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Service

**Southwestern
Region**

MB-R3-03-25

February 2013

Draft Environmental Impact Statement for Roca Honda Mine

Sections 9, 10 and 16, Township 13 North, Range 8 West, New Mexico Principal Meridian

Cibola National Forest, McKinley and Cibola Counties, New Mexico

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Environmental Impact Statement for Roca Honda Mine

Cibola National Forest
McKinley and Cibola Counties, New Mexico

Lead Agency:	U.S. Forest Service
Cooperating Agencies:	U.S. Environmental Protection Agency (Region 6), New Mexico Mining and Minerals Division, New Mexico Environment Department, New Mexico Department of Game and Fish
Responsible Official:	Nancy Rose, Forest Supervisor Cibola National Forest 2113 Osuna Road, NE Albuquerque, NM 87113
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Abstract: Roca Honda Resources (RHR), LLC, has submitted a plan of operations to the United States Forest Service proposing to develop and conduct underground uranium mining operations at their mining claims on and near Jesus Mesa in the Mt. Taylor Ranger District of the Cibola National Forest. The proposed Federal action is to: (1) approve RHR's plan of operations with mitigations needed to protect other nonmineral surface resources consistent with the 1985 forest plan, regulations, and other applicable laws, and (2) approve a project-specific forest plan amendment to allow the Roca Honda project to deviate from the forest plan standards of management with regard to historic properties. During the scoping process for the EIS, water and cultural resources issues generated the greatest concern. The EIS finds that, even after the implementation of recommended mitigation measures, adverse significant impacts are likely to remain in the areas of groundwater, cultural and historic resources, environmental justice, human health and safety, and legacy issues. Certain socioeconomic and human health effects are determined to be beneficial and significant. Other adverse and beneficial impacts are identified but not found to be significant.

Reviewers should provide the Forest Service with their comments during the review period of the draft environmental impact statement. This will enable the Forest Service to analyze and respond to the comments at one time and to use information acquired in the preparation of the final environmental impact statement, thus avoiding undue delay in the decisionmaking process. Reviewers have an obligation to structure their participation in the National Environmental Policy

Act process so that it is meaningful and alerts the Agency to the reviewers' position and contentions. Vermont Yankee Nuclear Power Corp. v. NRDC, 435 U.S. 519, 553 (1978). Environmental objections that could have been raised at the draft stage may be waived if not raised until after completion of the final environmental impact statement. City of Angoon v. Hodel (9th Circuit, l986) and Wisconsin Heritages, Inc. v. Harris, 490 F. Supp. 1334, 1338 (E.D. Wis. 1980). Comments on the draft environmental impact statement should be specific and should address the adequacy of the statement and the merits of the alternatives discussed (40 CFR 1503.3).

Send Comments to:

Forest Supervisor
Cibola National Forest
2113 Osuna Road, NE
Albuquerque, NM 87113
comments-southwestern-cibola@fs.fed.us

Please reference Roca Honda Mine DEIS in the subject line of the letter or email.

Date Comments Must Be Received: The 60-day public comment period begins on the day after the Environmental Protection Agency publishes a notice of availability for the draft EIS in the Federal Register. Comments MUST be received before the close of business on the last day of the comment period.

The Forest Service uses the most current and complete data available. GIS data and product accuracy may vary. They may be developed from sources of differing accuracy, accurate only at certain scales, based on modeling or interpretation, incomplete while being revised, etc. Using GIS products for purposes other than intended may yield inaccurate or misleading results. The Forest Service reserves the right to correct, update, modify or replace GIS products without notification.

Summary

Roca Honda Resources, LLC (RHR), the applicant, has submitted a plan of operations –a.k.a. mine operations plan (MOP) on the parallel application for a New Mine Permit to the New Mexico Mining and Minerals Division, or the proposed plan – to the Cibola National Forest (U.S. Forest Service) for development of underground uranium mining and surface support facilities on the Mt. Taylor Ranger District near Grants, New Mexico. This draft environmental impact statement (DEIS) assesses the potential environmental impacts of implementing the proposed plan.

Purpose and Need for the Proposed Action

The Forest Service has a need to respond to Roca Honda's proposal to exercise their statutory rights to enter public lands and utilize these particular mining claims in order to access the mineral resources. The Federal action associated with the EIS is the Forest Service's decision on whether to approve the applicant's plan of operations as submitted, or to require further mitigation measures needed to protect other nonmineral surface resources consistent with the 1985 "Cibola National Forest Land and Resource Management Plan" (LRMP or forest plan), Federal regulations, and other applicable laws. An additional Forest Service need is to decide whether to approve a project-specific forest plan amendment that would allow the applicant's project to deviate from the 1985 standards of management with regard to historic properties. The applicant has the right to exercise their rights under U.S. mining laws to develop and remove the mineral resources as set forth by the General Mining Law of 1872, as amended. These laws provide that the public has a statutory right to conduct prospecting, exploration, development, and production activities (1872 Mining Law and 1897 Organic Act), provided they are reasonably incident (1955 Multiple Use Mining Act and case law) to mining and comply with other Federal laws.

The Forest Service has the responsibility to protect surface resources. Mining regulations state that "operations shall be conducted so as, where feasible, to minimize adverse environmental effects on National Forest System surface resources (36 CFR 228.8)" provided such regulation does not endanger or materially interfere with prospecting, mining, or processing operations or reasonably incident uses (1955 Multiple Use Mining Act and case law). Under 36 CFR 228.4(a) (Code of Federal Regulations) subsection (4), "If the district ranger determines that any operation is causing or will likely cause significant disturbance of surface resources, the district ranger shall notify the operator that the operator must submit a proposed plan of operations for approval and that the operations cannot be conducted until a plan of operations is approved."

Public Involvement

The notice of intent (NOI) was published in the Federal Register on November 24, 2010. The NOI asked for public comment on the proposal from November 24, 2010, to January 14, 2011. In addition, as part of the public involvement process, the Agency held open house scoping meetings in Grants, New Mexico, on December 14, 2010, and Gallup, New Mexico, on December 16, 2010.

Notices advertising the scoping meetings were printed in the State's newspaper of record, the Albuquerque Journal, and local newspapers (Cibola Beacon in Grants and Gallup Independent in Gallup) in the preceding weeks. In addition, a project newsletter was distributed to agencies, nongovernmental organizations (NGOs), and interested parties. Also, a 30-second public service announcement (PSA) was aired on local radio stations for the week prior to and the week of the public scoping meetings.

The scoping process itself often involved face-to-face contact and one-on-one participation by stakeholders and members of the interested and affected public. The opportunity for this interaction and exchange came in the form of the two informal, open house style scoping meetings in Grants and Gallup. The Forest Service and the third party contractor then investigated substantive issues raised in scoping, conducted research and analysis, and drafted this EIS. Availability of the DEIS is announced through public notice, including a notice of availability (NOA) in the Federal Register, letters to interested parties, and notices in the print and broadcast news media.

As part of the public involvement process, the Forest Service set up a link on the Southwestern Region's Web site to present information and documentation about the project to interested parties. This information is included in the "Cibola National Forest Schedule of Proposed Actions" (SOPA) report. As part of their responsibilities under Section 106 of the National Historic Preservation Act (NHPA), the Forest Service has been conducting ongoing consultation with tribes and other interested and affected parties and solicited their input on the project. Using comments from the public, agencies, tribes, and other interested parties, the Forest Service developed a list of issues to address in this draft EIS as identified below.

Issues Identified During Scoping

The Forest Service separated the issues into two groups: significant and nonsignificant issues. Significant issues were defined as those directly or indirectly caused by implementing the proposed action. Nonsignificant issues were identified as those: (1) outside the scope of the proposed action; (2) already decided by law, regulation, forest plan, or other higher level decision; (3) irrelevant to the decision to be made; or (4) conjectural and not supported by scientific or factual evidence. The Council on Environmental Quality (CEQ) National Environmental Policy Act (NEPA) regulations explain this delineation in Sec. 1501.7, "…identify and eliminate from detailed study the issues which are not significant or which have been covered by prior environmental review (Sec. 1506.3)…."

The Forest Service identified the following significant issues for discussion in the DEIS:

- Potential impacts on geology and soils at the proposed mine site.
- Need for reclamation and restoration of disturbed land.
- Potential contamination of ground and surface water, and how such contamination would be avoided.
- Predicted effects of mine dewatering on aquifers and springs.
- Potential effects on air quality locally, in particular, the exposure of the public to radioactive radon gas vented from the mine shafts.
- Potential effects on vegetation, habitats, wildlife, and special status species.
- Potential effects on nearby land use and recreation resources.
- Potential effects on environmental justice populations.

- Potential effects on the characteristics that make the Mt. Taylor Traditional Cultural Property TCP) eligible for the National Register of Historic Places (NRHP).
- Potential effects of uranium mining on the local and State economy.
- Risks to the public of hauling of uranium ore out of the Cibola National Forest and along State roads to the Interstate highway system.
- Potential health and safety risks of uranium mining and associated developments (such as an influx of workers) to miners and the wider community.
- Potential impacts on the site's visual resources.
- Cumulative effects of uranium mining with respect to all relevant resource topics.

Proposed Action and Alternatives

Alternative 1 – No Action

Under the no action alternative, the Roca Honda Mine would neither be constructed nor operated. For purposes of NEPA analysis and disclosure, the no action alternative provides a baseline for comparison of the effects of the action alternatives.

The General Mining Act of 1872 confers a statutory right to enter upon public lands open to location in pursuit of locatable minerals, and to conduct mining activities, in compliance with Federal and state statutes and regulations. The Multiple-Use Mining Act of 1955 confirms the ability to conduct mining activities on public lands, locate necessary facilities, and conduct reasonable and incidental uses to mining on public lands, including National Forest System lands. Forest Service locatable mineral mining regulations correspondingly recognize the rights of mining claimants. The Forest Service ensures that proposed activities are required for, and reasonably incidental to, prospecting, mining, or processing operations, and ensure operations minimize adverse environmental effects. The Forest Service may reject an unreasonable or illegal plan of operations, but cannot categorically prohibit mining activity or deny reasonable and legal mineral operations under the mining laws.

Alternative 2 – Proposed Action (Two Shaft Alternative)

The proposed action is to approve the plan of operations submitted by RHR to the Forest Service and approve the project-specific forest plan amendment described above. This proposed action is the plan of operations as submitted to the Forest Service by RHR in accordance with its rights under the General Mining Law of 1872, as amended, and Forest Service mining regulations at 36 CFR 228 Subpart A. In addition, the proposed Action is also subject to State of New Mexico permitting and regulatory requirements.

Proposed surface disturbance associated with the underground mine is located within portions of Sections 9, 10, and 16, Township 13 North, Range 8 West, New Mexico Principle Meridian. These sections are located in McKinley County, New Mexico, approximately 3 miles northwest of San Mateo and 22 miles northeast of Grants, New Mexico. Sections 9 and 10 are National Forest System lands, which are open to mineral entry under the General Mining Law of 1872. Section 16 is State of New Mexico land, which is not subject to the regulatory jurisdiction of the Forest Service, but rather under the jurisdiction of the New Mexico State Land Office. RHR proposes a mine permit area of 1,968 acres, including 48 acres of haul roads, utility corridor, and mine dewater discharge pipeline corridor outside of Sections 9, 10, and 16. There are 183 acres of proposed disturbance within Sections 9, 10, and 16, plus 35 acres outside those sections for a total disturbance area of 218 acres.

Mine Development

Mine development activities would include gathering of baseline characterization data, and construction of depressurizing wells, a water treatment plant, two main production shafts, ventilation shafts, and ancillary surface facilities. RHR estimates that approximately 3.6 years would be required for development activities before ore production can begin. At that point, the mine operation phase would begin at Section 16 and mine development activities would shift to Section 10 thereafter.

Roca Honda proposes to construct 10 water depressurizing wells near the production shaft in Section 16 and 15 depressurizing wells near the production shaft in Section 10. The purpose of these wells is to reduce water pressure and control groundwater inflows during construction of the shafts.

Water pumped from the depressurizing wells may produce natural water quality that does not meet numerical surface water discharge standards. RHR proposes to treat water produced from mine depressurization, as necessary, through construction of a water treatment plant.

RHR proposes to construct a pipeline approximately 5.5 miles in length to transport water produced from the mine offsite. The pipeline would be laid on the ground surface so that no trenching or excavation would be required. Almost the entire length would be across private land; a very small portion of Cibola National Forest land would be crossed as well. The proposed destination of the water would be a water storage tank on private ranchland whose owner intends to use this treated water to irrigate range or pastureland for livestock. As a contingency, Laguna Polvadera and San Lucas Arroyo would be utilized for overflow.

RHR proposes to mine ore that is located at approximately 1,650 to 2,650 feet below the ground surface. Two 18-foot diameter production shafts are proposed to access that ore and to provide a means to move workers, equipment, and rock into and out of the mine.

Mine ventilation is a critical aspect of underground mining. Air must be pumped through the underground mine to provide sufficient fresh air to workers, and to vent or exhaust air from the mine to prevent buildup of contaminants, including radon gas, carbon monoxide, and diesel fumes.

Additional ancillary surface facilities would support the underground mine operation, such as:

- Haul and access roads
- Head frames, hoists, and ventilation shafts
- Soil stockpiles, rock stockpiles, ore pads, and nonore stockpiles
- Fuel, chemical, explosives, and equipment storage areas
- Drill pads to support development drilling and monitoring well construction
- Utility lines, pipelines, storm water control facilities, and fencing.

Mine Operation

Mine operation includes activities directly related to production of uranium ore from the underground mine. Under the proposed action, these activities would commence first in Section 16, with initial production planned to start approximately 3.5 years after all required permits for the mine are received. At that time, ore production would start in Section 16, and mine development would continue in Sections 9 and 10. Ore production from the Section 10 production shaft is planned to start approximately 8.5 years after all required permits for the mine are received. The production phase would last approximately 13 years. However, the ultimate mine life may be extended if additional ore is identified or if economic conditions change.

Extraction of ore would use drilling, blasting, and excavation to construct a network of underground tunnels and rooms. Ore would be blasted, loaded in underground mine haulage equipment, and hauled to the surface through the production shaft. The ore would then be placed on the ore pad for temporary storage until it was loaded onto a highway haul truck. The ore would then be hauled from the mine on one of the haul roads to an existing public highway.

Mine Reclamation

Mine reclamation would be the last phase of the proposed operation. Mine reclamation is designed to reclaim the effects of mining and achieve a post-mining land use of grazing. Most reclamation would occur after mining is complete, because major surface facilities are planned to be used for the life of the underground mine. This type of reclamation is termed final reclamation. RHR estimates that the life of the mine would be approximately 18–19 years. Final reclamation would be complete at that time. Some contemporaneous reclamation is planned, which is reclamation that would be conducted during the development or operations period.

Alternative 3 – Require Modified Plan of Operations (One Shaft Alternative)

Under this alternative, the Cibola National Forest supervisor would require RHR to locate most surface facilities and infrastructure associated with the Roca Honda Mine onto Section 16. The production shaft and associated facilities located on Section 10 in the proposed action (alternative 2) would be eliminated in this alternative. The facilities that would be eliminated from Section 10 under alternative 3 duplicate those proposed in alternative 2. The purpose of the Cibola National Forest supervisor requiring this change in the plan of operations would be to reduce the overall acreage of surface impacts from the mine itself by about one-third (from 183 acres to 120 acres).

In the one production shaft alternative, all ore production from the RHR mine would be achieved by constructing only a single production shaft on State-leased lands in Section 16, i.e., the shaft described in RHR's proposed action. All of the ore in the permit area would be accessed by excavating underground mine declines horizontally under the ore and vertical raises up into the ore pods. In this alternative the ore located in Section 10 would be accessed by constructing two long parallel development drifts from the Section 16 shaft northwest into Section 10 to the approximate location where the Section 10 production shaft described in the proposed action would have been constructed.

Under alternative 3, the overall volume of materials mined (ore and nonore) and the configuration of underground mining tunnels and rooms within the ore-bearing Westwater Canyon Formation would not differ substantially from the proposed action. In other respects as well, the modified plan of operations alternative would be essentially the same as the proposed action. Thus, the description of the three phases in the proposed action—mine development, mine operation, and final reclamation—is applicable to this alternative as well, except that mine development and operation would be mostly limited to Section 16 and avoid most of the disturbance to the land surface in Sections 9 and 10.

Summary of Potential Impacts

Table S-1 summarizes potential environmental impacts associated with the proposed Roca Honda Mine.

Table S-1. Summary of potential environmental impacts associated with the project

Resource	Impacts and Mitigation
Geology and Soils	• Impacts of both action alternatives on both geology and soils would be less than significant, but initial impacts of alternative 3 on soils would be about 30 percent less than alternative 2. • Implementation of BMPs would reduce impacts to soils. • Upon reclamation, soils should be stabilized sufficiently to support vegetation restoration, but would not recover 100 percent of pre-mining condition for centuries.
Surface Water	• Majority of action alternatives' potential surface water effects from storm water and its impacts on water quality, sediment movement, and flooding. • Initial impacts of alternative 3 would be less than alternative 2 due to less surface disturbance, but impacts of both alternatives would be less than significant. • Impacts on surface water would be reduced by BMPs.
Groundwater Resources	• At the mine itself, maximum drawdown of Westwater Canyon Member of Morrison Formation at the mine would be 1,806 feet at the end of mining. • One hundred years after mining has ceased, drawdown in the Westwater would still be both broad (10 foot drawdown about 17 miles out) and shallow (30 foot maximum drawdown at the mine itself). • Action alternatives would both have significant adverse impacts on groundwater quantity. • Limited adverse impacts on springs in the vicinity of the mine from both action alternatives. • Cumulative long-term effects from all possible actions likely to be significant.
Air Quality	• Short-term effects of both action alternatives limited to fugitive dust and diesel emissions from drilling and heavy equipment during mine development. • Radon doses to people living continuously or collecting wood in the vicinity of the mine would not exceed the Federal safety standard. • Overall impacts on air quality adverse but less than significant.
Vegetation	• Alternative 2 would disturb about 218 acres of vegetation in total for the duration of the mine; alternative 3 about 155 acres; BMPs would limit impacts of both action alternatives. • Special status plants unlikely to be affected by either action alternative. • Mine site and other disturbed areas would be reclaimed and vegetation restored after mining concludes.

Resource	Impacts and Mitigation
	• Overall impacts on vegetation would be adverse but less than significant.
Wildlife	• Under both action alternatives, mine may impact wildlife through mortality; habitat loss, alteration, degradation, and fragmentation; displacement; and exposure to chemical and radiation hazards associated with bioaccumulation in the air, soil, vegetation, and prey species. • Alternative 3 would reduce alternative 2's disturbance of wildlife habitat by about 30 percent—155 acres vs. 218 acres. • Special status wildlife unlikely to be affected by either action alternative. • No significant impacts on expected Forest Service listed sensitive, management indicator species, migratory bird species, or their habitat. • Habitats and populations likely to recover fully after mine reclamation. • Overall impacts on wildlife of either action alternative would be adverse but less than significant.
Land Use	• Under both action alternatives, the mine would limit access to all of the development and operations areas to the extent necessary to protect public safety and control the work space. • Proposed post-mining land use of grazing is consistent with the Cibola National Forest LRMP. • Overall impact on land use, while adverse, would not be significant.
Recreation	• Distance of mine operations from designated recreation sites is great enough that there would be a negligible direct effect on the recreation experience at these sites. • Existing onsite recreational activities, such as hunting, on and near the permit itself would be curtailed or restricted for the duration of the mine, or about 2 decades. • Adverse effects of alternative 3 on recreation are qualitatively similar to those of alternative 2, but on a somewhat smaller scale. • Impact of action alternatives adverse but less than significant.
Environmental Justice and Protection of Children	• Action alternatives would potentially create beneficial impacts due to the provision of jobs and economic opportunities in minority and low-income communities. • Adverse mental health impacts of moderate magnitude would occur to tribal environmental justice communities due to mine development so close to spiritually significant Mt. Taylor. • Neither action alternative expected to disproportionately expose children to toxic substances, radionuclides, or other safety hazards. • Beneficial and adverse effects on environmental justice of the action alternatives, as well as cumulative effects both positive and negative, are likely to be significant.
Socioeconomics	• Overall, both action alternatives would support over a billion dollars in economic activity, about 2,400 jobs with salaries worth $355 million, and generate $81 million in local and State revenue during the life of the project. • Although the mine would yield tangible economic benefits for the region during its 2 decades of construction, operation, and reclamation, it remains controversial due to the historical uranium boom and bust cycles that have occurred in the region and elsewhere. • Mine would likely contribute to significantly beneficial cumulative economic impacts within the region of influence (ROI) over the coming decades, though perhaps not permanent prosperity.

Resource	Impacts and Mitigation
Cultural and Historic Resources	• Both action alternatives would cause adverse impacts to tribal cultural resources and practices related to the sacred character of Mt. Taylor for the Acoma, Laguna, Zuni, Hopi, and Navajo in particular. • Both action alternatives would adversely affect the Mt. Taylor TCP and cause irreparable harm to surrounding tribes and their traditional cultural practices. • Both action alternatives would have a perceived impact upon the Spirit Beings associated with the TCP. • Ground disturbance from construction activities of both action alternatives would result in direct physical impacts to four historic properties. • Due to less development in Section 10 with less ground disturbance, fewer surface facilities, and less activity and traffic, the totality of the impacts to the Mt. Taylor TCP and related resources would be less than alternative 2. • Impacts of both action alternatives on cultural resources would be significant, and would result in an adverse effect to historic properties. • Cumulative effects of both action alternatives in combination with other past, present, and reasonably foreseeable future actions would be adverse and significant, exacerbating loss of integrity of Mt. Taylor TCP.
Visual Resources	• Magnitude of impacts of both action alternatives would fit in with the Forest Service visual quality objectives for the area. Therefore, the magnitude of impacts would be minor. • Largest impact would be from viewers on Mt. Taylor. • Viewshed of alternative 3 is smaller than that of alternative 2, in that the area east and northeast of Section 10 would not be impacted. • Overall impacts to visual resources would be adverse but not significant. • Cumulative impact on visual resources would be medium term but impermanent and adverse but not significantly adverse.
Transportation	• Both action alternatives would have short- and long-term minor effects on transportation. • Long-term minor effects would be due to ore hauling trucks, continued delivery of supplies, and worker commutes. • Risks from transportation of uranium ore are dominated by conventional risks associated with virtually all commercial transportation and the probability of accident related fatalities is no different than those associated with conventional truck transportation. • Long-term beneficial effects would be due to upgrades to roadways. • No significant cumulative effects expected.
Human Health and Safety	• Action alternatives may entail direct and indirect effects on five important pathways related to the health and safety: traffic safety; noise; environmental exposure; impacts stemming from employment; and impacts stemming from in-migrating workers. • While actual contamination of water, air, and soil is predicted to be minor at most, perceived contamination on the part of Native Americans and others, along with actual changes to water and land from the project in the vicinity of sacred lands, especially within the context of uranium mining and milling legacy issues, may have real effects on the mental and physical health of some community members. • Jobs and income are strongly associated with a number of beneficial health outcomes such as an increase in life expectancy, improved child health status, improved mental health, and reduced rates of chronic and acute disease morbidity and mortality. • Stress and anxiety levels of residents in the ROI and, in turn, the mental, physical, and social health effects of these feelings, are affected by both historical and present-day factors, which include known and unknown health effects of uranium mining and large

Resource	Impacts and Mitigation
	number of unreclaimed and contaminated mine sites within the area. • Overall cumulative impacts on human health and safety would be significant.
Legacy Issues	• Legacy issues associated with contamination and health and safety impacts from past uranium mining and milling would continue for the foreseeable future. • The lack of open pit mining, leachate treatment, ore milling, in situ leachate handling, and wastepile disposal; and the requirements for ventilation and similar health and safety requirements of current uranium mining regulations suggest that there is little or no connection between the legacy health issues of uranium mining and processing in the past, and anticipated health and safety effects from the proposed Roca Honda Mine.

Decision Framework

The Cibola National Forest supervisor will use the EIS process to develop the necessary information to make an informed decision on whether or not to approve the proposed plan (alternative 2) as submitted, to approve the modified plan (alternative 3), or to decide what additional mitigation measures are needed to protect other resources as provided for in 36 CFR 228.8. The decision would ensure that the project conforms to provisions set forth in the existing 1985 Cibola National Forest LRMP.

Table S-2 lists the various permits and approvals that may be needed to protect the environment, health, and safety before the Roca Honda Mine could begin operations.

Table S-2. Potential permits and approvals

Agency	Permit or Approval
Federal	
U.S. Forest Service	• Plan of Operations (plan) • Special use permits (rights-of-way (ROWs), etc.)
U.S. Army Corps of Engineers	• No evidence of jurisdictional waters or wetlands of sufficient quantity as to trigger Sec. 404 permitting requirements.
U.S. Environmental Protection Agency	• Spill Prevention Control and Countermeasures Plan (SPCC) • Notification of Hazardous Waste Activity • Storm Water Pollution Prevention Plan (SWPPP) • Subpart A of the Radionuclide National Emission Standards for Hazardous Air Pollutants (NESHAPs) • National Pollutant Discharge Elimination Plan (NPDES) permit
U.S. Fish and Wildlife Service	• Threatened and Endangered Species (Section 7 Consultation)
Federal Communications Commission	• Radio authorizations
U.S. Department of Transportation, 49 CFR	• Requirements for transport and handing of radioactive materials including ore
Treasury Department (Bureau of Alcohol, Tobacco, Firearms and Explosives)	• Explosives use permits

Agency	Permit or Approval
Mine Safety and Health Administration	• Mine Identification Number • Legal Identity Report • Ground Control Plan • Miner Training Plan • Worker exposure standards
State	
New Mexico Energy, Minerals and Natural Resources, Department, Mining and Minerals Division	• New Mine Permit
New Mexico Environment Department Groundwater Bureau	• Discharge Permit
New Mexico Environment Department Drinking Water Bureau	• Public water supply system
New Mexico Environment Department Waste, Management Bureau	• Solid Waste System Permit
New Mexico Environment Department Petroleum Storage Tank Bureau	• Registration of diesel and petroleum tanks
New Mexico Environment Department Radiation Control Bureau	• Radiation Control License for Nuclear Density Gauge
New Mexico Office of the State Engineer	• Permit to Appropriate Public Waters • Mine Dewatering Permit • Dam Safety • Drilling Permit
New Mexico Game & Fish Department	• Wildlife consultation
State Historic Preservation Office	• Section 106 (NHPA) consultation
New Mexico Highway and Transportation Department	• Road access
McKinley County	
Building Department	• Building Permits • Septic System Approval

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Acronyms and Abbreviations

AADT	annual average daily traffic counts
ABQ	Albuquerque International Sunport Airport
ACHP	Advisory Council on Historic Preservation
AF	acre-feet (325,851 gallons of water)
AFY	acre-feet per year
AHPA	Archeological and Historic Preservation Act
AIDS	Acquired Immune Deficiency Syndrome
AIRFA	American Indian Religious Freedom Act
APE	area of potential effects
AQCR	Air-Quality Control Region
AQCR 156	Southwestern Mountains-Augustine Plains Air Quality Control Region
ARPA	Archeological Resources Protection Act
ATSDR	Agency for Toxic Substances and Disease Registry
BA	biological assessment
BBS	breeding bird survey
BDR	baseline data report
BIA	Bureau of Indian Affairs

BMP	best management practice
BRFSS	Behavioral Risk Factor Surveillance Survey
CAA	Clean Air Act
CDC	Centers for Disease Control and Prevention
CEQ	Council on Environmental Quality
CERCLA (“Superfund”)	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
Cfs	cubic feet per second
CI	confidence interval
CO	carbon monoxide
CO_2	carbon dioxide
COPD	Chronic Obstructive Pulmonary Disorder
CPRC	Cultural Properties Review Committee
CWA	Clean Water Act
CWCS	New Mexico Comprehensive Wildlife Conservation Strategy
dBA	decibels, A-weighting
de minimis	of minimal importance
DEIS	draft environmental impact statement
DNA	deoxyribonucleic acid
DP	discharge permit
EAP	Employee Assistance Program
EE	environmental evaluation
EIS	environmental impact statement
EJ	environmental justice
EMNRD	[New Mexico] Energy, Minerals and Natural Resources Department
EMS	Emergency Medical System
EMT	Emergency Medical Trained
EO	Executive Order
EPA	U.S. Environmental Protection Agency
FEA	Future Educator’s Association
FR	Federal Register
ft	foot or feet
FTE	full time equivalent
FUS	formerly used sites
G&A	general and administrative
GHG	greenhouse gas
Gpd	gallons per day
Gpm	gallons per minute

H1N1	Influenza A virus, subtype H1N1
HIV	Human Immunodeficiency Virus
HPS	Hantavirus Pulmonary Symptom
HPSA	Health Professional Shortage Area
HPD	Historic Preservation Division
HUC	hydrologic unit code
IBA	important bird area
IBS	Individual Business Taxes
IHS	Indian Health Services
JC	Joint Commission
LMAS	Lone Mountain Archaeological Services
LRMP	land and resource management plan
m	meter
$\mu g/m^3$	micrograms per cubic meter
MBTA	Migratory Bird Treaty Act
MESA	Mathematics, Engineering, and Science Achievement
MGD or mgd	million gallons per day
Mlb.	million pounds
MMD	[New Mexico] Mining and Minerals Division
MOA	memorandum of agreement
MORP	Mining Operations and Reclamation Plan
MOU	memorandum of understanding
MRVDs	thousand recreation visitor days
MSGP	Multi-Sector General Permit
MSHA	Mine Safety and Health Administration
msl	mean sea level (elevation in feet above mean sea level)
NAAQS	National Ambient Air Quality Standards
NAGPRA	Native American Graves Protection and Repatriation Act
NEPA	National Environmental Policy Act of 1969
NESHAPS	national emissions standards for hazardous air pollutants
NGO	nongovernmental organization
NHPA	National Historic Preservation Act
NJHS	National Junior Honor Society
NMED	New Mexico Environment Department
NMDGF	New Mexico Department of Game and Fish
NMOSE	New Mexico Office of the State Engineer
NMSA	New Mexico Statutes Annotated
NMSHPO	New Mexico State Historic Preservation Officer
NMSLO	New Mexico State Land Office

NMWQCC	New Mexico Water Quality Control Commission
NOA	notice of availability
NOI	notice of intent
NO_x	nitrogen oxides
NPDES	National Pollutant Discharge Elimination System
NPL	national priorities list
NPS	National Park Service
NRC	Nuclear Regulatory Commission
NRHP	National Register of Historic Places
NSLP	National School’s Lunch Program
O_3	ozone
OB-GYN	obstetrics and gynecology
OSE	Office of the State Engineer
OSHA	Occupational Safety and Health Administration
PAP	permit application package
PCEs	primary constituent elements
PIF	Partners in Flight
PM_{10}	particulate matter less than 10 microns in diameter
$PM_{2.5}$	particulate matter less than 2.5 microns in diameter
ppm	parts per million
project	Roca Honda Mine
PSA	public service announcement
PTE	part time equivalent
RAP	Remedial Action Program
RECA	Radiation Exposure Compensation Act
RHR	Roca Honda Resources, LLC
ROD	record of decision
ROI	region of influence
SCOA	Sumitomo Corporation of America
SHPO	State Historic Preservation Officer
SIP	state implementation plan
SLO	State Land Office
SIR	standardized incidence ratio
SMR	standardized mortality ratio
SO_2	sulfur dioxide
SOC	species of concern
SOPA	Schedule of Proposed Actions
SPCC	Spill Prevention, Control and Countermeasures
SRCP	State Register of Cultural Properties

STD	sexually transmitted disease
SWPPP	Storm Water Pollution Prevention Plan
TB	Tuberculosis
TCP	traditional cultural property
TMR	Travel Management Rule
tpy	tons per year
U_3O_8	uranium oxide
UAA	Use Attainability Analysis
UNFCC	United Nations Framework Convention on Climate Change
US	United States
USC	United States Code
USACE	U.S. Army Corps of Engineers
USDA	U.S. Department of Agriculture
USEPA	U.S. Environmental Protection Agency
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
VOC	volatile organic compound
WQCC	Water Quality Control Commission
y	year
YRBSS	Youth Risk Behavior Surveillance Survey

Chapter 1. Purpose of and Need for Action

Document Structure

The Forest Service has prepared this draft nvironmental impact statement (DEIS) in compliance with the National Environmental Policy Act (NEPA) and other relevant Federal and State laws and regulations. This draft environmental impact statement discloses the direct, indirect, and cumulative environmental impacts that would result from the proposed action and alternatives. The document is organized as follows:

Chapter 1. Purpose of and Need for Action: The chapter includes information on the history of the project proposal, the purpose of and need for the project, and the Agency's proposal for achieving that purpose and need. This section also details how the Forest Service informed the public of the proposal and how the public responded.

Chapter 2. Alternatives, including the Proposed Action: This chapter provides a more detailed description of the Agency's proposed action as well as alternative methods for achieving the stated purpose. These alternatives were developed based on significant issues raised by the public and other agencies. This discussion also includes mitigation measures. Finally, this section provides a summary table of the environmental consequences associated with each alternative.

Chapter 3. Affected Environment and Environmental Consequences: This chapter describes the environmental effects of implementing the proposed action and other alternatives. This analysis is organized by resource topics.

Chapter 4. Consultation and Coordination: This chapter provides a list of preparers and agencies consulted during development of the draft environmental impact statement.

Glossary. A glossary of certain key terms follows chapter 4.

References Cited. References cited in the text are included here.

Index: The index provides page numbers by document topic.

Additional documentation, including more detailed analyses of project-area resources, may be found in the project planning record located at the Cibola National Forest headquarters.

Background

Roca Honda Resources, LLC (RHR) has submitted a plan of operations to the United States Forest Service proposing to develop and conduct underground uranium mining operations on their mining claims on and near Jesus Mesa (figure 1) in the Mt. Taylor Ranger District of the Cibola National Forest. The proposed mine is located within portions of Sections 9, 10, and 16, Township 13 North, Range 8 West, New Mexico Principal Meridian (figures 2 and 3). These sections are located in McKinley County, New Mexico, approximately 3 miles northwest of San Mateo and 22 miles northeast of Grants, New Mexico.

Sections 9 and 10 are National Forest System lands open to mineral entry under the General Mining Law of 1872. Section 16 is State of New Mexico land, which is not subject to the regulatory jurisdiction of the Forest Service. The proposed project also includes infrastructure in Sections 2, 11, 15, 17, 20, and unplatted lands to the north. RHR proposes a mine permit area of

1,968 acres, including 48 acres of haul roads, utility corridor, and mine dewater discharge pipeline corridor outside of Sections 9, 10 and 16. There are 183 acres of disturbance within Sections 9, 10 and 16, plus 35 acres outside those sections for a total disturbance area of 218 acres.

Figure 1. Jesus Mesa viewed from the south (Section 16) in the vicinity of the proposed Roca Honda Mine

Additional surface disturbance associated with the mine haul roads is proposed for Sections 11, 17, and 20. The Cibola National Forest has decided to prepare an EIS to assess the development of this uranium mining operation on the Mt. Taylor Ranger District.

Purpose of and Need for Action

The Federal action associated with the EIS is the Forest Service's decision on whether or not to approve the applicant's proposed plan. The Forest Service need is to respond to the plan of operations submitted by the applicant, and to decide whether to approve it as submitted, or to require further mitigation measures needed to protect other nonmineral surface resources consistent with the forest plan, Federal regulations, and other applicable laws. An additional Forest Service need is to decide whether to approve a project-specific forest plan amendment that would allow the applicant's project to deviate from the 1985 forest plan standards of management with regard to historic properties. The applicant has the right to exercise their rights under U.S. mining laws to develop and remove the mineral resources as set forth by the General Mining Law of 1872, as amended. These laws provide that the public has a statutory right to conduct prospecting, exploration, development, and production activities (1872 Mining Law and 1897 Organic Act) provided they are reasonably incident (Multiple Use Mining Act of 1955 and case law) to mining and comply with other Federal laws.

The Forest Service has the responsibility to protect surface resources. Mining regulations state that "operations shall be conducted so as, where feasible, to minimize adverse environmental effects on National Forest System surface resources (36 CFR 228.8)" provided such regulation does not endanger or materially interfere with prospecting, mining, or processing operations or reasonably incident uses (Multiple Use Mining Act of 1955 and case law). Under 36 CFR 228.4(a) (Code of Federal Regulations) subsection 4, "If the district ranger determines that any operation is causing or will likely cause significant disturbance of surface resources, the district ranger shall notify the operator that the operator must submit a proposed plan of operations for approval and that the operations cannot be conducted until a plan of operations is approved."

General Mining Law of 1872

Signed into law on May 10, 1872, the **General Mining Act of 1872** is a Federal statute that authorizes and governs prospecting and mining on Federal public lands for economically valuable minerals, such as gold, platinum, silver, copper, lead, zinc, tungsten, and uranium. The General Mining Act codified an informal system for obtaining and protecting mining claims on public lands pioneered by prospectors in California and Nevada from the 1840s onward. Under the act, all citizens of the United States 18 years or older have the right to locate a lode (hard rock) or placer (gravel) mining claim on those Federal lands that are open to mineral entry. These claims may be staked once a discovery of a **locatable mineral** is made.

The General Mining Act of 1872 broadly opens the "public domain" to mining. The public domain consists of Federal lands owned by the Federal government since they became part of the United States, and which have never been set aside or withdrawn for a specific use. Lands dedicated for specific uses—such as national parks, national monuments, national wilderness areas, wild and scenic rivers, American Indian reservations, most reclamation projects, scientific test areas, and military reservations—are not subject to mineral entry and development. West of the Great Plains, lands managed by the U.S. Forest Service (USFS) or Bureau of Land Management (BLM), unless specifically designated by Congress as part of the National Wilderness Preservation System, are generally open to mining claims.

The Mining Law only addresses "locatable minerals." The list of locatable minerals does not include fossil fuels such as petroleum and coal, or construction materials such as sand and gravel. Rights to extract such nonlocatable minerals are usually acquired through a competitive bidding process.

Proposed Action

RHR proposes to conduct mining operations for a period of approximately 18–19 years, including mine development, operations, and reclamation. The proposed mining operations consist of three phases:

1. **Mine Development** – This phase includes baseline data gathering, initial site development, construction, and depressurizing activities, which would be conducted to facilitate mine shaft construction. Depressurizing consists of constructing a ring of wells around the perimeter of the area of the productions shafts into the Gallup, Dakota, and Westwater formations. These wells would be installed in advance of shaft construction and pumped in order to relieve the hydrostatic pressure in the formation, thus reducing the amount of water flowing into the shaft excavation as it advances through the formation. Five ventilation shafts, 8–10 feet in diameter, and two concrete-lined production shafts, 18 feet in diameter, would be constructed.

2. **Mine Operation** – This phase includes activities directly related to production of uranium ore from the underground mine, and transport of the ore offsite for mineral processing. Soils, rock, and ore would be stockpiled on the surface. Up to 4,000 gallons per minute (gpm) of water would initially be pumped from the mine and treated prior to discharge onto a nearby rancher's private property, where it would irrigate pastureland. Subsequent, long-term volumes of water pumped, treated, and discharged would likely be substantially less than the initial maximum of 4,000 gpm.

3. **Mine Reclamation** – This phase consists of activities intended to reclaim land affected by mine development and operation, and to return that land to an approved post-mining land use (grazing).

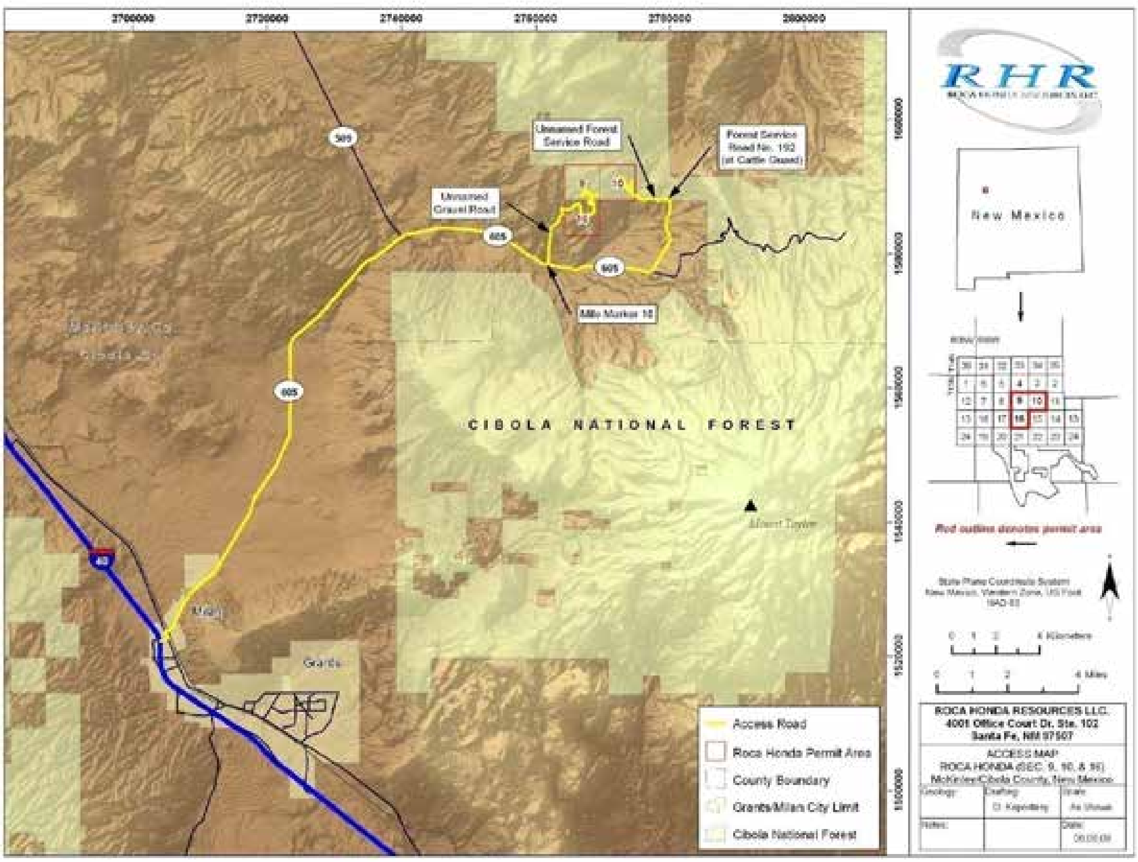


Figure 2. Proposed Roca Honda Mine permit area location map

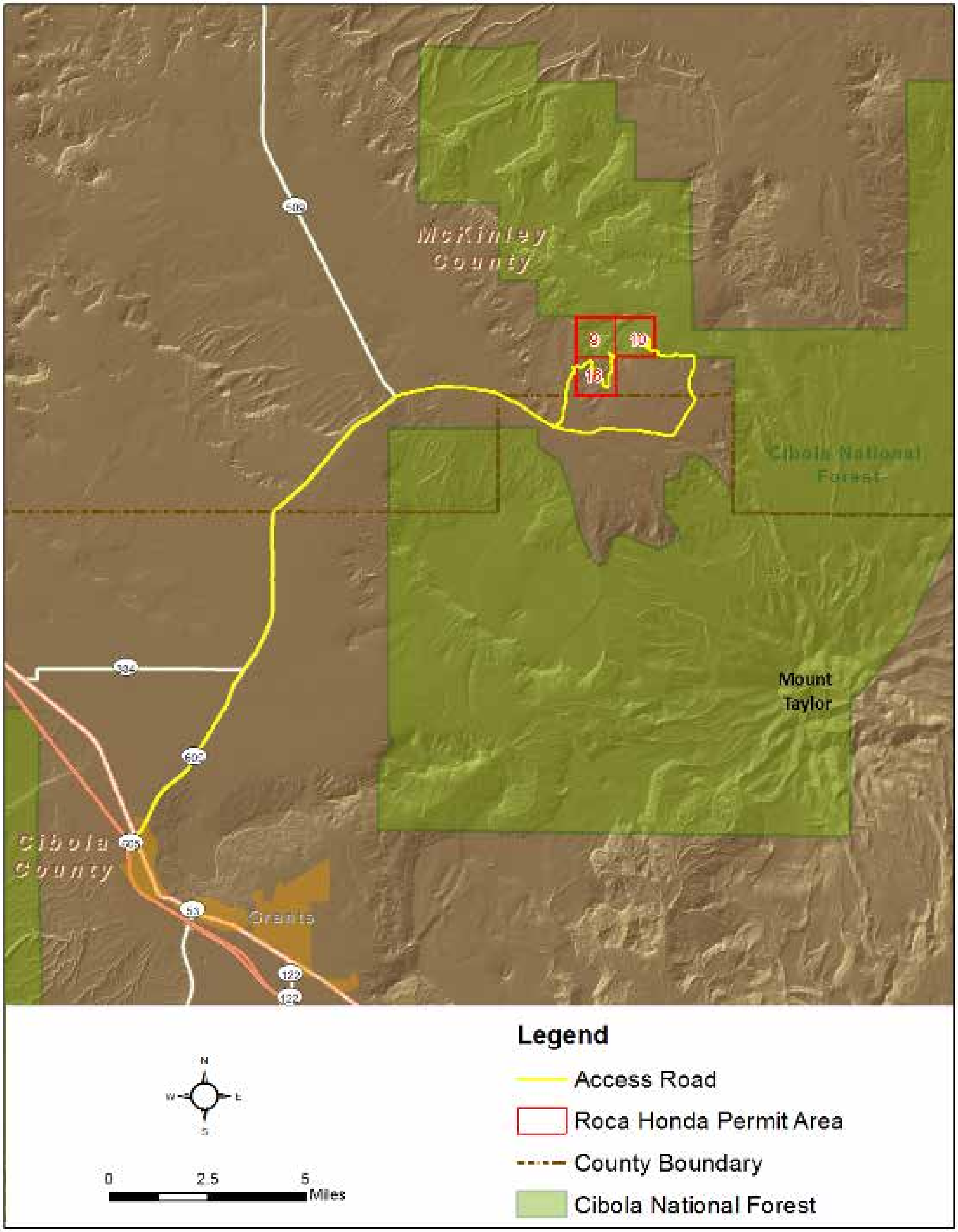


Figure 3. Vicinity map of the proposed Roca Honda Mine permit area

Also included in the proposed action is Forest Service approval of a project-specific forest plan amendment to allow the Roca Honda project to deviate from two specific forest plan standards of management with regard to historic properties. The “Cibola Nationa Forest Land and Resource Management Plan” (USFS, 1985) guides decisions for how the Cibola National Forest and its resources will be managed. Among many other things, the plan lists standards for the treatment of historic properties on lands managed by the Cibola National Forest. These standards only apply to lands and resources managed by the Cibola National Forest such as those in Sections 9 and 10, and not to, for example, Section 16, which is managed by the New Mexico State Land Office. Two of these standards in particular are applicable to the proposed action and its potential for impacts on historic properties:

- Standard No. 4 states that historic properties “will be managed during the conduct of undertakings to achieve a “no effect” finding in consultation with the SHPO and the Advisory Council on Historic Preservation.” (USFS,1985:63)
- Standard No. 5 addresses instances where resource management conflicts occur. It gives a list of conditions under which “preservation of cultural resources in place will be the preferred option.” These conditions include:

  Where the cultural values derive primarily from qualities other than research potential, and where those values are fully realized only when the cultural remains exist undisturbed in their original context(s) (e.g., association with significant historical persons or events, special ethnic or religious values, or unique interpretive values). (USFS, 1985:63)

If the Forest Service selects either of the two action alternatives in this EIS, the Forest Service would approve a project-specific forest plan amendment to allow the Roca Honda Mine to deviate from these two forest plan standards of management with regard to historic properties. This amendment would only apply to the Roca Honda Mine project and only to the standards of management with regard to historic properties. The amendment would allow impacts to historic properties resulting from this project, in accordance with normally applicable law, e.g., Section 106 of the NHPA and 36 CFR Part 800.

Decision Framework

For the Cibola National Forest, the proposed Federal action is to (1) approve RHR’s plan of operations with reasonable mitigations needed to protect other nonmineral surface resources consistent with forest plan, regulations, and other applicable laws, and (2) approve a project-specific forest plan amendment to allow the Roca Honda project to deviate from the 1985 forest plan standards of management with regard to historic properties.

After publishing the final EIS (FEIS), the Cibola NF supervisor will sign and publish the record of decision (ROD). The forest supervisor will then approve a plan of operations. Only the approved plan of operations authorizes mining on the national forest. As noted earlier, the supervisor has the discretion to accept RHR’s plan as is, or require modifications to RHR’s plan of operations as needed to reasonably protect the surface resources and uses of the Cibola National Forest. The plan of operations will incorporate Forest Service mitigation measures identified through the EIS process and selected in the ROD.

Public Involvement

The notice of intent (NOI) was published in the Federal Register on November 24, 2010 (Vol. 75, No. 226, pp. 71668-71669). The NOI asked for public comment on the proposal from November 24, 2010, to January 14, 2011. In addition, as part of the public involvement process, the Agency held open house scoping meetings in Grants, New Mexico, on December 14, 2010, and Gallup, New Mexico, on December 16, 2010.

Notices advertising the scoping meetings were printed in the State's newspaper of record, the Albuquerque Journal, and local newspapers (Cibola Beacon in Grants and Gallup Independent in Gallup) in the preceding weeks. In addition, a project newsletter was distributed to agencies, nongovernmental organizations (NGOs), and interested parties. Also, a 30-second public service announcement (PSA) was aired on local radio stations for the week prior to and the week of the public scoping meetings.

The scoping process itself often involved face-to-face contact and one-on-one participation by stakeholders and members of the interested and affected public. The opportunity for this interaction and exchange came in the form of the two informal, open house style scoping meetings in Grants and Gallup. The Forest Service and the third party contractor then investigated substantive issues raised in scoping, conducted research and analysis, and drafted this EIS. Availability of the draft EIS (DEIS) is announced through public notice, including a notice of availability (NOA) in the Federal Register, letters to interested parties, and notices in the print and broadcast news media.

Tribal Consultation

The United States has a unique legal and political relationship with Native American (or American Indian) tribes as provided in the U.S. Constitution, various treaties, the Federal trust doctrine, and Federal statutes. These relationships extend to the Federal government's historic preservation activities, mandating that Federal consultation with Native American tribes be meaningful, in good faith, and conducted on a government-to-government basis (GSA, 2010).

Mandates for the Federal government's unique policies and relationship with Native American tribal governments are also codified in various Executive Orders and statutes, several of the most relevant of which are cited below:

- **Executive Memorandum Government-to-Government Relationship with Tribal Governments:** President George W. Bush issued this memorandum, recommitting the Federal government to work with Federally recognized Native American tribal governments on a government-to-government basis, and strongly supporting and respecting tribal sovereignty and self-determination.
- **Executive Order 13175 Consultation and Coordination with Indian Tribal Governments:** issued by President Bill Clinton in 2000, recognized tribal rights of self-government and tribal sovereignty, and affirmed and committed the Federal government to work with Native American tribal governments on a government-to-government basis.
- **Native American Graves Protection and Repatriation Act (NAGPRA):** provides a process for museums and Federal agencies to return certain Native American cultural items—human remains, funerary objects, sacred objects, and objects of cultural

patrimony—to lineal descendants, culturally affiliated Native American tribes, and Native Hawaiian organizations.

- **Archeological Resources Protection Act (ARPA):** requires Federal agencies to consult with tribal authorities before permitting archaeological excavations on tribal lands. It also mandates the confidentiality of information concerning the nature and location of archaeological resources, including tribal archaeological resources.
- **American Indian Religious Freedom Act (AIRFA):** passed in 1978, affirms a national policy to protect and preserve Native Americans' inherent right of freedom to believe, express, and exercise the traditional religions of indigenous America, including protecting and preserving access to sacred sites.
- **National Environmental Policy Act (NEPA):** calls for the Federal government to invite the participation of any affected Native American tribe in the environmental review process.
- **National Historic Preservation Act (NHPA):** enhanced Native American tribal roles in historic preservation by creating the Tribal Historic Preservation Officer (THPO) program. Obligates Federal agencies to consult with Native American tribal governments under Section 106 of NHPA (GSA, 2010).
- **Religious Freedom Restoration Act (RFRA):** limits the Federal government's ability to impose a substantial burden on the free exercise of religion. To substantially burden the free exercise of religion, there must be government coercion to act contrary to religious beliefs under the threat of civil or criminal sanction, or a condition on receipt of a government benefit on conduct that would violate religious beliefs.

The USDA has recently completed a review of Forest Service policies and procedures for accommodation and protection of American Indian and Alaska Native sacred sites within the Agency's multiple-use mission. The report of this review contains recommendations of how the USDA and Forest Service might improve the manner in which sacred sites are protected. The report has been provided to the USDA Secretary for his review and consideration.

Federal government agencies must consult with Native American tribes to identify traditional cultural properties (TCPs), sacred sites, or properties of religious or cultural significance. This consultation is government-to-government and, thus, the U.S. Forest Service must consult directly with the tribal governments.

Tribal leaders and Tribal Historic Preservation Officers (THPOs) received letters with similar information provided to the agencies as well as information on the Section 106 consultation process. Representatives from the Pueblo of Acoma, Pueblo of Laguna, and Pueblo of Zuni attended the public scoping meetings in December 2010. The Pueblo of Zuni, Hopi Tribe, and Pueblo of Acoma requested that they be a part of Section 106 consultation. In addition, the New Mexico Environmental Law Center, on behalf of the Multicultural Alliance for a Safe Environment ("MASE") requested that the Forest Service schedule additional meetings within nearby tribal and land grant communities.

In the context of the proposed action, eight tribes were invited to participate as consulting parties in the Section 106 Consultation process under the NHPA. These include the Acoma, Laguna, Jemez, and Sandia Pueblos, as well as the Zuni, Hopi, Navajo, and Jicarilla Apache Tribes. Each of these tribes has an historic association with or spiritual connection to the Mt. Taylor area and/or the mountain itself.

Public Scoping Meetings

The Forest Service, Cibola National Forest and Grasslands, and the Mt. Taylor Ranger District conducted two public scoping meetings using an open house format. The first was held from 6 to 9 p.m. on Tuesday, December 14 in Grants at the Cibola County Convention Center on 515 West High Street; the second was held, also from 6 to 9 p.m., on Thursday, December 16 in Gallup at the McKinley County Courthouse on 207 West Hill Street. Figures 4 and 5 are photos from each open house meeting.

Figure 4. Open house scoping meeting in Grants, December 14, 2010

Figure 5. Open house scoping meeting in Gallup, Dec. 16, 2010

The purpose of the public scoping meetings was to provide the public with information regarding the proposed project, answer questions, identify concerns regarding the potential environmental impacts that may result from construction and operation of the project, and gather information to determine the scope of issues to be addressed in the EIS.

The open house format was used to encourage discussion and information sharing and to ensure that the public had opportunities to speak with representatives of the U.S. Forest Service, Cibola National Forest and Grasslands, Mt. Taylor Ranger District, State of New Mexico, and RHR. Several display stations with exhibits, maps, and other information materials were staffed by representatives of the Forest Service, MMD, New Mexico Environment Department, RHR, and third party consultant the Mangi Environmental Group. Posters and informational materials were provided at the meetings by RHR, along with staff to answer questions.

Comment forms were made available to all scoping meeting attendees to fill out then and there, to take home, fill out and send in, or to distribute to friends and other interested parties. Attendees were invited to write comments and questions directly on "Parallel Processes – NEPA/EIS and New Mexico Permit Reviews" posters taped to the walls and to a Cause-and-Effect-Questions diagram that depicted possible cause and effect linkages between actions and effects for the proposed mine.

Public Scoping Comments

A total of 272 comments were received during the scoping comment period, from 25 distinct commenters. Most commenters submitted multiple comments covering more than one topic. Public comments were submitted using letters and emails as well as comment forms distributed at the public scoping meetings. Responses included those made by private citizens, elected and tribal officials, government agencies, and entities and representatives of nongovernmental organizations.

In addition to the individual commenters, 480 form letters were submitted under one cover page in which all of the substantive comments were identical. These identical letters, each signed by a different stakeholder, addressed the range of potential environmental consequences caused by the proposed project, as well as questioning the purpose and need for the proposed project. As such, the form letter was counted as one commenter, though it included nine comments regarding various resources.

Following is a summary of issues identified through the scoping process which will be addressed in the EIS (table 1).

Table 1. Summary of scoping comments received on the proposed Roca Honda Mine EIS

Resource Area	No. of Commenters	No. of Comments	Summary of Issues
Water	19	45	Concern about project effects on water discharge and quality, groundwater, and water supply. Request that springs, seeps, and hydrological connections in the area be identified in EIS.
Vegetation	16	29	Concern about a comprehensive reclamation plan able to return the area to pre-mining conditions, the

Resource Area	No. of Commenters	No. of Comments	Summary of Issues
			introduction of noxious weeds, and off-highway vehicle (OHV) uses damaging vegetation.
Wildlife	17	25	Request for the project to examine what effect the proposed mine may have on wildlife habitats and ecosystems.
Threatened and Endangered Species	2	4	Requests that project comply with Endangered Species Act and the Bald and Golden Eagle Protection Act; and address State threatened and endangered species.
Land Use	10	14	Concern that the area is roadless and the project would necessitate change in use, as well as the impact to geological formations.
Recreation	3	3	Request to protect habitat for recreational uses. Concern that project may promote irresponsible OHV use.
Environmental Justice	11	21	Historical impacts from uranium mining on Native Americans need to be considered.
Socioeconomics	15	24	There was a request for the project to examine what effect the proposed mine may have on range livestock, timber harvest, and other economic factors. Several commenters noted that the project would provide employment and economic benefits to community, while others noted that there may also be negative impacts caused by the proposed mining project.
Cultural and Historic	12	26	Potential impact to Mt. Taylor as a traditional cultural property and sacred site, and the cultural and natural resources within it. Potential impacts to archaeological sites. Preference to protect the area as a cultural resource under the National Register of Historic Places. Request that the EIS identify specific cultural attributes of the site and project effects to the area as a cultural site.
Transportation	8	8	Safety concerns of transporting uranium offsite and environmental effects of constructing project roads.
Human Health and Safety	13	20	Some commenters noted that uranium mining was a health and safety risk. There were concerns about cumulative effects from historical uranium mining.
Cumulative Impacts	14	27	Request for an examination of all past, present, and future uranium mining projects on all environmental resources.
Proposed Action	9	12	Many commenters support the no action alternative for the proposed mine.
Regulatory Compliance	14	14	Requests that project comply with regulations and permitting requirements.
Total	25*	272	

*This figure is not a sum of the previous figures in the same column; the total of number of commenters was 25, but most submitted many comments, hence the greater number of comments than commenters.

Future Opportunities for Public Involvement

The DEIS will be made available to the public for a 60-day comment period, during which time public meetings will be held in Grants and Gallup to accept comments on the adequacy of the DEIS in correctly identifying potential impacts of the proposed uranium mine. The Forest Service will respond to all written comments received during the DEIS comment period. The "Response to Comments" will be included in the FEIS.

Issues

Using the comments from the public, other agencies, and tribes, and internal scoping, the interdisciplinary team developed a list of issues to address.

The Forest Service separated the issues into two groups: significant and nonsignificant issues. Significant issues were defined as those directly or indirectly caused by implementing the proposed action. Nonsignificant issues were identified as those: (1) outside the scope of the proposed action; (2) already decided by law, regulation, forest plan, or other higher level decision; (3) irrelevant to the decision to be made; or (4) conjectural and not supported by scientific or factual evidence. The Council on Environmental Quality (CEQ) NEPA regulations explain this delineation in Sec. 1501.7, "…identify and eliminate from detailed study the issues which are not significant or which have been covered by prior environmental review (Sec. 1506.3)…" As for significant issues, the Forest Service identified the following issues during scoping.

Geology and Soils

Proper management of soils is essential both in preventing and reducing erosion during the operation of the proposed mine, as well as in the ultimate success of reclamation measures once the mine ceases operation. While no comments from agencies, tribes, or the public directly addressed geology and soils, reclamation was mentioned indirectly and during internal scoping, Forest Service staff decided to cover this topic.

The main indicators used to measure and compare impacts to soils between the alternatives are the size of the area or footprint of ground disturbance associated with each alternative, erosion (e.g., gullying) and sedimentation during and after the project, and the ability of soils to support planned future vegetative restoration and land uses.

Water Resources

Forty-five comments were received regarding water resources, mainly focused on the proposed project's effects to water quality, groundwater resources, and water supply. Several comments were made relative to the effects of exploration and road use on watershed and downstream land areas. In addition, some comments were made regarding the contamination of water resources, and how treated and discharged waters would impact surface waters, springs, seeps, and aquifers. Concern was also expressed regarding the scarcity of water in the watershed and that the water supply could, thus, be impacted by mine dewatering. It was requested that springs and hydrological connections in the area be identified in the EIS, and that all draft studies—such as the groundwater modeling study—be disclosed early and fully for review prior to publication of the draft and final EIS.

The main indicators used to measure and compare impacts to surface and groundwater between the alternatives are water quality parameters, changes to flows at springs and wells, and any changes to surface flows.

Vegetation

Twenty-nine comments were received regarding potential impacts to plant species used by Native people for cultural, ceremonial, and medicinal purposes. Three Native American tribal governments recommended that the project be altered so as to not affect these plant species; or that the no action alternative be implemented to avoid disturbance altogether. It was suggested RHR reconsider grazing as the post-mining land use; that the project area should instead be returned to conditions suitable for carrying out traditional cultural activities, such as plant gathering. Some commenters expressed concern about a comprehensive reclamation plan for the project, citing impacts of past mining activities which lacked adequate restoration.

Comments also included concerns that increased vehicle use—due to mining activities—would aid in the potential spread of noxious weeds. It was suggested that mining operations include inspections and equipment cleaning in order to avoid the introduction of noxious weeds into new areas. Disturbed soils and gravel piles were also noted as potential sites for weed colonization and it was suggested that the piles be stabilized to prevent the spread of noxious weeds. It was also recommended that trained weed control work crews inspect roadways and adjacent land to help eliminate noxious weeds.

Additional concerns expressed that improving roads in the area would encourage unauthorized off-highway vehicle (OHV) use which may result in the degradation of ecosystems. It was, thus, recommended that the Forest Service manage, monitor, and enforce control of OHV use.

The main indicators used to measure and compare impacts to vegetation between the alternatives are the size of the area or footprint of disturbance and vegetation clearing associated with each alternative and the ability to restore desired vegetation during and after reclamation.

Wildlife

Twenty-five comments were received regarding wildlife, mostly expressing concern of the potential impacts to wildlife and wildlife habitats for common species in the area during mining operations. Some commenters suggested that the proposed project avoid potential impacts to State or federally protected species and habitats.

The main indicators used to measure and compare impacts to wildlife between the alternatives are the size of the area of habitat disturbance and fragmentation associated with each alternative and wildlife abundance and diversity during and after the proposed project.

Threatened and Endangered Species

Four comments were received regarding threatened and endangered species. The commenters suggested that the EIS process should include consultation with the U.S. Fish and Wildlife Service to ensure that the project be in compliance with the Endangered Species Act and with the current policies for the implementation of the Bald and Golden Eagle Protection Act. It was suggested that the proposed project avoid impacts to the State endangered wrinkled marshsnail

(*Stagnicola caperata*) and the State threatened spotted bat (*Euderma macalatum*), since the project area is considered suitable habitat for both.

The main indicators used to measure and compare impacts to threatened and endangered species between the alternatives are the area of habitat disturbance and fragmentation, likely presence/absence of the species in question, and the likelihood of particular actions and activities that might pose a threat.

Land Use

Fourteen comments were received addressing land use, recommending greater protection for roadless areas. It was stated that the Forest Service has authority to enforce the 2005 Roadless Rule when considering impacts caused by transportation activities from the proposed mining project. Concerns were expressed about opening access to the area by off-road vehicles, as well as loss of existing land uses such as grazing and hunting for the duration of the project. The need to comply with the “Cibola National Forest Land and Resource Management Plan” (LRMP) was also emphasized.

The main indicators used to measure and compare impacts to land use between the alternatives are any qualitative or quantitative changes to land uses on the mine permit area iteself (Sections 9, 10, and 16) as well as on surrounding areas.

Recreation

Three comments were received with regard to recreation activities and their effect on the habitat, suggesting that the proposed mining operations would allow easier accessibility to the area for OHVs, which could be problematic for soils, vegetation, and wildlife.

The main indicators used to measure and compare impacts to recreation between the alternatives are any qualitative or quantitative changes to recreation, in particular OHV use, on nearby lands.

Environmental Justice

Twenty-one comments were received regarding environmental justice (EJ), expressing that legacy uranium mining impacts need to be considered for local Native American communities, including downstream and downwind communities. Substantive comments from the Hopi Tribe, the Pueblo of Zuni, and the Pueblo of Acoma regarded recognition of their local and cultural issues and Mt. Taylor as a traditional cultural property.

It was recommended that an extensive number of alternatives, including the no action alternative, should address potentially disproportionate impacts to historically low income and minority communities, historic and cumulative environmental impacts from previous uranium mining, and the irreparable impacts to traditional cultures.

The main indicators used to measure and compare impacts to environmental justice between the alternatives are whether concentrations of minority and/or low-income populations occur within the area, and whether the health and/or economic circumstances of these populations would be disproportionately impacted.

Socioeconomics

Twenty-four comments were received regarding socioeconomics, requesting that the EIS examine the potential direct, indirect, and cumulative, social and economic impacts from the proposed project. The Roca Honda Mine would represent a tangible increase in economic activity for a depressed region, with both direct and indirect effects on jobs, income, and tax revenues. Several comments observed the costs and benefits of the proposed project, whereby the benefits may fall short when compared to the environmental costs; others noted the much needed employment and economic benefits to the local communities, the county, and the State of New Mexico. However, it was pointed out that the social impacts of bust-and-boom economic cycles associated with mining towns should be evaluated. It was also pointed out that mine reclamation would also create jobs, as would investment in renewable, clean energy in solar, wind, and hydrothermal technologies.

Bonding and financial assurance was requested to ensure that reclamation be completed in the event of site abandonment (as has been seen in the past) and also for emergencies such as flood events that are common in this locale.

The main indicators used to measure and compare impacts related to socioeconomics between the alternatives are predicted changes to employment, income, and tax revenues in Cibola and McKinley Counties.

Cultural and Historic Resources

Twenty-six comments were received expressing opposition to the proposed mining operations because of specific cultural, historic, and archaeological resources. Commenters expressed concern that the proposed project would impact lands considered historically significant (within Mt. Taylor Traditional Cultural Property designation) and eligible for the National Register of Historic Places, and that mining activities would interfere with ongoing cultural activities conducted on Mt. Taylor. Commenters also requested the protection of cultural resources in the area, and that the EIS identify specific cultural attributes of the site and potential effects to the area. One tribe requested notification if cultural resources (including human remains) are recovered during construction.

More specifically, the Hopi Tribe claimed cultural affiliation to the Paleoindian, Archaic, and Anasazi prehistoric cultural groups on the Mt. Taylor Ranger District; archaeological sites of their ancestors are considered “footprints” and traditional cultural properties. The Hopi Tribe requested that the identification of cultural resources include a traditional cultural properties study of the project area that may identify contributing cultural elements of the Mt. Taylor Traditional Cultural Property.

Laguna Pueblo’s scoping comments also assert cultural affiliation to the prehistoric cultural groups that occupied the area. Their letter states that the opening of the mine will affect the Mt. Taylor TCP and will adversely affect National Register prehistoric sites within the TCP.

The Pueblo of Zuni similarly expressed concern for potential archaeological sites located within the proposed underground uranium mining area, since Mt. Taylor—“like any other living being”—can be harmed, injured, and hurt when cut, gouged, or otherwise mistreated. As such, it was requested that Mt. Taylor be protected. From a Zuni perspective, all shrines, plants, animals, and minerals are of religious significance.

The Pueblo of Acoma also expressed concern regarding cultural preservation and restoration concerns, the proposed development having the potential to erase or destroy pieces of their history for future generations, since paths of migration and settlement are contained within the landscape and not in books.

The main indicators used to measure and compare impacts to cultural and historic resources between the alternatives are the number of affected historic properties, in particular those eligible for the National Register of Historic Places, ethnographic resources as identified by affected tribes, and overall effects, including visual, on the Mt. Taylor Traditional Cultural Property (TCP).

Transportation

Eight comments were received regarding transportation, specifically as it relates to the safety of transporting uranium ore and other hazardous materials offsite and through communities. Commenters requested a thorough risk analysis of radiation exposure and contamination of resources resulting from the transport of hazardous materials. Development of new roads for the project was noted as having a significant impact on the environment.

The main indicators used to measure and compare impacts related to transportation between the alternatives are predicted conditions of roads and projected traffic levels and predicted exposure of the public to radioactivity during the hauling of uranium ore from mine to mill.

Human Health and Safety

Twenty comments were received expressing concerns over human health and safety. Commenters expressed concern for the detrimental effects to public health and to the communities downstream and downwind of the proposed mine from contaminated groundwater. Some comments focused on health and safety issues suffered by community residents and miners from historical mining activities. It was recommended that a hazardous materials plan be developed to address the release of hazardous materials—such as fuel, solvents, radon gas, and uranium dust—or other toxic materials which may leach into intermittent streams or drainages.

It was further recommended that the large numbers of Radiation Environmental Compensation Act recipients be included in the EIS.

The main indicators used to measure whether impacts to human health and safety can be remedied by implementing the alternative action or mitigation measures are predicted changes to traffic safety, predicted noise levels, levels of real and perceived exposure to environmental contaminants, and predicted impacts stemming from employment and in-migrating workers.

Air Quality

Both during construction and operation of the proposed mine, there is some potential for localized air pollution. During the construction phase, fugitive dust emissions could occur from access road construction, ground disturbance, piles of excavated earth, and movement of workers' vehicles and heavy equipment along unpaved roads as well as off-road. Also during construction, tailpipe emissions of certain criteria air pollutants (e.g., nitrogen dioxide, carbon monoxide, particulates) would occur from both heavy construction equipment and workers' vehicles. During the mine's operation, there could be fugitive dust emissions from stockpiles of soil, ore, and nonore. Some of these dust particles could contain somewhat elevated concentrations of uranium and other heavy metals and radioactive elements, i.e., naturally occurring substances that emit ionizing radiation or particles. In addition, radioactive radon gas may be vented and dispersed from the mine ventilation shafts as part of the mine's ventilation and safety apparatus. The ventilation system aims to maintain fresh air and low radon levels and, thus, safe working conditions in the air space within the active mine itself, minimizing worker exposure to this radioactive gas.

The main indicators used to measure and compare impacts to air quality between the alternatives are predicted emissions of criteria pollutants during construction and operation and the National Ambient Air Quality Standards.

Visual Resources

Protecting its visual resources is a priority of the Cibola National Forest. The proposed action would place a number of large, conspicuous facilities on national forest land and would, therefore, impact visual resources.

The main indicator used to measure and compare impacts to visual resources is the U.S. Forest Service's Scenery Management System and its scenic attractiveness classes.

Tribal Scoping Issues

As described earlier, the Forest Service retains a unique trust relationship with American Indian tribes who have concerns about the proposed RHR uranium mine. During the scoping period, four tribes submitted letters to the Forest Service in response to the notice of intent. These four tribes include the Pueblos of Acoma, Laguna, and Zuni, and the Hopi Tribe. Concerns about the proposed project and related issues as expressed in these letters included many topics, as described here. The letters reiterated the Forest Service's Federal trust responsibilities regarding land, water, and cultural resources of the tribes, and the importance of meaningful consultation with tribes during the preparation of the EIS.

The tribes expressed concerns about the potential impact of the project on aquifers from proposed dewatering activities, specifically about changes to groundwater flows, changes to connectivity between aquifers, impacts to the watershed, and associated impacts to other natural resources such as plants and animals. They are also concerned about impacts to water quality, specifically mentioning potential regional groundwater contamination, contamination of local shallow alluvial aquifers, contamination of land and resources from the discharge of treated mine water, and contamination of aquifers from backfilling shafts and caverns with contaminated waste materials.

The tribes expressed considerable concern about the potential impacts to Mt. Taylor, which is an important cultural place to many southwestern tribes. The concerns expressed included effects to the physical integrity of Mt. Taylor as a traditional cultural property, as a sacred site, and as a living sacred entity. Other related concerns included potential impacts to shrines, archaeological resources that are evidence of tribal history, other resources imbued with traditional cultural importance such as water, plants, animals, herbs, minerals, pigments, and feathers, and effects to their spiritual connection to the mountain and their ability to conduct traditional ceremonies, rituals, and other practices that continue to be followed.

The tribes are also concerned about the potential effects to human health from exposure to radiation and hazardous materials, both for workers and the public. These potential impacts are seen to arise from stockpiling of overburden and ore at the mine facility, and from transportation of ore through populated areas, including across tribal lands.

Scoping comments provided by the tribes repeatedly emphasized the importance of considering legacy impacts from previous mines and mills in the region when determining the cumulative impacts of the proposed project on groundwater flows, water quality, air quality, soil contamination, human health, and cultural resources and practices, specifically relating to Mt. Taylor as a traditional cultural property and sacred site. The tribes expressed concern that these cumulative impacts be included in the discussions of environmental justice to disclose the long-term legacy impacts on tribal communities that seem evident to them from legacy mining and milling in the region.

Other Related Efforts

In an effort to reduce duplication and redundancy, several New Mexico governmental agencies that have jurisdiction over State resources potentially affected by the proposed uranium mine are collaborating closely with the Forest Service in the analysis of its potential impacts. Concurrently, the New Mexico Mining and Minerals Division (MMD) of the New Mexico Energy, Minerals and Natural Resources Department is conducting an environmental evaluation (EE) of the permit application package (PAP) it has received from RHR. The New Mexico Environmental Department (NMED) is reviewing an application for a discharge permit (DP). The State Engineers Office is deciding whether or not the proposed Roca Honda Mine would need a water right to account for use of produced water. The New Mexico State Land Office (SLO) is reviewing the proposed action because of its partial location on State lands.

The institutions and agencies involved with the proposed action in some manner—either with this EIS or with other Federal and state permitting or review processes—are described briefly below.

Applicant

Roca Honda Resources, LLC, the applicant for the proposed Roca Honda Uranium Mine project, is a joint venture between Strathmore Resources (U.S.), Ltd. (60 percent) and Sumitomo Corporation (40 percent). Strathmore is a Canadian-based resource company specializing in the strategic acquisition, exploration, and development of advanced uranium properties in the United States. Headquartered in Vancouver, British Columbia, Canada, with a branch administrative office in Kelowna, B.C., the company also has a U.S.-based Development Office in Riverton, Wyoming and a Government, Regulatory & Environmental Affairs Office in Santa Fe, New Mexico. Sumitomo is one of Japan's largest integrated trading and investment business enterprises (SCOA, no date).

U.S. Forest Service

Established in 1905, the Forest Service is an agency within the U.S. Department of Agriculture (USDA). Nationally, the Forest Service manages some 193 million acres of public lands in national forests and grasslands, an area equivalent in size to the

State of Texas. The Forest Service mission is to sustain the health, diversity, and productivity of the Nation’s forests and grasslands to meet the needs of present and future generations (USFS, 2010a).

The Cibola National Forest and National Grasslands are located in New Mexico, Texas, and Oklahoma (figure 6). They are part of the Southwestern Region of the Forest Service, headquartered in Albuquerque, NM. The Southwestern Region contains 22.3 million acres of national forests and grasslands on 11 national forests and 3 national grasslands in Arizona, New Mexico, Texas, and Oklahoma. This is a highly diverse region geographically, ranging from Arizona’s lower Sonoran Desert with an elevation of 1,600 feet above sea level and an annual rainfall of just 8 inches to New Mexico’s 13,171-foot Wheeler Peak (highest point in the State) and over 35 inches of precipitation a year in northern New Mexico (USFS, Southwestern Region, no date).

Cibola National Forest (NF) includes more than 1.6 million acres in New Mexico, while the Cibola National Grasslands cover 263,954 acres in northeastern New Mexico, western Oklahoma, and northern Texas. Elevations on the Cibola NF range from 5,000 feet to over 11,300 feet and the forest includes four congressionally designated wilderness areas—Sandia Mountain, Manzano Mountain, Withington, and Apache Kid (Cibola NF, no date).

As indicated above, the proposed action is located on the Mt. Taylor District of the Cibola NF. This district includes two principal mountain ranges, Mt. Taylor (figures 7 and 8) and the Zuni Mountains, comprising nearly 520,000 acres of national forest land. Elevations range from 6,500 to 11,301 feet msl. As will be discussed in depth in chapter 3 of the EIS, Mt. Taylor is an area of special religious and cultural significance to several Native American communities in the vicinity. Mt. Taylor and the Zuni Mountains also contain historic resources including many historic sawmills and logging communities.

With regard to the proposed Roca Honda Mine, the Cibola National Forest supervisor will use the EIS process to develop the necessary information to make an informed decision on whether or not to approve the proposed plan as submitted, or to decide what additional mitigations are needed to protect other resources, as provided for in 36 CFR 228.8. Furthermore, the forest supervisor will use the EIS findings to decide whether to approve a project-specific forest plan amendment that would allow the Roca Honda Mine to deviate from two 1985 forest plan standards of management with regard to historic properties.

The Forest Service has the discretion to accept or require modifications to RHR’s plan of operations as needed to reasonably protect the surface resources and uses of the Cibola National Forest. As part of this approval process, the forest supervisor must comply with the National Environmental Policy Act (NEPA) of 1969, the National Forest Management Act of 1976, the Forest Land Policy and Management Act of 1976, the U.S. Mining Law of 1872 as amended, the National Historic Preservation Act of 1966 as amended, and other applicable statutes, regulations, Executive Orders, and the Forest Service Manual and Handbook direction before any action by RHR can proceed. Collectively, these requirements are known as the applicable legal requirements.

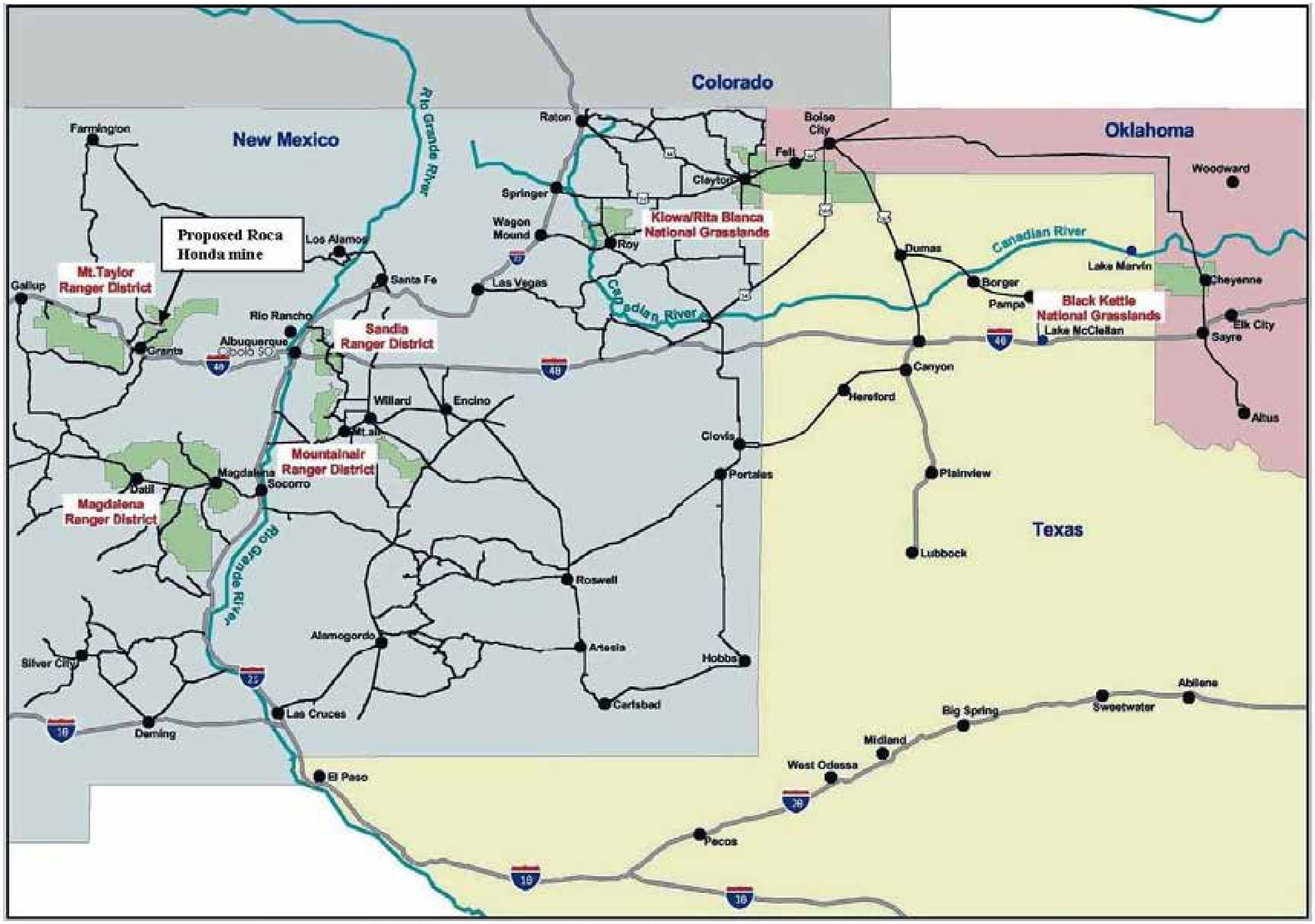


Figure 6. Cibola National Forest and Grasslands vicinity map

Figure 7. Mt. Taylor from Acoma Pueblo 20 miles to the south

Figure 8. Looking southeast from the project site toward Mt. Taylor

U.S. Environmental Protection Agency

The mission of the U.S. Environmental Protection Agency (EPA) is to protect human health and the environment. To accomplish this mission, the EPA develops and enforces regulations, provides grants, studies environmental issues, sponsors partnerships, teaches people about the environment, and publishes information (USEPA, 2010a).

Among the multiple responsibilities of EPA is the protection of the Nation's waters and wetlands under the Clean Water Act (CWA). In addition, with regard to NEPA, EPA reviews and comments on EISs prepared by other Federal agencies, maintains a national filing system for all EISs, and assures that its own actions comply with NEPA (USEPA, 2010b).

The proposed action is located with Region 6 of EPA, located in Dallas, Texas. Region 6 will be responsible for all of EPA's involvement and regulatory action on the proposed mine. Region 6 has also indicated that EPA will serve as a cooperating agency for the EIS.

U.S. Fish and Wildlife Service

The U.S. Fish and Wildlife Service (USFWS) is the primary Federal agency responsible for conserving, protecting, and enhancing America's fish and wildlife resources and their habitats. The mission of the USFWS is "working with others to conserve, protect, and enhance fish, wildlife, and plants and their habitats for the continuing benefit of the American people."

While the USFWS shares responsibilities for wildlife conservation with other Federal, state, tribal, and local entities, the USFWS has specific and primary responsibilities for endangered species, migratory birds, interjurisdictional fish, and certain marine mammals, as well as for lands and waters administered by the agency for the management and protection of these resources (e.g., National Wildlife Refuges). It also operates national fish hatcheries, fishery resource offices, and ecological services field stations. The USFWS enforces Federal wildlife laws; administers the Endangered Species Act; manages migratory bird populations; restores nationally significant fisheries; conserves and restores wildlife habitat, such as wetlands; and helps foreign governments with their conservation efforts (USFWS, 2009).

With regard to the proposed action, the Ecological Services Office of USFWS Region 2, based in Albuquerque, will primarily be involved in the evaluation of potential impacts to Federally threatened and endangered species through Section 7 of the Endangered Species Act of 1973. Under Section 7, the Forest Service may engage in formal or informal consultation with the USFWS and is responsible for preparation of a biological assessment (BA) evaluating potential effects of the proposed mine on federally listed species. The USFWS reviews the determinations as to effect reached in the BA and issues a biological opinion with its own determinations. Biological opinions may also include measures to avoid, reduce, or mitigate adverse effects.

New Mexico Environment Department

The New Mexico Environment Department (NMED) was established in 1991 under the provisions set forth in the Department of the Environment Act by the 40th New Mexico Legislature (NMED, 2011). NMED's mission is to provide the highest quality of life throughout the State by promoting a safe, clean and productive environment. The agency is committed to promoting environmental awareness through open and direct communication and sound decisionmaking by carrying out departmental mandates and initiatives in a fair and consistent manner.

One of the Water Quality Program’s goals is to protect the quality of New Mexico’s ground and surface water through the issuance of permits and monitoring water quality. One of the objectives under this goal is to “increase the number of permitted facilities in compliance with groundwater discharge permit requirements.” Strategies under this objective include:

- Ensure requirements of groundwater discharge permits are met by conducting inspections of permitted facilities.
- Document groundwater inspection and compliance reviews in database.
- Review and evaluate monitoring results submitted by permitted groundwater facilities to determine facilities are in compliance with their permits.

NMED conducts all of the permitting, spill response, abatement, and public participation activities for mining facilities in New Mexico, in accordance with the Water Quality Act NMSA 1978, 74-6-1 to 17 and the Water Quality Control Commission (WQCC) Regulations outlined in Title 20, Chapter 6, Part 2 of the New Mexico Administrative Code. In addition, the NMED participates in implementation of the New Mexico Mining Act and Non Coal Mining Regulations by reviewing and commenting on mine permits and closeout plans, coordinating environmental protection requirements at mine sites with MMD, and providing determinations that environmental standards will be met during operation and after closure of mining operations.

In order to begin operations and discharge of treated groundwater, the proposed uranium mine must be issued a discharge permit (DP) by NMED. Figure 9 shows the process NMED follows from the time it receives a permit application to issuing a DP. RHR has submitted a permit application to NMED for a DP.

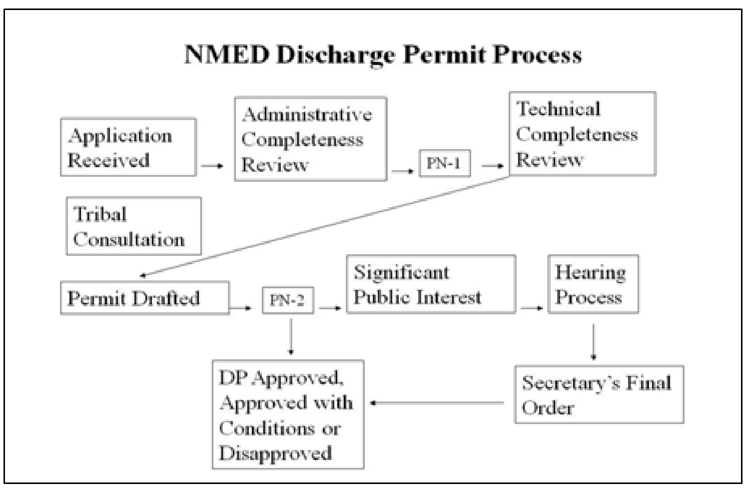


Figure 9. New Mexico Environment Department discharge permit process

New Mexico Mining and Minerals Division

The Mining and Minerals Division (MMD) is in the New Mexico Energy, Minerals and Natural Resources Department (EMNRD), which was created in 1987 through a merger between the Natural Resources Department and the Energy and Minerals Department. However, the various administrative components (divisions) of the department have been around well before 1987. The mission of the department is to "position New Mexico as a national leader in the energy and natural resources areas for which the department is responsible." Its vision is: "a New Mexico where individuals, agencies, and organizations work collaboratively on energy and natural resource management to ensure a sustainable environmental and economic future" (EMNRD, no date).

EMNRD includes divisions on Energy Conservation Management, Forestry, State Parks, MMD, Oil Conservation, and the Youth Conservation Corps. The New Mexico Department of Game and Fish is also administratively attached to EMNRD, but receives no direct budget support from it.

MMD's mission is to promote the public trust by ensuring the responsible utilization, conservation, reclamation, and safeguarding of land and resources affected by mining. MMD pursues this mission via four major programs. The Abandoned Mine Land Program works with grants from the Federal government to identify, safeguard, and reclaim (pre-1977) abandoned mines that present a public safety hazard or environmental detriment. The Coal Mine Reclamation Program regulates, inspects, and enforces on all coal mines not on Indian reservations. Mining Act Reclamation Program regulates, inspects, and enforces on all hard rock or mineral mines. The Mine Registration Program registers all mines, collects production and employment data on active mining operations, distributes statistical information on New Mexico's mining industry, and acts as the division's public information office (MMD, no date).

MMD administers New Mexico Administrative Code Title 19, Chapter 10, which recognizes the requirements of the New Mexico Mining Act. The purposes of this act (NMSA 1978 69-36-1 to 20) include promoting responsible utilization and reclamation of land affected by minerals exploration, mining, or the extraction of minerals that are vital to the welfare of the State.

RHR has submitted a permit application package (PAP) to MMD. The PAP consists of a Sampling and Analysis Plan (SAP), a Baseline Data Report (BDR), and a Mining Operations and Reclamation Plan (MORP). When these are deemed administratively and technically complete, MMD, with the assistance of the third party EIS contractor, conducts an environmental evaluation (EE). MMD then notifies the public that a draft EE has been prepared, and a public hearing is held if requested. The public may submit comments, which must be addressed by MMD. If necessary, the EE and PAP are modified, and a new mine permit approved or denied.

Per a 2010 memorandum of understanding (MOU) with the Forest Service, MMD will accept the final EIS to meet the requirements of the EE.

New Mexico State Land Office

The State Land Office (SLO) grew out of the Ferguson Act of 1898 of the Territorial Laws and Treaties of New Mexico. The Ferguson Act and subsequent Enabling Act of 1910 granted certain lands held by the Federal government to the Territory of New Mexico. The terms of these land grants stipulated that these 13.4 million acres were to be held in trust for the benefit of public schools and other specified institutional beneficiaries. In addition to public schools, beneficiaries include the University of New Mexico, New Mexico State University, New Mexico Institute of Mining and Technology, New Mexico Military Institute, New Mexico School for the Blind and Visually Impaired, New Mexico School for the Deaf, Rio Grande Improvements, and others.

The Land Commissioner's mandate is to generate and maximize revenue from State trust lands in order to support the aforementioned public education and other beneficiary institutions, while at the same time protecting, conserving, and maintaining the lands for future generations. The Land Commissioner generates revenues for these designated public beneficiaries by leasing lands for grazing, agriculture, commercial use, oil and gas drilling, mining, and other surface and subsurface activities (SLO, no date).

The SLO's Minerals Program comprises activities and programs related to subsurface natural resources on State lands—oil, natural gas and minerals. The group has two divisions: the Oil, Gas, and Minerals Division and the Royalty Management Division. The former manages and evaluates nonrenewable resources, issues all mineral leases, administers the monthly oil and gas lease sales, processes and audits mineral royalty revenues, and administers leases for oil, natural gas, carbon dioxide, sand and gravel, caliche, coal, potash, salt, geothermal energy, and other minerals. The Royalty Management Division collects, processes, and audits oil and gas royalty revenues.

RHR's proposed facilities and operations on Section 16 are on State trust lands and, as such, would be subject to regulation and royalty management by the SLO.

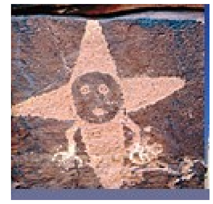
New Mexico Office of the State Engineer

The Office of the State Engineer (OSE) is responsible for administering the State's water resources. The State Engineer has power over the supervision, measurement, appropriation, and distribution of all surface and groundwater in New Mexico, including streams and rivers that cross State boundaries. The State Engineer is also Secretary of the Interstate Stream Commission, which is charged with separate duties, including protecting New Mexico's right to water under eight interstate stream basins, ensuring the State complies with each of those basins, as well as water planning in New Mexico (OSE, 2005).

All water users in New Mexico must have a permit from the State Engineer. When evaluating an application for a new appropriation or to change the place and/or purpose of use of an existing water right, the State Engineer must determine (1) that water is available, (2) that the appropriation will not impair existing rights, (3) that the intended use meets State water conservation efforts, and (4) that the intended use is not detrimental to the public welfare. State water law also requires that the applicant publish the application in a newspaper and provide anyone with a legitimate objection the chance to protest the application (OSE, 2005).

RHR has applied to the OSE for a mine dewatering permit. The Pueblo of Acoma is a formal protestant in this process. OSE's review of the application is ongoing.

New Mexico Historic Preservation Division



The National Historic Preservation Act (NHPA) of 1966 established the position of State Historic Preservation Officer (SHPO) for each of the 50 states. NHPA also listed preservation-related tasks to be carried out by the SHPO, who is appointed by the governor, and his or her staff. The New Mexico Cultural Properties Act designates the director of the State's Historic Preservation Division (HPD) within the Department of Cultural Affairs as New Mexico's SHPO and lists a number of other preservation duties for the SHPO and staff. The division staff includes professional historians, archaeologists, architects and architectural historians, as well as administrative and financial support staff (HPD, 2003).

The SHPO's efforts and activities are overseen at the Federal level by the National Park Service (NPS), through which HPD receives funding from the National Historic Preservation Fund. At the State level, a number of HPD's activities are reviewed by the governor appointed, 7-member Cultural Properties Review Committee (CPRC), a board of preservation professionals from all parts of New Mexico. With staff support from HPD, the CPRC grants permits for archaeological surveys and excavations on State lands (such as those undertaken on Section 16 at the Roca Honda Mine site), places properties on the State Register of Cultural Properties, and makes recommendations for nomination to the National Register of Historic Places (NRHP). CPRC also reviews and approves State income tax credits for rehabilitation and stabilization of registered properties (HPD, 2003).

HPD is responsible for ensuring that projects carried out, sponsored, or approved by Federal agencies such as the Forest Service comply with Federal and State historic preservation laws. All Federal agencies are required to initiate consultation with the SHPO as part of the Section 106 review process as established in the NHPA. HPD reviews and comments on thousands of projects annually. The SHPO is heavily involved in the Section 106 consultation process for the proposed Roca Honda Mine.

Figure 10 depicts the Section 106 process. On Federal projects requiring substantial environmental review, such as the proposed Roca Honda Mine, the EIS process and the Section 106 process are conducted concurrently and interact extensively (figure 11).

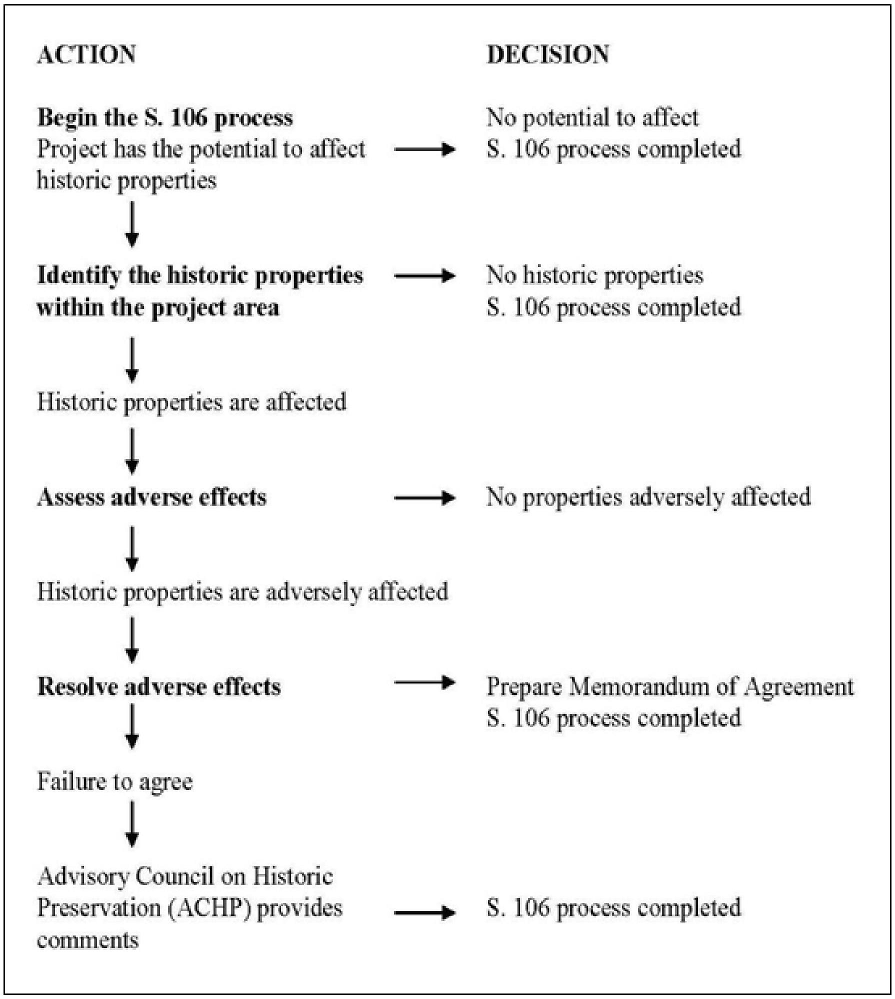


Figure 10. Flow chart of Section 106 review process

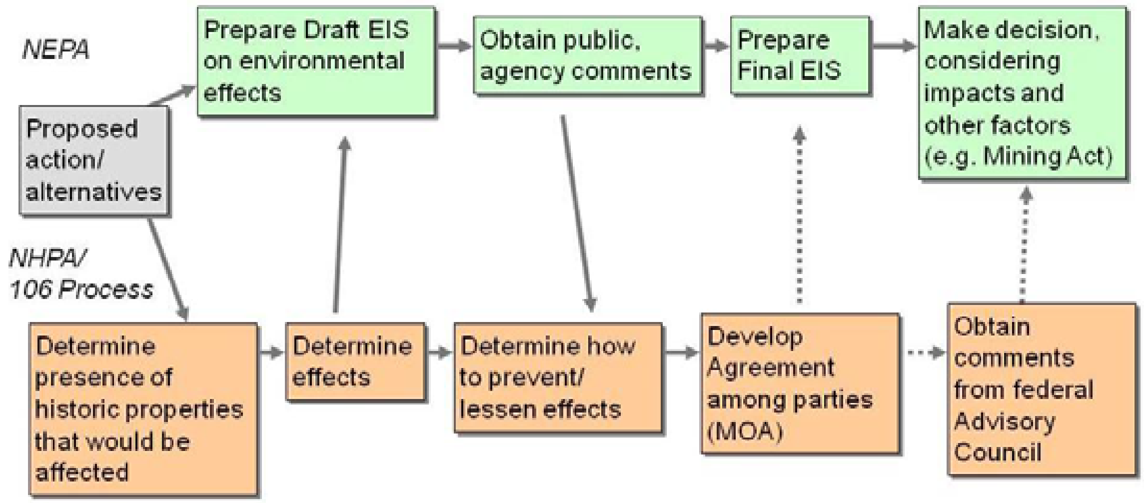


Figure 11. Parallel NEPA and Section 106 processes with points of interaction

New Mexico Department of Game and Fish

The mission of the New Mexico Department of Game and Fish (NMDGF) is "to provide and maintain an adequate supply of wildlife and fish within the State by utilizing a flexible management system that provides for their protection, conservation, regulation, propagation, and for their use as public recreation and food supply" (NMDGF, 2009).

Among the NMDGF's goals are to:

- Provide a statewide system for hunting activities and self-sustaining and hatchery-supported fisheries that satisfies the participation expectations of New Mexico residents and takes into consideration hunter safety, quality hunts, high demand areas, guides and outfitters, quotas and local and financial interests.
- Provide information and technical guidance to hunters, anglers, appreciative wildlife interests, the Director and State Game Commission, and all persons or agencies that manage lands results in the conservation and enhancement of wildlife habitat and recovery of indigenous species of threatened or endangered wildlife.

According to the MOU described earlier, NMDGF is a cooperating agency in the current EIS.

Chapter 2. Alternatives, Including the Proposed Action

Introduction

The Council on Environmental Quality (CEQ) was established by NEPA in the Executive Office of the President. Among its other duties, CEQ drafted and promulgated the regulations for implementing NEPA, located at Parts 1500–1508 in Title 40, Chapter V of the Code of Federation Regulations (CFR). Section 1502.14 of the NEPA Regulations addresses “alternatives including the proposed action,” which the CEQ states is “the heart of the environmental impact statement.”

Section 1502.14 directs Federal agencies to:

a. Rigorously explore and objectively evaluate all reasonable alternatives, and for alternatives which were eliminated from detailed study, briefly discuss the reasons for their having been eliminated.

b. Devote substantial treatment to each alternative considered in detail including the proposed action so that reviewers may evaluate their comparative merits.

c. Include reasonable alternatives not within the jurisdiction of the lead agency.

d. Include the alternative of no action.

e. Identify the agency's preferred alternative or alternatives, if one or more exists, in the draft statement and identify such alternative in the final statement unless another law prohibits the expression of such a preference.

f. Include appropriate mitigation measures not already included in the proposed action or alternatives.

This chapter describes and compares the alternatives considered for the proposed Roca Honda Mine. It includes a description and map of each alternative considered. This section also presents the alternatives in comparative form, sharply defining the differences between each alternative and providing a clear basis for choice among options by the decision maker and the public. Some of the information used to compare the alternatives is based upon the design of the alternative and some of the information is based upon the environmental, social, and economic effects of implementing each alternative.

Alternatives Considered in Detail

The Forest Service developed three alternatives, including the no action and proposed action alternatives, in response to issues raised by the public.

Alternative 1 – No Action

As just noted, Section 1502.14 of the NEPA Regulations directs the Cibola National Forest to consider the no action alternative with regard to RHR’s proposed plan of operations for the Roca Honda Mine. Under the no action alternative, the Roca Honda Mine would neither be constructed nor operated. However, for purposes of NEPA analysis and disclosure, the no action alternative provides a baseline for comparison of the effects of the action alternatives.

The General Mining Act of 1872 confers a statutory right to enter upon public lands open to location in pursuit of locatable minerals, and to conduct mining activities, in compliance with Federal and state statutes and regulations. The Multiple-Use Mining Act of 1955 confirms the ability to conduct mining activities on public lands, locate necessary facilities, and conduct reasonable and incidental uses to mining on public lands, including National Forest System lands. Forest Service locatable mineral mining regulations at 36 C.F.R. Part 228 subpart A, correspondingly recognize the rights of mining claimants. Under 36 C.F.R. Part 228, Subpart A and 30 U.S.C. § 612(a), the Forest Service ensures proposed activities are required for, and reasonably incidental to, prospecting, mining, or processing operations, and ensure operations minimize adverse environmental effects. The Forest Service may reject an unreasonable or illegal plan of operations, but cannot categorically prohibit mining activity or deny reasonable and legal mineral operations under the mining laws. Havasupai Tribe v. U.S. 752 F. Supp. 1471 (9th Cir. 1990).

Before the proposed Roca Honda Mine can ever be developed, there are requirements to receive several crucial permits from New Mexico State agencies, including a New Mine Permit from MMD, a mine dewatering permit from the OSE, and a discharge permit from NMED. Furthermore, the Federal EPA may have to issue a National Pollutant Discharge Elimination System (NPDES) permit for discharges to waters of the United States.

In the next chapter, the EIS will consider the affected environment and the environmental consequences of the no action alternative.

Alternative 2 –The Proposed Action: Accept Mine Operations Plan and Approve Project-Specific Forest Plan Amendment

The proposed action is to approve the mine operations plan (revision 1) submitted by RHR and approve the project-specific forest plan amendment described in chapter 1 and below. This proposed action was not developed by the Cibola National Forest in response to an identified purpose and need, but instead was brought to the Forest Service by RHR in accordance with its rights under the General Mining Law of 1872 and Forest Service mining regulations at 36 CFR 228 Subpart A. In addition, the proposed action is also subject to State of New Mexico permitting and regulatory requirements.

Roca Honda Mine Plan of Operations

Forest Service mining regulations at 36 CFR 228.4(a)(3) require a potential mine operator to submit a plan of operations "if the proposed operations will likely cause a significant disturbance of surface resources." In 2009, RHR initially submitted a permit application consisting of five documents:

1. Roca Honda Resources, LLC, "Permit Application for the Roca Honda Mine" (October 2009)
2. Roca Honda Resources, LLC, "Sampling and Analysis Plan for the Roca Honda Mine" (October 2009)
3. Roca Honda Resources, LLC, "Baseline Data Report for the Roca Honda Mine" (October 2009)

4. Roca Honda Resources, LLC, “Mine Operations Plan for Roca Honda Mine” (RHR, 2009a), and
5. Roca Honda Resources, LLC, “Reclamation Plan for Roca Honda Mine” (RHR, 2009b).

This set of documents also included a Plan of Operations for Mining Operations on National Forest System Lands (Forest Service Form FS-2800-5) (RHR, 2009c).

In January 2012, RHR submitted revision 1 of the mine operations plan (plan) for Roca Honda Mine to the New Mexico Mining and Minerals Division (MMD) and the Cibola National Forest.

Forest Service mining regulations define “operations” broadly to include: “all functions, work, and activities in connection with prospecting, exploration, development, mining, or processing of mineral resources and all uses reasonably incident thereto, including roads and other means of access on lands subject to the regulations in this part, regardless of whether said operations take place on or off mining claims” (36 CFR 228.3(a)). Therefore, approval of the plan of operations would also constitute approval of road improvements, power lines, and other facilities on National Forest System lands that are reasonably “incident” or related to the proposed operations.

Proposed surface disturbance associated with the underground mine is located within portions of Sections 9, 10 and 16, Township 13 North, Range 8 West, New Mexico Principle Meridian. These sections are located in McKinley County, New Mexico, approximately 3 miles northwest of San Mateo and 22 miles northeast of Grants, New Mexico (see figures 12, 13, and 14). Sections 9 and 10 are National Forest System lands which are open to mineral entry under the General Mining Law of 1872. Section 16 is State of New Mexico land which is not subject to the regulatory jurisdiction of the Forest Service, but rather under the jurisdiction of the New Mexico State Land Office. Each section is a 1-mile-square area, that is an approximate square with four sides each measuring 5,280 feet in length, perpendicular and parallel to each other, and encompassing approximately 640 acres. RHR proposes a mine permit area of 1,968 acres, including 48 acres of haul roads, utility corridor and mine dewater discharge pipeline corridor outside of Sections 9, 10, and 16. There are 183 acres of disturbance within Sections 9, 10, and 16, plus 35 acres outside those sections for a total disturbance area of 218 acres.

Additional surface disturbance associated with mine haul roads is proposed for several sections outside the permit area. In Section 11, an existing forest road would be upgraded to accommodate haul truck traffic and furnish general access to the Section 10 facilities. It would also be rerouted to the extent necessary (approximately 8 acres) to avoid archaeological resources. Likewise, the existing road on private land in Sections 17 and 20 providing access to Section 16 would be rerouted and/or upgraded as necessary (approximately 7,656 feet in length or 10 acres in Sections 17 and 20) to serve as a haul road. A portion of the utility corridor is located on private land in Section 15 and totals approximately 5,016 feet or 4 acres of disturbance.

Most of the surface facilities for the proposed Roca Honda Mine would be located in Section 16 on New Mexico State Lease HG-0036. Remaining facilities and surface features would be situated on Cibola National Forest lands in Sections 9 and 10. Figure 15 shows the general surface facility footprints and associated disturbed area of the proposed mine project. Figures 16, 17, and 18 show surface facilities on Sections 16, 9, and 10. These figures have been updated from earlier versions to depict the most recent detailed design of the plan.

Figure 12. Regional map depicting proposed Roca Honda Mine within northern New Mexico

Figure 13. View of project area from Section 10

Figure 14. Power line crossing Section 16 portion of project site

Figure 15 also shows the location of a treated mine water (water reuse) transportation line and corridor leaving the mine permit area at the southeast corner of Section 10. This 20-inch diameter pipeline would run along the haul road to the southeast corner of Section 11 then turn north for a distance of approximately 6 miles where the water would be discharged onto private land. This water line is a substantial new addition to the plan, not previously proposed in RHR's October 2009 permit application.

In brief, the water reuse pipeline was proposed by RHR in response to Agency concerns and comments received upon review of RHR's October 2009 submittal and during public and Agency scoping. Concerns were expressed regarding potential adverse impacts of discharge of water upon the San Mateo Creek drainage. In response, RHR committed to transporting the water to a location outside of the San Mateo Creek drainage for discharge. This pipeline would be placed next to the haul road and the utility corridor in Sections 16, 15, 10, and 11. It would then turn north along the road at the junction with the Section 11 haul road and proceed north through Section 2 (Forest Service lands) and onto private land, as shown on figure 15. An estimated width of 20 feet was assumed to be disturbed during the placement of the pipeline over a distance of 28,919 feet (5.48 linear miles), which totals 13.3 acres, 2.5 acres of which would be on National Forest System lands and 10.8 acres on private land. The pipeline would feed into a new water storage tank to be used for pasture irrigation. As a contingency during overflow periods, water may also be discharged into Laguna Polvadera or San Lucas Arroyo.

RHR proposes to conduct mining operations for a period of approximately 18–19 years, including mine development, operations, and reclamation. The project would start after all required permits have been obtained, including approval by the Cibola National Forest of the mine plan of operations. However, the ultimate mine life of the Roca Honda Mine would depend on uranium market conditions and potential identification of additional uranium ore. Therefore, the ultimate mine life could well exceed 18–19 years.

The following sections summarize the "Roca Honda Mine Plan of Operations, Revision 1" (plan) in relation to three phases of proposed mining activities:

- **Mine Development** includes baseline data gathering, initial site development, construction, and depressurizing activities which would be conducted to facilitate mine shaft construction.
- **Mine Operation** includes activities directly related to production of uranium ore from the underground mine and transport of the ore offsite for mineral processing.
- **Mine Reclamation** includes activities intended to reclaim land affected by mine development and operation, and to return that land to an approved post-mining land use.

Although these activities would generally be performed in sequence, the proposed development, operations, and reclamation activities would overlap to some extent throughout the mine's life. RHR proposes that it would have an archaeologist onsite to monitor all surface disturbance activities undertaken during mine development, operations, and reclamation. The proposed activities are further described in the following sections.

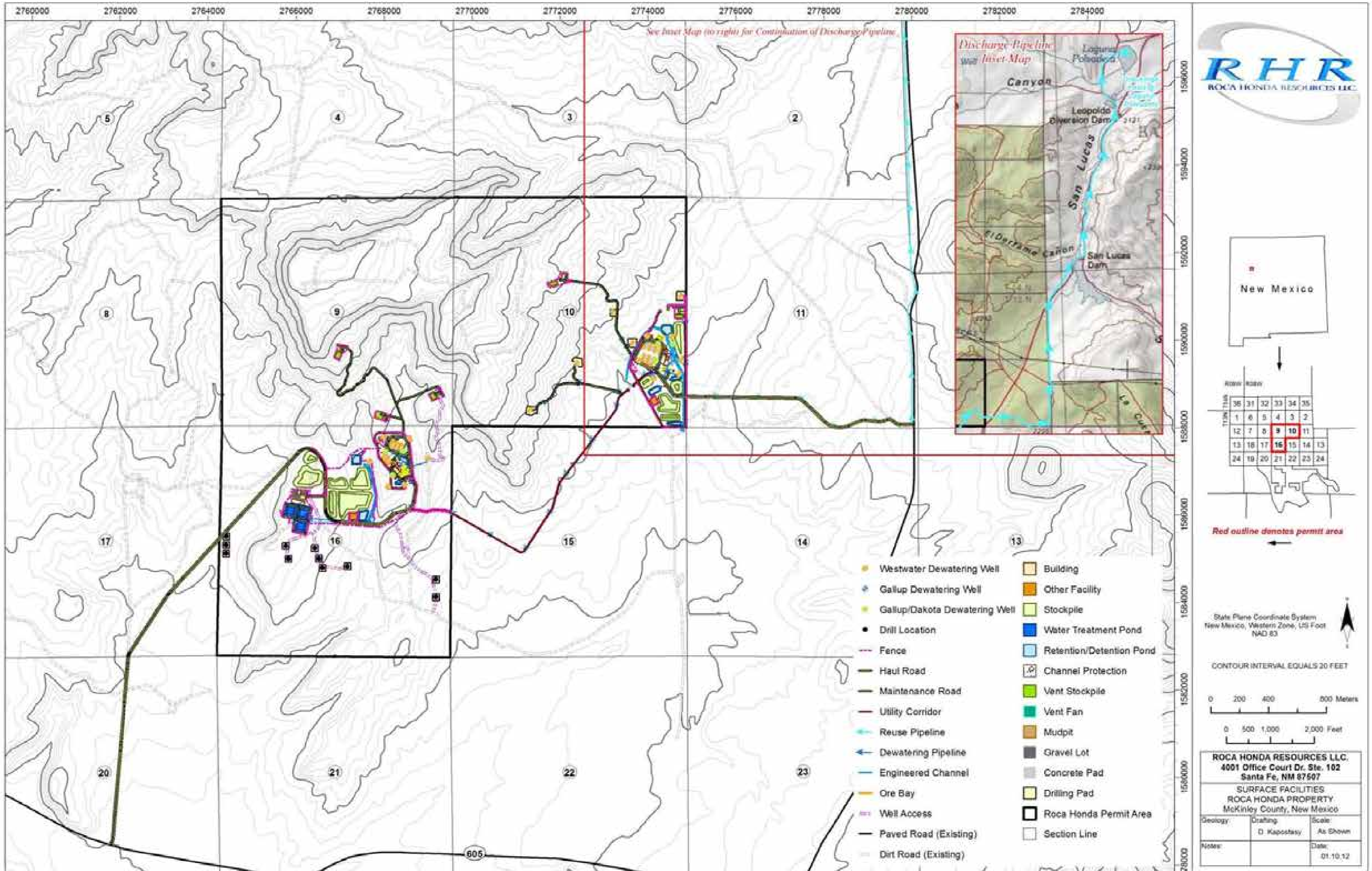


Figure 15. Proposed Roca Honda Mine – layout of surface facilities

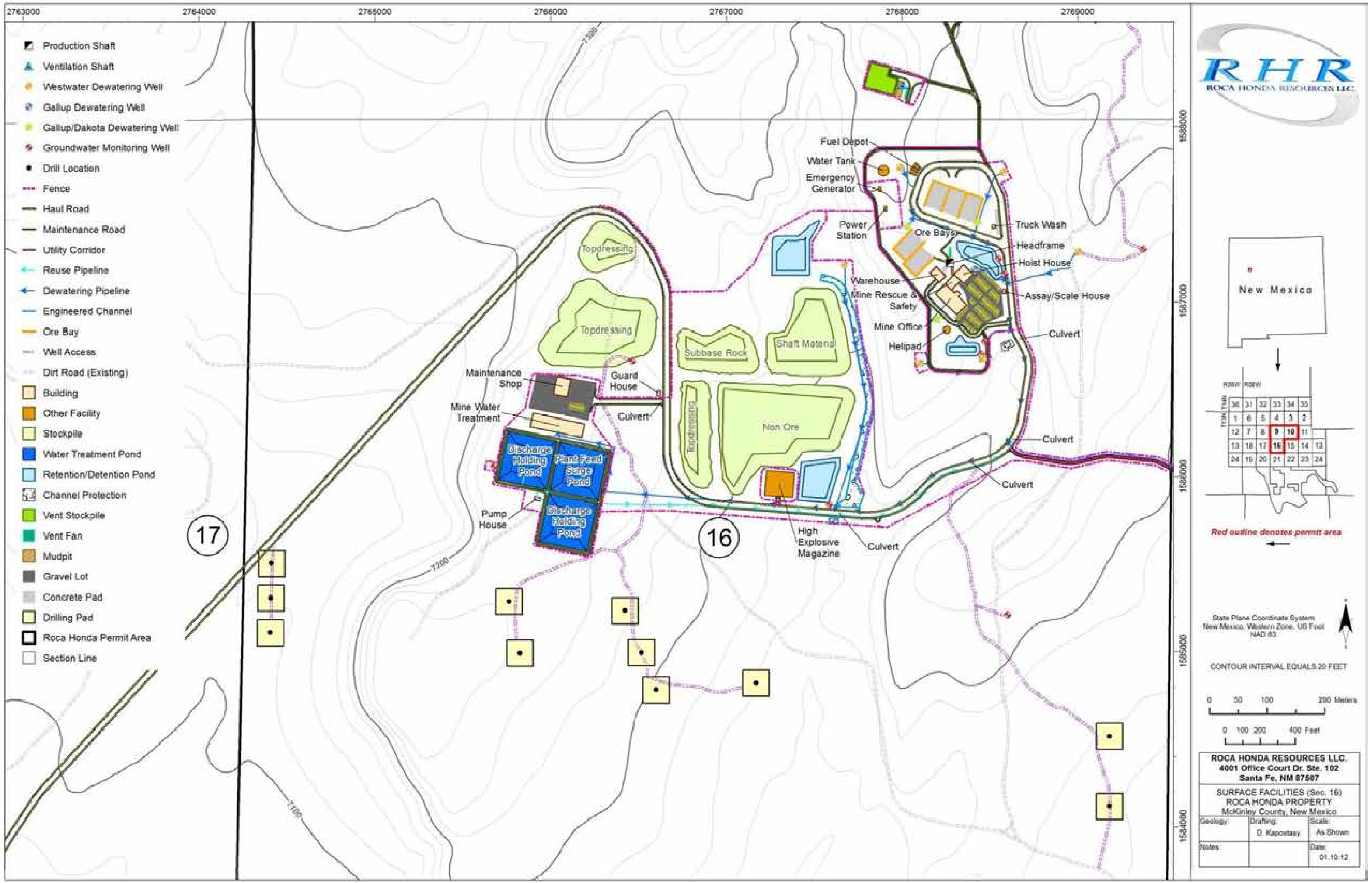


Figure 16. Layout of surface facilities in Section 16 for the proposed Roca Honda Mine

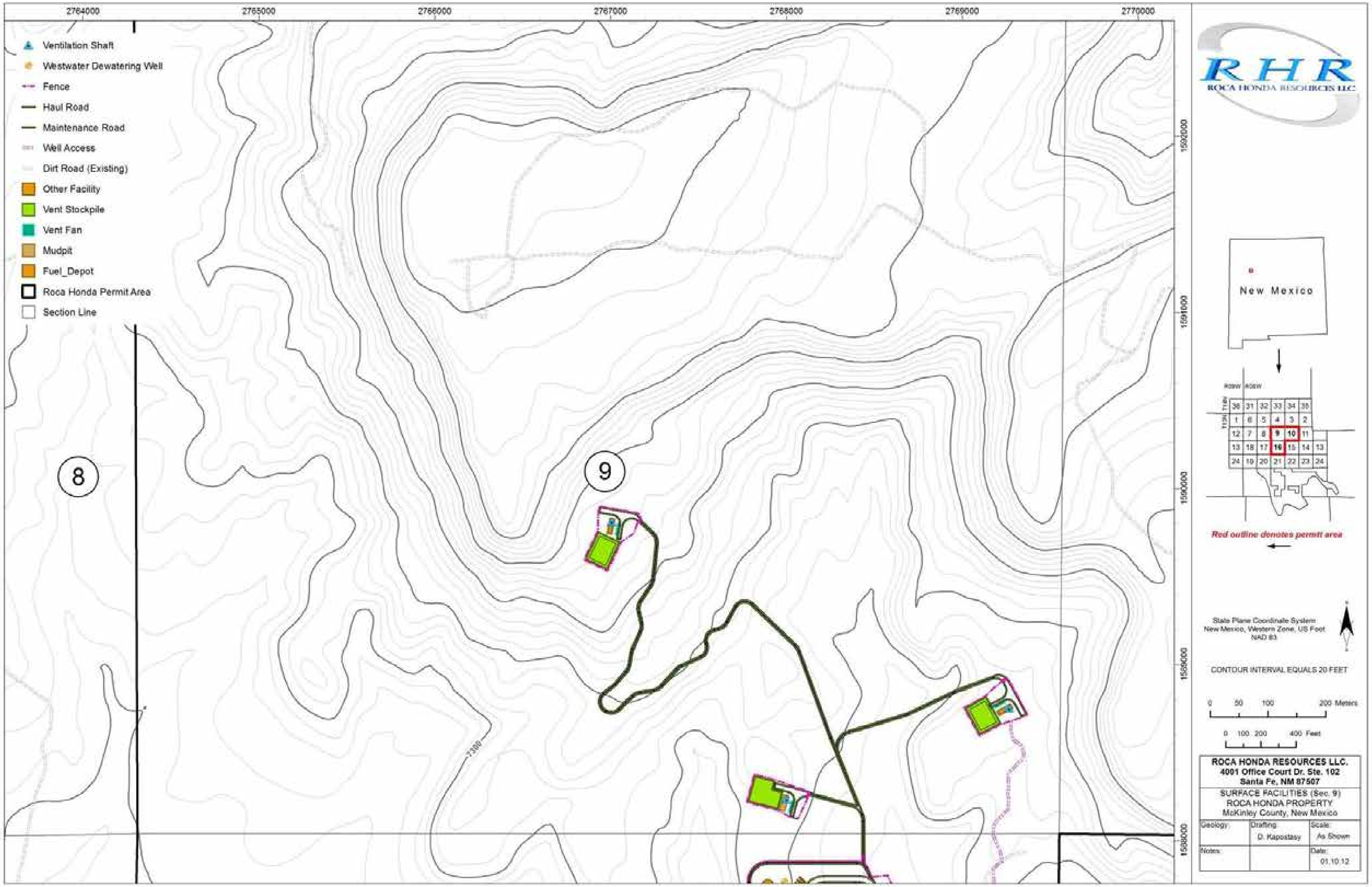


Figure 17. Layout of surface facilities in Section 9 for the proposed Roca Honda Mine

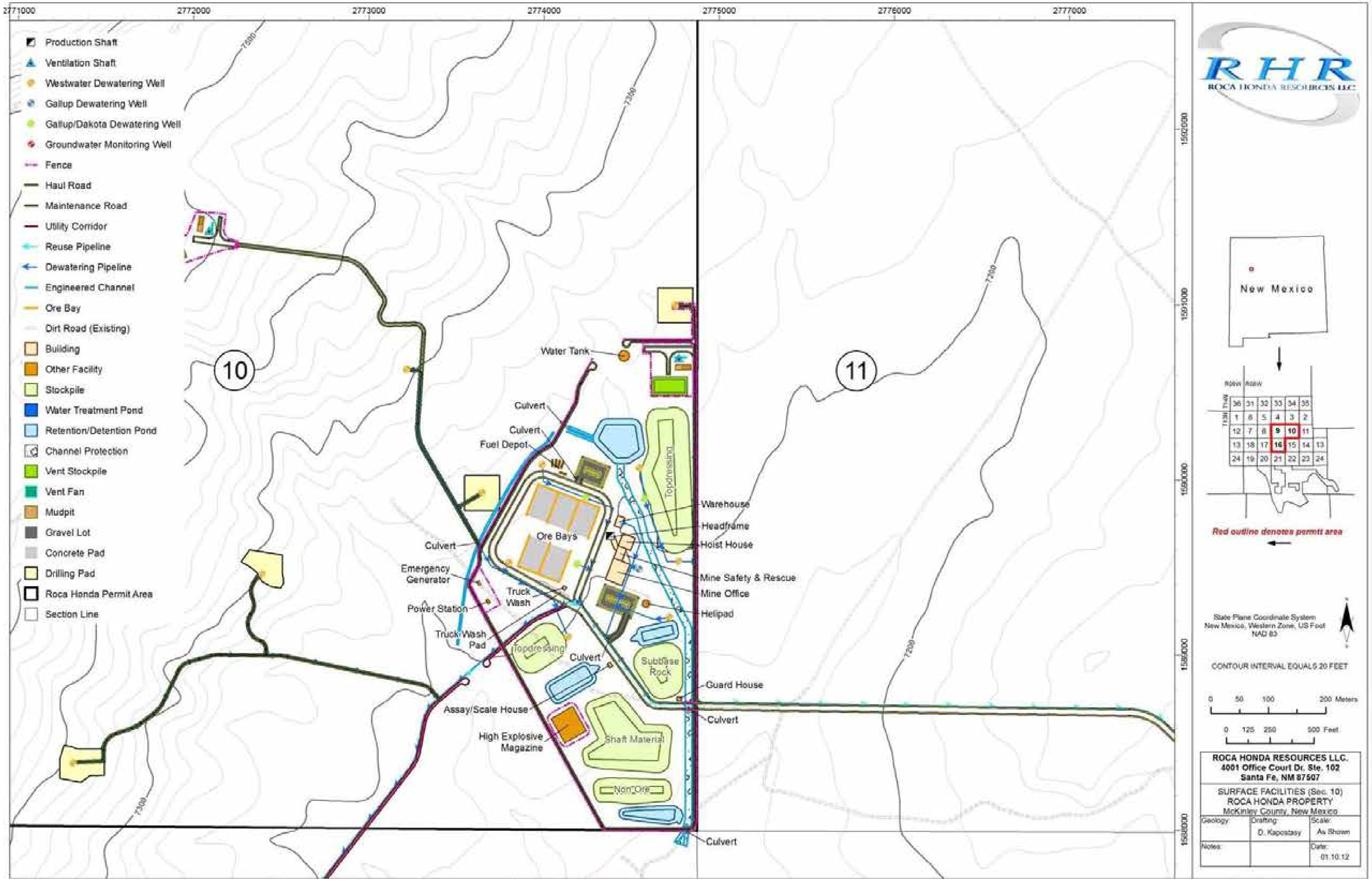


Figure 18. Layout of surface facilities in Section 10 for the proposed Roca Honda Mine

Mine Development

Mine development activities would include gathering of baseline characterization data and construction of depressurizing wells, a water treatment plant, production shafts, ventilation shafts, and ancillary surface facilities. RHR estimates that approximately 3.6 years would be required for development activities before ore production can begin. At that point, the mine operation phase would begin at Section 16 and mine development activities would shift to Section 10 thereafter.

Depressurizing Wells

Artesian aquifers are present in rocks that overlie the uranium ore that RHR proposes to extract. An aquifer is a saturated rock unit with sufficient permeability to provide a significant source of water to wells or springs. An artesian aquifer is one that is under pressure; specifically, it is overlain by a confining bed, such that the pressure causes the water level to rise above the top of the aquifer in a well. As a result, control of potential inflows of water from these artesian aquifers would be critical to facilitate construction of production and ventilation shafts.

Roca Honda proposes to construct 10 water depressurizing wells near the production shaft in Sections 16 and 15 depressurizing wells near the production shaft in Section 10. The sequence described herein would be initiated for the Section 16 production shaft and repeated for the Section 10 production shaft in accordance with the mine development schedule. Four to six such wells would be completed into the Gallup Formation and subsequently deepened into the Dakota Formation. These are the two artesian aquifers that exist above the ore-containing formation, i.e., the Westwater Canyon Member of the Morrison Formation. Six to eight depressurizing wells would be completed into the Westwater Canyon Member.

The purpose of these wells is to reduce water pressure and control groundwater inflows during construction of the shafts. Each well is planned to be 12 to 14 inches in diameter with electric pumps capable of pumping groundwater at a rate of 250 to 500 gallons per minute, for a total dewatering rate of up to 4,500 gpm. The Gallup Formation wells would be operated for a period of time (3 to 6 months) prior to the shaft construction reaching that formation and during the time that it took to complete the shaft through the formation. Thereafter, these wells would be deepened into the Dakota Formation and similarly operated prior to and during completion of the shaft through the Dakota Formation.

The Westwater Canyon Formation wells would be operated from the time they were completed until the production shaft was completed and for a brief period of time thereafter while initial mine development at the bottom of the shaft in the immediate area of the initial mine workings was performed. The anticipated volume of water produced from these wells will vary depending upon the formation being depressurized and the sequencing of events; it is anticipated that the rate of water production will not exceed 4,000 gallons per minute (gpm) at any one time.

RHR also proposes to use pressure grouting to reduce groundwater flow through rocks located in close proximity to the production shafts. Pressure grouting is essentially like filling up the pore spaces of a sponge with grout. It reduces the ability of water to flow through the rock and, thereby, reduces the volume of water that would flow into the production shaft during or after construction. In this process, numerous closely spaced bore holes would be drilled into the rock surrounding the shaft location. Cement grout would be pumped into the drill holes at pressure, and the cement would flow into pore spaces of the rock in the immediate vicinity of the shaft.

The shaft would also be lined to reduce inflow of water from aquifers overlying the underground mine after construction, and to prevent flow of water between aquifers.

During mine operations, mine depressurizing would be accomplished by drilling “long holes” into the rock at the working faces of the mine to drain the formation. The water flowing into the underground mine would be conveyed into underground sumps and would then be pumped out of the mine to the surface through a vertical pipe located within the shaft. Therefore, all of the depressurizing wells would be shut down after construction of the production shafts and initial mine development in the Westwater Canyon Formation is complete.

RHR proposes to plug and abandon most depressurizing wells after shaft construction is complete. However, some may be maintained as long term water quality monitoring wells. The wells would be reclaimed in accordance with State requirements for wells constructed in artesian aquifers.

Water Treatment Plant

Water pumped from the depressurizing wells may produce natural water quality that does not meet numerical surface water discharge standards. Water quality from these wells would be monitored to further develop baseline conditions for each aquifer. RHR proposes to treat water produced from mine depressurization, as necessary, through construction of a water treatment plant. Construction of this plant would be completed within 180 days (about 6 months) after permit approval.

The Water Treatment Plant 60 percent Design Revision 1, as revised to address Agency comments, was submitted in December 2011 (Lyntek, 2011). RHR prepared revision 1 in response to NMED comments on the initial water treatment plant submittal, in support of the discharge plan and MMD permit application. The water treatment facility would encompass approximately 10 acres and would consist of the water treatment process building, an influent surge pond, and two treated water holding ponds. The effluent flow rate is expected to be 2,500 to 4,500 gpm. The maximum design capacity of the treatment facility is 8,000 gpm, which adds redundancy for most treatment units. Water generated from mine dewatering activities, water collected from within the Roca Honda permit area in the retention ponds, and the effluent from the sanitary wastewater treatment system would be treated onsite at the water treatment facility.

The water from the dewatering wells would be pumped to the water treatment plant in a network of 18-inch high density polyethylene (HDPE) pipelines with fused joints. Water from dewatering of the mine proper would be pumped to the water treatment plant in a separate 18-inch HDPE pipeline. This would allow for different options for treatment within the treatment plant based on the influent quality. These pipelines would be monitored for change in pressure utilizing pressure gages throughout the system. In the unlikely event a leak occurred, a specially designed leak-proof saddle would be installed on the damaged area to seal the leak without a pump shutdown. A redundant plan would involve a system of piping and valves to switch the flow of water from one dewater pipeline to the other until the leaking portion of a line can be replaced. This system will be designed as a part of the construction drawings (RHR, 2012).

The water produced from the mine dewatering wells (see the “Water Resources” section) would be pumped to the water treatment facility for treatment prior to disposal. Water produced by the mine would be gathered in a sump located within the mine itself to remove sand and grit. The water would then be pumped to the surface and delivered to the water treatment plant. The water would be pumped into the reaction tank(s) where barium chloride would be added and any necessary pH adjustment would be made.

Radium would be precipitated and the solution would be pumped to the pressure leaf filters to separate solids from the water. The solids would proceed to the filter press to remove the remaining water. The solids would be bagged for offsite disposal. The filtrate from the leaf filters would then flow to the ion exchange columns, where a selective resin would remove and bind the uranium. The water from the ion exchange columns would be adjusted for pH and sent to the treated water holding ponds and for subsequent discharge in compliance with Federal and State requirements. The resins would be regenerated offsite. The plant is not only designed with some redundant treatment units but it would have piping flexibility to bypass units if they are not needed. The water treatment design package contains a monitoring plan with instrumentation readouts at a logic control panel.

Pipeline

RHR proposes to construct a 20-inch diameter pipeline approximately 5.5 miles in length to transport water produced from the mine offsite (figure 16). The pipeline would be laid on the ground surface so that no trenching or excavation would be required. Almost the entire length would be across private land; a very small portion of Cibola National Forest land would be crossed as well. The proposed destination of the water would be a water storage tank on private ranchland whose owner intends to use this treated water to irrigate range or pastureland for livestock. As a contingency, Laguna Polvadera and San Lucas Arroyo would be utilized for overflow.

This pipeline would be placed next to the haul road and the utility corridor in Sections 16, 15, 10, and 11. It would then turn north along the road at the junction with the Section 11 haul road and proceed north through Section 2 and unplatted lands, as shown on figure 16. An estimated width of 20 feet was assumed to be disturbed during the placement of the pipeline over a distance of 28,919 feet (5.48 linear miles), which totals 13.3 acres, 2.5 acres of which would be on National Forest System lands and 10.8 acres on private land.

Mine Shafts

RHR proposes to mine ore that is located at approximately 1,650 to 2,650 feet below the ground surface. Two production shafts are proposed to access that ore and to provide a means to move workers, equipment, and rock into and out of the mine. A shaft is a vertical tunnel that extends from the surface into the underground mine. Under the proposed action, RHR proposes to construct two production shafts, one located in the northeast quarter of Section 16, and one located in the southeast quarter of Section 10. The production shafts are proposed to be 18 feet in diameter. Development of the Section 16 shaft would occur first, followed by development of the Section 10 shaft. Roca Honda estimates that the Section 16 shaft would be in production approximately 3.6 years after all permits are approved and the Section 10 shaft would be constructed thereafter and in production approximately 8.6 years after all permits are approved.

Mine ventilation is a critical aspect of underground mining. Air must be pumped through the underground mine to provide sufficient fresh air to workers, and to vent or exhaust air from the mine to prevent buildup of contaminants, including radon gas, carbon monoxide, and diesel fumes. Carbon monoxide and diesel fumes would be generated by mechanized equipment used within the mine to extract ore. Radioactive radon gas, one of the “daughter products” in the decay sequence of U-238 (the most abundant form or isotope of uranium), would be generated by the mine itself as the uranium-bearing rock in the formation is exposed to air when the working faces are opened up in the mine.

RHR is proposing construction of up to five ventilation shafts approximately 9 feet in diameter to facilitate effective mine ventilation at the Roca Honda Mine. Final configuration and location is subject to change depending on conditions encountered at the time of operations. Three of these ventilation shafts are proposed to be constructed in the southeast quarter of Section 9, and two are proposed to be constructed in the northwest and southeast quarters of Section 10.

Secondary escape routes are also critical to facilitate safe underground mining. These secondary escape routes provide a means for workers to escape from the mine in the event of an incident that disabled the production shaft or prevented underground access to the production shaft. Some ventilation shafts would also be designed for use as secondary escape ways.

Radon

Radon is a naturally occurring element with the symbol Rn and an atomic number of 86. The atomic number refers to the number of protons in the nucleus of every atom of a given element. Radon is produced in soil, rock, and water by the natural (radioactive) breakdown, or decay, of two other naturally occurring chemical elements – namely uranium, with an atomic number of 92, and thorium, atomic weight 90.

Rn is a radioactive, colorless, odorless, and tasteless gas. The most stable isotope of radon, Rn-222, has a half-life of 3.8 days, after which half of the original amount has disintegrated into yet another element of the U-238 decay chain, polonium, through radioactive decay, in this case alpha decay (emission of a helium nucleus).

Radon is estimated to cause about 21,000 lung cancer deaths per year, and is the second-leading cause of lung cancer after smoking (EPA, 2010).

Ancillary Surface Facilities

Additional ancillary surface facilities are proposed to support the underground mine operation such as:

- Haul and access roads
- Head frames, hoists, and ventilation shafts
- Soil stockpiles, rock stockpiles, ore pads, and nonore stockpiles
- Fuel, chemical, explosives, and equipment storage areas
- Drill pads to support development drilling and monitoring well construction
- Utility lines, pipelines, storm water control facilities, and fencing.

These facilities would be constructed during the development phase starting with facilities in Section 16 and proceeding to facilities in sections 9 and 10. Major ancillary surface facilities are planned to be constructed in the north half of Section 16 and the southeast quarter of Section 10.

A series of haul roads, mine access roads, and ventilation shaft access roads are proposed to support the mining operation.

After extraction, the Roca Honda ore, like all uranium ore, requires mineral processing to separate uranium from the rock and produce a marketable form of uranium—"yellowcake"—or U_3O_8, the most stable chemical compound or form of uranium oxide. This mineral processing would not be conducted at the Roca Honda Mine. Ore would be shipped from the mine to an offsite mineral processing mill, either an existing mill or a new mill, which would be licensed by and is under the jurisdiction of the Nuclear Regulatory Commission (NRC).

Two existing roads are planned to be rerouted and/or upgraded to provide for ore haulage from the mine to a public highway. The haul road from the Section 16 facilities would lead west from the Section 16 mine site and then south on private land through the east half of Sections 17 and 20. The haul road from the Section 10 facilities would lead east from the Section 10 mine site along the general orientation of an existing two-track road located along the southern edge of Section 11. The haul roads would be 60 feet wide and have a gravel surface. Additional mine access roads are proposed to be constructed in sections 9, 10, and 16.

Head frames, hoists, and fans are surface facilities that service the production and/or ventilation shafts. RHR proposes to install head frames and hoists at the Section 16 and Section 10 production shafts. The head frames would be steel structures, 90 to 120 feet tall, which support the wire rope that lifts workers, equipment, and rock into and out of the mine. The hoist services the shaft and may be located in an adjacent building. Ventilation fans are large fans that may be located at production or ventilation shafts. These fans move air into and out of the mine and provide for a safe working environment underground.

RHR is proposing to install several types of rock and soil stockpiles at the mine. Separate topsoil and subsoil stockpiles are planned to be constructed as the surface facilities are developed. These stockpiles would segregate and protect soil resources for future use during mine reclamation. RHR plans to separately manage and stockpile rock produced during construction of production and ventilation shafts in stockpiles located near the shafts. This material would be either removed to offsite disposal and/or reclaimed onsite.

Once the production shafts reach the rock unit that hosts uranium mineralization—the Westwater Canyon Member of the Morrison Formation—two additional types of rock would be produced, ore and nonore. Ore is rock that contains sufficient concentrations of uranium to profitably extract the rock, truck it to a mineral processing facility, and produce uranium yellowcake. Ore pads are proposed to provide for temporary storage of ore until it is trucked to an offsite mineral processing facility. Nonore is rock mined from the same rock unit as the ore, which may contain slightly elevated, but noneconomical concentrations of uranium. Production of nonore material would be minimized to the extent possible. Initial development of the mine would require that a small amount of nonore material be hoisted to the surface. However, as the mine workings grow, nonore material would remain underground in the mine. RHR proposes to construct separate stockpiles for nonore brought to the surface. This material would be removed offsite over time or placed back in the underground mine workings.

Fuel, chemical, explosives, and equipment storage areas are also proposed to be constructed. Fuel storage areas are proposed to store fuel and other petroleum products. A chemical storage area is proposed to provide for storage of water treatment chemicals. Explosives storage is proposed for blasting agents that would be used within the underground mine. Equipment storage areas would provide for storage of surface and subsurface equipment. These facilities would be located within the Section 16 and Section 10 mine sites.

Drill pads are proposed to be constructed to support development drilling and monitoring well construction. Development drilling requires short-term use of the surface, including a 150-by-150-foot area for drill rig operations, and access roads for transportation of the drill rig and other support equipment. RHR proposes to construct up to12 drill pads to support development drilling. The majority of these drill pads would be located in the southern half of Section 16, with additional drill pads proposed for the northern half of Section 16 and the southeast corner of Section 10. Some drill pads would also be necessary for constructing monitoring wells. Monitoring wells are used to monitor and test groundwater conditions. Roca Honda proposes to construct two monitoring wells in the south half of Section 9 and one in the southeast quarter of Section 10. Temporary access roads in Section 16, 9, and 10 are proposed to provide access to the drill pads. Those drill holes converted to water monitoring wells would have road access for the duration of the mine.

Utility lines, pipelines, storm water control facilities, and fencing are also proposed. These facilities would be constructed primarily in the northern half of Section 16 and the southeastern quarter of Section 10. Storm water control facilities include water conveyances and storm water management structures designed to mitigate potential nonpoint-source water pollution that could be generated at the site.

Figures 16-19 depict the layout of all major surface facilities associated with the Roca Honda Mine.

Additional Construction Commitments

RHR has made the following additional commitments to reduce potential impacts to cultural resources in the permit area.

1. **Roads** – Upon receipt of the necessary permits to allow start of construction, the first activity conducted by RHR would be to blade new access roads within the proposed haul road routes. The new bladed roads would be the access used by all mine related vehicles, while the haul roads are constructed. The existing ranch roads in Sections 17 and 16, and the unauthorized two-track road in Section 11, would not be used for mine related activities. In Sections 9 and 10, new proposed access roads to vent shafts and dewatering wells would be established prior to drilling the shafts and wells.
2. **Section 16 Perimeter Fencing –** Perimeter fencing in Section 16 would be installed at the beginning of construction activities in that section.
3. **Section 10 Perimeter Fencing –** Perimeter fencing in Section 10 would be installed prior to the start of construction of the main mining cantonment area in that section.
4. **Well Pad Fencing and Erosion Control** – For all water monitoring and dewatering wells, including those exploratory drill locations turned into monitoring wells, the well pads would be fenced for the duration of their use, erosion control measures would be implemented around the pad, and a permanent access road to the well would be developed along the route shown on the project maps.
5. **Haul Road Gate** – In Section 11, where Forest Road 192 and the proposed haul road diverge, a gate will be installed across the mine’s haul road to discourage public use of the haul road.

Mine Operation

Mine operation includes activities directly related to production of uranium ore from the underground mine. Under the proposed action, these activities would commence first in Section 16, with initial production planned to start approximately 3.5 years after all required permits for the mine are received. At that time, ore production would start in Section 16 and mine development would continue in Sections 9 and 10. Ore production from the Section 10 production shaft is planned to start approximately 8.5 years after all required permits for the mine are received. The production phase would last approximately 13 years. However, the ultimate mine life may be extended if additional ore is identified or if economic conditions change.

Some additional disturbance to surface resources is proposed during mine operation, but most activities would be related to operation of previously constructed facilities, extraction of ore from the underground mine, and shipment of the ore to an offsite mineral processing mill. Major activities during this phase would include:

- Extraction of ore and non-ore
- Placement of ore on ore pads, truck loading, hauling
- Depressurizing and treatment of mine water
- Transportation of mining supplies and personnel to and from the mine

Extraction of ore would use drilling, blasting, and excavation to construct a network of underground tunnels and rooms. Ore would be blasted, loaded in underground mine haulage equipment (figure 19), and hauled to the surface through the production shaft. The ore would then be placed on the ore pad for temporary storage until it was loaded onto a highway haul truck. The ore would then be hauled from the mine on one of the haul roads to an existing public highway.

Continued depressurizing from the mining area is expected throughout the production phase using long-hole drilling techniques as previously described. Water that flows into the underground mine would be collected in sumps and pumped to the surface through the production shaft. Because groundwater within the mine is in close association with uranium ore, it may contain elevated levels of uranium or other elements. The mining operation itself may also affect the solubility of uranium or other elements within the mine water as the mine workings are developed. RHR proposes to treat water removed from the mine in the water treatment plant described above for the duration of the underground mine operation. Treated water would then be piped onto a private ranch northwest of the mine site via the pipeline described above.

Transportation of mining supplies and personnel to and from the mine would occur throughout the production period. Mining supplies such as fuel, blasting agents, and supplies for water treatment would require transport to the mine. Mine workers would also travel to and from the mine during the production period. In addition, materials such as used petroleum products and solid wastes would require transport from the mine. These personnel and materials would be transported using the mine haul roads.

Figure 19. Uranium mine tunnel and haul equipment at Mining Museum in Grants

Mine Reclamation

Mine reclamation would be the last phase of the proposed operation. Mine reclamation is designed to reclaim the effects of mining and achieve a post-mining land use of grazing. Most reclamation would occur after mining is complete, because major surface facilities are planned to be used for the life of the underground mine. This type of reclamation is termed final reclamation. RHR estimates that the life of the mine would be approximately 18–19 years. Final reclamation would be complete at that time. Some contemporaneous reclamation is planned, which is reclamation that would be conducted during the development or operations period.

RHR initially presented general reclamation concepts in “Reclamation Plan for Roca Honda Mine” (Roca Honda Resources, 2009b). However, revision 1 of the plan contains more detailed reclamation designs. Forest Service regulations at 36 CFR 228.13 require a mine operator to furnish a reclamation bond before a plan of operations is approved. The purpose of the reclamation bond is to provide for reclamation of mining-related disturbance in the event that RHR does not reclaim the mine. The regulations require that the amount of the reclamation bond be based on “the estimated cost of stabilizing, rehabilitating, and reclaiming the area of operations.” The following section summarize RHR’s proposed reclamation plan.

Contemporaneous Reclamation

Contemporaneous reclamation is reclamation that would be conducted during the mine development and/or operations phases. RHR would implement contemporaneous reclamation to the maximum extent practicable. Nevertheless, in an underground mining operation such as the proposed action, opportunities for contemporaneous reclamation are limited compared to a surface mining operation. Many of the areas that would be disturbed early in the project would remain disturbed until mine closure and reclamation. Since the majority of activity would take place thousands of feet below the surface, a relatively small percentage of project operation affects surface resources (RHR, 2012).

As described above, surface disturbances would consist of the administrative buildings and support facilities, water treatment plant and ponds, excavation material stockpiles, roads, utility corridors, surface water flow channels and detention basins, retention ponds, and other facilities. Most of these areas must remain as constructed and functional until mining operations cease and final site reclamation begins. However, since Roca Honda mining would be split between Section 16 and Section10, some contemporaneous reclamation would begin to the extent possible in Section 16 on facilities and areas not required for the mining efforts in Section 10.

The overall approach to contemporaneous reclamation is to avoid site disturbance wherever possible and minimize the area that must be disturbed. Contemporaneous reclamation would be initiated with soil salvage and interim revegetation, and would continue through mine operations with protection and maintenance of excavation material stockpiles, closure of wells, and reclamation (revegetation) of drilling pads when they are no longer needed. This early reclamation would minimize erosion, while isolating and protecting material for later use; it would provide for mitigation of potential effects and reduce the final reclamation work and costs (RHR, 2012).

Contemporaneous reclamation would also involve avoidance of disturbance and the use of existing roads and access corridors whenever possible. For example, there are a number of previously disturbed sites within the permit area consisting of historic drill pads and existing dirt roads. RHR would improve some of these existing roads for its needs and locate ventilation holes and escape shafts on old drill pads whenever possible. Candidate areas for contemporaneous reclamation include the mud pits, development drill pads, and the excavated material stockpiles, which consist of: (1) topdressing, (2) subbase rock, (3) shaft material, and (4) nonore material.

Final Reclamation

Final reclamation is designed to remove surface facilities, plug the mine shafts, recontour the disturbed area, replace stockpiled soil, and establish vegetation suitable for the post-mining land use of grazing. The reclamation approach was initially presented in the reclamation plan for Roca Honda Mine (Roca Honda Resources 2009b); this plan was subsequently revised in response to input from State agencies.

In general, final reclamation would include the following components:

- Survey the disturbed area and ore haulage routes for uranium-bearing materials, and develop a plan to excavate and dispose of any affected soil.
- Remove salvageable equipment and any hazardous or toxic substances from the underground mine.
- Place concrete plugs at surface openings and plug extraction and monitoring wells.
- Remove water, sediments, and pond liners from storm water evaporation ponds and regrade to match surrounding terrain.

- Decommission water treatment plant and water storage ponds including removal and disposal of remaining chemicals or other hazardous substances.
- Remove storm water control structures such as detention basins and arroyo armoring.
- Remove surface mine facilities, provide for reuse or dispose as appropriate.
- Recontour areas of surface disturbance to provide for positive drainage and slope stability.
- Remove road base material and reclaim roads that are not planned to be retained by surface landowners.
- Spread stockpiled topsoil on recontoured areas, revegetate with native seed mixture designed to facilitate post-mining land use of grazing, and implement erosion control measures.
- Remove perimeter fences.

RHR proposes reclamation performance standards that would be used to assess growth of grasses, forbs, and woody species in reclaimed areas. These reclamation performance standards would assist in evaluating reclamation performance and achieving release of the mine reclamation bond after reclamation is complete.

In response to Agency comments on the initial reclamation plan, RHR submitted revision 1 in August 2011. Revision 1 revised and updated the original 2009 reclamation plan. Revision 1 contains a detailed discussion of the steps that would be taken to stabilize and configure the site so as to achieve the approved grazing post-mining land use. These steps, which are consistent with State regulations at NMAC 19.10.6.603.D (1 through 5), are summarized below.

Final slopes and drainage configurations would be constructed to conform with the geomorphic character of the region and surrounding area, and would be compatible with the approved post-mining land use of grazing.

Impoundments, roads, and other depressions would be backfilled, as described in the reclamation plan, revision 1 to meet stability requirements and the geomorphic character of the region and surrounding areas.

Prevention of mass movement of reclaimed slopes, embankments, roads, or other fill areas would be achieved through the construction of fill areas in lifts of 24 inches or less, with the addition of water, and the areas wheel rolled to achieve compaction. Since the areas will not be required to support any structures or weight other than overlying material, these procedures will be adequate to prevent mass movement.

The soil and rock stockpiles would be used as part of the final reclamation for fill and vegetation growth. No stockpiles would remain on the surface in the permit area after final reclamation.

Given the expected geochemical properties of the excavated and stockpiled overburden, the potential for acid and other toxic drainage is believed to be inconsequential. However, RHR would characterize the excavated materials as a part of the NM Mining Act Baseline Data Report in addition to the NMED Discharge Plan process. These excavated materials would be analyzed to determine their potential for release of acid or other toxic constituents. Material excavated during construction of the mine shafts and vent holes would be temporarily stored in designed stockpiles to prevent mass movement and protected from storm water runoff. If the material is inert, it would be returned to the mine and used to backfill areas for stability during mining.

Alternatively, if the analytical results indicate that acid producing or other toxic constituents could be leached, the material would be loaded in haulage trucks and taken offsite for disposal. Runoff from these stockpiles would be collected in storm water retention ponds. The water would be pumped to the onsite water treatment plant before it is discharged. The bottom sediment from the ponds would be analyzed for constituent makeup and disposed of appropriately in an offsite facility. Thus, any material with the potential to release acid or other toxic drainage would not be on the permit area after reclamation (RHR, 2012).

Sufficient material has been identified to restore a vegetative community that would support the approved post-mining land use of livestock grazing. Topdressing that has been stockpiled for more than 1 year would be analyzed to determine if soil amendments are necessary to support successful reclamation of disturbed areas. RHR commits to the addition of mycorrhizal inoculum for all topsoil materials stockpiled at depths greater than 2 feet from the surface.

As part of reclamation operations, disturbed areas would be stabilized through grading areas to conform to the geomorphic character of the region and surrounding area, including shaping, berming, and grading to final contour. Reclamation of slopes would incorporate the practice of minimizing slope lengths and gradients, while conforming to the geomorphic character of the region and surrounding areas to minimize the potential for excessive erosion. Both runoff and runon (water entering a site) would be diverted from reclaimed areas to prevent erosion of those areas. The reclaimed slopes would be protected using best management practices (BMPs) to reduce erosion into these diversion channels. If a channel has the potential to erode into a reclaimed slope, the bank would be armored temporarily until the reclamation project has been approved. The reclaimed areas would be monitored for erosion until stabilization and revegetation has been achieved. Any areas of major erosion discovered during this monitoring would be repaired, stabilized, and revegetated (RHR, 2012).

With regard to revegetation, salvaged topdressing would be redistributed over regraded areas, amended with mycorrhyzae and organic fertilizers, and then seeded using native, adapted species characteristic of the region and supportive of livestock grazing. The proposed seed mix in table 2 is used at the nearby Lee Ranch Coal Mine, which has similar topography, soils and climatic regime. It has shown to be effective over more than 30 years, and is a mixture of cool and warm season species of grasses, forbs, and shrubs that have demonstrated ability to reestablish in mine reclamation soils and also to support livestock grazing. All species are known for their palatability to livestock and wildlife, are high in nutritive value for native plant species, and have differing seasonal value between species, which makes the mix supportive of the post-mining land use of grazing on a year-round basis (RHR, 2012).

Table 2. Proposed reclamation seed mix for the Roca Honda Mine

Common Name	Scientific Name	Variety/Source	Application Rate*
Cool Season Grasses			
Thickspike Wheatgrass	*Agropyron dasystacyum*	Critana	2.0
Western Wheatgrass	*A. smithii*	Arriba	3.0
Warm Season Grasses			
Blue Grama	*Bouteloua curtipendula*	Hachita or Alma	2.0
Sideoats Grama	*B. gracilis*	Niner or Vaughn	2.0
Galleta	*Hilaria jamesii*	Viva	3.0
Alkali sacaton	*B. curtipendula*	Native	0.1
Forbs			
Munro Globemallow	*Sphaeralcea munroana*	Native	0.4
Blue Flax	*Linum lewisii*	Appar	0.5
Violet Prairie Clover	*Dalea purpurea*	Native	2.0
Shrubs			
4-Wing Saltbush	*Atriplex canescens*	Native	3.0
Winterfat	*Ceratoides lanata*	Native	1.0
Shadscale	*A. confertifolia*	Native	1.0

* Pure live seed lbs per acre (broadcast)

Alternative 3 – Require Modified Plan of Operations (One Shaft Alternative)

Under this alternative (figure 20), the Cibola National Forest supervisor would require RHR to locate most surface facilities and infrastructure associated with the Roca Honda Mine onto Section 16. The production shaft and associated facilities located on Section 10 in the proposed action (alternative 2) would be eliminated in this alternative. The facilities that would be eliminated from Section 10 under alternative 3 duplicate those proposed in alternative 2. The purpose of the Cibola National Forest supervisor requiring this change in the plan of operations would be to reduce the overall acreage of surface impacts from the mine itself by about one-third (from 183 acres to 120 acres).

In the one production shaft alternative, all ore production from the RHR Mine would be achieved by constructing only a single production shaft on State-leased lands in Section 16, i.e., the shaft described in RHR’s proposed action. All of the ore in the permit area would be accessed by excavating underground mine declines horizontally under the ore and vertical raises up into the ore pods. In this alternative, the ore located in Section 10 would be accessed by constructing two long parallel development drifts from the Section 16 shaft northwest into Section 10 to the approximate location where the Section 10 production shaft described in the proposed action would have been constructed (Velasquez, 2011).

Development and subsequent production of this one production shaft scenario would result in a substantially reduced “footprint” of surface disturbance on Section 10 than that described for the proposed action. While RHR identified that the proposed action would disturb 71 acres of land surface on Section 10, the one production shaft alternative would disturb approximately 18 acres in Section 10.

As shown by comparing figure 20 with figures 15-18, all of the surface facilities described by RHR in Sections 16 and 9 for the proposed action would remain in place, with the exception of the location of one of the ventilation shafts. In the one production shaft alternative, the northernmost ventilation shaft in Section 9 and its attendant access road would be eliminated.

This would also result in a surface disturbance of approximately 2 acres in Section 9 rather than the 12 acres identified in the proposed action. In total then, implementation of the one shaft alternative would result in a reduction of surface disturbance of approximately 63 acres, mainly in Section 10.

In the one production shaft alternative, a new ventilation shaft would be constructed in the northeast corner of Section 16. The location of the new ventilation shaft would be accessed via the well access road identified in the proposed action leading from the ventilation shaft located in the southeast corner on Section 9 south to the existing monitoring well in the northeast corner of Section 16.

In Section 10, the production shaft and attendant supporting surface facilities described in the proposed action, except as described below, would be eliminated. All of the buildings including the hoist house, office (including the miners changing facilities, mine safety and rescue, and administrative offices), explosives magazine, assay/scale house, security building, and warehouse would be eliminated. Other structures, including the ore bays, truck wash, power substation, water tank, fuel depot, and emergency generator would also be eliminated. The nonore, shaft material, subsoil, subbase rock, and topsoil stockpiles would all be eliminated. Other surface disturbance manifestations including the mine dewatering wells around the perimeter of the production shaft, the three evaporation ponds, the detention basin, the helipad and parking lot, and the site perimeter fencing would all be eliminated as well (Velasquez, 2011).

The surface facilities remaining in Section 10 in the one production shaft alternative would include the single mine development drill hole, the two ventilation shafts, and the utility and mine dewatering discharge pipeline corridor described in the proposed action. The one production shaft alternative would also require some modifications and additions in Section 10. The two ventilation shafts identified in the proposed action would be relocated as shown on figure 20 to an area roughly coincident with the northeasternmost end of the underground development drift described above. This would provide fresh air into that area of the mine to replace air that would have otherwise been provided by the Section 10 production shaft identified in the proposed action.

Also, two additional ventilation shafts would be constructed generally along the path of the underground development drift. One would be located in the southwest corner of Section 10 as shown on figure 20. The other would be located approximately 200 feet north of where RHR’s proposed action identifies the location of the development drill hole proposed in Section 10.

One of the six dewatering wells in figure 20 is at the same location as the proposed development drill hole. The drill hole would be completed first and then converted to a mine dewatering well. To accommodate the one production shaft alternative, this well would be converted at a later date to a backfill material transport access hole from the surface into the mine through which engineered backfill material would be introduced by gravity into the mine. This area would require a surface work area footprint larger than the typical dewatering well pad, i.e., approximately the same size as the footprint of the ventilation shaft. The surface disturbance footprint of the typical dewatering well would be less than an acre. The anticipated surface disturbance footprint of the backfill hole would be approximately 5 acres, sufficient to accommodate backfill material stockpiling and equipment. In addition, because this area would be the receiving point for imported backfill material, the access road through Section 11 into Section 10 would be needed in the one production shaft alternative. While the purpose of use and length of the haul road would differ from the proposed action, the road would still be constructed up to the location of the backfill hole.

Under this alternative, the overall volume of materials mined (ore and nonore) and the configuration of underground mining tunnels and rooms within the ore-bearing Westwater Canyon Formation would not differ substantially from the proposed action. In other respects as well, the modified plan of operations alternative would be essentially the same as the proposed action. Thus, the description of the three phases in the proposed action—mine development, mine operation, and final reclamation—is applicable to this alternative as well, except that mine development and operation would be more limited to State lands on Section 16 and avoid most of the disturbance to surface lands in Cibola National Forest on Sections 9 and 10.

Project-Specific Forest Plan Amendment

Before either could proceed, alternative 2 and alternative 3 would both require approval by the Cibola National Forest supervisor of a project-specific amendment to the Cibola National Forest plan. The land and resource management plan, in force since 1985, guides management decisions concerning the Cibola National Forest and its resources. Among many other topics, the plan includes standards for the treatment of historic properties on lands managed by the Cibola National Forest. These standards only apply to lands and resources managed by the Cibola National Forest. With regard to the proposed project and its potential for impacts on historic properties, it is important to note the following:

- Standard No. 4 states that historic properties “will be managed during the conduct of undertakings to achieve a ‘no effect’ finding in consultation with the SHPO and the Advisory Council on Historic Preservation.” (USFS, 1985:63)
- Standard No. 5 addresses instances where resource management conflicts occur. It gives a list of conditions under which “preservation of cultural resources in place will be the preferred option.” These conditions include:

  Where the cultural values derive primarily from qualities other than research potential, and where those values are fully realized only when the cultural remains exist undisturbed in their original context(s) (e.g., association with significant historical persons or events, special ethnic or religious values, or unique interpretive values). (USFS, 1985:63)

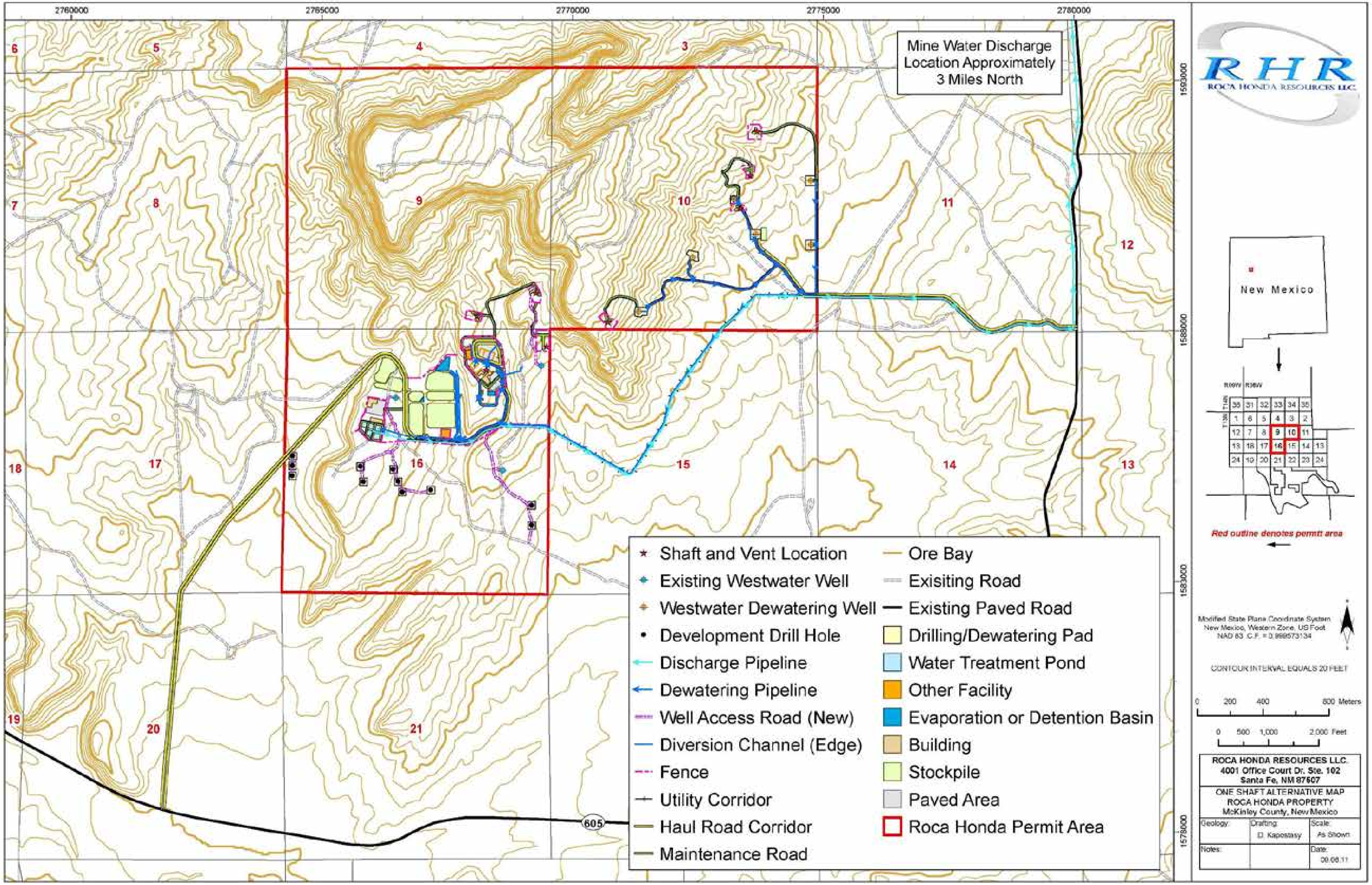


Figure 20. Layout of surface facilities under alternative 3 (one productive shaft alternative)

If this EIS concludes that alternative 2 or alternative 3, or both, were to result in adverse effects to historic properties on Forest Service lands, then selection by the Forest Service of that alternative would be in conflict with these two standards of management for historic properties. Thus, the Forest Service would approve a project-specific forest plan amendment to allow the Roca Honda project to deviate from the forest plan standards of management with regard to historic properties identified above. This amendment would only apply to the Roca Honda Mine project and only to the standards of management with regard to historic properties. The amendment would allow impacts to historic properties resulting from this project, in accordance with normally applicable law, e.g., Section 106 of the NHPA and 36 CFR Part 800.

Mitigation Common to All Alternatives

The Forest Service also developed the following mitigation measures to be used as part of all of the action alternatives. These mitigation measures complement and, to some extent, overlap with draft commitments and measures submitted by RHR to the Forest Service and the State of New Mexico regulatory and resource agencies in the draft mine operations plan, new mine permit application (to MMD), and other documents. With regard to the Forest Service and RHR, mitigation measures will not be finalized, and will not represent firm commitments, until the mine operations plan is approved after the final EIS and record of decision are issued.

The list below is organized by resource topic in the following EIS.

Geology and Soils

- Implement best management practices (BMPs) for erosion control.
- Prepare and implement Storm Water Pollution Prevention Plan (SWPPP) in compliance with EPA and State of New Mexico requirements.
- Implement soil control measures detailed in the mine reclamation plan.
- Examples of measures include using straw bales, wattles (fences of stakes interlaced with twigs or branches), and silt fencing to minimize the transport and loss of soil from erosion and storm runoff; installing sedimentation control structures prior to construction; minimizing the area that must be disturbed; and conducting contemporaneous reclamation during operations.

Water Resources

Surface Water

- Implement BMPs for storm water control.
- Prepare and implement SWPPP.
- Implement storm water controls as detailed in the mine operations plan.
- Implement storm water and erosion controls detailed in the reclamation plan.
- Examples of measures and controls committed to in the plans include installation and implementation of runoff control devices (swales, ditches, fiber mats, and fiber rolls), energy dissipaters, slope drains, sediment traps, evaporation ponds, diversion channels, detention basins, stockpile slope construction, stockpile soil cover, and revegetation.

- Water impoundments constructed onsite would include storm water detention ponds, evaporations ponds, and settling ponds. These ponds would be lined and monitored.
- Construction, operation, and restoration of the mud pits at drilling locations would be in compliance with the Pit Rule (19.15.17 NMAC).
- Some of the arroyos that transect the operational area would be armored or straightened.
- Discharges to surface water courses would be monitored.

Groundwater

- Implementation of offsets (mitigation measures) as defined by NMOSE through the permitting process.
- Discharge plan would include measures to prevent soil water logging or increased flood runoff.
- Mine backfill materials would be mixed with cement prior to placement.
- Implementation of controls as detailed in the Groundwater Discharge Permit (in review by NMED).
- Implement proposed monitoring program to include routine inspection of operating and storage areas, instrumentation of key equipment (as an example, pressure sensors on discharge pipelines), and installation of monitoring wells for overall monitoring of the process areas, including components that do not include leak detection systems per se—for example, the lined retention ponds that drain the stockpiles.

Air Quality

- Implement BMPs to control for fugitive dust.
- Water would be used to control fugitive dust emissions from blasting, drilling, and surface disturbance. Ore stockpiles and waste rock stockpiles would be sprayed with water to minimize the amount of dust generated during loading operations.
- Fuels, explosives, and chemical storage would comply with any applicable fuel storage and fuel dispensing air quality regulations.

Vegetation

- Implement BMPs for storm water control and erosion control.
- Revegetation design would follow the reclamation plan.

Wildlife

- Implement BMPs for control of storm water, erosion, and fugitive dust.
- Conduct periodic inspections of mining activities.
- Implement measures outlined in the mine operations plan. These include:
    - The maximum speed limit on the mine permit area would be posted at 15 miles per hour and signs would be posted along access roads to and around the permit area alerting drivers to the presence of wildlife.

   - Fences would be placed around mine shafts and ventilation holes to keep wildlife out of these areas, and screens would be placed over ventilation openings to deter birds and bats.
   - Power lines and associated equipment such as transformers and substations would be built using BMPs for raptor safety.
   - Appropriate avoidance and minimization measures would be developed in consultation with the Forest Service to address migratory bird nests discovered during mining operations.
   - Pruned and felled trees would be scattered to provide cover, where appropriate. Also when trees are chopped, the mulch would be spread onsite in open areas away from personnel traffic.

Land Use

- Implement BMPs for control of storm water and erosion.

Recreation

- None.

Environmental Justice and Protection of Children

- A spill prevention, control and countermeasures (SPCC) plan would be developed to train workers and employees on handling hazardous substances, prevention of spills, cleaning up spills, emergency or accidental releases, and the notifications and reporting requirements.
- Access to the permit area will be controlled during mining operations to protect the public from possible injury due to operating conditions such as heavy equipment and truck traffic and other operations that have the potential to cause injury to untrained personnel.
- All personnel entering the site will be checked in and allowed access to the administration building only with a company escort.

Socioeconomics

- None.

Cultural and Historic Resources

- Implement BMPs for storm water and erosion control.
- Implement a programmatic agreement (to be developed between the draft EIS and final EIS) that contains measures to avoid, minimize, and mitigate impacts to cultural resources.
- Implement additional facility commitments: initial blading of access roads within proposed haul road routes, perimeter fencing of Sections 10 and 16, well pad fencing and erosion control, and installation of a gate on Section 11 haul road.

Visual Resources

- None.

Transportation

- Implement BMPs as described in the mine operations plan.
- Place construction staging areas where they would least interfere with traffic. All vehicles associated with mine development would be equipped with backing alarms, two-way radios, and slow moving vehicle signs when appropriate. Ore hauling trucks would be placarded and covered with tarps.

Human Health and Safety

- Implement company safety manual that outlines training and sets forth policies and requirements for safe driving procedures such as onsite speed limits and no tolerance of drug or alcohol use.
- Workers would shower and change clothes before leaving the mine facility, and work clothes would remain at the facility to be washed.
- All trucks carrying ore materials would be sprayed down before leaving the site at the vehicle washing station located onsite.
- Implement a detailed SPCC plan to train employees on safety procedures (see the mine operations plan for details).
- Implement best practices for waste management.

Alternatives Considered but Eliminated from Detailed Study

Federal agencies are required by NEPA to rigorously explore and objectively evaluate all reasonable alternatives and to briefly discuss the reasons for eliminating any alternatives that were not developed in detail (40 CFR 1502.14). Public comments received in response to the proposed action provided suggestions for alternative methods for achieving the purpose and need. Some of these alternatives—such as developing renewable resources like wind and solar instead—were outside the immediate scope of the proposal. The Forest Service’s purpose and need regarding this project is to respond to the proposal to exercise Roca Honda’s statutory rights to enter public lands and mine these particular claims.

Renewable Energy Development

Development of renewable energy sources (such as wind and solar) on Cibola National Forest or elsewhere in the region, as an alternative to mining uranium at the Roca Honda site, will not be considered in this EIS. While such projects may well have merit and be worth pursuing in their own right—and indeed are being developed in the area, such as the 102 MW Red Mesa Wind Energy Center in Cibola County (near Bibo)—they do not meet the Forest Service’s purpose and need as defined above.

Treated Water Discharge in an Alternative Location

This alternative was the original proposed action at the time of scoping in December 2010, under which the Roca Honda Mine would have discharged treated groundwater from the mine into an unnamed arroyo on Section 16. It was eliminated because, according to expert opinion, its potential impacts on water resources would be difficult to ascertain without lengthy, costly, and possibly inconclusive investigation, and these effects could possibly be moderate to major, as well as controversial.

This unnamed arroyo (figures 21 and 22) is characterized by ephemeral or intermittent flows (i.e., it is dry most of the time), and it is tributary to San Mateo Creek. Discharging up to 4,000 gpm of treated water into the arroyo would have changed its flow regime from ephemeral to permanent for the duration of the mine.

This alternative, in other respects identical to the current proposed action, was complicated by the presence of legacy environmental effects from previous eras of uranium mining and milling in the San Mateo Creek watershed. These legacy effects made evaluation of potential environmental effects of the proposed Roca Honda Mine discharge much more difficult (Nelson, 2011).

Groundwater pumped from the mine would have been treated as necessary to meet an NPDES permit prior to discharge into a tributary to San Mateo Creek. However, legacy mine water discharges from historic uranium mining and milling operations are suspected of causing contamination in sediments and alluvium in the San Mateo Creek watershed downstream of the proposed Roca Honda Mine discharge. Discharge of treated water meeting NPDES standards could potentially “rinse” these potential legacy contaminants from sediments and unconsolidated alluvial sediments within the San Mateo Creek watershed, and transport these contaminants into surface water or groundwater.

Figure 21. Arroyo originally intended to receive treated water from Roca Honda Mine at approximate point of discharge

Figure 22. Bottom of same unnamed arroyo originally intended for water discharge

Here, the term “rinse” refers broadly to various water–rock interactions that could result in transfer of potential legacy contaminants from the solid phase to the dissolved phase. Dissolved solids discharged in mine water from legacy operations may have been sequestered into the sediments and alluvium of San Mateo Creek though mechanisms such as adsorption of dissolved solids to mineral surfaces, mineral co–precipitation, or ion exchange reactions. Although these mechanisms would have sequestered contaminants from the discharged mine water into the solid phase, such reactions are reversible to some extent. Treated water discharged from the Roca Honda Mine could potentially cause rinsing of legacy contaminants through desorption or ion exchange reactions. The processes could lead to mobilization of potential legacy contaminants from the solid phase to the dissolved phase, and cause adverse effects to surface or groundwater quality downstream from the mine (Nelson, 2011).

Another consideration related to legacy pollution that affected the viability of this alternative is the presence of a former uranium mill site downstream from the proposed Roca Honda Mine discharge. At this site, the Homestake Mining Company Mill Superfund Site, groundwater contamination occurs within the San Mateo Creek alluvial aquifer, and groundwater remediation is currently in progress. Groundwater contamination within the San Mateo alluvial aquifer is also reported to be present downgradient (southwest) from the Homestake Mill (NMED, 2010), and up–gradient from the Homestake Mill. This up–gradient contamination is attributed to still other legacy mines and mills in the Ambrosia Lake District.

During scoping, State agencies and members of the public raised concerns about the possible interaction between the Roca Honda Mine and legacy contamination. Ultimately, due to these various complications and uncertainties, RHR voluntarily changed their proposal and the interdisciplinary EIS team dropped this alternative from detailed consideration, and replaced it with what is now the proposed action.

Single Production Shaft in Section 10

The interdisciplinary team considered, but dismissed from more detailed analysis, the option to construct a single production shaft in Section 10. In this alternative, all of the ore in the permit area would be accessed by excavating horizontally underground from this shaft to the ore deposits. All of the facilities planned for Section 16 under the proposed action would be constructed instead in Section 10. Construction of ventilation shafts and associated access in Sections 9 and 16 would still be required. This alternative was dismissed from detailed analysis for multiple reasons.

There is a concern about reducing the overall visibility of the mine facilities, especially from the adjoining private land, the community of San Mateo, from Mt. Taylor, and those traveling Highway 605. The Section 16 topography is defined by long ridges and valleys. The facilities in this section were planned to be located as much as possible within the valleys, utilizing the ridges to hide them from view. By contrast, the portion of Section 10 that would house facilities is an open, gentle slope that is angled toward Mt. Taylor, the village of San Mateo, and the highway and, thus, almost all mine facilities located on this slope would be readily visible from these vantage points, as well as from adjacent private land. Placing the full facility on the topography of Section 10 would increase the visual impact of the mine.

There is a concern with increasing traffic on Highway 605 past the village of San Mateo. Locating one shaft and the mine facilities solely on Section 10 would funnel all traffic, including all haul trucks, past the village of San Mateo. This impact would be greater for this alternative versus locating the two shafts on Section 16 and 10, as proposed, or much greater than locating one shaft on Section 16.

The mine plan of operations proposed to access the ore in Section 16 and then expand the mine toward Section 10, where a second shaft was proposed to be constructed at a later date. Initial access to the ore-bearing zone was proposed for Section 16 because the ore body is shallower in Section 16 and the mine could be put into production sooner. The ore body in Section 10 is deeper, and would require an additional year of underground drilling before it could be accessed. In addition to the time factor, and also due to the depth of the ore body, the cost of a single shaft located in Section 10 would be more expensive than a single shaft in Section 16. Both are significant circumstances that would increase the costs of developing the mine before it could begin to generate revenue.

Another impact associated with locating a one-shaft mine all on Section 10 (except for the previously identified ventilation shafts) is that the surface footprint would be greater on Section 10 over a one-shaft alternative located all on Section 16. The total facilities footprint itself would be similar in size to that associated with a one-shaft alternative in Section 16, but since the shaft would be one-third deeper, one-third more waste rock would be generated in sinking the shaft. This would necessitate a larger area for storing rock associated with shaft construction. The total footprint (mine facilities plus all rock removed during shaft construction) for this alternative would be larger than the footprint for having a one-shaft facility located in Section 16.

Comparison of Alternatives

This section provides a summary of the effects of implementing each alternative. Information in table 3 is focused on activities and effects where different levels of effects or outputs can be distinguished quantitatively or qualitatively among alternatives.

Table 3. Impact comparison matrix

Topic	Alternative 1 – No Action	Alternative 2 – Proposed Action (Two-shaft alternative)	Alternative 3 – One-shaft Alternative
Geology and Soils	• No disturbance of surface topography and soils on Sections 9, 10, and 16. • No excavation within Westwater Canyon Formation, no extraction of uranium ore, and no back-filling of excavated spaces and rooms. • In sum, would have essentially no impacts on geology and soils at the RHR permit site.	• Hundreds of thousands to millions of cubic yards of ore and nonore rock would be mined and extracted over the life of the mine. • Permanent changes to the geologic character and structure of large volumes within the Westwater Canyon Member of the Morrison Formation. • Overall impacts to geology would be direct, long term, localized, moderate, probable, and of slight precedence or uniqueness. • Impacts on geology would be less than significant. • Direct, medium term to long term, localized adverse impacts on soils at mine site. • Placement of treated water (water reuse) pipeline would have negligible, short-term, localized effects on soils. • Upon completion of reclamation, soils should be stabilized sufficiently to support restoration of vegetation. • Disturbed soils would not recover 100 percent of their predisturbance condition for centuries. • In conclusion, impacts on both geology and soils would be less than significant.	• Impacts on geology very similar to alternative 2's impacts. • Impacts on geology would be less than significant. • Impacts on soils of a similar nature to those of alternative 2, but reduced in scale. • Alternative 3 reduces alternative 2's area of surface disturbance overall by 29%; 155 acres vs 218 acres. • Alternative 3 has a lower potential to disturb soils than alternative 2. • In sum, impacts on soils would be less than significant.

Topic	Alternative 1 – No Action	Alternative 2 – Proposed Action (Two-shaft alternative)	Alternative 3 – One-shaft Alternative
Surface Water Resources	• No impacts to surface water resources beyond the naturally occurring effects of storm water, erosion, flooding, and drought that are existing conditions at the site.	• Potential to adversely affect surface water resources, but these effects can be mitigated by appropriate actions during construction, operation, and reclamation. • Majority of potential surface water effects are associated with storm water and its impacts on water quality, sediment movement, and flooding. • Overall impacts on surface water, after all permit conditions and mitigation, would be direct and indirect, short term and long term, localized, minor, probable, and of slight precedence or uniqueness. • In conclusion, impacts on surface water would be less than significant. • Little or no cumulative effects on surface water resources.	• Effects on surface water would be very similar to but perhaps less than alternative 2, due to the reduced area of ground surface disturbance, most of which would be confined to Section 16 on State lands off the national forest. • Ground surface disturbance and localized impacts on surface water would be reduced on Sections 9 and 10 within the Cibola National Forest. • The same water quality mitigation measures and BMPs would be employed as in alternative 2. • Overall impacts on surface water, after all permit conditions and mitigation measures, would be direct and indirect, short term and long term, localized, minor, probable, and of slight precedence or uniqueness. • In conclusion, impacts on surface water would be less than significant.
Groundwater Resources Groundwater	• No mine constructed and no groundwater pumped out of the Westwater Canyon Member under Sections 9, 10, and 16. • No direct or indirect impacts on groundwater resources. • From other projects and actions, 20,000 AFY of new pumping from existing water rights, which would be an overestimate if there is little future mining development, but possibly low if uranium prices greatly increase.	• Model predicts mine dewatering would form cones of depression in pumped aquifers centered in the permit area and sized in proportion to the rate and total amount of pumping. • Maximum drawdown of Westwater at the mine site is 1,806 feet at the end of mining. • 100 years after mining has ceased, draw-down in the Westwater would still be both broad (10 foot drawdown about 17 miles out; 1 foot to as much as 27 miles out) and shallow (30 foot maximum drawdown at	• Impacts from the one-shaft alternative would be identical in kind and only slightly less in magnitude than from the two-shaft option (alternative 2). • Overall effects on groundwater would be direct and indirect, long term, of large extent and moderate magnitude. • Impacts adverse and significant. • Cumulative long-term effects from all possible actions likely to be significant.

Topic	Alternative 1 – No Action	Alternative 2 – Proposed Action (Two-shaft alternative)	Alternative 3 – One-shaft Alternative
Resources (cont.)	• From development of other mines, substantial cumulative impacts near Gallup, Crownpoint, Ambrosia Lake, and other potential mining areas where bulk of existing but currently unused water rights found.	mine itself). • These impacts are very large and long lasting, adverse, and significant. • No significant impact to San Mateo community well. • Impact on ranch well 143 would be immediate and large, reaching about 200 foot maximum drawdown; water levels recover after mining ceases. • No impact at Crownpoint, where community wells also draw from Westwater but are outside the cone of depression of the mine. • Would likely dry up Bridge Spring for foreseeable future. • No impact on other springs in vicinity of mine, including the following: San Miguel (Menefee), San José de Atarque (Mancos), or San Lucas, Maruca, La Mosca, El Rito, San Mateo, Cienega, Gooseberry, Gummi, and De Armand. • No significant impact of RHR pumping on Horace Springs; however, there may be a small cumulative effect on the springs as a result of combined pumping from all sources over the coming century. • Impacts to the San Juan River and Rio Puerco are minimized by distance but would be very long lasting. • Severe legacy impacts to groundwater quality would not occur, but could be some adverse water quality effects from backfilling and from increased waterflow	

Topic	Alternative 1 – No Action	Alternative 2 – Proposed Action (Two-shaft alternative)	Alternative 3 – One-shaft Alternative
		through the Westwater. • Overall effects on groundwater would be direct and indirect, long term, of large extent, and moderate magnitude. • Impacts adverse and significant. • Cumulative long-term effects from all possible actions likely to be significant.	
Air Quality	• No direct or indirect impacts to air quality. • No radon-222 releases to the air. • No environmental consequences from radon-222 emission. Background radon-222 concentrations in and around the proposed Roca Honda Mine would likely remain as they are today.	• Short- and medium-term minor adverse effects would be expected from criteria pollutants. • Short-term effects limited to fugitive dust and diesel emissions from drilling and heavy equipment during mine development. • Medium-term effects due to fugitive dust and heavy vehicle emissions during drilling and blasting and the transportation of materials during mine operation and reclamation. • Would not exceed *de minimis* thresholds under the general conformity rule, or contribute to a violation of any State, Federal, or local air regulation. • Radon doses to people living continuously or collecting wood in the vicinity of the mine would not exceed the safety standard of 10 mrem/y due to radon emissions from underground uranium mines. • Overall impacts on air quality adverse but less than significant.	• Impacts of alternative 3 on air quality, including radon-222 emissions, would be essentially the same as from alternative 2. • Overall impacts on air quality adverse but less than significant.

Topic	Alternative 1 – No Action	Alternative 2 – Proposed Action (Two-shaft alternative)	Alternative 3 – One-shaft Alternative
Vegetation	• Would have essentially no impacts on vegetation at the RHR permit site. • No disturbance of the site's vegetation communities and sensitive plants from clearing, grubbing, grading, and other project-related activities, either at the mine site or along the proposed treated water pipeline route. • Natural and unnatural disturbances may occur in the area, as they have in the past, but overall, the three communities now present – juniper savanna, piñon-juniper woodland, and grassland and/or shrubland – would be expected to remain for some decades into the future. • Over the coming decades, climate change's effects may begin to alter the vegetation composition and structure of the RHR permit area, with some species and commun-ities increasing in abundance while others decrease.	• A total of 218 acres of vegetation would be severely disturbed or essentially eliminated for the duration of the mine—183 acres within the three main sections (12 acres in Section 9; 71 acres in Section 10; and 100 acres in Section 16) plus 35 additional acres. • Most of the impacted acreage in Section 9 would be piñon-juniper woodland; in Section 10 desert grassland/shrubland; and in Section 16 juniper savanna and desert grassland/shrubland. • Unlikely to affect special status plant species. • Negligible to minor linear impacts to existing vegetation communities on approximately 84 acres of right-of-way along the proposed treated water pipeline route. • Overall impacts to vegetation would be both short term and long term (but not permanent). Short-term impacts would be adverse, localized, moderate in magnitude, probable, and of slight to moderate precedence/uniqueness. • Long-term impacts would be fewer because of proposed reclamation and mitigation. They would be adverse, localized, negligible to minor in magnitude, probable, and of slight uniqueness. • In sum, impacts on vegetation within the RHR permit area would be less than significant. • Cumulative impacts to vegetation are minor.	• Overall impacts on vegetation would be of a similar nature to but on a smaller scale (155 acres of disturbance) than those from alternative 2 (218 acres). • For duration of the mine, would result in disturbance or elimination of approximately 120 acres of vegetation, of which 20 acres would be Cibola National Forest lands in Sections 9 and 10—compared to 83 acres of Cibola National Forest vegetation adversely affected by alternative 2. • Alternative 3 reduces the area of impacts to vegetation from the mine itself overall by about 29% and the area of vegetation impacts on National Forest System lands by about three-quarters (76%). • Impacts would persist for about 2 decades, for the operational lifetime of the mine. Upon reclamation and revegetation, the magnitude and extent of these adverse effects would gradually diminish as restoration took place. • Not likely to affect special status plant species. • In sum, impacts on vegetation would be less than significant. • Cumulative impacts to vegetation are minor.

Topic	Alternative 1 – No Action	Alternative 2 – Proposed Action (Two-shaft alternative)	Alternative 3 – One-shaft Alternative
Wildlife	• No impacts from mine development, operation, and reclamation. • No wildlife mortality; habitat loss, degradation, and fragmentation; or displacement would occur. • Exposure to low levels of radioactivity in the environment from past mining projects would occur, but additional uranium and radon-related contamination would not occur. • Overall adverse effects from cumulative actions to wildlife would be minor, possible, long term, medium in extent, and slight in precedence.	• Mine development, operation, and reclamation may impact wildlife through mortality; habitat loss, alteration, degradation, and fragmentation; displacement; and exposure to chemical and radiation hazards associated with bioaccumulation in the air, soil, vegetation, and prey species. • Overall adverse impacts on wildlife, including bats and migratory birds, would be direct and indirect, short term and long term, localized, minor, to moderate probable, and of slight precedence. • Once mining activities have ceased and reclamation has occurred, both wildlife numbers and species diversity are expected to return to their pre-mine levels over a period of years as habitats are restored. • In sum, impacts on wildlife would be less than significant. • Cumulative effects on wildlife would be similar to those for vegetation because of the dependence of wildlife on habitat. • Past impacts to the piñon-juniper woodland habitat and wildlife in the project vicinity include livestock grazing, timber harvesting, recreation (e.g., hunting), exploratory drilling, mining, power line construction, timber harvesting, recreation, and access road construction. • No significant cumulative impacts are expected to occur to wildlife species, including any Forest Service listed sensitive, MIS, or migratory bird species or their habitat.	• Overall adverse impacts would be somewhat less than the impacts from alternative 2, because of reduced habitat conversion during mine construction and operations. • Impacts to general wildlife, including migratory birds and bats, would be qualitatively similar and quantitatively somewhat less than alternative 2. • Impacts would be direct and indirect, short term and long term, localized, minor to moderate probable, and of slight precedence or uniqueness. • In most instances, once mining activities have ceased and reclamation has occurred, both wildlife numbers and species diversity are expected to return to their pre-mine levels over a period of years as habitats are restored. • In sum, impacts on wildlife would be less than significant. • Cumulative effects would be similar to those of alternative 2.

Topic	Alternative 1 – No Action	Alternative 2 – Proposed Action (Two-shaft alternative)	Alternative 3 – One-shaft Alternative
Sensitive, Threatened, and Endangered Species	• No additional impacts to sensitive, threatened and endangered species with the no action alternative. • Wildlife mortality; habitat loss, degradation, and fragmentation; and displacement would not occur. • Exposure to radionuclides in the environment from past mining projects would occur, but additional radionuclide contamination would not occur. • Adverse effects to sensitive, threatened, and endangered species would be minor, possible, long term, and medium in extent, and slight in precedence.	• Conversion and development of wildlife habitat during mine operations could result in changes in the prey base of bats. • Habitat loss and disturbance could impact roosting sites for some bat species and cause some bat species to avoid the area. • Direct bat mortality could also occur. • Overall adverse effects to listed bats would be long term, minor to moderate in magnitude, and medium in extent. • After reclamation, populations of listed bat species expected to return in a few years to pre-mine levels. • Possible temporary, direct and indirect adverse effects to onsite Gunnison's prairie dogs from a variety of mine related activities. • Population recovery of the Gunnison's prairie dog expected after reclamation. • For duration of mining, possible direct or indirect adverse impacts to other State listed species, including the red fox, ringtail, western spotted skunk, peregrine falcon, loggerhead shrike, and gray vireo; recovery of each likely after reclamation. • Overall impacts would be direct and indirect, short term and long term, localized, minor to moderate, probable, and of slight precedence or uniqueness. • In sum, impacts to special status wildlife would be less than significant.	• Impacts to sensitive, threatened, and endangered species would be similar, but likely less than, impacts under alternative 2 because of the reduction in the project footprint and disturbed acreage. • Because fewer habitats and less acreage would be altered and developed, overall adverse effects to sensitive, threatened, and endangered species are expected to be less except to migratory birds. • Adverse effects to migratory birds are expected to be long term, minor to moderate in magnitude, and medium in extent, probable to possible and slight to moderate in precedence. • Once mining activities have ceased and reclamation has occurred, populations of any special status species which now occur within the permit area are likely to return to their pre-mine levels over a period of years as habitats are restored. • In conclusion, impacts on special status species would be less than significant. • Cumulative impacts on special status species of all reasonably foreseeable actions would likely be minor to moderately adverse but not significant.

Topic	Alternative 1 – No Action	Alternative 2 – Proposed Action (Two-shaft alternative)	Alternative 3 – One-shaft Alternative
Land Use	• Current land uses would remain in place on Sections 9 and 10, the Federal lands, on Section 16, the State of New Mexico lands, as well as on Sections 11, 15, 17, and 20, the private lands through which utility corridors and access roads would be utilized in the mining operations. • With existing land uses remaining as they currently are, there would be no effects to land use. • Overall impact on land use not significant.	• RHR would limit access to all of the development and operations areas to the extent necessary to protect public safety and control the work space. • To the extent that fencing and other access limiting controls are in place, those areas would not be available for the current land uses of grazing, firewood gathering, or hunting. • Temporary removal of some of lands as grazing allotments may have a restorative effect on forage production within those parcels on these lands that contain growing areas. • Because of the extended range of firearms and potential danger to mine workers, hunting activity may be restricted from access at a distance greater than simply the perimeter of fencing around the mine. • The proposed post-mining land use of grazing is consistent with the Cibola National Forest LRMP. • Overall impact on land use, while adverse, would not be significant.	• Effects are relatively similar to those of alternative 2, but on a somewhat smaller scale. • Overall impact on land use, while adverse, would not be significant.
Recreation	• Current recreational uses would continue on Sections 9 and 10, the Federal lands; and on Section 16, the State of New Mexico lands. • There would be no effects on recreation to consider, and the overall impact would be less than significant.	• Distance of the proposed mine from designated recreation sites is great enough that there would be a negligible direct effect on the recreation experience at these sites as a result of mining operations. • Existing recreational activities on and near the permit itself would be curtailed or restricted for the duration of the mine, or approximately two decades.	• Adverse effects on recreation are qualitatively similar to those of alternative 2, but on a somewhat smaller scale. • Overall impact on recreation would not be significant.

Topic	Alternative 1 – No Action	Alternative 2 – Proposed Action (Two-shaft alternative)	Alternative 3 – One-shaft Alternative
Recreation (cont.)		• Restrictions would temporarily limit hunting in a very small fraction of the area open to hunting within the Cibola National Forest and Mt. Taylor Ranger District. • Overall, impacts on recreation would be adverse, of minor magnitude, medium term in duration, small in extent, of probable likelihood, and slight precedence. • In sum, impacts would not be significant.	
Environmental Justice and Protection of Children	• Since ongoing activities would be substantially the same as those already occurring, no significant additional change in community character and setting would be anticipated. • Existing conditions would remain substantially unchanged and have no effect on the populations of concern.	• Would potentially create beneficial impacts due to the provision of jobs and economic opportunities in minority and low-income communities. • Potential adverse impacts of minor magnitude due to potential health risks for miners and nearby residents of San Mateo, as well as adverse impacts associated with increased income. • Adverse mental health impacts of moderate magnitude would occur to tribal environmental justice communities due to mine development so close to spiritually significant Mt. Taylor. • Health impacts to miners from exposure to radon and other environmental hazards is possible. • Provision of jobs to environmental justice communities would be medium term to long term and last roughly 2 decades; impacts would be reversed in the long term once the mine closes and well paying mining jobs are lost.	• Impacts from the one-shaft alternative would be essentially identical to those of alternative 2.
Environmental Justice		• Health risks to miners would be both short	

Topic	Alternative 1 – No Action	Alternative 2 – Proposed Action (Two-shaft alternative)	Alternative 3 – One-shaft Alternative
and Protection of Children (cont.)		and long term, as diseases from radiation or toxics exposure may become manifest after the mine's lifetime. • Not expected to disproportionately expose children to toxic substances, radionuclides, or other safety hazards. • Would potentially create impacts of negligible to minor magnitude due to increased risk of inhaling fugitive dust and exhaust emissions from vehicles and mining equipment. • Both beneficial and adverse effects on EJ would likely be significant. • Moderately beneficial and adverse cumulative effects related to environmental justice would likely occur. • Beneficial and adverse cumulative effects would likely be significant.	
Socioeconomics Socioeconomics (cont.)	• No socioeconomic changes would occur to the counties in the ROI. • Since ongoing activities would be substantially the same as those already occurring, no significant additional change in community character and setting would be anticipated.	• Would potentially create beneficial impacts of moderate magnitude due to the creation of jobs, labor income, and tax revenues. • Overall, would support over a billion dollars in economic activity, about 2,400 jobs with salaries worth $355 million, and generate $81 million in local and State revenue during the life of the project. • Although it would yield tangible economic benefits for the region during its approximately 2 decades of construction, operation, and reclamation, the mine remains controversial due to the historical uranium boom and bust cycles that have	• Direct, indirect, and cumulative socioeconomic impacts would be virtually identical to those of alternative 2.

Topic	Alternative 1 – No Action	Alternative 2 – Proposed Action (Two-shaft alternative)	Alternative 3 – One-shaft Alternative
		occurred in the region and elsewhere. • Provided the global price of uranium remains favorable, several other reasonably foreseeable exploration and mining projects are also likely to occur. • Under this scenario, the projects in combination would support several billion dollars in economic activity, which would represent a significantly beneficial cumulative economic impact for the ROI over the coming decades, though perhaps not a source of permanent prosperity.	
Cultural and Historic Resources Cultural and Historic	• No additional impacts to cultural resources from mine development, operation, and reclamation. • Impacts to cultural resources already occurring from livestock management and access to the area by the public would continue; these include vandalism, trampling, and inadvertent damage. • Adverse impacts to cultural resources would be less than significant.	• Would cause adverse impacts to tribal cultural resources and practices related to the sacred character of Mt. Taylor for the Acoma, Laguna, Zuni, Hopi, and Navajo in particular. • Would adversely affect the Mt. Taylor TCP and cause irreparable harm to surrounding tribes and their traditional cultural practices. • Would have a perceived impact upon the Spirit Beings associated with the TCP. • Would cause adverse effects in the view of the tribes because of concerns about the toxic nature of uranium and the perceived waste of water, the lifeblood of the sacred mountain. • Ground disturbance from construction activities would result in direct physical impacts to four historic properties, plus the Mt. Taylor TCP, which would be permanent and severe in magnitude. • Construction of mine facilities would	• Direct and indirect impacts to historic properties and other cultural resources identified by the tribes would occur. • Direct and indirect adverse effects to historic properties, to natural features within the setting of historic properties, and to the visual and audible characteristics of historic property settings would occur. • Direct physical impacts would occur to four historic properties, plus the Mt. Taylor TCP. • During the operational phase, indirect physical disturbance of historic properties could occur from changed erosion patterns, inadvertent impacts, and vandalism or illegal artifact collecting. • Due to less development in Section 10 with less ground disturbance, fewer surface facilities, and less activity and traffic, the totality of the impacts to the Mt. Taylor TCP and related resources would be less

Topic	Alternative 1 – No Action	Alternative 2 – Proposed Action (Two-shaft alternative)	Alternative 3 – One-shaft Alternative
Resources (cont.)		result in impacts to physical features within the Mt. Taylor TCP's setting that contribute to its historic significance. • During the operational phase, indirect physical disturbance of historic properties could occur from changed erosion patterns, inadvertent impacts, and vandalism or illegal artifact collecting. • Operation and reclamation activities at would continue to introduce visual and audible elements out of character with the Mt. Taylor TCP, further impacting the setting of this historic property. • After reclamation, the setting of the Mt. Taylor TCP would not be the same as it is currently, but the reclaimed area would fit in with the surrounding landscape. • Would cause impacts to natural resources with cultural value, such as springs, aquifers, wildlife and vegetation. • In sum, impacts on cultural resources would be significant, and the proposed action would result in an adverse effect to historic properties. • Other past, current, and future projects are also anticipated to result in significant impacts. • Cumulative effect of the proposed action in combination with others would be adverse and significant, exacerbating loss of integrity of Mt. Taylor TCP.	than alternative 2. • Impacts on cultural resources would still be significant, and alternative 3 would result in an adverse effect to historic properties. • Other past, current, and future projects are also anticipated to result in significant impacts. • Cumulative effect of alternative 3 in combination with others would be adverse and significant, exacerbating loss of integrity of Mt. Taylor TCP.
Visual Resources	• Visual aesthetics at the proposed site would remain unchanged.	• Mining operation plan describes the following practices that would take place to follow the naturally established form,	• Viewshed is smaller than that of alternative 2, in that the area east and northeast of

Topic	Alternative 1 – No Action	Alternative 2 – Proposed Action (Two-shaft alternative)	Alternative 3 – One-shaft Alternative
	• Would have no impacts to visual resources.	line, and color: - All exterior colors will be selected from a list of colors approved by Forest Service. - The combination of use of existing vegetation, berming of soil wherever possible, vegetation of exposed stockpiles, and selection of appropriate use of color schemes for the facilities will all aid in mitigating impact to scenic values. - At Section 10, scenic values will be protected by utilizing the existing vegetation as a visual break between the facility and the public road. • Magnitude of impacts to the permit area would fit in with the Forest Service visual quality objectives for the area. Therefore, the magnitude of impacts would be minor. • Largest impact would be from viewers on Mt. Taylor. • Overall impacts to visual resources would be adverse but not significant. • Cumulative impact on visual resources would be medium term but impermanent and adverse but not significantly adverse.	Section 10 would not be impacted. • Impacts to visual resources would be of minor magnitude, medium term, of a small extent, probable, and of moderate uniqueness. • Moderate uniqueness is due to the proximity of the proposed mine to Mt. Taylor. • The small extent of the impacts is mainly due to the small number of viewers; this is especially because the facilities would not been seen from any major roadways. • Largest impact would be from viewers on Mt. Taylor. • Overall impacts to visual resources would be adverse but not significant. • Cumulative impact on visual resources would be medium term but impermanent and adverse but not significantly adverse.
Transportation Transportation (cont.)	• No impacts to transportation resources. • Conditions would remain as described under the “Transportation Affected Environment” section.	• Would have short and long term minor effects to transportation. • Short-term effects during mine development and reclamation would be due to the delivery of heavy equipment, pipe, water treatment equipment and supplies, as well as their removal during reclamation activities. • Long-term minor effects would be due to	• Impacts would be broadly similar to alternative 2. • Forest Service roads in Sections 9 and 10 would not be used. • County Road 605 would be the arterial roadway leading to the site and aggregate access roads would be developed.

Topic	Alternative 1 – No Action	Alternative 2 – Proposed Action (Two-shaft alternative)	Alternative 3 – One-shaft Alternative
		ore hauling trucks, continued delivery of supplies, and worker commutes. • Would contribute small changes in localized traffic patterns. • Would have no impact on public transit or air traffic in the area. • Traffic congestion would increase at and around the site due to additional heavy vehicles associated with mine development. • Upgrades to roadways accessing the site would make local road infrastructure sufficient to support mining activities. • To haul uranium ore, about 50 truck trips per 24 hours or about 2.1 trucks per hour would be expected in each direction. • Risks from transportation of uranium ore are dominated by conventional risks associated with virtually all commercial transportation and the probability of accident related fatalities is no different than those associated with conventional truck transportation. • Long-term beneficial effects would be due to upgrades to roadways. • No significant cumulative effects expected.	
Human Health and Safety Human Health and Safety (cont.)	• Conditions described under the "Affected Environment" section for "Human Health and Safety" would continue for the foreseeable future. • Not expected to have any impact	• May entail direct and indirect effects on five important pathways related to the health and safety: traffic safety; noise; environmental exposure; impacts stemming from employment; and impacts stemming from in-migrating workers.	• Impacts on human health and safety would be essentially identical to alternative 2.

Topic	Alternative 1 – No Action	Alternative 2 – Proposed Action (Two-shaft alternative)	Alternative 3 – One-shaft Alternative
Human Health and Safety (cont.)	on these conditions.	• Impacts to traffic safety expected to be of minor to moderate magnitude, to have a medium to large geographic extent, and to be of short- to medium-term duration. • Overall impact on traffic safety would be adverse but less than significant. • The remoteness of the project site means that human receptors unlikely to face noise above the 40-55 dBA range. • However, it is possible that some residents along haul routes would become annoyed with increased noise levels due to truck traffic. • Overall noise impacts would be adverse but not significantly adverse. • While actual contamination of water, air, and soil is predicted to be minor or minimal at most, perceived contamination on the part of Native Americans, along with actual changes to water and land from the project in the vicinity of sacred lands, especially within the context of uranium mining and milling legacy issues, may have real effects on the mental and physical health of some community members. • In sum, likely impacts to health from environmental exposures are expected to be of moderate magnitude, to have a medium geographic extent, and to be of medium- to long-term duration. • Overall level of environmental health impacts would be less than significant.	

Topic	Alternative 1 – No Action	Alternative 2 – Proposed Action (Two-shaft alternative)	Alternative 3 – One-shaft Alternative
Human Health and		• Resulting employment has the potential to impact health through two pathways: providing jobs and income to individuals and exposing those individuals to a specific set of working conditions. • Jobs and income are strongly associated with a number of beneficial health outcomes such as an increase in life expectancy, improved child health status, improved mental health, and reduced rates of chronic and acute disease morbidity and mortality. • At the same time, in some settings, income and employment also promote a number of adverse health outcomes such as social pathologies. • Overall, positive impacts to health stemming from employment would be less than significant. • Potential adverse effects on health stemming from employment would be less than significant. • Introduction of a transient workforce population into an established community often changes the social functioning of that community in negative ways. • Increased rates of sexually transmitted diseases are common when male worker populations making high wages are sited near small/medium-sized communities. • Workforce migration has potential to increase rates of infectious respiratory disease.	

Topic	Alternative 1 – No Action	Alternative 2 – Proposed Action (Two-shaft alternative)	Alternative 3 – One-shaft Alternative
Safety (cont.)		• May increase demand on local health care services through the direct or indirect increase of certain conditions including alcohol and drug related issues, social pathology and increased rates of infectious disease. • Overall impacts to health stemming from workforce migration would be less than significant. • Stress and anxiety levels of residents in the ROI and, in turn, the mental, physical, and social health effects of these feelings, are affected by both historical and present-day factors, which include known and unknown health effects of uranium mining and large number of unreclaimed and contaminated mine sites within the area. • High levels of poverty and the past reality and future possibility of a boom-bust cycle magnify the potential for impacts to mental health in the ROI. • Overall cumulative impacts on human health and safety would be significant.	

Topic	Alternative 1 – No Action	Alternative 2 – Proposed Action (Two-shaft alternative)	Alternative 3 – One-shaft Alternative
Legacy Issues	• Because of little or lax regulation during the earlier (pre-1990s) round of uranium mining, New Mexico was left with a legacy of environmental contamination and health problems. • Legacy issues associated with contamination and health and safety impacts from past uranium mining and milling would continue for the foreseeable future. • Ongoing environmental cleanup, reclamation, and remediation would gradually reduce actual levels of contamination and potential exposure but confidence would take longer to be restored and certain long-term health effects from past exposures would continue to play out. • Elevated lung cancer rates were documented in underground uranium miners, especially among those who also smoked. • Uranium mill workers exposed to uranium dusts and mill products showed no clear evidence of uranium-related disease, indicating that exposure to normal levels of uranium ore was not an acute health risk, unlike exposure to radon within	• Same as alternative 1. • The lack of open pit mining, leachate treatment, ore milling, in situ leachate handling, and wastepile disposal; and the requirements for ventilation and similar health and safety requirements of current uranium mining regulations suggest that there is little or no connection between the legacy health issues of uranium mining and processing in the past, and anticipated health and safety effects from the proposed Roca Honda Mine.	• Same as alternative 2.

Topic	Alternative 1 – No Action	Alternative 2 – Proposed Action (Two-shaft alternative)	Alternative 3 – One-shaft Alternative
Legacy Issues (cont.)	an enclosed mine. • Native American miners had more nonmalignant respiratory disease from underground uranium mining, and less disease from smoking, than other miners, and were less likely to receive compensation for mining-related disease. • According to one recent study, the excesses of lung cancer among men seem likely to be due to previously reported risks among underground miners from exposure to radon gas and its decay products. • With the exception of male lung cancer, this study provided no clear or consistent evidence that operation of uranium mills and mines adversely affected cancer incidence or mortality of Cibola County residents in general. • The Radiation Exposure Compensation Act (RECA) of 1990 required payments to uranium miners diagnosed with cancer or other respiratory ailments; subsequent amendments expanded the number of claimants. • The Uranium Mill Tailings Radiation Control Act (UMTRA) of 1978 was passed to ensure that uranium mill		

Topic	Alternative 1 – No Action	Alternative 2 – Proposed Action (Two-shaft alternative)	Alternative 3 – One-shaft Alternative
	tailings be managed and cleaned up as appropriate; it designated 22 inactive uranium ore processing sites for remediation, including Shiprock and Ambrosia Lake in New Mexico.		

Other Actions and Projects Considered in Cumulative Effects Analysis

Introduction

The mile-deep Grand Canyon of the Colorado River in Arizona is a dramatic illustration of cumulative impacts, although in this case from natural forces—erosion occurring over 6 million years—rather than human causes.

In the context of NEPA and EISs, the Council on Environmental Quality's (CEQ) Regulations (40 CFR 1500–1508) implementing the procedural provisions of NEPA, as amended (42 USC 4321 et seq.), define cumulative effects as:

> …the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other action. (40 CFR 1508.7)

Cumulative effects may be adverse, beneficial, or both.

Incorporating the principles of cumulative effects analysis into the environmental impact assessment of a proposed action should address the following:

- Past, present, and future actions;
- Other Federal, non-Federal, and private actions;
- Impacts on each affected resource, ecosystem, and human community; and
- Truly meaningful effects.

In analyzing cumulative impacts, spatial and temporal boundaries should be considered. These form the context of the cumulative analysis. Judgment should be used in choosing the most appropriate boundaries to meaningfully assess the role of the proposed action, secondary actions, and connected actions in comparison with overall effects from all past, present, and future actions. If spatial and temporal boundaries are set too narrow, this will tend to overstate the relative importance of the proposed action compared with others, but perhaps reduce the overall cumulative scale of impacts to a misleadingly small magnitude.

In contrast, if spatial and temporal boundaries are set too broad, the contribution of the proposed action to cumulative impacts will be unduly small in comparison with the contributions of all other actions, but the overall scale of cumulative effects may be enormous and exaggerated. Consider the example of a proposed action that in conjunction with all others was predicted to lead cumulatively to the extinction of a given species. If a cumulative impacts analysis considered this phenomenon in the context of a geologic time scale measured in millions of years, during which time a number of species could disappear while new ones evolved, such an analysis would improperly diminish the significance of cumulative impacts leading to the permanent extinction of the species in question.

Ideally, natural boundaries should be used, but sometimes institutional or geographic boundaries are relevant as well, especially when certain key impacts weigh as much on the human environment as the natural environment. Spatial boundaries may also vary by resource topic. In the present cumulative analysis, McKinley and Cibola Counties boundaries may be the most appropriate for some resource topics, the State of New Mexico's the most appropriate for others, and the nearest reaches of the Rio Puerco or Rio Grande for still others. However, a number of impacts to which the proposed action and secondary and connected actions might hypothetically contribute incrementally are much further away, much larger, or widely dispersed, such as the widely separated winter and summer ranges of migratory birds, which may be thousands of miles apart, connected by a migratory flyway.

Past, Present, and "Reasonably Foreseeable" Future Actions

Uranium Mines

JJ No. 1/L-Bar Mine

Past Mine

The JJ No. 1 Mine, located about 10 air miles north-northeast of Laguna Pueblo in Cibola County, was an underground uranium mine which produced uranium ore from a depth of 500–600 feet below ground surface for a period of about 5 years from 1976 to 1981. From 1981–1986 it was on standby status due to low uranium prices; reclamation began in 1986. The L-Bar mill associated with the mine was demolished at this time and the mill and tailings areas were reclaimed between 1986 and 1989. An interim radon barrier was placed in 1989 to cover tailings and the contiguous mill area. After settlement and consolidation of the tailings area from 1989 to 2000, the final radon barrier cover was installed in 2000. The covered tailings and mill area, including the area of the mine headframe and one of the 12 vent shafts, were transferred to the Department of Energy (DOE) Office of Legacy Management in December 2004. Beyond this area, the only evidence of the former mine, prior to the closeout activities, were 11 capped steel vent shafts and associated cement pads, steel gravel shoots, and two-track trails between the vent shafts (figure 23). Final closure of these vent shafts will permanently stabilize the surface and eliminate any potential hazards to humans or wildlife (Intera, 2011a).

Figure 23. JJ No. 1/L-Bar Mine site (after reclamation)

The surrounding terrain is hilly and the ground surface rocky. The goal of reclamation was to return the topography at each of the vent shaft pads to a condition similar to that of the pre-mining natural topography. The challenge was to establish natural grades while limiting disturbance to stable slopes and vegetated areas. Backfilled soils were then placed on the reclaimed areas, compacted, and graded. The reclaimed areas were then revegetated by conditioning the soils (adding mulch, compost, and an organic fertilizer) and reseeding the areas. The seed mix selected for the site was formulated specifically for this arid desert region to establish plant life as quickly as possible, as well as achieve long-term growth and survival in a highly erosive setting. The seed mixture (applied at a rate of 17.12 lbs/acre) was mixed with a granular Mycorrhizae (applied at a rate of 20 lbs/acre) before being hand broadcast. The revegetation monitoring program will continue for 12 years or as long as required by MMD (Intera, 2011a).

San Mateo Uranium Mine

Past mine, Current Cleanup

Conventional Underground Uranium Mine

The San Mateo Mine site is located on the Cibola National Forest's Mt. Taylor Ranger District, approximately 5.5 miles west of the town of San Mateo. This inactive mine operated sporadically from 1959 through 1971, then briefly in the 1980s under four different operators. No uranium ore was milled onsite. Waste rock was disposed at the head of the mine in a series of waste rock terraces. Although not typically ore quality, it can contain elevated concentrations of uranium, its decay products, and other heavy metals. In addition, a pad consisting of material similar to the main waste rock pile was constructed on a flat area northeast of the main rock pile. Since closure of the mine, all buildings and surface facilities have been removed (though foundations remain), and the main shaft and all emergency shafts and air shafts have been sealed. The mine road, waste rock pile, north pad, and several settlings ponds remain at the site (USFS, 2009a).

The San Mateo Mine area is not a popular recreation area due to its remote, inaccessible setting. Although camping is allowed, there is no indication of overnight use. Uranium-bearing rock exposed by mining is a source of elevated gamma radiation, to which hunters, hikers, and/or ATV-riders can be exposed by walking or driving through the area. These areas include the waste rock pile where remnants of uranium-bearing rock formation may be exposed (USFS, 2009a).

The Forest Service has recently started the reclamation process, placing a geo-membrane cover with rock armoring.

Mt. Taylor Uranium Mine

Past Mine; Either Future Mine or Reclamation

Conventional Underground Mine

The inactive Mt. Taylor Mine is located about 1/2 mile northeast of the village of San Mateo and is accessible from New Mexico State Route 605. It was developed in the 1970s by Gulf Mineral Resources Company. After excavating two 3,300-foot shafts, Gulf began production in 1980 using the room-and-pillar and stope mining methods; production continued until September 1982, when the market price of uranium dropped suddenly, causing a temporary cessation of production. Mine water continued to be pumped during this shutdown period. Mining resumed but was suspended again in 1990, and has not taken place since then (RGRC, 2012).

Gaining access to the ore zones required dewatering of the mine, which began in the mid-1970s. Mine water was treated prior to discharge. Approximately 675,085 tons of ore and 698,000 tons of waste rock were mined from the Morrison Formation. Ore was shipped offsite for milling. Waste rock from shaft sinking (shaft muck) and from mine development was placed in an onsite waste rock pile (RGRC, 2012).

It is expected that operations at this mine will resume once more now that the uranium market is more favorable.

Cebolleta Uranium Mine

Future Mine

Conventional Underground and Open Pit

This project is located in Cibola County. Neutron Energy submitted an application and sampling and analysis plan to NM MMD in March 2012 for up to 84 holes that would be drilled on 14 acres of previously disturbed private land. Drilling using conventional truck-mounted rigs and supporting equipment was to have begun in May 2012 and be completed within 8–10 weeks. The purpose of the drilling is to determine whether enough uranium ore occurs to justify mine development on this privately owned land (MMD, 2012a).

La Jara Mesa Uranium Mine

Future Mine

Conventional Underground

Over a period of 20 years, Laramide Resources proposes to tunnel two inclined adits (horizontal or nearly horizontal passages) from under the west edge of La Jara Mesa, on the Cibola National Forest approximately 10 miles northeast of Grants, to remove 40,000 tons of uranium ore for testing and to begin development of a production mine. This project is located about 8 air miles from the proposed Roca Honda Mine. Disturbance on the 16.4 acres would include improvements to existing roads, construction of a new water pipeline and electric distribution line in the road right-of-way, and an escape raise/air vent at the top of La Jara Mesa. If approved, this project would operate concurrently with the Roca Honda Mine. A draft EIS on this proposal was released to the public in June 2012 (USFS, 2009b; USFS, 2012a).

Uranium Exploration

Combined Uranium Exploratory Drilling Project

Future

There is a proposal to approve multiple plans of operation for exploratory drilling to determine the extent of uranium deposits in several areas on the mesas surrounding Mt. Taylor, including San Mateo Mesa and La Jara Mesa northeast of Grants. Cibola National Forest is currently preparing the EIS for this exploratory drilling (USFS, 2012b).

Marquez Canyon Exploration

Current

In 2009, Neutron Energy applied for permission to drill up to 44 holes 2,500 feet in depth in Marquez Canyon of McKinley County. The permit was renewed in 2012. Drilling activities would disturb approximately 10 acres of land surface and drill pads would have to be reclaimed upon completion. BMPs are to implemented at all surface disturbances and temporary low water crossings during exploration and reclamation activities, as needed for erosion control, spill prevention, and avoidance of damage to ephemeral stream channels in the area (MMD, 2009a).

Mesa Montanosa Exploration

Current

Under the conditions of a permit renewed in 2012, permittee Grants Ridge, Inc., is authorized to conduct mineral exploration (drilling boreholes) and reclamation operations on approximately 5 acres situated on BLM land in McKinley County (MMD, 2012b).

Elizabeth Claims Exploration

Current

The Elizabeth Claims Exploration project area is located on private lands within the Ambrosia Lake Mining District approximately 20 miles northwest of Grants. It consists of 28 drill holes, 5.5 inches wide and up to 1,800 feet deep. About 5 acres of surface area would be disturbed and reclaimed upon completion of the exploration (MMD, 2009b). MMD renewed this permit in August 2011.

Uranium Mills

Ambrosia Lake Disposal Site (former uranium mill)

Past

The Ambrosia Lake disposal site was a uranium mill (ore-processing facility) located near the center of the Grants Mineral Belt, within the Ambrosia Lake Mining District of McKinley County approximately 25 miles north of Grants. The Ambrosia Lake Valley is a thinly populated area characterized by desert grassland and bordered by basalt-capped mesas to the north (DOE, 2011).

Built by Phillips Petroleum Company in 1957, the Ambrosia Lake mill processed more than 3 million tons of uranium ore between 1958 and 1963, providing uranium for U.S. national defense programs. In the late 1970s to early 1980s, United Nuclear Corporation operated an ion exchange system, extracting uranium from mine water. All operations came to an end in 1982, leaving behind radioactive mill tailings, a predominantly sandy material, on approximately 111 acres. Wind and water erosion dispersed some of these tailings across a 230-acre area (DOE, 2011).

After Congress passed the Uranium Mill Tailings Radiation Control Act (UMTRCA) in 1978, the U.S. Department of Energy (DOE) remediated the Ambrosia Lake site between 1987 and 1995, under the Uranium Mill Tailings Remedial Action Project and in accordance with standards promulgated by the U.S. EPA in Title 40 (CFR) Part 192 (DOE, 2001; DOE, 2011). DOE closed the 91-acre disposal cell in 1995 upon consolidation and encapsulation of the tailings and completion of the cell cover. The cell contains almost 7 million dry tons of contaminated material, with total radioactivity of 1,850 curies of radium-226. The uppermost aquifer beneath the site consists of alluvium (river deposits), sandstone, and weathered shale. This uppermost aquifer is not a current or potential source of drinking water because of its low yield (DOE, 2011).

Rising about 50 feet above the surrounding flat terrain, the rectangular disposal cell is approximately 2,500 feet long by 1,600 feet wide, including the toe apron. Its cover consists of several layers designed to encapsulate and seal off the contaminated materials. The disposal cell cover includes a low-permeability radon barrier (first layer placed over compacted tailings) comprised of compacted clayey soil, a bedding layer of granular bedding material, and a rock (riprap) erosion protection layer for the top and side slopes (figure 24). In accordance with 40 CFR 192.32, the disposal cell is designed to last 1,000 years, to the extent reasonably achievable, and, in any event, for at least 200 years (DOE, 2011).

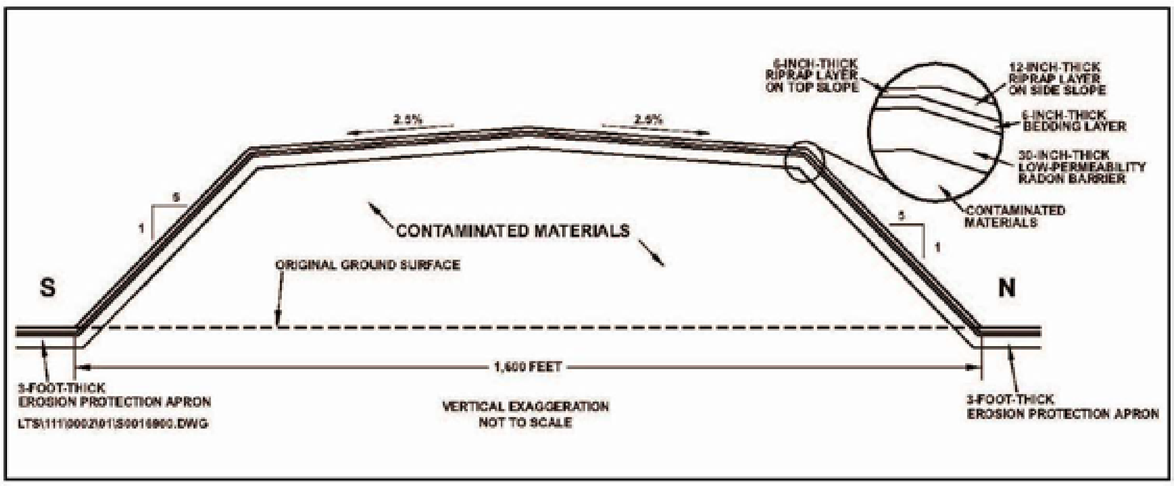


Figure 24. South-north cross-section of Ambrosia Lake disposal cell

The DOE's Office of Legacy Management (LM) manages the Ambrosia Lake disposal site according to a site-specific long-term surveillance plan to prevent the release of radioactive contaminants to the environment. Under provisions of this plan, LM conducts annual inspections of the site to evaluate the condition of surface features, performs site maintenance as necessary, and samples two monitoring wells every 3 years. The encapsulated tailings will remain potentially hazardous for thousands of years. However, the NRC general license for UMTRCA Title I sites has no expiration date, and LM's responsibility for the safety and integrity of the Ambrosia Lake disposal site will last indefinitely (DOE, 2011).

Rio Algom Mine and Mill Tailings Site (Ambrosia Lake area)

Past; Current Reclamation

The Rio Algom Mine and mill tailings site is in the Ambrosia Lake uranium district. Located about 25 miles north of Grants, this tailings impoundment contains 33 million tons of uranium ore and covers an area of approximately 370 acres.

The site status changed from standby to reclamation in 2003, reflecting the licensee's intent to begin full demolition and reclamation. The mill was demolished and disposed of in the tailings impoundment in late 2003. Consequently, all groundwater corrective actions have been discontinued, and Rio Algom is finalizing the site tailings reclamation. A portion of the tailings impoundment is still open for disposal of Atomic Energy Act, Section 11e.(2) byproduct material. A final soil DP entitled, “Closure Plan - Lined Evaporation Ponds” (relocation plan) was submitted to the NRC in November of 2004, and partially approved. A portion of the report, pertinent to the “Section 4” and Pond 9 evaporation pond sediment material has been reviewed and approved. The final licensing action will be the approval of a redesigned channel. The cost for decommissioning is estimated to be approximately $18 million (USNRC, 2012a).

Other Past, Present, Future, and Ongoing Actions

Other cumulative impacts on environmental resources from actions occurring on and near the Mt. Taylor Ranger District—and Cibola and McKinley Counties more broadly—during and after the projected 2-decade life of the Roca Honda Mine may occur from a variety of other ongoing actions. These include:

- **Timber projects** – includes use of heavy equipment in timber harvesting, log skidding, use of existing access roads, and construction and reclamation of temporary access.
- **Wildlife habitat improvements** – includes vegetation treatments such as forest thinning, prescribed burning, seeding of grasses, and water source development.
- **Firewood gathering** – includes permitted collection of dead-and-down and greenwood trees using hand-held equipment and existing access.
- **Piñon nut gathering** – includes the gathering of piñon nuts on foot.
- **Wildland fire management** – includes wildland fire suppression, fuel management, prescribed fire, involving the use of hand-held firefighting equipment and heavy machinery such as planes and dozers. Wildland fires are unpredictable in location, size, and severity of impact. These activities occur at a low level because there is very little fire frequency in the area and a long natural fire return interval.
- **Livestock grazing** – includes permittees using the area for grazing cattle, water development (e.g., earthen or fiberglass tanks,well drilling, pipelines), fencing, and scheduled movement of cattle from one grazing area to another.
- **Recreation** – includes hunting, hiking, camping, mountain biking, ATV/dirt bike use, 4-wheel drive use, and winter sports on Mt. Taylor (e.g., cross-country skiing, snowshoeing, snowmobiling). Specific activities and facilities include the Mt. Taylor 50-kilometer running race, use and maintenance of the Continetal Divide Trail, the annual winter quadrathalon on Mt. Taylor. Ongoing activities include maintenance and improvement of trails, campgrounds, and picnic areas.
- **Road and utility corridor maintenance** – includes mechanical clearing and use of herbicides to control vegetation along power line and pipeline rights-of-way, as well as use of heavy equipment like graders, snowplows, backhoes, trucks, and bulldozers.
- **Construction and maintenance of communication sites** – includes maintenance of communication sites on Mt. Taylor, involving making use of existing access.
- **Renewable energy projects** – includes developments off the Cibola National Forest, such as the wind farm northeast of Bibo, in Cibola County, New Mexico.

Chapter 3. Affected Environment and Environmental Consequences

This chapter summarizes the physical, biological, social, and economic environments of the project area and the effects of implementing each alternative on that environment. It also presents the scientific and analytical basis for the comparison of alternatives presented in the alternatives chapter (chapter 2).

Methodology

The interdisciplinary study team (see “Chapter 4. Preparers and Contributors”) followed a structured process to analyze the potential environmental impacts, or effects, resulting from the no action and two action alternatives. This procedure, called the cause-effects-questions (C-E-Q) process, is described in the text box below.

Causes-Effects-Questions: A Structured Analytic Process

Step 1: Identify the specific activities, tasks, and subtasks involved in the proposed action(s) and alternative(s).

Step 2: For each specific activity, task, and subtask, determine the full range of direct effects that each could have on any environmental resource. For example, removing vegetation could cause soil erosion.

Step 3: For each conceivable direct effect, identify which further effects could be caused by the direct effects. For example, soil erosion could cause stream sedimentation, which could harm or kill aquatic macroinvertebrates, which could diminish the food supply for fish, leading to decreased fish populations. This inquiry can identify multistepped chains of potential causes and effects.

Step 4: Starting at the beginning of each chain of causes and effects, work through a series of questions for each potential effect:

- Would this effect actually occur from this project?
- If not, why not?
- What would preclude it from happening?
- If the effect cannot be ruled out, characterize which types of data, other information, and analyses are needed to determine the parameters of the effect, including its extent, duration, and intensity.
- Identify the sources from which the data are to be obtained.

Step 5: Gather the data and conduct the analyses identified by the above steps, utilizing only relevant information.

Step 6: Document the results of this study process.

Using this process, both direct and indirect effects that could occur as a result of implementing the proposed action were identified. As mentioned above, direct effects are immediate impacts caused by an action at approximately the same time and place as the action. Indirect effects are impacts caused by the action(s) that occur at some distance in space and/or time from the action, or, as described above, by means of a longer chain of cause-and-effect linkages.

The preliminary C-E-Q diagram that the study team prepared at the outset of the analysis helped organize the investigation and focus it on relevant issues. The team also used this C-E-Q in the two scoping meetings in Grants and Gallup to solicit input from the public in December 2010.

Environmental Impact Statement Significance Criteria

A project such as the proposed Roca Honda uranium mine can have a wide variety of impacts on different components of the environment. The importance, or "significance," of each of these diverse impacts depends on several factors. Some of these factors are matters of objective fact. For example, if a Federal law would clearly be violated by any aspect of the proposed action, then that would obviously be a significant impact. Other factors affecting significance are matters of judgment, such as the importance of losing some amount of wildlife habitat. The Council on Environmental Quality (CEQ) regulations on NEPA provide a list of factors to be considered in determining impact significance. These factors are presented in the text box at the right. The EIS study team used an assessment methodology that combines these multiple factors into an overall assessment of significance.

During the planning stage of the EIS study, the study team reviewed similar projects and documentation to ascertain the activities associated with the proposed action, and the types of impacts they could cause. Research was supplemented by professional judgment concerning impacts of typical concern for any large construction project. A preliminary environmental evaluation diagram (i.e., the C-E-Q diagram) which lists the potential impacts for that activity, was developed for each activity associated with the proposed action.

CEQ Regulations on Significance (40 CFR 1508.27)

The rating of an impact as "significant" in NEPA requires consideration of both the context and intensity of the impact.

Context: The significance of an action must be analyzed in several contexts, including society as a whole, the affected region, the affected interests, and the locality. Both short- and long-term effects on an action should be analyzed.

Intensity: Intensity refers to the severity of an impact. In evaluating the intensity of an impact of the proposed action, the following should be considered:

- Impacts that may be both beneficial and adverse;
- Effects on human health and safety;
- Unique characteristics of the geographic area;
- Highly controversial effects;
- Highly uncertain or risky effects;
- Potential for the action to set a precedence for future actions with significant effects;
- Cumulative effects;
- Adverse effects on significant scientific, cultural, or historic resources;
- Adverse effects on a threatened or endangered species or its habitat; and
- Whether the action violates or threatens a Federal, State, or local law or requirement.

Factors considered in the impact analysis and in determinations of significance include:

- Magnitude of the impact (how much);
- Duration or frequency of the impact (how long or how often);
- Extent of the impact (how far);
- Likelihood of the impact occurring (probability); and
- Precedence and uniqueness of the impact (e.g., unique setting, unprecedented impacts, uncertain impacts, and controversiality).

For these factors, the team identified several useful levels of that factor, as shown below:

Magnitude:
- major
- moderate
- minor
- negligible

Duration:
- permanent
- long term
- medium term (intermittent)
- short term

Areal Extent:
- large
- medium (localized)
- small (limited)

Likelihood:
- probable
- possible
- unlikely

Precedence and Uniqueness:
- severe
- moderate
- slight

The team then identified which combinations of these factors would constitute various overall ratings of significance. Given this general structure, applied to all types of impacts on all environmental resources, each member of the study team then determined which of these terms best demonstrate the level of impact, and the significance or nonsignificance of that impact.

For the fifth major factor presented above—Precedence and Uniqueness—the study team developed a set of definitions, based on intensifying factors, for each level that are applicable to impacts in essentially all resources areas. In other words, no resource-specific definitions are needed for intensity. These definitions are as follows:

Severe:

Impacts occur in such close proximity to national parks, properties eligible to the National Register of Historic Places (such as the Mt. Taylor TCP), or national historic landmark sites, or other especially valued, unique, or protected sites, that the valued features of those nearby sites are severely jeopardized;

OR

Impacts are completely unprecedented; no similar impacts have ever been known to occur;

OR

The types, extent, or probability of the impacts cannot be reasonably predicted;

OR

There is substantial and sustained dispute among subject matter experts, agencies, organizations, and/or citizens about the nature or importance of the impacts.

Moderate:

Impacts would occur at sufficient distance from any protected site that the valued features would be perceptibly altered but not severely compromised or jeopardized;

OR

There is moderate confidence in the accuracy of the predictions as to types, extent, and likelihood of the impacts;

OR

There is moderate dispute among subject matter experts, agencies, organizations, and/or citizens about the nature or importance of the impacts.

Slight:

Impacts would occur at sufficient distance from any protected site that the valued features would be imperceptibly altered;

OR

The types, extent, or probability of the impacts can be reasonably predicted with only slight uncertainty;

OR

There is very limited dispute among subject matter experts, agencies, organizations, and/or citizens about the nature or importance of the impacts.

With this structure established for this study, the team then conducted the EIS study. Through the use of this approach, diverse impacts will be assessed on a common footing. If a biological impact is rated by the study team as “very significant,” the team intends that rating to have approximately the same meaning as a “very significant” impact rating in any other resource area; however, depending on the type of proposed action and its setting and context, some similarly rated impacts would in fact be weighted differently by the public and decision makers.

As indicated above, assessing significance does involve discretion and professional judgment, as well as some degree of subjectivity as to what to value and how much to value it, and this approach does not remove that element from the process. What this method does is organize the analysts’ judgment, and make the bases for their judgment more explicit and more uniform. Accordingly, the study team does not present their assessments as indisputable facts, but rather as the considered judgments of the professional team based on the explicit factors and considerations as described here.

Impacts determined to be “below significant” or “insignificant” are not dismissed as unimportant or nonexistent. Rather, these impacts, while adverse (or beneficial, as the case may be) are not considered to have crossed the threshold of significance.

Definitions

Discussions of environmental consequences in the following sections utilize a general vocabulary consisting of some of the terms and definitions below:

Types of Impact

Beneficial – A positive change in the condition or appearance of the resource, or a change that moves the resource toward a desired condition.

Adverse – A change that moves the resource away from a desired condition or detracts from its appearance or condition.

Direct – An effect that is caused by an action and occurs in the same time and place.

Indirect – An effect that is caused by an action but is later in time or farther removed in distance, but is still reasonably foreseeable.

Duration of Impact

Permanent – Impact would last indefinitely.

Long term – Impact would likely last more than 2 years, or over the lifetime of the project and possibly longer, exceeding the project lifetime.

Medium term – Impact would extend past the transition phase, or construction phase for future developments, but would not last more than 5 years, at most.

Intermittent – Impact would not be constant or continuous but may last indefinitely.

Short term – Impact would occur during a transition phase only, or in the case of potential future developments, during the site preparation and construction phases only. Once these phases have ended, resource conditions are likely to return to pre-transition/construction conditions.

Extent of Impact

Large – Impacts would affect the resource on a regional level, extending well past the immediate project site.

Medium or Localized – Impacts would affect the resource only on the project site or its immediate surroundings, and would not extend into the region.

Small or Limited – Impacts would affect the resource over a fraction of the project site.

Magnitude of Impact

Major – Substantial impact or change in a resource area that is easily defined, noticeable, and measurable, or exceeds a standard.

Moderate – Noticeable change in a resource occurs, but the integrity of the resource remains intact.

Minor – Change in a resource area occurs, but no substantial resource impact results.

Negligible – The impact is at the lowest levels of detection—barely measurable and with no perceptible consequences.

Likelihood of Impact

Probable – More likely to occur than not, i.e., approximately 50 percent likelihood or higher.

Possible – Some chance of occurring, but probably below 50 percent.

Unlikely – A non-zero but very small likelihood of occurrence.

Geology and Soils

Affected Environment

Regional Geologic Setting

The proposed Roca Honda Mine is located in the southeastern portion of the Ambrosia Lake subdistrict of the Grants uranium district; it is near the boundary between the Chaco slope and the Acoma sag tectonic features. This subdistrict is situated in the southeastern part of the Colorado Plateau physiographic province and is mostly on the south flank (called the Chaco slope) of the San Juan Basin (RHR, 2009d). Regional geology is depicted in figure 25.

Bordering the San Juan Basin to the south-southwest is the Zuni uplift, where rocks as old as Precambrian (more than 570 million years old) are exposed 25–30 miles southwest of the Roca Honda permit area. Within 5 miles of the permit area to the east and south, Neogene volcanic rocks of the Mt. Taylor volcanic field cap Horace Mesa and Mesa Chivato. On the Chaco slope, sedimentary strata mainly of Mesozoic age (between 65 and 245 years old) dip gently northeast into the central part of the San Juan Basin.

The San Rafael fault zone cuts the Fernandez monocline and has right-lateral displacement (figure 26). Other faults in or near the proposed action are mostly normal with dip-slip displacement and vertical movement less than 40 feet. The large, northeast-striking San Mateo normal fault about 2 miles west of the Roca Honda permit area has vertical displacement of as much as 450 feet. Strata within the permit area along the Fernandez monocline dip east to southeast at 4–8 degrees toward the McCartys syncline, an expression of the Acoma sag (RHR, 2009d).

Uranium ore deposits in the Grants uranium district are mainly in fluvial (river associated) sandstones in the Westwater Canyon, Brushy Basin, and Jackpile Sandstone Members of the Morrison Formation of the Upper Jurassic Period. The Morrison Formation crops out near the southern edge of the San Juan basin and dips gently northward into the basin. In ascending order, the formations of Late Cretaceous age that overlie the Morrison Formation are Dakota Sandstone, Mancos Shale, Gallup Sandstone, Crevasse Canyon Formation, Point Lookout Sandstone, and Menefee Formation.

The Morrison Formation was deposited in a continental (as opposed to a marine) environment, mainly under fluvial conditions. These deposits were derived from an uplifted arc terrane to the west and locally from the Mogollon highlands to the south. Late Cretaceous Period formations were deposited in or on the margin of the Western Interior Seaway, a shallow continental sea, and the formations represent transgressive or regressive episodes of the seaway. The Mancos Shale and its several tongues were deposited on the shallow marine sea bottom, and the formations of the Mesaverde Group were deposited along the western shoreline of the seaway.

Stratigraphy Beneath the Permit Area

Rocks exposed in the Ambrosia Lake subdistrict include marine and nonmarine sediments of Late Cretaceous age, unconformably overlying the uranium ore bearing Upper Jurassic Morrison Formation. All rocks that crop out at the Roca Honda permit area are of Late Cretaceous age; these rocks and the Quaternary (more recent) deposits that cover them in some places are shown in the geologic map in figure 27 (RHR, 2012).

The formations and members and their approximate depth from the surface are shown in the stratigraphic section in figure 28, which is based on historical drilling in the area. The Menefee Formation does not outcrop in the Roca Honda permit area, but a partial thickness of it is below Quaternary colluvium as a subcrop in the southeast quarter of Section 10.

In descending order, the formations present at the permit area are alluvium, Point Lookout Sandstone, Crevasse Canyon, Gallup Sandstone, Mancos Shale, Dakota Sandstone, and the Morrison Formation. The Westwater Canyon member of the Morrison Formation is the ore-bearing strata or layer (RHR, 2012). Figure 28 shows the stratigraphy of the Morrison Formation.

Section 7.0, Geology, of the Baseline Data Report, Revision 1, contains a detailed description of each geological formation in the permit area, from the ground surface down to the ore bearing Westwater Canyon Member of the Morrison Formation (RHR, 2011a).

Uranium Ore Body

The uranium at the Roca Honda Mine permit area is contained within five sandstone units of the Westwater Canyon Member (figure 29). Core recovery from the 2007 drilling program indicates that uranium occurs in sandstones with large amounts of organic material. The uranium in the permit area is dark gray to black and is found at depths of approximately 1,650 to 2,600 feet below the ground surface. Mineralization zones range from 1 to 25 feet thick, 100–200 feet wide, and 200 to more than 1,200 feet long. The ore averages 4–8 pounds of uranium oxide (U_3O_8) per ton of host rock. Nonmineralized host rock is much lighter (light brown to light gray) and has radiometric readings ranging from background to slightly elevated (RHR, 2012).

The ore is typically confined to sandstones in the Westwater Canyon Member, although there is some overlap into the shales that divide the sandstone strata; there is also some minor extension (less than 10 ft.) into the underlying Recapture Member. The ore is in all of the Westwater Canyon Member sandstones across the permit area, but in Sections 9 and 16, the mineralization is typically found in the upper sandstones (A, B1, and B2 in figure 28). In Section 10, the A and B1 sandstones pinch out in some areas because of a thickening of the overlying Brushy Basin Member, so mineralization in the middle and western portions of Section 10 is typically in the lower sandstones (B2, C, and D) (RHR, 2009d).

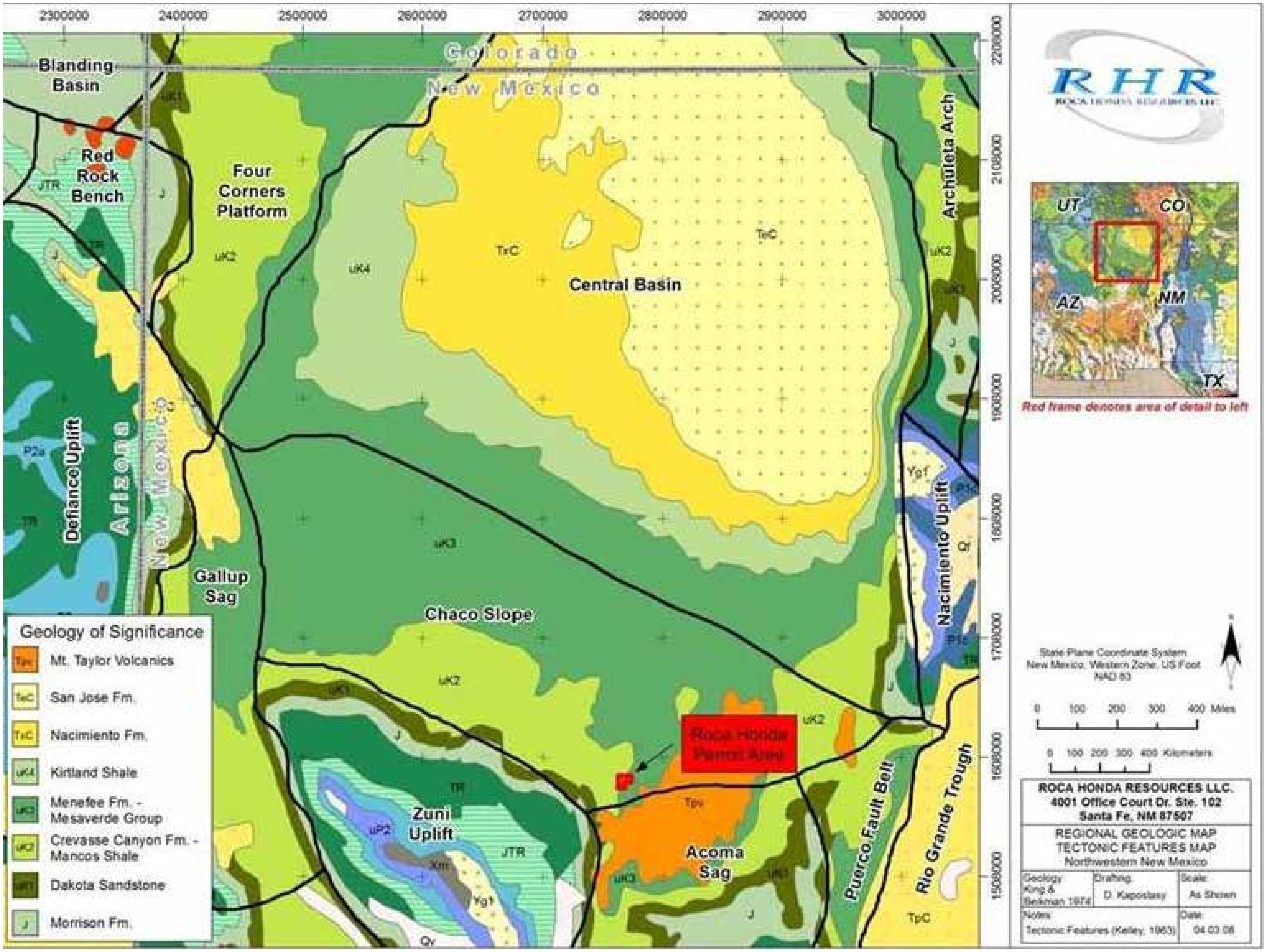


Figure 25. Regional geologic map of northwestern New Mexico

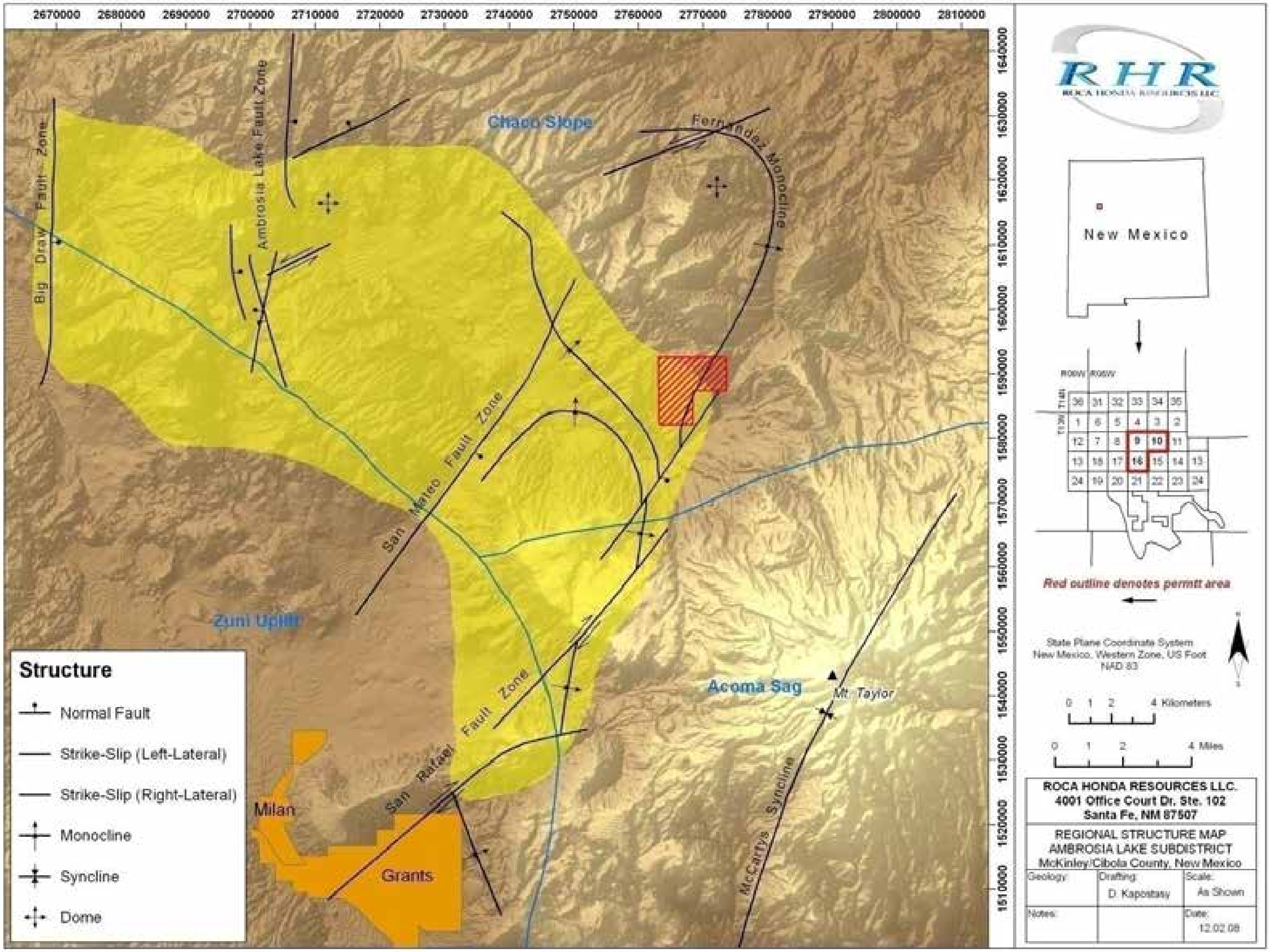


Figure 26. Regional structural features in the vicinity of the Roca Honda permit area

Nature and Depth of Overburden

In mining, "overburden" refers to the soil and rocks overlying the target mineral deposit. Miners have to remove or bore through (constructing shafts through) the overburden to reach the desired ore body. The overburden in the Roca Honda permit area consists of Upper Jurassic and Upper Cretaceous rocks that overlie the ore bearing Westwater Canyon Member of the Morrison Formation. Overburden thicknesses range from 1,600 to 2,800 feet and are primarily controlled by topography; higher ground surface elevation equals thicker overburden. The thickening of the overburden reaches 2,800 feet in the southeastern corner of Section 10 and reflects deeper burial as formations dip eastward along the Fernandez monocline toward the McCartys syncline (RHR, 2009d).

Most of the overburden is composed of shale and sandstone, with lesser amounts of coal and siltstone. Except for the coal, these rock types are relatively stable and resistant to chemical alteration.

Soils

General Soil Principles

Soil is a naturally occurring, three-dimensional layer on the surface of the earth that supports plants. Although the mantle of soil on the earth's surface varies widely from place to place, all soils share common traits. They are all comprised of minerals, organic matter, living organisms, water, and air that occur in varying proportions depending on the type of soil. Soils are the result of soil-forming processes at work on materials deposited or accumulated by geological processes. Soil properties at any given site are determined by five factors: (1) physical and mineralogical composition of the parent material, (2) climate under which the soil material accumulated and has existed since accumulation, (3) plant and animal life atop and within the soil, (4) topography, or the "lay of the land," and (5) length of time that these forces of soil formation have acted on the parent material (NRCS, 2006).

Soil texture is determined by the proportions of different sized particles—sand, silt, and clay—found in a particular soil sample (figure 30).

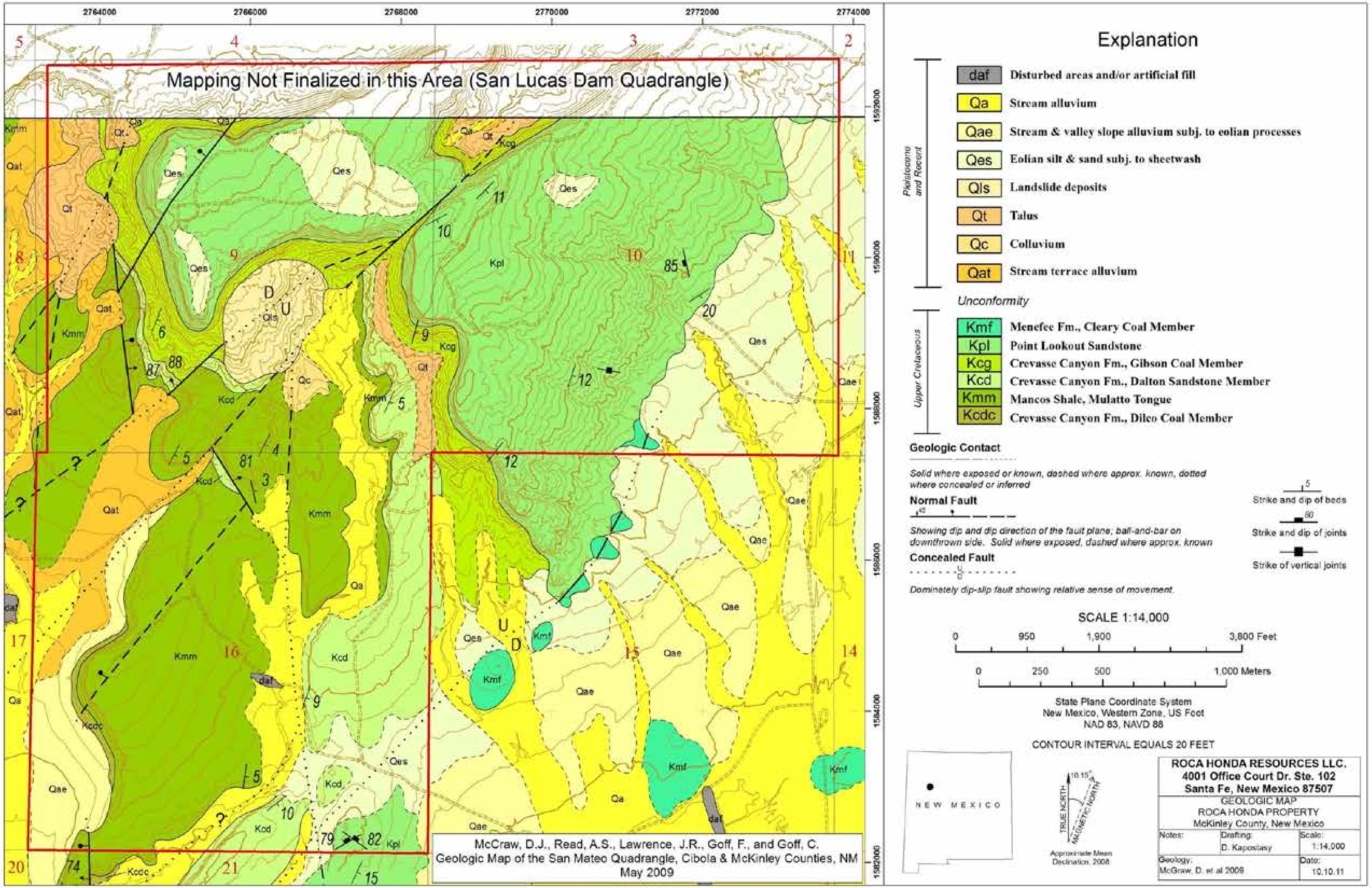


Figure 27. Geologic map of the Roca Honda permit area

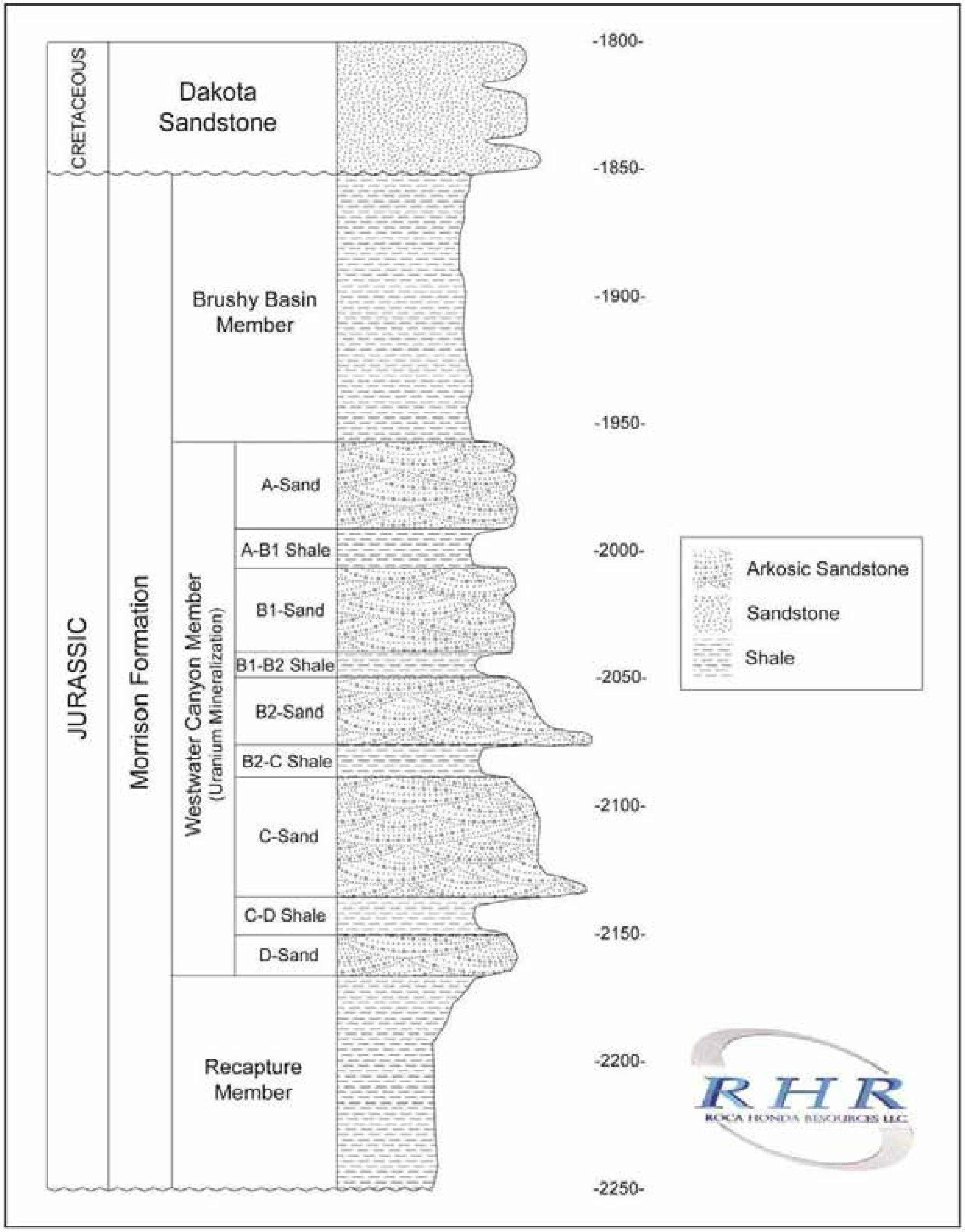


Figure 28. Typical stratigraphic section of the Morrison Formation

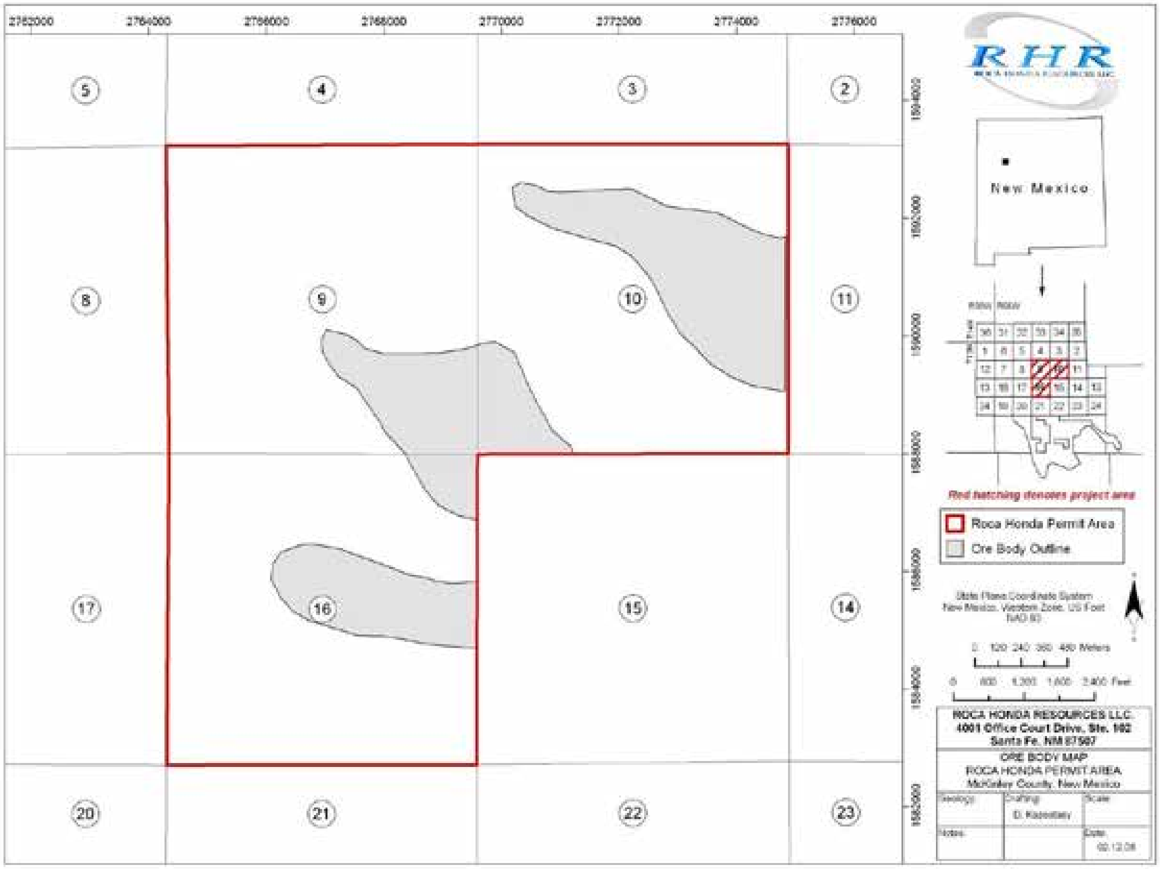


Figure 29. Uranium ore bodies at the Roca Honda permit area

Soils on the Site

Most of Section 9 and some of the northwest and southwest portions of Section 10 are covered by Typic and Lithic Haplustepts (166 in figure 31) that are poorly developed, coarse-loamy to fine soils on steep slopes of about 55 percent. Soil depth to sandstone bedrock typically varies from 20 to 40 inches. However, these thicknesses vary throughout the site as the surface materials tend to pinch out toward contact with bedrock. This condition is applicable to all of the soils within the permit area. The potential for soil erosion in this area is severe because of the steep slopes. NRCS rates the topsoil suitability as “poor” due to the relatively steep slopes.

Most of Section 10 and a large portion of Section 9 are covered by shallow Typic and Lithic Haplustalfs (165) on slopes of approximately 2–4 percent. Bedrock in this area lies within 10 to 40 inches of the surface. These soils have particle size classes of fine, fine-loamy, loamy, and coarse-loamy, and have moderate erosion potential. NRCS rates topsoil suitability as “poor” to “fair” due to the soil being too clayey or too thin a layer (RHR, 2009d).

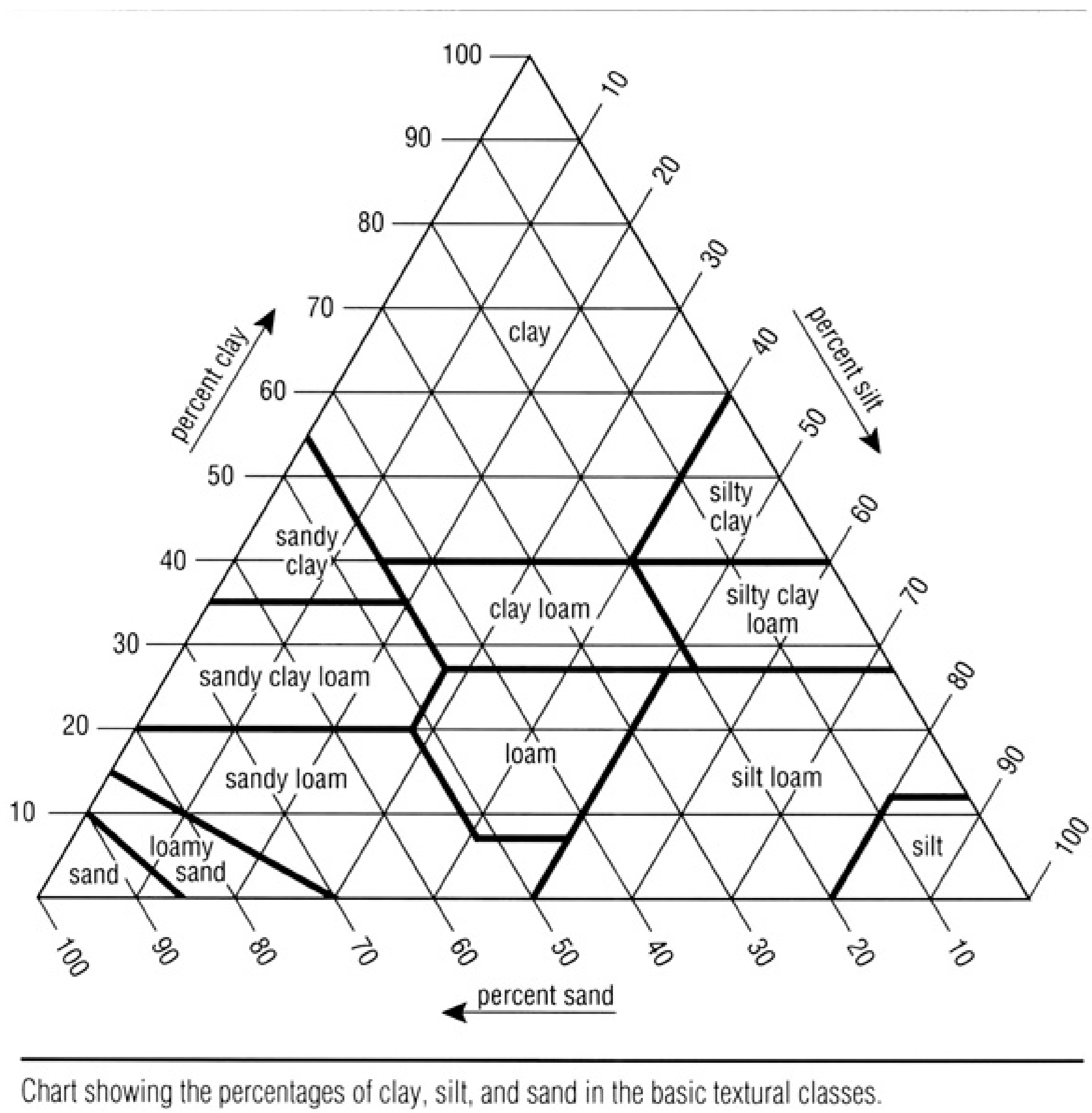


Figure 30. Diagram depicting soil textural classes. Source: NRCS, no date

Inceptic, Typic, and Lithic Haplustalfs (34) soils cover small areas throughout Sections 9 and 10. Their particle size classes range from fine-loamy, coarse-loamy, to sandy. These soils are primarily in valleys on low slopes of 4–6 percent and are particularly susceptible to wind erosion when vegetation is removed. NRCS rates topsoil suitability as “poor” due to either being too alkaline or too sandy.

A complex of Typic Ustorthents, Calcic Haplustalfs, and Typic Haplustalfs (200) cover a small portion of the northwest part of Section 9, on slopes of 7–35 percent. Depth to a paralithic contact (that is, to a weathered layer of bedrock) ranges from 4–20 inches in some areas. Particle-size classes range from fine to fine-loamy to loamy skeletal. NRCS rates the soil erosion hazard in this area as severe because of the silty nature of the surface, and topsoil suitability as “poor” to “fair” due to either low fertility or too thin a layer (RHR, 2009d).

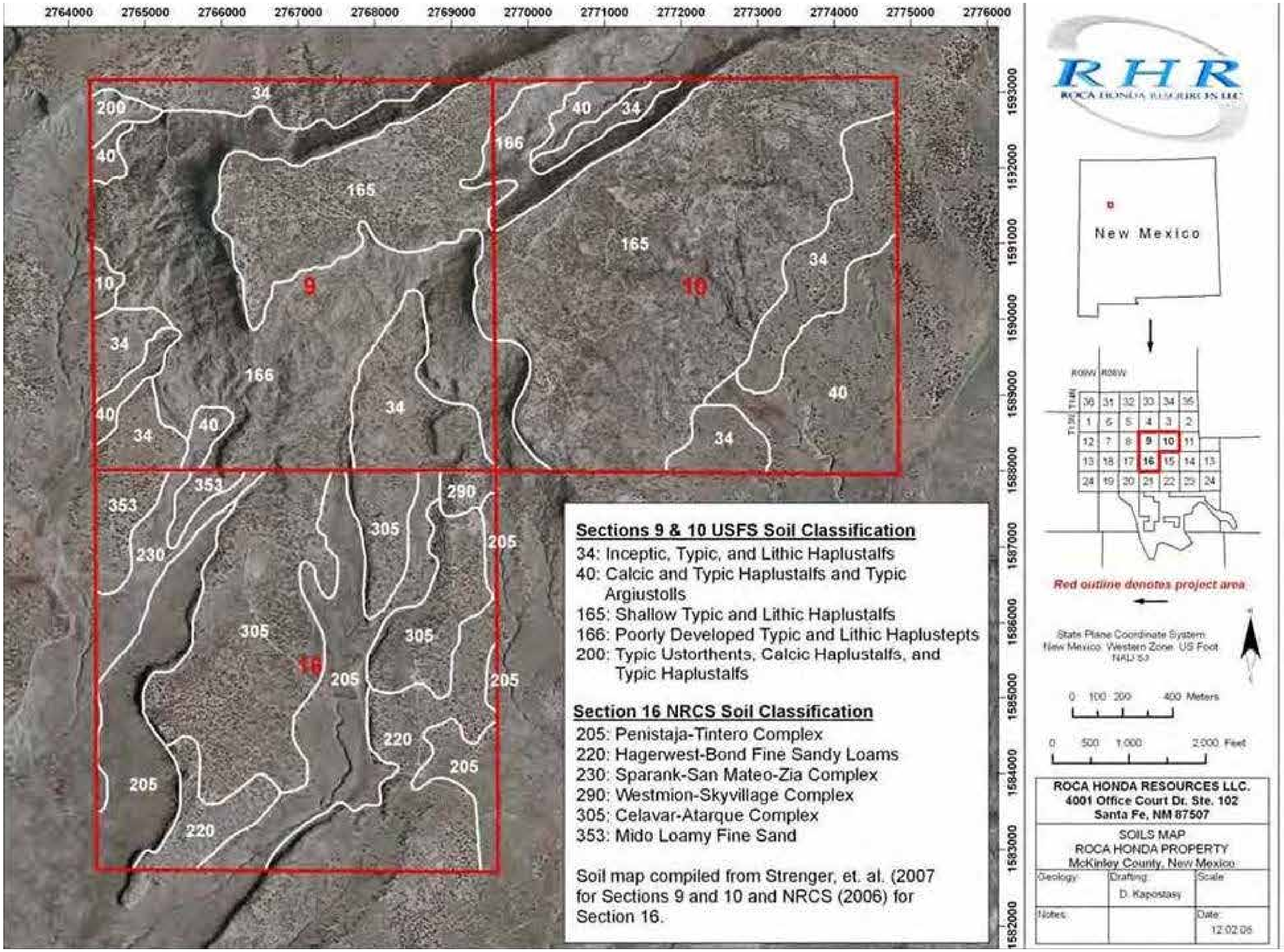


Figure 31. Soil survey of Roca Honda permit area

Most of Section 16 is covered by a Celavar-Atarque complex (305), with roughly 50 percent Celavar soils, 35 percent Atarque, and 15 percent other minor components. Depth to bedrock for Celavar soils in this area ranges from 20 to 40 inches. Depth to bedrock for Atarque soils ranges from 10 to 20 inches. These soils are well drained and have sandy clay loam and clay-loam textures. Slopes range from 1 to 8 percent and topsoil suitability is rated "poor" to "fair" due to shallow depth to bedrock.

Two long, narrow bands of Penistaja-Tintero complex (205) soils run north-south through Section 16. Approximately 45 percent of this complex consists of Penistaja and similar soils, while 40 percent is Tintero and similar soils, and 15 percent other minor soil components. Depth to bedrock for both Penistaja and Tintero soils is 60 inches or more. These soils are in well drained to excessively well drained areas on 1–10 percent slopes and topsoil suitability is rated "good" (RHR, 2009d).

Hagerwest-Bond fine sandy loams (220) occur in two areas of Section 16. Approximately 50 percent of these areas is Hagerwest and similar soils, 35 percent Bond and similar, and 15 percent minor components. Depth to bedrock for Hagerwest soils in this area ranges from 20 to 40 inches, and for the Bond soils, from 10 to 20 inches. Both soils have textures of fine sandy loam, sandy loam, and sandy clay loam. Slopes are from 1 to 8 percent and topsoil suitability is rated "poor" to "fair" due to shallow depth to bedrock and the presence of rock fragments.

Mido loamy fine sand (353) covers about 90 percent of the northwest portion of Section 16 while 10 percent consists of other minor components. Depth to bedrock for this soil is 60 inches or more; it is excessively well drained and occurs on 1–6 percent slopes. NRCS rates topsoil suitability as "poor" due to excessive sandiness (RHR, 2009d).

The northwest part of Section 16 also contains the Sparank-San Mateo-Zia complex (230). This complex is approximately 40 percent Sparank, 35 percent San Mateo, 20 percent Zia, and 5 percent other minor soil components. Depth to bedrock for this soil complex is more than 60 inches, and soils are well drained to excessively well drained. Soil textures range from silty clay loam, clay loam, sandy loam, to fine sandy loam. This complex is on gentle 0–3 percent slopes but topsoil suitability is rated "poor" to "fair" due to high sodium and/or clay content.

Environmental Consequences

Alternative 1

Under the no action alternative, there would be no disturbance of the surface topography and soils from clearing and construction on Sections 9, 10, and 16. No mining would take place, so there would be no excavation within the Westwater Canyon Formation, no extraction of uranium ore, and no backfilling of excavated spaces and rooms.

In sum, alternative 1 would have essentially no impacts on geology and soils at the RHR permit site.

Effects and Mitigation Measures Common to the Action Alternatives

It is not possible to specify exactly how much uranium ore would be mined from the Roca Honda Mine. Nevertheless, under both alternative 2 and alternative 3, some 4 million tons of uranium ore, more or less, containing about 18 million pounds of uranium oxide (U_3O_8), could be mined at depths ranging from 1,650 to 2,600 feet below the ground surface and permanently extracted from the rock formations where it has been present for millions of years. At an ore grade averaging roughly 0.23 percent U_3O_8, the ore would yield 4–8 pounds of U_3O_8 per ton of rock. Overall, hundreds of thousands and perhaps millions of cubic yards of ore and nonore rock would be mined and extracted over the life of the mine. Smaller volumes of nonore rock would be temporarily brought to the surface during the boring of mine production and ventilation shafts.

Roof collapse within the mine would be prevented by backfilling previously mined rooms with excavated nonore grade material and/or aggregate imported into the mine from the surface. The backfill material would be tested and characterized to ensure that its reintroduction into the mine would not have a detrimental impact on groundwater. Ultimately, upon completion of the mine, it is expected that no spaces or voids would be left underground. However, under both action alternatives, there would be long term, indeed permanent, changes to the geologic character and structure of large volumes within the Westwater Canyon Member of the Morrison Formation. The backfill materials would differ from the original source rock.

Overall, impacts of alternatives 2 and 3 to geology at the site would be direct, long term, localized, moderate, probable, and of slight precedence or uniqueness. In sum, impacts of the action alternatives on site geology would be insignificant.

Both alternatives would result in direct, medium term to long term, localized adverse impacts on soils from clearing, grubbing, and grading, construction of mine facilities, and mine operation. These impacts would be controlled to an acceptable level through the diligent application of best management practices (BMPs), which would utilize various measures and structures such as straw bales, wattles (fences of stakes interlaced with twigs or branches), and silt fencing to minimize the transport and loss of soil from erosion and storm runoff. Sedimentation control structures would be installed prior to construction and a Storm Water Pollution Prevention Plan (SWPPP), in compliance with EPA and State of New Mexico requirements, would be implemented.

During construction and preparation activities, topsoil and subsoil would be removed and stockpiled as necessary. As is true across much of New Mexico and indeed the Southwest, the upper layers of existing soil horizons in nonriparian zones at the RHR mine site do not qualify as topsoil according to the criteria established by soils scientists. Thus, the soil material to be stockpiled for revegetation and reclamation is identified as “topdressing” in the RHR reclamation plan revision 1 (August 2011). These soils to be removed above the rock layer would be stockpiled together, identified as topdressing, and protected for use in future reclamation of the site.

As noted in chapter 2, contemporaneous reclamation would take place, that is, while the mine is still in operation. RHR’s proposed approach to contemporaneous reclamation—to avoid site disturbance where possible and minimize the area that must be disturbed—would help minimize soil disturbance erosion throughout life of the mine.

As part of final reclamation operations, disturbed areas would be stabilized by grading with earth-moving equipment to conform to the geomorphic character of the region and the surrounding area, including shaping, berming, and grading to final contour. Slope reclamation would incorporate the practice of minimizing slope lengths and gradients, while conforming to the geomorphic character of the surrounding areas to minimize the potential for excessive erosion.

Both runoff and "runon" (surface water running onto an exposed site) would be diverted from reclaimed areas to prevent erosion. Reestablishing vegetation, as proposed in the RHR reclamation plan, would serve to stabilize underlying soils.

Since no trenching would be involved, placement of the treated water (water reuse) pipeline under both action alternatives would have only negligible, short term, localized effects on soils, due to the movement and operation of vehicles and machinery in the immediate vicinity.

With diligent implementation of the above mitigation measures, overall impacts of alternatives 2 and 3 to landforms, topography, and soil structure at the site would be adverse, direct, long term, localized, moderate, probable, and of slight precedence or uniqueness. After closure of the mine and completion of reclamation procedures, soils should be stabilized and restored to support vegetation. The goal is to restore/reclaim to a landform and function consistent with the forest plan and the surrounding landscape or other undisturbed areas adjacent to the mine, which should be achievable. However, the disturbed soils would not recover 100 percent of their pre-disturbance condition for centuries. Therefore, impacts of the action alternatives on site soils would be adverse but not significant.

Alternative 2

As noted in chapter 2, alternative 2 (the proposed action) would entail a total surface disturbance area of approximately 218 acres, including 183 acres within the three main mine sections (12 acres in Section 9; 71 acres in Section 10; and 100 acres in Section 16) plus an additional 35 acres for other infrastructure (e.g., roads, utility corridor) outside these sections. A total of 93.5 acres of National Forest System lands would be disturbed (83 acres in the three main sections plus 8 acres in Section 11 and 2.5 acres along dewatering pipeline route). Within these areas, most soils would likely be disturbed and would require diligent implementation of the BMPs, SWPPP, and mitigation measures in the reclamation plan to contain and minimize this impact. Assuming this to be the case, overall impacts of alternative 2 to soils at the mine site would be direct, long term, localized, moderate, probable, and of slight precedence or uniqueness.

In conclusion, impacts of the proposed action on both geology and soils would be adverse but not significant.

Alternative 3

As noted in chapter 2, alternative 3 (the one shaft alternative) would entail a total surface disturbance area of approximately 120 acres in Sections 9, 10, and 16, of which 20 acres would be National Forest System lands in Sections 9 and 10—compared to 83 acres with alternative 2. In addition, alternative 3 would disturb 35 acres outside of these three sections. Thus, alternative 3 reduces the area of surface disturbance overall by about 29 percent and the area of surface disturbance—and attendant disturbance of soils—on National Forest System lands by about two-thirds (67 percent).

Within the 155 acres of likely surface disturbance, most soils would likely be disturbed and would require diligent implementation of the BMPs, SWPPP, and mitigation measures in the reclamation plan to contain and minimize this impact. Assuming this to be the case, overall impacts of alternative 3 to soils at the mine site would be direct, long term, localized, moderate, probable, and of slight precedence or uniqueness.

Like alternative 2, impacts of alternative 3 on both geology and soils would be adverse but not significant. However, alternative 3 would result in a smaller extent of disturbed soils than alternative 2, 155 acres versus 218 acres.

Cumulative Effects

The cumulative effect on surface and subsurface geology considers the impacts of the two action alternatives when added to past, present, and reasonably foreseeable future human actions in the area. Cumulative effects analysis requires spatial and temporal boundaries. For geology and soils, a logical spatial boundary is the Grants Mineral Belt, an important uranium-producing region primarily in Cibola and McKinley Counties of western New Mexico. The initial temporal boundary begins with the latter half of the 20th century and continues to approximately 2050.

For more than half a century, the Grants Mineral Belt in which the proposed Roca Honda uranium mine is located has been subjected to a substantial amount of mining exploration and development, both surface and underground; a number of these projects are cited in chapter 2. Geologic landforms have also been altered by road cuts, logging, transmission lines, pipeline construction, and other human activities and structures. Because the proposed action (alternatives 2 and 3) would not permanently modify the ground surface at the mine site, it would not contribute to these long term cumulative effects on the area's surface geology. However, the act of extracting uranium ore and backfilling mined rooms with waste rock rubble hundreds of feet underground would permanently alter the stratigraphy (order and relative position of native rock strata) of these subsurface zones, adding to similar effects from many other underground mines in the region.

The cumulative effect on soils considers the impacts of the proposed project when added to soil disruption impacts from activities at the Roca Honda Mine site itself and the Mt. Taylor area, ranging from the mid-1900s to the present.

Past impacts to local soils have occurred from road construction and use, including road cuts between NM 605 and the mine site from private roads and Forest Service roads and Forest Service and other 4-wheel roads across Sections 9, 10, and 16. Long-term livestock grazing in the vicinity may have caused some degree of soil compaction and erosion (from removing plant cover). Constructing and maintaining the power line that crosses Section 16 probably caused some soil disturbance, compaction, and erosion. Additional soil impacts in the vicinity of the project resulted from surface disturbances associated with past uranium exploration activities that included drill holes, trenching, and exploratory mining in the middle to late 1900s. Exploratory drilling has already occurred as part of the proposed action, as well as earlier by a previous mining company in an effort to discover and characterize uranium ore grade. As indicated above, because soil impacts would be mitigated through BMPs and implementation of the reclamation plan, cumulative impacts to soils in the immediate mine area would be at most minor.

Although the project area represents approximately a tiny fraction of percent of the Mt. Taylor Ranger District, in combination with past, present, and foreseeable future actions, it would result in the incremental increase in impacts to soils in the Cibola National Forest. Other potential mine exploration and development projects in the vicinity of the proposed action include the proposed La Jara Mesa uranium mine located 8 miles south of the site and others listed at the end of chapter 2. The La Jara Mesa proposal would entail less than 20 acres of surface disturbance, and would contribute to the soil impacts from mining in the Mt. Taylor area. A separate EIS has been prepared for that mine project. There are additional permit applications for existing mining operations, and occasional exploration permit requests filed with the MMD. Active uranium exploration occurs in the vicinity of the project site.

Other past, present, and foreseeable actions that contribute to impacts on soil resources in the Mt. Taylor area and the two-county region include gravel mining, recreational uses, road use and construction, timber harvesting, livestock grazing, and utility line construction. The proposed Roca Honda Mine would contribute to these soil impacts, but with implementation of BMPs and mining reclamation, predicted long-term impacts are limited compared to the size of Mt. Taylor or the Grants Mineral Belt, and are expected to be minor after reclamation.

Water Resources

Possible effects of the proposed action on surface and groundwater quantity and quality were prominent in the scoping comments. The existing conditions described below will be altered primarily by: (1) road and surface facility construction and operations, including storm water facilities and various ponds; (2) pumping of groundwater to allow shaft construction and mining of ore, and subsequent recovery after mining ceases; (3) discharge of treated mine water; and (4) backfill of the mine workings.

Affected Environment

This section provides information related to the existing quantity and quality of the surface water and groundwater resources of the region and the proposed project area.

Surface Water Resources

New Mexico is characterized by high mountains, expansive plains and plateaus, river gorges, and broad valleys. The State’s climate is arid to semiarid. About half of annual precipitation is received during a period with brief but intense summer storms, commonly referred to as the “Monsoon season.” Statewide, the annual average precipitation is much less than evaporation from open water surfaces. New Mexico has 108,649 miles of streams, of which 6 percent are perennial and 94 percent are ephemeral or intermittent (New Mexico Water Quality Control Commission, 2010).

The RHR permit area lies within the middle portion of the San Mateo Creek watershed. Figure 32 and figure 33 identify the location of surface watercourses and the size of the watersheds in and adjacent to the permit area. Watercourses in the vicinity of the RHR permit area are identified as ephemeral, intermittent, or perennial in figure 33.

The following sections provide a general overview of the surface water environment that is likely to be affected by the RHR project. An evaluation of the potential environmental consequences to surface water resources follows.

Hydrologic Setting

The hydrologic setting includes the following components that are described in more detail in the following sections:

- Regional Hydrologic Setting
- San Mateo Creek

Regional Hydrologic Setting

The main Roca Honda site is located within two subwatersheds: Upper San Mateo Creek, HUC 130202070301 (most of the site) and San Lucas Canyon, HUC 130202050101 (northern portion of the site and effluent disposal pipeline and disposal area). See figure 33. The Upper San Mateo Creek subwatershed drains an area of 57.8 square miles and contains one stream, San Mateo Creek, five springs, numerous stock ponds and one reservoir. According to RHR, there are no riparian or wetland areas as defined by the Clean Water Act Section 404 in the Roca Honda permit area. The San Lucas Canyon subwatershed drains an area of 47.8 square miles and contains a small section of the permit area consisting of the northern portion of Sections 9 and 10 of the permit area where there are no planned surface facilities. The surface facilities in Sections 9 and 10 nearest to the subwatershed boundary include two vent shafts. These facilities do not come close to any watercourses within the San Lucas Canyon subwatershed.

The effluent disposal pipeline and disposal area are also within this subwatershed. The effluent pipeline would parallel a watercourse and discharges to a reservoir located within the San Lucas Canyon subwatershed. A brief description of the subwatershed is found subsequently in this section, although comprehensive data and a detailed description of this subwatershed and its watercourses are not included in this section as minimal disturbance is expected to occur in these areas.

The Upper San Mateo subwatershed is part of the Rio Grande drainage basin which drains south into San Mateo Creek. San Mateo Creek is a tributary of the Rio San José. The Rio San José joins the Rio Puerco west of the city of Los Lunas, and the Rio Puerco confluences with the Rio Grande near the community of Bernardo, south of the city of Belen. The Upper San Mateo subwatershed is bordered to the west by the Middle San Mateo Creek subwatershed and on the north by the San Lucas Canyon subwatershed. The San Lucas Canyon subwatershed drains north into the Arroyo Chico, a tributary of the northern branch of the Rio Puerco. The Arroyo del Puerto subwatershed lies north of the Middle San Mateo Creek subwatershed.

Neither San Mateo Creek nor the Rio San José contains streams with protected status; they are not designated as wild rivers (under the Wild and Scenic Rivers Act, 16 U.S.C. 1271 et seq) or Outstanding National Resource Water (under NMAC 20.6.4). The watershed does not have stream segments that have been listed as impaired in the “2012-2014 State of New Mexico Clean Water Act §303(d)/§305(b) Integrated Report, U.S. EPA–Approved May 8, 2012” (NMED, 2012). The streams in the watershed were scheduled for assessment by the NMED in 2011 (NMED, 2012), but as of December 2012 the streams are not shown as having been assessed in the NMED Surface Water Quality Bureau “SWQB Mapper” (http://gis.nmenv.state.nm.us/SWQB/). For regulatory purposes the stream in the watershed are considered perennial, as New Mexico does not recognize ephemeral streams unless a use attainability analysis (UAA) for the stream has been completed. The WQCC and EPA must approve the UAA and adopt the designation of the ephemeral stream into the "State of New Mexico Standards for Interstate and Intrastate Surface Waters 20.6.4 NMAC."

The Rio San José is perennial in its upper reaches in the Zuni Mountains, but becomes ephemeral in the Malpais area of its lower reaches (Stone et al., 1983). It flows only occasionally above Grants. For years prior to 2003, the city of Grants discharged water from its wastewater treatment plant under Discharge Permit DP-695 into the Rio San José, augmenting the flow of the river. Discharge of treated wastewater into the river ceased in 2003; that treated water is now discharged to ponds on the city golf course.

According to Risser (1982), in pre-development times, the natural streamflow of the Rio San José at the western boundary of Acoma Pueblo was composed of water from runoff upstream of the pueblo, Horace Spring, and Ojo del Gallo Spring. Risser found that by 1980, the flow of Ojo del Gallo into the Rio San José had ceased, wastewater from the Grants municipal treatment augmented streamflow, and Horace Spring contributed the majority of the natural water entering the pueblo. He estimated that the flow of Horace Spring was about 3,600 acre-feet/year or 4.9 cubic feet per second (cfs), as calculated from records from 1959. Horace Spring still provides much of the perennial flow of the Rio San José.

The Rio San José is gaged above and below Grants (Stations 08343000 and 08343500 respectively). The Rio San José gaging station designated as 08343000 is located below its confluence with San Mateo Creek at Grants and has operated from October 1912 through present. Mean daily streamflows are plotted for the 6-year period from 1977 through 1982 in figure 35 and for the complete period of record in figure 36. The flow measurements suggest that the 08343000 Rio San José gage is in an ephemeral stream that flows in response to rainfall events during the summer/early fall period.

The Rio San José discharges into the Rio Puerco. Although physically much wider and longer than the other watercourses, the Rio Puerco is also an intermittent to ephemeral stream below the point where it is joined by the Rio San José, losing most of its water to the underlying alluvium except during periods of precipitation or snowmelt.

The San Lucas Canyon subwatershed contains a stream system that encompasses the northward trending San Miguel Creek, and American, Colorado, Canones, and San Lucas Canyons. These canyons and streams are for the most part ephemeral. After a rain, standing water can persist for a time in low areas of some short reaches. There is one spring, San Lucas Spring, which reportedly has perennial flow measured at 0.04 cfs in 1973 (NMEI, 1974). RHR conducted field investigations in 2010 that found two manmade water impoundments, San Lucas Dam and Leopoldo Diversion Dam, in Canada de las Vacas, north of the permit area within the San Lucas Canyon subwatershed. In this area, wetlands, springs, and perennial or intermittent streamflow were absent. A number of earthen tanks and reservoirs for watering of livestock or flood control exist outside the permit area including Laguna Polvadero where treated water storage is expected to occur. Laguna Polvadero is a reservoir located on private property where the capacity and dimensions are unknown. Its current use is for irrigation purposes for privately owned land.

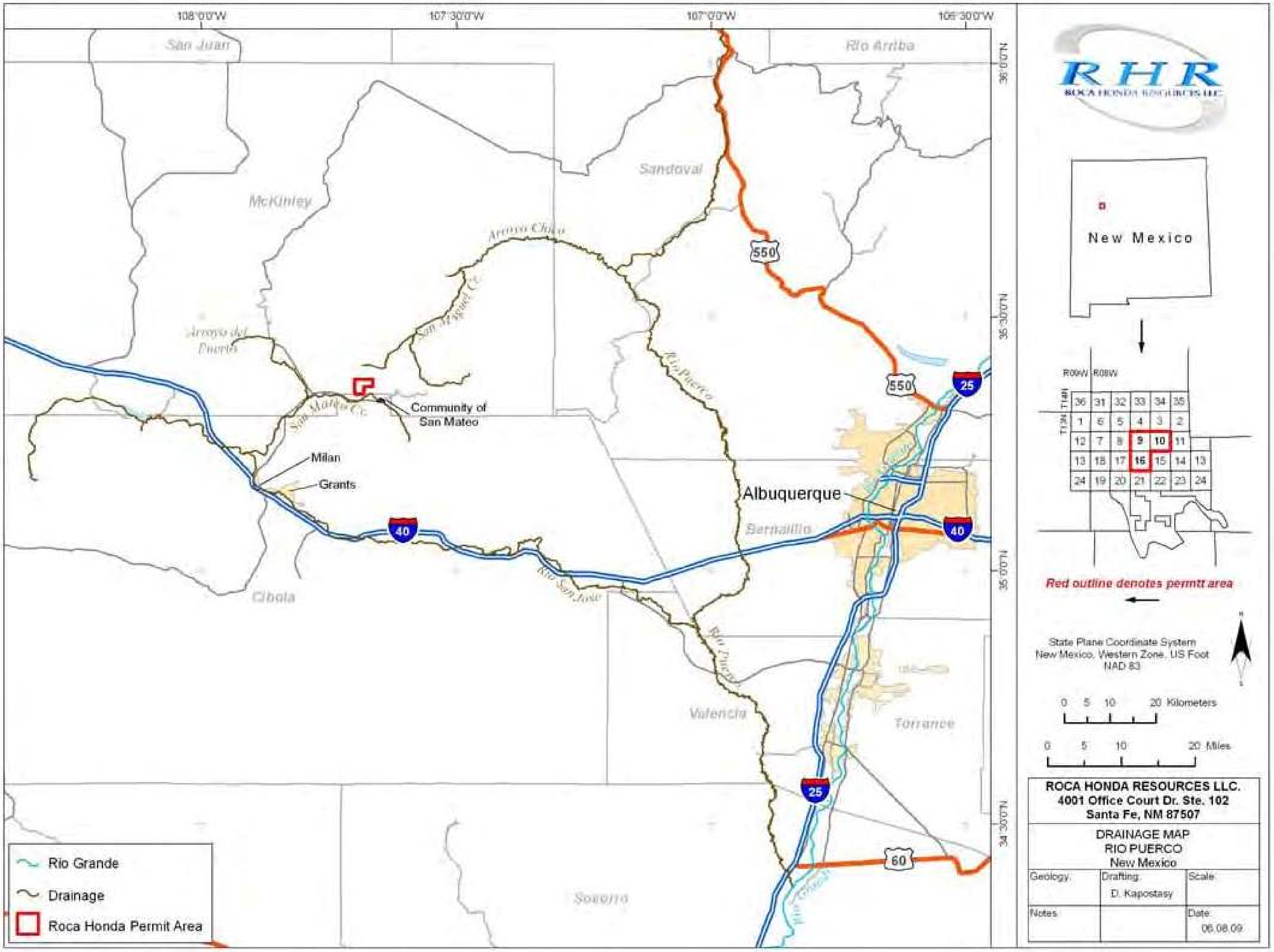


Figure 32. Drainage map of San Mateo Creek, Rio San José, and Rio Puerco, New Mexico

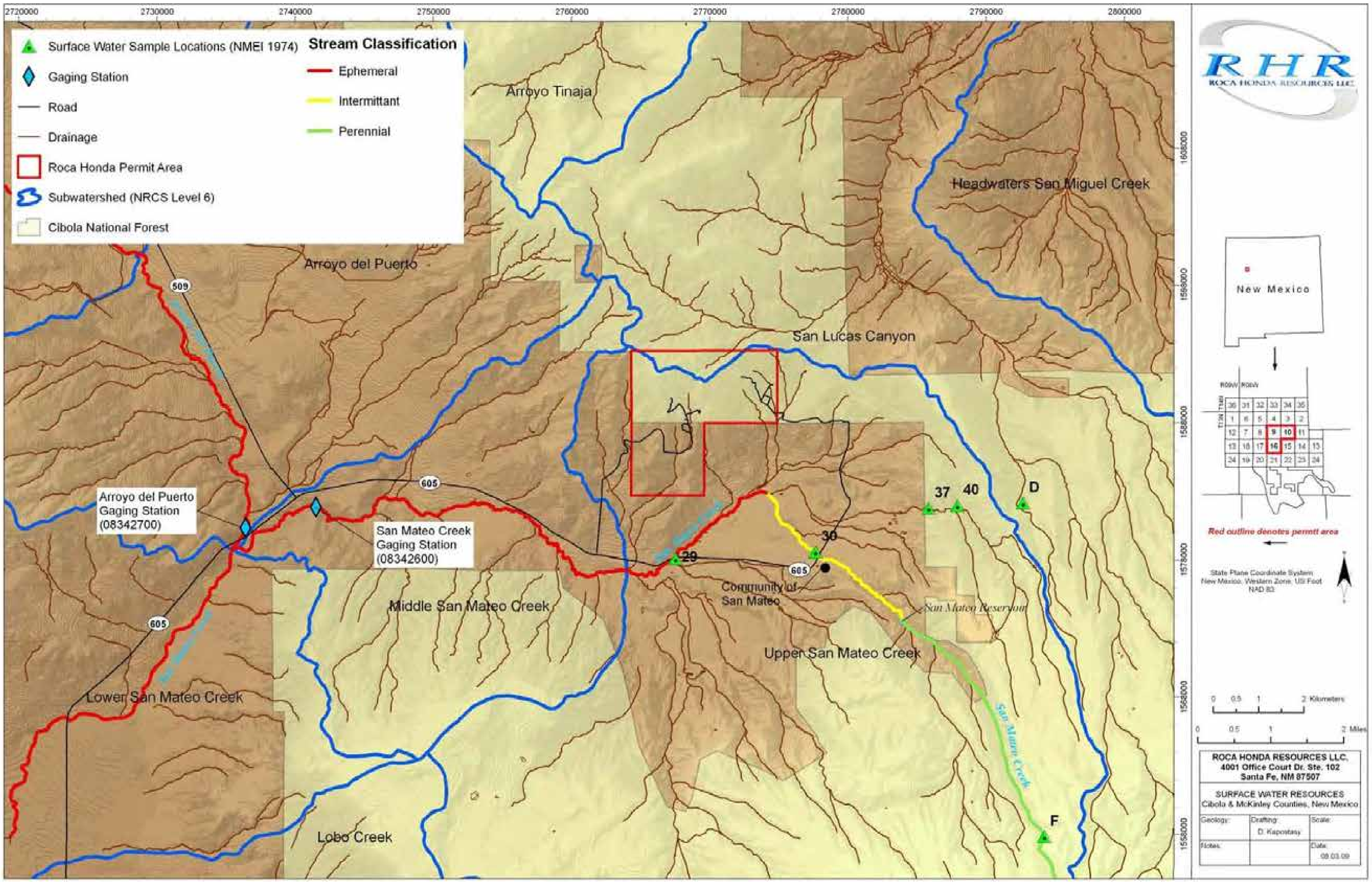


Figure 33. Permit area watershed and surface water resources

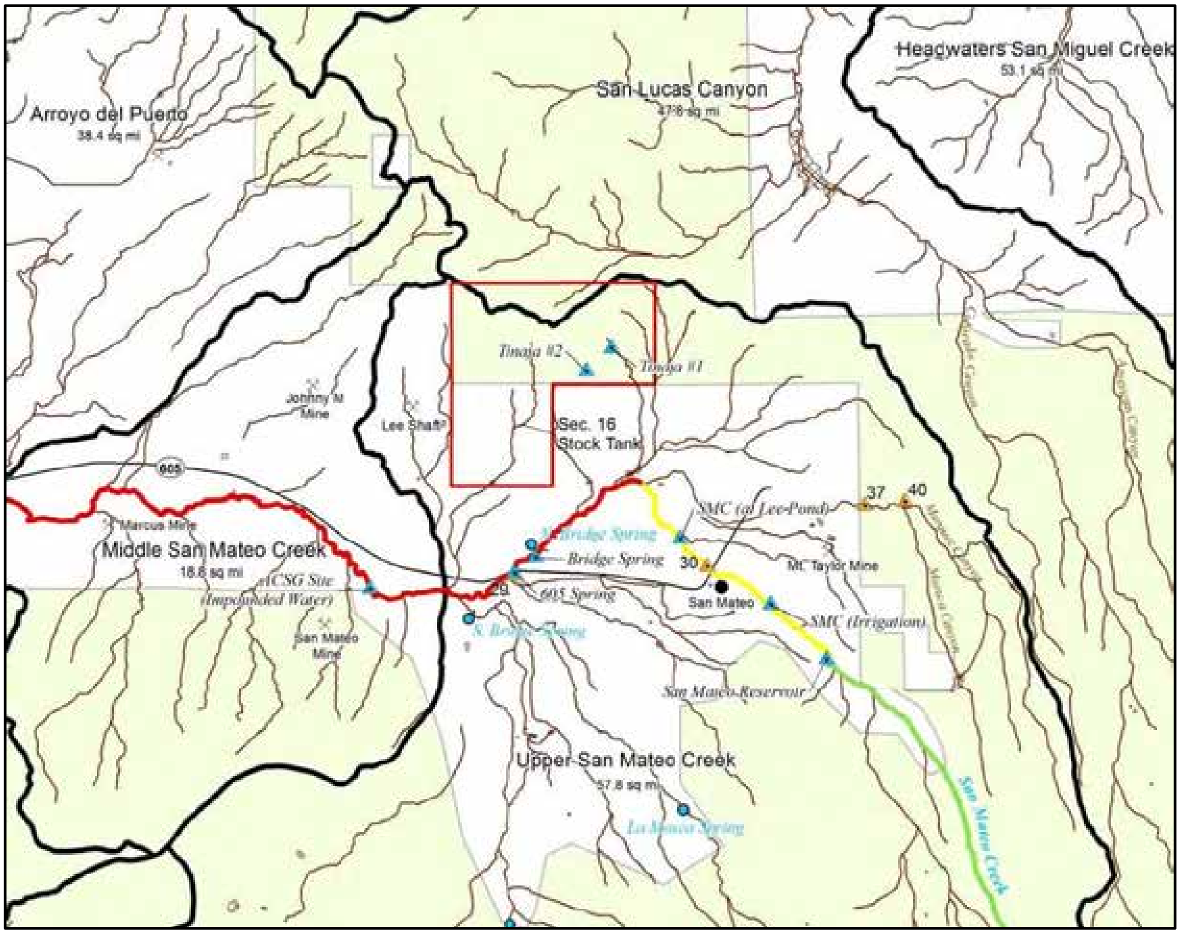


Figure 34. Map showing the two-digit USGS HUC watersheds in relation to the RHR mine site

San Mateo Creek

San Mateo Creek is the master stream within the Upper San Mateo subwatershed and all watercourses in the subwatershed drain to this stream. The headwaters of San Mateo Creek are on the north flank of Mt. Taylor. One branch heads in San Mateo Canyon above the community of San Mateo and drains down San Mateo Canyon, while the other drains the San Mateo arch/Jesus mesa area via Marquez and Maruca canyons.

Within the San Mateo Canyon branch, springs maintain a small perennial flow that is captured in San Mateo Reservoir, located above the community of San Mateo. In the Marquez Canyon branch of the subwatershed, there is an ephemeral stream that flows as a result of snowmelt or heavy rainfalls during the summer/early fall period. It was estimated that the drainage in Marquez Canyon had an annual discharge of 7.5 ac-ft/yr (NMEI, 1974). The flow conditions and water quality for San Mateo Creek are presented in the following subsections.

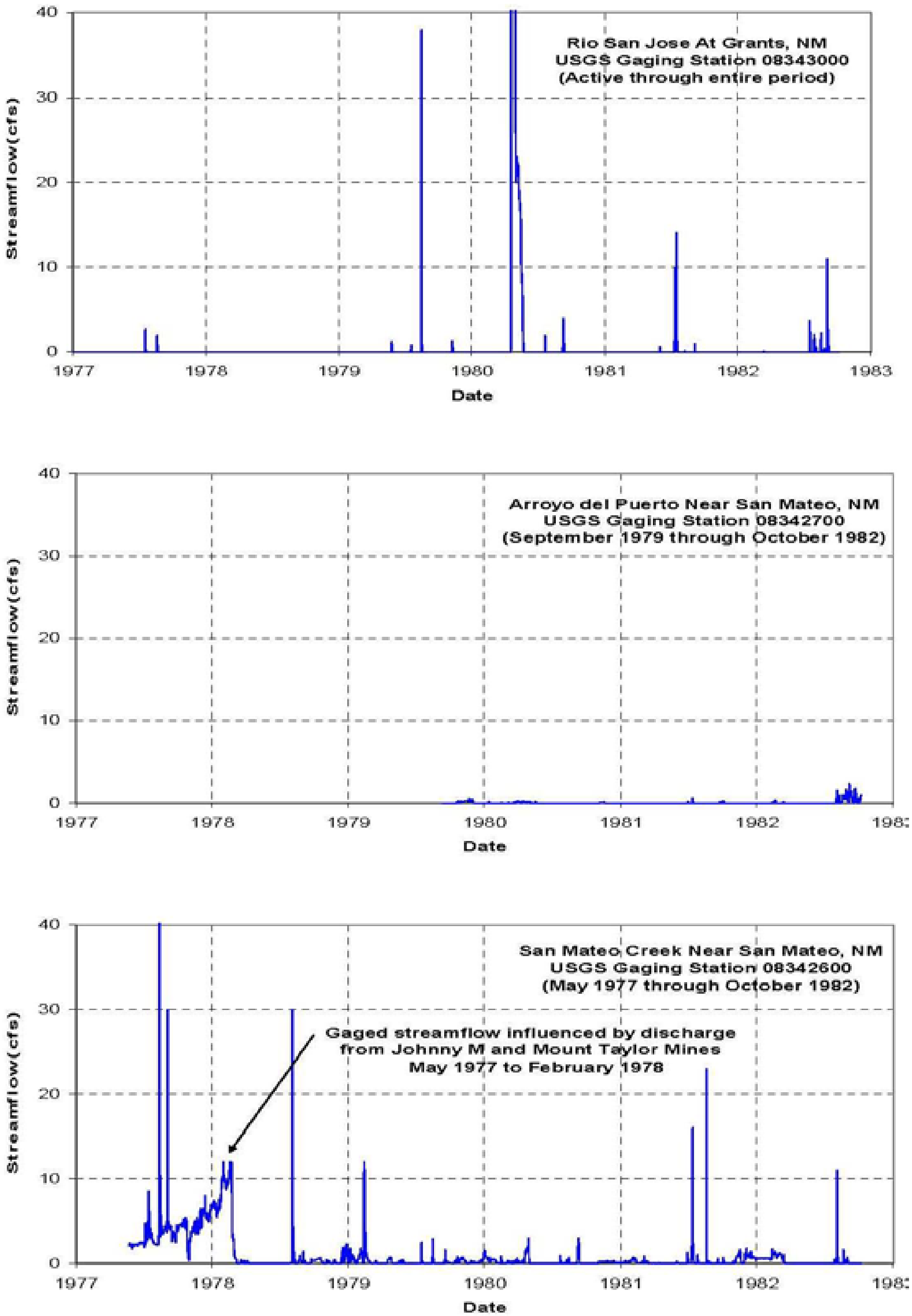


Figure 35. Mean daily streamflow for Rio San José, Arroyo del Puerto, and San Mateo Creek, 1977–1982

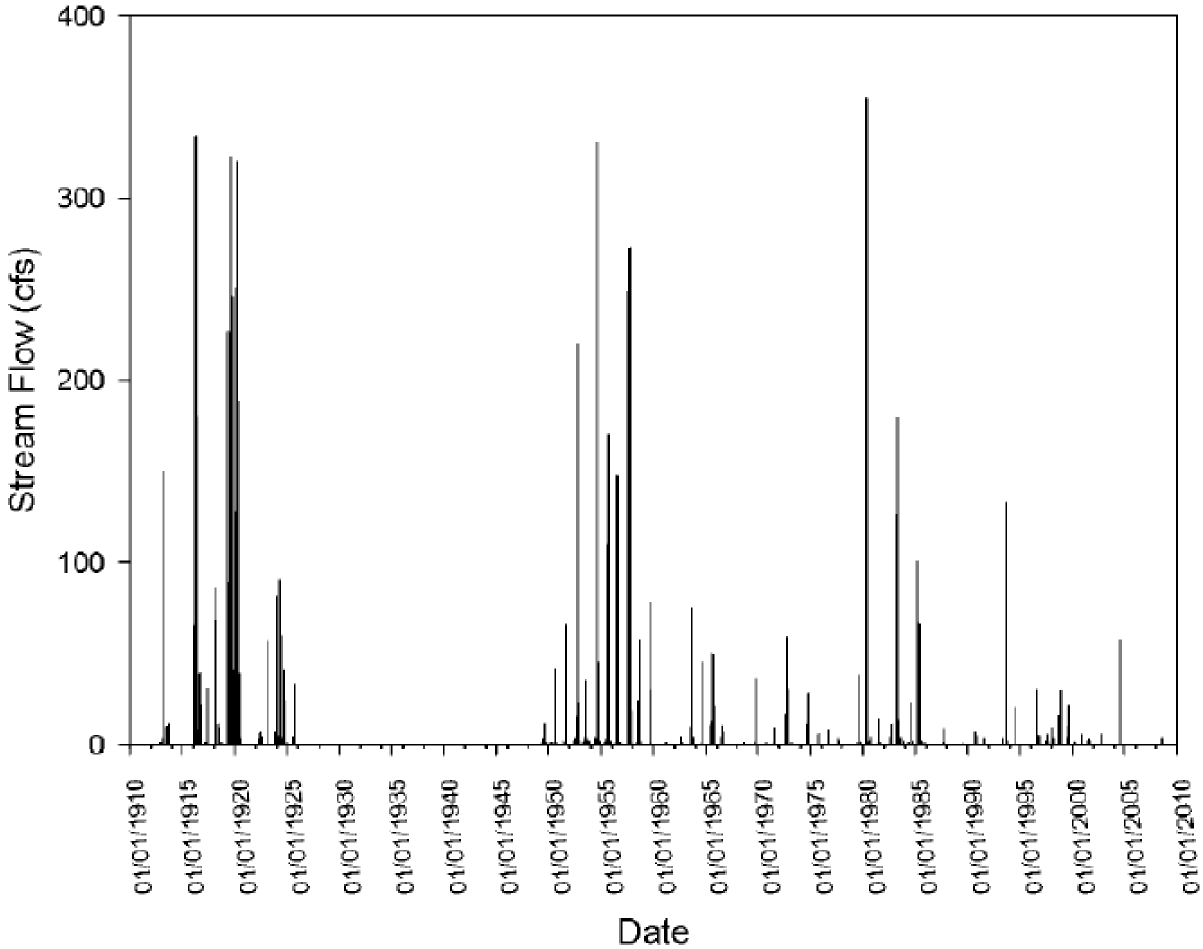


Figure 36. Daily streamflow in Rio San José at Gallup (USGS Gaging Station 8343000)

San Mateo Creek Flow

Flow conditions for San Mateo Creek are described based on data collected in two time periods: historical and recent data. The historical data are from the early 1980s and were collected to establish baseline hydrologic conditions prior to development of the Gulf Mt. Taylor Mine and during subsequent mining and dewatering activities. The recent data were collected between 2008 and 2010 by RHR to establish baseline environmental conditions in the watershed.

The historical data include streamflow measurements and water quality analyses. Streamflow was measured at:

- San Mateo Creek near San Mateo, NM (Station 08342600)
- Arroyo del Puerto near San Mateo, NM (Station 08342700)
- Temporary gages for a Mt. Taylor Mine Study

The two gaging stations operated in the late 1970s and early 1980s and measured mine water discharge to San Mateo Creek above its confluence with the Arroyo del Puerto (which drains

Ambrosia Lake Valley). The gaging stations are approximately 1 mile apart and about 5 miles downstream of the RHR permit area (figure 37).

The San Mateo gaging station recorded daily flow of the creek from a watershed drainage area of 75.6 square miles from May 23, 1977, to October 7, 1982. Mean daily streamflow data for the 5-year period that this gage was operational are shown on figure 35. Mean monthly flow of San Mateo Creek is shown on figure 37 for the same period.

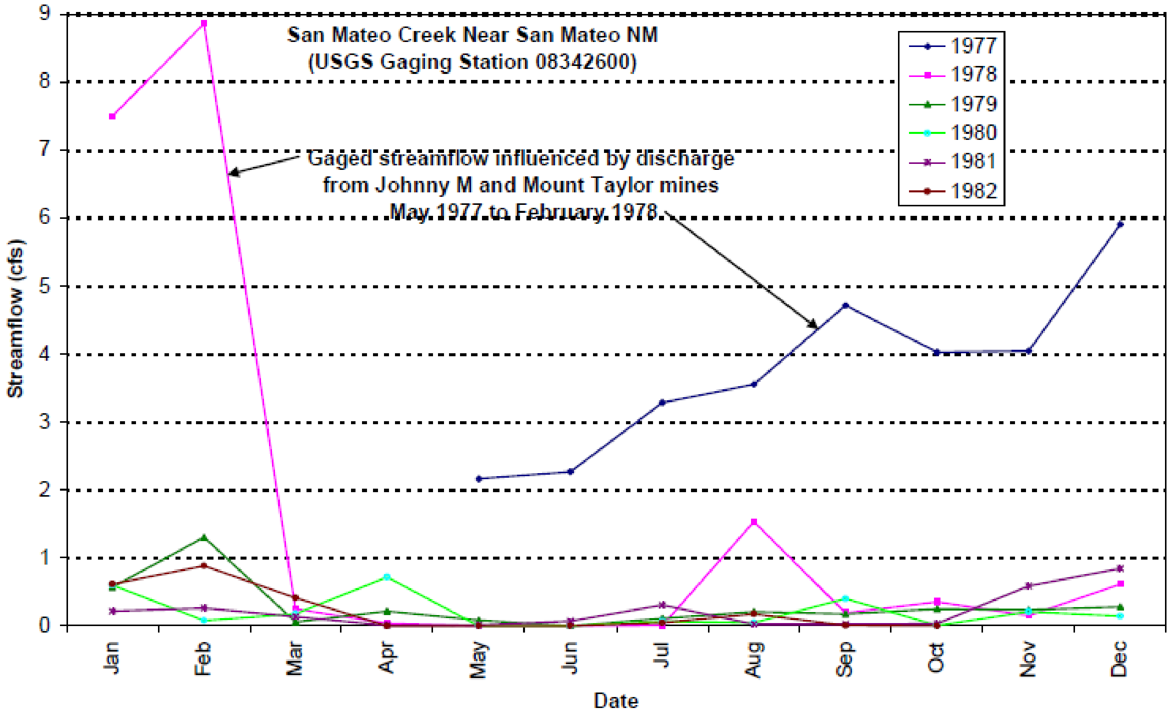


Figure 37. Mean monthly average flow of San Mateo Creek

Prior to 1978, the San Mateo Creek daily streamflow measurements indicate that flow was perennial. The flows ranged from 2 to 12 cfs (900 to 5,400 gpm). These flows reflect mine dewatering discharge during prior mining activities including the Johnny M mine and discharge during excavation of the Mt. Taylor mine shafts. After 1978, the flow pattern reflects an ephemeral stream with sporadic high flows of the creek associated with rainfall events during the summer/early fall and spring snowmelt runoff periods.

During peak runoff from snowmelt in the late spring or during heavy summer/fall rain storms, San Mateo Creek may flow west as far as a few miles beyond its confluence with Arroyo del Puerto, but according to previous investigators, flow rarely reached the Rio San José even 30 years ago (Brod, 1979; Stone et al., 1983). The flows of 30 to 40 cfs measured in 1977 and 1978 did not extend as far downstream at the Rio San José gaging station.

Since about 1995, the lower portion of San Mateo Creek has been influenced by the Homestake Mill Superfund Site remediation. Homestake Mine is located approximately 12 miles downstream of the RHR permit area. Homestake Mining Company diverted the channel of San Mateo Creek to the west and southwest around the Homestake Mill Superfund Site and directed it onto one of Homestake's center pivot irrigation areas. Field investigations determined that the channel of San

Mateo Creek is presently indistinguishable from the surrounding countryside above its former confluence with the Rio San José and the creek may no longer join that stream except during very high flow events.

The Arroyo del Puerto gaging station was located about 0.1 mile north of the confluence of that drainage with San Mateo Creek. The station operated from mid-September 1979 through early October 1982. Average daily streamflow data for this 3-year operational period are shown on figure 34. Although the Arroyo del Puerto drains a large area, the historical flow record reflected very little flow. The Arroyo del Puerto is presently ephemeral.

An additional investigation of San Mateo Creek streamflow was conducted in the early 1970s by NMEI as part of the environmental baseline study of the Mt. Taylor area associated with permitting of the proposed GMRC Mt. Taylor uranium mine (NMEI, 1974). Field data were collected during 1972 and 1973. Flow measurements were made in tributaries to San Mateo Canyon to determine the location and quantity of groundwater discharge into San Mateo Creek. Mean annual runoff of the creek was also calculated. NMEI concluded that the mean annual runoff of San Mateo Canyon was 1,800 ac-ft/yr, and that of this volume, about 0.5 cfs, or 360 ac-ft/yr, was contributed by spring and groundwater discharge, all of which entered San Mateo Creek in its upper watershed above San Mateo Reservoir.

NMEI concluded that the flow characteristics of upper elevation (higher than 7,950 feet) and lower elevation locations within the watershed are different. The upper elevations generally contain snowpack for most of the winter and contribute snowmelt to the stream in late April and early May. San Mateo Creek in the upper elevations is perennial, but it is the reach above the reservoir (NMEI, 1974). In contrast, San Mateo Creek in the lower elevation is ephemeral, where flow occurs in response to precipitation. NMEI observed that three rainfall events of variable amounts (0.22 to 0.90 inch) caused streamflows of the same magnitude in the lower elevations of San Mateo Creek.

Recent data on streamflow come from field investigations conducted by RHR from late 2008 through 2010 to assess the presence of surface water in the vicinity of the RHR permit area. These field investigations included**:**

- Completing a UAA equivalent level 1 evaluation of San Mateo Creek following the New Mexico Environment Department Hydrology Protocol (NMED, 2011);
- Observing the creek during field visits over a period of 2 years; and
- Collecting water samples for chemical analysis from perennial and intermittent water within the stream basin and from stream bed sediments.

The first survey was conducted in the early fall, the time of year when surface water would be likely to be present. Standing water was located in:

- Tinajas along the eastern side of Section 10
- Localized ponded areas in the San Mateo Creek
- Seepage from two springs (Bridge Spring and 605 Spring)
- Seepage along the creek

- San Mateo Reservoir
- Flowing in San Mateo Creek above the community of San Mateo

When these locations were revisited during different seasons, surface water was found only in the San Mateo Reservoir, as irrigation releases from the reservoir, and at Bridge spring. Based on these recent observations, RHR concluded that from the town of San Mateo downstream to a pond on the Lee Ranch, San Mateo Creek is an intermittent stream that has flow when water is being released from the reservoir for irrigation purposes and during high rainfall events. Downstream of the pond, San Mateo Creek is ephemeral. This conclusion is consistent with the historical data and conclusions presented by NMEI (1974).

San Mateo Creek Surface Water Quality

The 1974 NMEI baseline study collected data on surface water chemistry within the San Mateo Creek watershed. Surface water samples were collected from the perennial upper reach of San Mateo Creek and from ephemeral tributaries to San Mateo Creek during rain or spring runoff events. The historical study provides general information on water quality. Surface water collected from higher elevations tended to be lower in total dissolved solids (TDS), but more acidic and higher in sulfate than water from lower elevations. Samples from some locations, for example, near the community of San Mateo, exhibited high levels of sodium. High levels of suspended solids were associated with high flow rates (NMEI 1974).

NMEI collected surface water samples from upper San Mateo Creek and the Marquez Canyon drainages within the upper San Mateo Creek watershed, above the RHR permit area. Table 4 tabulates chemistry data for two locations along San Mateo Creek south of and closest to the permit area (locations 29 and 30 on figure 33) and two locations (numbers 37 and 40 on figure 34) in Marquez Canyon.

Permit Area Surface Water Hydrology

The permit area is drained by a number of ephemeral arroyos which drain south to San Mateo Creek and north to Canada de las Vacas (figure 33). RHR field investigations between 2008 and 2010 included observations of surface water. No perennial or intermittent surface water systems, lakes, wetlands, reservoirs, or springs were observed within the permit area, with the exception of a stock reservoir in Section 16 and seasonal tinajas (seasonal water pockets in bedrock) in Section 10. The stock reservoir over this period was not observed to have standing water. The tinajas were located within small, eastward draining arroyos on the east side of Section 10. They contained water in September 2009 and water samples were later collected from the two largest tinajas. During the following summer the tinajas were dry.

Table 4. Range of constituents – San Mateo Creek and Marquez Canyon samples

Constituent	San Mateo Creek at State Highway 605 Bridge (Loc. 29)	San Mateo Creek at Marquez Ranch (Loc. 30)	Marquez Canyon (Loc. 37, 2 Samples)	Junction with Maruca Canyon (Loc. 40)
pH	8.62–8.97	8.16–8.45	9.17–9.18	8.46–8.69
Specific conductance (µmhos)	650–1,090	187–241	522–526	405–1,180
Calcium (mg/L)	24.53–93.76	22.98–88.01	5.98	61.01–102.5
Magnesium (mg/L)	16.12–30.40	4.32–6.21	1.46–2.13	11.38–33.75
Potassium (mg/L)	3.85–204	3.93–5.65	3.63–4.42	9.40–28.93
Sodium (mg/L)	148–281	11.83–19.89	127.1–129.5	67.48–249.0
Chloride (mg/L)	16.7–41.4	2.4–7.0	3.4–3.8	13.3–130
Sulfate (mg/L)	42–250	6–23	2	37–352
Phosphate (mg/L)	0.02–0.38	0.28–0.53	0.07–0.18	0.20–0.39
Nitrate (mg/L)	0.33–1.71	0.20–1.64	0.32–0.33	0.76–1.26
Bicarbonate (mg/L)	369.2–550.8	78.8–134.8	244.2–249.0	288.2–387.2
Alkalinity (CaCO3) (mg/L)	336.8–469.7	64.6–112.5	244.2–246	256.0–350.3
Total Dissolved Solids	535–2,020	180–620	640–896	850–7,450

Data from NMEI, 1974

See figure 33 for sampling locations

Groundwater Resources

A major issue to be considered in this EIS is the possible effect of the proposed action on the groundwater resources of the permit area and surroundings. This section describes the existing condition—first the regional hydrogeologic context and then the detailed hydrogeology of the permit area and its surroundings. The relevant existing conditions are the character of rock units that contain groundwater, including their properties that determine the response to pumping, the depth at which water is found by drilling and (for the artesian aquifers typical of this area), the level to which water levels rise in wells, and the quality of the native groundwater. The emphasis here is on the Westwater Canyon aquifer, which is the ore-bearing body and from which large amounts of water will be pumped during the mining process.

Regional Hydrogeology

Sources of Information

The project area is near the southern edge of the San Juan structural basin and has a hydrogeology consistent with other areas of the basin. The San Juan structural basin has been extensively studied, because the area contains deposits of recoverable coal, uranium, and hydrocarbons, as well as valuable groundwater resources. Studies by the U.S. Geological Survey (USGS), the New Mexico Bureau of Mines and Mineral Resources, the New Mexico State Engineer, and others have described area aquifers, compiled and analyzed groundwater quality data, and developed estimates of aquifer properties (Brod and Stone, 1981; Frenzel and Lyford, 1982; Stone et al., 1983; Craigg et al., 1989; Dam et al., 1990; Dam, 1995; and Craigg, 2001).

As part of the Regional Aquifer System Analysis program, the USGS developed a steady-state multi-aquifer groundwater flow model of the San Juan basin (Kernodle, 1996). No copy of the actual model code still exists. However both DBSA (2001, on behalf of Acoma Pueblo) and Intera (2011, on behalf of RHR) have used reconstructions and modifications of the model to predict impacts of pumping in the region. Another USGS model is Frenzel (1992), which simulates impacts from pumping in the San Andres-Glorieta aquifer, including effects on Horace Springs. DBSA (2001) has also modified and used this model for the same purpose.

Aquifers

Figure 38 is a cross-section of the San Juan Basin which shows the major aquifers and confining beds (rocks that restrict water movement). Sandstones and limestones are the primary aquifers within the southeastern part of the San Juan Basin; the confining beds are typically shales. The aquifers include the following, from shallowest to deepest:

- Cretaceous Formations including the Menefee; Point Lookout Sandstone; Crevasse Canyon Formation, and Gallup Sandstone; and the Dakota Sandstone.
- The Jurassic Westwater Canyon Member of the Morrison Formation, and the deeper Entrada sandstone.
- Permian Glorieta Sandstone and San Andres Limestone.

The line of this cross-section lies considerably to the west of the Roca Honda permit area. On the figure, the location north of Crownpoint where the Mesaverde group outcrops is where the geologic sequence most closely resembles the Roca Honda permit area, although some thicknesses of units in the permit area are different than shown on figure 38. See Stone et al., 1983 for an expanded discussion of the stratigraphy shown in figure 38. A version of figure 38 that contains information on water quality and aquifer transmissivity is published in Wilson and Holland (1979).

Groundwater can occur in other geologic settings. For example, within topographic valleys, Quaternary alluvium can be a local aquifer. Also, while low permeability confining beds separate the major aquifers on a regional scale, in specific areas they can yield small quantities of water to wells from localized sandstone lenses. Formations older than the San Andres Limestone may contain groundwater; however, their depths generally preclude groundwater exploration or development except along the margins of the basin where they are close to the surface.

Table 5, from Levings, et al. 1996, is a convenient summary of the then available data regarding the aquifer properties that impact flow and storage. Transmissivity of San Juan Basin aquifers ranges from 450,000 ft^2/day for the cavernous Glorieta Sandstone-San Andres Limestone aquifer to less than 1 ft^2/day for some of the finer grained, well-cemented sandstones, such as the Pictured Cliffs Sandstone. The better sandstone aquifers of Tertiary, Cretaceous and Jurassic age have transmissivity values ranging from 25 to 500 ft^2/day (Stone et al., 1983). Specific storage in confined portions of the aquifers is expected to be within the range stated by Lohman (1972), 10^{-6} per foot of thickness. Specific yield in unconfined aquifers in the range of 10 to 30 percent, but can be lower in tightly cemented units (Stone et al., 1983).

Flow Patterns

Groundwater flows from areas of recharge to areas of discharge, from locations of high water levels to locations of lower water levels, and from locations of high water pressure to less pressure. On a regional scale, most recharge enters the groundwater flow systems as precipitation or stream channel loss on permeable formations which are at the surface along the southern margin of the basin and on the flanks of the Zuni, Chuska, and San Mateo Mountains.

Groundwater then flows downgradient northwestward to discharge along the San Juan River; and northeastward, eastward, or southeastward to tributaries of the Rio Grande including the Rio Salado, Rio Puerco, and Rio San José; and to springs which discharge along faults or dikes (Stone et al., 1983). Discharge also occurs artificially from wells. An undetermined amount of subsurface, interformational movement of water may occur.

As groundwater moves downgradient from the recharge area within permeable formations, it is restricted from moving vertically by shale units; as the water gets ever deeper, the restriction causes water pressures to increase, such that high artesian heads (water levels that have the potential to rise far above the actual rock formation) occur in most bedrock aquifers away from their outcrops. Arrows on figure 38 show the general pattern of deep groundwater flow between the Jurassic and Cretaceous aquifers. Additional information on deep flow is available in Stone et al. (1983) and Kernodle (1996).

The movement of groundwater through the alluvium of valleys and through shallow aquifer systems in some Upper Cretaceous rocks is influenced by topography and surface water drainages and is independent of, and sometimes trends in, a different direction than groundwater movement in the deep aquifers. This shallow groundwater is unconfined.

According to Stone et al. (1983), the steady state inflow/outflow rate of groundwater through the basin is approximately 40 cfs (cubic feet per second, about 18,000 gallons per minute) for Cretaceous and Jurassic sandstone aquifers combined, and less than half of that for Cenozoic aquifers. Kernodle (1996) simulated a total steady state outflow from the entire 19,380-square-mile San Juan basin aquifer system of 195 cfs, all of which was simulated as being discharged to the surface water system in the lower reaches of the San Juan River and Rio Puerco. That simulation indicated 135 cfs of the recharge to the aquifers was from streambed infiltration, 56 cfs was from direct precipitation, and 4 cfs was leakage from the Chuska Sandstone. The total water budget of 195 cfs represents a basinwide average of 0.14 inch per year, or about 1 percent of the average annual precipitation in the basin (DBSA, 2001: 26).

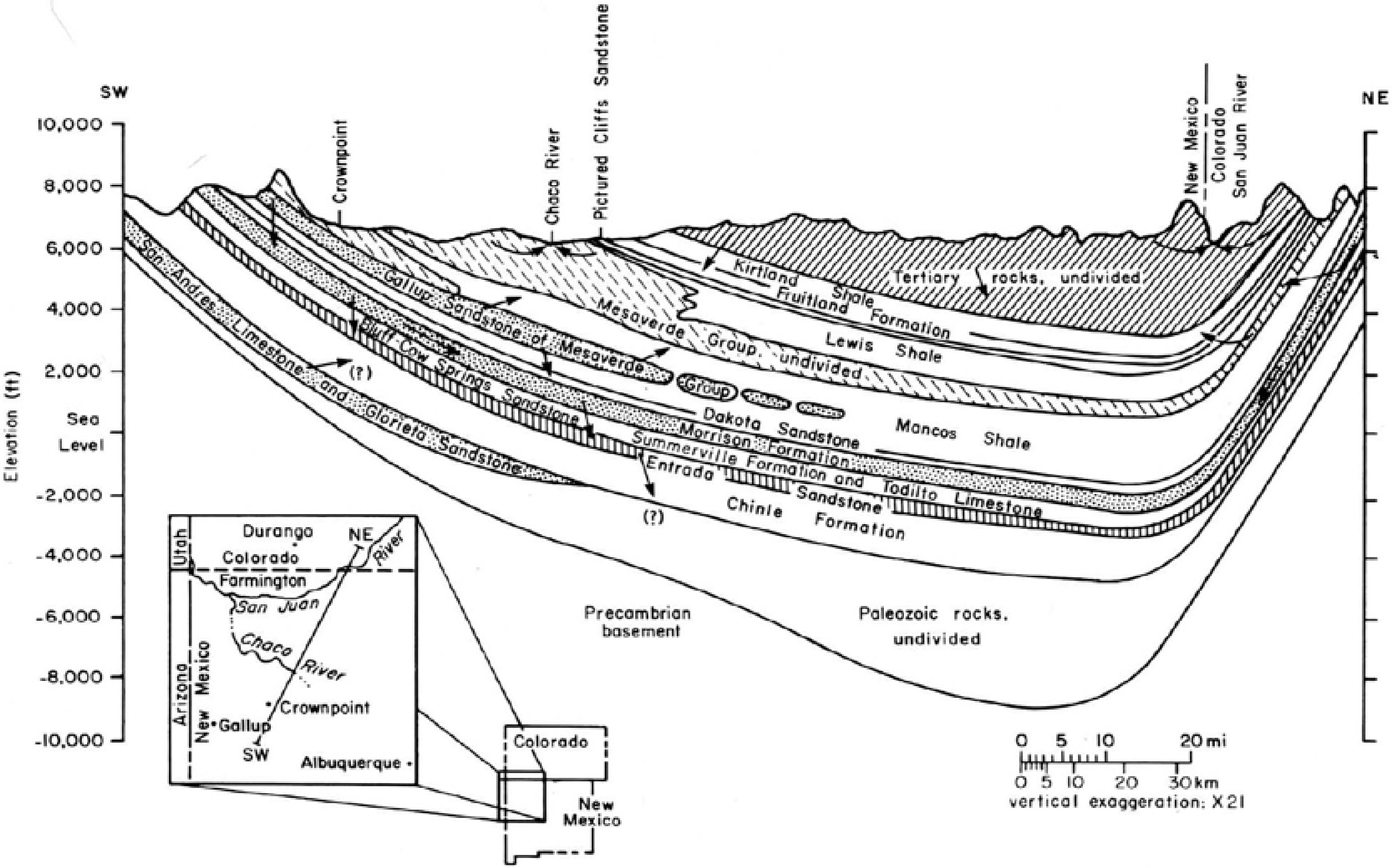


Figure 38. Generalized hydrogeologic cross-section of San Juan Basin

Notes: Diagram shows major aquifers (stippled), confining beds (blank), and directions of groundwater flow (arrows). From Stone et al. (1983). The scales indicate a large vertical exaggeration in this diagram.

Table 5. Summary of hydrologic characteristics of hydrogeologic units in the San Juan structural basin

Hydrogeologic Unit	Transmissivity (feet squared per day)			Storage coefficient		Hydraulic conductivity (feet per day)	Discharge (gallons per minute)			Specific capacity (gallons per minute per foot of drawdown)		
	Range or Value	Median	Number of tests	Range or Value	Number of tests		Range or Value	Median	Number of wells	Range or Value	Median	Number of wells
San José aquifer	40–117	100	3	–	–	–	0.15–61	5	46	0.23	–	2
Nacimiento aquifer	–	–	–	–	–	–	2–70	24	14	0.03–0.80	0.24	10
Animas aquifer	–	–	–	–	–	–	2–90	6	39	0.031	–	1
Ojo Alamo aquifer	57–245 0.05-0.39	140 0.35	9 3[1]	–	–	–	1.2–112	12	19	0.02–2.04 0.01–0.03	0.28 0.02	7 2[1]
Kirtland aquifer	2.4	–	1	0.00001	1	–	1–12	3	12	0.01–0.42	0.03	6
Fruitland aquifer	0.6–130	7	5	–	–	–	1–12	2.5	8	0.003–0.04	0.02	3
Pictured cliffs aquifer	0.001–3	0.01	5	–	–	0.007[2]	2–73	21	12	0.01–0.70	0.01	7
Lewis confining unit	–	–	–	–	–	–	2–25	7	13	0.04–2.5	0.67	3
Cliff House aquifer	2.1	–	1	–	–	0.0015[2]	1–40	8.5	27	0.01–0.15	0.06	14
Menefee confining unit	2.7–112	10	9	–	–	0.017[2]	2–308	10	83	0.02–0.57	0.11	37
Point Lookout aquifer	0.4–236	56	4	0.000041	1	0.0058[2]	1–360	20	22	0.02–1.67	0.25	6

Hydrogeologic Unit	Transmissivity (feet squared per day)			Storage coefficient		Hydraulic conductivity (feet per day)	Discharge (gallons per minute)			Specific capacity (gallons per minute per foot of drawdown)		
	Range or Value	Median	Number of tests	Range or Value	Number of tests		Range or Value	Median	Number of wells	Range or Value	Median	Number of wells
Mancos confining unit	–	–	–	–	–	–	1–15	7	10	–	–	–
Crevasse Canyon aquifer[3]	41	–	1	–	–	–	14	–	1	0.14	–	1
Gallup aquifer	15–390	124	20	0.000032–0.000033	2	–	0.42–645	42	49	0.12–2.10	0.46	13
Dakota aquifer	44–2,000	85	3	0.00004–0.000057	2	0.03[2]	1.25–75	12	30	0.03–3.67	0.06	13
Morrison aquifer	2–490	135	39	0.00002–0.0002	9	0.025–0.39	1.3–2,258	30	83	0.01–3.98	0.42	32
Entrada aquifer	50–400[4]	–	?	–	–	0.5–5	8–616	105	8	0.33	–	1
Chinle confining unit	13–144	100	5	–	–	–	1–500	35	28	0.1–0.75	0.43	4

[1]Value from deep test hole near the center of the basin.

[2]Value is an average from oil and gas test holes.

[3]Not a regional hydrogeologic aquifer.

[4]Value from Stone and other (1983, p.41) Data from Levings et al. (1996)

The flow pattern also influences water quality, with the best quality water typically closer to the recharge zone at the aquifer outcrops, and poorer quality water downdip in the aquifers (and also in the interleaved aquitards). For example, figure 75 in Stone et al. (1983) indicates that water in the Morrison Formation over a large portion of southern McKinley County (north of the outcrop) is generally of excellent quality with respect to specific conductance, a measure of the dissolved minerals content.

Where there is a demand for water, the limited availability of surface water results in widespread use of groundwater in the San Juan Basin for all purposes.

Hydrogeology of the Permit Area and Surroundings

Introduction

The Roca Honda permit area is located in the southeastern part of the San Juan structural basin, within the southeast part of the Ambrosia Lake uranium subdistrict. This subdistrict was the site of uranium mining and associated mine dewatering activities from the 1960s through the 1980s, and the impacts from such mining are one basis for prediction of impacts at Roca Honda. The permit area lies within the Bluewater Underground Water Basin as extended by the New Mexico Office of the State Engineer (OSE) on May 14, 1976. The area discussed below includes the 3-section permit area and surrounding lands for several miles in all directions from the permit area boundaries.

Sources of Information

RHR compiled groundwater quality data and hydraulic parameter estimates from the Mt. Taylor mine and various other uranium mines west of the Roca Honda permit area in the Ambrosia Lake subdistrict (NMEI, 1974; GMRC, 1979a; and Kelley et al., 1980; see compilation in Section 9 of the Baseline Data Report). The Mt. Taylor Mine is approximately 3 miles southeast of the Roca Honda permit area; it formerly was operated by Gulf Mineral Resources Company (GMRC) and others and now is owned by Rio Grande Resources Corporation (RGRC). This mine was dewatered during the 1970s and early 1980s. Much information on this mine is not publically available. Although far from the permit area, RHR considered information on the groundwater quality and hydraulic characteristics of the Westwater Canyon Member of the Morrison Formation that were considered in site licensing in the Crownpoint and Church Rock areas (HRI, 1988 and 1991; and USNRC, 1997).

Historical data on water quality and aquifer hydraulic characteristics specific to the permit area and immediate surroundings are sparse. Consequently, RHR compiled the relevant published and unpublished information near the permit area. This effort included an inventory of wells previously identified in published and unpublished reports as being present near the Roca Honda permit area. The inventory of 149 records includes location, completion date, well depth, producing formation, measured water levels, and availability of chemical data for each well. The wells were field checked. Selected wells from the inventory were sampled. In addition, RHR drilled three monitoring wells within Section 16 of the permit area in 2007 and subsequently sampled them. RHR incorporated a subset of the selected inventory wells and all three monitoring wells into an ongoing water quality sampling program, termed the Regional Groundwater Sampling Program.

RHR completed an aquifer test in May 2010, pumping its Well S-4 in the permit area to establish the local aquifer properties of the Westwater Canyon. Additionally, RHR has submitted a proposed detailed groundwater monitoring plan and a work plan to establish baseline groundwater quality in response to an NMED request pursuant to RHR's discharge plan application. The data provided in the Roca Honda Baseline Data Report (2011) will be used in conjunction with data generated in future monitoring by RHR to further refine its understanding of existing water quality.

RHR summarized its groundwater investigations made as part of the permitting process in Section 9 of its Baseline Data Report (RHR, January 2011 Revision 1). RHR placed the discussion of springs with surface water (Section 8 of the BDR), but in this EIS they are considered as a manifestation of groundwater conditions.

DBSA (2001) provides information on water supply available at the site of the Mt. Taylor Mine. Their work included reliance on a report by Hagan et al. (2001), an update of the model by Frenzel (1992), and application of a model by Carpenter and Shomaker (1998). Although the Westwater Canyon at Mt. Taylor Mine is considerably deeper than at the Roca Honda permit area, the nature of impacts from developing the Westwater Canyon Member of the Morrison Formation represents one basis for assessing impacts at the Roca Honda location.

Aquifers and Confining Beds

Based on past and recent drilling for uranium exploration, the stratigraphy at the Roca Honda site is consistent with elsewhere in the San Juan structural basin. Figure 39 is a stratigraphic column showing the rock units that RHR has identified in the vicinity of the permit area, and the depth below the land surface where each unit is found. The section omits the highest bedrock unit found within the permit area, the Menefee Formation, which is found only to a limited extent and not known to contain water in the three sections of the area. It also omits Quaternary deposits (including alluvium) found over portions of the surface, especially along valleys.

Three formations are known to be significant aquifers such that they must be dewatered during mine construction or operation: the Gallup and Dakota Sandstones and the Westwater Canyon Member of the Morrison Formation. Recent drilling by RHR to find "first water" for purposes of the State's groundwater discharge plan process found the shallowest saturated zone to be in the Gallup. The primary confining beds are the shales above each aquifer: the Brushy Basin Member of the Morrison above the Westwater Canyon and two units of the Mancos shale above the Dakota and Gallup. The Recapture Member of the Morrison provides a degree of hydraulic isolation between the Westwater Canyon and deeper aquifers such as the San Andres limestone.

The sections below provide information on the six units within the permit area that are most important to prediction of impacts from the RHR project. From deepest (oldest) to shallowest (youngest) these are as follows:

- **Westwater Canyon Member of the Morrison Formation**. This is the target horizon for mining and the unit for which dewatering pumping is by far the greatest, hence the unit of greatest impact from such pumping.
- **Dakota Sandstone.** Dewatering of the Dakota will occur during shaft construction, and it is the aquifer most directly impacted by pumping of the Westwater Canyon.

- **Gallup Sandstone.** Similar to the Dakota, except farther up in the stratigraphic section and less directly impacted by Westwater Canyon pumping.
- **Point Lookout Sandstone**. This unit is found at or near the land surface in the permit area. Although it was found to be dry within the area during the “first water” drilling, it is known to be the source of a small spring (Bridge Spring) discussed subsequently. For this unit, the issues are impacts from deep pumping and from water management activities at and near the land surface within the mine area.
- **Menefee Formation.** This unit is found at or near the land surface in the permit area. Although it was found to be dry within the area during the “first water” drilling, it is known to be the source of small springs discussed subsequently. For this unit, the issues are impacts from deep pumping and from water management activities at and near the land surface within the mine area.
- **Alluvium.** This unit is known to contain groundwater along the larger valleys such as San Mateo Creek. For this unit, the issues are impacts from deep pumping and from water management activities at and near the land surface within the mine area.

Table 6, after table 9-13 of the Baseline Data Report, summarizes the available information from various sources on the thickness, hydraulic conductivity, transmissivity (product of thickness times horizontal hydraulic conductivity), yield, summary water quality, and storage properties of each water-yielding interval. One unit in the table, the Dalton Sandstone of the Crevasse Canyon Formation (Cretaceous), is not considered below; it is a minor source of water to stock wells north and east of the permit area. The well inventory includes two wells in the Dalton Sandstone, Nos. 124 and 126, in the northwest quarter of Section 4, T12N R8E, a little less than 6 miles north of the northern boundary of the permit area.

A section below provides information on the springs of interest to this EIS, some of which have a hydrogeology which relates to units other than those above (e.g. Horace Springs and Ojo del Gallo, where the Permian San Andres Formation is a major source for Acoma and Laguna Pueblos). The following section briefly discusses two other locations of interest that are outside the permit area: the volcanic rocks of Mt. Taylor which potentially act as a partial barrier to groundwater flow and transmission of impacts; and the area where treated wastewater from the Roca Honda Mine would be discharged.

Westwater Canyon Member of the Morrison Formation

Because the Westwater Canyon Member of the Morrison Formation is the target horizon for the proposed uranium mining, but also an aquifer containing abundant water, any mine workings in it would be flooded unless the ore beds and access points are dried out before mining occurs. There are minimal other uses of the aquifer in the area that could be affected. The RHR well inventory identified only two wells completed in the Westwater Canyon within 2 miles of the permit area: No. 15, the converted Lee Mine Shaft in Section 17; and No. 143, OSE water rights file number B-1778 in Section 18, both to the west of the permit area. Based on its construction, the latter is not deep enough to have reached the Westwater (its reported depth is no more than 940 feet). The primary issue regarding the Westwater is, thus, the effects of pumping on the other aquifers and on springs that discharge from other aquifers, including effects that are cumulative with other pumping.

Data obtained by RHR regarding aquifer properties and water chemistry are consistent with table 6. TDS (total dissolved solids, a measure of overall salinity) in Westwater Canyon water samples collected from the three RHR monitoring wells ranged from 425 to 532 mg/l, which is fresh water. Calculations from an aquifer test indicated average transmissivity between 80 and 200 ft2/day and a storage coefficient of 0.0002 (RHR, January 2011 Revision 1).

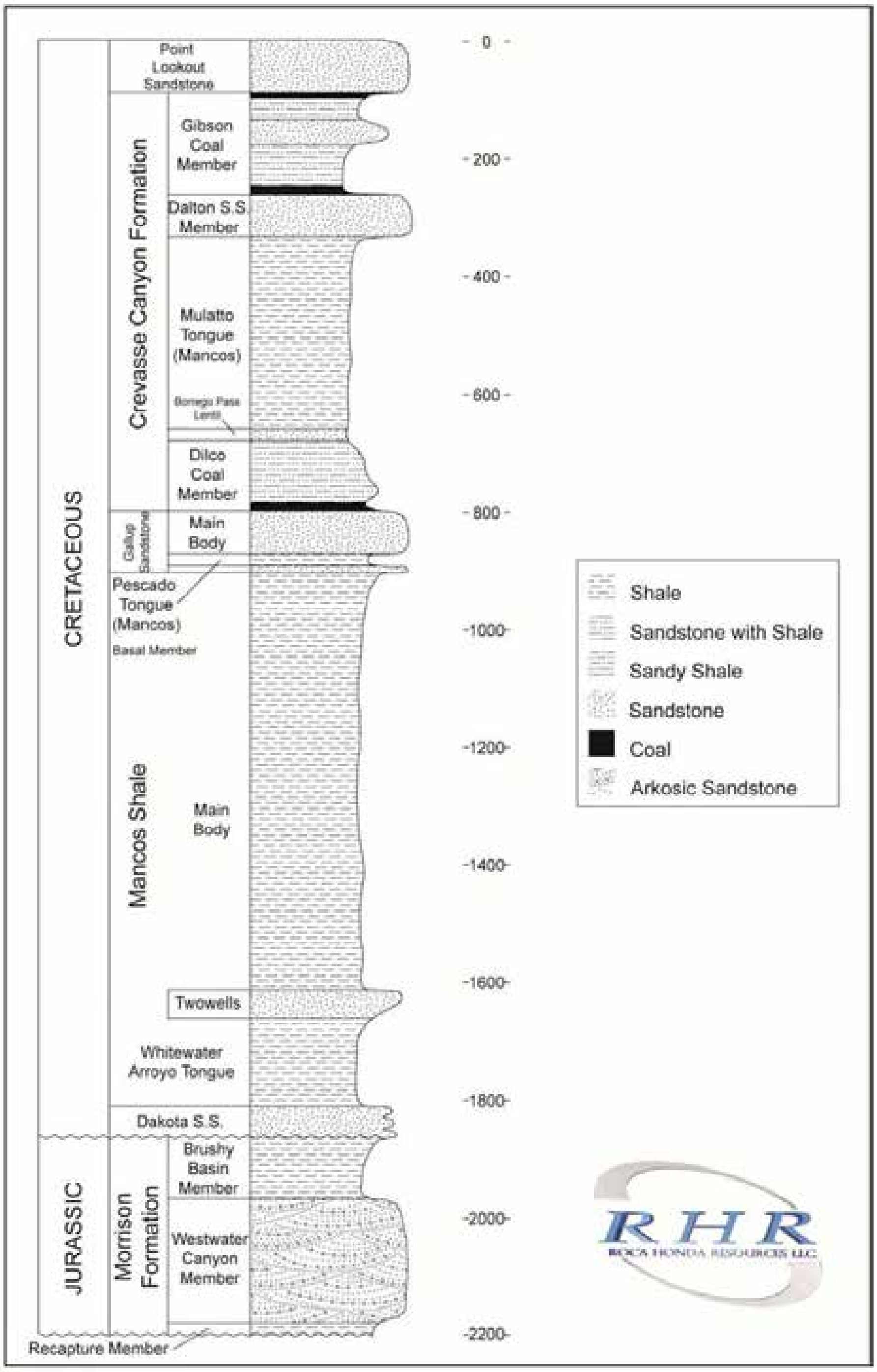


Figure 39. Typical stratigraphy of the Roca Honda permit area

Table 6. Summary of aquifer characteristics in the vicinity of the Roca Honda permit area

Aquifer	Thickness Range in the San Juan Basin (ft)	Probable Thickness at the Roca Honda Permit Area (ft)	Transmissivity Range (median) (ft^2/day)	Hydraulic Conductivity (horizontal) (ft/day)	Hydraulic Conductivity (vertical) (ft/day)	Yield Range (gpm) (median)	TDS (mg/L)	Storativity	
								Specific Yield (Sy)	Storativity
Alluvium	10–80	0	700—1,450[h]	27[h]		<20[a]	590–14,000[a]	.1 to .25[f]	NA
Menefee	400–1,000[b]	<100[g]	10–100[b]	0.05–0.01[b]	0.00001[f]	<20[a]	200–1,400[a]	0.1	0.0001
Point Lookout Sandstone	40–415[b]	<120[g]	<1—240[b]	0.002–0.02[cb]	0.01–0.002[c] 0.0002–0.0001[f]	To >50[a]	200–700[a]		.000041[f]
Dalton Sandstone	80–180[bdg]	>100[g]	10–<50		0.0001[f]		4,500[a]	0.1	0.0001
Gallup Sandstone	90–700[b]	85[g]	15–390 (123)[bhf]	0.1—1.0[h]	0.002[f]	1–645(30)[ef]	1,200—2,200[h]	.09[h]	.000002 to .000033[f]
Lower Mancos Shale Sandstones	125[g]	125[g]	134[a]	0.05	0.002[f]	0–2,000[ag]	2,500–9,000[a]	0.1	0.0001
Dakota Sandstone	50–350[b]	50–60[g]	44–134[abf]	0.25–1.5[b]	0.002[f]	1–200 (13)[e]	600–1,400[a]	0.1	0.0001
Westwater Canyon	100–250[bg]	100–250[g]	50–500[ab]	0.1	0.001[f]	1–401 (32)[e]	360–2,200[a]	0.1[f.]	.0002 to .00002[bf]

[a]Brod and Stone 1981
[b]Stone et al., 1983
[c]Craigg et al. 1989
[d]RGRC 1994
[e]Dam 1995
[f]Kernodle 1996 (note hydraulic conductivity [vertical] values are model-simulated)
[g]Roca Honda Resources drilling
[h]GMRC 1979a
[i]Pike 1947

Water Levels in the Westwater

There are two water levels of importance in this and other artesian aquifers. The first is the level at which water in the aquifer will be encountered; this is the top of the actual aquifer material, which for the Westwater Canyon in the permit area varies from about 1,600 feet to more than 2,700 feet beneath the land surface. The second is the level to which water will rise in wells that reach the aquifer; within the permit area, the Westwater potentiometric surface (i.e., the level to which water will rise in a well under artesian pressure from below) is on the order of 800 to 900 feet above the top of the aquifer. Prior to uranium mining in the region, the water level elevation in the permit area was probably above 6,500 feet MSL, and may have been much higher (e.g., see figure 9-5 in the BDR).

Several aspects of water levels and flow directions are of particular interest.

The artesian pressure in the Westwater aquifer might indicate a potential for water to move upward under natural conditions. However, potentiometric levels in the overlying Dakota aquifer appears to be slightly higher than the Westwater Canyon, and that in the Gallup Sandstone is at least a few hundred feet higher. In contrast, levels in the San Andres-Glorieta aquifer are less, indicating flow in undeveloped conditions would be downward into the Westwater from above and toward the San Andres below. However, the low permeability of the rocks above and below the Westwater would be expected to keep actual interaquifer flow to a minimum.

A possible exception to the conclusion is suggested by GMRC (1979a), which noted that the Westwater Canyon and the Dakota Sandstone locally were hydraulically connected in the Mt. Taylor mine area. The possibility of such an interconnection in the Roca Honda permit area was assessed in the Baseline Data Report, because the faulting mapped within the permit area and vicinity conceivably could provide a pathway for aquifer fluids through the intervening Brushy Basin Member (Morrison) aquitard. Borehole geophysical data collected in the permit area indicate that the Brushy Basin Member is as much as 279 feet thick. A detailed reanalysis of the drill logs of holes drilled through the Brushy Basin Member into the Westwater Canyon in 2007 and 2010 showed that the Brushy Basin Member is composed almost entirely of mudstones. The aquifer test conducted in 2010 using S-4 as the pumping well, "demonstrated that faulting within the permit area does not appear to provide a conduit for vertical groundwater movement" (RHR, 2011a). Note that this is not the same as concluding that faulting would not have any impact on such movement.

The limited available data on potentiometric levels in Westwater Canyon in and near the permit area indicate a slope of the potentiometric surface and, thus, a direction of groundwater flow to the northeast. This is consistent with Morrison water level elevation maps in Hagan and others (2001) and the Baseline Data Report. At a greater distance from the outcrop, flow is toward the east and southeast and the Rio Grande (Lyford et al., 1980, figure 2). More data to evaluate this gradient may become available upon construction of RHR's monitoring well network.

Dewatering of the Westwater Canyon Member for the purpose of underground mining lowered the potentiometric surface in the local area of uranium mines during the 1970s, but water levels have substantially recovered since mining ceased. Simulations from RHR's model and results from the model of Carpenter and Shomaker (1998) indicate that in the permit area, the Westwater Canyon water levels were lowered by more than 400 feet, and that at least 100 feet of residual drawdown remains. One effect of dewatering is to substantially increase the downward gradient from the Dakota Sandstone to the Westwater Canyon Member of the Morrison Formation.

Water Quality in the Westwater

As part of the baseline investigations, RHR compiled historical water quality data for the Westwater Canyon in the study area. Beginning in 2008, RHR collected water quality samples from 10 area wells completed in the Westwater Canyon, including the three monitoring wells constructed in Section 16 of the permit area (S-1, S-3, and S-4). Figure 9-15 of the BDR shows the locations of the wells sampled and those for which there are historical data. Nine Westwater Canyon wells will be part of the Groundwater Sampling Program in the future, including the three onsite monitoring wells; see figure 9-16 and table 9-14 in the BDR (RHR, 2011a).

Most wells have been sampled multiple times. The samples were analyzed in the field for conductivity, pH and temperature; and in the laboratory for general chemical parameters, metals, radionuclides, volatile organic compounds (VOCs), and synthetic organic compounds (SOCs). The analytical results for the Westwater Canyon are summarized in tables 9-9 (Major Constituents) and 9-10 (Minor Constituents) of the Baseline Data Report; Appendices 9-F (Regional Wells) and 9-G (Permit Area Wells) of the report provide more detailed data. Note that no VOCs or SOCs were detected in any of the samples analyzed from any of the wells, regardless of aquifer, so the data for those parameters are not included in the report.

TDS content of the water from the 3 permit area wells was low, ranging from 425 to 532 milligrams per liter (mg/L) in the 15 samples analyzed. Five Westwater Canyon wells approximately 5-1/2 miles west of the permit area had much higher TDS, ranging from 1,980 to 3,440 mg/L (excluding an apparent outlier value). Much of the higher TDS was in the form of sulfate, ranging from 1,188 to 2,150 mg/L. That level of sulfate is far above the Federal Safe Drinking Water Act (SDWA) Secondary Standard of 250 mg/L, and would not be considered potable. Some of the high TDS wells also exceeded standards for a few metals and radionuclides.

Permit area monitoring well S-4 water was not found to contain any parameters exceeding SDWA Primary or Secondary Standards, aside from the slight exceedance of the 500 mg/L Secondary Standard for TDS. Permit area monitoring wells S-1 and S-3, however, produced water that exceeded the SDWA Primary Standard for one or more radionuclides, though not uranium; see table 7.

Table 7. Radionuclide data from permit area water monitoring wells

Well	Parameter	Gross Beta	Gross Alpha	Radium-226
	Standard	~50[1]	15	5[2]
	Units	pCi/L	pCi/L	pCi/L
S-1		50.1 to 178	135 to 418	27 to 69
S-3		Not exceeded	17.8 to 35.2	Not exceeded

Standard is 4 millirem/year, approximately 50 pCi/L, depending on radionuclide
Standard is 5 pCi/L for Radium-226 and Radium-228 combined

The SDWA standards are based on long-term ingestion of the water as the sole source of drinking water; different standards could apply to discharge of water of this quality to surface water drainage, for example.

DBSA (2001) reported on water quality from the Mt. Taylor Mine. The TDS was on the order of 800 mg/l, with elevated sulfate. Arsenic was found above the current SDWA standard, and some high selenium concentrates were reported, although the average was below the SDWA standard. Dissolved uranium was found about 0.9 mg/l, above the SDWA standard of 0.03 mg/l.

Dakota Sandstone

Within the permit area, the Dakota Sandstone has an average thickness of about 50 feet. The top of the Dakota is an elevation of about 5,600 to 5,400 feet. The Dakota Sandstone near the permit area was not considered an aquifer in Sheet 1 of Stone et al. (1983), but rather as “Locally an aquifer or contains aquifer.” RHR reports “significant” quantities of groundwater in the Dakota during drilling of its deep monitor wells in Section 16, and expects to have to pump Dakota groundwater at up to 144 gpm for up to 12 months during advancement of the production shaft (RHR, January 2011 Revision 1; Intera, 2011b).

Five wells completed in the Dakota were identified in the RHR well inventory; none were sampled and none are included in the ongoing monitoring program. The closest to the permit area is No. 139, KMC LMD-1, in Section 17 of T13N, R8W (no OSE file number provided). Reported water level elevation in this well was 6,308 feet in late 1981; it was 6,400.6 feet in October of 2010. Two other wells identified were associated with the defunct Johnny M Mine. The BDR speculates that a few wells may produce from the Dakota for stock watering north of the RHR permit area; No. 129, the Polvadera well, is the only Dakota well identified in the inventory north of the permit area.

Absent site-specific data, water quality in the Dakota is assumed to be typical of what is found elsewhere, which would make it poorer than that in the underlying Westwater Canyon Member of the Morrison (Stone et al., 1983). Brod and Stone (1981) and Kelley et al. (1980) report that water in the Dakota is typically of the sodium-sulfate type, with TDS in the range of 600 to 1,400 mg/L.

Stone et al. (1983) note that pre-development heads in the Dakota may have been more than 200 feet higher than in the underlying Morrison (Westwater Canyon) aquifer, and suggest that the persistence of such differences is an indication that relatively low vertical permeability exists in the confining unit between the two.

Overlying the Dakota Sandstone is the Mancos Shale, which in other areas of the basin contains productive sandstones in the middle and lower parts, including at the Mt. Taylor Mine. However, no producible quantities of groundwater in the Mancos were found in the three monitor wells drilled by RHR in Section 16 that penetrated the Mancos Shale section on the way to Westwater Canyon. This indicates that the Mancos acts as a confining bed, as is common in many areas.

Gallup Sandstone

In the permit area, the Gallup Sandstone is composed of two sandstone units with a total thickness approximating 85 feet. They are separated by the Pescado Tongue of the Mancos Shale, approximately 20 feet thick. The top of the Gallup is at an elevation of about 6,700 to 6,900 feet in Section 16 of the permit area and, as confirmed by the “first water” drilling, this is expected to be the first significant aquifer beneath Section 16 (RHR, 2011b: Groundwater Monitoring Plan, January).

The Gallup is confined in the permit area. Insufficient data are available to contour the potentiometric surface of the Gallup Sandstone in the permit area, and there is no information on interformation flows to or from the Gallup. The Gallup provides a source of municipal supply to the towns of Gallup and Crownpoint to the northwest and the community of Marquez to the east.

The Gallup Sandstone is mapped as an aquifer near the permit area by Stone et al. (1983), consistent with the RHR expectation that it may have to pump as much as 502 gpm from the Gallup for a period of up to 12 months during construction of the production shaft (Intera 2011).

Four wells completed in the Gallup were identified in the well inventory. The identification of one of them, No. 32 Lee Ranch Section 23 pivot, as a Gallup well is uncertain; the BDR report states that the well "may produce partially from the Gallup Sandstone." The closest of the four to the permit area is No. 10, in the northeast quarter of Section 17 adjoining the permit area. The inventory does not provide an owner or an OSE file number for the well.

Water quality data are available for one Gallup well on the inventory from a historical source and for two others from RHR monitoring, which will continue. The Gallup water is of potable quality, with a TDS range of 530–669 mg/L. One sample of six from No. 16 exceeded the SDWA Secondary Standards for iron and manganese, and the single historical sample and three of the six RHR samples from No. 16 exceeded the SDWA Secondary Standard for sulfate. All eight samples exceeded the SDWA Secondary Standard for TDS. No primary SDWA standards were exceeded in the parameters analyzed. The Gallup water is a sodium-bicarbonate type. Tables 9-7 and 9-8 of the BDR summarize the data and figure 9-14 shows the locations of the wells sampled.

Point Lookout Sandstone

The Point Lookout Sandstone crops out in Sections 9 and 10 of the permit area. Whether any of the Point Lookout sediments are saturated within the permit area is uncertain. The formation was dry in the three wells recently drilled to find "first water." The Point Lookout outcrop may capture recharge along the eastern side of the Fernandez monocline (RHR, January 2011 Revision 1). If the Point Lookout is saturated within the permit area, it is expected to be unconfined, with a depth to water of 70–150 feet (RHR, 2011b).

Logs from the Mt. Taylor mine area wells indicate that the Point Lookout Sandstone in that area consists of two sandstone units, each 115 feet thick, separated by the Satan Tongue of the Mancos Shale. Yields averaging 20 gpm were reported by Kernodle (1996), with a median specific capacity of 0.25 gpm/ft. The formation dips to the east beneath the Menefee. Insufficient data are available to permit mapping the water table in the immediate vicinity of the permit area (RHR, January 2011 Revision 1).

Nineteen wells completed in the Point Lookout area were identified in the well inventory, most of them near the community of San Mateo southeast of the permit area. In this area fractures and faults are believed to have enhanced the permeability of the Point Lookout; within the permit area, it is described as "dense, with low primary permeability" (RHR, 2011b). The closest Point Lookout well to the permit area was No. 22, (OSE File B-01085) in the northeast quarter of Section 22, T13N, R8W.

Water quality data from historic sources and/or from RHR monitoring are available for 10 Point Lookout wells. The water is of the sodium bicarbonate type. The SDWA Primary Standard for fluoride (4.0 mg/L) was exceeded in 4 of a total of 24 samples, in 2 different wells. A third well exceeded the SDWA Action Level for lead in one of two historic analyses. TDS ranged from 192 to 695 mg/L, with at least one sample each from six different wells exceeding the SDWA Secondary Standard for TDS. Other SDWA Secondary Standards exceeded were those for iron and fluoride (2.0 mg/L). Tables 9-5 and 9-6 of the BDR summarize the data and figure 9-13 shows the locations of the wells sampled.

Menefee Formation

The Menefee Formation is composed of shales interbedded with thin to thick sandstones and minor coal seams. The fine grained fluvial sandstones constitute the aquifer, which while apparently dry in the permit area, does supply many small stock and domestic wells in the broader area (Hagan and others, 2001, p. 8). The Menefee is also the source of Bridge Spring, discussed below. Logs from Mt. Taylor mine wells indicate a total thickness of 767 feet for the Menefee in that area. Few Menefee wells in the upper San Mateo Creek valley penetrate more than a few hundred feet of Menefee, rather than its entire thickness.

Except for the southeast corner of Section 10 beneath colluvium, the Menefee Formation has been removed from the permit area and the western part of the San Mateo Creek valley by erosion (see figure 9-7 of the BDR). North of San Mateo Creek, the Menefee extends only to the central part of Section 21, T13N, R8W; south of San Mateo Creek, the Menefee extends farther west, to near the western boundary of Section 29, T13N, R8W (McCraw et al. 2009).

The Menefee dips to the east, but groundwater flow in the formation is to the northwest. Groundwater in the Menefee generally is unconfined, though it is under “slightly confined” conditions in the area of the community of San Mateo (RHR, January 2011 Revision 1). At the pinch-out of the Menefee, the groundwater flow must enter the adjacent Point Lookout Sandstone or alluvium where the alluvium is saturated.

Forty-seven wells completed in the Menefee were identified in the well inventory, generally in the vicinity of the community of San Mateo. The closest Menefee well to the permit area was No. 7 (no OSE file number) in the southwest quarter of Section 11, just east of the permit area; total depth of the well was 192 feet and depth to water was 76.9 feet (no measurement date). This well has been sampled by RHR five times and contains nonpotable water with TDS ranging from 2,680 to 3,320 mg/L and three of five gross alpha measurements above the SDWA primary standard. The BDR did not indicate any prior mining activity in this area.

Water quality data from historic sources or RHR monitoring are available from 23 Menefee wells in addition to No. 7. Menefee water is of the sodium-bicarbonate type with some sulfate. Quality is quite variable, with TDS ranging from 169 to 2,299 mg/L in the 23 wells. The SDWA Secondary Standard for TDS was exceeded in at least 1 sample each from 13 wells; SDWA Secondary Standards for sulfate, iron, manganese and aluminum also were exceeded in 1 or more of the 23 Menefee wells. SDWA Primary Standards were exceeded for lead (Action Level, seven wells), arsenic (four wells), and combined radium (one well). Tables 9-3 and 9-4 of the BDR summarize the data and figure 9-12 shows the locations of the wells sampled.

Alluvium

Quaternary-age alluvial material overlies bedrock throughout the San Mateo Creek valley and up the tributary drainages, but is likely unsaturated except near the creek. Well logs indicate that the alluvium consists of 10 to 80 feet of unconsolidated sands and silts. It may be significantly thicker in some areas (OSE, 2008). Most alluvial well completions also include some of the underlying Menefee Formation.

Groundwater in the alluvium is unconfined. Locally it may be perched above the regional water level by relatively impermeable shale and siltstone in the underlying Menefee. GMRC (1979b) suggests that springs in the valley may have this mechanism as their origin.

Thirty-one wells completed in the alluvium were identified in the inventory, most of which are in the area of the community of San Mateo. The closest alluvial "well" to the permit area is No. 19 (OSE file number B-00557) near Bridge Spring and the south margin of Section 21, the section due south of Section 16 in the permit area. Review of OSE records suggests that this item in the inventory was actually a sump in the alluvium pumped to provide water for construction of a bridge in the late 1970s.

Water quality data from historic sources or RHR monitoring are available from six wells in the alluvium. The water is of the sodium-bicarbonate-sulfate type. TDS ranged from 365 to 1,610 mg/L, with five of the wells having at least one sample exceeding the SDWA Secondary Standards for manganese and TDS, and four having at least one sample exceeding the Secondary Standard for sulfate. SDWA Primary Standards for gross alpha radiation and uranium were exceeded in two wells and one well, respectively; a third well exceeded the Action Level for lead. Tables 9-1 and 9-2 of the BDR summarize the data, and figure 9-11 shows the locations of the wells sampled.

Springs

Springs represent visible, specific locations of groundwater discharge to the land surface; this is distinct from baseflow, which is a groundwater discharge to a stream that occurs out of sight and gradually along a stream length. RHR has conducted an intensive survey of San Mateo Creek, which included investigation of on-channel springs in the area (Hydroscience Associates, Inc. (2010); the Intera modeling effort for RHR identified a large number of springs within the modeled area (Intera, 2011b, 2012). Based on project scoping, there is particular concern for one set of springs not included in the area modeled, specifically Horace Springs and related springs along the Rio San José at Acoma Pueblo, and also including Ojo del Gallo at San Rafael. Both the inventoried and Rio San José springs are discussed below.

Springs in the RHR Inventory

Over 100 springs have been identified within 50 miles of the RHR permit area (Intera, 2012). Figure 40 is a map of spring locations. Forty-one of the springs discharge directly from the volcanic rocks of Mt. Taylor and Mesa Chivato (typically where basalts overly ashbeds) and 20 springs are associated with the contact of the Mt Taylor-Chivato Mesa volcanic platform with the underlying sedimentary volcanic rocks. Many of these Mt. Taylor springs are reported to be perennial. The springs associated with the volcanic platform occur between 6,800 and 11,000 feet in elevation and are the result of rain and snowmelt seeping into fractures and flowing by gravity through the volcanic rocks (Intera, 2012). Some of the springs within 10 miles of the RHR permit area that get their water from volcanic rocks are Tecolote, Diablo, San Mateo, Marquez, Guadalupe, Salado, Moses, Jaralosa, and Canoa Springs. Additionally, El Rito, La Mosca, Cliff, Pine, Pumice, San Miguel and Maruca Springs emanate from the contact between volcanics and landslide materials (Intera, 2012). NMEI estimated the flow of the springs above San Mateo to average 0.5 cfs or 360 acre-feet per year; in recent years the springs have produced little flow.

Langman et al. (2012) provide considerable information on the springs of the Upper San Mateo Creek basin. Among the findings of this report are to identify geologic conditions which isolate the springs and seeps from deep formations such as the Westwater.

Four springs have been identified within the Upper San Mateo Creek subwatershed within 2 miles of the permit area (table 8), although no springs are present within the permit area. NMEI (1974) provided information on Bridge Spring, which discharges from the Point Lookout Sandstone near its contact with the Menefee, and North Bridge Spring and South Bridge Spring, which discharge from the Menefee Formation. In 2009, RHR field investigators walked the central channel of San Mateo Creek along the reach into which these springs discharged. They located Bridge Spring and also another spring at the point where NM 605 crosses San Mateo Creek in the south central part of Section 21, T13N R8W (informally referred to as “605 spring”). South Bridge Spring and North Bridge Spring are off-channel springs that were not observed during the RHR investigation of the channel. Bridge Spring is the closest spring to the RHR permit area.

Table 8 is a summary of the water chemistry data from the five of the springs within 5 miles of the permit area, two associated with the high elevation volcanics and three low elevation springs associated with the sandstones near the permit area. In addition to data from the NMEI study, RHR sampled Bridge Spring once; it was dry on all other occasions. RHR sampled 605 Spring twice, but the analytical results may be impacted by trash and debris present at the spring.

Table 8. Water chemistry of spring samples

Constituent	Units	El Rito Spring[1]	La Mosca Spring (a)[1]	La Mosca Spring (b)[1]	Bridge Spring[1, 2]	South Bridge Spring[1]	605 Spring[2]
pH		7.35	7.75	7.55	7.92	8.15	8.86–9.22
Specific conductance	µmhos	155	197	156	969	1,252	1,149–1,800
Temperature	°C	13.2	11.0	12.5	20.2		40.3–52.9
Calcium	mg/L	16.8	20.9	14.3	44.4	22.9	43
Magnesium	mg/L	4.5	4.6	2.4	23.9	22	12–20
Potassium	mg/L	4.1	5.0	3.2	5.0	6.9	6–8
Sodium	mg/L	8.3	14.0	14.0	168.0	268.0	–
Chloride	mg/L	6.0	8.0	8.0	33.0	40.0	66–160
Sulfate	mg/L	6.5	6.8	4.5	17.8	19.5	183–207
Nitrogen	mg/L	0.23	0.16	0.75	0.31	0.30	Not Detected
Bicarbonate	mg/L	90.3	117.1	73.2	608.0	749.0	419–587
Total dissolved solids	mg/L	213.7	267.6	208.6	940.5	940.5	882–1,170

[1] From NMEI, 1974; [2] From RHR Baseline Data Report, 2011

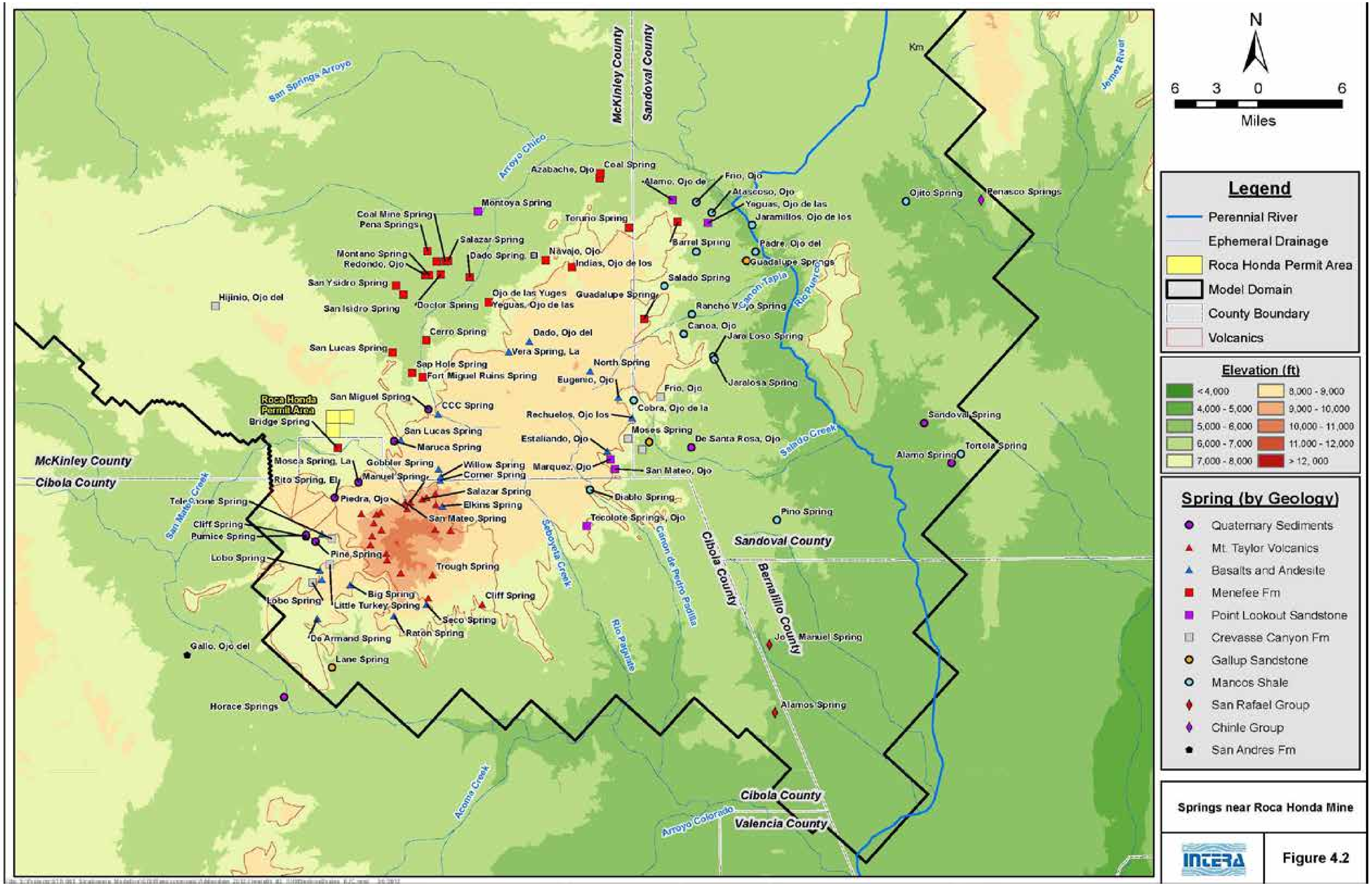


Figure 40. Springs near the proposed Roca Honda Mine

It is clear from the limited available data that compared to the high elevation volcanic springs, Bridge Spring, South Bridge Spring, and 605 Spring have water that is slightly more basic, and with higher levels of all constituents except potassium. Generally, water from high elevation springs was of the calcium-sulfate bicarbonate type, and water from low elevation areas was of the calcium bicarbonate type. The data are consistent with the fact that the springs near the permit area have a source of water that is distinct from both El Rito and La Mosca Springs. The water in the lower elevation springs probably has had a longer residence time within siltstones and sandstones, whereas the source of La Mosca and El Rito Springs is probably water which entered the Mt. Taylor volcanics as precipitation and moved quickly through the rocks.

Springs That Supply Acoma and Laguna Pueblos

Since before European settlement, the Rio San José has been the primary source of water supply for Acoma and Laguna Pueblos. Risser (1982) quantified this supply as it existed prior to non-Indian development, and considered the following sources: (1) Horace Springs and other groundwater discharges within the pueblos; (2) the spring known as Ojo del Gallo; and (3) surface supplies from Bluewater Creek and local runoff. In the scoping process, impacts to this supply—and especially to Horace and related springs—received extensive attention. Consequently, the components of the existing supply are discussed below as a foundation for evaluating whether the Roca Honda project might affect any such supply. See figure 33 for locations of features mentioned.

A portion of the Horace Springs discharge and all of that at Ojo del Gallo originates from the San Andres Limestone-Glorieta Sandstone aquifer. This aquifer is Permian in age and, thus, lower in the stratigraphic column than the formations discussed above with respect to the Roca Honda permit area. In the permit area, the San Andres-Glorieta is separated from the Westwater Canyon by the Chinle Formation, which is dominated by siltstones and mudstones, and which Hagan and others (2001) consider to be a regional confining unit. Frenzel (1992, figure 4) indicates 1,000 feet or more thickness of the Chinle in the general area and (in figure 9 in Frenzel, 1992) a water level that is probably below the pre-development Westwater Canyon level, but similar to or higher than levels during times of mine dewatering..

On the northeastern flanks of the Zuni Mountains and in the Grants-Bluewater area, the San Andres-Glorieta aquifer occurs at or near the land surface. It receives recharge in the mountains and along Bluewater Creek. The groundwater in this unit generally flows east toward the Rio Grande. Its flow is substantially impacted by faults and other structures, which in some places force water toward the surface, and elsewhere put the aquifer so deep that it is unused. Near Grants, the aquifer has been substantially developed using large capacity wells for municipal, irrigation, industrial, and power plant supplies; irrigation also provides recharge to the aquifer.

Relatively recent basalt lava flows occur at the land surface between Grants and Acoma Pueblo and are incised by Rio San José. Alluvium occupies the stream valley. Just west of the western boundary of Acoma Pueblo, the basalt constricts the stream valley and the alluvium and causes groundwater to surface at Horace Springs; there also may be faults at this location that impact groundwater flow. A significant amount of groundwater passes underground along the stream alluvium, and is discharged at springs (such as Anzac Springs) and as baseflow for several miles downstream (shown as gaining reach on figure 41).

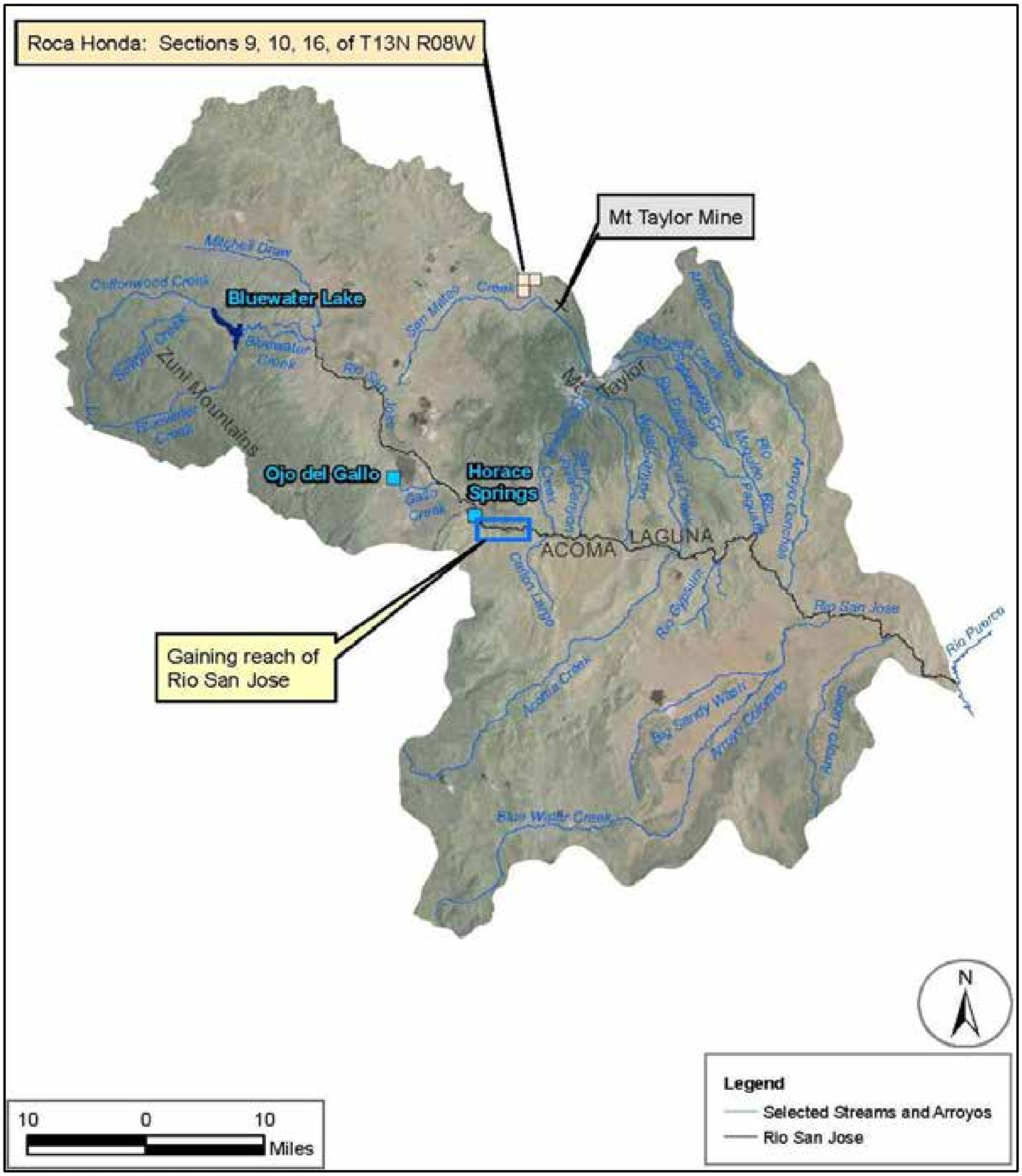


Figure 41. Drainage basin of Rio San José

Another spring of great importance to Acoma Pueblo is Gummi Springs, which is located south of the Rio San Jose, near the Acoma Pinal. This location has no direct connection with the hydrogeology at the Roca Honda Mine, and is at such a distance from the mine that it would not be impacted by mine dewatering.

The San Andres-Glorieta contribution to this flow is considered to occur upstream of Horace Springs, because at the springs and gaining reach, the aquifer is separated from the surface by an intervening layer of Chinle (Frenzel, 1992, p. 43). Wolf (2010) concluded from geochemistry that the San Andres-Glorieta is the dominant source of Horace Springs water, and that it mixes with basalt and alluvial water upstream of the springs. For additional discussions of Horace Springs, see Risser and Lyford (1984) and Baldwin and Anderholm (1992).

Based on Frenzel (1992), unnamed "Jurassic and Cretaceous" rocks also contribute some flow to Horace Springs and the gaining reach, although he did not quantify that contribution. Based on geochemistry data, Wolf (2010) confirmed that the "Cretaceous-Jurassic" units are a source of water for Horace Springs, contributing between 0 and 10 percent. The available geologic mapping indicates that the contributing units could include Dakota Sandstone and the Morrison Formation (e.g. Westwater Canyon Member), and the deeper Entrada Sandstone. In this location, these units are reported to have low yields (Rapp, 1960, p. 10; Baldwin and Rankin, 1995).

Risser (1982) estimated the total undepleted flow of Horace Springs at 4,000 acre-feet per year (AFY) (5.5 cfs), and the additional spring and baseflow discharge downstream at 2,200 AFY (3 cfs). Based on the model of DBSA (2001, p.13), the downstream discharge may be closer to 4 cfs. At one time, wastewater effluent from the city of Grants reached Horace Springs; that supply no longer exists and, in any event, was not a component of the pre-development flow calculated by Risser.

Ojo del Gallo is a spring located in San Rafael, south of Grants. Based on Frenzel (1992) and other studies, it naturally discharged 5 to 7 cfs of San Andres-Glorieta water at a specific location controlled by a fault. Risser estimated that the entire spring discharge (which he rounded to 3,000–5,000 AFY) would flow down Gallo Creek to the Rio San José and reach Acoma Pueblo. Other studies (e.g., Petronis, 2010) consider that some portion of this flow would have been lost to evapotranspiration before reaching Acoma.

Risser indicates that in pre-development times and in some years, snowmelt in late winter or early spring from the Zuni Mountains could reach the pueblos via Bluewater Creek. He quantified this supply at an average of 5,000 AFY (7 cfs), recognizing that it would be zero in many years, and considerably higher in high runoff years. Risser also considered runoff above Laguna Pueblo from Rio San José tributaries to be part of the pueblo supply and quantified it at 2,000 AFY (2.75 cfs), but highly variable over time.

Risser estimated the total undepleted water flowing to the pueblos of 16,200–18,200 acre-feet per year (as much as 25 cfs), of which as much as 19 cfs could be observed at the western boundary of Acoma Pueblo, below Horace Springs. While elements of this estimate have been questioned (e.g., by Larson, 2009; Wilson, 2009), for EIS purposes it is the current condition that is most relevant. The flow reaching the west boundary of Acoma Pueblo is measured at USGS gage 08243500. For much of the period of record there were many years with flow in the 5 to 6 cfs range, which Risser and most others consider comes largely from Horace Springs. In the last 20 years, this flow has declined to 4 cfs or less; it was only 3.38 cfs in 2003, which was entirely from Horace Springs and about 2 cfs less than Risser's estimate of the natural flow.

Several factors explain why the current flow at gage 08243500 of 4 cfs is so much less than Risser's estimate of as much as 19 cfs:

- Whatever actual supply from Bluewater Creek may have occurred in the past is much reduced due to storage of winter snowmelt in Bluewater Lake. While the gage data do show significant runoff contributions in some years, there has been little or none since the mid-1980s.

- The contribution from the City of Grants wastewater discharge ended in 1992.
- Pumping of the San Andres-Glorieta aquifer has completely dried up Ojo del Gallo, such that whatever contribution that spring made through Gallo Creek has ceased. Pumping has had some impact on Horace Springs and, presumably, the gaining reach. See Frenzel, (1992) and DBSA (2001) for results of computer models that simulate these impacts.
- DBSA (2001) suggest that the recent reduction in flow is at least partly a consequence of reduced recharge due to lower precipitation.

The reasons for a far greater impact of development on Ojo del Gallo than on Horace Springs relate to the elevation and gradient of the regional water table. As discussed in Gordon (1961, p. 48), Ojo del Gallo was dried up by only a 5- to 12-foot decline in the San Andres water level, whereas another 175-foot decline would be required to eliminate flow at Horace Springs. The decline that has occurred, however, does reduce the gradient and supply of San Andres-Glorieta water to Horace Springs.

DBSA (2001, p. 30) reported on the use of the model of Carpenter and Shomaker (1998) to simulate the impacts of dewatering at the Mt. Taylor Mine. The estimate of the impact on the Rio San José was 0.07 cfs (72 acre-feet/year) by the end of pumping in 1990. This would be about 2 percent of the current flow. The model prediction was that continued pumping would add to the depletion by about 1.5 acre-feet/year each year.

Other Areas of Interest

Volcanic Core

Intera (2011, 2012) concludes that the near surface volcanic rocks on Mt. Taylor are connected to the underlying lava source through conduits or volcanic necks, which are very low in permeability. From this they postulate that there is an extensive zone of very low permeability rocks throughout a large area east and southeast of the proposed mine, and the zone extends to and below the Westwater Canyon Member of the Morrison Formation. An alternative interpretation is that the lower permeability zone is limited to the conduits and immediately adjoining altered sedimentary rocks.

Discharge Area

At this stage in EIS preparation, details on the proposed discharge of treated wastewater have not been provided, but the indication is that it will be well outside the permit area. When details on the discharge are provided, information on the hydrogeology of the impacted area will be added to this section.

Environmental Consequences

Surface Water Resources

Alternative 1

In the case of the no action alternative, there would be no impacts to surface water resources beyond the naturally occurring effects of storm water, erosion, flooding, and drought that are the existing conditions at the site.

Alternative 2

The proposed action has the potential to affect surface water resources, but these effects can be mitigated by appropriate actions during construction, operation, and reclamation. The majority of potential surface water effects are associated with storm water and its impacts on water quality, sediment movement, and flooding. Other potential surface water effects are related to spring flow, water rights, and treated water disposal.

The measures of whether surface water resources are affected by mining activities are:

- An increase or decrease in surface waterflow in the watershed compared to historical conditions
- Introduction of surface water contaminants that would not otherwise be present in surface water

Sections 4 and 5 of the mine operations plan (MOP) revision 1 addresses surface facilities and performance standards for storm water controls. The surface facilities will have a disturbed area of a total of approximately 183 acres within the permit area and 35 acres outside the permit area: 12 acres in Section 9, 71 acres in Section 10, and 100 acres in Section 16. The anticipated surface facilities include: ore pads; retention (holding ponds), detention basins, diversions; wastewater treatment facilities, water treatment facilities; warehouse and storage areas for equipment, vehicles, chemicals and solutions; maintenance buildings; topdressing stockpiles, excavated materials stockpiles; parking areas, truck wash station; mine shafts, vent shafts, and escape ways; hoist buildings and head frames; roads; drill holes; dewatering wells; fences, power and water lines; and surface runoff control features.

RHR proposes to dispose of treated water from the water treatment plant in a stock pond on private ranchland whose owner intends to use this treated water to irrigate range or pasture land for livestock. The estimated flow rate from the water treatment facility is expected to be 2,500 to 4,500 gpm. The treated water or effluent would be conveyed through a 20-inch diameter pipeline approximately 8 miles in length to an offsite location northeast of the mine (figure 1-3 MOP Rev 1). This pipeline will be positioned next to the haul road and the utility corridor in Sections 16, 15, 10, and 11. The pipeline would be laid on the ground surface for ease of maintenance and operation with an estimated total disturbed area of 13.3 acres. Almost the entire 8-mile length would be across private land (10.8 acres of disturbed area), but the pipeline would also cross a small portion of Cibola National Forest land (2.5 acres of disturbed area). The discharge would occur on private property in the vicinity of Laguna Polvadera. At that location the water would become available for reuse by others or may simply flow down the San Lucas Arroyo as a permitted discharge.

The soils within the permit area have a high potential for erosion. Storm water can transport soil and sediment downslope and downstream, potentially increasing the turbidity of the receiving surface waters and causing exceedance of surface water quality standards. Additionally, developing the site would increase the impervious area, which can increase the amount of storm water discharging from the site. However, with the planned storm water controls, the amount of storm water discharge from the permit area is expected to decrease during the operational period of the mine. Water flowing over alluvial stream sediments can potentially mobilize chemical constituents found in the sediments or physically move those sediments.

Of particular concern are the stockpiles of nonore materials. While this material does not contain enough ore for economic recovery, it is mineralized in the same way as the recoverable ore rock, but to a lesser extent. As this material is brought to the surface, the minerals will oxidize and tend to become more soluble in water. Storm water impinging on these stockpiles could be more enriched in metals such as arsenic, molybdenum, selenium, uranium, and vanadium.

Table 9 shows the potential contaminants that could affect storm water quality at the site during the construction and operation phases of the mine. Table 10 shows excavated materials that would be stockpiled for some length of time at the mine surface that could potentially pollute surface water or groundwater (through infiltration), if not properly controlled and managed.

Table 9. Potential site storm water contaminants from equipment and nonequipment

Material	Chemical/Physical Description	Use	Storm Water Constituent of Concern
Antifreeze	Oily liquid – colorless or colored	Antifreeze coolant for equipment	Ethylene Glycol
Cleaning Solvents	Liquid – colorless, blue or yellow green	Cleaning equipment	Perchloroethylene, Methylene Chloride, Trichloroethylene, Petroleum Distillate
Diesel fuel	Liquid – clear, blue-green or yellow	Fuel for generator, trucks, heavy equipment	Petroleum Hydrocarbon, Benzene, Ethyl Benzene, Toluene, Xylene, Methyl Tertiary-Butyl Ether
Gasoline	Liquid – colorless, pale brown or pink	Fuel for trucks	Petroleum distillates, Oil and Grease, Naphthalene, Xylene
Petroleum-Based Grease	Semi-solid gel – reddish	Lubricant	Petroleum Hydrocarbon
Hydraulic fluid	Oily Liquid – brown	Hydraulic devices	Mineral Oil
Oil	Liquid – Oily liquid - brown	Lubricant	Petroleum Hydrocarbon
Barium chloride; acids; sodium hydroxide	Water-soluble crystal; liquid; granule or solution	Water treatment plant chemicals	Barium chloride, acids, sodium hydroxide
Sediment	Particulate earth materials	--	Sediment
Material stockpile areas	Soluble metals	---	Dissolved Metals - Arsenic, Molybdenum, Selenium, Uranium, and Vanadium

Source: Table 5-1 in MOP, Rev 1

Construction Phase Effects

During the construction phase, the primary effects would be the result of land-disturbing activities related to shaft and surface facility construction and installation of dewatering wells. To mitigate the potential effects during the construction phase, RHR would take the following actions to address storm water.

Storm water control would be through compliance with Clean Water Act National Pollutant Discharge Elimination System (NPDES) permit requirements. RHR would be required to submit a notice of intent to comply with the Construction Activities Storm Water General Permit. As part of the permit requirements, a storm water pollution prevention plan (SWPPP) would be developed for the Roca Honda Mine permit area. The purpose of the SWPPP is to describe the mechanisms (BMPs) to control storm water runon and runoff from the disturbed areas during construction. BMPs would likely include runoff control devices (swales, ditches, fiber mats, and fiber rolls), energy dissipaters, slope drains, sediment traps, evaporation ponds, diversion channels, detention basins, stockpile slope construction, and stockpile soil cover and vegetation. The Construction Activities Storm Water General Permit includes requirements for monitoring, inspections, training, and reporting that would be addressed in the SWPPP.

Structural BMPs would be coordinated with site preparation and construction activities so that BMPs are in place before these activities begin. The BMPs placed prior to site preparation activities would be placed away from and downgradient enough to allow an operating perimeter so that equipment can operate safely and efficiently without damage to the BMPs. After the site preparation operations are complete for an area, the BMPs would be relocated to the edge of the newly constructed areas.

RHR has conducted a surface water hydrologic analysis as part of the mine operations plan revision 1 (Jan 2012). The hydrologic analysis was considered as a high level planning analysis to be refined with a detail design level analysis in the spring of 2012. The purpose of the drainage summary includes the following:

- Identify the watershed that contributes surface runoff to the proposed surface disturbance area associated with development of the Roca Honda Mine.
- Identify existing and proposed drainage patterns in the contributing watershed and in the proposed disturbance area.
- Quantify peak rates and volumes of runoff resulting from the 100-year recurrence, 24-hour rainfall event in both existing and proposed conditions.
- Identify proposed facilities to manage storm water surface flow in the proposed condition.

Table 10. Estimated types and quantities of excavated materials at the Roca Honda Mine

Source of Material Excavated	Potential Groundwater Contaminants	Stockpile	Disposition	Controls Upstream of Water Treatment Plant (WTP)
Ore from mine Westwater Canyon Recapture Member?	Uranium, radium, heavy metals, acid drainage.	Concrete-floored, walled temporary storage ore bays; 12,500 tons capacity each; 5 bays each in Sections 10 and 16.	Removed from site for processing.	Downstream lined retention pond with sump and lift station, plumbed to WTP; sloped concrete floor in bay drains to pond. Truck wash plumbed to pond.
"Nonore" from mine (mineralized but below current ore grade) Westwater Canyon Recapture Member	Uranium, radium, heavy metals, acid drainage.	216,900 cu. yd. stockpile in Section 16; 4,050 cu. yd. stockpile in Section 10. (Removed from mine initially to create working room; most of such material would remain underground in the mine.)	Most nonore to remain in mine; that hoisted to surface will be blended with ore after transport offsite, or returned to mine (after character-ization), or removed from site at the end of mining.	Liner beneath stockpile to prevent seepage into the ground surface; drainage swales to prevent runon erosion; storm runoff diverted to downstream lined retention pond with sump and lift station, plumbed to WTP. Solids trapped by sump to be removed, dried and transported off-site with ore.
Production shafts (including nonmineralized mine drifts, raises, etc.)	Acid drainage from thin coal beds in Dilco Coal and Gibson Coal Members of Crevasse Canyon Formation traversed by drilling of vertical shafts. Historically, has not been a problem in Grants Mineral Belt.	83,970 cu. yd. stockpile in Section 16; 51,970 cu. yd. stockpile in Section 10; each mixed with vent shaft materials.	Assuming characterization sampling indicates no problems, returned to shafts and mine as backfill; if problematic, removed from site.	Assuming characterization sampling indicates no problems, drainage swales where necessary to minimize storm runon erosion. Material failing the characterization sampling presumably will be subject to controls analogous to those applied to nonore for any time that it remains onsite.
Vent shafts (Some material will be stockpiled at vent shafts, when they are distant.)		26,230 cu. yd. stockpile in Section 16 (from 3 vents in Section 9); 20,750 cu. yd. stockpile in Section 10 from 2 vent shafts in that section.		
Dewatering wells	Drilling fluids and cuttings from mud pit.	Location of "designated" stockpiles uncertain.	Dried in a second pit and stockpiled.	Grading to minimize storm runon; contemporaneous reclamation.
Development wells				
Topdressing (localized stockpiles in distant areas)	None expected.	190,000 cu. yd. stockpile in Section 16; 105,000 cu. yd. stockpile in Section 10.	Used in concurrent and final reclamation.	Stabilized with grass cover; diversion ditches and/or wattles to minimize storm runon/runoff and erosion.
Subbase rock (excavated as part of surface facility construction)	None expected.	50,200 cu. yd. stockpile in Section 16, 9,400 cu. yd. stockpile in Section 10.	Used for rip-rap and road base in mine construction; used for fill in reclamation.	Drainage swales to minimize runon erosion; wattles or other best management practices below piles to minimize sediment release.

Notes: All stockpile volumes from mine operations plan, revision 1 (2012); 15 percent swell assumed for topdressing stockpile, 50 percent swell assumed for all other stockpiles. "Swell" is the increase in volume of excavated material from its in-situ volume.

From the surface water hydrologic analysis, RHR states that it is not anticipated that the project would have significant impacts during runoff events on the watercourses located downstream of the project area, given that increases to storm water runoff, peak flow rates, and volumes would be relatively insignificant with construction of the facilities, and the fact that diversions from historic flow paths would be minimized. The 100-year, 24-hour precipitation depth utilized in the hydrologic model was 2.77 inches which correspond to NOAA Atlas 14 upper bound of the 90 percent confidence interval for an average location in the tributary watershed. The Natural Resource Conservation Service (NCRS) NM Type IIa-70 rainfall distribution was utilized to simulate storm events utilizing the previously mentioned rainfall depth. The rainfall depth, distribution, and assumption for hydrologic soil groups used in this model are thought by RHR to be conservative.

The assumptions for the approach used in the hydrologic analysis are reasonable and consistent with standard hydrologic analyses used in planning level studies. The expected amount of runoff from each of the developed areas for the specified storm event is shown in table 11. The discharges are reasonable where typical values for discharge per area range between 3 and 4 cfs per acre for nonurbanized watersheds during a 100-year storm. For the larger subwatersheds, a lower discharge per acre is expected, however values under 1 cfs per acre are unusual. The subbasin delineation is shown in the drawings from attachment 2 of the MOP Rev 1. RHR will give additional consideration to using the mean 100-year 24-hour point precipitation depth of 2.50 inches and the less intense New Mexico Department of Transportation Modified NOAA-SCS rainfall distribution prior to final design of storm water controls and conveyances. The size of the culverts and detention/retention pond volumes appear to be adequate, although this could not be confirmed because no information regarding calibration or validation of the model using existing conditions or the results or accuracy of the results were provided in the hydrologic analysis.

The storm water controls for the ore bays are described in section 4 of the MOP Rev 1. The 3-walled concrete bays will have a sloped concrete floor with a drain to catch and transport water to the process area retention/holding pond where solids will be cleaned out periodically.

Section 4.2.1 of the mining operations plan revision 1 describes the storm water controls for stockpiles at the site. Table 12 is a summary of the stockpile storm water controls presented in the mining operations plan revision 1.

Three types of water impoundments would be constructed onsite: storm water detention ponds, evaporations ponds, and settling ponds. These impoundments serve to control storm water flow and reduce the quantity of potentially contaminated water and treated water when necessary. The consequences of a release from these impoundments is adding water, potentially containing pollutants to streams. The impoundments should be designed and constructed with sufficient capacity to contain the design storm without overtopping or discharging water.

RHR estimates that dewatering of the proposed Roca Honda Mine during construction would be approximately 600 gpm to 2,000 gpm for Section 16. Section 10 discharges would be substantially less than Section 16 during construction. The actual amount cannot be accurately assessed until such time as there is sufficient drawdown data available from the depressurizing activity from Section 16.

Table 11. Estimated storm water runoff for developed and undeveloped conditions

Subbasin	Area (acres)	Discharge (cfs)	Volume (ac-ft)	Developed Discharge per Acre	Undeveloped Discharge per Acre
101	10.8	42	1.46	3.89	3.89
102	18.9	64	2.55	3.39	3.39
103	21.9	79	2.96	3.61	3.61
104	35.4	98	4.77	2.77	2.77
105	31.6	102	3.68	3.23	3.23
106[1]	626.5	595	66.64	0.95	0.92
107[1]	499.8	814	60.6	1.63	1.55
108	82.8	185	9.65	2.23	2.23
109[1]	54.1	204	6.58	3.77	2.78
110[1]	224.2	457	26.88	2.04	1.81
111[1]	23.3	88	2.83	3.78	3.67
112	5.5	20	0.65	3.64	3.64
113	42.9	112	4.54	2.61	2.61
114	58.8	159	5.92	2.70	2.70
115	15.8	39	1.27	2.47	2.47
116	13.0	52	1.67	4.0	4.0
117	15.9	58	1.86	3.65	3.65
118	20.1	77	2.45	3.83	3.83
119	75.6	219	8.82	2.90	2.90
120	88.5	206	10.32	2.33	2.33
121	140.3	366	16.36	2.61	2.61
122[1]	154.2	527	19.41	3.42	1.27
123	474.5	620	55.32	1.31	1.31
124	9.2	34	1.07	3.60	3.60
125	244.5	423	28.51	1.73	1.73

Source: Attachment 2, MOP Rev 1;

[1] Sum of values for subbasin number from RHR Mine Operations Plan Revision Attachment 2, Jan 2011

In addition to storm water impacts on disturbed land, the installation of dewatering wells, ventilation holes, and escape shafts would be accomplished with drilling rigs or boring machines. Pits to hold drilling mud for recirculation are anticipated to be excavated. Drilling mud pits can be of concern to surface water quality, in the event of overtopping or flooding. Construction, operation, and restoration of the mud pits are expected to be in compliance with the Pit Rule (19.15.17 NMAC).

Table 12. Storm water controls for stockpiles

Stockpile Material	Slope	Runoff Controls	Sediment Release Controls	Storm Water Discharge Area
Topdressing	4:1	Diversion ditch around piles ending in sediment trap with rock filter	Filter rolls below stockpile; soil cover, revegetation	Nearest arroyo
Subsoil	3:1	Diversion ditch around piles ending in sediment trap with rock filter	Filter rolls below stockpile	Nearest arroyo
Subbase Rock	3:1	Diversion ditch around piles ending in sediment trap with rock filter	Filter rolls below stockpile; stabilized with spray	Nearest arroyo
Shaft Excavation Material	3:1	Diversion ditch around piles ending in sediment trap with rock filter	Filter rolls below stockpile; stabilized with spray	Nearest arroyo
Nonore Material	3:1	Diversion ditch around piles ending in sediment trap with rock filter	Filter rolls below stockpile; stabilized with spray	Lined evaporation pond
Ore Material	–	Staged on pads in ore bays with sloped concrete floors draining to retention ponds	Sump collects solids before water enters retention pond	Lined retention pond

Operational Phase Effects

Mine operations surface facilities were designed and located to avoid disturbance to minimize potential effects to surface hydrologic resources and the hydrologic balance through minimizing alteration of arroyos, springs, and stock ponds, as described in the mine operations plan revision 1. The direct and indirect effects on surface water associated with operation of the RHR project are discussed in the following paragraphs.

Effects on Surface Runoff

During mine operations, surface facilities of the mine site can impact storm water as summarized in table 13.

Table 13. Potential sources of storm water contamination

Drainage Area	Source of Contamination	Contaminants
Cleared and graded areas, material stockpile areas	Storm water erosion of disturbed soils and material stockpile areas	Soil, sediment
Operations areas	Storm water erosion of disturbed soils; leaking equipment and support vehicles; spills during fueling; and maintenance of equipment and vehicles	Soil, sediment, hydraulic fluid, oil, gasoline, diesel from heavy equipment
Site entrances and exits and access roads	Leaking vehicles; spills during fueling or maintenance; tacking of soil to and from work areas	Soil, sediment, gasoline, diesel, oil, hydraulic fluid

Mitigations to contamination of surface runoff during the operations phase are described in the mine operations plan, revision 1. Storm water controls during the operations phase include routing storm water around the disturbed area via constructed diversion channels. Surface water entering the permit area would continue to flow through and exit the permit area in its natural channels during operations. Some of the arroyos that transect the operational area may be armored or straightened to avoid further erosion into the site, stabilizing and enhancing the surface hydrologic resources, and otherwise be unaltered. Some surface water detention basins and/or evaporation ponds would capture surface runoff from the permit area facilities and control surface water flow into the area. The detention basins would be designed to capture and temporarily hold surface water runoff that will then be released in a controlled manner. Because they will be capturing water upgradient of the RHR facility and will be empty most of the time, the detention basins will not impact groundwater. The evaporation ponds will be located so as to capture whatever water and sediment might drain from the mine facilities. The ponds will be lined and monitored with groundwater wells and vadose instrumentation to ensure that captured water does not enter groundwater. (The vadose zone is the unsaturated region between the ground surface and the water table.)

Table 14 summarizes BMPs during and after the operational life of the Roca Honda Mine.

Table 14. Temporary and permanent best management practices

Best Management Practices	Effectiveness Assessment
Preserving existing vegetation	Reduces or eliminates erosion.
Wattles	Stabilize slopes by slowing, spreading, and filtering overland waterflow preventing sheet erosion and rill and gully development. Placed along perimeter downgradient of cleared or graded areas; along arroyos, stockpiles, and downslope of exposed soil areas.
Straw bales	Controls and filters overland waterflow. Used to reduce velocity and divert surface flow. Used as necessary.
Ditches/swales	Divert and convey runoff to desired locations. Used as necessary.
Energy dissipaters	Prevents scour of soil by concentrated flows. Used where appropriate.
Slope drains	Intercepts and directs surface flow away from sloped areas to protect cut or fill slopes. Used as necessary.
Sediment traps	Temporarily holds sediment-laden runoff allowing sediment to settle out. Used at earthen embankments across waterways and low drainage areas.
Diversion channels	Prevents property damage, erosion, and interference with establishment of vegetation. Constructed across a slope where runoff from higher elevations occur.
Check dam	Reduces velocity of concentrated storm water flow into receiving drainage. Installed at outlet from the diversion channels.
Detention basins	Controls flow of runon water diverted and captured to prevent pass over or through the mine site. Requires no treatment and/or monitoring prior to discharge. Used throughout the site.

Best Management Practices	Effectiveness Assessment
Retention ponds	Captures and stores potentially contaminated water from the mine site. Constructed with sumps to collect solids for periodic removal and disposal. Requires treatment prior to disposal. Used throughout the site.
Stockpile management procedures and practices	Reduce or eliminate release of materials from stockpiles. Used in conjunction with ditches and/or wattles throughout the site.
Wind erosion control	Prevents or reduces erosion by the forces of wind. Water spray would be applied to roads and small, temporary soil piles during construction activities. Topdressing and revegetation would be applied to larger and/or inactive stockpiles.

RHR will be required to submit a notice of intent to comply with the Multi-Sector General Permit (MSGP) for Storm Water Discharges Associated with Industrial Activity, Sector G2. The MSGP specifies steps that facility operators must take, including storm water control measures to minimize pollutants in storm water runoff and developing a SWPPP.

Effects on Streamflow

Untreated mine water discharge is not expected to reach any lakes, streams, springs, reservoirs, riparian, or wetland areas. Treated mine water pumped from the proposed Roca Honda Mine and dewatering wells will be discharged via a 20-inch diameter pipeline transporting water to private land. A local rancher has sought to use the treated water for irrigation purposes. As mentioned above, the discharge will occur on private property in the vicinity of Laguna Polvadera. At that location the water will become available for reuse by others or may simply flow down the San Lucas Arroyo as a permitted discharge. Appropriate permits from the OSE, U.S. Environmental Protection Agency, and NMED Groundwater Quality Bureau shall be obtained. Conditions of these permits will include monitoring of discharges to surface water.

RHR estimates that dewatering of the proposed Roca Honda Mine when both shafts are operating will be a maximum of 8.9 cfs (8,000 gpm) of water, although a lower volume is considered more likely. The estimate of an average mine water discharge rate of 4,000 gpm is based on experience at previous uranium mines that dewatered the Westwater Canyon Member of the Morrison Formation such as the Gulf Mt. Taylor Mine, Kerr McGee’s Ambrosia Lake Mines, and the Nose Rock Mine. For example, Rio Grande Resources Company (RGRC 1994) discharged groundwater at a rate of 5.6 to 11.1 cfs (2,500 to 5,000 gpm) from the Mt. Taylor mine when it was in operation. RHR performed an aquifer test of the Westwater Canyon Member in order to determine whether the hydrogeologic characteristics in the RHR permit area were similar to those calculated for that geologic unit in the area of other mines for which discharge rates were known. The results of that test indicated that the storage properties and transmissivity of the Westwater Canyon Member are in the middle range of reported values, an indication that volumes of water similar to those produced by earlier mines can be expected at the RHR mine. The test values were also used to refine RHR’s groundwater flow model and estimate the volume of mine discharge.

Effects on Water Quality

There is the potential for storm water to transport sediment and potentially other pollutants associated with an operating facility (e.g., petroleum products) downstream. The mine operations plan revision 1 describes an extensive storm water control infrastructure that is expected to keep storm water and potential contaminants onsite. In the event of failure of one or more storm water controls, there could be storm water with entrained pollutants released to the ephemeral arroyos draining the site and potentially into San Mateo Creek, which is also ephemeral in this segment. The effect of one or a small number of releases is not anticipated to be measurable in the ephemeral stream system.

While the proposed action anticipates the permitted discharge of treated mine water to the natural drainage system within the permit area, there is a potential for pipeline leaks that would cause the release of untreated mine water to surrounding soil. Both the treated and untreated water would be pumped via HDPE pipelines within the permit area. All water requiring treatment would be conveyed to retention ponds where it will be piped to the mine water treatment facility. The anticipated quality of the mine water flowing into the water treatment facility is shown in table 15. All treated water would be conveyed to private land outside the permit area. In the unlikely event a leak occurred in any pipeline, a specifically designed leak proof saddle would be installed on the damaged area to seal the leak without a pump shutdown. A redundant plan would involve a system of piping and valves to switch the flow of water from one dewater pipeline to the other until the leaking portion of a line can be replaced. The water produced at each dewatering well would be tested to establish its water quality and determine if treatment is necessary prior to discharge. The effect on surface water quality is dependent upon the water quality of the untreated and treated water.

The RHR mine site would also contain sanitary wastewater treatment facilities to treat wastewater produced from toilets, sinks, showers, and laundry. The water would be collected in a series of buried septic tanks which are designed to treat approximately 10,000 gallons per day (gpd). The effluent from the tanks would be pumped to the water treatment facility and combined with mine water for additional treatment as necessary. As with the untreated and treated wastewater, there is potential for the septic tank effluent to enter the natural drainage system within the permit area, therefore potentially affecting the water quality of a downstream surface water system.

During operations, runoff to the detention basins will not come in contact with the mine site but would be monitored accordingly. The two detention basins would be sampled at the outlets after a storm event, when practical, to provide background sediment and water quality data. Samples would also be collected at predetermined locations below the operational areas in the arroyos. Analyses will include major cations, major anions, other water quality parameters, and targeted constituents for ephemeral, intermittent, and perennial receiving drainages.

Transportation of hazardous or toxic materials to and from the site has the potential to affect surface water quality in the event of an accident that releases the materials near drainages. Trucks hauling ore would be inspected and cleaned of any detritus materials at the washing station prior to leaving the site. The amount of ore to be hauled offsite has not yet been established. The water from the truck wash station would also be collected in a retention pond, reused/recirculated and ultimately pumped to the water treatment facility.

Effects of Treated Water Discharge

The potential effects of disposing of treated water by land application include buildup of minerals in the soil and groundwater impacts. The impact of this disposal practice occurs over a period of time, so there is no significant effect over the short 18-year operational period of mining.

Effects on Sediment Transport and Deposition

Storm water controls for mitigation of sediment erosion include preserving existing vegetation, placing wattles downgradient of areas that have been cleared and/or graded, along washes and arroyos, downslope of exposed soil areas, and around stockpiles. Sediment traps would be installed by excavating or constructing an earthen embankment across a waterway or low drainage area, as necessary. These installed sedimentation control structures established in the SWPPP would minimize sediment transport and deposition for the operational period, therefore, no significant sediment transport and deposition effects are anticipated.

Table 15. Anticipated Roca Honda Mine influent water quality to treatment plant

Constituent	Mt. Taylor 11/15/1979	Johnny M 11/07/1979	RHR Mine Water Quality	Groundwater Standards
NMWQCC Human Health				
As	0.007	0.044	0.04	0.1
Ba	0.149	0.212	0.22	1
Cd			<0.01	0.01
Cr			0.02	0.05
Cn			<0.02	0.2
Fl			0.08	1.6
Pb			0.008	0.05
Hg (total)			0.00178	0.002
Nitrate as N	0.25	0.36	1.5	10
Se	0.018	0.128	0.03	0.05
Ag			0.02	0.05
U	0.45	5.09	7	0.03
Gross alpha	990±50 pCi/l	1,700±100	1,700 pCi/l	15 pCi/l
Ra-226+228	17±5 pCi/l	Not analyzed	178 pCi/l	30 pCi/l
NMQCC Domestic Water				
Cl	11.9	8.53	12	250
Cu			<0.02	1
Fe			0.03	1
Mn			0.03	0.2
Phenols				0.005
Sulfate	251.9	188.5	250	600
TDS	696	753	750	1,000
Zn	<0.25	<0.25	0.07	10
pH (s.u.)	9.02	7.85	8.5	6 to 9 su

Constituent	Mt. Taylor 11/15/1979	Johnny M 11/07/1979	RHR Mine Water Quality	Groundwater Standards
NMQCC Irrigation Use				
Al			1.12	5
B			0.2	0.75
Co			0.02	0.05
Mo	0.13	0.612	0.62	1
Ni			0.02	0.2
EPA NPDES				
TSS				30 daily max, 20 mo. Ave.
COD				200 daily max, 100 mo. Ave.
Zn			0.07	1.0 daily max, 0.5 mo. Ave.
Ra 226 (dissolved)				10 pCi/l daily max, 3 pCi/l mo. Ave
Ra 226 (total)				30 pCi/l daily max, 10 pCi/l mo. Ave.
U			7	4 daily max, 2 mo. Ave.
pH			8.5	6 to 9 su

Notes: Mg/l unless otherwise noted. Highlight = value above corresponding NMWQCC standard

Effects on Flooding or Flood Plains

For the proposed action the potential for flooding is anticipated to be moderated by the construction of ponds and storm water controls. The facilities are not in the flood plain and would have no effect on flood plain function. From the hydrologic analysis performed by RHR, culverts and detention ponds were sized adequately to hold the expected amount of runoff from each of the developed areas for a 100-year storm event. Further, based on historical measurements of streamflow, streams in the area are capable of conveying higher streamflow without routine flooding events.

Reclamation Phase Effects

The RHR reclamation plan revision 1 describes the storm water erosion controls that would be part of reclamation. These controls include:

- Disturbed areas would be stabilized through grading areas to conform to the geomorphic character of the region and surrounding area, including shaping, berming, and grading to final contour.
- Slope lengths and gradients would be minimized.
- Both runoff and runon would be diverted from reclaimed areas to prevent erosion of reclaimed areas.
- Vegetation would be reestablished.
- Existing natural drainage arroyos would be preserved and/or improved.

- Pre-mining storm water runoff in the areas of construction would be restored via surface flow to an arroyo.
- Preexisting drainages that were diverted away from the mine operation would be recreated following natural surface gradients so that control structures and energy dissipaters would not be required.
- Detention basins and evaporation ponds would be filled, graded, and reclaimed.
- Remove and properly dispose of sludge in the bottom of the evaporation ponds and the liner.
- Constructed channels will be filled and compacted with the stockpiled material.

The removal of storm water control infrastructure, regrading, and revegetation are expected to return the site to pre-mining conditions with respect to surface water resources. No additional effects are anticipated when the mining areas have been reclaimed.

Conclusion – Impacts of Alternative 2 on Surface Water

Overall impacts of alternative 2 on surface water quality and quantity, once all permit conditions and mitigation measures are taken into consideration and assuming that these would be diligently implemented, would be direct and indirect, short term and long term, localized, minor, probable, and of slight precedence or uniqueness.

Overall, cumulative effects on surface water from mine construction and operation combined with reasonably foreseeable actions from other mining operations in the area would be potentially significant, but the incremental contribution of surface water purturbations from the Roca Honda Mine to these cumulative effects would be small.

In conclusion, impacts of the proposed action on surface water would be insignificant.

Alternative 3

Effects of alternative 3, the one shaft alternative, on surface water would be very similar to but perhaps less than alternative 2, due to the reduced area of ground surface disturbance, most of which would be confined to Section 16 on State lands off the national forest. In particular, ground surface disturbance and localized impacts on surface water would be reduced on Sections 9 and 10 within the Cibola National Forest. The same water quality mitigation measures and BMPs would be employed as in alternative 2. Overall impacts of alternative 3 on surface water, once all permit conditions and mitigation measures are taken into consideration and assuming that these would be diligently implemented, would be direct and indirect, short term and long term, localized, minor, probable, and of slight precedence or uniqueness.

In conclusion, impacts of the One Shaft alternative on surface water would be insignificant.

Groundwater Resources

Alternative 1

Under alternative 1, no mine would be constructed and no groundwater would be pumped out of Sections 9, 10, and 16. Thus, alternative 1—the no action alternative—would have no impacts on groundwater resources in the Cibola National Forest beyond those caused by actions other than the RHR mine. There would be certain cumulative impacts to groundwater arising from actions other than the Roca Honda Mine, as discussed subsequently.

Alternative 2

The primary impact to groundwater identified during scoping is drawdown from pumping of groundwater to allow shaft construction and mining of ore and subsequent recovery of groundwater levels after mining ceases. Specific impacts of concern include effects of pumping on offsite wells and springs and changes to water chemistry. Other sources of impacts to groundwater are related to backfill of mine workings and discharges from surface facilities and operations.

Impacts of Groundwater Pumping and Recovery

As described in chapter 2, dewatering would be by wells and by underground collection systems, to an estimated maximum rate of 4,500 gpm (about 10 cfs) from all sources. In assessing impacts from dewatering, the Forest Service has coordinated with the New Mexico Office of the State Engineer (NMOSE). RHR has submitted an application to NMOSE for a temporary permit that seeks authorization for pumping that is equivalent to that considered in this EIS. The State permitting process involves considerable technical review by the NMOSE; any State approval would be expected to require mitigation of effects judged significant by NMOSE. The application has been protested by Acoma Pueblo. As currently scheduled, the State process would not be expected to produce a final decision until 2014.

Overview of RHR Groundwater Model

To predict dewatering impacts for both the Forest Service and OSE, and for its own planning, RHR developed a groundwater model (Intera, 2011). Forest Service and NMOSE personnel, along with the EIS consultants, reviewed this model and provided comments to RHR. These comments led to substantive revisions of the model, as for example the addition of an explicit representation of Horace Springs. The most recent version of the model is Intera (2012). The following attributes indicate the nature of the model and its ability to predict impacts:

- The model uses a framework for the San Juan Basin developed by the USGS (Kernodle, 1996) with many modifications and incorporation of more recent data. It uses the MODFLOW-SURFACT, a variation of the established MODFLOW computer code.
- Figure 42 is a map of the model area showing the model domain (area covered) and grid. The model domain extends from the Rio San José on the south to beyond the San Juan River and into Colorado in the north, a total of 37,000 square miles. The grid has variable spacing with a maximum of 30,000 feet to a side and in the mine area, cells which are 330 feet on a side.
- The model is three-dimensional, with 10 layers that represent geologic units from the Westwater Canyon Member of the Morrison Formation at the bottom, upward to the San Jose Formation. Table 16 identifies the layers and lists hydraulic conductivies (“Ks”) used in the model. The horizontal to vertical hydraulic conductivity ratios vary from 1 to 1,000. In the area of the mine, the hydrologic unit containing the Menefee Formation is the shallowest unit represented, and most of the thickness is in layers 5 and 7. Layer elevations are specified in the model based on the best available stratigraphic data.

Specific yield in the model is 0.1 for all layers except 4, 6 (NE), 7, and 9 for which the value is 0.05. Specific storage values are in the range 10^{-5} to 10^{-6}.

- The bottom layer in the model, layer 10, represents the Westwater Canyon Member of the Morrison Formation. The model bottom is set at the contact between the Westwater and its underlying regional aquitard, the Recapture Member of the Morrison Formation. The model does not represent impacts to the Recapture, although mining and dewatering will penetrate that unit to a limited degree. The model also does not simulate effects in deeper units, including the San Andres-Glorieta unit which is an important regional aquifer and source of water for Horace Springs.
- Aquifer properties used in the model were determined from published studies specific to the San Juan Basin from generalized literature relationships, from site-specific aquifer tests performed by RHR, and from model calibration.
- The model was constructed to represent a steady-state period prior to 1930, transient conditions from 1930 through 2012, and predictions of future conditions from 2013 through 2125 (13 years of mine construction and operation and the subsequent 100 years). The transient period included pumping for dewatering from uranium mines in the Ambrosia Lake area through 1986 at rates in the range of 7,000–12,000 gpm, 2,000–4,000 gpm in the Church Rock area, up to 4,500 gpm from the Mt. Taylor Mine, and up to 800 gpm from the Johnny M. Mine.
- Recharge simulated in the model occurs primarily at higher elevations and especially at mountain fronts. Recharge related to discharges from past mine operations is incompletely simulated (e.g., while prior discharge impacts are simulated downstream of the RHR mine, there is no simulation of historic effects of discharge of water from the Mt. Taylor mine to San Mateo Creek in the area of San Mateo). This could cause historic drawdowns to be overpredicted in the shallowest units. See below for a discussion of pumping assumed to occur in the future.
- Consistent with how Intera interprets the geology, the volcanic core under Mt. Taylor, Horace Mesa, and Mesa Chivato is simulated as a low permeability zone east of the mine. The USFS technical review of the model considered that this could overstate the effect of Mt. Taylor as a barrier to propogation of pumping effects to the southeast (e.g. toward Horace Springs). As a result of the review, Intera conducted sensitivity simulations in which the barrier effect of the volcanic core was reduced. These and other sensitivity evaluations indicated that the model results primarily respond to the amount of pumping simulated, with details such as reasonable variations in permeability having a lesser effect on simulated drawdown. Intera's sensitivity analysis did not assess the effects on simulated springflow changes or streamflow depletions. The permeability values for aquifers under Mt. Taylor, Horace Mesa, and Mesa Chivato are orders of magnitude below values in surrounding areas and are not supported by any direct evidence. Whether the values are sufficiently conservative may require further consideation.
- Model construction should allow prediction of streamflow impacts to the San Juan River, Rio San José. and Rio Puerco. However, model outputs have unrealistic variability and do not provide a reliable quantification of impact.

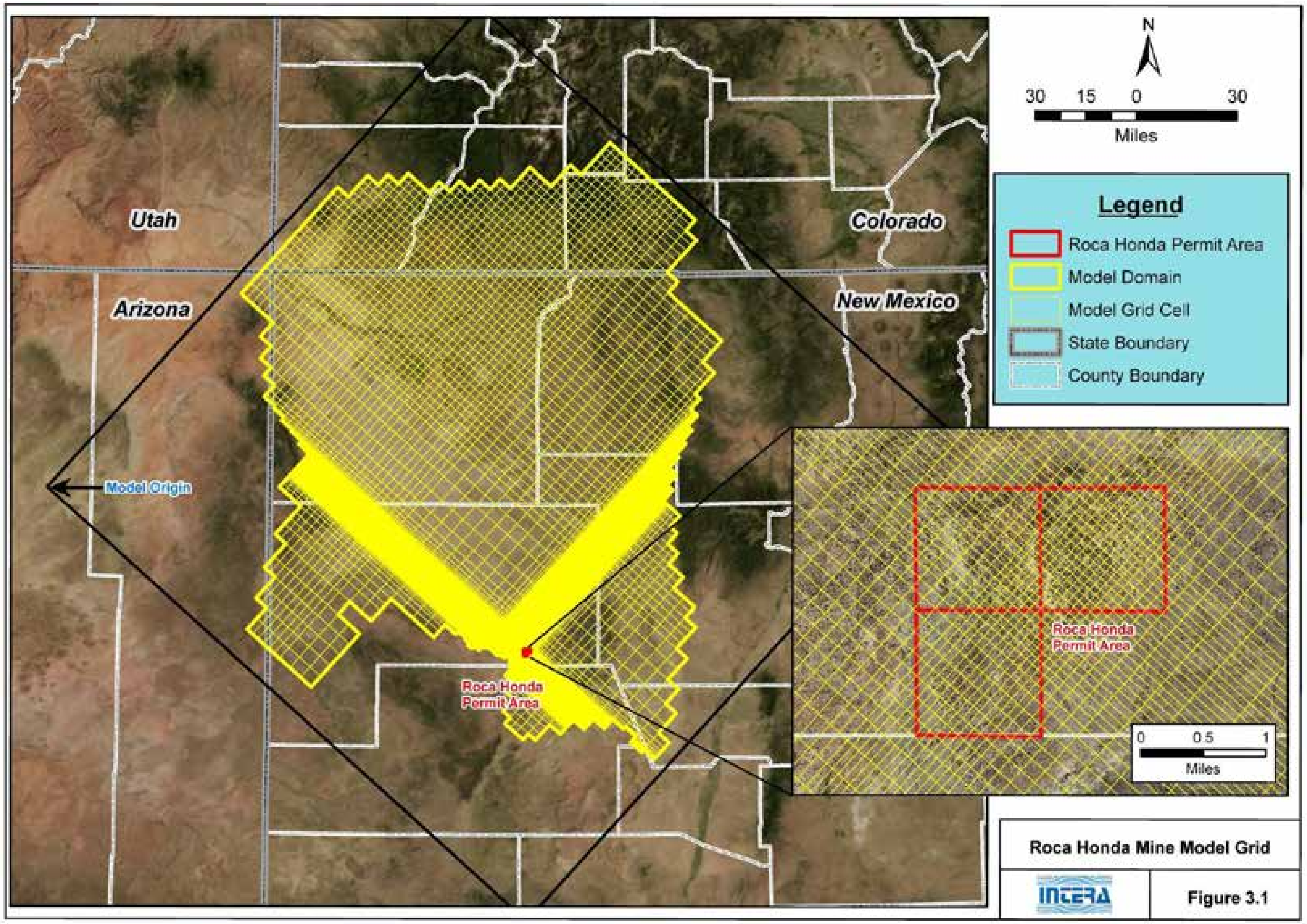


Figure 42. Extent and grid of INTERA model used to predict groundwater impacts

Table 16. Stratigraphic identification and calibrated hydraulic properties of each hydrogeologic unit used in the RHR groundwater model of the San Juan Basin and ratio between horizontal and vertical hydraulic conductivities for each unit

Model Layers	Geologic Units	Geologic Symbol	Occurrence	Horizontal K	Vertical K	Horizontal to Vertical Ratio	Hydrogeologic Role	General lithology	Specific storage	Specific Yield
1	San Jose Formation	Tsj	Basin-wide	0.5	0.002	250	aquifer	conglomerate, sandstone, shale	-	-
1 to 2	Animas and Nacimiento Fms	Tka	Basin-wide	0.01	0.0001	100	poor aquifer	sandstone, siltstone, shale	-	-
1 to 3	Ojo Alamo Sandstone	Toa	Basin-wide	0.3	0.001	300	mixed	sandstone, shale, coal	-	-
	Kirtland and Fruitland Fms	Kkf								
	Pictured Cliffs Sandstone	Kpc								
1 to 4	Lewis Shale	Kls	Basin-wide	5.00E-005	2.50E-006	20	aquitard	shale	-	-
1 to 5	Cliff House Sandstone	Kch	Basin-wide	0.05	0.0003	166.6666667	mixed	sandstone, shale, coal	-	-
	Menefee Formation	Kmf								
	Point Lookout Sandstone	Kpl								
	Crevasse Canyon Formation	Kcc								
1 to 5	Mancos Shale	Km1	Basin margin	1.00E-004	1.00E-004	1	aquitard	shale	-	-
6		Km2	Upper Mancos	3.00E-003	5.00E-006	600	aquitard	shale	-	-
1 to 7		Km3	Lower Mancos	5.00E-005	2.50E-006	20	aquitard	shale	-	-
1 to 6	Gallup Sandstone	Kg1	Southern basin	0.25	0.0025	100	aquifer	sandstone	-	-
6		Kg2	RHR permit area	1.5	0.002	750	aquifer	sandstone	-	-
7 to 8	Dakota Sandstone	Kd1	Basin-wide	0.1	0.0001	1000	aquifer	sandstone	-	-
1 to 8		Kd2	Ambrosia Lake subdistrict	0.1	0.002	50	aquifer	sandstone	-	-
7 to 8		Kd3	Rio San Jose	1	0.001	1000	aquifer	sandstone	-	-
9	Brushy Basin Member of Morrison Formation	Jmbb	Basin-wide	3.00E-003	5.00E-006	600	aquitard	shale	-	-
10	Westwater Canyon Member of Morrison Formation	Jmw1	Northern basin	0.02	0.0002	100	aquifer	sandstone	-	-
		Jmw2	Southern basin	1.25	0.00125	1000	aquifer	sandstone	-	-
		Jmw3	Ambrosia Lake subdistrict	1.6	0.002	800	aquifer	sandstone	-	-
		Jmw4	RHR permit area	0.5	0.001	500	aquifer	sandstone	-	-
		Jmw5	Mt Taylor mine area	3	0.003	1000	aquifer	sandstone	-	-
6 to 10	Mt. Taylor volcanic rocks	Tnv1	Volcanics in the aquifer	0.1	0.001	100	aquitard	-	-	-
		Tmv1	Basalt and andesite flows in the aquifer							
		Tnv2	Volcanics in the aquifer	1.00E-004	5.00E-006	20	aquitard	-	-	-
		Tnv2	Basalt and andesite flows in the aquiftard							

- Except for Horace Springs, the model does not directly predict impacts to springflow. Instead, for springs whose source formation is within the model, spring effects are inferred based on the amount of drawdown that is predicted at the surface layer at a spring location. If the prediction is for no impact to water level, then no impact to springflow is expected. The Forest Service recognizes that model predictions have no necessary relationship to intangible attributes of springs, such as their spiritual significance. See the disuccsion in the “Cultural and Historic Resources” section.
- For Horace Springs, the model does predict the change in discharge from the Mesozoic units that are in the model. The model does not predict total flow of the springs, nor the specific springflow contributions from alluvium or the San Andres aquifer.
- The influence of faults on groundwater flow was not simulated. Intera (2012, p. 37) considers this to be justified by observations that show no effect of faults on groundwater flow in this area. They conclude that if there were an effect on model predictions from faults it would be to increase predicted drawdowns at the mine and result in less predicted impact to Horace Springs.

Model calibration was based primarily on observed matches between model outputs and observed groundwater levels (maps and hydrographs); some statistical evaluations also were performed. While residuals (differences between observed and simulated water levels) exceed 100 feet in many locations (ranging from extremes of -188 to +219), the net error averages out close to zero. The USFS considers that overall the calibration results are reasonable given the limited amount of information on the aquifer properties in the region of impact and the scarcity of data against which to calibrate the model. Recalibration of the model when mine dewatering effects have been measured in observation wells would result in a more accurate model.

As a result of its review of the model, the USFS considers that the model is sufficient for making approximate quantitative predictions of mine impacts to wells, springs, and possibly streams. The model confirms that such impacts would occur over a substantial area, would last for decades, and would be locally large; the model also shows that impacts would be potentially cumulative to impacts from pumping by others. Predictions can be considered reasonably reliable with respect to whether a particular impact is likely to occur, and its gross magnitude, but with limited accuracy at any particular location. The suitability of the model for use in the OSE determination of stream impacts has not been determined.

Dewatering Schedule

The proposed action was simulated based on 3 years for mine construction and 10 years of mine operations. During construction, the shafts would pass through two units that contain sufficient groundwater to require some degree of dewatering: the Gallup and Dakota sandstones. During operations, dewatering (initially by wells and eventually through the mine workings) would be done in the unit being mined, the Westwater Canyon Member of the Morrison Formation. The dewatering schedule in table 17 is based on Intera (2012), especially their table 1.1 and related text. For scenario 2, the proposed action, no change in other model inputs was assumed in the modeling; e.g. recharge rates and pumping by others were the same as in the no action alternative.

Total simulated pumping by RHR is 80,661 acre-feet over 13 years, which is an average of 17 acre-feet per day, 8.6 cfs or 3,840 gallons per minute (gpm). Intera reports that dewatering in the early years of mining is expected to be much less than shown in table 17. Information from RHR does not clearly specify the source of potable water for the project; the USFS assumes the 30 gpm of ongoing Gallup pumping could serve that purpose and, thus, impacts from such a water supply are included in the model.

Table 17. Predicted dewatering phases and rates at the Roca Honda Mine

Aquifer to be Pumped	Depth of Pumping (feet below surface)	Rate of Pumping (gallons per minute)	Pumping Period	Total acre-feet Pumped
Gallup (construction)	640	503	1 year	611
Gallup (mining)	640	30	12 years	581
Dakota (construction)	1,710	144	1 year	232
Westwater (construction)	2,100	2,000	2 years	6,452
Westwater (mining)	2,100–2,800	4,500	10 years	72,585

Model Scenarios

The RHR model was used by Intera to simulate four future scenarios. In all four scenarios, there is “existing pumping” from dewatering of the Lee Ranch coal mine and pumping at Crownpoint and Gallup. Supply wells in the Grants-Milan area typically pump from the San Andres and are not represented in the model. The scenarios are summarized in table 18.

Scenario 1 is the no action alternative and scenario 3 is the cumulative impact scenario without RHR. Scenario 2 adds RHR’s dewatering to existing pumping, and scenario 4 adds RHR to existing and possible future regional pumping. Possible future regional pumping was based on filed water rights and totaled more than 20,000 AFY. Much of the future pumping is attributed to potential uranium mining and milling in the Ambrosia Lake area, but may not include all potential withdrawal for purposes of mine dewatering.

Table 18. Groundwater modeling scenarios for Roca Honda Mine

Activity Simulated	Scenarios			
	1	2	3	4
RHR dewatering		X		X
Existing pumping of public water supply at Crownpoint and Gallup; dewatering pumping at Lee Ranch coal mine	X	X	X	X
Pumping of rights of others in the region e.g. large water rights from Gallup, Dakota and Westwater on file with OSE in San Juan, Gallup, and Bluewater groundwater basins. See table 3-5 of INTERA, 2012.			X	X

Water Balance

Under simulated steady state conditions (representing natural background), the entire San Juan Basin receives 42,000 acre-feet per year (58 cfs) of groundwater recharge. Intera considers this value to be within the range of prior estimates. Most of the water is infiltration from rivers, from precipitation on exposed bedrock aquifers or from seepage from runoff from adjoining highlands. A relatively small proportion of the recharged water is modeled to originate from shallow aquifers near the Chuska Mountains and on Mt. Taylor. The steady state groundwater is modeled as discharging to streams, including normally dry streambeds.

Table 19 compares current water balance conditions simulated by the model to the pre-development state. The water balance in the basin is simulated to change only slightly during the 83-year (1930-2012) historical period, even though 1,174,000 acre-feet of water was pumped from the basin. Pumping resulted in a net decline of 1,035,000 acre-feet in the amount of water stored in the basin. The remaining difference was made up of a 138,000 acre-foot increase in the input from rivers. The increased input from rivers includes 83,000 acre-feet that infiltrated along San Mateo Creek downstream of the mine, which originated as water discharged to the stream from mine dewatering operations (e.g., from Ambrosia Lake).

The model predicts that the pattern of future changes will be similar to the historic pattern. Table 20 summarizes the water balance calculated by the model in scenarios 1 and 2. Scenario 2 includes RHR dewatering.

The model produces a good balance, in that the total inputs and total outputs of water are within 2,000 acre-feet of one another in all cases (an error of 0.3 percent or less). Under scenario 2, RHR would pump 80,659 acre-feet over the 113-year period of the simulation, all within the first 13 years. As a result, the amount of groundwater in storage would decline by an equivalent amount (slightly different due to the small model error). Ninety-seven percent of the change in storage is predicted to occur in the Westwater Member of the Morrison Formation, the rest from other formations including the Gallup, Dakota, and Brushy Basin. The model is not capable of simulating any possible effects on the underlying Recapture.

In the model results, water remaining in storage redistributes after pumping stops. Specifically, while water levels at the mine recover, there is an expansion in the cone of depression outward that continues to the end of the simulation, and presumably beyond. Impacts on the flows into or out of the model domain are small, and predicted values are considered to have a a low level of reliability. Qualitiatively, the prediction that there would be an increase of river impacts over time is considered probable, as is the expectation that changes in external conditions (such as from climate change) would not effect the predictions. Overall the model shows that the water removed by the Roca Honda Mine is a mined resource which for practical purposes represents a permanent loss of stored groundwater, primarily from the Westwater.

Table 19. San Juan Basin water balance: pre-development vs. current condition

	Predevelopment Acre-feet/year	Current Condition Acre-feet/year
Mountain front recharge	12,535.5	12,539.6
Recharge at outcrops	13,788.3	13,788.3
Recharge from rivers	16,116.8	18,359.7
Water supply pumping	0	-4636.7
Discharge to ephemeral streams	-10,233.5	-10,226.6
Discharge to rivers	-32,168.5	-32,179.6
Flow from storage	0	2348.8
Percent error	0.09%	-0.01%

Table 20. Predicted change in San Juan Basin water balance from RHR Mine; positive numbers are inputs and negative numbers are outputs, in total acre-feet

	Scenario 1		Scenario 2		Roca Honda Effect	
	2012-2025	2026-2125	2012-2025	2026-2125	2012-2025	2026-2125
Mountain front recharge	162,903	1,253,101	162,903	1,253,101	0	0
Recharge at outcrops	179,126	1,377,888	179,126	1,377,888	0	0
Recharge from Rivers	236,574	1,780,306	236,538	1,780,427	-36	121
Water Supply pumping	-60,236	-463,351	-60,236	-463,351	0	0
Dewatering	0	0	-80,659	0	-80,659	0
Discharge to ephemeral streams	-133,155	-1,022,065	-133,082	-1,022,094	73	-29
Discharge to rivers	-416,532	-3,203,984	-416,444	-3,203,754	88	230
Flow from storage	31,784	278,729	112,587	278,778	80,803	49

Drawdown in Pumped Units

As expected, the RHR model predicts that mine dewatering would form cones of depression (areas in which water levels are drawn down) in the pumped aquifers that are centered in the permit area and that are sized in proportion to the rate and total amount of pumping. Table 21 summarizes the model predictions for scenario 2 (no new pumping except RHR), as determined from review of Intera (2012) and from model output files. Drawdown values are for the units within the permit area and indicate the depth of the drawdown cone created. Maximum drawdown in aquifers shallower than the Gallup sandstone are predicted to total no more than a few feet and are discussed later in respect to springs.

Table 21. Predicted drawdown caused by dewatering at the Roca Honda Mine

Aquifer	Maximum Drawdown	Drawdown at End of Mining	Drawdown 100 Years after Mining	Extent of 10 ft Drawdown at End of Mining	Extent of 1 ft Drawdown at End of Mining
Gallup	366 ft	<50 feet	1 feet	In permit area	Up to 3.75 miles
Dakota	1,655 ft	<100 feet	14 feet	Just outside permit area	Up to 4 miles
Westwater	1,806 ft	1,806 eeft	30 feet	Up to 8 miles	Up to 11+ miles

Drawdown from pumping in the Gallup and Dakota can be large, but is predicted to be localized to in and near the mine permit aera. Drawdown in the Westwater is modeled as much more extensive. Figure 43 is a map of the modeled drawdown in the Westwater caused by the Roca Honda Mine (i.e., the difference between scenarios 2 and 1) at the end of mining (assumed to be 13 years from startup). The map was prepared by the USFS using data from the Intera model. Contour lines are given for 1,000 feet of drawdown, 100 feet, 10 feet, and 1 foot. The Westwater cone of depression would continue to expand after mining and dewatering stop and water levels at the mine begin to recover. This occurs in the Dakota as well, but as its pumping is limited in time, the effect is much less. The result is that maximum Westwater drawdowns outside the permit area may occur years after mining.

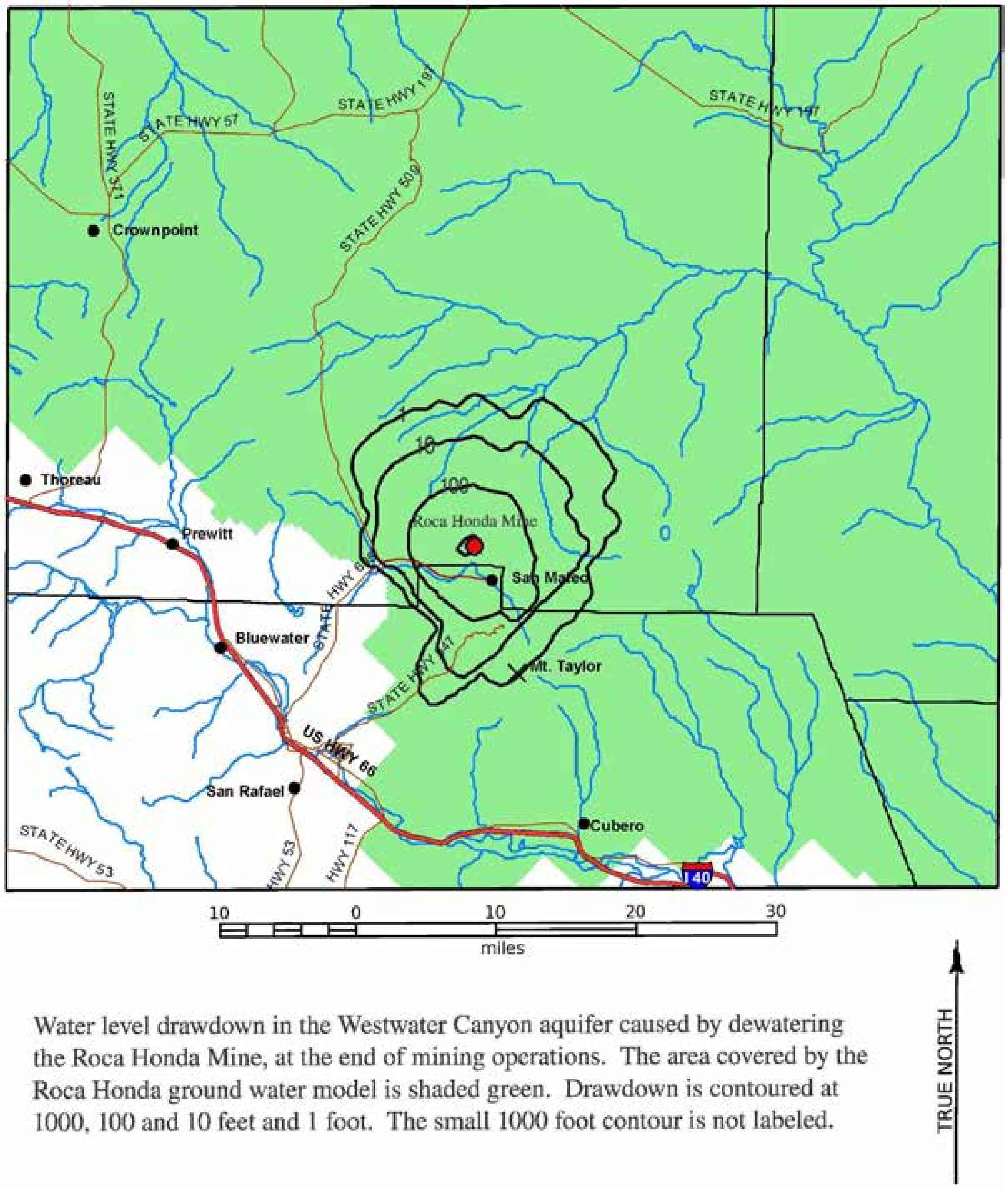
Figure 44 is a map showing modeled drawdowns 100 years after mining ceases (assumed to be the year 2125). At this time the Westwater cone is both broad and shallow. As of 2025, the 10-foot drawdown contour extends 16.6 miles out from the mine and the 1-foot contour extends as far as 17 miles. At this time, the maximum drawdown is still within the permit area and is about 30 feet. Changes beyond 2125 are not simulated.

Due to the length of time it would take water levels in the Westwater Canyon aquifer to recover to pre-pumping conditions, the impact of the Roca Honda Mine on this groundwater resource would be considered significantly adverse.

It is possible to plot drawdown over time for any layer and any grid location within the model domain. Figures 45–47 provide three such hydrographs; the impact of RHR is seen by comparing scenario 2 (with the mine) to scenario 1 (existing pumping only). The hydrographs were prepared by the USFS using data from the Intera model. Year 0 in each graph represents the year construction begins. Scenario 4 is also shown in these figures and it and scenario 3 are discussed below under cumulative impacts.

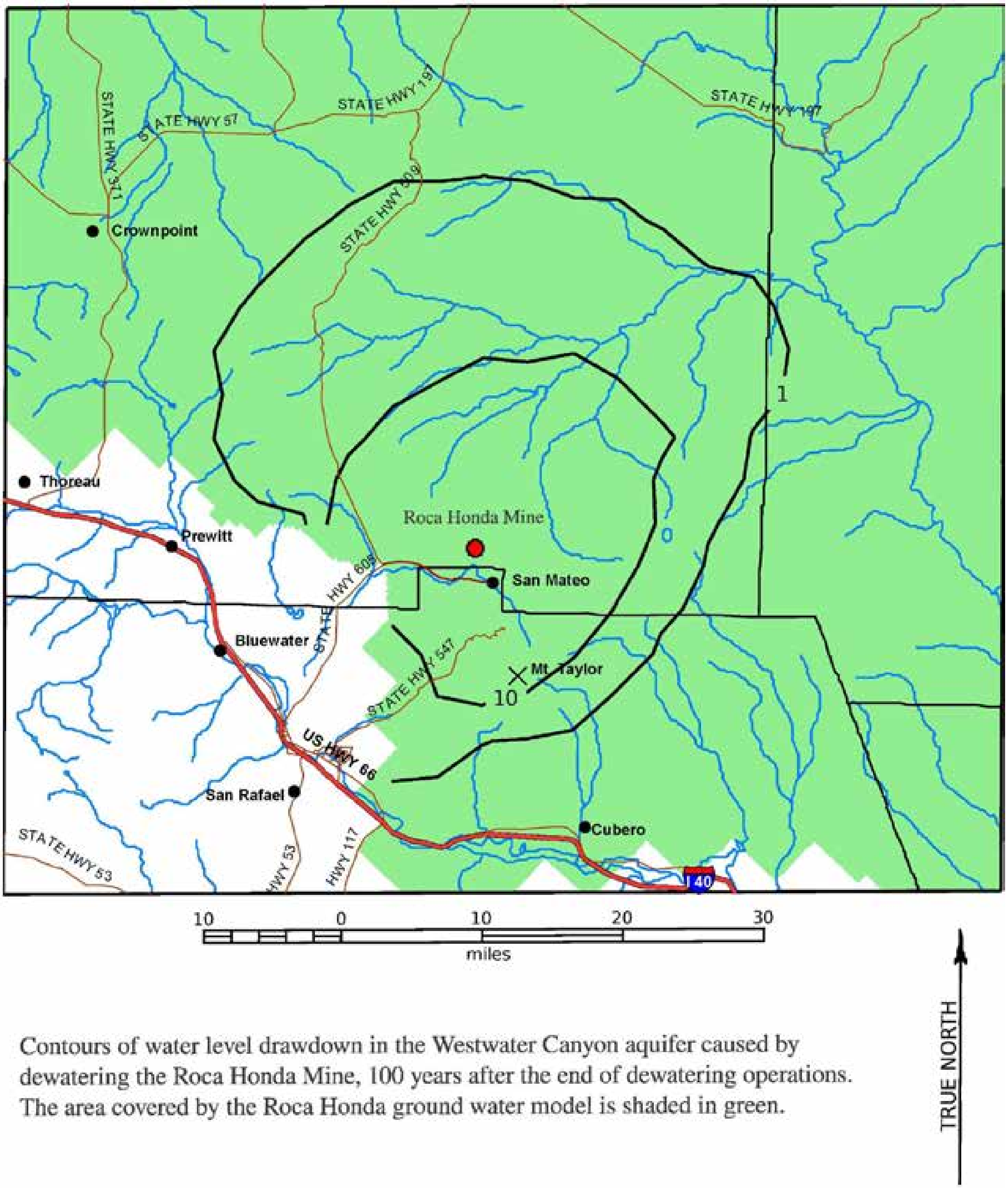
- As indicated in figure 45, Roca Honda Mine dewatering would cause no significant impact to the San Mateo community well, which draws from the Point Lookout aquifer, far higher in the stratigraphic column than the Westwater.
- Well 143 is a ranch well about 2 miles west of the mine that may be completed in the Westwater. (Based on the reported depth of the well, it may be completed in a shallower unit.) As shown in figure 46, under existing conditions, water levels are simulated as rising as they recover from past mining. The RHR impact is immediate and large, reaching about 200 feet of maximum drawdown. Water levels are predicted to recover after mining ceases.
- As indicated in figure 47, there would be no impact from RHR at Crownpoint, where community wells also draw from the Westwater but outside the cone of depression of the mine.

No wells drawing from the Dakota or Gallup were identified that would have significant impacts from the RHR mine. A possible exception is Well 143, which could be completed in one of those units; if so, impacts would be much smaller than shown in figure 46.



Water level drawdown in the Westwater Canyon aquifer caused by dewatering the Roca Honda Mine, at the end of mining operations. The area covered by the Roca Honda ground water model is shaded green. Drawdown is contoured at 1000, 100 and 10 feet and 1 foot. The small 1000 foot contour is not labeled.

Figure 43. Drawdown of Westwater Canyon aquifer after 13 years of pumping (close of Roca Honda Mine)



Contours of water level drawdown in the Westwater Canyon aquifer caused by dewatering the Roca Honda Mine, 100 years after the end of dewatering operations. The area covered by the Roca Honda ground water model is shaded in green.

Figure 44. Drawdown of Westwater Canyon aquifer after 13 years of pumping and 100 years of recovery

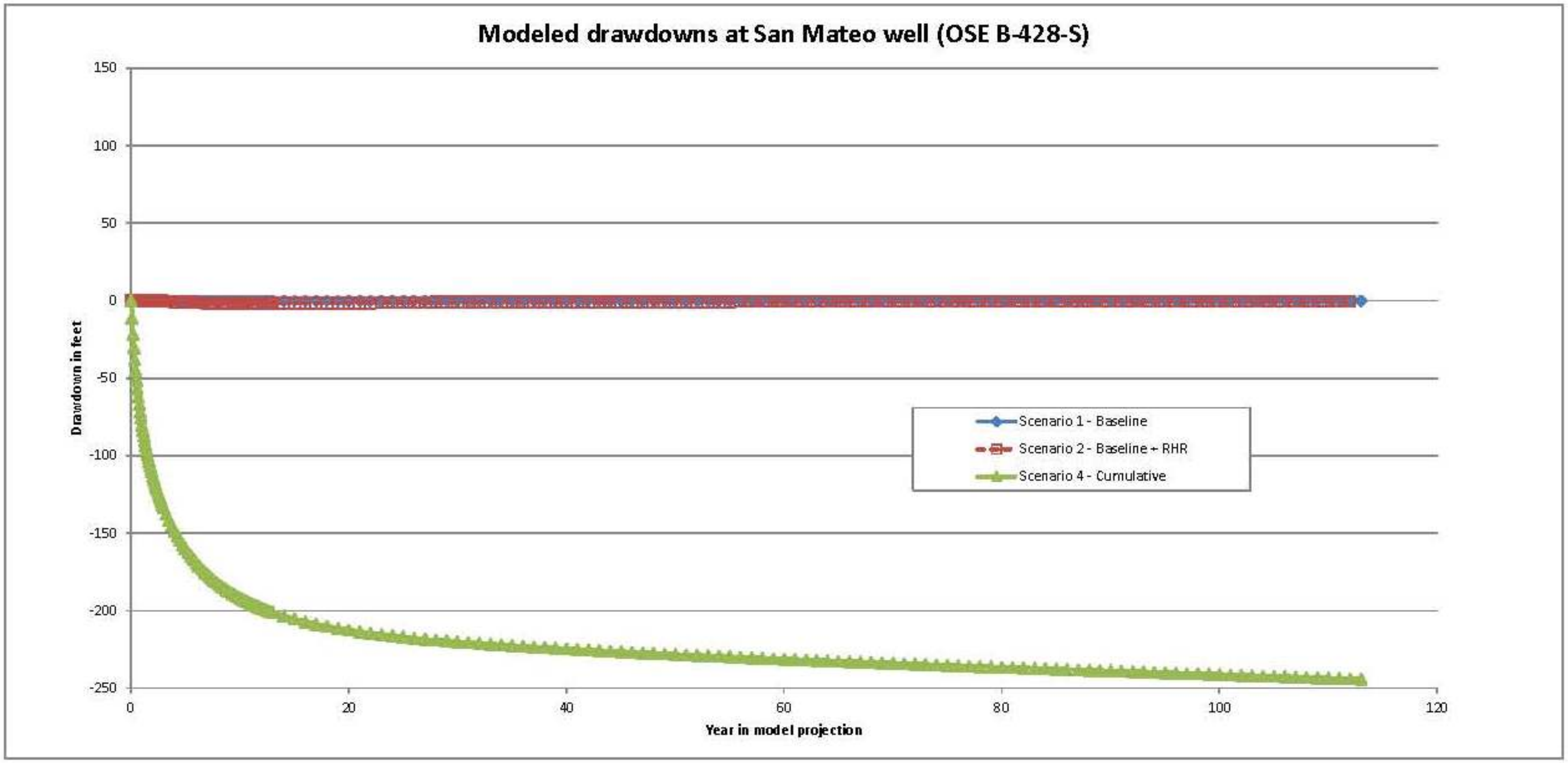


Figure 45. Modeled hydrograph for San Mateo well

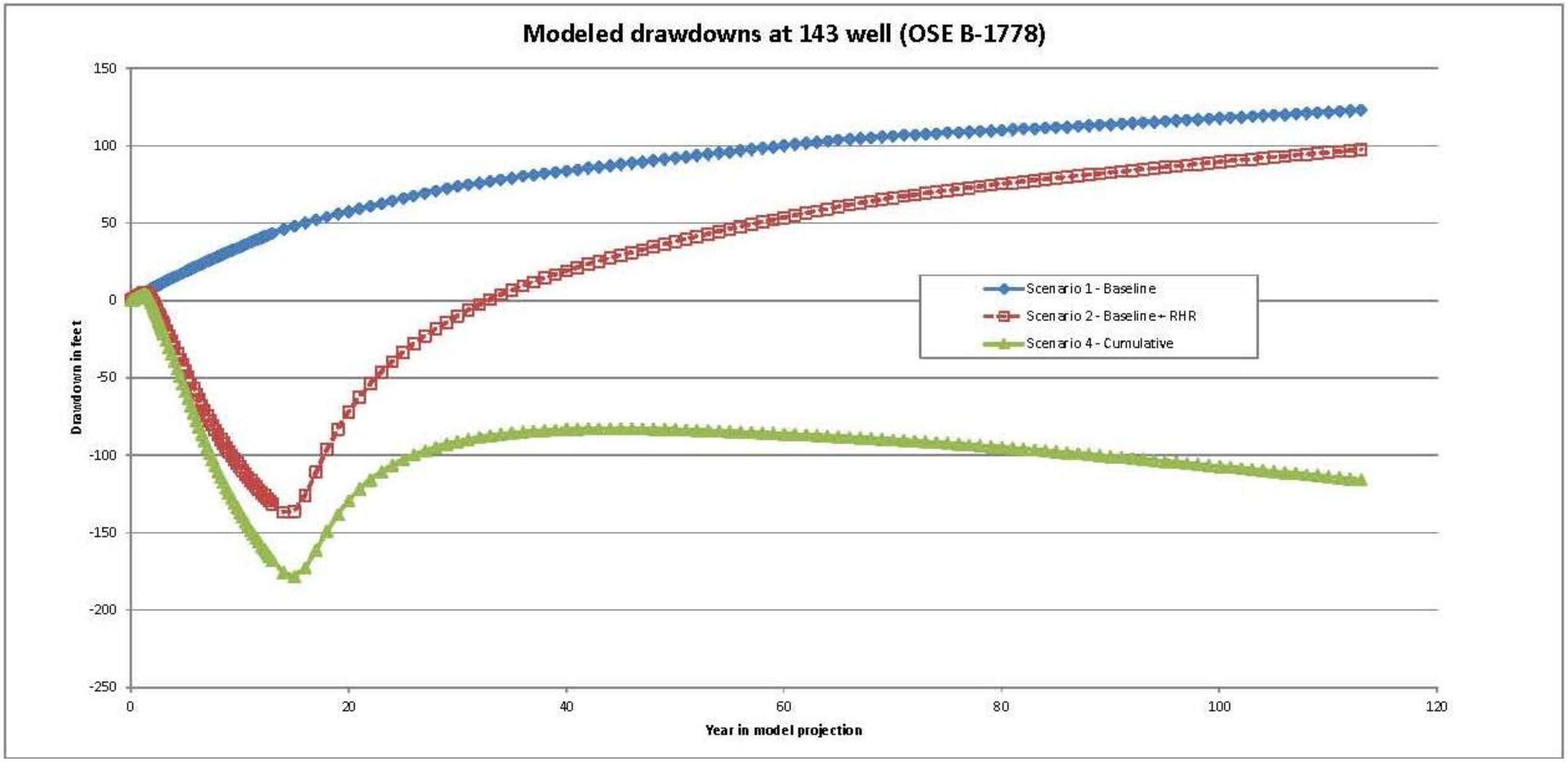


Figure 46. Modeled hydrograph for 143 well

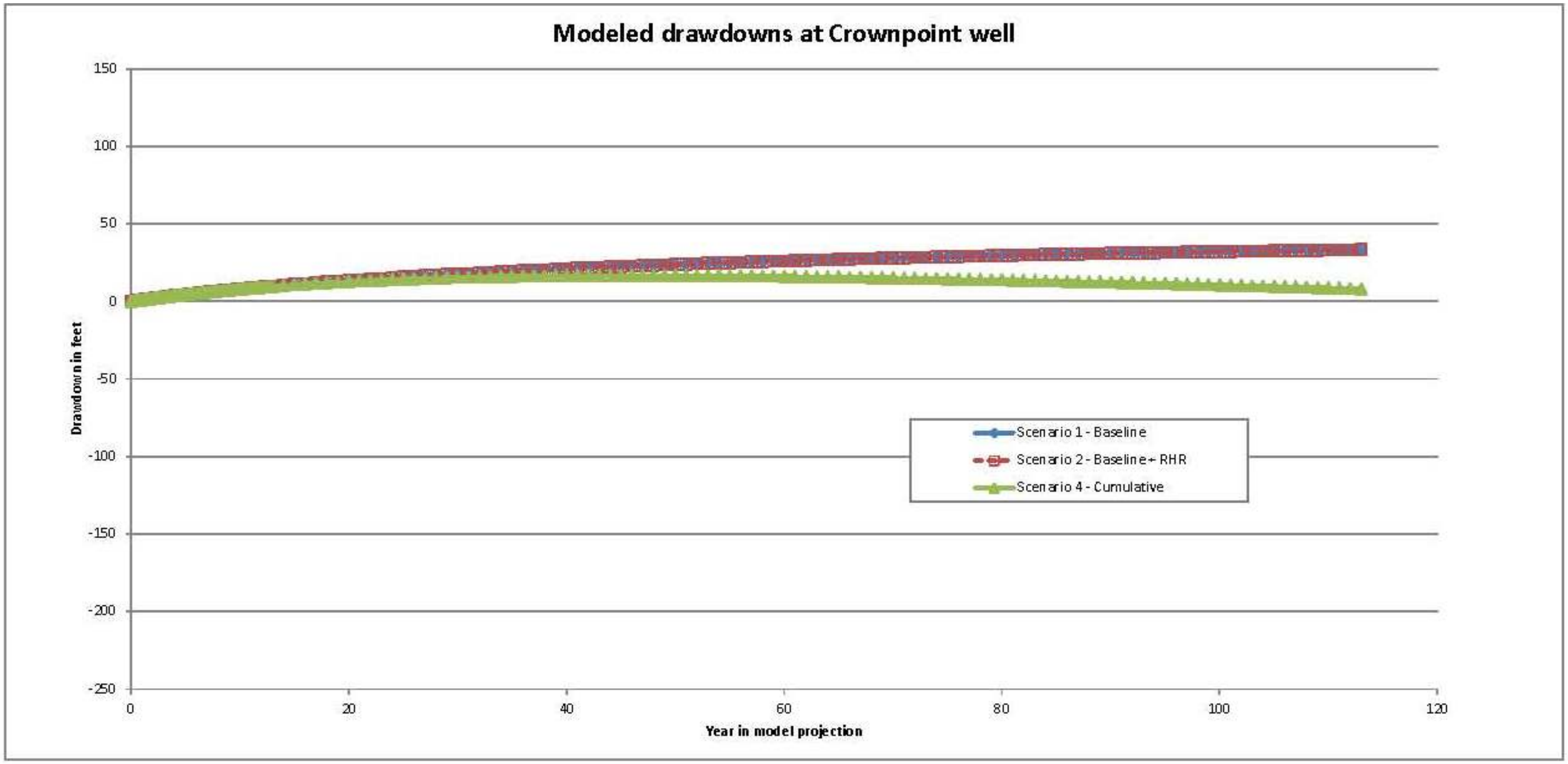


Figure 47. Modeled hydrograph for Crownpoint well

Spring Impacts

Springs Other Than Horace Springs. As previously noted, the RHR model is not designed to directly predict changes in spring flow, but to predict drawdowns in locations where springs are known to exist. Such drawdown can be assumed to intercept flow to the springs, regardless of where the ultimate source of spring recharge may occur. The largest predicted drawdown is for Bridge Spring, the spring closest to the permit area. For the Point Lookout sandstone in this location, the presumed source of the spring, the model predicts that the RHR dewatering will cause a drawdown of 0.7 feet. The relationship between water levels and spring discharge is not known, but it is known that historic water levels at times decline to the point that there is no spring flow. Absent better information, an assumption is that the Roca Honda Mine would dry up this spring for the foreseeable future.

The geologic source is represented in the model for two springs of cultural significance: San Miguel Spring (Menefee) and San José de Atarque Spring (Mancos). For both these springs, the model predicts no drawdown through 2125. Many other springs are known to be of cultural or other interest, including numerous springs located on or near the Mt. Taylor shallow volcanics, which are not represented in the model. Those of cultural interest and specifically identified by RHR are San Lucas, Maruca, La Mosca, El Rito, San Mateo, Cienega, Gooseberry, and De Armand Springs. Intera (2012) provides a qualitative analysis indicating that there should be no effects of mine pumping on such springs. The USFS considers this reasonable based on two facts: (1) the model water balance indicates heavy impacts to the Westwater Canyon Member of the Morrison Formation, and small impacts in other units; and (2) the springs are fed by water from much higher elevations than the Westwater and, thus, it is reasonable to consider them to be isolated from mine dewatering.

Horace Springs. As constructed, the model simulates flow from Jurassic and Cretaceous units to Horace Springs, but not other components of the spring flow. The simulation indicates that these simulated flows account for 3 percent of the estimated 4 cfs flow at Horace Springs, which is consistent with Wolf (2010). Model results show no impact to such flow from RHR pumping.

Intera (2012, appendix E) provides supporting assessments which indicate that (a) the Westwater is not a contributing factor to flows at Horace Springs (e.g. p. E-4) and (b) the flows at Horace Springs may be accounted for by recharge in the contributing watershed. The Forest Service considers these assessments to be reasonable but not definitive. To augment them, the Forest Service has considered the model predictions of drawdown at and near the location of Horace Springs. For the first 40 years after dewatering begins, the effect of RHR pumping on the Westwater Canyon Member of the Morrison Formation is on the order of 0.01 feet (3 millimeters) in the cell that lies beneath Horace Springs; this cell is separated vertically from the springs by the Brushy Basin aquitard and the Mancos shale. Drawdown in the Dakota sandstone, between the two aquitards, is effectively simulated as zero, which is why the inflow prediction noted above shows no effect. It is reasonable to interpret these results as indicating no significant impact of RHR pumping on Horace Springs.

However, the model predicts Westwater drawdowns at this location of nearly 2 feet without any RHR pumping, i.e. from pumping that is already occurring (scenario 1). Also, in scenario 2, the initial small drawdown increases over time as the RHR cone of depression continues to expand. Drawdown exceeds 2 inches at the end of the simulation period in 2125, and presumably is larger after that. This impact to the Westwater is separated from the springs by the low permeability

Brushy Basin Member and Mancos shale and is not expected to have a quantifiable impact on the springs.

A separate issue with Horace Springs is that a prior model did predict small impacts to Horace Springs from pumping at the Mt. Taylor Mine (see discussion in DBSA, 2001, referring to the model originally prepared by Carpenter and Shomaker, 1998). Intera (2012, p. 113–117) provides an extended discussion of the Mt. Taylor Mine model, which presumably would predict effects on Horace Springs if it were used to simulate the RHR pumping. Intera considers that the Mt. Taylor Mine model would overpredict such impacts, because it does not include the Brushy Basin aquitard and, thus, does not simulate the retarding effects of that unit. Intera considers their model to be preferred to that of Carpenter and Shomaker; in respect to the Brushy Basin, the Forest Service agrees. However it should be noted that the Intera model also excludes potentially important units, e.g. the San Andres.

On balance, it is reasonable that the thick and relatively impermeable aquitards above and below the Westwater do limit the impact of RHR pumping on the Rio San José, including Horace Springs, to the point that for EIS purposes the result is no significant effect. The USFS expects this will be continue to be investigated as part of the NMOSE permitting process. If significant short-term effects were predicted to occur to the Rio San José or Horace Springs, the USFS is aware that such effects will be identified by NMOSE and will be subject to mitigation according to NMOSE requirements.

Streamflow Impacts

The Intera model simulates the Westwater Canyon Member of the Morrison Formation to be in direct contact with the Rio San José near and above Seama on Laguna Pueblo. In that location, the simulated depletion effect of the mine is 3.4 cubic feet per day as of 100 years.

Although perennial streams other than the Rio San José (i.e. San Juan River, Rio Puerco) are distant from the mine, the model does provide a hydraulic connection to the Westwater Canyon Member of the Morrison Formation and should predict effects from mine dewatering. The model results are difficult to interpret, as the values fluctuate from year to year in an unrealistic manner. When averaged out over decades, the simulated results are typically a few to a few tens of acre-feet per year (0.1 cfs or less), but those values should be considered approximate at best. Impacts to the San Juan River are minimized by the long distance from the mine to the river but would be very long lasting; those on the Rio Puerco would be minimized by distance and intervening geology but would also extend beyond the period simulated. There are no impacts predicted to ephemeral or intermittent streams. The USFS is aware that the permitting process by NMOSE will determine whether impacts to the San Juan River or Rio Puerco represent impairment and require offsets (mitigation) according to State requirements.

Discharge Area

Treated water will be discharged on private lands north of the mine. Details of the discharge plan are not now available to the USFS. The full discharge plan will require approval by the NMED, a cooperating agency with the Forest Service. In general, the expectation is that use of the water for private irrigation would result in a rise in water levels in the areas irrigated, and near any unlined storage facility. Proper project design will be necessary for this increase in groundwater storage to not adversely impact soil water logging or increased flood runoff.

Water Quality Impacts

There is an extensive literature relating to impacts to water quality from uranium mining and milling in the Grants Uranium Belt. Otton (2011) provides citations to hundreds of references on the subject, including USEPA (1975), which provides information specific to conditions at the time when many mines were active. Legacy impacts are the subject of ongoing studies; see especially USEPA (2010e) and NMED (2010). The most severe impacts associated with past mining are not expected to result from the Roca Honda Mine because those impacts related to mill wastes and to discharge of untreated mine water, whereas in this instance a mill is not part of RHR's proposed action; and mine water will be treated prior to discharge. It is also the case that regulatory controls today are far more extensive than in decades past. While the severe legacy impacts would not occur from the Roca Honda Mine, there would be some potential water quality effects.

- Dewatering would increase the flow of water through the Westwater, which may create an oxidizing environment that leads to degradation of the quality of water in that unit. For example, Kaufmann et al. (1976) found "radium concentrations in the discharge waters of a producing mine tend to increase substantially as the ore body is developed;" and "radium, selenium, nitrate and, to a lesser extent, uranium are of most value as indicators of groundwater contamination." Some existing wells are already elevated in radionuclides. The pumped water would be treated prior to discharge (see discussion under "Surface Water"), but water remaining underground after mining would likely be affected.
- The lowering of water levels at the mine would facilitate movement of water into the cone of depression created by dewatering. Kelly et al. (1980) reported that this could degrade water quality in the Westwater due to leakage from formations above, i.e., the Brushy Basin and Dakota units. The amount of such flow is likely to be small. High sulfate water now located west of the mine may move eastward as well. These effects would be localized to the permit area and to water resources that for the foreseeable future are not expected to be used for any purpose other than mine dewatering.
- Given adequate treatment, there should be no adverse impacts to quality of groundwater in the distant discharge area.

Impacts of Mine Backfill and Resaturation

Backfill of mined rooms is an important step in preventing roof collapse. According to the January 2012 mine operations plan (p. 37), RHR would initially hoist nonore grade material to surface stockpiles and reintroduce it to the mine in a cement mixture, after testing to insure it would not adversely impact groundwater. Subsequently, nonore grade material would be stored underground and then used in the mine. When nonore material is exhausted, backfill material would be sourced from a local quarry.

Stockpiled material can reasonably be expected to be loose compared to the bedrock that existed prior to mining, and minerals in the material would oxidize to some extent while unsaturated. Given this chemical change and the texture of the material, there would be more potential for chemical reactions with the water that resaturates the mine when water levels recover after mining and there is a return to reducing conditions.

Details on the chemistry of the material and of potential reactions are not known at this time and, thus, it will be important for RHR to perform testing and to mix the materials with cement prior to placement. EPA (1975, p. 2) reports that from other mines in the area, conventional underground mining has caused deterioration of post-mine groundwater quality, most dramatically from increased dissolved radium and uranium. Increased concentrations of dissolved metals would also be expected, including arsenic, molybdenum, selenium, and vanadium. For EIS purposes, the oversight of backfill by NMED—a State regulatory requirement—is expected to ensure that there is no backfill using materials capable of having an adverse effect on groundwater quality.

Mine shafts would be grouted during construction, but this is not expected to seal off waterflow entirely. The shafts would not be backfilled, so that when dewatering ceases, the shaft would provide a pathway for a small amount of water movement among aquifers, due both to the nature of the grouting material and its physical breakdown over time. In general the flow would be expected to be downward (e.g., Gallup to Dakota to Westwater), reflecting the predevelopment regional gradient and residual drawdown effects. This minor component of the water budget is not simulated in the Intera model. For the Westwater, the contribution of Dakota water would degrade water quality; based on Kelly and others (1980), the most noticeable effect would be increased sulfate.

Impacts of Surface Facilities and Operations

Impacts to groundwater are possible from: (a) seepage related to surface discharge of treated mine water, (b) construction and operation of mine facilities at the land surface including stockpiles of excavated materials, and (c) liquids and wastes used by or created by the mine that contain hazardous constituents. Potential contaminants include especially radionuclides and heavy metals. The mineralogy and geochemistry of the uranium deposits have not caused acid mine drainage historically in the Grants Uranium Belt, and no mineralization at the RHR mine indicates that conditions are different at this location.

The project is designed to eliminate all potentially significant seepage of impacted surface water to groundwater. The measures to control groundwater pollution will be specifically regulated by NMED through issuance (or denial) of a groundwater discharge permit for RHR. The NMED permitting process began with RHR’s application for a permit in 2009, and has progressed through numerous submittals by RHR to NMED at increasing levels of detail. That process will ultimately require a public notice of a draft permit. One outcome of the process could be control measures beyond what is now planned. Such further control or mitigation measures would result in fewer impacts than those evaluated in the EIS.

The most important control now included in RHR’s plan is that water pumped from the mine, along with water gathered from surface facilities, will be treated at the wastewater treatment plant (WTP) with required removal of contaminants to safe levels (see brief discussion above under surface water). Based on data from other mines, treatment will likely be required for selenium and may be necessary for other substances, such as radionuclides.

Information now available indicates the WTP would have substantial capacity to deal effectively with influent of variable quality; 8,000 gpm is the basis for equipment sizing although maximum dewatering rates are estimated to be 4,500 gpm. Plant design includes one double-lined surge and two double-lined treated water holding ponds to minimize the potential for discharge of untreated water due to WTP upsets, or discharge of treated water at uncontrolled locations because of pipeline upsets. Each of the ponds has the capacity to store a 12-hour flow of 8,000 gpm, and the ponds are plumbed so as to be interchangeable in function; that is, up to a maximum of 36 hours of retention is possible for the design maximum WTP discharge, the WTP influent water, or any combination of the two. During normal operation, a single discharge pond and the plant feed surge pond would be on standby. Backup power would be installed.

Additional controls now in the plans include the following; see also discussion of “Surface Water Impacts.”

- All locations where potentially toxic materials are to be stored would be lined or have a concrete floor and drain to lined ponds which, in turn, discharge to the water treatment plant.
- Storm water is routed such that it would not run onto areas of potential contamination (e.g., it is diverted around stockpiles).
- Septic tank wastes, which were a problem at the Mt. Taylor mine, would be piped to the water treatment plant, and would not be discharged through local leach fields.
- Fueling and vehicle maintenance would occur in designated areas or distant from drainways, would be on level areas, and always supervised.
- Plans to prevent and control spills would be developed, including a storm water pollution protection plan. Among other protocols, the plans would require training of personnel, sampling of possible release, and availability of cleanup materials and equipment onsite.

Details on management of drilling fluids and cuttings are not complete, but are expected to involve standard practices with use of short-term pits followed by restoration. Details on discharge of treated wastewater to private land for use in a ranching enterprise are not available. This use would probably result in substantial seepage of treated mine water to groundwater. Provided the water has been treated to safe levels as planned, there would be no adverse impact to groundwater quality.

An important component of any NMED approval would be requirements to monitor potential discharges. The monitoring program as now proposed includes routine inspection of operating and storage areas, instrumentation of key equipment (as an example, pressure sensors on discharge pipelines), and monitoring wells. Monitoring wells are proposed for overall monitoring of the process areas, including components that do not include leak detection systems per se—for example, the lined retention ponds that drain the stockpiles.

In the area of the Section 16 facilities, RHR proposes four monitoring wells be completed in the unsaturated zone, one each adjacent to the three retention ponds and one adjacent to the WTP ponds.

In the unlikely event that significant contamination reached groundwater, it would be detected by one of the three monitoring wells completed in the Gallup. Monitoring well locations are not yet available for the Section 10 facilities, but would be identified in a future NMED permit (e.g. renewal of the initial permit). This would be prior to any mining in that section.

An important monitoring provision would be a requirement for a post-mine radiological survey, a measure recently identified by MMD (Clark, 2012). If such a survey also provided for evaluation of soil moisture and chemistry beneath removed facilities, it would provide an important confirmation that seepage impacts had no significant effect on groundwater.

Alternative 3

During mine construction, less dewatering would be needed for the one shaft alternative than for the proposed action; however, the difference is small compared to the water budget during mining, which would be similar under either alternative. Thus, impact predictions for a one-shaft option would be only slightly less than for the two-shaft option (alternative 2). Overall, effects of alternative 3 on groundwater would be adverse, probable, of large extent, and long term. In sum, they would be significantly adverse.

Cumulative Effects

The spatial boundary for cumulative effects analysis is the San Juan Basin and the temporal boundary is 100 years after mining ends. As noted, scenario 3 of the RHR model includes 20,000 AFY of new pumping related to existing water rights held by entities other than RHR, which would be an overestimate if there is little future mining development, but possibly low if uranium prices greatly increase. As would be expected, the result is to predict substantial impacts near Gallup, Crownpoint, Ambrosia Lake, and other potential mining areas where the bulk of the existing, but currently unused, water rights are found; see for example the scenario 4 graphs in figures 45-47. In sum, cumulative effects related to drawdown from pumping associated with reasonably foreseeable actions would be probable, long term, of large extent, and significantly adverse.

For springs, the effect of new pumping can be large, but the incremental effect of adding RHR dewatering in scenario 4 compared to scenario 3 is small. A particular example is Bridge Springs, where the predicted incremental drawdown is 0.7 feet in scenario 2 (effects of RHR), 32.9 feet in scenario 3 (i.e., large effects from new pumping not RHR), and 33.9 feet in scenario 4 (i.e. RHR adds 1 foot to new pumping).

The model does show that with cumulative pumping, there would be a drawdown of 0.1 foot or more at San Miguel Spring; and no drawdown at San Jose de Atarque Spring. For Horace Springs, the effect from scenario 3 is simulated to be 0.11 acre-feet per year, with no demonstrable adverse effect from RHR pumping in Scenario 4.

Overall, cumulative effects on springs from groundwater pumping associated with reasonably foreseeable actions would be adverse and potentially significant, but the incremental contribution of pumping from the Roca Honda Mine to these cumulative effects would be small.

Monitoring Program

The Forest Service anticipates that the final monitoring plans for groundwater impacts at RHR will be determined by NMOSE for water levels and NMED for water quality. Table 9-14 and figure 9-16 in the revised Baseline Data Report (RHR, 2011) identify wells that are currently proposed for inclusion in the RHR monitoring programs. These include three deep monitoring wells already drilled into the Westwater Canyon Member within Section 16 of the permit area, along with existing wells in the Westwater, Gallup, Point Lookout, Menefee, and alluvium. Beyond the fact that no well in the Dakota was identified, the well distribution appears to need some expansion to confirm the predicted cone of depression. Monitoring of springs has occurred in the past, both as to flow and quality, and is assumed to occur in the future, but specific plans have not yet been provided by RHR.

Mitigation Measures

The large water level impacts cannot be avoided. For such impacts, NMOSE can require mitigation in the form of requiring that replacement water be provided to users of groundwater, and surface impacts be offset such that there is no net effect on streamflows. While reasonable onsite mitigation can be required by the Forest Service, mitigation involving any such replacement of water to non-Federal uses is subject to requriements of the regulating State agency. NMED will specify measures required to prevent adverse water quality impacts from occurring.

Air Quality

Affected Environment

Criteria Air Pollutants

The U.S. Environmental Protection Agency (EPA) Region 9 and the New Mexico Environment Department (NMED) regulate air quality in New Mexico. The Clean Air Act (CAA) (42 United States Code (U.S.C.) 7401-7671q), as amended, gives EPA the responsibility to establish the primary and secondary National Ambient Air Quality Standards (NAAQS) (40 CFR Part 50) that set acceptable concentration levels for seven criteria pollutants: particulate matter (PM_{10}), fine particles ($PM_{2.5}$), sulfur dioxide (SO_2), carbon monoxide (CO), nitrous oxides (NO_x), ozone (O_3), and lead (Pb). Short-term standards (1-, 8-, and 24-hour periods) have been established for pollutants that contribute to acute health effects, while long-term standards (annual averages) have been established for pollutants that contribute to chronic health effects. Each state has the authority to adopt standards stricter than those established under the Federal program; however, New Mexico accepts the Federal standards.

The NMED monitors levels of criteria pollutants at representative sites in each region throughout New Mexico. For reference purposes, table 22 shows the maximum monitored concentrations of criteria pollutants in the closest monitoring location in Bernalillo County, about 60 miles east of the proposed site. McKinley County does not have monitoring sites due to its remote location, and it is expected that the level of criteria pollutants would be lower than shown below.

Table 22. NAAQS and monitored levels of criteria pollutants

Pollutant and Averaging Time	Primary NAAQS[a]	Secondary NAAQS[a]	Monitored Data[b]	Location
CO				
8-hour maximum[c] (ppm)	9	(None)	2.4	Bernalillo County
1-hour maximum[c] (ppm)	35	(None)	6.5	

Pollutant and Averaging Time	Primary NAAQS[a]	Secondary NAAQS[a]	Monitored Data[b]	Location
NO_X				
1-hour maximum[f] (ppb)	100	100	51	Bernalillo County
Annual arithmetic mean (ppb)	53	53	12	Bernalillo County
O_3				
8-hour maximum[d] (ppm)	0.08	0.08	0.072	Bernalillo County
$PM_{2.5}$				
Annual arithmetic mean[e] (µg/m³)	15	15	6.0	Bernalillo County
24-hour maximum[f] (µg/m³)	65	65	18.9	
PM_{10}				
Annual arithmetic mean[g] (µg/m³)	50	50	35	Bernalillo County
24-hour maximum[c] (µg/m³)	150	150	169	
SO_2				
Annual arithmetic mean (ppm)	0.03	(None)	(No Data)	Bernalillo County
24-hour maximum[c] (ppm)	0.14	(None)	(No Data)	
3-hour maximum[c] (ppm)		0.5	(No Data)	

ppm = parts per million; µg/m³ = micrograms per cubic meter

Notes:

[a] Source: 40 CFR 50.1-50.12.

[b] Source: USEPA, 2011a.

[c] Not to be exceeded more than once per year.

[d] The 3-year average of the fourth highest daily maximum 8-hour average ozone concentrations over each year must not exceed 0.08 ppm.

[e] The 3-year average of the weighted annual mean $PM_{2.5}$ concentrations must not exceed 15.0 µg/m³.

[f] The 3-year average of the 98th percentile of 24-hour concentrations at each population-oriented monitor must not exceed 65 µg/m³.

[g] The 3-year average of the weighted annual mean PM_{10} concentration at each monitor within an area must not exceed 50 µg/m3.

Carbon Monoxide

Carbon monoxide (CO) is an odorless, colorless gas formed by the incomplete combustion of fuels. The single largest source of CO is the motor vehicle. When inhaled at high concentrations, CO combines with hemoglobin in the blood and reduces the oxygen-carrying capacity of the blood. This results in reduced oxygen reaching the brain, heart, and other body tissues. This condition is especially critical for people with cardiovascular diseases, chronic lung disease, or anemia, as well as fetuses. Healthy people exposed to high CO concentrations can experience headaches, dizziness, fatigue, unconsciousness, and even death. Such concentrations occur in enclosed spaces containing combustion products and are not found outdoors during normal conditions.

Nitrogen Dioxide

Nitrogen dioxide (NO_2) is a reddish brown gas that is a byproduct of combustion processes. Automobiles and industrial operations are the main sources of NO_2. Aside from its contribution to ozone formation, NO_2 can increase the risk of acute and chronic respiratory disease and reduce visibility. NO_2 may be visible as a coloring component of a brown cloud on high pollution days, especially in conjunction with high O_3 levels. The only sources of NO_2 for the proposed project are the diesel generators and mobile sources burning gasoline or diesel fuel.

Ozone

Ozone (O_3) is not emitted directly into the environment, but is formed in the atmosphere by complex chemical reactions between NO_x and VOCs in the presence of sunlight. O_3 formation is greatest on warm, windless, sunny days. The main sources of NO_x and volatile organic compounds (VOCs), often referred to as ozone precursors, are combustion processes (including motor vehicle engines) and the evaporation of solvents, paints, and fuels. As with CO, automobiles are the single largest source of ozone precursors. O_3 levels usually build up during the day and peak in the afternoon hours. Short-term exposure can irritate the eyes and cause constriction of the airways. Besides causing shortness of breath, it can aggravate existing respiratory diseases such as asthma, bronchitis, and emphysema. Chronic exposure to high O_3 levels can permanently damage lung tissue, plants and trees, and materials such as rubber and fabrics.

Particulate Matter

Particulate matter 10 microns or less in aerodynamic diameter and 2.5 microns or less in diameter (PM_{10} and $PM_{2.5}$) refer to a wide range of solid or liquid particles in the atmosphere, including smoke, dust, aerosols, and metallic oxides. Some particulate matter, such as pollen, is naturally occurring. However, most particulate matter is caused by combustion, construction, grading, demolition, agricultural activities, and motor vehicles. Extended exposure to particulate matter can increase the risk of chronic respiratory disease. Inhalable coarse particles, such as those found near roadways and dusty industries, are larger than $PM_{2.5}$ and typically smaller than PM_{10}. Fine particles ($PM_{2.5}$), as defined by EPA, include smoke and haze and are a subset of PM_{10}. These particles can be directly emitted from sources such as forest fires, or they can form when gases emitted from combustion equipment, industries, and automobiles react in the air.

PM_{10}, which includes $PM_{2.5}$, is of concern because it bypasses the body’s natural filtration system more easily than larger particles and can lodge deep in the lungs. $PM_{2.5}$ is so small it behaves much like a gas and can bypass all of the human body’s defenses to reach the deepest portions of the lungs where oxygen is absorbed.

As with CO and ozone precursors, motor vehicles constitute the single largest source of PM_{10}. Motor vehicles produce particulates through direct tailpipe emissions of particulate matter; direct emissions of NOx, which become particulate ammonium nitrate in the atmosphere; and the suspension of road dust by tires. Vehicles also produce PM_{10} from brake pad and tire wear.

High levels of particulates have also been known to exacerbate chronic respiratory ailments, such as bronchitis and asthma, and have been associated with increased emergency room visits and hospital admissions. $PM_{2.5}$ is, furthermore, the primary cause of reduced visibility (haze) in parts of the U.S., including many national parks and wilderness areas. Particles can be carried over long distances by wind and then settle on ground or water. The effects of this settling include: making lakes and streams acidic; changing the nutrient balance in coastal waters and large river basins; depleting the nutrients in soil; damaging sensitive forests and farm crops; and affecting the diversity of ecosystems. Particle pollution can stain and damage stone and other materials, including culturally important objects such as statues and monuments.

Sulfur Dioxide

Sulfur dioxide (SO_2) is a colorless acid gas with a strong odor that is produced by the combustion of sulfur-containing fuels such as oil, coal, and diesel. It has the potential to damage materials and can have health effects, contributing to respiratory illness particularly in children and the elderly, and aggravating existing heart and lung diseases. SO_2 can irritate lung tissue and increase the risk of acute and chronic respiratory disease. SO_2 aerosols are also implicated in visibility impairment because they scatter and absorb light. SO_2 in the presence of a catalyst such as NO_2 can form sulfuric acid (H_2SO_4) in the atmosphere, resulting in acid rain which damages trees, crops, historic buildings and monuments, and acidifies soils, lakes, and streams, often reducing or eliminating aquatic life. SO_2 and the pollutants formed from SO_2, such as sulfate particles, can be transported over long distances and deposited far from the point of origin. This means that problems with SO_2 are not confined to areas where it is emitted. The only sources of SO_2 for the proposed project would be diesel generators and mobile sources.

Attainment Status

Federal regulations designate Air Quality Control Regions (AQCRs) in violation of the NAAQS as nonattainment areas. Federal regulations designate AQCRs with levels below the NAAQS as attainment areas. McKinley County and, therefore, the proposed action is in the Southwestern Mountains-Augustine Plains Intrastate Air Quality Control Region (AQCR 156) (40 CFR 81.241). EPA has designated McKinley County as an attainment area for all criteria pollutants (USEPA, 2011b). Because the project is in an attainment area, the air conformity regulations do not apply. However, the project’s emissions and the *de minimis* thresholds (that is, the minimum threshold for which a conformity determination must be performed) under the general conformity rules were carried forward to determine the level of impact under NEPA.

Class I Areas

The CAA outlines different levels or classes of air quality protection. Generally, Class I areas are the most pristine and any substantial emission sources located in or near them have strict limits set by regulatory agencies. EPA provides rigorous safeguards to prevent deterioration of the air quality in Class I areas as specified in 40 CFR §81.421(e). The Prevention of Significant Deterioration (PSD) program designates EPA Mandatory Class I areas as all international parks, all national wilderness areas, and national memorial parks that exceed 5,000 acres, and all national parks that exceed 6,000 acres in existence on August 7, 1977. Table 23 contains a list of all the PSD Class I areas within the State of New Mexico and their approximate distance from the proposed site.

Table 23. Class I areas in New Mexico and their distance from the proposed site

Area Name	Acreage	Approximate Miles (kilometers) from Proposed Action
Bandelier Wilderness	23,267	84 (135)
Bosque del Apache Wilderness	80,850	112 (181)
Carlsbad Caverns National Park	46,435	285 (459)
Gila Wilderness	433,690	150 (242)
Pecos Wilderness	167,416	120 (194)
Salt Creek Wilderness	8,500	224 (360)
San Pedro Parks Wilderness	41,132	70 (112)

Source: EPA, 2011c.

National Emission Standards for Hazardous Air Pollutants (NESHAP)

Mine ventilation is a critical component of underground uranium mining. Fresh air must be pumped through the mine to provide sufficient air to workers and to vent or exhaust air from the mine to prevent buildup of contaminants, including radon-222 gas among others. Radon-222 and its associated decay product concentration within the mine must be controlled to levels below those published in Title 30 of the Code of Federal Regulations, Part 57, Section 57.5037. All radon-222 released from underground mine surfaces would either be contained in the ventilation exhaust or it would decay in underground airways because of stagnation. As a result of the mine ventilation, radon-222 and its associated decay products are released to the environment through ventilation shafts or other mine openings. The magnitude of these emissions is directly related to the amount of radon-222 emanated from underground mine surfaces.

Federal law regulates radon emissions from uranium mines. The NESHAP's Subpart B regulations, National Emission Standards for Radon Emissions from Underground Uranium Mines, apply to an underground uranium mine that (a) has mined, will mine, or is designed to mine over 100,000 tons of ore during the life of the mine, or (b) has had or will have an annual ore production rate greater than 10,000 tons, unless it can be demonstrated … that the mine will not exceed total ore production of 100,000 tons during the life of the mine (40 CFR 61.20). For any mine meeting this definition, the mine operator must comply with the emission standard for radon-222 as required at 40 CFR 61.22 and is subject to the annual NESHAP Subpart B reporting requirements, where emissions of radon-222 to the ambient air from an underground uranium mine shall not exceed those amounts that would cause any member of the public to receive in any year an effective dose equivalent of 10 mrem/y (40 CFR 61.22).

Climate and Greenhouse Gases

The existing climate in the area is warm in the summer and very cold in winter. The warmest month is July with an average maximum temperature of 89.2 °Fahrenheit (F) (32 ºCelsius (C)), while the coldest month is January with an average minimum temperature of 13.6 °F (-10.2 ºC). The annual average precipitation is 10.9 inches. Precipitation is evenly distributed throughout the year. The wettest month of the year is August with an average precipitation of 2.1 inches and the driest month is February with 0.4 inch of precipitation (Idcide, 2011).

Greenhouse gases (GHGs) are components of the atmosphere that contribute to the greenhouse effect and global warming or climate change. Some GHG occur naturally in the atmosphere, while others result from human activities such as the burning of fossil fuels. Federal agencies, states, and local communities address global warming by preparing GHG inventories and adopting policies that will result in a decrease of GHG emissions. There are six GHGs: carbon dioxide (CO_2), nitrous oxide, methane, hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride (UNFCCC, 2007). Although the direct GHGs (CO_2, methane, and nitrous oxide) occur naturally in the atmosphere, human activities have increased their atmospheric concentrations. On a global scale, fossil fuel combustion added approximately 30 $x10^9$ tons (27 $x10^9$ metric tons) of CO_2 to the atmosphere in 2004, of which the United States accounted for about 22 percent (USEPA, 2011d). Since 1900, the Earth's average surface air temperature has increased by about 1.2 to 1.4 ºF. The warmest global average temperatures on record have all occurred within the past 15 years, with the warmest 2 years being 1998 and 2005 (USEPA, 2007). The Council on Environmental Quality (CEQ) recently released draft guidance on when and how Federal agencies should consider GHG emissions and climate change in NEPA. The draft guidance includes a presumptive effects threshold of 25,000 metric tons of CO_2 equivalent emissions from an action (CEQ, 2010).

Environmental Consequences

Alternative 1

Selecting the no action alternative, meaning that the proposed action is not carried out in any setting, would have no impacts to air quality. Conditions would remain as described above under the "Air Quality Affected Environment" section.

With regard to radon in particular, there would be no environmental consequence of radon-222 emission. Background radon-222 concentrations in and around the proposed Roca Honda Mine would likely remain as they are today. It might be noted, however, the absence of the Roca Honda Mine may prompt the interest of others to establish new or reopen existing uranium mines in the vicinity to meet the national and global demand for uranium.

Conditions described in the no action alternative provide a comparative baseline for the following alternatives.

Alternative 2

Short- and medium-term minor adverse effects would be expected from the proposed action. Short-term effects would be limited to fugitive dust and diesel emissions from drilling and heavy equipment during mine development, while medium-term effects would be due to fugitive dust and heavy vehicle emissions during drilling and blasting and the transportation of materials during mine operation and reclamation. The proposed action would not exceed the *de minimis* thresholds under the general conformity rule, or contribute to a violation of any state, Federal, or local air regulation. An overview of the impacts to air quality is outlined in table 24.

Table 24. Levels of impact for air quality

Magnitude	Duration	Extent	Likelihood	Precedence and Uniqueness	Impact Rating
Mine Development					
Minor to Moderate	Short term	Small	Probable	Slight or Moderate	Insignificant
Mine Operation					
Minor to Moderate	Medium term, intermittent, or short term	Small	Probable	Slight or Moderate	Insignificant
Mine Reclamation					
Minor to Moderate	Short term	Small	Probable	Slight or Moderate	Insignificant
Overall					
Minor to Moderate	Medium term, intermittent, or short term	Small	Probable	Slight or Moderate	Insignificant

General Effects to Air Quality

The general effects of mine development, operation, and reclamation on air quality are outlined below.

Mine Development. Mine development would consist of a number of activities that have the potential to create air emissions over an approximate 3.6-year period. These activities include:

> **Drilling and Blasting**. During the excavation of two production shafts and one secondary escape route, drilling and blasting would contribute short duration releases of fugitive dust. As needed, water would be used to control dust emissions.
>
> **Surface disturbance and roadway fugitive dust**. The ground surface would be disturbed to create room for support facilities, soil and rock stockpiles, ore pads and stockpiles, parking, equipment delivery and storage, vehicle parking, and an escape raise. A 5.5-mile water pipeline would also be sited for water treatment plant use.
>
> **Mobile equipment exhaust.** Gasoline and diesel-powered mobile equipment would be used for mine development. Emissions would be generated from tailpipe exhaust both underground and on the surface. Notably, exhaust emitted underground would be released with ventilation air. Mine development emissions

are expected to have a minor impact on air quality due to the remote nature of the site, the limited number of vehicles, and the temporary nature of the activity.

Backup electric generator exhaust. Portable generators would be used for the initial portal site and underground development work. An emergency generator would be placed at the escape raise upon completion of that feature. Impacts of emissions on the environment are expected to be negligible due to the remote nature of the site and intermittent generator use.

Fuel and chemical storage and use. Fuels, explosives, and chemical storage would comply with any applicable fuel storage and fuel dispensing air quality regulations. Chemicals for water treatment and solvents used for maintenance/parts cleaning would be kept in closed containers when not in use.

Mine Operation. Mine operation would consist of a number of activities that have the potential to create air emissions and. These activities include:

Mobile equipment exhaust. To the extent possible, electrically powered tools and equipment would be used for mining. Some mobile equipment powered by gasoline or diesel fuel would be used, resulting in some combustion emissions. Additionally, 50–60 ore trucks per day would be used to haul ore (1,000 tons/day) to an offsite processing facility. It is anticipated that mobile equipment exhaust would not have a significant impact due to the remote nature of the facility.

Fuel and chemical storage and use. Fuels, explosives, and chemical storage would comply with any applicable fuel storage and fuel dispensing air quality regulations. Chemicals for water treatment and solvents used for maintenance/parts cleaning would be kept in closed containers when not in use.

Backup electric generator exhaust. An emergency generator would be placed at the escape raise. Impacts of emissions on the environment are expected to be negligible due to the remote nature of the site and intermittent generator use. As such, these would be temporary emission sources for which there is expected to be no impact.

Disturbed surface wind erosion, paved and unpaved fugitive road dust. Approximately 183 acres of surface within Sections 9, 10, and 16 would have the potential to be disturbed to create room for support facilities, waste rock placement, ore and growth medium storage, equipment storage, vehicle parking, and an escape raise. Two existing roadways are in the planning stages for upgrades which include widening to 60 feet and gravel surfacing. These activities would generate some amount of fugitive dust.

Transport of mineralized ore. Ore stockpiles would be sprayed with water to minimize the amount of dust generated during loading operations. Water sprays would be applied as necessary to moisten the ore and ore pad area. Ore transport trucks would meet Federal and State standards for the transport of uranium ore, including covering and labeling.

Mine Reclamation. Reclamation of the project area includes both construction reclamation and final reclamation. During the course of reclamation activities, diesel powered machinery would be used. This includes graders, scrapers, loaders, and other material placement and stabilization devices. It is expected that these activities would have no significant impact due to their temporary nature and remote location.

Estimated Emissions and General Conformity

The general conformity rules require Federal agencies to determine whether their action(s), or actions they approve or support, would increase emissions of criteria pollutants above preset threshold levels (40 CFR 93.153(b)). These *de minimis* (of minimal importance) rates vary depending on the severity of the nonattainment and geographic location. Because AQCR 156 is in attainment, the general conformity regulations do not apply. However, all direct and indirect emissions of criteria pollutants were estimated and compared to *de minimis* threshold levels of 100 tons per year (tpy) to determine whether implementation of RHR's proposed project would cause significant impacts. The total direct and indirect emissions associated with the following activities were accounted for:

- Site preparation and drilling of depressurizing wells and well pads;
- Site preparation and construction of water treatment plant and pipeline;
- Site preparation and construction of production and ventilation mine shafts;
- Site preparation and construction of utility lines, storm water control, chemical, explosive, equipment storage areas, and fencing;
- Site preparation of access roads for heavy truck hauling and site deliveries;
- Extraction of uranium ore from mine shafts and upload to haul trucks;
- Regrade and vegetate all soil stockpiles, remove drill pads, and backfill depressurizing wells in accordance with State requirements;
- Remove all equipment, place concrete plugs at surface openings, and remove all storm water liners, sediment, and ponds and regrade to match existing terrain.

The total direct and indirect emissions associated with the proposed action would not exceed *de minimis* threshold levels (table 25); therefore, these activities would not have significant effects to air quality.

Table 25. RHR's proposed project emissions compared to *de minimus* thresholds

Activity	Annual emissions (tpy)						*De Minimis* Threshold (tpy)	Would Emissions Exceed *de Minimis* Thresholds? (Yes/No)
	CO	NO_x	VOC	SO_2	PM_{10}	$PM_{2.5}$		
Mine Development	37.4	65.6	8.5	0.1	3.1	3.0	100	No
Mine Operation	21.5	37.4	4.6	<0.1	1.7	1.7		
Mine Reclamation	17.3	25.9	3.4	<0.1	1.1	1.1		

Notes: VOC is volatile organic compounds.

Regulatory Review

New stationary sources of emissions may be subject to both Federal and State permitting requirements. These requirements include, but are not limited to, New Source Review, Prevention of Significant Deterioration, and New Source Performance Standards for selected categories of industrial sources. The rules for NMED's Air Quality Program Laws and Rules are found in the New Mexico Administrative Code (NMAC). NMAC Title 20 Chapter 2 Part 7 includes emission standards and control requirements on both a pollutant specific basis and process/equipment/ industry specific basis. NMAC Title 17 Chapter 2 also set forth the permitting requirements for stationary emission sources and construction emissions. Given the variety and complexity of the activities at the RHR site, case-by-case determinations would be necessary to determine if new stationary sources of air emissions would require permitting.

National Emission Standards for Radon Emissions from Underground Uranium Mines, apply to an underground uranium mine that (a) has mined, will mine, or is designed to mine over 100,000 tons of ore during the life of the mine, or (b) has had or will have an annual ore production rate greater than 10,000 tons, unless it can be demonstrated...that the mine will not exceed total ore production of 100,000 tons during the life of the mine *(*40 CFR 61.20). As discussed in more detail below, RHR would comply with national standard radon-222 (40 CFR 61.22) as annual proposed production would be greater than 10,000 tons per year.

To reduce fugitive emissions generated at the mine surface, areas belowground would be backfilled with waste rock. However, due to the expansion of the waste rock as it is mined, some waste rock would still be placed at the surface. Water spray would be used to reduce dust emissions from disturbed areas of the surface where waste rock is placed. In addition, BMPs would be required and implemented for activities associated with the proposed action. The mine development, operation, and reclamation would be accomplished in full compliance with current New Mexico regulatory requirements, with compliant practices and/or products. These requirements include:

- Smoke and visible emissions (NMAC 20-2.61)
- Open burning (NMAC 20-2.60)
- Emissions from gas burning equipment (NMAC 20-2.33)
- Emissions from oil burning equipment (NMAC 20-2.34)

This listing is not all-inclusive; RHR and any contractors would comply with all applicable New Mexico air pollution control regulations.

3.4.2.2.4 Radon-222 Emissions

The environmental consequences of radon-222 emission to the air from the proposed action are predominantly related to human health concerns from the radiation dose resulting from breathing radon-222 and its short-lived decay products. As discussed previously, Federal law limits the radiation dose from radon-222 emissions from uranium mines to any member of the public at 10 mrem/yr (40 CFR 61.22). The Federal limit of 10 mrem per year is 4.7 percent of the average effective dose from background sources of radon-222 and its short-lived decay products of 212 mrem per year to the U.S. population (NCRP, 2009).

Regarding worker safety in the mine itself, radon-222 exposures are regulated by the Mine Safety and Health Administration (MSHA), the Federal enforcement agency responsible for the health and safety of America's miners. These exposures are limited at 4 working level months (WLM). With proper ventilation and personal protection equipment (PPE), worker exposures would be below this level. If the operator cannot demonstrate compliance, the mine will be shut down. Furthermore, smoking is not allowed in underground uranium mines (Schierman, 2012).

The tools used to evaluate the dose to any member of the public (i.e., the environmental consequence) are prescribed by Federal law.

> 40 CFR 61.23 states…"Compliance with the emission standard in this subpart shall be determined and the effective dose equivalent calculated by the U.S. Environmental Protection Agency (EPA) computer code COMPLY-R".

Working Level Month

The working level month (WLM) is a common unit of exposure of miners' lung tissue to one type of radioactivity called alpha emissions. The WLM is when human lungs have been exposed for 170 hours (a typical month's work) to air which has 3.7 kBq of radon-222. This is air with an alpha dose rate of one working level (WL). The average person in the general public is estimated to be subject to 0.2 WLM per year, which adds up to a total exposure of approximately 15–20 WLM in a typical lifetime. In humans a relationship has been established between lung cancer and radon-222 exposure for levels of 100 WLM and above.

COMPLY-R is a computer program that may be used to demonstrate compliance with the national emissions standards for hazardous air pollutants (NESHAPS) in 40 CFR 61, Subpart B. It can also be used as a predictive tool to evaluate potential but unmeasurable impacts of a proposed uranium mine provided reasonable assumptions and site-specific information where available are used as input to the computer program. COMPLY-R requires the following information as input:

- The number of radon-222 release points, typically mine vents
- The radon-222 release rate
- The release height from the ground surface of each release point
- Mine vent diameter
- Volumetric flow rate from each release point or vent
- Distance from each release point to each receptor
- Ventilated and ambient air temperatures
- Annual average wind speed or wind frequency distribution data

Realistic and reasonable results from the COMPY-R computer code are dependent on realistic and reasonable input parameters. The use of site-specific information as input to COMPLY-R is clearly the most realistic and should be used when available. There are cases where site-specific information is not available and estimates are necessary. A description of each input item identified above is provided below. Site-specific information is identified and, in cases where estimates are needed, the assumptions and methods to derive these estimates are provided.

The following information was provided by RHR in two documents entitled "Modeling of Dose Due to Radon Emissions from the Proposed Roca Honda Mine, New Mexico" (SENES, 2012a) and “Comply-R Analysis for Roca Honda Mine-Response to ERG Comments” (SENES, 2012b). These reports were reviewed independently by qualified specialists.

Source Term Evaluation

Number and Nature of Release Points

Five release points were modeled: Vents 1 through 5. There are no surface release points, e.g., waste rock that contributes significantly to underground sources of radon.

Radon Release Rate

A radon emission factor of 26 Ci/y per ton/y of anticipated uranium oxide (U_3O_8) production from “Standard for Radon-222 Emissions from Underground Uranium Mines” (USEPA, 1985). The resulting radon release rate of 35,766 Ci/y was distributed equally over the five vents, or 7,150 Ci/y per vent.

Release Height

All vents were modeled with a release height of 1.83 meters (6 feet).

Vent Diameter

All vents were modeled with a diameter of 2.74 meters (9 feet).

Volumetric Air Flow

Vents 1, 2, and 3 were assigned a flow rate of 106 m^3/s. Vents 4 and 5 were assigned a flow rate of 118 m^3/s.

Receptor Evaluation

Location of Existing Receptors

The June 2012 SENES report (SENES, 2012a) included three existing receptors in the vicinity of the mine: two on a local ranch and one U.S. Forest Service facility.

The two residents on the ranch are nominally R9 (1.9 miles southeast) and R12 (1.8 miles west/southwest). The Forest Service facility (Receptor R4; 11.2 miles from the approximate center of the vents) appears to be a ranger tank, upon evaluation using Google Earth. There are no residential structures in this area.

The September 2012 SENES followup report (SENES, 2012b) includes the residents at Schmitt Ranch and the village of San Mateo. The September 2012 SENES followup report (SENES, 2012b) also includes nine people—wood gatherers—the locations of whom are:

- At the nearby permit boundary, 1 km from the boundary; and 2 km from the boundary west of Vent 2.
- At the nearby permit boundary, 1 km from the boundary; and 2 km from the boundary east of Vent 3. The receptor at 2 km coincides with the permit boundary.
- At the nearby permit boundary, 1 km from the boundary; and 2 km from the boundary east of Vent 4.

Land Use Around the Project Area

Land use in the area includes ranching and recreational use (i.e., camping, wood gathering).

Identification of Critical Receptor

The critical receptor is a resident living in the village of San Mateo, approximately 5,100 m (about 3.2 miles) from Vent 3, the nearest point source.

Meteorological Data

SENES used an average annual temperature of 44 degrees Farenheit (^{o}F) as a model parameter, for 335 days: May 25, 2011, to April 25, 2012.

Average Wind Speeds and Frequency Distributions (Need Windrose if Used in COMPLY-R)

SENES included a windrose in its June 2012 report (SENES, 2012a), compiled using onsite meteorological data for 335 days: May 25, 2011, to April 25, 2012. The windrose is presented with supporting data in appendix A of the report.

Ambient Temperature

The ambient temperature of 44 ^{o}F compiled using onsite meteorological data for 335 days: May 25, 2011, to April 25, 2012.

Comply-R Results

The June 2012 SENES (SENSES, 2012a) report lists a range of dose rates for 3 existing and 13 arbitrary far field receptors ranging from to 0.3 to 8.4 mrem/yr.

The September 2012 SENES followup report (SENES, 2012b) lists a range of dose rates for nine arbitrary potential wood collectors ranging from to 0.02 to 1.6 mrem/yr.

The September 2012 SENES followup report also lists dose rates of 2.3 and 8.8 mrem/y to residents at Schmitt Ranch and the village of San Mateo, respectively.

The maximum observed dose (8.8 mrem/y) is to the resident at the village of San Mateo.

Conclusion for Radon Emissions

The COMPLY-R modeled predictions, which incorporated EPA radon emission estimates for uranium mines, indicate that the doses to people living continuously or collecting wood for 5 hours per week at known and/or arbitrary locations in the vicinity of the mine would not exceed the 40 CFR 61, Subpart B standard of 10 mrem/y due to radon emissions from underground uranium mines.

Greenhouse Gasses and Global Warming

The overall amount of CO_2 generated due to heavy equipment use during the proposed action would be approximately 7,111 tons during the highest year, and 85,223 tons over the life of RHR's proposed action (table 26). This is equivalent to 1,265 passenger vehicles, or 804 household's annual electricity usage (USEPA, 2012a). Notably, this is less than 0.0001 percent of the global CO_2 emissions. In addition, the Council on Environmental Quality (CEQ) recently released draft guidance on when and how Federal agencies should consider GHG emissions and climate change in NEPA analyses. The draft guidance includes a presumptive effects threshold of 27,563 tons (25,000 metric tons) of CO_2 equivalent emissions from RHR's proposed project on an annual basis (CEQ, 2010). The GHG emissions associated with RHR's proposed action fall well below the CEQ threshold. These effects would be less than significant.

Table 26. Estimated net CO2 emissions for the proposed Roca Honda Mine

Activity	Annual Emissions (tpy)	Duration (years)	Total Emission (tons)
Mine Development	7,114.9	3.6	25,613.6
Mine Operation	4,696.7	11.5	54,012.1
Mine Reclamation	2,798.9	2.0	5,597.8
Total		**17.1**	**85,223.5**

The Forest Service has not determined that GHG emissions are a significant issue for this EIS. However, the effect of GHG emissions on world climate is an important issue that has received increasing national and international attention in recent years. The effects of Federal decisions on GHG emissions has become a factor in NEPA analysis and in Agency operations in the last few years, depending on the significance of the issue for any project.

On October 5, 2009, President Obama signed Executive Order (E.O.) 13514 (74 Federal Register 52117) to establish an integrated strategy toward sustainability in the Federal Government and to make reduction of GHG emissions a priority for Federal agencies. Among other provisions, E.O. 13514 requires agencies to "measure, report, and reduce their GHG emissions from direct and indirect activities." Section 2 of E.O. 13514 establishes a timeline for Federal agencies to establish GHG reduction targets and report inventories. The guidance includes the establishment of a working group to set up reporting protocols and requirements, and is designed to quantify emissions over which the agency has direct and operational control. This order does not obligate the Forest Service to inventory the emissions of projects or activities like the applicant's proposed Roca Honda Mine, but is referenced here to document the government's interest in this issue.

The CEQ has developed guidance on the treatment of GHGs in NEPA EISs and released a draft guidance document for review and comment on February 19, 2010. The guidance is in draft form and has no direct administrative applicability to the Roca Honda Project or to this EIS for the following reasons:

- It is in draft form and in the process of evaluation. Comments received during the 90-day comment period are being evaluated and the guidance is not final and not in effect.
- As proposed, it suggests that a quantitative GHG analysis of agency activities should be done if a proposed Federal action could reasonably be assumed to cause direct emissions of 25,000 metric tons (27,500 short tons) of carbon dioxide annually. This would not apply to the proposed project. This EIS projects operation emissions of approximately 5,000 (short) tons per year of CO_2.
- The guidance states that CEQ does not propose to make this guidance applicable to Federal land and resource management actions.

The guidance emphasizes the importance of scoping and significance in determining the level of appropriate analysis for an EIS, and concludes that "Emissions from many proposed Federal actions would not typically be expected to produce an environmental effect that would trigger or otherwise require a detailed discussion in an EIS."

The guidance emphasizes the "rule of reason" in NEPA and states that agencies should ensure that they keep in proportion the extent to which they document their assessment of the effects of climate change. Although the Forest Service has not begun to revise its NEPA implementing regulations or otherwise adopt procedures to incorporate the draft CEQ guidance on GHG emissions, the forest supervisor has made the following determination on the level of analysis needed for greenhouse gas emissions for the Roca Honda Project:

> The forest supervisor has concluded that GHG emissions from a mining project such as this are not a significant issue. It is not a manufacturing, processing, or thermal energy generating project requiring the combustion of fossil fuels for energy or processing; it has no industrial point source emissions during operation, and emissions are limited to transportation sources, such as commuting vehicles, uranium ore transport vehicles, and onsite ore handling vehicles. The project does not recover fossil fuels for eventual combustion and GHG release; it recovers uranium, which could potentially be used to generate electricity and displace or avoid such future combustion. For those reasons, a detailed quantitative life-cycle GHG analysis has not been done for this project. Instead, an estimate of annual vehicle emissions of CO_2 is provided in the table above.

Alternative 3

The RHR modified plan of operations alternative (one shaft alternative) would have short and medium term minor adverse effects to air quality. Thus, the description of the three phases in the proposed action—mine development, mine operation, and final reclamation—is also applicable to this alternative with development more heavily concentrated on State lands on Section 16 and largely avoiding Cibola National Forest surface lands on Sections 9 and 10. Radon-222 emissions and exposures would be approximately the same as for alternative 2.

Estimated Emissions and General Conformity

The total direct and indirect emissions associated with alternative 3 would be similar to, but somewhat less than, the proposed action alternative. Total emissions would not exceed *de minimis* threshold levels (table 25). These effects would be minor.

Regulatory Review

Regulatory requirements and BMPs would be identical to those outlined under the proposed action (alternative 2). All activities would be accomplished in full compliance with current New Mexico regulatory requirements with compliant practices and/or products as described above.

Radon-222 Emissions

The results for alternative 3 would be identical to alternative 2: the Roca Honda Mine would not exceed the 40 CFR 61, Subpart B standard of 10 mrem/y due to radon emissions from underground uranium mines.

Greenhouse Gasses and Global Warming

The total GHG emissions associated with alternative 3 would be similar to, but somewhat less than, the proposed action alternative. Total emissions would not exceed threshold levels outlined in the CEQ guidance (table 25). These effects would be minor.

Mitigation

Impacts to air quality from both action alternatives (alternative 2/proposed action and alternative 3/one shaft alternative) would be less than significant. No mitigation measures outside the BMPs outlined above would be required.

Cumulative Effects

Existing air quality is the sum of past and present sources and ambient conditions, including natural windblown dust that contributes to particulate matter. The area of effect considered in the cumulative analysis includes the mine site and areas downwind in the prevailing wind direction.

There are no known major sources of air emissions in the vicinity of the proposed mine site. Another uranium mine is proposed approximately 8 miles south of the site (La Jara Mesa) and beyond the influence of any air emissions or impacts noted here except for GHG emissions which are global. Air emissions from the proposed mine may also contribute localized emissions to Mt. Taylor. The nearest known residences are about 3 miles from the Roca Honda Mine site. The nearest towns of Grants and Milan, New Mexico, are located 15 miles southwest of the vent and support facility location. There are significant topographical features located between the mine portal location and Grants-Milan. There is no wind downslope from the mine portal location toward Grants-Milan.

Because the proposed project would meet applicable Federal and State air quality standards, the mine portal and its impacts would be remotely located, and mine air quality impacts would be mitigated, neither the proposed action (alternative 2) nor the one shaft alternative (alternative 3) would contribute to any significant cumulative impacts.

With regard to cumulative effects related to radon-222 emissions, the proposed Mt. Taylor Mine would also have to comply with Federal regulations regarding radon-222 emission. It is unlikely that the cumulative effects of these emissions would results in public doses significantly different from background radiation doses from radon.

Vegetation

Affected Environment

> **Transect**
>
> A transect is a straight line or narrow section through an object or natural feature or across the earth's surface, along which observations are made, often of plant and/or animal presence and distribution within a given area.

The information in this section is drawn almost entirely from section 4 (vegetation) of the Baseline Data Report submitted in October 2009 by RHR to the New Mexico Mining and Minerals Division (MMD) and the U.S. Forest Service (Cibola National Forest) (RHR, 2009d). The information in section 4 in turn is derived from a variety of sources, principally surveys conducted by botanists with the consulting firm Permits West, Inc., on the proposed mine site permit area conducted from July to October 2006. Botanists surveyed the project area by walking parallel transects spaced at 50- to 75-foot intervals, depending on the habitat and terrain. Surveys to measure vegetative cover, density, and productivity of the plant communities within the permit area were initiated in the spring of 2008. Surveys included inventories of Forest Service sensitive, and threatened, or endangered plant species (RHR, 2009d; Wood, 2006a; Wood, 2006b).

Vegetation Communities in Sections 9, 10, and 16

Three main vegetation communities are present within the permit area: juniper savanna, piñon-juniper woodland, and grassland and/or shrubland (figures 48 and 49). The dominant trees in the first two communities are Utah, Rocky Mountain, and oneseed juniper (*Juniperus osteosperma*, *J. scopulorum*, and *J. monosperma*) and piñon pine (*Pinus edulis*) which are widespread through much of New Mexico at these elevations. Jesus Mesa occupies about half of Section 9 and slopes eastward into Section 10. The upper portion of this mesa consists of mostly open piñon-juniper woodland with some desert grassland and scattered stands and individual specimens of ponderosa pine (*Pinus ponderosa*). The perimeter of the mesa has sandstone ledges with areas of exposed shale, particularly to the south of the mesa. The landscape southwest, north, and southeast of the mesa is predominantly desert grassland, with an extensive area of wooded slopes on the southeast side between the mesa and the lower grassland. These slopes are frequently dissected by arroyos that can range from a few to 40 feet deep. Several areas of semistabilized sand dunes are also present (RHR, 2009d).

The predominant plants in the desert grassland community are herbaceous (nonwoody) grasses and forbs. Dominant grasses are hairy and blue grama (*Bouteloua hirsute* and *B. gracilis*). Galleta (*Pleuraphis jamesii*) is also common throughout, and sand dropseed (*Sporobolus cryptandrus*) is common in some areas. The southeast side includes an area of little bluestem (*Schizachyrium scoparium* var. *scoparium*) on the southeast side. The ground cover is dominated by garden purslane (*Portulaca oleracea*), changing to kiss-me-quick *(Portulaca pilosa*) in the sandiest areas, with Wislizenus's threadleaf (*Schkuhria pinnata* var. *wislizeni*) common throughout. Dodder (*Cuscuta sp*.) appears to be growing on a large percentage of the garden purslane.

Other common forbs in the desert grassland community include spiderwort (*Tradescantia occidentalis*), tufted evening-primrose (*Oenothera caespitosa*), and flixweed (*Descurainia s*ophia). The southeast corner of the permit area has several areas dominated by Russian-thistle (Salsola tragus) with smotherweed (Bassia hyssopifolia) and American bugseed (Corispermum americanum var. americanum). There are widely scattered oneseed juniper, piñon pine, and four-wing saltbush (Atriplex canescens) (RHR, 2009d)

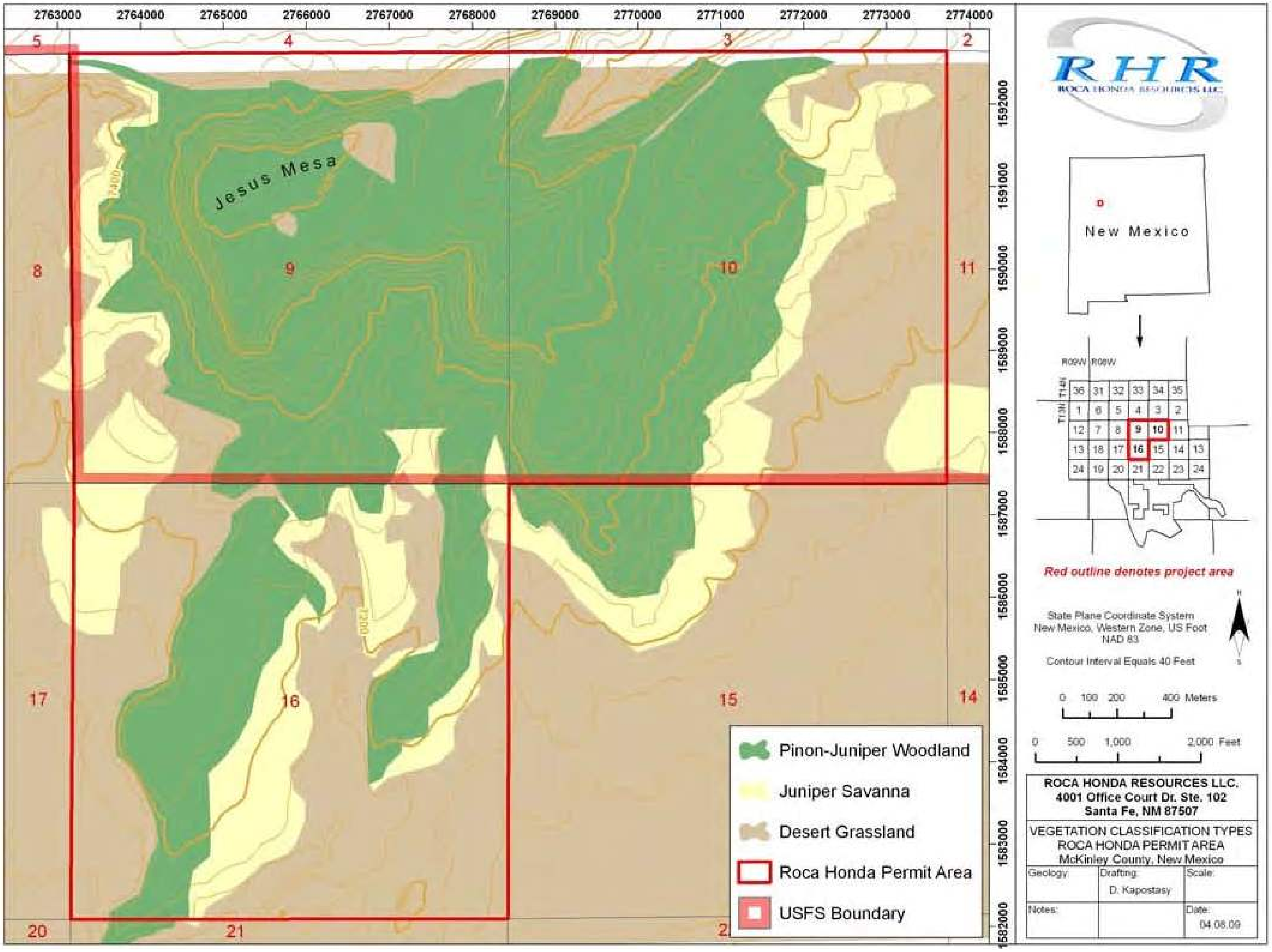


Figure 48. Vegetation communities in the Roca Honda Mine permit area

Figure 49. Jesus Mesa and the three vegetation communities

The woodlands on the site are comprised mostly of piñon pine and oneseed juniper. Several ponderosa pines are on the top of Jesus Mesa and along the southeast drainages. There are a few Rocky Mountain junipers at the top of the drainage on the north side of Jesus Mesa. Within the woodland, hairy and blue grama are typically the dominant ground cover, while cliffrose (*Purshia stansburiana*) and common mountain mahogany (*Cercocarpus montanus*) are the most abundant shrubs. Common forbs include fragrant snakeroot (*Ageratina herbacea*) and thyme-leaf spurge (*Chamaesyce serpyllifolia*). Under the trees, fetid-goosefoot (*Dysphania graveolens*), Colorado four-o'clock (*Mirabilis multiflora*), and Fendler's drymary (*Drymaria glandulosa*) are widespread. In the sandiest areas, field wormwood (*Artemisia campestris* var. *caudata*), flat sagebrush (*Artemisia bigelovii*), spectacle-pod (*Dimorphocarpa wislizeni*), kiss-me-quick, spiderwort, and fine-leaf woolywhite (*Hymenopappus filifolius*) are all common (RHR, 2009d).

Jesus Mesa's rocky slopes support a similar plant community of scattered piñon pine and oneseed juniper with hairy and blue grama quite common. Abundant shrubs include flat sagebrush and cliffrose. New Mexico muhly (*Muhlenbergia pauciflora*) and both plumed andCalifornia brickellbush (*Brickellia brachyphylla* and *B. californica*, respectively) are also widespread. Santa Felipfern (*Cheilanthes feei*) and brittle bladder-fern (*Cystopteris fragilis*) are found occasionally at the base of the rocks. Shale slopes are infrequent on the site and mostly barren, though they do support a small number of piñon pines, oneseed juniper, Colorado four-o'clock, galleta, and a four-wing saltbush. Black sagebrush (*Artemisia nova*), flat sagebrush, and common mountain mahogany occur along the rocky rims of the mesa and drainages (RHR, 2009d).

The ravines on the southeast side of Jesus Mesa reach depths of 30–40 feet and support scattered ponderosa pines within a piñon-juniper woodland. The most common plants on these sites include broom groundsel (*Senecio spartioides* var. *multicapitatus*), tassel-flower brickellbush (*Brickellia grandiflora*), and hairy grama.

Several small pools of water apparently gather along some of the drainages off Jesus Mesa. These may support small communities of wetland plants, indicating that they are moist much of the year. Species present include scratchgrass (*Sporobolus contractus*), mesa dropseed (*S. flexuosus*), straw-color flat-sedge (*Cyperus strigosus*), sand dropseed, rush (*Juncus* sp.), pale spikerush (*Eleocharis macrostachya*), and even cattail (*Typha domingensis*).

The drainages on the west and north sides of Jesus Mesa have sandier soils and support desert grassland. In these drainages the most common plants are hairy and blue grama, rubber rabbitbrush (*Ericameria nauseosa* var. *graveolens*), and sage (*Salvia* prob. *incisa*). There are occasional stabilized and semistabilized sand dunes throughout the permit area, especially to the west, northwest, and southeast of the mesa. These areas support a variety of sand-dependent plants, including sandhill muhly (*Muhlenbergia pungens*), spectacle pod, sand sage (*Artemisia filifolia*), spiderwort, Bigelow's rubber rabbitbrush (*Ericameria nauseosa* var. *bigelovii*), kiss-me-quick, and field wormwood (RHR, 2009d).

In Section 16, desert grassland and very open piñon-juniper woodland communities dominate. The largest drainage basin begins at the base of Jesus Mesa and runs south-southwest. Smaller drainages generally run southeast from the highest point in Section 16 on unnamed mesa at 7,292 ft elevation (mesa 7292). On both the west and east sides of mesa 7292, drainages are found with steep slopes and cliffs up to 50 feet in height.

The area east of mesa 7292 is grazed desert grassland. The dominant grasses are hairy and blue grama, with several areas of ring muhly (*Muhlenbergia torreyi*); however, much of the area is dominated by carpets of garden purslane with other annuals in abundance. The most plentiful of these annuals are Colorado rubberweed (*Hymenoxys richardsonii* var. *floribunda*), wild potato (*Solanum jamesii*), and both spotted and thyme-leaf spurge (*Chamaesyce maculata* and *C. serpyllifolia*). Another plant found in abundance is dodder (*Cuscuta* sp.), which is apparently parasitizing the garden purslane (RHR, 2009d).

The rest of the Roca Honda permit area is very open piñon-juniper woodland with areas of desert grassland. Oneseed juniper is much more common than piñon, but is usually widely scattered. There are very few understory shrubs, although flat sagebrush is common along the rims of the mesas where there is more exposed bedrock. Cliffrose occurs occasionally along the drainages. Garden purslane is quite common here, with kissme-quick replacing it in sandier areas. Colorado four o'clock is common both under the Utah junipers and in the open.

There is one seasonal cattle pond in the center of Section 16. The dominant plants in this artificial pond include Mexican fireweed (*Kochia scoparia*), Russian thistle (*Salsola tragus*), and golden crownbeard (*Verbesina encelioides*), rubber rabbitbrush (*Ericameria nauseosa* var. *graveolens*), saltcedar (*Tamarix chinensis*), and foxtail barley (*Hordeum jubatum*) (RHR, 2009d).

Vegetation Communities Along the Proposed Water Reuse Pipeline Route

As related in chapters 1 and 2, RHR originally intended to discharge treated mine water into an unnamed arroyo that is tributary to San Mateo Creek on the southern edge of the proposed surface facilities within Section 16. However, concerns were expressed during and after scoping about the potential for remobilization of toxic materials and radionuclides in tailings and alluvial sediments downstream along San Mateo Creek in the vicinity of the Homestake Mining Company Mill

Superfund Site. Responding to these concerns and uncertainties, RHR opted to change the location and method of treated water disposal.

Instead of discharging groundwater pumped to the surface and treated during mine dewatering depressurizing operations, the proposed action now calls for reusing this water by irrigating approximately 5,000 acres of rangeland located about 5 miles north-northeast of the permit area. At the request of the Forest Service, RHR agreed to conduct resource surveys along the proposed pipeline route. These were conducted in the spring of 2012 (McClain and Thompson, 2012).

SWCA Environmental Consultants (SWCA) conducted a reconnaissance-level biological survey of approximately 84 acres along the proposed pipeline route (figures 50 and 51). This field survey evaluated the potential presence of special status species and sensitive habitats, as well as determining the similarities, consistencies or lack thereof with the Roca Honda Mine project area as outlined in the BDR (McClain and Thompson, 2012).

Figure 50. Southern end of proposed water reuse pipeline route

The proposed reuse pipeline route occurs on both privately owned and Forest Service land, all within McKinley County. The surveyed portion begins approximately 3.2 km (2 miles) north of San Mateo (figure 50), where it runs north and parallel to the west side of County Road 75, crosses the Leopoldo Diversion Dam and San Lucas Road, and ends near Laguna Polvadera (figure 52). The topography of the area is variable, including upland rolling hills, lowlands, and incised arroyos. Electrical transmission wires follow along much of the proposed pipeline as it parallels County Road 75. The project vicinity consists of Cibola NF multi-use land and private grazed ranchland throughout the majority of the pipeline route (McClain and Thompson, 2012).

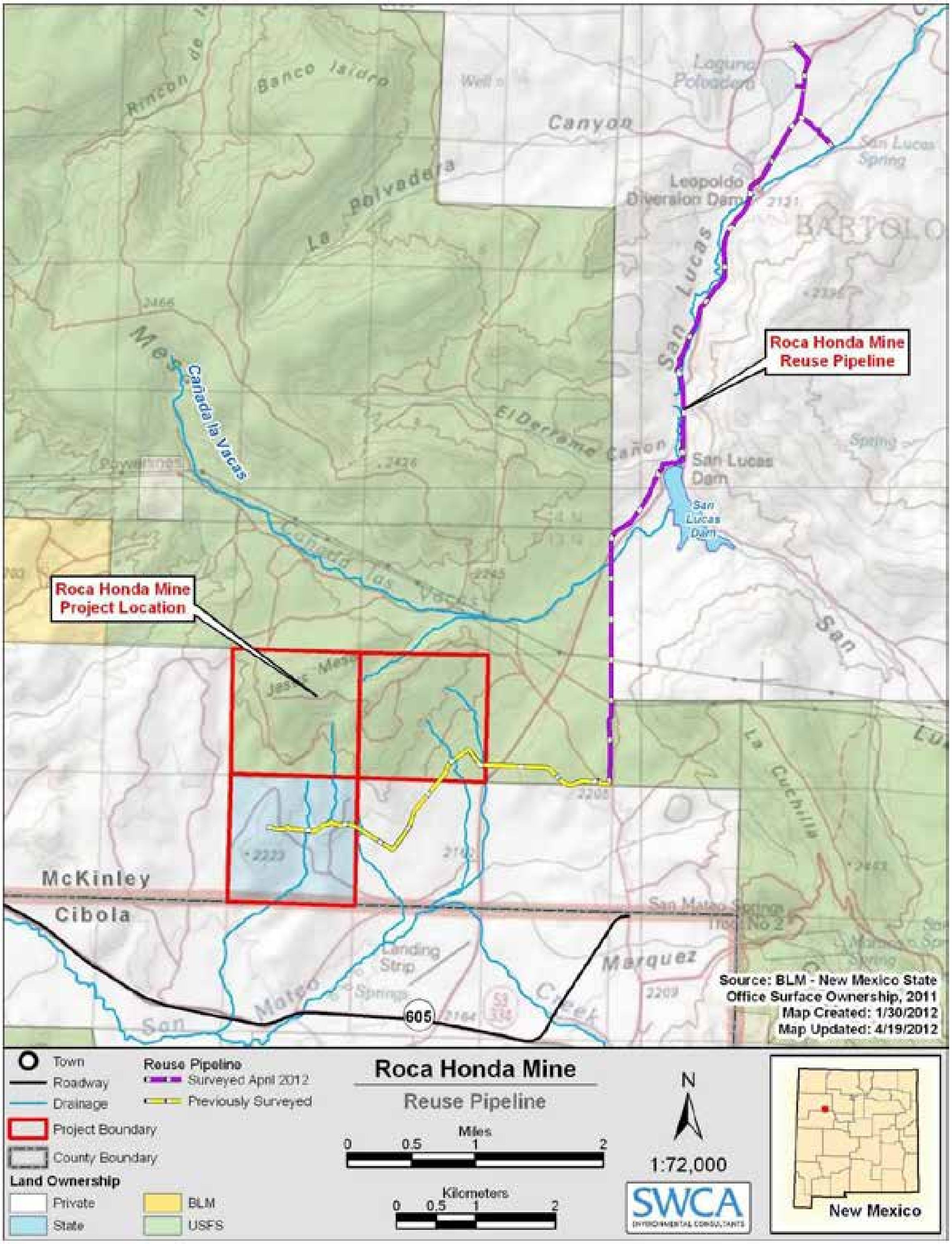


Figure 51. Location map of proposed water reuse pipeline route

Figure 52. View of Laguna Polvadera (near northern end) facing southwest

Grasses observed at the site during the survey include blue grama (*Bouteloua gracilis*), Indian ricegrass (*Achnatherum hymenoides*), alkali sacaton (*Sporobolus airoides*), western wheatgrass (*Pascopyrum smithii*), purple threeawn (*Aristida purpurea*), and long-leaf squirreltail (*Elymus elemoides*). Other plant species recorded onsite include fourwing saltbush (*Atriplex canescens*), broom snakeweed (*Gutierrezia sarothrae*), Bigelow sagebrush (*Artemisia bigelovii*), plains prickly pear (*Opuntia polyacantha*), Adonis blazingstar (*Mentzelia multiflora*), rubber rabbitbrush (*Ericameria nauseosa*), fetid goosefoot (*Chenopodium graveolens*), tree cholla (*Cylindropuntia imbricata*), fineleaf hymenopappus (*Hymenopappus filifolius*), winterfat (*Krascheninnikovia lanata*), and pale desert-thorn (*Lycium pallidum*) (McClain and Thompson, 2012).

One-seed juniper (*Juniperus monosperma*) and twoneedle piñon (*Pinus edulis*) are sparsely scattered across the site. Two common invasive species, prickly Russian thistle (*Salsola tragus*, aka tumbleweed) and five-stamen tamarisk (*Tamarix chinensis*), are present at the site.

The vegetation surveyed within the proposed pipeline route can be classified into four vegetation communities as described in the USGS Southwest Gap Analysis Project (USGS 2011). These classifications are illustrated in figure 53. For the purposes of table 27, which shows the acreages of vegetation communities in the main mine area and pipeline route, the two different vegetation classification systems used were collapsed into one based on Bailey (2008).

The vegetation surveys of the Roca Honda Mine location within the 3-section permit area (9, 10, 16) classified five broad vegetation types that the majority of the project area fell into as first described by Robert Bailey in 1978 (Bailey, 2008). A different classification system developed by the USGS (2011), called the “USGS Southwest Gap Analysis Project,” was used to characterize vegetation along the proposed pipeline route, but the classifications of the two sytems are similar enough to be relatively interchangeable. The vegetation classifications that are not found in both project areas are juniper savanna and semi-stable dune, which only occur in the Roca Honda Mine site but not along the proposed water reuse route (McClain and Thompson, 2012).

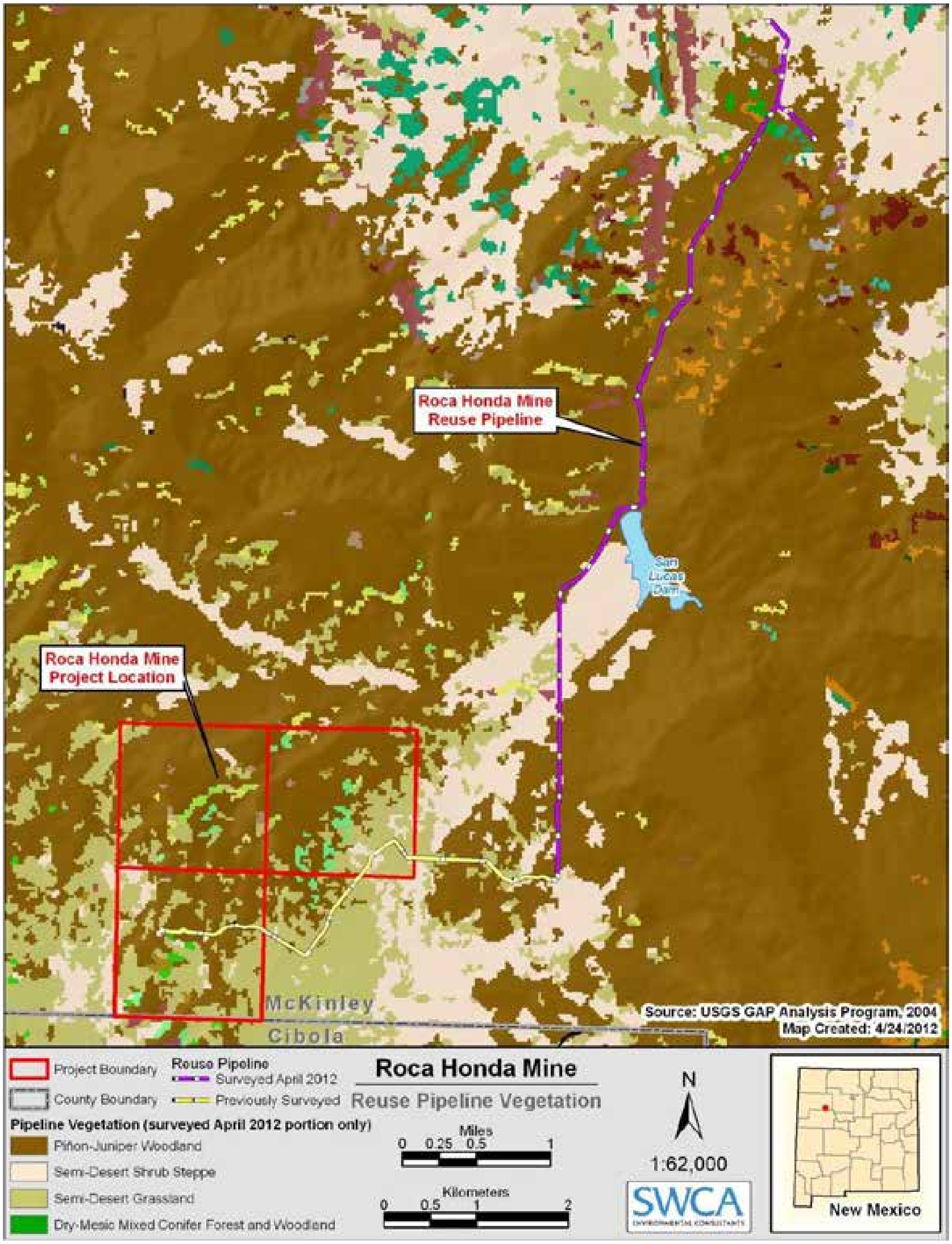


Figure 53. Roca Honda permit area and pipeline route vegetation communities

Table 27. Comparison of vegetation classifications in areas of potential impact

Vegetation Classification	Roca Honda Mine Project Location (Sections 9,10, and 16)		Water Reuse Pipeline Route	
	Total Acreage	Percent of Survey Area	Total Acreage	Percent of Survey Area
Piñon-Juniper Woodland	375.4	20	57.6	70
Piñon-Juniper Mixed Woodland	373.0	19	1.5	2
Juniper Savanna	679.3	35	—	—
Shrub Grassland	185.3	10	23.0	28
Semi-Stable Dune	17.3	1	—	—

Source: Modified from McClain and Thompson, 2012

Forest Service Sensitive, State Listed, and Federally Listed Threatened and Endangered Species

Federally Listed Threatened and Endangered Plant Species

The USFWS lists two Federally threatened plant species that occur in McKinley and Cibola Counties, New Mexico: the Zuni fleabane (*Erigeron rhizomatus*) and Pecos sunflower (*Helianthus paradoxus)*. Neither has appropriate habitat in the Roca Honda Mine permit area nor along the proposed pipeline route and, therefore, neither is likely to occur. Table 28 lists the two species with their protection status, habitat requirements, and potential to occur onsite. As expected, neither of these species was found during the surveys (RHR, 2009d).

Table 28. USFWS-listed endangered, threatened, or candidate plants, McKinley and Cibola Counties

Species	Status	Habitat and Distribution	Potential to Occur in the Permit Area or Along the Pipeline Route
Pecos sunflower (*Helianthus paradoxus*)	Threatened	Saturated saline soils of desert wetlands. Usually associated with desert springs or the wetlands created from modifying desert springs, and from 3,300–6,600 feet. Known from Cibola County.	No appropriate habitat. There is one area with saturated soils created by damming a drainage; however, the area is not saline. Both the permit area and the pipeline route are above the elevation range of the species.
Zuni fleabane (*Erigeron rhizomatus*)	Threatened	Nearly barren detrital-clay hillsides with soils derived from shales of the Chinle or Baca Formations (often seleniferous), most often on north- or east-facing slopes in open piñon-juniper woodlands at 7,300–8,000 feet. Known from McKinley County.	No appropriate habitat. There are no shales of the Chinle or Baca formations in the permit area. Most of the permit area and all of the pipeline route is below the elevation range for this species.

Source: RHR, 2009d

State Listed Plant Species

Fifteen plant species listed by the State of New Mexico as endangered, threatened, or species of concern (SOC) are known to occur in McKinley and Cibola Counties. Two of these species are federally listed as threatened and are addressed in table 28. The remaining 13 species are listed in table 29. Two of the 13 have the potential to occur in the Roca Honda permit area: Naturita milkvetch (*Astragalus naturitensis*) and Laguna fame flower (*Talinum brachypodium*).

The permit area contains bedrock exposures of the Point Lookout Sandstone, Crevasse Canyon Formation (Gibson Coal and Dalton Sandstone Members), and Mulatto Tongue of the Mancos Shale. Bedrock is eroded in many places, but sandstone and shale is exposed in some places on ledges and rimrock. This environment provides limited areas of potential habitat for both Naturita milkvetch and Laguna fame flower. Two species of milkvetch were observed within the permit area, but neither matched Naturita milkvetch in habitat or vegetative characters. One species of *Phemeranthis* (formerly included in *Talinum*) was observed. However, both vegetative and floral characteristics are quite different from Laguna fame flower.

Table 29. State of New Mexico endangered, threatened, or species of concern listed plants in McKinley and Cibola Counties

Species	Status	Habitat and Distribution	Potential to Occur in the Permit Area or Along Pipeline Route
Acoma fleabane (*Erigeron acomanus*)	Species of Concern	Sandy slopes and benches beneath sandstone cliffs of the Entrada Sandstone in piñon-juniper woodland; from 6,900-7,100 feet. Known from McKinley and Cibola Counties.	No appropriate habitat. There is no Entrada Sandstone in the permit area.
Chaco milkvetch (*Astragalus micromerius*)	Species of Concern	Gypseous or limy sandstones in piñon-juniper woodland or Great Basin desert scrub from 6,600–7,300 feet. Known from McKinley County.	No appropriate habitat. No gypseous or limy sandstone was observed in the permit area.
Chuska milkvetch (*Astragalus chuskanus*)	Species of Concern	Degraded Chuska Sandstone in openings in montane coniferous forest above 5,500 feet. Known from McKinley County.	No appropriate habitat. There is no Chuska Sandstone in the permit area.
Cinders phacelia *(Phacelia serrata)*	Species of Concern	In deep volcanic cinders, primarily associated with volcanic cones, but also in road cuts and abandoned quarries in open, exposed, sunny locations; near ponderosa pine and piñon-juniper woodlands from 5,900-7,200 feet. Known from Cibola County.	No appropriate habitat. There are no areas of volcanic cinders in the permit area.
Laguna fame flower (*Talinum brachypodium)*	Species of Concern	Very shallow pockets of calcareous silt to clay soils overlying limestone or travertine, or fine silty sand overlying calcareous sandstones; open piñon-juniper woodland with little understory and scattered cacti and shrubs or Chihuahuan desert scrub. Known from Cibola County.	Limited areas of potential habitat could exist on the low mesa in the permit area. Some of the sandy loam soil does have a high component of silt in it. No plants of this species were observed.

Species	Status	Habitat and Distribution	Potential to Occur in the Permit Area or Along Pipeline Route
Lost sunflower (*Helianthus praetermissus*)	Species of Concern	Perhaps wet ground based on the collection locality for the only specimen. This species is known only from the type specimen collected in 1851 on the Sitgreaves expedition at the head of the Rio Laguna (now Rio San José) at Ojo de la Gallina, Cibola County. This species may have been named from a depauperate specimen of *Helianthus paradoxus*.	There is wet ground in the permit area associated with a manmade cattle pond; however, the permit area is not near the only known location for the species near the Zuni Mountains.
Mt. Graham beardtongue (*Penstemon deaveri*)	Species of Concern	Slopes and rocky areas from ponderosa pine forest to above timberline; from 6,500-11,280 feet. Known from Cibola County.	No appropriate habitat. There are no ponderosa pine forest or plant communities associated with higher elevations in the permit area.
Naturita milkvetch (*Astragalus naturitensis*)	Species of Concern	Sandstone ledges and rimrock along canyons in piñon-juniper woodland from 5,000-7,000 feet. Known from McKinley County.	Limited areas of potential habitat could exist along the rim and ledges of the low unnamed mesa in the permit area. No *Astragalus* matching this distinctive species was observed.
Navajo bladderpod (*Physaria navajoensis*)	Species of Concern	Windswept mesa rims of Todilto Limestone in sparse piñon-juniper woodland from 7,200–7,600 feet. Known from McKinley County.	No appropriate habitat. There is no Todilto Limestone cropping out in the permit area. Most of the permit area is lower than the elevation range of the species.
Parish’s alkali grass (*Puccinellia parishii*)	Endangered	Alkaline springs, seeps, and seasonally wet areas that occur at the heads of drainages or on gentle slopes from 2,600-7,200 feet; the species requires continuously damp soils during its late winter to spring growing period. Known from McKinley and Cibola Counties.	No appropriate habitat. There are no seasonally wet alkaline areas in the permit area.
Sivinski’s fleabane (*Erigeron svinskii*)	Species of Concern	Steep barren shale slopes of the Chinle Formation in piñon-juniper woodland and Great Basin desert scrub from 6,100-7,400 feet. Known from McKinley County.	No appropriate habitat. There is no Chinle Formation cropping out in the permit area.
Yeso bladderpod (*Physaria newberryi* var. *yesicola*)	Species of Concern	Nearly barren badlands of sandy gypsum and silty strata of the Yeso Formation in shortgrass steppe and juniper savanna; from 5,700-6,900 feet. Known from Cibola County.	No appropriate habitat. There is no Yeso Formation cropping out in the permit area. Most of the permit area is higher than the elevation range of the species.

Species	Status	Habitat and Distribution	Potential to Occur in the Permit Area or Along Pipeline Route
Zuni milkvetch (*Astragalus missouriensis* var. *Acumbens*)	Species of Concern	Gravelly clay banks and knolls, in dry alkaline soils derived from sandstone, in piñon-juniper woodland from 6,200-7,900 feet. Known from McKinley and Cibola Counties.	No appropriate habitat. No gravelly clay banks or knolls are present in the permit area. The soils in the permit area are not saline.

None of these sensitive species is expected to occur along the proposed water reuse pipeline route due to unfulfilled habitat requirements (McClain and Thompson, 2012).

Forest Service Sensitive Species

A list of Forest Service sensitive species with potential to occur within the project area was obtained in 2012 from the Forest Service. The Forest Service listed four plant species that occur or are suspected to occur in the Mt. Taylor Ranger District. Table 30 lists these species, a description of their habitat, and their potential to occur at the Roca Honda permit area.

Table 30. Forest Service sensitive plants documented on the Mt. Taylor district

Species	Habitat and Distribution	Potential to Occur in the Permit Area or Along the Pipeline Route
Zuni milkvetch (*Astragalus missouriensis* var. *Acumbens*)	Gravelly clay banks and knolls, in dry alkaline soils derived from sandstone, in piñon-juniper woodland from 6,200-7,900 ft. Known from McKinley and Cibola Counties.	No appropriate habitat. No gravelly clay banks or knolls are present in the permit area. The soils in the permit area are not saline.
Villous ground cover milkvetch (*Astragalus humistratus var. crispulus*)	Sandy soils of volcanic origin on slopes, benches, and ledges in xeric pine forests from 7,250 – 8,150 feet.)	No appropriate habitat. No pine forests.
Chaco milkvetch (*Astragalus micromerius*)	Gypseous or limy sandstones in piñon-juniper woodland or Great Basin desert scrub from 6,600–7,300 feet. Known from McKinley County.	No appropriate habitat. No gypseous or limy sandstone was observed in the permit area.
Arizona leatherflower (*Clematis hirsutissima var. hirsutissima*)	Limestone outcroppings in ponderosa pine forest.	No appropriate habitat. No limestone outcropping.
Sivinski's fleabane (*Erigeron svinskii*)	Steep barren shale slopes of the Chinle Formation in piñon-juniper woodland and Great Basin desert scrub from 6,100-7,400 feet. Known from McKinley County.	No appropriate habitat. There is no Chinle Formation cropping out in the permit area.

(RHR, 2009d; CPC, 2010; UNM, 2005)

None of these sensitive species is expected to occur along the proposed water reuse pipeline route due to unfulfilled habitat requirements (McClain and Thompson, 2012).

Environmental Consequences

Alternative 1

Under the no action alternative, there would be no disturbance of the site's vegetation communities and special status plants from clearing, grubbing, grading, and other project-related activities, either at the mine site or along the proposed treated water pipeline route. No vegetation and no habitat would be disturbed or temporarily removed, and the existing vegetation communities described above would be expected to continue indefinitely. Natural and unnatural disturbances may occur in the area, as they have in the past, but overall, the three communities now present—juniper savanna, piñon-juniper woodland, and grassland and/or shrubland—would be expected to remain for some decades into the future. Beyond that, climate change's effects may alter the vegetation composition and structure of the RHR permit area, with some species and communities increasing in abundance while others decrease.

In sum, alternative 1 would have essentially no impacts on vegetation at the RHR permit site. Table 31 lists determinations of impact for two categories of special status plants—federally listed species and Forest Service sensitive plants.

Table 31. Alternative 1 determinations of effect for special status plants

Species	Status	Determination
Pecos sunflower (*Helianthus paradoxus*)	Federally Threatened	No Effect
Zuni fleabane (*Erigeron rhizomatus*)	Federally Threatened	No Effect
Zuni milkvetch (*Astragalus missouriensis* var.*Acumbens*)	Forest Service Sensitive	No impact on the species
Villous ground cover milkvetch (*Astragalus humistratus var. crispulus*)	Forest Service Sensitive	No impact on the species
Chaco milkvetch (*Astragalus micromerius*)	Forest Service Sensitive	No impact on the species
Arizona leatherflower (*Clematis hirsutissima var. hirsutissima*)	Forest Service Sensitive	No impact on the species
Sivinski's fleabane (*Erigeron svinskii*)	Forest Service Sensitive	No impact on the species

Effects Common to the Action Alternatives

In constructing the surface facilities at the Roca Honda Mine, both woody and herbaceous (nonwoody) vegetation would be cleared and grubbed, essentially being eliminated for the approximately 2-decade duration of the mine. All three main habitat types would be impacted to some extent, although in the context of the 50,000-60,000 acres of piñon-juniper habitat present on the Mt. Taylor Ranger District, the acreages impacted would not be significant.

> **Mycorrhyzae**
>
> Mycorrhyzae are symbiotic or mutualistic associations between fungi and the roots of vascular plants. In such a mutually beneficial relationship, the fungus colonizes the plant's roots, where it aids in uptake of water and mineral nutrients, while receiving access to carbohydrates in return. Mycorrhyzae are important components of a healthy soil ecosystem.

Upon closure of the mine, final reclamation would aim to restore original vegetation communities to the disturbed sites. All affected areas would be backfilled, regraded and shaped to conform with the landscapes' original character prior to mining. Salvaged topdressing would be redistributed over regraded areas, amended with mycorrhyzae and organic fertilizers and then seeded using native, adapted species which are characteristic of the region. The proposed seed mix is shown in table 2 in chapter 2. This same seed mix has been used successfully in reclamation at the nearby Lee Ranch Coal Mine for more than 30 years. It is a mix of cool and warm season grasses, forbs and shrubs with a proven ability to reestablish in mine reclamation soils and also to support livestock grazing.

Revegetation success would be gaged through comparison of ground cover, productivity, and species diversity and with a reference area located in Section 16, as well as through the use of technical guidance procedures published by the U.S. Department of Agriculture.

Both alternative 2 and alternative 3 would result in negligible to minor linear impacts to existing vegetation communities on approximately 84 acres of right-of-way along the proposed treated water pipeline route as a result of the movement of wheeled or treaded construction equipment and the laying of the 20-inch pipeline along the ground surface. Once the pipeline has been put into place, nearby vegetation would be expected to recover on its own, although BMPs, erosion control measures, and seeding would assist the process.

Neither action alternative is likely to adversely impact sensitive plant species. No federally listed species or Forest Service sensitive species are present either in the permit area or along the pipeline route, and the two State listed species which have some potential for occurring within the permit area—the Naturita milkvetch and the Laguna fame flower (both species of concern)—were not documented in surveys. No sensitive plant species are expected to occur along the pipeline route and, thus, there would be no impact (table 32).

Overall, impacts to vegetation from both action alternatives would be both short term and long term (but not permanent). Short-term impacts would be adverse, localized, moderate in magnitude, probable, and of slight to moderate precedence/uniqueness. Long-term impacts would be fewer because of proposed reclamation and mitigation. They would be adverse, localized, negligible to minor in magnitude, probable, and of slight uniqueness.

In sum, impacts of the action alternatives on vegetation within the RHR permit area would be adverse but less than significant.

Table 32. Alternatives 2 and 3 determinations of effect for special status plants

Species	Status	Determination
Pecos sunflower (*Helianthus paradoxus*)	Federally Threatened	No Effect
Zuni fleabane (*Erigeron rhizomatus*)	Federally Threatened	No Effect
Zuni milkvetch (*Astragalus missouriensis* var.*Acumbens*)	Forest Service Sensitive	No impact on the species
Villous ground cover milkvetch (*Astragalus humistratus var. crispulus*)	Forest Service Sensitive	No impact on the species
Chaco milkvetch (*Astragalus micromerius*)	Forest Service Sensitive	No impact on the species
Arizona leatherflower (*Clematis hirsutissima var. hirsutissima*)	Forest Service Sensitive	No impact on the species
Sivinski's fleabane (*Erigeron svinskii*)	Forest Service Sensitive	No impact on the species

Alternative 2

Under the proposed action, approximately 183 acres of vegetation within the 3 sections (12 acres in Section 9; 71 acres in Section 10; and 100 acres in Section 16) would be disturbed and/or essentially eliminated for the duration of the Roca Honda Mine. Within these 3 sections, 83 acres of vegetation on the Cibola National Forest (Sections 9 and 10) would be adversely affected. An additional 35 acres would be adversely affected outside the 3 sections. A total of 218 acres of disturbance is anticipated within Forest Service, private, and State land. A total of 93.5 acres of Forest Service land would be disturbed, with 8 acres in Section 11 and 2.5 acres along the pipeline corridor in addition to the 83 acres within Sections 9, 10, and 16. Most of the impacted acreage in Section 9 would be piñon-juniper woodland; most of the impacted acreage in Section 10 would be desert grassland/shrubland; and most of the impacted acreage in Section 16 would be juniper savanna and desert grassland/shrubland. Most of the impacted acreage on Section 11 and the pipeline corridor would be desert grassland/shrubland and piñon-juniper woodland.

As noted above, when the mine closes, final reclamation, including revegetation, would be undertaken. Since the approved post-mining land use is livestock grazing, revegetation design, species mix, and methods proposed in the RHR reclamation plan would result in the area supporting this land use while at the same time furnishing self-sustaining habitat and forage for indigenous wildlife species.

Alternative 3

For the duration of the mine, alternative 3 (the one shaft alternative) would result in disturbance or elimination of approximately 120 acres of vegetation, of which 20 acres would be Cibola National Forest lands in Sections 9 and 10—compared to 83 acres of Cibola National Forest vegetation adversely affected in these three sections by alternative 2. The acres disturbed on Cibola National Forest in Section 11 and along the dewatering discharge pipeline would remain the same as under alternative 2. Therefore, alternative 3 reduces the area of impacts to vegetation overall by about 29 percent and the area of vegetation impacts on National Forest System lands by about 67 percent.

These impacts would persist for about 2 decades, for the operational lifetime of the mine. Upon reclamation and revegetation, the magnitude and extent of these adverse effects would gradually diminish as restoration took place.

Like alternative 2, alternative 3 is not likely to affect special status plant species (table 32).

In conclusion, impacts of alternative 3 on vegetation would be insignificant. While alternative 3 has a lower potential to adversely affect vegetation than alternative 2, both would be insignificant, once mitigation measures, reclamation, and restoration are taken into account.

Cumulative Effects

Cumulative vegetation effects were evaluated for the general environs within 1 mile of the mine and the Mt. Taylor Ranger District generally. Past and present vegetative impacts in the project area include livestock grazing and stock pond construction, recreation (e.g., hunting), exploratory drilling, mining, power line construction and operation, and access road construction. Approximately 180 acres of direct vegetation loss would occur at the mine site to construct mine facilities, about 83 acres of which would be on the Cibola National Forest. Approximately 35 acres of vegetation might be affected or damaged when laying the water reuse pipeline, upgrading haul roads, and developing the utility corridor. There are no other projects in the immediate vicinity that would contribute to vegetative impacts that are not already described as part of the affected environment. The proposed La Jara Mesa Mine 8 miles away would disturb approximately 16 acres of vegetation as part of that project within the general Mt. Taylor area. The cumulative effects of this and Roca Honda are nearly 240 acres of disturbance. Roads and other future land development activities would contribute to additional and ongoing impacts, although total acreage affected is not known. Both the Roca Honda and La Jara Mesa Mines would reclaim and restore local vegetation upon closure as part of reclamation.

The proposed action would add about 218 acres to the ongoing and foreseeable impacts on vegetation, and alternative 3 about one-third less. Past and present activities affecting vegetation have been discussed and include forest roads, recreational activity, drilling, mining, and utility lines. The area of project impact on National Forest System lands represents approximately 0.035 percent of piñon-juniper vegetation type present in Management Areas 13 and 14 of the Mt. Taylor Ranger District; in terms of the Mt. Taylor Ranger District as a whole, the Roca Honda project would temporarily affect at most some 83 acres (alternative 2) of more than 50,000 acres of piñon-juniper vegetation; alternative 3 would reduce this still further. These losses would not change the ratio of piñon-juniper habitat to other habitats in the Cibola National Forest. Therefore, the cumulative impacts to vegetation of either action alternative, when added to past, present, and reasonably foreseeable future actions, are minor and would not be considered significant.

Wildlife

Affected Environment

The information in this section on species presence within the permit area is primarily drawn from the "Wildlife Section" (section 5) of the Baseline Data Report submitted in October 2009 and the Baseline Data Report, Revision 1 submitted in January 2011 by RHR to the New Mexico Mining and Minerals Division (MMD) and the U.S. Forest Service (Cibola National Forest) (RHR, 2011a). The information in section 5 in turn is derived from a variety of sources, principally surveys conducted by wildlife specialists with the consulting firm Permits West, Inc., on the proposed mine site permit area conducted from 2006 to 2008. Prior to implementation of all fieldwork, the current lists of Federal (USFWS 2006–2009) and State of New Mexico (NMDGF 2006–2009) listed and sensitive animal species known to occur in McKinley and Cibola Counties were reviewed. In addition, management indicator species, as identified by the Forest Service, Cibola National Forest were also of focus. The list of Mt. Taylor District Forest Service zensitive zpecies was also reviewed to determine their likely presence. Information not drawn from the Baseline Data Report was based on species' habitat preference and known occurrence within or surrounding the permit area. The 2009 "Regional Forester's Sensitive Species List Draft Reference Document" was also utilized and a copy of this document can be found in the project record.

To determine the wildlife types present in the permit area, Permits West, Inc., conducted wildlife surveys including fall, winter, breeding season bird surveys, and raptor surveys on each of the proposed sites, 9, 10, and 16. To provide the most comprehensive overview of the existing wildlife communities, additional sections where project impacts are expected were also included in the study areas in the 2008 wildlife surveys. Additional areas surveyed included Sections 11, 12, 15, 21, and 27. Before the surveys were performed, a literature review was conducted to determine which wildlife species had the potential to occur in the permit area.

Surveys were conducted to determine which frogs and amphibians, small mammals, birds, furbearers and big game, and threatened, endangered, and sensitive species exists in the permit area. Except for a few small pockets of wetlands within the three main sections (9, 10, 16), there is no perennial surface water or aquatic habitat found within the mine permit area (RHR, 2009d). As such, there are no fish species currently living within the permit boundaries and fish are not discussed further. Below is a discussion of wildlife species found within the permit area.

Roca Honda Mine Permit Area (Sections 9, 10, and 16) Habitats and Wildlife

Sections 9, 10, and 16 have gently to moderately sloped topography interrupted by sheer rock faces, mesas, and arroyos. As discussed above, the main vegetation types within the permit area consist of piñon-juniper woodland (749 acres) with scattered pockets of ponderosa pines, desert grass/shrublands (865 acres, including 680 acres of juniper savanna), mountain shrub (185 acres), and semi-stable dunes (17 acres) (table 33). A disturbed piñon-juniper woodland mosaic also occurs in Section 9 on cliff sides and lower west- and southwest-facing slopes where there are historic drill hole locations from exploration in the last 40 years. Habitat disturbance within the permit area includes grazing by native and domestic ungulates, bladed roads and jeep trails, exploratory drilling, and fences. Several small pools of water apparently gather along some of the drainages off Jesus Mesa and these areas may support small communities of wetland plants, indicating that they are moist much of the year.

Because there are numerous large stands of shrubs and also many isolated individual shrubs within the grasslands found within the permit area, shrublands and grasslands are grouped together for this analysis of habitat effects. Acres of mountain grassland and mountain shrub habitat correlate to the shrub-grassland habitat found within the permit area. While the disturbance anticipated from mining activities cannot be separated between mountain grassland and mountain shrub habitat, the maximum amount of disturbance that is anticipated in either of these habitats is analyzed in this document. Grassland habitat includes both grass/shrublands and juniper savannas.

Table 33. Habitat acreages in Sections 9, 10, and 16

Habitat Type	Acres
Mountain Grassland	865
Mountain Shrub	185
Piñon-Juniper Woodland	749
Semi-stable Dunes	17

Within Section 16, habitat consists mainly of heavily grazed desert grassland and very open piñon-juniper woodland, and the elevation ranges from approximately 7,070 to 7,300 feet. Several drainage areas are also found in Section 16. Small areas of inundation were found during surveys conducted in the fall, including one manmade stock pond. Though portions of this section are undisturbed, largely due to the geological features and rugged terrain, disturbance from year-round grazing and dirt and two-track roads has been documented in this section. Wildlife communities found within this section are typical of Great Basin Desert and/or piñon-juniper woodland interfaces (RHR, 2009d).

Habitat found within Section 9 varies from desert grassland and open piñon-juniper woodlands in the lower areas to sheer rock faces in the higher elevations. Elevation ranges from approximately 7,200 to 7,832 feet and changes sharply throughout the section; much of the area is bare bedrock. Sand dunes also occur in some areas. Jesus Mesa, a mountain summit, occupies about 50 percent of Section 9. Rafael Canyon also runs north to south along the section's western boundary.

Section 10 is positioned along the northeastern slope of Jesus Mesa. Terrain and habitat in this area are highly variable and ranges from flat mesa top with rock outcroppings to gentle slopes at the base of the mesa. Elevation ranges from approximately 7,152 to 7,720 feet and vegetation throughout the section is dominated by piñon-juniper woodland with desert-scrub and grassland along the southeast corner and along the canyon bottom in the north. A nameless canyon is located in the northwest quarter of this section, with sheer cliff faces greater than 15 meters in height along the rim. Wildlife documented within Sections 9 and 10 are indicative of desert grassland and piñon-juniper interfaces. Habitat disturbance in these sections has occurred from moderate grazing from native and domestic ungulates at higher elevations. Bladed roads, jeep trails, multiple drill pads, and several cow trails are also found in these sections (RHR, 2009d).

Amphibians and reptile species that could occur within the permit area include the New Mexico spadefoot (*Spea mutliplicata*), leopard lizard (*Gambelia wislizenii*), greater short-horned lizard (*Phynosoma hernandesi*), sagebrush lizard (*Sceloporus graciosus*), prairie lizard (*S. tristichus*), plateau striped whiptail (*Aspidoscelis velox*), plateau lizard (*Sceloporus tristichus*), gopher snake (*Pituophis melanoleucus*), western terrestrial garter snake (*Thamnophis elegans*), and prairie rattlesnake (*Crotalus viridis*). The four most common species found during surveys were the plateau striped whiptail, sagebrush lizard, plateau lizard, and the greater short-horned lizard (RHR, 2009d).

Small mammals potentially found in the permit area include the pinyon mouse (*Peromyscus truei*), silky pocket mouse (*Perognathus flavus*), deer mouse (*Peromyscus maniculatus*), white-throated woodrat (*Neotoma albigula*), Ord's kangaroo rat (*Dipodomys ordii*), cliff chipmunk (*Tamias dorsalis*), white-tailed antelope ground squirrel (*Ammospermophilus leucurus*), desert shrew (*Notiosorex crawfordi*), black-tailed jackrabbit (*Lepus californicus*), desert cottontail (*Sylvilagus auduboni*), Botta's pocket gophers (*Thomomys bottae*), big brown bat (*Eptesicus fuscus*), little brown bat (*Myotis occultis*), fringed myotis (*Myotis thysanodes*), and Gunnison's prairie dog (*Cynomys gunnisoni*). The prairie dog populations within the permit area appear to be healthy (RHR, 2009d).

Big game species documented within the permit area include Rocky Mountain elk (*Cervus elaphus nelsoni*), mule deer—Rocky Mountain subspecies (*Odocoileus hemionus*), and mountain lion (*Puma concolor*). Other mammals found within the permit area include porcupine (*Erthizon dorsatum*), coyote (*Canis latrans*), gray fox (*Urocyon cinereoargenteus*), badger (*Taxidea taxus*), striped skunk (*Mephitis mephitis*), and bobcat (*Lynx rufus*).

For each of the habitats on Forest Service managed lands, analysis will focus on Cibola National Forest special status species including: threatened, endangered, proposed, and Regional Forester's sensitive species; management indicator species (MIS); and high priority migratory birds.

Roca Honda Mine Permit Area

Federally Listed Threatened and Endangered Species

The Endangered Species Act (ESA) of 1973 provides conservation and protection of threatened and endangered species and the habitats in which they are found. Under Section 7 of the ESA, Federal agencies must consult with the U.S. Fish and Wildlife Service (USFWS) to ensure that the actions they authorize, fund, or carry out are not likely to jeopardize the continued existence of any listed threatened or endangered species or result in the destruction or adverse modification of designated critical habitat of threatened and endangered species. The New Mexico Ecological Services Web site lists of USFWS listed and sensitive species in McKinley and Cibola Counties were reviewed in 2012 (USFWS, 2012a; USFWS, 2012b). Table 34 lists Federally listed threatened and endangered species, a description of their preferred habitat, and their potential to occur at the Roca Honda permit area.

No federally listed species or designated critical habitat were documented during wildlife surveys in 2008 and habitat for these species does not occur in the permit area. Since federally listed or candidate species or their habitats do not occur in the proposed project area, they are not analyzed further in this document.

Table 34. Federally listed threatened and endangered species potential to exist in the permit area

Common Name (Scientific name)	Federal Status	Potential to Occur in Permit Area**	Habitat Description
Birds			
Yellow-billed cuckoo (*Coccyzus americanus*)	C	NP	Extensive, mature riparian corridors. Breed in open woodland, parks, and deciduous riparian woodlands.
Southwestern willow flycatcher (*Empidonax traillii extimus*)	E	NP	Dense, riparian vegetation near surface water or saturated soil, monotypic or mixed stands of native and/or exotic species.
Whooping crane (*Grus americana*)	NEP	NP	Nesting occurs in dense emergent vegetation, in shallow ponds, freshwater marshes, wet prairies, or along lake margins. Migration and winter habitat includes marshes, shallow lakes, lagoons, salt flats, grain and stubble fields, and barrier islands.
Mexican spotted owl (*Strix occidentalis lucida*)	T	NP	Rocky canyons in mature montane forests below 9,500 ft. in elevation.

Common Name (Scientific name)	Federal Status	Potential to Occur in Permit Area**	Habitat Description
Mammals			
Black-footed ferret (*Mustela nigripes*)	E	NP	Open grasslands with year-round prairie dog colonies. Strongly associated with black-tailed prairie dogs
Fish			
Zuni bluehead sucker (*Catostomus discobolus yarrowi*)	C	NP	Often inhabits swift water areas in mountain streams and smaller tributaries to large rivers (nursery habitat).

Source: USFWS, 2012a; USFWS, 2012b; RHR, 2009d; USFWS 2006-2009; NatureServe, 2012a

Status E Endangered T Threatened C Candidate NEP Non-Essential Population

Presence**
K Known, documented observation within permit area.
S Habitat suitable and species could occur within the permit area.
NS Habitat suitable but species is not suspected to occur within the permit area.
NP Habitat not present and species unlikely to occur within the permit area.

Roca Honda Mine Permit Area State Listed Threatened and Endangered Species

The New Mexico Biota Information System Web site State listed threatened and endangered species for McKinley and Cibola Counties were reviewed in 2012 (NMGF, 2012). Table 35 lists State listed threatened and endangered species, a description of their preferred habitat, and their potential to occur at the Roca Honda permit area.

Table 35. New Mexico State listed threatened and endangered species potential to exist in the permit area

Common Name (Scientific name)	State Status	Potential to Occur in Permit Area**	Habitat Description
Birds			
Bald eagle (*Haliaeetus leucocephalus*)	T	NP	Mature shoreline forests with scattered openings and little human use, near water with abundant fish and waterfowl.
American peregrine falcon (*Falco peregrinus anatum*)	T	S (marginal habitat)	Rare breeders (NM) in rocky, steep cliff areas, generally near water or mesic canyons
Artic peregrine falcon (*Falco peregrinus tundris*)	T	NP	Nest in treeless tundra of Alaska, Canada, and Greenland. Occasional winter migrant, but rare.
Southwestern willow flycatcher (*Empidonax traillii extimus*)	E	NP	Dense, riparian vegetation near surface water or saturated soil, monotypic or mixed stands of native and/or exotic species.

Common Name (Scientific name)	State Status	Potential to Occur in Permit Area**	Habitat Description
Gray vireo (*Vireo vicinior*)	T	K – migrant	Thorn scrub, oak-juniper woodland, piñon-juniper, dry chaparral, mesquite and riparian willow habitats.
Least tern (*Sterna antillarum*)	E	NP	Marine or estuarine shores, or on sandbar islands in large rivers. Prefers area free from humans and predators.
Costa's hummingbird (*Calypte costae*)	T	NS	Desert scrub, chaparral, thornscrub, tropical deciduous forest, and suburban areas.
Mammals			
Spotted bat (*Euderma maculatum*)	T	S	Highly variable habitats from coniferous forest to desert scrub. Found in piñon-juniper woodland, grasslands, and shrublands (NatureServe, 2010a).
Fish			
Zuni bluehead sucker (*Catostomus discobolus yarrowi*)	E	NP	Often inhabits swift water areas in mountain streams and smaller tributaries to large rivers (nursery habitat).

Source: NMDGF2006-2009; RHR, 2009d

State Status E Endangered T Threatened

Presence** K Known, documented observation within the permit area.
S Habitat suitable and species could occur within the permit area.
NS Habitat suitable but species is not suspected to occur within the permit area.
NP Habitat not present and species unlikely to occur within the permit area.

Three State listed threatened and endangered species have the potential to occur within the permit area: the gray vireo, American peregrine falcon, and spotted bat. The gray vireo was documented onsite; however, this species was likely misidentified during surveys. While the American peregrine falcon and the spotted bat were not documented on the permit area during surveys, suitable habitat is present and these species could occur within the permit area.

The **spotted bat** is not known to occur within the permit area and was not observed during surveys, though suitable habitat for this species does exist within the permit area. Habitat of the spotted bat varies and includes bare rocks, cliffs, deserts, grassland/herbaceous vegetation, shrubland/chaparral vegetation, and woodland-conifer vegetation (NatureServe, 2010a). In New Mexico, the spotted bat is typically found in conifer forests in northern New Mexico (RHR, 2009d). Overall population abundance is unknown, but the bat has been found very rarely in collections. Threats to the spotted bat could include habitat destruction, collection of bats by humans, and the use of pesticides (NatureServe, 2010a).

The **American peregrine falcon** prefers to nest in cliffs, mountains, open forested regions, and human population centers. Terrestrial habitat includes cliffs, deserts, shrubland/chaparral, tundra, urban, and conifer, hardwood, and mixed woodlands. The peregrine falcon is a year-round resident and local breeder in New Mexico. This species also migrates across the State from more northern breeding areas in the United States and Canada. The peregrine falcon winters along the coast and farther south and occupies a range of habitats during migration. It feeds primarily on birds but will also consume other small vertebrate species. The peregrine falcon is threatened by loss of wetland habitat of primary prey, poachers robbing nests, shooting by hunters, and pesticide use (NatureServe, 2010b). This falcon was not observed during surveys and is not known to occur within the permit area. While no surveys found peregrine falcons in the permit area, marginal habitat exists for both hunting and nesting. Nesting habitat within the permit area is restricted to arroyo canyons and cliffs (RHR, 2011a).

The **gray vireo** is a small, insectivorous bird. These birds migrate long distances arriving in the southern United States around April. The gray vireo breeds in central New Mexico in areas characterized by hot, semiarid, shrubby habitats, mesquite and brushy piñon -juniper woodlands, chaparral, and desert scrub. Nests are cupped and suspended from forked twigs in shrubs or trees (NatureServe, 2010c). Within New Mexico, some gray vireo populations have disappeared from historic habitats but other populations have persisted (NMGF, 2010). Threats are unknown but could include livestock grazing and habitat clearing (NatureServe, 2010c).

A gray vireo was reported in September of 2006 in Section 16. This is an extremely late record for this species and the gray vireo was never recorded during point count surveys, which likely means the species was misidentified during surveys. The Roca Honda permit area is probably too high in elevation for gray vireo breeding. In central New Mexico, this highly localized species is found at the base and lower slopes of foothills areas with juniper savannah and a healthy grassland component, generally from 5,700 up to 6,400 feet. The lowest portions of the Roca Honda site and pipeline route are above 6,900 feet. Gray vireos bear a close resemblance to plumbeous vireos (a widespread migrant at Roca Honda well into September), and this species could have been misidentified within the permit area. It is unlikely that this species occurs in the permit area and gray vireos are not analyzed further in this document.

Roca Honda Mine Permit Area Forest Service Sensitive Species

A list of sensitive species with potential to occur within the project area was obtained in 2012 from the Forest Service. The Forest Service lists 21 wildlife species that occur or may occur in the Mt. Taylor Ranger District. Table 36 lists these Forest Service sensitive species, a description of their preferred habitat, and their potential to occur at the Roca Honda permit area.

Table 36. United States Forest Service sensitive species potential to exist in the permit area

Common Name (Scientific Name)	Potential to Occur in Permit Area**	Habitat Description
Amphibians		
Northern leopard frog (*Rana pipiens*)	NP	Varity of habitats including springs, marshes, wet meadows, riparian areas, vegetated irrigation canals, ponds, and reservoirs. Requires a high degree of vegetative cover for concealment. In New Mexico they are known from about 3,500-10,000 feet and breed in ponds or lake edges with fairly dense aquatic emergent vegetation. Overwintering habitats are larger lakes and streams that do not freeze completely during winter.

Common Name (Scientific Name)	Potential to Occur in Permit Area**	Habitat Description
Birds		
Bald eagle (*Haliaeetus leucocephalus*)	NP	Mature shoreline forests with scattered openings and little human use, near water with abundant fish and waterfowl.
Northern goshawk (*Accipiter gentilis*)	NS	Ponderosa pine, mixed conifer, and spruce-fir forests.
American peregrine falcon (*Falco peregrinus anatum*)	S	Rare breeders (NM) in rocky, steep cliff areas, generally near water or mesic canyons.
Western burrowing owl (*Athene curnicularia hypugaea*)	NS	Grasslands and prairies, associated with prairie dog towns (typically black-tailed prairie dogs and Richardson's ground squirrels). No individuals or signs of occurrences were documented, although they may occur in association with the Gunnison's prairie dog colony.
Western yellow-billed cuckoo (*Coccyzus americanus occidentalis*)	NP	Extensive, mature riparian corridors. Breed in open woodland, parks, and deciduous riparian woodlands.
Gray vireo (*Vireo vicinior*)	K - migrant	Thorn scrub, oak-juniper woodland, piñon-juniper, dry chaparral, mesquite and riparian willow habitats.
Mammals		
Merriam's shrew (*Sorex merriami leucogenys*)	S	Montane shrublands, piñon-juniper woodlands, mixed montane and subalpine forests and grasslands. Most commonly associated with sagebrush-bunchgrass shrub steppe, but in New Mexico species was found in the white fir, Douglas-fir, and ponderosa pine zone at about 8,000 feet. Its general range is considered to overlap that of the range of big sagebrush.
Dwarf shrew (*Sorex nanus*)	NP	White fir/Douglas-fir zone from about 7,000 to 9,000 feet and occasionally in alpine areas. The preferred habitat is talus and other rocky areas primarily in subalpine coniferous forest.
Spotted bat (*Euderma maculatum*)	S	Highly variable habitats from coniferous forest to desert scrub.
Pale Townsend's big-eared bat (*Corynorhinus townsendii pallescens*)	S	Semidesert shrublands, piñon-juniper woodlands, and open montane forests, including spruce-fir. Associated with caves and abandoned mines for day roosts and hibernacula, but will also use abandoned buildings and crevices on rock cliffs for refuge.
White mountains ground squirrel (*Spermophilus tridecemlineatus monticola*)	NP	Open short grass subalpine fields to open grass-sedge meadows. Short grass is preferred but they may be observed in patches of taller grass. This species has expanded into mowed lawns, golf courses, cemeteries, well-grazed pastures, parks, and roadsides.

Common Name (Scientific Name)	Potential to Occur in Permit Area**	Habitat Description
Gunnison's prairie dog (*Cynomys gunnisoni*)	K	Level to gently sloping grasslands, semidesert and montane shrublands (6,000–12,000 feet).
Botta's pocket gopher (*Thomomys bottae morulus*)	NP	This species occurs in the extreme southeast foothills of the Zuni Mountains and southward to the Grants lava field.
Botta's pocket gopher (*Thomomys bottae planorum*)	S	Found in Cibola County, southwest of San Mateo, in 1940. It is from the Mt. Taylor vicinity and along the east side of the Grants lava field. Marginal distribution records include: New Mexico, Horace Mesa, 1.5 miles south of Canyon Lobo Ranger Station; and 11 miles south-southeast of Grants. Specimens have been taken at 6,700 feet (type locality) elevation, as well as at higher elevations (e.g. 9,000 feet at Cloudcroft).
Cebolletta southern pocket gopher (*Thomomys bottae paguatate*)	NP	Occurs in the vicinity of the village of Cebolleta, Cibola County on the Rio Paquate on the southeast side of Mt. Taylor. Gophers were collected only in the areas of the flood plain that were, or had been, under cultivation.
Mt. Taylor northern pocket gopher (*Thomomys talpoides taylori)*	NP	The type locality for was taken in November 1940 from 6 miles northeast of the summit of Mt. Taylor, at about 8,900 feet elevation, near Fernandez Summer Camp, Valencia County (now Cibola County), New Mexico. Also found at Mirabel Spring on the southwest slope of Mt. Taylor. Prefers deep soils along streams and in meadows and cultivated fields.
Long-tailed vole (*Microtus longicaudus*)	NP	Permanent water in montane habitats. The long-tailed vole is found in coniferous forest, but most abundant where there is at least some grassy vegetation present on the forest floor, usually associated with meadows and forest edge. It is most common in mixed coniferous and spruce-fir forest, descending into ponderosa forest along sheltered canyon sides where stands of spruce and fir occur and riparian spruce, willow, and alder communities from 8,100 to 9,500 feet in elevation.
Insects		
Nitocris fritillary (*Speyeria nokomis nitocris*)	NP	Found in streamside meadows and open seepage areas with an abundance of violets in generally desert landscapes. The colonies are often isolated.
Crustaceans		
Clam shrimp (*Eulimnadia follisimilis*)	S	Temporary waters. Found in dirt stock tanks in New Mexico.
Fairy shrimp (*Streptocephalus* n. sp.1)	S	Temporary waters.

RHR, 2011a; USFS, 2009d

Presence**
K Known, documented observation within the permit area.
S Habitat suitable and species could occur within the permit area.
NS Habitat suitable but species is not suspected to occur within the permit area.
NP Habitat not present and species unlikely to occur within the permit area.

The following Forest Service sensitive species are found within the permit area or have the potential to occur within the permit area: American peregrine falcon, gray vireo, Merriam's shrew, spotted bat, Pale Townsend's big-eared bat, Gunninson's prairie dog, Western burrowing owl, Botta's pocket gopher, clam shrimp, and fairy shrimp. The American peregrine falcon, gray vireo, and spotted bat are discussed above. The remaining species or their habitats do not occur and will not be considered further for this proposed project.

In New Mexico, **western burrowing owls** inhabit grasslands, open shrublands, and woodlands at lower to middle elevations (2,800–7,500 feet). These owls occupy nonriparian habitats exclusively or nearly so during the breeding season. Arthropods (beetles, grasshoppers, and crickets) form the majority of their diet. They use abandoned burrows of ground squirrels, prairie dogs, and other burrowing mammals for nest sites. Limiting factors include decreasing numbers of burrow-digging mammals, avian and mammalian predators, starvation, diseases and parasites, and poisoning (resulting from human efforts to control squirrels and prairie dogs). Optimum habitat is typified by shortgrass vegetation and presence of fresh small mammal burrows, especially prairie dogs.

The **Gunnison's prairie dog** is known to occur within the permit area and at least four small to large prairie dog towns were observed during wildlife surveys (RHR, 2011a). Habitat of Gunnison's prairie dog includes grassland/herbaceous and shrubland/chaparral vegetation. This species is found in high mountain valleys and plateaus between elevations of approximately 6,000 and 9,000 feet, open or slightly brushy country, and scattered junipers and pines (NatureServe, 2010d). In New Mexico they are found in level to gently sloping grasslands, semidesert and montane shrublands between 7,000 and 8,500 feet (RHR, 2009d). Their diet includes grasses, forbs, sedges, shrubs, and insects. Individuals have some periods of inactivity during winter, potentially lasting several months. During the prairie dogs' active months—spring and summer—they are active during the early morning and late afternoon. Populations throughout its range have declined significantly from historic levels. The main threat to the prairie dog is the sylvatic plague. Sylvatic plague is a bacterial disease generally transmitted among rodents by fleas and is often fatal. Other threats include poisoning and climate change in the montane portion of their range (NatureServe, 2010d).

Merriam's shrew is not known to occur in the permit area and was not observed during wildlife surveys, but piñon -juniper is considered suitable habitat. This is one of the least known of all the shrew species. It is extremely rare, with hundreds of pitfall trap/baited small mammal trap hours needed to capture one individual. In addition the species is extremely difficult to identify and only close, microscopic examination of the teeth will allow experts to identify it with certainty (USFS, 2009d).

Pale Townsend's big-eared bat is not known to occur in the permit area and was not observed during wildlife surveys, but suitable habitat does exist within the permit area. This bat is a western species occurring in semidesert shrublands, piñon-juniper woodlands, and open montane forests, including spruce-fir. It is associated with caves and abandoned mines for day roosts and hibernacula, but will also use abandoned buildings and crevices on rock cliffs for refuge. Maternity sites include trees, caves, or manmade structures. They do not move long distances from hibernacula to summer roosts nor do they forage far from their day roosts. Their diets consist of greater than 90 percent moths. Threats include habitat loss, cave vandalism, and disturbance by cave explorers at maternity and hibernation roosts (USFS, 2009d).

Pocket gophers are generally limited in their distribution by the quality and type of the soil (USFS, 2009d). The **Botta's pocket gopher** species includes many reproductively isolated populations with little interbreeding. Within the permit area, Botta's pocket gophers were identified and could potentially be *Thomomys bottae planorum* (RHR, 2011a). Botta's pocket gophers are found in a wide variety of habitats from valleys to high mountain meadows. They also inhabit a wide variety of soils from soft sands to friable loams to hard clays (NatureServe, 2012b).

Fairy shrimp and **clam shrimp** are found in vernal and ephemeral pools. While these species have not been documented on the permit area, there is evidence of temporary waters along some of the drainages off of Jesus Mesa. Fairy shrimp and clam shrimp are found in seasonal ponds called vernal pools. The eggs of these species survive the dry season and hatch when the rains come again (National Wildlife Federation, 2012).

Roca Honda Mine Permit Area
Forest Service Management Indicator Species

The "Cibola National Forest Land and Resource Management Plan" (LRMP) identified 13 management indicator species to estimate the effects planned activities may have on forestwide wildlife populations and habitat. Only those MIS whose habitat (vegetation) types occur within the permit area were analyzed. Of the 13 MIS identified, 3 species and their habitat are found within the analysis area. Table 37 displays the 3 species of the mountain districts and their habitats. The forestwide MIS report (as revised in 2011) was used to prepare the project specific MIS analysis.

Table 37. Management Indicator Species and current habitat/population trends analyzed for Roca Honda analysis area

Common Name	MIS Habitat Type	Acres in Sections 9, 10, and 16	Habitat Description	Existing Forestwide Habitat Trend	Existing Forestwide Population Trend
Rocky Mountain Elk	Mountain grassland	865	In general, elk prefer open grassy meadows located less than ½ mile from water. Hiding cover for elk occurs in stands of trees 30–60 acres in size with 70 percent canopy cover.	Stable	Up
Mule deer	Mountain shrub	185	Early stages of plant succession with an abundance of browse plants are more beneficial to mule deer than late stages. Mixtures of plant species are preferable to single species plant communities. Food requirements for deer average about 5 to 7 pounds of green forage per day.	Down	Down

Common Name	MIS Habitat Type	Acres in Sections 9, 10, and 16	Habitat Description	Existing Forestwide Habitat Trend	Existing Forestwide Population Trend
Mule deer	Piñon-juniper	376	Early stages of plant succession with an abundance of browse plants are more beneficial to mule deer than late stages. Mixtures of plant species are preferable to single species plant communities. Food requirements for deer average about 5 to 7 pounds of green forage per day.	Stable	Down
Juniper titmouse	Piñon-juniper	376	The juniper titmouse prefers warm, dry habitats of open piñon-juniper woodland sometimes mixed with oak. It is most common where juniper is dominant and where large, mature trees are present to provide cavities for nesting.	Stable	Down

In the "Cibola National Forest Land and Resource Management Plan" (LRMP) **Rocky Mountain elk** was selected as a management indicator species for the mountain grasslands and mixed conifer habitat found on the forest. The justification for this selection reads as follows: "Elk – grazer, fairly adaptable, not representative over entire forest, however, a good indicator of meadow types in those areas where it does appear. Easily monitored and identified. Is a species of high public interest and can be managed for."

At the time the LRMP was approved in 1985, elk were a popular, but not necessarily widespread game species. Elk numbers were considered an index for the extent and health of the mountain grasslands and mixed conifer habitat types. Limiting factors at the time the Cibola LRMP was approved were believed to be hiding cover (mixed conifer) and forage (mountain meadows). It is now recognized that elk are far more adaptable than previously believed, and occupy a wide variety of habitats at all times of the year.

Elk are grazers as well as browsers and their diet consists of shrubs, trees, and grasses. Starting in spring, elk migrate up to higher mountain pastures and as mating season begins, the elk move back to lower valleys. During winter they inhabit wooded slopes and dense woods of the lower valleys (eduscapes, 1999). Suitable grazing, calving, and winter range habitat exists within the permit area. Rocky Mountain elk appear to have been successfully reintroduced in many places throughout its range and existing forestwide population trend is up within the Cibola National Forest (USFS, 2005 MIS Report) .

Rocky Mountain elk were documented in the site during all survey periods. Suitable grazing, calving, and winter range habitat exists within the permit area (RHR, 2009d). In the Cibola LRMP EIS, page 142, mountain grasslands were determined to cover approximately 1 percent of the total area on the forest. Mountain grasslands are now estimated to cover 192,037 acres (USFS, 2005 MIS Report). The most recent analysis indicates the quantity of mountain grassland acres has changed due primarily to the way grasslands are classified and some shifting upon the landscape. This habitat type is well represented and distributed across all four mountain districts of the Cibola National Forest and the habitat trend is currently considered stable.

In the 1985 Cibola LRMP, **mule deer** was selected as a management indicator species for the mountain shrub and piñon-juniper habitat found on the forest. The justification for this selection reads as follows: "Mule Deer – browser, adaptable, easily identified and can be monitored by known methods. Is a species of high public interest and can be managed for" (USFS, 2005 MIS Report).

Sign and visual verifications were used to document mule deer in the permit area, and mule deer were documented during all survey periods. Does with fawns, juveniles, and subadults were also documented. These deer migrate seasonally from higher elevations in the summer to lower elevations in the winter. They occur throughout the entire western United States, but mule deer populations have been declining and forestwide population trends are down. Suitable grazing, fawning, and winter range habitat for mule deer exists within the permit area (RHR, 2009d).

Mule deer habitat depends on the season with preferred habitat being arid, open areas and rocky hillsides. Deer are browsers and eat a variety of vegetation. Approximately 57,755 acres of mountain shrub is estimated to occur within Cibola National Forest and the forestwide habitat trend is down. The Cibola National Forest contains 838,376 acres of piñon-juniper woodland and the forestwide habitat trend is stable (USFS, 2005 MIS Report).

In the 1985 Cibola LRMP, **juniper titmouse** (formerly known as the plain titmouse) was selected as a management indicator species for the piñon-juniper habitat found on the forest. The justification for this selection was as follows: "Plain titmouse - low versatility rating; nest only in piñon-juniper in this area." Limiting factors for juniper titmouse appear to be natural cavities and old woodpecker holes within the piñon-juniper woodlands (USFS, 2005 MIS Report).

This species is closely tied to piñon-juniper woodlands with approximately 39 percent or 838,376 acres of that habitat within the Cibola National Forest (USFS, 2005 MIS Report). Forestwide population trends for this species are down and forestwide habitat trends are stable. Juniper titmice were detected during all surveys, and breeding activity was documented within the permit area (RHR, 2009d).

Roca Honda Mine Permit Area
Forest Service High Priority Migratory Birds

A total of 1,781 individual birds were observed with 59 species recorded during the breeding seasons at Sections 9, 10, and 16. The most common bird species within the permit area appear to be ash-throated flycatcher (*Myiarchus tuberculifer*), juniper titmouse (*Baeolophus ridgewayi*), rock wren (*Sappinctes obseletus*), Bewick'swren (*Thryomanes bewickii*), and chipping sparrow (*Spizella passerina*). During these surveys two raptor species—red-tailed hawk (*Buteo jamaicensis*) and great horned owl (*Bubo virginianus*)—were documented. One great horned owl nest was also found within the project site in Section 16. The nest was 500 feet from a potential drill hole and within 50 feet of an existing road. Juvenile owls were found within ¼ mile of the nest site during the breeding season surveys. Three golden eagles, one subadult and/or juvenile and one adult were also detected during the surveys. It is unlikely that the eagles use this area as a wintering habitat because two of the eagles were not of breeding age.

On the Cibola National Forest, populations of birds are monitored through the use of breeding bird surveys (BBS) on geographic areas to detect population and trends during the breeding period. There are two types of BBS done on the Cibola National Forest and both types of survey routes are run on the district including: Mt. Taylor BBS (a USGS BBS route on the eastern side of Mt. Taylor) and a shorter BBS route at Rinconada Canyon. There is one important bird area (IBA) on the district at Rinconada Canyon. There are no important overwintering areas on the district. High priority migratory birds are determine by consulting several lists including the National Audubon Society Watchlist, the USFWS's Birds of Conservation Concern, the New Mexico Comprehensive Wildlife Conservation Strategy (CWCS), and the New Mexico Partners in Flight (PIF) list. Those species potentially occurring in habitats similar to the permit area on the Mt. Taylor Ranger District were reviewed. Table 38 summarizes species and habitat analyzed.

Table 38. Priority bird species and associated habitat

Priority Bird Species	Habitat
Piñon jay (*Gymnorhinus cyanocephalus*)**	Piñon-juniper woodland is used most extensively by this species but flocks also breed in sagebrush, scrub oak, and chaparral communities.
Black throated gray warbler (*Setophaga nigrescens*)**	This species can be found in piñon-juniper with some oak understory between 7,000 and 8,000 feet, but can also be common in more mesic piñon/juniper with a high canopy closure.
Band-tailed pigeon (*Columba fasciata*)	This species may be found from piñon-juniper up through spruce/fir depending on availability of food that includes a wide variety of mast such as fruits and nuts, especially acorns and piñon pine nuts.
Gray flycatcher (*Empidonax wrightii*)**	This species is found in piñon/juniper woodland up into the fringes of ponderosa pine, together with some understory of oak, mountain mahogany, etc., and often in semi-mixed xeric conditions.
Olive-sided flycatcher (*Contopus cooperi*)**	Rare on all mountain districts, usually occurring in ponderosa, mixed conifer and spruce/fir. Favors open forest and forest edges with snags.
Black-chinned hummingbird (*Archilochus alexandri*)**	On the Cibola National Forest, this species is the foothills hummingbird that occurs on all mountain districts up to about 7,000 feet.
Broad-tailed hummingbird (*Selasphorus platycercus*)**	This mountain hummingbird is found from about 7,000 feet upward. It frequents meadows and open forest with a shrubby component and forbs.
Scaled quail (*Callipepla squamata*) **	Primarily found in peripheral shrubby grasslands in the vicinity of canyon foothills on the San Mateo, Magdalena, and Bear Mountain ranges.
Grace's warbler (*Setophaga graciae*)	On the district, this species is fairly common in ponderosa pine but may extend into mixed conifer if ponderosa pine is also present.
Vesper sparrow (*Pooecetes gramineus*)**	On the district, this species is found in dry meadows with some shrub component from about 7,000 feet to at least 8,400 feet.
Loggerhead Shrike (*Lanius ludovicianus*)**	Generally prefers juniper savannah or grassland/shrub habitats below 7,000 feet in elevation.

Priority Bird Species	Habitat
Brewer's sparrow (*Spizella breweri*)	Usually associated with big sage but it has adapted to rabbitbrush in the Zunis, especially where it grows in large unbroken tracts, as in upper Bluewater Canyon.
Gray vireo (*Vireo vicinior*)	Prefers juniper savannah habitats especially on moderate rocky slopes generally below 6,800 feet in elevation.
Juniper titmouse (*Baeolophus ridgwayi*)**	Prefers juniper dominated relatively dry and open piñon-juniper habitats at elevations of 6,000 to about 7,200 feet.
Virginia's warbler (*Vermivora virginiae*)**	Considered to prefer arid montane forests with Gambel oak understory from 6,000 to 9,000 feet in elevation.

****** Indicates species observed in the permit area.

Piñon jays are known to occur abundantly throughout the permit area in all seasons, often forming into flocks of 20 or more birds (RHR, 2011a). Nests were located on Section 9 in 2008. This species was also detected on the USGS Mt. Taylor and Rinconada Canyon BBS routes (USGS, 2010; USFS, 2010b). The piñon jay can be found on all of the habitats within the permit area. This species is a highly social bird that places their nests in trees. Piñon jay populations are declining due to destruction of piñon-juniper habitat to create grazing land for cattle. Changes in fire regimes have also resulted in loss of many piñon pines, threating the piñon jay populations (Balda, 2002).

Black throated gray warblers are common within the permit area and their habitat includes piñon-juniper woodlands and juniper savannahs. Within the permit area this species is a summer resident and was found to be most common in denser, more matures stands of piñon-juniper woodlands (RHR, 2011a). This species has also been detected on the USGS Mt. Taylor and Rinconada Canyon BBS routes (USGS, 2010; USFS, 2010b). Black throated gray warbler populations appear to be stable or increasing rangewide. Threats include destruction and modification of habitat (NatureServe, 2012c).

Band-tailed pigeons are not known to occur within the permit area and this species was not observed during surveys. Band-tailed pigeons have been detected on the USGS Mt. Taylor BBS route (USGS, 2010). North American BBS data shows significant long-term declines surveywide, but sample sizes for interior populations are too small for reliable trend estimates. Habitat degradation and destruction, and overhunting are the primary threats to this species (NatureServe, 2012d).

Gray flycatchers are known to occur within the permit area and this species was found to be a particularly common breeder during surveys. Habitat within in the permit area includes piñon-juniper woodlands and juniper savannahs and this species is both a summer resident and migrant species of this area (RHR, 2011a). Gray flycatchers have also been detected on the USGS Mt. Taylor and Rinconada Canyon BBS routes (USGS, 2010; USFS, 2010b). This species is relatively common and its population is possibly increasing. Nest placement occurs in shrubs (Sterling, 1999).

Olive-sided flycatchers were observed in the permit area during breeding season surveys but this species is uncommon in the permit area. Within the permit area, this species is a late spring migrant and habitat includes piñon-juniper woodlands and juniper savannahs (RHR, 2011a).

Olive-sided flycatchers were also detected on the Rinconada Canyon BBS (USFS, 2010b). Loss of wintering habitat is a continuing threat to this species and this species has declined seriously throughout much of it range. Nesting occurs in open cup of twigs, rootlets, and lichens that are placed out near tips of horizontal tree branches (Altman and Sallabanks, 2000).

While uncommon, **Black-chinned hummingbirds** have been observed within the permit area and habitat includes piñon-juniper woodlands and juniper savannahs. This species breeds in lower wooded areas of the permit area and generally vacates by early August (RHR, 2011a). Black-chinned humming birds have also been detected on the USGS Mt. Taylor and Rinconada Canyon BBS routes (USGS, 2010; USFS, 2010b). This species of hummingbird is one of the most adaptable and black-chinned hummingbirds have been found often in urban areas and recently disturbed habitat as well as pristine natural areas. Black-chinned hummingbird populations are considered generally stable or increasing in some areas. In areas with arid conditions, the black-chinned hummingbird depends on intact streamside habitats. On average, nesting occurs 6 to 12 feet above the ground and is often on dead, horizontal tree branches below the canopy (Baltosser and Russell, 2000).

While uncommon, **broad-tailed hummingbirds** have been observed within the permit area and habitat includes piñon-juniper woodlands. This species is a summer resident and uncommon fall migrant. Within the permit area, this species is found nesting primarily in the highest portions of Jesus Mesa (RHR, 2011a). Broad-tailed hummingbirds have also been detected on the USGS Mt. Taylor and Rinconada Canyon BBS routes (USGS, 2010; USFS, 2010b). Although there are not enough data available to determine population trends for this species, this species is considered secure and numbers may be increasing. Nests are typically found in areas with an adequate food supply. This species typically looks for conifer, willow, alder, or cottonwood trees and places nests on low branches shielded by overhanging limbs or trunk deformities (NatureServe, 2012e; Calder and Cadar, 1992).

Though rarely (less than three records), **scaled quail** has been observed in desert grassland habitat of the permit area. Overall, this site is too high in elevation for this species (RHR, 2011a). Scaled quails have not been detected on the USGS Mt. Taylor or Rinconada Canyon BBS routes (USGS, 2010; USFS, 2010b). Scaled quail are highly social, live in large groups, are ground-dwelling birds of the southwestern desert grasslands, and this species typically runs to escape enemies rather than flying. Scaled quails hide their nests on the ground within dense vegetation which can include yucca plants, small bushes, potato patches, honey mesquite, packrat mounds, dead Russian thistle, sand sagebrush, acacia, and other desert herbs and shurbs. This species' boom-and-bust population cycles make it hard to estimate long-term trends, though populations seem to have declined sharply in the past decades. The main threat to this species is the reduction of food and cover that results from overgrazing (Schemnitz, 1994).

Grace's warblers are not known to occur within the permit area and this species was not observed during surveys. Grace's warblers have been detected on the USGS Mt. Taylor and Rinconada Canyon BBS routes (USGS, 2010; USFS, 2010b). This species nests in trees and is typically found in treetops. While little information on population trends is available for this species, Grace's warblers are considered common (Stacier and Guzy, 2002).

Vesper sparrows are a rare migrant species within the permit area on desert grasslands. While this area contains areas of suitable breeding habitat, the species was found to be completely absent during the nesting season. The permit area is probably too arid for this species to breed

(RHR, 2011a). Vesper sparrows have also been detected on the USGS Mt. Taylor route (USGS, 2010). These sparrows nest in shallow cups of woven grasses that are placed on the ground. Population trends are declining throughout this species range. Population declines are primarily due to various farming practices including the use of chemicals, large-scale tillage, and early harvesting of hay (Jones and Cornely, 2002).

Loggerhead shrikes are present in low numbers throughout the permit area in piñon-juniper woodlands, juniper savannahs, and desert grasslands. This species is a summer resident and migrant of this area (RHR, 2011a). Loggerhead shrikes have not been detected on the USGS Mt. Taylor or Rinconada Canyon BBS routes (USGS, 2010; USFS, 2010b). The loggerhead shrike nests in trees and was once an abundant species. Populations have declined drastically through the last half of the 20^{th} century and this species is essentially gone from the northeastern part of its range (Yosef, 1996).

While **Brewer's sparrows** have been observed within the permit area, this species is an uncommon migrant throughout the area. Habitat includes piñon-juniper woodlands, juniper savannahs, and desert grasslands (RHR, 2011a). Brewer's sparrows have not been detected on the USGS Mt. Taylor or Rinconada Canyon BBS routes (USGS, 2010; USFS, 2010b). The Brewer's sparrow has a fairly large range in the western United States, but this species is declining in many of these areas. This species nests low in sagebrush, other shrubs, and cactus (NatureServe, 2012)f.

Gray vireos have not been detected on the USGS Mt. Taylor or Rinconada Canyon BBS routes (USGS, 2010; USFS, 2010b). This species is discussed above under State threatened and endangered species.

Juniper titmice are discussed above under Forest Service MIS.

Virginia's warblers are an uncommon species within the permit area but they may occur as both summer residents and migrants in piñon-juniper woodland and juniper savannah habitats. While breeding status within the permit area is unknown, singing migrants persisted in late May of 2007 and early June of 2008 in small pockets of suitable breeding habitat (RHR, 2011a). Virginia's warblers have been detected on the USGS Mt. Taylor BBS route (USGS, 2010). Breeding bird surveys show a nonsignificant overall decrease per year from 1966 to 2011 and populations are expected to continue to decline due to the alteration of the species' habitat. Nests are typically in or near coniferous forests between 6,000 and 9,000 feet (National Audubon Society, 2012).

Wildlife along the Proposed Water Reuse Route

Since the habitats present along the proposed water reuse route are similar to those within the permit area (see the "Vegetation" section above), in general, the wildlife occurring within the permit area would also be expected to occur along the proposed water reuse route. The topography of the pipeline route fluctuates between upland rolling hills, lowlands, and incised arroyos and the elevation ranges from approximately 6,990 to 7,300 feet. Power lines follow along much of the proposed pipeline as it parallels County Road 75. The majority of this route consists of USFS multi-use land and private grazed ranchland. The majority of the habitat present consists of Colorado Plateau piñon -juniper woodland (57.57 acres) and intermountain basins semidesert shrub steppe (21.5 acres).

Avian wildlife observed during the spring 2012 survey of the proposed pipeline route include mountain bluebird (*Sialia currucoides*), common raven (*Corvus corax*), juniper titmouse

(*Baeolophus griseus*), rock wren (*Salpinctes obsoletus*), violet-green swallow (*Tachycineta thalassina*), vesper sparrow (*Pooecetes gramineus*), and prairie falcon (*Falco mexicanus*). Other wildlife observed include elk (*Cervus canadensis*) remains, tracks, and scat; harvester ant (*Pogonomyrmex barbatus*) mounds; white-throated woodrat (*Neotoma albigula*) middens; and small mammal burrows likely inhabited by kangaroo rats (*Dipodomys sp.*) or other small mammals. Other mammals that might be expected to occur on the project site include coyote (*Canis latrans*), black-tailed jackrabbit (*Lepus californicus*), and desert cottontail (*Sylvilagus auduboni*).

Also, most of the Forest Service sensitive species, federally and State listed species, high priority birds, and MIS listed and discussed above have about the same potential for occurrence within this corridor as they do within the mine permit area.

In the spring 2012 survey conducted of the proposed pipeline route, McClain and Thompson (2012) concluded that no species currently listed as federally threatened or endangered is likely to occur in the pipeline route. However, based on literature information and the survey observations, McClain and Thompson found that two State listed threatened species—peregrine falcon (*Falco peregrinus anatum*) and gray vireo (*Vireo vicinior*) (both listed above), six Forest Service sensitive species—western burrowing owl (*Athene cunicularia hypugaea*) (listed above), ferruginous hawk (*Buteo regalis*), Swainson’s hawk (*Buteo swainsoni*), loggerhead shrike (*Lanius ludovicianus*) (listed above), Botta’s pocket gopher (*Thomomys bottae*) (listed above**),** and Gunnison’s prairie dog (*Cynomys gunnisoni*) prairie population (listed above), and three MIS species—elk, mule deer and juniper titmouse (listed above)—have potential habitat within the pipeline route.

While the ferruginous hawk and Swainson’s hawk have potential habitat within the pipeline route, these species have not been documented within the Mt. Taylor district of Cibola National Forest (RHR, 2011a). Nor were these species identified during surveys of the permit area (RHR, 2011a) and the 2012 surveys of the pipeline route (McClain and Thompson, 2012). These species are dismissed from further analysis in this document.

The proposed pipeline route contains breeding and foraging habitat for all of the species listed above except for Swainson’s hawk, for which there is foraging habitat only. None of the species were observed during the spring 2012 survey, but Gunnison’s prairie dogs were observed occupying areas adjacent to the northern end of the pipeline route in grazed grassland habitat (McClain and Thompson, 2012).

Environmental Consequences

The following analysis details the expected direct, indirect, and cumulative effects of the alternatives on wildlife species, including MIS, High Priority Migratory Birds, and Forest Service sensitive species with the potential to occur in the permit area. The analysis area is comprised of State and Federal (Forest Service) lands. The cumulative effects analysis area includes private, tribal, State and Federal lands within and around the San Mateo Creek watershed and Cibola National Forest. Because projects like the proposed Roca Honda Mine can have a wide variety of impacts on wildlife, the impact analysis discussion uses the following terms and definitions when rating the significance of the different types of impacts under each alternative (table 39).

Table 39. Criteria for rating impacts to wildlife

Major Factor	Definition in Terms of Wildlife
Magnitude	
Major	Effects to wildlife would be obvious, long term, and would have substantial consequences to wildlife populations in the region, mortality of a number of individuals that subsequently jeopardizes the viability of the resident population, extensive mitigation measures not included in the plan of operations would be needed to offset any adverse effects and their success would not be guaranteed. Violation of the Migratory Bird Treaty Act (MBTA) and/or the Endangered Species Act of 1973 would occur.
Moderate	Effects to wildlife would be readily detectable, long term and localized, with consequences affecting the population level(s) of species. Mitigation measures not including in the plan of operations, if needed to offset adverse effects, would be extensive and likely successful. Violation of the MBTA and/or the Endangered Species Act of 1973 would not occur.
Minor	Temporary displacement of a few localized individuals or groups of animals, mortality of individuals that would not impact population trends, mitigation measures if needed to offset adverse effects, would be simple and successful. Violation of the MBTA and/or the Endangered Species Act of 1973 would not occur.
Duration	
Long-term	Greater than 1 year or during critical (reproduction or rearing periods)
Medium-term (limited or intermittent)	One month to 1 year
Short-term	Less than 1 month
Extent	
Large	Effects document at the population or habitat level
Medium (localized)	Effects documented at the groups of individual or localized level (permit area)
Small (limited)	Effects are limited to scattered individuals
Likelihood	
Probable	Occurs during typical operating conditions
Possible	Occurs under worst case operating conditions
Unlikely	Occurs under upset/malfunction conditions
Precedence and Uniqueness	
Severe	Impacts are completely unprecedented; no similar impacts have been known to occur; types, extent, or probability of the impacts cannot be reasonably predicted; there is substantial and sustained dispute among subject matter experts, agencies, organizations, and/or citizens about the nature or importance of the impacts.
Moderate	There is moderate confidence in the accuracy of the predications as to types, extent, and likelihood the impacts; there is moderate dispute among subject matter experts, agencies, organizations, and/or citizens about the nature or importance of the impacts.
Slight	The types, extent, or probability of the impacts can be reasonably predicted with only slight uncertainty there is very limited dispute among subject matters experts, agencies, organizations, and/or citizen about the nature or importance of the impacts.

Plan approval and periodic inspections of mining activities would manage mine operations to minimize adverse impacts. The LRMP sets mitigation measures regarding construction, reconstruction and maintenance of roads, and recreation use. These measures would reduce impacts on wildlife populations and habitat. The LRMP also contains management requirements which would maintain or, in most instances, increase management indicator species. It also provides measures which would protect threatened or endangered wildlife species and promote their recovery and delisting, if possible (USFS, 1985 as amended).

The impacts discussion of this EIS assumes that the Roca Honda Mine would comply with standard environmental regulatory requirements and procedures including, but not limited to, the Endangered Species Act; the Migratory Bird Treaty Act; the Bald and Golden Eagle Protection Act; and the New Mexico Department of Game and Fish regulations. The Roca Honda Mine and reclamation of the permit area would also be designed and operated using the most appropriate technology and BMPs available as described in the Roca Honda Plan of Operations.

Even with these measures, the loss of and disturbance to vegetation, along with alterations to the topographic features of the area may impact habitat for numerous species and may result in direct mortality to wildlife individuals. Direct effects on wildlife include habitat loss, alteration, degradation, and fragmentation; wildlife mortality; and an increase in potential to exposure of chemical and radiation hazards associated with bioaccumulation in the air, soil, vegetation, and prey species. Indirect effects on wildlife include displacement from noise and light pollution. Although impacts to sensitive, threatened, and endangered species are similar to impacts to general wildlife, impacts can have a higher magnitude and extent on special status species because these species are already vulnerable to environmental impacts. Small changes in their habitat or population size could have major impacts on the whole population of the species.

Alternative 1

There would be no additional impacts to general wildlife, high priority migratory birds, MIS, State listed species, or Forest Service sensitive species under the no action alternative. The Forest Service would not approve RHR's plan of operations and there would be no impacts from mine development, operation, and reclamation. No wildlife mortality, habitat loss, degradation, fragmentation, or displacement would occur. Exposure to low levels of radioactivity in the environment from past mining projects would occur, but additional uranium-related contamination would not. Under the no action alternative, adverse effects to wildlife due to the proposed uranium mine would not occur.

Effects Common to the Action Alternatives

This section describes the impacts to wildlife and habitat that would be common to both action alternatives. Mine development, operation, and reclamation may impact wildlife through:

- Mortality;
- Habitat loss, alteration, degradation, and fragmentation;
- Displacement; and
- Exposure to chemical and radiation hazards associated with bioaccumulation in the air, soil, vegetation, and prey species.

Wildlife Mortality

Wildlife mortality could occur during development and operation of the mine. These mortalities would generally be associated with collisions with vehicles and construction equipment, though mortality could also occur from wildlife collisions with stationary objects. These effects normally remain localized and limited to the immediate vicinity of a project site and are most pronounced for small ground-dwelling mammals, reptiles, and amphibians, since they are generally less mobile than larger mammals and birds. However, the eggs and young of birds are practically susceptible to mortality from nest destruction during nesting season. Birds and bats are also susceptible to collisions with stationary objects (power lines, buildings, construction equipment) (USFWS, 2002).

To minimize the amount of wildlife mortality from vehicle collisions, the maximum speed limit on the mine permit area would be posted at 15 miles per hour and signs would be posted along access roads to and around the permit area alerting drivers to the presence of wildlife onsite (RHR, 2009c). Wildlife, especially birds and bats, could also fly into the mine causing wildlife mortality. Fences would be placed around mine shafts and ventilation holes to keep wildlife out of these areas, and screens would be placed over ventilation openings to deter birds and bats. Also, power lines and associated equipment such as transformers and substations would be built using BMPs for raptor safety (RHR, 2009c). Additional BMPs and mitigation efforts not included in the plan of operations could be needed to minimize adverse effects to sensitive species, particularly migratory birds. These mitigation efforts include contacting the Forest Service and developing appropriate avoidance and minimization measures if a migratory bird nest is discovered during mining operations. Mitigation measures could include working around the nest site as feasible to avoid disturbance or developing a mitigation and monitoring plan. The Forest Service could also impose timing restrictions, where possible, so that some aboveground activities could be scheduled to avoid the nesting season, which could mitigate the habitat removal impact to migratory birds. The timing restriction would be April 1 to July 31. Long-term adverse effects to wildlife from wildlife mortality could range from minor to major in magnitude and would be medium in extent, probable, and slight in precedence. If high priority migratory bird mortality resulted from mining, RHR would be in violation of the Migratory Bird Treaty Act (MTBA), causing major impacts.

Habitat Loss, Alteration, Degradation and Fragmentation

Loss of habitat can be temporary or permanent and short term or long term (USFS, 2011c). Long-term loss of habitat would result from mining operations such as removing topsoil for surface facilities, digging, and road construction. To minimize harm to wildlife habitat, pruned and felled trees would be scattered to provide cover, where appropriate. Also when trees are chopped, the mulch would be spread onsite in open areas away from personnel traffic (RHR, 2009c). Reclamation activities would restore the permit area to rangeland after mining operations are complete. However, according to the plan of operations, the mine could be in operation for approximately 17 years (RHR, 2009c). This would lead to long-term habitat loss and avoidance. Many animals would avoid the permit area for the life of the mine, and this avoidance may continue for some time after reclamation for certain long-lived species. Impacts to vegetation are discussed in an earlier section and any alteration to vegetation could cause habitat loss or degradation.

Impacts to wildlife from habitat fragmentation are associated with the destruction or modification of habitat or with the introduction of a permanent disturbance to the habitat that serves to divide large areas of continuous habitat (USFS, 2011). Habitat fragmentation can isolate wildlife populations, decreasing population productivity. Construction of roads, utility corridors, and surface facilities could create wildlife barriers and alter migration patterns and species dispersal (Al-jabber, 2003). Habitat in the region has already been fragmented from previous mining operations (drill pads and access roads) and rangeland activities. BMPs would be used to minimize these impacts. When large pipelines are laid on the ground, wildlife “ramps” would be constructed across the pipeline at about 300-foot intervals. Culverts would be placed on grade wherever possible to allow animal passage (RHR, 2009c).

Fragmentation could impact smaller ground-dwelling animals because they may also have to go around the mining operation to locate forage or living space. Long-term adverse effects to wildlife from habitat loss, degradation, and fragmentation could range from minor to major in magnitude and would be medium in extent, probable, and slight in precedence. Major impacts would occur if the RHR mine violated the MBTA. These impacts could be avoided by implementing timing restrictions on habitat removal from April 1 to July 31, but during initial construction this may not be feasible.

Both action alternatives would entail installation and operation of the 20-inch diameter, 6-mile-long water reuse pipeline, which would be laid atop the ground surface. However, this connected action would not result in long-lived habitat loss, alteration, degradation, or fragmentation. Nonetheless, some short-term habitat degradation in the immediate vicinity of the line would be expected as a result of running and using equipment and vehicles off-road atop vegetation. Although the 20-inch diameter, aboveground line could conceivably interfere with movement and migration of small mammals, reptiles, and nonwinged insects, it is likely that imperfections (bumps and depressions) on the ground surface would in fact allow these small animals to pass beneath the pipeline relatively unobstructed.

Displacement

Impacts to wildlife from noise and associated visual disturbance could result in the temporary displacement of some species during mine development, operation, and reclamation including blasting and excavation activities. It could also occur while the water reuse pipeline is being laid. Noise can adversely affect wildlife in two ways: by inducing stress and by masking communication and other natural sounds (USFS, 2011). Animals rely on meaningful sounds for communication, navigation, avoiding danger, and finding food. Noise pollution is defined as any human sound that alters the behavior of animals or interferes with their daily functions (FHWA, 2011). The level of impact from noise on wildlife depends on decibel levels, durations, and the physical characteristics of the environment (Ouren et al., 2007). Noise pollution can harm the health, reproduction, survivorship, habitat use, physical distribution, abundance or genetic distribution of wildlife (FHWA, 2011). Noise can also lead to changes in behavior, including avoidance behavior and changes in normal patterns (Radle, 1998).

Development and/or operation noise and disturbance from human activity would continue until the completion of reclamation activities. Noise impacts could also impact the ability of wildlife to use vocal communication and natural sounds important for mate attraction, social cohesion, predator avoidance, prey detection, navigation, and other basic behaviors (USFS, 2011). Impacts would generally be localized and confined to the general permit area, around haul roads, and the pipeline during mine development and operation.

Impacts from light pollution depend on the brightness, intensity of the lights, size of the area illuminated, and habitat types surrounding the lights. Animals live by a pattern which is adapted to the 24-hour cycle associated with our planet's rotation. When this pattern is disrupted, animals can become disoriented. Types of animal behavior that rely on the length of dark hours include mating, migration, sleep, and foraging. Potential impacts from light pollution include decreases in reproduction, difficulty foraging, exposure to predators, impairment of night vision, confusion of natural instincts that protect against predators and the elements, high expenditures of energy, and interference with migration and mating. Light pollution may result in temporary to long-term displacement of wildlife surrounding the permit area depending on the frequency and duration of light use (IDSA, 2008). Impacts would generally be localized and confined to the general permit area, around haul roads, and the pipeline during mine development and operation.

Birds and raptors are especially vulnerable to disturbance during nesting activities and the level of sensitivity to a disturbance depends on the species and individual's tolerance level. Intrusion-induced behaviors—such as bird nest abandonment and decreased nest attentiveness—have led to species decline (USFS, 2009b). Temporary absence from a nest could result in high nestling mortality from overheating, chilling, desiccation, or premature fledging. Most raptors return to the same nest site or territory for consecutive years, but may not return to their nesting territory the following season if it was disturbed during the previous year (USFS, 2011).

Short- to long-term adverse effects from wildlife displacement could range from minor to major in magnitude and would be medium in extent, probable, and slight in precedence. Major impacts would occur if RHR violated the MBTA.

Exposure to Chemical and Radiation Hazards Associated with Bioaccumulation in the Air, Soil, Vegetation, and Prey Species

A potential impact to wildlife from mining activities is the degradation of habitat from contamination of chemical elements, including uranium, radon, radium, and other radioactive decay products. The greatest potential for the release of radioactive decay products into the environment would occur from:

- Exposing uranium-bearing rock;
- Extraction of ore and nonore;
- Placement of ore on ore pads;
- Loading ore on trucks;
- Hauling ore offsite; and
- Depressurizing mine water.

Uranium is an element that undergoes radioactive decay. Radioactive decay occurs naturally and breaks uranium down at a steady and predictable rate by releasing one or more small particles and ionizing radiation. This process can produce an isotope of uranium that has a different mass, or create different elements altogether (daughter products). All uranium isotopes are radioactive and the three natural uranium isotopes found in the environment also undergo radioactive decay. The predominant isotope (comprising about 99.3 percent of naturally occurring uranium) is termed "U-238" (sometimes written U_{238} or ^{238}U) and forms a series of decay products including radionuclides radium-226 and radon-222. The decay process continues until a stable, nonradioactive decay product is formed – lead (Pb-206, in the case of U-238) (USEPA, 2011g). These decay products emit energetic particles or energetic waves that travel through a medium or space and which can damage the tissue in a living organism. The amount and duration of radiation exposure determines the severity or type of health effects. These heavy elements also have a chemical toxicity, which is the degree to which a substance is poisonous to a living organism.

Because the amount of exposure and uptake of uranium could determine the severity of the impact on wildlife, it is important to understand how wildlife can be repeatedly exposed to uranium and its decay products in the environment. Unless properly controlled, uranium and other radionuclides could be transported through the environment via atmospheric deposition (sedimentation of uranium or radionuclide particles from the air), dust, runoff, erosion and deposition, groundwater and surface water, and the food chain. Groundwater and surface water could become contaminated with uranium and its decay products from mining activities. Soil and food (prey species) could also have elevated levels of uranium and decay products due to mining activities (Hincks et al., 2010). When living organisms are exposed repeatedly to these radionuclides, toxins can build up in their tissues over time. Bioaccumulation is the buildup of a toxin in a living organism over time. Predator species, like the mountain lion, tend to accumulate higher concentrations of substances released into the environment because they are exposed to more pathways than prey species. For this analysis, major exposure pathways include ingestion, inhalation, absorption, and bioaccumulation. Figures 54 and 55 document these potential uranium and radionuclide exposure pathways.

The extent and nature of the health effects on wildlife associated with exposure to uranium and its decay products remain somewhat inconclusive. Very little research has been conducted on the biological impacts of uranium and other radionuclide exposure on wildlife. Even fewer studies have attempted to quantify the risks to wildlife caused by the chemical or radiation releases at uranium mining sites. Though research is limited, it does suggest that uranium and other radionuclides can affect the survival, growth, and reproduction of plants and animals (Hincks et al., 2010). Exposure to chemical and radiation hazards is influenced by an animal's life history and surrounding environment (Hincks et al., 2010). The sensitivity of wildlife to radiation and chemical exposures is also influenced by body size. Large-bodied species are typically more vulnerable to high levels of ration exposure as described above than small-bodied species (BLM, 2011). Animal studies have shown that sufficiently high doses of uranium ingested into the body may damage the kidneys, and at a still greater dose may cause death (Kathern, 2011).

Historical mining and milling practices in this region in high localized levels of uranium and other radionuclide exposure to living organisms. Even a small increase in uranium contamination could hypothetically contribute to adverse impacts on wildlife. While past uranium mining in the area has contributed to contamination, there have been limited studies on the impacts of uranium on wildlife (EPA, 2011g). Although radiation from uranium and its decay products does not travel far, in the absence of proper ore handling and controls, uranium particles could be transported off the permit area due to the action of wind and water. If groundwater or surface water were to become contaminated, uranium and radionuclides could impact areas outside of the permit area.

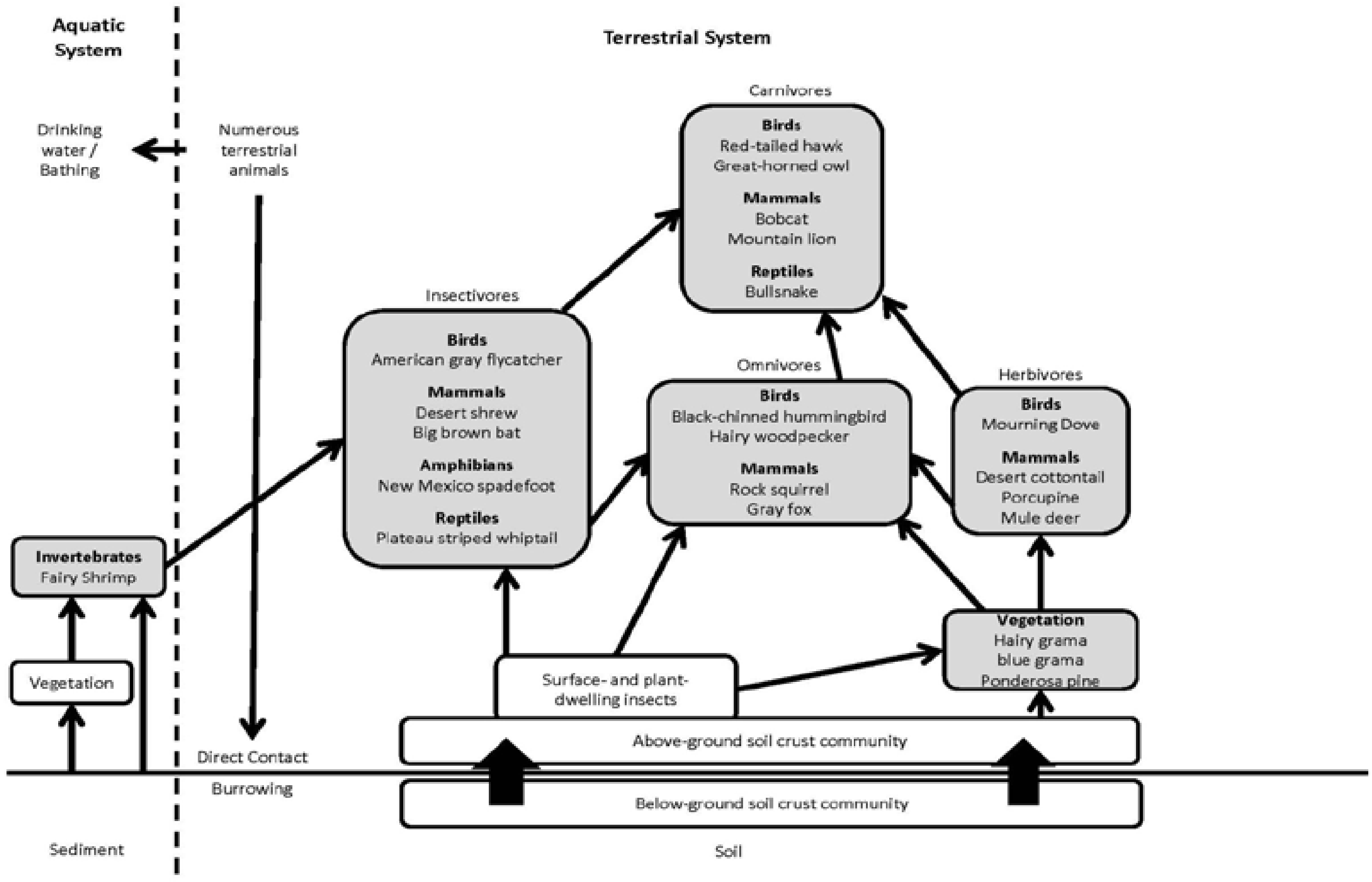


Figure 54. Biological pathways of exposure for uranium and association radionuclides within a food web in New Mexico (adapted from Hincks et al., 2010).

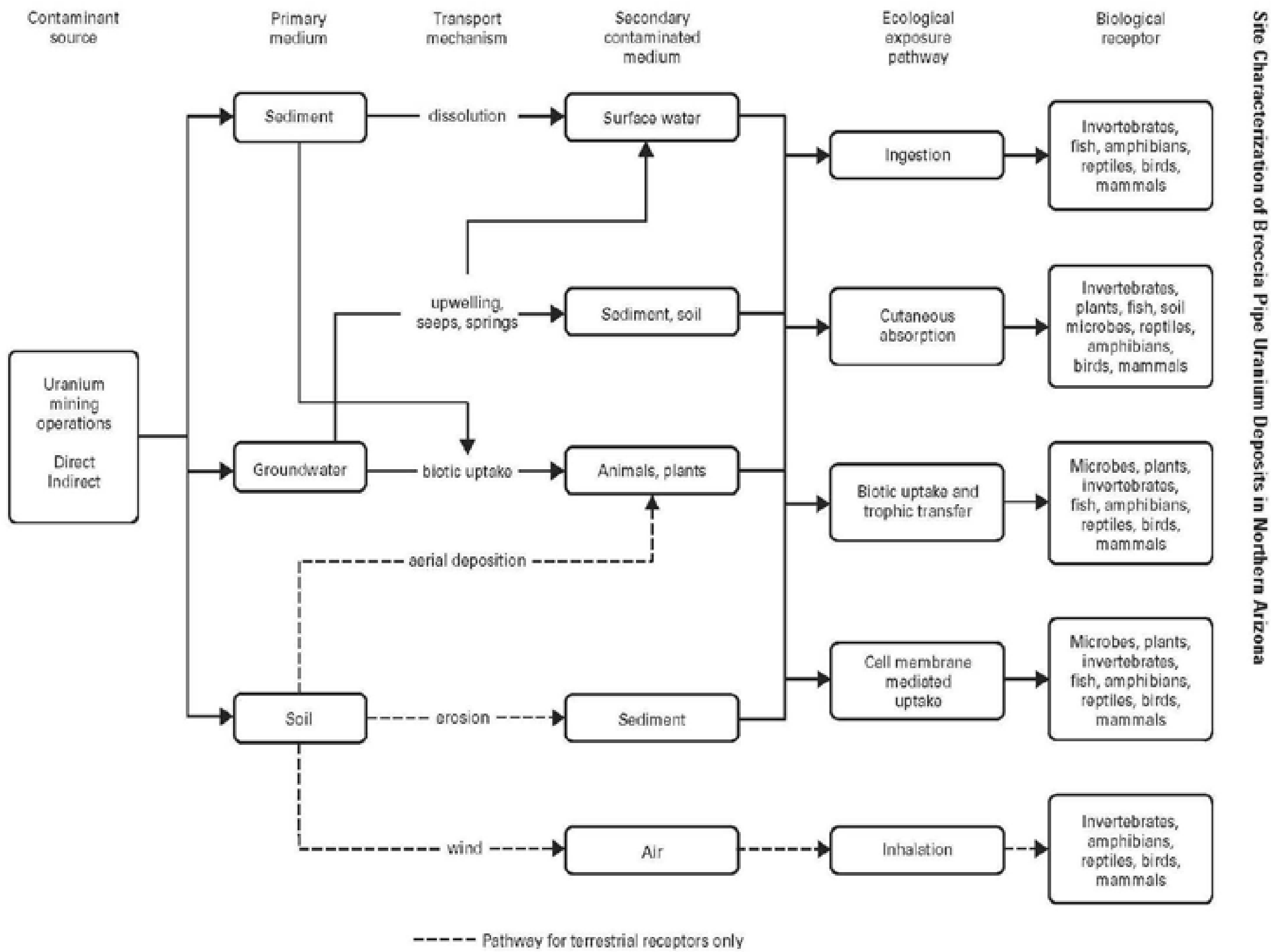


Figure 55. Hypothetical exposure pathways of uranium and other radionuclides (Hincks et al., 2010)

However, because this would be an underground uranium mine with state-of-the-art procedures and BMPs to handle and manage uranium ore, and a water treatment plant to treat and eliminate contaminants from mine water brought to the surface during depressurization/dewatering, problems with unchecked migration or transport of uranium particles above ground and offsite are not expected to occur at the Roca Honda Mine. Thus, direct and indirect adverse impacts to wildlife from exposure to radiation or chemical exposure to uranium and other radionuclides are expected to be minor, long term, limited, unlikely or possible, and of slight precedence. Wildlife and humans alike are exposed to background levels of ionizing radiation from a variety of natural and manmade sources on a daily and annual basis; the Roca Honda Mine might raise exposures of nearby wildlife to a limited extent, but not sufficient so as to substantially impair the health and affect the size of nearby wildlife populations.

Alternative 2

This section analyzes the impacts of the proposed action on general wildlife, State listed threatened and endangered species, Forest Service sensitive species, MIS, and high priority migratory birds.

General Wildlife

Under alternative 2, approximately 218 acres would be disturbed during construction and mine operation activities within the permit area. As noted in chapter 1, Sections 9 and 10 are located on Cibola National Forest land and Section 16 is located on New Mexico State land. The RHR proposed mine permit area would encompass all three of these sections (1,920 acres) and 48 acres of additional land for haul roads, a utility corridor, and mine dewater discharge pipeline corridor. Of these 48 acres, 35 would occur outside of Sections 9, 10, and 16. Surface disturbance within Sections 9, 10, and 16 is expected to be 12 acres (1.9 percent) in Section 9, 71 acres (11.1 percent) in Section 10, and 100 acres (15.6 percent) in Section 16. Within these three sections, 83 acres of vegetation on Cibola National Forest (Sections 9 and 10) would be adversely affected. Additional vegetation disturbance on Cibola National Forest land would occur on 8 acres in Section 11 and 2.5 acres along the pipeline. A total of approximately 93.5 acres would be disturbed on Cibola National Forest land. Most of the impacted acreage in Section 9 would be piñon-juniper woodland; most of the impacted acreage in Section 10 would be desert grassland/shrubland; and most of the impacted acreage in Section 16 would be juniper savanna and desert grassland/ shrubland. Most of the impacted acreage on Section 11 and the pipeline corridor would be desert grassland/shrubland and piñon-juniper woodland.

Additional surface disturbance of 35 acres would occur outside of the permit area from haul roads, utility corridor, and the mine water discharge pipeline. Upgrades and rerouting of mine haul roads would occur to existing roads in Sections 11, 17, and 20. The haul roads would be 60-feet wide and have a gravel surface. New power lines would also be constructed and a portion of the utility corridor would be located on private land in Section 15 totaling approximately 4 acres of disturbance. Approximately 5.5 miles of pipeline carrying treated water off of the project site for discharge and use on a private rancher’s property and would disturb an additional 13.3 acres. This pipeline would be positioned next to the haul road and the utility corridor in Sections 16, 15, 10, and 11. The pipeline would turn north along the road at the junction with the Section11 haul road and proceed north. Approximately 2.5 acres would be on national forest lands and 10.8 acres would be disturbed on private land.

Removing 218 acres of vegetation would result in long-term habitat loss, degradation, and fragmentation and have long term, probable, moderate adverse effects that are medium in extent and slight in precedence to general wildlife. Though habitat would be lost, mitigation discussed above and reclamation efforts would help minimize the effects of habitat loss and fragmentation. Reclamation activities would restore the current use of rangeland. While this would benefit species that rely on grasslands for habitat or food, some habitat would be removed from the permit area. The haul roads would create additional fragmentation for wildlife populations in the area. The direct mortality of wildlife expected during mining operations cannot be quantified. However, based on the size of the affected area, the effects would be minor to moderate in magnitude, short term, medium extent, probable, and slight in precedence. Most wildlife species in the permit area are mobile and could readily avoid direct mortality. Small mammals, amphibians, and reptiles that are more sedentary and less conspicuous would be most susceptible. Speed limit postage of 15mph would reduce the amount of wildlife mortality.

Displacement during mine development and operation would occur and is expected to have long-term, minor to moderate, and probable adverse effects that are medium in extent and slight in precedence. After reclamation activities, many wildlife species would return to the area. Because this area is currently used as grasslands for livestock grazing, existing wildlife in the region is already adapted to this type of land use. Major effects from exposure to chemical and radiation hazards associated with bioaccumulation in the air, soil, vegetation, and prey species are not anticipated. Adverse effects overall would be minor to moderate, long term, and medium in extent, possible, and slight to moderate in precedence.

Overall adverse effects to general wildlife from wildlife mortality, habitat loss, alteration, degradation, fragmentation, displacement, and exposure to chemical radiation hazards are expected to be long term, minor to moderate in magnitude, medium in extent, probable to possible, and slight to moderate in precedence.

State Listed Threatened and Endangered Species

Although the **spotted bat** is not known to occur in the project area and was not observed during surveys, habitat removal during mine development could remove suitable or occupied habitat of this bat. Adverse impacts to the spotted bat would be similar to impacts to general wildlife discussed above. While up to 218 acres of the spotted bats' habitat (piñon juniper-woodland and desert grassland/shrublands) could be removed, the isolated and scattered permanent water bodies or stock tanks that provide the spotted bat with foraging habitat would be unaffected.

Bats in the area may change their roosting habitat, moving to undisturbed areas adjacent to the mining site. Because bats are nocturnal and adapted to low light and unlit conditions (Bat Conservation Trust, 2012), artificial lighting at night could also disturb them and cause these species to displace to other areas. RHR has proposed several measures to minimize the amount of wildlife mortality including posting speed limits of 15 mph and placing screens over ventilation openings (RHR, 2009c). Reclamation activities would restore the area to pre-mining conditions. Bats would not be able to use the mines for hibernation, limiting their exposure to uranium and other radionuclides. Overall adverse effects to this bat species is expected to be long term, minor to moderate in magnitude, and medium in extent. Effects would also be probable or possible and slight to moderate in precedence. Once reclamation has taken place, this species population would be expected to return in a few years to pre-mine levels, barring the local appearance of white-nose syndrome or other catastrophic conditions (USFWS, 2012c). Any mining related behavior change, habitat loss, or mortality is not expected to reduce the overall population in the Cibola National Forest or surrounding areas and would not result in a trend toward Federal listing.

While no surveys found any **American peregrine falcons** in the permit area, suitable habitat exists for both hunting and nesting. Impacts to the falcon would be the same as the impacts to other migratory birds discussed below. Nesting habitat is limited in the area and would be restricted to arroyo canyons and cliffs. Displacement of the falcon during the breeding season could have major adverse effects to the falcon in the area. BMPs and mitigation efforts not included in the Plans of Operations would be needed to minimize effects to the American peregrine falcon if this species is found during mining development or operation. These mitigation efforts include contacting the Forest Service and developing appropriate avoidance and minimization measures if a migratory bird nest is discovered during mining operations. Mitigation measures could include working around the nest site as feasible to avoid disturbance or developing a mitigation and monitoring plan that may include timing restrictions during the peregrine breeding season.

Hypothetically, raptors like the falcon would also be most susceptible to adverse effects from bioaccumulation of uranium and other radionuclides; however, as noted earlier, proper handling and management, as proposed, would likely avoid these effects altogether. Overall long-term, adverse effects are anticipated to range from minor to moderate in magnitude and medium to large in extent as long as proper mitigation efforts were taken if this species was discovered. Effects would be possible and slight to moderate in precedence. If American peregrine falcon mortality or nest destruction resulted from mine development or operation, effects to this species would be major in magnitude.

Forest Service Sensitive Species

At least four small to large **Gunnison's prairie dog** towns exist on the project area. During surveys, these towns appeared to be healthy (RHR, 2009d). Possible direct adverse effects would be similar to effects to general wildlife and could occur from mineral exploration; clearing and crushing vegetation; habitat loss due to surface facilities, pipeline, power lines, and road development as well as from well operation; fragmentation of available habitat; displacement and mortality of prairie dogs; alteration of surface water drainage; and increased compaction of soils (CODNR, 2010). Because there is limited surface water on the permit area, alteration of surface water in this area is not anticipated.

Indirect effects of mineral development could include increased exposure to shooters and OHV users because of improved road access into the area and invasion of habitats by invasive weeds. A potential beneficial impact to the prairie dog would be the reduction in shrub cover through blading and grading, enhancing the available prairie dogs habitat. The use of BMPs would also help protect prairie dogs. Speed limits of 15 mph would reduce the amount of vehicle collisions and fencing around the mine shaft would help to keep prairie dogs out of the mine. In 2008, the USFWS published a "12-Month Finding on a Petition to List the Gunnison's Prairie Dog as Threatened or Endangered." The USFWS found that this species is not threatened or endangered throughout all of its range, but that the portion of the current range of the species located in central and south-central Colorado and north-central New Mexico represents a significant portion of the range where the Gunnison's prairie dog is warranted for listing under the ESA (USFWS, 2008). The Gunnison's prairie dogs found within the project area are not warranted for listing under the ESA (RHR, 2009d). Because of the location of prairie dog towns in the area, adverse effects would be moderate in magnitude and medium in extent (CODNR, 2010). Effects would also be probable, long term (but not permanent), and slight to moderate in precedence. Once mining and related activities have ceased and reclamation has occurred, population recovery of the Gunnison's prairie dog would be expected. Because the populations within the permit area are healthy and do not warrant listing under the ESA, any impacts to habitat or individuals from the proposed mining would not result in a trend toward Federal listing.

Possible direct adverse effects to the **Western burrowing owl** would be similar to effects to general wildlife and could occur from mineral exploration; clearing and crushing vegetation; habitat loss due to surface facilities, pipeline, power lines, and road development as well as from well operation; fragmentation of available habitat; displacement and mortality of prairie dogs; alteration of surface water drainage; and increased compaction of soils (CODNR, 2010).

Indirect effects of mineral development could include increased exposure to OHV users because of improved road access into the area and invasion of habitats by invasive weeds. A potential beneficial impact to the burrowing owl due to its dependence on prairie dog burrows would be the reduction in shrub cover through blading and grading, enhancing the available prairie dog habitat. The use of BMPs would also help protect prairie dogs. Speed limits of 15 mph would reduce the amount of vehicle collisions and fencing around the mine shaft would help to keep burrowing owls out of the mine. Because of the location of prairie dog towns that provide burrowing owl habitat in the area, adverse effects would be moderate in magnitude and medium in extent (CODNR, 2010). Effects would also be probable, long term (but not permanent), and slight to moderate in precedence. Once mining and related activities have ceased and reclamation has occurred, population recovery of the burrowing owl would be expected. Because the populations within the permit area are healthy relative to the presence of prairie dogs, any impacts to habitat or individuals from the proposed mining would not result in a trend toward Federal listing.

Although **Merriam's shrews** are not known to occur in the permit area, it is a difficult species to capture and suitable habitat occurs in the permit area. Adverse impacts to the shrew are anticipated to be similar to impacts to general wildlife discussed above. Removal of 12 acres of piñon-juniper habitat within the permit area during mine development could adversely affect the shrew. Though the area of habitat likely disturbed under this alternative is small and any impacts to habitat or individuals would not result in a trend toward Federal listing since it is not known to occur in the project area. Effects would be minor in magnitude, medium in extent, possible, long term (but not permanent), and moderate in precedence.

Although the **pale Townsend's big-eard bat** is not known to occur in the permit area, suitable habitat of this species does. Adverse impacts to this bat would be similar to impacts to the spotted bat discussed above. Habitat loss and disturbance from mine development could impact the roosting sites for this species and disturbance during development and operation could cause individuals of this species to avoid the area. Overall adverse effects to this bat species is expected to be long term, minor to moderate in magnitude, and medium in extent. Effects would also be probable or possible and slight to moderate in precedence. Once reclamation has taken place, this species population would be expected to return in a few years to pre-mine levels, barring the local appearance of white-nose syndrome or other catastrophic conditions (USFWS, 2012c). Any mining related behavior change, habitat loss, or mortality is not expected to reduce the overall population in the Cibola National Forest or surrounding areas and would not result in a trend toward Federal listing.

The **Botta's pocket gopher** is known to occur within the permit area and could potentially be *Thomomys bottae planorum.* Adverse impacts to this species would be similar to impacts to general wildlife species discussed above. Pocket gophers typically live alone in a burrow system that can cover an area that is 200 to 2,000 square feet. The use of BMPs would help to protect this species. Speed limits of 15 mph would reduce the amount of vehicle collisions and fencing around the mine shaft would help keep gophers out of the mine. Adverse effects are anticipated to be moderate in magnitude and medium in extent. Effects would also be probable, long term (but not permanent), and slight to moderate in precedence. Once mining and related activities have ceased and reclamation has occurred, population recovery of this species would be expected to recover. Impacts to habitat or individuals would not result in a trend toward Federal listing.

Both the **fairy shrimp** and **clam shrimp** are not known to occur within the permit area, but suitable habitat is present. Adverse effects to these species would be similar to impacts to general wildlife species discussed above. Mining development or operation could cause temporary pools of water to collect in the permit area, benefiting these species. Adverse effects are anticipated to be minor in magnitude and medium in extent. Effects would also be possible, long term, and slight to moderate in precedence. Once mining and related activities have ceased and reclamation has occurred, population recovery of these species would be expected. Impacts to habitat or individuals would not result in a trend toward Federal listing.

Forest Service Management Indicator Species

Impacts to the **Rocky Mountain elk** would be similar to impacts to general wildlife. Direct impacts to browse and forage habitat of elk would occur from mine development and operation (USFS, 2011). Approximately 171 acres of montane grassland (desert grassland/shrubland and juniper savannah) of the 865 acres within Sections 10 and 16 could be temporarily lost due to mining development and operations. Additional habitat would be lost in 35 acres outside of these sections. Within Forest Service land on Sections 9 and 10, 71 acres of mountain grassland could be removed. Up to an additional 10.5 acres of desert grassland/shrubland could be temporarily lost due to the pipeline development on Cibola National Forest. The Cibola National Forest contains 192, 037 acres of this habitat (USFS, 2005 MIS Report). In addition, reclamation activities would restore grasslands in this area. The proposed action is not expected to impact elk to the point of causing declining population trends forestwide. The forestwide habitat trend for mountain grassland is anticipated to remain stable.

Overall adverse effects to elk are expected to be long term, minor in magnitude, medium in extent, probable, and slight to moderate in precedence.

Impacts to **mule deer** would be similar to impacts to general wildlife and Rocky Mountain elk. Suitable grazing, fawning, and winter range habitat for mule deer would be removed on about 12 acres of piñon-juniper woodland and up to 171 acres of montane grassland/shrubland on Sections 9, 10, and 16 with 71 acres removed on National Forest Service land. Up to an additional 10.5 acres of desert grassland/shrubland or piñon-juniper woodland could be temporarily lost due to the pipeline development on Cibola National Forest. The Cibola National Forest contains approximately 57,755 acres of mountain shrub and 838,376 acres of piñon-juniper woodland.

Mule deer numbers have decreased over the past decade across the western United States, which may be due to the mule deer's need for early and mid-successional habitats that are being lost due to a lack of disturbance either from fire and/or mechanical (timber harvest) treatment. Recent increases in mule deer numbers on Cibola National Forest may be a result of several large wildfires which have occurred in the area. Mountain shrub and piñon-juniper habitat have not proven to be a limiting factor for population expansion (USFS, 2005 MIS Report). Because populations of mule deer are declining in the permit area, overall adverse effects from the proposed action over the short term are expected to be moderate, medium in extent, probable or possible, and slight to moderate in precedence.

Reclamation activities would restore mule deer habitat in the permit area. Over the long term then, adverse impacts would likely be at most minor, medium in extent, probable or possible, and slight to moderate in precedence. The forestwide trend of piñon-juniper woodland habitat is anticipated to remain stable. Any adverse effects to mountain shrub habitat would be mitigated by reclamation activities and would not contribute to the overall decline of this habitat forestwide. Mountain shrub habitat trend would remain downward forestwide. The forestwide population trend for mule deer is expected to remain downward since factors other than this project are causing the current population trends.

Impacts to the **juniper titmouse** would be similar to impacts to general wildlife as well. About 12 acres of piñon-juniper—the preferred habitat of juniper titmouse—would be removed in Section 9 for the duration of the Roca Honda Mine. Up to an additional 10.5 acres of desert grassland/shrubland or piñon-juniper woodland could be temporarily lost due to the pipeline development on Cibola National Forest. Cibola National Forest contains 838,376 acres of this habitat forestwide. The titmouse is very sedentary and disinclined to wander, even in winter. Thus, it would be more susceptible to wildlife mortality than larger, more mobile species.

Though populations at the national level show a stable trend for the juniper titmouse, surveys conducted since 1966 through 2003 indicate a downward population trend in New Mexico. The titmouse also appears to be declining on the Cibola National Forest (USFS, 2005 MIS Report). Overall adverse effects of the proposed action on the juniper titmouse are expected to be moderate over the short term and, once reclamation has taken place, minor over the long term, and medium in extent, probable to possible, and slight to moderate in precedence. Forestwide habitat trend in the piñon-juniper habitat type is expected to remain stable because a very small amount of the total habitat available would be affected. The forestwide population trend of the juniper titmouse is expected to remain downward since factors other than this project are causing the current population trend.

High Priority Migratory Birds

Impacts to migratory birds under this alternative would be similar to impacts to general wildlife, though removal of nesting habitat or disturbance and displacement of migratory birds during the breeding season could have moderate to major adverse effects to migratory birds in the area and would result in unintentional take. BMPs and mitigation efforts not included in the plan of operations would be needed to minimize these effects. These mitigation efforts include contacting the Forest Service and developing appropriate avoidance and minimization measures if a migratory bird nest is discovered during mining operations.

Mitigation measures could include working around the nest site as feasible to avoid disturbance or developing a mitigation and monitoring plan. Effects on migratory birds in the process of migration from, for example, collisions with structures and facilities, would likely be minor.

Predatory birds (raptors) would hypothetically be most susceptible to adverse effects from bioaccumulation of uranium and other radionuclides, except that, as noted above, due to the nature of the planned facilities and the manner in which uranium ore and mine water would be managed and treated, these effects are expected to be minor in magnitude, possible, medium to large in extent, and slight in precedence.

Conclusion – Impacts of Alternative 2 on Wildlife

Overall adverse impacts of the proposed action on State listed threatened and endangered species, Forest Service sensitive species, MIS, and high priority migratory birds once all permit conditions and mitigation measures are taken into consideration, and assuming that these would be diligently implemented, would be direct and indirect, short term and long term, localized, minor to moderate, probable, and of slight precedence or uniqueness. In most instances, once mining activities have ceased and reclamation has occurred, the populations of any special status species which now occur within the permit area are likely to return to their pre-mine levels over a period of years as habitats are restored.

In conclusion, impacts of alternative 2 on wildlife would be less than significant as long as mitigation efforts related to migratory birds are fully implemented, including contacting the Forest Service and developing appropriate avoidance and minimization measures if a migratory bird nest is discovered during mining operations.

Alternative 3

Under this alternative, there would only be one mine shaft. Mining development, operation, and reclamation would occur primarily on Section 16 and Section 9. This section analyzes the general impacts to wildlife, State listed threatened and endangered species, Forest Service sensitive species, MIS, and high priority migratory birds.

General Wildlife

Impacts under this alternative would be similar to impacts under alternative 2. Under this alternative, approximately 120 acres would be disturbed during construction and mine operation activities within Sections 9, 10, and 16. Additional surface disturbance of 35 acres would occur outside of the permit area from haul roads, utility corridor, and the mine water discharge pipeline. Thus, the total area of habitat disturbance would be 155 acres, versus 218 acres for alternative 2.

Vegetation cover types that could be removed in Sections 9, 10, and 16 include 12 acres of piñon-juniper woodland, 8 acres of desert grassland/shrubland, and 100 acres of juniper-savannah/desert grassland/shrubland. Up to an additional 10.5 acres of desert grassland/shrubland or piñon-juniper woodland could be temporarily lost due to the pipeline development on Cibola National Forest.

Overall effects to general wildlife are expected to be long term, minor to moderate, and medium in extent, probable to possible, and slight to moderate in precedence. Impacts to wildlife on Cibola National Forest land would be mostly confined to Section 9.

State Listed Threatened and Endangered Species, Forest Service Sensitive Species, and High Priority Migratory Birds

Impacts to sensitive and State listed threatened and endangered species under this alternative would be similar, but likely less than, impacts under alternative 2 because of the reduction in the project footprint and disturbed acreage. Under alternative 3, approximately 120 acres would be disturbed during construction and mine operation activities within the Sections 9, 10, and 16. On section 9, 10, and 16, 12 of these acres would be on national forest land. Additional surface disturbance of 35 acres would occur outside of the permit area from haul roads, utility corridor, and the mine water discharge pipeline. Of these 35 acres, 10.5 acres of desert grassland/ shrubland or piñon-juniper woodland could be temporarily lost due to the pipeline development on Cibola National Forest.

Vegetation cover type that could be removed in the permit area includes piñon-juniper woodland, juniper-savannah, and desert grassland/shrubland.

Because fewer habitats and less acreage would be altered and developed, overall adverse effects to forest sensitive and State listed threatened and endangered species are expected to be less except to migratory birds. Any violation of the MBTA would result in a major adverse effect. Adverse effects are expected to be long term, minor to moderate, and medium in extent, probable to possible, and slight to moderate in precedence to nonmigratory bird species. Adverse effects to migratory birds are expected to be long term, minor to moderate and medium in extent, probable to possible, and slight to moderate in precedence.

As with alternative 2, in most instances, once mining activities have ceased and reclamation has occurred, the populations of any special status species which now occur within the permit area are likely to return to their pre-mine levels over a period of years as habitats are restored.

Management Indicator Species

Impacts to **Rocky Mountain elk** under this alternative would be similar to impacts under alternative 2, but smaller in extent. Approximately 108 acres of montane grassland (desert grassland/shrubland and juniper savannah) of the 865 acres within Sections, 9, 10, and 16 could be temporarily lost due to mining development and operations. Eight of the 108 acres of montane grassland would occur on national forest land. Additional habitat would be disturbed on 35 acres outside of these sections. Of these 35 acres, 10.5 acres of desert grassland/shrubland or piñon-juniper woodland could be temporarily lost due to the pipeline development on Cibola National Forest.

The Cibola National Forest contains 192,037 acres of this habitat (USFS, 2005 MIS Report). In addition, reclamation activities would restore grasslands in the permit area. The proposed action is not expected to impact elk to the point of triggering declining population trends forestwide so that forestwide the population trend is expected to remain upward. The forestwide habitat trend for mountain grassland is also anticipated to remain stable.

Overall adverse effects to this species are expected to be long term, minor in magnitude, medium in extent, probable, and slight to moderate in precedence.

Suitable grazing, fawning, and winter range habitat for **mule deer** would be removed on about 12 acres of piñon-juniper woodland and up to 108 acres of montane grassland/shrubland in the permit area, with 8 of these acres occurring on national forest land. The Cibola National Forest contains approximately 57,755 acres of mountain shrub and 838,376 acres of piñon-juniper woodland.

Over the long term then, adverse impacts would likely be at most of minor magnitude, medium in extent, probable or possible, and slight to moderate in precedence. The forestwide trend of piñon-juniper woodland habitat is anticipated to remain stable.

Any adverse effects to mountain shrub habitat would be mitigated by reclamation activities and would not contribute to the overall decline of this habitat forestwide. The forestwide habitat trend for mountain shrub would remain downward. Forestwide population trend for this species is expected to remain downward since factors other than this project are causing the current population trends.

Impacts to the **juniper titmouse** would be the same as impacts discussed under alternative 2 because habitat removal for this species would remain the same.

Conclusion – Impacts of Alternative 3 on Wildlife

Overall adverse impacts of alternative 3 on wildlife, once all permit conditions and mitigation measures are taken into consideration and assuming that these would be diligently implemented, would be somewhat less than the impacts from alternative 2, because of reduced habitat conversion during mine construction and operations.

Overall adverse impacts of the proposed action on State listed threatened and endangered species, Forest Service sensitive species, MIS, and high priority migratory birds would be direct and indirect, short term and long term, localized, minor to moderate, probable, and of slight precedence or uniqueness. In most instances, once mining activities have ceased and reclamation has occurred, the populations of any sensitive species which now occur within the permit area are likely to return to their pre-mine levels over a period of years as habitats are restored.

In conclusion, impacts of alternative 3 on wildlife would be less than significant as long as mitigation efforts related to migratory birds are fully implemented, including contacting the Forest Service and developing appropriate avoidance and minimization measures if a migratory bird nest is discovered during mining operations.

Cumulative Effects

Cumulative effects on wildlife are considered in the context of the Mt. Taylor Ranger District and Cibola National Forest as a whole, and for a period of several decades into the future following mine closure. Cumulative effects on wildlife would be similar to those for vegetation because of the dependence of wildlife on habitat. Past impacts to the piñon-juniper woodland habitat in the project vicinity include livestock grazing, timber harvesting, recreation (e.g., hunting), exploratory drilling, mining, power line construction, OHV use, and access road construction. Most of these are currently passive activities except for hunting and livestock grazing.

The proposed surface facilities (encompassing about 180 acres within the permit area), road improvements, and water pipeline construction would all directly impact (by temporarily eliminating) piñon-juniper, desert grassland, and wildlife habitat during the life of the project (approximately 18 years or 2 decades). During both construction of the mine, as well as its operation, the movement of humans and machinery, and the noise generated by heavy equipment, trucks, and explosives within the permit area and along transportation routes would be expected to disturb wildlife to some extent across an area somewhat greater than these 180 acres.

However, both the piñon-juniper habitat and desert grassland habitats are widespread in the landscape surrounding the permit area, and the cumulative effect of an additional 180 acres would not be significant, as noted above under the “Vegetation” section. The 180 acres of disturbed vegetation would be reclaimed at the close of active mining operations. Impacts to wildlife from the mine would last until the mining operation ends and reclamation of the disturbed areas is complete, that is until they are restored with vegetation, which would occur over the ensuing years and decades.

No known activities are proposed for the proposed project area that would contribute to wildlife impacts to Mt. Taylor as a whole except for the La Jara Mesa uranium mine, proposed for the other side of Mt. Taylor.

Both the proposed action (alternative 2) and one shaft alternative (alternative 3), in combination with past, present, and reasonably foreseeable future actions that may result in increased impacts to wildlife habitat and wildlife populations, would not create significant cumulative impacts to wildlife species. Therefore, no significant cumulative impacts are expected to occur to wildlife species.

Cumulative effects on special status species (State listed threatened and endangered, Forest Service sensitive species, MIS, and high priority migratory birds) would be broadly similar to those for wildlife in general because of the dependence of all wildlife on habitat. However, the fact that certain species such as those described above are listed as sensitive, threatened, or endangered in the first place is a clear sign that all combined human activities over long periods of time have had a greater cumulative impact on their well-being than on wildlife in general.

The cumulative impact on special status species of all these reasonably foreseeable actions would likely be minor to moderately adverse but not significant.

Land Use

Affected Environment

The Roca Honda project area lies within the Navajo section of the Colorado Plateau. Past, current and potential uranium milling operations in the area are found in two locations: (1) the central western part of McKinley County, east of Gallup, New Mexico and (2) the southeastern part of McKinley County where the Roca Honda project is located and the northern part of Cibola County, east and northeast of Grants, New Mexico. These two areas are parts of the Grants Uranium District, an area rich in mineral deposits where a number of uranium sites exist, once existed, or are planned (USNRC, 2010).

The project site lies primarily within Sections 9, 10, and 16, Township 13 North, Range 8 West. Sections 9 and 10 are U.S. Forest Service land and Section 16 is State of New Mexico land. The U.S. Forest Service land is designated as the Mt. Taylor Ranger District, one of four ranger districts in the Cibola National Forest. The Cibola National Forest and surrounding land uses are shown on figure 56. The 1,618,459-acre forest generally surrounds the Albuquerque metropolitan area, with the Mt. Taylor Ranger District located in portions of Cibola, Sandoval, and McKinley Counties (USFS, 1985).

Cibola National Forest

The forest landscape is generally mountainous with numerous canyons, washes, and mesas. Elevations range from about 5,660 feet in the lowland desert to the highest point, Mt. Taylor, at 11,301 feet. The lower elevations of the forest are rolling, hilly terrain cut by sand washes and small canyons. Rock outcrops are prevalent. With an increase in elevation, the terrain becomes mountainous with prominent canyons and exposed rock faces. There are numerous peaks in excess of 9,000 feet (USFS, 1985).

The “Cibola National Forest Land and Resource Management Plan” (forest plan) of July 1985 identified several land management issues and opportunities that continue to be the primary management foundation for policies applied to Cibola National Forest lands that include the project site (Reidy, 2012). Despite the age of the plan, the issues and opportunities in the forest plan that are relevant to the affected land use environment for this project include:

> ***Range Management.*** Forage production and/or intensity of management on approximately 75 percent of the forest grazing allotments is inadequate to support permitted livestock. Current levels of use and management intensity on these allotments result in declining site productivity and unacceptable soil loss (USFS, 1985). Currently, the mine permit area is actively used for grazing management (Reidy, 2012).
>
> ***Soil and Water.*** Resource use and activities have created unacceptable soil erosion and reduced water quality on some watersheds on the Cibola NF. Soil productivity has been reduced on these areas, and continuing erosion further reduces potential production (USFS, 1985).
>
> ***Recreation.*** Across the Cibola National Forest, demand for dispersed recreation opportunities, including off-road vehicle use and winter sports activities, has steadily increased. This results in visitor conflicts and resource conflicts. Demand for developed recreation, especially opportunities for large group use areas on the Sandia district near Albuquerque, exceeds capacity. Overcrowding exists on peak days. Opportunities need to be identified in private and public sectors for various types of public use sites. A more thorough analysis of the project’s effects on recreation is presented under that section heading (USFS, 1985). Specific current recreation uses of the mine permit area in Sections 9 and 10 include hunting and firewood gathering (Reidy, 2012). It is also likely that general recreation activities such as hiking, viewing of natural features, and similar activities are common uses as well. There is no further written documentation of the details of these current recreation uses in these sections such as numbers of particpants or seasonal variation of visits.
>
> ***Minerals Management.*** Exploration, development, and production of minerals, energy resources, and common varieties have the potential to conflict with other resource protection, uses and activities. Knowledge of mineral potential is lacking for some areas on the forest, and more of this type of information is

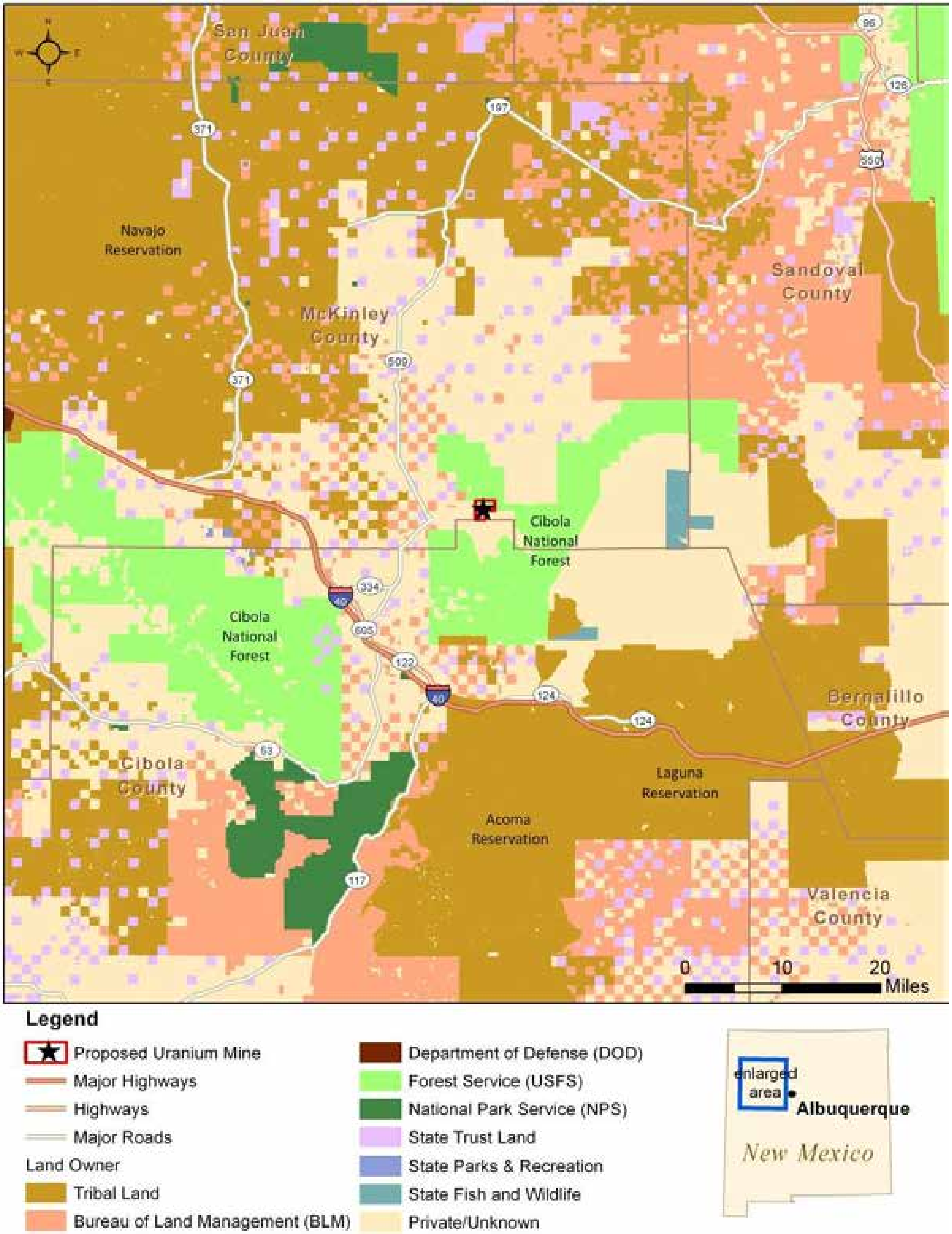


Figure 56. Regional map with surrounding land ownership

needed for long-range resource planning. Minerals exploration is limited in some locations by lack of rights-of-way (USFS, 1985).

Transportation. Management of the forest is somewhat restricted by lack of access and an inadequate transportation system. A more complete analysis of the project's effects on transportation is presented under that section.

Electronic Site Management. As population and technology increase, the demand for key electronic sites in central New Mexico will become critical as present demand exceeds available suitable sites.

Unauthorized Use. The level of Forest Service law enforcement is generally perceived as inadequate and does not meet public expectations. The protection of cultural resources, off-road vehicle use, firewood theft, vandalism, and user protection are some of the major problems identified (USFS, 1985).

Roadless Area Conservation Rule

The Forest Service has implemented the Roadless Area Conservation Rule that seeks to protect designated roadless areas on U.S. Forest Service lands from future development. Cibola National Forest has completed an inventory of roadless areas within the forest. The roadless areas within Mt. Taylor Ranger District all lie east of the proposed mine site, either in the old checkerboard area or on the east slope of the mountain (Hall, 2011).

Travel Management Rule

On November 9, 2005, the Forest Service published final regulations governing off-highway vehicles (OHVs) and other motor vehicle use on national forests and grasslands (Travel Management; Designated Routes and Areas for Motor Vehicle Use, Federal Register / Vol. 70, No. 216/36 CFR Parts 212, 251, 261, and 295).

The Travel Management Rule (TMR) requires the responsible official to provide for a system of USFS roads, USFS trails, and areas on USFS lands that are designated for motor vehicle use by class of vehicle and, if appropriate, by time of year, to display those designations on a motor vehicle use map." In April 2011, the Cibola forest supervisor signed a decision document that implemented the TMR for the Mt. Taylor Ranger District. In this decision document, all Forest Service roads within Sections 9 and 10 where the Roca Honda project is located are restricted to administrative use.

USFS roads restricted to administrative use are roads for which the USFS has an ongoing, regular maintenance responsibility but are not designated for motor vehicle use under the TMR. The Agency does not want to close them (closing is an administrative designation that places the road in the lowest maintenance level and prohibits any motorized vehicle use, including administrative use) or decommission them because they are needed for management of the forest. They can still be used for limited administrative use by the Agency or used by those outside the Agency when authorized by permit. If there is a permitted user, the Forest Service may require that user to maintain the road or pay deposits to the Agency for maintenance, depending on the nature of the permitted use (Baker, 2011).

In addition, the TMR provided for the prohibition of unrestricted motorized cross-country travel and limited cross-country motorized vehicular use to designated areas. There is only one such area within the Mt. Taylor Ranger District and it is located in the Zuni Mountains, far removed from the vicinity of the Roca Honda Mine site (Baker, 2011b).

New Mexico State Lands

The current surface land use for State owned Section 16 is grazing (Lease GM-1352). There is also a power line right-of-way (RW-18717) of 5.98 acres in the northern half of the section issued to Continental Divide Electric Coop. Current grazing land use would be able to coexist with the mining operation inasmuch as the commissioner would most likely withdraw the mineral operation acreage from the grazing lease (Norwick, 2012).

Tribal Lands

Nearby American Indian reservations include lands of the Acoma Pueblo, Laguna Pueblo, Zuni, Navajo, Ramah Navajo, and Hopi Tribes (USNRC, 2010). Historically, Forest Service lands including the project site have been used for traditional cultural and religious activities by these tribes and others (for a more detailed discussion see the “Cultural Resources” section). Mt. Taylor in particular is a sacred place of veneration to all of the tribes in this part of New Mexico and is frequently visited by tribal members.

Private and Other Lands

Although sparsely populated, the region surrounding the project has three fairly large population centers: Gallup, with more than 21,000 people; Grants, with approximately 9,200 people; and Zuni Pueblo, with about 6,300 people. Smaller communities are scattered along the Interstate 40 corridor. Generally, private, Federal, and tribal lands in this region are rural, mainly undeveloped, sparsely populated, and mostly used for livestock grazing and to a lesser extent for timber and agricultural production. In McKinley County, for example, more than 85 percent of the land is used for agricultural purposes and 83 percent of that land is used for livestock grazing. Only 9 percent and 0.6 percent of the land is used for timber production and for dry and irrigated crop production, respectively. Coal and uranium milling activities use less than 1 percent of the land in McKinley County (USNRC, 2010).

Environmental Consequences

As described in chapter 2, mining activity at the Roca Honda Mine will include the major phases of mine development, mine operation, and mine reclamation. The following evaluation and discussion of environmental consequences for land use considers the full range of these major phases. In many cases the environmental consequences are the same or similar for all or nearly all of these major phases, but where important differences between phases are present, the discussion will specifically reference these differences between phases.

Table 40 shows the resource-specific criteria and definitions for land use that are used as impact criteria for of the three alternatives. The basis for describing the overall significance of the impact to the resource may be seen in the “Methodology” section at the beginning of chapter 3.

Table 40. Impact characterization for land use

Term	Definition
Magnitude	
Major	In conflict with Federal or State land use plans
Moderate	In conflict with regional or county land use plans
Minor	In conflict with nearby municipa1 or site specific land use plans
Duration	
Long Term	Project life is more than 20 years
Medium Term (limited or intermittent)	Project life is 5–20 years
Short Term	Project life is less than 5 years
Extent	
Large	Proposed project occupies an area greater than 5 percent of the planning area jurisdiction.
Medium (localized)	------
Small (limited)	Proposed project occupies an area less than 5 percent of the planning area jurisdiction.
Likelihood	
Probable	Occurs under typical operating conditions
Possible	Occurs under worst-case operating conditions
Unlikely	Occurs under upset/malfunction conditions

Land use policies on Cibola National Forest lands are derived from a series of land management issues and opportunities that are relevant to land use and that are identified in their forest plan (USFS, 1985) as described above and listed again below:

- Range Management
- Soil and Water
- Recreation
- Minerals Management
- Transportation
- Electronic Site Management
- Unauthorized Use

The land use policies are, therefore, potentially affected by actions from each alternative that alter the conditions of these issues and opportunities. Environmental consequences of the proposed action and alternatives are evaluated as they impact these established land management issues and opportunities.

Alternative 1

Under this alternative, the mine would not be developed, would not be operated, and there would, therefore, be no need for reclamation. Current land uses would remain in place on Sections 9 and 10, the Federal lands; on Section 16, the State of New Mexico lands; as well as on Sections 11, 15, 17, and 20, the private lands through which utility corridors and access roads would be utilized in the mining operations.

With existing land uses remaining as they currently are, there would be no effects to land use to consider, the levels of impact for the five significance criteria would all be at the lowest possible impact levels, and the overall impact of this alternative is determined to be not significant.

Effects Common to the Action Alternatives

Range Management

To the extent that National Forest System lands in Sections 9 and 10 are among those lands that Cibola National Forest has identified in the forest plan as inadequate to support permitted livestock, the temporary removal of some of these lands as grazing allotments due to the domination of hard rock mining as an exclusive primary activity may have a restorative effect on forage production within those parcels on these lands that contain grazing areas.

Those areas of the mine development that would permanently remain unvegetated, such as access roads that would remain after reclamation has ended, would moderately decrease the forage lands available on these affected lands, but this will be counterbalanced by the benefit of increased access to the grazing lands for management and maintenance. The reclamation plan has specifically targeted grazing as a post-mining land use, so reclamation efforts would concentrate on reestablishing this important existing land use.

Soil and Water

Potential effects on storm water quality during mine development and operation come primarily from heavy equipment activities associated with construction, and later during operations, the transportation of ore and stockpile materials. When precipitation occurs, the potential for downgradient effects from transport of sediment and, to a lesser extent, fuels and lubricants from equipment are the greatest. To minimize the potential effects from precipitation during mining operations, sediment control BMPs would be established downgradient of activity areas to localize effects of rain during mine development and operations. The BMPs are described in detail in section 5.1 of the Roca Honda Mine operations plan (RHR, 2012).

Recreation

The “Affected Environment” section on “Land Use” identified that Cibola National Forest’s implementation of the Travel Management Rule resulted in restricting all NFS roads in Sections 9 and 10 to administrative use only. This means that there is no authorized use of roads within these sections for recreational purposes including OHVs, except perhaps limited travel by permit for the existing hunting land use.

The existing hunting land use would be curtailed by restricted access, including fencing, due to safety concerns for mine development and operations. Because of the extended range of firearms and potential danger to mine workers, it is likely that hunting activity would be restricted from access at a distance greater than simply the perimeter of fencing around the protected areas of the mine, which may be the limit for the grazing land use or firewood gathering land use.

Other forms of general recreation that may include hiking and similar activities would continue within Sections 9 and 10 where access is not restricted by fencing.

Minerals Management

The forest plan identifies concerns about minerals management related to conflicts with other resource protection, uses, and activities. There are also issues related to unknown mineral potential and limited access for exploration. The Roca Honda Mine operations plan (RHR, 2012) systematically addresses these issues and facilitates the minerals management opportunities provided for as one of the multiple uses of the forest plan.

Transportation

As indicated above, the roads within Sections 9 and 10 are open system roads not designated for motor vehicle use. Public transportation in these sections is, therefore, already restricted and, therefore, no effects are anticipated with regard to public use. Transportation improvements in the form of access roads are planned for the project that will facilitate efficient movement of mine-related traffic.

As the project moves out of the reclamation stage, some of the road improvements made for the project would remain in place. This would enhance the grazing management post-mining land use, in particular, by allowing more efficient access to grazing allotments for maintenance and management purposes. An undetermined level of maintenance would be necessary for these roads which is likely to require more resources than is currently the situation in these sections.

Electronic Site Management

The forest plan identified a latent demand for electronic sites in the district. This alternative will do nothing to increase or decrease the opportunity for implementing more electronic sites, and there are no known sites in existence or in the planning stages.

Unauthorized Use

The existence of the Roca Honda Mine and the presence of mining personnel during mine development, mine operations, and mine reclamation could provide a complementary balance for the inadequacies of Forest Service law enforcement identified by the forest plan. The mine would have its own security personnel, who won’t have jurisdiction beyond mining permit areas, but the mere presence of additional personnel in the area may be a deterrent to some unauthorized use. Once the mine-related transportation network is developed, this could also foster increased attraction for unauthorized use. The increased incentive would be counterbalanced by the presence of personnel while the mine is active, but this will not be the case once the mine is closed.

Alternative 2

All Federal lands of Sections 9 and 10 are designated as part of the mine permit area. Mine development and operations activities in Section 9 are limited to construction of ventilation shafts proposed on that section and access roads to them, or approximately 12 acres of disturbance. Development and operations on Section 10 are more substantial, i.e., approximately 71 acres including surface facilities, ventilation shaft locations, and dewatering well locations (Velasquez, 2012a). Although located on State of New Mexico land, the development and operations related to a second shaft on Section 16, with surface facilities and features similar to that surrounding the shaft in Section 10, will total approximately 100 acres (RHR, 2012).

Although Section 11 is not part of the mine permit area, an existing forest road will be upgraded and rerouted to the extent necessary (approximately 8 acres) to avoid archaeological resources to accommodate haul truck traffic and general access to the Section 10 facilities. Similarly, the haul road providing access to Section 16 is an existing road on private land, i.e., Sections 20 and 17, will be upgraded as necessary (approximately 10 acres in Sections 17 and 20). A portion of the utility corridor is located on private land in Section 15 and totals approximately 4 acres of disturbance.

RHR would limit access to all of the development and operations areas to the extent necessary to protect public safety and control the work space. To the extent that fencing and other access limiting controls are in place, those areas would not be available for the current land uses of grazing management, firewood gathering, or hunting. The degree of additional limited access to Sections 9 and 10 is to be determined by the Forest Service based upon the nature of the access activity. Hunting, for example, would be more unlikely to occur in proximity to active mine development and operations than grazing management for reasons of human safety associated with the mining (Velasquez, 2012a).

It is possible that the public will have access to most of Section 9 and 10 other than those areas that RHR is allowed or required to fence off. Project planning activities to date have closely considered this access as it relates to potential adverse impacts on cultural properties, with U.S. Forest Service cultural resource managers expressing concern about the risk of archaeological site disturbance resulting from easier access to forest land because of the better roads that RHR would develop for the operations (Velasquez, 2012a).

New Mexico Mining Act regulations require that the mine be reclaimed to achieve a self-sustaining ecosystem appropriate for the life zone of the surrounding areas unless conflicting with the approved post-mining land use (RHR, 2009). The forest plan provides for multiple land uses, including grazing. In a July 21, 2009, letter, the forest supervisor of the Cibola National Forest provided written approval of RHR's proposal to reclaim Sections 9 and 10 to a post-mining land use of grazing. The forest supervisor further concluded that RHR's proposal is consistent with the "Cibola National Forest Land and Resource Management Plan" for the area (RHR, 2009).

Conclusion – Effects of Alternative 2 on Land Use

The magnitude of the effect of this alternative on land use is evaluated as the degree of conflict with established local, regional, or national land use plans and with established and current land uses. The most meaningful land use plan in this regard is the forest plan for the Cibola National Forest. This alternative complies with the minerals management uses identified within that plan as one of the multiple uses acceptable or even promoted by the Forest Service. With plan compliance there is no conflict, so the appropriate magnitude of an adverse effect would be none. However, the proposed action would reduce the area of livestock grazing land available to about

12 permittees for a period of about 2 decades, and this would be considered a minor to moderate impact.

The duration of the effect of this alternative on the land use resource is evaluated as the length of the project life while this alternative is viable. The mine project is scheduled to last 18–19 years from the issuance of a permit to the completion of reclamation (RHR, 2012), so the duration is categorized as medium term, which is a project life of 5–20 years.

The extent of the effect of this alternative on the land use resource is evaluated as the area affected by this alternative as a percentage of the planning area jurisdiction. The planning area jurisdiction is the total area of the Cibola National Forest, which is 1,618,459 acres. When considering the area affected by the alternative, four options might be considered. The first option could be described as the area of Federal lands disturbed by the project, which is 93.5 acres. The second is the total area of land disturbed, both Federal and State lands, which is 183 acres. The third option is the total Federal area covered by the mining permit, which is Sections 9 and 10, or 1,280 acres. The fourth option would also include all of Section 16, the State of New Mexico lands, and part of the permitted mining area, which would be 1,920 acres. There are also approximately 22 acres disturbed on private lands in Sections, 11, 15, 17, and 20.

Without regard to which of these options is the most representative of the project extent, and using the conservative fourth choice plus private lands total of 1,942 acres, this affected land area is approximately 0.1 percent of the planning area jurisdiction. This is then categorized as a small extent, which is an affected area of less than 5 percent of the planning area jurisdiction.

The likelihood of the effect of this alternative on the land use resource is evaluated as the estimated potential that the effects of the alternative would occur. For this purpose, the EIS considers the likelihood for occurrence of effects such as temporary exclusion of current land uses including grazing and hunting or the condition that an improved mine transportation network would encourage unauthorized use of national forest lands. The former is a probable occurrence and the latter is a possible occurrence, so the likelihood of incurring effects would then be categorized conservatively as probable, or that the effects would occur under typical operating conditions.

The precedence for the effect of this alternative on the land use resource is evaluated as the degree of precedence setting, uniqueness, or predictability of the effects of the alternative. Mining development, operations, and reclamation have been performed in this country for several decades and the effects as they relate to land use are well known and predictable. Therefore, the precedence (for unexpected effects) in this alternative is categorized as slight.

Considering the levels of impact for these five criteria collectively, the overall impact or environmental consequence of this alternative on land use is determined to be not significant.

Alternative 3

In the one production shaft alternative, all ore production from the RHR mine would be accomplished by constructing only a single production shaft in Section 16, i.e., the shaft described in RHR’s proposed action, and accessing all of the ore in the permit area by excavating underground mine declines horizontally under the ore and vertical raises up into the ore pods. In this alternative, the ore located in Section 10 would be accessed by constructing two long parallel development drifts from the Section 16 shaft northwest into Section 10 to the approximate location where the Section 10 production shaft described in the proposed action would have been constructed.

The resulting differences in land use effects from implementing alternative 3 arise from elimination of the second shaft along with a considerable amount of surface facilities and infrastructure. There is a reduction of area disturbed by the project, or its footprint, of 63 acres, mostly in Section 10. This includes a reduction from three to two ventilation shafts in Section 9. Access roads in Sections 9 and 10 service ventilation shafts and monitoring wells only and are reduced somewhat in overall length and number of locations serviced. Utility corridors and access roads across private lands in Sections 11, 15, 17, and 20 are still required.

The effects of alternative 3, the one shaft alternative identified above, are relatively similar in scale to those of alternative 2, the two shaft alternative, but on a somewhat smaller scale. In the following discussion of differing changes to the land management issues and opportunities from the forest plan, the effects are determined to be the same as for alternative 2 except as specifically noted.

Range Management

In alternative 3, 63 fewer acres are required for mine development, operations, and reclamation that are potentially available to other uses, presumably the current land uses of grazing management, firewood gathering, and hunting, subject again to maintaining a safe buffer with mine site activities as provided in alternative 2.

Soil and Water

There would be a reduced requirement to disturb native ground and less impermeable area with alternative 2 because of the fewer surface facilities and slightly reduced road lengths. This will mean there are reduced instances of BMPs employed to maintain higher levels of water quality and soil retention. The net outcome is that fewer acres are disturbed and a smaller amount of soil and water resources is affected.

Recreation

Some current recreational activities such as firewood gathering, hunting, and hiking could be allowed at a slightly increased level than that of alternative 2 because of the fact that fewer facilities will be built and less area fenced. It is possible that the addition of 63 acres of land not developed by the mine would not influence a decision about higher levels of hunting activity because of the extended range of possible unsafe effects for hunting.

Minerals Management

There are no meaningful differences between alternatives 2 and 3 perceived for minerals management, as the mineral resource will be extracted to the same extent through a more extensive range of subsurface activity.

Transportation

There would likely be fewer roads left to remain in place following recreation, meaning that there may be a slightly reduced benefit to ensuing grazing management land uses and also a reduced level of maintenance required with fewer roads left.

Electronic Site Management

As in alternative 2, this alternative would do nothing to increase or decrease the opportunity for implementing more electronic sites, and there are no known sites in existence or in the planning stages.

Unauthorized Use

With alternative 3, there are fewer mine activity sites whose presence could serve as a deterrent to unauthorized use of the national forest. The transportation network would be slightly less robust than alternative 2, and so the opportunity for unauthorized use as a result of this improved network is reduced to a small degree.

Conclusion – Effects of Alternative 3 on Land Use

The magnitude of alternative 3’s adverse impacts on land use would be minor to moderate, its duration medium term, its extent small, its likelihood probable, and its precedence slight. Considering the levels of impact for these five criteria collectively, the overall impact or environmental consequence of this alternative is determined to be not significant. These impact ratings are identical to alternative 2 but, as noted, alternative 3 would be somewhat reduced in scale from alternative 3, particularly on national forest lands and, therefore, its effects on land use would be correspondingly less.

Cumulative Effects

Because the final land use for the site, after closure of the mine and reclamation, is the same as the current land use—grazing (primarily)—there would be no cumulative effects.

Recreation

Affected Environment

Nearby recreational activities for the public are available in the Mt. Taylor Ranger District within the Cibola National Forest (figure 57). The forest includes the Zuni Mountains to the west of Grants and the San Mateo Mountains and Mt. Taylor, about 24 km (15 miles) to the east-northeast of Grants. Mt. Taylor is designated by the Navajo Nation as one of six sacred mountains. In Navajo tradition, Mt. Taylor has a special significance as it represents the southern boundary of the Navajo traditional homeland. On June 14, 2008, the New Mexico Cultural Properties Review Committee approved a 1-year emergency listing of more than 171,000 ha (422,000 acres) of land surrounding Mt. Taylor on the New Mexico Register of Cultural Properties (USNRC, 2010).

Recreation in the Cibola National Forest

As the Southwest regional population increases, the U.S. Forest Service expects future needs for outdoor recreation to also increase, including dispersed recreation such as hiking, backpacking, picnicking, hunting, fishing, gathering forest products, bird watching, water skiing, off-road vehicle travel, swimming, and sightseeing (USFS, 1985).

According to the Forest Service’s most recent National Visitor Use Monitoring (NVUM) results, there were approximately 1.43 million visits to the Cibola National Forest to participate in recreation activities in the year 2011 and about 166 million visitors overall to national forests across the U.S. More than 83 percent of interviewed visitors indicated that the purpose of their visit to the Cibola National Forest was for recreation. Of the overall number of visitors, 63 percent were male and 37 percent were female, with the most common age group being the 50–59 year-olds. About 92 percent of the visitors were white with American Indian/Alaska Native the second most common race of visitors at 6.5 percent (USDA, 2012a).

Visits to the Cibola NF area are generally short. The average visit is about 4 hours, and about half last only 2 hours. There appears to be a fairly sizeable core of frequent users. About 16 percent of all visits to this area are made by people who visit at least 50 times per year (USDA, 2012a).

More than half the people who visit the Cibola indicate they participate in hiking/walking and viewing natural features. The key primary activities include hiking (35 percent), viewing natural features (15 percent), and bicycling (10 percent) (USDA, 2012a).

Overall satisfaction ratings for the Cibola NF are quite high. Nearly 94 percent of visits are satisfied with the overall quality of their recreation experience. Most satisfaction measures are 80 percebt or greater (USDA, 2012a).

Recreation Use in the Project Area

Direct observation by Forest Service staff of current recreation uses of the mine permit area in Sections 9 and 10 indicate that they are primarily hunting and firewood gathering (Reidy, 2012). Based upon the above NVUM results, it is likely that general recreation activities such as hiking, viewing natural features, and bicycling may also be common uses. There is no further written documentation of the details of the current uses in these sections such as numbers of participants or seasonal variation of visits.

The “Land Use” section above indicated that in April 2011, the Cibola forest supervisor signed a decision document that implemented the Travel Management Rule for the Mt. Taylor Ranger District. In this decision document, all roads within Sections 9 and 10 where the Roca Honda Mine project is located are identified as Forest Service roads restricted to administrative use.

Forest Service roads restricted to administrative use are U.S. Forest Service system roads for which the U.S. Forest Service has an ongoing, regular maintenance responsibility but are not designated for motorized use by the public. The public cannot use these roads for any motorized use, including OHVs and associated recreation.

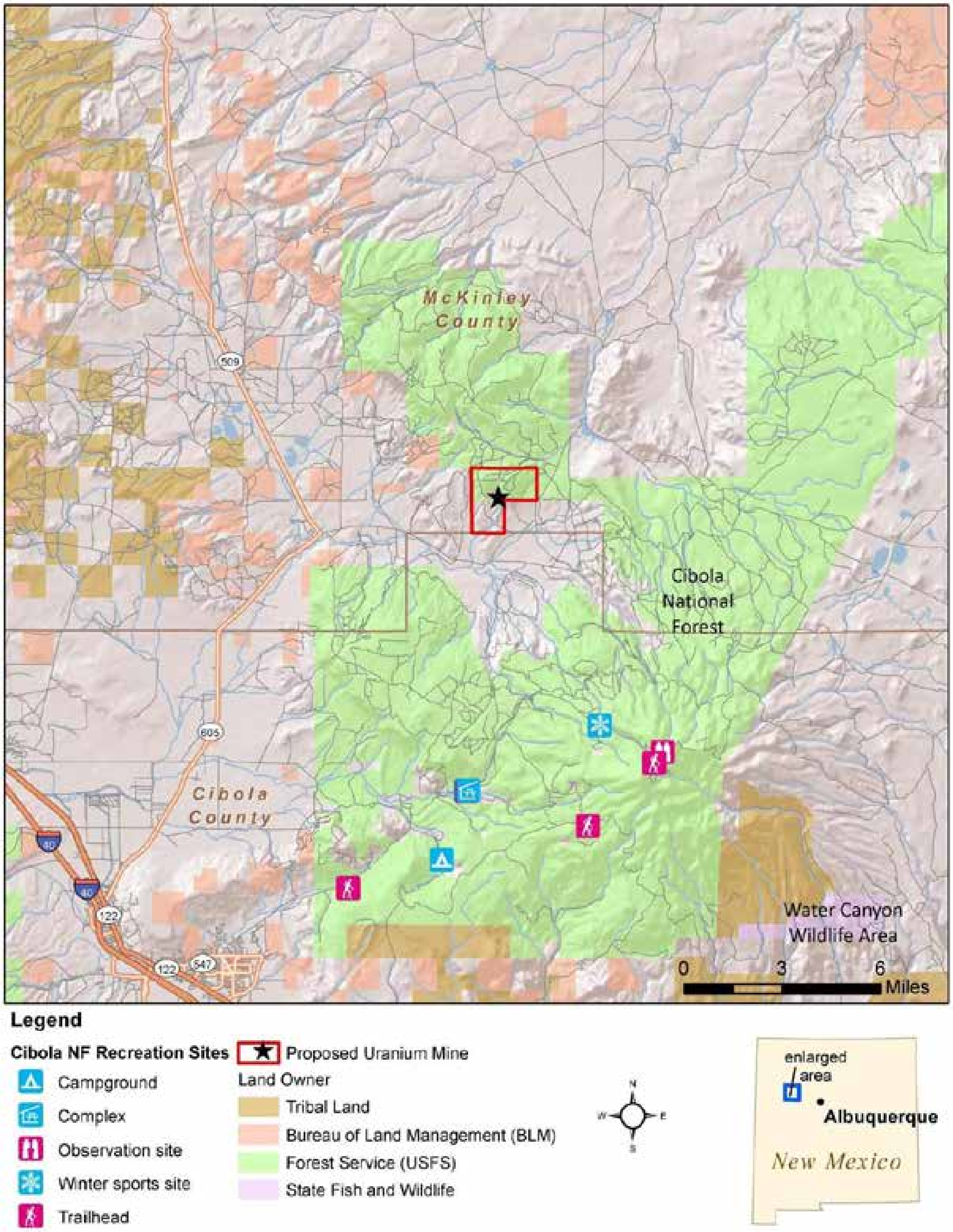


Figure 57. Nearby recreation sites

Specific current recreation uses of the mine permit area in Sections 9 and 10 include hunting and firewood gathering (Reidy, 2012). It is also likely that general recreation activities such as hiking, bird watching, and similar activities are also common uses. There is no written documentation of the details of these current uses in these sections such as numbers of participants or seasonal variation of visits.

The nearest designated recreation sites within Cibola National Forest are in a southerly direction from the mine site at a distance of 7–13 miles. These sites include three trailheads, one campground, one winter sports site, one observation site, and one recreation complex. There are five other recreation areas that are not managed by the Forest Service ranging from 13 to 33 miles from the mine site.

Nearby Recreation Areas

El Malpais National Monument in Cibola County and the Chaco Culture National Historical Park, which has several sites in McKinley County and San Juan County farther north, are the two main recreational and cultural areas managed by the National Park Service in the project area (NRC, 2009).

Water Canyon Wildlife Area is a nearby 2,840-acre site purchased by the State of New Mexico in 1953 to improve winter range for turkey and provide public access to big game hunting. The property sits on the side of Mt. Taylor and is covered with a mixture of piñon, juniper, and mixed grasses and forbs. Supported activities include hunting for elk, turkey, and deer; hiking; camping; wildlife viewing; and horseback riding. The area is located 50 miles west of Albuquerque via I-40 and local roads (PLIC, 2011a).

Bluewater Lake State Park is a 3,000-acre lake surrounded by piñon/juniper covered hills that provides fishing, summer sailing, water-skiing and winter ice fishing. It is located 28 miles west of Grants via I-40 and NM 412 (PLIC, 2011b).

Route 66 Historic Trail follows the remnants of the original Chicago-to-LA blacktop highway through New Mexico. Scenic driving is available along a route that is roughly parallel and sometimes covered by I-40, totaling 373.5 miles from Texas to Arizona (PLIC, 2011c).

Marquez State Wildlife Area is an area of 15,000 acres with no facilities. Here there is hunting for deer and elk in season. It is located north of Laguna Pueblo and Cebolletita (Bibo) via NM 279 and Tribal Road 52 (PLIC, 2011d).

Environmental Consequences

Table 41 shows the resource-specific criteria and definitions for recreation that are used as impact criteria for of the three alternatives. The basis for describing the overall significance of the impact to the resource may be seen in the "Methodology" section at the beginning of chapter 3.

Table 41. Impact characterization for recreation

Term	Definition
Magnitude	
Major	Eliminates or severely restricts recreation opportunities with large numbers of recreationists, typically including those from outside the region or county.
Moderate	Eliminates or severely restricts recreation opportunities with medium numbers of recreationists, typically including those from outside the municipality or local site.
Minor	Eliminates or severely restricts recreation opportunities with small numbers of recreationists, typically including those from within the municipality or local area.
Duration	
Long Term	Project life is more than 20 years
Medium Term (limited or intermittent)	Project life is 5–20 years
Short Term	Project life is less than 5 years
Extent	
Large	Affected recreational use is more than 30 percent of the areas available for recreation within a 4-hour drive of the site.
Medium (localized)	Affected recreational use is more than 20 percent of the areas available for recreation within a 4-hour drive of the site.
Small (limited)	Affected recreational use is more than 10 percent of the areas available for recreation within a 4-hour drive of the site.
Likelihood	
Probable	The effect occurs under typical operating conditions.
Possible	The effect occurs under worst-case operating conditions.
Unlikely	The effect occurs under upset/malfunction conditions.

Alternative 1

As discussed in chapter 2, the Forest Service must develop conditions for approval of the mine operations plan, but cannot legally prevent the development of the mine due to Federal mining laws. The State of Mexico, however, must grant several permits for the mine to operate, so the possibility that the mine cannot be developed and operated exists and is represented here as the no action alternative.

Under this alternative, the mine would not be developed, would not be operated, and there would be no need for reclamation. Current recreational uses would continue on Sections 9 and 10, the Federal lands; on Section 16, the State of New Mexico lands; and on Sections 11, 15, 17, and 20, the private lands through which utility corridors and access roads would be utilized by the mining operations, had the mining been authorized.

With existing recreational uses remaining as they currently are, there would be no effects on recreation to consider, the levels of impact for the five significance criteria would all be at the lowest possible impact levels, and the overall impact or environmental consequence of this alternative is determined to be not significant.

Effects Common to the Action Alternatives

The distance of the mine from designated Cibola National Forest recreation sites is great enough that there would be a negligible direct effect on the recreation experience at these sites as a result of mining operations. Access to and from the mine from mine-related vehicles would occur along State Route 605, and it appears that access to the above listed recreation sites would be mainly State Route 547 (to the nearest U.S. Forest Service recreation sites) or routes that are further away from State Route 605. Therefore, there would likely be minimal exposure of formal recreation site visitors to increased traffic from the mine, except on major roadways where such encounters with commercial traffic of this type are more common.

As discussed in the “Land Use” section above, there are current recreation-related land uses on Forest Service lands within the mine permit area that include hunting and firewood gathering. It is likely that the hunting activity would be curtailed by the Forest Service to some extent while the mine is active due to safety concerns for personnel at the mine. These restrictions would temporarily limit hunting in a very small fraction of the area open to hunting within the Cibola National Forest. Firewood gathering would be restricted within the limited number of fenced areas of the mine, but would otherwise be a compatible land use within the more open areas of Sections 9 and 10.

Conclusion – Common Effects of Action Alternatives on Recreation

The magnitude of the effect of the action alternatives on the recreation resource is evaluated as the elimination or severe restriction of recreational opportunities having varying levels of recreational users participating. The effect of both action alternatives on recreation is on a small number of recreational users mainly hunters and, to a lesser extent, firewood gatherers who would be expected to be local users, so the appropriate magnitude of an adverse effect is minor.

The duration of the effect of these alternatives on recreation resources is evaluated as the length of the project life while this alternative is viable. The mine project is scheduled to last 18–19 years from the issuance of a permit to the completion of reclamation (RHR, 2012), so the duration is categorized as medium term, which is a project life of 5–20 years.

The extent of the effect of the action alternatives on the recreation resource is evaluated as the area affected by this alternative as a percentage of available recreation area within a 4-hour drive. From information taken from the forest plan, the applicable dispersed recreation area would include the total area of the Cibola National Forest, which is currently 1,618,459 acres.

When considering the area affected by the alternative, four options might be considered. The first option could be described as the maximum area of Federal lands disturbed by the project, which is 93.5 acres. The second option is the maximum total area of land disturbed, both Federal and State lands, which is 183 acres. The third option is the total Federal area covered by the mining permit, which is Sections 9 and 10, or 1,280 acres. The fourth option would include all of Section 16, the State of New Mexico lands, which would be 1,920 acres. There are also approximately 22 acres disturbed on private lands in Sections 11, 15, 17, and 20.

Without regard to which of these options is the most representative of project extent, and using the conservative fourth choice plus private lands total of 1,942 acres, this affected land area is at most approximately 0.1 percent of the area available for dispersed recreation. This is then categorized as a small extent, which is an affected area of less than 10 percent of the areas available for recreation within a 4-hour drive.

The likelihood of the effect of this alternative on the land use resource is evaluated as the estimated potential that the effects of these alternatives would occur. For this purpose, we examine the likelihood for occurrence of effects such as temporary exclusion of current recreational uses including hunting and firewood gathering. The former is a probable occurrence and the latter is a possible occurrence, so the likelihood of incurring effects would then be categorized conservatively as probable, or that the effects would occur under typical operating conditions.

The precedence for the effect of this alternative on the recreation resource is evaluated as the degree of precedence setting, uniqueness, or predictability of the effects of the alternative. Mining development, operations, and reclamation have been performed in this country for several decades and the effects, as they relate to recreational compatibility, are well known and predictable. Therefore, the precedence (for unexpected effects) of both action alternatives is categorized as slight.

Alternative 2

Overall, alternative 2’s impacts on recreation would be adverse, of minor magnitude, medium term in duration, small in extent, of probable likelihood, and slight precedence. Considering the levels of impact for these five criteria collectively, the overall impact of the proposed action on recreation is determined to be not significant.

Alternative 3

The differences in recreation effects from implementing alternative 3 arise from elimination of the second shaft along with a considerable amount of surface facilities and infrastructure. There is a reduction of area disturbed by the project of 63 acres, mostly in Section 10. This includes a reduction from three to two ventilation shafts in Section 9. Access roads in Sections 9 and 10 service ventilation shafts and monitoring wells only and are reduced somewhat in overall length and number of locations serviced. Utility corridors and access roads across private lands in Sections 11, 15, 17, and 20 are still required.

Overall, alternative 3’s impacts on recreation would be adverse, of minor magnitude, medium term in duration, small in extent, of probable likelihood, and slight precedence. Considering the levels of impact for these five criteria collectively, the overall impact of alternative 3 on recreation is determined to be not significant. Alternative 3’s impacts on recreation may be slightly less than alternative 2’s, but neither would be rated as significant.

Cumulative Effects

The nearest active or proposed project to the Roca Honda Mine site is the proposed La Jara Mesa Mine that is situated about 8 miles to the south. Other mines and uranium exploration activity are proposed for McKinley and Cibola Counties, some in the vicinity of Mt. Taylor. The nearest designated recreation sites within Cibola National Forest are located at a distance of 7–13 miles. Overall, the incremental effect on recreation of the proposed Roca Honda Mine in combination with other existing and reasonably foreseeable actions would be adverse and minor in magnitude, but not considered significant.

Environmental Justice and Protection of Children

Affected Environment

Executive Order 12898 "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations" (The White House, February 11, 1994), requires that Federal agencies consider as a part of their action, any disproportionately high and adverse human health or environmental effects to minority and low income populations. Agencies are required to ensure that these potential effects are identified and addressed.

The goal of the executive order is to ensure that:

- All people are treated fairly with respect to the development and enforcement of protective environmental laws, regulations, and policies;
- Potentially affected community residents are meaningfully involved in the decisions that would affect their environment and/or their health.

The Environmental Protection Agency defines environmental justice as: "the fair treatment and meaningful involvement of all people regardless or race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies." The goal of "fair treatment" is not to shift risks among populations, but to identify potential disproportionately high adverse impacts on minority and low-income communities and identify alternatives to mitigate any adverse impacts. For purposes of assessing environmental justice under NEPA, the CEQ defines a minority population as one in which the percentage of minorities exceeds 50 percent or is substantially higher than the percentage of minorities in the general population or other appropriate unit of geographic analysis (CEQ, 1997).

Executive Order (EO) 13045 "Protection of Children from Environmental Health Risks and Safety Risks" (The White House, February 11, 1994) places a high priority on the identification and assessment of environmental health and safety risks that may disproportionately affect children. The EO requires that each agency "shall ensure that its policies, programs, activities, and standards address disproportionate risks to children." It considers that physiological and social development of children makes them more sensitive than adults to adverse health and safety risks and recognizes that children in minority, low-income, and indigenous populations are more likely to be exposed to, and have increased health and safety risks from, environmental contamination than the general population.

Since the uranium mine and operations would be contained in Cibola and McKinley Counties, they represent the primary focus and region of influence (ROI) for any direct and indirect impacts that may be associated with the implementation of the proposed action. For purposes of comparison, the State of New Mexico is also defined as a geographic unit of analysis.

Minority Populations

The Council on Environmental Quality (CEQ) defines minority as including the following population groups: American Indian or Alaskan Native; Asian or Pacific Islander; Black, not of Hispanic Origin; or Hispanic. According to the CEQ guidance, minority populations should be identified where either: (a) the minority population of the affected area exceeds 50 percent, or (b) the minority population percentage of the affected area is meaningfully greater than the minority population percentage in the general population or other appropriate unit of geographic analysis (CEQ, 1997). For purposes of this analysis, the general population or the appropriate unit of geographic analysis is the State of New Mexico. The intent of the EO is to recognize and consider minority populations (>50 percent minority in Cibola and McKinley Counties or a "meaningfully greater" minority population than that of the State of New Mexico); and not merely the presence of a minority group. Calculation of the percentage of minorities was based on population data available from the 2010 U.S. Census. Cibola County's population consists of 79.1 percent minorities compared with McKinley County's 90 percent.

Within the broader category of minority, American Indians represent 41 percent of the total Cibola County population, lower than the 75.5 percentage in McKinley County. However, these ratios are both significantly higher than the 9.4 percent in the State of New Mexico. These percentages are considered – both individually and when aggregated – higher than the general population in a meaningful way, and therefore qualify the ROI as an environmental justice population (Census, 2010a, Census, 2010b, Census, 2010c).

The Asian population represents 0.5 percent of the total Cibola County population, and 0.8 percent of McKinley County; both lower when compared with the 1.4 percent overall in the State. Thus, neither county constitutes an environmental justice population for Asians (Census, 2010a; Census, 2010b; Census, 2010c).

The Black or African American population represents 1.0 and 0.5 percent of the population in Cibola and McKinley Counties, respectively. Both are lower than the 2.1 percent in the State overall and therefore neither county qualifies as an environmental justice population on this basis (Census, 2010a; Census, 2010b; Census, 2010c).

The Native Hawaiian and Other Pacific Islander population is essentially nonexistent in Cibola and McKinley; and represents only 0.1 percent of the total State population. Since the representation of Native Hawaiian and Other Pacific Islanders in both counties are lower the State, they do not constitute environmental justice populations (Census, 2010a; Census, 2010b; Census, 2010c).

Hispanic populations represent 36.5 percent of the total Cibola County population and 13.3 percent of the McKinley population, both lower than the 46.3 State percentage. The ROI, then, does not constitute an environmental justice population on this basis (Census, 2010a; Census, 2010b; Census, 2010c).

The overall minority populations in both Cibola and McKinley Counties are both greater than 50 percent of the county population, but so is the State minority population. The percentage of American Indians in McKinley County both exceeds 50 percent *and* is substantially higher than the 9.4 percentage of American Indians in the State of New Mexico. Thus, by both CEQ definitions, the American Indian population in McKinley constitutes an environmental justice population. The American Indian population in Cibola County does not exceed 50 percent but is about 30 percent higher than for the State, which as established earlier is considered the general population for purposes of this study. As such, the American Indian population in Cibola County constitutes an environmental justice population. The breakdown of minority populations is summarized in table 42.

Table 42. Summary of minority populations

County	Population	Minority (%)	American Indian and Alaska Native (%)	Black or African American (%)	Asian (%)	Native Hawaiian and Other Pacific Islander (%)	Hispanic or Latino (%)
Cibola	27,213	21,540 (79.1)	11,156 (41.0)	275 (1.0)	149 (0.5)	26 (0.1)	9,934 (36.5)
McKinley	71,492	64,412 (90.0)	53,988 (75.5)	360 (0.5)	568 (0.8)	23 (0.0)	9,473 (13.3)
New Mexico	**2,059,179**	1,219,193 (59.2)	193,222 (9.4)	42,550 (2.1)	28,208 (1.4)	1,810 (0.1)	953,403 (46.3)

Source: U.S. Census Bureau, 2010

To examine racial/ethnic distribution in the vicinity of the mine, all census tracts in Cibola and McKinley Counties were identified (figure 58). From census information race and ethnicity could be identified for people within those tracts, whether they were owners or renters of property. The data reveal that within a 20-mile radius of the proposed uranium mine site, minority populations represent either less than 50 percent or between 86 and 100 percent of the total census tract population. Therefore, because of this 86–100 percent concentration, the immediate vicinity of the proposed project site represents an environmental justice population. The distribution of minority populations by census tracts confirms that since the McKinley population is comprised of at least half minority status, and the representation is more than the State of New Mexico in a meaningful way, it constitutes an environmental justice population by both bases of the CEQ definition. Since more than half of the Cibola population south of the proposed mine site consists of minority populations, it constitutes an environmental justice population by this basis of the CEQ definition (CEQ, 1997).

Low-Income Populations

There are two components to addressing income as it relates to environmental justice: “low income” and “below poverty level.” A low-income population is defined by the U.S. Department of Housing and Urban Development as 80 percent of the median family income for the designated area (USDHUD, 2012). The low-income designation is subject to adjustment for areas with unusually high or low incomes or housing costs. According to the 2010 Census, New Mexico’s median family income is $52,300; therefore, the poverty level threshold for family income would be $41,840 (80 percent of median family income). McKinley County had a 2010 median family income of $36,924, which is 70.6 percent of the State’s median income. Therefore, McKinley County is classified as a low-income area for the purposes of this study. Cibola County had a median family income of $39,349, which is 75.2 percent of the State’s median income. Therefore, Cibola County is also classified as a low-income area for the purposes of this study (Census, 2010).

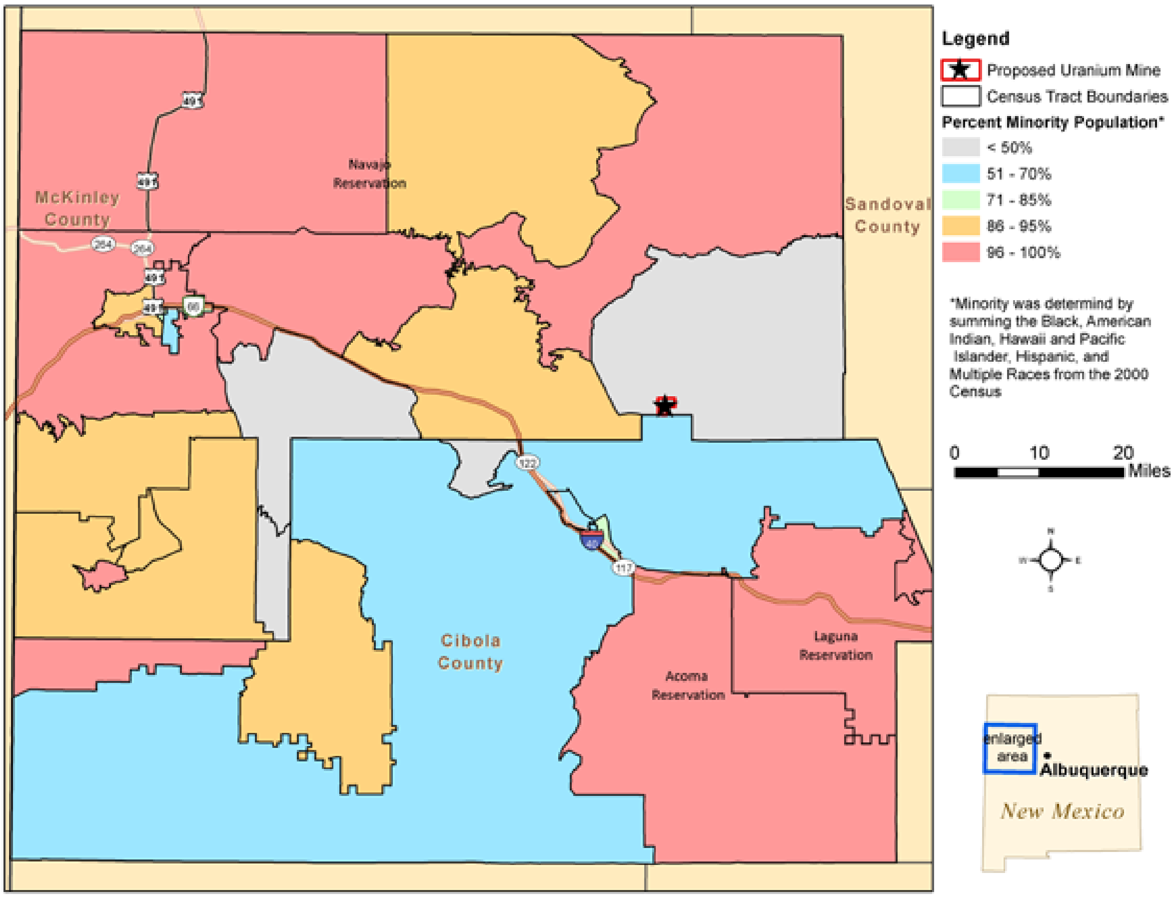


Figure 58. Distribution of minority populations by census tract

There are two slightly different versions of the Federal poverty measure: poverty guidelines and poverty thresholds. The poverty thresholds are the original version of the Federal poverty measure. They are updated each year by the U.S. Census Bureau and are used mainly for statistical purposes—for instance, preparing estimates of the number of Americans in poverty each year. Families and persons are classified by the U.S. Census Bureau as “below poverty level” if their total family income or unrelated individual income was less than the poverty threshold specified for the applicable family size, age of householder, and number of related children under 18 that are present. For persons not in families, poverty status is determined by their income in relation to the appropriate poverty threshold. Thus, two unrelated individuals living together may not have the same poverty status. The U.S. Census Bureau defines poverty level thresholds for individuals and a family of three as income levels below $11,139 and $17,374, respectively (Census, 2010d). A community is considered an environmental justice community if the total number of individuals living below poverty level is 50 percent or more of the community or greater than the unit of geographic analysis (State of New Mexico) in a meaningful way.

Table 43 provides some measures relevant to assessing the importance of low-income populations and persons living in poverty in the areas that would be affected by the proposed project.

Persons living at or below the poverty line represent 25.6 percent of the Cibola County population and 30.7 percent of the McKinley County population. Socioeconomically disadvantaged individuals in both counties constitute proportions larger than those for the State of New Mexico. The percentage of poverty in Cibola County is greater than the percentage of poverty in New Mexico by 6.9 percent, but this is not substantially different. However, the percent below the poverty line in McKinley County exceeds the Statewide percentage by 12 percent, which is a meaningful difference. Thus, McKinley County qualifies as an environmental justice population on this basis (Census, 2010a; Census, 2010b; Census, 2010c).

The homeownership rate measures the percentage of households that own their home (including homeowners with and without a mortgage), as opposed to those households that rent their home. It is calculated by dividing the number of owner occupied housing units by the number of total occupied housing units. The homeownership rate in Cibola County is 74.2 percent, higher than both McKinley County and the State. McKinley County’s 71.6 percent homeownership rate is also higher than the State’s. The percentage of persons 65 years and older in Cibola County is slightly lower than the State percentage. In McKinley County, the percentage over 65 is roughly 4 percent lower than in Cibola County and in the State overall.

Protection of Children

In general, the McKinley County population is younger than that of the State as a whole. It contains approximately 6,166 children under the age of 5 and 18,903 children between 5 and 19; or 35 percent of the total county population is younger than 19 years (table 44). Distribution of the Cibola County population by age categories is roughly equal to that of the State. The representation of children under the age of 19 is slightly lower than the 28.1 percent State average (Census, 2010b; Census, 2010a; Census, 2010c).

Table 43. Income and poverty statistics

County	Median Family Income 2010**	Number and percent of Persons Below Poverty	Percent of Families Below Poverty	Homeownership Rate, 2010	Persons 65 Years and Older *(Percent)*
Cibola	$39,349**	6,967 (25.6)	19.1%	74.2%	3,486 (12.8)
McKinley	$36,924**	10,466 (30.7)	24.3%	71.6%	6,813 (9.6)
New Mexico	$52,300**	385,066 (18.7)	14.0%	68.5%	272,255 (13.2)

Source: U.S. Census Bureau, 2010

**In 2010 inflation-adjusted dollars

Table 44. Age distribution in Cibola and McKinley Counties compared with State

County	Population	Children Under 5 (Percent)	Children 5 to 19 Years (Percent)	Population 20 to 24 Years (Percent)	Population 25 Years and Over (Percent)
Cibola	27,213	1,892 (7.0)	5,671 (20.9)	1,821 (6.7)	17,829 (65.5)
McKinley	71,492	6,166 (8.6)	18,903 (26.4)	5,503 (7.7)	40,920 (57.2)
New Mexico	2,059,179	144,981 (7.0)	434,860 (21.1)	142,370 (6.9)	1,336,968 (64.9)

Source: U.S. Census Bureau, 2010

Since the safety risks are higher in the immediate vicinity of the uranium mine, census tracts were examined to identify the age distribution in the ROI. The percentage of children under the age of 5 tended to be lower in the vicinity of the proposed mine than elsewhere in the ROI (figure 59). From this it is concluded that young children are not especially exposed or at risk from the proposed Roca Honda Mine.

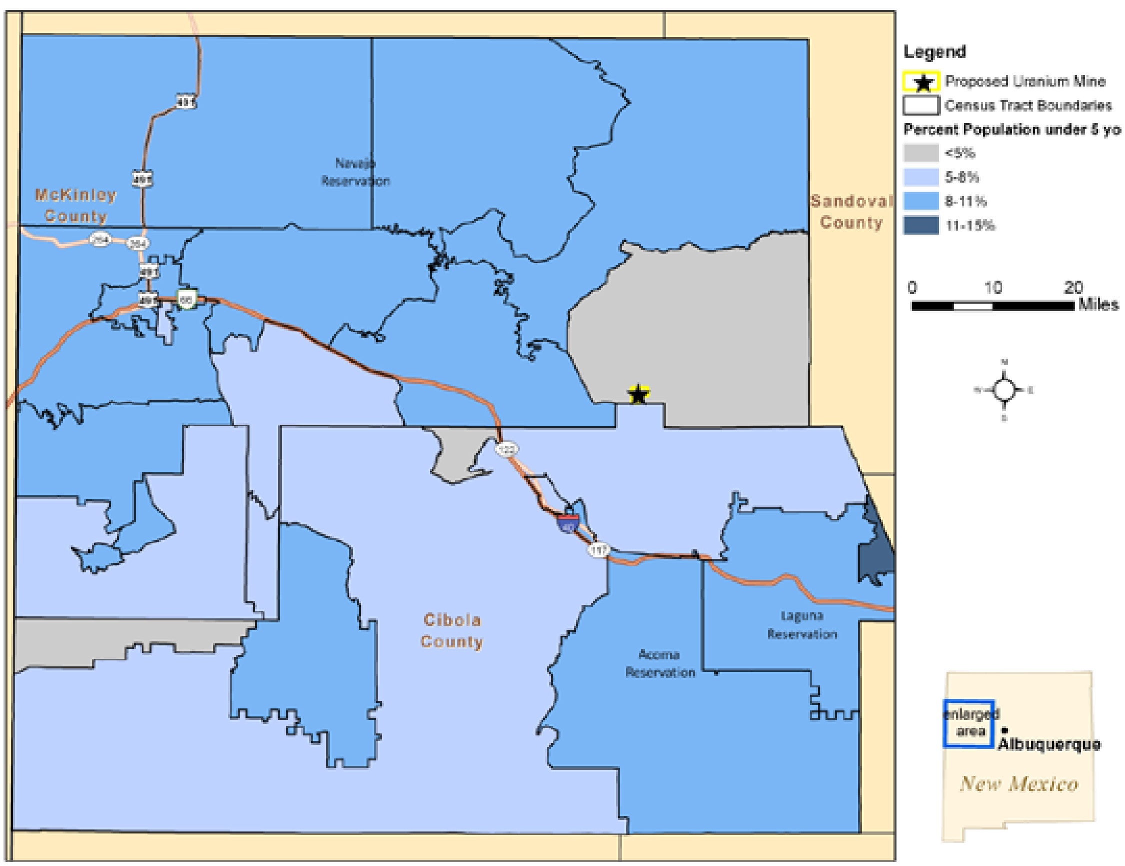


Figure 59. Percent of population below the age of 5 years in the project ROI

Environmental Consequences

Consideration of the potential consequences of the proposed action for environmental justice requires three main components:

1. A demographic assessment of the affected community to identify the presence of minority or low-income populations that may be potentially affected.
2. An assessment of all potential impacts identified to determine if any result in significant adverse impact to the affected environment; and
3. An integrated assessment to determine whether any disproportionately high and adverse impacts exist for minority and low-income groups present in the study area.

Where minority and low income or youth populations are found to represent a high percentage of the total affected population, the potential for these populations to be displaced, suffer a loss of employment or income, or otherwise experience adverse effects to general health and well-being is assessed for posing an environmental justice concern.

Alternative 1

Assuming that the proposed project is not implemented, no change would occur to the existing counties. Since ongoing activities would be substantially the same as those already occurring, no significant additional change in community character and setting would be anticipated. Existing conditions would remain substantially unchanged and have no effect on the populations of concern.

Alternative 2

As discussed above, McKinley and Cibola Counties represent the primary focus and region of influence (ROI) for any direct and indirect impacts that may be associated with implementation of the proposed action. For purposes of comparison, the State of New Mexico was defined as the geographic unit of comparison and the “general” population.

Minority and Low-Income Populations

As previously established above and summarized in table 36, McKinley and Cibola Counties constitute an environmental justice population since the minority populations both exceed 50 percent of the total population; both counties are also substantially higher than the percentage of minorities in the State of New Mexico. Table 37 shows that the proportion of socioeconomically disadvantaged individuals in Cibola County is slightly higher than in the State of New Mexico, but not in a meaningful way. The percentage in McKinley County, however, is significantly greater and, as such, constitutes an environmental justice concern by this basis. Potential impacts to community and recreational facilities such as institutional places of worship, recreation, hospitals, and public health facilities located in Cibola and McKinley Counties would determine the qualification and level of potential impacts to minority and socioeconomically disadvantaged individuals. In general, the types of potential impacts to EJ communities could include:

- Mental health benefits to mine workers through economic pathways during the operation phase;

- Adverse physical health impacts from work conditions in an underground uranium mine;
- Restricted or delayed access to recreational and youth facilities due to traffic and/or time delays;
- Safety risks to area recreationists associated with mining operations;
- Restricted or delayed access to hospital or health care facilities due to traffic and/or time delays; or as a result of increased service demand from workforce migration;
- Restricted access to institutional places of worship or traditional locations for spiritual activities due to traffic/time delays, or diminished quality of religious, spiritual, or cultural experience;
- Disturbances and health risks to children from increased fugitive dust and tailpipe emissions.

Health Risks

The proposed action would produce 220–250 direct jobs, and it is anticipated that many of these jobs would be filled by the local labor force (see the following section on “Socioeconomics” for a detailed discussion of jobs and economic activity). Potential health risks and benefits associated with employment could affect minority and low-income individuals hired by Roca Honda Resources, Inc. Mine workers would experience positive long-term health benefits through economic pathways during the operation phase. However, boom periods can also bring about negative health impacts including increases in alcohol and drug use, domestic violence, and unintentional injuries (see the “Human Health and Safety – Health Effects Stemming from Employment” section for a complete discussion). Potential health risks of employment can also include exposures to unhealthy air in the mines. In the past miners and mill workers were exposed primarily to radon gas and dust, and some experienced health impacts including cancer, kidney disease, lung toxicity, and other toxicities. Kidney disease is the most common adverse health effect from chemical exposure to uranium; however, it is important to note that studies of factors affecting the health of uranium miners and mill workers have not demonstrated unusual kidney disease rates. Furthermore, as noted in the “Air Quality” section, in contrast to the past uranium mining during World War II and the peak of the Cold War (1950s), exposure to radon is now strictly controlled in modern underground uranium mines.

As noted under “Air Quality,” underground uranium mines today must be well ventilated. Fresh air is constantly pumped through the mine both for workers to breathe and to vent underground air to the surface to prevent any problematic increase in the concentrations of air contaminants, including radon gas among others. The concentrations of radon-222 and its associated decay products must be controlled to levels below those published in Title 30 of the CFR, Part 57, Section 57.5037. Within the mine, radon-222 exposures are regulated by the Mine Safety and Health Administration (MSHA), the Federal enforcement agency responsible for the health and safety of America’s miners. These exposures are limited at 4 working level months (WLMs). With proper ventilation and personal protection equipment (PPE), worker exposures would be held below this level. If the operator cannot demonstrate compliance, the mine would be shut down. Furthermore, in another measure intended to safeguard underground air quality, smoking is prohibited.

As discussed under “Air Quality,” Federal law also regulates emissions of radon from uranium mines. Thus, neither miners nor the nearest neighbors of the proposed mine are expected to be subjected to dangerous exposures to radon gas and its decay products.

Historically, at some uranium mines, uranium milling occurred right at or close to the mine site itself. Raw uranium ore was transported to the surface and was crushed at the mill into a fine sand or powder. Uranium was then recovered or extracted using chemical processing (leaching) and further concentrated into “yellowcake,” so called because of its yellowish color; yellowcake consists of 70–90 percent percent uranium oxide (U308). The radioactive sand or powdery residues from these processes are referred to as uranium tailings (USNRC, 2012c; USEPA, 2010c).

These tailings typically contain a number of radionuclides. Although the milling process extracts approximately 95 percent of the uranium present in raw ores, the tailings still contain naturally occurring radioactive elements or radionuclides, among them uranium, thorium, radium, polonium, and radon. In addition, tailings typically contain certain chemically hazardous heavy metals like arsenic (USEPA, 2010c).

The past use of these mine/mill tailings in homes, schools, roads, and as materials in other construction created public radiation health hazards, or so-called legacy issues. Waste from uranium mining and milling operations that closed before the mid-1970s are of particular concern even today. In a number of cases, these mines remain unclaimed and the waste is still piled near the mine. When the tailings are left exposed to weathering, both wind and water can transport them offsite. If permitted to dry out, the radioactive sand or dust can be dispersed long distances by the wind and deposited over large areas, contaminating both soils and water bodies, and entering the food chain. Uranium tailings piles are also susceptible to erosion and seepage of contaminants into surface water and groundwater (USEPA, 2010c). To avoid these problems, later mines began storing tailings in large impoundments.

However, the actions and their consequences associated with these legacy issues are not part of the proposed action and would not occur at the proposed Roca Honda Mine. Under this proposed action, uranium ore would be blasted and hauled to the mine surface through the production shaft. The ore, consisting of chunks of rock and rubble at this stage, would then be placed on the ore pad for temporary storage until it is loaded onto a highway haul truck. The ore would then be hauled from the mine on this covered truck using one of the haul roads to an existing public highway. From there it would be transported to an as yet undetermined uranium mill at some distance from the mine and possibly out of State. Milling would be under the jurisdiction of the U.S. Nuclear Regulatory Commission (NRC) and its relevant statutes and regulations. Management and disposal of milling wastes (tailings) would be regulated, and the public interest and environment protected by the Uranium Mill Tailings Radiation Control Act of 1978 (UMTRCA). No crushing, processing, milling, or disposal of the raw uranium ore extracted at the Roca Honda Mine would occur at the mine site and is not part of the plan of operations. As described in chapter 2, nonore waste rock would be used to backfill mined-out spaces once all ore and rock have been removed. No tailings would accumulate at the surface of the mine.

As described under the “Air Quality” section, during development, operation, and reclamation of the mine fugitive dust emissions associated with surface disturbance (drilling, blasting, site development, and other earth-moving activities) would be generated. Fugitive dust and exhaust emissions from vehicles and equipment traveling over paved and unpaved (gravel) surfaces during the mine's lifetime could hypothetically create adverse impacts to low-income and minority populations. The majority of the NO_X, SO_2, CO, Volatile Organic Compounds (VOC), and CO_2 emissions are associated with the vehicle/equipment exhaust. Most of the particulate matter emissions would result from surface disturbances associated with the ore haul trucks and other vehicle and equipment travel over paved and unpaved surfaces. Since these emissions would occur at ground level and would likely cause temporary increases in air pollutant emissions in the immediate vicinity of the permit site, it is unlikely that these emissions would be transported more than a few miles, except on windy days and during significant wind events (see "Air Quality" for detailed discussion).

Based on hourly data from 1992 to 2002 and defined as the direction with the highest percent of frequency, the prevailing wind direction at Grants Airport is from the northwest (WRCC, 2002). Therefore, on windy days and significant wind events, the residents of San Mateo may be subject to some air pollutant and air particulate matter emissions.

As noted in the "Air Quality" section above, the magnitude of adverse impacts on air quality from the proposed action during the main phases would range from minor to moderate. The overall impact on air quality was rated as insignificant. Thus, potential impacts to nearby minority communities related to air pollution would be adverse but insignificant as well.

The proposed action would potentially entail adverse impacts to the quality of life for environmental justice communities in the study area. In particular, tribal environmental justice communities—Acoma, Laguna, Zuni, Hopi, and Navajo—have an intimate spiritual relationship with the landscape and specifically with Mt. Taylor, a traditional cultural property (TCP). See the EIS section on "Cultural and Historic Resources" for a far more detailed discussion of these issues. All of the aforementioned tribal nations have expressed strong concerns about mining activity on Mt. Taylor. For some tribal members, mining here is desecrating a sacred site. Tribes also express particular concern about water—both the potential for its contamination and/or waste. Negative mental health impacts stemming from other realties or perceptions associated with the mine could also occur, and are discussed further under "Human Health and Safety."

Traffic and Roadways

As discussed under the "Transportation" section of this EIS, there are very few roadways and trails in this area and travel is minimal. Because of the remote location and light traffic patterns, roadways surrounding the proposed mine are free flowing during both the a.m. and p.m. peak periods. The proposed action is not expected to cause traffic and produce time delays. Therefore, access to recreation, hospitals and public health facilities, and places of worship would be neither delayed nor restricted and potential impacts would be minimal.

Issues of traffic accidents are discussed in "Human Health and Safety – Traffic Safety;" however, potentially health and safety impacts to environmental justice populations are discussed below. Vehicle crashes in Cibola and McKinley Counties have been decreasing over the past decade, due in large part to a concerted effort by the local police departments. However, traffic fatality rates remain significantly higher in Cibola and McKinley Counties than for New Mexico as a whole. Rates of alcohol and drug related deaths and injuries are higher in New Mexico than in the rest of the country, and rates in McKinley and Cibola Counties appear to be significantly higher than the rates for New Mexico.

In Cibola County, death rates attributable to alcohol are almost three times higher than the U.S., and in McKinley County this figure is over four times the national rate. In the event of an accident, hazardous contaminants may be released; however, exposure to uranium or other radioactive substances would unlikely affect the health of individuals within the vicinity, since handling and storage of hazardous substances would follow guidance and preventative measures from the onsite material safety data sheets (MSDS) and the RHR site safety officer instructions. A spill prevention, control and countermeasures (SPCC) plan would be developed before development of the mining facilities begins. The SPCC Plan would be used to train workers and employees on handling hazardous substances, prevention of spills, cleaning up spills, emergency or accidental releases, and the notifications and reporting requirements.

Recreation

Nearby recreational and cultural activities are available in the Mt. Taylor Ranger District within the Cibola National Forest. The forest includes the Zuni Mountains west of Grants and the San Mateo Mountains and Mt. Taylor, about 24 km (15 miles) east-northeast of Grants. Dispersed recreation on the forest includes such activities as hiking, backpacking, picnicking, hunting, fishing, gathering forest products, bird watching, water skiing, off-road vehicle travel, swimming, and sightseeing. Winter sports include cross-country skiing and snowmobiling. Several golf courses are popular in the area, including the Zuni Mountain Golf Course facility in Milan and the Coyote del Malpais Golf Course in Grants (Golf Link, 2012a and 2012b).

Safety risks associated with the mining operations could hypothetically affect area recreationists; however, these risks would be mitigated by safety measures mandated by the land managing agencies such as the New Mexico Energy, Minerals and Natural Resources Department and the Forest Service, as well as Mine Safety and Health Administration (MSHA). Access to the mine area will be controlled during mining operations to protect the public from possible injury due to operating conditions such as heavy equipment and truck traffic and other operations that have the potential to cause injury to untrained personnel. All personnel entering the site will be checked in, and will be allowed access to the administration building only with a company escort.

Hospitals and Public Health Facilities

Cibola General Hospital is a 25-bed general medical and surgical hospital in Grants accredited by the Joint Commission (JC). Survey data for the latest year available shows that 9,621 patients visited the hospital’s emergency room. The hospital had a total of 873 admissions in a recent year (AHA, 2012). Onsite services include general surgery, 24-hour emergency care, intensive care nursing, internal medicine, obstetrics, pathology, pediatric dentistry, podiatry, primary care, and radiology. Time delays and traffic are not anticipated and, therefore, access would not be restricted in the case of a serious accident; however, as discussed in “Human Health and Safety,” health care services in Cibola and McKinley Counties are listed as health professional shortage areas, or as having limited capacity to handle health care emergencies or increases in service demand (see “Human Health and Safety – Health Effects Stemming from Workforce Migration”).

Basin Home Health, Inc., is a home health care service based in Grants, NM. It provides services to individuals and families on an intermittent basis in their place of residence. The purpose is to promote, maintain, restore, or minimize the effects of illness and disability by achieving maximal rehabilitation with the least possible disruption of the daily pattern, thus enhancing life and living. (Basin Coordinated, 2012).

The Cibola Public Health Office in Grants and the McKinley Public Health Office in Gallup are branches of the New Mexico Department of Health. These offices facilitate health programs, health promotion and prevention, American Indian Health, development disabilities support, LGBT initiatives, and emergency preparedness (NMDH, 2012).

Places of Worship

Approximately 63 and 40 percent of the population is affiliated with an institutionalized religion in Cibola and McKinley Counties, respectively (Admaveg, Inc., 2012). There are nine institutional places of worship located within 20 miles of the proposed mine site, including the Bible Baptist Church, First United Methodist Church, Saint Theresa's Avila Church, and Grants Mission in Grants; Santa Maria de Acoma in McCartys; Indian Assembly of God in Prewitt; San Rafael Parish in San Rafael; and San Mateo Church in San Mateo. The proposed action is not expected to cause traffic and produce time delays, therefore, impacts to religious activities at the nine aforementioned places of worship are expected to be minimal.

Tribal environmental justice communities—Acoma, Laguna, Zuni, Hopi, and Navajo—have an intimate spiritual relationship with the landscape and specifically with Mt. Taylor (which includes the mine area), a TCP. A TCP is typically a location—frequently a land formation or landscape—recognized for its association with the cultural practices or beliefs of a living community that are rooted in history and are important to maintaining cultural identity. Traditional practitioners may conduct cultural and religious activities at the Mt. Taylor TCP as discussed below. Over time these have included, but are not limited to, collection of plants, stones, minerals, pigments, soil, sand, and feathers, catching eagles, hunting game and birds, pilgrimages to place offerings, and visits to shrines and springs (Benedict and Hudson, 2008).

The term "heritage resources," used by the Forest Service, encompasses not only cultural resources but also traditional and historic use areas by all groups (Native Americans, Euro-Americans, etc.). Objects, buildings, places, and their uses become recognized as "heritage" through conscious decisions and unspoken values of particular people, for reasons that are strongly shaped by social contexts and processes. Heritage resources define the characteristics of a social group (i.e., community, families, ethnic group, disciplines, or professional groups). Places and objects are transformed into "heritage" through values that give them significance.

The proposed action would potentially entail adverse impacts to the quality of life for environmental justice communities in the study area, as discussed in greater detail under the "Cultural and Historic Resources" section. All of the aforementioned tribal nations have expressed strong concerns about mining activity within the Mt. Taylor TCP. For some tribal members, mining is tantamount to desecrating a sacred site. Tribes also express particular concern about water—both the potential for its contamination and/or waste. Negative mental health impacts stemming from other realities or perceptions associated with the mine could also occur, discussed further under "Human Health and Safety." Tribal environmental justice communities, as established earlier, are found to represent a high percentage of the total affected population, and the potential for these communities to experience adverse effects to general health and well-being exists. As such, adverse mental health impacts would occur to tribal environmental justice communities due to mine development so close to spiritually significant Mt. Taylor.

Conclusion – Effects of Alternative 2 on Environmental Justice

The proposed action would potentially create beneficial impacts due to the provision of jobs and economic opportunities in minority and low-income communities; and adverse impacts of minor magnitude due to potential health risks for miners and nearby residents of San Mateo. Additionally, adverse mental health impacts of moderate magnitude would occur to tribal environmental justice communities due to mine development within the spiritually significant Mt. Taylor TCP. Both beneficial and adverse effects on EJ would likely be significant.

The proposed mining activities would not require lane closures or cause traffic/time delays and, therefore, not restrict access to hospitals and public health facilities, recreation areas, or institutional places of worship. The extent of impacts would be medium (localized), since safety mechanisms mandated by the MSHA tightly regulate public access to the mine site.

Underground mining remains an inherently hazardous occupation, and may always be, but implementation of more stringent mining regulations and more advanced technologies and techniques in recent decades has made it much safer than in the past. The likelihood of health risks and impacts to miners from worksite injuries would be probable but this is mitigated with new technology, standards, and safety measures that have been recently developed and introduced. Health impacts to miners from exposure to unsafe levels of radon and other hazards are unlikely to possible. The precedence and uniqueness of the impact would be severe, since mining activities in the designated Mt. Taylor TCP is very controversial.

The provision of jobs to environmental justice communities would be medium term to long term and last roughly 2 decades, the estimated duration of the construction and operation phases; the impacts would be reversed in the long term once the mine closes and well-paying mining jobs are lost. The impact of mining on local economies around the world has often been described as "boom and bust." Expected health effects would be limited to fugitive dust, diesel, and heavy vehicle emissions from the activities of drilling, blasting, use of heavy equipment, and the transportation of materials throughout the lifetime of the proposed mine.

Protection of Children

As discussed above, the McKinley County population is younger than that of the State as a whole. It contains approximately 6,166 children under the age of 5 and 18,903 children between 5 and 19; 35 percent of the total county population is younger than 19 years. Distribution of the Cibola County population by age categories is roughly equal to that of the State, however, the distribution of children younger than 5 years—as displayed in figure 59—appears to be concentrated on the Navajo, Acoma, Laguna, and Zuni Reservations which are located in both McKinley and Cibola Counties. As such the potential for disproportionate harm to children needs to be addressed in these areas (ESRI, 2010).

While it has been established that uranium mining caused serious health impacts to miners in the past, techniques, technologies, and safety measures have advanced significantly in recent decades. However, it is not known whether exposure to uranium and its daughter products would affect children differently. Very young animals absorbed more uranium than did adults when fed uranium, but it is not know if this would happen in children. Extremely high doses of uranium in drinking water resulted in birth defects and an increase in fetal deaths in lab animals. While it is not likely that uranium can cause these problems in pregnant women who are exposed to background levels of uranium in food, water, and air, it is not known whether exposures to naturally occurring uranium can affect the developing human fetus (Charp, 2011). Quantifiable impacts to children (as opposed to adults) from present-day uranium mining are unknown. However, for purposes of this analysis it is assumed that children are more sensitive to any radioactivity exposure because their cells are more actively dividing than those of adults.

As such, potential impacts to youth community and recreational facilities including childcare centers, schools, recreational facilities, and social welfare facilities located in Cibola and McKinley Counties will be used to determine if the proposed action poses a concern to children. The duration, proximity, and frequency of potential health risks from mining are considered to qualify the potential level of impacts.

For the same reasons discussed above with regard to minority and low-income populations, children are not likely to be disproportionately exposed to uranium, its daughter products such as radon, or radioactivity as a result of the proposed action. No milling or processing would take place at the Roca Honda Mine site, it is set back by approximately 3 miles from the nearest residences (further from schools), and it would be sequestered from the public by fencing.

Other potential impacts from the proposed action on children could hypothetically stem from its effects on air quality (fugitive dust and tailpipe emissions) and traffic/transportation.

Six elementary schools (kindergarten through 6th grade) are located within a 20-mile radius of the proposed mine site. Two secondary schools are also located within 20 miles of the proposed mine site in Grants (USDA, 2012b). The “Save the Children” after-school program is available to all students enrolled in the aforementioned schools, but is not offered at any of the six elementary schools (Lujan, 2012).

The Head Start Program in Gallup is part of the U.S. Department of Health and Human Services that provides comprehensive education, health, nutrition, and parent involvement services to low-income children aged 3 to 4 and their families. As defined by the U.S. Department of Health and Human Services, the 2010 poverty threshold is defined as a maximum annual income of $18,310 or less for a family of three (USDHHS, 2010). A total of 197 children aged 3 to 5 are currently enrolled in the Gallup Head Start Program. Since most children reside in the larger Gallup area and do not travel far, potential impacts from the proposed mining activities would be negligible. As discussed above, traffic, time delays, and road closures due to mining and transport activities associated with the proposed action are not anticipated.

A total of 174 children are currently enrolled in the Grants Head Start Program, 22 of whom have a disability. The majority of children reside in the Grants-Milan area, but some travel from Centerwater and San Mateo (Diaz, 2012). Traffic, road closures, and time delays from the proposed action are not anticipated at the Gallup and Grants Head Start Programs.

The Grants Recreation Department in Grants manages parks, recreation facilities, and offers youth summer programs. Mirabel Park offers a playground, two picnic shelters, and one basketball goal. The Paddy Martinez Park is named after the shepherd who originally discovered uranium in 1950, which sparked the uranium boom and is a public space for children to play (GRD, 2011). Other parks in close proximity to the proposed mine site include Wells, Peel Street, Kiwanis Park, and the Kerr McGee Park. Summer youth activities include rollerblading, frisbee, biking, field trips, arts and crafts, swimming, football, golf, cheerleading, tennis, and reading at the Mother Whiteside Library. Potential impacts to children and youth recreation activities would be negligible since traffic and time delays are not expected, and the risk of inhaling emissions would be unlikely based on the location of Grants with regards to the proposed mine site.

Conclusion – Effects of Alternative 2 on Protection of Children

The proposed action is not expected to expose children to toxic substances or radionuclides. It would potentially create impacts of negligible to minor magnitude due to increased risk of inhaling fugitive dust and exhaust emissions from vehicles and mining equipment. The extent of impacts would be small, limited primarily to the village of San Mateo. The likelihood of impacts would be possible and depend on wind and moisture. The precedence and uniqueness of the impact would be slight in light of current mining in close proximity, i.e., Peabody Natural Resources (d.b.a Lee Ranch Coal Company) 10 miles north of San Mateo (Martinez, 2012). The increased risk of inhaling emissions is not unique to uranium mining. The mine site is not controversial with regards to protecting children since access to youth facilities would not be restricted and the quality of youth activities would not be adversely affected. Impacts would be short and long term and last for the lifetime of the mine (about 2 decades); and increased inhalation of emissions would be intermittent and related to wind direction and intensity.

Alternative 3

Impacts from the one shaft alternative would be essentially identical to those of alternative 2.

Cumulative Effects

The cumulative effects considered under environmental justice and protection of children criteria include the potential for disproportionate impacts to low-income and minority populations and to children within McKinley and Cibola Counties. Cumulative effects analysis takes into account the sum of past, present, and reasonably foreseeable future actions that, when combined, may affect the human environment to a different degree (usually a greater degree) than when considered individually.

In this context, the past history of widespread and large-scale uranium mining and milling in the Grants Mineral Belt has an important bearing in several respects. Uranium mining and milling activities furnished many direct and indirect jobs to minorities and lower-income working class residents in the ROI for several decades, providing a strong boost to the regional economy. However, when these jobs disappeared in the 1980s with the closure of uranium mines and mills, these economic benefits disappeared with them, in keeping with the experience of raw material extraction “boom and bust”economies elsewhere. Minorities and poorer working class residents both benefited and were harmed disproportionately with this waxing and waning of the mining industry.

As indicated above, the proposed Roca Honda Mine would generate both beneficial and adverse effects related to environmental justice. The beneficial effects would occur by improving the economic prospects for about 2 decades of an area with high unemployment, high poverty rates, and high minority populations. The adverse effects would stem from a perception among some in the population of unacceptable health and environmental risks—not borne out by the analysis in this EIS—as well as spiritual and psychological harm inflicted on many American Indians (a minority population) at the opening of a new mine within the Mt. Taylor Traditional Cultural Property.

As described in chapter 2, a number of other projects related to uranium exploration and mines are reasonably foreseeable in Cibola and McKinley Counties. In effect, if the Roca Honda Mine were to open and operate, and a portion of these other projects were to be realized, the potential economic effects on minority and low-income populations would represent a long term, moderately beneficial, cumulative impact related to environmental justice. On the other hand, there would also be a corresponding cumulative, moderately adverse social impact for those American Indians concerned about Mt. Taylor, and for those minorities and low-income residents convinced that new uranium mining projects would exacerbate long-standing and unresolved legacy health issues (see “Human Health and Safety” and “Legacy Issues” sections for more detailed discussion). Beneficial and adverse cumulative effects would be significant.

Socioeconomics

Affected Environment

The analysis of socioeconomic resources identifies those aspects of the social and economic environment that are sensitive to changes and that may be affected by the proposal to conduct mining operations for a period of approximately 18.5 years, including mine development, operations, and reclamation. The assessment specifically considers how these actions might affect individuals, surrounding communities, and the larger social and economic systems of Cibola and McKinley Counties, the surrounding region; and the State of New Mexico. This section addresses the socioeconomic conditions that may be affected by implementation of the proposed actions and any potential sources of impact.

The proposed uranium mine, located in McKinley County, New Mexico, approximately 3 miles northwest of San Mateo and 22 miles northeast of Grants, NM, would be situated on both State and National Forest land. Sections 9 and 10 (2 square miles) are National Forest System lands, which are open to mineral entry under the General Mining Law of 1872. Section 16 (1 square mile) is State of New Mexico land, which is not subject to the regulatory jurisdiction of the Forest Service. The actual mine and related operations would take place in McKinley and Cibola Counties and,, therefore are defined as the region of influence (ROI) since impacts to individuals, communities, and economic systems may be associated with implementation of the proposed action.

The data supporting this analysis are collected from standard sources, including the U.S. Census Bureau, Federal, State, and local agencies or other research institutes. This section addresses the socioeconomic conditions that may be affected by implementation of the proposed action and any potential sources of impact.

Population

The 2010 estimated combined population of Cibola and McKinley Counties is 98,705, a net decrease of 1,688 or 1.7 percent from the 2000 estimated population of 100,393. The 2010 total population of Cibola County was 27,213, a 6.3 percent increase since the 2000 census. The total 2010 McKinley County population was 71,492, a 4.4 percent decrease since 2000. As shown in table 45, McKinley County has the larger population of the two counties, and experienced not only a decrease in population but also a larger change between the two during this period.

Table 45. Population change, 2000–2010

County	2000	2010	Numeric Change	Percent Change
Cibola	25,595	27,213	1,618	6.3
McKinley	74,798	71,492	-3,306	-4.4
Totals	**100,393**	**98,705**	**-1,688**	**-1.7**
New Mexico	1,819,046	2,059,179	240,133	13.2

Source: U.S. Census Bureau, 2000 and 2010

Statewide population grew from 1,819,064 in the 2000 Census to 2,059,179 in 2010, a net increase of 240,133, or 13.2 percent. Cibola and McKinley populations then declined in size by 1.7 percent while the State population increased more than tenfold during the same time period.

Table 46 presents basic demographic data for the towns of Grants and Gallup, Cibola and McKinley Counties, and the State of New Mexico.

Table 46. Demographics of Cibola and McKinley Counties

	Town of Grants	Cibola County	Town of Gallup	McKinley County	New Mexico
Population					
Population, 2010	9,182	27,213	21,678	71,492	2,059,179
Median age (yrs)	35.7	36.6	31.9	30.7	36.7
Race					
White persons, percent 2010	57.4%	41.8%	35.2%	15.2%	68.4%
Black persons, percent, 2010	1.7%	1.0%	1.2%	0.5%	2.1%
American Indian and Alaska Native persons, percent, 2010	16.9%	41.0%	43.8%	75.5%	9.4%
Asian persons, percent, 2010	0.8%	0.5%	2.0%	0.8%	1.4%
Native Hawaiian and Other Pacific Islander, percent, 2010	0.2%	0.1%	0.1%	0.0%	0.1%
Persons of Hispanic or Latino origin, percent 2010	52.1%	36.5%	31.7%	13.3%	46.3%
White persons not Hispanic, percent, 2010	28.9%	21.5%	22.1%	10.3%	40.5%
Persons reporting two or more races, percent, 2010	4.3%	3.1%	5.8%	3.1%	3.7%
Non-Hispanic White persons, percent, 2010	28.9%	21.5%	22.1%	10.3%	40.5%

Education					
High school graduates, percent of persons age 25+, 2006-2010	72.0%	76.4%	76.4%	69.6%	82.7%
Bachelor's degree or higher, percent of persons age 25+, 2006-2010	15.3%	11.5%	21.3%	10.9%	25.5%
Income					
Median household income (2010)	$39,923	$37,361	$43,750	$31,335	$43,820
Per capita income, last 12 months (2010)	$16,018	$14,712	$19,077	$12,932	$22,966

Source: Census, 2010

Labor

Civilian Labor Force

The size of a county's labor force is measured as the sum total of those currently employed and those actively seeking employment. As can be seen in table 47, from 2000 through 2010 Cibola County's labor force grew at 10 times the rate of McKinley County, but not as fast as the State of New Mexico (17.4 percent). The overall percent change for the ROI was 2.5 percent, almost 15 points lower than the State percent change in annual civilian labor force.

Table 47. Annual labor force size, 2000-2010

County	Annual Civilian Labor Force			
	2000	2010	Numeric Change	Percent Change 2000-2010
Cibola	9,832	10,851	1,019	10.4
McKinley	26,297	26,180	-118	-0.4
Totals	**36,129**	**37,031**	**902**	**2.5**
New Mexico	823,440	966,712	143,272	17.4

Source: U.S. Census Bureau, 2000 and 2010

Employment

Table 48 exhibits the annual employment levels in both counties for the years 2000 and 2010. McKinley County has a greater number employed in 2010, representing a 7.6 percent increase from the 21,940 employed in 2000. Cibola County experienced a slight decrease in number employed, down from 8,703 in 2000 to 8,582 in 2010. The number employed in the State of New Mexico increased by 125,282, or 16.4 percent.

Table 48. Annual employment

County	Number in Employment			
	2000	2010	Numeric Change	Percent Change 2000-2010
Cibola	8,703	8,582	-121	-1.4
McKinley	21,940	23,602	1,662	7.6
Totals	**30,643**	**32,184**	**1,541**	**5.0**
New Mexico	763,116	888,398	125,282	16.4

Source: U.S. Census Bureau, 2000 and 2010

Unemployment Rates

The unemployment rate is defined as the number of unemployed persons divided by the labor force, where the labor force is the number of unemployed persons plus the number of employed persons. McKinley County has an unemployment rate of 7.8 percent, the highest it has been since 2000, though still consistent with a rate above that of the State for the same interval. Conversely, in 2010 Cibola County's 7.3 unemployment rate dipped below the State's 7.9 percent rate for the first time in a decade. All, however, had parallel and roughly equal decreased unemployment rates between 2004 and 2006, which increased slightly during the 2006–2008 interval, and rose rapidly since 2008. This can be attributed to the 2008 economic recession, which was part of a global financial downturn. Unemployment rates in the ROI and for the State are shown in figure 60.

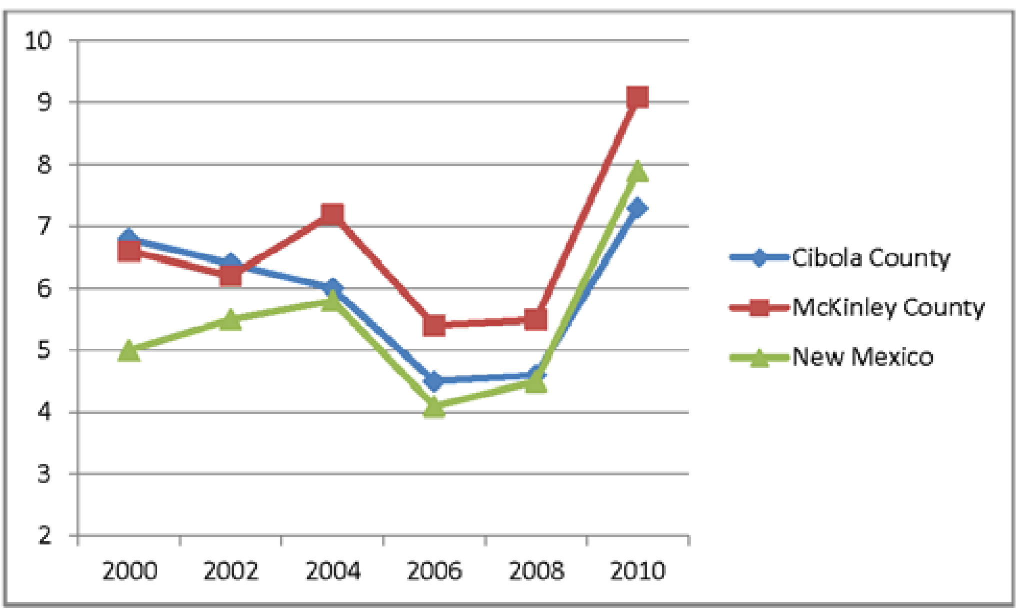


Figure 60. Annual unemployment rates, 2000-2009
Source: U.S. Bureau of Labor Statistics, 2000 and 2010

Earnings

Several measures are used to discuss earnings, including per capita personal income, total industry income, and compensation by industry. Personal income data are measured and reported for the county of the place of residence. Per capita personal income, then, is the total personal income for the county divided by population in the county. Compensation data, however, are measured and reported for the county of work location, and are typically reported on a per job basis. Total compensation includes wages and salaries, as well as employer contribution for employee retirement funds, social security, health insurance, and life insurance.

Per Capita Personal Income

Personal income is the income received by all persons from all sources, or the sum of net earnings by a place of residence, property income, and personal current transfer receipts (USDOC, 2011). This includes earnings from work received during the period. It also includes interest and dividends received, as well as government transfer payments, such social security checks. It is measured before the deduction of personal income taxes and other personal taxes and is reported in current dollars.

Table 49 contains 2000, 2005, and 2010 annual per capita personal income for Cibola and McKinley Counties, as well as the State of New Mexico. All dollar estimates are in current dollars (not adjusted for inflation). Cibola County had the higher per capita personal income at $25,373, though McKinley County’s per capita personal income was only $1,409 less. Both counties have consistently had per capita personal incomes less than the State average during this 10-year interval.

McKinley County experienced the largest percentage change in per capita income from 2000 to 2010 with an increase of 72.9 percent. However, Cibola County’s annual per capita income has consistently been higher than McKinley’s over this 10-year interval. The annual per capita personal income for both Cibola and McKinley Counties grew at rates faster than the State overall.

Table 49. Annual per capita personal income (in $1,000s)

County	Income			
	2000	2005	2010	Percent Change 2000-2010
Cibola	15,256	20,747	25,373	66.3
McKinley	13,858	19,335	23,964	72.9
New Mexico	22,746	28,641	32,940	44.8

Source: USDOC, 2012

Households

A housing unit indicates a house, an apartment, a mobile home or trailer, a group of rooms, or a single room occupied as separate living quarters or, if vacant, intended for occupancy as separate living quarters. McKinley County has more housing units, occupied housing units, and owner occupied housing units, but Cibola County has a higher median value of housing units and median household income (table 50). An owner occupied housing unit indicates that the owner or co-owner lives in the unit even if it is mortgaged or not fully paid for. The median value(s) of housing units reflects housing units with and without a mortgage. A household includes all the people who occupy a housing unit as their usual place of residence.

Table 50. Household characteristics, 2010

County	Total Housing Units	Occupied Housing Units/Total Households	Owner Occupied Housing Units	Median Value of Housing Units*	Median Household Income
Cibola	11,101	8,860	6,575	$80,300	$34,916
McKinley	25,813	21,968	15,722	$77,000	$30,403
New Mexico	901,388	791,395	542,122	$163,300	$43,569

Source: U.S. Census Bureau, 2010

*with and without a mortgage

**In 2010 inflation-adjusted dollars

Total Industry Compensation

What is often termed in economic data as total industry compensation is somewhat of a misnomer, in that a portion of the "industry earnings" stems from government related activity. This will be made clear when the composition of industry compensation is presented. Nevertheless, total industry compensation provides a good picture of the relative sizes of market-related economic activity, or business activity, performed in the various counties (table 51). McKinley County clearly dominates economic activity, with employee compensation figures roughly twice those of Cibola County.

Table 51. Total compensation of employees (in $1,000s)

County	2001	2005	2010
Cibola	208,477	325,969	367,025
McKinley	742,349	866,334	989,988

Source: USDOC, 2012

Income is generated by economic activity in the local area counties through a variety of sectors, including various types of business as well as government. This income is not always received by a person in the county, for a person from neighboring counties may commute across county lines to go to work. The employee compensation by industry, however, is a measure of economic activity generated in the counties, regardless of where the employee resides.

Compensation for work is broader than salaries and wages. Total compensation also includes employer contributions for employee retirement funds, social security, health insurance, and life insurance. These supplements to income comprise roughly 20 percent of total compensation. Also, rather than measuring per capita personal income, which includes government transfers to people who are not employed, total compensation measures are presented "per job," meaning in terms of full-time and part-time wage and salary employment. So total average compensation per job is the compensation of employees received divided by total full-time and part-time wage and salary employment.

The local area counties display a variety of business activity. The sources of economic activity in the two counties are individually discussed below.

Cibola County: Compensation by Industry

As can be seen in table 52, government and government services account for a total of $163,863 of the annual compensation of employees in 2010. Sky City Casino is the largest employer in Cibola County, contributing more than $12 million annually to the State (due to a compact agreement) and employing 500 people from the local area; supplemented by Casino Express and Dancing Eagle Casino in Casa Blanca. The Grants Cibola County School District is also a main employer in the county.

Table 52. Compensation of employees by industry in Cibola County (in $1,000s)

Sector	2001	2005	2010
Farm	255	818	1,196
Forestry, Fishing, Related Activities	(D)	(D)	(D)
Mining	(D)	(D)	(D)
Oil and Gas Extraction	0	0	0
Mining (except oil and gas)	(D)	21,525	(D)
Support Activities for Mining	(D)	(D)	(D)
Utilities	(D)	9,317	14,526
Construction	5,944	8,912	11,555
Manufacturing	10,730	12,432	2,229
Wholesale Trade	5,414	4,856	5,941
Retail Trade	18,989	22,217	26,462
Transportation and Warehousing	(D)	5,770	7,192
Information	1,468	2,231	1,601
Finance and Insurance	2,545	2,984	4,040
Real Estate and Rental and Leasing	449	697	1,607
Professional, Scientific, and Technical Services	1,445	(D)	(D)
Management of Companies and Enterprises	99	(D)	(D)
Administrative and Waste Management Services	13,778	17,266	22,792
Educational Services	0	(D)	103
Health Care and Social Assistance	(D)	(D)	48,126
Arts, Entertainment, Recreation	487	224	222
Accommodation and Food Services	7,417	7,874	11,842
Other Services Except Public Administration	4,622	5,847	7,218
Government and Government Enterprises	105,174	165,841	163,863

Source: USDOC, 2012

(D) Not shown to avoid disclosure of individual confidential information

McKinley County: Compensation by Industry

Table 53 displays the compensation of employees by industry for McKinley County in 2001, 2005, and 2010. Most of the major employers are located in Gallup, the county seat, but not all. In 2010, the government and government services sector generated more employee compensation than any other sector by almost fourfold, accounting for $481,505. Gallup-McKinley County Schools is the largest single employer in McKinley County; additionally the City of Gallup is the fourth largest employer. Second to the government and government services sector is health care and social assistance; SUPS Gallup Indian Medical Center and Rehoboth McKinley Christian Hospital are the second and third largest employers in the county, respectively.

Table 53. Compensation of employees by industry in McKinley County (in $1,000s)

Sector	2001	2005	2010
Farm	652	768	830
Forestry, Fishing, Related Activities	(D)	(D)	(D)
Mining	(D)	(D)	8,081
Oil and Gas Extraction	(D)	(D)	(D)
Mining (except oil and gas)	54,109	(D)	(D)
Support activities for mining	0	0	(D)
Utilities	10,972	11,508	17,248
Construction	24,255	24,255	32,598
Manufacturing	29,650	33,492	39,832
Wholesale Trade	18,543	22,301	22,597
Retail Trade	82,259	92,278	91,035
Transportation and Warehousing	29,703	37,027	35,028
Information	5,023	6,545	8,875
Finance and Insurance	9,520	14,310	14,886
Real Estate and Rental and Leasing	2,710	3,367	6,658
Professional, Scientific, and Technical Services	(D)	9,614	9,707
Management of Companies and enterprises	(D)	1,371	1,322
Administrative and Waste Management Services	8,316	6,948	7,692
Educational Services	12,602	14,004	8,964
Health Care and Social Assistance	59,113	91,575	114,487
Arts, Entertainment, Recreation	339	476	(D)
Accommodation and Food Services	30,385	39,316	45,668
Other Services Except Public Administration	21,932	23,354	26,443
Government and Government Enterprises	330,778	404,225	497,308

Source: USDOC, 2012

(D) Not shown to avoid disclosure of individual confidential information

Public Finance

The State of New Mexico levies direct taxes on uranium, including a severance tax, a natural resources excise tax, and a conservation tax on the value of uranium produced. The severance tax is 3.5 percent of the taxable value of each pound of severed and saved uranium. The resources excise tax is 0.75 percent of the value of the uranium with some deductions allowed. The conservation tax is levied at 0.19 percent of the taxable value of uranium sold (NMTRD, 2011).

Property taxes are dependent upon the appraised value of the property for taxation purposes and on the property tax rates (table 54). Two types of property taxes are levied on uranium operations by the local government as well as the State government. The property tax levy is applied to 50 percent of the production value of uranium. The average nonresidential property tax rate in 2009 for these two counties was 1.106 percent. A property tax is also levied on 33 percent of the value of mining equipment.

Table 54. Net taxable value for property tax purposes, 2009

County	Total Appraised Value Available for County Taxation	Nonresidential	All Property Types Tax Rate	Nonresidential Property Tax Rate
Cibola	$275,071,854	$177,916,811	1.034	1.063
McKinley	$737,555,704	$480,875,429	1.101	1.149

Source: New Mexico Taxation and Revenue Department, 2009

Environmental Consequences

The analysis for socioeconomics evaluates the social and economic effects, both positive and negative, of the development, operation, and reclamation phases of the proposed action.

As noted earlier, the ROI for the socioeconomic analysis includes Cibola and McKinley Counties, or the communities most likely to be affected by the proposed project. These communities may experience a direct, indirect, and/or induced economic impact as a result of the proposed mine, either as a result of permitting, construction, operation, or reclamation (e.g., from employment, wages and taxes, etc.). Additionally, the impact may consist of changes in the quality of life for area residents and visitors due to tax increases. The framework for analysis utilizes the following criteria:

- Magnitude of the impact (how much);
- Duration or frequency of the impact (how long or how often);
- Extent of the impact (how far);
- Likelihood of the impact occurring (probability); and
- Precedence and uniqueness of the impact (e.g., unique setting and controversiality).

The temporal bounds of analysis for analyzing socioeconomics will be guided in part by available data, an assessment of current conditions (without the proposed mine or associated activity), and the phases of activity associated with the proposed mine, including construction, operation, reclamation, and closure.

Alternative 1

Assuming that the proposed project is not implemented, no socioeconomic changes would occur to the counties in the ROI. Since ongoing activities would be substantially the same as those already occurring, no significant additional change in community character and setting would be anticipated. Existing conditions would remain substantially unchanged and have no effect on the populations of concern.

There would be no change to population, housing, employment, income characteristics, economic activity, taxes and revenues, or quality of life conditions. Fluctuations or changes would occur at rates consistent with historical trends.

Alternative 2

As noted above, McKinley and Cibola Counties are the primary focus and ROI for any direct and indirect impacts that may be associated with implementation of the proposed action. For purposes of comparison, the State of New Mexico was defined as the geographic units of comparison and the “general” population. Table 55 shows estimated project costs.

Project development would create an estimated total of 100 to 150 part-time equivalent (PTE) jobs over a 4-year period. Approximately 220 to 250 FTE jobs (220 to 253 annual average full- and part-time jobs) would be created during the operation phase; 16 of these would be maintenance jobs, and 25 would be general and administrative (G&A), and the remaining miners and other related labor support. Operation of the mine would occur over an 11-year period. During the 2-year reclamation phase, 30 PTE jobs would be created (Velasquez, 2012b).

Table 55. Estimated project costs

Description	Cost (USD)
Permitting (5 years)*	$18,000,000
Development (4 years)*	$300,000,000
Operation (11 years)*	$389,000,000
Reclamation (2 years)*	$7,000,000
TOTAL COST	**$714,000,000**
Annual Average Cost of Equipment and Materials (17–18 years)	*$18,500,000*
Annual Average Payroll (17–18 years)	*$19,000,000*

*Equipment and Materials and Payroll captured in cost of each phase.

Input-Output Model

The economic impacts of the development, operation, and reclamation phases of the proposed project were estimated using the **Im**pact Analysis for **Plan**ning (IMPLAN) input-output economic modeling system, originally developed by the Minnesota IMPLAN Group. This type of regional economic modeling is a standard approach to measuring the production and consumption linkages in an economy between households, industries, and institutions (such as government), thus providing an estimate of the “ripple” effects in an economy associated with a direct stimulus or investment.

The Employment Multiplier

A “multiplier” is a number used by economists to determine the impact of a project on the economy. It is the ratio of total change in output or employment to initial change (or direct change). For example, if an industry were to create 100 new jobs, it would require materials and services from its supplying industries. If this increase in demand created 30 new jobs in the supplying industries, the employment multiplier would be 1.3 (i.e., 100 (direct) + 30 (indirect and induced)).

The multipliers of IMPLAN measure these downstream or ripple effects. The multipliers in IMPLAN are defined as the sum of the direct, indirect, and induced effects divided by the direct impact (table 56). In the IMPLAN model, businesses produce goods to sell to other businesses, consumers, governments, and purchasers outside the region. The output is produced using labor, capital, fuel, and intermediate inputs. The demand for labor, capital, and fuel per unit of output depends on their relative costs.

The modeled impacts include the direct effects of spending for development activities and consumption spending of new residents and construction workers; the indirect effects of local vendors providing goods and services to the primary firms; and the induced impacts of employees of these firms spending a portion of their earnings in the local economy. Economic activity is measured in terms of income and employment generated (or lost) due to the proposed action. With increased spending, many different sectors of the economy benefit—not only the directly impacted sector but also many sectors indirectly. All sides of the cost-benefit analysis are analyzed, including costs to the local community and surrounding area as well as benefits the mine would bring.

Table 56. IMPLAN definitions

Effect	Definition
Direct	The set of expenditures applied to the predictive model (i.e., I/O multipliers) for impact analysis (i.e., a $10 million dollar order is a $10 million dollar direct effect).
Indirect	The amount of the direct effect spent within the study region on supplies, services, labor and taxes.
Induced	Measures the money that is re-spent in the ROI as a result of spending from the indirect effect.

Source: MIG, 2012

Each of these steps (direct, indirect, and induced) recognizes an important “leakage” from the economic study region spent on purchases outside of the defined area. “Leakage” is the nonconsumption uses of income, including savings, taxes, and imports that “leak” out of the main flow between output, factor payments, national income, and consumption. Eventually these leakages would stop the cycle (MIG, 2012).

It is difficult to estimate what portion of labor, materials, and equipment that would be provided locally, by each county, or by the State. Ideally, 100 percent of the labor force would be filled by the local population. In IMPLAN, the multipliers for new construction sectors have built in what materials could likely be bought locally versus being imported. Roca Honda Resources, LLC, would recruit locally, statewide, and nationally to fill labor and/or professional needs. Equipment and materials would be procured locally as much as possible. However, a significant amount of specialized equipment and materials required for uranium mining would not be available locally. Such items would be shipped from other areas (Velasquez, 2012b).

A quantitative economic evaluation of revenues, expenditures, taxes, and income and costs of public services and utilities from this project to Grants, Milan, Gallup, and other local towns was not warranted because there would be few, if any, impacts to public services and utilities and, therefore, no requirement to examine revenue sources to pay for them. Similarly, there were no significant local costs anticipated to local government as a result of increased demands for housing and associated infrastructure.

Implementation of the action alternatives and development of the proposed Roca Honda Mine could have direct and indirect impacts to the local (counties) and State economies in terms of employment, government revenues, personal income, business sales, and quality of life. Results are expressed in terms of employment (annual average full- and part-time jobs); wages and salaries (total payroll costs, including benefits); State and local taxes (indirect business taxes, property income, social insurance, and personal income taxes); and total economic activity (total value of production). All results are expressed in 2012 dollars.

Permitting

The period from 2009 to 2014 is assumed for the permitting phase. Costs are estimated at $18 million, or $3.6 million per year. An $18 million change in the environmental and other technical consulting services sector would yield a $26 million impact on the local economy (table 57).

Table 57. Overall economic impacts of permitting in Cibola and McKinley Counties

Description	Impact
Total Economic Activity	$26,087,880
Total Wages and Salaries	$11,814,124
Total Employment	340
Total Taxes	$859,603

Employment and Income

The permitting phase would support 262 direct jobs and an additional 78 indirect and inducted jobs (table 58). The environmental and other technical consulting services sector would reap the most benefits, accounting for about $9.6 million of the $11.8 million in income labor (wages and salaries, including benefits). Wages and salaries represent total payments by industries to workers, not take-home pay.

Table 58. Economic impacts of permitting in Cibola and McKinley Counties

Impact Type	Employment*	Wages and Salaries**	Economic Activity
Direct Effect	262	$9,576,583	$18,631,869
Indirect Effect	27	$789,287	$2,394,576
Induced Effect	51	$1,449,253	$5,061,435
Total Effect	340	$11,814,124	$26,087,880

*Annual average full- and part-time jobs.
**Total payroll costs (including benefits).

Tax Revenue

Indirect business taxes (IBS)—the combination of excise, sales, and property taxes, as well as fees, fines, licenses, and permits—would account for approximately 70 percent of the $859,000 increase in tax revenues during this period.

Development Phase

Baseline data gathering, initial site development, construction, and depressurizing activities would occur over an approximately 4-year period. For purposes of this analysis the development phase was modeled to begin in 2015 and conclude in 2018. Capital costs for development are estimated at $300 million ($75 million per year), which captures the $19 million per year in equipment and materials. The capital cost is the value of industry production, or the sum of value added (which includes employee compensation) and the cost of goods. Since the $300 million capital costs already factors in “intermediate expenditures” such as the cost of equipment and materials, and RHR is able to estimate the number of jobs that would be supported during this phase, the model was adjusted so as to not overstate the impacts. The multipliers for new construction sectors reflect the portion of equipment and materials imported versus purchased locally. Construction is a temporary impact and would cease to occur past the development phase. An overview of its economic impacts is presented in table 59.

Table 59. Overall economic impact of Roca Honda Mine development in Cibola and McKinley Counties

Description	Impact
Total Economic Activity	$482,643,470
Total Salaries and Wages	$150,993,568
Total Employment	840–890
Total Taxes	$35,402,101

Employment and Income

The proposed project would directly employ approximately 100–150 jobs annually, or support a total of about 840–890 direct, indirect, and induced jobs (table 60). Indirect jobs would include local vendors from whom RHR would make purchases and local retail stores and establishments where Roca Honda employees would shop.

Table 60. Economic impacts of development in Cibola and McKinley Counties

Impact Type	Employment*	Salaries and Wages **	Total Economic Activity
Direct Effect	100–150	$127,662,117	$396,513,021
Indirect Effect	111	$5,282,503	$23,348,731
Induced Effect	629	$18,048,949	$62,781,718
Total Effect	840–890	$150,993,568	$482,643,470

*Annual average full- and part-time jobs.

**Total payroll costs (including benefits).

Construction employment is expected to draw largely from the local workforce in the greater Grants area. This would result in a direct increase in employment of both skilled and unskilled labor in area communities. The construction workforce would be expected to be filled by the available labor supply. In 2010, McKinley County had an unemployment rate of 9.1 percent, its highest rate since 2000. Cibola County’s 2010 unemployment was 7.3 percent. Both counties have sizeable construction sectors.

Indirect and induced impacts during the development phase of the project would support an additional 740 jobs in Cibola and McKinley Counties. Associated consumer spending in these counties would increase during the construction phase. However, the indirect and induced jobs supported are often relatively low-wage jobs such as fast food workers or convenience store clerks. Increases in equipment manufacturing and health care jobs would provide wages similar to those in the mining industry.

Development includes actual construction activity, such as labor, materials, and subcontractors, as well as construction equipment rentals, engineering and project management, and commissioning and spare parts, which would be procured by local vendors to the extent possible.

Population and Demographics

It is anticipated that the vast majority of the approximately construction workforce would be drawn from the local workforce. These workers are expected to commute to the project area from their residences, rather than relocate. Construction employees typically commute up to 2 hours from their homes (Gilmore et al., 1982).

Thus, direct impacts to population in the analysis area would result from those employees likely to relocate to the region; these employees would need to possess specialized skills and would either relocate to the region temporarily or permanently, including staying in hotels/motels, apartments, or purchasing a home. Population is expected to grow at least temporarily over the duration of the construction phase, and Cibola and McKinley Counties would likely receive these residents. Further, because of the considerable loss of construction jobs in surrounding communities in recent years as a result of the current economic recession, there is a significant pool of unemployed skilled construction labor in the region. Consequently, workers hired to construct the project would likely be drawn from the existing workforce and not from a migratory workforce from outside the ROI.

Housing

As previously noted, research indicates that construction workers are willing to commute up to 2 hours one way for a job (an average of 73 miles and maximum of 115 miles one way) (Gilmore et al. 1982). As a result, most of the workers would be coming from the Grants area and its suburbs, approximately 25 miles southwest of the project area.

Housing vacancy rates in the analysis area in 2010 averaged approximately 18 percent (table 61). Considering the significant number of vacant housing units in the analysis area, and with most of the construction workforce expected to commute to the project area rather than relocate, little or no transient housing would be required in the project area or in the communities closest to the project area. Those who relocate would have ample housing options in Cibola and McKinley Counties. There would be minimal demands on the local housing supply.

Table 61. Household characteristics (2010)

County	Total Housing Units	Occupied Housing Units/ Total Households	Owner-Occupied Housing Units	Vacancy Rate
Cibola	11,101	8,860	6,575	20.2
McKinley	25,813	21,968	15,722	14.9
New Mexico	901,388	791,395	542,122	12.2

Source: U.S. Census Bureau, 2005-2009 American Community Survey.

Tax and Revenues

The Roca Honda Mine would generate direct tax revenues for State and local governments during the development phase. It is subject to severance taxes in New Mexico, which is an indirect business tax (IBS). Severance taxes would represent $2.5 million during this phase. Because of the shared distribution of severance taxes throughout the State (majority to the State general fund and the rest to counties and municipalities), the portion of severance taxes paid to Cibola and McKinley Counties and municipalities would only equate to a portion of the total severance taxes generated as a result of the mine. Additionally, the excise tax would generate $1.6 million.

Total direct revenues over development are estimated at $35.4 million. Roca Honda has 17.5 million pounds (Mlb.) measured and indicated and 15.8 million inferred. Tax revenue is based on uranium being valued at $50 per pound (UxC, 2012).

Operation Phase

The production of uranium ore would occur over an 11-year period. This phase would create approximately $607 million in total economic activity and support almost 1,200 jobs (table 62).

Table 62. Overall economic impacts of operation in Cibola and McKinley Counties

Description	Impact
Total Economic Activity	$607,039,473
Total Salaries and Wages	$189,910,487
Total Employment	1,151–1,184
Total Taxes	$44,526,601

Employment and Income

Direct impacts include employees and payroll at Roca Honda as well as the value of production. Total jobs include local vendors from whom Roca Honda would make its purchases and local establishments where employees would shop. These local vendors and their employees in turn would make additional local purchases that are captured in the total impact estimates. The total impacts include both the direct and the secondary impacts created by other local businesses and their employees. Additional purchases by both Roca Honda and its employees would also occur outside of the ROI and are not represented here.

The Roca Honda Mine would directly employ approximately 220–250 people during the operation phase (table 63), including mine workers and G&A workers as well as maintenance personnel. Workers in the ROI would experience a roughly $190 million increase in salaries and wages (including benefits).

These workers would represent new purchasing power that would support additional jobs and payroll at local retail and service establishments in the area, most of which would occur in the ROI. Service industries (retail), unlike basic industries, consist of business firms that serve local markets. Through this spending, Roca Honda Mine would indirectly support almost 1,000 indirect and induced jobs.

Table 63. Economic impacts of Roca Honda Mine operation in Cibola and McKinley Counties

Impact Type	Employment*	Salaries and Wages**	Economic Activity
Direct Effect	220–253	$160,565,612	$498,709,856
Indirect Effect	140	$6,644,009	$29,366,608
Induced Effect	791	$22,700,866	$78,963,010
Total Effect	1,151–1,184	$189,910,487	$607,039,473

* Annual average full and part-time jobs

**Total payroll costs (including benefits)

Taxes and Revenues

New Mexico imposes a severance tax, conservation tax, and resource excise tax on uranium production. In addition, renewed uranium operations would generate State tax revenue through direct, indirect, and induced economic activity. These taxes include personal income tax, corporate income tax, and gross receipts tax.

The total tax impacts from operation of the mine would be $44.5 million. Approximately $35.7 million in IBS would result from operation of the mine. The severance tax (an IBS) would represent about $3.2 million. Property income, the dividends and corporate profits tax paid by corporations, would represent about $4.7 million. The Federal excise tax would be $1,988,374.

Reclamation

The 2-year reclamation phase would begin 2 years after completion of the mine operation. Theoretically, this phase would occur between 2032 and 2033. However, IMPLAN data is not available past 2030. As such, the estimated impacts from this phase may be overstated. Removing surface facilities, plugging mine shafts, recontouring the disturbance area, replacing stockpile soil, and establishing vegetation for grazing would support 30 direct PTE jobs and 45 total jobs (table 64). Unlike the development and operation phases, due to the nonspecialized workers needed for reclamation, nearly 100 percent of jobs should be filled by the local labor force. Almost $7 million in economic activity would result from this phase.

Table 64. Overall economic impacts of Ronda Honda Mine reclamation in Cibola and McKinley Counties

Description	Impact
Total Economic Activity	$6,855,668
Total Labor Income	$1,745,581
Total Employment (number of jobs)	45
Total Taxes	$343,218

Employment and Income

In contrast to the development and operation phases, the reclamation phase would directly support the waste management sector (as opposed to the mining sector), which would enjoy the majority of the increased labor income (table 65). However, the reclamation phase would also create additional labor income in the food and health care sectors.

Table 65. Economic impacts of reclamation in Cibola and McKinley Counties

Impact Type	Employment*	Labor Income**	Economic Activity
Direct Effect	30	$1,251,318	$5,098,053
Indirect Effect	8	$285,225	$1,030,284
Induced Effect	7	$209,038	$727,331
Total Effect	45	$1,745,581	$6,855,668

*Annual average full and part-time jobs.

**Total payroll costs (Salaries and wages, including benefits).

Taxes and Revenues

The tax impact during the reclamation phase would be about $343,000, including approximately $33,000 in dividends and corporate profits taxes and $270,000 in IBS. The severance tax would represent $24,383 and the excise tax $15,229.

Conclusion – Socioeconomic Effects of Alternative 2

The Roca Honda Mine would potentially create beneficial impacts of major magnitude due to the creation of jobs, labor income, and tax revenues. Overall, the proposed project would support over a billion dollars in economic activity, about 2,400 jobs with salaries worth $355 million, and generate $81 million in local and State revenue during the life of the project. The extent of impacts would be medium (localized) to large, since most of the jobs would be filled by area residents but a portion still would travel from outside of the economic region. The likelihood of impacts would be probable, since the relationship between an infusion of capital and direct, indirect, and induced impacts is well established. The precedence and uniqueness of the impact would be minor due to the historical nature of uranium mining in the Grants Mineral Belt of New Mexico, though the area has not been a significant uranium producer for over 2 decades. Due to the lack of operational uranium mines in the area with which to compare or base projected impacts, there is moderate confidence in the accuracy of the predictions as to the types, extent, and likelihood of impacts. Impacts to tax revenue, for example, are dependent on the global price of uranium.

With regard to socioeconomics, although the proposed action would yield tangible, significant economic benefits for the region during its approximately 2 decades of construction, operation, and reclamation, the economic impact of this mine remains controversial due to the historical uranium boom and bust cycles that have occurred in the region and elsewhere.

Alternative 3

Socioeconomic impacts of the one shaft alternative would be virtually identical to those of the proposed action (i.e., two shaft alternative).

Cumulative Effects

The action alternatives would have major beneficial socioeconomic effects over the medium to long term, though not permanently. Provided the global price of uranium remains favorable, several of the other reasonably foreseeable projects listed in chapter 2 are also likely to occur. Under this scenario, the projects in combination would support several billion dollars in economic activity, which would represent a significantly beneficial cumulative economic impact for the ROI over the coming decades, though perhaps not a source of permanent prosperity.

Cultural and Historic Resources

Affected Environment

Definitions and Descriptions

Cultural resources are manifestations of culture, specifically archaeological sites, architectural properties, ethnographic resources, and other historical resources relating to human activities, society, and cultural institutions that hold communities together and link them to their surroundings. They include past and present expressions of human culture and history in the physical environment, such as prehistoric and historic archaeological sites, buildings, structures, objects, and districts, which are considered important to a culture, subculture, or community. Cultural resources can also include aspects of the natural and physical environment, such as natural features of the land or biota, which are part of traditional lifeways and practices. Such resources identified for this analysis include prehistoric and historic archaeological resources, as well as ethnographic resources.

Prehistoric and historic archaeological resources are the tangible remains of past activities that show use or modification by people. They can include artifacts, features such as hearths, rock alignments, trails, rock art, cairns, landscape alterations, or architecture. These are sometimes grouped in distinct geographic areas that represent broad cultural styles and traditions. Prehistoric and historic archaeological resources are the loci of purposeful human activity that has resulted in the deposition of cultural materials or tangible modification of the natural environment. In general, prehistoric resources are those that originate from cultural activities prior to the establishment of a European presence in northern New Mexico in the early 17th century. Historic resources are those that date from the period of written records, which began with the arrival of Europeans in the region.

Resources that have a direct association with, and are significant to, a living cultural group may be considered ethnographic resources. Ethnographic resources are associated with the cultural practices, beliefs, and traditional history of a community. They are used within social, spiritual, political, and/or economic contexts, and are important to the preservation and viability of a culture. Examples of ethnographic resources include, but are not limited to, places that play an important role in oral histories, such as a particular rock formation, the confluence of two rivers, or a rock pile (cairn); large areas where resources are interrelated, such as landscapes and viewsheds; sacred sites and places important for religious practices; natural resources traditionally used by people such as plant communities or clay deposits; and “traditional infrastructure” such as trails or camping locations. The features of an ethnographic resource can be manmade or natural. It is important to note that a single cultural resource can possess both archaeological and ethnographic components.

The National Register of Historic Places (NRHP) is a listing of buildings, structures, sites, districts, and objects that are considered significant at a national, state, or local level. Listed resources can have significance in the areas of history, archaeology, architecture, engineering, or culture. Cultural resources that are listed on the NRHP, or have been determined eligible for listing, have been documented and evaluated according to uniform standards and found to meet criteria of significance and integrity. Cultural resources that meet the criteria for listing on the NRHP are called “historic properties.” Resources that have undetermined eligibility are treated as historic properties until a determination otherwise is made. More information on the evaluation of historic properties is provided below. Thus it is important for the reader to understand that the broad category of cultural resources includes a subcategory of resources called historic properties. All historic properties are cultural resources; however, not all cultural resources meet the criteria to be historic properties. The identification of resources and analysis of effects to those resources in this EIS tries to be very clear which group of resources is being discussed in any particular section.

Regulatory Setting

Federal Laws and Regulations

A number of Federal laws address cultural resources and Federal responsibilities regarding them. The long history of legal jurisdiction over cultural resources, dating back to the 1906 passage of the Antiquities Act (16 United States Code (U.S.C.) 431–433), demonstrates a continuing concern on the part of Americans for such resources. Cultural resources include historic properties, as defined in the National Historic Preservation Act (NHPA) (16 U.S.C. 470); cultural items, as defined in the Archeological and Historic Preservation Act (AHPA) (16 U.S.C. 469); cultural items and human remains, as defined by the Native American Graves Protection and Repatriation Act (NAGPRA) (25 U.S.C. 3001); archaeological resources, as defined by the Archeological Resources Protection Act (ARPA) (16 U.S.C. 470aa-mm); the cultural environment, as defined by Executive Order (EO) 11593, Protection and Enhancement of the Cultural Environment (36 Federal Register (FR) 8921); Indian sacred sites to which access is provided under the American Indian Religious Freedom Act (AIRFA) (42 U.S.C. 1996) and as defined in EO 13007 Indian Sacred Sites (61 FR 26771); and religious practices as addressed in AIRFA and the Religious Freedom Restoration Act (RFRA) (42 U.S.C. 2000bb). Similarly, Section 101(b)(4) of the National Environmental Policy Act (NEPA) establishes a Federal policy for the conservation of historic and cultural aspects of the nation’s heritage. Requirements set forth in this legislation, and their implementing regulations, define the Forest Service's responsibilities for management of cultural resources.

Foremost among these statutory provisions is Section 106 of the NHPA, which only applies to historic properties. Section 106 of the NHPA requires Federal agencies to take into account the effect of their undertakings on historic properties. The Advisory Council on Historic Preservation (ACHP) regulations that implement Section 106 (36 Code of Federal Regulations (CFR) Part 800) describe the process for identifying and evaluating resources; assessing effects of Federal actions on historic properties; and consulting to avoid, minimize, or mitigate adverse effects. The NHPA does not mandate preservation of historic properties, but it does ensure that Federal agency decisions concerning the treatment of these resources result from meaningful consideration of cultural and historic values, and identification of options available to protect the resources.

The Southwestern Region of the Forest Service has executed a programmatic agreement with four state historic preservation officers and the ACHP that outlines how the national forests of the Southwestern Region will administer their activities subject to Section 106 of the NHPA. The Cibola National Forest follows the programmatic agreement to meet its Section 106 responsibilities.

As a Federal agency, the Forest Service has a trust responsibility to American Indian tribes to protect tribal cultural resources and to consult with tribes regarding those resources. Certain laws, regulations, and executive orders guide consultation with American Indians to identify cultural resources important to tribes and to address tribal concerns about potential impacts to these resources. Section 101(d)(6) of the NHPA mandates that Federal agencies consult with American Indian tribes and Native American groups who either historically occupied the project area or may attach religious or cultural significance to cultural resources in the region. The legislation is designed to identify cultural resources important to tribes and to address tribal concerns about potential impacts to these resources. The NEPA implementing regulations link to the NHPA, as well as AIRFA, RFRA, NAGPRA, EO 13007, EO 13175 Consultation and Coordination with Indian Tribal Governments (65 FR 67249), and the Executive Memorandum on Government-to-Government Relations with Native American Tribal Governments (59 FR 22951). This legislation calls on agencies to consult with American Indian tribal leaders and others knowledgeable about cultural resources important to them.

The Forest Service consulted with tribes throughout development of the Roca Honda Mine draft EIS, and this consultation will continue through development of the final EIS. The consultation history for the RHR mine project is described below in detail. Ultimately, five tribes elected to continue their participation in the consultation process for the RHR mine. These tribes include the Pueblos of Acoma, Laguna, and Zuni, the Hopi Tribe, and the Navajo Nation. For purposes of clarity, these five tribes collectively are referred to in this document as the "involved tribes."

State Statutes and Rules

In addition to Federal legislation, the State of New Mexico has statutes and rules that address cultural resources. New Mexico's Cultural Properties Act (§18-6-1 through 17 New Mexico Statutes Annotated (NMSA) 1978) addresses a number of cultural resource related issues, including but not limited to, listing of significant cultural properties on the State Register of Cultural Properties (SRCP), prohibiting destruction of significant cultural properties on State land without a permit or on private land without the owner's consent, and regulating excavation or disturbance of unmarked human burials on any lands within New Mexico outside of Federal lands. Section 18-6-8.1, Review of proposed state undertakings states that "the head of any state agency or department having direct or indirect jurisdiction over any land or structure modification which may affect a registered cultural property shall afford the State historic preservation officer a reasonable and timely opportunity to participate in planning such undertaking so as to preserve and protect, and to avoid or minimize adverse effects on, registered cultural properties." The implementing rule (4.10.7 New Mexico Administrative Code (NMAC)) defines indirect jurisdiction as the issuance of an authorization, permit, or license by a state agency, entity, board, or commission for land modification on Federal, state, or private lands. Registered cultural properties are those listed on the SRCP.

The Prehistoric and Historic Sites Preservation Act (§18-8-1 through 8 NMSA 1978) addresses the protection of cultural properties listed on the SRCP or NRHP, stating that no State funds shall be spent on programs or projects that require the use of listed properties. Exceptions include when there is no feasible or prudent alternative to such use, or if all possible planning has occurred to preserve, protect, and minimize harm to the listed property. The implementing rule (4.10.12 NMAC) places the responsibility of the determination on the State agency, which is required to issue the determination in the form of a written record available to all interested parties.

Consultation with American Indians is also addressed by State statute. The New Mexico State – Tribal Collaboration Act (§11-18 NMSA 1978) stipulates that State agencies shall make a reasonable effort to collaborate with Indian nations, tribes, or pueblos in the development and implementation of policies, agreements, and programs of the State agency that directly affect American Indians. Pursuant to the act, the New Mexico Environment Department (NMED), New Mexico Energy, Minerals, and Natural Resources Department (of which the Mining and Minerals Division (MMD) is a part), and the New Mexico Office of the State Engineer (NMOSE) developed the Tribal Collaboration and Communication Policy. The purpose of the policy is to foster, facilitate, and strengthen positive government-to-government relations between these agencies and New Mexico's Indian Nations, tribes, and pueblos.

The New Mexico State Land Office (NMSLO) established a memorandum of agreement (MOA) on April 21, 2011, with the Acoma Pueblo, Laguna Pueblo, Hopi Tribe, Zuni Tribe, and Navajo Nation. The MOA sets forth a process of consultation by the NMSLO with the tribes for proposed activities on New Mexico State Trust Lands that are located within the boundaries of the Mt. Taylor Traditional Cultural Property (TCP). The MOA provides for clear lines of communication between the agency and tribes.

Region of Influence

The region of influence (ROI) is the area within which impacts to cultural resources can occur. Under the regulations implementing Section 106 of the NHPA, analysis of effects to historic properties is conducted within the area of potential effects (APE). An APE is:

> ". . . the geographic area or areas within which an undertaking may directly or indirectly cause alterations in the character or use of historic properties, if any such properties exist. The area of potential effects is influenced by the scale and nature of an undertaking and may be different for different kinds of effects caused by the undertaking." (36 CFR 800.16(d))

The Forest Service adopted this definition for assessing the potential impacts of the proposed project on all cultural resources, whether or not they are evaluated as historic properties.

The Forest Service initially determined that the proposed Roca Honda Mine could have the potential to impact cultural resources through physical impacts to resources, through physical impacts to natural features in resource settings, and through changes to the visual and audible character of resource settings. To analyze the potential for these impacts, the Forest Service established two APEs: a physical APE and a setting APE.

The APE for physical effects includes the areas within which construction or operations activities would occur, hereafter referred to as the physical APE. The physical APE includes the mine permit area requested by Roca Honda Resources (Sections 9, 10, and 16 in their entirety), plus additional areas where associated construction or operations activities would take place. These additional areas include the haul road routes in Sections 11, 17, and 20; the utility corridor and access road in Section 15; and the dewatering discharge pipeline corridor and discharge points in Sections 11, 2, and the unplatted private land to the north. Because the locations of the mine permit area and the additional areas do not differ between the three alternatives (alternative 1 – no action, alternative 2 – proposed action, and alternative 3 – one shaft alternative), the boundaries of the physical APE are the same for all three (figure 61).

Due to the nature of the proposed project, changes to the visual or audible character of resources or their settings could occur to cultural resources located either within or outside the physical APE. This is important for certain resources where the setting contributes to the values and significance of the resource. To analyze the potential for these impacts, the Forest Service established a setting APE based on the locations from which there is a line-of-sight to the proposed mine facilities (buildings, structures, and infrastructure), within which both visual and audible impacts could occur. This area was identified using geographic information systems technology to find those locations where a 6-foot tall person would have line-of-sight to the facilities, regardless of distance and vegetation. The setting APE is dependent on the proposed surface facilities, which differ between the action alternatives. However, the setting APEs for each alternative are incredibly similar to one another, with only very slight differences and, thus, are blended together to form one setting APE that is the same for either alternative (figure 61). This blended setting APE is approximately 75,023 acres in size.

Historical Context of the Project Area

Cultural resources are best understood when viewed within their historical context. Contexts are the broad patterns or trends in history by which a specific resource is understood and its meaning (and ultimately its significance) within prehistory and history is made clear (NPS, 1990). The settlement and land use of the region of the mine project area is well documented in the archaeological, ethnographic, oral, and archival record. Cultural resources in northwest New Mexico embody a long progression of time beginning with the Paleoindian occupation of 12,000 years ago and continuing through 470 years of historic use. The following section briefly describes the major patterns of prehistory and history for the proposed mine project area and its vicinity. The text in this section is based on information developed for the archaeological studies of the proposed mine project area and on information provided by the consulted tribes, except where noted.

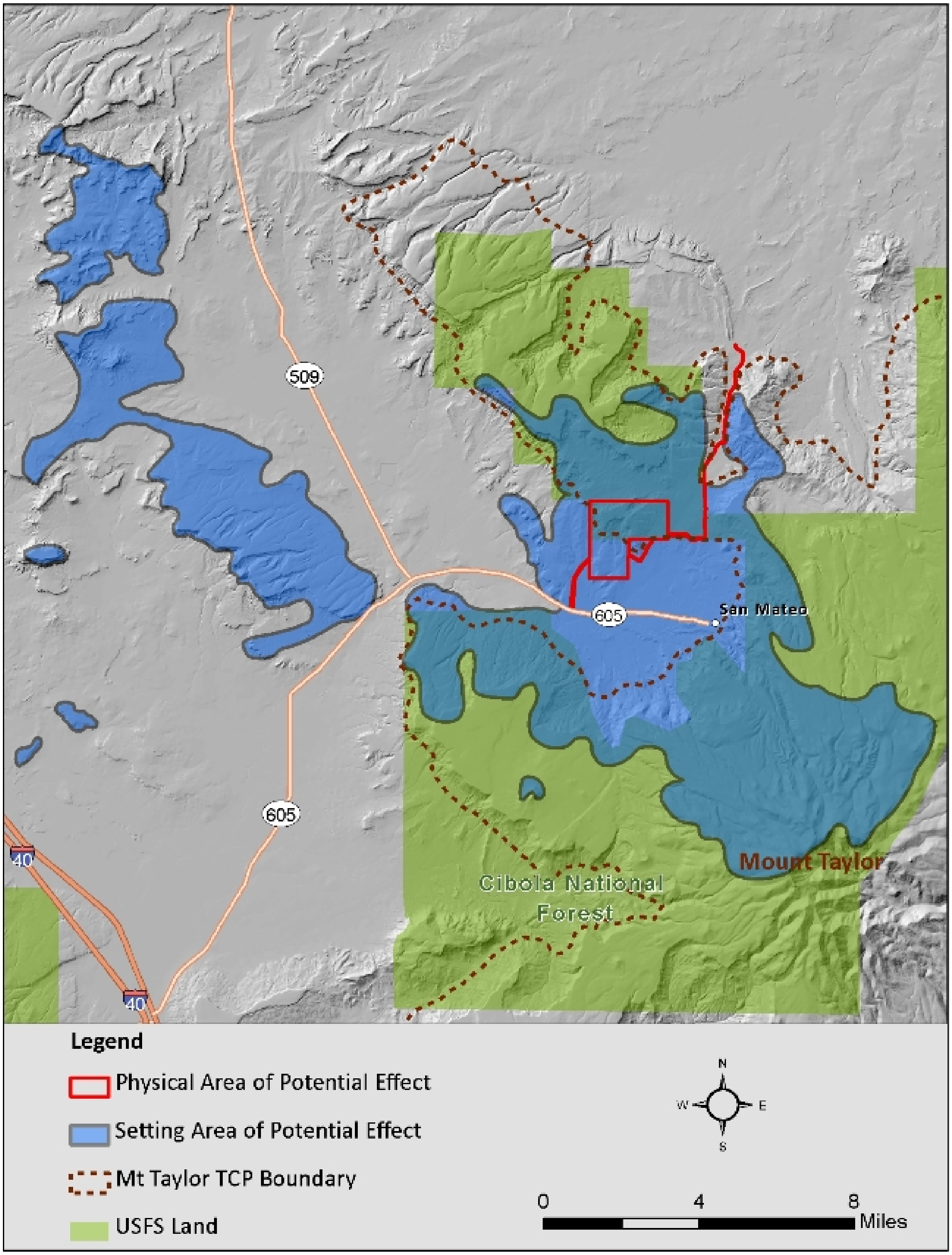


Figure 61. Areas of Potential Effect for the proposed Roca Honda Mine

Prehistory

The earliest identified human settlement in North America occurs during the Paleoindian period (10,500–5000 B.C.). Archaeological evidence from this period indicates a nomadic lifestyle with a subsistence strategy focused on big game hunting. Although Paleoindian groups likely utilized small game and plant foods in addition to big game, a substantial change in the subsistence strategy to these food sources marks the transition to the Archaic period (5000 B.C.–A.D. 400). People during this period were still mobile; however, mobility was more restricted in geographical extent and cyclical, usually tied to the seasons. Once productive resource procurement locations were identified, people returned to these locations on a seasonal basis. Most early (5500–3200 B.C.) and middle (3200–1800 B.C.) Archaic sites appear to be single-use hunting camps, though grinding tools are encountered at sites, indicating seed and nut processing. During the late Archaic (1800 B.C. – A.D. 400), major changes were initiated with the acceptance of horticulture (e.g., maize) into the subsistence strategy and a higher degree of sedentism. In general, this portion of the Archaic is characterized by a shift from hunting and gathering as the prime subsistence economy to horticulture, and a much higher site density is noted.

As with most areas of the American Southwest, evidence of Paleoindian people in the region is sparse. Paleoindian cultural deposits have been found in the Puerco Valley east of Mt. Taylor. Within the region of the proposed project area, the frequency of Archaic sites increases through the middle and late Archaic. Evidence for Archaic occupation is most common at San Mateo Mesa (which includes the mine project area), La Jara Mesa, Lobo Canyon, and Grants Canyon (Benedict and Hudson 2008).

General cultural developments associated with the Basketmaker III period (A.D. 400–800) include the appearance of settlements consisting of between 1 and 20 pithouse structures (semi-subterranean dwellings), an everincreasing dependence on cultivated crops, and a continued practice of local plant food gathering and hunting. During the Pueblo I period (A.D. 800–950), aboveground masonry dwellings are introduced and the number of sites found in flood plains and along canyon floors, in proximity to agricultural fields, increases. Agricultural practices began to include unique methods to improve crop production, such as terracing, irrigation, and gridding. Settlements continued to increase in size and complexity during the Pueblo II (A.D. 950–1100). There is a trend toward centralization in larger villages, with associated outlying limited-task sites (such as field houses) where supporting activities were conducted. The increase in residential density was met with an increase in the importance of agriculture, with the development of complex systems for irrigation and water control, along with further development of terraced gardens and grid systems.

Population in the region during the Basketmaker and Pueblo I periods continued to be low; however, settlement in the area increased during the Pueblo II period, particularly in the San Mateo Valley (near the mine project area). Evidence that this increase in population may be related to the rise of Chaco Canyon as a major cultural center includes the multiple Chaco-related outlier sites in the vicinity, including in El Rito Canyon and around the village of San Mateo. The relationship between the populations in Chaco Canyon and the Mt. Taylor area is firmly demonstrated by the presence of timber beams from Mt. Taylor in Chaco Canyon structures. Intensive use of the landscape in the San Mateo Valley is shown by the high density of Pueblo II-era habitation sites (Benedict and Hudson, 2008).

The Pueblo III period (A.D. 1100–1300) shows a dramatic change from its predecessors, with movement of populations to areas with permanent water sources. The Pueblo IV period (A.D.

1300–1540) also saw a continuation of shifting populations, as well as increased populations, but this time settlement appears to coalesce in large villages that are the predecessors of the present-day Pueblo villages. Many scholars theorize that during this period, the ancestral Navajos and Apaches established themselves in northern New Mexico. However, Navajo traditional history says that the Navajo did not migrate here, but originated here. These people were nomadic hunters and gatherers who moved into and settled areas previously occupied by Puebloan groups, and some may have adopted horticulture of corn, beans, and squash.

By 1100 A.D., the Chaco-related sites were abandoned and populations in the San Mateo Valley declined (Benedict and Hudson, 2008). Although the results of this population shift differ in various areas of New Mexico, with some areas gaining population and others losing, the region of the proposed project area shows evidence of settlement dispersion with groups located near major activity areas. Intensive habitation of the region declined; however, the area shows continued Puebloan use of the region's resources through to the present day.

History

Francisco Vasquez de Coronado's exploration of the northern Rio Grande Valley from 1540 to 1542 marks the beginning of the Historic period, when Europeans first contacted the native populations of the region. However, it was not until 1598, when New Mexico became a Spanish colony, that life began to change for American Indians. Spanish settlement introduced new technologies, such as the use of metal, and a new religion, Catholicism, which was forcibly instituted through the establishment of missions throughout northern New Mexico. Changes in native settlement patterns reflect the reorganization of indigenous peoples to meet Spanish labor demands and accommodate the establishment of the missions. Rapid reductions in native populations demonstrate the effect of introducing Old World diseases.

Puebloan use of Mt. Taylor and its environs continued from prehistoric through historic times. While no permanent settlements were established in the northwest area in the San Mateo Valley, this area was used for hunting, resource collecting, ceremonial activities, and sheepherding. The Navajo had moved south into the Mt. Taylor area starting in the 1600s, and by the late 1700s, San Mateo was being listed as one of the geographic divisions of the Navajo Tribe (Benedict and Hudson, 2008). The 17th and 18th centuries saw a rapid increase in the number of Spanish settlements in the Rio Grande Valley and surrounding areas. Beginning in 1753, Spanish settlers were awarded land grants in the Mt. Taylor region that encroached on lands used by the pueblos and Navajo for hunting and grazing. The Navajo retaliated by attacking Spanish settlements surrounding Mt. Taylor. The Spanish responded by establishing military outposts in the area. Cycles of drought, raiding, land grant occupation, military action, and temporary treaties defined the region into the 1800s. In 1821, with the declaration of independence by Mexico from Spain, the first officially sanctioned Anglo-American traders traveled west on the Santa Fe Trail.

The Treaty of Guadalupe Hidalgo was signed in 1848 between the U.S. and Mexico, giving the territory of New Mexico to the U.S. Several military campaigns ended with placing the Navajo and Ute on reservations. Allocating tribal lands to the pueblos in the form of land grants was a part of Spanish colonial policy, and encroaching on those grants had been a practice of the Spanish, Mexicans, and Americans. Pueblos began fighting this process in the courts in 1880, and were finally successful with the passage of the Pueblo Lands Act of 1924, in which Congress recognized the validity of the land grants.

The Santiago Durán y Chaves Grant, or the San Mateo Springs Grant, including the village of San Mateo, was awarded in 1768. This grant is located immediately southwest of the project area. At that time, however, only seasonal and intermittent occupation by Spanish families was possible due to extensive raiding. The Spanish families used the San Mateo Valley, and presumably portions of the San Mateo Basin, as summer range for livestock, primarily sheep. The village of San Mateo was not settled permanently until the mid-1800s (Scheick, 2011). In the 1870s and early 1880s, the Star Mail Stagecoach Route, connecting Fort Marcy in Santa Fe with Fort Whipple in Prescott, Arizona, ran through the San Mateo Valley. Use of this route was discontinued when the transcontinental railroad was completed south of Mt. Taylor.

By the early 1800s, the Navajo, including those living in the San Mateo Valley area, had shifted their primary subsistence strategy from hunting and gathering, supplemented by raiding, to sheep herding, although the previous activities continued. Settlement patterns changed in response, with people living in summer and winter camps to follow the good pasturage. Returning to the area in 1868 after their confinement at Fort Sumner, the Navajo prospered, relying mainly on sheep herding. Based on dated Navajo sites on San Mateo Mesa, the Navajo gradually shifted their activities west to less accessible and less desirable land. This was likely due to pressures from the Spanish people settled in San Mateo village, who were also using the area for livestock (Benedict and Hudson, 2008).

The area including and surrounding the proposed Roca Honda Mine was utilized by Hispanic, Navajo, and pueblo people throughout the Historic period. Resource extraction, such as hunting, firewood gathering, ponderosa pine bark removal, and plant gathering, was conducted extensively historically, and similar activities continue at some level to the present day. Farming may have been conducted on the slopes below the mesas of Mt. Taylor. Sheep herding was conducted historically by Acoma, Laguna, and Navajo, and by the Hispanic settlers, but since then cattle have replaced sheep. The vicinity of the proposed project also played (and continues to play) an important role in tribal religious practices and tribal histories. Evidence of these uses is provided by the presence of archaeological remains and through written and oral histories.

A settler named Manuel Chaves started what was called the Fernandez or, later, the Floyd Lee Ranch west of San Mateo in 1876. His half-brother, Ramon Baca, built a home at La Providencia just to the south. Both ranches ran thousands of sheep. Over the decades after World War I, Floyd Lee moved from ranch hand to manager to owner and made the ranch the third largest in New Mexico (Popelish, 2005). While the ranch initially raised both cattle and sheep, it simplified to cattle in the 1970s (Pena, 2005).

While mining activity in the San Mateo region included coal, uranium was the major focus of the mining industry. Intensive development of uranium resources began in the vicinity of the proposed project in the 1950s, with the majority of the exploration located on the La Jara, San Mateo, and Jesus Mesas. Development included exploratory drilling, new road construction, and pipeline construction, in addition to actual mining. The San Mateo Mine, located south of the proposed project area on the northern slope of La Jara Mesa about 5 miles west of the village of San Mateo, was operated from 1955 to 1971 (USFS, 2009a). The uranium mining boom collapsed in the late 1980s with the drastic reduction in ore prices. The Mt. Taylor Uranium Mine, the deepest in the world, was built in the mid-1980s immediately north of the village of San Mateo and east of the proposed project area, and operated until 1989 when it was mothballed (Popelish, 2005).

Tribal History

The tribes whose traditional land use includes the proposed project area maintain information about their historical ties to this area. This information, called ethnohistory, though not always available to or shared with outsiders, is part of the definition of each tribe and is essential to the maintenance of tribal identity. These histories demonstrate the tribes' relationships to the land and its varied resources. As described in an ethnographic assessment prepared for this EIS, the identity of the native people and the land are inseparably fused (Colwell-Chanthaphonh and Ferguson, 2012b), and this relationship is reaffirmed through tribal histories. Information from ethnohistories can be paired with other sources of information (such as archaeological or archival) to develop a fuller picture of history than would be possible when taken alone. Ethnohistory is another source of information that helps form a context within which cultural resources are understood and given meaning. The following information provides a very general introduction to the historical use of the proposed project location and the surrounding area by each of the involved tribes as described in their traditional histories. More information about each involved tribe's connection with the Mt. Taylor area is provided in another section further below.

Hopi Tribe

Hopi tradition holds that the people emerged into this world and migrated throughout the Southwest until finally gathering at the Hopi Mesas in Arizona. Some Hopi clans have traditions of residing in the area of Mt. Taylor, while others migrated through the area on their way to the Hopi Mesas. Mt. Taylor served as a landmark for Hopi travels to Acoma and the Rio Grande pueblos. Even after the migrations, Mt. Taylor continued to be visited for conducting ceremonies and other religious activities, and for collecting materials. Although not visited as often today, Mt. Taylor still plays an important role in traditional practices (Benedict and Hudson, 2008).

Navajo Nation

Mt. Taylor is one of four sacred mountains that bound Dinetah, or the traditional Navajo land. The mountain and its mesas were used historically for homesteading, sheep herding, hunting, gathering of food and materials, and for conduct of traditional healing ceremonies. The San Mateo Band of Navajo settled in and around the Roca Honda project area around the 1720s. This group, referred to as the Dine Anáá or "enemy Navajo" (Joe, personal communication, 2011), are said to have split from the primary tribe due to internal conflicts. The San Mateo Band likely maintained a very traditional lifestyle; grazing sheep in the valleys and remaining very mobile. Their use of the area was probably on a seasonal, but cyclic basis. The San Mateo Band is believed to have left the area by the 1820s due to disease, and the band, or a portion of it, eventually settled on the southeast side of Mt. Taylor in the area now referred to as To'hajilee (Cañoncito Band of Navajo) (Joe, personal communication, 2011; To'hajilee Chapter n.d.). Collection of food and materials and conduct of ceremonies continues in the Mt. Taylor area to the present day (Benedict and Hudson, 2008).

Pueblo of Acoma

Acoma history relates the migration of the people from their place of emergence, with all groups eventually coming together south of Mt. Taylor at Acoma. These migrations occurred in all directions, including in the area surrounding Mt. Taylor and its western slopes. The mesas to the west and northwest of Mt. Taylor play a significant role in the migration traditions of the Acoma, and these places along with other locations have Acoma place names recounted in their histories (Benedict and Hudson 2008). The Acoma history documents past use of Mt. Taylor and the slopes and mesas surrounding it, for hunting, collecting of food, fuel, and other materials, and for religious activities. Acoma herdsmen are also known to have used the area for sheep herding. Many of these uses have continued to the present day (Anschuetz, 2012).

Pueblo of Laguna

Pueblo of Laguna tradition holds that ancestors of the Lagunas emerged into this world at the origin place, and began a migration that would eventually lead them to Mt. Taylor, where they are located today. The migration route extended over a wide geographic area and lasted eons of time, and included settlements in other places such as Mesa Verde, Chaco Canyon, and the Magdalena Mountains. They settled at Laguna Pueblo, which is on Mt. Taylor, before the arrival of the Spaniards in the 16th century. Laguna use of Mt. Taylor is well documented, and includes the area of the proposed mine project northwest of the mountain proper. This use included hunting, gathering of materials, and ceremonial use. Lagunas conducted extensive sheep herding on the flanks and mesas north and west of Mt. Taylor, with herds they owned and herds owned by other tribes or Hispanic families. The grazing areas included the areas within and around the proposed mine project by the mid-1800s. Although sheep herding is no longer practiced to any great extent on Mt. Taylor today, Laguna use of Mt. Taylor and its vicinity for other activities continues to present times (Colwell-Chanthaphonh and Ferguson, 2012a).

Pueblo of Zuni

Zunis believe that after emerging into this world, the Zuni ancestors embarked on an epic migration across the American Southwest. The Zunis received special wisdom and medicines in various places they settled during the migration, including Mt. Taylor. After arriving at and settling at the Middle Place, where Zuni Pueblo is found today, Mt. Taylor continued to serve as an important place for Zunis. It served as a boundary, farming and grazing areas extended to its western base, and Zunis traversed the entire mountain and beyond for hunting, plant, animal, and mineral collecting, and for religious observances. In the mid- and late-1800s, Zunis began to be separated from Mt. Taylor due to political influences and Anglo-American land ownership. While this separation challenged the traditional use of Mt. Taylor, use of the mountain for hunting, collecting, and religious activities continued, and continues through to the present day (Colwell-Chanthaphonh and Ferguson, 2012b).

Cultural Resource Investigations

A number of resource investigations have been undertaken to develop the information needed to assess the potential impacts of the proposed action on cultural resources. These investigations were conducted in accordance with Federal legislation, as described above, and included archaeological survey, archaeological testing, geomorphological study, and tribal ethnographic assessment. These investigations are described in this section.

Archaeological Survey

The Forest Service oversaw eight intensive archaeological surveys of the physical APE to identify archaeological resources that would meet the criteria for listing on the NRHP. The physical APE is much larger than the area needed for construction and operation activities, or the actual footprint of the surface facilities, for three reasons. First, the APE includes the entire permit area requested by Roca Honda Resources. Second, the APE encompasses the surface expression of the subsurface ore bodies, due to expressed concerns by some regarding the possibility for subsidence and associated impacts to cultural resources. Finally, the larger APE allows RHR room to relocate project components during planning and design of the facilities in order to reduce potential impacts to resources or for other reasons.

The surveys included background research to determine the prehistoric and historic contexts of the project area and vicinity, site file searches for information on previously recorded archaeological resources, 100 percent coverage pedestrian survey of the project area, and recording to State or Forest Service standards all identified archaeological resources aged 50 years or older. The results are presented in eight survey reports, listed in table 66.

Table 66. Archaeological surveys conducted of the physical APE

Portion of Physical APE	Land Status	Acreage Surveyed	Reference
Sections 9 and 10 of mine permit area	USFS	1,280	Walley et al., 2006
Section 16 of mine permit area	NMSLO	640	Walley, 2006
Section 11 haul road	USFS	28	Allison, 2010
Sections 17 and 20 haul road	private	49	McCormack, 2010
Section 15 utility corridor/access road reroute	private	23	McCormack, 2012
Reroute of Section 11 haul road, reroute of Section 17 haul road, reroute of Section 15 utility corridor/access road	private, USFS	170	Boggess, 2012
Dewatering discharge pipeline	USFS, private	220	McCormack and Boggess 2012
Additional site recording	USFS, NMSLO	NA	in progress

NMSLO = New Mexico State Land Office; USFS = United States Forest Service

For each survey, the Forest Service evaluated the identified archaeological resources for NRHP eligibility, and submitted the report and eligibility determinations to the New Mexico State Historic Preservation Officer (NMSHPO) for review and concurrence. The Forest Service made the reports available to the consulting parties, with a request for input on resource eligibility. The reports or their findings were also available to the four tribes conducting ethnographic assessments. Information from these reports is incorporated into the analysis in this draft EIS.

The report for the dewatering discharge pipeline survey has only recently been provided to the consulting parties for their input. After consideration and appropriate incorporation of the input from the consulting parties, the report will be submitted to the NMSHPO as part of formal Section 106 consultation. Information from this survey is incorporated into the analysis in this draft EIS.

Based on information received from the involved tribes during their ethnographic assessments and from project area visits, the Forest Service has initiated recording of additional archaeological resources identified by the tribes. Some of these resources will be recorded as new sites, and some will be incorporated into existing recorded sites as new features, as appropriate. Currently, it is estimated that 15 already recorded sites will be modified to include new features, and 15 new sites will be recorded. Because the fieldwork is currently underway, the results will not be available to inform the impact analysis until the final EIS. The future report on the results will be made available to the consulting parties for review and input, and then will be submitted to the NMSHPO as part of formal Section 106 consultation.

Chaco Roads Reconnaissance

A potential was recognized for the presence of prehistoric roads crossing through the proposed project area, connecting large archaeological sites, called Great Houses, associated with the extensive prehistoric settlement of Chaco Canyon. The locations of Chaco Great Houses at San Mateo and Kin Nizhoni (west of the San Mateo Valley) are well known, as are the alignments of several Chaco roads in their immediate vicinities. Using a map, a simple straight-line connection drawn between the Great Houses themselves passes through Section 16. Field reconnaissance of this potential alignment within the physical APE was conducted; however, no linear features and no indications of any modifications of the mesa edge (ramps, stairways, or hand-and-foot holds) were identified. Subsequent field visits by the involved tribes' representatives revealed a nearby trail providing a means of passage over the mesa edge, and this discovery prompted a revisitation of the broader question of a potential for the existence of such alignments.

The Great Houses themselves are the focus of many known road alignments, but there are also known to be intersections of roads in their near vicinities. These "nodes" are the points where yet other roadways have been observed to branch off. Previous investigations have revealed that each of these two Great Houses may be seen to exhibit northern and southern nodes outside of, but within a few hundred meters from the ruins themselves. A series of straight-line connections between the Great Houses and the nearby nodes revealed a total of nine potential crossings of Section 16. Each of these crossings was the subject of additional field visits. Each visit involved pedestrian inspection of the area and documentation with photographs taken in both directions along the potential alignments.

Section 11 of the project area also contains suspected routes that were previously investigated by the BLM (Nials et al., 1987:20, 100, 101). The previous investigations concluded that none of the routes in Section 11 were Chaco roads. However, to be thorough, the current investigation examined the location of these suspected routes.

Information from this reconnaissance is incorporated into the analysis in this draft EIS. Reporting of this work and the results will be included in the documentation submitted to the consulting parties for review and input, and then submitted to the NMSHPO as part of formal Section 106 consultation.

Archaeological Testing

The Forest Service also oversaw archaeological testing of 10 sites in the physical APE to provide additional information for determining potential impacts (Boggess and McCormack, 2012). These sites are located within or adjacent to proposed mine facilities. The purpose of the testing effort was twofold: (1) to determine the eligibility of some sites where eligibility could not be determined based on survey information; and (2) to determine the boundaries of some sites that are located close to proposed mine facilities, thereby providing information on whether sites could be avoided or not. The information collected through this effort is reflected in this draft EIS. The testing report has recently been made available to the consulting parties for review and input. After consideration and appropriate incorporation of the input from the consulting parties, the report will be submitted to the NMSHPO as part of formal Section 106 consultation.

Geomorphological Study

Geomorphology is the study of how landforms on the surface of the earth are created through wind, water, and other forces. The Forest Service oversaw a geomorphological study in the proposed mine permit area to address questions raised by the consulting parties about the potential for deeply buried cultural deposits in the physical APE. The report on the geomorphological study has recently been made available to the consulting parties for review and input, as part of the testing report. After consideration and appropriate incorporation of the input from the consulting parties,, the report will be submitted to the NMSHPO as part of formal Section 106 consultation.

Tribal Ethnographic Assessment

Based on input received from the involved tribes, the Forest Service determined that it was necessary to complete ethnographic assessments in order to obtain the information needed to adequately address impacts to cultural resources as a result of the proposed project. The Forest Service oversaw tribal ethnographic assessments conducted within the physical and setting APEs. These assessments were conducted by the tribes themselves, using professional ethnographers of their choosing. Acoma Pueblo, Laguna Pueblo, the Hopi Tribe, and the Zuni Tribe all participated, and each conducted an internal ethnographic investigation for their tribe (the Navajo Nation declined to participate). The objectives of the assessments were to identify cultural resources of religious and cultural significance to the tribes, as well as cultural practices, and provide information on these resources and practices and potential impacts thereto that would assist the Forest Service in analyzing the potential impacts of the proposed project under NEPA and assessing the potential effects under Section 106 of the NHPA.

To accomplish the work, each tribe was provided with funding by RHR to cover labor costs and expenses incurred during the investigations. The Forest Service provided each tribe with the results of archaeological surveys; other available environmental information; detailed information about the proposed project including plans, drawings, and GIS information; and access to the proposed project area. The investigations, led by experienced ethnographers employed by each tribe, included research of existing literature, interviews with knowledgeable tribal members, and project area visits with tribal members. Each tribe prepared a report detailing the results of their investigation (table 67). Information from these investigations is incorporated into the analysis in this draft EIS. The assessments by the Pueblos of Acoma, Laguna, and Zuni have been finalized. The draft assessment from the Hopi Tribe has been provided to the Forest Service, but a final report has not been submitted. These reports will be submitted to the NMSHPO as part of formal Section 106 consultation to support eligibility and effect determinations.

Table 67. Ethnographic assessments conducted by the four tribes

Title	Reference
The Pueblo of Acoma Ethnographic Study and Traditional Cultural Properties Consultation for the Proposed Roca Honda Uranium Mine at the Foot of Kaweshtima in the San Mateo Valley, New Mexico	Anschuetz, 2012

Title	Reference
Footprints and Rain Storms in a Living Landscape: More Notes on Hopi Culture and History Relating to Mt. Taylor, Draft	Koyiyumptewa, 2012
The Pueblo of Laguna and Tsibina: Mt. Taylor and the Proposed Roca Honda Uranium Mine	Colwell-Chanthaphohn and Ferguson, 2012a
Dewankwin Kyaba:chu Yalanne: The Zuni Cultural Landscape and the Proposed Roca Honda Uranium Mine	Colwell-Chanthaphohn and Ferguson, 2012b

Tribal Consultation

Consultation with tribes is required under multiple Federal and State statutes. Prominent among these, and related to the current analysis effort, are NEPA, Sections 101 and 106 of the NHPA, NMSA § 11-18, and the MOA between the NMSLO and certain tribes. The purposes of consultation are to elicit from tribal representatives concerns for potential impacts from the proposed project on the tribe or resources (not just cultural resources) that are significant to the tribe, and to identify possible mitigation measures to resolve or minimize potential impacts. Because the Federal government has a unique legal relationship with tribes, this consultation must recognize the government-to-government relationship between the Federal government and tribes, and be conducted in a manner sensitive to tribal sovereignty.

The Forest Service regularly consults with eight American Indian tribes that have used and may continue to use the lands managed as the Mt. Taylor Ranger District for traditional cultural or religious activities. These include: the Pueblos of Acoma, Jemez, Laguna, Sandia, and Zuni, the Hopi Tribe, the Jicarilla Apache Nation, and the Navajo Nation. Additionally, the Forest Service consults on a more limited basis with 12 Navajo Chapters that are located in the vicinity of the land managed by the Mt. Taylor Ranger District.

Tribal Consultation Prior to This EIS

The Forest Service first initiated consultation about uranium development in general with the tribes after receiving plans of operation for exploratory drilling from two different companies. By late 2007, four companies had submitted plans of operation for exploratory drilling on the Mt. Taylor Ranger District. At this point, the Forest Service initiated extensive consultation based upon those four plans, and at the same time initiated consultation regarding the traditional uses of Mt. Taylor, as well as potential effects to the mountain as a result of uranium development.

In October 2007, the Forest Service contacted 16 tribes and 12 Navajo chapters, inviting all to be consulting parties regarding uranium exploration on the Mt. Taylor Ranger District, and to assist the Agency in its efforts to determine the cultural values and traditional uses of Mt. Taylor by American Indians. This consultation included the four proposed drilling projects mentioned previously, one of which was Strathmore Mineral Corporation's proposed Roca Honda exploration project. The invitation letter was sent to the Pueblos of Acoma, Cochiti, Isleta, Jemez, Laguna, Sandia, San Felipe, San Ildefonso, Santa Ana, Santo Domingo, Zia, and Zuni, the Hopi Tribe, the Jicarilla Apache Nation, the Mescalero Apache Tribe, the Navajo Nation, and the following Navajo chapters: Baca, Casamero Lake, Crownpoint, Mariano Lake, Ojo Encino, Prewitt, Ramah, Smith Lake, Thoreau, To'hajilee, Torreon, and Whitehorse Lake. In phone conversations with the governors or tribal officials from the Pueblos of Cochiti, San Felipe Santo

Domingo, and Zia, and the Mescalero Apache Tribe, all deferred consultation to the tribes that are closer to Mt. Taylor, namely Acoma, Laguna, and Zuni. The efforts to consult with the Pueblos of Sandia, Santa Ana, and San Ildefonso were unsuccessful.

Between October 2007 and February 2008, the Forest Service conducted extensive consultation with the remaining eight tribes, which included the Pueblos of Acoma, Isleta, Jemez, Laguna, and Zuni, the Hopi Tribe, the Jicarilla Apache Nation, and the Navajo Nation. These are the tribes whose input was used in the Forest Service's NRHP eligibility determination report for the Mt. Taylor Traditional Cultural Property (Benedict and Hudson 2008). Topics of discussion focused not only on the cultural significance of Mt. Taylor, but also on potential impacts to the mountain as a result of uranium development. This conversation was based upon the four plans of operation that the Forest Service had received by that point, all of which involved exploration drilling. One of the four plans, that submitted by Strathmore Mineral Corporation, indicated its intent to also drill water monitoring wells, the purpose being to establish a groundwater quality baseline, and to allow for long-term groundwater quality monitoring. Strathmore's plan indicated that its need for these data was tied to its intention to develop plans for a mine.

In March 2008, the Forest Service completed a NRHP eligibility determination for Mt. Taylor. The mountain was determined eligible for inclusion in the NRHP as a TCP. Strathmore had withdrawn its plan of operations for drilling four to nine exploration bore holes in February 2008 and submitted a new plan of operations in July 2008 to drill one bore hole in Section 10. The Forest Service sent a consultation letter in August 2008 to the eight tribes outlining Strathmore's project in some detail. It served as notification that the company's proposal had changed from drilling four to nine holes, to just one hole. The stated purpose for the drilling was to confirm the ore grade and obtain geological and geotechnical data. The Pueblo of Isleta notified the Forest Service in September 2008 of its decision to decline further comment and consultation on the Roca Honda Mine project, deferring to the Pueblos of Acoma, Laguna, and Zuni. This left seven tribes with an interest in consulting on the Roca Honda project.

Strathmore/Roca Honda Resources, LLC, withdrew the plan for one bore hole and submitted a new plan of operations to the Forest Service in October 2009 to develop and operate an underground uranium mine on their claims near Jesus Mesa. A description of the proposed project was included in the Forest Service's annual project consultation letter sent to the regularly consulted tribes in February 2010, which included the remaining seven tribes plus Sandia Pueblo. This was intended to initiate a new round of project consultation. Followup consultation meetings took place between June and September 2010 with the Pueblos of Jemez, Sandia, and Zuni, the Hopi Tribe, the Jicarilla Apache Nation, and the Navajo Nation. Attempts to meet with the Pueblos of Acoma and Laguna were unsuccessful during this time.

Tribal Consultation as Part of This EIS

Formal consultation under NEPA was initiated with a scoping letter sent to all eight regularly consulted tribes on December 1, 2010. Responses were received from the Pueblos of Acoma and Laguna, the Hopi Tribe, and the Zuni Tribe. In February 2011, the Forest Service invited these eight tribes to participate in a meeting and fieldtrip to the proposed project area. The April 2011 meeting and fieldtrip, led by the Forest Service, was attended by the Pueblos of Acoma, Laguna, and Zuni, the Hopi Tribe, and the Navajo Nation, as well as the involved State agencies and the mine applicant. The guided fieldtrip showed the locations of proposed facilities, included discussion of the facilities and proposed operations, and addressed questions about the project.

The Forest Service sent letters to the eight tribes on March 30, 2011, asking if they wished to continue consultation and be part of the Section 106 consultation process as consulting parties. The Jicarilla Apache Nation and the Pueblos of Jemez and Sandia did not respond to the invitation. The five remaining tribes elected to continue their participation in the consultation process for the RHR Mine. These tribes include the Pueblos of Acoma, Laguna, and Zuni, the Hopi Tribe, and the Navajo Nation. For purposes of clarity, these five tribes collectively are referred to in this document as the “involved tribes.”

Multiple meetings and field visits have been held between the Forest Service, the involved State agencies, and each of the involved tribes, sometimes with tribal staff and sometimes with tribal officials and leaders, between December 2010 and the issuance of this draft EIS. These meetings included information sharing on such topics as details of the proposed project, Federal and State processes for permit application reviews and NEPA analyses, the status of environmental analyses, and concerns of the tribes. In addition, the involved tribes have been kept informed of the progress of the NEPA analyses and permit application reviews through emails and phone calls. The involved tribes have also been provided information, kept informed of progress, and consulted on impact concerns throughout the Section 106 compliance process (see section below on “Section 106 Compliance Process”).

During the time between the availability of this draft EIS and issuance of the final EIS and Forest Service’s record of decision (ROD), consultation with the involved tribes by the Forest Service and the involved State agencies will continue, to ensure tribal concerns are well understood and presented in the documentation, to identify appropriate mitigation measures, and to fulfill the requirements of the Federal and State statutes as they apply to each agency. Consultation with the involved tribes regarding the proposed project will also likely continue beyond the ROD, in a manner determined during development of mitigation measures.

Section 106 Compliance Process

The Forest Service has endeavored to conduct a robust and thorough process to ensure compliance with Section 106 and its implementing regulations 36 CFR Part 800. These efforts have resulted in the collection of pertinent and valuable information for use by the Forest Service in making its determinations of NRHP eligibility and adverse effect, per the regulations. It bears repeating that Section 106 compliance and analysis of effects only applies to historic properties, which is a subcategory of the larger cultural resources being analyzed for this EIS. The process implemented for Section 106 compliance includes the conduct of extensive cultural resource investigations, tribal consultation, and consultation with interested parties. The resource investigations (archaeological, geomorphic, and ethnographic) and tribal consultation are described above. The consultation with interested parties is described here, followed by discussions of resource significance evaluation and the status of the Section 106 compliance process.

Consultation with Interested Parties

There are multiple participants in the Roca Honda Mine Section 106 compliance process. The lead agency is the Forest Service, which is the agency that holds the statutory obligation to comply with Section 106. The Forest Service requested and has received the ACHP’s involvement in the project’s Section 106 process to provide guidance and assistance. Remaining interested participants, including government entities, tribes, and the public, are grouped together under the term “consulting parties.”

Entities with a demonstrated interest in the undertaking or its effects on historic properties play a role in the Section 106 compliance process as consulting parties. Consulting parties are involved in the findings and determinations made during the Section 106 process by providing the lead agency, in this case the Forest Service, information and other input at all stages of the process. The lead agency uses this input to guide its decisions throughout the process. The NMSHPO is a consulting party who advises the Forest Service in carrying out its Section 106 responsibilities, and ensures that historic properties are taken into consideration at all levels of project planning and development. In addition to the NMSHPO, the Forest Service initially identified five government entities, two nongovernmental organizations, two private entities, and eight tribes as potentially interested parties. This identification was based upon a specific request, or by virtue of their standing as a party with a demonstrated interest. The Forest Service sent these parties a letter on March 30, 2011, inviting them to participate in the Section 106 process as consulting parties. There are 15 entities total who indicated their intent to participate in the Section 106 process as consulting parties: NMSHPO, NMSLO, MMD, NMED, Acoma Pueblo, Laguna Pueblo, Hopi Tribe, Navajo Nation, Zuni Tribe, McKinley County, Cibola County, the private landowner, Roca Honda Resources, LLC, the National Trust for Historic Preservation, and the New Mexico Archeological Council. The Jicarilla Apache Nation and the Pueblos of Jemez and Sandia did not respond to the invitation. At the same time, letters to the Cebolleta and Cubero Land Grants, and the Juan Tafoya Land Corporation, were sent seeking information on cultural resources within or near the proposed project area to incorporate into the analysis for the EIS and the Section 106 documentation. No responses were received. After the EPA became a cooperating agency for the EIS, they were also invited by the Forest Service to be a consulting party; however, no response was received.

The consulting parties have been given the opportunity to provide input to findings and decisions made throughout the Section 106 process. This has involved an extensive process of information sharing between the Forest Service and the consulting parties through meetings, project area visits, document sharing and review, phone calls, and emails. The first meeting of the Section 106 consulting parties was held in June 2011 and included a fieldtrip to the project area to familiarize the parties with the project area and project proposal. The second meeting of the Section 106 consulting parties was held in September 2011. This meeting also included a field trip to Section 16 of the proposed project area to observe and discuss the archaeological site testing that was underway. A third meeting was in October 2012. The Forest Service has provided the consulting parties with extensive documentation regarding the proposed project facilities, proposed operations plans, and cultural resource investigations and results. In turn, the Forest Service has requested and received input from the consulting parties on the designation of the APEs, the identification and NRHP eligibility of cultural resources in the APEs, and the methodology of archaeological test excavations.

During the time between the availability of this draft EIS and issuance of the final EIS and Forest Service’s ROD, consultation with the consulting parties will continue in order to fulfill the requirements of Section 106. The Forest Service is continuing to consult with the parties regarding NRHP eligibility of cultural resources, the results of archaeological testing, the results of the geomorphological study, and its formal determination of the effect of the proposed project on historic properties. If a determination is made that the proposed project will have an adverse effect on historic properties, as is anticipated, the Forest Service will continue consultation with the consulting parties and the ACHP during development of a programmatic agreement to resolve the adverse effect.

Evaluation of Resource Significance

The Forest Service has evaluated the cultural resources identified for the EIS to determine if they are eligible for listing on the NRHP. The evaluation of resources located on State Trust Land was done in consultation with the State Land Office. This evaluation was conducted to determine those resources that have status as historic properties, which is needed in order to determine the effect of the project on historic properties under Section 106 of the NHPA and 36 CFR Part 800. Properties eligible for the NRHP must have significance in American history, archaeology, architecture, engineering, or culture. The guidelines for evaluation of significance can be found in 36 CFR 60.4. In order for a cultural resource to be considered significant, the resource must meet at least one of four significance criteria:

1. Association with events that have made a significant contribution to the broad patterns of our history.
2. Association with the lives of persons significant in our past.
3. Embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction.
4. Have yielded, or may be likely to yield, information important in prehistory or history.

The property must also possess integrity, or the ability to convey its significance. The NRHP recognized seven aspects or qualities that, in varying combinations, define integrity. These are: location, design, setting, materials, workmanship, feeling, and association. In the case of properties that possess traditional cultural significance, it is also important to consider the integrity of relationship and condition, in addition to the previous seven aspects of integrity.

Compliance Status

The Forest Service has conducted cultural resource investigations, tribal consultation, and consultation with consulting parties, all in an effort to identify significant resources in the APEs, ascertain their NRHP eligibility, and determine the effect of the project on eligible historic properties. As of the availability of this draft EIS, the Forest Service has collected information on archaeological and ethnographic resources in the APEs, and has received input from the tribes and consulting parties on the APEs, resources in the APEs, NRHP eligibility of resources, and the potential effect of the project on eligible properties.

The Forest Service is still collecting information on eligible properties in the APEs. Ongoing work includes additional resource recording, consulting on the report of the dewatering discharge pipeline survey, consulting on the report of the archaeological testing and geomorphological study, and continued tribal consultation.

The next steps will include development by the Forest Service of a Section 106 compliance document that summarizes all of the cultural resource investigations and results; describes the tribal consultation activities and input; describes the consulting party consultation process; and presents and supports the Forest Service’s determinations of resource eligibility and project effect. The Forest Service will provide this document to the ACHP and the consulting parties for their review and input. Upon consideration of and response to the input received, the Forest Service will finalize the document and submit it to the NMSHPO for formal Section 106 review and consultation. When concurrence by the NMSHPO on the Forest Service's determinations has been received, the Forest Service will consult with the ACHP and the consulting parties to develop a programmatic agreement to resolve adverse effects to historic properties. This programmatic agreement will be incorporated into the final EIS and the Forest Service's record of decision.

Cultural Resources in the Region of Influence

As a result of the cultural resource investigations, tribal consultation, and input received from the Section 106 consulting parties, the Forest Service has identified cultural resources located within the region of influence (i.e., the physical and setting APEs). These resources are described in this section.

The Forest Service appreciates that the definitions and boundaries applied to cultural resources by the Forest Service are meaningful mainly from scientific and management perspectives. Such definitions and boundaries are necessary for assessing the impacts and effects of the proposed project, managing these cultural resources for the long term, and for compliance with various laws, regulations, etc. The Forest Service recognizes the complexity inherent when resources overlap, and when the significance of those resources is tied to multiple cultures of use. Depending on one's viewpoint, the boundaries may be different or even nonexistent, the separation between resource types or groupings may not exist, and the many relationships between resources may vary to reflect the perspectives of the people to whom the resources are important. The Forest Service also recognizes that these varied perspectives are not exclusive, and can often contribute together to a fuller definition of historical and cultural importance.

As described earlier, the Forest Service has some additional work to complete between the draft and final EISs to define cultural resources located within the ROI. This work will have varying levels of impact on the information presented in this section. Recording of additional archaeological resources, with some recorded as new sites and others incorporated into existing sites, may result in changes to the number of archaeological resources or changes to the sizes of some resources. Review by the consulting parties of the dewatering discharge pipeline survey report and the archaeological testing report could result in changes to the eligibility of some resources. The geomorphological study, which is addressing the potential for deeply buried archaeological deposits, could result in changes to what is known about the nature, number, or extent of some archaeological resources. Continued consultation by the Forest Service with the tribes could provide additional information about cultural resources in the ROI. Finally, the Forest Service will use the information collected through resource investigations, tribal consultation, and consulting party input to prepare a Section 106 compliance document that presents and supports the Forest Service's determinations of resource eligibility and project effect. The review and input of the ACHP and the consulting parties on this document could result in changes to the information presented in this section.

The involved tribes have expressed concern that potentially not every single cultural resource within the APEs has been identified and recorded. Missing information about cultural resources for such a large project can be due to the challenges of conducting fieldwork, difficulties of translation of traditional concepts or government standards between tribal languages and English, restrictions on the transmittal of culturally sensitive information, and limitations on access to certain sources of information. The regulations governing conduct of cultural resource identification under the NHPA state that the Federal agency shall make a “reasonable and good faith effort” to identify resources (36 CFR 800.4(b)(1)). The regulations and guidance go on to describe how a such an effort is determined based on: (1) past planning, research, and studies; (2) the magnitude and nature of the undertaking; (3) the degree of Federal involvement; (4) the nature and extent of potential effects on historic properties; and (5) the likely nature and location of historic properties within the area of potential effects (ACHP 2009 and 2011:1). Ultimately, the methodology for identification should be such that “the Federal agency can ensure that it produces enough information, in enough detail, to determine what the undertaking’s effects will likely be on historic properties” (ACHP 2011:2). The Forest Service has determined that it has sufficient information to determine the likely effects of the proposed project on historic properties and also the potential impacts to other cultural resources and, therefore, has met the standard of reasonable and good faith.

A comprehensive archaeological survey was not conducted of the setting APE, and the four tribes did not visit many portions of the setting APE during conduct of their ethnographic assessments. However, there is sufficient existing information regarding cultural resources located within the setting APE to meet the standard of having “enough information, in enough detail, to determine what the undertaking’s effects will likely be on historic properties” (ACHP 2011:2). In the areas where the potential for impacts is greatest, namely in close vicinity to the proposed facilities, the Forest Service has the information from the resource investigations of the physical APE. In areas further removed, where it is likely that potential impacts lessen, information on cultural resources from the resource investigations, plus other sources, can be used to inform the likelihood for types and densities of resources in various areas of the setting APE. Other sources supplying relevant information include:

- The New Mexico Cultural Resources Information System, maintained by the State’s Archaeological Records Management Section of the Historic Preservation Division, for archaeological resources recorded during previously conducted surveys throughout the setting APE;
- The Forest Service’s determination of eligibility for Mt. Taylor (Benedict and Hudson 2008); and
- The nomination of Mt. Taylor to the SRCP (Chestnut Law Offices, 2009).

Ethnographic landscapes

Definition

A landscape is a place where a cultural group has combined the social, cultural, and natural environments together to form a culturally meaningful context, which is part of the shared symbols and beliefs of the group, and which forms the basis for understanding the individual places and resources within the landscape. Landscapes are defined as “any geographic area which possesses a notable human relationship with the land and tangible physical features” (CDOT, 1999). Landscapes document the interactions between geographical space and cultural use, and are created through the interactions of people with the world.

Ethnographic landscapes are one type of landscape. As defined by the NPS, ethnographic landscapes are “areas of geographic space that have been given special and specific cultural or social meaning by people associated with them", and such a landscape is "a relatively contiguous area of interrelated places that contemporary cultural groups define as meaningful because it is inextricably and traditionally linked to their own local or regional histories, cultural identities, beliefs, and behaviors" (Evans et al., 2001: 53-54). Such landscape is a geographically definable area possessing a concentration, linkage, or continuity of landscape components. It is based upon an integrative perspective that examines relationships among natural and cultural features.

The importance of a landscape and the individual components therein arises from the interrelationships between cultural resources and natural resources such as plants, animals, minerals, landforms, and bodies of water that give the landscape meaning through their association with a people's history and cultural identity. Within the landscape, often the space in between individual components is in itself meaningful. Landscapes provide a framework within which to map the relationships between people and the landscape's resources. A landscape that is culturally significant to one group may contain elements that are significant to other groups in other ways within their own culturally defined landscape. The distinction of ethnographic landscapes lies in what makes the landscape significant and who determines the nature of that significance. Ethnographic landscapes are identified and defined by the cultural groups associated with them and are not rooted in historic analysis. Such landscapes are not rooted in the NRHP, are not pitted against defined criteria of significance, and are not dependent upon NRHP eligibility for their existence or importance.

Landscapes in the Region of Influence

There are five defined ethnographic landscapes that overlap the proposed project area and the region of influence. The analysis presented in the Mt. Taylor Cultural Property nomination (Chestnut Law Offices, 2009: Continuation Sheet, Section 15, page 2) describes how the landscapes associated with traditional land use for each of the involved tribes (Pueblos of Acoma, Laguna, and Zuni, Hopi Tribe, and Navajo Nation) encompass the region of influence, with all five overlapping at Mt. Taylor and the proposed project area. These landscapes are vernacular in origin, meaning that the cultural and natural resources within the landscapes and the distribution of those resources across the landscapes, evolved through function or use, reflecting the physical circumstances and cultural character of daily life, and are demonstrative of past land uses rather than a conscious planned design. The cultural resources, their spatial organization, and their relationship and connection to natural resources and landforms demonstrate and inform about how this area was used and why it developed the way it did over time. Additionally, the patterns of land use shown by this landscape form a context for the traditional histories and beliefs of the involved tribes and a foundation for group identity.

In the ROI, the juxtaposition of mountain slopes, the San Mateo Valley, and the low-lying mesas influenced how this area was used, and this use is demonstrated by the types and distribution of archaeological remains, other culturally important resources, and natural resources within the landscape. Evidence of land use points to hunting, gathering of plant and mineral resources, farming, herding, and use of the area for ceremonial activities. Archaeological remains indicate a variety of habitations, from temporary use of camp sites and rock shelters, to more substantial structures that point to long term or repeated seasonal use.

Based on previous studies as well as the resource identification work conducted for this EIS, the types of cultural and natural resources associated with the ethnographic landscapes and located within the area of overlap is expected to include habitation sites (villages, family hamlets, field houses, camps), resource procurement areas (plant gathering areas, hunting areas, mineral sources), water sources (springs, drainages, tinajas), transportation features (trails, navigational markers), religious or ceremonial locations (shrines, blessing places, offering places), herding corrals, and farming areas. Within the area of overlap, it would not be unusual to have landscape components that are defined, interpreted, and assigned meaning under multiple culturally significant contexts. Evidence of this was seen during the field visits to the proposed project area, with individual cultural features interpreted in multiple ways by the involved tribes.

Tribal Significance

Each of the involved tribes ascribes importance to the landscape related to traditions, beliefs, practices, lifeways, and social institutions of their respective communities. This area of overlap is imbued with layers upon layers of traditional cultural meaning and affiliation specific to each cultural group (Chestnut Law Offices, 2009). In general, these landscapes provide a basis for understanding the world and the peoples' place in it. They are a foundation for personal and group identity, thereby helping to answer questions about who the people are individually, as a member of the tribe, and as a member of various tribal social groups. Each landscape provides a context for group history and for understanding the individual resources within the landscape and the association of those resources with the group history. These resources are material representations of what the people know about their culture and history. The landscapes perform a function for the tribal communities by helping them understand past and current behaviors (Anschuetz, 2012).

Archaeological Resources

All five involved tribes maintain a special connection to the American Indian archaeological resources located within the ethnographic landscape surrounding Mt. Taylor and the proposed project area. Archaeological sites provide a tangible connection to history and place, commemorate the lives of the ancestors, and impart specific information about tribal histories and culture, all of which help to shape and inform tribal identity. Archaeological sites not only document and provide evidence of tribal histories, they are considered to be sacred for a number of reasons. Sacredness of the sites is rooted in the oral traditions and religious knowledge that relates to the movement of the tribal ancestors through the area. The life force or spirits of the ancestors still reside within the materials and locations at these sites (Anschuetz, 2012 p. 32; Colwell-Chanthaphonh and Ferguson, 2012a), and as such, these sites provide a place to communicate with the ancestors. Tribal people reconnect with spirits of the deceased through offerings, and these reconnections are believed to replenish the land. Laguna considers each site to have a heart and each site as consecrated (Colwell-Chanthaphonh and Ferguson, 2012a:11-12). For Zuni, archaeological sites "are sources for religious instruments (such as arrowheads), referenced in Zuni religious songs and prayers, and are living abodes of ancestral spirits" (Colwell-Chanthaphonh and Ferguson, 2012b:33).

Archaeological sites are viewed as key to the retention and transmission of traditional culture and history. Each archaeological site is believed to contain records of events, instructions from ancestors, and reminders from ancestors to current generations, and therefore has a teaching purpose. The Acoma people "view their ancestral archaeological sites as part of an ongoing transformational process within which the current generations interact and maintain their cultural identity" (Anschuetz, 2012:32). With the onrush of the modern world, these sites are seen as even more important to the recognition, retention, and transmission of traditional history and sacred knowledge to the youth (Colwell-Chanthaphonh and Ferguson, 2012a:40).

Natural Resources

Natural resources, while they may not exhibit human-caused modifications, can be ascribed with cultural meaning and, thus, have a cultural element. This is true for the involved tribes. Plants, animals, water, and minerals are collected for food, fuel, medicine, and ceremony, and the locations of these items are pantry, medicine cabinet, and sanctuary, all at once. However, natural resources are not only material resources to be used by the tribes. Animals and plants are included in songs, prayers, and histories; play an integral role in stories needed to pass along important tribal lessons; and are sometimes intermediaries between the people and the Spiritual Beings. The wholesale integration of natural resources into the cultural practices and identity of the tribes is demonstrative of the significance of these resources to the ethnographic landscape.

Because natural resources are used in various forms in ceremonies and ritual, there is a need to maintain pristine sources of these materials in order for rituals to work. When collecting resources for ritual or ceremonial use, the collection trip itself is often a religious event (Colwell-Chanthaphonh and Ferguson, 2012b:17), accompanied by prayers and offerings. Prayers are conducted for the well-being of animals and, in turn, the animals are depended upon for the people’s spiritual welfare (Colwell-Chanthaphonh and Ferguson, 2012b:22). The land provides the resources that are necessary for the cultural life of the tribes to continue and flourish and, in turn, these resources are used in rituals that bind the people to the land.

Water

Water and those places associated with it are particularly significant within the tribal cultures. Tribal histories regarding Mt. Taylor emphasize the provision of water by the mountain and the Spiritual Beings within, and the appropriate uses of the water by the people. The mountain is seen as a “spiritual beacon for moisture” (Colwell-Chanthaphonh and Ferguson, 2012b:23). Many ceremonies and rituals are focused on water and bringing water to the people. Because water is integral to the earth, plants, animals, and humans, and without it there is nothing (Colwell-Chanthaphonh and Ferguson, 2012b), water is a central theme for many ritual activities. Water has both economic and cultural importance, and is an essential element of tribal social identity and cultural history (Colwell-Chanthaphonh and Ferguson 2012a). Water is the common link that joins the spiritual world, the clouds, the mountain, and the people, and this interconnectedness informs many aspects of traditional belief (Anschuetz 2012).

The tribal ethnographic assessments and tribal consultations revealed that those places associated with water, specifically springs and *tinajas* (water catchments formed in bedrock outcrops and boulders), have such significance. They may have served an important role in the past occupation of an area as they would have provided a reliable source of surface water, as a result of rain and snowmelt. The importance of these resources stems from the pathway of the water, and the provision thereof, being traditionally tied to the interior of the mountain and the Spiritual Beings (Anschuetz, 2012). These places are believed to play an integral role in maintaining the balance of the cosmos through renewal of important supernatural associations and, thereby, are tied to many aspects of traditional belief and practice. Water from these these places in general is collected for medicines and ceremonies performed back in the communities, and associated items such as cattails and certain insects from these places also play specific roles in rituals.

Tribal Concepts of Landscape

The involved tribes view the proposed project area, Mt. Taylor, and the larger ethnographic landscape as an integrated whole. To consider cultural and natural resources in an area separately, in isolation from one another, is an alien concept. To understand the one resource, the viewer must take into account where one is, what resources are located in that area, what is adjacent, or down the valley, or on the slopes of the mountain, in order to fully understand the resource's place within the whole. The tribes have described this concept repeatedly during the consultation conducted for the proposed project and for uranium mining in general, and it is expressed throughout the State listed TCP nomination and their ethnographic assessments conducted for this EIS. Some ideas expressed by the involved tribes regarding the concept of landscape are presented here.

The Hopi believe that Mt. Taylor comprises a living landscape, and that it is part of the sacred, ancestral landscape of the Hopi people. As a way of demonstrating this, the Hopi point out that throughout the region surrounding Mt. Taylor, "Hopi place names serve to situate Mt. Taylor in a regional geographic context" (Koyiyumptewa, 2012:6).

The concept of landscape is demonstrated throughout traditional Navajo history. The Holy People made the landscape and designated it with mountains, including Mt. Taylor (Chestnut Law Offices, 2009: Continuation Sheet, Section 12, page 82). The Holy People travel throughout the landscape between Mt. Taylor and the other sacred mountains that bound the Navajo traditional homeland to the east, west, and north (Benedict and Hudson 2008). Many traditional stories reference specific landscape features in the area surrounding Mt. Taylor that can be pointed to today.

The Pueblo of Acoma perceives its aboriginal homeland, which includes Mt. Taylor and the proposed project area, as a living, traditional cultural landscape. "The cultural landscape is as much a living thing as the people themselves" (Anschuetz, 2012:22). Cultural resources on Mt. Taylor derive significance from their relationship with the mountain, and like Acoma's people, are inseparable from it. Acoma's past is considered an intrinsic part of this landscape. Archaeological traces "are material representations of that which the people of Acoma know to be true of their culture, history and becoming" (Anschuetz, 2012:8).

The Pueblo of Laguna considers the project area and the surrounding landscape together as a holy land. All of the facets of Mt. Taylor are interconnected to create a whole sacred landscape, with Mt. Taylor as the anchor. "The project area is an integral part of a much larger cultural landscape surrounding Mt. Taylor" (Colwell-Chanthaphonh and Ferguson 2012a:15). Cultural sites in the proposed project area are considered to be vitally important parts of the environment as a whole. One Laguna man expressed the following during the ethnographic fieldwork conducted for this EIS: "No one has studied the relationship between this site and others in the area, how they are all related. But you can't just look at one of these sites in isolation. One here could be related to a site miles away. This creates pathways and relationships between sites" (Colwell-Chanthaphonh and Ferguson, 2012a:15).

Mt. Taylor has been described by the Pueblo of Zuni as a sacred landscape, viewed as a whole that is comprised of interconnected cultural and natural resources (Colwell-Chanthaphonh and Ferguson, 2012b). The surrounding cultural and natural resources and environment are important to the maintenance of that sacredness. The Zuni people regard the landscape as an array of inextricable elements, as a single, complete whole. Some parts of the whole, such as Mt. Taylor, bear special meaning. This meaning then extends out to the other parts that make up the whole, such as water, plants, animals, soil, and minerals.

Physical APE

As described above in the section of “Region of Influence,” the physical APE includes the mine permit area requested by Roca Honda Resources (Sections 9, 10, and 16 in their entirety); the haul road routes in Sections 11, 17, and 20; the utility corridor and access road in Section 15; and the dewatering discharge pipeline corridor and discharge points in Sections 11, 2, and the unplatted private land to the north. Because the locations of the mine permit area and the additional areas do not differ between the alternatives, the boundaries of the physical APE are the same for all three.

Mt. Taylor TCP

The Mt. Taylor TCP has previously been determined eligible under Criteria A, B, and D and, thus, is an historic property as well as a cultural resource. The TCP boundary encompasses almost all of Sections 9 and 10, and only a small piece of the northeast corner of Section 16. Most of Sections 11 and 2, where the discharge pipeline runs north, are also within the boundaries. A small area of Section 15 is within the boundaries, but not where the utility corridor and access road would be located. Sections 17 and 20 are not within the TCP (figure 62). Extensive discussion of the Mt. Taylor TCP is presented below.

Within the area of overlap between the Mt. Taylor TCP and the physical APE, there are certain specific locations identified for this EIS that contribute to the eligibility of the TCP. These contributing elements “. . . are those features that can be demonstrated to be associated with the traditional and ceremonial use of the mountain. These include shrines, offering places, pilgrimage trails, cairns, and springs” (Benedict and Hudson, 2008:31). The tribal ethnographic assessments resulted in the identification of four specific locations that contribute to the eligibility of the Mt. Taylor TCP and are located within the area of overlap between the TCP and the physical APE.

Archaeological Resources

The types of archaeological resources identified in the physical APE include various types of habitations, from roomblocks with associated trash piles indicating long-term use, to shorter term field houses, campsites, rock shelters, and hogans. Hearths, American Indian petroglyphs, historic inscriptions, rock alignments, rock cairns, shrines, and corrals were identified. Also found were concentrated scatters of ceramic sherds, flaked stone tools and debris, and ground stone. Other artifacts identified were bone artifacts, shell ornaments, glass fragments, metal cans and fragments, and rifle cartridges.

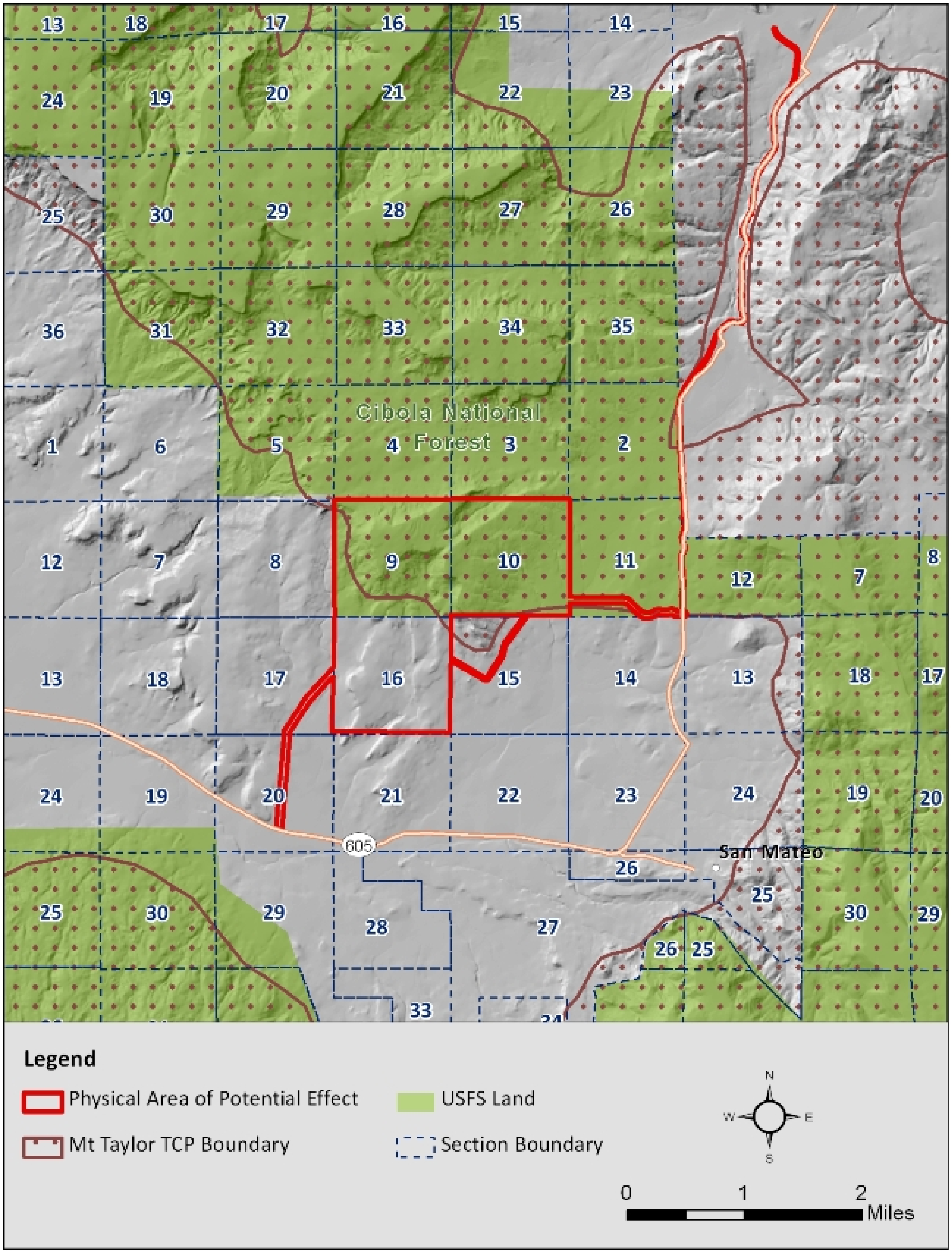


Figure 62. Mt. Taylor Traditional Cultural Property and physical APE

The archaeological resources within the physical APE have been evaluated for eligibility. The four sites that contribute to the eligibility of the Mt. Taylor TCP are eligible under Criterion A. An additional site associated with traditional religious practices that is outside of the TCP boundary is individualluy eligible under Criterion A. Sites with rock art, including American Indian petroglyphs and Euroamerican inscriptions, may be significant under Criterion B for their connection to people or beings important in history, or Criterion C for possessing high artistic values or exhibiting aesthetic principles through quality of execution or through the presence of symbols representative of a specific style or technique. In general, more research is needed to determine the eligibility of these rock art sites under these two criteria. Many of the archaeological sites are eligible under Criterion D for their potential to provide important information related to a number of research topics and areas of interest. Through appropriate study, information could be gleaned regarding the early presence of Archaic peoples; the settlement, community development, and land use and organization of Ancestral Puebloan communities; social history and ethnic heritage of Puebloan, Navajo, Hispanic, and Euroamerican communities; traditional cultural practices and history; and other topics. This information could be uncovered through archaeological study, ethnohistorical research of existing documentation, and ethnographic research such as interviews with local American Indian and Hispanic communities associated with the region. Some of the archaeological sites require more investigation in order to determine if they are eligible under Criterion D.

Section 9 contains 34 archaeological sites. Five of these have been determined eligible under Criterion D and 25 have undetermined eligibility under Criterion D. Five of the sites have rock art or inscriptions. Of these, three sites could be eligible under Criterion B, one site under Criterion C, and one site under Criteria B and C; however, not enough information is currently available to make these eligibility determinations and more research is needed.

Section 10 contains 57 archaeological sites. Fifteen have been determined eligible under Criterion D and 35 have undetermined eligibility under Criterion D. One of the sites has rock art and could be eligible under Criterion C; more research is needed to determine this. Four of the sites also contribute to the eligibility of the Mt. Taylor TCP under Criterion A.

Section 16 has 55 archaeological sites, of which 29 have been determined eligible under Criterion D and 26 have undetermined eligibility under Criterion D. One site is eligible under Criterion A. Thirteen of the sites have rock art or inscriptions. Of these, four sites could be eligible under Criterion B, two sites under Criterion C, and seven sites under Criteria B and C; however, not enough information is currently available to make these eligibility determinations and more research is needed.

The surveys of the haul road routes in Sections 11, 17, and 20 identified five archaeological sites. Three of the sites are eligible for the NRHP under Criterion D and two are undetermined under Criterion D. The surveys of the utility corridor in Section 15 found two archaeological sites, one eligible for the NRHP under Criterion D and the other undetermined under Criterion D. The dewatering discharge pipeline corridor and discharge points in Sections 11, 2, and the unplatted private land to the north contain three archaeological sites, all of which are eligible under Criterion D. One of the sites has rock art and could also be eligible under Criterion C; however, more information is needed to make this eligibility determination.

A total of 260 isolated occurrences were identified within the physical APE. Isolated occurrences are those archaeological resources that do not meet the Forest Service’s criteria for definition as a site. In general, isolated occurrences are thought to result from accidental or inadvertent deposition of a few artifacts, whereas a site indicates purposeful use of a particular place. Within the proposed project area, isolated occurrences generally consist of only a few artifacts. All of the isolated occurrences have been determined not eligible for the NRHP by the Forest Service.

Agricultural Fields

The tribal ethnographic assessments and tribal consultation illuminated a concern regarding potential agriculture related resources located within the proposed project area. The involved tribes view some areas of the project, particularly basins, canyon heads, upland areas at the headwaters of drainages, and alluvial fans at the mouths of watercourses in Section 10 and 16, as settings where traditional agricultural techniques were practiced both prehistorically and historically. What makes these types of settings preferable for farming is the types of soil present, the presence of adequate water, and control of the water. Techniques implemented at these locations would have included water management practices (to divert, convey, and distribute surface water), pest management, and nutritional supplementation of the soil. These fields would not be located in isolation, but would be associated with other archaeological resources such as field houses or other habitation sites. It is hypothesized by the tribes that these areas are still affected today by those techniques, that the results are visible in the current vegetation growing on them, and because of this, "they are the tangible products of human interaction with natural environmental variables, [and] are, by definition, anthropogenic features" (Anschuetz, 2012:28). Further study of these places would be necessary in order to determine if each is actually an agricultural area and retains cultural deposits. If such deposits were found, such a place would be considered an archaeological resource and would be evaluated for NRHP eligibility.

Chaco Roads

Research was conducted to address the potential for prehistoric roads, associated with the Chaco Great Houses, to be located within the physical APE. Based on the work conducted (see section above on "Chaco Roads Reconnaissance"), no definitive cultural features indicating the presence of such a road or trail were detected.

Setting APE

As described above, the setting APE includes the area within which the project could potentially impact or affect the visual or audible character of cultural resources or their settings. This APE includes the physical APE, plus additional area around the proposed mine site, and totals 75,023 acres in size. The setting APEs for the alternatives are very similar to one another, with only very slight differences and, thus, are blended together to form one setting APE that is the same for all three alternatives.

Because the setting APE includes the physical APE, all of the resources in the latter are also located within the former. This includes the Mt. Taylor TCP and the archaeological resources. Due to the large size of the setting APE, a much larger portion of the Mt. Taylor TCP (approximately 40,359 acres) is included in this APE (figure 63). The ethnographic landscapes discussed above are also encompassed within the setting APE.

Mt. Taylor TCP

The Mt. Taylor TCP overlaps a large portion of the setting APE (approximately 40,359 acres). Information presented in the Forest Service's determination of eligibility for the TCP (Benedict and Hudson, 2008) and the nomination form for listing of the Mt. Taylor Cultural Property as a TCP on the SRCP (Chestnut Law Offices, 2009) contribute information to the expectations for the types of cultural resources that are likely found within the setting APE on Mt. Taylor and the mesas extending from its slopes. Such resources include ceremonial locations such as shrines, blessing places, and offering places; boundary markers, trails, traditional waypoints, and cairns; springs; viewsheds; traditional gathering areas for plant resources for food, timber, and medicine; hunting areas; mineral resource procurement places; and places associated with farming and herding. While all springs are revered, Acoma's people regard those associated with Mt. Taylor as shrines. Some springs, including the cluster of springs referred to as the "San Mateo Springs" located within the setting APE, are important places of pilgrimage and prayer (Anschuetz, 2012:26).

Archaeological Resources

The New Mexico Cultural Resources Information System, maintained by the State's Archaeological Records Management Section of the Historic Preservation Division, keeps records of archaeological resources recorded throughout the State, including within the setting APE. A search of these records indicates that within the setting APE, 165 archaeological surveys have been conducted, resulting in a total of 20,632 acres having undergone archaeological survey. This is 27.5 percent of the setting APE. The total number of recorded archaeological sites is 829. The completeness of information recorded for these sites varies widely, with some sites missing information, but the information that is recorded nonetheless provides an indication of what can be expected throughout the setting APE with regard to archaeological resources.

More than half of the sites do not have recorded NRHP eligibility determinations. Of the ones that do (n=408), 35 percent are eligible under Criterion D, 14 percent are not eligible, and 51 percent require further information to determine eligibility. For all 408 sites, none have been determined eligible under Criteria A, B, or C. Of the 829 sites, 63 percent are prehistoric sites, 18 percent are historic sites, 8 percent have both prehistoric and historic components to them, and 11 percent do not have this information recorded. All time periods are represented, from Paleoindian through recent times, and represented cultures include Navajo, Puebloan, and Euroamerican.

The types of archaeological sites recorded and the features on them are consistent with the sites recorded in the physical APE. The types of sites represented include religious or ceremonial locations such as shrines, sweat lodges, and kivas; trails and cairns; a wide variety of habitation sites; food processing and storage features; trash piles and middens; water control features; rock art and graffiti; various rock alignments; and places associated with mining, herding, and timber harvesting.

The land status of the site locations includes Forest Service (68 percent of sites), private (23 percent), Bureau of Land Management (4 percent), Navajo Nation (3 percent), and NM State land (2 percent). Sites have been recorded on every type of topographic feature present in the zetting APE and, not surprisingly, site locations show a preference for being located near drainages; a preference that is demonstrated on mountain slopes, mesas, mesa slopes, canyons, and valley floors. On the slopes of Mt. Taylor, the sites are all located adjacent to drainages. While sites are present on the tops of mesas, site density is much greater on the lower, gentler slopes of the mesas, where the drainages become less steep and water is likely to slow and spread out as it flows. This is the same situation that was found within the physical APE.

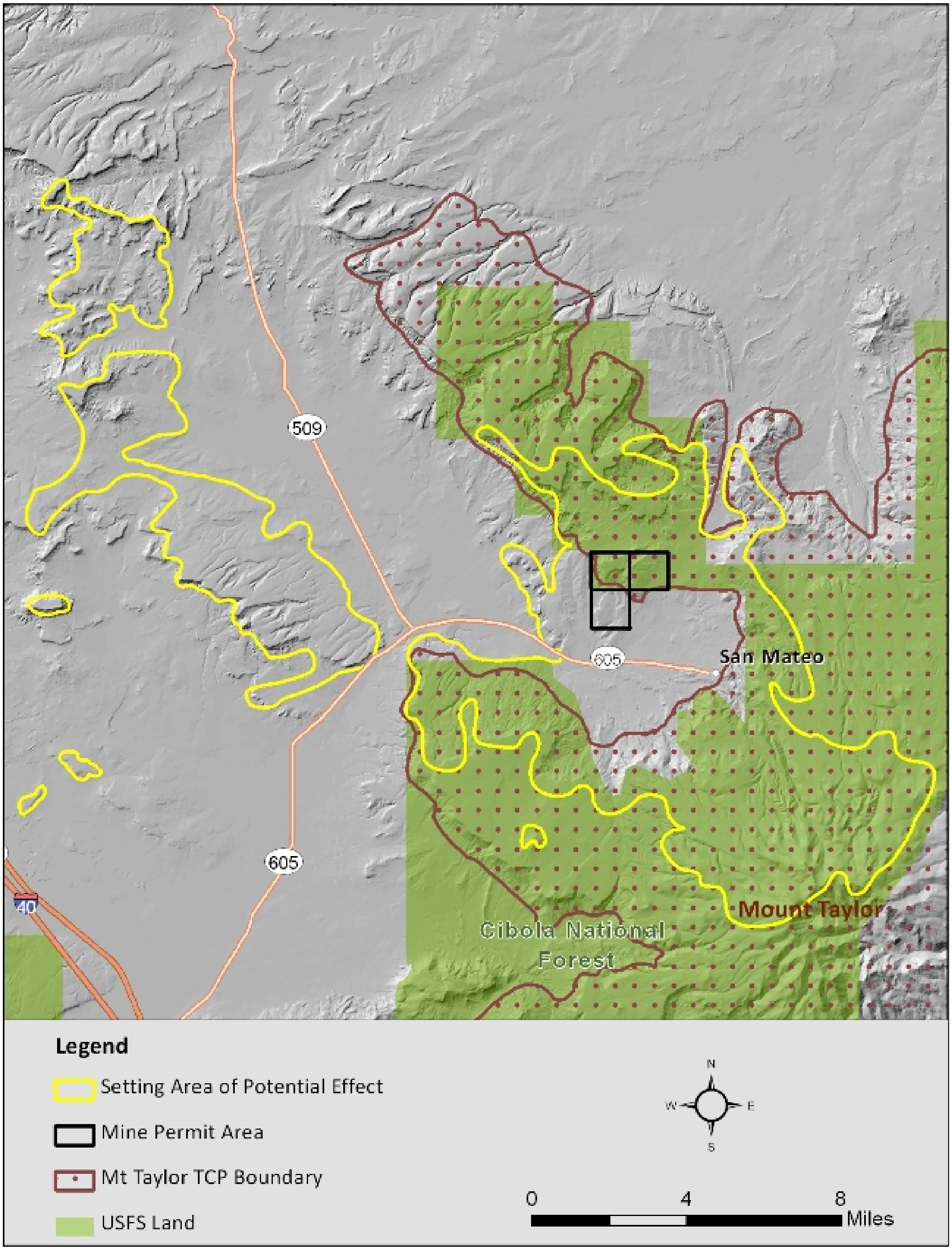


Figure 63. Setting APE, mine permit area, and Mt. Taylor TCP boundary

Agricultural Fields

If agricultural fields were defined within the physical APE, it stands to reason that such fields could also be located in similar topographic zones throughout the setting APE.

Chaco Roads

As reported above, no archaeological features indicating the presence of Chaco roads or trails were detected within the physical APE. However, there are alignments within the setting APE that have been previously identified near the San Mateo great house and the great kiva at San Mateo, which appear to connect to other known Chaco sites located to the north, west, and southwest. Besides the great house and great kiva at San Mateo, a known concentration of sites likely to be related to the Chaco system occurs south of the proposed project, in the vicinity of El Rito Canyon, and other Chaco sites may be located in other portions of the setting APE. It is possible that efforts to search for additional Chaco roads or trail alignments could be successful in these areas and elsewhere in the setting APE, provided the availability of appropriate imagery and the opportunity for dedicated, well-designed efforts to identify and ground-truth such manifestations.

Mt. Taylor Traditional Cultural Property

Reaching an elevation of 11,301 feet, Mt. Taylor is a prominent landmark, situated within the larger landform identified as the San Mateo Mountains. The summits of Mt. Taylor and La Mosca, and the ridge that runs between them, form the high points and are covered in snow much of the year. These high points are the remnants of the cone of this composite volcano. The remarkable views from the top of the mountain, and its vast and varied natural resources, have attracted people to the area for millennia.

Mt. Taylor has been determined eligible to the NRHP as a TCP by the Forest Service. It has also been listed as a TCP on the SRCP by the State of New Mexico. In this EIS, the term Mt. Taylor TCP refers to both of these designations together. When there is a need to distinguish them from one another, such as in this section, they are referred to as either the NRHP-eligible TCP or the SRCP-listed TCP.

Management

In 2008, the Forest Service conducted a study of American Indian traditional cultural uses and values associated with Mt. Taylor. While the Forest Service recognized—then and now—that the mountain holds importance for many cultural groups besides American Indians, it was decided at the time to limit the study’s scope. The study was prompted by the anticipated increase in mine exploration and development applications. This study combined cultural, historical, and ethnographic information into an evaluation of the eligibility of Mt. Taylor for the NRHP. The Forest Service determined that the mountain is eligible for the NRHP as a TCP due to its traditional cultural significance (Benedict and Hudson, 2008). This significance is discussed in more detail below.

The NRHP-eligible TCP is comprised of a vernacular landscape, meaning: (1) the category of property comprising the TCP is a landscape or a geographic space containing cultural and natural resources that when taken together are imbued with meaning; and (2) the landscape of this TCP is composed of cultural and natural resources whose distribution evolved through function or use. The type of property that was identified and evaluated for NRHP eligibility is categorized as a site.

In terms of bounding the mountain from the standpoint of its status as an NRHP-eligible TCP, Mt. Taylor extends downward from the summit of the peak, encompassing the slopes and contiguous or adjacent mesas in their entirety. The property's boundary is drawn at the base of these landforms, or rather the toe of their slopes, where the land transitions to the valley floors. The total size of the NRHP-eligible TCP is 442,659 acres and includes Federal, tribal, State, and private lands.

In 2008 and 2009, the involved tribes prepared, revised, and submitted a nomination of the Mt. Taylor Cultural Property for permanent listing on the SRCP as a TCP. In this nomination, the property is also a vernacular landscape site. The outer boundary of the SRCP-listed TCP is the same as the boundary for the NRHP-eligible TCP with the exception of three small adjustments, resulting in an overall size of 450,000 acres. However, unlike the NRHP-eligible TCP, 133,544 acres of privately-owned lands contained within the outer SRCP-listed TCP boundary are considered to be noncontributing resources. The nomination was accepted and the Mt. Taylor Cultural Property was listed as a TCP on the SRCP in 2009. The listing is being contested through the court system, and the New Mexico Court of Appeals ordered the case to be considered by the New Mexico Supreme Court (NM Court of Appeals, 2012). The New Mexico Supreme Court heard legal testimony on the case on September 24, 2012, and a decision is pending.

Contributing Resources

The contributing resources to the NRHP-eligible TCP are those features associated with the traditional and ceremonial use of the mountain (Benedict and Hudson, 2008). These types of resources include shrines, offering places, blessing places, pilgrimage trails, cairns, and springs. The contributing resources to the SRCP-listed TCP include archaeological sites, shrines, springs, lakes, boundary markers, trails, blessing places, traditional gathering areas for medicinal plants, foodstuffs, and minerals, and locations of ceremonial activities (Chestnut Law Offices, 2009).

The four tribes that conducted ethnographic assessments for this EIS do not differentiate between Mt. Taylor and cultural and natural resources found in the project area. In their view, the resources contained within the proposed project area are all associated with, or are considered a part of, the Mt. Taylor TCP. The Mt. Taylor TCP contains some specific places of traditional cultural and religious significance within its boundaries that have been formally documented (Benedict and Hudson, 2008; Colwell-Chanthaphonh and Ferguson, 2012a). The tribal ethnographic assessments resulted in the identification of four specific locations that contribute to the eligibility of the Mt. Taylor TCP and are located within the area of overlap between the TCP and the physical APE.

Mt. Taylor TCP within the APEs

The NRHP-eligible TCP overlies portions of the physical APE and the setting APE (figures 62 and 63). The property encompasses most of Sections 2, 9, 10, and 11, small portions of Sections 15 and 16, and some of the unplatted private land to the north. Sections 17 and 20 are not within the TCP. The NRHP-eligible TCP overlies approximately 40,359 acres of the setting APE; put another way, about 9 percent of the TCP overlies 54 percent of the setting APE.

The boundary of the SRCP-listed TCP is the same as the NRHP-eligible TCP in the northwest portion of the property (i.e., in the region of the proposed Roca Honda Mine project), with the exception of moving the boundary slightly upslope behind the village of San Mateo. As a result, the amount of overlap between the SRCP-listed TCP and the physical APE is the same as for the

NRHP-eligible TCP, but the amount of overlap between the SRCP-listed TCP and the setting APE is slightly smaller than that for the NRHP-eligible TCP.

NRHP and SRCP Significance

Mt. Taylor holds considerable traditional cultural significance for the area tribes, including the Navajo Nation, the Hopi Tribe, the western Pueblos of Acoma, Zuni, and Laguna, the Jicarilla Apache, and many of the Rio Grande Pueblos. It has long standing and ongoing historical, cultural, and religious importance for these tribes. All consider the mountain to be sacred, and some acknowledge and have identified specific sites of cultural and religious significance within the larger boundaries of the mountain. The mountain is used by these tribes for a variety of traditional cultural and religious activities such as hunting, plant and mineral gathering, religious pilgrimages, and ceremonial activities (Benedict and Hudson, 2008).

The NRHP-eligible TCP was determined eligible under Criterion A because of its significant association with traditional cultural practices and beliefs of living American Indian communities that are rooted in their history and are important in maintaining the continuing cultural identity of their community. This significant association with tribal practices, beliefs, and history is discussed in more detail below. Mt. Taylor is rooted in the tribes' history and traditions. It is central to their cultural practices as living communities and is critical to the maintenance of their cultural identity. The mountain is a place that figures prominently in oral traditions regarding origin, place of emergence, and migration, and plays a vital role in their cosmology, ceremony, and religion. The multiple roles of Mt. Taylor in the tribes' cultures illustrate its significant association with traditional cultural uses.

The NRHP-eligible TCP was determined eligible under Criterion B because of its association with important beings that figure prominently in the oral tradition of the tribes. The tribes believe that Spirit Beings inhabit the mountain, and they figure prominently in the oral traditions and histories. These traditions tie the Spirit Beings to the mountain by virtue of their role in stories of creation and migration related to Mt. Taylor. While these elements are intangible, it is these Spirit Beings associated with the mountain that play a vital role in the view of the mountain as a powerful living, breathing entity.

The NRHP-eligible TCP was determined eligible under Criterion D for yielding, and the potential to yield, important information through ethnographic and archaeological research. Mt. Taylor has already provided important insights into Puebloan and Navajo traditions and culture, through archaeological survey, ethnographic studies, scholarly research, and published stories and poetry describing the mountain and its importance to the tribes. However, there is more to learn about this property through archaeological, ethnographic, ethnohistoric, and other avenues of research.

In the SRCP, the TCP is listed under Criteria A, B, and D. Under all three criteria, it is eligible for the same reasons as the NRHP-eligible TCP, as described above. Under Criterion B, the State listing expands the description of significance to say that the mountain itself is a live sentient being.

Integrity

In addition to the significance under Criteria A, B, and D, the Mt. Taylor TCP also possesses integrity of location, setting, association, relationship, and condition. Integrity in this sense means the ability of the property to convey its significance. The Forest Service has determined that the

Mt. Taylor TCP retains integrity of location, setting, and association. These aspects of integrity address the character and presence of the physical features that convey the significance of the property. Despite some modern intrusions onto the TCP or within the viewshed, the TCP retains the essential physical features that convey its significance.

In evaluating properties like the Mt. Taylor TCP that possess traditional cultural significance, it is particularly important to consider the integrity of relationship and condition. The Mt. Taylor TCP possesses both integrity of relationship and condition, even though some development has occurred on the mountain that requires the tribes to modify their traditional activities to ensure privacy and solitude.

The TCP retains integrity of relationship because there is an integral relationship between the property and its resources and American Indian traditional beliefs and practices. “If the property is known or likely to be regarded by a traditional cultural group as important in the retention or transmittal of a belief, or to the performance of a practice, the property can be taken to have an integral relationship with the belief or practice, and vice versa” (Parker and King, 1998:11). The tribes that ascribe cultural significance to the mountain have stated that the mountain is essential to their cultural practices and is critical to the continuity of their beliefs and traditional cultural practices. The involved tribes consulted still engage in traditional cultural and religious activities on Mt. Taylor. They regard the mountain with deep reverence and consider it a vital entity in their lives and the continuance of their cultural practices and beliefs.

The TCP also retains integrity of condition because it retains the essential physical features that define the relationship with the traditional beliefs and practices. With regard to integrity of condition, NPS guidance (Parker and King, 1998) addresses a property’s significance through physical alteration of its location, setting, design, or materials. The mountain, from whichever direction it is viewed, appears largely as it always has through time. There have been alterations and development within the TCP; however, based on information provided by the tribes, it is evident that Mt. Taylor continues to have integrity of condition.

Tribal Significance

Following is a brief discussion of some of the tribes’ uses of Mt. Taylor and the role it plays in their culture and history. This information is taken from the Forest Service’s TCP eligibility determination (Benedict and Hudson, 2008), the tribes’ nomination of the Mt. Taylor Cultural Property to the SRCP (Chestnut Law Offices, 2009), and the ethnographic assessments conducted by four tribes specifically for this EIS (Anschuetz, 2012; Colwell-Chanthaphonh and Ferguson, 2012a and 2012b; Koyiyumptewa, 2012). Those documents provide a more comprehensive discussion of the role that Mt. Taylor plays in the beliefs and cultural practices of the tribes. It bears repeating that the tribes that conducted ethnographic assessments for this EIS do not differentiate between Mt. Taylor and cultural and natural resources found in the proposed project area. In their view, the resources contained within the proposed project area are all associated with, or are considered a part of, the Mt. Taylor TCP. The TCP and the individual resources are all interconnected to form a sacred landscape, all of which has traditional cultural significance to the tribes.

The following discussion also incorporates information that was shared by the tribes with the Forest Service during government-to-government consultations between 2007 and 2012 regarding this undertaking and uranium development in general. Thus information on the mountain’s significance to the Pueblos of Jemez and Isleta, and the Jicarilla Apache Nation, is presented here in addition to information from the involved tribes. This information was provided by the tribes to the Forest Service to assist in their analysis of potential impacts.

Hopi Tribe

The Hopi refer to Mt. Taylor as *Tsiipiya*, the mountain of the cardinal direction of the northeast (Stephen in Anyon, 2001:16). This place name encompasses a landscape in both a temporal and cultural sense. The Hopi have more than one name for the mountain, each reflecting a slightly different context. For example, *Nuvakukya' ovi* is a name used to describe both Mt. Taylor and the San Francisco Peaks. It means snow-mountains-peaks-place (Anyon, 2001). The two mountains share some of the same properties, namely their high elevations and volcanic history. Both are distinct natural features that rise above and are easily seen and distinguished from their surrounding landscape. One of the villages on First Mesa is inhabited by Tewa people who migrated from the Rio Grande area in the 17th Century. These Tewa refer to the mountain as *Pingtsey*, which means "white capped mountain."

Mt. Taylor plays a significant role in the emergence and migration traditions of the Hopi. This spans a very long period of time prior to the people's arrival at Hopi, which is considered the "spiritual place." Several of the Hopi clans have oral traditions of having resided in the general area of Mt. Taylor, prior to their gathering at the Hopi Mesas. Other clans are thought to have migrated through the area on their way to the Hopi Mesas. The Hopi believe they emerged from the south. Clans dispersed in all directions (Aztec, Chaco, Zuni, Rio Grande etc.). Mt. Taylor played an important role as a landmark and sacred landscape during the migrations, when the clans met up with the spirit *Ma'asaw* for final instruction. Mt. Taylor was meant to be "touched" but was never intended to be the permanent home for the Hopi. Mt. Taylor served as a place of instruction only (Kuwanwisiwma, personal communication, 2007).

The Hopi shrines established on Mt. Taylor may not be physically visited very often or at all (Kuwanwisiwma, personal communication, 2007). The Tewa shrine, referred to as *Pingtsey'kwaya*, was built when the Tewa travelled from their home near the Rio Grande to First Mesa (Anyon, 2001:6). It is not practical to travel a great distance, and sometimes it is prohibited, for spiritual or ritual reasons. Even so, the Hopi people have an "unbroken living connection to Mt. Taylor." The tribe's spiritual bond with sacred landmarks like Mt. Taylor becomes stronger when its shrines are not visited regularly. Mt. Taylor "feeds the soul" of the Hopi, and the people spiritually feed the soul of the mountain (Kuwanwisiwma, personal communication, 2007). As noted by Gulliford (2000:81), however, shrines and altars represent conduits to the spirit world, even when they are rarely visited.

Once the Hopi villages were established, the tribe designated directional shrines in and around Hopi. One of these was constructed as a representation of Mt. Taylor, the actual mountain. Mt. Taylor and the shrines upon it receive continual use from the Hopi people, in a spiritual sense. This and other local shrines are used continually "in recognition of" the important areas more distant to Hopi. The shrines serve this purpose since regular visits cannot be made to Mt. Taylor. According to Anyon, Hopi religious pilgrimages are still conducted to Mt. Taylor, the primary purpose being to collect plants and minerals for ceremonial purposes (in Koyiyumptewa, 2012).

Shrines and other significant locations such as archaeological sites, springs, migration routes, trails, petroglyphs, and burials are seen as the footprints of Hopi ancestors, and are inextricably linked to their migration. These features "are the tangible and physical manifestation of [Hopi] fulfillment of a Covenant with *Massaw*, the Earth Guardian—to travel to the four directions of the

Continent and leave these footprints" (Chestnut Law Offices, 2009: Continuation Sheet, Section 12, page 39; Koyiyumptewa, 2012).

Navajo Nation

The *Diné*, as the Navajo people call themselves, refer to Mt. Taylor as *Tsoodzil*. It is the southern sacred mountain, one of the four cardinal mountains that together with the two mountains of the center, define the lands that bound the *Dinetah* or homeland (Acoma et al., 2009). The mountain and its immediate surroundings represent the stronghold of the Diné, and figure prominently in their origin stories and ceremonies. It is the home of spiritual beings, or Holy People, who travel between the sacred mountains and must be present and protected on the mountain for contemporary healing ceremonies to be successful. The Diné utilize the entire mountain and its immediate surroundings for traditional herb gathering, religious pilgrimages, and to conduct ceremonies and leave offerings to the supernatural (Benedict and Hudson, 2008).

The Diné do not think of important places such as Mt. Taylor as isolated locations, but rather they are part of a larger landscape connected by story and use. "[Significant places] derive their significance from their position in larger, culturally 'constructed' landscapes" (Kelley and Francis,1994:50).

Mt. Taylor is central to Blessingway ceremonies. For that reason, certain materials collected for the Blessingway ceremonies, as well as offerings left for the Holy People, must be done at specific locations on Mt. Taylor. "Testimony to Mt. Taylor's integrity of feeling and association for Diné is its continued use as a storehouse where Diné collect plant medicines and other natural resources for ceremonies, including soil for the all-important Mountain Soil Bundle of Blessingway, a type of ceremonial bundle maintained by most Diné extended families" (Chestnut Law Offices 2009: Continuation Sheet, Section 12, page 93).

Pueblo of Acoma

The Acoma refer to Mt. Taylor as *Kaweshtima*, which means "a place of snow." The mountain is central to their belief system. It is a place where religious practitioners as well as the community as a whole have historically gone, and are known to go today, to perform ceremonial activities in accordance with traditional cultural practices that are important in maintaining the identity and cultural continuity of the community. The Acoma view the mountain as a living, breathing entity that encompasses all physical attributes such as the plants, animals, stone, minerals, and water, as well as air, clouds, and rain, which are all believed to embody spiritual elements. The mountain is a vital part of Acoma's oral traditions, and it figures prominently in their prayers, stories, and songs.

Acoma regards Mt. Taylor as the most important mountain because it is the starting point to the north. In recounting their migration through prayer, Mt. Taylor is mentioned as their first mountain. The mountain retains a prominent role in songs, stories, and other prayers used by the Acoma people, even though there are other important mountains in other directions. Acoma stories say that the ancestors migrated from the north to *Haaku* "a place already prepared."

Mt. Taylor is rooted in Acoma's history and traditions, and is central to the cultural practices of Acoma as a living community and critical to the maintenance of the pueblo's cultural identity. The prominence of Mt. Taylor forms a significant part of the cultural history of the Acoma people. The mountain is within the greater spiritual and physical landscape of the Rio San José watershed as well as the Acoma Cultural Province. Within the greater landscape of the mountain are natural features as well as features with an archaeological signature, all of which are considered culturally significant to the Acoma. The province as a whole encompasses significant landscape features, archaeological sites, and areas of aboriginal importance to the Acoma.

The ethnographic assessment (Anschuetz, 2012:11) describes the Acoma's traditional landscape as being enclosed by four Mountains of Cardinal Direction. "Beginning with *Kaweshtima Kuutyu* in the North, the people of Acoma define the *rightful orientation* of their community—and themselves—within their aboriginal stewardship area following a clockwise circuit." The other three Cardinal Mountains of Direction include: the San Francisco Peaks (*Tsibiina*) to the west, the Sawtooth Mountains (*Dautyuma*) to the south, and the Sandia Mountains (*Kuchana*) to the east. Each mountain shares the significant qualities of being the source of life-giving water, as well as soil, plant, and animal resources that are necessary for cultural and traditional uses. The sacred mountains contain sites and places that are significant in the history and cultural practices of Acoma (Benedict and Hudson, 2008).

Pueblo of Laguna

The Laguna refer to Mt. Taylor as *Tsibina*, which translates as "forested mountain." Mt. Taylor is one of the sacred mountains that are said to form a "basket" containing Laguna Pueblo lands (Chestnut Law Offices, 2009). Other significant forested mountains include the Zuni Mountains to the west, the Sawtooth-Gallinas Mountains to the south, and the Sandia Mountains to the east. "Mt. Taylor is an integral part of a larger cultural landscape that sets the stage for Laguna Pueblo history and traditions" (Chestnut Law Offices, 2009: Continuation Sheet, Section 12, page 43). The Laguna do not see Mt. Taylor as having a discrete boundary, but rather it is seen as spiritually connected to these other sacred mountains. As they describe it, "The cultural beliefs and practices associated with Tsibina transcend a single landform, imbuing the entire landscape with a sacredness that should not be reduced by considering the component elements in isolation from one another" (Chestnut Law Offices, 2009: Continuation Sheet, Section 12, page 48).

The Laguna identify what are referred to as "Guardian Peaks" that surround Mt. Taylor and protect it. They are distinctive, highly visible volcanic formations. One such Guardian Peak is Cerro Alesna, located just to the northeast of the proposed dewatering discharge pipeline. It was a landmark when traveling over Mt. Taylor, particularly when driving and grazing sheep.

Practitioners use all areas of the mountain for personal and traditional cultural activities (Benedict and Hudson 2008). The mountain was also used extensively by the Laguna during the 19^{th} and 20^{th} centuries for sheep herding. Sheep were grazed in areas on all sides of the mountain, well beyond what is now defined as the Mt. Taylor TCP (Chestnut Law Offices, 2009).

Mt. Taylor is the focus of Laguna's traditional activities such as hunting, pilgrimages for prayer and special offerings, visiting shrines and springs, and gathering plants and minerals that have special healing properties and are used by medicine people. The mountain is central to the pueblo's beliefs about the place of emergence. The people believe that they were given this place to "live abundantly." They were placed here and the sacred mountain was provided to them for their survival. The kiva leaders and heads of the various clans within the pueblo all go to different parts of the mountain for their traditional activities. These places are visited on a seasonal or cyclic basis, and only after extensive cleansing and prayer preparation (Benedict and Hudson, 2008).

Traditional gathering activities occur on Mt. Taylor, as well as areas well beyond the boundaries of the Mt. Taylor TCP. Any and all areas may be used, depending on the plant or mineral that is needed, and where it is known to exist. Trails from the south and east traverse the mesas and extend up the slopes of the peak (Polk, 1997:42). These trails have been in place for centuries and provided access to Mt. Taylor for a variety of traditional cultural and religious activities.

Pueblo of Zuni

The Zuni call Mt. Taylor *Dewankwin Kyaba:chu Yalanne,* which translates "in the east snow-capped mountain." In the tribe's significance statement for the SRCP nomination, the Zuni Heritage and Historic Preservation Office described the mountain this way:

> "Mt. Taylor is historically significant because it contains special places that reveal aspects of the Zuni culture's origin, development, and continuation through the form, features, and the ways these special places are utilized. That is, Mt. Taylor is inextricably tied to the Zuni cultural landscape and the Zuni religion and culture. Mt. Taylor itself is considered by the Zuni people to be a living entity, a shrine, and a demarcation of the eastern most extent of Zuni aboriginal lands. In addition, Mt. Taylor contains places where prayer offerings are made, medicinal herbs and plants [are] gathered, special wood for prayer sticks are [*sic*] collected, water collected from sacred springs, minerals collected and numerous other activities that are vital to the continuation of the Zuni culture. The identity of the individual Zuni, as well as the collective Zuni community's identity, is in part determined and reinforced by their conceptualization of their place in relationship to Mt. Taylor." (Chestnut Law Offices: Continuation Sheet, Section 12, page 96)

The Zuni describe the mountain as a living entity: "The perception of Mt. Taylor by the Zuni as a living being is, in part, because it is an active volcano, but also because it is a snow-capped mountain that nourishes all of the plants and wildlife during spring runoff. The minerals and subsurface substances of the mountain, the Zuni people believe, are the "meat" of the mountain and contained within the meat is the mountain's heart. Water is conceptualized as the "blood" of the mountain. Any disturbance to the meat of Mt. Taylor has the possibility to disturb the heart which could cause the mountain to become angry. If the mountain gets angry it might erupt. Thus, Mt. Taylor is viewed as a living entity by the Zuni, similar to a living human being, and the relationship between the Zuni people and Mt. Taylor is similar to ones relationship to a family member" (Chestnut Law Offices, 2009: Continuation Sheet, Section 12, page 94).

The use of the Mt. Taylor area is ongoing but sporadic, and is dictated by the cycle of cultural activities. The nature and frequency of the use is based upon a lunar schedule and the structure of the individual religious societies at Zuni. For example, seeds used in a ceremonial context must come from the Mt. Taylor area. The mesas that flank the peak are visited when societies make trips to the mountain for the collection of plants and sand. The mesa may also contain places of offerings (Kucate, personal communication, 2008). The collection of seeds and other materials (forest products, minerals, pigments, feathers, etc.) has a direct bearing on any given society's ability to conduct their ceremonies (Damp, personal communication, 2008).

Mt. Taylor possesses many features such as archaeological sites, petroglyphs, burial places, and ancient objects that in the eyes of the Zuni, combine to create what is described as a "total landscape" (Colwell-Chanthaphonh and Ferguson, 2012b). These places are seen as the material evidence of Zuni's "spiritual destiny."

Jicarilla Apache Nation

The Jicarilla Apache refer to Mt. Taylor as *dzil nii yedi*, or a mountain that grows or flows from within. Considered the sibling of the Valles Caldera, the mountain plays a role in Jicarilla ceremonies, is mentioned in songs, and is depicted in ceremonial sand paintings.

The Jicarilla traveled to the mountain, and still do, to collect medicinal plants, minerals and plants for pigments, and sand for sand paintings used in ceremonies. They have made trips in recent years to visit culturally significant sites on the mountain's eastern flanks (Benedict and Hudson, 2008). The Jicarilla support the other tribes' traditional uses of the mountain, because the Jicarilla depend on them to provide certain plants needed for medicinal or ceremonial use through trade (Velarde, personal communication, 2008).

The entire mountain is important to the Jicarilla Apache, not just specific locations. To them, the mountain is a living being with great power. They pray before visiting because they are concerned that the mountain will come back to life (Vigil, personal communication, 2008). The mountain provides guidance to the tribe. The Jicarilla's connection to the mountain is essential for the survival of the tribe. Their faith is linked to the earth and sacred places, such as Mt. Taylor, and the connection must be maintained and remain intact to ensure survival of the people (Monarco, personal communication, 2008).

Pueblo of Isleta

The Isleta refer to Mt. Taylor as *Tuwie-'ai*. Pueblo members do not physically travel to Mt. Taylor to conduct activities. However, their people traveled through that area historically when traveling to areas further west, such as the Hopi Mesas. Isleta regards all Puebloan people as part of an extended community, who emerged on the earth together and then evolved into separate tribes. As such, they consider it important to support the continued use of the mountain by the other Pueblos, especially Acoma and Laguna, who Isleta believes were assigned as caretakers of that area (Benedict and Hudson, 2008).

Pueblo of Jemez

The Jemez regard Mt. Taylor as a living entity. The mountain, which is referred to in songs, is home of the Twin War Gods, who bring blessings, strength, and power to the people of the pueblo. The link between Jemez traditional cultural practices and the mountain is strong, and is ongoing. Activities conducted on Mt. Taylor are conducted according to an established traditional calendar that varies for each of the 12 religious societies. One such activity is the collection of plants that are used to make medicine. The activity areas used on the mountain have been used for a very long time, and cannot simply be changed or moved without directly impacting the effectiveness or success of the activities being performed. Some areas cannot be changed at all (Benedict and Hudson, 2008).

Mt. Taylor is the heart, and its springs the lifeline, that provide blessings to the people. The water is deified and consuming the water "takes in" the spirit. The mountain plays a necessary role in maintaining the flow of power and harmony between the natural and supernatural realms.

Indian Sacred Sites

The involved tribes consulted for this EIS do not make a clear distinction between what others call “sacred” and “secular.” In tribal communities, terms such as sacred, spiritual, ceremonial, religious, and ritualistic do not distinguish an activity, place, or object into a realm that is separate from daily life. The activities, places, and objects given these descriptors “are pervasive in these tribal communities and in their ways of living and thinking, and are seen by the tribes themselves as inseparable from their daily activities” (Benedict and Hudson, 2008:17). Sacred sites are not solitary, but rather are linked together by a set of religious relationships that are part of the cultural makeup of the group; this results in a holistic sacred geography that is a fundamental part of and context for the everyday lives of the individuals in the group. Gulliford (2000:68) explains that “Sacred sites remain integral to tribal histories, religions, and identities . . .”, and Benedict and Hudson reiterate that tribes’ activities at sacred sites “are simply expressions of cultural practices that are part of a larger continuum of activity that defines their cultural identity” (2008:31).

However, for the purposes of this EIS and its analysis, sacred sites must meet the definition in Executive Order 13007, Indian Sacred Sites. This order addresses Federal land managing agency requirements for accommodating access to and ceremonial use of Indian sacred sites by Indian religious practitioners and avoiding adversely affecting the physical integrity of such sacred sites. Sacred sites are defined in the executive order as:

> “Any specific, discrete, narrowly delineated location on Federal land that is identified by an Indian tribe, or Indian individual determined to be an appropriately authoritative representative of an Indian religion, as sacred by virtue of its established religious significance to, or ceremonial use by, an Indian religion; provided that the tribe or appropriately authoritative representative of an Indian religion has informed the agency of the existence of such a site.” (Executive Order 13007, 61 FR 26771, Section 1, Part (b)(iii))

Some places are considered sacred due to their association with traditional religious activities. The activity itself in that place imbues the place with sacredness. Other places are sacred by definition, whether an activity occurs there or not. Sacred narratives often define sacred places by their role in origin stories, stories of spiritual beings or cultural heroes, or stories about the origins of ceremonies, sacred instructions, and sacred objects. Some sacred places are required to be visited, and maintain their sacredness through physical or spiritual use. Other sacred places are specifically forbidden to be visited, perhaps by certain groups of people, or only visited by those who are properly prepared through prayer or ceremony. Such places are never truly abandoned, even if not visited in person. Use of a sacred site can be determined through a traditional religious calendar, or can be sporadic, determined when conditions require it. In many instances, visitation to a sacred site requires privacy, and the places and objects left there need to remain undisturbed in order to fulfill their function within the traditional belief system of the tribe.

Ultimately, and per the Executive Order, sacredness of a place is defined by the group to whom it is sacred. It is important to note that there is no review of such determinations by a Federal agency (ACHP, 2005). For all of the involved tribes, Mt. Taylor is considered in and of itself to be a sacred site in its entirety, one that is currently used for ceremonial activities, and which plays a distinctive role in the religion and cultural traditions of the tribes. The tribes view Mt. Taylor and its associated lands in a holistic manner, referring to it as a sacred landscape that includes landforms, rocks, soil, sand, water, springs, tinajas, drainages, plants, animals, archaeological sites in all their permutations, ceremonial sites, shrines, offering places, blessing places, and the viewshed from these places. The entirety is considered sacred by the tribes, and those individual elements that make up the entirety are, by definition, also sacred. The Mt. Taylor sacred site, which herein is considered to have the same outer boundary as the Mt. Taylor TCP, encompasses Federal lands within the physical APE (Sections 9, 10, 11, and 2) as well as some federally-owned lands within the setting APE.

Traditional Cultural Practices

Information on current traditional uses of the region of influence was collected during consultation and ethnographic assessment for the proposed Roca Honda Mine, as well as during the preparation of the Forest Service's determination of eligibility and the tribes' nomination for the Mt. Taylor TCP. Many of these uses are described above in association with specific cultural resources. Based on the information collected, these varied uses likely occur not only within the physical APE for the proposed project, but also in other areas included in the setting APE.

The research documented ritual use of sites and resources. This includes physical visitation to specific locations to conduct ceremonies, blessings, offerings, prayers, and other spiritual activities. Some places are visited for gathering materials for use in religious activities, such as certain plants, specific minerals, or water from certain sources. These activities often include spiritual actions such as prayers. Also documented is "remote" use of specific religious locations that are integral to transmitting prayers and other messages from one spiritual site to another. Thus, some activities conducted within the tribal community are tied to places located within the region of influence. These religious activities are often, though not always, cyclic and tied to a traditional calendar. Others are conducted not by schedule, but during other activities when the conditions require it. Many of these activities require privacy, and the places and objects left there need to remain undisturbed in order to fulfill their function within the traditional belief system of the tribe.

The research documented other activities being conducted in the ROI. These include plant gathering for food, medicine, and pigments, collecting of soil, sand, minerals, and feathers, firewood gathering, and hunting. All of these activities may appear "secular" from an outsider's perspective; however, while not overtly ceremonial in nature, some of these activities can also have religious connotations.

Environmental Consequences

Methods of Analysis

The following analysis details the anticipated direct, indirect, and cumulative impacts of the project alternatives on cultural resources. The analysis area includes the ROI as defined earlier, which is comprised of the physical APE and the setting APE. Potential impacts to cultural resources arising from mine development, operation, and reclamation were identified through application of the Section 106 Criteria of Adverse Effects and consultation with the involved tribes to learn about potential impacts to traditional cultural resources. These two methods are discussed below, along with a discussion of assumptions included in the analysis of impacts.

In this EIS, the analyses of two types of impacts are described, one type analyzed under NEPA and the other under Section 106. As explained earlier, cultural resources as a category contains a subcategory of resources called historic properties. "Cultural resources" are analyzed under

NEPA to identify potential *impacts* arising from the proposed project. For Section 106 compliance, "historic properties" are analyzed to identify potential *effects* arising from the proposed project. Impacts can occur to any cultural resource; however, when talking about historic properties, impacts are called effects. This difference in nomenclature is important from the view of Agency compliance and the thoroughness of this EIS and, thus, the analysis presented herein attempts to be clear when talking specifically about one or the other. If the discussion applies in general to both impacts and effects, the term *impacts* is used. In reality, as shown below, the actual analysis methods and information considered to determine impacts and effects is extremely similar.

Tribal Consultation

As described in detail earlier in this section, the Forest Service engaged in extensive consultation with the involved tribes to identify important traditional cultural resources and potential impacts arising from the proposed project to these resources or associated traditional practices. Additionally, four of the tribes prepared ethnographic assessments, described above. The objectives of the assessments were to identify cultural resources of religious and cultural significance to the tribes, as well as cultural practices, and provide information on these resources and practices and potential impacts thereto. This information assisted the Forest Service in analyzing the potential impacts of the proposed project under NEPA and assessing the potential effects under Section 106 of the NHPA. Through the consultation and development of the assessments, the involved tribes described potential impacts to cultural resources within the APEs and how these resource impacts could have additional indirect impacts to traditional practices and institutions that extend outside of the APEs.

Criteria of Adverse Effects

Section 106 of the NHPA requires Federal agencies to take into account the effects of their actions on any district, site, object, building, or structure included in, or eligible for inclusion in, the NRHP. Implementing regulations for Section 106 provide specific criteria for identifying effects on historic properties. Effects to historic properties listed, or eligible for listing, on the NRHP are evaluated with regard to the criteria of adverse effects.

> "An adverse effect is found when an undertaking may alter, directly or indirectly, any of the characteristics of a historic property that qualify the property for inclusion in the National Register in a manner that would diminish the integrity of the property's location, design, setting, materials, workmanship, feeling, or association. Consideration shall be given to all qualifying characteristics of a historic property, including those that may have been identified subsequent to the original evaluation of the property's eligibility for the National Register. Adverse effects may include reasonably foreseeable effects caused by the undertaking that may occur later in time, be farther removed in distance, or be cumulative." (36 CFR 800.5(a)(1)).

Under Section 106 and its implementing regulations, the types of possible adverse effects include:

- Physical destruction of or damage to all or part of a property;
- Physical alteration of a property;

- Removal of a property from its historic location;
- Change in the character of a property's use or of physical features within a property's setting that contribute to its historic significance;
- Introduction of visual, atmospheric, or auditory elements that diminish the integrity of a property's significant historic features;
- Neglect of a property which causes its deterioration, except where such neglect and deterioration are recognized qualities of a property of religious and cultural significance; and
- Transfer, lease, or sale of property out of Federal ownership or control without adequate and legally enforceable restrictions or conditions to ensure long-term preservation of a property's historic significance. (36 CFR 800.5(a)(2).

The Forest Service applied the criteria of adverse effect to the activities proposed for mine development, operation, and reclamation to identify potential effects to historic properties identified within the physical and setting APEs. These same criteria were also used to identify the potential for impacts to other cultural resources not defined as historic properties.

Assumptions in Analysis

Built-In Project Plan Commitments

During the analysis conducted to identify cultural resources and assess potential impacts, RHR incorporated certain design and operations commitments to minimize the potential for impacts to cultural resources. These commitments are included as part of the two action alternatives, as described in chapter 2. As such, the analysis of potential impacts to cultural resources assumes that these commitments will be included in the approved mine plan of operations should either action alternative be selected. These commitments include:

- Haul Roads and Access Roads
    - *Commitment* – upon receipt of the necessary permits to allow start of construction, the first activity conducted by RHR will be to blade new access roads within the proposed haul road routes. The new bladed roads will be the access used by all mine-related vehicles, while the haul roads are being formally constructed. The existing ranch roads in Sections 17 and 16, and the unauthorized two-track road in Section 11, will not be used for mine-related activities. In Sections 9 and 10, new proposed access roads to vent shafts and dewatering wells will be established prior to drilling the shafts and wells.
    - *Purpose* – this commitment was developed to address the potential for impacts from mine traffic prior to the establishment of formal haul roads and access roads.
- Perimeter Fencing
    - *Commitment* – perimeter fencing in Section 16 will be installed at the beginning of construction activities in that section. The fencing will surround all facilities and activity areas, with the exception of the exploratory drill locations. Perimeter fencing will also be installed around all vent shaft locations in Sections 9 and 10. Perimeter

fencing will be installed surrounding all facilities and activity areas in Section 10 prior to the start of construction of those facilities in that section.

- *Purpose* – this commitment was developed to address the potential for impacts from construction activities and mine activities inadvertently extending outside the planned mine area, and to address the potential for vandalism and looting of cultural resources.

- Well Pad Fencing and Erosion Control
  - *Commitment* – for all water monitoring and dewatering wells, including those exploratory drill locations that are converted into water monitoring wells, the well pads will be fenced for the duration of their use, erosion control measures will be implemented around the pad, and a permanent access road to the well will be developed along the route shown on the proposed project maps.
  - *Purpose* – this commitment was developed to address the potential for impacts from mine traffic and activities related to project facilities located outside the main facility areas.

- Haul Road Gate
  - *Commitment* – in Section 11, where Forest Road 192 and the proposed haul road diverge, a gate will be installed across the proposed mine's haul road to discourage public use of the road.
  - *Purpose* – this commitment was developed to address the potential for impacts from public access on a new road into this portion of Forest Service lands.

Programmatic Agreement

As described in detail below, the Forest Service has determined that there would be impacts to cultural resources from the action alternatives, and either of the action alternatives would result in an adverse effect to historic properties. The general sources of these impacts would include facility construction, surface activities at the mine site, removal of mineralized ore, and traffic. If one of the action alternatives is selected by the Forest Service, the Forest Service would complete consultation with the ACHP, NMSHPO, and the consulting parties prior to commencement of mine development activities by RHR. The purpose of the consultation would be to develop measures to avoid, minimize, or mitigate the anticipated impacts to cultural resources and the adverse effects to historic properties. A programmatic agreement would be developed for signature by the Forest Service, ACHP, NMSHPO, NMSLO, RHR, and the other consulting parties,

Why a Programmatic Agreement?

The Forest Service has determined that a programmatic agreement is the appropriate document to record the commitments made by the Agency to address impacts to cultural resources, resolve adverse effects to historic properties, and document associated responsibilities and actions assigned to each of the signatories. Because there are three phases to the proposed mine (construction, operation, reclamation), and due to the proposed mine term of 18–19 years, there is a likelihood that changes to project infrastructure or operational activities could occur, which may result in additional or different impacts to cultural resources or adverse effects to historic properties. For complex undertakings such as the Roca Honda Mine development, programmatic agreements provide procedures to be followed to address any proposed changes to the project and resolve the impacts and effects.

which would document the measures to be implemented. This programmatic agreement would be included in the final EIS, incorporated into the record of decision, and made part of the mine plan of operations.

The following measures to avoid, minimize, or mitigate adverse effects and impacts are examples that could be considered and included in the programmatic agreement:

- Conducting data recovery excavations of archaeological sites;
- Conducting research on various topics with regard to relevant cultural resource issues;
- Implementing specific practices during construction and operations activities to control erosion and changes to erosion patterns;
- Training of RHR construction, operations, and reclamation personnel and contractors to recognize when archaeological resources or human remains have been discovered, to recognize when inadvertent damage has occurred to a resource, to halt ground-disturbing activities in the vicinity of the discovery, and to notify appropriate personnel; and
- Educating RHR personnel and contractors on the importance of cultural resources, the laws and regulations protecting cultural resources, the need to stay within defined work zones, and the legal implications of vandalism and looting.

The programmatic agreement would also describe the processes to be followed if previously unknown cultural resources or human remains are discovered during construction or operation of the selected alternative, and would address processes to be followed if inadvertent physical damage to an historic property occurs. While some impacts and effects to the resources would remain, the programmatic agreement and the measures contained within it would resolve these effects and reduce the significance of the impacts. The programmatic agreement would address all cultural resource impacts, whether defined through Section 106 analysis or through NEPA analysis, and would document the Forest Service’s commitment to ensure these mitigation measures are implemented.

Alternative 1

There would be no additional impacts to cultural resources with selection of the no action alternative. The Forest Service would not approve RHR’s plan of operation and there would be no impacts from mine development, operation, and reclamation. Impacts to cultural resources already occurring from livestock management and access to the area by the public would continue; these include vandalism, trampling, and inadvertent damage. Under the no action alternative, adverse impacts to cultural resources would be less than significant. This alternative would result in no effect to historic properties.

Effects Common to the Action Alternatives

This section describes the anticipated impacts to cultural resources that would be common to both action alternatives.

Impacts to Tribal Cultural Resources and Practices

This section summarizes the potential project impacts to tribal cultural resources and practices as identified by the involved tribes. The information for this section was derived in part from tribal consultation efforts conducted by the Forest Service since 2006 regarding the anticipated increased in uranium development applications for the Mt. Taylor district. More detailed information was obtained during tribal consultations conducted since 2010 specifically regarding the proposed RHR mine. Finally, information on the anticipated impacts of the proposed project was provided in the ethnographic assessments prepared by the Hopi Tribe and the Pueblos of Acoma, Laguna, and Zuni.

It bears repeating that the tribes that conducted ethnographic assessments for this EIS do not differentiate between Mt. Taylor and cultural and natural resources found in the proposed project area. In their view, the resources contained within the proposed project area are all associated with, or are considered a part of, the Mt. Taylor TCP. The TCP and the individual resources are all interconnected to form a sacred landscape, all of which has traditional cultural significance to the tribes.

The discussion below is organized by tribe. Each tribe’s section first presents general concerns regarding uranium development in the region, then discusses the potential impacts that they foresee arising from the proposed RHR uranium mine.

Hopi Tribe

General Concerns

The Hopi Tribe opposes exploratory uranium drilling and uranium mining. The Hopi describe uranium as a natural resource in a dormant state. Mining is man’s intent, and when this intent is used on a natural resource such as uranium, it is viewed negatively as it is considered desecration to the sacred landscape. From the view of the Hopi, bringing uranium to the surface has been and would be disastrous. Uranium in its natural state is a blessing and is part of the earth. Its contemporary use is viewed as exploitive and would cause harm.

The mountain is considered a living being, and mining is akin to hurting a living being. Uranium drilling and mining activities would threaten sacred landscape features and harm the spiritual heart of the mountain. Impacts to important locations would have local impacts for the Hopi people; it would affect their spiritual and emotional energy.

The Hopi people believe that prayer must be positive, and that the individual must be focused and able to drive away disturbance. Having in mind the knowledge and thought of the impending disturbance or intent to disturb through drilling and mining would alter the ability to conduct prayer and ceremony in a manner it is intended to be done. It would make it very hard for the Hopi people, particularly the traditional practitioners and those engaged in ceremonial activity, to carry on in a manner that is essential for them as Hopi to be Hopi.

Exploratory drilling and mining for uranium are both seen as having an adverse impact and causing harm to the Hopi people. To impact important elements of a people’s faith is to desecrate the whole of the faith. To desecrate the Mt. Taylor landscape would place a substantial burden upon the culture of *katsina* and the Hopi people as a whole. Katsina is fundamental to Hopi culture. Peaks such as San Francisco Peaks and Mt. Taylor are the home of the katsinas. The tribe fears that continued and cumulative desecration of sacred landscapes such as Mt. Taylor would ultimately lead to their prayers and ceremonies becoming simply a performance with no true link to the sacred place. Physical alterations and impacts to the mountains such as Mt. Taylor would irreparably harm the cultural practices of the Hopi, and affect the very core of their cultural identity and essence of what it means to be Hopi.

Proposed Uranium Mine

The Hopi Tribe has indicated that the proposed project would adversely affect the Mt. Taylor TCP and would adversely affect NRHP eligible prehistoric sites that fall within the boundary of the Mt. Taylor TCP. Adverse effects to the archaeological sites would have subsequent adverse effects on the entire Mt. Taylor TCP. The tribe is concerned that human remains may be encountered during the proposed project or during mitigation activities. Medicinal plants in the mine area may also be affected.

The Hopi understand that this project would pump, treat, and discharge large amounts of water. Treating water as a waste product in the pursuit of uranium would be a misuse of the environment and the Hopi, therefore, believe that this proposal would also adversely affect the natural environment. The Hopi are also concerned that the proposed project would result in contamination of the Mt. Taylor area.

When the impacts are considered together, the Hopi Tribe believes that the proposed project would adversely affect the Mt. Taylor TCP and cause irreparable harm to the Hopi people and their traditional cultural practices. This harm would derive from adversely affecting the core of Hopi cultural identity and essence of what it means to be Hopi; adversely affecting the Katsina; impacting the integrity of the mountain’s sacred landscape; and diminishing the power or effectiveness of prayers and ceremony.

Navajo Nation

General Concerns

The Navajo Nation opposes uranium development on and near Navajo lands. The tribe recognizes the past problems related to uranium development on and adjacent to Navajo land, and its link to health issues and degradation of the environment, both of which continue to impact the tribe.

The existence and purpose of uranium from a traditional viewpoint was discussed during consultation. Uranium is meant to remain where it is, buried in the earth. It is believed that uranium changes when it is brought to the surface; extracting uranium contaminates and poisons the surface. It is believed that once uranium is extracted, it would poison humans and other living resources such as plants and water, and cause illness.

Contamination and depletion of groundwater and springs is a major concern for the Navajo Nation. Water is a resource critical to the survival of the Navajo and the continuity of their way of life. The Navajo believe that if plants are misused, they will move away. Drilling or digging into the earth is considered misuse and is viewed in a negative way because of the impacts it has upon the plants. Digging and removing earth from Mt. Taylor is akin to removing an organ from a living being. Digging into the earth is also believed to alter the otherwise beneficial effects of other land treatments intended to regenerate the growth of plants.

The older practitioners speak of how uranium drilling changed the landscape and plant growth. Practitioners were forced to move their traditional activities away from the impacted areas. The

Navajo believe that contamination of these areas anger the Holy People. In anger, they withhold moisture (rain and snow), hinder plant growth, and allow the springs to dry up. The approach to Mt. Taylor and the traditional activities of a practitioner all rely upon going to certain places, such as springs. If the springs are dry, it requires a practitioner to find a different route and begin the pilgrimage over again. These impacts to traditional practices in turn impact the efficacy of the prayers or medicine being conducted.

The mining of uranium has contributed to a reduction of Navajo traditional use of the San Mateo area. Chanters are leery of using the area because of the impacts that these extractive activities have had upon the natural resources (plants and water) and the overall loss of spiritual integrity of the area. This has resulted in the displacement of some traditional activities. Traditional practitioners have said that the San Mateo area no longer possesses as much power as it once did. The chanters and practitioners began shifting their activities in the latter half of the 20th century due to impacts and contamination that were occurring in the San Mateo area. The chanters began to see a pattern between use of plants and water, and subsequent illness and death of some Navajo, and suspected that some of the resources that were being collected and used were contaminated by uranium mining in the area.

Proposed Uranium Mine

The Navajo Nation has indicated that the input previously provided to the Forest Service about the impacts of uranium drilling and mining is applicable to the proposed project, and may be used to document the tribe's concerns and position regarding potential impacts of the RHR project.

The primary impacts identified by the Navajo Nation include: displacement of plants and traditional activities, contamination of plants and water, loss of integrity (in a spiritual sense), and noise and visual impacts. These impacts would themselves accumulate to result in disruption, alteration, and forced displacement of traditional practices. Impacted areas would lose their integrity and become less effective, and practitioners would not be able to use those areas as they once did. Once an area lost its integrity, the ceremonies would no longer be effective and a patient would not be healed.

In the tribe's view, the proposed RHR mine and exploratory drilling would adversely impact the Mt. Taylor TCP, an area that plays a vital role in Navajo oral tradition, cultural identity, and continuity of traditional cultural practices.

Pueblo of Acoma

General Concerns

Mt. Taylor is viewed as critical to the cultural survival of Acoma, and the watershed is critical to the physical survival of Acoma. Mt. Taylor is perceived as a living, breathing entity. The mountain possesses more than cultural significance. It is the source of water (springs and streams). The mountain is actively used today for traditional activities, as it has been for millennia. It is essential for the spiritual and economic well-being of the Acoma people, and they are dependent upon it for these reasons. The Pueblo of Acoma has expressed grave concern over the impacts of exploratory drilling and mining. This concern encompasses health-related issues, environmental degradation, and traditional cultural concerns, which are all interrelated.

It should be noted that while the following treats water largely as a natural resource, to the Acoma people, water is a cultural resource as well. Water is the life blood of their community and inextricably linked to their survival in both a physical and cultural sense. An overwhelming concern for the Pueblo of Acoma is the depletion of the water table and the potential for widespread contamination of the aquifer(s) resulting from mining. The Rio San José has significant cultural value to the pueblo, and it is the primary source of water for the pueblo, along with smaller tributary drainages that feed it. Water from the San José is used each spring for religious purposes. Portions of the river flow through or near pueblo lands. This river is fed by permanent springs. The pueblo believes that mine dewatering would deplete the aquifers, move water from one basin to another and thereby take water that they depend on, and affect the flow of water in springs.

The pueblo is also concerned that mining activity around Mt. Taylor would result in contamination of water that is relied upon for domestic, agricultural, and ceremonial uses. The Rio San José water system is downstream of historical and proposed uranium development on national forest lands along the western portion of Mt. Taylor. Water quality specialists at the pueblo anticipate that adverse groundwater impacts would eventually migrate downstream to Acoma before they can be mitigated or detected.

There is great uncertainty and concern in the pueblo about how uranium development would affect the next generation’s relationship with the mountain. Spiritual places are altered by activities that impact the earth, and the pueblo believes that these cultural impacts cannot be mitigated by simply moving drill locations or facilities in order to avoid physical impacts to a particular site. Activities such as drilling and mining that impact the earth are seen to have an impact on the integrity of the area. This integrity is diminished regardless of whether or not the work is designed to avoid physical impacts to archaeological resources that may possess information valued by the scientific community.

Uranium activity is seen by the Acoma as a “one way street” with no benefits. It consumes resources, but provides no benefit except to those few who profit from its extraction and sale. It is also costly to the people of the area who rely upon the mountain’s resources to sustain their livelihood, both physically and spiritually. The cost is seen in terms of resource contamination and spiritual degradation. The activity would affect the integrity of the area in general.

Proposed Uranium Mine

The Pueblo of Acoma foresees multiple impacts to traditional cultural resources from the proposed RHR mine. Water, pilgrimage trails, shrines, archaeological sites, locations where certain plants, animals, and minerals traditionally have been harvested, and viewsheds, are all predicted to be subject to a variety of direct and indirect impacts associated with the proposed land altering activities. Other impacts they are concerned about include violations of sacred blessing places, and disturbance of subsurface archaeological deposits that are not yet identified.

Depletion of water from the aquifers as a result of dewatering the proposed mine, and contamination of the water that remains, are a major concern. Dewatering is seen as a threat to Horace and Gummi Springs, as well as other springs on Mt. Taylor. These springs are vital to the economic, social, and cultural identity of the pueblo. Surface and groundwater are predicted to be adversely affected by the dewatering of the mine, resulting in long-term consequences.

The Pueblo of Acoma holds that the proposed mine would result in the severing of relationships between cultural resources, relationships that have accrued over time, that are essential for each property’s meaningfulness and integrity. Direct disturbance of the ground would impede the flow of blessings that move across the landscape following watercourses and people. Regarding Mt. Taylor, the Pueblo stated “If [Mt. Taylor] is disturbed in ways that endanger its well-being, the people’s personal and community ritual to protect their world, in turn, will be interrupted. Should such an awful consequence occur because the exchange of blessings between Acoma Pueblo (the center) and [Mt. Taylor] (the edge) becomes impeded, the world will change. If Acoma’s people are unable to fulfill their sacred obligations as stewards, the world might experience upheaval” (Anschuetz, 2012:56).

Acoma predicts that a fundamental injury would be inflicted upon Mt. Taylor because of the proposed project. Because Acoma and its landscape are so inextricably linked, disturbances that threaten the integrity of Mt. Taylor would also imperil Acoma’s traditional culture, cohesiveness, and continuity. The long-term consequences that Acoma would suffer because of the proposed project would be irreversible, and the loss of meaningful cultural relationships, without material manifestations, could not be mitigated.

Pueblo of Laguna

General Concerns

The Pueblo of Laguna opposes uranium exploratory drilling and mining and believe these activities would adversely affect Mt. Taylor. The pueblo recognizes that there are direct and indirect impacts of uranium activity, that all actions are cumulative, and that no matter how small the physical impacts are, the overall affects would be widespread. Impacts to specific locations are believed to affect the whole of Mt. Taylor.

Protection of the water supply, both surface and groundwater, is a core issue and concern for the pueblo. The contamination of groundwater is a major concern for the pueblo. This contamination can transfer to the plants and animals and evergreens, rendering them unpure and unfit for traditional use. Contamination and altering of the vegetation would make it unavailable to the traditional practitioners.

Drilling and mining activities for uranium are considered by the pueblo to be a disturbance to the mountain, and a desecration of the mountain. To desecrate Mt. Taylor is dangerous and could lead to unforeseen problems, and ultimately extinction. The disturbance causes by drilling and/or mining would stop religious leaders from the various kiva groups from using some of their areas to collect herbs for healing. If an area becomes unusable due to impacts or contamination, the practitioners would need to find new locations to do their collection.

Proposed Uranium Mine

The Pueblo of Laguna has determined that the proposed RHR mine would have direct, indirect, and cumulative impacts on the Laguna cultural environment. Some long-term impacts expected by the pueblo include the continued exclusion of Lagunas from their traditional landscape, changes to the viewshed, ecosystem shifts, and compromises to the physical health and well-being of animal, plant, and human life that come in contact with the uranium ore. Permanent impacts include the destruction of archaeological sites, the removal of earth and water beneath Mt. Taylor, disturbance of ancestral human remains, and the disrespect shown to the spirits and beings that make Mt. Taylor of such irreplaceable value to the Laguna people.

Laguna views the opening of the RHR mine as adversely affecting the Mt. Taylor TCP and the properties within it. Impacts anticipated to the mountain include excavation within the mountain, the removal of earth, ore, and water, disturbance of cultural sites, and the alteration of the ecosystem.

The impacts would profoundly and fundamentally alter the integrity of Mt. Taylor. The pueblo believes that these anticipated impacts could not be mitigated. The desecration of the mountain would directly harm the Spiritual Beings that are associated with the mountain, and the relationship of the people with them. Even when shrines on the mountain are left physically intact, the mining underground would harm the “lifeline” beneath it that connects the shrine to Laguna and other sacred places. The spiritual insult and disrespect to these places may not ever be fixed.

The pueblo is equally concerned about the impact of the mere presence of the proposed mine on the traditional religious practices associated with Mt. Taylor. In addition to a direct impact to the viewshed in the region, the project would impact the Lagunas on the other side of the mountain who maintain their “spiritshed.” Laguna defined “spiritshed” as a spiritual line-of-sight. Although they may not see the project on a daily basis, the knowledge that this project is destroying their sacred land would dramatically and negatively affect the Laguna sense of harmony between humans and their environment. This, is turn, would negatively affect the Lagunas’ communication with the mountain, their “spiritshed,” and the Laguna traditionalists have no religious mechanism to make amends or correct these offenses.

The pueblo predicts that archaeological sites would be destroyed, some sites looted, some petroglyphs defaced, and ancestral human remains disturbed. The pueblo believes that all archaeological sites within the APEs would be impacted by the proposed project, even if the sites are physically preserved and located at some distance from mining infrastructure. Any archaeological site within the viewshed of the mining infrastructure would mean that visiting the site would compel all visitors to see and, thus, think about the mine, and the Lagunas consider this to have a negative impact on the integrity of the sites. Even when archaeological sites are physically preserved, the building of infrastructure nearby would indirectly impact these “saved” sites. In many cases, the holistic context of a site would be ruined, and the whole experience of that traditional landscape would be altered. These impacts would fundamentally alter the ability of Lagunas to obtain and share important information about their history, prehistory, traditions, and culture.

Laguna practitioners use all areas of Mt. Taylor to collect natural materials for use in rituals and ceremonies. The Pueblo of Laguna believes that the destruction of habitat, the alteration of the local ecosystem, and further limitations on land access would impact Laguna religious practitioners who depend on Mt. Taylor to perform ceremonial, subsistence, and collection activities. The ecosystem would be impacted for decades, and even for the animals and plants that survive the mining operations, Laguna traditionalists would likely be concerned about the purity of these resources and question whether they would be healthy to consume. The most dramatic impact to natural resources is seen to be the mine’s plan for dewatering. At Laguna, it is seen as an insult to Mt. Taylor, the natural world, and the Laguna people. Dewatering is equated with draining the “lifeblood” of the mountain.

For the Laguna people, these negative impacts are anticipated to be long term, defined as lasting decades, or permanent. None of the negative impacts are anticipated to be minor, but instead would result in severe and dire impacts to the Mt. Taylor TCP and the traditional cultural resources and practices of the Laguna.

Pueblo of Zuni

General Concerns

The Pueblo of Zuni opposes exploratory drilling and mining for uranium in the area surrounding Mt. Taylor. The pueblo recognizes the impacts to tribal communities that have resulted from uranium activity in the past. This activity is believed to have caused significant health issues and these problems continue today. The Zuni express a great deal of concern and frustration over the fact that tribes would be left to deal with the aftermath of this extractive activity.

Religious societies within Zuni collect and use resources from Mt. Taylor for their ceremonies. The collection of seeds and other materials (forest products, minerals, pigments, feathers, etc.) has a direct bearing on any given society's ability to conduct their ceremonies, and some items must come from specific places on the mountain. Access restrictions and impacts to the environment within Zuni's cultural landscape represent a constant erosion of their ability to practice their religion. The Zuni are concerned about the impacts arising from mining projects, such as impacts to archaeological sites, development of new roads allowing access into previously remote areas, damage to their cultural landscape, disruption and displacement of traditional cultural and ceremonial activities, and the impacts to the mountain itself, not just on the surface but from extraction of materials.

Proposed Uranium Mine

Zuni Pueblo has determined that the proposed RHR mine project would adversely affect Mt. Taylor and its associated resources, values, and environment through direct, indirect, and cumulative impacts. Most of the project's impacts are anticipated to be permanent. Some long-term (if not permanent) impacts include the continued exclusion of Zunis from their traditional landscape, changes to the viewshed, ecosystem shifts, and the physical health and well-being of animal, plant, and human life that comes into contact with uranium ore. The mine's infrastructure and activities would directly "interrupt" the land's beauty, the viewsheds of the historic mountain, and its sacredness. The permanent impacts include the destruction of archaeological sites and shrines, removal of earth and water beneath Mt. Taylor, disturbance of ancestral human remains, and the disrespect shown to the spirits and beings that make the mountain of such irreplaceable value to the Zuni people.

It is the position of the Pueblo of Zuni that the proposed project would adversely impact those qualities and characteristics that the Zuni people ascribe to Mt. Taylor as a living being, and that make it a NRHP-eligible TCP. It would fundamentally alter the integrity of the mountain and its natural and cultural landscape. The mining activity and infrastructure would directly diminish the land's beauty, the viewshed, and the sacredness of the mountain. The removal of millions of gallons of water would drain the "lifeblood" of the mountain. Desecration of the mountain through extraction of ore, disturbance of the surface, and degradation of the ecosystem would also directly harm the Spiritual Beings that are associated with the mountain. These impacts would damage the Zuni relationship with the total landscape of the mountain, and alter the ability of the Zunis to use Mt. Taylor to obtain, share, and honor important information about their history.

The Zunis believe that Mt. Taylor and all ancestral sites are rooted in Zuni traditions and are still vitally needed today to ensure the survival of Zuni culture. Site impacts raise subsequent concerns about the well-being of the Zuni ancestors' spirits and the living. The destruction of ancestral sites, the alteration of the traditional landscape, and the disrespect shown to the ancestors would seriously impact the freedom of Zuni cultural practices, beliefs, and ceremonies. Further limiting access to the landscape would impact Zuni practitioners who depend on Mt. Taylor to perform ceremonial, subsistence, and collection activities. Ceremonies and rituals by Zunis continue to reaffirm their connection to these ancestral places and the reasons why Zuni people are still here and have a rightful claim to the landscape. Even when shrines and other holy sites are left physically intact, the mining underground will harm the “lifeline” beneath them that connects the shrines to Zuni Pueblo and other sacred places. In this way, even shrines some distance from the mine would suffer adverse impacts.

From a Zuni perspective, archaeological sites in the Mt. Taylor area validate Zuni traditional histories and, as such, are considered to have been left there by Zuni ancestors for a specific purpose: to serve as Zuni markers on the landscape. For the Zuni people, archaeological sites are imbued with religious and cultural values that are alien and intangible to western-trained scientists of Federal land managers. The Zuni foresee destruction of archaeological sites and shrines, defacement of petroglyph sites, impacts of vibrations from the traffic and blasting, disturbance of ancestral human remains, and vandalism and looting of archaeological sites, all as a result of the proposed project. They note that some of these impacts have already occurred to the sites. The construction of the mine infrastructure and its activities would impact the archaeological sites by changing the settings in which these archaeological sites are situated, destroying archaeological materials, and altering the feelings of place and spiritual associations. Even where archaeological sites are physically preserved, the building of substantial infrastructure nearby would indirectly impact these “saved” sites. In many cases, the whole context of a site would be ruined, the whole experience of that traditional landscape would be altered. The Zuni Tribe considers that the presence of a mine constructed in an area encompassing so many sacred ancestral sites would be disrespectful and damaging.

To the Zuni, the removal of water for the proposed mining project would be an affront to the mountain’s meaning as a spiritual beacon for moisture. The extraction of water would impact springs and other sources of water on Mt. Taylor, both in terms of drying up water sources and contamination. Water from Mt. Taylor is used by religious practitioners. Water is collected from springs and used for mixing pigments for religious materials, for offerings, for plantings, and for consumption with medicines. Thus, impacts to water supplies would, in turn, impact religious practices on the mountain. There is also the concern that contamination from the mine operations would make available water unusable for consumption or other religious uses.

The Zuni predict that the natural ecosystem, the plants, and animals, would be impacted by the proposed project through displacement, habitat loss, dewatering, and potentially contamination. Zuni religious men are intimately interconnected to animals; medicine men specifically pray to animals and prayer sticks are prepared for animals. The mine is an offense to the Zuni because they depend on these animals for their own spiritual welfare. Thus, the proposed mine would affect the welfare not only of the animals but of the Zuni people as well. The impacts of the proposed mine anticipated by Zuni would discourage the productive harmony between the Zunis and their environment, undermine the Zunis’ efforts to protect the environment and biosphere, diminish the health and welfare of the Zuni people, and devalue the Zunis’ understanding of ecological systems and natural resources important to the Zuni Tribe. The impacts to the ecosystem would last for decades, and it may never fully recover even with rehabilitation.

The Zuni believe these impacts from the proposed project would be severe and dire, and they do not think that the permanent impacts can be mitigated.

Effects to Historic Properties

This section discusses the types of effects anticipated to historic properties within the region of influence from the action alternatives. Later sections discuss the numbers of historic properties anticipated to be affected by physical impacts by alternative.

Although operational and reclamation activities would generally occur within those areas previously impacted by construction, there still remains the potential for effects to historic properties, as described below. Many of the properties identified within the APEs are located away from the proposed areas of construction, operations, and reclamation, and would not be affected by the proposed project. Effects and the likelihood of their occurrence were generally determined based on the proximity of the property to mine facilities or infrastructure, proximity to construction, operations, or reclamation activities, and the presence of workers in an area.

Construction

Ground disturbance from construction activities would result in direct physical damage to historic properties. These affected historic properties would include archaeological sites and the Mt. Taylor TCP. In addition, there is the potential for physical damage to buried archaeological resources that have not yet been identified or recorded, but could be discovered during earth-moving activities. The direct physical damage to historic properties would be permanent and range from moderate to severe in magnitude.

Construction could result in indirect physical damage to historic properties. Construction of facilities and infrastructure, compaction of soils, and removal of vegetation would likely alter erosion patterns, which in turn could physically damage properties. While RHR would implement standard best management practices to reduce the amount of new erosion, with the level of earthwork planned for the project, it remains likely that not all new erosion patterns could be prevented. The level of construction activities being undertaken at the mine site and the increased number of workers present would increase the chances that inadvertent physical damage would occur to historic properties that are planned for avoidance. Increased development and activity in the area would likely result in an increase in the number of people accessing the region of influence, which could also result in an increase in vandalism and illegal artifact collecting at historic properties. The effects from erosion, inadvertent damage, vandalism, and illegal artifact collecting would be permanent and could range from negligible to severe.

Construction of the mine facilities would result in damage to physical features within the Mt. Taylor TCP's setting that contribute to its historic significance. The natural and cultural landscape in and surrounding the proposed project area contributes to the context and historical significance of the Mt. Taylor TCP. These changes would include the removal of vegetation, disruption to wildlife, changes to landforms, and physical damage to archaeological resources. This damage to the features within the setting would range from long term to permanent, and would be moderate to severe in magnitude.

Construction of mine facilities and infrastructure and earth-moving activities would introduce modern facilities and activity into a largely undeveloped landscape that retains a substantial amount of its historic natural and cultural integrity. This would result in the introduction of visual and audible elements out of character with the Mt. Taylor TCP. These elements would derive from modern facilities, vegetation removal, dust, machinery, and traffic. Although there are some modern intrusions into this landscape already, the scenery and viewshed currently retain the historic sense of place, which is a significant historic feature of this property. Further disruption of this setting would affect the Mt. Taylor TCP, the context and integrity of the property, and a person's appreciation and understanding of the historical context and significance of the property. Some of these effects would be temporary and others long term, and would range from minor to severe in magnitude.

Operation

During the operational phase of the proposed project, indirect physical disturbance of historic properties could occur from changed erosion patterns, inadvertent damage caused during mine activities, and vandalism or illegal artifact collecting. In addition, there would continue to be the potential for physical damage to buried archaeological resources that have not yet been identified or recorded, but could be discovered during maintenance or operational activities. The effects from erosion, inadvertent damage, vandalism, and illegal artifact collecting, and damage to newly discovered properties, would be permanent and could range from negligible to severe.

Operational activities at the mine would continue to introduce visual and audible elements out of character with the Mt. Taylor TCP, further affecting the setting of this historic property. These effects would derive from general onsite activity, use of large machinery and equipment, onsite traffic, and heavy haul traffic along Highway 605. Some of these effects would be temporary and others long term, lasting the duration of the operational phase, and would range from minor to moderate in magnitude.

Reclamation

Reclamation activities have the same potential for physical damage to historic properties as operational activities. Changed erosion patterns, inadvertent damage caused during reclamation activities, and vandalism or illegal artifact collecting, as well as the potential for physical damage to buried archaeological resources that have not yet been identified or recorded, could all occur during the reclamation phase of the proposed project. These effects would be permanent and could range from negligible to severe.

Reclamation activities at the mine would continue to introduce visual and audible elements out of character with the Mt. Taylor TCP, further affecting the setting of this historic property. These effects would derive from general onsite activity, use of large machinery and equipment, and onsite traffic. Some of these effects would be temporary and others long term, lasting the duration of the reclamation phase, and would range from minor to moderate in magnitude.

Reclamation goals are to return the area to grazing use. As part of reclamation operations, disturbed areas would be stabilized by grading them to conform to the geomorphic character of the region and surrounding area, including shaping, berming, and grading to final contour. Reclamation of slopes would incorporate the practice of minimizing slope lengths and gradients, while conforming to the geomorphic character of the area to minimize the potential for excessive erosion. The reclaimed area would be revegetated using native, adapted species that are characteristic of the region and supportive of livestock grazing. With these guidelines in mind, once reclamation has been completed and accepted, the mine project area would be similar in look to the surrounding area. While the setting of the Mt. Taylor TCP would not be the same as it is currently, the reclaimed area would be similar to the surrounding landscape. Any changes to the setting would be permanent, and would be moderate in magnitude.

Effects to Mt. Taylor TCP

Impacts from construction, operations, and reclamation that would affect the Mt. Taylor TCP are discussed above. Either of the action alternatives would have an adverse affect on this historic property because it would alter the characteristics of the property that qualify it for inclusion in the NRHP in a manner that would diminish the property's integrity of relationship, condition, and setting. These effects, discussed more below, would be permanent and severe.

Mt. Taylor has an integral relationship with the beliefs and traditional cultural practices of the involved tribes and it is critical to the maintenance of the cultural identity and transmittal of their beliefs. It is this relationship that contributes to the property's significance. The action alternatives would result in the disruption, alteration, and displacement of traditional cultural activities that are critical to the continuity of cultural beliefs and practices of these tribes. In the view of the involved tribes, changes to the traditional practitioners' ability to conduct their traditional cultural activities would lessen the overall effectiveness of their prayers, medicine, and healing ceremonies, thereby impacting the traditional practices and diminishing their value. These impacts and changes would affect the TCP by diminishing the property's integrity of relationship.

In the view of the tribes, Spirit Beings and their association with Mt. Taylor are integral to the spiritual and cultural beliefs of the tribes and play a vital role in the view of the mountain as a powerful living, breathing entity. These beings provide vital resources such as rain, snow, plants, and wildlife that allow the tribal communities to survive and prosper. The Spirit Beings' presence and protection on the mountain is essential for contemporary prayers, medicine, and healing ceremonies to be successful. The proposed project would have an impact upon the Spirit Beings associated with the TCP. The action alternatives threaten the relationship between the Spirit Beings and the mountain. It is believed that mining for uranium is an activity that would anger the Spirit Beings who reside on or travel to the mountain, and impact the relationship of the Beings to the mountain, the people, and the traditional cultural practices associated with the mountain. These impacts would also affect the TCP by diminishing the property's integrity of relationship.

Physical damage to the Mt. Taylor TCP itself would occur as a result of either of the action alternatives. The natural and cultural landscape of the TCP contributes to the context and historical significance of the Mt. Taylor TCP, and is important to convey the TCP's cultural values. The extent of alteration to the TCP, which is 442,659 acres in size, would be limited. Under alternative 2 (proposed action), 71 acres in Section 10 and 12 acres in Section 9 would be developed within the TCP. Under alternative 3 (one shaft alternative), 18 acres in Section 10 and 12 acres in Section 9 would be developed within the TCP. While the size of the damage to the TCP under either action alternative would not significantly alter the landform, the impact would still affect the TCP by diminishing the property's integrity of condition.

Construction of the mine facilities would result in damage to physical features within the Mt. Taylor TCP's setting. The natural and cultural landscape surrounding the TCP contributes to the context and historical significance of the Mt. Taylor TCP. In addition, all three phases of the proposed project are anticipated to introduce visual and audible elements out of character with the Mt. Taylor TCP. The scenery and viewshed currently retain the historic sense of place for this property, and this setting is a significant historic feature of the TCP. Impacts to the physical features of the TCP's setting and the introduction of elements out of character with the TCP would affect the TCP by diminishing the property's integrity of setting.

Impacts to Natural Resources with Cultural Value

Interrelationships between cultural resources and natural resources give a landscape meaning through their association with a people's history and cultural identity. As described previously, the tribal landscapes that overlap the proposed project area include natural resources that are infused with cultural meaning and values and are, therefore, another type of cultural resource. Thus, any discussion of project impacts to cultural resources must include mention of impacts to these natural resources.

Springs

Throughout the tribal consultation and the ethnographic assessments, the involved tribes have expressed the importance of springs to traditional cultural practices and to the significance of the Mt. Taylor TCP. Springs do provide a source of water. However, their importance to the tribes truly stems from their association with the mountain and the supernatural realm. Springs are considered a conduit or portal for prayers and blessings to reach the Spiritual Beings. The water and associated vegetation from springs is considered to have spiritual significance and is used for ceremonies and rituals.

The "Water Resources" section of this EIS presents the analysis of whether the flow of water at springs in the area would be impacted by the proposed project. The conclusions reached are that one spring, Bridge Spring located adjacent to Highway 605 south of the mine permit area, would be noticeably affected, potentially running dry during the mine's dewatering operations and for years afterwards. Qualitative analysis of other springs, including San Lucas, Maruca, La Mosca, El Rito, San Mateo, Cienega, Gooseberry, and De Armand Springs, indicate that because these springs are largely fed by water from much higher elevations than the Westwater Canyon member, it is reasonable to consider them to be isolated from changes resulting from mine dewatering. Analysis of the potential for impacts to Horace Spring indicates the possibility for a small, long-term impact to the spring.

The potential that any changes could occur to the springs is a concern to the tribes. Because of the very important and sacred role of springs in the traditional cultural and religious practices of the tribes, the integrity of springs is paramount to the success of those practices. To cause changes to a spring, no matter how small, could impact the ceremonies and rituals associated with that spring, and subsequently result in detriments to the health and well-being of the tribe and its people. From a cultural perspective, any change to the springs is considered an adverse impact.

Groundwater

Aquifers are considered part of Mt. Taylor, and are part of the cycle whereby the mountain and the Spiritual Beings provide water to the people. The provision of water by the mountain is directly influenced by and influences the traditional cultural practices conducted on the mountain. Through these connections, the aquifers are considered part of the cultural "universe" associated with the Mt. Taylor TCP.

During construction of the Roca Honda Mine, the shafts would pass through two aquifers that contain sufficient groundwater to require some degree of dewatering: the Gallup and Dakota sandstones. During operations, dewatering would be done in the unit being mined, the Westwater Canyon Member of the Morrison Formation. Over the life of the mine, an estimated 1,192 acre-feet of groundwater would be pumped from the Gallup aquifer, 232 AF from the Dakota aquifer, and 79,037 AF from the Westwater aquifer. The groundwater analysis shows that the magnitude of estimated dewatering of these three aquifers would not have a significant impact on groundwater resources overall.

The involved tribes have expressed concern throughout the EIS process that the operation of the mine and the dewatering associated with it would result in depletion of the aquifers, transfer of water from one basin to another, and contamination of water. These changes are seen to result in impacts to the water supply that the tribes depend on for religious and subsistence uses.

Wildlife and Vegetation

Plants and animals play an important role in the traditional cultural practices and beliefs of the involved tribes. The health and well-being of these wild populations is not only important from a subsistence point of view, but also from the viewpoint of supplying specific materials for rituals, acting as messengers to Spiritual Beings, and acting as healers. Tribal people send wildlife prayers and blessings and, in return, they provide for the spiritual welfare of the people.

The “Wildlife” section of this EIS presents analysis of the potential impacts to wildlife resulting from the proposed project. Overall, long-term adverse impacts to wildlife are expected to occur as a result of mortality, habitat loss, degradation, and fragmentation, and displacement during the life of the mine. Once the mine is reclaimed, both wildlife numbers and species diversity are expected to eventually return to pre-mine levels as habitats are restored. Impacts to vegetation, which are addressed in the EIS in the “Vegetation” section, are not expected to be significant, as reclamation is anticipated to restore the habitats disturbed for the mine.

The involved tribes foresee long-term impacts to the Mt. Taylor spiritual landscape as a result of the impacts to wildlife and vegetation. The long-term impacts of an impacted ecosystem on the traditional cultural practices of the tribes are a concern. The spiritual well-being of the mountain, and the spiritual relationship between the people and the Spiritual Beings of the mountain, would be impacted by the changes to the ecosystem, and it is unknown if those impacts can be repaired. It could result in a permanent impact. Although it is expected by analysts that wildlife and vegetation would be rehabilitated, there is concern by the involved tribes that the rehabilitation may not completely repair the damage caused by the proposed mine.

Project-Specific Forest Plan Amendment

The land and resource management plan (USFS, 1985) guides decisions for how the Cibola National Forest and its resources will be managed. The plan lists standards for the treatment of historic properties on lands managed by the Cibola National Forest. These standards only apply to lands and resources managed by the Cibola National Forest. With regard to the proposed project and its potential for impacts on historic properties, it is important to note the following:

- Standard No. 4 states that historic properties “will be managed during the conduct of undertakings to achieve a “no wffect” finding in consultation with the SHPO and the Advisory Council on Historic Preservation.” (USFS, 1985:63)
- Standard No. 5 addresses instances where resource management conflicts occur. It gives a list of conditions under which “preservation of cultural resources in place will be the preferred option.” These conditions include:

- ○ Where the cultural values derive primarily from qualities other than research potential, and where those values are fully realized only when the cultural remains exist undisturbed in their original context(s) (e.g., association with significant historical persons or events, special ethnic or religious values, or unique interpretive values). (USFS, 1985:63)

Both of the action alternatives for the proposed project would result in adverse effects to historic properties, including to the Mt. Taylor TCP and other sites with cultural values beyond research potential. For example, the Mt. Taylor TCP is eligible for listing on the NRHP in part due to its association with significant events and persons, and Mt. Taylor is significant for its special ethnic and religious values with respect to the role it plays in American Indian religion. Selection by the Forest Service of either of the action alternatives would be in conflict with these two standards of management for historic properties. It is unlikely that complete mitigation can be developed for the Mt. Taylor TCP or other sites with cultural values beyond research potential.

If the Forest Service selects either of the action alternatives, the Forest Service would approve a project-specific forest plan amendment to allow the Roca Honda project to deviate from the forest plan standards of management with regard to historic properties identified above. This amendment would only apply to the Roca Honda Mine project and only to the standards of management with regard to historic properties. The amendment would allow impacts to historic properties resulting from this project, in accordance with normally applicable law, e.g., Section 106 of the NHPA and 36 CFR Part 800.

Conflicts with Other Federal Requirements

Executive Order 13007 addresses the protection and preservation of American Indian religious practices. The order states that Federal land-managing agencies shall:

> "To the extent practicable, permitted by law, and not clearly inconsistent with essential agency functions, (1) accommodate access to and ceremonial use of Indian sacred sites by Indian religious practitioners and (2) avoid adversely affecting the physical integrity of such sacred sites." (61 FR 26771, Section 1)

The order construes neither to require a taking of vested property rights, nor to impair enforceable rights to use of Federal lands that have been granted to third parties (61 FR 26771, Section 3). As such, and in consideration of the General Mining Act of 1872, for the current proposed project the order does not preclude selection of a project alternative that would result in impacts to the physical integrity of the Mt. Taylor TCP as a sacred site, or to access to this sacred site. The order also requires that the Agency ensure reasonable notice is provided of proposed actions that may restrict future access to or ceremonial use of or adversely affect the physical integrity of sacred sites. This requirement has been satisfied with consultation by the Forest Service with the involved tribes on a government-to-government basis through the NEPA and NHPA compliance processes.

AIRFA addresses the protection and preservation of traditional religions of Native Americans, including but not limited to access to sites. Agencies were directed to "evaluate their policies and procedures in consultation with native traditional religious leaders in order to determine appropriate changes necessary to protect and preserve Native American religious cultural rights and practices" (42 U.S.C. 1996, Section 2). The conduct and completion of this EIS is in accordance with current policies and procedures of the Forest Service.

The Religious Freedom Restoration Act is often cited as a protection for religious and sacred sites. The act, passed in 1993, states that government shall not substantially burden a person's exercise of religion, even if the burden results from a rule of general applicability. On June 25, 1997, the Supreme Court declared the Act unconstitutional, but only as it applies to State government actions (Supreme Court 1997, Decision 521 U.S. 507). The act limits the Federal government's ability to impose a substantial burden on the free exercise of religion. To substantially burden the free exercise of religion, there must be government coercion to act contrary to religious beliefs under the threat of civil or criminal sanction, or a condition on receipt of a government benefit on conduct that would violate religious beliefs (Navajo Nation v. USFS, 535 F.3d 1058, 9th Cir. 2008). Such conditions do not exist in this project.

Alternative 2

This section describes the impacts of the proposed action on cultural resources. Mining development, operation, and reclamation would occur in Section 10 and 16, with vent shafts and safety features in Section 9. The direct and indirect impacts to cultural resources identified by the involved tribes (described above) would occur under this alternative. Impacts to springs, groundwater, wildlife, and vegetation, all as resources infused with cultural meaning and value, would occur under this alternative. Also, direct and indirect adverse effects (described above) to historic properties, to features within the setting of historic properties, and to the visual and audible characteristics of the setting of the Mt. Taylor TCP would occur. Specific direct physical damage to historic properties under this alternative are displayed in table 68. Under alternative 2, direct physical damage would be expected to occur to a total of four historic properties, plus the Mt. Taylor TCP. An additional 37 historic properties could be at varying levels of risk for indirect effects from erosion, inadvertent damage, and vandalism or looting, based on their proximity to the proposed project facilities and mine activities. The impacts of this alternative on cultural resources would be significant, and the proposed project would result in an adverse effect to historic properties.

Table 68. Historic properties that would be directly physically damaged under alternative 2 (proposed action)

Site No.	Project Section	Land Status	Criteria for Eligibility	Source/Project Facility
Mt. Taylor Traditional Cultural Property LA 156475	16, 9, 10, 11, 2	Federal and NMSLO (portions outside of project area include private lands)	A, B, and D	Construction of surface facilities in Sections 9, 10, 11, and 2. Extraction of mineralized ore under Sections 9, 10, and 16. Reclamation of surface facilities in Sections 9, 10, 11, and 2.
78873	16	NMSLO	D	Construction of haul road and perimeter fence.
160744	NA	private	D	Construction of dewatering discharge pipeline and storage tank.

Site No.	Project Section	Land Status	Criteria for Eligibility	Source/Project Facility
162763	16	NMSLO	D	Stock piles, haul road, and reclamation activities
165884	20	private	D	Construction of haul road.

Alternative 3

This section describes the impacts of the one shaft alternative on cultural resources. Under this alternative, only one mine shaft and associated facilities would be constructed. Mining development, operation, and reclamation would occur primarily on Section 16, with vent shafts and safety features in Sections 9 and 10. The direct and indirect impacts to cultural resources identified by the involved tribes (described above) would occur under this alternative. Impacts to springs, groundwater, wildlife, and vegetation, all as resources infused with cultural meaning and value, would occur under this alternative. Also, direct and indirect adverse effects (described above) to historic properties, to features within the setting of historic properties, and to the visual and audible characteristics of the setting of the Mt. Taylor TCP would occur. Specific direct physical damage to historic properties under this alternative are displayed in table 69. Under alternative 3, direct physical damage would be expected to occur to the same four historic properties as alternative 2, plus the Mt. Taylor TCP. Because there would be no mine shaft and associated facilities in Section 10, the extent of direct physical damage to the Mt. Taylor TCP would be less under this alternative. An additional 33 historic properties could be at varying levels of risk for indirect effects from erosion, inadvertent damage, and vandalism or looting, based on their proximity to the proposed project facilities and mine activities.

Because of the reduction in surface facilities constructed in Section 10, which would mean less ground disturbance, fewer surface facilities, and less activity and traffic, the totality of the impacts and effects to the Mt. Taylor TCP and the resources and historic properties in that area would be less under this alternative. However, the impacts of this alternative on cultural resources would still be significant, and the proposed project would result in an adverse effect to historic properties.

Table 69. Historic properties that would be directly physically damaged under alternative 3 (one shaft alternative)

Site No.	Project Section	Land Status	Criteria for Eligibility	Source/Project Facility
Mt. Taylor Traditional Cultural Property LA 156475	16, 9, 10, 11, 2	Federal and NMSLO (portions outside of project area include private lands)	A, B, and D	Construction of surface facilities in Sections 9, 10, 11, and 2. Extraction of mineralized ore under Sections 9, 10, and 16. Reclamation of surface facilities in Sections 9, 10, 11, and 2.
78873	16	NMSLO	D	Construction of haul road and perimeter fence.

Site No.	Project Section	Land Status	Criteria for Eligibility	Source/Project Facility
160744	NA	private	D	Construction of dewatering discharge pipeline and storage tank.
162763	16	NMSLO	D	Stock piles, haul road, and reclamation activities
165884	20	private	D	Construction of haul road.

Cumulative Effects

Both action alternatives are expected to result in adverse effects to historic properties, including the Mt. Taylor TCP, and significant impacts to other important cultural resources and to traditional cultural practices. These impacts and effects would include physical damage to the resources, and damage to physical features within the setting of the resources, resulting from activities conducted during construction, operations, and reclamation phases. The introduction of visual and audible elements out of character with the resources would also impact the resources. These impacts would derive from the surface activities conducted during all three phases, from the presence of modern facilities in the rural environment, and from the changes to the natural landscape. Traditional cultural practices would be affected due to physical disturbance of the cultural and natural resources in the project area during construction, operation, and reclamation. Impacts to practices would also occur from extraction of ore, dewatering, and the surface activities being conducted. These overall impacts would be significant, and either action alternative would result in an adverse effect to historic properties.

In compliance with Section 106 of the NHPA, the Forest Service would develop a programmatic agreement in consultation with the ACHP and the consulting parties. This programmatic agreement would define measures to be implemented to avoid, minimize, and mitigate adverse effects to historic properties, and to address impacts to other cultural resources and practices. While the adverse effects would remain, the mitigation measures would resolve these effects per 36 CFR Part 800. However, the impact to cultural resources overall and traditional cultural practices would remain significant.

Past, present, and reasonably foreseeable projects within the Mt. Taylor area are described in chapter 2. Some of these projects are those that are proposed and conducted by the Forest Service to maintain the health of the forest and its resources, and facilitate use and enjoyment of the forest by the public. These projects, which occur periodically throughout the forest, include wildlife habitat improvements, wildland fire management, improvements for livestock grazing, maintenance of recreational facilities such as trails, picnic areas, and campgrounds, and maintenance of roads. Other projects are conducted by non-Agency project proponents, and include timber harvesting and maintenance of utility corridors and communications sites. Due to the type and scale of these projects, and the review conducted by the Forest Service prior to initiating them, these projects are designed to minimize the potential for impacts to cultural resources, per the land and resource management plan (USFS, 1985). All such projects undergo review through the Section 106 compliance process and efforts are made to avoid or minimize potential effects. As such, these projects usually result in minor or no impacts to cultural resources. General activities conducted by the public on Forest Service lands include firewood gathering, pinon nut gathering, livestock grazing, and recreational activities. These activities are also considered to have no to minimal impact on cultural resources. Tribes consulted about these projects generally have few concerns, as the project are seen as regenerative. Because of this, these projects and activities are not considered further in this cumulative analysis.

The type of projects considered in this analysis are those designed and proposed by private corporations or utilities, many of which were or would have to be permitted or licensed by the Federal or State government, and result in construction of facilities or disturbance beyond a few acres. These projects are usually much larger than the projects described above, and because they are designed by private interests, the focus of design is to facilitate the project, not avoid impacts to cultural resources. In the Mt. Taylor region, due to the prehistoric and historic patterns of extensive and intensive land use, these projects are likely to have some level of impact to cultural resources. The projects that require a Federal or State license undergo some level of analysis to identify environmental impacts and appropriate mitigation as part of compliance with a variety of environmental regulations. However, even for these projects, impacts often still remain to cultural resources, some of them significant. These projects, which are described in detail in chapter 2, include current and future uranium exploration (i.e., drilling), past and future uranium mines, current mine reclamation, and past and future uranium mills.

These cumulative projects occurred or are planned to occur on or in the vicinity of Mt. Taylor. Based on the resource investigations, tribal consultation, and consultation with consulting parties conducted to identify cultural resources in the physical and setting APEs for the proposed RHR mine, similar cultural resources and traditional cultural practices would be expected in the areas of these past, current, and future projects. These projects, when taken together, have ground-disturbing activities, facility development, ore extraction, dewatering, and surface activities associated with them that are similar to those planned for the RHR mine. Based on similar resources and similar activities, it is reasonable to assume that the impacts that occurred due to the past projects, and would occur as a result of the current and future projects, would be similar in type, magnitude, and duration to those of the proposed RHR mine. These impacts would likely include direct and indirect physical impacts to archaeological sites and natural resources that are imbued with cultural value; impacts to the physical composition and visual and audible characteristics of resource settings; and impacts to the Mt. Taylor TCP and its setting through physical damage, changes to the landscape, and changes to the visual and audible characteristics of that landscape.

Four archaeological sites would be subject to direct physical damage from either of the action alternatives and would likely undergo data recovery excavations prior to being impacted. Indirect impacts from erosion, inadvertent damage, or vandalism would also likely occur to some extent and may be mitigated through data recovery excavations. Site destruction and data recovery excavation have likely occurred in past cumulative projects and will likely occur for future projects. From a scientific perspective, these four sites are not considered to be unique, and many other sites like them occur throughout the physical and setting APEs. The information contained in the four sites, which is what makes the sites significant under Criterion D, would be collected prior to damaging the sites and would contribute to the knowledge about those sites and the prehistory of the region. Data recovery efforts would not exhaust regional information potential overall and others sites like the four would be available for excavation and study in the future. Due to the density of archaeological sites throughout the region, this is also likely true for past and future projects. Thus, when considering the scientific value of archaeological site information, the cumulative effect of the Roca Honda Mine project would be minor.

Archaeological resources also have significant cultural value to the tribes. Archaeological sites provide a tangible connection to history and place, commemorate the lives of the ancestors, and impart specific information about tribal histories and culture, all of which help to shape and inform tribal identity. Archaeological sites are viewed as key to the retention and transmission of traditional culture and history. Each archaeological site is believed to contain records of events, instructions from ancestors, and reminders from ancestors to current generations and, therefore, has a teaching purpose. Archaeological sites not only document and provide evidence of tribal histories, they are considered to be sacred for a number of reasons. Sacredness of the sites is rooted in the oral traditions and religious knowledge of the tribes, and these sites provide a place to communicate with the ancestors. From this perspective, destruction of even one site is considered sacrilege, as that site is not replaceable or interchangeable with any other site; it is unique and plays a distinctive role in the tribes' beliefs. Thus when considering the cultural values of archaeological sites, the cumulative effect of the Roca Honda Mine project would be significant.

The involved tribes consulted for this EIS have demonstrated the traditional cultural and religious significance of the cultural resources in the APEs for the Roca Honda Mine project and that the proposed project would significantly impact cultural resources due to the anticipated physical damages and changes to setting of individual cultural resources, important natural resources, and the Mt. Taylor TCP. The addition of another mine to past projects would further impair the relationship of the tribes with the mountain and its landscape, further impacting the beliefs and practices associated with the mountain and its place within the traditions of the tribes. Either of the action alternatives would further disrupt American Indian cultural and religious activities on Mt. Taylor and impact the integrity of the mountain. The "cumulative burden" is on the tribes who have and would continue to suffer from the lasting cultural and environmental consequences of mineral extraction in this area. The proposed project would contribute to the furtherance of the degradation of the resources and the tribes' relationship with those resources and Mt. Taylor and its landscape, and would result in a significant cumulative effect.

The "Water Resources" section states that cumulative effects on springs from groundwater pumping associated with reasonably foreseeable actions would be adverse and potentially significant, though the incremental contribution of pumping from the Roca Honda Mine to these cumulative effects would be small. However, this cumulative effect to springs would be significant with regard to the ongoing traditional cultural and religious beliefs and practices of the tribes.

Both alternative 2 (proposed action) and alternative 3 (one shaft alternative) would result in significant impacts to cultural resources. The other past, current, and future projects are also anticipated to result in significant impacts. When the impacts of the proposed project (either action alternative) are considered in combination with those of the past, current, and future cumulative projects, the impacts would be additive to Mt. Taylor, the associated natural and cultural resources in the landscape, and associated traditional cultural practices, and would exacerbate the loss of integrity and use of these resources. The overall cumulative effect of the proposed project would be adverse and significant.

Visual Resources

Affected Environment

Terminology and Methodology

In environmental analysis, the term "visual resources" is often used interchangeably with "scenic resources" or "aesthetics." A visual resource is the interaction between a human observer and the landscape he or she is observing. The subjective response of the observer to the various natural and/or artificial elements of a given landscape and the arrangement and interaction between them is fundamental to visual resources impacts analysis (USDA, 2007). A related term, "viewshed" is a subset of a landscape unit and consists of all the surface areas visible from an observer's viewpoint. The limits of a viewshed are defined as the visual limits of the views located from the proposed project. A viewshed also includes the locations of viewers likely to be affected by visual changes brought about by project features (Caltrans, no date).

The U.S. Forest Service (USFS) manages 193 million acres of forest and grassland throughout the country. The Agency has as mission "to provide the greatest amount of good for the greatest amount of people in the long run." Accordingly, the Forest Service has developed a number of tools to best manage its natural resources. One of the tools developed to manage its visual resources is the Scenery Management System (SMS), detailed in "A Handbook for Scenery Management." The SMS was developed to provide a systematic approach for determining the value and importance of scenery in a national forest (USFS, 1995). The SMS was developed as a followup to the prior Forest Service's Visual Management System (VMS). The Cibola National Forest still has visual inventory from the VMS, and has not updated to the SMS. Therefore, we will use the principles from the VMS to remain consistent with the "Cibola National Forest Land and Resource Management Plan" (USFS, 1985). As part of the land and resource management plan a visual inventory was conducted that categorized the resources, and set acceptable levels of modification to the landscape. We will use these existing descriptions of the visual resources to analyze project impacts in this section.

The VMS inventories the visual resource of the land by describing the Variety Class and Sensitivity Level; and subsequently setting a Visual Quality Objective (VQO). The Variety Class defines the physical features of the land by classifying the landscape into differing degrees of variety. Those landscapes with the most variety potentially have the highest scenic values. The Variety Classes are broken into Class A: Distinctive, Class B: Common, and Class C: Minimal. Sensitivity Level is defined as the concern for scenic quality. This is described by how the landscape is viewed, i.e. from the road, from trails, campgrounds, vistas, from recreating on the water, etc. Generally people recreating will have a higher sensitivity to the landscape than someone commuting to work. The Sensitivity Levels are Level 1 – Highest Sensitivity, Level 2 – Average Sensitivity, and Level 3 – Lowest Sensitivity. Visual Quality Objectives then set the degree of acceptable alteration of the natural landscape. The definition of each Visual Quality Objective is described in table 70.

Table 70. Visual Management System Visual Quality Objectives

Preservation	Allows ecological changes only, only low impact recreation facilities are allowed.
Retention	Allows management activities which are not visually evident. Activities may only repeat form, line, color, and texture which are frequently found in the characteristic landscape.
Partial Retention	Allows management activities that remain visually subordinate to the characteristic landscape. Activities may repeat form, line, color, or texture common to the characteristic landscape but changes in their qualities of size, amount, intensity, direction, pattern, etc., remain visually subordinate to the characteristic land. Activities may also introduce form, line, color, or texture which are found infrequently or not at all in the characteristic landscape, but they should remain subordinate to the visual strength of the characteristic landscape.
Modification	Allows management activities that visually dominate the original characteristic landscape. Activities which are predominately introduction of facilities such as buildings, signs, roads, etc., should borrow naturally established form, line, color, and texture so completely and at such scale that its visual characteristics are compatible with the natural surroundings.
Maximum Modification	Allows management activities of vegetative and landform alterations may dominate the characteristic landscape. However, when viewed as background, the visual characteristics must be those of natural occurrences within the surrounding area or character type. When viewed as foreground or middle ground, they may not appear to completely borrow from naturally established form, line, color, or texture. Alterations may also be out of scale or contain detail which is incongruent with natural occurrences as seen in foreground or middle ground.

Visual Setting

The proposed permit area for the Roca Honda Mine is approximately 1,920 acres in size which is based on 640 acres for each of Sections 9, 10, and 16 as described in chapter 2. The total disturbed acreage within the permit area is significantly smaller, approximately 12 acres in Section 9, 71 acres in Section 10, and 100 acres in Section 16. This section will describe the visual resources or aesthetics for each of those three sections. This is done by describing the characterized landforms, vegetation, human modifications, and the VMS Visual Quality Objectives within each section.

The entire permit area is within the Arizona-New Mexico Mountains Semidesert—Open Woodland—Coniferous Forest—Alpine Meadow Province, characterized by steep foothills and plateaus. Elevations range from 4,500 to 10,000 feet (USFS, 2008). Areas such as these with high relief in the landscape often allow for large and far viewsheds. The vegetation cover in the area consists of desert grass/shrubland, and open woodland (figures 64, 65, and 66).

In Section 9 the landscape consists of mostly very open piñon-juniper woodland. It includes Jesus Mesa with an elevation of 7,839 feet, and most of the remaining section area sits about 300–500 feet below the mesa (USGS, 2009). There are three unpaved roads in this section; however, as described earlier, these roads are not open to public use. There are no residences or human development in this section. Therefore, the number of viewers of this landscape is low. The Forest Service visual inventory in the section gives the area a VQO for modification (figure 67) (USFS, 1991).

Figure 64. View looking north from the permit area

Figure 65. View looking southeast from the permit area

Section 10 includes vegetation similar to section 9 but with more desert grassland. Elevations range from about 7,100 to 7,600 feet, with the lowest areas in the southeast corner of the section. There are two unpaved roads in this section, and same as section 9, they are closed to the public. There are also no residences or human development in this section, thus the number of viewers is low. The Forest Service visual inventory in Section 10 gives the area a VQO for modification (figure 67) (USFS, 1991).

Section 16 is mostly desert grassland with some open piñon -juniper woodland and savannah. The elevation range is much flatter, only about 7,100 to 7,300 feet. There are two unpaved roads in this section. This is State land, as compared to Forest Service land in the other two sections, so the roads are open to the public. There are no residences in the section, but there is one residence on Lee Ranch 1 mile west of the section boundary. The only development is a power line that runs through the section. There is still a low number of viewers to this section. Since this is State land, there is no Forest Service visual inventory for this section. Extrapolating the VMS principles onto this section, and making a determination, the VQO for this area would also be for modification.

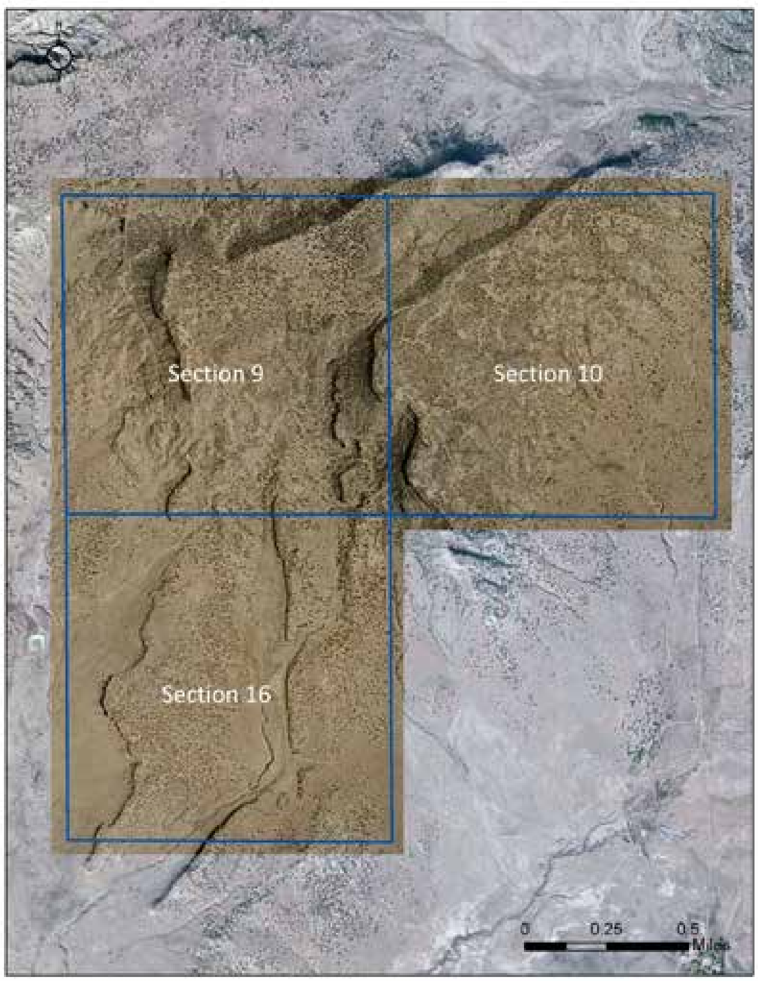


Figure 66. Aerial image of permit area (ESRI, 2010)

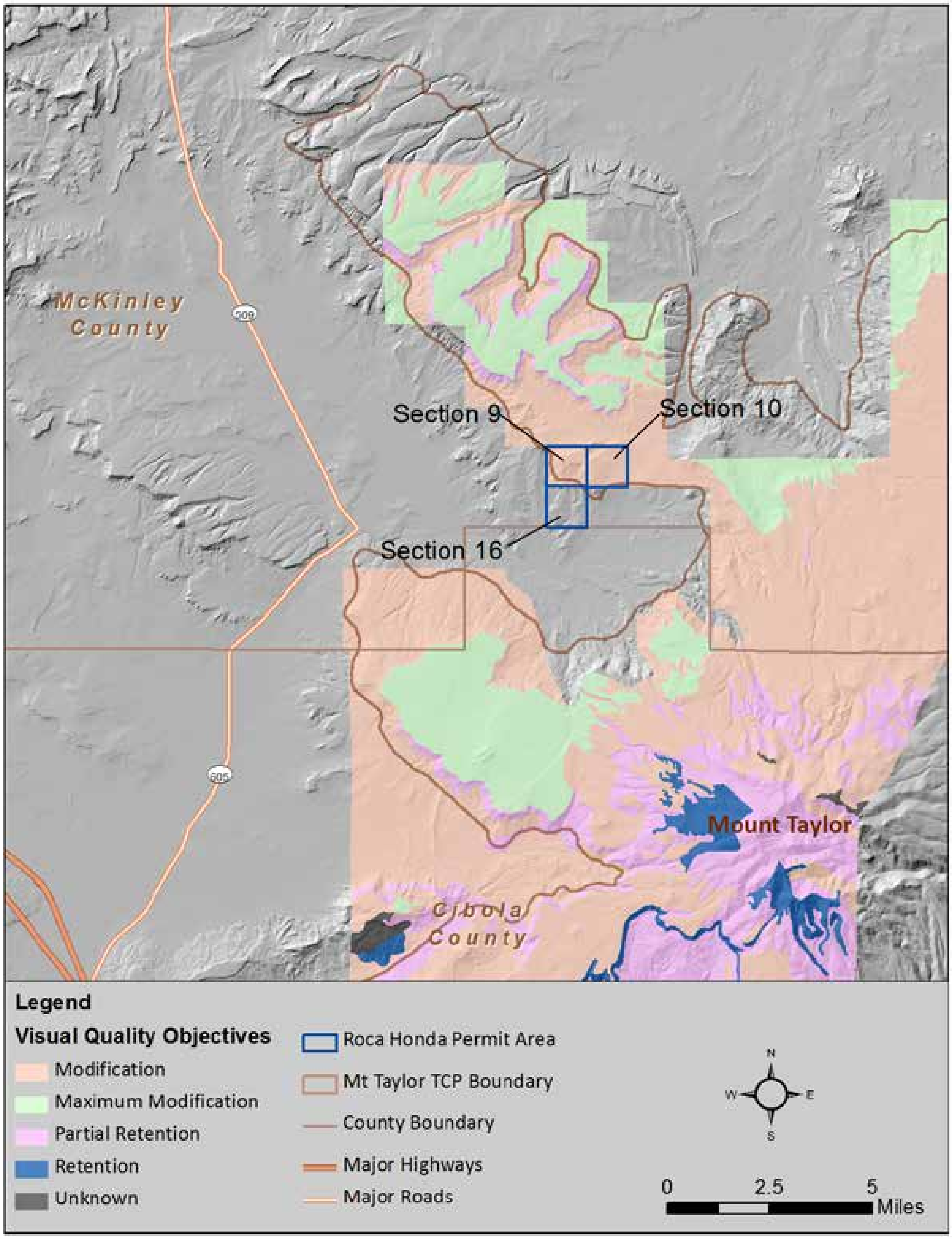


Figure 67. Forest Service Visual Management System Visual Quality Objectives in the permit and surrounding areas
Sources: ESRI, 2010; USGS, 2009; USFS, 1991

Environmental Consequences

The visual resource impact analysis is an assessment of the changes to the landscape character that would occur from the proposed action. The visual resource analysis stage involves determining the significance of the potential visual impacts from the proposed activity to include construction of the mine and associated facilities, operation of the mine, and reclamation of the land. The significance definitions that will be used to describe the impacts to visual the visual setting are described in table 71.

Table 71. Significance definitions, impacts to visual resources

Term	Definition
Magnitude	
Major	Proposed activities do not fit at all within the Modification VQO guidance.
Moderate	Proposed activities fit with the Modification VQO guidance in some ways but not all.
Minor	Proposed activities within the Modification VQO guidance. It may dominate the landscape but borrow from naturally established form, line, color, and texture so completely and at such scale that its visual characteristics are compatible with the natural surroundings.
Duration	
Long Term	Alteration lasts 10 years or more
Medium Term (limited or intermittent)	Alteration lasts 1 to 10 years
Short Term	Alteration lasts less than 1 years
Extent	
Large	Visual quality is altered for more than 1,000 people
Medium (localized)	Visual quality is altered for 100 to 1,000 people
Small (limited)	Visual quality is altered for less than 100 people
Likelihood	
Probable	Occurs under typical operating conditions
Possible	Occurs under worst-case operating conditions
Unlikely	Occurs under upset/malfunction conditions
Precedence/ Uniqueness	
Severe	Impacts occur in such close proximity to national parks, National Register of Historic Places, traditional cultural properties, or national historic landmark sites, or other especially valued, unique, or protected sites, that the valued features of those nearby sites are severely jeopardized;
Moderate	Impacts would occur at sufficient distance from any protected site that the valued features would be perceptibly altered but not severely compromised or jeopardized;
Slight	Impacts would occur at sufficient distance from any protected site that the valued features would be imperceptibly altered

Alternative 1

Under the no action alternative, no mine construction or operation would occur. Thus, the visual aesthetics at the proposed site would remain unchanged. The no action alternative would have no impacts to visual resources.

Effects Common to the Action Alternatives

Mine Development

Construction and development of the mine is expected to take 3.5 years, and will begin to affect the visual resources of the area with the first construction steps of blading new access roads. The construction of the facilities will impact visual resources includes as many as 14 depressing wells, a water treatment plant, a 5.5 mile aboveground water pipeline, headframes and hoists, haul and access roads, soil stockpiles, rock stockpiles, ore pads and nonore stockpiles, storage areas, drill pads, utility lines, storm water control facilities, and fencing. As described in chapter 2, the construction will begin primarily in section 16 and then move to sections 9 and 10. The effects to visual resources are similar in each section so the impacts throughout the construction phase will be similar. The construction of the facilities will include using an approved color scheme, but will otherwise not match the form, line, and texture of the landscape.

Mine Operations

Visual impacts occur from the change in the landscape so once the construction is complete, the operation will add no additional effects except to extend the lifetime of the effects of construction. The mine operations plan does not include removing any facilities during the operation and, thus, will not remove any of the visual impacts to the landscape. Mine operations are expected to continue for 13 years.

Mine Reclamation

Final mine reclamation is to begin once the mine operations are complete and should take approximately 2 to 3 years. Reclamation will remove all physical structures from the landscape and recontour the land to conform to the geomorphic character of the area. Revegation will be in the form of grasses, forbs, and shrubs. The effects to the visual effects will be with the modification objective of the area. The removal of the buildings and mine structures will remove the activities that disturbed the form and line of the area. While the vegetation may not be what existed originally, the color, form, and line will be compatible with the surrounding areas.

Alternative 2

Under the proposed action, the underground mine would be constructed with facilities in Sections 9, 10, and 16. The majority of the facilities would be in Sections 10 and 16, including a production shaft and several ventilation shafts in each section.

Overall the adverse impacts to visual resources from the proposed action alternative would be of moderate magnitude, long term, of a small extent, probable, and of severe uniqueness. It fits in the moderate magnitude category because while the modification objective allows for something to dominate the landscape, at this scale it would not be compatible with the natural surroundings. It would borrow from the naturally established color, which helps meet the objective in one way.

Construction and operation of the mine would last longer than 10 years and, thus, the duration reaches the long-term criteria. The maximum extent of impacts would be the viewshed for the two shaft headframes, as they are the tallest facilities in the proposed mine plan.

Figure 68 shows in red the area that would have their viewshed altered by the proposed action. This area includes the top of Mt. Taylor but does not include any major roadways or other heavily used areas and, therefore, the extent is still small. Severe uniqueness is due to the location of the proposed action partially within the Mt. Taylor Traditional Cultural Property and its proximity to Mt. Taylor itself. As seen in figure 68, the mine would be visible from the top of Mt. Taylor. As discussed in the "Cultural Resources" section of this report, many Native American tribes in the area use Mt. Taylor for traditional ceremonies and place a high value on the intactness of the whole Mt. Taylor area. Even though the proposed mine may occur in only a small fraction of the viewshed from Mt. Taylor, its mere existence in the viewshed would be enough to impact the aesthetic experience for these tribal users. For the discussion of potential impacts to cultural resources, see the "Cultural and Historic Resources Section." Using the signifance criteria outlined in table 71 specifically for visual resources, the overall impacts from alternative 2 would be adverse but less than significant. Table 72 outlines the level of impacts at each phase.

Table 72. Levels of impact for visual resources

Magnitude	Duration	Extent	Likelihood	Precedence and Uniqueness	Impact Rating
Mine Development					
Moderate	Medium term	Small	Probable	Severe	Insignificant
Mine Operation					
Moderate	Long Term	Small	Probable	Severe	Insignificant
Mine Reclamation					
Minor	Medium Term	Small	Probable	Severe	Insignificant
Overall					
Moderate	Long Term	Small	Probable	Severe	Insignificant

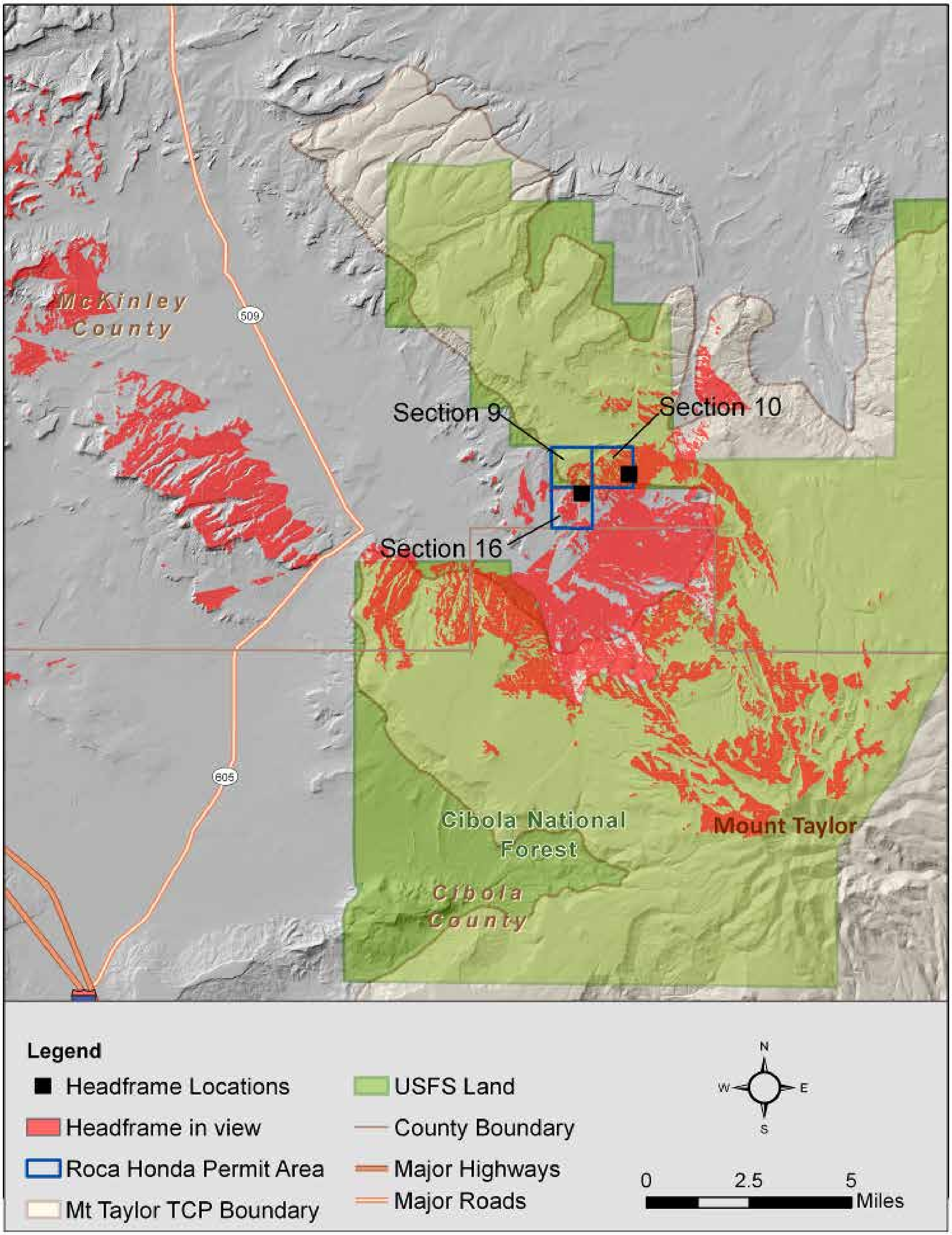


Figure 68. Viewshed of the proposed headframe locations in proposed action (alternative 2)

Alternative 3

Under alternative 3, the underground uranium mine would be constructed with only one production shaft located in Section 16. The majority of the facilities would also be in Section 16, with some pipeline and dewatering facilities in Section 10 and ventilation shafts in all three sections. The maximum area of impacts would be the viewshed for the shaft headframe, as it is the tallest facility in the proposed mine plan. Figure 69 shows in red the areas that would have their viewshed altered by the one shaft alternative. This viewshed is smaller than that of the proposed action, in that Section 10 itself, and areas northwest, north, northeast and east of Section 10, would not be impacted as they were in the two shaft alternative. This difference in number of headframes is the main determiner for the difference in the VMS analysis of visual impacts between the two action alternatives. Notably, however, in a simply subjective sense, the absence of duplicative mine facilities (which would be needed to support a second shaft in Section 10) has an obvious advantage when compared to the impacts to visual resources from alternative 2. That said, they both fit within the small level for extent of impacts according to the VMS. Therefore, the impact level and significance values are identical for both alternatives, as seen in table 73.

Table 73. Levels of impact for visual resources

Magnitude	Duration	Extent	Likelihood	Precedence and Uniqueness	Impact Rating
Mine Development					
Moderate	Medium Term	Small	Probable	Severe	Insignificant
Mine Operation					
Moderate	Long Term	Small	Probable	Severe	Insignificant
Mine Reclamation					
Minor	Medium Term	Small	Probable	Severe	Insignificant
Overall					
Moderate	Long Term	Small	Probable	Severe	Insignificant

Cumulative Effects

Past and current human activities and artificial structures in the area have altered the appearance of the natural landscape within the viewshed of the proposed mine. Activities include mining, logging, ranching, and structures include paved and unpaved roads, the village of San Mateo, ranch houses and homes, sheds, barns, water storage tanks and facilities, fences, electrical transmission and distribution lines, abandoned or closed mines, and tailings piles. From the higher reaches and summit of Mt. Taylor, these and many other structures would be visible. Nonetheless, for most observers, the overall visual impression of the landscape would be one that is relatively open and uncluttered, even semiwild, though not pristine wilderness.

As indicated above, inserting the Roca Honda Mine, both the one and two shaft alternatives, into this landscape would have an adverse but not significant effect on visual resources. The principal reasonably foreseeable action that would occur within the same timeframe is the La Jara Mesa Mine, which would be on a smaller scale and have a smaller visual footprint. The landscapes at both mine sites would be reclaimed and, thus, restored to approximately pre-mine condition in several decades. Therefore, the cumulative impact on visual resources would be medium term but impermanent and adverse but not significantly adverse.

Transportation

Affected Environment

This section provides a brief description of the existing transportation resources near the proposed mine site, including an overview of the regional and local traffic, airports, public transit, and rail resources.

Roadways

The project area covers approximately 1,920 acres of land in southeast McKinley County. There are very few roadways and trails in this area and travel is minimal. There are no existing residences in the vicinity and the closest town—Grants—is approximately 18 miles from the proposed site. The village of San Mateo is about 3 miles away. The closest interstate (I) to the proposed site is I-40 traveling east-west approximately 20 miles to the south. Road 556 is the closest access road to the proposed site and travels north-south approximately 1 mile to the east. Road 556 also provides access to State Highway 605 approximately 17 miles southwest and is the nearest access road leading to I-40. Because of the remote location in the light traffic patterns, traffic on roadways surrounding the proposed mine is free flowing during both the a.m. and p.m. peak periods.

Air Travel, Rail, and Public Transportation

The closest airport is Grants Milan Municipal Airport approximately 20 miles southwest of the proposed site. Grants Milan is open to the public and has two runways for charter flights, freight, and ambulance services (AirNav, 2011). The closest international airport is Albuquerque International Sunport Airport (ABQ) approximately 60 miles east-southeast of the proposed site. ABQ handled over 5 million passengers in 2010. ABQ also shares its runways with Kirkland Air Force Base, which provide aircraft rescue and firefighting services for the airport (CABQ, 2011). There are rail spurs to the north and northwest as close as 9 miles to the proposed site. These spurs have served the sawmill and timber industry providing timbers for uranium mine shafts in the area. Most of the freight rail service in New Mexico is serviced by Burlington Northern Santa Fe Railway (NRGNHA, 2011). There is no public transportation in McKinley County.

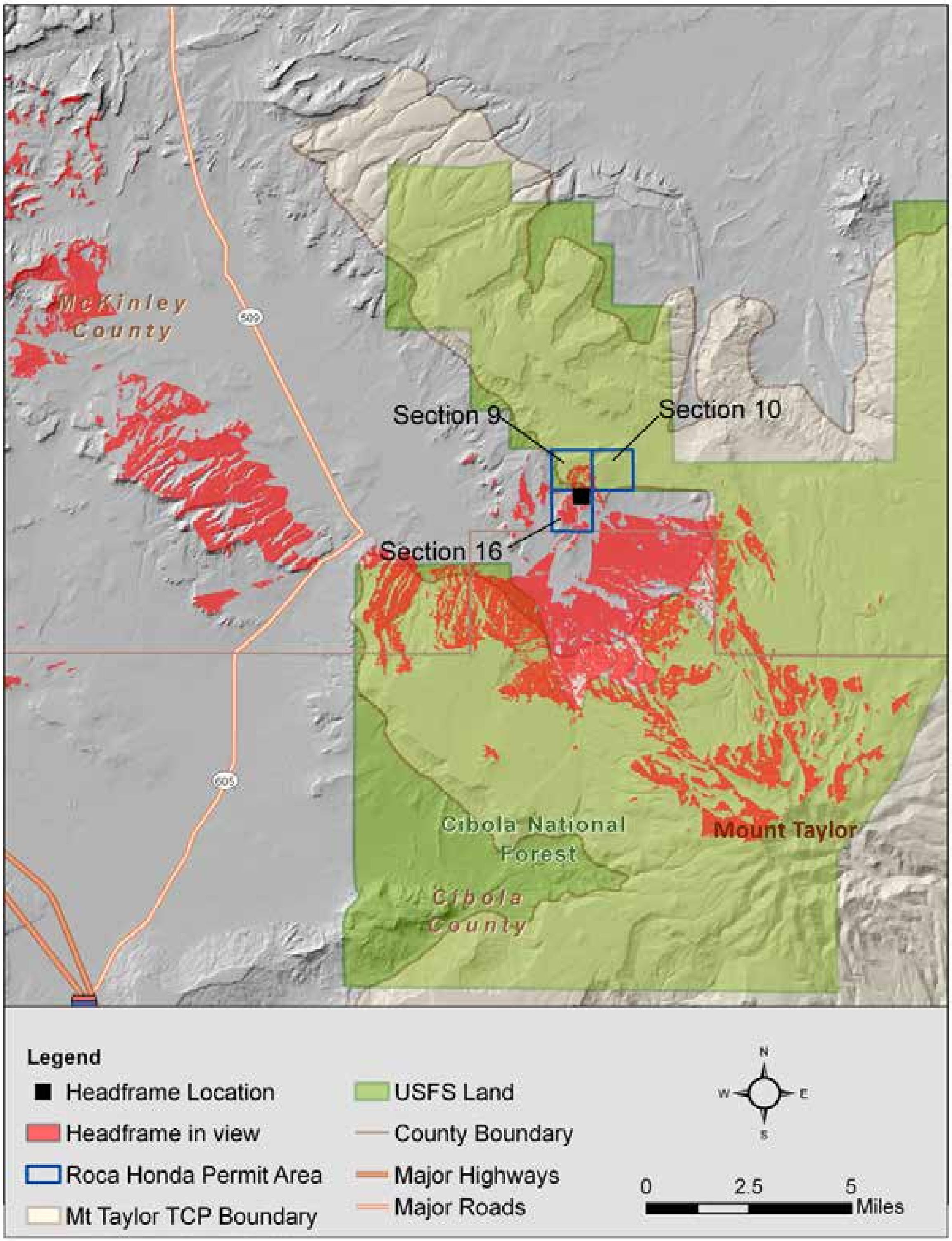


Figure 69. Viewshed of the proposed headframe location in one shaft alternative (alternative 3)

Environmental Consequences

Alternative 1

Selecting the no action alternative, meaning that the proposed action would not be carried out in any setting; thus, there would be no impacts to transportation resources. Conditions would remain as described above under the “Transportation Affected Environment.” Conditions described in the no action alternative provide a comparative baseline for the following alternatives.

Alternative 2

The proposed action alternative would have short and long-term minor effects to transportation. Short-term effects during mine development and reclamation would be due to the delivery of heavy equipment, pipe, water treatment equipment and supplies, as well as their removal during reclamation activities. Medium term minor effects would be due to operational hauling trucks, continued delivery of supplies, and worker commutes. However, implementing the proposed action would contribute small changes in localized traffic patterns. The proposed action would have no impact on public transit or air traffic in the area. An overview of the impacts to transportation is outlined on table 74.

Table 74. Levels of impact for transportation

Magnitude	Duration	Extent	Likelihood	Precedence and Uniqueness	Impact Rating
Mine Development					
Minor to Moderate	Short Term	Small	Probable	Slight or Moderate	Less than Significant
Mine Operation					
Minor to Moderate	Long term, intermittent, or short term	Medium	Probable	Slight or Moderate	Less than Significant
Mine Reclamation					
Minor to Moderate	Short Term	Small	Probable	Slight or Moderate	Less than Significant
Overall					
Minor to Moderate	Medium term, intermittent, or short term	Small	Probable	Slight or Moderate	Less than Significant

Mine Development

Short-term minor effects to transportation would be expected during the mine development phase. Short-term increases in traffic would be expected due to workers’ vehicles, construction vehicles, and delivery of equipment and supplies to the site.

Traffic congestion would increase at and around the site due to additional heavy vehicles associated with mine development. These effects would last approximately 3–4 years and would end with the mine development phase. In addition, road closures or detours to accommodate utility system work may be expected, creating short-term traffic delays. Such effects would be minimized by placing construction staging areas where they would least interfere with traffic. All vehicles associated with mine development would be equipped with backing alarms, two-way radios, and slow moving vehicle signs when appropriate.

The primary roadways affected would be County Road 122 that connects with I-40 (north of the intersection of County Road 122 and County Road 605. Annual average daily (AADT) counts for that intersection are 1,196 vehicles per day. The Grants-Milan Interchange of I-40 has an AADT of 9,993 (NRC 2008). County Road 605 is the arterial roadway to the RHR site and unnamed Forest Service roads lead directly to areas slated for mine development. Due to the limited amount of existing traffic on these roadways, small changes in traffic associated with mine development would not to have an appreciable effect on any roadway segment or intersection near the site. These effects would stop at the end of the development phase.

The condition of the local roadway infrastructure is not sufficient to support the increase in traffic during mine development, operation, and reclamation. Existing roads in Sections 10 and 16, and a forest system road along the southern edge of Section 11 would be upgraded with aggregate and widened to 60 feet.

Mine Operation

Medium-term minor effects to transportation would be expected during mine operation. These effects would be due to mine worker commutes and truck traffic associated with the transport of ore to and from the site.

Mine operation is expected to produce at an average capacity of approximately 1,000 tons of ore per day (50 tons per hour). Trucks that haul over the public roads are limited to a payload of 20 tons (40,000 lbs). The mine would operate 24-hours per day. Therefore, approximately 50 truck trips per 24 hours or about 2.1 trucks per hour would be expected in each direction. Notably, truck operation would be distributed throughout the day and night, and would not be concentrated during peak periods. Commuting traffic for mine workers is expected to be limited, and would occur during changes in shifts.

As outlined under mine development, roads near the site would be the ones primarily affected, particularly those along the designated route to the processing center. Due to the limited amount of existing traffic on these roadways, small changes in traffic associated with mine operation would not to have an appreciable effect on any roadway segment or intersection near the site. These effects would end at the end of the operations phase.

Risk Assessment for the Transport of Uranium Ore

Consistent with the requirements of 10 Code of Federal Regulations (CFR) Part 51, and NEPA, the potential for environmental effects due to the transport of radioactive material from the proposed Roca Honda Mine were investigated (LPES, 2012). This transportation study included a traffic route bounded analysis, vehicle related impacts, cargo-related incident free impacts, and cargo-related accident impacts during the transport of uranium ore from the proposed mine. Since

RHR is proposing to use on-road trucks only for the transport of ore, rail-based transport was not evaluated.

Because the mill destination(s) have not been finalized, a bounded analysis was performed based on the location of known and potential milling facilities and economic constraints associated with shipping costs. The impact assessment determines possible upper bounds of shipping distances of uranium ore, the amount of material in each shipment, and effects to the environment from these shipments. The RADTRAN 6 computer code was used extensively (Neuhauser and Kanipe, 2003).

The uranium ore that would be shipped from the mine to the mill(s) is classified as Class 7 Radioactive Low Specific Activity (LSA) LSA-I “hazardous material” under 49 CFR 171.8. It would be hauled in conventional over-the-road side or belly-dump trucks. They are typically 40-feet long and 8.5-feet wide and hold approximately 20 tons of material. The overall weight of the ore would be less than 20 tons as it would contain approximately 10–15 percent moisture. The truck trailers would be DOT placarded as LSA material and covered with a tarp. The assessment was written for 52 loads per day, or 18,980 loads per year, over the 13-year life of the mine.

The ore contains natural uranium with an average grade of 0.365 percent uranium. Natural uranium contains 6.7×10^{-7} curies per gram of uranium. This translates to each truck transporting 0.045 curies of uranium. It is expected that all other radionuclides would when combined make up less than 0.0001 percent of the total radioactivity of the material and/or have a half-life less than 2 days (LPES, 2012). The radionuclide data and shipping container characteristics for input into RADTRAN 6 were obtained from the U.S. Department of Energy’s (DOE’s) “A Resource Handbook on DOE Transportation Risk Assessment” (DOE, 2002) and the NRC’s NUREG-0170 (USNRC, 1977).

As noted above, the mill destination or destinations have not been finalized; a 450-mile shipping radius was considered the reasonable upper bound for analysis purposes. These distances are considered representative of routes that would be used and would provide access to both current and potential milling facilities. Although the final routes may vary, due to the limited transport distance and low levels of radioactivity in the ore, a different methodology would not substantially change the effects.

According the RADTRAN analysis, the nonradiological effects (fatalities from traffic accidents) would dominate the effects associated with uranium ore transport by truck. It is estimated that there would be 1.5 accidents per year along the shipping route to the mill(s). Fatalities from traffic accidents associated with truck traffic were estimated to be 0.16 per year or one every 6 years. These accident and fatality rates are identical to other trucking activities, and lower than the national averages for the same activities. These effects would be less than significant.

Radiological effects are expressed in terms of latent (eventual) cancer fatalities from incident-free transport. Incident-free transport represents the transport of the shipments without a release from the shipment. Radiological latent cancer fatalities from incident-free transport were estimated to be 0.104 individuals per year or one every 10 years. For perspective, an individual has a lifetime probability of dying of cancer from all sources of about 246,000 in 1 million, or a risk of lung cancer of 65,000 in 1 million (CDC, 2011). These effects would be less than significant.

RADTRAN also estimates radiological effects from accidents during uranium ore shipments. Accident results include the impact (risk per year) from various accident scenarios that potentially could occur during the transport of the radioactive material. The results are presented in terms of risk, which means weighting the impact of the various accident scenarios by the frequency that the accident scenario occurs. Radiological latent cancer fatalities from accidents during shipment were estimated to be 0.000222 individuals a year or one cancer fatality every 4,500 years. These effects would be negligible.

The NRC has evaluated the environmental effects resulting from the transport of nuclear materials, including accident scenarios related to the transportation of radioactive material. The NRC found that these accidents have no significant environmental effects (USNRC, 1977; USNRC, 1987). Natural uranium ore would be the only material transported from the proposed Roca Honda Mine. The radioactivity contained in this material is substantially lower than the amount of radioactivity contained in the high-level waste and spent fuel used in the NRC studies. The effects associated with transportation of radioactive materials to and from the proposed mine are well within the scope of the environmental effects previously evaluated by the NRC, and would be less than significant.

In conclusion, the nonradiological effects (fatalities from traffic accidents) dominate the overall effects for uranium ore transport to a mill site from the Roca Honda Mine. The combined probability of a fatality from a trucking accident, latent cancer from either incident-free transport, or a radioactivity release during an accident would be 0.264—or approximately one every 4 years—and over 60 percent of these fatalities would be due to trucking accidents not involving radioactive releases.

To put these risks in perspective,

1. The lifetime risk of a fatal cancer in the U.S. from all causes is about 20–25 percent (one in every four or five people).
2. The actual radiological doses projected associated with incident-free transportation as well as from accidents are very small and would be essentially indistinguishable from existing natural background radiation in the U.S.
3. Risks associated with transportation of uranium ore are dominated by conventional risks associated with virtually all commercial transportation and the probability of accident-related fatalities is no different than those associated with conventional truck transportation of this nature (USNRC, 1977; DOE, 2002; DOE, 2007; SENES, 2012c).

Mine Reclamation

Short-term minor effects to transportation would be expected during mine reclamation. Short-term increases in traffic due to removal of supplies and equipment to the site would be expected.

The effects of traffic would be similar to those as outlined under the mine development phase. As with mine development and operation, roads near the site would be the ones primarily affected. Due to the limited amount of existing traffic on these roadways, small changes in traffic associated with mine reclamation would not to have an appreciable effect on any roadway segment or intersection near the site. These effects would stop with the end of the reclamation phase.

During the mine development stage, upgrades to roadways accessing the site would make local road infrastructure sufficient to support the proposed action. Other than the infrastructure upgrades, at the end of the reclamation phase, conditions would return to those described in the "Transportation Affected Environment" section. Long-term beneficial effects would be due to the upgrades to roadways as part of the proposed action alternative

Alternative 3

Short- and long-term minor adverse effects to transportation would be likely with the one ahaft alternative. This alternative has essentially the same components as the proposed action. Thus, the description of the three phases in the proposed action alternative—mine development, operation, and reclamation are applicable to this alternative with the exception of location. All mine development and operations would largely be confined to State lands on Section 16 and avoid Cibola National Forest surface lands on Sections 9 and 10; therefore, Forest Service roads in Sections 9 and 10 would not be used. As with the proposed action alternative, this alternative would have no impact on public transit or air traffic in the area.

County Road 605 would be the arterial roadway leading to the site and aggregate access roads would be developed. As with the proposed action, the mine would operate 24 hours per day, and approximately 50 truck trips per 24 hours or about 2.1 trucks per hour would be expected in each direction. As outlined under the proposed action, roads near the site would be the ones primarily affected, particularly those along the designated route to the uranium mill. Due to the limited amount of existing traffic on these roadways, small changes in traffic associated with mine operation would not to have an appreciable effect on any roadway segment or intersection near the site. These effects due to mine development, operation, and reclamation would stop at the end of each phase.

As with the proposed action alternative, upgrades to roadways accessing the site would make local road infrastructure sufficient to support the mining activities. Other than the infrastructure upgrades, conditions would return to those described above under "Transportation Affected Environment" at the end of the reclamation phase. Long-term beneficial effects would be due to the upgrades to roadways as part of alternative 3.

Proposed Mitigation

Impacts to transportation resources would be less than significant. No mitigation measures outside the BMPs outlined above would be required.

Cumulative Effects

No cumulative effects related to transportation are expected.

Human Health and Safety

Affected Environment

This section provides an overview of human health and safety conditions in the communities that comprise the affected environment for this EIS of the proposed Roca Honda Uranium Mine. First, the study area of relevance for the human health and safety impacts is described. This is followed by the data sources that were used throughout this section. Then baseline conditions for biomedical health outcomes (illnesses, diseases, injuries, and other health states experienced by individuals) are discussed, followed by relevant data on health determinants, which are the main drivers of biomedical health outcomes.

Study Area and Population Demographics

The ROI for human health and safety comprises those areas with residents who may experience health changes as a result of the project or who may be affected by social or environmental changes that result from the project. Since socioeconomic circumstances strongly determine health outcomes, the ROI for human health and safety is the same as that for the socioeconomic affected environment (see “Socioeconomics” section). The ROI is described as Cibola and McKinley Counties since mining and associated activities would take place in these regions.

Within the ROI there are two study areas: local and regional. Communities in the local study area may experience direct impacts from the proposed development (i.e., they are close to project transportation routes, are key potential sources of employment for the mine, they house major health care centers) while the regional study area includes communities who may experience indirect impacts (e.g., may supply some workers but are not close to project lands). The towns in each study area are listed in table 75 and shown in figure 70. These areas were determined by professional judgment and may change as more project details become available.

Table 75. Study area for proposed project

County	Local Study Area	Regional Study Area
Cibola County	Grants, Milan, San Mateo	Acomita Lake, Laguna, Encinal, Mesita, North Acomita Village, Paguate, Paraje, Pine Hill, Seama, Skiline-Ganipa, San Fidel
McKinley County	Gallup	Nakaibito, Navajo, Pueblo, Nakaibito, Navajo, Pueblo Pintado, Ramah, Black Rock, Brimhall, Nizhoni, Church Rock, Crownpoint, Crystal, Rock Springs, Thoreau

Table 46 in the “Socioeconomics” section presents a summary of demographic characteristics for the population of Cibola and McKinley Counties as well as for New Mexico as a whole.

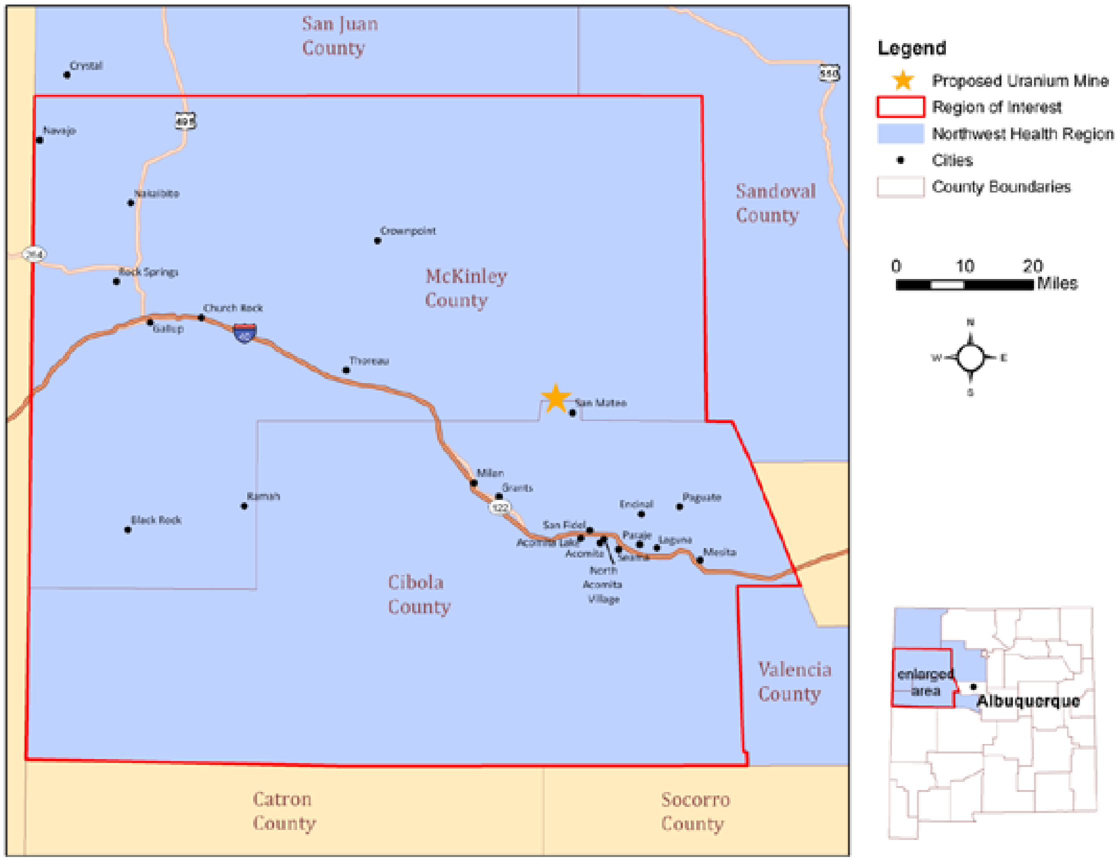


Figure 70. Region of Influence and Northwest Health Region

Data Sources

Data for the “Human Health and Safety” section were derived from multiple sources. These included:

- Population health databanks including the Behavioral Risk Factor Surveillance System (BRFSS), the Youth Risk Behavior Surveillance System (YRBSS) and the United States (U.S.) Census. Much of these data were gathered through the New Mexico Department of Health, which has compiled the recent available data and presented it in summary reports.
- Health reports published by New Mexico government departments and organizations such as the New Mexico Tumor Registry and the University of New Mexico.
- Community studies by independent researchers or institutions such the Southwest Research Information Center.
- Peer-reviewed scientific publications on special topics, such as studies examining the health impacts of uranium mining on miners (e.g., Roscoe et al., 1995) or reviews of toxicological impacts of radon (e.g., ATSDR, 1990).

Health data are seldom available for specific communities or small populations. This is due to several factors, including individual privacy concerns. Therefore, much of the data presented to describe baseline health conditions in the ROI is presented at the county level, for Cibola and McKinley Counties. Some health data are also presented at the level of the health region. The northwest health region is one of five health jurisdictions delineated by the New Mexico Department of Health. The northwest health region includes five counties, including Cibola and McKinley. Other counties are: San Juan (population = 130,044), Sandoval (population = 131,561), and Valencia (population = 76,569).

For Native American tribal groups in the project area, data are presented on the level of the State of New Mexico for all Native Americans/Alaska Natives. Where possible data are presented by tribe; however, in most circumstances data on the level of the tribe are unavailable (Best, 2011). For the purposes of this EIS it is assumed that data on the level of the State are similar for the local tribes in the ROI, realizing that there are likely variations within and between tribal groups.

It should be noted that for all sources, the rates presented for some diseases and health indicators may be unstable, meaning that the point estimates are highly variable. Small numbers of cases reported and small population values can cause some rates to differ greatly over time or in comparison to other areas. The instability is illustrated by wide confidence intervals surrounding the point estimate. Where confidence intervals are not provided, it is not possible to determine whether rates are statistically different from one another.

Public Health Context

Health in all settings is influenced by a wide range of social and environmental factors. However, there is one unique factor that affects health in the ROI: the historical legacy of uranium mining in the region. This is a complex and emotionally charged issue, but one that is important to understand, as it has had a significant health effect for some residents in the past, and continues to affect health in the present. A brief overview of relevant legacy issues is, therefore, presented below in order to contextualize the health data that is presented in this affected environment section.

“Legacy issues” is the term used to refer to the historical impacts of uranium mining in the ROI, including peoples’ biophysical, social, and political experiences. Although these experiences may have taken place in the past, they remain deeply embedded within the social history and collective psyche of these communities, and continue to affect current perceptions and the adaptive potential of both communities and individuals toward new proposed projects. In the ROI, there are three types of historical experiences that have colored the way people in the ROI may perceive a new mining operation at it relates to their individual or collective health.

The first of these are the health effects experienced as a result of previous mining activity. A large burden of disease was experienced by miners, their families, and other community members that was a direct result of exposure to hazardous substances. The disease burden was particularly felt by the local Navajo population. These health effects (discussed more in the “Cumulative Impacts” section) persist among former workers and their families, as people continue to die from uranium mining-related illnesses and as new cases of these illnesses are diagnosed. Exacerbating unease is the fact that the full extent of health impacts from uranium mining and milling remains understudied and thus uncertain; to date, no comprehensive public health study has ever been conducted within these uranium mining communities (Shuey, 2007).

The second health-related effect of legacy mining has to do with compensation for past exposure and associated illness. Some people in the ROI feel that they have not been adequately compensated for the adverse health effects associated with working in or living near uranium mines. Government restitution, via the Radiation Exposure Compensation Act (RECA), came about in 1990 and is available for those miners who worked prior to 1971 as well as widows of these miners and former residents downwind of uranium mines (USDOJ, 2011); however, some have found that stringent government rules and bureaucracy make receiving compensation difficult (Boulanger and Gorman, 2004). As well, some have argued that there is a shortcoming in the number of illnesses recognized by RECA and that workers post-1971 should also be eligible for compensation due to poor safety standards that persisted (Evers et al., 2009).

The final issue has to do with unreclaimed mining sites that may continue to affect health in the ROI. There are many past mining and milling sites that have yet to be reclaimed in the ROI, including 500 abandoned mines in Navajo Nation and 97 legacy mines and 5 mills in the Grants Mining District. A number of assessment programs and plans have been initiated to reclaim the land and rectify some of the environmental and health legacy issues due to uranium mining in the area (USEPA, 2008; USEPA, 2011f); however, there is a feeling from some residents that the cleanup effort has not gone quickly enough. Community consultations have also revealed that there exists a lack of trust in government and in mining companies, and the feeling of being ‘trapped’ due to the inability to sell homes close to contaminated sites (Gunnell, 2012; Head-Dylla et al., 2012).

Uranium mining, milling, and health impacts related to soil, air, and water contamination remain an area of concern for residents and community leaders in the ROI. This is reflected in the 20 comments that were collected in the scoping period that outline health concerns around proposed uranium developments (USFS, 2011b). These comments, along with both government and community efforts to gain more information about the health impacts of uranium mining legacy indicate that:

- uranium is very much on the minds of local residents;
- past uranium mining has raised interest in the ROI about the potential health impacts associated with new mining activity; and
- therefore, despite improved safety regulations, proposed new mines may raise stress and anxiety levels in the affected environment.

Legacy issues are explored more fully in the “Cumulative Impacts” section for “Human Health and Safety” and in the “Legacy Issues” section.

Biomedical Health Outcomes

This section presents an overview of biomedical health outcomes and diseases experienced by the population in the affected environment. Biomedical health refers to illnesses, diseases, injuries, and other health states experienced by individuals. The indicators presented were selected because of their potential to be impacted by the proposed action alternative. The linkages between each health outcome and the proposed action alternative are outlined at the outset of each subsection.

General Health Indicators

General health indicators provide a picture of the overall health status of the population. Self-rated health and mortality are important indicators that reflect population health and wellness and can be compared across time and regions to understand how the health of one population compares with the health of others.

Self-rated health is one of the strongest and most consistent predictors of illness, premature death, health care utilization, and hospitalization (Idler and Benyamini, 1997). In 2008, 16.9 percent of the population in the northwest health region rated their health as fair or poor (NMDH, 2008a); this is very similar to the State of New Mexico at 17.9 percent.

Leading causes of death for Cibola and McKinley Counties are listed in table 76. The leading causes of death for Cibola and McKinley Counties are heart disease, cancer, and unintentional injury. These leading causes have remained the same over the past decade and are similar across the nation. Because confidence intervals are not available for these estimates, it is not possible to determine whether rates are significantly different between the various regions. All of these diseases are further discussed in the following sections.

Chronic Disease

Chronic diseases are illnesses that have a long duration and slow progression, such as cancer, heart disease, and diabetes. They are generally multifactorial; that is, they are not caused by any one factor, but rather by a combination of biological, environmental, and personal influences. Chronic diseases are now are the leading cause of ill health and death across the U.S. and internationally. The Centers for Disease Control and Prevention (CDC) estimates that chronic diseases account for 70 percent of all deaths in the U.S. (USCDC, 2011).

Cancer

Cancer is the second leading cause of death in Cibola and McKinley Counties. Cancer is a concern of community members in the ROI (USFS, 2011b), and has been shown to be associated with uranium mining activities (ATSDR, 2008, 2011). In order to assess potential impacts from the proposed action, it is important to understand current cancer rates as well as trends over time.

Table 76. Leading and selected causes of death, rates per 10,000 population by region, 2007-2009

	Cibola County	McKinley County	New Mexico
All-cause mortality	101.9	121.0	93.0
Heart disease	12.2	21.2	20.4
Cancer	14.8	17.6	16.6
Unintentional injury	7.2	10.6	6.9
Chronic lower respiratory disease	3.1	5.4	5.5
Cerebrovascular disease (stroke)	1.6	6.7	4.6
Diabetes*	5.8	7.9	3.3

	Cibola County	McKinley County	New Mexico
Motor vehicle crash (2005-2009)	2.9	NA	1.4**
Suicide	2.8	2.3	1.9

Source: NMDH, 2011a

Notes: *Includes all cases of death where diabetes mellitus was an underlying condition; **These data are from 2007.

In Cibola and McKinley County, the top three causes of cancer are breast cancer for women, prostate cancer for men, followed by lung cancer and colorectal cancer for both sexes. These overall trends mirror those observed for the State of New Mexico and the U.S. as a whole. Overall cancer incidence and mortality rates and counts of cancer cases and deaths between 1995 and 2004 are presented in table 77.

Table 77. Incidence and mortality rates and counts of cancer cases and deaths in Cibola and McKinley Counties, 1995-2004

	Cancer Incidence (per 10,000 population)	Number of New Cases	Cancer Mortality (per 10,000 population)	Number of Cancer Deaths
Cibola County	38.23	888	16.57	367
McKinley County	31.13	1,487	16.72	732
New Mexico	41.50	71,164	17.21	28,734

Source: NMDH, 2007

In the State of New Mexico, the tumor registry reports on rates of cancer incidence and mortality by three different racial cohorts. In Cibola and McKinley Counties cancer incidence and mortality rates are lowest in the American Indian cohort, highest among the non-Hispanic White cohort and rates for the Hispanic cohort fall in between the two. Although rates of cancer are lowest in American Indian cohort compared to the other racial cohorts, cancer is the leading cause of death among American Indians in New Mexico (NMDH, 2005).

Table 78 shows incidence rates of lung and bronchus cancer for Cibola and McKinley Counties for the years 2006–2008. It is estimated that smoking causes 85–90 percent of all lung cancer in the U.S. every year. Other agents known to contribute to or cause lung cancer are radon gas, airborne asbestos and high-dose ionizing radon (NMDH, 2005). For the proposed action alternative, the association between radon exposure and lung cancer (USEPA, 2011a) is of particular importance.

Table 78. Lung and bronchus cancer incidence by county, 2006-2008, per 100,000 population

	Cibola County (95% CI)	McKinley County (95% CI)	New Mexico (95% CI)
Lung and bronchus	34.0 (21.6 – 46.5)	15.7 (8.5 – 22.8)	43.7 (42.0 – 45.3)

Source: NMDH, 2011a

Abbreviations: CI – confidence interval

During the early years of the uranium boom in the ROI (1940–1970s) many uranium miners were exposed to high levels of radon gas while working in the mines, mainly because ventilation systems were not mandated. Many studies conducted during and since that time period have helped establish the causal connection between radon gas exposure in uranium mines and the development of lung cancer (Tomasek et al., 1994; Roscoe et al., 1995; Stram et al., 1999; Saccomanno et al., 1996; Gilliland et al., 2000). Smoking has also been shown to exacerbate lung cancer cases in miners; however, in the Navajo population the observed rates of lung cancer remained even after controlling for smoking status, suggesting that the Navajo may be particularly susceptible to the impacts of radon (Gilliland et al., 2000).

For example, a study published in 2000, reported that Navajo uranium miners had 28 times higher the risk of being diagnosed with lung cancer than those Navajo men who never mined and that uranium mining accounted for approximately two-thirds of all lung cancer cases in the study sample (Gilliland et al., 2000). Another study looked at Navajo uranium miners (this also includes Hopi, Laguna, and Comanche) who worked in the mines prior to 1963 and followed chronic disease outcomes to 1990. Death rates from lung cancer in Navajo miners were found to be 3.3 times greater than the U.S. average. Death rates for pneumoconioses and silicosis were 2.6 times greater for Navajo uranium miners (Roscoe et al., 1995). These studies indicate that the Navajo population was particularly susceptible to the cancer-causing effects of uranium mining.

Table 79 shows the trends in lung cancer incidence over the last 20 years for three different racial cohorts. Examining data over a longer time period is important for detecting future changes in population trends. However, because of the small time intervals and the low rates of lung cancer, the rates are quite unstable, making it difficult to detect trends in the project area. In New Mexico, rates of lung cancer in men have been decreasing slightly since 1974, with a slight increase seen in Hispanic and Native American men (figure 71) (NMDH, 2007; NMDH, 2005). In women, rates of lung cancer are increasing in White and Black women but remaining stable among Hispanics and American Indians (NMDH, 2007).

Cardiovascular Disease

Cardiovascular (CV) disease is classified as any disease involving the heart or blood vessels. The main biological risk factors for CV disease include aging and being male, however, there are also many environmental exposures that can increase one’s risk of CV disease, including particulate matter (i.e., air pollution), alcohol consumption, smoking, and stress. Preliminary data also show a potential link between hypertension and proximity to uranium mining features in the Navajo Tribe (Lewis et al., 2010). Since these risk factors could all be influenced by the proposed action alternative, it is important to discuss CV disease and related health outcomes, like hypertension, in the ROI.

Table 79. Lung and bronchus cancer incidence rates in Cibola and McKinley Counties per 10,000 population

	1990-1995	1996-2001	2002-2007
Non-Hispanic White			
Cibola County	8.37 (5.87 – 11.98)	7.39 (5.19 – 10.47)	6.96 (5.02 – 9.71)
McKinley County	6.36 (4.45 – 9.07)	5.71 (3.88 – 8.24)	4.47 (2.99 – 6.71)
New Mexico	5.89 (5.69 – 6.10)	5.74 (5.55 – 5.93)	5.86 (5.68 – 6.05)
Hispanic			
Cibola County	4.66* (2.13 – 9.03)	3.84* (1.97 – 6.99)	4.09 (2.43 – 6.63)
McKinley County	2.65* (0.99 – 5.95)	3.09* (1.35 – 6.25)	2.29* (1.09 – 4.35)
New Mexico	3.39 (3.14 – 3.63)	3.49 (3.28 – 3.72)	3.13 (2.95 – 3.32)
American Indian			
Cibola County	0.80* (0.16 – 2.52)	1.16* (0.37 – 2.92)	1.47* (0.58 – 3.11)
McKinley County	.80* (.38 – 1.52)	1.52 (.96 – 2.31)	.94 (.55 – 1.54)
New Mexico | 1.69 (1.32 – 2.15) | 2.12 (1.73 – 2.56)	1.56 (1.27 – 1.90)		

Source: NMDH, 2011; * Note: these rates are considered statistically unstable by the NM Tumor Registry.

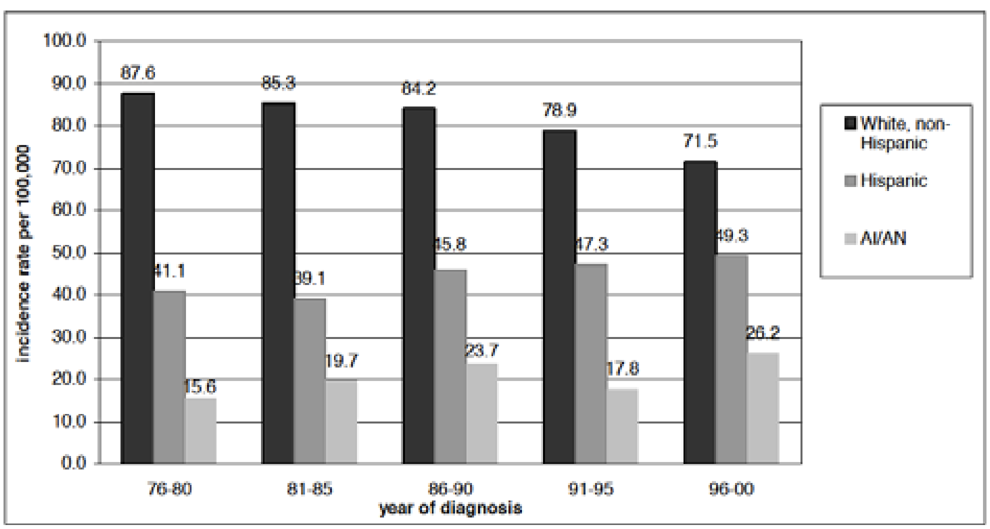


Figure 71. Lung and bronchus cancer incidence rates for males by race/ethnicity, New Mexico, 1976–2000

Cardiovascular disease has been a leading cause of death in the U.S. for many decades, and is currently the leading cause of death in New Mexico. In New Mexico, cardiovascular disease more greatly impacts White males compared to other racial groups (NMDH, 2011a). Since 1999, rates of hospital admissions for diseases of the circulatory system (heart) in non-Federal hospitals have decreased in both McKinley and Cibola County (figure 72).

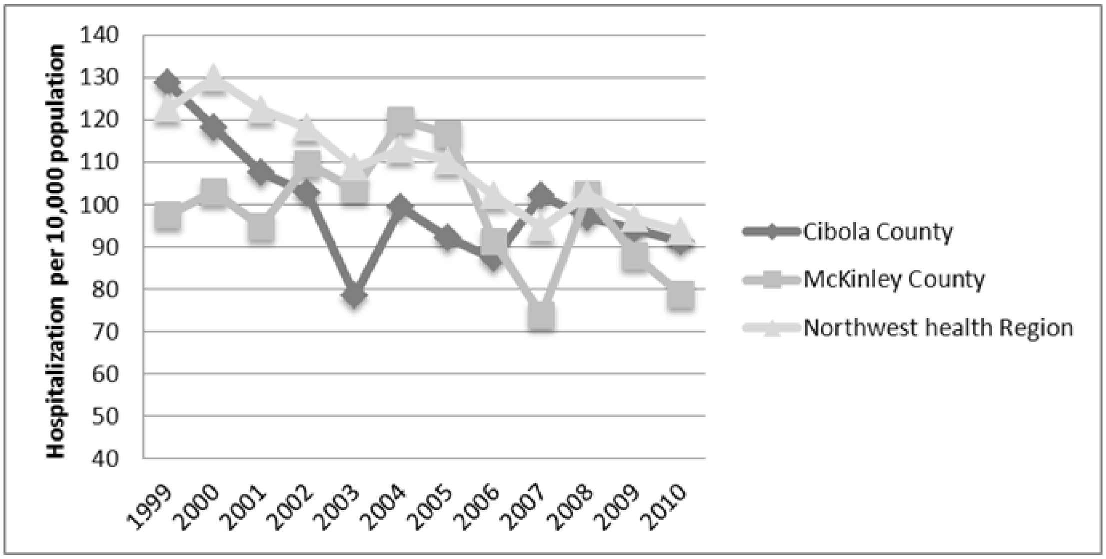


Figure 72. Hospitalizations for diseases of the circulatory system in Cibola and McKinley Counties, 1999–2010

Current death rates due to diseases of the heart are similar in the ROI and the State as are the hospitalization rates for acute myocardial infarction. However, in McKinley County death due to stroke is much higher compared to Cibola County, and McKinley County has one of the highest rates in the State (table 80).

Table 80. Mortality and hospitalization due to cardiovascular diseases in the Cibola and McKinley Counties, per 10,000 population

	Cibola County	McKinley County	New Mexico
Diseases of the heart death rate (2005-2007)	17.67 (13.88 – 21.47)	21.22 (17.93 – 24.50)	20.38 (19.95 – 20.81)
Stroke death rate (2005-2009)	2.68 (1.69 – 3.67)	5.00 (3.88 – 6.11)	3.82 (3.69 – 3.95)
Acute myocardial infarction hospitalization rate (2006-2008, aged 35+yrs)	19.7 (16.7 – 22.6)	10.8 (9.5 – 12.1)	14.1 (13.8 – 14.4)

Source: NMDH, 2008a; NMDH 2011a

Abbreviations: CI – confidence interval

High blood pressure (i.e., blood pressure greater than 140/90) is also a risk factor for cardiovascular disease (e.g., heart attacks, stroke, or heart failure). Since 1995, rates of high blood pressure have been increasing in the State of New Mexico and across the country; rates in the State remain somewhat lower (25.6 percent) than the country (27.8 percent) (NMDH, 2011a). Rates of high blood pressure in McKinley County are statistically lower than the State (18.9 percent), while rates in Cibola County are statistically similar to the State (21.9 percent) (NMDH, 2011a).

Preliminary results of a Navajo-based study suggest that high blood pressure (hypertension) may be associated with proximity to uranium mine features. In this study, Navajo living closer to uranium mine features were more likely to have diabetes, hypertension, and kidney disease (Lewis et al., 2010). Rates of hypertension in the Navajo population are not reported in the preliminary results.

Respiratory Disease

Asthma and chronic obstructive pulmonary disorder (COPD) are common respiratory diseases that are exacerbated by certain irritants. Irritants of relevance for this project include vehicle emissions or air pollution, dust from project related traffic and stress. Below is a summary of the prevalence of asthma and COPD in the study area.

Over the last 10 years, rates of asthma in New Mexico and in the country have been steadily increasing. In 2000, approximately 10 percent of New Mexicans reported ever having asthma; this rate currently stands around 13 percent (NMDH, 2011a). The current rate for those ever having been told they have asthma (lifetime prevalence) in the northwest health region is similar at 12 percent (table 81). Between 2007 and 2009, adult lifetime prevalence of asthma in Cibola and McKinley Counties was 10.6 percent and 13 percent, respectively (NMDH, 2011a). Children have similar rates of current asthma and lifetime asthma as adults in the northwest health region. Rates of asthma do not seem to differ by sex or ethnic group (NMDH, 2009).

Table 81. Rates of asthma in adults and children in the northwest health region and State of New Mexico

		Northwest Health Region (95% CI)	New Mexico (95% CI)
Population, 2010		436, 879	2,059,179
Current prevalence	Percent of adults who currently have asthma	7.4% (6.1 – 8.8)	8.6% (7.8 – 9.5)
	Percent of children who currently have asthma	8.0% (5.3 – 11.8)	8.3% (6.6 – 10.4)
Lifetime prevalence	Percentage of adults who have ever been told that they have asthma	11.9% (10.3 – 13.8)	13.5% (12.5 – 14.7)
	Percentage of children who have ever been told that they have asthma	11.6% (8.4 – 15.9)	13.0% (11.0 – 15.3)

Source: USCDC, 2009

Abbreviations: CI – confidence interval

Despite having average prevalence rates of asthma, the hospital admission rates for asthma in McKinley County are high compared to the State. Between 2004 and 2006 the hospital admission rates for asthma for Cibola and McKinley Counties were 19.4 and 38.2 per 10,000 population, respectively. This compares to a State rate of 21.7 per 10,000.

COPD is the coexistence of two diseases: chronic bronchitis and emphysema. Unlike asthma, COPD is harder to treat and gets progressively worse over time. COPD is highly associated with smoking and other environmental irritants. Rates of hospitalization for COPD in Cibola and McKinley Counties are presented in table 82.

Table 82. Hospital admission rates for COPD in Cibola and McKinley Counties, per 10,000 population, 1999-2009

	Cibola County (95% CI)	McKinley County (95% CI)	New Mexico (95% CI)
Hospital admissions	1.54 (1.39 – 1.69)	1.44 (1.34 – 1.55)	1.45 (1.36 – 1.53)

Source: NMDH, 2011a

Abbreviations: CI – confidence interval

Kidney Disease

Ingestion of uranium has been shown to cause kidney toxicity in humans (ATSDR, 2011). Exposure to uranium and the subsequent health impacts is a major concern of government agencies in the ROI (NMDH, 2011f; USEPA, 2011f; USEPA, 2008; Toth et al., 2003) and is a concern of some people in the study area (USFS, 2011b).

Rates of kidney cancer are reported by the New Mexico Tumor Registry for three racial cohorts. Incidence rates of kidney cancer over the last 20 years are reported in table 83.

Table 83. Rates of kidney cancer in the Cibola and McKinley Counties, per 10,000 population, 1995-2007

	1990-1995	1996-2001	2002-2007
Non-Hispanic White			
Cibola County	1.44* (0.55 – 3.68)	1.35* (0.49 – 3.29)	1.74* (0.81 – 3.66)
McKinley County	1.06* (0.31 – 2.82)	1.33* (0.56 – 2.85)	0.57* (0.15 – 1.95)
New Mexico	0.9 (0.86 – 1.03)	1.06 (0.98 – 1.15)	1.05 (0.98 – 1.13)
Hispanic			
Cibola County	1.10* (0.19 – 3.94)	1.20* (0.35 – 3.41)	2.18* (1.02 – 4.27)
McKinley County	0.98* (0.20 – 3.46)	2.53* (1.11 – 5.37)	0.20* (0.01 – 1.42)

	1990-1995	1996-2001	2002-2007
New Mexico	1.11 (0.98 – 1.25)	1.27 (1.14 – 1.40)	1.45 (1.33 – 1.58)
American Indian			
Cibola County	1.18* (0.32 – 3.13)	2.54* (1.26 – 4.73)	1.85* (0.84 – 3.60)
McKinley County	2.59 (1.79 – 3.65)	1.33 (0.86 – 2.02)	2.53 (1.89 – 3.36)
New Mexico	1.91 (1.52 – 2.38)	1.61 (1.29 – 1.98)	1.89 (1.58 – 2.24)

Source: NMTR, 2011

* Note: these rates are considered statistically unstable by the New Mexico Tumor Registry data are fairly unstable due to low numbers of cancer cases, the data for the American Indian cohort in McKinley County seem to be consistently higher than rates for the other racial cohorts and geographic regions.

Figure 73 shows rates of kidney cancer for the same three racial cohorts since 1976 in New Mexico. These data also illustrate the higher rates of kidney cancer in the American Indian population, especially since 1991.

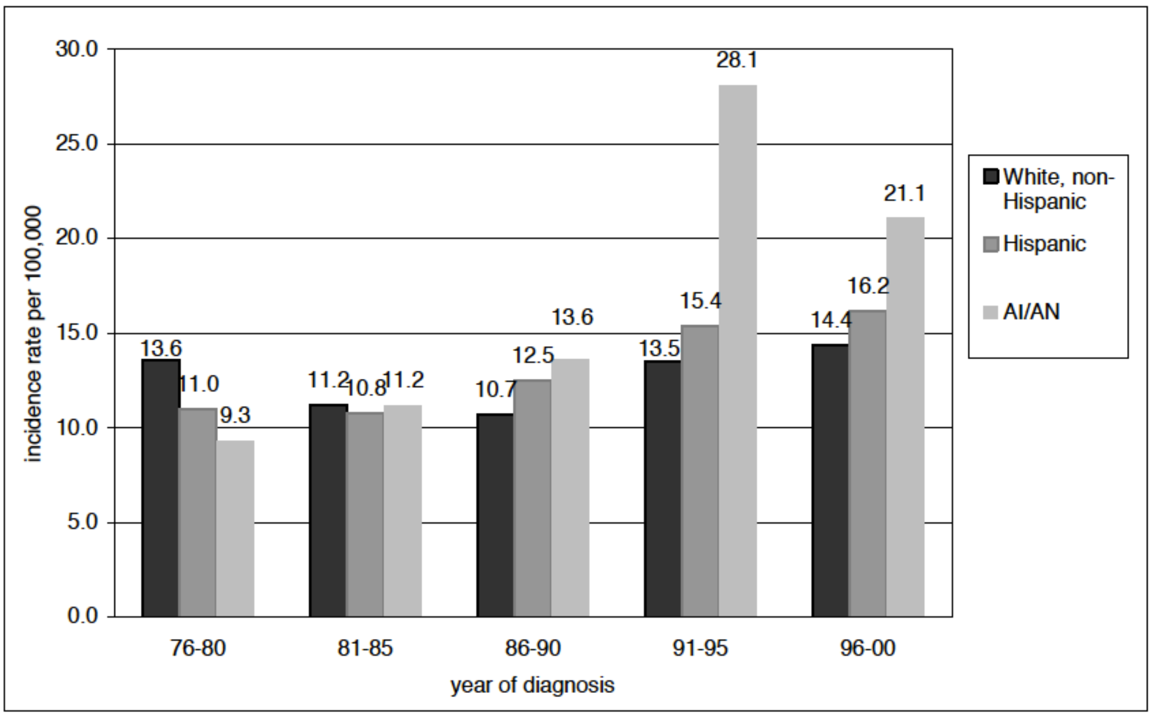


Figure 73. Kidney cancer incidence rates for males by race, New Mexico, 1976–2000

Some baseline surveys are underway which attempt to characterize levels of kidney disease in the Navajo Nation, however, finalized data are not available for this study. Preliminary results suggest that kidney disease is associated with exposure to active uranium mining and proximity to uranium mining features (Lewis et al., 2011).

People who have diabetes or other types or renal damage have been shown to be particularly sensitive to kidney toxicity from uranium exposure (Toth et al., 2003). Both Native American and Hispanic population groups have higher rates of diabetes in New Mexico and should be considered to be sensitive to kidney toxicity and the subsequent health indications. Uranium miners who have inhaled uranium have also shown evidence of renal toxicity; however, most data illustrate the radioactive impacts of inhaling radon daughters and the subsequent development of lung cancer (ATSDR, 2008; Toth et al., 2003).

In the ROI, the New Mexico Department of Health recently conducted a study examining uranium in sources of drinking water and in urine samples. Their study found that 88 out of 91 water samples collected had uranium content below the safe drinking water standard of 30 micrograms per liter and that only three samples were at or above the safe drinking water standard. However, despite these results, residents in the study had uranium concentrations in their urine that were 6–9 times higher than the U.S. national average. Although there were limitations to the study design, this information suggests that residents in the ROI are being exposed to high amounts of uranium through pathways other than drinking water (NMDH, 2011f). The study did not make inferences as to what the health implications might be for the current elevated levels of uranium in urine.

Other studies in the ROI have found contaminated water around past mining and milling sites as well as high levels of radioactivity in and around certain dwellings. These contaminated areas are all being examined in multiagency 5-year plans for the Grants Mining District and Navajo Nation (USEPA, 2008; USEPA, 2011f).

Other Chronic Diseases

Table 84 outlines other chronic diseases rates for Cibola and McKinley County.

Table 84. Chronic disease rates in Cibola and McKinley Counties

	Cibola County (95% CI)	McKinley County (95% CI)	New Mexico (95% CI)
Diabetes (%), 2007-2009	13.9 (10.7 – 17.7)	12.4 (10.4 – 14.8)	7.9 (7.5 – 8.4)
Adult obesity (%), 2001-2009	33.4 (27.2 – 40.3)	33.0 (29.5 – 36.7)	25.7 (24.1 – 27.4)
Adolescent obesity (%), 2001-2009	14.4 (12.0 – 17.1)	15.4 (13.6 – 17.3)	13.5 (11.3 – 16.0)

Source: NMDH, 2011a

Abbreviations: CI – confidence interval

The prevalence of diabetes has been steadily increasing over the past decade in New Mexico, increasing from approximately 6.6 percent in 2000 to 8.3 percent in 2009 (NMDH, 2011a). This trend resembles that which has been seen across the country. It is estimated that one-third of diabetes cases are undiagnosed, therefore, these rates likely underestimate the actual prevalence. In New Mexico, Hispanic, American Indian, and African American populations have statistically significantly higher rates of diabetes than non-Hispanic Whites. Rates of diabetes in Cibola and

McKinley Counties are higher than the overall rates in the State (table 84). This may be due to the high percentage of Hispanic and American Indian populations living in these counties.

Preliminary results of a study conducted with the Navajo population suggest there is an association between diabetes and proximity to uranium mining features (Lewis et al., 2011). These results are not finalized and will be updated once this study is published.

Highly associated with the prevalence of Type II diabetes is obesity. Rates of obesity in New Mexico have almost doubled since 1990 (NMDH, 2011a). In McKinley County, rates of obesity are significantly higher than rates for the State. Across the State, American Indians have significantly higher rates of obesity than non-Hispanic Whites (33.7% (95% CI = 30.4-37.1)) vs. 20.4% (95% CI = 24.1-27.4), respectively).

Infectious Disease

Infectious diseases are those diseases that are transferred from one host to another. In many cases the transfer is from human to human (as in the case of influenza or sexually transmitted diseases) and in other cases this transfer occurs between animals or insects and humans (e.g., mosquito-borne illnesses such as malaria and West Nile virus). Infectious diseases can have erratic patterns, and sometimes spikes in transmission rates occur. Population influx and overcrowding often result from resource development activities and are common instigators of infectious disease outbreaks. This section reports on influenza, sexually transmitted infections, and tuberculosis, three diseases that may be relevant in the context of the project.

Influenza

Influenza is a common condition that circulates every year in the general population, with certain influenza strains (A and B) resulting in epidemics during the winter months. Usually this disease results in “flu-like” symptoms of congestion, headaches, vomiting, and diarrhea; however, in some immune-compromised populations, like the elderly, this disease can be deadly. Influenza season in the U.S. is generally from October to May, peaking in January and February.

Vaccines are available for influenza and are believed to reduce the spread of this infectious disease (NMDH, 2011b). Sixty-four and 70 percent of residents over the age of 65 in Cibola and McKinley Counties received an influenza vaccine in 2009 (table 85).

Table 85. Respiratory infections and influenza vaccination in New Mexico, 2005–2009

	Cibola County (95% CI)	McKinley County (95% CI)	New Mexico (95% CI)
Influenza vaccination rates per 100,000, adults 65+, 2005–2009	64.0 (54.0 – 73.0)	70.5 (63.8 – 76.5)	68.7 (67.6 – 69.8)
Influenza and pneumonia death rates per 100,000, 2006–2009	27.0 (14.7 – 39.3)	39.3 (28.0 – 50.6)	20.6 (19.5 – 21.7)

Source: NMDH, 2011a

Abbreviations: CI – confidence interval

In 2009, New Mexico and the world witnessed the spread of a new influenza virus, the Influenza A virus, subtype H1N1 (H1N1). In New Mexico, the overall lab-confirmed hospitalization rate due to influenza was 4.9 per 10,000, which includes 969 confirmed cases (NMDH, 2010a). Young children were the most greatly impacted with a hospitalization rate of 13.4 per 10,000. Hospitalization due to H1N1 and death rates due to H1N1 were disproportionately higher in American Indian populations in New Mexico (NMDH, 2010a). Worker influx could result in a higher number of cases of influenza and increased strain on public health care systems.

Sexually Transmitted Diseases (STD's)

In-migration of young male workers making high wages has been shown to increase the rates of sexually transmitted diseases in the affected community (Goldenberg et al., 2008). Since the proposed action is likely to result in an in-migration of young male workers, it is important to understand current rates of STDs in the study area.

The State of New Mexico Department of Health STD program collects information on chlamydia, gonorrhea, and syphilis as well as human immunodeficiency virus (HIV) and autoimmune deficiency syndrome (AIDS). Reported rates of STDs that are available at the county level are highly variable as illustrated by the wide range of values seen in figures 74 and 75. Overall, the highest rates of STDs are observed in people aged 20–24. In New Mexico, the northwest health region sees higher rates of STDs than most other health regions and African American, American Indian, and Hispanic racial cohorts have disproportionately higher rates than non-Hispanic Whites.

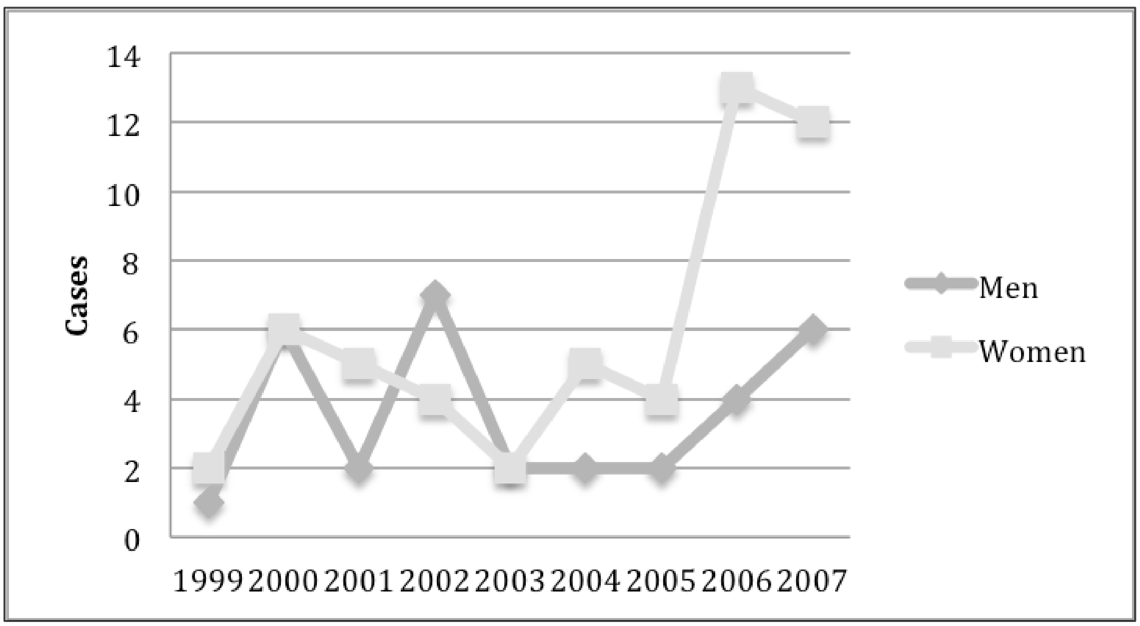


Figure 74. Cases of gonorrhea in Cibola County, 1999-2007 (NMDH, 2011b)

Although rates of gonorrhea remain below the national average in New Mexico, there was a recent increase in incidence rates with the number of reported cases increasing 52 percent between 2000 and 2006 (NMDH, 2011b). Antibiotic-resistant gonorrhea is a new challenge that health care professionals are facing. Figures 81 and 82 depict the absolute number of reported cases of gonorrhea in Cibola and McKinley Counties, respectively. Men and women have relatively similar rates of gonorrhea (NMDH, 2008).

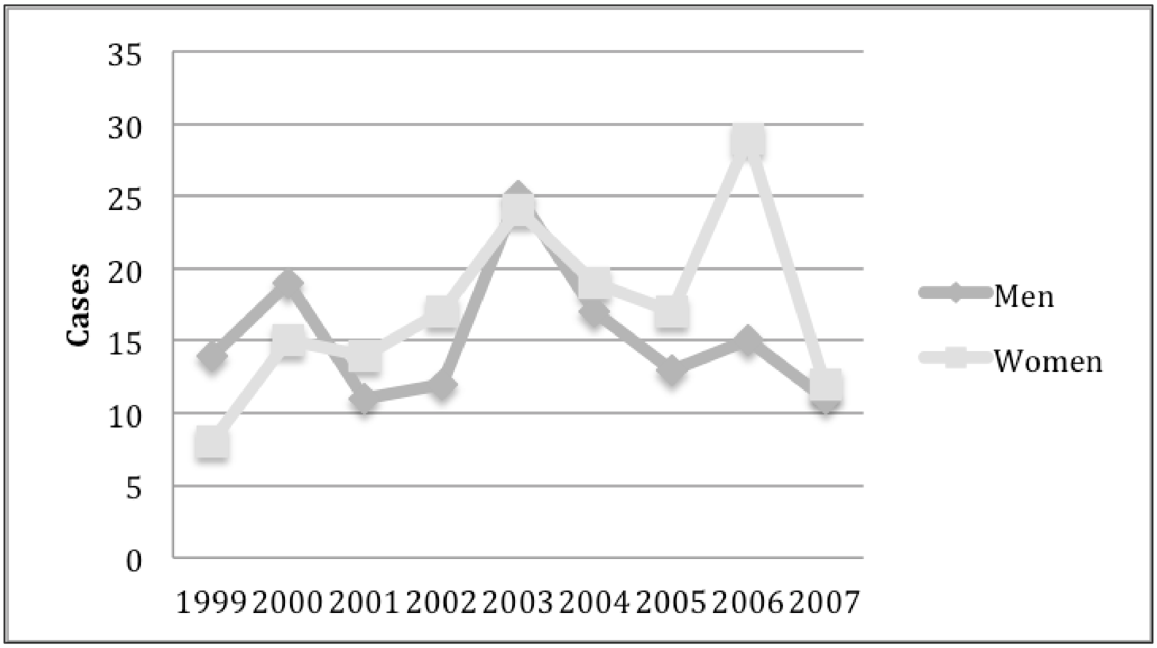


Figure 75. Cases of gonorrhea in McKinley County, 1999-2007 (NMDH, 2011b)

Syphilis incidence is also changing in New Mexico, with rates increasing 270 percent between 2000 and 2006, although the rate of syphilis has come down slightly since that time. Rates of syphilis in McKinley County were the highest of the State in 2009 (Gorgos et al., 2010). Men have much higher rates of syphilis than women.

Rates of chlamydia in New Mexico are one of the highest in the nation and they have been steadily increasing since 2000. Current county rates are presented in table 86. The incidence rate for chlamydia in New Mexico is 55.6 per 10,000, many times the rate of any other STD. McKinley County reported the highest rate for chlamydia at around 95.7 per 10,000 (NMDH, 2011a). The rate of chlamydia in Cibola County was 73.6 per 10,000, also one of the highest rates in the State. Chlamydia more greatly impacts females than males.

Although the incidence rate of HIV is well below the national average (0.80 vs. 1.94 per 10,000, New Mexico vs. U.S), this rate has increased 14 percent since 2005 in New Mexico, while the national rate has remained stable. American Indians and African Americans in New Mexico have seen disproportionate increases in HIV incidence rates between 2005 and 2009 (NMDH, 2010b). Within this timeframe, rates of HIV incidence have increased from 0.46 to 1.17 per 10,000 and from 0.95 to 2.32 per 10,000 in American Indians and African Americans, respectively (NMDH, 2010b).

While incidence of HIV is increasing in New Mexico, rates of AIDS diagnoses (the final stage of HIV disease) are decreasing. Between 2005 and 2009, the incidence of AIDS decreased 11 percent. AIDS disproportionately impacts males (NMDH, 2010b).

Hepatitis B is a disease spread through similar modes as HIV/AIDS. Rates of Hepatitis B in Cibola and McKinley Counties are similar to State rates (table 86).

Table 86. Rates of sexually transmitted diseases in Cibola and McKinley Counties, per 10,000 population

	Cibola County	McKinley County	New Mexico
Chlamydia cases, 2010 (95 percent CI)	73.64	95.67	55.79
Hepatitis B, acute and chronic infections, 2006–2009 (95 percent CI)	1.04 (0.45 – 1.63)	.59 (0.22 – 0.86)	0.71 (0.65 – 0.77)
HIV/AIDS (20)	NA	NA	0.80
Syphilis (2010)	0.37	2.74	0.39
Gonorrhea (2010)	5.55	3.03	8.73

Source: NMDH, 2011a; NMDH, 2010

Abbreviations: CI – confidence interval

The New Mexico Sexually Transmitted Diseases Prevention Unit aims to prevent and reduce the incidence of sexually transmitted diseases in New Mexico. Services offered by this program include “consultation and assistance, partner services, screening, surveillance, health care provider education, case management, and partner notification for reportable STDs in the State” (NMDH, 2011c). HIV prevention programs have also been developed that specifically focus on American Indian, African American, and Hispanic communities.

Tuberculosis

Tuberculosis (TB) is an infectious disease that usually impacts the lungs but can spread to other parts of the body. Between 2008 and 2010 there were 4 cases of TB reported in Cibola County and 12 cases in McKinley County (NMDH, 2011d). TB is highly associated with HIV infection and poor living conditions (McSherry and Connor, 1993).

Injury

Injuries are a major public health problem. They are the third-leading overall cause of death in New Mexico and the leading cause of death among people ages 1 to 44 years old (NMDH, 2011b). Injury is a major cause of premature death, disability, lost worker productivity, and income, and increased health care costs. Not only do injuries impact those injured, they can also decrease quality of life and cause mental anguish in caregivers and family members. Injury can be exacerbated by the proposed action through traffic injuries and social pathways described later on.

Unintentional injuries include falls, motor vehicle collisions, poisoning, drowning, suffocation, and other accidents. Rates of death due to unintentional injury are significantly higher in Cibola and McKinley Counties than the State of New Mexico as a whole (NMDH, 2011a) (table 87). Although no data are available on the county level, in the State of New Mexico, poisoning—

mainly due to drug overdose—accounts for the greatest number of unintentional injury deaths, followed by motor vehicle collisions and falls (NMDH, 2011b). In New Mexico, injury death rates also differ greatly by race. Injury related death rates are highest among American Indian populations (8.35 per 10,000), followed by Hispanics (6.55 per 10,000), and non-Hispanic Whites (5.84 per 10,000). The lowest rates were found in African American (3.66 per 10,000) and Asian populations (2.67 per 10,000) (NMDH, 2011b).

Table 87. Unintentional injury death rates for Cibola and McKinley Counties, per 10,000 population, 2003-2007

	Cibola County (95% CI)	McKinley County (95% CI)	New Mexico (95% CI)
Unintentional injury death rates	7.86 (6.39 – 9.32)	10.03 (9.04 – 11.02)	6.23 (6.07 – 6.38)

Source: NMDH, 2011a

Abbreviations: CI – confidence interval

Traffic-related Injuries

Since the proposed action may increase traffic on roads in the vicinity of the mine and, therefore, the potential for traffic accidents, the current state of traffic-related injuries is discussed. For a more thorough discussion of traffic patterns and road infrastructure refer to the “Transportation” section.

Vehicle crashes in Cibola and McKinley Counties have been decreasing over the past decade, due in large part to a concerted effort by the local police departments. However, traffic fatality rates remain significantly higher in Cibola and McKinley Counties than for New Mexico as a whole (table 88).

Table 88. Motor vehicle collision death rates for Cibola and McKinley Counties, per 10,000 population, 2005–2009

	Cibola County (95% CI)	McKinley County (95% CI)	New Mexico (95% CI)
Motor vehicle traffic crash death rates	2.89 (2.01 – 3.78)	3.81 (3.16 – 4.45)	1.83 (1.75 – 1.91)

Source: NMDH, 2011a

Abbreviations: CI – confidence interval

Overall crash rates for Gallup and Grants in 2009 were 38 per 1,000 people and 23 per 1,000 people, respectively (NMDOT, 2011). Alcohol is a significant factor in some of these collisions. In 2008 in Cibola County, alcohol was involved in 83 percent of fatal crashes (5 fatal accidents in total) and 19 percent of all collisions resulting in injury (28 accidents resulting in injury in total). In McKinley County, alcohol was involved in 67 percent of all fatal crashes (18 fatal accidents in total) and 17 percent of all crashes resulting in injury (52 accidents resulting in injury in total) (NMDOT, 2008).

Social Pathologies and Mental Health

Social pathologies are social and psychological health problems that arise in the context of specific sociocultural and physical environments. Of particular concern are alcohol and drug abuse, and associated injuries and mental well-being. These types of health impacts have commonly been experienced in other resource extraction communities across North America, and have been documented in Louisiana, Wyoming, British Columbia, Alberta and other areas (Goldenberg et al., 2010; Seydlitz and Laska, 1994; Bush and Medd, 2005). These impacts have also been observed in the ROI during previous uranium development boom periods (Milkman et al., 1980; Brodeur, 2003) and are, therefore, important to discuss here.

Alcohol- and drug-related deaths and injuries include diseases such as chronic liver disease and events such as falls, motor vehicle-related deaths, non-alcohol poisoning, suicide, and homicide. Since 1990, rates of drug and alcohol-induced death and alcohol-related injury have been increasing steadily in New Mexico. Rates of alcohol- and drug-related deaths and injuries are higher in New Mexico than in the rest of the country (table 89), and rates in McKinley and Cibola Counties appear to be significantly higher than the rates for New Mexico; in Cibola County death rates attributable to alcohol are almost three times higher than the U.S. as a whole, and McKinley County this figure is over four times the national rate. Social pathology-related health outcomes also extend to younger populations; approximately one-third of youth in Cibola and McKinley Counties report using illicit drugs. Suicide death rates in youth are similar to rates observed in adults in McKinley County. Overall, suicide death rates have been fairly stable since 1995.

Table 89. Social pathology-related mortality in selected jurisdictions, per 10,000 population

	Cibola County (95% CI)	McKinley County (95% CI)	New Mexico	U.S.*
Adults (2007-2009)				
Alcohol-related death rate,	7.81 (5.87 – 10.42)	11.64 (9.93 – 13.73)	5.29	2.81
Alcohol-related chronic disease death rates	4.17 (2.82 – 6.22)	6.52 (5.26 – 8.19)	2.39	1.19
Alcohol-related injury death rates	3.64 (2.33 – 5.68)	5.11 (4.01 – 6.63)	2.90	1.62
Drug-induced death rate	1.52 (0.80 – 3.01)	1.27 (0.84 – 2.14)	2.28	1.27
Suicide death rates	2.24 (1.22 – 3.25)	2.25 (1.61 – 2.90)	1.86	1.13 (2007)
Youth				
Past 30-day illicit drug use, grades 9-12, 2007 (per 100)	30.4% (22.9 – 39.1)	35.1% (28.8 – 42.0)	25.5% (21.7 – 29.7)	NA
Suicide death rates (per 10,000) among youth (15-24yrs), 2005-2009	0.88 (0.0 – 21.0)	2.54 (14.0 – 36.8)	2.06	0.97 (2007)

Source: NMDH, 2011a

Abbreviations: CI – confidence interval

Table 90 outlines mental health indicators in Cibola and McKinley Counties for adults and youth. Of note are the particularly high rates of current depression in Cibola County—15.4 percent, which represents the second highest rates of depression in New Mexico. The rates of contemplating or attempting suicide among youth are also alarmingly high, with over 15 percent of youth in McKinley County reporting having attempted suicide in 2009. The rates of feeling sadness or hopelessness have remained steady over the last 10 years for youth.

Domestic violence is another manifestation of social pathology. The rate of domestic violence reported in Cibola County was 9 per 1,000 population in 2007 and in McKinley County this rate was 13.2 per 1,000 (NMDH, 2011a); however, domestic violence is commonly underreported, thus, true figures are likely to be higher.

The New Mexico Department of Health has services at the local and/or State level targeting mental health and substance abuse: alcohol and drug use and mental health in teens; suicide, violence, sexual assault and domestic violence prevention programs; and mental health and substance abuse treatment. Youth suicide prevention efforts have been developed that specifically target American Indian populations at the tribe and State levels. Similarly, substance abuse programs exist that target American Indian and bordering Mexico communities.

Table 90. Mental health outcomes in Cibola and McKinley County

	Cibola County	McKinley County	New Mexico
Adult			
Frequent Mental Distress (FMD), 2009	11.9%	9.2%	10.6%
Current Depression, 2006	15.4%	7.0%	9.3%
Youth			
Persistent sadness or hopelessness, 2001-2009* (95% CI)	32.5% (29.2 – 36.0)	31.7% (29.0 – 34.5)	29.7% (28.2 – 31.3)
Seriously considered suicide, 2009	13.2%	19.0%	15.9%
Attempted suicide, 2009	6.3%	15.5%	9.7%

Source: NMDH, 2011e; *NMDH, 2011a

Abbreviations: CI – confidence interval

Notes: FMD: Respondents who report that they experienced 14 or more days when their mental health was “not good” in the past 30 days are classified as experiencing FMD.

Persistent sadness or hopelessness: Percentage who felt so sad or hopeless almost every day for 2 weeks or more in a row that they stopped doing some usual activities during the past 12 months.

Social Determinants of Health

To a large extent, health is determined by where we live, the state of our environment, our income and education levels, our jobs, and our relationships with friends, family, and the larger community. These critical factors are often called determinants of health because of their roles in shaping health in individuals and communities. Some health determinants are under the direct control of individuals: for example, the choice to use alcohol or to smoke, to eat healthy foods, or to use seatbelts. Other health determinants are more closely tied to the physical environment (e.g., air and water quality); activities under the control of governments (public utilities, land use, access to alcohol and tobacco); working conditions (jobs, income); or the social environment (social, emotional, and religious supports).

The biomedical health outcomes described above share the fact that rates of disease incidence, prevalence, and mortality are driven in large part by these determinants, although genetics also plays a role. The effects of individual health determinants on disease rates often persist even after controlling for standard risk factors such as smoking rates, cholesterol and blood pressure levels, and overall poverty.

The following section describes health determinants that are relevant for the affected population and to the proposed uranium mine development. These health determinants help elucidate part of the pathway between resource development activities and biomedical health outcomes.

Table 91 shows where there is an evidence-based interaction between the biomedical health outcomes presented above, and the social determinants.

Table 91. Interaction between health determinants and health outcomes

	Chronic Diseases	Infectious Diseases	Injuries	Social Pathologies and Mental Health
Income and employment	x	x	x	x
Health and social services	x	x	x	x
Alcohol/drug misuse	x	x	x	x
Personal health behaviors	x			

Income and Employment

The proposed action has the potential to generate employment and income in the ROI, through both direct and indirect means. Since employment and income are widely accepted as fundamental determinants of physical and mental health (CFPTAC, 1999; WHO, 2004), it is important to understand the current status of income and employment in the project area. However, the affected environment portion of the “Socioeconomics” section of this EIS presents substantial data on income and employment that need not be repeated here. Specifically, the “Socioeconomics” section reports on labor, employment, unemployment, earnings, and public finance. This section will touch on a few additional indicators of income and employment that have links to health: poverty and food insecurity.

The median household income for both Cibola and McKinley Counties is lower than New Mexico averages and the number of persons living in poverty exceeds State levels (table 92). In Cibola and McKinley Counties approximately one in four people are living in poverty. These proportions are higher among children; greater than one in three children are reported to be living in poverty and across the State, Hispanic and American Indian children experience much higher rates of poverty (NMDH, 2011a). Low income and poverty may put many New Mexicans at risk for poor health conditions.

Table 92. Economic indicators for Cibola and McKinley Counties

	Cibola County	McKinley County	New Mexico
Median household income, 2009	$32,954	$30, 794	$42,830
Persons living in poverty, 2009 (95% CI)	25.8% (20.2 – 31.4)	28.4% (22.6 – 34.3)	18.2% (17.7 – 18.8)
Children living in poverty, under 18 yrs old, 2009 (95% CI)	35.4% (27.6 – 43.2)	38.9% (30.6 – 47.3)	28.8% (24.7 – 26.9)
Children living in poverty, under 5 yrs old, 2000	35.0%	42.6%	27.6%

Source: NMDH, 2011a; Abbreviations: CI – confidence interval

Data available at the State level indicate that people in the natural resources, construction, and maintenance occupations are at greater risk of unemployment compared to all other occupational categories listed (table 93). This information is confirmed by the low levels of compensation for these industries that are presented in tables 52 and 53. This indicates that miners in the ROI may be at particular risk of poor health outcomes.

Table 93. Unemployment rates in New Mexico by occupation, 2011

Occupation	Unemployment Rate
Management, professional and related occupations	4.7%
Service occupations	10.3%
Sales and office occupations	9.0%
Natural resources, construction, and maintenance occupations	16.1%
Production, transportation and material moving occupations	12.8%

Source: USBLS, 2011

Food insecurity is also related to income and employment. It is estimated that between 2007 and 2009, 15 percent of New Mexicans were food insecure (i.e., lacking basic food intake necessary to provide energy and nutrients to live a fully productive life) (Nord et al., 2010). Rural populations are particularly vulnerable to food insecurity.

Rates of food insecurity are not available at the county level; however, food stamp participation is available and presented in table 94. Families with children are particularly susceptible to poverty, with 60 and 78 percent of food stamp enrolled households in Cibola and McKinley Counties, respectively having children under the age of 18 years old (Census, 2008).

Table 94. Food stamp enrollment in Cibola and McKinley Counties, 2008-2010

	Cibola County	McKinley County	New Mexico
Households receiving food stamps	16.8%	14.5%	12.1%
Percent of households receiving food stamps with children under 18 years	68.2%	77.5%	62.1%

Source: Census, 2010x

Health Care Services

The proposed action could impact health care services by: (1) bringing new people into the area, and (2) through project-related injuries. For this reason, it is important to understand the current status of health care services in the ROI.

New Mexico's health system is comprised of Indian Health Services (IHS) and private health institutions. Cibola County has one private hospital and one IHS hospital, while McKinley County has four IHS hospitals and one private hospital. Various health centers also exist in the ROI. Along with these institutions there are a number of private physicians' offices.

All health care facilities located in Cibola and McKinley Counties are listed as health professional shortage areas (HPSA's) [1] (USDHHS, 2012). During stakeholder consultation, it was confirmed that there is an extreme shortage of health care workers in the project area (Gunnell, 2012). It was also noted that approximately half the positions available at medical facilities are not being filled due to funding shortages and that IHS hospitals are funded at less than 50 percent of the required need.

Access to health care in the ROI is also influenced by health insurance. Many people in the study area lack health insurance, which, compounded with high rates of poverty, may exacerbate negative health impacts. Not only are those living in poverty at greater risk of having poor health outcomes, uninsured adults in the United States have less access to recommended care, receive poorer quality of care, and experience worse health outcomes than do insured adults (IOM, 2002).

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[1] An HPSA meets the following criteria:

1. The area is a rational area for the delivery of primary medical care services.

2. One of the following conditions prevails within the area:

(a) The area has a population to full-time-equivalent primary care physician ratio of at least 3,500:1.

(b) The area has a population to full-time-equivalent primary care physician ratio of less than 3,500:1 but greater than 3,000:1 and has unusually high needs for primary care services or insufficient capacity of existing primary care providers.

3. Primary medical care professionals in contiguous areas are over-utilized, excessively distant, or inaccessible to the population of the area under consideration.

McKinley and Cibola Counties both have high rates of uninsured persons compared to the United States population (16.7 percent) (table 95), which places many at risk of adverse health outcomes, and worsening of existing health outcomes. Compared with New Mexico averages, Medicaid enrollment is higher in both Cibola and McKinley Counties at 29 and 36 percent, respectively (table 95). The number of households enrolled in Medicaid has increased steadily since 2006 (NMDH, 2011a).

Table 95. Health care insurance and access to health care services

	Cibola County	McKinley County	New Mexico
People without health insurance, under 65 years, 2007 (95% CI)	21.6% (18.3 – 24.9)	30.8% (27.9 – 33.7)	26.7% (25.3 – 28.1)
Medicaid enrollment, average per month, 2010*	28.6%	36.4%	23.4%
Number of residents per primary health care provider, 2008	756	749	832

Source: NMDH, 2011a; Abbreviations: CI – confidence interval

Notes: * Medicaid is measured by monthly averages since enrollment changes so frequently. The data provided are the average of 12 monthly averages for 2010.

Provision of health insurance to the uninsured is associated with improved general health outcomes, i.e., general health and physical functioning, and mortality; improvement of chronic conditions, i.e., cardiovascular disease and diabetes, cancer, and depression; improvement of acute conditions (McWilliams, 2009) and reduced mortality by as much as 5–15 percent (Hadley, 2003).

Access to emergency medical care is also crucial health care services component for prevention death due to cardiac events, stroke, and serious trauma. In New Mexico, EMS services are administered by fire departments, hospitals, tribal affiliations as well as non-fire and non-hospital based private organizations. In Cibola County the current median response time for EMS services to a medical emergency is 6 minutes; in McKinley it is 7 minutes (NMDH, 2011a). These response times are some of the lowest in the State.

Health Behaviors

Health behaviors also influence biomedical health outcomes. Smoking is one major health behavior associated with cancer, diabetes, heart disease, and other chronic conditions. Smoking is also shown to be associated with the negative health impacts of radon, a common exposure in uranium mines.

Rates of smoking in Cibola and McKinley Counties are similar to the national and State average, with approximately 17–21 percent of the population reporting being current smokers. Rates of smoking in youth (Grades 9–12) are slightly higher with approximately 28 percent of youth reporting regular smoking in Cibola and McKinley Counties (table 96). Rates of adult and youth smoking did not differ by ethnic group in New Mexico. In New Mexico rates of smoking tobacco in adults and youth has been decreasing slightly over the past decade (NMDH, 2011a).

Table 96. Smoking rates in Cibola and McKinley County

	Cibola County	McKinley County	New Mexico
Adult smoking prevalence, 2006-2008	21.3% (15.0 – 29.3)	17.0% (13.3 – 21.4)	20.1%
Youth smoking prevalence, 2009	28.4% (20.9 – 37.3)	27.8% (23 – 33.1)	24.0%

Source: NMDH, 2011a

Numerous programs exist that target tobacco use in New Mexicans. Smoking was prohibited in most public places as of 2007, prices of tobacco products were raised in 2003, and New Mexico is the only state in the nation requiring insurance companies to cover costs associated with quitting smoking. Prevention campaigns exist that target youth and American Indian populations.

Environmental Consequences

Table 97 shows the criteria and definitions specific to human health and safety used to evaluate impacts of the three alternatives.

Table 97. Impact characterization for public health and safety

Magnitude	Descriptor
Major	Predicted to result in a measureable change in population health indicators and/or exceeds capabilities of infrastructure and/or service management systems.
Moderate	Predicted to result in a decline in individual health and/or a deterioration of the capability of infrastructure and/or service management systems.
Minor	Within normal variation of human health conditions or within current capabilities of infrastructure and/or service management systems.
Extent	
Large	Effects extend beyond the regional study area
Medium (localized)	Effects occurs within the local study area
Small (limited)	Effects mainly occur in close proximity of project activities
Duration	
Long term	Remaining after project closure
Medium term (intermittent)	Lasting the life of the project
Short-term	Occurring only during construction or less than 3 months after construction ends
Likelihood	
Probably	Evidence suggests that effects commonly occur in similar projects
Possible	Evidence suggests that effects may occur, but are not common in similar projects
Unlikely	There is little evidence that effects will occur as a result of this project

Magnitude	Descriptor
Precedence or Uniqueness	
Severe	Impacts occur in such close proximity to national parks, National Register of Historic Places, or national historic landmark sites, or other especially valued, unique, or protected sites, that the valued features of those nearby sites are severely jeopardized; OR Impacts are completely unprecedented; no similar impacts have ever been known to occur; OR The types, extent, or probability of the impacts cannot be reasonably predicted; OR There is substantial and sustained dispute among subject matter experts, agencies, organizations, and/or citizens about the nature or importance of the impacts.
Moderate	Impacts would occur at sufficient distance from any protected site that the valued features would be perceptibly altered but not severely compromised or jeopardized; OR There is moderate confidence in the accuracy of the predictions as to types, extent, and likelihood of the impacts; OR There is moderate dispute among subject matter experts, agencies, organizations, and/or citizens about the nature or importance of the impacts.
Slight	Impacts would occur at sufficient distance from any protected site that the valued features would be imperceptibly altered; OR The types, extent, or probability of the impacts can be reasonably predicted with only slight uncertainty; OR There is very limited dispute among subject matter experts, agencies, organizations, and/or citizens about the nature or importance of the impacts.

Alternative 1

Under the no action alternative, conditions described above under the “Affected Environment” section would continue for the foreseeable future. This alternative is not expected to have any impact on these conditions.

Alternative 2

This section describes the direct and indirect effects of alternative 2—the proposed action—on five important pathways that may affect the health and safety of the people who live in the study area:

- Traffic safety;
- Noise;
- Environmental exposure;
- Impacts stemming from employment; and
- Impacts stemming from in-migrating workers

Traffic Safety

Figure 76 depicts links between the proposed action and traffic safety outcomes.

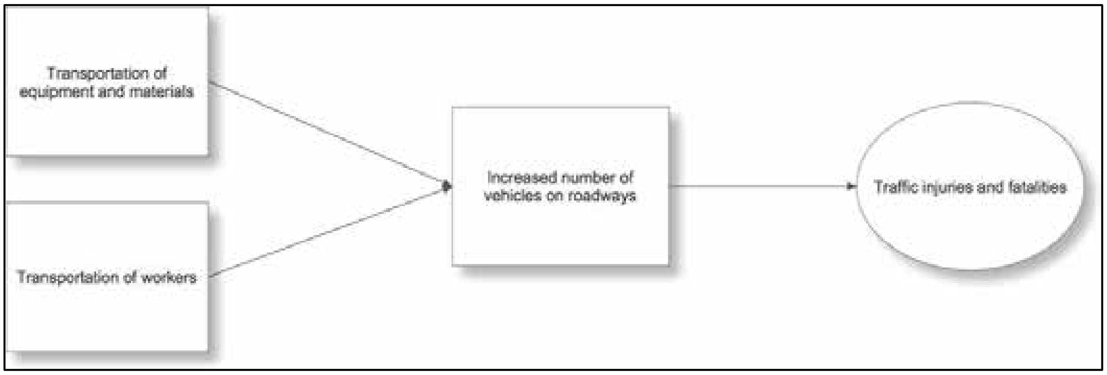

Figure 76. Links between the project and traffic safety outcomes

Traffic safety is an important issue from a community and public health perspective. Traffic injury or fatality is a highly visible, tragic, and largely preventable public health outcome. The proposed action has the potential to change traffic safety in the local area by adding construction and operations vehicles to local and regional roadways and by workers transporting themselves to the Roca Honda Mine (project) site.

Motor vehicle injuries and fatalities are significant health issues in Cibola and McKinley Counties, with rates of traffic fatalities higher in these areas than in the State of New Mexico (see table 88). Overall collision rates for Gallup and Grants in 2009 were 38 per 1,000 people and 23 per 1,000 people, respectively (NMDOT, 2011). Alcohol was and is a significant factor in many of these collisions. In 2008 in Cibola County alcohol was involved in 83 percent of all fatal crashes and 19 percent of all collisions resulting in injury. In McKinley County alcohol was involved in 67 percent of all fatal crashes and 17 percent of all crashes resulting in injury (NMDOT, 2008).

For the proposed action, project-related traffic will comprise both vehicles (mainly trucks) used to transport materials and equipment, and vehicles used to transport workers. Worker transportation will comprise both private vehicles, which will be used for workers to commute to the project site from their temporary or permanent residences (mainly in Grants and Gallup), and company vehicles that will be used to transport personnel during their work shifts.

For the proposed action, several aspects of project-related traffic for during construction, operation and decommissioning have the potential to impact traffic safety.

1. The number of vehicles on the road. A higher number of vehicles means a higher number of collisions, with some resulting in injury or fatality.

   Construction is expected to last 7 years and will overlap with the operations phase for approximately 3.5 years. However, the number of construction vehicles required during the construction phase is not known at this time. It is estimated that several hundred workers would be required for project construction at its peak (Velasquez et al., 2012); however, it is also unknown how many vehicles would be required to transport these workers to the project site at given times of day.

Operations are expected to last 13 years. During operations the main source of traffic will be haul trucks that will bring ore from the project site to the mill site, and transportation of mining supplies and workers to and from the project site. Two existing roads are planned to be upgraded for haulage routes from the project site. Currently it is unknown how many haul trucks will be in operation on a daily basis.

Mining supplies travelling to the project site during operations include fuel, blasting agents, and water treatment. Supplies that would need to be removed include petroleum products and solid wastes. Workers would transport themselves to and from the mine during operations in private vehicles likely from Grants or Gallup and the surrounding villages. During peak production, RHR is expecting there would be a workforce of approximately 250 workers (Velasquez et al., 2012). The workers will operate in three shift rotations around the clock. Supplies and personnel will travel to and from the mine on haul roads.

Decommissioning will be completed approximately 2 years after the end of operations; however, reclamation activities will overlap with project operations for approximately 6.5 years. Overall, reclamation is estimated to last 8.5 years. Because of this overlap in activities and the slower pace of reclamation activities it is expected that the number of additional vehicles on the road would be less than that required for construction mainly due to decreased labor requirements.

Due to the gaps in data around number of vehicles being added to the roadways it is not possible to estimate the absolute increase in traffic during all phases; however, the certainty that there will be Project-related vehicles operating on the local roadways means an increased risk of traffic collisions, with the possibility of resultant injuries or fatalities.

2. The types of vehicles on the road. Project construction will require the transportation of construction materials and large construction-related vehicles required to develop mine operations facilities and structures. Project operations will require the haul trucks to transport ore to the mill site and will require vehicles carrying mine supplies to travel to and from the site. Decommissioning activities will be similar to construction with large demolition machinery and removal of project materials. The trucks used during all of these phases are large in size and may move at a slower speed. Slower moving vehicles on rural roads have been found to cause other drivers to engage in risky or illegal passing maneuvers, which increases the likelihood of collisions (CCMTA, 2006).
3. The location of vehicles. As stated in the “Affected Environment” section, the closest interstate to the proposed project site is I-40, which runs east-west approximately 20 miles to the south. Road 556 is the closest access road to the proposed site, which runs north-south approximately 1 mile to the east. Road 556 also provides access to State Highway 605 approximately 17 miles southwest and is the nearest access road leading to I-40. Both Road 556 and Highway 605 will be used by project-related construction and decommissioning vehicles and by workers transporting themselves to and from their residences. It is assumed that most workers will be coming from Grants or Gallup. Currently these roads are lightly trafficked and traffic on the roadways surrounding the proposed mine is free flowing during both the morning and evening peak periods. The low traffic volumes may minimize the potential risks of traffic collisions.

A haul road will be used to transport ore to the mill during project operations. As stated in chapter 2, the haul road from Section 16 will lead west through section 16 and then travel south on private lands through section 17 and 20. A haul road from section 10 will lead east from section 10 along the general orientation of an existing forest system road located in section 11. The mill site has not yet been selected so the exact haulage route, after leaving the private lands cannot be assessed, however the selected route will likely include smaller highways that will contain local traffic and possibly traffic from other resource development projects in the area. It is expected that there will be minimal local traffic on these roads; however, interactions with other resource development projects may increase the risk of traffic collisions and risky behavior of other drivers trying to maneuver around slower moving traffic.

4. Driver behavior. The behavior of workers behind the wheel can affect traffic safety. Behaviors of greatest concern include inappropriate or excessive speed, presence of alcohol, medicinal or recreational drugs, fatigue, and traveling in darkness (WHO, 2004). RHR has developed a company safety manual that outlines training and sets forth policies and requirements for safe driving procedures such as onsite speed limits and no tolerance of drug or alcohol use. This safety manual should meet the appropriate safety regulations as laid out by Occupational Safety and Health Administration (OSHA). Contractors should be obliged to follow these safety procedures in order to provide contract work to the project. Strict enforcement of these behaviors for safe driving will be essential for minimizing potential impacts on traffic safety.

The impacts to traffic safety from the project could be minimized with the following strategies:

- Police and emergency services personnel in the project area should be consulted on a regular basis to keep them informed of traffic schedules and enlist their services when they are needed.
- Once routes for heavy trucks are known, route-specific mitigation may be required. Project personnel should liaise with local police and emergency services personnel once routes are known to discuss any further mitigation (e.g., route changes, changes to signage at intersections, etc.).
- Heavy truck and slow moving work vehicles on main roads should be limited to off-peak hours to the extent possible.
- All project workers should adhere to RHR’s safety standards, which prohibit drug and alcohol use, cell phone use, and speeding while driving. Strict enforcement of these standards is required

The impacts to traffic safety from construction, operation, and decommissioning for the proposed action are expected to be of minor to moderate magnitude, to have a medium to large geographic extent, and to be of short- to medium-term duration. There is probable likelihood of these impacts occurring and the precedence or uniqueness is slight. Therefore, the overall significance of the impacts to traffic safety during construction, operation, and decommissioning would be adverse but less than significant.

Noise

Figure 77 depicts links between the proposed action and noise outcomes.

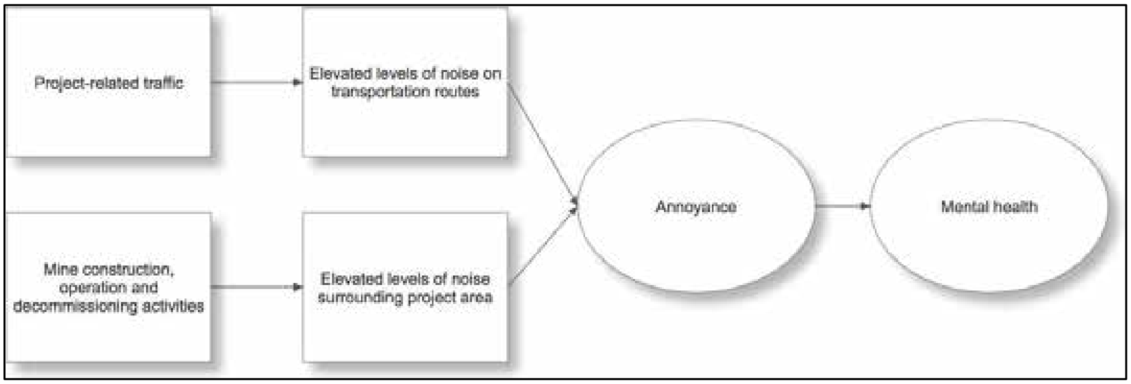

Figure 77. Links between the project and noise outcomes

Noise would be generated in the proposed action from construction activities, traffic, and possibly mining operations. Noise can have a negative impact on human health and well-being particularly if it interferes with sleep. Hearing damage, annoyance, sleep disturbance, impaired communication, reduced school performance, and poor cardiovascular health have all been linked to exposure to high levels of noise in a community setting (WHO, 1999; 2011).

It is generally agreed that environmental noise ranging from 40 to 55 decibels, A-weighting (dBA) is likely to lead to annoyance in a portion of a population (London Health Commission, 2003); levels that range between 40 and 60 dBA may interfere with sleep; and levels above this range (i.e., 65 to 70 dBA) may decrease school performance and increase ischemic heart disease. In general, intermittent, higher frequency, short duration, intense sounds have greater impacts on health than do continuous low-frequency, long-duration, low-intensity sounds (London Health Commission, 2003).

In terms of project-related noise from fixed sources (e.g., drilling, building of surface facilities), there is likely to be little to no noise generated that would cause human health effects. As stated in the “Affected Environment” section, there are no existing residences in the vicinity. The closest town—Grants—is approximately 18 miles from the proposed site while the village of San Mateo is about 3 miles away. There are also very few roadways or trails in the area. Noise studies are not being conducted for the Roca Honda Mine project so there is no estimate of baseline noise levels or projected project activity-related noise levels on local receptors. However, the remoteness of the proposed project site means that human receptors are not likely to experience noise above the 40–55 dBA range.

Noise would also be generated through project-related traffic. Large trucks would travel along local roadways during construction, operation, and decommissioning. It is possible that some residents who reside along the transportation routes would become annoyed with increased noise levels due to truck traffic. Loss of sleep from nighttime truck travel is a particular impact of concern. Sleep disturbance and annoyance are the first impacts of nighttime noise and can be detrimental to mental health (WHO, 2009). Sleep disturbance may affect people’s ability to cope with normal stresses in life and work productively. Annoyance can affect people’s perceived levels of happiness and increase stress, which negatively affects mental well-being and has other potentially negative impacts on health, including increased risk of cardiovascular disease (WHO, 2009).

Because the routes that trucks would travel on outside of the project area have not yet been determined, it is not possible to know which people would be potentially impacted by truck-related noise. It has also not been determined whether trucks would be traveling at night to and from the project site. Once project routes and transportation schedules are finalized it will be important to assess noise levels at receptors along the transportation corridors and to establish complaint resolution communication channels for residents who may be impacted. Limiting nighttime travel would limit negative health impacts experienced by people living along transportation corridors.

The impacts to health from project-related noise could be minimized by implementing the following strategies:

- Restricting all heavy truck transportation to day-time hours.
- Landowners could be consulted to identify any roads to be avoided at night to prevent sleep disturbance of nearby residents.
- Any complaints raised by local residents related to noise in the communities should be followed up by project personnel and if relevant, government agencies. A phone number and/or email address should be made easily available so that they can easily report any concerns.

The impacts to noise from construction, operation and decommissioning for the proposed action are expected to be of minor magnitude, to have a medium geographic extent, and to be of medium-term duration. There is a probable likelihood of these impacts occurring and the precedence or uniqueness is slight. Therefore the overall significance of the impacts from the proposed action related to noise would be adverse but less than significant.

Health Effects Associated with Environmental Exposures

Figure 78 depicts potential links between the proposed action and environmental health outcomes.

Activities associated with underground uranium mining can affect human health via changes to environmental conditions. This section reviews three potential pathways: health changes that could arise from potential exposure to contaminants; health changes that could arise from the perception of exposure; and health changes that could result via alterations to land and water.

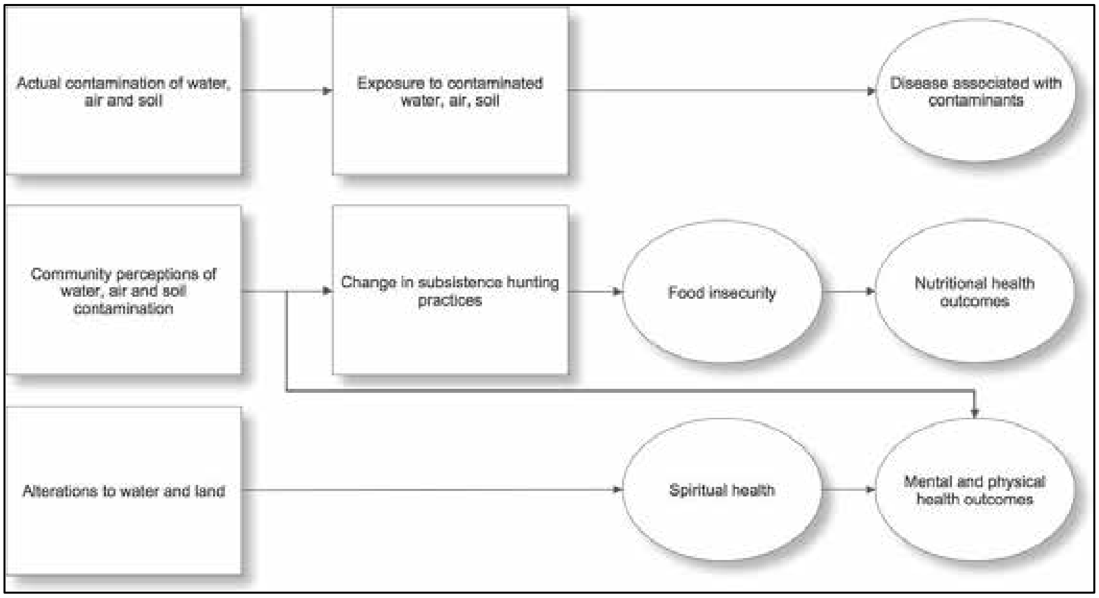

Figure 78. Links between the project and environmental health outcomes

Health Changes Arising from Exposure to Contaminants and Pollutants

Below are described potential routes of exposure to air and water-borne contaminants and potential effects on human health. Project-related changes to air and water quality are discussed elsewhere in this EIS in the sections of air, water, and environmental justice; impacts to human health from potential exposure to project-related radioactive substances are addressed air quality. Characterizing the extent of human exposure to contaminant loads and the modeling of subsequent changes in human health outcomes is beyond the scope of this assessment.

Community Exposure to Radioactive Materials

The mining dust from the project will contain three potentially hazardous naturally-occurring substances: radon, radium and uranium.

Radon is a radioactive gas that is formed as a decay product of radioactive elements in soil and rock. It is common and is found in many homes and other buildings. Radon gas can attach to dust particles or other substances and be inhaled. It can also be ingested through drinking water from underground sources. Most radon that enters the body is breathed out; however, small amounts can remain and enter organs or fat tissues to become a health hazard. Radon exposure is associated with the development of lung cancer. Since tobacco products are naturally sticky, radon is more easily retained in the body when someone is smoking (ATSDR, 2008).

Radium is another radioactive substance that results from the decay of uranium and thorium in rock and soil. It can enter the body when it is inhaled or swallowed. Most radium leaves the body immediately if it is ingested; however up to 20 percent can remain in the bloodstream and be carried to all parts of the body. Health impacts from long-term exposure to radium include anemia, cataracts, fractured teeth, cancer (especially bone) and death (ATSDR, 1990).

Uranium is mainly ingested through water and food, but can also be ingested through air, although minimally. Most ingested uranium leaves the body though the urine, however, some can be deposited in the kidney, bone, and liver. The main health impact of ingesting uranium is kidney disease. There is no conclusive evidence that uranium causes cancer (ATSDR, 2011).

Some workers on the project would be exposed to these substances while on the job. Worker health and safety is regulated by MSHA, OSHA, and the New Mexico Environment Department and companies are required to follow their regulations. Worker exposure to hazardous substances and situations is covered by the field of occupational health and safety, and is outside the scope of this section. Brief discussions of worker health and safety are included in the “Air Quality” and “Environmental Justice” sections.

However, potential exposure of community members to dust remains relevant. Community members, and in particular workers’ families, could be exposed to radioactive mining dust if dust is inadvertently carried home by the worker on his/her clothing or person.

RHR has developed a system to reduce the exposure of workers and their families to mining dust. When workers exit the mine they would immediately enter personal change stalls where they would change from their soiled mine clothes into their street clothes. Mine clothes would be placed in a basket and removed from the work stall, washed, and returned to the worker for the following shift. All soiled clothes including boots would remain onsite. Miners will also have showers in their stalls to clean thoroughly before returning home in their clean clothes (Velasquez et al., 2012). These methods would greatly reduce family exposure to radioactive materials. Also, all water collected from the showers, from mine operations and any water runoff on the site would be treated before being released back into the environment. This mitigation measure would decrease the public exposure of uranium, radium and radon through water pathways.

Another pathway through which the public might hypothetically be exposed to radioactive materials is via vehicles exiting the mines either carrying radioactive ore material or by spreading dust that accumulated on the vehicles while they were on site. All trucks carrying ore materials would be sprayed down before leaving the site at the vehicle washing station located onsite. As previously stated, all water from the wash stations would enter the water treatment plant and be treated before being used as irrigation water on private ranch land.

Decommissioning would present a health risk to the community if the mine were not properly reclaimed after mining activities have stopped. This could occur if mine operations were to be suspended because reductions in the price of uranium made it no longer viable to mine or once the natural mine cycle has been completed. As previously and subsequently stated in this EIS, there is a legacy of contaminated mining sites in the project area (ATSDR, 2009; USEPA 2011a; Shuey and Ronca-Battista, 2007). These contaminated sites are of great concern to residents in the local area (Head-Dylla et al., 2012; Gunnell, 2012; Luarkie et al., 2012; Bonne et al., 2012; Juanico et al., 2012). RHR has submitted detailed plans to reclaim the mining site and new regulations require the reclamation process to be bonded, meaning that sufficient funds for cleanup must be set aside before project construction can begin. This is a requirement that did not exist in the past, which allowed many companies to walk away from their sites when project operations halted mid-production. Because of these past actions of uranium mining companies and the perceived slow progress of the government to clean up the contaminated sites, there is substantial skepticism on the part of community members that the Roca Honda Site would, in fact, be properly reclaimed in a timely manner (Head-Dylla et al., 2012; Gunnell, 2012).

Several additional mitigation measures could further decrease community exposure to mining dusts. These additional measures, which are not currently part of RHR's plans, include:

- Treating water from mine operations and related activities to EPA drinking water standards.
- Allowing employees to wash their vehicles of dust that accumulated during the day before leaving for home; or locating all private vehicles in a dust-protected area.
- Ensuring haul trucks are securely covered with a material that prevents radioactive dust from exiting the mine site with the vehicles.
- Implementation of BMPs during all stages of the Project to reduce dust generation on the Project site. This generally includes watering down areas prone to dust. Because of existing arid conditions it may be necessary to implement specialized techniques to reduce dust more effectively.
- Any complaints raised by local residents related to Project-related dust in the communities should be followed up by Project personnel, and if relevant, regulatory agencies. A phone number and/or email address should be made easily available so that they can easily report any concerns.
- It is important to note that many of the exposure pathways for working conditions are controlled through established work and safety regulations. In the past, health and safety regulations were non-existent or followed very minimally, exposing workers and the community to high levels of contaminants (Dawson, 1992; Head-Dylla et al., 2012; Pasternak, 2010). This has generated a feeling of distrust amongst some stakeholders including some past uranium miners. It will require strict enforcement of safety regulations and good communication to gain the trust of the community and properly manage risk perception regarding worker health and safety.

As with any carcinogen, any amount of exposure to radon and radium increases the risk of developing cancer; however, due to the complicated etiologic pathway of cancer, it is not possible to quantify the increase in cancer that mine workers or their families might face through the described exposure pathways. Exposure pathways for families of workers are greatly mitigated through diligent implementation of worker health and safety procedures.

Community Exposure to Traffic Emissions, Including Dust

Trucks, machinery, and heavy equipment used in mining activities use internal combustion engines and gasoline or diesel fuel that upon combustion produce many EPA criteria pollutants. The known pollutants in vehicle tailpipe exhaust include carbon monoxide, nitrogen dioxide, ozone, particulate matter, and polycyclic aromatic hydrocarbons (e.g., benzene). The health impacts associated with these toxins include headaches, respiratory infections, eye and throat irritation, asthma, heart attacks, lung damage, impaired fetal development, and cancer (USEPA, 2011b). Because of these health impacts, the EPA has established limits on the amount of emissions humans can be exposed to from industrial projects. Dust from road traffic may also exacerbate existing respiratory conditions.

Project-related traffic will comprise both vehicles used to transport materials and equipment and private vehicles used to transport workers. Because of the remote location of the project and the use of rural roads for transporting materials and workers to and from the site it is unlikely that project-related traffic emissions will cause exposures that exceed EPA criteria. Since transportation routes have not yet been established for transportation of ore to the processing mill it may be necessary to complete a health risk assessment on receptors along the transportation corridor to model actual changes in air quality on human receptors once these routes have been established. To reduce the impacts of traffic emissions and dust on human health it is recommended that:

- BMPs be implemented during all stages of the project to reduce traffic related dust. This generally includes watering down roadways prone to dust. Because of the arid conditions at the project it may be necessary to implement specialized techniques to reduce dust more effectively.
- An air quality test be carried out at nearby receptors along transportation corridors during each stage of construction, operation, and decommissioning to ensure levels of EPA criteria pollutants are within the range that is safe for human health.
- Any complaints raised by local residents related to air pollution in the communities should be followed up by project personnel, and if relevant, government agencies. A phone number and/or email address should be made easily available so that they can easily report any concerns.

Intentional or Accidental Releases of Contaminants to Air, Water or Soil

Hazardous substances that will be kept onsite from time to time during project construction and operations include antifreeze, cleaning solvents, diesel fuel, gasoline, petroleum-based grease, hydraulic fluid, oil, barium chloride, hydrochloric or sulfuric acid, and sodium hydroxide. These substances are used for equipment fueling, lubricating drilling processes, or water treatment.

Historically, there have been very few accidental releases of contaminants to air, water, or soil with underground uranium mining (this is not to be confused with uranium milling, which has had major contamination impacts, especially in the project area (for example see Shuey and Ronca-Battista, 2007). National regulations require that these substances be handled, stored, and disposed of in accordance with applicable rules. In addition, a detailed spill prevention control and countermeasure plan is to be developed and used to train employees on safety procedures (see mine operations plan for details). RHR will also be required to implement best practices for waste management.

The predicted effects of the project on air and water quality are described in those sections of this EIS. Air and water are the media through which human exposure to these substances could occur.

As noted above, characterizing the extent of human exposure to contaminant loads and the modeling of subsequent changes in human health outcomes is beyond the scope of this assessment. If this level or type of modeling is required, a human health risk assessment could be performed once project details are finalized.

Health Changes Arising from the Perception of Exposure

Risk perception and control over one’s environment also has strong ties to health. Legacy issues in the area have created a high-stress environment for receiving a uranium mine. Regardless of the results of air and water quality assessments, there may be some residual concern and stress in many communities regarding the perceived quality of their surrounding environment and the impacts that may occur to their health.

Aside from actual exposure to environmental contamination, the *perception* of exposure to contamination is also linked with known health consequences. The issue of exposure to environmental contaminants is contentious, and few data exist to support or deny resident concerns regarding degradation of environmental quality and local health impacts. In general, the field of public health addresses this concern through efforts to control exposure to environmental contaminants, rather than through responding to specific increases in disease rates related to a known exposure.

Perception of contamination may result in stress and anxiety about the safety of subsistence foods and avoidance of subsistence food sources (CEAA, 2010; Joyce, 2010; Loring et al., 2010), with potential changes in nutrition-related diseases as a result. It is important to note that these health results arise regardless of whether or not there is any “real” contamination at a level that could induce toxicological effects in humans; the effects are linked to the perception of contamination, rather than to measured levels.

In discussion with representatives from the Pueblo of Zuni and Pueblo of Laguna, it was mentioned that tribal members partake in regular hunting around the project area, close to Mt. Taylor. Hunting has become more important for supplying food to families since the economic collapse in 2008, which has made healthy nutritious foods more unattainable (Bonne et al, 2012; Luarkie et al., 2012). Several members of the tribes in the project area mentioned that they were concerned about the contamination of animals by mining activities and how that would impact their health if consumed. Hunting is not only important from a nutritional standpoint, but can also contribute to cultural identity, tradition, and social cohesion. Hunting has been an important part of pueblo culture for hundreds of years (Bonne et al, 2012; Luarkie et al., 2012).

Perception of contamination can also increase stress levels. In the project area many residents are already concerned about past uranium mining and current levels of contamination. In addition to the concern that the proposed action would further contaminate water, air, and land, they also feel disappointed and betrayed as they feel their concerns are not being acted upon by various governing agencies (Head-Dylla, 2012; Gunnell, 2012; Luarkie et al., 2012). It was expressed several times by these community members that the idea of adding another mine to an area that has many unresolved issues with legacy contamination is unreasonable and possibly inhumane.

Many stakeholders see this as a concern for not only the present generation, but generations to come (Head-Dylla et al., 2012; Gunnell, 2012; Bonne et al., 2012; Luarkie et al., 2012; Juanico et al., 2012). Stress and mental health are key components of overall health and well-being. Unmanaged stress has physical health consequences that include weakened immune systems, weakened functioning of the circulatory and metabolic systems, and increased incidence of cardiovascular disease and Type 2 diabetes (Brunner and Marmot, 2006). Assigning a quantitative estimate on expected stress response is not possible given the data available; however, it could be estimated that stress will increase with perceived contamination. In order to reduce health impacts related to perceived contamination of water, air and land the following mitigation strategies could be implemented:

- Public consultation with community members on Project-related issues causing anxiety;

- Involvement of community members in contamination monitoring efforts and public release of air, land and water monitoring results;
- Initiation of a population health study following contaminant-related health impacts over time;
- Monitoring animal exposure to contaminants throughout the life of the Project;
- Involvement of community members in monitoring remediation efforts.

Health Changes Resulting from Alterations to Land and Water

Finally, to fully appreciate the suite of health impacts that could result through changes in environmental conditions it is important to understand how health is defined by many of the residents in the project area. The Zuni, Acoma, Laguna, and Hopi Pueblos and Navajo all define health or well-being broadly. This definition likely differs slightly by tribe and by each individual; however, what is similar amongst all the tribes in the project area is that environmental integrity is important to the health and well-being of the individuals. This viewpoint on health was confirmed in conversation with the Zuni and Laguna Pueblos (Bonne et al., 2012; Luarkie et al., 2012) and a report on the Navajo (Sittler, 1999) and, thus, it is important to consider when looking at impacts to environmental exposures.

The Native concept of health does not separate environmental and human experiences; essentially all people and all living things are connected. This means that any impact to the environment is perceived to impact the health of the Native peoples. Water contamination was the primary concern of all of the tribal groups when it came to health impacts (Bonne et al., 2012; Luarkie et al., 2012; Juanico et al., 2012). Water is not only important for farming practice and daily living; water is also a very important component of spiritual health in these communities.

This health belief likely means that any impacts to the environment resulting from the proposed action would result in human health impacts to tribal members. These impacts would be comprised of mainly mental and spiritual health impacts, both of which are key components of overall well-being (WHO, 1946). Previous studies have shown an association between American Indian culture and health (Herman-Stahl et al., 2002; Cain 1999; Dorton 2007; Garroutte et al., 2003). It was stated in stakeholder interviews that further degradation to environmental conditions, would be experienced as another sign of minimizing cultural beliefs (Luarkie et al., 2012). Because Native Americans in the project area have been identified as an environmental justice population (see “Environmental Justice” section), it is important that impacts to health are not exacerbated in this population group. Native Americans already suffer disproportionately from poverty, unemployment and have lower quality of health than all other racial groups in the project area. The Laguna and Zuni Tribal Councils both stated that mitigating impacts through this pathway would require ongoing conversation with the councils and the community members. It is hoped that through conversation with governments and industry that there can be mutual understanding developed of the pathways through which health can be impacted.

Impacts to health resulting from alterations to land and water could be reduced by:

- Having ongoing conversations with the tribes in the study area on project-related development activities to ensure that a full understanding of health is incorporated into project plans.

- Ensuring all measures are in place to minimize alterations to land, water, and air to the greatest extent possible.
- Ensuring tribes are aware of and invited to participate in project-related conversations about issues of importance to health—particularly water (hydrology) issues.
- Collaborating with the tribes to determine opportunities to mitigate harmful health impacts

Effect Characterization

Actual contamination of water, air, and soil from the proposed action is predicted to be minor or minimal at most. However, perceived contamination on the part of Native Americans, along with actual changes to water and land from the project in the vicinity of sacred lands, especially within the context of uranium mining and milling legacy issues, may have real effects on the mental and physical health of some community members.

Overall then, the likely impacts to health from environmental exposures during construction, operation, and decommissioning of the proposed action are expected to be of moderate magnitude, to have a medium geographic extent, and to be of medium to long-term duration. There is a probable likelihood of these impacts occurring and the precedence or uniqueness is moderate. Therefore, the overall level of environmental health impacts would be less than significant.

Effects Stemming from Employment

Figure 79 depicts potential links between the proposed action and employment impacts.

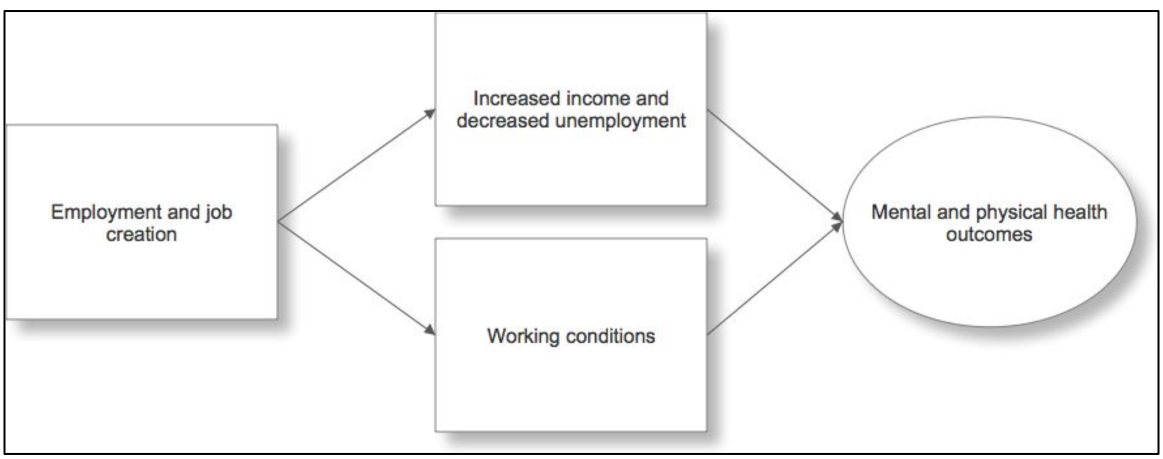

Figure 79. Links between the project and employment impacts

Employment resulting from the proposed action has the potential to impact health through two pathways: through providing jobs and income to individuals and through exposing those individuals to a specific set of working conditions.

Jobs and income are strongly associated with a number of beneficial health outcomes (HDA, 2004; Cox et al., 2004). These include an increase in life expectancy, improved child health status, improved mental health, and reduced rates of chronic and acute disease morbidity and mortality. Health insurance (often provided by employers in the United States) is a determinant of health that is highly related to income. Health insurance is associated with improved general health outcomes, i.e. general health and physical functioning, as well as mortality. It is also associated with improvement of chronic conditions, such as cardiovascular disease and diabetes, cancer, and depression; and improvement of acute conditions. Evidence suggests that providing insurance to the uninsured can reduce mortality by as much as 5–15 percent (Hadley, 2003).

At the same time, in some settings, income and employment also promote a number of adverse health outcomes. Among resource extraction projects in rural and remote settings, direct and indirect income and employment have sometimes been found to be associated with an increased prevalence of social pathologies, including substance abuse, assault, domestic violence, and unintentional and intentional injuries. These adverse impacts on social pathologies have been observed in the project area during previous “boom” periods (Milkman et al., 1980; Brodeur, 2003). Additionally, if jobs and income increase social or economic disparity in a region, this has also been shown to have adverse health impacts across the entire population, at all income levels.

Working conditions take into consideration both the potential for worker exposure to hazards (e.g., toxic chemicals) and job characteristics that define the nature of the work. Working conditions that have the potential to affect health include long working hours, shift work, degree of control over working conditions, and occupational health and safety practices. The health effects that have been associated with poor working conditions include an increased risk of physical injuries at work, high blood pressure, cardiovascular disease, coronary heart disease, depression and other mental health conditions, and increases in negative personal health practices such as smoking and drinking (Jackson, 2002; Schnall and colleagues 1994; Nishiyama and Johnson, 1997; IWH, 2002). Although many working conditions fall under the purview of Occupational Health & Safety, they remain relevant to review from the viewpoint of public health and safety since injury, disease or disability experienced by workers affects families, friends, and the community at large.

The ways in which the proposed action may impact health via either of these pathways—providing jobs and income and through specific working conditions—are described below.

The impacts to income and employment are outlined in the “Socioeconomics” section. In discussions that took place in February 2012, local stakeholders stated that the community is in need of employment opportunities and that there are community members in the local area who are very eager for employment opportunities with the project (Michaels, 2012; Yarlborough, 2012). The “Environmental Justice” section also points out that McKinley County is considered an environmental justice community based on the high proportion of low-income households. RHR is proposing to fill most construction-related jobs from the population in the ROI. Operations jobs are expected to be filled by a mix of local and outside workers. RHR is also proposing to provide basic health insurance to employees of the project (Velasquez et al., 2012). As noted above, provision of health insurance can substantially increase positive health outcomes.

It is likely that the health of some segments of the local population would improve as a result of the direct, indirect, and induced jobs and income associated with project construction and operation. The positive health benefits may be realized not only by project workers, but also their families and other community members who benefit indirectly. However, given the estimated size of the project workforce (see “Socioeconomics” section), it is likely that positive health effects would be too small to measure with population health indicators.

Project decommissioning after closure of the mine in approximately 2 decades would result in the opposite impact of project construction and operation, mainly that jobs would be eliminated, increasing the potential for unemployment among project workers. Unemployment has negative health impacts. It is associated with increased stress, depression, and anxiety, which are known contributors to cardiovascular disease (Doyle et al. 2005).

There are a number of strategies that can be implemented to maximize the potential health benefits of employment provision and minimize negative health impacts from project-caused unemployment. These are:

- Development and implementation of hiring policies that ensure maximum recruitment of local residents, especially Native American populations (considered an Environmental Justice population group).
- Sourcing of local procurement for mine construction, operation and decommissioning activities.
- Provision of training opportunities for local residents in advance of construction, operation, and decommissioning to ensure that required skill sets are developed. Training should be accessible to low-income population groups. Future job description information should be shared with local education authorities to assist them in planning for future training programs.
- Provision of comprehensive health insurance to all employees of the project, including contract workers.
- A workers and employment open house should be held in advance of project construction and operations. At this open house information should be presented on the estimated number and types of workers that will be required for construction/operations. The construction and operations contractor should explain the bidding and contracting process that the project will use for selecting subcontractors.
- Support the collection of information on local skills and employment interests and focus business opportunities on areas where the local community already has developed skills.
- Offer workshops to employees on money management techniques and planning for a secure financial future.

Direct and indirect employment and income from the proposed action is also likely to lead to increases in social pathologies (e.g., alcohol and drug abuse, assault, domestic violence, and unintentional and intentional injuries); however, it is not possible to predict the size of the effect—for example, the number of people that will turn to illegal drug use or the absolute increase unintentional injuries. Regardless, it is important to consider mitigation efforts to help reduce the magnitude of the impacts. Several strategies that should be considered to minimize potential negative consequences are:

- Strict enforcement of company policies on alcohol and drug use, including a no-tolerance policy for alcohol and drug use while working.
- Provision of information to all workers on community-based resources targeting addictions.

- Implementation of an alcohol and drug abuse education program, including the availability of an Employee Assistance Program for those employees who self-identify as needing help.

Finally, in terms of worker conditions, shift work has been linked to sleep disturbances, digestive problems, cardiovascular disease, unhealthy behaviors, and stress from work/family conflict (IWH, 2002). During operations, the project workers would work in three shifts around the clock. Some of the negative health impacts expected from shift work may be alleviated if workers are given some control over their schedule.

As mentioned above, occupational health and safety is generally not assessed in a health impact assessment. Worker health is regulated by occupational health and safety requirements of Federal and state agencies. RHR hired an occupational health and safety specialist to draft performance manuals in the following areas: Health and Safety Program; Radiation Protection Plan for In Situ Recovery and Conventional Milling; Strathmore Radiation Protection Plan and various safety manuals, including one on substance abuse. These performance manuals will be under the scrutiny of MSHA and OSHA and the New Mexico Environment Department. Worker hazards that are relevant for the general population are discussed in “health effects stemming from environmental consequences.”

The impacts to health stemming from employment during construction, operation, and decommissioning phases of the proposed action are expected to be both positive and negative.

The positive impacts of employment on health are expected to be of moderate magnitude, to have a medium geographic extent, and to be of medium-term duration. There is probable likelihood of these impacts occurring and the precedence or uniqueness is moderate. Therefore, the overall impacts to health stemming from employment during construction, operation, and decommissioning are positive but less than significant.

The negative impacts of employment on health are expected to be of minor to moderate magnitude, to have a medium geographic extent, and to be of medium to long-term duration. There is probable likelihood of these impacts occurring and the precedence or uniqueness is slight to moderate. Therefore, the potential adverse effects on health stemming from employment during construction, operation, and decommissioning would be less than significant.

Health Effects Stemming from Workforce Migration

Figure 80 depicts potential links between the proposed action and environmental health outcomes.

An influx of workers into the local area for work opportunities related to the proposed action may cause specific health effects in the population. There are three distinct mechanisms through which an in-migrating workforce tends to influence community health outcomes:

1. change in the social functioning of the community;
2. directly and indirectly increasing infectious disease rates;
3. impacts on the capacity of local health care services.

All three of these outcomes are commonly associated with in-migrating workforces – particularly those associated with resource development projects. From a public health perspective, these populations are often referred to as "mobile men with money."

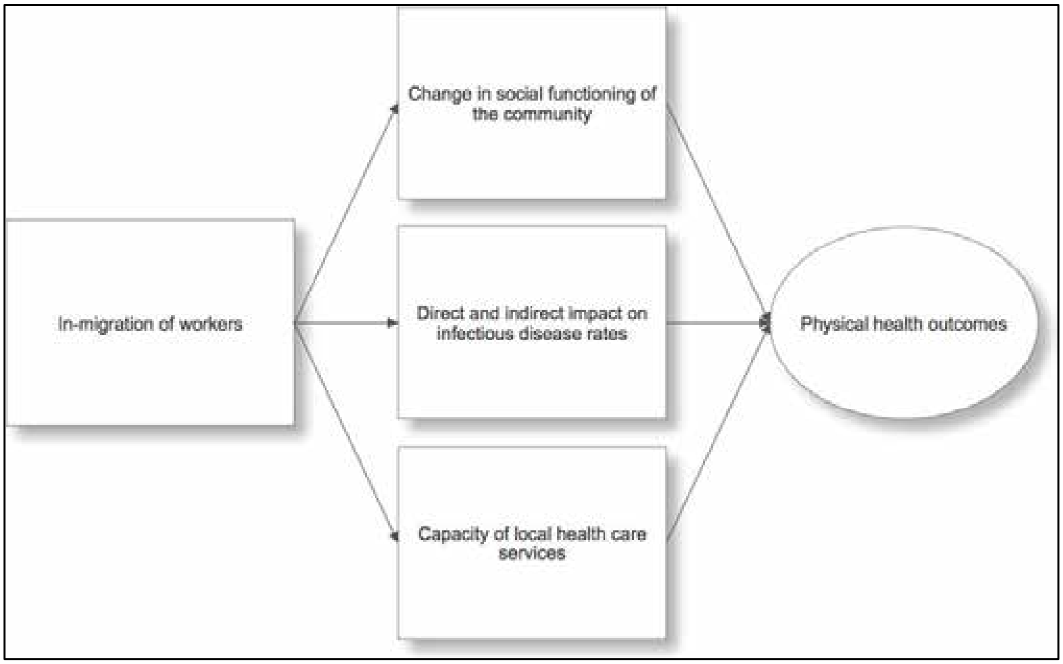

Figure 80. Links between the project and impacts from in-migration of workers

Change in Social Functioning and Associated Health Effects

The introduction of a transient workforce population into an established community often changes the social functioning of that community, resulting in increases in the consumption of alcohol, illegal drugs (e.g., crack cocaine, crystal meth, marijuana), and misuse of prescription drugs (e.g., OxyContin or Vicodin). Subsequently, there may be increases in violence, crime, injury, chronic disease, and mental well-being associated with alcohol and substance misuse. The increases in alcohol and drug use arise from a combination of factors that include increased disposable income, changing family roles, and increased stress among local residents (Mucha, 1978).

These types of health impacts have commonly been experienced in other resource communities across North America, and have been documented in Louisiana, Wyoming, British Columbia, Alberta, and other areas (Goldenberg et al., 2010; Seydlitz and Laska, 1994; Bush and Medd, 2005). These impacts have also been observed in the project area during previous "boom" periods (Milkman et al., 1980; Brodeur, 2003).

The changes to social functioning and the related health impacts listed above are common impacts associated with resource development projects and they are expected to occur as a result of the project; however, it is not possible to predict the size of the effect—for example, the number of people that will turn to illegal drug use or the absolute increase in traffic accidents resulting from alcohol use. Based on conclusions made about workforce need and local availability in the "Socioeconomics" section, it is estimated that most in-migration would occur during development and operations phases, where the project will require more workers from outside the ROI. It is important to consider mitigation efforts to help reduce the magnitude of the impacts. Factors that can help to mitigate these outcomes with respect to the project include:

- Strict enforcement of company policies on alcohol and drug use, including a no-tolerance policy for alcohol and drug use while working.
- Provision of information to all workers on community-based resources targeting addictions.
- Implementation of an alcohol and drug abuse education program, including the availability of an Employee Assistance Program for those employees who self-identify as needing help.
- Offering workshops to employees on money management techniques and planning for a secure financial future.
- Any complaints raised by local residents related to worker behavior in the communities should be followed up and project personnel should work with local groups to address these concerns. This may include training, disciplinary action and followup.

Increases in Infectious Disease Rates

The two main types of infectious diseases that pose a concern with respect to the proposed action are sexually transmitted diseases (STDs) and infectious respiratory diseases.

STDs include gonorrhea, chlamydia, syphilis, hepatitis, and human immunodeficiency virus or autoimmune deficiency syndrome (HIV/AIDS). These diseases are transmitted from one person to another through unprotected sexual contact. The diseases can cause irritating symptoms that need to be treated; they can also have much more serious consequences including infertility or sterility, or even in some cases death (Goldenberg et al. 2007). They represent a large public health concern because of their ability to rapidly spread through a community. Increased rates of sexually transmitted diseases are common when male worker populations making high wages are sited near small or medium-sized communities (Goldenberg et al. 2008).

Currently, STDs are markedly high in the study area: syphilis and chlamydia rates are significantly higher than State and national rates, and the incidence of gonorrhea, syphilis, and HIV is increasing at notable rates, which suggests that this is an area of particular concern (baseline). In small communities, the social stigma associated with acquiring STDs can be large and may pose a particular challenge in rural areas in terms of detection and treatment. Local workers may seek treatment in the Public Health centers located in Grants or Gallup, which are already severely understaffed, or they may travel to Albuquerque if they are concerned about confidentiality.

The impacts to STDs in resource development projects are mainly observed in oil and gas-related projects, where young male workers are getting paid very high wages. Wages for the project are not expected to reach those observed in oil and gas projects; however, for those previously unemployed or coming from lower paying jobs, the wages obtained would still constitute increased income. It is expected that this project would result in an increase in STDs in the ROI above the normal variation. These impacts can be reduced with the following types of mitigation strategies:

- Providing access to STD testing for workers; this could mean partnering with public health centers to increase availability of STD testing;
- Providing condoms to workers, particularly to employees who travel frequently;
- Workers should receive awareness training on appropriate, respectful behaviour in small rural communities;

Workforce migration into an area also has potential to increase rates of infectious respiratory disease through overcrowding associated with high demand for limited housing availability. Crowded housing conditions are associated with an increase in the incidence of infectious respiratory diseases such as influenza, pertussis, and tuberculosis. In addition to increasing the risk of respiratory disease transmission, crowded housing is also associated with increases in mental health problems and domestic abuse and violence.

Health impacts stemming from housing depends highly on housing conditions and housing availability. Housing vacancy rates in the ROI are estimated to be 29 percent (see "Socioeconomics" section), meaning that there is likely sufficient housing available for those in-migrating workers looking for permanent relocation during operations phase. It is unknown, however, how much temporary housing is available to accommodate any workers relocating for construction, although the number of workers migrating into the area for construction is expected to be small. Impacts to infectious disease from housing shortages can be mitigated by:

- Performing a needs assessment for housing in advance of project construction and operations;
- Ensuring there is adequate housing for families in the project area;
- Partnering with local housing authorities to plan for adequate low-income housing options for workers.

Impacts to Capacity of Local Health Care Services

Resource development projects around the world have demonstrated the potential for causing an increased demand on local health care and social services. Impacts on the capacity of local health care services may be felt due to any or all of the following three factors:

1. growth in the population leading to additional demand for health care services;
2. workplace injuries and accidents causing injuries and trauma that require treatment;
3. project-related increases in disease and injury (as described in this and other sections) leading to addition need for services.

In the project area there is a limited ability to absorb an increase in demand for health care services. All health care facilities located in Cibola and McKinley Counties are listed as health professional shortage areas (USDHHS, 2012). During stakeholder consultation, it was confirmed that there is an extreme shortage of health care workers in the project area (Gunnell, 2012). It was also noted that approximately half the positions available at medical facilities are not being filled due to funding shortages and that Indian Health Services hospitals are funded at less than 50 percent of the required need. Key informants have confirmed that increasing usage rates of medical services would negatively impact the ability to deliver services to the current population.

The following project information is important for determining the extent of impact on health care resources based on the three mechanisms of impact listed above.

The proposed action would result in a population influx for the duration of construction, operation, and decommissioning phases, which would increase demand on local health care services in the project area. In the "Socioeconomics" section it is predicted that hundreds of workers (direct and indirect employment) would be required over the life of the project. Based on these estimates this may mean large numbers of workers and their families would move into the project area during various stages of the project. It is expected that operations (lasting 11 years) would bring in the most workers. Since health care capacity is influenced by a wide range of factors at a local, regional, and national level, it is difficult to predict how health care services will change over the life of the project. However, if capacity stays the same the project-related population influx would put additional strain on existing health care services potentially resulting in a further degradation of care for the local population. These potential impacts to health care services could be reduced by:

- Providing onsite access to health care for workers;
- Collaborating with local health care services to determine feasibility of partnerships to increase health care capacity in the local area;

Accidents at the worksite may also increase the usage rates of local health care services. Table 98 presents the injuries reported for underground uranium mining in the U.S. between 2006 and 2009. Overall there have been no fatal injuries and 21 nonfatal injuries reported in that timeframe.

Table 98. MSHA-recorded injuries for underground uranium mining in the United States, 2006–2009

	Fatal Injuries	Nonfatal Injuries	Average Number of Workers	Employee Hours	Number of Operations
2009	0	10	130	147,426	12
2008	0	8	135	110,588	14
2007	0	3	89	66,569	14
2006	0	0	44	18,420	9

Source: USDL, 2009

Based on table 98, it is expected that annual injury rates resulting from the proposed action would be low, although injury rates depend highly on the corporate culture of safety of the proponent and how strongly safety regulations and procedures would be enforced. RHR has developed health and safety manuals for its mining operations. The various plans include having safety meetings before the beginning of each shift, ensuring safe driving procedures, and having first aid and EMT trained staff available at all times during mining operations. RHR's safety procedures align with the health and safety requirements of MSHA and OSHA. If the company adheres to these procedures, this would reduce the risk of accidents in the workplace. It was also noted that onsite Emergency Medical Technician (EMT) trained professionals can and often do respond to remote accidents offsite, further reducing the burden on local Emergency Medical Services (EMS) (Velasquez et al., 2012).

Regardless of emergency care onsite, it is likely that some injuries would require the use of local health care services. The project site would have a helicopter pad available for quick access to emergency medical air ambulance. These patients will likely be transferred to Albuquerque where there is increased capacity for care of severe injuries. Overall, if MSHA and OSHA regulations are adhered to it is expected that workplace injuries would create very little increased demand for local health care services.

The project may also increase demand on local health care services through the direct or indirect increase of certain conditions including alcohol and drug related issues, social pathology, and increased rates of infectious disease. The project-related mechanisms through which these impacts may occur are described earlier on in this section. It is expected that there would be an increase in these conditions and that that will result in an increase in demand for local health care services. The mitigation measures that can be implemented to reduce these impacts, and reduce use of local services, are repeated here:

- Strict enforcement of company policies on alcohol and drug use, including a no tolerance policy for alcohol and drug use while working
- Implementation of an alcohol and drug abuse education program, including the availability of an Employee Assistance Program (EAP) for those employees who self-identify as needing help
- Providing access to STD testing for workers
- Providing condoms to workers, particularly to employees who travel frequently
- Providing clear messages on appropriate behavior in the community
- Partnering with public health centers to increase availability of STD testing
- Performing a needs assessment for housing in advance of Project construction and operations
- Partnering with local housing authorities to plan for adequate low income housing options for workers.

Effect Characterization

The extent of all these impacts would depend on the actual numbers of in-migrant workers required for each phase of project construction, operations, and decommissioning, the length of time for each of these phases, the housing options available in the local area, and the current and future capacity of health care services. If this increased demand exceeds the capacity of local services, then community health may be affected by reduced access to, and quality of, available health and social services.

The impacts to health stemming from workforce migration during construction, operation, and decommissioning for the proposed action are expected to be of moderate magnitude, to have a medium geographic extent, and to be of medium-term duration. There is probable likelihood of these impacts occurring and the precedence or uniqueness is slight. Therefore, the overall level of the impacts to health stemming from workforce migration during construction, operations and decommissioning is less than significant.

Alternative 3

The impacts of the one shaft alternative on human health and safety would be essentially identical to alternative 2.

Cumulative Effects

Health outcomes—such as those documented for the ROI in the affected environment section—are generally multifactorial, that is, shaped by a variety of societal, environmental, and individual factors. A number of trends such as the rise in obesity, diabetes, and cancer are observed at a State and national level and reflect general societal, environmental and personal behavior changes that have been occurring over the past 30–50 years.

However, the ROI also has several particular historic and present-day characteristics that have made its population vulnerable to specific health challenges; these characteristics are: (1) high rates of poverty; (2) boom-bust cycles; and (3) contamination from legacy uranium mining. Each of these factors is associated with health outcomes that have the potential to be influenced by the current proposed action or the one shaft alternative as well as the arrival of future resource development projects.

In this section the impacts of past mining activities as well as future projects on the health of the population in the ROI are considered. Potential future projects include:

- Mt. Taylor Uranium Mine (mothballed)
- La Jara Mesa Uranium Mine (proposed)
- San Mateo Mine (remediation work)

High Rates of Poverty

Approximately 25–28 percent of residents living in Cibola and McKinley Counties report living in poverty. The proportion of children under 5 years of age living in poverty is even higher, with estimates ranging from 35 to 39 percent. The health impacts of living in poverty are well documented. Specifically, low income increases risk of birth to low birth weight babies, injuries, violence, most cancers, and chronic conditions (Yen and Syme, 1999) and unemployment is associated with increased stress, depression, and anxiety, which are known contributors to cardiovascular disease (Doyle et al. 2005). In addition, economic disparity—the gap between the well off and the less well off in any community—has been linked to conditions ranging from injuries to chronic disease and cancer (Yen and Syme, 1999).

Low income, poverty, food insecurity, and unemployment are indicators of concern in the ROI. American Indian, Hispanic peoples, and children are particularly vulnerable to poverty and food insecurity, and those employed in the natural resources industries are susceptible to unemployment (see “Socioeconomics,” “Environmental Justice,” and “Human Health and Safety” affected environment sections). Current health trends in the ROI illustrate that there are particularly high rates of alcohol-related deaths, injuries, sexually transmitted diseases (STD), and stroke (McKinley County only) compared to the State of New Mexico. Since there are many personal, environmental, and societal influences that impact health, it is difficult to determine to what extent poverty in the ROI contributes to these health trends; however, given the strong association between poverty and health outcomes it is reasonable to conclude that poverty plays a role in some of these observed trends.

The proposed action as well as future development in the local area have the potential to influence poverty by providing employment opportunities for those in need of work. In discussions that took place in February 2012, local stakeholders stated that the community is in need of employment opportunities and that there are community members in the local area who are very eager for employment opportunities associated with the project (Michael, 2012; Yarlborough, 2012). In order for this impact to be of maximal benefit to the population in the ROI, jobs will have to be provided to those who are currently unemployed or underemployed. There are many reasons why people are unemployed, including lack of a particular skill set, physical or mental disabilities, substance abuse issues, lack of job availability and, to a lesser degree, personal will. It is unknown how many people who are unemployed will be able to find work in the currently planned and future developments. Adding to the uncertainty that increased employment with these developments will reduce poverty levels is the fact that with many resource development projects, a number of outsiders tend to migrate into the area to seek out employment opportunities. This trend was observed in the past boom cycle of the 1950s and 1960s in the ROI. This in-migration could result in fewer net jobs going to those people in the ROI who are in need of work.

There already exist patterns of economic and health disparity within the ROI, with health outcomes and health determinants unevenly distributed within and across the population. Recent and present developments, as well as future development have the potential to exacerbate these disparities both because of the uneven distribution of the “rewards” of development and the uneven distribution of the risks.

Taking all of these factors into consideration, it is likely that some people in the ROI would benefit from current and future developments. Finding work can have a positive influence on human health. However, there is a risk that health disparities may be exacerbated by these developments as well.

Boom-Bust Cycles

Boom-bust cycles are a potential area where past, current, and future mining and other developments could impact population health in the ROI. Between 1976 and 2006, there were 10,000 jobs lost in metal mining in New Mexico; 6,400 of these jobs were lost between 1980 and 1986 in uranium mining alone (Power, 2008). Despite this loss, other nonmining job sectors were not impacted. Payrolls in the government, services, and trade sectors continued to expand, resulting in a net increase in employment, aggregate real per capita incomes, and personal incomes. Overall, between 1983 and 2005, 17,000 new jobs were created in the ROI and the unemployment rate rose to 3.5 or 4 percent. The counties were able to overcome the bust period by ensuring diversity in employment opportunities (Power, 2008).

Since 2008, however, the U.S. has undergone a severe economic recession, from which it is still only emerging in a so-called “weak recovery.” Unemployment rates have increased substantially and now sit at 8.4 percent in the State of New Mexico, similar to the national rate. Unemployment rates in Cibola and McKinley Counties were 7.6 and 9.6 percent, respectively in 2010 (NMDH, 2011).

The arrival of the proposed action and future developments would likely stimulate the economy in the ROI by increasing employment opportunities and by supporting local businesses. This would probably generate certain characteristics of a boom period: in-migration of workers, an increase in disposable income, and decreased unemployment. Conversely, if the price of uranium deems projects to be economically unviable, or when project life cycles end, characteristics of a bust period could occur: out-migration of workers and families, decreases in disposable income, and increased unemployment. The extent to which these impacts affect health greatly depends on the overall magnitude of the boom and bust periods (e.g., number of operations and price fluctuations of the commodity) and the overall economic climate within the ROI.

Various health and societal impacts have been documented in boom bust cycles in resource development towns. Although the extent to which these impacts manifest greatly depends on the general trends present in the local context. The majority of these health and societal impacts are summarized in an article by Shandro and colleagues (2011) and are stated below:

During boom periods, the following impacts have been observed:

- shortages in housing
- strained education and health care systems
- less time for family and traditional activities
- challenges in finding child care
- mental health and depression in women of miners unable to find work
- increase in pregnancies and sexually transmitted diseases

During bust periods, the following impacts have been observed:

- mental health issues such as depression and anxiety
- increased morbidity in unemployed workers

During both boom and bust periods, the following impacts have been observed:

- increased levels of substance abuse and gambling
- family instability, abandonment and divorce and child neglect
- increased violence toward women

Perspectives on Uranium Mining’s Long-term Legacy

> “We are still undergoing what appears to be a never-ending Federal experiment to see how much devastation can be endured by a people and a society from exposure to radiation in the air, in the water, in mines, and on the surface of the land. We are unwilling to be the subjects of that ongoing experiment any longer.”
> – George Arthur, Navajo Resources Chairman, Testimony before the House Committee on Uranium, Washington, D.C., October 24, 2007 (Navajo Nation, 2007).

"Legacy issues," discussed more systematically and from a somewhat different angle in the next section, is the term used to refer to the historical impacts of uranium mining in the ROI, including peoples' biophysical, social, and political experiences. Although these experiences may have taken place in the past, they remain deeply embedded within the social history and collective psyche of these communities, and continue to affect current perceptions and the adaptive potential of both communities and individuals toward new proposed projects. As such, legacy issues act as a social determinant of health and are linked with chronic diseases, social pathologies, and mental health. Ultimately they affect the future trajectory of communities.

In order to fully elucidate the health impacts that could result from the culmination of legacy issues and present and future developments, it is important to understand the experiences of the population living in the ROI as they relate to past uranium mining. This section presents: a brief historical review of uranium mining in the ROI; a synopsis of some of the scientific findings of the health effects of uranium mining on workers and nearby residents; an overview of the community-based studies on uranium mining and human health in the ROI; and a brief description of the multiagency remediation plans for the abandoned uranium mines in the ROI.

History of Uranium Mining in the ROI

The ROI is situated in the Grants Mineral Belt, one of the largest uranium belts in the world (Boulanger and Gorman, 2004). As such, uranium mining has been active in this area since the late 1940s. During the peak of uranium mining in the mid-1950s—a time that was known as the "uranium rush" —there were roughly 750 mines in operation in the area (Brugge and Goble, 2002). Today more than 1,200 abandoned uranium mines remain scattered across the Grants Mineral Belt; most of these mines are on Navajo lands (Grey et al., 2003).

On July 16, 1979, the area also became the site of the largest release of radioactive waste in the United States. In total, 1100 tons of radioactive mill waste and 93 million gallons of contaminated liquids were released from the Church Rock Uranium Mill into the Rio Puerco River when the tailing pond's earthen dam failed (Boulanger and Gorman, 2004; Brugge et al., 2007). This spill site continues to contaminate water and land of the Navajo Nation and is a priority cleanup area for the Navajo Nation (USEPA, 2008).

Scientific Study of Health Effects Associated with Uranium Mining

The scientific study of health effects associated with uranium mining is ongoing and is continuing to yield new findings. This section describes the U.S. government's characterization of uranium and health and reviews the literature on the impact uranium mining has had on both uranium miners and community residents living adjacent to uranium mining activities.

It is the responsibility of the U.S. government's Environmental Protection Agency (EPA) and Agency for Toxic Substances and Disease Registry (ATSDR) to provide data that are significant in the protection of public health. As such, and in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (aka Superfund), the ATSDR provides peer-reviewed toxicological profiles for toxic substances, which characterize the toxicological and adverse health effects information for these toxic substances. In the toxicological profile for uranium, the ATSDR states: oral exposure to large amounts of uranium can damage the kidneys; there is no conclusive evidence that uranium produces cancer in humans; the health effects seen in children from exposure to toxic levels of uranium are expected to be similar to the effects seen in adults; and whether uranium can cause birth defects in humans is unknown (ATSDR, 2011). Furthermore, the Federal government has recognized 27 uranium-associated illnesses (USDOJ, 2011) and continues to investigate the health and environmental impacts of uranium contamination in the Grants Mining District and Navajo Nation (USEPA, 2011f; USEPA, 2008). A number of scientific studies within the occupational and nonoccupational (offsite) context are explored below.

Studies report that in the early days of uranium mining, working conditions and ventilation within these mines were exceedingly poor (Mapel et al., 1997). The primary impact of early uranium mining on worker health involved the inhalation of silica dust, radon decay products, and diesel fumes (Brugge et al., 2007; Mapel et al., 1997). Many workers, including a significant number of Navajo workers, reported that they were not sufficiently informed about the health hazards associated with this type of mining, nor were they adequately provided with protective equipment or ventilated workplaces (Brugge et al., 2006). Despite evidence based on the earlier European mining experience and initial findings in the U.S. (Holaday et al., 1952; Wagoner et al., 1964), U.S. government regulations to protect worker health within uranium mines were slow to come on the scene (Brugge and Goble, 2002). The U.S. government adopted the first in-mine radon exposure standard in 1968. This standard was poorly enforced and, in 1980, declared inadequate for the protection of underground miners (Shuey, 2007). As a result, generations of uranium miners experienced negative health outcomes, most notably, the risk of lung cancer due to the inhalation of radon decay products (USEPA, 2011f; ATSDR, 2011; Boice et al., 2008; Ross and Murray, 2004; Gilliland et al., 2000; Roscoe, 1995; Archer et al., 1990; Samet et al., 1984; Wagoner et al., 1964); respiratory diseases (pneumoconiosis, tuberculosis, silicosis and emphysema) (Roscoe, 1995); and adverse changes in kidney function (NMDH, 2005). Higher mortality rates were also documented from interstitial pulmonary fibrosis, multiple myeloma, and non-Hodgkin lymphoma (Schubauer-Berigan et al., 2009). Negative health outcomes were particularly high among Navajo miners (Samet et al., 1984; Mapel et al., 1997; Gilliland et al., 2000). Not only did Navajo miners experience physical health impacts, they also experienced negative psychosocial impacts from their experience in the mining industry (Dawson, 1992). Because workers were not informed of the human and environmental dangers of uranium mining they were not able to properly make decisions regarding their health. This has left many feeling betrayed by mining companies and the government. Dawson (1992) illustrates in a case study how this has resulted in psychological trauma for the miners.

There is no conclusive evidence that residents living near uranium mines experience negative health impacts. In fact, very little research to date has been concluded on the risks for residents living within close proximity to mines (Shuey, 2007; Boulanger and Gorman, 2004). A number of peer-reviewed studies that have been conducted within these contexts conclude that there are no health impacts to nearby populations (Boice et al., 2003, 2007a, 2007b, 2008). For example, Boice et al. (2003) examined rates of cancer based on death certificates in the uranium mining area of Karnes, Texas, and found no significant patterns of cancer mortality when compared with other “control counties” in the U.S. Boice and colleagues also conducted similar studies in Montrose County, Colorado (Boice et al., 2007a), Uravan, Colorado (Boice et al., 2007b), and Cibola County, New Mexico (Boice et al., 2010); these studies yield no conclusive evidence that the operation of uranium mines and processing facilities increased cancer or mortality rates for the nearby populations. Preliminary findings from a few peer-reviewed studies, however, suggest that uranium mines may have posed a risk for miscarriages (Shields et al., 1992), as well as for chromosomal aberrations, which can potentially give rise to cancers and birth defects (Shields et al., 1992; Au et al., 1995) although these results should be interpreted with caution. Effects on the cardiovascular system, liver, muscle, and nervous system have also been noted (Taylor and Taylor, 1997).

Community Health Studies in the ROI

Government agencies and community residents are greatly concerned about the ongoing impacts of past uranium mining and abandoned uranium mine sites on environmental and human health. This concern is reflected in the continued efforts being made by both groups within the ROI to better understand the health impacts.

Overall, a number of scientific studies have shown negative impacts on the physical environment of uranium mining communities. Contamination of water and aquifers and its subsequent health effects on humans and animals has been a significant concern (Kurttio et al., 2002; Brugge et al., 2005; Raymond-Whish et al., 2007; Orloff et al., 2004; Zamora et al., 1998; Malczewska-Toth et al., 2003). It has been estimated that 25,320 acres and 69 miles of streams have been affected by acid mine drainage and inactive and abandoned mines in New Mexico (US EPA/DOE, 1996).

More specifically in regard to human health, a number of ongoing studies in the ROI are continuing to investigate how historical mining may have impacted local residents. These studies reflect a continued high concern surrounding uranium mining issues.

- *Dine Network for Environmental Health (DiNEH) Project* – an ongoing project that began in 2004 to investigate the relationship between kidney disease, diabetes, high blood pressure, and autoimmune diseases, as well as lifetime and current exposure to uranium and other heavy metals within the Navajo population. Preliminary results from this study suggest that proximity to mines and past uranium mining exposure are predictors of poor health outcomes, specifically kidney disease, diabetes, hypertenstion, and autoimmune disease (Shuey, 2010; Lewis et al., 2011).
- *Post-71 Uranium Mining Exposure Study* – This study was created and administered by workers and family members who worked in uranium mining and milling. The survey, which was sent out in 2007 and again in 2009, examines the health conditions of uranium workers who were employed in New Mexico after 1971 and advocates for the expansion of Radiation Exposure Compensation Act (RECA) compensable disease (Evers et al., 2009).
- *Navajo Birth Cohort Study* – this study will examine uranium waste, reproductive outcomes, and child development in the Navajo Nation (Begay and Charley, 2011; Dearwent, 2011).
- *Navajo Uranium Miner Oral History and Photography Project* – an oral history and photography project that details the lives of 25 Navajo people that had been impacted by uranium mining. The stories detail the physical and mental health impacts that resulted from years of mistreatment by the U.S. government and mining companies during the initial years of the uranium boom on Navajo Nation lands. The study documents the impacts on wives of miners who became widows, including depression and poverty, the exposure of the wives to uranium dust when they washed the clothes of their working husbands, the questions and hurt that remain over the government's nondisclosure of health impacts of uranium mining when the health impacts were already well established,

and the lack of safety procedures that existed when mining operations began (Brugge et al., 2006; Brugge et al., 1997).

Further to these studies, it was noted in stakeholder engagement activities for this EIS that residents are concerned about the proposed current and future mining developments. Specifically, Native and non-Native residents worry about current and future levels of contamination of water, air, land and animals caused by mining activities. The Native concept of health does not separate environmental and human experiences; all people and all living things are connected. This means that any impact to the environment affects the health of the Native peoples. Water contamination was the primary concern of the tribes and tribal stakeholders when it came to health impacts (Boone et al., 2012; Luarkie et al., 2012; Juanico et al., 2012). Water is not only important for farming practices and daily living; water is also a very important component of cultural health in these communities. Impacts to air quality (contaminated dust particles) and to the land (contaminated soils) were also important concerns of the Native tribes. A specific concern about how these factors would impact health of animals and, therefore, health of residents that hunt and consume animals was also mentioned.

Native and non-Native stakeholders also believe they have been disregarded in the past and some feel hurt and betrayed as they believe their concerns are not being acted upon by various governing agencies (Head-Dylla, 2012; Gunnell, 2012; Luarkie et al., 2012; Juanico et al., 2012). It was expressed several times by these community members that the idea of adding another mine to an area that has many unresolved issues with legacy contamination is unreasonable and possibly inhumane. Many stakeholders see this as a concern for not only the present generation, but for generations to come (Head-Dylla et al., 2012; Gunnell, 2012; Boone et al., 2012; Luarkie et al., 2012; Juanico et al., 2012). These stakeholders believe that any future developments would further exacerbate existing health issues in the area and have concerns about the development of the current or future mines.

Assessment and Cleanup Programs in the ROI

The legacy of uranium mining continues in New Mexico, due to a number of sites still un-reclaimed and, thus, posing potential hazards to nearby residents. These sites include: the 500 abandoned mines in Navajo Nation; the Grants Mining District located in the northwestern New Mexico including many sites close to the proposed action site; the Jackpile Mine (once the world's largest open pit uranium mine) located on the Pueblo of Laguna; the United Nuclear Corporation Superfund site located 17 miles northeast of Gallup on the southern border of the Navajo Indian Reservation; and the Homestake Mining Company site in Cibola County, north of Grants (USEPA, 2011f). A number of assessment programs and plans have been initiated to reclaim the land and rectify some of the environmental and health legacy issues due to uranium mining in the area (USEPA, 2008; USEPA, 2011a). These cleanup programs are outlined below.

Grants Mining District 5-Year Plan (2010-2014)

The Grants Mining District was an extremely active uranium mining area in New Mexico from the 1950s to the late 20th century and is comprised of an area of 100 miles by 25 miles. The Grants Mining District 5-year plan includes: assessment of water supply for contamination; assessment and cleanup of legacy uranium mines; contaminant assessment, cleanup, and long-term management of former uranium milling sites; assessment and cleanup of contaminated structures; and ongoing public health surveillance activities (USEPA, 2011i). The assessment and cleanup activities are being coordinated amongst Federal, State, and tribal organizations whose mandate includes human health and the environment (USEPA, 2010d).

Health and Environmental Impacts of Uranium Contamination in the Navajo Nation, 5-year Plan

Between 1944 and 1986, uranium mining operators extracted approximately 4 million tons of uranium ore from the Navajo Nation lands and, consequently, have left behind over 500 abandoned uranium mines; 4 inactive milling sites; a former dump site; as well as contaminated groundwater and structures within Navajo Lands. In 2008, the House Committee on Oversight and Government Reform requested the Bureau of Indian Affairs (BIA), Department of Energy (DOE), Nuclear Regulatory Commission (NRC), Environmental Protection Agency (EPA), and Indian Health Service (IHS) to develop a 5-year plan to address public health and environmental impacts from historical uranium mining on Navajo Lands. These Federal agencies are working toward a number of objectives involving the assessment, cleanup, and remediation of uranium mine sites in the Navajo Nation (BIA et al., 2008).

Greater detail is provided in the paragraphs below on two of the projects incorporated into the 5-year plans because these projects have extensive public documentation and because they illustrate some of the health concerns related to these sites.

Homestake Mining Company Mill Site

The Homestake Mining Company Mill Site is located within the Grants Mining District. In 1958, Homestake opened a mill to process uranium and the mill operated for 30 years, closing in 1990. Even after the reclamation activities, the mill left behind two tailings piles of waste products; one covers an area of 200 acres and is roughly 100 feet high; the other pile covers 40 acres and is 25 feet high. In 1983, EPA placed Homestake on the National Priorities List (NPL) because of groundwater contamination in residential wells; in addition, Homestake had to provide an alternate potable water supply to affected residents for 10 years (1985 to 1995). Remediation of the contaminated aquifers has been ongoing since 1977 and will be completed in 2015. Even after 2015, it is expected that the uranium and selenium will still be above drinking water standards. Other community concerns include health effects with respect to livestock and vegetable gardens; however, at a public meeting in March 2005, no adverse health effects were reported in livestock by residents (ATSDR, 2009). Homestake sampling activities completed to date include: radon sampling, radiation scanning and structures assessment, soil sampling, water sampling, vegetation sampling, and an environmental radiation ground scanning survey. The EPA expected the evaluation of these activities to be completed by April 2012 (USEPA, 2012b).

Church Rock Uranium Monitoring Project (2003-2007)

The Church Rock Chapter of the Navajo Nation initiated this project in 2003 to assess environmental conditions in residential areas affected or potentially affected by abandoned uranium mines. The program also aimed to build community-based research and advocacy capacity to address the long-term impacts of uranium development in the area. The primary activities of this program involved assessing the water quality in unregulated water wells, surface radiation levels, trace metals (uranium) in the soil, indoor radon levels, and airborne dust. A number of recommendations for the Federal government came out of this project, including: funding a cleanup program targeting abandoned uranium mine sites; comprehensive health studies of residents in the uranium mining districts of the Navajo Nation; closure of specific wells and development of new wells; soil testing; and ongoing air sampling (Shuey and Ronca-Battista, 2007).

Conclusion

Uranium mining, milling, and health impacts related to soil, air, and water contamination remain an area of concern for some residents in the study area. This is reflected in the 20 comments that were collected in the scoping period that outline health concerns around proposed uranium developments (USFS, 2011d), in the stakeholder interviews, and in the various ongoing government and community studies examining the environmental and health impacts of uranium. Although evidence pertaining to the actual physical health impacts of previous mining activities on community members is inconclusive, it is likely that the mental health of residents in the ROI is being affected by past, present, and the idea of future mining activities.

Stress and mental health are key components of overall health and well-being. Unmanaged stress has physical health consequences that include weakened immune systems, weakened functioning of the circulatory and metabolic systems, and increased incidence of cardiovascular disease and Type 2 diabetes (Brunner and Marmot, 2006). Generally, higher socioeconomic status, strong social and family supports, and healthy living environments are associated with less stress and improved mental health. Industrial projects can improve stress levels through providing economic and employment benefits. However, industrial projects can also increase stress by influencing community structure and social support systems, aspects of the biophysical environment, and anxiety levels related to perceived, potential, or actual contamination.

The stress and anxiety levels of residents in the ROI and, in turn, the mental, physical, and social health effects of these feelings, are affected by both historical and present-day factors. These factors include the known and the unknown health effects of uranium mining and the large number of unreclaimed and contaminated mine sites within the area. As well, high levels of poverty and the past reality and future possibility of a boom-bust cycle magnify the potential for impacts to mental health in the ROI. Not only are the factors interactive; that is, they can heighten stress and anxiety because they occur together, but the stress and anxiety related to these factors are cumulative and may compound over time. While the interactive and cumulative nature of legacy issues makes future outcomes of communities facing new resource development projects difficult to predict, the complex nature of legacy issues also underscores the importance of developing a deep understanding of these issues, and the need to mitigate stress and anxiety levels associated with them when proposing new projects.

Overall, the likely cumulative impacts resulting from past, current, and future developments in the ROI would be:

1. In-migration of workers not originally from the area;
2. Economic changes at the level of both individual residents and the local municipalities;
3. Potential exposure to environmental contaminants;
4. Exacerbation of mental health impacts related to perceived contamination;
5. Further mental health impacts to Native community members due to exploitation of land and water resources;

6. Social pathologies (e.g., alcohol and drug abuse, violence, child neglect); and
7. Exacerbation of health disparities

Mitigation strategies to help address some of these impacts include:

- transparency in project planning for operation and decommissioning phases;
- involvement of affected communities in development of project operations and decommissioning plans around issues of importance to the community (e.g., water, land, air contamination; remediation commitments);
- continuation of local and regional governments' efforts to diversify the economic base in the ROI;
- continued cleanup and monitoring of contaminated mines sites and finalizing cleanup efforts in a timely manner;
- strong commitment to the highest standards of health and safety at uranium mine and mill worksites; and
- continued study of the environmental and human health effects of uranium mining, as well as a commitment to commence a comprehensive study of the community human health impacts of uranium mining.

Legacy Issues – New Mexico Uranium Mining

Legacy Health Issues

As noted in the previous section, among the issues raised during scoping for the proposed Roca Honda Mine were historical health effects associated with uranium mining, milling, and ore handling activities in New Mexico and elsewhere. Stakeholders expressed concern about the extent to which the proposed action and similar actions—such as the nearby proposed La Jara Mesa Mine, about which a draft EIS was released by Cibola National Forest in March 2012—would contribute to further similar uranium mining-related health issues.

Potential health and safety impacts associated with the Roca Honda Mine in particular are discussed under the "Air Quality," "Environmental Justice," and "Human Health and Safety" sections of this EIS. This section discusses historical health issues associated with uranium mining in the region, including past activities related to uranium mining, processing, waste disposal, abandoned sites, and the nuclear weapons program. The topic of historical and remaining health issues and risks that are suspected of being caused by uranium mining and milling practices that were followed decades ago, including contamination from these activities, is referred to as "legacy health issues." The legacy is a history of contamination and various health problems left by an active uranium mining history in New Mexico that started as far back as the 1950s.

Legacy health effects result from historical uranium mining and milling activities, particularly in the Grants Mining District of New Mexico. Such activities have included the mining, transport, processing (milling), storing, and disposing of uranium ore and waste products. Also referred to as the Grants Mineral Belt, the area extends along the southern margin of the San Juan Basin, within Cibola, McKinley, Sandoval and Bernalillo Counties, and on tribal reservation lands. The Shiprock Mining District and Ambrosia Lake Subdistrict of the Grants Mining District are under

Navajo Nation jurisdiction and are administered by EPA Region 6. Remaining areas are under the jurisdiction of EPA Region 6 and the State of New Mexico.

Environmental conditions at legacy mining and milling sites are affected by the technologies available at the time, mining techniques used in the past, historical health and safety practices, regulations and enforcement, availability of funding for cleanup, and other factors. They are also affected by the location, design, and type of mine; the methods used to extract, transport, and process ore; and reclamation practices. Most of the contaminated site issues in the region include waste piles, ore processing sites, abandoned mines, and other surface facilities. Some of the contamination problems were exacerbated by mining companies that went out of business before cleaning up (reclaiming) their mine sites. This section describes the status of uranium mining and processing, with a focus on New Mexico, and describes legacy health issues and how they may relate to the proposed Roca Honda Mine on the Cibola National Forest near San Mateo and Grants.

Uranium Health Effects

Uranium Metal Toxicity

Uranium and its byproducts and related nuclides can cause harm through exposure or ingestion, by mouth or via inhalation. Exposure to uranium can result in both chemical and radiological toxicity. The primary human health effect associated with exposure to uranium metal itself and its compounds is kidney toxicity. This is distinct from radiation effects. Uranium toxicity can result from breathing air containing uranium dust or by ingesting substances containing uranium, which then enter the bloodstream. Very high uranium intakes (ranging from about 50 to 150 mg, depending on the individual) can cause acute kidney failure and death. At lower intake levels (around 25 to 40 mg), damage can be detected by the presence of protein and dead cells in the urine, but there are no other symptoms. After exposure to lower nonlethal intake levels, the kidney can repair itself over a period of several weeks after the uranium exposure has stopped.

Radiological Toxicity

Radiological effects of uranium exposure are much more varied and potentially persistent. Several possible health effects are associated with human exposure to radiation from uranium. Because all uranium isotopes, as they decay to the element thorium, emit primarily alpha particles (essentially a helium nucleus, or two protons and two neutrons bound together) that have little penetrating ability, the main radiation hazard from uranium occurs when uranium compounds are ingested or inhaled. However, workers in the vicinity of large quantities of uranium in storage or in a processing facility, also are exposed to low levels of external radiation from uranium decay products. At the exposure levels typically associated with the handling and processing of uranium, the primary radiation health effect of concern is an increased probability of the exposed individual to develop cancer during his or her lifetime, rather than immediate illness. Cancer cases induced by radiation are generally indistinguishable from other “naturally occurring” cancers and typically occur years after the exposure takes place. The probability of developing a radiation-induced cancer increases with increasing uranium exposure and intakes. The management approach to reduce that risk is to reduce the level of exposure to workers in particular and the public in general.

The extent of damage from exposure to a uranium compound depends on the solubility of the compound and the route of exposure. In most health assessments evaluating the health effects of uranium exposure, inhalation, ingestion, and external radiation are all considered. Although absorption of some soluble compounds through the skin is possible, such dermal exposures generally are not significant. For inhalation or ingestion of soluble or moderately soluble compounds such as uranyl fluoride (UO_2F_2) or uranium tetrafluoride (UF_4), the uranium enters the bloodstream and reaches the kidney and other internal organs, so that chemical toxicity is of primary importance. For inhalation of insoluble compounds such as uranium dioxide (UO_2) and triuranium octaoxide (U_3O_8, the uranium compound typically found in uranium ore), the uranium is generally deposited in the lungs and can remain there for long periods of time (months or years). The main concern from exposure to these insoluble compounds is increased cancer risk from the internal exposure to radioactivity. Ingested insoluble compounds are poorly absorbed from the gastrointestinal tract and are only retained in the body for a short time, thus generally having a low toxicity.

Today’s mining procedures include mine dust control to reduce the potential for inhalation; dose measurements to ensure that safe levels of exposure are not exceeded; precautionary management practices followed by miners; and in the case of underground mines like the proposed Roca Honda Mine, proper ventilation.

Radon

Radon gas is another exposure risk and one which is more related to mining than to processing or disposal, especially underground mining. Thus, it is more relevant to the proposed Roca Honda Mine than to open pit mines. Radon gas exposure is somewhat different than other forms of radionuclide exposure in that it is found naturally throughout the U.S. It has the potential for exposure to the public at large, even if not near a mine.

Radon is a naturally occurring radioactive gas found at elevated concentrations in many areas of the U.S., including basements of homes and other underground structures. Based on radon exposure studies, the EPA has suggested that homeowners should provide extra ventilation in basements or take other measures if radon levels exceed 4 piC/L (picocuries per liter). One common solution is an installed vacuum system that collects air under the foundation of the home and exhausts it before radon can penetrate walls and create exposure.

The EPA has found that radon gas is the number two cause of lung cancer in the United States, behind smoking, and is responsible for 21,000 lung cancer deaths per year—most of which (18,000) are from smokers, demonstrating the link between radon exposure health risk and smoking. When radon decays, it releases small radioactive particles that drift in the air. Because these radioactive particles adsorb (attach) to the surface of small particulate matter in the air, they can be inhaled if dust or small particles are inhaled. One source of small particulate matter is cigarette smoke. Thus, radon particles can absorb to the smoke that is inhaled by smokers, move deep into the lung, and stay there while exposing the lung to radiation. There has been a correlation between smoking in uranium mines and lung cancer, and the combination of smoking and radon exposure increases cancer risk considerably. Smoking allows fine particulates to which radioactive particles have adsorbed to travel deep into the lungs and attach to the surface of the lung. Absent the fine particles, the radon particles are not as likely to find a mechanism to attach to the lungs.

The New Mexico Bureau of Geology and Mineral Resources has stated that nonsmoking miners have a 100 times greater chance of getting lung cancer than the rest of the population. Miners who smoke have been shown to be at higher risk of developing cancers than nonsmoking miners. No mention of modern mining practices and ventilation control and its effects was provided. However, mine ventilation systems and dust control are control mechanisms to reduce radon exposure health risks to miners.

Legacy Health Effects, Uranium Industry Workers

One of the concerns related to legacy health effects is the potential for increased health problems in New Mexico among residents, tribal members, and uranium industry workers. A number of epidemiological studies have been conducted in New Mexico to examine the potential for such problems and they continue today. Such studies can be challenging because they need to cover dozens of years and multiple exposures to various sources, and determine if observed effects are related to the uranium industry or to many other exposure possibilities.

Mining and Milling

A cohort mortality study of mine workers was conducted on workers engaged in uranium milling and mining activities near Grants, New Mexico, during the period from 1955 to 1990 (Boice et al., 2008). Vital health status of these miners was tracked and determined through 2005. Standardized mortality ratio (SMR) analyses were conducted for 2,745 men and women alive after the year 1978 who had been employed for at least 6 months in the uranium mining and milling industry. Overall, mortality from all causes (SMR 1.15; 95 percent CI 1.07-1.23; n = 818) and all cancers (SMR 1.22; 95 percent CI 1.07-1.38; n = 246) was greater than average U.S. mortality rates.

Increased mortality, was seen among the 1,735 underground uranium miners and was due to malignant (SMR 2.17; 95 percent CI 1.75-2.65; n = 95) and nonmalignant (SMR 1.64; 95 percent CI 1.23-2.13; n = 55) respiratory diseases, cirrhosis of the liver (SMR 1.79; n = 18), and external causes (SMR 1.65; n = 58). The lung cancer excess likely was attributable to the historically high levels of radon in uranium mines of the Colorado Plateau, combined with the heavy use of tobacco products by the same miners. In the early days of uranium mining, smoking was not prohibited and ventilation was not provided in underground mines to the extent it is provided today.

Among 718 mill workers with the greatest potential for exposure to uranium ore, no statistically significant increase in any cause of death of a priori interest was seen, i.e., cancers of the lung, kidney, liver, or bone, lymphoma, nonmalignant respiratory disease, renal disease, or liver disease. Although the population studied was relatively small, the followup was long (up to 50 years) and complete. In contrast to miners exposed to radon and radon decay products which did show effects, uranium mill workers exposed to uranium dusts and mill products showed no clear evidence of uranium related disease. This indicated that exposure to normal levels of uranium ore was not an acute health risk, while exposure to radon within an enclosed mine did appear to cause health problems.

Another study, published in 1997 (Mapel et al., 1997) concluded that Native American miners have more nonmalignant respiratory disease from underground uranium mining, and less disease from smoking, than other miner groups, and are less likely to receive compensation for mining related disease. Uranium mining is more strongly associated with obstructive lung disease and radiographic pneumoconiosis in Native Americans than in Hispanics and non-Hispanic whites. Obstructive lung disease in Hispanic and non-Hispanic white miners is mostly related to cigarette smoking. Native Americans have the highest prevalence of radiographic pneumoconiosis, or lung disease caused by dust in the lungs, and are less likely to meet criteria for compensation. This disease can be caused by coal dust, silica, or other sources as well; in coal miners it is known as "black lung disease."

Mining History of New Mexico

Because there was very little regulatory framework in place during the earlier (pre-1990s) round of uranium mining, New Mexico has been left with what is referred to as a legacy of environmental contamination from these activities (NMBGMR). According to a University of Michigan study, mining began in earnest in the Southwest United States after World War II, when atomic weapons were being developed. Escalation of the Cold War between the United States and the Soviet Union sent workers to uranium mines to mine the ore for processing into nuclear weapons. More than 15,000 people have mined uranium or worked in ore processing mills in the Southwest since the 1940s. Some 13 million tons of uranium were mined while the mines were in operation. The Vanadium Corporation of America and Kerr-McGee Corporation were the principal owners of these mines.

Mine Types

Uranium mines are generally one of three types: open pit, underground hard rock mines, or in situ leach mines. Open pit and underground hard rock mines can process (mill) the ore onsite, or instead can ship the ore offsite for processing. In situ leach, processes would leach the uranium out of rock in place, far underground, by pumping chemicals from the surface into the underground ore deposit and bringing uranium to the surface in solution for further processing. The overall footprint and potential for exposure and contamination is generally less with an underground mine, because it is generally smaller in scope and works with a more confined ore. This is especially true if processing is done offsite, which is what would occur with the Roca Honda Mine. Other factors affecting health risk potential include the presence or absence of groundwater, mine depth, and waste rock overall contamination and handling and characteristics.

Ore Processing

Ore can be processed (milled) onsite with either mine type. Open pit and underground mines can also haul ore to a treatment (milling) facility where it is exposed to acid to leach out the mineral. Surface exposure of ore to water and chemicals is referred to as a heap leach process. This process can be done at the mine or at offsite processing facilities. Ore can also be processed in situ using acids or other chemicals to leach out the mineral in place, far underground, and then pump the leachate to the surface to recover the uranium. The advantage of the in situ leach process is lower worker exposure, potentially lower recovery costs, and the elimination of a waste tailings pile. Disadvantages include potential groundwater contamination and the possibility of a permanently contaminated underground area upon completion, although surface areas are generally less affected.

Mill Tailings

Mill tailings are the waste products remaining after uranium ore has been processed into uranium (yellow cake) for further refinement at a finishing plant. The Roca Honda Mine would not produce mill tailings. Rather, these would be generated at an offsite processing facility licensed by the NRC or the State, depending on the facility. Mill tailings are one of the legacy health issues in New Mexico. Radiation exposure to the public from uranium tailings can occur from direct exposure to the surface, ingestion of contaminated food or water or, in rare cases, from exposure to materials made from the tailings, including fill materials.

Legacy Health Effects Assessment and Remediation

In 1990, a Federal law was passed known as the Radiation Exposure Compensation Act of 1990 (RECA) (Eichstaedt, 1994). The law required $100,000 in “compassion payments” to uranium miners diagnosed with cancer or other respiratory ailments (Eichstaedt, 1994; Benally Sr., 1995). To qualify for compensation, a miner had to prove that s/he had worked in the mines and was now suffering from one of the diseases on the compensation list (Eichstaedt, 1994; Benally Sr., 1995) or were otherwise exposed to radiation from atomic bomb testing from the 1940s to the 1960s. In 2000, additional amendments were passed which added two new claimant categories (uranium mill and ore workers, both eligible to receive as much money as uranium miners), added additional geographic regions to the “downwinder” provisions, changed some of the recognized illnesses, and lowered the threshold radiation exposure for uranium miners. In 2002, additional amendments were passed to improve coverage. The law expanded the downwind exposure area to include seven states and funded a study of health impacts on families of uranium workers and people living near uranium development. A later proposed bill would add all of New Mexico, Arizona, Colorado, Idaho, Montana, Nevada, and Utah in areas defined as downwind from atomic tests (AP, Apr. 20, 2010). This legislation expands existing compensation programs for those who may have been harmed by the uranium industry.

Current Mine Safety Regulations

Part 61 B of 40 CFR specifies national emissions standards for radon from underground mines. These standards are designed to protect the public and apply to any uranium mine with a production capacity of 100,000 tons of ore. They require mine operation and radon emission limits from ambient air leaving the mine to limit any member of the public to receive a dose of 10 mrem per year. Thus, the actual allowable mine emission rate would depend on the proximity of amount, the ambient concentrations of radon in the air. Worker exposure must meet minimum standards accomplished through ventilation resulting in ventilation exhaust concentrations that must be under safe worker thresholds. The human health and safety analysis in this EIS selected the highest potential exposure level that could reasonably be assumed for the public, since the nearest residence is actually miles away. The assumption and analysis is included in the “Air Quality” section.

Current Legacy Health Investigations and Activities

HRSA Compensation Program

The Health Resources and Services Administration has been tracking and attempting to compensate for health claims related to radiation exposure. Through 2007, $577 million in claims have been paid. Table 99 indicates the categories of payments made to employees of the uranium mining industry as of 2007. As of February 2011, 23,500 claims under the act were approved (expending a total of $1.6 billion).

Table 99. Uranium worker compensation – April 1992 through June 2007

Category	Claims Approved	Claims Denied	Claims Pending	Total Payments
Uranium Miner	4,560	2,661	208	$455 million
Uranium Miller	1,000	239	33	$100 million
Uranium Ore Transporter	217	70	7	$22 million
Total	5,777	2,970	248	$577 million

Uranium Mill Tailings Radiation Control Act (UMTRA)

This act of Congress in 1978 was passed to ensure that uranium mill tailings be managed and cleaned up as appropriate, and that every reasonable effort be made to provide for the stabilization, disposal, and control in a safe and environmentally sound manner of such tailings in order to prevent or minimize radon diffusion into the environment and to prevent or minimize other environmental hazards from such tailings. Title I of UMTRCA designated 22 inactive uranium ore processing sites for remediation, including Shiprock and Ambrosia Lake in New Mexico. Remediation of these sites resulted in the creation of 19 disposal cells that contain encapsulated uranium mill tailings and associated contaminated material. These sites are currently managed by the Office of Legacy Management within the U.S. Department of Energy (DOE). When the act was passed, there were a number of active processing sites that are now covered under Title II of the act and were licensed by NRC. The DOE currently administers these sites.

Shiprock Site Cleanup

This site is licensed to DOE and was turned over to the Office of Legacy Management in 2003. A groundwater cleanup and management plan is in effect at this site and will continue.

Ambrosia Lake Site Cleanup

This abandoned mill processing site located about 25 miles north of Grants was remediated between 1987 and 1995. Materials have been encapsulated in an engineered disposal cell and isolated from the environment, but will be monitored by the DOE and the encapsulated materials, according to the DOE fact sheet on the site, will be “potentially hazardous for thousands of years.” This is an abandoned processing site and not a mine.

USDOE/Corps FUSRAP Memorandum of Understanding

In 1999, the DOE signed a memorandum of understanding (MOU) with the U.S. Army Corps of Engineers to take over a remedial action program (RAP) for formally used sites (FUS) involving the cleanup of areas used for atomic bomb making, nuclear fuel rod processing and manufacture, and research. Some of these sites are located in New Mexico, such as Acid Pueblo Canyon, Bayo

Canyon, and Chupadera Mesa site northeast of Bingham. These sites have been remediated and are not directly related to mining activities, but contribute to the legacy of uranium production and handling in New Mexico.

EPA Uranium Cleanup Enforcement Actions

In September 2010, the EPA entered into two enforcement actions related to cleanup of uranium contamination at the Navajo Nation and Hopi Reservation. One involves the control of radium (a decay product of uranium and precursor to radon) from the Quivira Mine site near Gallup, New Mexico. The other involves a comprehensive investigation of the levels of uranium and other contaminants in the waste, soils, and groundwater at the Tuba City Dump Site in Arizona. To date, two New Mexican uranium mills have been remediated. The Phillips Uranium Mill in Ambrosia Lakes cost $40 million to remediate 3.1 million tons of tailings. The Shiprock Mill cost $25 million to remediate 1.7 million tons of tailings; and the Homestake Mill with its 22 million tons of tailings to remediate and the groundwater issues will probably far exceed the $56 million suggested by the NRC.

Future Uranium Mining Health

Legacy Activities – Grants Mining District

Region 6 of EPA has developed a 5-year plan that is intended to compile all activities contributing to the identification and cleanup of legacy uranium milling and mining activities in the Grants Mining District in the State of New Mexico. Assessment efforts will be coordinated among Federal, State, and tribal participants responsible for protecting human health and the environment. The authorized organizations will implement appropriate laws, regulations, and policies within their jurisdiction to accomplish cross-organizational activities. Although this plan is specific to the Grants District, it is anticipated that some of the actions adopted here may be applied elsewhere. A separate plan for the Ambrosia Lake District is underway and is under the jurisdiction of the Navajo Nation.

The goal of the 5-year plan is to promote and advance the work needed to help restore and preserve the natural and cultural resources in the Grants Mining District and to ensure protection of human health for future generations. There are six objectives in the plan which will be implemented by the State of New Mexico or the Federal Government:

1. Assess water resources for contamination. Test and evaluate potential groundwater and well contamination to evaluate the impacts of legacy uranium sites and historical activities.
2. Evaluate and clean up abandoned mine sites. This includes screening of mine sites in the Poison Canyon area in 2009, assessment and abatement of 13 legacy uranium mines in the Ambrosia Lake and Laguna subdistricts, and cleanup on Bureau of Land Management (BLM) lands under CERCLA (Superfund).
3. Assess, clean up, and manage old uranium processing sites, including USDOE monitoring and maintenance at the Anaconda Bluewater mill, Ambrosia Lake-Phillips mill, and L-Bar mill. NRC is also overseeing cleanup of the Homestake Mining and Ambrosia Lake-Rio Algom mills in the Ambrosia Lake subdistrict.

4. Assess and clean up radiation-contaminated structures in the region by the EPA under Superfund.
5. Continue investigations and cleanup of the Jackpile open pit mine site which mined from 1953 to 1982. EPA is funding legacy activity investigations under Superfund and working under a MOU with the Laguna Pueblo.
6. Conduct human health screening led by the New Mexico Department of Health.

Each of the six activities has its own funding, time line, responsible agency(ies) and management plan details that are discussed in the overall plan. A total of 96 mines are under consideration within the plan. The plan describes EPA's ongoing Superfund work at the major uranium mines in the district. This includes extensive cleanup activities at:

- The Homestake Mining Mill site and area. The mill operated between 1958 and 1990, and was dismantled from 1993 to 1995.
- The UNC uranium processing mill in McKinley County which operated from 1977 to 1982.
- The UNC Church Rock mine that operated from 1967 to 1982 next to the Navajo Reservation. Extensive soil remediation activities commenced in 2006 and 2007.

Ongoing Research and Investigations

Uranium Millers and Miners Study

One recent study related to residents as a result of exposure to legacy uranium issues in New Mexico and included in this analysis was published in September 2010 (Boice et al., 2010). It evaluates cancer mortality during 1950–2004 and cancer incidence during 1982–2004 among Cibola County residents. The total numbers of cancer deaths and incident cancers were close to that expected in the general population. Lung cancer mortality and incidence were significantly increased among men but not women. Similarly, among the population of the three census tracts near the Grants Uranium Mill, lung cancer mortality was significantly elevated among men but not women. Except for an elevation in mortality for stomach cancer among women, which declined over the 55-year observation period, no significant increases in SMRs or standardized incident ratios (SIRs) for 22 other cancers were found.

Although the causes of these cancers cannot be drawn from these ecological data, the excesses of lung cancer among men seem likely to be due to previously reported risks among underground miners from exposure to radon gas and its decay products. Smoking, socioeconomic factors, or ethnicity may also have contributed to the lung cancer excesses observed in the study. The stomach cancer increase was highest before the uranium mill began operation and then decreased to normal levels. With the exception of male lung cancer, this study provides no clear or consistent evidence that the operation of uranium mills and mines adversely affected cancer incidence or mortality of county residents.

CDC Pregnancy and Children's Health Assessment

The legacy health issues associated with uranium mining, transport, milling, and disposal continue to receive attention in the United States including the desert Southwest and New Mexico. For example, the Centers for Disease Control and Prevention (CDC) announced its cooperative agreement with the University of New Mexico Health Sciences Center in August 2010 for a $1 million a year, 3-year study on pregnancy outcomes and child development in relation to uranium exposure among Navajo mothers and infants living on the Navajo Nation.

Conclusion

The health risks and exposure pathways of uranium mining are well known. Past activities conducted under lax regulations, lack of closure bonds, and limited oversight have left contaminated sites that are being investigated and remediated by State and Federal agencies in New Mexico and elsewhere. Lung cancer among men in Cibola County is more common than other parts of the State and the United States, but other cancers among the general population in New Mexico have not been shown to be elevated. Additional health effects studies continue.

Many sites were closed and abandoned without reclamation, leaving mill tailings and other contaminants at the sites. Some cleanup projects have been completed and others are underway, under the oversight of the NRC, BLM, EPA, and the State of New Mexico. No processing or mill tailings would occur at the Roca Honda Mine site.

The contamination associated with open pit mining practices and abandoned uranium milling properties is not expected at the Roca Honda Mine, as it is proposed as an underground mine with no onsite milling. Existing and new mills are regulated and licensed by the NRC or by some states under equivalent regulations. Contemporary underground mining procedures include management practices such as dust control, ventilation, prohibition of smoking, radiation monitoring, radon concentration standards, reclamation plans, and financial assurance for reclamation. Related requirements to reduce health risks and ensure reclamation are much different than the practices followed during the early years of uranium mining in the middle of the last century and described and denounced in numerous articles and books (Pasternak, 2010). The lack of open pit mining, leachate treatment, ore milling, in situ leachate handling, and wastepile disposal; and the requirements for ventilation and similar health and safety requirements of current uranium mining regulations suggest that there is little or no connection between the legacy health issues of uranium mining and processing in the past, and anticipated health and safety effects from the proposed Roca Honda Mine.

Short-term Uses and Long-term Productivity

NEPA requires consideration of “the relationship between short-term uses of man’s environment and the maintenance and enhancement of long-term productivity” (40 CFR 1502.16). As declared by Congress, this includes using all practicable means and measures, including financial and technical assistance, in a manner calculated to foster and promote the general welfare, to create and maintain conditions under which man and nature can exist in productive harmony, and fulfill the social, economic, and other requirements of present and future generations of Americans (NEPA Section 101).

Consequences of Proposed Action

Existing productivity of the site and nearby areas includes grass and forb growth that is grazed by livestock (cattle), mule deer, and Rocky Mountain elk, as well as providing general wildlife habitat. It is not used for timber growth or harvest, for farming, or any aquatic productivity uses as there is little or no water on the site. However, firewood gathering takes place in the woodlands on Sections 9 and 10.

The Roca Honda Mine in portions of Sections 9, 10, and 16 would be mined for uranium to remove underground ore resources. After completion of the mining phase, the project site would be reclaimed and restored as required by the Forest Service and the New Mexico Mining and Minerals Division. Once reclaimed, the site would return to the same uses of the land that occur at present. This would include open range cattle grazing, low density recreational uses such as hunting, and wildlife value. Therefore, development of this site for a mine would not eliminate the potential for long-term productivity of this land. As a result, no significant impacts to long-term productivity are expected to occur from the proposed project.

Unavoidable Adverse Effects

Table 100 lists unavoidable adverse effects for each of the three alternatives considered in depth.

Table 100. Unavoidable adverse effects of the three alternatives considered

Resource Area	Alternative 1 – No Action	Alternative 2 – Proposed Action (2 shafts)	Alternative 3 – 1 Shaft Option
Geology and Soils	- None	- Disturbance of soils on 218 acres in total. - Not considered significantly adverse.	- Disturbance of soils on 155 acres in total. - Not considered significantly adverse.
Surface Water Resources	- None	- Temporary increase in erosion due to disturbed ground surface. - Not considered significantly adverse.	- Same as alternative 2 but to a smaller extent. - Not considered significantly adverse.
Groundwater Resources	- None	- Pumping of nearly 80,000 AF of groundwater from Westwater aquifer and drawdown of the same that would take centuries to recover. - Would dry up Bridge Spring. - Negligible but likely adverse impact on Horace Spring. - Aquifer drawdown considered significantly adverse.	- Same as alternative 2.
Air Quality	- None	- Negligible to minor impacts on air quality from tailpipe emissions of equipment and fugitive dust. - Negligible impacts from radon emissions. - Not considered significantly adverse.	- Same as alternative 2.

Resource Area	Alternative 1 – No Action	Alternative 2 – Proposed Action (2 shafts)	Alternative 3 – 1 Shaft Option
Vegetation	- None	- Would disturb 183 acres of vegetation within Sections 9, 10, and 16, as well as 35 acres outside of these sections along the pipeline route, haul roads, and the utility corridor. - Not considered significantly adverse.	- Would disturb 120 acres of vegetation mostly within Section 16, as well as 35 acres along the pipeline route, haul roads, and utility corridor (155 acres in total). - Not considered significantly adverse.
Wildlife	- None	- Would disturb a total of 218 acres of wildlife habitat, including 183 acres within Sections 9, 10, and 16 and 35 acres outside of these sections, and a number of species of wildlife, for a period of approximately 2 decades. - Not considered significantly adverse.	- Would disturb a total of 155 acres, including 120acres within Sections 9, 10, and 16, plus 35 acres outside of these sections, and a number of species of wildlife, on and near these sites for a period of approximately 2 decades. - Not considered significantly adverse.
Sensitive, Threatened, and Endangered Species	- None	- Possible adverse effects to State listed bats and several other State listed species, due to habitat disturbance, noise, moving machinery, etc. - Not considered significantly adverse.	- Same as alternative 2.
Land Use	- None	- Would limit access to all of the development and operations areas to the extent necessary to protect public safety and control the work space. - Not considered significantly adverse.	- Would limit access to all of the development and operations areas to the extent necessary to protect public safety and control the work space, but on a smaller scale than alternative 2. - Not considered significantly adverse.
Recreation	- None	- Would limit recreational access to to all of the development and operations areas to the extent necessary to protect public safety and control the work space. - Not considered significantly adverse.	- Would limit recreational access to all of the development and operations areas to the extent necessary to protect public safety and control the work space. - Not considered significantly adverse.
Environmental Justice and Protection of Children	- None	- Adverse mental health impacts of moderate magnitude would occur to tribal environmental justice communities due to mine development so close to spiritually significant Mt. Taylor. - Adverse cumulative effects would occur related to environmental justice. - Cumulative effects considered significantly adverse.	- Same as alternative 2.

Resource Area	Alternative 1 – No Action	Alternative 2 – Proposed Action (2 shafts)	Alternative 3 – 1 Shaft Option
Cultural and Historic Resources	- Impacts to cultural resources already occurring from livestock management and access to the area by the public would continue; these include vandalism, trampling, and inadvertent damage. - Not considered significantly adverse.	- Would cause adverse impacts to tribal cultural resources and practices related to the sacred character of Mt. Taylor for the Acoma, Laguna, Zuni, Hopi, and Navajo in particular. - Ground disturbance would result in direct physical impacts to 4 historic properties and the Mt. Taylor TCP. - Operation and reclamation activities would continue to introduce visual and audible elements out of character with the Mt. Taylor TCP, further impacting the setting of this historic property. - Effects considered significantly adverse. - Cumulative effects also considered significantly adverse.	- Same types and significance of impacts as alternative 2 - Due to less development in Section 10, the totality of the impacts to the Mt. Taylor TCP and related resources would be less than alternative 2.
Visual Resources	- None	- Adverse impact on Mt. Taylor viewshed. - Not considered significantly adverse.	- Same as alternative 2, though on smaller scale. - Not considered significantly adverse.
Transportation	- None	- To haul uranium ore, about 50 truck trips per 24 hours or about 2.1 trucks per hour would be expected in each direction.	- Same as alternative 2.
Human Health and Safety	- None	- Impacts to traffic safety would be adverse but less than significant. - Noise impacts would be adverse but not significantly adverse. - Perceived contamination on the part of Native Americans, along with actual changes to water and land from the project in the vicinity of sacred lands, especially within the context of uranium mining and milling legacy issues, may have real effects on the mental and physical health of some community members. - Overall adverse environmental health impacts would be less than significant. - Overall adverse impacts to health stemming from workforce migration would be less than significant. - Overall cumulative impacts on human health and safety would be significant.	- Same as alternative 2.

Irreversible and Irretrievable Commitments of Resources

NEPA Section 102(C) (v) requires a discussion of whether implementing the proposed action would, for any reason, irreversibly commit resources that would no longer be available for other purposes. Examples might include a commitment to consume resources that are then no longer available for other purposes (such as fuel), or that cannot be recycled or reused in some way. This would occur if a project used an enormous amount of resources, which are lost or consumed and no longer available. Such a commitment is intended to be described and then compared with the benefits of the project to compare those benefits to the irreversible commitment of such resources.

Irreversible commitments of resources are those that cannot be regained, such as the extinction of a species or the removal of mined ore. Irretrievable commitments are those that are lost for a period of time such as the temporary loss of timber productivity in forested areas that are kept clear for use as a power line rights-of-way or road.

Consequences of Proposed Action

The resources to be committed for this project involve typical amounts of steel, iron, concrete, and fuel required to construct a mine to extract uranium ore. Project equipment and construction commuters would use fossil fuels (diesel and gasoline derived from nonrenewable oil) during the construction development phase of the mine. The amount of construction resources used for such a mine (e.g., gravel, cement, iron, etc.) is expected to be minor and insignificant. No significant impact on, or demand for, construction material resources is anticipated. During operation of the mine, fuel resources would be consumed by trucks hauling ore to an offsite processing facility. Considering the number of trucks per day involved in this transport, no significant impacts to gasoline or diesel fuel resources would occur in the State or the region. Some materials such as steel and concrete may be reclaimed/recycled when the project is completed and the site reclaimed; fuel used during construction and operation is irretrievable. Water pumped out of the mine, even though used for irrigating rangeland or pasture, is not renewable and represents an irreversible use of resources, even though the aquifers that would be partially dewatered would eventually replenish over a period of centuries.

Uranium ore is mined and processed at a uranium processing mill into a more concentrated form of uranium for future uses such as conversion to fuel rods as a fuel to generate nuclear power. Once used, at this present state of technology it cannot be used again and is, therefore, a nonrenewable source of energy. While generating electricity, a nuclear power plant does not emit the combustion pollutants of either natural gas or coal-fired generating stations, nor carbon dioxide; thus, it does not contribute directly to increasing concentrations of CO_2, the main greenhouse gas, in the earth’s atmosphere. (Since fossil fuels are used at other stages in the nuclear fuel cycle—such as mining and milling uranium ore—nuclear power it is not entirely free of CO_2 emissions. Nevertheless, one recent study estimates that it accounts for well under 10 percent of the CO_2 emitted per kilowatt-hour of electricity than coal-fired plants (Kleiner, 2008).) The use of uranium ore for nuclear power may displace the use of fossil fuel combustion for the generation of electricity when it is provided to existing nuclear power plants or for new plants in the future. This would help conserve such fossil fuel resources and potentially reduce overall greenhouse gas emissions and levels in the atmosphere, with commensurately reduced levels of radiative or climate forcing and, perhaps, less global warming and climate change.

Cumulative Effects

Cumulative impacts are discussed in detail under each resource topic. Cumulative effects were found to be significant for groundwater resources, environmental justice, socioeconomics, cultural and historic resources, and human health and safety.

Other Required Disclosures

NEPA at 40 CFR 1502.25(a) directs “to the fullest extent possible, agencies shall prepare draft environmental impact statements concurrently with and integrated with other environmental review laws and executive orders.”

This DEIS serves as the means by which the Forest Service initiates informal coordination with the U.S. Fish and Wildlife Service under the Fish and Wildlife Coordination Act, as well as informal consultation under Section 7 of the Endangered Species Act. The Forest Service is following procedures under Section 106 of the National Historic Preservation Act in consulting with the State Historic Preservation Office, tribes, and other consulting parties. New Mexico State law and regulations apply under the New Mexico Mining Act and laws governing the New Mexico Environment Department, the Office of State Engineer, the State Land Office, as well as any further State laws that may apply.

Chapter 4. Consultation and Coordination

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Federal, State, Tribal, and Local Agencies

The Forest Service consulted the following individuals, Federal, State, and local agencies, tribes and non-Forest Service persons during the development of this environmental impact statement:

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Advisory Council on Historic Preservation, Washington, D.C.

Bureau of Land Management

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Tribes

- Acoma Pueblo
- Jemez Pueblo
- Laguna Pueblo
- Sandia Pueblo
- Zuni Pueblo
- Hopi Tribe
- Jicarilla Apache Nation
- Navajo Nation

List of Agencies, Organizations and Persons to Whom Copies of the DEIS Were Sent

This environmental impact statement has been distributed to individuals who specifically requested a copy of the document during the scoping process. In addition, copies have been sent to the following Federal agencies, federally recognized tribes, Sate and local governments, and organizations representing a wide range of views regarding mining on public lands.

Federal Agency	Location
U.S. Environmental Protection Agency (EPA), Office of Federal Activities	Washington, DC
EPA Region 6	Dallas, TX
U.S. Fish and Wildlife Service Ecological Services	Albuquerque, NM
Advisory Council on Historic Preservation	Washington, DC
Natural Resources Conservation Service National Environmental Coordinator	Washington, DC
U.S. Department of Energy Director, Office of National Environmental Policy Act (NEPA) Policy and Compliance	Washington, DC
Division Administrator Federal Highway Administration	Santa Fe, NM
U.S. Department of Agriculture (USDA), Animal and Plant Health Inspection Service	Washington, DC
U.S. Department of the Interior Director, Office of Environmental Policy and Compliance	Washington, DC
USDA, Office of Civil Rights	Washington, DC
USDA, National Agricultural Library	Washington, DC

Tribe	Location
Acoma Pueblo	Acoma, NM
Laguna Pueblo	Laguna Pueblo, NM
Zuni Pueblo	Zuni, NM
Jemez Pueblo	Jemez, NM
Sandia Pueblo	Bernalillo, NM

Hopi Tribe	Kykotsmovi, AZ
Jicarilla Apache Tribe	Dulce, NM
Navajo Nation	Window Rock, AZ

State Agency	Location
New Mexico Mining and Minerals Division	Santa Fe, NM
New Mexico Environment Department	Santa Fe, NM
New Mexico Office of the State Engineer	Santa Fe, NM
New Mexico Historic Preservation Division	Santa Fe, NM
New Mexico State Land Office	Santa Fe, NM
New Mexico Department of Game and Fish	Santa Fe, NM

Organization	Location
Wildearth Guardians	Santa Fe, NM
Center for Biological Diversity	Tucson, AZ
Southwest Information and Research Center	Albuquerque, NM

County Government	Location
Cibola County Commissioners	Grants, NM
McKinley County Commissioners	Gallup, NM

Glossary

Air-Quality Control Region: A contiguous area where air quality is relatively uniform. AQCRs may consist of two or more cities, counties, or other governmental entities, and each region is required to adopt consistent pollution control measures across the political jurisdictions involved.

Attainment areas: A region within which the level of a pollutant is considered to meet the National Ambient Air Quality Standards.

Criteria pollutants: Six primary air pollutants found throughout the United States as defined by USEPA pursuant to the Clean Air Act. They are particulates, ground-level ozone, carbon monoxide, sulfur oxides, nitrogen oxides, and lead.

Direct effects: The set of expenditures applied to the predictive model (i.e., I/O multipliers) for impact analysis. It is a series (or single) of production changes or expenditures made by producers/consumers as a result of an activity or policy. These initial changes are determined by an analyst to be a result of this activity or policy. Applying these initial changes to the multipliers in an IMPLAN model will then display how the region will respond economically to these initial changes.

Fossorial small mammals: Species adapted to digging.

Girdling: Surround.

Greenhouse gas: Any gas, such as carbon dioxide or CFCs, that contribute to the greenhouse effect when released into the atmosphere.

Haul trucks: Used to transport ore from the mine site to the mill. The type of truck will be determined when the mill location is selected.

Hibernate: Remaining inactive for a seasonal time period.

Indirect business taxes: The combination of excise, sales, and property taxes, as well as fees, fines, licenses, and permits.

Indirect effects: The impact of local industries buying goods and services from other local industries. The cycle of spending works its way backward through the supply chain until all money leaks from the local economy, either through imports or by payments to value added. The impacts are calculated by applying direct effects to the type I multipliers.

Induced effects: The response by an economy to an initial change (direct effect) that occurs through respending of income received by a component of value added. IMPLAN's default multiplier recognizes that labor income (employee compensation and proprietor income components of value added) is not a leakage to the regional economy. This money is recirculated through the household spending patterns causing further local economic activity.

Insectivores: An animal that preys on insects.

Intermediate inputs: Purchases of goods and services—such as energy, materials, and purchased services—that are used for the production of other goods and services rather than for final consumption. These inputs are sometimes referred to as current account expenditures. They do not include any capital account purchases nor do they include the inputs from the primary factors of production (capital and labor) that are components of value added.

Labor income: The sum of employee compensation (wages and benefits) as well as income from sole proprietors. Labor income represents total payments by industries to workers, not take-home pay.

Lagomorphs: Relatively large gnawing animals that are distinguished from rodents by their two pairs of upper incisors specialized for gnawing.

Migration: Movement of animals from one location to another, typically on a seasonal basis.

National Ambient Air Quality Standards: Standards established by the USEPA that apply to outdoor air throughout the country. Primary standards are designed to protect human health, with an adequate margin of safety, including sensitive populations such as children, the elderly, and individuals suffering from respiratory disease.

Nocturnal: Active at night.

Nonattainment areas: A region where air pollution levels persistently exceed National Ambient Air Quality Standards.

Output: The value of industry production, or the sum of value added and the cost of goods. In IMPLAN these are annual production estimates for the year of the data set and are in producer prices.

PM_{10}: Particulate matter less than 10 microns in diameter.

$PM_{2.5}$: Particulate matter less than 2.5 microns in diameter.

Roost: A place where birds and bats regularly settle or congregate to rest.

Scat: Animal droppings, especially those of carnivorous mammals.

State Implementation Plan: The state plan for complying with the Federal Clean Air Act. A SIP consists of narrative, rules, technical documentation, and agreements that an individual state will use to clean up areas not meeting the National Ambient Air Quality Standards.

Tumorigenic: Producing or tending to produce tumors.

Unincorporated area: In law, an unincorporated area is a region of land that is not a part of any municipality.

Value added: Combination of employee compensation, proprietor income, other property income (largely dividends and profits), and indirect business taxes (taxes collected by businesses on behalf of governments).

Volant mammals: Mammal species adapted to flying.

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