the 2016 mine plan and schedule for the dewatering simulations.

No changes were made to the domain extent, boundary conditions (other than those representing the mine workings), or hydraulic properties of the hydrolithologic units used in the 2012 RHR model. Disposal of the water produced by mine dewatering is not included in the model update. We compared the pre-development and transient historical calibration results to those from the 2012 RHR model and found negligible changes to the model calibration (INTERA, 2017).

Dewatering simulation results for the November 2016 mine plan showed that total average annual inflow rates of all the mine workings ranged from about 2,170 to about 5,920 gpm (INTERA, 2017). The maximum average annual inflow rate of 5,920 gpm occurs in year 7 of the mine plan. Average annual inflow rates for the mine workings in Section 17 were higher in the early mining period and decreased gradually, whereas average annual inflow rates for the mine workings in Sections 9, 10, and 16 were lower in the early mining period and increased gradually. The total average inflow rate of all mine workings was about 4,700 gpm.

4.2 Assessing Potential Impacts from 2016 Roca Honda Mine Plan

We created the simulations for Scenario 1 and Scenario 2 that are needed to assess potential impacts using the updated 2016 RHR model. We removed the drains and extended the simulation period for 100 years after the end of Roca Honda mining for a total of 113 years. The simulations for both scenarios used the groundwater heads at the end of the transient calibration simulation as the starting heads. For Scenario 1, which predicts future conditions without mining at Roca Honda, the only pumping stresses that remove water are the public water supplies at Gallup and Crownpoint and the Lee Ranch coal mine wells. For Scenario 2, which predicts future conditions with mining at Roca Honda, pumping stresses include the public water supplies in Gallup and Crownpoint as well as dewatering at the Lee Ranch coal mine and at Roca Honda.

We selected conservative pumping rates to represent withdrawals from the Gallup, Dakota, and Westwater aquifers for Roca Honda dewatering in Scenario 2, just as was done for the 2012 RHR model. Groundwater will be pumped at the same rates and time periods from the Gallup and

Dakota during the Section 16 shaft production in the 2016 mine plan model as in the 2012 mine plan model (**Table 2**). The pumping rate for shaft construction in Section 16 is 502 gpm for one year in the Gallup and 144 gpm for another year in the Dakota (**Table 2**). Moreover, groundwater will be pumped from the Gallup at an additional rate of 30 gpm to support water supply needs during the entire life of mine (**Table 2**). Mining Section 17 increased the maximum annual dewatering rate for the November 2016 mine plan relative to the 2012 mine plan. Stope and underground mine workings in Section 17 will be constructed in the Westwater over the 13-year period under the 2016 mine plan and schedule. As a consequence, the maximum average annual dewatering rate for the Westwater is larger than that used in the 2012 RHR model and it is applied over a longer period than the 2012 RHR model (**Table 2**). For the 2016 RHR model, the maximum average annual rate of 5,900 gpm is applied to the mine workings in the Westwater over the entire 13-year mining period, whereas the maximum rate was 4,500 gpm and was applied for 10 years in the 2012 RHR model (**Table 2**).

According to the 2016 revised mine plan and schedule, the average annual dewatering rates were conservatively estimated to vary between 2,170 and 5,920 gpm over the 13-year mining period with an overall average of 4,700 gpm (Section 4.1 and INTERA, 2017). The maximum annual dewatering rate of about 5,900 gpm only occurs during the seventh year of the 13-year mine plan; the maximum annual rates are smaller for all other years under the November 2016 mine plan (Section 4.1 and INTERA, 2017). This means that the potential impacts simulated in the 2016 RHR model are very conservative because the simulated Westwater dewatering is much larger than will actually occur during the mining period, thus causing simulated drawdowns that are much larger than those expected when the mine operates.

As was done for the 2012 RHR model, we used the specified flux (well) boundary condition to force the maximum dewatering rate across all mine workings, including the production shaft, declines, stopes, and underground workings in Sections 9, 10, 16, and 17. The specified flux boundary conditions were placed in a total of 180 model grid cells located along the proposed mine workings (**Figure 1**), compared to 77 model grid cells in the 2012 RHR model. The combined pumping rate from the individual specified flux boundary condition cells was checked to ensure that it equaled 5,900 gpm at all times and that the groundwater level in those boundary condition cells did not fall below the bottom of the Westwater.

We compared the differences in results for Scenarios 1 and 2 to assess the potential impacts caused by the proposed 2016 Roca Honda mine dewatering, as was done for the 2012 RHR model. Potential impacts were defined as changes in groundwater levels and changes in groundwater discharges to surface water bodies and Horace Spring, as was done for the 2012 RHR model. Changes are defined as the difference between Scenario 2 results and Scenario 1 results because the Westwater aquifer is still recovering from historical mine dewatering, so groundwater levels continue to change even without Roca Honda pumping. We calculated and plotted the differences in groundwater levels between Scenarios 1 and 2 in the Gallup, Dakota, and Westwater at each model cell over time to assess potential impacts from mine dewatering drawdown. To assess potential impacts at springs and wells, we identified the grid cells in which they are located, then examined all drawdown values at each cell and selected the maximum drawdown for each. To assess potential impacts on groundwater flow to the rivers, we used the boundary reach reporting tool in Groundwater Vistas (Rumbaugh and Rumbaugh, 2011) to quantify the cumulative values of groundwater discharge into and seepage out of rivers for both Scenarios 1 and 2. The differences of the cumulative flux values between the two scenarios were compared to Scenario 1 results over the 13-year mining period and subsequent 100-year recovery period.

Changes to water balances for the Gallup, Dakota, and Westwater aquifers were also assessed, as had been done for the 2012 RHR model. We used the USGS ZONEBUDGET (Harbaugh, 1990; Harbaugh, 2008) tool to extract the fluxes between different hydrostratigraphic units (aquifers and aquitards) and boundary conditions. ZONEBUDGET reads the model output that contains the flows between adjacent model cells for each time step. The USGS ZONEBUDGET tool only works with flux rates, not cumulative fluxes, so it is sensitive to the frequency with which results are written to the output files. The values of water balance components were calculated for both Scenarios 1 and 2, and then compared to evaluate how the proposed mine dewatering affects each component, such as aquifer storage, leakage from adjacent aquitards, etc.

5.0 RESULTS

5.1 Comparison with 2012 RHR Model Results

Results from the 2016 RHR modeling were very similar to those from the 2012 RHR modeling. As expected, comparison of groundwater levels simulated in the 2016 Scenario 1 with those in the 2012 Scenario 1 showed close agreement. Potential impacts from the 2016 RHR model simulations were also very similar to those determined with the 2012 RHR model. The 2016 mine plan is predicted to have negligible impact on the springs and groundwater flow to rivers. Aquifer drawdown and drawdown at the wells in the vicinity of mine are higher under the 2016 mine plan than those found in the 2012 RHR model, which is understandable due to the higher dewatering rate and longer pumping period in the Westwater. Overall, similar impacts were found and no new impacts were identified. The details of the impacts on aquifer drawdown, springs, wells, groundwater flow to rivers, and water balance are described below.

5.2 Drawdown in the Gallup, Dakota, and Westwater

Maximum drawdown in the Gallup occurs at the end of the first year of depressurization for construction of Section 16 production shaft. Thereafter, groundwater levels in the Gallup recover rapidly. After one year of depressurization pumping at a rate of 532 gpm, drawdown in the Gallup reaches a maximum of 378 feet at the production shaft, but the 10-foot contour of drawdown does not extend beyond the Roca Honda permit area (**Figure 2**). Drawdown in the Gallup is about 34 feet at the end of Roca Honda mining, and decreases to 1 foot at 100 years after the end of mining (**Figure 3**).

Maximum drawdown in the Dakota occurs at the end of the second year of depressurization for construction of the Section 16 production shaft, but the 10-foot contour of drawdown does not extend beyond the Roca Honda permit area (**Figure 4**). Drawdown in the Dakota near the production shaft reaches a maximum of 1,300 feet at the end of second year, decreases to 94 feet at the end of the Roca Honda mining, and continues to decrease to 25 feet at 100 years after the end of mining (**Figure 3**). The 10-foot drawdown contours in the Gallup and Dakota aquifers (**Figures 2 and 4**) do not reach the public water supplies at Crownpoint or the City of Gallup, or the pueblos of Laguna or Acoma.

Maximum drawdown in the Westwater occurs at the end of Roca Honda mining and decreases thereafter. The maximum extent of the simulated 10-foot contour of drawdown in the Westwater is located up to 8 miles beyond the Roca Honda permit area (**Figure 5**) at the end of mining. Within the Roca Honda permit area, drawdown reaches a maximum of 1,850 feet (**Figure 6**). At 40 years after the end of mining, the 10-foot contour of drawdown in the Westwater extends up to 15 miles beyond the permit area (**Figure 7**). By this time, the maximum drawdown within the permit area has decreased to 110 feet (**Figure 8**). At 100 years after the end of mining, the maximum extent of the simulated 10-foot drawdown in the Westwater contour is 17.3 miles beyond the permit area (**Figure 9**), but the largest drawdown is only 49 feet (**Figure 10**). The simulated 10-foot drawdown contour in the Westwater does not reach the Acoma Pueblo, the Laguna Pueblo, the Crownpoint water supply, or the two City of Gallup well fields.

5.3 Drawdown at Wells for Water Supply Uses

Drawdown is predicted to be larger at the non-project wells in the Westwater than those in the other hydrostratigraphic units in the vicinity of Roca Honda mine plan area (**Table 3**). Other hydrostratigraphic units include the Gallup, Dakota, and upper water-bearing sandstones. The non-project wells have multiple uses including mining purposes, domestic consumption, irrigation, or livestock watering. Note that monitoring and observation wells are not included. In the vicinity of the Roca Honda mine permit area, the San Mateo Community Water System pumps from the Point

Lookout sandstone, which is at least 1,900 feet stratigraphically higher than the Westwater and encompasses at least 1,600 feet of shale-dominated aquitards (e.g., Brushy Basin, Mancos, and upper Mesaverde Group). Although the public water supplies for the Village of Milan and the City of Grants are located within the model area, their water supply wells are also not constructed in the hydrostratigraphic units that could be affected by Roca Honda mine dewatering. Away from the Roca Honda mine permit area, public water supply wells that pump from the Gallup within the model area include those for Crownpoint and the City of Gallup, none of which are affected by the Roca Honda mine dewatering.

Nine Westwater wells are predicted to have drawdown that ranges between 41 and 393 feet (**Table 3**). These are the same nine Westwater wells identified in the INTERA (2012) report and the 2013 mine dewatering hearing before the NMOSE. Although the drawdowns under the 2016 mine plan are somewhat larger, the remaining water column in seven of the wells is more than sufficient for production to remain unimpaired (Hydroscience Associates, 2017). RHR already committed to replacing the remaining two wells, B-1104 and B-1115, as well as the B-1636 well that is not in the model domain (Stipulated Facts and Conclusions, 2013). Maximum drawdown occurs at these wells between 14 and 62 years after the start of Roca Honda mine dewatering and then declines.

Drawdown is predicted to be between 8 and 30 feet at two wells screened in the Dakota (**Table 3**). These are the same two Dakota wells identified in the INTERA (2012) report and the 2013 mine dewatering hearing before the NMOSE. Although the drawdowns under the 2016 mine plan are somewhat larger, the remaining water column in the wells is more than sufficient for production to remain unimpaired (Hydroscience Associates, 2017). Maximum drawdown in the Dakota wells occurs 36 years after the start of Roca Honda mine dewatering and declines thereafter.

Drawdown is predicted to be between 5 and 58 feet at four wells in the Gallup (**Table 3**). Three of these were considered in the INTERA (2012) report and the 2013 mine dewatering hearing before the NMOSE. The fourth well, B-1442 expl-2, is a deep exploratory well. The remaining water columns in all the wells will be more than sufficient for production to remain unimpaired (Hydroscience Associates, 2017). Maximum drawdown in the Gallup wells occurs mostly in the first year of Roca Honda mine dewatering and then declines thereafter.

Drawdown is predicted to be less than 4 feet at six wells completed in the Mancos Shale, and less than 11 feet at 92 wells in the younger hydrostratigraphic units (Point Lookout Sandstone, Menefee Formation, Crevasse Canyon Formation, and other upper Mesaverde Group units). Only four of the 92 wells in these younger units have drawdown greater than 5 feet (**Table 3**). For the two wells in the community of San Mateo, maximum drawdown is 0.5 feet at the water supply well B-428 (**Table 3**), which is screened across the Point Lookout Sandstone and the Menefee Formation.

Maximum drawdown reaches 1.7 feet at the public supply well B-428S (**Table 3**), which is screened across the Point Lookout Sandstone. The results are consistent with the little that is known about water level declines in the area of the Mt. Taylor mine during historical dewatering. There is no historical evidence that past dewatering of the Mt. Taylor mine affected water levels in local shallow domestic, stock, and water supply wells in the San Mateo area, all of which were completed in the Point Lookout Sandstone and the overlying Menefee Formation or alluvium. The potable water supply wells for both the Mt. Taylor mine and the community of San Mateo, completed in the Point Lookout Sandstone in the immediate vicinity of the mine, continued as viable water supply wells during the period the mine was dewatered, suggesting that any water level changes were not significant.

5.4 Drawdown at Springs

Dewatering at Roca Honda mine is predicted to have negligible impacts on the springs located on Mt. Taylor or in the vicinity of the Roca Honda permit area. Potential impacts to Horace Spring are discussed in the next sub-section. The predicted changes in groundwater levels in these springs show that maximum drawdown caused by Roca Honda mine dewatering are predicted to be 0.01 feet or less at 24 of the 25 springs (**Table 4**). The single exception is Bridge Spring, where a drawdown of 0.73 feet is predicted at 100 years after the end of mine dewatering. Located on private property, Bridge Spring is the nearest spring to the Roca Honda permit area.

5.5 Impacts on Groundwater Flow to River and Horace Spring

Dewatering at Roca Honda mine is predicted to have negligible impacts on groundwater flow to the main rivers and Horace Spring within the model domain during the 13-year mining period. Discharge of water produced from mine dewatering is not included in the assessment of potential impacts. The changes in net groundwater flow into the river cells from Scenario 2 relative to Scenario 1 are less than 1% for Horace Spring, Rio Puerco, and San Juan River, whereas the changes in net groundwater flow into the Rio San Jose and out of the Puerco River are 1% and 4% respectively during the 13-year mining period (**Table 5**). During that same time period, groundwater discharge to the San Juan River is estimated to show a negligibly small net gain of 58 ac-ft (0.03% of net discharge), groundwater discharge to the Rio Puerco is estimated to be a negligibly small loss of 34 ac-ft (0.1% of net discharge), groundwater discharge to the Rio San Jose is estimated to have a net gain of 29 ac-ft (1% of net discharge), and the estimated change in groundwater discharge to Horace Spring is 1 ac-ft (0.1% of net discharge). (**Table 5**). The estimated differences at the Horace Spring are sufficiently small to be considered effectively zero, whereas the error for measuring flow is certain to be far larger than 1 ac-ft. Puerco River discharges to groundwater, and the estimated change in discharge from the Puerco River is 89 ac-ft (4 % of net discharge) during the 13-year mining period (**Table 5**).

Dewatering at Roca Honda mine is also predicted to have negligible impacts on groundwater flow to those rivers and Horace Spring during the subsequent 100 years after the end of 13-year mining period. During the 100-year period, the changes in net groundwater flow into the river cells from Scenario 2 relative to Scenario 1 are less than 1% for the San Juan River, Rio Puerco, Rio San Jose, Puerco River, and Horace Spring. Groundwater discharge to the San Juan River is estimated to show a negligibly small net loss of 198 ac-ft (0.02% of net discharge), groundwater discharge to the Rio Puerco is estimated to be a negligibly small gain of 37 ac-ft (0.02% of net discharge), groundwater discharge to the Rio San Jose is estimated to have a net loss of 24 ac-ft (0.1% of net discharge), and the estimated change in groundwater discharge to Horace Spring is 9 ac-ft (0.1% of net discharge) (**Table 5**). Puerco River discharges to groundwater, and the estimated change in discharge from the Puerco River is 38 ac-ft (0.1% of net discharge) (**Table 5**).

5.6 Impacts on Water Balance

During the 13-year mining period, the removal of groundwater from the Westwater to dewater the Roca Honda mine is balanced by the change in aquifer storage, leakage from the adjacent aquitards, and groundwater discharge to rivers (**Table 6**). Decrease in aquifer storage accounts for 98% of the estimated 123,717 ac-ft of water removed from the Westwater by Roca Honda mine dewatering over 13 years. This storage decrease comprises two parts: one part from Scenario 1 and one part from Scenario 2. Under Scenario 1 (no RHR pumping), the amount of water in the Westwater is predicted to increase by 16,581 ac-ft as water levels rebounded from historical pumping, but this rebound water is captured instead by RHR dewatering (**Table 6**). Under Scenario 2, the amount of water stored in the Westwater aquifer is estimated to decrease by 104,706 ac-ft (**Table 6**). Increased leakage from the Brushy Basin aquitard accounts for 2% of the water extracted from the Westwater by Roca Honda mining, because the amount of water that leaked out of the Brushy Basin aquitard under Scenario 2 is 2,503 ac-ft larger than that for Scenario 1 (**Table 6**). An effectively zero (0.0%) percentage of water extracted from the Westwater during Roca Honda mining comes from groundwater discharge to rivers.

During the 100 years after the end of mining, the comparison of inflows and outflows to the Westwater for Scenarios 1 and 2 show minor differences. Total outflows for Scenario 1 and 2 show negligible differences whereas total inflows show a roughly 4% difference, attributable to the increase in seepage from the Brushy Basin aquitard under Scenario 2 (**Table 6.**). These results indicate that there are negligible impacts to the Westwater water balance for the 100 years after mining ends from Roca Honda dewatering.

5.7 Sensitivity Analysis

A sensitivity analysis was conducted to evaluate the potential impacts from Roca Honda mine dewatering with changes to key model parameters in the updated Scenario 1 and Scenario 2 simulations (base case). Nearly all pumping for dewatering will occur in the Westwater, and given that drawdown increases as hydraulic conductivity or specific storage decrease, sensitivity simulations were run to examine whether the 10-foot drawdown contour in the Westwater changes significantly if the hydraulic conductivity and specific storage in part of the Westwater aquifer along the San Juan Basin's southern margin were reduced relative to the base case simulations. The base case horizontal hydraulic conductivity is 1.25 ft/day, and the base case specific storage is 3×10^{-5} 1/ft. Four sensitivity simulations were conducted:

- The horizontal hydraulic conductivity was decreased to 0.125 ft/day;
- The horizontal hydraulic conductivity was decreased to 0.25 ft/day;
- The specific storage was decreased to 3×10^{-6} 1/ft;
- The specific storage was decreased to 1.5×10^{-5} 1/ft.

The above four simulations could not be completed because neither the reduced hydraulic conductivity nor specific storage can support the dewatering rate of 5,900 gpm in the Westwater. If these lower hydraulic conductivity or specific storage values are indeed present in the Westwater, then the proposed pumping rates to dewater the Roca Honda mine will be lower than those values listed in **Table 2**.

The second set of sensitivity simulations tested whether the very low hydraulic conductivity assumed for the Mt. Taylor core volcanics within the Gallup, Dakota, and Westwater prevented drawdown from propagating towards the Acoma or Laguna Pueblos. The base case horizontal hydraulic conductivity value is 0.1 ft/day. Two sensitivity simulations were performed with the horizontal hydraulic conductivity as 1 and 0.01 ft/day, ten times larger and smaller, respectively, than the original value. Results indicate that there is no significant difference between the locations of the 10-foot drawdown contours in the Westwater from the sensitivity simulations and the base case simulation at the end of mining (**Figure 11**). Just as was observed for the base case results, the 10-foot drawdown contours in the Westwater for the sensitivity simulations will also not reach the Acoma Pueblo, the Laguna Pueblo, the Crownpoint water supply, Horace Spring, or the two City of Gallup well fields (**Figure 11**).

The last sensitivity simulation was similar to one of the previous "hard-look" simulations, which tested whether a tenfold increase in the vertical hydraulic conductivity in the Brushy Basin aquitard affects potential impacts. The vertical hydraulic conductivity was increased from the base case value of 5×10^{-6} ft/day to 5×10^{-5} ft/day. Results indicate that there are negligible differences between the locations of the 10-foot drawdown contours in the Westwater at the end of mining from the sensitivity and base case simulations. Also, the 10-foot drawdown contours in the Westwater will not reach the Acoma Pueblo, the Laguna Pueblo, the Crownpoint water supply, Horace Spring, or the two City of Gallup well fields. Furthermore, this sensitivity simulation shows that Roca Honda mine dewatering has negligible impacts on the springs, including Horace Spring, and on groundwater discharge into and seepage out of the San Juan River, Rio Puerco, Rio San Jose, and Puerco River.

The impact analysis for the proposed Roca Honda mine over-estimates drawdowns in the aquifer units because the analysis assumed that dewatering occurred at the maximum permitted rate for the entire permitted duration. Actual dewatering rates will gradually increase as mine workings are slowly extended away from the shafts and will not approach the maximum rate for a number of years. At the end of mining, this conservative approach causes an area of approximately 3.0×10^8 ft^2 (about 6,900 acres) to have drawdown of 500 ft or more, whereas the actual area of mine workings is about 2.0×10^7 ft^2 (about 460 acres). The volume of water removed for dewatering is directly proportional to the area to be dewatered, so the volume of water estimated to be removed using the maximum permitted pumping rate is significantly larger than the volume of water that will actually be removed from the Westwater during mining. For these reasons, the total volume of groundwater pumped during dewatering will likely be much less than has been simulated, and drawdowns will be commensurately less than those simulated by this impact analysis.

Simulated dewatering of the Westwater provides a good match to historical mine dewatering data for the same general area and geology. The simulated rates and total volume to be dewatered compare well with data from historical uranium mining operations in the Westwater. The Roca Honda mine dewatering volume over 13 years is estimated to be approximately 123,717 ac-ft. Approximately 76,000 ac-ft were pumped at the nearby Johnny M mine over about 9 years (INTERA, 2012). At the Gulf Mt. Taylor mine, historical pumping rates reached 9,000 gpm and stabilized at about 4,500 gpm, and more than 660,000 ac-ft of water was pumped over 27 years (INTERA, 2012). The total volume of water dewatered in the Ambrosia Lake district was roughly 1.4 million ac-ft during a 31-year period (INTERA, 2012).

6.0 SUMMARY

In summary, the proposed Roca Honda mine dewatering will have (1) negligible impacts on groundwater levels at the public water supplies for Crownpoint and Gallup or at the pueblos of Laguna and Acoma, (2) essentially no impact on springs - including the Horace Spring, and (3) negligible impact on groundwater flow to rivers with perennial reaches, including the San Juan River, Rio San Jose, Puerco River, and Rio Puerco.

The maximum extent of the 10-foot contour of drawdown in the Westwater is predicted to be 17.3 miles. Drawdown at nine wells screened in the Westwater in the vicinity of the Roca Honda permit area is predicted to range from 41 to 393 ft, but only two are predicted to have enough drawdown for plans of replacement (Stipulated Facts and Conclusions, 2013). The 10-foot contour of drawdown in the Gallup and Dakota does not extend beyond the Roca Honda permit area. Drawdown is predicted to be 8 and 30 feet at two wells screened in the Dakota and between 5 and 58 feet at four wells in the Gallup; none of which is predicted to have enough drawdown to potentially require plans of replacement.

The public water supplies for the Village of Milan and the City of Grants will not be affected by Roca Honda mine dewatering because they pump groundwater from aquifers that are stratigraphically much lower than the Westwater aquifer, and are separated from the Westwater aquifer by thick shale with low hydraulic conductivity. The proposed Roca Honda mine dewatering will not adversely affect the water resources of the Acoma Pueblo, Laguna Pueblo, the Crownpoint area, or the City of Gallup. Mine dewatering may cause water level declines between 0.5 and 1.8 feet at the end of mining in the area of the public water supply wells for the community of San Mateo, but those wells pump from the Point Lookout Sandstone and Menefee Formation, not the Westwater.

The water removed by Roca Honda mine dewatering will be balanced by changes in aquifer storage and leakage from the various aquitard units: Brushy Basin, Mancos Shale, and upper Mesaverde group sediments. Furthermore, the sensitivity simulations show that reducing the horizontal hydraulic conductivity or specific storage in part of the Westwater aquifer along the San Juan Basin's southern margin by 5 or 10 times cannot support the dewatering rate of 5,900 gpm in the Westwater. No significant changes in the maximum extent of the 10-foot drawdown contour occur even if the horizontal hydraulic conductivity for the Mt. Taylor volcanic cores within the Gallup, Dakota, and Westwater is assigned an unrealistically high value. Moreover, increasing the vertical hydraulic conductivity of the Brushy Basin aquitard by tenfold is predicted to cause negligible differences in Westwater groundwater level changes compared to the base case simulation.

The model provides a conservative assessment of potential impacts from Roca Honda mine dewatering. The pumping rates and pumping time periods used to represent Roca Honda mine dewatering result in larger drawdowns than those that are expected to actually occur. Actual Roca Honda mine dewatering rates will increase gradually over the 13-year mining period, whereas the model simulations assumed the maximum anticipated dewatering rate for the maximum permitted time. This modeling approach results in a larger area than is necessary for mining to be dewatered. Realistically, actual pumping rates over time will be significantly less.

7.0 REFERENCES

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TABLES

Table 1. Proposed Roca Honda Mine Schedule for Sections 9, 10, 16, and 17

Mine Workings	Aquifer	Start Year	End Year	Mining Duration
Stopes and Underground Workings in Section 17	Westwater	1	13	13 years
Shaft in Section 16	Gallup	1	1	305 days
	Dakota	1	2	210 days
	Westwater	2	3	550 days
Declines and Underground Workings in Sections 9, 10 and 16	Westwater	4	13	10 years

Table 2. Maximum Dewatering Rates for 2012 and 2016 Mine Plans

Aquifer	Dewatering Depth (feet)	2012 Mine Plan		2016 Mine Plan	
		Maximum Pumping Rate (gpm)	Pumping Period (years)	Maximum Pumping Rate (gpm)	Pumping Period (years)
Gallup	640	502	1	502	1
		30	12	30	13
Dakota	1,710	144	1	144	1
Westwater	2,100 – 2,800	2,000	2	5,900	13
		4,500	10		

Table 3. Potential changes in groundwater levels at wells with water supply uses.

BDR Well ID	NAD 1983 UTM 13N		Well Location in Model			Depth of Well (ft)	Well Elevation (ft)	OSE File No.	Use	Aquifer	Maximum Drawdown (ft)
	Easting (m)	Northing (m)	Row	Column	Layer						
73	260350	3913856	78	135	10	3535	7300	B-00516	MIN	Jmw	286.7
143	252142	3916113	117	94	10	940	7010	B-1778	DOM	Jmw	392.9
1	262362	3912136.2	76	137	10	4207	8209			Jmw	181.3
137	250527	3920058	101	84	10	1553	7133	B-00993-S	MIN	Jmw	188.4
136	249310.1	3920610.5	105	80	10	1398	7077	B-00993	MIN	Jmw	112.9
119	249502.1	3914856	125	91	10	280	6867			Jmw	84.2
109	249372	3915145	125	90	10	303	6890	B-01104	DOM	Jmw	75.9
106	248512	3916669	124	86	10	390	6900	B-01190	STK	Qal/Jmw	79.7
111	247479	3915109	128	87	10	478	6847	B-01115	DOM	Jmw	40.8
17	252103	3916155	117	94	8	715	7041	B 01544	DOM	Kd	29.8
129	258241.4	3925189.3	55	89	8	830	7201			Kd	7.6
128	258241.4	3925189.3	55	89	7	1320	7201			Km	3.1
130	257531.2	3924423.1	55	89	7	1320	7247			Km	3.1
67	260736	3913769.8	76	136	7	2000	7352			Km	1.1
72	260727.7	3913778.1	76	136	7	2000	7349			Km	1.1
107	250096.7	3916461.4	121	89	7	155	6942			Km	0.3
101	252287	3912456	125	119	7		7267	B-00997	MUL	Km	0.1
10	254510.3	3916097.2	102	109	6		7174			Kg	58.2
146	257834	3916765	74	128	6	1420	7170	B1786 Exp	EXP	Kg	56.3
16	254295	3915909	105	109	6	320	7152	B 01084	STK	Kg	35.5
32	258063	3913591	96	134	6	1150	7123	B 01442 EXP L-2	EXP	Kg	4.9
7	258514.1	3917001.6	68	130	5	192.3	7198			Kmf	10.2
19	255825	3913453	112	131	5		7037	B 00557	PUB	Qal	9.0
20	257901.8	3914231.9	92	133	5	157.3	7103			Kmf	7.7
22	257866	3914204	92	133	5	476	7103	B 01085	IRR	Kpl	7.7
33	258355	3913491	94	134	5	68	7152	B 00544	SAN	Qal	4.1
25	257845	3913200	100	134	5	620	7136	B 01442	EXP	Kpl	3.8
8	259531.5	3915409.5	72	134	5		7185			Kmf	3.3
9	259531.5	3915409.5	72	134	5	200	7185			Kmf	3.3
4	260080.1	3919137.6	58	128	5	400	7162			Kmf	2.4
99	256604	3912429	114	134	5	300	7080	RG-43456	STK	Kmf	1.6
5	260480.2	3918556.4	58	131	5	394	7231	RG 33107 EXPL	EXP/DOM	Kmf, Kpl	2.2
37	259448	3913362	88	135	5		7247	B 00736	DOM	Qal	1.9
38	259448	3913362	88	135	5	80	7247	B 00737	DOM	Qal	1.9

Table 3. Potential changes in groundwater levels at wells with water supply uses.

BDR Well ID	NAD 1983 UTM 13N		Well Location in Model			Depth of Well (ft)	Well Elevation (ft)	OSE File No.	Use	Aquifer	Maximum Drawdown (ft)
	Easting (m)	Northing (m)	Row	Column	Layer						
75	259881.5	3912990	87	135	5	150	7303			Kmf	1.9
29	259385.7	3913592	86	135	5	100	7224			Qal	1.9
56	259898.1	3913126.6	86	135	5	200	7297			Kmf	1.9
57	259898.1	3913128.6	86	135	5	140	7297			Kmf	1.9
61	259898.1	3913131	86	135	5	120	7297			Kmf	1.9
62	259898.1	3913131	86	135	5	200	7297			Kmf	1.9
35	259248	3913362	89	135	5	73	7224	B 00734	DOM	Qal	1.8
36	259248	3913362	89	135	5	65	7224	B 00735	DOM	Qal	1.8
79	259632.6	3912981.7	89	135	5	21	7287			Qal	1.8
85	259733	3912847	89	135	5	230	7300	B-00906	DOM	Kmf,Qal	1.8
28	258857.4	3913552.2	90	135	5	79	7178			Qal	1.8
92	259508.2	3912990	90	135	5	57.5	7277			Kmf	1.8
63	260039.1	3913371.6	84	135	5	500	7280			Kmf	1.9
31	259048.8	3913331.9	91	135	5	92	7205			Kmf	1.8
96	259431	3912957	91	135	5	80	7274	B-00738	DOM	Qal	1.8
58	260321.2	3913363.3	82	135	5	250	7316			Kmf	1.9
64	260312.9	3913363.3	82	135	5	250	7316			Kmf	1.9
65	260312.9	3913363.3	82	135	5		7316			Kmf	1.9
26	258686.9	3913537.5	92	135	5		7172			Kmf	1.8
27	258686.9	3913396.5	93	135	5	305	7175			Kmf	1.7
30	258867.2	3913340.1	92	135	5		7185			Qal	1.8
90	259251	3913006.6	92	135	5	336	7254			Kpl	1.8
91	259251	3913006.6	92	135	5	200	7254			Kmf	1.8
93	259231	3912957	92	135	5	703	7251	B-00428 S	MDW	Kpl	1.8
94	259332	3912858	92	135	5	185	7270	B-01185	DOM	Kmf	1.8
95	259231	3912957	92	135	5	707	7251	B-00385	EXP	Kpl	1.8
54	260321.2	3913496	81	135	5	prob.60	7310			Qal	1.9
34	258652	3913380	93	135	5	300	7175	B 00815	DOM	Kmf	1.7
53	260321.2	3913786.4	79	135	5	44	7303			Qal	1.9
55	260321.2	3913786.4	79	135	5	prob.60	7303			Qal	1.9
88	258846.4	3912971	95	135	5	40	7215			Kmf,Qal	1.7
89	258848.9	3912971	95	135	5	180	7215			Kmf	1.7
45	260329.5	3913919.1	78	135	5	160	7290			Kmf	1.8
46	260329.5	3913919.1	78	135	5	160	7290			Kmf	1.8

Table 3. Potential changes in groundwater levels at wells with water supply uses.

BDR Well ID	NAD 1983 UTM 13N		Well Location in Model			Depth of Well (ft)	Well Elevation (ft)	OSE File No.	Use	Aquifer	Maximum Drawdown (ft)
	Easting (m)	Northing (m)	Row	Column	Layer						
69	260478.8	3913769.8	78	135	5	32.5	7326			Qal	1.8
41	260055.7	3914201.1	77	135	5	285	7257			Kmf	1.8
42	260055.7	3914201.1	77	135	5	250	7257			Kmf	1.8
43	260329.5	3914201.1	76	135	5	60	7277			Qal	1.8
44	260329.5	3914201.1	76	135	5	65	7277			Qal	1.8
39	260072.3	3914591.1	75	135	5	63	7257			Kmf	1.8
40	260329.5	3914333.9	75	135	5	65	7274			Qal	1.8
97	258812	3912368	99	135	5		7261		STK	Kmf	1.5
48	260877	3914317.3	71	135	5		7323			Kmf	1.7
23	256194	3912240	117	134	5	32	7070	B 00415 O-3	DOM	Qal	0.9
24	256194	3912240	117	134	5	32	7070	B 00415 O-3	DOM	Qal	0.9
98	256355.8	3912417.6	116	134	5		7070			Kmf	1.2
47	261109.5	3914516.1	68	135	5	245	7425	B 01429	DOM	Kmf	1.6
66	260736	3913769.8	76	136	5	800	7352			Kpl	0.6
68	260736	3913769.8	76	136	5		7352			Kpl	0.6
70	260453.9	3913496	80	136	5	47.5	7326			Qal	0.6
59	260304.6	3913122.7	83	136	5	46	7362			Qal	0.6
60	260304.6	3913122.7	83	136	5		7362			Qal	0.6
74	260251	3913154	84	136	5	520	7349	B-00524	DOM	Kpl?	0.6
83	260006	3912990	86	136	5		7313			Kpl	0.5
76	259889.8	3912699.6	89	136	5	120	7339			Kmf,Qal	0.5
77	259889.8	3912699.6	89	136	5	250	7339			Kmf	0.5
78	259889.8	3912699.6	89	136	5		7339			Kpl	0.5
80	259881.5	3912699.6	89	136	5	35	7339			Kmf	0.5
81	259881.5	3912699.6	89	136	5		7339			Kmf	0.5
82	259997.7	3912716.2	89	136	5	325	7392	B-00428	MDW	Kpl,Kmf	0.5
131	260782.9	3922629.1	55	110	5	50	7021			Qal	0.5
132	260782.9	3922629.1	55	110	5	230	7021			Kpl	0.5
133	260782.9	3922629.1	55	110	5	260	7021			Kmf	0.5
84	259920	3912641	90	136	5	420	7349	B-00839	STK	Kmf	0.5
87	259818	3912539	91	136	5	210	7402	B-00829	DOM	Kmf,Qal	0.4
100	255202	3911899	121	133	5	210	7070	B-01086	STK	Kmf	0.7
86	259618	3912339	94	136	5		7333	B-00729	STK	Kmf	0.4
102	255740.2	3910867.1	122	134	5	600	7169			Kpl	0.3

Table 3. Potential changes in groundwater levels at wells with water supply uses.

BDR Well ID	NAD 1983 UTM 13N		Well Location in Model			Depth of Well (ft)	Well Elevation (ft)	OSE File No.	Use	Aquifer	Maximum Drawdown (ft)
	Easting (m)	Northing (m)	Row	Column	Layer						
103	255791.7	3910857.9	122	134	5	500	7169			Kpl	0.3
104	255750	3910641	122	134	5	320	7192	RG-43457	DOM	Kmf	0.3
123	263316.3	3924150	54	117	5		6913			Kpl	0.2
105	255937	3910028	123	135	5		7402	B-01046	PUB	Tb	2.1
120	251266.1	3914846.1	122	95	5	80	6913		STK	Qal	0.3
121	251266.1	3914846.1	122	95	5	80	6913		EXP	Qal	0.3
2	262181	3911688.6	81	137	5	>1980	8304				0.2
127	260941.7	3926787.1	53	91	5		6972			Kmf,Kpu	0.0
3	265362.3	3910526.5	67	138	5	~1500	8520				0.0
124	255438.2	3927730.8	55	79	5		7133			Kcda	0.0
126	255438.2	3927730.8	55	79	5		7133			Kcda	0.0

Note:

Use: DOM-Domestic; EXP-Exploration; IRR-Irrigation; MDW-Community type use; MIN-Mining; MUL-Multiple domestic households; PUB-Public supply; SAN-Sanitary in conjuction with a commercial use; STK-Livestock watering.

Aquifer: Jmw-Westwater Canyon Member; Kcda-Dalton Sandstone Member of the Crevasse Canyon Formation; Kd-Dakota aquifer; Kg-Gallup aquifer; Km-Mancos Shale; Kmf-Menefee Formation; Kpl-Point Lookout Sandstone; Kpu-Upper Point Lookout Sandstone; Qal-Quaternary alluvium; Tb-Basalt and andesite flows.

Depth of Well: "prob.60" indicates probably 60 ft; ">1980" indicates deeper than 1980 ft; "~1500" indicates about 1500 ft.

Table 4. Potential Changes in Groundwater Levels at Springs

NAME	NAD 1983 UTM 13N		Model Row	Model Column	Model Layer	Spring Surface Elevation from DEM (ft)	Grid Maximum Elevation (ft)	Grid Minimum Elevation (ft)	Surface Geology	Maximum Drawdown (ft)
	Easting (m)	Northing (m)								
Azabache, Ojo	287137	3944068	49	134	2	6398	7276	6292	Kmf	0.01
Bridge Spring	255994	3913748	109	131	2	7043	7053	7037	Kmf	0.73
Burro Springs	268041	3934954	51	89	1	6563	6660	6499	Kmf	0.02
Cerro Spring	266570	3925896	53	128	2	6844	6931	6601	Kmf	0.00
Chamisa Losa Spring	298065	3935212	49	139	1	6518	8028	6122	Kmm	0.01
Dado Spring, El	271825	3933069	51	117	2	6597	6692	6535	Kmf	0.00
Doctor Spring	268481	3933463	51	93	1	6603	6791	6574	Kmf	0.02
Encinal Spring	275079	3895799	106	142	6	7604	7900	7503	Tb	0.00
Fort Miguel Ruins Spring	266081	3921652	54	134	1	7098	7460	6961	Kmf	0.00
Jose Manuel Spring	305193	3889614	52	146	1	5823	6597	5600	Jsr	0.00
Marquez, Ojo	287501	3911593	52	141	1	7351	8503	6610	Kph	0.01
Montoya Spring	272974	3940595	50	89	1	6434	6745	6368	Kph	0.01
Ojo de las Yuges	273918	3930117	51	134	1	6739	7319	6702	Kmf	0.01
Padre, Ojo del	304915	3935029	48	141	1	5878	7237	5728	Kml	0.00
Pena Springs	267041	3936245	51	85	1	6545	6650	6519	Kmf	0.01
Redondo, Ojo	266717	3933478	51	90	1	6596	6672	6509	Kmf	0.01
Rinconada Canyon Spring	259560	3884466	151	141	7	6141	6364	6089	Kmm/Kd	0.00
Salazar Spring	269379	3935012	51	92	1	6595	6745	6558	Kmf	0.02
San Jose Atarque Spring	258621	3891998	148	140	1	7578	8057	7454	Kmm	0.00
San Lucas Spring	262675	3924611	54	110	1	6901	7352	6899	Kmf	0.00
San Ysidro Spring	263308	3932334	52	85	1	6646	6781	6604	Kmf	0.03
Sap Hole Spring	264857	3922178	54	133	1	6923	7086	6902	Kmf	0.00
Tecolote Springs, Ojo	284488	3903926	54	142	2	7793	8523	7099	Kpl	0.01
Unnamed Spring	262226	3892263	144	140	1	6935	7290	6397	Kcc	0.01
Yeguas, Ojo de las	273918	3930086	51	134	1	6745	7319	6702	Kmf	0.01

Table 5. Potential Changes in Groundwater Discharge to Rivers

	Cumulative Groundwater Discharge During the 13-Year Mine Dewatering Period (ac-ft)			Cumulative Groundwater Discharge During the 100-Year Period After the End of Mine Dewatering (ac-ft)		
	Scenario 1	Scenario 2	Difference (%)	Scenario 1	Scenario 2	Difference (%)
San Juan River	166,444	166,502	-0.03	1,276,432	1,276,234	0.02
Horace Spring	1,136	1,135	0.09	8,699	8,708	-0.10
Rio Puerco	29,266	29,232	0.12	225,196	225,233	-0.02
Puerco River	(2,210)	(2,121)	4.03	(33,775)	(33,813)	-0.11
Rio San Jose	2,715	2,744	-1.07	21,092	21,068	0.11

Note: Value in red indicates river water flowing into groundwater

Table 6. Water Balance for Westwater Aquifer

	Water Balance Component (volume in AF) / Scenario		Mountain front recharge	Recharge at outcrops	Leakage from Brushy Basin aquitard	Water supply pumping	Discharge to ephemeral drainages	Discharge to rivers	Roca Honda dewatering	Total	Change in aquifer storage	Percent error
Mining Period: 13 Years	Scenario 1	Inflow	16,006	128	46,433					62,782	16,581	-1.3%
		Outflow				10,534	5,114	31,241	0	46,921		
	Scenario 2	Inflow	16,006	128	48,936					65,070	-104,706	-0.7%
		Outflow				10,534	5,113	31,240	123,717	170,605		
Recovery Period: 100 Years	Scenario 1	Inflow	72,432	983	345,862					419,277	57,232	0.4%
		Outflow				81,027	39,452	240,030	0	360,510		
	Scenario 2	Inflow	72,432	983	361,159					434,574	72,213	0.5%
		Outflow				81,027	39,451	240,066	0	360,544		

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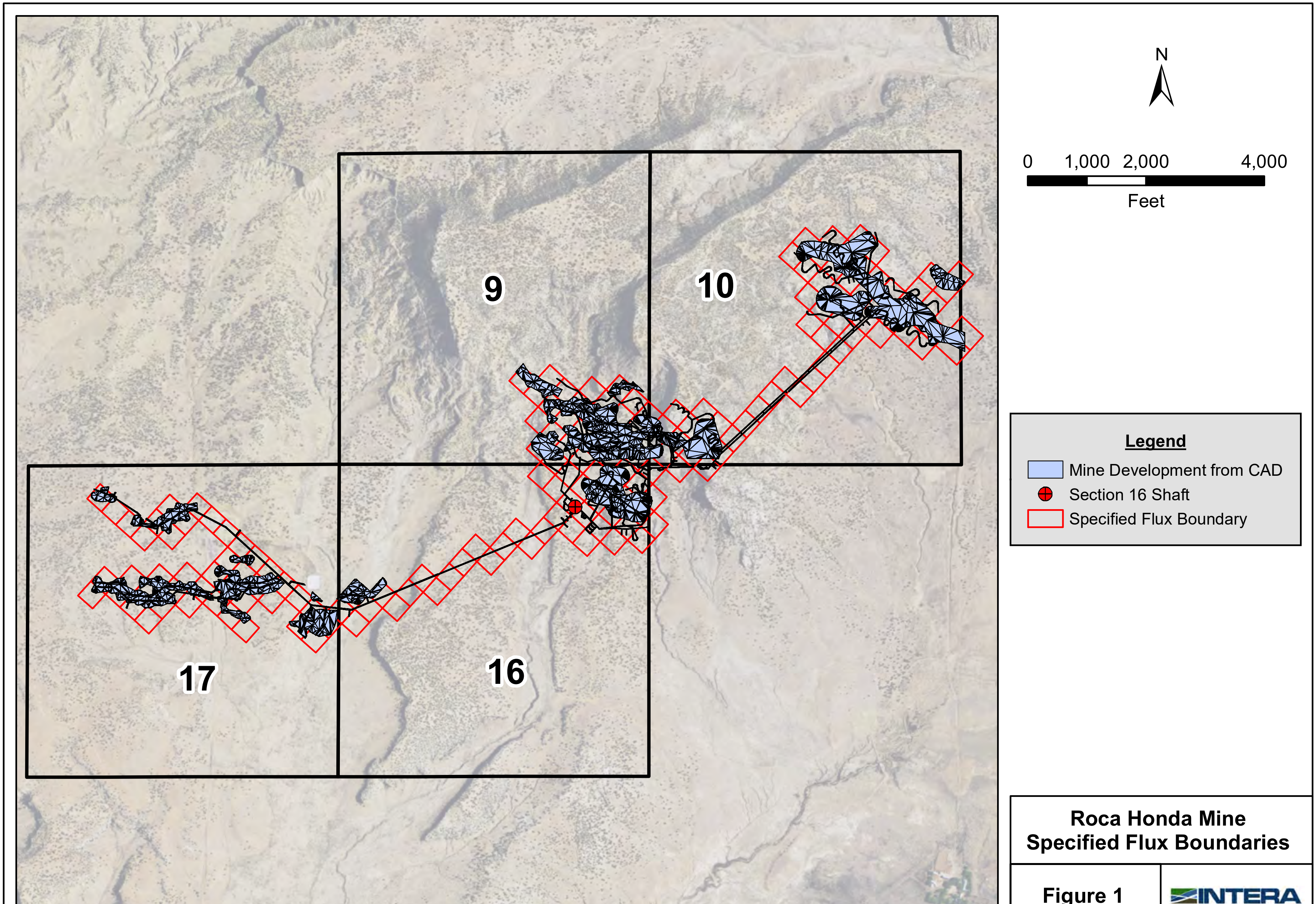
FIGURES



Roca Honda Mine
Specified Flux Boundaries

Figure 1

INTERA

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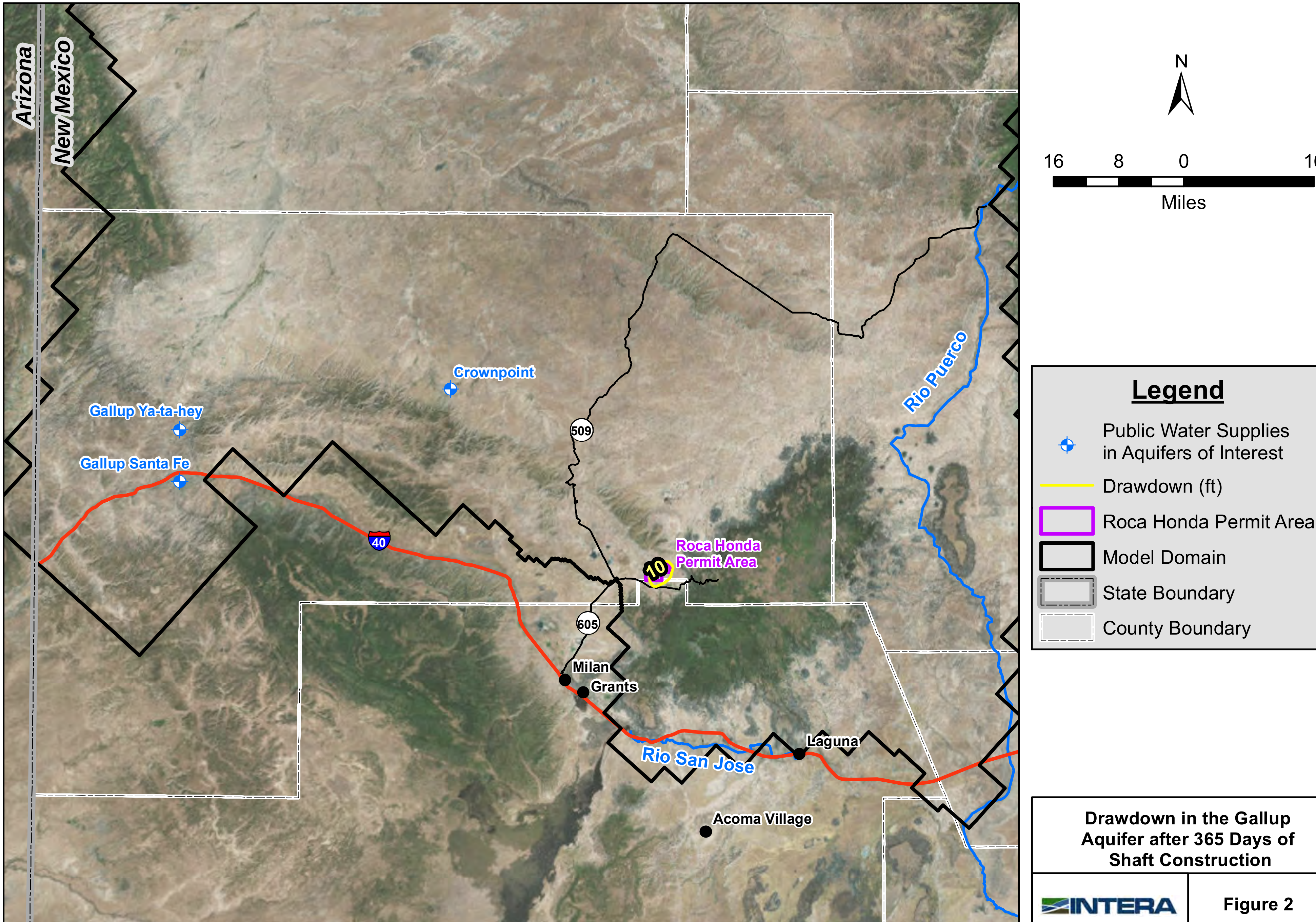
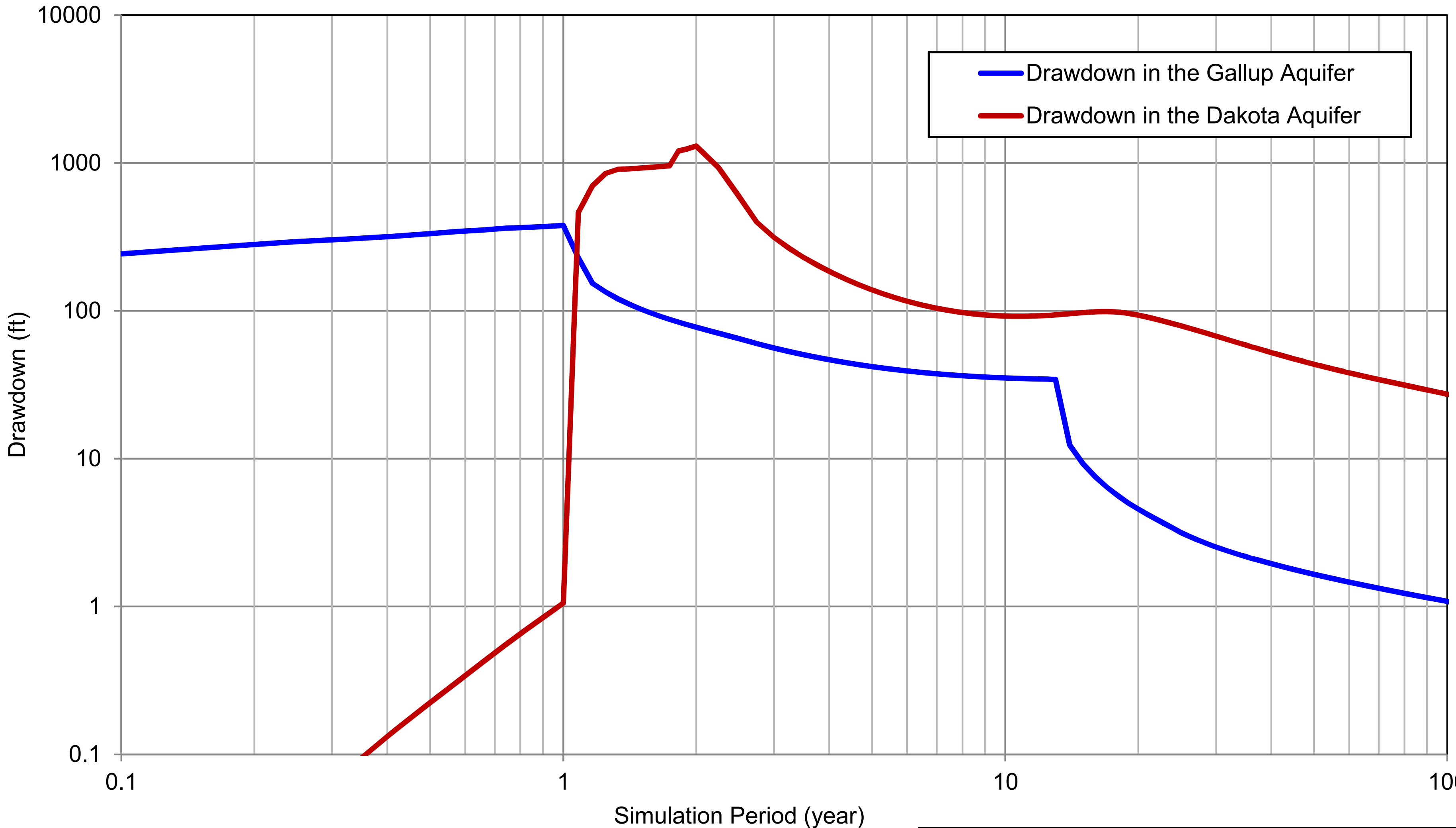


Drawdown in the Gallup Aquifer after 365 Days of Shaft Construction

INTERA

Figure 2

File: C:\Cheng\Strathmore\Additional_Tests\DewateringRates_Drains_2016\Model_Files\Impact_Analysis\MapDocument\Figure2_DD_Gallup365_RHM.mxd 1/20/2017



Drawdown at Section 16 Production Shaft
in the Gallup and Dakota Aquifers

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Figure 3

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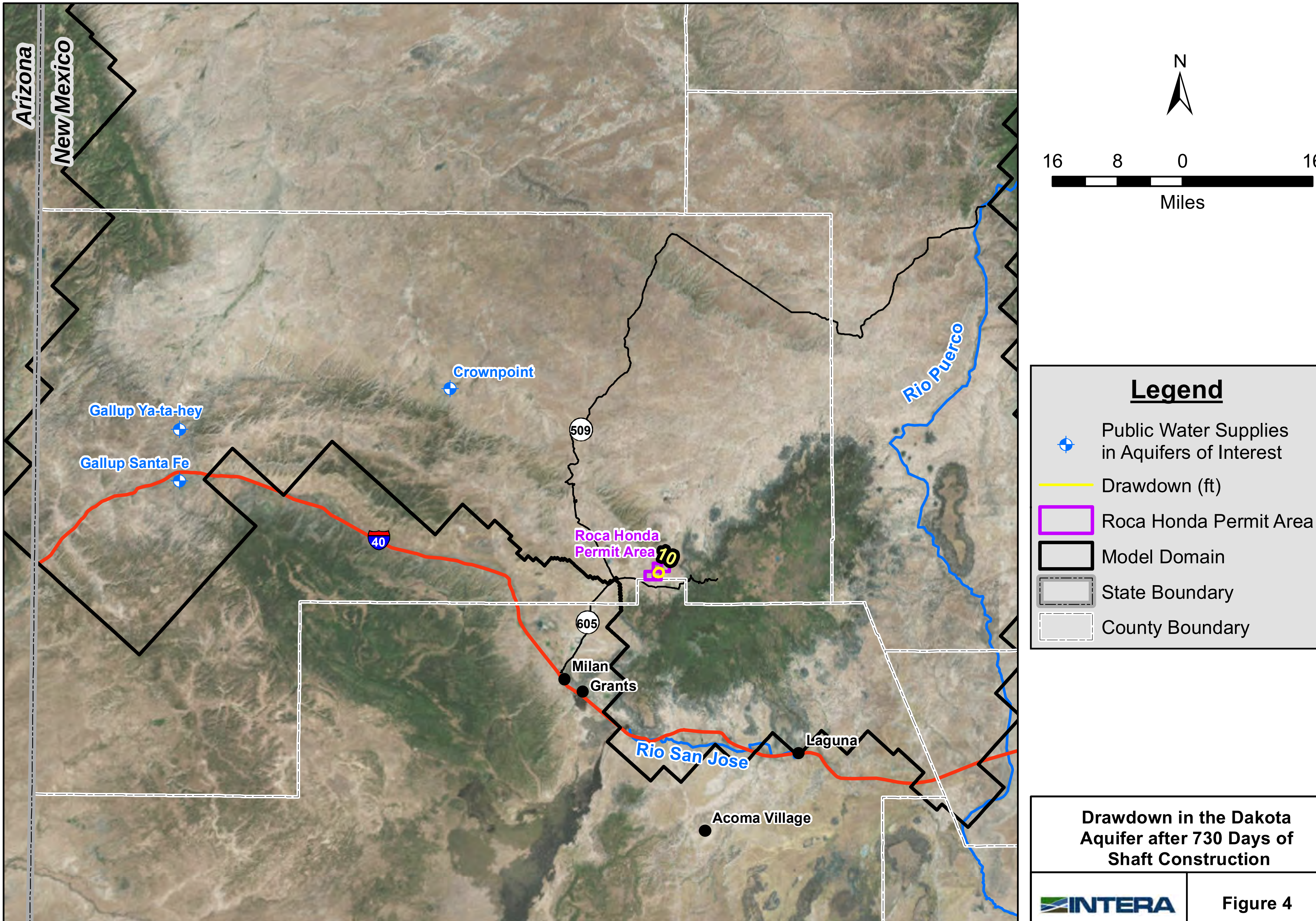
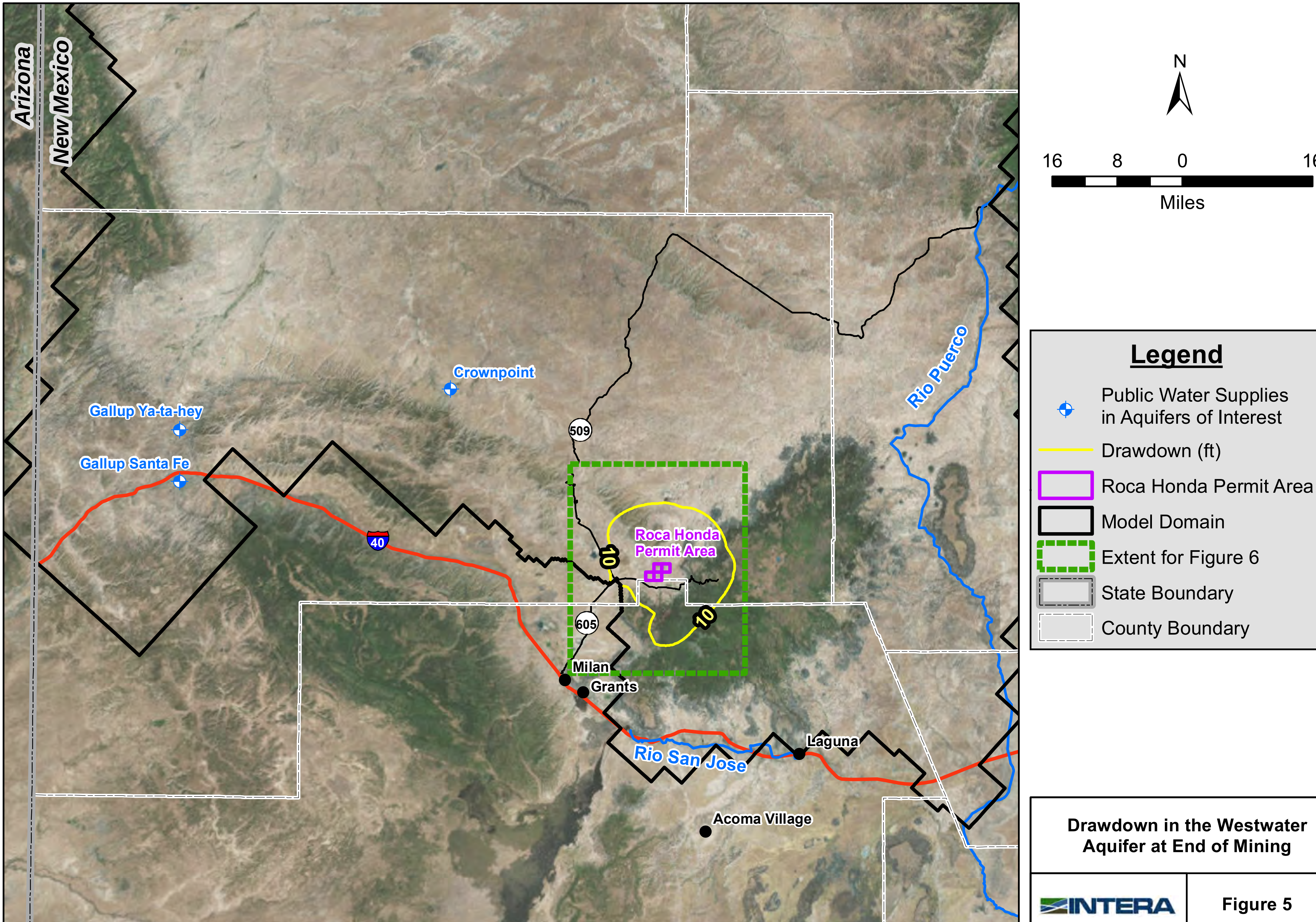


Drawdown in the Dakota Aquifer after 730 Days of Shaft Construction

INTERA

Figure 4

File: C:\Cheng\Strathmore\Additional_Tests\DewateringRates_Drains_2016\Model_Files\Impact_Analysis\MapDocument\Figure3_DD_Dakota730_RHM.mxd 1/25/2017

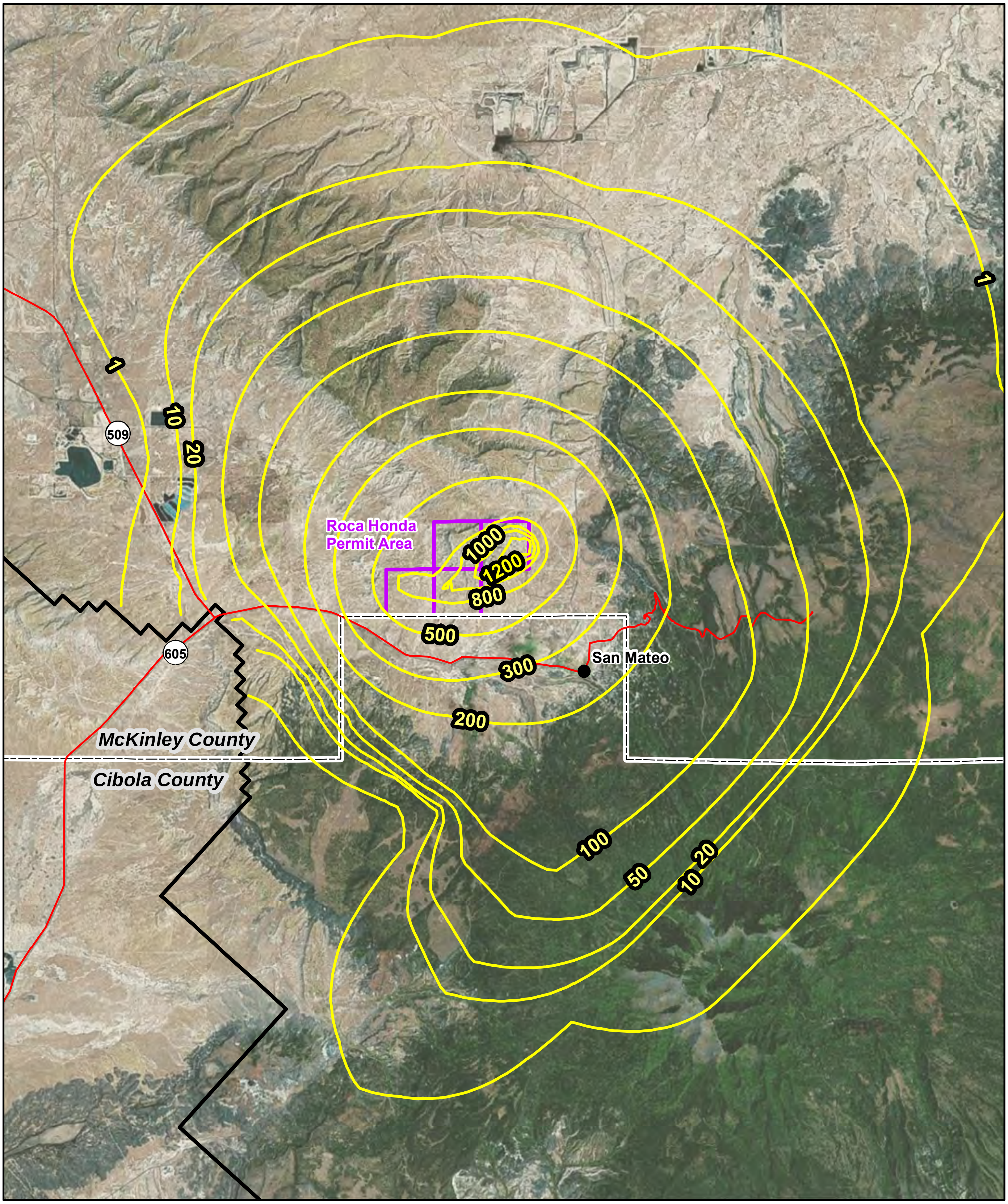


Drawdown in the Westwater Aquifer at End of Mining

INTERA

Figure 5

File: C:\Cheng\Strathmore\Additional_Tests\DewateringRates_Drains_2016\Model_Files\Impact_Analysis\MapDocument\Figure5_DD_Jmw2025_RHM.mxd 1/20/2017



Maximum drawdown of 1,850 ft not shown

N

Legend

Drawdown (ft)
Model Domain
Roca Honda Permit Area
County Boundary

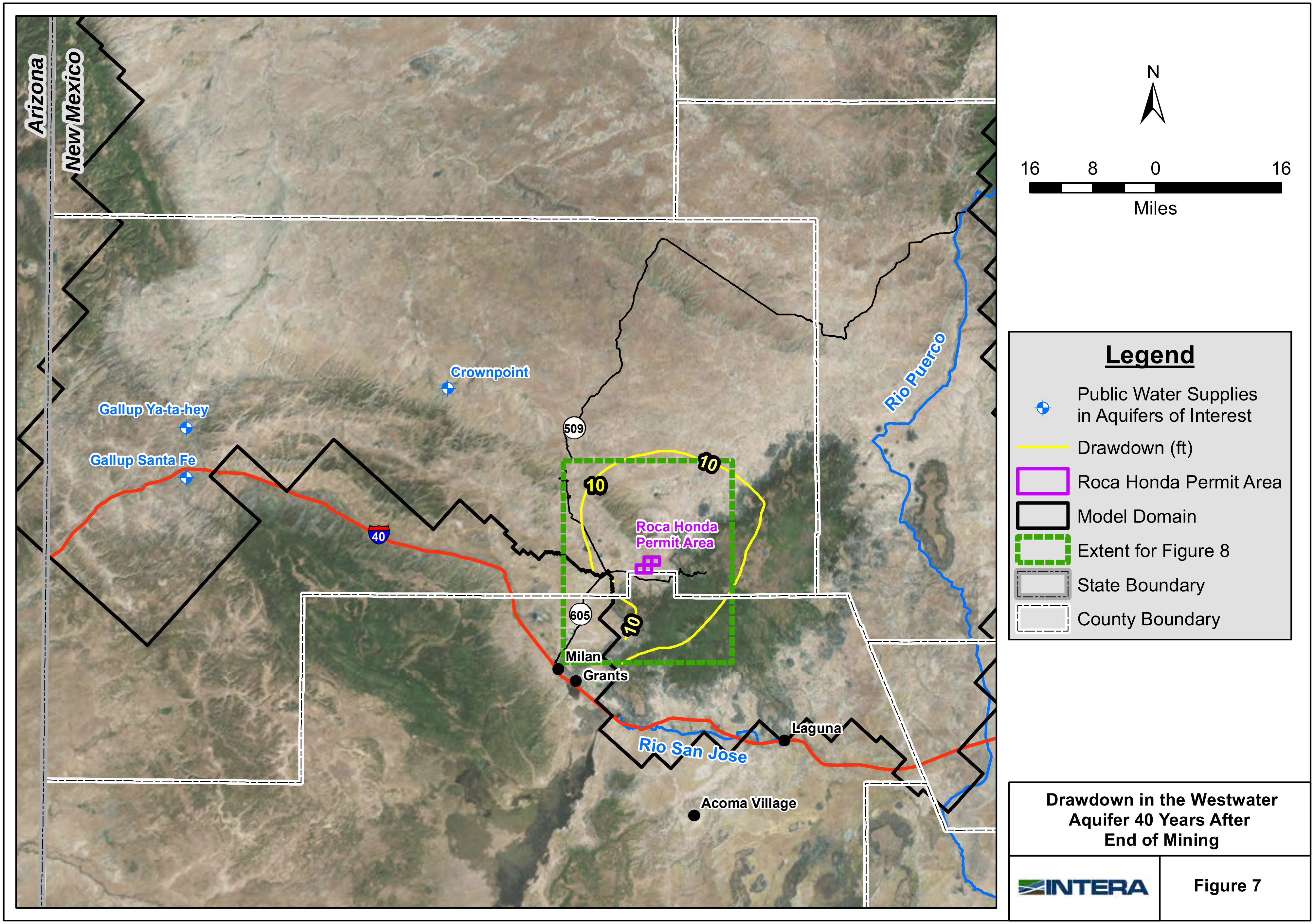
2.5 1.25 0 2.5
Miles

Drawdown in the Westwater Aquifer at End of Mining

INTERA

Figure 6

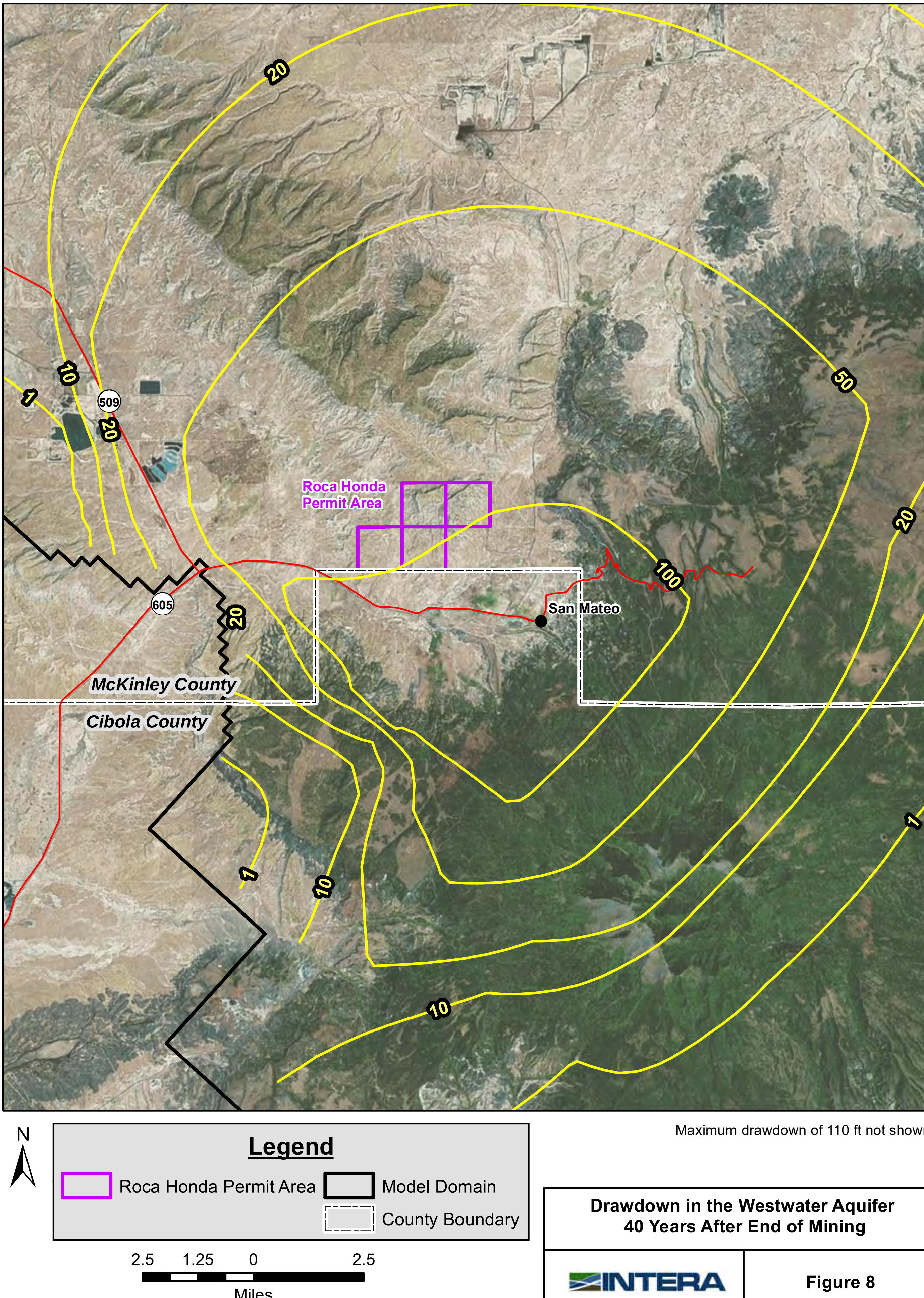
File: C:\Cheng\Strathmore\Additional_Tests\DewateringRates_Drains_2016\Model_Files\Impact_Analysis\MapDocument\Figure6_DD_Jmw2025_RHM.mxd 1/20/2017



Drawdown in the Westwater Aquifer 40 Years After End of Mining

INTERA

Figure 7



Maximum drawdown of 110 ft not shown

Drawdown in the Westwater Aquifer 40 Years After End of Mining

INTERA

Figure 8

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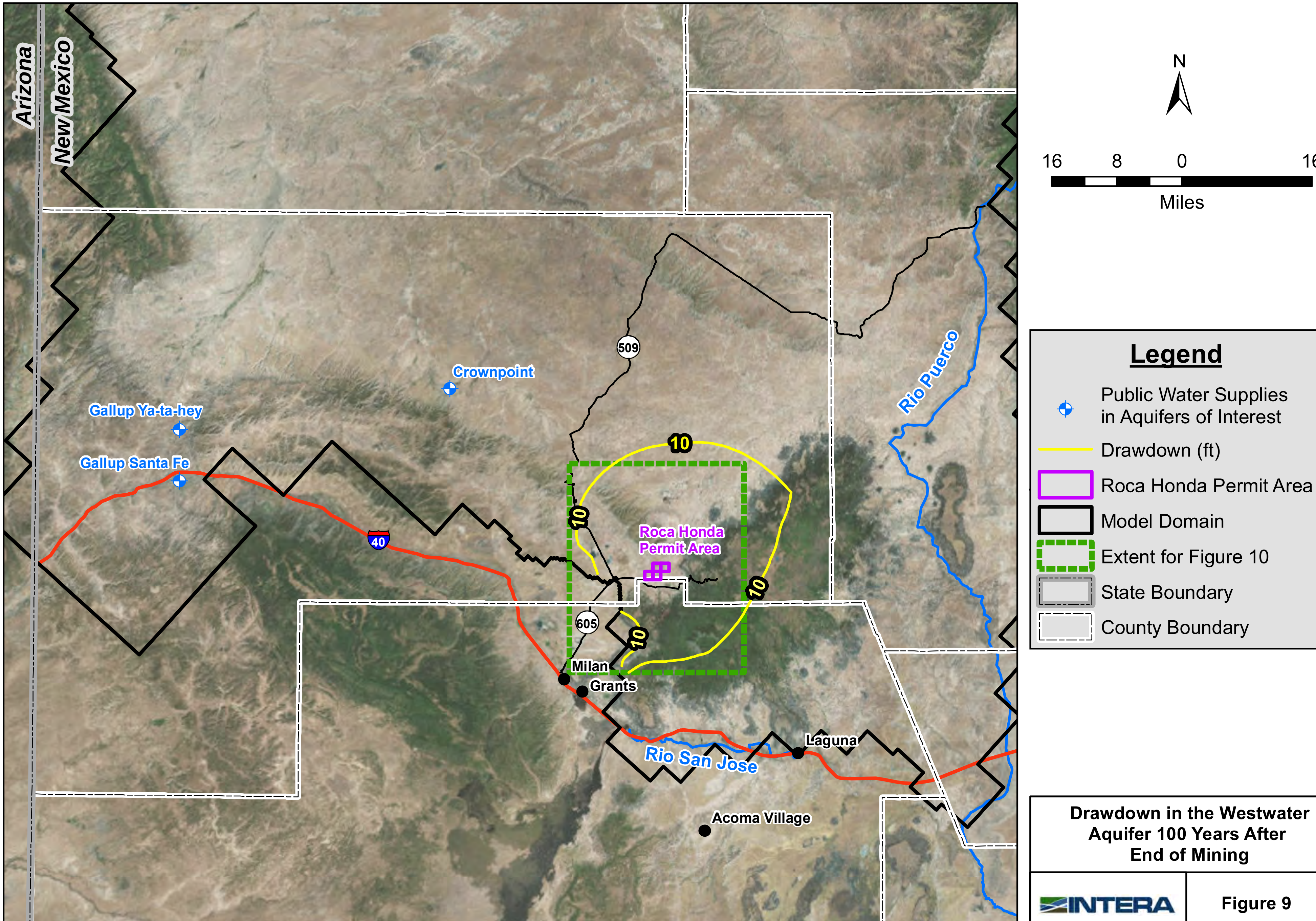

Drawdown in the Westwater Aquifer 100 Years After End of Mining

INTERA

Figure 9

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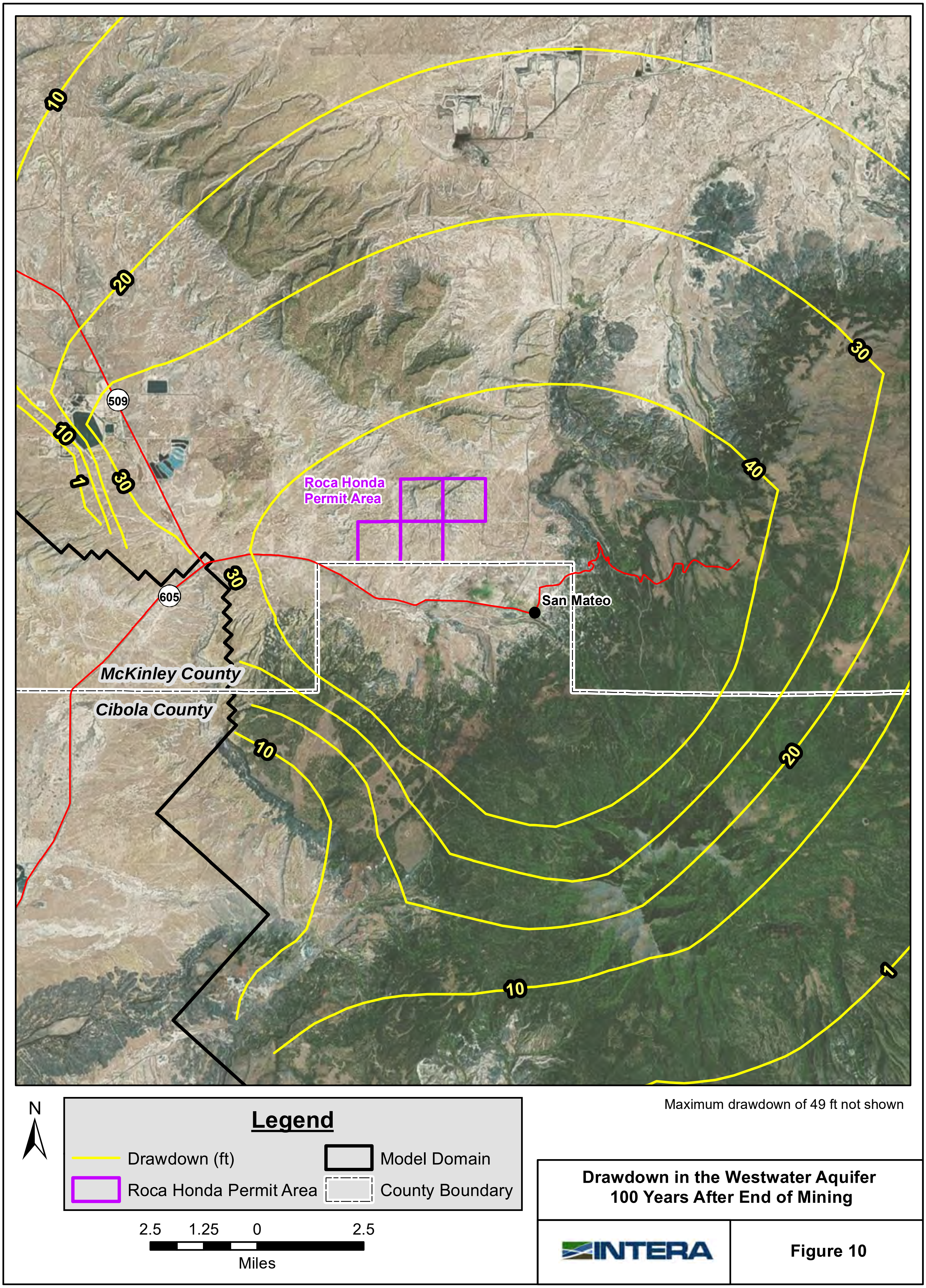

**Drawdown in the Westwater Aquifer
100 Years After End of Mining**

INTERA

Figure 10

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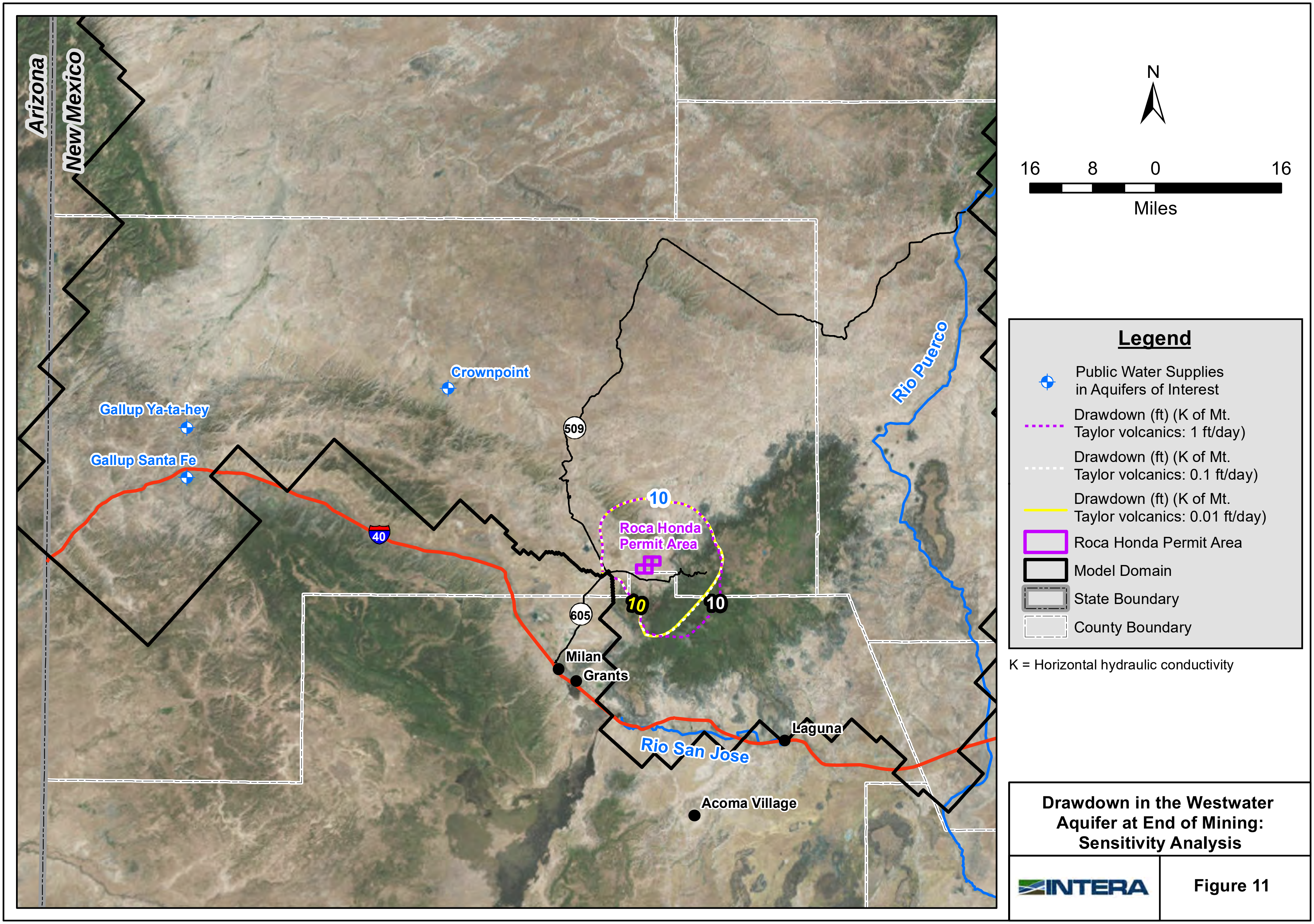


Drawdown in the Westwater Aquifer at End of Mining: Sensitivity Analysis

INTERA

Figure 11

File: C:\Cheng\Strathmore\Additional_Tests\DewateringRates_Drains_2016\Model_Files\Impact_Analysis\MapDocument\Figure11_DD_Jmw2025_RHM_Sensitivity.mxd 1/20/2017

Table 3. Potential changes in groundwater levels at wells with water supply uses.

BDR Well ID	NAD 1983 UTM 13N		Well Location in Model			Depth of Well (ft)	Well Elevation (ft)	OSE File No.	Use	Aquifer	Maximum Drawdown (ft)
	Easting (m)	Northing (m)	Row	Column	Layer						
73	260350	3913856	78	135	10	3535	7300	B-00516	MIN	Jmw	286.7
143	252142	3916113	117	94	10	940	7010	B-1778	DOM	Jmw	392.9
1	262362	3912136.2	76	137	10	4207	8209			Jmw	181.3
137	250527	3920058	101	84	10	1553	7133	B-00993-S	MIN	Jmw	188.4
136	249310.1	3920610.5	105	80	10	1398	7077	B-00993	MIN	Jmw	112.9
119	249502.1	3914856	125	91	10	280	6867			Jmw	84.2
109	249372	3915145	125	90	10	303	6890	B-01104	DOM	Jmw	75.9
106	248512	3916669	124	86	10	390	6900	B-01190	STK	Qal/Jmw	79.7
111	247479	3915109	128	87	10	478	6847	B-01115	DOM	Jmw	40.8
17	252103	3916155	117	94	8	715	7041	B 01544	DOM	Kd	29.8
129	258241.4	3925189.3	55	89	8	830	7201			Kd	7.6
128	258241.4	3925189.3	55	89	7	1320	7201			Km	3.1
130	257531.2	3924423.1	55	89	7	1320	7247			Km	3.1
67	260736	3913769.8	76	136	7	2000	7352			Km	1.1
72	260727.7	3913778.1	76	136	7	2000	7349			Km	1.1
107	250096.7	3916461.4	121	89	7	155	6942			Km	0.3
101	252287	3912456	125	119	7		7267	B-00997	MUL	Km	0.1
10	254510.3	3916097.2	102	109	6		7174			Kg	58.2
146	257834	3916765	74	128	6	1420	7170	B1786 Exp	EXP	Kg	56.3
16	254295	3915909	105	109	6	320	7152	B 01084	STK	Kg	35.5
32	258063	3913591	96	134	6	1150	7123	B 01442 EXP L-2	EXP	Kg	4.9
7	258514.1	3917001.6	68	130	5	192.3	7198			Kmf	10.2
19	255825	3913453	112	131	5		7037	B 00557	PUB	Qal	9.0
20	257901.8	3914231.9	92	133	5	157.3	7103			Kmf	7.7
22	257866	3914204	92	133	5	476	7103	B 01085	IRR	Kpl	7.7
33	258355	3913491	94	134	5	68	7152	B 00544	SAN	Qal	4.1
25	257845	3913200	100	134	5	620	7136	B 01442	EXP	Kpl	3.8
8	259531.5	3915409.5	72	134	5		7185			Kmf	3.3
9	259531.5	3915409.5	72	134	5	200	7185			Kmf	3.3
4	260080.1	3919137.6	58	128	5	400	7162			Kmf	2.4
99	256604	3912429	114	134	5	300	7080	RG-43456	STK	Kmf	1.6
5	260480.2	3918556.4	58	131	5	394	7231	RG 33107 EXPL	EXP/DOM	Kmf, Kpl	2.2
37	259448	3913362	88	135	5		7247	B 00736	DOM	Qal	1.9
38	259448	3913362	88	135	5	80	7247	B 00737	DOM	Qal	1.9

Table 3. Potential changes in groundwater levels at wells with water supply uses.

BDR Well ID	NAD 1983 UTM 13N		Well Location in Model			Depth of Well (ft)	Well Elevation (ft)	OSE File No.	Use	Aquifer	Maximum Drawdown (ft)
	Easting (m)	Northing (m)	Row	Column	Layer						
75	259881.5	3912990	87	135	5	150	7303			Kmf	1.9
29	259385.7	3913592	86	135	5	100	7224			Qal	1.9
56	259898.1	3913126.6	86	135	5	200	7297			Kmf	1.9
57	259898.1	3913128.6	86	135	5	140	7297			Kmf	1.9
61	259898.1	3913131	86	135	5	120	7297			Kmf	1.9
62	259898.1	3913131	86	135	5	200	7297			Kmf	1.9
35	259248	3913362	89	135	5	73	7224	B 00734	DOM	Qal	1.8
36	259248	3913362	89	135	5	65	7224	B 00735	DOM	Qal	1.8
79	259632.6	3912981.7	89	135	5	21	7287			Qal	1.8
85	259733	3912847	89	135	5	230	7300	B-00906	DOM	Kmf,Qal	1.8
28	258857.4	3913552.2	90	135	5	79	7178			Qal	1.8
92	259508.2	3912990	90	135	5	57.5	7277			Kmf	1.8
63	260039.1	3913371.6	84	135	5	500	7280			Kmf	1.9
31	259048.8	3913331.9	91	135	5	92	7205			Kmf	1.8
96	259431	3912957	91	135	5	80	7274	B-00738	DOM	Qal	1.8
58	260321.2	3913363.3	82	135	5	250	7316			Kmf	1.9
64	260312.9	3913363.3	82	135	5	250	7316			Kmf	1.9
65	260312.9	3913363.3	82	135	5		7316			Kmf	1.9
26	258686.9	3913537.5	92	135	5		7172			Kmf	1.8
27	258686.9	3913396.5	93	135	5	305	7175			Kmf	1.7
30	258867.2	3913340.1	92	135	5		7185			Qal	1.8
90	259251	3913006.6	92	135	5	336	7254			Kpl	1.8
91	259251	3913006.6	92	135	5	200	7254			Kmf	1.8
93	259231	3912957	92	135	5	703	7251	B-00428 S	MDW	Kpl	1.8
94	259332	3912858	92	135	5	185	7270	B-01185	DOM	Kmf	1.8
95	259231	3912957	92	135	5	707	7251	B-00385	EXP	Kpl	1.8
54	260321.2	3913496	81	135	5	prob.60	7310			Qal	1.9
34	258652	3913380	93	135	5	300	7175	B 00815	DOM	Kmf	1.7
53	260321.2	3913786.4	79	135	5	44	7303			Qal	1.9
55	260321.2	3913786.4	79	135	5	prob.60	7303			Qal	1.9
88	258846.4	3912971	95	135	5	40	7215			Kmf,Qal	1.7
89	258848.9	3912971	95	135	5	180	7215			Kmf	1.7
45	260329.5	3913919.1	78	135	5	160	7290			Kmf	1.8
46	260329.5	3913919.1	78	135	5	160	7290			Kmf	1.8

Table 3. Potential changes in groundwater levels at wells with water supply uses.

BDR Well ID	NAD 1983 UTM 13N		Well Location in Model			Depth of Well (ft)	Well Elevation (ft)	OSE File No.	Use	Aquifer	Maximum Drawdown (ft)
	Easting (m)	Northing (m)	Row	Column	Layer						
69	260478.8	3913769.8	78	135	5	32.5	7326			Qal	1.8
41	260055.7	3914201.1	77	135	5	285	7257			Kmf	1.8
42	260055.7	3914201.1	77	135	5	250	7257			Kmf	1.8
43	260329.5	3914201.1	76	135	5	60	7277			Qal	1.8
44	260329.5	3914201.1	76	135	5	65	7277			Qal	1.8
39	260072.3	3914591.1	75	135	5	63	7257			Kmf	1.8
40	260329.5	3914333.9	75	135	5	65	7274			Qal	1.8
97	258812	3912368	99	135	5		7261		STK	Kmf	1.5
48	260877	3914317.3	71	135	5		7323			Kmf	1.7
23	256194	3912240	117	134	5	32	7070	B 00415 O-3	DOM	Qal	0.9
24	256194	3912240	117	134	5	32	7070	B 00415 O-3	DOM	Qal	0.9
98	256355.8	3912417.6	116	134	5		7070			Kmf	1.2
47	261109.5	3914516.1	68	135	5	245	7425	B 01429	DOM	Kmf	1.6
66	260736	3913769.8	76	136	5	800	7352			Kpl	0.6
68	260736	3913769.8	76	136	5		7352			Kpl	0.6
70	260453.9	3913496	80	136	5	47.5	7326			Qal	0.6
59	260304.6	3913122.7	83	136	5	46	7362			Qal	0.6
60	260304.6	3913122.7	83	136	5		7362			Qal	0.6
74	260251	3913154	84	136	5	520	7349	B-00524	DOM	Kpl?	0.6
83	260006	3912990	86	136	5		7313			Kpl	0.5
76	259889.8	3912699.6	89	136	5	120	7339			Kmf,Qal	0.5
77	259889.8	3912699.6	89	136	5	250	7339			Kmf	0.5
78	259889.8	3912699.6	89	136	5		7339			Kpl	0.5
80	259881.5	3912699.6	89	136	5	35	7339			Kmf	0.5
81	259881.5	3912699.6	89	136	5		7339			Kmf	0.5
82	259997.7	3912716.2	89	136	5	325	7392	B-00428	MDW	Kpl,Kmf	0.5
131	260782.9	3922629.1	55	110	5	50	7021			Qal	0.5
132	260782.9	3922629.1	55	110	5	230	7021			Kpl	0.5
133	260782.9	3922629.1	55	110	5	260	7021			Kmf	0.5
84	259920	3912641	90	136	5	420	7349	B-00839	STK	Kmf	0.5
87	259818	3912539	91	136	5	210	7402	B-00829	DOM	Kmf,Qal	0.4
100	255202	3911899	121	133	5	210	7070	B-01086	STK	Kmf	0.7
86	259618	3912339	94	136	5		7333	B-00729	STK	Kmf	0.4
102	255740.2	3910867.1	122	134	5	600	7169			Kpl	0.3

Table 3. Potential changes in groundwater levels at wells with water supply uses.

BDR Well ID	NAD 1983 UTM 13N		Well Location in Model			Depth of Well (ft)	Well Elevation (ft)	OSE File No.	Use	Aquifer	Maximum Drawdown (ft)
	Easting (m)	Northing (m)	Row	Column	Layer						
103	255791.7	3910857.9	122	134	5	500	7169			Kpl	0.3
104	255750	3910641	122	134	5	320	7192	RG-43457	DOM	Kmf	0.3
123	263316.3	3924150	54	117	5		6913			Kpl	0.2
105	255937	3910028	123	135	5		7402	B-01046	PUB	Tb	2.1
120	251266.1	3914846.1	122	95	5	80	6913		STK	Qal	0.3
121	251266.1	3914846.1	122	95	5	80	6913		EXP	Qal	0.3
2	262181	3911688.6	81	137	5	>1980	8304				0.2
127	260941.7	3926787.1	53	91	5		6972			Kmf,Kpu	0.0
3	265362.3	3910526.5	67	138	5	~1500	8520				0.0
124	255438.2	3927730.8	55	79	5		7133			Kcda	0.0
126	255438.2	3927730.8	55	79	5		7133			Kcda	0.0

Note:

Use: DOM-Domestic; EXP-Exploration; IRR-Irrigation; MDW-Community type use; MIN-Mining; MUL-Multiple domestic households; PUB-Public supply; SAN-Sanitary in conjuct

Aquifer: Jmw-Westwater Canyon Member; Kcda-Dalton Sandstone Member of the Crevasse Canyon Formation; Kd-Dakota aquifer; Kg-Gallup aquifer; Km-Mancos Shale; Kmf-
Kpu-Upper Point Lookout Sandstone; Qal-Quaternary alluvium; Tb-Basalt and andesite flows.

Depth of Well: "prob.60" indicates probably 60 ft; ">1980" indicates deeper than 1980 ft; "~1500" indicates about 1500 ft.

Table 4. Potential Changes in Groundwater Levels at Springs

NAME	NAD 1983 UTM 13N		Model Row	Model Column	Model Layer	Spring Surface Elevation from DEM (ft)	Grid Maximum Elevation (ft)	Grid Minimum Elevation (ft)	Surface Geology	Maximum Drawdown (ft)
	Easting (m)	Northing (m)								
Azabache, Ojo	287137	3944068	49	134	2	6398	7276	6292	Kmf	0.01
Bridge Spring	255994	3913748	109	131	2	7043	7053	7037	Kmf	0.73
Burro Springs	268041	3934954	51	89	1	6563	6660	6499	Kmf	0.02
Cerro Spring	266570	3925896	53	128	2	6844	6931	6601	Kmf	0.00
Chamisa Losa Spring	298065	3935212	49	139	1	6518	8028	6122	Kmm	0.01
Dado Spring, El	271825	3933069	51	117	2	6597	6692	6535	Kmf	0.00
Doctor Spring	268481	3933463	51	93	1	6603	6791	6574	Kmf	0.02
Encinal Spring	275079	3895799	106	142	6	7604	7900	7503	Tb	0.00
Fort Miguel Ruins Spring	266081	3921652	54	134	1	7098	7460	6961	Kmf	0.00
Jose Manuel Spring	305193	3889614	52	146	1	5823	6597	5600	Jsr	0.00
Marquez, Ojo	287501	3911593	52	141	1	7351	8503	6610	Kph	0.01
Montoya Spring	272974	3940595	50	89	1	6434	6745	6368	Kph	0.01
Ojo de las Yuges	273918	3930117	51	134	1	6739	7319	6702	Kmf	0.01
Padre, Ojo del	304915	3935029	48	141	1	5878	7237	5728	Kml	0.00
Pena Springs	267041	3936245	51	85	1	6545	6650	6519	Kmf	0.01
Redondo, Ojo	266717	3933478	51	90	1	6596	6672	6509	Kmf	0.01
Rinconada Canyon Spring	259560	3884466	151	141	7	6141	6364	6089	Kmm/Kd	0.00
Salazar Spring	269379	3935012	51	92	1	6595	6745	6558	Kmf	0.02
San Jose Atarque Spring	258621	3891998	148	140	1	7578	8057	7454	Kmm	0.00
San Lucas Spring	262675	3924611	54	110	1	6901	7352	6899	Kmf	0.00
San Ysidro Spring	263308	3932334	52	85	1	6646	6781	6604	Kmf	0.03
Sap Hole Spring	264857	3922178	54	133	1	6923	7086	6902	Kmf	0.00
Tecolote Springs, Ojo	284488	3903926	54	142	2	7793	8523	7099	Kpl	0.01
Unnamed Spring	262226	3892263	144	140	1	6935	7290	6397	Kcc	0.01
Yeguas, Ojo de las	273918	3930086	51	134	1	6745	7319	6702	Kmf	0.01

Table 5. Potential Changes in Groundwater Discharge to Rivers

	Cumulative Groundwater Discharge During the 13-Year Mine Dewatering Period (ac-ft)			Cumulative Groundwater Discharge During the 100-Year Period After the End of Mine Dewatering (ac-ft)		
	Scenario 1	Scenario 2	Difference (%)	Scenario 1	Scenario 2	Difference (%)
San Juan River	166,444	166,502	-0.03	1,276,432	1,276,234	0.02
Horace Spring	1,136	1,135	0.09	8,699	8,708	-0.10
Rio Puerco	29,266	29,232	0.12	225,196	225,233	-0.02
Puerco River	(2,210)	(2,121)	4.03	(33,775)	(33,813)	-0.11
Rio San Jose	2,715	2,744	-1.07	21,092	21,068	0.11

Note: Value in red indicates river water flowing into groundwater

Table 6a. Water Balance for Westwater Aquifer

	Water Balance Component (volume in AF) / Scenario		Mountain front recharge	Recharge at outcrops	Leakage from Brushy Basin aquitard	Water supply pumping	Discharge to ephemeral drainages	Discharge to rivers	Roca Honda dewatering	Total	Change in aquifer storage	Percent error
Mining Period: 13 Years	Scenario 1	Inflow	16,006	128	46,433					62,782	16,581	-1.3%
		Outflow				10,534	5,114	31,241	0	46,921		
	Scenario 2	Inflow	16,006	128	48,936					65,070	-104,706	-0.7%
		Outflow				10,534	5,113	31,240	123,717	170,605		
Recovery Period: 100 Years	Scenario 1	Inflow	72,432	983	345,862					419,277	57,232	0.4%
		Outflow				81,027	39,452	240,030	0	360,510		
	Scenario 2	Inflow	72,432	983	361,159					434,574	72,213	0.5%
		Outflow				81,027	39,451	240,066	0	360,544		

Table 6b. Water Balance for Dakota Aquifer

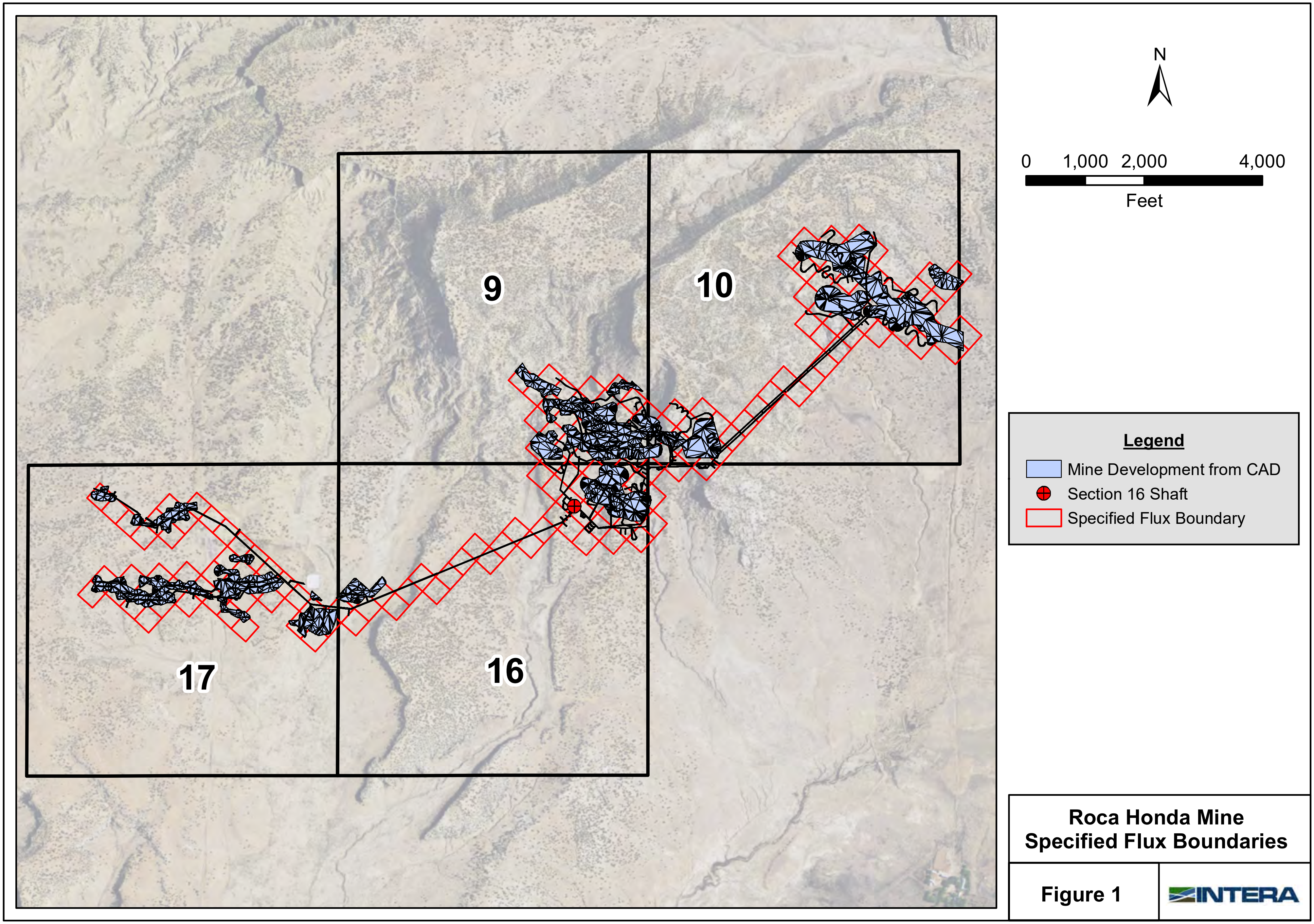
Water Balance Component (volume in AF) / Scenario			Mountain front recharge	Recharge at outcrops	Leakage from Mancos Shale aquitard	Leakage from Brushy Basin aquitard	Water supply pumping	Discharge to ephemeral drainages	Discharge to rivers	Roca Honda dewatering	Total	Change in aquifer storage	Percent error
Mining Period: 13 Years	Scenario 1	Inflow	81,383	40,943							122,326	-11,113	2.0%
		Outflow			82,743	45,264	212	0	2,663	0	130,882		
	Scenario 2	Inflow	81,383	40,943							122,326	-13,000	2.1%
		Outflow			82,738	46,275	212	0	2,764	232	132,672		
Recovery Period: 100 Years	Scenario 1	Inflow	626,023	314,943							940,967	-56,043	0.0%
		Outflow			636,102	339,486	1,634	0	19,848	0	997,070		
	Scenario 2	Inflow	626,023	314,943							940,967	-69,167	0.0%
		Outflow			635,874	352,877	1,634	0	19,998	0	1,010,371		

Table 6c. Water Balance for Gallup Aquifer

	Water Balance Component (volume in AF) / Scenario		Mountain front recharge	Recharge at outcrops	Leakage from Mancos Shale aquitard	Leakage from Layer 5 aquitard	Water supply pumping	Discharge to ephemeral drainages	Discharge to rivers	Roca Honda dewatering	Total	Change in aquifer storage	Percent error
Mining Period: 13 Years	Scenario 1	Inflow	16,720	25,268	10,491	33,549					86,027	-9,560	1.6%
		Outflow					48,022	13,961	32,134	0	94,116		
	Scenario 2	Inflow	16,720	25,268	10,494	34,612					87,093	-10,550	2.3%
		Outflow					48,022	13,964	32,099	1,439	95,523		
Recovery Period: 100 Years	Scenario 1	Inflow	128,612	194,366	80,746	279,971					683,696	-44,517	0.5%
		Outflow					369,398	107,895	247,075	0	724,369		
	Scenario 2	Inflow	128,612	194,366	80,732	280,133					683,844	-43,989	0.5%
		Outflow					369,398	107,883	247,375	0	724,656		

Table 6d. Water Balance for Entire Domain

	Water Balance Component (volume in AF) / Scenario		Mountain front recharge	Recharge at outcrops	Water supply pumping	Discharge to ephemeral drainages	Discharge to rivers	Roca Honda dewatering	Total Net	Change in aquifer storage	Percent error
Mining Period: 13 Years	Scenario 1	Inflow	1.79E+05	1.79E+05					3.58E+05	-3.46E+04	0.4%
		Outflow			6.02E+04	1.33E+05	1.98E+05	0.00E+00	3.91E+05		
	Scenario 2	Inflow	1.79E+05	1.79E+05					3.58E+05	-1.60E+05	0.3%
		Outflow			6.02E+04	1.33E+05	1.98E+05	1.25E+05	5.17E+05		
Recovery Period: 100 Years	Scenario 1	Inflow	1.33E+06	1.38E+06					2.70E+06	-2.86E+05	0.1%
		Outflow			4.63E+05	1.03E+06	1.50E+06	0.00E+00	2.99E+06		
	Scenario 2	Inflow	1.33E+06	1.38E+06					2.70E+06	-2.86E+05	0.1%
		Outflow			4.63E+05	1.03E+06	1.50E+06	0.00E+00	2.99E+06		



Roca Honda Mine
Specified Flux Boundaries

Figure 1

INTERA

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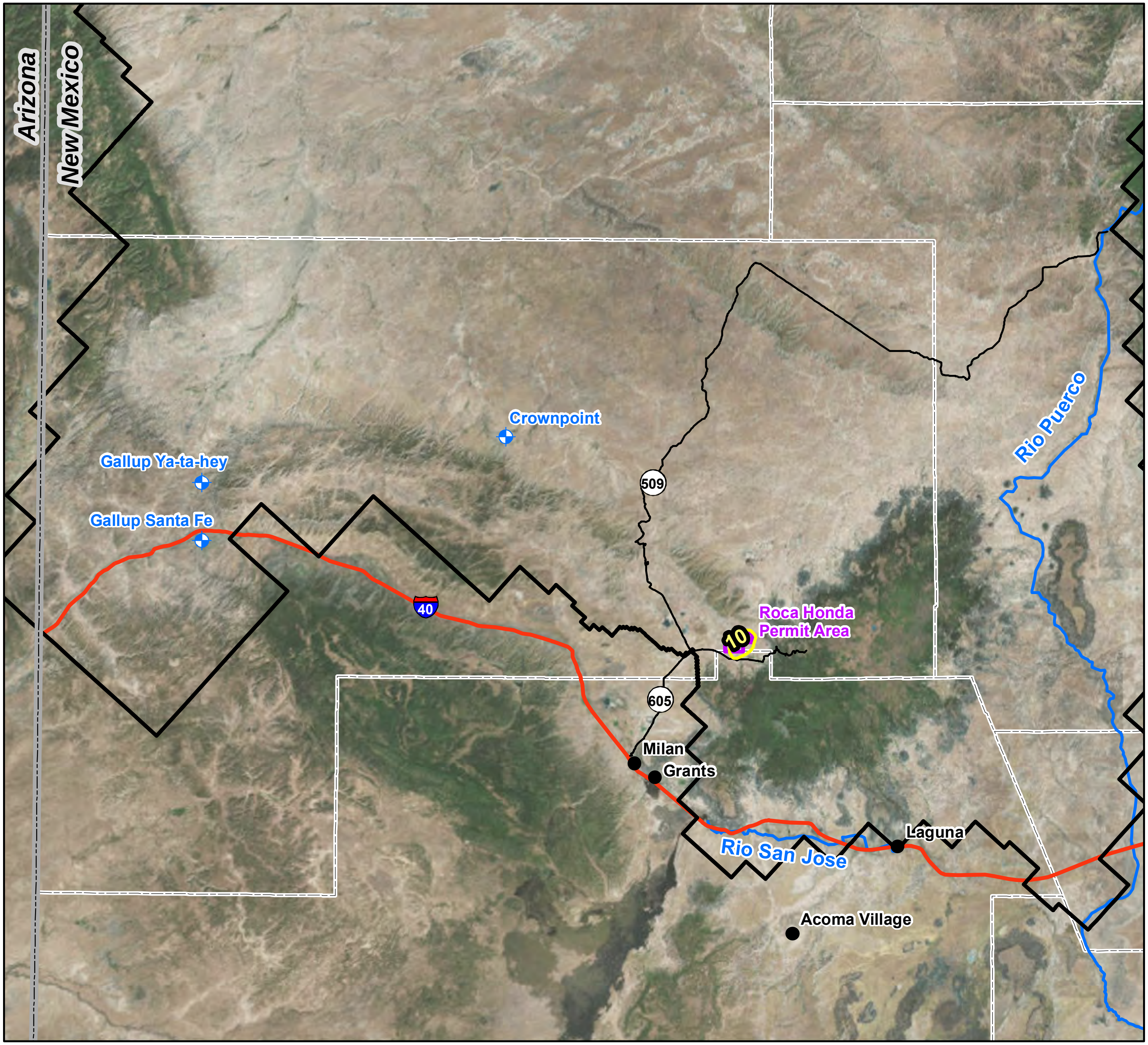

Drawdown in the Gallup Aquifer after 365 Days of Shaft Construction

INTERA

Figure 2

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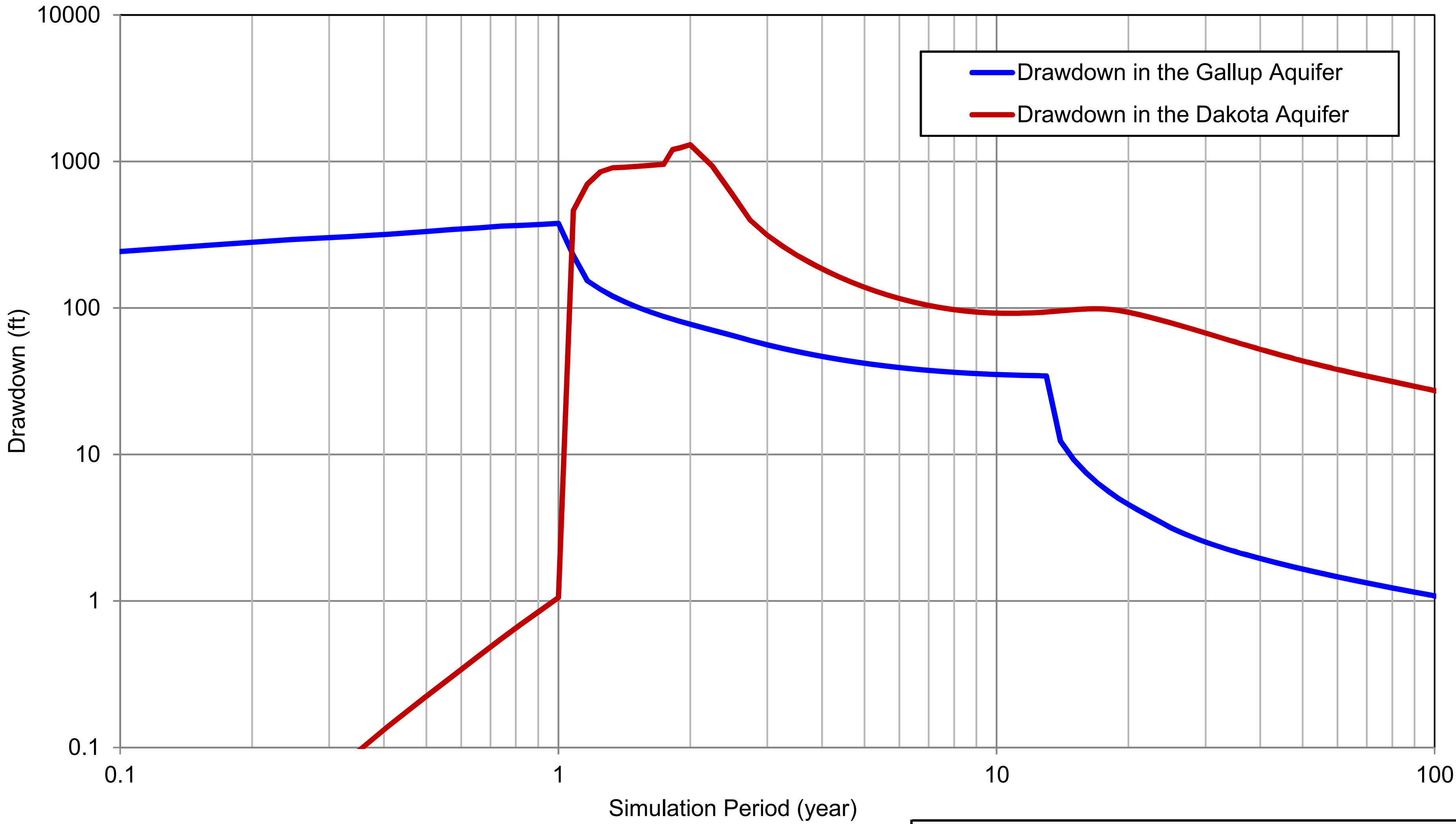
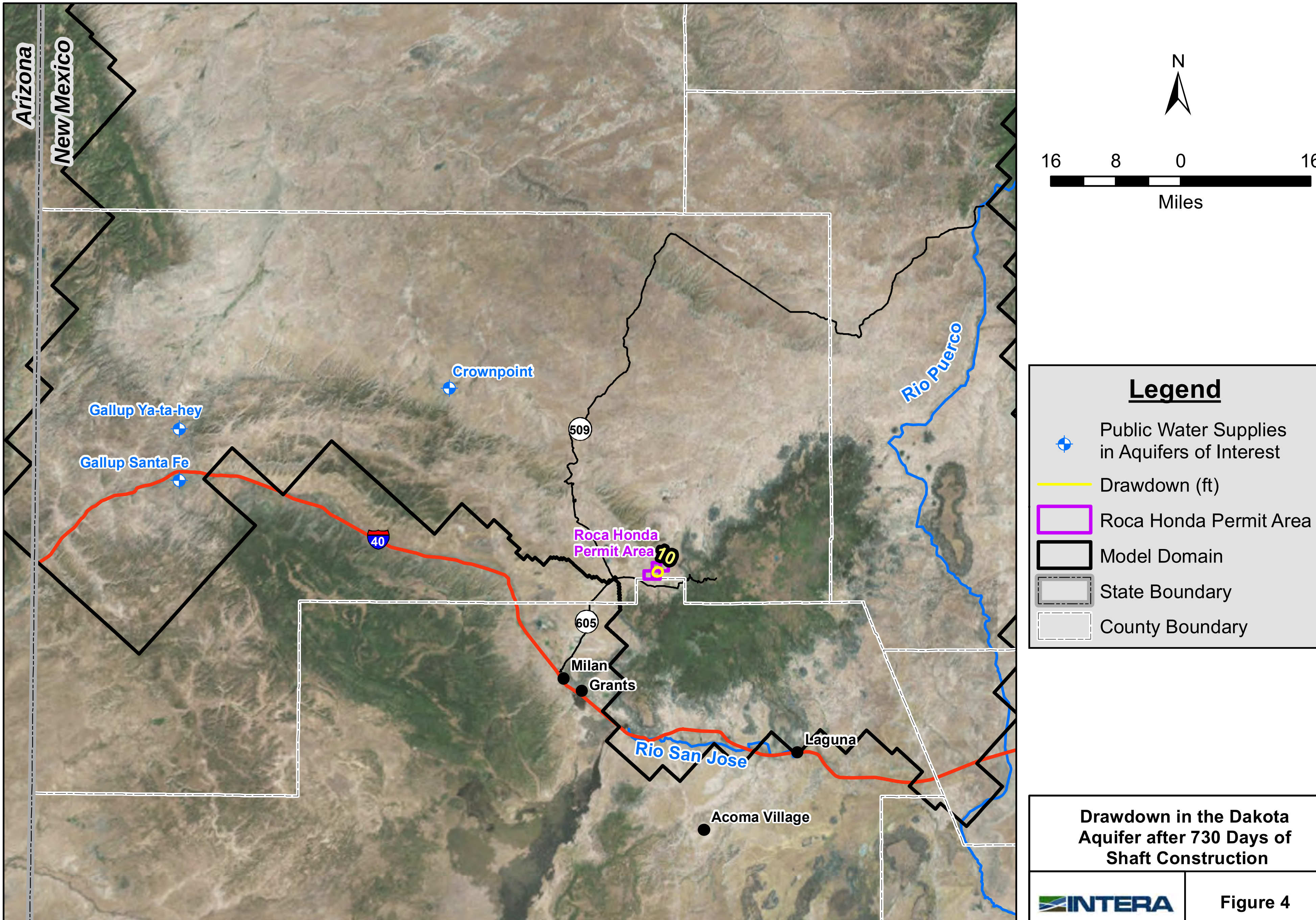


Drawdown at Section 16 Production Shaft
in the Gallup and Dakota Aquifers

INTERA

Figure 3



Drawdown in the Dakota Aquifer after 730 Days of Shaft Construction

INTERA

Figure 4

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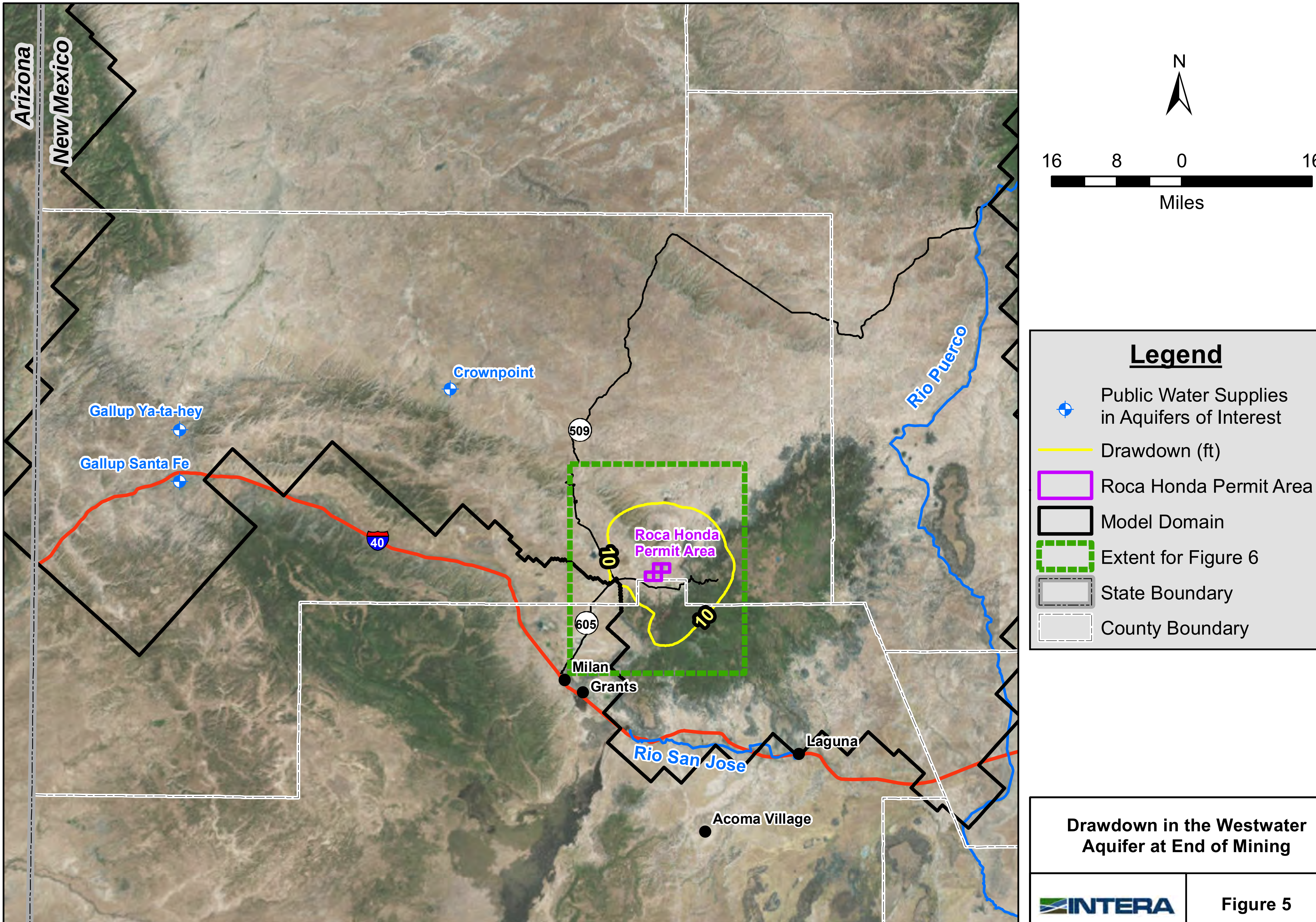

Drawdown in the Westwater Aquifer at End of Mining

INTERA

Figure 5

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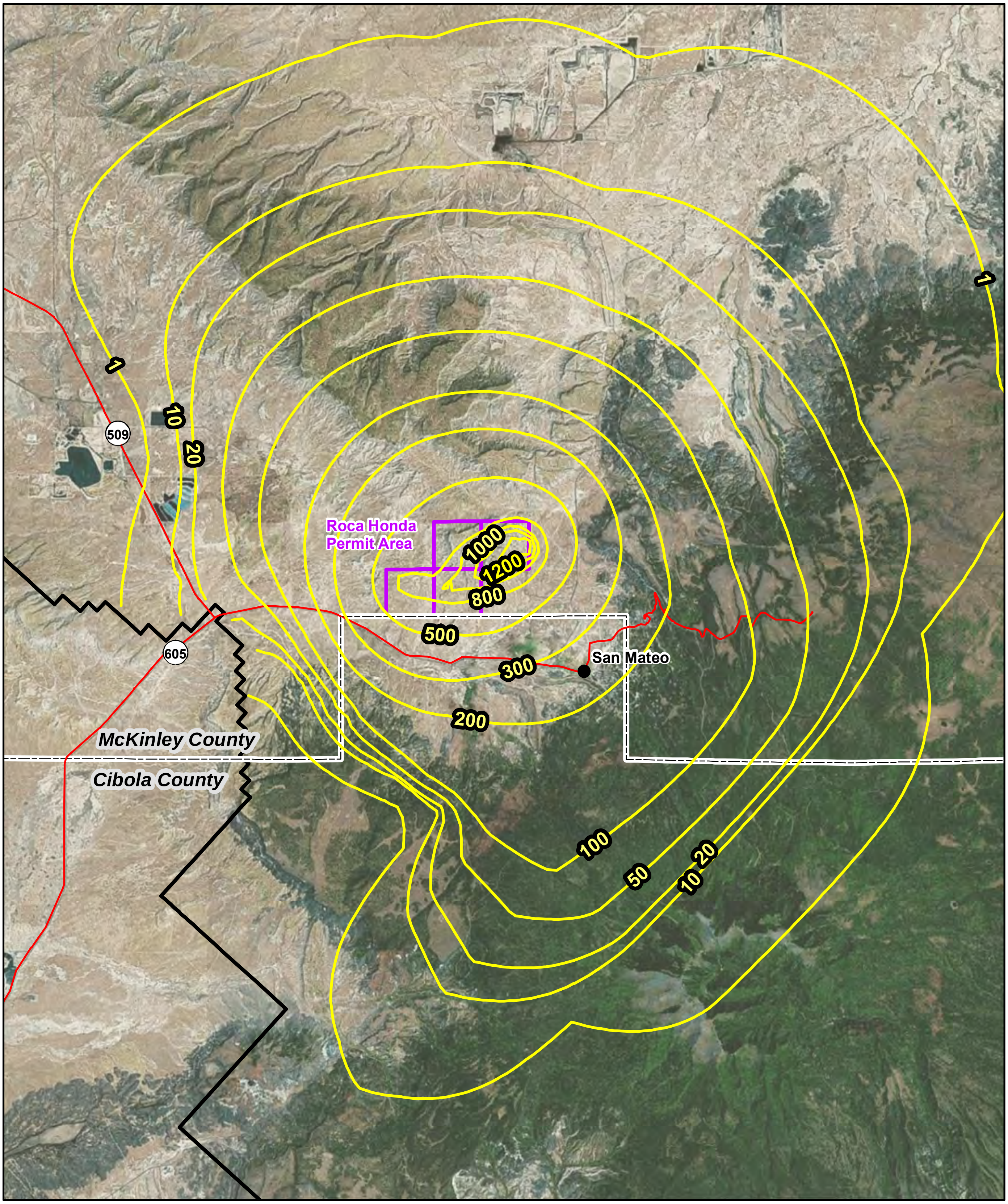

N

Legend

Drawdown (ft)
Model Domain
Roca Honda Permit Area
County Boundary

2.5 1.25 0 2.5
Miles

Maximum drawdown of 1,850 ft not shown

Drawdown in the Westwater Aquifer at End of Mining

INTERA

Figure 6

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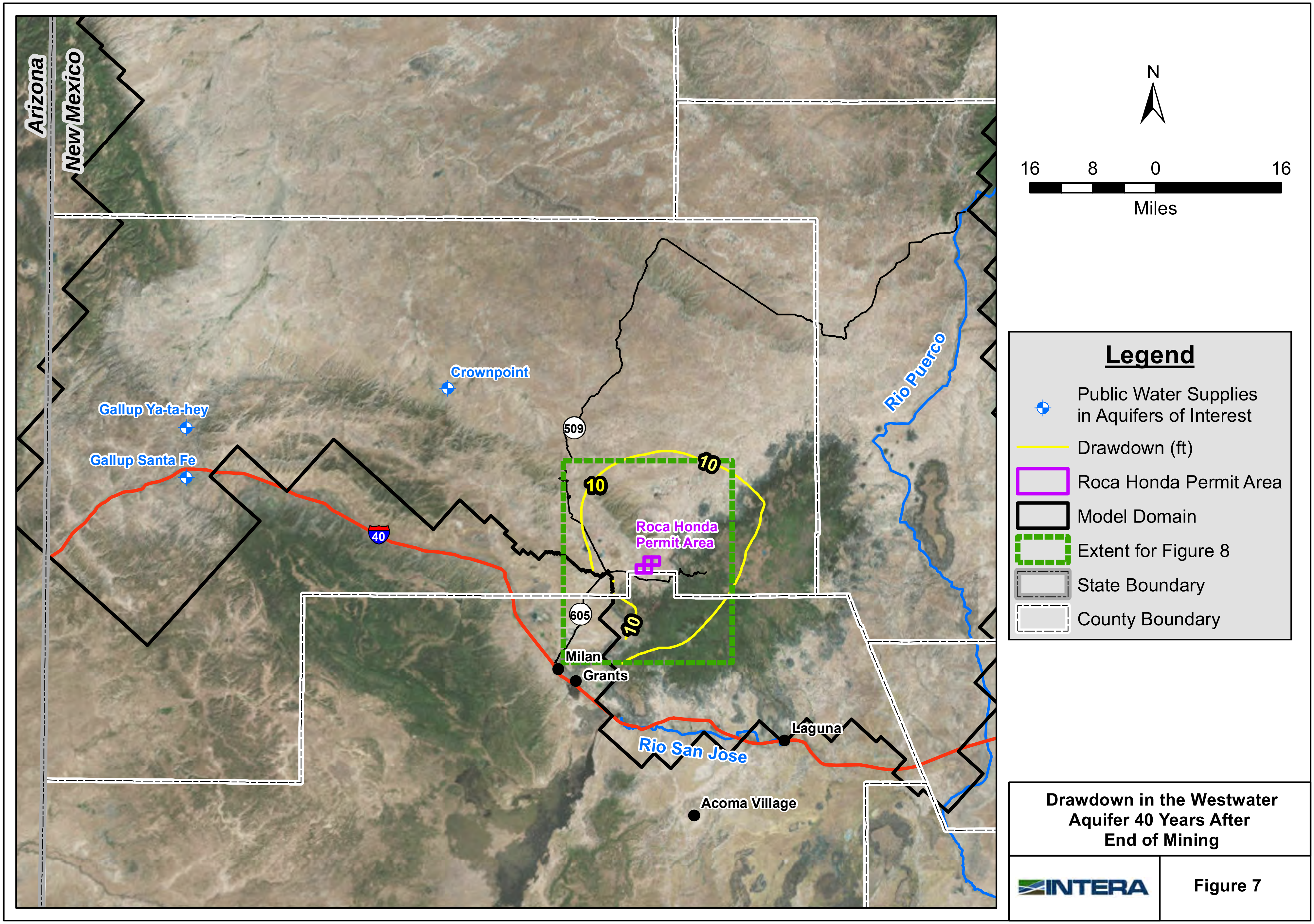

Drawdown in the Westwater Aquifer 40 Years After End of Mining

INTERA

Figure 7

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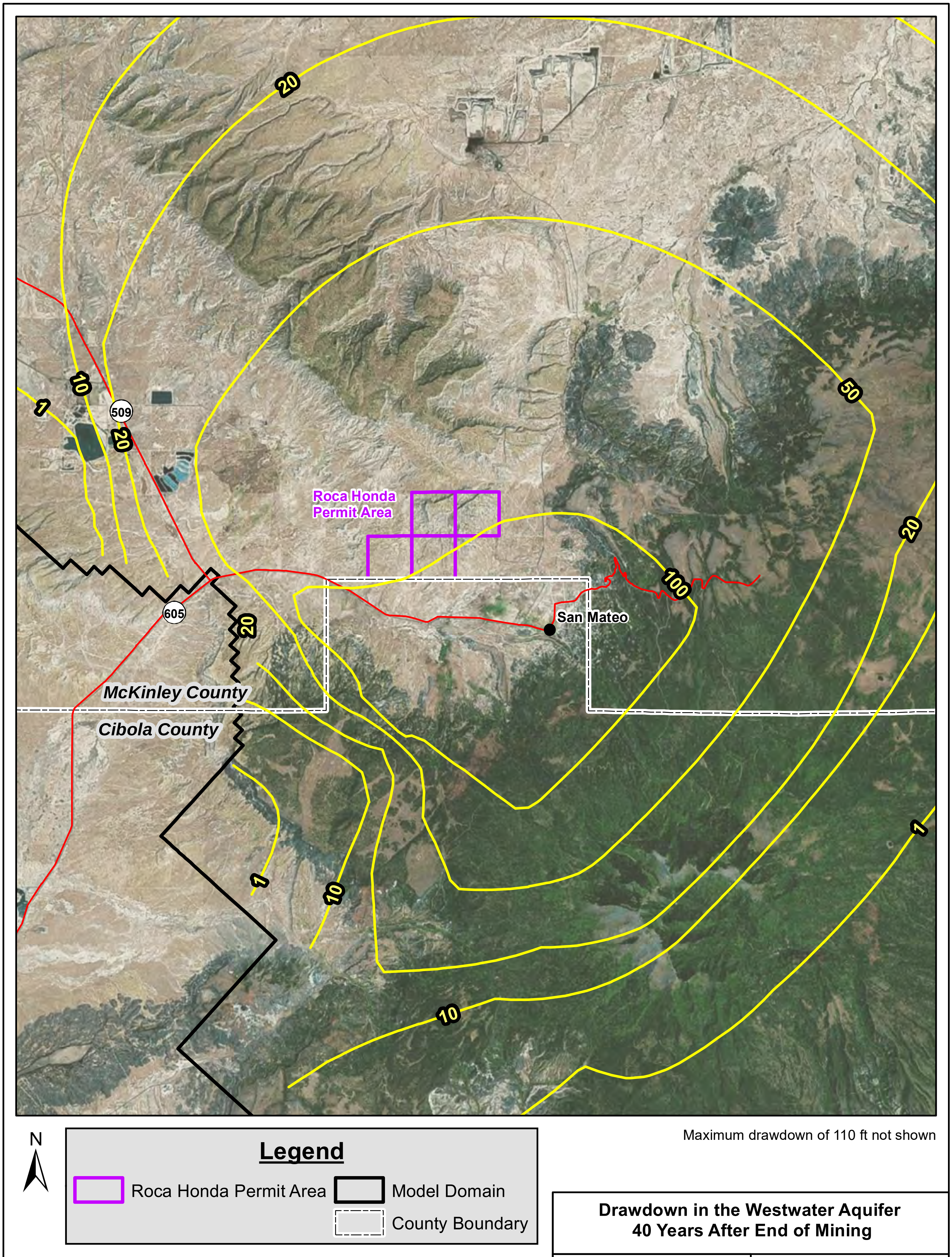

Maximum drawdown of 110 ft not shown

Drawdown in the Westwater Aquifer 40 Years After End of Mining

INTERA

Figure 8

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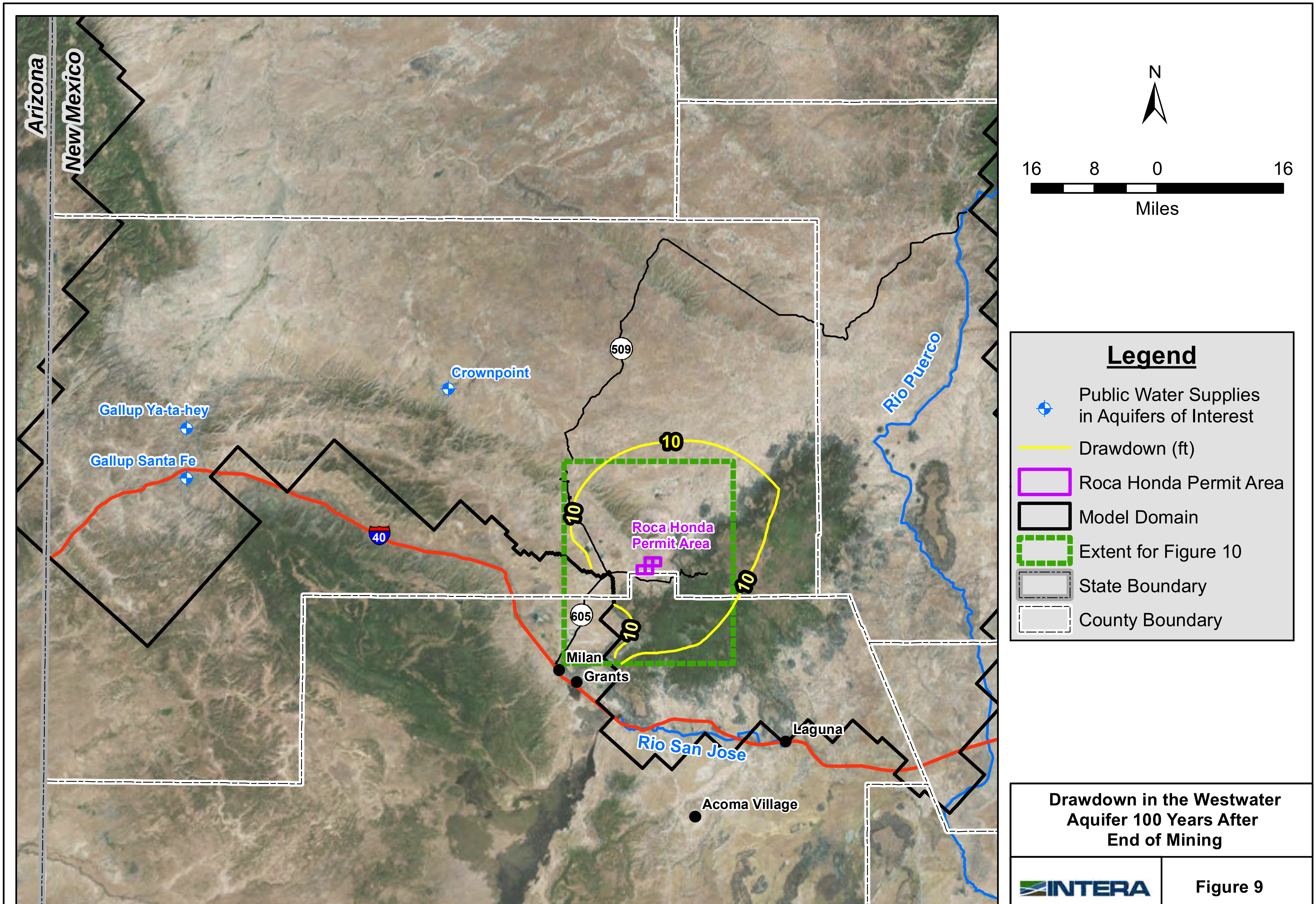

Drawdown in the Westwater Aquifer 100 Years After End of Mining

INTERA

Figure 9

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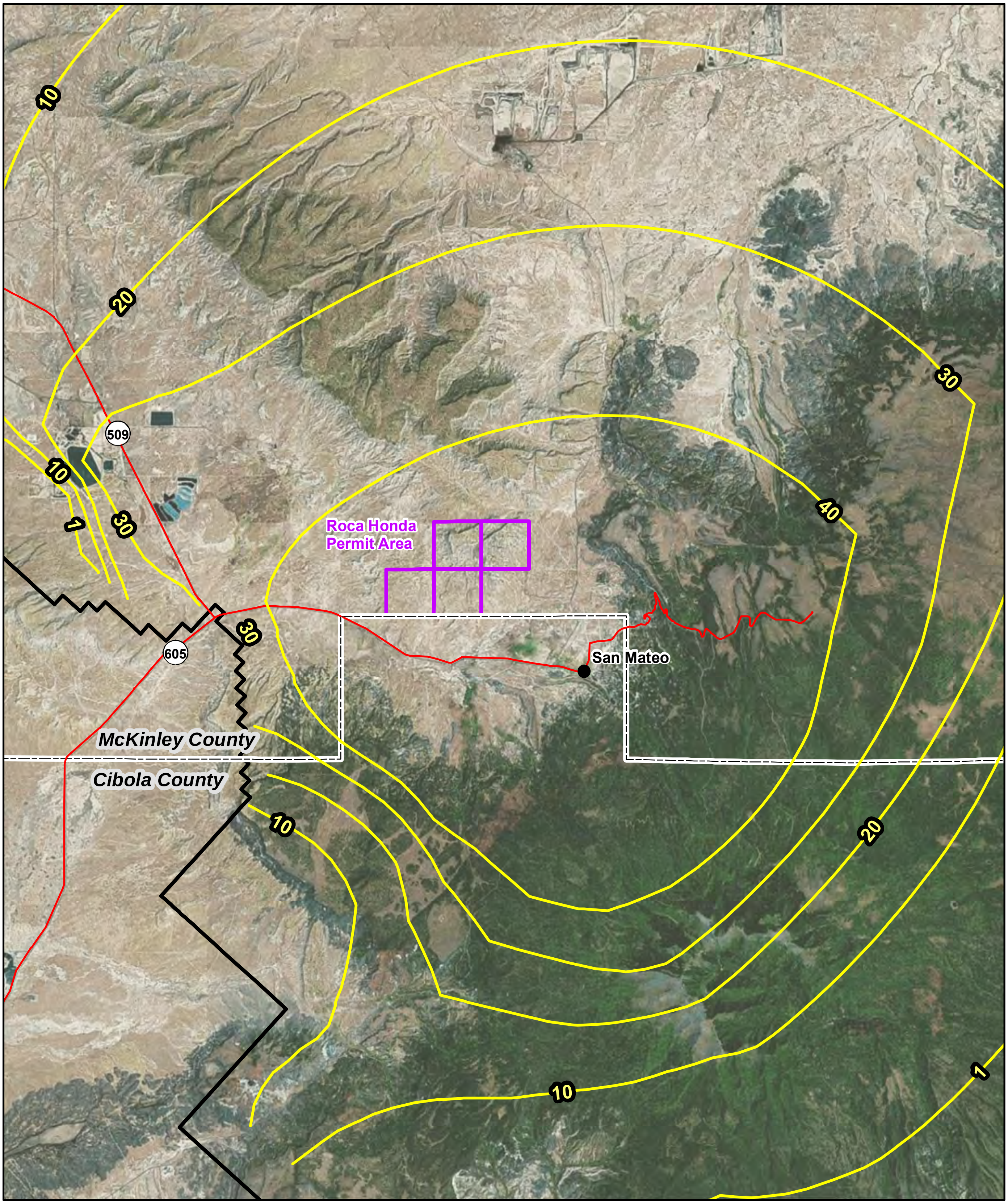

N

Legend

Drawdown (ft)
Model Domain
Roca Honda Permit Area
County Boundary

2.5 1.25 0 2.5
Miles

Maximum drawdown of 49 ft not shown

Drawdown in the Westwater Aquifer 100 Years After End of Mining

INTERA

Figure 10

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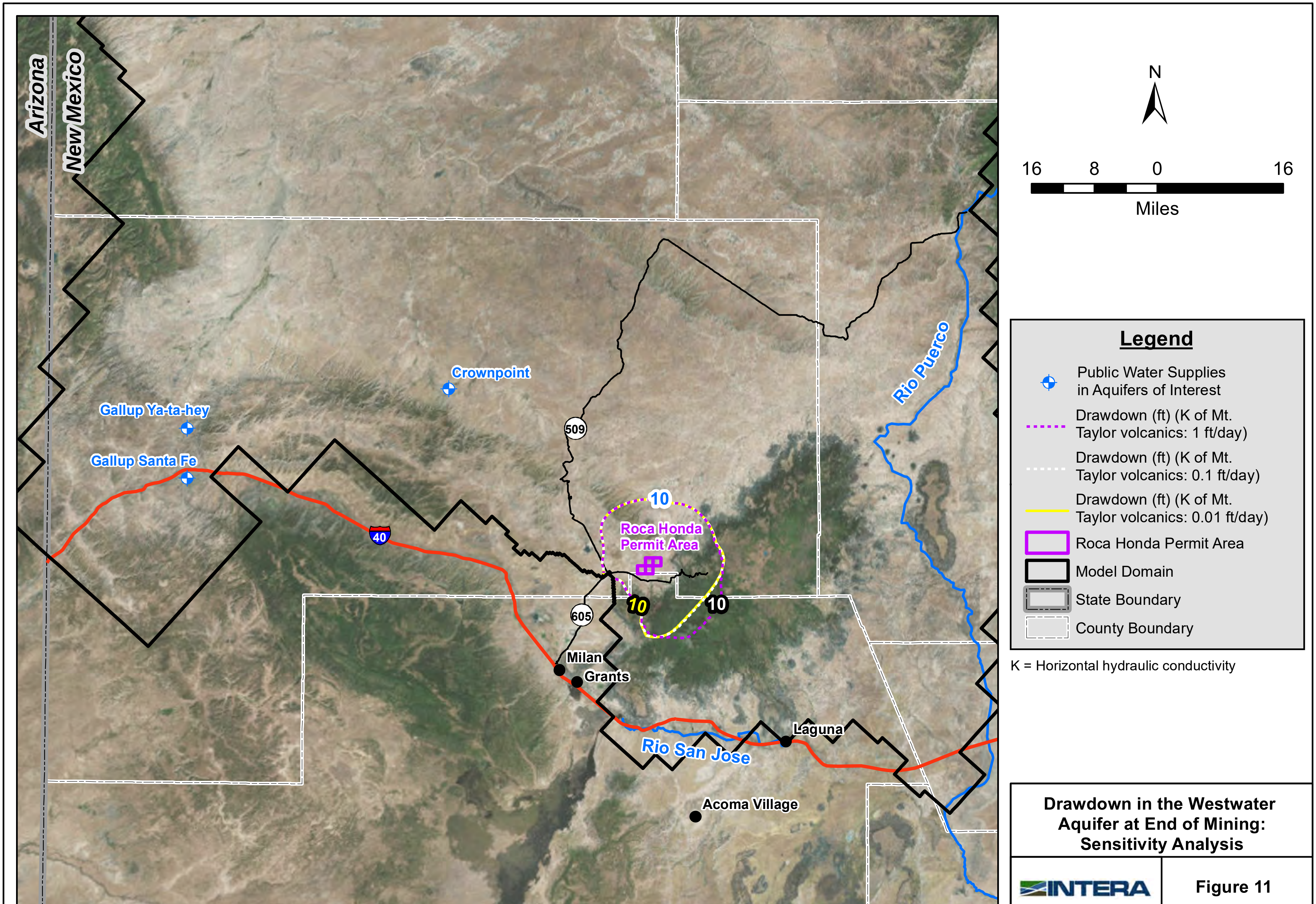

Drawdown in the Westwater Aquifer at End of Mining: Sensitivity Analysis

INTERA

Figure 11

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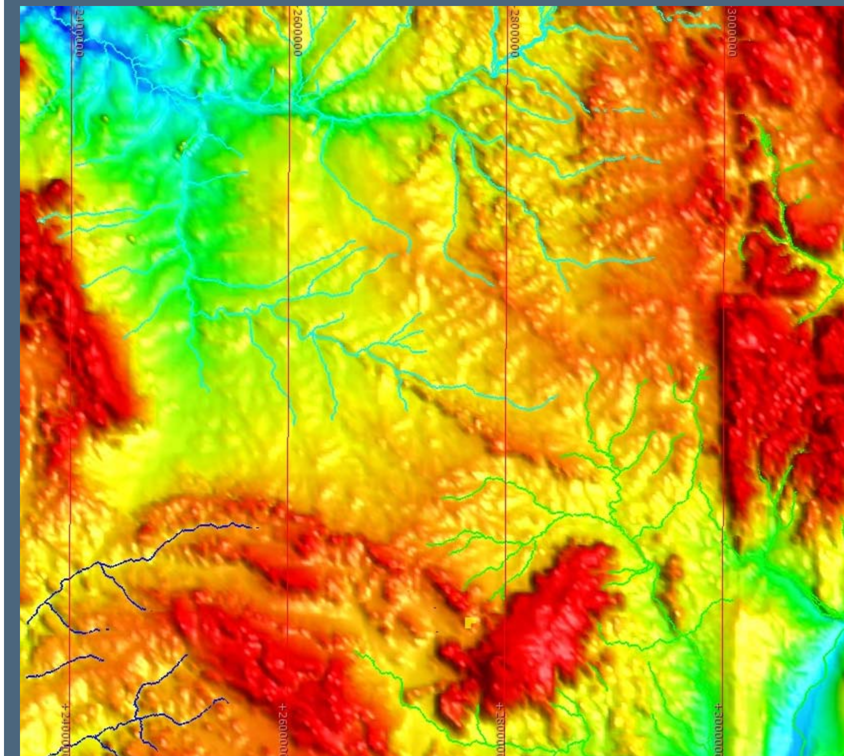
APPENDIX E-2

Slide Presentation: Assessing Potential Impacts from Proposed Roca Honda Mine Dewatering

INTERA Inc., April 28, 2017



Assessing Potential Impacts from Proposed Roca Honda Mine Dewatering in the Gallup, Dakota, and Westwater Canyon Aquifers

Dr. John Sigda,
INTERA, Incorporated
28 April 2017

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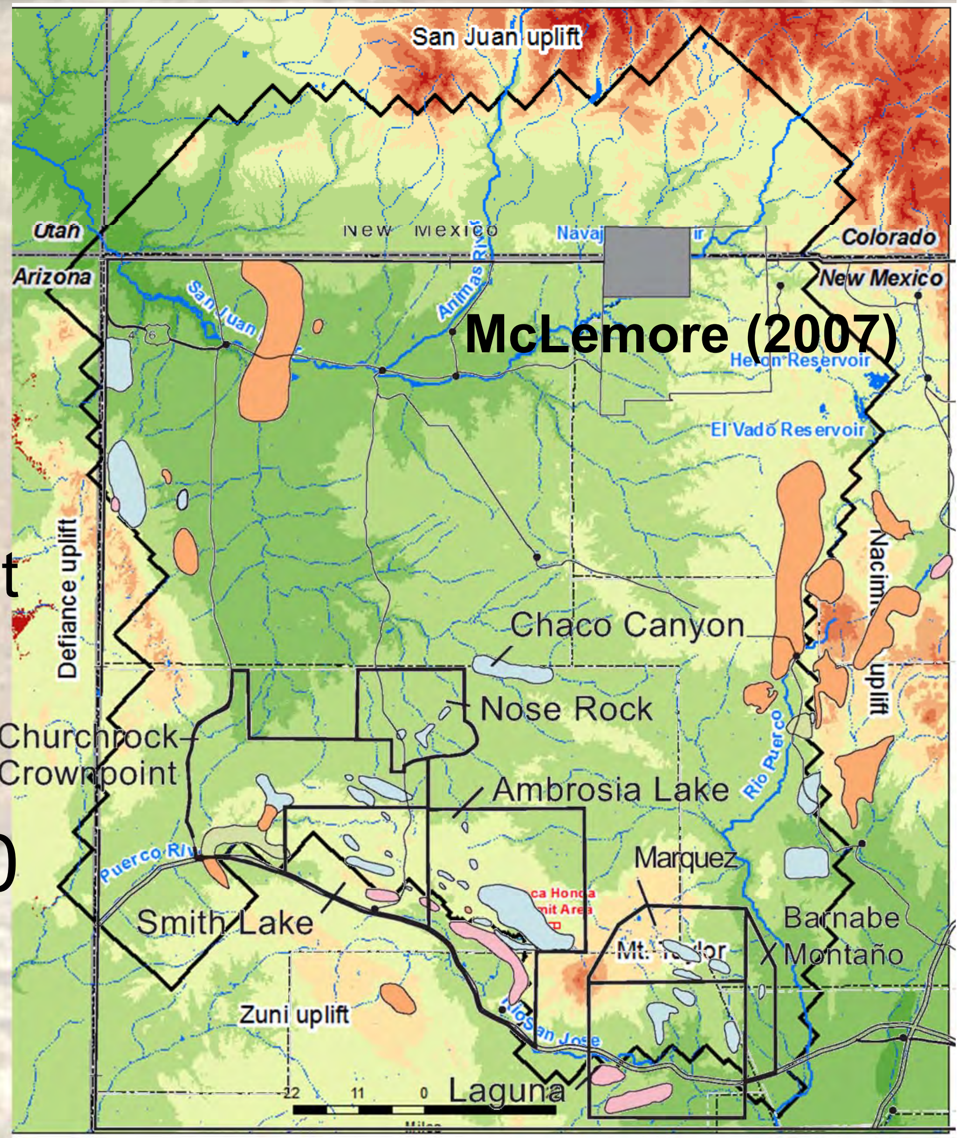
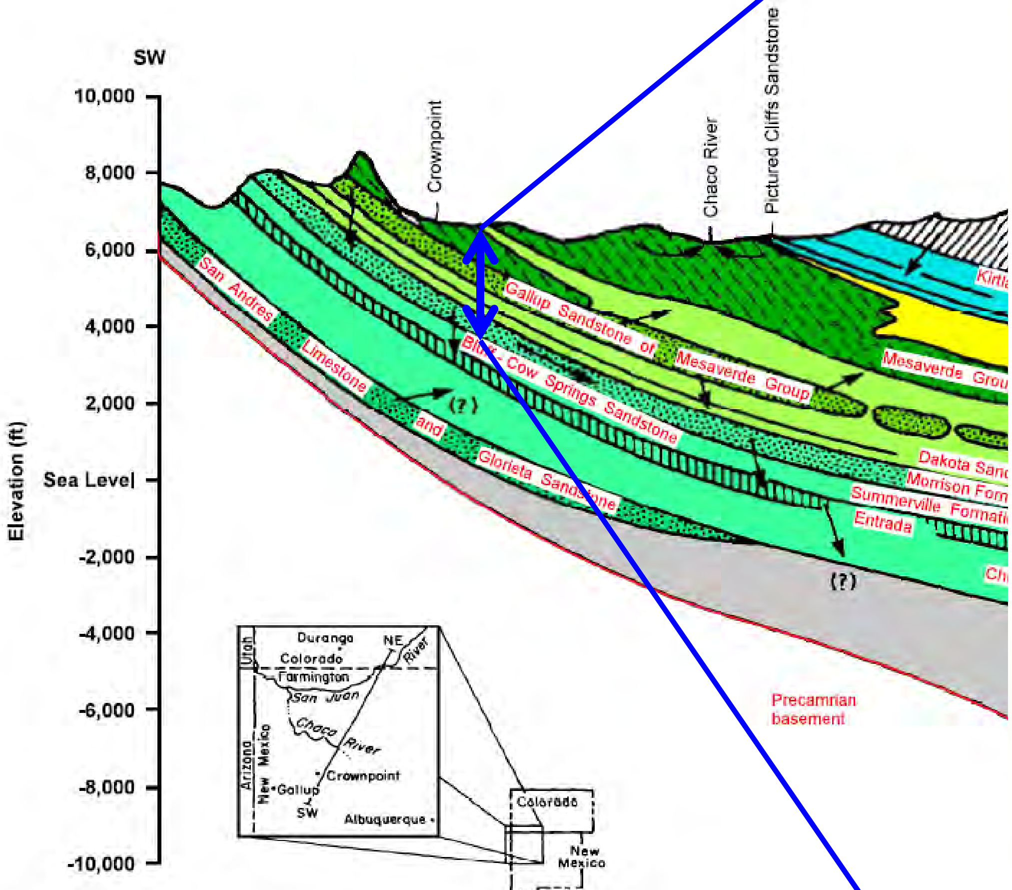
GEOSCIENCE & ENGINEERING SOLUTIONS

Background

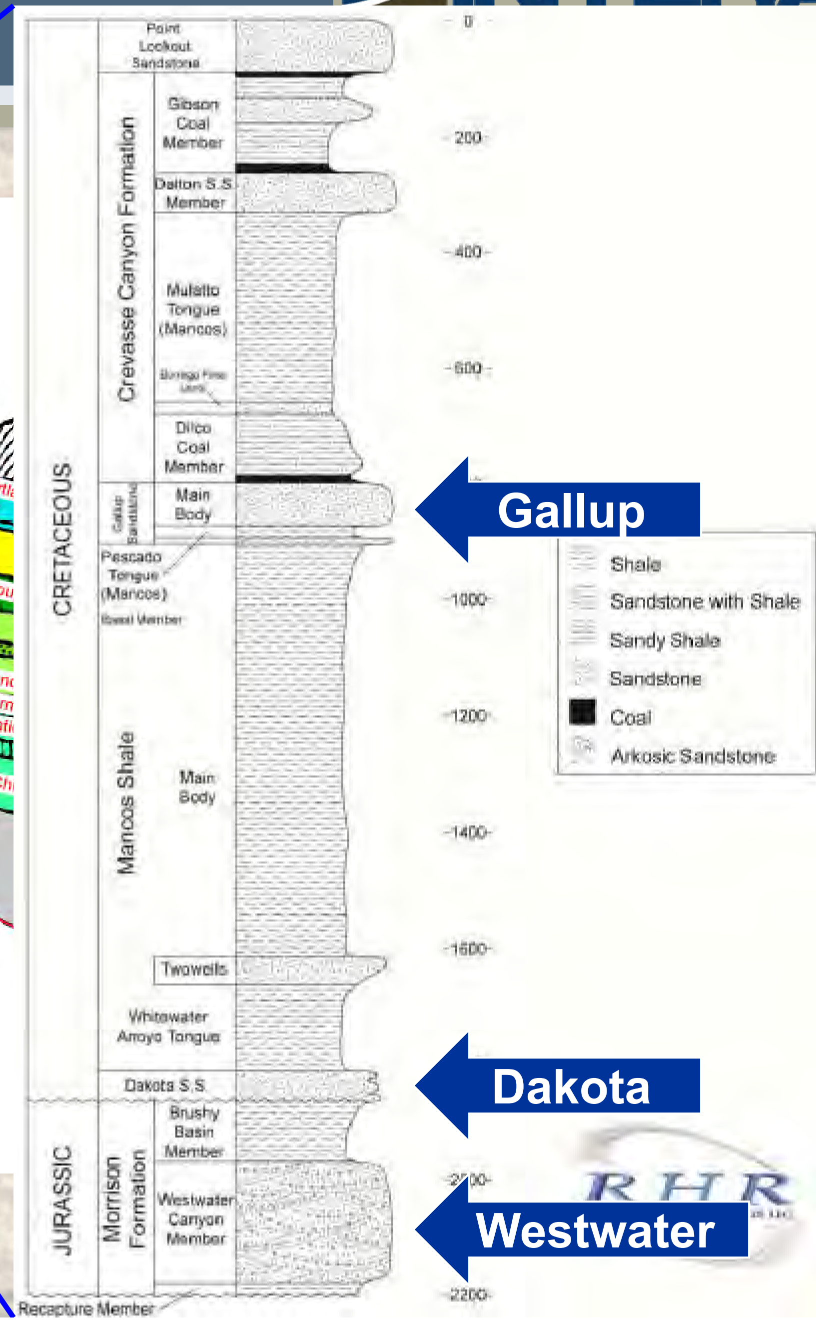
• Regional basin
  - 21,000 square miles
  - Spans 4 states
• Intensive historical uranium mining
  - Grants Uranium Mineral Belt
  - 340 million pounds produced 1948-2002
• Dewatering removed 100 billion gallons



San Juan Basin Stratigraphy
SW-NE Cross-Section



Stone et al., 1983; Kernodle, 1996



Approach

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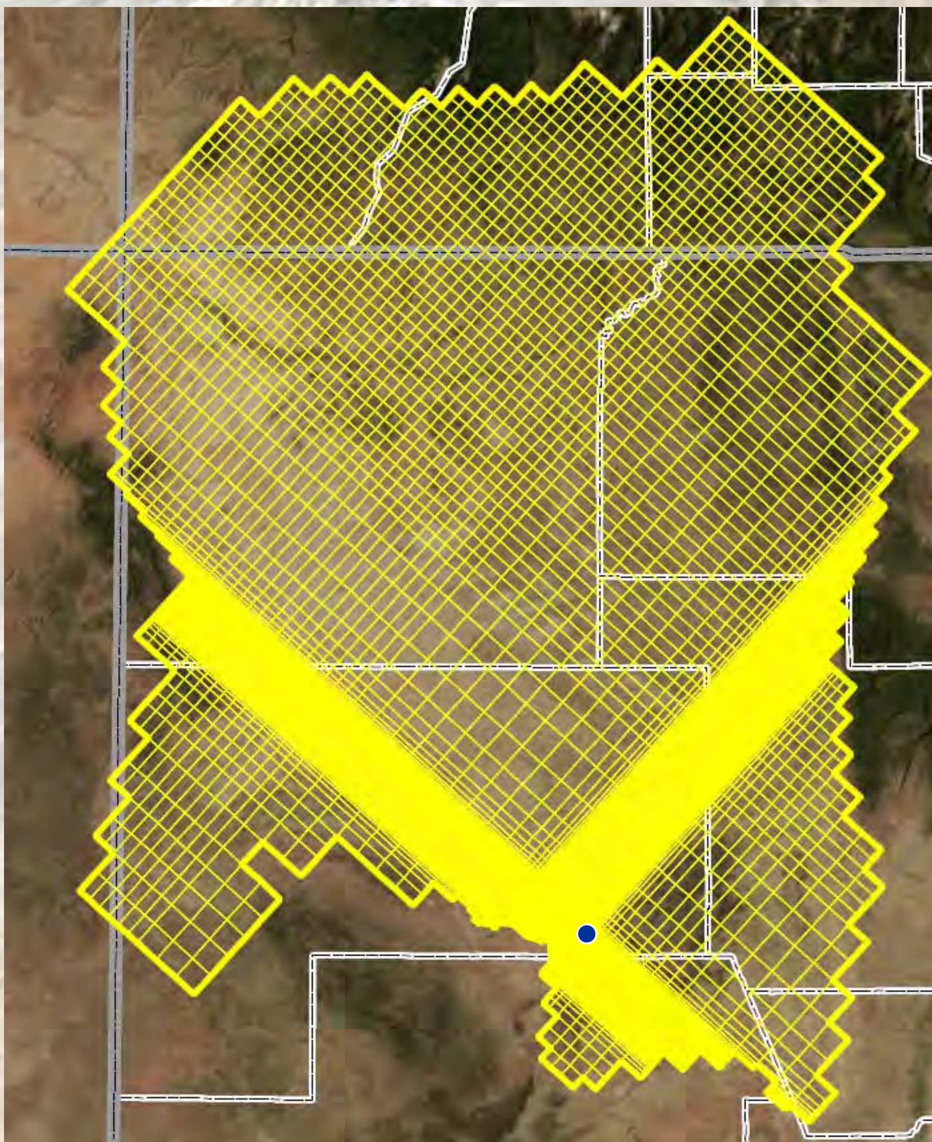
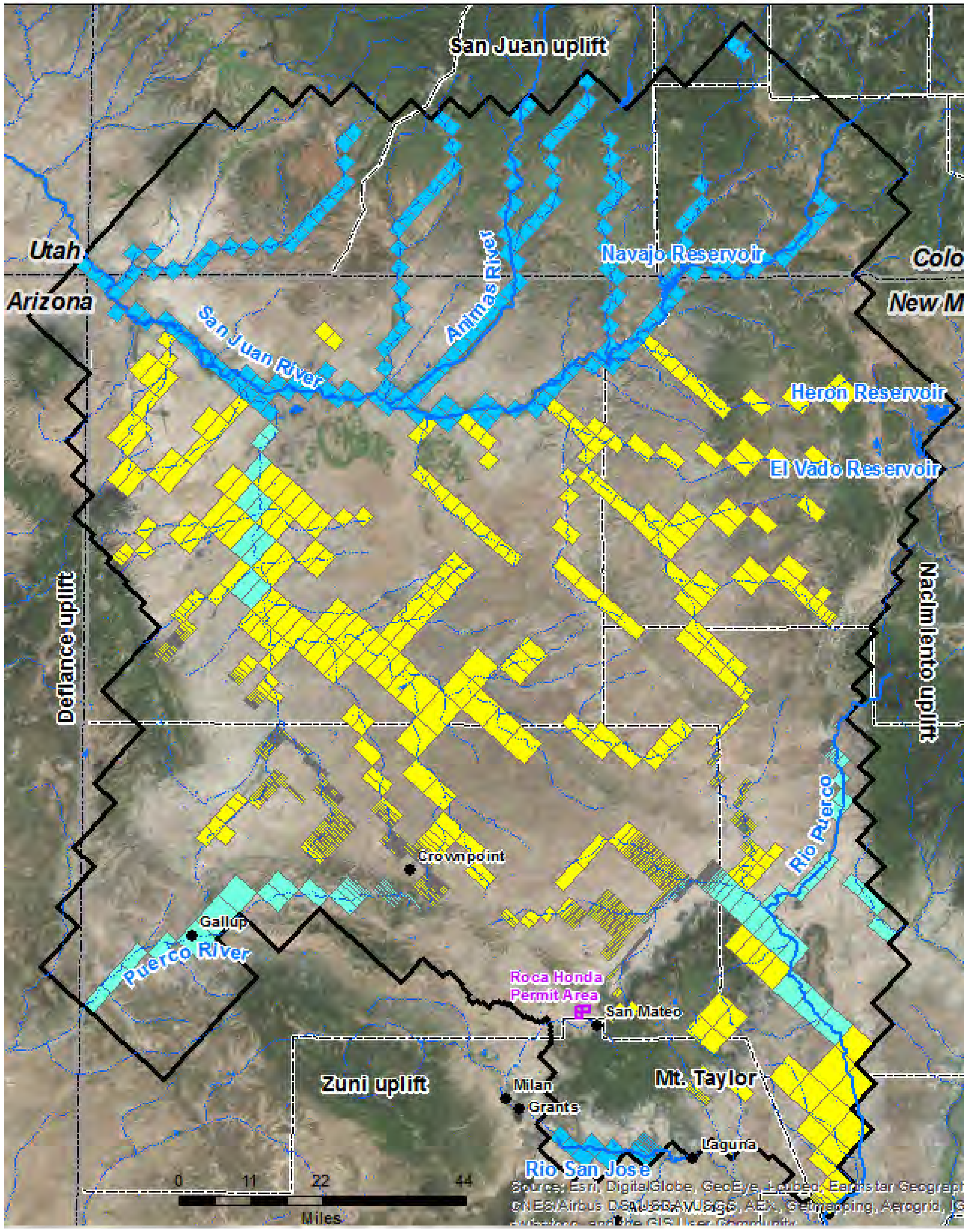
1. Construct and calibrate 3D numerical groundwater flow modeling tool
2. Construct predictive simulations for scenarios without and with mine dewatering
3. Assess impacts by comparing changes in heads and groundwater discharges to surface water bodies

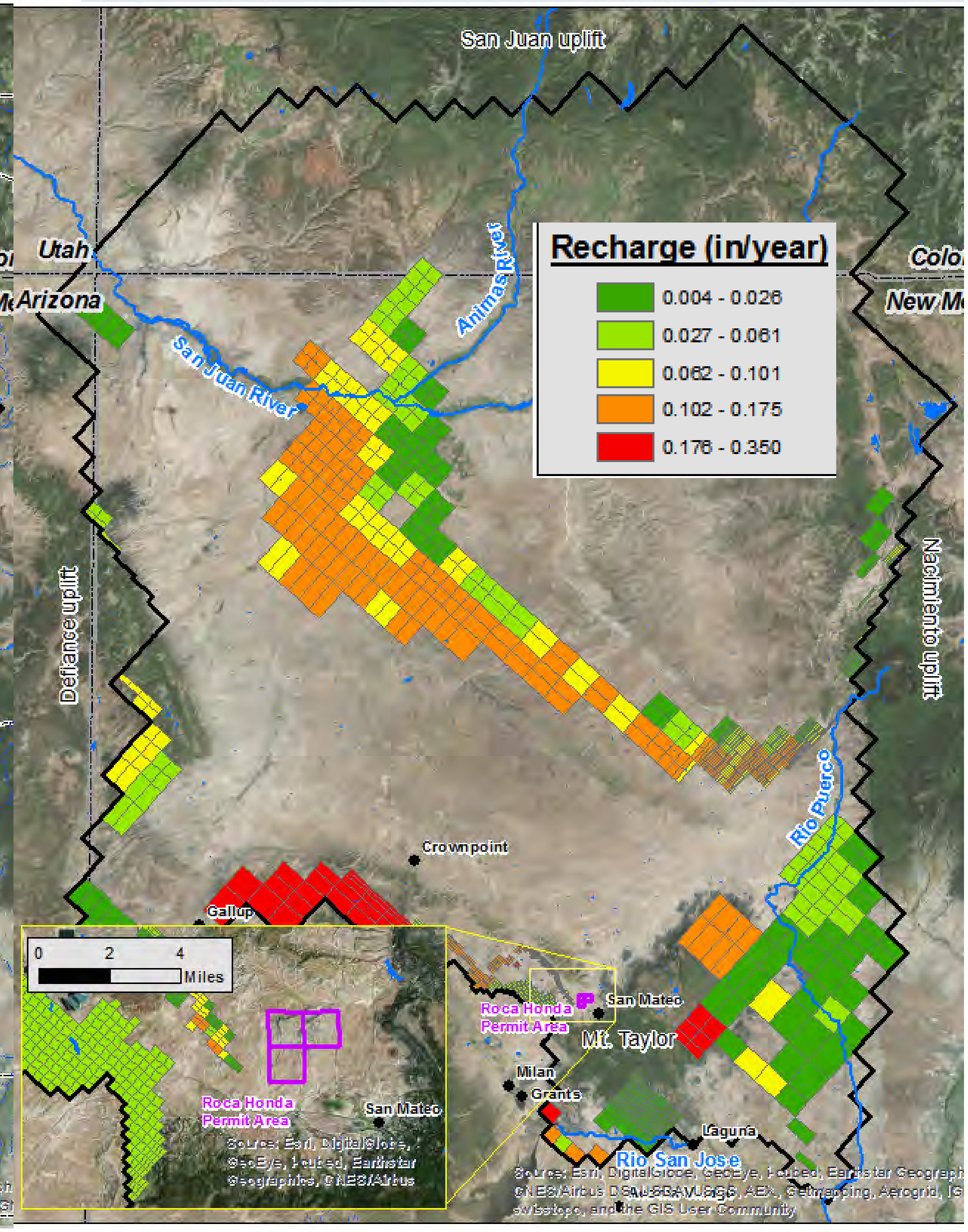
Model Grid and Layers



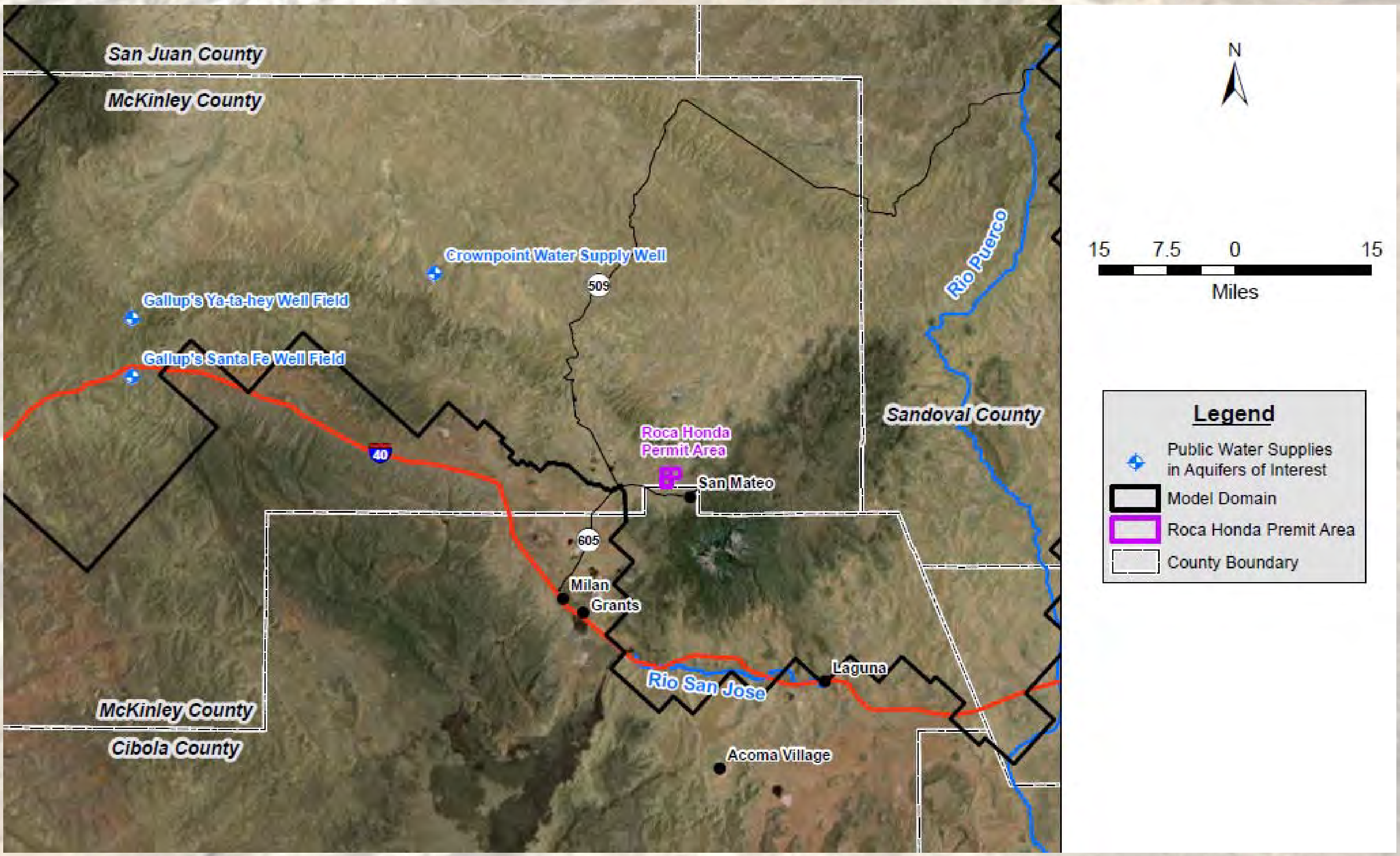
Model Layer	Hydrostratigraphic Unit	Thickness Range (feet)
1	San Jose Formation	200 – 2,700[a]
2	Animas Fm and Nacimiento Fm	230[d] – 2700[e] 500 – 1,300[f]
3	Ojo Alamo Sandstone	20 – 400[e]
	Kirtland Shale and Fruitland Fm	0 – 1,500[eg] 0 – 500[eg]
	Pictured Cliffs Sandstone	0 – 400[e]
4	Lewis Shale	0 – 2,400
5	Cliff House Sandstone	20 – 500
	Menefee Formation	0 – 2,000[g]
	Point Lookout Sandstone	40 – 415[a]
6	Mancos Shale (NE only)	1,000 – 2,300
	Gallup Sandstone (SW only)	0 – 600[c] 0 - 700[a]
7	Mancos Shale	1,000 – 2,300
8	Dakota Sandstone	50 – 350[a]
9	Brushy Basin Member of Morrison Formation	80 – 250
10	Westwater Canyon Member of Morrison Formation	100 – 300

RHR Model Boundary Conditions





Public Water Supply Wells



Impact Assessment

- Scenario 1: no Roca Honda pumping
- Scenario 2: Roca Honda pumping at maximum rate for entire mining period
- Impacts defined by differences between scenarios
  - Differences in groundwater discharge to surface water bodies for rivers and Horace Spring
  - Drawdown for wells and springs

Springs

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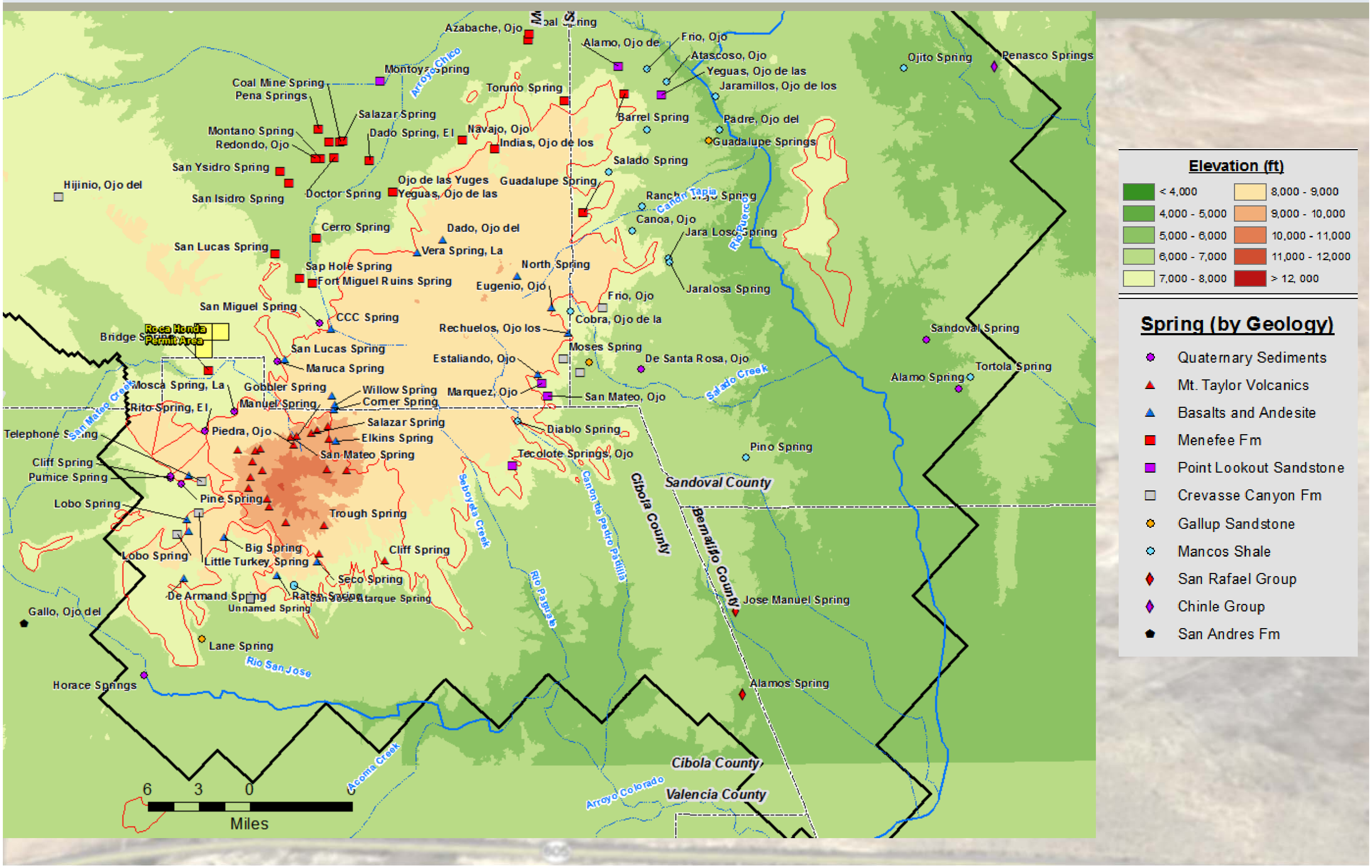
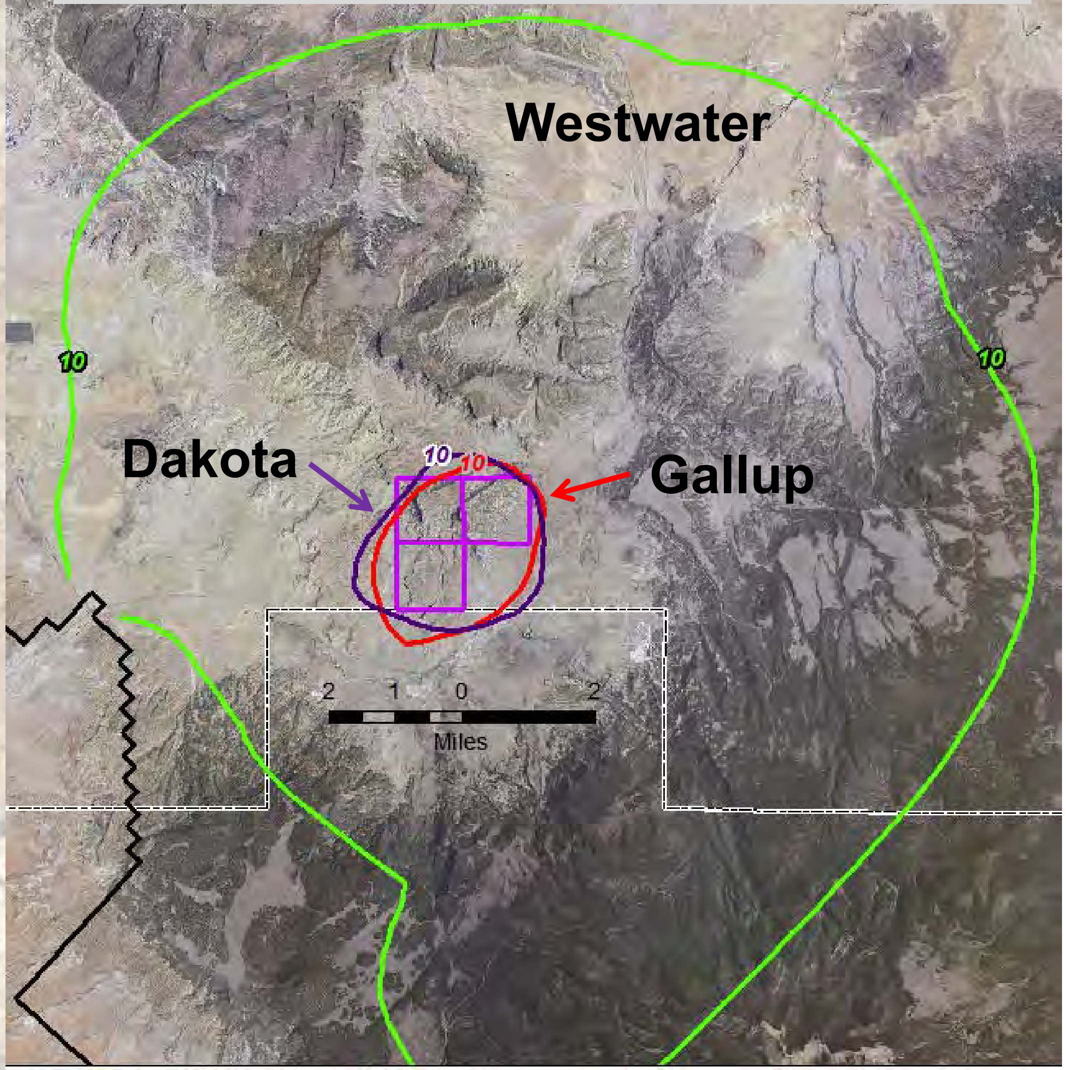


2012 Results

- Negligible impacts at springs
  - 0.7 ft max drawdown
- Westwater head recovers to 97% within 100 years after end of mining
- Negligible changes in groundwater discharges
  - << 1% for San Juan, Rio San Jose, and Rio Puerco Rivers and Horace Springs
  - < 2% for Puerco River

Drawdown at End of Mining



2012 Findings

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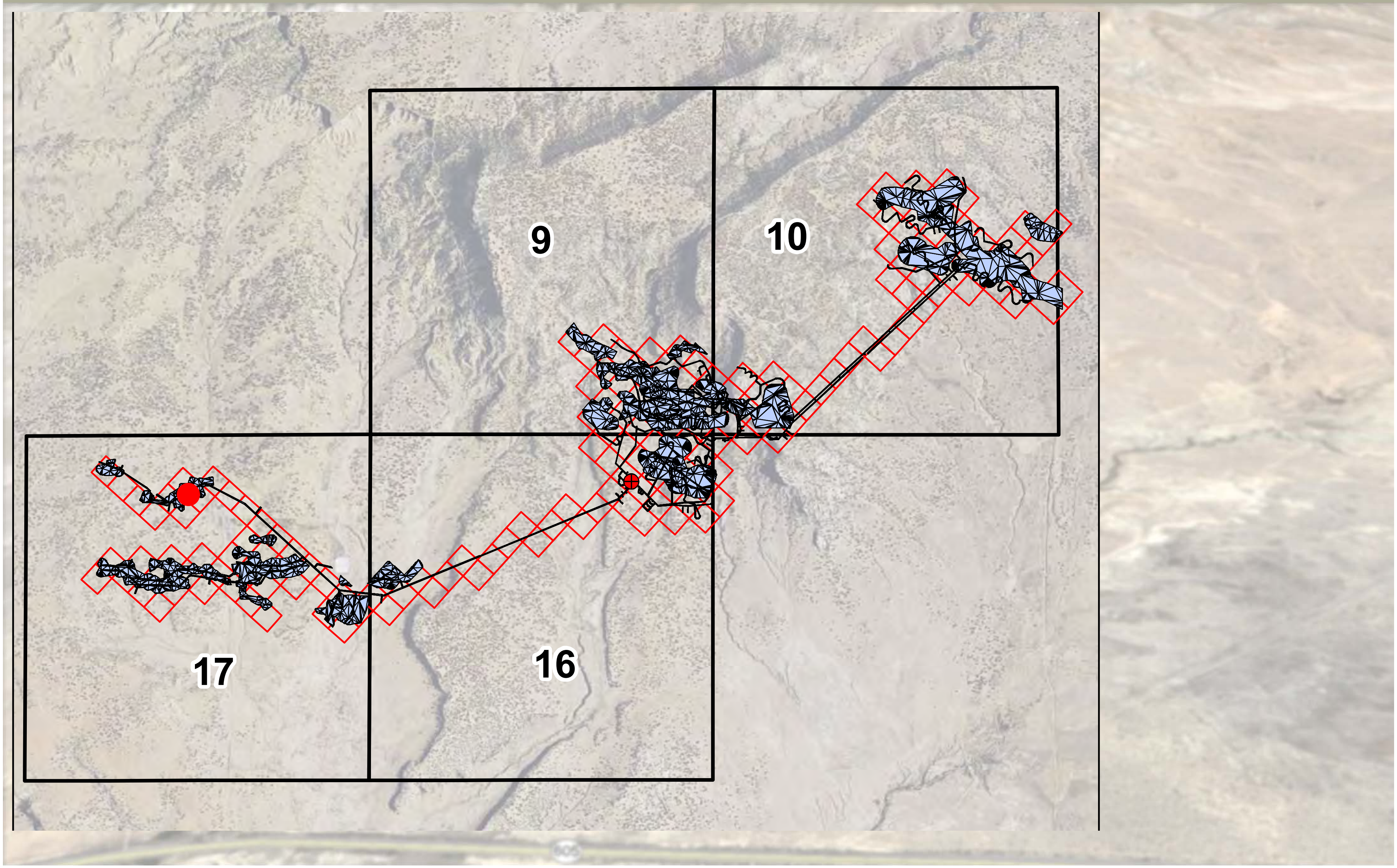
- No impacts to rivers, springs, and all but 2 wells
- Strathmore committed to replace 3 wells
- Accepted by Acoma consultant
- US Forest Service accepted model for EIS analysis
  - Included NMED, NMOSE, and USFS
- NM State Engineer awarded Roca Honda the first mine dewatering permit since NM's Mine Dewatering Act was passed in 1980
- Subsequent "hard look" analyses confirmed original findings

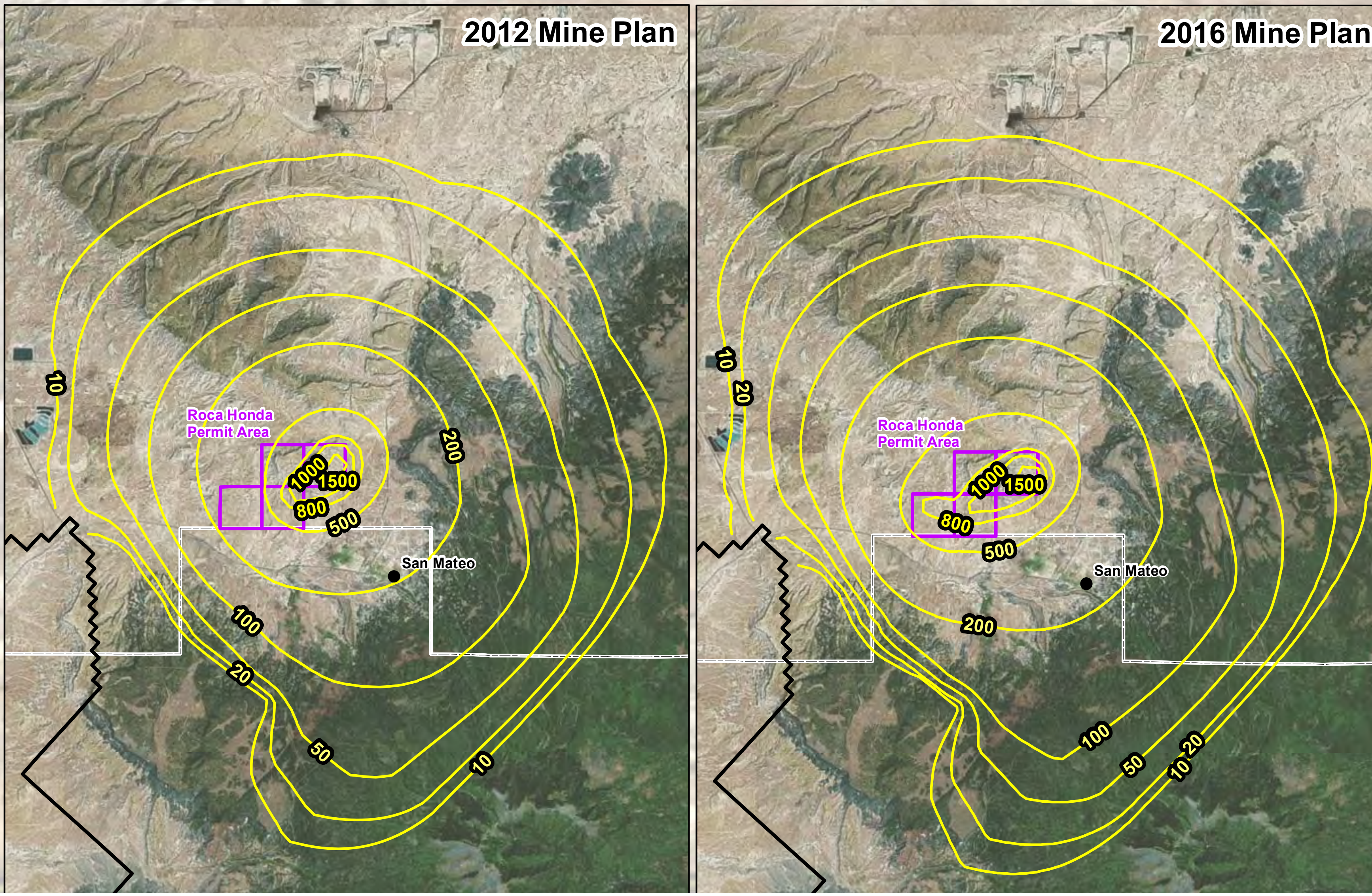
2016 Mine Plan

- Mining in Sections 9, 10, and 16 as in 2012 and in Section 17
- Mining occurs over a 13-yr period in Section 17 and over 10 years in other sections
- Average dewatering rate is 4,700 gallons per minute (gpm) with an maximum annual rate of 5,900 gpm
- As for 2012 assessment, assume maximum annual rate is applied for entire mining period
  - Very conservative approach

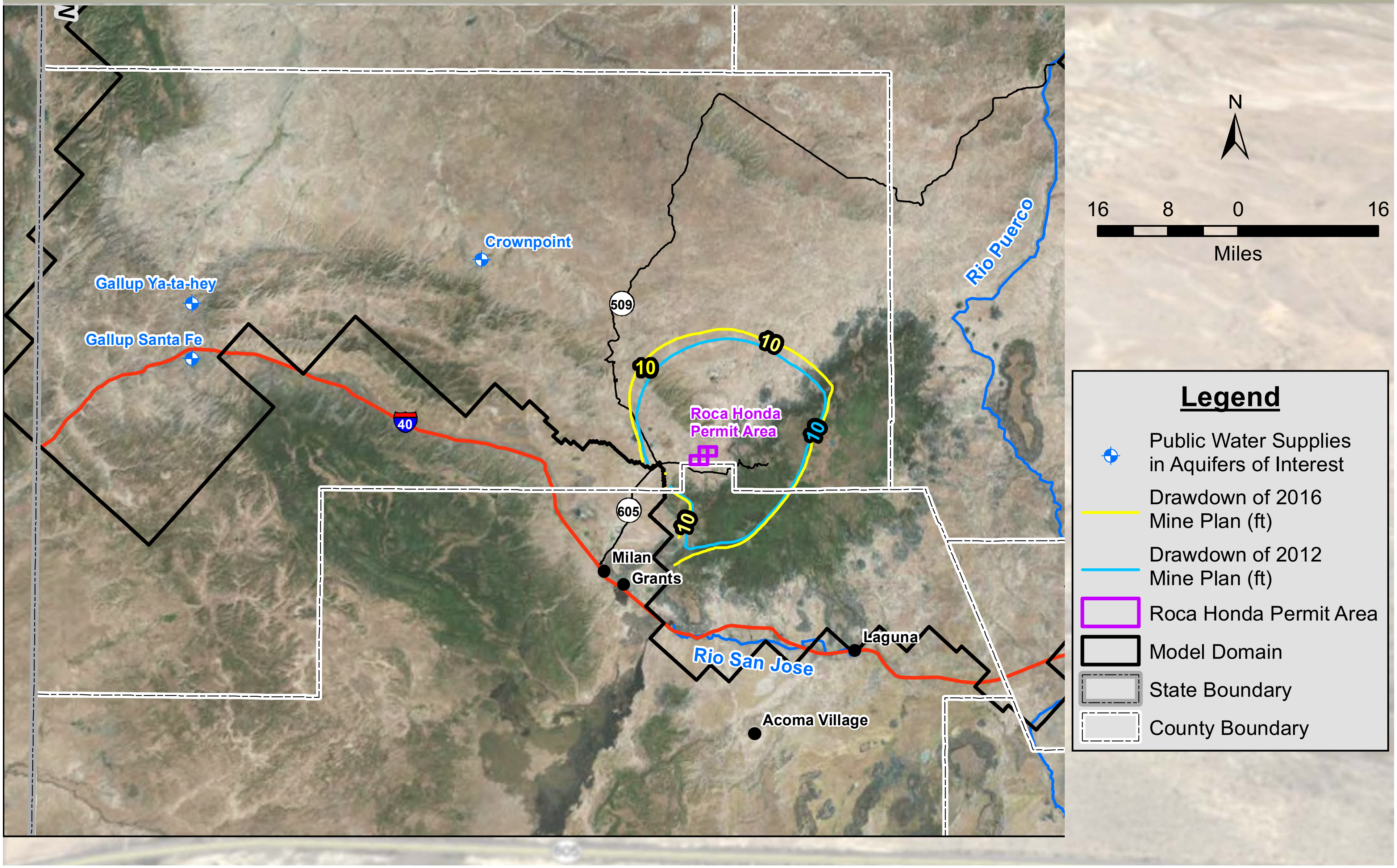
2016 Mine Plan



Westwater Drawdown at End of Mining



Westwater Drawdown at 40 Years After End of Mining



Westwater Drawdown at 100 Years After End of Mining

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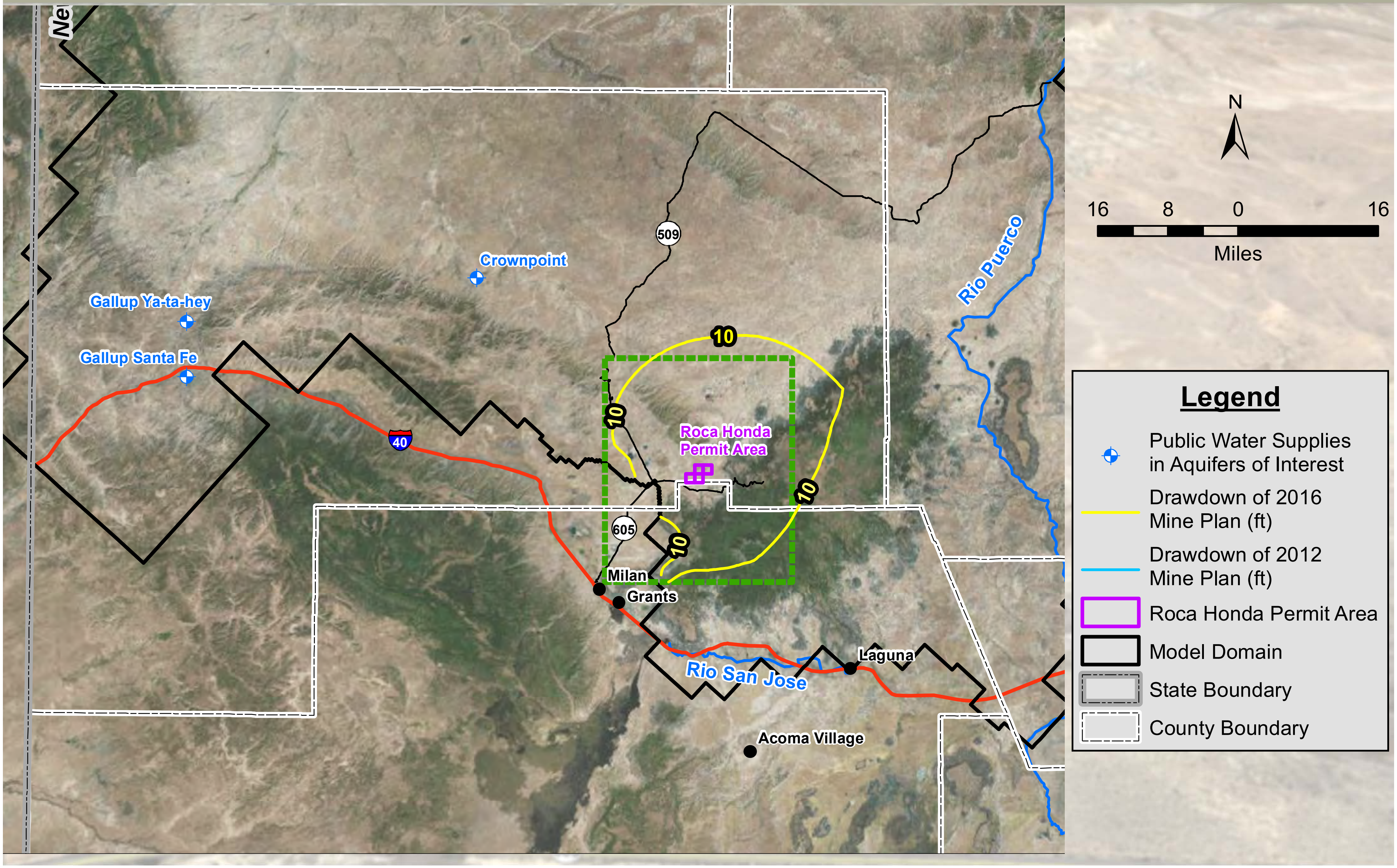

2016 Findings

- As expected, findings are very similar to those for 2012
  - Dakota and Gallup drawdowns identical
  - Maximum Westwater dewatering rate less than that for earlier “hard look” simulation
- 2016 predictive model used to evaluate potential impacts to water resources from mine dewatering
  - No impacts to rivers
  - No impacts to springs, including Horace Spring
  - No impacts to all but 2 wells
  - EFRI committed to replace 3 wells