Rio Algom Mining LLC

June 27, 2019

Mr. Holland Shepard
Program Manager, MARP
NM Energy, Minerals and Natural Resources Department
1220 South St. Francis Drive
Santa Fe, NM 87505

Mr. Kurt Vollbrecht
Program Manager
NM Environment Department
1190 St. Francis Drive.
P.O. Box 5469
Santa Fe, NM 87502

Re: **Interim Closure/Closeout Plan, New Mexico Mine Permit No. MK009RE and New Mexico Discharge Permits -67, -71, -264, and -362**

Dear Mr. Shepard and Mr. Vollbrecht:

Rio Algom Mining LLC (RAML) respectfully submits the enclosed Interim Closure/Closeout Plan (CCP) for mine permit no. MK009RE and discharge permits (DP) 67, 71, 264, and 362. The purpose of this interim CCP is to provide a basis for updating RAML's financial assurance with the State of New Mexico during the pendency of discussions amongst RAML, the State of New Mexico, and the U.S. Environmental Protection Agency (EPA) regarding the scope of potential investigation and remediation response actions in the western portion of the San Mateo Creek Basin near Grants, New Mexico (hereafter referred to "Ambrosia Lake"). The geographic scope of this Interim CCP was approved by New Mexico Mining and Minerals Division and New Mexico Environment Department in a 13 May 2019 letter to RAML.

As you are aware, the geographic scope of this Interim CCP includes parcels of land which have been impacted by operations historically conducted by several entities, including those with no affiliation to RAML. Significantly, Tronox Worldwide LLC (formerly Kerr-McGee Corporation ["KM"]) conducted operations on and impacting parcels included in the Interim CCP beginning in the 1950s and through the early 1980s. RAML is not the corporate successor to Tronox/KM. It is a separate entity. In 1983, Tronox/KM transferred its mining leases to a subsidiary, Kerr-McGee Nuclear Corporation (KMNC). KMNC subsequently changed its name to Quivira Mining Company, and RAML purchased Quivira from Tronox/KM in 1988. As part of the transaction, Tronox/KM retained responsibility for the bulk of environmental concerns at Ambrosia Lake.

In 2009, Tronox declared bankruptcy. Both EPA and RAML filed proofs of claim in the bankruptcy proceeding for future response costs at Ambrosia Lake. The State of New Mexico declined to participate. In the resultant litigation, Tronox admitted it was 100% responsible for all future response costs at Ambrosia Lake. Moreover, EPA's claim in bankruptcy supplanted RAML's. EPA took a priority position under the premise that EPA would recover funds from the liable party, Tronox, to satisfy future obligations. Thus the projected future response costs at Ambrosia Lake were disbursed to EPA as part of the Tronox Funds. Indeed, EPA is currently conducting non-time critical actions on these same parcels using Tronox Funds.

Since at least 2017, RAML has been in discussions with EPA and the State of New Mexico regarding the scope of potential investigation and remediation response actions at Ambrosia Lake and associated distribution of the Tronox Funds. RAML remains committed to these discussions and submits this Interim CCP in good faith for the purposes of providing a basis for updating RAML's financial assurance with the State of New Mexico. The Interim CCP outlines a conceptual plan for the closeout of permit MK009RE and closure of DPs -67, -71, -264, and -362. This conceptual plan forms the basis for estimating costs associated with the identified closure and closeout activities, which in turn forms the basis for updating RAML's financial assurance with the State of New Mexico. As such, this Interim CCP does not outline a timeframe for implementing the work described within. Rather, RAML anticipates that the ongoing discussions will identify mutually agreeable timeframes, scopes of work, and legal agreements under which to conduct any such work. By submitting this Interim CCP, RAML does not intend to waive any legal arguments with respect to the scope of and responsibility for the closure/closeout activities described in this interim CCP.

An electronic copy of this report is included on the accompanying disc. If you have any questions or need additional information, please call me at (916) 947-7637 or Theresa Ballaine at (209) 753-7005.

Sincerely,

Sandra L. Ross, P.G.
Manager
Rio Algom Mining LLC

cc: Theresa Ballaine, RAML New Mexico Project Manager

P.O. Box 218, Grants, NM USA 87020 - Tel: 505.287.8851 - Fax: 505.285.5550

Prepared for:

RIO ALGOM MINING, LLC
PO Box 218
Grants, NM 87020

INTERIM CLOSURE/CLOSEOUT PLAN

NEW MEXICO MINE PERMIT NO. MK009RE
AND
NEW MEXICO DISCHARGE PERMITS -67, -71, -264, -362

June 27, 2019

Prepared by:

Environmental Restoration Group
8809 Washington St NE
Ste. 150
Albuquerque, NM 87113

and

INTERA Incorporated
6000 Uptown Blvd NE Suite 220
Albuquerque, NM 87110

Table of Contents

List of Figures

List of Tables

Acronyms and Abbreviations

ACHP	Advisory Council on Historic Preservation
ARPA	Archaeological Resources Protection Act
BMP	Best Management Practice
CEQ	Council on Environmental Quality
CCP	Closure/Closeout Plan
CFR	Code of Federal Regulation
CSM	Conceptual Site Model
CSR	Characterization Summary Report
CWP	Characterization Work Plan
cpm	counts per minute
Cy	cubic yard
DOE	U.S. Department of Energy
DP	Discharge Permit
DQO	Data Quality Objective
EMNRD	New Mexico Energy, Minerals, & Natural Resources Department
EPA	U.S. Environmental Protection Agency
ERG	Environmental Restoration Group, Inc.
ft	feet
FSS	Final Status Survey
FWS	U.S. Fish and Wildlife Service
lb	pounds
LiDAR	Light Detection and Ranging
MSGP	Multi Sector General Permit
NMED	New Mexico Environmental Department
NMMMD	New Mexico Mining and Minerals Department
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NM	New Mexico
NMAC	New Mexico Administrative Code
NRC	U.S. Nuclear Regulatory Commission
NCRP	National Council on Radiation Protection
NRCS	Natural Resource Conservation Service
m	meter
OSL	Old Stope Leaching
pCi	picoCurie
μR/hr	micro-roentgen per hour
mrem/yr	milli-roentgen equivalent man per hour
R	range
RAML	Rio Algom Mining, LLC
RHR	Roca Honda Resources
s	second
SAP	Sampling and Analysis Plan
SRWP	Site Reclamation Work Plan
SWPPP	Stormwater Pollution Prevention Plan
T	township
WQCC	New Mexico Water Quality Control Commission
Yd	yard

1 Introduction

Rio Algom Mining, LLC (RAML) owns parcels of land in the Ambrosia Lake Valley, approximately 25 miles north of Grants, New Mexico, that are associated with a former uranium recovery operation. Uranium recovery on the property was historically conducted by several entities, including those with no affiliation to RAML. Of specific interest to this submittal, RAML has five permits with the State of New Mexico related to historical Ambrosia Lake mining operations: MK009RE (issued by the New Mexico Mining and Minerals Division [NMMMD]) and Discharge Permits (DPs) -67, -71, -264, and -362 (issued by the New Mexico Environment Department [NMED]). Uranium recovery ceased in 2002, and RAML has no plans to resume mining. As such, all facilities and mines described or referenced in this interim closure/closeout plan (CCP) should be regarded as “former”.

1.1 Purpose and Objectives

The purpose of this interim CCP is to provide a basis for updating RAML’s financial assurance with the State of New Mexico. This interim CCP outlines a conceptual plan for the closeout of permit MK009RE and closure of DPs -67, -71, -264, and -362. This conceptual plan forms the basis for estimating costs associated with closure and closeout activities, which in turn provides the basis for updating RAML’s financial assurance with the State of New Mexico.

The geographic scope of this interim CCP (“project area”) is presented on Figure 1. The project area includes a number of mine sites specifically designated for special funding held and administered by the United States Environmental Protection Agency (EPA). EPA is currently conducting non-time critical actions to inform distribution of this special funding. RAML has been negotiating with EPA, NMMMD and NMED since at least 2017 regarding affected areas associated with activities authorized by RAML’s mining and discharge permits. The project area depicted on Figure 1 was approved by NMMMD and NMED for the purposes of this interim CCP in May 2019. Neither RAML nor the State of New Mexico intend to waive any legal arguments with respect to the scope of and responsibility for the closure/closeout activities described in this interim CCP.

This interim CCP has been written to satisfy guidance for closeout issued by the New Mexico Mining Act Reclamation Bureau (NMMMD, 1996) and joint guidance issued by NMED and NMMMD for uranium mines (EMNRD & NMED, 2016) during the pendency of these negotiations. The performance objectives and cleanup levels described in the guidance documents above were used to develop the cost estimate for surety purposes. The scope of this interim CCP and the associated performance objectives and clean up levels are subject to change.

Based on this conceptual plan, the total estimated closure/closeout cost associated with the project area described in this interim CCP is $85,561,000. This cost includes capital, operational, and maintenance costs, as well as contingency and indirect costs.

1.2 Organization

The organization of this interim CCP is as follows:

- Section 1 provides an overview of this interim CCP, regulatory setting and history.
- Section 2 describes RAML’s mine permit and applicable discharge permits.
- Section 3 describes existing mine features, land use, and environmental setting.
- Section 4 summarizes completed reclamation within the project area.

- Section 5 describes the performance objectives and conceptual reclamation design, as appropriate, for each component of the planned reclamation.
- Section 6 describes confirmatory environmental monitoring and reporting.
- Section 7 provides a cost estimate for reclamation, confirmatory monitoring and reporting, and post-closure care.
- References used to prepare this interim CCP.
- Appendix A presents typical, conceptual designs for store-and-release covers for proposed repositories.
- Appendix B provides remedial soil volumes by section and type.
- Appendix C presents the cost estimate for all closure/closeout components.

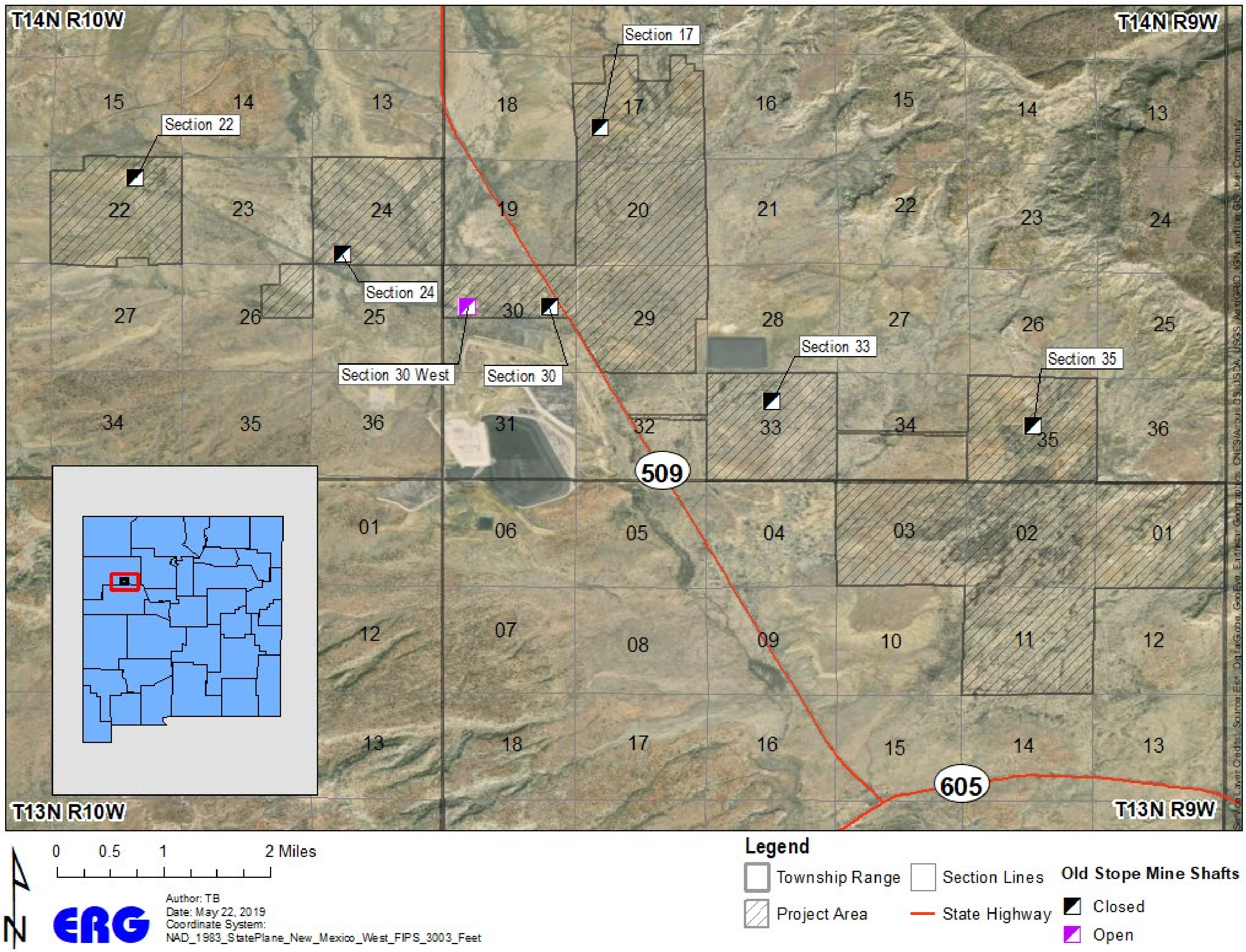


Figure 1. Map of the project area and shafts used to access project area mines.

1.3 Regulatory Authority

The New Mexico Mining Act (the Act), promulgated in 1993, requires that closeout plans be put into place for applicable mines. State regulations implementing the requirement of the Act were passed in 1994. This interim CCP was prepared to comply with the applicable regulations and conditions specified in the Act, Mining Act Rules for Existing Mining Operations, the New Mexico Water Quality Act, and the New Mexico Water Quality Control Commission (WQCC) regulations, in addition to applicable guidance documents (EMNRD & NMED, 2016 and NMMMD, 1996).

1.3.1 The New Mexico Mining Act Administrative Rules

The administrative rules (regulations) that implement the requirements of the Act are contained in the New Mexico Administrative Code (NMAC), specifically 19.10 NMAC administered by the NMMMD. 19.10 NMAC describes the permitting requirements for non-coal mining. 19.10.5 NMAC further describes the permitting requirements for existing mining operations, including the requirements for closeout plans.

The New Mexico Water Quality Act is implemented by regulations developed by the WQCC. The regulations contained in 20.6.2 NMAC define the requirements for discharge plan permitting, permit closure, and abatement and are administered by the NMED.

1.3.2 Closeout Planning

The Closeout Plan Guidelines for Existing Mines (NMMMD, 1996) was used as the primary guidance document to development this interim CCP. “Closeout”, as used in this document, refers to the process of and commitments related to reclamation of the project area to meet the requirements of Section 69-36-11B(3) of the Act and the performance and reclamation standards and requirements in 19.10.5.507 NMAC and the “Joint Guidance for the Cleanup and Reclamation of Existing Uranium Mining Operation in New Mexico” (EMNRD & NMED 2016).

1.3.3 Closure Planning

The WQCC Regulations define the requirements for discharge plan permitting, permit closure, and abatement. The WQCC Regulations (20.6.2.4103 NMAC) also defines the abatement process that an operator must complete to close a discharge permit where groundwater concentrations exceed the WQCC Standards (20.6.2.3103 NMAC). In summary, characterization data must be adequate to support the design of an effective abatement remedy.

Though all discharges associated with RAML’s discharge permits have ceased, NMED has directed RAML to characterize potential impacts to groundwater and soils associated with RAML’s discharge permits, per 20.6.2.4106 (C) NMAC. For the purpose of this interim CCP, “Closure” reflects NMED’s direction that RAML complete the abatement process as described in the WQCC regulations and in a manner consistent with the site-specific requirements given in RAML’s discharge permits. Some soil and groundwater abatement activities associated with RAML’s discharge permits are complete. The results of these activities are presented in the Phase 1 Interim Site Investigation Report (INTERA, 2017a).

1.3.4 Scope and Authority of Closure/Closeout Plan

Due to the complex operational history on the RAML-owned parcels in the Ambrosia Lake valley, RAML and NMMMD and NMED have disagreements regarding the scope of closure and abatement requirements pursuant to permit MK009RE and the DPs. At the request of NMMMD and NMED, RAML has prepared a conceptual joint closure/closeout interim CCP for the project area in order to provide a conservative approach for estimating costs and updating financial assurances. Neither RAML nor the State of New

Mexico intend to waive any legal arguments with respect to the scope of and responsibility for the closure / closeout activities described in this interim CCP.

1.4 History of CCP Submittal

The existing closeout plan (Quivira, 1999) was submitted to New Mexico Energy, Minerals and Natural Resources Department (EMNRD), Mining and Minerals Division on August 30, 1999 and approved on September 21, 1999. The existing closeout plan does not incorporate the closure requirements for DPs associated with old stope mining or the recommendations in the "Joint Guidance for the Cleanup and Reclamation of Existing Uranium Mining Operations in New Mexico" (EMNRD & NMED, 2016).

This interim CCP is intended to supersede the 1999 MK009RE closeout plan (Quivira, 1999) for purposes of updating financial assurances. The project area that is described in this interim CCP was approved by NMMMD and NMED in May 2019 (NMMMD & NMED, 2019).

1.5 Description and History of Project Area Mines

The project area is located approximately 25 miles north of Grants in McKinley County, New Mexico. The project is within the Ambrosia Lake mining subdistrict of the Grants Mineral Belt. The Ambrosia Lake mining subdistrict consists of more than 50 mines that were active between approximately 1950 and 2002 (McLemore et al, 2013).

Portions of 15 sections of land and seven uranium mines are within the project area (Figure 1). Two sections (T14N R09W sections 34 and 32) contain uranium mines historically operated by other entities. The project area thus includes only the portions of these sections associated with a water pipeline easement utilized by RAML. At the request of NMMMD and NMED, four sections (T13N R09W sections 1, 2, 3, and 11) are included in the project area as they may have been affected by upgradient mining operations in adjacent T14N R09W section 35.

Uranium mining in the Ambrosia Lake Valley began in the late 1950s. RAML and its predecessors in interest conducted operations beginning in 1983. Today, none of the mines within the project area are operational, and, except for the Section 30W shaft, which is currently used to conduct groundwater monitoring, all the mine shafts within the project area have been closed. The mines in the Ambrosia Lake Valley produced uranium from the Westwater Canyon Member of the Morrison Formation via a combination of underground (conventional) mining and mine water recovery of uranium. Ore from the mines within the project area was processed at the Ambrosia Lake West uranium mill facility. Ion exchange facilities to support mine water recovery from mines within the project area were located at the Ambrosia Lake West uranium mill (T14N R09W section 31) and near the Section 35 mine (T14N R09W section 35). Mine water was also used as process water at the Ambrosia Lake West uranium mill.

1.5.1 Conventional Mining Period (1958-1985) [1]

In 1958, the Section 22 mine became the first mine within the project area to produce uranium ore. Conventional mining had ceased at all mines by 1985, when the nearby Ambrosia Lake West mill went on standby status following a decrease in uranium prices. Between 1958-1985, conventional mining production occurred from shafts located on T14 R10W sections 22 and 24 and T14N R09W sections 17, 30 (two shafts),

[1] RAML offers the information in this Section to provide important historical context regarding conventional mining operations at Ambrosia Lake. Due to the nature of this document, the information is represented in summary form. The vast majority of these operations were conducted by, or under the express control of, parties other than predecessors to RAML, primarily Tronox Worldwide LLC ("Tronox") (formerly known as Kerr-McGee Corporation). Not until late 1983 did Tronox/Kerr McGee yield some control of these operations to its subsidiary Quivira Mining Company (Quivira). RAML acquired certain Ambrosia Lake properties in late 1988 through its purchase of Quivira from Tronox/KM, well after conventional mining operations had ceased.

33 and 35. The production period differs for each mine. In some cases, the underground workings associated with the conventional mines extend onto adjacent sections (Table 1).

All conventional mines within the project area were dewatered prior to and during underground mining. Mine water was actively managed, and each conventional mine had infrastructure, including leach holes, ponds, ditches, and pipelines, dedicated to mine water management and facilitating uranium recovery from mine water. Uranium was extracted from mine water via ion exchange, or directly via the use of mine water in the Ambrosia Lake West mill's process.

Each conventional mine had infrastructure (e.g., ore and waste rock piles, laydown area, and operations buildings) to support mine operation and facilitate management and shipment of uranium ore (Figure 2). T14N R10W section 26 and T14N R09W sections 20 and 29 did not have mine shafts or other operational infrastructure associated with conventional mining activities but did have infrastructure associated with mine water management and uranium recovery (Figure 3).

1.5.2 Old Stope Leaching Period (1985-2002)

In 1985, the nearby Ambrosia Lake West Mill was placed on standby status and conventional mining and milling of uranium within the project area ceased. From 1985 on, uranium was recovered only via ion exchange removal of uranium from recirculated mine water (Old Stope Leaching or OSL), an activity that was permitted under DP-362 with the New Mexico Environmental Improvement Division in the same year. Mine water was recirculated throughout the project area and sent to ion exchange facilities at the Ambrosia Lake West mill or on T149 R09W section 35. OSL had ceased by 2002, although the operational period for OSL differs in each section (Table 1). The infrastructure required to support OSL was like that required to manage mine water.

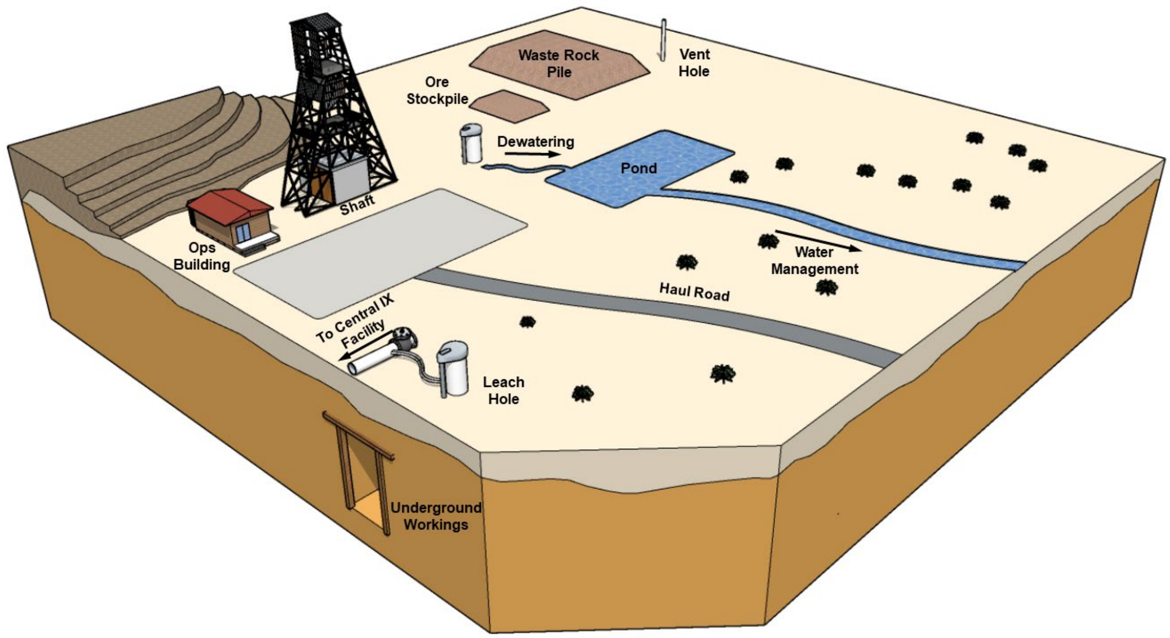


Figure 2. Typical infrastructure associated with former conventional mines-affected sections within the project area (i.e., T14N R10W sections 22, 24 and T14N R09W sections 17, 30, 33, 35)

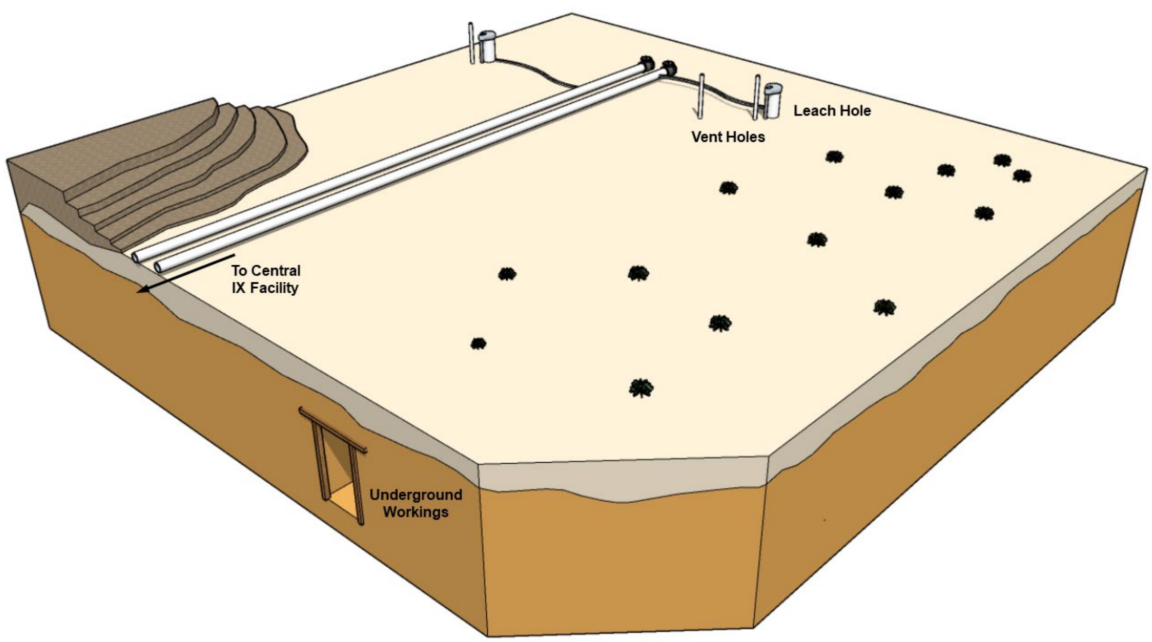


Figure 3. Typical infrastructure associated with former mine water recovery or OSL affected sections within the project area (i.e., T14N R10W section 26 and T14N R09W sections 20 and 29).

Table 1. Summary characteristics of those sections and former mines addressed within this interim CCP.

Section	Township Range	Shaft Coordinates [3, 4]	Surface Physical Disturbance (acres) [6]	OSL Period [4]	Notes
22	14N-10W	2708652 (X) 1612763 (Y)	24.7+2.4[8]	1985 -1991	Section 22 mine was used to access ore in section 22
24	14N-10W	2717030 (X) 1609003 (Y)	59	1985 -1999	Section 24 mine was used to access ore in sections 24 and 26
26	14N-10W	No shaft	N/A	N/A	Mined through the Section 24 shaft
17	14N-09W	2727461 (X) 1615257 (Y)	39.7	1985 -1993	Section 17 mine was used to access ore in sections 17 and 20
20	14N-09W	No shaft	N/A	N/A [2]	Mined through the Section 17 shaft
29	14N-09W	No shaft	N/A	N/A [2]	NM Hwy 509 passes through this section Mined through the Section 30 shaft and Section 33 shaft
30	14N-09W	2725418 (X) 1606359 (Y)	63.4	1985 -1999	NM Hwy 509 passes through this section Release previously approved; areas included in this interim CCP are adjacent affected areas Section 30 mine was used to access ore in sections 30 and 29
30 (West)	14N-09W	2722125 (X) 1606403 (Y)	63.4	1985 -2002	NM Hwy 509 passes through this section Release previously approved; areas included in this interim CCP are adjacent affected areas Used to access ore in section 30 Pumped from 2002-2005 in accordance with the NRC-approved groundwater CAP [7]
32 [1]	14N-09W	No shaft [1,2]	N/A	N/A	NM Hwy 509 passes through this section Right-of-way for water pipeline crosses this section
33	14N-09W	2734441 (X) 1601752 (Y)	50.35	1985 -1992	Section 33 mine was used to access ore in sections 29 and 33
34 [1]	14N-09W	No shaft [1,2]	N/A	N/A	Right-of-way for water pipeline crosses this section
35	14N-09W	2744988 (X) 1600504 (Y)	74.7	1985 -1999	Section 35 mine was used to access ore in section 35
1 [5]	13N-09W	No shaft	N/A	N/A	Section 35 adjacent area
2 [5]	13N-09W	No shaft	N/A	N/A	Section 35 adjacent area
3 [5]	13N-09W	No shaft	N/A	N/A	Section 35 adjacent area
11 [5]	13N-09W	No shaft	N/A	N/A	Section 35 adjacent area

[1] The portions of sections 32 and 34 evaluated by RAML for the purpose of this interim CCP are limited to disturbances related to RAML's easements within these sections. The estimates provided in this interim CCP do *not* include disturbance and infrastructure related to the uranium mines located on these sections.
[2] Some data are not independently available for sections without shafts. For sections without shafts, the relevant data are included within the section whose shaft was used to access the subsurface of a secondary section.
[3] Coordinate system is State Plane NM West FIPS 3003 (ft)
[4] Defined as the issuance of DP-362 (1985) through the final production date in NMMMD's mine database (2011)
[5] The surface of these sections may have been impacted by historic mining operations that may include the adjacent Section 35 mine. The volume and cost estimates provided in this interim CCP are limited to potential impacts from adjacent operations and do *not* reflect disturbance and infrastructure related to historical mining that may have occurred in these sections.
[6] RAML surface disturbance memo (RAML, 2013).
[7] AVM and AHA, 2000.
[8] Reported disturbance consists of two spatially discontinuous areas.

2 Permits and Discharge Plans

This section describes RAML's mine permit and applicable discharge permits

2.1 Mining Act Permits

NMMMD issued Mine Permit MK009RE for OSL in 1999. MK009RE completely incorporated the separate, older permit for the Section 35 mine (MK002RE). At the time of issuance, the permit recognized closeout plans for the OSL program and the Section 35 mine.

2.2 Discharge Permits

This interim CCP addresses four RAML DPs on file with NMED: DP-67, DP-71, DP-362, and DP-264. These four DPs are currently in Stage 1 Abatement in accordance with 20.6.2.4103 NMAC. Monitoring and reporting requirements for these DPs are included in the DP-362 permit renewal application (INTERA, 2012) and in the sampling and analysis plan (SAP) (INTERA, 2015). Summaries of the four DPs, along with ongoing monitoring and reporting requirements, are presented below:

- **DP-67** – This DP authorized historical mine dewatering discharges associated with the ion-exchange facility and treatment ponds at the Section 35 and 36 mines. Conditions of DP-67 required RAML to prepare a closure plan which was submitted in 1997 (RAML, 1997). The abatement plan proposal for this area was submitted on April 8, 2008 and was approved by NMED in a letter dated September 29, 2009. A well network, consisting of nine monitoring wells in the alluvium and one monitoring well in the Tres Hermanos C sandstone, is monitored quarterly and results are reported to NMED semiannually in a combined monitoring report for DP-67, DP-71, and DP-362.
- **DP-71** – This DP authorized discharge of fluids from the Ambrosia Lake West uranium mill and associated mines into 11 evaporation ponds on T13N R09W section 4. The post-closure monitoring plan (INTERA, 2008) covered groundwater monitoring associated with discharges to the alluvium from the ponds. The ponds have been removed following requirements of the Nuclear Regulatory Commission (NRC). A monitoring well network consisting of 14 alluvial monitoring wells is monitored annually. The 14 wells are either dry or do not contain enough water to collect a representative sample. Annual monitoring includes measuring total depth and depth to water (if present) and results are reported semiannually in a combined monitoring report for DP-67, DP-71, and DP-362.
- **DP-362** – The original DP covered mine water recovery of uranium from conventional mining areas. A closure plan was submitted in 1993. A SAP (INTERA, 2013, 2015) was developed as a part of DP-362 Stage 1 Abatement activities and includes groundwater monitoring from mine shafts, vent holes, and monitoring wells in both the Westwater Canyon Member and the alluvium. The monitoring network for DP-362 consists of quarterly monitoring of groundwater from the alluvium and the Westwater Canyon Member. Results are reported semiannually in a combined monitoring report for DP-67, DP-71, and DP-362.
- **DP-264** – This DP covered discharges associated with tailings sand backfilling of mined out stopes. This DP was originally approved on May 27, 1983. Backfilling activities had ceased at all mines by 1985. Monitoring of groundwater is described in the SAP (INTERA, 2015).

Mine dewatering discharges at RAML's mine sites are no longer occurring, and current regulatory requirements associated with the DPs are limited to monitoring and reporting of the approved groundwater monitoring well network in accordance with the SAP (INTERA, 2015).

2.3 Stormwater Permit

A multi-sector general permit (MSGP) is in place for closure and reclamation activities associated with the Section 35 mine (NPDES ID NMR053107). A stormwater pollution prevention plan (SWPPP) is in place as required by the MSGP. The MSGP was re-certified on October 31, 2018.

Control measures described by the SWPPP include:

1) diverted run-on,
2) placement of uncontaminated alluvial cover over a small pile of residual low-grade uranium ore, a disposal cell, and areas where industrial materials were removed,
3) stabilization of alluvial covers and regraded native soils using revegetation, and
4) clarification of runoff using vegetated swale areas.

The SWPPP will be revised if needed to address any further reclamation in the T14N R09W section 35 area.

3 Facilities and Conditions

This section describes existing mine features in addition to current land use and environmental setting.

3.1 Description of Existing Mine Features

3.1.1 Mine Shafts and Underground Workings

Historical mine shafts are located on T14 R10W sections 22 and 24 and T14N R09W sections 17, 30 (two shafts), 33, and 35 (Figure 1). Historical underground workings associated with these shafts are present on T14 R10W sections 22, 24, and 26 and T14N R09W sections 17, 20, 29, 30, 33, and 35 (Figure 4).

3.1.2 Vent Holes and Leach Holes

Vent and leach holes were historically located on sections that also had underground workings: T14 R10W sections 22, 24, and 26 and T14N R09W sections 17, 20, 29, 30, 33, and 35. Most project area vent and all project area leach holes have been closed. At present, open vent holes occur on T14N R10W sections 22, 26, and 24 and T14N R09W sections 17, 30, and 35 (Figure 5).

3.1.3 Historical Mine Disposal Areas

Within the project area, there is one known historical mine disposal area, located on T14N R09W section 35.

3.2 Past and Current Land Use

Mining has been the primary land use and economic support for the area since the 1950s. The Ambrosia Lake mining subdistrict is rural and sparsely populated. The closest population center is the community of San Mateo, approximately 10 miles southeast of the project area, and the largest incorporated city in the region is Grants, NM. The project area lands have had a variety of uses including residential, utility access, grazing, and recreation. Current use is limited to grazing.

NM State Highway 509 crosses the project area and access roads reach into most of the sections within the project area. NM 509 splits the project area into western and eastern regions, which is important for planning remedial logistics, the siting of repositories, and understanding historical mine operations. Figure 6 depicts existing roads within the project area.

Approximately 5 miles to the south of the project area, NM 509 terminates in NM Highway 605. NM 605 connects San Mateo, NM to Milan, NM. Interstate 40 is located approximately 15 miles south-southwest of the NM 605/509 interchange in Milan, NM.

3.3 Environmental Setting

3.3.1 Topography

The topography of the Ambrosia Lake site consists of broad valleys separated by elongated mesas. The project area is bounded by the San Mateo Mesa to the northeast and an unnamed elevated ridge of mesas to the southwest. These elevated areas bound the watershed for the Arroyo del Puerto and ultimately San Mateo Creek. Elevation varies from about 2,070 m to 2,200 m above sea level, with a slight downward gradient from northwest to southeast. A topographic map is provided in Figure 7.

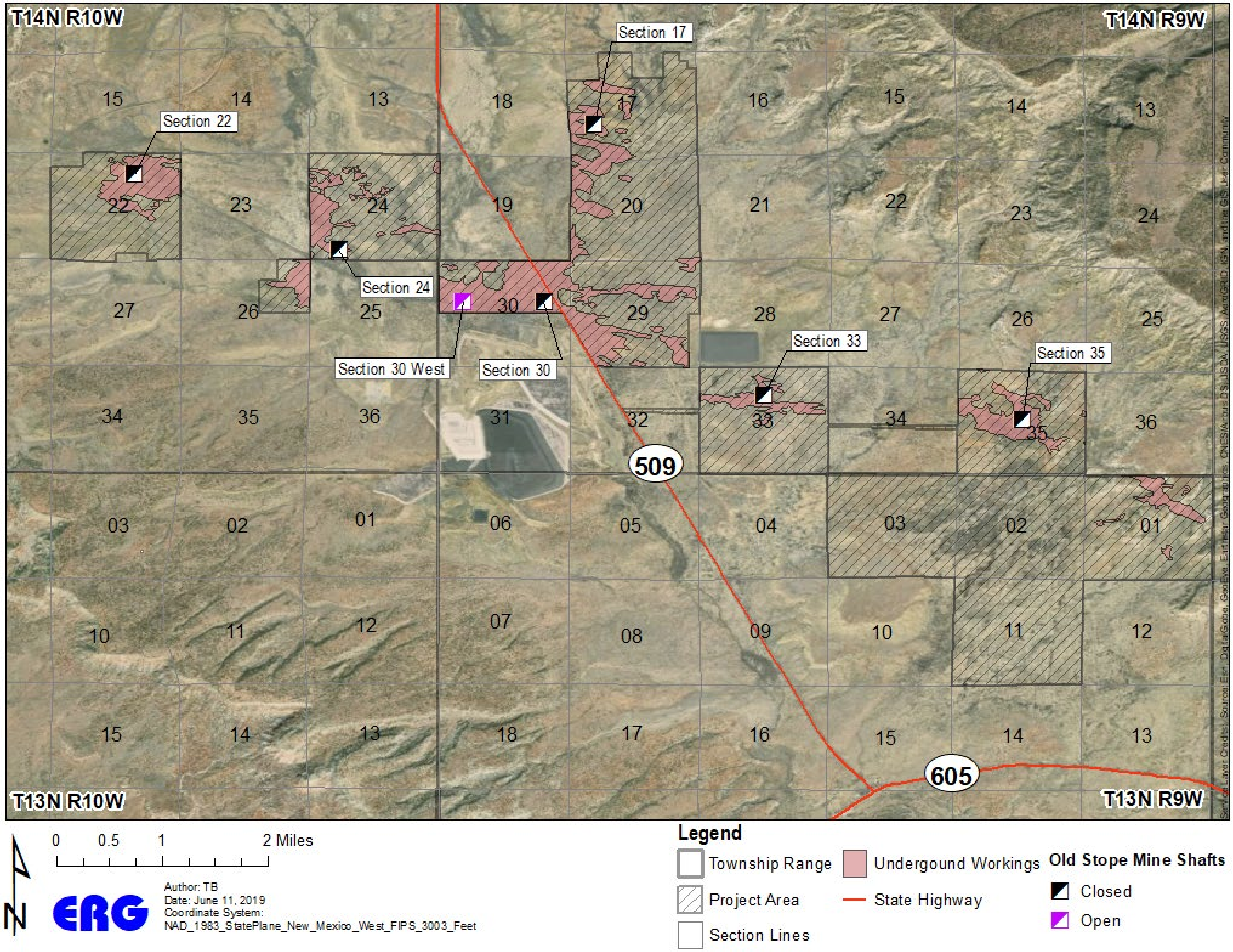


Figure 4. Map of historical underground workings in the project area.

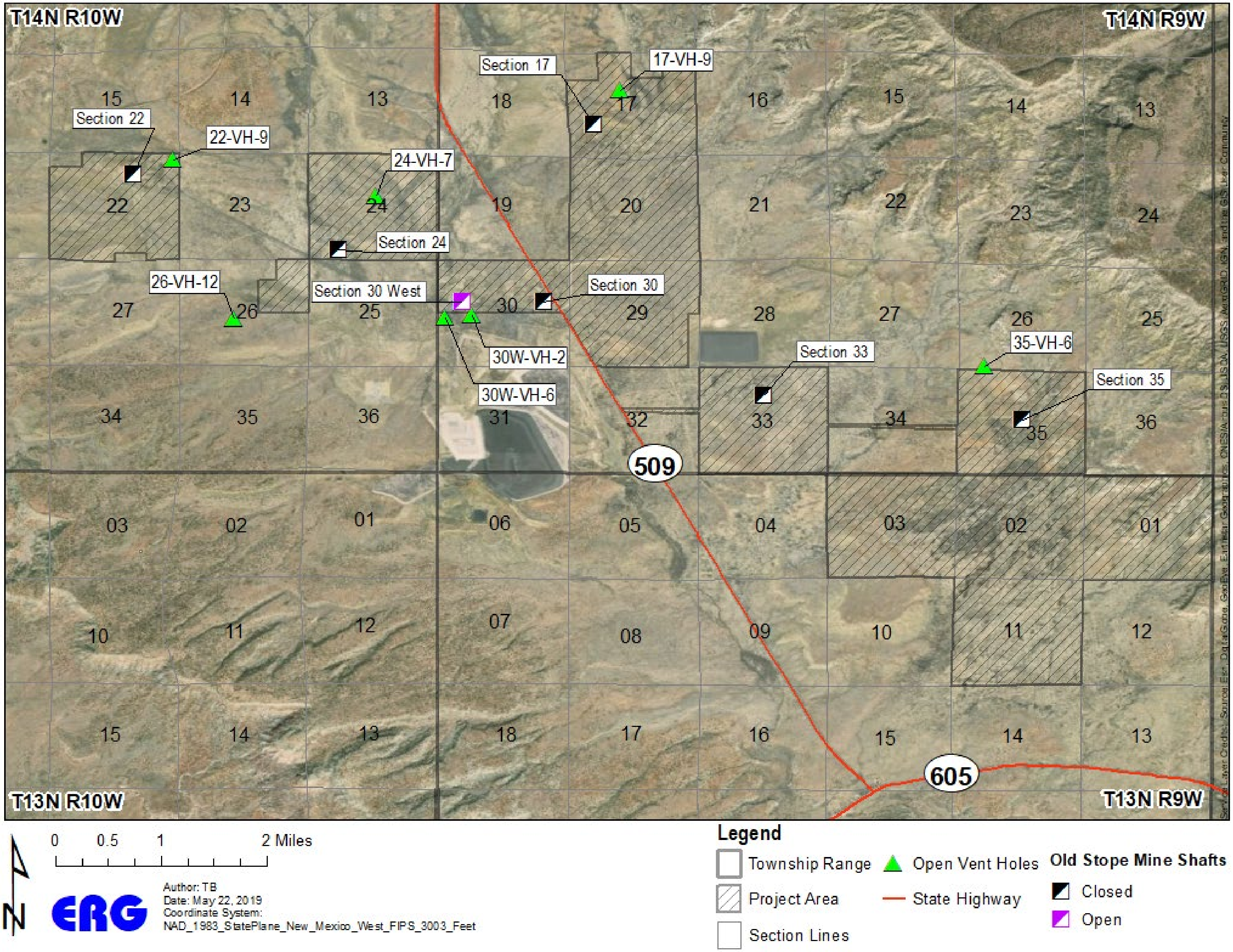


Figure 5. Map of open vent holes within and adjacent to the project area

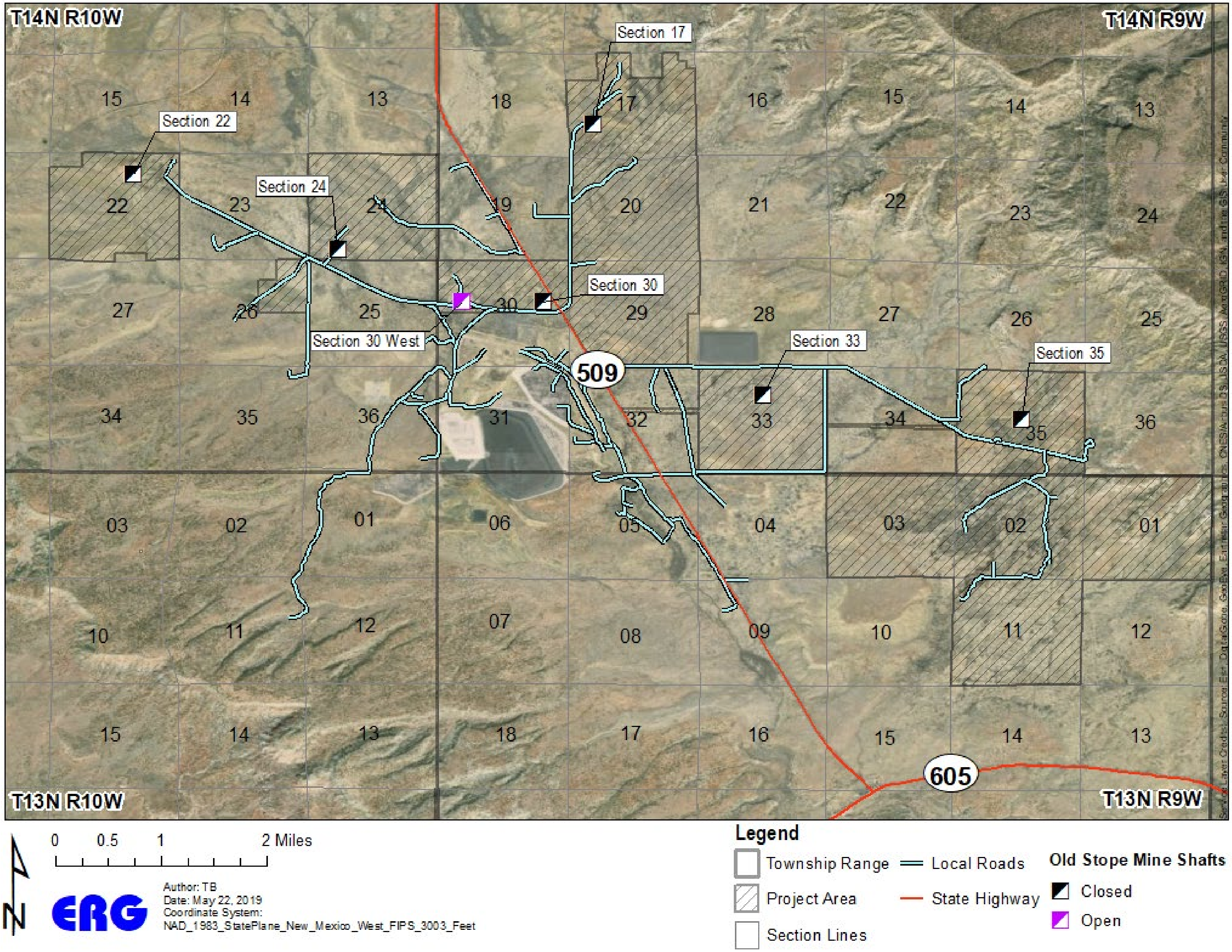


Figure 6. Map of roads within the project area.

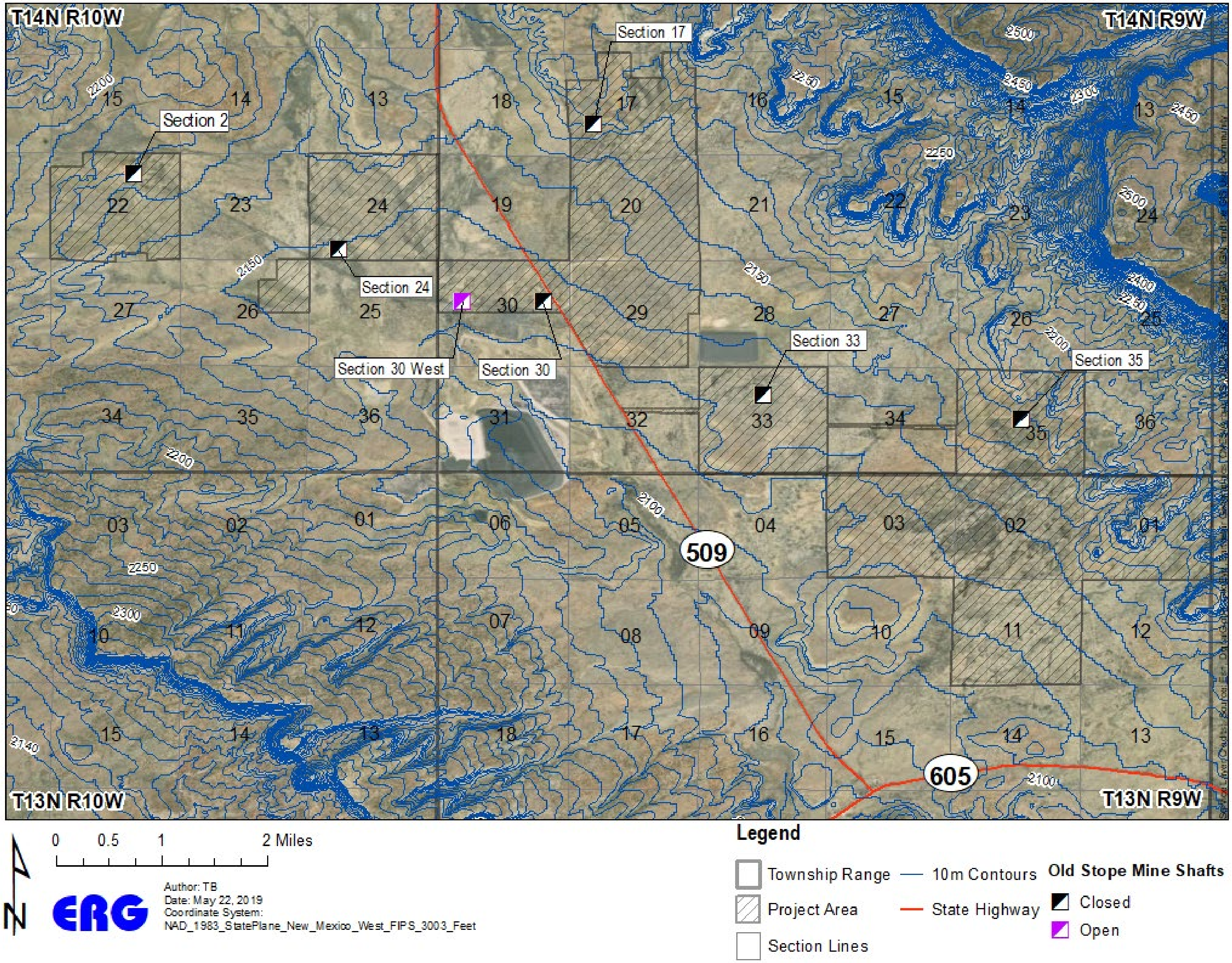


Figure 7. Topographic map of the project area

3.3.2 Geology

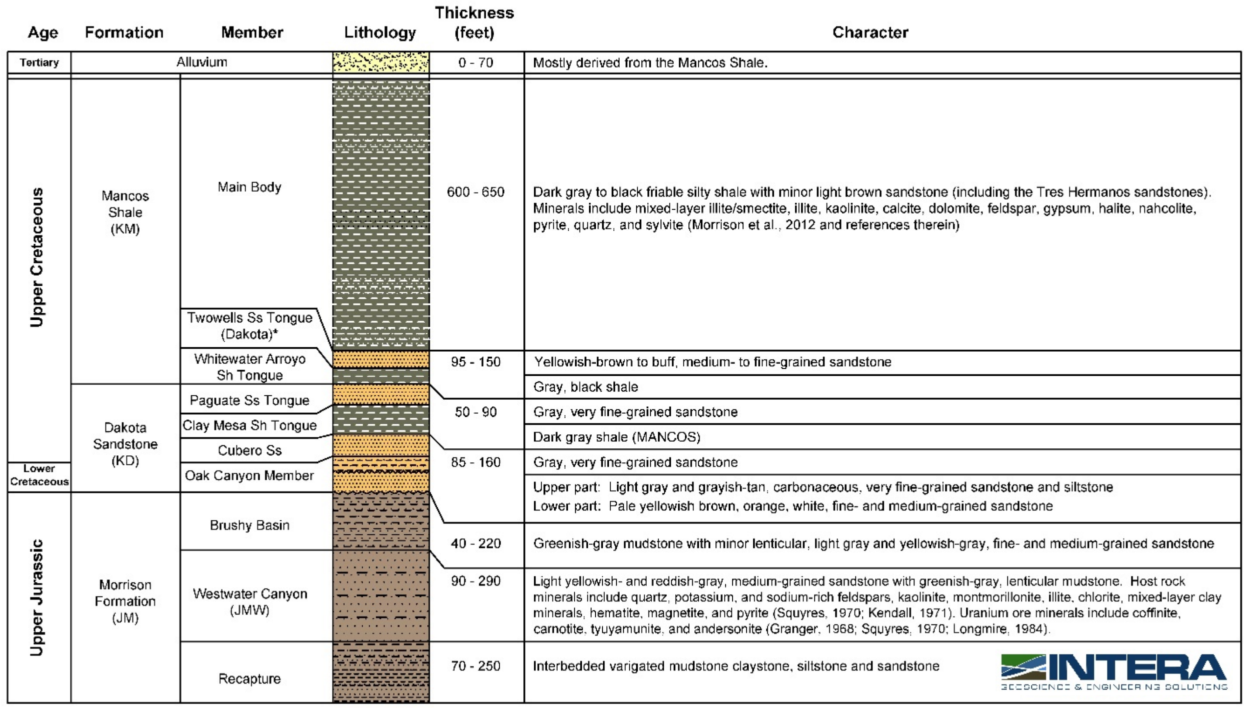
The geology of the Ambrosia Lake area has been described by numerous authors (Stone et al., 1983; Bostick, 1985; Kernodle, 1996), and summarized most recently by RAML in an Environmental Report to the Nuclear Regulatory Commission (RAML, 2018b). A generalized stratigraphic column is presented in Figure 8, and a geologic map of the Ambrosia Lake valley is presented in Figure 9.

Alluvium occurs over much of the Ambrosia Lake Valley. It is composed primarily of Mancos Shale-derived sediments, producing soils ranging from clayey sands to sandy clays. The alluvium is stratified and contains occasional basal gravels (Bostick, 1985). The thickness of the alluvium ranges from 0 feet (ft) near outcrops to 70 ft thick in the center of the valley. A paleochannel occurs within the alluvium in the center of the valley, striking roughly parallel to the modern Arroyo del Puerto (Maxim, 2001).

The Westwater Canyon and the Brushy Basin Members are the two uppermost units of the Morrison Formation (Figure 8). The Westwater Canyon Member is present throughout the San Juan Basin at thicknesses that range from about 50 ft in the southeast corner of the basin to about 300 ft in the southwest-central part of the basin; in the Ambrosia Lake area, the Westwater Canyon Member thickness is roughly 200 ft. It consists of locally conglomeratic sandstone interbedded with sandstone, shale, and claystone; the proportion of sandstone and the grain size of the sandstones decrease toward the northeast. The Westwater Canyon Member is the uranium-ore-bearing unit in Ambrosia Lake area (McLemore et al., 2005; McLemore, 2007). The Westwater Canyon Member is underlain by the Recapture Member of the Morrison Formation, which is a shale unit and is considered an impermeable lower boundary to groundwater flow in the Westwater Canyon Member and shallower sandstone units. The Brushy Basin Member consists mainly of calcareous and bentonitic claystone and mudstone and functions as an aquitard throughout the basin. It is generally 100 to 200 ft thick in the Ambrosia Lake area.

The Dakota Sandstone overlies the Westwater Canyon Member throughout the San Juan Basin. It consists of a basal section of sandstone and conglomeratic sandstone overlain by a middle section of siltstone, shale, and lenticular sandstone beds, and an upper section of fine-grained sandstone interbedded with shale. The Dakota Sandstone ranges from 10 to about 500 ft thick and is commonly 200 to 300 ft thick. Its thickness in the Ambrosia Lake area is generally 100 to 300 ft thick.

The main body of the Mancos Shale is present above the Dakota Sandstone throughout the San Juan Basin. In the northern part of the basin, the main body of the Mancos Shale is up to 2,300 ft in thickness. The aggregate thickness of the Mancos Shale tongues in the southern part of the basin is about 1,000 ft. The main body of the Mancos Shale is generally 500 to 800 ft thick in the Ambrosia Lake area. Three sandstone beds are found near the bottom of the Mancos Shale, termed the Tres Hermanos (Bostick, 1985). From highest to lowest the three sandstone beds are referred to as Tres Hermanos C, Tres Hermanos B, and Tres Hermanos A. They are thin (less than10 ft thick), fine-grained sandstones and do not yield much water.

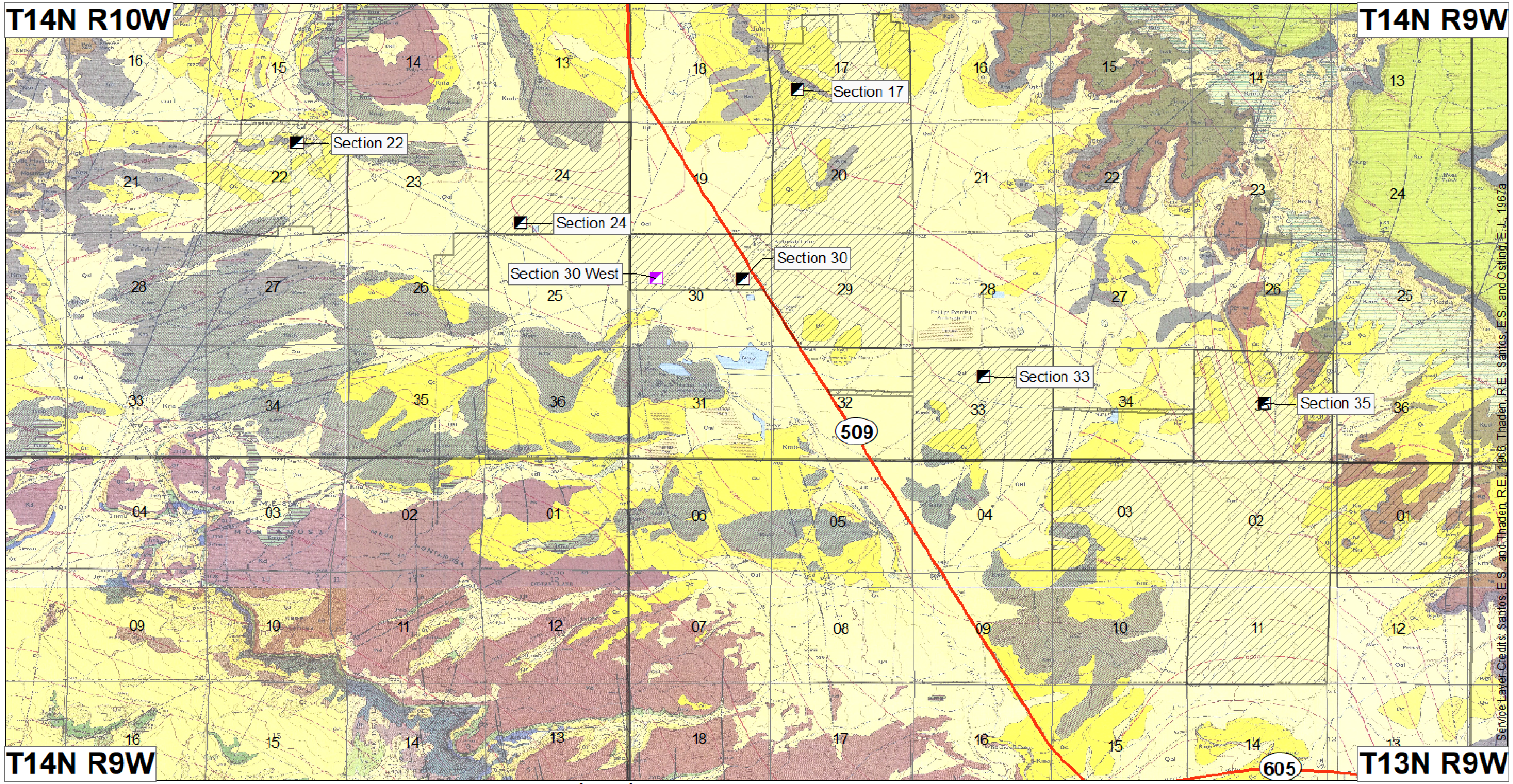


Modified from W.L. Chenoweth and E.A. Learned, January 1979 Rautman, C. A. (compiler), Geology and mineral technology of the Grants uranium region 1979: New Mexico Bureau of Mines and Mineral Resources, Memoir 38.

R.G., Marvin (Kerr-McGee Corporation), 1967, Dakota Sandstone - Tres Hermanos Relationship Southern San Juan Basin Area

* = Local terminology: Tres Hermanos C, B, and A. Varying thicknesses, source: Boring logs for monitoring wells 33-02, 35-09, 35-10 (INTERA, 2013).

Figure 8. Ambrosia Lake Valley stratigraphic column.



0 0.5 1 2 Miles

N

Author: TB
Date: May 22, 2019
Coordinate System:
NAD_1983_StatePlane_New_Mexico_West_FIPS_3003_Feet

Legend

Old Stope Mine Shafts
- Closed
- Open
- Township Range
- Project Area
- Section Lines
- State Highway

Geologic Map Legend
- Jmb - Brushy Basin Member of Morrison Formation
- Jmr - Recapture Member of Morrison Formation
- Jmw - Westwater Canyon Member of Morrison Formation
- Jmwl - Lower Morrison Formation
- Jmwu - Upper Morrison Formation (Posion Canyon Sandstone)
- Kcda - Dalton Sandstone Member Crevasse Canyon Formation
- Kcdi - Dilco Coal Member of Crevasse Canyon Formation
- Kcg - Gibson Coal Member of Crevasse Canyon Formation
- Kcs - Stray Sandstone of Crevasse Canyon Formation
- Kd - Dakota Sandstone
- Kg - Gallup Sandstone
- Kga - Gallup Sandstone
- Kgb - Gallup Sandstone
- Km - Mancos Shale
- Kma - Lower Part of Mancos Shale
- Kmb - Lower Part of Mancos Shale
- Kmc - Lower Part of Mancos Shale
- Kmf - Menefee Formation
- Kp - Point Lookout Sandstone
- Kph - Hosta Tongue Point Lookout Formation
- Kpu - Upper Point Lookout Sandstone
- Qal - Alluvial and Eolian Deposits
- Qc - Saprolite
- Qt -Talus and Landslide Block

Figure 9. Geologic map of the Ambrosia Lake Valley
Note: Geologic map is from Santos and Thaden (1966); Thaden, Santos, and Ostling (1967).

3.3.3 Soils

In general, soils in the project area are composed predominantly of silty sands and sandy to silty clays (Figure 10). Petrologic analysis indicates that they contain abundant clay, quartz, and chalcedony in limonite and calcite cement (RAML, 2001). Presence of abundant iron oxyhydroxides (limonite) and calcite give these soils a high capacity to attenuate metals and radionuclides (i.e. remove these constituents from infiltrating water).

Much of the project area is covered by what is classified as “uranium mined lands (265)” by the Natural Resource Conservation Service (NRCS) soil survey of McKinley County Area and shown on Figure 10 (NRCS, 2005).

3.3.4 Climate

The Ambrosia Lake Valley has a cool semiarid climate characterized by low precipitation, abundant sunshine, low relative humidity, and a relatively large diurnal temperature range. Meteorological data are collected at the Grants Airport (approximately 20 miles south of the project area). Climate summary data for the most recent available observational period (November 1997 through December 2008) are presented in Table 2.

Table 2 Climate data from the Grants airport for Grants, NM for the most recent observational period.

	Mean Temperature (°F)	Mean Max Temperature (°F)	Mean Min Temperature (°F)	Mean Precipitation (in.)	Mean wind speed (mph)	Mean Snowfall[1] (in.)
Jan	31.0	46.9	15.2	0.41	7.7	2.7
Feb	34.5	50.7	18.3	0.36	8.5	1.9
Mar	40.5	58.2	22.8	0.56	9.1	0.4
Apr	47.8	66.1	29.4	0.33	10.4	0.3
May	57.1	76.7	37.4	0.25	9.6	0
Jun	66.1	86.1	46.1	0.45	9.3	0
Jul	71.1	88.0	54.2	1.40	7.7	0
Aug	68.4	84.7	52.1	1.65	6.9	0
Sept	61.5	79.2	43.7	0.94	7.5	0
Oct	50.1	68.1	32.0	0.94	8.1	0.5
Nov	38.7	56.3	21.1	0.59	7.8	0.7
Dec	29.3	45.5	13.1	0.58	7.6	2.9
Year	49.7	67.2	32.1	8.44	8.3	9.4

[1] Snowfall totals are for National Oceanic and Atmospheric Administration’s (NOAA’s) 1971-2000 observational period.
°F = degrees Fahrenheit
in. = inches
mph = miles per hour
Sources: Western Regional Climate Center, NOAA

A former NMED meteorological station was used to collect data near the center of the project area over an 11-month period during 1976-77. The general trend in temperature and precipitation data from this NMED station is consistent with data collected at the Grants airport, although NMED’s weather station measurements are consistently 3-5 °F cooler (RAML, 2004). The NMED meteorological station did not measure precipitation; precipitation data from nearby communities (e.g., San Mateo, Marquez, and San Fidel) suggests that mean precipitation is quite variable on a hyperlocal basis (with up to 30 percent difference between observation location), likely due fluctuations in topography and elevation (RAML, 2004).

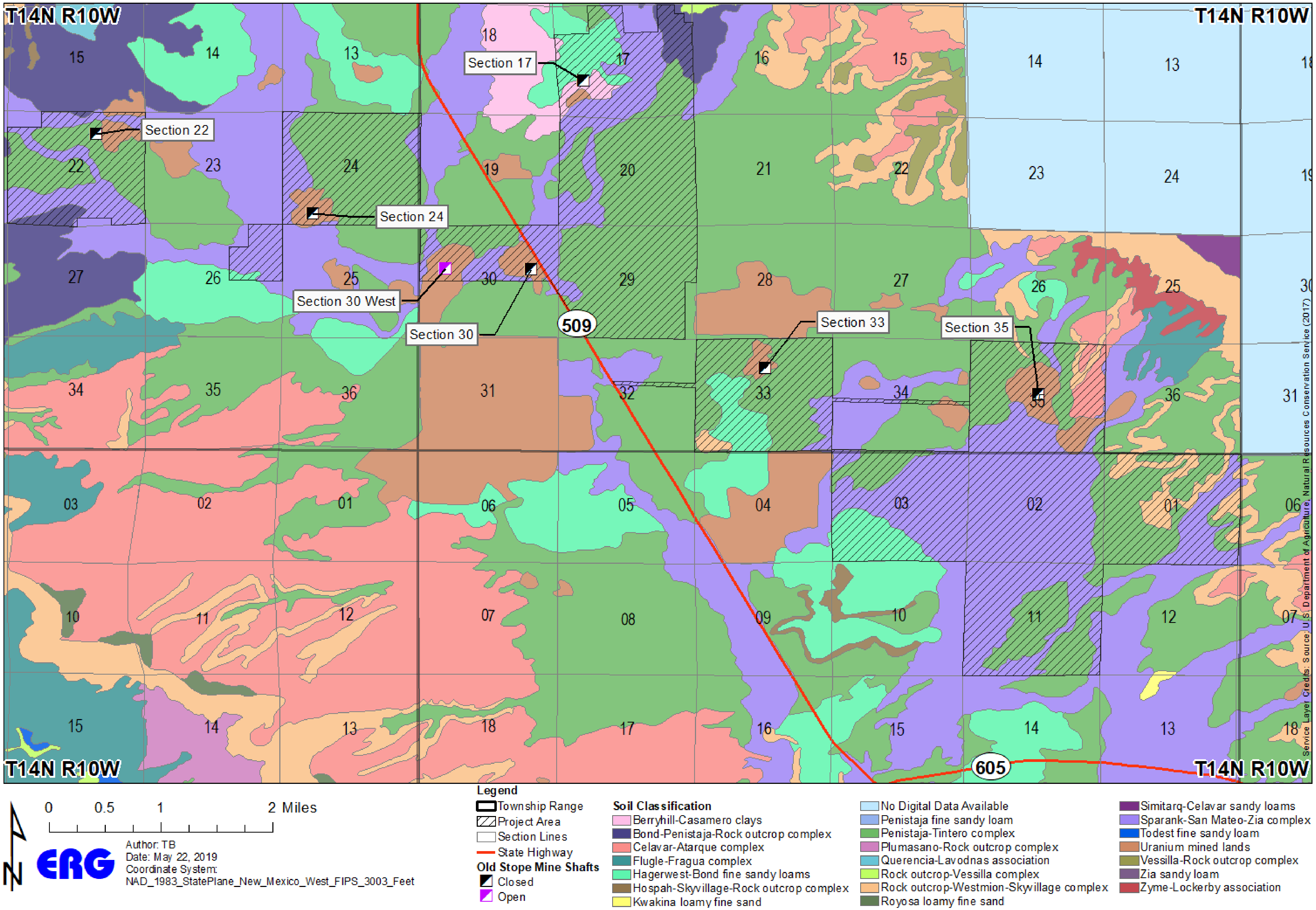


Figure 10. Ambrosia Lake Valley soils map

Note: Soils map is from NRCS (2005).

3.3.5 Hydrology

For over 30 years, uranium was extracted from the host sandstones of the Westwater Canyon Member, the principal uranium-bearing zone in the Ambrosia Lake area (RAML, 2018b). Development of uranium from subsurface mines required continuous dewatering during mining operations. As a result, conventional mining could not proceed without production of large quantities of water being pumped and discharged to the surface (Stone et al., 1983).

3.3.5.1 Surface Water Hydrology

There are no natural perennial streams or other surface water bodies in the Ambrosia Lake Valley. The principal drainage channel for the Ambrosia Lake area is the Arroyo del Puerto, which is a tributary of San Mateo Creek. The Arroyo del Puerto is classified as an intermittent stream and flows from the northwest to the southeast through the valley (Figure 11). Intermittent streams flow for only a part of the year in response to heavy storms or periods of prolonged snow melt while ephemeral drainages flow only after exceptionally heavy storms and may not have surface flow for many years.

Water discharge from historical mine dewatering operations occurred throughout the project area and created continuous surface water flow in portions of the Arroyo del Puerto and other local ephemeral drainages (DOE, 1990) during the Valley's operational period. Since the termination of mining, there has been no perennial surface water in the Ambrosia Lake Valley.

3.3.5.1 Groundwater Hydrology

Groundwater in the project area is found in the alluvium, the Tres Hermanos sandstones A, B, and C of the lower Mancos Shale, the Dakota Sandstone, and the Westwater Canyon Member of the Morrison Formation (Figure 8).

The occurrence of groundwater in the alluvium was historically limited or non-existent due to limited natural recharge in this area. At present, saturation in the alluvium within the project area (Figure 1) is largely due to mine dewatering-related surface discharge. Alluvial groundwater saturation is diminishing, and is expected to continue to diminish, due to removal of the source of water and downward drainage along shafts, vent holes, and leach holes. The extent of groundwater flow in the Tres Hermanos A, B, and C is not well documented, as these are relatively thin, discontinuous units that generally have not been developed for beneficial use. Saturated conditions in these units may also be largely due to mine dewatering-related recharge, and groundwater flow is also expected to be diminished due to downward drainage along shafts, vent holes, and leach holes (Ganus, 1980).

Regional groundwater flow is generally towards the northeast in the bedrock units, toward the center of the San Juan Basin, and toward the southeast in the alluvium following the natural drainage. However, mine dewatering in the Westwater Canyon Member has modified the hydraulic gradient by forming a large cone of depression in the Ambrosia Lake area (INTERA, 2018). A cone of depression has also formed in the Dakota Sandstone, and most likely in the saturated areas of the Tres Hermanos units, due to downward drainage into mine shafts, vent holes, and leach holes that penetrate to the Westwater Canyon Member from the ground surface. Figure 12 illustrates a conceptual model of this process. Water levels began to recover following the end of conventional mining and mine dewatering in the 1980s; however, pumping of the Westwater Canyon Member continued within the project area through 2005 via the Section 30W mine shaft in accordance with the NRC-approved groundwater CAP (AVM and AHA, 2000). Pre-mining groundwater flow patterns in the Westwater Canyon Member are not expected to return within 1,000 years, limiting transport of mine-impacted groundwater outside the Ambrosia Lake area.

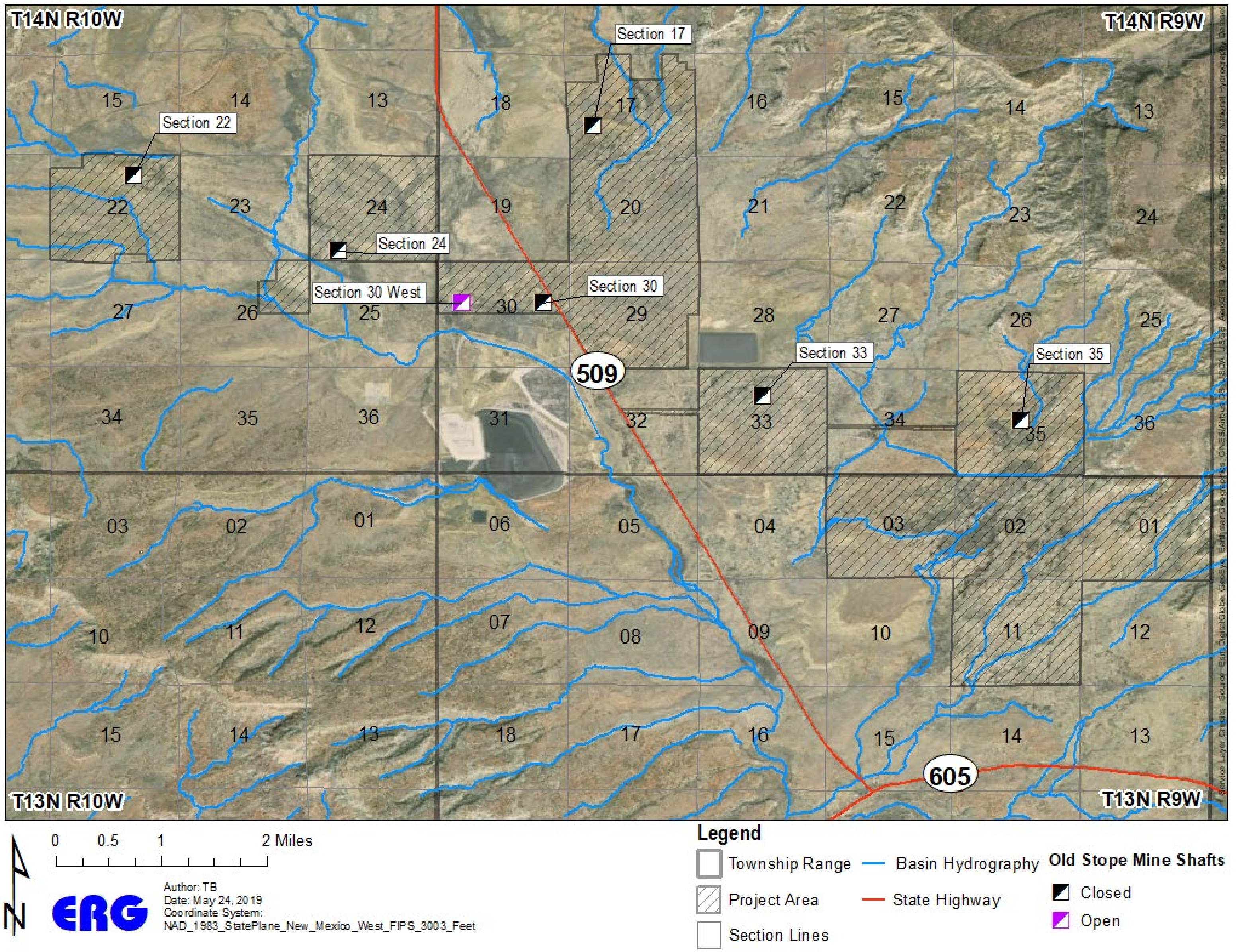


Figure 11. Map of surface water features in the Ambrosia Lake Valley (Hydrography Data sourced from the National Hydrography Dataset)
Note: Basin hydrography is from USGS (2018).

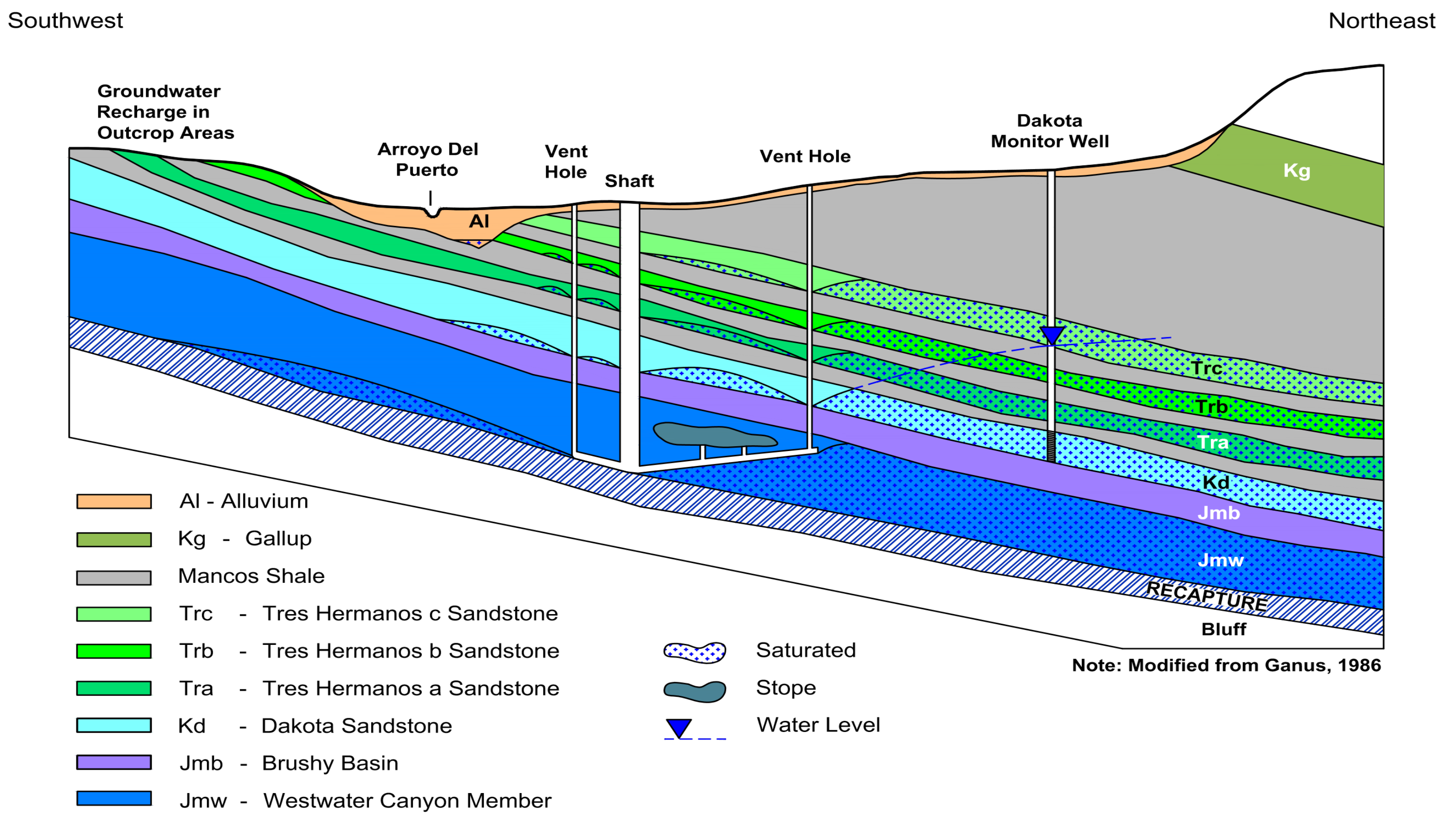


Figure 12. Ambrosia Lake Valley hydrogeological conceptual site model.

3.3.6 Vegetation

Existing vegetation resources adjacent to the project area have been characterized in nearby T13N R09W section 4 (Marron, 2004), which is geographically outside of but similar to the project area.

The plant community is dominated by blue grama grass (*Bouteloa gracilis*), winterfat (*Krascheninnikovia lanaga*), rabbitbrush (*Ericamaria nauseosa*), Southwestern rabbitbrush (*Chrysothamnus pulchellus*), dropseed (*Sporobolus contractus*), sand sagebrush (*Artemisia filifolia*), blazingstar (*Mentzelia sp.*), one-seed juniper (*Juniperus monosperma*), spineless horsebrush (*Tetradymia canescens*), and snakeweed (*Gutierrezia sarothrae*). Other common plants include common sunflower (*Helianthus annuus*), Russian thistle (*Salsola tragus*), milkweed (*Asclepias latifolia*), hoary aster (*Machaeranthera canescens*), nightshade (*Solanum elaeagnifolium*), kochia (*Kochia scoparia*), ring muhly (*Muhlenbergia torreyi*), gumweed (*Grindelia nuda*), ragwort (*Senecio flaccidus*), and four-wing saltbrush (*Atriplex canescens*) (Marron, 2004).

3.3.7 Wildlife

Avian wildlife expected in the project may include northern mockingbird (*Mimus polyglottos*), mourning dove (*Zenaida macroura*), turkey vulture (*Carthartes aura*), western kingbird (*Tyrannus verticalis*), barn swallow (*Hirundo rustica*), common raven (*Corvus corax*), scaled quail (*Callipepla squamata*), sparrow (*Zonotrichia* sp.), white crowned sparrow (*Zonotrichia leucophrys*), dark eyed junco (*Junco hyemalis*), and horned lark (*Eremophilia alpestris*). Scattered juniper trees provide nesting potential and perching habitat for the ferruginous hawk (*Buteo regalis*) (Marron, 2004).

Other vertebrate species that may be found in the area include elk (*Cervus canadensis*), mule deer (*Odocoileus hemionus*), pocket gopher (*Thomomys sp.*), desert cottontail (*Sylvilagus audubonі*), black-tailed jackrabbit (*Lepus californicus*), ground squirrel (*Spermophilus sp.*), kangaroo rat (*Dipodomus ordi*), pronghorn (*Antilocapra americana*), coyote (*Canis latrans*), New Mexico whiptail (*Cnemidophorus neomexicanus*), collared lizard (*Crotaphytus collaris*), gopher snake (*Pituophis meanoleucus*), and striped whipsnake (*Masticophis taeniatus*) (Marron, 2004).

By letter dated September 1, 2015, the U.S. Fish and Wildlife Service (FWS) (FWS, 2015) transmitted the Federal list of potential threatened and endangered species for the former Ambrosia Lake West mill area (on T14N R09W section 31 and T13N R09W section 4). Although these areas are not within the geographic scope of the project area, RAML believes that this list is indicative of species likely to be found within the project area. According to the FWS, a total of 5 threatened or endangered species may be found within T13N R09W section 4. No critical habitats were found on T13N R09W section 4.

The Mexican Spotted owl (*Strix occidentalis lucida*) and the Yellow-Billed Cuckoo (*Coccyzus americanus*) are listed as threatened bird species and the Southwestern Willow Flycatcher (*Empidonax traillii extimus*) is listed as an endangered bird species that may occur within the project area. The Zuni Bluehead Sucker (*Catostomus discobolus yarrowi*) is listed as an endangered fish species within the surrounding area. The Zuni Fleabane (*Erigeron rhizomatus*) is listed as a threatened flowering plant that may be found within the area. Although the Bald Eagle was delisted on August 9, 2007, both the Bald Eagle (*Haliaeetus leucocephalus*) and the Golden Eagle (*Aquila chrysaetos*) are still protected under the Migratory Bird Treaty Act and the Bald and Golden Eagle Protection Act which protect both eagles from unlawful disturbance.

SWCA Environmental Consultants (SWCA) conducted a threatened and endangered species habitat survey of the former Ambrosia Lake West mill area and surrounding area (near T14N R09W section 31 and T13N R09W section 4) in September 2015. No special-status species, endangered or threatened, were observed during the survey (SWCA, 2015). In addition, the special-status species were determined not to have the potential to occur and no suitable habitat was observed in the area (SWCA, 2015). No bald or golden eagles were observed during the biological survey (SWCA, 2015).

3.3.8 Cultural Resources

RAML's previous work identifying and mitigating impacts to cultural resources has focused on the Ambrosia Lake West mill facility, including the former section 4 ponds area (RAML, 2018b) (near T14N R09W section 31 and T13N R09W section 4, respectively). These results are indicative of cultural resources likely to be present throughout the project area. A cultural resource survey (Class III Survey) of 18.58 hectares (45.91 acres) conducted for RAML by Ecosystem Management, Inc in September 2004 identified eight isolated occurrences. These occurrences consisted of three separate occurrences of sandstone tool fragments and five separate occurrences pottery fragments (Burleson, 2004). Further, a 2006 environmental assessment conducted in support of the Ambrosia Lake West mill soil decommissioning plan (NRC, 2006) noted that cultural resource surveys conducted in 1990 identified two recordable cultural sites in undisturbed locations on 97 surveyed acres north and east of the T13N R09W section 4 area.

3.3.9 Acid Rock Drainage

RAML considers the potential for acid or other toxic drainage from project area mines to be low due to the geochemical properties of the excavated material. Groundwater samples from the Westwater Canyon Member collected via mine shafts and vent holes exhibit circumneutral pH values (INTERA, 2017a). Additionally, calcareous cement noted within the Westwater Canyon Member in the region of Ambrosia Lake supports the assumption that acid rock drainage potential is low at Ambrosia Lake mines (Freeman and Hilpert, 1956). Geological properties are anticipated to be very similar to the nearby, well-documented Roca Honda mine (RHR, 2012). Previous work has indicated that acid rock drainage has not been a problem in the Grants Mineral Belt, with acid neutralization potential exceeding acid generation potential, although some sulfides are known to exist. (RHR, 2012).

4 Description of Completed Reclamation

This section summarizes completed reclamation within the project area.

Prior reclamation within the project area was completed under a closeout plan prepared by Quivira Mining Company (Quivira, 1999). A detailed history of prior reclamation activities per section is provided in correspondence from RAML to NMED (RAML 2011). In general, reclamation proceeded with the following basic steps:

1. Removal and disposal of surface structures and equipment,
2. Earthwork for project area recontouring, and
3. Revegetation

Step 1 included plugging and covering of leach holes, ventilation holes, and production shafts. Leach holes were reclaimed by excavating down approximately four feet, cutting off and capping the pipe, and backfilling to the original grade. This step was also applied to closure of ventilation holes, including excavation of the ventilation hole casing, casing removal, and welding steel plates onto the open holes (Figure 13). For mine shafts, closure included removal and disposal of all equipment and capping of the hole (Figure 14).

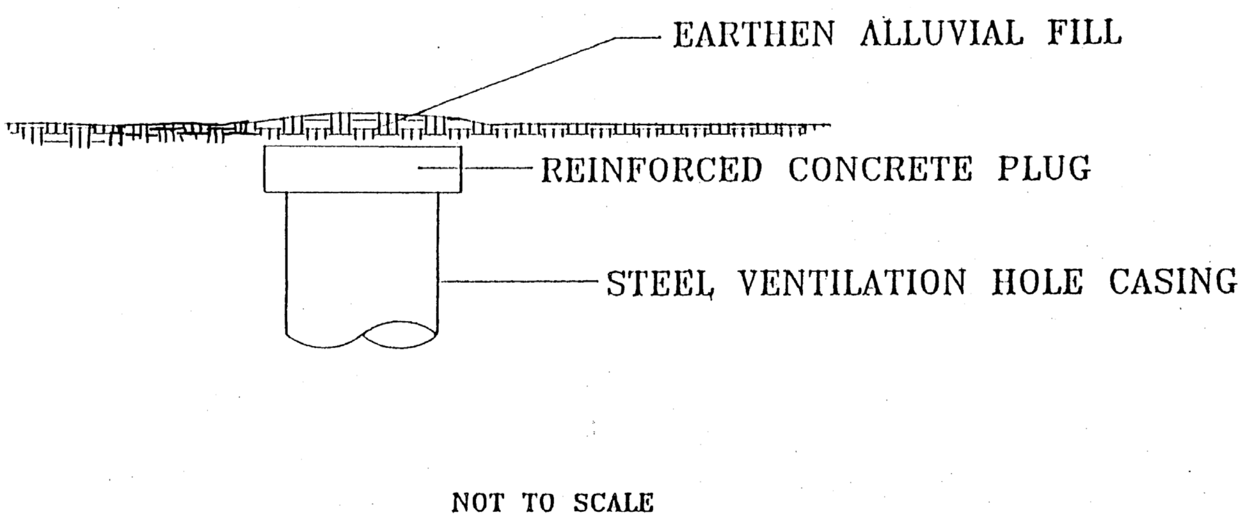


Figure 13 Schematic of capping process for closure of ventilation holes.

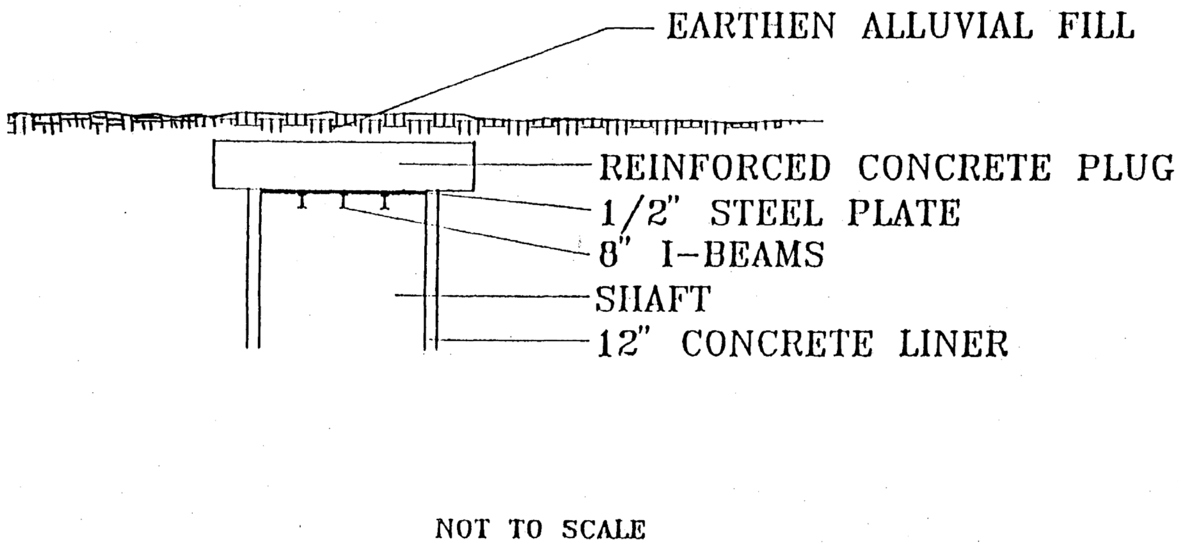


Figure 14. Schematic of capping process for closure of mine shafts.

Recontouring and land shaping (step 2) followed removal of all non-permanent surface facilities and equipment. The objective of recontouring was to have the project area blend in with the surrounding land area taking into consideration post mining use. Grading activity has been accomplished using earthmoving equipment, with generally minimal impact due to the minimal surface disturbance associated with the OSL process. Contouring was followed by placement of cover material with an overall average of one-foot depth for use as a growth medium where required for revegetation efforts and to reduce gamma exposure rates less than 57 μR/hr, consistent with guidance for limiting radiation exposure to members of the public (NCRP, 1993).

Prior revegetation activities (step 3) were performed in a manner consistent with the revegetation methods described in Section 5.5 of this interim CCP.

5 Reclamation Design Criteria

This section summarizes the conceptual reclamation design for future work under this interim CCP. These conceptual design criteria were developed with the intent of meeting NMMMD and NMED's requirements and guidance (NMMMD, 1999 and EMNRD & NMED, 2016). A final reclamation design will be submitted to NMMMD in a separate site reclamation work plan (SRWP). The final design may deviate from the conceptual design presented in this interim CCP.

5.1 Reclamation Objectives

The following sections describe reclamation objectives for each project type.

5.1.1 Grading

The final surface configuration of the project area will be suitable to support a self-sustaining ecosystem, consistent with the approved post-closure land use.

Where practical, final surface configuration will allow for even, unconcentrated drainage and facilitate revegetation. Slopes will be revegetated and will be graded to no steeper than 3 horizontal to 1 vertical. Areas prone to instability or subsidence will be identified and mitigated, and durability of engineered solutions will be documented. The goal for erosion control is that soil loss will be equal to or less than the natural rate of soil formation (NMMMD, 1996).

5.1.2 Drainage Areas

RAML will implement measures to minimize the transport mine related material, including diversion of surface waters, construction of rock drains, encapsulation or placement of impermeable covers to reduce surface water infiltration.

5.1.3 Roads

Existing roads within the project area are shown in Figure 6. Additional access roads may be constructed with the project area during remedial activities.

Roads which will no longer be needed after completion of closure activities will be ripped or scarified prior to reseeding. Road reclamation will be designed to control erosion and prevent unauthorized entry over the removed road.

5.1.4 Vent Holes and Mine Shafts

All surface entrances that do not have a post-mining land use will be reclaimed to prevent water from flowing into these entrances.

Vent holes and mine shafts will be closed in a similar manner. The surface in the vicinity of the hole casing will be excavated to facilitate the installation process. The exposed steel casing will be removed, and a steel plate will be welded on the open hole. A steel reinforced concrete collar plug will then be placed on the sealed hole. The reinforced collar plug diameter will exceed the inside diameter of the hole to provide stability and ensure a seal. Upon completion of the plug, the areas in the vicinity of the hole will be backfilled and covered with a minimum of two fee of alluvial fill material. Upon placement of the alluvial cover, the area will be graded and seeded.

Vent hole reclamation may be postponed or modified (i.e., monitoring ports or equipment may be installed) for vents that are required for groundwater monitoring under an agency-approved monitoring program.

5.1.5 Radiological

The objective of radiological reclamation is to ensure protection of the public and meet the criteria of NMED and NMMMD's 2016 joint guidance (EMNRD & NMED, 2016).

5.1.5.1 Cleanup criterion

For the purpose of this interim CCP, RAML selected a soil cleanup criterion of 6 pCi g^{-1} of radium-226 averaged over the upper 15 cm of soil and an area of 100 square meters as the basis for estimating removal volumes. This is consistent with NMED and NMMMD's 2016 joint guidance (EMNRD & NMED, 2016) of 5 pCi g^{-1} plus background. The average background concentration of radium-226 in soil is assumed to be 1 pCi g^{-1} of radium-226 based on data collected for the nearby Roca Honda mine baseline investigation (RHR, 2011).

Mine waste repository covers will achieve an average radon flux equal to or less than 20 pCi m^{-2} s^{-1}.

5.1.5.1 Gamma guideline corresponding to the cleanup criterion

In 2015, Roca Honda Resources (RHR) conducted a supplemental radiological survey as part of its baseline characterization for the Roca Honda Mine (RHR, 2018). In addition to other characterization work, RHR collected data to correlate the concentration of radium-226 in surface soil to both ambient gamma count rate and ambient exposure rate. RHR's survey – including correlation work - was submitted to NMMMD in July 2018. The function (taken as the regression mean) relating radium-226 to gamma count rate reported by RHR to NMMMD was:

$$\gamma = 5511 \times \left\{ \ln\left(\frac{^{226}Ra}{0.0119}\right) - 2.1639 \right\}$$

<u>Where:</u>

γ is in units of counts per minute (cpm), as measured on a 2x2 inch sodium iodide crystal, doped with thallium, and
^{226}Ra is the soil concentration of radium-226 in units of pCi g^{-1}

Using this relationship, 6 pCi g^{-1} of radium-226 corresponds to a gamma count rate of about 22,000 cpm.

5.1.6 Vegetation

The goal of this work is to reclaim the project area to a condition that allows for the reestablishment of a self-sustaining ecosystem following closure, appropriate for the life zone of the surrounding area unless conflicting with the approved post-mining land use. RAML will define a standard for revegetation success based on vegetation surveys as discussed in Section 6.1.3.

5.1.7 Wildlife

If wildlife habitat is included in the post mine land use, technical expertise from the New Mexico Game and Fish Department will be sought. RAML will provide an analysis of remedial activities' impact on wildlife, including mitigative steps which will be implemented at closeout. Developed water resources or any other retained features will be described along with their impact or use to wildlife.

5.1.8 Protection of Biological and Cultural Resources

RAML will appropriately manage project area cultural and historical resources throughout the reclamation process. Once areas subject to remediation are identified, a cultural resource survey will be conducted as discussed in Section 5.7.3.

5.1.9 Post Closure/Closeout Land Use

Future land use will ensure compliance with Federal, State, and local laws, regulations, and standards and adequate protection of the public. RAML conducts an annual land use survey near the former Ambrosia Lake West mill facility (near T14N R09W section 31 and T13N R09W section 4); the most recent year is 2018 (RAML, 2018a). Although these areas are not within the project area, RAML believes this survey is indicative of post-closure land use throughout the project area. This survey found that land use within two miles of the nearby former Ambrosia Lake West Mill was limited to grazing land and utilities and noted the presence of a nearby residence approximately three miles north-northeast of the mill.

Project area closure activities have been planned to remediate operational surface impacts that are present within the project area and to restore disturbed areas to a livestock grazing habitat with utility access capacity. Livestock grazing or industrial use are the most likely future use scenarios for the project area. The closure goal is to reclaim to a range condition consistent in content and form to that of the surrounding area (Quivira, 1999).

5.2 Radiological

This section describes remedial type classification and alternative selection for radionuclides in soil. Under the conceptual site models described in Figure 2 and Figure 3, and on the basis of field and desktop observation and analysis, seven remedial types have been identified. These types are summarized in Table 3. The assumed geographic extent of each remedial type within the project area boundary is provided in Figure 16.

5.2.1 Estimation of Horizontal Extent of Remedial Types

The horizontal extent of each gamma-based remedial type (“Other Drainage”, “Miscellaneous Above Gamma Guideline”, and “Overland Flow”) was determined, per section, using gamma survey data provided to RAML by the U.S. Environmental Protection Agency (EPA). EPA’s data was collected using the same instruments described in Section 5.1.5 and used to derive the gamma guideline value of 22,000 cpm. EPA’s gamma data is presented as Figure 15. Future characterization efforts will include development of a project area-specific gamma guideline level and additional gamma surveys, as needed, to fill potential gamma data gaps within the project area.

The horizontal extent of the disturbed areas was determined from historical imagery showing the mine facilities and supporting infrastructure, which corresponds approximately to the areas reported by RAML (2013). In most cases, the disturbed area was covered with mine material to provide a stable and well drained foundation for mine operations.

The horizontal extent of roads within the project area was determined by analysis of Light Detection and Ranging (LiDAR) data. The horizontal extent of the arroyo within the project area was based on a 100-foot buffer on either side of its thalweg. The areal extent of historical disposal areas is based on LiDAR data, project area reconnaissance, and knowledge from project area personnel. Details for the horizontal extent of each remedial type by section is provided in Appendix B.

5.2.2 Soil Depth of Remedial Types

The estimate of impacted soil depth for each remedial type and the basis for the estimate is provided in Table 4. Little information regarding the depth of impacted soil is available. When additional characterization data becomes available to better delineate the vertical extent of mine-related material above the cleanup level, the depths provided in will be updated.

Table 3 Remedial types found within the project area boundary.

Area Classification	Found in Section(s)	Description
Arroyo	T14N R10W: 26	Portions of the Arroyo del Puerto within the project area.
Disturbed area	T14N R10W: 22, 24 T14N R9W: 17, 30, 33, 35	Areas where mine material was historically applied as a base course material. LiDAR analysis of disturbed areas shows that they are like the surrounding natural grade. Disturbed areas correspond approximately to the areas reported in RAML (2013). Application of a gamma guideline value directly may be inappropriate due to historical reclamation work which reduced the associated gamma count rate.
Historical disposal area	T14N R10W: 24 T14N R9W: 33, 35	Areas were mine material has historically been consolidated, these were identified using LiDAR analysis, project area reconnaissance, and historical project area knowledge.
Miscellaneous above gamma guideline	T14N R10W: 22, 24, T14N R9W: 17, 20, 29, 30, 32, 33, 34 35 T13N R9W: 1	Areas not meeting another classification that exceed the gamma guideline value. Typically, the result of aeolian deposition.
Other Drainage	T14N R10W: 22 T14N R9W: 17, 20, 30	Any other channeled drainage (excluding the Arroyo del Puerto) that also exceeds the gamma guideline value.
Overland flow	T14N R9W: 35 T13N R9W: 1, 2, 3, 11	Areas impacted by historical overland flow of water which exceed the gamma guideline value.
Roads	T14N R10W: 22, 24 T14N R9W: 30	Portion(s) of a road that exceed the gamma guideline value.

Table 4 Depth assumptions used to estimate removal volumes.

Area Classification	Assumed Depth (yd)	Basis for Assumption
Arroyo	0.67	Considered a conservative estimate for a well-incised drainage
Drainage	0.33	Considered a conservative estimate for a shallow drainage
Disturbed Area	0.5	Assumes 6 inches of mine waste covered by 12 inches of soil used in previous reclamation.
Overland	0.67	Considered a conservative estimate for a drainage
Existing repository	Varies	LiDAR was used to estimate above ground height and horizontal extent.
Miscellaneous above gamma guideline	0.17	Typically, this results from aeolian deposition and is superficial. The minimum depth heavy equipment can efficiently excavate is six inches.
Road	0.9	LiDAR was used to estimate above ground height and horizontal extent.

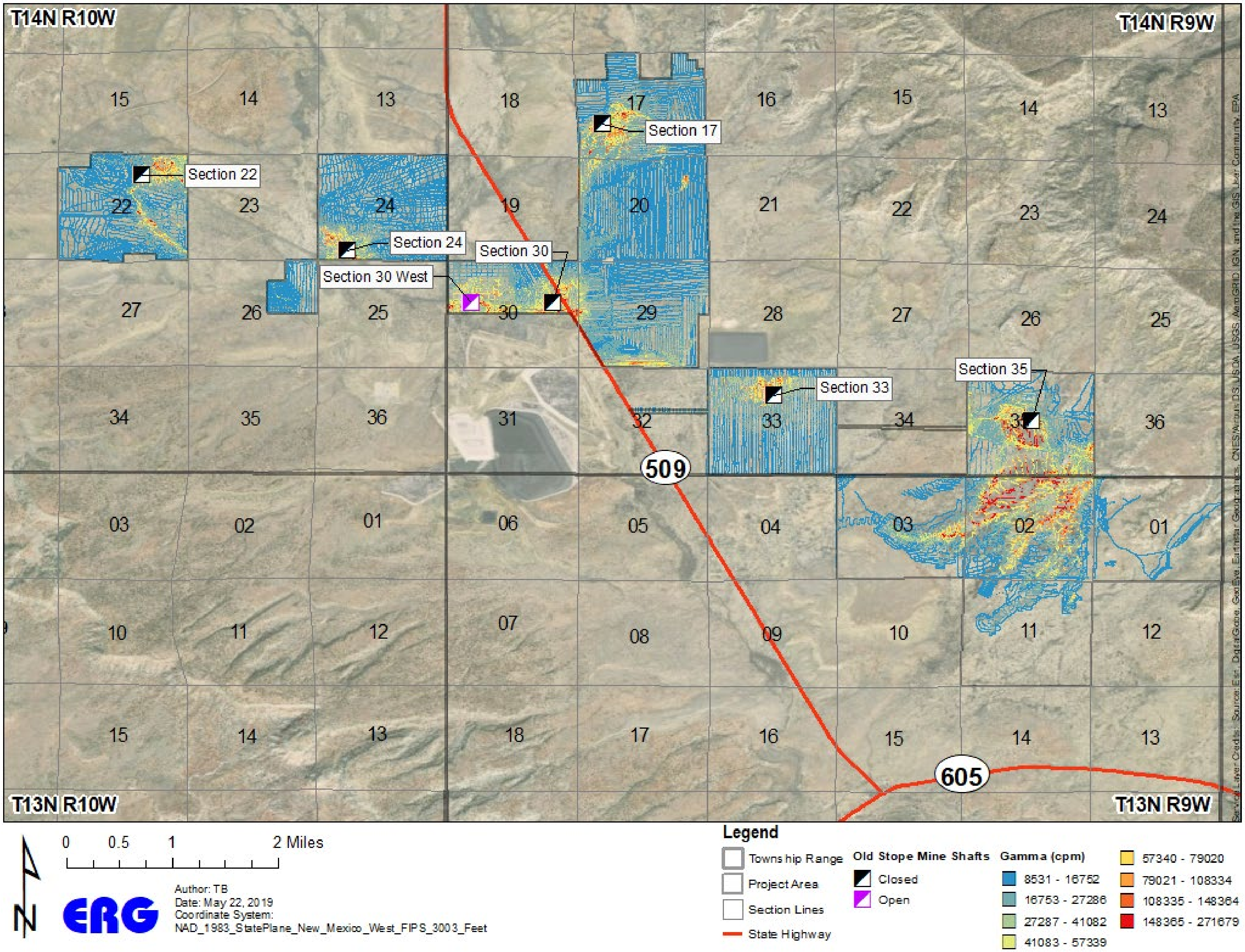


Figure 15. EPA gamma survey data within the project area.
Note: Gamma survey data received by ERG from the EPA (2018).

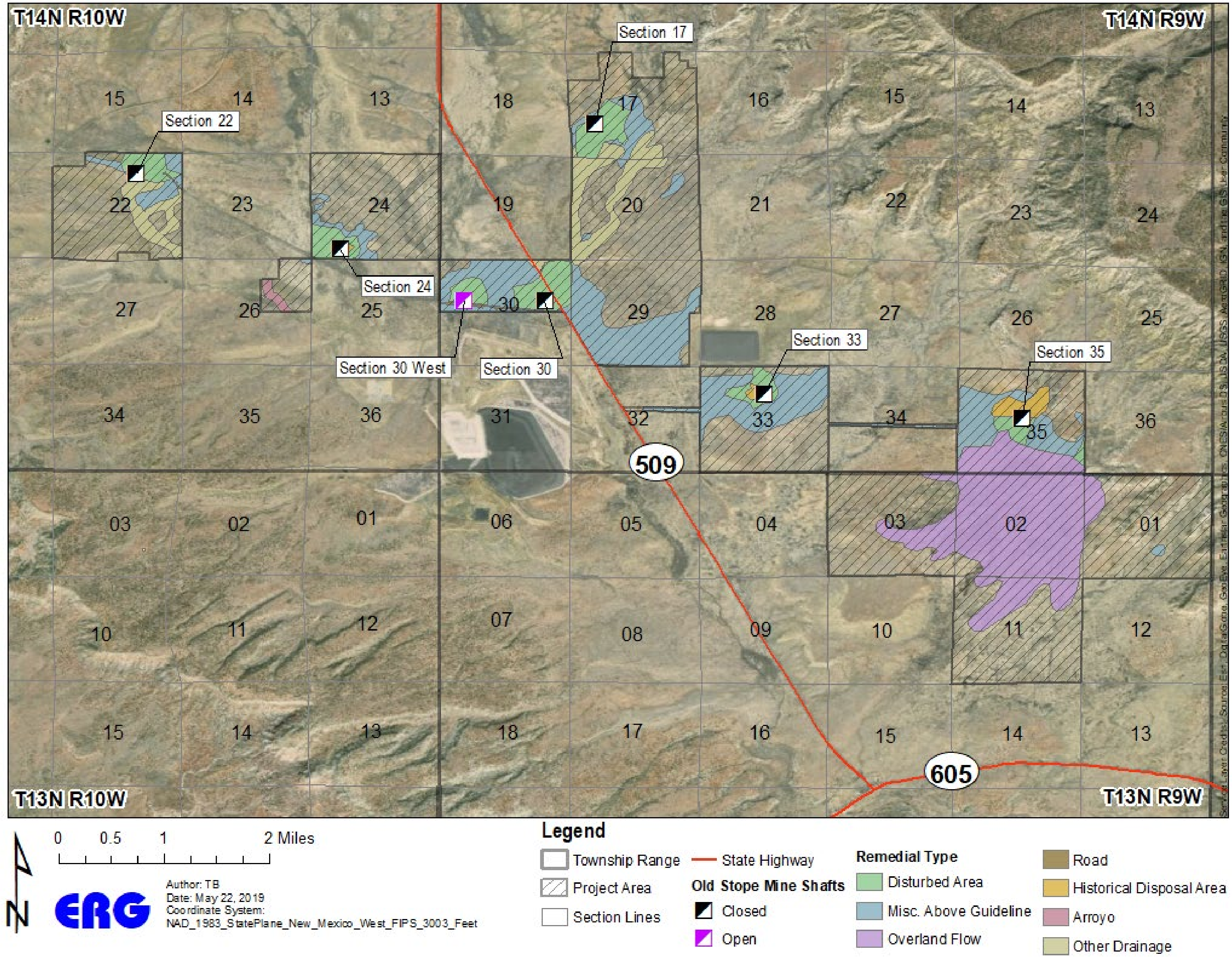


Figure 16. Map of remedial type extent within the project area

5.2.3 Remedial Volumes by Section

The estimate of soil volume to be remediated by section is presented in Table 5. Remedial areas and volumes are further described by remedial type in Appendix B.

Table 5. Estimated soil volume requiring removal to meet a 6 pCi g^{-1} radium-226 soil cleanup level, per section.

Section	Township Range	Removal volume (cy)
22	14N-10W	353,270
26	14N-10W	61,597
24	14N-10W	192,310
17	14N-09W	343,225
20	14N-09W	250,642
29	14N-09W	255,120
30	14N-09W	494,422
32	14N-09W	8,080
33	14N-09W	323,665
34	14N-09W	14,887
35	14N-09W	1,224,008
1	13N-09W	135,444
2	13N-09W	1,929,411
3	13N-09W	333,933
11	13N-09W	421,371
	Total	**6,341,382**

5.2.4 Alternatives analysis

5.2.4.1 No-action alternative

This alternative is to leave the project area as is, without any further remediation.

5.2.4.2 Removal action, on-site repository

This involves the consolidation of mine material in engineered repositories. Typical repository covers are provided in Appendix A.

Two on-site repositories

This option involves consolidation of soil and waste material above the cleanup criterion in one of two on-site repositories. Each repository will be designed to incorporate features such that the cover will be both resistant to erosion and degradation without maintenance for the long-term and infiltration of precipitation to the maximum extent practicable. To accomplish this goal, repositories will be incised or partially incised to the extent practicable, have shallow slopes, and incorporate an evapotranspiration cover. The repository will also be designed to reduce the average radon flux from the cover material to less than 20 pCi m^{-2} s^{-1}.

Three on-site repositories

This option involves consolidation of soil and waste material above the cleanup criterion in one of three on-site repositories. The three-repository alternative was selected to provide localized repositories, thus reducing transportation cost. Each repository will be designed to incorporate features such that the cover will be both resistant to erosion and degradation without maintenance for the long-term and infiltration of precipitation to the maximum extent practicable. To accomplish this goal, repositories will be incised or partially incised to the extent practicable, have shallow slopes, and incorporate an evapotranspiration cover.

The repository will also be designed to reduce average radon flux from the cover material to less than 20 pCi m^{-2} s^{-1}.

5.2.5 Alternative selection

Table 6 presents remaining remedial activities within the project area on a per-section basis. Table 6 assumes that three repositories will be constructed on T14N R10W section 22, T14N R09W section 35, and T13N R09W section 4.

Table 6. Summary of selected remedial action(s), per section.

Section	Township-Range	Selected Remedy(ies)
22	14N-10W	• Impacted soil will be placed in a repository established in T14N R10W section 22. • Subsidence areas will be stabilized. • One (1) vent hole will be closed.
26	14N-10W	• Impacted soil will be placed in a repository established in section T14N R10W 22. • One (1) vent hole will be closed.
24	14N-10W	• Impacted soil will be placed in a repository established in section T14N R10W 22. • One (1) vent hole will be closed.
17	14N-09W	• Impacted soil will be placed in a repository established in T13N R09W section 4. • One (1) vent hole will be closed.
20	14N-09W	• Impacted soil will be placed in a repository established in T13N R09W section 4.
29	14N-09W	• Impacted soil will be placed in a repository established in T13N R09W section 4.
30	14N-09W	• Seventy-five percent of impacted soil volume will be placed in T14N R10W section 22. • Twenty-five percent of impacted soil volume will be placed in T13N R09W section 4. • Mine shaft (Section 30W) will be closed. • Two (2) vent holes will be closed.
32	14N-09W	• Ninety-seven percent of impacted soil will be placed in a repository established in T13N R09W section 4. • Three percent of impacted soil will be placed in a repository in section T14N R10W 22.
33	14N-09W	• Impacted soil will be placed in a repository established in T13N R09W section 4.
34	14N-09W	• Impacted soil will be placed in a repository established in section 35.
35	14N-09W	• Impacted soil placed will be placed in repository established in T14N R09W section 35. • One (1) vent hole will be closed.
1	13N-09W	• Impacted soil placed will be placed in repository established in T14N R09W section 35.
2	13N-09W	• Impacted soil placed will be placed in repository established in T14N R09W section 35.
3	13N-09W	• Impacted soil placed will be placed in repository established in T14N R09W section 35.
11	13N-09W	• Impacted soil placed will be placed in repository established in T14N R09W section 35.

5.3 Stormwater Management

Post-reclamation surface hydrology will be addressed during reclamation to support positive drainage away from buried materials to prevent re-exposure. Reconstructed drainages will be designed to stabilize and control flow velocities, including addressing areas prone to flooding during storm events. All major reconstructed drainages that carry runoff across or around regraded mine wastes or dumps will be designed for long term stability.

Final closure of the project area will include removal and reclamation of all temporary runoff control measures (including ditches, berms, dikes, contour furrows, etc) once the project area has been finally stabilized with vegetation or equivalent permanent stabilization measures.

5.4 Cover Design and Materials

Cover, where needed to reclaim areas with rocky soils following removal of mine related material, will consist of native soil obtained from borrow areas, with an overall average of one foot of material for use as a growth medium. Some areas may include check dams, water bars, terracing along the contour, installation of armored channels, slope reduction and/or use of other erosion control practices where required for the successful establishment of vegetation.

Cover will also be used to ensure long-term stability and reduce radiation dose from approved on-site repositories. The repositories will be designed to incorporate features such that the cover will be both resistant to erosion and degradation without maintenance for the long-term and infiltration of precipitation to the maximum extent practicable. To accomplish this goal, repositories will be incised or partially incised to the extent practicable, have shallow slopes, and incorporate an evapotranspiration cover. The repository will also be designed to reduce average radon emission from the final surface to less than 20 pCi m^{-2} s^{-1}. A typical repository cover design is included in Appendix A.

5.5 Revegetation

Revegetation activities will consist of a three-step process to include drill seeding/broadcast spreading, hay/straw mulching, and mulch crimping. To facilitate revegetation, compacted areas such as roads and parking areas will either be scarified or they will be disced to a depth of 1.5 feet prior to seeding.

The seed mixture to be used will be similar to the seed mixture employed in revegetation activities at other sites in the vicinity of the project area and that developed for the 1999 project area interim CCP (Table 7). Based on vegetation results at other nearby sites, successful revegetation is achievable with a variety of seed mixes, provided the composition is like plant communities found in the surrounding areas (Quivira, 1999).

Table 7. Seed mixture to be used for revegetation (Quivira, 1999).

Species	Seed Mix (%)
Blue grama grass	20
Indian ricegrass	15.5
Native Western wheatgrass	20
Sideoats grama	20
Galleta	2
Sand dropseed	2.5
Alkali sacaton	3
Intermediate Western wheatgrass	4
Fourwing saltbrush	5
Winterfat	4
Forbs*	4

*Two forb species will be selected from the following in equal proportions (i.e. 2% each): 1) blue flax, 2) California poppy, 3) purple prairie clover, 4) yellow sweetclover, 5) desert globemallow, or 6) purple aster.

5.6 Reclamation Permitting

A Section 404 Permit (Section 404 of the Clean Water Act) will be obtained prior to any soil or sediment remediation in the Arroyo del Puerto.

NMED's requirement for a construction permit related air emissions will be evaluated at the time of the remedial activities, and, if needed, a permit will be obtained.

Stormwater permitting related to closure will be conducted under the existing EPA construction general permit. A project area and activity-specific storm water pollution prevention plan will be developed to cover closure activities.

5.7 Field Components

The following actions support earthwork and remedial activities.

5.7.1 Soil Characterization

A characterization work plan (CWP) will be developed to characterize the project area by section prior to reclamation. The CWP will focus on determining background radiological conditions and the nature and extent of impacts to surface soil above background levels using both field instruments and laboratory analysis. The scope of the characterization work plan will allow for the discrimination of areas impacted by mining activities, unimpacted areas (background) and areas containing suitable cover or borrow materials. The work plan will supplement existing data collected by RAML and others where appropriate.

Data from the soil characterization will be used to establish a Project Area-specific background concentration of radium-226 and also a new cleanup criterion and associated gamma guideline value by correlating radium-226 concentrations in soil to gamma count rate. This data will also be used to re-evaluate mine impacted and unimpacted areas within the project area.

A characterization summary report (CSR) including all results and conclusions from data gathered under the CWP will be submitted to NMMMD for review and approval.

5.7.2 Wildlife Surveys

A wildlife survey will also be conducted prior to reclamation. This survey will include the following:

- A description where wildlife areas are present, the habitat in use, and the species using it
- An analysis of the mining operation's impact on wildlife and what mitigative steps if any will be used upon mine closeout
- An analysis if any mine features are currently being used by wildlife (e.g. bats using shafts or adits)
- A description of how the specific reclamation effort and post-closure land use promotes wildlife use.

5.7.3 Cultural Resources Surveys

RAML takes measures to appropriately manage cultural and historical resources throughout the project area. Prior to conducting future remedial activities on lands within the project area RAML will conduct a Class I Cultural investigation consisting of a combination of background research and fieldwork designed to identify resources and define project area boundaries. RAML will provide the State with maps of the project area indicating the locations of any cultural resources potentially eligible for the National Register of Historic Places and/or Historic Places and/or the State Register of Cultural Properties. RAML will further describe how impacts to cultural resources will be avoided during reclamation activities. Where impacts to cultural resources cannot be avoided, RAML will consult with the State Historic Preservation Office to develop appropriate data recovery and mitigation plans specific for each project area.

On lands within the project area that require future reclamation and where surface ownership is the State of New Mexico or any other Tribal or Federal agency, cultural resources activities will be conducted in compliance with all applicable laws, including, the National Historic Preservation Act (NHPA) (including the 36 CFR Part 800 implementing regulations) and the Archaeological Resources Protection Act (ARPA) (PL 95-96). Appropriate efforts will be made to (a) inventory and evaluate eligibility of cultural resources in the area of potential effect, and (b) evaluate adverse effects of the undertaking and pursue related mitigation efforts in conjunction with NHPA and Section 106 compliance. These compliance efforts will follow steps in the flow chart included in Figure 17 and as outlined in the *NEPA and NHPA handbook for integrating NEPA and Section 106* (CEQ and ACHP, 2013). RAML will be the proponent and will follow the State or Federal agency as the lead in the Section 106 consultation process.

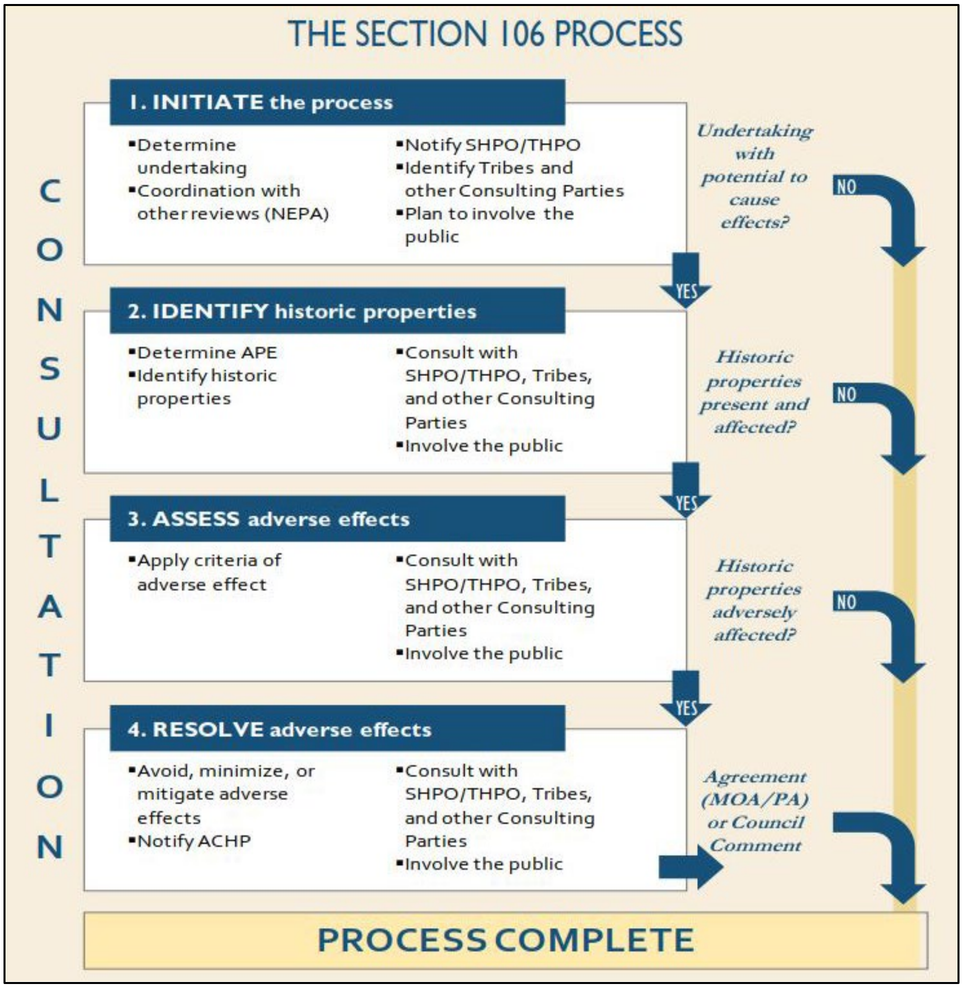


Figure 17. The Section 106 process (CEQ and ACHP, 2013)

5.7.4 Remediation

5.7.4.1 Site Reclamation Work Plan

Following submittal of the characterization report, a site reclamation work plan (SRWP) will be prepared. The SRWP will specify the proposed final location of the excavated material above the cleanup criterion, the design and proposed cover materials for the repository(s), and the post-reclamation radiation assessment and sampling program (final status survey) to document remediation goals.

5.7.4.2 Soil Remediation

Soil remediation will consist of consolidation of soil and mine waste exceeding the cleanup criterion into one of three incised or partially incised repositories. RAML will establish permanent markers to delineate the boundaries of reclaimed mine project area areas.

6 Confirmatory Environmental Monitoring and Reporting

This section describes confirmatory environmental monitoring and reporting occurring after remediation.

6.1.1 Groundwater Monitoring

RAML will conduct groundwater quality monitoring in accordance with the conditions specified in approved NMED abatement plans. Current groundwater quality monitoring includes 41 monitoring locations in four hydrostratigraphic units. Site characterization activities will be identified during the Data Gap Analysis (INTERA, 2017b) and may include characterization of sediment in the Arroyo del Puerto, characterization of alluvial saturation in the Section 35 and 36 discharge area, and identification of public water supply wells. As abatement activities are implemented and completed, the monitoring program will be optimized (in consultation with NMED) to include additional wells where needed and remove wells that are no longer necessary. As abatement activities and permit closure progress, RAML estimates a reduced monitoring well network in each of the four hydrostratigraphic units to address post-closure monitoring requirements.

6.1.2 Radiological Final Status Survey

A post-reclamation radiation assessment and sampling program (final status survey or FSS) will be conducted in accordance with joint guidance from EMNRD & NMED (2016). The objective of the FSS is to demonstrate that the final condition of the site is protective of the public and consistent with the approved post-mining land use.

The FSS will be based on the gamma guideline level developed during the characterization process based on project area-specific background radium-226 concentration(s) and approved cleanup level(s). The FSS strategy will be described in detail in the SRWP.

Parts of the project area which are designated as unimpacted by mining activities may be released without a survey with appropriate documentation of unimpacted classification. Areas impacted by mining activities will be scanned for gross gamma radiation, and release will be based on a comparison of grid-average gamma count rate with the derived gamma guideline value.

The result of the FSS will be described in the reclamation summary report.

6.1.3 Vegetation Surveys

Vegetation field measurements will be conducted in the manner prescribed in the 1999 closeout plan (Quivira, 1999). Measurements will utilize a 9.6 ft^2 sample size as vegetation density and production within the project area and surrounding areas is expected to be relatively light. Using a plot of this size allows a direct conversion from grams per plot to pounds per acre when sampling ten plots.

Ground cover, abundance, and estimated production values will be determined for each sample plot. Sampling will consist of identifying species present within the plot and utilizing the weight-unit method for estimating and recording the weight in grams of each species found in the sample plot. Productivity will be determined by estimating and harvesting the production of species located within the plots. The unit weight method is described in Section 604 of the NRCS National Range Handbook, Methods of Determining Production and Composition.

Number of samples will be determined at 90% confidence within 10% of the mean. The formula to determine sample adequacy will be:

$$n = \frac{t^2 \times s^2}{(0.1 \times N)^2}$$

Where:

n is the number of samples
t is the t value from standardized statistical tables
s^2 is the variance
N is the mean

In general, the procedure used will be to establish a grid pattern over the area to be evaluated. The project areas to be evaluated will be randomly selected from the overall population group with the following minimum sample numbers:

- Continuous disturbed area of 20 acres or less: minimum of 3 samples
- Continuous disturbed area of 20 acres or more: minimum of 10 samples, maximum of 30 samples

In the case where a grid pattern is not feasible or several small areas are present such as may be expected in revegetation of a leach field, each land section (1 square mile) will be classified as a discrete area where a minimum of 10 samples will be required.

The results of vegetation surveys will be described in the reclamation summary report.

6.1.4 Reclamation Summary Report

A final reclamation report that compiles all post-reclamation data, engineering calculations, engineering drawings, and activities that were conducted during reclamation will be submitted to NMMMD for review and approval. Once approved, the report will also be provided to surface landowners if applicable and recorded with McKinley County for a permanent record.

7 Basis for Cost Estimate

Section 7 summarizes all conceptual activities associated with project area reclamation for which a cost has been assigned as part of this interim CCP.

Subtasks have been grouped into tasks and then assigned to one of five reclamation phases: pre-reclamation studies (PSW), remedy implementation (EM), cover construction (CC), post-reclamation studies (PSR), post-closure care (PC) and groundwater abatement activities (ABA). A description of the tasks required to execute each reclamation phase and associated costs are presented in Appendix C.

The total estimated closure/closeout cost associated with the project area described in this interim CCP is $85,561,000. This cost includes capital, operational, and maintenance costs, as was all contingency and indirect costs.

8 Schedule

The schedule for closure and closeout will defer to the ongoing negotiation between RAML, the State Agencies, and the EPA.

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Appendix A – Repository cover typical

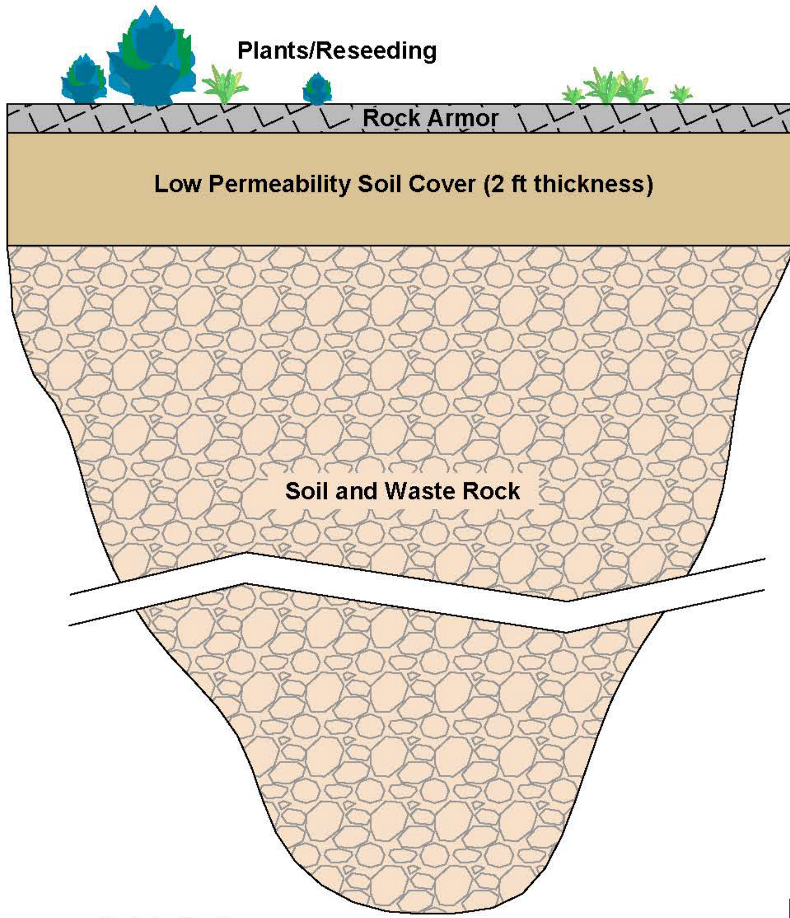

Figure 18
Conceptual Cover Design
Ambrosia Lake

INTERA

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Appendix B – Remedial volumes and areas by section and by type

LOCATION		VOLUME ESTIMATE (cu yd)							
Township: Range	Section	Other Drainage	Disturbed area	Miscellaneous above gamma guideline	Overland flow	Arroyo	Road	Historical disposal area	**Total**
13N9W	1	0	0	6,413	129,031	0	0	0	135,444
13N9W	2	0	0	0	1,929,411	0	0	0	1,929,411
13N9W	3	0	0	0	333,933	0	0	0	333,933
13N9W	11	0	0	0	421,371	0	0	0	421,371
14N9W	17	74,490	211,912	56,823	0	0	0	0	343,225
14N9W	20	236,111	0	14,531	0	0	0	0	250,642
14N9W	29	3,721	11,049	240,351	0	0	0	0	255,120
14N9W	30	10,257	330,123	126,799	0	0	27,243	0	494,422
14N9W	32	0	0	8,080	0	0	0	0	8,080
14N9W	33	0	103,219	192,336	0	0	0	28,110	323,665
14N9W	34	0	0	14,887	0	0	0	0	14,887
14N9W	35	0	102,904	123,920	557,195	0	0	439,990	1,224,008
14N10W	22	163,725	134,573	47,411	0	0	7,561	0	353,270
14N10W	24	0	134,678	37,229	0	0	1,684	18,719	192,310
14N10W	26	1,005	0	1,557	0	59,035	0	0	61,597
								Total Volume:	6,341,382

LOCATION		**AREA ESTIMATE (Acres)**							
Township: Range	Section	Other Drainage	Disturbed area	Miscellaneous above gamma guideline	Overland flow	Arroyo	Road	Historical disposal area	**Total**
13N9W	1	0	0	8	40	0	0	0	48
13N9W	2	0	0	0	598	0	0	0	598
13N9W	3	0	0	0	103	0	0	0	103
13N9W	11	0	0	0	130	0	0	0	130
14N9W	17	46	88	70	0	0	0	0	204
14N9W	20	146	0	18	0	0	0	0	164
14N9W	29	2	4	298	0	0	0	0	304
14N9W	30	6	137	157	0	0	6	0	306
14N9W	32	0	0	10	0	0	0	0	10
14N9W	33	0	43	238	0	0	0	12	293
14N9W	34	0	0	18	0	0	0	0	18
14N9W	35	0	42	173	154	0	0	51	420
14N10W	22	101	56	59	0	0	2	0	218
14N10W	24	0	56	47	0	0	0	8	111
14N10W	26	1	0	2	0	18	0	0	21
								Total Area:	**2,948**

Appendix C – Closure/closeout plan cost estimate

Reclamation Phase		**Cost Estimate**
PSW	Pre-reclamation Studies& Workplans	$9,032,000
EM	Remedy Implementation	$42,628,000
CC	Cover Construction	$26,359,000
PSR	Post Reclamation Studies & Reports	$1,939,000
PCC	Post Closure Care	$230,000
ABA	Groundwater Abatement Activities	$3,695,000
	Indirect Costs[1]	$0
	Subtotal	$83,883,000
	Contingency 2% (total > $50 million)[2]	$1,678,000
	Total	**$85,561,000**

[1] Indirect costs are built into line item estimates.

[2] Per Attachment 4 of Closeout Plan Guidelines for Existing Mines (NMMMD, 1996)

Pre-Reclamation Studies and Reports — Phase Total : $9,032,000

Characterization Work Plan

Task	Description	No. Units	Unit	Unit Cost	Total Cost
PSW-1	**Prepare Workplan**				
PSW-1.1	Evaluate nature and extent of contamination	1	ea	$157,000	$157,000
PSW-1.2	Geotechnical characterization of borrow material	300	hr	$102	$31,000
PSW-1.3	Cultural resource surveys	1	ea	$35,000	$35,000
PSW-1.4	Biological resource surveys	1	ea	$25,000	$25,000
PSW-1.5	Geomorphology surveys	233	hr	$102	$24,000
PSW-1.6	Vegetation surveys	1	ea	$25,000	$25,000
PSW-1.7	Soil & vegetation suitability	1	ea	$15,000	$15,000
PSW-2	**Field sampling services to implement workplan**				
PSW-2.1	Evaluate nature and extent of contamination	1	ea	$1,307,000	$1,307,000
PSW-2.2	Geotechnical characterization of borrow material	1,000	ea	$260	$260,000
PSW-2.3	Cultural resource surveys	3,000	ac	$667	$2,000,000
PSW-2.4	Biological resource surveys	7,500	ac	$10	$75,000
PSW-2.5	Geomorphology surveys	210	hr	$102	$21,000
PSW-2.6	Vegetation surveys	7,500	ac	$13	$100,000
PSW-2.7	Soil & vegetation suitability	1	ea	$75,000	$75,000
PSW-3	**Prepare Report**				
PSW-3.1	Evaluate nature and extent of contamination	1	ea	$249,000	$249,000
PSW-3.2	Geotechnical characterization of borrow material	400	hr	$102	$41,000
PSW-3.3	Cultural resource surveys	1	ea	$20,000	$20,000
PSW-3.4	Biological resource surveys	1	ea	$25,000	$25,000
PSW-3.5	Geomorphology surveys	425	hr	$102	$43,000
PSW-3.6	Vegetation surveys	1	ea	$25,000	$25,000
PSW-3.7	Soil & vegetation suitability	1	ea	$10,000	$10,000
				Task Subtotal	**$4,563,000**

Reclamation Design & Workplan

Task	Description	No. Units	Unit	Unit Cost	Total Cost
PSW-4	**Prepare Site Reclamation Workplan**				
PSW-4.1	Repository design - cover, stormwater management	3,027	hr	$102	$309,000
PSW-4.2	Grading plan for reclaimed areas	527	hr	$102	$54,000
PSW-4.3	Soil management plan	378	hr	$102	$39,000
PSW-4.4	Erosion control (soil loss modeling)	156	hr	$102	$16,000
PSW-4.5	Borrow material description	139	hr	$102	$14,000
PSW-4.6	Closure of 30W shaft and project area ventholes	1,400	hr	$102	$143,000
PSW-4.7	Final status survey plan for contaminants	300	hr	$130	$39,000
PSW-4.8	Final status survey plan for vegetation	1	ea	$35,000	$35,000
				Task Subtotal	**$649,000**

Remedy Implementation — Phase Total : $42,628,000

Earthmoving, Grading, and Revegetation

Task	Description	No. Units	Unit	Unit Cost	Total Cost
EM-1	**T14N R10W Section 22**				
EM-1.1	Remove soil above gamma guideline	353,270	CY	$1	$378,000
EM-1.2	Seeding & grading	218	Acre	$3,100	$676,000
EM-2	**T14N R10W Section 24**				
EM-2.1	Remove soil above gamma guideline	192,310	CY	$3	$575,000
EM-2.2	Seeding & grading	110	Acre	$3,100	$341,000
EM-3	**T14N R10W Section 26**				
EM-3.1	Remove soil above gamma guideline	61,597	CY	$3	$206,000
EM-3.2	Seeding & grading	21	Acre	$3,100	$65,000
EM-4	**T14N R09W Section 30**				
EM-4.1	Remove soil above gamma guideline	494,422	CY	$5	$2,331,000
EM-4.2	Seeding & grading	306	Acre	$3,100	$949,000
EM-5	**T14N R09W Section 17**				
EM-5.1	Remove soil above gamma guideline	343,225	CY	$7	$2,252,000
EM-5.2	Seeding & grading	204	Acre	$3,100	$632,000
EM-6	**T14N R09W Section 20**				
EM-6.1	Remove soil above gamma guideline	250,642	CY	$6	$1,439,000
EM-6.2	Seeding & grading	164	Acre	$3,100	$508,000
EM-7	**T14N R09W Section 29**				
EM-7.1	Remove soil above gamma guideline	255,120	CY	$4	$901,000
EM-7.2	Seeding & grading	305	Acre	$3,100	$946,000
EM-8	**T14N R09W Section 32**				
EM-8.1	Remove soil above gamma guideline	8,880	CY	$3	$23,000
EM-8.2	Seeding & grading	10	Acre	$3,100	$31,000
EM-9	**T14N R09W Section 33**				
EM-9.1	Remove soil above gamma guideline	323,665	CY	$4	$1,143,000
EM-9.2	Seeding & grading	293	Acre	$3,100	$908,000
EM-10	**T14N R09W Section 34**				
EM-10.1	Remove soil above gamma guideline	14,887	CY	$4	$60,000
EM-10.2	Seeding & grading	19	Acre	$3,100	$59,000
EM-11	**T14N R09W Section 35**				
EM-11.1	Remove soil above gamma guideline	1,224,008	CY	$2	$2,387,000
EM-11.2	Seeding & grading	420	Acre	$3,100	$1,302,000
EM-12	**T13N R09W Section 1**				
EM-12.1	Remove soil above gamma guideline	135,444	CY	$3	$339,000
EM-12.2	Seeding & grading	48	Acre	$3,100	$149,000
EM-13	**T13N R09W Section 2**				
EM-13.1	Remove soil above gamma guideline	1,929,411	CY	$3	$6,560,000
EM-13.2	Seeding & grading	598	Acre	$3,100	$1,854,000
EM-14	**T13N R09W Section 3**				

Remedy Implementation — Phase Total : $42,628,000

Earthmoving, Grading, and Revegetation

Task	Description	No. Units	Unit	Unit Cost	Total Cost
EM-14.1	Remove soil above gamma guideline	333,933	CY	$3	$1,149,000
EM-14.2	Seeding & grading	104	Acre	$3,100	$322,000
EM-15	**T13N R09W Section 11**				
EM-15.1	Remove soil above gamma guideline	421,371	CY	$4	$1,597,000
EM-15.2	Seeding & grading	131	Acre	$3,100	$406,000
				Task Subtotal	**$30,488,000**

Infrastructure to Support Remedy Implementation

Task	Description	No. Units	Unit	Unit Cost	Total Cost
EM-16	**Road installation**				
EM-16.1	T14N R10W Section 22	47,520	ft	$11	$543,000
EM-16.2	T13N R09W Section 4	38,200	ft	$12	$440,000
EM-16.3	T14N R09W Section 35	28,560	ft	$15	$431,000
EM-17	**Road maintenance**				
EM-17.1	T14N R10W Section 22	870	day	$4,000	$3,480,000
EM-17.2	T13N R09W Section 4	458	day	$5,130	$2,349,000
EM-17.3	T14N R09W Section 35	622	day	$3,013	$1,874,000
EM-18	**Upgrades and expansion of water supply**				
EM-18.1	T14N R10W Section 22	2,640	ft	$69	$182,000
EM-18.2	T13N R09W Section 4	2,640	ft	$94	$249,000
EM-19	**Construction worker mobe-demobe**				
EM-19.1	Mobilization	1	ea	$219,479	$219,000
EM-19.2	Demobilization	1	ea	$236,240	$236,000
EM-20	**Radiological support services during construction**				
EM-20.1	Radiation control technician	1,950	person-day	$784	$1,529,000
EM-20.2	Health physicist	390	person-day	$1,560	$608,000
				Task Subtotal	**$12,140,000**

Cover construction — Phase Total : $26,359,000

Earthmoving & Revegetation

Task	Description	No. Units	Unit	Unit Cost	Total Cost
CC-1	**T14N R10W Section 22**				
CC-1.1	Repository preparation	2,077,287	CY	$1	$2,846,000
CC-1.2	Install and compact barrier layer	347,933	CY	$3	$929,000
CC-1.3	Placement of rock mulch	69,855	CY	$40	$2,802,000
CC-1.4	Final cover QA including report	90	Acre	$17,500	$1,575,000
CC-1.5	Stormwater management	16,300	ft	$4	$60,000
CC-1.6	Seeding	90	Acre	$3,100	$279,000
CC-1.7	Radon Flux Measurements	100	Number	$100	$10,000
CC-2	**T14N R09W Section 35**				
CC-2.1	Repository preparation	2,077,287	CY	$2	$3,469,000
CC-2.2	Install and compact barrier layer	349,105	CY	$3	$988,000
CC-2.3	Placement of rock mulch	87,276	CY	$37	$3,260,000
CC-2.4	Final cover QA including report	90	Acre	$17,500	$1,575,000
CC-2.5	Stormwater management	16,300	ft	$4	$68,000
CC-2.6	Seeding	90	Acre	$3,100	$279,000
CC-2.7	Radon Flux Measurements	100	Number	$100	$10,000
CC-3	**T13N R09W Section 04**				
CC-3.1	Repository preparation	1,263,859	CY	$1	$1,845,000
CC-3.2	Install and compact barrier layer	313,122	CY	$4	$1,112,000
CC-3.3	Placement of rock mulch	78,278	CY	$43	$3,356,000
CC-3.4	Final cover QA including report	90	Acre	$17,500	$1,575,000
CC-3.5	Stormwater management	16,300	ft	$4	$63,000
CC-3.6	Seeding	80	Acre	$3,100	$248,000
CC-3.7	Radon Flux Measurements	100	Number	$100	$10,000
				Task Subtotal	**$26,359,000**

Post-Reclamation Studies and Reports — Phase Total: $1,939,000

Final Status Surveys

Task	Description	No. Units	Unit	Unit Cost	Total Cost
PSR-1	**Field sampling services to implement reclamation workplan**				
PSR-1.1	Radiological final status survey	16000	hr	$83	$1,332,000
PSR-1.2	Vegetation final status survey	1	ea	$150,000	$150,000
PSR-2	**Prepare report**				
PSR-2.1	Radiological final status survey	600	hr	$130	$78,000
PSR-2.2	Vegetation final status survey	1	ea	$35,000	$35,000
				Task Subtotal	**$1,595,000**

Reclamation Summary Report

Task	Description	No. Units	Unit	Unit Cost	Total Cost
PSR-3	**Prepare Report**				
PSR-3.1	As-builts	1577	hr	$102	$161,000
PSR-3.2	Final grading	526	hr	$102	$54,000
PSR-3.3	Inspection schedule	158	hr	$102	$16,000
PSR-3.4	Maintenance plan	235	hr	$102	$24,000
PSR-3.5	Confirmation reporting	352	hr	$102	$36,000
PSR-3.6	Draft report	522	hr	$102	$53,000
				Task Subtotal	**$344,000**

Post-Closure Care

Phase Total : $230,000

Post-Closure Care					
Task	**Description**	**No. Units**	**Unit**	**Unit Cost**	**Total Cost**
PC-1	**Final cover inspection**				
PC-1.1	Inspection	10	decade	$1,000	$10,000
PC-1.2	Record keeping & reporting	10	decade	$500	$5,000
PC-2	**Storm water systems**				
PC-2.1	Inspection and repairs	10	decade	$5,000	$50,000
PC-2.2	System upgrades (rip-rap)	1	decade	$150,000	$150,000
PC-3	**Fencing and site security**				
PC-3.1	Inspection and repairs	10	decade	$1,500	$15,000
				Task Subtotal	**$230,000**

Groundwater Abatement Activities

Phase Total : $3,695,000

Task	Description	No. Units	Unit	Unit Cost	Total Cost
Groundwater Abatement Activities					
ABA-1	**Routine groundwater monitoring and reporting**				
ABA-1.1	Abatement activities	1	ea	$1,395,000	$1,395,000
ABA-2	**Stage 1 abatement workplan, report, and model update**			min	
ABA-2.1	Abatement update	1	ea	$550,000	$550,000
ABA-3	**Optimization of well network**				
ABA-3.1	Optimization of well network	1	ea	$1,750,000	$1,750,000