Prepared for:

United Nuclear Corporation
P.O. Box 3077
Gallup, NM 87305

GE Corporate Environmental Program
640 Freedom Business Center
King of Prussia, PA 19406

NORTHEAST CHURCH ROCK MINE
EASTERN DRAINAGE REMOVAL ACTION

CONSTRUCTION COMPLETION REPORT

March 13, 2013

Prepared by:

MWH
2130 Resort Dr., Suite 200
Steamboat Springs, Colorado 80487
(970) 879-6260

TABLE OF CONTENTS

Section No. **Page No.**

LIST OF TABLES

LIST OF DRAWINGS

LIST OF APPENDICES

Appendix **Description**

CERTIFICATION

Under penalty of law, I certify that to the best of my knowledge, after appropriate inquiries of all relevant persons involved in the preparation of the report, the information submitted is true, accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

_____

Lance Hauer
GE, Corporate Environmental Programs
Designated Project Coordinator

1.0 INTRODUCTION

This Eastern Drainage Removal Action (EDRA) Construction Completion Report provides information on the soil removal action and results of confirmation sampling and testing completed as part of EDRA activities north and northeast of the Northeast Church Rock (NECR) Mine (the mine site). The site is located approximately 16 miles northeast of Gallup, New Mexico, as shown on Drawing 1, *Cover and Index Sheet*. The original ground conditions that were present prior to the EDRA construction are shown on Drawing 2, *Original Conditions*. The Eastern Drainage area is located east of and adjacent to Red Water Pond Rd, as shown on Drawing 2.

The removal activities were performed in accordance with the *Administrative Settlement Agreement and Order on Consent for Time Critical Removal Action and Cost Recovery* (AOC) between General Electric Company (GE) and the U.S. Environmental Protection Agency, Region 9 (USEPA), dated September 26, 2011. Concurrent with the EDRA, Rio Algom performed a removal action to address impacts from the Quivira Mine to Red Water Pond Road and the road shoulders. The work was performed pursuant to an EPA Unilateral Administrative Order (EPA, 2012).

This report describes the activities that were performed to comply with the AOC and has been prepared to meet the requirements of Section 31 of the AOC and referenced regulations and guidance documents. This report is organized into five sections, as follows:

- Section 1 provides a brief introduction to the project, background summary and the major activities performed.
- Section 2 describes removal activities performed in the EDRA areas.
- Section 3 presents the results of the Interim and Final Status Surveys.
- Section 4 provides an estimate of the total costs incurred implementing the AOC.
- Section 5 lists the references cited.

1.1 SCOPE OF WORK

Removal activities were performed in accordance with the AOC and as described in the *Removal Action Construction Work Plan, Eastern Drainage Area* (Work Plan), dated August 30, 2012 (MWH). The removal activities required by the AOC are described in the Scope of Work (SOW) attached to the AOC and included the following:

- Removal of soils from the EDRA areas containing Radium-226 (Ra-226) in excess of the Removal Action Level (RAL) of 2.24 pCi/g consistent with the *Multi-Agency Radiation Survey and Site Investigation Manual* (MARSSIM)(EPA, 2000).

- Consolidation and covering of excavated materials within the Consolidation Area located on the NECR-1 pad at the mine site.

- Installation and maintenance of erosion and sedimentation controls.

- Interim and final status surveys to demonstrate that the objectives of the EDRA were met.

- Applying organic mulch and reseeding of areas disturbed by the removal activities.

- Removal of commingled ^{226}Ra and diesel fuel in impacted soil area north of NECR-1 pad and placement at the NECR mine.

- Installation and operation of a bio-venting system and performing monitored natural attenuation to reduce total petroleum hydrocarbon concentrations in the subsurface on lands within the Navajo Reservation. This work is in progress and will be reported separately.

- Confirmation sampling and analysis.

- Returning disturbed areas to pre-removal conditions.

1.2 BACKGROUND SUMMARY

1.2.1 Ra-226 Impacted Soils

The areas of concern for the EDRA were investigated in 2011 as described in the document *Supplemental Removal Site Evaluation Report, East Drainage Area* (MWH, 2011). The results of that Supplemental Removal Site Evaluation (SRSE) indicated that elevated Ra-226 concentrations were present in soils within the Eastern Drainage channel between Red Water Pond Rd. and unnamed arroyo no. 2 and portions of the flats area to the north of this section of the channel. A supplemental RSE was previously conducted along Red Water Pond Rd. and the road shoulders and described in the document

Removal Site Evaluation Report, Red Water Pond Rd. (MWH, 2010c). The results of these supplemental RSEs are shown on Drawing 3, *Supplemental RSE Results and Preliminary Construction Zones.* Ra-226 concentrations were screened against the field screening level (FSL) for Ra-226 (2.24 pCi/g), which is based on an average background concentration of 1.0 pCi/g plus the Derived Concentration Guidance Level ($DCGL_W$) of 1.24 pCi/g (MWH, 2006), in accordance with MARSSIM.

The Eastern Drainage SRSE was initially limited to the Eastern Drainage channel itself. However, during the gamma radiation survey of the north bank of the channel, it was observed that the flats area north of the channel appeared to have received runoff from the channel during high rainfall events or snowmelt runoff. Therefore, the Eastern Drainage SRSE was extended to the north into the flats area bounded by Red Water Pond Rd., unnamed arroyo no. 2 and the Eastern Drainage channel (see Drawing 3). The results of the SRSE confirmed that the flats area contained elevated levels of Ra-226 in shallow soils.

USEPA surveyed surface soil surrounding the home site located within the Eastern Drainage area. A continuous walk-over gamma radiation survey of the area was conducted and readings ranged up to 65,000 counts per minute (cpm). Soil samples were then collected on an approximately 80-ft triangular grid and submitted to a laboratory for analysis of Ra-226 by USEPA Method 903.1. Results ranged from non-detect (<0.03 pCi/g) to 9.16 pCi/g, as shown on Drawing 3.

The majority of soil impacts above the FSL were determined to be at or near the ground surface (0 to 6 inches below ground surface (bgs)). Some impacts were detected in the subsurface from 0.5 to less than 2 feet bgs in the Eastern Drainage flats area and to less than seven feet bgs within the Eastern Drainage channel. To delineate subsurface impacts, soil samples were collected below six inches in selected, representative locations where surface static gamma measurements indicated Ra-226 activities above the FSL. Subsurface soil samples were collected at multiple depths in some locations in order to fully delineate the vertical extent of impacts.

1.2.2 Petroleum Impacted Soils

While removing Ra-226 impacted soils during the prior Interim Removal Action (IRA), petroleum impacted soils were encountered beneath and north of the NECR-1 pad, as discussed in the document *Completion Report, Interim Removal Action* (MWH, 2010a). Approximately 4,000 cubic yards of impacted soils were removed during the IRA.

Excavated materials were placed at the mine site in the TPH Stockpile Area east of Pond 3, as shown on Drawing 2. Excavation of the petroleum impacted soils was discontinued during the IRA due to the depth and to avoid causing instability to the slope of the NECR-1 pile. Consequently, these areas were covered with approximately six inches of clean borrow soil. Additional investigation into the extent of petroleum impacts and remaining Ra-226 impacts in this area were conducted in April 2010 and December, 2010, respectively. Alternatives for remediation of the petroleum impacts were evaluated and described in the report *Petroleum Investigation Results and Bioventing Pilot Study Plan* (MWH, 2010a). Since excavation in this area was discontinued during the IRA, Ra-226 impacted soil was left in place. Consequently, this area was included as part of the EDRA in order to address remaining impacted soils.

2.0 REMOVAL ACTION ACTIVITIES

Based on the results of the SRSE (MWH, 2011b) and the petroleum investigation (MWH, 2010a), as discussed in Section 1.2 and shown on Drawing 3, the EDRA areas were divided into 6 zones based on their location and expected excavation depths, as follows:

- Zone 1 – Eastern Drainage channel
- Zones 2-5 – Eastern Drainage flats area
- Zone 6 – Area North of NECR-1 (petroleum impacted soil area within step out area 1 addressed as part of 2009 IRA)

Zones 1 through 5 were located east of Red Water Pond Rd. within Step-out Area No. 2 and Zone 6 was located adjacent to the NECR-1 pile within Step-out Area No. 1, as shown on Drawing 3.

2.1 REMOVAL SCHEDULE

Weekly construction reports and field notes were prepared during construction that explain the sequence of events and the dates on which they occurred, by way of text and photographs. Copies of those reports are included in *Appendix A, Weekly Construction Reports and Field Notes*. Removal activities were implemented between August 15 and November 10, 2012. Baseline vegetation sampling was conducted on August 15 and 16, 2012. Equipment and personnel mobilization, and pre-construction activities were conducted September 3 through September 7, 2012. Major earthworks were conducted between September 10 and October 26, 2012. Seeding to revegetate the disturbed areas was conducted November 9 and 10, 2012.

2.2 RESIDENT HOUSING

Temporary, voluntary housing was provided by the USEPA to residents of households located in or near the EDRA, as well as the RWPR Removal Action.

2.3 PRE-CONSTRUCTION ACTIVITIES

2.3.1 Erosion and Sedimentation Controls

Erosion and sediment (E&S) control methods were implemented during and after the EDRA construction in accordance with the approved *Construction Storm Water Pollution*

Prevention Plan (SWPPP) included in the Work Plan. The objective of the SWPPP was to isolate and control water at the source and minimize sediment transport offsite during construction activities. Surface water was controlled to limit flow velocities and route runoff away from regraded and revegetated slopes. The E&S control measures that were implemented included:

- silt fencing
- soil berms
- hay bales
- grading to maintain positive drainage in the preferred directions

In addition, field inspections were conducted following significant storm events. There were no major E&S issues encountered during the construction and all sedimentation was contained onsite.

2.3.2 Radiological Boundary Survey

Prior to the start of excavation, the excavation boundaries were confirmed by conducting scan and static gamma radiation surveys. The methods and equipment that were used to conduct the boundary survey were the same as were used for excavation control surveying, as explained in Section 2.4.1. The results of the boundary survey indicated that the boundaries specified in the Work Plan were correctly located, except for a small area in the southwestern corner of the Eastern Drainage area, in which the boundary was extended south of the channel approximately 75 feet adjacent to Red Water Pond Rd.

2.3.3 Existing Conditions Topographic Survey

Prior to the start of excavation, the EDRA areas were surveyed by Morris Surveying Engineering, LLC to determine the current topography. The original conditions topographic survey was used to ensure accurate elevation data and to calculate the volumes of soil removed and backfilled, by comparing to a post-construction topographic survey that was conducted, as discussed in Section 2.5.2.

2.3.4 Cultural Resources Inventories

Two cultural resources inventories were conducted within Step-out Area No. 2, which encompasses the EDRA area east of Red Water Pond Rd. (Zones 1-5, as shown on Drawing 3). The surveys were conducted by Dinetahdoo Cultural Resources

Management (Dinetahdoo) in March 2011 and July 2012. The survey identified no significant cultural resources within the EDRA area, but two archaeological sites (NM-Q-21-100 and NM-Q-20-50) were identified to the south of the area. The results of those surveys are included in *Appendix B, Cultural Resource Survey Reports*.

One of the two sites identified, NM-Q-21-100, was directly adjacent to the south side of the Eastern Drainage channel. As requested by the Navajo Nation Historic Preservation Office, the boundary of this site was flagged by a qualified archaeologist prior to ground disturbing activities in the vicinity of the site. All disturbance activities were kept at least 50 feet away from the site boundary, except along its northern side. The northern side of the site was less than 50 feet from the southern edge of the Eastern Drainage channel excavation area. As such, extra caution was taken while excavating near the north side of the site and was overseen by an archeologist from Dinetahdoo. That site was fully preserved and no impacts occurred to the site during construction.

In addition to the surveys conducted in Step-Out Area No. 2, a cultural resources inventory was also conducted in Step-Out Area No. 1 in 2009 as part of the IRA (MWH, 2010b). Step-Out Area No. 1 encompasses Zone 6 located adjacent to the NECR Mine site, as shown on Drawing 3. No cultural resource sites were identified within or near (less than 100 feet) Zone 6.

2.3.5 Borrow Area

The borrow material that was used to cover the Soil Consolidation Area and to backfill excavations, including the Eastern Drainage Channel, came from the same borrow pit used during the 2009 IRA, as shown on Drawing 2. The borrow pit was sampled and analyzed in 2009 for Ra-226, the results of which were below 2.24 pCi/g (MWH, 2010b).

2.4 CONSTRUCTION ACTIVITIES

2.4.1 Perimeter Air Monitoring

Perimeter air monitoring was conducted during the EDRA in accordance with the Work Plan and included monitoring for radiation exposure and airborne respirable dust. Engineering controls were used during construction order to ensure radiation protection and to limit doses to members of the public that are as low as reasonably achievable (ALARA), in accordance with the Code of Federal Regulations, Title 10, Part 20, Subpart D, Radiation Dose Limits for Members of the Public. Air monitoring was conducted at

upwind and downwind locations for internal and external radiation, as shown on Drawing 4, *Perimeter Air Monitoring Stations*.

The perimeter air monitoring program also included monitoring for respirable dust according to EPA's Primary National Ambient Air Quality Standard during.

2.4.2 Excavation Control Surveying

Radiological excavation control surveys were conducted during soil removal for the EDRA in a manner consistent with MARSSIM guidance (EPA, 2000). The objective of the excavation control surveys was to guide removal of impacted soils to confirm that the EDRA areas had been sufficiently excavated in accordance with MARSSIM, and to provide initial radiological data for the status surveys, which are presented in Section 3.0. Both in-situ and ex-situ excavation control surveys were used, as described below.

The in-situ excavation control surveys consisted of real-time direct gamma radiation level measurements in the field, as described in Section 5.4 of MARSSIM (EPA, 2000) for remedial action support surveys. The in-situ excavation control surveys were conducted within the shallow areas of Zones 2-6 (i.e., not within the Eastern Drainage channel or any excavations deeper than approximately two feet) using a 2x2-inch Sodium Iodide (NaI) gamma scintillation detector, as described in Appendix C. The excavation control surveying included both static and scan radiation surveys. Following the specified initial excavation lift within each area, the excavation control scan surveying was performed to identify any location that exceeded RAL. The scan survey for the excavation control was performed for 100% coverage in each excavation area. If no point or a location exceeding the RAL was identified within a 200-ft grid cell by the scan, the area was marked as <RAL in the Excavation Control Grid Forms, which are included in Appendix C. A one-minute static radiation measurement at several points in that grid area was then conducted and recorded in the Static Gamma Radiation Survey Field Forms, included in Appendix C. If the static radiation survey counts (cpm) were below the RAL in that grid cell, the grid cell was considered to meet the RAL and ready for the Interim Status Survey.

Ex-situ gamma radiation surveying was used for excavation control in the Eastern Drainage channel and other deeper excavations due to radiation shine interferences from the channel banks. Once the excavation of impacted channel bed sediments was completed to the depths estimated from the Eastern Drainage SRSE results (MWH, 2011b), a soil sample was collected from the base of the excavation and screened in the field using a 3x3 NaI detector fitted with a 1.5-inch lead collimator, as described in

Appendix C. The gamma counts (cpm) of the excavation samples were compared to the counts of a reference sample with a known Ra-226 concentration (near the RAL) to screen the excavation and evaluate the Ra-226 concentrations. Subsurface soil samples were collected for screening continuously during excavation, as needed, based on the results of the SRSE, field observations (e.g., soil color and texture) and the requirements of the excavator. Excavation of the channel bed, collection of soil samples, and ex-situ soil screening was continued at each location to confirm that soils had been sufficiently excavated in accordance with MARSSIM. Once this was complete for each segment of the channel, that segment was then considered finished and ready for a Final Status Survey, as explained in Section 3.0. The results of the ex-situ field screening measurements are included Appendix C.

The limits of excavation of soils from the Area North of NECR-1 (Zone 6) was determined in the field based on excavation control surveying, as discussed above, for the areas containing commingled TPH and Ra-226. For shallow soils (less than two feet bgs) containing only TPH-impacted soils, the excavation limits were determined by visual observation (e.g., dark staining).

2.4.3 Excavation and Backfilling

Excavation of materials from the Eastern Drainage flats area (Zones 2-5) that exceeded the RAL was conducted from north to south, starting with Zones 2, 3 and 5, and finishing with Zone 4. A number of methods were used to remove the material depending on the depth of removal and ground conditions in the area. Open areas with few obstacles (e.g., roads, utilities, and fences) were excavated by stockpiling surface materials with dozers, loaders, and a motor grader. Other areas including excavations to greater depth and/or around obstacles were excavated with an excavator. Depth of excavation varied from six inches to about five feet within discrete areas of the flats, as shown on Drawing 5, *Excavation Depths*. Areas within the Eastern Drainage channel and the head-cut erosion gulley were excavated deeper, as shown on Drawing 5. Following the completion of status surveying (see Section 3.0), deep excavations were backfilled to the elevation of the surrounding grade with material from the borrow area. Excavated materials were hauled to the NECR-1 pile and placed in the Soil Consolidation Area, which is shown on Drawing 6, *Final Conditions* (see also Section 2.4.3). A total of 26,475 cubic yards (yd^3) were excavated from Zones 2-5 and 3,100 yd^3 of borrow soil were used to backfill the deeper excavations and ensure the ground surface provided positive drainage. The final site conditions are shown on Drawing 6, *Final Conditions* and Drawing 7, *Detailed Final Conditions, Eastern Drainage Area*.

The Eastern Drainage channel was then excavated from the west end to the east end, using an excavator. The depth of excavation ranged from approximately 2 to 4 feet below the original grade along most of the channel length to as much as 10 feet adjacent to Red Water Pond Rd. A total of 2,210 yd^3 were excavated from the channel and a total of 2,250 yd^3 were used to backfill and reshape the channel.

The channel was reconstructed with a trapezoidal shaped cross-section, as shown on Drawing 8, *Plan and Profile, Eastern Drainage Channel*, and Drawing 9, *Profile Sections, Eastern Drainage Channel*. A filter/bedding gravel material was used between the native subgrade and an overlying layer of riprap, which provides erosion protection. The filter gravel was imported from offsite and was tracked into place, 6-inches thick, prior to placing a 12-inch riprap channel lining. The source of the filter gravel and riprap was the same as that used for the IRA, the General Rock Products' Thoreau Pit. A copy of the current gradation data from the rock supplier and the results of the 2009 gamma scanning of the material are included in Appendix D.

Following excavation of Zones 1-5, excavation of Zone 6 within Step-out Area 1 was conducted. A total of 3,695 yd^3 were excavated from Zone 6, and 2,268 yd^3 were used to backfill the excavation and bring it up to grade. TPH-impacted shallow soil that was shown by excavation control surveying and field observations to contain both TPH and Ra-226 above the RAL was excavated and placed in the Commingled TPH and Ra-226 Stockpile, which is located on top of the TPH Stockpile Area, as shown on 6. The Commingled TPH and Ra-226 Stockpile was covered with six-inches of clean borrow soil. Soils excavated from Zone 6 that did not contain TPH were placed in the Soil Consolidation Area, shown on Drawing 10, *Detailed Final Conditions, Soil Consolidation Area*.

2.4.4 Soil Consolidation Area

Excavated soils from Zones 1-5 were placed in the Soil Consolidation Area, which is shown in Drawing 10. The Soil Consolidation Area is located on top of the NECR-1 pile where the 2009 IRA soils were placed. The pile was constructed so that no slopes are greater than 3H:1V and the top surface slopes to the central channel at a grade of approximately 3.5 percent. Following completion of excavation, the Soil Consolidation Area was covered with six inches of clean soil.

2.5 POST-CONSTRUCTION ACTIVITIES

2.5.1 Interim and Final Status Surveys

Subsequent to the completion of excavation, each Removal Action area underwent an Interim Status Survey (Zones 2-6) or a Final Status Survey (Zone 1) in accordance with MARSSIM in order to confirm that excavation activities met the objectives of the EDRA. The Interim and Final Status Surveys are described in Section 3.0.

2.5.2 As-Built Topographic Survey

At the completion of the excavation, backfilling and final grading, a final conditions topographic survey was conducted by Morris Surveying Engineering, LLC. The final conditions topography is shown on Drawing 6 and all of the subsequent drawings.

2.5.3 Revegetation

The final restoration step for the EDRA was revegetation of the disturbed areas, which was conducted in accordance with the *2012 Eastern Drainage Revegetation Plan* (Cedar Creek, 2012), a copy of which is included in Appendix E, *Final Revegetation Plan and Seed Certificates*. Revegetation included planting of the designated seed mixes, which are shown in Table 1, *Primary Seed Mix* and Table 2, *Supplemental Seed Mix*. The primary seed mix is the same seed mix that was used for revegetation of the 2009 IRA areas. Seeding of the primary seed mix was used on all revegetated areas of the EDRA: Zones 2-6 and the borrow area. The supplemental seed mix was used in addition to the primary seed mix on all restored areas east of Red Water Pond Rd.: Zones 2-5 and the borrow area. Zone 1 was not revegetated because it was covered with riprap. Copies of the seed mix certification tags are included in Appendix E. Planting took place in November 2012 after surface preparation was completed.

Two preferred planting techniques were used in most areas, as indicated on the seed mix tables. These two methods were broadcast seeding with harrowing and drill seeding. Seed designated for broadcasting was applied first, followed by seed designated for drilling. On the steeper portions of the borrow area and the Area North of NECR-1 (Zone 6) the seed was mixed into a hydro mulch solution and sprayed onto the ground surface. One area high on the steepest portion of the borrow area was out of reach by the hydroseed method and so the seed was therefore broadcast by hand. The seed in all other areas was applied in accordance with the methods listed in Tables 1 and 2.

Broadcast seeding was accomplished by placing a cyclone spreader on the front of the equipment (tractor) that pulls the seed drill. The cyclone was adjusted to spread seed the approximate width of the drill. The action of the seed drill then acts as a harrow to lightly cover the broadcast seed with soil. Harrowing was very light so as not to overly bury distributed seed (i.e., no deeper than 2 to 3 mm). A very short length of chain-link fencing dragged over the broadcast area was used for light harrowing. Drilling of grass seed was accomplished by setting depth bands on a seed drill to place seed 5 to 8 mm below the surface. An experienced seed applicator was used in order to obtain proper distribution of the indicated amount of seed on a per acre basis, as indicated in Tables 1 and 2.

Areas exhibiting flatter slopes (<3:1) were not mulched and no areas received any straw. However, the steeper areas (e.g., the borrow area and Area North of NECR-1) were hydro-mulched with wood fiber that contained a pre-mixed tackifier.

As indicated on Tables 1 and 2, the seed mixes were comprised entirely of native species adapted to low-fertility soils and to the climactic regime of the project area. As stated above, the primary seed mix was the same seed mix that was used for revegetation of the 2009 IRA areas. Prior to seeding, four tons per acre of sterile organic cow manure was incorporated into the soil profile by disking. The manure amendment was added to improve the potential for revegetation success by increasing the organic content and improving the agronomic properties of the soil. Inorganic fertilizers were not used during the EDRA.

2.5.4 Post-Removal Site Control

The EDRA areas are surrounded by existing fencing. Any fencing that was removed or damaged during the EDRA was repaired. Fencing around the revegeted areas is necessary to restrict access to seeded areas by grazing animals to enable vegetative success. The alignment of the fences is shown on Drawing 6.

The fence consists of metal t-posts driven into the ground at approximately 10 foot centers. Hog wire was placed from ground level to four feet above ground. Two strands of barbed wire were installed above the hog wire. Total fence height is approximately five feet.

2.6 PERIMETER AIR MONITORING RESULTS

2.6.1 Monitoring for Radiation Exposure

Perimeter air monitoring for internal and external radiation exposure to individual members of the public was conducted during RA construction according to the methods described in the Work Plan. Perimeter air monitoring was conducted for:

- Internal radiation exposure from the radionuclides U-nat, Th-230 and Ra-226
- Internal radiation exposure from ambient radon concentrations
- External radiation dose

Perimeter air monitoring was conducted at an upwind location, near the school bus stop downwind of the Soil Consolidation Area and Zone 6, and along the north perimeter of the Eastern Drainage area downwind of construction activities in Zones 1-5.

The air monitoring was conducted for gross alpha activity to assess compliance with the U-nat, Th-230 and Ra-226 internal dose limits for individual member of the public, as specified in 10 CFR20.1302(b). Radiological air monitoring was conducted at the following frequency at each of the locations:

- Baseline - two days prior to any construction activities.
- Five days per week for the first week of excavation activities
- Three days per week for the second week of construction
- Two days per week for the third, fourth, fifth and sixth weeks of construction
- One day per week for the seventh and eighth weeks

The sampling results are summarized in Table 3, *Internal Radiation Monitoring Results*. The sampling and counting data are included in Appendix C. The baseline sampling conducted prior to construction activities showed the upwind and downwind concentrations to be similar. The results showed that U-nat, Ra-226 and Th-230 net concentrations (upwind subtracted) for all individual perimeter air samples at both downwind locations were less than their Derived Air Concentrations (DACs), except on one occasion. On 09/17/2012 Th-230 at the north perimeter location was at 2.54E-14 uCi/ml (119% of DAC). On this day, the air sampler was placed within the work zone, approximately 15 feet from the excavation activities in Zone 2 near the dust monitor to provide power to the dust monitor from the generator that was used for the perimeter air

sampler. When noticed, the perimeter air sampler was moved back to its north perimeter location. No air concentration exceeded any DAC thereafter. The results showed that the mean downwind net concentrations for U-nat, Ra-226 and Th-230 were less than 25% of their respective DACs for the EDRA activities.

Ambient radon concentrations during the NECR EDRA were monitored by placing Landauer radon trek etch detectors at the same three air monitoring stations discussed above. The radon trek etch detectors were exposed at the sampling stations during the EDRA and sent back to Landauer for analysis. The radon monitoring report is included in Appendix F. The results showed radon concentration of 1.5 pCi/l, 1.7 pCi/l and 2.1 pCi/l at the upwind location, the school bus stop location and the downwind north perimeter location, respectively, less than the 4.0 pCi/l *indoor* standard recommended by USEPA.

External radiation exposure rate monitoring was conducted by placing environmental dosimeters at the same stations as discussed above. The environmental dosimeter report is included in Appendix F. The results showed net exposure (ambient dose), after subtracting the control, of: (1) less than detection for the upwind station; (2) 1.6 mrem for the school bus stop station; and (3) 2.3 mrem for the downwind north perimeter station, respectively, which were all below the 4.0 pCi/l indoor level recommended by USEPA.

Additional monitoring was provided to on-site workers by the construction contractor. Breathing-zone air sampling was performed on a representative number of employees from September 7, 2012, to October 12, 2012. Individuals selected to be monitored, mainly equipment operators, were issued breathing-zone air samplers in the morning so that their breathing-zone exposures could be monitored and evaluated during the day. At the end of the workday, the sample filters were collected and analyzed using an on-site Ludlum 2929 alpha-beta counting system. Filter counting results were used to determine individual DAC values for the wearer for that day. DAC values were tracked for each individual monitored on a daily basis through the monitoring period. The monitoring period coincided with the period during which contaminated and suspect-contaminated soil was being handled by the equipment operators.

The highest daily single DAC assigned value for a wearer was 0.219. This equates to a dose of approximately 4.38 mrem for the day below the allowable 8-hr DAC of 20 mrem. The average daily DAC value assigned over the entire monitoring period for the group was 0.060 (~1.2 mrem/d).

2.6.2 Monitoring for Airborne Respirable Dust

Airborne respirable dust was also monitored during construction in accordance with the Work Plan. Respirable dust is defined by USEPA's Primary National Ambient Air Quality Standard (40 CFR 50) as dust less than or equal to 2.5 μm in diameter (PM 2.5) and 10 μm in diameter (PM 10). Monitoring was conducted at similar locations as described in Section 2.6.1: one upwind location and two downwind locations. The precise location of the monitoring station downwind of excavation activities in the Eastern Drainage area was based on the location of the excavation activities (i.e., the monitor was moved during construction to ensure that it was directly downwind of excavation activities). Dust monitoring was conducted using a Thermo DataRAM 4 Model DR-4000 ambient dust monitor and was conducted continuously during working hours.

Airborne dust monitoring was conducted 24 hrs/day at the upwind location for the first three days of significant earthmoving activities, and then continuously during working hours thereafter, alternating between PM 2.5 and PM 10. It was intended for the same to be done at the downwind location, but a malfunction of the monitor occurred during this initial period, and the 24-hr test was therefore repeated at the downwind station at a later time. The start of dust monitoring coincided with the start of major earthmoving activities in each area (i.e., September 10, 2012 for the upwind and Eastern Drainage area downwind locations, and October 1, 2012 for the bus stop downwind location when Zone 6 was being excavated).

The results of the dust monitoring were reviewed and assessed during construction to determine any potential health hazards or risks. The respirable dust standards used were the USEPA's Primary National Ambient Air Quality Standards at 24 hour Time Weighted Average (TWA) of:

PM 2.5: 35 micrograms/cubic meter ($\mu g/m^3$)
PM 10: 150 $\mu g/m^3$

A summary of the dust monitoring results is presented in Table 4, *Dust Monitoring Data Summary*. Complete data results and charts from select days are included in Appendix F. The results show that no exceedances of the standards occurred at any time during construction. Average (over the work periods) concentrations for PM 2.5 ranged from 1.5 to 24.4 $\mu g/m^3$ and for PM10 from 2.0 to 23.5 $\mu g/m^3$, all below the standards, as shown on Table 4.

3.0 INTERIM AND FINAL STATUS SURVEY RESULTS

3.1 SUMMARY OF STATUS SURVEYS

Subsequent to the completion of excavation, each EDRA area underwent an Interim Status Survey (Zones 2-6) or a Final Status Survey (Zone 1) in accordance with MARSSIM. The objective of the Interim Status Survey conducted on Zones 2-6 was to demonstrate that soils with Ra-226 in excess of the 2.24 pCi/g RAL had been removed from the EDRA areas. Because the areas were being addressed due to Ra-226 impacts in excess of the RAL, they are considered Class 1 Areas under MARSSIM and will therefore require a Class 1 Final Status Survey subsequent to the final Non-Time-Critical Removal Action. The Interim Status Survey was performed to confirm that excavation activities met the objectives of the EDRA. The data collected during the Interim Status Survey will be included in the Final Status Survey at a later date.

Zone 6 was within the area addressed during the 2009 IRA, as discussed in Section 1.2. Therefore, the Interim Status Survey results from Zone 6 were evaluated with the results from the Post-IRA status survey conducted for the IRA. The IRA status survey results were presented in the document *Completion Report Addendum, Interim Removal Action* (MWH, 2011a).

The Interim Status Survey consisted of a direct gamma radiation static survey and confirmatory soil sampling for laboratory analysis of Ra-226. A direct gamma radiation static survey was designed for the NECR Removal Site Evaluation consistent with MARSSIM to support Data Quality Objectives for Class 1 areas (MWH, 2006). The instrumentation used for the gamma radiation static survey consisted of a 2x2 NaI scintillation detector (Eberline SPA-3) for detection of gamma radiation, connected to a portable ratemeter/scaler (Ludlum 2221), and a global positioning system (GPS) unit to locate static survey grid points from spatial coordinates. A detailed discussion of the methods and instrumentation used and the results of the gamma measurements and soil laboratory analyses are included in Appendix C. A discussion of the results of the Interim Status Survey is included in Section 3.1.2 below.

Because the area within the Eastern Drainage channel excavation (Zone 1) required backfilling and final restoration during implementation of the Removal Action, a Final Status Survey was conducted in the channel. The Final Status Survey consisted of ex-situ soil screening and soil analysis for Ra-226. The objective of the Final Status Survey was to demonstrate that the MARSSIM release criteria was achieved in the excavated areas.

The instrumentation used for the Final Status Survey gamma measurements consisted of a 3x3 NaI scintillation detector (Eberline SPA-3) for detection of gamma radiation connected to a portable ratemeter/scaler (Ludlum 2221) (see Appendix C).

3.1.1 Gamma Correlation Analysis

The static gamma results were converted to Ra-226 concentrations by developing a correlation using regression analysis between the gamma survey results and co-located surface soil samples analyzed for Ra-226. A direct gamma radiation level of 5,075 cpm for the collimated 2x2 detector equivalent to the RAL was used to assess the gamma scan results from the excavation control survey and was initially used to evaluate the gamma scan results from the Interim Status Survey. The gamma results were converted to Ra-226 concentrations using the most recent updated site-specific correlation (Ra-226 pCi/g = (0.0013cpm x gamma radiation level CPM) - 4.3582) that was conducted for the Eastern Drainage Supplemental RSE, as described in the *Supplemental Removal Site Evaluation Report*, *East Drainage Area* (MWH, 2011b). The value of 5,075 cpm is consistent with the 5,214 counts per minute (cpm) equivalent to the RAL that was determined for the IRA (MWH, 2010b).

The excavation and removal of contaminated soils during the EDRA resulted in changes to the Ra-226 distribution in soil (i.e., lower concentrations and more surficial), which likely changed the site-specific correlation between direct gamma radiation levels and Ra-226 concentrations in soil. Therefore, the April 2011 Eastern Drainage area supplemental RSE correlation for the collimated 2x2 NaI detector presented above was updated in accordance with the Work Plan using data from soil sampling and direct gamma radiation measurements at 15 locations collected during the EDRA Interim Status Survey. The EDRA updated correlation data are included in Appendix C. Regression analysis modeling for the updated correlation resulted in a regression equation, Ra-226 pCi/g = (0.0013 x gamma radiation level CPM) – 4.4308, with an R^2 value of 0.92, very similar to the Eastern Drainage Area SRSE regression equation shown above. This revised regression equation was used to update the gamma scan readings from the Interim Status Survey.

3.1.2 Interim Status Survey

The Interim Status Survey was conducted once the excavation control survey indicated that excavation and removal of impacted soil above the RAL was complete. The number of data points for the Interim Status Survey was determined using the Wilcoxon Rank Sum (WRS) test per MARSSIM guidance with statistical parameters selected to achieve a

low error rate. Since the areas that underwent the EDRA are Class 1 Areas, the Interim Status Survey was conducted consistent with the RSE Work Plan for Class 1 Areas (MWH, 2006), and was also consistent with the 2009 IRA (MWH, 2010b). Therefore, the Interim Status Survey conducted in the flats area consisted of direct gamma radiation static measurements (converted to Ra-226 soil concentration) conducted on an 80-foot grid. The Work Plan specified that confirmatory soil samples be collected for laboratory analysis at 5% of the static gamma survey points, or a minimum of 13 samples. Additionally, during implementation of the EDRA, excavation control radiation scan surveying was conducted at 100% coverage of the excavated areas, in accordance with the Work Plan, which augment the Interim Status Survey. Detailed results of the excavation control surveying are included in Appendix C.

The Interim Status Survey was performed in stages as each area within the excavation zones was determined to be ready for the status survey based on the excavation control survey. The purpose of performing the Interim Status Survey in stages was to allow backfilling and/or grading of excavated areas as soon they were completed. This was done to keep the construction on schedule and for project control, since no excavated area could be backfilled or graded until completion of the Interim Status Survey. The Interim Status Survey began with static gamma measurements on September 28, 2012 in Zone 2. The status survey began with locating each survey point (grid nodes) using geographic coordinate data. Then a one-minute direct gamma measurement was performed at each of the points.

The 80-ft triangular grid was cast from the origin of the Post-IRA Status Survey 80-ft triangular grid and resulted in a total of 159 grid points: 149 in the flats area (Zones 2-5) and 10 in the Area North of NECR-1 (Zone 6), as shown on Drawing 11, *Post-Excavation Static Gamma Survey Results - Zones 2-5* and Drawing 13, *Post-Excavation Static Gamma Survey Results – Zone 6.* The static gamma survey measurements and other information were recorded on the 80-ft Triangular Grid Status Static Gamma Radiation Survey Field Forms, which are included in Appendix C. Confirmatory soil samples then collected for laboratory analysis and co-located with 15 randomly selected gamma static survey points, as shown in Drawing 12, P*ost-Excavation Surface Soil Analytical Results - Zones 2-5* and Drawing 14, *Post-Excavation Surface Soil Analytical Results – Zone 6*. Field QA/QC duplicate soil samples were collected from two locations. The soil sampling information was recorded in the EDRA Soil Sample Log, included in Appendix C. A total of 17 soil samples (15 primary and 2 duplicates) were submitted to ELI for Ra-226 analysis using USEPA Method 901.1 with a reporting limit of <0.6 pCi/g. The laboratory analytical Chain-of Custody (COCs) forms are included in Appendix C.

All of the confirmatory soil sample Ra-226 results were reported at less than the RAL, as discussed in Section 3.2.2, except for one sample, SSPT-033, for which the Ra-226 result was reported at 6.2 pCi/g. During the Interim Status Survey, the static gamma level at this location was measured at 4,997 cpm, below the 5,075 cpm RAL for the collimated 2x2 NaI detector (i.e., less than 2.24 pCi/g). The laboratory reported result of 6.2 pCi/g was equivalent to about 8,100 cpm direct gamma radiation level, significantly above the measured static gamma radiation level of 4,997 cpm. Therefore, the area was rescanned and another soil sample, SSPT-033R was collected from the exact same location. The static gamma level was measured at 4,787 cpm during re-scanning. Also, the scan gamma survey was extended to an approximately 20-foot radius around the point during the resampling, which showed gamma levels from about 4,200 to 4,900 cpm, all below the RAL. The replacement soil sample SSPT-033R was sent to the laboratory for Ra-226 analysis. The laboratory reported a Ra-226 result for SSPT-033R of 1.5 pCi/g, less than the RAL, and significantly lower than the 6.2 pCi/g reported for the initial sample SSPT-033, indicating that the 6.2 pCi/g value previously reported was likely an erroneous result.

3.1.3 Final Status Survey for Eastern Drainage Channel

The Final Status Survey conducted within the Eastern Drainage Channel consisted of the results of the ex-situ soil screening conducted during construction (see Appendix C) and soil samples submitted for laboratory analysis of Ra-226. A soil sample was collected every 50 feet along the channel bed (29 locations) and channel sidewalls (29 locations) for excavation control by ex-situ gamma radiation soil screening, in accordance with the Work Plan. The Final Status Survey was conducted in segments of the excavation as it progressed along the length of the channel to facilitate backfilling of the excavation in a timely manner and to reduce safety risks. Once ex-situ field screening results indicated that the RAL had been achieved, as shown in Appendix C, and the excavation was deemed complete, every other soil sample collected for excavation control were selected for laboratory analysis of Ra-226 (EPA approved submittal of every other sample through a field change based on the initial scan results). A total of fifteen channel bed samples and 15 channel sidewall samples plus 4 duplicate samples were submitted for laboratory analysis.

3.2 INTERIM STATUS SURVEY RESULTS (ZONES 2-6)

3.2.1 Static Gamma Survey Results

The Interim Status Survey direct gamma radiation static survey one-minute readings were converted into Ra-226 surface soil concentrations using the updated correlation regression analysis equation, as discussed in Section 3.1.1. The Ra-226 concentrations in soil converted from the direct gamma radiation level measurements are included in Appendix C and shown on Drawing 11. The gamma static survey results indicated that Ra-226 concentrations in soil were below the RAL at 137 of the total 149 survey points in the Eastern Drainage flats area (Zones 2-5) and 8 of 10 survey points in the Area North of NECR-1 (Zone 6). Ra-226 concentrations at the remaining 14 locations that exceeded the RAL were all below the MARSSIM Derived Concentration Guidance Limit Elevated Measurement Comparison ($DCGL_{EMC}$) level of 3.0 pCi/g, with the highest at 2.72 pCi/g.

The results showed Ra-226 concentrations for the 149 locations within the flats area as follows:

Average = 1.6 pCi/g
Standard deviation = 0.5 pCi/g
Median = 1.6 pCi/g
Maximum = 2.7 pCi/g

The results showed Ra-226 concentrations for the 10 locations within the Area North of NECR-1 as follows:

Average = 2.0 pCi/g
Standard deviation = 0.4 pCi/g
Median = 2.1 pCi/g
Maximum = 2.7 pCi/g

All gamma measurements were less than the $DCGL_{EMC}$ of 3.0 pCi.g. Since some of the results exceeded the RAL, but were less than the EMC value, statistical evaluations were conducted to demonstrate that the mean concentration in the EDRA areas is not statistically different than the mean of the background area, and that these areas still meet the MARSSIM release criterion. Zone 6 is part of the original IRA area, and so the statistical evaluation for Zone 6 included the Post-IRA Status Survey dataset (MWH, 2011a) with the Zone 6 data inserted. Each dataset (Zones 2-5 and Zone 6/IRA Area)

was statistically compared to the background dataset using the WRS test, in accordance with MARSSIM. The WRS test was used with the following parameters:

- Null Hypothesis (Ho): EDRA Area Mean/Median ≥ Background Mean/Median Plus Substantial Difference, S (Form 2)
- Alternative Hypothesis (HA): EDRA Area Mean/Median < Background Mean/Median Plus Substantial Difference, S
- Substantial Difference (S): $DCGL_W$ (1.14 pCi/g)
- Confidence Level: 95 percent

The statistical analyses were conducted using the software ProUCL 4.1. The outputs from ProUCL showing the results of the tests are included in Appendix G, *Status Survey Results*.

The results for Zones 2-5 show that the p-value was less than 0.05, and so at a 95% confidence level ($\alpha = 0.05$), the null hypothesis is rejected. The conclusion from the test is that the mean of the Zones 2-5 static gamma dataset is less than the mean of the background reference area plus the substantial difference and, therefore, the Zones 2-5 areas pass the MARSSIM release criterion based on the correlated gamma measurements.

The results for Zone 6/IRA Area show that the p-value was less than 0.05, and so at a 95% confidence level ($\alpha = 0.05$), the null hypothesis is rejected. The conclusion from the test is that the mean of the Zone 6/IRA Area static gamma dataset is less than the mean of the background reference area plus the substantial difference and, therefore, the Zone 6/IRA Area areas pass the MARSSIM release criterion based on the correlated gamma measurements.

3.2.2 Surface Soil Analytical Results

Surface soil samples were collected from 14 locations within the Zones 2-5 and one location from Zone 6, subsequent to completion of excavation activities. The surface soil samples were submitted to the laboratory and analyzed for Ra-226. The locations of each of the soil samples and analytical results are shown on Drawing 12. The laboratory analytical reports and the results of the data validation are included in Appendix C.

The results showed Ra-226 concentrations for the 14 Zones 2-5 samples as follows:

Mean = 1.6 pCi/g
Standard deviation = 0.3 pCi/g
Median = 1.5 pCi/g
Maximum = 2.2 pCi/g

The one sample from Zone 6 indicated a Ra-226 concentration of 1.3 pCi/g, as shown on Drawing 14.

The Zones 2-5 results are consistent with the static gamma measurements and indicated that no sample results exceeded the RAL and that Zones 2-5 met the MARSSIM release criterion. The result for Zone 6 was also below the RAL.

3.3 FINAL STATUS SURVEY RESULTS (ZONE 1)

3.3.1 Ex-Situ Gamma Screening

As discussed in Section 3.1, in-situ direct gamma radiation surveying was not used for excavation control in the Eastern Drainage channel due to radiation shine interferences from the channel banks or sidewalls. Ex-situ field soil screening was performed instead for excavation control in the Eastern Drainage channel (see Appendix C). Once the ex-situ soil screening results indicated that soils in excess of the RAL had been removed from the channel bed and the side walls one sample every 100 feet was collected along the channel bed and sidewalls and submitted to ELI for analysis of Ra-226. The results of the laboratory analyses are presented in Section 3.3.2. The results of the ex-situ soil screening indicated that all soils in excess of the RAL had been removed and excavation from the Eastern Drainage channel had met the objectives of the EDRA.

3.3.2 Soil Analytical Results

The results of the analyses for Ra-226 conducted on the subsurface soil samples collected from the channel are included in Appendix C and shown on Drawing 15, *Post-Excavation Subsurface Soil Analytical Results – Zone 1*. All of the channel bed and channel sidewall soil sample Ra-226 results reported from the laboratory were less than the 2.24 pCi/g RAL, except for one channel sidewall sample, EDC-29-NSW, for which the Ra-226 result was reported at 3.0 ± 0.6 pCi/g. While this result was equal to the acceptable EMC level of 3.0 pCi/g, it is likely an erroneous value because the results of the ex-situ field soil screening indicated that it was less than the RAL and the analytical result for the

laboratory duplicate sample from the same location (EDC-DS4) was 1.7 ± 0.6 pCi/g. Excluding sample EDC-29-NSW (i.e., using the duplicate sample instead), the results indicated Ra-226 concentrations as follows:

Mean = 1.3 pCi/g
Standard deviation = 0.3 pCi/g
Median value = 1.2 pCi/g
Maximum = 1.9 pCi/g

These results indicated that Ra-226 concentrations were all below the RAL and demonstrated that the Eastern Drainage channel excavation met the EDRA objectives.

4.0 ESTIMATE OF COSTS INCURRED

It is estimated that approximately $1,647,000 was spent to comply with the AOC. This includes costs to conduct the EDRA RSE, prepare a design and work plans, removal, removal oversight, sampling and monitoring, and project management. This does not include costs incurred by USEPA and its contractors and consultants.

Removal Site Evaluation:	$60,000
Construction Planning:	$108,000
Construction Management:	$75,000
Construction Oversight:	$155,000
Construction:	$1,249,000
Total:	**$1,647,000**

These costs do not include planning and execution of the bioventing system for the Area North of NECR-1 Remediation included in the AOC. These costs will be reported following implementation of the bioventing remedy.

5.0 REFERENCES CITED

Cedar Creek, 2012. *2012 Eastern Drainage Revegetation Plan*, Northeast Church Rock Mine, November.

EPA, 2012. *Administrative Settlement Agreement and Order on Consent for Time-Critical Eastern Drainage Removal Action and Cost Recovery*, Northeast Church Rock Mine Site, New Mexico, U.S.USEPA Region 9, CERCLA Docket No. 2012-02.

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

MWH, 2012. *Removal Action Construction Work Plan, Eastern Drainage Area*, Northeast Church Rock Mine, August 30.

MWH, 2011a. *Completion Report Addendum*, *Interim Removal Action*, Northeast Church Rock Mine. March 4.

MWH, 2011b. *Supplemental Removal Site Evaluation Report, East Drainage Area*, Northeast Church Rock Mine, September 2.

MWH, 2010a. *Petroleum Investigation Results and Bioventing Pilot Study Plan,* Northeast Church Rock Mine Site, July 22.

MWH, 2010b. *Completion Report, Interim Removal Action*, Northeast Church Rock Mine, June 29.

MWH, 2010c. *Removal Site Evaluation Report, Red Water Pond Road*, Northeast Church Rock Mine, January 26.

MWH, 2006. *Removal Site Evaluation Work Plan*, Northeast Church Rock Mine Site, August 30.

TABLES

Table 1
Primary Seed Mix

Seed Names		Specifications					Comments
Common Name	**Scientific Nomenclature**	**PLS / lb**	**Recommended PLS lbs/ac**	**PLS / ft^2**	**% of Seeds in Mix**	**Method of Seeding**	
Western wheatgrass	*Agropyron smithii*	110,000	1.00	2.5	2.0%	Drill	NRCS indicated climax species
Sand Dropseed	*Sporobolus cryptandrus*	5,298,000	0.50	60.8	47.9%	B-cast/Harrow	NRCS indicated climax species
Blue Grama	*Bouteloua gracilis*	825,000	0.50	9.5	7.5%	Drill	Stong component of native community
Galleta	*Hiliaria jamesii*	159,000	0.50	1.8	1.4%	Drill	Stong component of native community
Thickspike Wheatgrass	*Agropyron dasystachyum*	154,000	0.50	1.8	1.4%	Drill	Fair performer - Offers diversity
Indian Ricegrass	*Oryzopsis hymenoides*	141,000	0.75	2.4	1.9%	Drill	Should do well in areas of sandy texture
Sideoats Grama	*Bouteloua curtipendula*	191,000	0.75	3.3	2.6%	Drill	Good performer - Offers diversity
Bottlebrush Squirreltail	*Sitanion hystrix*	192,000	0.25	1.1	0.9%	Drill	Fair performer - Offers diversity
		Subtotal	**4.75**	**83.2**	**65.5%**		
Desert Globemallow	*Sphaeralcea ambigua*	500,000	0.75	8.6	6.8%	B-cast/Harrow	Sufficient performer for diversity
Palmer Penstemon	*Penstemon palmeri*	610,000	0.50	7.0	5.5%	B-cast/Harrow	Good performer - Offers diversity
Rocky Mountain Penstemo	*Penstemon strictus*	592,000	0.25	3.4	2.7%	B-cast/Harrow	Fair performer - Offers diversity
Lewis Flax	*Linum lewisii*	293,000	1.00	6.7	5.3%	B-cast/Harrow	Good performer - Offers diversity
		Subtotal	**2.50**	**25.7**	**20.3%**		
Fourwing Saltbush	*Atriplex canescens*	52,000	0.75	0.9	0.7%	Drill	NRCS indicated climax species - good forage value
Wyoming Big Sagebrush	*Artemisia tridentata wyo.*	2,500,000	0.25	14.3	11.3%	B-cast/Harrow	Occasional performer - Offers diversity
Cliffrose	*Purshia mexicana*	64,600	1.00	1.5	1.2%	B-cast/Harrow	Fair performer - Offers diversity
Winterfat	*Ceratoides lanata*	56,700	1.00	1.3	1.0%	B-cast/Harrow	Good performer - good forage value
		Subtotal	**3.00**	**18.0**	**14.2%**		
		Total	**10.25**	**127.0**			

Notes:

1. This seed mix is for the disturbred areas on the mine site, Zone 6, the Eastern Drainage area, and the borrow area.
2. PLS = Pure Live Seed.
3. The amount of seed per acre used was 10.25 lb/ac mix for areas that were drill seeded for grasses. In areas where broadcast and harrow methods were used for grasses, the rate was increased 1.5 times, and where hydroseeding methods were used, the rate was doubled.

Table 2
Supplemental Seed Mix

Names		Recommendations					
Common Name	**Scientific Nomenclature**	**PLS / lb**	**Recommd. PLS lbs/ac**	**PLS / ft^2**	**% of Seeds in Mix**	**Preferred Method of Seeding**	**Comment**
Alkali Sacaton	*Sporobolus airoides*	1,758,000	0.25	10.1	28.6%	B-cast/Harrow	NRCS indicated climax species
Blue Grama	*Bouteloua gracilis*	825,000	0.50	9.5	26.8%	Drill	Stong component of native community
	Subtotal		**0.75**	**19.6**	**55.4%**		
Scarlet Globemallow	*Sphaeralcea coccinea*	500,000	0.25	2.9	8.1%	B-cast/Harrow	Sufficient performer for diversity
Rocky Mtn. Bee Plant	*Cleome serrulata*	65,900	1.50	2.3	6.4%	B-cast/Harrow	Good performer - Offers diversity
Upright Prairie Coneflower	*Ratibida columnifera*	737,104	0.25	4.2	12.0%	B-cast/Harrow	Fair performer - Offers diversity
	Subtotal		**2.00**	**9.4**	**26.5%**		
Fourwing Saltbush	*Atriplex canescens*	52,000	1.50	1.8	5.1%	Drill	NRCS indicated climax species - good forage value
Rubber Rabbitbrush	*Chrysothamnus naseousus*	400,000	0.50	4.6	13.0%	B-cast/Harrow	NRCS indicated climax species
	Subtotal		**2.00**	**6.4**	**18.1%**		
	Total		**4.75**	**35.3**			

Notes:
1. This seed mix was used as a supplement to the Primary Seed mix (see Table 1) in disturbed areas east of Red Water Pond Rd.
2. PLS = Pure Live Seed.
3. The amount of seed per acre used was 4.75 lb/ac for areas that were drill seeded for grasses. In areas where broadcast and harrow methods were used for grasses, the rate was increased 1.5 times, and where hydroseeding methods were used, the rate was doubled.

Table 3
Internal Radiological Exposure Data Summary

							DAC (uCi/ml)10CFR20, AppB				
							Gross Alpha [4]	U-nat	Ra-226	Th-230	
							1.8E-12	9.0E-13	9.0E-13	2.0E-14	
Perimeter Air Station [5]	Sample Date	Sample ID	Airborne Particulate Activity (uCi/ml) [1]				% of DAC [3]				Comments
			Gross Alpha	U-nat	Ra-226	Th-230	Gross Alpha	U-nat	Ra-226	Th-230	
NECR-D1	Mean	D1 Baseline	6.5E-15	3.2E-15	1.6E-15	1.6E-15	0.1%	0.1%	0.0%	1.2%	Baseline Sampling, downwind and upwind essentially the same
NECR-D2	Mean	D2 Baseline	3.0E-15	1.5E-15	7.6E-16	7.6E-16	-0.1%	-0.1%	-0.1%	-3.1%	
NECR-D1	Mean	NECREDRA-D1 (Scool Bus Stop Area)	2.6E-15	1.3E-15	6.4E-16	6.4E-16	0.0%	0.0%	0.0%	-0.2%	Mean School Bus Stop air concentrations similar to upwind
	Max		1.2E-14	6.1E-15	3.0E-15	3.0E-15	1%	1%	0%	15%	
NECR-D2	Mean	NECREDRA-D2 (EDA Downwind (North Perimeter)	1.8E-14	9.1E-15	4.6E-15	4.6E-15	0.9%	0.9%	0.4%	19.4%	Mean Perimeter air concentrations less than 25% of DACs
	Max		9.8E-14	4.9E-14	2.5E-14	2.5E-14	5%	5%	3%	119%	
NECR-U1	Mean	NECREDRA-U1 (Upwind) Project Mean	2.7E-15	1.4E-15	6.8E-16	6.8E-16	-	-	-	-	

Notes:
(1) U-nat, Ra-226 and Th-230 activity calculated from measured gross alpha activity @ faction of 0.5 for U-nat, 0.25 for Ra-226 and 0.25 for Th-230 of gross alpha activity
(2) DACs from 10CFR20, Appendix B, Table 2 for control and assessment of dose to the public
(3) Net % of DACs for downwind, i.e subtracting upwind concentration from downwind
(4) Calculated DAC for gross alpha activity by summing U-nat, Ra-226 and Th-230 DACs for control measures, not a regulatory DAC.
(5) Monitoring station: NECR-D1 = Downwind 1 (Scool Bus Stop); NECR-D2 = Downwind 2 (East Drainage Area North Perimeter); NECR-U1 = Upwind 1

Table 4 Airborne Dust Monitoring Results			
Maximum Particle Size (µm)	**Dates**	**Average Concentration ($\mu g/m^3$) [1]**	**Operating Hours [2]**
Upwind			
10	9/10 to 9/13/12	2.6	76.5
10	9/14/12	5.3	7.8
2.5	9/18/12	6.1	6.7
10	9/19/12	5.6	8.4
2.5	9/20/12	7.6	7.9
10	9/21/12	10.3	7.3
2.5	9/24/12	4.6	7.8
10	9/25/12	3.5	8.8
2.5	9/26/12	3.6	8.4
10	9/27/12	2.8	8.9
2.5	9/28/12	1.8	5.9
10	10/1/12	3.8	7.8
2.5	10/2/12	4.5	8.0
10	10/3/12	4.1	8.8
2.5	10/4/12	6.0	3.1
Downwind			
2.5	9/10/12 to 9/14/12	Monitor malfunctioned	
10	9/17/12	16.7	8.5
10	9/19/12	12.2	8.4
2.5	9/20/12	13.8	8.4
10	9/21/12	17.2	7.8
10	9/24 to 9/27/12	10.3	72.0
2.5	9/27/12	4.1	8.0
10	9/28/12	2.9	5.9
2.5	10/1/12	4.6	8.3
10	10/2/12	23.5	8.6
2.5	10/3/12	12.5	8.8
10	10/4/12	17.5	7.7
10	10/5/12	10.0	7.7
2.5	10/8/12	4.7	8.5
10	10/9/12	6.2	9.0
2.5	10/10/12	3.0	8.9
2.5	10/11/12	3.9	8.2
10	10/12/12	4.5	2.7
10	10/15/12	4.1	5.8
2.5	10/16/12	7.4	8.6
10	10/17/12	6.5	8.7
2.5	10/18/12	20.8	8.7
10	10/22/12	23.0	6.7
2.5	10/23/12	24.4	8.7
10	10/24/12	14.3	8.6
2.5	10/25/12	24.1	8.4

Table 4 Airborne Dust Monitoring Results			
Maximum Particle Size (µm)	**Dates**	**Average Concentration ($\mu g/m^3$) [1]**	**Operating Hours [2]**
Bus Stop [3]			
10	10/1/12	Data Rejected	
10	10/3/12	4.7	8.9
2.5	10/4/12	7.0	4.0
2.5	10/5/12	3.5	8.1
10	10/8/12	3.9	8.4
2.5	10/9/12	2.7	9.4
10	10/10/12	7.0	8.9
10	10/11/12	6.4	8.2
2.5	10/15/12	2.9	6.1
10	10/16/12	5.0	8.6
2.5	10/17/12	3.1	8.7
10	10/18/12	9.0	8.5
2.5	10/22/12	1.5	6.8
10	10/23/12	3.3	8.6
2.5	10/24/12	5.7	8.2
10	10/25/12	2.0	7.9

Notes:

1. The standard for PM 2.5 is a 24-Hr TWA of 35 $\mu g/m^3$. The standard for PM 10 is a 24-Hr TWA of 150 $\mu g/m^3$.
2. Operating hours are the hours that the dust monitor was operating, which was normally limited to construction work hours, except for two 72+ hour periods, one each at the upwind and downwind stations.
3. Monitoring at the bus stop was started when construction at Zone 6 began, which was the week of 10/1/12.

DRAWINGS

APPENDIX A
WEEKLY CONSTRUCTION REPORTS AND FIELD NOTES

APPENDIX B
CULTURAL RESOURCE SURVEY REPORTS

APPENDIX C
GAMMA SURVEY RESULTS AND LABORATORY ANALYTICAL REPORTS

APPENDIX D
RIPRAP QUALITY AND GRADATION DATA

APPENDIX E
FINAL REVEGETATION PLAN AND SEED CERTIFICATES

APPENDIX F
ENVIRONMENTAL MONITORING DATA

APPENDIX G
RESULTS OF INTERIM AND FINAL STATUS SURVEYS