ENGINEERING EVALUATION/COST ANALYSIS

NORTHEAST CHURCH ROCK (NECR) MINE SITE
GALLUP, NEW MEXICO

May 30, 2009

U.S. EPA Region 9
75 Hawthorne Street
San Francisco, California 94105

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

ACRONYMS AND ABBREVIATIONS

ARARs	Applicable, Relevant and Appropriate Requirements
ATSDR	Agency for Toxic Substances and Disease Registry
bgs	below ground surface
BLM	Bureau of Land Management
BMP	Best Management Practice
BOE	Basis of Estimate
CERCLA	Comprehensive Environmental Response Compensation and Liability Act
CFR	Code of Federal Regulations
cm/sec	centimeter per second
COC	Contaminants of Concern
COPC	Contaminants of Potential Concern
CSM	Conceptual Site Model
CWA	Clean Water Act
c.y.	cubic yards
DOE	Department of Energy
EA	Environmental Assessment
EE/CA	Engineering Evaluation/Cost Analysis
EIS	Environmental Impact Statement
F	Fahrenheit
FR	Federal Register
Ft	feet
GIS	Geographical Information System
IAEA	International Atomic Energy Agency
ILCR	Incremental Lifetime Cancer Risk
HI	Hazard Index
HHRA	Human Health Risk Assessment
m	meters
MARSSIM	Multi-Agency Radiation Survey and Site Investigation Manual
MCL	Maximum Contaminant Level
mg/L	Milligrams Per Liter
mrem	Milirem
mrem/yr	Milli-Roentgen-Equivalent-Man Per Year
MSGP	Multi Sector General Permit
MWH	Montgomery Watson Harza
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NECR	Northeast Church Rock Mine Site
NEMSA	Non Economic Material Storage Area
NESHAP	National Emission Standards for Hazardous Air Pollutants

ACRONYMS AND ABBREVIATIONS, CONTINUED

NMAC	New Mexico Administrative Code
NMMMD	New Mexico Mining and Minerals Division
NMSA	New Mexico Statutes Annotated
NMWQCC	New Mexico Water Quality Control Commission
NN EPA	Navajo Nation Environmental Protection Agency
NPDES	National Pollution Discharge Elimination System
NPL	National Priorities List
NRC	U.S. Nuclear Regulatory Commission
ODC	Other Direct Costs
O&M	Operation and Maintenance
OSWER	Office of Solid Waste and Emergency Response
pCi/g	PicoCurie Per Gram
pCi/L	PicoCuries Per Liter
POLREP	Pollution Report
PRG	Preliminary Removal Goal
PRP	Potentially Responsible Parties
RAO	Removal Action Objectives
RAP	Remedial Action Plan
RBCG	Risk Based Cleanup Goal
RCRA	Resource Conservation and Recovery Act
ROD	Record of Decision
RWPR	Red Water Pond Road
RSE	Removal Site Evaluation
SARA	Superfund Amendments and Reauthorization Act
SDWA	Safe Drinking Water Act
SSHP	Site Safety and Health Plan
SSL	Soil Screening Level
START	Superfund Technical Assessment & Response Team
SVOC	Semi Volatile Organic Compounds
SWPPP	Stormwater Pollution and Prevention Plan
TCLP	Toxic Characteristic Leaching Procedure
TCRA	Time Critical Removal Action
TN&A	T N & Associates, Inc.
TSDF	Treatment, Storage, Disposal Facility
UIC	Underground Injection Control
UNC	United Nuclear Corporation
UMTRCA	Uranium Mill Tailing Radiation Control Act
USDW	Underground Sources of Drinking Water
U.S. EPA	United States Environmental Protection Agency
VOC	Volatile organic compounds
WBS	Work Breakdown Structure

EXECUTIVE SUMMARY

This Engineering Evaluation/Cost Analysis (EE/CA) was prepared to evaluate Non-Time-Critical Removal Action (NTCRA or "removal action") alternatives for soil and sediment (mine wastes) at the Northeast Church Rock (NECR) Mine Site, which is located approximately 16 miles northeast from Gallup in McKinley County, New Mexico.

The NECR mine site was operated by the United Nuclear Corporation (UNC). The mine site is located within Navajo Nation Tribal Trust Lands. The mine site, as defined by the Nuclear Regulatory Commission (NRC) mine permit, is approximately 125 acres. UNC mined Uranium ore from the NECR mine, with active operations between 1968 and 1982. Mining facilities on the NECR mine site included two mine shafts, mine vent holes, wastewater processing ponds, roads, water supply well and support buildings.

The following wastes were produced by the operations at NECR: Uranium protore (low grade ore), the associated decay products of the Uranium, such as Radium-226, waste rock, overburden and contaminated water from dewatering activities. Currently, Radium and its decay products of alpha, beta and gamma radiation are of primary concern at the NECR mine site. Radium can be found naturally in all media including soil, air and water. At the NECR mine site, Radium is present in significantly elevated concentrations in soil and sediment according to the NECR Removal Site Evaluation (RSE) Report. Because the contaminants have been transported via wind and water processes to areas around or adjacent to the site, humans, plants and animals may experience exposures through the food chain, air, surface water or groundwater.

Thirteen areas of concern on the mine site, plus an adjacent unnamed arroyo (Arroyo #1), and nine off-site Navajo home sites have been recently investigated. Of these nine home sites, four home sites required mitigation which was completed by a time critical removal action in May 2007 to reduce or eliminate threats to human health and the environment. Groundwater has not been adequately characterized beneath the NECR mine site nor in the immediate vicinity; however, U.S. EPA Region 6 is conducting a groundwater investigation and cleanup action focused on the alluvial and Upper Gallup Sandstone unit at the UNC mill facility.

Documented in this report is an evaluation of five alternatives and several sub-options for the removal action to address the surface and near-surface soil contamination. Alternatives include:

1. No Action;
2. Excavation and disposal at an off-site disposal facility of all NECR mine site wastes;
3. Consolidation and covering of mine wastes on the NECR mine site;
4. Construction of above-ground, capped and lined repository on the NECR mine site; and
5. Consolidation of the mine wastes with a cap and liner at the UNC mill facility currently under license by the U.S. Nuclear Regulatory Commission (NRC), either in an existing tailings cell or in a newly-constructed repository.

Alternatives 3, 4 and 5 have the following option:

- A: Removal of high-concentration ("principal threat waste") material to an off-site Class I hazardous waste disposal facility, or an alternative appropriate facility

In addition, Alternatives 3 and 4 have the following option:

- B: Removal of principal threat waste material for containment in an existing tailings cell on the UNC mill facility.

Each alternative was evaluated and compared for effectiveness, implementability, and cost in accordance with criteria established by the U.S. EPA. The costs for design, construction, and long-term operation and maintenance for each of Alternatives 2 through 5 are presented in this report.

The Proposed Action Level for Ra-226 is 2.24 pCi/g (1.24 pCi/g above the mean of the Ra-226 background concentration 1.0 pCi/g) and corresponds to an acceptable risk range of 2×10^{-4} for residential scenarios. This risk-based Action Level is proposed for the following reasons:

- It is within the risk range cited in the NCP (300.430(e) (2)(I);
- It is distinguishable from background and therefore measurable in the field; and
- It is above the analytical detection limit.

EPA manages risk to achieve 10^{-6} to 10^{-4} overall risk, therefore the Removal Action Objective (RAO) is health protective, detectable, and distinguishable from background.

Ra-226 and Uranium are co-located. In using the Ra-226 RAO, we will capture contamination associated with Uranium to below its Preliminary Remediation Goal (PRG). Other stable metals associated with the mineral belt, such as Arsenic, Molybdenum, Selenium and Vanadium, 1) are below their respective PRGs; and 2) appear to be within the range observed in the background area and do not appear to be associated with mining operations. Confirmation sampling will be conducted to verify protectiveness.

Principal Threat Waste Level

The NCP allows for identification of 'principal threat waste', i.e. those sources that are considered to be of higher concentrations, toxicity or mobility. EPA Guidance on Principal Threat and Low Level Threat (OSWER 9380.3-06FS) recommends remediation of Principal Threat Waste when practicable. Site specific conditions and risk are also considered in defining and identifying Principal Threat Waste at a site.

The sampling from the NECR site indicates that there are several areas of significantly higher concentrations of total Uranium and/or Radium-226, most notably in Ponds 1, 2 and 3. Of the over 400 samples collected and analyzed at the site, the distribution of the results does not follow a standard distribution with samples equally divided above and below the average concentration. Instead, the distribution shows the majority of the samples are below the

average, while a limited number of samples are much higher in concentration which substantially raises the average. For example, the average Radium-226 activity concentration at the site is 42.2 pCi/g but if all the locations where Radium-226 exceeds 200 piC/g are removed, the average activity concentration of waste remaining on-site drops to 30.4 pCi/g representing a 28% decrease in the average activity concentration.

The Atomic Energy Act (42 U.S.C. Sect. 2011 - Sect. 2259) (AEA) defines source material to include ores containing concentrations of Uranium or Thorium that are high enough to be separately managed. Source material is defined as (1) Uranium or Thorium, or any combination thereof, in any physical or chemical form; or (2) Ores that contain by weight one-twentieth of one percent (0.05% or 500 mg/kg) or more of (i) Uranium, (ii) Thorium, or (iii) any combination thereof (Reference: 10 CFR §20.1003). There is no equivalent definition of source material based on Radium-226 content.

Based on the above discussion, the U.S. EPA proposes to define the principal threat waste at the site as waste containing either 200 pCi/g or more of Ra-226 or 500 mg/kg or more of total Uranium. These concentrations represent a break in the distribution of the results between the significantly higher concentrations and the majority of the sample concentrations.

1.0 INTRODUCTION

1.1 PURPOSE AND SCOPE

This Engineering Evaluation/Cost Analysis (EE/CA) was performed in accordance with U.S. EPA policies and procedures implementing the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) and consistent with the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). Specifically, guidance is found in the U.S. EPA 1993 *Guidance on Conducting Non-Time-Critical Removal Actions Under CERCLA.*

The purpose of the EE/CA is to evaluate removal action alternatives for the Northeast Church Rock (NECR) mine site near Gallup, New Mexico (Figure 1.1). The NECR mine site is located within lands held in trust by the Bureau of Indian Affairs for the Navajo Nation (Figure 1.5). The U.S. EPA Region 9 is the lead federal agency at the NECR mine site and consistent with EPA Indian policy, consults with the Navajo Nation Environmental Protection Agency (NN EPA) and Navajo Department of Justice (NDOJ) during the investigation process and before making remedy decisions. Investigations at the Site have identified conditions that indicate that a removal action is necessary to reduce or eliminate threats to human health and the environment.

The EE/CA for the NECR mine site identifies removal action objectives, describes five removal action alternatives, and assesses the effectiveness, implementability, and cost of each of the alternatives. The EE/CA considers the nature of the contamination, potential risks to human health and the environment, and how the alternatives fit into future land use of the Site.

The scope of the NECR mine site removal action addresses the waste material deposited on the Site surface from former mining and related operations of the United Nuclear Corporation (UNC). The mine wastes consist of Uranium-bearing waste rock that produces Uranium daughter products during decay, in particular Radium. In turn, Radium decay products produce alpha, beta, and gamma radiation. Radium can be found in air and soil and produces airborne Radon gas. Additionally, natural processes at this Site can transport waste materials and radionuclides via surface water, particularly down existing drainage pathways.

By addressing the mine wastes, human health risks associated with the radionuclide content of the mine wastes will be reduced. When selected, the removal action is intended to serve as an effective remedy for the Site.

1.2 SITE DESCRIPTION

For the purposes of this removal action, the U.S. EPA has defined the "Site" as the NECR mine permit area and other areas where hazardous substances associated with the Northeast Church Rock Mine have been deposited, stored, disposed of, or otherwise come to be located. The NECR mine permit area comprises approximately 125 acres and is located 16 miles northeast of Gallup, McKinley County, New Mexico. A location map is provided on Figure 1.1. The area is accessed via Highway 566.

The majority of the NECR mine site is located on lands held in trust by the Bureau of Indian Affairs for the Navajo Nation; mineral rights are owned by Newmont USA, Ltd. UNC has the patented mining claim. The NECR mine site is located in Sections 34 and 35 of Township 17 North (T17N), Range 16 West (R16W) and Section 3 of T16N, R16W (MWH, 2004).

UNC owns Section 36 (T17N, R16W) to the east and Section 2 (T16N, R16W) to the southeast of the Site and approximately 40 acres in the southeast corner of Section 34 (MWH 2007). The former UNC mill facility, which is now a Region 6 NPL site under the joint lead of the U.S. Nuclear Regulatory Commission (NRC) and U.S. EPA Region 6, is located approximately ½ mile south of the NECR mine site within Sections 2 and 36 (Figures 1.2 and 1.5). Mill byproduct materials (tailings) are stored on the UNC mill site in impoundment areas under license by the NRC (Figure 1.2).

Surrounding land is maintained by the Bureau of Land Management (BLM) and is currently used for grazing by local Navajo Nation members who reside adjacent to the NECR mine site. Land to the north of the NECR mine site belongs to the Navajo Nation Reservation where currently fourteen homes are located in the immediate vicinity of the site.

The federal government, including the EPA, bears a trust responsibility to Indian Tribes, including the Navajo Nation. The EPA acknowledges this trust responsibility in its Policy for the Administration of Environmental Programs on Indian Reservations, which states: "In keeping with [the] trust responsibility, the Agency will endeavor to protect the environmental interests of Indian Tribes when carrying out its responsibilities that may affect the reservations." (U.S. EPA, 1984)

The EPA's Indian Policy also states: "In carrying out our responsibilities on Indian Reservations, the fundamental objective of the Environmental Protection Agency is to protect human health and the environment. The keynote of this effort will be to give special consideration to Tribal interests in making Agency policy, and to insure the close involvement of Tribal Governments in making decisions and managing environmental programs affecting reservation lands." *Id*. at 1.

The EPA has consulted with the Navajo Nation throughout the development of the EE/CA. Remediation of uranium contamination on Navajo land presents a longstanding problem, particularly as concerns the NECR mine site. The Navajo Nation has made clear its opposition to any removal alternative that retains nuclear waste in or near Indian Country, and has articulated several cultural, historical, and legal concerns in support of this position. Among these are the Navajo people's unique reliance on the land for religious purposes and many other aspects of their lives. In accordance with its trust responsibility and the Indian Policy, the EPA has considered the Navajo Nation's interests during preparation of the EE/CA.

1.2.1 Historical Operations

Historical operations are described in detail in several references including the Site Assessment report (MWH, 2003) and the Final Removal Site Evaluation Report (MWH, 2007). This section summarizes the historical operations information derived from these sources.

The NECR mine was an underground Uranium mine active from 1968 to 1982, when it went to stand-by status. The primary ore mined was coffinite. The Site has been regulated under the terms or jurisdiction of several permits during its active years and post closure. Details of the permit history can be found in the Final Removal Site Evaluation Report (MWH, 2007).

The mine had two shafts (NECR-1 and NECR-2) and associated vent holes, and water treatment facilities. Up until 1983, wastewater from the mine dewatering operations was pumped to three on-site ponds where it was treated prior to discharge into the Unnamed Arroyo. Water treatment in the ponds consisted of flocculation for removal of suspended solids followed by addition of sulfuric acid or barium chloride to precipitate Radium sulfate. The collected and consolidated precipitate was transported to the mill for further processing after being dried on the Sediment Pad. In later years of operation dewater was fed into an ion exchange plant before discharge into Arroyo #1 pursuant to a NPDES permit.

Tailings sands (mill byproduct wastes) from the UNC mill were staged at three surface locations on the NECR mine site, mixed to form a slurry, and injected into the mine stopes and workings during operations for structural control. The ponds, ion exchange plant, and tailings sand holding areas were closed in 1983 in accordance with the NRC Source Materials License.

After operations ceased at the Site, closure activities were conducted by UNC under NRC oversight from 1986 through 1994. These closure activities are described in Section 1.3.2. The mining related features remaining at the NECR mine site include unpaved roads, power poles, and concrete foundations. The area is enclosed by a chain-link fence with a locked gate that is maintained by UNC.

1.2.2 Site Geology and Hydrology

The following summary of Site geology and water resources is taken from the RSE report (MWH, 2007). U.S. EPA staff and consultants provided additional facts and interpretation.

The Site lies within the Colorado Plateau Physiographic Province at the juncture of the San Juan Basin, the Zuni Uplift, and the Defiance Uplift. It varies in elevation from 7,100 to 7,200 feet in a canyon consisting of sandstone from the Dalton Sandstone Member and Crevasse Canyon Formation. Underlying the Site is the Crevasse Canyon Formation consisting of unsaturated mudstones, sandstone, and coal beds. Beneath this lies the Gallup and Mancos Shale formation. The Mancos Shale, with a thickness of 500-800 feet, acts largely as an aquitard. Beneath the Mancos Shale are the Dakota and Morrison Formations. It is in the Westwater Canyon Sandstone Member of the Morrison Formation that the primary Uranium ore body is found.

Both the NECR-1 and NECR-2 shafts reach approximately 1500 to 1800 feet below ground surface (bgs) into this Member.

The Site lies within an arroyo draining to the northeast (downstream of the NECR-1 shaft) into another lateral arroyo (Unnamed Arroyo B) and draining into Pipeline Canyon east of Red Water Pond Road (RWPR) and the Kerr McGee Quivira Mines (NE Church Rock I and IE). Pipeline Canyon in turn drains into the North Fork of the Rio Puerco. There have been no surface water discharges from the NECR mine site since 1983, when dewatering activities ceased. Since that time, water levels in the Pipeline Canyon alluvium have been dropping. However, rain events continue to release mine wastes onto the Navajo Reservation via surface runoff.

The Site is in the San Juan Hydrologic Basin within which are two producing aquifers located in the Upper Gallup Formation and Morrison Formation. The aquifer in the Upper Gallup Formation is present at the Site but is not a producing aquifer in the immediate area. Two supply wells provide water from the Westwater Canyon Member located in the Morrison Formation, and acted as a water supply for both the mill and the NECR Mine site. According to the log for a NECR Mine shaft constructed in 1968 and 1969, groundwater was first encountered approximately 400 feet below the surface of the mine in the lower portion of the First Gallup Sandstone Member of the Gallup Formation. Inflow of water from this formation was small, amounting to only 30 gpm. Water was also encountered at a low inflow rate of 50 gpm in the Second Gallup Sandstone Member. Water was not encountered again until the Dakota Formation was reached at the base of the Mancos Shale. Groundwater inflows from the Dakota Formation were at 800 gpm prior to grouting. Water inflows from the underlying Westwater Canyon Member were even larger, averaging from 1,500 to 2,100 gpm during shaft construction.

The U.S. EPA notes that the Site hydrogeology has not been adequately characterized beneath the NECR mine site. UNC has conducted episodic sampling of the one on-site supply well; however, there is no well network on the mine site. Therefore, the depth to groundwater and interconnection of shallow to deeper water bearing units is not established for this site. Based on data provided by UNC, the depth to groundwater in the Westwater Canyon Sandstone Member is approximately 1,500 to 1,800 feet.

1.2.3 Climate

The Site lies in a semiarid climate with a high annual net pan evaporation of 54 inches. The nearby town of Gallup receives an average annual rainfall of 11 inches. Wind for 11 months of the year originates from the southwest and in the month of August originates predominantly from the south. The winter average temperature is 29 degrees Fahrenheit (F) with an average temperature in summer of 68 degrees F. Extreme heat in the summer (100 degrees F) and cold in the winter (-34 degrees F) can occur.

1.2.4 Surrounding Land Use and Populations

The Site is in a Pinyon-juniper, sparsely vegetated area. In some places the underbrush is dense with sage and snakeweed predominately, while in other areas bare ground is prevalent. Current and future land use includes agricultural grazing (grazing of livestock, such as sheep, cattle, and horses). UNC owns the parcel to the southeast of the mine Site which is part of the Church Rock mill and tailings storage facility (Figure 1.2). These facilities will be eventually deeded to the U.S. Department of Energy (DOE) as part of the Legacy Management Program. In order to protect the integrity of the existing cells, the DOE will limit re-use of the facilities.

The surrounding residential population is concentrated in Gallup and Church Rock. Gallup is approximately 16 miles from the Site and has a population of approximately 20,000. Church Rock's population is approximately 2,802 (churchrock.nndes.org, 2008). The Site is located within the Navajo Nation Pinedale Chapter (population approximately 1,129) and is adjacent to a residential area of the Coyote Canyon Chapter on the Navajo Nation Reservation. Lands to the north of the Site are part of the Navajo Nation Reservation.

EPA identified fourteen home sites in the immediate vicinity of the mine site during fieldwork. Approximately 25 families reside along Pipeline Road, northeast of the Site and approximately 12 families reside along State Rt. 566 south of the UNC Mill Site (Navajo DOJ, December 2008). Several Navajo families have stated they collect herbs and plants from the Site and surrounding area for ceremonial purposes.

1.3 PREVIOUS CLEANUP ACTIVITIES

1.3.1 UNC Mill Facility Groundwater Remedial Action and NRC's License Decommissioning

UNC began a groundwater remedial action under a Record of Decision (ROD) in 1988 to clean up contamination resulting from the tailings located at the UNC mill facility NPL Site. Mill process water commingled with tailings in the disposal area and leaked into the underlying alluvium aquifer and two sandstone zones within the Upper Gallup Formation. As part of this activity two evaporation ponds were created on site and groundwater pumping wells were installed. The groundwater extraction wells are no longer operating due to limited effectiveness; a supplemental feasibility study is underway for additional activities under CERCLA.

According to NRC's website, the UNC NPL site includes a former ore processing mill and tailings disposal area, which cover about 25 and 100 acres, respectively. UNC operated the site as a Uranium mill facility from 1977 to 1982. The mill, designed to process 4,000 tons of ore per day, extracted Uranium using conventional crushing, grinding, and acid-leach solvent extraction methods. Uranium ore processed at the site came from the Northeast Church Rock and the Old Church Rock mines. The average ore grade processed was approximately 0.12 percent Uranium oxide. The milling of Uranium ore produced an acidic slurry of ground waste rock and fluid (tailings) that was pumped to the tailings disposal area. Uranium milling and tailings disposal were conducted and an estimated 3.5 million tons of tailings were disposed in

the tailings impoundments. The tailings disposal area is subdivided by dikes into three cells identified as the South Cell, Central Cell, and North Cell. Surface reclamation is complete, except for the area of the south tailings cell covered by two evaporation ponds, which are part of the groundwater corrective action plan.

1.3.2 NECR Mine Site Closure Activities

Closure activities between 1986 and 1994 were required by the mining lease and NRC requirements in various locations on the mine site. The NRC Source Materials license required the closure of the ion exchange plant, removal of sludge from the mine water treatment ponds, and closure of the tailing sand backfill areas. Radionuclide contaminated soils and process equipment were disposed of at the UNC mill site in conjunction with mill decommissioning and reclamation activities. The NRC certified these closure actions in 1989 and released the license areas of the mine for unrestricted use (NRC, 1989). UNC performed the following activities:

- removal of contaminated sludge and sediments from mine wastewater treatment ponds (Ponds 1, 2, 3, and 3a);
- removal of equipment and demolition and removal of buildings to their foundations;
- backfilling and sealing of the two mine shafts;
- capping of vent holes (four total) with reinforced concrete caps;
- regrading, covering with one-foot of soil, and seeding of the Non-Economic Material Storage Area (NEMSA); and
- removal or burial of materials at the Boneyard and covering with one foot of soil and reseeding.

1.3.3 Residential Time Critical Removal Action

The U.S. EPA and UNC, under the direction of the U.S. EPA completed a Time Critical Removal Action (TCRA) at nearby residences in May 2007 (U.S. EPA, 2007a). The objective of the TCRA was to remove soil around five structures to reach a cleanup goal of 2.24 pCi/g Radium. Approximately 6,500 cubic yards (c.y.) of soil were excavated, stockpiled and taken by UNC to a licensed off-site disposal facility (U.S. EPA, 2007a). The areas around the home were restored with clean backfill.

1.4 Previous Investigations of the Mine Site

1.4.1 Investigations Performed by UNC

Under NRC and then under New Mexico Mining and Minerals Division (NMMMD), UNC conducted reclamation investigations and license decommissioning activities at the NECR Site. These activities are documented in the following reports:

- Final Removal Site Evaluation Report (MWH, 2007);
- Closeout Plan (MWH, 2004);
- Material Characterization Work Plan (MWH, 2004);
- Groundwater Quality in the Westwater Canyon Member at the Northeast Church Rock Mine (MWH, 2004);
- Northeast Church Rock Mine Site Assessment (MWH, 2003), based on a site assessment checklist provided by the State of New Mexico Mining and Minerals Division; and
- Tailings Sand Backfill Cleanup Verification Report (UNC, 1989), provided to NRC for the UNC license no. SUA-1475.

The primary investigative activities relevant to this U.S. EPA removal action are briefly described in the following sections.

1.4.1.1 Site Assessment

In 2003, with NMMMD oversight, UNC performed a site assessment focused on three areas of concern within the NECR mine permit boundary (MWH, 2003). This action was conducted based on the authority of the New Mexico Mining Act. Based on the site assessment results, UNC concluded that environmental impacts were limited due to the underground nature of the mine, the minimal amount of non-economical mine materials kept at the surface and the fact that ore was not processed on the NECR mine site. During earlier reclamation activities, dust suppression had been used on haul routes to keep fugitive dust to a minimum. UNC also concluded that the hydrologic impacts from mine water pumping and discharge activities were limited in extent and duration. Additionally, UNC concluded that impact to local communities from the mining operation was primarily economic in nature. Wildlife would have been displaced from the mine area during active operations, moving to nearby areas; however, evidence of several species of fauna was found on the inactive NECR mine site during the site assessment. No known threatened or endangered species are present at the site. A listing of wildlife and vegetation species observed at the mill and mine site is presented in further detail in the list of Fauna and Signs of Fauna on or Near the NCRM Property and in Plant Composition and Areal Cover by Species for Pinyon-Juniper sites, in the Northeast Church Rock Mine Site Assessment Report (MWH, 2003).

1.4.1.2 Removal Site Evaluation

Under a negotiated order with the U.S. EPA Region 9, UNC completed a Removal Site Evaluation in 2006 (MWH, 2007). Surface and subsurface soils and sediments were screened and sampled between August 14 and December 5, 2006. The RSE survey area encompassed 13 areas (former operational units) on the NECR mine site, plus nine off-site home sites located northeast of NECR. Scan and static gamma surveying, and surface and subsurface soil sampling were conducted.

The objective of the gamma radiation surveys performed in the RSE survey area was to characterize the nature and lateral and vertical extent of Radium concentrations in surface and

subsurface soils and sediments. Screening levels were based on U.S. EPA Region 9 PRGs for all stable metals.

The results of the RSE (MWH, 2007) are summarized below. Further details of the findings are provided in the RSE Report (MWH, 2007).

- Surface soil samples (≤ 0.5 feet bgs) were analyzed for Radium-226, Arsenic, Molybdenum, Selenium, Uranium, and Vanadium. Values above the field screening levels were:
    - Radium values ranged from 0.8 to 875 pCi/g;
    - Uranium values ranged from 0.7 to 3,970 mg/kg; and
    - Arsenic values ranged from ND to 14.9 mg/kg with no correlation with Radium and Uranium locations.
- Subsurface soil samples (>0.5 ft bgs) were analyzed for Radium-226, Arsenic, Molybdenum, Selenium, Uranium, and Vanadium. Values above the field screening levels were:
    - Radium values ranged from 0.6 to 438 pCi/g;
    - Uranium ranged from 0.7 to 760 mg/kg; and
    - Arsenic ranged from ND to 13.9 mg/kg with no correlation with Radium and Uranium locations.
- The ratio of Uranium-natural to Radium-226 concentrations around Home Sites was 1.14, compared to the average ratio for background soils of 1.11; and
- Toxicity characteristic leaching procedure analyses of subsurface samples from the Boneyard was non-detect.
- Arsenic concentrations were below the residential non-cancer PRG of 22 mg/kg used in the RSE Report (MWH, 2007).

1.5 SOURCE, NATURE, AND EXTENT OF CONTAMINATION

1.5.1 Source: Radium and Uranium Laden Mine Wastes

In Uranium mining and milling operations, contamination mainly comes in the form of decay products of Uranium that are exposed at the surface through various waste materials. For the purposes of this EE/CA and the recommended removal action, mine wastes refer to the radioactive and heavy metal contaminated surface and near-surface soils.

Radium and its decay products remain in the mine wastes and can be released to the soil or drainage areas. This may, in turn, adversely affect ground and surface waters. Radon gas, alpha,

beta and gamma radiation are also emitted into the air from waste rock piles. Additionally, during the leaching process, heavy metals such as Selenium, Arsenic, Molybdenum, Vanadium, Iron, and Lead may be released from the mined rock.

Cleanup activities have removed or buried some of the waste tailings. However, Radium and Uranium remain in the surface and subsurface soils at unacceptable levels (refer to the RSE, MWH 2007).

1.5.2 Areas of Concern

The areas of concern for soil contamination are listed below (approximate boundaries are shown on Figures 1.3 through 1.6):

1. NECR-1 consisting of former mining facility buildings. The NECR 1 pad was used to stockpile the ore and low-grade ore mined from the shaft located there. The stockpiled ore was then transported from the NECR 1 pad to the mill facility for processing;
2. NECR-1 "Step-Out", consisting of the area surrounding NECR-1 including the former trailer park, former fuel storage area, sediment pond, ion exchange plant, and other areas containing mine wastes to the north and east;
3. Sandfill areas 1-3. The sandfill areas were temporary staging grounds for mill tailings material that had been processed through the mill facility. The material was staged in the sand backfill areas until placed in the mine stopes;
4. Ponds 3 and 3a, plus surrounding areas affected by mine wastes. The ponds held stormwater and dewater from the mine. The water was subsequently treated in the ponds prior to discharge (under NPDES permit) to the Unnamed Arroyo (Arroyo #1);
5. Ponds 1 and 2, plus surrounding areas affected by mine wastes. Use of these ponds was similar to Ponds 3 and 3a;
6. Sediment Pad. The sediment pad was a holding area for the flocculated sediments that were regularly removed from the ponds. The sediment was be held at the Pad until transferred to the mill facility;
7. NECR-2 pad also was used to stockpile the ore and low-grade ore mined from the second on-site mine shaft. The stockpiled ore was then transported from the NECR 2 pad to the mill facility for processing;
8. Former Magazine Area. Storage area for blasting materials for the mining operation;
9. Vents 3 and 8 combined areas. The vents were for the underground mining operation;
10. Boneyard. Refuse and discarded equipment from the mine site were stored here;

11. Non-Economic Material Storage Area (NEMSA). This area was for storage of the mine overburden and low-grade ore (non-economic materials);
12. Unnamed Arroyo (Arroyo #1). The arroyo draining west to east from the Boneyard/NEMSA area to its discharge point past the residential area; and
13. The residential area "Step-Out" that extends approximately 1,000 feet east from the NECR-1 "Step-Out" boundary, and includes Red Water Pond Road to the south.

1.5.3 Soil Contamination

Soil sample results from field collection in the areas of concern (excluding Red Water Pond Road) and the nine home sites are presented in detail in Figure 1.6 and in Appendix D (MWH RSE Final Report, October 2007 and MWH Supplemental RSE Data, April 2008). This Appendix includes a summary of surface soil analytical results for preliminary COPCs: Radium-226, Selenium, Arsenic, Molybdenum, Uranium, and Vanadium.

1.5.4 Groundwater Contamination

The scope of this EE/CA is to present alternatives for surface and near-surface soil removal actions only. A detailed groundwater characterization has not been performed at the NECR mine facility to date.

There are two aquifers at the Site. The upper aquifer located in the Gallup formation is not a producing aquifer in the immediate area. The lower aquifer located in the Westwater Canyon Member of the Morrison Formation is separated from the upper aquifer by Mancos Shale aquitard. There is one well on-site located in the lower aquifer. UNC has conducted episodic sampling of the one well; however, there is no well network on the mine site. Based on data provided by UNC, the depth to groundwater in the Westwater Canyon Sandstone Member is approximately 1,500 to 1,800 feet.

The available soil data and limited hydrogeologic information were evaluated using synthetic precipitation leaching procedure (SPLP) modeling by UNC. While the SPLP leachate results were primarily below the New Mexico Human Health Standards for groundwater (NMAC 20.6.2.3103) or the Federal Maximum Contaminant Levels (MCLs) for most analyses, there were a few exceedances of one or the other of these standards for Ra-226, Uranium and Selenium. However, the concentrations of these constituents are all within the range of concentrations detected in the Westwater Canyon Member. Additionally, it should be noted that rainfall does not directly impact groundwater in the Westwater Canyon Member as a result of a combination of arid climate, depth to groundwater and the number and thickness of intervening confining layers.

Therefore, no conclusions have been reached with respect to the pathway for surface contamination to reach groundwater. The scope of this EE/CA is to present alternatives for surface and near-surface soil removal actions only. Further study will be necessary to characterize impacts to groundwater from site activities.

1.5.5 Human Health Risk Evaluation

A human health risk assessment (HHRA) is an evaluation of potential impacts of Site-derived contaminants on human health, in the event that no cleanup action is taken. Results of the HHRA are used to determine whether residual levels of contaminants in Site media are protective of human health and may be left in place, or a cleanup action should be considered.

Under EPA supervision, UNC performed a human health risk assessment, including a conceptual site model, screening level HHRA, and a baseline HHRA. The results of the HHRA are part of the documentation that supports a removal action at the NECR mine site. The following is a brief summary of the HHRA; a complete report is provided in the Final RSE report (MWH, 2007).

Off-site releases have been observed in the residential area and the unnamed arroyo. Based on Site conditions and the radioactive properties of the contamination, EPA anticipates the threat of further release of hazardous substances from the Site into the air, water and surrounding soils if control measures are not implemented. Radium and Uranium are the contaminants of primary concern. Radium is formed when Uranium and Thorium undergo natural decay in the environment. During the decay processes, alpha, beta, and gamma radiation are released. Radium may be found in soil, air and water.

The HHRA indicated that there are three predominant human exposure pathways of concern for Uranium and Radium. Whole body radiation may be experienced by nearby residents and trespassers on or near the NECR mine site itself or at secondary sources (e.g., water or windborne). Radium in the soil may be absorbed by plants and may concentrate in terrestrial organisms; and persons and wildlife may also directly ingest radionuclides which then may be transported to organs or other sites in the body. Radionuclides such as Radium and radon and daughters may be inhaled creating alpha sources in the lungs.

Persons traversing the NECR mine site may be exposed to contaminated dust by inhalation or ingestion of particulate matter. Activities that occur in the vicinity of the Site that may put persons at risk include walking or hiking, livestock grazing, and modes of transportation including all-terrain vehicle, motorcycle, or on horseback.

Off site accumulation of hazardous substances may present secondary contamination exposure routes through inhalation or ingestion, particularly for children at play. Contamination deposited on residential yards and in the nearby arroyo, may settle on clothing of residents traversing contaminated areas and be transferred to house dust. Traditional uses of plants also may result in secondary exposure.

Animal studies have reported inflammatory reactions in the nasal passages and kidney damage from acute inhalation exposure to Uranium. Chronic (long-term) inhalation exposure to Uranium and radon in humans has been linked to respiratory effects, such as chronic lung disease, while Radium exposure has resulted in acute leucopenia, anemia, necrosis of the jaw, and other effects.

Cancer is the major effect of concern from radionuclides. Radium is known to cause bone, head, and nasal passage tumors in humans, and radon, via inhalation exposure, causes lung cancer in humans. Uranium may cause lung cancer and tumors of the lymphatic and hematopoietic tissues (U.S. EPA, www.epa.gov website).

The HHRA indicates the need for a response action to control releases and prevent exposure. Actual and threatened releases of hazardous substances from this site, if not addressed by implementing a Non Time-Critical Removal Action, may continue to present an imminent and substantial endangerment to public health, or welfare, or the environment.

2.0 IDENTIFICATION OF REMOVAL ACTION GOALS AND SCHEDULE

2.1 PRELIMINARY REMOVAL ACTION GOALS

The main objective of this removal action is to mitigate risks posed to human health and the environment by on-site contamination and to restore the land for use by nearby residents and the Navajo Nation. Characterization of the Site identified the primary environmental concern to be radiological contamination. The presence of Radium and Uranium could pose a risk to the air quality by emitting radon, alpha, beta and gamma radiation. Persons traversing the Site may be exposed to contaminated dust by inhalation or ingestion of contamination adsorbed to particulate matter. Incidences of direct contact with natural and mechanically generated dust during these activities account for known contamination exposure scenarios faced at the Site.

Proposed Action Level

The Proposed Action Level for Ra-226 is 2.24 pCi/g (1.24 pCi/g above the mean of the Ra-226 background concentration 1.0 pCi/g) and corresponds to an acceptable risk range of 2×10^{-4} for residential scenarios. This risk-based Action Level is proposed for the following reasons:

It is within the risk range cited in the NCP (300.430(e) (2)(I);

It is distinguishable from background and therefore measurable in the field; and

It is above the analytical detection limit.

EPA manages risk to achieve 10^{-6} to 10^{-4} overall risk, therefore the Removal Action Objective (RAO) is health protective, detectable, and distinguishable from background.

Ra-226 and Uranium are co-located. In using the Ra-226 RAO, we will capture contamination associated with Uranium to below its Preliminary Remediation Goal (PRG). Other stable metals associated with the mineral belt, such as Arsenic, Molybdenum, Selenium and Vanadium, 1) are below their respective PRGs; and 2) appear to be within the range observed in the background area and do not appear to be associated with mining operations. Confirmation sampling will be conducted to verify protectiveness. The site-specific Action Level is presented in Table 5.4.

Although the area exceeding the Proposed Action Level is reasonably well defined (Figures 1.3 and 1.4), there is insufficient data to confidently define the depth of contamination. Therefore, for the purposes of this EE/CA, a reasonably conservative estimate of the total area and depth to be addressed was estimated to be 871,000 c.y. The volume was estimated by breaking down the areas of concern into a discrete block volume approach of contamination based on sampling and historic operations. The volume of each block was estimated by multiplying the well-defined lateral extent of Ra-226 contamination by a reasonable maximum depth of contamination from the sampling. EPA was provided with a smaller volume estimate using a finite element approach to estimate volume; however, EPA's experience with previous excavation removals suggests that the finite element approach tends to underestimate contaminated volumes unless there are a large number of samples at depth.

Principal Threat Waste Level

The NCP allows for identification of 'principal threat waste', i.e. those sources that are considered to be of higher concentrations, toxicity or mobility. EPA Guidance on Principal Threat and Low Level Threat (OSWER 9380.3-06FS) recommends remediation of Principal Threat Waste when practicable. Site specific conditions and risk are also considered in defining and identifying Principal Threat Waste at a site.

The sampling from the NECR site indicates that there are several areas of significantly higher concentrations of total Uranium and/or Radium-226, most notably in Ponds 1, 2 and 3. Of the over 400 samples collected and analyzed at the site, the distribution of the results does not follow a standard distribution with samples equally divided above and below the average concentration. Instead, the distribution shows the majority of the samples are below the average, while a limited number of samples are significantly higher in concentration which substantially raises the average. For example, the average Radium-226 activity concentration at the site is 42.2 pCi/g but if all the locations where Radium-226 exceeds 200 piC/g are removed, the average activity concentration of waste remaining on-site drops to 30.4 pCi/g, representing a 28% decrease in average activity concentration.

The Atomic Energy Act (42 U.S.C. Sect. 2011 - Sect. 2259) (AEA) defines source material to include a concentration of uranium or thorium that is high enough to be separately managed. Source material is defined as (1) Uranium or Thorium, or any combination thereof, in any physical or chemical form, or (2) Ores that contain by weight one-twentieth of one percent (0.05% or 500 mg/kg) or more of (i) Uranium, (ii) Thorium, or (iii) any combination thereof (Reference: 10CFR20). There is no equivalent definition of source material based on Radium-226 content.

Based on the above discussion, the U.S. EPA proposes to define the principal threat waste at the site as waste containing either 200 pCi/g or more of Ra-226 or 500 mg/kg or more of total Uranium. These concentrations represent a break in the distribution of the results between the significantly higher concentrations and the majority of the sample concentrations. The principal threat waste volume is difficult to estimate with the current data. The Removal Site Evaluation Report and the two subsequent addendums focused on delineating the waste at the 2.24 pCi/g Radium-226 level, and thus sampled mostly near the edges of the areas of concern, where Ra-226 levels are lower. Therefore, there are fewer sampling data points in the center of the areas of concern where the principal threat waste appears to be located. There are only eight samples with total Uranium above 500 mg/kg and eight samples exceeding Radium-226 of 200 pCi/g. EPA estimates, for cost purposes only, that there are 10,000 c.y. of principal waste. Actual volumes may vary depending on actual field conditions.

2.2 IMMINENT AND SUBSTANTIAL ENDANGERMENT

Current Site conditions pose the threat of potential future releases of a hazardous substance, namely Radium-226. The likelihood of direct human exposure, via ingestion and/or inhalation of hazardous substances, and the threat of potential future releases and migration of those substances, pose an imminent and substantial endangerment to public health, and/or welfare, or the environment based on the factors set forth in the NCP, 40 CFR § 300.415(b)(2). These factors include:

1. Actual or potential exposure to hazardous substances or pollutants or contaminants by nearby populations or the food chain

High concentrations of Radium-226 have been detected in samples in the unnamed arroyo and several areas not currently fenced. Radium is formed when Uranium and Thorium break down in the environment. Two of the main radium isotopes found in the environment are Radium-226 and Radium-228. During the decay process, alpha, beta, and gamma radiation are released. Radium may be found in air, soil and water. Radium in the soil may be absorbed by plants.

2. High levels of hazardous substances in soils at or near the surface that may migrate

Contaminated soils from the Site may migrate off-site via wind and water transport mechanisms including mechanical dust generation. It is believed that Radium in soils and sediments was transported there from sources including the upgradient NECR Mine Site. It is likely that this contamination could continue to migrate beyond the NECR Residential Site boundary. Some of the Radium daughter particles, such as radon, also have a specific tendency to adhere to dust particles and migrate and may have traveled off-site in historic surface water flows.

3. Weather conditions that may cause hazardous substances to migrate or be released

Rainfall events may lead to transport of the contamination from the Site. High soil erosion rates may indicate transport of contamination from the Site constituting a release of hazardous substances and resulting in secondary contamination sources. In addition, contaminants may migrate during high wind events due to the propensity for contaminants to adhere to windborne dust particles.

4. Availability of other appropriate federal or state response mechanisms to respond to the release

The NNEPA has informed EPA that it does not have the authority or resources to address the Site. Further, the NNEPA has sent a formal request to U.S. EPA, requesting that U.S. EPA address this area through a Non Time-Critical Removal Action.

The NECR site presents a time-sensitive problem that should be addressed promptly to avoid further exposure to nearby residents and to reduce the likelihood of further migration of contaminants into the residential area and the unnamed arroyo. Failure to implement a site-

wide response action in the near term would increase the threat of further releases and could eliminate the progress made by EPA's two residential removals in 2007.

2.3 APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

Applicable or relevant and appropriate requirements (ARARs) cover both federal and state environmental requirements and are used to: (1) evaluate the appropriate extent of Site cleanup; (2) scope and formulate alternatives; and (3) guide the implementation and operation of a selected action. Section 300.415(j) of the NCP requires that "removal actions pursuant to CERCLA Section 106, shall "to the extent practicable, considering the exigencies of the situation, attain ARARs under federal or state environmental or facility siting laws."

The U.S. EPA Region 9 requested and received ARARs from the State of New Mexico and the NN EPA for consideration in this EE/CA (see Appendix A for a list of ARARs).

2.3.1 Terms and Definitions

The following are explanations of the terms and definitions used throughout this ARARs discussion:

> **Applicable requirements** are clean-up standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site (52 Federal Register [FR] 32496, August 27, 1987).
>
> **Relevant and appropriate requirements** are clean-up standards, standards of control, or other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that, while not applicable to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well-suited to the particular site (52 FR 32496). Portions of a requirement may be relevant and appropriate even if the entire requirement is not.
>
> **Information to be considered** are non-promulgated advisories or guidance issued by federal or state government that are not legally binding and do not have the status of potential ARARs. They are considered in the absence of federal or state ARARs, or when such ARARs are not sufficiently protective. An example of information to be considered is the U.S. EPA Region 9 PRGs that provide guidance to assess human health implications during a removal action.

Under the description of ARARs set forth in the NCP, state and federal ARARs are categorized as:

- Chemical-specific ARARs are usually health- or risk-based standards that limit concentrations of chemicals found in or discharged to the environment. They govern the extent of site remediation by providing either actual clean-up levels or the basis for

calculating such levels. Chemical-specific ARARs may also be used to indicate acceptable levels of discharge in determining treatment and disposal requirements and to assess the effectiveness of future remedial alternatives. For example, state water quality standards apply to a site where treatment effluent is discharged to a surface water body.

- Location-specific ARARs set restrictions on chemical concentrations or the conduct of activities solely because they are in special locations (53 FR 51394). In determining the use of location-specific ARARs for selected remedial actions at CERCLA sites, the jurisdictional prerequisites of each of the regulations must be investigated. In addition, basic definitions and exemptions must be analyzed on a site-specific basis to confirm the correct application of the requirements. For example, federal and state regulations concerning groundwater may apply at a site where a removal action may impact groundwater quality.
- Action-specific ARARs set controls or restrictions on particular kinds of activities related to the management of particular wastes or materials (53 FR 51437). Selection of a particular response action at a site will invoke the appropriate action-specific ARARs that may specify particular performance standards or technologies as well as specific environmental levels for discharged or residual chemicals. For example, the federal noise regulations apply at a site where construction and heavy equipment activities are occurring.

Identification and evaluation of ARARs is an iterative process that continues throughout the response process. As a better understanding is gained of Site conditions, contaminants, and response alternatives, the lists of ARARs and their relevance to the removal action may change.

2.3.2 Other Considerations and Assumptions

The following additional considerations and assumptions were made during the ARAR-identification process.

2.3.2.1 Occupational Safety and Health Administration (OSHA)

OSHA has promulgated standards for protection of workers who may be exposed to hazardous substances at Resource Conservation and Recovery Act (RCRA) or CERCLA sites (29 CRF Parts 1910.120 and 1926.65). The U.S. EPA requires compliance with OSHA standards in the NCP (40 Code of Federal Regulations [CFR] 300.150), but not through the ARAR process. Therefore, OSHA standards are not considered ARARs. Although the requirements, standards, and regulations of OSHA are not ARARs, they will be complied with during the removal action.

2.3.2.2 Uranium Mill Tailing Radiation Control Act (UMTRCA)

UMTRCA programs are categorized under Title I and Title II. Title I addresses specific inactive Uranium processing sites and Title II addresses active sites that are required to have a license from NRC. Under UMTRCA, the U.S. EPA was directed to devise standards for both the control

and cleanup remedial actions. The NECR mine site is not a listed site under Title I of UMTRCA nor would NECR mine wastes be classified under Title II. However, UMTRCA requirements may be ARARs under certain circumstances, as reflected in the ARARs table attached as Appendix A.

2.3.2.3 Cap Design Criteria

Alternatives 3, 4, and 5 use a cap for part of the remediation solution. This section discusses the conceptual model used for the capping options for the purposes of cost analysis for these alternatives.

Regarding the remediation of mine wastes, Title I UMTRCA standards (Subpart A of 40 CFR §192(d)) offer the following guidance. Remediation should:

- Be designed to be effective for up to one thousand years to the extent reasonably achievable, but at a minimum of 200 years;
- Provide reasonable assurance that releases of Radon-222 will not exceed an average release rate of 20 pico Curies per square meter per second ($pCi/m^2/s$);

In designing a cap at the NECR mine site there are several critical factors. These design elements are discussed briefly here and assumptions are made in order to prepare the cost analysis for the alternatives. Upon further investigation of the Site these assumptions may change. Ultimately the containment design will be based on comprehensive planning and site-specific risk analysis.

Longevity of the Cap. At the NECR mine site, a cap will be designed to have a life of a minimum of 200 years and will require long term monitoring.

Shielding of Gamma Rays. To provide assurance that Gamma rays are being shielded appropriately (i.e., that the release of Radon-222 will not exceed an average release rate of 20 $pCi/m^2/s$), an appropriate soil layer needs to be in place.

Revegetation. Revegetation goals will be consistent with the end-use of the repository but are not to be an integral component in the cap design to achieve protectiveness. Revegetation should attempt to emulate the structure, function, diversity, and dynamics of native plant communities in the area. Diverse mixtures of native and naturalized plants would maximize water removal and remain more resilient given variable and unpredictable changes in the environment resulting from pathogen and pest outbreaks, disturbances (grazing, fire, etc.), and climatic fluctuations. Therefore, the revegetation plan will include species that are sustainable, once established, under typical climate patterns.

Water infiltration. The cover must protect the mine wastes and reduce leachate development by minimizing the infiltration of water from precipitation.

Erosion and Biointrusion. Cap shaping, sloping and proper drainage patterns are also important to ensure stability of the final consolidated material. Placement of rip rap is expected to be the most effective surficial erosion mitigation measure. Approximately 18 inches of rip rap

will be placed over the soil sealing layer. Erosion modeling should be done to determine the effectiveness of the proposed design.

The cap will be designed to prevent roots and burrowing animals from infiltrating too deeply into the sealing layer. Biointrusion controls may need to be incorporated into the final design and long-term maintenance plan.

For cost purposes, EPA used the Midnite Mine NPL Site cap design to estimate the cost for comparison of alternatives only. It is assumed that since the material has the same radioactivity, the cover design will be the same for alternatives 3 through 5, and therefore, the costs are similar. The cost estimate assumed that a two-foot thick layer of on- or near-site material will provide the radon protection. An 18-inch layer of rip rap, also assumed to be available on- or near-site will be placed on top of the soil cover to provide the armoring need for long-term durability. To facilitate grazing re-use, 6 –inches of bio-solids or other off-site organic material will be used on the top of the cover to promote re-vegetation. Although the final design may vary, the major cost factors - thickness of cover and source of material – will likely not be significantly different from the cost estimate assumptions. Final design parameters will be determined by U.S.EPA in consultation with Navajo and other key agencies. Under Alternative 5 and Option B, the final design will need concurrence from NRC.

2.4 REMOVAL ACTION SCHEDULE

The NCP requires a public comment period of 30 days following release of the final EE/CA report by the U.S. EPA. The U.S. EPA will respond to significant comments received during the public comment period, and will publish an Action Memorandum following the response to comments. The schedule for completion of the removal action(s) is dependent upon negotiations with the Potentially Responsible Party(ies) (PRPs) or failing negotiations, issuance of a unilateral order or availability of U.S. EPA funding for the action. The U.S. EPA will provide public notification of the schedule for this process upon issuance of the Action Memorandum.

3.0 IDENTIFICATION OF REMOVAL ACTION ALTERNATIVES

3.1 INTRODUCTION

U.S. EPA guidance (1993) for preparing EE/CAs suggests identifying and assessing a limited number of alternatives appropriate for addressing the removal action objectives. Based on knowledge of work at other sites, the following five alternative removal actions were evaluated for the NECR mine site:

1. No Action;
2. Excavation and disposal at an off-site treatment, storage and disposal facility (TSDF) of all NECR mine site wastes;
3. Consolidation and covering of mine wastes on the NECR mine site;
4. Construction of an above-ground, capped and lined repository on the NECR mine site; and
5. Consolidation of the mine wastes with a cap and liner at the UNC mill facility currently under license by the U.S. Nuclear Regulatory Commission (NRC), either in an existing tailings cell or in a newly-constructed repository.

Alternatives 3, 4 and 5 have the following option:

- A: Removal of high-concentration ("principal threat waste") material to an off-site Class I hazardous waste disposal facility, or an alternative appropriate facility

In addition, Alternatives 3 and 4 have the following option:

- B: Removal of principal threat waste material for containment in an existing tailings cell on the UNC mill facility.

The main assumptions used for each alternative are discussed in the following sections. The area and depth estimates used to calculate the removal action volumes are provided in Table 3.1.

The conceptual design assumptions used for each alternative are discussed in the following sections. The area and depth estimates used to calculate the removal action volumes were developed by the U.S. EPA based on preliminary data provided by UNC. As additional site data are obtained, it is anticipated that the volume estimate will be refined. However, the U.S. EPA considers the volume estimates summarized in Table 3.1 to be sufficiently accurate for the purposes of comparing costs and conceptual designs in this EE/CA.

For Alternatives 2 - 5, comprehensive planning will have to be done and work plans and engineering design documents developed prior to the work activities on site. Procurement for services and materials will need to be completed. This planning phase is not discussed in detail in this section; however, it is assumed that the following documents would have to be developed: plans for transportation, erosion and stormwater control, work schedule, air

monitoring, the sampling and analysis plan, quality control/quality assurance plan, a site safety and health plan, and an environmental protection plan. Engineering design documents will be required for Alternatives 3, 4, and 5.

3.2 ALTERNATIVE 1: NO ACTION

3.2.1 Alternative 1 Summary

Under Alternative 1 - No Action, no treatment, containment, or removal action would occur at the NECR mine site.

3.2.2 Site Work Activities

This alternative would have no site work activities associated with it. The residual mine wastes would be left in place.

3.2.3 Site Restoration Activities

Since there will be no work activities at this Site under this alternative there will be no site restoration.

3.2.4 Site Controls and Security

No site access controls or security would be maintained under Alternative 1. Nearby residents would have access to the NECR mine site areas with potential exposure to gamma radiation and radon emissions.

3.2.5 Stormwater and Erosion Control, O&M Activities

Wind and water would continue to move contaminated dust from the upland areas of NECR to downstream and downwind residential areas. No monitoring or maintenance of the site would occur.

3.3 ALTERNATIVE 2: EXCAVATION AND DISPOSAL OFF SITE OF ALL WASTES

3.3.1 Alternative 2 Summary

Alternative 2 assumes that all mine wastes with concentrations above the Proposed Action Level of 2.24 pCi/g Radium would be excavated and disposed of off site at a licensed and permitted disposal facility such as at US Ecology, in Grandview, Idaho. As a CERCLA waste, uranium mine wastes taken off-site would require disposal at a Long Term Remedial Action (LTRA) approved facility. Disposal costs at the Clive, Utah LTRA-approved facility is significantly higher than at the Grandview facility and therefore, Grandview was chosen to price this alternative.

An estimated 871,000 cubic yards of soil, or 1.26 million tons (using conversion factor of 1.45), have contamination levels above the Proposed Action Level and would need to be excavated from multiple areas on the NECR mine site. A total of approximately 157 acres would be affected.

3.3.2 Site Work Activities

The implementation of Alternative 2 would include site preparation, excavation, waste transportation and disposal, and post-excavation/site restoration activities. Site preparation includes an underground utility survey to identify and/or verify the location of subsurface utilities in all areas having excavation and stockpiling activities and heavy equipment operation. Existing civil improvements (e.g., structures, culverts, catch basins, vaults) would be decontaminated where practicable and disassembled for future use or demolished for removal. Temporary on-site facilities for decontamination of personnel and equipment (e.g., tools, salvageable equipment, passenger vehicles and heavy equipment) would be built. Temporary facilities for the storage of demolition wastes and large volumes of excavated contaminated material would also be constructed. Clearance for natural and cultural resources would be needed prior to the start of excavation.

Prior to excavating, clearing and grubbing of organic debris (stump removal, cutting and chipping) is expected for about 157 acres. Stormwater controls (as required in the existing permit or additional controls) will be assessed and would be implemented during this time. Perimeter air monitoring stations would be positioned and operated to monitor emissions during grubbing, excavation, stockpiling, loading of bulk-carriers, stockpile management, and site restoration. An excavation sequence would be developed for the scheduled areas and coordinated with a stockpile management plan.

3.3.3 Post-Excavation and Site Restoration Activities

Concurrent with the excavation activities, confirmation testing of the bottom and side soils in each excavated area would help determine the vertical and lateral extent of contamination.

After the waste is removed from the Site, the NECR mine site will be restored for grazing use. Clean backfill, assumed to be available from a local source, would be used for re-contouring the landscape. Regrading would re-establish pre-mining land surface contours with slopes to aid in erosion control (e.g., a slope of 3:1). It is anticipated that the excavated areas will require 200,000 c.y. of clean backfill of which 10% (20,000 c.y.) will require topsoil amendments and will be placed as topsoil.

Revegetation goals for the Site include the establishment of plants that emulate the structure, function, diversity, and dynamics of native plant communities in the area. Diverse mixtures of native and naturalized plants would maximize water removal and remain more resilient given

variable and unpredictable changes in the environment resulting from pathogen and pest outbreaks, disturbances (grazing, fire, etc.), and climatic fluctuations.

3.3.4 Site Controls and Security

During removal and restoration activities Site access would be restricted by construction of a temporary fence. Domestic livestock would not be allowed to enter the Site until completion. Though controls would be in place, there may be contaminated fugitive dust and general disturbance to the local community during restoration activities. In this case, residents living near active work areas, for example those close to the arroyo and NECR-1, may require temporary lodging.

3.3.5 Stormwater and Erosion Control, O&M Activities

Excavated areas would be graded to a gentle rolling contour and oriented to reduce scouring with low-energy flow rates and patterns. The draining system would be integrated with the existing topography and drainage patterns to the extent possible. Planning for stormwater runoff during the removal activities is essential. A surface water drainage system (including weirs) would be constructed and part of the infrastructure may remain in place after the work activities have ceased. It is assumed that the discharge from the NECR mine site would not be significantly altered; however, future activities at the Site must be evaluated for potential impacts on federally listed species and critical habitat for certification in the Notice of Intent, as required under the Multi-Sector General Permit (MSGP) under the NPDES permit. Long-term monitoring of the Site includes maintaining the stormwater runoff system.

3.4 ALTERNATIVE 3: ON-SITE CONSOLIDATION AND COVERING OF MINE WASTES

3.4.1 Alternative 3 Summary

This alternative assumes that the mine wastes will be consolidated and subsequently contained under a cover on the NECR mine site. An estimate of 871,000 cubic yards (1.26 million tons) of soil has contamination levels above the proposed Action Level and will need to be covered on the NECR mine site. Identified principal threat waste will be consolidated and placed in the bottom center of the consolidated mine waste pile; in this way, they will be encapsulated by lower concentration material which will provide an extra measure of radon emissions protection.

Alternative 3A

Alternative 3A involves on-site consolidation and capping, with the principal threat mine wastes taken to an off-site licensed controlled disposal facility, such as at Grandview, ID, or an alternative appropriate facility. For waste with total Uranium concentrations exceeding 500 mg/kg, it may be viable to reprocess the waste at the White Mesa Mill in Utah or a similar mill.

Alternative 3B

Alternative 3B involves on-site consolidation and cap, with the principal threat wastes consolidated with the mill waste at the UNC mill facility.

3.4.2 Site Work Activities

To prepare the site an underground utility survey would be performed to identify and/or verify the location of subsurface utilities in areas scheduled for in-situ cap, excavation and transfer to a consolidation area or off-site disposal, heavy equipment traversing paths, and stockpile activities. A land survey would be completed to delineate the areas of mine wastes to remain in-place for cover and delineate the excavation areas. Existing structures such as culverts, catch basins, and vaults would be disassembled for future use, demolished for removal, or included within a covered area.

Temporary on-site facilities for project management and project controls would be mobilized to the site for the duration of the project. Temporary facilities would be constructed for the storage of decontamination equipment (e.g., tools, salvageable equipment, passenger vehicles and heavy equipment), demolition wastes, and excavated material. Natural and cultural resources will be surveyed by a Navajo Nation archeologist and the existing permit issued for the Residential Area Time Critical Removal Action (TCRA) will be updated for the additional step out areas that would be affected by the removal action.

The initial site removal work includes grubbing and removal of organic debris. Stormwater controls (as required in the permit or additional controls) would be implemented during these activities. Perimeter air monitoring stations would be positioned and operated to monitor emissions during grubbing, excavation, stockpiling, loading of bulk-carriers, stockpile management, consolidation, cover construction and site restoration.

For the purposes of the EE/CA cost estimation, the preferred area to consolidate the excavated waste material is the area of Ponds 1 and/or 2. However, alternative on-site locations may be developed during the design phase. The consolidated mine waste subsequently will be covered. The covered area is shown in plan view on Figure 3.1; Figure 3.2 shows the covered area in cross section.

3.4.3 Consolidate and Cap Conceptualization

Areas considered for excavation and transport for consolidation include: Sandfills 2 and 3; NECR-2, Sediment Pad, Boneyard, NEMSA, Vents 3 and 8, Trailer Park, Arroyo 1, Sandfill 1, NECR-1 and NECR-1 step-out. Depth of excavation will not exceed ten feet, except in areas susceptible to erosion or where placing clean backfill to current grade is not planned. Excavation greater than ten feet will be required for removal of principal threat waste. For those areas not susceptible to erosion or not regraded to existing grade, excavation will continue until

the concentrations are at or below the proposed action level. For conceptual purposes, it is assumed that the material will be consolidated over Ponds 1 and Ponds 2. Final location of the consolidated material will be determined during the design phase of the project. A critical factor that will influence the final location of the waste pile and cover is the need to minimize exposure to up-gradient surface water flow and to minimize waste movement. By positioning the consolidated material in the upper-portion of the drainage basin, the size of the watershed up gradient of the covered area would be minimized. Where practicable, the cover may be integrated into the ridgelines of the basin perimeter to divert precipitation (rain water and snow melt) to the adjacent basins. This approach may also reduce the need for an extensive surface flow diversion system in the upper portion of the drainage basin.

The construction area will be cleared and grubbed and any topographic features that would hinder optimal consolidation of the mine wastes will be removed. The impacted materials within the footprint of the cover (Ponds 1 and 2 – approximately 95,000 cubic yards) will remain in place. Based on the conceptual model, the consolidate/cover removal action footprint will cover an area of approximately 12 acres and would hold 776,000 cubic yards. The cover will be designed to provide a radon shield, to be durable, to minimize infiltration, and maximize run-off. For cost purposes, it was assumed that a two-foot thick layer of on- or near-site material will provide the radon protection. An 18-inch layer of rock, also assumed to be available on- or near-site will be placed on top of the soil cover to provide the armoring need for long-term durability. To facilitate grazing re-use, 6 –inches of bio-solids or other off-site organic material will be used on the top of the cover to promote re-vegetation.

Air monitoring during construction would be required and dust suppression control would be implemented to maintain a safe working environment and to protect human health and the environment.

3.4.3.1 Post Excavation/Site Restoration Activities

Confirmation testing of the bottom and sidewall soils during excavation will determine the vertical and lateral extent of the removal action for the consolidation phase.

After the waste is removed, the NECR mine site will be restored for grazing use, except that the footprint of the cap will require O&M. Clean backfill, assumed to be available from a local source, will be used for re-contouring the landscape. Regrading will re-establish pre-mining land surface contours with slopes to aid in erosion control (e.g., a slope of 3:1). It is anticipated that the excavated areas will require 175,000 c.y. of clean backfill of which 10% (17,500 c.y.) will require topsoil amendments and will be placed as topsoil.

Although careful design of the cap (including the use of biosolids, appropriate seeding, and erosion control) helps to ensure proper revegetation after construction, it is best practice to preclude intrusion onto the cover until vegetation is firmly established.

3.4.4 Site Controls and Security

During the Alternative 3 removal and restoration activities, Site access would be restricted by construction of a temporary fence. Domestic livestock would not be allowed to enter the Site until restored. Though controls would be in place, there may be contaminated fugitive dust and general disturbance to the local community during restoration activities. In this case, residents living near active work areas, for example those close to the arroyo and NECR-1, may require temporary lodging.

3.4.5 Stormwater and Erosion Control, O&M

Excavated areas would be graded to a gentle rolling contour and oriented to reduce scouring with low-energy flow rates and patterns. The drainage system would be integrated with the existing topography and drainage patterns to the extent possible. Additionally, planning for stormwater runoff during the removal activities would be necessary. A surface water drainage system (including weirs) would be constructed and part of this infrastructure may remain in place after construction is completed. It is assumed that the discharge from the NECR mine site will not be significantly altered; however, future activities at the Site must be evaluated for potential impacts on federally listed species and critical habitat for certification in the Notice of Intent, as required under the MSGP.

Rain and snowmelt would contribute sheet flow off the cover. Gentle slopes, terraces, and earthen ridges of soil positioned along the contours would divert runoff to catch drains. Catch drains (swales), constructed laterally on catchments would divert runoff into side diversion drains, toe drains, and swales constructed along contours and at the base of a slope (respectively). Depending on the design capacity and hydraulic loads, swales would be sized and constructed with compacted base material and stabilized with filter fabric and riprap. Additional stormwater controls may include stormwater control channel (header), weirs, spillways, catch basins, check dams, and sediment basins. Stormwater control elements would be constructed to the extent practicable to minimize the risks of percolation from ponded water. The cover and stormwater controls would be regularly inspected for maintenance and repair.

3.5 ALTERNATIVE 4: LINED AND CAPPED REPOSITORY ON THE NECR MINE SITE

3.5.1 Alternative 4 Summary

Alternative 4 includes the second option for an above-ground containment of the mine wastes at the NECR mine site: a lined and capped repository. An estimated 871,000 cubic yards (1.26 million tons) of soil have contamination levels above the Proposed Action Level and will need to be placed in the repository on the NECR mine site. Similar to Alternative 3, the identified principal threat mine wastes will be placed in the bottom center of the Alternative 4 repository so that the mine wastes with higher concentration are encapsulated by wastes of lower concentration.

The main difference between Alternative 3 and 4 is that a liner is used underneath the mine waste pile in Alternative 4. Placement of a liner is to prevent potential infiltration of the mine wastes to the groundwater on the NECR mine site.

Alternative 4A

Alternative 4A involves an on-site capped repository, with the principal threat wastes taken to an off-site licensed controlled disposal facility, such as at Grandview, ID, or an alternative appropriate facility. For waste with total Uranium concentrations exceeding 500 mg/kg, it may be viable to reprocess the waste at the White Mesa Mill in Utah or a similar mill.

Alternative 4B

Alternative 4B involves an on-site capped repository, with the principal threat wastes consolidated with the mill waste at the UNC mill facility.

3.5.2 Site Activities

To prepare the site for implementation of Alternative 4, an underground utility survey would be performed to identify and/or verify the location of subsurface utilities in areas scheduled for grading, excavation and transfer to the repository, heavy equipment traversing paths, and stockpile management activities. A land survey would be completed to delineate the areas of tailings to be excavated and the boundary (footprint) for construction of the repository. Existing structures such as culverts, catch basins, and vaults would be disassembled for future use, demolished for removal, or included within a covered area.

Temporary on-site facilities for decontamination of personnel and equipment (e.g., tools, salvageable equipment, passenger vehicles and heavy equipment) and for the storage of demolition wastes and excavated material would be constructed. Natural and cultural resources will be surveyed by a Navajo Nation archeologist and the existing permit for the TCRA will be updated for the additional step out areas that would be affected by the removal action.

The initial site removal work includes grubbing and removal of organic debris. Stormwater controls (as required in the current permit or additional controls) would be implemented during these activities. Perimeter air monitoring stations would be positioned and operating to monitor emissions during grubbing, excavation, stockpiling, loading of bulk-carriers, stockpile management, consolidation, and address construction and site restoration. Air monitoring results would be used to maintain compliant air quality conditions. Dust suppression control would be implemented to maintain a safe working environment and to protect human health and the environment. Air monitoring for particulates will also be ongoing throughout the construction of the repository. Dust suppression using on-site well water along haul routes and as necessary in the excavation areas will continue until all activities have ceased and the danger of dust is no longer present.

3.5.3 Repository Conceptualization

Repositories are typically large lined storage cells with embankments that stabilize the cell and isolate the radioactive mine. At the NECR mine site, it is assumed that the best location for the repository would be within Drainage Basin 2, NECR-2 (which includes NECR-2 drainage), Sandfill No. 2, Sandfill No. 3, and portions of the Sediment Pad and Magazine area. This area is contained in a valley that appears to have only intermittent surface water flow based on UNC topographic information. Positioning of the repository and cap to minimize exposure to up-gradient surface water flow is critical to the design. By positioning the consolidated material in the upper-portion of the drainage basin the cap may be integrated into the ridgelines of the basin's perimeter to divert precipitation (rain water and snow melt) to the adjacent basins. This approach may also reduce the amount of surface flow diversion system for the upper portion of the drainage basin.

A conceptual plan view of the potential repository location is shown on Figure 3.3. Figure 3.4 shows the covered area in cross section. The footprint encompasses approximately 14.4 acres and cap would be approximately 20.2 acres. Final location of the repository will be made during the design.

The first-phase would remove and store material within the repository footprint. Areas within the repository footprint include: Sandfill 2, Sandfill 3, and NECR-2 areas. These areas would be sequentially excavated, inventoried and secured in a stockpile management cell(s) while the liner portion of the repository is constructed.

For cost purposes, it is assumed that two feet of compacted clay soil plus liner and geofabric will form the liner of the repository. Final liner design will also consider the final cap design to ensure a consistent approach in minimizing infiltration through the repository.

The cap will be designed to provide a radon shield, to be durable, to reduce infiltration to equal the permeability of the liner, and to maximize run-off. For cost purposes, it was assumed that a two-foot thick layer of on- or near-site material will provide the radon protection. An 18-inch layer of rock, also assumed to be available on- or near-site will be placed on top of the soil cap to provide the armoring need for long-term durability. To facilitate grazing re-use, 6 –inches of bio-solids or other off-site organic material will be used on the top of the cap to promote re-vegetation.

3.5.4 Post Excavation Activities/Site Restoration

Concurrent with the excavation activities, confirmation testing of the bottom and side soils in each excavated area will help determine the vertical and lateral extent of contamination.

After the waste is removed from the Site, the NECR mine site excavated areas will be restored for grazing use, except that the footprint of the cap will require O&M. Clean backfill, assumed to be available from a local source, would be used for re-contouring the landscape. Regrading

would re-establish pre-mining land surface contours with slopes to aid in erosion control (e.g., a slope of 3:1). It is anticipated that the excavated areas will require 200,000 c.y. of clean backfill of which 10% (20,000 c.y.) will require topsoil amendments and will be placed as topsoil.

Although careful design of the cap (including the use of biosolids, appropriate seeding, and erosion control) helps to ensure proper revegetation after construction, it is best practice to preclude intrusion onto the cap until vegetation is firmly established.

3.5.5 Site Control and Security

During the removal and restoration activities Site access will be restricted by construction of a temporary fence. Domestic livestock will not be allowed to enter the Site until restoration is complete. Though controls will be in place, there may be contaminated fugitive dust and general disturbance to the local community during restoration activities. In this case, residents near the work activities, for example those close to the arroyo and NECR-1, may require temporary lodging.

3.5.6 Stormwater and Erosion Control and O&M

Excavated areas will be graded to a gentle rolling contour and oriented to reduce scouring with low-energy flow rates and patterns. The draining system would be integrated with the existing topography and drainage patterns to the extent possible.

Planning for stormwater runoff during the removal activities is essential. A surface water drainage system (including weirs) will be constructed. It is assumed that the discharge from the NECR mine site will not be significantly altered; however, future activities at the Site must be evaluated for potential impacts on federally listed species and critical habitat for certification in the Notice of Intent, as required under the MSGP.

Rain and snowmelt will contribute sheet flow off the cap. Gentle slopes, terraces, and earthen ridge of soil positioned along the contours would divert runoff to catch drains. Catch drains (swales), constructed laterally on catchments, would divert runoff into side diversion drains, toe drains and swales generally constructed along contours and at the base of a slope (respectively). Depending on the design capacity and hydraulic loads, swales would be sized and constructed with compacted base material and stabilized with filter fabric and riprap. Additional stormwater controls may include stormwater control channel (header), weirs, spillways, catch basins, check dams, and sediment basins. Stormwater control elements would be constructed to the extent practicable to minimize the risks of percolation from the ponded water. The cap and stormwater controls would be regularly inspected for maintenance and repair.

Long-term monitoring activities include O&M for the capped repository.

3.6 ALTERNATIVE 5: ABOVE-GROUND, REPOSITORY ON THE UNC MILL FACILITY

Conceptually, Alternative 5 is envisioned to evaluate disposal of the waste at a nearby location outside the NECR mine area. Several potential sites have been brought to EPA's attention including the UNC Mill facility, the Ambrosia Lake Mill facility, the Homestake Mill facility, and the Fort Wingate property. Each location poses possible community acceptance issues and differing logistical, administrative and technical challenges. EPA has chosen to evaluate the UNC Mill Site as the off-NECR repository for Alternative 5

3.6.1 Alternative 5 Summary

In Alternative 5, all NECR mine wastes would be excavated, transported and consolidated at one of the existing tailing sands disposal cells at the UNC mill facility. At UNC currently, there are three cells containing an estimated 3.5 million tons of tailings covering approximately 128 acres. All are under the regulatory jurisdiction of the NRC which requires long-term stability, erosion protection and a radon shield in their cell design requirements. These cells are currently unlined and capped. Recent analysis by EPA Region 6 has determined that the cells are currently not contributing to the groundwater uranium contamination underlying the UNC Site.

It is EPA Region 9's preference to incorporate the NECR mill tailings into one or more of the existing disposal cells. The Post Removal Site Control (PRSC) responsibility for the UNC Mill Site would be with the Department of Energy's long-term stewardship program upon completion of the action and all other requirements. After the NRC license is terminated, DOE would become the perpetual custodian under an NRC general license. This would result in one less disposal cell for long-term maintenance and an improved cap on the existing cells, resulting in an overall improvement in protection, reliability and administrative management at the UNC Site. However, incorporating the waste requires designing a system that satisfies all EPA's, NRC's, DOE's and the State's requirements. EPA Region 9 will work with the NRC, DOE, EPA Region 6, and the State of New Mexico to create an acceptable design of incorporating the NECR mill tailing into the existing cells that complies with the NRC/DOE permit requirements and EPA's regulations and decisions. If an agreeable design cannot be completed due to administrative or technical issues, then all the NECR wastes could be placed in a new, separate repository on the UNC Mill Site. This would require a release of property currently under NRC oversight. In this case, the PRSC oversight responsibility of a new repository would remain with EPA.

Alternative 5A

Alternative 5A involves excavation, transportation and consolidation of NECR waste into one of the existing cells at the UNC Mill Site, with the principal threat mine wastes taken to an off-site licensed controlled disposal facility, such as at Grandview, ID, or an alternative appropriate

facility. For waste with total Uranium concentrations exceeding 500 mg/kg, it may be viable to reprocess the waste at the White Mesa Mill in Utah or a similar mill.

3.6.2 Site Activities

To prepare the site for implementation of Alternative 5, an underground utility survey would be performed to identify and/or verify the location of subsurface utilities in areas scheduled for grading, excavation and transfer to the disposal cell, heavy equipment traversing paths, and stockpile management activities. A land survey would be completed to delineate the areas of tailings to be excavated.

Temporary on-site facilities for decontamination of personnel and equipment (e.g., tools, salvageable equipment, passenger vehicles and heavy equipment) and for the storage of demolition wastes and excavated material would be constructed. Natural and cultural resources will be surveyed by a Navajo Nation archeologist and the existing permit for the TCRA will be updated for the additional step out areas that would be affected by the removal action.

The initial site removal work includes grubbing and removal of organic debris. Stormwater controls (as required in the current permit or additional controls) would be implemented during these activities. Perimeter air monitoring stations would be positioned and operated to monitor emissions during grubbing, excavation, stockpiling, loading of bulk-carriers, stockpile management, consolidation, cap and repository construction and site restoration. Air monitoring results and dust suppression control would be implemented to maintain compliant air quality conditions and a safe working environment and to protect human health and the environment.

3.6.3 UNC Repository Conceptualization

For cost estimating purposes, this alternative assumes that NECR wastes will be added to the largest NRC-regulated cell at the UNC Mill Facility - the Center Cell that is approximately 40 acres. An estimated 871,000 cubic yards (1.26 million tons) of NECR waste will be placed on top of the cell, pending the appropriate approval necessary for the UNC NRC permit, and agreement from the DOE. This conceptual design would add approximately four feet of waste to the height of the current cell. A new cap would be constructed over the waste material, which would add additional height and protection against infiltration. A liner would be included. NECR waste could also be incorporated in the two other cells: the South Cell which is 19 acres in size; or the North Cell which is 28 acres. Alternatively, the waste from NECR could be placed in a separate repository located on the UNC Site. The best approach to incorporate the NECR waste into an existing cell, or into a new repository, will be evaluated in the design phase.

All areas at the NECR site will be considered for excavation and transport for consolidation. Depth of excavation will not exceed ten feet, except in areas susceptible to erosion or where

placing clean backfill to current grade is not planned. Excavation greater than ten feet will be required for removal of principal threat waste. For those areas not susceptible to erosion or not regraded to existing grade, excavation will continue until the concentrations are at or below the field screening levels.

For cost purposes, it is assumed that the NECR waste would be incorporated into an existing cell by expanding the footprint of the cell. It is also assumed that the cap and the liner are the same design as Alternative 4.

3.6.4 Post Excavation Activities/Site Restoration

Concurrent with the excavation activities, confirmation testing of the bottom and side soils in each excavated area will help determine the vertical and lateral extent of contamination.

After the waste is removed from the NECR site and placed in the existing or new repository at the UNC site, the NECR mine site will be restored for grazing use. Clean backfill, assumed to be available from an on-site source, will be used for re-contouring the NECR mine site landscape. Regrading will be to pre-mining contours with slopes to aid in erosion control (e.g., a slope of 3:1). It is estimated that the excavated areas will require 200,000 c.y. of clean backfill.

It is assumed that no grazing or other land use would be permitted on the UNC mill facility site and therefore, only signage was assumed to be required to prevent intrusion onto the cap.

3.6.5 Site Controls and Security

During the removal and restoration activities site access to the NECR mine site and UNC mill facility will be restricted by construction of a temporary fence. Domestic livestock would not be allowed to enter the UNC mill facility for a scheduled period. Though controls will be in place, there may be contaminated fugitive dust and general disturbance to the local community during restoration activities. In this case, residents near the work activities, for example those close to the arroyo and NECR-1, may require temporary lodging.

3.6.6 Stormwater and Erosion Control, O&M

Excavated areas will be graded to a gentle rolling contour and oriented to reduce scouring with low-energy flow rates and patterns. The draining system would be integrated with the existing topography and drainage patterns to the extent possible.

Planning for stormwater runoff during the removal activities is essential. A surface water drainage system (including weirs) will be constructed. It is assumed that the discharge from the NECR mine site will not be significantly altered; however, future activities must be evaluated for potential impacts on federally listed species and critical habitat for certification in the Notice of Intent, as required under the MSGP.

Rain and snowmelt will contribute sheet flow off the cap. Gentle slopes, terraces, and earthen ridge of soil positioned along the contours would divert runoff to catch drains. Catch drains (swales), constructed laterally on catchments, would divert runoff into side diversion drains, toe drains and swales generally constructed along contours and at the base of a slope (respectively). Depending on the design capacity and hydraulic loads, swales would be sized and constructed with compacted base material and stabilized with filter fabric and riprap. Additional stormwater controls may include stormwater control channel (header), weirs, spillways, catch basins, check dams, and sediment basins. Stormwater control elements would be constructed to the extent practicable to minimize the risks of percolation from the ponded water. The cap and stormwater controls would be regularly inspected for maintenance and repair.

4.0 ANALYSIS OF ALTERNATIVES

Section 4 presents an analysis of the five alternative methods for the removal action. The previous section provides a description of the removal actions that were selected for further review in this EE/CA. These include:

1. No Action;
2. Excavation and disposal at an off-site TSDF of all NECR mine site wastes;
3. Consolidation and covering of mine wastes on the NECR mine site;
4. Construction of above-ground, capped and lined repository on the NECR mine site; and
5. Consolidating the mine wastes on the UNC mill facility (currently permitted under license by the U.S. Nuclear Regulatory Commission (NRC), either in an existing tailings cell or in a newly constructed repository.

Alternatives 3, 4 and 5 have the following option:

- A: Removal of high-concentration ("principal threat waste") material to an off-site Class I hazardous waste disposal facility, or an alternative appropriate facility

In addition, Alternatives 3 and 4 have the following option:

- B: Removal of principal threat waste material for containment in an existing tailings cell on the UNC mill facility.

Each removal action alternative needs to meet the following overall project objectives:

- Mitigation of human health and ecological risks associated with the mine wastes;
- Control of current or future release and migration of contaminants;
- Return of the NECR mine site to reasonably anticipated future uses;
- Compliance with regulatory requirements and/or the public concerns to result in stakeholder acceptance.

4.1 ALTERNATIVE ANALYSIS APPROACH

Each alternative was evaluated on the basis of effectiveness, implementability, and cost, as set forth in the NCP and U.S. EPA guidance on conducting an EE/CA for a removal action (U.S. EPA 1993). The feasibility of any remedy must be measured against the legal constraints that may prevent or complicate the use of tribal land without contemporaneous tribal consent.

4.1.1 Effectiveness

Effectiveness refers to the ability of an alternative to meet the removal action objectives. The following criteria are used to evaluate effectiveness:

- Overall protection of human health and the environment;
- Compliance with ARARs and other criteria, advisories, and guidance;
- Long-term effectiveness and permanence;
- Reduction of toxicity, mobility, or volume through treatment; and
- Short-term effectiveness.

4.1.2 Implementability

Implementability addresses the technical and administrative feasibility of implementing an alternative and availability of various required services and materials. The following criteria are used to evaluate implementability:

- Technical feasibility;
- Administrative feasibility;
- Availability of services and materials;
- State acceptance; and
- Community acceptance.

4.1.3 Cost

Cost estimates were prepared for Alternatives 2 through 5 to compare the alternatives and support remedy selection. The elements for an action's estimated total cost generally include capital costs, operation and maintenance costs (O&M [annual and periodic]), and net present value for capital and O&M costs. The cost analysis for the alternatives in this document includes capital costs and annual O&M costs with the total cost for the removal action alternative limited to capital costs only. Cost estimates are located in Appendix B.

The scope and costs presented for the various alternatives are based on the best available information regarding current site conditions and readily available information on the applicability and effectiveness of the selected removal actions. However, uncertainties and data gaps remain because the site characterization was based on a limited number of borings, observations, and analyses. In preparing the cost estimates, conservative assumptions have been used and an overall contingency of 10 percent added to each alternative to account for these uncertainties. Changes in the cost elements are likely as new information and site conditions change during the removal action design.

The costs given should be considered order of magnitude type estimates with an accuracy of +50/-30 percent. Actual costs may vary from these estimates depending on variations in actual site conditions from those estimated, such as weather conditions, inflation, actual fuel costs, actual insurance and bonding costs, the availability of materials, equipment, and labor, changes in regulatory requirements, and other factors that are difficult to estimate or control.

4.2 ENGINEERING AND LOGISTICAL CONCERNS APPLICABLE TO ALL ALTERNATIVES

4.2.1 Activities Applicable to Alternatives 2 - 5

Alternatives 2 through 5 each require the following activities:

- Engineering/design and inspection;
- Road improvements;
- Site security and access controls;
- Management of mine wastes;
- Stormwater management following the removal action;
- Erosion control and maintenance following the removal action; and
- Site restoration, including revegetation.

The costs for these activities are included in the estimated cost for each alternative. Costs for procurement are not included in the costs. Stormwater management and erosion control and maintenance for 30 years following the removal action are identified under O&M costs, but are not included in the total removal action cost used in the comparative analysis.

4.2.2 Unavoidable Impacts Common to All Alternatives

Except for Alternative 1 (no action), each of the removal action alternatives would result in an overall improvement to the local environment. However, for Alternatives 2 through 5, it is important to note that there will be some unavoidable impacts. These include:

- Short term inconvenience to local populations using Highway 566, general disturbance to the local residents from heavy equipment activity for the assumed one and a half to two year construction period.
- Disruption of wildlife and livestock access to the completed removal action areas due to the construction activities and potentially for three years afterwards for revegetation establishment.
- Site restoration activities will include regrading and revegetation; the NECR mine site landscape will appear changed and unfamiliar.

- Local drainage patterns will be altered due to the change in site topography and stormwater and erosion controls. However, the stormwater and erosion controls are necessary to prevent down-stream flooding or erosion off site.
- Haul roads are assumed to remain after removal action construction is completed to allow access for monitoring and O&M activities.
- Long-term O&M activities are required for minimum maintenance of erosion controls (Alternative 2) and for maximum maintenance of cap and storm-water diversion measures (Alternatives 3, 4, and 5).

4.3 ALTERNATIVE 1 ANALYSIS

Under Alternative 1 - No Action, no treatment, containment, or removal action would occur at the NECR mine site. Consequently, potential human health and environmental impacts associated with wind and water transport of contaminated surface soils would remain unchanged. The No Action Alternative is used as a baseline for comparison with the removal action alternatives.

4.3.1 Effectiveness

The effectiveness of the No Action Alternative is considered low for achieving the removal action objectives. This alternative would not minimize the potential exposure to or transport of mine wastes from the NECR mine site. This alternative would provide no control of soil concentrations or mobility and no reduction in risk to human health or the environment. Home sites that were addressed by the May 2007 TCRA may become re-contaminated due to movement of contaminated surface soils by wind and water. Therefore, increased protection of human health and the environment would not be achieved under the No Action Alternative.

A comprehensive list of federal and state ARARs for the NECR mine site is presented in Appendix A. Under the No Action Alternative, mine wastes and mill byproduct material would not be treated, removed, or actively managed. Surface water discharge through Arroyo 1 would continue to transport contaminated soils from NECR mine site to the downstream watershed. Nearby residents would continue to be exposed to wind and water-borne contaminants. Free-roaming domestic livestock and their owners/caretakers would be exposed to surface soil contamination through direct contact and dust inhalation. Therefore, the No Action Alternative would not comply with ARARs.

No controls or long-term measures would be implemented to control contaminated soils at the Site under the No Action Alternative; therefore, this alternative offers no long-term or short-term effectiveness in reducing potential risks to human and ecological receptors.

The No Action Alternative would provide no reduction in toxicity, mobility, or volume of mine wastes at the NECR mine site.

4.3.2 Implementability

The No Action Alternative would be readily implementable and administratively feasible. No permits would be required to implement this alternative. No services or materials would be needed to implement this alternative. The community and other stakeholders are unlikely to accept this alternative.

4.3.3 Cost

There are no direct or indirect capital costs, annual O&M, or monitoring costs for this alternative.

4.4 ALTERNATIVE 2 ANALYSIS

Implementation of Alternative 2, excavation and off-site disposal of all wastes, would require the following steps:

- Excavation of all wastes on NECR mine site;
- Off site disposal of mine wastes; and
- Site restoration with erosion and stormwater controls, regrading and revegetation.

4.4.1 Effectiveness

4.4.1.1 Protection of Human Health and the Environment

Alternative 2 would protect human health and the environment by preventing direct contact of the wastes with humans and the environment, since the mine wastes would be removed from the NECR mine site.

4.4.1.2 Compliance with ARARs

Alternative 2 is expected to comply with the ARARs identified in Appendix A. This alternative would be implemented to achieve clean-up goals. Alternative 2 includes the excavation and relocation of the mine wastes off site, resulting in compliance with location-specific ARARs for the NECR mine site. Action-specific ARARs for this alternative include Federal and State hazardous waste management regulations to the extent applicable; Federal and State standards for protection of workers, the public, and environment from low-level radioactivity; the New Mexico Administrative Code (NMAC) 20.2 for air quality control regulations; and Federal and Navajo Nation rules and regulations pertaining to the on-site accumulation of wastes in stockpiles and the control of stormwater discharges during construction activities.

DOT rules and regulations on manifesting and the on-site and off-site transport of hazardous materials would also be action-specific ARARs for implementation of Alternative 2. Federal requirements for hazardous waste disposal will be ARARs if the removal action encounters wastes subject to these requirements.

4.4.1.3 Long-Term Compliance

Since all mine wastes will be excavated and removed from the Site, Alternative 2 is expected to effectively mitigate the effects on potential human and ecological receptors in the long term.

4.4.1.4 Reduction of Toxicity, Mobility, and Volume

Alternative 2 would reduce the volume, mobility and toxicity of the contaminants at the NECR mine site by physically removing all wastes to an off-site disposal facility.

4.4.1.5 Short-Term Compliance

The primary considerations for this criterion are protection of the community, workers, and environmental impacts during and after implementation.

Alternative 2 involves demolition/disposal of existing foundations, excavation, material transfer, stockpile development/management, loading of bulk carriers, and site restoration activities. Heavy equipment would be used to clear and grub, excavate, transfer, load, and grade impacted materials. Potential exposure and protection procedures for workers engaged in these activities would be addressed in detail under a site safety and health plan (SSHP). During excavation and material handling activities, measures will be taken to reduce fugitive dust emissions and associated impacts to workers. Water would be available for dust control, and workers in the controlled area will don the appropriate safety equipment and implement safety practices such as air monitoring. Work areas would be secured (e.g., marked or fenced) to control access by authorized personnel only.

Bulk carriers hauling the containerized wastes off site would be covered and secured and weighed to document compliance with total and axle load limits. Truck traffic would be coordinated under a transportation plan for routes, times of operation, and on-site traffic rules. Emergency spill containment and cleanup contingencies actions would also be included in the transportation plan to address material spills.

4.4.2 Implementability

4.4.2.1 Technical and Administrative Feasibility

Alternative 2 is technically feasible and would not require unconventional techniques, materials or labor for the excavation and associated activities. The site is readily accessible. Excavation would be scheduled and performed in a manner to maximize direct loading and ensure worker and public safety. Engineering controls for fugitive dust and site monitoring would be utilized to control sensitive issues. Profiling and manifesting of the material will be done in coordination with the transporters and off-site disposal facility. Due to the large number of truckloads (35,000 loads) and the long drive to Grandview, Idaho (12 hours), it is estimated that the time period of implementation of Alternative 2 would be nine years.

Alternative 2 is administratively feasible. The mine wastes may be transported across state boundaries for disposal and transportation permits will be necessary. All NECR mine waste is anticipated to be accepted by permitted facilities.

4.4.2.2 Availability of Services

The excavation of contaminated material would be accomplished using a variety of conventional equipment. Heavy equipment needed for this project, such as scrapers, excavators, dozers, loaders, compactors, and/or bulk carriers, are commercially available. On-site wells are assumed to be available and readily accessible for construction water. Working space is available for establishing temporary construction office trailers. Utilities (power, drinking water, and telephone services) are available via local grid or already on site. Portable sanitary services and refuse disposal are locally available. Construction materials for the cap and site restoration activities (backfilling and hydroseeding) and an off-site laboratory for sample analysis are commercially available.

Trained and experienced labor is available for site work activities. Special certifications and training requirements are commercially available. Health and safety training to comply with OSHA including radiation and hazardous material handling training is available. The Navajo Nation will provide cultural resource liaison.

4.4.2.3 State and Community Acceptance

EPA understands that the Navajo Nation and the local community strongly support Alternative 2, because this alternative contemplates off-site removal of all wastes.

The State, Tribal and Community Acceptance criteria will be considered following the 30-day public comment period on the EE/CA. Potential impacts to the community include inconvenience from noise and dust from truck traffic and heavy equipment operation, and restriction of NECR mine site land from grazing and other activities for a period of time after the removal action ceases. Community acceptance of this alternative may decrease with increased awareness of the estimated nine-year implementation period, with accompanying traffic and air impacts.

4.4.3 Cost

The cost estimate prepared for Alternative 2 is included in Appendix B. The total cost for Alternative 2 is estimated to be $293,600,000.

4.5 ALTERNATIVE 3 ANALYSIS

Implementation of Alternative 3, on-site consolidation and capping of mine wastes would require the following steps (also refer to Section 3.4):

- Excavation of wastes;
- Consolidation of mine wastes to area in Drainage Basin 2 (or other suitable on-site location);
- Construction of a cap of consolidated mine wastes;
- Site restoration with erosion and stormwater controls, regrading and revegetation; and

- Long-term maintenance for cap.

Alternative 3 also has two options:

- Alternative 3A: On-site consolidation and cap with removal of principal threat material to off-site Class I licensed controlled disposal facility, or alternative appropriate facility; and
- Alternative 3B: On-site consolidation and cap with removal of Principal Threat Waste material to UNC mill facility.

4.5.1 Effectiveness

4.5.1.1 Protection of Human Health and the Environment

Alternative 3 will protect human health and the environment as the mine wastes exceeding the Action Level would be consolidated and covered or covered in-situ on the NECR mine site. These activities will prevent direct contact between the wastes and humans and the environment. Proper construction and design of the cap includes the establishment of vegetation, which prevents erosion of the cap. Proper stormwater controls and maintenance of the cap will prevent release of the mine wastes back into the environment. A liner is not used in Alternative 3.

4.5.1.2 Compliance with ARARs

Alternative 3 is expected to comply with chemical, location and action specific ARARs identified in Appendix A.

This removal action alternative would be implemented to reach the proposed Action Level. Data available on the Site conditions suggest no groundwater flux from sidewalls and the base of Drainage Basin 2, which is the location of the proposed covered area. In addition, stormwater controls will be included in the design, so that surface water would be diverted from the area. The cap is a physical barrier that also offers protection from water infiltration to the consolidated mine wastes, protecting groundwater resources, and also provides adequate shielding from ionizing radiation to protect human health and the environment.

Consolidation and covering of the mine wastes will prevent exposure to airborne radon emissions to protect the environment and human health, and will meet chemical-specific ARARs. The activities set forth for the removal action would provide compliance with location-specific ARARs. An environmental protection plan will be developed for monitoring protocols during the work activities and include a review and evaluation of potential impacts to historic properties and locations. Natural resource (e.g., biological and botanical) inspections have been conducted at the site and information from these inspections will be included in the environmental protection plan. Environmental protection would include a review and evaluation of potential impacts on government protected species and critical habitats.

The removal action would provide compliance with action-specific ARARs. These include Federal and State hazardous waste management regulations to the extent applicable; Federal and State standards for protection of workers, the public, and environment from low-level radioactivity; and Federal and Navajo Nation rules and regulations pertaining to air quality management and fugitive dust emission control, the on-site accumulation of stockpiled wastes, protection and monitoring of groundwater, and the control of stormwater discharges during construction activities.

4.5.1.3 Long-Term Compliance

The long-term effectiveness and permanence of Alternative 3 is dependent on the future maintenance activities. If properly maintained the caps and diversion structures will minimize water infiltration and the caps will prohibit human or animal disturbance to the mine wastes.

4.5.1.4 Reduction of Toxicity, Mobility, and Volume

Consolidating and covering the mine wastes on the NECR mine site would reduce the mobility of the contaminants. The toxicity would not be reduced; however, the cap (if maintained appropriately) would provide long-term protection of human health and the environment from the process of natural radioactive decay.

4.5.1.5 Short-Term Compliance

The primary criterion for short-term compliance is to protect community health, workers, and the environment during and after work activities at the Site. Alternative 3 activities are anticipated to extend over three full construction seasons (April through September).

Alternative 3 involves several types of construction activities (primarily demolition and disposal of existing foundations, clearing and excavation, material transfer and stockpiling/loading, construction of cap and stormwater controls, and site restoration through backfilling/reseeding). Worker protection, safety equipment, air monitoring protocols, and control of fugitive dust emissions during these activities will be addressed and will comply with OSHA, State and local standards. Water from on-site wells will be available for dust control. Work areas would be secured, marked or otherwise controlled to limit access to authorized personnel only.

Bulk carriers traveling on site may operate with uncovered beds but will exercise dust control during transfer operations. Truck traffic would be coordinated under a transportation plan for routes, times of operation, and on-site traffic rules. Emergency spill containment and cleanup contingencies actions would also be included in the transportation plan to address material spills.

4.5.2 Implementability

4.5.2.1 Technical and Administrative Feasibility

Alternative 3 is technically feasible and would not require unconventional techniques, materials or labor for the excavation and associated activities. The site is readily accessible. Due to the

magnitude of the volume to be excavated and handled, field activities are assumed to extend over a three-year period. Excavation would be scheduled and performed in a manner to maximize direct loading. Work can be performed in a manner that would ensure worker and public safety and minimize multiple handling where possible.

Roadway improvements will be made to optimize access of equipment, materials and labor. Storm and surface water control and improvements will be developed under BMPs in preparation for the removal action. "Winterization" elements in the stormwater control plans will help secure the site during extreme storm events, providing institutional controls to protect human health and wildlife.

Alternative 3 is administratively feasible. Construction of an on-site cap will not require special permitting because mine wastes are considered low-level radioactive materials.

4.5.2.2 Availability of Services and Materials

The excavation of contaminated material would be accomplished using a variety of conventional equipment. Heavy equipment needed for this project, such as scrapers, excavators, dozers, loaders, compactors, and/or bulk carriers, are commercially available. On-site wells are assumed to be available and readily accessible for construction water. Working space is available for establishing temporary construction office trailers. Utilities (power, drinking water, and telephone services) are available on site. Construction materials for the cap and site restoration activities (backfilling and hydroseeding) are commercially available.

Trained and experienced labor is available for site work activities. Special certifications and training requirements are commercially available. Health and safety training to comply with OSHA including radiation and hazardous material handling training is available. The Navajo Nation will provide cultural resource liaison.

4.5.2.3 State and Community Acceptance

EPA understands that Alternative 3 would not be acceptable to the Navajo Nation and the local community because it would result in waste remaining on-site. This understanding is based on ongoing consultation between EPA and the Navajo Nation, and particularly dated September 2, 2008 from the Navajo Nation Department of Justice to EPA, which is attached as Appendix C. That letter states:

Because of the Navajo's unique connection with the land, a remedial alternative that simply retains radioactive material on Navajo land will not only be ineffective and difficult to implement (and impossible to implement without Navajo Nation consent) it will be rejected by the community it is supposed to serve.

The State, Tribal and Community Acceptance criteria will be further considered following the 30-day public comment period on the EE/CA. Potential impacts to the community during implementation of Alternative 3 include inconvenience from noise and dust from truck traffic and heavy equipment operation, and restriction of NECR mine site land from grazing and other activities for a period of time after the removal action ceases.

4.5.3 Cost

The cost estimate prepared for Alternative 3 is included in Appendix B. The total cost for Alternative 3 is estimated to be approximately $25,800,000. The estimated cost for Alternative 3A is $28,500,000 and for Alternative 3B is: $26,700,000.

4.5.4 Alternative 3 Options

Both Alternatives 3A and 3B are acceptable in terms of effectiveness, implementability, and cost, but are opposed by the Navajo Nation and the local community for the same reasons that they oppose Alternative 3. The removal action proposed in Alternative 3 is enhanced in effectiveness by removing the highest concentration material to an off-site controlled disposal facility. The disadvantage is additional costs for materials management, transportation, and for 3A disposal fees. For 3B, the existing tailings cell at the UNC mill facility will need to be modified for the principal threat waste disposal.

4.6 ALTERNATIVE 4 ANALYSIS

Implementation of Alternative 4, constructing an above-ground, capped repository at the NECR mine site, would require the following steps (also refer to Section 3.5):

- Design, siting and construction of above-ground repository with liner;
- Excavation of all wastes;
- Placement of mine wastes in repository;
- Construction of cap to prevent airborne radon emissions and liner to prevent infiltration to groundwater;
- Site restoration with erosion and stormwater controls, regrading and revegetation;
- Long-term maintenance of cap and stormwater infrastructure.

Alternative 4 also has associated with it the following options:

  - Alternative 4A: On site repository with removal of principal threat material to off-site Class I licensed controlled disposal facility, or an alternative appropriate facility; and
  - Alternative 4B: On site repository with removal of Principal Threat Waste material to UNC mill facility.

4.6.1 Effectiveness

4.6.1.1 Protection of Human Health and the Environment

Alternative 4 will protect human health and the environment as all mine wastes would be placed in a capped and lined above-ground repository. These activities will prevent direct contact between wastes and humans and the environment in the future. The liner would be expected to prevent leakage out of the repository and further act to isolate the wastes at the Site.

4.6.1.2 Compliance with ARARs

Alternative 4 is expected to comply with chemical, location and action specific ARARs identified in Appendix A.

This removal action alternative would be implemented in accordance with chemical-specific ARARs. The repository design would include a liner system and cap to fully contain and isolate mine wastes exceeding the Action Level. Stormwater controls will be included in the design, so that surface water would be diverted from the area. The cap is a physical barrier that also offers protection from water infiltration to the mine wastes, protecting groundwater resources, and also provides adequate shielding from ionizing radiation to protect human health and the environment. Although limited data indicate that there may not be a pathway between contaminated mine wastes and groundwater, the liner acts as extra protection to isolate the mine wastes.

The activities set forth for the removal action would provide compliance with location-specific ARARs. An environmental protection plan would be developed for monitoring protocols during the work activities and would include a review and evaluation of potential impacts to historic properties and locations. Natural resource (e.g., biological and botanical) inspections have been conducted at the Site and information from these inspections will be included in the environmental protection plan. Environmental protection would include a review and evaluation of potential impacts on government protected species and critical habitats.

The removal action would provide compliance with action-specific ARARs. These include Federal and State hazardous waste management regulations, to the extent applicable; DOE standards for protection of workers, the public, and environment from low-level radioactivity; and Federal and Navajo Nation rules and regulations pertaining to air quality management and fugitive dust emission control, the on-site accumulation of stockpiled wastes, protection and monitoring of groundwater, and the control of stormwater discharges during construction activities.

4.6.1.3 Long-Term Compliance

The long-term effectiveness of Alternative 4 is dependent on the future maintenance activities. If properly maintained the cap, repository, and diversion structures will minimize water infiltration and the cap will prohibit human or animal disturbance to the mine wastes.

4.6.1.4 Reduction of Toxicity, Mobility, and Volume

Alternative 4 would reduce the mobility of contaminants at the Site by placing the mine wastes in a capped and lined repository. The liner would prevent any potential leaching of contaminants into the groundwater thus reducing mobility. The toxicity would not be reduced; however, the cap (if maintained appropriately) would provide long-term protection of human health and the environment from the process of natural radioactive decay.

4.6.1.5 Short-Term Compliance

The primary criterion for short term compliance is to protect the community, workers, and environment from impacts during work activities at the Site. Field activities are anticipated to extend over four full construction seasons (April through September) for Alternative 4.

Alternative 4 involves the construction activities primarily including demolition/disposal of existing foundations, excavation, material transfer, stockpile development/management, loading of bulk carriers, and backfill and grading. Heavy equipment would be used to clear and grub, excavate, transfer, load, and grade. Potential exposure and protection procedures for workers engaged in these activities would be addressed in detail under the SSHP. During excavation and material handling activities measures will be taken to reduce fugitive dust emissions and associated impacts to workers. Water would be available for dust control and workers in the controlled area will don the appropriate safety equipment and implement safety practices. Work areas would be secured, marked or otherwise controlled to limit access to authorized personnel only.

Bulk carriers traveling on site may operate with uncovered beds but exercise dust control during transfer operations. Truck traffic would be coordinated under a transportation plan for routes, times of operation, and on-site traffic rules. Emergency spill containment and cleanup contingencies would also be included in the transportation plan to address material spills.

4.6.2 Implementability

4.6.2.1 Technical and Administrative Feasibility

Alternative 4 is technically feasible and would not require unconventional techniques, materials or highly specialized labor for the work activities. The materials, equipment and labor are commercially available. However, the labor force will require training and certification for environmental work. Due to the magnitude of the volume to be excavated and handled, volume of materials needed to be imported to the site, and distances for the disposal of regulated substances, the field activities are assumed to extend over four years.

Conventional earthwork equipment would be used during the scheduled activities. Excavations would be scheduled and performed in a manner to minimize multiple handling of material where possible and ensure worker and public safety.

The site is readily accessible. Roadway improvements will be made to optimize access of equipment, materials and labor. Storm and surface water control and improvements will be

developed under BMPs in preparation for the removal action. "Winterization" elements in the stormwater control plans will help secure the site during extreme storm events, providing institutional controls to protect human health and wildlife.

Alternative 4 is administratively feasible. Construction of an on-site repository will not require special permitting because mine wastes are considered low-level radioactive materials.

4.6.2.2 Availability of Services and Materials

The excavation of contaminated material would be accomplished using a variety of conventional equipment. Conventional earthwork equipment needed for this project (scrapers, excavators, dozers, loaders, compactors, and/or bulk carriers) is commercially available. On site and/or adjacent site wells are available and readily accessible for construction water supplies. Working space is available for establishing temporary construction office trailers. Utilities (power, water, and telephone services) are available from the local grid or are already on site. Construction materials for the capped repository and an off-site laboratory for sample analysis are commercially available.

Trained and experienced labor is commercially and locally available for job site activities. Special certifications and training are commercially available. OSHA, radiation, and hazardous material handling requirements would be met by appropriate safety training before mobilizing or on site during the construction season. The Navajo Nation will provide cultural resource liaison.

4.6.2.3 State and Community Acceptance

Because Alternative 4 contemplates on-site disposal of wastes, EPA understands that Alternative 4 would not be acceptable to the Navajo Nation and the local community. See Section 4.5.2.3, State and Community Acceptance of Alternative 3, for further discussion.

The State, Tribal and Community Acceptance criteria will be further considered following the public comment period. Potential impacts to the community during implementation of Alternative 4 include inconvenience from noise and dust from truck traffic and heavy equipment operation, and restriction of NECR mine site land from grazing and other activities for a period of time after the removal action ceases.

4.6.3 Cost

The cost estimate prepared for Alternative 4 is included in Appendix B. The construction cost for Alternative 4 is estimated to be $32,000,000. The cost for Alternative 4A is: $34,700,000 and for Alternative 4B: $32,800,000.

4.6.4 Alternative 4 Options

Both Alternatives 4A and 4B are feasible and acceptable in terms of effectiveness, implementability, and cost, but are opposed by the Navajo Nation and the local community for

the same reasons that they oppose Alternative 4. The removal action proposed in Alternative 4 is enhanced in effectiveness by removing the highest concentration material to an off-site controlled disposal facility. The disadvantage is additional costs for materials management, transportation, and for 4A disposal fees. For 4B, the existing tailings cell at the UNC mill facility will need to be modified for the principal threat waste disposal.

4.7 ALTERNATIVE 5 ANALYSIS

Implementation of Alternative 5, consolidation of NECR waste in a disposal cell on the UNC mill facility, would require the following steps (also refer to Section 3.6).

- Excavation and transport of all wastes;
- Design, siting and consolidation in an existing disposal cell on the UNC mill site, or construction of a new repository on the UNC mill site;
- Site restoration with erosion and stormwater controls, regrading and revegetation; and
- Long-term maintenance for capped repository.

4.7.1 Effectiveness

4.7.1.1 Protection of Human Health and the Environment

Alternative 5 will protect human health and the environment as all wastes exceeding the Proposed Action Level would be placed in an existing cell or in an above-ground repository at the UNC mill facility. These activities will prevent direct contact between wastes and humans and the environment in the future. A liner would be installed to prevent leakage out of the cell/repository, thereby providing long-term protection of groundwater quality at the UNC mill facility. Proper construction and design of the cap will include approval by U.S. EPA, and the NRC if NECR waste is consolidated into the existing cell, and will comply with associated standards for airborne radon gas emissions, protecting human health and the environment. Lining and properly siting the repository will isolate the contaminants protecting humans and groundwater resources.

4.7.1.2 Compliance with ARARs

Alternative 5 is expected to comply with chemical, location and action specific ARARs identified in Appendix A.

This removal action alternative would be implemented in accordance with chemical-specific ARARs. Mine wastes to be capped in the repository on the UNC mill facility would comply with approved clean-up goals. The repository design would include a liner system and cap to fully contain and isolate mine wastes exceeding the Action Level. Stormwater controls will be included in the design so that surface water would be diverted from the area. The cap is a physical barrier that also offers protection from water infiltration to the mine wastes and

provides adequate shielding from ionizing radiation to protect human health and the environment.

The activities set forth for the removal action would provide compliance with location-specific ARARs. An environmental protection plan will be developed for monitoring protocols during the work activities and will include a review and evaluation of potential impacts to historic properties and locations. Natural resource (e.g., biological and botanical) inspections have been conducted at the site and information from these inspections will be included in the environmental protection plan. Environmental protection would include a review and evaluation of potential impacts on government protected species and critical habitats.

The removal action would provide compliance with action-specific ARARs. These include Federal and State hazardous waste management regulations, to the extent applicable; DOE standards for protection of workers, the public, and environment from low-level radioactivity; and Federal and Navajo Nation rules and regulations pertaining to air quality management and fugitive dust emission control the on-site accumulation of stockpiled wastes, protection and monitoring of groundwater, and the control of stormwater discharges during construction activities. Implementation of Alternative 5 would be in compliance with action specific ARARs, following DOT regulations for transport of hazardous materials, and complying with Federal requirements for hazardous waste disposal.

4.7.1.3 Long-Term Compliance

The long-term effectiveness of Alternative 5 is dependent on the future maintenance activities. The cap and liner would provide long-term protection of groundwater quality at the UNC mill facility. EPA's intent is to oversee construction and transfer to NRC & DOE of the PRP-lead removal action. If the NECR wastes are consolidated, the operation and maintenance of the existing NRC cells, on the UNC Mill site will be turned over to the DOE under their long-term stewardship program upon completion of the NRC license. If because of siting criteria, NRC and DOE decline to accept the new repository, UNC would provide PRSC and EPA would retain oversight responsibility of the new repository. If properly maintained the cap, repository, and diversion structures will minimize water infiltration and the cap will prohibit human or animal disturbance to the wastes. The potential for long-term effectiveness of the cap will be enhanced by expected long-term fencing and monitoring of the mill facility, including the expected prohibition of grazing.

4.7.1.4 Reduction of Toxicity, Mobility, and Volume

Alternative 5 would reduce the mobility of contaminants to the air, surface water, and groundwater at the NECR mine site by physically isolating the wastes in a cell at the UNC mill facility. The toxicity and volume would not be changed.

4.7.1.5 Short-Term Compliance

The primary criterion for short-term compliance is to protect the community, workers, and environment from impacts during work activities at the sites. Field activities are anticipated to extend over four construction seasons (April through September).

Alternative 5 involves the construction activities primarily including demolition/disposal of existing foundations, excavation, material transfer, stockpile development/management, loading of bulk carriers, backfill and grading, and the capped and lined repository construction. Potential exposure and protection procedures for workers engaged in these activities would be addressed in detail under the SSHP. Heavy equipment would be used to clear and grub, excavate, transfer, load, grade and construct the repository. During these activities measures will be taken to reduce fugitive dust emissions and associated impacts to workers. Water would be available for dust control and workers in the controlled area will don the appropriate safety equipment and implement safety practices. Work areas would be secured, marked or otherwise controlled to limit access to authorized personnel only.

Bulk carriers hauling wastes off site would be securely covered and weighed to document compliance with total and axle load limits. Bulk carriers traveling on site may operate with uncovered beds but will exercise dust control during transfer operations. Truck traffic would be coordinated under a transportation plan for routes, times of operation, and on-site traffic rules. The traffic plan will include an evaluation to use routes on private property for hauling, in lieu of public roads. Emergency spill containment and cleanup contingencies would also be included in the transportation plan to address material spills.

4.7.2 Implementability

4.7.2.1 Technical and Administrative Feasibility

Alternative 5 is technically feasible and would not require unconventional techniques, materials or highly specialized labor for the work activities. The materials, equipment and labor are commercially available. However, the labor force will require training and certification for environmental work. Due to the magnitude of the volume to be excavated and handled and the volume of materials needed to be imported to the site the field activities may extend over four construction seasons.

Conventional earthwork equipment would be used during the scheduled activities. Excavations would be scheduled and performed in a manner to minimize multiple handling of material where possible and ensure worker and public safety.

The site is readily accessible. Roadway improvements will be made to optimize access of equipment, materials and labor. Storm and surface water control and improvements will be developed under BMPs in preparation for the removal action. “Winterization” elements in the stormwater control plans will help secure the site during extreme storm events, providing institutional controls to protect human health and wildlife as well as the cell integrity.

Alternative 5 is administratively feasible; and it will require additional coordination among UNC, NRC, U.S. EPA Region 9, U.S. EPA Region 6, and the State of New Mexico. The current UNC license might need to be amended. A design-ready plan would need to be submitted to the NRC for approval before the license could be amended.

4.7.2.2 Availability of Services and Materials

The excavation of contaminated material would be accomplished using a variety of conventional equipment including scrapers, excavators, dozers, loaders, compactors, and bulk carriers. On site and/or adjacent site wells are available and readily accessible for construction water. Working space is available for establishing temporary construction office trailers. Utilities (power, water, telephone services) are available from the local grid or are already on site. Portable sanitary services and refuse disposal are locally available. Construction materials for the capped, lined repository and an off-site laboratory for sample analysis are all commercially available.

Trained and experienced labor is available for site work activities. Special certifications and training requirements are commercially available. Health and safety training to comply with OSHA including radiation and hazardous material handling training is available. The Navajo Nation will provide cultural resource liaison.

4.7.2.3 State and Community Acceptance

Alternative 5 contemplates disposal of all wastes outside the reservation and off Navajo tribal trust land. For this reason, Alternative 5 may be acceptable to the Navajo Nation and the local community.

The State, Tribal and Community Acceptance criteria will be considered following the public comment period. Potential impacts to the community include inconvenience from noise and dust from truck traffic and heavy equipment operation.

4.7.3 Cost

The cost estimate prepared for Alternative 5 is included in Appendix B. The total cost for Alternative 5 is estimated to be $41,600,000. The cost for Alternative 5A is: $44,300,000.

5.0 COMPARATIVE ANALYSIS OF REMOVAL ACTION ALTERNATIVES

This section of the EE/CA provides a comparison of the five removal action alternatives described in Section 4. A summary of this comparative analysis is provided in Table 5.1.

5.1 EFFECTIVENESS

5.1.1 Overall Protection of Human Health and the Environment

The alternatives offer similar levels of protection of human health and the environment with the exception of Alternative 1 and some differences listed below. Alternative 1 does not offer protection, since under this alternative there would be No Action taken to remove or decrease the contaminants on site.

- Alternative 1: No action is not protective to human health and the environment.
- Alternative 2: Off-site transport and disposal is protective to human health and the environment and is considered a permanent solution, since it removes all wastes from the NECR mine site.
- Alternative 3: Capping of mine wastes in situ (where applicable), or consolidating the wastes and capping them is effective for protecting human health and the environment.
- Alternatives 3A and 3B would increase the protectiveness of Alternative 3 by moving some wastes from the site (principal threat wastes) and thereby reducing the average concentration of materials left on the site.
- Alternative 4: As with Alternative 3 (consolidate and cap), with appropriate design and O&M the repository will remain protective of human health and the environment. A greater degree of protection for groundwater underlying the site is provided by the liner.
- Alternatives 4A and 4B would increase the protectiveness of Alternative 4 by moving some wastes from the site (principal threat wastes) and thereby reducing the average concentration of materials left on the site.
- Alternative 5 would consolidate the NECR waste into an existing cell on the UNC mill facility to assure that the O&M essential to sustain the high level of protection to human health and the environment is continued.
- Alternative 5A would increase protectiveness of Alternative 5 by moving some wastes from the UNC mill facility (principal threat waste) and thereby reducing the average concentration of material left there.

5.1.2 Compliance with ARARs and Other Criteria, Advisories, and Guidance

Except for Alternative 1, each alternative evaluated in this EE/CA will be designed and implemented to comply with the identified ARARs to the extent practicable. Some key areas of ARAR compliance are reviewed below.

5.1.2.1 Water Resources

Currently surface water resources are not protected and would continue to be unprotected under Alternative 1, No Action. All other alternatives would comply with chemical-specific ARARs to protect surface water resources by either eliminating all of the mine wastes (in Alternative 2), eliminating part of the mine wastes (principal threat wastes) in Alternatives 3A/B, 4A/B and 5A, or isolating wastes from the environment as in Alternatives 3, 4 and 5.

5.1.2.2 Cultural Resources

In Alternative 1, cultural resources will not be disturbed, since no action will occur on the site. For Alternatives 2 through 5, during construction activities existing cultural resources will be protected to meet location-specific ARARs. This includes during excavation, siting of the covered areas, utilizing an on-site borrow pit, siting of the capped repository on the NECR mine site and the UNC mill facility, and subsequent site restoration.

5.1.2.3 Air Resources

In Alternative 1 radon emissions would be emitting into the surrounding air and would be carried by the wind to potential human or animal exposure pathways. Thus, this alternative would not meet chemical-specific ARARs. Removal off site of all of the wastes in Alternative 2 to a regulated and maintained disposal facility will alleviate radon emissions. Placing the wastes underneath a cap (Alternative 3) or in a capped repository (Alternative 4 and 5) will also eliminate radon emissions, if properly maintained in the long term.

5.1.3 Long-Term Effectiveness and Permanence

Implementing any of the evaluated alternatives except for Alternative 1 will provide a long term solution. Alternative 2 removes all of the mine wastes from the site. Alternatives 3, 4, and 5 will require long-term maintenance to maintain their long-term effectiveness. Options 3A/B, 4A/B and 5A remove the principal threat wastes from the site when appropriate. Required maintenance activities would apply for erosion and stormwater controls for all alternatives, and cap maintenance and monitoring for Alternative 3, and repository and cap maintenance and monitoring for Alternatives 4 and 5.

5.1.4 Reduction in Toxicity, Mobility, or Volume

In Alternatives 2 and 5, all waste will be removed from the NECR mine site, thereby reducing the volume, toxicity and mobility of the waste. In Alternatives 3 and 4, the waste remains on-site, but the mobility is reduced due to the capping. Alternative 4 has the additional feature of a

liner which further reduces potential mobility to groundwater. In Options 3A/B and 4A/B part of the waste will be removed from the site.

5.1.5 Short-term Effectiveness

Short-term effectiveness includes an assessment of the time period until the removal action goals are met. Short-term effectiveness also considers the magnitude of potential threats to the community, site workers, and the environment during implementation of the removal action. This includes threats that result from implementing the remedy itself, as well as existing threats that persist until mitigated by the removal action.

5.1.5.1 Time Period to Achieve Removal Action Goal

Alternatives 2, 3, 4, and 5 and Options 3A/B, 4A/B and 5A offer short-term effectiveness in terms of an immediate substantial or complete reduction of contaminants upon implementation of the removal action. The removal action and construction time period for each removal alternative is anticipated to be as follows: three years for Alternative 3; four years for Alternatives 4 and 5; and nine years for Alternative 2. The driving force in estimating the length of implementation is the estimated number of truckloads, the number of trucks potentially available, and the driving distance to disposal. These time periods do not include initial up front time required for procurement of the work, plans and design of the erosion and stormwater control systems, the cap, and capped repository alternatives. It is also expected that the coordination necessary to amend the current permit at the UNC mill impoundment facility will take additional time for Alternative 5 and Options 3B and 4B.

5.1.5.2 On-Site Worker Exposure and Safety Risks

Alternatives 2, 3, 4, and 5 involve substantial construction-related activity and truck traffic that would result in an increase of noise and dust to local residents. Construction-related activities include excavation, stockpiling of wastes, off-site and on-site truck hauling and site restoration. This activity may result in some inconvenience and directly impact the local residents for the period of activity. Road weight limits, waste stockpile strategies, and the length of the construction season will affect truck traffic volume. Mitigation efforts would include securing the loads with covers, using water for dust suppression.

More community impact in regards to off-site truck traffic will occur for Alternative 2 and Alternative 5.

5.2 IMPLEMENTABILITY

5.2.1 Technical Feasibility

All five alternatives are technically feasible. There are proven technologies and methods for cover, cap and lined repository construction. Therefore, technical feasibility is not a strong distinguisher between the alternatives.

5.2.2 Administrative Feasibility

All five alternatives and options are administratively feasible. Coordination with appropriate state and local agencies will be required to implement any of the alternatives.

For Alternative 5 there are potentially significant administrative hurdles to negotiate among a number of stakeholders. The administrative hurdles include the following:

- An expanded cell compliant with NRC regulations would need to be constructed on the UNC mill facility. Pre-design data acquisition and an engineering design and construction plan would be required. The NRC license for the UNC facility might need to be revised for the expanded storage facility.
- The DOE would need to accept the expansion of the storage facility at the UNC mill facility because it is the agency responsible for long-term maintenance of the facility.
- A new repository on the UNC Mill site separate from the existing cells will not require as much administrative coordination with NRC or DOE. According to NRC, DOE would not be required to be involved. UNC can request, and NRC can grant, removal from the license of a portion of the site that has been remediated to standards for release. Once released from the license, EPA can implement a CERCLA remedy without NRC or DOE involvement.

5.2.3 Availability of Services and Materials

Materials and services are not needed for Alternative 1. For all other alternatives materials and services are mostly commercially available and the site is readily accessible. For Alternative 2, Alternative 3A and Alternative 4A, off-site disposal facilities are available to handle the mine wastes.

5.2.4 State and Community Acceptance

EPA believes that Alternative 2, disposal of all wastes at an off-site TSDF, has the highest likelihood of acceptance by the Navajo Nation and the local community, although the long implementation period and high traffic volume on local highways may reduce community acceptance. EPA believes that Alternative 5, disposal of wastes at the UNC mill facility, may receive acceptance from the Navajo Nation and the community because it requires removal of all wastes from the reservation and tribal trust land, is implementable more quickly, and will have significantly lower traffic impacts than Alternative 2. Alternatives 1, 3 and 4 are unlikely to be accepted by the Navajo Nation and the community because they contemplate leaving waste on tribal trust land. State, Tribal and community acceptance will be further addressed through the public comment process.

5.3 COSTS OF RESPONSE ALTERNATIVES

The estimated total costs with contingency, to complete each of the response alternatives are summarized in Table 5.2. The total costs include only the capital costs for each alternative; the basis-of-estimate cost sheets in Appendix B provide operations and maintenance costs for Alternatives 2 through 5. The total costs for Alternative 2 ($293.6 million) are the highest because all the waste is transported under multi-state and federal DOT rules across a relatively greater distance to an existing off-site licensed controlled disposal facility. The costs for Alternatives 4A ($34.7 million) and 3A ($28.5 million) are also relatively high in most part because of the transportation costs to meet state and federal DOT rules for off-site transportation of the principal threat materials. The costs for Alternatives 2 and 5, and Alternatives 3A/3B and 4A/4B are also subject to substantial fluctuations based on the dynamic impacts of the contemporary changes in fuel cost, and transportation labor market rates. Estimated costs for Alternative 3 ($25.8 million) are less because final disposition will be at the NECR mine site. Alternative 3 is estimated to be the least costly of the three engineered alternatives due to no bottom liner, and an optimized excavation and material handling effort.

5.4 DIFFERENTIATORS AMONG ALTERNATIVES

In summary, the alternatives that have been described and evaluated in this EE/CA are very similar when evaluated against most of the evaluation criteria with some notable exceptions.

Alternative 1, No Action, offers no protection to human health and the environment, as it does not remove the source of the mine wastes.

Alternative 2, Excavation and disposal of all mine wastes off-site calls for a long construction period due to trucking capacity for the long haul to a TSDF facility and the Site. The availability of licensed low-level radiation material haulers is more finite than transportation resources for non-low-level radiation material and the number of truck-trips necessary to travel to a licensed low level radioactive waste disposal facility is very high. The time needed for each round-trip is 2-3 days; consequently the number of specialized transporting resources is also very high. Securing adequate trucking resources for nine work seasons will be a challenge. With a long lead-time for procurement and strong commitment to continued hauling, the resources may be secured; however, delays to excavation and loading may jeopardize the availability or commitment by the transporters. This alternative would incur more logistical difficulty, has a greater potential of transport incidents on the public ways and poses undue hazards to human health and the environment based on estimated trucking emissions, as shown on Table 5.3. With the large number of transport miles and possibility of transport incident the alternative presents a higher risk to the general public. Based on these factors Alternative 2 presents the highest risk.

Alternative 3, Consolidation of mine wastes with cover on the NECR mine site, requires the least amount of excavation and handling of mine wastes of the five alternatives. The excavated mine wastes would be consolidated with the impacted materials at Ponds 1 and 2 covered. Of

the three alternatives (Alternative 3, 4, and 5), Alternate 3 requires least amount of backfill material for the cover and drainage controls, and is the least costly of the three engineered removal actions. It relies solely on the cap and stormwater management for protection of groundwater, as there is no liner beneath the consolidated material. However, Alternative 3 is likely not acceptable to the Navajo Nation and the local community.

Alternative 3A, Consolidation and covering with off site disposal of principal threat material at a licensed controlled disposal facility, requires a slightly more aggressive schedule than Alternative 3 and carries higher risk as described in Alternative 2, due to more truck trips. This alternative, as compared to Alternative 3, offers more long-term effectiveness by reducing the average concentration of the material left on-site.

Alternative 3B, Consolidation and covering with off site disposal at the UNC mill facility, carries a lower risk in terms of transportation of the principal threat material due to a shorter distance of travel from the NECR mine site to the UNC mill facility.

Alternative 4, Construction of NECR mine site above-ground, capped and lined repository, requires the construction of a repository on the NECR mine site. This activity includes the excavation and handling of all materials, installation of a liner beneath all wastes, and requires more equipment and labor to consolidate the mine wastes than Alternative 3. Alternative 4 also requires more backfill material than Alternative 3 for the liner, cap and drainage controls. Alternative 4 offers more groundwater protection than Alternative 3 due to the bottom liner. However, Alternative 4 is likely not acceptable to the Navajo Nation and the local community.

Alternative 4A, Construction of repository with off site disposal of principal threat material at a licensed controlled disposal facility, requires a more slightly aggressive schedule than Alternative 4 and carries higher risk as described in Alternative 2, due to the more truck trips. This alternative, as compared to Alternative 3, offers more long-term effectiveness by reducing the average concentration of the material left on-site.

Alternative 4B, Construction of repository with off site disposal at the UNC mill facility, carries a lower risk in terms of transportation of the principal threat material due to a shorter distance of travel from the NECR mine site to the UNC mill facility. This alternative provides a relatively high level of protectiveness at a cost that is only moderately greater than Alternative 4.

Alternative 5, Consolidation of the NECR waste into the existing cells on the UNC mill facility, requires modification of the existing cell and approval from NRC. All construction elements were assumed to be the same as for Alternative 4 and the same excavation and site restoration considerations as for Alternative 2. This removal action requires more equipment and labor as compared to both Alternatives 3 and 4 because of the transport to the off-site location. This alternative has fewer off-site trucking miles and is therefore significantly less damaging to the environment than Alternative 2 based on CO, NOX and VOC emissions estimates, as shown on Table 5.3. EPA expects that Alternative 5 will be more acceptable to the Navajo Nation and the local community than Alternatives 1, 3, and 4, and may be as acceptable as Alternative 2 after

consideration of significantly reduced construction time (4 years versus 9 years) and accompanying reduction in traffic and air impacts.

Alternative 5A, Consolidation at UNC Mill site with off site disposal of principal threat material at a licensed controlled disposal facility, requires a slightly more aggressive schedule than Alternative 3 and carries higher risk as described in Alternative 2, due to the longer and increased number of truck trips. This alternative, as compared to Alternative 3, offers more long-term effectiveness by reducing the average concentration of the material left on-site.

6.0 RECOMMENDATIONS

Cleanup levels are based primarily on radiological Preliminary Remediation Goals and Federal ARARS which specify media concentrations or risk levels to be met unless natural background levels are higher. The UMTRCA standard for radon flux is also an Applicable and/or Relevant and Appropriate Requirement (ARAR).

The main objective of this removal action is to mitigate risks posed to human health and the environment by on-site contamination and to restore the land for use by nearby residents and the Navajo Nation. Characterization of the Site identified the primary environmental concern to be radiological contamination. The presence of Radium and Uranium could pose a risk to the air quality by emitting radon, alpha, beta and gamma radiation. Persons traversing the Site may be exposed to contaminated dust by inhalation or ingestion of contamination adsorbed to particulate matter. Incidences of direct contact with natural and mechanically generated dust during these activities account for known contamination exposure scenarios faced at the Site.

Radium is present in significantly elevated concentrations in soil and sediment according to the NECR Removal Site Evaluation (RSE) Report. Because the contaminants have been transported via wind and water processes to areas around or adjacent to the site, humans, plants and animals may experience exposures through the food chain, air or surface or groundwater.

PROPOSED ACTION LEVEL

The Proposed Action Level for Ra-226 is 2.24 pCi/g (1.24 pCi/g above the mean of the Ra-226 background concentration 1.0 pCi/g) and corresponds to an acceptable risk range of 2×10^{-4} for residential scenarios. This risk-based Action Level is proposed for the following reasons:

It is within the risk range cited in the NCP (300.430(e) (2)(I);

It is distinguishable from background and therefore measurable in the field; and

It is above the analytical detection limit.

EPA manages risk to achieve 10^{-6} to 10^{-4} overall risk, therefore the Removal Action Objective (RAO) is health protective, detectable, and distinguishable from background.

Ra-226 and Uranium are co-located. In using the Ra-226 RAO, we will capture contamination associated with Uranium to below its Preliminary Remediation Goal (PRG). Other stable metals associated with the mineral belt, such as Arsenic, Molybdenum, Selenium and Vanadium, 1) are below their respective PRGs; and 2) appear to be within the range observed in the background area and do not appear to be associated with mining operations. Confirmation sampling will be conducted to verify protectiveness.

Although the area exceeding the Proposed Action Level is reasonably well defined (Figures 1.3 and 1.4), there is insufficient data to confidently define the depth of contamination. Therefore,

for the purposes of this EE/CA, a reasonably conservative estimate of the total area and depth to be addressed was estimated to be 871,000 c.y.

PREFERRED ALTERNATIVE

EPA's Preferred Alternative is Alternative 5A. The primary elements of the Preferred Alternative include:

- Excavation and transport of all mine waste soil with radium above 2.24 pCi/g (10-4), except in the ponds, where we would excavate to a maximum depth of 10 feet;

- The waste to be consolidated includes ore and protore, waste rock, building foundations and adjacent soil, and contaminated sediment;

- Consolidation of the mine wastes with a cap and liner in an existing disposal cell on the UNC mill site, or construction of a new cell at the UNC mill facility currently under license by the U.S. Nuclear Regulatory Commission (NRC);

- Principal threat mine wastes taken to an off-site licensed controlled disposal facility, such as at Grandview, ID, or an alternative appropriate facility. For waste with total Uranium concentrations exceeding 500 mg/kg, it may be viable to reprocess the waste at the White Mesa Mill in Utah or a similar mill;

- Site restoration with erosion and stormwater controls, regrading and revegetation for future grazing; and

- Long-term maintenance for capped repository, which would occupy an estimated 30 acres and would become part of DOE's legacy management program in perpetuity.

- If an agreeable design cannot be completed due to administrative or technical issues, then the NECR wastes could be placed in a new, separate repository on the UNC Mill Site. This would require a release of property currently under NRC oversight. In this case, the PRSC responsibility of a new repository would remain with EPA.

The largest costs are capital costs associated with consolidating and transporting the mine wastes and construction of the protective cover and liner.

It is estimated that up to four years could be required for remedy construction. Removal Action Objectives (RAOs) and cleanup levels for surface materials, air, radiation, and pit sediment would be achieved at the completion of remedy construction. A period of recovery would be needed to achieve vegetative Site restoration.

The cost estimate prepared for Alternative 5A is included in Table 5.2 and Appendix B. The total cost for Alternative 5A is estimated to be $44,300,000.

Alternative 5 would consolidate the NECR waste into an existing cell on the UNC mill facility to assure that the O&M essential to sustain the high level of protection to human health and the environment is continued. Alternative 5A would increase protectiveness of Alternative 5 by removing the principal threat waste, thereby reducing the average concentration of material left at the UNC Mill Facility. This alternative has fewer off-site trucking miles and is therefore significantly less damaging to the environment than Alternative 2 based on CO, NOX and VOC emissions estimates, as shown on Table 5.3. EPA expects that Alternative 5 will be more acceptable to the Navajo Nation and the local community than Alternatives 1, 3, and 4, and may be as acceptable as Alternative 2 after consideration of significantly reduced construction time (4 years versus 9 years) and accompanying reduction in traffic and air impacts.

7.0 REFERENCES

Congressional Research Service (CRS) 2006. *Radioactive Waste Streams: Waste Classification for Disposal*. CRS Report for Congress. RL32163. Updated December 13.

Ecology and Environment, Inc. 2007. NECR Home Site Investigation Trip Report. September 11, 2007.

Church Rock Chapter Census Data. 2004. Accessed from the internet at: http://churchrock.nndes.org/cms/kunde/rts/churchrocknndesorg/docs/429390660-09-28-2004-10-58-27k.pdf Accessed December 2008.

IAEA 2004. The Long Term Stabilization of Uranium Mine Tailings, IAEA TECDOC 1403, August 2004.

MWH 2003. Site Assessment Report. Prepared for UNC, July 2003.

MWH 2004. NECR Closeout Plan. Prepared for UNC, January 2004.

MWH 2006. Final Removal Site Evaluation Work Plan, NECR. Prepared for UNC. August 30, 2006.

MWH 2007. Final Removal Site Evaluation Report Northeast Church Rock Mine Site. Prepared for UNC. October l, 2007.

MWH 2009. Supplemental Removal Site Evaluation data tables. April 2008

Navajo Nation Department of Justice (NNDOJ) 2008. Correspondence to the U.S. EPA Region, December 12, 2008,

Natural Resource Conservation Service 2003. User's Guide Revised Universal Soil Loss Equation (RUSLE2) Version 2.U.S. Department of Agriculture, Agricultural Research Service, Washington, D.C.

Norman, David K., and Raforth, Robert L. 1998. *Innovations and Trends in Reclamation of Metal-Mine Tailings in Washington. Washington Geology*. 26(2/3):29-41.

State of New Mexico 2007. Correspondence to the U.S. EPA Region 9.

U.S. Department of Energy (DOE). *Summary Data on the Radioactive Waste, Spent Nuclear Fuel, and Contaminated Media Managed by the U.S. Department of Energy, Chapter 9, 11e(2) Byproduct Material.* Accessed from the internet at: http://cid.em.doe.gov/Modules/Reporting/Summary/CH9.pdf.

U. S. Environmental Protection Agency (U.S. EPA) 1984. EPA Policy for the Administration of Environmental Programs on Indian Reservations. Accessed from the internet at: http://www.epa.gov/tribalportal/pdf/indian-policy-84.pdf

U.S. EPA 1993. *Guidance on Conducting Non-Time-Critical Removal Actions Under CERCLA.* Office of Solid Waste and Emergency Response, Washington, D.C. EPA540-R-93-057.

U.S. EPA 1995. *Technical Resource Document, Extraction and Beneficiation of Ores and Minerals, Volume 5 – Uranium*. January 1995.

U.S. EPA 1997a. OSWER No. 9200.4-23, August 22, 1997, "Clarification of the Role of Applicable, or Relevant and Appropriate Requirements in Establishing Preliminary Remediation Goals under CERCLA"

U.S. EPA 1997b. OSWER No. 9200.4-18, August 22, 1997, Establishment of Cleanup Levels for CERCLA Sites with Radioactive Contamination.

U.S. EPA 2000a. *Guide to Field Storage of Biosolids, U.S. EPA Office of Wastewater Management*, EPA/832-B-00-007.

U.S. EPA 2000b. *Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)*. EPA 402-R-97-016, Rev. 1.

U.S. EPA 2007a. Pollution Reports (POLREP) for Time Critical Removal Action at NECR Residential 1 and 2. Six POLREPs dated from 5/1/07 through 6/13/07.

U.S. EPA 2008a. Technology Transfer Network Air Toxics Web Site. Accessed from the internet at: www.epa.gov

U.S. EPA 2008b. Fremont National Forest Uranium Mines (USDA) NPL Site Cleanup webpage, Accessed from the internet at: http://yosemite.epa.gov/r10/cleanup.nsf/d67b5aa82151d9ae88256da6005fb54e/8e2eef8a4cd8891b8825651a005885fa!OpenDocument

U.S. EPA 2008c. Midnite Mine NPL Site Cleanup webpage, Accessed from the internet at: http://yosemite.epa.gov/R10/CLEANUP.NSF/7d19cd587dff1eee8825685f007d56b7/25f296f579940d8b88256744000327a5!OpenDocument

U.S. Nuclear Regulatory Commission (NRC) 1989. Cleanup of Tailings at the Northeast Church Rock Mine. Memorandum dated October 31, 1989 for Docket No. 40-8907 from NRC Region IV, Uranium Recovery Field Office, Denver, Colorado.

NRC 2000. *Statement Submitted By The United States Nuclear Regulatory Commission to the Committee on Environment and Public Works, United States Senate, Concerning the Management and Disposal of Low Activity Radioactive Waste.* Presented by Carl J. Paperiello, Deputy Executive Director For Materials, Research And State Programs; Submitted: July 25, 2000.

NRC 2008a. UNC webpage, http://www.nrc.gov/info-finder/decommissioning/uranium/united-nuclear-corporation-unc-.html

NRC 2008b. Email correspondence from Myron Fliegel. April 28, 2008

Tables

Table 3.1 Estimated Volumes for Removal

North East Church Rock Areas	Estimated Area (sq ft)	Estimated Depth of Mine Wastes (feet)	Estimated Volume (cubic yards)	Estimated Mass[6] (tons)
NECR1 West	409,764			
NECR1 East	218,401			
Total NECR-1 Facility Boundary[1]	**628,165**	**10**	**232,654**	**337,348**
Trailer Park	355,516			
Fuel Storage Area	304,004			
Ion-Exchange Plant	54,894			
Sediment Pond	84,531			
NECR1 Stepout North	57,394			
NECR1 Stepout East	1,028,483			
Total NECR-1 Step-Out Area[1]	**1,884,822**	**1**	**75,995**	**110,193**
TOTAL NECR-1 (Facility + stepout areas)	***2,512,987***		***308,649***	***447,541***
Step-Out into Residential Area plus Red Water Pond Road[2]	***793,735***	*1*	***29,398***	***42,627***
Pond 3/3a	260,954	6	57,990	84,085
Pond 3 Stepout	587,696	1	21,767	31,561
TOTAL POND 3/3a [3]	***848,650***		***79,756***	***115,647***
Ponds 1 & 2	174,000	10	64,444	93,444
Ponds 1 & 2 Stepout	301,600	1	11,170	16,197
TOTAL POND 1 & 2 [4]	***475,600***		***75,615***	***109,641***
Arroyo from NECR-1 to discharge point	60,390	4	8,947	12,973
Arroyo from NEMSA to Sediment Pad	6,846	4	1,014	1,471
TOTAL ARROYO [5]	***67,236***		***9,961***	***14,443***
Sandfill 1	327,616	3	36,402	52,783
Sediment Pad	157,370	3	17,486	25,354
Sandfill 3	170,114	3	18,902	27,407
NECR-2	426,524	3	47,392	68,718
Sandfill 2	89,104	2	6,600	9,570
NEMSA	186,101	7	48,248	69,960
NEMSA Stepout	5,000	1	185	268
Boneyard	236,399	1	8,756	12,696
Former Magazine Area	72,119	2	5,342	7,746
Vent 8/3 (Combined Areas)	297,750	3	33,083	47,971
TOTAL ALL OTHER AREAS	***1,968,097***		***222,395***	***322,472***
TOTAL	**6,666,305**		**725,773**	**1,052,371**
TOTAL PLUS 20% CONTINGENCY[6]			**870,928**	**1,262,845**
TOTAL + CONTINGENCY ROUNDED			**871,000**	**1,263,000**

Notes:

1. NECR-1 facility boundary based on mining permit; UNC's step-out areas are based on gamma readings greater than the field-screening level (FSL) 2.24 piC/g
2. EPA assumed a Step-out area encompassing the off-site residential area (minus the areas cleaned up during the time-critical removal action) plus Red Water Pond Rd
3. Pond 3/3a consists of the middle, deeper part of the pond; Pond 3/3a stepout includes the pond side walls
4. Pond 1 & 2 consists of the middle, deeper parts of each pond; Pond 1 & 2 Stepout includes the pond side walls
5. Arroyo areas between the upgradient boundary of the Sediment Pad and the down-gradient boundary of NECR-1 Step-Out Area are incorporated into the other removal areas (Sediment Pad, Pond 3/3a, NECR-1 Step-out)
6. EPA assumes a 20% contingency to account for uncertainties in the data used to estimate the removal volume
7. Conversion of cubic yards to tons assumes a 1.45 multiplier

Table 5.1: Summary of Comparative Analysis of Removal Action Alternatives

Evaluation Criteria Summary	Alternative 1 No Action	Alternative 2 Excavation and Off Site Disposal of Wastes	Alternative 3 Consolidation and Covering of Wastes	Alternative 4 Construction of Lined/Capped Repository at NECR Mine Site	Alternative 5 Construction of Lined/Capped Repository at UNC Mill Facility
Effectiveness					
Protection of Human Health and the Environment	Waste remains exposed to humans, animals, and the environment.	Removal of source material leaves no waste exposed and no further maintenance is required.	Leaves no waste exposed. Long-term maintenance is required for the cover.	Leaves no waste exposed. Long-term maintenance is required for the cap and the repository.	Leaves no waste exposed. Long-term maintenance is required for the repository and the cap.
Compliance with ARARs	Chemical, action and location specific ARARs would not be met.	Chemical and action specific ARARs would be met. Cultural resources protected areas should be considered during excavation in order to meet location-specific ARARs.	Chemical and action specific ARARs would be met. Siting of covered areas needs to consider existing cultural resources to meet location-specific ARARs.	Chemical and action specific ARARs would be met. Siting of repository needs to consider existing cultural resources to meet location-specific ARARs.	Chemical and action specific ARARs would be met. Siting of repository needs to consider existing cultural resources to meet location-specific ARARs.
Long-Term Effectiveness	There is no long-term effectiveness with no action taken, thus allowing current waste to remain on-site.	Long-term effectiveness relies on compliance of off-site disposal facility with state/federal rules and regulations governing solid waste disposal and landfills.	Long-term effectiveness requires long-term maintenance and monitoring of cover and erosion and stormwater controls.	Long-term effectiveness requires long-term maintenance and monitoring of repository cap as well as erosion and stormwater controls.	Long-term effectiveness requires long-term maintenance and monitoring of repository cap as well as erosion and stormwater controls.
Reduction of Toxicity, Mobility, Volume	There will be no reduction of toxicity, mobility, or volume of wastes at the site under this alternative.	Toxicity, mobility and volume of wastes on the NECR mine site would be reduced by removing all wastes to an off-site location	Mobility of waste would be reduced by isolating the waste within a cover; volume would not be reduced except under Alternative 3A or 3B.	Waste would be isolated within a lined and capped repository reducing mobility. Volume would not be reduced except under Alternative 4A or 4B.	Waste would be isolated within a repository reducing mobility.

Table 5.1: Summary of Comparative Analysis of Removal Action Alternatives

Evaluation Criteria Summary	Alternative 1 No Action	Alternative 2 Excavation and Off Site Disposal of Wastes	Alternative 3 Consolidation and Covering of Wastes	Alternative 4 Construction of Lined/Capped Repository at NECR Mine Site	Alternative 5 Construction of Lined/Capped Repository at UNC Mill Facility
Short Term Effectiveness	This Alternative is not effective in the short term to reduce contamination nor does it offer protection to human health or the environment.	Benefits would be achieved relatively quickly without subjecting workers, the community, or the environment to unacceptable risk.	Benefits would be achieved relatively quickly without subjecting workers, the community, or the environment to unacceptable risk.	Benefits would be achieved relatively quickly without subjecting workers, the community, or the environment to unacceptable risk.	Benefits would be achieved relatively quickly without subjecting workers, the community, or the environment to unacceptable risk.
Implementability					
Technical and Administrative Feasibility, Availability of Services	Technically and administratively feasible. No services or materials are required.	Technically and administratively feasible. Services and materials are commercially available.	Technically and administratively feasible. Services and materials are commercially available.	Technically and administratively feasible. Services and materials are commercially available.	Technically and administratively feasible. Services and materials are commercially available.

Table 5.2 Summary of Removal Alternatives Estimated Costs

Alternative	Description	Estimated Construction Cost
2	All mine wastes taken to licensed disposal facility in Grandview, Idaho	$ 293,600,000
3	On-site Consolidate & Cover, no off-site disposal	$ 25,800,000
3A	On-site Consolidate & Cover, with principal threat waste (PTW) taken to Grandview, ID	$ 28,500,000
3B	On-site Consolidate & Cover, with PTW taken to UNC mill waste site for incorporation into existing containment	$ 26,700,000
4	On-site Lined and Capped Repository, no off-site disposal	$ 32,000,000
4A	On-site Lined & Capped Repository, with PTW taken to Grandview, ID	$ 34,700,000
4B	On-site Lined & Capped Repository, with PTW taken to UNC mill waste site for incorporation into existing containment	$ 32,800,000
5	All mine wastes take to UNC mill waste site and placed on Lined & Capped Repository there	$ 41,600,000
5A	All mine wastes take to UNC mill waste site and placed on Lined & Capped Repository there with PTW taken to Grandview, ID	$ 44,300,000

Table 5.3 Estimated Trucking Emissions

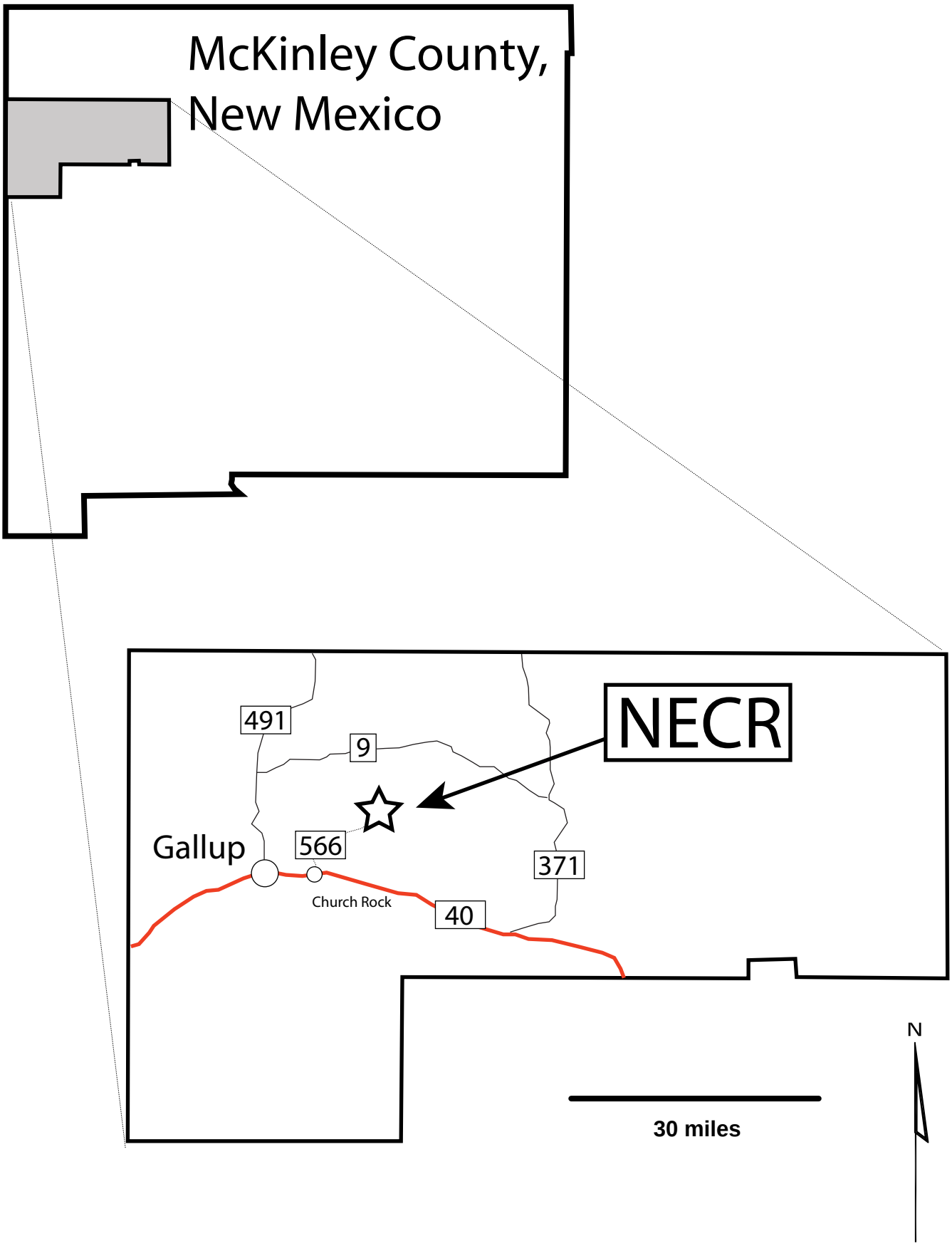
	Truckloads	Miles/Roundtrip	Nitrogen oxides (NOX): metric tons	Carbon monoxide (CO): metric tons	Volatile organic compounds (VOCs): metric tons
Alternative 1 - No Action	0	0	0	0	0
Alternative 2 Off-site Disposal	34840	1400	604	70	13
Alternative 3 - Consolidation & Capping	51660	1.0	0.6	0.1	0.0
Alternative 4 - On-site lined repository	58067	1.0	0.7	0.1	0.0
Alternative 5 - Consolidate at UNC Mill Site	58067	6.0	4.3	0.5	0.1

Table 5.4
NECR Action Levels

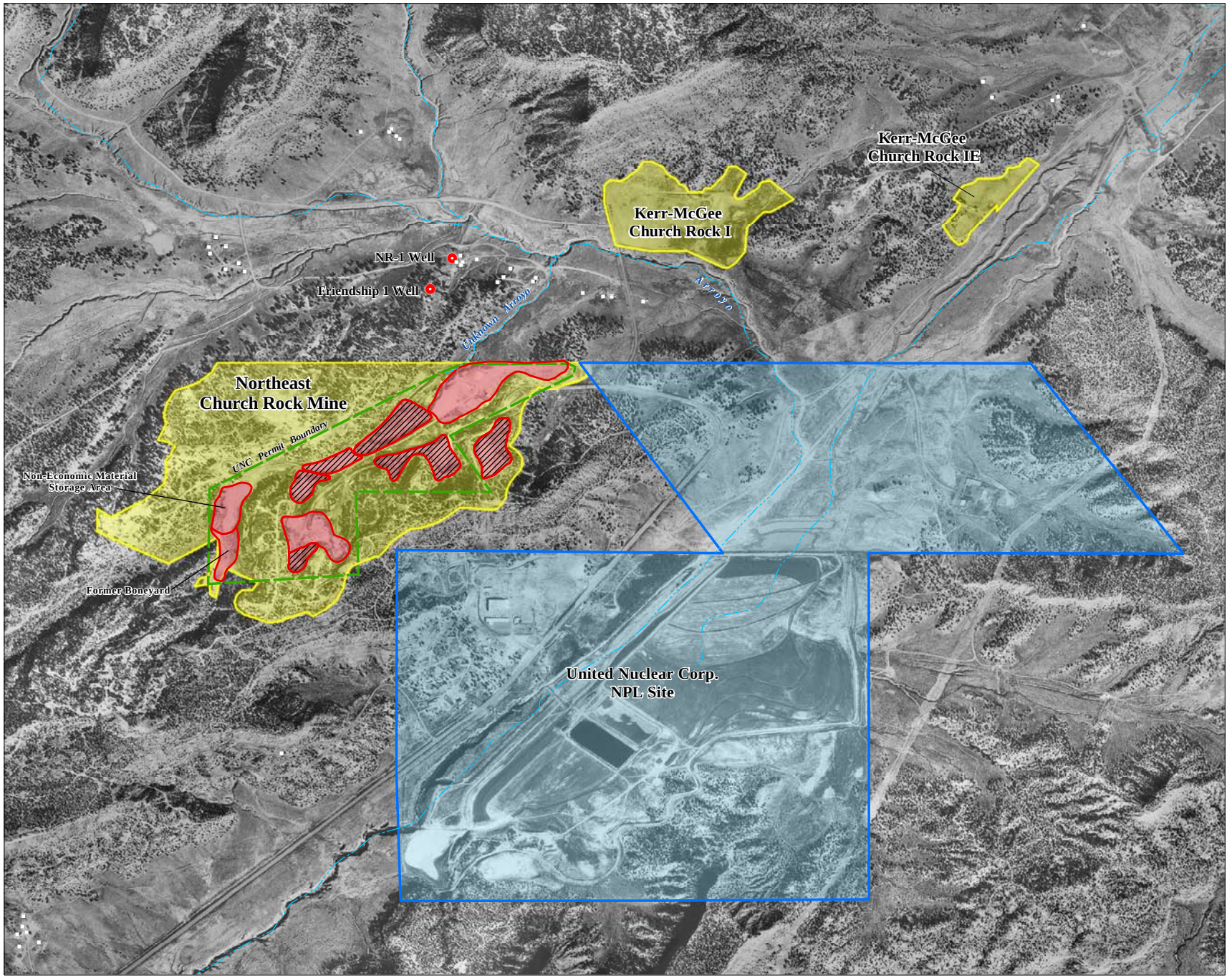
Contaminant of Concern	Residential	Industrial	Screening Level	Basis
Ra 226	1.24 pCi/g		2.24 pCi/g	10-4 risk + background
As	22 mg/kg nc, 0.39 mg/kg ca	1.6 ca mg/kg	22 mg/kg	PRG for non-cancer effects
Mo	390 nc mg/kg	5100 nc mg/kg	390 mg/kg	PRG
Se	390 mg/kg nc	5100 nc mg/kg	390 mg/kg	PRG
U	230 mg/kg nc	3100 nc mg/kg	230 mg/kg	PRG for non-cancer effects
V	390 mg/kg nc	5200 nc mg/kg	390 mg/kg	PRG

ca – cancer end point
nc- non cancer end point

Figures



VERIFY SCALES BAR IS ONE CM ON ORIGINAL DRAWING 0 —— 1 IF NOT ONE CM ON THIS SHEET, ADJUST SCALES ACCORDINGLY	DSGN DR CHK APVD		U.S. EPA REGION 9 NORTH EAST CHURCH ROCK MINE SITE, CHURCH ROCK, NEW MEXICO	FIGURE 1.1 NECR LOCATION MAP	DWG NO. SHEET XX DATE OCT. 2007 PROJ ID 2007062 FILE



Wells
AUM Sites
UNC Permit Boundary
Sandfills/Ponds
Areas of Surface Disturbances
Building Structures

0 0.125 0.25 0.5 0.75 1 Miles

Figure 1.2
NECR Mine Site Map and UNC Mill Facility

Sources:
Air Photo: USGS 1997 1:12000
UNC NPL Site: US EPA Region 6, 2003
UNC Permit Boundary: UNC, 2004
AUM Sites: UNC, 2004
Surface Disturbances: TerraSpectra Geomatics, 2008

EPA Region 9 GIS Center

SFD0501156.2 December 2008

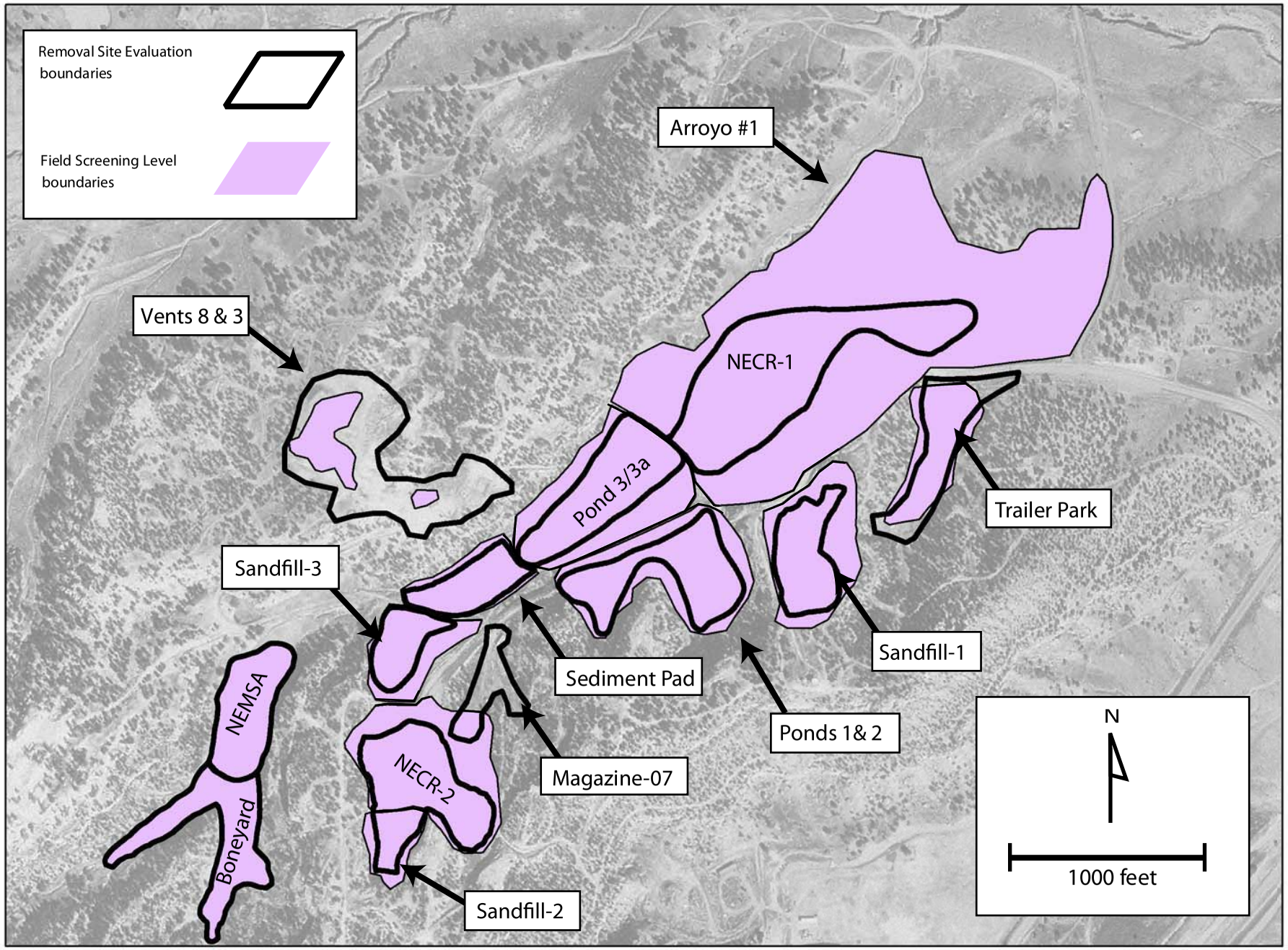


FIGURE 1.3
SITE MAP OF OVERLAPPED FSL AND RSE DATA SET BOUNDARIES

U.S. EPA REGION 9
NORTH EAST CHURCH ROCK MINE SITE,
CHURCH ROCK, NEW MEXICO

DWG NO. XX
SHEET
DATE OCT. 2007
PROJ ID 20070062
FILE

DSGN
DR
CHK
APVD

VERIFY SCALES
BAR IS ONE CM ON ORIGINAL DRAWING
0 1
IF NOT ONE CM ON THIS SHEET ADJUST SCALES ACCORDINGLY

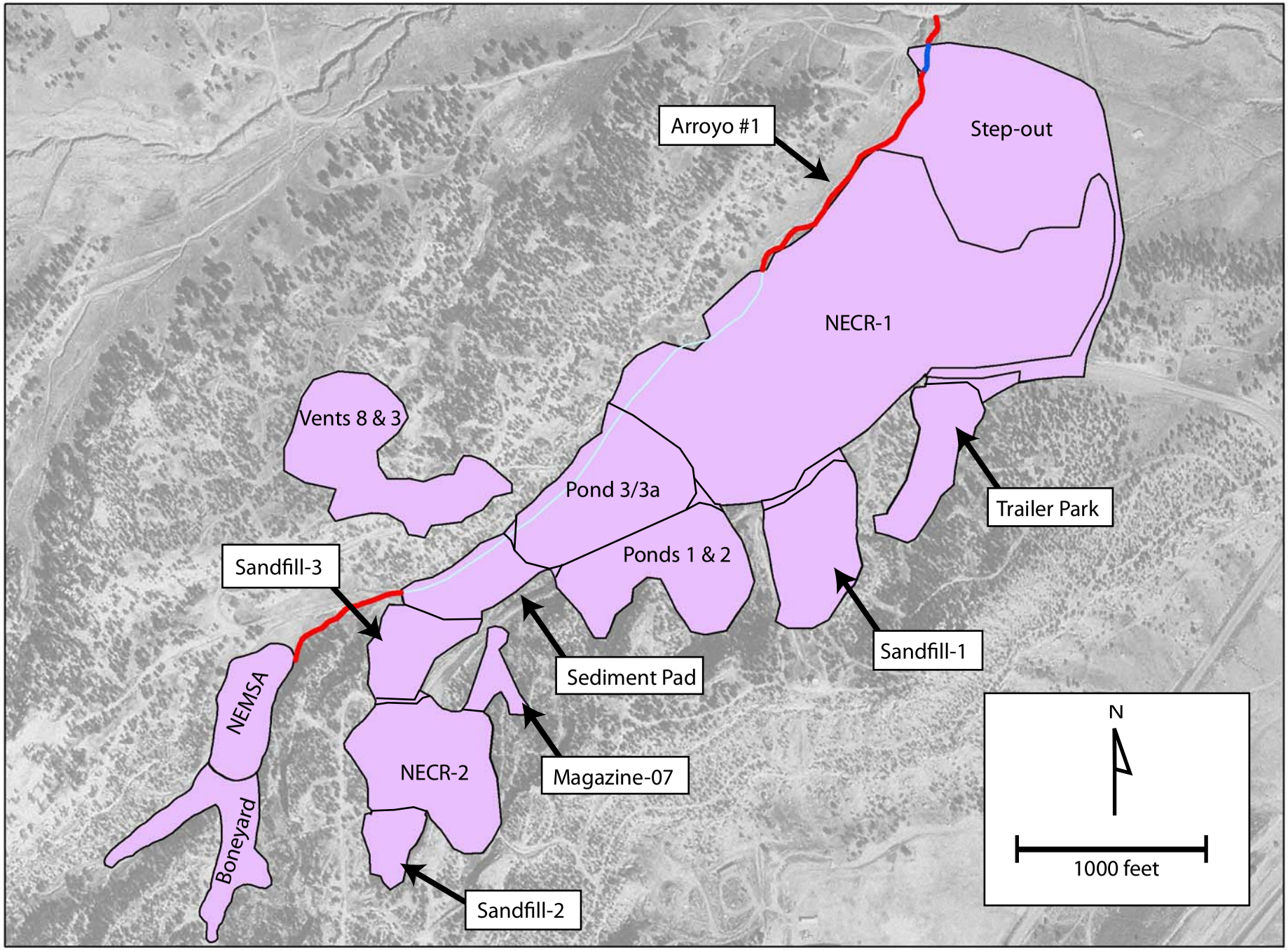


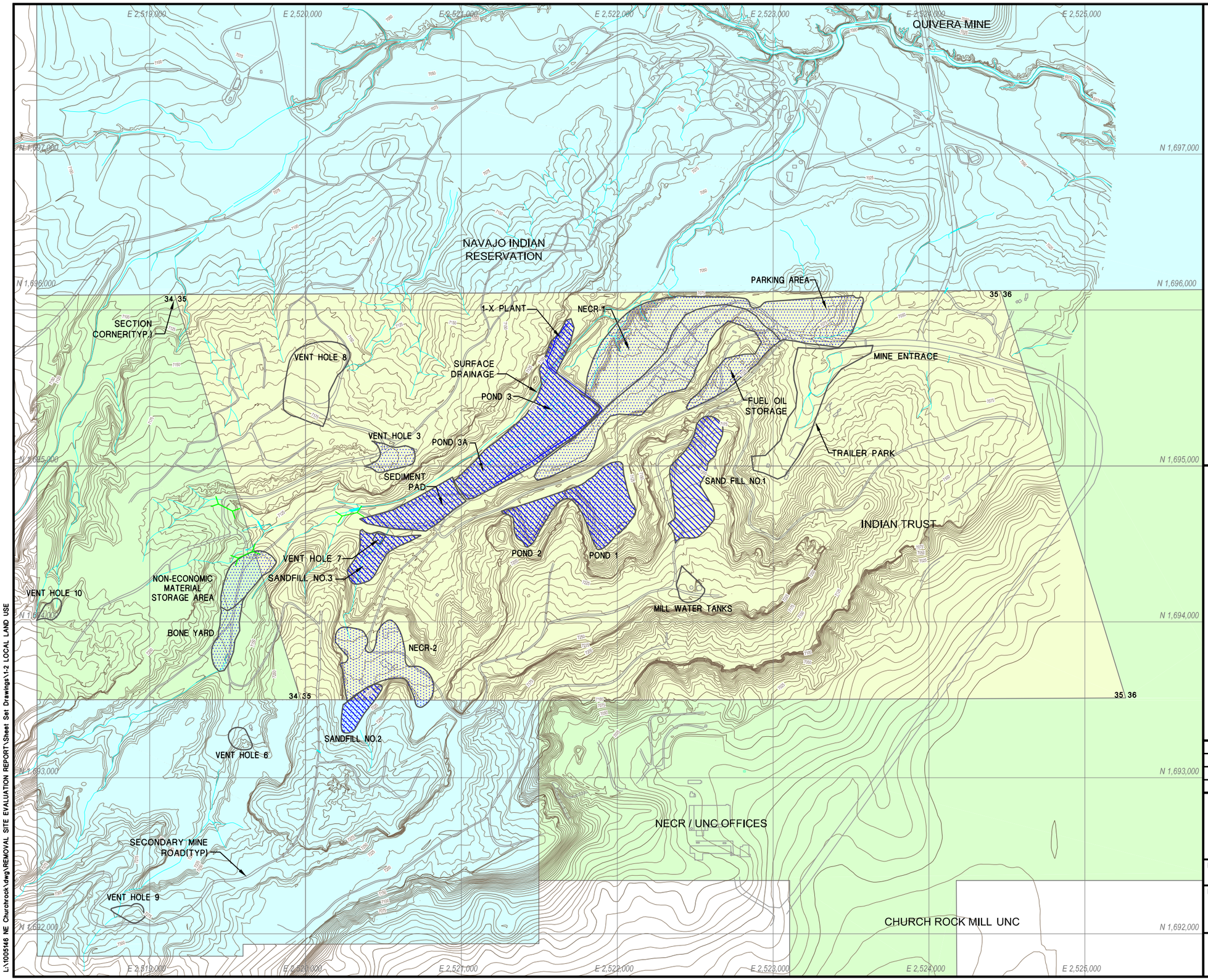
FIGURE 1.4
SITE MAP OF COMBINED
POLYGON BOUNDARIES

U.S. EPA REGION 9
NORTH EAST CHURCH ROCK
MINE SITE,
CHURCH ROCK, NEW MEXICO

DWG NO. XX
SHEET
DATE OCT. 2007
PROJ ID 20070062
FILE

DSGN
DR
CHK
APVD

VERIFY SCALES
BAR IS ONE CM ON ORIGINAL DRAWING
0 1
IF NOT ONE CM ON THIS SHEET ADJUST SCALES ACCORDINGLY



LEGEND

- ROADS
- MINE PERMIT AREA
- FORMER NRC REGULATED AREA
- LAND OWNERSHIP - NAVAJO INDIAN RESERVATION
- LAND OWNERSHIP - UNC
- LAND OWNERSHIP - INDIAN TRUST

NOTES:

1. SURFACE TOPOGRAPHY GENERATED FROM AERIAL PHOTOGRAPHS DATED MAY 2007 BY COOPER AERIAL SURVEYS CO. NEW MEXICO WEST STATE PLANE COORDINATES, NAD 83.
2. NOT ALL AREAS IDENTIFIED DURING THE RSE ARE SHOWN ON THIS FIGURE.
3. THE AREA BOUNDARIES SHOWN HERE ARE THE ORIGINAL BOUNDARIES, WHICH WERE ADJUSTED SLIGHTLY DURING THE RSE. (SEE SUBSEQUENT FIGURES)

N

SCALE
600' 0 600'
CONTOUR INTERVAL 5FT.

REV. No.	REVISIONS	DATE	DESIGN BY	DRAWN BY	REVIEWED AND SIGNED BY
0	Issued For Final	09/07	T.Leeson	C.Fowler	T.Leeson

P.O. BOX 3077
Gallup, New Mexico 87305-3077

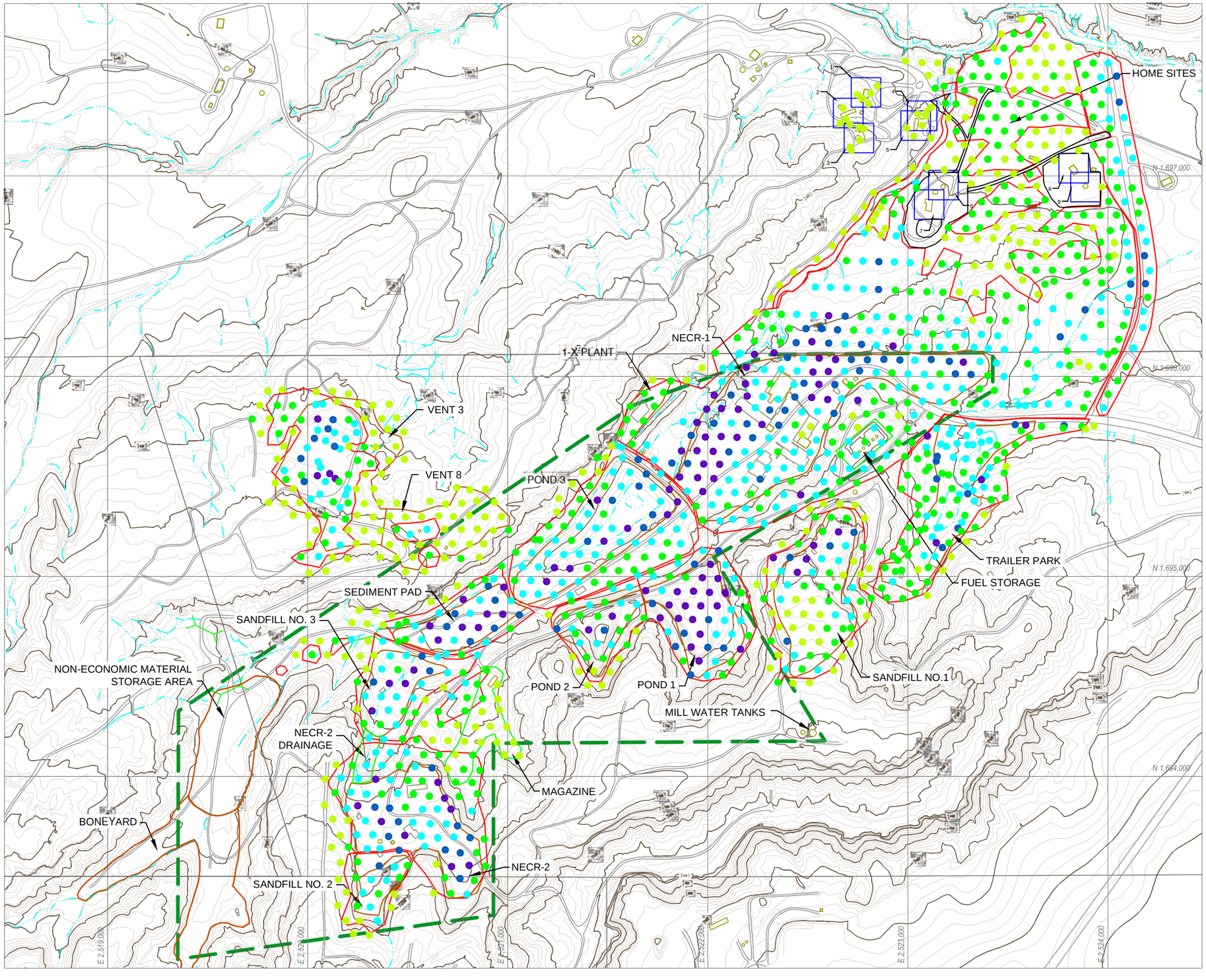
PROJECT:
REMOVAL SITE EVALUATION REPORT

DRAWING TITLE:
SOIL AREAS OF CONCERN

MWH

Sheet 1 Of 1 Sheets
SCALE: As Shown
FIGURE No. 1-5

L:\1005146 NE Churchrock\dwg\REMOVAL SITE EVALUATION REPORT\Sheet Set Drawings\1-2 LOCAL LAND USE



LEGEND

- CONTOURS
- STREAMS
- ROADS
- STRUCTURES
- PERMIT BOUNDARY
- SURVEY AREA BOUNDARY
- MINE FEATURE BOUNDARY
- EPA REMOVAL ACTION BOUNDARY
- HOME SITE 0.5ACRE SURVEY AREA BOUNDAY
- AREAS ABOVE FIELD SCREENING LEVEL

STATIC GAMMA MEASUREMENT LOCATIONS SHOWING EQUIVALENT Ra-226 (pCi/g) CONCENTRATION

- < 2.2
- 2.2 ~ 6.0
- 6.1 ~ 22.4
- 22.4 ~ 50
- > 50

NOTES:

1. SURFACE TOPOGRAPHY GENERATED FROM AERIAL PHOTOGRAPHS DATED MAY 2007 BY COOPER AERIAL SURVEYS CO. NEW MEXICO WEST STATE PLANE COORDINATES, NAD 83.

REV. No.	REVISIONS	DATE	DESIGN BY	DRAWN BY	REVIEWED AND SIGNED BY
0	ISSUE FOR INTERNAL REVIEW	01/08	T.Leeson	E.Marks	T.Leeson

UNC
P.O. BOX 3077
Gallup, New Mexico 87305-3077

PROJECT: ***SUPPLEMENTAL REMOVAL SITE EVALUATION REPORT***

DRAWING TITLE:

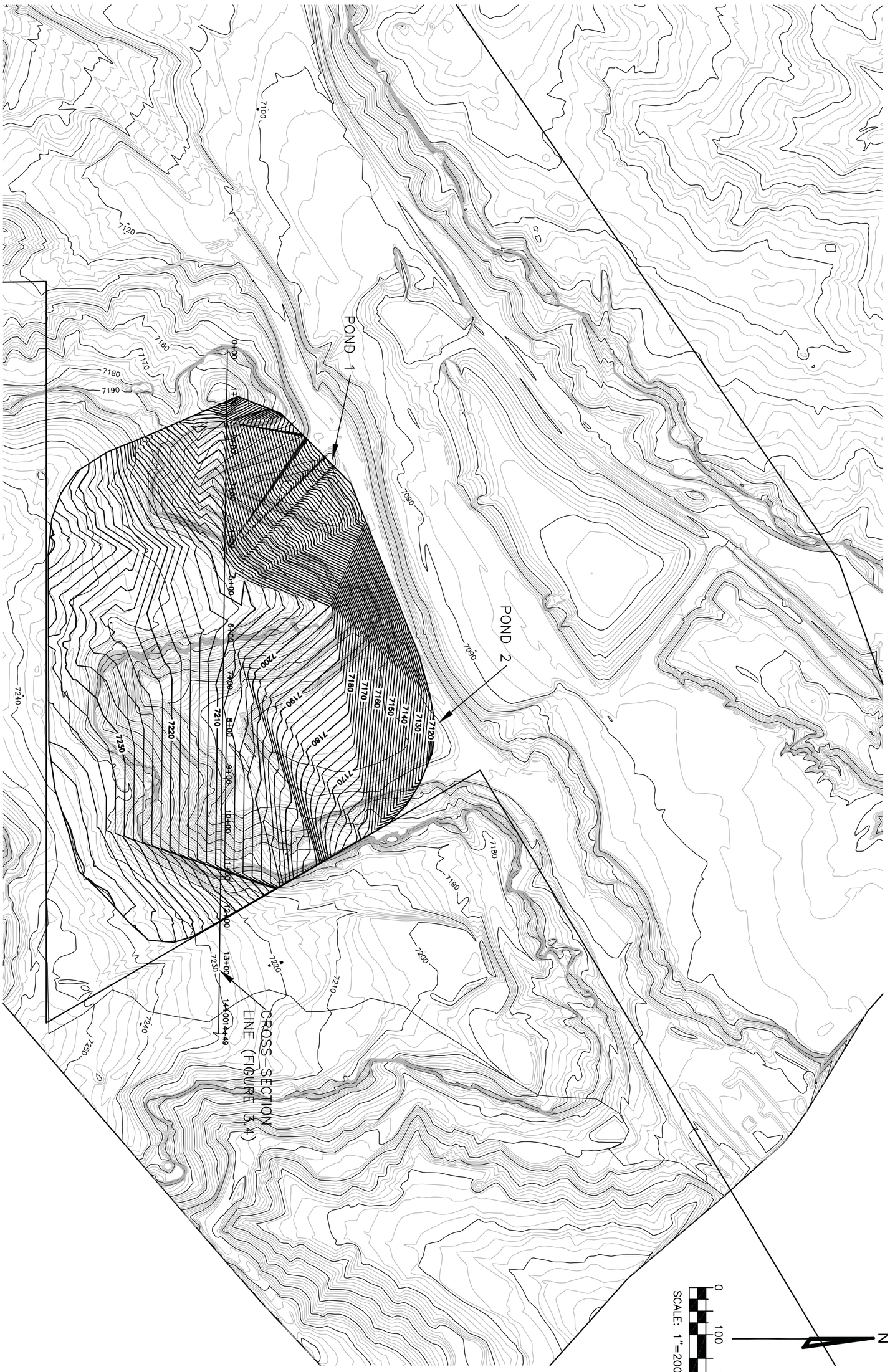
REMOVAL ACTION BOUNDARIES

MWH

SCALE: *As Shown*

FIGURE No. 1-6

N:\Design-Drafting\Clients Q-Z\United Nuclear Corporation\1005146 NECR Supplemental RSE Rev0\021-Sheet Set\1005146F020-0



VERIFY SCALES		
BAR IS ONE INCH ON ORIGINAL DRAWING.	DSGN	PM
0 ——— 1"	DR	MP
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY	CHK	ER
	APVD	NC

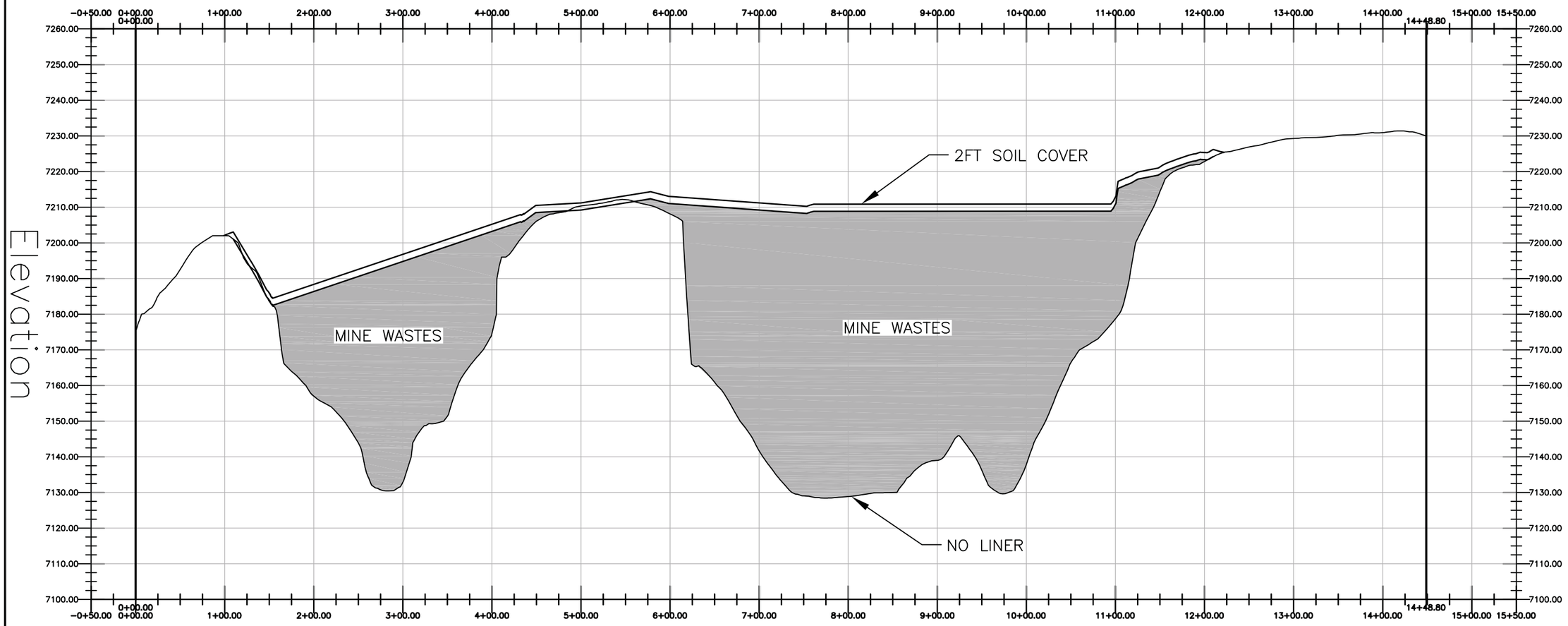
U.S. EPA REGION 9
NORTH EAST CHURCH ROCK MINE SITE,
CHURCH ROCK, NEW MEXICO

FIGURE 3.1
ALTERNATIVE 3
NECR MINE SITE ON-SITE CONSOLIDATE AND COVER
PLAN VIEW

DWG NO.	S1
SHEET	XX
DATE	FEB. 2008
PROJ ID	2007062
FILE	2007062-volumes_new.dwg

FILE NAME: P:\Survey CADD\2007062 church rock NM\2007062-volumes_new.dwg

ALTERNATIVE 3 CONSOLIDATE AND COVER CROSS SECTION



HORIZONTAL SCALE: 1" = 120'
VERTICAL SCALE: 1" = 30'

FIGURE 3.2
ALTERNATIVE 3
NECR MINE SITE ON-SITE
CONSOLIDATE AND COVER
PLAN VIEW

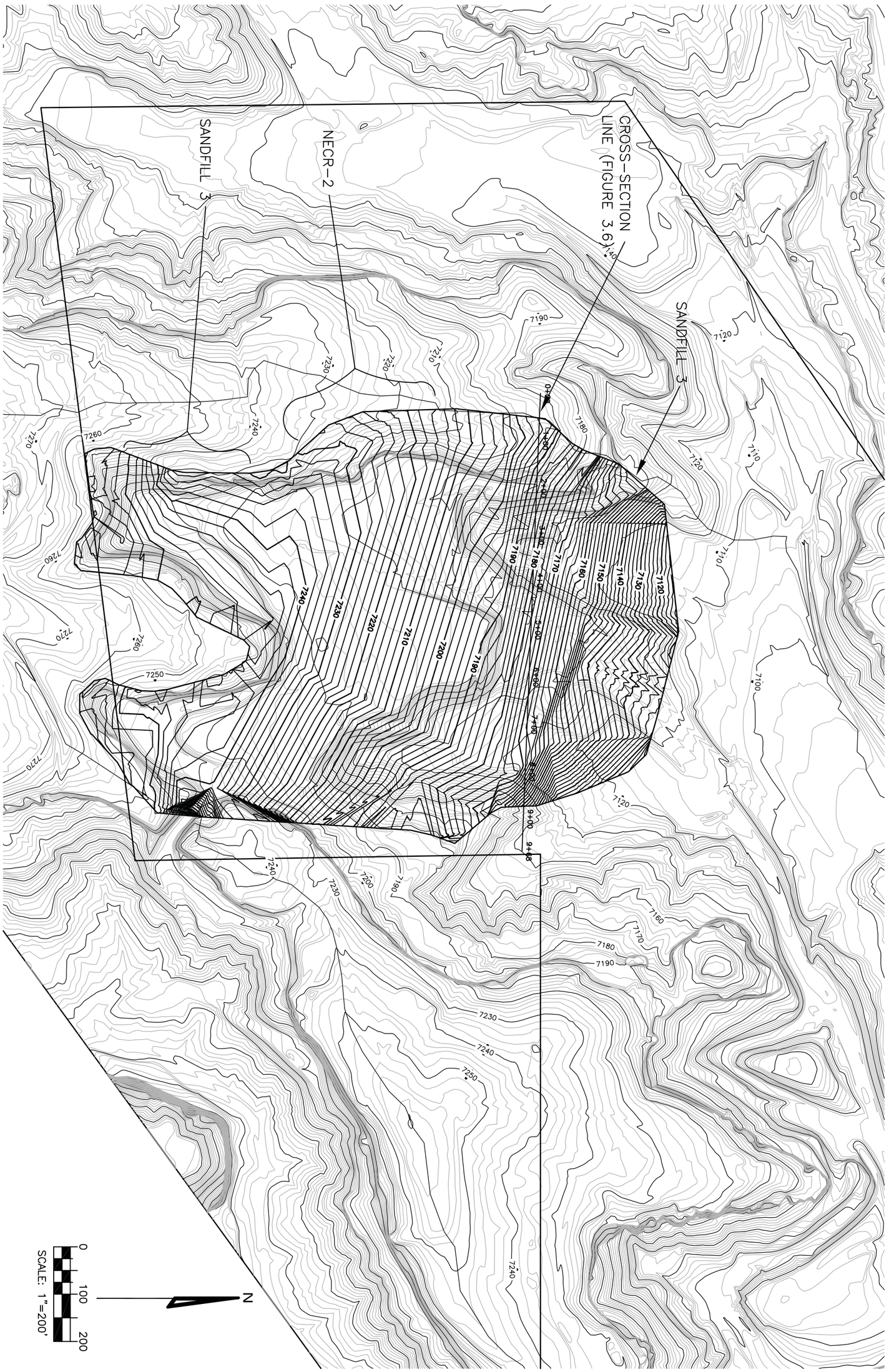
U.S. EPA REGION 9
NORTH EAST CHURCH ROCK
MINE SITE,
CHURCH ROCK, NEW MEXICO

DWG NO.	S1
SHEET	XX
DATE	FEB. 2008
PROJ ID	20070622

DSGN PM
DR MP
CHK ER
APVD NC

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING.
0 ——— 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

FILE NAME: P:\Survey CADD\20070622 church rock NM\20070622--volumes_new.dwg



VERIFY SCALES	DSGN	
BAR IS ONE INCH ON ORIGINAL DRAWING.		PM
0 ——— 1"	DR	MP
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY	CHK	ER
	APVD	NC

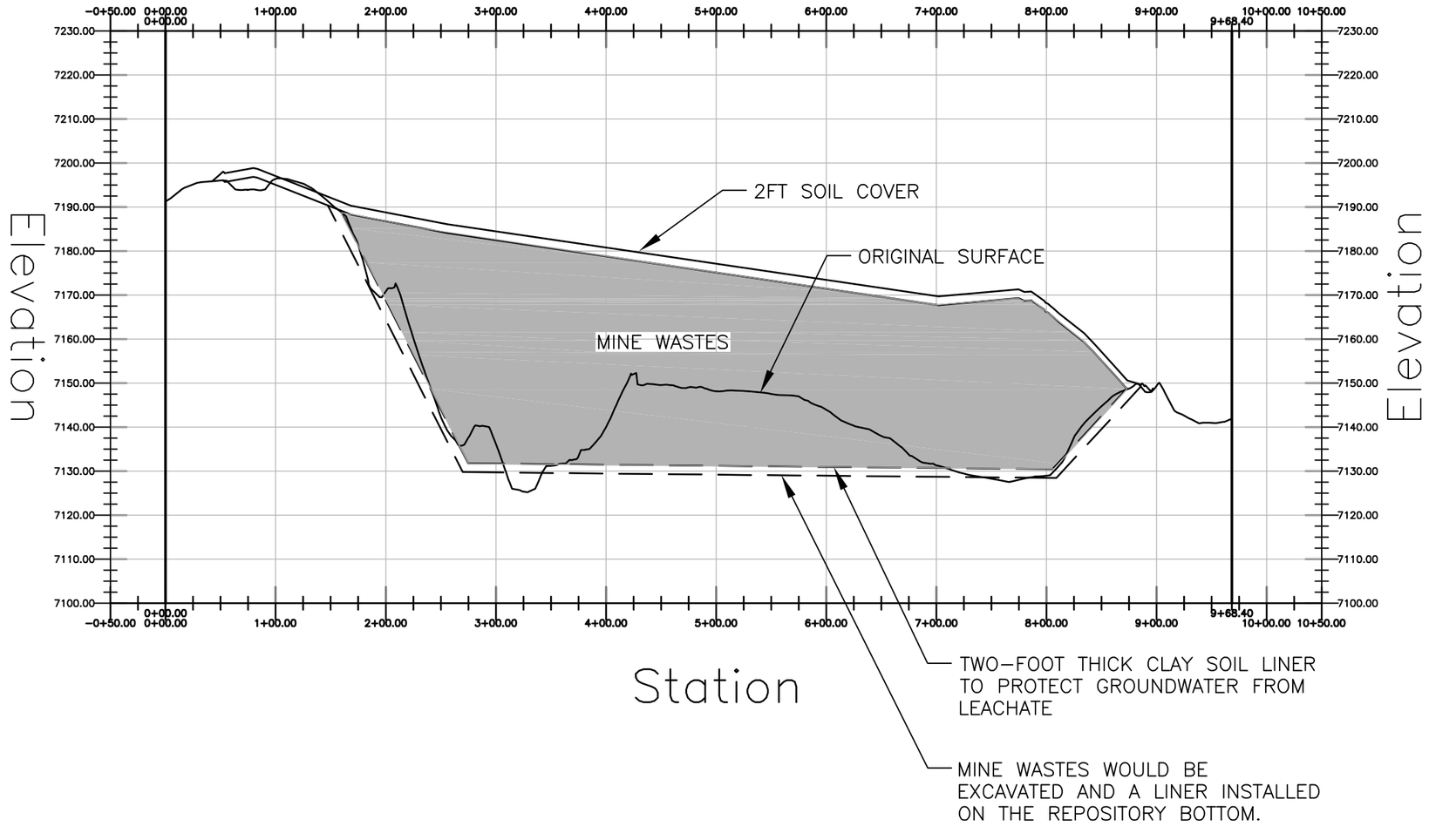
U.S. EPA REGION 9
NORTH EAST CHURCH ROCK MINE SITE,
CHURCH ROCK, NEW MEXICO

FIGURE 3.3
ALTERNATIVE 4
NECR MINE SITE
ABOVE GROUND REPOSITORY
PLAN VIEW

DWG NO.	S1
SHEET	XX
DATE	FEB. 2008
PROJ ID	2007062
FILE	2007062-volumes_new.dwg

FILE NAME: P:\Survey CADD\2007062 church rock NM\2007062-volumes_new.dwg

ALTERNATIVE 4 ABOVE GROUND REPOSITORY CROSS SECTION



HORIZONTAL SCALE: 1" = 120'
VERTICAL SCALE: 1" = 30'

FIGURE 3.4
ALTERNATIVE 4
NECR MINE SITE
ABOVE GROUND REPOSITORY
CROSS SECTIONS

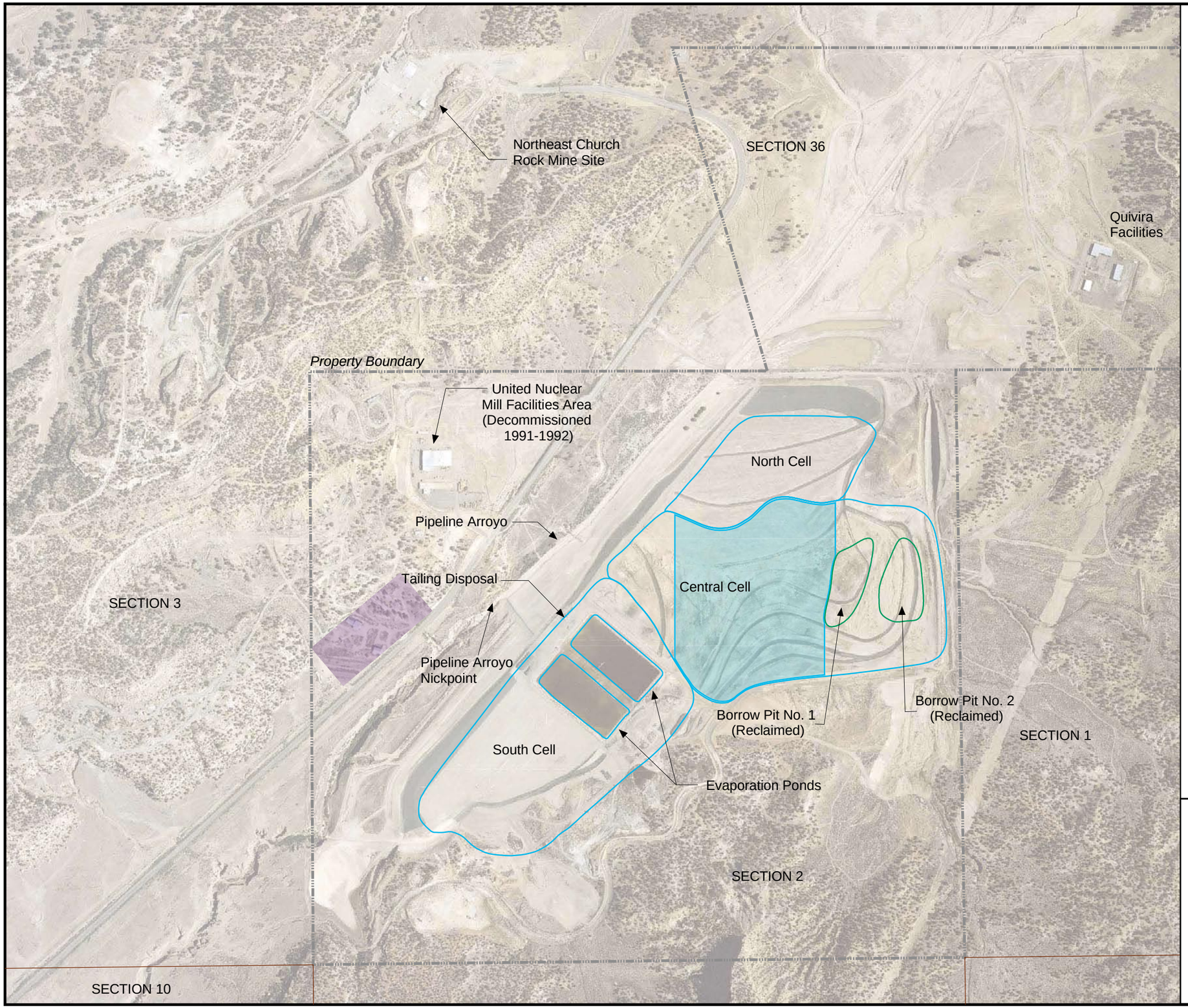
U.S. EPA REGION 9
NORTH EAST CHURCH ROCK
MINE SITE,
CHURCH ROCK, NEW MEXICO

DWG NO.	S1
SHEET	XX
DATE	FEB. 2008
PROJ ID	20070620

DSGN	PM
DR	MP
CHK	ER
APVD	NC

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

FILE NAME: P:\Survey CADD\20070620 church rock NM\20070620-volumes_new.dwg



Legend

- Potential location for consolidation of NECR waste
- Potential location of new repository (exact location TBD)

0 400 800 1,600

Feet

Figure 3.5
Conceptual Cover Plan
Alternative 5 and 5A

United Nuclear Corporation Church Rock Site,
Church Rock, New Mexico

Appendix A

Applicable, Relevant, and Appropriate Requirements

APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARs)

Engineering Evaluation/Cost Analysis
North East Church Rock Mine Site
Gallup, New Mexico
May, 2009

Acronyms

BMP	Best Management Practice
CAA	Clean Air Act
CFR	Code of Federal Regulations
CWA	Clean Water Act
ESA	Endangered Species Act
Mrem/yr	Milli-Roentgen-Equivalent-Man/Year
NESHAP	National Emissions Standards for Hazardous Air Pollutants
NMAC	New Mexico Administrative Code
NMSA	New Mexico Statutes Annotated
NN	Navajo Nation
NPDES	National Pollutant Discharge Elimination System
NRC	Nuclear Regulatory Commission
RCRA	Resource Conservation and Recovery Act
SMCRA	Surface Mining Control and Reclamation Act
TBC	To Be Considered
UMTRCA	Uranium Mill Tailings Radiation Control Act
USC	United States Code

Table A-1 Chemical-Specific ARARs and TBC Information			
Media	**Requirement**	**Requirement Synopsis**	**Status and Rationale**
Solid Wastes	FEDERAL **Resource Conservation and Recovery Act (RCRA) of 1976, as amended –** Subtitle C, 42 USC 6901 et seq.	Regulates disposal of solid waste. Per 42 USC 6903(27), RCRA does not regulate "source, special nuclear, or byproduct material" as defined in the Atomic Energy Act, but may apply to other wastes, including ores containing uranium in concentrations less than 500 ppm.	Substantive requirements may be applicable to wastes that are subject to the Act
Hazardous Wastes	FEDERAL **Resource Conservation and Recovery Act (RCRA) of 1976, as amended –** Subtitle D, 42 USC 6901 et seq.	Provides for "cradle-to-grave" regulation of hazardous wastes. Per 42 USC 6903(27), RCRA does not regulate "source, special nuclear, or byproduct material" as defined in the Atomic Energy Act. Per 40 CFR 261.4(b)(7), wastes derived from the extraction, beneficiation and processing of ores are not hazardous wastes. EPA does not anticipate encountering RCRA hazardous wastes during this removal action. However, if hazardous wastes (e.g., buried drums containing solvents) are discovered, RCRA hazardous waste requirements would be ARARs.	Substantive requirements may be applicable if wastes that are subject to the Act are encountered
Soils	FEDERAL **Surface Mining Control and Reclamation Act of 1977 (SMCRA), as amended --** And regulations at 30 CFR Parts 816 and 817	Establishes a program for regulating surface coal mining and reclamation (mandatory uniform standards). Includes minimization of impacts on fish, wildlife, and related environmental values. Revegetation requirements (e.g., 30 CFR 816.111) may be relevant & appropriate to protect against erosion.	Substantive requirements may be relevant and appropriate
Hazardous Materials	FEDERAL **Uranium Mill Tailings Radiation Control Act of 1978 (UMTRCA), as amended –** And regulations at 40 CFR Part 192, Subparts A-E	Protect the public and the environment from uranium mill tailings. Some requirements (e.g., 40 CFR 192.02, 192.12, 192.32) may be ARARs.	Substantive requirements may be applicable to activities involving uranium mill tailings, and/or activities on UNC NPL site, if any; may be relevant and appropriate to other activities

Table A-1 Chemical-Specific ARARs and TBC Information			
Media	**Requirement**	**Requirement Synopsis**	**Status and Rationale**
Other	FEDERAL **Code of Federal Regulations (CFR), Title 10, Part 20** NRC Regulations – Standards for Protection Against Radiation; Subpart D – Radiation Dose Limits	Establishes standards for protection against ionizing radiation resulting from activities conducted under licenses issued by the NRC	Substantive requirements may be applicable or relevant and appropriate if source, byproduct or special nuclear material is encountered
Air	FEDERAL **Clean Air Act (CAA) –** National Emission Standards for Hazardous Air Pollutants (NESHAPs) that apply to radionuclides, Title 40 CFR Part 61, Subpart H.	Regulates airborne emissions of radionuclides to nearest off site receptor during cleanup of Federal facilities and licensed U.S. NRC facilities. Emissions of radionuclides cannot exceed 10 milli-Roentgen-Equivalent-Man per year (mrem/yr)	Substantive requirements may be applicable to activities on UNC NPL site, if any; may be relevant and appropriate to activities in other areas
Other	FEDERAL **EPA Directive on Protective Cleanup Levels for Radioactive Contamination at CERCLA sites.** OSWER Directive 9200.4-18	Provides guidance for cleanup levels for CERCLA sites with radioactive contamination. Cleanup of radionuclides are governed by risk established in the NCP when ARARS are not available or sufficiently protective.	TBC
Water	NAVAJO NATION **Navajo Nation Pollutant Discharge Elimination System Program** – applicable regulations	Protection of NN watershed from discharges of pollutants from any point source	Substantive requirements may be applicable to activities on reservation and tribal trust land
Solid Wastes	NAVAJO NATION **Navajo Nation Solid Waste Act** – Subchapter 2 – Prohibited Act Subchapter 5 – Enforcement	Protect the health, safety, and preserve the resources of the NN. Regulates solid waste but exempts mine tailings and waste rock. Some requirements are applicable to salts.	Substantive requirements may be relevant and appropriate if regulated salts are encountered during removal action
Air	NAVAJO NATION **Navajo Nation Air Pollution Prevention and Prevention Act –** Air Quality Control Programs – Permits, 2004; Code of Regulations for air emissions, Rules and Regulations.	Outlines Best Management Practices (BMPs) to control dust that would be generated during earth moving activities. Details the BMPs to control excessive amounts of particulates.	Substantive requirements may be applicable to activities on reservation and tribal trust land

Table A-1 Chemical-Specific ARARs and TBC Information			
Media	**Requirement**	**Requirement Synopsis**	**Status and Rationale**
Water	NAVAJO NATION **Navajo Nation Clean Water Act –** Title 4 Navajo Nation Code.	Establishes water quality standards; prevention of pollutant discharges. Standards protect fish, wildlife, and domestic, cultural, agricultural, and recreational uses of water.	Substantive requirements may be applicable to activities on reservation and tribal trust land
Hazardous Waste	STATE **20.4 NMAC** – Hazardous Waste Management	Establishes criteria for the classification of hazardous waste and for the treatment, storage, and disposal of hazardous waste. The state Act incorporates most Federal RCRA regulations, including the definition of solid waste, which excludes "source, byproduct or special nuclear material." New Mexico's definition of hazardous waste also excludes wastes from the extraction, beneficiation, and processing of ores and minerals.	Substantive requirements may be applicable or relevant and appropriate if wastes that are subject to the Act are encountered
Water	STATE **20.6.2 NMAC** – New Mexico Water Quality Ground and Surface Water Protections	Establishes water quality standards and regulations to prevent or abate water pollution from discharges.	Substantive requirements may be relevant and appropriate to surface runoff on reservation or tribal trust land, and may be applicable to surface runoff on non-tribal lands
Water	STATE **20.6.4 NMAC** – New Mexico Standards for Interstate and Intrastate Surface Waters	Establishes water quality standards that consist of the designated use or uses of surface waters, water quality criteria necessary to protect the use or uses, and an anti-degradation policy.	Substantive requirements may be relevant and appropriate to surface runoff on reservation or tribal trust land, and may be applicable to surface runoff on non-tribal lands
Other	STATE **20.3.14 NMAC –** New Mexico Standards for Protection Against Radiation	Establishes standards for protection against radiation resulting from extraction, transport, transfer and storage of naturally occurring radioactive materials in the oil and gas industry.	Substantive requirements may be relevant and appropriate
Other	STATE **20.3.4 NMAC** – Standards for Protection Against Radiation	Establishes standards for protection against ionizing radiation resulting from activities conducted pursuant to licenses or registrations issued by the Department	Substantive requirements may be relevant and appropriate

Table A-2 Location-Specific ARARs and TBC Information			
Media	**Requirement**	**Requirement Synopsis**	**Status and Rationale**
Cultural Resources	FEDERAL **The Native American Graves Protection And Repatriation Act** – 25 United States Code (USC) Section 3001 *et seq* and its regulations Title 43 CFR Part 10.	Protects Native American graves from desecration through the removal and trafficking of human remains and cultural items including funerary and sacred objects	Substantive requirements applicable if Native American burials or cultural items are identified within area to be disturbed
Cultural Resources	FEDERAL **National Historic Preservation Act –** 16 USC 470 *et seq;* 36 CFR Part 800	Provides for the protection of sites with historic places and structures	Substantive requirements applicable if eligible resources identified within area to be disturbed
Cultural Resources	FEDERAL **Archeological Resources Protection Act of 1979 –** 16 USC Sections 47000-47011; 43 CFR Part 7	Prohibits removal of or damage to archaeological resources unless by permit or exception	Substantive requirements applicable if eligible resources are identified within area to be disturbed
Cultural Resources	FEDERAL **American Indian Religious Freedom Act –** 42 USC Section 1996 *et seq*.	Protects religious, ceremonial, and burial sites, and the free practice of religions by Native American groups	Substantive requirements applicable if Native American sacred sites are identified within area to be disturbed
Wildlife	FEDERAL **ESA** – 7 USC Section 136; 16 USC Sections 15331-1548, Title50 CFR Parts 17 and 402	Regulates the protection of threatened and endangered species or critical habitat of such species	Substantive requirements applicable if protected species are identified within area to be disturbed

Table A-2 Location-Specific ARARs and TBC Information			
Media	**Requirement**	**Requirement Synopsis**	**Status and Rationale**
Wildlife	NAVAJO NATION **Navajo Nation Endangered Species List –** Resource Committee Resolution RCAU-103-05	Regulates the protection of Navajo Nation threatened and endangered species or critical habitat of such species	Substantive requirements applicable if protected species are identified within area to be disturbed on reservation or tribal trust land
Cultural Resources	STATE **NMSA 1978 –** New Mexico Cultural Properties Act	Requires the identification of cultural resources, assessment of impact on those resources that may be caused by the proposed remedy, and consultation with the State Historic Preservation Officer	Substantive requirements applicable to response actions on non-tribal lands in New Mexico

Table A-3 Action-Specific ARARs and TBC Information			
Media/ Activity	**Requirement**	**Requirement Synopsis**	**Status and Rationale**
Hazardous Materials	FEDERAL **Federal Hazardous Materials Transportation Law (formerly Hazardous Materials Transportation Act) –** 49 CFR Parts 171, 172, 173	Provides protection against the risks to life, property, and the environment that are inherent in transportation of hazardous materials in commerce	Substantive requirements applicable to transportation of materials subject to the Act, including radionuclides
Water	FEDERAL **EPA Guidance for Developing Best Management Practices for Storm Water –** Publication EPA/832/R-92006	Guidance for developing stormwater BMPs for industrial facilities	TBC
Water	FEDERAL **CWA** – Section 402, National Pollutant Discharge Elimination System (NPDES) Stormwater discharges (40 CFR parts 122, 125).	On-site and off-site discharges from site are required to meet the substantive CWA requirements, including discharge limitations, monitoring and best management practices	Substantive requirements may be applicable
Water	FEDERAL **CWA** – Section 404, dredged or fill material, 33 CFR parts 320-330, 40 CFR 230.	Regulates discharge of dredge or fill material into waters of the U.S.	Substantive requirements may be applicable to activities impacting waters of the U.S.
Air	STATE **20.2 NMAC** – Air Quality	Establishes ambient air quality standards, performance standards for specific sources of air pollutants, and specifies monitoring methods	Substantive requirements may be relevant and appropriate to sources on reservation or tribal trust land; may be applicable to sources on non-tribal lands in New Mexico
Mining	STATE **19.10 NMAC –** Regulation of Non-Coal Mining	Establishes requirements for mine reclamation and close-out plans	Substantive requirements may be relevant and appropriate

Table A-3 Action-Specific ARARs and TBC Information			
Media/ Activity	**Requirement**	**Requirement Synopsis**	**Status and Rationale**
Wildlife	STATE **19.21.2 NMAC** – New Mexico Wildlife Conservation Act **NMSA 178** Sections 17-2-37 thru 17-2-46	Regulates taking of endangered plant species	Substantive requirements may be applicable if protected species are identified within area to be disturbed on non-tribal lands; may be relevant and appropriate on reservation or tribal trust land

Appendix B

Removal Action Cost Analysis Sheets

Summary of All Costs

	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Total Labor Cost:	$8,161,740	$2,765,300	$3,702,000	$3,702,000
Total Material Cost:	$324,349	$113,800	$173,732	$173,732
Total Construction Cost	$12,230,552	$15,415,697	$19,347,013	$20,969,444
Total Disposal Cost:	$66,021,260	$694,953	$694,953	$626,049
Total Transportation Cost:	$172,215,862	$0	$0	$6,314,750
Total ODC:	$6,540,357	$1,391,168	$1,704,532	$1,834,178
CONSTRUCTION COST	$265,494,120	$20,380,918	$25,622,230	$33,620,154
Design, Plans	$1,223,055	$1,541,570	$1,934,701	$3,355,111
O&M (Present Worth)	$368,330	$1,841,651	$1,841,651	$1,227,767
TOTAL CONTINGENCY COST	$26,549,412	$2,038,092	$2,562,223	$3,362,015
TOTAL COST (With Contingen	**$293,634,917**	**$25,802,231**	**$31,960,805**	**$41,565,048**
Total Cost with Option A		**$28,529,451**	**$34,688,025**	***$44,292,268***
Total Cost with Option B		**$26,651,206**	**$32,809,780**	

Option A: Removal of Hot Spot to off-site Class I HazWaste Facility (tons)
Option B: Removal of Hot Spot material to UNC NPL Site

ALTERNATIVE 2 - BASIS OF ESTIMATE SHEETS

Statement of Work

Scope Description:

Alternative 2.
The scope covered by this BOE contains only those elements directly associated with the offsite disposal of contaminated waste at the NECR site. Assumptions are explained in a separate document and are generally explained in the column to the far right of each row. Elements including design, plan development, and O&M are covered by this BOE but as a seperate and distinct line item.

Judgemental Factors Applied In Projecting From Known Source Data to the Estimate:

1) Cost developed for this BOE were based RSE Means, RACER, Quotes and Company Experience
2) RS Means Heavy Construction Cost Data 21st annual Edition.
3) Disposal Facilities - US Ecology - Grandview Id. Transportation - MPe Inc.

Key Assumptions (not in conflict with the WBS):

1) All material will be excavated and disposed off site at an approved facility. 2) Based on volume estimates, it is estimated that the project will take 9 years. 3) Soil conversion factor 1.45 (cy to ton). 4) 100,000cy backfill will be used from an on-site source 5) 100% of excavated waste will be LLRW and hauled to a Class A disposal facility 6) Based on area and volume data, 151 acres will be disturbed and will require hydroseeding. 8) A 10% contingency is added for unknowns

Cost Elements

Labor:

Labor Category	Labor Hours	Labor Rate	TOTAL COST
Office Labor			
Program	10800	$133.00	$1,436,400
Project Manager	18000	$45.00	$810,000
Engineer-Sr.	10800	$41.00	$442,800
Health & Safety	17280	$44.00	$760,320
Geologist/Hydrog	12240	$38.00	$465,120
Env. Scientist-Sr.	11520	$42.00	$483,840
Chemist-Sr.	14400	$40.00	$576,000
GIS-CADD-Sr.	7200	$27.00	$194,400
Admin Support	7200	$22.00	$158,400
Office Labor Total			$5,327,280
Field Labor			
Field	17280	$44.00	$760,320
Field Inspector	17280	$27.00	$466,560
SSHO/QC	17280	$36.00	$622,080
Surveyor	8640	$25.00	$216,000
Security	19440	$20.00	$388,800
Laborer	19440	$19.58	$380,700
Field Labor Total			$2,834,460
Total Labor Cost			**$8,161,740**

ALTERNATIVE 2 - BASIS OF ESTIMATE SHEETS

Item Description	Number of Units	Numbe r of	Unit Price	TOTAL COST	
PPE, Level D (day)	1,575	20	10.00	$315,000	
Misc disposable field equipment (lump)	7	1	1000.00	$7,000	
Drums (each)	15	1	60.00	$900	
Scaffolding	483	3	34.50	$1,449	1 54 23.70 4370
Total Material Cost				**$324,349**	
Construction Costs:					
Construction Description	**Number of Units**	**Total Hours**	**SubCont Rate**	**TOTAL COST**	
Util. clearance - air vac. extract. (HR)	15	4	210.00	$12,600	
Provide/place 6" Class II base (SY)	15	11,100	7.06	$1,175,490	321123.230100
Asphalt pavement (SF)	60,000	1	2.12	$127,200	32 12 16.140020
Liner - HDPE/LLDPE (sqft)	20,000	15	1.17	$386,100	334713.5312
Geocomposite (SY)	2,220	15	2.25	$82,418	31 32 19.161500
Geotextile Fabric (SY)	2,220	15	2.25	$82,418	31 32 19.161500
Development of local borrow source	35,000	1	1.00	$35,000	engineering estimate
Rip Rap load, haul on-site source (CY)	2,220	1	25.37	$56,321	312323.15.6020+312323.18.2150
subtotal				**$1,957,546**	
Data validation (each)	4,100	1	10.00	$41,000	
Lab - CAM 17 Metals - solid (each)	4,100	1	95.00	$389,500	Est. based on prior experience at Site
Lab - Radionuclides - solid (each)	4,100	1	100.00	$410,000	
Air Monitoring (cost/year)	9	1	75000.00	$675,000	Racer
subtotal				**$1,515,500**	
Land surveying, Mob/Demob (Lump)	15	1	1000.00	$15,000	
Land surveying, field (hr)	15	16	200.00	$48,000	
Land surveying report (lump)	15	1	4500.00	$67,500	
Construction BMPs (lump)	15	1	10000.00	$150,000	
Security fencing (LF)	1,000	1	17.04	$17,040	323113.401300
Temporary fencing (LF)	15	5,000	4.18	$940,500	01 56 26.500250
150HP equipment-Mob/Demob	16	20	271.00	$86,720	15436.500100
FOGM - Equip refuel (Day)	90	3	4000.00	$1,080,000	
Pavement removal (SY)	1,110	1	5.25	$5,828	02 41 13.175050
Concrete demolition (CY)	370	1	92.00	$34,074	02 41 13.175500
Clearing and Grubbing (AC)	151	1	2550.00	$385,050	31 11 10.10 0020
Excavate, place in stockpile (no util's.)	261,300	1	2.12	$553,956	31 23 16.42 0300
Excavate, direct load to trucks (no	609,700	1	2.44	$1,486,449	31 23 16.42 0300+15%
Load stockpiles to trucks (CY)	261,300	1	0.80	$209,040	31 23 16.42 1650
Excavation factor for utilities (CY)	8,710	1	3.55	$30,921	3123 16.13 0110
Backfill soil, local source (CY)	200,000	1	8.88	$1,776,000	31 23 23.18 1255
Place/compact backfill (CY)	200,000	1	1.99	$398,000	31 23 23.17 0020+312323.23 5600
Soil amendments (topsoil) (SF)	20,000	1	1.15	$23,000	32 91 13.23 3600
topsoil placement and grading (SY)	20,000	1	4.18	$83,600	32 91 19.13 0800
subtotal				**$7,390,677**	
Geotechnical survey field	15	1	200.00	$3,000	
Geotechnical testing - field obs./tests	155	8	200.00	$248,000	
Geotech. anal. D1557 moist./density	15	2	140.00	$4,200	
Geotech. report (lump)	15	1	1000.00	$15,000	
subtotal				**$270,200**	
Hydroseeding (MSF)	6,578	1	60.30	$396,628	329219.145400
Site Winterization	1	7	100000.00	$700,000	
Total Construction Costs				**$12,230,552**	

ALTERNATIVE 2 - BASIS OF ESTIMATE SHEETS

Disposal Costs:

Waste Disposal Description	Total Volume	Total units	Disposal Rate	TOTAL COST	
soil, RCRA haz. Class I T&D (CY) -	871,000	1	75.00	$65,325,000	US Ecology verbal quote
IDW soil T&D (drum)	10	1	217.80	$2,178	02 81 20.101100
IDW water T&D (drum)	10	1	217.80	$2,178	
waste T&D demurrage (HR)	580	1	118.80	$68,904	02 81 20.103110
Concrete, non-haz. Class II SW, T&D	5,000	7,600	7.60	$38,000	02 41 19.18 0400
Asphalt, non-haz. Class II SW, T&D	5,000	6,500	90.00	$585,000	02 41 19.19 0100
Misc. Disposal Costs				$696,260	
Total Disposal Costs				**$66,021,260**	

Transportation Costs:

Waste Transportation Description	Unit Measure	Total units	Transp Rate	TOTAL COST	
Rad waste soil, RCRA haz. Class I T&D (ton)	1,262,950	1	136.36	$172,215,862	US Ecology verbal quote
Total Transportation Cost				**$172,215,862**	

Other Direct Costs:

Item Description	units/yr	yr	Unit Price	TOTAL COST	
Lodging for residents	200	2	109.00	$43,600	per email 9/17/07 from Bill Schaal
Trailer/office space (Month)	36	9	282.00	$91,368	01 52 13.20 0350+01 52 13.20 0700
Trailer/Conex (Month)	36	9	76.00	$24,624	01 52 13.20 1250
Portable sanitary station (week)	160	9	165.00	$237,600	01 54 33.40 6410
Trash (Month)	18	9	435.00	$70,470	
Utilities hook-up fees (lump)	2	1	1000.00	$2,000	
Electric power PG&E (month)	36	9	110.00	$35,640	01 52 13.40 0160
Land phone/fax (month)	36	9	210.00	$68,040	01 52 13.400140
Office Equipment (month)	36	9	150.00	$48,600	01 52 13.40 0100
Office Supplies (month)	36	9	95.00	$30,780	01 52 13.40 0120
Water	36	9	62.00	$20,088	01 51 13.800700
Per diem, (day)	900	9	109.00	$882,900	per email 9/17/07 from Bill Schaal
Travel, air fare (year)	104	9	1000.00	$936,000	
Mobile phone (month)	36	9	50.00	$16,200	
Radios (month)	90	9	25.00	$20,250	
Rental truck 4WD (month)	36	9	585.00	$189,540	01 54 33.40 7200
4WD truck fuel (week)	160	9	24.00	$34,560	
Rental car (day)	48	9	40.00	$17,280	
Generator (Month)	9	9	780.00	$63,180	01 54 33.40 2600
Generator fuel (Week)	40	9	3.00	$1,080	
Submersible Pump (Month)	18	9	198.00	$32,076	01 54 33.40 4700
Truck Scales (Month)	18	7	200.00	$25,200	
ODC's - Site Support				**$2,891,076**	
Labor	332,088	9	0.58	$1,733,499	
Equipment	90,650	9	0.58	$473,193	
Material:	25,270	9	0.58	$131,909	
ODC's	247,638	9	0.58	$1,292,670	
Subcontractors	3,450	9	0.58	$18,009	
ODC's - Rad H&S				**$3,649,281**	
Total ODC Costs				**$6,540,357**	

ALTERNATIVE 2 - BASIS OF ESTIMATE SHEETS

Other Direct Costs: O&M, Design, Plans					
Develop Design	1		6% construction cost		$733,833
Develop Plans	1	1	4% construction cost		$489,222
O&M Costs	30,000	30	1.00	Net present Worth 7%	$368,330
Total Excluded ODC's - O&M, Design, Plans					**$1,591,385**

Contingency:

Basis of Contingency:
10% general contingency applied in accordance with DOE G 430.1-1, Table 11-3 as the Sanitary Waste location/excavation is well known and documented.

Percent Contingency: 10.0%

Total WBS Cost:

Total Labor Cost:	$8,161,740
Total Material Cost:	$324,349
Total Construction Cost	$12,230,552
Total Disposal Cost:	$66,021,260
Total Transportation Cost:	$172,215,862
Total ODC:	$6,540,357
TOTAL COST (Less Contingency):	$265,494,120
TOTAL CONTINGENCY COST:	$26,549,412
TOTAL COST (With Contingency):	**$292,043,532**
Total Excluded ODC Costs - O&M, Design, Plans	$1,591,385

Approvals:			
Prepared By:	Eric Rixen (revised by Nova Clite)	Date:	10/31/2007 (rev February 14, 2008)
Revised By:	Cynthia Wetmore	Date:	10/15/2008 (rev 05/22/2009)
Approved By:		Date:	

ALTERNATIVE 3 - BASIS OF ESTIMATE SHEETS

Statement of Work

Scope Description:

Alternative 3.

The scope covered by this BOE contains only those elements directly associated with the excavation and consolidation of waste material into an onsite covered disposal cell at the NECR site. Assumptions are explained in a separate document and are generally explained in the column to the far right of each row. Elements including design, plan development, and O&M are covered by this BOE but as a seperate and distinct line item.

Judgemental Factors Applied In Projecting From Known Source Data to the Estimate:

1) Cost developed for this BOE were based RSE Means, RACER, Quotes and Company Experience
2) RS Means Heavy Construction Cost Data 21st annual Edition.
3) Disposal Facilities - US Ecology - Grandview Id. Transportation - MPe Inc.

Key Assumptions (not in conflict with the WBS):

1) 21% of all waste material will be covered in-situ in Ponds 1 & 2 2) 74% of all waste material excavated and consolidated into an onsite area to be covered. 3) Assume the project will take 3 years. 4) Soil conversion factor 1.45 (cy to ton). 5) 200,000cy Backfill will be used from on-site borrow source; rip rap also from on-site quarry 6) Based on area and volume data, 151 acres will be disturbed and will require hydroseeding. 7) A 10% contingency is added for unknowns.

Cost Elements

Labor:

Labor Category	Labor Hours	Labor Rate		TOTAL COST	References
Office Labor					
Program Manager	3600	$133.00		$478,800	
Project Manager	6000	$45.00		$270,000	
Engineer-Sr.	3600	$41.00		$147,600	
Health & Safety	5760	$44.00		$253,440	
Geologist/Hydroge	2880	$38.00		$109,440	
Env. Scientist-Sr.	5280	$42.00		$221,760	
Chemist-Sr.	3200	$40.00		$128,000	
GIS-CADD-Sr.	2400	$27.00		$64,800	
Admin Support	4800	$22.00		$105,600	
Office Labor Total				$1,779,440	
Field Labor					
Field	6480	$44.00		$285,120	
Field Inspector	6480	$27.00		$174,960	
SSHO/QC	6480	$36.00		$233,280	
Surveyor	1440	$25.00		$36,000	
Security	6480	$20.00		$129,600	
Laborer	6480	$19.58		$126,900	
Field Labor Total				$985,860	
Total Labor Cost				**$2,765,300**	

ALTERNATIVE 3 - BASIS OF ESTIMATE SHEETS

Material:

Item Description	Number of Units	Number of	Unit Price	TOTAL COST	
PPE, Level D (day)	525	20	10.00	$105,000	
Misc disposable field equipment (lump)	7	1	1000.00	$7,000	
Drums (each)	15	2	60.00	$1,800	
Scaffolding	483	3	34.50	$1,449	1 54 23.70 4370
Total Material Cost				**$113,800**	
Construction Costs:					
Construction Description:	**Number of Units**	**Total Hours**	**SubCont Rate**	**TOTAL COST**	
Util. clearance - air vac. extract. (HR)	15	4	210.00	$12,600	
Provide/place 6" Class II base (SY)	15	11,100	7.06	$1,175,490	321123.230100
Asphalt pavement (SF)	60,000	1	2.12	$127,200	32 12 16.140020
Liner - HDPE/LLDPE (sqft)	720,583	1	1.17	$843,082	334713.5312
Geotextile Filter Fabric (SY)	80,065	1	2.25	$180,146	31 32 19.161500
Geonet Fabric (SY)	80,065	1	2.25	$180,146	31 32 19.161500
Development of local borrow source	539,789	1	1.00	$539,789	RSMeans estimate
Rip Rap load, haul on-site source (CY)	40,032	1	25.37	$1,015,622	312323.15.6020+312323.18.2150
subtotal				**$4,074,075**	
Data validation (each)	4,000	1	10.00	$40,000	
Lab - CAM 17 Metals - solid (each)	4,000	1	95.00	$380,000	Est. based on prior experience at Site
Lab - Radionuclides - solid (each)	4,000	1	100.00	$400,000	
Air Monitoring (cost/year)	3	1	75000.00	$225,000	Racer
subtotal				**$1,045,000**	
Land surveying, Mob/Demob (Lump)	13	1	1000.00	$13,000	
Land surveying, field (hr)	13	8	200.00	$20,800	
Land surveying report (lump)	13	1	4500.00	$58,500	
Construction BMPs (lump)	13	1	10000.00	$130,000	
Security fencing (LF)	1,000	1	17.04	$17,040	323113.401300
Temporary fencing (LF)	15	5,000	4.18	$313,500	01 56 26.500250
Hydro-Geological survey report (lump)	1	1	100000.00	$100,000	
150HP equipment	15	20	271.00	$81,300	15436.500100
FOGM - Equip refuel (Day)	155	3	4000.00	$1,860,000	
Pavement removal (SY)	1,110	1	5.25	$5,828	02 41 13.175050
Concrete demolition (CY)	370	1	92.00	$34,074	02 41 13.175500
Clearing and Grubbing (AC)	151	1	2550.00	$385,050	31 11 10.10 0020
Excavate, direct load to trucks (no	776,000	1	2.44	$1,891,888	31 23 16.42 0300+15%
Excavation factor for utilities (CY)	7,760	1	3.55	$27,548	3123 16.13 0110
Local borrow soil, backfill delivered	175,000	1	8.88	$1,554,000	31 23 23.18 1255
Place/compact backfill (CY)	175,000	1	1.99	$348,250	31 23 23.17 0020+312323.23 5600
Soil amendments (topsoil) (SF)	17,500	1	1.15	$20,125	32 91 13.23 3600
topsoil placement and grading (SY)	17,500	1	4.18	$73,150	32 91 19.13 0800
Place/compact Waste material (CY)	737,200	1	2.47	$1,820,884	31 23 23.17 0020+312323.23 5640
Local borrow soil, cover material	53,376	1	8.88	$473,979	31 23 23.18 1255
Place/compact cover material (CY)	53,376	1	2.47	$131,839	31 23 23.17 0020+312323.23 5640
subtotal				**$9,360,754**	
Geotechnical survey field	13	1	200.00	$2,600	
Geotechnical testing - field obs./tests	200	8	200.00	$320,000	
Geotech. anal. D1557 moist./density	13	2	140.00	$3,640	
Geotech. report (lump)	13	1	1000.00	$13,000	
subtotal				**$339,240**	
Hydroseeding (MSF)	6,578	1	60.30	$396,628	329219.145400
Site Winterization	2	1	100000.00	$200,000	
Construction Costs:				**$15,415,697**	

ALTERNATIVE 3 - BASIS OF ESTIMATE SHEETS

Disposal Costs:

Waste Disposal Description	Total Volume	Total units	Disposal Rate	TOTAL COST
IDW soil T&D (drum)	7	1	217.80	$1,525 02 81 20.101100
IDW water T&D (drum)	7	1	217.80	$1,525
waste T&D demurrage (HR)	580	1	118.80	$68,904 02 81 20.103110
Concrete, non-haz. Class II SW, T&D	5,000	7,600	7.60	$38,000 02 41 19.18 0400
Asphalt, non-haz. Class II SW, T&D	5,000	6,500	90.00	$585,000 02 41 19.19 0100
Misc. Disposal Costs				$694,953
Total Disposal Costs				**$694,953**

Transportation Costs for optional handling of "Principal Threat" Material:

Option	Unit Measure		Transp Rate	TOTAL COST
Option A: To off-site Class I Hazardous Waste Disposal Facility (tons)				
Transportation Costs (tons)	14,500	1	136.36	$1,977,220 MPe Verbal Quote
Disposal fee - (CY)	10,000	1	75.00	$750,000 US Ecology verbal quote
Subtotal Option A				**$2,727,220**
Option B: To UNC NPL Site				
Transport to UNC Mill Site	14,500	1	5.00	$72,500 engineering estimate
Construction of Hot Spot Cell at NPL site				$776,475 5% of construction costs for Alt 3
Subtotal Option B				**$848,975**

Other Direct Costs:

Item Description	units/yr	yr	Unit Price	TOTAL COST
Lodging for residents	200	2	109.00	$43,600 per email 9/17/07 from Bill Schaal
Trailer/office space (Month)	36	3	282.00	$30,456 01 52 13.20 0350+01 52 13.20 0700
Trailer/Conex (Month)	36	3	76.00	$8,208 01 52 13.20 1250
Portable sanitary station (week)	160	3	165.00	$79,200 01 54 33.40 6410
Trash (Month)	18	3	435.00	$23,490
Utilities hook-up fees (lump)	2	1	1000.00	$2,000
Electric power PG&E (month)	36	3	110.00	$11,880 01 52 13.40 0160
Land phone/fax (month)	36	3	210.00	$22,680 01 52 13.400140
Office Equipment (month)	36	3	150.00	$16,200 01 52 13.40 0100
Office Supplies (month)	36	3	95.00	$10,260 01 52 13.40 0120
Water	36	3	62.00	$6,696 01 51 13.800700
Per diem, (day)	900	3	109.00	$294,300 per email 9/17/07 from Bill Schaal
Travel, air fare (each)	104	3	1000.00	$312,000
Mobile phone (month)	36	3	50.00	$5,400
Radios (month)	90	3	25.00	$6,750
Rental truck 4WD (month)	36	3	585.00	$63,180 01 54 33.40 7200
4WD truck fuel (week)	160	3	24.00	$11,520
Rental car (day)	48	3	40.00	$5,760
Generator (Month)	9	3	780.00	$21,060 01 54 33.40 2600
Generator fuel (Week)	40	3	3.00	$360
Submersible Pump (Month)	18	3	198.00	$10,692 01 54 33.40 4700
Truck Scales (Month)	18	0	200.00	$0
ODC's - Site Support				**$985,692**
Labor	332,088	1	0.58	$192,611
Equipment	90,650	1	0.58	$52,577
Material:	25,270	1	0.58	$14,657
ODC's	247,638	1	0.58	$143,630
Subcontractors	3,450	1	0.58	$2,001
ODC's - Rad H&S				**$405,476**
Total ODC Costs				**$1,391,168**

ALTERNATIVE 3 - BASIS OF ESTIMATE SHEETS

Develop Design	1	1	6% construction cost		$924,942
Develop Plans	1	1	4% construction cost		$616,628
O&M Costs	150,000	30	1.00	Net present Worth 7%	$1,841,651
Total Excluded ODC's - O&M, Design, Plans					**$3,383,221**

Contingency:

Basis of Contingency:

10% general contingency applied in accordance with DOE G 430.1-1, Table 11-3 as the Sanitary Waste location/excavation is well known and documented.

Percent Contingency: 10.0%

Total WBS Cost:

Total Labor Cost:	$2,765,300	
Total Material Cost:	$113,800	
Total Construction Cost	$15,415,697	
Total Disposal Cost:	$694,953	
Total Transportation Cost:		
Total ODC:	$1,391,168	
TOTAL COST (Less Contingency):	$20,380,918	
TOTAL CONTINGENCY COST:	$2,038,092	
TOTAL COST (With Contingency):	**$22,419,010**	
Additional Cost with Option A TSD Disposal	**$2,727,220**	$25,146,230
Additional Cost with Option B UNC NPL Disposal	**$848,975**	$23,267,985
Total Excluded ODC Costs - O&M, Design, Plans	$3,383,221	

Approvals:

Prepared By:	Eric Rixen (revised by Nova Clite)	Date:	10/31/2007 (rev February 13, 2008)
Revised By:	Cynthia Wetmore	Date:	10/15/2008 (rev 05/22/2009)
Approved By:		Date:	

ALTERNATIVE 4 - BASIS OF ESTIMATE SHEETS

Statement of Work

Scope Description:

Alternative 4.

The scope covered by this BOE contains only those elements directly associated with the excavation and consolidation of waste material into an onsite fully encapsulated disposal cell at the NECR site. Assumptions are explained in a separate document and are generally explained in the column to the far right of each row. Elements including design, plan development, and O&M are covered by this BOE but as a seperate and distinct line item.

Judgemental Factors Applied In Projecting From Known Source Data to the Estimate:

1) Cost developed for this BOE were based RSE Means, RACER, Quotes and Company Experience
2) RS Means Heavy Construction Cost Data 21st annual Edition.
3) Disposal Facilities - US Ecology - Grandview Id. Transportation - MPe Inc.

Key Assumptions (not in conflict with the WBS):

1) All material will be excavated and consolidated into an onsite repository. 2) Based on volume estimates, it is estimated that the project will take 4 years. 3) Soil conversion factor 1.45 (cy to ton). 4) 200,000cy Backfill will be obtained from an on-site borrow source, rip-rap also assumed from on-site quarry. 5) Based on area and volume data, 151 acres will be disturbed and will require hydroseeding. 7) A 10% contingency is added for unknowns. 8) Repository will be located over Sandfill 2, NECR-2, and Sandfill 3 areas.

Cost Elements

Labor:

Labor Category	Labor Hours	Labor Rate			TOTAL COST	Reference
Office Labor						
Program	4800	$133.00			$638,400	
Project Manager	8000	$45.00			$360,000	
Engineer-Sr.	4800	$41.00			$196,800	
Health & Safety	7680	$44.00			$337,920	
Geologist/Hydrog	3840	$38.00			$145,920	
Env. Scientist-Sr.	7040	$42.00			$295,680	
Chemist-Sr.	6400	$40.00			$256,000	
GIS-CADD-Sr.	3200	$27.00			$86,400	
Admin Support	3200	$22.00			$70,400	
Office Labor Total					$2,387,520	
Field Labor						
Field	8640	$44.00			$380,160	
Field Inspector	8640	$27.00			$233,280	
SSHO/QC	8640	$36.00			$311,040	
Surveyor	1920	$25.00			$48,000	
Security	8640	$20.00			$172,800	
Laborer	8640	$19.58			$169,200	
Field Labor Total					$1,314,480	
Total Labor Cost					**$3,702,000**	

Material:

Item Description	Number of Units	Numbe r of	Unit Price	TOTAL COST	
PPE, Level D (day)	700	20	$10.0	$140,000	
Misc disposable field equipment (lump)	15	2	$1,000.0	$30,000	
Drums (each)	15	2	$60.0	$1,800	
Scaffolding	483	4	34.50	$1,932	1 54 23.70 4370
Total Material Cost				**$173,732**	

ALTERNATIVE 4 - BASIS OF ESTIMATE SHEETS

Construction Costs:

Construction Description	Number of Units	Total Hours	SubCont Rate	TOTAL COST	
Util. clearance - air vac. extract. (HR)	15	4	$210.0	$12,600	
Provide/place 6" Class II base (SY)	15	11,100	7.06	$1,175,490	321123.230100
Asphalt pavement (SF)	60,000	1	2.12	$127,200	32 12 16.140020
Liner - HDPE/LLDPE (sqft)	1,526,533	1	1.17	$1,786,044	334713.5312
Geotextile Filter Fabric (SY)	169,615	1	2.25	$381,633	31 32 19.161500
Geonet Fabric (SY)	169,615	1	2.25	$381,633	31 32 19.161500
Development of local borrow source	539,789	1	1.00	$539,789	RSM estimate
Rip Rap load, haul on-site source (CY)	49,889	1	25.37	$1,265,681	312323.15.6020+312323.18.2150
subtotal				**$5,670,071**	
Data validation (each)	4,100	1	10.00	$41,000	
Lab - CAM 17 Metals - solid (each)	4,100	1	95.00	$389,500	Est. based on prior experience at Site
Lab - Radionuclides - solid (each)	4,100	1	100.00	$410,000	
Air Monitoring (cost/year)	4	1	75000.00	$300,000	Racer
subtotal				**$1,140,500**	
Land surveying, Mob/Demob (Lump)	16	1	$1,000.0	$16,000	
Land surveying, field (hr)	15	8	$200.0	$24,000	
Land surveying report (lump)	16	1	$4,500.0	$72,000	
Security fencing (LF)	1,000	1	17.04	$17,040	323113.401300
Temporary fencing (LF)	15	5,000	4.18	$313,500	01 56 26.500250
Hydro-Geological survey report (lump)	1	1	100000.00	$100,000	
Construction BMPs (lump)	20	1	10000.00	$200,000	
150HP equipment	15	20	271.00	$81,300	15436.500100
FOGM - Equip refuel (Day)	155	3	4000.00	$1,860,000	
Pavement removal (SY)	1,110	1	5.25	$5,828	02 41 13.175050
Concrete demolition (CY)	370	1	92.00	$34,074	02 41 13.175500
Clearing and Grubbing (AC)	151	1	2550.00	$385,050	31 11 10.10 0020
Excavate, place in stockpile (no util's.) (CY)	130,650	1	$7.6	$998,166	31 23 16.463320
Excavate, direct load to trucks (no util's.) (CY)	740,350	1	2.44	$1,804,973	31 23 16.42 0300+15%
Load stockpiles to trucks (CY)	130,650	1	$0.3	$37,889	31 23 16.420020
Excavation factor for utilities (CY)	8,710	1	3.55	$30,921	3123 16.13 0110
Local borrow soil, backfill delivered (CY)	200,000	1	8.88	$1,776,000	31 23 23.18 1255
Place/compact backfill (CY)	200,000	1	1.99	$398,000	31 23 23.17 0020+312323.23 5600
Soil amendments (topsoil) (SF)	20,000	1	1.15	$23,000	32 91 13.23 3600
topsoil placement and grading (SY)	20,000	1	4.18	$83,600	32 91 19.13 0800
Place/compact Waste material (CY)	871,000	1	2.47	$2,151,370	31 23 23.17 0020+312323.23 5640
Import soil, Repository material delivered (CY)	113,077	1	8.88	$1,004,124	31 23 23.18 1255
Place/compact imported repository material (CY)	113,077	1	2.47	$279,300	31 23 23.17 0020+312323.23 5640
subtotal				**$11,696,134**	
Geotechnical survey field (mob/demob)	16	1	$200.0	$3,200	
Geotechnical testing - field obs./tests (Hr)	200	8	$200.0	$320,000	
Geotech. anal. D1557 moist./density relation	16	2	$140.0	$4,480	
Geotech. report (lump)	16	1	$1,000.0	$16,000	
subtotal				**$343,680**	
Hydroseeding (MSF)	6,578	1	60.30	$396,628	329219.145400
Site Winterization	1	1	100000.00	$100,000	
Construction Costs:				**$19,347,013**	

ALTERNATIVE 4 - BASIS OF ESTIMATE SHEETS

Disposal Costs:

Waste Disposal Description	Total Volume	Total units	Disposal Rate	TOTAL COST
IDW soil T&D (drum)	7	1	217.80	$1,525 02 81 20.101100
IDW water T&D (drum)	7	1	217.80	$1,525
waste T&D demurrage (HR)	580	1	118.80	$68,904 02 81 20.103110
Concrete, non-haz. Class II SW, T&D (CY)	5,000	7,600	7.60	$38,000 02 41 19.18 0400
Asphalt, non-haz. Class II SW, T&D (ton)	5,000	6,500	90.00	$585,000 02 41 19.19 0100
Misc.Disposal Costs				$694,953
Total Disposal Costs				**$694,953**

Transportation Costs for optional handling of "Principal Threat" Material:

Options	Unit Measure	Total units	Transp Rate	TOTAL COST
Option A: To off-site Class I Hazardous Waste Disposal Facility (tons)				
Transportation Costs (tons)	14,500	1	136.36	$1,977,220 MPe Verbal Quote
Disposal fee - (CY)	10,000	1	75.00	$750,000 US Ecology verbal quote
Subtotal Option A				**$2,727,220**
Option B: To UNC NPL Site				
Transport to UNC Mill Site	14,500	1	5.00	$72,500 engineering estimate
Construction of Hot Spot Cell at NPL site				$976,037 5% of construction costs for Alt 4
Subtotal Option B				**$1,048,537**

Other Direct Costs:

Item Description	units/yr	yr	Unit Price	TOTAL COST
Lodging for residents	200	2	109.00	$43,600 per email 9/17/07 from Bill Schaal
Trailer/office space (Month)	36	4	282.00	$40,608 01 52 13.20 0350+01 52 13.20 0700
Trailer/Conex (Month)	36	4	76.00	$10,944 01 52 13.20 1250
Portable sanitary station (week)	160	4	165.00	$105,600 01 54 33.40 6410
Trash (Month)	18	4	435.00	$31,320
Utilities hook-up fees (lump)	2	1	1000.00	$2,000
Electric power PG&E (month)	36	4	110.00	$15,840 01 52 13.40 0160
Land phone/fax (month)	36	4	210.00	$30,240 01 52 13.400140
Office Equipment (month)	36	4	150.00	$21,600 01 52 13.40 0100
Office Supplies (month)	36	4	95.00	$13,680 01 52 13.40 0120
Water	36	4	62.00	$8,928 01 51 13.800700
Per diem, (day)	900	4	109.00	$392,400 per email 9/17/07 from Bill Schaal
Travel, air fare (each)	104	4	1000.00	$416,000
Mobile phone (month)	36	4	50.00	$7,200
Radios (month)	90	4	25.00	$9,000
Rental truck 4WD (month)	36	4	585.00	$84,240 01 54 33.40 7200
4WD truck fuel (week)	160	4	24.00	$15,360
Rental car (day)	48	4	40.00	$7,680
Generator (Month)	9	4	780.00	$28,080 01 54 33.40 2600
Generator fuel (Week)	40	4	3.00	$480
Submersible Pump (Month)	18	4	198.00	$14,256 01 54 33.40 4700
Truck Scales (Month)	18	0	200.00	$0
ODC's - Site Support				**$1,299,056**
Labor	332,088	1	0.58	$192,611
Equipment	90,650	1	0.58	$52,577
Material:	25,270	1	0.58	$14,657
ODC's	247,638	1	0.58	$143,630
Subcontractors	3,450	1	0.58	$2,001
ODC's - Rad H&S				**$405,476**
Total ODC Costs				**$1,704,532**

ALTERNATIVE 4 - BASIS OF ESTIMATE SHEETS

Develop Design	1	1	6% construction cost		$1,160,821
Develop Plans	1	1	4% construction cost		$773,881
O&M Costs	150,000	30	$1.0	Net present Worth 7%	$1,841,651
Total Excluded ODC's - O&M, Design, Plans					**$3,776,352**

Contingency:

Basis of Contingency:
10% general contingency applied in accordance with DOE G 430.1-1, Table 11-3 as the Sanitary Waste location/excavation is well known and documented.

Percent Contingency: 10.0%

Total WBS Cost:

Total Labor Cost:	$3,702,000	
Total Material Cost:	$173,732	
Total Construction Cost	$19,347,013	
Total Disposal Cost:	$694,953	
Total Transportation Cost:		
Total ODC:	$1,704,532	
TOTAL COST (Less Contingency):	$25,622,230	
TOTAL CONTINGENCY COST:	$2,562,223	
TOTAL COST (With Contingency):	**$28,184,453**	
Additional Cost with Option A TSD Disposal	**$2,727,220**	$30,911,673
Additional Cost with Option B UNC NPL Disposal	**$1,048,537**	$29,232,990
Total Excluded ODC Costs - O&M, Design, Plans	$3,776,352	

Approvals:

Prepared By:	Eric Rixen (revised by Nova Clite)	Date:	10/31/2007 (rev February 13, 2008)
Revised By:	Cynthia Wetmore	Date:	10/15/2008 (rev 05/22/2009)
Approved By:		Date:	

ALTERNATIVE 5 - BASIS OF ESTIMATE SHEETS

Statement of Work

Scope Description:

Alternative 5.
The scope covered by this BOE contains only those elements directly associated with the excavation and consolidation of waste material into a fully encapsulated disposal cell at the NECR UNC site. Assumptions are explained in a separate document and are generally explained in the column to the far right of each row. Elements including design, plan development, and O&M are covered by this BOE but as a seperate and distinct line item.

Judgemental Factors Applied In Projecting From Known Source Data to the Estimate:

1) Cost developed for this BOE were based RSE Means, RACER, Quotes and Company Experience
2) RS Means Heavy Construction Cost Data 21st annual Edition.
3) Disposal Facilities - US Ecology - Grandview Id. Transportation - MPe Inc.

Key Assumptions (not in conflict with the WBS):

1) 100% of excavated waste material will be excavated and consolidated into a repository constructed at the UNC-NPL site. 2) Project will take 4 years. 3) Soil conversion factor 1.45 (cy to ton). 4) 200,000cy Backfill will be used from an on-site borrow source; rip-rap also from developed on-site quarry. 5) 151 acres will be disturbed and will require hydroseeding. 6) A 10% contingency is added for unknowns.

Cost Elements

Labor:

Labor Category	Labor Hours	Labor Rate			TOTAL COST	Reference
Office Labor						
Program Manager	4800	$133.00			$638,400	
Project Manager	8000	$45.00			$360,000	
Engineer-Sr.	4800	$41.00			$196,800	
Health & Safety	7680	$44.00			$337,920	
Geologist/Hydrogeo-Sr.	3840	$38.00			$145,920	
Env. Scientist-Sr.	7040	$42.00			$295,680	
Chemist-Sr.	6400	$40.00			$256,000	
GIS-CADD-Sr.	3200	$27.00			$86,400	
Admin Support	3200	$22.00			$70,400	
Office Labor Total					$2,387,520	
Field Labor						
Field Superintendent	8640	$44.00			$380,160	
Field Inspector	8640	$27.00			$233,280	
SSHO/QC	8640	$36.00			$311,040	
Surveyor	1920	$25.00			$48,000	
Security	8640	$20.00			$172,800	
Laborer	8640	$19.58			$169,200	
Field Labor Total					$1,314,480	
Total Labor Cost					**$3,702,000**	

Material:

Item Description	Number of Units	Number of Units	Unit Price	TOTAL COST	
PPE, Level D (day)	700	20	$10.0	$140,000	
Misc disposable field equipment (lump)	15	2	$1,000.0	$30,000	
Drums (each)	15	2	$60.0	$1,800	
Scaffolding	483	4	34.50	$1,932	1 54 23.70 4370
Total Material Cost				**$173,732**	

ALTERNATIVE 5 - BASIS OF ESTIMATE SHEETS

Construction Costs:

Construction Description	Number of Units	Total units	SubCont Rate	TOTAL COST	
Util. clearance - air vac. extract. (HR)	15	8	$210.0	$25,200	
Provide/place 6" Class II base (SY)	15	16,380	7.06	$1,734,642	321123.230100
Asphalt pavement (SF)	81,760	1	2.12	$173,331	32 12 16.140020
Liner - HDPE/LLDPE (sqft)	1,526,533	1	1.17	$1,786,044	334713.5312
Geotextile Filter Fabric (SY)	169,445	1	2.25	$381,252	31 32 19.161500
Geonet Fabric (SY)	169,445	1	2.25	$381,252	31 32 19.161500
Development of local borrow source	539,789	1	1.00	$539,789	RSM estimate
Rip Rap load, haul on-site source (CY)	49,889	1	25.37	$1,265,684	312323.15.6020+312323.18.2150
subtotal				**$6,287,193**	
Data validation (each)	4,100	1	10.00	$41,000	
Lab - CAM 17 Metals - solid (each)	4,100	1	95.00	$389,500	Est. based on prior experience at Site
Lab - Radionuclides - solid (each)	4,100	1	100.00	$410,000	
Air Monitoring (cost/year)	4	1	75000.00	$300,000	Racer
subtotal				**$1,140,500**	
Land surveying, Mob/Demob (Lump)	16	2	$1,000.0	$32,000	
Land surveying, field (hr)	18	24	$200.0	$86,400	
Land surveying report (lump)	16	2	$4,500.0	$144,000	
Surveying Costs				**$262,400**	
Security fencing (LF)	1,000	2	17.04	$34,080	323113.401300
Temporary fencing (LF)	15	5,000	4.18	$313,500	01 56 26.500250
Hydro-Geological survey report (lump)	1	1	100000.00	$100,000	
Construction BMPs (lump)	15	2	10000.00	$300,000	
150HP equipment	16	20	271.00	$86,720	15436.500100
FOGM - Equip refuel (Day)	155	3	4000.00	$1,860,000	
Pavement removal (SY)	1,110	1	5.25	$5,828	02 41 13.175050
Concrete demolition (CY)	370	1	92.00	$34,074	02 41 13.175500
Clearing and Grubbing (AC)	192	2	2550.00	$979,200	31 11 10.10 0020
Excavate, direct load to trucks (no util's.) (CY)	871,000	1	2.44	$2,123,498	31 23 16.42 0300+31 23 16.42 0020
Excavation factor for utilities (CY)	8,710	1	3.55	$30,921	3123 16.13 0110
Local soil source, backfill delivered (CY)	200,000	1	8.88	$1,776,000	31 23 23.18 1255
Place/compact backfill (CY)	200,000	1	1.99	$398,000	31 23 23.17 0020+312323.23 5600
Soil amendments (topsoil) (SF)	20,000	1	1.15	$23,000	32 91 13.23 3600
topsoil placement and grading (SY)	20,000	1	4.18	$83,600	32 91 19.13 0800
Place/compact Waste material (CY)	871,000	1	2.47	$2,151,370	31 23 23.17 0020+312323.23 5640
Import soil, Repository material delivered (CY)	113,077	1	8.88	$1,004,124	31 23 23.18 1255
Place/compact imported repository material (CY)	113,077	1	2.47	$279,300	31 23 23.17 0020+312323.23 5640
subtotal				**$11,583,214**	
Geotechnical survey field (mob/demob)	16	2	$200.0	$6,400	
Geotechnical testing - field obs./tests (Hr)	200	16	$200.0	$640,000	
Geotech. anal. D1557 moist./density relation	16	4	$140.0	$8,960	
Geotech. report (lump)	16	1	$1,000.0	$16,000	
subtotal				**$671,360**	
Hydroseeding (MSF)	6,839	2	60.30	$824,777	329219.145400
Site Winterization	1	2	100000.00	$200,000	
Construction Costs:				**$20,969,444**	

ALTERNATIVE 5 - BASIS OF ESTIMATE SHEETS

Disposal Costs:

Waste Disposal Description	Total Volume	Total units	Disposal Rate	TOTAL COST	
IDW soil T&D (drum)	7	1	217.80	$1,525	02 81 20.101100
IDW water T&D (drum)	7	1	217.80	$1,525	
Concrete, non-haz. Class II SW, T&D (CY)	5,000	7,600	7.60	$38,000	02 41 19.18 0400
Asphalt, non-haz. Class II SW, T&D (ton)	5,000	6,500	90.00	$585,000	02 41 19.19 0100
Misc.Disposal Costs				$626,049	
Total Disposal Costs				**$626,049**	

Transportation Costs for optional handling of "Principal Threat" Material:

Options	Unit Measure	Total units	Transp Rate	TOTAL COST	
Option A: To off-site Class I Hazardous Waste Disposal Facility (tons)					
Transportation Costs (tons)	14,500	1	136.36	$1,977,220	MPe Verbal Quote
Disposal fee - (CY)	10,000	1	75.00	$750,000	US Ecology verbal quote
Subtotal Option A				**$2,727,220**	

Transportation Costs:

Waste Transportation Description	Unit Measure	Total units	Transp Rate	TOTAL COST
Transport to UNC Mill Site	1,262,950	1	5.00	$6,314,750
Total Transportation Cost				**$6,314,750**

Other Direct Costs:

Item Description	units/yr	yr	Unit Price	TOTAL COST	
Lodging for residents	200	2	109.00	$43,600	per email 9/17/07 from Bill Schaal
Trailer/office space (Month)	36	4	282.00	$40,608	01 52 13.20 0350+01 52 13.20 0700
Trailer/Conex (Month)	36	4	76.00	$10,944	01 52 13.20 1250
Portable sanitary station (week)	160	4	165.00	$105,600	01 54 33.40 6410
Trash (Month)	18	4	435.00	$31,320	
Utilities hook-up fees (lump)	2	1	1000.00	$2,000	
Electric power PG&E (month)	36	4	110.00	$15,840	01 52 13.40 0160
Land phone/fax (month)	36	4	210.00	$30,240	01 52 13.400140
Office Equipment (month)	36	4	150.00	$21,600	01 52 13.40 0100
Office Supplies (month)	36	4	95.00	$13,680	01 52 13.40 0120
Water	36	4	62.00	$8,928	01 51 13.800700
Per diem, (day)	900	4	109.00	$392,400	per email 9/17/07 from Bill Schaal
Travel, air fare (each)	104	4	1000.00	$416,000	
Mobile phone (month)	36	4	50.00	$7,200	
Radios (month)	90	4	25.00	$9,000	
Rental truck 4WD (month)	36	4	585.00	$84,240	01 54 33.40 7200
4WD truck fuel (week)	160	4	24.00	$15,360	
Rental car (day)	48	4	40.00	$7,680	
Generator (Month)	9	4	780.00	$28,080	01 54 33.40 2600
Generator fuel (Week)	40	4	3.00	$480	
Submersible Pump (Month)	18	4	198.00	$14,256	01 54 33.40 4700
Truck Scales (Month)	18	3	200.00	$10,800	
ODC's - Site Support				**$1,309,856**	
Labor	332,088	1	0.75	$249,066	
Equipment	90,650	1	0.75	$67,988	
Material:	25,270	1	0.75	$18,953	
ODC's	247,638	1	0.75	$185,729	
Subcontractors	3,450	1	0.75	$2,588	
ODC's - Rad H&S				**$524,322**	
Total ODC Costs				**$1,834,178**	

ALTERNATIVE 5 - BASIS OF ESTIMATE SHEETS

Develop Design		1	12% construction cost		$2,516,333
Develop Plans		1	4% construction cost		$838,778
O&M Costs	100,000	30	$1.0	Net present Worth 7%	$1,227,767
Total Excluded ODC's - O&M, Design, Plans					**$4,582,879**

Contingency:

Basis of Contingency:

10% general contingency applied in accordance with DOE G 430.1-1, Table 11-3 as the Sanitary Waste location/excavation is well known and documented.

Percent Contingency: 10.0%

Total WBS Cost:

Total Labor Cost:	$3,702,000	
Total Material Cost:	$173,732	
Total Construction Cost	$20,969,444	
Total Disposal Cost:	$626,049	
Total Transportation Cost:	$6,314,750	
Total ODC:	$1,834,178	
TOTAL COST (Less Contingency):	$33,620,154	
TOTAL CONTINGENCY COST:	$3,362,015	
TOTAL COST (With Contingency):	**$36,982,169**	
Total Excluded ODC Costs - O&M, Design, Plans	$4,582,879	
Additional Cost with Option A TSD Disposal	**$2,727,220**	$39,709,389

Approvals:

Prepared By:	Eric Rixen (revised by Nova Clite)	Date	10/31/2007 (rev February 14, 2008)
Revision By:	cynthia wetmore	Date	10/15/2008 (rev 05/22/2009)
Approved By:		Date	

Appendix C

Navajo Department of Justice letter to EPA discussing Trust Responsibilty.

September 2, 2008

NAVAJO NATION DEPARTMENT OF JUSTICE
OFFICE OF THE ATTORNEY GENERAL

LOUIS DENETSOSIE
ATTORNEY GENERAL

HARRISON TSOSIE
DEPUTY ATTORNEY GENERAL

September 2, 2008

Mr. Dustin Minor
Office of Regional Counsel
United States Environmental Protection Agency Region IX
75 Hawthorne St.
San Francisco, CA 94105

Re: Draft Engineering Evaluation/Cost Analysis for the Northeast Church Rock site

Dear Mr. Minor:

The Navajo Nation writes regarding the Engineering Evaluation/Cost Analysis ("EE/CA") currently being assembled for the Northeast Church Rock mine site near Gallup, New Mexico ("NECR"). As previously expressed to the Agency, the Navajo Nation opposes disposal of radioactive waste on Navajo tribal land as being inconsistent with both federal law and the Agency's federal trust responsibility. Unique historical, cultural, and religious realities of Navajo life, as well as the Agency's own guidelines for completing the EE/CA, militate against the selection of such an alternative. Accordingly, the Navajo Nation urges the Agency to consider and apply these and the other factors discussed below as it identifies and recommends cleanup alternatives in the EE/CA.

1. The Agency's Indian Policy Should Guide the Agency's Decisions Regarding the NECR Mine Site

The federal government bears a unique trust responsibility to Indian Tribes, including the Navajo Nation. In a 2001 Supreme Court decision involving the Klamath Tribe's water rights, the Court described the trust doctrine as "one of the primary cornerstones of Indian law,' ... with the United States as trustee, the Indian tribes ... as beneficiaries, and the property and natural resources managed by the United States as the trust corpus." *Dep't of Interior v. Klamath Water Users Protective Ass'n*, 532 U.S. 1, 11 (2001) (quoting Felix S. Cohen's Handbook of Federal Indian Law 221 (Rennard Strickland et al. eds., 1982) (1942)).

This trust obligation applies to every arm of the federal government, including the Agency. Courts have not only acknowledged the Agency's trust duties to the Navajo Nation, they have also upheld EPA positions regarding tribal lands based on its trust duties. *See, e.g., HRI, Inc. v. EPA*, 198 F.3d 1224, 1246 (10th Cir. 2000) ("Congress's intent to protect tribal lands and governance extends no less to EPA than to other departments of the federal government.").

The EPA acknowledged this unique trust relationship in its Policy for the Administration of Environmental Programs on Indian Reservations.[1] The Policy recognizes the Agency's duty to protect the lands and jurisdiction of the Indian tribes: "In keeping with that trust responsibility, the Agency will endeavor to protect the environmental interests of Indian Tribes when carrying out its responsibilities that may affect the reservations." Significantly, the Policy commands the Agency to "ensure the close involvement of Tribal Governments in making decisions and managing environmental programs affecting reservation lands," and to "give special consideration to Tribal interests in making Agency policy."

2. **Several Factors Militate Against Retaining Radioactive Waste on Navajo Land**

The Navajo Nation believes that the unique cultural, religious, and historical context surrounding the NECR mine render inappropriate any remedial measure that results in mine waste remaining on Navajo land. Furthermore, under the Agency's Guidance on Conducting Non-Time-Critical Removal Actions under CERCLA (Aug. 1993) ("Guidance"), the NECR EE/CA must consider several criteria when analyzing cleanup alternatives. Among these criteria are effectiveness, implementability, and community acceptance, which also weigh heavily in favor of an off-site solution. (Guidance at 20, 43.)

As explained below, each of these considerations is relevant to the NECR EE/CA. The EE/CA must contain a comparative analysis of the cleanup alternatives in order to "evaluate the relative performance of each alternative in relation to each of the criteria. The purpose of the comparative analysis is to identify the advantages and disadvantages of each alternative relative to one another so that the key tradeoffs that would affect the remedy selection can be identified." (Guidance at 45.) Accordingly, the Navajo Nation urges the Agency to discuss these considerations in its analysis of alternatives in the EE/CA and to apply them should a preferred alternative for the NECR site be selected.

a. Historical and Cultural Considerations

No analysis of the NECR mine site or any other mine in Navajo Indian Country is complete without recognition of the long and devastating history of uranium mining in that area. Over fifty years ago, the Navajo Nation opened its lands and provided the services of its people in assisting with the development of the United States' nuclear capacity. Various groups mined millions of tons of uranium ore from Navajo lands, providing uranium for the Manhattan Project and for the United States' weapons stockpile. As a result, the United States was able to prevail in the Cold War, but not without great cost.

A grossly disproportionate share of that cost has been borne by the Navajo Nation and the Navajo people. The decades of uranium mining have left the Navajo a blighted homeland with over 500 abandoned mines, four inactive milling sites, a former dump site, contaminated groundwater, structures that may contain elevated levels of radiation, and other environmental and public health concerns. As a result of the radioactive waste still permeating their land, the Navajo people suffer any number of maladies. The livestock on which many Navajo depend for their livelihood are often born deformed or diseased. Water and soil pollution are common. During hearings on Capitol Hill last October, Members of both political parties in the United States Congress rightly termed the Navajo's plight a "modern American tragedy."

In addition to the historical significance any clean-up at NECR has to the Navajo people, the Agency must also consider the cultural significance of the Navajo lifestyle. Navajo is an agrarian society: its people eat what they raise on the land. Yet, the radioactive waste still permeating their land has made this a dangerous practice. There is cultural and spiritual value to the Navajo in living off of land that is free from

[1] Available at http://www.epa.gov/superfund/ tools/topics/relocation/policy.htm.

harmful levels of radioactive contaminants. When considered in light of the Agency's legal and trust responsibility to the Navajo people, this cultural spiritual value necessitates more than merely cleaning up property to an arbitrary agricultural standard.

b. Application to EE/CA analysis through Guidelines and recommendations

The Agency's own Guidelines require special consideration in the EE/CA to the unique concerns of the Navajo Nation. Among the most important of these guidelines are the effectiveness, implementability, and community acceptance criteria.

i. Effectiveness

As concerns effectiveness, extensive experience of the Navajo Nation, including in this very area of Navajo Indian country, has demonstrated that consolidating and capping is a temporary and ineffective remedy, notwithstanding good faith expectations to the contrary. The weather characteristics, intensive land use, and special demographic, cultural and economic factors make Navajo Indian country unique in this respect.

ii. Feasibility

The EE/CA's alternatives must be administratively and legally feasible. To be feasible in these respects, any alternative that implicates on-site disposal on Navajo trust land must be carefully and explicitly qualified in the EE/CA because, under applicable federal law, such a remedy requires the consent of the Navajo Nation. Neither outside governments nor private parties can take tribal trust lands, either directly or by unauthorized occupation, for use as a dump without tribal consent. *See United States v. Pend Oreilles Pub. Util. Dist.*, 28 F3d 1544, 1548 (9th Cir. 1994) ("The Utility may not condemn tribal lands embraced in a reservation under the [Federal] Power Act *or any other federal statute*) (emphasis added), *cert. denied*, 514 U.S. 1015 (1995); *United States v. 2,005.32 Acres of Land*, 160 F.Supp. 193 (D.S.D.) (Army could not condemn tribal lands), *vacated as moot*, 259 F.2d 271 (8th Cir. 1958).[2]

iii. Community Acceptance

[2] Importantly, the only lawful uses of lands owned by the United States and held in trust for Indian nations are those undertaken in conformity with federal law, and this has been true since the first Congress of the United States. *See* 25 U.S.C. § 177 (Indian Trade and Intercourse Act, first enacted in 1793;. *See*, *e.g.*, *Golden Hill Paugusett Tribe v. Weicker*, 39 F.3d 51, (2d Cir. 1994) (purpose of § 177 is to prevent encroachment by white settlers on Indian lands); *Bear v. United States*, 611 F.Supp. 589 (D. Neb. 1985) (under § 177, congressional approval was required to condemn Winnebago trust land along Missouri River), *aff'd*, 810 F.2d 153 (8th Cir. 1987); *Schaghticoke Tribe v. Kent School Corp.*, 423 F.Supp. 780 (D. Conn. 1976) (Tribal trust land is an instrumentality of the federal government and may not be taken from the Indians by contract, adverse possession, or otherwise, without the consent of the government); *7,405.3 Acres*, *supra* (same). Congress has buttressed this federal protection through other laws, also. *See Imperial Granite Co. v. Pala Band of Mission Indians*, 940 F.2d 1269, 1272 n.4 (9th Cir. 1991) (federal Quiet Title Act poses an "insuperable burden" to a suit to establish right to use Indian land).

The Agency must consider community acceptance in fashioning and selecting alternatives. This factor should be given added weight in this instance because the Agency and the Department of the Interior have determined that NEC residents comprise a "dependent Indian community," a distinct community of Indians dependent primarily on federal and tribal services.[3]

The Church Rock Chapter desires the off-site removal of all contaminated materials. This position is not an arbitrary one, but stems from cultural attributes of the Navajo people that have been expressed to the Agency both in this letter and on several prior occasions. Navajo tribe members share unique and profound ties to the land that justify their strong preference for total removal of contaminated materials from Navajo trust land. The unique attachment of the Navajo to their land has been judicially acknowledged. For example, in *United States v. Tsosie*, the court was asked to evict a Navajo woman from land where she had lived most of her life and where her umbilical cord was buried in accordance with Navajo tradition. The court explained:

> [M]any of the cultural traditions and values [of Navajo society] are strong enough and important enough to the preservation of a balanced and harmonious society to have the force of law, equivalent to a statute or even a constitutional provision in United States laws. There tradition, values and related rights and obligations are viewed by the Navajo people as sacred because they are rooted in religious songs, prayers and chants. . . . Relocating traditional Navajos from the land where their umbilical cords are buried and where they have always lived is uprooting them from their religion, and from a central part of their own identities. There are no precise analogies in the non-Navajo society of which I am aware to describe the harm that such relocation causes. It would be like yanking an infant away from its mother when the infant is still screaming and the mother is reaching for it, and the mother is killed from loneliness and the child is killed for lack of tenderness and sustenance. It is tantamount to separating the Navajo from her spirit.

849 F.Supp. 758, 774-75 (D.N.M. 1994), *aff'd*, 92 F.3d 1037 (10th Cir. 1999).

Because of the Navajo's unique connection with the land, a remedial alternative that simply retains radioactive material on Navajo land will not only be ineffective and difficult to implement (and impossible to implement without Navajo Nation consent) it will be rejected by the community it is supposed to serve. To ignore the Church Rock community's complete opposition to a solution other than complete off-site removal would be a violation of the EPA's trust responsibilities to the Navajo people. *See, e.g., HRI, Inc. v. EPA*, 198 F.3d 1224, 1247 (10th Cir. 2000) ("The fact that EPA is not specifically charged with administration of Indian lands or funds does not render unreasonable its solicitude for core Indian interests.")

3. **Conclusion**

The Navajo continue to pay much more than their fair share for the United States' successes in the Cold War. As the Agency recognizes, the uranium contamination at NECR poses a grave risk to human health and the environment. Any action that retains radioactive material on Navajo land will only prolong rather than remedy the disharmony between the Navajo and their land. To the Navajo people, for whom the land is "a central part of their identities," this disharmony is as palpable as the more outwardly visible manifestations of NECR's uranium contamination such as livestock deformities or human illnesses.

Ultimately, the Navajo Nation recognizes that, in drafting the EE/CA, the Agency must balance the conflicting interests of many important constituencies. We appreciate the difficultly inherent in this task, and

[3] 18 U.S.C. § 1151(b). *See* 72 Fed. Reg. 8380 (Feb. 26, 2007)

remain thankful for the thoughtful attention that the Agency has paid and will continue to pay to the Navajo Nation's unique situation as it completes work on the NECR EE/CA. We emphasize that any alternative that requires use or occupancy of Navajo lands must be explicitly conditioned on Navajo Nation consent, which the Navajo Nation may withhold in its sole discretion. By analyzing the unique context of the Navajo people and the NECR mine as required by the Agency's Indian Policy, trust responsibility, and established factors for EE/CA analyses, we believe the Agency will reach a fair and just resolution to this continuing problem.

Very truly yours,
NAVAJO NATION DEPARTMENT OF JUSTICE
LOUIS DENETSOSIE ATTORNEY GENERAL

David A. Taylor

David A. Taylor, Senior Attorney
NATURAL RESOURCES UNIT

P.O. Drawer 2010 • Window Rock, Navajo Nation (AZ) 86515 • 928-871-6931-6934 • Fax No. 928-871-6200

Appendix D

Supporting Data and Analysis

ANAGRP	METALS
ZONE	(All)
UNITS	(All)

Max of RESULT2			CHEM_CODE					
AREA	LOC_ID2	LABSAMPID2	AS	MO	RA-226	SE	U	V
Arroyo	Arroyo-SB-001	C06120235-072	2.6	0	14.9	4.4	29	27.1
		C06120235-073	5.4	0	17.3	3.7	27.3	29.6
		C06120235-074	7.8	0	8.4	2.1	14.3	32.6
	Arroyo-SB-002	C06120336-001	2.2	0	12.7	5.9	15.6	24
		C06120336-002	2.8	0	21.1	8	21.7	28.1
		C06120336-003	6.1	0	21	11.1	108	34.2
	Arroyo-SB-003	C06120336-004	1.4	0	12.9	0	14.2	20
		C06120336-005	3.6	0	13.3	1.9	18.6	23.3
		C06120336-006	4.7	0	12.4	3	16.4	29.6
	Arroyo-SB-004	C06120336-007	1.2	0	12.5	1.1	14.6	19.8
		C06120336-008	2.9	0	14.9	5.3	16.6	23.8
		C06120336-009	6.3	0	18.5	2.8	23.7	34.9
	Arroyo-SB-005	C06120336-010	2.2	0	18.1	12.7	25.7	30.4
		C06120336-011	4.7	0	30.2	14.4	79.2	37.9
		C06120336-012	7.3	0	10.3	4.9	27	36.6
	Arroyo-SB-006	C06120336-013	1.7	0	11.2	2.9	18.7	20.7
		C06120336-014	3.3	0	11.8	3	23.7	24
		C06120336-015	8.2	0	11.1	2.1	19.4	36.1
	Arroyo-SB-007	C06120336-016	1.8	0	14.8	3.5	21.7	34.7
		C06120336-017	2.6	0	11.1	2.9	17.1	25.5
		C06120336-018	4.3	0	35.7	4.3	45.4	37.3
	Arroyo-SB-008	C06120336-019	1.9	0	17.6	4.6	17.4	27.9
		C06120336-020	2.1	0	21.5	6.3	17.1	28
		C06120336-021	2.1	0	24.5	7.4	21.3	30.9
	Arroyo-SB-009	C06120336-024	2.2	0	11.7	5.6	22.6	22.7
		C06120336-025	1.3	0	15.5	2.3	23.7	23.5
		C06120336-026	3.5	0	15.5	11.3	31.7	32.5
	Arroyo-SB-010	C06120336-027	2.6	0	18.5	12.4	35.1	34.1
		C06120336-028	1.9	0	18.6	5.5	26.6	25.1
		C06120336-029	1.5	0	12.9	6	21.9	23.1

Arroyo	Arroyo-SB-208	C06120336-022	2.2	0	20.2	4.5	19.2	29.1
		C06120336-023	2.2	0	23	8.1	22.3	32.4
Backgrd	NECRBKG-01	C06081541-001	4.4	0	0.8	0.2	0.8	24.7
	NECRBKG-02	C06081541-002	9.2	0	1.3	0.7	1.4	29.8
	NECRBKG-03	C06081541-003	10	0	1.1	0.7	1.8	32.3
	NECRBKG-04	C06081541-004	5.1	0	1.3	0.7	1.3	40.7
	NECRBKG-05	C06081541-005	4.5	0	1.1	0.5	1	30.7
	NECRBKG-06	C06081541-006	6.1	0	1	0.6	1.1	31.9
	NECRBKG-07	C06081541-007	4.2	0	1.1	0.5	1.3	33.5
	NECRBKG-08	C06081541-008	3.1	0	1.2	0.4	1.4	32.5
	NECRBKG-09	C06081541-009	2.8	0	1.2	0.5	1.4	31.6
	NECRBKG-10	C06081541-010	2.5	0	0.9	0.5	1.1	27.3
	NECRBKG-11	C06081541-011	2.9	0	1	0.4	0.9	30.6
	NECRBKG-12	C06081541-012	3.1	0	1.2	0.3	1	23.7
	NECRBKG-13	C06081541-013	2.8	0	1	0.4	1.1	31.2
	NECRBKG-14	C06081541-014	2.4	0	1	0.2	1.1	20.1
	NECRBKG-15	C06081541-015	2.7	0	1.2	0.5	1.2	28.7
	NECRBKG-16	C06081541-016	2.7	0	0.7	0.4	1.2	23
	NECRBKG-17	C06081541-017	3	0	1.1	0	1.2	29
	NECRBKG-18	C06081541-018	2.4	0	0.6	0	1.1	21.2
	NECRBKG-19	C06081541-019	2.7	0	1.1	0.2	0.9	18.4
	NECRBKG-20	C06081541-020	2.7	0	1	0	0.9	20
	NECRBKG-21	C06081541-021	2.9	0	1	0.3	1	22.5
	NECRBKG-22	C06081541-022	3.4	0	0.8	0.2	0.9	18
	NECRBKG-23	C06081541-023	2.9	0	0.9	0	0.9	22.6
	NECRBKG-24	C06081541-024	2	0	1	0	0.9	18.8
	NECRBKG-25	C06081541-025	2.5	0	1.3	0	1.2	24.9
	NECRBKG-42	C06081541-026	3.3	0	1	0	0.9	17.5
	NECRBKG-45	C06081541-027	2.7	0	1.3	0.3	1	26.8
CORR	NECR-COR-A-01	C06081547-001			1.9			
	NECR-COR-A-02	C06081547-002			5.4			
	NECR-COR-A-03	C06081547-003			4.5			
	NECR-COR-A-04	C06081547-004			1.8			
	NECR-COR-A-05	C06081547-005			3.7			
	NECR-COR-A-06	C06081547-006			1.1			
	NECR-COR-A-07	C06081547-007			1.5			

CORR	NECR-COR-A-08	C06081547-008	3.5					
	NECR-COR-A-09	C06081547-009	6.6					
	NECR-COR-A-10	C06081547-010	31.6					
	NECR-COR-A-11	C06081547-012	1.9					
	NECR-COR-A-12	C06081547-013	6.8					
	NECR-COR-A-13	C06081547-014	8.9					
	NECR-COR-A-14	C06081547-015	10.3					
	NECR-COR-A-15	C06081547-016	9.2					
	NECR-COR-A-16	C06081547-018	6.2					
	NECR-COR-A-17	C06081547-019	185					
	NECR-COR-A-18	C06081547-020	40.4					
	NECRCOR-A-19	C06081541-028	1					
	NECR-COR-A-50	C06081547-011	32.3					
	NECR-COR-A-55	C06081547-017	8.8					
	NECR-COR-B-01	C06081542-001	11.9					
	NECR-COR-B-02	C06081542-002	10.6					
	NECR-COR-B-03	C06081542-003	9.7					
	NECR-COR-B-04	C06081542-004	11.4					
	NECR-COR-B-05	C06081542-005	15.8					
	NECR-COR-B-06	C06081542-006	15.7					
	NECR-COR-B-07	C06081542-007	14.9					
	NECR-COR-B-08	C06081542-008	14.4					
	NECR-COR-B-09	C06081542-009	18.9					
	NECR-COR-B-10	C06081542-010	21.2					
	NECR-COR-B-11	C06081542-012	19.6					
	NECR-COR-B-12	C06081542-013	21.4					
	NECR-COR-B-13	C06081542-014	19.2					
	NECR-COR-B-14	C06081542-015	21					
	NECR-COR-B-15	C06081542-016	26.4					
	NECR-COR-B-40	C06081542-011	22.1					
	NECR-COR-B-45	C06081542-017	27.6					
Homes	Home1-SS-001	C06110906-048	2.9	0	1.2	0	0.8	21.5
	Home1-SS-002	C06110906-049	2.7	0	0.9	0.3	1	28.9
	Home1-SS-003	C06110906-050	3.2	0	1	0.2	1	27.8
	Home1-SS-004	C06110906-051	2.3	0	1.3	0	1	31.2
	Home1-SS-005	C06110906-052	5.7	0	1.5	0	1.4	32.3

Homes	Home2-SS-001	C06110906-053	5.9	0	0.9	0.7	1	35.9
	Home2-SS-002	C06110906-054	5.1	0	0.9	0.3	0.7	37.5
	Home2-SS-003	C06110906-055	4.1	0	0.9	0.6	1	36.1
	Home2-SS-004	C06110906-056	3.6	0	0.9	1.2	0.8	33.4
	Home2-SS-005	C06110906-058	4.5	0	0.9	0.3	1	35.5
	Home2-SS-204	C06110906-057	4.7	0	1	0.7	1	36.5
	Home3-SS-001	C06110906-059	3.3	0	0.9	0	1.4	32.8
	Home3-SS-002	C06110906-060	3.3	0	1.1	0	0.9	31.2
	Home3-SS-003	C06110906-061	3.7	0	1.1	0.6	0.7	28.5
	Home3-SS-004	C06110906-062	4.5	0	1.2	0.7	1	37.4
	Home3-SS-005	C06110906-063	6.4	0	1.1	0	1.1	42.6
	Home4-SS-001	C06110906-064	3.9	0	1.3	0	1.1	33.5
	Home4-SS-002	C06110906-065	3	0	2.1	0.8	1.5	26.6
	Home4-SS-003	C06110906-067	3.2	0	1.6	0.7	1.5	25.8
	Home4-SS-004	C06110906-068	6	0	3.6	1.6	3.5	28.8
	Home4-SS-005	C06110906-069	4.3	0	3	1.1	2.7	28.2
	Home4-SS-202	C06110906-066	3.1	0	2.1	0.4	1.4	26.5
	Home5-SS-001	C06110906-070	3	0	1	0.9	0.8	30.1
	Home5-SS-002	C06110906-071	5.2	0	1.4	1.2	1.1	31.9
	Home5-SS-003	C06110906-072	4.4	0	0.9	1	0.9	30
	Home5-SS-004	C06110906-073	7.2	0	1.3	0.8	1.4	31.2
	Home5-SS-005	C06110906-074	3.3	0	2.1	0.7	2.4	23.8
	Home6-SS-001	C06110906-075	4.2	0	6.1	1.5	9.3	33.9
	Home6-SS-002	C06110906-076	4.4	0	11.4	2	11.1	38.4
	Home6-SS-003	C06110906-077	4.5	0	5.6	2	5.7	34.8
	Home6-SS-004	C06110906-078	4.5	0	8.9	1.7	10.2	36.8
	Home6-SS-005	C06110906-079	4.2	0	14.9	2.7	12.7	37.3
	Home7-SS-001	C06110906-080	4.9	0	3.4	1.2	2.3	31
	Home7-SS-002	C06110906-081	4.4	0	5.5	1.5	6.3	34.1
	Home7-SS-003	C06110906-082	5.2	0	29.6	6.3	20.5	49.7
	Home7-SS-004	C06110906-083	5.5	0	9.4	2	11.8	43.3
	Home7-SS-005	C06110906-084	3.4	0	7.4	1.3	9.2	28.4
	Home8-SS-001	C06110906-085	3.5	0	2.3	0.2	2.1	30.9
	Home8-SS-002	C06110906-086	3	0	2.5	0.5	2.7	33.2
	Home8-SS-003	C06110906-087	2.7	0	3.2	0.5	5.3	34
	Home8-SS-004	C06110906-088	4.1	0	5.6	1.2	6.4	34

Homes	Home8-SS-005	C06110906-089	5.3	0	3.3	0	4.9	38.8
	Home9-SS-001	C06110906-090	5	0	3.4	1	7.9	29.8
	Home9-SS-002	C06110906-091	3.6	0	3.3	0.7	8.1	27.8
	Home9-SS-003	C06110906-092	4.1	0	6.7	1.8	19.1	33.1
	Home9-SS-004	C06110906-093	2.8	0	5.4	1.2	12.4	26.1
	Home9-SS-005	C06110906-094	4.5	0	2.6	0.4	3.3	29.4
NECR-1	NECR1-SB-016	C06111057-012	0	0	80.8	59.5	758	62.4
		C06111057-014	3.8	0	21.1	9.5	99.5	34.2
		C06111057-015	0	0	64.6	29.6	141	54.4
		C06111057-016	0	0	63.1	32.8	144	35
		C06111057-017	5.1	0	1.4	0.6	21.4	38.7
	NECR1-SB-046	C06111057-003	0	0	58.8	54.2	176	52.5
		C06111057-044	0	0	31.9	24.6	71.1	41.7
		C06111057-045	0	0	19.3	5.4	72.7	31
		C06111057-046	6.9	0	1.3	1.4	337	41.5
		C06111057-047	5.2	0	1	0	3.4	34.4
		C06111057-048	5.5	0	1.1	0.5	0.8	39.2
		C06111057-049	6.2	0	1.1	0	1.1	37.9
	NECR1-SB-095	C06111057-018	3.8	0	27.7	6.7	90.4	41.9
		C06111057-019	7.9	0	7.9	1.1	11.4	48.4
		C06111057-020	5.2	0	1.8	0.9	2.4	39.7
		C06111057-078	3	0	75.7	30.6	209	45.1
	NECR1-SB-131	C06111057-084	1.6	0	41.5	14.7	58.7	34.3
		C06111057-117	2.8	0	67.4	15.4	58.6	47.8
		C06111057-118	7.3	0	1.9	0	59.4	40.7
		C06111057-119	5.1	0	1.8	0	19.2	31.5
		C06111057-120	7.9	0	1.2	0	1.6	39.8
		C06111057-121	5.2	0	1.3	0	1.5	37.3
	NECR1-SB-90	C06111057-021	4.4	0	6.9	1.9	8.5	41.2
		C06111057-022	3.1	0	4.2	0.8	43.2	44.5
		C06111057-023	0.8	0	103	20.6	125	89.5
		C06111057-024	0.9	0	90	45.4	144	63.7
		C06111057-025	0.6	0	48.9	47	218	83.3
		C06111057-026	6.4	0	1.7	0.2	313	31.7
		C06111057-027	4.9	0	1.3	0.4	331	34.5
		C06111057-028	4.3	0	1.2	1	240	35.1

NECR-1	NECR1-SB-90	C06111057-029	5.3	0	1.3	0.8	165	42
		C06111057-093	2.3	0	84.8	29	122	47.1
	NECR1-SS-005	C06111057-013	3.7	0	8.9	2.6	5.1	28.6
	NECR1-SS-018	C06111057-011	2.1	0	21.7	5.4	17	27.1
	NECR1-SS-020	C06111057-010	1.9	0	46.2	54.1	52	38.3
	NECR1-SS-023	C06111057-009	4.5	0	18.3	11.2	71.2	42.8
	NECR1-SS-026	C06111057-008	0	0	68.4	69.4	199	42.5
	NECR1-SS-028	C06111057-007	7.4	63.8	26.3	6.6	79.9	35.4
		C06120336-054	5.7	55.5	18.5	5.5	42.4	21.4
	NECR1-SS-030	C06111057-006	5.3	0	6.5	2.1	8.5	32.5
	NECR1-SS-044	C06111057-004	1.3	0	47.9	27.3	57.7	48.4
	NECR1-SS-047	C06111057-002	2.3	0	31.3	19.2	27.7	33.8
	NECR1-SS-049	C06111057-001	8.3	214	29.3	5.1	664	22.9
	NECR1-SS-065	C06111057-097	5.7	0	28.4	16	59.1	56.9
	NECR1-SS-067	C06111057-096	2.9	0	38.3	21.2	55.1	39.1
	NECR1-SS-068	C06111057-095	1.9	0	12.8	5.7	256	21.6
	NECR1-SS-070	C06111057-094	2.5	0	26.1	9.4	49.6	32.8
	NECR1-SS-101	C06111057-090	4.4	0	12.7	4.1	27.2	30.2
	NECR1-SS-103	C06111057-089	5.6	0	17.7	7.9	17.7	41.6
	NECR1-SS-126	C06111057-087	5.9	10.8	50.9	14.1	99.3	48.6
	NECR1-SS-127	C06111057-086	6.9	15.2	93.3	21.6	177	75.9
	NECR1-SS-129	C06111057-085	4.4	0	7	2.4	7.7	31.9
	NECR1-SS-133	C06111057-083	2.1	0	54.7	12.6	52.6	35.8
	NECR1-SS-135	C06111057-082	4.6	0	63.2	16.5	81	61.3
	NECR1-SS-137	C06111057-081	5.4	0	52.6	17.6	98.5	64.2
	NECR1-SS-138	C06111057-080	2.2	0	48.6	13.5	19.9	26.8
	NECR1-SS-140	C06111057-079	4.8	0	15.8	4.2	21.2	34.7
	NECR1-SS-164	C06120235-037	4.3	0	35.7	11.4	22	43.2
	NECR1-SS-173	C06120235-038	4.5	0	4.6	1.4	5.6	32.3
	NECR1-SS-184	C06120235-039	2.7	0	1.2	1	2.9	35.9
	NECR1-SS-281	C06120235-047	4	0	80.5	53.1	83.4	69.7
	NECR1-SS-289	C06120235-048	5.7	0	1.8	1	3.1	30.6
	NECR1-SS-293	C06120235-049	9	0	7	3.2	21.4	32.9
	NECR1-SS-307	C06120235-050	13.3	0	3.8	1.1	6.8	41
	NECR1-SS-316	C06120235-009	2.7	0	1.3	0	1.2	19.3
	NECR1-SS-323	C06120235-007	3.7	0	2.6	0.9	2.2	32.3

NECR-1	NECR1-SS-326	C06120235-008	2.8	0	5.2	1.6	4.3	28.5
	NECR1-SS-92	C06111057-092	3.1	0	13.2	8.2	18.1	28.3
	NECR1-SS-93	C06111057-091	2	0	35.7	12.8	56.9	29.6
	NECR1-TP-138	C06120405-010	6.9	0	24.2	13.2	73.6	42.3
	NECR-SS-207	C06120235-040	4.9	0	3.1	1.4	7.6	30.5
	NECR-SS-238	C06120235-041	7.9	0	1.6	1.4	3.4	42.9
	NECR-SS-240	C06120235-042	14.9	0	1.5	0.5	3.6	50.2
	NECR-SS-240 DUP	C06120235-043	13.9	0	1.2	1.1	3.8	48.7
	NECR-SS-262	C06120235-044	5.2	0	1.4	1.1	2.2	30.4
	NECR-SS-265	C06120235-045	4.9	0	1.6	0.4	2.4	30.6
	NECR-SS-266	C06120235-046	5.1	0	1.7	0.6	57.7	34.6
NECR-2	NECR2-SS-004	C06110906-046	4	0	1.2	0	1.5	28.9
	NECR2-SS-015	C06110906-032	3.5	0	97.2	11.9	107	46.7
	NECR2-SS-017	C06110906-033	2.8	0	55.3	13.3	48.9	39.9
	NECR2-SS-018	C06110906-034	3.4	0	3.6	1.2	2.2	29.4
	NECR2-SS-020	C06110906-042	1.3	0	38.1	15.7	66.2	26.8
	NECR2-SS-027	C06110906-047	3.4	0	35.3	6.6	12.3	34.9
	NECR2-SS-033	C06110906-035	3.3	0	2	1.2	5.2	16
	NECR2-SS-035	C06110906-037	1.9	0	160	26.7	370	67.3
	NECR2-SS-037	C06110906-036	4.8	0	4.6	1.2	7.1	33
	NECR2-SS-039	C06110906-038	2.3	0	35.4	6.5	29.5	26.7
	NECR2-SS-050	C06110906-040	6.4	0	1.2	0	2	24.7
	NECR2-SS-052	C06110906-045	2.5	0	23	5.6	43.5	31
	NECR2-SS-056	C06110906-041	3.4	0	11.9	2.6	3.9	33
	NECR2-SS-069	C06110906-043	4.7	0	8.9	2.6	9.6	34.2
	NECR2-SS-071	C06110906-044	5	0	40	14.5	45.7	58.9
	NECR2-SS-083	C06120235-017	3.3	0	3.1	0.4	3.2	26.5
	NECR2-SS-096	C06120235-018	8.1	0	1.4	0.4	3.7	39
	NECR2-SS-103	C06120235-019	4.9	0	1.5	0.6	2.1	35.6
	NECR2-SS-109	C06120235-020	6.4	0	1.6	0.9	1.7	37.2
	NECR2-TP-015	C06110906-021	3.6	0	2.5	1	17	35.4
	NECR2-TP-020	C06110906-018	3.2	0	1.2	0.9	9.7	25
	NECR2-TP-035	C06110906-015	2.9	0	10.4	1.4	35.5	18.8
	NECR2-TP-039	C06110906-019	3.6	0	5.5	2.1	32.2	33.7
	NECR2-TP-052	C06110906-016	3.4	0	12.6	4	70.6	32.5
		C06110906-017	3.2	0	2.9	0.8	32.7	25.9

NECR-2	NECR2-TP-239	C06110906-020	3.3	0	5.2	1.4	15.8	34.1
NEMSA	NEMSA-TP-001	C06110906-027	3.6	0	1.2	0.6	1	28.6
		C06110906-028	0.8	0	45.8	17.5	71	32.5
		C06110906-029	1.5	0	57.3	15.6	67	35.1
		C06110906-030	4.9	0	1.3	0.4	311	28.5
	NEMSA-TP-002	C06120336-030	4.2	0	1.7	1	4.8	32.4
		C06120336-031	0.7	0	46.6	19	79.5	41.7
		C06120336-032	0	0	68.8	38.9	125	47.3
		C06120336-033	3.7	0	1.1	0	227	25.6
	NEMSA-TP-003	C06120336-034	3.2	0	0.9	1.7	0.9	18
		C06120336-035	0.6	0	38.2	24.2	17.6	36.4
		C06120336-036	4	0	0.8	0	49.3	24.9
	NEMSA-TP-004	C06120336-037	4.3	0	1.3	1.2	4.8	29.2
		C06120336-038	1.3	0	68.8	112	136	44
		C06120336-052	0.8	0	140	40.1	390	43.2
		C06120336-053	0	0	112	132	75.8	38.5
	NEMSA-TP-005	C06120336-039	4.3	0	2.6	0	2.2	28.9
		C06120336-040	4.5	0	8.4	0.5	27.3	32.8
		C06120336-041	3.4	0	0.8	0	1.4	26.5
Pond 1/2	Pond1/2-SB-71	C06111057-071	5.5	0	0.7	0	2.1	37.6
		C06111057-072	6.7	0	1	1	3.3	43.2
	Pond1/2-SB-82	C06111057-073	2.7	0	177	56.3	339	75.6
		C06111057-074	4.6	0	14.4	3.7	22.7	36.2
		C06111057-075	5	0	12.2	3.4	18.1	38
		C06111057-076	6.8	0	1.1	0	5	42.6
		C06111057-077	5.1	0	1.5	0	1.7	37.9
	Pond12-SB-071	C06111057-069	3.1	0	49.9	11.3	73.9	34.9
	Pond12-SB-71	C06111057-070	4.7	0	0.9	0	1.3	30.2
	Pond12-SS-009	C06120235-010	2.2	0	1.7	1.2	1.6	24.6
	Pond12-SS-011	C06111057-050	5	0	1.1	0	1	35.3
	Pond12-SS-012	C06120235-011	4.5	0	1.5	0.8	1.7	35.2
	Pond12-SS-014	C06111057-051	3.2	0	96.9	36.3	47.5	56.2
	Pond12-SS-019	C06111057-052	4.9	0	4.7	0.9	7.8	34.9
	Pond12-SS-020	C06111057-054	5	0	2.2	0.5	2	35.6
	Pond12-SS-023	C06111057-055	2.5	0	62.4	22.8	28.6	38.5
	Pond12-SS-024	C06111057-056	2.5	0	26.9	7.1	16.2	28.7

Pond 1/2	Pond12-SS-032	C06120235-012	4.4	0	1.6	0.8	2	33.5
	Pond12-SS-035	C06111057-057	8.8	0	78.5	30.6	85.5	83.7
	Pond12-SS-041	C06111057-059	4.2	0	3	1.5	4.1	26.8
	Pond12-SS-042	C06111057-060	5.6	0	1	0	1.5	35.5
	Pond12-SS-047	C06111057-061	3.7	0	73.1	24.3	37.7	49.6
	Pond12-SS-050	C06111057-062	5.3	0	13.7	5.3	11.9	35.8
	Pond12-SS-056	C06111057-063	5.3	0	11.2	3.2	10.1	35.9
	Pond12-SS-058	C06111057-064	5.5	0	655	159	1080	198
	Pond12-SS-061	C06111057-065	4.4	0	26.5	5.2	36.6	35.8
	Pond12-SS-063	C06120235-013	3	0	1.2	0.6	1.3	40.1
	Pond12-SS-069	C06111057-066	3.8	0	161	33	166	79.6
	Pond12-SS-076	C06111057-067	5.2	0	2.2	0.2	8	40.8
	Pond12-SS-077	C06111057-068	5.1	0	487	83.7	423	123
	Pond12-TP-030	C06120235-057	5.5	0	41.3	13.2	149	45.2
		C06120235-058	6.4	0	6.2	1.6	80.3	30.7
	Pond12-TP-035	C06120235-060	1.4	0	41.5	11.2	38.9	31.6
		C06120235-061	4.4	0	19.6	15.5	206	35.3
	Pond12-TP-035)	C06120235-059	3.2	0	417	159	286	158
	Pond12-TP-058	C06120235-062	4.3	0	438	227	760	173
		C06120235-063	5.6	0	1.3	2.6	59.4	31.9
Pond 3/3a	Pond3/3a-SB-61	C06111057-111	3.7	0	17.3	6.8	28.4	30.3
		C06111057-112	4.8	0	0.9	0	1.3	29.6
		C06111057-113	4.8	0	1.1	0	1	27.9
		C06111057-114	4.1	0	1.5	0	1	29.7
		C06111057-115	4.5	0	1	0	1.1	34.5
		C06111057-116	4.9	0	1.3	0	1	35
	Pond3-SS-001	C06111057-110	6.1	0	18.1	5.2	42	50.4
	Pond3-SS-007	C06111057-109	5.5	0	259	22.3	1020	64.1
	Pond3-SS-014	C06111057-122	5.7	6.6	875	71.9	3970	118
	Pond3-SS-015	C06111057-108	3.9	0	18.8	8.6	11.1	32.4
	Pond3-SS-027	C06111057-107	4	0	4.7	0.9	19.1	26.9
	Pond3-SS-038	C06111057-105	6.1	0	20.9	4.2	34.9	34.1
	Pond3-SS-042	C06111057-103	5.1	0	1.4	0.7	1.9	28.8
	Pond3-SS-046	C06111057-099	6.7	0	19.5	3.3	34.3	42.5
	Pond3-SS-057	C06111057-098	8.1	0	2.8	0.7	4.5	39.9
	Pond3-SS-059	C06111057-100	5.5	0	26.9	5.2	62.9	39.5

Pond 3/3a	Pond3-SS-063	C06111057-102	6.4	0	3.8	2.9	8.8	38.9
	Pond3-SS-065	C06111057-101	5.7	0	39.6	5.2	68.4	46.8
	Pond3-SS-29	C06111057-106	5	0	312	24.5	1240	79.3
	Pond3-TP-007	C06120336-042	4.9	0	4.5	3.1	24.4	35.8
		C06120336-043	2.9	0	0.7	0	0.7	22.6
	Pond3-TP-014	C06120336-044	3.3	0	0.8	0	1.5	25.6
		C06120336-045	3.2	0	0.8	0	1.4	22.1
	Pond3-TP-029	C06120336-046	6.2	0	14.3	0.8	102	28.5
		C06120336-047	6.7	0	15.7	2.9	116	31.1
		C06120336-048	4.5	0	2.1	0	30.8	33.7
	Pond3-TP-037	C06120336-049	2.7	0	7.7	1	9.8	19.2
		C06120336-050	6.6	0	2.2	1	16.3	45.7
		C06120336-051	4.9	0	0.7	0	23.5	31.4
Sand 1	Sand1-SS-009	C06110737-028	5.1	0	1.8	0.3	1.9	20.2
	Sand1-SS-011	C06110737-024	3.2	0	5.8	0.9	2.5	22.8
	Sand1-SS-017	C06110737-022	2	0	2.1	0.3	2.8	11.8
	Sand1-SS-021	C06110737-026	2.6	0	2.3	0.7	12.6	13.4
	Sand1-SS-027	C06110737-027	2.8	0	4.4	0.6	1	14.1
	Sand1-SS-028	C06110737-029	3	0	0.8	0.2	0.7	15.6
	Sand1-SS-030	C06110737-023	4.1	0	14.3	2.5	10.6	33.9
	Sand1-SS-032	C06120235-014	4.6	0	3.8	1.3	2.5	34.4
	Sand1-SS-041	C06110737-025	5.6	0	1.3	0.4	2.1	23.2
	Sand1-SS-043	C06110737-030	3.4	0	6.7	1.7	1.8	18.8
	Sand1-SS-044	C06110737-015	6.7	0	11	1.6	1.7	31.9
	Sand1-SS-049	C06110737-016	4.9	0	16.8	3	41	81.3
	Sand1-SS-050	C06110737-018	5	0	15.7	8.1	4.5	26.1
	Sand1-SS-051	C06110737-019	4.6	0	1.9	0.5	1	32.6
	Sand1-SS-053	C06120235-015	7	0	5.4	1.4	2.5	32
	Sand1-SS-063	C06110737-020	3.3	0	20.8	3.5	6.9	28.5
	Sand1-SS-065	C06120235-016	4.6	0	4.3	1	3	30.1
	Sand1-SS-068	C06110737-021	2.3	0	47.3	19.2	41.3	42.1
	Sand1-SS-249	C06110737-017	5.1	0	19.1	3.7	44.8	82.5
	Sand1-TP-030	C06120405-011	2.9	0	113	15.8	31.7	45.7
		C06120405-020	13.9	0	4.8	1.4	5.2	44.8
	Sand1-TP-043	C06120405-012	3.4	0	0.6	0.4	0.8	17.4
	Sand1-TP-049	C06120405-013	3.4	0	75.8	17.3	32.3	40.6

Sand 1	Sand1-TP-049	C06120405-014	4.4	0	6.4	2.4	3	23.9
	Sand1-TP-063	C06120405-016	1.1	0	80.6	21.7	89.8	48.5
		C06120405-017	9.2	0	8.8	4.6	60.5	28.3
	Sand1-TP-068	C06120405-018	2.5	0	57.4	34.3	91.6	45.3
		C06120405-019	6.5	0	7.1	0.6	27	10.4
	Sand1-TP-249	C06120405-015	4.2	0	9	3.3	3.6	21.7
Sand 2	Sand2-SS-003	C06110737-001	8	0	3.3	0.9	4.2	22.6
	Sand2-SS-004	C06110737-002	7.3	0	2	0.8	2.2	29.1
	Sand2-SS-006	C06110737-003	7.8	0	1.2	0.2	1	30.9
	Sand2-SS-007	C06110737-004	4	0	16.1	2.8	7	37.6
	Sand2-SS-010	C06110737-005	9	0	1.2	0.3	1.2	42.6
	Sand2-SS-011	C06110737-006	4.7	0	6.2	1	5.4	29.6
	Sand2-SS-012	C06110737-008	3.3	0	6.2	0.9	26.3	54.2
	Sand2-SS-014	C06110737-009	3.5	0	0.8	0	0.7	12.4
	Sand2-SS-015	C06110737-010	5.5	0	4.4	0.8	2.7	38.1
	Sand2-SS-016	C06110737-011	4.5	0	6.1	1.3	2.5	34.3
	Sand2-SS-017	C06110737-012	3.2	0	36	6.3	9	41.5
	Sand2-SS-019	C06110737-013	3.3	0	21.6	3.6	27.5	49.7
	Sand2-SS-020	C06110737-014	4.1	0	27.7	5	41.4	49
	Sand2-TP-008	C06110906-026	3.6	0	2.4	0.4	15.3	45
	Sand2-TP-011	C06110906-022	5.3	0	1.1	0.5	2.5	41.7
	Sand2-TP-012	C06110906-023	3.1	0	3.8	0	26.5	50.9
	Sand2-TP-017	C06110906-024	3.8	0	1.9	0.7	2.8	29.9
	Sand2-TP-019	C06110906-025	3.6	0	1.8	0	3.2	35.2
Sand 3	Sand3-SS-002	C06110906-013	3.4	0	15.3	4.2	42.6	43.7
	Sand3-SS-004	C06120235-064	2.1	0	1.4	1	3.5	34.9
	Sand3-SS-006	C06110906-012	4.7	0	17.4	3.5	119	39.6
	Sand3-SS-008	C06110906-014	3.7	0	1.4	0.5	2.9	34.1
	Sand3-SS-010	C06110906-010	3.8	0	33.4	7.2	136	45
	Sand3-SS-012	C06120235-065	4.3	0	1.4	0	2.3	38.8
	Sand3-SS-014	C06110906-005	1.7	0	123	33.5	396	51.5
	Sand3-SS-017	C06110906-011	5.3	0	1	0.7	1.4	26
	Sand3-SS-022	C06110906-004	2.9	0	1.2	0	0.9	22.7
	Sand3-SS-024	C06110906-003	4.3	0	27.4	5.8	7.4	33.2
	Sand3-SS-025	C06110906-002	2.7	0	26.9	5.5	10.9	28.6
	Sand3-SS-026	C06110906-001	2.5	0	19.6	5.3	7.3	20.6

Sand 3	Sand3-SS-027	C06110906-007	4.7	0	4.5	1.4	3.2	28.7
	Sand3-SS-05	C06110906-009	1.5	0	66.9	32.2	86.4	54.5
	Sand3-SS-09	C06110906-008	3.7	0	31.9	14	41.4	41
	Sand3-SS-214	C06110906-006	1.7	0	123	47.6	516	63.5
	Sand3-TP-005	C06120235-066	0.8	0	40.8	39.2	131	63.3
		C06120235-067	4.3	0	28.1	3.6	78.8	33.9
	Sand3-TP-006	C06120235-068	5	0	8.4	0.8	102	35
	Sand3-TP-009	C06120235-069	6.9	0	5.1	1.7	90.6	38
	Sand3-TP-014	C06120235-070	4.2	0	1.2	1.3	227	29.4
		C06120235-075	1.5	0	84.1	29	488	52.2
	Sand3-TP-025	C06120235-071	4.6	0	27.2	8.9	21.1	41.3
Sed Pad	SEDPAD-SS-005	C06111057-030	3.1	0	17.7	3.7	14.1	25.5
	SEDPAD-SS-006	C06111057-031	3	0	38.8	14.2	21.7	39.5
	SEDPAD-SS-011	C06111057-033	11.6	0	3.8	2.7	27.3	502
	SEDPAD-SS-014	C06111057-036	2.7	0	236	78.8	366	106
	SEDPAD-SS-015	C06111057-037	1.5	0	33.4	12.9	34.7	31.5
	SEDPAD-SS-018	C06111057-038	7.1	0	1.5	1.3	1.9	46.8
	SEDPAD-SS-020	C06111057-039	6	0	12.8	3.8	17.7	22.2
	SEDPAD-SS-021	C06111057-040	1.3	0	85.6	45.4	1640	59.1
	SEDPAD-SS-022	C06111057-041	1.3	0	104	44.5	85.9	60.7
	SEDPAD-SS-025	C06111057-042	1.5	0	36.7	7.5	21.9	29.9
	SEDPAD-SS-026	C06111057-043	3	0	27.1	9	33.1	32.1
	SEDPAD-SS-07	C06111057-032	1.1	0	106	45.5	92.4	63.4
	SEDPAD-SS-08	C06111057-034	3	0	25.8	7.9	19.8	35.5
	SEDPAD-SS-12	C06111057-035	0.9	0	118	37.8	363	52.9
	SEDPAD-TP-006	C06120405-001	0.6	0	92.9	161	68.6	74.7
		C06120405-002	4.2	0	2.8	2.4	88.7	29
	SEDPAD-TP-012	C06120405-003	0.8	0	84	83.5	147	48.4
		C06120405-004	4.3	0	2.9	2.7	158	30.7
	SEDPAD-TP-014	C06120405-005	2.7	0	165	61.4	252	75
		C06120405-006	3.8	0	9.8	3.4	18.9	31.5
	SEDPAD-TP-021	C06120405-007	1.9	0	99.7	63.9	357	60.3
		C06120405-008	0	0	86.3	74.1	270	63.9
	SEDPAD-TP-026	C06120405-009	5.5	0	86.6	40.9	89	65.4
Trailer	Trailer-SS-001	C06120235-051	3.7	0	12.5	6.6	12.7	43.7
	Trailer-SS-009	C06120235-053	6.1	0	102	39.8	139	61.3

Trailer	Trailer-SS-013	C06120235-052	0	0	33.2	101	44	78.4
	Trailer-SS-024	C06120235-054	5.4	0	2.1	1.7	16.7	32.8
	Trailer-SS-027	C06120235-056	5.3	0	2.1	0.8	1.7	31.7
	Trailer-SS-224	C06120235-055	5.5	0	1.8	1.1	16.5	33.1
Vent 3/8	Vent3-SS-034	C06120235-005	2.3	0	1.4	0.2	1.1	9
	Vent8-SS-002	C06120235-001	5.1	0	3.6	2.9	5.2	35.3
	Vent8-SS-006	C06120235-003	3.3	0	13.2	5	19.4	30.3
	Vent8-SS-019	C06120235-006	3.3	0	137	27.4	358	55.4
	Vent8-SS-031	C06120235-004	2.6	0	2.2	0.9	2.1	21.6
	Vent8-SS-202	C06120235-002	4.6	0	3.9	1.4	4.6	32.8
Boneyard	Boneyard-TP-001	C06110906-031	1.3	0	45.9	16.7	17.4	41.3
		C06120235-021	5.2	0	1.3	0.2	0.8	29.9
		C06120235-022	3.7	0	1.6	0.4	0.8	29
	Boneyard-TP-002	C06120235-023	5.5	0	2.2	0.6	2.1	32
		C06120235-024	5.2	0	1.1	0	1.5	31.1
		C06120235-025	4	0	1.1	0	0.9	27.8
	Boneyard-TP-003	C06120235-026	5.1	0	1.1	0.8	1.5	31.6
		C06120235-027	5.1	0	1.2	0	1	37.8
	Boneyard-TP-004	C06120235-029	1.9	0	50.7	33.4	228	33.9
		C06120235-030	3.3	0	10.1	3.1	240	22.2
		C06120235-031	3.5	0	1.9	0.8	5.5	24.7
	Boneyard-TP-004)	C06120235-028	0.8	0	48.4	24.3	12.5	36.9
	Boneyard-TP-005	C06120235-033	4	0	1.2	0	1	26
		C06120235-034	4	0	1.4	1.2	5.6	25.2
		C06120235-035	4	0	1.7	0.3	4.3	24.7
		C06120235-036	4.9	0	1.9	0.5	8.4	25.6
	Boneyard-TP-204	C06120235-032	4.2	0	13	4.6	475	24.5

Subsurface Soil Analytical Results Supplemental Removal Site Evaluation Sampling, April 2008 Northeast Church Rock Mine Site					
Location ID	**Depth (ft bgs)**	**Ra-226 (pCi/g)**	**Uranium (mg/kg)**	**Gamma (cpm)**	**Comments**
Unnamed Arroyo					
A-420	2	n/a		51,997	
	5	6.7	22.9	48,306	
	10	1.1	10.1	45,876	
	15	n/a		45,491	
	20	n/a		42,922	Possible bedrock
	25	n/a		45,957	Weathered bedrock
A-421	2	n/a		40,592	
	5	7.0	42.9	40,813	
	10	1.4	11.3	37,414	
A-422	2	n/a		63,052	
	5	n/a		63,185	
	10	6.6	14.6	58,560	
	15	1.6	7.69	56,082	
	20	1.3	7.11	53,924	
A-423	2	n/a		80,863	
	5	n/a		79,971	
	10	1.2	24.6	72,861	
	15	2.9	14.9	72,028	
	20	n/a		73,970	
	25	n/a		73,680	
	30	n/a		72,234	
	35	n/a		73,808	
	40	n/a		72,458	
	45	n/a		n/a	Bedrock
Boneyard					
BY-415	5	1.8	48.2	18,852	
	10	0.7	34.6	17,938	
	15	n/a		17,863	Possible bedrock
NECR-1					
N1-419	2	n/a		84,000	
	5	19	13.9	75,326	
	10	2.4	55.2	72,758	
	15	n/a		n/a	
NEMSA					
NA-416	5	n/a		50,573	
	10	n/a		37,417	
	15	17.5	117.0	44,685	
	20	1.9	17.6	31,452	
NA-417	2	3.1	21.6	23,570	
	5	2.5	11.1	23,531	

Subsurface Soil Analytical Results Supplemental Removal Site Evaluation Sampling, April 2008 Northeast Church Rock Mine Site					
Location ID	**Depth (ft bgs)**	**Ra-226 (pCi/g)**	**Uranium (mg/kg)**	**Gamma (cpm)**	**Comments**
Pond 1					
P1-418	2	n/a		226,493	
	5	n/a		226,202	
	10	15.6	74.6	229,405	
	15.5	n/a		n/a	Bedrock
Pond 3					
P3-414	2	n/a		74,081	
	5	n/a		73,993	
	10	2.4	26.5	66,348	
	15	1.8	21.9	65,897	
	20	n/a		n/a	Weathered bedrock
Notes: n/a = not applicable					