United States Department of the Interior
Bureau of Land Management

Environmental Assessment DOI-BLM-NM-P020-2015-0586-EA

HB AMAX Solution Mine Extension Project

BLM

Carlsbad Field Office

U.S. Department of the Interior
Bureau of Land Management
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UNITED STATES DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT
Pecos District
Carlsbad Field Office
620 E Greene Street
Carlsbad, NM 88220

Finding of No Significant Impact
for the
Intrepid HB AMAX Solution Mine Extension
NEPA No. DOI-BLM-NM-P020-2015-0586-EA

FINDING OF NO SIGNIFICANT IMPACT:

I have determined that the proposed action, as described in the EA will not have any significant impact, individually or cumulatively, on the quality of the human environment. Because there would not be any significant impact, an environmental impact statement is not required.

In making this determination, I considered the following factors:

1. The activities described in the proposed action do not include any significant beneficial or adverse impacts (40 CFR 1508.27(b)(1)). The EA includes a description of the expected environmental consequences of expanding Intrepid's solution mining activities into the abandoned AMAX mine workings.

2. The activities included in the proposed action would not significantly affect public health or safety (40 CFR 1508.27(b)(2)).

3. The proposed activities would not significantly affect any unique characteristics (40 CFR 1508.27(b)(3)) of the geographic area such as prime and unique farmlands, caves, wild and scenic rivers, designated wilderness areas, wilderness study areas, or areas of critical environmental concern.

4. The activities described in the proposed action do not involve effects on the human environment that are likely to be highly controversial (40 CFR 1508.27(b)(4)).

5. The activities described in the proposed action do not involve effects that are highly uncertain or involve unique or unknown risks (40 CFR 1508.27(b)(5)).

6. My decision to implement these activities does not establish a precedent for future actions with significant effects or represent a decision in principle about a future consideration (40 CFR 1508.27(b)(6)).

7. The effects of expanding Intrepid's solution mining activities would not be significant, individually or cumulatively, when considered with the effects of other actions (40 CFR 1508.27(b)(7)). The EA discloses that there are no other connected or cumulative actions that would cause significant cumulative impacts.

8. I have determined that the activities described in the proposed action will not adversely affect or cause loss or destruction of scientific, cultural, or historical resources, including those listed in or eligible for listing in the National Register of Historic Places (40 CFR 1508.27(b)(8)). Known cultural resources will be avoided by project activities and contribution to the PBPA has been made in lieu of cultural surveys. Effects to cultural resources are discussed in the EA starting on page 75.

9. The proposed activities are not likely to adversely affect any endangered or threatened species or its habitat that has been determined to be critical under the Endangered Species Act (40 CFR 1508.27(b)(9)). The project area contains a small portion of potential habitat for lesser prairie-chicken. Effects to this habitat will be mitigated by controls on timing of construction to avoid critical breeding times. Effects to wildlife are discussed in the EA starting on page 62.

10. The proposed activities will not knowingly threaten any violation of Federal, State, or local law or requirements imposed for the protection of the environment (40 CFR 1508.27(b)(10)). Plan conformance and conformance with relevant laws, regulations, and policies are listed on pages 2 and 3 of the EA.

APPROVED:

for Jeanette A. Martinez
George MacDonell
Field Manager
Carlsbad Field Office

06/16/2015
Date

UNITED STATES DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

Pecos District
Carlsbad Field Office
620 E Greene Street
Carlsbad, NM 88220

DECISION RECORD
for the
Intrepid HB AMAX Solution Mine Extension
NEPA No. DOI-BLM-NM-P020-2015-0586-EA

I. Decision

I have decided to select the proposed action for implementation as described in the EA, DOI-BLM-NM-P020-2015-0586-EA, dated June 16th 2015. Based on my review of the Environmental Assessment (EA), associated EIS (DOI-BLM-NM-P020-2011-498-EIS), and project record, I have concluded that the proposed action was analyzed in sufficient detail to allow me to make an informed decision. I have selected this alternative because it will provide Intrepid with the best access to underground potash reserves to develop their federal potassium leases while protecting and conserving natural resources.

Following is a summary of the preferred alternative as described in the EA:

- Modification of 8,001.4 acres of Intrepid's potash leases (all leases that touch the AMAX flood areas) to be classified as solution mining leases instead of conventional mining leases.
- Approval of all new project components listed below with a total of 84.4 acres of new disturbance during construction and 47.1 acres of long-term disturbance during operation:
  - Two injection wells and two extraction wells with Pilot/Testing/Instrumentation (PTI) wells immediately adjacent to each extraction well
  - Possible twin holes adjacent to injection and extraction wells if old mine pillars are encountered and initial drilling locations are unusable
  - Buried pipelines (12.4 miles) with associated maintenance roads
  - One booster pump station located along the existing HB pipeline corridor
  - Overhead electric lines (1.6 miles)
  - One additional source of injectate brine make-up water from the Intrepid North Plant scrubber water recycle system
- Approval to utilize all relevant facilities and project components of the existing HB Solution mine including the HB mill, main trunk pipelines, injectate water sources and brine make-up system, solar evaporation ponds, leak detection system, and groundwater monitoring system.
- At the completion of the project, all project surface components and all disturbed areas will be reclaimed and infrastructure would be decommissioned.

The proposed action includes a number of environmental protection measures to protect the human and natural environment. The decision to approve the proposed action is contingent upon adherence to all environmental protection measures listed in the EA, EIS, and associated documents. In compliance with federal regulations, the BLM will set a reclamation bond for the project sufficient to ensure that reclamation is completed at the end of the project lifespan.

II. Finding of No Significant Impact

I have reviewed the direct, indirect and cumulative effects of the proposed activities documented in the EA for the Intrepid HB AMAX Solution Mine Extension. I have also reviewed the project record for this analysis. The effects of the proposed action are disclosed in the Environmental Consequences section of the EA. I have determined that the proposed action as described in the EA will not significantly affect the quality of the human environment. Accordingly, I have determined that the preparation of an Environmental Impact Statement is not necessary.

III. Other Alternatives Considered

One other alternative was considered in detail for this project. This alternative is included in the impacts analysis in the EA. The proposed action was selected over the alternative because it will allow Intrepid more direct access to potassium reserves via shorter pipeline paths.

IV. Public Involvement

Public involvement for this project included a public scoping period for issues and a public comment period. All public involvement activities are detailed below:

- Public luncheons sponsored and facilitated by Intrepid were held in late August 2014 to inform interested stakeholders about the project.
- A Purpose and Need statement and brief description of the Proposed Action were posted on the BLM website on Wednesday, March 18, 2015 for a 30-day scoping period. A reminder email about the scoping period was sent to all landowners within or adjacent to the project boundary on April 2, 2015. The public was respectfully asked to provide comments by April 17, 2015.
- The complete EA with a proposed FONSI and Decision Record were posted on the BLM website on May 7. The public was respectfully asked to provide comments by June 8, 2015.
- A notice was published in local newspapers notifying the public that the EA was available for viewing and comment. Notices were run from May 7 to June 8, 2015.
- The Carlsbad Field Office (CFO) also publishes a NEPA log for public inspection. This log contains a list of proposed and approved actions in the field office. The log is located in the lobby of the CFO as well as on the BLM New Mexico website.

V. Appeals

This decision may be appealed to the Interior Board of Land Appeals (IBLA), Office of the Secretary, in accordance with the regulations contained in 43 CFR Part 4. Any appeal must be filed within 30 days of this decision. Any notice of appeal must be filed with George MacDonell, Carlsbad Field Manager, at 620 E.Greene St., Carlsbad, NM 88220. The appellant shall serve a copy of the notice of appeal and any statement of reasons, written arguments, or briefs on each adverse party named in the decision, not later than 15 days after filing such document (see 43 CFR 4.413(a)). Failure to serve within the time required will subject the appeal to summary dismissal (see 43 CFR 4.413(b)). If a statement of reasons for the appeal is not included with the notice, it must be filed with the IBLA, Office of Hearings and Appeals, U. S. Department of the Interior, 801 North Quincy St., Suite 300, Arlington, VA 22203 within 30 days after the notice of appeal is filed with the IBLA, Office of Hearings and Appeals, U.S. Department of the Interior, 801 North Quincy St., Suite 300 Arlington, VA 22203 within 30 days after the notice of appeal is filed with George MacDonell, Carlsbad Field Manger.

Notwithstanding the provisions of 43 CFR 4.21(a)(1), filing a notice of appeal under 43 CFR Part 4 does not automatically suspend the effect of the decision. If you wish to file a petition for a stay of the effectiveness of this decision during the time that your appeal is being reviewed by the Board, the petition for a stay must accompany your notice of appeal.

A petition for a stay is required to show sufficient justification based on the following standards:

(1) The relative harm to the parties if the stay is granted or denied;

(2) The likelihood of the appellant's success on the merits;
(3) The likelihood of immediate and irreparable harm if the stay is not granted; and
(4) Whether the public interest favors granting the stay.

In the event a request for stay or an appeal is filed, the person/party requesting the stay or filing the appeal must serve a copy of the appeal on the Office of the Field Solicitor, 1100 Old Santa Fe Trail, Santa Fe, NM 87505.

Jeanette A. Martinez 06/16/2015

for George MacDonell
Field Manager

Date

United States Department of the Interior

BUREAU OF LAND MANAGEMENT
Carlsbad Field Office
620 E. Greene St.
Carlsbad, NM 88220-6292

TAKE PRIDE IN AMERICA

06/16/2015

IN REPLY REFER TO:
DOI-BLM-NM-P020-2015-0586-EA

Bryan Mortimer
Intrepid Potash, Inc.
707 17th Street, Suite 4200
Denver, CO 80202

Dear Mr. Mortimer,

We have evaluated Intrepid's proposal for the HB AMAX Extension project. In accordance with the National Environmental Policy Act, an Environmental Assessment (EA) was completed to analyze and disclose potential environmental impacts from this project, DOI-BLM-NM-P020-2015-0586-EA. This EA was tiered to and made a part of the Environmental Impact Statement for the HB Solar Solution Mine, DOI-BLM-NM-P020-2011-498-EIS.

All safety guidelines, environmental protection measures, and indemnification clauses, listed in the EA will be adhered to by Intrepid and their contractors during construction and operation of this project.

Notification is required to BLM prior to construction start. Please make this notification and direct any questions to Craig Cranston at ccransto@blm.gov or (575) 234-5936.

Sincerely,

Jeanette A. Martinez
for George MacDonell
Field Manager
Carlsbad Field Office

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Acronyms and Abbreviations

%	percent
°C	degrees Celsius
°F	degrees Fahrenheit
$\mu g/m^3$	micrograms per cubic meter
1st	first
3rd	third
ac-ft	acre-feet
amsl	mean sea level
API	American Petroleum Institute
AQB	Air Quality Bureau
AQCR	Air Quality Control Region
AMAX	AMAX-Horizon Mine
ATV	all terrain vehicle
AUM	animal unit month
BLM	Bureau of Land Management
CAA	Clean Air Act
CFO	Carlsbad Field Office
CFR	Code of Federal Regulations
CH_4	methane
CO	carbon monoxide
CO_2	carbon dioxide
CO_2e	carbon dioxide equivalents
COA	conditions of approval
CP	Capitan Basin
CR	County Road
CVEC	Central Valley Electric Co.
CWA	Clean Water Act
db	decibels
DDT	dichlorodiphenyltrichloroethane
EA	Environmental Assessment
EIS	HB In-Situ Solution Mine Project Environmental Impact Statement
E.O.	Executive Order
ESA	Endanger Species Act
FEIS	Final Environmental Impact Statement
FEMA	Federal Emergency Management Agency
FLPMA	Federal Land Policy and Management Act
FT	Federally Threatened Species List
ft	feet/foot
ft/day	feet per day
GHG	Greenhouse Gases
gpm	gallons per minute
gwp	Global Warming Potential

HAP	Hazardous Air Pollutants
HDPE	high density polyethlyene
HUC	Hydrologic Unit Code
Intrepid	Intrepid Potash – New Mexico, LLC
KCl	potassium chloride, sylvite
MBTA	Migratory Bird Treaty Act
mg/L	milligrams per liter
MMPA	Mine and Mineral Policy Act
NAAQS	National Ambient Air Quality Standards
NaCl	sodium chloride
NE	Northeast
NEPA	National Environmental Policy Act
NHD	National Hydrography Dataset
NHPA	National Historic Preservation Act
NM	New Mexico
NM-E	New Mexico - State listed as Endangered Species
NM-T	New Mexico - State listed as Threaten Species
NMAAQS	New Mexico Ambient Air Quality Standards
NMAC	New Mexico Administrative Code
NMDOT	New Mexico Department of Transportation
NMED	New Mexico Environment Department
NMOSE	New Mexico Office of State Engineer
NMSA	New Mexico Statutes Annotated
NMWQCC	New Mexico Water Quality Control Commission
NOITP	Notice of Intent to Plug
NO_x	nitrogen oxides
NO_2	nitrogen dioxide
N_2O	nitrous oxide
NRCS	National Resources Conservation Service
NW	Northwest
NWI	National Wetland Inventory
O_3	ozone
OHV	off highway vehicle
PBPA	Permian Basin Programmatic Agreement
PCB	polychlorinated biphenyl
PFYC	Potential Fossil Yield Classification
$PM_{10, 2.5}$	Particular Matter $_{(< 10 \text{ microns}, <2.5 \text{ microns})}$
ppm	parts per million
psi	pounds per square inch
PTI	Pilot/Testing/Instrumentation
R30E	Range 30 East
ROD	Record of Decision
ROW	right of way
RV	recreation vehicle
SDR	Standard Dimension Ratio

SE	Southeast
SHPO	State Historic Preservation Office
SO_2	sulfur dioxide
SPA	Secretary's Potash Area
SPCC	Spill Prevention, Control, and Countermeasure
SRMA	Special Recreation Management Area
SSURGO	Soil Survey Geographic Database
STH	State Trunk Highway
SWPPP	Storm Water Pollution Prevention Plan
SWQB	Surface Water Quality Bureau
SWReGAP	Southwest Regional Gap Analysis Project
T19S	Township 19 South
TD	total depth
TDS	total dissolved solids
TSP	total suspended particulates
tpy	tons per year
U.S.	United States
USC	United States Code
USDA	United States Department of Agriculture
USEPA	United States Environmental Protection Agency
USFWS	United States Fish & Wildlife Service
UWI	Unique Well Identification
VOC	Volatile Organic Compound
VRM	Visual Resource Management
WIPP	Waste Isolation Pilot Plant
WRCC	Western Regional Climate Center

All additions to the text that were inserted after the public comment period are designated by ***bold, italicized, underlined text***.

1. PURPOSE AND NEED FOR ACTION

1.1. Background

Intrepid Potash – New Mexico, LLC (Intrepid) is proposing to use solution mining to extract potash, a potassium compound commonly used in fertilizer, which remains in the abandoned underground AMAX-Horizon Mine (AMAX) workings. The HB AMAX Solution Mine Extension Project would be an extension to Intrepid's existing HB Solar Solution Mine located in Eddy County approximately 20 miles east of Carlsbad, New Mexico. The AMAX Mine is a closed conventional mine that lies to the north of the HB Solar Solution Mine. The Proposed Project is designed to recover and process potassium chloride (KCl) ore from the abandoned underground mine workings of the AMAX Mine.

The HB AMAX Solution Mine Extension Project would tie directly into Intrepid's existing HB AMAX Solution Mine Extension Project and would expand the size and extend the life of that mine. The Bureau of Land Management (BLM) evaluated the HB Solar Solution Mine (formerly known as the HB In-Situ Solution Project) by preparing an Environmental Impact Statement (EIS), DOI-BLM-NM-P020-2011-498-EIS. A final EIS (FEIS) was published in January 2012 and a Record of Decision (ROD) followed in March 2012.

The BLM Carlsbad Field Office is evaluating the proposed HB AMAX Solution Mine Extension Project with this Environmental Assessment (EA). This EA is tiered from HB Solar Solution Mine EIS and therefore made a part hereof. A brief project description follows, which details how the proposed HB AMAX Solution Mine Extension Project would use existing infrastructure and employ techniques that would minimize impacts. A more detailed description of the project and associated infrastructure can be found in Section 2, Proposed Action.

1.2. Brief Project Description

Intrepid holds the federal, State, and private potassium leases for the area of proposed potash extraction. Surface disturbance would occur on BLM, State, and fee lands depending upon the final project alignment. The AMAX Mine would provide approximately 14 years of solution mine reserves beyond the 28-year HB Solar Solution Mine life.

To the maximum extent practicable, it is proposed that the HB AMAX Solution Mine Extension Project would utilize existing HB Solar Solution Mine facilities and infrastructure to minimize environmental impacts. The solution mining process would be identical to that of the existing HB Solar Solution Mine with injection of salt (NaCl) saturated brine into the workings and extraction of a KCl (potash) enriched (pregnant) brine. Potash recovered from the AMAX Mine would be pumped to the existing HB Solar Solution Mine solar evaporation ponds. Once the solution evaporates in the ponds and precipitates out KCL and NaCl, the salts would be harvested and transported to the existing HB Mill for ore refinement.

1.3. Purpose and Need for Action

The purpose of this action it to modify Intrepid's HB Solar Solution Mine workings to include the AMAX Mine in order to recover potash resources.

The BLM is required to evaluate and respond to Intrepid's proposal to construct, operate, maintain, and decommission an in-situ solution mining operation, which is described in Section 2, Proposed Action. This includes analyzing the impacts of the proposed mine plan modification and the lease conversion from conventional mining to solution mining leases. The need for this project is established by the BLM responsibility to promote the orderly and efficient development and maximum recovery of leasable minerals, including potash, as specified under 30 United States Code (USC) Chapter 2 §21a, the Mineral Leasing Act of 1920 as amended, the Federal Land Policy and Management Act (FLPMA) of 1976 (43 USC 1761), and the Secretary of the Interior's 1986 Potash Order (51 Federal Register 39425, October 28, 1986).

The BLM is responsible for the balanced management of the public lands and resources and its various values in a fashion that will best serve the needs of the American people. Potash is an important industrial mineral in wide demand in the United States (U.S.) with limited production in the U.S. The BLM has the duty to allow and encourage a federal leaseholder to develop their leases subject to reasonable restrictions. The proposed project will fulfill the BLM mission and responsibilities by allowing Intrepid to mine potash and associated minerals for which it holds federal leases.

1.4. Conformance with Applicable Land Use Plan(s)

The Proposed Action, as described in Section 2, is in conformance with the 1988 Carlsbad Resource Management Plan, as amended by the 1997 Carlsbad Resource Management Plan Amendment for Oil and Gas, and the 2008 Special Status Species Resource Management Plan Amendment. ***The Proposed Action described in Section 2 conforms to all local rules and regulations.***

1.5. Relationship to Statutes, Regulations or Other Plans

The BLM authority for land management derives from the Federal Land Policy and Management Act (FLRPA). All BLM regulations are contained in 43 Code of Federal Regulations (CFR), Subtitle B—Regulations Relating to Public Lands, Chapter II—Bureau of Land Management, Department of the Interior. BLM regulations for the management of mining on federal potash leases are found in 43 CFR Subpart 3590, Solid Minerals (Other Than Coal) Exploration and Mining Operations. Section 3592.1, Operating Plans, specifies that before any operations are conducted under any lease, the operator must submit a detailed mine and reclamation plan to the BLM, which the BLM must approve before operations can begin. These regulations contain specific criteria that the mine and reclamation plan must address to assure the protection of non-mineral resources and the reclamation of the lands affected by the operations.

Potash is a solid leasable mineral that is managed by the BLM under the authority of the Mineral Leasing Act of 1920, as amended, the Potash Leasing Act of 1927, and, in southeastern New Mexico, Secretary of the Interior Order No. 3324, dated December 3, 2012 (2012 Secretary's Order). The Mineral Leasing Act establishes qualifications for mineral lessees, defines maximum limits on the total acres of a mineral that can be held by a lessee, and authorizes the BLM to grant these leases. Federal regulations that pertain to leasing these minerals are contained in 43 CFR Part 3500, Leasing of Solid Minerals Other than Coal and Oil Shale.

The State of New Mexico's Order No. R-111-P applies to State lands and minerals in the area. While the BLM may incorporate elements of R-111-P into its management of the Secretary's Potash Area (SPA), the BLM is not mandated to follow it. In particular, Life of Mine Reserves, as defined in R-111-P, is not used for management of federal lands and minerals.

The Mining and Mineral Policy Act of 1970 (MMPA) mandates that federal agencies ensure that closure and reclamation of mine operations be completed in an environmentally responsible manner. The MMPA states that the federal government should promote the "development of methods for the disposal, control, and reclamation of mineral waste products, and the reclamation of mined lands, so as to lessen any adverse impact of mineral extraction and processing upon the physical environment that may result from mining mineral activities."

Other major federal and State regulations and permits that are relevant to the proposed project include those listed below:

- National Environmental Policy Act (NEPA) (P.L. 91-190) and CEQ – Regulations for implementing NEPA (40 CFR Parts 1500 – 1508)
- Clean Water Act (CWA) and Federal Water Pollution Control Act Amendments
- New Mexico Water Quality Act, New Mexico Statutes Annotated (NMSA) 1978, §§74- 6-1 et seq.
- Federal Safe Drinking Water Act, 40 CFR Parts 144 and 147; New Mexico Ground and Surface Water Protection, New Mexico Administrative Code (NMAC) Part 20.6.2, 2005
- Underground Water, NMSA 1978, §§72-12-1 et seq.
- Endangered Species Act (ESA) of 1973, as amended (P.L. 93- 205)
- Migratory Bird Treaty Act (MBTA) of 1918, as amended; Bald and Golden Eagle Protection Act of 1940
- Clean Air Act (CAA); delegated to the State of New Mexico under Air Quality Control Act, NMSA 1978, §§74-2-1 through 74-2-17
- National Historic Preservation Act (NHPA) (36 CFR Part 800); New Mexico Cultural Properties Act, NMSA 1978, §§18-6-1 through 18-6-17
- Federal Cave Resources Protection Act of 1988, 16 USC 4301 – 4309
- P. L. 111-011 Omnibus Public Land Management Act, Subtitle D – Paleontological Resources Preservation
- NMSA 1978 Sections 19-1-1 and 19-7-57
- NMAC Part 14.5.2

1.6. Decision to be Made

The decision to be made is whether or not to approve Intrepid's application to extend the existing HB Solar Solution Mine workings to include the AMAX Mine, and, if to approve, under what terms and conditions.

1.7. Scoping, Public Involvement, and Issues

Summary of Public Outreach Activities from the HB Solar Solution Mine EIS:

EIS Public Outreach
September 16, 2008 – two public scoping meetings
Prior to publication of the EA, the BLM determined that the preparation of an EIS would be required for the proposed project
January 12, 2010 – Notice of Intent to prepare an EIS was published in the Federal Register
January 26, 2010 – two public scoping meetings
April 15, 2011 – Notice of Availability for the Draft EIS was published in the Federal Register
May 10, 2011 – public meeting in Carlsbad
May 11, 2011 – public meeting in Hobbs

EIS Consultation and Coordination
February 1, 2010 – BLM Carlsbad Field Office (CFO) sent letters to the following pueblos and tribes notifying them of the proposed HB Solar Solution Mine project:

- Apache Tribe of Oklahoma
- Comanche Indian Tribe
- Hopi Tribe
- Kiowa Tribe of Oklahoma
- Mescalero Apache Tribe
- Pueblo of Isleta
- Ysleta del Sur Pueblo

EA Scoping
Materials documenting scoping and public outreach can be found in Appendix A. Public luncheons sponsored and facilitated by Intrepid were held in Carlsbad in late August 2014 to inform interested stakeholders about the project.

A Purpose and Need statement and brief description of the Proposed Action were posted on the BLM website on Wednesday, March 18, 2015 for a 30-day scoping period. A reminder email about the scoping period was sent to all landowners within or adjacent to the project boundary on April 2, 2015. The distribution list included people that attended the public luncheons in August 2014, and stakeholders that had been identified during the scoping period for the HB Solar Solution Mine EIS. The public was respectfully asked to provide comments by April 17, 2015.

As a result of scoping, one public comment was received from the Mayor of Carlsbad.

The following is a list of specific issues identified by the BLM and the public for this EA:

- Geological resources – concern over actual drawdown impacts to caves in comparison to the model predictions, potential for subsidence, oil and gas operations, potential of impacts to paleontology
- Water resources – performance of the Rustler wells in comparison to the model predictions, minimizing fresh water use
- Soils – erosion
- Air quality – emissions and dust
- Vegetation – noxious weeds
- Wildlife – raptors, bats, owls
- Rangeland and Livestock grazing – impacts to grazing and cattle
- Lands and Realty – impacts to ROW
- Recreation – ensure the EA addresses recreational use in the area
- Visual – impacts to visual resources
- Cultural – avoidance of known sites
- Hazardous Materials – potential for releases
- Socioeconomics – benefits and impacts to the area
- Project infrastructure – use of existing infrastructure
- EA approach – tier the EA from the EIS

Availability of EA for Public Comment
The EA, a Frequently Asked Question sheet, and draft versions of the FONSI and Decision Record were made available for public comment on the BLM on May 8, 2105.

Notification of the availability of the EA for public comment included:

- ***An email to interested stakeholders***

- ***Newspaper display advertisements were run in the Artesia Daily Press, Hobbs News-Sun and the Carlsbad Current Argus. Affidavits of publication can be found in Appendix A.***

Letters of notification were sent to:

- ***Office of the State Engineer***
- ***Water Right District 2 Supervisor***
- ***Eddy County***
- ***Lea County***
- ***City of Carlsbad***
- ***Carlsbad Soil & Water Conservation District***

All of these materials can be found in Appendix A.

Three comment letters were received during the public comment period. Two were in support of the project and one requested more coordination with the BLM for all projects. These letters can be found in Appendix A.

2. PROPOSED ACTION

2.1. Introduction

Intrepid is proposing to expand solution mining activities permitted for the HB Solar Solution Mine to include portions of the abandoned AMAX Mine. The HB Solar Solution Mine and the proposed HB AMAX Solution Mine Extension Project are located in Eddy County approximately 20 miles east of Carlsbad, New Mexico (see **Map EA-1 – *Project Location and Vicinity Map***).

The HB AMAX Solution Mine Extension Project would expand Intrepid's existing HB Solar Solution Mine and is proposed as a Mine Plan Modification of Intrepid's existing HB Solar Solution Mine Operations and Closure Plan, dated March 9, 2012. With regard to federal lands, the proposed extension project lies completely on potassium leases held by Intrepid and thus can be permitted as a mine plan modification. No separate rights of way (ROW) in addition to the mine modification are proposed for in this project.

The proposed HB AMAX Solution Mine Extension Project is located within State, federal, and private leases that Intrepid currently holds. As part of this Proposed Action all federal potassium leases associated with the proposed HB AMAX Solution Mine Extension Project would be converted from conventional mining leases to solution mining leases. The same conversion of lease type was analyzed for the existing HB Solar Solution Mine EIS (see ROD). Four federal potash leases are to be converted from conventional mining leases to solution mining leases. These leases are listed **in Table 2.1-1 - *Existing and Proposed HB Solar Solution Mine Facilities*** as shown on **Map EA-2 – *Mineral Lease*.**

Table 2.1-1 Existing and Proposed HB Solar Solution Mine Facilities

Lease Number	Total Lease Acreage
NMLC-046729-D	2,560.0
NMNM-113455	2,400.8
NMNM-113456	2,480.0
NMNM-113457	560.6

The AMAX Mine ceased production in 1993 and has been closed according to applicable regulatory requirements. The shafts have been sealed and the surface restoration and reclamation activities have been completed by the former owner. The remaining ore is located in the pillars and fringe areas of the underground mine workings.

Conventional mining at the AMAX property occurred on the 1st and 3rd Ore Zones. The 3rd Ore Zone lies stratigraphically above the 1st Ore Zone with roughly 30 feet (ft) of separation between them. The two Ore Zones are connected by several slopes and stopes that would allow injected brine to move vertically providing contact to ore in pillars and fringe areas from both ore zones.

The HB AMAX Solution Mine Extension Project would utilize existing facilities wherever possible. The infrastructure associated with the HB Solar Solution Mine and the proposed HB AMAX Solution Mine Extension Project is shown in **Map EA-3 – *Existing and Proposed HB Solar Solution Mine Facilities***. All existing infrastructure for the HB Solar Solution Mine that would be also used by the HB AMAX Solution Mine Extension Project was previously analyzed in the HB EIS.

As shown on Map EA-3, new construction for the HB AMAX Solution Mine Extension Project would include:

- Two injection wells with150 ft by 250 ft construction areas and 80 ft by 80 ft operational areas.
- Two extraction wells with150 ft by 250 ft construction areas and 80 ft by 80 ft operational areas.

- Two Pilot/Testing/Instrumentation (PTI) wells; one PTI well immediately adjacent to each extraction well and contained within each 80 ft by 80 ft operational area.
- 12.4 miles of 50-ft wide utility corridor that will include buried pipelines of various diameters (4 to 18 inches) and a 12-ft wide access road.
- One booster pump station with a 100 ft by 130 ft area for construction and operations; half of this area (50 ft by 130 ft) is a new disturbance and half is within the existing HB pipeline corridor.
- 1.6 miles of overhead electric lines.
- One additional source of injectate brine make-up water from the Intrepid North Plant scrubber water recycle system.

Due to uncertainty in the precise location of remaining ore pillars, it is possible that the initial boreholes for the injection and extraction wells could intersect an ore pillar and be unusable. If an ore pillar is intersected by the borehole the hole would be properly plugged and a second, twin hole would be drilled as close as possible to the original well location. The BLM would be notified of any twin holes.

The HB Solar Solution Mine currently utilizes several monitoring systems to verify and document operational conditions as required by the New Mexico Environment Department (NMED) and the BLM. All existing monitoring systems would be utilized for the proposed HB AMAX Solution Mine Extension Project and are summarized as follows:

- A groundwater monitoring well network used to collect regular water level and water quality data throughout the area potentially influenced by Rustler groundwater withdrawal.
- A groundwater monitoring well network used to collect regular water level, water quality, and electrical conductivity data to define baseline characteristics of the groundwater beneath the solar evaporation ponds and monitor for potential releases of solar pond brine.
- Regular water level measurements collected monthly to monitor water levels in specified karst and cave resources.
- Regular pipeline inspections by mine personnel and pipeline instrumentation that monitors pressure and flow rate to monitor for potential pipeline leaks.
- Down-hole instrumentation to guide extraction well and injection well operation and control flood elevations.
- Monitoring wells to detect potential brine excursions to down-gradient portions of the mine workings outside of flood zones.

2.2. HB AMAX Solution Mine Extension Mine Operation

The solution mining process at the proposed HB AMAX Solution Mine Extension Project would be identical to that employed at the existing HB Solar Solution Mine. The proposed AMAX solution mining process is to inject a salt (NaCl) saturated brine into the AMAX workings. The brine would remain in place to allow an ion exchange to occur between KCl in the mine ore body and sodium in the brine (KCl in the ore body is dissolved and an equivalent amount of NaCl precipitates out from the brine). The result would be a potassium-rich (pregnant) brine to be extracted from the mine after a desired concentration of KCl is reached. Pregnant brine would be pumped to the existing HB solar evaporation ponds. Water in the pregnant brine would evaporate in the ponds and KCl and NaCl would precipitate out as solids. The precipitated salts would be harvested from the ponds and transported to the existing HB Mill for ore refinement. This process is described in detail in the HB EIS (Section 2.4.2.2).

Salt conditioned injectate brine would be pumped to injection wells located in upper elevations of the AMAX Mine and would flow to the lower areas of the flood zone. As injectate brine is added, a leach lake would form and rise to the maximum control elevation. After the brine is injected it would flow via advection (gravity induced, downhill flow) and dispersion (driven by density gradients developed as the brine becomes increasingly saturated with KCl). Although it would take time to fill the AMAX Mine (over two years at the maximum injection rate of 3,000 gpm), KCl dissolution is expected to occur quickly but may take several month to concentrate to the desired pregnant brine KCl grade. The in-situ process would leave behind insolubles (clay slimes) in the former workings eliminating the need for separation and disposal on the surface. Once the cavern is filled to the control level, long term production would become a relatively steady-state operation where injection roughly equals extraction. **Figure EA-1 - *Proposed HB Operational Diagram*** summarizes the cumulative HB solar solution mine processes including the proposed HB AMAX Solution Mine Extension Project.

2.2.1. General Design Features Included to Avoid and Minimize Environmental Impact

The following design features are common to all action alternatives. A number of design features and mitigation measures for the HB Solar Solution Mine were identified in the FEIS and approved in the ROD. Specific mitigation measures include:

1. ROD, Section 2.1 - Applicant-committed Environmental Protection Measures
2. ROD, Section 2.2 - BLM Environmental Protection Measures
3. EIS, Appendix B – Existing Potash Lease Stipulations and Potential Conditions of Approval for HB In-Situ Solution Mine EIS

In addition, according to the ROD, all monitoring, spill response, and remedial actions will comply with Intrepid's HB In-Situ Solution Mine Operations and Closure Plan (March 2012) approved by the BLM. Section 8.2.2, *Pipeline, Well, and Uncontained Mill Facility Releases* of the HB In-Situ Solution Mine Operations and Closure Plan (March 2012) states:

The NMED and BLM, as appropriate, will be promptly notified of releases as required by Discharge Permit DP-1681. Inconsequential failures that do not threaten ground water quality shall be reported in the quarterly monitoring reports and include a brief action plan and completion report.

The NMED Discharge Permit DP-1681 spill reporting requirements are as follows:

Section III. Permit Conditions, Number 30. Operational Failures

In the event of a berm breach, pipeline break, pump failure or other system failure at the facility that threatens ground water as defined by 20.6.2.310 I NMAC, tailings and process waters shall be contained, pumped and/or transferred to areas of the facility that impose minimal impacts to ground water quality. Failed components shall be repaired or replaced as soon as possible and no later than 72 hours from the time of failure. Inconsequential failures that do not threaten ground water quality shall be reported in the quarterly monitoring reports and include a brief action plan and completion report. [20.6.2.31007A (l 0) NMAC]

Section III. Permit Conditions, Number 32. Spill Reporting and Remediation

In the event of a spill or release that is not prescribed under this Discharge Permit, IPNM shall initiate the notifications and corrective actions as required in 20.6.2.1203 NMAC. IPNM shall take immediate corrective action to contain and remove or mitigate the damage caused by the discharge. Within 24 hours after discovery of the discharge, IPNM shall verbally notify NMED and provide the information required by 20.6.2.1203.A.l NMAC. Within 7 days of discovering the discharge, IPNM shall submit a written reply to NMED verifying the oral notification and providing any additional information or changes. IPNM shall submit a corrective action report within 15 days after discovery of the discharge. [20.6.2.1203 NMAC]

Those design features and mitigation measures would be included for the HB AMAX Solution Mine Extension Project facilities where applicable. Specific design features and mitigation measures identified by BLM resource specialists for the HB AMAX Solution Mine Extension Project are described below.

Solid Minerals

1. A qualified person would be onsite at all times to monitor construction activities for compliance with federal and State permits and requirements. This construction monitor would report to the BLM on a regular basis. Intrepid would notify the BLM at least 3 working days prior to commencing construction of access roads and/or pads.

2. Intrepid would obtain prior written approval from the BLM of any construction not authorized in a previously approved plan. Notification to the BLM of the activity would be in the form of a written mining plan modification.

3. A closed-loop fluid control system would be used to contain drill fluids and cuttings.

4. A bermed, synthetic lined pit or roll-off containers would be constructed to contain fluids and cuttings and to prevent fluids from seeping into the underlying soils. Berms would be placed around the lined pit with the liner extending beyond the crest of the berm and anchored in place. In addition, a berm shall be constructed on the down-slope portion of the pad as secondary spill containment.

5. If the site would be left unattended before removing the closed-loop system and underlying liner, a fence constructed with T-posts and 3 strands of barb wire will be placed around the outside perimeter of the berm, completely enclosing the lined fluid and cutting pit to prevent people and cattle from accessing the pit .

6. Intrepid would notify BLM a minimum of 24 hours in advance for a representative to witness:

   a. Spudding wells
   b. Drilling
   c. E-logging, if performed
   d. Cementing
   e. Reclamation (seeding)

7. In the event of an off-pad spill, unauthorized discharge, or soil contamination, the operator or person in charge would provide notification to the BLM as approved by BLM in the AMAX Mine Operations and Closure Plan and as required by NMED Discharge Permit DP-1681.

8. All well information would be supplied to the BLM Carlsbad Field Office. The required information includes:

   - Drilling reports.

   - Well completion report including casing intervals, cements zones, and screened intervals.

- Geologic log of the hole, including any drilling events encountered (e.g., lost circulation, air/gas blows, etc.).

- If geophysical logs are run, a copy of each log shall be submitted. The log submitted can be either in paper or digital format.

9. Any water erosion that may occur due to the construction of roads or well pads or during the life of the wells will be corrected in a timely manner and proper measures would be taken to prevent future erosion.

Fluid Minerals

1. Operations would not be conducted which in the opinion of the Authorized Officer would constitute a hazard to oil and gas production or that would unreasonably interfere with the orderly development and production under any oil and gas lease issued for the same lands.

2. Lost circulation zones (the uncontrolled flow of drilling fluid into flows into one or more geological formations instead of returning up the annulus of the drill) would be logged and reported in the drilling report so BLM can assess the situation and work with the operator on corrective actions.

3. To protect freshwater bearing units, freshwater mud would be used to drill down through the Rustler Formation and the Rustler Formation section of the borehole would be cased/cemented.

Lands and Realty

1. All aboveground structures not subject to safety requirements would be painted by the holder to blend with the natural color of the landscape. The paint used would be color which simulates “Standard Environmental Colors” – Shale Green, Munsell Soil Color No. 5Y 4/2.

2. The pipeline would be identified by signs at the point of origin, the point of termination, and at all road crossings. At a minimum, signs would state the holder’s name, BLM lease/serial number, and the product being transported. All signs and information thereon would be posted in a permanent, conspicuous manner, and will be maintained in a legible condition for the life of the pipeline.

3. Intrepid would not use the pipeline route as a road for purposes other than inspection and routine maintenance as determined necessary by the Authorized Officer in consultation with Intrepid before maintenance begins. Intrepid would take whatever steps are necessary to ensure that the pipeline route is not used as a roadway. As determined necessary during the life of the pipeline, the Authorized Officer may ask Intrepid to construct temporary deterrence structures.

4. All construction and maintenance activity would be confined to the authorized corridor. No additional disturbance beyond that in the approved plan shall take place.

Wildlife

1. Mine related activities, including drilling, would not be allowed in lesser prairie-chicken habitat during the period from March 1st through July 15th, annually. During that period, other activities that produce noise or involve human activity, such as pipeline, road, and well pad construction, would be allowed except between 3:00 a.m. and 9:00 a.m. Noise from well heads and pump booster station would be muffled or otherwise controlled so as not to exceed 75 decibels (db) measured at 30 ft from the source of the noise.

a. The 3:00 a.m. to 9:00 a.m. restriction would not apply to normal, around-the-clock operations, such as pumping, which do not require a human presence during this period. Normal vehicle use on existing roads would not be restricted.

b. Exceptions to these requirements will be considered for areas of no or low prairie chicken booming activity, or unoccupied habitat, including leks, as determined at the time of permitting, or in emergency situations.

2. In order to prevent raptor perching and improve the probability of maintaining a stable lesser prairie-chicken population, upon abandonment of wells a low profile abandoned well marker would be installed. The well marker would be approximately two inches aboveground level and contain the following information: operator name, lease name, and well number and location, including unit letter, section, township, and range. The previous listed information will be welded, stamped, or otherwise permanently engraved into the metal of the marker.

3. Escape Ramps - the operator would construct and maintain pipeline/utility trenches that are not otherwise fenced, screened, or netted to prevent livestock, wildlife, and humans from becoming entrapped. At a minimum, the operator will construct and maintain escape ramps, ladders, or other methods of avian and terrestrial wildlife escape in the trenches according to the following criteria:

   a. Any trench left open for (8) hours or less is not required to have escape ramps; however, before the trench is backfilled, an agency approved monitor shall walk the entire length of the open trench and remove all trapped vertebrates. The bottom surface of the trench will be disturbed a minimum of 2 inches in order to arouse any buried vertebrates. All vertebrates will be released a minimum of 100 yards from the trench.

   b. For trenches left open for eight (8) hours or more, earthen escape ramps will be provided. Earthen escape ramps and/or structures (built at no more than a 30 degree slope and spaced no more than 500 feet apart) shall be placed in the trench. Metal structures will not be authorized. One approved monitor shall be required to survey up to three miles of trench between the hours of 11 AM-2 PM. A daily report (consolidate if there is more than one monitor) on the vertebrates found and removed from the trench shall be provided to the BLM (email/fax is acceptable) the following morning. Prior to backfilling of the trench all structures used as escape ramps will be removed and the bottom surface of the trench will be disturbed a minimum of 2 inches in order to arouse any buried vertebrates. All vertebrates will be released a minimum of 100 yards from the trench.
   Open trenches will have ramps, bridges, or earthen plugs, at least six feet wide, every one-quarter mile to pass livestock and wildlife. Earthen plugs would be placed at obvious game or livestock trails that cross the trench.

4. Should it be documented that bats are found to be drinking from the solar evaporation ponds, and should this be proven to be detrimental to bats, mitigation measures would be collaboratively developed by the BLM and the operator.

Archaeology

Should discoveries of human remains or funerary objects occur during project construction or operations on federal land with the PBPA area, Intrepid would cease operations in the area of discovery, protect the remains, and notify the BLM within 24 hours. The BLM would determine the appropriate treatment of the remains in consultation with culturally affiliated Indian Tribe(s) and lineal descendants. Intrepid would be required to pay for treatment of the cultural items independent and outside of the mitigation fund. In all cases it is illegal to remove any type of cultural item from Federal land.

Any cultural resource (historic site, object, or remains) discovered by the Intrepid, or any person working on Intrepid's behalf, on State land shall be immediately reported to the State Historic Preservation Office (SHPO). The holder shall suspend all operations in the immediate area of such discovery until written authorization to proceed is issued by the SHPO. The authorized officer shall determine the appropriate actions necessary in order to prevent the loss of significant cultural or scientific values. The holder would be responsible for the cost of evaluation and any measures necessary to mitigate the site as determined by the Authorized Officer with consultation with the Intrepid.

Paleontology

Any paleontological resource discovered by Intrepid or any person working on Intrepid's behalf, on Federal land shall be immediately reported to the Authorized Officer. Intrepid shall suspend all operations in the immediate area of such discovery until written authorization to proceed is issued by the Authorized Officer. The Authorized Officer shall determine the appropriate actions necessary in order to prevent the loss of significant paleontological or scientific values. Intrepid will be responsible for the cost of collection, evaluation and curation and any measures necessary to mitigate the site as determined by the Authorized Officer in consultation with Intrepid.

Cave-Karst

1. Turnout ditches and drainage leadoffs would not be constructed in such a manner as to increase or decrease the natural flow of water into or out of cave or karst features.

2. Intrepid will inform the BLM, Carlsbad Field Office, immediately if any subsurface drainage channels, cave passages, or voids are penetrated during construction and no further construction would be done until clearance has been issued by the Authorized Officer. Special restoration stipulations or realignment may be required.

3. Intrepid will submit a pipeline leak detection plan to BLM for approval prior to operational start.

4. Intrepid will report all spills or leaks to the BLM as required by the BLM-approved HB Mine Operations and Closure Plan and NMED Discharge Permit DP-1681.

5. Intrepid will notify the BLM if the water level in the Burton Flats karst monitoring wells drops below the threshold outlined in groundwater adaptive management plan.

Hydrology

1. Fresh water or fresh water spud mud would be used to drill to surface casing depth. If surface casing is set at a lesser depth than the top of the Rustler Formation, fresh water mud may be used to drill down to the first salt in the Salado Formation after which brine must be used.

2. While drilling from the surface casing to the Rustler Formation operators would periodically sweep the hole with viscous low water loss additives to help build a filter cake across usable water zones in the redbeds, if encountered.

3. Surface casing would be set at a sufficient depth to protect usable water zones and cement circulated to surface. In areas where the salt section (Salado) is present, surface casing would be set at least 25 ft into the top of the Rustler Anhydrite and cement circulated to the surface. As an alternative, surface casing would be set through the Santa Rosa Formation or other potable water bearing zones and circulate cement to surface.

Rangeland, Noxious Weeds, and Soils

1. Intrepid would minimize disturbance to existing fences and other improvements, such as structures that provide water to livestock (i.e., windmills, pipelines, drinking troughs, and earthen reservoirs), on public lands. Intrepid would promptly repair improvements to at least their former state. Functional use of these improvements would be maintained at all times. Intrepid would

contact the owner of any improvements prior to disturbing them. When necessary to pass through a fence line, the fence would be braced on both sides of the passageway prior to cutting of the fence. No permanent gates will be allowed unless approved by the Authorized Officer.

2. In those areas where erosion control structures are required to stabilize soil conditions, Intrepid would install such structures as are suitable for the specific soil conditions being encountered and which are in accordance with sound resource management practices.

3. Intrepid would be held responsible if noxious weeds become established within the areas of operations. Weed control would be required on the disturbed land where noxious weeds exist, which includes associated roads, pipeline corridor and adjacent land affected by the establishment of weeds due to this action. Intrepid would consult with the Authorized Officer for acceptable weed control methods, which include following EPA and BLM requirements and policies.

4. If a fence is crossed during lease operations, to prevent slacking of fence wire, Intrepid would brace and tie-off each existing fence to be crossed before cutting. During construction, the opening shall be protected to prevent the escape of livestock. Fences cut during construction would be restored by Intrepid to a condition which is equal to or better than the original. Cattle guards would be installed in any fence where a road created during construction is to be regularly traveled.

5. Gates or cattle guards on public lands would not be locked or closed to public use by Intrepid. Gates would be kept closed at all times unless the grazing allottee requests them to be left open.

6. Prior to any construction, Intrepid would notify the grazing allottee or the surface owner, in the case of private ownership, of the activity.

Recreation

1. Power poles and associated ground structures (poles, guy wires) would not be placed within 20 ft of recreation trails. Guy wires would be equipped with a sleeve, tape or other industry approved apparatus that is highly visible during the day and reflective at night.

2. Appropriate safety signage would be in place during all phases of the project.

3. Upon completion of construction, trails would be returned to pre-construction condition.

2.2.2. Proposed Construction

The proposed new construction required for the HB AMAX Solution Mine Extension Project includes new injection wells, extraction wells (with associated PTI wells), well head components, conveyance pipelines, booster pump station, power distribution facilities, and access roads. The following subsections present details of the proposed infrastructure and the design features related to environmental protection.

Injection/Extraction Well Locations
Two injection and two extraction wells are proposed to provide conduits to flood the target ore zones as follows:

- **IP-301** 1st Ore Zone Injection Well
  NW ¼, SE ¼, Section 8, T19S, R30E

- **IP-302** 1st Ore Zone Extraction Well
  NE ¼, SE ¼, Section 10, T19S, R30E

- **IP-303** 3rd Ore Zone Injection Well
  SE ¼, SE ¼, Section 5, T19S, R30E

- **IP-304** 3rd Ore Zone Extraction Well
  NE ¼, NE ¼, Section 14, T19S, R30E

A twin hole may be drilled adjacent to the original location if the initial borehole is unsuccessful. The injection and extraction wells are classified as Class V Underground Injection Wells for in-situ mineral processing and would be constructed using a similar design as the injection and extraction wells approved and installed for the HB Solar Solution Mine (see Section 2.4.2.1 of the HB EIS). The following figures illustrate the injection and extraction well design:

- **Figure EA-2 – *Injection Well General Design***
- **Figure EA-3 – *Extraction Well General Design***

Proposed wells IP-301 and IP-302 may require modifications to the drilling and well completion design based on the occurrence and condition of the 3rd Ore Zone as drilling passes through it. BLM would be notified of any modification to an approved plan prior to construction.

Injection and Extraction Well Access and Drill Pads

Access routes to the injection and extraction well locations shall be via the pipeline routes, which include an inspection/maintenance road within the utility corridor. The drill pad would be cleared and grubbed of vegetation and graded to facilitate well installation. Cleared vegetation would be randomly scattered outside the drill pad and not left in piles or rows. The disturbance area would be graded to the degree necessary to allow drilling and well construction activities. In the event that graded surface materials cannot support drilling and support equipment, a lift of caliche may be applied. The caliche would be supplied by an area contractor/supplier from sources controlled by that contractor.

The drill pad and associated disturbance area would be 150 ft by 250 ft and would contain all drilling equipment, drilling material storage, subcontracted services such as drilling fluid supply and delivery, cementing, casing installation, geophysical logging, fueling, etc. The site would contain bermed and lined pits, tanks, and other components to manage drill cuttings and drilling fluids. The sites would also be bermed and equipped with straw booms on the down-slope edges to serve as secondary containment. All fuels and lubricants would be contained in secondary containment facilities. The location would contain portable sanitary facilities, office/maintenance trailers, and light plants.

Once drilling activities are complete, all well construction equipment, left over materials, and waste would be removed from the site. Following well head construction associated with the surface control facilities, which would be contained within an 80-ft by 80-ft fenced area within the drill pad, the well pad would be graded and seeded with a seed/fertilizer mix as specified by the BLM. If caliche was used to stabilize the pad, all caliche would be removed from the site prior to reclamation.

Figure EA-4 – *General Drill Pad Layout* illustrates the drill pad configuration for the injection and extraction wells. Drilling and well construction would be performed on a 24/7 shift rotation, unless hours are restricted due to lesser prairie-chicken habitat. All pad, drilling and well construction activities would be overseen and directed by qualified personnel. The technical site representative would be responsible for all decisions regarding drill depths and well completion details.

Well Head Infrastructure

Each of the four well locations would be equipped with operating infrastructure to facilitate brine injection and extraction as follows:

- Well head manifold and valving.
- Power transformation and motor control components.
- Well head security and fencing.
- Down-hole equipment.

All four well head areas would utilize an 80 ft by 80 ft operational area for the life of the operation. All equipment would be contained within the 80 ft by 80 ft area. Any area within the 80 ft by 80 ft operating area that falls outside of concrete pad footprints would feature a gravel base and be fenced with a 4-strand wire fence with access gates as per BLM stipulations.

The working area would contain various electrical cabinets for instrumentation, motor control/variable frequency drive, and power transformation/distribution mounted on concrete pads. Manifold piping inclusive of various vents, valves, sample ports, and instrumentation would be connected from the well to the distribution piping via flanged fittings to facilitate future maintenance.

The operational area would also include telemetry and distributed control system equipment to transfer data and allow remote operation of the well site. The telemetry system is anticipated to consist of a radio-based network that would tie into the existing HB Solar Solution Mine telemetry system and would require small antennas at each of the well heads. Key control and instrumentation would include manifold and pipeline pressure monitoring, injection and extraction flow rates, mine flood level elevations, site security features, and various power parameters such as voltage, amperage, pump speed, etc.

The immediate area containing the extraction or injection well, the well head piping manifold, and the electrical cabinetry would be surrounded by a shaded, chain link fence with locking gates. Power would be brought to the site via overhead service terminating adjacent to the operating area. Power would be transformed to three phase 480 volt and then run underground to electrical transforming cabinetry within the operating area and distributed to various components within the operating area.

Access, Piping and Roads

All new pipelines would be constructed with high density polyethylene (HDPE) Type PE 4710 pipe. The designed flow rates and maximum operating pressures determine the Standard Dimension Ratio (SDR), which is the ratio of pipe diameter to wall thickness for the pipe, to be selected for each pipeline. The lower the SDR, the higher the maximum operating pressure rating.

Injection brine would be transported from the northern extent of the existing HB Solar Solution Mine main trunk injection line to injection wells IP-301 and IP-303 (see Figure EA-2). Injection pipelines would be designed to convey up to 3,000 gpm within the pipelines rated operating pressure of 250 pounds per square inch (psi) for SDR-9 pipe. The injection pipelines would be constructed with extrusion welded and/or flanged 18-inch diameter Standard Dimension Ratio (SDR)-9 HDPE pipe PE 4710.

The pipeline would be equipped with manual isolation valving, vent and vacuum relief valves, and pressure monitoring points as needed to monitor brine flow, as part of the leak detection system. All injection lines would be buried with a minimum of 2 ft of fill over the pipe. During construction open trenches would be limited to ½ mile in length or escape ramps would be installed every ¼ mile. Once backfilled, a 6-inch to 12-inch mound would be left over the pipeline to allow for settlement. Blinded wyes would be installed approximately every 1,500 ft to provide access for maintenance. All pipeline access points for instrumentation, monitoring or control would be within vaults or small areas of pipeline surface exposure.

The injection line would cross State Trunk Highway (STH) 360 at one new location as shown in Figure EA-2. The STH 360 crossings would be facilitated by boring and jacking beneath the highway as described in Section 2.4.2.1 of the HB EIS. A New Mexico Department of Transportation (NMDOT) permit would be obtained for these crossings. The ROW area of construction disturbance would be 50-ft wide. Within the 50-ft ROW containing the buried pipeline, a 12-ft wide access road would be established to allow the pipeline to be inspected on a regular basis. The access road would also provide access for maintenance and routine monitoring of the instrumentation. **Figure EA-5 – *Typical Pipeline ROW Section*** illustrates the pipeline footprint. Upon completion of pipeline and access road construction all disturbance within the 50-ft ROW would be seeded, fertilized, and mulched as per BLM requirements and Conditions of Approval.

The brine extraction pipeline and associated dilution water line would be extended from the existing HB Solar Solution Mine pipeline network to each HB AMAX extraction well as detailed in Section 2.4.2.1 of the HB EIS. The extraction and dilution lines would be buried together for their entire length. The pipeline bundle would cross STH 360 at the location (see Figure EA-2) of the existing HB Solar Solution Mine injection line crossing in Section 33 to minimize disturbance areas.

The extraction pipeline has been designed to convey up to 2,000 gpm within the pipelines rated operating pressure of 200 PSI for SDR-11. The extraction line would consist of 12-inch and 16-inch diameter, SDR-11 HDPE pipe. The dilution line would be composed of 4-inch and 6-inch diameter SDR-9 HDPE pipe and has been designed to operate at a pressure of 250 PSI. The new pipelines installed as part of the proposed HB AMAX Solution Mine Extension Project would be buried with a minimum 2 ft of cover.

The pipeline leak detection system consists of routine inspections by Intrepid personnel to observe for potential pipeline leaks and monitoring with automated instrumentation to minimize the potential for unauthorized discharges of the transported brine.

Booster Pump Station

Hydraulic analysis of the proposed HB AMAX injection pipelines indicates that a booster pump station would be required to achieve maximum desired flow rates within designed operating of the pipeline. Accordingly, a booster pump station is proposed to be installed where the new HB AMAX injection line connects to the existing HB Solar Solution Mine injection main trunk line. **Figure EA-6 – *Booster Pump System Detail*** illustrates the booster pump station location.

The pump station would require a graded footprint of 130 ft by 100 ft and would contain a primary pump, standby/back-up pump, a building to house the pumps, power transformation, and motor controls. The site would also include instrumentation, data acquisition, and automated controls connected by radio repeater to the adjacent HB Solar Solution Mine well facilities which would be routed to the HB control center.

The booster pump station is estimated to require 350 HP driven operations. Power would be supplied by the existing overhead power line to well IP-016. The booster station would be fenced with a 4-strand wire fence and access gates would be installed along the access pipeline roadway per BLM requirements. Figure EA-6 shows the booster station location, configuration, and how the maintenance access road would be constructed and maintained.

Power Distribution

Power would be required at each of the four well sites and the booster pump station. Overhead power has been previously supplied to existing extraction well IP-016 by Xcel Energy. The same line that distributes power to IP-016 is routed immediately adjacent to the proposed booster station location. It is anticipated that Xcel Energy would be able to modify the existing power service to support the requirements at the booster station and the only new infrastructure required may be an additional pole and associated underground service from the pole to the booster station.

Central Valley Electric Cooperative (CVEC) operates an existing power line ROW located between Sections 4/5 and Sections 8 /9, T19S, R30E. New overhead power service is expected to proceed north from this existing ROW approximately ¼ mile to IP-303 along the proposed pipeline alignment and south from this existing ROW approximately ¾ mile to the south to IP-301. CVEC also operates an overhead power line in the middle of Section 11, T19S, R30E and another power ROW running immediately adjacent to IP-304. It is anticipated that the ROW adjacent in Section 11 would be extended approximately ¾ mile west to IP-302 and that the ROW to IP-304 would provide power directly to IP-304. Since the proposed power distribution is a connected action of the HB AMAX Solution Mine Extension Project, the environmental analysis for the proposed power distribution is contained in this EA.

Figure EA-5 illustrates the power ROWs and assumed distribution routes. The referenced power supply logistics above would be verified with Xcel Energy and CVEC.

2.2.3. Final Restoration and Reclamation

Construction and mitigation measures for the proposed project components would be the same as those as described in the HB In-situ Solution Mine Project documents, including:

- HB In-situ Project Mine Operations and Closure Plan, Revised March 9, 2012
- HB In-situ Project FEIS, January 2012
- HB Pipeline Right-of-Way Grant, Serial Number NM-121815, April 11, 2012
- HB In-Situ Solution Mine Project ROD, March 19, 2012

Restoration, reclamation, and financial assurance quantification of all HB Solar Solution Mine components used separately or in conjunction with the proposed HB AMAX Solution Mine Extension Project are specifically addressed in the NMED Discharge Permit Mine DP-1681 Modification submittal Discharge Permit Renewal Modification Request - HB Solar Solution Mine NMED DP-1681 – HB AMAX Extension dated February 12, 2015.

2.3. No Action

The No Action Alternative would deny the approval of the proposed project and would not grant permission for Intrepid to access public lands in order to solution mine federal potash and associated minerals. Current land and resource used would continue under current conditions in the project area. As a result, BLM would not realize royalties from the extraction of federal potash from the proposed HB AMAX Solution Mine Extension Project. Also, a large erosional feature near IP-302 would not be stabilized and would continue to deteriorate.

2.4. Alternative Analyzed in Detail

Intrepid developed an alternative pipeline layout with the goal of keeping the injection and extraction pipelines in the same ROW for as long as practicable to minimize environmental impacts. The drill pads, booster pump station, and power routes would remain as discussed in Proposed Action Section 2.1.

Map EA-4 - *Disturbance Areas along Proposed and Alternative Pipeline Routes* illustrates the proposed pipeline and alternative pipeline options and the locations of designated disturbed, undisturbed, and adjacent areas. The impact categories are defined as follows:

- Disturbed – pipeline would be within previously disturbed area (i.e., abandoned railroad grade)
- Undisturbed – pipeline would be located within an area that has not been previously disturbed

- Adjacent Area – pipeline would be located adjacent to a previously disturbed area which would consolidate the disturbance into one area or corridor. This is accounted for in this EA as a new disturbance on a previously undisturbed area.

The alternative pipeline option would utilize one trench to transport both the injection and extraction pipeline along the abandoned railroad grade to where the extraction and injection pipeline would split trenches in Section 15, T19S, R30E. The construction details and methods would be the same for the proposed pipeline option and the alternative pipeline option. The pipeline trench disturbance acreage for both pipeline options is represented in **Table 2.3-1 – *Pipeline Disturbance Acreage During Construction***.

Table 2.3-1 Pipeline Disturbance Acreage During Construction

Alternative Pipeline Option	
Description	**Acres**
Disturbed Area (Non-Fee Area) Disturbed Area (Fee)	36.2 7.0
Undisturbed Area (Non-Fee Area) Undisturbed Area (Fee)	26.0 0
Total Acreage	**69.2**
Proposed Pipeline Option	
Description	**Acres**
Disturbed Area (Non-Fee Area) Disturbed Area (Fee)	33.7 0
Immediately Adjacent to Disturbed Area	27.6
Undisturbed Area (Non-Fee Area) Undisturbed Area (Fee)	17.3 0
Total Acreage	**78.5**
Total Length of Alternative Pipeline	111,100 linear ft.
Total Length of Proposed Pipeline	104,600 linear ft.

Note: Total pipeline length numbers are rounded to nearest 100 ft.

The alternative pipeline would utilize approximately 9.3 fewer acres than the proposed pipeline option, but would increase the total length of the pipeline by approximately 6,500 linear ft. The alternative pipeline option would run through 7.0 acres (of total ROW area) of private fee land. The proposed option would run through no private fee land.

3. ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

The No Action Alternative reflects the current situation within the project area and will serve as the baseline for comparing the environmental impacts of the analyzed alternatives.

During the analysis process, the interdisciplinary team considered several resources and supplemental authorities. The interdisciplinary team determined that the resources discussed below would be affected by the proposed action.

3.1. Geology and Minerals

3.1.1. Affected Environment

Site Geology

The following section discusses pertinent geology at the project site starting with a brief introduction to the regional geologic setting, focusing on mineral resources, karst, subsidence, and paleontology.

Regional Geologic Setting

The regional geologic setting at the AMAX Mine is nearly identical to the geologic setting discussed in Section 3.2 of the HB EIS. The HB Solar Solution Mine and the HB AMAX Solution Mine Extension Project occurs at the northern edge of the Delaware Basin, extending north toward the Northwest Shelf (**Map EA-5 – *Major Geologic Structural Elements***). The AMAX Mine is located closer to the basin edge (Northwest Shelf) than the HB Solar Solution Mine. Sedimentary deposits in the Delaware Basin are up to 30,000 ft thick and range in age from Cambrian to the Quaternary (Section 3.2.1 of the HB EIS, BLM 2012).

The Delaware basin is bound on four sides by topographic highs. The Northwest Shelf forms a northern boundary, the Central Basin Platform is to the east, the Glass and Apache Mountains are to the south, and the Diablo Platform and Guadalupe Mountains are to the west (Montgomery et al. 1999).
Locally, the structure can be controlled by salt flowage and dissolution. The plasticity of salt results in a flowage response to stress; this flowage can deform adjacent strata. Dissolution of evaporites and carbonates creates cavities with the potential for collapse of overlying strata; on a local scale these collapse features can dominate the geologic structure (Section 3.2.1.3 of the HB EIS, BLM 2012).

Stratigraphy at Project Site

A generalized stratigraphic column showing the geologic sequence in the northern Delaware Basin is shown in **Figure EA-7 – *Delaware Basin Stratigraphic Column*.** The depositional environments within this sequence reflect changes in the Delaware Sea water level and include continental, shallow marine, shelf, and basin. The sedimentary basin is underlain by Precambrian basement that includes granitic, meta-sedimentary and some volcanic rocks (Section 3.2.1.2 of the HB EIS, BLM 2012).

The potash mineral zone of interest for the HB Solar Solution Mine and the HB AMAX Solution Mine Extension Project is in late Permian Ochoan Series. This geologic discussion includes the formation directly underlying the ore zone and all overlying formations. A generalized cross section for the Delaware Basin is shown in **Figure EA-8 – *Representative Cross Section*.** The AMAX Mine is in the transition zone between the reef and the Northwestern Shelf.

The following sections outline the major geologic units at the project site. They have been divided by age and are presented from the older Permian units to the younger Quaternary units. Additional information on these units can be found in Section 3.2.1.3 of the HB EIS (BLM 2012).

Permian Rocks

Guadalupian Series

The upper Guadalupian Series has several time-equivalent members that vary based on the depositional environment. The Bell Canyon Formation is a sandstone, siltstone, limestone that was deposited in the deep basin beyond the reef (NPS 2008). The Capitan Limestone Formation is a reef complex that formed during the Permian and outlines the margin of the Delaware Basin (Standen et al. 2009). The sandstone, siltstone, and dolomite of the Yates and Tansill Formations were deposited in the back reef depositional environment (NPS 2008). Generalized stratigraphic columns showing the deep basin, reef, and back reef for the Delaware Basin can be seen in **Table 3.1-1 – *Upper Guadalupian-Ochoan Stratigraphy in the Project Area, after BLM (2012)***; geology at the HB Solar Solution Mine and the HB AMAX Solution Mine Extension Project would be most similar to the "Shelf-Back Reef" column. The Figure EA-8 cross section shows the transition from the deep Delaware Basin to the Northwest Shelf.

Table 3.1-1 Upper Guadalupian-Ochoan Stratigraphy in the Project Area, after BLM (2012)

		South	Project Area	North	**Approximate Thickness in Project Area (feet)**
		Delaware Basin		**Northwest Shelf**	
System	**Series**	**Basin**	**Basin Margin – Reef**	**Shelf – Back Reef**	
Permian	Ochoan	Dewey Lake Red Beds	Dewey Lake Red Beds	Dewey Lake Red Beds	Up to 250
		Rustler Formation	Rustler Formation	Rustler Formation	Up to 350
		Salado Formation	Salado Formation	Salado Formation	150 to 1,000
		Castile Formation	Castile Formation	No equivalent	10 to 80
	Guadalupian	Bell Canyon Formation	Capitan Limestone	Tansill Formation	1,500
				Yates Formation	
				Seven Rivers	

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Approved By: BAL3

Castile Formation

The Castile Formation is a predominantly anhydrite sequence with minor occurrences of limestone and halite (NPS 2008). The Castile Formation is thick in the deep basin, thins toward the reef, and is mostly absent in the back reef (Figure EA-8). If present within the proposed project area, the Castile Formation would only be a thin unit between the Guadalupian Series and the overlying Salado Formation.

Salado Formation

The Salado Formation of the Ochoan Series directly overlies the Guadalupian Series. The Salado Formation is a thick, predominantly evaporite deposit containing the McNutt Potash Member of interest. This formation is 1000 ft thick at the mine site and dominated by halite with minor zones of siltstone, sandstone, anhydrite, gypsum, and potash minerals. The important economic potassium minerals in the McNutt Member are sylvite (KCl) and langbeinite ($K_2Mg_2(SO_4)_3$) (Lambert 1983).

Rustler Formation
The Rustler Formation overlies the Salado Formation and contains anhydrite, dolomite, siltstone, sandstone, and gypsum units. Members of the Rustler Formation from oldest to youngest are Los Medaños, Culebra Dolomite, Tamarisk, Magenta Dolomite, and Forty-Niner (Intrepid/Shaw 2008a).

The Los Medaños Member is composed of siltstone, gypsum, and fine-grained sandstone layers. The Culebra Dolomite is a thinly bedded, crystalline dolomite. The Tamarisk member is a massive anhydrite unit with minor halite and siltstone layers; when exposed in outcrops the Tamarisk weathers to gypsum. The Magenta dolomite is a pink, red, and purple dolomite. The Forty-Niner Formation has layers of gypsum, anhydrite, siltstone, shale, and clay (Section 3.2.1.3 of the HB EIS, BLM 2012).

Dewey Lake Formation/Quartermaster Formation
The Dewey Lake Red Beds, also referred to as the Quartermaster Formation, mark the end of marine incursions into the basin and the beginning of continental deposition. This formation contains reddish-orange siltstone with some sandstone and clay layers (Vine 1963). The top of the Dewey Lake Formation is an erosional surface dividing the Permian from the overlying Triassic rocks (Lambert 1983).

Triassic Rocks

Triassic strata in the project area include the Santa Rosa Formation (Tecolotito, Los Esteros, and Tres Lagunas Members) with limited occurrence of the Upper Chinle Group (Garita, Trujillo, Bull Canyon, and Redonda Formations). The Santa Rosa Formation is an orange, red, yellow, purple, and grey sandstone with interbedded siltstones and occasional calcareous units. The Upper Chinle Group is a mix of mudstone, siltstone, and sandstone dominated sequences (Lucas et al. 2001).

Cenozoic Rocks

Several Cenozoic units are present at the HB Solar Solution Mine and the HB AMAX Solution Mine Extension Project site. These units are generally not as widespread as the underlying strata. The Gatuña Formation is a late Cenozoic, poorly consolidated alluvial formation in the ancestral Pecos River valley (Lambert 1983). This formation is dominated by sand and locally contains mudstone, conglomerate, limestone, gray shale and gypsum (Kelley 1980). Near Carlsbad the Gatuña is typically buried by more recent floodplain, terrace, caliche or aeolian deposits (Kelley 1980) including the Mescalero Caliche and unconsolidated materials. The Mescalero Caliche is a dense to traventine-like limestone with intermixed sand grains (Vine 1963) Unconsolidated Quaternary material includes alluvial, eolian, and lacustrine deposits.

Surficial Geology

The surficial geology within the project boundary is shown in **Map EA-6 - *Surficial Geology Map***. It includes outcrops of the Rustler Formation, Quartermaster Formation (Dewey Lake Formation), Upper Chinle Group, and unconsolidated quaternary deposits. The Rustler and Quartermaster Formations outcrop along the edges of the project site. The Upper Chinle Group is exposed at the center of the project site. The remainder of the project site is mapped as unconsolidated quaternary deposits.

Mineral Resources

Potash
The history of potash mining was discussed in detail in Section 3.2.2.1 of the HB EIS (BLM 2012). Potash was discovered in Eddy County, New Mexico in 1925 during oil and gas exploration. The federal government designated the SPA in 1939 (BLM 2014c). Mining has occurred in the McNutt potash zone of the Salado Formation and this zone contains the potash minerals of interest to this project. There are 11 ore zones in the McNutt potash zone (Barker and Austin 1993). Today, two companies, Intrepid and Mosaic, operate underground potash mines in the SPA (USGS 2009). Intrepid operates the only solution mine in the SPA.

Conventional mining in the SPA is done by sinking shafts from the land surface to the mineral zone of interest and excavating ore using a room and pillar method. Large pillars of ore are left in the mine for support of the overlying strata. Once excavated, the ore is transported to the land surface and refined. The room and pillar method leaves behind ore in the pillars, walls and floors (Section 3.2.2.1 of the HB EIS, BLM 2012).

Recently, solution mining has been used in idled potash mines as a means of recovering ore that was unrecoverable using conventional mining methods. The HB Solar Solution Mine uses this method, and approval of the HB AMAX Solution Mine Extension Project would provide access to more mine workings for flooding and extraction. During solution mining, the idled underground mine workings are flooded with injectate brine. The remaining ore is selectively dissolved into the brine and the resulting pregnant brine is pumped out of the mine using extraction wells.

<u>Oil and Gas</u>
The history of oil and gas development in the Delaware Basin was discussed in detail in Section 3.2.2.2 of the HB EIS (BLM 2012). The Delaware Basin is part of the prolific Permian Basin oil and gas reserves. As of 2000, oil plays in the New Mexico portion of the Permian Basin have produced 4.5 billion barrels of oil; most of this production has occurred on the Northwest Shelf and Central Platform (Broadhead et al. 2004).

Production and exploration are ongoing. Untapped oil and gas resources from known existing plays in the SPA are estimated at 468 million barrels of oil and 5.5 trillion cubic ft of natural gas (Balch et al. 2011). Target formations for commercially producible hydrocarbons in the SPA include the Pennsylvanian (Morrow, Atoka, and Strawn Formations) and Permian (Delaware Mountain Group, Bone Spring Formation, Wolfcamp Group, Queen Formation, Grayburg, Formation, Seven Rivers Formation, and Yates Formation) (Walsh 2006). Petroleum targets are below the McNutt potash zone of the Salado Formation. The Delaware Mountain Group is the shallowest petroleum target. When present, the Castile Formation separates the Delaware Mountain Group from the potash bearing Salado Formation.

Relevant policies addressing potential conflicts between the production of oil and gas and the extraction of potash were discussed in Section 3.2.2.3 of the HB EIS (BLM 2012).

The area around the HB Solar Solution Mine and HB AMAX Solution Mine Extension Project has been involved with historical petroleum exploration and development since the 1930s. As such, active and inactive oil wells within the proposed project area have been researched and documented. There are 67 oil and gas wells within the project boundary, including abandoned and active wells, which are shown in **Map EA-7 - *Oil and Gas Wells***. Of these 67 wells, three wells are within the proposed flood zone in the AMAX Mine working, two wells are less than 100 ft from the flood zone, and one well is within 1,000 ft from the flood zone.

The six wells within or near the flood zone are summarized in **Table 3.1-2 – *Abandoned Oil Wells Within the AMAX Mine Flood Workings***. All six of these wells have been plugged, as of April 2015, using BLM approved plugging practices. (Intrepid Potash Inc./Foth 2015). Intrepid plugged wells 30015045970000, 30015045990000, and 30015046000000 in 2015.

<u>Other Minerals</u>
Other minerals being mined in Eddy County, New Mexico include sand and gravel, crushed stone, salt, and sulfur (USGS 2009).

Table 3.1-2 Abandoned Oil Wells Within the AMAX Mine Flood Workings

API/UWI	Operator	Name	Status	TD	Spud Date	Completed	Plug Date	Distance from Flood Zone	Location (Township – Range – Section)
30015045900000[1]	Baird, O J	Cannon	Plugged[2]	3,205	9/19/1938	3/19/1939	7/29/1940	Within	T19S – R30E – Sec. 4
30015045900001[1]	Elliott, James	Cannon	Plugged[2]	3,660	7/15/1939		7/29/1940	Within	T19S – R30E – Sec. 4
30015045950000	Yates, Harvey	Foard	Plugged	2,990	10/26/1943	1943	1/10/1944	Within	T19S – R30E – Sec. 10
30015045980000	Southwestern Inc.	Southern Cal-Fed	Plugged	2,203	8/22/1960	9/9/1960	2/26/1961	690 ft	T19S – R30E – Sec. 13
30015045970000	Culbertson, E A & WW	Federal 13	Plugged[3]	2,216	10/25/1960	11/13/1960	2015	Within	T19S – R30E – Sec. 13
30015045990000	Culbertson, E A & WW	Federal 13	Plugged[3]	2,321	2/2/1961	2/20/1961	2015	83 ft	T19S – R30E – Sec. 13
30015046000000	Southwestern Inc.	Southern Cal-Fed	Plugged[3]	2,181	5/15/1960	6/2/1960	2015	20 ft	T19S – R30E – Sec. 14

Notes:

[1] Wells 30015045900000 and 30015045900001 are the same well head; the latter was a deepening of the initial well.
[2] Plugged based on BLM Memorandum (dated February 24, 1941) and field verification of dry abandonment well marker
[3] Plugged by Intrepid in 2015. Plugging was approved by the BLM.
API: American Petroleum Institute
TD: Total Depth
UWI: Unique Well Identification

Prepared by: NMG1
Checked By: BAL3

Subsidence

Subsidence is the gradual settling or sudden sinking of the ground surface resulting from extraction, dissolution, or consolidation of subsurface materials. Subsidence can be natural or anthropogenic in origin. Karst is a natural landscape shaped by the dissolution of carbonate and evaporite bedrock. Caves and sinkholes are two common karst features. Human activities that can contribute to or cause subsidence include underground mining, the withdrawal of subsurface fluids, and the addition of weight, such as roads and buildings, to the land surface (CGS Undated).

Cave and Karst

Karst topography, resulting mostly from the dissolution of carbonates and evaporites, is widespread in the Delaware Basin. Dissolution is common in the Capitan Limestone and in the evaporite deposits. Karst terrain is expressed as a rolling landscape caused by slow dissolution and may have collapse sinkholes from sudden failure of the ground surface into an underground cavity (Hill 2000). Karst features explain the numerous closed basin watersheds found in the project area.

Karst allows for rapid recharge of aquifers and transmission of groundwater. Groundwater causes continued dissolution of soluble rock and expansion of karst features. Water is also critical to the highly specialized cave-dwelling animals that may inhabit caves (Section 3.2.3.1 of the HB EIS, BLM 2012)

More than 60 caves and karst features within the project boundary have been identified from the BLM karst dataset (Goodbar 2015). The BLM also has a cave/karst potential rating system. **Map EA-8 - *Karst Occurrence Potential*** shows the distribution of karst potential within the proposed project boundary. The majority, 92.5 percent (%) of the project area is rated as having high karst potential. The rest of the project area, 7.5%, has a medium karst potential rating.

Anthropogenic Subsidence

In the Delaware Basin, anthropogenic subsidence is mainly caused by potash mining and fluid extraction of petroleum products and water.

Potash Mining

Mining subsidence occurs when the rock and soil around a mined cavity deform in an effort to reach a new equilibrium position. In room and pillar mining, rooms are void spaces where ore has been removed and pillars are the remaining ore that is left in place to prevent closure. Subsidence within the mine can occur when overlying or adjacent materials deform in toward the mine rooms. On the land surface this deformation can manifest as surface cracking, ground deformation, and the modification of surface water drainages. The aerial extent of subsidence often extends beyond the mine workings and is controlled by the angle of influence (Section 3.2.3.1 of the HB EIS, BLM 2012).

Solution Halite Mining

Brine wells are used to solution mine halite in the Delaware Basin. Freshwater is pumped into the brine well and then brine is pumped out. The extracted brine is used for oil and gas development. This extraction method has the potential to cause rapid subsidence; two such collapse sinkholes occurred in 2008 near brine wells located outside of Carlsbad, New Mexico (Oil Conservation District 2011).

Subsidence Related to Oil and Gas Extraction

Subsidence from petroleum extraction can result from dissolution of salt either by drilling fluids during construction of the well or by formation fluids moving along a poorly cemented casing. Without adequate cement the annular space between the casing and borehole wall can act as a preferential pathway for formation water to move up and down the borehole. This pathway could transport groundwater to an evaporite zone, resulting in dissolution and subsequent subsidence (Section 3.2.3.1 of the HB EIS, BLM 2012). Petroleum wells in the Permian Basin were cased, but not necessarily cemented, until the 1930s; cement was not required in the salt formations until the 1950s and early cement techniques were often poor (Giroux et al. 1988). Cementing methodology has improved with time. Current well construction requires cement throughout the whole salt interval, greatly reducing the potential for salt dissolution in modern oil and gas wells. However, even in properly cemented wells, the brines can deteriorate the cement and compromise the seal (Section 3.2.3.1 of the HB EIS, BLM 2012). The extraction of fluids can also cause subsidence from the collapse of pore spaces and reorganization of the rock matrix.

Paleontology

Scientifically important paleontological resources are federally protected under the Antiquities Act of 1906, the Archaeological and Paleontological Salvage Act, and the National Registry of Natural Landmarks (BLM 2012). In addition to internal guidelines on managing paleontological resources, the BLM has identified following applicable statues and regulations (BLM Undated):

- FLPMA of 1976
- NEPA of 1969
- BLM regulations in Title 43 CFR addressing invertebrate and plant fossils
- The Paleontological Resources Preservation Act of March 2009
- 43 CFR Subpart 3622 – Free Use of Petrified Wood

The BLM has adopted a Potential Fossil Yield Classification (PFYC) as a quick reference for assessing possible fossil resources on BLM land (BLM 2007a). This classification system uses the surficial geology as a predictor for fossil potential. The purpose of this classification system is to serve as a guideline for determining the need for further mitigation or actions. The classification system has five classes (1-5); Class 1 has a low potential for scientifically important fossils while Class 5 has a high potential. Each class includes an associated response.

The surficial geology and associated paleontological classes within the project boundary are summarized in **Table 3.1-3 – *Potential Fossil Yield Classes for Surficial Geologic Units in the Project Boundary*** and shown in **Map EA-9 - *Paleontology Map***. **Table 3.1-4 – *Total Area of each Potential Fossil Yield Class in the Project Boundary*** tabulates the acres for each PFYC in the project boundary.

Table 3.1-3 Potential Fossil Yield Classes for Surficial Geologic Units in the Project Boundary

Surficial Geologic Unit	Description of Paleontological Resources[1]	Fossil Potential Class from PFYC
Alluvial and Eolian Deposits	Because such deposits are younger than 10,000 years old, there would be a low potential for fossils.	Class 2 – Low potential for vertebrate fossils or scientifically important nonvertebrate fossils.
Cave Deposits (possible)	Cave deposits (Pleistocene to recent) can host a variety of vertebrate fossils	Class 4 – High potential for scientifically important fossils
Rustler Formation	Fossils in the Rustler Formation are scarce; there are mollusk fossils in the Culebra Member of the Rustler Formation	Class 2/3 – Low/Moderate potential for scientifically important fossils. Class 3 is only applicable to the Culebra Member. The remaining members of the formation would be considered Class 2.
Quartermaster (Dewey Lake Red Beds)	No fossils identified in the literature.	Class 2 – Low potential for scientifically important fossils
Upper Chinle Group	Vertebrate fossils, tetrapod footprints, and megafossils plants have been found in these formations (Lucas et al. 2001).	Class 4 – High potential for scientifically important fossils

Notes:
[1] The description of fossil resources came from Section 3.2.4.2 of the HB EIS (BLM 2012), unless otherwise specified.

Prepared By: MJH5
Checked By: BAL3

Table 3.1-4 Total Area of each Potential Fossil Yield Class in the Project Boundary

PYFC	Acres	Percentage of Total Area
Class 2	10,149	55%
Class 2/3	6,270	34%
Class 4	1,928	11%
Total	**18,347**	**100%**

Notes:
1. Areas were calculated in ArcGIS using the surficial geology layer provided by the BLM.
2. Areas were rounded up to the nearest tenth of an acre.

Prepared By: MJH5
Checked By: BAL3

An outcrop survey was conducted on February 1, 2015 by a licensed paleontology contractor at Zeigler Geologic Consulting, LLC. The purpose of this survey was to look for potential fossil resources that may be impacted during ground disturbing activities related to the proposed project. The survey covered a 150-ft corridor on either side of the pipeline centerline stake and all well pads. No fossil material PFYC Classes 3 or 4 was found. The majority of outcrop and subcrop through these areas was gypsiferous, which would not preserve invertebrate or vertebrate fossil material. There is a low siltstone and sandstone bluff leading to well pad IP-304 that could contain fossil material.

3.1.2. Impacts from the No Action Alternative

Direct and Indirect Impacts

Mineral Resources

Under the No Action Alternative the remaining potash resources in the AMAX Mine would not be recovered. This would result in a loss of recoverable resource, revenues, taxes, and royalties. The resource is inaccessible under conventional mining techniques and would remain unmined unless some other practical method could be found to extract the resource safely.

Impacts to petroleum development would be identical under the No Action Alternative. The location of new wells would continue to be limited by a designated buffer zone around the existing AMAX Mine workings, regardless of whether or not solution mining occurs. Such a buffer zone is defined and discussed in 2012 Secretary’s Order. Impacts from poorly cased oil and gas wells and improperly abandoned wells would not affect potash mining if solution mining did not occur.

Karst Resources

Karst resources would not be affected under the No Action Alternative. Karst features that are actively forming would continue to do so, unless hydrologic conditions become unfavorable. Caves may be subject to degradation by entry of unpermitted spelunkers. Unpermitted entries are expected to be infrequent with BLM maintenance of cave lists and caves locations not accessible to the general public. Fluid and solid mineral extraction activities would likely continue in the vicinity and would be regulated by the BLM to reduce impacts to karst.

Subsidence

Under the No Action Alternative subsidence would continue to pose a risk to surface resources. Naturally occurring evaporite karst features would continue to develop and existing features would be a risk for surface infrastructure. Subsidence from conventional underground mining at the AMAX Mine may continue indefinitely. Both historic data and anecdotal evidence suggest that for southeastern New Mexico potash mines, the majority of subsidence occurs within 5 to 7 years after completion of second mining of the ore pillars (Section 4.2.5.1 of the HB EIS, BLM 2012). Underground mining at the AMAX

Mine ended in 1993; the majority of subsidence for the HB AMAX Solution Mine Extension Project has likely already occurred with minor subsidence ongoing as a new equilibrium is achieved underground. The salt creep process is likely ongoing.

Paleontology

Under the No Action Alternative there would be no potential fossil damage from burying the pipeline and from the construction of well pads. Unauthorized collection of fossils could still occur.

3.1.3. Impacts from the Proposed Action

Direct and Indirect Impacts

Mineral Resources

Regarding impacts to mineral resources, the Proposed Action has the beneficial impact of additional ore recovery. There are no mineral resource impacts specifically related to the construction phase of the Proposed Action.

The Proposed Action utilizes an existing underground mine that is already a restricted area for new oil and gas development. As such, there would be no change to access for oil and gas development and exploration. New oil and gas wells must maintain a buffer from the open mine workings, as defined and discussed in the 2012 Secretary's Order. All wells in or near the flood zone are plugged and abandoned using BLM approved plugging methods (Table 3.1-2). The closest oil or gas well that is not abandoned is UWI 30015355250000, located 1,521 ft north of the flood zone.

The Proposed Action could impact the nearby HB North Mine if a connection formed where the mine workings are within proximity to the AMAX Mine workings between Sections 16 and 21 and 21 and 22 See, **Map EA-10 - *Structure on the Base of First Ore Zone***. The potential for accidental flooding of the HB North Mine is reduced by structural and mechanical controls on the flooding process. Locally, the ore structure forms a syncline with a southwest – northeast axis running down the approximate middle of the AMAX Mine ore bodies. The syncline axis represents a structural control which, if not over-topped, would prevent brines from migrating south into the adjacent HB North Mine. The maximum flood elevation would be set at 2,500 ft above mean sea level (amsl); the lowest elevation where a potential connection could develop is around 2,550 ft amsl. To avoid and minimize the potential for an unplanned flood, monitoring is discussed in the mitigation section below.

Based on the structural geometry brine cannot spill into the HB North workings as long as the flood elevation is not exceeded. In the unlikely event that brine from the AMAX Mine did enter the HB North Mine, the fluid would eventually find its way to the HB North extraction wells and be controlled via the existing HB Solar Solution Mine system.

Karst Resources

The primary direct impacts to cave/karst resources under the Proposed Action include disturbance during pipeline burial, power line installation, and well pad construction. The pipeline route and power line corridors for the Proposed Action have at least a 200 meter buffer around all known cave features identified by the BLM. Ground disturbing activities during the construction phase still have the potential to damage unknown karst features.

Other potential adverse impacts to caves and karst features from construction include the following:

- New access roads in the project area could increase the opportunity for public entry and disturbance or damage to cave resources.

- Drill holes for the injection and extraction wells may intersect an undocumented cave/karst feature, allowing drilling fluids and mud to enter the cavity. This could affect groundwater and dissolve evaporite strata. Such an incident could pose risks to groundwater quality, health and safety, roads, and structures.

- If construction and drilling operation occur over an undocumented cave/karst feature there is the potential to cause a collapse sinkhole. Such an event would impact the karst landscape, may injure personnel, and could damage equipment.

Karst impacts from pumping injectate make-up water out of the Rustler Formation were explored in detail in the EIS. Two groundwater models (Preferred and Enhanced) were developed to support Section 4.3 of the HB EIS and used to assess the potential impacts of drawdown on karst. More details on the design and applicability of these two models are provided in the Water Resources Section 3.2 of this EA.

Under the Proposed Action the groundwater pumping rates for the Rustler Aquifer wells would be the same those presented in the EIS but pumping duration would increase. Because the original groundwater models were run in steady state, a longer pumping duration would not change the drawdown prediction, as discussed in Section 3.2. The number of caves and acreage for each karst potential affected by groundwater pumping (**Table 3.1-5 – *Caves and Karst Features Affected by Groundwater Drawdown Under the Proposed Action***) were estimated for Section 4.2.6 of the HB EIS using the Preferred and Enhanced models.

Table 3.1-5 Caves and Karst Features Affected by Groundwater Drawdown Under the Proposed Action

Features Affected by Drawdown	Impacts (Preferred Groundwater Model)	Impacts (Enhanced Groundwater Model)
Known Caves (number)	18	38
High Cave/Karst Potential Area (acres)	10,977	23,961
Medium Cave/Karst Potential Area (acres)	2,949	5,832
Low Cave/Karst Potential Area (acres)	1,537	1,921

Notes:
1. All data are from the EIS (BLM 2012).
2. The number of caves and acres impacted were calculated by determining the quantity of caves and karst areas that would no longer have a groundwater table within 90 ft of the ground surface.

Prepared By: MJH5
Checked By: BAL3

Predicted karst impacts do not increase by adding the Proposed Action but the longer pumping duration may change the actual observed impacts to caves and karst, depending on if and when steady state is reached. It is unlikely impacts would ever exceed the total predicted impacts presented in the EIS because the groundwater model utilized a worst-case scenario and conservative assumptions. The original HB Solar Solution Mine EIS analyzed pumping for 28 years; the Proposed Action adds 14 additional years of pumping for a total of 42 years. If the steady state drawdown predicted by the groundwater models is reached before year 28, drawdown magnitude and extent would theoretically remain constant in perpetuity. At a constant drawdown, the additional impacts to caves and karst from extended pumping during years 28-42 is inconsequential; caves that were dry would continue to be dry and no new caves would go dry.

If maximum steady state drawdown was not reached by year 28, drawdown could continue to increase from years 28-42, up to the maximum drawdown predicted by the groundwater models. In this scenario more caves and karst areas could continue to go dry from years 28-42, up to the maximum predicted number. Therefore, if drawdown has not reached steady state by year 28, additional caves could be adversely affected by the Proposed Action that would not have been affected under the HB Solar Solution Mine. These potential impacts were discussed and accounted for in the EIS. If drawdown were to exceed the steady state model predictions there would be additional habitat loss, beyond that predicted in the HB EIS, for the troglobitic species utilizing these cave habitats. To avoid and minimize the potential for these impacts, ongoing monitoring and adaptive management is discussed below in the mitigation section.

Subsidence

The Proposed Action has the potential to increase anthropogenic subsidence by solution mining the pillars in the AMAX Mine. The following paragraphs describe in detail how mining subsidence has occurred and may occur in the future for both traditional mining and solution mining.

Predicted Subsidence Effects Associated With Conventional Underground Mining

The surface effects from the collapse of room-and-pillar workings depend on the depth, width, and thickness of the minerals extracted, the extraction ratio, and the extent of area over which underground pillar failure takes place. The maximum subsidence cannot exceed the mined thickness (Van Sambeek 2008). Maximum subsidence depth is seldom observed, due to one or more of the following reasons (Section 4.2.5.1 of the HB EIS, BLM 2012):

- Subsidence spreads over an area that is larger than the mined area, so the depth of subsidence is proportionately less than the total mined area.
- Total closure of the mined area is rarely reached. Remaining voids reduce the amount of subsidence.
- The overlying rock strata expand slightly in volume due to breakage as the ground moves downward into the mined area, resulting in a “bulking” effect, which contributes to a reduction in total subsidence volume and depth.
- The subsidence process can be slow for rocks that creep and several hundred (or more) years may be required for complete subsidence to occur.

Historic data and anecdotal evidence suggest that for the southeastern New Mexico potash mines, the majority of subsidence occurs within 5 to 7 years after completion of second mining of the pillars (Intrepid Potash Inc./Shaw 2008b). Because potash and other salts can creep, minor subsidence may continue to occur over an extended period of time.

Historic data and observations of subsidence in the potash areas of southeast New Mexico have demonstrated that the relationship between the extent of vertical surface subsidence and the thickness of the mining horizon varies with the degree of extraction. For full extraction (100%) of the mineable zone, it is likely that the maximum surface subsidence would approach the thickness of the mined zone. This is due to evidence suggesting very little breakup and bulking during collapse of the overlying strata (Section 4.2.5.1 of the HB EIS, BLM 2012). For extraction of less than 100%, the expected subsidence can be assessed using the mine height and data from mines in the area.

The AMAX Mine targeted the 1st and 3rd Ore Zones with the majority of ore produced from the 1st Ore Zone. Due to variations in thickness of the overlying formations and the dip of the beds, the depth to the ore zones from the ground surface is variable. The 1st Ore Zone can occur from about 816 ft to 1,042 ft below the ground surface and the 3rd Ore Zone can occur from about 787 ft to 1,027 ft below the ground surface. At the AMAX Mine, the 1st Ore Zone was extracted with an average mine height of 5.6 ft; the average mine height for the 3rd Ore Zone was 4.8 ft (Intrepid Potash Inc./Foth 2015).

During the period when the AMAX Mine was operational, an estimated 69% of the 3rd Ore Zone reserve and 85% of the 1st Ore Zone reserve was extracted (Intrepid Potash Inc./Foth 2015). This extraction was accomplished through first and second mining. During first mining, removal of ore typically results in a corresponding decrease in the available cross-sectional area remaining to support the overlying rock and an increase in the magnitude of vertical stress on the ore in the remaining pillars. The increase in vertical stress is offset by the plastic nature of the salt (i.e., the salt adjusts for the change in stress through very slow, flow-like movements) and through redistribution of the stresses to the edges (the surrounding intact rock) of the mine workings. This pressure redistribution is referred to as “arch action” (Section 4.2.5.1 of the HB EIS, BLM 2012).

Second mining of pillars was typically accomplished by taking perpendicular cuts through the center of the pillars, leaving four corners of each pillar for support. The pillar remnants may be insufficient to support the overlying ground because the stress must be carried over a reduced cross-sectional area. Pillar failure usually occurs within about a month after “second” mining is completed (Intrepid Potash, Inc./Shaw 2008b). The residual corner pillars typically compress or crush due to the increased vertical stress from the overlying rock, eventually sloughing or spalling off at the midriff of the pillar to form an hour-glass shape. The sloughing and spalling action causes debris to accumulate on the floor surrounding the pillar. In the advanced stages of compressive action (as closure or full convergence of the mining void is approached), the roof may receive some support from the debris pile or underground backfilling from non-economic material within mined-out areas, ultimately delaying or precluding full convergence in a localized area of the mine (Section 4.2.5.1 of the HB EIS, BLM 2012).

Several subsidence studies were conducted in the late 1950s by United States Potash. Findings from these studies suggest that first mining ore removal had the potential to influence the surface at about 20% of the mined height, with second mining contributing an additional 50% of the mined height (Intrepid Potash, Inc./Shaw 2008c). Thus, the total surface expression of subsidence due to conventional first and second mining at the AMAX Mine is estimated at:

- 3.9 ft of subsidence for the 1st Ore Zone, calculated as [0.2 x 5.6 ft]+[0.5 x 5.6 ft]
- 3.4 ft of subsidence for the 3rd Ore Zone, calculated as [0.2 x 4.8 ft]+[0.5 x 4.8 ft]
- 7.3 ft of subsidence in areas where the 1st and 3rd Ore Zones were both mined, calculated as [3.9 ft + 3.4 ft]

Predicted Subsidence Effects Associated With Proposed Solution Mining

Subsidence from solution mining is possible through removal of support material and expansion of the mine cavity. It is generally thought that solution mining does not drastically enlarge the mine cavity. Solution mining of potash ore at the former Texas Gulf Mine (now owned and operated by Intrepid) in Moab, Utah has shown no evidence of active dissolution occurring in ore beyond the original workings (Section 4.2.5.1 of the HB EIS, BLM 2012). The in-situ solution mining process would solubilize ore from exposed remnant pillars and debris piles, with a lesser contribution expected from wall and floor rock. Wall and floor rock typically define the transition or contact zone between the ore and surrounding host rock. Therefore, subsidence from solution mining would depend on the extent to which support material is removed. There is some control in the in situ process because the injectate is conditioned to selectively dissolve KCl through an ion exchange process. It is anticipated that a replacement lattice of NaCl would remain within the residual contact zone. Thus, the volume of NaCl precipitated correspondingly “reduces the potential for convergence and surface subsidence volume” (Van Sambeek 2008). The remaining NaCl in non-collapsed residual pillars or debris piles would not dissolve and would continue to provide support.

It was estimated for the HB solution mines that the in-situ process may cause surface subsidence equal to 10% of the overall mined height (Intrepid Potash Inc./Shaw 2008a). Applying this estimate to the AMAX Mine predicts a nominal 0.6 ft (1st Ore Zone) and 0.5 ft (3rd Ore Zone) of additional subsidence at the surface from solution mining. In areas where the mine working for the 3rd and 1st Ore Zones overlap, a combined maximum subsidence of 1.1 ft (0.6 ft + 0.5 ft) is possible. The predicted overall maximum surface subsidence expression, from both conventional and solution mining, is estimated as:

- 4.5 ft of subsidence for the 1st Ore Zone, calculated as [3.9 ft (conventional mining) + 0.6 ft (solution mining)]

- 3.9 ft of subsidence for the 3rd Ore Zone, calculated as [3.4 ft (conventional mining) + 0.5 ft (solution mining)]

- 8.4 ft of subsidence in areas where the 1st and 3rd Ore Zones were both mined, calculated as [3.9 ft + 4.5 ft]

In addition to subsidence impacts resulting from the conventional and solution mining, the additional weight from construction equipment could contribute to rapid collapse of unknown existing shallow subsurface cavities.

Impacts from Subsidence

Much of the subsidence due to conventional mining has likely occurred already. Due to the widespread areal distribution of the proposed in-situ process throughout the project area, the additional 0.5 – 1.1 ft of subsidence from solution mining would likely manifest itself very gradually over a number of years. It is anticipated that such gradual deformation would result in the development of wide-area, gentle depressions rather than localized, abrupt changes in the ground surface.

Subsidence has been monitored during the operation of Intrepid's nearby HB solution mines through a network of subsidence monitoring monuments installed in 2009 (**Map EA-11 - *Subsidence Monitoring Transects***). The elevation of these monuments is surveyed quarterly to assess changes in the ground surface elevation. The maximum difference between the January 2014 monument elevations and the 2009 starting elevations, as of January 21, 2014 is 0.2 ft. Most monuments show no trend in elevation; some quarter's exhibit monument elevations that are higher than the 2009 reference data point and some are lower. No discernable trends are apparent based on the data collected to date. This lack of trends suggests that the elevation differences observed may reflect measurement limitations more than actual changes in ground elevation. Therefore, to date, subsidence impacts from operation of the HB Solar Solution Mine have been minimal.

Potential direct impacts from subsidence include pushed up well casings, damaged or failed well casings, cracking and fissuring of the ground, damaged or broken pipelines, and damaged buried utilities (Galloway et al. 2008). Sudden collapse without obvious warning may occur and potentially damage surface infrastructure. Indirect effects include alteration of surface drainages commonly resulting in impoundment of runoff or "sinking streams," disruption of shallow water tables, livestock or wildlife loss, and public safety hazard. Components of the Proposed Action most at risk are facilities such as wells, pipelines, and roads. Damage to surficial infrastructure is primarily caused by sudden, localized subsidence and any subsidence expected from solution mining is expected to be gradual, extending over a large area of gentle deformation.

Continued monitoring and evaluation of the existing subsidence monitoring network is planned to document potential surficial effects as discussed in the mitigation section below.

Paleontology

Based on the paleontology survey results included in Appendix B there is generally low risk for adverse impacts to fossils because of the low potential for the occurrence of scientifically important fossils. The siltstone and sandstone bluff leading to well pad IP-304 was identified as potentially fossil-bearing and may have a greater risk for impacts.

Mitigation Measures

Throughout the construction and operation of the Proposed Action several design features and best management practices would be utilized to minimize impacts to geological and mineral resources as described in Sections 2.1 and 2.2 of this EA. Additional mitigation measures recommended include the following:

- Monitoring data described in Sections 2.1 and Section 2.2, such as flow rates and mine flood level elevations, would be used to develop working-specific time/elevation/fill curves for the HB AMAX Solution Mine Extension Project. The working-specific curves would be used to understand the actual fill volume versus elevation and verify that brine levels are being maintained at prescribed elevations in the underground flood zone.

- Wells within and immediately adjacent to the flood zone have been evaluated with respect to integrity, proximity to the flood zone, and the need for further abandonment procedures. Accordingly, wells 30015045970000, 30015045990000, and 30015046000000 were plugged by April 2015.

- Adaptive management strategies involving modification of Rustler pumping rates would be employed if drawdown impacts are observed at the caves from the continuation of the existing monitoring network.

- Intrepid would work with the BLM to determine proper well plugging procedures for wells that are installed in areas of high karst potential. Proper plugging would minimize future impacts to karst features.

- Prior to trenching the BLM will identify which portions of the pipeline alignment will require an onsite karst monitor during construction. If a void were encountered during excavation of the trenches or during drilling operations, construction will be suspended and the BLM will be notified. BLM would then work with Intrepid to determine proper mitigation.

- Subsidence at the HB Solar Solution Mine would continue to be assessed on a regular basis. If data collected for the HB Solar Solution Mine continues to demonstrate a lack of discernable trends or is within the modeled allowable subsidence rate described in the Evaluation of Ground Subsidence over the Intrepid HB Mines, Carlsbad, New Mexico, RESPEC, April 2011 prepared for the FEIS, additional monitoring would not be conducted for the Amax Mine area. If the observed subsidence, as documented by the existing subsidence monitoring network shows a definitive trend and approaches the limits established in the EIS, a subsidence network for the AMAX Mine would be evaluated in conjunction with the BLM.

- A qualified paleontological inspector would be used to spot monitor for fossils during grubbing and after trenching construction of the pipeline in the vicinity of the siltstone, sandstone, and gypsum bluff where it intersects the pipeline ROW leading to well pad IP-304 (NE ¼, Section 14, T19S, R30E). Any paleontological resources (prehistoric site, object, or remains discovered during project construction would be reported immediately to the BLM. Such a discovery would suspend operations until approval to proceed is received from the authorized officer. The authorized officer would also determine the appropriate actions needed to prevent and mitigate any loss of significant paleontological resources within the defined level 4 / ROW intersected area.

3.1.4. Impacts from Alternative

Direct and Indirect Impacts

Under the Alternative, the impacts to geology resources including subsidence, karst, mineral resources, and paleontology would be the same as those described in the Proposed Action.

3.2. Water

3.2.1. Affected Environment

Water resources have been divided into surface water and groundwater sections to describe the affected environment. In reality, surface water and groundwater systems are often connected and impacts to one may impact the other.

Surface Water

Surface water resources have been characterized for the proposed project area and include wetlands, lakes, playas, and streams. The affected surface water environment covers the following:

- Climate
- Watersheds
- Floodplains
- Wetlands
- Surface water quality
- Surface water usage

Climate

Climate parameters such as temperature, precipitation, and evaporation are key factors in determining and understanding the hydrology of a region. Climate parameters determine the amount and frequency of water available for surface runoff and for groundwater recharge. Using Köppen climate designations, the project location is in a BSk climate (Kottek et al. 2006). BSk climates are found in dry, mid-latitude regions with average temperatures less than 64 degrees Fahrenheit (°F) (18 degrees Celcius [°C]) and potential evaporation rates that exceed precipitation (NOAA 2011). The nearest climate station with historical and current climate data is the Carlsbad, New Mexico station (# 291469) located approximately 25 miles southeast of the project site and 200 ft lower in elevation.

Carlsbad temperature and precipitation records from February 1, 1900 to March 31, 2013 (WRCC 2014) are displayed in **Figure EA-9 – *Climate Data***. The average annual maximum and minimum temperatures are 78.6°F and 47.2°F. June and July are the warmest months; December and January are the coldest months. Average annual precipitation is 12.84 inches; July, August, and September are the wettest months. Brief, but intense thunderstorms deliver most of the summer precipitation. The Western Regional Climate Center (WRCC) estimates an average potential evaporation rate of 73 inches/year for southeastern New Mexico; the closest weather station with evaporation data is at Brantley Dam where the measured average potential evaporation is 109 inches/year. Potential evaporation rates far exceed annual precipitation, resulting in a moisture deficit. With little rainfall and high evaporation rates, few streams have streamflow year round; most streams are ephemeral.

Watersheds

Watersheds provide information on surface water drainage. The Watershed Boundary Dataset (USDA-NRCS et al. 2014) divides the United States into hierarchical hydrologic units, generally synonymous with the classic definition of a watershed, except that hydrologic units may have multiple outlets and can accept water from outside the unit boundary. The largest hydrologic units are called regions; the United States is divided into 15 regions. Each region is split into subregions made up of basins, divided into subbasins, then watersheds, and finally subwatersheds. The subwatershed is the smallest division in the Watershed Boundary Dataset. A hydrologic unit is assigned a Hydrologic Unit Code (HUC) with each level of the hierarchy represented by two digits; subwatersheds have a 12-digit code (HUC-12).

The National Hydrography Dataset (NHD) identifies surface water bodies including streams, rivers, canals, lakes, and ponds (USGS 2014). Stream channels are named using the HUC-12 subwatershed code from the Watershed Boundary Dataset followed by additional numbers to differentiate between stream reaches. Together, these stream reaches makes up the flow network. A map displaying subwatersheds and surface water features in and near the project boundary can be found in **Map EA-12 - *Watershed Map***.

The five subwatersheds listed in **Table 3.2-1 - *Subwatersheds that are In / Intersect the Project Boundary (USGS 2014)*** are fully or partially contained in the project boundary. Of these five subwatersheds, three are closed basins, one drains into a closed basin, and one to a connected watershed that eventually flows into the Pecos River. These subwatersheds and associated surface water features are discussed below.

Table 3.2-1 Subwatersheds that are In / Intersect the Project Boundary (USGS 2014)

Region	Subregion	Basin	Sub Basin	Watershed	Subwatershed	HUC12 ID	Contributing To/Closed
Rio Grande	Upper Pecos	Upper Pecos	Upper Pecos – Black	Clayton Basin	Clayton Basin	130600110204	Closed
					Nimenim Ridge	130600110202	Clayton Basin
					Little Lake	130600110203	Closed
				Burton Flat	Burton Flat	130600110104	Scanlon Draw-Pamilla Draw
					130600110103	130600110103	Closed
					Cedar Lake Draw	130600110102	130600110103

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Checked By: BAL3

Clayton Basin

Clayton Basin is intersected by the southern edge of the project boundary. Clayton Basin is a closed basin bound by topographic highs. Streams in the eastern portion of the basin are classified as intermittent in the NHD meaning they do not continuously carry flow but do contain water more often than ephemeral streams; an ephemeral stream only has flow immediately after precipitation events (Dingman 2002). Clayton Basin also has several intermittent lakes and treatment reservoirs.

Burton Flat

Burton Flat is intersected by the western project boundary. Burton Flat is the only subwatershed in the project boundary that is not classified as closed or connected to a closed subwatershed. Theoretically, water in Burton Flat could flow into Scanlon Draw-Pamilla Draw, then into Lone Tree Draw, and finally into the Pecos River. However, this subwatershed is almost flat and there are no mapped streams, suggesting that surface water flow is rare. Burton Flat is a known karst terrain and most of the surface water flow likely enters the shallow karst aquifers through cave entrances, swallets and sinkholes (Goodbar 2013).

130600110103

Subwatershed 130600110103 is intersected by the western project boundary. This is a closed subwatershed with one surface water feature along the western edge outside the project boundary. Like the streams in Clayton Basin this stream is classified as intermittent.

Nimenim Ridge

Nimenim Ridge is intersected by the northern project boundary. While not a closed basin, Nimenim Ridge is connected to the closed Clayton Basin. Nimenim Ridge is a long, thin subwatershed oriented roughly northeast to southwest. There are several intermittent streams in this subwatershed; the majority of streams within the project boundary are in Nimenim Ridge. There are also several small (<0.01 square kilometers) intermittent lakes and two perennial lakes within the project boundary. The largest perennial lake is associated with an old tailings basin. The intermittent lakes are likely playas that collect runoff, which then evaporates and leaves behind dissolved salts. Over time, these salts deposits accumulate and decrease the soil permeability, supporting continued water pooling during future precipitation events.

Little Lake

The eastern edge of the project boundary intersects the Little Lake subwatershed. This subwatershed is separated from Clayton Basin by a minor ridge at the southwest edge. This is a closed basin with two intermittent streams that drain into a small intermittent lake.

Cedar Lake Draw

The northern edge of the project boundary intersects the Cedar Lake Draw subwatershed. This is an open basin that contributes to the closed basin, 130600110103. There are several intermittent streams at the northeastern edge of the watershed.

Floodplains

The Federal Emergency Management Agency (FEMA) produces and maintains the floodplain maps used by the National Flood Insurance Program (FEMA 2010). Zone A Special Flood Hazard Areas are within the 100-year floodplain and are defined as areas with ≥1% probability of flooding in a given year (FEMA 2014). FEMA describes Zone A as “No base flood elevations determined.” Zone A areas within the Proposed Project boundary are shown in **Map EA-13 - *FEMA Flood Hazard Area Map***.

There are six 100-year floodplains within the project boundary. Three floodplains are located at the western edge of the project boundary away from the proposed pipelines and wells. The other three floodplains are along the southern edge of the project boundary. All infrastructure for the Proposed Action is more than half a mile from Zone A floodplains.

Wetlands

Wetland maps (USFWS 2010) of the United States are maintained by the National Wetlands Inventory (NWI) established by the U.S. Fish & Wildlife Service (USFWS). The NWI delineates the areal extent of wetlands and surface waters using a classification system proposed by Cowardin et al. (1979). This hierarchical wetland classification system classifies wetlands based on hydrologic, geomorphologic, chemical, and biological factors. The wetlands dataset from the NWI was used to generate a wetlands map for the project area (**Map EA-14 - *Surface Water Bodies***).

Under the Cowardin et al. (1979) classification system lakes and streams from the NHD are classified as lakes or freshwater ponds and riverine wetlands, respectively. There was only one other wetland type, a freshwater emergent wetland, within the project boundary. The freshwater emergent wetland category includes herbaceous marshes, fens, swales, and wet meadows.

Table 3.2-2 - *Total Area for Each NWI Wetland Type Within the Project Boundary* summarizes the area for each wetland type within the project boundary. In total, there are 178.5 acres of wetlands within the project boundary; wetlands cover 1.% of the project area. Lakes represent the majority of wetlands within the project boundary.

Table 3.2-2 Total Area for Each NWI Wetland Type Within the Project Boundary

Wetland Type	Total Area (Acres)	Percentage of Project Area (%)
Freshwater Emergent Wetland	0.7	0.003
Riverine	18.5	0.1
Freshwater Pond	33.2	0.2
Lake	126.1	0.7

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Checked By: BAL3

No wetlands, as defined by the NWI are positioned closer than 2.2 miles from any new proposed HB AMAX Solution Mine Extension Project infrastructure.

Surface Water Quality

Surface water quality standards and waterway beneficial use designations for the State of New Mexico are developed by the New Mexico Water Quality Control Commission (NMWQCC). There are no classified waters within the project boundary and all surface water features are either unclassified perennial waters of the State or unclassified intermittent waters of the State. Both unclassified perennial and intermittent waters have designated uses listed in 20.6.4.98 NMAC and 20.6.4.99 NMAC as: livestock watering, wildlife habitat, and primary contact. Perennial waters also have a warmwater aquatic life designation; intermittent waters have a marginal warmwater aquatic life designation (NMAC 2000). Water quality standards for these designated uses can be found in 20.6.4.900 NMAC.

In addition to the standards for unclassified waters, the State of New Mexico has a basinwide provision (20.6.4.52 NMAC) for preventing increased total dissolved solids (TDS) in the Pecos River Basin pursuant to the New Mexico Water Quality Act. One subwatershed, Burton Flat, intersected by the project boundary is hydrologically connected to the Pecos River. However, no streams have been mapped in Burton Flat and the potential for surface flow to the Pecos River is low. All of the subwatersheds have the potential to be connected to the Pecos River through the groundwater system and fall within the Pecos River Basin boundary. Additional water quality standards for the main stem of the Pecos River are total dissolved solids threshold goals of 500 milligrams per liter (mg/L) at Santa Rosa, 2,700 mg/L near Artesia, and 3,600 mg/L near Malaga.

Surface water quality in New Mexico is regulated by the NMED, Surface Water Quality Bureau (SWQB). In accordance with the requirements of the Clean Water Act (CWA) the SWQB prepares a CWA §303(d)/305(b) Integrated Report ("Integrated Report") on water quality parameters and impairments for the U.S. Environmental Protection Agency (USEPA). The most recent Integrated Report from the SWQB was released November 18, 2014 (NMWQCC 2014).

No water bodies within the project area are listed in the 2014 Integrated Report as impaired waters. The closest impaired waters to the project boundary is the Pecos River. Several sections of the Pecos River are listed in the 2014 Integrated Report, including the Avalon Reservoir, which is listed for mercury in fish tissue and the Brantley Reservoir, which is listed for dichlorodiphenyltrichloroethane (DDT) in fish tissue. The Pecos River is approximately 14 miles east of the project boundary and may be hydrologically connected through Burton Flat or groundwater discharge. The closest river section is between Brantley Reservoir and Avalon Reservoir. There is no direct surface water drainage from the project area to the Pecos River.

Surface Water Use

The New Mexico Office of the State Engineer (NMOSE) administers water use in the State of New Mexico. The online NMOSE water rights database is currently being updated for Eddy County. A search for water rights in and within one mile of the project boundary was completed using NMOSE – Roswell, New Mexico records in 2014. No surface water rights were found within the project boundary.

Surface water provisions from the nearby Pecos River are administered by a commission, as outlined in the Pecos River Compact between the State of New Mexico and the State of Texas. The compact was approved by Congress in 1949 (NMOSE and ISC 2015).

Groundwater

Water for the processing plant and for injection would come from three existing well fields – a well field in the Ogallala aquifer (Caprock Well Field), a well field in the Rustler Formation (North Rustler Well Field) and a well field being developed (South Rustler Well Field). In addition, injectate make-up water would come from Intrepid's North Plant scrubber water (Caprock water with KCl) or from Intrepid's existing brine recycling process at the West plant facility.

The North Rustler Well Field is located approximately 10 miles south of the AMAX Mine and the Caprock Well Field is 30 miles northeast of the HB AMAX Solution Mine Extension Project, as shown in **Map EA-15 – *Location of the Rustler Section 2 Well Field*** and **Map EA-16 – *Location of the Caprock Well Field Relative to Project Area***. The third well field (South Rustler Well Field) is located downgradient from the Intrepid West tailing facility in lower Nash Draw.

In addition to these aquifers of interest, this section discusses the aquifers and aquitards (hydrostratigraphic units) that have regional significance in the project area.

Hydrostratigraphy
The following hydrostratigraphic units, from deepest (oldest) to shallowest (youngest), occur in the northern Delaware Basin where the HB AMAX Solution Mine Extension Project is located:

- Bell Canyon aquifer
- Capitan Formation aquifer
- Castile Formation aquitard
- Salado Formation aquitard
- Los Medaños Member aquifer/aquitard (of the Rustler Formation)
- Culebra Dolomite Member aquifer (of the Rustler Formation)
- Tamarisk Member aquitard (of the Rustler Formation)
- Magenta Dolomite Member aquifer (of the Rustler Formation)
- Forty-Niner Member aquitard (of the Rustler Formation)

The overlying Santa Rosa Formation, Dewey Lake Red Bed Formation, and unconsolidated deposits may locally yield water, but do not act as regional aquifers. . The Ogallala Formation, while not present at the project site, is a water source for the project and is included in the affected groundwater environment.

Bell Canyon Aquifer

The Bell Canyon Aquifer is in the upper sandstone units of the Bell Canyon Formation. The Bell Canyon Formation is a deep water turbidite sandstone that was deposited on the basin side of the Capitan Reef, grading into carbonates toward the edge of the Capitan Reef and finer siltstones and shales moving deeper into the basin. The aquifer is confined both by the underlying Lamar Shale Member of the Bell Canyon Formation and the overlying Castile evaporites (Mercer 1983).

Porous sandstone units are 45 to 60 ft thick and occur in the upper 600 ft of the Bell Canyon Formation. Interbedded siltstones and the heterogeneity of cementation create locally confined layers within the aquifer; large hydraulic head differences have been observed in adjacent sandstone units. Well yields are typically less than 5 gpm (Mercer 1983). Groundwater flow is generally toward the northeast (Intrepid/Shaw 2008a). Recharge is from the west, possibly in the Guadalupe and Delaware Mountains. Regional flow through the aquifer is thought to be slow with intervening, low permeability siltstones impeding water movement. Most water produced from the Bell Canyon aquifer is a brine; the TDS, as measured at the Waste Isolation Pilot Project (WIPP) site, ranged from 180,000-270,000 mg/L. TDS generally increases in the Bell Canyon Aquifer as water moves across the Delaware Basin (Mercer 1983).

Moving laterally toward the basin margin, the Bell Canyon Formation is in contact with the Capitan Limestone (Figure EA-8). Even though the Capitan Limestone abuts the Bell Canyon Aquifer, the different hydrogeologic characteristics of these two systems likely limits interaction; the hydraulic conductivity in the Bell Canyon aquifer is typically several orders of magnitude smaller than in the Capitan Aquifer. This lack of interaction is supported by the distinct water chemistry observed in these two aquifers (Mercer 1983).

Capitan Aquifer

The Capitan Aquifer includes the Capitan Limestone, the Goat Seep Formation, and the carbonate portions of the Artesia Group, including the Grayburg, Queen, Seven Rivers, Yates, and Tansill Formations. The Capitan Aquifer is a horseshoe shaped formation that outlines the margins of the Delaware Basin and is only absent on the southern edge of the basin. At the northern edge of the Delaware Basin, near the project site, the Capitan Aquifer is 10 to 14 miles wide (Mercer 1983). The thickness of this aquifer is variable with thicker sections behind the forereef and thinner sections were submarine canyons and surge channels eroded the reef surface. Near the project site the reef is generally 1,500-2,000 ft thick in the middle of the reef complex and thins toward the edges (Standen et al. 2009).

The hydraulic conductivity of the Capitan Aquifer varies from 1-25 ft per day (ft/day), with an average near Carlsbad of 5 ft/day (Mercer 1983). Secondary porosity from karst formation can greatly increase local porosity and create preferential flowpaths for groundwater. Well yields near Carlsbad are often greater than 1,000 gpm (Standen el al. 2009). West of the Pecos River the Capitan Aquifer outcrops and is recharged in the Guadalupe Mountains. Lake Avalon located northeast of Carlsbad has also been identified as a local recharge area (Richey and Wells 1985). East of the Pecos River the Capitan Aquifer becomes confined by the overlying Salado and Castile Formations, when present (Standen et al. 2009). The higher hydraulic head in the underlying Delaware Mountain Group prevents significant downward movement of groundwater (Richey and Wells 1985). Lateral groundwater movement follows the reef structure starting at the recharge zone in the Guadalupe Mountains and moving east with a major discharge zone near Wink, TX (Standen et al. 2009). Locally, water from the Capitan Aquifer discharges to the Pecos River at Carlsbad Springs (Mercer 1983).

Water quality in the Capitan aquifer is variable. Southwest of Carlsbad salinity is generally low and water is used for domestic consumption. East of the Pecos River the water can be saline and is used for agricultural and industrial purposes (Richey and Wells 1985).

Castile Formation Aquitard

The Castile Aquitard overlies the Bell Canyon Formation in the deep water depositional environment of the Delaware Basin. Toward the Capitan Reef where water levels were shallower the Castile Aquitard thins substantially and is absent in the backreef of the Northwestern Shelf. This aquitard is a thick anhydrite series with thinly interbedded halite layers. Within the deep basin the Castile Formation is generally 1,500 to 1,850 ft thick. The hydraulic conductivity of the Castile Formation is so small it is considered unmeasurable. Occasional brine pockets associated with fractures have been found in the Castile Formation but a regional groundwater flow system is assumed to be absent (Mercer 1983).

Salado Formation Aquitard

The Salado Formation is a thick evaporite sequence with low hydraulic conductivity. Unit thickness at WIPP ranged from 1,700 – 2,000 ft. Occasional brine pockets have been found in the Salado Formation but there is no evidence of groundwater movement within the formation. Dissolution has been observed at the top of the Salado and a brine aquifer may be present between the Salado and the overlying Los Medaños Member of the Rustler Formation. This brine aquifer is considered to be part of the Los Medaños Aquifer (Mercer 1983).

Rustler Formation Aquifers and Aquitards

Three aquifers (Los Medaños Member, Culebra Member, Magenta Member) and three aquitards (Los Medaños Member, Tamarisk Member, and Forty-Niner Member) have been identified in the Rustler Formation.

The Los Medaños Member of the Rustler Formation contains both an aquifer and an aquitard. The majority of the formation is a siltstone, anhydrite, and fine-grained sandstone that generally acts as an aquitard. The base of this member has a discontinuous breccia zone that formed at the contact of the overlying Rustler Formation and underlying Salado Formation. The breccia layer consists of gypsum and sandstone fragments in a clay residuum. Dissolution of the top of the Salado Formation has created a local brine aquifer in the breccia layer, when present. The thickness of this brine aquifer ranges from 10 to 60 ft and averages 24 ft. The extent of the aquifer is unknown; it has been identified as far south as U.S. Route 285 and as far north as U.S. Route 180. It trends northeast – southwest from U.S. Route 285 to Nash Draw and north-south from Nash Draw to U.S. Route 180. Within this zone the width varies between 2 and 8 miles. Recharge may occur in Bear Grass Draw while discharge from the Los Medaños aquifer has been identified at Malaga Bend in the Pecos River. Groundwater flow is generally to the south/southwest (Mercer 1983).

The Culebra Dolomite Aquifer is the deepest, regionally extensive aquifer in the Rustler Formation sequence. This silty, thinly bedded to massive dolomite carries groundwater in bedding planes and fractures. Aquifer thickness observed in Intrepid's wells ranges from 18-23 ft. The Culebra Dolomite is considered the most persistent and productive hydrologic unit in the area. Where dissolution has not occurred, this aquifer is confined above by the thick anhydrite of the Tamarisk Aquitard and below by the siltstone and anhydrite layers of the Los Medaños Member. Near Nash Draw and Salt Lake dissolution of the Salado below, and of the Tamarisk above, has caused collapse in the Culebra and Magenta Members and hydraulic communication between these two, otherwise confined, units. The Culebra is likely recharged in Bear Grass Draw and discharges to Salt Lake; groundwater flow is generally to the south. Hydraulic conductivity can be quite variable in the Culebra Aquifer depending on the extent of secondary porosity introduced by fractures and collapse features. Transmissivity measured at the WIPP site was generally 1 ft^2/day. Transmissivity measured in wells near Nash Draw was several orders of magnitude larger because of additional fracturing and probable conduit flow. Water quality is generally marginal with observed TDS values ranging from 3,200 to 420,000 mg/L. When TDS levels allow, groundwater from the Culebra aquifer is used for stock watering and is rarely a domestic water source (Mercer 1983).

The Magenta Dolomite Aquifer consists of siltstone, silty dolomite, and occasional anhydrite beds. Aquifer thickness observed in Intrepid's wells ranges from 11-29 ft. Groundwater transport occurs along bedding planes and in fractures. Where dissolution has not highly altered the structure of the Rustler Formation and where the Magenta is not outcropping at the land surface, the overlying Forty-Niner Member can act as an aquitard and create confining conditions. Within Nash Draw the aquifer is generally unconfined due to the hydraulic connection with the underlying Culebra Dolomite. However, even within Nash Draw the Magenta aquifer may be locally confined. Large head differences between the Culebra Dolomite and the Magenta Dolomite were also observed at the WIPP site and suggest confined conditions. Water quality is variable with TDS values ranging from 5,460 to 270,000 mg /L (Mercer 1983).

Where it has not been eroded, the Forty-Niner aquitard confines the underlying Magenta Dolomite. This aquitard is an anhydrite with a single thin bed of clayey silt (Mercer 1983). Where the Forty-Niner outcrops at or near the surface in Burton Flat there are numerous cave entrances. These entrances provide point sources for rapid groundwater recharge. These caves provide habitat for aquatic troglobitic species (Goodbar 2015).

Formations above the Rustler

None of the formations above the Rustler are regionally continuous hydrostratigraphic units but they may locally act as an aquifer or an aquitard. The Dewey Lake Red Beds (Quartermaster Formation) overlie the Rustler Formation. The Dewey Lake Red Beds at WIPP are 345-541 ft thick (Mercer 1983); within the project area this unit is discontinuous and of variable thickness due to erosion. The Dewey Lake Red Beds are generally a low permeability unit that, when present, contain little to no groundwater. Trace amounts of groundwater may be found in lenticular sand layers (Mercer 1983). The Santa Rosa Formation is a sandstone that overlies the Dewey Lake Red Beds. The Santa Rosa is 0 to 176 ft thick at the WIPP site (Mercer 1983). While the Santa Rosa Formation is a principal aquifer in Lea County, this unit has been eroded away over much of project site. WIPP wells completed in the Santa Rosa produced little to no water (Mercer 1983) The Gatuña Formation is a discontinuous, poorly sorted, silt, clay and stand unit with erratic distribution. At the WIPP site it was absent in some borings and up to 100 ft thick in others. No water was found in the Gatuña Formation at the WIPP site; isolated, perched occurrences of water are possible in the sand-rich lenses. A lack of regional continuity prohibits lateral groundwater flow through the Gatuña Formation. Quaternary, unconsolidated alluvial and eolian deposits range from 0 to tens of feet thick and may locally contain water. When present, groundwater within the quaternary material is generally perched or semi-perched.

Ogallala Aquifer

The Ogallala Aquifer is part of the large, regionally extensive High Plains Aquifer covering parts of Colorado, Kansas, Nebraska, New Mexico, Oklahoma, South Dakota, Texas, and Wyoming. This aquifer is a major source of water for irrigation and domestic consumption (USGS 2014). In southeastern New Mexico the Ogallala Formation has interbedded layers of sand and gravel capped with a caliche layer. Cementation is greatest near the surface and becomes poorly cemented with depth. The saturated thickness of the Ogallala Aquifer ranges from a few feet to 250 ft. The thickness of the upper caliche layer ranges from a few to 60 ft. Water quality is generally good with TDS values ranging from 300 to 729 mg/L in Lea County (NMOSE 1999).

Groundwater Use

Like surface water rights, groundwater rights are managed by the NMOSE. A search for groundwater water rights in and within one mile of the project boundary was conducted using data from the NMOSE office in Roswell, New Mexico. Twenty-four (24) groundwater rights were found within the project boundary.

Table 3.2-3 - *Water Rights Within One Mile of the Project Boundary* summarizes the permit amount, use type, owner, and status for the groundwater rights in and within one mile of the project boundary. **Map EA-17 - *Water Rights Within 1 Mile of HB AMAX Project Boundary*** shows the locations of the groundwater rights. All of these rights are listed within the Capitan Basin, as designated by the “CP” in the NMOSE file number.

Table 3.2-3 Water Rights Within One Mile of the Project Boundary

Owner/Permittee	NMOSE File #	Location (T-R-S)	Use	Allotment (ac-ft)	Status	Source
Mosaic Potash	CP-378	19S-30E-09	IND	1,371	Declared	GW
Mosaic Potash	CP-379	19S-30E-10	IND	484	Declared	GW
Snyder Ranch	CP-819	18S-30E-32	STK	3	Declared	GW
Snyder Ranch	CP-820	19S-29E-13	STK	3	Declared	GW
Snyder Ranch	CP-821	19S-29E-25	STK	3	Declared	GW
Snyder Ranch	CP-822	19S-30E-15	STK	3	Declared	GW
Snyder Ranch	CP-823	19S-30E-17	STK	3	Declared	GW
Snyder Ranch	CP-824	19S-30E-20	STK	3	Declared	GW
Snyder Ranch	CP-825	19S-30E-28	STK	3	Declared	GW
Snyder Ranch	CP-827	19S-30E-35	STK	3	Declared	GW
Snyder Ranch	CP-828	19S-30E-35	STK	3	Declared	GW
Snyder Ranch	CP-834	20S-30E-06	STK	3	Declared	GW
H.R. Carpenter	CP-522	19S-30E-30	STK	3	Unknown	GW
Southwest Royalties	CP-357	19S-30E-24	PRO	48	Unknown	GW

Owner/Permittee	NMOSE File #	Location (T-R-S)	Use	Allotment (ac-ft)	Status	Source
Southwest Royalties	CP-357-S	19S-30E-24	PRO	48	Unknown	GW
Southwest Royalties	CP-357-x-2	19S-30E-24	PRO	48	Unknown	GW
P.R. Patton	CP-767	19S-30E-03 19S-30E-04	PRO	300	Withdrawn	GW
P.R. Patton	CP-773	18S-30E-28	PRO	300	Withdrawn	GW
Devon Energy	CP-703	19S-29E-36	PRO	3	Permitted	GW
CHI Operating	CP-1226*	19S-29E-36	PRO	3	Expired	GW
CHI Operating	CP-1227*	19S-29E-36	PRO	3	Expired	GW
CHI Operating	CP-1228*	19S-29E-36	PRO	3	Expired	GW
Fred Pool	CP-742	19S-30E-31	PRO	3	Expired	GW
A	CP-647	19S-30E-15			Unknown	Unknown

Notes:
*: using CP-703 well for fracking and completion of CHI Operating Inc. project well.
ac-ft: acre-ft
GW: Groundwater
IND: Industrial
OSE: Office of the State Engineer
PRO: Prospecting of development of natural resources
STK: Livestock
T-R-S: Township – Range – Section

Prepared by: MJH5
Checked by: BAL3

Water rights near Intrepid's Rustler and Caprock Formation well fields have been evaluated and discussed in the EIS. Intrepid has established water rights from the NMOSE to use up to 4,353 ac-ft per year (2,697 gpm) of Rustler water from the Rustler Formation groundwater supply wells installed for use in the HB Solar Solution Mine. Intrepid also maintains water rights that allow for the use of up to 7,700 ac-ft per year (4,771 gpm) from the West, East, North, and HB Caprock well fields. Only existing water rights would be used for the Proposed Action; no new water rights would be obtained.

3.2.2. Impacts from the No Action Alternative

Direct and Indirect Impacts

Under the No Action Alternative there would be no impacts to surface water resources in the project area beyond those small areas of surface disturbance resulting from current potash mining and oil and gas activities.

Groundwater pumping at Intrepid's Rustler and Caprock Formation well fields would continue to occur for the HB Solar Solution Mine. The total duration of pumping would be shorter. Minor amounts of groundwater extraction would likely occur for oil and gas activities.

Under the No Action Alternative the abandoned oil wells near the AMAX Mine would remain plugged. There may be a potential hazard to aquifer systems as the cement ages and deteriorates; cement failure could potentially open up preferential pathways between otherwise confined aquifer units, allowing for migration of brine and production formation water into freshwater zones.

3.2.3. Impacts from the Proposed Action

Direct and Indirect Impacts

Surface Water

Under the Proposed Action none of the new roads, pipelines, or utility corridors is within 650 ft of 100-year floodplains (Map EA-13). The majority of the 100-year floodplains are located west of the proposed infrastructure. The pipeline from IP-302 and IP-304 crosses two unnamed, intermittent streams.

Temporary water quality impacts associated with construction could occur and would be managed with best management practices to prevent storm water pollution.

Buried pipelines, as outlined for the Proposed Action, have less impact to surface water drainages, relative to aboveground pipelines. Roads adjacent to the buried pipelines have the potential to block, divert, or concentrate storm water runoff if the natural land grade is altered. Surface runoff can erode roads and potentially uncover pipelines if erosion is severe enough. The access road along the pipeline has an increased potential for erosion due to removal of vegetation. To avoid and minimize the potential for these negative impacts, mitigation has been developed and is presented below in the mitigation section. The power line corridors should cause little to no impedance to surface water flow as long as existing land grades are maintained.

Under the Proposed Action the total initial disturbance footprint during the construction phase totals 84.3 acres, including disturbance from pipeline burial, well pad construction, and power line corridors. The long-term disturbance totals 46.8 acres and represents disturbance during the operational phase of the project before final reclamation. The initial and long-term disturbance is summarized by sub-watershed in **Table 3.2-4 - *Initial Disturbance in each Subwatershed for the Proposed Action*** and **Table 3.2-5 – *Long-term Disturbance in each Subwatershed for the Proposed Action***. Half of the disturbance is in subwatershed Clayton Basin with lesser amounts in Nimenim Ridge and 130600110103; no disturbance would occur in Burton Flat or Little Lake. Disturbance in any given subwatershed is less than 0.1% of the subwatershed area. All project disturbance is in closed basins or subwatersheds connected to closed basins.

Table 3.2-4 Initial Disturbance in each Subwatershed for the Proposed Action

Subwatershed (HUC-12)	Total Disturbed (acres)	% HUC-12
Burton Flat	0.0	0.00
Little Lake	0.0	0.00
130600110103	21.6	0.08
Clayton Basin	43.5	0.08
Nimenim Ridge	19.2	0.06
Cedar Lake Draw	0.0	0.00
Total	*84.3*	*0.22*

Notes
1. Percentage of the HUC-12 was calculated using the USGS HUC Area, defined as the “area of subwatershed including non-contributing areas.”
2. The disturbed area was rounded up to the nearest tenth of an acre.

Prepared By: MJH5
Checked By: BAL3

Table 3.2-5 Long-term Disturbance in each Subwatershed for the Proposed Action

Subwatershed (HUC-12)	Total Disturbed (acres)	% HUC-12
Burton Flat	0.0	0.00
Little Lake	0.0	0.00
130600110103	13.6	0.05
Clayton Basin	21.9	0.04
Nimenim Ridge	11.3	0.03
Cedar Lake Draw	0.0	0.00
Total	*46.8*	*0.12*

Notes

1. Percentage of the HUC-12 was calculated using the USGS HUC Area, defined as the "area of subwatershed including non-contributing areas".
2. The disturbed area was rounded up to the nearest tenth of an acre.

Prepared By: MJH5
Checked By: BAL3

The disturbance summary evaluates total disturbance, regardless of prior disturbance. Much of the pipeline corridor is in or adjacent to previously disturbed areas (see Map EA-4). Existing rail grades or roadways may already have adaptations for surface water conveyance, including ditches and culverts, which would reduce additional alterations to surface water drainages from the Proposed Action.

There is a potential to impact water quality if a pipeline leak develops. A leak or catastrophic break in a pipeline would result in the release of brines ranging from relatively fresh water (dilution lines) to saturated brine. Monitoring and mechanical controls for such an event are discussed in the mitigation section. Road crossing upgrades to stabilize the erosional features near IP-302 should improve downstream water quality by reducing the sediment loads during flow events.

Groundwater

Impacts to groundwater are primarily associated with pumping of the Rustler and Ogallala Aquifers and potential water quality degradation from brine fluid leaks. Drawdown from aquifer pumping could impact cave ecosystems as well as affect other aquifer users. Minor impacts during well construction are possible from drilling through aquifer units; drilling fluids may enter the aquifer. The mitigation measures that would be used to reduce these construction impacts are discussed in the mitigation section.

Groundwater impacts were analyzed separately for the Caprock well field and the Rustler well field for the EIS. Two numerical groundwater models, a Preferred Model and an Enhanced Model, were developed for the Rustler well field. The Enhanced Model used slightly higher hydraulic conductivity values, relative to the Preferred Model, and produced results that were more similar to the observed drawdown. A single, analytical model was used to evaluate the Caprock well field. All of the pumping scenarios for both the Rustler Aquifer models and the Caprock Aquifer model were run using a steady state simulation. A summary of the modeling methodology, applicability to the Proposed Action, and availability of new hydrogeologic data are presented in the TM-EA-002: Analysis and Applicability of the Hydrological Assessment and Groundwater Modeling Report for the HB In-Situ Solution Mine Project EIS (AECOM 2011) to the Proposed HB AMAX Solution Mine Extension Project to the HB Solar Solution Mine, (May 2015), included in Appendix C.

Predicted drawdown obtained from a steady state analysis, such as the results from the Caprock and Rustler Aquifer models, are not estimates of the drawdown at any particular phase or point in time. These results are estimates of the drawdown that would occur if the wells were pumped at the assigned rates in perpetuity. The point at which such equilibrium drawdown is reached could occur during the project or at some point after the project. Therefore, these drawdown predictions are not projected drawdowns of any given project year; rather, they are estimates of the maximum drawdown expected if the well field were operated at the given pumping rates in perpetuity. Because the Proposed Action uses pumping rates as modeled for the HB Solar Solution Mine EIS, the modeled drawdown presented in the EIS also represents the maximum drawdown expected under the Proposed Action.

Several pumping alternatives were evaluated for the EIS. The actual pumping that is occurring and would be used for the Proposed Action is as described for Alternative B from the EIS (BLM 2012). Under Alternative B, only the existing North Rustler well field (located to the north and east of the solar evaporation ponds) and Caprock wells were used; no water was obtained from the Rustler wells located at the former PCA facility in Section 4, T20s, R30E. A maximum sustainable pumping rate (the rate at which wells could be pumped and not go dry) was estimated for the Rustler Aquifer wells with additional water demand met by the Caprock Aquifer wells. **Map EA-18 - *Modeled Drawdown as Compared to Actual Observed Drawdown*** shows the modeled, maximum drawdown for the Preferred and Enhanced Models as well as the observed drawdown from April 2014. Pumping began in August 2012. The observed drawdown is substantially less than the modeled drawdown. Also shown in Map EA-18 is the location of Bear Grass Draw, relative to the predicted drawdown. Bear Grass Draw, identified as a potential recharge zone for the groundwater system, is outside the predicted cone of depression.

The actual sustainable pumping rates from 2012 through 2014 were significantly higher than the model predicted; the Rustler Aquifer wells are being pumped at a higher pumping rate than modeled and the observed drawdown is still less than the model predicted. The modeled drawdown intentionally reflected a worst-case, conservative estimate with which to conduct the associated resource impact analysis for the EIS, which likely reflects why actual drawdown is different than modeled drawdown. It is also unknown where the groundwater system is in relation to steady state; drawdown may continue to expand until steady state is reached. Given the current observed drawdown after approximately three years of pumping and considering the degree of conservancy built into the model methodology, it is unlikely that actual drawdown would reach or exceed the modeled drawdown.

To summarize, no additional groundwater impacts, besides those already addressed in the EIS, are expected. The timing of impacts remains unknown because the predicted drawdown reflects steady state. If steady state is not reached before the end of the project, drawdown could continue to increase every year throughout operations. The additional 14 years of pumping for the Proposed Action could result in an increase in observed impacts, up to the maximum predicted steady state impacts. Therefore, if steady state is not reached before year 28, then the extended duration of pumping for the Proposed Action could have an impact on actual water level declines, relative to the No Action Alternative. However, the maximum expected modeled drawdown would likely still be the same as shown in the EIS. Total expected impacts were fully addressed in the EIS and it is not likely the observed drawdown will exceed the modeled drawdown predicted for the EIS.

Water quality degradation of groundwater resources is possible if a pipeline leak developed and process water recharged an underlying aquifer. Similar degradation is possible if a leak developed in the well casing and process water migrated into a surrounding aquifer. These potential water quality impacts are reduced through the best management practices described in Section 2.1 and 2.2 and the mitigation measures presented below.

Mitigation Measures

Throughout the construction and operation of the Proposed Action several design features and best management practices would be utilized to minimize impacts to water resources as described in Sections 2.1 and 2.2 of this EA. Additional mitigation measures recommended include the following:

- Turbidity impacts to surface water resources would be reduced through the implementation of best management practices to prevent storm water pollution during all construction activities.

- At drainage crossings, additional road stabilizing measures would be required to maintain road access along the buried pipeline and reduce further channel incision, which could potentially expose the buried pipeline. Appropriately sized drainage crossings (such as culverts) would be designed and installed as appropriate

- As additional mitigation for the Propose Action, and at the request of the BLM, Intrepid has committed to stabilizing large erosional features near IP-302.

- In the event of a pipeline leak, Intrepid would contain and clean up the spill area in accordance with the permit conditions stated in Discharge Permit DP 1681 and other applicable BLM or State requirements.

- The current monitoring well network depicted on **Map EA-19 – *Current HB Solar Solution Mine Monitoring Well Network*** illustrates the monitoring well network would continue to be sampled as required by Discharge Permit DP 1681, Intrepid would continue to provide BLM with a dataset with which to evaluate observed drawdown and groundwater chemistry trends. The position of intermediate monitoring wells between the North Rustler well field and the monitored cave and karst areas allows measurement and evaluation of drawdown well before potential drawdown would occur at the monitored cave and karst sites and serves as an "early warning system". Using this system, adaptive measures can be considered prior to seeing unacceptable drawdown in groundwater levels in monitored caves and karsts.

- If observed drawdown exceeds the groundwater model predictions presented in the HB EIS the mitigation presented in the adaptive management plan will be followed.

3.2.4. Impacts from Alternative

Direct and Indirect Impacts

Under the Alternative, the impacts to surface water resources would be similar to those described for the Proposed Action. The only difference is the amount of disturbance in each subwatershed. The impact to groundwater resources is identical to those described for the Proposed Action.

Under the Alternative the initial disturbance during the construction phase totals 75.0 acres, including disturbance from pipeline burial, well pad construction, and newly added power line corridors. The long-term disturbance totals 42.3 acres and represents disturbance during the operational phase of the project before final reclamation. The initial and long-term disturbance are summarized by sub-watershed in **Table 3.2-6 - *Initial Disturbance in each Subwatershed for Alternative*** and **Table 3.2-7 - *Long-term Disturbance in each Subwatershed for Alternative***.

Half of the disturbance would occur in subwatershed Clayton Basin with lesser amounts in Nimenim Ridge and 130600110103; no disturbance would occur in Burton Flat, Little Lake or Cedar Lake Draw. Disturbance in any given subwatershed is less than or equal to 0.11% of the subwatershed area. All project disturbance is in closed basins or subwatersheds connected to closed basins.

Table 3.2-6 Initial Disturbance in each Subwatershed for Alternative

Subwatershed (HUC-12)	Total Disturbed (acres)	% HUC-12
Burton Flat	0.0	0.00
Little Lake	0.0	0.00
130600110103	14.1	0.05
Clayton Basin	25.1	0.05
Nimenim Ridge	35.8	0.11
Cedar Lake Draw	0.0	0.00
Total	*75.0*	*0.21*

Notes

1. Percentage of the HUC-12 was calculated using the USGS HUC Area, defined as the "area of subwatershed including non-contributing areas".
2. The disturbed area was rounded up to the nearest tenth of an acre.

Prepared By: MJH5
Checked By: BAL3

Table 3.2-7 Long-term Disturbance in each Subwatershed for Alternative

Subwatershed (HUC-12)	Total Disturbed (acres)	% HUC-12
Burton Flat	0.0	0.00
Little Lake	0.0	0.00
130600110103	9.8	0.04
Clayton Basin	12.8	0.02
Nimenim Ridge	19.7	0.06
Cedar Lake Draw	0.0	0.00
Total	*42.3*	*0.12*

Notes

1. Percentage of the HUC-12 was calculated using the USGS HUC Area, defined as the "area of subwatershed including non-contributing areas".
2. The disturbed area was rounded up to the nearest tenth of an acre.

Prepared By: MJH5
Checked By: BAL3

3.3. Soils

3.3.1. Affected Environment

Within the project boundary, 19 soil type units are present according to the United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) Soil Survey Geographic Database (SSURGO) (USDA-NRCS 2014). Each soil type unit contains one or two soil components. Soil textures range from sand to clay loam and most of the soils present are deep to very deep, well drained, and formed from alluvial or residual materials derived from sedimentary rocks (BLM 2012). The soil type units and acreages contained within the project area are summarized in **Table 3.3-1 - *Soil Type Within Project Boundary*** and depicted in **Map EA-20 - *USDA NRCS SSURGO Soils***.

Soil type unit descriptions obtained from USDA-NRCS (2014) for all soil type units present within the project boundary are provided in Appendix D for reference. Additional details regarding soil types, such as soil characteristics, are described in Section 3.4.2 of the HB EIS (BLM 2012).

Within and immediately adjacent to the project boundary, around proposed extraction well IP-302, several large erosional features are present. The approximate locations of these erosional features are shown in Map EA-20.

Table 3.3-1 Soil Type Within Project Boundary

Soil Type	Acres in Project Boundary	Percent of Project Boundary
BA: Berino loamy fine sand, 0 to 3 percent slopes	384.5	2.1%
BB: Berino complex, 0 to 3 percent slopes, eroded	2,985.4	16.3%
BD: Berino-Dune land complex, 0 to 3 percent slopes	612.9	3.3%
GA: Gypsum land	418.5	2.3%
GP: Gravel pit	18.4	0.1%
KM: Kermit-Berino fine sands, 0 to 3 percent slopes	1,365.1	7.4%
KT: Kimbrough-Stegall loams, 0 to 3 percent slopes	1,465.5	7.8%
LA: Largo loam, 1 to 5 percent slopes	1,110.3	6.1%
LS: Likes loamy fine sand, 1 to 5 percent slopes	59.5	0.3%
ML: Mined land	277.7	1.5%
PA: Pajarito loamy fine sand, 0 to 3 percent slopes, eroded	592.1	3.2%
PD: Pajarito-Dune land complex, 0 to 3 percent slopes	22.4	0.1%
PS: Potter-Simona complex, 5 to 25 percent slopes	747.5	4.1%
RG: Reeves-Gypsum land complex, 0 to 3 percent slopes	2,706.2	14.8%
RO: Rock land	59.7	0.3%
SG: Simona gravelly fine sandy loam, 0 to 3 percent slopes	458.5	2.5%
SM: Simona-Bippus complex, 0 to 5 percent slopes	4,248.9	23.2%
SR: Stony and Rough broken land	184.8	1.0%
TF: Tonuco loamy fine sand, 0 to 3 percent slopes	658.1	3.6%
Total	**18,347**	**100.0%**

Notes:
Soil types acreages are rounded up to a tenth of an acre. Therefore, the total acreage is slightly larger than the proposed project boundary acreage and the calculated total percentage is greater than 100 percent.

Prepared by: MCC2
Checked by: BJW1

3.3.2. Impacts from the No Action Alternative

Direct and Indirect Impacts

The No Action Alternative would deny the approval of the proposed project and would not grant permission for Intrepid to access public lands in order to expand solution mine operations to produce potash. Current land and resource used would continue under current conditions in the project area.

The large erosional features near the prosed extraction well IP-302 would likely continue to expand during high flow events and pose a hazard to nearby recreation trails. Under the No Action Alternative these features would probably remain unrepaired.

3.3.3. Impacts from the Proposed Action

Direct and Indirect Impacts

Direct and indirect impacts to soil resources would include short-term impacts resulting from construction related activities and long-term impacts resulting from the presence of permanent facilities during the operation of the Proposed Action. Impacts to soil from the Proposed Action would be similar to the soil impacts for the existing HB Solar Solution Mine as described in Section 4.4 of the HB EIS (BLM 2012). Short-term impacts would include increased potential erosion due to the removal of vegetation during construction activities, compaction of the soils during heavy equipment usage, disruption of soil biological processes as the soil layers are altered during site trenching and site grading, and effects from accidental spills of fuel and lubricants. Long-term impacts would include increased runoff and erosion along the pipeline maintenance road, and soil contamination from accidental pipeline leakage. To avoid and minimize the potential for these impacts, mitigation has been developed and is described in the mitigation section below.

Construction activities associated with trenching of the proposed pipelines, installation of the injection and extraction well pads, installation of the booster pump station, and installation of overhead power-runs to well heads, as described in Section 2.2, would directly impact approximately 84.5 acres of soil resources. Approximately 33.8 acres is already disturbed and 27.8 acres is immediately adjacent to current disturbed areas. Direct construction impacts to soils are summarized in **Table 3.3-2 - *Proposed Action Construction Soil Type Disturbances***.

Table 3.3-2 Proposed Action Construction Soil Type Disturbances

Soil Type	Total Disturbance (acres)	New Area Disturbance (acres)	Within Prior Disturbed Area Disturbance (acres)
BB: Berino complex, 0 to 3 percent slopes, eroded	15.1	12.0	3.1
GA: Gypsum land	1.3	0.0	1.3
KM: Kermit-Berino fine sands, 0 to 3 percent slopes	6.0	6.0	0.0
LA: Largo loam, 1 to 5 percent slopes	10.7	4.1	6.6
LS: Likes loamy fine sand, 1 to 5 percent slopes	1.7	1.7	0.0

Soil Type	Total Disturbance (acres)	New Area Disturbance (acres)	Within Prior Disturbed Area Disturbance (acres)
PA: Pajarito loamy fine sand, 0 to 3 percent slopes, eroded	6.3	0.9	5.5
PS: Potter-Simona complex, 5 to 25 percent slopes	10	7.5	2.5
RG: Reeves-Gypsum land complex, 0 to 3 percent slopes	6.7	0.0	6.7
SG: Simona gravelly fine sandy loam, 0 to 3 percent slopes	5.3	5.3	0.0
SM: Simona-Bippus complex, 0 to 5 percent slopes	19.3	11.2	8.1
SR: Stony and Rough broken land	2.0	2.0	0.0
Total	**84.5**	**50.7**	**33.8**

Soil types acreages are rounded up to a tenth of an acre. Slight variations between the total disturbance acres presented in this table and total disturbance acres presents for other resources for similar analyses is due to variations within the various resources datasets used for analysis.

Prepared by: MCC2
Checked by: BJW1

The operation of Proposed Action system components and infrastructure, as described in Section 2.2, would directly impact approximately 47.1 acres of soil resources. Approximately 17.6 acres is already disturbed and 13.8 acres is immediately adjacent to disturbed areas. Direct operational impacts to soil resources are summarized in **Table 3.3-3 –** ***Proposed Action Operations Soil Type Disturbances***.

Table 3.3-3 Proposed Action Operations Soil Type Disturbances

Soil Type	Total Disturbance (acres)	New Area Disturbance (acres)	Within Prior Disturbed Area Disturbance (acres)
BB: Berino complex, 0 to 3 percent slopes, eroded	8.2	6.6	1.6
GA: Gypsum land	0.7	0.0	0.7
KM: Kermit-Berino fine sands, 0 to 3 percent slopes	3.0	3.0	0.0
LA: Largo loam, 1 to 5 percent slopes	6.7	2.9	3.8
LS: Likes loamy fine sand, 1 to 5 percent slopes	1.4	1.4	0.0

Soil Type	Total Disturbance (acres)	New Area Disturbance (acres)	Within Prior Disturbed Area Disturbance (acres)
PA: Pajarito loamy fine sand, 0 to 3 percent slopes, eroded	3.2	0.5	2.7
PS: Potter-Simona complex, 5 to 25 percent slopes	5.8	4.5	1.3
RG: Reeves-Gypsum land complex, 0 to 3 percent slopes	3.5	0.0	3.5
SG: Simona gravelly fine sandy loam, 0 to 3 percent slopes	2.9	2.9	0.0
SM: Simona-Bippus complex, 0 to 5 percent slopes	10.4	6.4	4.0
SR: Stony and Rough broken land	1.3	1.3	0.0
Total	**47.1**	**29.5**	**17.6**

Soil types acreages are rounded up to a tenth of an acre. Slight variations between the total disturbance acres presented in this table and total disturbance acres presents for other resources for similar analyses is due to variations within the various resources datasets used for analysis.

Prepared by: MCC2
Checked by: BJW1

Mitigation Measures

Throughout the construction and operation of the Proposed Action, several best management practices would be utilized to minimize impacts to soil resources as described in Section 2.2 of this EA. Additional mitigation measures recommended include the following:

- Regular monitoring of reclaimed areas along with maintenance or reseeding as needed.
- Periodic inspection for erosion around the constructed infrastructure and ROWs. If erosion is noted, erosion control measures would be evaluated and implemented as appropriate.

3.3.4. Impacts from Alternative

Direct and Indirect Impacts

Direct and indirect soil impacts associated with the alternative proposed pipeline route and subsequent operation of the Alternative Action would remain consistent with the impacts described for the Proposed Action, with the exception of the number of disturbed soil acres.

Construction activities associated with trenching of the alternative route pipelines, installation of the injection and extraction well pads, installation of the booster pump station, and installation of overhead power-runs to well heads, as described in Section 2.2, would directly impact approximately 75.2 acres of soil resources. Approximately 43.6 acres is already disturbed. Direct construction impacts to soil are summarized in **Table 3.3-4 - *Alternative Construction Soil Type Disturbances***.

Table 3.3-4 Alternative Construction Soil Type Disturbances

Soil Type	Total Disturbance (acres)	New Area Disturbance (acres)	Within Prior Disturbed Area Disturbance (acres)
BB: Berino complex, 0 to 3 percent slopes, eroded	8.4	5.1	3.3
GA: Gypsum land	1.3	0.0	1.3
LA: Largo loam, 1 to 5 percent slopes	10.8	4.1	6.7
LS: Likes loamy fine sand, 1 to 5 percent slopes	1.7	1.7	0.0
ML: Mined land	3.8	0.0	3.8
PA: Pajarito loamy fine sand, 0 to 3 percent slopes, eroded	5.5	0.0	5.5
PS: Potter-Simona complex, 5 to 25 percent slopes	8.7	2.4	6.3
RG: Reeves-Gypsum land complex, 0 to 3 percent slopes	6.7	0.0	6.7
SG: Simona gravelly fine sandy loam, 0 to 3 percent slopes	3.0	3.0	0.0
SM: Simona-Bippus complex, 0 to 5 percent slopes	23.3	13.3	10.0
SR: Stony and Rough broken land	2.0	2.0	0.0
Total	**75.2**	**31.6**	**43.6**

Soil types acreages are rounded up to a tenth of an acre. Slight variations between the total disturbance acres presented in this table and total disturbance acres presents for other resources for similar analyses is due to variations within the various resources datasets used for analysis.

Prepared by: MCC2
Checked by: BJW1

Following construction, the operation of Alternative Action system components and infrastructure, as described in Section 2.2, would directly impact approximately 42.3 acres of soil resources. Approximately 21.3 acres is already disturbed. Direct operational impacts to soil resources are summarized in **Table 3.3-5 - *Alternative Operations Soil Type Disturbances***.

Table 3.3-5 Alternative Operations Soil Type Disturbances

Soil Type	Total Disturbance (acres)	New Area Disturbance (acres)	Within Prior Disturbed Area Disturbance (acres)
BB: Berino complex, 0 to 3 percent slopes, eroded	4.7	3.0	1.7
GA: Gypsum land	0.7	0.0	0.7
LA: Largo loam, 1 to 5 percent slopes	6.6	3.7	2.9
LS: Likes loamy fine sand, 1 to 5 percent slopes	1.5	1.5	0.0

Soil Type	Total Disturbance (acres)	New Area Disturbance (acres)	Within Prior Disturbed Area Disturbance (acres)
ML: Mined land	1.9	0.0	1.9
PA: Pajarito loamy fine sand, 0 to 3 percent slopes, eroded	2.7	0.0	2.7
PS: Potter-Simona complex, 5 to 25 percent slopes	5.0	2.0	3.0
RG: Reeves-Gypsum land complex, 0 to 3 percent slopes	3.5	0.0	3.5
SG: Simona gravelly fine sandy loam, 0 to 3 percent slopes	1.9	1.9	0.0
SM: Simona-Bippus complex, 0 to 5 percent slopes	12.5	7.6	4.9
SR: Stony and Rough broken land	1.3	1.3	0.0
Total	**42.3**	**21.0**	**21.3**

Soil types acreages are rounded up to a tenth of an acre. Slight variations between the total disturbance acres presented in this table and total disturbance acres presents for other resources for similar analyses is due to variations within the various resources datasets used for analysis.

Prepared by: MCC2
Checked by: BJW1

3.4. Air Quality

3.4.1. Affected Environment

The Proposed Action in Eddy County is located in the Pecos-Permian Basin Interstate Air Quality Control Region (AQCR) 155. Generally, this AQCR includes areas known as the Southern High Plains and the Middle Pecos River drainage basin. The total area of the AQCR is 23,749 square miles. The landscape is predominantly plains or rolling hills, although the southwestern part of the region is somewhat mountainous. Elevation ranges from 2,900 ft where the Pecos River flows into Texas to above 7,000 ft in the mountains of the southwest. Vegetation is generally grassland dotted with yucca, mesquite, or cholla; small piñon-juniper forests are found in the northern part of the region and near the Guadalupe, Sacramento, and Capitan Mountains along the southwestern border of the region. AQCR 155 also contains the most extensive areas of croplands in New Mexico.

Productive farm and rangeland, extensive oil and natural gas deposits, and potash are the major natural resources of AQCR 155. Most irrigated farming occurs along the Pecos River in lower Chaves and Eddy Counties and along the eastern border with Texas in Quay, Curry, Roosevelt, and Lea Counties. Some dryland farming is also done in this latter area (NMED 2015).

Mean monthly temperatures in the region range from 37.4°F in January to 79.7°F in July. Average annual precipitation ranges from 11.5 inches in Eddy County to 16.8 inches in Curry and Roosevelt Counties. Approximately 75% of the total precipitation falls between April and September (Powers et al. 1978). Pan evaporation is around 110 inches per year, about 73 inches of evaporation occurs from May to October over the entire area. The measured potential evaporation rates far exceed the average annual precipitation (Powers et al. 1978).

Average wind speeds are about 11 miles per hour. A wind rose available from the NMED that represents surface data for nearby Artesia, New Mexico indicates that the predominant wind direction for the area is from the southwest (NMED 2015).

Existing Air Quality

Existing air quality is presented in Section 3.5 of the EIS and excerpts are included below. Air quality is influenced by the regional climate, soil, terrain, and ongoing activities in the area. The Proposed Action is in an area classified as a Class II air quality area. Emission sources that contribute to air quality in the project area are from biogenic sources, motorized equipment, and windblown dust. Particulates from nearby oil and gas production, agricultural burning, recreational and industrial vehicular traffic, and ambient air dust can also affect air quality.

Air quality in the area near the Proposed Action is considered good, and USEPA designates Eddy County as being in attainment or unclassified with respect to the National Ambient Air Quality Standards (NAAQS) for ozone (O_3), carbon monoxide (CO), nitrogen oxides (NO_x), sulfur dioxide (SO_2), Particulate Matter < 10 microns (PM_{10}), Particulate Matter < 2.5 microns ($PM_{2.5}$), and lead.

The NMED Air Quality Bureau (AQB) conducts monitoring of ambient concentrations of pollutants throughout the State. The USEPA summarizes ambient air quality at specific monitoring locations in terms of multi-year averages. The most often used term is the design value, which is a statistic that describes the air quality status of a given location relative to the level of the NAAQS. **Table 3.4-1 - *Design Values for Criteria Pollutants in Lea, Chaves, and Eddy Counties, 2011-2013*** shows design values for O_3, NO_2, and particulate matter at locations in Eddy County, as well as locations in nearby Lea and Chaves Counties. All design values are below the applicable NAAQS (USEPA 2015).

Table 3.4-1 Design Values for Criteria Pollutants in Lea, Chaves, and Eddy Counties, 2011-2013

Criteria Pollutant	Averaging Period	NAAQS	Carlsbad	Carlsbad Caverns National Park	Hobbs
O_3 (ppm)	8-hour	0.075	0.071	0.070	0.066
$PM_{2.5}$ (μg/m^3)	24-hour	35	--	--	22
	Annual	12	--	--	8.4
PM_{10} (μg/m^3)	24-hour	150	--	--	100
NO_2 (ppb)	1-hour	100	--	--	
	Annual	53	--	--	

Notes:
μg/m^3: micrograms per cubic meter
ppb: parts per billion

Prepared by: CED1
Checked by: BAL3

The Proposed Action will not add any new sources of air emissions subject to NMED air permitting requirements.

Air emissions from the HB Plant (i.e., milling and refining processes, material handling operations and haul road activities associated with the HB Solar Solution Mine) are permitted under an NMED AQB New Source Review (NSR) Permit (NMED AQB 2013). The air permit sets limits for emissions from point sources as well as sources of fugitive dust. Fugitive dust sources include material handling operations and paved and unpaved haul roads.

In addition to the HB Plant Intrepid operates the North and West Plants. Air emissions for these three facilities are aggregated for the purpose of Clean Air Act Title V permitting, and the potential air emissions from the facilities are provided in **Table 3.4-2 - *Total Potential Pollutant Emissions from Entire Facility***.

Emissions of hazardous air pollutants are stated to be less than one ton per year for all three facilities.

Table 3.4-2 Total Potential Pollutant Emissions from Entire Facility

Pollutant	Emissions – HB Plant Only (tpy)	Emissions – HB, North, and West Plants (tpy)
Nitrogen Oxides (NO_x)	15.1	72.4
Carbon Monoxide (CO)	12.7	186.9
Volatile Organic Compounds (VOC)	0.8	4.6
Total Suspended Particulates (TSP)	89.7	426.14
Particulate Matter < 10 microns (PM_{10})	29.7	243.43
Particulate Matter < 2.5 microns ($PM_{2.5}$)	12.5	197.67
Sulfur Dioxide (SO_2)	0.4	1.8
Greenhouse Gases (GHG)	< 100,000	< 100,000

Source: Intrepid Potash, Barbara Hodgson, Environmental Manager, March 25, 2015.

The HB Plant and the "new" North Plant currently operate under separate NSR permits. The West Plant operates under a Title V permit. These permits require Intrepid to follow certain requirements to demonstrate continued compliance with NAAQS and New Mexico Ambient Air Quality Standards (NMAAQS). Intrepid has applied for an amendment of the existing Title V air permit that would include the air permit requirements for the HB Plant and the "new" North Plant.

3.4.2. Impacts from the No Action Alternative

Direct and Indirect Impacts

Under the No Action Alternative, the Proposed Action would not be developed, and the associated air quality impacts would not occur. Under this alternative, the existing HB Solar Solution Mine and associated HB Plant would continue to operate under current permits and authorizations.

3.4.3. Impacts from the Proposed Action

Direct and Indirect Impacts

Direct impacts associated with the Proposed Action would include air emissions from activities associated with construction of the new pipeline to support injection and extraction operations at the AMAX Mine as well as during ongoing operations. Construction activities are expected to generate fugitive dust during construction of access roadways to the pipelines, excavation of trenches for installation of pipelines, and backfill of soil into the trench once the pipeline installation is completed. Windblown dust may be expected for a short period of time from removed soil stored adjacent to the trench. Fugitive dust may also be generated during installation of injection and extraction wells, and installation of a booster pump station. In addition, providing overhead power to support the Proposed Action wells and booster pump station may involve minor excavation activities and movement of materials that may disturb soil during the construction process. Procedures would be developed to minimize potential effects associated with these activities and are described below in the mitigation section.

Combustion emissions would occur from mobile vehicles and ancillary equipment that are used to install the pipeline for the Proposed Action. Mobile vehicles would include trucks, excavators and other mobile equipment used during the construction activities. Combustion emissions would also occur from equipment such as trucks and drill rigs used during drilling and installation of the four injection and extraction wells. While combustion emissions associated with the construction activities have not been quantified, they could be expected to be similar or less than those identified in the EIS for construction of the HB Solar Solution Mine facilities (Section 3.5 of the HB EIS, BLM 2012).

Once construction is completed, the primary sources of airborne emissions are expected to be from fugitive dust and vehicle emissions associated with occasional vehicles that would travel on access roads to inspect and service equipment associated with the Proposed Action. There would be no new point sources of emissions, such as stacks for processing operations. Given the actual process only involves movement of liquid through wells and pipelines, airborne emissions from actual processing of the brine should be minimal. No volatile Hazardous Air Pollutants (HAP) are associated with the Proposed Action and its operations.

Operations at the HB Plant and facilities would continue to support the existing solution mining activities as well as new activities associated with the Proposed Action. No changes are planned in the HB Plant process rate or other operations at the site that would affect airborne emissions of criteria pollutants from those operations.

During NSR permitting of the HB Plant, air dispersion modeling was performed to assess the potential impact to the NAAQS and NMAAQS at the facility boundary. Results are shown in the following **Table 3.4-3 - *Summary of NAAQS Modeling Results, HB Mill Point and Fugitive Emissions***. Results show that facility-wide emissions, when adjusted for assigned background levels, were expected to be in compliance with all ambient air quality limits based on maximum capability to operate the equipment. Impacts from actual operations are expected to be less in that equipment typically operates at levels below the maximum design level. The maximum predicted impacts for the CO 1-hour and 8-hour averaging periods were below the modeling impact levels, therefore, CO modeling was not required.

Table 3.4-3 Summary of NAAQS Modeling Results, HB Mill Point and Fugitive Emissions

Pollutant	Averaging Period	Modeled Results (µg/m^3)	Background (µg/m^3)	Modeled Results with Background (µg/m^3)	NAAQS (µg/m^3)	NMAAQS
NO_2	Annual	2.4	—	2.4	100	0.050 ppm
	24-hour	10.8	—	10.8	—	0.10 ppm
$PM_{2.5}$	Annual	1.7	7.3	9.0	15	—
	24-hour	8.3	7.3	15.6	35	—
PM_{10}	Annual	5.1	20.0	25.1	—	—
	24-hour	17.6	20.0	37.6	150	—
TSP	Annual	18.2	26.6	44.8	—	60 µg/m^3
	24-hour	58.6	26.6	85.3	—	150 µg/m^3

Notes:
Modeled results rounded to one-tenth micrograms per cubic meter (µg/m^3).
NO_2: Nitrogen dioxide

Prepared by: CED1
Checked by: BAL3

The primary sources of particulate matter emissions were from unpaved and paved haul roads fugitive sources used for harvesting KCl from the solar evaporation ponds and hauling potash concentrate to the North Plant for compaction. Fugitive emissions from access roads associated with the HB Solar Solution Mine (pipelines and injection/extraction wells) were not included in dispersion modeling, as these sources of emissions are not subject to NMED air permitting. A copy of the Ambient Air Quality Modeling Report to support the air permit application is included as Appendix E, Air Dispersion Modeling.

It is expected that additional activities on the new access roads associated with the Proposed Action would not adversely impact ambient air quality levels given the smaller number of disturbed acres. In addition the access roads to the pipelines and associated equipment for the Proposed Action would only be used periodically to service and inspect equipment and would typically be used by light trucks. Therefore, expected fugitive dust emissions from access roads would be less than for haul roads used in operations.

Permits stipulate use of certain control equipment to minimize pollutant emissions and rely on mitigation to verify ongoing compliance with requirements. For example, at the HB Solution Mine and Mill, the facility controls fugitive dust from unpaved haul roads by applying a cover of base course or gravel to control particulate emissions. The facility would need to verify the frequency, quantity, and locations of the applications and assess the effectiveness of the applications to minimize visible dust.

Air dispersion modeling was also performed to determine potential impacts of the HB Plant at the nearby Living Desert State Park. Modeled results indicated that airborne concentrations are well below both Class I and Class II modeling significance levels. The highest-first-high short-term and highest annual average modeled values are presented in **Table 3.4-4 –** ***Summary of Modeled Results for Living Desert State Park*** along with background values and significance levels. It is therefore expected that fugitive emissions from the Proposed Action should also be well below these levels (Section 3.5 of the HB EIS, BLM 2012).

Table 3.4-4 Summary of Modeled Results for Living Desert State Park

Pollutant	Averaging Period	Modeled Results ($\mu g/m^3$)	Class II Modeling Significance Levels ($\mu g/m^3$)	NAAQS ($\mu g/m^3$)	NMAAQS
CO	8-hour	0.1	500	10,000	8.7 ppm
	1-hour	0.7	2,000	40,000	13.1 ppm
NO_2	Annual	0.0	1.0	100	0.050 ppm
	24-hour	0.0	5.0	—	0.10 ppm
	1-hour	1.0	5.0	188	—
$PM_{2.5}$	Annual	0.0	0.3	15	—
	24-hour	0.0	1.2	35	—
PM_{10}	Annual	0.0	1.0	—	—
	24-hour	0.1	5.0	150	—
TSP	Annual	0.0	1.0	—	60 $\mu g/m^3$
	24-hour	0.2	5.0	—	150 $\mu g/m^3$

Notes:
Modeled results rounded to one-tenth micrograms per cubic meter ($\mu g/m^3$).

Prepared by: CED1
Checked by: BAL3

Mitigation Measures

To mitigate fugitive dust emissions during construction activities, a water truck would be available to wet traffic areas as pipelines are being installed along the proposed route. Similarly, water would be used to wet down areas during installation of injection and extraction wells and the booster pump station. Use of water during these activities should minimize fugitive dust generated during these operations. A coarser gravel material may be applied in certain higher traffic locations to minimize dust generation from the roadways.

Additional mitigation measures include development of a dust control plan prior to the start of construction activities. The dust control plan would provide more details on how dust suppression methods would be used, such as water application to access roads and other disturbed areas or chemical dust suppressant application where appropriate, according to accepted and reasonable industry practice. To the extent practicable, Intrepid would use equipment that meets USEPA's Highway Diesel and Non-road Diesel Rules for project construction and maintenance operations to reduce the potential impact from combustion emissions associated with the equipment used for the Proposed Action.

3.4.4. Impacts from Alternative

Direct and Indirect Impacts

The Alternative would involve a different pipeline route, but would otherwise be similar to the Proposed Action. During the construction process, the total disturbed acres would be slightly less than the Proposed Action. However, it should be noted that while much of the pipeline for the Proposed Action would follow disturbed areas where existing pipelines are located, a larger portion of the pipeline installation for the Alternative would be on undisturbed area (see Map EA-3). As a result, the amount of new disturbed area would be greater.

3.5. Climate Change

3.5.1. Affected Environment

Greenhouse gases (GHG) consist of compounds in the earth's atmosphere that absorb outgoing long-wave radiation emitted from the earth's surface, resulting in a warming of the atmosphere. Naturally occurring greenhouse gases include water vapor, carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and O_3. Human activities also result in the release of GHG including several compounds containing fluorine, chlorine, or bromine that result, for the most part, from industrial activities. Through a natural carbon cycle, CO_2 is absorbed by the oceans and by living biomass through plant photosynthesis, and then released to the atmosphere through natural processes (USEPA 2008).

In the U.S., the primary source of anthropogenic GHG emissions is fossil fuel combustion. Fossil fuel combustion accounted for 80 percent of 2008 GHG emissions (USEPA 2010). Fossil fuels are responsible for supplying approximately 85 percent of U.S. primary energy needs and approximately 98 percent of estimated anthropogenic CO_2 emissions. N_2O is also a product of fossil fuel combustion but is largely accounted for as a byproduct of agricultural practices; methane is emitted by petroleum production operations (USEPA 2008). The U.S. released approximately 5921.2 million metric tons of CO_2 into the atmosphere in 2008. Of this total, approximately 30.0 million metric tons were released from natural gas systems (USEPA 2010).

According to the NMED, emissions of GHGs remained essentially level from 2000 to 2007, despite a 6.7% growth in New Mexico's population over that period. The largest sources of GHG emissions in 2007 were electricity production (41%), the fossil fuel industry (22%), and transportation fuel use (20%), which remains consistent with estimation for the years 1990 and 2000 (BLM 2014a).

It is estimated that approximately 17.3 million metric tons of GHGs from the natural gas industry and 2.3 million metric tons of GHGs from the oil industry were projected in 2010 as a result of oil and natural gas production, processing, transmission, and distribution (Center for Climate Strategies 2006). It is estimated that 0.01% of U.S. total GHG emissions are produced by oil and gas production in the Permian Basin (BLM 2014a).

Preliminary GHG emissions inventories have been prepared for each State in a cooperative effort between the Center for Climate Strategies and the environmental departments for each State. According to the inventory for New Mexico the GHG emissions for reporting year 2000 were 83 million metric tons of carbon dioxide equivalents (CO_2e). For any quantity and type of greenhouse gas, CO_2e signifies the amount of **CO_2** which would have the **equivalent** global warming impact. A quantity of GHG can be expressed as CO_2e by multiplying the amount of the GHG by its Global Warming Potential (GWP). The reference case GHG emissions for year 2020 were estimated at 102 million metric tons of CO_2e (Center for Climate Strategies 2006).

For 2011, GHG emissions in Chaves, Eddy, and Lea counties in New Mexico from fires (both wildfires and man-made) and mobile sources were estimated at 1,434,260 metric tons CO_2e. For the same year, industrial sources in Chaves, Eddy, and Lea Counties reported emitting 5,811,875 metric tons CO_2e (BLM 2014b). Total GHG emissions for the three counties are 7,246,135 metric tons CO_2e.

3.5.2. Impacts from the No Action Alternative

Direct and Indirect Impacts

Under the No Action Alternative, the Proposed Action would not be developed, and any associated climate change impacts would not occur. Under this alternative, Intrepid's existing HB Solar Solution Mine facility would continue to operate as currently configured. GHG emissions from existing operations would continue as presently estimated.

3.5.3. Impacts from the Proposed Action

Direct and Indirect Impacts

The primary sources of GHG emissions from the Proposed Action would be from vehicle and equipment emissions during the construction phase and to a lesser extent during operations. During construction, vehicles and equipment would include construction vehicles such as light and heavy trucks, excavators, motor graders, drilling rigs, and other support equipment. Construction activities would include trenching of proposed pipelines, installation of the injection and extraction well pads, wells, and well heads, installation of the booster pump station, and installation of overhead power lines for the booster pump and wells. Associated access roads would also be constructed during this phase.

During operations, light duty vehicles such as pickup trucks would be used to periodically conduct inspections and maintenance on the pipeline extension and well heads. In addition to the above, there may be a slight increase in GHG emissions through use of additional electricity to operate the booster pump and extraction well pumps.

While annual GHG CO_2e emissions have not been estimated for this project, during preparation of the EIS, the estimated annual electrical usage for existing operations and the Proposed Action were expected to result in a range of 114,449 to 133,979 metric tons of GHG CO_2e per year. For the same operations, mobile sources at the facility were expected to contribute up to 5,411 metric tons per year GHG CO_2e from diesel combustion, while the gasoline combustion was estimated to contribute up to 924 metric tons per year.

During construction activities, the estimated GHG CO_2e contributions from combined diesel and gasoline combustion were estimated to be 20,986 metric tons for the entire project (BLM 2012).

While the contributions from electrical use and vehicle fuel combustion have not been estimated for operations at the Proposed Action, it is projected to be minimal. Additional electricity use would be at the booster station and at the two injection and extraction wells for the Proposed Action. Once construction is completed, the use of vehicles would be limited to periodic inspections and maintenance activities for the pipeline, the booster pump station, and injection and extraction wells.

Mitigation Measures

Climate change mitigation measures would include the implementation of process and energy efficiency programs. As it is in the best interest of Intrepid to conduct operations in an efficient manner to facilitate fuel conservation, process and energy efficiency methods would be incorporated into operational practices where prudent. This may include use of energy efficient equipment and newer vehicles that meet the most stringent USEPA mobile vehicle standards.

3.5.4. Impacts from Alternative

Direct and Indirect Impacts

Impacts associated with the Alternative would be similar to the Proposed Action.

3.6. Vegetation

3.6.1. Affected Environment

Within the project area the vegetation of interest includes native vegetation, noxious and invasive weeds, and special status plant species. The following details these and how they relate to the Proposed Project.

The project area is located within the Chihuahuan Desert ecoregion, which is composed of two subregions: the Chihuahuan Basins and Playas and Chihuahuan Desert Grasslands. The Chihuahuan Desert ecoregion historically has been dominated by desert grasslands and shrublands with shrublands becoming more dominant over the last several hundred years. The transition from grasslands to shrublands is believed to be primarily the result of cattle grazing activities (NMSU 2013). The Chihuahuan Basins and Playas subregion is located mostly below 4,500 ft amsl with Chihuahuan Desert Grasslands found at higher elevations, such as elevated basins between mountain ranges, low mountain benches and plateau tops. Both the Chihuahuan and Playas subregions are extremely arid, however, the Chihuahuan Desert Grasslands have higher annual precipitation than the Chihuahuan Basins and Playas. The dominant cover types within the project area are: Desert Scrub, Mesquite Upland Scrub, and Grasslands. The following descriptions of dominant cover types are excerpts from the EIS.

Desert scrub is the most common cover type in the project area and is found in combination with the Mesquite Upland Scrub vegetation cover type throughout the majority of the project area. It is composed of several land cover types: the Chihuahuan Creosotebush Xeric Basin Desert Scrub, the Chihuahuan Mixed Desert and Thorn Scrub, and Chihuahuan Mixed Salt Desert Scrub. The Chihuahuan Creosotebush Xeric Basin Desert Scrub landcover type occurs in xeric basins and plains, the Chihuahuan Mixed Desert and Thorn Scrub is found in the transition zone between the foothills and lower montane woodlands, and the Chihuahuan Mixed Salt Desert Scrub occurs in saline basins, alluvial flats and around playas. Vegetation consists of creosotebush often found with other desert scrub species such as American tarwort (tarbush) (*Flourensia cernua*), catclaw mimosa (*Mimosa aculeaticarpa* var. *biuncifera*), junipers (*Juniperus* spp.), honey mesquite (*Prosopis glandulosa*), and plumed crinklemat (*Tiquilia greggii*). In the Chihuahuan Mixed Salt Desert Scrub areas, the dominant shrub species tend to be salt tolerant such as fourwing saltbush (*Atriplex canescens*) and other atriplex species (*Atriplex* spp.) associated with the above shrub species. Herbaceous species have lower cover than shrubs in these areas and common species include side-oats grama (*Bouteloua curtipendula*), black grama (*Bouteloua eriopoda*), bush muhly (Muhlenbergia porter), Tobosagrass (*Pleuraphis mutica*), Plains bristlegrass (*Setaria* spp.), Plains lovegrass (*Eragrostis intermedia*), and alkali sacaton (*Sporobolus airoides*).

The Mesquite Upland Scrub cover type is the second most dominant vegetation cover type and is found in combination with Desert Scrub throughout the majority of the project area. It is composed of upland shrublands and is typically found in the transition zone of foothills and piedmonts of the Chihuahuan Desert Ecoregion. It is typically found on alluvium derived substrates that are often gravelly. Vegetation is typically dominated by shrubs with little grass cover. The deep-rooted shrubs are able to exploit the deep soil moisture that is unavailable to grasses and cacti. Species include honey mesquite, littleleaf sumac, soapberry (*Sapindus* spp.) and other succulent species. Desertification has increased the extent of Mesquite Upland Scrub.

The Grassland cover type is found on a broad range of geologic areas and soil types. It is the third most common vegetation cover type, and is found on the western side of the project area. It occurs on alluvial fans, flats, slopes and basins, sandy plains and sandstone mesas. It is found on moderate to deep soils; gypsum outcrops; sandy gypsiferous and/or alkaline soils; sandy to clayey loamy, ustic soils; and soils with high sand content. The vegetated cover is typically dominated by graminoids with an open shrub layer. Graminoid species include blue grama, needle-and-thread grass (*Hesperostipa comata*), alkali sacaton, gypsum grama (*Bouteloua breviseta*), purple threeawn (*Aristida purpurea*), side-oats grama, sand dropseed (*Sporobolus cryptandrus*), hairy grama (*Bouteloua hirsuta*), and black grama (*Bouteloua eriopoda*). Shrubs and dwarf shrubs include sand sagebrush (*Artemisia filifolia*), fourwing saltbush, honey mesquite, soaptree yucca, crinklemat species (*Tiquilia* spp.), broom snakeweed, Torrey's jointfir, Apache plume (*Fallugia paradoxa*), and Torrey's yucca (Yucca torreyi). The vegetative cover is influenced by the underlying soil type. Sandy soils have higher cover of spike dropseed, soaptree yucca, and needle-and-thread grasses; while gypsum soils are dominated by gypsophilous plants such as gypsum grama.

Vegetation types and acreages contained within the project boundary were analyzed using the Southwest Regional Gap Analysis Project (SWReGAP) Land Cover data (USGS 2004). Vegetation types present within the project boundary are depicted in **Map EA-21 - *Land Cover***. Vegetation types and acreages for each type are summarized in **Table 3.6-1 - *Land Cover Type Within Project Boundary***. Land cover type descriptions obtained from NatureServe (2004) for all cover types present within the Proposed Project boundary are provided in Appendix F for reference.

Table 3.6-1 Land Cover Type Within Project Boundary

Land Cover Type	Acres in Project Boundary	Percent of Project Boundary
Apacherian-Chihuahuan Mesquite Upland Scrub	8,715.1	47.5%
Apacherian-Chihuahuan Piedmont Semi-Desert Grassland and Steppe	161.5	0.9%
Chihuahuan Creosotebush, Mixed Desert and Thorn Scrub	7,165.6	39.1%
Chihuahuan Gypsophilous Grassland and Steppe	142.2	0.8%
Chihuahuan Mixed Salt Desert Scrub	202.8	1.1%
Chihuahuan Sandy Plains Semi-Desert Grassland	146.8	0.8%
Chihuahuan Stabilized Coppice Dune and Sand Flat Scrub	57.5	0.3%
North American Arid West Emergent Marsh	3.2	0%
North American Warm Desert Active and Stabilized Dune	1.6	0%
North American Warm Desert Lower Montane Riparian Woodland and Shrubland	9.7	0.1%
North American Warm Desert Riparian Woodland and Shrubland	125.1	0.7%
North American Warm Desert Wash	11	0.1%
Open Water	345.2	1.9%
Western Great Plains Saline Depression Wetland	184.7	1.0%
Western Great Plains Sandhill Shrubland	799.1	4.4%
Western Great Plains Shortgrass Prairie	275.9	1.5%
Total	**18,347**	**100.2%**

Notes:
Land cover type acreages are rounded up to a tenth of an acre. Therefore, the total acreage is slightly larger than the proposed project boundary acreage and the calculated total percentage is greater than 100 percent.

Prepared by: MCC2
Checked by: BJW1

Noxious and Invasive Weeds

A noxious and invasive weeds survey was conducted by qualified biologists along the proposed and alternative pipeline routes, the well sites, and within 200 meters of the proposed ROW on

February 18 and 19, 2015. No noxious weeds were identified during the surveys. However, African Rue has been observed and/or sprayed within the proposed HB AMAX Solution Mine Extension Project boundary as indicated on Map EA-21. *Lepidium* and *Phacelia* were found in abundance during the surveys at the locations shown on Map EA-21. A survey narrative, datasheets, photos, and a map showing locations of the survey observations are provided in Appendix G.

Special Status Plant Species
As described in Section 3.7.2 of the HB EIS (BLM 2012), a number of special status plant species have previously been evaluated for potential occurrence within and around the project area. The EIS analysis identified two species as having a potential to occur within and around the project area. As indicated by BLM (2012) Scheer's Beehive Cactus (*Coryphantha scheeri*) and Gypsum Wild Buckwheat (*Eriogonum gypsophilum*) have the potential to be present within the vicinity of the Proposed Action.

Scheer's Beehive Cactus is listed by the State as an endangered species. It is a low growing cactus, about the size of a pineapple or beehive. Scheer's Beehive Cactus is typically found in gravelly or silty soils and occasionally on limestone or gypsum benches in nearly level areas in desert grassland and desert scrub (NMRPTC 1999). Threats to the species are primarily from trampling or domestic livestock grazing. This species was not found during the field survey.

Gypsum Wild Buckwheat is listed as a federally threatened species, and endangered by the State. Gypsum Wild Buckwheat in a perennial species with a woody stem that grows to 5 to 8 inches tall. It primarily reproduces vegetatively. This species grows almost exclusively on pure gypsum soils in areas with sparse vegetation (NMRPTC 1999). Threats to this species include grazing, domestic livestock grazing, and gypsum mining.

3.6.2. Impacts from the No Action Alternative

Direct and Indirect Impacts

The No Action Alternative would deny the approval of the Proposed Action and would not grant permission for Intrepid to access public lands in order to expand solution mine operations to produce potash. Current land and resource use would continue under current conditions in the project area.

3.6.3. Impacts from the Proposed Action

Direct and Indirect Impacts

Direct and indirect impacts to vegetation resources include short-term impacts resulting from construction related activities and long-term impacts resulting from the presence of permanent facilities during the operation of the Proposed Action. Short-term impacts would include trampling of herbaceous vegetation and removal of vegetation during construction activities. Long-term impacts would include permanent loss of vegetation for operational facilities and the conversion of shrub-dominated land cover types to grass/forb-dominated land cover types. Long-term impacts could also result due to groundwater withdrawals for operational activities. Impacts to vegetation from groundwater drawdown are described in Section 4.7 of the HB EIS (BLM 2012).

Short-term construction activities associated with trenching of the proposed pipelines, installation of the injection and extraction well pads, installation of the booster pump station, and installation of overhead power-runs to well heads, as described in Section 2.2, would directly impact approximately 84.4 acres of vegetation resources. Approximately 33.7 acres is already disturbed and 27.6 acres is adjacent to disturbed areas. Direct construction impacts to vegetation are summarized in **Table 3.6-2 - *Proposed Action Construction Land Cover Type Disturbances***.

Table 3.6-2 Proposed Action Construction Land Cover Type Disturbances

Land Cover Type	Total Disturbance (acres)	New Area Disturbance (acres)	Within Prior Disturbed Area Disturbance (acres)
Apacherian-Chihuahuan Mesquite Upland Scrub	49.7	28.2	21.5
Apacherian-Chihuahuan Piedmont Semi-Desert Grassland and Steppe	0.9	0.3	0.6
Chihuahuan Creosotebush, Mixed Desert and Thorn Scrub	30.8	19.7	11.1
Chihuahuan Gypsophilous Grassland and Steppe	0.2	0.0	0.2
Chihuahuan Mixed Salt Desert Scrub	0.1	0.1	0.0
Chihuahuan Sandy Plains Semi-Desert Grassland	0.3	0.3	0.0
North American Warm Desert Wash	0.2	0.2	0.0
Western Great Plains Sandhill Shrubland	1.9	1.9	0.0
Western Great Plains Shortgrass Prairie	0.3	0.0	0.3
Total	**84.4**	**50.7**	**33.7**

Land cover type acreages are rounded up to a tenth of an acre. Slight variations between the total disturbance acres presented in this table and total disturbance acres presents for other resources for similar analyses is due to variations within the various resources datasets used for analysis.

Prepared by: MCC2
Checked by: BJW1

Following construction, the operation of Proposed Action system components and infrastructure, as described in Section 2.2, would directly impact approximately 47.2 acres of vegetation resources. Approximately 17.5 acres is already disturbed and 14.0 acres is adjacent to disturbed areas. Long-term direct operational impacts to vegetation are summarized in **Table 3.6-3 - *Proposed Action Operations Land Cover Type Disturbances***.

Table 3.6-3 Proposed Action Operations Land Cover Type Disturbances

Land Cover Type	Total Disturbance (acres)	New Area Disturbance (acres)	Within Prior Disturbed Area Disturbance (acres)
Apacherian-Chihuahuan Mesquite Upland Scrub	27.1	16.1	11.0
Apacherian-Chihuahuan Piedmont Semi-Desert Grassland and Steppe	0.8	0.2	0.6
Chihuahuan Creosotebush, Mixed Desert and Thorn Scrub	17.6	12.0	5.6
Chihuahuan Gypsophilous Grassland and Steppe	0.1	0.0	0.1

Land Cover Type	Total Disturbance (acres)	New Area Disturbance (acres)	Within Prior Disturbed Area Disturbance (acres)
Chihuahuan Mixed Salt Desert Scrub	0.1	0.1	0.0
Chihuahuan Sandy Plains Semi-Desert Grassland	0.2	0.2	0.0
North American Warm Desert Wash	0.1	0.1	0.0
Western Great Plains Sandhill Shrubland	1.0	1.0	0.0
Western Great Plains Shortgrass Prairie	0.2	0.0	0.2
Total	**47.2**	**29.7**	**17.5**

Land cover type acreages are rounded up to a tenth of an acre. Slight variations between the total disturbance acres presented in this table and total disturbance acres presents for other resources for similar analyses is due to variations within the various resources datasets used for analysis.

Prepared by: MCC2
Checked by: BJW1

Indirect impacts to vegetation during construction and vehicle travel during operation would include the potential colonization of noxious and invasive weeds, fugitive dust, and fragmentation of land cover types. The colonization of noxious and invasive weeds would impact vegetation resources by degrading and modifying native vegetation types.

Mitigation Measures

Throughout the construction and operation of the Proposed Action several best management practices would be utilized to minimize impacts to vegetation resources as described in Section 2.2 of this EA. Additional mitigation measures include the following:

- Areas disturbed due to the construction and operations of Proposed Action system components and infrastructure would be inspected for the presence of noxious and invasive weeds.
- If noxious and invasive weeds become established, BLM approved weed control methods would be utilized to eradicate the noxious and invasive weeds.

3.6.4. Impacts from Alternative

Direct and Indirect Impacts

Direct and indirect vegetation impacts associated with the alternative proposed pipeline route and subsequent operation of the proposed p would remain consistent with the impacts described for the proposed project, with the exception of the number of disturbed acres.

Short-term construction activities associated with trenching of the alternative pipelines, installation of the injection and extraction well pads, installation of the booster station, and installation of overhead power-runs to well heads, as described in Section 2.2, would directly impact approximately 75.2 acres of vegetation resources. Approximately 43.3 acres is already disturbed. Direct construction impacts to vegetation are summarized in **Table 3.6-4 - *Alternative Construction Land Cover Type Disturbances***.

Table 3.6-4 Alternative Construction Land Cover Type Disturbances

Land Cover Type	Total Disturbance (acres)	New Area Disturbance (acres)	Within Prior Disturbed Area Disturbance (acres)
Apacherian-Chihuahuan Mesquite Upland Scrub	39.7	17.0	22.7
Apacherian-Chihuahuan Piedmont Semi-Desert Grassland and Steppe	1.8	0.2	1.6
Chihuahuan Creosotebush, Mixed Desert and Thorn Scrub	32.6	14.2	18.4
Chihuahuan Gypsophilous Grassland and Steppe	0.2	0.0	0.2
Chihuahuan Mixed Salt Desert Scrub	0.1	0.1	0.0
Open Water	0.1	0.1	0.0
Western Great Plains Saline Depression Wetland	0.0	0.0	0.0
Western Great Plains Sandhill Shrubland	0.3	0.3	0.0
Western Great Plains Shortgrass Prairie	0.4	0.0	0.4
Total	**75.2**	**31.9**	**43.3**

Land cover type acreages are rounded up to a tenth of an acre. Slight variations between the total disturbance acres presented in this table and total disturbance acres presents for other resources for similar analyses is due to variations within the various resources datasets used for analysis.

Prepared by: MCC2
Checked by: BJW1

Following construction of pipelines along the alternative route, the operation of proposed project system components and infrastructure, as described in Section 2.2, would directly impact approximately 42.3 acres of vegetation resources. Approximately 22.3 acres is already disturbed. Long-term direct operational impacts to vegetation for the alternative are summarized in **Table 3.6-5 - *Alternative Operations Land Cover Type Disturbances*.**

Table 3.6-5 Alternative Operations Land Cover Type Disturbances

Land Cover Type	Total Disturbance (acres)	New Area Disturbance (acres)	Within Prior Disturbed Area Disturbance (acres)
Apacherian-Chihuahuan Mesquite Upland Scrub	22.0	10.4	11.6
Apacherian-Chihuahuan Piedmont Semi-Desert Grassland and Steppe	1.2	0.1	1.1
Chihuahuan Creosotebush, Mixed Desert and Thorn Scrub	18.6	9.3	9.3
Chihuahuan Gypsophilous Grassland and Steppe	0.1	0.0	0.1
Open Water	0.0	0.0	0.0

Land Cover Type	Total Disturbance (acres)	New Area Disturbance (acres)	Within Prior Disturbed Area Disturbance (acres)
Western Great Plains Sandhill Shrubland	0.2	0.2	0.0
Western Great Plains Shortgrass Prairie	0.2	0.0	0.2
Total	**42.3**	**20.0**	**22.3**

Land cover type acreages are rounded up to a tenth of an acre. Slight variations between the total disturbance acres presented in this table and total disturbance acres presents for other resources for similar analyses is due to variations within the various resources datasets used for analysis.

Prepared by: MCC2
Checked by: BJW1

3.7. Wildlife and Fish

3.7.1. Affected Environment

Terrestrial Wildlife

Within the project area the main wildlife habitat types are desert scrub, mesquite upland scrub, and grasslands, with small areas of open water, saline depression wetland, woody riparian, active and stabilized dune, warm desert wash, caves, and emergent marsh. This varying habitat offers support for a variety of wildlife species from different taxonomic groups. This section provides basic information on species potentially occurring within and around the Proposed Action and may be sensitive to disturbance or of special concern to one of the agencies responsible for the well-being of that species.

Big game species have the potential to occur within and around the Proposed Action. Potential big game species include mule deer (*Odocoileus hemionus*), pronghorn (*Antilopcapra americana*), javelina (*Dicotyles tajacu*), and mountain lion (*Felis concolor*) (BLM 2007b). Mule deer are found east of the Pecos River in isolated areas that have adequate permanent water sources, adequate cover, abundant food sources (shinnery oak), and some topographic relief. Pronghorn habitat consists of the prairie grasslands and shinnery oak dunes. Javelinas prefer habitat areas of mixed desert shrub or mesquite grassland. Mountain lions may occasionally travel through the mesquite grasslands and shinnery oak dune areas in and near the Proposed Action area.

A number of small game species have the potential to occur within and around the Proposed Action. Potential species could include mourning dove (*Zenaidura macroura*), scaled quail (*Callepepla squamata*), bobwhite quail (*Colinus virginianus*), black-tailed jackrabbit (*Lepus californicus*), and desert cottontail (*Sylvilagus audubonii*) (BLM 2007b). Bobcat (*Lynx rufus*), coyote (*Cannis letrans*), raccoon (*Procyon lotor*), and badger (*Taxidea taxus*) could also occur within and around the Proposed Action area as well.

Non-game species, such as mammals, raptors, passerines, amphibians, and reptiles, have the potential to occur within the diverse habitat types located around and within the Proposed Action area. Non-game mammals potentially occurring within and around the project boundary include bats, mice, shrews, squirrels, rabbits, and rats. These small mammals provide a prey base for the predators, such as mammals (coyote, badger, skunk), raptors (eagles, buteos, accipiters, owls), and reptiles.

Nongame birds encompass a variety of passerine and raptor species, these include a diversity of neotropical migrants (birds that breed in North America and winter in the neotropical region of South America). These birds are considered integral to natural communities and act as environmental indicators due to their sensitivity to environmental changes. Common bird species that occur within and around the project boundary may include, but are not limited to, horned lark (*Eremophila alpestris*), western meadowlark (*Sturnella neglecta*), Chihuahuan raven (*Corvus cryptoleucus*), western kingbird (*Tyrannus* *vertucalis*), sage sparrow (*Amphispiza belli*), and lesser prairie-chicken (Tympanuchus pallidicintus) (BLM, 2007b). Representative raptor species include the golden eagle (*Aquila chrysaetos*), red-tailed hawk (*Buteo jamaicensis*), Swainson's hawk (*Buteo swainsoni*), rough-legged hawk (*Buteo lagopus*), ferruginous hawk (*Buteo regalis*), American kestrel (*Falco sparverius*), and great-horned owl (*Bubo virginianus*) (BLM 2007b).

Aquatic Species

No fisheries occur within and around the project boundary. The closest perennial stream to the Proposed Project is the Pecos River, which is approximately 14 miles away. The Pecos River supports warm water fisheries. Other aquatic organisms may occupy karst features such as sinkholes, within and around the project boundary. Two troglobitic species, a new species of amphipod and a new species of cocopod, were found in the karst aquifers of Burton Flat during a biological survey for the HB EIS.

Special Status Species

The Proposed Action lies within and adjacent to areas that have been identified as habitat areas for special status species lesser prairie-chicken and dunes sagebrush lizard (*Sceloporus arenicolus*) as determined in the Special Status Species ROD and Approved RMPA (BLM 2008). The special status species habitat area for these two species in relationship to the project boundary is shown in **Map EA-22 - *Wildlife Map***.

In addition to the lesser prairie-chicken and the dunes sagebrush lizard, several other special status species have the potential to occur within project boundary, based on the sensitive species analysis conducted for the EIS as described in Section 3.8.3 of the HB EIS (BLM 2012). **Table 3.7-1 - *Special Status Species Potentially Occurring Within the Project Area*** provides a summary of the special status species that may potentially be present.

Table 3.7-1 Special Status Species Potentially Occurring Within the Project Area

Common Name (Scientific Name)	Status	Habitat Information	Notes
Pale Townsends's big-eared bat (*Corynothinus townsendii pallescens*)	BLM, USFWS	This subspecies relies on caves, inactive mines, trees, and manmade structures for roosting. Mixed grass prairies, piñon–juniper woodlands, desert shrublands, and coniferous forests are likely habitat types for the bat.	This is the only bat subspecies common to New Mexico in the wintertime.
Cave Myotis (*Myotis velifer incautus*)	BLM	This bat uses caves, tunnels, mine shafts, bridges, and even old barn swallow nests and the undersides of bridges to roost. Populations are scattered and their presence is dependent on sufficient roosting habitat. Usually found not far from riparian areas.	The cave myotis prefers to roost in small enclosed, crevices, holes, or pockets of caves, mines, and buildings.
Brazilian free-tail bat (*Nyctinomops mactotis*)	BLM	Forests and cliff faces are the preferred habitat types of this species. Cracks and fissures along rock walls provide hibernacula and coniferous forests with ponderosa pine, and douglas fir are prime areas for feeding and roosting.	This species is found most often below 6,000 ft altitude, and rarely up to 8,000 ft.

Common Name (Scientific Name)	Status	Habitat Information	Notes
Fringed Myotis (*Myotis thysanodes thysanodes*)	BLM	This species has a wide range of potential habitats, from montane forests, riparian woodlands, and mixed coniferous forests, to mixed shrub, grassland, sage brush, and even cropland.	Roosting sites include caves, mines, and buildings often near a water source.
Long-legged myotis (*Myotis volans interior*)	BLM	Largely a forest species, the long-legged myotis utilizes cottonwood trees in riparian woodlands, and ponderosa or piñon-juniper woodlands on mountainsides.	This species roosts primarily in trees, often aspen, douglas fir, or sycamores.
Western small-footed myotis (*Myotis ciliolabrum melanorhinus*)	BLM	This species is common among willow lined stream banks and other riparian habitat, as well as coniferous forests and grasslands.	This species has been known to roost in caves, rock crevices, under bark and rocks, and in burrows.
Yuma myotis (*Myotis yumanensis yumanensis*)	BLM	This species is closely associated with permanent water sources and riparian habitat; however it is also present in upland areas where juniper-piñon woodlands are dominant.	Mainly feeds in open surface water habitat for insects. Primarily present in the 4,000 to 7,000 ft elevation range.
Swift fox (*Vulpes velox velox*)	BLM, USFWS	Short- and mid-grass prairie and grassland or open shrubland with flat or gentle topography suited for hunting and burrowing.	Preys on small rodents such as the kangaroo rat (*Dipodomys* spp.) and rabbits. Has been documented capturing and eating insects.
Burrowing owl (*Athene cunicularia hypagaea*)	BLM, USFWS	Open grasslands, croplands, and semi desert shrublands. Requires dry, open, flat areas for nesting.	Often nests in abandoned prairie dog, badger, or fox burrows in dry, open terrain.
Loggerhead shrike (*Lanius ludovicianus excubitorides*)	BLM	Native grasslands, open desert shrub with creosote bush (*Larrea tridentate*) and areas high in native, herbaceous forbs.	Also found in ponderosa pine, douglas fir, and aspen forest types.
Baird's sparrow (*Ammodramus bairdii*)	USFWS, NM-T	Short grass prairie, desert grasslands, and mountain meadows up to 3,600 ft.	Temporary migrant in New Mexico.
Gray vireo (*Vireo vicinior*)	NM-T	Open woodlands and shrublands dominated by junipers and oaks, sometimes with mixed conifer forests. Often found in proximity to a water source.	Foothills and mesas, with well-developed grass component are favored by this species.

Common Name (Scientific Name)	Status	Habitat Information	Notes
Texas horned lizard (*Phrynosoma cornutum*)	BLM	This species lives in open, dry desert with sparse vegetation, and relies on loose sand and soil or rocks to hide under.	The Texas horned lizard feeds almost exclusively on ants but will eat other invertebrates like beetles as well.
Lesser prairie-chicken (*Tympanuchus pallidicinctus*)	FT, BLM	Open grasslands of short-to mid-grass prairie with intermittent sagebrush and shinnery oak components is vital to this species. Open areas on hilltops or ridgelines are used as "leking" spots which is where the mating courtship takes place. Shrubs and grasses are necessary for nesting and feeding.	In the southeastern part of New Mexico, lesser prairie-chickens exist in the shrub-dominated High Plains Bluestem habitat type in mixed stands of tall grasses (i.e., sand bluestem, little bluestem) and shinnery oak.
Sand dune lizard (*Sceloporus arenicolus*) *Dunes sage brush lizard	BLM, NM-E	An open sand dune with shinnery oak is the habitat in which this reptile lives. Rarely is the sand dune lizard found more than 4-6 ft away from a shinnery oak plant. The dunes have to be active or semi-active, as it seems that when a dune becomes completely stabilized by vegetation and covered with grasses it is no longer suitable habitat for this lizard. The open sand is needed to bury eggs within.	Because of its close association with shinnery oak and active sand dunes, this reptile is somewhat limited in where it can survive and therefore highly sensitive to disturbance. Significant reductions in sand dune lizard populations are associated with the removal of shinnery oak.

Notes:
BLM = BLM sensitive: New Mexico State Office (NMSO)
FT = Federally listed as threatened
NM-E = State-listed as endangered in New Mexico
NM-T = State-listed as threatened in New Mexico
USFWS = USFWS species of concern

Prepared by: JBK
Checked by: MCC2

Source: BISON-M (2015)

Pursuant to Executive Order (EO) 13186 (2001), a Memorandum of Understanding between the BLM, United States Forest Service, and USFWS was drafted in order to promote conservation and protection of migratory birds. The EO provides guidance to federal agencies to minimize adverse effects and promote best management practices for the conservation of migratory birds.

Wildlife Survey

A burrowing owl and raptor nest survey was conducted by biologists along the proposed and alternative pipeline routes, the well sites, and within 200 meters of the proposed ROW on February 18 and 19, 2015. During the surveys, two long-eared owls (Asio otus) and one Cooper's hawk (Accipiter cooperii) were flushed. One raptor nest, whitewash, and castings suggesting the presence of raptors were also observed. No evidence of burrowing owls was observed. Small mammal burrows were observed throughout the length of the pipeline routes. The locations of observation made during the surveys are shown on Map EA-22. A survey narrative, datasheets, photos, and a map showing locations of the survey observations are provided in Appendix G.

3.7.2. Impacts from the No Action Alternative

Direct and Indirect Impacts

The No Action Alternative would deny the approval of the proposed project and would not grant permission for Intrepid to access public lands in order to expand solution mine operations to produce potash. Current land and resource use would continue under current conditions in the project area.

3.7.3. Impacts from the Proposed Action

Direct and Indirect Impacts

Impacts to wildlife include short-term impacts resulting from construction related activities and long-term impacts resulting from the presence of permanent facilities during the operation of the Proposed Action. Short-term impacts to wildlife would include direct disturbance of wildlife habitat and indirect reduction in habitat quality due to increased human activity. Long-term impacts would include direct habitat loss due to the presence of operational facilities and indirect reduction in habitat quality due to increased human activity associated with the operation of the Proposed Action.

Construction activities associated with trenching of the proposed action pipelines, installation of the injection and extraction well pads, installation of the booster pump station, and installation of overhead power-runs to well heads, as described in Section 2.2 of this EA, would result in approximately 84.7 acres of surface disturbance. Impacts to big game species (primarily pronghorn and mule deer) include the loss of forage and would result in minor habitat fragmentation from the installation of new infrastructure. Herbaceous species and grasses may become established within 3 to 5 years, depending on reclamation success. Suitable habitat adjacent to construction disturbance areas (new pipelines, transmission lines, maintenance roads, and well pads) would be available for these big game species until grasses and woody vegetation are reestablished within the construction disturbance areas. The predominant vegetation that would be affected by construction disturbance is Mesquite Upland Scrub and Desert Scrub. These vegetation types would be replaced by native grasses and herbaceous plants during initial reclamation, which would attract big game species as well as many small game and nongame species that utilize grasslands and herbaceous feed and cover.

Impacts to small nongame species would include nest or burrow abandonment or loss of eggs or young from the removal or crushing of natural habitat during construction due to disruption from human activity. Wildlife movements within the project area would be directly altered only during the installation of the pipelines while the trenches are open. After the installation of pipelines, direct impacts to wildlife movement are not expected as all pipelines would be buried.

Construction would result in the mortality of some less mobile or burrowing nongame species (e.g., small mammals, nesting birds, reptiles, amphibians, invertebrates) as a result of crushing from vehicles and construction equipment. Other impacts include the short-term displacement of some of the more mobile species (e.g., medium-sized mammals, adult birds) as a result of surface disturbance activities. The habitats adjacent to the proposed disturbance areas may support some displaced animals.
If surface-disturbing activities occur near nesting sites during the breeding season for passerines (approximately March 1 through August 31), impacts would result in nest or territory abandonment, loss of eggs or young resulting in the loss of productivity for the breeding season. For species protected under the MBTA, the loss of an active nest site, incubating adults, eggs, or young would be a violation of the MBTA. However, the extent of impacts to nesting birds would depend on the nest location relative to the actual locations of construction, the phase of the breeding period, and the level and duration of the disturbance.

Bats in the area could be attracted to the evaporation ponds by insects swarming around lights. These bats could then potentially drink from the evaporation ponds. The effects on bats from drinking brine from the ponds have not been determined.

During operations, direct impacts to wildlife species from the operation and maintenance activities associated with the operation of the Proposed Action would include long-term habitat loss or alteration of potential breeding or foraging habitats until native vegetation has become reestablished. Indirect impacts to wildlife species would result from the increase in habitat disruption from the increase of vehicle traffic and human presence for operation and maintenance activities. Over time, most wildlife species should become acclimated to the noise and human presence resulting from the operation of the Proposed Action.

Mitigation Measures

Throughout the construction and operation of the Proposed Action several best management practices would be utilized to minimize impacts to wildlife and fish as described in Section 2.2. Lights at the solar evaporative ponds would be turned off when harvesting was not taking place, approximately April through July of each year. A bat use survey would be conducted at the solar evaporative ponds to determine if bats are drinking from the solar ponds.

3.7.4. Impacts from Alternative

Direct and Indirect Impacts

Direct and indirect wildlife and fish impacts associated with the alternative action and subsequent operation of the proposed project would remain consistent with the impacts described for the Proposed Action, with the exception of the number of disturbed acres during construction.

3.8. Rangelands and Livestock Grazing

3.8.1. Affected Environment

The following section presents range management activities for the project area. The study area for range resources is defined as the project area and is represented in **Map EA-23 – *Range Allotments*.** There are three grazing allotments that occur in the project area, all of which are cattle allotments. Two allotments also show horses on the permit (Clayton Basin and Twin Wells North). **Table 3.8-1 – *Grazing Allotments in the Project Area*** summarizes each grazing allotment within the project area, including acreage calculations, current stocking rates, and permitted uses. **Table 3.8-2 – *Range Allotment Disturbance in Acres*** summarizes the surficial disturbance from pipelines, well pads, booster pump station, and power lines from the Proposed Action and Alternative routes of the pipeline. The proposed and alternative pipeline routes each cross 3 pasture fences, one rangeland allotment boundary, and one livestock freshwater pipeline.

All of the surficial disturbances represent a short term loss that would most likely be recovered within 3-5 growing seasons. Land ownership is primarily public with a small portion of each allotment encompassing private land. Additional details regarding rangelands and livestock grazing, such as grazing allotments in existing pipeline ROWs and management categories, are described in Section 3.9 of the HB EIS (BLM 2012).

Table 3.8-1 Grazing Allotments in the Project Area

Grazing Allotment Name	Total Allotment Active AUMs	Allotment Acreage Within the Project	Projected Active AUMs Within Project	Livestock		Season of Use	% of Public Land
				Type	Number		
Clayton Basin	10,200	1,311	154	Cattle/ Horses	1,000	Yearlong	85
Twin Wells North	11,664	15,476	2,831	Cattle/ Horses	1,200	Yearlong	81

Notes:
1. The number and class of livestock, active AUMs, and stocking rates come from the full grazing permit numbers.
2. Burton North, while in the project area, would not include any project infrastructure or disturbance.

AUM: Animal unit month

Prepared by: BAL3
Checked by: MJH5

Table 3.8-2 Range Allotment Disturbance in Acres

Grazing Allotment Name	Proposed Action Route		Alternative Route	
	Construction (50 ft)	Operational (25 ft)	Construction (50 ft)	Operational (25 ft)
Clayton Basin	5.0	2.9	5.0	2.9
Twin Wells North	79.2	44.0	69.9	39.3
Total	84.2	46.9	74.9	42.2

Prepared by: BAL3
Checked by: MJH5

Water sources for livestock include intermittent and ephemeral streams, lakes, and stock ponds. Water related range improvements in the project area include base water sources, water wells and water storage, troughs, and wells (**Table 3.8-3 - *Water Related Range Improvements Within the Project Area)*.**

Table 3.8-3 Water Related Range Improvements Within the Project Area

Grazing Allotment Name	Trough	Water Well and Storage	Livestock Pipeline
Clayton Basin	—	—	—
Twin Wells North	10	1	8 miles
Total	**10**	**1**	**8 miles**

Source: BLM 2012

Prepared by: BAL3
Checked by: MJH5

3.8.2. Impacts from the No Action Alternative

Direct and Indirect Impacts

The No Action Alternative would deny the approval of the proposed project and would not grant permission for Intrepid to access public land in order to expand solution mine operations to produce potash. Current land and resource use would continue under current conditions in the project area.

3.8.3. Impacts from the Proposed Action

Direct and Indirect Impacts

The loss of 84.2 acres of vegetation during construction and 46.9 acres of vegetation during operation would not affect the AUMs authorized for livestock use in this area. There would only be a temporary disturbance of 14 AUMs during the construction phase, and 6 AUMs during the operation phase. Several existing fences and one livestock water pipeline, shown in **Map EA-24 – *Range Allotments Features*,** may be affected during the construction of the pipeline and overhead power-runs.

There are occasional livestock injuries or deaths due to accidents such as collisions with vehicles, falling into excavations, and ingesting plastic or other materials present within the project area. If further development occurs, the resulting loss of vegetation could reduce the AUMs authorized for livestock use in this area. If a pipeline leak developed and brine reached the land surface from the buried pipeline the brine could kill vegetation and reduce the AUMs authorized for livestock use in that area. If fences are temporary down or gates are left open this could either disrupt the livestock rotation scheme or accidently allow cattle to move into another allotment. If the livestock freshwater supply pipeline is damaged during construction cattle could lose their water supply until the damage is repaired.

The impacts to the ranching operation are reduced by standard practices such as utilizing existing surface disturbance, minimizing vehicular use, placing parking and staging areas on caliche surfaced areas, always closing gates, not leaving fences open, and quickly establishing vegetation on the reclaimed areas.

Mitigation Measures

Throughout the construction and operation of the Proposed Action several best management practices would be utilized to minimize impacts to rangelands and livestock grazing as described in Section 2.2.

- In the event of a pipeline leak, Intrepid would contain and clean up the spill area in accordance with the permit conditions stated in Discharge Permit DP 1681 and other applicable BLM or State requirements.
- If a livestock pipeline is crossed during construction activities the pipeline would be protected to prevent damage.

3.8.4. Impacts from Alternative

Direct and Indirect Impacts

The loss of 74.9 acres of vegetation during construction and 42.2 acres of vegetation during operation would not affect the AUMs authorized for livestock use in this area. There would only be a temporary disturbance of 12 AUMs during the construction phase, and 6 AUMs for the operation phase. Livestock injuries or deaths due to accidents such as collisions with vehicles, falling into excavations, and ingesting plastic or other materials present at the work site could occur. If further development occurs, the resulting loss of vegetation could reduce the AUMs authorized for livestock use in this area.

3.9. Lands and Realty

3.9.1. Affected Environment

Land use within and around the project area is currently comprised of livestock grazing, recreation, oil and gas leases with well sites and associated infrastructure, and potash mining with associated infrastructure. Due to the nature of the existing land uses, construction and operation associated with the proposed project will temporarily interrupt current land use within small portions of the project area. There are no areas with wilderness characteristics within or near the Proposed Action. Hunting, off highway vehicle (OHV) use, camping, wildlife viewing, and picnicking are common recreational activities. Recreational activities are further discussed in Section 3.10.

Land ownership within the project boundary is summarized in **Table 3.9-1 - *Land Ownership*** and shown in **Map EA-25 - *Surface Ownership***. Land owned by the federal government is administered by the BLM and Trust lands granted to the State of New Mexico are managed by the New Mexico State Land Office (SLO).

Table 3.9-1 Land Ownership

Ownership	Percent Ownership	Acres
Federal Lands	77	14,184
State Trust Lands	20	3,603
Private	3	560
Total	100	18,347

Prepared by: MCC2
Checked by:BJW1

STH 360 extends across the central portion of project boundary in a northwest-southeast/south direction. Two pipeline crossings would intersect the STH 360 ROW within the proposed project area. Intrepid would obtain the appropriate permits for these crossing through the NMDOT. Additionally, CR 222/Shugart Road and County Road (CR) 235/Curry Comb Road initiate from within the southernmost part of the project boundary and run northeast and northwest, respectively. Most of the roads within and around the project boundary are BLM- and State-authorized ROWs, but there are a number of secondary, non-maintained two-track roads.

A number of existing BLM- and State-permitted ROWs lie within project boundary. ROWs for oil and gas pipelines, electric power lines, roads, telephone lines and fiber optic cables, and water pipelines are permitted within the project area and are shown in the following figures:

Map EA-26 – *Oil and Gas ROWs in the HB AMAX Extension Boundary*
Map EA-27 – *Electric ROWs in the HB AMAX Extension Boundary*
Map EA-28 – *Road ROWs in the HB AMAX Extension Boundary*
Map EA-29 – *Telephone/Fiber Optic ROWs in the HB AMAX Extension Boundary*
Map EA-30 – *Water ROWs in the HB AMAX Extension Boundary*

Additional information regarding the existing ROWs may be obtained from Appendix A of the *HB Solar Solution Mine Discharge Permit DP-1681 Renewal and Modification Application* (Intrepid Potash Inc./Foth 2015) prepared for the NMED.

3.9.2. Impacts from the No Action Alternative

Direct and Indirect Impacts

The No Action Alternative would deny the approval of the proposed project and would not grant permission for Intrepid to access public lands in order to expand solution mine operations so to produce potash. Current land use and resource management would continue under current conditions in the project area.

3.9.3. Impacts from the Proposed Action

Direct and Indirect Impacts

The Proposed Action would affect federal lands managed by the BLM and the State. New ROW authorizations may be required for power distribution to the proposed wells and booster pump station. No other new ROWs would be required as all other surface access and disturbance falls within the boundaries of existing State and federal leases. The establishment of new power line ROWs could limit other future land uses within the Proposed Action boundary for the life of the new power distribution network. Other uses common in the area that could be affected include OHV trails and access to oil and gas development.

New access roads would not be gated so they may increase public access for unauthorized OHV or other vehicle use. This unauthorized may require increased notification requirements, signage, and enforcement.

Pipelines would be installed under STH 360 at two locations within the project boundary. Because the pipelines would be bored under the roads, little to no interruption of traffic would occur during construction.

During construction, a minor increase in traffic due to the Proposed Action would be expected. During construction activities there would be increased traffic to and from the project site by service trucks, construction equipment, material delivery, and daily travel by construction workers. The increased traffic to and from the Proposed Action would be well within the capacity of the existing roads.

Subsidence resulting from the operation of the Proposed Action is projected to be minimal as indicated in Section 3.1.3. However, current land uses such as existing oil and gas pipelines could be affected. There are no residences or outbuildings within the area of potential subsidence.

Several utilities within Proposed Action boundary may be affected by the Proposed Action infrastructure, include the crossing of the following approximate number of ROWs:

- 12 oil and gas ROWs;
- 9 electric ROWs;
- 3 road ROWs;
- 3 telephone/fiber optic ROWs; and
- 3 water ROWs.

Mitigation Measures

Additional mitigation measures are not recommended beyond the design features that are described in Section 2.1. Prior to construction, all ROWs would be field verified and agreements would be made with ROW holders when their ROW is to be crossed by the proposed HB AMAX Solution Mine Extension Project pipelines, roads, and overhead power-runs.

3.9.4. Impacts from Alternative

Direct and Indirect Impacts

Direct and indirect lands and realty impacts associated with the proposed Alternative pipeline route and subsequent operation of the Alternative would remain consistent with the impacts described for the Proposed Action, with the exception of the number of existing ROWs that may be impacted. Several utilities within the project boundary may be affected by the alternative action infrastructure, include the crossing of the following approximate number of ROWs:

- 10 oil and gas ROWs;
- 5 electric ROWs;
- 4 road ROWs;
- 5 telephone/fiber optic ROWs; and
- 5 water ROWs.

3.10. Recreation

3.10.1. Affected Environment

Recreation within the project boundary is currently comprised of OHV activities as well as hunting, camping, and picnicking. All federal public lands in the area are designated as limited, open, or closed to OHV activities. All of the BLM-administered land in the project area is designated as open to OHV use. (Section 3.11 of the HB EIS, BLM 2012).

A portion of the Hackberry Lake Special Recreation Management Area (SRMA) covers the eastern part of the project boundary as shown in **Map EA-31 - *Recreation Lands***. This recreation area totals approximately 58,500 acres, and is open for intensive use of motorcycles, ATVs, and other OHVs and is getting frequent use year-round. The Desert Rough Riders hold a Special Recreation Use Permit in the Hackberry Lake OHV Area to hold a 2-day motocross and all-terrain vehicle race each April. The most commonly used parking area for the Hackberry Lake OHV Area is just to the east of the project boundary on the north side of CR 222/Shugart Road.

Approximately, 2,371 acres, or 4 percent, of the Hackberry Lake SRMA lies within the project boundary. The recreation area overlaps approximately 12 percent of the project boundary. Trails within the recreation area typically consist of many turns and steep hill climbs. Camping is allowed in the Hackberry Lake SRMA and facilities include picnic tables, shelters, fire rings, vault toilets, and parking areas at two different locations (trails on the east side and dune complex on the west side of the SRMA). Hunting is another recreational activity that occurs within and around the project boundary. A variety of species including big game, upland birds, and varmints are hunted in the project area.

3.10.2. Impacts from the No Action Alternative

Direct and Indirect Impacts

The No Action Alternative would deny the approval of the proposed project and would not grant permission for Intrepid to access public lands in order to expand solution mine operations to produce potash. Current land and resource used would continue under current conditions in the project area.

3.10.3. Impacts from the Proposed Action

Direct and Indirect Impacts

Construction activities would potentially affect recreation activities such as dispersed camping and hunting due to surface disturbance and occupancy during construction. Construction of the Proposed Action infrastructure would generate increased noise and traffic primarily during the day, which may temporarily diminish camping and hunting activities. The presence of new aboveground facilities also would potentially diminish the hunting experience by displacing habitat as well as increasing noise and human presence. Increased project-related traffic on both access roads and BLM roads may tend to reduce tourism and recreational uses in the area. This impact is likely to be minor due to the users being accustomed to existing mineral development and oil/gas operations within the project area.

The Hackberry SRMA receives the highest level of recreational use within the project boundary. Public access to this area may be impeded by increased project-related traffic, especially during construction. Also, increased vehicle and heavy equipment travel in the immediate area of the SRMA may pose a risk to OHV operators on access roads. Infrastructure such as new roads, power lines, and pipelines can interrupt existing recreation trail use. They also can be a hazardous obstacle to OHV users traveling along trails. Pipeline extending to extraction well IP-302 and IP-304 would lie adjacent to OHV trails and would cross existing OHV trails in the area.

Subsidence resulting from the proposed action is expected to be minimal, and is unlikely to affect recreational uses in the Hackberry SRMA because subsidence would be gradual. Uneven ground surface or open cracks in the surface that may result from subsidence may present a safety hazard to OHV riders. However, this type of subsidence has already occurred in the project boundary without adverse effects to recreational users.

Mitigation Measures

Throughout the construction and operation of the Proposed Action, several best management practices would be utilized to minimize impacts to recreation resources as described in Section 2.2 of this EA. Additional mitigation measures include the following:

- To minimize conflicts with recreational users, construction would not occur within the Hackberry Lake SRMA during the Desert Rough Riders organized OHV event in April.
- Pipelines would be buried as soon as possible and signage would be placed on either end of recreation trails during construction to warn approaching riders.
- During all phases of construction, open trenches shall have proper signage notifying trail users of potential hazards. Upon completion of construction, the roads shall be returned to pre-construction condition with no bumps or dips. All vehicle and equipment operators will observe speed limits and practice responsible defensive driving habits.
- As discussed in Section 3.2.3 in the mitigation section of the EA, large erosional features near IP-302 would be stabilized, which would improve existing trail breaches in the area.

Impacts from Alternative Direct and Indirect Impacts

Under the Alternative Action, the impacts to recreation would remain the same as for the Proposed Action.

3.11. Visual Resources

3.11.1. Affected Environment

As described in Section 3.12 of the HB EIS (BLM 2012), the project boundary is roughly bounded by Fade-A-Way Ridge to the northwest, Loco Hills to the north, Nimenim Ridge to the east and northeast, Maroon Cliffs to the southeast, Mimosa Ridge to the south, and Quahada Ridge to the southwest. The affected environment is characterized by little variety or contrast in vegetation, a variety in colors and contrast of the soil, rock, and vegetation, scattered pools of water that do not dominate the landscape, current oil and gas operations, and current and abandoned potash mining facilities (**Map EA-32 – *Visual Resource Management Map***). The project area is sparsely populated.

The BLM is responsible for managing public lands for multiple uses, while ensuring that the scenic values of public lands are considered before allowing uses that may have adverse visual impacts. The BLM accomplishes this by classifying areas according to its Visual Resource Management (VRM) system.

Each VRM class describes the degree of acceptable visual modification (i.e., contrast, color, line, and texture) within a landscape.

There are four classes within the VRM system. Classes I and II are the most valued visual resources, Class III are moderately valued visual resources, and Class IV are the least visually valued resources. The following are the minimum management objectives for each class, based on BLM Handbook H-8410-1, Visual Resource Inventory.

- Class I: This classification is applied to Visual Areas of Critical Environmental Concern, wilderness areas, wild and scenic rivers, and other relatively undisturbed landscapes. Natural ecological changes and very limited management activity are allowed, but should not attract attention.

- Class II: Management activities may be allowed, but the level of change to the characteristic landscape should be low. A contrast may be seen but should not attract attention.

- Class III: The level of change to the characteristic landscape should be moderate and remain subordinate in the existing landscape.

- Class IV: The level of change to the characteristic landscape can be high, but should be minimized.

The project boundary is within an area managed as VRM Class IV, which provides for management activities requiring major modifications of the existing character of the landscape. Management activities may dominate the view and be the primary focus of viewer attention. However, every attempt should be made to minimize the impact of activities through careful location of facilities, minimal disturbance, and repetition of the basic landscape elements of color, form, line, and texture.

The closest lower-level management area is a VRM Class III area located approximately 5.6 miles to the southeast of the Proposed Action as shown in Map EA-32. In Map EA-32, areas that are not designated as VRM Class I, Class II, or Class III can be assumed to be Class IV.

3.11.2. Impacts from the No Action Alternative

Direct and Indirect Impacts

The No Action Alternative would deny the approval of the Proposed Action and would not grant permission for Intrepid to access public lands in order to expand solution mine operations to produce potash. Current land and resource use would continue under current conditions in the project area.

3.11.3. Impacts from the Proposed Action

Direct and Indirect Impacts

Direct impacts to visual resources from the construction and operations of the Proposed Action would result in slight modifications of the view shed due to the construction of buried pipelines and addition of pipeline maintenance roads, well pads, booster pump station, and overhead power-runs. The most frequent viewers would be motorists traveling on STH 360, along the pipeline route, employees actively working in the area, and individuals utilizing the Hackberry Lake SRMA.

Construction of the proposed pipeline would create linear features in the landscape, and cause contrasts in soil color and vegetation types. This would result in a direct short term visual resource impact. The presence of the well pads, booster pump station, and overhead power-runs would create color and textural contrasts resulting in a long term visual impact for the life of operations.

Indirect impacts during construction and operations of the Proposed Action infrastructure would include dust generation from construction activities and vehicle traffic along the pipeline ROW maintained roads. The generation of dust may temporarily reduce visibility.

Mitigation Measures

The following mitigation measures will be used to minimize impacts to visual resources:

- All vegetation cleared during construction would be randomly scattered outside of the construction areas and would not be left in piles or rows. Scattered vegetation would be placed away from trails.
- All areas disturbed during construction would be reclaimed except where required for operational facilities and associated access roads.
- Within the well pads, the immediate area containing the extraction or injection well, the well head piping manifold, and the electrical cabinetry would be surrounded by a shaded chain link fence using colors in accordance with BLM requirements.

3.11.4. Impacts from Alternative

Direct and Indirect Impacts

Under the Alternative Action, the impacts to visual resources would remain the same as for the Proposed Action.

3.12. Cultural Resources

3.12.1. Affected Environment

Cultural resources are definite locations of human activity, occupation, or use identifiable through field inventory (survey), historical documentation, or oral evidence. The term includes archaeological, historic, or architectural sites, structures, or places with important public and scientific uses, and may include definite locations (sites or places) of traditional, cultural, or religious importance to specified social and/or cultural groups. Cultural resources are concrete, material places and things that are located, classified, ranked, and managed through the BLM's Land Use Planning system of identifying, protecting, and utilizing sites for public benefit. Required tribal consultation was conducted as part of the EIS.

There are a number of known eligible cultural resources in the project area. The majority of the proposed project lies on federal land covered by the Permian Basin Programmatic Agreement (PBPA), an alternative to traditional Section 106 compliance. Intrepid has opted to contribute to the PBPA archaeological mitigation fund in lieu of conducting a pedestrian survey.

Portions of the project under the Alternative that cross New Mexico State Trust Land were surveyed by Lone Mountain Archaeological Services, Inc., a contractor permitted by both BLM and the State of New Mexico. No eligible cultural resources were identified within the area of potential effect. The report is on file with the BLM CFO and, for reasons of confidentiality, is not appended to this EA.

3.12.2. Impacts from the No Action Alternative

Direct and Indirect Impacts

The No Action Alternative would deny the approval of the proposed project and would not grant permission for Intrepid to access public lands in order to expand solution mine operations to produce potash. Current land and resource use would continue under current conditions in the project area.

3.12.3. Impacts from the Proposed Action

Direct and Indirect Impacts

No impacts would be expected from the Proposed Action.

Mitigation Measures

The pipeline alignment was rerouted to allow at least a 100 ft. buffer around known cultural sites.

Should discoveries of human remains or funerary objects occur during project construction or operations on federal or State Trust land, Intrepid would cease operations in the area of discovery, protect the remains, and notify the BLM within 24 hours. The BLM would determine the appropriate treatment of the remains in consultation with culturally affiliated Indian Tribe(s) and lineal descendants. Intrepid would be required to pay for treatment of the cultural items independent and outside of the mitigation fund. In all cases it is illegal to remove any type of cultural item from federal or State Trust land.

Any cultural resource (historic site, object, or remains) discovered by the IPNM Intrepid or any person working on the Intrepid's behalf, on State land shall be immediately reported to the SHPO. Intrepid would suspend all operations in the immediate area of such discovery until written authorization to proceed is issued by the SHPO. The authorized officer would determine the appropriate actions necessary in order to prevent the loss of significant cultural or scientific values. Intrepid would be responsible for the cost of evaluation and any measures necessary to mitigate the site as determined by the authorized officer with consultation with the Intrepid.

3.12.4. Impacts from Alternative

Direct and Indirect Impacts

No impacts would be expected from the Alternative Action.

3.13. Hazardous Materials, Health and Safety

3.13.1. Affected Environment

The affected environment for hazardous materials, health, and safety includes employees, contractors, the public, air, water, soil, vegetation and wildlife that potentially could be affected by an accidental release of hazardous materials and by physical hazards from activities within the proposed project area. The affected environment for hazardous materials, health, and safety for the Proposed Action would remain consistent with the affected environment described in Section 3.14 of the HB EIS (BLM 2012).

3.13.2. Impacts from the No Action Alternative

Direct and Indirect Impacts

The No Action Alternative would deny the approval of the proposed project and would not grant permission for Intrepid to access public lands in order to expand solution mine operations to produce potash. Aspects related to Hazardous Materials, Health and Safety would be the same as currently exist and analyzed in the EIS.

3.13.3. Impacts from the Proposed Action

Direct and Indirect Impacts

Construction of the Proposed Action could pose an environmental and human health hazard. Potential risks would include impacts to human health, wildlife, air, soil and vegetation resulting from spillage, leakage, or improper disposal of fuel, lubricants and other substances. Physical hazards such as use of vehicles, heavy machinery and trenches would potentially pose risks to wildlife and humans.

During operations, potential environmental health hazard risks would include brine leakage from pipelines and well heads, and spillage and improper disposal of fuel, lubricants, and other substances potentially used during maintenance activities. The use of vehicles and heavy machinery and limited excavation associated with inspection and maintenance of the pipelines, well heads and booster pump station are sources of physical hazards during operations.

Mitigation Measures

Measures to protect environmental and public health and safety would be implemented as described in Section 2. In addition, the HB Solar Solution Mine spill response and cleanup plans would be adapted to cover the Proposed Action to mitigate potential hazardous materials and health and safety.

Following construction all trenches would be backfilled and the booster station and well pads would be encircled by fences to limit physical hazards.

To decrease potential hazardous materials impacts, Intrepid performs regular inspections of pipelines and has automated instrumentation to monitor pipeline and well head operations. In the event of a pipeline or well head release relating to the Proposed Action, Intrepid would implement spill response and cleanup measures and provide appropriate notification to BLM and as otherwise required by State regulations and permits.

3.13.4. Impacts from Alternative

Under the Alternative Action, the hazardous materials, health, and safety impacts would be the same as for the Proposed Action.

3.14. Socioeconomics and Environmental Justice

3.14.1. Affected Environment

Eddy County and Carlsbad comprise the primary study area for socioeconomic effects from the Proposed Project. Eddy County provides most public services to the project area and the majority of the project's construction and expanded operations work forces are likely to live in Carlsbad, based on the distribution of Intrepid's current work force (**Table 3.14-1 - *Residency Distribution of Intrepid's Current Work Force, February 2015***).

Table 3.14-1 Residency Distribution of Intrepid's Current Work Force, February 2015

	Carlsbad (Eddy County)	Loving (Eddy County)	Hobbs (Lea County	Elsewhere in New Mexico	Out of State	Artesia (Eddy County)	Total
Number of Employees	696	33	20	17	11	8	785
Percent of Total	89%	4%	3%	2%	1%	1%	100%

Source: Intrepid Potash, February 2015.

Prepared by: CED1
Checked by: BAL3

The construction work force for pipeline construction and well drilling are likely to come from outside of this area and would typically be part of the selected contractor's traveling work force. The construction work force for well pad construction, well head installation, booster pump station, and electrical power lines are more likely to be located in the Eddy County and Lea County areas.

More than 15 motels and several large recreation vehicle (RV) parks are located in Hobbs, nearby Eunice (2008 population 2,771), and the surrounding area in Lea County. These accommodations serve tourists, the region's natural resource industry, and the non-local construction work force for other construction projects in the nearby area.

Included as **Map EA-33 – *Proximity to Nearby Communities, Socioeconomics and Environmental Justice*** is an area site map that shows the location of nearby communities in relation to the Proposed Action.

Eddy County Population and Demographics

Eddy County resident population peaked at 53,266 in 1983. Oil and gas development was the major driver of growth as the potash industry had matured and actually experienced declines in production. The most recent information from the U.S. Census Bureau in 2010 estimates that the population in Eddy County increased by 4.2% from 2000 to 2010. The populations of the nearby communities of Carlsbad, Artesia, and Loving increased by 2 to 6% over the same period, with the remainder of the county increasing by 6%.

This information is shown in **Table 3.14-2 - *Population Settlement Within Eddy County, 2000 to 2010***.

Table 3.14-2 Population Settlement Within Eddy County, 2000 to 2010

Area	2000	2010	Percent Change (2000-2010)
Eddy County	51,658	53,829	4
Carlsbad	25,625	26,138	2
Artesia	10,692	11,301	6
Loving	1,326	1,413	7
Remainder of the County	14,015	14,977	7

Source: U.S. Census Bureau 2010.

Prepared by: CED1
Checked by: BAL3

Based on 2008 data from the EIS (Section 3.15.3 of the HB EIS, BLM 2012), the median age of Eddy County residents was 37.0 years compared with the median age of 35.0 for New Mexico. However, Eddy County had a larger share of residents under the age of 18.

The local population has a higher percentage share of whites and lower percentage shares of minorities and residents who are Hispanic or Latino than does the statewide population (**Table 3.14-3 - *Racial and Ethnic Population Composition, 2013***). There are no Indian reservations in Eddy County, unlike in many parts of New Mexico (Section 3.15.3 of the HB EIS, BLM 2012).

Table 3.14-3   Racial and Ethnic Population Composition, 2013

	Percent of the Total Population			
Location	**White and not Hispanic or Latino**	**American Indian and Alaska Native and not Hispanic or Latino**	**Other Races, Two or More Races, and not Hispanic or Latino**	**Hispanic or Latino Ethnicity**
New Mexico	39.4	10.4	2.9	47.3
Eddy County	50.3	2.3	1.7	45.7

Source: U.S. Census Bureau Quick Facts 2013.

Prepared by: CED1
Checked by: BAL3

Environmental Justice

Section 3.15.11 of the HB EIS (BLM 2012) provides an overview of how environmental justice is used to evaluate proposed development projects pursuant to Executive Order (E.O). 12898.

The portion of Eddy County surrounding the project area has a very low population density. In the EIS it was noted that the closest Census Block, the basic unit of geography used to enumerate population in the decennial census, with more than 10 persons is at least 8 miles from the project area. Census Block Group 1 of Census Tract 9, which surrounded that project area, covers 1,567 square miles and had a total population of 2,725 persons (or 1.7 persons per square mile) in 2000. Most of the population is in the surrounding communities of Artesia, Riverside and Loco Hills. The population density outside of these population centers averages less than 1 person per 3 square miles (Section 3.15.11 of the HB EIS, BLM 2012).

The city of Carlsbad is located about 20 miles west of the project area. The city's distance from the project area, its racial and ethnic composition, existence of substantial levels of intervening oil and gas development, lack of identified concerns during scoping, limited scale of incremental impacts, established operations of the mine, and effective land use buffer created by the 2012 Secretary's Order, effectively dismiss Environmental Justice as an issue for the city of Carlsbad.

3.14.2. Impacts from the No Action Alternative

Direct and Indirect Impacts

Under the No Action Alternative, the Proposed Action would not be developed. Under this alternative, the existing HB Solar Solution Mine and associated HB Mill operation would continue to operate under current permits and authorizations.

3.14.3. Impacts from the Proposed Action

Direct and Indirect Impacts

Intrepid is not planning on expanding its work force for the Proposed Action. The total number of temporary or construction employees would be 30 (Intrepid Potash Inc./Foth 2015). As shown in Section 3.14.1, population centers are some distance from the location of the Proposed Action. Development of the project would have little impact on the distribution of population, employment, and personal income in the local area.

Mitigation Measures

Given there are no anticipated direct or indirect impacts from the proposed project, mitigation measures are not necessary.

3.14.4. Impacts from Alternative

Direct and Indirect Impacts

The Alternative Action would be expected to be the same as those described for the Proposed Action.

4. CUMULATIVE IMPACTS

4.1. Overview

The relevant past and current actions within the project area contributed to the current conditions described as the affected environment in Section 3. For this reason, the cumulative impact analysis included in this section focuses primarily on reasonably foreseeable future actions (RFFA) that are known by the BLM at the time the analysis was performed. The impacts of the proposed HB AMAX Solution Mine Extension Project and the RFFA, along with the effects of the past and current activities that affect the same resources, would combine to have a cumulative impact on the environment in the region.

The activities and proposed projects listed in **Table 4.1-1 – *Reasonably Foreseeable Future Actions in the Region*** are reasonably foreseeable in the vicinity of the proposed HB AMAX Solution Mine Extension Project and existing HB Solar Solution Mine. The list includes actions that are likely to affect the same resources that were analyzed in Section 3. The areas of potential impacts may vary from one resource to another, and are described for each resource in the following sections. The impacts of these activities on the region over the life of the proposed project (14 years beyond the 28-year HB Solar Solution Mine life) were considered in combination with the proposed HB AMAX Solution Mine Extension Project and existing HB Solar Solution Mine Project, and other past and ongoing activities to predict the potential cumulative effects of all actions combined on each of the resources analyzed in this EA.

Table 4.1-1 Reasonably Foreseeable Future Actions in the Region

Project	Brief Description	Approximate Location
1. Hackberry events	Construction work on expanded picnic shelters/camping areas and event staging areas. Special events are expected to increase.	In and around Hackberry Lake Special Recreation Management Area
2. Caliche pits	Sources for this project, amount of increased disturbance.	Within and near project area as located by the contractor
3. BLM vegetation management	As part of the Restore New Mexico program, the BLM plans several chemical treatments to manage invasive plants (mesquite and creosote). Activities could also include brush control and salt cedar eradication and controlled burns. No surface disturbance is planned.	Within and near project area
4. Double Eagle Water Line	The City of Carlsbad is in the process of constructing a new buried water line. It will be completed before construction for this project would start.	Near project area
5. Oil and gas drilling and production	Oil and gas drilling of new wells and production from existing wells would continue in the SPA according to BLM policy and approval. It is anticipated that oil and gas drilling operations would continue at the current rate of 75 per year in the SPA and an average of 1 per year within the project area. An average of 3.5 acres would be disturbed for each new well pad constructed. Activities could also include drill islands which are large, consolidated drilling locations for oil and gas wells and would include associated pipelines, electric lines and other infrastructure.	In the SPA and project area
6. Solution mining projects	Additional solution mining projects may occur in the SPA as potash resources available for conventional mining decline. There are currently no additional proposed solution mines.	In the SPA

Project	Brief Description	Approximate Location
7. Miscellaneous Utilities and public infrastructure	Natural gas distribution lines, transmission lines and solar farms may be reasonably foreseeable. There may also be road construction on 360 and Shugart Road.	Near project area

4.2. Geology and Minerals

Mineral Resources

The proposed HB AMAX Solution Mine Extension Project would provide approximately 14 years of solution mine reserves beyond the 28-year HB Solar Solution Mine life. These reserves would add to the potash resources that were analyzed within the cumulative effects study area (CESA) of southeast New Mexico including Lea and Eddy counties in Section 5.2.2.1 of the HB EIS (BLM 2012). The cumulative impacts to potash resources would incrementally increase with the proposed HB AMAX Solution Mine Extension Project. The cumulative impacts would remain consistent with the impacts presented in Section 5.2.2.1 of the HB EIS (BLM 2012).

The CESA for oil and gas is the Oil Potash Leasing Area (OPLA), defined by OCC Order R-111-P that encompasses most of the SPA. The cumulative impacts to oil and gas resources would remain similar to the cumulative impacts described in Section 5.2.2.2 of the HB EIS (BLM 2012). The addition of the proposed HB AMAX Solution Mine Extension Project would not prevent oil and gas exploration and production in the OPLA where no commercial-grade potash occurs so development and production operations would continue.

Karst Resources

As indicated in Section 3.1.3 the primary impacts to karst resources would only result from disturbance during pipeline burial, power line installation, and well pad construction. Impacts to karst resources due to groundwater drawdown are not anticipated beyond the impacts addressed in the EIS (BLM 2012) are expected due to the proposed HB AMAX Solution Mine Extension Project. Therefore, the cumulative karst resources impacts described in Section 5.2.3 of the HB EIS (BLM 2012) would continue to remain valid.

Subsidence

As mentioned in Section 3.1.3, much of the subsidence due to conventional mining has likely occurred already. The additional subsidence due to solution mining is expected to be approximately 0.5 – 1.1 ft. Other projects in the vicinity of the proposed HB AMAX Solution Mine Extension Project are not anticipated to add to this projected subsidence amount within the area of projected subsidence for the HB AMAX Solution Mine Extension Project.

Paleontology

The generally limited potential for the occurrence of scientifically important fossils that could be affected by activities in the proposed HB AMAX Solution Mine Extension Project area would result in a low potential for adverse impact to paleontological resources. The cumulative impacts are expected to be negligible.

4.3. Water

The cumulative effects analysis focused on the past, present, and reasonably foreseeable water conservation plans, additional water depletions, oil and gas development, and recreation.

Surface Water

Cumulative impacts to surface water resources would primarily be related to ground surface disturbance from construction and operation of additional mining and oil and gas development. The cumulative impact to surface water would remain consistent with the cumulative impacts described in Section 5.3.1 of the HB EIS (BLM 2012) with the proposed HB AMAX Solution Mine Extension Project only contributing a minor incremental impact to surface water cumulative impacts.

Groundwater

As indicated in Section 3.2.3, no additional groundwater impacts, besides those already addressed in the HB EIS (BLM 2012) are expected due to the proposed HB AMAX Solution Mine Extension Project. Therefore, the cumulative groundwater resources impacts described in Section 5.3.2 of the HB EIS (BLM 2012) would remain valid.

4.4. Soils

RFFAs that would be expected to produce incremental and cumulative impacts within the analysis area are summarized in Table 4.1-1. These projects would contribute incremental changes to the current level of effects to soil resources described in the analysis area from historic and ongoing management activities.

The cumulative impacts to soil would be similar to the cumulative impacts described for the HB Solar Solution Mine in Section 5.4 of the HB EIS (BLM 2012). Projects that have contributed to cumulative impacts to soils result from surface disturbance associated with mining, grazing, vegetation management, recreation, oil and gas exploration and development, roads, and other natural and anthropogenic activities within the analysis area. Impacts associated with these types of activities include removal of vegetation, exposure of the soil, mixing of soil horizons, soil compaction, and loss of topsoil productivity. These impacts could increase runoff, decrease surface water infiltration, and lead to increased susceptibility of the soil to erosion and sedimentation.

Vegetation management projects may result in a decrease of invasive species and an increase in vegetation with better soil holding capacity, which would be a beneficial impact to soil resources.

With implementation of standard and additional mitigation measures, the proposed project, when added to past, present, and reasonably foreseeable future actions is not expected to result in significant cumulative impacts to soil resources.

4.5. Air Quality

Cumulative impacts to air quality would include impacts from the proposed HB AMAX Solution Mine Extension Project emission sources in combination with impacts from background emissions sources associated with past and present actions and RFFAs. Cumulative air quality impacts in the vicinity of the HB AMAX Solution Mine Extension Project would be minimal as oil and gas development is currently ongoing as described in Section 5.5 of the HB EIS (BLM 2012) for the HB Solar Solution Mine. Additional oil and gas development and plugging and abandoning old wells in the project vicinity would continue at generally the same rate that has been conducted in the past. Because past oil and gas activity is already included in the ambient background concentrations discussed in Section 3.4, total cumulative impacts are expected to remain below the NAAQS and NMAAQS for the region.

4.6. Climate Change

Cumulative impacts to climate change would include impacts from the proposed HB AMAX Solution Mine Extension Project emissions sources in combination with impacts from background emissions sources and RFFAs. Oil and gas development is currently ongoing, and additional oil and gas development in the project vicinity would continue at generally the same rate that has been conducted in the past. Past oil and gas activity is already included in the 2008 GHG emissions inventory summarized in Section 3.5, and the incremental contribution in addition to the Proposed Project would be small.

4.7. Vegetation

Past, present, and reasonably foreseeable future actions would cumulatively and incrementally reduce vegetation cover types until such time that reclamation is deemed successful and native plants are reestablished. Cumulative losses for vegetation resources potentially would include the reduction of native ecosystem functions such as soil stability, erosion control, livestock and wildlife forage, and wildlife habitat.

As indicated in Section 5.7 of the HB EIS (BLM 2012) for the HB Solar Solution Mine, it is estimated that herbaceous-dominated plant communities would require a minimum of 3 to 5 years to establish adequate ground cover to minimize erosion and provide forage for wildlife species and grazing operations. Woody-dominated plant communities would require 25 to 50 years for shrubs of similar stature to recolonize the area.

In addition to cumulative vegetation loss, other impacts on vegetation likely would occur as a result of cumulative forage use by livestock, and wildlife, affecting plant productivity and vegetation community structure and composition. Indirect impacts to vegetation resources associated with surface disturbance-related activities may include potential colonization of noxious and invasive weeds, fugitive dust, and fragmentation of land cover types. The colonization of noxious and invasive weeds would impact vegetation resources by degrading and modifying native vegetation types.

Noxious weeds and invasive species exist throughout the CESA. Surface disturbance activities from implementation of the proposed HB AMAX Solution Mine Extension Project as well as other future projects could further spread noxious weed and invasive species into previously undisturbed areas, and may increase the acreage and population numbers of already established noxious weed and invasive species populations.

The BLM vegetation treatment projects within the vicinity of the proposed HB AMAX Solution Mine Extension Project and HB Solar Solution Mine boundary seek to increase native grasslands, and reduce the cover and amount of invasive native and non-native shrubs (creosote and mesquite). Successful reclamation of disturbed areas with native grasses and forbs could assist in restoring the native grasslands and other vegetation, and may further the goals of the vegetation treatment programs.

Cumulative impacts to sensitive plant species, such as Scheer's beehive cactus and gypsum wild buckwheat would be unlikely as indicated in Section 5.7.2 of the HB EIS (BLM 2012).

4.8. Wildlife and Fish

Consistent with the methodology for analyzing cumulative impacts to wildlife in Section 5.8 of the HB EIS (BLM 2012), consideration was given to the cumulative effects of the past, present, and reasonably foreseeable mining activities, mining exploration programs, vegetation management, and potential habitat conversion associated with additional water depletion.

Cumulative impacts to terrestrial wildlife and sensitive species detailed in Section 3.7 would be primarily related to habitat loss, habitat fragmentation, and animal displacement and mortality. Nesting birds, small mammals, and reptile species would be the most susceptible to localized activities that remove their native habitat, especially in areas that may be at carrying capacity. Many of the local larger wildlife species that occur in the CESA would be likely to continue to occupy their respective ranges and breed successfully, although population numbers may decrease due to cumulative habitat loss and disturbance from incremental development.

The RFFAs in combination with implementation of the proposed project would result in additional habitat disturbance. While these activities would result in an incremental increase in habitat-related wildlife impacts, reclamation of disturbed areas would minimize the impacts to wildlife. The BLM vegetation treatment program may have a beneficial cumulative effect on habitat in the CESA over time.

Cumulative impacts to aquatic species associated with the proposed HB AMAX Solution Mine Extension Project are not anticipated.

4.9. Rangelands and Livestock Grazing

In addition to available forage and AUM loss resulting from the RFFAs and proposed HB AMAX Solution Mine Extension Project, the development of access roads and utility corridors would affect livestock grazing activities, livestock management, range facilities, and resources. Range facilities including water sources, fences, and cattle guards, could be adversely impacted by construction and maintenance activities associated with the proposed HB AMAX Solution Mine Extension Project and the other future actions within the CESA. There may be a loss of access to water sources due to the placement and construction of new facilities, roads, and fences. Fences and cattle guards could be damaged or destroyed by operation and maintenance activities, but maintenance and repairs would be required to mitigate damages on public lands.

Past, present, and RFFAs would reduce available acres of forage from active grazing preference during construction activities and where permanent structures or facilities are maintained. Successful reclamation would result in an increase in native grasses that would be available for forage. Grazing may inhibit the re-establishment of woody species in grazing allotments.

4.10. Lands and Realty

As indicated in Section 5.10 of the HB EIS (BLM 2012), resource development has been prominent on the landscape in and around the project area for many years, and with the anticipation of 75 new oil and gas wells a year, this trend is likely to continue. New ROWs within the CESA may open up access to the public where none previously existed and may affect existing and future land uses. The predominant use of the CESA is mining and fluid mineral development. Cumulative impacts to land use and realty are expected to be minimal because the current land uses would continue.

The proposed HB AMAX Solution Mine Extension Project area has a road network in place. Further expansion of this network to accommodate mineral resource development may have adverse and beneficial impacts. Adverse impacts would include an increase in traffic within the CESA and primary access roads, as well as greater maintenance needs on new and existing roads. A potential benefit would include a larger maintained road network that may be utilized by recreational and other land users.

4.11. Recreation

The cumulative impacts to recreation would remain consistent with the cumulative impacts described in Section 5.11 of the HB EIS (BLM 2012). Cumulative impacts to recreational resources within the CESA include access closures (mostly short-term), increased noise and activity associated with resource development, and a reduction in dispersed camping opportunities. Due to previous potash and oil and gas development through the years, the existing road network has reduced the value of primitive recreational values in the area including naturalness, primitive and unconfined recreation, and solitude. Additional roads for mineral development would provide increased easy access to motorized recreational users. This increase in human activities from mineral development and motorized vehicles is likely to have a long-term impact on recreational users such as hunters and hikers who tend to avoid areas that have been heavily developed. While a substantial portion of the CESA would be affected by industrial activities from the proposed project in combination with other RFFAs, there would be minimal overall impact to recreational activities within the CESA.

4.12. Visual Resources

The cumulative impacts to visual resources will be similar to the cumulative impacts presented in Section 5.12 of the HB EIS (BLM 2012). The primary source of cumulative impacts to visual resources would be caused by mineral development. Past, present, and reasonably foreseeable future resource development in the CESA would have both direct and indirect cumulative impacts to visual resources from emissions, ancillary facilities, and the general increase of human activities. In the future, the combination of all mineral development activities may dominate the view and become the major focus of viewer attention. However, the management directive for visual resources for BLM managed lands in the CESA allows for activities that may dominate the view and become the major focus of viewer attention.

4.13. Cultural Resources

The cumulative impacts to cultural resources would remain consistent to the cumulative impacts described in Section 5.13 of the HB EIS (BLM 2012) and the proposed HB AMAX Solution Mine Extension Project is not expected to cumulatively contribute to cultural resources impacts.

4.14. Hazardous Materials, Health and Safety

The cumulative impacts for hazardous materials, health, and safety would remain consistent with the cumulative impacts described in Section 5.14 of the HB EIS (BLM 2012) and the proposed HB AMAX Solution Mine Extension Project is only minimally expected to cumulatively contribute to hazardous materials, health, and safety impacts.

4.15. Socioeconomics and Environmental Justice

The CESA for socioeconomics and environmental justices is Eddy County. Socioeconomic cumulative impacts resulting from the proposed HB AMAX Solution Mine Extension Project are not anticipated and would remain consistent with impact described in Section 5.15 of the HB EIS (BLM 2012). The proposed HB AMAX Solution Mine Extension Project would be developed north of the current HB Solar Solution Mine and would be located far from any population centers. While there is a significant Hispanic minority population in Eddy County, none of these individuals live near the proposed development and therefore there is no possibility that they would be disproportionately affected.

5. SUPPORTING INFORMATION

5.1. List of Preparers

Table 5.1-1 BLM Interdisciplinary Team

Resource/Responsibility	BLM Team Member
Project Manager, Geology and Hydrology	Jessie Hubbling
NEPA Lead	Howard Parman
Caves/Karst	Jim Goodbar
Cultural	Stacy Galassini
Wildlife	John Chopp
Soils, Vegetation, Reclamation	Steve Daly
Recreation, Visual	Deanna Younger

Table 5.1-2 Foth EA Team

Resource/Responsibility	BLM Team Member
Project Manager	Julianne Hanson, P.E.
Environmental Analyst	Megan Haserodt

5.2. References

AECOM, 2011. Hydrological Assessment and Groundwater Modeling Report for the HB In-Situ Solution Mine Project EIS. Prepared for Bureau of Land Management, Carlsbad, New Mexico by AECOM, Fort Collins, Colorado.

Balch, R. S., M. Cather, and V. Bammidi. 2011. Oil and Gas Potential in Secretaries Potash Enclave. Search and Discovery Article #20113. Adapted from Oral Presentation at APPG Southwest Section Meeting Ruidoso, NM. June 5-7, 2011.

Barker, J. T. and G. S. Austin. 1993. Economic Geology of the Carlsbad Potash District, New Mexico. *New Mexico Geological Society Guidebook, 44th Field Conference, New Mexico and West Texas.*

Biota Information System of New Mexico (BISON-M). 2015. *Biological Database for New Mexico.* The New Mexico Department of Game and Fish in cooperation with the Bureau of Land Management, U.S. Fish & Wildlife Service, U.S. Army Corps of Engineers, U.S. Bureau of Reclamation, U.S. Forest Service, the University of New Mexico, and Conservation Management Institute. http://www.bison-m.org/databasequery.aspx. Accessed February 9, 2015.

Broadhead, R. F., Z. Jianhua, and W. D. Raatz. 2004. Play Analysis of Major Oil Reservoirs in the New Mexico Part of the Permian Basin: Enhanced Production Through Advanced Technologies, Open File Report 479. New Mexico Bureau of Geology and Mineral Resources.

Bureau of Land Management (BLM). Undated. Paleontological Laws and Policy. http://www.blm.gov/wo/st/en/prog/more/CRM/paleontology/paleontological_regulations.print.html. Accessed February 11, 2015.

Bureau of Land Management (BLM). 2007a. Instruction Memorandum No. 2008-009. http://www.blm.gov/wo/st/en/info/regulations/Instruction_Memos_and_Bulletins/national_instruction/20080/im_2008-009.html. Accessed February 11, 2015.

Bureau of Land Management (BLM). 2007b. Special Status Species Proposed Resource Management Plan Amendment/Final Environmental Impact Statement. Prepared by the U.S. Department of the Interior Bureau of Land Management, Pecos District Office, Roswell, New Mexico.

Bureau of Land Management (BLM). 2008. Special Status Species Record of Decision and Approved Resource Management Plan Amendment. Prepared by the U.S. Department of the Interior Bureau of Land Management, Pecos District Office, Roswell, New Mexico.

Bureau of Land Management (BLM). 2012. HB In-Situ Solution Mine Project Final Environmental Impact Statement. DOI-BLM-NM-P020-2011-498-EIS.

Bureau of Land Management (BLM). 2014a. Air Resources Report for Oil and Gas Development: New Mexico, Oklahoma, Texas, and Kansas.

Bureau of Land Management (BLM). 2014b. Environmental Assessment DOI-BLM-NM-P020-2014-0816 for Western Refining Southwest, Inc. 70-12 Pipeline Project in Chaves and Eddy Counties, New Mexico.

Bureau of Land Management (BLM). 2014c. Potash. http://www.blm.gov/nm/st/en/prog/energy/solid_minerals/solid_leasable_minerals/potash.print.html. Accessed February 3, 2015.

Center for Climate Strategies. 2006. New Mexico Greenhouse Gas Inventory and Reference Case Projections, 1990 – 2020. http://www.nmenv.state.nm.us/cc/documents/CCAGFinalReport-AppendixD-EmissionsInventory.pdf. Accessed March 5, 2015.

Colorado Geological Survey (CGS). Undated. Ground Subsidence. http://coloradogeologicalsurvey.org/geologic-hazards/ground-subsidence. Accessed February 9, 2015.

Cowardin, L. M., V. Carter, F. C. Golet, and E. T. LaRoe. 1979. Classification of Wetlands and Deepwater Habitats of the United States. U.S. Department of the Interior, Fish & Wildlife Service, Washington, D.C. Jamestown, ND: Northern Prairie Wildlife Research Center Online. http://www.npwrc.usgs.gov/resource/wetlands/classwet/index.htm. Accessed February 19, 2015.

Dingman, S.L. 2002. *Physical Hydrology, 2nd Edition.* Upper Saddle River, NJ: Prentice Hall.

Federal Emergency Management Agency (FEMA). 2010. National Flood Hazard Layer. http://www.msc.fema.gov. Accessed November 16, 2014.

Federal Emergency Management Agency (FEMA). 2014. Flood Zones. https://www.fema.gov/floodplain-management/flood-zones. Accessed December 23, 2014.

Galloway, D. L., G. W. Bawden, S. A. Leake, and D. G. Honegger. 2008. Land Subsidence Hazards. *Landslide and Land Subsidence Hazards to Pipelines*. Chapter 2.

Giroux, R. L., J. T. Brandell, and T. A. Scott. 1988. Annulus Packoff System Provides Economy in Recompletion of Permian Basin Wells (SPE 17298). Society of Petroleum Engineers Permian basin Oil and Gas Recovery Conference, Midland, Texas. March 10-11, 1988.

Goodbar, J.R. 2013. Solution Mining and the Protection of Karst Groundwater Supplies in Burton Flats, Southeast New Mexico, National Cave & Karst Management Symposium Proceedings. National Cave and Karst Research Institute.

Goodbar, J.R. 2015. Cave/Karst Resource Specialist at the Bureau of Land Management Carlsbad Field Office. Personal communication to Intrepid through the BLM Comment Form for Intrepid-AMAX Extension Project EA, April 22, 2015.

Hill, C.A. 2000. Overview of the Geologic History of Cave Development in the Guadalupe Mountains, New Mexico. *Journal of Cave and Karst Studies.* Vol. 62, Number 60-71.

Intrepid Potash Inc./Shaw. 2008a. Mine Operations and Closure Plan HB In-situ Project, HB Potash LLC, Eddy County, New Mexico Submitted to: Bureau of Land Management Carlsbad Field Office, Carlsbad, New Mexico. Prepared by Shaw Environmental and Infrastructure, Inc. May 28, 2008.

Intrepid Potash Inc./Shaw. 2008b. Technical Memorandum: Reviewed Subsidence Associated with Potash Mining; Tech Memo HB Potash EA-004, HB Potash LLC, Eddy County, New Mexico. Prepared by Shaw Environmental and Infrastructure, Inc. December 17, 2008.

Intrepid Potash Inc./Shaw. 2008c. Technical Memorandum: Subsidence Overview Tech Memo HB Potash DP-006. HB Potash LLC, Eddy County New Mexico. Prepared by Shaw Environmental and Infrastructure, Inc. September 29, 2008.

Intrepid Potash Inc./Foth. 2015. HB Solar Solution Mine Discharge Permit DP-1681 Renewal and Modification, Intrepid Potash – New Mexico, LLC, Eddy County, New Mexico.

Kelley, V. C. 1980. Gatuna Formation (Late Cenozoic), Pecos Valley, New Mexico and Trans-Pecos Texas. *New Mexico Geological Society Guidebook*. Conference 31, Number 213-217.

Kottek, M., J. Grieser, C. Beck, B. Rudolf, and F. Rubel. 2006. World Map of the Köppen-Geiger Climate Classification Updated. *Meteorol. Z.* Vol. 15, Number 259-263.

Lambert, S. J. 1983. Dissolution of Evaporites in and Around the Delaware Basin, Southeastern New Mexico and West Texas. Albuquerque, New Mexico: Sandia National Laboratories.

Lucas, S. G., A. B. Heckert, and A. P. Hunt. 2001. Triassic Stratigraphy, Biostratigraphy and Correlation in East-Central New Mexico. *New Mexico Geological Society Guidebook.* Conference 52, Number 85-102.

Mercer, J.W. 1983. Geohydrology of the Proposed Waste Isolation Pilot Plant Site, Los Medaños Area, Southeastern New Mexico. U.S. Geological Survey Water Resources Investigations Report 83-4016.

Montgomery, S. L., J. Worrall, and D. Hamilton. 1999. Delaware Mountain Group, West Texas and Southeastern New Mexico, A Case of Refound Opportunity: Part 1. *Brushy Canyon: American Association of Petroleum Geologists Bulletin.* Vol. 83.

National Oceanic and Atmospheric Administration (NOAA). 2011. JetStream – online school for weather. http://www.srh.noaa.gov/jetstream/global/climate_max.htm. Accessed February 18, 2015.

National Park Service (NPS). 2008. Guadalupe Mountains National Park Geologic Resource Evaluation Report. Natural Resource Report NPS/NRPC/GRD/NRR—2008/023.

NatureServe. 2004. Landcover Descriptions for the Southwest Regional Gap Analysis Project. September 10, 2004.

New Mexico Administrative Code (NMAC). 2000. Title 20: Environmental protection, Chapter 4: Water quality, Part 4: Standards for interstate and intrastate surface waters. New Mexico Water Quality Control Commission, Santa Fe, NM. http://www.nmcpr.state.nm.us/nmac/parts/title20/20.006.0004.htm. Accessed December 24, 2014.

New Mexico Environment Department Air Quality Bureau (NMED AQB). 2013. New Source Review Permit 4332-R1, HB Plant (HB In-Situ Project), August 2013.

New Mexico Environment Department (NMED). 2015. New Mexico Environment Department Air Quality Bureau Air Dispersion Modeling Website. http://www.nmenv.state.nm.us/aqb/modeling/Index.htm. Accessed March 5, 2015.

New Mexico Office of the State Engineer (NMOSE). 1999. Region 16 - Lea County Regional Water Plan. http://www.ose.state.nm.us/Planning/RWP/region_16.php. Accessed April 28, 2015.

New Mexico Office of the State Engineer (NMOSE) and Interstate Stream Commission (ISC). 2015. Pecos River Compact. http://www.ose.state.nm.us/Compacts/Pecos/isc_pecosCompact.php. Accessed February 2, 2015.

New Mexico Rare Plant Technical Council (NMRPTC). 1999. New Mexico Rare Plants. Albuquerque, NM: New Mexico Rare Plants Home Page. http://nmrareplants.unm.edu. Accessed March 5, 2015.

New Mexico State University (NMSU). 2013. The Chihuahuan Desert. Digital Desert Library. http://ddl.nmsu.edu/chihuahua.html. Accessed February 12, 2015.

New Mexico Water Quality Control Commission (NMWQCC). 2014. 2014-2016 State of New Mexico CWA §303(d)/§305(b) Integrated Report. NMED Surface Water Quality Bureau, Santa Fe, New Mexico. http://www.nmenv.state.nm.us/swqb/303d-305b/2014-2016/index.html. Accessed December 24, 2014.

Oil Conservation Division. 2011. Brine Well Collapse Evaluation Report. http://www.emnrd.state.nm.us/OCD/brinewellinfo.html. Accessed February 9, 2015.

Powers, D. W., S. J. Lambers, S. E. Shaffer, L. R. Hill, and W. D. Ewart. 1978. Geologic Characterization Report for the Waste Isolation Pilot Plant (WIPP) Site, Southeastern New Mexico, SADN78-1596.

Richey, S. F. and J. G. Wells. 1985. Geohydrology of the Delaware Basin and vicinity, Texas and New Mexico. U.S. Geological Survey Water-Resources Investigation Report 84-4077.

Standen, A., S. Finch, R. Williams, B. Lee-Brand, and P. Kirby. 2009. Capitan reef complex structure and stratigraphy. Texas Water Development Board Contract Number 0804830794.

U.S. Census Bureau (U.S. Census Bureau). 2010. *New Mexico: 2010 – Population and Housing Unit Counts*.

U.S. Census Bureau (U.S. Census Bureau). 2013. U.S. Census Bureau Quick Facts. http://quickfacts.census.gov/qfd/states/35/35015.html. Accessed March 5, 2015.

U.S. Department of Agriculture – Natural Resources Conservation Service (USDA-NRCS). 2014. Soil Survey Geographic (SSURGO) Database. Natural Resources Conservation Service Soils Website. http://websoilsurvey.sc.egov.usda.gov. Accessed February 2015.

U.S. Environmental Protection Agency (USEPA). 2008. Climate Change – Science – State of Knowledge. http://www.epa.gov/climatechange/science/stateofknowledge.html. Accessed March 5, 2015.

U.S. Environmental Protection Agency (USEPA). 2010. Inventory of U.S. Greenhouse Gas Emissions and Sinks, 1990 – 2008. EPA 430-R-10-006. April 15, 2010.

U.S. Environmental Protection Agency (USEPA), 2015. Design Value Reports. http://www.epa.gov/airtrends/values.html. Accessed April 2015.

U.S. Fish & Wildlife Service (USFWS). 2010. National Wetlands Inventory, New Mexico Scalable Section. 1:24,000 Scale. http://www.fws.gov/wetlands/Data/. Accessed November 21, 2014.

U.S. Geological Survey National Gap Analysis Program (USGS). 2004. Provisional Digital Land Cover Map for the Southwestern United States. Version 1.0. RS/GIS Laboratory, College of Natural Resources, Utah State University.

U.S. Geological Survey (USGS). 2009. Minerals Yearbook: The Mineral Industry in New Mexico 2009. http://minerals.usgs.gov/minerals/pubs/state/2009/myb2-2009-nm.pdf. Accessed February 3, 2015.

U.S. Geological Survey (USGS). 2014. High Plains water-level monitoring study. http://ne.water.usgs.gov/ogw/hpwlms. Accessed February 2, 2015.

Van Sambeek. 2008. HB Project Surface Subsidence (Revised). Technical Memorandum from Dr. Leo L. Van Sambeek to Mr. Craig Cranston, Bureau of Land Management, Carlsbad Resource Area, Carlsbad, New Mexico. December 15, 2008.

Vine, J.D. 1963. Surface geology of the Nash Draw Quadrangle, Eddy County, New Mexico: U.S. Geological Survey Bulletin 1141-B.

Walsh, P. 2006. Geologic Trends of Oil and Gas Production in the Secretary of the Interior's Potash Area, Southeastern New Mexico, Final Report to the Bureau of Land Management, New Mexico Bureau of Geology and Mineral Resources Open File Report 498.

Western Regional Climate Center (WRCC). 2014. Carlsbad, New Mexico (291469) period of record monthly climate summary. http://www.wrcc.dri.edu/cgi-bin/cliMAIN.pl?nm1469. Accessed December 3, 2014.

Figures

Maps

Appendix A
Scoping and Public Outreach

Intrepid Solution Mine Update to the Community

- Dates
  - 8/26/14
  - 8/28/14
- Location
  - Leo Suite Community Center, Carlsbad NM
- Time:
  - Noon to 1
- Invite List
  - Attached
- Attendees
  - Attached
- Comments Heard
  - Overall the comments during the presentations were supportive of the project.
  - There were questions concerning:
    - The performance of the HB Mill
    - Actual Rustler water use vs. modeled
    - Actual cavern performance vs modeled
  - Use of fresh water was a topic as well. It was explained that we are minimizing the use of fresh water as injectate but we learned that a small amount is required in the injectate to keep our injection lines from scaling up. In addition, modifications to the original permits have allowed us to utilize TBR for injectate which recycle process waster previously lost.
  - Can the BLM utilize the information developed in the HB EIS as a basis for the HB Amax EA. BLM representatives responded that they did not see a problem with this approach.

Thursday, August 28, 2014

NAME	Company
Colby Morris	Xcel Energy
Seth Thomason	" "
Joe Gant	attorney
Dick Doss	City Counsel
Sean Dunagan	Sandia National Labs
Jessie Hubbling	BLM
[illegible]	BLM
Roger Nelson	CBFO / U.S. DOE
Don Strickland	Murrell electric
DWAYNE KICKER	Stoller
COURTNEY HERRICK	SANDIA NATL LABS
ROSS KIRKES	SANDIA NATL LABS

Intrepid Update
August 28th Thursday

1. Roger Nelson
2. Kyle Marksteiner (Carlsbad focus)
3. Donald (diveplan@aol.com)
4. ~~Wanda Durham~~ (Tues.)
5. Don Strickland (munici)
6. Richard Doss City Council
7. Constructors Inc.
8. Constructors Inc.
9. Constructors Inc.
10. Constructors Inc.
11. Constructors Inc.
12. Constructors Inc.
13. Constructors Inc.
14. Joe Gant (attorney)
15. Colby Morris xcel
16. Seth Thomason xcel
17. ~~Ralph Kirkes~~
18. Jessie Hubbling BLM
19. Craig Cranston BLM
20. Sean Dunagan (Sandia)
21. Jeff Campbell - CDOD
22. Ned Elkins
23. Dale Janway (Mayor)
24. Courtney Herrick cgherri@sandia.gov
25. Dwayne C. Kicker Ph.D. dckicke@sandia.gov
26. Ross Kirkes (Sandia)

Tuesday, August 26, 2014

NAME	Company
Jim Putzey	BLM
George MacDonell	BLM
Jimmy Murris	Murrill Electric, LLC
Valerie Murrill	Murrill Electric
Gerald Goad	United Salt
John Vandekraats	United Salt
E.J. DANZEL	UNITED SALT
Todd S. Hyden	[illegible] Pressure Pumping
Russell Hardy	rhardy@nmsu.edu
ABRAHAM VAN LUIK	DOE
Randy Bailey	Mica Supply
Wanda Durham	Durham & assoc. arch.
Dave Jerich	Spring time Cleaning
Don Kidd	Western Commerce Bank
Janell Whitlock	City
Jay Jenkins	CDOD - Carlsbad National Bank
[illegible]	City of Carlsbad

Intrepid Update
August 26th Tuesday

1. Valerie (diveplan@aol.com)
2. Todd Hyden
3. Steve McCutcheon ~~(?)~~
4. James Rutley
5. * Jeff Campbell (?)
6. David Sepich
7. Gerald Goad
8. John Vandekraats
9. Dan Daniel
10. Jimmy Morris Muriel Electric
11. * Ned Elkins (?)
12. Russell Hardy
13. Abraham Van Luik (Vegetarian)
14. Janelle Whitlock
15. * Dale Janway (?)
16. Randy Bailey
17. George MacDonell (BLM)
18. Warde Durham
19. Don Kidd (UCB) former Senator

Cathy 20. Jay Jenkins CDOD/National Bank

Robert

John

Ryan

* lunch for tomorrow Town Off (?)

Call ~~Bea~~ Chet ✓ Buy tea

Hanson, Julianne M

From: Hubbling, Jessica <jhubbling@blm.gov>
Sent: Thursday, April 02, 2015 12:02 PM
Subject: Public Notice for proposed Intrepid HB AMAX Extension Solution Mining project

Greetings,

You are receiving this email because you have been identified as an interested party for notification of the proposed solution mining project, the HB AMAX Extension, for Intrepid Potash. The project is currently in a public scoping period that is scheduled to end on April 17th, 2015. Comments will be accepted until close of business on that date. More information can be found on the BLM Carlsbad Field Office webpage at the link below:

http://www.blm.gov/style/medialib/blm/nm/field_offices/carlsbad/docs.Par.50344.File.dat/PUBLIC_NOTICE_Intrepid_HB_AMAX_Extension.pdf

You can also contact me directly with your questions or comments. My contact information is below.
Thank you for your time,

Jessie Hubbling
Geologist
Bureau of Land Management
Carlsbad Field Office
(575) 234-5912

Not
e
: Before including your address, phone number, e-mail address, or other personal identifying information in your comment be advised that your entire comment – including your personal identifying information – may be made publicly available at any time. While we will work to meet any request that personal identifying information be withheld from public review, we cannot guarantee that we will be able to do so.

PUBLIC NOTICE
March 18th, 2015

Intrepid HB AMAX Extension Solution Mining Project

The Bureau of Land Management (BLM) Carlsbad Field Office is initializing public scoping for Intrepid Potash New Mexico for the proposed HB AMAX Extension project to solution mine the abandoned AMAX Potash mine. An Environmental Assessment (EA) is being prepared to assess the potential effects upon environmental resources in the area of the proposed HB AMAX Extension project.

Scoping gives the public a chance to tell the BLM what issues and concerns they think should be addressed in an EA. Public scoping is now underway for the Purpose and Need and Proposed Action sections of the EA (see below). Comments must be received within 30 days from the date of this notice.

This project is a connected action of the existing HB In-Situ Solution Mine Project. The EA for this project will reference the Environment Impact Statement (EIS) completed for the HB in Situ Solution Mining Project (DOI-BLM-NM-P020-2011-498-EIS). The complete EIS with supporting information can be found at the link below.

http://www.nm.blm.gov/cfo/HBIS/finalEIS.html

There will also be a public comment period for this project on the EA in its entirety. The anticipated dates of the EA public comment period are May 4th through June 3rd, 2015. Public comments will be requested via a public notice and all associated documents will be posted in this same location.

Please address any comments to:

BLM Carlsbad Field Office
Attn: Jessie Hubbling
620 East Greene St.
Carlsbad, NM 88220
Phone: 575-234-5912
Fax:575-885-9264
Email: jhubbling@blm.gov

Before including your address, phone number, e-mail address, or other personal identifying information in your comment be advised that your entire comment – including your personal identifying information – may be made publicly available at any time. While we will work to meet any request that personal identifying information be withheld from public review, we cannot guarantee that we will be able to do so.

1. PURPOSE AND NEED FOR ACTION

Background

Intrepid Potash – New Mexico, LLC (Intrepid) is proposing to extract potash, a potassium compound commonly used in fertilizer, which remains in abandoned underground mine workings using solution mining. The proposed HB AMAX Project would be an extension to Intrepid's existing HB Solar Solution Mine located in Eddy County approximately 20 miles east of Carlsbad, New Mexico (see **Map 1 – Project Location and Vicinity Map**) The AMAX Mine is a closed conventional mine that lies to the north of the HB Solar Solution Mine. This project is designed to recover and process potassium chloride (KCl) ore from the abandoned underground mine workings of the AMAX mine.

The HB AMAX Project would tie directly into Intrepid's existing HB Solar Solution Mine and would expand the size and extend the life of the HB solution mine. The Bureau of Land Management (BLM) evaluated the Solar Solution Mine project by preparing an Environmental Impact Statement (EIS), DOI-BLM-NM-P020-2011-498-EIS. A Final EIS (FEIS) was published in January 2012 and a Record of Decision (ROD) followed in March 2012.

The BLM Carlsbad Field Office is evaluating the proposed HB AMAX project with this Environmental Assessment (EA) tiered to the HB Solar Solution Mine EIS. A brief project description follows which details how the proposed HB AMAX project would use existing infrastructure and employ techniques that would minimize impacts. A more detailed description of the project and associated infrastructure can be found in the Proposed Action.

Brief Project Description

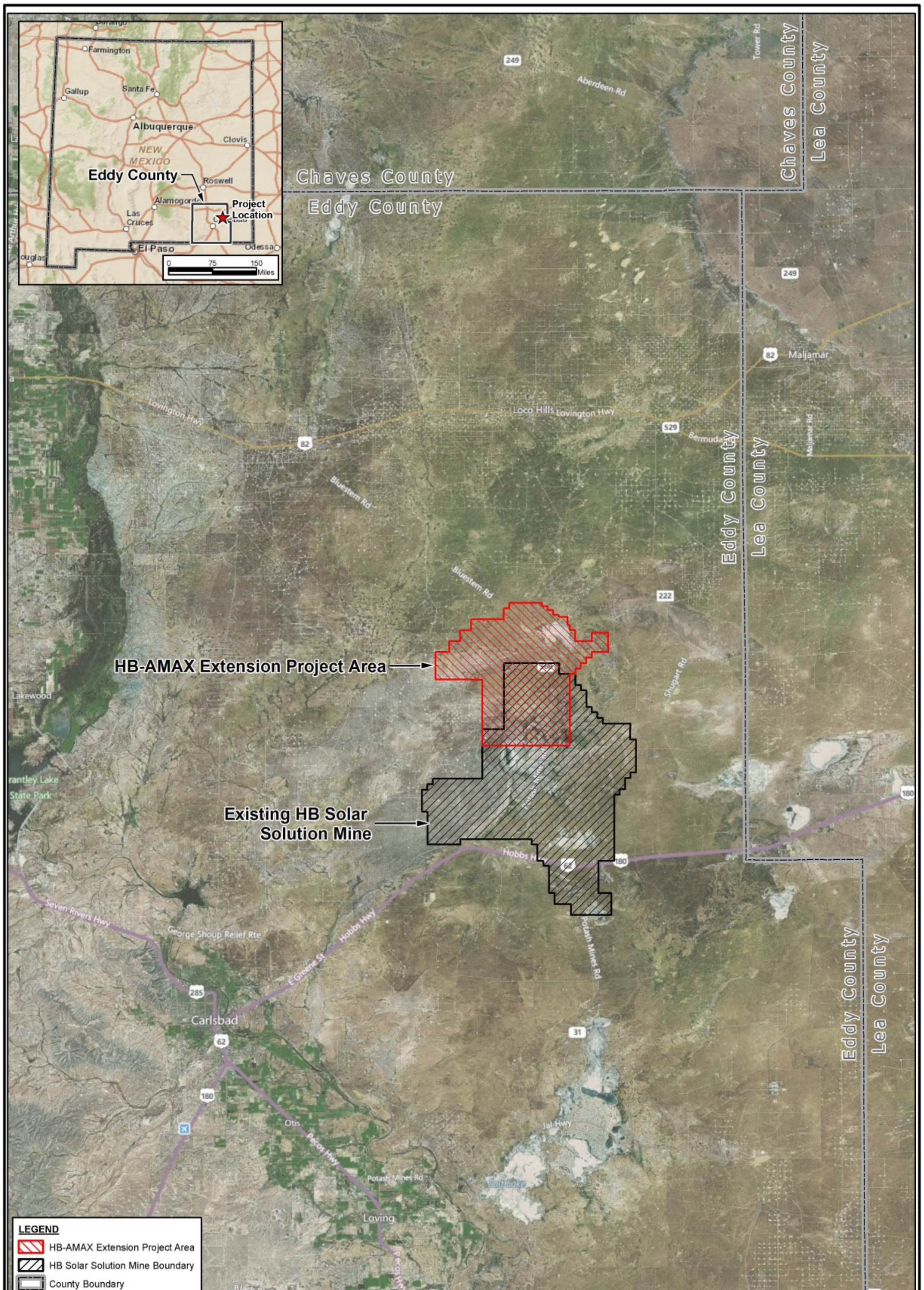
Intrepid holds the federal, state, and private potassium leases for the area of proposed potash extraction. Surface disturbance would occur on BLM, State, and fee lands depending upon the final alignment. The HB AMAX Mine would provide approximately 14 years of solution mine reserves beyond the 28-year HB Solar Solution Mine life.

To the maximum extent practicable, it is proposed that the HB AMAX extension would utilize existing HB Solar Solution Mine facilities and infrastructure to minimize environmental impacts. The solution mining process would be identical to that of the existing HB Solar Solution Mine with injection of salt (NaCl) saturated brine into the workings and extraction of a KCl (potash) enriched (pregnant) brine. Potash recovered from the HB AMAX Mine would be pumped to the existing HB Solar Solution Mine solar evaporation ponds. Once the solution evaporates in the ponds and precipitates out KCL and NaCl solids, the salts would be harvested and transported to the existing HB Mill for ore refinement.

Purpose and Need for Action

The purpose of this action it to modify Intrepid's HB Solar Solution Mine workings to include the AMAX mine in order to recover potash resources.

The BLM is required to evaluate and respond to Intrepid's proposal, described in the Proposed Action, to construct, operate, maintain, and decommission an in-situ solution mining operation. This includes analyzing the impacts of the proposed mine plan modification and the lease conversion from conventional mining to solution mining leases. The need for this project is established by the BLM responsibility to promote the orderly and efficient development and maximum recovery of leasable minerals, including potash, as specified under 30 United States Code (USC) Chapter 2 §21a, the Mineral Leasing Act of 1920 as amended, the Federal Land Policy and Management Act (FLPMA) of 1976 (43 USC 1761), and the Secretary of the Interior's 1986 Potash Order (51 Federal Register 39425, October 28, 1986).



NOTES:

1. Aerial imagery from esri.
2. Horizontal coordinate system is NAD 1983 New Mexico State Plane East, units in feet.

INTREPID POTASH

Foth

Foth Infrastructure & Environment, LLC			
REVISED	DATE	BY	DESCRIPTION
PREPARED BY:	NMG1	DATE:	MAR.'15
REVIEWED BY:	JMH6	DATE:	MAR.'15
APPROVED BY:	JMH6	DATE:	MAR.'15

INTREPID POTASH - NEW MEXICO, LLC

MAP 1

PROJECT LOCATION AND VICINITY MAP

Environmental Assessment
HB Solar Solution Mine - AMAX Extension

Scale: 0 2 4 Miles	Date: MARCH 18, 2015
Drafted by: BJW1	Project No: 0014I016-07

Path: X:\GB\IE\2014\14I016-00\GIS\mxd\EA_Report\PA_Figures\Intrepid_HB_Amax_Project_Location_11x17.mxd Date: 3/18/2015

The BLM is responsible for the balanced management of the public lands and resources and its various values in a fashion that will best serve the needs of the American people. Potash is an important industrial mineral in wide demand in the U.S. The BLM has the duty to allow and encourage a federal leaseholder to develop their leases subject to reasonable restrictions. The proposed project will fulfil the BLM mission and responsibilities by allowing Intrepid to mine potash and associated minerals for which they hold federal leases.

Conformance with Applicable Land Use Plan(s)

The Proposed Action is in conformance with the 1988 Carlsbad Resource Management Plan, as amended by the 1997 Carlsbad Resource Management Plan Amendment for Oil and Gas, and the 2008 Special Status Species Resource Management Plan Amendment.

Relationship to Statutes, Regulations or Other Plans

The BLM authority for land management derives from the Federal Land Policy and Management Act. General BLM regulations are described in 43 CFR, Subtitle B—Regulations Relating to Public Lands, Chapter II—BLM, USDI. BLM regulations for the management of mining on federal potash leases are included in 43 CFR Subpart 3590, Solid Minerals (Other Than Coal) Exploration and Mining Operations—General. Subpart 3592.1, Operating Plans, specifies that before any operations are conducted under any lease, the operator must submit a detailed mine and reclamation plan to the BLM, which the BLM must approve before operations can begin. These regulations contain specific criteria that the mine and reclamation plan must address to assure the protection of non-mineral resources and the reclamation of the lands affected by the operations. It also requires coordination with state agencies.

Potash is a solid leasable mineral that is managed by the BLM under the authority of the Mineral Leasing Act of 1920, as amended, the Potash Leasing Act of 1927, and, in southeastern New Mexico, the 2012 Order. The Mineral Leasing Act establishes qualifications for mineral lessees, defines maximum limits on the total acres of a mineral that can be held by a lessee, and authorizes the BLM to grant these leases. Federal regulations that pertain to leasing these minerals are contained in 43 CFR Part 3500, Leasing of Solid Minerals Other than Coal and Oil Shale.

The State of New Mexico’s Order No. R-111-P applies to state lands and minerals in the area. While the BLM may incorporate elements of R-111-P into its management of the Secretary’s Potash Area, the BLM is not mandated to follow it. In particular, Life of Mine Reserves, as defined in R-111-P, is not used for management of federal lands and minerals.

The Mining and Mineral Policy Act of 1970 (MMPA) mandates that federal agencies ensure that closure and reclamation of mine operations be completed in an environmentally responsible manner. The MMPA states that the federal government should promote the “development of methods for the disposal, control, and reclamation of mineral waste products, and the reclamation of mined lands, so as to lessen any adverse impact of mineral extraction and processing upon the physical environment that may result from mining mineral activities.”

Other major federal and state regulations and permits that are relevant to the proposed project include those listed below:

- NEPA (P.L. 91-190) and CEQ – Regulations for implementing NEPA (40 CFR Parts 1500 – 1508).
- Clean Water Act (CWA) and Federal Water Pollution Control Act Amendments.
- New Mexico Water Quality Act, New Mexico Statutes Annotated (NMSA) 1978, §§74- 6-1 et seq.

- Federal Safe Drinking Water Act, 40 CFR Parts 144 and 147; New Mexico Ground and Surface Water Protection, New Mexico Administrative Code (NMAC) Part 20.6.2, 2005.
- Underground Water, NMSA 1978, §§72-12-1 et seq.
- Endangered Species Act (ESA) of 1973, as amended (P.L. 93- 205).
- Migratory Bird Treaty Act (MBTA) of 1918, as amended; Bald and Golden Eagle Protection Act of 1940.
- Clean Air Act (CAA); delegated to the State of New Mexico under Air Quality Control Act, NMSA 1978, §§74-2-1 through 74-2-17.
- National Historic Preservation Act (NHPA) (36 CFR Part 800); New Mexico Cultural Properties Act, NMSA 1978, §§18-6-1 through 18-6-17.
- Federal Cave Resources Protection Act of 1988, 16 USC 4301 – 4309.
- P. L. 111-011 Omnibus Public Land Management Act, Subtitle D – Paleontological Resources Preservation.
- NMSA 1978 Sections 19-1-1 and 19-7-57.
- NMAC Part 14.5.2.

This EA is tiered to the HB In-Situ Project (now referred to as the HB Solar Solution Mine EIS, DOI-BLM-NM-P020-2011-498-EIS. The FEIS was published in January 2012 and the ROD followed in March 2012. The analyses contained in this EIS are incorporated into this EA by reference. The analyses can be found on pages 3-1 through 3-129 and 4-1 through 4-125 in the EIS.

Decision to be Made

The decision to be made is whether or not to approve Intrepid's application to extend the existing HB Solar Solution Mine workings to include the AMAX mine, and, if to approve, under what terms and conditions.

2. PROPOSED ACTION

Introduction

Intrepid is proposing to expand solution mining activities permitted for the HB Solar Solution Mine to include portions of the abandoned AMAX Horizon Mine. The HB Solar Solution Mine and the proposed HB AMAX Extension are located in Eddy County approximately 20 miles east of Carlsbad, New Mexico.

The HB AMAX Extension Project would expand Intrepid's existing HB Solar Solution Mine and is proposed as a Mine Plan Modification of Intrepid's existing HB Solar Solution Mine Operations and Closure Plan, dated March 9, 2012. The proposed extension project lies completely on potassium leases held by Intrepid and thus can be permitted as a mine plan modification. No separate Rights-of-Way (ROW) in addition to the mine modification are proposed for in this project.

The proposed HB AMAX Extension is located within state, federal, and private leases that Intrepid currently holds. As part of this Proposed Action all federal potassium leases associated with the proposed HB AMAX Extension would be converted from conventional mining leases to solution mining leases. The same conversion of lease type was analyzed for the existing HB Solar Solution Mine EIS (see Record of Decision). Four federal potash leases are to be converted from conventional mining leases to solution mining leases. These leases are listed in **Table 1 – Existing and Proposed HB Solar Solution Mine Facilities** below and shown on **Map 2 – Mineral Lease.**

Table 1 – Existing and Proposed HB Solar Solution Mine Facilities

Lease Number	Total Lease Acreage
NMLC-046729-D	2,560.0
NMNM-113455	2,400.8
NMNM-113456	2,480.0
NMNM-113457	560.6

The AMAX Mine ceased production in 1993 and has been closed as per applicable regulatory requirements. The shafts have been sealed and the surface restoration and reclamation activities have been completed by the former owner. The remaining ore is located in the pillars and fringe areas of the underground mine workings.

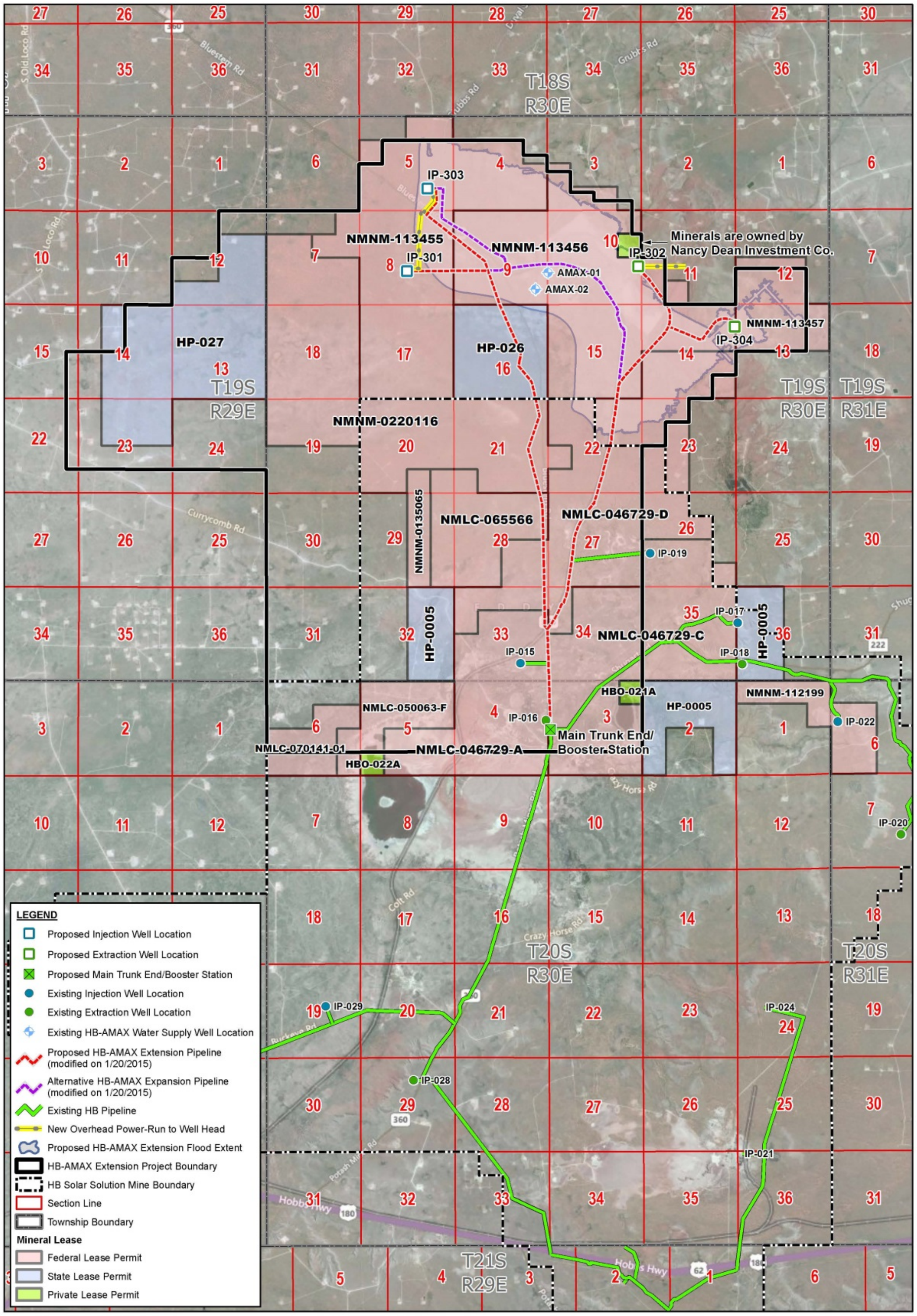
Conventional mining at the AMAX property occurred on the First and Third Ore Zones. The Third Ore Zone lies stratigraphically above the First Ore Zone with roughly 30 feet of separation between them. The two Ore Zones are connected by several slopes and stopes that would allow injected brine to move vertically providing contact to ore in pillars and fringe areas from both ore zones.

The HB AMAX Extension would utilize existing facilities wherever possible. The infrastructure associated with the HB Solar Solution Mine and the proposed HB AMAX Extension is shown on **Map 3 – *Existing and Proposed HB Solar Solution Mine Facilities***. All existing infrastructure for the HB Solar Solution Mine that would be also used by the HB AMAX Extension was previously analyzed in the HB In-Situ Solution Mine EIS.

As shown on Map 3, new construction for the HB AMAX Extension would include:

- Two injection wells with 80 feet by 80 feet operational areas.
- Two extraction wells with 80 feet by 80 feet operational areas.
- Two Pilot/Testing/Instrumentation (PTI) wells (one PTI well immediately adjacent to each extraction well and contained within each 80 feet by 80 feet operational area).
- 12.4 miles of 50-foot wide utility corridor that will include buried pipelines of various diameters (4 to 18 inches) and 12-foot wide access roads.
- One booster pump station.
- 1.6 miles of overhead electric lines.
- One additional source of injectate brine make-up water from the Intrepid North plant scrubber recycle system.

The HB Solar Solution Mine currently employs several monitoring systems and networks to verify and document operational conditions as required by the New Mexico Environment Department and the BLM. All existing monitoring systems would be utilized for the proposed HB AMAX Extension and are summarized as follows:



NOTES:

1. Aerial imagery from esri.
2. Locations of existing pipelines, existing wells, proposed HB-AMAX pipelines, and proposed HB-AMAX wells provided by Intrepid Potash, LLC and further defined through field surveys.
3. Final pipeline route to be surveyed upon regulatory approval.
4. Horizontal coordinate system is NAD 1983 New Mexico State Plane East, units in feet.

INTREPID POTASH

Foth

Foth Infrastructure & Environment, LLC			
REVISED	DATE	BY	DESCRIPTION
PREPARED BY: NMG1		DATE: MAR.'15	
REVIEWED BY: JMH6		DATE: MAR.'15	
APPROVED BY: JMH6		DATE: MAR.'15	

INTREPID POTASH - NEW MEXICO, LLC

MAP 2

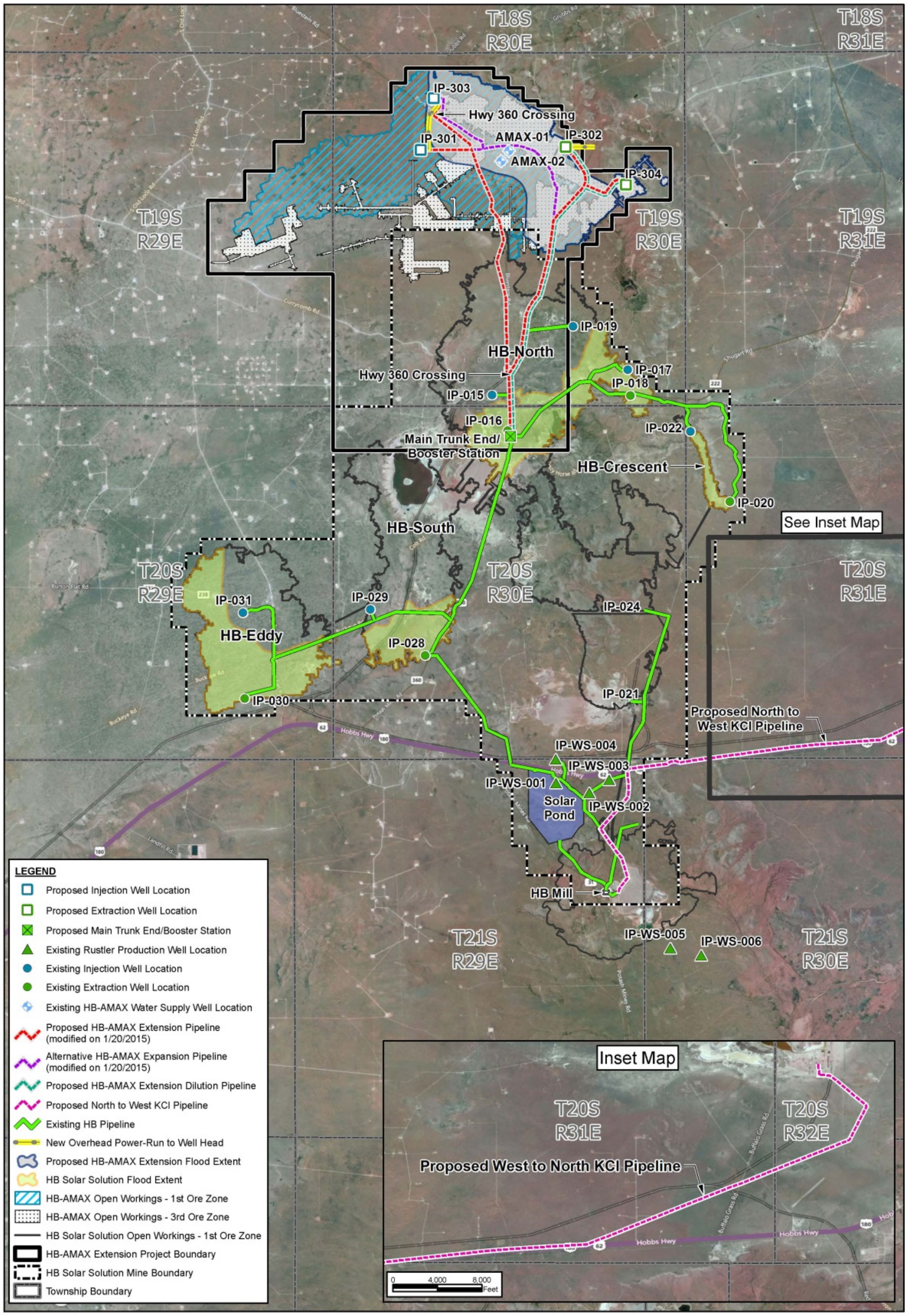
MINERAL LEASE

Environmental Assessment
HB Solar Solution Mine - AMAX Extension

Scale: 0 2,500 5,000 Feet | Date: MARCH 18, 2015

Drafted by: BJW1 | Project No: 0014I016-07

Path: X:\GB\IE\2014\14I016-00\GIS\mxd\EA_Report\PA_Figures\Intrepid_HB_Amax_Project_MineralLease_11x17.mxd Date: 3/18/2015



NOTES:
1. Aerial imagery from esri.
2. Locations of existing pipelines, existing wells, proposed HB-AMAX pipelines, and proposed HB-AMAX wells provided by Intrepid Potash, LLC and further defined through field surveys.
3. Final pipeline route to be surveyed upon regulatory approval.
4. Horizontal coordinate system is NAD 1983 New Mexico State Plane East, units in feet.

INTREPID POTASH.

Foth

Foth Infrastructure & Environment, LLC			
REVISED	DATE	BY	DESCRIPTION
PREPARED BY: NMG1			DATE: MAR.'15
REVIEWED BY: JMH6			DATE: MAR.'15
APPROVED BY: JMH6			DATE: MAR.'15

INTREPID POTASH - NEW MEXICO, LLC

MAP 3
EXISTING AND PROPOSED HB SOLAR SOLUTION MINE FACILITIES
Environmental Assessment
HB Solar Solution Mine - AMAX Extension

Scale: 0 4,000 8,000 Feet	Date: MARCH 18, 2015
Drafted by: BJW1	Project No: 0014I016-07

Path: X:\GB\IE\2014\14I016-00\GIS\mxd\EA_Report\PA_Figures\Intrepid_HB_Amax_Facilities_11x17.mxd Date: 3/18/2015

- A groundwater monitoring well network used to collect regular water level and water quality data throughout the area influenced by Rustler groundwater withdrawal.

- A groundwater monitoring well network used to collect regular water level, water quality, and electrical conductivity data to define baseline characteristics of the groundwater beneath the solar evaporation ponds and monitor for potential releases of solar pond brine.

- Regular water level measurements collected continuously or monthly to monitor water levels specified karst and cave resources.

- Regular pipeline inspections by mine personnel and pipeline instrumentation that monitors pressure and flow rate to monitor for potential pipeline leaks.

- Down-hole instrumentation to guide extraction well and injection well operation and control flood elevations.

- Monitoring wells to detect potential brine excursions to down-gradient portions of the mine workings outside of flood zones.

Map 3 shows the existing infrastructure associated with the HB Solar Solution Mine and the proposed HB AMAX Extension.

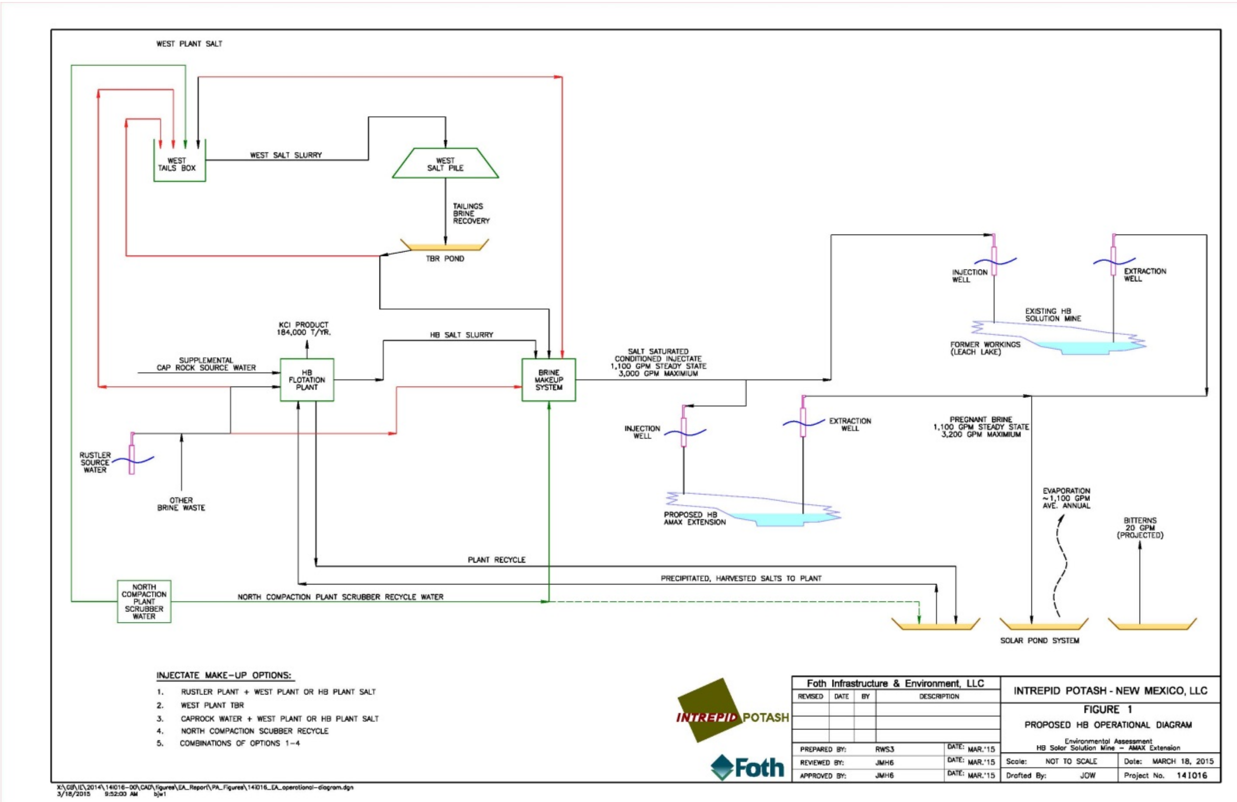
HB AMAX Extension Mine Operation

The solution mining process at the proposed HB AMAX extension would be identical to that employed at the existing HB Solar Solution Mine. The proposed HB AMAX solution mining process is to inject a salt (NaCl) saturated brine into the AMAX workings. The brine would remain in place to allow an ion exchange to occur between KCl in the mine ore body and sodium in the brine (KCl in the ore body is dissolved and an equivalent amount of NaCl precipitates out from the brine). The result would be a potassium-rich (pregnant) brine to be extracted from the mine after a desired concentration of potassium is reached. Pregnant brine would be pumped to the existing HB solar evaporation ponds. Water in the pregnant brine would evaporate in the ponds and KCl and NaCl would precipitate out as solids. The precipitated salts would be harvested from the ponds and transported to the existing HB Mill for ore refinement. This process is described in detail in the HB EIS (Section 2.4.2.2).

Salt conditioned injectate brine would be pumped to injection wells located in upper elevations of the HB AMAX Mine and would flow to the lower areas of the flood zone. As injectate brine is added, a leach lake would form and rise to the maximum control elevation. After the brine is injected it would flow via advection (gravity induced, downhill flow) and dispersion (driven by density gradients developed as the brine becomes increasingly saturated with KCl). Although it would take time to fill the HB AMAX Mine (over two years at the maximum injection rate of 3,000 gpm), KCl dissolution is expected to occur quickly but may take several month to concentrate to the desired pregnant brine KCl grade. The in-situ process would leave behind insolubles (clay slimes) in the former workings eliminating the need for separation and disposal on the surface. Once the cavern is filled to the control level, long term production would become a relatively steady-state operation where injection roughly equals extraction. **Figure 1 - Proposed HB Operational Diagram** summarizes the cumulative HB solar solution mine processes including the proposed HB AMAX Extension.

Proposed Construction

The proposed new construction required for the HB AMAX Extension includes new injection wells, extraction wells (with associated PTI wells), well head components, conveyance pipelines, booster station, power distribution facilities, and access roads. The following subsections present details of the proposed infrastructure and the design features related to environmental protection.


WEST PLANT SALT
WEST TAILS BOX
WEST SALT SLURRY
WEST SALT PILE
TAILINGS BRINE RECOVERY
TBR POND
KCl PRODUCT 184,000 T/YR.
HB SALT SLURRY
SUPPLEMENTAL CAP ROCK SOURCE WATER
HB FLOTATION PLANT
BRINE MAKEUP SYSTEM
SALT SATURATED CONDITIONED INJECTATE 1,100 GPM STEADY STATE 3,000 GPM MAXIMUM
RUSTLER SOURCE WATER
OTHER BRINE WASTE
INJECTION WELL
EXTRACTION WELL
EXISTING HB SOLUTION MINE
FORMER WORKINGS (LEACH LAKE)
PREGNANT BRINE 1,100 GPM STEADY STATE 3,200 GPM MAXIMUM
PROPOSED HB AMAX EXTENSION
EVAPORATION ~1,100 GPM AVE. ANNUAL
BITTERNS 20 GPM (PROJECTED)
PLANT RECYCLE
PRECIPITATED, HARVESTED SALTS TO PLANT
NORTH COMPACTION PLANT SCRUBBER WATER
NORTH COMPACTION PLANT SCRUBBER RECYCLE WATER
SOLAR POND SYSTEM
INJECTATE MAKE-UP OPTIONS:
1. RUSTLER PLANT + WEST PLANT OR HB PLANT SALT
2. WEST PLANT TBR
3. CAPROCK WATER + WEST PLANT OR HB PLANT SALT
4. NORTH COMPACTION SCUBBER RECYCLE
5. COMBINATIONS OF OPTIONS 1-4
INTREPID POTASH
Foth
Foth Infrastructure & Environment, LLC
REVISED DATE BY DESCRIPTION
PREPARED BY: RWS3 DATE: MAR.'15
REVIEWED BY: JMH6 DATE: MAR.'15
APPROVED BY: JMH6 DATE: MAR.'15
INTREPID POTASH - NEW MEXICO, LLC
FIGURE 1
PROPOSED HB OPERATIONAL DIAGRAM
Environmental Assessment
HB Solar Solution Mine - AMAX Extension
Scale: NOT TO SCALE
Date: MARCH 18, 2015
Drafted By: JOW
Project No. 141016
X:\GB\IE\2014\141016-00\CAD\figures\EA_Report\PA_Figures\141016_EA_operational-diagram.dgn
3/18/2015 9:52:00 AM bjw1

Injection/Extraction Well Locations
Two injection and two extraction wells are proposed to provide conduits to flood the target ore zones as follows:

- **<u>IP-301</u>** 1st Ore Zone Injection Well
  NW ¼, SE ¼, Section 8, T19S, R30E

- **<u>IP-302</u>** 1st Ore Zone Extraction Well
  NE ¼, SE ¼, Section 10, T19S, R30E

- **<u>IP-303</u>** 3rd Ore Zone Injection Well
  SE ¼, SE ¼, Section 5, T19S, R30E

- **<u>IP-304</u>** 3rd Ore Zone Extraction Well
  NE ¼, NE ¼, Section 14, T19S, R30E

The injection and extraction wells are classified as Class V injection wells for in-situ mineral processing and would be constructed using a similar design as the injection and extraction wells approved and installed for the HB Solar Solution Mine (See Section 2.4.2.1 of the HB EIS). The following figures illustrate the injection and extraction well design:

- **Figure 2 – Injection Well General Design**
- **Figure 3 – Extraction Well General Design**

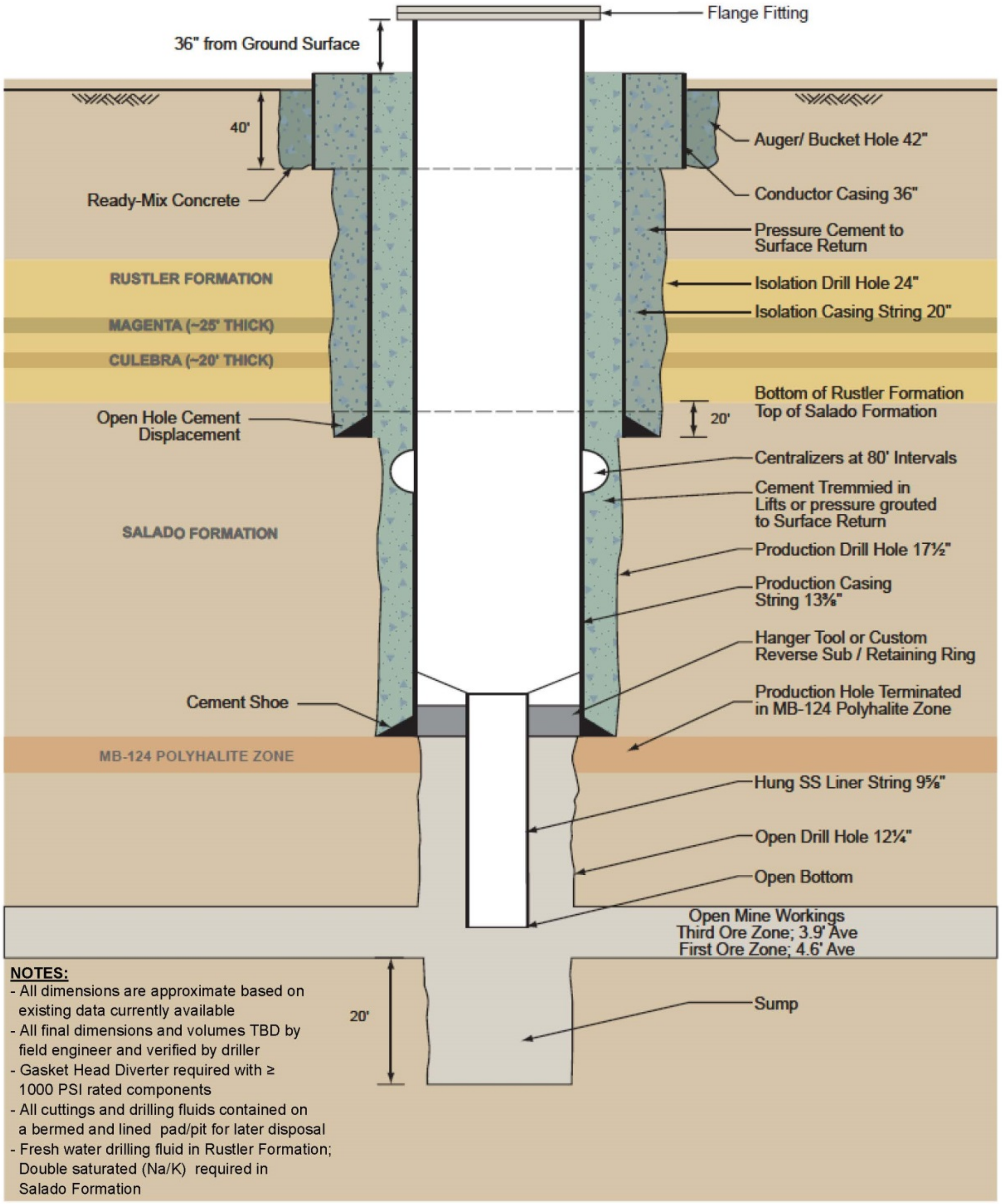
Proposed wells IP-301 and IP-302 may require modifications to the drilling and well completion design based on the occurrence and condition of the Third Ore Zone as drilling passes through it. Any modification to an approved plan would be notified to the BLM prior to construction.

Injection and Extraction Well Access and Drill Pads

Access routes to the injection and extraction well locations shall be via the pipeline routes which include an inspection/maintenance road within the utility corridor. The drill pad would be cleared and grubbed of vegetation and graded to facilitate well installation. Cleared vegetation would be randomly scattered outside the drill pad and not left in piles or rows. The disturbance area would be graded to the degree necessary to allow drilling and well construction activities. In the event that graded surface materials cannot support drilling and support equipment, a lift of caliche may be applied. The caliche would be supplied by an area contractor/supplier from sources controlled by that contractor. The drill pad and associated disturbance area would be 150 feet by 250 feet and would contain all drilling equipment, drilling material storage, subcontracted services such as drilling fluid supply and delivery, cementing, casing installation, geophysical logging, fueling, etc. The site would contain bermed and lined pits, tanks, and other components to manage drill cuttings and drilling fluids. The sites would also be bermed and equipped with straw booms on the down-slope edges to serve as secondary containment.

All fuels and lubricants would be contained in secondary containment facilities. Drilling and well construction would be performed on a 24/7 shift rotation and the location would contain portable sanitary facilities, office/maintenance trailers, and light plants. Once drilling activities are complete, all well construction equipment, left over materials, and waste would be removed from the site. Following well head construction associated with the surface control facilities, which would be contained within an 80-foot by 80-foot fenced area within the drill pad, the well pad would be graded and seeded with a seed/fertilizer mix as specified by the BLM. If caliche was used to stabilize the pad, all caliche would be removed from the site prior to reclamation

Figure 4 – General Drill Pad Layout illustrates the drill pad configuration for the injection and extraction wells. All pad, drilling and well construction activities would be overseen and directed by qualified personnel. The technical site representative would be responsible for all decisions regarding drill depths and well completion details.



NOTES:
- All dimensions are approximate based on existing data currently available
- All final dimensions and volumes TBD by field engineer and verified by driller
- Gasket Head Diverter required with ≥ 1000 PSI rated components
- All cuttings and drilling fluids contained on a bermed and lined pad/pit for later disposal
- Fresh water drilling fluid in Rustler Formation; Double saturated (Na/K) required in Salado Formation

INTREPID POTASH.

Foth

Foth Infrastructure & Environment, LLC

REVISED	DATE	BY	DESCRIPTION

PREPARED BY:	NMG1	DATE:	MAR.'15
REVIEWED BY:	JMH6	DATE:	MAR.'15
APPROVED BY:	JMH6	DATE:	MAR.'15

N

INTREPID POTASH - NEW MEXICO, LLC

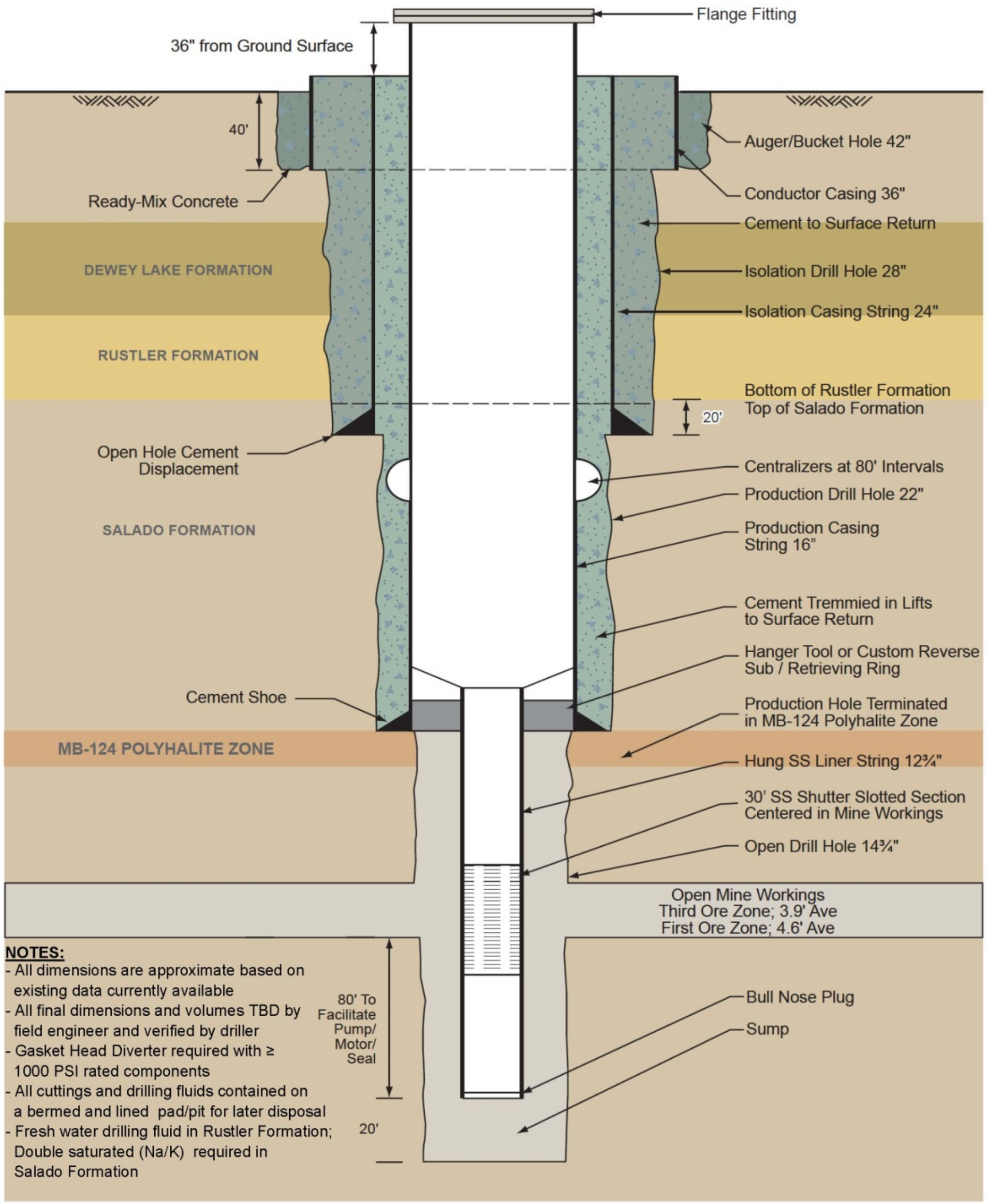
FIGURE 2

INJECTION WELL GENERAL DESIGN

Environmental Assessment
HB Solar Solution Mine - AMAX Extension

Scale: NOT TO SCALE	Date: MARCH 18, 2015
Drafted by: DAT	Project No: 0014I016-05

Path: X:\GB\IE\2014\14I016-00\GIS\mxd\EA_Report\PA_Figures\Intrepid_HB_Amax_Injection_Well_General_Design.mxd Date: 3/18/2015



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Foth

Foth Infrastructure & Environment, LLC

REVISED	DATE	BY	DESCRIPTION

PREPARED BY:	NMG1	DATE:	MAR.'15
REVIEWED BY:	JMH6	DATE:	MAR.'15
APPROVED BY:	JMH6	DATE:	MAR.'15

INTREPID POTASH - NEW MEXICO, LLC

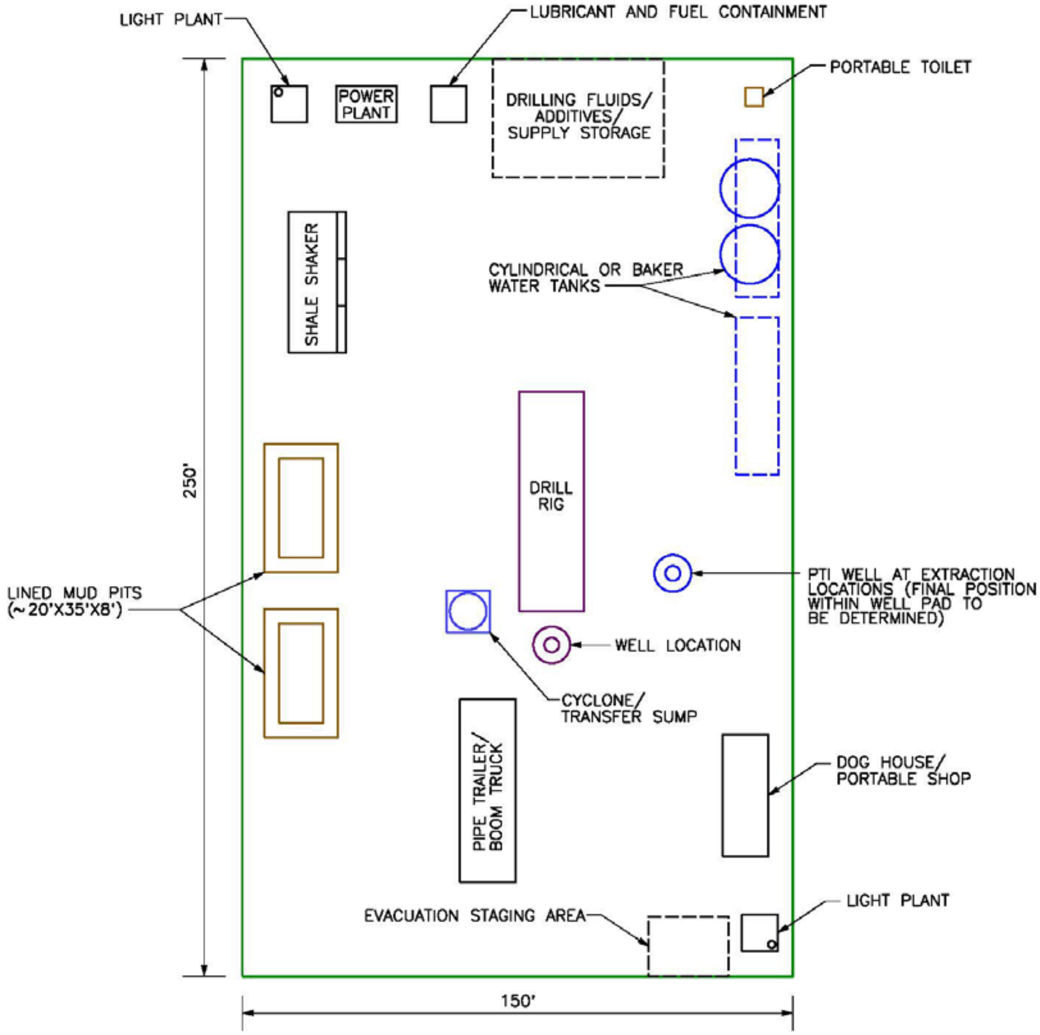
FIGURE 3

EXTRACTION WELL GENERAL DESIGN

Environmental Assessment
HB Solar Solution Mine - AMAX Extension

Scale:	NOT TO SCALE	Date:	MARCH 18, 2015
Drafted by:	DAT	Project No:	0014I016-05

Path: X:\GB\IE\2014\14I016-00\GIS\mxd\EA_Report\PA_Figures\Intrepid_HB_Amax_Extraction_Well_General_Design.mxd Date: 3/18/2015



NOTES:

1. 150' X 250' WORKING SURFACE.
2. TO BE RECLAIMED BACK TO A 80'X80' OPERATING SURFACE.
3. PADS TO BE GRUBBED AND GRADED LEVEL.
4. SMALL BERM AND STRAW WATTLES PLACED ALONG EXTERIOR BOUNDARY.
5. DRILLING FLUIDS, DRILLING MUDS, AND CUTTINGS TO BE DISPOSED OF WITHIN THE TAILINGS AREA OF THE FORMER PCA FACILITY.
6. PAD CORNERS STAKED WITH STEEL POSTS.
7. THE PAD MAY BE SURFACED WITH A CALICHE BASE AS SITE CONDITIONS DICTATE.

INTREPID POTASH

Foth

Foth Infrastructure & Environment, LLC

REVISED	DATE	BY	DESCRIPTION

PREPARED BY:	RWS3	DATE: MAR.'15
REVIEWED BY:	JMH6	DATE: MAR.'15
APPROVED BY:	JMH6	DATE: MAR.'15

INTREPID POTASH - NEW MEXICO, LLC

FIGURE 4

GENERAL WELL PAD LAYOUT

Environmental Assessment
HB Solar Solution Mine – AMAX Extension

Scale:	NOT TO SCALE	Date:	MARCH 18, 2015
Drafted By:	JOW	Project No.	14I016

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3/18/2015 9:50:47 AM bjw1

Well Head Infrastructure

Each of the four well locations would be equipped with operating infrastructure to facilitate brine injection and extraction as follows:

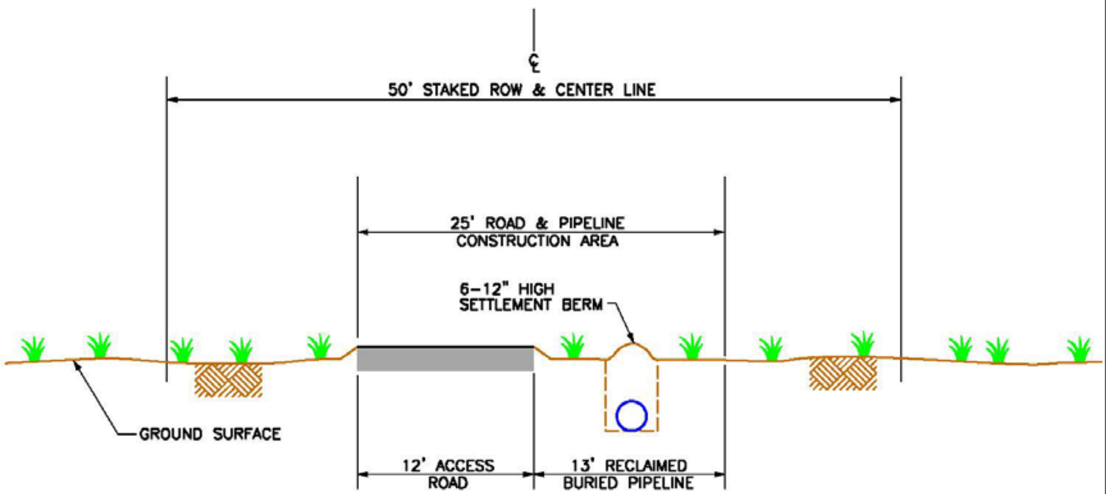
- Well head manifold and valving.
- Power transformation and motor control components.
- Well head security and fencing.
- Down-hole equipment.

All four well head areas would utilize an 80 feet by 80 feet operational area for the life of the operation. All equipment would be contained within the 80 foot by 80 foot area. The working area would contain various electrical cabinets for instrumentation, motor control/variable frequency drive, and power transformation/distribution mounted on concrete pads. Manifold piping inclusive of various vents, valves, sample ports, and instrumentation would be connected from the well to the distribution piping via flanged fittings to facilitate future maintenance. The operational area would also include telemetry and distributed control system equipment to transfer data and allow remote operation of the well site. The telemetry system is anticipated to consist of a radio-based network that would tie into the existing HB Solar Solution Mine telemetry system and would require small antennas at each of the well heads. Key control and instrumentation would include manifold and pipeline pressure monitoring, injection and extraction flow rates, mine flood level elevations, site security features, and various power parameters such as voltage, amperage, pump speed, etc. Any area within the 80 foot by 80 foot operating area that falls outside of concrete pad footprints would feature a gravel base and be fenced with a 4 strand wire fence with access gates as per BLM stipulations. The immediate area containing the extraction or injection well, the wellhead piping manifold, and the electrical cabinetry would be surrounded by a shaded, chain link fence with locking gates. Power would be brought to the site via overhead service terminating adjacent to the operating area. Power would be transformed to three phase 480 volt and then run underground to electrical transforming cabinetry within the operating area and distributed to various components within the operating area.

Access Piping and Roads

Injection brine would be transported from the northern extent of the existing HB Solar Solution Mine main trunk injection line to injection wells IP-301 and IP-303 (see Map 3). The new high density polyethylene (HDPE) injection pipelines would be designed to provide sufficient diameter and strength to convey up to 3,000 gpm at 228 PSI. The injection pipelines would be constructed with extrusion welded and/or flanged 18-inch diameter, SDR-9 HDPE pipe. The pipeline would be equipped with manual isolation valving, vent and vacuum relief valves, and pressure monitoring points as needed to monitor brine flow, as part of the leak detection system. All injection lines would be buried with a minimum of 2 feet of fill over the pipe. During construction open trenches would be limited to ½ mile in length or escape ramps would be installed every ¼ mile. Once backfilled, a 6 to 12-inch mound would be left over the pipeline to allow for settlement. Blinded wyes would be installed approximately every 1,500 feet to provide access for maintenance. All pipeline access points for instrumentation, monitoring or control would be within vaults or small areas of pipeline surface exposure.

The injection line would cross State Highway (STH) 360 at one new location as shown in Map 3. The STH 360 crossings would be facilitated by boring and jacking beneath the highway as described in Section 2.4.2.1 of the HB EIS. A New Mexico Department of Transportation (NMDOT) permit would be obtained for these crossings. The ROW area of construction disturbance would be 50-foot wide. Within the 50-foot ROW containing the buried pipeline, a 12-foot wide access road would be established to allow the pipeline to be inspected on a regular basis. The access road would also provide access for maintenance and routine monitoring of the instrumentation. **Figure 5 – Typical Pipeline ROW Section** illustrates the pipeline footprint. Upon completion of pipeline and access road construction all disturbance within the 50-foot ROW would be seeded, fertilized, and mulched as per BLM requirements and Conditions of Approval.



NOTES:

1. ALL ACCESS & DISTURBANCE CONFINED TO 50' ROW.
2. 12' ACCESS ROAD FOR PIPELINE INSPECTION TO BE OPERATIONAL FOR THE LIFE OF THE PROJECT.
3. ALL PIPELINES BURIED & BEDDED AS PER SPECIFICATIONS.
4. CERTAIN SECTIONS OF ACCESS ROAD MAY REQUIRE CALICHE SURFACE AS OPERATIONAL CONDITIONS DICTATES.
5. ALL DISTURBED SURFACES SHALL BE GRADED, FERTILIZED, SEEDED & MULCHED AS PER SPCIFICATIONS.

INTREPID POTASH

Foth

Foth Infrastructure & Environment, LLC				
REVISED	DATE	BY	DESCRIPTION	
PREPARED BY:		RWS3	DATE: MAR.'15	
REVIEWED BY:		JMH6	DATE: MAR.'15	
APPROVED BY:		JMH6	DATE: MAR.'15	

INTREPID POTASH - NEW MEXICO, LLC

FIGURE 5

TYPICAL PIPELINE ROW SECTION

Environmental Assessment
HB Solar Solution Mine – AMAX Extension

Scale: NOT TO SCALE	Date: MARCH 18, 2015
Drafted By: JOW	Project No. 14I016

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The brine extraction pipeline and associated dilution water line would be extended from the existing HB Solar Solution Mine pipeline network to each HB AMAX extraction well as detailed in Section 2.4.2.1 of the HB EIS. The extraction and dilution lines would be buried together for their entire length. The pipeline bundle would cross STH 360 at the location (see Map 3) of the existing HB Solar Solution Mine injection line crossing in Section 33 to minimize disturbance areas. The extraction pipeline has been designed to convey up to 2,000 gpm at 160 PSI. The extraction line would consist of 12-inch and 16-inch diameter, SDR-11 HDPE pipe and the dilution line would be composed of 4-inch and 6-inch diameter, SDR-9 HDPE pipe. The new pipelines installed as part of the proposed HB AMAX extension would be buried with a minimum 2 feet of cover.

The pipeline leak detection system consists of routine inspections by Intrepid personnel to observe for potential pipeline leaks and monitoring with automated instrumentation to minimize the potential for unauthorized discharges of the transport brine.

Booster Pump Station

Hydraulic analysis of the proposed HB AMAX injection pipelines indicates that a pump station would be required to achieve maximum desired flow rates within prescribed operating of the pipeline. Accordingly, a booster pump station is proposed to be installed where the new HB AMAX injection line connects to the existing HB Solar Solution Mine injection line main trunk. **Figure 6 – Booster Pump Station Plan** illustrates the booster pump station location. The pump station would require a graded footprint of 130 feet by 100 feet and would contain a primary pump, standby/back-up pump, a building to house the pumps, power transformation, and motor controls. The site would also include instrumentation, data acquisition, and automated controls connected by radio repeater to the adjacent HB Solar Solution Mine well facilities which would be routed to the HB control center. The booster pump station is estimated to require 350 HP driven operations. Power would be supplied by the existing overhead power line to well IP-016. The booster station would be fenced with a 4 strand wire fence and access gates would be installed along the access pipeline roadway per BLM requirements. Figure 6 shows the booster station location, configuration, and how the maintenance access road would be constructed and maintained.

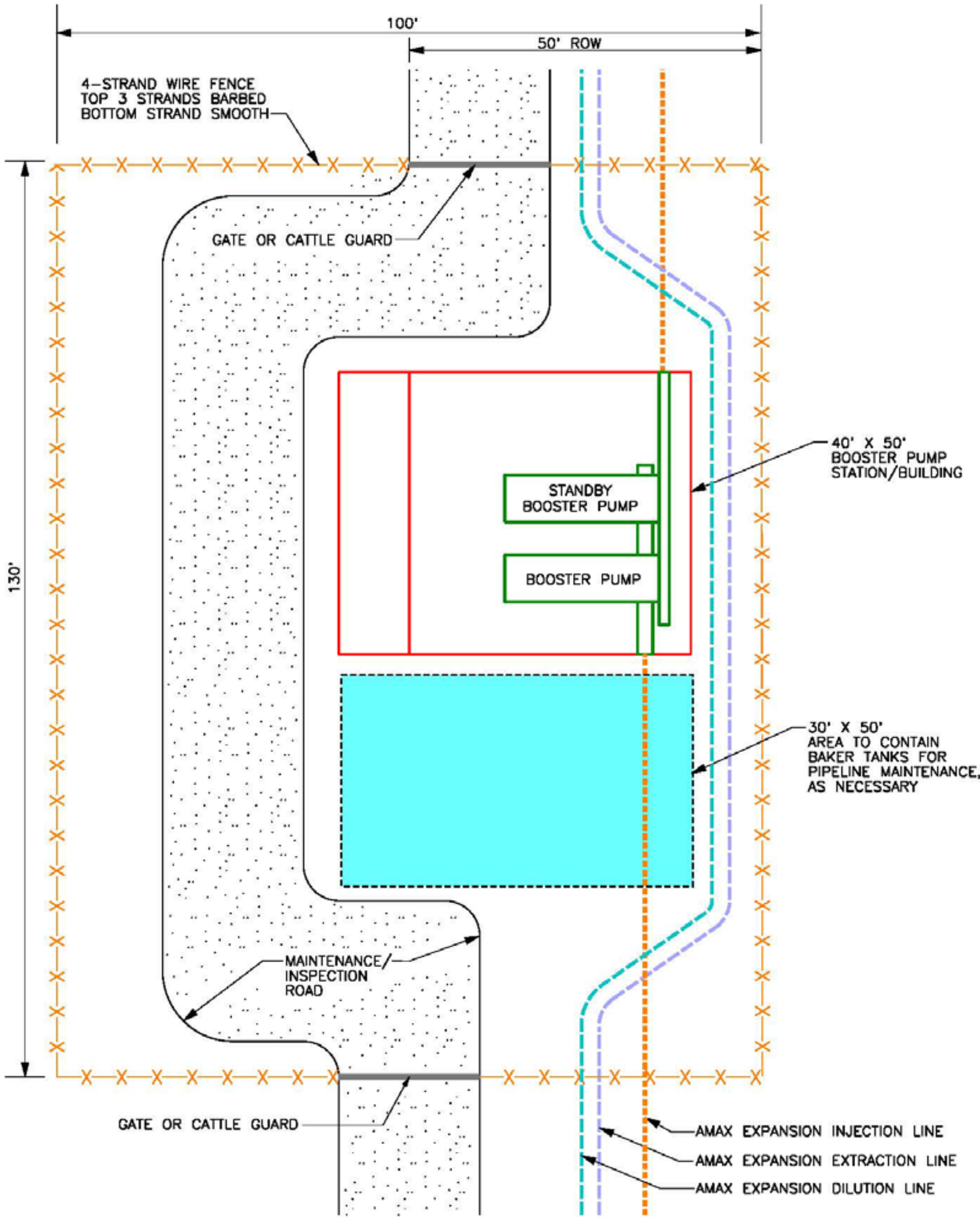
Power Distribution

Power would be required at each of the four well sites and the booster pump station. Overhead power has been previously supplied to existing extraction well IP-016 by Xcel. The same line that distributes power to IP-016 is routed immediately adjacent to the proposed booster station location. It is anticipated that Xcel would be able to modify the existing power service to support the requirements at the booster station and the only new infrastructure required may be an additional pole and associated underground service from the pole to the booster station. Central Valley Electric Cooperative (CVEC) operates an existing power line ROW located between Sections 4/5 and Sections 8 /9, T19S, R30E. New overhead power service is expected to proceed north from this existing ROW approximately ¼ mile to IP-303 along the proposed pipeline alignment and south from this existing ROW approximately ¾ mile to the south to IP-301. CVEC also operates an overhead power line in the middle of Section 11, T19S, R30E and another power ROW running immediately adjacent to IP-304. It is anticipated that the ROW adjacent in Section 11 would be extended approximately ¾ mile west to IP-302 and that the ROW to IP-304 would provide power directly to IP-304. Since the proposed power distribution is a connected action of the HB AMAX extension, the environmental analysis for the proposed power distribution is contained in this EA.

Map 3 illustrates the power ROWs and assumed distribution routes. The referenced power supply logistics above would be verified with Xcel and CVEC.

Existing Infrastructure

The existing HB Solar Solution Mine infrastructure that would be utilized with the proposed HB AMAX extension would include: groundwater supply wells, HB Mill facility, solar evaporations ponds, and portions of the existing pipeline network. Details pertaining to each of these components can be found in Section 2.4.2 of the HB EIS. Specifically, Section 2.4.2.1 details construction and layout and Section 2.4.2.2 describes the mining process.



INTREPID POTASH

Foth

Foth Infrastructure & Environment, LLC

REVISED	DATE	BY	DESCRIPTION

PREPARED BY:	RWS3	DATE: MAR.'15
REVIEWED BY:	JMH6	DATE: MAR.'15
APPROVED BY:	JMH6	DATE: MAR.'15

INTREPID POTASH - NEW MEXICO, LLC

FIGURE 6

BOOSTER PUMP SYSTEM DETAIL

Environmental Assessment
HB Solar Solution Mine – AMAX Extension

Scale: NOT TO SCALE	Date: MARCH 18, 2015
Drafted By: JOW	Project No. 141016

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Final Restoration and Reclamation

Upon completion of solution mining activities, all above ground infrastructure associated with the proposed HB AMAX extension project would be removed and recycled or properly disposed of at a licensed off-site facility. The extraction, injection, and PTI wells would be abandoned as per state of New Mexico requirements. All sections of buried pipeline would be evacuated, flushed and abandoned in place. The power runs would be the responsibility of the utility and would be abandoned or used by other power users. Caliche and concrete pads would be removed from the well head operating areas, booster pump station area, and access road where applied. All disturbed surfaces would be graded or scarified, seeded, fertilized, and mulched as per BLM requirements. Restoration, reclamation, and financial assurance quantification of all other HB Solar Solution Mine components used separately or in conjunction with the proposed HB AMAX extension are specifically addressed in the Discharge Permit Mine Modification submittal *Discharge Permit Renewal Modification Request - HB Solar Solution Mine NMED DP-1681 – HB AMAX Extension* dated February 12, 2015.

Construction and mitigation measures for the proposed project components would be the same as those as described in the HB In-situ Solution Mine Project documents, including:

- HB In-situ Project Mine Operations and Closure Plan, Revised March 9, 2012
- HB In-situ Project Final Environmental Impact Statement, January 2012
- HB Pipeline Right-of-Way Grant, Serial Number NM-121815, April 11, 2012
- HB In-Situ Solution Mine Project Record of Decision, March 19, 2012 (HB ROD)

CARLSBAD

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DALE JANWAY
MAYOR

STEVE McCUTCHEON
CITY ADMINISTRATOR

April 14, 2015

Jessie Hubbling
620 E. Greene St.
Carlsbad, NM 88220

575-234-5912
jhubbling@blm.gov

Dear Ms. Hubbling:

Thank you for the opportunity to comment during the scoping period for the BLM's development of an Environmental Assessment on the plan to modify Intrepid's HB Solar Solution Mine workings to include the AMAX mine in order to recover additional potash resources.

I strongly support Intrepid's proposal and believe the company's reclamation efforts associated with the HB Solar Solution Mine so far have been remarkable.

We all especially appreciate the fact that the HB AMAX Mine would provide approximately 14 years of solution mine reserves beyond the 28-year HB Solar Solution Mine life. Also, the proposal's plan to largely use existing infrastructure means that environmental impact will be minimal. The solution mining process is the same as the existing process. It is worth mentioning that the proposed extension project lies completely on potassium leases held by Intrepid and no separate Rights-of-Way (ROW) in addition to the mine modification are proposed for in this project.

The BLM should develop a new EA plan for this modification that relies heavily on existing data and current assessments obtained through the already-completed EIS. This will expedite the process and allow Intrepid to move forward with the expansion. My only other recommendation would be to make sure that the EA addresses recreational use in the area. The BLM's Hackberry OHV is highly valued by our community's desert racers.

While this is not the EA's public comment period, it is also worth noting during this scoping period that Intrepid's proposal is an extremely responsible one. The solution mining effort has been beneficial to this community. The AMAX Mine ceased production in 1993 and will now be put to good use.

We all appreciate the BLM's balanced management of public lands and appreciation of the importance of this area's potash resources.

Sincerely,

Carlsbad Mayor Dale Janway

*note this letter was received by the BLM in June 2015

Lea County Board of Commissioners
Lea County Manager
100 North Main Avenue, Suite 4
Lovington, New Mexico 88260

Lea COUNTY new mexico

Phone (575) 396-8602
Fax (575) 396-2093
sstout@leacounty.net
www.leacounty.net

April 13, 2015

Bureau of Land Management
Attn: Tony Harrell
New Mexico State Office
301 Dinosaur Trail
Santa Fe, NM. 87508

BLM Carlsbad Field Office
Attn: Jessie Hubbling
620 East Greene St.
Carlsbad, NM 88220

Dear Ms. Hubbling,
In response to the Public Notice soliciting comments for project scoping dated March 18, 2015 regarding the proposed Intrepid HB AMAX Extension Solution Mining Project, Lea County submits the following comments and for project scoping.

1. Lea County is interested in the amount of fresh water that will be used once this project is fully developed. What is the total amount of fresh water that will be used for this project?
2. What are the sources of fresh water? Where are these sources located?
3. What fresh water conservation measures will Intrepid deploy?
4. What level of non-fresh water will be used once this project is completed? What are the sources of non-fresh water?
5. How will use of non-fresh water sources impact the aquafers'?
6. What is the total amount of water rights Intrepid will use for this project?
7. Will all of the water rights that will be used for this project be leased by Intrepid or will Intrepid water usage be limited to water rights owned by Intrepid?
8. How will the increased fresh water usage for this project impact the aquafers?
9. Lea County has adopted a 40 year water development plan. How will this plan be included in the forthcoming EA?
10. The Lea County Commission respectfully requests coordination with the Bureau of Land Management for this request from Intrepid Potash.

For questions, comments or to schedule a coordination meeting, please contact me at mgallagher@leacounty.net or my cell 575-605-6567.

Sincerely,

Mike Gallagher
County Manager

Office of the State Engineer
130 South Capitol Street
Concha Ortiz y Pino Building
P.O. Box 25102
Sante Fe, NM 87504-5102

Mr. Andy Morley, District Supervisor
Water Rights Division District 2
1900 West Second Street
Roswell, NM 88201-1712

Mr. Rick Rudometkin
Eddy County Manager
Eddy County Admin Complex Ste 110
101 W. Greene Street
Carlsbad, NM 88220

Lea County
100 N. Main Street
Lovington, NM 88260

City of Carlsbad
City Hall
1200 Carlsbad Village Drive
Carlsbad, CA 92008

Carlsbad Soil & Water Conservation
District
3219 S. Canal Street
Carlsbad, NM 88220

PUBLIC NOTICE

May 8th, 2015

Intrepid HB AMAX Extension Solution Mining Project

The Bureau of Land Management (BLM) Carlsbad Field Office is initializing a public comment period for Intrepid Potash New Mexico for the proposed HB AMAX Extension project to solution mine the abandoned AMAX Potash mine. An Environmental Assessment (EA) has been prepared to assess the effects upon environmental resources in the area of the proposed HB AMAX Extension project.

This comment period gives the public a chance to tell the BLM their comments on the proposed project and how they should be addressed in the EA. The public comment period is now underway for the EA. Please submit comments by 5 pm on June 8th, 2015.

The EA along with a list of frequently asked questions can be found on the BLM website at the location below.

http://www.blm.gov/nm/st/en/fo/Carlsbad_Field_Office.html

A proposed Finding of No Significant Impact (FONSI) and Decision Record (DR) have also been posted for the proposed project. These documents do not represent a decision that has been made, but instead are meant to notify the public of the BLM preferred alternative as described in the EA.

This project is an extension of Intrepid's existing HB Solution Mine. The EA for this project tiers to the Environment Impact Statement (EIS) that was completed for the HB Solution Mine (DOI-BLM-NM-P020-2011-498-EIS). The complete EIS with supporting information can be found at the link below.

http://www.nm.blm.gov/cfo/HBIS/finalEIS.html

Please address any comments to:
BLM Carlsbad Field Office
Attn: Jessie Hubbling
620 East Greene St.
Carlsbad, NM 88220
Phone: 575-234-5912
Fax:575-885-9264
Email: jhubbling@blm.gov

Before including your address, phone number, e-mail address, or other personal identifying information in your comment be advised that your entire comment – including your personal identifying information – may be made publicly available at any time. While we will work to meet any request that personal identifying information be withheld from public review, we cannot guarantee that we will be able to do so.

Intrepid HB AMAX Solution Mine Extension Project Frequently Asked Questions (FAQs)

Who is the project sponsor?

Intrepid Potash – New Mexico, LLC

Where is the project?

Eddy County, NM about 20 miles east of Carlsbad

What is the project?

The AMAX Mine is a closed conventional potash mine that lies to the north of the HB Solar Solution Mine. The Proposed Project is designed to recover and process potassium chloride (KCl) ore from the abandoned underground mine workings of the AMAX Mine. The HB AMAX Solution Mine Extension project would tie directly into Intrepid's existing HB Solar Solution Mine and would expand the size and extend the life of that mine. Intrepid holds the federal, State, and private potassium leases for the area of proposed potash extraction. Surface disturbance would occur on BLM, State, and fee lands. The HB AMAX Solution Mine would provide approximately 14 years of solution mine reserves beyond the 28-year HB Solar Solution Mine life.

To the maximum extent practicable, the HB AMAX Solution Mine Extension project would utilize existing HB Solar Solution Mine facilities and infrastructure to minimize environmental impacts. The solution mining process would be identical to that of the existing HB Solar Solution Mine with injection of salt (NaCl) saturated brine into the workings and extraction of a KCl (potash) enriched (pregnant) brine. Potash recovered from the HB AMAX Solution Mine would be pumped to the existing HB Solar Solution Mine solar evaporation ponds. Once the solution evaporates in the ponds and precipitates out KCL and NaCl, the salts would be harvested and transported to the existing HB Mill for ore refinement.

What is the BLM's role?

The BLM has the responsibility and authority to manage the surface and subsurface resources on public lands. The Carlsbad Resource Management Plan (RMP) has designated lands within the proposed project area as open for mineral exploration and development. Under Continuing Management Guidance for Energy and Mineral Resources, the RMP states that the "BLM will encourage and facilitate the development by private industry of public land mineral resources so that national and local needs are met, and environmentally sound exploration, extraction, and reclamation practices are used."

The decision to be made is whether or not to approve Intrepid's application to extend the existing HB Solar Solution Mine workings to include the AMAX Mine, and, if to approve, under what terms and conditions.

Intrepid HB AMAX Solution Mine Extension Project Frequently Asked Questions (FAQs)

Project at-a-glance:

- 2 wells for injection of salt-saturate brine into underground mine caverns
- 2 wells for extraction of KCl enriched brine from the cavern
- 2 pilot/testing/instrumentation (PTI) wells – adjacent to extraction wells for brine sampling and instrumentation during operation
- Extension of injection/extraction pipelines
- 1 booster pump station
- 1.6 miles of overhead power lines
- 1 additional source of injectate brine make-up water from the Intrepid North Plant scrubber water recycle system
- 104,600 linear feet of injection and extraction pipelines and 69.2 acres of pipeline disturbance

Should the project be approved, how would it affect the human and natural environment?

Groundwater

- To date (October 2012 – March 2015), 89% of the total injected brine pumped into solution mines has come from non-potable water sources
- Water for processing and injection would come from three existing well fields:
  - North Rustler Well Field (Rustler Formation, non-potable)
  - South Rustler Well Field (Rustler Formation, non-potable)
  - Caprock Well Field (Ogallala aquifer, potable)
- A supplemental water supply consisting of recycled from the Intrepid North Plant scrubber system is also a planned source of water for the HB and HB AMAX Solution Mines
- Supplemental recycled water supplies are used wherever possible
  - The use of recycled process brines from the West Plant was permitted in 2013
  - Construction is underway for the use of recycled scrubber water from the Intrepid North Plant
- Intrepid would continue to monitor drawdown and water quality in the Rustler Formation using the existing monitoring well network
- Rustler well production improvements were made in 2015

Recreation

- Hackberry Lake Recreation Area lies on the eastern edge of the project boundary
- Some crossings of OHV trails but all pipelines would be buried
- Safety signage would be in place during all phases (construction, operations, reclamation) of the project
- New, aboveground facilities and operational activities could potentially affect hunting, trail riders and campers

Intrepid HB AMAX Solution Mine Extension Project Frequently Asked Questions (FAQs)

Oil and Gas

- Delaware Basin is part of the prolific Permian Basin reserves
- 67 abandoned oil and gas wells in the project area
- 6 wells in or within 1,000 feet of the proposed flood zone
  - All six wells have been properly plugged and abandoned

Paleontology

- The bluff leading to IP-304 has a rock type capable of preserving fossil material
- Spot survey during construction of the pipeline where recommended
- Any fossils found would be immediately reported to the BLM; operations would be suspended until approval to resume

Surface Water

- All proposed infrastructure is >650 feet from 100-year floodplains
- Closest wetland to project infrastructure is 2.2 miles away
- Closest stream or navigable waterway is the Pecos River located 14 miles east of project
- No surface water rights in project boundary

Vegetation

- Chihuahuan Desert Ecoregion
- Predominantly desert scrub, mesquite upland scrub, and grassland
- Project would result in of re-vegetation around operational facilities
- Disturbed areas will be inspected for noxious and invasive weeds and if found will use BLM approved methods to eradicate

Wildlife and Fish

- Minor habitat loss at operational facilities
- Slight reduction in habitat quality due to increased human presence
- Impact wildlife movement during trenching for pipelines

Rangelands and Livestock Grazing

- Disturbance of 14 Animal Unit Month (AUMs) during the construction phase
- Disturbance of 6 AUMs during the operation phase after reclamation is completed

First Name	Last Name	Title	Organization	Address	City	State	Zip	Email	Phone Number	Notification Method	Notificaiton Date	Notification Date
Paul	Aguilar		City	1613 W. Tansill	Carlsbad	NM	88220	pcaguilar@cityofcarlsbadnm.com	(575) 885-8520			
Beverly	Allen		Senator Tom Udall	102 Hagenman, Ste A	Carlsbad	NM		beverly_allen-ananins@tomudall.senate.gov	(575) 640-5343	email	4/2/2015	5/8/2015
Vernon	Asbill		Former State Senate			NM		vernon@asbillforsenate.com	(575) 302-8135			
Randy	Bailey		Mine Supply Company	P.O. Box 1330	Carlsbad	NM	88221	randybailey@theminesupplyco.com	(575) 887-2888	email	4/2/2015	5/8/2015
Draper	Brantley		Owner, Brantly Farms									
Joe	Brininstool		CDOD Executive Committee/BES Rental & Sales					joe@equipsales.com	(575) 887-3550	email	4/2/2015	5/8/2015
Ken	Britt		City of Carlsbad / Chamber of Commerce		Carlsbad	NM		kbritt@windstream.net		email	4/2/2015	5/8/2015
Cathrynn	Brown		State Rep	1814 N. Guadalyn	Carlsbad	NM	88220	cnbrownesq@plateautel.net	(575) 302-2746	email	4/2/2015	5/8/2015
Michael	Calvani	Board of Directors	Carlsbad Chamber of Commerce	Calvani Carpets 704 W Pierce St	Carlsbad	NM	88220	calvaniscarpet@valornet.com	(575) 885-2535	email	4/2/2015	5/8/2015
Steven	Calvert		Manager, Navarro Research									
Jeff	Campbell		Carlsbad Department of Development	107 W. Mermod	Carlsbad	NM	88220	jcampbell@developcarlsbad.org	(575) 887-6562	email	4/2/2015	5/8/2015
Chad	Campbell		Carlsbad Medical Center									
Wesley	Carter	City Council Ward 3	Carlsbad City Council	101 N. Halaqueno	Carlsbad	NM	88220		(575) 887-1191			
Martha	Chapman		Carlsbad Chamber of Commerce		Carlsbad	NM		wethreelittlepigs@yahoo.com		email	4/2/2015	5/8/2015
Lisa	Chavez		NMSU / Carlsbad Chamber of Commerce		Carlsbad	NM		lchaves@nmsu.edu		email	4/2/2015	5/8/2015
Larry	Coalson	Honorary Board Member	Carlsbad Chamber of Commerce	221 S. Canyon St.	Carlsbad	NM	88220	lcoalson@cavern.nmsu.edu				
Lyle	Cole		Burba, Cole & Overstreet	412 N. Canal	Carlsbad	NM	88220		(575) 887-2013			
Glen	Collier		Eddy County - Commissioner			NM		gcollier@co.eddy.nm.us	(575) 200-7501	email	4/2/2015	5/8/2015
Susan	Crockett		Eddy County - Commissioner			NM		scrockett@co.eddy.nm.us		email	4/2/2015	5/8/2015
Dan	Cross	Pharmacist	Southwest Pharmacy	2402 W. Pieke, Ste 2D	Carlsbad	NM		southwestpharmacy@yahoo.com	(575)885-2979	email	4/2/2015	5/8/2015
Randy	Culver		Owner, Plains Welding									
Mike	Currier		Guaranty Title Co.	108 N. Canyon	Carlsbad	NM	88220		(575) 887-3593			
Dan	Daniels		United Salt	P.O. Box 55	Carlsbad	NM	88220	edan@usccarlsbad.com	(575) 885-2105	email	4/2/2015	5/8/2015
Robert	Defer		Chamber of Commerce			NM		director@carlsbadchamber.com	(575) 887-6516	email	4/2/2015	5/8/2015
Lewis	Derrick	Commissioner District 2	Former Eddy County Commissioner	P.O. Box 1441	Artesia	NM	88211	ldpatriot@yahoo.com	(575) 703-0678	email	4/2/2015	5/8/2015
J.R.	Doporto		City Council		Carlsbad	NM						
Dick	Doss		City Council	1204 W. Orchard Lane	Carlsbad	NM	88220	dossward4@live.com	(575) 885-6228	email	4/2/2015	5/8/2015
Marsha	Drapala		Carlsbad Chamber of Commerce		Carlsbad	NM		marsha@landsunhomes.com		email	4/2/2015	5/8/2015
George	Dunagan		Dunagan Associates	212 W. Stevens	Carlsbad	NM	88220	georged@dunaganassociates.com	(575) 885-2138	email	4/2/2015	5/8/2015
Wanda	Durham	Board of Directors	Carlsbad Chamber of Commerce	Durham & Associates 102 N. Canyon	Carlsbad	NM	88220	wdurham@durhamarchitects.us	(575) 885-5545	email	4/2/2015	5/8/2015
Ned	Elkins		Los Alamos National Laboratory	115 N. Main	Carlsbad	NM	88220	elkins@lanl.gov	(575) 628-3934	email	4/2/2015	5/8/2015
Joe	Epstein	Retired		1312 W. Riverside Drive	Carlsbad	NM	88220	jlepstein@warpdriveonline.com	(575) 885-5324 / (575) 361-5325			5/8/2015
Richard	Forrest		Forrest Tire Co	414 S. Canal		NM		rforrest@forresttire.com	(575) 887-3567	email	4/2/2015	5/8/2015
Bobby	Forrest		Stevens Inn		Carlsbad	NM						
Bob	Forrest		Former Mayor / Forrest Tire									
Tracy	Francis		Carlsbad National Bank									
Joe	Franco		DOE CBFO									
Joe	Gant	Attorney		P.O. Drawer DD	Carlsbad	NM		jgant3@plateautel.net	(575) 887-3956	email	4/2/2015	5/8/2015
Michael D.	Garringer		Resource Management	2302 W. Pierce - C-5	Carlsbad	NM	88220		(575) 887-2566			
Don	George		S.M. Stoller Corp.	314 W. Mermod Street, Ste 102		NM		dgeorge@stoller.com	(575) 885-0172	email	4/2/2015	5/8/2015
Garth	Goody		Southeast Ready Mix									
Dr. John	Gratton		NMSU Carlsbad									
William	Gray		State Rep	1503 W. Dallas	Artesia	NM	88221	wjgray@pvtn.net	(575) 746-2849	email	4/2/2015	5/8/2015
James	Greer		Owner, Greer Construction									
Ron	Griggs		State Senator		Alamogordo	NM						
Russell	Hardy		CEMRC	1500 University Drive	Carlsbad	NM	88220	rhardy@cemrc.org	(575) 234-9210	email	4/2/2015	5/8/2015
Jim	Harrison	Board of Directors	Carlsbad Chamber of Commerce / Carlsbad Foundation	Carlsbad Community Foundation 116 S. Canyon St	Carlsbad	NM	88220		(575) 887-1131			5/8/2015
John	Heaton	State Representative (Former)	Former State Representative					jheaton@caverns.com		email	4/2/2015	5/8/2015
Tony	Hernandez		Eddy County	1771 Pecos Highway	Loving	NM	88256	tonyhernandez@bakerhughes.com	(575) 361-3141			
Don	Hughes		Carlsbad Radio	P.O. Box 1538	Carlsbad	NM	88221		(575) 887-7563			
Todd	Hyden		Pace Setter Pumping / Carlsbad Chamber of Commerce	1044 N. Canal	Carlsbad	NM		todd@pacesetterpumping.com	(575) 887-5555	email	4/2/2015	5/8/2015
Ben	Jaime		Xcel Energy	525 E. Bender	Hobbs	NM	88240	ben.jaime@xcelenergy.com	(575) 391-3251	email	4/2/2015	5/8/2015
Dale	Janway		City	3706 Brentwood	Carlsbad	NM		mayor.office@cityofcarlsbadnm.com	(575) 887-3383	email	4/2/2015	5/8/2015
Jay	Jenkins		CDOD Executive Board/Carlsbad National Bank					jjenkins@carlsbadnational.com	(575)234-2500	email	4/2/2015	5/8/2015
Nick	Jenkins		Owner, KCCC Radio									
Jill	Jennings		Manager, Wells Fargo Bank									
Chuck	Jones		Jones & Kluesner	209 W. McKay	Carlsbad	NM	88220		(575) 885-3167			
Gay	Kernan		State Senator		Carlsbad	NM						
Don	Kidd		Western Commerce Bank	Box 1358	Carlsbad	NM	88220	don@wcb.net	(575) 887-6686	email	4/2/2015	5/8/2015
Debbie	Kimbley		Western Commerce	P.O. Box 1358	Carlsbad	NM	88220		(575) 887-6686			
Lauire	Kincaid		Former County Commissioner									
Ross	Kirkes		SNL/JHA	4100 National Pks Hwy	Carlsbad	NM	88220	grkirke@sandia.gov	(575) 234-0187	email	4/2/2015	5/8/2015
Hayley	Klein		Director, Artesia Chamer of Commerce									
Chris	Knittle		NM Transportation									
Jody	Knox		Lakeview Christian Home	1965 W. Pierce Street		NM		jknox@lakeviewchristian.com	(575) 887-3947	email	4/2/2015	5/8/2015
Susan	Langowski											
Gary	Lanier		Nichols Printing	212 West Lea	Carlsbad	NM	88220		(575) 885-3313			
Roxanne	Lara		Lara Law Firm	310 N. Canyon	Carlsbad	NM		laralaw@windstream.net	(575) 302-6667	email	4/2/2015	5/8/2015
Carroll	Leavell	State Senator	State of New Mexico	P.O. Drawer D	Jal	NM	88252	leavell4@leaco.net	(575) 395-3154	email	4/2/2015	5/8/2015
Matt	Leroch	Past Chairman of the Board	Carlsbad Chamber of Commerce	URS - Engineered Products Division PO Box 2138	Carlsbad	NM	88221	matt.leroch@wgint.com		email	4/2/2015	5/8/2015
Robert	Light		The Light Co. LLC	P.O. Box 1658	Carlsbad	NM	88221		(575) 302-1547			
Roger	Logan		Former Owner Ford Town									
Guy	Lutman		Eddy County	910 S. Canal	Carlsbad	NM	88220	lutman@carlsbad.com	(575) 302-1820			
Denise	Madrid-Boyea											
Donavan	Mager		Nuclear Waste Partnership		Carlsbad	NM		donavan.mager@wipp.ws	(575)234-7586			
John	Manganaro		Accounting & Consulting	201 S. Halagueno	Carlsbad	NM	88220		(575) 885-4184			
Kyle	Marksteiner							kmarksteiner@yahoo.com		email	4/2/2015	5/8/2015
Tom	Martin		Martin, Dugan & Martin	P.O. Box 2168	Carlsbad	NM		martinlaw@zianet.com	(575) 887-3528	email	4/2/2015	5/8/2015
John	McCormick		SW Railroad					swrrc@valornet.com		email	4/2/2015	5/8/2015
Steve	McCutcheon		City of Carlsbad					svmccutcheon@cityofcarlsbadnm.com		email	4/2/2015	5/8/2015
Bob	McQuinn		General Manager Washington Tru Solutions									
Oran	Means			1514 Farrell		NM			(575) 361-0207			

Jim	Miller		Chamber of Commerce / Fairfield Inn		Carlsbad	NM		jmiller@intermtn.biz		email	4/2/2015	5/8/2015
Colby	Morris		Xcel Energy					colby.d.morris@xcelenergy.com		email	4/2/2015	5/8/2015
Gil	Moutray		Owner Seven Rivers Inc.									
Terry	Mullins		PVT	4011 W. Main	Artesia	NM		tmullins2@pvt.com	(575) 748-1241	email	4/2/2015	5/8/2015
Valerie	Murrill		Murrill Electric	P.O. Box 1266	Carlsbad	NM	88221	diveplan@aol.com	(575) 234-9905	email	4/2/2015	5/8/2015
Jeff C.	Neal		CIA	1311 Doepp Drive	Carlsbad	NM	88220	jeffnealcia@gmail.com	(575) 885-4033	email	4/2/2015	5/8/2015
Roger	Nelson		US DOE	P.O. Box 3070	Carlsbad	NM		roger.nelson@wipp.ws	(575) 834-7213	email	4/2/2015	5/8/2015
Brad	Nesser		NPSR Architects	606 W. Pierce	Carlsbad	NM	88220		(575) 885-4775			
Sandy	Nunley	City Council Ward 2	City of Carlsbad	101 N. Halaqueno	Carlsbad	NM	88220	council@cityofcarlsbadnm.com	(575) 887-1191	email	4/2/2015	5/8/2015
Alisa	Ogden		Lookout Farms	P.O. Box 94	Loving	NM	88256	alisaogden@plateautel.net	(575) 361-6460	email	4/2/2015	5/8/2015
Rhonda	Parchman		Manager, SOS Staffing									
Larry	Pardue		Pardue LTD									
Stevan	Pearce		US House of Representatives									
Royce	Pearson		Eddy County - Commissioner					rpearson@co.eddy.nm.us	(575) 200-7519	email	4/2/2015	5/8/2015
Gary	Perkowski		Carlsbad Municipal Schools	1710 Loretta Lane		NM		gary.perkowski@carlsbad.k12.nm.us	(575) 706-8520	email	4/2/2015	5/8/2015
Stan	Power		Tessenderlo Kerley Services	209 S. Halaguero Street	Carlsbad	NM	88220	spower@tkinet.com	(575) 885-4784	email	4/2/2015	5/8/2015
Raul	Quintana		Owner, Décor Furniture									
Nick	Salcido		City Council	206 Plum Street	Carlsbad	NM		ngsalcido@mywdo.com	(575) 725-0319			
Allen	Sartin	County Manager	Eddy County	101 W. Green Street #225	Carlsbad	NM	88220	asartin@co.eddy.nm.us	(575) 887-9511			
Mark	Schinnerer	Board of Directors	CARC / Carlsbad Chamber of Commerce	CARC, Inc. 902 W. Cherry Lane	Carlsbad	NM	88220	mark.schinnerer@carcinc.org		email	4/2/2015	5/8/2015
Dave	Sepich		Springtime Jepio International	801 N. 8th	Carlsbad	NM		dsepich@springtimesupply.com	(575) 885-4696	email	4/2/2015	5/8/2015
Lisa	Sexton		Acu-Rite Tax & Accounting / Carlsbad Chamber of Commerce									
Faroke	Shariff											
Jason	Shirley		City of Carlsbad Councilor		Carlsbad	NM						
Paul	Shoemaker		Manager Sandia National Lab, Carlsbad		Carlsbad	NM						
David	Shoup		Constructors, Inc.	3003 S. Boyd Drive	Carlsbad	NM	88220	dshoup@ciconstructors.com	(575) 885-8838	email	4/2/2015	5/8/2015
Keith	Sparks		Sparks Office Solutions	301 N. Canal Street	Carlsbad	NM	88220	k.sparks@sparksos.com	(575) 885-3146			
Craig R.	Stephens		ERA Real Estate	101 S. Canyon	Carlsbad	NM	88220		(575) 885-4131			
Cliff	Stroud		Los Alamos National Laboratory	115 N. Main	Carlsbad	NM	88220	cstroud@lanl.gov	(575) 706-0218	email	4/2/2015	5/8/2015
Don	Titus		PNM	P.O. Box 1419	Carlsbad	NM	88221		(575) 236-6503			
Paul	Trone		Edward Jones Investments									
Jack	Valpato		Eddy County	1526 Muscatel	Carlsbad	NM		jackvalpato@hotmail.com	(575) 302-1236			
Angela	Vasquez		Carlsbad Insurance Agency	P.O. Box 490	Carlsbad	NM		angelavasquez@carlsbadinsurance.com	(575) 361-0201			
Dr. George	Veni	Honorary Board Member	Carlsbad Chamber of Commerce	National Cave & Karst Research Institute 1400 Commerce Drive	Carlsbad	NM	88220	gveni@nckri.org		email	4/2/2015	5/8/2015
Debe	Wagner		Pioneer Bank	P.O. Box 55	Carlsbad	NM		dwagner@pioneerbnk.com	(575) 885-7460	email	4/2/2015	5/8/2015
Phillip	Walterscheid		Walterscheid Farms									
Ronnie	Walterscheid		Walterscheid Farms									
John	Waters		CDOD	P.O. Box 1090	Carlsbad	NM	88220	jwaters@developcarlsbad.org	(575) 887-6562	email	4/2/2015	5/8/2015
Judith	Waters	Councilmember Ward 3	City of Carlsbad	101 N. Halaqueno	Carlsbad	NM	88220	council@cityofcarlsbadnm.com	(575) 887-1191	email	4/2/2015	5/8/2015
Bill	Waters		Hall Machines Welding Co. Inc.	102 W. Mermod Street	Carlsbad	NM	88220	bill_waters@hallmachine.com	(575) 887-1143	email	4/2/2015	5/8/2015
Rachel	West		West Consulting	1711 Stardpipe Road	Carlsbad	NM	88220	rachel@westconsultingllc.com	(575) 885-3005	email	4/2/2015	5/8/2015
Rick	West		Owner, West Services, Inc.									
Janelle	Whitlock		City Council		Carlsbad	NM						
Mike	Wiemers		URS - WA Div - Eng Prod	P.O. Box 2138	Carlsbad	NM	88221		(575) 234-5703			
Bobby	Yeager	Retirement Council Committee Chair	Carlsbad Chamber of Commerce	Century 21 1205 W. Pierce	Carlsbad	NM	88220	bob.yeager@pvtnetworks.net	(575) 885-9722	email	4/2/2015	5/8/2015

Affidavit of Publication

STATE OF NEW MEXICO
COUNTY OF LEA

I, Daniel Russell, Publisher of the Hobbs News-Sun, a newspaper published at Hobbs, New Mexico, solemnly swear that the clipping attached hereto was published in the regular and entire issue of said newspaper, and not a supplement thereof for a period of 1 issue(s).

Beginning with the issue dated
May 13, 2015
and ending with the issue dated
May 13, 2015.

Daniel Russell

Publisher

Sworn and subscribed to before me this 13th day of May 2015.

Gussie Black

Business Manager

My commission expires
January 29, 2019
(Seal)

OFFICIAL SEAL
GUSSIE BLACK
Notary Public
State of New Mexico
My Commission Expires 1-29-19

This newspaper is duly qualified to publish legal notices or advertisements within the meaning of Section 3, Chapter 167, Laws of 1937 and payment of fees for said

PUBLIC NOTICE

The Bureau of Land Management (BLM) Carlsbad Field Office is initializing a public comment period for Intrepid Potash New Mexico for the proposed HB AMAX Extension project to solution mine the abandoned AMAX Potash mine. An Environmental Assessment (EA) has been prepared to assess the effects upon environmental resources in the area of the proposed HB AMAX Extension project. Comments must be received by 5 pm on June 8, 2015.

The EA can be found on the BLM website:
http://www.blm.gov/nm/st/en/fo/Carlsbad_Field_Office.html

Please address any comments to:
BLM Carlsbad Field Office
Attn: Jessie Hubbling
620 East Greene St.
Carlsbad, NM 88220
Phone: 575-234-5912
Fax:575-885-9264
Email: jhubbling@blm.gov

67112717 00156395

JANET FORREST
FOTH INFRASTRUCTURE & ENVIRONMENT, LLC
2121 INNOVATION COURT, STE 300
DE PERE, WI 54115

Affidavit of Publication

State of New Mexico,
County of Eddy, ss.

Rynni Henderson, being first duly sworn, on oath says:

That she is the Publisher of the Carlsbad Current-Argus, a newspaper published daily at the City of Carlsbad, in said county of Eddy, state of New Mexico and of general paid circulation in said county; that the same is a duly qualified newspaper under the laws of the State wherein legal notices and advertisements may be published; that the printed notice attached hereto was published in the regular and entire edition of said newspaper and not in supplement thereof on the date as follows, to wit:

May 13 2015

That the cost of publication is **$235.40** and that payment thereof has been made and will be assessed as court costs.

Rynni Henderson

Subscribed and sworn to before me this 19 day of May, 2015

Cynthia Arredondo

My commission Expires 2/13/17

Notary Public

OFFICIAL SEAL
Cynthia Arredondo
NOTARY PUBLIC
STATE OF NEW MEXICO
My Commission Expires 2/13/17

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Please address any comments to:

BLM Carlsbad Field Office
Attn: Jessie Hubbling
620 East Greene St.
Carlsbad, NM 88220
Phone: 575-234-5912
Fax:575-885-9264
Email: jhubbling@blm.gov

NATIONAL SYSTEM OF PUBLIC LANDS
U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

Affidavit of Publication

No. ____________

State of New Mexico

County of Eddy:

Brienne Green Brienne Green

being duly sworn, sayes that he is the **Editor**

of the Artesia Daily Press, a daily newspaper of General circulation, published in English at Artesia, said county and state, and that the hereto attached

Display Ad

was published in a regular and entire issue of the said Artesia Daily Press, a daily newspaper duly qualified for that purpose within the meaning of Chapter 167 of the 1937 Session Laws of the state of New Mexico for 1 Consecutive weeks/day on the same day as follows:

First Publication	May 13, 2015
Second Publication	
Third Publication	
Fourth Publication	
Fifth Publication	
Sixth Publication	

Subscribed ans sworn before me this

13th day of May 2015

OFFICIAL SEAL
DANNY SCOTT
Notary Public
State of New Mexico
My Comm. Expires 4/14/18

Danny Scott

Danny Scott

Notary Public, Eddy County, New Mexico

Copy of Publication:

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Please address any comments to:

BLM Carlsbad Field Office
Attn: Jessie Hubbling
620 East Greene St.
Carlsbad, NM 88220
Phone: 575-234-5912
Fax:575-885-9264
Email: jhubbling@blm.gov

NATIONAL SYSTEM OF PUBLIC LANDS
U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

Lea County Board of Commissioners
Lea County Manager
100 North Main Avenue, Suite 4
Lovington, New Mexico 88260

Lea COUNTY new mexico

Phone (575) 396-8602
Fax (575) 396-2093
sstout@leacounty.net
www.leacounty.net

June 3, 2015

Bureau of Land Management
Attn: Tony Harrell
New Mexico State Office
301 Dinosaur Trail
Santa Fe, NM. 87508

BLM Carlsbad Field Office
Attn: Jessie Hubbling
620 East Greene St.
Carlsbad, NM 88220

Dear Ms. Hubbling,

In response to the Public Notice dated May 8, 2015 soliciting public comments regarding the Environmental Assessment for the proposed Intrepid HB AMAX Extension Solution Mining Project, Lea County submits the following comments and concerns.

Lea County is a legal subdivision of the New Mexico State government, organized under state law. It is the constitutional duty of the duly elected County Commissioners to protect and promote the public health, safety and general welfare of the citizens of Lea County. Congress has long recognized the importance of local government in the management of and the actions upon the nation's resources and it has been specific in mandating that federal land use agencies coordinate their policies and management activities with local government. Congress clearly set forth statutory authority for coordination in the Federal Land Policy and Management Act, the National Forest Management Act, the National Environment Policy Act, the Endangered Species Act, the Wild and Scenic River Act, the Clean Water Act, the Intergovernmental Cooperation Act as well as through the Homeland Security Act. Congress has defined "coordination" to mean the "meaningful public involvement of state and local government officials…in the development of land use programs, land use regulations, and land use decisions for public lands", and reasonably contemplates "meaningful involvement" as referring to on-going consultations and involvement throughout the planning cycle, not merely at the end of the planning cycle. This coordination extends to the level of "prior notice" and "meaningful" participation above and ahead of "public participation". Lea County formally requests coordination with the Bureau of Land Management on the Intrepid HB AMAX Extension Solution Mining Project. As you are aware, Lea County is interested in the amount of fresh water that will be used for this project, the impact this increased water usage will have on the aquafers', and other fresh water users and the County's 40 Year Water Development Plan.

For questions, comments or to schedule a coordination meeting, please contact me at mgallagher@leacounty.net or my cell 575-605-6567.

Sincerely,

Mike Gallagher

Mike Gallagher
County Manager

CARLSBAD NEW MEXICO
department of development

RESOLUTION 2015-02:
"Support for the Intrepid HB AMAX Extension Solution Mining Project"

Whereas the Intrepid Potash has been successfully mining potash from the Carlsbad area and southeastern New Mexico for eleven years, and

Whereas this company has gainfully employed thousands of people from the local area during this time, and

Whereas the Intrepid successfully opened and has been safely and responsibly operating the HB Solar Solution Mine since November of 2012 and

Whereas the HB Solar Solution Mine and the Proposed HB Amax Extension will use largely non-potable water to extract its product and

Whereas the HB Solar Solution Mine added 28 years of minable ore life to our local potash industry, and

Whereas the HB Solar Solution Mine created numerous construction and mining jobs and has had a positive economic effect upon the economy of our community, and

Whereas the Amax potash mine was closed in 1993 and has not supported any jobs or created any local, state, or federal revenue since then, and

Whereas the HB AMAX Extension Solution Mining Project would access significant potash resources to increase the life of potash mining in our area by an additional 14 years, and

Whereas the construction and operation of the HB Amax Solution Mine will expand the existing HB Solar Solution Mining operation and thus create additional construction and operational jobs for the local economy.

Now therefore be it resolved that I, Jay Jenkins, President of the Board of Directors for the Carlsbad Department of Development, on this day of May 7, 2015, acting by order and on behalf of the Board of Directors, do hereby support the proposed plan (as attached) for expansion of the existing HB Solar Solution Mine to include the area proposed in the Intrepid HB AMAX Extension Solution Mining Project.

Jay Jenkins,
President of the Board of Directors,
Carlsbad Department of Development

Attest:

Russell Hardy,
Secretary Treasurer of the Board of Directors,
Carlsbad Department of Development

CARLSBAD

Post Office Box 1569
Carlsbad, NM 88221-1569
(575) 887-1191
1-800-658-2713
www.cityofcarlsbadnm.com

DALE JANWAY
MAYOR

STEVE McCUTCHEON
CITY ADMINISTRATOR

June 2, 2015

Jessie Hubbling
620 E. Greene St.
Carlsbad, NM 88220

575-234-5912
jhubbling@blm.gov

Dear Ms. Hubbling:

I'm writing to again show my support for the Intrepid HB Amax Solution Mine Extension Program. I'm especially pleased by the fact that the mine would provide approximately 14 years of solution mine reserves beyond the 28-year HB Solar Solution Mine life. I encourage approval of this project under terms and conditions being applied to the HB Solar Solution Mine.

it is important to stress that the mine, along with the proposed HB Amax Extension, will use largely non-potable water. The solution mining process would be identical to that of the existing HB Solar Solution Mine with injection of salt saturated brine into the workings and extraction of potash enriched brine.

I appreciate your recognition of the Hackberry Lake Recreation Area, and mention of the fact that all pipelines will be buried.

In looking over the BLM's Frequently Asked Questions, it is clear that the environmental impact will be extremely minimal. Additionally, the proposal's plan will largely continue to use existing infrastructure. I strongly agree with the BLM's recommendation that an environmental impact statement is not necessary. In addition to supporting this project, I also endorse the BLM's proposed action over the alternative because it will allow Intrepid more direct access to potassium reserves via shorter pipeline paths.

Thank you again for the BLM's commitment to the safety of our area's citizens and to responsible stewardship.

Sincerely,

Dale Janway

Carlsbad Mayor Dale Janway

United States Department of the Interior

BUREAU OF LAND MANAGEMENT
Carlsbad Field Office
620 E. Greene St.
Carlsbad, NM 88220-6292

TAKE PRIDE IN AMERICA

CERTIFIED-RETURN RECEIPT REQUESTED
9114 9999 4431 4536 7348 25

June 16th, 2015

Lea County Board of Commissioners
Lea County Manager
Attn: Mike Gallagher
100 North Main Avenue, Suite 4
Lovington, NM 88260

Dear Mr. Gallagher,

Thank you for your comments to the Environmental Assessment for the Intrepid HB AMAX Extension project. We appreciate your involvement on this project and look forward to working with you and your board of commissioners in the future.

This letter is meant to address your questions and comments as outlined in the letter received via email on June 8th, 2015. Your letter raises two issues regarding the HB AMAX Extension project; water usage and agency coordination.

Water usage was identified early in our process as a resource of high concern for the HB Solution Mine. Due to the large amounts of water required for solution mining, we understand your concern over water from Lea County being used to solution mine potash in Eddy County. Our task at the BLM is to analyze and disclose potential impacts to resources from groundwater use for a particular project. The analysis and mathematical models for the original HB Solution Mine EIS were created to analyze groundwater usage for the HB Solution Mine. Due to their time-independent nature, we feel that these models remain valid for disclosing effects to groundwater from the HB AMAX Extension project. Supplemental analysis was also completed to look at the effects to groundwater specific to the HB AMAX Extension project. Answers to your questions are provided as an attachment to this letter, with citations to further information in the EIS and EA.

We appreciate your offer to coordinate with our office on this project. Unfortunately, the point in our process for establishing cooperating and coordinating agencies for this project has passed. Our office did not receive a request for coordination with Lea County until June 8th, 2015. This was the ending date of the public comment period for this project. Although the timeline for this specific project has passed, we look forward to working with you and your board to establish better procedures for coordination on BLM projects in the future.

The BLM strives to maintain open communication with all affected parties via the NEPA process. We look forward to working with you and your board to ensure that all of your concerns are met.

Thank you for your time. If you have any questions or to schedule a meeting, please contact me at gmacdone@blm.gov or (575) 234-5901.

Sincerely,

Jeanette A. Martinez
for George MacDonell
Field Manager, Carlsbad Field Office

1. Lea County is interested in the amount of fresh water that will be used once this project is fully developed. What is the total amount of fresh water that will be used for the project?

BLM has evaluated the Proposed Project's water use from a combination of fresh water and non-potable sources, as well as solely from fresh water. These sources of water would be supplied from existing Intrepid water rights and associated well fields. The total amount of fresh water that the Proposed Project is permitted to use is described in the HB Solar Solution Mine (HB EIS) and in the HB Amax Extension Environmental Assessment (HB Amax EA). As described in the HB Amax EA, Appendix C, *Groundwater Memorandum*, the maximum total amount of fresh water use for the duration of the HB Solar Solution Mine and proposed HB Amax Extension is:

PROJECT PHASE	TOTAL PUMPING RATE
Phase I (year 0 – 14)	2,267 gpm
Phase II (year 15 – 32)	1,262 gpm
Phase II (year 33 – 42)	208 gpm

However, the actual amount of fresh water use may be offset by use of non-potable water from the Rustler Formation and recycled process brines. BLM developed the modeled maximum Rustler Formation water yield using the Enhanced Rustler Model and fresh water use is reduced to the following amounts (See HB Amax EA, Appendix C, *Groundwater Memorandum*, Table 7):

PROJECT PHASE	TOTAL PUMPING RATE
Phase I (year 0 – 14)	1,597 gpm
Phase II (year 15 – 32)	592 gpm
Phase II (year 33 – 42)	208 gpm

Intrepid has also added use of recycled process brines as an additional brine injectate makeup water source that may further reduce use of fresh water for the project. These recycled process brines are from the West Plant tailing brine return (TBR) and North Plant recycled process brines.

2. What are the sources of fresh water? Where are these sources located?

As addressed in the response to Question 1, the only source of fresh water is the Ogallala Aquifer obtained from existing Intrepid well fields under its existing permitted water rights. The location of these well fields is shown in the HB Amax EA, Appendix C, *Groundwater Memorandum*, Figure TM-EA-00203.

3. What fresh water conservation measures will Intrepid deploy?

Intrepid will utilize non-potable water sources whenever possible, Rustler Formation groundwater from Intrepid water rights, and recycled process brines as makeup water to reduce use of fresh water.

4. What level of non-fresh water will be used once this project is completed? What are the sources of non-fresh water?

Intrepid is permitted to use both fresh and non-fresh water in its existing operations. As these operations are already operational and permitted by BLM, no analysis of use of non-fresh water upon completion of the HB Solar Solution Mine and HB Amax Extension were analyzed. Sources of non-fresh water are from the Rustler Aquifer pumped from Intrepid wells adjacent to the HB Solar Solution Mine and from recycled process brine obtained from Intrepid's West and North plants.

5. How will use of non-fresh water sources impact the aquifer?

   Potential impacts to aquifers from using non-freshwater sources are discussed in section 3.2.3, of the HB Amax EA. Drawdown from Rustler Aquifer pumping could impact cave ecosystems and there is potential water quality degradation from brine fluid leaks. Mitigation measures have been identified for these potential impacts and are described in Section 2.1 (page 6), Section 2.2.1 (page 11), Section 2.2.2 (page 14), and Section 3.2.2 (page 44), and Figure EA-2 and EA-3, of the HB Amax EA.

6. What is the total amount of water rights Intrepid will use for this project?

   As discussed in Section 3.2.1, of the HB Amax EA Intrepid holds rights to 4,353 acre-feet/year (2,697 gpm) for Rustler Aquifer water and 7,700 acre-feet/year (4,771 gpm) for Ogallala Aquifer water.

7. Will all of the water rights that will be used for this project be leased by Intrepid or will Intrepid water usage be limited to water rights owned by Intrepid?

   As discussed in Section 3.2.1 (page 40), of the HB Amax EA, only existing Intrepid water rights would be used for the Proposed Action.

8. How will the increased fresh water usage for this project impact the aquifers?

   Potential impacts to aquifers from fresh water sources are discussed in section 3.2.3, of the HB Amax EA. Drawdown from the Ogallala Aquifer could affect other aquifer users. In order to determine potential effects on other aquifer users, drawdown impacts to the Ogallala Aquifer were evaluated using a steady state, analytical groundwater model for the HB EIS. A steady state model the evaluation of a pumping rate is time-independent; extending the duration of pumping for the HB AMAX Extension does not impact the model results. Therefore, the model results presented in the HB Solar Solution Mine EIS, which the EA is tiered from, apply for evaluation of the Proposed Action.

   As described in Section 4.3.6.2, Caprock Model (Caprock Only), p. 4 – 37, of the HB Solar Solution Mine EIS, maximum drawdown impacts using only Caprock water was evaluated on 373 wells identified within 3 miles of the Caprock well fields. Maximum drawdown was approximately 13 feet at the Lovington municipal wells, with a sustained drawdown of less than 10 feet for the life of the project. This amount of drawdown would not adversely affect the other Caprock wells in the area.

   Impacts to the Rustler aquifer are monitored quarterly by Intrepid. Monitoring is conducted in accordance with the BLM and NMED approved Intrepid Groundwater Monitoring Plan. The approval for the HB Solar Solution Mine and the new HB AMAX extension provide for adaptive management of the affected aquifers if significant drawdown or water quality concerns are observed.

9. Lea County has adopted a 40-year water development plan. How will this plan be included in the forthcoming EA?

   The Lea County 40-year water plan is administered by the New Mexico Office of the State Engineer, but BLM did consider impacts to the Ogallala Aquifer from the HB Solar Solution Mine and HB Amax Extension as described in response to Question 9. Intrepid holds adequate Ogallala Aquifer water rights to supply Ogallala Aquifer water for the project as described in response to Question 7 and has not proposed water be supplied from sources identified in the Lea County 40-year water plan. Water conservation measures include use of non-freshwater sources including Rustler Aquifer water and recycled process brines.

Appendix B

Paleontological Survey Report

Intrepid Potash Pipeline Expansion Project

Paleontology Resource Survey Summary Report

Kate E. Zeigler and Peter Reser

Zeigler Geologic Consulting, LLC

February 2, 2015

Introduction

The Intrepid Potash proposed pipeline expansion corridors are located approximately 20 miles northeast of Carlsbad in sections 5, 8-11, 14-16, 21-22, 27-28 and 33-34 of T19S, R30E and sections 3 and 4 of T20S, R30E. This project will be a series of buried pipelines ranging in diameter from 4” to 18”. Portions of the proposed expansion corridors cross through areas designated as Potential Fossil Yield Categories (PFYC) 3 and 4, which necessitates pedestrian survey of the outcrop to look for potential fossil resources that may be impacted during ground disturbing activities. The outcrop exposures indicated on some geologic maps of the area show these outcrops to be Permian Rustler Formation; however, based on other geologic maps, there was also initial concern that there may have been some exposures of the Upper Triassic Chinle Formation, which sits stratigraphically above the Rustler Formation and is renowned for its vertebrate fossil record (Figure 1).

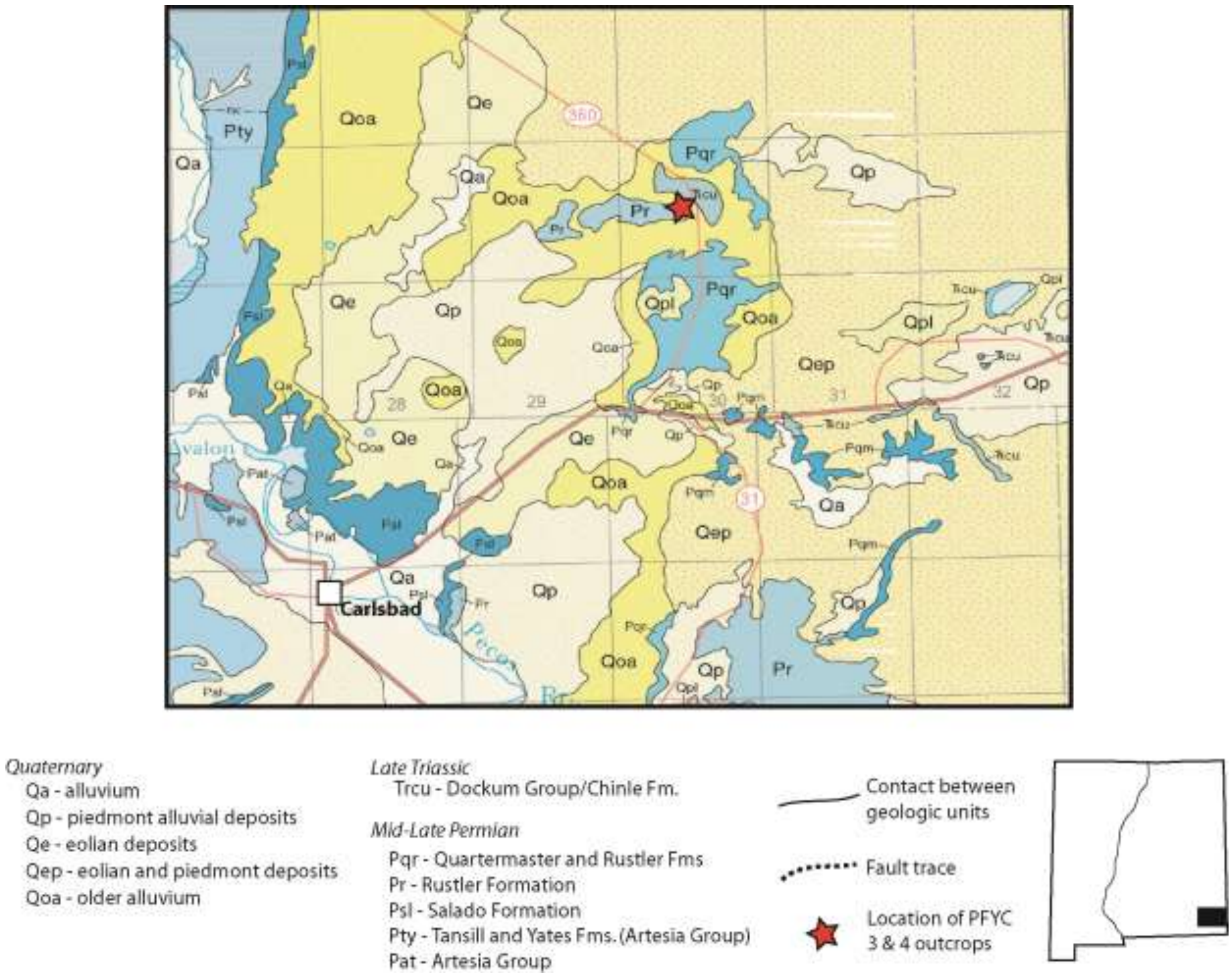

Figure 1. Regional geology of the area from Anderson and Jones (2003), showing potential Triassic Dockum Group (=Chinle Formation) outcrops.

Geologic History

Southeastern New Mexico has been the focus of a variety of different tectonic events, which are reflected not only by the different units discussed above, but also by the modern topography, as well as the vast oil and natural gas reserves of the western Permian Basin. Permian strata in the project area include the Castile, Salado and Rustler Formations (Figure 2). During the Middle Permian, the Delaware Basin of southeastern New Mexico saw maximum subsidence just prior to and during the deposition of the San Andres Formation (Kues and Giles, 2004). As deposition of the San Andres Formation ended, southeastern New Mexico was tectonically quiet and marine environments regressed to the south. The Artesia Group, deposited above the San Andres Formation, records this overall regression, but also smaller fluctuations in sealevel (Kues and Giles, 2004). These units were deposited adjacent to the massive Capitan Reef complex that developed to the south. As sealevel continued to drop through the Late Permian, the contact between normal marine and evaporite facies migrated closer to the reef complex to the south (Kues and Giles, 2004). Units deposited during this time are dominated by dolostone to the south and grade to the north into evaporites and red siliciclastics.

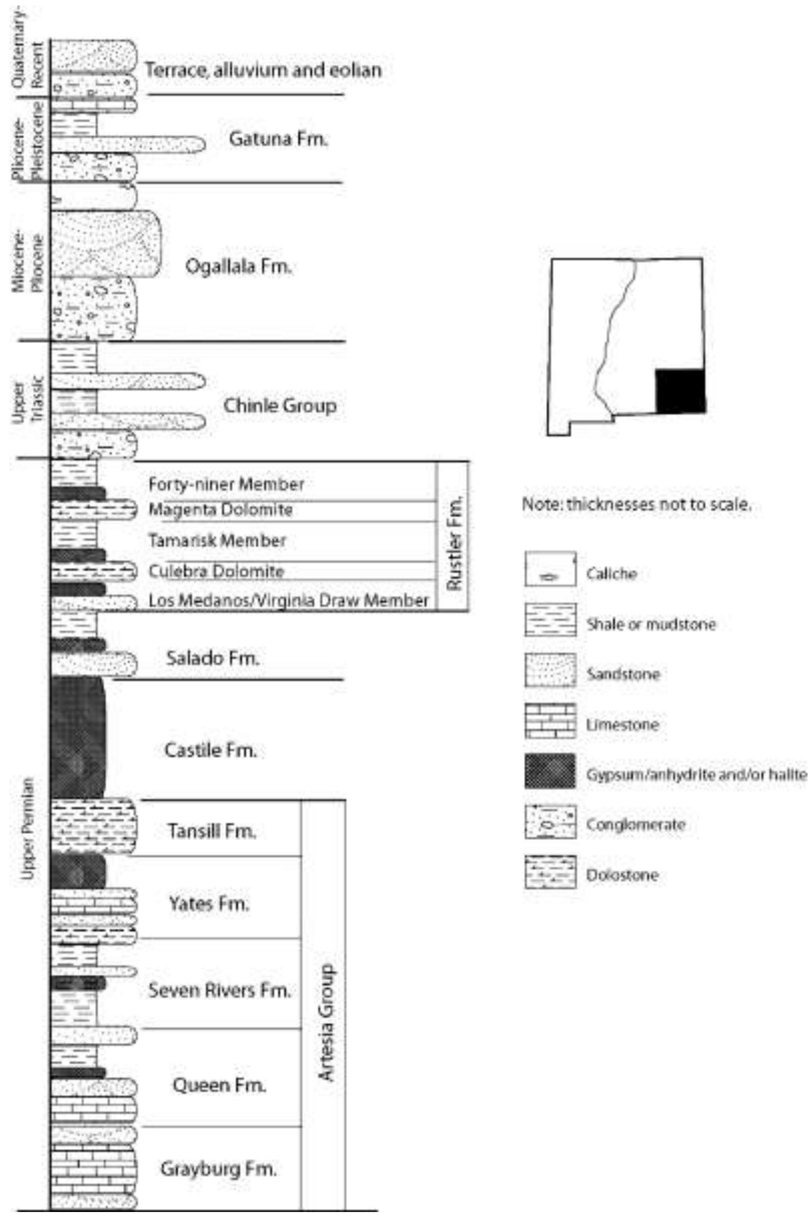

Figure 2. Regional stratigraphy for the proposed project area.

During the Late Permian, the Castile, Salado and Rustler Formations were deposited. Sealevel was continuing to regress and marine deposition was confined to the Delaware Basin in the far southeastern corner of New Mexico (Kues and Giles, 2004). Connections between the basin and the open ocean to the south became very restricted, turning most of the basin into a relatively isolated lagoon, thus causing the thick evaporite deposits of the Castile and Salado Formations (Kues and Giles, 2004). By the onset of Rustler deposition, an overall sealevel transgression had begun. This rise in sealevel brought normal marine deposition back to the region, although this return to a marine environment was interspersed with small sea level fluctuations that led to development of sabkha and mudflat environments (Kues and Giles, 2004).

Rustler Formation Sedimentology

The Rustler Formation is anywhere from 60 to 150 m in thickness with considerable variation in thickness in both outcrop and the subsurface (Vine, 1963; Kelley, 1971; Bachman, 1983; Kues and Giles, 2004). The formation is divided into five members (in ascending order): Los Medaños/Virginia Draw Member, Culebra Dolomite, Tamarisk Member, Magenta Dolomite and Forty-niner Member (Kelley, 1971; Kues and Giles, 2004; Powers and Holt, 1999; Powers et al., 2006). The lower 25-50 m of the Rustler Formation include reddish siltstone, dolostone, minor limestone and gypsum and invertebrate fossils represent normal marine fauna, as opposed to brackish water or higher salinity faunas (Kues and Giles, 2004). The Culebra Dolomite includes both normal marine and marginal marine fossils. Above this unit, the remainder of the Rustler Formation includes gypsum/anhydrite, halite and minor red siliciclastics. Both the Culebra and Magenta Dolomites are useful marker beds for this unit. The Culebra Dolomite is a brownis-gray, thin-bedded crystalline dolomite with distinctive spherical to ovoid vugs whereas the Magenta Dolomite includes couplets of anhydrite or gypsum interbedded with laminated dolomite with a light reddish-brown (or magenta) color (Kelley, 1971; Bachman, 1983).

In the southern part of the survey area, a PFYC 3 area, we observed thick anhydrite beds with very thin, pale green mudstone partings in an open trench that is part of ongoing construction on a Western Refining pipeline (Figure 3). The ground surface in the area is primarily weathered gypsum intermittently covered with eolian sheet sand deposits or small coppice dunes. Along the primary proposed expansion pipeline corridors for lines 2-INJ, 2-EXT and 4-INJ, which cross a PFYC 4 area, we observed distorted gypsum with red mudstone partings and calcrete rubble, also interspersed with eolian deposits that were locally in excess of 6 m thick (Figure 3). These areas were designated PFYC 4 but are comprised almost entirely of rock types (gypsum and calcrete) that do not preserve fossil material.

The 3-EXT corridor branches eastward to proposed well pad IP-304 and climbs a low bluff (designated PFYC 3) that includes exposures of thin gypsum beds, along with reddish brown, laminated siltstone to fine sandstone with greenish-gray mottling in places (Figure 3). The bluff is capped by a 1 to 3 m thick deeply weathered calcrete horizon that may be a relict surface related to the Miocene-Pliocene Ogallala Formation. Along the alternative expansion pipeline corridor for 2-INJ we observed the distorted gypsum with red mudstone partings and abundant eroded calcrete rubble. The interbedded gypsum and siliciclastics suggest that these outcrops may pertain to the lowest member of the Rustler Formation, the Los Medaños Member, but with a lack of exposure of dolomite beds, it is not possible to be certain of the stratigraphic position of these units.

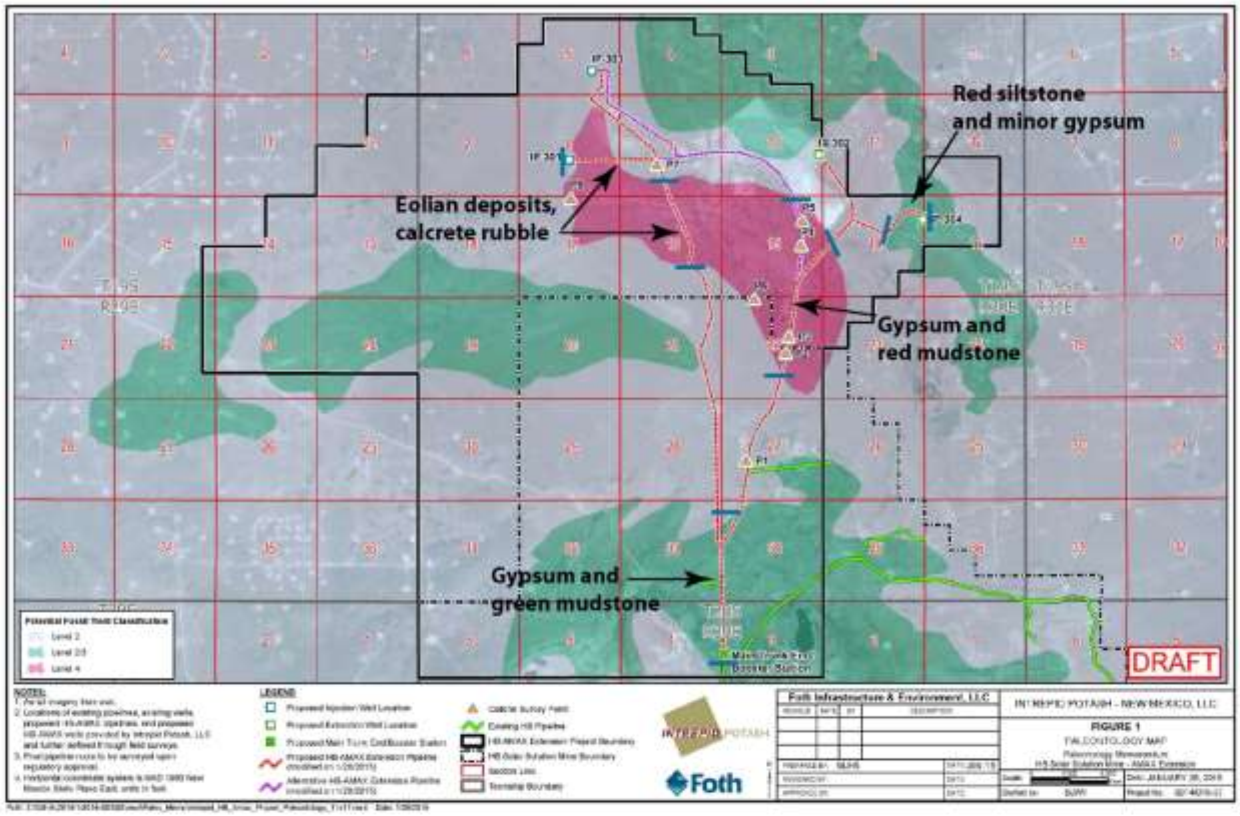

Figure 3. PFYC areas along the proposed pipeline corridors and well pad locations with local geology of the Rustler Formation.

Rustler Formation Paleontology

Few fossils have been recovered from the Rustler Formation and all of these are marine invertebrates. Macrofossils that have been reported include molluscs and brachiopods (Walter, 1953) as well as conodonts (Croft, 1978; Wardlaw and Grant, 1992). These invertebrate fossils have been useful for ascertaining the age of the Rustler Formation as being Late Permian. In general, sabkha and marginal marine environments usually do not preserve fossil material well.

Paleontology Resource Survey

On Sunday February 1, 2015, we performed pedestrian survey of outcrop exposures along the proposed corridor that crosses through the BLM-designated PFYC 3 and 4 areas. We surveyed a 150' corridor on either side of the center line stakes except where current construction for Western Refining is co-located with the proposed corridors. Much of the bedrock is partially to completely covered by eolian sheet sands or small coppice dunes. Other than the low bluff leading to the proposed well pad IP-304, outcrop exposures consisted almost entirely of distorted gypsum beds with occasional mudstone partings that are either pale green or reddish brown in color. The low bluff consists of interbedded reddish brown siltstone to sandstone and gypsum. Much of the area includes outcrop exposures and/or weathered remanents of a thin calcrete that may be related to the Ogallala Formation. We observed no fossil material in any of the PFYC 3 or 4 areas and recommend no monitoring for the majority of the proposed pipeline corridors and well pads, given that the majority of the outcrop and subcrop is gypsiferous, which will not preserved invertebrate or vertebrate fossil material. Few fossil resources are known from the Rustler Formation, making any potential discoveries of scientific significant. We recommend spot monitoring after grubbing/top soiling and after trenching through the low bluff leading to well pad IP-304 on the chance that fossil material might be uncovered during excavation activities.

References

Anderson, O.J. and Jones, G.E. , 2003 New Mexico Geologic Highway Map: New Mexico Geological Society and New Mexico Bureau of Geology and Mineral Resources OFR 408: scale 1:1,000,000.

Croft, J.S., 1978, Upper Permian conodonts and other microfossils from the Pinery and Lamar Limestone Members of the Bell Canyon Formation and from the Rustler Formation, West Texas [M.S. thesis]: Ohio State University, 176 p.

Hays, P.T., 1964, Geology of the Guadalupe Mountains, New Mexico: U.S. Geological Society Professional Paper 446, 68 p.

Hayes, P.T. and Koogle, R.L., 1958, Geology of the Carlsbad Caverns West quadrangle, New Mexico-Texas: U.S. Geological Survey Geologic Quadrangle Map GQ-112.

Kelley, V.C., 1971, Geology of the Pecos Country, southeastern New Mexico: New Mexico Bureau of Mines and Mineral Resources Memoir 24, 78 p.

Kelley, V.C., 1972, Geology of the Fort Sumner sheet, New Mexico: New Mexico Bureau of Mines and Mineral Resources Bulletin 98, 55 p.

Kues, B.S. and Giles, K.A., 2004, The Late Paleozoic Ancestral Rocky Mountains system in New Mexico: *in* Mack, Greg H. and Giles, Katherine A., eds., The Geology of New Mexico: A Geologic History, p. 95-136.

Motts, W.S., 1962, Geology of the west Carlsbad quadrangle, New Mexico: U.S. Geological Survey Geologic Quadrangle Map GQ-167.

Powers, D.W., Holt, R.M., Beauheim, R.L. and Richardson, R.G., 2006, Advances in depositional models of the Permian Rustler Formation, southeastern New Mexico: New Mexico Geological Society Guidebook 57, p. 267-276.

Tait, D.B., Ahlen, J.L., Gordon, A., Scott, G.L., Motts, W.S. and Spitler, M.E., 1962, Artesia Group of New Mexico and West Texas: American Association of Petroleum Geologists Bulletin, v. 46, p. 504-517.

Walter, J.C. Jr., 1953, Paleontology of Rustler Formation, Culberson County, Texas: Journal of Paleontology, v. 27, p. 679-702.

Wardlaw, B.R. and Grant, R.E., 1992, Detailed conodont biostratigraphy of the North American regional stratotype for the Permian (West Texas) and its international correlation: 29th International Geological Congress Abstracts, v. 2, p. 270.

Appendix C
Groundwater Memorandum

Technical Memorandum TM-EA-002

Analysis and Applicability of the Hydrological Assessment and Groundwater Modeling Report for the HB In-Situ Solution Mine Project EIS (AECOM, 2011) to the Proposed HB AMAX Extension to the HB Solar Solution Mine

HB Solar Solution Mine
Proposed AMAX Extension
Eddy County, New Mexico

Project I.D.: 14I016

Intrepid Potash New Mexico, LLC

May 2015

Analysis and Applicability of the Hydrological Assessment and Groundwater Modeling Report for the HB In-Situ Solution Mine Project EIS (AECOM, 2011) to the Proposed HB AMAX Extension to the HB Solar Solution Mine

HB Solar Solution Mine
Proposed AMAX Extension
Eddy County, New Mexico

Project I.D.: 14I016

Intrepid Potash New Mexico, LLC

Prepared for

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Prepared by

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Green Bay, Wisconsin
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May 2015

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1 Introduction

Intrepid Potash - New Mexico, LLC (IPNM) is proposing to expand the current in-situ solution mining operations involved with the extraction of potash from former underground mine facilities in the Secretary's Potash Area (SPA), Eddy County, New Mexico. The currently operating HB Solar Solution Mine is proposed to be expanded by flooding an additional underground mine complex (former AMAX workings) located immediately north of the existing operation. The expanded project area is illustrated by the heavy black line in **Figure TM-EA-002-1 - *General Infrastructure***, and the current HB Solar Solution Mine Project Area is illustrated by the dashed black line in Figure TM-EA-002-1. The strategy for the in-situ mining involves using injection wells to inject water into the abandoned underground mine cavities to dissolve sylvite from un-mined portions of the workings, followed by extraction of the pregnant brine solution via extraction wells, and evaporative concentration of potassium chloride (KCl) and sodium chloride (NaCl) via solar evaporation ponds. The HB AMAX Extension will require new extraction wells and piping but will rely on the existing HB Solar Solution Mine solar evaporation pond and processing mill components.

As part of the mine planning and permitting process for the HB Solar Solution Mine, an Environmental Impact Statement (EIS) was prepared to evaluate the impacts of those mining operations (BLM, 2012a). BLM issued approval for this project in the March 19, 2012 Record of Decision (ROD). The approved and permitted HB Solar Solution Mine includes solution mining in four former underground mine cavities largely located in Township 20S, Range 30E and Township 20S, Range 29E. Intrepid proposes to expand the project to include solution mining in the former AMAX underground workings located in the northern portion of the project area in Township 19S, Range 30E (see Figure TM-EA-002-1).

To supply make-up water for injection into the underground workings, for surface ore processing, and for general operations, Intrepid currently operates two existing well fields. One well field, referred to as the "North Rustler well field," produces water from the shallow, saline Rustler Formation and is located in the southern portion of the project area (indicated by the red rectangle in **Figure TM-EA-002-2 - *Location of the North Rustler Well Field***). The other well field, referred to as the "Caprock well field", produces water from the Ogallala Formation and is located 40 miles to the northeast of the project in Lea County, New Mexico (**Figure TM-EA-002-3 – *Location of the Caprock Well Field Relative to Project Area***).

To support evaluation of impacts resulting from groundwater extraction associated with the HB Solar Solution Mine Project (as required by the National Environmental Policy Act [NEPA]) the Carlsbad office of the Bureau of Land Management (BLM) commissioned a groundwater modeling study (*Hydrological Assessment and Groundwater Modeling Report for the HB In-Situ Solution Mine Project EIS* - AECOM, 2011). The groundwater study was, in turn, used to support the EIS process for the proposed action. The modeling study applied two separate models to evaluate impacts of groundwater withdrawals from the two well fields. One model addressed operation of the North Rustler well field wells and the other model addressed the Caprock well field.

Groundwater withdrawals from the North Rustler well field area are made from two confined aquifers within the Rustler Formation, the Magenta dolomite aquifer and the lower Culebra dolomite aquifer. The Magenta and Culebra aquifers are separated by a 40 foot (ft) thick aquitard. However, the two aquifers can be locally hydraulically connected due secondary porosity from the dissolution and collapse of underlying geologic units. Due to the complex hydrostratigraphy and variable aquifer characteristics of the Magenta and Culebra aquifers, AECOM (2011) developed a detailed numerical model for the North Rustler well field wells based on the U.S. Geological Survey MODFLOW code (McDonald and Harbaugh, 1988).

At the existing Caprock well field, groundwater is pumped from the Ogallala aquifer. The Ogallala aquifer is a sedimentary aquifer comprised of semi-consolidated deposits of gravel, sand, silt, and clay. Although the hydrogeologic characteristics of the Ogallala are spatially variable, the aquifer system is less complex than the Rustler system. Given the relative uniformity in the Ogallala, AECOM (2011) modeled the Ogallala well field using an analytical model based on the GLOW analytical element code (Haitjema Software, 2007).

AECOM used the two models to estimate the sustainable yield for each well field and the drawdown associated with the withdrawals. The project duration evaluated in the EIS modeling studies performed by AECOM involved groundwater extraction spanning 28 years (projected life of the HB Solar Solution Mine). Total groundwater withdrawal rates analyzed for the original project configuration include the following:

- Phase I (years 0 - 7), 2,267 gallons per minute (gpm)
- Phase II (years 8 - 21), 1,262 gpm
- Phase III (years 22 - 28), 208 gpm

With the addition of the HB AMAX Extension, annual water needs for the combined HB Solar Solution Mine/HB Amax Extension will not change from the original case. However, the project life has been expanded from 28 to 42 years. With the additional in-situ operations at HB AMAX under consideration, the proposed groundwater withdrawals maintain the same approximate pumping rates for each phase but expand the duration of pumping. Under the HB AMAX expansion the following timeframes and associated groundwater withdrawal rates (same as the original case) are expected:

- Phase I (years 0 - 14), 2,267 gpm
- Phase II (years 15 - 32), 1,262 gpm
- Phase III (years 33 - 42), 208 gpm

The purpose of the analysis presented herein and the opinions provided in this Technical Memorandum are to:

1. Review and summarize the model development and calibration for both the Rustler and the Caprock groundwater flow models;

2. Identify new site information which has been obtained since the AECOM (2011) models were developed and analyze the impact, if any, that the new data might have on the validity of model predictions;

3. Determine if the drawdown predictions from the two groundwater flow models developed by AECOM (2011) can be reasonably applied to the extended duration of groundwater withdrawals proposed under the AMAX expansion; and

4. Determine the merit, if any, in updating the EIS groundwater models.

2 Model Development and Calibration

The development and calibration of a groundwater flow model requires compiling available data to define the model geometry, select boundary conditions, and provide calibration targets to evaluate the model performance. The following sections discuss the methodology and data sources used to develop and calibrate the Rustler and Caprock groundwater models. The material presented below was compiled by reviewing the AECOM (2011) report and other support information provided by the BLM.

2.1 Rustler Section 2 Groundwater Flow Model

Model Geometry
AECOM (2011) developed and calibrated a well-recognized and professionally accepted groundwater flow model ("Rustler model") for the Rustler formation aquifers using the finite difference code, MODFLOW (McDonald and Harbaugh, 1988). The six layer MODFLOW model discretized a 429 square mile model domain into 1,000 x 1,000 ft grid cells with a total of 71,982 grid cells. The model domain is shown in **Figure TM-EA-002-4 – *Rustler Groundwater Model Domain***. The six model layers correlated to site stratigraphy with the following designations:

- Layer 1 = Dewey Lake Red Beds and overlying alluvial deposits
- Layer 2 = Forty Niner Member of the Rustler Formation
- Layer 3 = Magenta Dolomite Member of the Rustler Formation
- Layer 4 = Tamarisk Member of the Rustler Formation
- Layer 5 = Culebra Dolomite Member of the Rustler Formation
- Layer 6 = Los Medaños Member of the Rustler Formation

For this model the geologic units represented by Layers 2, 4, and 6 were considered aquitards. Model parameters and boundary conditions reflective of these conditions were assigned to these aquitard layers. The parameters used for these units were not varied as part of the calibration process, thus the parameter values used in Layers 2, 4, and 6 of the calibrated model were the same as those assigned at the outset of model development.

Layers 1, 3, and 5 represent aquifers. The Culebra Dolomite (Layer 5) and the Magenta Dolomite (Layer 3) of the Rustler Formation supply water to the North Rustler well field and were the main hydrogeologic units of interest. The Dewey Lake Red Bed aquifer (Layer 1) is not continuous on a regional scale but locally can produce sustainable well yields. Boundary conditions and model parameters were selected for each of these layers, as described in the sections below.

Boundary Conditions
The specification of boundary conditions is a required element in the development of a groundwater flow model; boundary conditions define the state of the groundwater system at the perimeter of the modeling domain and in some instances, at key locations on the interior of the modeling domain. Standard modeling practice calls for selecting boundary condition types and locations such that the boundary has minimal impact on simulation results in the area of interest.

Three types of boundary conditions are common in MODFLOW: specified head, specified flux, and head-dependent flux boundaries. The Rustler model used all three boundary types. Specified head boundaries were assigned to the eastern, southern, and part of the northern edge of Layers 1, 3, and 5. These boundary conditions were based on a report by Geohydrology Associates (1979) indicating groundwater flow entering or leaving the model domain in those areas.

A specified flux, no flow, boundary was assigned to the western edge of the model where groundwater flow was assumed to be parallel (north-south) to the model boundary. A no flow boundary was also assigned to the bottom of the model and represents the contact between the Rustler and relatively impermeable Salado evaporite formation.

A specified flux was assigned to the top of the model to represent groundwater recharge. Further discussion of how the recharge was estimated is provided below. An additional head-dependent flux boundary was assigned to the uppermost model layer to represent evaporative water loss resulting from groundwater discharge to springs, seeps, playas, and salt ponds. At this head-dependent boundary water is removed from the model only when the water levels rise above a threshold elevation, such as the elevation of a lakebed.

Model Parameters

The following sections outline how recharge, layer thickness, and hydraulic conductivity parameters were selected for the Rustler model.

Recharge

A constant flux recharge term was assigned to model Layer 1. Recharge is difficult to measure directly and is often a source of uncertainty in a groundwater model. For the Rustler model, the recharge rate was estimated from water balance studies (Geohydrology, 1978b and Hunter, 1985) that were conducted near the project site. Results of these studies indicated that in the project area, 96 percent (%) of precipitation evaporates, 1% is held as soil moisture, and 3% recharges the groundwater system. Additional, anthropogenic recharge is provided by seepage from tailings basins. According to Geohydrology (1978b), 3% of average rainfall for the region translates into a 0.42 inches per year (in/yr) recharge rate. The recharge rate used in the AECOM model was 0.48 in/yr and reflects recharge from precipitation as well as seepage from tailings basins.

Layer Thickness

Thickness of the model layers represents the actual thickness of hydrostratigraphic units in the model domain. Layer thickness was represented by assigning a top and a bottom elevation to each grid cell in each layer. These elevations were estimated for the Rustler model using data from boring logs. Conventional modeling techniques use boring logs to identify top and bottom elevations of a hydrostratigraphic unit. These elevation data and geographic coordinates of the borings are commonly interpolated to provide top and bottom elevations for the model grid cells. Uncertainty in this interpolation largely depends on the quality of logs available, the spatial distribution of log data, and the degree of variability in layer thickness. AECOM (2011) indicated that areas where layers thinned or pinched out were assigned a default thickness of 10 ft; this was based on a simplifying assumption of formation continuity.

Hydraulic Conductivity

Hydraulic conductivity reflects the rate at which a fluid can flow through a given porous medium. Within a single geologic unit, hydraulic conductivity can vary based on changes in the rock properties including the degree of cementation, presence of fractures, changes in grain size, etc. Estimates of hydraulic conductivity for this model came from several data sources including available literature and pumping test data from seven Intrepid wells (IP-WW-001 through IP-WW-007).

Some groundwater flow models assume homogeneity in the hydraulic conductivity field while others incorporate complex, heterogeneous distributions in conductivity. The degree to which heterogeneity is incorporated into the model should be a reflection of measured heterogeneity in the unit's hydraulic conductivity, type of rock being modeled, and general geologic knowledge of a given unit. The two aquifers of interest were fractured dolomite units. Fractured rocks can present a modeling challenge when fractures of high hydraulic conductivity are present within a low permeability rock matrix. Additionally, the location and continuity of fractures is often unknown. Hydrogeologic testing in fractured rocks can produce a wide range of hydraulic conductivity estimates depending on the proximity of the test well to individual fractures or fracture sets. AECOM (2011) treated the fractured rock as an equivalent porous media (EPM). This is a widely-used approach when fractures are relatively uniform in distribution and the scale of the model domain is large relative to fracture spacing.

Because of uncertainty in hydraulic conductivity and the possibility for heterogeneity, many groundwater models use some form of parameter optimization software to optimize a hydraulic conductivity distribution. The Rustler model used what is referred to as the pilot point method to calibrate the model with respect to hydraulic conductivity. This approach resulted in an optimized and heterogeneous distribution of hydraulic conductivity. Each pilot point was assigned a range of acceptable hydraulic conductivity values that were informed by the estimates provided in Table 1. The model calibration technique and results are discussed in greater detail below.

Table 1

Summary of Hydraulic Conductivity Estimates and Data Sources for the Rustler Model

Geologic Unit/Model Layer	Estimated Hydraulic Conductivity (ft/day)	Data Source
Dewey Lake Red Beds/Layer 1 (Intrepid Project Site)	0.77	Constant rate discharge, single well pumping test in IP-WW-007
Dewey Lake Red Beds/Layer 1 (Clayton Basin)	0.02-1.2	Water Management Consultants (1999)
Dewey Lake Red Beds/Layer 1(Overall)	***0.02-1.2***	
Magenta Dolomite/Layer 3 (Intrepid Project Site)	0.001 – 92.7	Constant rate discharge, single well pumping tests in IP-WW-001, IP-WW-003, IP-WW-004, IP-WW-005, and IP-WW-006
Magenta Dolomite/Layer 3 (WIPP Site)	3.0×10^{-5} - 2.8	U.S. Geological Survey and Sandia National Laboratories

Geologic Unit/Model Layer	Estimated Hydraulic Conductivity (ft/day)	Data Source
Magenta Dolomite/Layer 3 (Overall)	***$3.0x10^{-5}$ – 92.7***	
Culebra Dolomite/Layer 5 (Intrepid Project Site)	0.55-0.58	Constant rate discharge, single well pumping test in IP-WW-002
Culebra Dolomite/Layer 5 (General)	$6x10^{-5}$ - 56.7	Brinster (1991)
Culebra Dolomite/Layer 5 (Overall)	***$6x10^{-5}$ - 56.7***	
Rustler Formation/Layers 3 and 5 (Undivided, Clayton Basin)	0.003 - 25	Water Management Consultants (1999)

ft/day = feet per day

Prepared By: MJH
Checked By: DRD

Model Calibration

The Rustler model was calibrated using 65 hydraulic head targets for Layers 1, 3, and 5. These targets were distributed throughout the model domain (**Figure TM-EA-002-5 – *Distribution of Calibration Targets*).** Head targets were assigned using data from Geohydrology Associates (1978a and 1978b), Water Management Consultants (1999), Cooper and Glanzman (1971), Intrepid Potash Inc./Shaw (2008), and other reports from the nearby WIPP site. The dates of measurement ranged from the 1950s-2008, with the majority of available data collected in the 1970s. AECOM (2011) assumed that these head values represented equilibrium conditions that are still present today. It is known that there was some pumping, albeit minimal, that was occurring in these aquifers during the 1970s.

A pilot point method was used to calibrate the groundwater model with hydraulic conductivity as the only parameter being optimized. Using this method pilot points are scattered throughout the model domain; each point is assigned a starting parameter value and a range of acceptable values. For the pilot point calibration, the model is run repeatedly, using evolving estimates of the parameter of interest, in this case hydraulic conductivity, that provide evolving estimates of the variable of interest; hydraulic head for the Rustler model. An optimization algorithm evaluates the difference between modeled heads and known heads (the calibration targets) and uses that information to inform an improved estimate of hydraulic conductivities throughout the model domain. This process is repeated numerous times until the difference between modeled heads and known heads is within a pre-defined error tolerance. The final, calibrated hydraulic conductivity distributions for Layers 1, 3, and 5 can be seen in **Figure TM-EA-002-6 – *Distribution of Hydraulic Conductivity in the Dewey Lake Red Beds;* Figure TM-EA-002-7 – *Distribution of Hydraulic Conductivity in the Magenta Dolomite Aquifer;* and Figure TM-EA-002-8 – *Distribution of Hydraulic Conductivity in the Culebra Dolomite Aquifer***.

Hydraulic conductivity was the only parameter calibrated in the AECOM model of the Rustler wells; layer thickness was not specifically included as a calibration parameter for this model. However, hydraulic conductivity and layer thickness are coupled in the governing groundwater equation used by MODFLOW. Together, thickness and hydraulic conductivity are used to calculate a transmissivity. Because hydraulic conductivity was used as a calibration parameter and thickness was not, and because the MODFLOW calculations are based on the product of hydraulic conductivity and thickness, the calibrated hydraulic conductivity values may be influenced by variations and uncertainty in both unit thickness and hydraulic conductivity. For example, in areas where the estimated layer thickness is too thin, the transmissivity will be too low. The calibration process in this scenario is likely to yield an elevated hydraulic conductivity resulting from the code's attempt to increase transmissivity. The effective transmissivity in this case may approach the correct value, but the estimated hydraulic conductivity could be substantially greater than the actual.

The result of this methodology is that the calibrated hydraulic conductivity values may be influenced by interpretations of layer thickness. However, the ability to compensate for errors in layer thicknesses by adjusting hydraulic conductivity partially nullifies the problem of not knowing the exact layer thickness at each grid cell. Therefore, not knowing small variations in layer thickness may become irrelevant as long as the modeler is comfortable with a hydraulic conductivity distribution that has two sources of deviation from actual field conditions, one derived from the layer thickness and the other from the actual hydraulic conductivity field. Understanding the limitations of this calibrated hydraulic conductivity distribution becomes important when new hydraulic conductivity estimates are compared to the modeled distributions, as done in Section 2.3 of this Technical Memorandum.

Preferred and Enhanced Rustler Models

The calibrated Rustler model discussed above was termed “the preferred model.” Because some aquifer tests performed on wells in the North Rustler well field area and actual observed production well discharge rates indicated potentially higher hydraulic conductivities in the Magenta and Culebra aquifers (associated with fracturing surrounding breccia pipes), a second version of the model was constructed. This model, termed “the enhanced model”, incorporated higher hydraulic conductivities in the Magenta model layer in the vicinity of the North Rustler well filed and to the north. This enhanced hydraulic conductivity distribution for the Magenta layer can be seen in **Figure TM-EA-002-9 –** ***Distribution of Hydraulic Conductivity in the Magenta Dolomite Aquifer – Enhanced Model***.

2.2 Caprock Groundwater Flow Model

AECOM (2011) developed and calibrated an analytical element model for the Caprock wells in the Ogallala aquifer using the GFLOW code (Haitjema Software, 2007). Unlike the numerical model used for the Rustler well field, an analytical model is less sophisticated and requires the modeler to make several simplifying assumptions about a groundwater system. Analytical models perform best in simple aquifer systems with low heterogeneity. Compared to the Rustler aquifers, the Ogallala aquifer is a much more prolific, homogeneous, and less complex system. The Ogallala aquifer is composed of relatively continuous hydrostratigraphy and generally lacks the spatial variation of hydraulic conductivity.

The Caprock model domain covered Intrepid’ s HB and East Caprock well fields, an area with a 10-mile radius centered near Buckeye, NM (**Figure TM-EA-002-10 –** ***Model Domain for the Caprock Analytical Model***). This two dimensional, single layer, steady state model used the parameters shown in Table 2. All parameters were estimated using information provided by the New Mexico Office of the State Engineer, McAda (1984), and Musharrafieh and Chudnoff (1999). Heterogeneity in the transmissivity was introduced by changing the saturated aquifer thickness at various locations.

Table 2

Model Parameters for the Caprock Analytical Model

Parameter	Value
Saturated Thickness	120 – 180 ft
Hydraulic Conductivity	15 – 32 ft/day
Transmissivity	3,000-3,200 ft^2/day
Porosity	0.2
Recharge	0.49 inches/year

Prepared By: MJH
Checked By: DRD

The model was calibrated using 35 hydraulic head values estimated from a map of measured and estimated groundwater elevations (Tillery, 2008). The calibration involved manually adjusting hydraulic conductivities and aquifer bottom elevations until differences between observed and simulated groundwater elevations were minimized.

2.3 Additional Data

Since the modeling effort, Intrepid has installed 41 new well locations within the Rustler model domain. Pilot, testing and instrument (PTI) wells are immediately adjacent to either a water supply well, extraction well, or injection well; the PTI well and its adjacent operational well were considered a single, new data source. The locations of these wells are displayed in **Figure TM-EA-002-11 – *Current HB Solar Solution Mine Monitoring Well Network*** and **Figure TM-EA-002-12 – *Current HB Solar Solution Mine Operational Components***. Figure TM-EA-002-11 shows all the monitoring wells and Figure TM-EA-002-12 shows the production, injection, extraction, and PTI wells. No new well locations were added by Intrepid in the Caprock model domain, accordingly no new information is available for the Caprock well field and this additional data discussion will focus solely on new data for the Rustler models. Table 3 summarizes the available data for each of the Intrepid wells. Available data includes boring logs, geophysical logs, pump test data, time series water level data from pressure transducers, and quarterly manual water level measurements. Of the wells shown in Table 3, the Rustler model only used information from Intrepid wells IP-WW-001 through IP-WW-007. Estimates of hydraulic conductivity from the pumping tests are shown in Table 4.

Table 3

Summary of Available Data from Intrepid Wells

Well Name	Well Type	Boring Log	Geophysical Log	Pump Test Data	Quarterly Water Level Data	Pressure Transducer Data (Date Range, Sample Interval)
IP-SWW-021C	Monitoring Well	x	x	x	x	6/26/12 - 1/14/14, 5 minute
IP-SWW-021M	Monitoring Well	x			x	
IP-SWW-022D	Monitoring Well	x	x	x	x	
IP-SWW-022G	Monitoring Well	x		x	x	6/26/12 - 1/14/14, 5 minute
IP-SWW-023C	Monitoring Well	x	x	x	x	
IP-SWW-023M	Monitoring Well	x		x	x	6/26/12 - 2/19/14, 5 minute

Well Name	Well Type	Boring Log	Geophysical Log	Pump Test Data	Quarterly Water Level Data	Pressure Transducer Data (Date Range, Sample Interval)
IP-SWW-024M	Monitoring Well	x		x	x	
IP-SWW-025C	Monitoring Well	x	x	x	x	6/26/12 - 2/18/14, 5 minute
IP-SWW-026M	Monitoring Well	x	x	x	x	
IP-SWW-028M	Monitoring Well	x	x	x	x	
IP-SWW-029M	Monitoring Well	x	x	x	x	6/26/12 - 2/18/14, 5 minute
IP-SWW-030A	Monitoring Well	x		x	x	
IP-SWW-030C	Monitoring Well	x		x	x	
IP-WW-001	Monitoring Well	x	x	x	x	
IP-WW-002	Monitoring Well	x	x	x	x	7/21/12-7/22/12, 5 minute
IP-WW-003	Monitoring Well	x	x	x	x	
IP-WW-004	Monitoring Well	x	x	x	x	
IP-WW-005	Monitoring Well	x	x	x	x	
IP-WW-006	Monitoring Well	x	x	x	x	
IP-WW-007	Monitoring Well	x		x	x	
IP-WW-008	Monitoring Well	x			x	
IP-WW-009	Monitoring Well	x			x	
IP-WW-010	Monitoring Well	x			x	
WW-11	Monitoring Well	x	x			
WW-12	Monitoring Well	x	x			
WW-13	Monitoring Well	x	x			
WW-14	Monitoring Well	x	x			
IP-015	Injection Well	x	x			
IP-016	Extraction Well	x	x			
IP-PTI-016	PTI	x	x			
IP-017	Injection Well	x	x			
IP-018	Injection Well	x	x			
IP-019	Injection Well	x	x			
IP-020	Extraction Well	x	x			
IP-PTI-020	PTI	x	x			
IP-021	Extraction Well	x	x			
IP-022	Injection Well	x	x			
IP-024	Extraction Well	x	x			
IP-025	Extraction Well	x	x			
IP-028	Extraction Well	x	x			
IP-PTI-028	PTI	x	x			
IP-029	Injection Well	x	x			
IP-030	Extraction Well	x	x			
IP-PTI-030	PTI	x	x			
IP-031	Injection Well	x				
IP-WS-001	Rustler Water Supply Well	x	x			6/26/12-7/17/12; 5 minute
IP-WS-002	Rustler Water Supply Well	x				7/31/12 - 8/1/12; 5 minute
IP-WS-003	Rustler Water Supply Well	x				
IP-WS-004	Rustler Water Supply Well	x				

Well Name	Well Type	Boring Log	Geophysical Log	Pump Test Data	Quarterly Water Level Data	Pressure Transducer Data (Date Range, Sample Interval)
IP-WS-005	Rustler Water Supply Well		x			
IP-WS-006	Rustler Water Supply Well					
IP-WS-007	Rustler Water Supply Well					
IP-PTI-001m	PTI	x				
IP-PTI-002m	PTI	x				
IP-PTI-002c	PTI	x				
IP-PTI-003m	PTI	x				7/12/12-7/31/12; 5 min
IP-PTI-003c	PTI	x	x			
IP-PTI-004m	PTI	x	x	x		
IP-PTI-004c	PTI	x				
IP-PTI-005	PTI		x			
IP-PTI-006	PTI		x			

Notes
1. The PTI wells are pilot, instrument, testing, and instrument wells.
2. The quarterly water levels were measured between 3/2012 and 11/2014 for the IP-SWW-### wells. The water levels were measured between 3/2007 and 11/2014 for wells IP-WW-001 through IP-WW-007 wells. The water levels were measured between 4/2009 and 11/2014 for wells IP-WW-008 through IP-11-010.

Prepared By: MJH5
Checked By: DRD

Table 4

Pump Test Data

Well Name	Screened In	Pump Test Type	Solution Method	Estimated Transmissivity (ft^2/min)	Hydraulic Conductivity (ft/day)
IP-SWW-030A	Alluvium	Single Well	Cooper-Jacob	0.18	7.1
IP-SWW-021C	Culebra	Single Well	Cooper-Jacob	1	72.0
IP-SWW-023C	Culebra	Single Well	Cooper-Jacob	1.54	170.0
IP-SWW-025C	Culebra	Single Well	N/A	N/A	N/A
IP-SWW-030C	Culebra	Single Well	N/A	N/A	N/A
IP-SWW-022D	Dewey Lake	Single Well	Cooper-Jacob	0.17	1.8
IP-SWW-022G	Gatuña	Single Well	Cooper-Jacob	0.12	3.0
IP-SWW-023M	Magenta	Single Well	N/A	N/A	N/A
IP-SWW-024M	Magenta	Single Well	Cooper-Jacob	1	96.0
IP-SWW-026M	Magenta	Single Well	Cooper-Jacob	0.79	40.6
IP-SWW-028M	Magenta	Single Well	N/A	N/A	N/A
IP-SWW-029M	Magenta	Single Well	N/A	N/A	N/A
IP-WS-004	Magenta	Single Well	Gringarten	N/A	16.1

Notes
1. All tests were done using a single well pumped at a constant pumping rate.
2. Wells with "N/A" did not have reliable pump test results.

Prepared By: MJH5
Checked By: DRD

The new boring data from the Intrepid wells may improve the estimated layer thicknesses for the Rustler model. Layer thicknesses from the Intrepid borings were compared to the thicknesses from the IP-WW wells (1 through 7) that were used in the development of the Rustler model (Table 5). Modeled thicknesses were generally similar to the ranges observed in the new well data. The largest thickness differences were seen in Layer 1, with new well data having a lower end member for the range of values.

Table 5

Comparison of Modeled Layer Thicknesses and New Layer Thickness Data

Data Source	Layer 1 Thickness (ft)	Layer 2 Thickness (ft)	Layer 3 Thickness (ft)
Range from New Well Data[4]	49-501	10-29	12-30
Range from Model Data[5]	184-398	29-37	24

Notes
1. Layer 1 includes unconsolidated quaternary material, the Gatuña Formation, the Dewey Lake Red Beds, and Caliche.
2. Layer 2 is the Magenta aquifer.
3. Layer 3 is the Culebra aquifer.
4. New well data includes all Intrepid wells that were not considered for the original model.
5. Model data are the thickness from Intrepid wells IP-WW-001 through 007.

Prepared By: MJH5
Checked By: RWS3

Because the Rustler model varied hydraulic conductivity during the model calibration and because MODFLOW uses transmissivity (layer thickness multiplied by hydraulic conductivity), the calibrated hydraulic conductivity field has already compensated for some uncertainty in layer thickness (as discussed in the Rustler Model Calibration Section). The additional borehole data would likely improve the interpolated layer thicknesses. However, since the governing model equations use transmissivity (saturated thickness multiplied by hydraulic conductivity), improvements in the thickness layer of the model are offset by and already compensated for by the hydraulic conductivity assignment and iterative calibration. It is not anticipated that the additional boring data would materially improve the model results.

The impact of additional hydraulic conductivity data depends on how these data compare to the range of acceptable values used for the pilot point calibration. The Dewey Lake Red Beds, the discontinuous Gatuña Formation (a poorly consolidated, tertiary alluvial deposit), and quaternary alluvium were all lumped into Layer 1 of the Rustler model. The estimated hydraulic conductivities for these units, based on the new pumping test data, range from 1.8-7.1 ft/day. These new estimates are within the range of calibrated hydraulic conductivities (Figure TM-EA-002-6) for Layer 1 (<1.0 – 20.7 ft/day). The new estimates for the Culebra (72 ft/day and 170 ft/day) are higher than the calibrated hydraulic conductivities (Figure TM-EA-002-8) for the Culebra aquifer (<1 – 22 ft/day). The new estimates for the Magenta (16.1 ft/day, 40.6 ft/day, and 96 ft/day) are within and reflect the distribution observed in the calibrated hydraulic conductivity range (<1 – 177.3 ft/day) for the Magenta aquifer (Figure TM-EA-002-7).

Including these new hydraulic conductivity data in the groundwater model are not expected to have a substantial impact for Layer 1 (Dewey Lake Red Beds, Gatuña Formation, and unconsolidated quaternary material) and Layer 2 (the Magenta aquifer) because these data fall within the calibrated range of hydraulic conductivity values. The high hydraulic conductivity values observed in the Culebra aquifer reflect known, localized karst features which exhibit direct hydraulic communication between the Magenta and Culebra aquifers. At the project site these high conductivity karst features are surrounded by solid bedrock with a much lower hydraulic conductivity. Single well pumping tests reflect local variability in hydraulic conductivity. If a well intersects a fracture, the pump tests results would estimate a high hydraulic conductivity but that conductivity is only applicable for rock containing that fracture; the bedrock adjacent to that fracture would have a much lower conductivity value. In the groundwater model a single hydraulic conductivity value was applied to each grid cell. The model grid cells are 1,000 ft x 1,000 ft and reflect the average hydraulic conductivity over a large area, including both fractures and low permeability bedrock. The hydraulic conductivity used in a grid cell is, therefore, lower than the hydraulic conductivity observed in a single fracture or karst feature. Consequently, it is not surprising that the additional hydraulic conductivity values for the Culebra aquifer, as measured near known karst features, are above the values used in the model grid cells.

The Magenta aquifer typically exhibits higher hydraulic conductivity than the Culebra in the Clayton Basin area, as witnessed by observations during production well drilling and pump test results. This hydraulic conductivity distribution is accounted for by the pilot point calibration in the AECOM model. The pre-calibration hydraulic conductivity distribution could be updated using recent aquifer testing values. However, the overall conductivity distribution still must be extrapolated over the spatial domain of the model where natural conditions exhibit a high degree of heterogeneity due to the fractured rock aquifer characteristics. Using a calibration technique such as the pilot point method (which was employed in the AECOM modeling effort) is still the best approach for estimating the hydraulic conductivity distribution for this groundwater system.

It should be noted that neither new estimates for recharge nor better boundary condition data are available since the AECOM (2011) modeling effort. The values used by AECOM (2011) are likely still the best estimates for these boundary conditions.

2.4 Model Results from the Initial Proposed Action and Applicability to Extended Pumping Durations

In the original model analysis for the EIS (BLM, 2012a), pumping impacts were evaluated under two scenarios (Alternative A and Alternative B) for both the preferred and enhanced Rustler models as well as the Caprock model. Under Alternative A, all injection make-up water is pumped from Rustler wells (Section 2 and PCA wells located at the former PCA facility) and water for the refinery is pumped from the Caprock wells. Under Alternative B, injection make-up water is pumped from both the North Rustler well field wells and the Caprock wells; no water is pumped from the PCA wells. The BLM ROD (March 19, 2012) was based on Alternative B and actual water use today as well as proposed water use during the HB AMAX expansion is reflected by Alternative B (BLM, 2012b). Therefore, only Alternative B will be discussed in this Technical Memorandum; Alternative A is no longer applicable. The pumping rates modeled during the EIS for Alternative B are summarized in Table 6 (preferred model – lower hydraulic conductivity values) and Table 7 (enhanced model – higher hydraulic conductivity values). As discussed earlier, the pumping rates proposed for the combined HB Solar Solution Mine and HB AMAX Extension are the same as those modeled to support the EIS analysis for the HB Solar Solution Mine. The proposed pumping rates under the HB AMAX Extension are summarized in Tables 8 and 9.

Table 6

Analyzed Pumping Rates for EIS Alternative B, Preferred Rustler Model

Project Phase	North Rustler Well Field Combined Pumping Rate (gpm)	Caprock Wells Combined Pumping Rate (gpm)	Total Pumping Rate (gpm)
Phase I (yr 0-7)	177	2,090	2,267
Phase II (yr 8-21)	177	1,085	1,262
Phase III (yr 22-28)	0	208	208

Prepared By: MJH
Checked By: DRD

Table 7

Analyzed Pumping Rates for EIS Alternative B, Enhanced Rustler Model

Project Phase	North Rustler Well Field Combined Pumping Rate (gpm)	Caprock Wells Combined Pumping Rate (gpm)	Total Pumping Rate (gpm)
Phase I (yr 0-7)	670	1,597	2,267
Phase II (yr 8-21)	670	592	1,262
Phase III (yr 22-28)	0	208	208

Prepared By: MJH
Checked By: DRD

Table 8

Pumping Schedule for Project Including HB Amax Extension, Preferred Rustler Model

Project Phase	North Rustler Well Field Combined Pumping Rate (gpm)	Caprock Wells Combined Pumping Rate for Injectate (gpm)	Caprock Well Field Pumping Rate for Mill Water (gpm)	Total Caprock Pumping Rate (gpm)	Total Project Pumping Rate (gpm)
Phase I (yr 0-14)	177	1,882	208	2,090	2,267
Phase II (yr 15-32)	177	877	208	1,085	1,262
Phase III (yr 33-42)	0	0	208	208	208

Prepared By: MJH
Checked By: DRD

Table 9

Pumping Schedule for Project Including HB Amax Extension, Enhanced Rustler Model

Project Phase	North Rustler Well Field Combined Pumping Rate (gpm)	Caprock Wells Combined Pumping Rate for Injectate (gpm)	Caprock Well Field Pumping Rate for Mill Water (gpm)	Total Caprock Pumping Rate (gpm)	Total Project Pumping Rate (gpm)
Phase I (yr 0-14)	670	1,389	208	1,597	2,267
Phase II (yr 15-32)	670	384	208	592	1,262
Phase III (yr 33-42)	0	0	208	208	208

Prepared By: MJH
Checked By: DRD

Drawdown predictions were made using the Caprock and Rustler models used to support the EIS process. In both the preferred and enhanced Rustler models, water supply wells for the project were simulated as pumping from only the Magenta aquifer, although the wells are actually screened in both the Magenta and Culebra aquifers. This discrepancy results in model under-estimates of well sustainable pumping rates and over-estimates of drawdown associated with well pumping.

Drawdown in the Magenta Member of the Rustler Formation

The pumping rate reported in Table 6 for the Rustler well field is the sustainable pumping rate for this aquifer, as determined from the preferred model. A sustainable pumping rate was determined by iteratively running the Rustler model in steady state mode at a range of different pumping rates (AECOM, 2011). The goal was to determine the pumping rate which would allow a convergent, steady state solution that did not reduce water levels in the pumping wells below a point defined as 10 ft above the bottom of the Magenta aquifer. A steady state, sustainable pumping rate of 177 gpm was obtained from this simulation for the North Rustler well field wells using the preferred model; a value of 670 gpm was obtained using the enhanced model.

Resulting drawdown for the Rustler preferred model using the 177 gpm sustainable pumping rate is shown in **Figure TM-EA-002-13 –** ***Rustler Preferred Model Predicted Drawdown, Alternative B*** and for the enhanced model (670 gpm) in **Figure TM-EA-002-16 –** ***Rustler Enhanced Model Predicted Drawdown, Alternative B***. Figure TM-EA-002-16 shows that the maximum drawdown for the enhanced Rustler model is essentially the same as that estimated using the preferred model (Figure TM-EA-002-13), but the areal extent of the drawdown cone-of-depression is increased as a result of assigning a pumping rate of 670 gpm versus the 177 gpm evaluated in the preferred model. Note, in both the enhanced and preferred models the combined pumping rate from the North Rustler well field does not equal or exceed the desired production rate of 2,267 gpm needed for use as injectate. The balance of water required for the project (2,090 or 1,597 gpm for the injectate make-up water and mill – from the preferred or enhanced model respectively) must be obtained from the Caprock well field or other non-Rustler sources, as outlined in Tables 6 and 7.

Drawdown in the Ogallala Aquifers

Similar to the numerical simulation of the Rustler formation wells, the Caprock well fields were analyzed (AECOM, 2011) by conducting a steady state simulation of pumping. Unlike the Rustler models a sustainable pumping rate was not evaluated for the Caprock model; the model was run using pumping rates defined as total project water demand less water available from pumping the Rustler wells at the sustainable pumping rates, as outlined in Tables 6 and 7. A sustainable pumping rate analysis was not needed based on the long-term historical pumping record and known capacity of the Caprock well fields. As described in the EIS (Section 4.3.6.2), the Caprock well fields could supply all project water based on the Caprock model (AECOM, 2011). Intrepid owns adequate water rights to supply the maximum amount of water required for both the HB Solar Solution Mine and the HB AMAX Extension. Because the analytical model does not allow for transient pumping rates, the Caprock model was run four separate times using four different pumping rates for the well field. The first two rates correspond to the preferred Rustler model scenario (Table 6), where the sustainable Rustler pumping rate is 177 gpm and the second two pumping rates correspond to the enhanced Rustler model scenario (Table 7), where the sustainable Rustler pumping rate is 670 gpm.

The first pumping rate analyzed was 2,090 gpm, corresponding to the pumping rate for the Caprock system during Phase I if the Rustler wells were pumped at 177 gpm. The second rate analyzed was 1,117 gpm, a time-weighted average of the Phase 1, II, and III Caprock pumping rates if the Rustler wells were pumped at 177 gpm. The third rate analyzed was 1,597 gpm, representing the total Phase I Caprock pumping rate minus 670 gpm (the enhanced Rustler model sustainable pumping rate). The fourth rate analyzed was 747 gpm, the time-weighted average of the Phase I, II, and III Caprock pumping rates from Table 7, assuming a sustainable pumping rate of 670 gpm from the Rustler wells.

Analyzing the Phase I Caprock rate of 2,090 gpm resulted in the predicted drawdown depicted in **Figure TM-EA-002-14 - *Caprock Model Predicted Drawdown Alternative B, Pumping Rate = 2,090 gpm*.** Figure TM-EA-002-14 shows that the maximum additional drawdown (beyond that already present from historic pumping in the area) created by Phase I operation (2,090 gpm) of the Caprock well field is 30 to 50 ft during initial Phase 1 pumping. Analyzing the time-weighted average of the Caprock Phase I, II, and III pumping rates (1,117 gpm) resulted in the predicted drawdown depicted in **Figure TM-EA-002-15 - *Caprock Model Predicted Drawdown Alternative B, Pumping Rate = 1,117 gpm***. Figure TM-EA-002-15 shows that drawdown increases beyond that already present from historic pumping are in the range of 20 to 25 ft over the life of the project. Analyzing the Phase I Caprock rate of 1,597 gpm resulted in the predicted drawdown depicted in **Figure TM-EA-002-17 – *Caprock Model Predicted Drawdown Alternative B, Pumping Rate = 1,597 gpm***. The maximum increase in drawdown beyond that from historic pumping is 46 ft when the wells are pumped at a rate of 1,597 gpm. Analyzing the Phase I Caprock rate of 747 gpm resulted in the predicted drawdown in the range of 15 to 20 ft depicted in **Figure TM-EA-002-18 - *Caprock Model Predicted Drawdown Alternative B, Pumping Rate = 747 gpm***.

Model Applicability to the HB AMAX Extension

The proposed expansion of the HB Solar Solution Mine to include HB AMAX has raised the question of whether or not the modeling completed by AECOM (2011) can still be relied upon for evaluation of future drawdown impacts on the Rustler formation and Ogallala aquifers.

All of the pumping scenarios for both the Rustler models and the Caprock model were run using a steady state simulation. Predicted drawdowns obtained from a steady state analysis are not estimates of the drawdown at any particular phase or point in time; rather, they are estimates of the drawdown that would occur if the wells were pumped at the assigned rates in perpetuity. The point at which such equilibrium drawdown is reached could occur within Phase I, II, III or some point in time beyond Phase III. Therefore, these drawdown predictions are not projected drawdowns of any given project year; rather, they are estimates of the maximum drawdown expected if the well field were operated at the given pumping rates in perpetuity. The point in time at which this equilibrium drawdown would occur is not provided by the steady state models. However, to the extent the models provide a reasonable simulation of the Rustler and Caprock systems, the drawdown shown on Figures TM-EA-002-13 through TM-EA-002-18 will be the maximum expected at any point in the operation of the project. As previously described, several other factors such as the assumption of EPM throughout the model domain and only modeling groundwater withdrawal from the Magenta aquifer further add conservancy to the drawdown extent and well pumping capacity results.

Therefore, because these were steady states models, this modeling effort remains applicable to the extended pumping durations proposed for the HB AMAX Extension, assuming no changes to the modeled pumping rates. Predicted pumping rates for the AMAX Extension are scheduled to be the same as those analyzed for the original HB Solar Solution Mine, as shown in Table 8 (preferred Rustler model) and Table 9 (enhanced Rustler model); the Rustler sustainable pumping rates are projected to be the same. These projected pumping rates over a longer period of time means that the drawdown predicted for the Caprock well field in the EIS will be the same as the drawdown the model would predict for the new pumping schedule. Under the extended pumping schedule and the sustainable pumping rate from the preferred Rustler model (Table 8), the time-weighted average pumping rate for the Caprock wells is 1,211 gpm; is the same as the time-weighted average of 1,117 gpm shown in Figure TM-EA-002-15. Under the extended pumping schedule and the sustainable pumping rate from the enhanced Rustler model (Table 9), the time-weighted average pumping rate for the Caprock wells is 836 gpm; again the same as the time-weighted average of 747 gpm shown in Figure TM-EA-002-18 and analyzed in the EIS. The net effect of the projected pumping rates over a longer period of time would result in the same drawdown extent and depth as analyzed in the EIS. Again, this pumping schedule does not change the sustainable pumping rates for the North Rustler well field; model predictions for the Rustler aquifer are still applicable.

Since completion of the EIS, Rustler production wells WS-001, 002, 003, and 004 have been installed, equipped with pumps, and have been used for several years. The combined pumping rate has exceeded 1,800 gpm and is currently pumping at approximately 1,000 gpm (versus the simulated sustainable pumping rates of either 177 gpm or 670 gpm predicted by the Rustler models) and the associated March 2014 drawdown is significantly less than the drawdown predicted by the AECOM model as shown in **Figure TM-EA-002-19 – *Predicted and Observed Drawdown, March 2014***. The pumping rates and drawdown may further change, until steady state is achieved but based on observed water levels, drawdown may be less than the model results indicate. Sustainable pumping rates are also expected to continue to be appreciably higher than the model predicted. The most recent pumping yields and associated drawdowns from WS-002 and WS-003 indicate that pumping rates and corresponding well drawdown in the pumping wells has stabilized and may be approaching a steady state condition. These observed sustainable pumping rates in the Rustler aquifer suggest that the current model does not accurately represent site conditions to date. This discrepancy could be due to either the model hydraulic conductivity or the storativity being too low. Without new data to better estimate these terms, the modeled values cannot be improved and the modeling approach used is still the best available prediction. However, the EIS and associated analysis were inherently designed to be highly conservative in order to evaluate impacts from groundwater pumping and to develop mitigation measure to protect natural resources and it is not surprising that actual pumping rates are higher and drawdown is less than predicted.

Moving forward, an adaptive monitoring strategy of continued drawdown observations is likely the best method for identifying and mitigating actual impacts. As required by the ROD, Intrepid has established a comprehensive groundwater monitoring network (Figure TM-EA-002-11) and conducts regular monitoring to measure actual groundwater elevations throughout the project area. The primary concerns with drawdown of groundwater is the potential effect on groundwater levels in caves and karsts to the west of the project area (Macha, Banded Pit, and Skylite) and on impacts to other Rustler water users. The position of intermediate monitoring wells between the North Rustler well field and the monitored cave and karst areas allows measurement and evaluation of drawdown well before potential drawdown would occur at the monitored cave and karst sites and serves as an "early warning system". Using this system, adaptive measures can be considered prior to seeing unacceptable drawdown in groundwater levels in monitored caves and karsts. As the actual groundwater elevations are significantly higher than the modeled extent and drawdowns have not extended beyond the immediate North Rustler well field area, no reductions in pumping have been considered to date. Based on the observed data and considering the conservative model design, it is extremely unlikely that the actual observed drawdowns will exceed the model predictions for the existing HB Solar Solution Mine operation and with the addition of the proposed HB AMAX Extension.

3 Conclusions

The AECOM (2011) numerical and analytical models have been calibrated and incorporated into the final EIS (BLM, 2012a). Both the numerical and analytical models used steady state simulations to estimate equilibrium drawdown for a variety of pumping rates in the Rustler and Caprock well fields. The Amax expansion project uses rates that in all instances are equal to or lower than those in the project scope considered in EIS Alternative B. The combination of identical or lower pumping rates for the HB AMAX Extension and the fact that the original modeling studies were steady state or equilibrium analyses allows the drawdowns estimated via the existing AECOM (2011) studies to serve as a conservative estimation of maximum drawdowns associated with the HB AMAX Extension.

Since the EIS was published, additional boring data, hydraulic conductivity estimates, and water level data have been collected at various Intrepid production and monitoring wells. As is typical for a groundwater model, the Rustler model was compiled using existing sub-surface data that reflected the best available information at that time, as required by NEPA. The question posed in this Technical Memorandum is "*Would updating the Rustler model with the additional data that was not available during the original formulation of the model change the predicted drawdowns and alter the BLM impact analysis completed to date?*" To answer this question it is necessary understand the original goal of creating this groundwater model; that goal was to assess the potential impacts to groundwater resources resulting from water extraction for the solution mining.

Given that the new data is mostly within the range of values used in the calibration process, the additional data points are localized, and that some variables (boundary conditions, including recharge) have no new data, the drawdown results are not expected to materially change. Updating the original model with the limited additional data, including the transient water levels, may improve the model calibration on a local basis and result in drawdown predictions slightly different than those obtained from the original model. The original model was run to provide a conservative, worse-case estimate of drawdowns. Given the drawdowns observed to date, it is obvious that the actual drawdowns are significantly less severe than the original model predicted (Figure TM-EA-002-19). This discrepancy in actual versus modeled drawdown is expected; the model was designed to be conservative. Under the original EIS, the modeled drawdown was considered an acceptable impact. An improved model may yield more accurate estimates of project drawdowns but these changes would likely reduce the drawdown extent. Such improvements would not alter the conclusions obtained from the original modeling effort; namely that the impact to the groundwater system arising from the operation of the production wells was acceptable. Therefore, there does not appear to be substantive added value for updating the model. The new results would show less impact than that predicted by the existing model. Accordingly, a reasonable path forward is the continued implementation of the current adaptive management approach including continued monitoring of actual drawdowns relative to the predicted scenario.

4 References

AECOM, 2011. Hydrological Assessment and Groundwater Modeling Report for the HB In-Situ Solution Mine Project EIS. Prepared for Bureau of Land Management, Carlsbad, New Mexico by AECOM, Fort Collins, Colorado.

Brinster, K. F., 1991. Preliminary Geohydrologic Conceptual Model of the Los Medanos Region near the Waste Isolation Pilot Plant for the Purpose of Performance Assessment. SAND 89-7147.

Bureau of Land Management (BLM), 2012a. HB In-Situ Solution Mine Project Final Environmental Impact Statement. Document No. DOI-BLM-NM-P020-2011-498-EIS. Prepared by Carlsbad Office of Bureau of Land Management, U.S. Department of Interior.

Bureau of Land Management (BLM), 2012b. Record of Decision, HB In-Situ Solution Mine, Bureau of Land Management, March 19, 2012.

Cooper, J. B. and V. M. Glanzman, 1971. Geohydrology of the Project GNOME Site, Eddy County, New Mexico. U.S. Geological Prof. Paper 712-A.

Geohydrology Associates, Inc., 1978a. Collection of Hydrologic Data for the East Side Roswell Range Environmental Impact Statement Area, New Mexico. Prepared for BLM Denver, Colorado, Contract YA-512-CT7-217.

Geohydrology Associates, Inc., 1978b. Ground-Water Study Related to Proposed Expansion of Potash Mining near Carlsbad, New Mexico. Prepared for BLM, Denver, Colorado. Contract YA-512-CT7-217.

Geohydrology Associates, Inc., 1979. Water-Resources Study of the Carlsbad Potash Area, New Mexico. Prepared for the BLM, Denver, Colorado. Contract YA-512-CT8-195.

Haitjema Software., 2007. GFLOW, Analytic Element Model Version 2.1.2, July 2007.

Hunter, R. L., 1985. Regional Water Balance for the WIPP Site and Surrounding Area, New Mexico. SAND 84-2233.

McDonald, M.G. and A.W. Harbaugh, 1988. A Modular Three-Dimensional Finite-Difference Ground-Water Flow Model. U.S. Geological Survey Techniques of Water Resources Investigations, Book 6, 586 pp.

Intrepid Potash Inc./Shaw, 2008. Mine Operations and Closure Plan HB In-situ Project, HB Potash LLC, Eddy County, New Mexico Submitted to: Bureau of Land Management Carlsbad Field Office, Carlsbad, New Mexico. Prepared by Shaw Environmental and Infrastructure, Inc. May 28.

McAda, D., 1984. Projected Water Level Declines in the Ogallala Aquifer in Lea County New Mexico, USGS in cooperation with New Mexico State Engineer Office. Water Resources Investigations Report 84-4062.

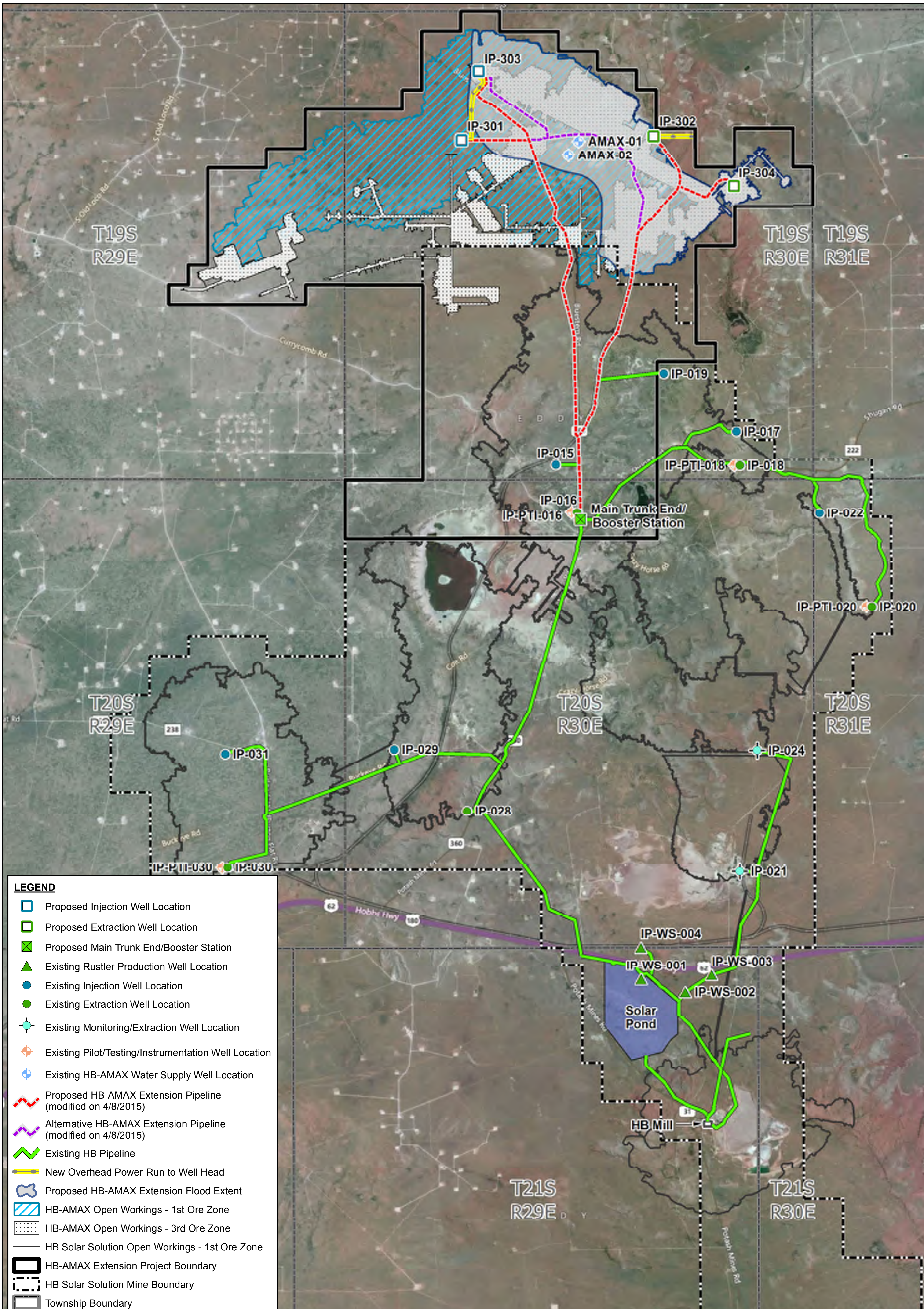
Musharrafieh, G. and Mustafa Chudnoff, 1999. Numerical Simulation of Groundwater Flow for Water Rights Administration in the Lea County Underground Water Basin, New Mexico. New Mexico Office of State Engineer Technical Report 99-1.

Tillery, A., 2008. Current (2004-2007) Conditions and Changes in Groundwater Levels from Predevelopment to 2007, Southern High Plains Aquifer, southeastern New Mexico, Lea County Underground Water Basin. USGS Scientific Investigation Map 3041.

Water Management Consultants (WMC), 1999. Hydrogeological Assessment of the Proposed Evaporation Ponds at the Eddy Potash Mine. Prepared for SNC-Laturn Engineers and Constructors, Inc. 357 Third Ave. South, Saskatoon, Saskatchewan, Canada. S7K 1M6.

Attachments

Figure TM-EA-002-1	*General Infrastructure*
Figure TM-EA-002-2	*Location of the North Rustler Well Field*
Figure TM-EA-002-3	*Location of the Caprock Well Field Relative to Project Area*
Figure TM-EA-002-4	*Rustler Groundwater Model Domain*
Figure TM-EA-002-5	*Distribution of Calibration Targets*
Figure TM-EA-002-6	*Distribution of Hydraulic Conductivity in the Dewey Lake Red Beds*
Figure TM-EA-002-7	*Distribution of Hydraulic Conductivity in the Magenta Dolomite Aquifer*
Figure TM-EA-002-8	*Distribution of Hydraulic Conductivity in the Culebra Dolomite Aquifer*
Figure TM-EA-002-9	*Distribution of Hydraulic Conductivity in the Magenta Dolomite Aquifer – Enhanced Model*
Figure TM-EA-002-10	*Model Domain for the Caprock Analytical Model*
Figure TM-EA-002-11	*Current HB Solar Solution Mine Monitoring Well Network*
Figure TM-EA-002-12	*Current HB Solar Solution Mine Operational Components*
Figure TM-EA-002-13	*Rustler Preferred Model Predicted Drawdown, Alternative B*
Figure TM-EA-002-14	C*aprock Model Predicted Drawdown Alternative B, Pumping Rate = 2,090 gpm*
Figure TM-EA-002-15	*Caprock Model Predicted Drawdown Alternative B, Pumping Rate = 1,117 gpm*
Figure TM-EA-002-16	*Rustler Enhanced Model Predicted Drawdown, Alternative B*
Figure TM-EA-002-17	*Caprock Model Predicted Drawdown Alternative B, Pumping Rate = 1,597 gpm*
Figure TM-EA-002-18	*Caprock Model Predicted Drawdown Alternative B, Pumping Rate = 747 gpm*
Figure TM-EA-002-19	*Predicted and Observed Drawdown, March 2014*



NOTES:

1. Aerial imagery from esri.
2. Locations of existing pipelines, existing wells, proposed HB-AMAX pipelines, and proposed HB-AMAX wells provided by Intrepid Potash, LLC and further defined through field surveys.
3. Final pipeline route to be surveyed upon regulatory approval.
4. Horizontal coordinate system is NAD 1983 New Mexico State Plane East, units in feet.

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FIGURE TM-EA-002-1

GENERAL INFRASTRUCTURE

Technical Memorandum TM-002, Groundwater Modeling Applicability
HB Solar Solution Mine - AMAX Extension

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Drafted by: BJW1	Project No: 0014I016

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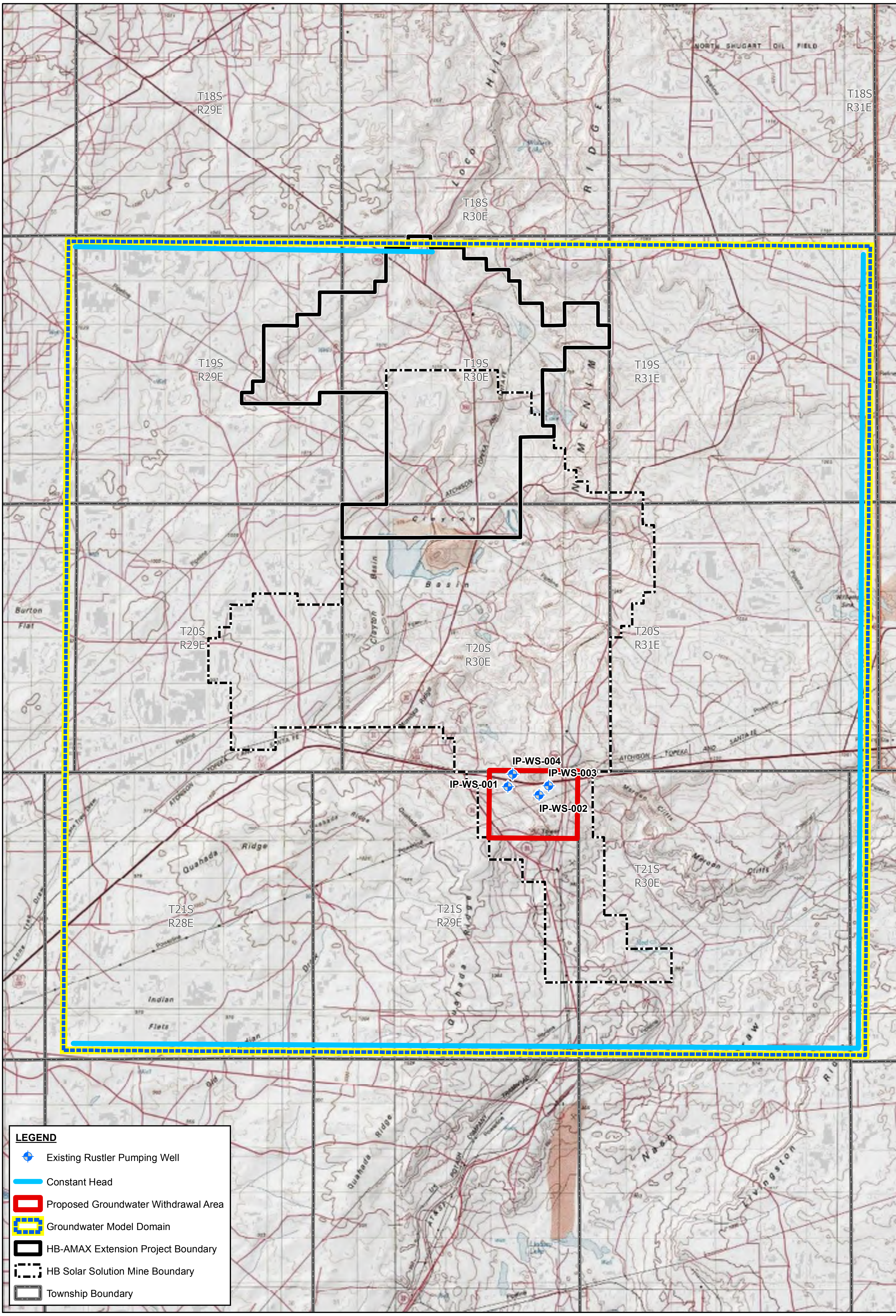

NOTES:

1. Basemap from esri.
2. Red box in center denotes the location of the "Section 2" area in which surface evaporation ponds and Rustler Formation production wells are located.
3. Figure orginally from AECOM, February 2011.
4. Horizontal coordinate system is NAD 1983 New Mexico State Plane East, units in feet.

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FIGURE TM-EA-002-2

LOCATION OF THE NORTH RUSTLER WELL FIELD

Technical Memorandum TM-002, Groundwater Modeling Applicability
HB Solar Solution Mine - AMAX Extension

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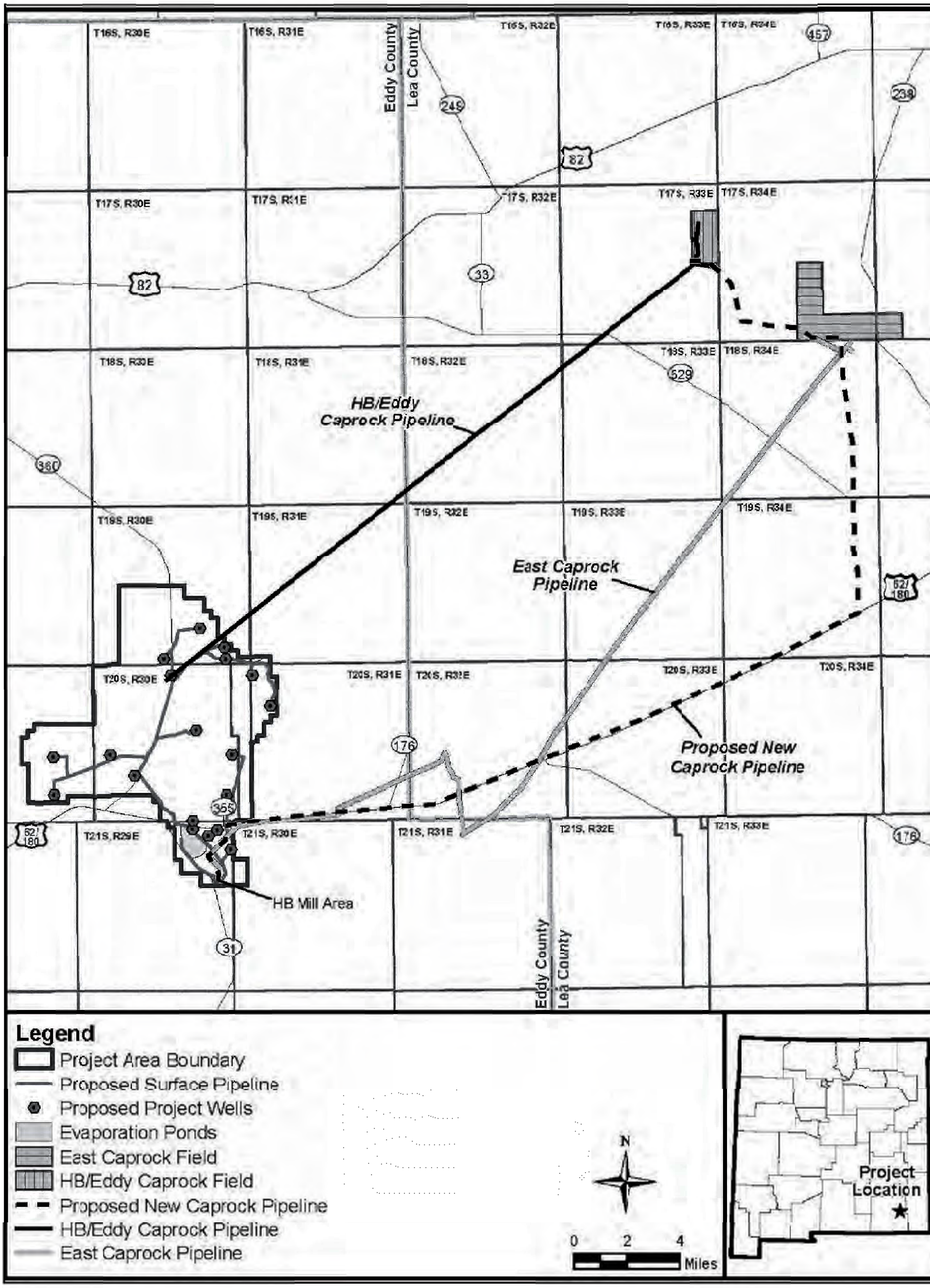

NOTES:
1. Figure from BLM, 2012.

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FIGURE TM-EA-002-3
LOCATION OF THE CAPROCK WELL FIELD
RELATIVE TO PROJECT AREA
Technical Memorandum TM-002, Groundwater Modeling Applicability
HB Solar Solution Mine - AMAX Extension

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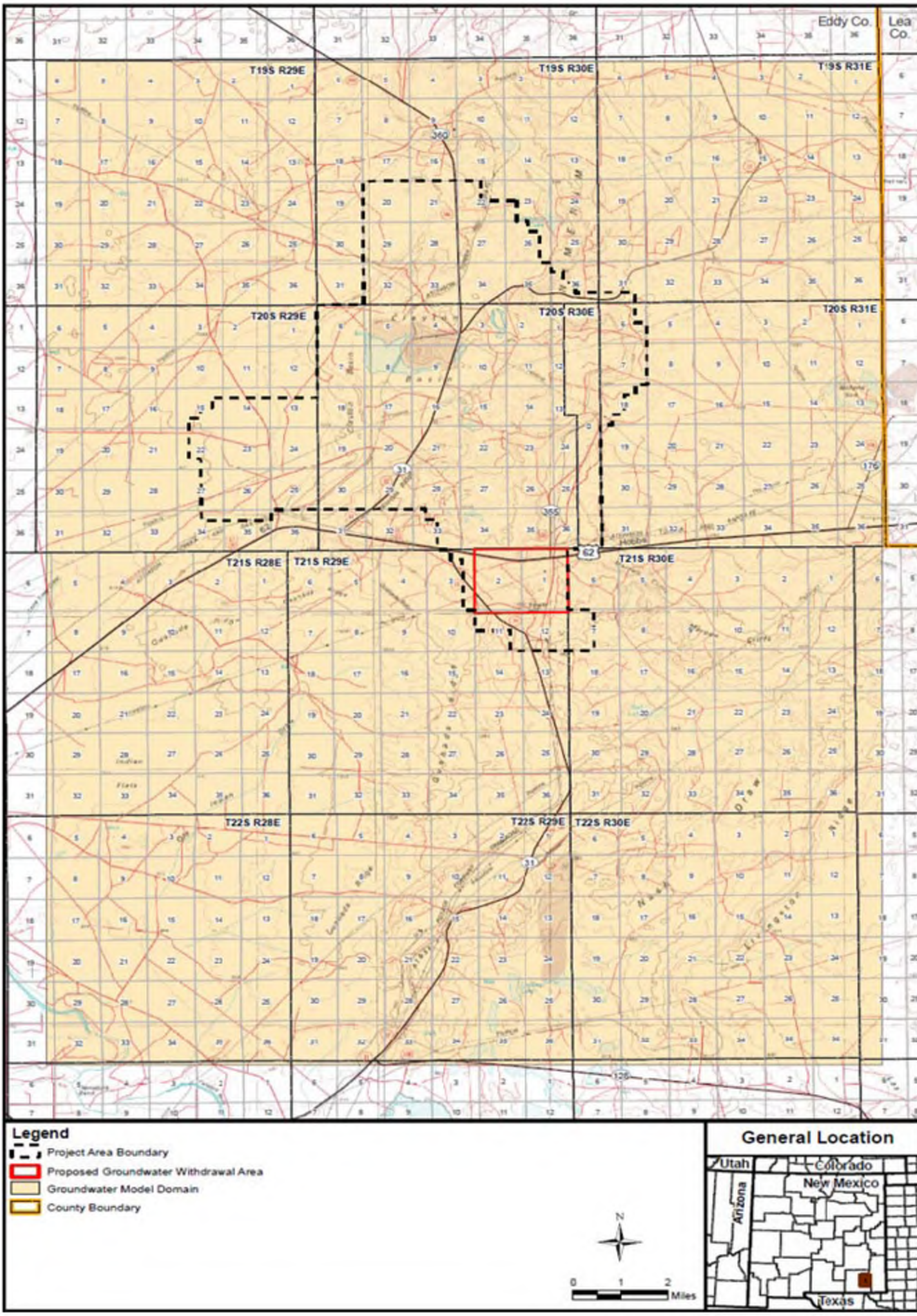

NOTES:

1. Figure from Hydrological Assessment and Groundwater Modeling Report for the HB In-Situ Solution Mine Project EIS. AECOM, February 2011, Figure 7-1.

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FIGURE TM-EA-002-4
RUSTLER GROUNDWATER
MODEL DOMAIN

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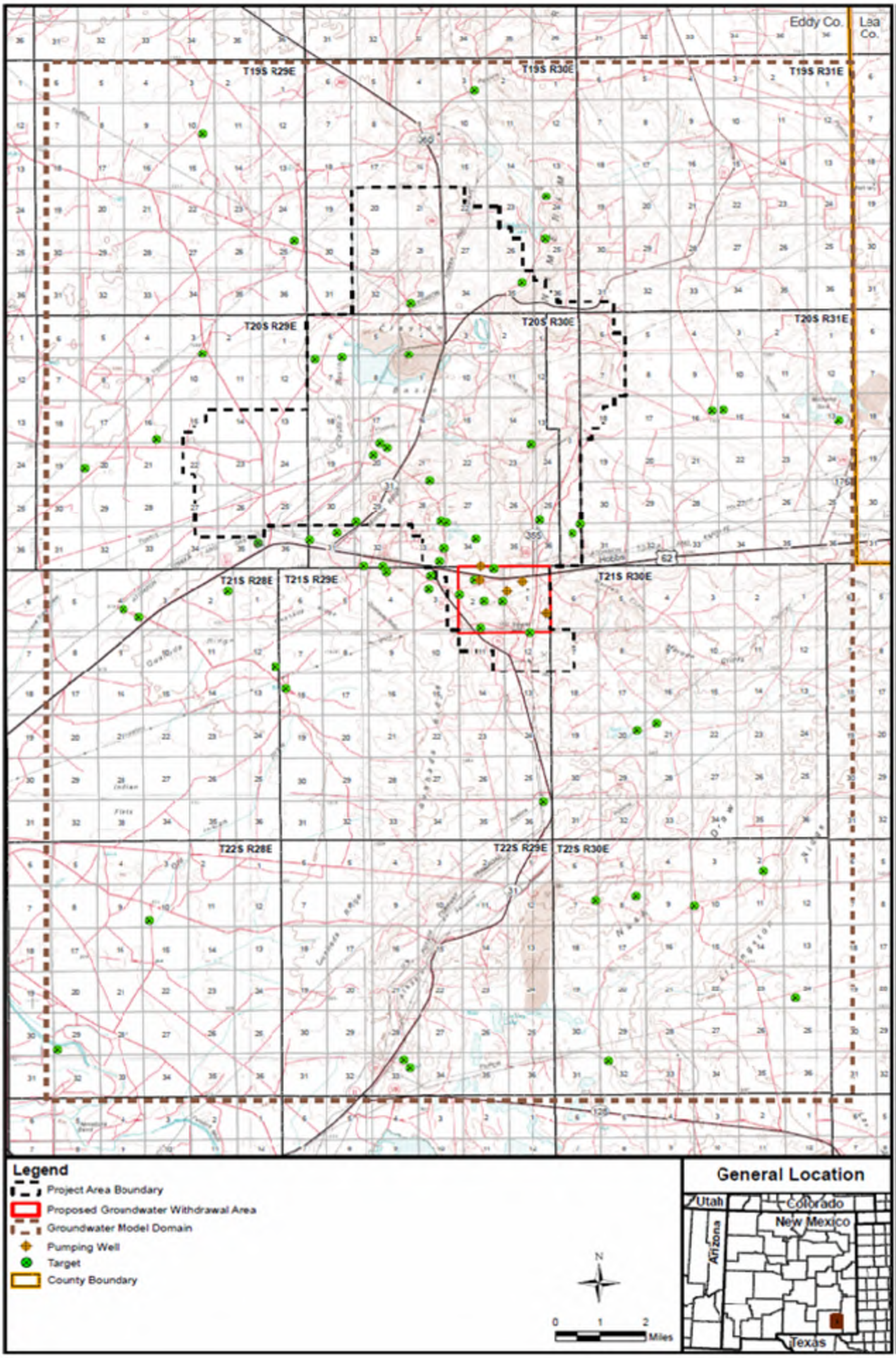

NOTES:

1. Figure from Hydrological Assessment and Groundwater Modeling Report for the HB In-Situ Solution Mine Project EIS. AECOM, February 2011, Figure 7-5.

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FIGURE TM-EA-002-5

DISTRIBUTION OF CALIBRATION TARGETS

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HB Solar Solution Mine - AMAX Extension

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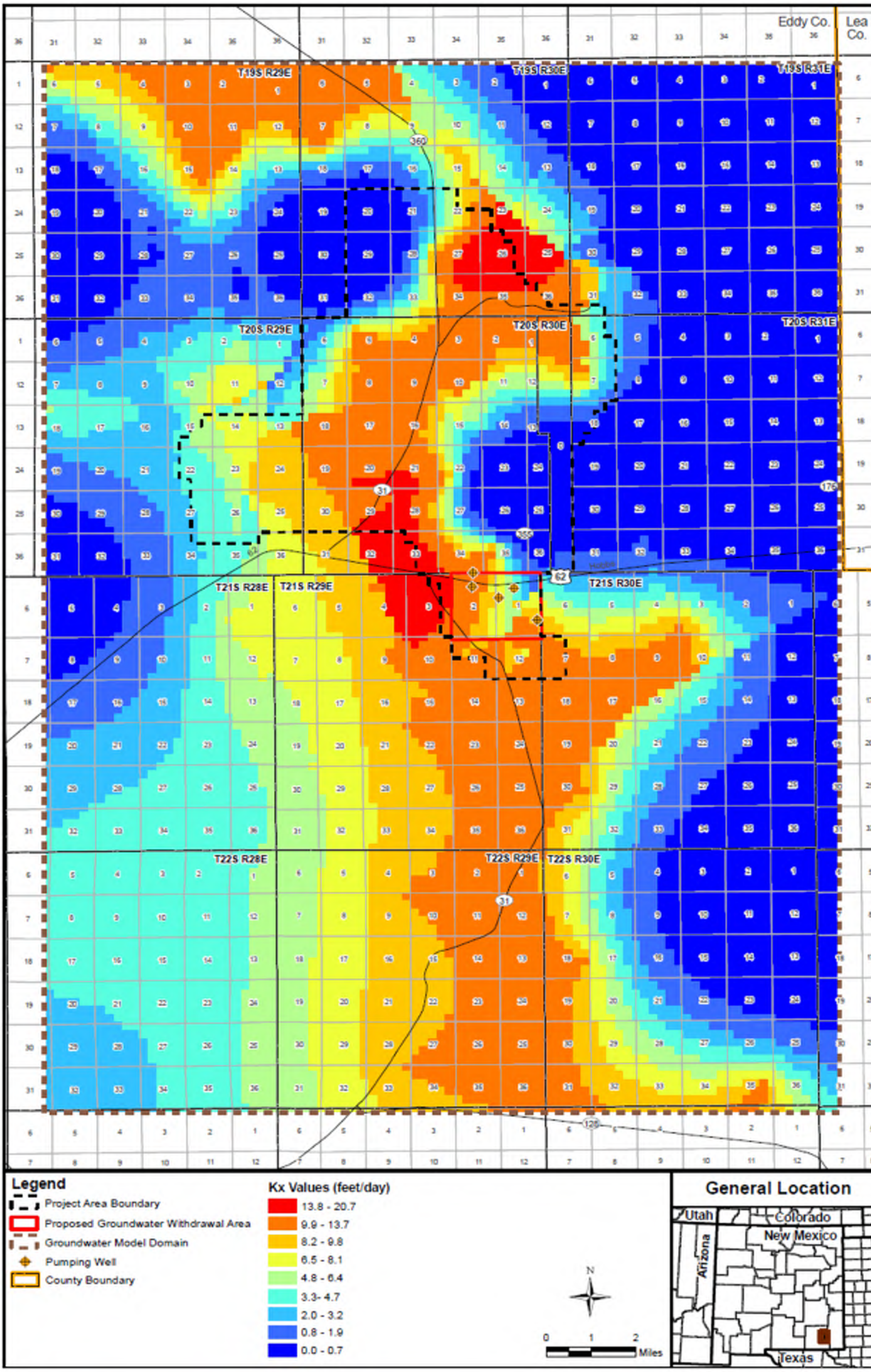

NOTES:

1. Figure from Hydrological Assessment and Groundwater Modeling Report for the HB In-Situ Solution Mine Project EIS. AECOM, February 2011, Figure 8-5.

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FIGURE TM-EA-002-6

DISTRIBUTION OF HYDRAULIC CONDUCTIVITY IN THE DEWEY LAKE RED BEDS

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HB Solar Solution Mine - AMAX Extension

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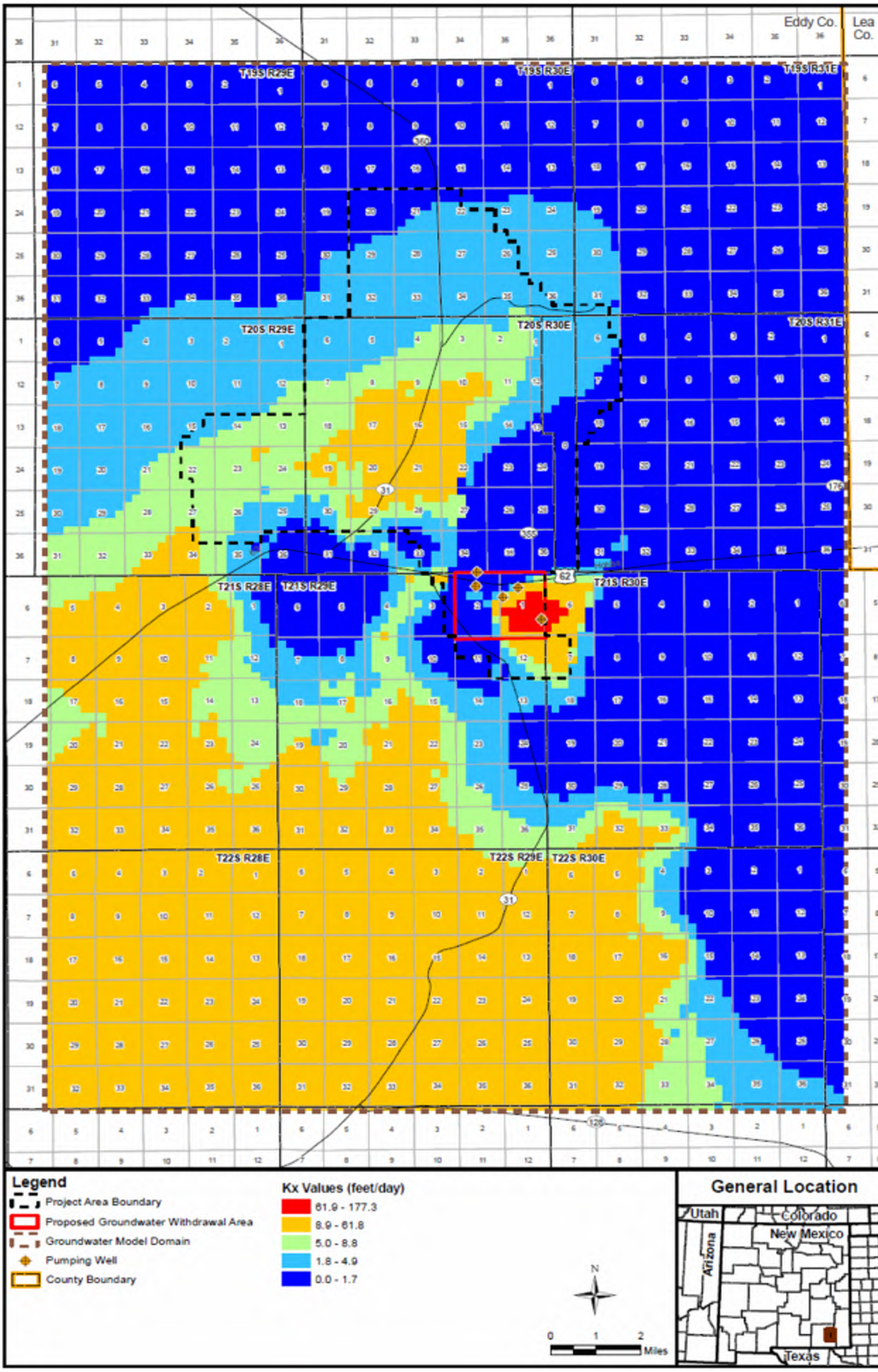

NOTES:
1. Figure from Hydrological Assessment and Groundwater Modeling Report for the HB In-Situ Solution Mine Project EIS. AECOM, February 2011, Figure 8-6.

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FIGURE TM-EA-002-7
DISTRIBUTION OF HYDRAULIC CONDUCTIVITY IN THE MAGENTA DOLOMITE AQUIFER
Technical Memorandum TM-002, Groundwater Modeling Applicability
HB Solar Solution Mine - AMAX Extension

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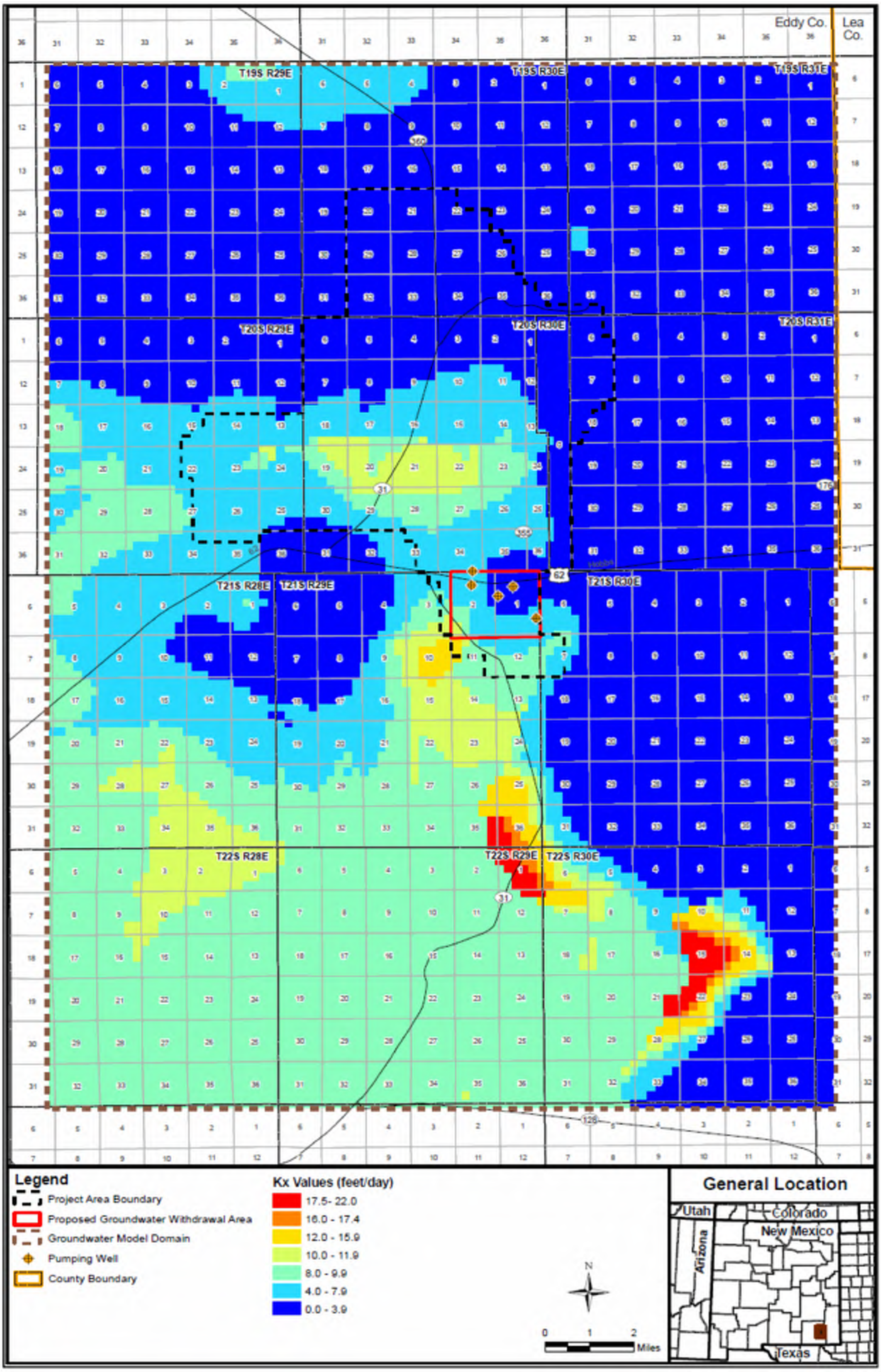

NOTES:

1. Figure from Hydrological Assessment and Groundwater Modeling Report for the HB In-Situ Solution Mine Project EIS. AECOM, February 2011, Figure 8-7.

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FIGURE TM-EA-002-8

DISTRIBUTION OF HYDRAULIC CONDUCTIVITY IN THE CULEBRA DOLOMITE AQUIFER

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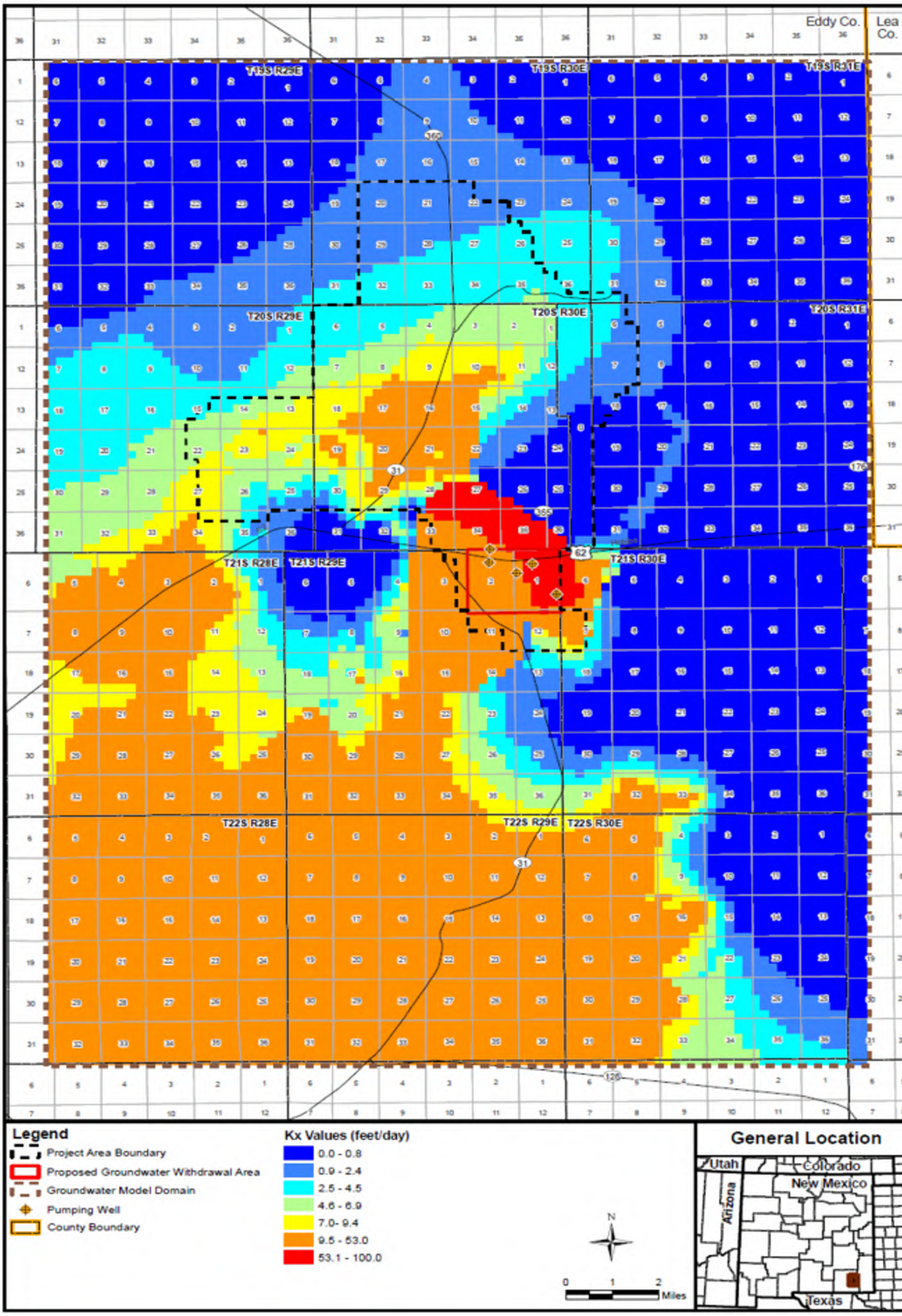

NOTES:
1. Figure from Hydrological Assessment and Groundwater Modeling Report for the HB In-Situ Solution Mine Project EIS. AECOM, February 2011, Figure 9-2.

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FIGURE TM-EA-002-9

DISTRIBUTION OF HYDRAULIC CONDUCTIVITY IN THE MAGENTA DOLOMITE AQUIFER - ENHANCED MODEL

Technical Memorandum TM-002, Groundwater Modeling Applicability HB Solar Solution Mine - AMAX Extension

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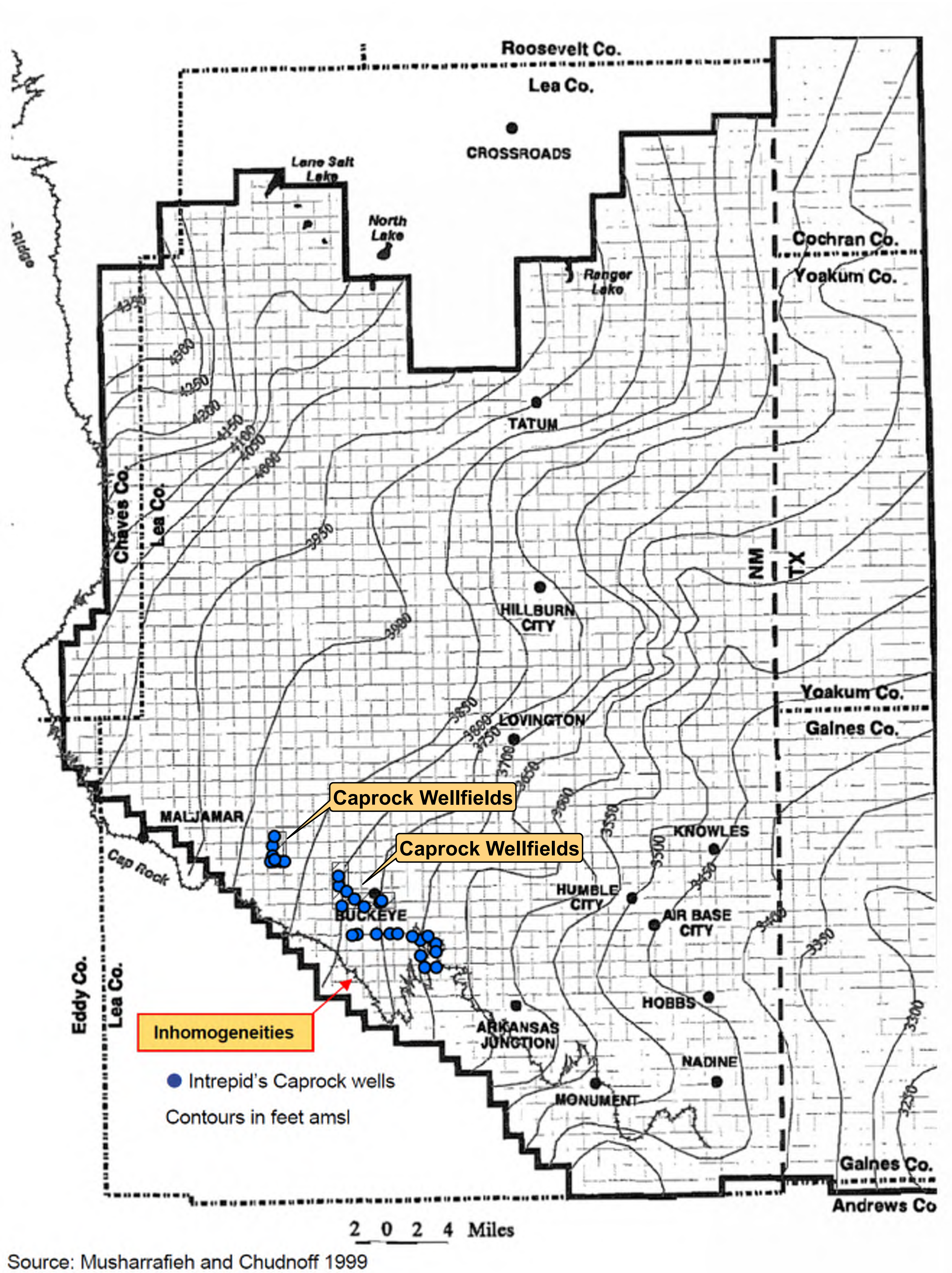

NOTES:

1. Figure from Hydrological Assessment and Groundwater Modeling Report for the HB In-Situ Solution Mine Project EIS. AECOM, February 2011, Figure 10-2.

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FIGURE TM-EA-002-10
MODEL DOMAIN FOR THE CAPROCK ANALYTICAL MODEL
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HB Solar Solution Mine - AMAX Extension

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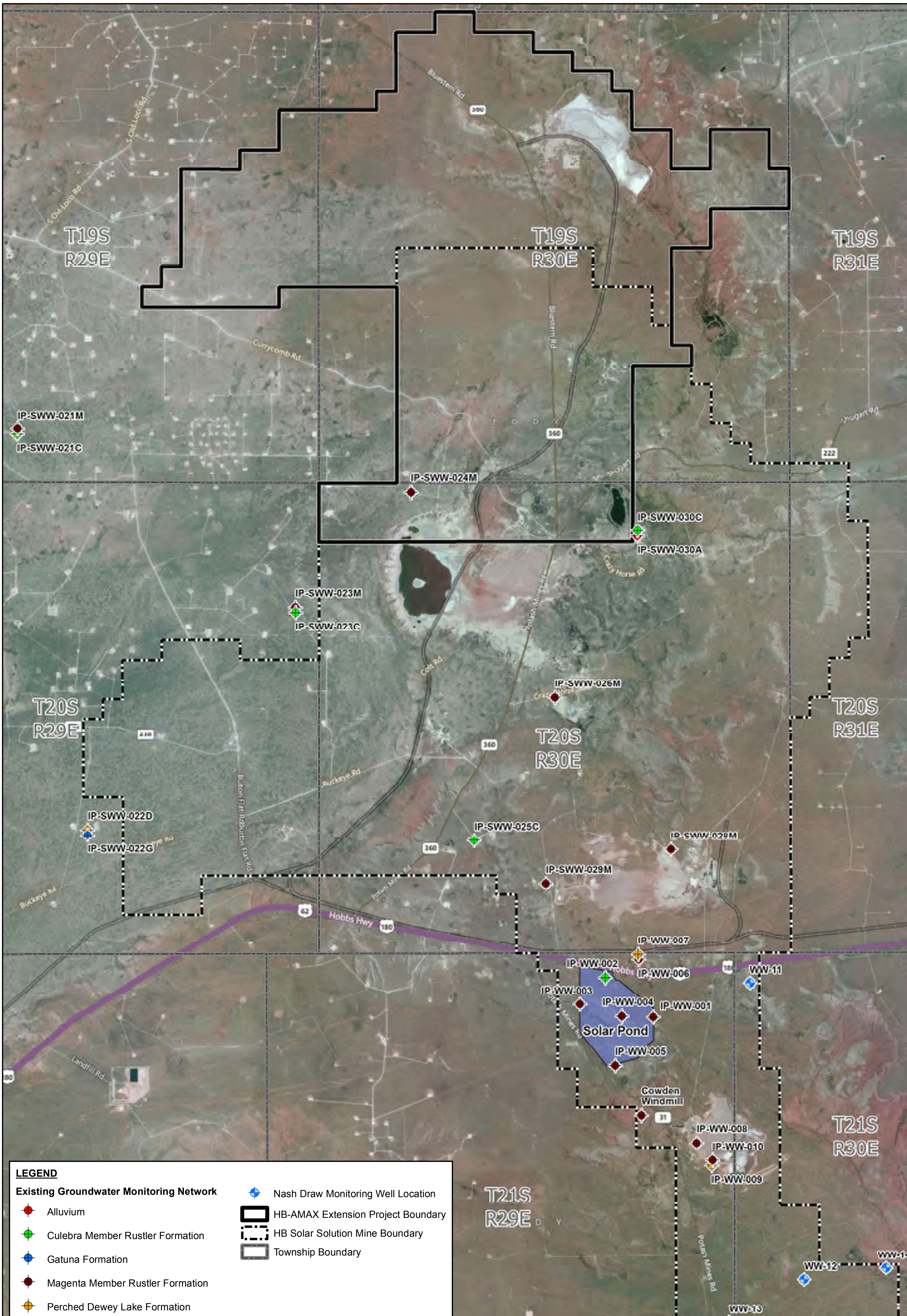
Drafted by: BJW1	Project No: 0014I016

Path: X:\GB\IE\2014\14I016-00\GIS\mxd\Technical_Memorandum_TM-EA-002\Intrepid_HB_Amax_ModelDomain_CaprockModel_11x17.mxd Date: 5/4/2015



NOTES:

1. Aerial imagery from esri.
2. Location of monitoring wells based on site survey coordinates.
3. Horizontal coordinate system is NAD 1983 New Mexico State Plane East, units in feet.

INTREPID POTASH

Foth

N

Foth Infrastructure & Environment, LLC			
REVISED	DATE	BY	DESCRIPTION
PREPARED BY: MJH5			DATE: MAY '15
REVIEWED BY: JMH6			DATE: MAY '15
APPROVED BY:			DATE:

INTREPID POTASH - NEW MEXICO, LLC

FIGURE TM-EA-002-11

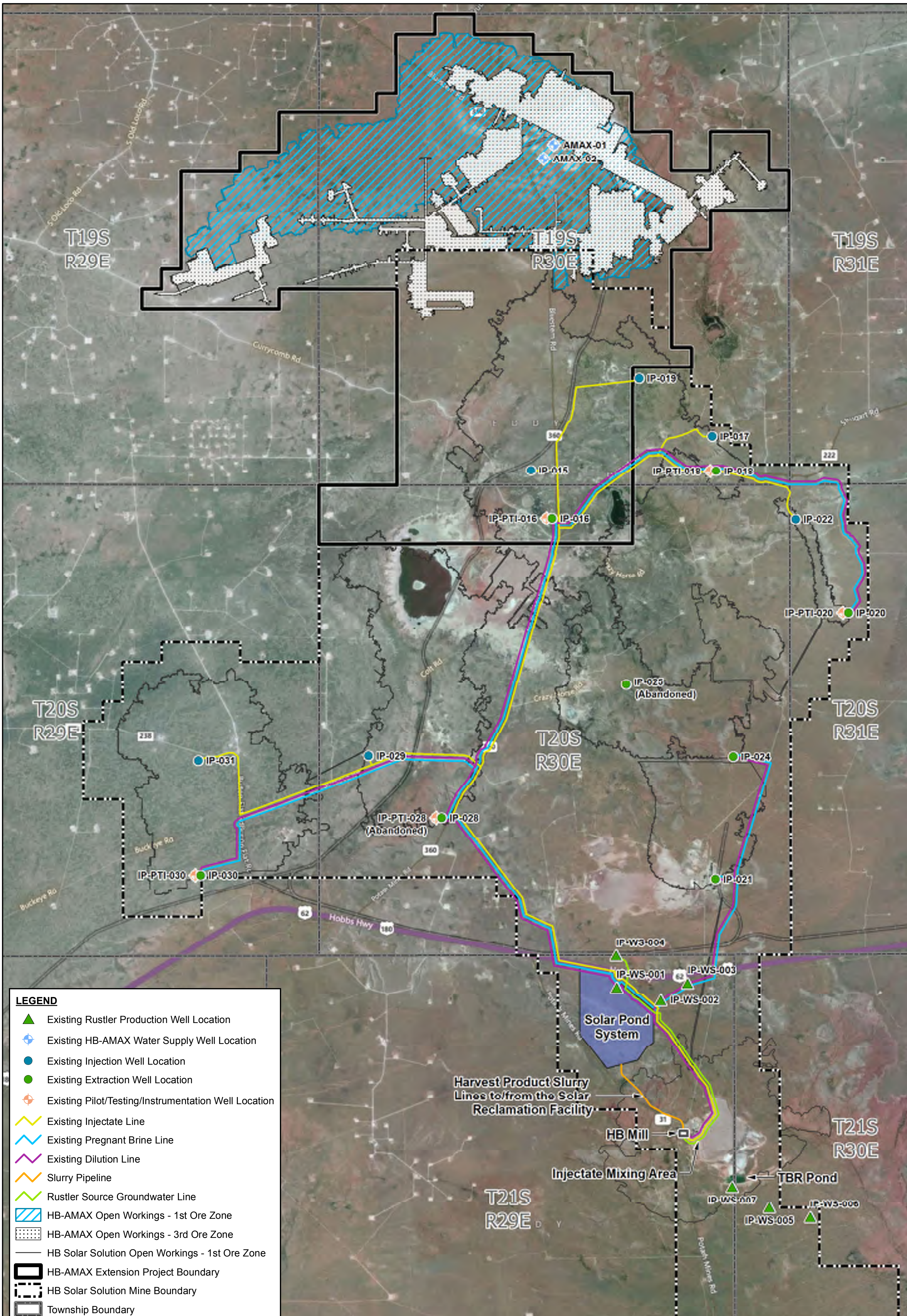
CURRENT HB SOLAR SOLUTION MINE MONITORING WELL NETWORK

Technical Memorandum TM-002, Groundwater Modeling Applicability

HB Solar Solution Mine - AMAX Extension

Scale: 0 3,000 6,000 Feet	Date: MAY 4, 2015
Drafted by: BJW1	Project No: 0014I016

Path: X:\GB\IE\2014\14I016-00\GIS\mxd\Technical_Memorandum_TM-EA-002\Intrepid_HB_Amax_HB Solar Solution Mine Monitoring_Points_11x17.mxd Date: 5/5/2015



NOTES:

1. Aerial imagery from esri.
2. Locations of existing pipelines, existing wells, proposed HB-AMAX pipelines, and proposed HB-AMAX wells provided by Intrepid Potash, LLC.
3. Location of existing HB Solar Solution Mine Infrastructure from as-built survey information provided by Intrepid Potash, LLC.
4. Horizontal coordinate system is NAD 1983 New Mexico State Plane East, units in feet.

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REVIEWED BY: JMH6			DATE: MAY '15
APPROVED BY:			DATE:

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FIGURE TM-EA-002-12

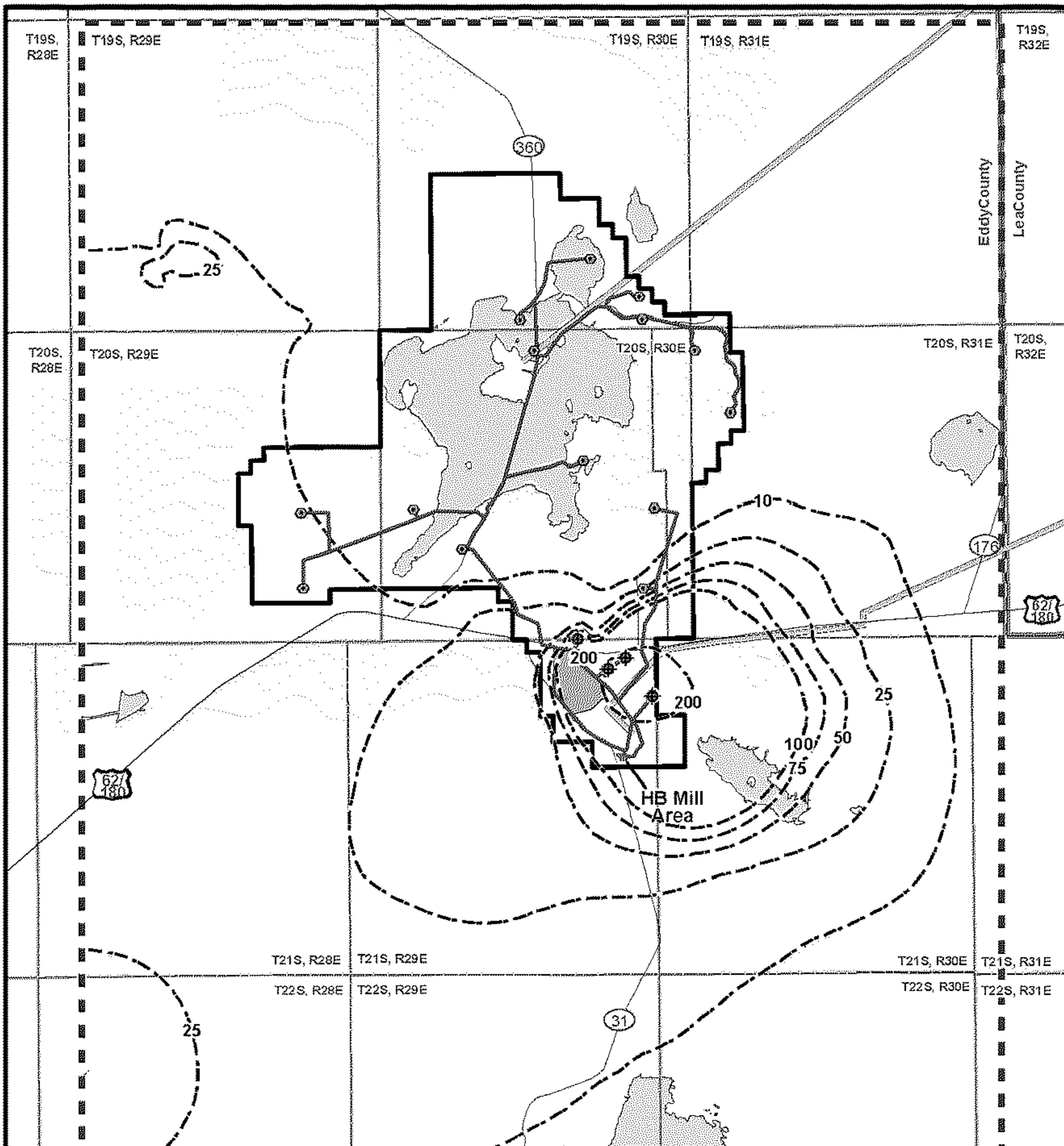
CURRENT HB SOLAR SOLUTION MINE OPERATIONAL COMPONENTS

Technical Memorandum TM-002, Groundwater Modeling Applicability
HB Solar Solution Mine - AMAX Extension

Scale: 0 3,000 6,000 Feet | Date: MAY 4, 2015

Drafted by: BJW1 | Project No: 0014I016

Path: X:\GB\IE\2014\14I016-00\GIS\mxd\Technical_Memorandum_TM-EA-002\Intrepid_HB_Amax_HB_Solar_Solution_Mine_Components_11x17.mxd Date: 5/4/2015



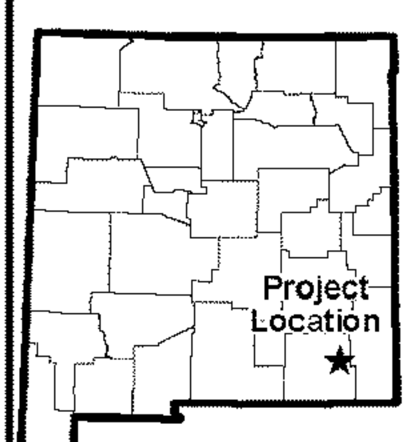
Legend

- Project Area Boundary
- Groundwater Drawdown, Preferred Calibration, Alternative B (feet)
- Proposed Pipeline ROW
- Existing Caprock Pipeline
- Proposed Project Well
- Pumping Well
- Evaporation Ponds
- Existing Groundwater <40-feet below Surface

N

0 1 2 Miles

Note: Pumping rate of 177 gpm.



NOTES:
1. Figure from Hydrological Assessment and Groundwater Modeling Report for the HB In-Situ Solution Mine Project EIS. AECOM, February 2011, Figure 12-3.

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REVIEWED BY: JMH6			DATE: MAY '15
APPROVED BY:			DATE:

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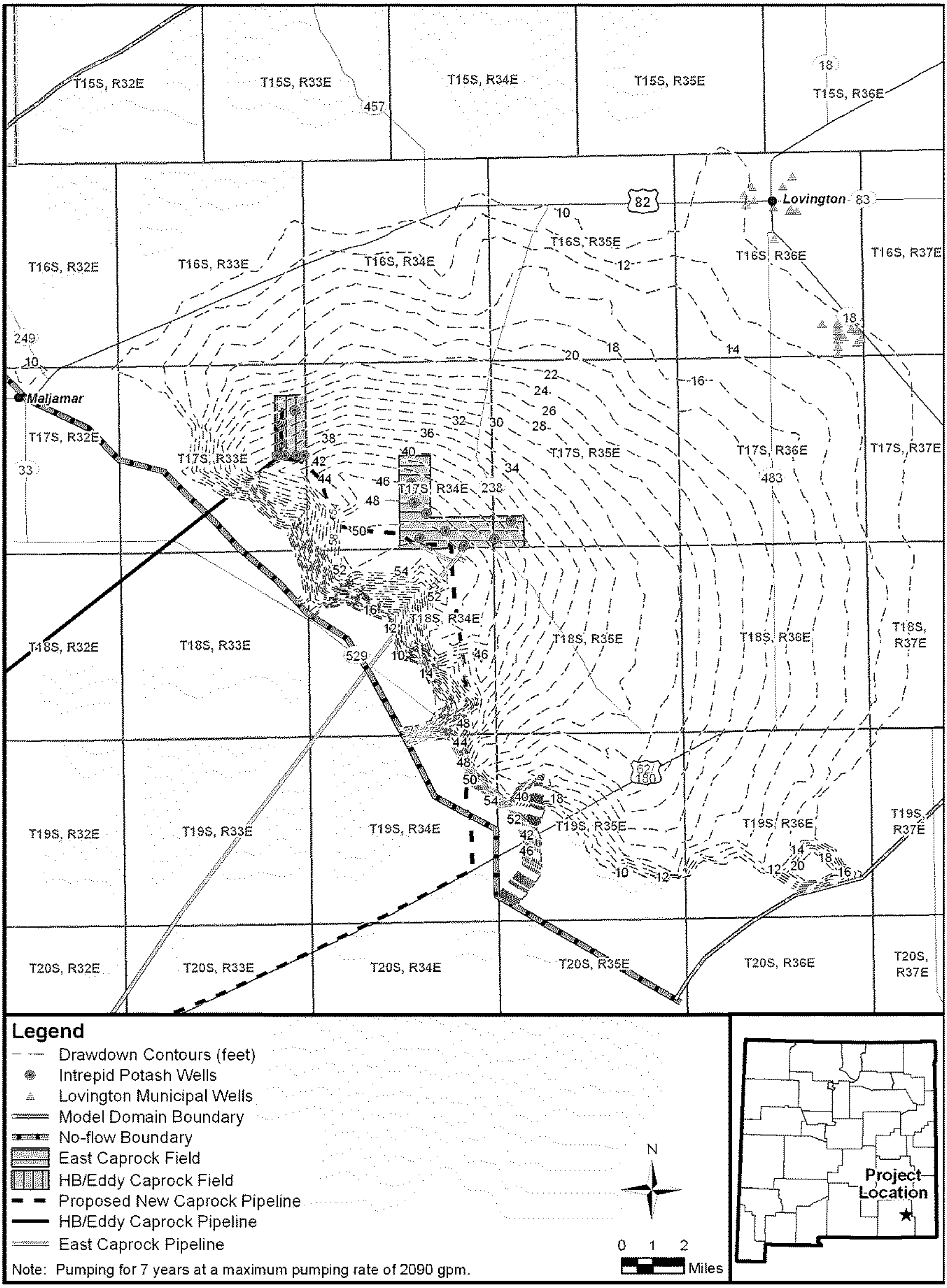
FIGURE TM-EA-002-13
RUSTLER PREFERRED MODEL PREDICTED DRAWDOWN, ALTERNATIVE B
Technical Memorandum TM-002, Groundwater Modeling Applicability HB Solar Solution Mine - AMAX Extension

Scale: AS SHOWN	Date: MAY 4, 2015
Drafted by: BJW1	Project No: 0014I016

Path: X:\GB\IE\2014\14I016-00\GIS\mxd\Technical_Memorandum_TM-EA-002\Intrepid_HB_Amax_RusterModelDrawdown_11x17.mxd Date: 5/4/2015



NOTES:

1. Figure from Hydrological Assessment and Groundwater Modeling Report for the HB In-Situ Solution Mine Project EIS. AECOM, February 2011, Figure 12-1.

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REVISED	DATE	BY	DESCRIPTION
PREPARED BY: MJH5			DATE: MAY '15
REVIEWED BY: JMH6			DATE: MAY '15
APPROVED BY:			DATE:

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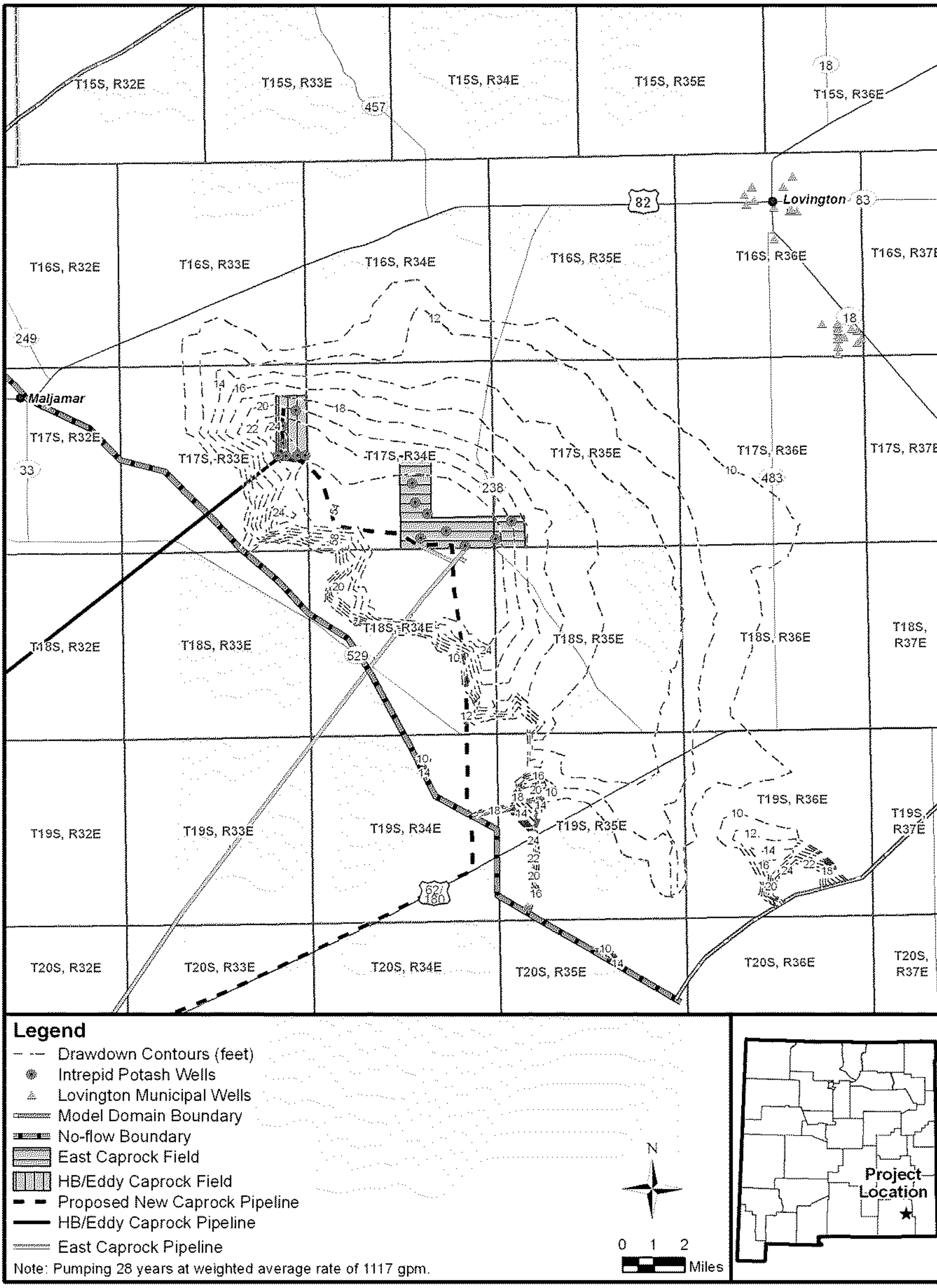
FIGURE TM-EA-002-14

CAPROCK MODEL PREDICTED DRAWDOWN
ALTERNATIVE B, PUMPING RATE = 2090 GPM

Technical Memorandum TM-002, Groundwater Modeling Applicability
HB Solar Solution Mine - AMAX Extension

Scale: AS SHOWN	Date: MAY 4, 2015
Drafted by: BJW1	Project No: 0014I016

Path: X:\GB\IE\2014\14I016-00\GIS\mxd\Technical_Memorandum_TM-EA-002\Intrepid_HB_Amax_CaprockModelDrawdownAltB_2090gpm_11x17.mxd Date: 5/4/2015



NOTES:
1. Figure from Hydrological Assessment and Groundwater Modeling Report for the HB In-Situ Solution Mine Project EIS. AECOM, February 2011, Figure 12-2.

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REVISED	DATE	BY	DESCRIPTION
PREPARED BY: MJH5			DATE: MAY '15
REVIEWED BY: JMH6			DATE: MAY '15
APPROVED BY:			DATE:

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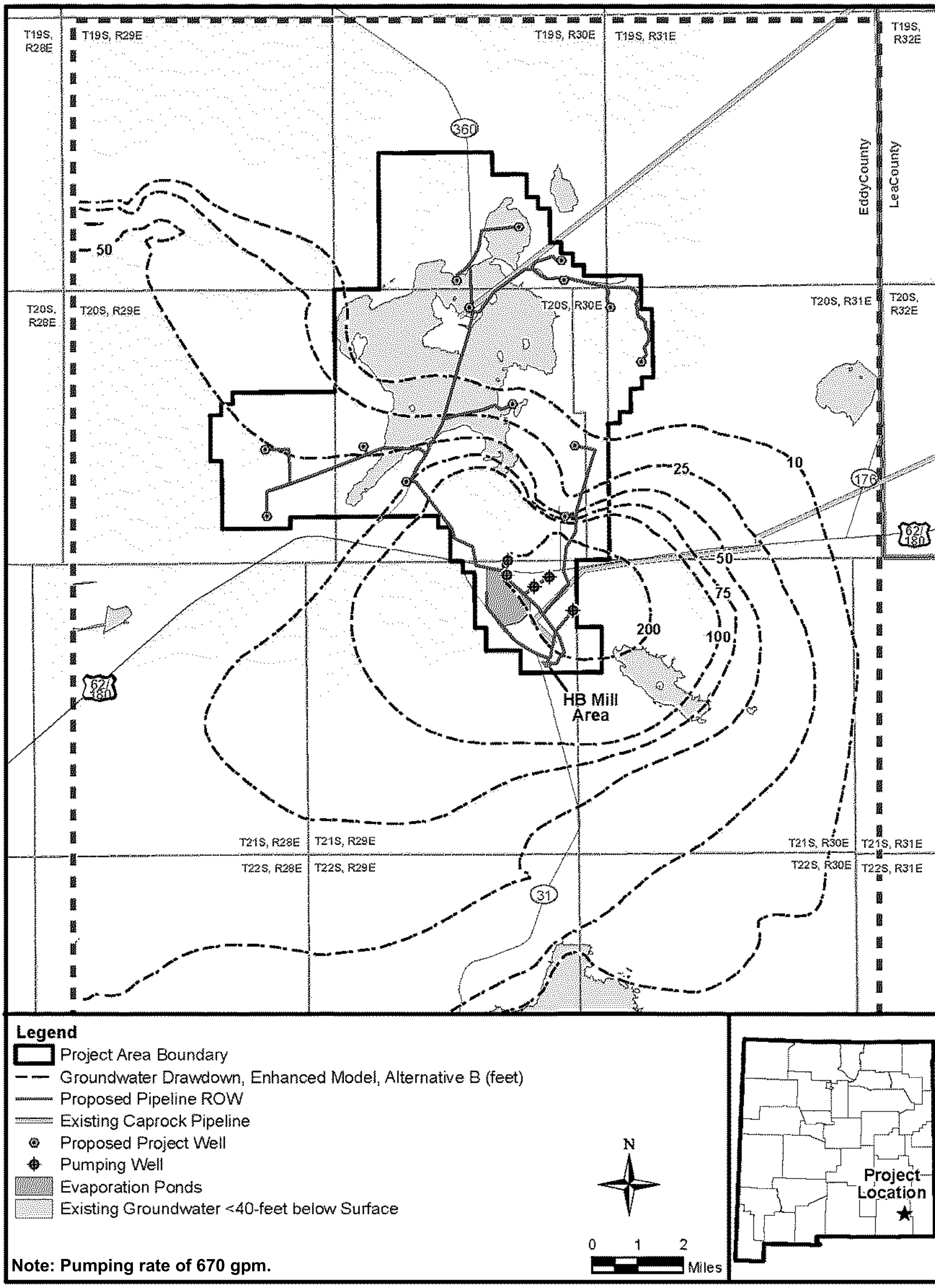
FIGURE TM-EA-002-15
CAPROCK MODEL PREDICTED DRAWDOWN
ALTERNATIVE B, PUMPING RATE = 1,117 GPM
Technical Memorandum TM-002, Groundwater Modeling Applicability
HB Solar Solution Mine - AMAX Extension

Scale: AS SHOWN	Date: MAY 4, 2015
Drafted by: BJW1	Project No: 0014I016

Path: X:\GB\IE\2014\14I016-00\GIS\mxd\Technical_Memorandum_TM-EA-002\Intrepid_HB_Amax_CaprockModelDrawdownAltB_1117gpm_11x17.mxd Date: 5/4/2015



NOTES:

1. Figure from Hydrological Assessment and Groundwater Modeling Report for the HB In-Situ Solution Mine Project EIS. AECOM, February 2011, Figure 12-6.

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REVISED	DATE	BY	DESCRIPTION
PREPARED BY: MJH5			DATE: MAY '15
REVIEWED BY: JMH6			DATE: MAY '15
APPROVED BY:			DATE:

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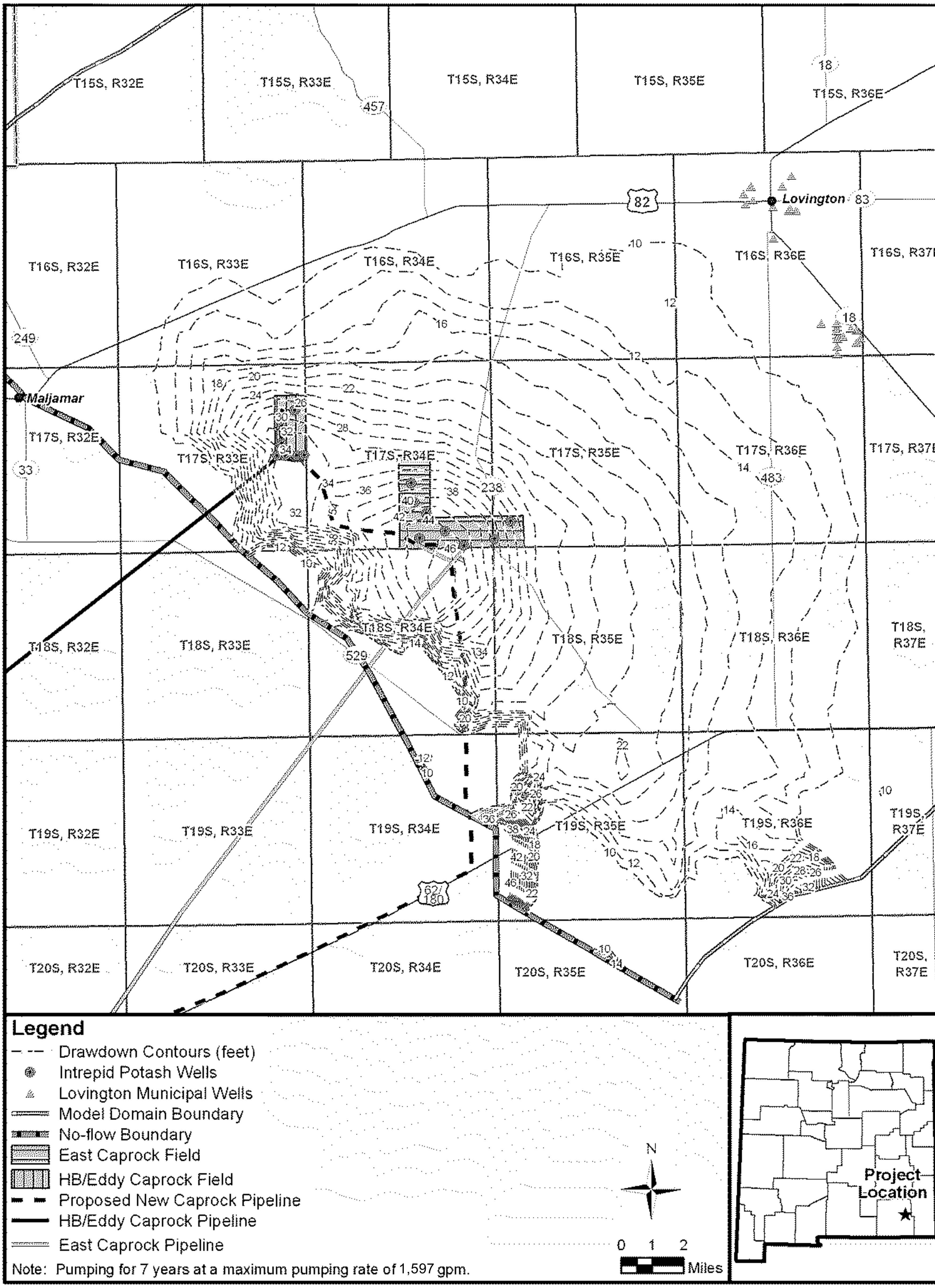
FIGURE TM-EA-002-16

RUSTLER ENHANCED MODEL PREDICTED DRAWDOWN, ALTERNATIVE B

Technical Memorandum TM-002, Groundwater Modeling Applicability HB Solar Solution Mine - AMAX Extension

Scale: AS SHOWN	Date: MAY 4, 2015
Drafted by: BJW1	Project No: 0014I016

Path: X:\GB\IE\2014\14I016-00\GIS\mxd\Technical_Memorandum_TM-EA-002\Intrepid_HB_Amax_RustlerEnhancedModel_AltB_11x17.mxd Date: 5/4/2015



NOTES:
1. Figure from Hydrological Assessment and Groundwater Modeling Report for the HB In-Situ Solution Mine Project EIS. AECOM, February 2011, Figure 12-4.

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REVISED	DATE	BY	DESCRIPTION
PREPARED BY: MJH5			DATE: MAY '15
REVIEWED BY: JMH6			DATE: MAY '15
APPROVED BY:			DATE:

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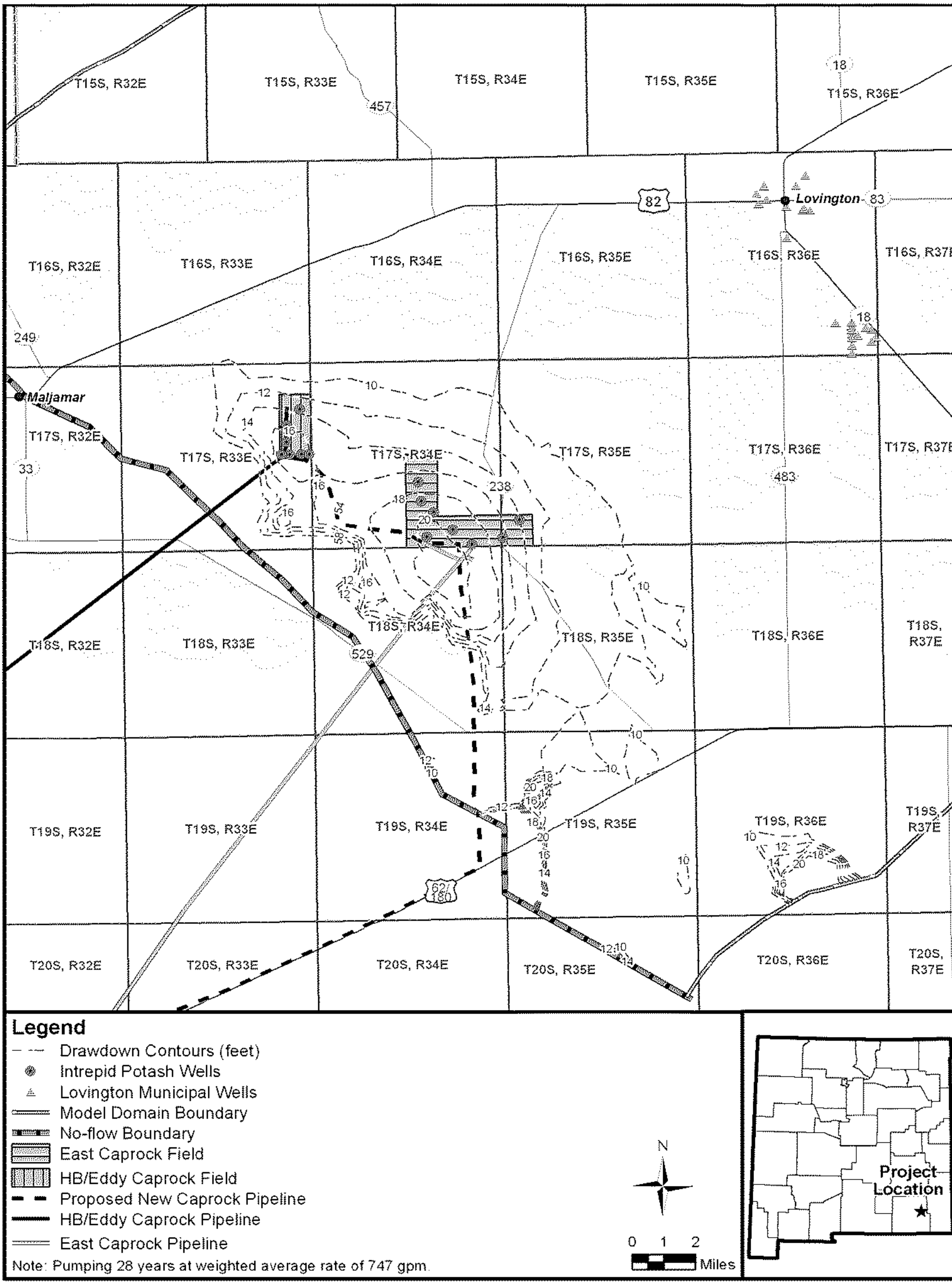
FIGURE TM-EA-002-17
CAPROCK MODEL PREDICTED DRAWDOWN
ALTERNATIVE B, PUMPING RATE = 1,597 GPM
Technical Memorandum TM-002, Groundwater Modeling Applicability
HB Solar Solution Mine - AMAX Extension

Scale:	AS SHOWN	Date:	MAY 4, 2015
Drafted by:	BJW1	Project No:	0014I016

Path: X:\GB\IE\2014\14I016-00\GIS\mxd\Technical_Memorandum_TM-EA-002\Intrepid_HB_Amax_CaprockModel_PredictedDrawdown_AltB_1597gpm_11x17.mxd Date: 5/4/2015



NOTES:
1. Figure from Hydrological Assessment and Groundwater Modeling Report for the HB In-Situ Solution Mine Project EIS. AECOM, February 2011, Figure 12-5.

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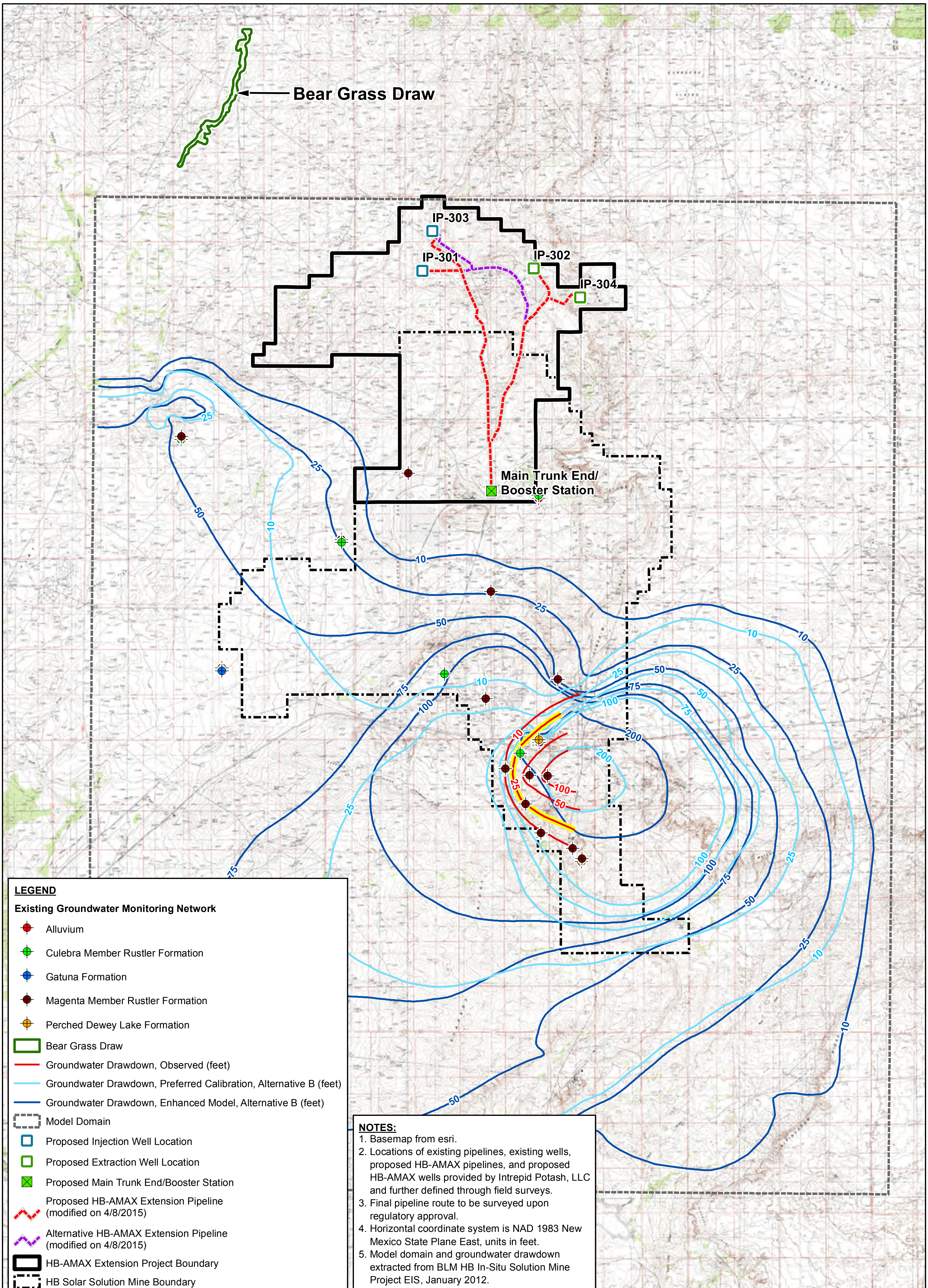
REVISED	DATE	BY	DESCRIPTION
PREPARED BY: MJH5			DATE: MAY '15
REVIEWED BY: JMH6			DATE: MAY '15
APPROVED BY:			DATE:

INTREPID POTASH - NEW MEXICO, LLC

FIGURE TM-EA-002-18
CAPROCK MODEL PREDICTED DRAWDOWN
ALTERNATIVE B, PUMPING RATE = 747 GPM
Technical Memorandum TM-002, Groundwater Modeling Applicability
HB Solar Solution Mine - AMAX Extension

Scale: AS SHOWN	Date: MAY 4, 2015
Drafted by: BJW1	Project No: 0014I016

Path: X:\GB\IE\2014\14I016-00\GIS\mxd\Technical_Memorandum_TM-EA-002\Intrepid_HB_Amax_CaprockModel_PredictedDrawdown_AltB_747gpm_11x17.mxd Date: 5/4/2015



LEGEND

Existing Groundwater Monitoring Network

- Alluvium
- Culebra Member Rustler Formation
- Gatuna Formation
- Magenta Member Rustler Formation
- Perched Dewey Lake Formation
- Bear Grass Draw
- Groundwater Drawdown, Observed (feet)
- Groundwater Drawdown, Preferred Calibration, Alternative B (feet)
- Groundwater Drawdown, Enhanced Model, Alternative B (feet)
- Model Domain
- Proposed Injection Well Location
- Proposed Extraction Well Location
- Proposed Main Trunk End/Booster Station
- Proposed HB-AMAX Extension Pipeline (modified on 4/8/2015)
- Alternative HB-AMAX Extension Pipeline (modified on 4/8/2015)
- HB-AMAX Extension Project Boundary
- HB Solar Solution Mine Boundary

NOTES:

1. Basemap from esri.
2. Locations of existing pipelines, existing wells, proposed HB-AMAX pipelines, and proposed HB-AMAX wells provided by Intrepid Potash, LLC and further defined through field surveys.
3. Final pipeline route to be surveyed upon regulatory approval.
4. Horizontal coordinate system is NAD 1983 New Mexico State Plane East, units in feet.
5. Model domain and groundwater drawdown extracted from BLM HB In-Situ Solution Mine Project EIS, January 2012.

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PREPARED BY: MJH5			DATE: MAY '15
REVIEWED BY: JMH6			DATE: MAY '15
APPROVED BY:			DATE:

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FIGURE TM-EA-002-19
PREDICTED AND OBSERVED DRAWDOWN, MARCH 2014
Technical Memorandum TM-002, Groundwater Modeling Applicability
HB Solar Solution Mine - AMAX Extension

Scale: 0 1 2 Miles	Date: MAY 4, 2015
Drafted by: BJW1	Project No: 0014I016

Path: X:\GB\IE\2014\14I016-00\GIS\mxd\Technical_Memorandum_TM-EA-002\Intrepid_HB_Amax_Project_Observed_Drawdown_11x17.mxd Date: 5/4/2015

Appendix D
Soils Supporting Data

Map Unit Description (Brief, Generated)

Eddy Area, New Mexico

[Minor map unit components are excluded from this report]

Map unit: BA - Berino loamy fine sand, 0 to 3 percent slopes

Component: Berino (100%)

The Berino component makes up 100 percent of the map unit. Slopes are 0 to 3 percent. This component is on fan piedmonts, uplands. The parent material consists of mixed alluvium and/or eolian sands. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is moderately high. Available water to a depth of 60 inches (or restricted depth) is moderate. Shrink-swell potential is moderate. This soil is not flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 0 percent. This component is in the R042XC007NM Loamy ecological site. Nonirrigated land capability classification is 7e. Irrigated land capability classification is 3e. This soil does not meet hydric criteria. The soil has a very slightly saline horizon within 30 inches of the soil surface. The soil has a maximum sodium adsorption ratio of 1 within 30 inches of the soil surface.

Map unit: BB - Berino complex, 0 to 3 percent slopes, eroded

Component: Berino (60%)

The Berino component makes up 60 percent of the map unit. Slopes are 0 to 3 percent. This component is on fan piedmonts, uplands. The parent material consists of mixed alluvium and/or eolian sands. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is moderately high. Available water to a depth of 60 inches (or restricted depth) is moderate. Shrink-swell potential is moderate. This soil is not flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 0 percent. This component is in the R042XC003NM Loamy Sand ecological site. Nonirrigated land capability classification is 7e. This soil does not meet hydric criteria. The soil has a very slightly saline horizon within 30 inches of the soil surface. The soil has a maximum sodium adsorption ratio of 1 within 30 inches of the soil surface.

Component: Pajarito (25%)

The Pajarito component makes up 25 percent of the map unit. Slopes are 0 to 3 percent. This component is on sand dunes, uplands. The parent material consists of mixed alluvium and/or eolian sands. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is high. Available water to a depth of 60 inches (or restricted depth) is moderate. Shrink-swell potential is low. This soil is not flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 1 percent. This component is in the R042XC003NM Loamy Sand ecological site. Nonirrigated land capability classification is 7e. Irrigated land capability classification is 2e. This soil does not meet hydric criteria. The calcium carbonate equivalent within 40 inches, typically, does not exceed 30 percent. There are no saline horizons within 30 inches of the soil surface.

Map Unit Description (Brief, Generated)

Eddy Area, New Mexico

Map unit: BD - Berino-Dune land complex, 0 to 3 percent slopes

Component: Berino (45%)

The Berino component makes up 45 percent of the map unit. Slopes are 0 to 3 percent. This component is on fan piedmonts, uplands. The parent material consists of mixed alluvium and/or eolian sands. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is moderately high. Available water to a depth of 60 inches (or restricted depth) is moderate. Shrink-swell potential is moderate. This soil is not flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 1 percent. This component is in the R042XC007NM Loamy ecological site. Nonirrigated land capability classification is 7e. Irrigated land capability classification is 3e. This soil does not meet hydric criteria. The soil has a very slightly saline horizon within 30 inches of the soil surface.

Component: Dune land (40%)

Generated brief soil descriptions are created for major soil components. The Dune land is a miscellaneous area.

Map unit: GA - Gypsum land

Component: Gypsum land (100%)

Generated brief soil descriptions are created for major soil components. The Gypsum land is a miscellaneous area.

Map unit: GP - Gravel pit

Component: Gravel pit (100%)

Generated brief soil descriptions are created for major soil components. The Gravel pit is a miscellaneous area.

Map unit: KM - Kermit-Berino fine sands, 0 to 3 percent slopes

Component: Kermit (50%)

The Kermit component makes up 50 percent of the map unit. Slopes are 0 to 3 percent. This component is on alluvial fans, uplands. The parent material consists of mixed alluvium and/or eolian sands. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is excessively drained. Water movement in the most restrictive layer is very high. Available water to a depth of 60 inches (or restricted depth) is very low. Shrink-swell potential is low. This soil is not flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 0 percent. This component is in the R042XC005NM Deep Sand ecological site. Nonirrigated land capability classification is 7e. This soil does not meet hydric criteria.

Map Unit Description (Brief, Generated)

Eddy Area, New Mexico

Map unit: KM - Kermit-Berino fine sands, 0 to 3 percent slopes

Component: Berino (35%)

The Berino component makes up 35 percent of the map unit. Slopes are 0 to 3 percent. This component is on uplands, fan piedmonts. The parent material consists of mixed alluvium and/or eolian sands. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is moderately high. Available water to a depth of 60 inches (or restricted depth) is moderate. Shrink-swell potential is moderate. This soil is not flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 0 percent. This component is in the R042XC003NM Loamy Sand ecological site. Nonirrigated land capability classification is 7e. Irrigated land capability classification is 4e. This soil does not meet hydric criteria. The soil has a very slightly saline horizon within 30 inches of the soil surface.

Map unit: KT - Kimbrough-Stegall loams, 0 to 3 percent slopes

Component: Kimbrough (70%)

The Kimbrough component makes up 70 percent of the map unit. Slopes are 0 to 3 percent. This component is on alluvial fans, uplands. The parent material consists of mixed alluvium and/or eolian sands. Depth to a root restrictive layer, petrocalcic, is 8 to 20 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is very low. Available water to a depth of 60 inches (or restricted depth) is very low. Shrink-swell potential is low. This soil is not flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 2 percent. This component is in the R042XC025NM Shallow ecological site. Nonirrigated land capability classification is 7s. This soil does not meet hydric criteria. The calcium carbonate equivalent within 40 inches, typically, does not exceed 10 percent. There are no saline horizons within 30 inches of the soil surface.

Component: Stegall (25%)

The Stegall component makes up 25 percent of the map unit. Slopes are 0 to 3 percent. This component is on alluvial fans, uplands. The parent material consists of mixed alluvium and/or eolian sands. Depth to a root restrictive layer, petrocalcic, is 20 to 40 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is low. Available water to a depth of 60 inches (or restricted depth) is low. Shrink-swell potential is moderate. This soil is not flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 2 percent. This component is in the R042XC007NM Loamy ecological site. Nonirrigated land capability classification is 3e. Irrigated land capability classification is 3e. This soil does not meet hydric criteria. The calcium carbonate equivalent within 40 inches, typically, does not exceed 65 percent. There are no saline horizons within 30 inches of the soil surface.

Map Unit Description (Brief, Generated)

Eddy Area, New Mexico

Map unit: LA - Largo loam, 1 to 5 percent slopes

Component: Largo (100%)

The Largo component makes up 100 percent of the map unit. Slopes are 1 to 5 percent. This component is on alluvial fans, uplands. The parent material consists of calcareous alluvium. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is moderately high. Available water to a depth of 60 inches (or restricted depth) is high. Shrink-swell potential is low. This soil is not flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 1 percent. This component is in the R042XC007NM Loamy ecological site. Nonirrigated land capability classification is 7e. Irrigated land capability classification is 3e. This soil does not meet hydric criteria. The calcium carbonate equivalent within 40 inches, typically, does not exceed 10 percent. There are no saline horizons within 30 inches of the soil surface.

Map unit: LS - Likes loamy fine sand, 1 to 5 percent slopes

Component: Likes (100%)

The Likes component makes up 100 percent of the map unit. Slopes are 1 to 5 percent. This component is on alluvial fans, uplands. The parent material consists of calcareous alluvium and/or colluvium. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is excessively drained. Water movement in the most restrictive layer is high. Available water to a depth of 60 inches (or restricted depth) is very low. Shrink-swell potential is low. This soil is not flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 0 percent. This component is in the R042XC005NM Deep Sand ecological site. Nonirrigated land capability classification is 6e. This soil does not meet hydric criteria. The calcium carbonate equivalent within 40 inches, typically, does not exceed 5 percent. There are no saline horizons within 30 inches of the soil surface.

Map unit: ML - Mined land

Component: Mined land (100%)

Generated brief soil descriptions are created for major soil components. The Mined land is a miscellaneous area.

Map unit: PA - Pajarito loamy fine sand, 0 to 3 percent slopes, eroded

Component: Pajarito (100%)

The Pajarito component makes up 100 percent of the map unit. Slopes are 0 to 3 percent. This component is on uplands, sand dunes. The parent material consists of mixed alluvium and/or eolian sands. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is high. Available water to a depth of 60 inches (or restricted depth) is moderate. Shrink-swell potential is low. This soil is not flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 1 percent. This component is in the R042XC003NM Loamy Sand ecological site. Nonirrigated land capability classification is 7e. Irrigated land capability classification is 2e. This soil does not meet hydric criteria. The calcium carbonate equivalent within 40 inches, typically, does not exceed 10 percent. There are no saline horizons within 30 inches of the soil surface.

Map Unit Description (Brief, Generated)

Eddy Area, New Mexico

Map unit: PD - Pajarito-Dune land complex, 0 to 3 percent slopes

Component: Dune land (45%)

Generated brief soil descriptions are created for major soil components. The Dune land is a miscellaneous area.

Component: Pajarito (45%)

The Pajarito component makes up 45 percent of the map unit. Slopes are 0 to 3 percent. This component is on uplands, sand dunes. The parent material consists of mixed alluvium and/or eolian sands. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is high. Available water to a depth of 60 inches (or restricted depth) is moderate. Shrink-swell potential is low. This soil is not flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 1 percent. This component is in the R042XC003NM Loamy Sand ecological site. Nonirrigated land capability classification is 7e. Irrigated land capability classification is 2e. This soil does not meet hydric criteria. The calcium carbonate equivalent within 40 inches, typically, does not exceed 10 percent. There are no saline horizons within 30 inches of the soil surface.

Map unit: PS - Potter-Simona complex, 5 to 25 percent slopes

Component: Potter (80%)

The Potter component makes up 80 percent of the map unit. Slopes are 5 to 25 percent. This component is on hills, uplands. The parent material consists of alluvium. Depth to a root restrictive layer inches , petrocalcic,. The natural drainage class is well drained. Water movement in the most restrictive layer is very low. Available water to a depth of 60 inches (or restricted depth) is very low. Shrink-swell potential is low. This soil is not flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 1 percent. This component is in the R042XC025NM Shallow ecological site. Nonirrigated land capability classification is 7s. This soil does not meet hydric criteria. The calcium carbonate equivalent within 40 inches, typically, does not exceed 50 percent. There are no saline horizons within 30 inches of the soil surface.

Component: Simona (15%)

The Simona component makes up 15 percent of the map unit. Slopes are 5 to 10 percent. This component is on alluvial fans, uplands. The parent material consists of mixed alluvium and/or eolian sands. Depth to a root restrictive layer, petrocalcic, is 7 to 20 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is very low. Available water to a depth of 60 inches (or restricted depth) is very low. Shrink-swell potential is low. This soil is not flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 1 percent. This component is in the R042XC002NM Shallow Sandy ecological site. Nonirrigated land capability classification is 7e. This soil does not meet hydric criteria. The calcium carbonate equivalent within 40 inches, typically, does not exceed 10 percent. There are no saline horizons within 30 inches of the soil surface.

Map Unit Description (Brief, Generated)

Eddy Area, New Mexico

Map unit: RG - Reeves-Gypsum land complex, 0 to 3 percent slopes

Component: Reeves (55%)

The Reeves component makes up 55 percent of the map unit. Slopes are 0 to 1 percent. This component is on uplands, gypsum hills. The parent material consists of residuum weathered from gypsum. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is very low. Available water to a depth of 60 inches (or restricted depth) is low. Shrink-swell potential is moderate. This soil is not flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 1 percent. This component is in the R042XC007NM Loamy ecological site. Nonirrigated land capability classification is 7s. Irrigated land capability classification is 3s. This soil does not meet hydric criteria. The calcium carbonate equivalent within 40 inches, typically, does not exceed 20 percent. The soil has a slightly saline horizon within 30 inches of the soil surface. The soil has a maximum sodium adsorption ratio of 2 within 30 inches of the soil surface.

Component: Gypsum land (30%)

Generated brief soil descriptions are created for major soil components. The Gypsum land is a miscellaneous area.

Map unit: RO - Rock land

Component: Rock land (100%)

Generated brief soil descriptions are created for major soil components. The Rock land is a miscellaneous area.

Map unit: SG - Simona gravelly fine sandy loam, 0 to 3 percent slopes

Component: Simona (95%)

The Simona component makes up 95 percent of the map unit. Slopes are 0 to 3 percent. This component is on alluvial fans, uplands. The parent material consists of mixed alluvium and/or eolian sands. Depth to a root restrictive layer, petrocalcic, is 7 to 20 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is very low. Available water to a depth of 60 inches (or restricted depth) is very low. Shrink-swell potential is low. This soil is not flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 1 percent. This component is in the R042XC002NM Shallow Sandy ecological site. Nonirrigated land capability classification is 7e. This soil does not meet hydric criteria. The calcium carbonate equivalent within 40 inches, typically, does not exceed 10 percent. There are no saline horizons within 30 inches of the soil surface.

Map Unit Description (Brief, Generated)

Eddy Area, New Mexico

Map unit: SM - Simona-Bippus complex, 0 to 5 percent slopes

Component: Simona (55%)

The Simona component makes up 55 percent of the map unit. Slopes are 0 to 3 percent. This component is on alluvial fans, uplands. The parent material consists of mixed alluvium and/or eolian sands. Depth to a root restrictive layer, petrocalcic, is 7 to 20 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is very low. Available water to a depth of 60 inches (or restricted depth) is very low. Shrink-swell potential is low. This soil is not flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 1 percent. This component is in the R042XC002NM Shallow Sandy ecological site. Nonirrigated land capability classification is 7e. This soil does not meet hydric criteria. The calcium carbonate equivalent within 40 inches, typically, does not exceed 10 percent. There are no saline horizons within 30 inches of the soil surface.

Component: Bippus (30%)

The Bippus component makes up 30 percent of the map unit. Slopes are 0 to 5 percent. This component is on alluvial fans, alluvial plains. The parent material consists of mixed alluvium. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is moderately high. Available water to a depth of 60 inches (or restricted depth) is moderate. Shrink-swell potential is low. This soil is occasionally flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 2 percent. This component is in the R042XC017NM Bottomland ecological site. Nonirrigated land capability classification is 3e. Irrigated land capability classification is 2e. This soil does not meet hydric criteria. The calcium carbonate equivalent within 40 inches, typically, does not exceed 30 percent. There are no saline horizons within 30 inches of the soil surface.

Map unit: SR - Stony and Rough broken land

Component: Stony and rough broken land (100%)

Generated brief soil descriptions are created for major soil components. The Stony and rough broken land is a miscellaneous area.

Map unit: TF - Tonuco loamy fine sand, 0 to 3 percent slopes

Component: Tonuco (100%)

The Tonuco component makes up 100 percent of the map unit. Slopes are 0 to 3 percent. This component is on alluvial fans, uplands. The parent material consists of mixed alluvium and/or eolian sands. Depth to a root restrictive layer, petrocalcic, is 6 to 20 inches. The natural drainage class is excessively drained. Water movement in the most restrictive layer is very low. Available water to a depth of 60 inches (or restricted depth) is very low. Shrink-swell potential is low. This soil is not flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 0 percent. This component is in the R042XC004NM Sandy ecological site. Nonirrigated land capability classification is 7e. This soil does not meet hydric criteria.

Appendix E
Land Cover Support Data

NLCD Barren Lands Types

(Rock/Sand/Clay)-Barren areas of bedrock, desert pavement, scarps, talus, slides, volcanic material, glacial debris, sand dunes, strip mines, gravel pits and other accumulation of earthen material. Generally, vegetation accounts for less than 15% of total cover.

S018 NORTH AMERICAN WARM DESERT ACTIVE AND STABILIZED DUNE

Division 302, Barren, CES302.744

Spatial Scale & Pattern: Large Patch **Classification Confidence:** medium
Required Classifiers: Natural/Semi-natural, Non-vegetated (<10% vasc.), Upland
Diagnostic Classifiers: Dune (Landform), Dune field, Dune (Substrate), Temperate [Temperate Xeric], Sand Soil Texture, W-Landscape/High Intensity

Non-Diagnostic Classifiers: Lowland [Lowland], Shrubland (Shrub-dominated), Herbaceous, Dune (undifferentiated), Tropical/Subtropical [Tropical Xeric], Gypsiferous, Aridic

Concept Summary: This ecological system occurs across the warm deserts of North America and is composed of unvegetated to sparsely vegetated (generally <10% plant cover) active dunes and sandsheets derived from quartz or gypsum sands. Common vegetation includes *Ambrosia dumosa, Abronia villosa, Eriogonum deserticola, Larrea tridentata, Pleuraphis rigida, Poliomintha* spp., *Prosopis* spp., *Psorothamnus* spp., *Artemisia filifolia*, and *Rhus microphylla*. Dune "blowouts" and subsequent stabilization through succession are characteristic processes.

DISTRIBUTION

Range: Occurs across the warm deserts of North America.
Ecological Divisions: 302
TNC Ecoregions: 17:C, 22:C, 23:C, 24:C
Subnations/Nations: AZ:c, CA:c, MXBC:c, MXBS:c, MXCH:c, MXSO:c, NM:c, NV:c, TX:c

CONCEPT

Alliances and Associations:

- ABRONIA VILLOSA SPARSELY VEGETATED ALLIANCE (A.1852)
  Abronia villosa Sparse Vegetation [Placeholder] (CEGL003001)
- ARTEMISIA FILIFOLIA SHRUBLAND ALLIANCE (A.816)
  Artemisia filifolia - Psorothamnus scoparius - Dalea lanata Gypsum Dune Shrubland (CEGL004561)
  Artemisia filifolia / Andropogon hallii - Achnatherum hymenoides Gypsum Dune Shrubland (CEGL004559)
  Artemisia filifolia / Sporobolus flexuosus Shrubland (CEGL001547)
  Artemisia filifolia / Sporobolus giganteus Shrubland (CEGL001078)
- CLEOME ISOMERIS - EPHEDRA CALIFORNICA - ERICAMERIA LINEARIFOLIA SHRUBLAND ALLIANCE (A.819)
  Cleome isomeris - Ephedra californica - Ericameria linearifolia Shrubland [Placeholder] (CEGL003056)
- ERIOGONUM DESERTICOLA SPARSELY VEGETATED ALLIANCE (A.1856)
  Eriogonum deserticola Sand Dune Sparse Vegetation (CEGL001962)
- HELIOTROPIUM CONVOLVULACEUM SPARSELY VEGETATED ALLIANCE (A.1853)
  Heliotropium convolvulaceum - Psoralidium lanceolatum - Polanisia jamesii Sparse Vegetation (CEGL004581)
- HELIOTROPIUM RACEMOSUM SPARSELY VEGETATED ALLIANCE (A.1854)
  Heliotropium racemosum - Chamaesyce sp. Sparse Vegetation (CEGL004582)
- POLIOMINTHA INCANA SHRUBLAND ALLIANCE (A.862)
  Poliomintha incana / Muhlenbergia pungens Shrubland (CEGL002672)
- PROSOPIS GLANDULOSA SHRUBLAND ALLIANCE (A.1031)
  Prosopis glandulosa / Atriplex canescens Shrubland (CEGL001382)
  Prosopis glandulosa / Sporobolus flexuosus Shrubland (CEGL001386)
- PSOROTHAMNUS POLYDENIUS SHRUBLAND ALLIANCE (A.1039)
  Psorothamnus polydenius var. polydenius / Achnatherum hymenoides Shrubland (CEGL001353)
- PSOROTHAMNUS SPINOSUS INTERMITTENTLY FLOODED SHRUBLAND ALLIANCE (A.2520)
  Psorothamnus spinosus Shrubland [Placeholder] (CEGL002701)
- SPOROBOLUS FLEXUOSUS HERBACEOUS ALLIANCE (A.1268)
  Sporobolus flexuosus - Dasyochloa pulchella Herbaceous Vegetation (CEGL001693)
  Sporobolus flexuosus - Paspalum setaceum Herbaceous Vegetation (CEGL001694)
  Sporobolus flexuosus - Sporobolus contractus Herbaceous Vegetation (CEGL001696)

- **California community types:**
- Cismontane and Desert Interior Dunes (22.000.00)
- Active Desert Dunes and Sand Fields (22.010.00)

- Desert Sand-verbena (22.100.00)
- Stabilized and Partially Stabilized Desert Dunes (22.300.00)
- Stabilized and Partially Stabilized Desert Sand Fields (22.400.00)
- San Joaquin Valley Dunes (22.500.00)
- Sonoran Dune Scrub (33.010.02)
- Creosote Bush - Big Galleta (33.010.13)
- Creosote Bush - Big Galleta - Anderson's Wolfberry (33.010.14)
- Big Galleta (41.030.01)
- Big Galleta - Rayless Goldenhead (41.030.02)
- Big Galleta - Cooper's Goldenbush (41.030.03)
- Big Galleta - Downy Dalea (41.030.04)
- Desert Needlegrass Grassland (41.090.00)
- Indian Ricegrass (41.120.00)
- Mesquite Dune Scrub (61.510.01)

SOURCES

References: Bowers 1982, Bowers 1984, Holland and Keil 1995, MacMahon 1988, Powell and Turner 1974, Thomas et al. 2003a

Last updated: 20 Feb 2003 **Stakeholders:** WCS, SCS

Concept Author: NatureServe Western Ecology Team **LeadResp:** WCS

S020 NORTH AMERICAN WARM DESERT WASH

Division 302, Woody Wetland, CES302.755

Spatial Scale & Pattern: Linear **Classification Confidence:** medium

Required Classifiers: Natural/Semi-natural, Vegetated (>10% vasc.), Wetland

Diagnostic Classifiers: Lowland [Lowland], Shrubland (Shrub-dominated), Toeslope/Valley Bottom, Tropical/Subtropical [Tropical Xeric], Temperate [Temperate Xeric], Riverine / Alluvial, Intermittent Flooding

Non-Diagnostic Classifiers: Sideslope, Short (50-100 yrs) Persistence

Concept Summary: This ecological system is restricted to intermittently flooded washes or arroyos that dissect bajadas, mesas, plains and basin floors throughout the warm deserts of North America. Although often dry, the intermittent fluvial processes define this system, which are often associated with rapid sheet and gully flow. This system occurs as linear or braided strips within desert scrub- or desert grassland-dominated landscapes. The vegetation of desert washes is quite variable ranging from sparse and patchy to moderately dense and typically occurs along the banks, but may occur within the channel. The woody layer is typically intermittent to open and may be dominated by shrubs and small trees such as *Acacia greggii, Brickellia laciniata, Baccharis sarothroides, Chilopsis linearis, Fallugia paradoxa, Hymenoclea salsola, Hymenoclea monogyra, Juglans microcarpa, Prosopis* spp., *Psorothamnus spinosus, Prunus fasciculata, Rhus microphylla, Salazaria mexicana,* or *Sarcobatus vermiculatus*.

DISTRIBUTION

Range: Restricted to intermittently flooded washes or arroyos that dissect bajadas, mesas, plains and basin floors throughout the warm deserts of North America.

Ecological Divisions: 302

TNC Ecoregions: 17:C, 22:C, 23:C, 24:C

Subnations/Nations: AZ:c, CA:c, MXBC:c, MXCH:c, MXSO:c, NM:c, NV:c, TX:c

CONCEPT

Alliances and Associations:

- (A.0)
  Baccharis emoryi Shrubland [Provisional] (CEGL002974)
- ACACIA GREGGII SHRUBLAND ALLIANCE (A.1036)
  Acacia greggii - Parkinsonia microphylla Shrubland (CEGL001340)
- BACCHARIS SALICIFOLIA - BACCHARIS NEGLECTA SEASONALLY FLOODED SHRUBLAND ALLIANCE (A.987)
  Baccharis salicifolia - Baccharis neglecta / Eustoma exaltatum Shrubland (CEGL004590)
- BACCHARIS SALICIFOLIA INTERMITTENTLY FLOODED SHRUBLAND ALLIANCE (A.933)
  Baccharis salicifolia / Muhlenbergia rigens Shrubland (CEGL004572)
- BACCHARIS SAROTHROIDES INTERMITTENTLY FLOODED SHRUBLAND ALLIANCE (A.840)
  Baccharis sarothroides - Baccharis salicifolia Shrubland (CEGL001160)
  Baccharis sarothroides - Parkinsonia microphylla Shrubland (CEGL001159)
- BACCHARIS SERGILOIDES INTERMITTENTLY FLOODED SHRUBLAND ALLIANCE (A.2531)

Baccharis sergiloides Shrubland [Placeholder] (CEGL002953)

- BRICKELLIA LACINIATA INTERMITTENTLY FLOODED SHRUBLAND ALLIANCE (A.940)
  Brickellia laciniata - Hymenoclea monogyra Shrubland (CEGL001953)
- CHILOPSIS LINEARIS INTERMITTENTLY FLOODED SHRUBLAND ALLIANCE (A.1044)
  Chilopsis linearis / Brickellia laciniata Shrubland (CEGL004933)
  Chilopsis linearis Shrubland (CEGL001164)
- ENCELIA VIRGINENSIS SHRUBLAND ALLIANCE (A.860)
  Encelia virginensis Shrubland (CEGL001335)
- EPHEDRA CALIFORNICA INTERMITTENTLY FLOODED SHRUBLAND ALLIANCE (A.2536)
  Ephedra californica Shrubland [Placeholder] (CEGL002958)
- ERICAMERIA PANICULATA INTERMITTENTLY FLOODED SHRUBLAND ALLIANCE (A.2509)
  Ericameria paniculata Shrubland [Placeholder] (CEGL002706)
- FORESTIERA PUBESCENS TEMPORARILY FLOODED SHRUBLAND ALLIANCE (A.969)
  Forestiera pubescens Mojave Desert Shrubland [Provisional] (CEGL002959)
- GRAYIA SPINOSA INTERMITTENTLY FLOODED SHRUBLAND ALLIANCE (A.1045)
  Grayia spinosa - Lycium andersonii Shrubland (CEGL001347)
  Grayia spinosa - Lycium pallidum Shrubland (CEGL001348)
- HYMENOCLEA MONOGYRA SHRUBLAND ALLIANCE (A.1034)
  Hymenoclea monogyra Thicket Shrubland (CEGL001169)
- HYMENOCLEA SALSOLA SHRUBLAND ALLIANCE (A.2512) Hymenoclea salsola - (Ambrosia eriocentra) Shrubland (CEGL002702) Hymenoclea salsola - Salazaria mexicana Shrubland (CEGL002703)
- HYPTIS EMORYI INTERMITTENTLY FLOODED SHRUBLAND ALLIANCE (A.2537) Hyptis emoryi Shrubland [Placeholder] (CEGL002960)
- JUGLANS MICROCARPA TEMPORARILY FLOODED SHRUBLAND ALLIANCE (A.945) Juglans microcarpa / Cladium mariscus ssp. jamaicense Shrubland (CEGL004593)
  Juglans microcarpa / Sorghastrum nutans Shrubland (CEGL004594) Juglans microcarpa Shrubland (CEGL001103)
- LEPIDOSPARTUM SQUAMATUM INTERMITTENTLY FLOODED SHRUBLAND ALLIANCE (A.838)
  Lepidospartum squamatum Intermittently Flooded Shrubland [Placeholder] (CEGL003060)
- PANICUM BULBOSUM TEMPORARILY FLOODED HERBACEOUS ALLIANCE (A.1356) Panicum bulbosum - Alopecurus aequalis Herbaceous Vegetation (CEGL001653)
  Panicum bulbosum - Lycurus phleoides Herbaceous Vegetation (CEGL001654)
- PROSOPIS (GLANDULOSA, VELUTINA) WOODLAND ALLIANCE (A.661) Prosopis (glandulosa var. torreyana, velutina) Woodland [Placeholder] (CEGL003082)
- PROSOPIS GLANDULOSA SHRUB HERBACEOUS ALLIANCE (A.1550)
  Prosopis glandulosa / Bouteloua eriopoda Shrub Herbaceous Vegetation (CEGL001510)
- PROSOPIS GLANDULOSA SHRUBLAND ALLIANCE (A.1031) Prosopis glandulosa - Atriplex spp. Shrubland (CEGL002193) Prosopis glandulosa / Atriplex canescens Shrubland (CEGL001382) Prosopis glandulosa / Bouteloua gracilis Shrubland (CEGL001383) Prosopis glandulosa / Mixed Grasses Shrubland (CEGL001384) Prosopis glandulosa / Muhlenbergia porteri Shrubland (CEGL001511) Prosopis glandulosa / Sporobolus airoides Shrubland (CEGL001385)
  Prosopis glandulosa var. glandulosa / Bouteloua gracilis - Buchloe dactyloides Shrubland (CEGL003877) Prosopis glandulosa var. torreyana Shrubland (CEGL001381)
- PROSOPIS GLANDULOSA TEMPORARILY FLOODED WOODLAND ALLIANCE (A.637) Prosopis glandulosa Temporarily Flooded Woodland (CEGL004934)
- PROSOPIS GLANDULOSA WOODLAND ALLIANCE (A.611)
  Prosopis glandulosa / Bouteloua curtipendula - Nassella leucotricha Woodland (CEGL002133)
- PROSOPIS PUBESCENS SHRUBLAND ALLIANCE (A.1042) Prosopis pubescens Shrubland (CEGL001387)
- PROSOPIS VELUTINA SHRUBLAND ALLIANCE (A.1043) Prosopis velutina - Acacia greggii Shrubland (CEGL001388)
- PRUNUS FASCICULATA INTERMITTENTLY FLOODED SHRUBLAND ALLIANCE (A.2519) Prunus fasciculata Shrubland [Placeholder] (CEGL002704)
- PSOROTHAMNUS SPINOSUS INTERMITTENTLY FLOODED SHRUBLAND ALLIANCE (A.2520)
  Psorothamnus spinosus Shrubland [Placeholder] (CEGL002701)
- RHUS MICROPHYLLA SHRUBLAND ALLIANCE (A.1040)
  Rhus microphylla / Bouteloua curtipendula Shrubland (CEGL001354)
- SAPINDUS SAPONARIA TEMPORARILY FLOODED FOREST ALLIANCE (A.303) Sapindus saponaria - Juglans major Forest (CEGL000557)
- VIGUIERA RETICULATA INTERMITTENTLY FLOODED SHRUBLAND ALLIANCE (A.2539) Viguiera reticulata Shrubland [Placeholder] (CEGL002962)

- **California community types:**
- Scalebroom Scrub (32.070.00)
- California Buckwheat - Scalebroom (32.070.01)
- Scalebroom - Hairy Yerba Santa - Chaparral Yucca (32.070.02)
- Scalebroom / Mixed Ephemeral Herbs (32.070.03)
- Creosote Bush Wash Scrub (33.010.06)
- Creosote Bush - Cheesebush (33.010.08)
- Creosote Bush - Cheesebush - Woolly Brickellia (33.010.15)
- Catclaw Acacia Thorn Scrub (33.040.00)
- Catclaw Acacia-wash association (33.040.01)
- Catclaw Acacia Savanna (33.040.02)
- Catclaw Acacia / Desert Lavender (33.040.03)
- Catclaw Acacia / Cheesebush (33.040.04)
- Catclaw Acacia - Cheesebush - Virgin River Encelia (33.040.05)
- Catclaw Acacia - Desert Sunflower (33.040.06)
- Catclaw Acacia - Desert Almond (33.040.07)
- Catclaw Acacia - Woolly Bursage (33.040.08)
- Catclaw Acacia - Blue Sage (33.040.09)
- Catclaw Acacia - Sweetbush (33.040.10)
- Catclaw Acacia/Naked buckwheat (33.040.11)
- Desert Lavender Wash Scrub (33.190.00)
- Cheesebush - wash association (33.200.01)
- Cheesebush - California Buckwheat (33.200.02)
- Cheesebush - Blackstem Rabbitbrush (33.200.03)
- Cheesebush - Shadscale (33.200.04)
- Cheesebush - Sweetbush (33.200.05)
- Cheesebush - Woolly Bursage (33.200.06)
- Cheesebush - Woolly Brickellia (33.200.07)
- Cheesebush - Spiny Senna (33.200.08)
- Mojave Wash Scrub (33.213.00)
- Desert Almond Scrub (33.300.00)
- Desert Almond (33.300.01)
- Desert Almond - Bladder Sage (33.300.02)
- Desert Almond - Skunkbrush (33.300.03)
- Desert Almond - Stansbury's Antelope Bush (33.300.04)
- Desert Almond - Woolly Bursage (33.300.05)
- Desert Almond - Net-veined Viguiera - (Utah Mortonia) (33.300.06)
- Bladder Sage (33.310.01)
- Blue Palo Verde - Ironwood - Smoke Tree Woodland (61.530.00)
- Blue Palo Verde Woodland (61.540.00)
- Blue Palo Verde Wash Woodland (61.540.01)
- Blue Palo Verde / Desert Lavender (61.540.02)
- Desert-willow Woodland (61.550.00)
- Desert-willow / Cheesebush (61.550.02)
- Desert-willow - Desert Almond - Cheesebush (61.550.03)
- Desert-willow - Desert Almond (61.550.04)
- Desert-willow - Blue Sage (61.550.05)
- Desert-willow - Desert Sunflower (61.550.06)
- Desert-willow - Blackstem Rabbitbrush (61.550.07)
- Ironwood Woodland (61.560.01)
- Ironwood / Desert Lavender (61.560.02)
- Smoke Tree Woodland and Scrub (61.570.00)
- Smoketree Wash Woodland (61.570.01)
- Smoketree - Cheesebush - Sweetbush (61.570.02)
- Smoketree / California Ephedra (61.570.03)
- Smoketree - Desert Lavender - Catclaw Acacia (61.570.04)
- Mulefat Scrub (63.510.00)
- Arrow Weed Scrub (63.710.00)
- Sandy to Cobbly wash bottom (99.900.01)

SOURCES

References: Barbour and Major 1988, Brown 1982, Dick-Peddie 1993, MacMahon 1988, Muldavin et al. 2000b, Szaro 1989, Thomas et al. 2003a

Last updated: 20 Feb 2003 **Stakeholders:** WCS, SCS

Concept Author: NatureServe Western Ecology Team **LeadResp:** WCS

NLCD Shrub/Scrub Types

Areas dominated by shrubs; less than 5 meters tall with shrub canopy typically greater than 20% of total vegetation. This class includes true shrubs, young trees in an early sucesional stage or trees stunted from environmental conditions.

S048 Western Great Plains Sandhill Shrubland

Division 303, Shrubland, CES303.671

Spatial Scale & Pattern: Large Patch **Classification Confidence:** high

Required Classifiers: Natural/Semi-natural, Vegetated (>10% vasc.), Upland

Non-Diagnostic Classifiers: Shrubland (Shrub-dominated), Sand Soil Texture, Ustic, F-Landscape/Medium Intensity, G-Landscape/Medium Intensity

Concept Summary: This system is found mostly in south-central areas of the Western Great Plains Division ranging from the Nebraska Sandhill region south to central Texas, although some examples may reach as far north as the Badlands of South Dakota. The climate is semi-arid to arid for much of the region in which this system occurs. This system is found on somewhat excessively to excessively well-drained, deep sandy soils that are often associated with dune systems and ancient floodplains. In some areas, this system may actually occur as a result of overgrazing in Western Great Plains Tallgrass Prairie (CES303.673) or Western Great Plains Sand Prairie (CES303.670). This system is characterized by a sparse to moderately dense woody layer dominated by *Artemisia filifolia*. Associated species can vary with geography, amount and season of precipitation, disturbance and soil texture. Several graminoid species such as *Andropogon hallii, Schizachyrium scoparium, Sporobolus cryptandrus, Calamovilfa gigantea, Hesperostipa comata*, and *Bouteloua* spp. can be connected with this system. Other shrub species may also be present including *Yucca glauca, Prosopis glandulosa, Rhus trilobata*, and *Prunus angustifolia*. In the southern range of this system, *Quercus havardii* may also be present and represents one succession pathway that develops over time following a disturbance. *Quercus havardii* is able to resprout following a fire and thus may persist for long periods of time once established. Fire and grazing are the most important dynamic processes for this type, although drought stress can impact this system significantly in some areas. Overgrazing can lead to decreasing dominance of some of the grass species such as *Andropogon hallii, Calamovilfa gigantea*, and *Schizachyrium scoparium*.

Comments: This system may overlap in concept with Crosstimbers Southern Xeric Sandhill (CES205.897).

Distribution

Range: This system is found primarily within the south-central areas of the Western Great Plains Division ranging from the Nebraska Sandhills south into central Texas. However, examples of this system can be found as far north as the Badlands in South Dakota.

Ecological Divisions: 303

TNC Ecoregions: 26:C, 27:C, 28:C, 33:C

Subnations/Nations: CO:c, KS:c, NE:c, OK:c, TX:?

Concept

Alliances and Associations:

- ARTEMISIA FILIFOLIA SHRUBLAND ALLIANCE (A.816)
  Artemisia filifolia / Andropogon hallii Shrubland (CEGL001459)
  Artemisia filifolia / Bouteloua (curtipendula, gracilis) Shrubland (CEGL002176)
  Artemisia filifolia / Calamovilfa longifolia Shrubland (CEGL002177)
  Artemisia filifolia / Schizachyrium scoparium - Andropogon hallii Shrubland (CEGL002178)
  Artemisia filifolia / Sporobolus cryptandrus Shrubland (CEGL002179)
- PRUNUS ANGUSTIFOLIA SHRUBLAND ALLIANCE (A.1884)
  Prunus angustifolia / Schizachyrium scoparium Shrubland (CEGL002180)
- QUERCUS HAVARDII SHRUBLAND ALLIANCE (A.780)
  Quercus havardii / Sporobolus cryptandrus - Schizachyrium scoparium Shrubland (CEGL002171)

Environment: This system is found primarily in semi-arid to arid areas of the Western Great Plains Division. It occurs on somewhat excessively to excessively well-drained and deep sandy soils. This system is often found associated with dune systems and/or ancient floodplains but may occur in soils derived from sandstone residuum.

Vegetation: This system is distinguished by a sparse to a moderately dense shrub layer dominated by *Artemisia filifolia*. Graminoid species such as *Andropogon hallii, Schizachyrium scoparium, Sporobolus cryptandrus, Calamovilfa gigantea, Hesperostipa comata*, and *Bouteloua* spp. can also be found within this system. Other shrub species such as *Yucca glauca, Rhus trilobata*, and *Prunus angustifolia* may be present. *Quercus havardii* and

Prosopis glandulosa may also be present in the southern extent of this system.

Dynamics: Fire and grazing constitute the most important processes impacting this system. Burning shrublands reduces cover of *Artemisia filifolia* for several years resulting in grassland patches that form a mosaic pattern with shrublands. Composition of grasslands depends on precipitation and management. Drought stress can also influence this system in some areas.

SOURCES

References: Ramaley 1939b, Sims et al. 1976, Tolstead 1942
Last updated: 05 Mar 2003 **Stakeholders:** MCS, WCS
Concept Author: S. Menard and K. Kindscher **LeadResp:** MCS

S058 APACHERIAN-CHIHUAHUAN MESQUITE UPLAND SCRUB

Division 302, Shrubland, CES302.733

Spatial Scale & Pattern: Matrix **Classification Confidence:** low
Required Classifiers: Natural/Semi-natural, Vegetated (>10% vasc.), Upland
Diagnostic Classifiers: Lowland [Foothill], Lowland [Lowland], Shrubland (Shrub-dominated), Thorn Shrub, Prosopis spp.-dominated

Non-Diagnostic Classifiers: Tropical/Subtropical [Tropical Xeric], Temperate [Temperate Xeric], Aridic, Intermediate Disturbance Interval, F-Patch/High Intensity [Seasonality/Winter Fire]

Concept Summary: This ecological system occurs as upland shrublands that are concentrated in the extensive grassland-shrubland transition in foothills and piedmont in the Chihuahuan Desert. It extends into the Sky Island region to the west, and the Edwards Plateau to the east. Substrates are typically derived from alluvium, often gravelly without a well-developed argillic or calcic soil horizon that would limit infiltration and storage of winter precipitation in deeper soil layers. *Prosopis* spp. and other deep-rooted shrubs exploit this deep soil moisture that is unavailable to grasses and cacti. Vegetation is typically dominated by *Prosopis glandulosa* or *Prosopis velutina* and succulents. Other desert scrub that may codominate or dominate includes *Acacia neovernicosa*, *Acacia constricta*, *Juniperus monosperma*, or *Juniperus coahuilensis*. Grass cover is typically low. During the last century, the area occupied by this system has increased through conversion of desert grasslands as a result of drought, overgrazing by livestock, and/or decreases in fire frequency. It is similar to Chihuahuan Mixed Desert and Thorn Scrub (CES302.734), but is generally found at higher elevations where *Larrea tridentata* and other desert scrub is not codominant. It is also similar to Chihuahuan Stabilized Coppice Dune and Sand Flat Scrub (CES302.737), but does not occur on eolian-deposited substrates.

DISTRIBUTION

Range: Foothills and piedmont in the Chihuahuan Desert, extending into the Sky Island region and into lower Mogollon Rim to the west, and the Edwards Plateau to the east.
Ecological Divisions: 302
TNC Ecoregions: 22:C, 24:C, 29:P, 30:P
Subnations/Nations: AZ:c, MXCH:c, MXSO:p, NM:c, TX:c

CONCEPT

Alliances and Associations:

- ACACIA NEOVERNICOSA SHRUBLAND ALLIANCE (A.1037)
  Acacia neovernicosa / Flourensia cernua Shrubland (CEGL001341)
  Acacia neovernicosa / Muhlenbergia porteri Shrubland (CEGL001342)
- JUNIPERUS COAHUILENSIS WOODLAND ALLIANCE (A.503)
  Juniperus coahuilensis / Canotia holacantha Woodland (CEGL000701)
- JUNIPERUS MONOSPERMA WOODLAND ALLIANCE (A.504)
  Juniperus monosperma / Bouteloua eriopoda Woodland (CEGL000709)
  Juniperus monosperma / Prosopis glandulosa Woodland (CEGL000719)
- PROSOPIS GLANDULOSA SHRUBLAND ALLIANCE (A.1031)
  Prosopis glandulosa / Atriplex canescens Shrubland (CEGL001382)
  Prosopis glandulosa / Bouteloua gracilis Shrubland (CEGL001383)
  Prosopis glandulosa / Muhlenbergia porteri Shrubland (CEGL001511)
  Prosopis glandulosa / Sporobolus airoides Shrubland (CEGL001385)
  Prosopis glandulosa / Sporobolus flexuosus Shrubland (CEGL001386)
  Prosopis glandulosa var. torreyana Shrubland (CEGL001381)

- PROSOPIS VELUTINA SHRUBLAND ALLIANCE (A.1043)
  Prosopis velutina - Acacia greggii Shrubland (CEGL001388)
  Prosopis velutina / Celtis laevigata var. reticulata Shrubland (CEGL001390)
  Prosopis velutina / Muhlenbergia porteri Shrubland (CEGL001391)

SOURCES

References: MacMahon 1988, McAuliffe 1995, McPherson 1995, Muldavin et al. 2002
Last updated: 20 Feb 2003 **Stakeholders:** WCS, SCS, LACD
Concept Author: NatureServe Western Ecology Team **LeadResp:** WCS

S062 CHIHUAHUAN CREOSOTEBUSH, MIXED DESERT AND THORN SCRUB

Division 302, Shrubland

Spatial Scale & Pattern: Matrix **Classification Confidence:** medium
Required Classifiers: Natural/Semi-natural, Vegetated (>10% vasc.), Upland
Diagnostic Classifiers: Lowland [Foothill], Lowland [Lowland], Shrubland (Shrub-dominated)

Non-Diagnostic Classifiers: Toeslope/Valley Bottom, Tropical/Subtropical [Tropical Xeric], Temperate [Temperate Xeric], Aridic, Xeromorphic Shrub, Thorn Shrub

Concept Summary: This widespread Chihuahuan Desert land cover type is composed of two ecological systems the Chihuahuan Creosotebush Xeric Basin Desert Scrub (CES302.731) and the Chihuahuan Mixed Desert and Thorn Scrub (CES302.734). This cover type includes xeric creosotebush basins and plains and the mixed desert scrub in the foothill transition zone above, sometimes extending up to the lower montane woodlands. Vegetation is characterized by *Larrea tridentata* alone or mixed with thornscrub and other desert scrub such as *Agave lechuguilla, Aloysia wrightii, Fouquieria splendens, Dasylirion leiophyllum, Flourensia cernua, Leucophyllum minus, Mimosa aculeaticarpa var. biuncifera, Mortonia scabrella (= Mortonia sempervirens ssp. scabrella), Opuntia engelmannii, Parthenium incanum, Prosopis glandulosa*, and *Tiquilia greggii*. Stands of *Acacia constricta Acacia neovernicosa* or *Acacia greggii* dominated thornscrub are included in this system, and limestone substrates appear important for at least these species. Grasses such as *Dasyochloa pulchella, Bouteloua curtipendula, Bouteloua eriopoda, Bouteloua ramosa*, *Muhlenbergia porteri* and *Pleuraphis mutica* may be common, but generally have lower cover than shrubs.

DISTRIBUTION

Range: This landcover type is characterist of the Chihuahuan Desert.
Ecological Divisions: 302
TNC Ecoregions: 22:C, 24:C
Subnations/Nations: AZ:c, MXCH:c, MXSO:c, NM:c, TX:c

CONCEPT

Alliances and Associations:

- ACACIA NEOVERNICOSA SHRUBLAND ALLIANCE (A.1037) Acacia neovernicosa / Flourensia cernua Shrubland (CEGL001341) Acacia neovernicosa / Muhlenbergia porteri Shrubland (CEGL001342)
- BOUTELOUA HIRSUTA - BOUTELOUA GRACILIS - BOUTELOUA ERIOPODA SHRUB HERBACEOUS ALLIANCE (A.1548)
  Acacia neovernicosa / Bouteloua hirsuta - Bouteloua gracilis - Bouteloua eriopoda Shrub Herbaceous Vegetation (CEGL004244)
  Larrea tridentata / Bouteloua hirsuta - Bouteloua gracilis - Bouteloua eriopoda Shrub Herbaceous Vegetation (CEGL004246)
- FLOURENSIA CERNUA SHRUBLAND ALLIANCE (A.861) Flourensia cernua / Achnatherum eminens Shrubland (CEGL001338) Flourensia cernua / Bouteloua curtipendula Shrubland (CEGL001336) Flourensia cernua / Pleuraphis mutica Shrubland (CEGL001541) Flourensia cernua / Sporobolus airoides Shrubland (CEGL001337)
- FOUQUIERIA SPLENDENS SHRUBLAND ALLIANCE (A.863) Fouquieria splendens / Bouteloua curtipendula Shrubland (CEGL001376) Fouquieria splendens / Bouteloua hirsuta Shrubland (CEGL001377) Fouquieria splendens / Parthenium incanum Shrubland (CEGL001378) Fouquieria splendens / Petrophyton caespitosum Shrubland (CEGL001379)
- LARREA TRIDENTATA SHRUBLAND ALLIANCE (A.851) Larrea tridentata - Flourensia cernua Shrubland (CEGL001270) Larrea tridentata - Hechtia texensis Shrubland (CEGL004565)
  Larrea tridentata - Jatropha dioica var. graminea Shrubland (CEGL004566) Larrea tridentata - Parthenium incanum Shrubland (CEGL001274)
  Larrea tridentata - Prosopis glandulosa Shrubland (CEGL001275) Larrea

tridentata / Bouteloua eriopoda Shrubland (CEGL001265) Larrea tridentata / Bouteloua gracilis Shrubland (CEGL001266) Larrea tridentata / Bouteloua ramosa Shrubland (CEGL004563) Larrea tridentata / Dasyochloa pulchella Shrubland (CEGL001269) Larrea tridentata / Muhlenbergia porteri Shrubland (CEGL001272) Larrea tridentata / Sparse Understory Shrubland (CEGL001276) Larrea tridentata / Sporobolus airoides Shrubland (CEGL001277)

- Larrea tridentata / Tiquilia hispidissima Shrubland (CEGL001267)
- MORTONIA SEMPERVIRENS SHRUBLAND ALLIANCE (A.859) Mortonia scabrella / Dasylirion wheeleri Shrubland (CEGL001279)

SOURCES

References: Brown 1982, Dick-Peddie 1993, MacMahon 1988, Muldavin et al. 2000b, Muldavin et al. 2002
Last updated: 20 Feb 2003 **Stakeholders:** WCS, SCS, LACD
Concept Author: NatureServe Western Ecology Team **LeadResp:** WCS

S068 CHIHUAHUAN STABILIZED COPPICE DUNE AND SAND FLAT SCRUB

Division 302, Shrubland, CES302.737

Spatial Scale & Pattern: Large Patch **Classification Confidence:** low
Required Classifiers: Natural/Semi-natural, Vegetated (>10% vasc.), Upland
Diagnostic Classifiers: Lowland [Lowland], Shrubland (Shrub-dominated), Plain, Tropical/Subtropical [Tropical Xeric], Temperate [Temperate Xeric], Sand Soil Texture, Aridic, Very Short Disturbance Interval, W-Landscape/High Intensity, Thorn Shrub, Prosopis spp.-dominated

Concept Summary: This ecological system includes the open shrublands of vegetated coppice dunes and sandsheets found in the Chihuahuan Desert. Usually dominated by *Prosopis glandulosa* but includes *Atriplex canescens, Ephedra torreyana, Ephedra trifurca, Poliomintha incana*, and *Rhus microphylla* coppice sand scrub with 10-30% total vegetation cover. *Yucca elata, Gutierrezia sarothrae*, and *Sporobolus flexuosus* are commonly present.

DISTRIBUTION

Range: Dunes and sandsheets found in the Chihuahuan Desert.
Ecological Divisions: 302
TNC Ecoregions: 24:C
Subnations/Nations: MXCH:c, NM:c, TX:c

CONCEPT

Alliances and Associations:

- ATRIPLEX CANESCENS SHRUBLAND ALLIANCE (A.869)
  Atriplex canescens / Sporobolus wrightii Shrubland (CEGL001292)
- EPHEDRA TORREYANA SHRUBLAND ALLIANCE (A.2572)
  Ephedra torreyana - Achnatherum hymenoides Hummock Shrubland (CEGL005802)
- PROSOPIS GLANDULOSA SHRUBLAND ALLIANCE (A.1031)
  Prosopis glandulosa / Atriplex canescens Shrubland (CEGL001382)
  Prosopis glandulosa / Bouteloua gracilis Shrubland (CEGL001383)
  Prosopis glandulosa / Muhlenbergia porteri Shrubland (CEGL001511)
  Prosopis glandulosa / Sporobolus flexuosus Shrubland (CEGL001386)
- PSOROTHAMNUS SCOPARIUS SHRUBLAND ALLIANCE (A.837)
  Psorothamnus scoparius / Sporobolus flexuosus Shrubland (CEGL001695)
- RHUS MICROPHYLLA SHRUBLAND ALLIANCE (A.1040)
  Rhus microphylla / Bouteloua curtipendula Shrubland (CEGL001354)

SOURCES

References: Bowers 1982, Bowers 1984, Dick-Peddie 1993, Muldavin et al. 2000b
Last updated: 20 Feb 2003 **Stakeholders:** WCS, SCS, LACD
Concept Author: NatureServe Western Ecology Team **LeadResp:** WCS

S116 CHIHUAHUAN MIXED SALT DESERT SCRUB
Division 302, Shrubland, CES302.017

Spatial Scale & Pattern: Large Patch **Classification Confidence:** medium
Required Classifiers: Natural/Semi-natural, Vegetated (>10% vasc.), Upland
Diagnostic Classifiers: Lowland [Lowland], Shrubland (Shrub-dominated), Tropical/Subtropical [Tropical Xeric], Temperate [Temperate Xeric], Atriplex spp.

Concept Summary: This system includes extensive open-canopied shrublands of typically saline basins in the Chihuahuan Desert. Stands often occur on alluvial flats and around playas. Substrates are generally fine-textured, saline soils. Vegetation is typically composed of one or more *Atriplex* species such as *Atriplex canescens, Atriplex obovata*, or *Atriplex polycarpa* along with species of *Allenrolfea, Flourensia, Salicornia, Suaeda*, or other halophytic plants. Graminoid species may include *Sporobolus airoides, Pleuraphis mutica*, or *Distichlis spicata* at varying densities.

DISTRIBUTION

Range: Saline basins in the Chihuahuan Desert.
Ecological Divisions: 302
TNC Ecoregions: 22:C, 24:C, 28:C, 29:P, 30:P
Subnations/Nations: AZ:c, MXCH:c, MXCO:c, MXDU:c, MXNU:c, MXSO:c, NM:c, TX:c

CONCEPT

Alliances and Associations:

- ATRIPLEX CANESCENS SHRUBLAND ALLIANCE (A.869)
  Atriplex canescens / Parthenium confertum Shrubland (CEGL001290)
  Atriplex canescens / Sporobolus airoides Shrubland (CEGL001291)
  Atriplex canescens / Sporobolus wrightii Shrubland (CEGL001292)
- ATRIPLEX OBOVATA DWARF-SHRUBLAND ALLIANCE (A.1108)
  Atriplex obovata / Tidestromia carnosa Dwarf-shrubland (CEGL004575)
- ATRIPLEX POLYCARPA SHRUBLAND ALLIANCE (A.873)
  Atriplex polycarpa / Pleuraphis mutica Shrubland (CEGL001319)
- DISTICHLIS SPICATA INTERMITTENTLY FLOODED HERBACEOUS ALLIANCE (A.1332)
  Distichlis spicata Herbaceous Vegetation (CEGL001770)
- FLOURENSIA CERNUA SHRUBLAND ALLIANCE (A.861)
  Flourensia cernua / Achnatherum eminens Shrubland (CEGL001338)
  Flourensia cernua / Bouteloua curtipendula Shrubland (CEGL001336)
  Flourensia cernua / Pleuraphis mutica Shrubland (CEGL001541)
  Flourensia cernua / Sporobolus airoides Shrubland (CEGL001337)

SOURCES

References: Brown 1982, Dick-Peddie 1993, Muldavin et al. 2000b, Muldavin et al. 2002, Shreve and Wiggins 1964
Last updated: 24 Mar 2003 **Stakeholders:** WCS, LAC
Concept Author: NatureServe Western Ecology Team **LeadResp:** WCS

NLCD Grassland/Herbaceous Types

Areas dominated by grammanoid or herbaceous vegetation, generally greater than 80% of total vegetation. These areas are not subject to intensive management such as tilling, but can be utilized for grazing.

S077 APACHERIAN-CHIHUAHUAN PIEDMONT SEMI-DESERT GRASSLAND AND STEPPE
Division 302, Herbaceous, CES302.735

Spatial Scale & Pattern: Large Patch **Classification Confidence:** medium
Required Classifiers: Natural/Semi-natural, Vegetated (>10% vasc.), Upland
Diagnostic Classifiers: Lowland [Foothill], Lowland [Lowland], Herbaceous, Temperate [Temperate Xeric], Short Disturbance Interval, F-Patch/High Intensity [Seasonality/Winter Fire], Graminoid

Non-Diagnostic Classifiers: Tropical/Subtropical [Tropical Xeric], Aridic, Broad-Leaved Evergreen Tree, Xeromorphic Tree, Xeromorphic Shrub, Thorn Shrub, Succulent Shrub

Concept Summary: This ecological system is a broadly defined desert grassland, mixed shrub-succulent or xeromorphic tree savanna that is typical of the Borderlands of Arizona, New Mexico and northern Mexico

[Apacherian region], but extends west to the Sonoran Desert, north into the Mogollon Rim and throughout much of the Chihuahuan Desert. It is found on gently sloping bajadas that supported frequent fire throughout the Sky Islands and on mesas and steeper piedmont and foothill slopes in the Chihuahuan Desert. It is characterized by a typically diverse perennial grasses. Common grass species include *Bouteloua eriopoda, B. hirsuta,B. rothrockii, B. curtipendula, B. gracilis, Eragrostis intermedia, Muhlenbergia porteri, Muhlenbergia setifolia, Pleuraphis jamesii, Pleuraphis mutica*, and *Sporobolus airoides*, succulent species of *Agave*, *Dasylirion*, and *Yucca*, and tall shrub/short tree species of *Prosopis* and various oaks (e.g., *Quercus grisea, Quercus emoryi, Quercus arizonica*). Many of the historical desert grassland and savanna areas have been converted, some to Chihuahuan Mesquite Upland Scrub (CES302.733) (*Prosopis* spp.-dominated), through intensive grazing and other land uses.

DISTRIBUTION

Range: Borderlands of Arizona, New Mexico and northern Mexico [Apacherian region], extending to the Sonoran Desert and throughout much of the Chihuahuan Desert.
Ecological Divisions: 302
TNC Ecoregions: 22:C, 24:C, 28:C
Subnations/Nations: AZ:c, MXCH:c, NM:c, TX:c

CONCEPT

Alliances and Associations:

- BOUTELOUA CURTIPENDULA HERBACEOUS ALLIANCE (A.1244)
  Bouteloua curtipendula - Bothriochloa barbinodis Herbaceous Vegetation (CEGL001590)
  Bouteloua curtipendula - Hilaria belangeri - Bouteloua eriopoda Herbaceous Vegetation (CEGL001591)
  Bouteloua curtipendula - Schizachyrium cirratum Herbaceous Vegetation (CEGL001592)
- BOUTELOUA CURTIPENDULA SHRUB HERBACEOUS ALLIANCE (A.1552)
  Dasylirion wheeleri / Bouteloua curtipendula Shrub Herbaceous Vegetation (CEGL001593)
- BOUTELOUA ERIOPODA DWARF-SHRUB HERBACEOUS ALLIANCE (A.1570)
  Artemisia bigelovii / Bouteloua eriopoda Dwarf-shrub Herbaceous Vegetation (CEGL001741)
- BOUTELOUA ERIOPODA HERBACEOUS ALLIANCE (A.1284)
  Bouteloua eriopoda - Bouteloua curtipendula Herbaceous Vegetation (CEGL001747)
  Bouteloua eriopoda - Bouteloua gracilis Herbaceous Vegetation (CEGL001748)
  Bouteloua eriopoda - Bouteloua hirsuta Herbaceous Vegetation (CEGL001749)
  Bouteloua eriopoda - Bouteloua trifida Herbaceous Vegetation (CEGL001750)
  Bouteloua eriopoda - Hesperostipa neomexicana Herbaceous Vegetation (CEGL001753)
  Bouteloua eriopoda - Pleuraphis jamesii Herbaceous Vegetation (CEGL001751)
  Bouteloua eriopoda Semi-desert Herbaceous Vegetation (CEGL001752)
- BOUTELOUA ERIOPODA XEROMORPHIC SHRUB HERBACEOUS ALLIANCE (A.1553)
  Ayenia microphylla / Bouteloua eriopoda Shrub Herbaceous Vegetation (CEGL001729)
  Dasylirion wheeleri / Bouteloua eriopoda Shrub Herbaceous Vegetation (CEGL001730)
  Parthenium incanum / Bouteloua eriopoda Shrub Herbaceous Vegetation (CEGL001734)
- BOUTELOUA GRACILIS DWARF-SHRUB HERBACEOUS ALLIANCE (A.1571)
  Artemisia bigelovii / Bouteloua gracilis Dwarf-shrub Herbaceous Vegetation (CEGL001742)
- BOUTELOUA GRACILIS HERBACEOUS ALLIANCE (A.1282)
  Bouteloua gracilis - Bouteloua curtipendula Herbaceous Vegetation (CEGL001754)
  Bouteloua gracilis - Bouteloua hirsuta Herbaceous Vegetation (CEGL001755)
  Bouteloua gracilis - Buchloe dactyloides Herbaceous Vegetation (CEGL001756)
  Bouteloua gracilis - Eragrostis intermedia Herbaceous Vegetation (CEGL001758)
  Bouteloua gracilis - Hesperostipa neomexicana Herbaceous Vegetation (CEGL001763)
  Bouteloua gracilis - Sporobolus cryptandrus Herbaceous Vegetation (CEGL001761)
  Bouteloua gracilis - Sporobolus flexuosus Herbaceous Vegetation (CEGL001762)
- BOUTELOUA HIRSUTA - BOUTELOUA GRACILIS - BOUTELOUA ERIOPODA SHRUB HERBACEOUS ALLIANCE (A.1548)
  Yucca faxoniana / Bouteloua hirsuta - Bouteloua gracilis - Bouteloua eriopoda Shrub Herbaceous Vegetation (CEGL004248)
- BOUTELOUA HIRSUTA HERBACEOUS ALLIANCE (A.1285)
  Bouteloua hirsuta - Bouteloua curtipendula Herbaceous Vegetation (CEGL001764)
  Bouteloua hirsuta - Bouteloua radicosa Herbaceous Vegetation (CEGL001765)
  Bouteloua hirsuta - Digitaria californica Herbaceous Vegetation (CEGL001767)
  Bouteloua hirsuta - Hesperostipa neomexicana Herbaceous Vegetation (CEGL001766)
- BOUTELOUA RAMOSA HERBACEOUS ALLIANCE (A.1275)
  Bouteloua ramosa Herbaceous Vegetation (CEGL004522)
- DASYLIRION LEIOPHYLLUM - (AGAVE LECHUGUILLA, VIGUIERA STENOLOBA) SHRUBLAND ALLIANCE (A.850)
  Dasylirion leiophyllum - Agave lechuguilla / Bouteloua hirsuta - Bouteloua gracilis - Bouteloua eriopoda Shrubland (CEGL004245)

Dasylirion leiophyllum - Viguiera stenoloba - Agave lechuguilla / Bouteloua ramosa Shrubland (CEGL004604)

- FOUQUIERIA SPLENDENS SHRUBLAND ALLIANCE (A.863)
  Fouquieria splendens / Bouteloua curtipendula Shrubland (CEGL001376)
  Fouquieria splendens / Bouteloua hirsuta Shrubland (CEGL001377)
- HESPEROSTIPA NEOMEXICANA HERBACEOUS ALLIANCE (A.1272)
  Hesperostipa neomexicana - Bouteloua curtipendula Herbaceous Vegetation (CEGL001709)
  Hesperostipa neomexicana - Dasylirion wheeleri Herbaceous Vegetation (CEGL001710)
- MUHLENBERGIA EMERSLEYI HERBACEOUS ALLIANCE (A.1259)
  Muhlenbergia emersleyi - Bouteloua curtipendula Herbaceous Vegetation (CEGL001644)
  Muhlenbergia emersleyi - Bouteloua hirsuta Herbaceous Vegetation (CEGL001645)
- MUHLENBERGIA SETIFOLIA / ARTEMISIA BIGELOVII SHRUB HERBACEOUS ALLIANCE (A.1530)
  Artemisia bigelovii / Muhlenbergia setifolia Shrub Herbaceous Vegetation (CEGL001544)
- MUHLENBERGIA SETIFOLIA SHRUB HERBACEOUS ALLIANCE (A.1541)
  Dasylirion wheeleri / Muhlenbergia setifolia Shrub Herbaceous Vegetation (CEGL001512)
  Fouquieria splendens / Muhlenbergia setifolia Shrub Herbaceous Vegetation (CEGL001513)
- PLEURAPHIS JAMESII HERBACEOUS ALLIANCE (A.1287)
  Pleuraphis jamesii - Sporobolus airoides Herbaceous Vegetation (CEGL001778)
- PLEURAPHIS MUTICA SHRUB HERBACEOUS ALLIANCE (A.1551)
  Larrea tridentata / Pleuraphis mutica Shrub Herbaceous Vegetation (CEGL001542)
  Prosopis glandulosa / Pleuraphis mutica Shrub Herbaceous Vegetation (CEGL001641)
- PROSOPIS GLANDULOSA SHRUB HERBACEOUS ALLIANCE (A.1550)
  Prosopis glandulosa / Bouteloua eriopoda Shrub Herbaceous Vegetation (CEGL001510)
- QUERCUS ARIZONICA WOODLAND ALLIANCE (A.482)
  Quercus arizonica / Bouteloua curtipendula Woodland (CEGL000680)
  Quercus arizonica / Muhlenbergia emersleyi Woodland (CEGL000681)
- QUERCUS EMORYI WOODLAND ALLIANCE (A.483)
  Quercus emoryi / Bouteloua curtipendula Woodland (CEGL000683)
  Quercus emoryi / Muhlenbergia emersleyi Woodland (CEGL000685)
  Quercus emoryi / Schizachyrium cirratum Woodland (CEGL000687)
- QUERCUS GRISEA WOODLAND ALLIANCE (A.478)
  Quercus grisea / Bouteloua curtipendula Woodland (CEGL000689)
- SCHIZACHYRIUM SCOPARIUM BUNCH HERBACEOUS ALLIANCE (A.1266)
  Schizachyrium scoparium var. scoparium - Muhlenbergia pungens Herbaceous Vegetation (CEGL001684)
- SPOROBOLUS AIROIDES HERBACEOUS ALLIANCE (A.1267)
  Sporobolus airoides - Muhlenbergia porteri Herbaceous Vegetation (CEGL001689)

SOURCES

References: Brown 1982, Burgess 1995, Dick-Peddie 1993, McAuliffe 1995, McPherson 1995, Muldavin et al. 2000b, Muldavin et al. 2002

Last updated: 20 Feb 2003 **Stakeholders:** WCS, SCS, LACD

Concept Author: NatureServe Western Ecology Team **LeadResp:** WCS

S080 CHIHUAHUAN GYPSOPHILOUS GRASSLAND AND STEPPE

Division 302, Herbaceous, CES302.732

Spatial Scale & Pattern: Large Patch **Classification Confidence:** medium

Required Classifiers: Natural/Semi-natural, Vegetated (>10% vasc.), Upland

Diagnostic Classifiers: Herbaceous, Tropical/Subtropical [Tropical Xeric], Temperate [Temperate Xeric], Alkaline Soil, Gypsiferous, Dwarf-Shrub, Graminoid

Non-Diagnostic Classifiers: Lowland [Foothill], Lowland [Lowland], Oligotrophic Soil, Aridic

Concept Summary: This ecological system is restricted to gypsum outcrops or sandy gypsiferous and/or often alkaline soils that occur in basins and slopes in the Chihuahuan Desert. Elevation range is from 1100-2000 m. These typically sparse grasslands, steppes or dwarf-shrublands are dominated by a variety of gypsophilous plants, many of which are endemic to these habitats. Characteristic species include *Tiquilia hispidissima, Atriplex canescens, Calylophus hartwegii, Ephedra torreyana, Frankenia jamesii, Bouteloua breviseta, Mentzelia perennis, Nama carnosum, Calylophus hartwegii (= Oenothera hartwegii), Selinocarpus lanceolatus, Sporobolus nealleyi, Sporobolus airoides*, and *Sartwellia flaveriae*. This system does not include the sparsely vegetated gypsum dunes that are included in North American Warm Desert Active and Stabilized Dunes (CES302.744).

Distribution

Range: Basins and slopes in the Chihuahuan Desert; elevation range from 1100-2000 m.
Ecological Divisions: 302
TNC Ecoregions: 22:P, 24:C
Subnations/Nations: AZ:p, MXCH:c, NM:c, TX:c

CONCEPT

Alliances and Associations:

- ATRIPLEX OBOVATA DWARF-SHRUBLAND ALLIANCE (A.1108)
  Atriplex obovata / Tidestromia carnosa Dwarf-shrubland (CEGL004575)
- BOUTELOUA BREVISETA SPARSELY VEGETATED ALLIANCE (A.1870)
  Bouteloua breviseta Sparse Vegetation (CEGL004609)
- SCHIZACHYRIUM SCOPARIUM BUNCH HERBACEOUS ALLIANCE (A.1266)
  Schizachyrium scoparium var. scoparium - Muhlenbergia pungens Herbaceous Vegetation (CEGL001684)
- SPOROBOLUS AIROIDES HERBACEOUS ALLIANCE (A.1267)
  Sporobolus airoides - Scleropogon brevifolius Herbaceous Vegetation (CEGL001692)
- SPOROBOLUS NEALLEYI HERBACEOUS ALLIANCE (A.1269)
  Sporobolus nealleyi - Bouteloua eriopoda Herbaceous Vegetation (CEGL001697)
  Sporobolus nealleyi - Calylophus hartwegii Herbaceous Vegetation (CEGL001698)
- SPOROBOLUS NEALLEYI SHRUB HERBACEOUS ALLIANCE (A.1542)
  Fouquieria splendens / Sporobolus nealleyi Shrub Herbaceous Vegetation (CEGL001517)
- TIDESTROMIA CARNOSA SPARSELY VEGETATED ALLIANCE (A.1873)
  Tidestromia carnosa - Kallstroemia grandiflora Sparse Vegetation (CEGL004580)
- TIQUILIA HISPIDISSIMA DWARF-SHRUBLAND ALLIANCE (A.1101)
  Tiquilia hispidissima - Yucca torreyi / Sporobolus nealleyi Dwarf-shrubland (CEGL003959)
  Tiquilia hispidissima / Bouteloua breviseta - Mentzelia humilis Dwarf-shrubland (CEGL004573)
  Tiquilia hispidissima / Sporobolus airoides Dwarf-shrubland (CEGL004574)
  Tiquilia hispidissima / Sporobolus nealleyi Dwarf-shrubland (CEGL001546)
  Tiquilia hispidissima Dwarf-shrubland [Provisional] (CEGL008425)

SOURCES

References: Dick-Peddie 1993, Henrickson et al. 1985, MacMahon 1988, Muldavin et al. 2000b, Muldavin et al. 2002, Powell and Turner 1974
Last updated: 20 Feb 2003 **Stakeholders:** WCS, SCS, LACD
Concept Author: NatureServe Western Ecology Team **LeadResp:** WCS

S088 WESTERN GREAT PLAINS SHORTGRASS PRAIRIE

Division 303, Herbaceous, CES303.672

Spatial Scale & Pattern: Matrix **Classification Confidence:** high
Required Classifiers: Natural/Semi-natural, Vegetated (>10% vasc.), Upland
Non-Diagnostic Classifiers: Herbaceous, Loam Soil Texture, Ustic, F-Landscape/Low Intensity

Concept Summary: This system is found primarily in the western half of the Western Great Plains Division in the rain shadow of the Rocky Mountains and ranges from the Nebraska Panhandle south into Texas and New Mexico, although grazing impacted examples may reach as far north as southern Canada where it grades into Northwestern Great Plains Mixedgrass Prairie (CES303.674). This system occurs primarily on flat to rolling uplands with loamy, ustic soils ranging from sandy to clayey. In much of its range, this system forms the matrix system with *Bouteloua* gracilis dominating this system. Associated graminoids may include*Aristida purpurea, Bouteloua curtipendula, Bouteloua hirsuta, Buchloe dactyloides, Hesperostipa comata, Koeleria macrantha (= Koeleria cristata), Pascopyrum smithii (= Agropyron smithii), Pleuraphis jamesii, Sporobolus airoides* and *Sporobolus cryptandrus*. Although mid-height grass species may be present especially on more mesic land positions and soils, they are secondary in importance to the sod-forming short grasses. Sandy soils have higher cover of *Hesperostipa comata, Sporobolus cryptandrus*, and *Yucca elata.* Scattered shrub and dwarf-dwarf species such as *Artemisia filifolia, Artemisia frigida, Artemisia tridentata, Atriplex canescens, Eriogonium effusum, Gutierrezia sarothrae, Lycium palida*, may also be present. Also, because this system spans a wide range, there can be some differences in the relative dominance of some species from north to south and from east to west. Large-scale processes such as climate, fire and grazing influence this system. High variation in amount and timing of annual precipitation impacts the relative cover of cool and warm season herbaceous species. In contrast to other prairie systems, fire is less important, especially in the western range of this system, because the often dry and xeric climate conditions can decrease the fuel load and thus the relative fire frequency within the system. However, historically, fires that did occur were often very expansive. Currently, fire suppression and more extensive grazing in the region have likely decreased the fire frequency even more, and it is unlikely that these processes could occur at a natural scale. A large part of the range for this system (especially in the east and near rivers) has been converted to agriculture. Areas of the central and western range have been impacted by the unsuccessful attempts to develop dryland cultivation during the Dust Bowl of the 1930s. The short grasses that dominate this system are extremely drought- and grazing- tolerant. These species evolved with drought and large herbivores and, because of their stature, are relatively resistant to overgrazing. This system in combination with the associated wetland systems represents one of the richest areas for mammals and birds. Endemic bird species to the shortgrass system may constitute one of the fastest declining bird populations.

DISTRIBUTION

Range: This system is found primarily in the western half of the Western Great Plains Division east of the Rocky Mountains and ranges from the Nebraska Panhandle south into panhandles of Oklahoma and Texas and New Mexico, although some examples may reach as far north as southern Canada where it grades into Northwestern Great Plains Mixedgrass Prairie (CES303.674).

Ecological Divisions: 303

TNC Ecoregions: 26:P, 27:C, 28:C, 33:P

Subnations/Nations: CO:c, KS:c, NE:c, NM:c, OK:c, TX:c, WY:c

CONCEPT

Alliances and Associations:

- (COMPLEX)
  Blacktailed Prairie Dog Town Grassland Complex (CECX005703)
- ARISTIDA PURPUREA HERBACEOUS ALLIANCE (A.2570) Aristida purpurea Herbaceous Vegetation (CEGL005800)
- BOUTELOUA CURTIPENDULA HERBACEOUS ALLIANCE (A.1244)
  Bouteloua curtipendula - Bouteloua (eriopoda, gracilis) Herbaceous Vegetation (CEGL002250)
- BOUTELOUA ERIOPODA HERBACEOUS ALLIANCE (A.1284)
  Bouteloua eriopoda - Bouteloua gracilis Herbaceous Vegetation (CEGL001748) Bouteloua eriopoda - Bouteloua hirsuta Herbaceous Vegetation (CEGL001749)
- BOUTELOUA GRACILIS HERBACEOUS ALLIANCE (A.1282)
  Bouteloua gracilis - Bouteloua curtipendula Herbaceous Vegetation (CEGL001754) Bouteloua gracilis - Bouteloua hirsuta Herbaceous Vegetation (CEGL001755)
  Bouteloua gracilis - Buchloe dactyloides - Pleuraphis jamesii Herbaceous Vegetation (CEGL002271)
  Bouteloua gracilis - Buchloe dactyloides Herbaceous Vegetation (CEGL001756)
  Bouteloua gracilis - Buchloe dactyloides Xeric Soil Herbaceous Vegetation (CEGL002270)
  Bouteloua gracilis - Pleuraphis jamesii Herbaceous Vegetation (CEGL001759)
  Bouteloua gracilis Herbaceous Vegetation (CEGL001760)
- BOUTELOUA HIRSUTA HERBACEOUS ALLIANCE (A.1285)
  Bouteloua hirsuta - Bouteloua curtipendula Herbaceous Vegetation (CEGL001764) Bouteloua hirsuta Herbaceous Vegetation [Placeholder] (CEGL002673)
- HESPEROSTIPA NEOMEXICANA HERBACEOUS ALLIANCE (A.1272) Hesperostipa neomexicana Mixed Prairie Herbaceous Vegetation (CEGL001711)
- SPOROBOLUS AIROIDES HERBACEOUS ALLIANCE (A.1267) Sporobolus airoides Southern Plains Herbaceous Vegetation (CEGL001685)
- YUCCA GLAUCA SHRUB HERBACEOUS ALLIANCE (A.1540)
  Yucca glauca / Calamovilfa longifolia Shrub Herbaceous Vegetation (CEGL002675)

Environment: Climate is continental with mean annual precipitation is generally about 300 mm ranging to 500 mm to the south in Texas. Most of the annual precipitation occurs during the growing season as thunderstorms. Precipitation events are mostly <10 cm with occasional larger events.

This system is located on primarily flat to rolling uplands. Soils typically are loamy and ustic and range from sandy to clayey.

Vegetation: This system spans a wide range and thus there can be some differences in the relative dominance of some species from north to south and from east to west. This system is primarily dominated by *Bouteloua* gracilis throughout its range with various associated graminoid species depending on preciptation, soils and management. Associated graminoids may include *Achnatherum hymenoides, Aristida purpurea, Bouteloua curtipendula, Bouteloua hirsuta, Buchloe dactyloides, Carex filifolia, Hesperostipa comata, Koeleria macrantha (= Koeleria cristata), Muhlenbergia torreyana, Pascopyrum smithii (= Agropyron smithii), Pleuraphis jamesii, Sporobolus airoides* and *Sporobolus cryptandrus*. Although mid-height grass species may be present especially on more mesic land positions and soils, they are secondary in importance to the sod-forming short grasses. Sandy soils have higher cover of *Hesperostipa comata, Sporobolus cryptandrus,* and *Yucca elata.* Scattered shrub and dwarf-dwarf species such as *Artemisia filifolia, Artemisia frigida, Artemisia tridentata, Atriplex canescens, Eriogonium effusum, Gutierrezia sarothrae, Lycium palida,* may also be present. High annual variation in amount and timing of precipitation impacts relative cover of herbaceous species. Cover of cool season grasses are dependant on winter and early spring precipitation.

Dynamics: Climate, fire and grazing constitute the primary processes impacting this system. Drought tolerant shortgrass species have root systems that extend up near the soil surface where they can utilize low precipitation events (Sala and Lauenroth 1982). However, fire is less important in this system compared to other Western Great Plains prairie systems, especially in the western portion of its range. Previous comments in the literature citing *Opuntia* spp. increasing with overgrazing may not be borne out by more recent research (R. Rondeau pers. com.). Conversion to agriculture and pastureland with the subsequent irrigation has degraded and extirpated this system in some areas of its range.

SOURCES

References: Barbour and Billings 1988, Dick-Peddie 1993, Lauenroth and Milchunas 1991, Milchunas et al. 1989, Ricketts et al. 1999, Sala and Lauenroth 1982

Sala, O.E. and W.K. Lauenroth. 1982. Samall rainfall events: an ecological role in semi-arid regions. Oecologia Berlin,
53:301-304.

Last updated: 21 Aug 2003 **Stakeholders:** MCS, WCS
Concept Author: S. Menard and K. Kindscher **LeadResp:** MCS

S113 CHIHUAHUAN SANDY PLAINS SEMI-DESERT GRASSLAND
Division 302, Herbaceous, CES302.736

Spatial Scale & Pattern: Large Patch **Classification Confidence:** medium
Required Classifiers: Natural/Semi-natural, Vegetated (>10% vasc.), Upland
Diagnostic Classifiers: Herbaceous, Sand Soil Texture, Graminoid

Non-Diagnostic Classifiers: Lowland [Foothill], Lowland [Lowland], Mesa, Plain, Toeslope/Valley Bottom, Tropical/Subtropical [Tropical Xeric], Temperate [Temperate Continental], Temperate [Temperate Xeric], Aridic, Xeromorphic Shrub, Succulent Shrub

Concept Summary: This ecological system occurs across the Chihuahuan Desert and extends into the southern Great Plains where soils have a high sand content. These dry grasslands or steppe are found on sandy plains and sandstone mesas. The graminoid layer is dominated or codominated by *Achnatherum hymenoides, Bouteloua eriopoda, Bouteloua hirsuta, Hesperostipa neomexicana, Pleuraphis jamesii, Sporobolus cryptandrus*, Sporobolus airoides or *Sporobolus flexuosus*. Typically, there are found scattered desert shrubs and stem succulents such as *Ephedra torreyana, Ephedra trifurca, Fallugia paradoxa, Prosopis glandulosa,Yucca elata*, and *Yucca torreyi* that are characteristic of the Chihuahuan Desert.

DISTRIBUTION

Range: Chihuahuan Desert extending into the southern Great Plains where soils have a high sand content.
Ecological Divisions: 302
TNC Ecoregions: 22:C, 24:C, 28:C
Subnations/Nations: AZ:c, MXCH:c, NM:c, TX:c

CONCEPT

Alliances and Associations:
- BOUTELOUA ERIOPODA XEROMORPHIC SHRUB HERBACEOUS ALLIANCE (A.1553)
  Ephedra torreyana / Bouteloua eriopoda Shrub Herbaceous Vegetation (CEGL001731)
  Ephedra trifurca / Bouteloua eriopoda Shrub Herbaceous Vegetation (CEGL001732)
  Yucca elata / Bouteloua eriopoda Shrub Herbaceous Vegetation (CEGL001735)
- SPOROBOLUS FLEXUOSUS HERBACEOUS ALLIANCE (A.1268)
  Sporobolus flexuosus - Paspalum setaceum Herbaceous Vegetation (CEGL001694)
  Sporobolus flexuosus - Sporobolus contractus Herbaceous Vegetation (CEGL001696)

SOURCES

References: Dick-Peddie 1993, Muldavin et al. 2000b, Muldavin et al. 2002
Last updated: 20 Feb 2003 **Stakeholders:** WCS, SCS, LACD
Concept Author: NatureServe Western Ecology Team **LeadResp:** WCS

NLCD Woody Wetland Types

Areas where forest or shrubland vegetation accounts for greater than 20 percent of vegetative cover and the soil or substrate is periodically saturated with or covered with water.

S094 NORTH AMERICAN WARM DESERT LOWER MONTANE RIPARIAN WOODLAND AND SHRUBLAND

Division 302, Woody Wetland, CES302.748

Spatial Scale & Pattern: Linear **Classification Confidence:** medium
Required Classifiers: Natural/Semi-natural, Vegetated (>10% vasc.), Wetland
Diagnostic Classifiers: Forest and Woodland (Treed), Shrubland (Shrub-dominated), Riverine / Alluvial

Non-Diagnostic Classifiers: Lowland [Lowland], Tropical/Subtropical [Tropical Xeric], Temperate [Temperate Xeric], Short (50-100 yrs) Persistence

Concept Summary: This ecological system occurs in mountain canyons and valleys of southern Arizona and New Mexico, and adjacent Mexico and consists of mid- to low-elevation (1100-1800 m) riparian corridors along perennial and seasonally intermittent streams. The vegetation is a mix of riparian woodlands and shrublands. Dominant trees include *Populus angustifolia, Populus deltoides ssp. wislizeni, Populus fremontii, Platanus wrightii, Juglans major, Fraxinus velutina*, and *Sapindus saponaria*. Shrub dominants include *Salix exigua, Prunus* spp., *Alnus oblongifolia*, and *Baccharis salicifolia*. Vegetation is dependent upon annual or periodic flooding and associated sediment scour and/or annual rise in the water table for growth and reproduction.

DISTRIBUTION

Range: Southern Arizona and New Mexico, and adjacent Mexico.
Ecological Divisions: 302
TNC Ecoregions: 17:C, 22:C, 23:C, 24:C
Subnations/Nations: AZ:c, CA:c, MXBC:c, MXBS:c, MXCH:c, MXSO:c, NM:c, NV:c, TX:c

CONCEPT

Alliances and Associations:

- ALHAGI MAURORUM SEMI-NATURAL SHRUBLAND ALLIANCE (A.2567)
  Alhagi maurorum Semi-natural Shrubland (CEGL002784)
- BETULA OCCIDENTALIS TEMPORARILY FLOODED SHRUBLAND ALLIANCE (A.967)
  Populus fremontii / Betula occidentalis Wooded Shrubland (CEGL002981)
- JUGLANS MAJOR TEMPORARILY FLOODED SHRUBLAND ALLIANCE (A.957)
  Juglans major - Pinus edulis / Bromus carinatus Shrubland (CEGL001101)
  Juglans major Shrubland [Provisional] (CEGL001102)
- JUGLANS MICROCARPA TEMPORARILY FLOODED SHRUBLAND ALLIANCE (A.945)
  Juglans microcarpa / Cladium mariscus ssp. jamaicense Shrubland (CEGL004593)
  Juglans microcarpa / Sorghastrum nutans Shrubland (CEGL004594)
  Juglans microcarpa Shrubland (CEGL001103)
- PLATANUS WRIGHTII TEMPORARILY FLOODED FOREST ALLIANCE (A.309)
  Platanus wrightii - Alnus oblongifolia / Baccharis salicifolia Forest (CEGL002686)
  Platanus wrightii - Fraxinus velutina Forest (CEGL000644)
  Platanus wrightii - Juglans major Forest (CEGL000645)
- PLATANUS WRIGHTII TEMPORARILY FLOODED WOODLAND ALLIANCE (A.643)
  Platanus wrightii Woodland (CEGL000937)
- POPULUS ANGUSTIFOLIA TEMPORARILY FLOODED FOREST ALLIANCE (A.310)
  Populus angustifolia / Rosa woodsii Forest (CEGL000653)
- POPULUS ANGUSTIFOLIA TEMPORARILY FLOODED WOODLAND ALLIANCE (A.641)
  Populus angustifolia - Juniperus deppeana / Brickellia californica Woodland (CEGL000933)
  Populus angustifolia / Alnus oblongifolia Woodland (CEGL000938)
  Populus angustifolia / Salix exigua Woodland (CEGL000654)
  Populus angustifolia / Salix irrorata Woodland (CEGL002647)
- POPULUS DELTOIDES SSP. WISLIZENI TEMPORARILY FLOODED FOREST ALLIANCE (A.312)
  Populus deltoides ssp. wislizeni / Baccharis sarothroides Forest (CEGL000663)
- POPULUS DELTOIDES TEMPORARILY FLOODED WOODLAND ALLIANCE (A.636)
  Populus deltoides ssp. wislizeni / Rhus trilobata Woodland (CEGL000940)
- POPULUS FREMONTII SEASONALLY FLOODED WOODLAND ALLIANCE (A.654)
  Populus fremontii / Muhlenbergia rigens Woodland (CEGL001455)
  Populus fremontii / Salix geyeriana Woodland (CEGL000943)
- POPULUS FREMONTII TEMPORARILY FLOODED FOREST ALLIANCE (A.313)

Populus fremontii - Platanus wrightii Forest (CEGL000665)
Populus fremontii - Salix gooddingii / Baccharis salicifolia Forest (CEGL002683)
Populus fremontii - Salix gooddingii / Salix exigua Forest (CEGL002684)
Populus fremontii / Acer negundo Forest (CEGL000662)
Populus fremontii Forest [Placeholder] (CEGL000661)

- POPULUS FREMONTII TEMPORARILY FLOODED WOODLAND ALLIANCE (A.644)
  Populus fremontii - Fraxinus velutina Woodland (CEGL000942)
  Populus fremontii - Salix gooddingii Woodland (CEGL000944)
  Populus fremontii / Baccharis emoryi Woodland [Provisional] (CEGL002946)
  Populus fremontii / Baccharis salicifolia Woodland (CEGL000941)
- RHUS TRILOBATA INTERMITTENTLY FLOODED SHRUBLAND ALLIANCE (A.938)
  Rhus trilobata - Prunus serotina Shrubland (CEGL001119)
- ROBINIA NEOMEXICANA SHRUBLAND ALLIANCE (A.924)
  Robinia neomexicana / Thalictrum fendleri Shrubland (CEGL001125)
- SALIX (EXIGUA, INTERIOR) TEMPORARILY FLOODED SHRUBLAND ALLIANCE (A.947)
  Salix exigua / Agrostis stolonifera Shrubland (CEGL001199)
  Salix exigua / Elymus X pseudorepens Shrubland (CEGL001198)
- SALIX BONPLANDIANA TEMPORARILY FLOODED FOREST ALLIANCE (A.314)
  Salix bonplandiana Forest (CEGL000679)
- SALIX EXIGUA SEASONALLY FLOODED WOODLAND ALLIANCE (A.649)
  Salix exigua / Baccharis salicifolia - Baccharis neglecta / Schoenoplectus spp. Woodland (CEGL004587)
- SALIX GOODDINGII TEMPORARILY FLOODED WOODLAND ALLIANCE (A.640)
  Salix gooddingii - Fraxinus velutina Temporarily Flooded Woodland (CEGL003729)
  Salix gooddingii Woodland [Provisional] (CEGL002743)
- SALIX IRRORATA TEMPORARILY FLOODED SHRUBLAND ALLIANCE (A.976)
  Salix irrorata Shrubland (CEGL001214)
- SALIX LAEVIGATA TEMPORARILY FLOODED WOODLAND ALLIANCE (A.646)
  Salix laevigata - Fraxinus velutina Woodland (CEGL000950)
  Salix laevigata Woodland [Provisional] (CEGL002952)
- TAMARIX SPP. SEMI-NATURAL TEMPORARILY FLOODED SHRUBLAND ALLIANCE (A.842)
  Tamarix spp. Temporarily Flooded Shrubland (CEGL003114)

SOURCES

References: Brown 1982, Dick-Peddie 1993, Muldavin et al. 2000a, Szaro 1989, Thomas et al. 2003a
Last updated: 20 Feb 2003 **Stakeholders:** WCS, SCS
Concept Author: NatureServe Western Ecology Team **LeadResp:** WCS

S097 NORTH AMERICAN WARM DESERT RIPARIAN WOODLAND AND SHRUBLAND

Division 302, Woody Wetland, CES302.753

Spatial Scale & Pattern: Linear **Classification Confidence:** medium
Required Classifiers: Natural/Semi-natural, Vegetated (>10% vasc.), Wetland
Diagnostic Classifiers: Lowland [Lowland], Forest and Woodland (Treed), Shrubland (Shrub-dominated), Tropical/Subtropical [Tropical Xeric], Temperate [Temperate Xeric], Riverine / Alluvial

Non-Diagnostic Classifiers: Toeslope/Valley Bottom, Short (50-100 yrs) Persistence

Concept Summary: This ecological system consists of low-elevation (<1200 m) riparian corridors along medium to large perennial streams throughout canyons and the desert valleys of the southwestern United States and adjacent Mexico. The vegetation is a mix of riparian woodlands and shrublands. Dominant trees include *Acer negundo, Fraxinus velutina, Populus fremontii, Salix gooddingii, Salix lasiolepis, Celtis laevigata var. reticulata*, and *Juglans major*. Shrub dominants include *Salix geyeriana, Shepherdia argentea*, and *Salix exigua*. Vegetation is dependent upon annual or periodic flooding and associated sediment scour and/or annual rise in the water table for growth and reproduction.

DISTRIBUTION

Range: Throughout canyons and the desert valleys of the southwestern United States and adjacent Mexico.
Ecological Divisions: 302

TNC Ecoregions: 17:C, 22:C, 23:C, 24:C, 29:P
Subnations/Nations: AZ:c, CA:c, MXBC:c, MXCH:c, MXSO:c, NM:c, NV:c, TX:c

CONCEPT

Alliances and Associations:

- ARUNDO DONAX TEMPORARILY FLOODED HERBACEOUS ALLIANCE (A.1339)
  Arundo donax Riverbank Herbaceous Vegetation (CEGL004101)
- CELTIS LAEVIGATA VAR. RETICULATA SHRUBLAND ALLIANCE (A.1033)
  Celtis laevigata var. reticulata / Celtis pallida Shrubland (CEGL001163)
- JUGLANS MAJOR TEMPORARILY FLOODED SHRUBLAND ALLIANCE (A.957)
  Juglans major - Pinus edulis / Bromus carinatus Shrubland (CEGL001101)
  Juglans major Shrubland [Provisional] (CEGL001102)
- JUGLANS MICROCARPA TEMPORARILY FLOODED SHRUBLAND ALLIANCE (A.945)
  Celtis laevigata var. reticulata - Juglans microcarpa / Leptochloa dubia Shrubland (CEGL002166)
  Juglans microcarpa / Cladium mariscus ssp. jamaicense Shrubland (CEGL004593)
  Juglans microcarpa / Sorghastrum nutans Shrubland (CEGL004594)
  Juglans microcarpa Shrubland (CEGL001103)
- PLATANUS RACEMOSA TEMPORARILY FLOODED WOODLAND ALLIANCE (A.634)
  Platanus racemosa Temporarily Flooded Woodland [Placeholder] (CEGL003079)
- PLATANUS WRIGHTII TEMPORARILY FLOODED FOREST ALLIANCE (A.309)
  Platanus wrightii - Alnus oblongifolia / Baccharis salicifolia Forest (CEGL002686)
  Platanus wrightii - Fraxinus velutina Forest (CEGL000644)
  Platanus wrightii - Juglans major Forest (CEGL000645)
- PLATANUS WRIGHTII TEMPORARILY FLOODED WOODLAND ALLIANCE (A.643)
  Platanus wrightii Woodland (CEGL000937)
- POPULUS DELTOIDES SSP. WISLIZENI TEMPORARILY FLOODED FOREST ALLIANCE (A.312)
  Populus deltoides / Muhlenbergia asperifolia Forest (CEGL000678)
  Populus deltoides ssp. wislizeni / Baccharis sarothroides Forest (CEGL000663)
- POPULUS DELTOIDES TEMPORARILY FLOODED WOODLAND ALLIANCE (A.636)
  Populus deltoides ssp. wislizeni / Rhus trilobata Woodland (CEGL000940)
- POPULUS FREMONTII SEASONALLY FLOODED WOODLAND ALLIANCE (A.654)
  Populus fremontii / Leymus triticoides Woodland (CEGL002756)
  Populus fremontii / Muhlenbergia rigens Woodland (CEGL001455)
- POPULUS FREMONTII TEMPORARILY FLOODED FOREST ALLIANCE (A.313)
  Populus fremontii - Celtis laevigata var. reticulata / Salvia pinguifolia Forest (CEGL000664)
  Populus fremontii - Platanus wrightii Forest (CEGL000665)
  Populus fremontii - Salix gooddingii / Baccharis salicifolia Forest (CEGL002683)
  Populus fremontii - Salix gooddingii / Salix exigua Forest (CEGL002684)
  Populus fremontii / Acer negundo Forest (CEGL000662)
  Populus fremontii Forest [Placeholder] (CEGL000661)
- POPULUS FREMONTII TEMPORARILY FLOODED WOODLAND ALLIANCE (A.644)
  Populus fremontii - Fraxinus velutina Woodland (CEGL000942)
  Populus fremontii - Salix gooddingii Woodland (CEGL000944)
  Populus fremontii / Baccharis salicifolia Woodland (CEGL000941)
- PARKINSONIA FLORIDA - OLNEYA TESOTA WOODLAND ALLIANCE (A.588)
- Parkinsonia florida - Olneya tesota Woodland [Placeholder] (CEGL003035)
- SALIX (EXIGUA, INTERIOR) TEMPORARILY FLOODED SHRUBLAND ALLIANCE (A.947)
  Salix exigua / Agrostis stolonifera Shrubland (CEGL001199)
  Salix exigua / Barren Shrubland (CEGL001200)
- SALIX GOODDINGII TEMPORARILY FLOODED WOODLAND ALLIANCE (A.640)
  Salix gooddingii - Fraxinus velutina Temporarily Flooded Woodland (CEGL003729)
  Salix gooddingii Woodland [Provisional] (CEGL002743)
- TAMARIX SPP. SEMI-NATURAL TEMPORARILY FLOODED SHRUBLAND ALLIANCE (A.842)
  Tamarix spp. Temporarily Flooded Shrubland (CEGL003114)

- **California community types:**
- Sonoran Cottonwood - Willow Riparian (61.130.05)
- Arroyo Willow Riparian Forests and Woodlands (61.201.00)
- Central Coast Arroyo Willow Riparian (61.201.01)
- Southern Arroyo Willow Riparian (61.201.02)
- Arroyo Willow / Blackberry Riparian (61.201.03)
- Arroyo Willow - Shining Willow (61.201.04)
- Black Willow Riparian Forests and Woodlands (61.202.00)

- Red Willow Riparian Forests (61.205.00)
- Red Willow (61.205.01)
- Red Willow / Arroyo Willow (61.205.02)
- Gooding Willow (61.211.01)
- Desert Olive Scrub (61.580.00)
- Desert Olive (61.580.01)
- Oregon Ash Riparian Forest (61.960.00)
- Narrowleaf Willow (63.110.00)
- Narrowleaf Willow - Desert Baccharis (63.110.01)
- Narrow-leaf Willow Riparian Scrub (63.110.02)
- Lemmon's Willow Riparian Scrub (63.113.00)
- Lemmon's Willow (63.113.01)
- Tamarisk Scrubs and Woodlands (63.810.00)
- Shrub Tamarisk (63.810.02)

SOURCES

References: Barbour and Major 1988, Brown 1982, Dick-Peddie 1993, Holland and Keil 1995, Muldavin et al. 2000a, Szaro 1989

Last updated: 20 Feb 2003 **Stakeholders:** WCS, SCS

Concept Author: NatureServe Western Ecology Team **LeadResp:** WCS

NLCD Emergent Herbaceous Wetland Types

Areas where perennial herbaceous vegetation accounts for greater than 80 percent of vegetative cover and the soil or substrate is periodically sturated with or covered with water.

S100 NORTH AMERICAN ARID WEST EMERGENT MARSH

Division 300, Herbaceous Wetland, CES300.729

Spatial Scale & Pattern: Small Patch **Classification Confidence:** high

Required Classifiers: Natural/Semi-natural, Vegetated (>10% vasc.), Wetland

Diagnostic Classifiers: Herbaceous, Mineral: W/ A-Horizon >10 cm, Graminoid, Aquatic Herb, Depressional [Lakeshore], Depressional [Pond], Deep (>15 cm) Water, Saturated Soil

Non-Diagnostic Classifiers: Montane [Montane], Montane [Lower Montane], Lowland [Foothill], Lowland [Lowland], Backwater, Drainage bottom (undifferentiated), Floodplain, Marsh, Oxbow, Pond, Temperate [Temperate Continental], Forb, Alga, Clay Subsoil Texture

Concept Summary: This widespread ecological system occurs throughout much of the arid and semi-arid regions of western North America. Natural marshes may occur in depressions in the landscape (ponds, kettle ponds), as fringes around lakes, and along slow-flowing streams and rivers (such riparian marshes are also referred to as sloughs). Marshes are frequently or continually inundated, with water depths up to 2 m. Water levels may be stable, or may fluctuate 1 m or more over the course of the growing season. Marshes have distinctive soils that are typically mineral, but can also accumulate organic material. Soils have characteristics that result from long periods of anaerobic conditions in the soils (e.g., gleyed soils, high organic content, redoximorphic features). The vegetation is characterized by herbaceous plants that are adapted to saturated soil conditions. Common emergent and floating vegetation includes species of *Scirpus* and/or *Schoenoplectus, Typha, Juncus, Potamogeton, Polygonum, Nuphar*, and *Phalaris*. This system may also include areas of relatively deep water with floating-leaved plants (*Lemna, Potamogeton*, and *Brasenia*) and submergent and floating plants (*Myriophyllum, Ceratophyllum*, and *Elodea*).

DISTRIBUTION

Range: Occurs throughout much of the arid and semi-arid regions of western North America.

Ecological Divisions: 301, 302, 303, 304, 305, 306

TNC Ecoregions: 11:C, 17:C, 18:C, 19:C, 20:C, 21:C, 23:C, 24:C, 26:C, 27:C, 28:C, 29:C, 30:C, 6:C, 7:C, 8:C, 9:C

Subnations/Nations: AB:c, AZ:c, BC:c, CA:c, CO:c, ID:c, MT:c, MXBC:c, MXCH:c, MXSO:c, ND:c, NE:c, NM:c, NV:c, OK:c, OR:c, SD:c, TX:c, UT:c, WA:c, WY:c

CONCEPT

Alliances and Associations:

- (POTAMOGETON DIVERSIFOLIUS, STUCKENIA FILIFORMIS) PERMANENTLY FLOODED HERBACEOUS ALLIANCE (A.1763)
  Potamogeton diversifolius Herbaceous Vegetation (CEGL002007)

Stuckenia filiformis Herbaceous Vegetation (CEGL002008)

- CALAMAGROSTIS CANADENSIS SEASONALLY FLOODED HERBACEOUS ALLIANCE (A.1400)
  Calamagrostis canadensis Western Herbaceous Vegetation (CEGL001559)
- CAREX (ROSTRATA, UTRICULATA) SEASONALLY FLOODED HERBACEOUS ALLIANCE (A.1403)
  Carex utriculata Herbaceous Vegetation (CEGL001562)
- CAREX NEBRASCENSIS SEASONALLY FLOODED HERBACEOUS ALLIANCE (A.1417)
  Carex nebrascensis Herbaceous Vegetation (CEGL001813)
- CAREX VESICARIA SEASONALLY FLOODED HERBACEOUS ALLIANCE (A.2501)
  Carex vesicaria Herbaceous Vegetation (CEGL002661)
- DISTICHLIS SPICATA INTERMITTENTLY FLOODED HERBACEOUS ALLIANCE (A.1332)
  Distichlis spicata - (Scirpus nevadensis) Herbaceous Vegetation (CEGL001773)
- ELEOCHARIS (MONTEVIDENSIS, PALUSTRIS, QUINQUEFLORA) SEASONALLY FLOODED HERBACEOUS ALLIANCE (A.1371)
  Eleocharis (montevidensis, palustris, quinqueflora) Seasonally Flooded Herbaceous Vegetation [Placeholder] (CEGL003050)
- GLYCERIA BOREALIS SEMIPERMANENTLY FLOODED HERBACEOUS ALLIANCE (A.1445)
  Glyceria borealis Herbaceous Vegetation (CEGL001569)
- JUNCUS BALTICUS SEASONALLY FLOODED HERBACEOUS ALLIANCE (A.1374)
  Juncus balticus - Carex rossii Herbaceous Vegetation (CEGL001839)
  Juncus balticus Herbaceous Vegetation (CEGL001838)
- LEMNA SPP. PERMANENTLY FLOODED HERBACEOUS ALLIANCE (A.1747)
  Lemna spp. Permanently Flooded Herbaceous Vegetation (CEGL003059)
- MYRIOPHYLLUM SIBIRICUM PERMANENTLY FLOODED HERBACEOUS ALLIANCE (A.1761)
  Myriophyllum sibiricum Herbaceous Vegetation (CEGL002000)
- NYMPHAEA ODORATA - NUPHAR SPP. PERMANENTLY FLOODED TEMPERATE HERBACEOUS ALLIANCE (A.1984)
  Nuphar lutea ssp. polysepala Herbaceous Vegetation (CEGL002001)
- PHALARIS ARUNDINACEA SEASONALLY FLOODED HERBACEOUS ALLIANCE (A.1381)
  Phalaris arundinacea Western Herbaceous Vegetation (CEGL001474)
- PHRAGMITES AUSTRALIS SEMIPERMANENTLY FLOODED HERBACEOUS ALLIANCE (A.1431)
  Phragmites australis Western North America Temperate Semi-natural Herbaceous Vegetation (CEGL001475)
- POTAMOGETON FOLIOSUS PERMANENTLY FLOODED HERBACEOUS ALLIANCE (A.2518)
  Potamogeton foliosus Herbaceous Vegetation (CEGL002742)
- POTAMOGETON SPP. - CERATOPHYLLUM SPP. - ELODEA SPP. PERMANENTLY FLOODED HERBACEOUS ALLIANCE (A.1754)
  Potamogeton natans Herbaceous Vegetation (CEGL002925)
- RANUNCULUS AQUATILIS SEMIPERMANENTLY FLOODED HERBACEOUS ALLIANCE (A.1679)
  Ranunculus aquatilis - Callitriche palustris Herbaceous Vegetation (CEGL001984)
- RUPPIA (CIRRHOSA, MARITIMA) PERMANENTLY FLOODED HERBACEOUS ALLIANCE (A.1755)
  Ruppia (cirrhosa, maritima) Permanently Flooded Herbaceous Vegetation [Placeholder] (CEGL003119)
- SALICORNIA RUBRA SEASONALLY FLOODED HERBACEOUS ALLIANCE (A.1818)
  Salicornia rubra Herbaceous Vegetation (CEGL001999)
- SCHOENOPLECTUS ACUTUS - (SCHOENOPLECTUS TABERNAEMONTANI) SEMIPERMANENTLY FLOODED HERBACEOUS ALLIANCE (A.1443)
  Schoenoplectus acutus Herbaceous Vegetation (CEGL001840)
  Schoenoplectus tabernaemontani Temperate Herbaceous Vegetation (CEGL002623)
- SCHOENOPLECTUS AMERICANUS SEMIPERMANENTLY FLOODED HERBACEOUS ALLIANCE (A.1432)
  Schoenoplectus americanus - Carex spp. Herbaceous Vegetation (CEGL004144)
  Schoenoplectus americanus - Eleocharis palustris Herbaceous Vegetation (CEGL001585)
  Schoenoplectus americanus - Eleocharis spp. Herbaceous Vegetation (CEGL001586)
  Schoenoplectus americanus - Flaveria chlorifolia - (Helianthus paradoxus) Herbaceous Vegetation (CEGL004592)
  Schoenoplectus americanus Western Herbaceous Vegetation (CEGL001841)
- SCHOENOPLECTUS MARITIMUS SEMIPERMANENTLY FLOODED HERBACEOUS ALLIANCE (A.1444)
  Schoenoplectus maritimus Herbaceous Vegetation (CEGL001843)
- SCHOENOPLECTUS PUNGENS SEMIPERMANENTLY FLOODED HERBACEOUS ALLIANCE (A.1433)
  Schoenoplectus pungens Herbaceous Vegetation (CEGL001587)
- SPARGANIUM ANGUSTIFOLIUM PERMANENTLY FLOODED HERBACEOUS ALLIANCE (A.1760)
  Sparganium angustifolium Herbaceous Vegetation (CEGL001990)
- SPARGANIUM EURYCARPUM PERMANENTLY FLOODED HERBACEOUS ALLIANCE (A.2598)
  Sparganium eurycarpum Herbaceous Vegetation (CEGL003323)
- SPARTINA GRACILIS SEASONALLY FLOODED HERBACEOUS ALLIANCE (A.1407)
  Spartina gracilis Herbaceous Vegetation (CEGL001588)
- SPARTINA PECTINATA TEMPORARILY FLOODED HERBACEOUS ALLIANCE (A.1347)
  Spartina pectinata Western Herbaceous Vegetation (CEGL001476)

- TRIGLOCHIN MARITIMA SEMIPERMANENTLY FLOODED HERBACEOUS ALLIANCE (A.1681)
  Triglochin maritima Herbaceous Vegetation (CEGL001995)
- TYPHA (ANGUSTIFOLIA, LATIFOLIA) - (SCHOENOPLECTUS SPP.) SEMIPERMANENTLY FLOODED HERBACEOUS ALLIANCE (A.1436)
  Schoenoplectus acutus - Typha latifolia - (Schoenoplectus tabernaemontani) Sandhills Herbaceous Vegetation (CEGL002030)
  Typha latifolia Western Herbaceous Vegetation (CEGL002010)
- TYPHA DOMINGENSIS SEASONALLY FLOODED TEMPERATE HERBACEOUS ALLIANCE (A.1392)
  Typha domingensis Western Herbaceous Vegetation (CEGL001845)

SOURCES

References: Brown 1982, Cooper 1986b, Dick-Peddie 1993, Faber-Langendoen et al. 1997, Hansen et al. 1995, Kittel et al. 1994, Neely et al. 2001, Padgett et al. 1989, Rondeau 2001, Szaro 1989, Ungar 1965, Ungar 1972
Last updated: 20 Feb 2003 **Stakeholders:** WCS, SCS
Concept Author: NatureServe Western Ecology Team **LeadResp:** WCS

S108 WESTERN GREAT PLAINS SALINE DEPRESSION WETLAND

Division 303, Herbaceous Wetland, CES303.669

Spatial Scale & Pattern: Small Patch **Classification Confidence:** medium
Required Classifiers: Natural/Semi-natural, Vegetated (>10% vasc.), Wetland
Non-Diagnostic Classifiers: Herbaceous, Depression, Saline Water Chemistry

Concept Summary: This system is very similar to Northwestern Great Plains Open Freshwater Depression (CES303.675) and Western Great Plains Closed Depression Wetland (CES303.666). However, strongly saline soils cause both the shallow lakes and depressions and the surrounding areas to be more brackish. Salt encrustations can occur on the surface in some examples of this system, and the soils are severely affected and have poor structure. Species that typify this system are salt-tolerant and halophytic species such as *Distichlis spicata, Sporobolus airoides*, and *Hordeum jubatum*. During exceptionally wet years, an increase in precipitation can dilute the salt concentration in the soils of some of examples of this system which may allow for less salt-tolerant species to occur. Communities found within this system may also occur in floodplains (i.e., more open depressions), but probably should not be considered a separate system unless they transition to areas outside the immediate floodplain.

Comments: Open and emergent saline marshes may be a separate system from saline wet meadows and prairies.

DISTRIBUTION

Range: This system can occur throughout the Western Great Plains, but is likely more prevalent in the south-central portions of the division.
Ecological Divisions: 303

TNC Ecoregions: 26:?, 27:C, 28:C, 33:C, 34:?
Subnations/Nations: CO:c, KS:c, MT:p, ND:c, NE:c, NM:c, OK:c, SD:c, WY:c

CONCEPT

Alliances and Associations:
- CAREX SPP. - PLANTAGO ERIOPODA TEMPORARILY FLOODED HERBACEOUS ALLIANCE (A.1350)
  Calamagrostis stricta - Carex sartwellii - Carex praegracilis - Plantago eriopoda Saline Herbaceous Vegetation (CEGL002255)
- DISTICHLIS SPICATA - (HORDEUM JUBATUM) TEMPORARILY FLOODED HERBACEOUS ALLIANCE (A.1341)
  Distichlis spicata - (Hordeum jubatum, Poa arida, Sporobolus airoides) Herbaceous Vegetation (CEGL002042)
  Distichlis spicata - Hordeum jubatum - (Poa arida, Iva annua) Herbaceous Vegetation (CEGL002031)
  Distichlis spicata - Hordeum jubatum - Puccinellia nuttalliana - Suaeda calceoliformis Herbaceous Vegetation (CEGL002273)
  Distichlis spicata - Schoenoplectus maritimus - Salicornia rubra Herbaceous Vegetation (CEGL002043)
  Distichlis spicata - Spartina spp. Herbaceous Vegetation (CEGL002275)
- DISTICHLIS SPICATA INTERMITTENTLY FLOODED HERBACEOUS ALLIANCE (A.1332)
  Distichlis spicata Herbaceous Vegetation (CEGL001770)
- HORDEUM JUBATUM TEMPORARILY FLOODED HERBACEOUS ALLIANCE (A.1358)
  Hordeum jubatum Herbaceous Vegetation (CEGL001798)
- PASCOPYRUM SMITHII TEMPORARILY FLOODED HERBACEOUS ALLIANCE (A.1354)
  Pascopyrum smithii - Distichlis spicata Herbaceous Vegetation (CEGL001580)
  Pascopyrum smithii - Hordeum jubatum Herbaceous Vegetation (CEGL001582)
- PUCCINELLIA NUTTALLIANA INTERMITTENTLY FLOODED HERBACEOUS ALLIANCE (A.1335)
  Puccinellia nuttalliana Herbaceous Vegetation (CEGL001799)

- SALICORNIA RUBRA SEASONALLY FLOODED HERBACEOUS ALLIANCE (A.1818)
  Salicornia rubra Herbaceous Vegetation (CEGL001999)
- SARCOBATUS VERMICULATUS INTERMITTENTLY FLOODED SHRUB HERBACEOUS ALLIANCE (A.1554)
  Sarcobatus vermiculatus / Pascopyrum smithii - (Elymus lanceolatus) Shrub Herbaceous Vegetation (CEGL001508)
- SARCOBATUS VERMICULATUS SHRUB HERBACEOUS ALLIANCE (A.1535)
  Sarcobatus vermiculatus / Distichlis spicata - (Puccinellia nuttalliana) Shrub Herbaceous Vegetation (CEGL002146)
- SCHOENOPLECTUS AMERICANUS SEMIPERMANENTLY FLOODED HERBACEOUS ALLIANCE (A.1432)
  Schoenoplectus americanus - Carex spp. Herbaceous Vegetation (CEGL004144)
  Schoenoplectus americanus Great Plains Herbaceous Vegetation (CEGL002226)
- SCHOENOPLECTUS MARITIMUS SEMIPERMANENTLY FLOODED HERBACEOUS ALLIANCE (A.1444)
  Schoenoplectus maritimus - Schoenoplectus acutus - (Triglochin maritima) Herbaceous Vegetation (CEGL002227)
  Schoenoplectus maritimus Herbaceous Vegetation (CEGL001843)
- SCHOENOPLECTUS PUNGENS SEMIPERMANENTLY FLOODED HERBACEOUS ALLIANCE (A.1433)
  Schoenoplectus pungens - Suaeda calceoliformis Alkaline Herbaceous Vegetation (CEGL002040)
  Schoenoplectus pungens Herbaceous Vegetation (CEGL001587)
- SCOLOCHLOA FESTUCACEA SEASONALLY FLOODED HERBACEOUS ALLIANCE (A.1401)
  Scolochloa festucacea Herbaceous Vegetation (CEGL002260)
- SPARTINA PECTINATA TEMPORARILY FLOODED HERBACEOUS ALLIANCE (A.1347)
  Spartina pectinata - Schoenoplectus pungens Herbaceous Vegetation (CEGL001478)
- SPOROBOLUS AIROIDES HERBACEOUS ALLIANCE (A.1267)
  Sporobolus airoides Monotype Herbaceous Vegetation (CEGL001688)
  Sporobolus airoides Northern Plains Herbaceous Vegetation (CEGL002274)
  Sporobolus airoides Southern Plains Herbaceous Vegetation (CEGL001685)
- STUCKENIA PECTINATA PERMANENTLY FLOODED HERBACEOUS ALLIANCE (A.1764)
  Stuckenia pectinata - Ruppia maritima Herbaceous Vegetation (CEGL002004)
  Stuckenia pectinata - Zannichellia palustris Herbaceous Vegetation (CEGL002005)
- TYPHA (ANGUSTIFOLIA, LATIFOLIA) - (SCHOENOPLECTUS SPP.) SEMIPERMANENTLY FLOODED HERBACEOUS ALLIANCE (A.1436)
  Typha spp. - Schoenoplectus spp. - Mixed Herbs Great Plains Herbaceous Vegetation (CEGL002228)
  Typha spp. Great Plains Herbaceous Vegetation (CEGL002389)

Environment: This system is distinct from the freshwater depression systems by its brackish nature caused by strongly saline soils. Salt encrustations could occur near the surface in some examples of this system.

Vegetation: Salt-tolerant and halophytic species such as *Distichlis spicata, Sporobolus airoides,* and *Hordeum jubatum* typify the system.

Dynamics: Hydrology processes primarily drive this system. Increases in precipitation and/or runoff can dilute the salt concentration and allow for less salt tolerant species to occur. Conversion to agriculture and pastureland can also impact this system, especially when it alters the hydrology of the system.

SOURCES

References: Hoagland 2000, Lauver et al. 1999, Steinauer and Rolfsmeier 2000
Last updated: 05 Mar 2003 **Stakeholders:** MCS, WCS
Concept Author: S. Menard and K. Kindscher **LeadResp:** MCS

Appendix F
Wildlife and Plant Survey Report

CEHMM
505 North Main Street, Carlsbad, NM 88220 • 575-885-3700 • www.cehmm.org

Foth – Intrepid AMAX Surveys

The Center of Excellence for Hazardous Materials Management (CEHMM) was contracted by Foth Infrastructure to conduct noxious weed, burrowing owl, and raptor nest surveys for two pipeline routes at the Intrepid AMAX Expansion site. CEHMM dispatched wildlife technicians to the field on February 18, 2015 and February 19, 2015. Two technicians walked the length of the flagged pipeline routes, proposed roads, and well sites for the presence of African Rue, Malta Starthistle, and raptor and burrowing owl nests within 200 meters of the proposed right-of-way. GPS coordinates and photographs of all observations were taken. All work conducted was in full compliance with the Bureau of Land Management (BLM) specifications.

No noxious weeds were identified during these surveys, although *Lepidium* and *Phacelia* were found in abundance. Although these weeds are not a concern to the BLM, they were noted by the technicians due to their abundance at the site. Two long-eared owls and a Cooper's hawk were flushed during these surveys. One raptor nest was observed. Whitewash and castings suggesting the presence of raptors were also observed in an existing draw. No evidence of burrowing owls was observed. Small mammal burrows were observed throughout the length of the pipeline but were not recorded. Surveys concluded on February 19, 2015.

Below please find our datasheets (Figure 1 and Figure 2), map depicting observation locations (Figure 3), and photographs (Figures 4-12).

Please call Emily Wirth at CEHMM with any questions (575-885-3700).

Douglas C. Lynn, Executive Director
Center of Excellence for Hazardous Materials Management

10 March 2015
Date

Intrepid AMAX Surveys Datasheet

Date: 02.18.15 Survey start time: 0804 Survey end time: 1603

Starting UTMs: N32°40'42.9" W103°57'32.8" Ending UTMs: N32°36'13.2" W103°58'68.3"

Data recorder: ALynn Observers: TJ Hines, ALynn Camera # 4 GPS # 1

Start Temp (F): 43° End Temp (F): 68° Weather conditions: Sunny Wind speed(mph): 0-5 mph

Observation (ie, Raptor Nest, etc.)	Waypoint Number	Photo Number	Notes
No observations were made.			

Created 2/9/2015 EKW

Figure 1. Datasheet February 18, 2015.

Intrepid AMAX Surveys Datasheet

Date: 02.19.15 Survey start time: 0819 Survey end time: 1320

Starting UTMs: N32°40'20.5" W103°58'34.0" Ending UTMs: N 32°39'11.7" W 103°57'21.2"

Data recorder: A Lynn Observers: T. Hines Camera # 4 GPS # 1

Start Temp (F): 45° End Temp (F): 74° Weather conditions: Sunny Wind speed(mph): 0-5 mph

Observation (ie, Raptor Nest, etc.)	Waypoint Number	Photo Number	Notes
Pepper Grass (Lepidium)	764	#3,4	Very abundant
2 Long-eared Owls	765	no photo owls - flushed	Living in salt cedars where pipeline will be laid on the edge.
		Picture of Salt cedars #5	
Cooper's Hawk	766	Flushed	Right on staked area.
Raptor Nest	767	#6,7	
	768	#8,9	* From ~~waypoint 767 to waypoint~~ 768 evidence of diurnal & nocturnal raptors (ie whitewash, castings) in the draw system. The system is about 200' from proposed pipeline.
Whitewash in draw	769	#10	* about 100' from draw with raptors/evidenced by whitewash
		#11	
Seedling weed abundant throughout proposed lines esp. in disturbed areas. (Phacelia)	770		Very abundant

Created 2/9/2015 EKW

Figure 2. Datasheet February 19, 2015.

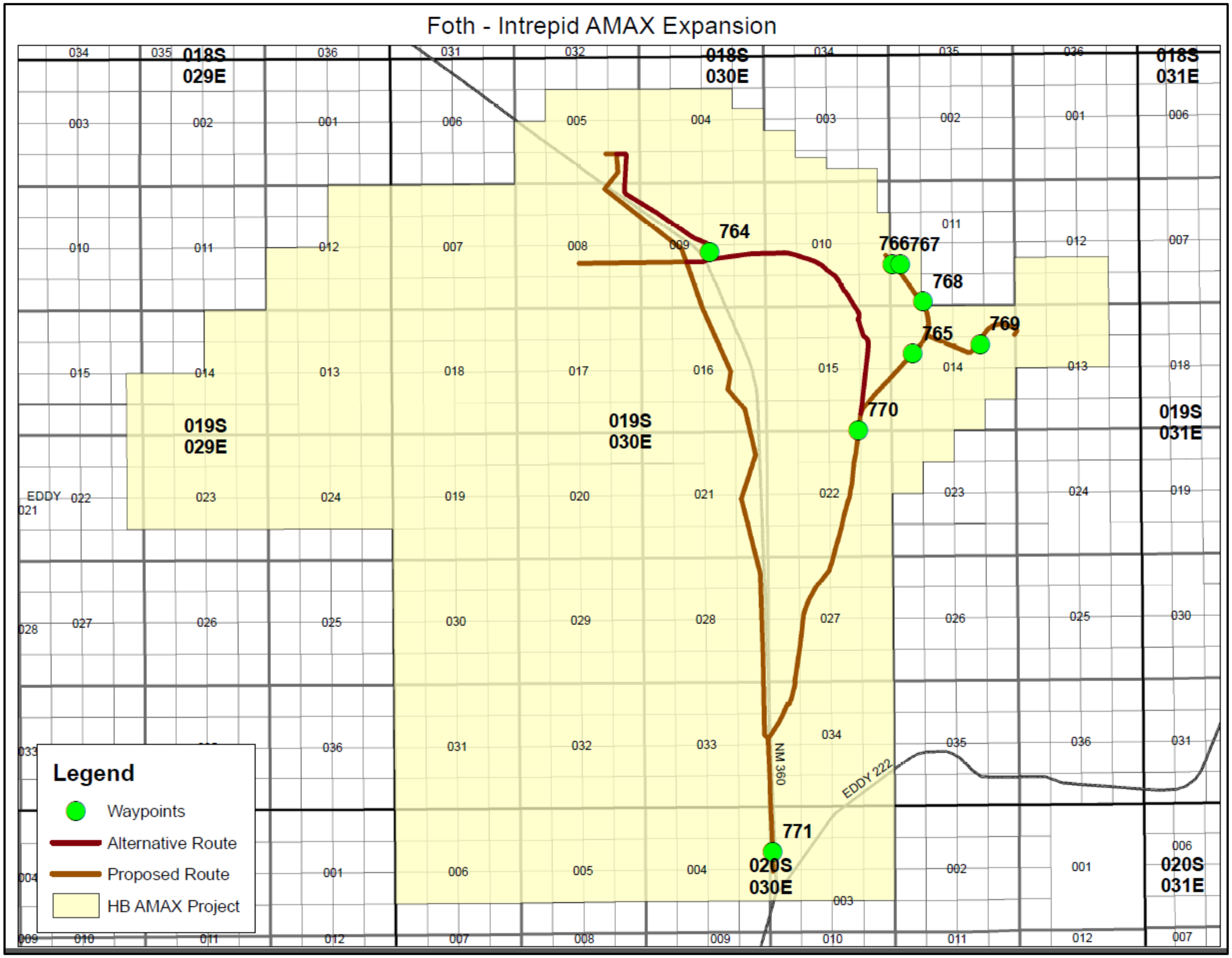

Figure 3. Map depicting locations of observations.

Figure 4. ***Lepidium*** **(Photo #3, Waypoint 764).**

Figure 5. ***Lepidium*** **(Photo #4, Waypoint 764).**

Figure 6. Salt Cedars where long-eared owls were observed (Photo #5, Waypoint 765).

Figure 7. Raptor nest (Photo #6, Waypoint 767).

Figure 8. Raptor nest (Photo #7, Waypoint 767).

Figure 9. Whitewash in draw system (Photo #8, Waypoint 768).

Figure 10. Whitewash in draw system (Photo #9, Waypoint 768).

Figure 11. Whitewash in draw system (Photo #10, Waypoint 769).

Figure 12. ***Phacelia*** **(Photo #11, Waypoint 771).**

Appendix G

Air Dispersion Modeling

AMBIENT AIR QUALITY MODELING REPORT

INTREPID POTASH

NEW HB MILL

Carlsbad, Eddy County, New Mexico

Prepared by **Intrepid Potash – New Mexico, LLC**
with assistance by:

FC&E Engineering, LLC
Brandon, Mississippi
(601) 824-1860

Nov. 2010

Intrepid Potash Inc.
HB In-Situ Project
Eddy County. New Mexico

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1.0 INTRODUCTION

Intrepid Potash Inc. is planning to construct and operate a solution mining facility which will be an in-situ project to be located in Eddy County in southeastern New Mexico. The operation when completed will involve miles of pipeline and numerous injection points and extraction wells. Additionally, a large solar evaporation pond area will be constructed to facilitate the removal of moisture such that potassium chloride salt may be harvested, slurried, and pumped to the new proposed HB Potash Solution Mill (HB Mill) for processing. The product will then be dried and screened prior to shipment via trucks. The proposed project will be beneficial to the area by providing numerous job opportunities and will result in a safe and more efficient way of producing potash from mining areas previously believed to be depleted and unsafe to mine via traditional methods. This modeling report has been prepared to describe the modeling analysis that has been performed and submitted to the NMED's air quality bureau for review.

1.1 Purpose of Modeling

The purpose of the modeling being performed for this project is to provide documentation to the New Mexico Environment Department that ambient air quality impacts beyond the property fenceline as a result of the construction and operation of the proposed equipment will not result in a violation of ambient air quality standards or the allowable increment. The following sections describe the facilities proposed for construction and operation in Eddy County, New Mexico. This ambient air quality analysis has been prepared in accordance with the "New Mexico Air Quality Bureau Air Dispersion Modeling Guidelines, Revised April 2010" and addresses all regulated air pollutants that are greater than the threshold requiring modeling as specified in the Bureau's modeling guidelines.

1.2 Facility Description

The facility to be constructed will consist of The HB Mill and Solar Evaporation Ponds which involve the flooding of designated portions of former underground mine workings with brine (salt – saturated water) to selectively extract potash left in the pillars and fringe ore areas after conventional mining was completed. Once the workings are flooded and required dissolution times are achieved, the pregnant (potash – laden) brine is pumped to the surface and routed to an approximate 500 acre solar pond system. Natural net evaporative characteristics of the area will concentrate and precipitate a sodium chloride (NaCl)/ potassium chloride (KCl) product which will be harvested and sent to a nearby processing facility (HB Mill). Through a series of sequential flotation steps within the HB Mill, KCl will be separated from NaCl. The KCl product will be transferred via truck to Intrepid's North compaction facility (about 12 miles by road to the east/northeast) for final preparation and shipping as a commercial product. The NaCl will either be sold as commercial product or returned to the mine workings as injectate.

Intrepid Potash Inc.
HB In-Situ Project
Eddy County, New Mexico

Project operations consist of:

- Brine make-up along with injection and extraction to and from underground mine workings
- Solar pond management and harvesting
- Product refinement in the HB Mill
- Safety, administrative, and environmental compliance support

Brine Makeup, Injection, and Extraction Operations

Injectate to be pumped into four underground mine working areas to selectively dissolve the KCl contained therein is made up at the HB Mill and consists of saline groundwater that is mixed with NaCl to create a salt-saturated brine. The injectate is then pumped via HDPE pipelines to six injection wells located in an up-gradient area of the four inactive underground mine working areas. The brine fills the mine workings to a specified elevation and selectively dissolves KCl left in the pillars and fringe ore areas. The resulting pregnant brine is pumped via five extraction wells and associated pipelines to the solar pond complex.

Brine conveyance will be managed and operated by a mechanical / electrical / instrumentation crew to assure that submersible pumps, booster stations, control and monitoring infrastructure, and pipelines function as required. Both automated data acquisition systems and manual observations will be used to monitor operations and all pipeline circuits will be inspected weekly. An on-call crew will be available 24 hours per day to maintain and control the system.

Solar Pond Management

The solar pond complex consists of approximately 25 ponds with an area of approximately 20 acres each, as well as associated access roads. Operation of the solar ponds complex will involve two components: 1) routing of the brines within the ponds to maximize potash precipitation, and (2) harvesting the precipitated solids. Each sub-pond will be filled with pregnant brine pumped from the underground workings via manifolded piping runs. As evaporation occurs, a designated crew will measure fluids levels in the ponds, chemistry of the brine, and deposition of KCl / NaCl precipitate. Brines will be transferred from pond to pond using portable pumps and siphons to manage brine chemistry. Once the KCl / NaCl product has precipitated, the ponds will be drained of free fluids and the precipitated solids will be harvested with scrapers. Up to two feet of precipitated solids will be removed and transported to a slurry system within the solar pond network. The harvested salt mixture is then fluidized with mill brine and pumped to the HB Mill via a slurry pipeline for refining.

Product Refinement

The product slurry consists of a mixture of NaCl and KCl which requires further beneficiation at the HB Mill. The NaCl and KCl are separated using an amine flotation process. After flotation, leaching, standard classification, filtration and dewatering methods are applied to further concentrate the KCl product. The KCl product is then transported from the HB Mill to the existing Intrepid North compaction facility for further drying, grading and load-out for sale.

1.3 Facility Identification and Location

The proposed facility is identified as the HB In-Situ Project. The area for proposed location of this project is in the southeastern portion of the state of New Mexico in Eddy County approximately halfway between Carlsbad and Hobbs along Highway 62/180 (Figure 1). The majority of the site is leased land from the Bureau of Land Management (BLM). An agreement between Intrepid Potash and the BLM has allowed the area proposed for this project to be fenced such that Intrepid has control of the land surrounding the proposed project and subsequently, the ambient air modeling proposed will utilize the fenceline and public roads as receptors for purposes of demonstrating compliance with state and federal ambient air quality standards at any offsite receptors.

The specific physical address for the site is uncertain at this time and will encompass many acres. However, the mailing address will be:
Intrepid Potash – New Mexico, LLC
c/o HB In-Situ Project
1996 Potash Mines Road
Carlsbad, NM 88220

2.0 Model Input Options

The latest version of AERMOD was used to determine compliance with the New Mexico Ambient Air Quality Standards. AERMOD is the recommended model for a wide range of regulatory applications in all types of terrain. AERMOD is appropriate for the following applications:

- Point, volume, and area sources;
- Surface, near-surface, and elevated releases;
- Rural or urban areas;
- Simple and complex terrain;
- Transport distances over which steady-state assumptions are appropriate, up to 50km;
- 1-hour to annual averaging times; and
- Continuous toxic air emissions.

The model was executed with all regulatory default options. The DFAULT option requires the use of terrain elevation data, stack-tip downwash, sequential date checking, and does not permit the use of the model in the SCREEN mode. Additionally, the most current version of the AERMOD model imposes a restriction on the urban roughness parameter to be 1 meter for regulatory default applications. In the regulatory default mode, pollutant half life or decay options are not employed, except in the case of an urban source of sulfur dioxide where a four-hour half life is applied.

As the site is located in a rural area, urban source control options will not be used. A building downwash analysis using the latest version of BPIP-Prime was conducted and incorporated into the modeling analysis to account for potential effluent downwash due to structures.

2.1 Building Downwash and Cavity Concentrations

The atmospheric flow and turbulence around buildings and other obstacles determines how pollutants are dispersed. The height above the ground of undisturbed atmospheric flow, Hg, is called the good engineering practice (GEP) height. Determining the GEP height is the initial phase of the air quality modeling analysis. GEP stack height is defined as the height necessary to ensure that emissions from the stack will not result in excessive concentrations of any air pollutant in the immediate vicinity of the sources as a result of atmospheric downwash, eddies, or wakes, which may be created by the source itself, nearby structures, or nearby terrain obstacles. A GEP analysis was conducted for all structures, combinations of structures (those within 1L of each other,) and terrain features that have a region of influence (5L) extending to one or more emission sources using the Prime Plume Rise and Building Downwash Model (BPIPPRM-Version 04274) which follows the *Guideline for Determination of Good Engineering Practice Stack Height (Technical Support Document for the Stack Height Regulations)*. These structures, along with the point sources, are depicted in Figure 2.

GEP stack height is calculated using the following equation:

$$Hg = H + 1.5L$$

Where, Hg = good engineering practice stack height; H = height of the adjacent structure or nearby structure; and L = lesser dimension (height or maximum projected width of the adjacent or nearby structure or terrain feature height).

The obstacle resulting in the largest GEP stack height (Hg) for each source is identified as the critical structure for that source. GEP was determined for each point source based upon the critical structure. It was determined that all of the structures were below GEP.

It is assumed that if a stack is within 5L downwind, ½ L crosswind or 2L upwind of a structure, that structure will cause downwash effects on that stack. AERMOD was used the Prime algorithms to determine the concentrations for receptors that fall within this region.

2.2 Point Sources

The project contains six (6) vertical stacks which were modeled as point sources. The base elevation, stack height and stack diameter used for these sources was based upon the project design. Emissions for the sources were based on the maximum hourly controlled emission rates. Table 2 and Table 2 summarize the parameters used in the modeling for the point sources.

Table 1 - Point source modeled parameters.

Source ID	Source Description	UTM-X	UTM-Y	Elevation (m)	Height (m)	Temp. °K	Velocity (m/s)	Diameter (m)
EP_01	Fluidized Bed Dryer	599500.1	3595191	1005.8	17.80032	328.705	9.85	1.2192
EP_02	Hydronic Boiler	599550.7	3595236	1005.8	6.5532	355.37	4.13	0.1524
EP_03a	Amine Water Heater	599554.1	3595230	1005.8	7.4676	355.37	4.8	0.4064
EP_03b	Amine Water Heater	599554	3595233	1005.8	7.4676	355.37	4.8	0.4064
EP_04a	Baghouse	599508.4	3595189	1005.8	8.5344	Ambient	5.93	0.7112
EP_04b	Baghouse	599520.2	3595193	1005.8	8.5344	Ambient	4.52	0.6096
EP_05a	Cooling Tower Fan	599504.1	3595272	1005.8	2.4765	Ambient	13.28	0.8128
EP_05b	Cooling Tower Fan	599505.8	3595272	1005.8	2.4765	Ambient	13.28	0.8128

Table 2 – Point source modeled emissions (lb/hr).

Source ID	CO	NO_x	PM_{10}	$PM_{2.5}$	TSP
EP_01	1.28	1.52	1.20	0.60	1.20
EP_02	0.05	0.06	4.85E-03	2.42E-03	4.85E-03
EP_03a	0.48	0.57	0.04	0.02	0.04
EP_03b	0.48	0.57	0.04	0.02	0.04
EP_04a	-	-	0.86	0.43	0.86
EP_04b	-	-	0.48	0.24	0.48
EP_05a	-	-	0.03	0.03	0.03
EP_05b	-	-	0.03	0.03	0.03

2.3 Haul Roads

The project contains emissions from paved and unpaved haul roads. Daily emissions were based upon the maximum number of vehicles traveling the road segment in a 24-hour period. Emissions from these roads were approximated using a series of alternating volume sources. As recommended in the New Mexico Air Quality Bureau Air Dispersion Modeling Guidelines, the input parameters for the volume sources were as follows:

- Volume height (H) – Twice the vehicle height rounded to the nearest meter.
- Release height (RH) – One-half the volume height (H/2)
- Initial vertical sigma – H/2.15
- Adjusted road width (W) –Actual road width plus 6 meters
- Initial horizontal sigma – 2W/2.15

Since alternating sources were used, the number of volume sources used to approximate the road segment was equal to one-half the road segment length divided by the adjusted road width. Where the road segment intersected a public road, volume sources used to approximate the road segment were excluded from the model if the volume source was within 50 meters of the public road. The road segment's estimated emissions were distributed evenly across each of the volume sources used to approximate the segment. Table 3 and Table 4 summarize the modeled road source parameters and emission rates.

Table 3 - Road source modeled parameters.

Source	Source Description	Release Height	Initial σ_y	Initial σ_z
HBP_XXX	HB Mill Paved Road	4	12.39	3.72
NP_XX	North Compaction Plant Paved Road	4	12.39	3.72
SP_XXX	Solar Pond Perimeter Road	4	14.09	3.72
SR_XX	Solar Pond North-South Road	4	16.93	3.72

Table 4 - Road source modeled emissions lb/hr.

Source	TSP	PM10	PM25
HBP_XXX	4.92	0.96	0.14
NP_XX	0.63	0.12	0.02
SP_XXX	17.95	4.57	0.46
SR_XX	3.66	0.93	0.09

2.4 Plume Depletion and Deposition

Plume depletion and deposition options were not used in the model

3.0 Receptor Grid Description

The following grids of receptors were used at and beyond the facility boundary:

Type	Spacing (meters)	Placement
Coarse	1000	5 kilometers beyond the fence line out to the ROI
Intermediate	250	Between1 to 3 kilometers from the facility fence line
Fine	100	Between 500 meters and 1 kilometer out from facility fence line
Very Fine	50	Within 500 meters of the facility fence line
Boundary	50	On property boundary line
Discrete	N/A	Monitoring sites and any sites requested by the regulating authority

Receptors were processed in the Universal Transverse Mercator (UTM, Zone 13) coordinate system (NAD 83) with the respective spacing extending at the listed distance in all directions from the facility fence line as pictured in Figure 3. As can be seen in the figure a receptor network was placed around the North Compaction Plant to determine impacts due to vehicle traffic coming from the proposed HB Mill to the North Compaction Plant.

Terrain elevations based on United States Geological Service (USGS) National Elevation Data (NED) were input to the AERMOD model for each receptor. A complete 1/3 arc second data set is available for the area surrounding the facility. The 1/3 arc second NED was used in the AERMAP (Version 09040) processor to develop elevations and hill heights for the receptors. AERMAP implementation guidance recommends that terrain data be included to a distance that captures a 10% slope from each receptor. An area of terrain data extending 5 kilometers beyond all receptors was used to incorporate adequate terrain information.

4.0 Meteorological Data

The one year Empire Abo met data set, EMPABO93_94.SFC & .PFL, collected in 1993-1994 and available on the NMED website was used to conduct the modeling. The corresponding base elevation, 1080 meters, is also posted on the NMED website. This elevation was used in the meteorology pathway of AERMOD with the PROFBASE keyword to define the base elevation for the potential temperature profile.

This met station is considered representative of meteorological conditions at facilities located in southeast New Mexico.

5.0 Radius of Impact (ROI) Analysis and Cumulative Impact Analysis (CIA)

5.1 Radius of Impact (ROI) Analysis

A significant impact analysis for each pollutant's emissions from the facility sources was conducted. The highest-first-highest short term modeled impact and the highest annual average modeled impact was compared to the significance levels listed in the following tables. The modeling results show the project to be below the modeling significance levels for CO.

Table 5 - HB Mill ROI analysis results

Pollutant	Averaging Period	Significant Impact Level ($\mu g/m^3$)	ROI (km)	Modeled Results ($\mu g/m^3$)	UTM X (M)	UTM Y (M)	Event (YYMMDDHH)
TSP	Annual	1	4.7	17.42049	597715.25	3598547.38	PERIOD
	24-hour	5		56.52669	598043.00	3598506.00	94020224
PM_{10}	Annual	1	2.9	4.46133	597715.25	3598547.38	PERIOD
	24-hour	5		14.64470	598043.00	3598506.00	94020224
$PM_{2.5}$	Annual	0.3	3.0	0.65160	599238.47	3595283.27	PERIOD
	24-hour	1.2		4.24259	599494.19	3594894.47	94011224
NO_x	Annual	1	2.2	1.17823	599544.18	3594894.99	PERIOD
	24-hour	5		9.94216	599544.18	3594894.99	94011224
CO	8-hour	500	0	17.84109	599594.18	3594895.52	94012908
	1-hour	2,000		75.98526	599293.00	3595006.00	93123005

Table 6 - North Compaction Plant ROI analysis results.

Pollutant	Averaging Period	Significant Impact Level ($\mu g/m^3$)	ROI (km)	Modeled Results ($\mu g/m^3$)	UTM X (M)	UTM Y (M)	Event (YYMMDDHH)
TSP	Annual	1	0.8	2.28345	612342.07	3604090.87	PERIOD
	24-hour	5		18.17224	612342.07	3604090.87	94011224
PM_{10}	Annual	1	0	0.44891	612342.07	3604090.87	PERIOD
	24-hour	5		3.53685	612342.07	3604090.87	94011224
$PM_{2.5}$	Annual	0.3	0	0.06734	612342.07	3604090.87	PERIOD
	24-hour	1.2		0.52399	612342.07	3604090.87	94011224

Where ambient impacts greater than the significance level were predicted, the maximum extent of the significant impact area was determined as measured from the center of the facility to the furthest extent of the significant impact. The center of the HB Mill facility was determined to be the center of the east-west and north-south extents of the boundary as (599193.3996, 3596801.511). The Radius of Impact (ROI) was determined as the distance from this point to the furthest significant receptor rounded up to the nearest 100 meters. The area within the ROI then was used as the modeling domain for the CIA. Figures 4 through 7 depict the determined pollutant specific ROIs.

A separate ROI was determined for the HB Mill impacts at the North Compaction Plant. The center of the North Compaction Plant was determined to be (612521, 3604807). The area within the ROI then was used as the modeling domain for the CIA at the North Compaction Plant. This ROI was determined using only the emissions resulting from the HB Mill project. Figure 8 depicts the ROI for TSP, which was the only pollutant that exceeded the significance level at the North Compaction Plant.

The results of the ROI analysis for NOx, TSP, PM_{10} and PM2.5 showed an exceedance of the significance levels, therefore, a NAAQS and PSD increment analysis was conducted.

5.2 Competing Source Inventory

An inventory of sources contained within the screening area were obtained from the MergeMaster regional sources database available on the NMED website. The most current version of MergeMaster on the NMED website is dated August 20, 2009.

The NAAQS and PSD increment cumulative impact analysis contained all sources within the screening area which met the criteria of the following table:

Table 7 - Surrounding Source Retention Criteria

Between	And less than	Retain neighboring source if total emissions within 2.5 km of that source exceed:	
Facility	ROI+10 km	Retain all sources	
ROI+10 km	ROI+20 km	24 lb/hr	105.12 lb/hr
ROI+20 km	ROI+30 km	53 lb/hr	232.14 lb/hr
ROI+30 km	ROI+40 km	86 lb/hr	376.68 lb/hr
ROI+40 km	ROI+50 km	119 lb/hr	521.22 lb/hr
ROI+50 km	∞	Sources beyond ROI + 50 km may be discarded (Subject to 65 km minimum for PSD Increment consuming sources)	
100 km	∞	No sources past an absolute distance of 100 km from the facility need to be included, regardless of the size of the ROI.	
Facility	65 km	Retain all PSD increment consuming sources that are less than 65 km from the facility.	

The PSD increment analysis contained all sources within 65 km of the proposed project. Appendix A contains the competing source determination for each pollutant for the NAAQS cumulative analysis. Adjustments to the inventory were made as follows:

- The Intrepid Potash - East Plant was included in the model as a separate "included" file to be consistent with a recent submitted application.
- The North Compaction Plant was included as a separate "included" file for the TSP cumulative impact analysis of the receptors surrounding the North Compaction Plant. This file included the downwash parameters for the North Compaction Plant.
- The James Hamilton Construction - HMA No1 GCP3-3135 facility was determined to be out of business or no longer at the location. The source entries were left in the "included" file, but were remarked out using "**".
- The Southwest Asphalt Paving - 13040ADM Cedarapids No0360 was determined to be out of business or no longer at the location. The source entries were left in the "included" file, but were remarked out using "**".
- Emissions from the West Flotation Plant No. 421 facility were adjusted to the permitted limit of 22.5 lb/hr TSP. PM_{10} and $PM_{2.5}$ were assumed to be limited at the same rate.
- The exit velocity was set to 0.001 m/s and stack diameter to 1 m for sources identified as having a horizontal release.
- Sources having exact same parameters in the inventory (location and stack) were merged to one source and the emission rate used was the sum of the individual sources. The source ID used was the last source ID in the list of the identical sources.

- A stack exit velocity of 32.6 m/s was used for sources having missing data indicated (-9999).

5.2 PSD Increment Modeling

The proposed project is located in Air Quality Control Region (AQCR) 155. The minor source baseline dates for this AQCR are as follows:

Pollutant	Minor Source Baseline Date
NO_2	March 16, 1988
SO_2	July 28, 1978
PM_{10}	February 20, 1979

Emissions of NO_2, SO_2, and PM_{10} from the proposed project will consume increment because the minor source baseline date for these pollutants has been set. Modeling was not required for SO_2. The results of the NO_2 and PM_{10} PSD increment cumulative analysis are presented in the following table.

Table 8 - PSD increment modeled results.

Pollutant	Averaging Period	Modeled Results (μg/m^3)	Increment (μg/m^3)	UTM X (M)	UTM Y (M)	Event (YYMMDDHH)
PM_{10}	Annual	5.02346	17	597715.25	3598547.38	PERIOD
	24-hour	17.55345	30	598108.68	3598475.21	93102124
NO_2*	Annual	2.8 (3.70067)	25	599229.29	3595510.40	PERIOD

*Modeled NOx values were adjusted with an ARM of 0.75 to determine the NO2 impacts. Values in parentheses represent the modeled NOx values.

The highest-first-highest short term modeled impact and the highest annual average modeled impact were compared to the Class II PSD increments and the facility was found to be in compliance; therefore, no additional analysis was required. The maximum impacts were within 50 meter grid spacing and below 75% of the standard, so no additional receptors were required to ensure controlling concentrations were within the fine grid.

5.3 NAAQS Modeling

5.2.1 Background

Background concentrations for NO_x, CO and SO_2 are not used unless the source is very near to Bernalillo County or El Paso. The proposed project is not located in these areas, therefore, only the modeled concentrations were compared to the ambient air quality standards to determine compliance.

The following background concentrations were added to the ambient air quality standards to determine compliance for the particulate matter analyses:

$PM_{2.5}$ (ug/m^3)	PM_{10} (ug/m^3)	TSP (ug/m^3)
7.3	20	26.6

5.2.2 NAAQS Analysis

A NAAQS Analysis was conducted for TSP, PM_{10}, $PM_{2.5}$ and NO_2. The results of the analysis are presented in the following table.

Pollutant	Averaging Period	Modeled Results (µg/m³)	Background (µg/m³)	Total (µg/m³)	NMAAQS (µg/m³)	UTM X (M)	UTM Y (M)	Event (YYMMDDHH)
TSP	Annual	18.23126	26.6	44.8	60	597715.25	3598547.38	PERIOD
	24-hour	58.66950	26.6	85.3	150	598108.68	3598475.21	93102124
PM_{10}	Annual	5.15941	20	25.1	revoked	597715.25	3598547.38	PERIOD
	24-hour	17.60951	20	37.6	150	598108.68	3598475.21	93102124
$PM_{2.5}$	Annual	1.73233	7.3	9.0	15	599222.93	3595482.14	PERIOD
	24-hour	8.39213	7.3	15.6	35	599189.66	3595356.20	93080324
NO_2*	Annual	2.4 (3.19770)	N/A	1 ppb	50 ppb	599229.29	3595510.40	PERIOD
	24-hour	10.8 (14.44559)	N/A	6 ppb	100 ppb	599174.06	3595403.71	93080324

*Modeled NOx values were adjusted with an ARM of 0.75 to determine the NO_2 impacts. Values in parentheses represent the modeled NOx values.

Conversion of NO_2 from ug/m³ to ppm

$$ppm = 4.553\times10^{-5}\times\frac{C\times T}{M_w}\times10^{Z\times1.598\times10^{-5}}$$

Annual

$$NO_2\,ppm = 4.553\times10^{-5}\times\frac{2.4\times520}{46}\times10^{3359\times1.598\times10^{-5}} = 0.001\text{ppm}$$

24-hr

$$NO_2\,ppm = 4.553\times10^{-5}\times\frac{10.8\times520}{46}\times10^{3350\times1.598\times10^{-5}} = 0.006\text{ppm}$$

All of the pollutant impacts were found to be below the New Mexico Air Quality Standards, therefore, no additional analysis was required. The maximum impacts were within 50 meter grid spacing and below 75% of the standard, so no additional receptors were required to ensure controlling concentrations were within the fine grid.

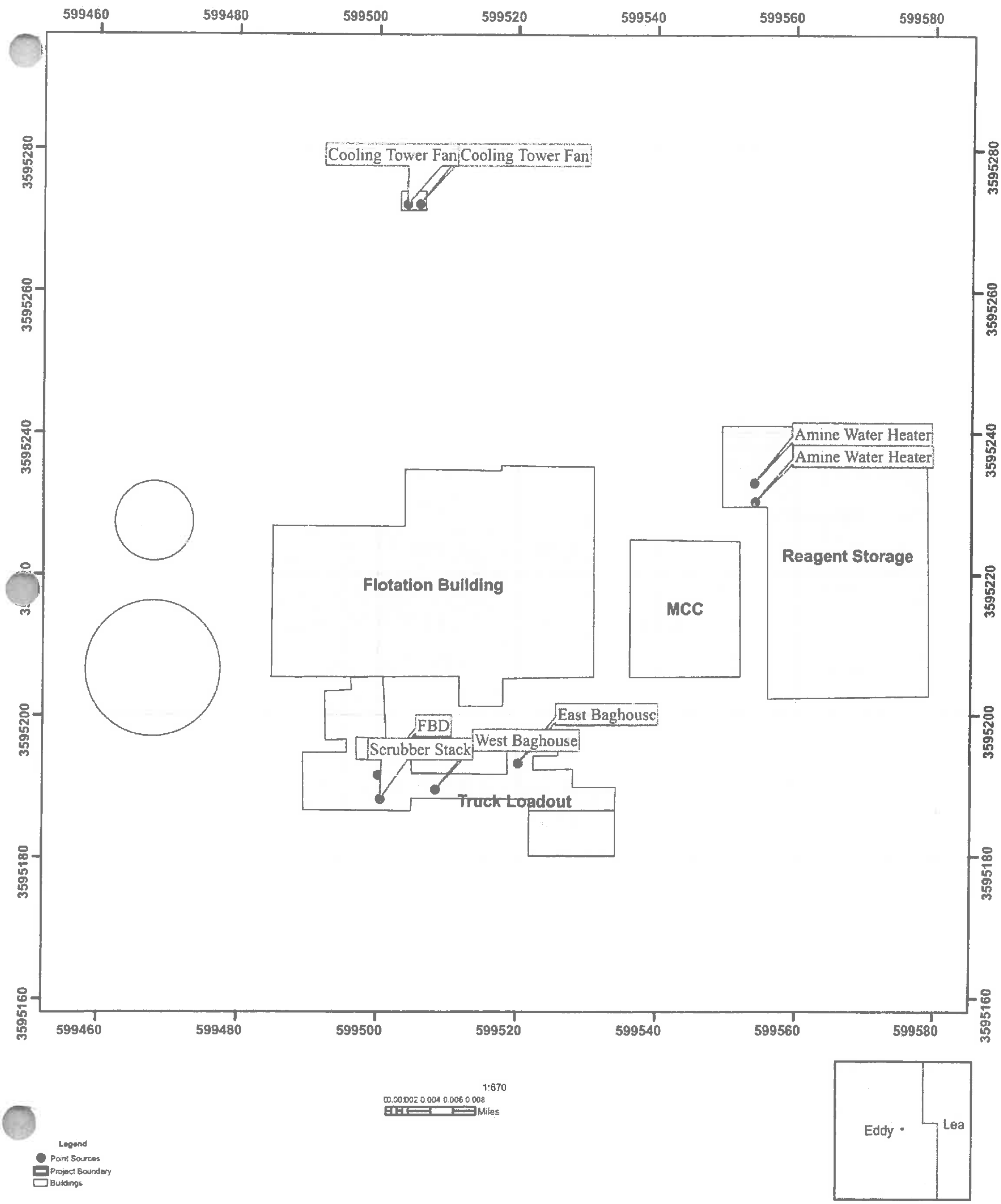
6.0 Class I Areas Analysis

Since the nearest Class I area is Carlsbad Caverns National Park, at 52 km from the facility, the Class I Area analysis is not applicable.

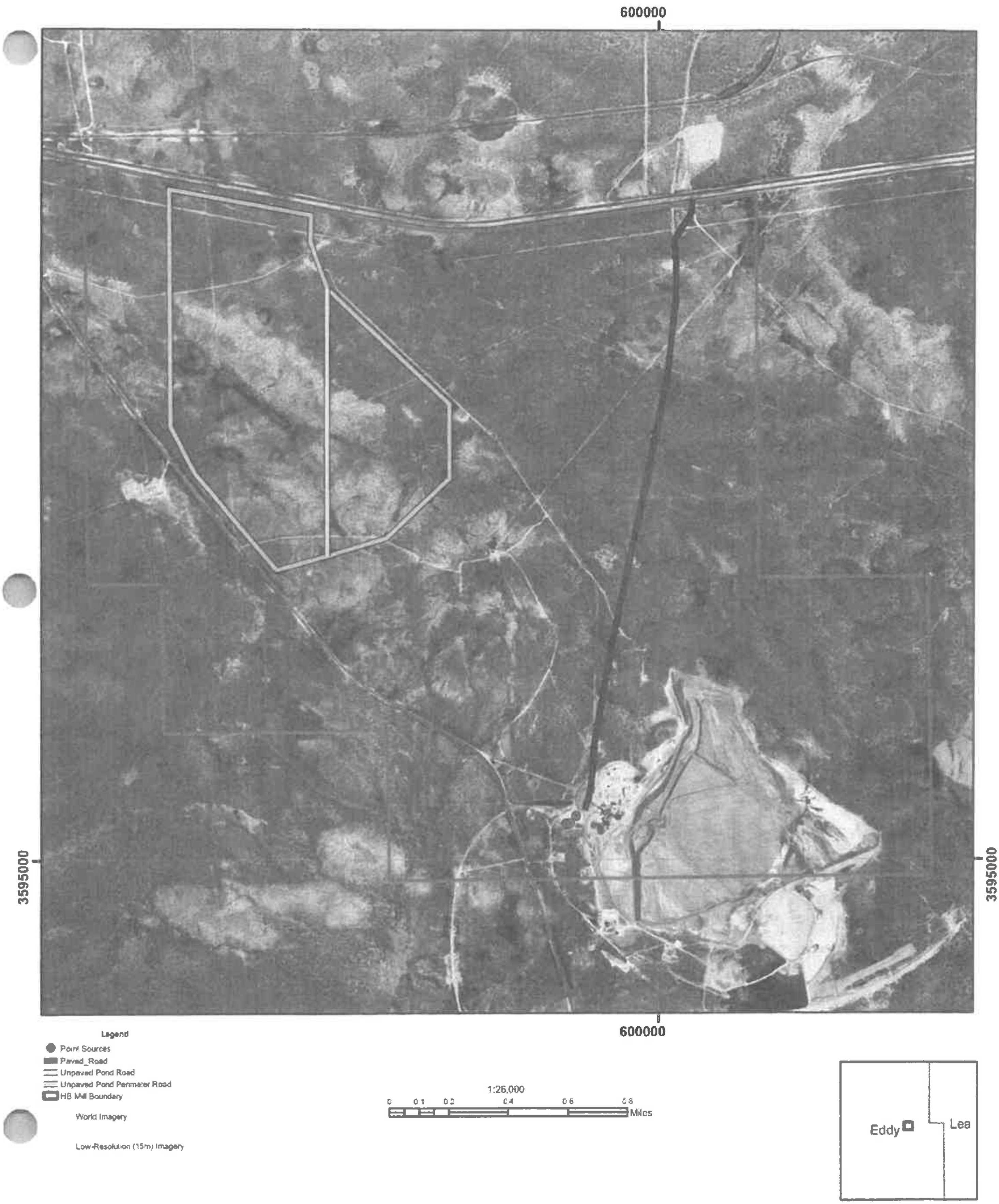
7.0 Conclusions

The modeling conducted in accordance with the in accordance with the "New Mexico Air Quality Bureau Air Dispersion Modeling Guidelines, Revised April 2010" as described in this report demonstrates that the proposed facility will not violate the New Mexico Ambient Air Quality Standards or the PSD increment.

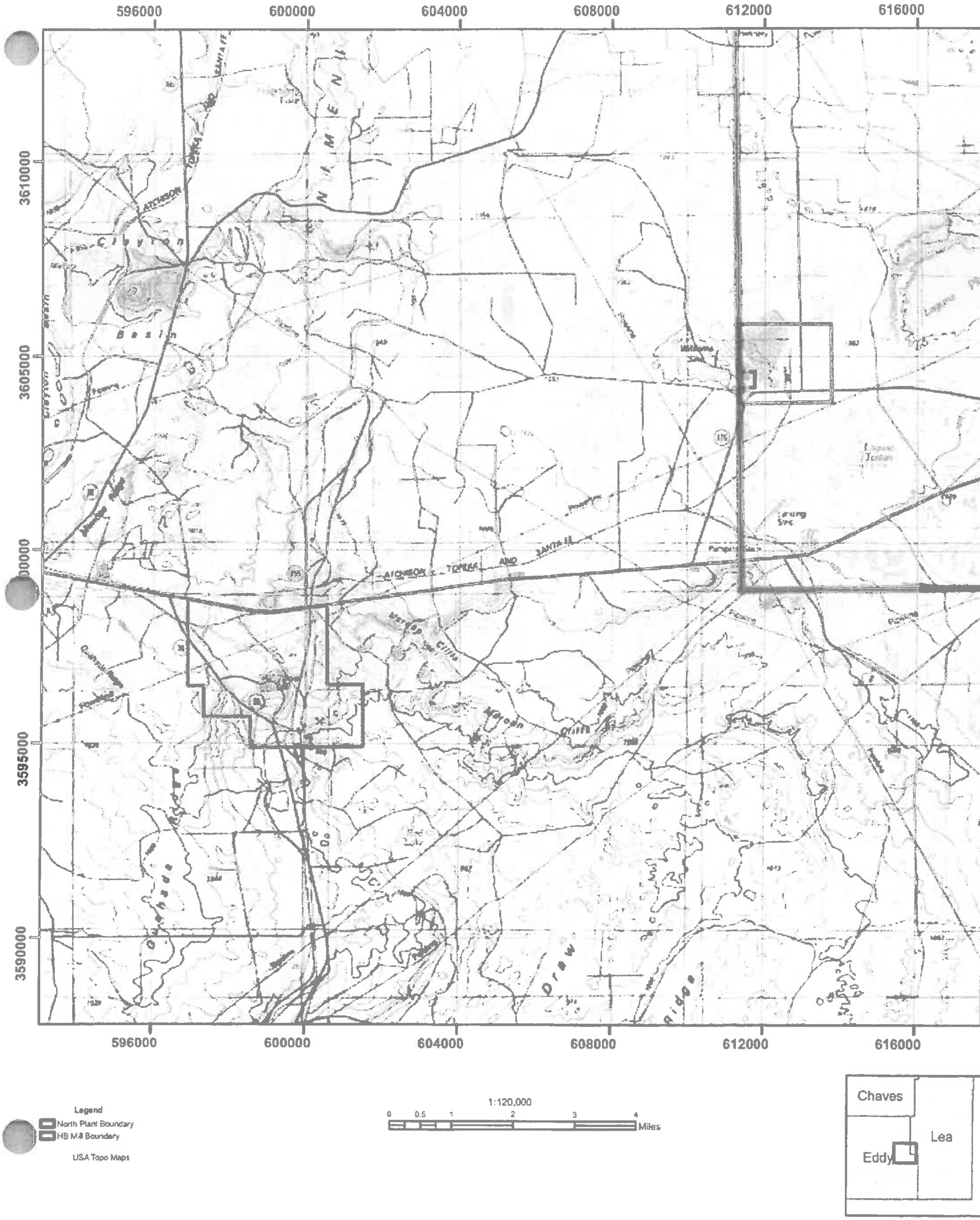
HB Mill Proposed Structures and Point Sources



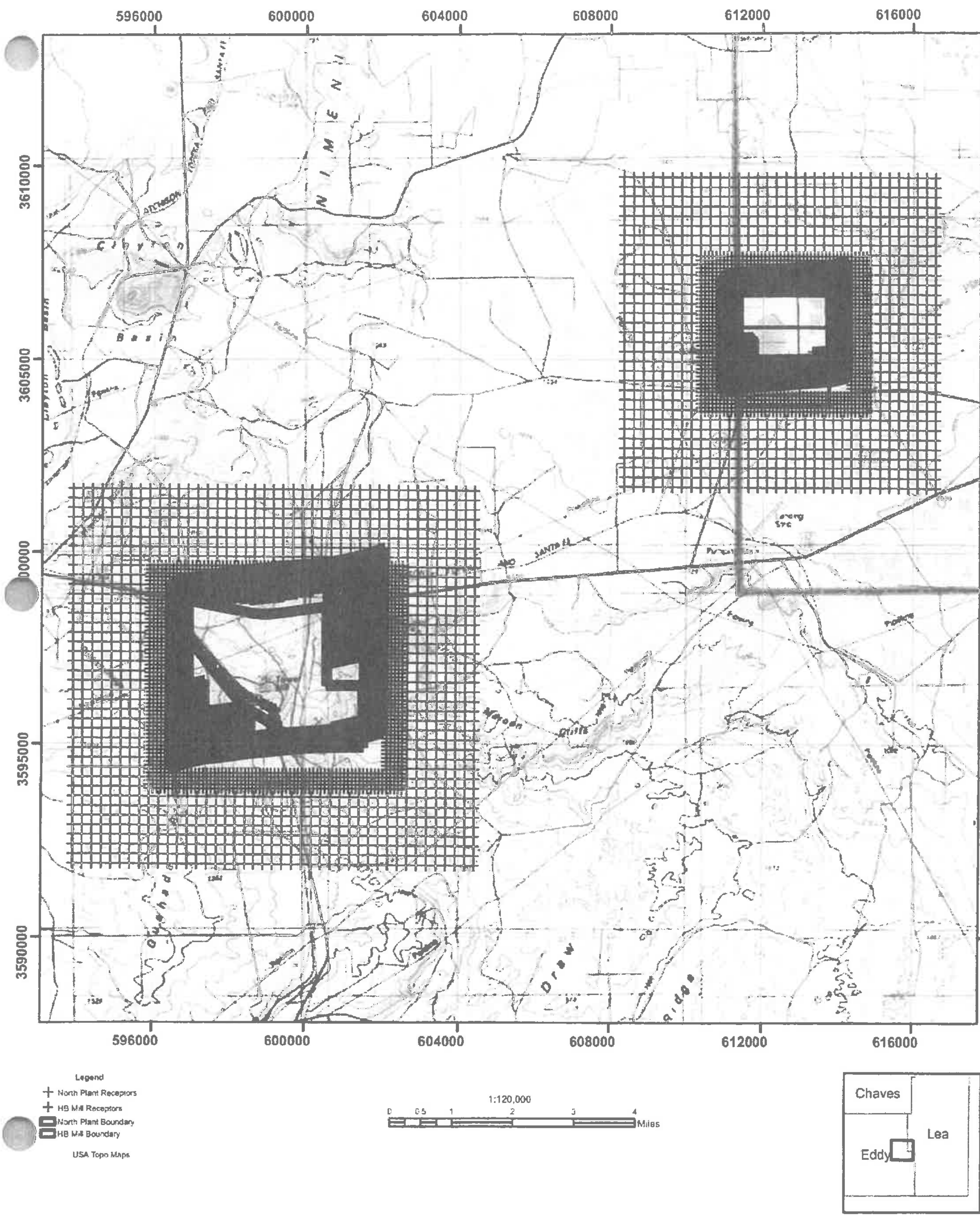
HB Mill Project Roads



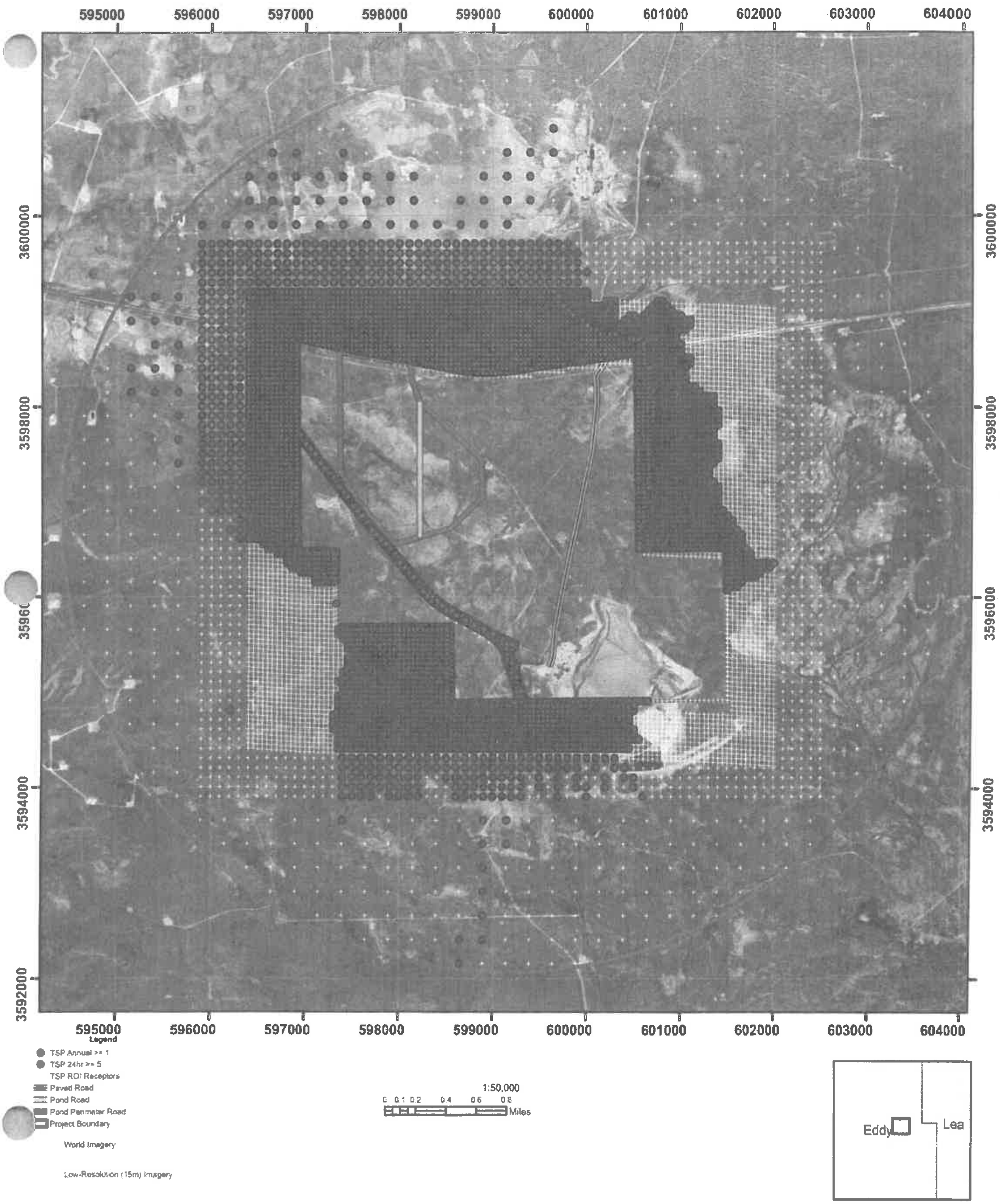
HB Mill Project Area



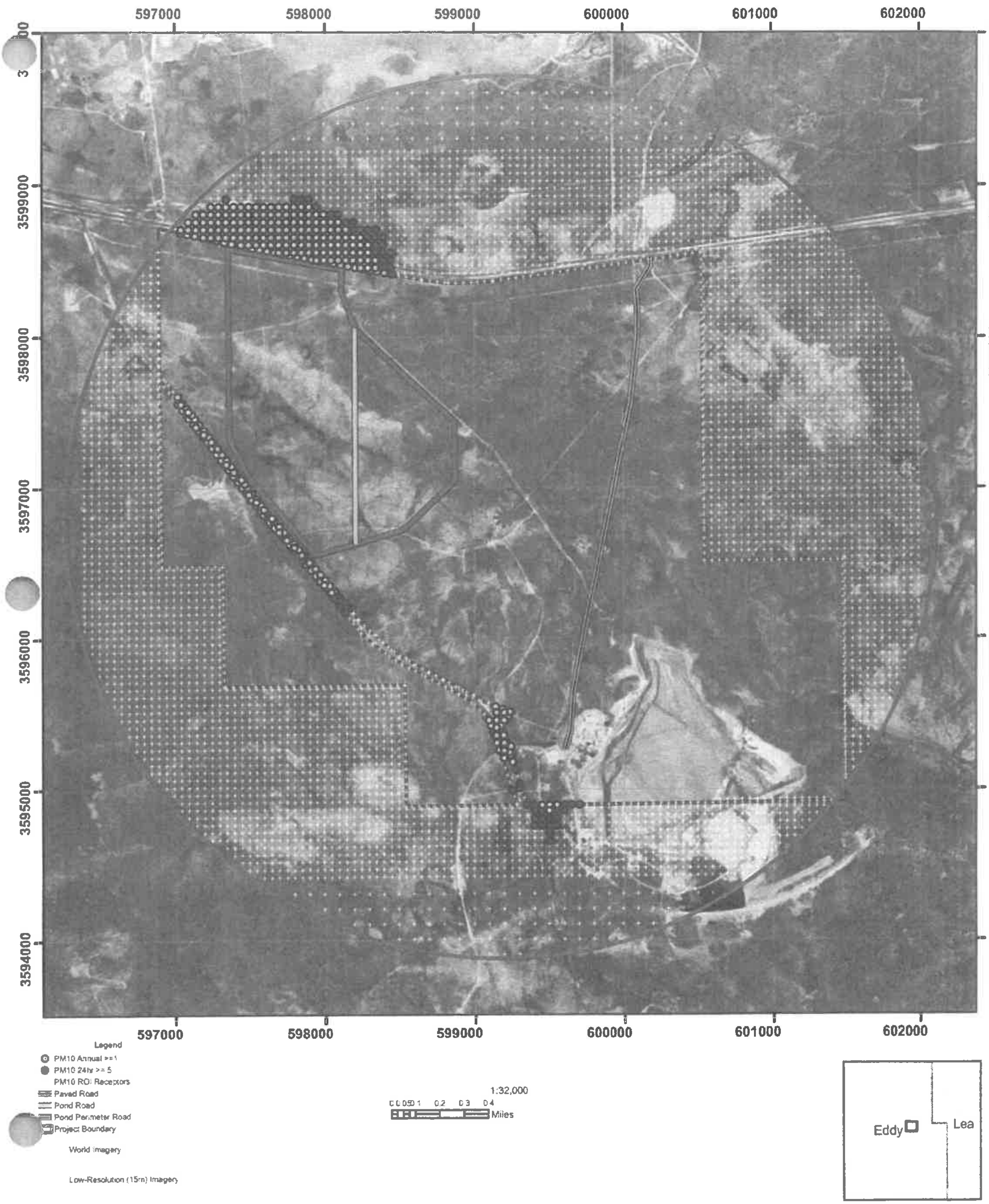
Preliminary Analysis Receptor Grid



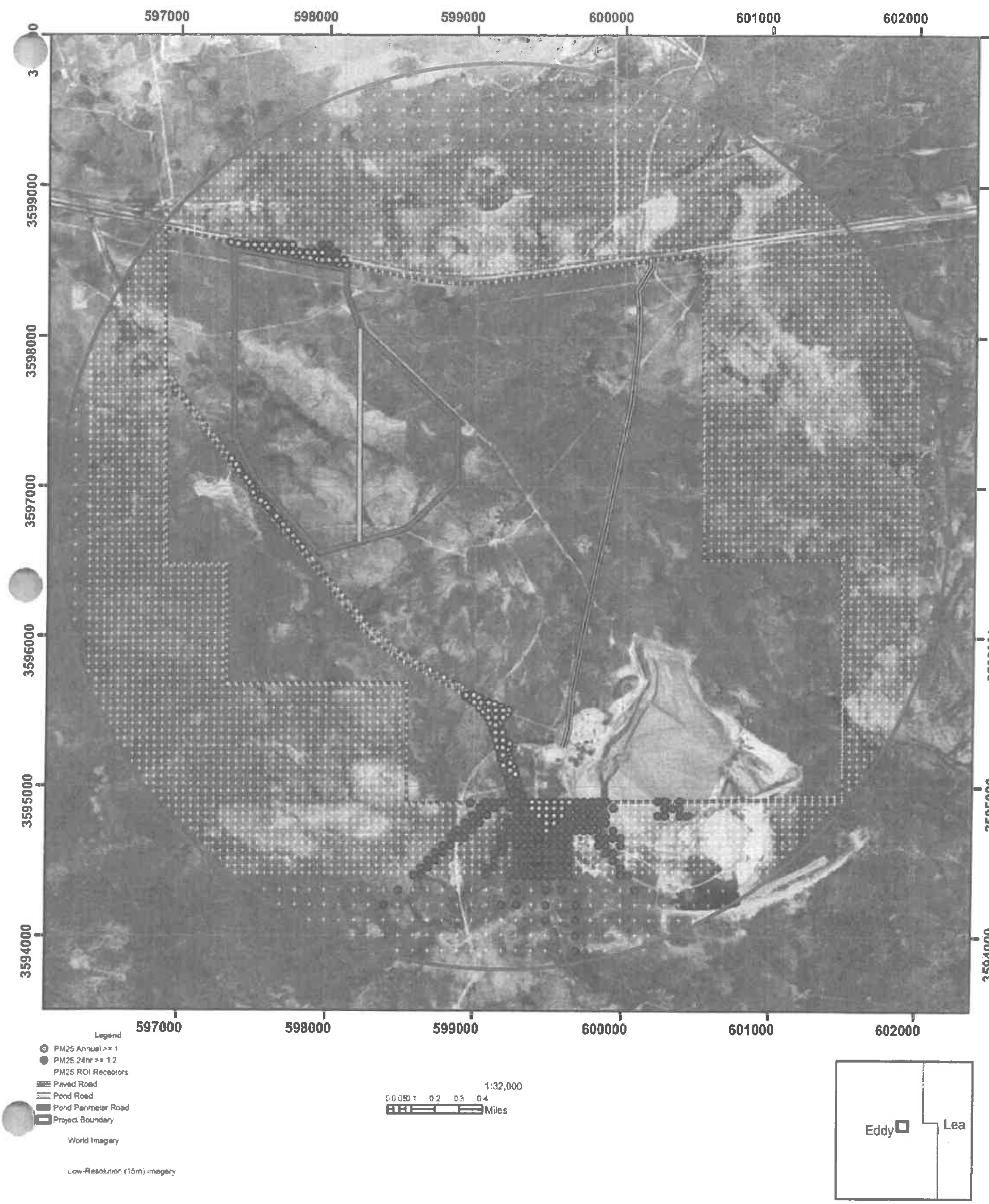
HB Mill TSP ROI



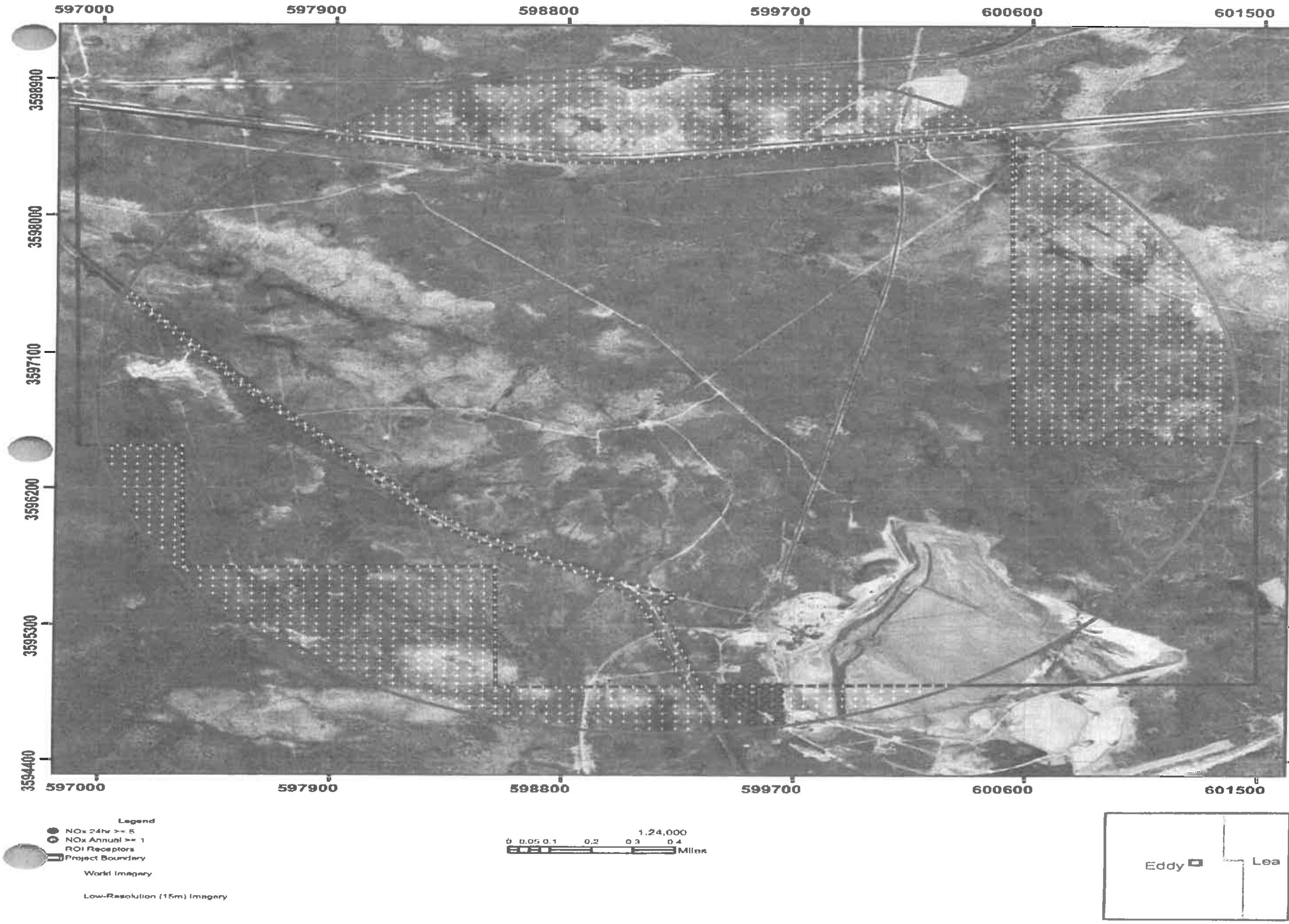
HB Mill PM10 ROI



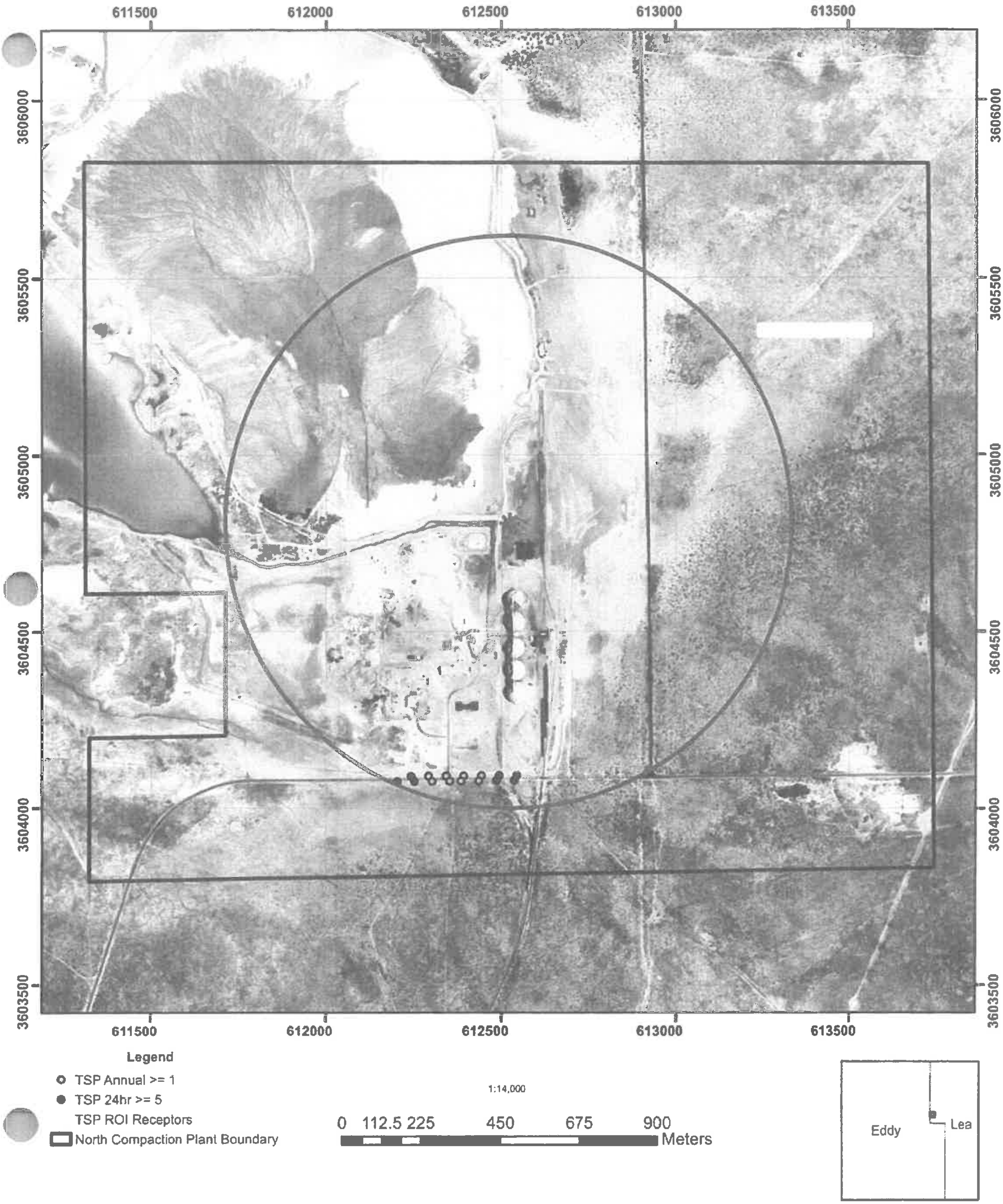
HB Mill PM25 ROI



HB Mill NOx ROI



North Compaction Plant TSP ROI



Appendix A

MASTER_AI_NAME	Distance	Facility TSP lb/hr	Facility TSP TPY	Model	Emissions within 2.5 km TSP_PPH	Emissions within 2.5 km TSP_TPY
Southwest Asphalt Paving - 13040ADM Cedarapids No0360	0.90	47.78	8.60	YES	173.05	107.19
West Flotation Plant No. 421	1.81	125.27	98.59	YES	173.05	107.19
New Mexico Salt and Minerals	3.20	1.71	7.50	YES	1.71	7.50
United Salt - Salt Drying Plant	10.01	13.74	60.20	YES	251.85	985.72
Mosaic Potash Carlsbad Inc	10.14	238.11	925.52	YES	251.85	985.72
Sand Point Landfill No52311	10.78	6.46	28.30	YES	6.46	28.30
Transwestern Pipeline - WT1 Compressor Station	13.15	42.77	10.69	YES	42.77	10.69
Dome Technology USA Inc - Intrepid East, GCP5-3531	15.19	43.38	190.00	YES	126.78	546.40
North Compaction Plant	15.27	20.50	89.79	NO	20.50	89.79
Intrepid Potash - East Plant	16.08	83.40	356.40	YES	126.78	546.40
Enterprise Products - Chaparral Gas Plant NSR No 3662	17.09	0.50	2.20	NO	0.50	2.20
James Hamilton Construction - HMA No1 GCP3-3135	18.28	220.03	190.00	YES	110.02	95.00
Las Animas Natural Gas - Dublin Ranch Compressor GCP43750	18.78	0.09	0.00	NO	0.09	0.00
New Mexico Salt and Minerals - Salt Drying Plant	19.96	0.03	0.12	NO	0.03	0.12
Waste Isolation Pilot Plant	20.44	6.66	0.80	NO	6.66	0.80
Lusk Booster Station	21.40	1.40	0.00	NO	1.40	0.00
TransColorado - Blanco Compressor Station	23.91	0.37	1.60	NO	0.37	1.60
Carlsbad Power Station	27.61	0.59	2.59	NO	0.59	2.59
Paige Booster Station GCP4-2424	28.22	0.11	0.00	NO	0.11	0.00
Baish Federal Production Facility	29.77	0.01	0.00	NO	0.01	0.00
Maverick 14 Federal Com No1 Compressor Station	30.12	0.11	0.00	NO	0.11	0.00
Southeast Readi-Mix - Carlsbad Plant GCP5-2096	30.15	43.38	190.00	YES	55.39	202.50
Constructors Inc - Southeast Materials GCP3-2792	30.86	21.69	95.00	YES	55.39	202.50
300TPH Asphalt Plant No1346	31.12	12.01	12.50	YES	55.39	202.50
Oxy USA Palladium 7 Federal No1 battery	32.31	0.00	0.00	NO	0.00	0.00
Crawford Compressor Station	33.06	0.26	1.17	NO	0.26	1.17
Bounds Junction Booster Station	33.14	0.00	0.00	NO	0.26	1.17
Kathleen Compressor Station GCP4-1923	34.19	0.41	0.90	NO	0.41	0.90
Cheasapeake - Queen Lake 20 FED 2H Compressor Station	34.75	0.14	0.00	NO	0.14	0.00
DCP Midstream - RJ Booster GCP4-3808	34.96	0.62	0.00	NO	0.62	0.00
Loco Hills Booster Station GCP4-1406	35.33	5.71	0.00	NO	5.71	0.00
Artesia Gas Plant	37.37	1.70	8.20	NO	1.70	8.20
Frontier Field Services - Maljamar Gas Plant	37.80	0.18	0.00	NO	0.18	0.00
Chevron USA - Levers No4 C.S and Tank Battery GCP4-3664	38.17	0.04	0.00	NO	0.04	0.00
DCP Midstream - Mescalero Booster Station, GCP4-3648	38.45	0.21	0.00	NO	0.21	0.00
Filaree 18 Fed No 1 Production facility	39.08	0.01	0.00	NO	0.01	0.00
Square Lake Booster Station GCP4-0855	40.15	0.41	0.00	NO	0.41	0.00
James Hamilton Construction Co - Crusher No1 NSR 0785	41.21	15.45	18.00	NO	15.45	18.00
Empire Abo Gas Plant	41.90	1.42	0.00	NO	3.91	10.60
Las Cruces Chile Plant	41.99	2.11	9.29	NO	3.91	10.60
Pecos Diamond Gas Plant	42.52	0.40	1.40	NO	3.91	10.60
PLU Pierce Canyon 17 Central Production Facility	42.61	0.14	0.00	NO	0.14	0.00
Gaucho Unit No2Y	44.72	0.01	0.06	NO	0.01	0.06
2008 January Pioneer VSI Crusher GCP2-1775	45.06	43.38	95.00	NO	43.38	95.00
Grama No1 and Booster Comp Station GCP4-3757	45.55	0.11	0.50	NO	0.11	0.50
Atoka No3 Compressor Station	47.03	0.30	0.00	NO	0.30	0.00
Outland St Unit No3	47.83	0.02	0.09	NO	0.02	0.09
Shadow Booster Station GCP4-1421	48.61	0.20	0.00	NO	0.20	0.00
PLU Ross Ranch 6 Central Production Facility	48.92	0.18	0.00	NO	0.18	0.00
Compressor Station No167	50.32	1.18	5.16	NO	1.18	5.16
Chevron USA - Buckeye CO2 Plant	51.14	2.67	11.19	NO	2.67	11.19
Lovington Booster Station	51.36	87.10	2.60	NO	87.10	2.60
Southwest Asphalt Paving - GCP3-3621	52.18	43.50	95.00	NO	43.50	95.00
Armstrong Construction Co Inc - Crushing & Screening GCP2-3444	55.62	7.20	16.00	NO	7.20	16.00
Navajo Refining - Artesia Refinery	56.14	10.41	12.09	NO	43.65	12.09
Navajo Refining - Artesia Refinery	56.81	29.54	0.00	NO	44.15	13.23
Navajo Refining - Artesia Refinery	57.66	3.70	0.00	NO	58.96	60.83
Holly Asphalt Company	58.28	14.82	47.60	NO	19.02	48.74
Land O' Lakes Purina Feed - Artesia Feed Mill	58.72	0.50	1.14	NO	48.56	48.74
Indian Basin Gas Plant	59.18	2.60	10.80	NO	2.60	10.80
Enstor Operating - Grama Ridge No1 Compressor Station	59.55	0.10	0.00	NO	0.10	0.00
Xcel Energy - Cunningham Station	60.59	17.64	27.00	NO	17.64	27.00
Monument Gas Plant	60.87	1.50	0.00	NO	1.50	0.00
Carlsbad Compressor Station	61.26	0.27	1.20	NO	0.27	1.20
Lipham Construction - Mri 400TPH Crusher No0427	61.36	40.00	9.60	NO	40.12	9.60
DCP Midstream - Eunice Gas Plant	61.83	2.57	11.50	NO	2.57	11.50

TSP Offsite Inventory Determination

ROI = 4.7 km

MASTER_AI_NAME	Distance	Facility TSP		Model	Emissions within 2.5 km	
		lb/hr	TPY		TSP_PPH	TSP_TPY
Federal 33 No1 Compressor Station GCP4-1743	62.53	0.12	0.00	NO	0.12	0.00
Oil Center Compressor Station, GCP4-3673	62.69	0.23	0.00	NO	0.23	0.00
Bogle Flats No18 Compressor Station	63.03	21.71	95.10	NO	21.71	95.10
Apex Booster Station	63.68	0.12	0.00	NO	80.53	104.69
Hobbs Generating Station	64.46	17.80	36.66	NO	40.53	95.09
Maddox Station	64.51	22.61	58.43	NO	40.53	95.09
Oil Center Booster Station	64.55	0.52	2.28	NO	0.52	2.28

MASTER_AI_NAME	Distance	Facility PM10		Model	Emissions within 2.5 km	
		lb/hr	TPY		TSP_PPH	TSP_TPY
Southwest Asphalt Paving - 13040ADM Cedarapids No0360	0.90	47.78	8.60	YES	173.05	107.19
West Flotation Plant No. 421	1.81	125.27	98.59	YES	173.05	107.19
New Mexico Salt and Minerals	3.20	0.82	3.52	YES	1.71	7.50
United Salt - Salt Drying Plant	10.01	13.74	60.20	YES	251.85	985.72
Mosaic Potash Carlsbad Inc	10.14	219.08	853.33	YES	251.85	985.72
Sand Point Landfill No52311	10.78	1.71	7.50	YES	6.46	28.30
Transwestern Pipeline - WT1 Compressor Station	13.15	42.77	0.70	YES	42.77	10.69
Dome Technology USA Inc - Intrepid East, GCP5-3531	15.19	43.38	0.00	YES	126.78	546.40
North Compaction Plant	15.27	20.50	89.79	NO	20.50	89.79
Intrepid Potash - East Plant	16.08	73.30	318.80	YES	126.78	546.40
Enterprise Products - Chaparral Gas Plant NSR No 3662	17.09	0.50	2.20	NO	0.50	2.20
James Hamilton Construction - HMA No1 GCP3-3135	18.28	220.03	0.00	YES	110.02	95.00
Las Animas Natural Gas - Dublin Ranch Compressor GCP43750	18.78	0.09	0.40	NO	0.09	0.00
New Mexico Salt and Minerals - Salt Drying Plant	19.96	0.03	0.12	NO	0.03	0.12
Waste Isolation Pilot Plant	20.44	6.66	0.80	NO	6.66	0.80
Lusk Booster Station	21.40	1.40	5.50	NO	1.40	0.00
TransColorado - Blanco Compressor Station	23.91	0.37	1.60	NO	0.37	1.60
Carlsbad Power Station	27.61	0.59	2.59	NO	0.59	2.59
Paige Booster Station GCP4-2424	28.22	0.11	0.50	NO	0.11	0.00
Baish Federal Production Facility	29.77	0.01	0.02	NO	0.01	0.00
Maverick 14 Federal Com No1 Compressor Station	30.12	0.11	0.25	NO	0.11	0.00
Southeast Readi-Mix - Carlsbad Plant GCP5-2096	30.15	43.38	0.00	NO	55.39	202.50
Constructors Inc - Southeast Materials GCP3-2792	30.86	21.69	95.00	NO	55.39	202.50
300TPH Asphalt Plant No1346	31.12	5.76	6.00	NO	55.39	202.50
Oxy USA Palladium 7 Federal No1 battery	32.31	0.00	0.01	NO	0.00	0.00
Crawford Compressor Station	33.06	0.26	1.17	NO	0.26	1.17
Bounds Junction Booster Station	33.14	0.00	0.02	NO	0.26	1.17
Kathleen Compressor Station GCP4-1923	34.19	0.41	1.80	NO	0.41	0.90
Cheasapeake - Queen Lake 20 FED 2H Compressor Station	34.75	0.14	0.60	NO	0.14	0.00
DCP Midstream - RJ Booster GCP4-3808	34.96	0.62	2.70	NO	0.62	0.00
Loco Hills Booster Station GCP4-1406	35.33	5.71	25.00	NO	5.71	0.00
Artesia Gas Plant	37.37	1.86	7.52	NO	1.70	8.20
Frontier Field Services - Maljamar Gas Plant	37.80	0.18	0.80	NO	0.18	0.00
Chevron USA - Levers No4 C.S and Tank Battery GCP4-3664	38.17	0.04	0.17	NO	0.04	0.00
DCP Midstream - Mescalero Booster Station, GCP4-3648	38.45	0.21	0.90	NO	0.21	0.00
Filaree 18 Fed No 1 Production facility	39.08	0.01	0.04	NO	0.01	0.00
Square Lake Booster Station GCP4-0855	40.15	0.41	1.80	NO	0.41	0.00
James Hamilton Construction Co - Crusher No1 NSR 0785	41.21	4.54	5.39	NO	15.45	18.00
Empire Abo Gas Plant	41.90	1.42	5.80	NO	3.91	10.60
Las Cruces Chile Plant	41.99	15.43	67.63	NO	3.91	10.60
Pecos Diamond Gas Plant	42.52	0.40	1.40	NO	3.91	10.60
PLU Pierce Canyon 17 Central Production Facility	42.61	0.14	0.60	NO	0.14	0.00
Gaucho Unit No2Y	44.72	0.01	0.06	NO	0.01	0.06
2008 January Pioneer VSI Crusher GCP2-1775	45.06	43.38	0.00	NO	43.38	95.00
Grama No1 and Booster Comp Station GCP4-3757	45.55	0.11	0.50	NO	0.11	0.50
Atoka No3 Compressor Station	47.03	0.30	1.50	NO	0.30	0.00
Outland St Unit No3	47.83	0.02	0.09	NO	0.02	0.09
Shadow Booster Station GCP4-1421	48.61	0.20	0.80	NO	0.20	0.00
PLU Ross Ranch 6 Central Production Facility	48.92	0.18	15.42	NO	0.18	0.00
Compressor Station No167	50.32	2.40	10.20	NO	1.18	5.16
Chevron USA - Buckeye CO2 Plant	51.14	2.67	11.19	NO	2.67	11.19
Lovington Booster Station	51.36	87.10	2.60	NO	87.10	2.60
Southwest Asphalt Paving - GCP3-3621	52.18	43.50	0.00	NO	43.50	95.00
Armstrong Construction Co Inc - Crushing & Screening GCP2-3444	55.62	3.40	7.50	NO	7.20	16.00
Navajo Refining - Artesia Refinery	56.14	10.41	44.69	NO	43.65	12.09
Navajo Refining - Artesia Refinery	56.81	29.54	129.30	NO	44.15	13.23
Navajo Refining - Artesia Refinery	57.66	3.70	15.80	NO	58.96	60.83
Holly Asphalt Company	58.28	3.37	11.38	NO	19.02	48.74

PM10 Offsite Inventory Determination

ROI = 2.9

MASTER_AI_NAME	Distance	Facility PM10		Model	Emissions within 2.5 km	
		lb/hr	TPY		TSP_PPH	TSP_TPY
Land O' Lakes Purina Feed - Artesia Feed Mill	58.72	0.50	1.14	NO	48.56	48.74
Indian Basin Gas Plant	59.18	2.60	11.39	NO	2.60	10.80
Enstor Operating - Grama Ridge No1 Compressor Station	59.55	0.10	0.50	NO	0.10	0.00
Xcel Energy - Cunningham Station	60.59	16.80	54.10	NO	17.64	27.00
Monument Gas Plant	60.87	1.50	6.50	NO	1.50	0.00
Carlsbad Compressor Station	61.26	0.27	1.20	NO	0.27	1.20
Lipham Construction - Mri 400TPH Crusher No0427	61.36	40.00	9.60	NO	40.12	9.60
DCP Midstream - Eunice Gas Plant	61.83	3.29	11.50	NO	2.57	11.50
Federal 33 No1 Compressor Station GCP4-1743	62.53	0.12	0.51	NO	0.12	0.00
Oil Center Compressor Station, GCP4-3673	62.69	0.23	1.00	NO	0.23	0.00
Bogle Flats No18 Compressor Station	63.03	21.71	95.10	NO	21.71	95.10
Apex Booster Station	63.68	0.12	0.53	NO	80.53	104.69
Hobbs Generating Station	64.46	17.60	36.06	NO	40.53	95.09
Maddox Station	64.51	22.61	58.43	NO	40.53	95.09
Oil Center Booster Station	64.55	0.52	2.27	NO	0.52	2.28

PM2.5 Offsite Inventory Determination

ROI = 3.0 km

MASTER_AI_NAME	Distance	Facility PM25		Model	Emissions within 2.5 km	
		lb/hr	TPY		TSP_PPH	TSP_TPY
Southwest Asphalt Paving - 13040ADM Cedarapids No0360	0.90	11.94	0.00	YES	137.22	0.00
West Flotation Plant No. 421	1.81	125.27	0.00	YES	137.22	0.00
New Mexico Salt and Minerals	3.20	0.54	0.00	YES	0.54	0.00
United Salt - Salt Drying Plant	10.01	13.74	0.00	YES	141.95	0.00
Mosaic Potash Carlsbad Inc	10.14	128.20	0.00	YES	141.95	0.00
Sand Point Landfill No52311	10.78	0.43	0.00	YES	0.43	0.00
Transwestern Pipeline - WT1 Compressor Station	13.15	42.77	0.00	YES	42.77	0.00
Dome Technology USA Inc - Intrepid East, GCP5-3531	15.19	43.38	0.00	YES	101.50	34.70
North Compaction Plant	15.27	14.75	0.00	NO	14.75	0.00
Intrepid Potash - East Plant	16.08	58.13	34.70	YES	101.50	34.70
Enterprise Products - Chaparral Gas Plant NSR No 3662	17.09	0.50	2.20	NO	0.50	2.20
James Hamilton Construction - HMA No1 GCP3-3135	18.28	220.03	0.00	YES	110.02	0.00
Las Animas Natural Gas - Dublin Ranch Compressor GCP43750	18.78	0.09	0.00	NO	0.09	0.00
New Mexico Salt and Minerals - Salt Drying Plant	19.96	0.01	0.00	NO	0.01	0.00
Waste Isolation Pilot Plant	20.44	6.66	0.00	NO	6.66	0.00
Lusk Booster Station	21.40	1.40	6.40	NO	1.40	6.40
TransColorado - Blanco Compressor Station	23.91	0.37	0.00	NO	0.37	0.00
Carlsbad Power Station	27.61	0.59	0.00	NO	0.59	0.00
Paige Booster Station GCP4-2424	28.22	0.11	0.00	NO	0.11	0.00
Baish Federal Production Facility	29.77	0.00	0.00	NO	0.00	0.00
Maverick 14 Federal Com No1 Compressor Station	30.12	0.10	0.00	NO	0.10	0.00
Southeast Readi-Mix - Carlsbad Plant GCP5-2096	30.15	43.38	0.00	NO	32.87	0.00
Constructors Inc - Southeast Materials GCP3-2792	30.86	5.42	0.00	NO	32.87	0.00
300TPH Asphalt Plant No1346	31.12	5.76	0.00	NO	32.87	0.00
Oxy USA Palladium 7 Federal No1 battery	32.31	0.00	0.00	NO	0.00	0.00
Crawford Compressor Station	33.06	0.26	0.00	NO	0.26	0.00
Bounds Junction Booster Station	33.14	0.00	0.00	NO	0.26	0.00
Kathleen Compressor Station GCP4-1923	34.19	0.41	1.80	NO	0.41	1.80
Cheasapeake - Queen Lake 20 FED 2H Compressor Station	34.75	0.14	0.00	NO	0.14	0.00
DCP Midstream - RJ Booster GCP4-3808	34.96	0.62	0.00	NO	0.62	0.00
Loco Hills Booster Station GCP4-1406	35.33	5.71	0.00	NO	5.71	0.00
Artesia Gas Plant	37.37	1.70	11.70	NO	1.70	11.70
Frontier Field Services - Maljamar Gas Plant	37.80	0.11	0.00	NO	0.11	0.00
Chevron USA - Levers No4 C.S and Tank Battery GCP4-3664	38.17	0.01	0.00	NO	0.01	0.00
DCP Midstream - Mescalero Booster Station, GCP4-3648	38.45	0.21	0.00	NO	0.21	0.00
Filaree 18 Fed No 1 Production facility	39.08	0.00	0.00	NO	0.00	0.00
Square Lake Booster Station GCP4-0855	40.15	0.41	0.00	NO	0.41	0.00
James Hamilton Construction Co - Crusher No1 NSR 0785	41.21	1.13	0.00	NO	1.13	0.00
Empire Abo Gas Plant	41.90	1.33	0.00	NO	5.31	3.20
Las Cruces Chile Plant	41.99	4.16	1.80	NO	5.31	3.20
Pecos Diamond Gas Plant	42.52	0.40	1.40	NO	5.31	3.20
PLU Pierce Canyon 17 Central Production Facility	42.61	0.14	0.00	NO	0.14	0.00
Gaucho Unit No2Y	44.72	0.00	0.00	NO	0.00	0.00
2008 January Pioneer VSI Crusher GCP2-1775	45.06	43.38	0.00	NO	43.38	0.00
Grama No1 and Booster Comp Station GCP4-3757	45.55	0.11	0.50	NO	0.11	0.50
Atoka No3 Compressor Station	47.03	0.30	1.50	NO	0.30	1.50
Outland St Unit No3	47.83	0.01	0.00	NO	0.01	0.00
Shadow Booster Station GCP4-1421	48.61	0.20	0.00	NO	0.20	0.00
PLU Ross Ranch 6 Central Production Facility	48.92	0.18	0.00	NO	0.18	0.00
Compressor Station No167	50.32	2.40	10.20	NO	2.40	10.20
Chevron USA - Buckeye CO2 Plant	51.14	2.60	0.00	NO	2.60	0.00
Lovington Booster Station	51.36	87.10	0.00	NO	87.10	0.00
Southwest Asphalt Paving - GCP3-3621	52.18	43.50	0.00	NO	43.50	0.00
Armstrong Construction Co Inc - Crushing & Screening GCP2-3444	55.62	1.10	2.40	NO	1.10	2.40
Navajo Refining - Artesia Refinery	56.14	9.43	0.00	NO	42.56	0.00
Navajo Refining - Artesia Refinery	56.81	29.48	0.00	NO	42.69	0.00
Navajo Refining - Artesia Refinery	57.66	3.65	0.00	NO	44.23	0.50
Holly Asphalt Company	58.28	1.54	0.50	NO	5.32	0.50
Land O' Lakes Purina Feed - Artesia Feed Mill	58.72	0.13	0.00	NO	34.80	0.50
Indian Basin Gas Plant	59.18	2.60	0.00	NO	2.60	0.00
Enstor Operating - Grama Ridge No1 Compressor Station	59.55	0.10	0.00	NO	0.10	0.00
Xcel Energy - Cunningham Station	60.59	16.73	0.00	NO	16.73	0.00

Monument Gas Plant	60.87	1.50	0.00	NO	1.50	0.00
Carlsbad Compressor Station	61.26	0.27	0.00	NO	0.27	0.00
Lipham Construction - Mri 400TPH Crusher No0427	61.36	10.00	0.00	NO	10.12	0.00
DCP Midstream - Eunice Gas Plant	61.83	3.24	0.00	NO	3.24	0.00
Federal 33 No1 Compressor Station GCP4-1743	62.53	0.12	0.00	NO	0.12	0.00
Oil Center Compressor Station, GCP4-3673	62.69	0.23	0.00	NO	0.23	0.00
Bogle Flats No18 Compressor Station	63.03	21.71	0.00	NO	21.71	0.00
Apex Booster Station	63.68	0.12	0.00	NO	49.96	0.00
Hobbs Generating Station	64.46	17.23	0.00	NO	39.96	0.00
Maddox Station	64.51	22.61	0.00	NO	39.96	0.00
Oil Center Booster Station	64.55	0.52	0.00	NO	0.52	0.00

NOx Offsite Inventory Determination

ROI = 2.2 km

MASTER_AI_NAME	Distance	Facility NOx lb/hr	Facility NOx TPY	Model	Emissions within 2.5 km NO2_PPH	Emissions within 2.5 km NO2_TPY
West Flotation Plant No. 421	1.81	37.34	29.39	YES	37.34	29.39
New Mexico Salt and Minerals	3.20	6.80	14.90	YES	6.80	14.90
Mewbourne Oil - Esperanza 11 Facility	7.06	1.25	21.50	YES	1.25	21.50
Temperate BEC Federal No1 Facility	7.41	5.40	23.50	YES	5.40	23.50
Big Eddy 2 Dehydrator	7.62	0.03	0.13	YES	0.03	0.13
United Salt - Salt Drying Plant	10.01	2.01	8.80	YES	23.53	79.35
Mosaic Potash Carlsbad Inc	10.14	21.52	70.55	YES	23.53	79.35
Eland Compressor Station	11.17	4.41	19.30	YES	7.91	34.60
Cabin Lake Compressor Station GCP4-1120	11.68	6.29	27.52	YES	6.29	27.52
BOPCO LP - Big Eddy 1 Dehydrator GCP1-3751	12.08	0.05	0.20	YES	0.05	0.20
Yates Petroleum Corportation - Zia AHZ No1	12.59	3.50	15.30	NO	11.61	49.10
Transwestern Pipeline - WT1 Compressor Station	13.15	19.00	4.75	NO	19.09	5.15
Transwestern Pipeline Co - Portable Remediation Site	13.20	0.09	0.40	NO	19.09	5.15
Gazelle Compressor Station	13.39	3.70	14.50	NO	14.00	59.60
Pickett Draw Federal Well No1	14.51	1.30	5.69	NO	4.60	20.19
Dome Technology USA Inc - Intrepid East, GCP5-3531	15.19	43.38	190.00	YES	89.73	387.19
North Compaction Plant	15.27	22.60	99.00	NO	22.60	99.00
Parkway Delaware Unit Oil and Gas Facility	15.29	1.70	0.14	NO	18.58	74.14
Magnum Compressor Station GCP1-0913	15.31	6.80	29.80	NO	10.50	44.30
BOPCO LP - Big Eddy Natural Gas Gathering System	15.35	3.31	14.50	NO	4.60	20.19
Freedom 31 Fed Com No1	16.17	4.12	17.83	YES	34.06	148.94
Fitz Compressor Station	16.36	16.88	74.00	NO	18.58	74.14
Intrepid Potash - East Plant	16.36	46.35	197.19	YES	89.73	387.19
Big Eddy Compressor Station GCP1-2512	16.39	18.32	80.26	NO	18.51	81.06
Apache 13-1 Compressor Station	16.50	1.42	6.20	NO	6.64	29.08
NE Carlsbad Booster Station	16.62	24.32	106.51	YES	48.79	213.40
Devon Energy - Arenoso 22 Federal Com No 1	16.98	2.20	9.80	NO	2.20	9.80
Enterprise Products - Chaparral Gas Plant NSR No 3662	17.09	36.32	97.65	YES	62.94	214.25
Apache Compressor Station	17.94	5.22	22.88	NO	6.64	29.08
Burton Flats Compressor Station	18.19	20.35	89.06	YES	44.67	195.57
James Hamilton Construction - HMA No1 GCP3-3135	18.28	220.03	190.00	YES	110.02	95.00
Liberty 36 Facility	18.30	5.62	24.60	NO	9.74	42.43
Shugart Compressor Station GCP1-2535	18.67	26.62	116.60	YES	63.54	216.75
Las Animas Natural Gas - Dublin Ranch Compressor GCP43750	18.78	1.64	7.20	NO	1.69	7.41
Cetane Energy - Deoxygenation Plant	18.84	0.18	0.80	NO	18.51	81.06
Strawberry 7 Fed No2 Battery	19.46	0.60	2.50	YES	27.22	119.10
Lucy State Tank Battery	19.62	0.09	0.41	NO	2.48	10.92
Oxy USA - Lost Tank 35 State No4	19.70	2.30	10.10	NO	2.48	10.92
Antongiovanni MJ No1 Facility	19.95	3.30	14.50	NO	16.50	71.90
New Mexico Salt and Minerals - Salt Drying Plant	19.96	0.66	2.90	NO	0.66	2.90
Flora State Tank Battery	20.24	0.09	0.41	NO	2.48	10.92
Devon Energy - Indian Draw 6 Fee Com 1 Battery	20.27	2.90	12.90	NO	9.27	40.89
Lusk Booster Station	20.30	4.20	18.40	YES	134.31	588.28
Waste Isolation Pilot Plant	20.44	93.32	11.18	YES	93.32	11.18
North Compressor Station, GCP1-1141	20.49	14.82	88.31	YES	20.46	113.01
BOPCO LP - Las Animas Dehy, GCP1-3888	20.83	0.05	0.21	NO	1.69	7.41
North Carlsbad Compressor Station	20.89	8.07	35.43	NO	8.07	35.43
West Turkey Track Compressor Station	21.06	12.89	56.38	NO	12.89	56.38

MASTER_AI_NAME	Distance	Facility NOx lb/hr	Facility NOx TPY	Model	Emissions within 2.5 km NO2_PPH	Emissions within 2.5 km NO2_TPY
Old Indian Draw Tanks UT 1 Tank Battery	21.18	0.50	2.20	NO	4.20	18.50
Zia Gas Plant	21.31	0.62	2.69	YES	130.73	572.57
Lusk Booster Station	21.40	126.80	555.40	YES	134.93	590.97
Zia Gas Plant	21.52	3.31	14.48	YES	134.93	590.97
Devon Energy Production - Indian Draw 13 Fed No3	21.78	3.70	16.30	NO	9.77	43.09
Delta Fee Compressor Station	21.96	2.67	11.69	NO	16.70	73.51
Nash Draw Compressor Station	22.14	16.80	73.20	NO	16.80	73.20
DCP Midstream - B3 Compressor Station	22.34	6.60	28.70	NO	16.50	71.90
Compressor Systems Inc - Caterpillar G399 TALE No1266	22.34	6.60	28.70	NO	16.50	71.90
Otis 2 Compressor Station	22.66	5.03	22.02	NO	10.10	44.31
DCP Midstream Angel Ranch Booster GCP1-1592	22.77	8.08	35.40	NO	22.23	97.40
Urquidez No2 Compressor Station	22.80	5.64	24.70	NO	35.87	178.77
Exterran Energy - Caterpillar 3306 TA No1501	22.82	8.65	37.90	NO	22.23	97.40
Superior Pipeline - Compressor Station No1036	22.85	5.50	24.10	NO	22.23	97.40
Rambo Booster Station GCP1-2923	23.27	17.18	75.22	NO	17.18	75.22
Bta Compressor Station	23.53	13.68	22.69	NO	33.86	137.45
Telltale 11 Fed Com NO1 Battery	23.57	2.40	10.60	NO	10.10	44.31
Oryx Pardue Compressor Station	23.58	5.07	22.20	NO	39.50	162.15
South Hat Mesa Booster Station	23.74	41.80	181.20	NO	46.89	203.49
Turkey Track Compressor Station, G3306TA	23.86	8.61	37.70	NO	8.61	37.70
TransColorado - Blanco Compressor Station	23.91	7.40	32.00	YES	57.18	249.78
Frontier Field Services - Lusk Compressor Station	23.91	15.00	65.60	YES	57.18	249.78
Cougar Federal No1 Compressor Station	24.02	5.37	23.50	NO	8.77	38.30
East Carlsbad Gas Plant	24.26	10.34	43.56	NO	39.50	162.15
Oxy - Cougar Federal No1	24.26	3.40	14.80	NO	8.77	38.30
Chesapeake Operating - Lost Tank 16 State 1	24.45	4.40	19.10	NO	4.40	19.10
Parkway Booster Station	24.59	25.70	112.40	NO	48.10	210.00
Livingston Ridge Compressor Station	24.67	5.66	24.81	NO	5.66	24.81
West Shugart 19 Federal No 5	24.77	0.14	0.63	NO	0.14	0.63
Carrasco Compressor Station GCP1-2306	24.83	4.77	49.00	NO	33.86	137.45
Harroun Compressor Station GCP4-3350	24.94	4.40	19.04	NO	4.40	19.04
Cedar Lake Compressor Station	25.20	3.96	17.37	NO	3.96	17.37
Triple C Booster	25.56	9.08	39.78	NO	31.48	137.38
Burton Flat Facility	25.57	3.30	14.40	NO	7.38	32.26
North Bilbrey Federal 7 No1 Compressor Station	25.83	5.09	22.29	NO	46.89	203.49
Devon Energy - Sito 27 Fee NO 1	26.38	3.30	14.50	NO	12.74	55.70
Burton Flat 7 Federal No1 Compressor Station	26.52	4.08	17.86	NO	7.38	32.26
Devon Energy - Lovelace 27 Fee No2	26.69	5.10	22.20	NO	12.74	55.70
Avalon Federal No2 Facility	26.75	0.48	2.10	NO	4.48	19.40
La Huerta 30 Fee Com No1Y	26.76	4.00	17.30	NO	4.48	19.40
Apache 24 No3 Battery Production Facility	26.89	0.10	0.40	NO	0.10	0.40
Sauza Compressor Station GCP4-2968	27.05	2.79	12.22	NO	2.79	12.22
Mewbourne Oil - Waukesha F1197G No2162	27.15	4.92	21.54	NO	6.43	28.14
West Shugart 19 Federal No1	27.34	0.03	0.11	NO	0.03	0.11
GPM Mandano No1329 Compressor Station	27.56	4.79	21.00	NO	4.79	21.00
Carlsbad Power Station	27.61	17.42	76.30	NO	22.94	100.45
South Carlsbad Compressor Station	27.95	56.00	245.40	YES	56.00	245.40
Devon Energy Production - Compressor Station No1891	28.07	4.34	19.00	NO	12.74	55.70
Avalon 360 Compressor Station	28.08	1.51	6.60	NO	6.43	28.14

NOx Offsite Inventory Determination

ROI = 2.2 km

MASTER_AI_NAME	Distance	Facility NOx lb/hr	Facility NOx TPY	Model	Emissions within 2.5 km NO2_PPH	Emissions within 2.5 km NO2_TPY
Douglas Com No1	28.22	5.52	24.15	NO	44.63	195.45
Paige Booster Station GCP4-2424	28.22	7.70	33.70	NO	7.70	33.70
HB State No1and HB State No2 Production Facility	28.76	2.86	12.51	NO	2.86	12.51
OXY USA - Lion Federal No1	28.86	3.40	14.80	NO	3.40	14.80
Pure Gold 28 Compressor Station	28.88	8.85	38.62	NO	8.85	38.62
Mewbourne Oil - Layla 35 Fee Compressor No1	29.25	7.91	17.36	NO	7.91	17.36
Shugart Booster Station	29.26	19.70	86.40	NO	36.83	161.09
Turkey Track Compressor Station	29.31	17.13	74.69	NO	36.83	161.09
OXY USA - Hopsing Federal No2	29.35	3.40	14.80	NO	8.70	38.00
Baish Federal Production Facility	29.77	2.21	9.68	NO	2.21	9.68
EOG Resources Inc - Sand Tank Compressor Site	29.78	3.30	14.50	NO	3.30	14.50
Penroc Compressor Station	29.84	5.30	23.20	NO	43.84	191.79
Federal East No1 Compressor Station	30.09	4.59	20.10	NO	9.52	41.70
Maverick 14 Federal Com No1 Compressor Station	30.12	2.30	10.05	NO	2.30	10.05
Todd Federal 26 SWD Reinjection Facility	30.14	5.50	24.10	NO	5.50	24.10
Southeast Readi-Mix - Carlsbad Plant GCP5-2096	30.15	43.38	190.00	YES	59.66	225.34
Double X Compressor Station	30.21	7.26	31.79	NO	7.26	31.79
Sunbright No1 Compressor Station	30.30	4.99	21.87	NO	4.99	21.87
Mewbourne Oil - Waukesha F1197G No2339	30.34	4.93	21.60	NO	9.52	41.70
Penroc Compressor Station	30.72	31.74	138.99	NO	40.44	176.99
YatesPetroleum - Avalon Compresson Station GCP1-2385	30.79	7.72	33.85	NO	24.62	68.40
Mesquite Tank Battery	30.79	4.03	17.69	NO	24.62	68.40
Constructors Inc - Southeast Materials GCP3-2792	30.86	21.69	95.00	YES	54.14	201.19
Lakeshore Federal No2 Compressor Station	31.00	12.75	16.36	NO	24.62	68.40
300TPH Asphalt Plant No1346	31.12	10.76	11.19	YES	54.14	201.19
Cedar Canyon Compressor Station	31.18	12.44	54.68	NO	12.44	54.68
Sand Dunes Booster Station	31.23	36.74	159.90	YES	54.00	235.40
Oxy USA - Buffalo Bill No1	31.43	3.40	14.80	NO	40.44	176.99
Arnold Federal Compressor Station	31.45	5.02	22.00	NO	5.02	22.00
Todd 26BC Battery Production Facility	31.50	0.20	0.50	YES	54.00	235.40
Todd 26 Fed No 1 Production Facility	31.53	3.90	17.40	YES	54.00	235.40
Loving Gas Plant	31.84	4.38	19.20	NO	4.38	19.20
Carlsbad 15 Federal No1Compressor Station	32.07	0.11	0.50	NO	25.25	71.17
Ranch Hand 5 Fee Compressor No1	32.18	5.00	21.90	NO	13.74	60.20
Oxy USA Palladium 7 Federal No1 battery	32.31	0.04	0.17	NO	0.04	0.17
Cal/Mon Compressor Station GCP4-1248	32.43	13.16	57.60	NO	57.63	251.29
Joel-Little Jewell Compressor Station, GCP4-3208	32.78	2.14	9.40	NO	13.74	60.20
Crawford Compressor Station	33.06	6.38	28.00	NO	14.13	61.96
Bounds Junction Booster Station	33.14	6.85	30.06	NO	14.13	61.96
South Carlsbad Compressor Station	33.19	6.60	28.90	NO	17.70	77.54
Elbow Canyon 4 Fed No 1 Production Facility	33.36	3.00	13.16	NO	3.00	13.16
Red Tank Compressor Station	33.37	4.38	19.20	NO	4.38	19.20
Devon Energy Production - Tomcat 16 State Battery Production Facility	33.40	0.20	0.40	NO	0.30	0.80
HB Ore Ida Compressor	33.50	4.80	21.20	NO	4.82	21.30
Oxy USA Red Tank 34 Federal No2 Bat	33.61	0.10	0.40	NO	5.10	22.40
Constructors Inc - Caviness Pit GCP2-2873	33.61	13.00	29.93	NO	13.00	29.93
Devon Energy - Tomcat 21 Federal Battery	33.76	0.10	0.40	NO	0.30	0.80
Ocotillo Hills Compressor Station No1	33.78	0.63	2.77	NO	0.75	3.27
Samson Resources - Loving 1 State CS, GCP4-3627	33.80	0.90	3.90	NO	14.13	61.96

NOx Offsite Inventory Determination

ROI = 2.2 km

MASTER_AI_NAME	Distance	Facility NOx		Model	Emissions within 2.5 km	
		lb/hr	TPY		NO2_PPH	NO2_TPY
Alisha Booster Station	33.97	5.00	22.00	NO	5.10	22.40
Mobile Unit 1 Compressor Station	34.07	3.63	15.89	NO	16.79	73.49
Chesapeake Operating Co - Lotus Federal 4	34.14	1.90	8.50	NO	1.90	8.50
Kathleen Compressor Station GCP4-1923	34.19	9.80	43.10	NO	14.91	65.49
Craft Dehy	34.20	0.02	0.10	NO	4.82	21.30
Smith Ranch Compressor Station	34.25	5.60	24.60	NO	5.60	24.60
Loco Hills Compressor Station	34.25	8.80	38.80	NO	34.07	149.49
Mewbourne Oil - Caterpillar G3306 NA LCR No2447	34.58	3.96	17.34	NO	10.56	46.24
Winchester Compressor Station	34.70	12.83	55.17	NO	16.13	69.67
Cheasapeake - Queen Lake 20 FED 2H Compressor Station	34.75	3.80	16.40	NO	3.80	16.40
Westside 4 State Com No1 Production Facility	34.91	5.10	22.20	NO	6.56	28.57
DCP Midstream - RJ Booster GCP4-3808	34.96	6.00	26.10	NO	6.00	26.10
Mesa Arriba Compressor Station	35.14	3.30	14.50	NO	3.30	14.50
Loco Hills Booster Station GCP4-1406	35.33	25.27	110.69	NO	34.07	149.49
Deep Units Compressor Station	35.43	5.11	22.39	NO	14.91	65.49
Nash Draw Compressor Station, GCP4-3224	35.45	5.00	22.00	NO	5.00	22.00
Parrot Federal No2 Facility	35.53	3.30	14.50	NO	6.60	29.00
Huber Pecos River Deep No6 Facility	36.20	3.30	14.50	NO	19.43	84.17
Fortson Compressor Station, GCP4-3223	36.48	2.70	11.80	NO	2.70	11.80
Jackson Booster Station	36.58	22.56	99.06	NO	27.16	119.16
Maljamar Compressor Station	36.59	17.12	74.89	YES	126.26	358.19
Avalon 31 No1Compressor Station	36.66	1.78	7.80	NO	1.78	7.80
Wisetail Compressor Station	36.77	5.60	24.40	NO	7.27	31.80
Yates Petroleum - Pierre State No1 Facility	36.99	1.67	7.40	NO	8.86	38.76
Skelly Compressor Station	37.01	34.43	149.10	NO	34.43	149.10
Pecos River Deep Unit No8, GCP4-3023	37.02	1.08	4.72	NO	2.54	11.09
Grayburg Booster Station	37.22	58.70	100.60	NO	61.91	114.66
Tropicana Fed Com No1, GCP4-3022	37.36	1.46	6.37	NO	7.64	33.29
Artesia Gas Plant	37.37	102.70	449.70	YES	102.70	449.70
MCA Tank Battery No2	37.55	12.40	28.50	YES	126.26	358.19
Read and Stevens Compressor Station	37.57	1.41	6.19	NO	28.41	124.09
Rustler Breaks - 26 Fee Compressor No1	37.65	3.96	17.34	NO	6.36	27.84
Trunk A Compressor Station	37.68	8.58	37.69	NO	13.88	60.89
Transwestern Booster Station, GCP1-2598	37.79	3.21	14.06	NO	61.91	114.66
Frontier Field Services - Maljamar Gas Plant	37.80	96.74	254.80	YES	126.26	358.19
Chevron USA - Levers No4 C.S and Tank Battery GCP4-3664	38.17	1.06	4.63	NO	2.40	10.53
Yates - Eastern Shores QW No1 Facility	38.42	4.17	18.30	NO	4.17	18.30
DCP Midstream - Mescalero Booster Station, GCP4-3648	38.45	6.10	26.70	NO	6.10	26.70
Muskegon 17 Well 1 Compressor Station	38.60	4.60	20.10	NO	48.86	214.36
State Line Booster Station	38.66	5.30	23.20	NO	28.41	124.09
Lynch Booster Station	38.66	21.70	94.70	NO	28.41	124.09
Chalk Compressor Station	38.75	1.59	6.96	NO	5.13	22.56
Illinois Camp Booster Station	38.80	21.20	92.80	YES	108.10	220.20
Aid State Compressor Station	38.93	21.70	95.20	NO	26.30	115.30
Filaree 18 Fed No 1 Production facility	39.08	2.75	12.04	NO	10.32	45.35
Chesapeake Operating Inc - Mosaic 34 Federal 2H	39.28	2.40	10.50	NO	6.36	27.84
ConocoPhillips - MCA Battery No4 GCP4-3138	39.30	0.51	2.00	NO	9.01	39.30
Devon Enegy - Federal N1 Battery	39.40	2.16	9.50	NO	2.16	9.50

NOx Offsite Inventory Determination ROI = 2.2 km

MASTER_AI_NAME	Distance	Facility NOx lb/hr	Facility NOx TPY	Model	Emissions within 2.5 km NO2_PPH	Emissions within 2.5 km NO2_TPY
Grayburg Booster Station	39.42	14.90	65.70	NO	35.79	157.58
Caviness Ranch Compressor Station	39.47	3.52	15.44	NO	3.52	15.44
Catclaw Draw Compressor Station GCP1-3418	39.48	5.60	24.40	NO	12.43	54.30
Exxon S Carlsbad Compressor Station	39.72	7.19	31.50	NO	11.15	48.84
Texmack 11 Federal Central Facility	39.75	4.92	21.55	NO	4.92	21.55
Catclaw No1 Compressor Station	39.78	5.48	24.00	NO	11.08	48.40
Pinnacle Natural Gas - Catclaw Compressor Station	39.84	1.35	5.90	NO	8.00	34.93
Devon Energy Production - Filaree 24 Fed No1	40.03	7.57	33.31	NO	10.32	45.35
Compressor Systems Inc - Caterpillar G333 NA No1344	40.03	5.30	23.20	NO	13.88	60.89
Kemnitz Compressor Station	40.10	8.50	37.30	NO	20.81	91.10
Square Lake Booster Station GCP4-0855	40.18	20.89	91.88	NO	35.79	157.58
Transwestern Pipeline - Atoka No1 Compressor Station	40.30	86.90	127.40	YES	108.72	222.90
Black River 35 State Compressor Station	40.37	3.96	17.34	NO	11.15	48.84
Atoka No2 Compressor Station	40.50	21.40	95.40	NO	21.40	95.40
Federal South No1 Compressor Station	40.52	1.87	8.20	NO	17.06	74.36
Karlsbad Corral Compressor Station	40.53	1.00	4.20	NO	1.00	4.20
Kemnitz Compressor Station	40.88	11.80	51.80	NO	20.30	89.10
Monument Lateral Compressor Station	41.58	6.56	28.72	NO	6.56	28.72
Empire Abo Gas Plant	41.90	612.10	2680.10	YES	650.51	2846.80
Las Cruces Chile Plant	41.99	7.90	35.10	YES	650.51	2846.80
Logan Draw	42.13	0.62	2.70	YES	131.95	324.26
Natural Gas Pipeline Co of America - Compressor Station No166	42.29	6.96	30.50	NO	45.05	196.86
Spurck 16 State Com No2, GCP4-3024	42.58	1.03	4.52	NO	1.03	4.52
PLU Pierce Canyon 17 Central Production Facility	42.61	2.60	11.60	NO	2.60	11.60
Pecos Diamond Gas Plant	42.69	30.51	131.60	YES	650.51	2846.80
Pecos Booster Station	42.97	13.60	59.20	NO	17.45	76.08
Logan Draw Booster GCP1-2308	43.05	10.57	46.06	NO	45.05	196.86
Cotton Draw Unit No76 Facility	43.32	2.50	10.95	NO	7.98	34.95
DCP Midstream - Black River Compressor Station GCP1-1953	43.52	11.82	51.76	NO	11.82	51.76
Cotton Draw Well No64 Compressor	43.57	5.48	24.00	NO	7.98	34.95
Mewbourne Oil - Caterpillar G3306 NA No1565	43.57	5.25	23.00	NO	5.25	23.00
Bootleg Compressor Station	43.67	5.39	23.60	NO	2.69	11.80
Mckittrick 30 Compressor Station	44.04	3.11	13.60	NO	3.11	13.60
Southern Union Compressor Station	44.36	26.90	117.60	NO	45.05	196.86
Enterprise Products - Pecos Compressor Station GCP4-3373	44.63	10.52	45.80	NO	10.52	45.80
Gaucho Unit No3	44.79	1.75	7.66	NO	10.80	32.82
Gaucho Unit No4	44.80	6.61	14.50	NO	10.80	32.82
Peterson Com No1 Compressor Station	44.81	1.98	8.68	NO	15.58	67.88
Gaucho Unit No2Y	44.93	2.44	10.66	NO	11.58	36.13
Pen Fed 9-1 Compressor Station, GCP4-3311	45.02	0.80	3.50	NO	3.93	17.10
Grama Ridge Federal No2 Compressor Station	45.03	3.91	17.12	NO	53.89	236.41
Revelation Compressor Station	45.05	5.48	24.00	NO	5.48	24.00
2008 January Pioneer VSI Crusher GCP2-1775	45.06	43.38	95.00	NO	43.38	95.00
Wadi Petroleum - Pen Fed 9-3 Compressor Station	45.15	3.13	13.60	NO	3.93	17.10
Hackberry No1 Compressor Station	45.27	5.25	23.00	NO	5.25	23.00
Grama Ridge Compressor Station	45.50	2.81	12.30	NO	53.89	236.41
Grama No1 and Booster Comp Station GCP4-3757	45.55	29.19	127.60	NO	48.99	214.31

NOx Offsite Inventory Determination

ROI = 2.2 km

MASTER_AI_NAME	Distance	Facility NOx lb/hr	Facility NOx TPY	Model	Emissions within 2.5 km NO2_PPH	Emissions within 2.5 km NO2_TPY
Devon Energy - Bell Lake No21	45.60	0.60	2.50	NO	3.22	13.97
Grama Booster Station	45.61	7.46	32.69	NO	48.99	214.31
Enstor Operating - Grama Ridge No1 Compressor Station	45.66	4.90	22.10	NO	32.05	140.99
North Indian Hills Gas Facility	45.69	3.13	15.25	NO	3.13	15.25
Enstor Operating Co - Grama Ridge No4 Compressor Station	45.69	2.71	11.85	NO	19.72	86.97
Grama Ridge 1a Compressor Station	45.87	5.62	24.60	NO	66.00	289.43
Enstor Operating Co - Grama Ridge No2 Compressor Station	45.87	12.11	53.02	NO	25.33	111.57
Bell Lake Unit 21	46.06	0.18	0.81	NO	3.22	13.97
Devon Energy - Atoka San Andreas Unit Battery	46.21	0.05	0.20	NO	41.57	182.40
Wadi Petroleum - Fed Com 22-1 Compressor Station	46.26	3.13	13.70	NO	3.13	13.70
Cotton Draw Compressor Station	46.32	39.99	89.90	NO	39.99	89.90
Atoka Dehydration Facility	46.91	0.23	1.00	NO	41.57	182.40
Atoka No3 Compressor Station	47.03	41.30	181.20	NO	41.57	182.40
OXY USA WTP LP - Ijam State No1	47.58	3.40	14.80	NO	3.40	14.80
Outland State No5 Production Facility	47.63	1.70	7.40	NO	24.10	86.34
St Mary Connie 19-1 Oil and Gas Production Facility	47.64	1.70	0.37	NO	1.70	0.37
Prairie Fire State No 1	47.65	2.90	13.00	NO	15.13	47.21
Wadi Petroleum - Exxon 17-2 Compressor Station	47.77	1.00	4.40	NO	1.00	4.40
Outland St Unit No3	47.83	2.52	11.02	NO	19.18	64.49
ConocoPhillips - Corner Pocket 14 State Com	47.86	6.31	27.50	NO	19.18	64.49
Kaiser-Francis - Bell Lake Compressor Station	47.99	2.25	9.84	NO	26.38	73.13
Outland State Unit No4 Production Facility	48.21	1.72	7.50	NO	24.10	86.34
Outland State Unit No2	48.41	6.79	10.46	NO	24.10	86.34
Outland State Unit No1-Y	48.43	0.14	0.61	NO	21.20	73.34
Devon Energy Production - State R No2 Production Facility	48.44	2.02	8.85	NO	15.27	47.82
Devon Energy - Rio Blanco 4 Federal No3	48.51	2.60	11.40	NO	15.94	69.85
Shadow Booster Station GCP4-1421	48.61	14.07	61.50	NO	14.07	61.50
Rio Blanco 9 St No 1 Production Facility	48.81	2.21	9.70	NO	15.94	69.85
Bell Lake Compressor Station GCP4-2208	48.86	4.77	20.89	NO	26.38	73.13
PLU Ross Ranch 6 Central Production Facility	48.92	3.57	15.64	NO	3.72	16.24
PitchFork Ranch Compressor Station No 0908	49.06	19.36	42.40	NO	26.38	73.13
Pecos River Compressor Station	49.39	159.30	699.00	YES	159.30	699.00
Maxus A1 Compressor	49.70	4.17	18.25	NO	19.59	85.85
BTA Oil - Antelope Ridge Compressor Station	49.88	3.65	16.00	NO	14.78	64.75
State 35 Compressor Station	49.89	9.68	42.40	NO	106.72	459.90
Yates Federal 8 No2 Gas Plant	50.30	0.15	0.60	NO	3.72	16.24
Compressor Station No167	50.32	270.80	1185.30	YES	270.80	1185.30
7 Rivers Compressor Station	50.44	3.09	13.52	NO	3.09	13.52
Triste Low Pressure Compressor	50.61	0.10	0.44	NO	0.10	0.44
BTA Oil - Antelope Ridge Low CS	50.74	6.96	30.50	NO	19.59	85.85
Dobbs Booster Station GCP1-2949	51.00	49.20	49.70	NO	49.20	49.70
Parker and Parley (P and P) Malaga Compressor Station	51.01	6.32	27.70	NO	6.32	27.70
Chevron USA - Buckeye CO2 Plant	51.13	6.84	22.30	NO	106.72	459.90
Potash Compressor Station	51.13	8.98	39.34	NO	8.98	39.34
Rock Tank 4 Compressor Station	51.18	3.33	14.60	NO	3.33	14.60

MASTER_AI_NAME	Distance	Facility NOx		Model	Emissions within 2.5 km	
		lb/hr	TPY		NO2_PPH	NO2_TPY
Lightning 24 Federal Com Compressor Station GCP4-3320	51.19	1.70	7.40	NO	1.70	7.40
Buckeye Compressor Station	51.25	90.20	395.20	NO	106.72	459.90
Yates Petroleum - Opuntia Draw Facility GCP4-3172	51.31	3.00	13.20	NO	3.00	13.20
Lovington Booster Station	51.36	81.10	28.30	NO	89.60	65.73
Frontier Field Services - Anderson Ranch Compressor Station	51.38	3.24	14.19	NO	3.24	14.19
Dazed Compressorr Station	51.49	2.40	10.50	NO	10.09	44.51
Antelope Ridge Gas Plant	51.55	48.19	210.69	NO	49.29	215.59
Mad Dog 15 No1 Production Facility	51.71	1.10	4.90	NO	49.29	215.59
Mystery	52.02	0.09	0.41	NO	10.09	44.51
Penasco Compressor Station	52.10	21.68	94.99	NO	24.25	106.19
Southwest Asphalt Paving - GCP3-3621	52.18	43.50	95.00	NO	43.50	95.00
Lady Luck No1 Facility	52.24	2.90	12.73	NO	89.60	65.73
Triste Low Pressure Compressor	52.25	2.65	11.61	NO	4.85	21.01
Triste Compressor Station	52.25	2.20	9.40	NO	4.85	21.01
Agave Dagger Draw Gas Plant	52.38	2.57	11.20	NO	24.25	106.19
Dilly Bar Compressor Station	52.44	6.28	27.50	NO	11.58	50.70
Barrel Facility	52.47	1.17	5.00	NO	1.17	5.00
Fasken Oil & Ranch Ltd - State 32 No 1 Compressor Station	52.50	7.60	33.60	NO	10.09	44.51
Yates - Bellagio Facility	52.72	4.20	18.30	NO	4.20	18.30
Bold Energy LP - Antelope Ridge Compression	52.85	2.62	11.60	NO	4.52	19.94
Blackbird 8 No1 Production Facility	53.02	2.90	12.72	NO	2.90	12.72
Yates - Anemone Compressor Station GCP1-1705	53.12	5.58	24.39	NO	26.38	115.19
Citation Oil and Gas - Antelope Ridge Unit	53.18	1.90	8.34	NO	4.52	19.94
Lucky Lobo ASX #2 Facility	53.39	5.60	24.70	NO	89.60	65.73
Chesapeake Operating - KF4 State Com 2	53.57	5.30	23.20	NO	11.58	50.70
Jay Booster Station	53.58	12.66	27.40	NO	71.45	232.84
Yates Petroleum - Chosa ATR Federal No1	53.67	11.26	49.40	NO	11.26	49.40
Ross Draw 25 No1 Gas Plant	54.16	0.18	0.79	NO	0.18	0.79
Baldridge Canyon 6 State No1Compressor Station	54.17	4.07	17.84	NO	4.07	17.84
Shell Federal No1 Compressor Station	54.18	3.30	14.40	NO	8.55	37.40
Carbon Valley 14 Fed Com No2	54.53	3.30	14.50	NO	13.76	60.30
Paducah Compressor Station	54.65	7.53	33.00	NO	7.53	33.00
Nagooltee Peak Facility CS, GCP1-2769	54.95	11.20	48.80	NO	73.39	318.28
Old Ranch Knoll, GCP1-2768	54.97	9.60	42.00	NO	64.40	279.16
Oxy USA - 129 Generator Station	55.15	7.40	24.50	NO	61.94	263.55
Indian Basin 32 St 1 Y	55.49	4.05	17.70	NO	75.70	320.39
Encore Operating - Encore 12 State Com No1	55.55	2.80	12.00	NO	2.80	12.00
OXY USA - Indian Basin Central Tank Battery	55.57	2.80	12.20	NO	58.82	254.77
Kemnitz Booster Station	55.66	7.48	32.78	NO	7.48	32.78
East Indian Basin CF Compressor Station	55.68	28.70	125.75	NO	57.79	245.25
Rat Camp Compressor Station	55.72	10.46	45.80	NO	13.76	60.30
East Vacuum Liquid Recovery	55.76	58.80	205.44	NO	71.45	232.84
Hickory Compressor Station	55.88	6.53	28.60	NO	47.62	205.97
Geronimo 28 State Com No1 GCP1-2878	55.90	0.28	1.22	NO	0.28	1.22
Pitchfork Ranch Compressor Station No 2194	55.91	3.53	15.46	NO	3.53	15.46
Feagan South Booster Station	55.93	19.99	87.56	NO	86.70	184.76
Martha Creek Battery and Compressor Site GCP1-2709	55.94	21.69	95.00	NO	78.74	336.75
Baldridge 1 State No1Compressor Station	56.06	3.77	16.50	NO	17.17	75.21

NOx Offsite Inventory Determination

ROI = 2.2 km

MASTER_AI_NAME	Distance	Facility NOx lb/hr	Facility NOx TPY	Model	Emissions within 2.5 km NO2_PPH	Emissions within 2.5 km NO2_TPY
Navajo Refining - Artesia Refinery	56.14	60.88	265.64	NO	221.48	968.54
Federal 6 No1 Compressor Station	56.19	5.25	23.00	NO	24.76	108.34
C2 Compressor Station	56.21	5.59	24.50	NO	5.59	24.50
Old Ranch Canyon Compressor Station	56.26	14.46	60.59	NO	79.67	345.67
Indian Hills No7 Compressor Station	56.34	4.77	20.90	NO	26.00	113.87
Winston Lease Battery and CS, GCP1-2485	56.62	0.10	0.60	NO	110.32	475.20
Vaca Compressor Station	56.65	4.72	4.69	NO	4.72	4.69
Baldridge Canyon 12 State No1 Compressor Station	56.71	5.02	22.00	NO	17.17	75.21
Indian Hills No5 Compressor Station	56.72	4.77	20.90	NO	26.00	113.87
Indian Hill No3 Compressor Station	56.76	2.79	12.22	NO	20.75	90.87
Devon Energy - Keller 4 State No1	56.78	2.10	9.20	NO	2.10	9.20
Navajo Refining - Artesia Refinery	56.81	104.60	457.60	NO	222.32	972.24
Old Ranch Canyon 7 No6 Compressor Station	56.83	8.80	38.80	NO	75.62	327.97
Dagger Draw Compressor Station	56.85	66.71	97.20	NO	86.70	184.76
Lisa EIB No1 Compressor Station	56.94	16.80	73.20	NO	126.18	550.09
KCS Medallion Resources - State of New Mexico 35 No1	57.04	5.66	24.79	NO	13.16	57.69
Marathon Oil Company - DPC360 Compressor Station No1189	57.24	2.78	12.19	NO	29.88	130.82
Smith Federal No1 Compressor Station	57.42	5.43	23.78	NO	47.62	205.97
Encore 36 State No1, GCP1-3826	57.62	7.50	32.90	NO	13.16	57.69
Navajo Refining - Artesia Refinery	57.66	56.00	245.30	NO	226.19	989.24
Dagger Draw Compressor Station	57.72	3.10	13.60	NO	22.41	77.00
Yates Petroleum - Big Hat No3 Facility	57.78	1.68	7.35	NO	1.68	7.35
Federal No3 Compressor Station	58.09	3.88	16.95	NO	37.66	164.96
Holly Asphalt Company	58.28	3.87	17.00	NO	60.71	266.00
Chaves Compressor Station	58.35	16.80	73.62	NO	16.80	73.62
Notserp Compressor Station	58.42	5.63	24.66	NO	24.63	107.82
Yates Petroleum - Portable Caterpillar G3304NA	58.42	3.31	14.50	NO	103.87	454.69
Yates Petroleum - Portable Unit	58.42	3.31	14.50	NO	103.87	454.69
Yates Petroleum - Portable Cummins G83	58.42	3.31	14.50	NO	103.87	454.69
Lowe State No1 Compressor Station	58.42	31.05	136.40	NO	103.87	454.69
Lowe State No1 Portable	58.43	4.18	18.29	NO	103.87	454.69
Baldridge Canyon 11 No2 Compressor Station	58.45	8.38	36.71	NO	19.98	87.50
7 Rivers Draw Compressor Station	58.49	14.96	44.40	NO	22.41	77.00
Pinnacle Natural Gas - Shoebar Compressor Station	58.55	1.53	6.69	NO	1.53	6.69
Thc Ranch Compressor Station	58.58	1.56	6.84	NO	1.56	6.84
Production Operators - Waukesha L3521 GL No1566	58.62	2.37	10.39	NO	15.32	78.57
Land O' Lakes Purina Feed - Artesia Feed Mill	58.72	0.84	3.70	NO	165.31	723.60
North Indian Basin No11 Compressor Station	58.80	20.12	88.16	NO	24.00	105.11
HOC Federal Compressor Station	58.82	1.32	5.78	NO	93.41	408.86
Lowe State No2 Compressor Station	58.89	2.61	11.43	NO	93.41	408.86
DD Federal Compressor Station	58.93	4.35	19.00	NO	22.41	77.00
Indian Basin Gas Plant	58.96	3.00	12.90	NO	144.37	632.70
Indian Basin Gas Plant	59.13	101.42	444.90	NO	146.85	643.59
Oxy - Indian Basin Remediation Project	59.39	0.84	3.68	NO	146.85	643.59
Roaring Springs Compressor Station	59.51	8.40	36.70	NO	139.11	609.62
Enstor Operating - Grama Ridge No1 Compressor Station	59.55	6.40	39.50	NO	15.32	78.57
Gramma Ridge No1 Booster	59.57	6.55	28.68	NO	15.32	78.57
Yates Petroleum - Red Bone BP Facility	59.64	2.81	12.29	NO	11.19	49.00

MASTER_AI_NAME	Distance	Facility NOx		Model	Emissions within 2.5 km	
		lb/hr	TPY		NO2_PPH	NO2_TPY
South Indian Basin Compressor Station	59.82	15.42	67.56	NO	175.49	769.50
Federal No1Compressor Station	59.84	1.18	5.19	NO	79.09	346.36
West Blevins Compressor Station GCP-3814	59.97	16.80	73.20	NO	22.25	96.70
Conoco State Compressor Station	59.98	13.68	59.54	NO	79.09	346.36
Larue Compressor Station GCP1-0849	60.22	39.30	172.14	NO	39.30	172.14
Station 235 Production Facility	60.24	7.60	33.20	NO	88.83	388.61
Marathon Oil Company - AG Station	60.35	7.16	31.38	NO	157.63	690.92
Xcel Energy - Cunningham Station	60.59	1078.60	4013.30	NO	1078.60	4013.30
Eunice A Compressor Station	60.74	823.90	3607.00	NO	1067.39	4664.89
Monument Compressor Station	60.76	111.20	486.20	NO	409.86	1812.10
Monument Gas Plant	60.87	298.66	1325.90	NO	409.86	1812.10
Bogle Flats No1 Compressor Station	60.87	4.96	21.73	NO	49.48	215.65
Federal Iba Com K No1 Compressor Station	61.11	8.12	35.58	NO	147.39	646.06
Marathon Oil Company - Ajax 280 Compressor Station No1205	61.17	2.49	10.89	NO	174.35	818.30
Oxy USA - North Indian Basin No1 210 Facility	61.24	5.19	22.70	NO	27.76	121.47
Carlsbad Compressor Station	61.26	2.49	10.89	NO	37.74	165.30
Four Dinkus Compressor Station GCP4-3091	61.29	5.45	23.50	NO	22.25	96.70
Page Compressor Station	61.43	1.80	7.88	NO	1.80	7.88
Bogle Flats No10 Compressor Station	61.55	2.58	11.30	NO	45.55	198.44
Bogle Flats No16 Compressor Station	61.65	11.23	49.18	NO	64.69	217.16
Federal Helbing No15-4 Compressor Station	61.66	4.05	17.74	NO	64.69	217.16
Eunice B&C Compressor Station	61.74	38.90	170.50	NO	1067.39	4664.89
DCP Midstream - Eunice Gas Plant	61.83	204.59	887.39	NO	1067.39	4664.89
Hobbs Gas Plant	62.29	8.12	35.21	NO	725.36	2336.51
BV No2 Compressor Station	62.44	4.34	19.00	NO	4.34	19.00
Apache Corp - Fed 28-1 CS GCP1-3999	62.46	15.10	92.00	NO	36.50	213.50
Federal 33 No1 Compressor Station GCP4-1743	62.53	2.41	10.57	NO	96.45	443.11
Bogle Flats No15 Compressor Station	62.55	3.57	15.64	NO	79.25	313.87
Bogle Flats No17 Compressor Station	62.55	3.57	15.64	NO	79.25	313.87
Bogle Flats No2 Compressor Station GCP4-1741	62.56	0.80	3.30	NO	71.65	280.67
Federal 33 No2 Compressor Station	62.57	0.18	0.40	NO	96.45	443.11
Red Hills Compressor Station, GCP1-3574	62.58	4.90	21.40	NO	4.90	21.40
Bright Federal No4	62.62	1.92	8.39	NO	54.80	294.03
Oil Center Compressor Station, GCP4-3673	62.69	15.30	67.30	NO	15.30	67.30
W Indian No2 Compressor Station	62.75	3.56	15.60	NO	62.48	327.62
Bright Federal No2 Compressor Station	62.75	2.81	12.45	NO	57.29	304.92
Fed 28-1 Compressor Station	62.76	7.11	59.17	NO	36.50	213.50
Bogle Flats No17 Compressor Station	62.84	5.01	21.93	NO	128.73	464.93
Apex Booster Station	62.86	11.10	48.63	NO	725.36	2336.51
Bogle Flats No18 Compressor Station	63.03	21.80	95.50	NO	64.69	217.16
Shoebar Compressor Station	63.29	8.66	38.00	NO	8.66	38.00
Bogle Flats No5 Compressor Station	63.62	4.34	19.02	NO	64.69	217.16
Apex Booster Station	63.68	6.34	27.77	NO	766.36	2412.71
Kerr-McGee - Ajax DPC 360 No1466	63.70	0.92	4.03	NO	37.03	216.18
Bogle Flats No13 Compressor Station	63.87	18.26	13.79	NO	76.69	294.56
A 14 Compressor Station, GCP4-3489	63.90	9.40	41.10	NO	9.40	41.10
Zingaro Compressor Station	63.92	8.62	13.00	NO	8.62	13.00
Bogle Flats No11 Compressor Station	64.21	36.56	102.76	NO	64.11	247.64
West Indian Basin Unit No1-Y Compressor Station GCP1-2432	64.22	5.61	24.54	NO	14.82	65.01

NOx Offsite Inventory Determination

ROI = 2.2 km

MASTER_AI_NAME	Distance	Facility NOx lb/hr	Facility NOx TPY	Model	Emissions within 2.5 km NO2_PPH	Emissions within 2.5 km NO2_TPY
Apache Corp - Bogle Flats 11 CS GCP1-4000	64.24	12.00	77.40	NO	82.37	261.43
C4 Compressor Station	64.26	4.28	18.78	NO	8.68	37.88
Chesapeake Operating - Langley Greer No4	64.39	4.40	19.10	NO	8.68	37.88
Hobbs Generating Station	64.46	41.00	76.20	NO	747.14	2328.87
Maddox Station	64.51	699.80	2224.90	NO	766.36	2412.71
Oil Center Booster Station	64.55	125.35	549.20	NO	125.35	549.20

Appendix B – CD Key

The directory structure for the attached CD is as follows

HB Mill\AERMAP – Contains input/output and database files for the preliminary analysis grid at the HB Mill

HB Mill\AERMAP\North Plant – Contains the input/output and database files for the North Compaction Plant receptor grid

HB Mill\BPIP\HB Mill – Contains the input/output files for the bpip runs on the HB Mill structures/sources

HB Mill\BPIP\North Plant – Contains the input/output files for the bpip runs on the North Compaction Plant structures/sources

HB Mill\CIA\NO2, \PM10, \PM25, \TSP – Contains the input/output files for the NAAQS cumulative impacts AERMOD runs at the HB Mill

HB Mill\CIA\North Plant\TSP – Contains the input/output files for the NAAQS cumulative impacts analysis at the North Compaction Plant

HB Mill\INCREMENT\NO2, \PM10 – Contains the input/output files for the increment cumulative analysis at the HB Mill

HB Mill\Offsite Inventory – Contains the mergemaster excel spreadsheet outputs

HB Mill\SIA\NO2, \PM10, \PM25, \TSP – Contains the input/output files for the preliminary analysis runs at the HB Mill

HB Mill\SIA\North Plant\PM10, \PM25, \TSP – Contains the input/output files for the preliminary analysis runs at the North Compaction Plant

Included receptor files are contained in the model run folder with the ".rou" extension.
Included offsite source files are contained in the model run folder with the ".inc" extension

SUSANA MARTINEZ
GOVERNOR

JOHN A. SANCHEZ
LIEUTENANT GOVERNOR

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ENVIRONMENT DEPARTMENT

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DAVE MARTIN
CABINET SECRETARY

RAJ SOLOMON, PE
DEPUTY SECRETARY

NEW SOURCE REVIEW PERMIT
Issued under 20.2.72 NMAC

Certified Mail No: 7008 0500 0001 1252 0423
Return Receipt Requested

NSR Permit No:	4332
Facility Name:	HB Plant (HB In-Situ Project)
Permittee Name:	Intrepid Potash, Inc.
Mailing Address:	PO Box 101 Carlsbad, NM 88220
TEMPO/IDEA ID No:	29939-PRN201000001
AIRS No:	35 0150563
Permitting Action:	New NSR Permit
Air Quality Bureau Contact	Cember Hardison
Main AQB Phone No.	(505) 476-4300

Richard L. Goodyear

Richard L. Goodyear, PE
Acting Bureau Chief
Air Quality Bureau

JUL 29 2011
Date

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PART A FACILITY SPECIFIC REQUIREMENTS

A100 Introduction - Not Required

A101 Permit Duration (expiration)

A. The term of this permit is permanent unless withdrawn or cancelled by the Department or cancelled by the permittee in writing.

A102 Facility: Description

A. The function of the facility is to produce potash product, using a brine extraction and evaporation method, for transport to Intrepid's North Plant for further processing.

B. This facility is located at UTM Zone 13, UTM Easting 599.5 km, UTM Northing 3595.2 km, in Township 21S, Range 29E, Section 12, approximately 20.3 miles east, northeast of Carlsbad, New Mexico in Eddy County.

C. Table 102.A and Table 102.B show the total potential emissions from this facility for information only, not an enforceable condition, excluding exempt sources or activities.

Table 102.A: Total Potential Criteria Pollutant Emissions from Entire Facility that exceed 1.0 ton per year

Pollutant	Emissions (tons per year) HB Plant Only	Emissions (tons per year) HB, North, & West Plants
Nitrogen Oxides (NOx)	15.1	143.1
Carbon Monoxide (CO)	12.7	156.9
Volatile Organic Compounds (VOC)	0.8	3.3
Total Suspended Particulates (TSP)	91.2	279.6
Particulate Matter less than 10 microns (PM_{10})	31.1	219.5
Particulate Matter less than 2.5 microns ($PM_{2.5}$)	14.0	14.0

Table 102.B: Total Potential HAPS that exceed 1.0 ton per year

Pollutant	Emissions (tons per year) HB Plant Only	Emissions (tons per year) HB, North, & West Plants
Individual and Total HAPs less than 1 tpy		

A103 Facility: Applicable Regulations

A. The permittee shall comply with all applicable sections of the requirements listed in Table 103.

Table 103: Applicable Requirements

Applicable Requirements	Federally Enforceable	Unit No.
20.2.1 NMAC General Provisions	X	Entire Facility
20.2.3 NMAC Ambient Air Quality Standards	X	Entire Facility
20.2.7 NMAC Excess Emissions	X	Entire Facility
20.2.19 NMAC Potash, Salt or Sodium Sulfate Processing Equipment – Particulate Matter	X	EP-01, EP-04a, EP-04b, and F1-F4.
20.2.61 NMAC Smoke and Visible Emissions	X	EP-03a and EP-03b
20.2.70 NMAC Operating Permits	X	Entire Facility
20.2.71 NMAC Operating Permit Emission Fees	X	Entire Facility
20.2.72 NMAC Construction Permit	X	Entire Facility
20.2.73 NMAC Notice of Intent and Emissions Inventory Requirements	X	Entire Facility
20.2.75 NMAC Construction Permit Fees	X	Entire Facility
40 CFR 50 National Ambient Air Quality Standards	X	Entire Facility
40 CFR 64 Compliance Assurance Monitoring	X	EP-01, EP-04a, and EP-04b

A104 Facility: Regulated Sources

A. Table 104 lists all of the emission units authorized for this facility. Emission units that were identified as exempt activities and/or equipment (as defined in 20.2.72.202 NMAC) not regulated pursuant to the Act are not included.

Table 104: Regulated Sources List

Unit No.	Source Description	Make Model	Serial No.	Capacity	Manufacture Date
EP-01	Fluidized Bed Dryer	Custom Design	TBD	16 MMBtu/hr / 42.0 tph	TBD
EP-03a	Amine Water Heater	TBD	TBD	6 MMBtu/hr	TBD
EP-03b	Amine Water Heater	TBD	TBD	6 MMBtu/hr	TBD

Unit No.	Source Description	Make Model	Serial No.	Capacity	Manufacture Date
EP-04a	Emissions Stack – Bins 1 & 2, & two Truck Loadouts	TBD	TBD	42.0 tph (21.0 tph per bin & loadout)	TBD
EP-04b	Emissions Stack – Material Transfer units F1 to F4	TBD	TBD	42.0 tph (21.0 tph per conveyor)	TBD
F1	Enclosed Product Weighbelt (CY-003)	TBD	TBD	42.0 tph	TBD
F2	Enclosed Product Bucket Elevator (CY-004)	TBD	TBD	21.0 tph	TBD
F3	Enclosed Product Screw Conveyor No. 1	TBD	TBD	21.0 tph	TBD
F4	Enclosed Product Screw Conveyor No. 2	TBD	TBD	21.0 tph	TBD
EP-05	Cooling Tower	Niagra Blower Co.	A4408	12,180 gal/h	TBD
F5	Paved Haul Road	N/A	N/A	N/A	N/A
F6	Unpaved Haul Road	N/A	N/A	N/A	N/A
HBTK156	38% HCl Storage Tank	TBD	TBD	25,550 gal/y	TBD

B. The permittee shall report to the Compliance Reporting Section all information listed as TBD (to be determined) in Table 104 within 15 days after the startup of a unit and in accordance with Condition B110.B(2).

A105 Facility: Control Equipment

A. Table 105 lists the pollution control equipment required for this facility. Each emission point is identified by the same number that was assigned to it in the permit application.

Table 105: Control Equipment List:

Control Equipment Unit No.	Control Description	Pollutant being controlled	Control for Unit Numbers[1]
EP-01	Cyclone and Venturi Scrubber with 99.8% control efficiency	TSP, PM_{10}, $PM_{2.5}$	EP-01
EP-04a	**Baghouse** with 99.9% control efficiency **Passive Fugitive Controls (described below) -** 100% capture and control with pick up to BH **Bin Controls:** Bin vents equipped with socks	TSP, PM_{10}, $PM_{2.5}$	EP-04a

	Truck loadout controls: **Partial enclosures** located in truck loadout area consist of two sided pull through with roof and curtained entry and exit ways. Reduces wind generated dusting during truck loading. **Loading spouts** on truck loadout bin discharge chutes to minimize dust. **Reduced energy consumption -** The passive controls are designed to increase efficiency and reduce energy consumption of the active dust collection BH at the truck loadout. **Negative pressure truck bed curtains**		
EP-04b / F1-F4	**Baghouse** with 99.9% control efficiency **Passive Fugitive Controls are full enclosures** on conveyors and other transfer points with 100% capture and control with pick up to the BH.	TSP, PM_{10}, $PM_{2.5}$	EP-04b / F1-F4
EP-05	Drift Eliminator with 0.002% drift rate (limited to 0.005%)	TSP, PM_{10}, $PM_{2.5}$	EP-05
F5	Paving and Sweeping (or other method of cleaning) at a minimum	TSP, PM_{10}, $PM_{2.5}$	F5
F6	Gravel or Base Course at a minimum	TSP, PM_{10}, $PM_{2.5}$	F6

1. Control for unit number refers to a unit number from the Regulated Equipment List

A106 Facility: Allowable Emissions

A. The following section lists the emission units and their allowable emission limits. (40 CFR 50, 20.2.19 NMAC; 20.2.72.210.A and B.1 NMAC).

Table 106: Allowable Emissions

Unit No.	NO_x[1] pph	NO_x[1] tpy	CO pph	CO tpy	TSP pph	TSP tpy	PM_{10} pph	PM_{10} tpy	$PM_{2.5}$ pph	$PM_{2.5}$ tpy	gr/dscf[2]
EP-01	1.9	8.4	1.6	7.1	1.2	5.3	1.2	5.3	1.2	5.3	0.10
EP-03a	1.4	6.3	1.2	5.3	<[3]	<	<	<	<	<	NA
EP-03b	Emission limits with EP-03a										
EP-04a	-[4]	-	-	-	0.9	3.8	0.9	3.8	0.9	3.8	0.04
EP-04b	-	-	-	-	0.5	2.1	0.5	2.1	0.5	2.1	0.04
F1-F4	-	-	-	-	0.0[5]	0.0	0.0	0.0	0.0	0.0	NA
F5	-	-	-	-	5.6	16.2	1.1	3.2	0.2	0.5	NA
F6	-	-	-	-	21.6	63.1	5.5	16.1	0.6	1.6	NA

Unit No.	NO_x[1] pph	NO_x[1] tpy	CO pph	CO tpy	TSP pph	TSP tpy	PM_{10} pph	PM_{10} tpy	$PM_{2.5}$ pph	$PM_{2.5}$ tpy	gr/dscf[2]
EP-05	-	-	-	-	0.1	0.3	0.1	0.3	0.1	0.3	NA
Totals[6]		14.7		12.4		90.8		30.8		13.6	NA

1 Nitrogen dioxide emissions include all oxides of nitrogen expressed as NO_2
2 Particulate matter grain loading limits required by 20.2.19.109.A(1) and 20.2.19.109.A(2) NMAC.
3 "<" indicates the application represented uncontrolled emissions are less than 1.0 pph or 1.0 tpy for this pollutant. Allowable limits are not imposed on this level of emissions, except for flares and pollutants with controls.
4 "-" indicates the application represented emissions of this pollutant are not expected.
5 F1-F4 fugitive emissions are controlled 100% and routed to EP-04b.
6 Totals are for information and are not enforceable conditions.

B. Fugitive emissions points associated with EP-04a and EP-04b (F1-F4) are subject to 20.2.19.110.B NMAC using Best Engineering Practices as defined in 20.2.19.7.A NMAC.

A107 Facility: Allowable Startup, Shutdown, & Maintenance (SSM)

A. SSM emissions do not exceed the allowable limits in Table 106. The permittee shall maintain all applicable records in accordance with Section B109.

A108 Facility: Allowable Operations

A. This facility is authorized for continuous operation. No monitoring, recordkeeping, and reporting are required to demonstrate compliance with continuous hours of operation.

A109 Facility: Reporting Schedules

A. For reporting requirements see this permit's specific conditions and B109.

A110 Facility: Fuel and Sulfur Requirements

A. Fuel Type and Fuel Sulfur Limits – Dryer EP-01 and Heaters EP-03a/b

Requirement: Units EP-01, EP-03a, and EP-03b shall combust only natural gas containing no more than 1 grain of total sulfur per 100 dry standard cubic feet of fuel.
Monitoring: None
Recordkeeping: The permittee shall demonstrate compliance with the natural gas limit on total sulfur content by maintaining records of a current, valid purchase contract, tariff sheet or transportation contract for the fuel, or fuel gas analysis, specifying the total sulfur content. If fuel gas analysis is used, the analysis shall not be older than one year.
Reporting: The permittee shall report according to Section B110.

A111 Facility: 20.2.61 NMAC Opacity

A. 20.2.61 NMAC Opacity Limits - Amine Heaters EP-03A and EP-03b

Requirement: Units EP-03a and EP-03b stack exhaust shall not exceed 20% opacity.
Monitoring: Use of natural gas fuel meet the fuel sulfur content of A110.A constitutes compliance with 20.2.61 NMAC unless opacity exceeds 20% averaged over a 10-minute period. When any visible emissions are observed during steady state operation, opacity shall be measured over a 10-minute period, in accordance with the procedures at 40 CFR 60, Appendix A, Method 9 as required by 20.2.61.114 NMAC
Recordkeeping: The permittee shall record dates of any opacity measures and the corresponding opacity readings.
Reporting: The permittee shall report according to Section B110.

A112 Facility: Production Limits

A. HB Mill Production Limits – Unit EP-01

Requirement: The dried potash throughput rate for Unit EP-01, the Fluidized Bed Dryer, shall not exceed 42.0 tph based on a monthly average.
Monitoring: At all times of operation, the permittee shall monitor the tph throughput rate at the outlet of Unit EP-01 with weigh belt HBCV-103. Weigh belt HBCV-103 shall be capable of measuring the totalized throughput in tons per hour and be capable of transmitting the data to the data capture system.
Recordkeeping: The following records shall be kept: • hourly data capture system records of the ton per hour throughput rate measured by weigh belt HBCV-103 and the dates and times when EP-01 is operating • monthly records of the monthly average tph throughput rates • records of the calculations used to determine the monthly average throughput rate
Reporting: The permittee shall report according to Section B110.

A113 Facility: Source Defined

A. **Source Defined – Intrepid's HB Plant, North Plant, and West Plant –** Intrepid's HB Plant (AI 29939), North Plant (AI 692), and West Plant (AI 213) are considered a single source for purposes of Title V (20.2.70 NMAC), Prevention of Significant Deterioration (20.2.74 NMAC), and Nonattainment permitting (20.2.79 NMAC).

(1) The permittee shall submit a complete Title V application within 12 months after issuance of this permit that includes, at a minimum, all units which have commenced operation.

(2) The facilities may operate under separate minor source NSR permits (20.2.72 NMAC). However for future NSR permit applications to revise or modify any of the three facilities, the permittee shall complete a project applicability

determination that considers the combined existing emission rates, changes to emission rates, and any associated emissions of all three facilities.

EQUIPMENT SPECIFIC REQUIREMENTS

A200 Oil and Gas Industry – Not Required

A300 Construction Industry – Not Required

A400 Power Generation Industry – Not Required

A500 Solid Waste Disposal Industry – Not Required

MINING INDUSTRY

A600 Mining Operations

A601 Dryer and Amine Heaters

A. Operational Inspections – Dryer EP-01 and Heaters EP-03a/b

Requirement: For Units EP-01, EP-03a, and EP-04a, the permittee shall demonstrate on-going compliance with allowable NOx, CO, and VOC emission limits in Table 106 through operational inspections.
Monitoring: The permittee shall conduct annual operational inspections to determine that the dryer and heaters are operating properly. The operational inspections shall include checks for indications of insufficient excess air, or too much excess combustion air. These checks shall include observation of common physical indications of improper combustion, including those specified by the manufacturers and based on operational experience with these units.
Recordkeeping: The permittee shall maintain records of operational inspections, describing the results of all inspections noting chronologically any adjustments needed to bring a unit into compliance. Records shall be maintained according Section B109.
Reporting: The permittee shall report according to Section B110.

B. Initial NOx, CO, and PM Compliance Tests - Dryer EP-01

Requirement: The permittee shall demonstrate compliance with the allowable emission limits in Table 106 for Dryer EP-01 by conducting EPA Method tests for NOx, CO, TSP, and condensable PM (CPM) in accordance with Section B111. Test results of filterable TSP and CPM shall be combined to verify compliance with allowable TSP, PM10, and PM2.5 limits. Compliance with the TSP emission limit shall be deemed to

demonstrate compliance with PM10 and PM2.5 emission limits. EPA Method 5 test results, which measures filterable PM, shall be used to demonstrate compliance with the gr/dscf limit in Table 106. The 20.2.19 NMAC gr/dscf limit does not apply to CPM. Compliance with the NOx and CO emission limits shall be deemed to demonstrate compliance with the VOC emission limit.
Monitoring: The permittee shall monitor all parameters necessary to meet the recordkeeping requirements of this condition.
Recordkeeping: Test records shall include the level of excess air; the tph production rate during each test run; the pph emission rates of filterable TSP and CPM; the total (filterable plus CPM) pph emission rates of TSP; the filterable TSP emission rates in gr/dcsf; the volumetric stack flow rate; and the scrubber pressure drop and water flow rate during each TSP and CPM test run. The permittee shall maintain the test records and shall meet the recordkeeping requirements in Conditions B109 and B111.D(3).
Reporting: The permittee shall meet the reporting requirements in Conditions B110.D and B111.D(3). Additionally, the permittee shall include in the test report all records required by this condition.

C. 20.2.19 NMAC Periodic PM Tests – Dryer EP-01

Requirement: Dryer EP-01 is subject to 20.2.19.109(A)(1) NMAC and shall demonstrate compliance with the allowable gr/dscf emission limit in Table 106 by the following periodic testing. The gr/dscf limit applies only to filterable particulate matter. Every calendar year the permittee shall conduct EPA Method tests for TSP in accordance with Section B111. The first periodic test shall be required during the first calendar year after completion of the initial EPA Method 5 compliance test required in Condition A601.B.
Monitoring: The permittee shall monitor all parameters necessary to meet the recordkeeping requirements of this condition.
Recordkeeping: Test records shall include the level of excess air; the tph production rate during each test run; the filterable TSP emission rates in pph and gr/dcsf; the volumetric stack flow rate; and the scrubber pressure drop and water flow rate during each test run. The permittee shall maintain the test records and shall meet the recordkeeping requirements in Conditions B109 and B111.D(3).
Reporting: The permittee shall meet the reporting requirements in Conditions B110.D and B111.D(3). Additionally, the permittee shall include in the test report all records required by this condition.

D. Cyclone and Scrubber Controls – Dryer EP-01

Requirement: At all times Dryer EP-01 is operating, exhaust emissions shall be routed to and

particulate matter controlled with a cyclone and venturi scrubber. The permittee shall verify that the cyclone and scrubber are started and working properly before commencing dryer operations. The scrubber pressure drop and water flow rate shall meet the manufacturer's recommended specifications and/or the values measured during the most recent Department approved EPA Methods 5 and 202 stack tests.
Monitoring **Scrubber:** To verify proper operation of the scrubber, the differential pressure across the venturi shall be continuously monitored by the use of a differential pressure gauge and the water flow rate monitored with a flow meter. Gauges, flow meters, and recording devices shall be maintained, replaced, and calibrated according to manufacturer's specifications and as required so that they consistently provide correct and accurate readings. **Cyclone:** At least once each month during operations**,** the permittee shall check for damage to the cyclone structure such as holes or breaks in seams, and shall check the dump valve operation.
Recordkeeping **Scrubber:** During operations, the permittee shall record the scrubber pressure drop and water flow rate three times per 24-hour period. These records shall include, for comparison, the range in scrubber pressure drop and the water flow rate specified by the manufacturer and recorded during the most recent, Department approved, EPA 5 and 202 Method tests. Electronic pressure drop and water flow rate records shall be maintained. **Cyclone:** The permittee shall record the dates and times of cyclone inspections, any damage to the cyclone structure, and malfunctions in the dump valve operation. The dates and description of cyclone repairs shall also be recorded. **Manufacturer Specifications:** Manufacturer specifications of the cyclone, scrubber, flow meters, gauges, and recording devices shall be kept. Records of gauge and flow meter inspections and calibrations shall also be kept.
Reporting: The permittee shall report according to Section B110.

A602 Material Transfer and Loadout – Stack Emissions

A. Initial PM Compliance Tests - Material Transfer and Loadout, Units EP-04a and EP-04b

Requirement: The permittee shall demonstrate compliance with the allowable emission limits in Table 106 for Units EP-04a and EP-04b by completing EPA Method tests for TSP in accordance with Section B111.

Compliance with the TSP emission limit shall be deemed to demonstrate compliance with PM10 and PM2.5.
Monitoring: The permittee shall monitor all parameters necessary to meet the recordkeeping requirements of this condition.
Recordkeeping: Test records shall include the tph production rate during each test run; the filterable TSP emission rates in pph and gr/dcsf; the volumetric stack flow rate; and the baghouse pressure drop during each test run. The permittee shall maintain the test records and shall meet the recordkeeping requirements in Conditions B109 and B111.D(3).
Reporting: The permittee shall meet the reporting requirements in Conditions B110.D and B111.D(3). Additionally, the permittee shall include in the test report all records required by this condition.

B. 20.2.19 NMAC Periodic PM Tests – Material Transfer and Loadout, Units EP-04a and EP-04b

Requirement: Units EP-04a and EP-04b are subject to 20.2.19.109(A)(2) NMAC and shall demonstrate compliance with the allowable gr/dscf emission limit in Table 106 by the following periodic testing. The gr/dscf applies only to filterable particulate matter. Every calendar year, the permittee shall conduct EPA Method tests for TSP in accordance with Section B111. The first periodic test shall be required during the first calendar year after completion of the initial EPA Method 5 compliance test required in Condition A602.A.
Monitoring: The permittee shall monitor all parameters necessary to meet the recordkeeping requirements of this condition.
Recordkeeping: Test records shall include the tph production rate during each test run; the filterable TSP emission rates in pph and gr/dcsf; the volumetric stack flow rate; and the baghouse pressure drop during each test run. The permittee shall maintain the test records and shall meet the recordkeeping requirements in Conditions B109 and B111.D(3).
Reporting: The permittee shall meet the reporting requirements in Conditions B110.D and B111.D(3). Additionally, the permittee shall include in the test report all records required by this condition.

C. Baghouse Control – Material Transfer and Loadout, Units EP-04a and EP-04b (F1-F4)

Requirement: At all times units EP-04a, EP-04b, and F1-F4 are operating particulate matter emissions shall be routed to and controlled with a baghouse. The permittee shall maintain the baghouse, using at a minimum, the manufacturer's specifications. The permittee shall verify that the baghouse is started and working properly before commencing operations.

The baghouse pressure drop shall meet the manufacturer's recommended specifications and/or the values measured during the most recent and Department approved EPA Method 5 stack test. Additionally, there shall be no visible particulate emissions from the baghouse outlet.
Monitoring **Differential Pressure:** To verify proper operation of the baghouse, the differential pressure across the baghouse shall be continuously monitored by the use of a differential pressure gauge. **Opacity:** At least once per week during operations, the permittee shall perform visible emissions observations at the baghouse outlet for a minimum of 6 minutes using EPA's Method 22 in 40 CFR 60, Appendix A. **Manufacturer Specifications:** Gauges and recording devices shall be maintained, replaced, and calibrated according to manufacturer's specifications and as required so that they consistently provide correct and accurate readings.
Recordkeeping **Differential Pressure:** During operations, the permittee shall record the baghouse pressure drop three times per 24-hour period. These records shall include, for comparison, the range in baghouse pressure drop specified by the manufacturer and recorded during the most recent, Department approved, EPA Method 5 test. Electronic pressure records shall be maintained. **Opacity:** The permittee shall record each EPA Method 22 observation and the results, including if any visible emissions were observed. **Manufacturer Specifications:** Manufacturer specifications of the baghouse, gauge, and recording device shall be kept. Records of gauge inspections, maintenance, and calibrations shall also be kept. **Corrective Actions and Maintenance:** The permittee shall record any adjustments, repairs, or bag replacements made to the baghouse in response to the required monitoring and that are necessary to meet the requirements of this condition. The permittee shall keep records of all maintenance activities completed on the baghouse.
Reporting: The permittee shall report according to Section B110.

A603 <u>Fugitives - Material Handling and Haul Roads</u>

A. Fugitive Controls & 20.2.19 NMAC – Material Transfer and Loadout, Units EP-04a and EP-04b (F1-F4)

Requirement: Fugitive emissions points associated with Units EP-04a and EP-04b (F1-F4) are subject to 29.2.19.110.B NMAC which requires Best Engineering Practices (BEP) as defined in

20.2.19.7.A NMAC. Additionally, fugitive emissions from these fugitive emission points shall be controlled 100% resulting in no visible emissions and in accordance with the control description in Table 105.
Monitoring: The permittee shall have a Qualified Engineer conduct semi-annual inspections of fugitive emission sources and certify that they are controlled in accordance with 20.2.19.110.B and according to the control description in Table 105. At a minimum, semi-annual inspections shall include visual checks for malfunctions and deficiencies in dust control effectiveness, such as breaches in the physical barriers controlling dust emissions and/or any other dust control equipment deficiencies or malfunctions. If the emissions point is found not to be compliant with 20.2.19.110.B or with the controls required by Table 105, then the permittee shall take the necessary action to make the emission point compliant no later than 30 days after discovery.
Recordkeeping: The permittee shall generate and keep records of the semi-annual inspections including all emission points found to be non-compliant, the date of non-compliance, and the date(s) and actions taken to remedy the non-compliance.
Reporting: The permittee shall submit the semi-annual inspection reports to the Department with the Title V semi-annual monitoring reports and meet the requirements of Section B110.

B. Paved Haul Road Control Requirements – Unit F5

Requirement: The 4.73 mile section of private paved haul road starting at the HB Plant and running north where it intersects with highway 62/180 shall be paved. This paved haul road shall be swept, or cleaned by some other method, to control fugitive particulate emissions.
Monitoring: The permittee shall monitor the frequency and any methods used to remove fugitive dust from the paved haul road.
Recordkeeping: The permittee shall keep records of the monitoring required in this condition including the dates that the haul road is cleaned.
Reporting: The permittee shall report according to Section B110.

C. Unpaved Haul Road Control Requirements – Unit F6

Requirement: The unpaved truck traffic areas and haul road located at the HB Plant shall, at a minimum, be treated with the application of base course or gravel to control fugitive particulate emissions.
Monitoring: The permittee shall monitor the frequency, quantity, and locations of the base course or gravel application, or other additional control measures.
Recordkeeping: The permittee shall keep records of the monitoring required in this condition including the dates that the truck traffic areas and haul roads are treated.
Reporting: The permittee shall report according to Section B110

A604 Cooling Tower

A. Cooling Tower – Unit EP-05

Requirement: The permittee shall demonstrate compliance with the Cooling Tower EP-05 allowable emissions in Table 106 by the following. • EP-05 shall be equipped with a drift eliminator with a manufacturer specified drift rate of 0.005% or less and shall be operated and maintained according to manufacturer's specifications, or equivalent. • The total dissolved solids (TDS) in EP-05's water shall not exceed 12,000 ppmw. • The circulation rate of EP-05's cooling water pump shall not exceed 12,180 gallons per hour (gph).
Monitoring: The permittee shall monitor the following parameters at least once each calendar month during operation of Cooling Tower EP-05. • inspect the cooling tower and the drift eliminator to ensure it is in place and in good repair • monitor the TDS of the cooling tower water • monitor the circulation rate of the cooling water pump
Recordkeeping: Records shall be kept of the following: • the monthly inspections of the drift eliminator including any repairs or maintenance; • the manufacturer's design specifications and manufacturer's recommended, or equivalent, maintenance procedures; and • the monthly cooling water TDS. Records shall also include the maximum circulation rate of the cooling water pump each month and the methods used to determine the cooling water pump circulation rate.
Reporting: The permittee shall report according to Section B110

PART B GENERAL CONDITIONS

B100 Introduction

A. The Department has reviewed the permit application for the proposed construction/modification/revision and has determined that the provisions of the Act and ambient air quality standards will be met. Conditions have been imposed in this permit to assure continued compliance. 20.2.72.210.D NMAC, states that any term or condition imposed by the Department on a permit is enforceable to the same extent as a regulation of the Environmental Improvement Board.

B101 Legal

A. The contents of a permit application specifically identified by the Department shall become the terms and conditions of the permit or permit revision. Unless modified by conditions of this permit, the permittee shall construct or modify and operate the Facility in accordance with all representations of the application and supplemental submittals that the Department relied upon to determine compliance with applicable regulations and ambient air quality standards. If the Department relied on air quality modeling to issue this permit, any change in the parameters used for this modeling shall be submitted to the Department for review. Upon the Department's request, the permittee shall submit additional modeling for review by the Department. Results of that review may require a permit modification. (20.2.72.210.A NMAC)

B. Any future physical changes, changes in the method of operation or changes in restricted area may constitute a modification as defined by 20.2.72 NMAC, Construction Permits. Unless the source or activity is exempt under 20.2.72.202 NMAC, no modification shall begin prior to issuance of a permit. (20.2.72 NMAC Sections 200.A.2 and E, and 210.B.4)

C. Changes in plans, specifications, and other representations stated in the application documents shall not be made if they cause a change in the method of control of emissions or in the character of emissions, will increase the discharge of emissions or affect modeling results. Any such proposed changes shall be submitted as a revision or modification. (20.2.72 NMAC Sections 200.A.2 and E, and 210.B.4)

D. The permittee shall establish and maintain the property's Restricted Area, as identified in the most recent modeling plan for which the permittee received Department approval. (20.2.72 NMAC Sections 200.A.2 and E, and 210.B.4)

E. Applications for permit revisions and modifications shall be submitted to:

Program Manager, Permits Section

New Mexico Environment Department
Air Quality Bureau
1301 Siler Road, Building B
Santa Fe, New Mexico 87507-3113

F. Pursuant to 20.2.72.210 NMAC, at all times, including periods of startup, shutdown, and malfunction, owners and operators shall, to the extent practicable, maintain and operate the source including associated air pollution control equipment in a manner consistent with good air pollution control practice for minimizing emissions. (20.2.72.210.A, 20.2.72.210.B, 20.2.72.210.C, 20.2.72.210.E NMAC)

B102 Authority

A. This permit is issued pursuant to the Air Quality Control Act (Act) and regulations adopted pursuant to the Act including Title 20, Chapter 2, Part 72 of the New Mexico Administrative Code (NMAC), (20.2.72 NMAC), Construction Permits and is enforceable pursuant to the Act and the air quality control regulations applicable to this source.

B. The Department is the Administrator for 40 CFR Parts 60, 61, and 63 pursuant to the delegation and exceptions of Section 10 of 20.2.77 NMAC (NSPS), 20.2.78 NMAC (NESHAP), and 20.2.82 NMAC (MACT).

B103 Annual Fee

A. The Department will assess an annual fee for this Facility. The regulation 20.2.75 NMAC set the fee amount at $1,500 through 2004 and requires it to be adjusted annually for the Consumer Price Index on January 1. The current fee amount is available by contacting the Department or can be found on the Department’s website. The AQB will invoice the permittee for the annual fee amount at the beginning of each calendar year. This fee does not apply to sources which are assessed an annual fee in accordance with 20.2.71 NMAC. For sources that satisfy the definition of “small business” in 20.2.75.7.F NMAC, this annual fee will be divided by two. (20.2.75.11 NMAC)

B. All fees shall be remitted in the form of a corporate check, certified check, or money order made payable to the “NM Environment Department, AQB” mailed to the address shown on the invoice and shall be accompanied by the remittance slip attached to the invoice.

B104 Appeal Procedures

A. Any person who participated in a permitting action before the Department and who is adversely affected by such permitting action, may file a petition for hearing before the Environmental Improvement Board. The petition shall be made in writing to the Environmental Improvement Board within thirty (30) days from the date notice is given of the Department's action and shall specify the portions of the permitting action to which the petitioner objects, certify that a copy of the petition has been mailed or hand-delivered and attach a copy of the permitting action for which review is sought. Unless a timely request for hearing is made, the decision of the Department shall be final. The petition shall be copied simultaneously to the Department upon receipt of the appeal notice. If the petitioner is not the applicant or permittee, the petitioner shall mail or hand-deliver a copy of the petition to the applicant or permittee. The Department shall certify the administrative record to the board. Petitions for a hearing shall be sent to: (20.2.72.207.F NMAC)

Secretary, New Mexico Environmental Improvement Board
1190 St. Francis Drive, Runnels Bldg. Rm. N2153
P.O. Box 5469
Santa Fe, New Mexico 87502

B105 Submittal of Reports and Certifications

A. Stack Test Protocols and Stack Test Reports shall be submitted electronically to Stacktest.AQB@state.nm.us.

B. Excess Emission Reports shall be submitted electronically to eereports.aqb@state.nm.us. (20.2.7.110 NMAC)

C. Regularly scheduled reports shall be submitted to:

Manager, Compliance and Enforcement Section
New Mexico Environment Department
Air Quality Bureau
1301 Siler Road, Building B
Santa Fe, New Mexico 87507-3113

B106 NSPS and/or MACT Startup, Shutdown, and Malfunction Operations

A. If a facility is subject to a NSPS standard in 40 CFR 60, each owner or operator that installs and operates a continuous monitoring device required by a NSPS regulation shall comply with the excess emissions reporting requirements in accordance with 40 CFR 60.7(c), unless specifically exempted in the applicable subpart.

B. If a facility is subject to a NSPS standard in 40 CFR 60, then in accordance with 40 CFR 60.8(c), emissions in excess of the level of the applicable emission limit during periods of startup, shutdown, and malfunction shall not be considered a violation of the applicable emission limit unless otherwise specified in the applicable standard.

C. If a facility is subject to a MACT standard in 40 CFR 63, then the facility is subject to the requirement for a Startup, Shutdown and Malfunction Plan (SSM) under 40 CFR 63.6(e)(3), unless specifically exempted in the applicable subpart.

B107 Startup, Shutdown, and Maintenance Operations

A. The permittee shall operate in accordance with the procedures set forth in the plan to minimize emissions during routine or predictable start up, shut down, and scheduled maintenance (SSM work practice plan), except for operations or equipment subject to Section B106 above. (20.2.7.14.A NMAC)

B108 General Monitoring Requirements

A. These requirements do not supersede or relax requirements of federal regulations.

B. The following monitoring requirements shall be used to determine compliance with applicable requirements and emission limits. Any sampling, whether by portable analyzer or EPA reference method, that measures an emission rate over the applicable averaging period greater than an emission limit in this permit constitutes noncompliance with this permit. The Department may require, at its discretion, additional tests pursuant to EPA Reference Methods at any time, including when sampling by portable analyzer measures an emission rate greater than an emission limit in this permit; but such requirement shall not be construed as a determination that the sampling by portable analyzer does not establish noncompliance with this permit and shall not stay enforcement of such noncompliance based on the sampling by portable analyzer.

C. If the emission unit is shutdown at the time when periodic monitoring is due to be accomplished, the permittee is not required to restart the unit for the sole purpose of performing the monitoring. Using electronic or written mail, the permittee shall notify the Department's Compliance and Enforcement Section of a delay in emission tests prior to the deadline for accomplishing the tests. Upon recommencing operation, the permittee shall submit any pertinent pre-test notification requirements set forth in the current version of the Department's Standard Operating Procedures For Use Of Portable Analyzers in Performance Test, and shall accomplish the monitoring.

D. The requirement for monitoring during any monitoring period is based on the percentage of time that the unit has operated. However, to invoke monitoring exemptions at B108.D(2), hours of operation shall be monitored and recorded.

(1) If the emission unit has operated for more than 25% of a monitoring period, then the permittee shall conduct monitoring during that period.

(2) If the emission unit has operated for 25% or less of a monitoring period then the monitoring is not required. After two successive periods without monitoring, the permittee shall conduct monitoring during the next period regardless of the time operated during that period, except that for any monitoring period in which a unit has operated for less than 10% of the monitoring period, the period will not be considered as one of the two successive periods.

(3) A minimum of one of each type of monitoring activity shall be conducted during any five-year period for sources not subject to 20.2.70 NMAC, Operating Permits.

E. For all periodic monitoring events, except when a federal or state regulation is more stringent, three test runs shall be conducted at 90% or greater of the unit's capacity as stated in this permit, or in the permit application if not in the permit, and at additional loads when requested by the Department. If the 90% capacity cannot be achieved, the monitoring will be conducted at the maximum achievable load under prevailing operating conditions except when a federal or state regulation requires more restrictive test conditions. The load and the parameters used to calculate it shall be recorded to document operating conditions and shall be included with the monitoring report.

F. When requested by the Department, the permittee shall provide schedules of testing and monitoring activities. Compliance tests from previous NSR and Title V permits may be re-imposed if it is deemed necessary by the Department to determine whether the source is in compliance with applicable regulations or permit conditions.

G. If monitoring is new or is in addition to monitoring imposed by an existing applicable requirement, it shall become effective 120 days after the date of permit issuance. For emission units that have not commenced operation, the associated new or additional monitoring shall not apply until 120 days after the units commence operation. All pre-existing monitoring requirements incorporated in this permit shall continue to apply from the date of permit issuance.

B109 <u>General Recordkeeping Requirements</u>

A. The permittee shall maintain records to assure and verify compliance with the terms and conditions of this permit and any other applicable requirements that become effective after permit issuance. The minimum information to be included in these records is:

(1) equipment identification (include make, model and serial number for all tested equipment and emission controls);

(2) date(s) and time(s) of sampling or measurements;

(3) date(s) analyses were performed;

(4) the qualified entity that performed the analyses;

(5) analytical or test methods used;

(6) results of analyses or tests; and

(7) operating conditions existing at the time of sampling or measurement.

B. Except as provided in the Specific Conditions, records shall be maintained on-site for a minimum of two (2) years from the time of recording and shall be made available to Department personnel upon request. Records for unmanned sites may be kept at the nearest company office. Sources subject to 20.2.70 NMAC "Operating Permits" shall maintain records on-site for a minimum of five (5) years from the time of recording.

C. Malfunction emissions and routine and predictable emissions during startup, shutdown, and scheduled maintenance (SSM):

(1) The permittee shall keep records of all events subject to the plan to minimize emissions during routine or predictable SSM. (20.2.7.14.A NMAC)

(2) If the facility has allowable SSM emission limits in this permit, the permittee shall record all SSM events, including the date, the start time, the end time, and a description of the event. This record also shall include a copy of the manufacturer's, or equivalent, documentation showing that any maintenance qualified as scheduled. Scheduled maintenance is an activity that occurs at an established frequency pursuant to a written protocol published by the manufacturer or other reliable source.

(3) If the facility has allowable malfunction emission limits in this permit, the permittee shall record all malfunction events to be applied against these limits, including the date, the start time, the end time, and a description of the event. Malfunction means any sudden, infrequent, and not reasonably preventable failure of air pollution control and monitoring equipment, process equipment, or a process to operate in a normal or usual manner which causes, or has the potential to cause, the emission limitations in an applicable standard to be exceeded. Failures that are caused in part by poor maintenance or careless operation are not malfunctions. (40 CFR 63.2)

B110 <u>General Reporting Requirements</u>
(20.2.72 NMAC Sections 210 and 212)

A. Records and reports shall be maintained on-site unless specifically required to be submitted to the Department or EPA by another condition of this permit or by a state or federal regulation. Records for unmanned sites may be kept at the nearest company office.

B. The permittee shall notify the Department's Compliance Reporting Section using the current Submittal Form posted to NMED's Air Quality web site under Compliance and Enforcement/Submittal Forms in writing of, or provide the Department with (20.2.72.212.A and B):

(1) the anticipated date of initial startup of each new or modified source not less than thirty (30) days prior to the date. Notification may occur prior to issuance of the permit, but actual startup shall not occur earlier than the permit issuance date;

(2) after receiving authority to construct, the equipment serial number as provided by the manufacturer or permanently affixed if shop-built and the actual date of initial startup of each new or modified source within fifteen (15) days after the startup date; and

(3) the date when each new or modified emission source reaches the maximum production rate at which it will operate within fifteen (15) days after that date.

C. The permittee shall notify the Department's Permitting Program Manager, in writing of, or provide the Department with (20.2.72.212.C and D):

(1) any change of operators or any equipment substitutions within fifteen (15) days of such change;

(2) any necessary update or correction no more than sixty (60) days after the operator knows or should have known of the condition necessitating the update or correction of the permit.

D. Results of emission tests and monitoring for each pollutant (except opacity) shall be reported in pounds per hour (unless otherwise specified) and tons per year. Opacity shall be reported in percent. The number of significant figures corresponding to the full accuracy inherent in the testing instrument or Method test used to obtain the data shall be used to calculate and report test results in accordance with 20.2.1.116.B and C NMAC. Upon request by the Department, CEMS and other tabular data shall be submitted in editable, MS Excel format.

E. The permittee shall submit reports of excess emissions in accordance with 20.2.7.110.A NMAC.

B111 General Testing Requirements

A. Compliance Tests

(1) Compliance test requirements from previous permits (if any) are still in effect, unless the tests have been satisfactorily completed. Compliance tests may be re-imposed if it is deemed necessary by the Department to determine whether the source is in compliance with applicable regulations or permit conditions. (20.2.72 NMAC Sections 210.C and 213)

(2) Compliance tests shall be conducted within sixty (60) days after the unit(s) achieve the maximum normal production rate. If the maximum normal production rate does not occur within one hundred twenty (120) days of source startup, then the tests must be conducted no later than one hundred eighty (180) days after initial startup of the source.

(3) Unless otherwise indicated by Specific Conditions or regulatory requirements, the default time period for each test run shall be **at least** 60 minutes and each performance test shall consist of three separate runs using the applicable test method. For the purpose of determining compliance with an applicable emission limit, the arithmetic mean of results of the three runs shall apply. In the event that a sample is accidentally lost or conditions occur in which one of the three runs must be discontinued because of forced shutdown, failure of an irreplaceable portion of the sample train, extreme meteorological conditions, or other circumstances, beyond the owner or operator's control, compliance may, upon the Department approval, be determined using the arithmetic mean of the results of the two other runs.

(4) Testing of emissions shall be conducted with the emissions unit operating at 90 to 100 percent of the maximum operating rate allowed by the permit. If it is not possible to test at that rate, the source may test at a lower operating rate, subject to the approval of the Department.

(5) Testing performed at less than 90 percent of permitted capacity will limit emission unit operation to 110 percent of the tested capacity until a new test is conducted.

(6) If conditions change such that unit operation above 110 percent of tested capacity is possible, the source must submit a protocol to the Department within 30 days of such change to conduct a new emissions test.

(7) The physical configuration of the Facility shall conform to the emissions testing requirements of 20.2.72.210.C NMAC and of 40 CFR 60.8(e), which is imposed under the authority of 20.2.72.210.C.4 NMAC.

B. EPA Reference Method Tests

(1) All compliance tests required by this permit, unless otherwise specified by Specific Conditions of this permit, shall be conducted in accordance with the requirements of CFR Title 40, Part 60, Subpart A, General Provisions, and the following EPA Reference Methods as specified by CFR Title 40, Part 60, Appendix A:

(a) Methods 1 through 4 for stack gas flowrate

(b) Method 5 for TSP

(c) Method 6C and 19 for SO_2

(d) Method 7E for NO_X (test results shall be expressed as nitrogen dioxide (NO_2) using a molecular weight of 46 lb/lb-mol in all calculations (each ppm of NO/NO_2 is equivalent to 1.194 x 10-7 lb/SCF)

(e) Method 9 for opacity

(f) Method 10 for CO

(g) Method 19 may be used in lieu of Methods 1-4 for stack gas flowrate upon approval of the Department. A justification for this proposal must be provided along with a contemporaneous fuel gas analysis (preferably on the day of the test) and a recent fuel flow meter calibration certificate (within the most recent quarter).

(h) Method 7E or 20 for Turbines per 60.335 or 60.4400

(i) Method 29 for Metals

(j) Method 201A for filterable PM_{10} and $PM_{2.5}$

(k) Method 202 for condensable PM

(l) Method 320 for organic Hazardous Air Pollutants (HAPs)

(m) Method 25A for VOC reduction efficiency

(2) Alternative test method(s) may be used if the Department approves the change

C. Portable Analyzer Requirements

(1) The permittee shall follow the *SOP for Use of Portable Analyzers in Performance Tests* posted to NMED's Air Quality web site under Compliance and Enforcement/Testing.

(2) A portable analyzer that is used for periodic emissions tests must meet the requirements of ASTM D 6522 – 00. However, if a facility has met a previously approved Department criterion for portable analyzers, the analyzer may be used until it is replaced.

(3) The portable emissions analyzer shall be setup and operated in accordance with the manufacturer's instructions, with the requirements of ASTM D-6522-00, or with the criterion of an analyzer previously approved by the Department.

(4) During emissions tests, pollutant, O_2 concentration and fuel flow rate shall be monitored and recorded. This information shall be included with the test report furnished to the Department.

(5) Pollutant emission rate shall be calculated in accordance with 40 CFR 60, Appendix A, Method 19 utilizing fuel flow rate (scf) and fuel heating value (Btu/scf) obtained during the test.

D. Test Procedures:

(1) The permittee shall notify the Department's Program Manager, Compliance and Enforcement Section at least thirty (30) days before the test date and allow a representative of the Department to be present at the test.

(2) Equipment shall be tested in the "as found" condition. Equipment may not be adjusted or tuned prior to any test for the purpose of lowering emissions, and then returned to previous settings or operating conditions after the test is complete.

(3) Contents of test notifications, protocols and test reports shall conform to the format specified by the Department's Universal Test Notification, Protocol and Report Form and Instructions. Current forms and instructions are posted to NMED's Air Quality web site under Compliance and Enforcement Testing.

(4) The permittee shall provide (a) sampling ports adequate for the test methods applicable to the facility, (b) safe sampling platforms, (c) safe access to sampling platforms and (d) utilities for sampling and testing equipment. Sample ports of a size compatible with the test methods shall be located on the stack with the provisions of EPA Method 1 of 40 CFR 60, Appendix A. The stack shall be of sufficient height and diameter so that a representative test of the emissions can be performed in accordance with EPA Method 1.

(5) Where necessary to prevent cyclonic flow in the stack, flow straighteners shall be installed.

B112 <u>Compliance</u>

A. The Department shall be given the right to enter the facility at all reasonable times to verify the terms and conditions of this permit. Required records shall be organized by date and subject matter and shall at all times be readily available for inspection. The permittee, upon verbal or written request from an authorized representative of the Department who appears at the facility, shall immediately produce for inspection or copying any records required to be maintained at the facility. Upon written request at other times, the permittee shall deliver to the Department paper or electronic copies of any and all required records maintained on site or at an off-site location. Requested records shall be copied and delivered at the permittee's expense within three business days from receipt of request unless the Department allows additional time. Required records may include records required by permit and other information necessary to demonstrate compliance with terms and conditions of this permit. (NMSA 1978, Section 74-2-13)

B. A copy of the most recent permit(s) issued by the Department shall be kept at the permitted facility or (for unmanned sites) at the nearest company office and shall be made available to Department personnel for inspection upon request. (20.2.72.210.B.4 NMAC)

C. Emissions limits associated with the energy input of a Unit, i.e. lb/MMBtu, shall apply at all times unless stated otherwise in a Specific Condition of this permit. The averaging time for each emissions limit, including those based on energy input of a Unit (i.e. lb/MMBtu) is one (1) hour unless stated otherwise in a Specific Condition of this permit or in the applicable requirement that establishes the limit.

B113 Permit Cancellation and Revocation

A. The Department may revoke this permit if the applicant or permittee has knowingly and willfully misrepresented a material fact in the application for the permit. Revocation will be made in writing, and an administrative appeal may be taken to the Secretary of the Department within thirty (30) days. Appeals will be handled in accordance with the Department's Rules Governing Appeals From Compliance Orders.

B. The Department shall automatically cancel any permit for any source which ceases operation for five (5) years or more, or permanently. Reactivation of any source after the five (5) year period shall require a new permit. (20.2.72 NMAC)

C. The Department may cancel a permit if the construction or modification is not commenced within two (2) years from the date of issuance or if, during the construction or modification, work is suspended for a total of one (1) year. (20.2.72 NMAC)

B114 Notification to Subsequent Owners

A. The permit and conditions apply in the event of any change in control or ownership of the Facility. No permit modification is required in such case. However, in the event of any such change in control or ownership, the permittee shall notify the succeeding owner of the permit and conditions and shall notify the Department’s Program Manager, Permits Section of the change in ownership within fifteen (15) days of that change. (20.2.72.212.C NMAC)

B. Any new owner or operator shall notify the Department’s Program Manager, Permits Section, within thirty (30) days of assuming ownership, of the new owner’s or operator’s name and address. (20.2.73.200.E.3 NMAC)

B115 Asbestos Demolition

A. Before any asbestos demolition or renovation work, the permittee shall determine whether 40 CFR 61 Subpart M, National Emissions Standards for Asbestos applies. If required, the permittee shall notify the Department’s Program Manager, Compliance and Enforcement Section using forms furnished by the Department.

B116 <u>Short Term Engine Replacement</u>

A. The following Alternative Operating Scenario (AOS) addresses engine breakdown or periodic maintenance and repair, which requires the use of a short term replacement engine. The following requirements do not apply to engines that are exempt per 20.2.72.202.B(3) NMAC. Changes to exempt engines must be reported in accordance with 20.2.72.202.B NMAC. A short term replacement engine may be substituted for any engine allowed by this permit for no more than 120 days in any rolling twelve month period per permitted engine. The compliance demonstrations required as part of this AOS are in addition to any other compliance demonstrations required by this permit.

(1) The permittee may temporarily replace an existing engine that is subject to the emission limits set forth in this permit with another engine regardless of manufacturer, model, and horsepower without modifying this permit. The permittee shall submit written notification to the Department within 15 days of the date of engine substitution according to condition B110.C(1).

(a) The potential emission rates of the replacement engine shall be determined using the replacement engine's manufacturer specifications and shall comply with the existing engine's permitted emission limits.

(b) The direction of the exhaust stack for the replacement engine shall be either vertical or the same direction as for the existing engine. The replacement engine's stack height and flow parameters shall be at least as effective in the dispersion of air pollutants as the modeled stack height and flow parameters for the existing permitted engine. The following equation may be used to show that the replacement engine disperses pollutants as well as the existing engine. The value calculated for the replacement engine on the right side of the equation shall be equal to or greater than the value for the existing engine on the left side of the equation. The permitting page of the Air Quality Bureau website contains a spreadsheet that performs this calculation.

EXISTING ENGINE	REPLACMENT ENGINE

$$\frac{[(g) \times (h1)] + [(v1)^2/2] + [(c) \times (T1)]}{q1} \le \frac{[(g) \times (h2)] + [(v2)^2/2] + [(c) \times (T2)]}{q2}$$

Where
g = gravitational constant = 32.2 ft/sec^2
h1 = existing stack height, feet
v1 = exhaust velocity, existing engine, feet per second
c = specific heat of exhaust, 0.28 BTU/lb-degree F
T1 = absolute temperature of exhaust, existing engine = degree F + 460
q1 = permitted allowable emission rate, existing engine, lbs/hour
h2 = replacement stack height, feet
v2 = exhaust velocity, replacement engine, feet per second
T2 = absolute temperature of exhaust, replacement engine = degree F + 460
q2 = manufacturer's potential emission rate, replacement engine, lbs/hour

The permittee shall keep records showing that the replacement engine is at least as effective in the dispersion of air pollutants as the existing engine.

(c) Test measurement of NOx and CO emissions from the temporary replacement engine shall be performed in accordance with Section B111 with the exception of Condition B111A(3) and B111B for EPA Reference Methods Tests or SectionB111C for portable analyzer test measurements. Compliance test(s) shall be conducted within fifteen (15) days after the unit begins operation, and records of the results shall be kept according to section B109.B. This test shall be performed even if the engine is removed prior to 15 days on site.

i. These compliance tests are not required for an engine certified under 40CFR60, subparts IIII, or JJJJ, or 40CFR63, subpart ZZZZ if the permittee demonstrates that one of these requirements causes such engine to comply with all emission limits of this permit. The permittee shall submit this demonstration to the Department within 48 hours of placing the new unit into operation. This submittal shall include documentation that the engine is certified, that the engine is within its useful life, as defined and specified in the applicable requirement, and shall include calculations showing that the applicable emissions standards result in compliance with the permit limits.

ii. These compliance tests are not required if a test was conducted by portable analyzer or by EPA Method test (including any required by 40CFR60, subparts IIII and JJJJ and 40CFR63, subpart ZZZZ) within the last 12 months. These previous tests are valid only if conducted at the same or lower elevation as the existing engine location prior to commencing operation as a temporary replacement. A copy of the test results shall be kept according to section B109.B.

(d) Compliance tests for NOx and CO shall be conducted if requested by the Department in writing to determine whether the replacement engine is in compliance with applicable regulations or permit conditions.

(e) Upon determining that emissions data developed according to B116.A.1(c) fail to indicate compliance with either the NOx or CO emission limits, the permittee shall notify the Department within 48 hours. Also within that time, the permittee shall implement one of the following corrective actions:

i. The engine shall be adjusted to reduce NOx and CO emissions and tested per B116.A.1(c) to demonstrate compliance with permit limits.

ii. The engine shall discontinue operation or be replaced with a different unit.

(2) Short term replacement engines, whether of the same manufacturer, model, and horsepower, or of a different manufacturer, model, or horsepower, are subject to all federal and state applicable requirements, regardless of whether they are set forth in this permit (including monitoring and recordkeeping), and shall be subject to any shield afforded by this permit.

(3) The permittee shall maintain a contemporaneous record documenting the unit number, manufacturer, model number, horsepower, emission factors, emission test results, and serial number of any existing engine that is replaced, and the replacement engine. Additionally, the record shall document the replacement duration in days, and the beginning and end dates of the short term engine replacement.

(4) The permittee shall maintain records of a regulatory applicability determination for each replacement engine (including 40CFR60, subparts IIII and JJJJ and 40CFR63, subpart ZZZZ) and shall comply with all associated regulatory requirements.

B. Additional requirements for replacement of engines at sources that are major as defined in regulation 20.2.74 NMAC, Permits – Prevention of Significant Deterioration, section 7.AF. For sources that are major under PSD, the total cumulative operating hours of the replacement engine shall be limited using the following procedure:

(1) Daily, the actual emissions from the replacement engine of each pollutant regulated by this permit for the existing engine shall be calculated and recorded.

(2) The sum of the total actual emissions since the commencement of operation of the replacement engine shall not exceed the significant emission rates in Table 2 of 20.2.74 NMAC, section 502 for the time that the replacement engine is located at the facility.

C. All records required by this section shall be kept according to section B109.

PART C MISCELLANEOUS

C100 Supporting On-Line Documents

A. Copies of the following documents can be downloaded from NMED's web site under Compliance and Enforcement or requested from the Bureau.

(1) Excess Emission Form (for reporting deviations and emergencies)

(2) Universal Stack Test Notification, Protocol and Report Form and Instructions

(3) SOP for Use of Portable Analyzers in Performance Tests

C101 Definitions

A. **"Daylight"** is defined as the time period between sunrise and sunset, as defined by the Astronomical Applications Department of the U.S. Naval Observatory. (Data for one day or a table of sunrise/sunset for an entire year can be obtained at http://aa.usno.navy.mil/. Alternatively, these times can be obtained from a Farmer's Almanac or from http://www.almanac.com/rise/).

B. **"Exempt Sources"** and **"Exempt Activities"** is defined as those sources or activities that are exempted in accordance with 20.2.72.202 NMAC. Note; exemptions are only valid for most 20.2.72 NMAC permitting actions.

C. **"Fugitive Emission"** means those emissions which could not reasonably pass through a stack, chimney, vent, or other functionally equivalent opening.

D. **"Insignificant Activities"** means those activities which have been listed by the department and approved by the administrator as insignificant on the basis of size, emissions or production rate. Note; insignificant activities are only valid for 20.2.70 NMAC permitting actions.

E. **"Natural Gas"** is defined as a naturally occurring fluid mixture of hydrocarbons that contains 20.0 grains or less of total sulfur per 100 standard cubic feet (SCF) and is either composed of at least 70% methane by volume or has a gross calorific value of between 950 and 1100 Btu per standard cubic foot. (40 CFR 60.631)

F. **“Natural Gas Liquids”** means the hydrocarbons, such as ethane, propane, butane, and pentane that are extracted from field gas. (40 CFR 60.631)

G. **“National Ambient air Quality Standards”** means, unless otherwise modified, the primary (health-related) and secondary (welfare-based) federal ambient air quality standards promulgated by the US EPA pursuant to Section 109 of the Federal Act.

H. **“Night”** is the time period between sunset and sunrise, as defined by the Astronomical Applications Department of the U.S. Naval Observatory. (Data for one day or a table of sunrise/sunset for an entire year can be obtained at http://aa.usno.navy.mil/. Alternatively, these times can be obtained from a Farmer’s Almanac or from http://www.almanac.com/rise/).

I. **“Night Operation** or **Operation at Night”** is operating a source of emissions at night.

J. **“NO2”** or "Nitrogen dioxide" means the chemical compound containing one atom of nitrogen and two atoms of oxygen, for the purposes of ambient determinations. The term **"nitrogen dioxide,"** for the purposes of stack emissions monitoring, shall include nitrogen dioxide (the chemical compound containing one atom of nitrogen and two atoms of oxygen), nitric oxide (the chemical compound containing one atom of nitrogen and one atom of oxygen), and other oxides of nitrogen which may test as nitrogen dioxide and is sometimes referred to as NOx or NOx. (20.2.2 NMAC)

K. “**NOx**” see NO_2

L. **“Potential Emission Rate”** means the emission rate of a source at its maximum capacity to emit a regulated air contaminant under its physical and operational design, provided any physical or operational limitation on the capacity of the source to emit a regulated air contaminant, including air pollution control equipment and restrictions on hours of operation or on the type or amount of material combusted, stored or processed, shall be treated as part of its physical and operational design only if the limitation or the effect it would have on emissions is enforceable by the department pursuant to the Air Quality Control Act or the federal Act.

M. “**Restricted Area**” is an area to which public entry is effectively precluded. Effective barriers include continuous fencing, continuous walls, or other continuous barriers approved by the Department, such as rugged physical terrain with a steep grade that would require special equipment to traverse. If a large property is completely enclosed by fencing, a restricted area within the property may be identified with signage only. Public roads cannot be part of a Restricted Area.

N. **"Shutdown"** for requirements under 20.2.72 NMAC, means the cessation of operation of any air pollution control equipment, process equipment or process for any purpose, except routine phasing out of batch process units.

O. **"SSM"** for requirements under 20.2.7 NMAC, means routine or predictable startup, shutdown, or scheduled maintenance.

(1) **"Shutdown"** for requirements under 20.2.7 NMAC, means the cessation of operation of any air pollution control equipment or process equipment.

(2) **"Startup"** for requirements under 20.2.7 NMAC, means the setting into operation of any air pollution control equipment or process equipment.

P. **"Startup"** for requirements under 20.2.72 NMAC, means the setting into operation of any air pollution control equipment, process equipment or process for any purpose, except routine phasing in of batch process units.

C102 <u>Acronyms</u>

2SLB .... 2-stroke lean burn
4SLB .... 4-stroke lean burn
4SRB .... 4-stroke rich burn
acfm .... actual cubic feet per minute
AFR .... air fuel ratio
AP-42 .... EPA Air Pollutant Emission Factors
AQB .... Air Quality Bureau
AQCR .... Air Quality Control Region
ASTM .... American Society for Testing and Materials
BTU .... British Thermal Unit
CAA .... Clean Air Act of 1970 and 1990 Amendments
CEM .... continuous emissions monitoring
cfh .... cubic feet per hour
cfm .... cubic feet per minute
CFR .... Code of Federal Regulation
CI .... compression ignition
CO .... carbon monoxides
COMS .... continuous opacity monitoring system
EIB .... Environmental Improvement Board
EPA .... United States Environmental Protection Agency
gr./100 cf .... grains per one hundred cubic feet
gr./dscf .... grains per dry standard cubic foot
GRI .... Gas Research Institute
HAP .... hazardous air pollutant
hp .... horsepower
H_2S .... hydrogen sulfide

IC .... internal combustion
KW/hr .... kilowatts per hour
lb/hr .... pounds per hour
lb/MMBtu .... pounds per million British Thermal Unit
MACT .... Maximum Achievable Control Technology
MMcf/hr .... million cubic feet per hour
MMscf .... million standard cubic feet
N/A .... not applicable
NAAQS .... National Ambient Air Quality Standards
NESHAP .... National Emission Standards for Hazardous Air Pollutants
NG .... natural gas
NGL .... natural gas liquids
NMAAQS .... New Mexico Ambient Air Quality Standards
NMAC .... New Mexico Administrative Code
NMED .... New Mexico Environment Department
NMSA .... New Mexico Statues Annotated
NOx .... nitrogen oxides
NSCR .... non-selective catalytic reduction
NSPS .... New Source Performance Standard
NSR .... New Source Review
PEM .... parametric emissions monitoring
PM .... particulate matter (equivalent to TSP, total suspended particulate)
PM_{10} .... particulate matter 10 microns and less in diameter
$PM_{2.5}$ .... particulate matter 2.5 microns and less in diameter
pph .... pounds per hour
ppmv .... parts per million by volume
PSD .... Prevention of Significant Deterioration
RATA .... Relative Accuracy Test Assessment
RICE .... reciprocating internal combustion engine
rpm .... revolutions per minute
scfm .... standard cubic feet per minute
SI .... spark ignition
SO_2 .... sulfur dioxide
SSM .... Startup Shutdown Maintenance (see SSM definition)
TAP .... Toxic Air Pollutant
TBD .... to be determined
THC .... total hydrocarbons
TSP .... Total Suspended Particulates
tpy .... tons per year
ULSD .... ultra low sulfur diesel
USEPA .... United States Environmental Protection Agency
UTM .... Universal Transverse Mercator Coordinate system
UTMH .... Universal Transverse Mercator Horizontal
UTMV .... Universal Transverse Mercator Vertical

VHAP...volatile hazardous air pollutant
VOC..volatile organic compounds