UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION IX
75 Hawthorne Street
San Francisco, CA 94105

MEMORANDUM

DATE: **September** 27, 2012

SUBJECT: Request for Concurrence on Proposed Nationally Significant or Precedent-Setting Removal at Section 32 AUM Site, Casamero Lake Chapter, Navajo Nation Indian Reservation, McKinley County, New Mexico,,

FROM: Daniel Meer, Assistant Director
Superfund Division (SFD-1), Region 9

TO: Lawrence M. Stanton, Director
Office of Emergency Management

I. PURPOSE

The purpose of this memorandum is to request your concurrence on a time-critical removal action to take response actions to mitigate threats to human health and the environment posed by the presence of uranium mine waste located at the Section 32 Mine Site on the Navajo Nation Indian Reservation within the Casamero Lake Chapter, in McKinley County, New Mexico ("the Section 32 Site" or "the Site"). Redelegation of Authority in R-14-2 gives the Director of the Office of Emergency Management the authority to concur on nationally significant or precedent-setting removals.[1] This removal action is estimated to cost $2,058,000 in direct extramural expenditures. As a result, contingent upon your concurrence, I will approve both the Action Memorandum and an emergency exemption from the $2 million limit on removal actions,[2] in order to avert the ongoing exposures to unsafe levels of uranium contamination that are occurring at the Site.[3]

[1] See September 2009 Superfund Removal Guidance on Preparing Actions Memoranda ("2009 Guidance"), removals in Indian Country generally require OEM concurrence (see p. 45).
[2] See Regional Delegation No. 1290.03A.
[3] "Removal Action Ceiling Costs," as defined by EPA guidance OSWER 9360.0-42 (November 5, 2001), includes only direct extramural costs. As discussed in this memorandum, additional costs may be incurred and recoverable as "incurred response costs."

Region 9 staff for the Section 32 Site has discussed this proposed removal with staff for the Office of Emergency Management's Program Operations and Coordination Division (POCD). POCD has advised that this removal is considered nationally significant or precedent setting because it is occurring at a site located in Indian country. As has been the case with all of Region 9's uranium mine site removals on the Navajo Nation, Region 9 has conducted extensive government to government consultation with the Navajo Nation and community involvement activities with local residents regarding the Site, including the proposed time-critical removal action.

The proposed removal action at the Sections 32 Site would address approximately 20 acres of land. The Site consists of two areas, the former mining area and a former transfer station area approximately 2,000 feet apart. Both areas are part of undeveloped, open grazing land that is within a single-family residence allotted land. There are two other residential properties with .5 mile. In addition, there are 40 to 50 residences about a mile and half away. Residents of this area have been concerned about the potential exposure from uncontrolled windblown erosion.

The Site was contaminated as a result of the mining, transport and handling of uranium mining ores and preparations to transport these ores to uranium milling operations. The uranium contamination at the Site poses an imminent and substantial endangerment to human health and the environment because it is resulting in ongoing exposures to levels of uranium contamination that pose an increased risk of toxic effects, including cancer. As noted above, the mine area and transfer station area are located in close proximity to residences and are currently being used for grazing animals that are eaten by local residents. In addition, waste from Site will continue to migrate to adjacent areas if not promptly addressed. As a result, Region IX is proposing to mobilize in early October to consolidate uranium contaminated waste from the Transfer Station area and from the portion of the mine area closest to the residence, to consolidate this material on the portion of the mine area more remote from the residence and to fence and sign the area of the consolidated waste as well as to cover it with a coating that will reduce erosion. This removal action is an interim action and is not intended to be a permanent disposition for the waste.

Post-removal monitoring of the removal action will be conducted by the Navajo Nation Superfund Program.

Exemption from Statutory Limit

Section 104(c)(1) of CERCLA generally restricts fund- lead removal actions to a total extramural direct cost of $2,000,000. 42 U.S.C. § 9604(c)(1). Region IX anticipates that the proposed removal action will cost in excess of $2,000,000, and that: (1) the continued response actions were immediately required to prevent, limit or mitigate an emergency; (2) that there was an immediate risk to the public health or welfare or the environment; and (3) that response assistance would not otherwise be provided on a timely basis. Accordingly, EPA determined that, based on the emergency circumstances of the Site, the response action would be exempt from the $2,000,000 statutory limitation based on the "emergency

exemption" justification set forth at Section 104(c)(1)(A) of CERCLA, 42 U.S.C. § 9604(c)(1)(A).

Pursuant to Section 104(c)(1)(A) of CERCLA and 40 C.F.R. § 300.415(b)(5)(i), application of the emergency exemption continues to be appropriate when: 1) there is an immediate risk to public health or welfare or the environment; 2) the response actions are immediately required to prevent, limit, or mitigate an emergency; and 3) such assistance will not otherwise be provided on a timely basis. There continues to be an immediate risk posed by the conditions at the Site, including no timely source of non-federal response funds, and the approval of this additional ceiling increase is necessary to abate these threats. EPA Region IX believes that, until the response has been completed, that the emergency conditions will persist at the Site and that these conditions warrant an exemption from the $2,000,000 limitation.

The Section 32 AUM Site Time-Critical Action Memorandum is attached for your review. My approval awaits your concurrence.

Approve: _____

Lawrence Stanton, Director Date
Office of Emergency Management

Disapprove: _____

Lawrence Stanton, Director Date
Office of Emergency Management

Attachment A:
Approval, Funding and Exemption from the $2 Million Statutory Limit for a Removal Action at the Section 32 Abandoned Uranium Mine (AUM) Site, Casamero Lake Chapter, Nation Indian Reservation, McKinley County, New Mexico.

cc: Sherry Fielding, U.S. EPA, OEM, HQ
Randy Nattis, U.S. EPA, R9 OSC, Superfund Division (SFD-9-2)
Laurie Williams, U.S. EPA, R9 ORC
Harry Allen, U.S. EPA, R9 Chief, Emergency Response Section, Superfund Division (SFD-9-2)

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY REGION IX

75 Hawthorne Street

San Francisco, CA 94105

MEMORANDUM

DATE: **DRAFT September 27, 2012 (Pending HQ Concurrence)**

SUBJECT: Approval, Funding, and Exemption for the $2 Million Statutory Limit for a Removal Action at the Section 32 and 33 Mine site – Abandoned Uranium Mine (AUM) Site, Casamero Lake Chapter, Navajo Nation Indian Reservation

FROM: Randy Nattis, On-Scene Coordinator
Emergency Response Section (SFD-9-2)

TO: Daniel A. Meer, Assistant Director
Superfund Division (SFD-9)

THROUGH: Harry L. Allen IV, Chief
Emergency Response Section (SFD-9-2)

Laurie Williams, Senior Attorney
Office of Regional Counsel

I. PURPOSE

The purpose of this memorandum is to request and document approval of the selected removal action described herein for the Section 32 Mine Site ("the Site" or "the Section 32 Site" or "AUM 32") located within the Navajo Nation Indian Reservation within the Casamero Lake Chapter, in McKinley County, New Mexico. The selected removal action address ongoing exposures of local residents to mining waste at the Site. The total cost of the removal action is estimated to be $2,058,000 in direct extramural costs. As a result, this removal requires an exemption from the $2 million statutory cost limit to mitigate threats to human health and the environment posed by the presence of hazardous substances at the Site. The funding will come from the Tronox Special Account.

In accordance with the Superfund Removal Guidance for Preparing Action Memoranda ("AM Guidance") (OSWER Sept. 2009), removal actions that may affect other sovereign nations, including Indian Tribes are issues of national significance, and require concurrence from the EPA Office of Solid Waste and Emergency Response. Headquarters concurrence will facilitate the execution of proper diplomatic protocol by the Department of State, and proper coordination with Indian Tribes, the Bureau of Indian Affairs, the Indian Health Service, and other appropriate organizations, where applicable.

II. SITE CONDITIONS AND BACKGROUND

Site Status: Non-NPL
Category of Removal: Time-Critical
AUM 32
CERCLIS ID: NNN000908747
SITE ID: 09XN

A. Site Description

1. Physical Location

The Site consists of approximately 20 acres, including the mine area and what appears to be a Former Transfer Area approximately 2000 feet to the southwest. The Site is located approximately 1 mile east of County Road 19, Prewitt, McKinley County, New Mexico, roughly 10 miles north of I-40 (Figure 2-1). There is a residence located on the main mine area and both areas of the Site are currently accessible to grazing animals.

AUM 32 is located approximately 1 mile east of County Road 19, Prewitt, McKinley County, New Mexico (Figure 2-1). AUM 32 is located in an Indian Allotment land which is part of the Casamero Lake Chapter of the Navajo Nation (Latitude: 35°29'26.7576"N, Longitude: -108°1'2.7798"W) and. The Chapter House is approximately 1.4 miles northwest of AUM 32. AUM 32 is in a vacant land surrounded by open space. AUM 32 has approximately 308,632 square feet (sf) of surface Uranium contamination of at least twice investigation level and contains an unsecured deep shaft located in the southeastern portion, and an undetermined extent of underground workings. The mine area is relatively flat with sparse vegetation. Available geographical information show an ephemeral stream or river located north and south of the site which converges approximately 0.25 mile west of the site. A 10-foot deep ditch was observed to run from east to west and bounded the mine area to the north. The ditch connects to a pond located northwest of the mine area (Figure 3-1).

AUM 32 Transfer Area is located approximately 0.3 miles south southwest of AUM 32. AUM 32 Transfer Area is located in an Indian Allotment land which is part of the Casemero Lake Chapter of the Navajo Nation (Latitude: 35°29'11.94"N, Longitude: 108°1'9.98"W). AUM 32 Transfer Area has approximately 322,592 sf of surface Uranium contamination of at least twice investigation level. The area also contains a concrete pad and a sealed air vent that support mining operations. The AUM 32 Transfer Area is located on a slight elevation with sparse vegetation. Evidence of past water flows toward a northwest direction was observed (Figure 3-1).

A related Mine area, the Section 33 Mine area, which is not being addressed in this removal action, is located immediately east of the AUM 32 mine area (Latitude: 35°29'26.1972"N, Longitude: -108°0'59.8583"W). AUM 33 is located on private land and is part of the Casamero Lake Chapter of the Navajo Nation. AUM 33 is in a vacant land surrounded by open space. AUM 33 has an approximate area of 151,552 sf of surface Uranium contamination of at least twice investigation level containing waste piles, a wooden hopper located in the northeastern corner, and an undetermined extent of underground

workings. AUM 33 is relatively flat with sparse vegetation. Available geographical information show an ephemeral stream or river located north and south of AUM 33 which converges approximately 0.25 mile to the west, and two ponds located on the northeast. Evidence of water flowing through the site was observed. The two ponds were observed to be filled with water (Figure 3-1).

Two home sites are located 0.5 mile west of AUMs 32, 32 Transfer Area and 33 and were also included as part of this assessment (Figure 3-1).

2. Site Characteristics

Portions of the Navajo Nation are on geologic formations rich in radioactive uranium ores. Beginning in the 1940s, widespread mining and milling of uranium ore for national defense and energy purposes on Navajo tribal lands led to a legacy of abandoned uranium mines. The Site is one of approximately 520 AUMs located on the Navajo Nation. Nearby residents have expressed concern to the Navajo Nation Environmental Protection Agency (NNEPA) regarding the potential for wind-blown and water-borne radioactive particles to migrate from the Site and impact their health as well as the health of their livestock and the environment.

U.S. EPA and NNEPA interviewed a local resident who showed the location of the AUM 32 Transfer Area southwest of the AUM 32 mine area (Figure 3-1). A concrete pad where a crane was reportedly mounted was located in the potential transfer area. This area is roughly 0.3 miles to the southwest from the AUM 32 and AUM 33 areas. The area is known to be mined at least three different times under the following local name / Aliases: West Ranch (Begay Allotment), Moe No. 5, Old Moe, Moe Mine, Moe #5, Moe decline. The area was believed to be mined from the 1960's until the 1980's.

3. Removal site evaluation

In November 2009, U.S. EPA conducted radiation assessments at the Site in coordination with NNEPA. A site screening for AUMs was conducted at the site which included collection of site information and gamma radiation activity (gamma activity) survey data. Gamma activity was measured from surface soil along the initial boundary of the mine areas and along two diagonal intersecting transects from the mine areas' four corners. Gamma activity measurements ranged from 10,689 to 180,367 counts per minute (cpm) at AUM 32, and 14,322 to 140,917 cpm at AUM 33. A rock from a waste pile at AUM 33 emitted over 800,000 cpm. Gamma activity was also measured from a background location. The gamma activity exceeded two times background which ranged from 16,630 to 17,128 cpm. The building materials in the nearest residence had gamma activity measurements of approximately 12,000 cpm. Based on these results, in 2011 the NNEPA requested assistance from the U.S. EPA in performing a removal assessment of AUM 32 and AUM 33 to determine the nature and extent of the contamination for the purpose of mitigating any potential impacts to human health and/or the environment.

A background area was established 0.45 miles east southeast of AUM 32 and AUM 33 in an area with no suspected impacts from mining. The area is up wind and up slope from all

suspected activities and within line of sight to the nearest resident and mining areas. Surface soil samples were collected from random locations within the background area. The sample results and co-located 1-minute gamma activity measurements are presented in Table 4-1. The background Ra-226 concentrations ranged from 0.592 to 0.900 picocuries per gram (pCi/g). The highest Ra-226 background concentration of 0.900 pCi/g was used to calculate the action level for the AUMs. The action level for Ra-226 was based on the sum of the highest background concentration of Ra-226 and the USEPA Preliminary Remediation Goal (PRG) of 1.21 pCi/g (USEPA 2010).

1.21 pCi/g (PRG) + 0.900 pCi/g (background) = 2.11 pCi/g

The site specific action level for Ra-226 in soil at the AUMs is 2.11 pCi/g.

Based on the 2009 radiation assessment and preliminary gamma activity measurements at AUM 32, AUM 32 Former Transfer Area, and AUM 33, sampling grids were established. The grid size and number of samples to be collected within each grid were determined using the Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM). A total of 68 samples were collected: AUM 32 – 01 through 25, AUM 32– 26 through– 49 (Transfer Area), and AUM 33 – 01 through 16 and AUM 33 WP - 01 through 03.

AUM 32: The sample results (samples AUM 32 - 01 through -25) and co-located 1-minute gamma radiation activity measurements from the AUM 32 mine area are presented in Table 4-2. Ra-226 concentrations in surface soil at the mine area ranged from 1.19 pCi/g to 37.3 pCi/g. Ra-226 concentrations detected down to 4 feet bgs in subsurface soil ranged from 0.787 pCi/g to 112 pCi/g. The soil depths of Ra-226 concentrations exceeding the action level are shown in Figure 4-1. Soil around the open shaft in the mine area contained Ra-226 concentrations above the action level down to depths of 2 to 3 feet bgs. The remainder of the mine area showed Ra-226 concentrations above the action level in surface soil and down to depths of 1 to 2 feet bgs except for AUM-32-04 which slightly exceeded the action level at 3 feet bgs.

AUM 32 Transfer Area: The sample results (samples AUM 32 - 26 through -49) and co-located 1-minute gamma radiation activity measurements from the AUM 32 Transfer Area are presented in Table 4-2. Ra-226 concentrations in surface soil ranged from 0.923 pCi/g to 300 pCi/g. Ra-226 concentrations detected down to 3 feet bgs in subsurface soil ranged from 0.740 pCi/g to 94.8 pCi/g. The soil depths of Ra-226 concentrations exceeding the action level are shown in Figure 4-2. Soil in the area with gamma radiation activity of above 1 million cpm during the survey contained Ra-226 concentrations of 237 pCi/g to 300 pCi/g in surface soil as detected in sampling locations AUM32 -27, -28, and -29. Ra-226 concentrations in sampling locations AUM32 -27 and -28, were above the action level down to 1 foot bgs. AUM32 -29 had elevated levels of Ra-226 up to 3 feet bgs. AUM32 -49 located between the mine and transfer area contained 108 pCi/g of Ra-226 in surface soil and concentrations exceeding the action level down to 2 feet bgs where refusal was met using a hand auger. Except for these four sampling locations, elevated levels of Ra-226 were limited to surface soil (0 to 2 inches bgs). The southern portion of the AUM 32 Transfer Area was bounded by Ra-226 concentrations below the action level.

AUM 33: The sample results (samples AUM 33 - 01 through -16) and co-located 1-minute gamma radiation activity measurements from AUM 33 are presented in Table 4-3. Ra-226 concentrations in surface soil at AUM 33 ranged from 0.996 pCi/g to 76.1 pCi/g. Ra-226 concentrations detected down to 3 feet bgs in subsurface soil ranged from 0.816 pCi/g to 35.4 pCi/g. The soil depths of Ra-226 concentrations exceeding the action level are shown in Figure 4-3. AUM33-02, -04, and -07 contained elevated concentrations of Ra-226 at 3 feet bgs. Ra-226 concentrations detected at areas with gamma radiation activity above twice the background level exceeded the action level. The waste pile samples (samples AUM 33-WP-01, -02, and -03) all exceeded the action level (Table 4-3). Ra-226 concentrations detected around the waste piles were above the action level up to a depth of 2 feet bgs. The eastern and southern portions of AUM 33 were bounded by Ra-226 concentrations below the action level.

4. Release or threatened release into the environment of a hazardous substance, or pollutant or contaminant

Background: Analytical results for the 11 background soils samples (TRONOX-BKG2-01 through TRONOX-BKG2-11) of Ra-226 concentrations ranged from 0.592 pCi/g to 0.900 pCi/g. The highest Ra-226 background concentration of 0.900 pCi/g was used to calculate the action level for the AUMs. The action level for Ra-226 was based on the sum of the highest background concentration of Ra-226 and the USEPA Preliminary Remediation Goal (PRG) of 1.21 pCi/g. The site specific action level for Ra-226 in soil at the AUM 32, AUM 32 Former Transfer Area and AUM 33 is 2.11 pCi/g. Surface gamma activity counts at the 11 background soil sample locations ranged from 23,706 cpm to 27,011 cpm with a daily mean ranging from 23,706 cpm to 23,870 cpm.

AUM 32: The removal assessment documented the presence of contaminated soils that contain Ra-226 about the site specific action level within the Site. Ra-226 concentrations in 25 locations ranged from 1.19 pCi/g to 37.3 pCi/g. The Ra-226 concentrations detected down to 4 feet bgs in the subsurface soil ranged from 0.787 pCi/g to 112 pCi/g. AUM 32 contains approximately 27,009 cubic yards of soils above the site specific action level.

AUM 32 Transfer Area: The removal assessment documented the presence of contaminated soils that contain Ra-226 about the site specific action level within the Site. Ra-226 concentrations in 24 locations ranged from 0.923 pCi/g to 300 pCi/g. The Ra-226 concentrations detected down to 3 feet bgs in the subsurface soil ranged from 0.740 pCi/g to 94.8 pCi/g. AUM 32 Transfer Area contains approximately 18,043 cubic yards of soils above the site specific action level.

AUM 33: The removal assessment documented the presence of contaminated soils that contain Ra-226 about the site specific action level within the Site. Ra-226 concentrations of 16 locations ranged from 0.996 pCi/g to 76.1 pCi/g. Ra-226 concentrations detected down to 3 feet bgs in the subsurface soil ranged from 0.816 pCi/g to 35.4 pCi/g. Ra-226 concentrations in the three waste pile locations ranged from 23.3 pCi/g to 52.2 pCi/g. AUM 33 contains approximately 18,556 cubic yards (excluding the waste piles) of soils above the site specific action level.

A summary of all soil sample results for Ra-226 and associated gamma activity counts is

included in Tables 4-1, 4-2, 4-3 and Figures 4-1, 4-2 and 4-3. The purposed removal areas and depths can be located in Figures 4-6, 4-7, and 4-8. A summary of all surface contamination and approximate removal volumes is included in Table 4-7.

5. NPL status

The Site is not on the National Priorities List (NPL). Current conditions at the Site pose an imminent and substantial endangerment. The proposed Removal Action will remove all contamination from AUM 32 Former Transfer Area and transfer it to AUM 32 for storage until NNEPA can reach a decision on a permanent solution for the disposition of the contaminated soils.

6. Maps, pictures and other graphic representations

See Attached.

B. Other Actions to Date

No actions have be recorded to date

C. State and Local Authorities' Roles

1. State and local actions to date

NNEPA has been and will continue to be closely involved in the planning and execution of this removal action.

These discussions satisfy the regulatory requirements of State and Tribal referral.

III. THREATS TO PUBLIC HEALTH OR WELFARE OR THE ENVIRONMENT, AND STATUTORY AND REGULATORY AUTHORITIES

Current Site conditions pose ongoing releases and the threat of future releases of hazardous substances, namely: uranium and its progeny (*i.e.*, radium-226 and radon) and ionizing gamma and alpha radiation associated with those progeny. The likelihood of direct human exposure, via ingestion and/or inhalation of hazardous substances, and the threat of future releases and migration of those substances, pose an imminent and substantial endangerment to the public health 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

As described in Section II.A.4, radium-226 has been documented in soils at the Site. 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 ionizing radiation are released. Radium may be found in air

and water. Radium in the soil may be absorbed by plants.

Analytical results indicate that concentrations of radium-226 identified in soils at the Site exceed background and U.S. EPA Preliminary Remediation Goals (PRGs). Acute inhalation exposure to high levels of radium can cause adverse effects to the blood (anemia) and eyes (cataracts). Radium exposure also has been shown to affect the teeth, causing an increase in broken teeth and cavities. Exposure to high levels of radium results in an increased incidence of bone, liver, and breast cancer. The U.S. EPA and the National Academy of Sciences, Committee on Biological Effects of Ionizing Radiation, has stated that radium is a known human carcinogen (ATSDR 1999a). Inhalation of radium contaminated particulates is of particular concern. Radium emits alpha radiation, which, when inhaled, becomes a source of ionizing radiation in the lung and throat, possibly leading to toxic effects.

Ionizing radiation is comprised of particles and rays given off by radioactive material. These include alpha particles, beta particles, x-rays, and gamma rays.
Ionizing radioactive particles and rays knock electrons from atoms and molecules (such as water, protein, and DNA) that they hit or pass by. There are myriad sources of low level ionizing radiation including the sun, rocks, soil, natural sources in the body, as well as human made sources. For example, additional exposures accompany each x ray exam. Background level exposure to environmental ionizing radiation has not been shown to affect the health of children or adults. Exposure to greater than background levels of gamma ionizing radiation may increase the chance of getting cancer depending on a person's level of exposure (ATSDR 1999b).

Exposure to high doses of ionizing radiation can result in skin burns, radiation sickness, and death. If a pregnant woman is exposed to high levels of ionizing radiation, it is possible that her child may be born with some brain abnormalities. As levels of ionizing radiation increase, so does the chance of brain abnormalities in the developing fetus (ATSDR 1999b).

Uranium is found in small amounts in most rocks and soil. It slowly breaks down to its progeny including radium and radon. Radium and radon enter the environment from the soil, and from uranium mines and sometimes other types of mines. Uranium occurring in a subsurface vein is brought to the surface during mining activities. Thorium is also often present in uranium ore. One of the radioactive properties of uranium is its half-life, or the time it takes for half of the isotope to give off its radiation and change into another substance. The half-lives are very long (between 200,000 years and 5 billion years). This is why uranium still exists in nature and has not all decayed away and does not itself emit high levels of ionizing radiation. Inhalation and ingestion of uranium can result in kidney damage.

Much of the contaminated material at the Site is fine-grained and therefore likely to result in human exposure via inhalation or ingestion. The Site contamination is readily accessible to onsite full-time residents and potentially to nearby offsite residents. Persons occupying or traversing the Site may be exposed to contaminated dust by inhalation or ingestion of contamination sorbed to particulate matter. Incidences of direct contact with natural and mechanically generated dust during such activities accounts for known contamination exposure scenarios at the Site. Radium-226 and uranium may be entrained in naturally and mechanically

generated dust and/or transported on shoes and clothing of residents passing over contaminated areas. Gardening and other yard work, including gathering traditional herbs and plants, also may result in exposure to contamination.

Activities that occur in contaminated areas that may put persons at risk include walking or hiking, livestock grazing, and different modes of transportation including all- terrain vehicles, motorcycles, or horses. Persons may drive their vehicles over contaminated areas as well, which likely contributes to exposure pathways via dust generation. Contamination in yards where children play may also be ingested. Children may eat contaminated soils during play activities.

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

Contamination documented in soils at the Site may migrate off-site via wind and water transport mechanisms including mechanical dust generation. Some of the radium daughter particles, such as radon, also have a specific tendency to adhere to dust particles and migrate.

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

NNEPA has informed U.S. EPA that it does not have the resources to address the Site. As noted above, the Navajo Nation sent U.S. EPA a formal written request for federal action to address this area.

IV. ENDANGERMENT DETERMINATION

Actual and threatened releases of hazardous substances from the Site, if not addressed by implementing a Time-Critical Removal Action, may continue to present an imminent and substantial endangerment to the public health or welfare or the environment.

V. EXEMPTION FROM STATUTORY LIMITS

EPA is requesting $2,058,000 in direct extramural cleanup costs, which is above the $2 million statutory limit. Subject to exceptions, 42 U.S.C. § 9604(c)(1) states that removal actions should not continue after $2 million has been obligated for response actions or 12 months have elapsed from the date of initial on-site response. Pursuant to EPA delegations 14-2 and R9 1290.03A, the Assistant Director to the Superfund Division is authorized to determine whether an exception from this statutory limitation is warranted. EPA Region 9 believes that,

consistent with the standards for exception stated in 42 U.S.C. § 9604(c)(1)(A) and 40 C.F.R. § 300.415(b)(5), an exception to the cost limit for removal actions is warranted for the following reasons:

1. There is an immediate risk to public health or welfare or the environment

Hazardous substances documented at the Site present a risk of exposure to external gamma and alpha ionizing radiation, radium-226, and uranium contamination to nearby residents, transient residents, livestock, and wildlife. Exposures to alpha ionizing radiation due to the presence of radium-226 pose an increased risk of toxic effects including cancer. See Section III.1 for more information and other health risks related to exposures to these hazardous substances.

2. Continued response actions are immediately required to prevent, limit or mitigate an emergency

If immediate actions are not taken to reduce, abate, and prevent discharges from the Site, then further damage to human health and the environment will continue from the release of radium-226. Contaminated soils at the Site are present in uncontrolled piles exposed to wind and water erosion. Moreover, if the government delays approval of this removal action, U.S. EPA will incur additional costs as contamination is likely to migrate past current Site boundaries, increasing the total affected area.

3. Assistance will not otherwise be provided on a timely basis

The NNEPA does not have the capabilities or resources to carry out this effort in a timely manner. The U.S. EPA investigation into potential liability at the Site has yielded no viable Potentially Responsible Parties. If the U.S. EPA does not begin the proposed removal action immediately, the risk of exposure to radiological contamination will continue unabated.

An exemption from the $2 Million Statutory Limit is justifiable under 40 C.F.R. § 300.415(b)(5)(i), which provides that the exemption is appropriate when: there is an immediate risk to public health or welfare or the environment; continued response actions are immediately required to prevent, limit, or mitigate an emergency; and such assistance will not otherwise be provided on a timely basis. As stated in this Memorandum, there is an immediate risk posed by the conditions at the Site and an emergency exemption to the $2 Million Statutory Limit is necessary to abate these threats.

VI. PROPOSED ACTIONS AND ESTIMATED COSTS A.

<u>Proposed Actions</u>

1. Proposed action description

U.S. EPA proposes to mitigate the imminent and substantial threats to human health and the environment by taking steps to prevent the release of radium-226, uranium, and external

gamma radiation. The removal action will include the excavation and internment of contaminated soils in an onsite repository. The following activities are proposed, but not limited to:

1) Archeological clearance of all areas impacted by removal activities;
2) Construction/improvement of limited access roads to both AUM 32 and AUM 32 Transfer Area areas;
3) Secure a water supply for dust suppression activities;
4) Development and implementation of an effluent dust monitoring program to prevent offsite release of contaminated particulate;
5) Excavate and consolidate contaminated soils from AUM 32 Transfer Area to AUM 32;
6) Consolidate contaminated that have migrated from AUM 32 back to AUM 32;
7) Apply soil sealant to AUM 32 after consolidation of contaminated soils;
8) Apply soil sealant to AUM 33 as needed;
9) Construct a fence and post signs around the consolidated wastes on AUM 32;
10) Construct retention area for runoff;
11) Development and implementation of a confirmation survey and sampling plan.

2. Contribution to remedial performance

U.S. EPA has identified imminent threats posed by external gamma and alpha ionizing radiation, radium-226 and uranium contamination at the Site. This removal action should remove the immediate threats posed by uncontrolled hazardous substances at the Site.

The long-term cleanup plan for the site:

EPA's removal activities described in this Memorandum will address the uncontrolled hazardous substances at AUM 32 Transfer Area and AUM 32. U.S. EPA in consultation with NNEPA, will make a future determination on the final response action with respect to the contaminated soils at AUM 32 and AUM 33.

Threats that will require attention prior to the start of a long-term cleanup:

It is expected that this removal action will eliminate any threat of direct or indirect contact with or inhalation of hazardous substances at the areas addressed in this removal.

The extent to which the removal will ensure that threats are adequately abated:

The removal of soil contaminated with hazardous substances by soil excavation and internment will abate the threats described in Section III.

Consistency with the long-term remedy:

The Time-Critical Removal proposed for the Site is consistent with addressing the larger issue of potential exposures posed by other AUMs located throughout the Navajo Nation.

Post Removal Site Control

After EPA completes its proposed removal action at this Site, U.S. EPA will inspect the soil sealant on AUM 32 in the spring of 2013.

3. Applicable or relevant and appropriate requirements (ARARs)

Section 300.415(j) of the NCP provides that removal actions must attain ARARs to the extent practicable, considering the exigencies of the situation.

Section 300.5 of the NCP defines applicable requirements as cleanup standards, standards of control, and other substantive environmental protection requirements, criteria or limitations promulgated under Federal environmental or State environmental or facility citing laws that specifically address a hazardous substance, pollutant, contaminant, remedial action, location or other circumstances at a CERCLA site.

Section 300.5 of the NCP defines relevant and appropriate requirements as cleanup standards, standards of control and other substantive requirements, criteria, or limitations promulgated under Federal environmental or State environmental or facility citing laws that, while not "applicable" to a hazardous substance, pollutant, or contaminant, remedial action, location, or other circumstances at a CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site and are well-suited to the particular site.

Because CERCLA on-site response actions do not require permitting, only substantive requirements are considered as possible ARARs. Administrative requirements such as approval of, or consultation with administrative bodies, issuance of permits, documentation, reporting, record keeping and enforcement are not ARARs for the CERCLA actions confined to the site.

Federal ARARs determined to be practicable for the Site are:

Native American Graves Protection and Repatriation Act, 25 USC §§3001 *et seq.* and its implementing regulations, 43 CFR Part 10.

National Historic Preservation Act, 16 USC §§ 470 *et seq.* and its implementing regulations, 36 CFR Part 800.

Archeological Resources Protection Act of 1979, 16 USC §§ 47000 *et seq.* and its implementing regulations, 43 CFR Part 7.

American Indian Religious Freedom Act, 42 USC §§ 1996 *et seq.* Endangered Species Act, 7 USC § 136 and 16 USC §§ 15331-1548, and its implementing regulations, 50 CFR Parts 17 and 403 (applicable if protected species identified in subject area).

RCRA Subtitle D for Disposal of Solid Waste, 42 USC 6901 *et seq.* and relevant and appropriate provisions of implementing regulations, 40 CFR Parts 257 and 258 Clean Water Act, Section 402 NPDES storm water discharges, 40 CFR Parts

122 and 125 (regulations discharges from site, including monitoring and applying best management practices).

Additional Federal guidance to be considered:

U.S. EPA Directive on Protective Cleanup Levels for Radioactive Contamination at CERCLA sites. OSWER Directive 9200.4-18.EPA Guidance for Developing Best Management Practices for Storm Water, Publication EPA/832/R-92006.

Navajo Nation ARARs determined to be practicable for the Site are:

Navajo Nation Air Pollution and Prevention Act, Air Quality Control Program, Code of Regulations for Air Emissions (outlines Best Management Practices (BMPs) to control dust that would be generated during earth moving activities).

Navajo Nation Endangered Species List, Resource Committee Resolution RCAU-103-05 (applicable if protected species identified within subject area).

4. Project schedule

It is estimated that it will take approximately 45 working days to complete excavation and transport to the repository. Site preparation activities such as archeological surveys and road building can be initiated as early as September 19, 2012. Removal activities are expected to begin October 8, 2012.

B. Estimated Costs

Cost estimates are based on existing ERRS rates for the EPA Region 9 contract. Cost estimates may have to be adjusted after potential bids for the removal are received, or if there is a substantial increase in the material that requires attention.

Funds Needed from Special Accounts

Cleanup Contractor (ERRS)	$ 1,500,000
Technical Contractor (START)	$ 215,000
Subtotal Extramural Costs	$ 1,715,000
Extramural Costs Contingency (20%)	$ 343,000
TOTAL, Removal Action Project Ceiling	$ 2,058,000

VII. EXPECTED CHANGE IN THE SITUATION SHOULD ACTION BE DELAYED OR NOT TAKEN

Given the Site conditions, the nature of the hazardous substances documented onsite, and the potential exposure pathways to nearby populations described in Sections III and IV above, actual or threatened releases of hazardous substances from the Site, if not addressed by implementing the response actions selected in this Action Memorandum, may present an

imminent and substantial endangerment to public health or welfare or the environment.

VIII. OUTSTANDING POLICY ISSUES

There are no outstanding policy issues that have been identified with respect to this Site at this time.

IX. ENFORCEMENT

Please see the attached Confidential Enforcement Addendum for a discussion regarding potentially responsible parties (PRPs). U.S. EPA has identified Kerr McGee Corporation as a PRP for this Site. Kerr McGee Corporation changed its name to Tronox, Inc. in 2005 and filed for Bankruptcy in 2009. As part of a settlement between the United States and the Tronox Bankruptcy Estate, EPA has received $12 million, which has been placed in a special account for use addressing the Kerr McGee/Tronox mine sites. Since the AUM section 32 and 33 are one of these sites, this special account funding is available to pay for this removal action

Intramural Costs[2]

U.S. EPA Direct Costs	$ 60,000
U.S. EPA Indirect Costs (36.19 % of Spending $2,058,000+ $60,000)	$ 766,504
TOTAL Intramural Costs	$ 826,504

The total U.S. EPA extramural and intramural costs for this removal action based on full-cost accounting practices that will be eligible for cost recovery are estimated to be $2,824,504.

[2] Direct costs include direct extramural costs and direct intramural costs. Indirect costs are calculated based on an estimated indirect cost rate expressed as a percentage of site-specific direct costs, consistent with the full cost accounting methodology effective October 2, 2000. These estimates do not include pre-judgment interest, do not take into account other enforcement costs, including Department of Justice costs, and may be adjusted during the course of a removal action. The estimates are for illustrative purposes only and their use is not intended to create any rights for responsible parties. Neither the lack of a total cost estimate nor deviation of actual costs from this estimate will affect the United States' right to cost recovery.

IX. U.S. EPA RECOMMENDATION

This decision document represents the selected removal action for the Section 32 and 33 AUM Site, McKinley County, New Mexico, Navajo Nation Indian Reservation developed in accordance with CERCLA, as amended, and not inconsistent with the NCP. This decision is based on the Administrative Record for the Site.

Because conditions at the Site meet the NCP Section 300.415(b) criteria for a removal and the CERCLA Section 104(c) emergency exemption from the $2 million statutory limitation, U.S. EPA enforcement staff recommends the approval of the removal action proposed in this Action Memorandum. The total project ceiling if approved will be $2,824,504 of which an estimated $2,058,000 comes from a special account and not the Regional Removal Allowance. Approval may be indicated by signing below

Approve: _____ _____
Daniel A. Meer, Assistant Director Date
Superfund Division

Disapprove: _____ _____
Daniel A. Meer, Assistant Director Date
Superfund Division

Confidential Enforcement Addendum

Attachments:

I. Index to the Administrative Record
II. Figures
III. Summary of Soil Sample Results for Ra-226 and Associated Gammy Activity Counts
IV. Photo Log

cc: Sherry Fielding, U.S. EPA, OERR, HQ
Steven Etsitty, Navajo Nation Environmental Protection Agency
David Taylor, Navajo Nation Department of Justice
Steven Spencer, U.S. Department of Interior
Ron Maldonado, Navajo Nation Historic Preservation Department

bcc: H. Allen, SFD-9-2
Laurie Williams, ORC-3
C. Temple, SFD-9-2
Eugene Esplain, Navajo Nation Environmental Protection Agency Freida White, Navajo Nation Environmental Protection Agency
Site File

ATTACHMENT I
INDEX TO THE ADMINISTRATIVE RECORD

1. Navajo Abandoned Uranium Mine Site Screen Report – Section 32 AUM Site. Navajo AUM Eastern Region. Weston Solutions, Inc. May 2009.

2. Navajo Abandoned Uranium Mine Site Screen Report – Section 33 AUM Site. Navajo AUM Eastern Region. Weston Solutions, Inc. May 2009.

3. Tronox AUM Section 32 and 33, Eastern Agency, Removal Assessment Report, Navajo Nation, McKinley County, New Mexico. Ecology and Environment, Inc. September, 2012.

4. Agency for Toxic Substances and Disease Registry (ATSDR) ToxFAQs, Radium CAS#7440-14-4. ATSDR. July 1999a.

5. Agency for Toxic Substances and Disease Registry (ATSDR) ToxFAQs, Ionizing Radiation. ATSDR. September 1999b.

6. Agency for Toxic Substances and Disease Registry (ATSDR) ToxFAQs, Uranium CAS#7440-61-1. ATSDR. September 1999c

ATTACHMENT
II
FIGURES

Figure 2-1 - Site Location Map

Figure 3-1 - Soil Sampling Location Map

Figure 4-1 - Gamma Radiation Activity and Ra-226 Soil Concentrations at AUM 32 Mine Area

Figure 4-2 - Gamma Radiation Activity and Ra-226 Soil Concentrations at AUM 32 Transfer Area

Figure 4-3 - Gamma Radiation Activity and Ra-226 Soil Concentrations at AUM 33

Figure 4-6 - Proposed Removal Areas at AUM 32 Mine Area

Figure 4-7 - Proposed Removal Areas at Southern Portion of AUM 32 Transfer Area

Figure 4-8 - Proposed Removal Areas at Northern Portion of AUM 32 Transfer Area

ATTACHMENT
III
SUMMARY OF SOIL SAMPLE RESULTS FOR Ra-226 AND ASSOCIATED GAMMY ACTIVITY COUNTS

Table 4-1 - Radium-226 Analytical Results and Co-located Surface Gamma Radiation Activity, Tronox AUM Sections 32 and 33 Background Area

Table 4-2 - Radium-226 Analytical Results and Co-located Surface Gamma Radiation Activity, Tronox AUM Section 32

Table 4-3 - Radium-226 Analytical Results and Co-located Surface Gamma Radiation Activity, Tronox AUM Section 33

Table 4-7 - Proposed Removal Volumes

ATTACHMENT
IV
PHOTO LOG

Project # EE-002693-2164-01TTO, EE-002693-2165-01TTO
TDD# TO-02-09-11-10-0004, TO-02-09-11-10-0005

Source: Aerial Photography - Bing Maps

LEGEND

- Site area
- Chapter boundary

N

0 1 2 3 4 Miles

Figure 2-1
Site Location Map
Tronox AUM Sections 32 and 33
Casamero Lake Chapter, Navajo Nation
Prewitt, New Mexico

ecology and environment, inc.
International Specialists in the Environment

Ecology & Environment, Inc. GIS Department Project: L:\Oakland\Tronox\Maps\MXDs\Old\Figure_2-1_Site_Location_Map_Overview.mxd Date: 9/19/2012)

Project # EE-002693-2164-01TTO, EE-002693-2165-01TTO
TDD# TO-02-09-11-10-0004, TO-02-09-11-10-0005

Source: Aerial Photography - Bing Maps

AUM 32 Mine Area

AUM 33

Wooden hopper

Open mine shaft

AUM 32 Transfer Area

Concrete pad

CASAMERO LAKE

HAYSTACK

32-01 32-02 32-03 32-04 32-05 32-06 32-07 32-08 32-09 32-10 32-11 32-12 32-13 32-14 32-15 32-16 32-17 32-18 32-19 32-20 32-21 32-22 32-23 32-24 32-25 32-26 32-27 32-28 32-29 32-30 32-31 32-32 32-33 32-34 32-35 32-36 32-37 32-38 32-39 32-40 32-41 32-42 32-43 32-44 32-45 32-46 32-47 32-48 32-49

33-01 33-02 33-03 33-04 33-05 33-06 33-07 33-08 33-09 33-10 33-11 33-12 33-13 33-14 33-15 33-16

LEGEND

Gamma activity levels in kilo counts per minute

- Less than or equal to Investigation Level (0 - 40)
- Greater than Investigation Level (40.1 - 50)
- Greater than 2x Background Level (50.1 - 240)
- Greater than 10x Background Level (>240)

Sample location type

- Subsurface
- Surface
- Background area

- Initial mine area
- Transfer area
- Homesite
- Chapter boundary

N

0 400 800 Feet

Figure 3-1
Soil Sampling Location Map
Tronox AUM Sections 32 and 33
Casamero Lake Chapter, Navajo Nation
Prewitt, New Mexico

ecology and environment, inc.
International Specialists in the Environment

Ecology & Environment, Inc. GIS Department Project: L:\Oakland\Tronox\Maps\MXDs\OldFigure_3-1_Viper_activity_scan_sample_locs_poster.mxd Date: 9/20/2012)

Project # EE-002693-2164-01TTO
TDD# TO-02-09-11-10-0004

Source: Aerial Photography - Bing Maps

AUM32-06	
Depth	Ra-226
0	22.20
1	1.14
2	1.62
3	1.49
4	NE

AUM32-19	
Depth	Ra-226
0	2.02

AUM32-20	
Depth	Ra-226
0	16.60

AUM32-21	
Depth	Ra-226
0	1.94

AUM32-05	
Depth	Ra-226
0	2.07
1	2.12
2	1.39
3	1.42
4	NE

AUM32-07	
Depth	Ra-226
0	1.65
1	12.80
2	31.00
3	40.70
4	NE

AUM32-24	
Depth	Ra-226
0	1.53

AUM32-16	
Depth	Ra-226
0	3.20

AUM32-15	
Depth	Ra-226
0	13.50

AUM32-22	
Depth	Ra-226
0	3.59

CASAMERO LAKE

HAYSTACK

AUM32-23	
Depth	Ra-226
0	4.75

AUM32-17	
Depth	Ra-226
0	7.88

AUM32-13	
Depth	Ra-226
0	2.07

AUM32-12	
Depth	Ra-226
0	1.19

AUM32-08	
Depth	Ra-226
0	37.30
1	112.00
2	9.78
3	2.45
4	1.07

AUM32-02	
Depth	Ra-226
0	2.89
1	2.09
2	2.47
3	1.98
4	NE

AUM32-03	
Depth	Ra-226
0	8.21
1	2.94
2	1.98
3	1.40
4	NE

AUM32-18	
Depth	Ra-226
0	10.00

AUM32-04	
Depth	Ra-226
0	12.40
1	2.58
2	1.45
3	2.15
4	NE

AUM32-10	
Depth	Ra-226
0	8.98

AUM32-11	
Depth	Ra-226
0	1.36

AUM32-09	
Depth	Ra-226
0	2.41
1	50.70
2	57.10
3	0.80
4	1.18

AUM32-01	
Depth	Ra-226
0	10.20
1	8.86
2	4.50
3	1.35
4	1.24

AUM32-14	
Depth	Ra-226
0	1.37

AUM32-25	
Depth	Ra-226
0	3.00

LEGEND

Gamma activity levels in kilo counts per minute

- Less than or equal to Investigation Level (0 - 40)
- Greater than Investigation Level (40.1 - 50)
- Greater than 2x Background Level (50.1 - 240)
- Greater than 10x Background Level (>240)

Ra-226 Concentration in Surface Soil (0 to 2 inches bgs)

- Less than or equal to Action Level (2.11 pCi/g)
- Greater than Action Level
- Chapter boundary

Note:

Sample depths were measured in feet below ground surface (bgs).
NE = Not applicable or not evaluated.
Radium-226 (Ra-226) concentrations in picocuries per gram (pCi/g).

N

0 100 200 300 400 Feet

Figure 4-1
Gamma Radiation Activity and Ra-226 Soil Concentrations at AUM 32 Mine Area
Tronox AUM Sections 32 and 33
Casamero Lake Chapter, Navajo Nation
Prewitt, New Mexico

ecology and environment, inc.
International Specialists in the Environment

Ecology & Environment, Inc. GIS Department Project: I:\Oakland\Tronox\Maps\MXD\s\Figure_4-1_Radium226_Soil_Concentration_AUM_32_V3.mxd Date: 8/30/2012)

Project # EE-002693-2164-01TTO
TDD# TO-02-09-11-10-0004

Source: Aerial Photography - Bing Maps

AUM32-39	
Depth	Ra-226
0	2.84

AUM32-28	
Depth	Ra-226
0	300.00
1	48.30
2	0.76
3	0.97

AUM32-30	
Depth	Ra-226
0	4.29
1	0.98
2	1.14
3	1.03

AUM32-48	
Depth	Ra-226
0	2.21

AUM32-29	
Depth	Ra-226
0	262.00
1	2.68
2	2.06
3	13.90

AUM32-31	
Depth	Ra-226
0	20.30
1	1.56
2	1.14
3	1.07

AUM32-45	
Depth	Ra-226
0	0.92

AUM32-47	
Depth	Ra-226
0	0.90

AUM32-42	
Depth	Ra-226
0	3.11

AUM32-26	
Depth	Ra-226
0	1.69
1	0.96
2	0.79
3	0.78

AUM32-44	
Depth	Ra-226
0	23.40
1	1.43
2	1.04
3	0.82

AUM32-38	
Depth	Ra-226
0	13.60
1	1.17
2	0.90
3	1.13

AUM32-40	
Depth	Ra-226
0	0.76

AUM32-27	
Depth	Ra-226
0	237.00
1	15.70
2	0.87
3	0.77

AUM32-34	
Depth	Ra-226
0	20.10
1	0.92
2	1.29
3	0.74

AUM32-35	
Depth	Ra-226
0	2.72
1	0.83
2	1.10
3	0.99

AUM32-36	
Depth	Ra-226
0	39.40
1	0.99
2	1.60
3	0.54

AUM32-32	
Depth	Ra-226
0	7.78
1	0.96
2	1.19
3	0.97

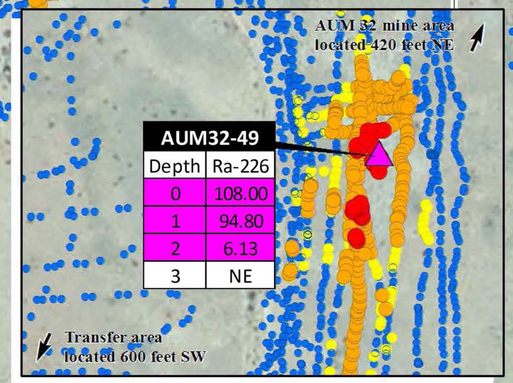
AUM32-33	
Depth	Ra-226
0	4.22
1	1.02
2	1.30
3	1.16

AUM32-41	
Depth	Ra-226
0	0.79

AUM32-37	
Depth	Ra-226
0	2.60
1	0.85
2	0.90
3	0.78

AUM32-43	
Depth	Ra-226
0	0.99

AUM32-46	
Depth	Ra-226
0	1.10



AUM32-49	
Depth	Ra-226
0	108.00
1	94.80
2	6.13
3	NE

CASAMERO LAKE

HAYSTACK

LEGEND

Gamma activity levels in kilo counts per minute

- Less than or equal to Investigation Level (0 - 40)
- Greater than Investigation Level (40.1 - 50)
- Greater than 2x Background Level (50.1 - 240)
- Greater than 10x Background Level (>240)

Ra-226 Concentration in Surface Soil (0 to 2 inches bgs)

- Less than or equal to Action Level (2.11 pCi/g)
- Greater than Action Level
- Chapter boundary

Note:

Sample depths were measured in feet below ground surface (bgs).
NE = Not applicable or not evaluated.
Radium-226 (Ra-226) concentrations in picocuries per gram (pCi/g).

N

0 100 200 300 400 Feet

Figure 4-2
Gamma Radiation Activity and Ra-226 Soil Concentrations at AUM 32 Transfer Area
Tronox AUM Sections 32 and 33
Casamero Lake Chapter, Navajo Nation
Prewitt, New Mexico

ecology and environment, inc.
International Specialists in the Environment

Ecology & Environment, Inc. GIS Department Project: L:\Oakland\Tronox\Maps\MXD\sFigure_4-2_Radium226_Soil_Concentration_AUM_32_V3.mxd Date: 8/30/2012)

Project # EE-002693-2165-01TTO
TDD# TO-02-09-11-10-0005

Source: Aerial Photography - Bing Maps

AUM33-02	
Depth	Ra-226
0	20.30
1	4.07
2	6.00
3	7.15

AUM33-10	
Depth	Ra-226
0	4.31

AUM33-09	
Depth	Ra-226
0	6.70

AUM33-05	
Depth	Ra-226
0	9.13
1	3.93
2	4.61
3	1.32

AUM33-16	
Depth	Ra-226
0	6.59

AUM33-15	
Depth	Ra-226
0	9.85

AUM33-07	
Depth	Ra-226
0	39.40
1	5.83
2	3.36
3	0.85
4	1.07

AUM33-14	
Depth	Ra-226
0	1.65

AUM33-08	
Depth	Ra-226
0	4.78

AUM33-13	
Depth	Ra-226
0	9.70

AUM33-03	
Depth	Ra-226
0	1.00
1	2.14
2	1.55
3	1.14

AUM33-12	
Depth	Ra-226
0	1.45

AUM33-11	
Depth	Ra-226
0	1.37

AUM33-04	
Depth	Ra-226
0	76.10
1	35.40
2	19.00
3	22.20

AUM33-01	
Depth	Ra-226
0	1.30
1	1.37
2	1.04
3	1.05

AUM33-06	
Depth	Ra-226
0	1.33
1	1.10
2	0.82
3	1.01

CASAMERO LAKE

HAYSTACK

LEGEND

Gamma activity levels in kilo counts per minute

- Less than or equal to Investigation Level (0 - 40)
- Greater than Investigation Level (40.1 - 50)
- Greater than 2x Background Level (50.1 - 240)
- Greater than 10x Background Level (>240)

Ra-226 Concentration in Surface Soil (0 to 2 inches bgs)

- Less than or equal to Action Level (2.11 pCi/g)
- Greater than Action Level
- Chapter boundary

Note:

Sample depths were measured in feet below ground surface (bgs).
NE = Not applicable or not evaluated.
Radium-226 (Ra-226) concentrations in picocuries per gram (pCi/g).

N

0 100 200 300 400 Feet

Figure 4-3
Gamma Radiation Activity and Ra-226 Soil Concentrations at AUM 33
Tronox AUM Sections 32 and 33
Casamero Lake Chapter, Navajo Nation
Prewitt, New Mexico

ecology and environment, inc.
International Specialists in the Environment

Ecology & Environment, Inc. GIS Department Project: L:\Oakland\Tronox\Maps\MXDs\Figure_4-3_Radium226_Soil_Concentration_AUM_33_Mine_Area.mxd Date: 9/11/2012)

Project # EE-002693-2164-01TTO
TDD# TO-02-09-11-10-0004

Source: Aerial Photography - Bing Maps

AUM32-RA-03
1 ft bgs

AUM32-RA-02
2 ft bgs

AUM32-RA-01
3 ft bgs

AUM32-RA-04
3 ft bgs

AUM32-RA-05
4 ft bgs

AUM32-06
AUM32-20
AUM32-19
AUM32-21
AUM32-22
AUM32-07
AUM32-05
AUM32-24
AUM32-16
AUM32-15
AUM32-08
AUM32-17
AUM32-04
AUM32-02
AUM32-23
AUM32-03
AUM32-18
AUM32-12
AUM32-13
AUM32-11
AUM32-09
AUM32-10
AUM32-01
AUM32-14
AUM32-25

CASAMERO LAKE

HAYSTACK

bing

LEGEND

Gamma activity levels in kilo counts per minute

- Less than or equal to Investigation Level (0 - 40)
- Greater than Investigation Level (40.1 - 50)
- Greater than 2x Background Level (50.1 - 240)
- Greater than 10x Background Level (>240)

Ra-226 Concentration in Surface Soil (0 to 2 inches bgs)

- Less than or equal to Action Level (2.11 pCi/g)
- Greater than Action Level
- Removal area
- Chapter boundary

Note:

ft bgs: Feet below ground surface
pCi/g: Picocuries per gram
AUM32-RA-11 - Removal area
1 ft bgs - Excavation depth

N

0 100 200 300 400 Feet

Figure 4-6
Proposed Removal Areas
at AUM 32 Mine Area
Tronox AUM Sections 32 and 33
Casamero Lake Chapter, Navajo Nation
Prewitt, New Mexico

ecology and environment, inc.
International Specialists in the Environment

Ecology & Environment, Inc. GIS Department Project: I:\Oakland\Tronox\Maps\MXDs\Figure_4-6_Proposed_Removal_Area_AUM_32_Mine_Area.mxd Date: 9/19/2012)

Project # EE-002693-2164-01TTO
TDD# TO-02-09-11-10-0004

Source: Aerial Photography - Bing Maps

AUM32-39
AUM32-48
AUM32-30
AUM32-47
AUM32-29
AUM32-28
AUM32-45
AUM32-44
AUM32-42
AUM32-27
AUM32-31
AUM32-26
AUM32-38
AUM32-35
AUM32-40
AUM32-34
AUM32-33
AUM32-36
AUM32-32
AUM32-41
AUM32-37
AUM32-46
AUM32-43

AUM32-RA-08
1 ft bgs

AUM32-RA-10
1 ft bgs

AUM32-RA-06
4 ft bgs

AUM32-RA-09
1 ft bgs

AUM32-RA-07
2 ft bgs

AUM32-RA-11
1 ft bgs

Transfer Area
located 141 feet N

CASAMERO LAKE

HAYSTACK

LEGEND

Gamma activity levels in kilo counts per minute

- Less than or equal to Investigation Level (0 - 40)
- Greater than Investigation Level (40.1 - 50)
- Greater than 2x Background Level (50.1 - 240)
- Greater than 10x Background Level (>240)

Ra-226 Concentration in Surface Soil (0 to 2 inches bgs)

- Less than or equal to Action Level (2.11 pCi/g)
- Greater than Action Level
- Removal area
- Chapter boundary

Note:

ft bgs: Feet below ground surface
pCi/g: Picocuries per gram
AUM32-RA-11 - Removal area
1 ft bgs - Excavation depth

N

0 100 200 300 400 Feet

Figure 4-7
Proposed Removal Areas in the Southern Portion of AUM 32 Transfer Area
Tronox AUM Sections 32 and 33
Casamero Lake Chapter, Navajo Nation
Prewitt, New Mexico

ecology and environment, inc.
International Specialists in the Environment

Ecology & Environment, Inc. GIS Department Project: L:\Oakland\Tronox\Maps\MXDs\Figure_4-7_Proposed_Removal_Area_AUM_32_South_Transfer.mxd Date: 9/19/2012

Project # EE-002693-2164-01TTO
TDD# TO-02-09-11-10-0004

Source: Aerial Photography - Bing Maps

AUM32-14

AUM32-25

AUM32-RA-13
2 ft bgs

AUM32-RA-14
2 ft bgs

AUM32-49

AUM32-RA-12
3 ft bgs

CASAMERO LAKE

HAYSTACK

AUM32-39

AUM32-48

bing

Ecology & Environment, Inc. GIS Department Project: L:\Oakland\Tronox\Maps\MXDs\Figure_4-8_Proposed_Removal_Area AUM_32_North_Transfer.mxd Date: 9/19/2012)

LEGEND

Gamma activity levels in kilo counts per minute

- Less than or equal to Investigation Level (0 - 40)
- Greater than Investigation Level (40.1 - 50)
- Greater than 2x Background Level (50.1 - 240)
- Greater than 10x Background Level (>240)

Ra-226 Concentration in Surface Soil (0 to 2 inches bgs)

- Less than or equal to Action Level (2.11 pCi/g)
- Greater than Action Level
- Removal area
- Chapter boundary

Note:

ft bgs: Feet below ground surface

pCi/g: Picocuries per gram

AUM32-RA-11 - Removal area

1 ft bgs - Excavation depth

N

0 100 200 300 400 Feet

Figure 4-8
Proposed Removal Areas in the Northern Portion of AUM 32 Transfer Area
Tronox AUM Sections 32 and 33
Casamero Lake Chapter, Navajo Nation
Prewitt, New Mexico

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Table 4-1

Radium-226 Analytical Results and Co-located Surface Gamma Radiation Activity
Tronox AUM Sections 32 and 33 Background Area
Casamero Lake Chapter, Navajo Nation
Prewitt, New Mexico

TDD No.: TO-02-09-11-10-0004 Project No.: EE-002693-2164-01TTO
TO-02-09-11-10-0005 EE-002693-2165-01TTO

Sample ID[a]	Ra-226 Concentration[b] (pCi/g)	Surface Gamma Radiation Activity[c] (cpm) Radiation Survey Equipment[d]	
		A1	B2
Tronox - BKG2 - 01	0.666	24,087	24,000
Tronox - BKG2 - 02	0.592	23,534	23,892
Tronox - BKG2 - 03	0.801	23,497	23,719
Tronox - BKG2 - 04	0.900		
Tronox - BKG2 - 05	0.648		
Tronox - BKG2 - 06	0.740		
Tronox - BKG2 - 07	0.701		
Tronox - BKG2 - 08	0.722		
Tronox - BKG2 - 09	0.728		
Tronox - BKG2 - 10	0.698		
Tronox - BKG2 - 11	0.626		

Notes:

a All background samples were collected from the surface (0 to 2 inches below ground surface).

b Concentrations shown in **bold** exceed the action level of 2.11 pCi/g

c Static 1-minute measurement at sampling location

d Paired radiation survey equipment which consisted of Ludlum Model 44-20 (3x3) detector and 2241 meter:
Equipment A1 consisted of a Ludlum 2241-3 meter (Serial No. 256844) and an Alpha Spectra detector (Serial No. 121611BP).
Equipment B2 consisted of a Ludlum 2241-3 meter (Serial No. 256852) and an Alpha Spectra detector (Serial No. 121611BQ).

AUM Abandoned uranium mine
cpm Counts per minute
pCi/g Picocuries per gram
Ra-226 Radium-226

Table 4-2
Radium-226 Analytical Results and Co-located Surface Gamma Radiation Activity
Tronox AUM Section 32
Casamero Lake Chapter, Navajo Nation
Prewitt, New Mexico

TDD No.: TO-02-09-11-10-0004 Project No.: EE-002693-2164-01TTO

Sample ID[a]	Ra-226 Concentration[b] (pCi/g)	Surface Gamma Radiation Activity[c] (cpm)	Radiation Survey Equipment[d]
Mine Area[e]			
AUM32-01-02	**10.2**		
AUM32-01-12	**8.86**		
AUM32-01-24	**4.50**		
AUM32-01-36	**6.18**		
AUM32-01-36 (G)	1.35		
AUM32-01-48 (G)	1.24		
AUM32-02-02	**2.89**	42,213	B2
AUM32-02-12	2.09		
AUM32-02-24	**2.47**		
AUM32-02-36	1.98		
AUM32-102-36	**2.51**		
AUM32-03-02	**8.21**	54,245	B2
AUM32-03-12	**2.94**		
AUM32-103-12	**2.67**		
AUM32-03-24	1.98		
AUM32-03-36	1.40		
AUM32-04-02	**12.4**	73,533	B2
AUM32-04-12	**2.58**		
AUM32-04-24	1.45		
AUM32-04-36	**2.15**		
AUM32-05-02	2.07	74,440	B2
AUM32-05-12	**2.12**		
AUM32-05-24	1.39		
AUM32-05-36	1.42		
AUM32-06-02	**22.2**	104,554	B2
AUM32-06-12	1.14		
AUM32-06-24	1.62		
AUM32-106-24	2.01		
AUM32-06-36	1.49		
AUM32-07-02	1.65	106,041	B2
AUM32-07-12	**12.8**		
AUM32-07-24	**31.0**		
AUM32-07-36	**40.7**		
AUM32-08-02	**37.3**	492,811	B2
AUM32-08-12	**112**		
AUM32-08-24	**9.78**		
AUM32-08-36	**10.8**		

Table 4-2
Radium-226 Analytical Results and Co-located Surface Gamma Radiation Activity
Tronox AUM Section 32
Casamero Lake Chapter, Navajo Nation
Prewitt, New Mexico

TDD No.: TO-02-09-11-10-0004 Project No.: EE-002693-2164-01TTO

Sample ID[a]	Ra-226 Concentration[b] (pCi/g)	Surface Gamma Radiation Activity[c] (cpm)	Radiation Survey Equipment[d]
AUM32-08-36 (G)	**2.45**		
AUM32-08-48 (G)	1.07		
AUM32-09-02	**2.41**	183,333	B2
AUM32-09-12	**50.7**		
AUM32-09-24	**57.1**		
AUM32-09-36	**4.59**		
AUM32-09-36 (G)	0.797		
AUM32-09-48 (G)	1.18		
AUM32-10-02	**8.98**	59,729	A1
AUM32-11-02	1.36	68,578	A1
AUM32-111-02	1.25	68,578	A1
AUM32-12-02	1.19	64,143	A1
AUM32-13-02	2.07	86,820	A1
AUM32-14-02	1.37	32,594	A1
AUM32-15-02	**13.5**	77,649	A1
AUM32-16-02	**3.20**	44,563	A1
AUM32-17-02	**7.88**	55,612	A1
AUM32-18-02	**10.0**	58,320	A1
AUM32-19-02	2.02	36,800	A1
AUM32-20-02	**16.6**	66,519	A1
AUM32-21-02	1.94	43,890	A1
AUM32-22-02	**3.59**	71,148	A1
AUM32-23-02	**4.75**	45,470	A1
AUM32-123-02	**5.43**	45,470	A1
AUM32-24-02	1.53	36,444	A1
AUM32-25-02	**3.00**	46,329	A1
Transfer Area[f]			
AUM32-26-02	1.69	30,994	B2
AUM32-26-12	0.963		
AUM32-26-24	0.786		
AUM32-26-36	0.779		
AUM32-27-02	**237**	356,219	B2
AUM32-27-12	**15.7**		
AUM32-27-24	0.866		
AUM32-27-36	0.767		
AUM32-28-02	**300**	381,942	B2
AUM32-28-12	**48.3**		
AUM32-28-24	0.759		

Table 4-2
Radium-226 Analytical Results and Co-located Surface Gamma Radiation Activity
Tronox AUM Section 32
Casamero Lake Chapter, Navajo Nation
Prewitt, New Mexico

TDD No.: TO-02-09-11-10-0004 Project No.: EE-002693-2164-01TTO

Sample ID[a]	Ra-226 Concentration[b] (pCi/g)	Surface Gamma Radiation Activity[c] (cpm)	Radiation Survey Equipment[d]
AUM32-28-36	0.967		
AUM32-29-02	**262**	313,237	B2
AUM32-29-12	**2.68**		
AUM32-29-24	2.06		
AUM32-29-36	**13.9**		
AUM32-30-02	**4.29**	38,309	B2
AUM32-30-12	0.982		
AUM32-130-12	1.03		
AUM32-30-24	1.14		
AUM32-30-36	1.03		
AUM32-31-02	**20.3**	60,674	B2
AUM32-31-12	1.56		
AUM32-31-24	1.14		
AUM32-31-36	1.07		
AUM32-32-02	**7.78**	35,581	B2
AUM32-32-12	0.964		
AUM32-32-24	1.19		
AUM32-32-36	0.966		
AUM32-132-36	0.909		
AUM32-33-02	**4.22**	60,721	B2
AUM32-33-12	1.02		
AUM32-33-24	1.30		
AUM32-33-36	1.16		
AUM32-34-02	**20.1**	62,878	B2
AUM32-134-02	**18.2**	62,878	B2
AUM32-34-12	0.921		
AUM32-34-24	1.29		
AUM32-34-36	0.740		
AUM32-35-02	**2.72**	47,842	B2
AUM32-35-12	0.832		
AUM32-35-24	1.10		
AUM32-135-24	1.00		
AUM32-35-36	0.991		
AUM32-36-02	**39.4**	56,926	B2
AUM32-36-12	0.986		
AUM32-136-12	1.20		
AUM32-36-24	1.60		
AUM32-36-36	0.544		

Table 4-2
Radium-226 Analytical Results and Co-located Surface Gamma Radiation Activity
Tronox AUM Section 32
Casamero Lake Chapter, Navajo Nation
Prewitt, New Mexico

TDD No.: TO-02-09-11-10-0004 Project No.: EE-002693-2164-01TTO

Sample ID[a]	Ra-226 Concentration[b] (pCi/g)	Surface Gamma Radiation Activity[c] (cpm)	Radiation Survey Equipment[d]
AUM32-37-02	**2.60**	34,570	B2
AUM32-37-12	0.846		
AUM32-37-24	0.901		
AUM32-37-36	0.777		
AUM32-38-02	**13.6**	67,451	B2
AUM32-138-02	**12.1**	67,451	B2
AUM32-38-12	1.17		
AUM32-38-24	0.897		
AUM32-38-36	1.13		
AUM32-39-02	**2.84**	31,108	B2
AUM32-40-02	0.761	28,824	B2
AUM32-41-02	0.789	29,694	B2
AUM32-42-02	**3.11**	31,173	B2
AUM32-43-02	0.993	27,817	B2
AUM32-44-02	**23.4**	89,687	B2
AUM32-44-12	1.43		
AUM32-44-24	1.04		
AUM32-144-24	0.875		
AUM32-44-36	0.815		
AUM32-45-02	0.923	27,751	A1
AUM32-46-02	1.10	26,615	A1
AUM32-47-02	0.900	29,128	A1
AUM32-48-02	**2.21**	29,905	A1
AUM32-148-02	2.04	29,905	A1
AUM32-49-02	**108**	237,696	A1
AUM32-49-12	**94.8**		
AUM32-49-24	**6.13**		

Notes:

a The sample ID indicates the following:

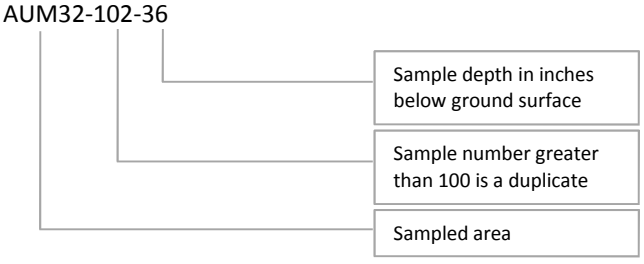


Table 4-2
Radium-226 Analytical Results and Co-located Surface Gamma Radiation Activity
Tronox AUM Section 32
Casamero Lake Chapter, Navajo Nation
Prewitt, New Mexico

TDD No.: TO-02-09-11-10-0004 Project No.: EE-002693-2164-01TTO

Notes (continued):

b	Concentrations shown in **bold** exceed the action level of 2.11 pCi/g
c	Static 1-minute measurement at sampling location
d	Paired radiation survey equipment which consisted of Ludlum Model 44-20 (3x3) detector and 2241 meter: Equipment A1 consisted of a Ludlum 2241-3 meter (Serial No. 256844) and an Alpha Spectra detector (Serial No. 121611BP). Equipment B2 consisted of a Ludlum 2241-3 meter (Serial No. 256852) and an Alpha Spectra detector (Serial No. 121611BQ).
e	Soil samples from the mine area were collected using a hand auger. Soil samples noted with a (G) were collected using a Geoprobe® system.
f	Soil samples from the transfer area were collected using a Geoprobe® system except for AUM32-49 which was collected using a hand auger.

AUM	Abandoned uranium mine
cpm	Counts per minute
pCi/g	Picocuries per gram
Ra-226	Radium-226

Table 4-3
Radium-226 Analytical Results and Co-located Surface Gamma Radiation Activity
Tronox AUM Section 33
Casamero Lake Chapter, Navajo Nation
Prewitt, New Mexico

TDD No.: TO-02-09-11-10-0005 Project No.: EE-002693-2165-01TTO

Sample ID[a]	Ra-226 Concentration[b] (pCi/g)	Surface Gamma Radiation Activity[c] (cpm)	Radiation Survey Equipment[d]
AUM33-01-02	1.30	37,862	B2
AUM33-01-12	1.37		
AUM33-101-12	1.38		
AUM33-01-24	1.04		
AUM33-01-36	1.05		
AUM33-02-02	**20.3**	116,387	B2
AUM33-02-12	**4.07**		
AUM33-02-24	**6.00**		
AUM33-102-24	**6.08**		
AUM33-02-36	**7.15**		
AUM33-03-02	0.996	43,300	B2
AUM33-03-12	**2.14**		
AUM33-03-24	1.55		
AUM33-03-36	1.14		
AUM33-103-36	1.26		
AUM33-04-02	**76.1**	158,830	B2
AUM33-04-12	**35.4**		
AUM33-04-24	**19.0**		
AUM33-04-36	**22.2**		
AUM33-05-02	**9.13**	67,668	B2
AUM33-05-12	**3.93**		
AUM33-05-24	**4.61**		
AUM33-05-36	1.32		
AUM33-06-02	1.33	37,582	B2
AUM33-06-12	1.10		
AUM33-06-24	0.816		
AUM33-06-34	1.01		
AUM33-07-02	**39.4**	116,594	B2
AUM33-07-12	**5.83**		
AUM33-07-24	**3.36**		
AUM33-07-36	**2.84**		
AUM33-07-36 (G)	0.847		
AUM33-07-48 (G)	1.07		
AUM33-08-02	**4.78**	58,287	A1
AUM33-108-02	**6.11**	58,287	A1
AUM33-09-02	**6.70**	81,632	A1

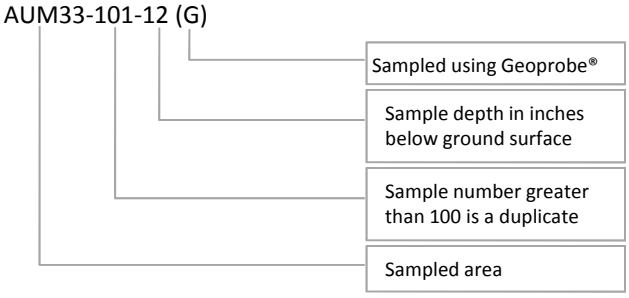
Table 4-3
Radium-226 Analytical Results and Co-located Surface Gamma Radiation Activity
Tronox AUM Section 33
Casamero Lake Chapter, Navajo Nation
Prewitt, New Mexico

TDD No.: TO-02-09-11-10-0005 Project No.: EE-002693-2165-01TTO

Sample ID[a]	Ra-226 Concentration[b] (pCi/g)	Surface Gamma Radiation Activity[c] (cpm)	Radiation Survey Equipment[d]
AUM33-10-02	**4.31**	47,868	A1
AUM33-11-02	1.37	41,483	A1
AUM33-12-02	1.45	39,720	A1
AUM33-13-02	**9.70**	75,707	A1
AUM33-14-02	1.65	36,513	A1
AUM33-15-02	**9.85**	57,764	A1
AUM33-16-02	**6.59**	62,778	A1
AUM33-WP-01	**52.2**		
AUM33-WP-02	**47.7**		
AUM33-WP-03	**23.3**		

Notes:

a The sample ID indicates the following:



The waste pile (WP) samples were all collected from the surface (0 to 2 inches below ground surface). The last 2 digits of the sample ID of the WP samples represent the sample number.

b Concentrations shown in **bold** exceed the action level of 2.11 pCi/g

c Static 1-minute measurement at sampling location

d Paired radiation survey equipment which consisted of Ludlum Model 44-20 (3x3) detector and 2241 meter:
Equipment A1 consisted of a Ludlum 2241-3 meter (Serial No. 256844) and an Alpha Spectra detector (Serial No. 121611BP).
Equipment B2 consisted of a Ludlum 2241-3 meter (Serial No. 256852) and an Alpha Spectra detector (Serial No. 121611BQ).

AUM Abandoned uranium mine
cpm Counts per minute
pCi/g Picocuries per gram
Ra-226 Radium-226

Table 4-7
Proposed Removal Volumes
Tronox AUM Sections 32 and 33
Casamero Lake Chapter, Navajo Nation
Prewitt, New Mexico

TDD No.: TO-02-09-11-10-0004 Project No.: EE-002693-2164-01TTO
TO-02-09-11-10-0005 EE-002693-2165-01TTO

Removal Area	Excavation		
	Depth (feet bgs)	Area (ft^2)	Volume (yd^3)
AUM32-RA-01	3	23,222	2,580
AUM32-RA-02	2	105,402	7,808
AUM32-RA-03	1	60,850	2,254
AUM32-RA-04	3	88,704	9,856
AUM32-RA-05	4	30,454	4,512
AUM 32 Mine Area		***308,632***	***27,009***
AUM32-RA-06	4	23,762	3,520
AUM32-RA-07	2	15,308	1,134
AUM32-RA-08	1	156,756	5,806
AUM32-RA-09	1	69,940	2,590
AUM32-RA-10	1	2,770	103
AUM32-RA-11	1	3,915	145
AUM32-RA-12	3	27,822	3,091
AUM32-RA-13	2	21,099	1,563
AUM32-RA-14	2	1,220	90
AUM 32 Transfer Area		***322,592***	***18,043***
AUM33-RA-01	2	29,890	2,214
AUM33-RA-02	4	76,253	11,297
AUM33-RA-03	3	45,409	5,045
AUM 33		***151,552***	***18,556***
TOTAL		***782,777***	***63,608***

Notes:

bgs	Below ground surface
ft^2	Square feet
yd^3	Cubic yards

PHOTOGRAPHIC LOG

Removal Assessment

Tronox AUM Section 32
Casamero Lake Chapter, Navajo Nation
Prewitt, New Mexico

TDD No.: TO-02-09-11-10-0004 Project No.: EE-002693-2164-01TTO

Direction:	Date:
East	06/12/12

Description:

View of the S portion of the initial AUM32 mine area

Direction:	Date:
North	06/12/12

Description:

Gamma radiation survey at the E portion of AUM 32 mine area where an open shaft is located

PHOTOGRAPHIC LOG

Removal Assessment

Tronox AUM Section 32
Casamero Lake Chapter, Navajo Nation
Prewitt, New Mexico

TDD No.: TO-02-09-11-10-0004 Project No.: EE-002693-2164-01TTO

Direction:	Date:
North	06/12/12

Description:

Transects of gamma radiation survey at AUM 32

Direction:	Date:
North	06/12/12

Description:

Boundary between AUM 32 and AUM 33 mine areas

PHOTOGRAPHIC LOG

Removal Assessment

Tronox AUM Section 32
Casamero Lake Chapter, Navajo Nation
Prewitt, New Mexico

TDD No.: TO-02-09-11-10-0004 Project No.: EE-002693-2164-01TTO

Direction:	Date:
North	06/12/12

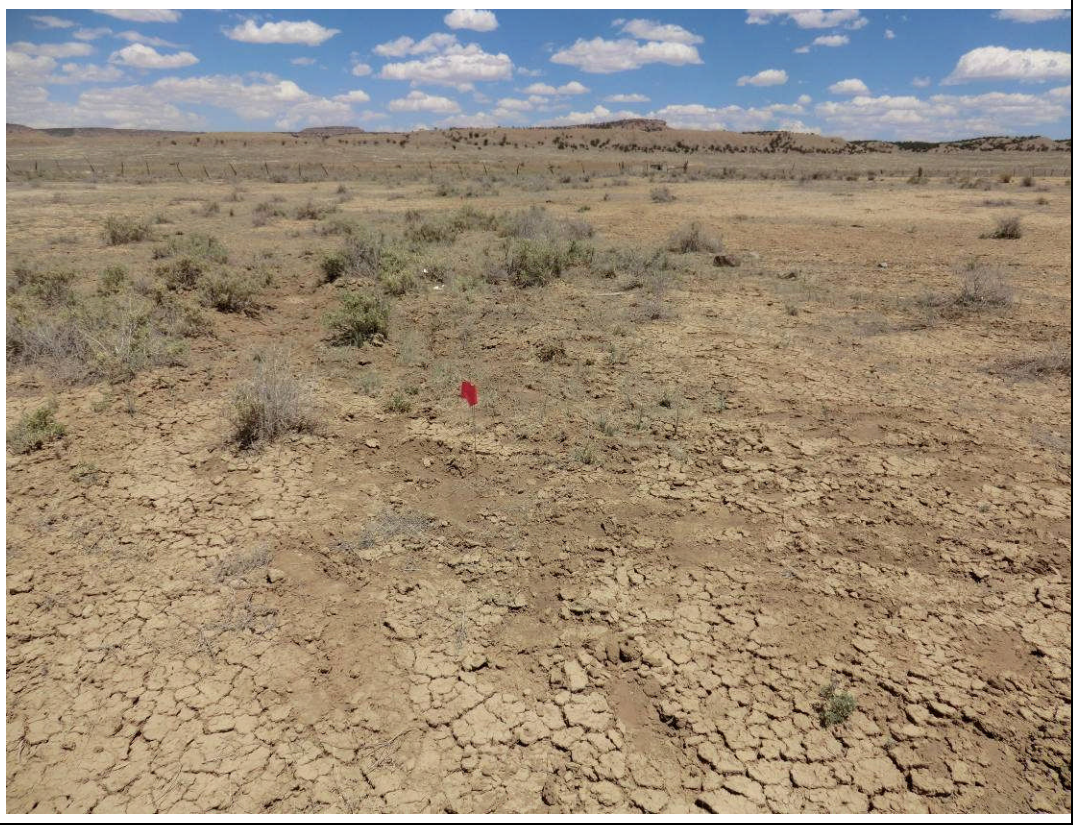
Description:

View of the initial W boundary of the AUM32 mine area

Direction:	Date:
East	06/12/12

Description:

N portion of AUM 32 mine area



PHOTOGRAPHIC LOG

Removal Assessment

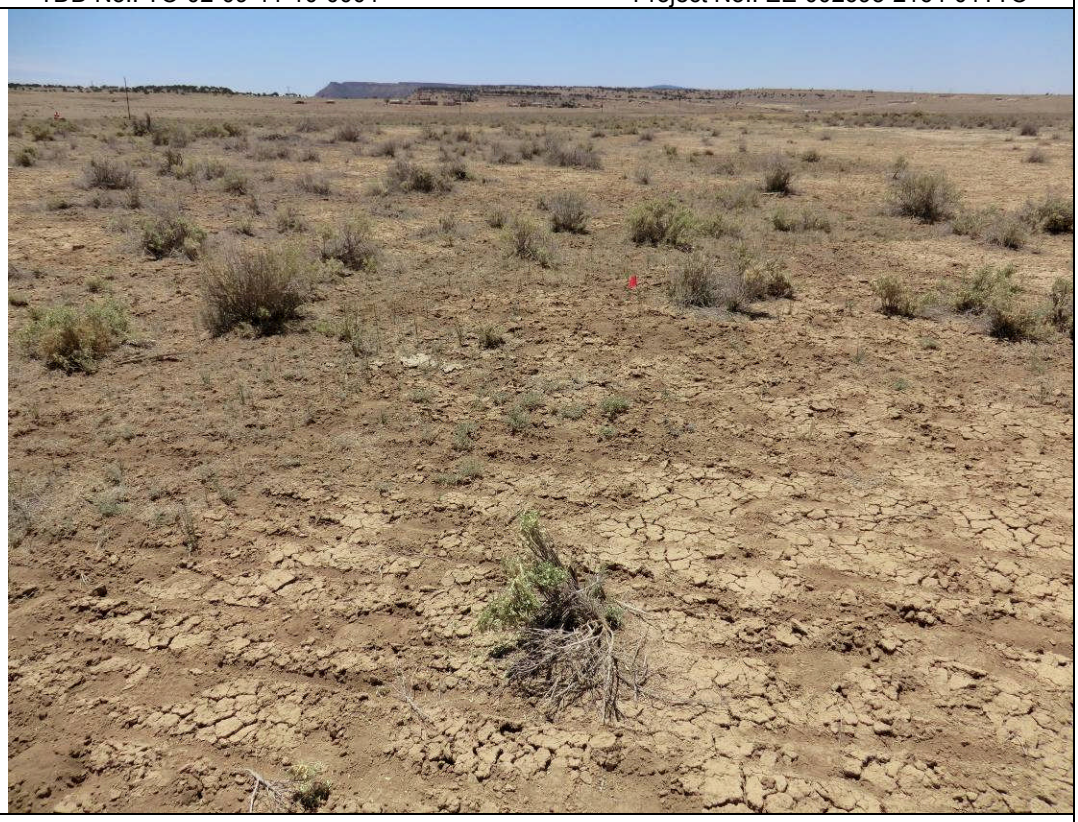
Tronox AUM Section 32
Casamero Lake Chapter, Navajo Nation
Prewitt, New Mexico

TDD No.: TO-02-09-11-10-0004 Project No.: EE-002693-2164-01TTO

Direction:	Date:
West	06/12/12

Description:

View of the step-out from the initial AUM32 mine area



Direction:	Date:
East	06/13/12

Description:

Dry pond located NW of the AUM 32 mine area

PHOTOGRAPHIC LOG

Removal Assessment

Tronox AUM Section 32
Casamero Lake Chapter, Navajo Nation
Prewitt, New Mexico

TDD No.: TO-02-09-11-10-0004 Project No.: EE-002693-2164-01TTO

Direction:	Date:
West	06/13/12

Description:

Step-out gamma radiation survey at AUM32 mine area

Direction:	Date:
South	06/13/12

Description:

Gamma radiation survey at W boundary of AUM 32 mine area

PHOTOGRAPHIC LOG

Removal Assessment

Tronox AUM Section 32
Casamero Lake Chapter, Navajo Nation
Prewitt, New Mexico

TDD No.: TO-02-09-11-10-0004 Project No.: EE-002693-2164-01TTO

Direction:	**Date:**
North	06/13/12

Description:

W boundary of AUM 32 mine area

Direction:	**Date:**
East	06/13/12

Description:

View of the S portion of the AUM 32 mine area

PHOTOGRAPHIC LOG

Removal Assessment

Tronox AUM Section 32
Casamero Lake Chapter, Navajo Nation
Prewitt, New Mexico

TDD No.: TO-02-09-11-10-0004 Project No.: EE-002693-2164-01TTO

Direction:	Date:
Downward	06/13/12

Description:

Rock with gamma radiation activity reading above 500 kilo counts per minute at the AUM 32 mine area

Direction:	Date:
Downward	06/13/12

Description:

Buried rock(s) with gamma radiation activity reading above 500 kilo counts per minute at the AUM 32 mine area

PHOTOGRAPHIC LOG

Removal Assessment

Tronox AUM Section 32
Casamero Lake Chapter, Navajo Nation
Prewitt, New Mexico

TDD No.: TO-02-09-11-10-0004 Project No.: EE-002693-2164-01TTO

Direction:	Date:
North	06/14/12

Description:

Gamma radiation survey equipment

Direction:	Date:
Downward	06/14/12

Description:

Concrete pad at AUM 32 transfer area

PHOTOGRAPHIC LOG

Removal Assessment

Tronox AUM Section 32
Casamero Lake Chapter, Navajo Nation
Prewitt, New Mexico

TDD No.: TO-02-09-11-10-0004 Project No.: EE-002693-2164-01TTO

Direction:	Date:
North	06/14/12

Description:

Local resident showing USEPA and NNEPA the concrete pad where a crane was reportedly staged in the former transfer area; START hand-scanning area for gamma radiation activity.

Direction:	Date:
South	06/14/12

Description:

Vent located in the AUM 32 transfer area

PHOTOGRAPHIC LOG

Removal Assessment

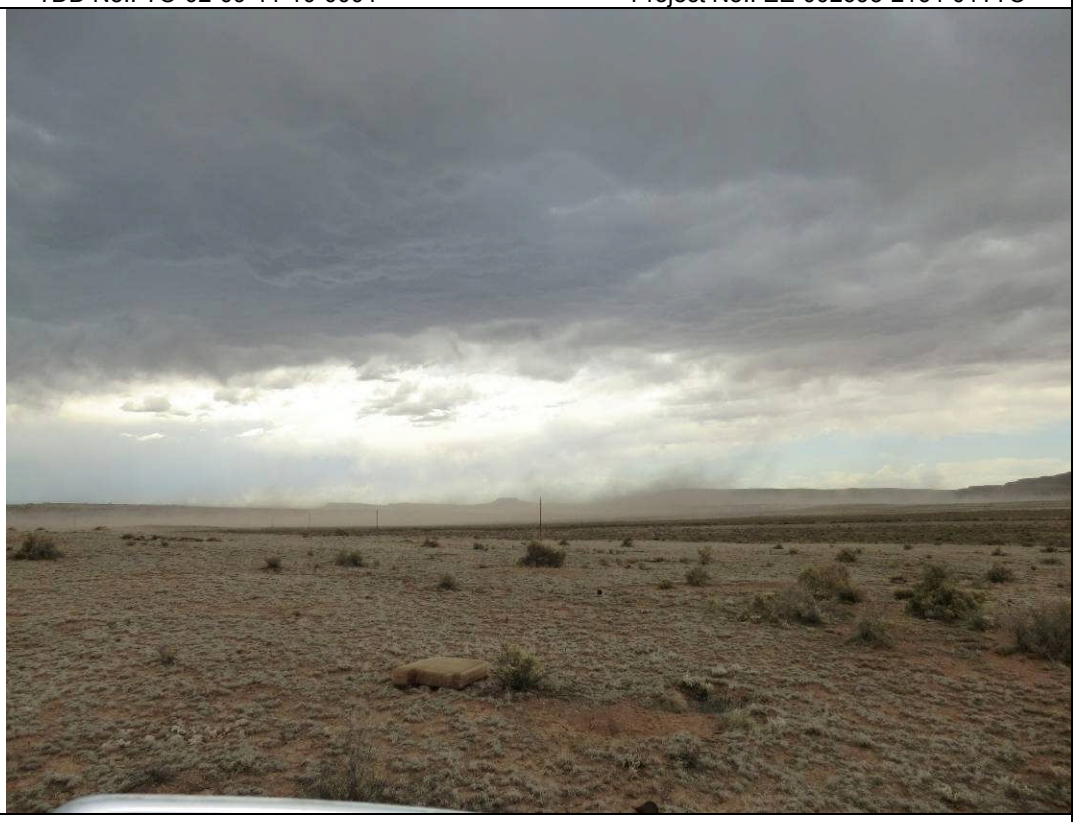
Tronox AUM Section 32
Casamero Lake Chapter, Navajo Nation
Prewitt, New Mexico

TDD No.: TO-02-09-11-10-0004 Project No.: EE-002693-2164-01TTO

Direction:	Date:
West	06/15/12

Description:

Wind-blown dust before a storm



Direction:	Date:
Northwest	07/17/12

Description:

View of background area, home site in the background

PHOTOGRAPHIC LOG

Removal Assessment

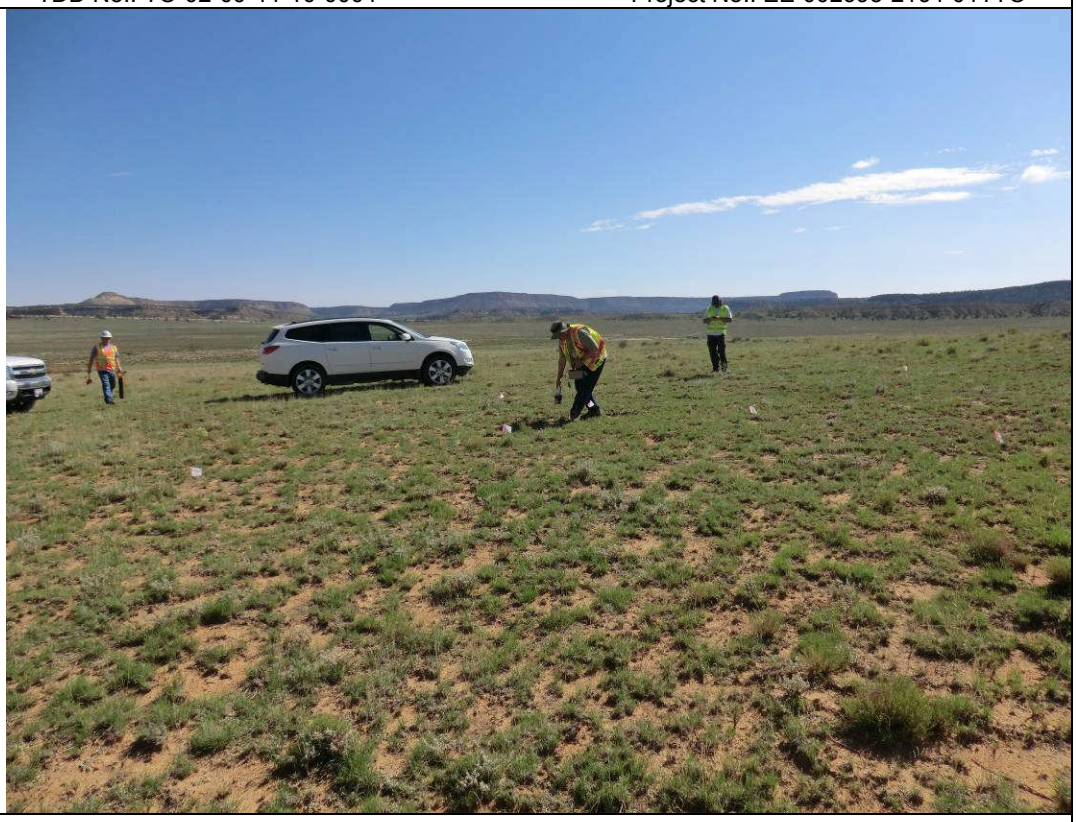
Tronox AUM Section 32
Casamero Lake Chapter, Navajo Nation
Prewitt, New Mexico

TDD No.: TO-02-09-11-10-0004 Project No.: EE-002693-2164-01TTO

Direction:	Date:
East	07/17/12

Description:

Background measurement of utility locating equipment (L) and radiation survey equipment (C)



Direction:	Date:
South	07/17/12

Description:

View of background area

PHOTOGRAPHIC LOG

Removal Assessment

Tronox AUM Section 32
Casamero Lake Chapter, Navajo Nation
Prewitt, New Mexico

TDD No.: TO-02-09-11-10-0004 Project No.: EE-002693-2164-01TTO

Direction:	Date:
North	07/17/12

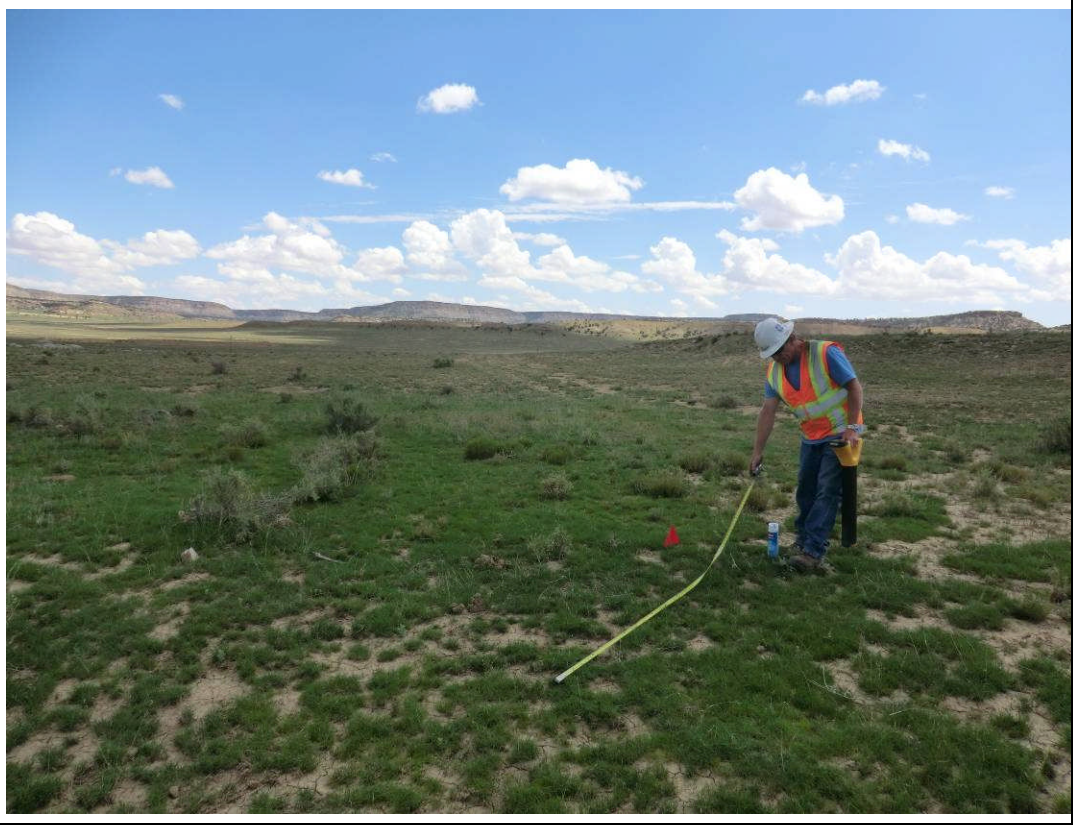
Description:

View of concrete pad in AUM 32 transfer area

Direction:	Date:
North	07/17/12

Description:

START's subcontractor measuring area for utility location



PHOTOGRAPHIC LOG

Removal Assessment

Tronox AUM Section 32
Casamero Lake Chapter, Navajo Nation
Prewitt, New Mexico

TDD No.: TO-02-09-11-10-0004 Project No.: EE-002693-2164-01TTO

Direction:	Date:
South	07/17/12

Description:

E boundary of AUM 32 transfer area

Direction:	Date:
West	07/17/12

Description:

View of AUM 32 transfer area

PHOTOGRAPHIC LOG

Removal Assessment

Tronox AUM Section 32
Casamero Lake Chapter, Navajo Nation
Prewitt, New Mexico

TDD No.: TO-02-09-11-10-0004 Project No.: EE-002693-2164-01TTO

Direction:	**Date:**
Northwest	07/17/12

Description:

View of AUM 32 transfer area, home site in the background

Direction:	**Date:**
North	07/17/12

Description:

View of E portion of AUM 32 transfer area

PHOTOGRAPHIC LOG

Removal Assessment

Tronox AUM Section 32
Casamero Lake Chapter, Navajo Nation
Prewitt, New Mexico

TDD No.: TO-02-09-11-10-0004 Project No.: EE-002693-2164-01TTO

Direction:	Date:
East	07/17/12

Description:

Hill bordering the E side of AUM 32 transfer area

Direction:	Date:
North	07/17/12

Description:

Water path at AUM 32 transfer area

PHOTOGRAPHIC LOG

Removal Assessment

Tronox AUM Section 32
Casamero Lake Chapter, Navajo Nation
Prewitt, New Mexico

TDD No.: TO-02-09-11-10-0004 Project No.: EE-002693-2164-01TTO

Direction:	Date:
South	07/17/12

Description:

Water path at AUM 32 transfer area

Direction:	Date:
Downward	07/19/12

Description:

A hare observed at the AUM 32 transfer area

PHOTOGRAPHIC LOG

Removal Assessment

Tronox AUM Section 32
Casamero Lake Chapter, Navajo Nation
Prewitt, New Mexico

TDD No.: TO-02-09-11-10-0004 Project No.: EE-002693-2164-01TTO

Direction:	Date:
North	07/17/12

Description:

Subsurface sampling at AUM 32 transfer area using a Geoprobe®

Direction:	Date:
North	07/17/12

Description:

Radiation monitoring of personnel

PHOTOGRAPHIC LOG

Removal Assessment

Tronox AUM Section 32
Casamero Lake Chapter, Navajo Nation
Prewitt, New Mexico

TDD No.: TO-02-09-11-10-0004 Project No.: EE-002693-2164-01TTO

Direction:	Date:
North	07/17/12

Description:

START's subcontractor performing utility location

Direction:	Date:
East	07/17/12

Description:

Gamma radiation survey of E boundary of AUM 32 transfer area

PHOTOGRAPHIC LOG

Removal Assessment

Tronox AUM Section 32
Casamero Lake Chapter, Navajo Nation
Prewitt, New Mexico

TDD No.: TO-02-09-11-10-0004 Project No.: EE-002693-2164-01TTO

Direction:	Date:
South	07/17/12

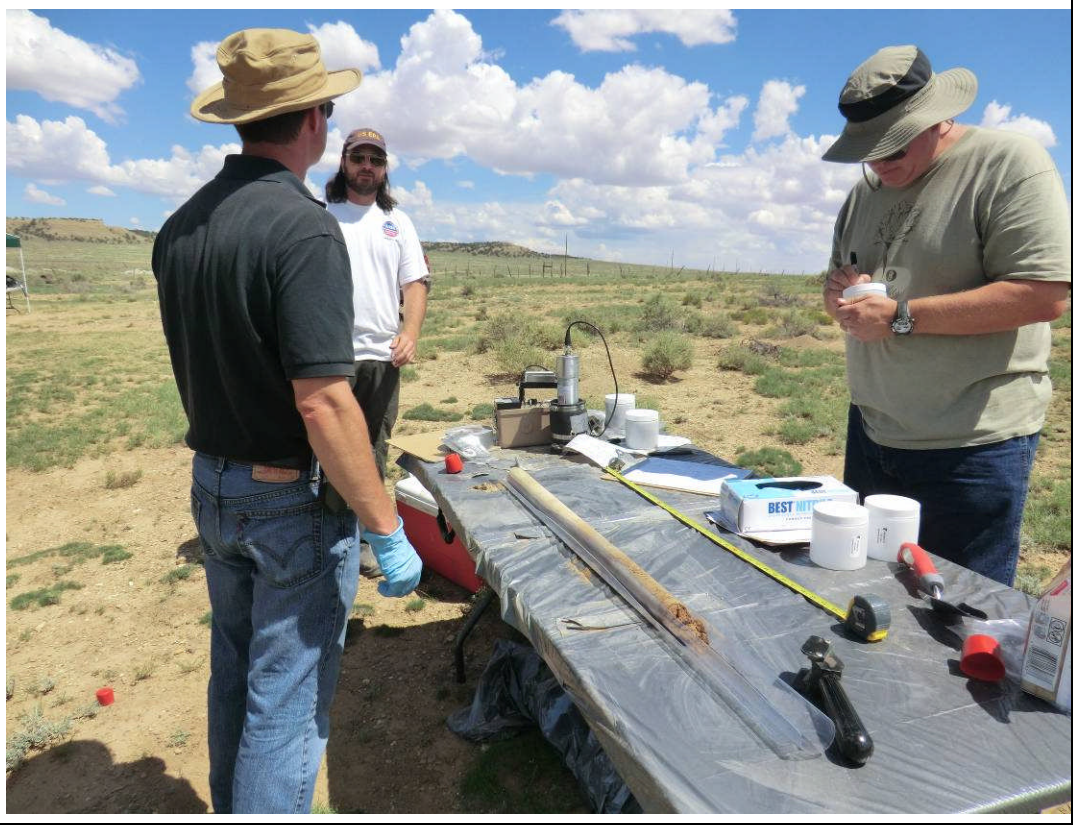
Description:

Subsurface sampling using a Geoprobe®

Direction:	Date:
East	07/17/12

Description:

Sampling and logging of soil core from AUM32-35



PHOTOGRAPHIC LOG

Removal Assessment

Tronox AUM Section 32
Casamero Lake Chapter, Navajo Nation
Prewitt, New Mexico

TDD No.: TO-02-09-11-10-0004 Project No.: EE-002693-2164-01TTO

Direction:	Date:
North	07/18/12

Description:

Drill bit located S of AUM 33

Direction:	Date:
Downward	07/18/12

Description:

Drill bits located S of AUM 33

PHOTOGRAPHIC LOG

Removal Assessment

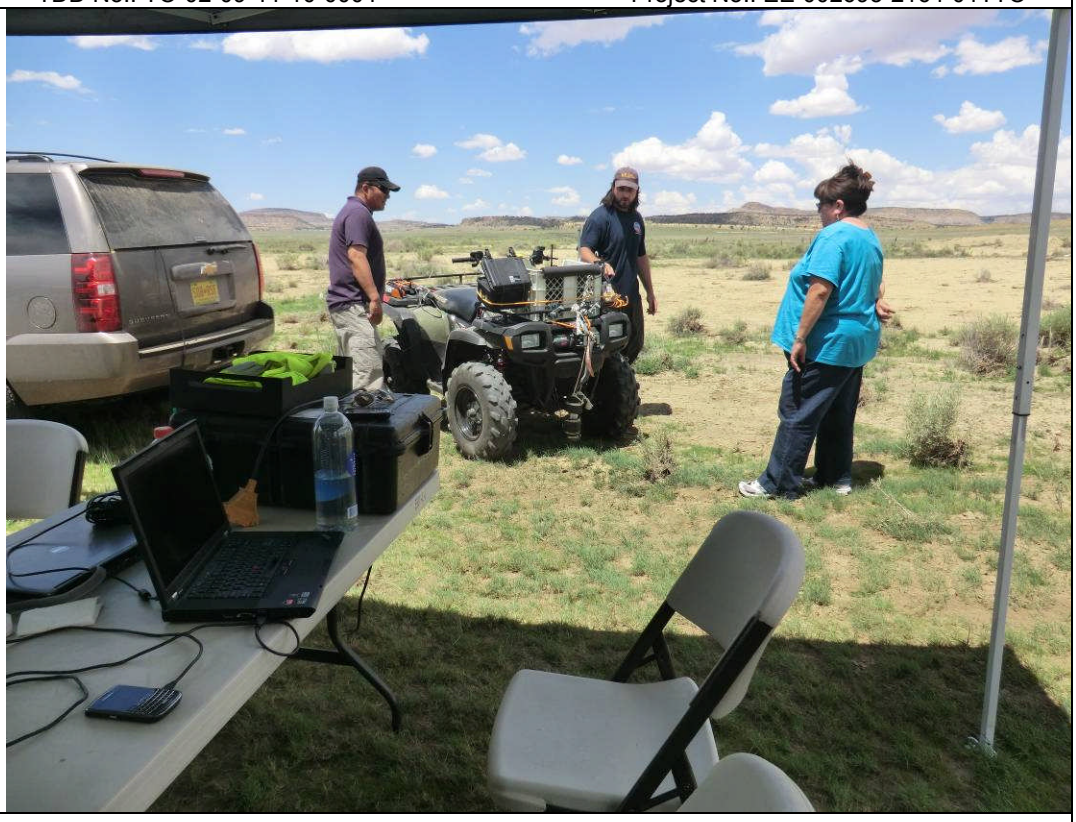
Tronox AUM Section 32
Casamero Lake Chapter, Navajo Nation
Prewitt, New Mexico

TDD No.: TO-02-09-11-10-0004 Project No.: EE-002693-2164-01TTO

Direction:	Date:
North	07/18/12

Description:

EPA showing NNEPA the gamma radiation survey equipment



Direction:	Date:
Downward	07/19/12

Description:

Rocks with gamma radiation activity reading above 500 kilo counts per minute at the AUM 32 transfer area

PHOTOGRAPHIC LOG

Removal Assessment

Tronox AUM Section 32
Casamero Lake Chapter, Navajo Nation
Prewitt, New Mexico

TDD No.: TO-02-09-11-10-0004 Project No.: EE-002693-2164-01TTO

Direction:	Date:
North	07/19/12

Description:

Location of AUM 32-49

Direction:	Date:
Downward	07/19/12

Description:

Hand-augered borehole

PHOTOGRAPHIC LOG

Removal Assessment

Tronox AUM Section 33
Casamero Lake Chapter, Navajo Nation
Prewitt, New Mexico

TDD No.: TO-02-09-11-10-0005 Project No.: EE-002693-2165-01TTO

Direction: North	**Date:** 06/13/12

Description:

Setting up the gamma radiation survey equipment

Direction: South	**Date:** 06/12/12

Description:

VIPER system deployment manager and gateway (R)

PHOTOGRAPHIC LOG

Removal Assessment

Tronox AUM Section 33
Casamero Lake Chapter, Navajo Nation
Prewitt, New Mexico

TDD No.: TO-02-09-11-10-0005 Project No.: EE-002693-2165-01TTO

Direction:	Date:
East	06/12/12

Description:

View of the N portion of AUM 33.

Direction:	Date:
South	06/13/12

Description:

View of the western portion of AUM 33 and fence between AUM 32 and AUM 33

PHOTOGRAPHIC LOG

Removal Assessment

Tronox AUM Section 33
Casamero Lake Chapter, Navajo Nation
Prewitt, New Mexico

TDD No.: TO-02-09-11-10-0005 Project No.: EE-002693-2165-01TTO

Direction: East	**Date:** 06/13/12

Description:

Gamma radiation survey of the waste piles located in the northeast corner of AUM 33

Direction: South	**Date:** 06/13/12

Description:

Gamma radiation survey and waste piles at AUM 33

PHOTOGRAPHIC LOG

Removal Assessment

Tronox AUM Section 33
Casamero Lake Chapter, Navajo Nation
Prewitt, New Mexico

TDD No.: TO-02-09-11-10-0005 Project No.: EE-002693-2165-01TTO

Direction:	**Date:**
Northeast	06/12/12

Description:

Gamma radiation survey of waste pile

Direction:	**Date:**
South	06/13/12

Description:

Gamma radiation survey of the southeast corner of AUM 33; waste piles (R)

PHOTOGRAPHIC LOG

Removal Assessment

Tronox AUM Section 33
Casamero Lake Chapter, Navajo Nation
Prewitt, New Mexico

TDD No.: TO-02-09-11-10-0005 Project No.: EE-002693-2165-01TTO

Direction: East	**Date:** 06/13/12

Description:

Gamma radiation survey of the waste piles located in the northeast corner of AUM 33

Direction: South	**Date:** 06/13/12

Description:

Gamma radiation survey and waste piles at AUM 33

PHOTOGRAPHIC LOG

Removal Assessment

Tronox AUM Section 33
Casamero Lake Chapter, Navajo Nation
Prewitt, New Mexico

TDD No.: TO-02-09-11-10-0005 Project No.: EE-002693-2165-01TTO

Direction: East	**Date:** 06/15/12

Description:

Measuring static gamma radiation activity at soil sampling location AUM33-07

Direction: South	**Date:** 06/13/12

Description:

Collecting subsurface samples by hand auger at AUM33-07