Discharge Pipeline Abandonment Work Plan

Mt. Taylor Mine

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CONTENTS

1.0 INTRODUCTION 7
2.0 PROJECT SCOPE 8
3.0 REGULATORY REQUIREMENTS 8
3.1 Existing Mine Compliance Documents 8
3.1.1 Closeout/Closure Plan Mine 22-1 Permit #C1002RE And Discharge Permit 61 8
3.2 Applicable Federal Requirements 10
3.2.1 Cultural and Biological Resource Protection 10
3.2.2 Storm Water 10
3.2.3 Aquatic Resources (Clean Water Act) 10
3.2.4 Protection Of Wildlife 10
3.2.5 Air 10
4.0 ACCESS 11
4.1 Private Property 11
4.2 County Road 11
4.3 USFS Land 11
5.0 FACILITY CHARACTERIZATION 12
5.1 Piping 12
5.2 Structures 12
5.2.1 Steel Anchor Structures 12
5.2.2 Concrete Thrust Blocks 12
5.2.3 Arroyo Crossings 12
5.2.4 Road Crossings 13
5.2.5 Other Structures 13
6.0 DEMOLITION AND REMOVAL 13
6.1 Pipeline 13
6.2 Structures 14
6.2.1 Steel Anchor Structures 14
6.2.2 45-Degree Steel Pipe 14
6.2.3 Concrete Thrust Blocks And Concrete Pads 14

6.2.4 Arroyo Crossings 14
6.2.5 Road Crossings 14
6.2.6 Other Structures 15
7.0 RADIATION AND SAFETY 15
7.1 RADIATION SURVEY OF MATERIALS 15
7.1.1 Containment Of Residual Solids 15
7.1.2 Asbestos 15
7.1.3 Lead-Based Paint 16
7.1.4 Fire Control 16
7.1.5 Dust Control 16
8.0 SOIL ASSESSMENT AND RECLAMATION 16
8.1 Soil Cleanup 16
8.1.1 Excavation 17
8.1.2 Confirmation Soil Sampling 17
8.1.3 Site Restoration 17
9.0 REFERENCES 18

LIST OF DRAWINGS

Sheet 1 - Overall pipeline and Mine Property

Sheet 2 - Pipeline in Area 1 STA 0+00 to STA 70+00

Sheet 3 - Pipeline in Area 2 (USFS Land) STA 70+00 to STA 106+00

Sheet 4 - Pipeline in Area 3 STA 106+00 to STA 145+50

Sheet 5 - Pipeline in Area 4 STA 145+00 to STA 204+60

Sheet 6 - Pipeline in Area 5 STA 204+60 to STA 213+52

LIST OF APPENDICES

Appendix A – Revegetation Plan

Appendix B – Photo Log of July 29 through August 1, 2024, Facility Characterization

Appendix C – Radiation Protection Program Manual, ERG, Revision 5, March 18, 2021

LIST OF ACRONYMS

α – Alpha Radiation

β – Beta Radiation

AAS – Atomic Absorption Analysis

ACM – Asbestos Containing Materials

AHERA - Asbestos Hazard and Emergency Response Act

ALARA – As Low as Reasonably Achievable

ANSI – American National Standards Institute

AQB – Air Quality Bureau

BMP - Best Management Practice

cm – Centimeter

cm^2 – Squared Centimeter

DP – Discharge Permit

EA – Environmental Analysis

ELLAP – Environmental Lead Laboratory Accreditation Program

EMNRD – Energy, Minerals and Natural Resources Department

EPA - Environmental Protection Agency

GPS – Global Positioning System

HP – Health Physicist

HPS – Health Physics Society

ID – Sample Identifier

m – Meter

m^2 – Square Meter

μR/hr – Micro-Roentgens Equivalent Man (rem) per Hour

mg/L – Milligrams per Liter

mil – One-Thousandth of an Inch

LBP – Lead-Based Paint

Mine – Mount Taylor Mine

MMD – Mining and Minerals Division of the New Mexico Energy, Minerals & Natural Resources Department

mrem – milli- Roentgens Equivalent Man (rem)

MWTU – Mine Water Treatment Unit

MSGP – Multi-Sector General Permit for Stormwater Discharges associated with Industrial Activities

NESHAP – National Emission Standards for Hazardous Air Pollutants

NIST – National Institute of Standards and Technology

NMCRIS – New Mexico Cultural Resources Information System

NMED – New Mexico Environmental Department

NMPM – New Mexico Principal Meridian

NOI – Notice of Intent

NPDES – National Pollution Discharge Elimination System

NRC – Nuclear Regulatory Commission

NVLAP – National Institute of Standards and Technology

OSHA – Occupational Safety and Health Administration

pCi/g – Picocuries per Gram

PLM – Polarized Light Microscopy

PMLU – Post-Mining Land Use

PRRL - Post-Reclamation Radiation Level

Radcon – Radiation Control Contractor

rem – Roentgen Equivalent Man

RGR – Rio Grande Resources Corporation

ROW – Right-of-Way

SUP - Special Use Permit

SWPPP – Stormwater Pollution Prevention Plan

T&E – Threatened and Endangered Species

USACE – United States Army Corps of Engineers

USFS – United States Forest Service

USFWS – United States Fish and Wildlife Service

UTM – Universal Transverse Mercator

1.0 INTRODUCTION

Engineering Analytics has prepared this Discharge Pipeline Abandonment Work Plan for the New Mexico Energy, Minerals and Natural Resources Department (EMNRD), Mining and Minerals Division (MMD). During operations, a 4.3-mile-long discharge pipeline was installed and operated at the Mount Taylor Mine (Mine). The pipeline traverses both private (Lee Ranch) and (United States Forest Service) USFS land. Approximately 0.3 miles of the pipeline has been removed from the Mine leaving approximately 4.0 miles of pipeline.

During active mining operations in the 1970s and 1980s, water pumped from the Mine was treated in the Mine Water Treatment Unit (MWTU) and discharged through a 24-inch diameter 4.3-mile-long pipeline that ran across private land, except for an approximate three-quarter mile portion on the USFS. The pipeline exited on private land at an outfall located in San Lucas Canyon north of the Mine site. The water was discharged under National Pollutant Discharge Elimination System (NPDES) Permit #NM 0028100 (now terminated) from the outfall (Outfall 001) into the San Lucas Canyon (35.39 N Latitude, 107.64 W Longitude). Although an ion exchange plant had been constructed, it was not operated because U-nat (natural uranium) concentrations discharged from the Mine were below applicable standards at the time.

Where crossing USFS land, the pipeline has operated under a USFS Special Use Permit (SUP) since 1977. The current SUP (MOT220) covers 3.35 acres, (0.01 square miles) and is located in Section. 12, Township. 13 N., Range. 8 W., New Mexico Principal Meridian (NMPM). On the USFS land, the pipeline lies inside a 40-foot-wide Right of Way (ROW) through a portion of the Mount Taylor Ranger District in the Cibola National Forest and National Grasslands near Milan, Cibola County, New Mexico. The length of the ROW on USFS land is approximately 0.7 miles and is 20 feet on either side from the centerline of the pipeline.

For the pipeline section on private land, there is an existing Land Use agreement with Lee Ranch with no defined easement. The length of the pipeline on private land owned by Lee Ranch is approximately 3.3 miles in Cibola County and McKinley County. The approximately 1.3 miles of pipeline located in Cibola County is located on Section. 13 Township. 13 N., Range 8 W., (NMPM), and the approximately 2.0 miles of pipeline located in McKinley County is described as Bartolome Fernandez Grant. The RGR pipeline is in the Southwest corner of the 25,519 acres included in the Bartolome Fernandez Grant.

The Mine is currently in the closure process, RGR is not currently discharging through the pipeline, and will completely remove it once all regulatory approvals have been obtained.

2.0 PROJECT SCOPE

The pipeline will be dismantled and transported by truck to the Mine site for staging and then final disposal. This work plan describes the removal process and measures that will be taken to protect human health and the environment.

3.0 REGULATORY REQUIREMENTS

Existing regulatory authorization for removal of the Discharge Pipeline includes the Mining Act permit issued by MMD EMNRD (CI002RE, Revision 13-2), and resource-specific permits for air and water discharges issued by the New Mexico Environmental Department (NMED), within which these permits have conditions for closeout and closure of the Discharge Pipeline upon cessation of mining. The applicable existing Mine compliance documents and other federal, state, and local requirements are briefly discussed below within the context of the planned removal of the discharge pipeline.

3.1 Existing Mine Compliance Documents

3.1.1 *Closeout/Closure Plan Mine 22-1 Permit #C1002RE And Discharge Permit 61*

The Mount Taylor Mine is regulated under Mining Act Permit CI002RE and Discharge Permit (DP) 61 administered by MMD and NMED respectively. As of August 2024, the 13-2 Closeout/Closure Plan (CCP) is the most current approved closure plan, however, this report only includes information from the 22-1 CCP, submitted on June 13, 2022, which is under current review with comments and includes updated provisions.

The discharge pipeline removal is addressed specifically in Permit Revision CCP 22-1, Section 4.3.4 Surface Facilities Removal Pending. Section 4.3.4, paragraph 6 states "*The treated water discharge pipeline.is 3/8-inch-thick steel pipe (approximate). The in-place and spare lengths total approximately 23,000 feet. Prior to the removal of the pipeline, a cultural resources study of the pipeline right of way will be conducted, followed by a clearing or protection of artifacts if necessary. RGR is working with the USFS on plans for the removal of this pipeline where crossing USFS land.*"

USFS has already been contacted and has determined that the cultural resources study did not determine any protection of artifacts is necessary. USFS will conduct a post-abandonment site walk to confirm this assessment and give final clearance to end the SUP agreement.

The nature and extent of affected areas are addressed specifically in Section 4.4.4 Affected Areas, paragraph 7 states "*The Treated Water Discharge Pipeline and Right-of-Way (ROW) are part of the permit area. RGR has identified two areas along the pipeline that indicate above-background gamma readings just outside of the ROW. Another area of above-background gamma readings is the outfall area, just beyond the pipe outfall. The areas outside of the ROW and downstream from the pipeline discharge point will be cleaned up to meet permitted soil standards. These areas will be revegetated along with the rest of the Pipeline corridor…. Because a portion of the pipeline* *traverses USFS land, approvals from the USFS will have to be granted for the cleanup and revegetation of the areas under their jurisdiction."*

The excavation and disposal of contaminated soils are addressed in Section 4.4.5 Excavation and Disposal of Contaminated Soil, Paragraph 3 states: *"The mine water discharge pipeline corridor includes isolated locations where surface soils have radiological contamination above the clean-up level, and removal of the pipeline could cause release of contaminated scale and sediment. After the pipeline is removed, the contaminated materials will be excavated and placed in the disposal cell."*

Post-mining land use (PMLU) is addressed in Section 4.4.7 and Section 4.5 of the 22-1 CCP, with the statements *"Grading along the treated water pipeline corridor will be performed as needed to prepare the ground for revegetation. Grading will be adjusted as needed to remove obstacles or depressions in the ground surface that might obstruct or divert runoff from the intended flow directions." … "Following regrading, areas that have been disturbed by Mt. Taylor mining operations and soil cleanup will be revegetated in accordance with the Revegetation and Weed Management Plan"*

RGR is committed to resurveying the area after pipeline abandonment to determine the above-background gamma readings from pipeline operation and abandonment. RGR has been in discussion with USFS and is reviewing the seeding mix and revegetation criteria for approval.

In addition to the materials above, there are provisions in CCP 22-1 to sample areas of the pipeline with radiologic surveys and remove materials that exceed the soil cleanup parameters outlined in Section 8.1.

In summary, Permit Revision CCP 22-1 addresses the following topics:

- Surface shaping and regrading
- Building demolition and cleanup
- Radiologic surveys, soil screening, and material removal
- Revegetation of disturbed area
- Post-closure monitoring and maintenance
- Development of a post-closure land-use of wildlife habitat/self-sustaining ecosystem

These topics have a broad bearing on the removal/demolition of the discharge pipeline and are incorporated in this Plan.

3.2 Applicable Federal Requirements

3.2.1 *Cultural and Biological Resource Protection*

In coordination with the USFS, RGR will ensure that it adheres to the Cibola National Forest and Grasslands Office's procedures for the protection of cultural and biological resources as directed by the United States Forest Service. The route of the pipeline falls within the bounds of a previously conducted cultural resources survey (NMCRIS Activity No. 91). Several previously recorded surveys are adjacent to the pipeline and a portion of the pipeline is within State Register No. 1939 site. If directed by the USFS, United States Fish and Wildlife Service (USFWS) protocol surveys will be conducted. Additionally, any wetlands encountered will be properly mapped and recorded, however, none are anticipated.

3.2.2 *Storm Water*

The regulatory authority for storm water discharge permitting in New Mexico is Environmental Protection Agency (EPA) Region 6. The NMED, Surface Water Quality Bureau, certifies federal permits and performs storm water inspections on behalf of the EPA, and acts as a local point of contact to provide information to operators and other agencies regarding the regulatory program. The overall pipeline corridor, including where it crosses through the USFS land, is part of the permitted Mine facility and may be covered by the existing NPDES Multi-Sector General Permit (MSGP) Industrial Stormwater Discharge Permit and Storm Water Pollution Prevention Plan (SWPPP). The removal of the Discharge Pipeline will disturb more than 1 acre of land, thus an application for coverage under EPA's 2012 Construction General Permit (CGP) for storm water may be required. If required, a Notice of Intent (NOI) for coverage under the CGP will be submitted to EPA 14 days before earth-disturbing activities and a site-specific Storm Water Pollution Prevention Plan will be developed for this project.

3.2.3 *Aquatic Resources (Clean Water Act)*

The United States Army Corps of Engineers (USACE) Albuquerque District Office will oversee the permitting of anticipated impacts to wetlands and waters of the U.S. to ensure compliance with Section 404 of the Clean Water Act. (EPA, 1972). RGR will contact the USACE to determine if there is any jurisdictional water that will be impacted, and if so, the type of permit and pre-construction notification that will be required in advance of pipeline removal.

3.2.4 *Protection Of Wildlife*

RGR has coordinated with the USFS Cibola Range District, and they have confirmed there are no Threatened and Endangered Species, Migratory Birds, or other species of conservation concern in the area that will be impacted, so no further action is required.

3.2.5 *Air*

An asbestos notification form under the National Emission Standards for Hazardous Air Pollutants (NESHAP) will be submitted to the NMED Air Quality Bureau (AQB) if required. Asbestos surveys will be performed by a certified asbestos inspector, and the NESHAP notification form will be filled if asbestos is identified.

Dust control measures will be implemented to minimize the generation of fugitive emissions and the potential for off-site transport of dust.

4.0 ACCESS

The pipeline will be accessed either by the adjacent pipeline access road or the County Road 75 (also known as Lee Ranch Hwy, Lee Ranch Commino Rd, and Road 192). The pipeline location and layout are shown on drawing Sheet 1. The discharge pipeline is sectioned into five areas. Area 1 includes pipeline STA 0+00 to STA 70+00 and is on private property from the Mine property boundary to the USFS boundary (Sheet 2). Area 2 includes pipeline STA 6+50 to STA 106+00 and is located entirely on USFS land (Sheet 3). Area 3 includes pipeline STA 106+00 to STA 145+50 and is located on private property to the west of County Rd 75 (Sheet 4). Area 4 includes pipeline STA 145+00 to STA 204+60 and is private property to the east of County Rd 75 (Sheet 5). Area 5 includes pipeline STA 204+60 to STA 213+52 and is private property to the north of County Rd 75 to the terminus is San Lucas Canyon (Sheet 6).

4.1 Private Property

Lee Ranch property is private and is encompassed in Areas 1, 3, 4, and 5.

The pipeline segment from the boundary of the Mine to USFS land is on private land owned by Lee Ranch. There is a 1970s pipeline access road following the length of the pipeline. This section will require rough grading of the access road to provide safe passage for heavy equipment.

There are additional pipeline segments after the USFS lands on the Bartolome Fernandez Grant. These segments also have the 1970s pipeline access road following the length of the pipeline.

4.2 County Road

County Road 75 parallels the pipeline from North to South. RGR intends to minimize the use of this road to prevent potential damage to the road that would have to be repaired, but several locations will be used to load pipe to a loading truck. Access to the pipeline will be constructed or graded from the county road to the pipeline access road as needed. These loading points will be discussed with Lee Ranch before construction

4.3 USFS Land

USFS property is encompassed in Area 2 (Sheet 3). The pipeline runs through USFS land between two segments that lie on private property. There is an existing 40-foot ROW, 20 feet on either side of the pipe, on the USFS property.

Vehicle and equipment traffic will be confined to the existing 40-foot ROW and the temporary truck turnouts for site safety. Existing roads and accesses will be used whenever available. All turnouts will be reclaimed to pre-existing conditions, including re-vegetation upon completion.

Trucks will transport dismantled pipe segments from the access road to the Mine site. The vehicles involved in the removal process should stay along the pipeline corridor or on the Mine site. \

Segments of the pipeline that pass through corrugated metal pipes (CMP) crossings will be cut on both sides of the pipe and carefully pulled out through one end. Care will be taken so as not to damage the existing pipes(s) and road crossing(s).

5.0 FACILITY CHARACTERIZATION

A facility characterization investigation was performed on the discharge pipeline from July 29 through August 1, 2024, to inventory the components for pipeline demolition and removal, as well as evaluating the components for potential asbestos-containing materials (ACM) and lead-based paint (LBP). The following information was collected during the initial facility characterization.

5.1 Piping

The pipe is approximately 24 inches in diameter and the pipe thickness is either 1/4” or 3/8”. There is no observed paint on the pipe. Suspect materials will be tested for asbestos. The remaining pipeline is a total of approximately 4 miles in length and includes bends and other features.

All the pipeline generally is located on or every near the ground surface except for 12 locations where it passes through the CMP crossing and at the terminus where it is buried.

5.2 Structures

In the context of this Plan, structures are objects associated with the pipeline excluding the pipe. These include steel anchor structures, thrust blocks, arroyo crossings, road crossings, etc. Please refer to Appendix B for typical pictures of these structures.

5.2.1 *Steel Anchor Structures*

There are two types of steel anchor structures. The first type of structure has a steel plate welded to the discharge pipe and bolted into a 5-foot by 5-foot concrete pad that is flush with the ground and is estimated, from conversation with previous site personnel, to extend 3 feet underground. The second structure type includes the features mentioned above in addition to two steel bollards set in the concrete with a steel bar welded above to contain the pipe in a steel frame. There is a total of 34 of these structures along the pipeline.

5.2.2 *Concrete Thrust Blocks*

The trust blocks are large concrete boxes that have bases that range in size from 4-foot by 3-foot to 8-foot by 9-foot. From conversations with previous site personnel, they are assumed to extend 3 feet underground and are approximately 3 feet aboveground with the 24-inch diameter discharge pipe running through the middle. There is a total of 6 of these structures along the pipeline and 1 near STA 2+00 not connected to the pipeline that is also set for demolition.

5.2.3 *Arroyo Crossings*

There are six arroyo crossings along the discharge pipeline in Area 1 (Sheet 2) and a single crossing in Area 3. The arroyo crossings were constructed as part of the original 1970s pipeline construction. They include large concrete wing walls with a circular CMP culvert buried under the road and concreted into the wing wall. They will not be removed or altered as part of this project, but they may require additional earthwork to allow heavy equipment to safely cross.

5.2.4 *Road Crossings*

The discharge pipeline crosses County Rd 75 three separate times. The discharge pipeline is in a 36-inch to 60-inch CMP crossing. There is an additional crossing under Rd 456 in Area 2. The remaining eight crossings are for access roads.

5.2.5 *Other Structures*

The pipeline has several other types of pipe structures installed. They will be managed on a case-by-case basis for removal.

6.0 DEMOLITION AND REMOVAL

Demolition will proceed following the approval of this work plan. It is anticipated that demolition will begin in stages. Due to access and timing, earthwork and road repair are going to be the primary activities once the work plan is approved. Earthwork is expected to begin in Area 1. Earthwork will ideally move to Area 4 followed by the pipeline demolition crew. It is anticipated that an access ramp will be created for access into Area 3 and install a CMP culvert with overburden for exit access. Area 2, USFS land, is expected to be the last item for earthwork road maintenance and repair. Due to the pipeline crossing the fence on USFS land, it is expected there will need to be two turnarounds and access areas at this location. Access will be from the South and North boundary lines and turnarounds will be located at the point where the pipeline crosses the USFS fence at STA 75+00 and STA 85+00. This process and schedule may change based on field observations with coordination equipment operators, project managers, and key stakeholders.

6.1 Pipeline

The overall pipeline demolition and removal activities will begin and end on private land. Pipeline segments will be separated into 100-foot lengths for handling and transport to the Mine, (RGR will contract a logging truck that can haul 100-foot segments). Two methods will be utilized to separate sections of pipe. The contractor will utilize a large shear designed for shearing a 36-inch diameter pipe for most operations and hand cutting for hard-to-access areas. Shear cuts will pinch the ends of the pipe to prevent debris from escaping. Any opening that remains will be sealed using solidifying foam. For the hand cuts, prefabricated steel caps will be spot welded or adhesive foamed on the opening of the pipe. Hand cuts will have catch pans for fallen debris which will be collected and transported to the Mine site.

After segments are transported to the Mine site, cleaning procedures will begin with moving the specific section of pipe over to the concrete wash pad for cutting and cleaning. RGR will plasma torch off the crimped or capped sections. The pipe segments will be pressure washed and knocked to remove internal scaling and debris and scanned for recyclability. Wash water will be contained in the concrete wash pad and then transported to Pond 3 for evaporation. Sediments will be periodically cleaned out of the wash pad and placed into 55-gallon drums for future disposal in the disposal cell. Continuous loop cradle straps will be utilized and attached to each side of the cut pipe for additional safety stability. Any pipe material that cannot be effectively cleaned will be moved to an approved staging area for future placement in the disposal cell.

It is envisioned that the pipeline dismantling, and removal activities will involve two work crews: a pipe shear, grapple, and transport crew (1 shear with 1 to 2 transport trucks), and a mine site cutting and disposal crew (one or two cutting stations and a crane or grapple to move segments). Separating the operation into two work crews allows demolition and cleaning activities to be independent of each other.

6.2 Structures

6.2.1 *Steel Anchor Structures*

Steel anchor structures were installed in areas to hold the pipeline in place and prevent shifting. These structures will be demolished after the pipeline has been removed. The structures will be hauled to a pre-determined staging area at the Mine site. Please refer to Section 8.2.3 for the demolition of the concrete pads associated with these structures.

6.2.2 *45-Degree Steel Pipe*

There is a single welded pipe section that has a bend of 45 degrees or greater. This section will be sheared and removed as a single piece that includes as little bend pipe as possible. This section is assumed to be elevated and will be placed in a staging area for future placement in the disposal cell.

6.2.3 *Concrete Thrust Blocks And Concrete Pads*

Concrete thrust blocks and concrete pads will be removed. All observed coatings will be re-sampled for the presence of asbestos. Any pipeline or support component found to contain asbestos will be segregated from the other materials and an asbestos abatement specialist will advise on proper handling and disposal procedures.

Concrete thrust blocks and pads will be demolished using a jackhammer into manageable pieces. Once reduced into manageable pieces, concrete will be loaded and hauled to a designated staging area at the Mine site.

6.2.4 *Arroyo Crossings*

The pipeline will be removed from the top of the crossings; however, the crossings are expected to be left in place and not demolished as they are currently operating as intended.

6.2.5 *Road Crossings*

Segments of the pipeline that pass-through CMP crossings will be cut on both sides of the CMP pipe and carefully pulled out through one end. Care will be taken so as not to damage the existing CMP pipe(s) and road crossing(s).

6.2.6 *Other Structures*

There are riser pipes, vacuum breakers, and emergency discharge pipes that will be sheared and transported to the mine site for assessment. These sections will be as small as possible to minimize the amount of discharge pipeline connected to these pipe structures in case on-site disposal is necessary.

7.0 RADIATION AND SAFETY

7.1 RADIATION SURVEY OF MATERIALS

The pipeline is known to be internally contaminated with naturally occurring uranium and thorium that exist in the form of residues embedded in rust/scale. RGR will follow the Radiation Protection Program Manual (ERG 2021) for release criteria of the pipeline or other materials. RGR has developed and tested cleaning methods to prepare the discharge pipeline on-site for transfer to the recycler or moved to a staging area for onsite future placement in the disposal cell.

7.1.1 *Containment Of Residual Solids*

Either a tarp or a containment basin will be placed beneath the pipeline where cutting activities are occurring to capture debris and other residual solids. Where necessary, berms lined with 6-mil polyethylene sheeting will be constructed to contain incidental liquids or solids that could otherwise be released from the pipe during segmenting activities.

If debris from inside the pipe is observed on the ground, it will be shoveled immediately into a designated container and transported to the Mine for final disposal. Once the pipeline is properly sheared into manageable segments, the pipe crimped ends will be sealed using an adhesive foam and transported to the cutting station at the mine site. After the pipe is properly prepared for transportation, the shear or suitable lifting device will be used to secure the pipe segment onto an end dump trailer with enclosed sides.

Once transported to the mine site, each segment will be opened by plasma or torch cutting near the pinched ends and lifted over the concrete containment pad associated with the 24-foot shaft. The section will be pressure washed at the concrete washout area. The cleaned segment will then scanned be and transported for off-site recycling or moved to a staging area for onsite future placement in the disposal cell.

7.1.2 *Asbestos*

Asbestos-containing materials (ACM) is defined by the EPA as any material that is found to contain greater than 1% asbestos as determined by the method specified in Appendix A, Subpart F of 40 CFR 763 Section 1 – polarized light microscopy (PLM). ACM is subject to the EPA NESHAP Regulations for Asbestos (40 Code of Federal Regulations (CFR) Part 61) and the NMED AQB 20 New Mexico Administrative Code 2.78 (20 NMAC 2.78). The NMED is presently responsible for administering the EPA NESHAP program for New Mexico. ACM is also subject to Occupational Safety and Health Administration (OSHA) General Industry Standards for

Asbestos (29 CFR Parts 1910.1001) and Construction Industry Standards for Asbestos (29 CFR Parts 1926.1101).

Bulk samples of suspect materials observed on facility components such as pipes, pipe support structures, and connections, and from suspect materials to be removed will be collected and tested. Sampling is anticipated to be performed the week of August 19th, 2024.

Upon completion of the asbestos survey, if asbestos is detected, RGR will contract with an Asbestos Contractor for the removal and disposal of the asbestos materials.

7.1.3 *Lead-Based Paint*

During the July 2024 field inspection, paint was not observed on any of the pipes or structures, therefore there are no concerns about lead-based paint materials being present.

7.1.4 *Fire Control*

During welding or any hot-cutting activities, a fire watch will be maintained during the activity and following, for at least 30 minutes. The contractor will provide a hot work SOP before starting any hot work. Work vehicles will contain firefighting equipment and will be parked in a manner that limits the potential for accidental ignition of vegetation.

7.1.5 *Dust Control*

All work areas and accesses will be watered to control dust, reduce the ability for dust-borne contamination, and reduce fire hazards.

8.0 SOIL ASSESSMENT AND RECLAMATION

Once all pipeline segments, supports, and other features have been removed from the corridor, a radiological survey will be conducted of impacted areas identified in previous studies. If any elevated levels beyond 6.8 pCi/g (see Section 8.1) are observed, additional remedial measures shall be taken to reduce these levels. Once the elevated soils have been removed, grading restoration efforts shall begin. Excavated areas will have surface contours restored to mimic the natural condition of the surrounding terrain. Compacted areas will be ripped or disked to aid in revegetation. Disturbed areas will be revegetated with the CCP-approved seed mix (Appendix C).

8.1 Soil Cleanup

To ensure an accurate reading of radiation levels along the pipeline corridor, the pipeline, including the cleanup of all residual material surrounding the pipeline will be completely removed. Then, an additional radiological survey of impacted areas identified, will be completed before reclamation.

Gamma readings, correlated against Radium-226 soil samples, are taken while soil cleanup excavation is being performed, and readings below pre-determined action levels will indicate that the soil radium concentrations are below 6.8 pCi/g, and the soil cleanup standard has been achieved. A final survey consisting of independent laboratory analysis of soils from all remediated areas will be used to verify that soil remediation is complete. RGR has submitted a radiation work plan for reclamation and post-reclamation cleanup, which was approved in May 2022. The Reclamation and Post-reclamation Radiation Survey Work Plan will serve to guide radiation contamination cleanup efforts.

8.1.1 *Excavation*

Any excavation of impacted areas indicated by the radiation survey may be implemented using gamma scanning results. In general, soil with readings more than the PRRL will be excavated. Confirmation soil samples will be collected from the vicinity near these areas to assess whether the reclamation goals have been achieved or if further removal is needed. Excavated soil will be hauled in an end dump trailer with enclosed sides to the Mine where it will be disposed of in the permitted disposal cell.

8.1.2 *Confirmation Soil Sampling*

Confirmation samples will be collected when survey values are indicative of a likelihood that cleanup criteria will be met. Areas, where confirmation sampling does not meet cleanup criteria, will require additional excavation using adjusted screening values before resampling.

8.1.3 *Site Restoration*

Areas disturbed by pipeline removal activities will be restored. Before revegetation, contaminated soil and other debris will be removed and for future containment within the disposal cell, Excavated areas will have surface contours restored to mimic the natural condition of the surrounding terrain. Compacted areas will be ripped or disked to aid in revegetation. Disturbed areas will be revegetated with a CCP-approved seed mix (See Appendix A) following the Mt Taylor CCP C.5 Revegetation Plan.

9.0 REFERENCES

ANSI/HPS, 2013. American National Standard – Surface and Volume Radioactivity Standards for Clearance. American National Standards Institute/Health Physics Society. N13.12-2013, May 6, 2013.

Environmental Protection Agency (EPA). 2021. United States Environmental Protection Agency Washington, DC 20460 Notice of Intent (NOI) for Stormwater Discharges Associated with Industrial Activity Under the NPDES Multi-Sector General Permit. NPDES ID: NMR05J02B. May 16.

Environmental Restoration Group, Inc (ERG) 2021. Radiation Protection Program Manual, Mount Taylor Mine, Revision 5, March 18.

MMD/NMED, 2016. Joint Guidance for the Cleanup and Reclamation of Existing Uranium Mining Operations in New Mexico. Energy, Minerals & Natural Resources Department, Mining and Minerals Division, and New Mexico Environmental Department, Mining Environmental Compliance Section. March 2016.

Rio Grande Resources Corporation (RGR). 2013. Application for Revision of Mine Permit #C1002RE from Standby to Active Status and Modification of Ground Water Discharge Permit DP-61 Mt. Taylor Mine, San Mateo, New Mexico. April.

Rio Grande Resources Corporation (RGR), 2020. Reclamation and Post-Reclamation Radiological Survey Work Plan; Permit C1002RE, Rev. 13-2.

Rio Grande Resources Corporation (RGR). 2022. Request for Submittal of a Permit Revision Application Including a Revised Closeout/Closure Plan for Mining Act Permit No. CI002RE and Additional Information for Discharge Permit 61 (DP-61) Renewal and Modification, Rio Grande Resource Corporation, Mt. Taylor Mine, June 13.

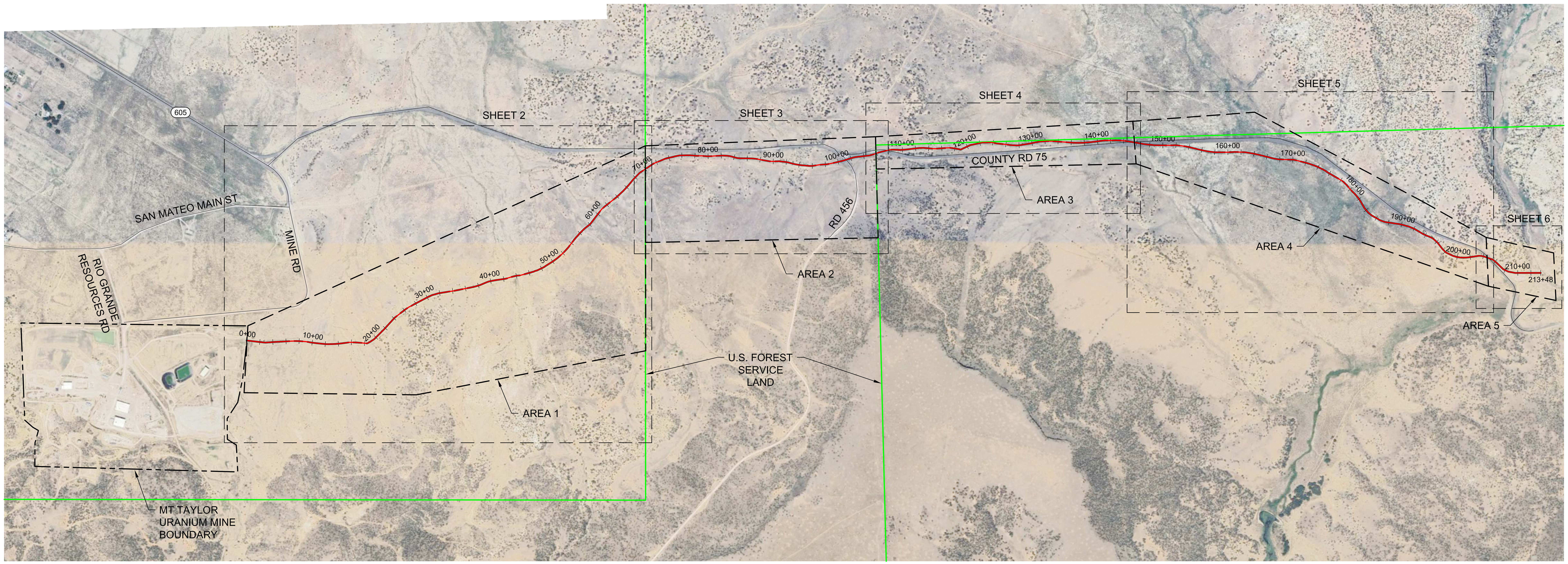
United States Code (U.S.C.). 1940. 16 U.S.C. 668-668c (“Bald and Golden Eagle Protection Act”).

United States Environmental Protection Agency (EPA). 1972. Federal Water Pollution Control Act as amended in 1972 (“Clean Water Act”).

United States Fish and Wildlife Service (USFWS). 1918. Migratory Bird Treaty Act of 1918.

USFWS. 1973. Endangered Species Act of 1973.

DRAWINGS



NORTH

SCALE IN FEET
800' 0 1600'

T:\111360 Mt. Taylor\Pipeline Demo.dwg SAVED: 8/15/24 PRINTED: 8/19/24

Revision	Date	Description

REVISIONS

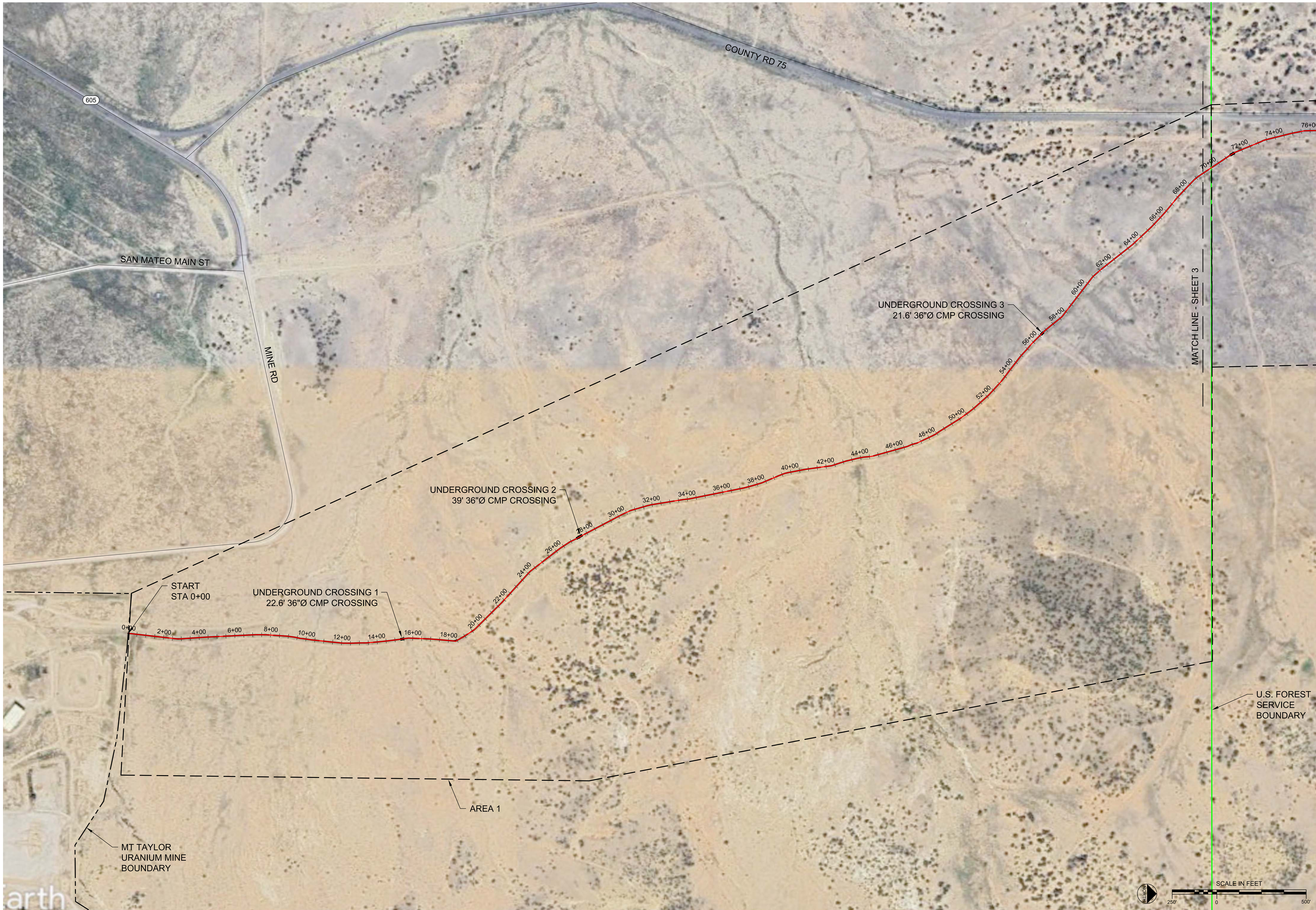
Designed by:
Engineering Analytics, Inc.
1600 Specht Point Road, Suite 209
Fort Collins, CO 80525
(970) 488-3111

Designed by: EMR
Approved by: MMM

MT. TAYLOR DISCHARGE PIPELINE ABANDONMENT

OVERALL SITEPLAN

Project Number: 111360
Date: August 14, 2024
Sheet: 1



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MT. TAYLOR DISCHARGE PIPELINE ABANDONMENT

AREA 1

Project Number: 111360

Date: August 14, 2024

Sheet: 2

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NORTH

SCALE IN FEET
150' 0 300'

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AREA 2

Project Number: 111360
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NORTH

SCALE IN FEET

150' 0 300'

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MT. TAYLOR DISCHARGE PIPELINE ABANDONMENT

AREA 3

Project Number: 111360

Date: August 14, 2024

Sheet: 4

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SCALE IN FEET

200' 0 400'

REVISIONS		
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MT. TAYLOR DISCHARGE PIPELINE ABANDONMENT

AREA 4

Project Number: 111360

Date: August 14, 2024

Sheet: 5

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Designed by: EMR
Approved by: MMM

MT. TAYLOR DISCHARGE PIPELINE ABANDONMENT

AREA 5

Project Number: 111360
Date: August 14, 2024
Sheet: 6

APPENDIX A
REVEGETATION PLAN

C.5 REVEGETATION

1 GENERAL TECHNICAL REQUIREMENTS

1.1. Summary of Work

Rio Grande Resources Corporation (RGR) is owner and operator of the Mt. Taylor Uranium Mine located in Cibola County, New Mexico in Section 24, T13N, R8W, NMPM (Drawing Sheet-CL-00). The mine site is 1/2 mile northeast of the Village of San Mateo and is accessible from New Mexico State Route 605. At the time of this submittal, the mine is on active (operating) status, but RGR has initiated closeout activities due to the depressed uranium market. The mine extracted uranium ore from depths of over 3,000 feet below ground surface that connect to two 3300-foot deep shafts from the mine surface. The mine surface facilities are located on 285.6 acres, of which approximately 148 acres are disturbed land and the remaining 137.9 acres are undisturbed. The existing disturbed land consists of:

- Support (Service and Support) Facilities
- Mine Water Treatment Area
- Treated Water Discharge Pipeline
- Ore Stockpile
- Waste Pile
- Storm Water Retention Ponds (2)
- Access Road

Closeout activities are anticipated to disturb an additional 27 acres, bringing the total future land disturbance to 175 acres.

The included work consists of providing the equipment, personnel and materials for revegetation of the mine site and pipeline corridor after demolition and earthwork have been performed by others. The required work includes:

- Mobilization and demobilization of contractor’s equipment,
- Preparation of the work area,

- Preparation of disturbed soil surfaces for reseeding, including application of amendments and mulch.
- Reseeding of the disturbed soil areas
- Installing or replacing fencing needed to limit access to revegetation areas.

The work is represented in Drawing Sheets:

CL02 Closeout Plan Task Summary

CL03 Facility Disposition Plan

CL07 Final Grading Plan - Mine Water Treatment Pond

CL09 Final Grading Plan – Expanded Disposal Cell

CL14 Final Drainage Plan

CL15 Final Site Plan

and in Figure C.5-1.

All areas that have been disturbed by Mt. Taylor mining operations and soil cleanup and not containing structures retained for post-mining land use (PMLU), approximately 140 acres, shall be revegetated except the storm water pond. Regraded areas, the waste rock pile, the ore stockpile area, mine water treatment pond area, the treated water pipeline corridor, and locations of demolished facilities shall be revegetated.

Preparations for revegetation and the selected seed mix will be directed toward establishing a vegetation community that can thrive at this site and that can support grazing of livestock. Plants native to the general area shall be used as much as possible to provide for long-term stability of the soils and vegetation communities. Plant species that provide rapid initial cover shall be used in the seed mix to achieve initial soil stabilization. Species selected will not necessarily be found in the surrounding undisturbed area, but shall have been approved for use in reclamation by the Natural Resources Conservation Service (NRCS) and other appropriate government agencies.

1.2. Site Survey

The contractor shall perform its own survey to determine soil properties and site conditions that will affect revegetation efforts, native and other existing vegetation in the area, and any conditions that appear to differ from those represented in this specification and accompanying information provided by RGR. The results of this site survey shall be submitted to the Project Manager for review and approval of work performed and for verification of payment quantities.

1.3. Site Restrictions

Access to the site is limited to ingress/ egress through the main gate. All contractor personnel and visitors shall log in and out at the guardhouse. All personnel shall wear the required safety equipment as directed by the site Safety Officer while inside the mine perimeter fence

.

1.4. Work Performed by Others

Prior to the commencement of this work, the shaft headframes, hydraulic control structures, selected buildings, the treated water pipeline, mine car rail, and mine water discharge pipe will be removed and the shafts will be plugged and backfilled by others. Earthwork to backfill mine water treatment ponds, reshape the waste rock pile, place cover soil over the ponds and waste pile, erosion protection, and final grading will be performed by others.

1.5. Codes, Standards, and Regulatory Requirements

All work must be performed according to OSHA and/ or MSHA requirements. The Contractor is responsible for identifying and complying with the relevant standards and requirements.

1.6. Site Investigation Reports and Data

RGR has conducted site investigations to characterize the waste rock pile materials, soil contamination, and geotechnical properties of on-site soil. Reports of these studies and related data are included in Appendix D of the Mt. Taylor Mine Closeout/ Closure Plan.

1.7. Health & Safety Practices

1.7.1. Health & Safety Practices

Work area safety is the responsibility of the contractor. The contractor shall submit and implement a Site Safety Plan that satisfies federal, state, and RGR requirements for the type of work being performed.

For the work under this specification, Level D PSE is required. In addition, safety measures required under section 1.5 and elsewhere in federal and state regulations shall be implemented.

All contractor personnel and others within the contractor's working area must be equipped with the required PSE and must comply with the requirements cited in section 1.5. The contractor shall have a qualified Safety Officer on site during working hours. The Safety Officer shall be responsible for enforcing all safety requirements and shall have the authority to remove from the contractor's working area anyone not complying with those requirements.

1.7.2. Site Safety and Emergency Communication

The contractor shall post emergency response phone numbers in the worker break area. The contractor shall maintain an active phone line at all times. Cell phone service is not reliable at the mine site.

1.7.3. Radiological Materials

Radiological contamination levels on the mine site do not exceed the NRC Regulatory Guide 1.86 criteria for unrestricted release and use. Prior to revegetation, contaminated soil and other debris will be removed and contained within the disposal cell, then cover with clean soil, thereby isolating the radiological materials from ground surface.

1.8. Field Engineering and Surveying

The contractor shall perform surveys and measurements as required under section 1.2 to verify dimensions, lines and grades, and revegetation materials described in this specification and the referenced drawings (CL series).

1.9. General Submittals

Prior to commencing the work, the contractor shall submit, in a format acceptable to RGR, the following:

- Site Safety Plan – including name and qualifications of Safety Officer
- Revegetation Plan – Methods, soil amendments and mulches, and seed mixes to be used for revegetation. The plan shall also describe equipment to be used, names and qualifications of key personnel, and schedule.

1.10. Construction Facilities and Field Office

1.10.1. Site Access, Field Office, Storage, and Maintenance

RGR will provide space for the contractor's field office, laydown areas, sanitary facilities, and equipment maintenance. Existing buildings, if any, will not be available for contractor use. If needed, electrical power must be arranged by the contractor with Continental Divide Electrical Coop.

Water, both potable and non-potable, is available on site. The contractor must make arrangements with RGR for pumping, storing, and discharge of water needed by the contractor.

1.10.2. Protection of Existing Facilities

The contractor shall not use, damage, or block access to site buildings and other facilities that are in use at the time of the contractor's work or that are to remain intact for post-mining land use (Drawing Sheet CL15). Any damage or loss of use shall be repaired or compensated at the contractor's cost.

1.10.3. Temporary Environmental Controls

The contractor shall be responsible for emplacing, utilizing, and removing those measures necessary to contain contaminants, surface water and fugitive dust releases generated by the contractor's work. Such measures may include, but are not limited to,

- Spraying of clean water for dust suppression
- Storage of fuels, solvents and lubricants
- Surface water diversions and erosion control materials
- Sanitary wastes containments
- Trash containers
- Fire suppression equipment

Wildlife, including large game animals, frequently enters the site. The contractor's workers shall do nothing to attract, injure, or otherwise interfere with wildlife.

No firearms may be brought on the mine site.

2 SITE CONSTRUCTION

2.1 Site Preparation

The contractor shall prepare its office, equipment, and laydown areas as approved by RGR so as not to obstruct or interfere with RGR site operations or other contractors' operations.

2.2 Runoff Control

During the revegetation period temporary runoff controls will be used as necessary to impede or divert rainfall and snowmelt runoff from revegetated areas. Locations of temporary runoff controls shall be selected by the contractor to retard or divert runoff, trap sediment, and provide improved conditions for germination and plant establishment.

Runoff control during revegetation shall utilize the most appropriate technology available at that time, including methods recognized by the NRCS or the International Association for Erosion Control.

Measures that use present technology include check dams constructed of hay bales, geotextile silt fences secured in shallow trenches, and water bars across the disturbed area and perpendicular to the slope. Tobacco net, Curlex or similar net-and-fiber mats might be used as required for protection of surfaces susceptible to rilling or wind erosion. The specific measures applied to revegetated surfaces shall be selected by the contractor based on the method most appropriate for the seeding method, erodibility and depth of the soils, degree of slope, proportion of large rocks at the surface, roughness of the surface, and anticipated rainfall.

2.3 Seed-Bed Preparation and Seeding

Revegetation of the re-contoured areas will employ a variety of methods, depending principally on the steepness of the slope. A large percentage of the total disturbed area will be revegetated using standard mine reclamation equipment; i.e., tracked and wheeled tractors, rangeland seed drill, and mulch applicator. In areas with slopes of 3H:1V or steeper (natural or cut slopes east of the shafts), a mixture of manual and mechanical application techniques will be used, including hand broadcasting and heavy chains dragged by a tracked dozer to incorporate the seed with the soil.

If applying seed with a seed drill, the contractor shall follow the ground contours as much as possible in order to minimize the development of rills. The contractor shall prepare surfaces for seeding by scarifying, as necessary, the surface finish-graded by others and by creating minor depressions to provide a proper seed bed. Seed shall then be applied by either rangeland drill or broadcast.

Broadcast seed shall be incorporated into the growth medium by hand raking or some mechanical means such as heavy chains dragged behind tracked dozers. The disturbed surfaces shall be reseeded using the seed mix described in Table C.5.1.

The method of reseeding shall be determined according to location and size of area to be reseeded. In general, drill seeding shall be used on flatter slopes covering larger areas. Broadcast seeding shall be used on shorter, steeper slopes. Hand seeding may be required on longer or very steep slopes.

2.4 Revegetation Species

The predominant native grass species in the area is blue grama (NMEI, 1974). Therefore, this species shall be the primary species in the revegetation seed mix if it is readily and economically available at the time of closeout. The seed mix for use at the Mt. Taylor Mine is listed in Table C.5.1. Several cool-season and warm-season grass and shrub species are proposed in this plan to reestablish species that have been severely impacted by grazing and to optimize the chances for successful germination and establishment, regardless of the particular microclimate.

Other species in the mix may be selected or substituted on the basis of their suitability for the terrain and climate, compatibility with native species and nutrient value to livestock. If the contractor proposes other species, additional factors in the selection of species shall include (1) likelihood of becoming a "pest" species in the area, (2) ability to achieve quick cover with a minimum of care and moisture, (3) strength of their root system for stabilizing the soil, and (4) ability to act as a nurse crop for the later establishment of local grasses, shrubs and forbs.

2.5 Seed Origin and Quality

Seed shall be harvested from native stands within 200 miles north, 300 miles south, 200 miles west, and 100 miles east of Mt. Taylor. If seed from native stands is not available, seed of suitable quality grown under appropriate conditions, or seed of released cultivars known to be adapted to the San Mateo area, shall be used. All seed must be certified, and each seed bag must have attached to it a complete label with certification information.

2.6 Mulching

After seeding of the soil surface, that surface shall be mulched to slow runoff and provide temporary protection to newly emergent vegetation. Mulching in most cases will be accomplished by a mulch blower and crimped by a tracked dozer. Alternatively, the mulch may be tracked into the soil surface with a dozer, crimped by mechanical crimper, or crimped by hand. If hand application of mulch is required, crimping will be accomplished by hand as well.

Hay mulch will be acceptable, but other mulch types may also be used with prior approval. To reduce the likelihood of introducing small grain species to the area, native grass hay shall be used. Blue grama or similar hay may be available locally and would be preferable since its use would likely provide additional seed source to the revegetated areas. Alfalfa *(Medicago sativa)* shall be used if native grass hay is unavailable or impractical. Hay mulch shall be spread by means of a blower, or by hand on steep slopes, applied at a rate of approximately 1-2.5 ton per acre.

Chipped vegetation may be used as mulch, with approval, after it has been aged. The amount of aging needed to make the chipped vegetation suitable for mulch shall be determined by field observations covering sufficient periods of time to determine aging requirements under the conditions prevailing at the site. Where rock (crusher fines) will be placed over the soil cover, actual organic mulch may be reduced to 80% of the amount that would be needed without rock.

2.7 Fencing

Upon completion of mulching, the contractor will replace fence that was damaged or had to be removed for revegetation. The contractor shall also install 2 ¼ inch mesh chain link fences, eight feet high, to enclose the the waste rock pile. An additional 2000 feet of this fence shall be installed around the mine shafts area (#46 under Area Description in Drawing CL-03) to prevent entry to the shaft areas. Each fenced area shall have one hinged 12-feet wide gate. The materials and construction shall conform to RR-F-191/1D: FEDERAL SPECIFICATION RR-F-191K/GEN. FENCING, WIRE AND POST, METAL.

2.8 Monitoring

Monitoring of revegetated areas shall be conducted on a periodic basis to assess revegetation success against an interim standard (section 2.9). Success of both germination and establishment will be dependent in large part on the moisture received in the summer and winter months and variations from year to year. Monitoring activities shall be designed and scheduled to recognize this.

An annual survey of the revegetated areas shall be conducted to determine species composition and vegetation cover, frequency and density. Since establishment of vegetation is a function of its ability to reproduce, vegetation shall also be assessed for its reproductive status, as well as its overall vigor. The annual survey shall be conducted toward the end of the growing season, no later than September or early October by a qualified vegetation specialist. Survey results shall be analyzed and summarized to aid in determining the need for any changes in management practices or the need for reseeding or other supplementary practices. Less formal monitoring shall be conducted through the year by RGR personnel to identify conditions in the revegetated areas that may require attention.

2.9 Revegetation Success

A technical standard based on range site descriptions has been proposed and is described in Table C.5.2. Range site descriptions were obtained from the Natural Resource Conservation Service (NRCS, 1980) for soil mapping units existing on the mine site.

3 GENERAL QUALITY ASSURANCE AND QUALITY CONTROL

3.1 Reviews

RGR shall meet with the contractor at the start of work each day to review the previous day's Daily Report and any deliverable from the contractor.

3.2 Daily Reports

Contractor shall prepare a written daily report of each working day. This report shall include a record of the units and quantities of work performed, events or conditions adversely affecting the work, and any deviations from the drawings or this specification necessitated by conditions encountered. This record shall be subject to review and independent verification by RGR.

3.3 Reports and Certifications

The contractor shall submit certifications from the vendor for all seed to be applied.
The contractor shall conduct and report the results of the annual survey for each year until the New Mexico MMD has determined that the vegetation success standards have been met. These standards will be determined in consultation with the contractor, RGR, and MMD.

4 FINAL ACCEPTANCE AND CONTRACT CLOSEOUT

4.1 Substantial Completion

The work will be substantially complete when all work required under sections 2 and 3 has been completed by the contractor and accepted by RGR.

4.2 Close-Out Documentation

The contractor shall submit written documentation, in a form acceptable to RGR, that all units of work have been completed in accordance with this specification. This documentation shall include quantities of work performed in accordance with the line items in the contractor's bid schedule that have been approved in writing by RGR. The documentation shall also include the contractor's affirmation that all regulatory requirements and environmental standards applicable to the work have been met.

The documentation shall bear the signature of the contractor's officer with signatory authority.

4.3 Final Payment

Final payment shall be made after close-out documentation has been accepted and approved by RGR.

Figure C.5-1 Treated Water Pipeline

TABLE C.5.1

SEED MIX: SELECTED SPECIES AND PLANTING RATES

1. Cool Season Grass-Western wheatgrass (Agropyron smithii) Rate: 6 PLS/ft2
2. Forb-Winterfat (Ceratoides /anata) Rate: 2 PLS/ft2
3. Warm Season Grass-Blue grama, Galleta, Spike Muhly (Boute/oua gracilis) Rate: 6.0-6.5 PLS/ft2*
4. Warm Season Grass-Vine Mesquite Rate: 2PLS/ft2
5. Warm Season Grass-Alkali Sacaton (Sporobolus airoides) Rate: 3 PLS/ft2
6. Forb-Rabbitbrush, 2 PLS/ft2
7. Forb-Fourwing saltbush (Atriplex canescens) Rate: 2 PLS/ft2
8. Forb-(Globemallow) (Sphaeralcea fend/en) Rate: 2 PLS/ft2
9. Forb-(Narrowleaf Penstemon) (Penstemon angustifo/ia) Rate: 2 PLS/ft2
10. Cool Season Grass-Bottlebrush Squirreltail Rate: 2 PLS/ft2
11. Other-(Perennial flower mix) as available, African Daisy, Cornflower, Perennial Gaillardia, Annual Gaillardia, Black-eyed Susan, Evening Primrose, Baby's Breath, Sweet William, Blue Flax, Shasta Daisy, Sweet Alyssum, Corn Poppy, California Poppy, Catchfly, Wall Flower, Siberian, Rocky Mtn. Penstemon, Prairie Coneflower, Spurred Snapdragon, Plains Coneflower, Purple Coneflower Rate: 6-8 lb./acre

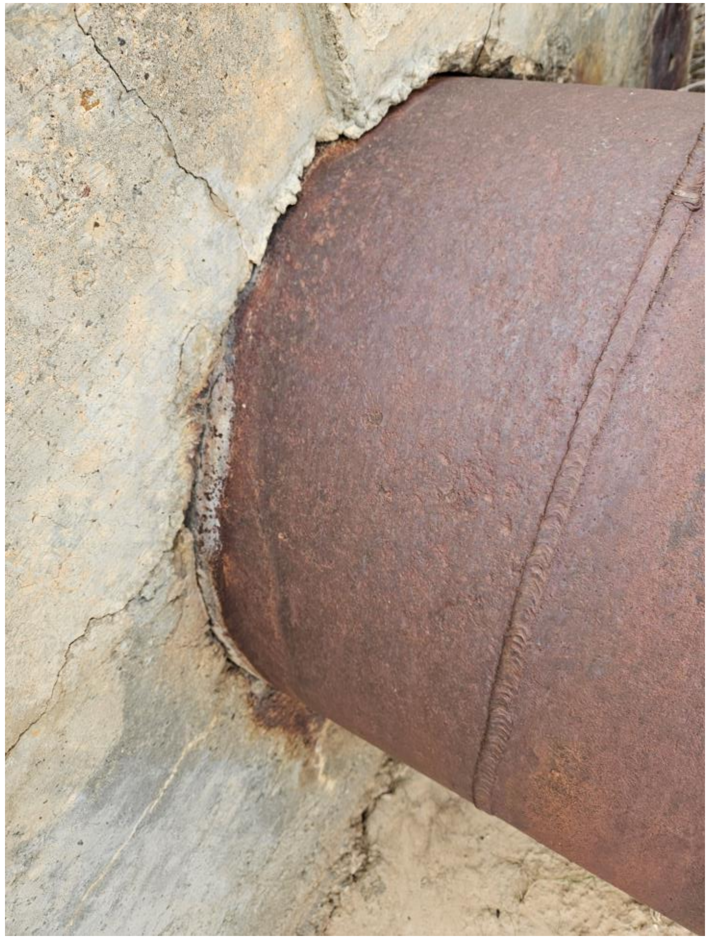
* black grama may be substituted for these species. Other variations and substitutions may be made based on cost and availability of seed at the time of closeout.

Seed origin and quality specifications: All seed must be certified, weed-free, and each bag must have attached to it a complete label with certification information. Seed labels or copies of seed labels will be submitted to MMD within 90-calendar days after seeding.

TABLE C.5.2 **REVEGETATION SUCCESS STANDARDS** **MT. TAYLOR MINE CLOSEOUT PLAN**			
POTENTIAL PLANT COMMUNITY FROM NRCS RANGE SITE DESCRIPTIONS Section IIE, Technical Guide			
Natural Plant Species	Percentage of Potential Production		
	Clayey Bottomland Mapping Unit 257	Bottomland MappingUnit57	Acceptable Production Range
Western Wheatgrass	35-45	20-30	20-45
Alkali Sacaton	5-10	30-40	5-40
Vine Mesquite	10-15	1-5	1-15
Blue Grama, Spike Mulhy, Galleta	15-25	10-15	10-25
Bottlebrush Squirreltail	1-3	1-5	1-5
Fourwing Saltbush	3-10	3-10	3-10
Winterfat	1-3	1-3	1-3
Rabbitbush,	1-5	1-5	1-5
Forbs	3-8	1-5	1-8
Others	1	9	1-9
Ground Cover, %	50	55	50-55
Production, Ib./acre	1250-3200	1200-3000	1250-3000

APPENDIX B
PHOTO LOG OF JULY 29 THROUGH AUGUST 1, 2024, FACILITY CHARACTERIZATION

Thrust Block Example



Closeup of Pipe in Concrete
Thrust Block

PROJECT: 111360	Mt. Taylor Discharge Pipeline Thrust Blocks	Engineering Analytics, Inc.
Date: July 2024		

Thrust Block Example

PROJECT: 111360 Date: July 2024	Mt. Taylor Discharge Pipeline Thrust Blocks	Engineering Analytics, Inc.

Steel Anchor Structure in
Concrete with Metal Bollards

PROJECT: 111360	Mt. Taylor Discharge Pipeline Steel Anchor Structure	Engineering Analytics, Inc.
Date: July 2024		

Steel Plate Welded into Pipe
and Bolted in Concrete

Broken Bolts with Steel Plate
Welded into Pipe and Bolted in
Concrete

PROJECT: 111360

Date: July 2024

Mt. Taylor Discharge Pipeline
Steel Anchor Structure

Engineering Analytics, Inc.

Pipe Crossing USFS Fence

PROJECT: 111360	Mt. Taylor Discharge Pipeline Fence	Engineering Analytics, Inc.
Date: July 2024		

Unknown Material on Pipe

Unknown Material on Pipe

PROJECT: 111360

Date: July 2024

Mt. Taylor Discharge Pipeline
Unknown Material Example

Engineering Analytics, Inc.

Unknown Material on Pipe

Unknown Material on Pipe and Thrust Block Interface

PROJECT: 111360	Mt. Taylor Discharge Pipeline Unknown Material Examples	Engineering Analytics, Inc.
Date: July 2024		

Unknown Material on Pipe

PROJECT: 111360

Date: July 2024

Mt. Taylor Discharge Pipeline
Unknown Material Examples

Engineering Analytics, Inc.

Pipe in CMP Crossing

Pipe in CMP Crossing

PROJECT: 111360

Date: July 2024

Mt. Taylor Discharge Pipeline
Types of CMP Crossings

Engineering Analytics, Inc.

Pipe in CMP Crossing and Steel
Anchor Structure in Concrete

Pipe in CMP Crossing, Crossing
County Rd 75

PROJECT: 111360

Date: July 2024

Mt. Taylor Discharge Pipeline
Types of CMP Crossings

Engineering Analytics, Inc.

Pipe in CMP Crossing in USFS
Hard-to-Access Area

Partially Buried Pipe in CMP
Crossing

PROJECT: 111360	Mt. Taylor Discharge Pipeline Types of CMP Crossings	Engineering Analytics, Inc.
Date: July 2024		

Pipe in CMP Crossing, Access Road Crossing

Pipe in CMP Crossing, County Rd 75 Crossing

PROJECT: 111360	Mt. Taylor Discharge Pipeline Types of CMP Crossings	Engineering Analytics, Inc.
Date: July 2024		

Pipe in CMP Crossing with
Heavy Sediment Fill

PROJECT: 111360	Mt. Taylor Discharge Pipeline Types of CMP Crossings	Engineering Analytics, Inc.
Date: July 2024		

Pipe in CMP Crossing, County
Rd 75 Crossing

PROJECT: 111360

Date: July 2024

Mt. Taylor Discharge Pipeline
Types of CMP Crossings

Engineering Analytics, Inc.

Vacuum Breaker Example

PROJECT: 111360

Date: July 2024

Mt. Taylor Discharge Pipeline
Vacuum Breaker

Engineering Analytics, Inc.

PROJECT: 111360

Date: July 2024

Mt. Taylor Discharge Pipeline
Primary Maintenance/Alternative Discharge Pipe
with 24-inch Valve

Engineering Analytics, Inc.

Bend Near Point of Discharge

Last Segment of Pipe Buried
and Point of Discharge

PROJECT: 111360 Date: July 2024	Mt. Taylor Discharge Pipeline Point of Discharge	Engineering Analytics, Inc.

APPENDIX C
RADIATION PROTECTION PROGRAM MANUAL, ERG, REVISION 5, MARCH 18, 2021

Radiation Protection Program Manual

Mount Taylor Mine

Cibola County, New Mexico

Revision 5

Prepared for:

RIO GRANDE RESOURCES

Mount Taylor Mine

PO Box 1150

Grants, NM 87020

505-287-7971

Prepared by:

ERG

Environmental Restoration Group, Inc.

8809 Washington St. NE, Suite 150

Albuquerque, NM 87113

505-298-4224

March 18, 2021

APPROVALS

This Radiation Protection Program (RPP) for operations at the Mount Taylor Mine has been reviewed and approved by the following authorized personnel:

Name	Title	Date
Bruce L. Norquist	Facilities Manager	March 18, 2021
Randy M. Whicker	Radiation Safety Officer	March 18, 2021

Changes to this RPP must be reviewed and approved by the above management personnel. A controlled hard copy of this RPP Manual will be maintained at the Mt. Taylor Mine near San Mateo, NM.

Revision History

Revision #	Date
*	12-04-2017
1	05-20-2019
2	11-19-2019
3	04-01-2020
4	05-22-2020
5	03-18-2021

*Formerly titled "Radiation Safety Program Manual" (per 2017 renewal application for NM radioactive materials license SO043-11).

TABLE OF CONTENTS

APPROVALS ii
1. INTRODUCTION 1
2. HISTORICAL SUMMARY 2
3. REGULATORY FRAMEWORK 2
4. PROGRAM APPROACH 3
5. NECESSITY AND OBJECTIVES 4
5.1 Radiological Exposures 4
5.2 Occupational Radiation Dose 4
5.3 Regulatory Requirements 5
5.4 ALARA Policy 6
6. MANAGEMENT AND ADMINISTRATION 6
6.1 Organizational Structure and Responsibilities 6
6.2 Qualifications and Training 7
6.2.1 RPP Staff Qualifications 7
6.2.2 Radiation Safety Training 8
7. RADIATION PROTECTION CONTROLS AND MONITORING 8
7.1 Engineering Controls 8
7.1.1 Physical Controls on Access 8
7.1.2 Security of Radioactive Materials 10
7.2 Administrative Controls 10
7.2.1 Administrative Controls on Access 10
7.2.2 Inspection and Leak Testing of Licensed Sources 10
7.2.3 Regulatory and Administrative Limits 11
7.2.4 Limitation of Radiological Dose 12
7.2.5 Radiation Safety Work Rules 12
7.2.6 Standard Operating Procedures for Radiation Protection 13
7.3 Effluent Controls 15
7.3.1 Management of Radioactive Sources and Materials 16
7.3.2 Environmental Monitoring 17
7.4 Records Retention 17

7.5 Quality Assurance 18
7.5.1 Quality Control for Radiological Field Measurement 18
8. REGULATORY CONTACT INFORMATION 18
9. REFERENCES 18
APPENDIX A – Standard Operating Procedures (SOPs) for the Radiation Protection Program........ 20

FIGURES

Figure 1: Location of Mt. Taylor Mine. 1
Figure 2: Gamma exposure rates at Mt. Taylor Mine (as of spring 2020). 4
Figure 3: Site layout for Controlled and Restricted Areas. 9
Figure 6: Environmental radiation monitoring stations in Controlled Areas. 17

TABLES

Table 1: Licensed radioactive sources. 2
Table 2: Summary of Regulatory and Administrative radiological control limits. 11
Table 3: Regulatory dose limits for workers, reproduced from NRC Regulatory Guide 8.30 (Revision 1, 2002). 12
Table 4: Standard Operating Procedure (SOP) numbers and titles under this RPP Manual. 13

1. INTRODUCTION

The Mt. Taylor Mine (Site) is a uranium mine in Cibola County near the town of San Mateo, New Mexico (Figure 1). Owned and operated by Rio Grande Resources (RGR), the Site is situated at the foot of Mount Taylor (an extinct volcano). From 1990-2017, the Mine was on standby status under Mine Permit C1002RE with the Mining and Minerals Division (MMD) of the New Mexico Energy, Minerals and Natural Resources Department (EMNRD). The mine permit was revised to Active status in December 2017 and for the next two years RGR engaged in the upgrading of mine facilities for a planned return to production. However, in December 2019 RGR announced plans to begin Site decommissioning and permanent mine closure due to the long-term persistence of a depressed uranium market. The objective of this Radiation Protection Program (RPP) Manual is to detail the methods and procedures for management and control of radioactive materials along with monitoring and limitation of human exposures to both licensed and unlicensed sources of ionizing radiation at the Site. A map of Site features and facilities is shown in Figure 2 (Section 5.1).

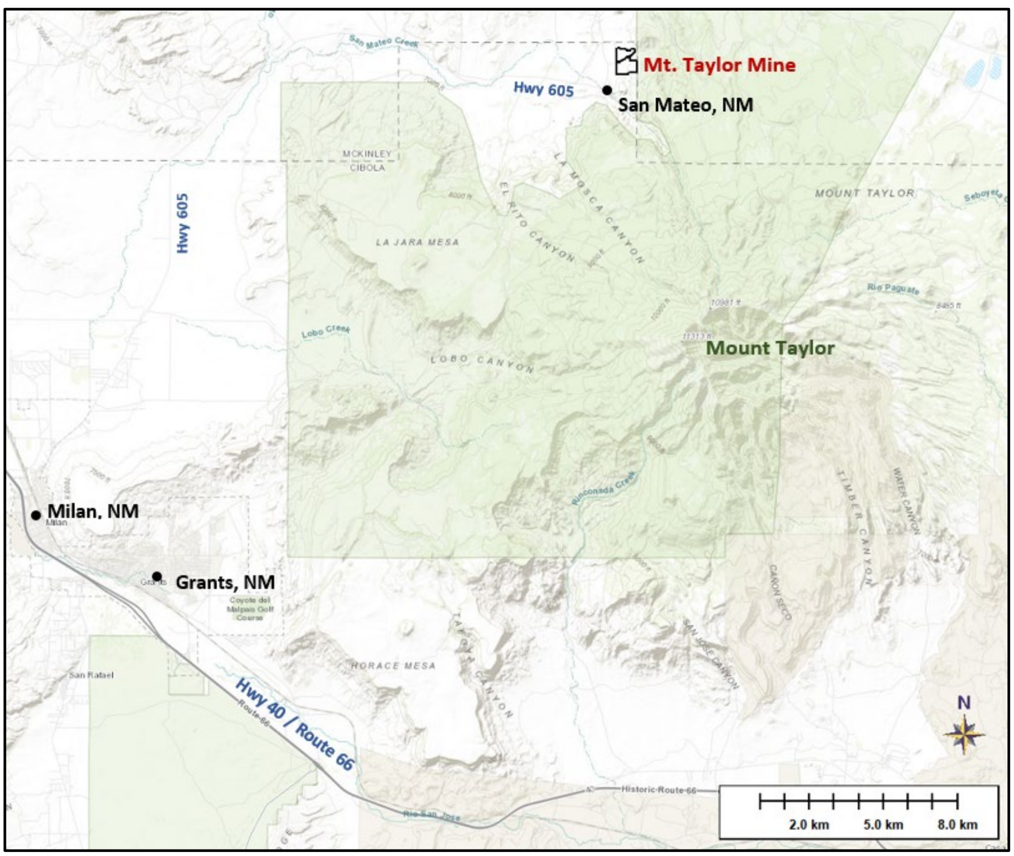


Figure 1: Location of Mt. Taylor Mine.

2. HISTORICAL SUMMARY

Gulf Mineral Resources Corporation acquired the Mt. Taylor Mine property in 1971 as an undeveloped uranium mining prospect. Some disturbance for exploratory drilling and access roads was created before 1971. The mine was developed in the 1970's, with excavation of two 3,300 foot shafts during a five-year period. Gulf started production in 1980 and continued until September 30, 1982, when the market price of uranium fell, resulting in the temporary cessation of production. Mine pumps continued pumping mine water during this shut-down period. Ownership was transferred to Chevron Resources Company in 1985 when the two companies merged. Chevron suspended production of uranium ore in 1990 due to low market price for uranium. RGR acquired the mine and other Chevron property in 1991. RGR has not mined any ore since acquiring the property due to a long-term depression in market prices for uranium.

The mine permit was revised to Active Status in December 2017 and for the next two years RGR engaged in upgrading mine facilities for a planned return to production. On December 3, 2019, RGR notified MMD of a decision to terminate plans for a return to active mining and to instead begin the process of decommissioning and Site closeout/closure.

3. REGULATORY FRAMEWORK

There is an existing Radioactive Materials License (RML) at the Site (SO043-13) issued by the Radiation Control Bureau (RCB) of the New Mexico Environment Department (NMED). The RML authorizes RGR to possess a variety of sealed or electroplated instrument testing and calibration sources as shown in Table 1. With the exception of the three Th-230 sources, all of the sources in Table 1 have been removed from the Site for disposal at an appropriately licensed waste disposal facility. There is a broader history of modifications to the RML since the first known issuance in 1979 to cover uranium loaded on ion exchange (IX) resin in the IX water treatment building. Density gauges also appear to have once been covered under the RML at the Site, and the historic locations of storage and use of both density gauges and instrument testing/calibration check sources is not well documented in the licensing records. Applicable regulatory requirements for licensing are found in Part 3 of the New Mexico Administrative Code for Radiation Protection (20.3.3 NMAC). Standards for Radiation Protection are given in Part 4 (20.3.4 NMAC). Part 20.3.4.404(A) NMAC requires a RPP for all licensees.

Table 1: Licensed radioactive sources.

Element and Mass Number	Chemical and/or Physical Form	Maximum Amount to be Possessed at Any Once Time
Cesium-137	Sealed source (New England Nuclear, Model #NER-580A)	1 source, not to exceed 110 millicuries, total.
Radium-226	Any	Five sources not to exceed 1.30 microcuries, total.
Natural Uranium	Any	Four sources not to exceed 1.32 microcuries.
Thorium-230	Electroplated metallic disk	Three sources not to exceed 0.011 microcuries, total.

Although regulatory requirements for radiation protection under the RML pertain only to licensed instrument testing/calibration sources and any residual contamination that may have historically resulted from these or other licensed sources (IX plant and density gages), exposure of Site workers to unlicensed remnant ore materials, mine waste rock and sediments in historic mine water treatment ponds is possible. The latter class of radioactive materials, considered "technologically enhanced naturally occurring radioactive materials" (TENORM), are regulated only in a context of mine reclamation under the New Mexico Mining Act for surface conditions as administered by the New Mexico EMNRD under MMD Mine Permit C1002RE.

Under current Site circumstances, radiation protection for TENORM falls under the Occupational Safety and Health Administration (OSHA). On an annualized basis, OSHA's occupational whole-body radiation dose limit is equivalent to the 5,000 mrem/yr dose limit for licensed facilities under New Mexico Standards for Protection Against Radiation (NMAC 20.3.4).

In addition to applicable regulatory dose limits as applied to both licensed and unlicensed radioactive materials, it is RGR policy to keep radiological doses to all Site personnel as low as reasonably achievable (ALARA). The ALARA principle means making every reasonable effort to maintain exposures to radiation as far below regulatory dose limits as is practical, given the work or activity that must be accomplished, and taking into account the current state of technology, cost-effectiveness in terms of radiological dose reductions, optimization in terms of overall health risks (radiological, chemical and physical), and benefits to public health and the environment in terms of societal and socioeconomic considerations including the beneficial use of nuclear energy in the public interest.

4. PROGRAM APPROACH

This RPP has been developed based on current Site decommissioning plans and radiological conditions at the Site. Given the low results of occupational radiation exposure monitoring over the past two years of pond cleanup and refurbishment construction activity, along with an expectation that the potential for radiological exposure of workers will remain low for routine decommissioning activities, occupational radiation exposure monitoring is not warranted[1] and will not be required[2]. For non-routine decommissioning activities that may involve exposure to licensed/unlicensed radioactive materials sufficient to result in occupational radiation doses > 500 mrem/yr (e.g. demolition of radiologically impacted buildings), the Radiation Safety Officer (RSO) will issue a Radiation Work Permit (RWP) to ensure that worker radiation exposures are monitored and that doses are kept ALARA below the occupational dose limits specified in NMAC 20.3.4. For each RWP, the RSO will specify use of applicable standard operating procedures (SOPs) summarized in Table 3 (Section 7.2.6.1), depending on the nature of the work that requires a RWP and the radiological hazards involved.

[1] NMAC 20.3.4.417 requires occupational radiation monitoring for doses > 10% of the 5,000 mrem/yr limit (i.e. doses > 500 mrem/yr). Workers engaged in routine decommissioning activities are not expected to receive exposures to radioactive materials that could result in an occupational radiation dose > 500 mrem/yr.

[2] Radiological contamination surveys are not evaluated in a context of occupational radiation exposures, and these surveys will continue for all personnel and equipment in potential contact with radioactive materials within Controlled Areas of the Site.

5. NECESSITY AND OBJECTIVES

5.1 Radiological Exposures

Radioactive elements that are important with respect to potential human exposures to ionizing radiation at the Site include natural uranium (U-nat), radium-226 (Ra-226), thorium-230 (Th-230), radon-222 (Rn-222) and short-lived radon decay progeny. Isotopes of U-nat (U-238, U-234 and U-235) have very long half-lives and as such, are not very radioactive. Toxicity-based health risks from uranium are possible if chemically soluble forms of U-nat are inhaled or ingested in sufficiently large quantities. As reflected in gamma survey data collected in spring 2020 (Figure 2), elevated concentrations of the uranium decay series radionuclides exist in unlicensed TENORM in the ore stockpile, ponds, hoist house and disposal cell areas.

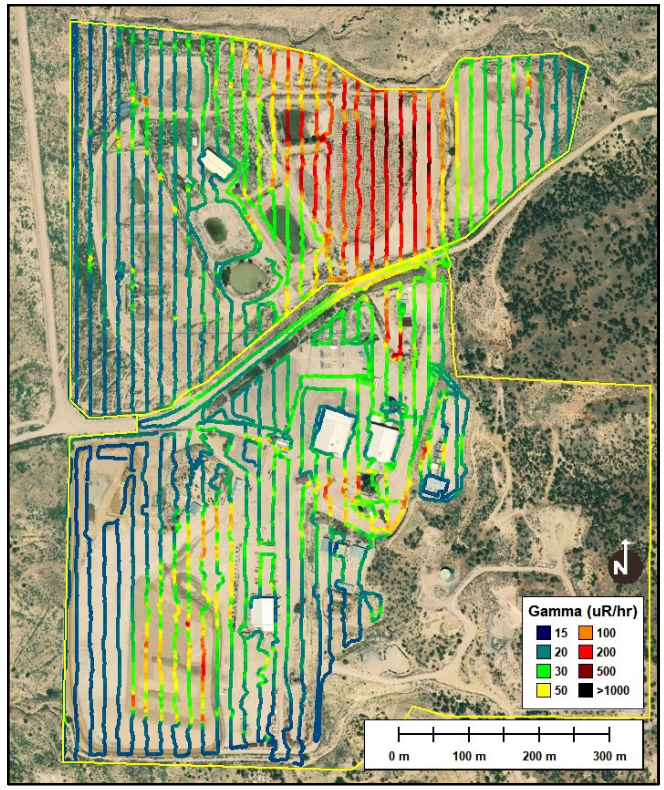


Figure 2: Gamma exposure rates at Mt. Taylor Mine (as of spring 2020).

Potential radiation dose to humans is generally limited to the following exposure pathways:

- Inhalation of short-lived radon decay products (radon progeny) in air associated with the escape of radon gas from unlicensed TENORM at the Site.
- Exposure to external (direct) gamma radiation from handling or working near licensed calibration sources (limited to authorized users only, i.e. the RSO and Facilities Manager), or from working in close proximity to the ore stockpile, ponds, and disposal cell areas.
- Inhalation of airborne radionuclides during construction or other activities that involve disturbance to unlicensed TENORM (e.g. due to excavation, transport, and placement of materials in the onsite disposal cell).
- Inadvertent ingestion of radionuclides during construction or other activities that involve disturbance to unlicensed TENORM (e.g. due to excavation, transport, and placement of materials in the onsite disposal cell).

5.2 Occupational Radiation Dose

A relatively low-level radiological environment is characteristic of current Site conditions. In both 2018 and 2019, contractors performing construction work required for mine re-activation, including construction of an engineered disposal cell and excavation of contaminated sediments in several ponds, were monitored with radiation dosimeters and air sampling to characterize exposures from external and internal pathways (external gamma radiation, airborne particulates and radon progeny). Resulting data and conservative assumptions were used to calculate generic upper-bound average occupational dose estimates, and results were low (94 and 109 mrem/yr for 2018 and 2019 respectively). These results are well below the 500 mrem/yr regulatory threshold that requires routine occupational exposure monitoring for licensed facilities as specified in the New Mexico Administrative Code (20.3.4.417 NMAC). Decommissioning activities are generally expected to pose a similar or lower risk of occupational radiation exposures versus recent mine-reactivation construction activities, and the analytical evidence supports a decision not to require routine monitoring of worker radiation exposures for Site decommissioning.

5.3 Regulatory Requirements

A Radiation Protection Program is required by 20.3.4.404 NMAC for licensed facilities in the State of New Mexico. Related License Conditions (LC) in the RML are also regulatory requirements. LCs that are applicable to the RPP under current Site conditions/circumstances are summarized as follows:

- LCs 6-8: Authorized radioactive materials, forms and possession limits (activities) authorized under the RML.
- LC 9: Authorized use – currently for storage only.
- LC 10: Requirements concerning applicable NMAC regulations, including;
  - 20.3.3 (Licensing of Radioactive Material)
  - 20.3.4 (Standards for Radiation Protection)
  - 20.3.10 (Notices, Instructions, Reports to Workers and Inspections)
  - 20.3.16 (Fees for Licensure of Radioactive Materials)
- LCs 11-15: Requirements for inspections, notifications for change of licensed premises, specification of RSO and Authorized Users of licensed material.
- LCs 16-18: Requirements for source inventory inspections/documentation, source leak testing, source utilization and storage records.

Given the evaluation in Section 5.2 above, routine occupational radiation exposure monitoring is not required for routine Site operations by regulation or license condition. However, there is the potential that some non-routine decommissioning activities could result in radiological exposures that warrant occupational monitoring (e.g. demolition of contaminated buildings or mine infrastructure). In this case, a RWP will be issued to define, at the discretion of the RSO, radiological control and monitoring requirements to protect workers based on the potential for radiological exposures. Regardless of whether occupational exposure monitoring is conducted or whether an RWP has been issued by the RSO, all workers and equipment with the potential for contact with contaminated materials within Controlled Areas of the Site will be required to be surveyed with radiation instruments prior to leaving the Site. The objective is to prevent potential offsite transport of trace amounts of radiological contamination and to verify that applicable regulatory criteria for release of both personnel and equipment are met.

5.4 ALARA Policy

As stated in 20.3.4.404 NMAC, "*The licensee or registrant shall use, to the extent practical, procedures and engineering controls based upon sound radiation protection principles to achieve occupational doses and doses to members of the public that are ALARA*". RGR policy requires all Site personnel to observe this regulatory requirement through compliance with the design and overarching objectives of this RPP to keep radiological doses and effluent releases ALARA. The RSO will conduct an ALARA Audit of the RPP and associated SOPs on an annual basis to ensure that the Radiation Protection Program is commensurate with radiological hazards at the Site and that radiological exposures are kept ALARA.

6. MANAGEMENT AND ADMINISTRATION

6.1 Organizational Structure and Responsibilities

- **License Holder**

  Rio Grande Resources. Ensures that the necessary resources are available to support the RPP in compliance with license conditions and applicable regulations, supports general safety culture, ALARA policy, and recommendations of the Facility Manager with respect to radiation protection requirements.

- **Facility Manager**

  Reports directly to RGR company management. Ensures that the necessary human resources and equipment are in place to support an effective RPP in compliance with license conditions and applicable regulations, supports general safety culture, ALARA policy.

- **Radiation Safety Officer (RSO)**

  Reports directly to the Facility Manager. Responsible for RPP design and oversight including development of RPP elements and procedures, performs instrument selections, reviews and evaluates radiation monitoring data, maintains program records, performs dose calculations, develops/provides radiation safety training, and modifies the RPP and associated Standard Operating Procedures (SOPs) as needed to keep radiological exposures ALARA. Develops decommissioning plans, including survey and monitoring requirements under related sampling and analysis plans (SAP) to support Site closeout/closure as needed, and submits required reports to applicable regulatory agencies and assists with license amendments, renewals, and audits.

- **Radiation Safety Technician (RST)**

  Reports to the RSO on all RPP matters, along with the Facility Manager where appropriate. Onsite management and implementation of the RPP including administration of monitoring and surveys conducted under a RWP, survey work plan or SAP at the direction of the RSO. In addition, the RST evaluates potential exposure circumstances associated with non-routine work activities, and describes the scope of the work to the RSO to obtain direction regarding the need for issuance of a RWP with special monitoring and surveys for potential worker exposures to radioactive materials.

- **Site Workers**

  Reports radiation safety issues or concerns to the RST, RSO or Site Manager. All workers performing work under a RWP are responsible for adhering to requirements of the RWP under the supervision of the RST and/or RSO to ensure consistency with RPP requirements and associated SOPs where applicable.

6.2 Qualifications and Training

6.2.1 RPP Staff Qualifications

In general, qualifications for radiation protection staff are based on regulatory guidance found in NRC Regulatory Guide 8.31 (NRC, 2002). However, since the Mt. Taylor Mine is not a uranium mill, qualifications for the RST position (as described below) have been modified to be commensurate with the scope of the RPP and radiological hazards that are present at the Site. The minimum qualifications and training required for radiation protection staff and Site workers (including contractors) are as follows:

- **Radiation Safety Officer (RSO)**

  A minimum of a 4-year degree in physical sciences, health physics, engineering or industrial hygiene with an accredited university, or an equivalent combination of training and relevant radiation protection experience at uranium recovery (UR) facilities. Two years of relevant experience can be considered equivalent to 1 year of academic study. At least 1 year of work experience with applied health physics at a UR facility or similar industrial setting (this experience must include working with radiation measurement equipment, not strictly administrative or “desk” work). In addition, the RSO must have at least 24 hours of applicable health physics training in health physics as applicable to UR facilities, and attend RSO refresher training every 2 years.[3] The RSO must have a thorough working knowledge of applicable regulations, health physics principles, radiation measurement instruments, radiological sampling/monitoring methods, calculation of doses from radiological exposures, and an understanding of sources of ionizing radiation at the Site.

- **Radiation Safety Technician (RST)**

  The preferred academic credential for the RST position is a 2-year (associates) degree in physical sciences, engineering or a health-related field with an accredited university or community college. The RST must attend annual radiation protection refresher training given by the RSO to all regular Site personnel. Sufficient on-the-job training and advisory support from the RSO is required. The RST must demonstrate sufficient working knowledge of the RPP, associated SOPs, radiation protection principles and proficiency in the operation of radiological instruments, surveying/monitoring techniques, and associated records keeping requirements. Previous applied experience with RPPs at other licensed facilities may be substituted for the above qualifications at the discretion of the RSO. Experience with uranium recovery facilities is preferred.

[3] If the RSO is a Certified Health Physicist (CHP) with the American Academy of Health Physics, biannual RSO refresher training is not required as certification requires continuing education in health physics to maintain this credential.

- **Site Workers**

  All regular Site workers (including contractors) must be trained by the RSO or RST in the potential radiological hazards and radiation protection requirements of the RPP and where applicable, any RWP issued by the RSO. All workers must also agree to RGR's ALARA policy and agree to abide by it.

6.2.2 Radiation Safety Training

On an annual basis, all regular RGR Site employees and Authorized Users of licensed radioactive materials at the Site shall receive at least 2 hours of refresher radiation protection training from the RSO regarding (but not limited to) the following general topics:

- Site-specific radiological hazards.
- Basic radiological science concepts (physics, units, etc.).
- Health effects of radiation exposure.
- Principles of radiation protection (justification, optimization and limitation).
- Regulatory jurisdiction and applicable regulations.
- RPP elements as applicable for non-routine projects that require a RWP (at RSO discretion) including worker exposure/dose monitoring, rad safety work rules, contamination control, instrument use, and accident and emergency response.
- Lessons learned from previous Site activities or incidents involving occupational radiation exposures, accidents, unplanned releases, procedural deficiencies, corrective actions, and general radiation protection precautions based on current data and circumstances.

In addition, all RGR Site employees and contractors performing work under a RWP shall be trained by the RSO or RST in the potential radiological hazards and radiation protection requirements of the RWP.

7. RADIATION PROTECTION CONTROLS AND MONITORING

7.1 Engineering Controls

7.1.1 Physical Controls on Access

Access to operational areas within the mine permit area are controlled by fencing, gates and radiation warning signage. These "Controlled Areas" can be divided into two basic regions, the mining facilities (Controlled Area 1) and the water treatment facilities (Controlled Area 2) (Figure 3). There are currently two secure "Restricted Areas" at the Site (Figure 3) including the ion exchange (IX) building and the Count Lab (Room 203) in the southeast corner of the second floor of the Administration Building. The Count Lab is the current/historic storage location for specifically licensed radioactive instrument testing/calibration standards (as previously indicated, only the Th-230 check sources from Table 1 remain onsite) along with a number of small, generally licensed or exempt sources (primarily in the form of sealed uranium or thorium ore standards). In addition, in a context of Site decommissioning, any residual contamination associated with historic IX water treatment equipment and infrastructure in the Restricted IX building is considered licensed material.

The definitions of Controlled and Restricted Areas are as follows:

Controlled Area: Mine permit area where warning signage and/or physical barriers (e.g. fencing) discourage or prevent unauthorized access for any reason, including trespass, theft, vandalism, exposure to physical or radiological hazards, etc.

Restricted Area: A secure room, building or designated area within the Controlled Area where access is limited to trained/authorized personnel to control exposure to radioactive materials and prevent potential spread of contamination. Authorized access to licensed radioactive materials in currently Restricted Areas is limited to the RSO and Facilities Manager.

For non-routine decommissioning projects that warrant an RWP, the RSO or RST will establish a temporary "Restricted Area" in the immediate vicinity of the work area to limit access to authorized workers and when required by the RSO, to conduct occupational radiation monitoring for potentially exposed workers. Any work conducted within Controlled Areas that involves excavation, transport or significant disturbance of unlicensed TENORM will require radiological surveys of potentially contaminated personnel and equipment prior to leaving the Site (this includes haul trucks loaded with remnant low-grade uranium ore for offsite delivery to the White Mesa uranium mill near Blanding, UT). This protocol does not apply to routine vehicle use on Site access roads within Controlled Areas where vehicles/personnel are not involved in excavation or transport of radioactive materials. While normally exempt from contamination surveys, if routine vehicle use within Controlled Areas results in accumulation of large amounts of visible mud on vehicle surfaces, the vehicle should be washed to remove the mud prior to leaving the Site.

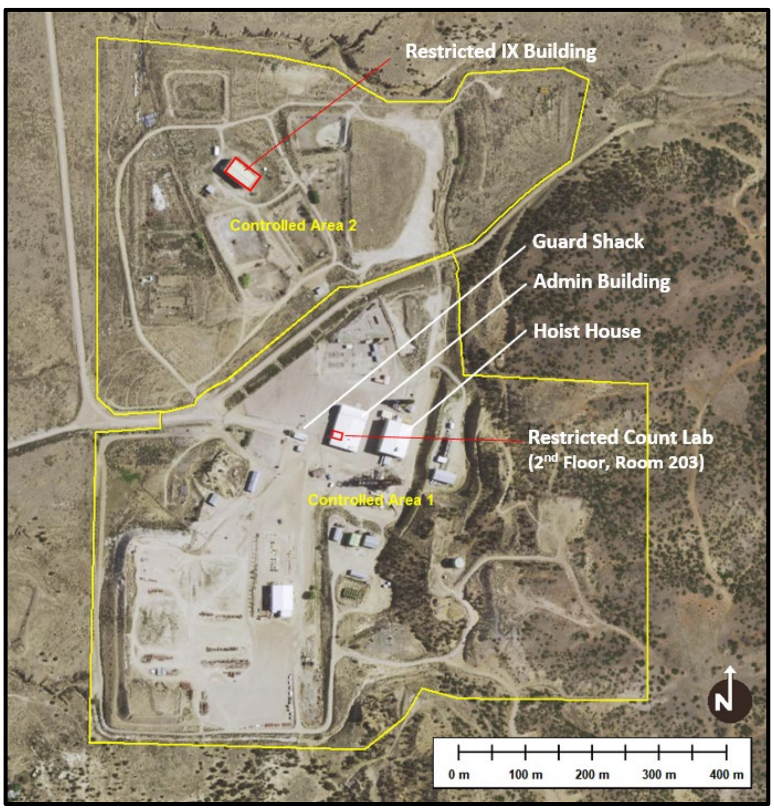


Figure 3: Site layout for Controlled and Restricted Areas.

7.1.2 Security of Radioactive Materials

Site access is controlled by a perimeter fence and locked gates along all roads that provide vehicular access to Controlled Areas. All entrances to the Site are conspicuously posted with the sign: “Any Area or Container on this Property May Contain Radioactive Materials.” In addition, buildings where licensed radioactive sources or materials are stored are kept locked at all times when authorized personnel are not present. Access to Restricted Areas within these buildings is limited to Authorized Users, and the RSO must be notified of any planned handling or use of licensed radioactive materials (the Facilities Manager has keys to access Restricted Areas).

7.2 Administrative Controls

In addition to the physical controls described above, administrative controls will be used to help ensure that radiation protection is optimized in accordance with ALARA principles. This includes controls to ensure that all licensed radioactive calibration or check sources are accounted for and monitored for containment integrity with leak testing or swipe testing for removable radiological contamination before any onsite use or offsite transport (e.g. for disposal at an appropriately licensed facility).

7.2.1 Administrative Controls on Access

- **Controlled Areas**

  Only authorized and trained Site personnel are permitted within the Controlled Area without escort by authorized personnel. Temporary contractors are authorized for independent access to Controlled Areas at the discretion of the Facilities Manager, but access to Restricted Areas containing licensed radioactive sources or materials is prohibited without escort or specific approval by an Authorized User (the Facilities Manager or RSO). Working inside of Controlled Areas with any type of equipment or materials that may have be impacted by TENORM, including any work conducted under a RWP, requires radiological contamination surveys for personnel or equipment prior to leaving the Site.

- **Restricted Areas**

  Restricted Areas require limitation of access to provide security and limit potential exposures to licensed radioactive sources or materials. At the discretion of the RSO, access to Restricted Areas may require occupational radiation exposure monitoring to evaluate and limit potential doses to workers.

7.2.2 Inspection and Leak Testing of Licensed Sources

In accordance with RML Condition 15, a physical inspection and inventory of all licensed sources shall be conducted every 6 months. The NMED/RCB has indicated to RGR that the only authorized use of licensed check sources under the RML is for storage only, suggesting that the intended use of licensed sources for instrument testing and/or calibration is prohibited. However, RML Condition 16 indicates that licensed sources may be used provided that the use, duration of use, and location(s) of use are documented, and that prior to any period of active use, sealed sources are first tested for leaks or removable contamination, and that leak testing be repeated every 6 months. Unless the RCB gives a definitive interpretation of this apparent inconsistency, RGR will refrain from any use of licensed check sources other than storage and periodic inventory inspections. During periods where licensed sources are stored only and are not used, routine tests for leaks or removable contamination are not required. In addition to testing for leaks or removable contamination, any transfer of possession and offsite transport of licensed sources requires advanced notification and approval from the NMED/RCB.

7.2.3 Regulatory and Administrative Limits

Administrative limits are a means of ensuring compliance with the ALARA policy to keep radiological exposures/doses and spread of contamination to levels that are as low below regulatory limits as is reasonably achievable. Typically, administrative limits are set at 10% of the regulatory limit. A summary of regulatory and administrative limits is provided in Table 2.

Table 2: Summary of Regulatory and Administrative radiological control limits.

Category	Parameter	Regulatory Limit (1)	Administrative Limit (1)
Limits on Occupational Exposure Levels	External Gamma Radiation	5 mrem/hour @ 30 cm (2)	1,000 µR/hr
	Airborne Particulate Radionuclides	DAC: U-nat: 6E-11 µCi/mL (3, 4)	10% of DAC: U-nat: 6E-12 µCi/mL
	Airborne Radon	30 pCi/L (5)	8.1 pCi/L (6)
Occupational Dose Limits	Total Effective Dose Equivalent (TEDE)	5,000 mrem/yr	500 mrem/yr
Public Dose Limits	TEDE	100 mrem/yr	10 mrem/yr
Contamination Limits	Personnel	1,000 dpm/100 cm^2 (9)	Background
	Equipment Release	5,000 dpm/100 cm^2 (7) 15,000 dpm/100 cm^2 (8) 1,000 dpm/100 cm^2 (9)	500 dpm/100 cm^2, 20 µR/hr (10)
	UN2910 Excepted Packages	24 dpm/cm^2 (11) 240 dpm/cm^2 (12) 500 µR/hr (13)	N/A

(1) Note that these limits generally represent net (above background) values (exceptions include occupational exposure limits). The regulatory limits cited in this Table reference NRC regulations, all of which have equivalent limits under the NM Administrative Code (NMAC) for licensed radioactive materials or OSHA or MSHA for unlicensed TENORM.

(2) Higher dose rates require “Radiation Area” posting (10 CFR 20.1003).

(3) DAC for uranium ore dust as given in 10 CFR 20, footnote 3 to Appendix B.

(4) Assumes continuous annual occupational exposure (2,000 hrs/yr).

(5) Assuming a radon equilibrium fraction of 1 (unity).

(6) IAEA recommended action level (equivalent to 300 Bq/ m^3) to limit public dose to 100 mrem/yr (IAEA, 2014).

(7) Average total (fixed plus removable) alpha (or beta) activity across any 1-m^2 area (NRC Reg Guide 8.30).

(8) Maximum total (fixed plus removable) alpha (or beta) activity across any 100-cm^2 area (NRC Reg Guide 8.30).

(9) Removable gross alpha (or beta) surface activity above background (NRC Reg Guide 8.30).

(10) Gamma exposure rate above local ambient background levels.

(11) Net (above background) removable alpha activity on package surface (average across 300 cm^2 area).

(12) Net (above background) removable beta/gamma or low toxicity alpha activity on package surface (average across 300 cm^2 area).

(13) Net (above background) gamma exposure rate on contact with package.

Note that limits on removable surface contamination and external dose rates for consigned shipments of uranium ore to an approved processing (milling) facility (not shown in Table 2), are provided in SOP-5 (Transport of Uranium Ore as LSA-1).

7.2.4 Limitation of Radiological Dose

The regulatory and administrative dose limits given in Table 2 apply to both licensed sources and unlicensed materials as described in Section 3 of this RPP Manual. Additional limits for various dosimetric quantities at uranium recovery facilities (NRC, 2002) are provided in Table 3. These limits are equivalent to those specified for licensed facilities in 20.3.4.405 NMAC. Occupational radiation exposure monitoring is not required for routine operations under the dose-based criteria specified in 20.3.4.417 NMAC (see Section 5.2). For non-routine activities conducted under a RWP, if there is reasonable potential for doses to exceed 500 mrem/yr, some form of radiological monitoring may be required by the RSO depending on the exposure hazards that may be present. SOP-3 and SOP-4 provide technical and procedural details of the various types of monitoring or surveys that may be required by the RSO.

Table 3: Regulatory dose limits for workers, reproduced from NRC Regulatory Guide 8.30 (Revision 1, 2002).

Dose Limits and Associated Terminology

Type of Exposure	10 CFR Part 20 Designation	Dose Limit
Total Whole Body Dose (Sum of External and Internal)	Total Effective Dose Equivalent (TEDE) TEDE = DDE + CEDE	5 rem/year
External Dose	Deep Dose Equivalent (DDE)	(a)
Internal Whole Body Dose	Committed Effective Dose Equivalent (CEDE)	(a)
Total Organ Dose (Sum of External and Internal)	Total Organ Dose Equivalent (TODE) TODE = DDE + CDE	50 rem/year
Internal Organ Dose	Committed Dose Equivalent (CDE)	(a)
Skin Dose	Shallow Dose Equivalent (SDE), Skin of Whole Body	50 rem/year
Extremity Dose	Shallow Dose Equivalent (SDE), Maximum Extremity	50 rem/year
Eye Dose	Eye Dose Equivalent to Lens of the Eye (LDE)	15 rem/year

(a) Included in limits for whole body and individual organs. In the absence of any internal exposure, external dose is limited to 5 rem per year. In the absence of any external exposure, internal exposure is limited to 2000 DAC-hours per year or 1 annual limit on intake (ALI) (50 rem/yr non-stochastic, 5 rem/yr stochastic).

7.2.5 Radiation Safety Work Rules

All personnel working within Controlled or Restricted Areas are required to observe the following radiation safety work rules:

1. Personal Hygiene – After working in Controlled or Restricted Areas, all personnel must wash hands before eating, drinking or using tobacco (even if personnel exit surveys show no evidence of radiological contamination).
2. Eating, Drinking and Tobacco Use – Eating and tobacco use are prohibited within Controlled or Restricted Areas. Drinking liquids is allowed to prevent dehydration, but only with single-use containers (i.e. commercial bottled water in plastic bottles with a screw-type lid) to help avoid soiling of containers and accidental ingestion of trace amounts of contaminated material.
3. Personal Protective Equipment – Standard personal protective equipment (PPE) as appropriate to protect from physical hazards, and additional PPE when specified by the RSO to protect against radiological hazards.
4. Personnel and Equipment Release Surveys – all personnel working with contaminated equipment or materials within Controlled or Restricted Areas must perform exit contamination surveys for egress from the Site, and no equipment, vehicles or materials may be released from these areas unless radiological surveys (conducted by the RST) verify compliance with release limits for contamination involving uranium decay series radionuclides (see Table 2 and SOP-3).
5. Decontamination – As needed to meet release limits. Decontamination procedures are provided in SOP-3 (Radiological Contamination Surveys).

When required by the RSO (e.g. under a RWP), occupational radiation exposure monitoring (dosimeters, air sampling) is also considered a radiation safety work rule.

7.2.6 Standard Operating Procedures for Radiation Protection

This RPP Manual has been prepared to address radiological and regulatory circumstances associated with planned decommissioning, reclamation and Site closure activities. Implementation of the RPP relies on associated standard operating procedures (SOPs). The SOP titles listed in Table 4 will be used as needed depending on the nature of the work being conducted and applicable provisions of this RPP. SOPs that support the RPP, as briefly described in the following Sections, are provided in Appendix A of this RPP Manual.

Table 4: Standard Operating Procedure (SOP) numbers and titles under this RPP Manual.

SOP No.	SOP Title	Current Revision No.	Revision Date
SOP-1	Radiation Work Permits	4	05-22-20
SOP-2	Instrument Testing and Calibration	5	03-18-21
SOP-3	Radiological Contamination Surveys	4	05-22-20
SOP-4	Radiological Monitoring for Occupational Exposure	4	05-22-20
SOP-5	Transport of Uranium Ore as LSA-1	2	11-19-19
SOP-6	Environmental Radiation Monitoring	4	05-22-20
SOP-7	GPS-based Gamma Radiation Surveys	0	05-22-20
SOP-8	Soil Sampling for Radiometric Analysis	0	05-22-20

7.2.6.1 SOP-1: Radiation Work Permits

The purpose of RWPs is to protect workers from exposure to radioactive materials due to non-routine Site operations. As previously indicated, routine decommissioning activities at the Site are generally expected to have very low potential for occupational radiation exposures and radiation exposure monitoring is not required. The need and justification for a RWP with occupational radiation monitoring will be determined by the RSO based on the nature of the non-routine activity or project and potential for occupational doses to exceed the administrative limits given in Table 2 of this RPP Manual. Standard Operating Procedure SOP-1 provides further details on the development and use of RWPs.

7.2.6.2 SOP-2: Instrument Testing and Calibration

When use of a radiation measurement instrument is required under this RPP, it must have been calibrated by a qualified vendor within 1 year prior to use at the Site. Before use in the field, quality control (QC) measurements shall be made daily for each instrument to ensure proper instrument function. For surface contamination surveys for alpha or beta radiation, the instrument counting efficiency will be determined based on measurements of check sources with certified 2π emission rates for alpha and beta emissions as given on the source calibration certificate. Procedural details are provided in SOP-2.

7.2.6.3 SOP-3: Radiological Contamination Surveys

When radiological contamination surveys for personnel and equipment are required for egress from the Site, the RSO or RST will ensure that these surveys are properly conducted and documented in accordance with SOP-3. Regulatory and Administrative limits for contamination on personnel and equipment are given in Table 2 of this RPP Manual and in Table 3-1 of SOP-3. SOP-3 also includes provisions for shipping of environmental samples containing small quantities of radioactive material under UN2910 excepted package shipping protocols. With respect to shipments of large quantities of uranium ore, specific surveys and release criteria are applicable as described in SOP-5. Survey results will be documented on the appropriate Form(s) provided in SOP-3 and/or SOP-5. Procedural details are provided in respective SOPs.

In addition, SOP-3 contains procedures for decontamination in the event that equipment, vehicles, personnel protective equipment (PPE), clothing or skin becomes contaminated in excess of administrative action levels or regulatory release limits. In such cases, decontamination is required before releasing the person and/or equipment from the Site. Section 5 of SOP-3 describes various methods for decontamination.

7.2.6.4 SOP-4: Radiological Monitoring for Occupational Exposure

When the RSO determines that a non-routine decommissioning activity requires radiological monitoring under a RWP to measure occupational exposure to radioactive material via external or internal pathways, the RSO or RST will ensure that this monitoring is conducted and documented in accordance with SOP-4. SOP-4 provides procedural details for monitoring of airborne particulate radionuclides, radon gas, radon progeny, and external (direct) radiation in support of occupational radiation dose estimation (where applicable). Where warranted, the RSO will use the data generated by occupational radiation exposure monitoring to calculate estimates of radiological dose using conventional health physics principles and methods traceable to applicable State and/or Federal regulations and regulatory guidance documents.

Regulatory and Administrative limits for radiological air concentrations or exposure levels, along with radiological dose limits, are given in Table 2 of this RPP Manual. Adherence to SOP-4 procedures requires use of applicable procedures in SOP-2 for instrument use, quality assurance (function checks and calibration), and instrument counting efficiency determinations for measurement of alpha emissions from air sample filters.

7.2.6.5 SOP-5: Transport of Uranium Ore as LSA-1

SOP-5 provides the steps necessary to ensure that a haul truck carrying uranium ore for offsite processing (milling) will meet U.S. Department of Transportation (DOT) requirements to transport Low Specific Activity (LSA)-1 radioactive material (49 CFR 173.401). Requirements include personnel training, radiological dose rate and removable contamination surveys, vehicle placarding and marking, and making sure all paperwork associated with the shipment is correct and complete.

7.2.6.6 SOP-6: Environmental Radiation Monitoring

While not required by the RML or mine permit, environmental monitoring of effluent radon and gamma radiation in both operational and adjacent areas is conducted in accordance with SOP-6. Additional details are provided in Section 7.3.2.

7.2.6.7 SOP-7: GPS-based Gamma Radiation Surveys

The Closeout/Closure Plan under the mine permit (RGR, 2013) requires radiological surveys of the permit area and affected lands to identify impacts to soil and guide remediation to meet release criteria for Ra-226 concentrations in soil. Gamma radiation from Ra-226 and its decay products is easily detected and measured with special instruments. SOP-7 provides the methods and data quality control measures that will be used to perform global positioning systems (GPS)-based gamma surveys across land areas.

7.2.6.8 SOP-8: Soil Sampling for Radiometric Analysis

SOP-8 provides the methods and data quality control measures that will be used to collect, process, document, and ship soil samples to a qualified commercial laboratory for radiometric analysis as part of radiological surveys required by the Site Closeout/Closure Plan under the mine permit with MMD.

7.3 Effluent Controls

The NRC defines "effluent" as "Liquid or gaseous waste containing plant-related, licensed radioactive material, emitted at the boundary of the facility (e.g., buildings, end-of-pipe, stack, or container)" (NRC, 2009). "Effluent discharge" is defined as "The portion of an effluent release that reaches an unrestricted area". Much of the TENORM at the Site has been stabilized/covered to isolate these materials from the active surface environment (to prevent human exposures and environmental migration). Runoff-driven erosional migration from other areas is limited by hydrologic engineering controls (runoff control features and catchment ponds) designed to prevent waterborne effluent discharges from Controlled Areas. Regulatory controls on water quality found in discharge permit DP-61 must be met for effluent releases of surface water and groundwater discharges from mine facilities.

Though historically contaminated sediments in water treatment ponds have largely been excavated and placed/covered in the onsite disposal cell, materials exposed at the surface of the low-grade ore stockpile and contaminated surface soils in other portions of the Site can be mobilized by wind-driven erosional processes, particularly during active construction disturbance. Radon and its short-lived decay products (progeny), along with long-lived uranium decay series radionuclides in air particulates, represent the only types of potential airborne radiological effluent discharges at the Site. Dust suppression with water trucks is the primary method of source control to limit fugitive dusts generated by construction-related disturbance in areas containing significant quantities of unlicensed TENORM (e.g. the waste repository, ponds and ore stockpile). An environmental monitoring program is in place to monitor potential airborne effluents in accordance with SOP-6 (see Section 7.3.2).

7.3.1 Management of Radioactive Sources and Materials

The current RML authorizes use and storage of a sealed Cs-137 source (110 mCi) and a sealed Ra-226 source (0.25 mCi) at the Mount Taylor Mine. On August 19, 2019, RGR reported to the Radiation Control Bureau (RCB) of NMED that the Geoco Ra-226 standard had previously been misidentified and was determined to be missing. On November 6, 2019, RGR reported to the RCB the missing Ra-226 standard had been found, along with discovery of three additional Geoco Ra-226 standards and two uranium standards in the form of 1% uranium oxide (yellowcake) in a silica matrix. The additional standards will be added to RML SO043-11, and since none of the Geoco calibration sources will be used in the future, RGR will transfer them to a service provider for transfer and offsite disposal at a licensed low-level radiological waste disposal facility. In the meantime, these sources will remain in storage and will not be accessed until removed from the Site.

In conjunction with this license amendment request, RGR intends to add several small Th-230 check sources to RML SO043-11. These check sources, used for instrument quality control testing and alpha counting efficiency determination, have been stored at the Site for decades, apparently with little or no use during a long period of inactive mine permit status. It is anticipated that water treatment facilities will be soon be updated to treat mine water for removal of molybdenum and selenium (in addition to uranium and radium) to attain compliance with water quality standards specified in DP-61. Once the water treatment system design has been finalized, RGR will request another RML amendment to include residual solid wastes from the updated water treatment process.

Shipping of small quantities of environmental samples containing radioactive material (licensed or unlicensed) to an offsite laboratory for analysis is permitted, but this may need to be performed in accordance with UN2910 shipping protocols for excepted packages (procedural requirements are specified in SOP-3). An exemption from the UN2910 shipping requirement is permitted for samples (solids or liquids) containing exempt quantities of radionuclides as defined by the U.S. Department of Transportation (DOT) regulations for transport of radioactive materials (49 CFR 173.436)

All radioactive materials, including sediments in water treatment ponds, mine waste rock and uranium ore in the low-grade ore stockpile, will be managed in a manner to prevent environmental migration and/or unauthorized access, use, or offsite transport of such materials. Offsite shipping of unlicensed low-grade ore in the ore stockpile will be conducted in accordance with SOP-5 in order to ensure compliance with DOT regulations.

7.3.2 Environmental Monitoring

Environmental monitoring of ambient radon gas concentrations and terrestrial gamma radiation dose rates is conducted on a quarterly basis. Radon gas is measured with passive alpha track-etch detectors, while gamma dose rates are measured with environmental OSL dosimeters. This monitoring is conducted in accordance with SOP-6 (Environmental Monitoring). Eight of the monitoring stations are located within Controlled Areas at the Site (Figure 6), while three locations are situated in adjacent offsite areas to evaluate differences in ambient radiation levels in surrounding environs versus those measured in onsite operational areas. One offsite station is located at a local residence in the nearby town of San Mateo, New Mexico.

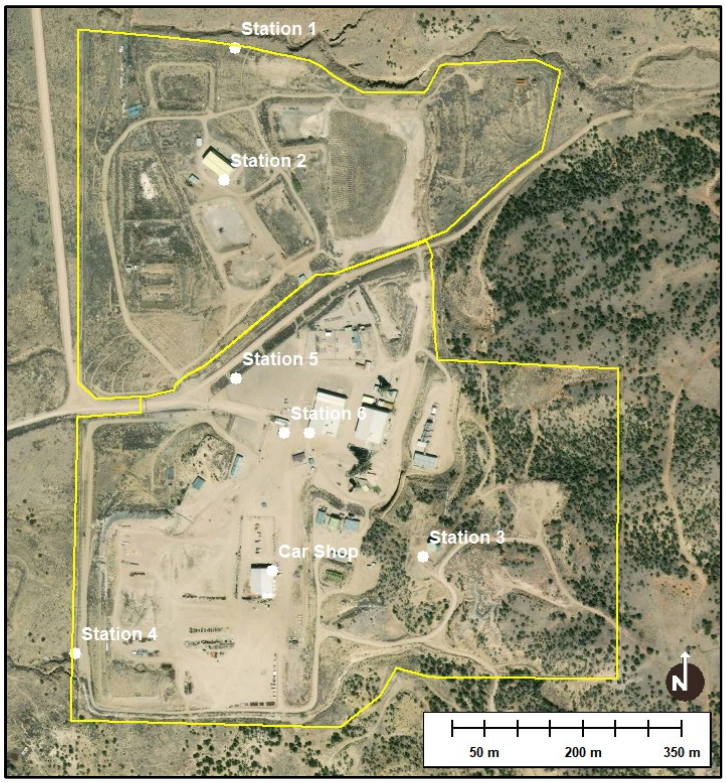


Figure 6: Environmental radiation monitoring stations in Controlled Areas.

7.4 Records Retention

To ensure compliance with 20.3.4.441-447 NMAC records-keeping requirements with respect to licensed radioactive sources and materials, all records of RPP activities, radiological monitoring/survey data, and program audits and inspections shall be retained until RML termination. Records will be maintained electronically on secure servers and backed up on electronic storage media.

7.5 Quality Assurance

7.5.1 Quality Control for Radiological Field Measurement

Quality control (QC) for individual measurement data refers to ensuring acceptable degrees of accuracy (deviation from the true value) and precision (reproducibility). Collectively, these measurement parameters determine the degree of analytical uncertainty reflected in the data. Analytical uncertainty can be minimized and quantified with proper instrument calibrations and routine QC measurements. Specifications for calibrations and QC measurements are given in SOP-2 (Instrument Testing and Calibration). A brief synopsis of the requirements of SOP-2 is provided below.

7.5.1.1 Calibration

Calibration of radiological measurement instruments and devices is necessary to ensure that the degree of accuracy achieved is sufficient to meet measurement objectives. All electronic radiation measurement instruments will be calibrated independently by the manufacturer or by a vendor that is qualified to perform such services at minimum on an annual basis as specified in SOP-2. Calibration is also required in the event of instrument maintenance or repair.

7.5.1.2 Quality Control Measurements

The operational stability and temporal consistency of performance for each field instrument will be monitored with QC measurements taken each day prior to use in the field, the results of which will be documented and maintained in accordance with SOP-2 specifications. Quality control measurements must meet uncertainty (precision) limits of ± 20% of the nominal (average) reading for ambient background and a check source over time in a consistent location/geometry to demonstrate acceptable instrument performance.

8. REGULATORY CONTACT INFORMATION

All correspondence, notifications and regulatory reporting required under the RML will be made to the appropriate contact(s) at the Radiation Control Bureau of the New Mexico Environment Department:

Telephone (505) 476-8600

Radiation Control Bureau
New Mexico Environment Department
PO Box 5469
Santa Fe, New Mexico 87502-5469

Radiation Control Bureau
New Mexico Environment Department
Marquez Building, Suite 1
525 Camino de Los Marquez
Santa Fe, New Mexico 87505-1816

http://www.nmenv.state.nm.us/nmrcb/home.html

9. REFERENCES

International Atomic Energy Agency (IAEA). 2014. Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards. General Safety Requirements Part 3. Safety Standards Series No. GSR Part 3.

Rio Grande Resources (RGR). 2013. Mount Taylor Mine Closeout/Closure Plan. Existing Mine Permit #C1002RE, Discharge Permit DP-61. Revision 1, November 2013.

Nuclear Regulatory Commission (NRC). 2002. Health Physics Surveys in Uranium Recovery Facilities. NRC Regulatory Guide 8.30 (Revision 1).

Nuclear Regulatory Commission (NRC). 2002. Information Relevant to Ensuring That Occupational Radiation Exposures at Uranium Recovery Facilities Will Be as Low as is Reasonably Achievable. NRC Regulatory Guide 8.31 (Revision 1).

Nuclear Regulatory Commission (NRC). 2009. Measuring, evaluating and reporting radioactive material in liquid and gaseous effluents and solid waste. NRC Regulatory Guide 1.21 (Revision 2).

U.S. Nuclear Regulatory Commission (USNRC). 2019. Evaluations of uranium recovery facility surveys of radon and radon progeny in air and demonstrations of compliance with 10 CFR 20.1301. Final Report. June 2019.

APPENDIX A – Standard Operating Procedures (SOPs) for the Radiation Protection Program

SOP No.	SOP Title (and historic procedure No.)	Current Revision No.	Revision Date
SOP-1	Radiation Work Permits	4	05-22-20
SOP-2	Instrument Testing and Calibration	5	03-18-21
SOP-3	Radiological Contamination Surveys	4	05-22-20
SOP-4	Radiological Monitoring for Occupational Exposure	4	05-22-20
SOP-5	Transport of Uranium Ore as LSA-1	2	11-19-19
SOP-6	Environmental Radiation Monitoring	4	05-22-20
SOP-7	GPS-based Gamma Radiation Surveys	0	05-22-20
SOP-8	Soil Sampling for Radiometric Analysis	0	05-22-20

SOP-1 *Radiation Work Permits*

Version History	Date
2017 RML Renewal	12-04-2017
Revision 1	05-20-2019
Revision 2	11-19-2019
Revision 3	04-01-2020
Revision 4	05-22-2020

Distribution
Facility Manager Radiation Safety Officer Radiation Safety Technician Radiation Protection Program Manual

1. PURPOSE

This Standard Operating Procedure (SOP) describes the use of Radiation Work Permits (RWP) at the Mount Taylor Mine (Site) under the Site's Radiation Protection Program (RPP). The purpose of RWPs is to protect workers from exposure to radioactive materials due to non-routine Site operations. Routine Site operations have little potential for significant occupational radiation exposures, and as such, issuance of an RWP with occupational radiation monitoring is not normally required. The need and justification for a RWP will be determined by Site Radiation Safety Officer (RSO) based on the nature of the non-routine activity or project and corresponding potential for occupational radiation doses or contamination to exceed the administrative limits given in Table 2 of the RPP Manual (RGR, 2020).

2. DISCUSSION

When a RWP is warranted for a non-routine project, the RSO will develop and issue the RWP to define the radiation protection measures and scope of radiological monitoring that will be required. The RWP will utilize Standard Operating Procedures (SOPs) provided in the Radiation Protection Program (RPP) Manual (RGR, 2020) where applicable. Should the RWP require special procedures that are not covered by existing SOPs, the RSO will develop a written procedure accordingly and will attach the new procedure to the RWP.

3. RESPONSIBILITY

- Facility Manager – responsible for informing the RSO of non-routine Site activities or projects that may involve higher than normal exposures to licensed or unlicensed radioactive materials.
- Radiation Safety Officer – responsible for evaluation of Work Plans for non-routine Site activities or projects to determine the need for a RWP, radiological monitoring and protection requirements, training of RWP workers, supervision/advising for RWP implementation, and review of survey/monitoring data generated under the RWP.
- Radiation Safety Technician – responsible for onsite management and implementation of the RWP (supervision of workers to ensure RWP procedures are followed, daily instrument QC checks, radiological surveys and exposure monitoring, documentation, etc.). The RST role may be filled by a temporary designee at the discretion of the RSO, provided that the individual is qualified by previous experience with similar responsibilities and sufficient on-the-job training.
- RWP Workers – responsible for reading the RWP, obtaining respective training, and following RWP procedures and work rules as applicable under the requirements of the RWP.

4. PROCEDURE

4.1. Equipment and Materials

- Work Plan for non-routine activity/project with complete description of the work to be performed (this information will be evaluated by the RSO when determining the need for a RWP).
- Radiation Work Permit (onsite hardcopy for reference).
- RPP Manual and associated SOPs.
- Form SOP-1A (Radiation Work Permit Training Log)

4.2. RWP Development, Issuance and Implementation

Determination, development, issuance and implementation of a RWP includes the following steps:

1. The Work Plan for any non-routine Site activity or project that could involve exposure to radioactive materials will be provided to the RSO for review and evaluation of the need for a RWP.
2. If a RWP is warranted for a given project, the RSO will develop a written RWP to define the scope of work and schedule for which the RWP applies, along with the radiation protection measures and type(s) of radiological monitoring that will be required.
3. The RWP will include a detailed description of the work to be performed under the RWP, an assessment of radiological hazards that may be encountered, and estimation of the occupational radiation doses that may be received by RWP workers.
4. The RSO or Radiation Safety Technician (RST) will conduct training on the RWP for applicable workers. The RST is responsible for implementation and management of RWP surveys, monitoring and documentation, as well as supervision of RWP workers to ensure that RWP procedures and work rules are being followed.
5. The RST will provide all required RWP documentation to the RSO in electronic format, and will maintain hardcopies on file at the Mount Taylor Mine. These records shall be available for inspection by the Radiation Control Bureau (RCB) of the New Mexico Environment Department (NMED) at any time.

If a RWP is to be issued, the following information, at minimum, will be provided in the RWP:

- Background information relevant to the project.
- Description of work.
- Potential radiological hazards.
- Radiation protection measures.
- Occupational exposure monitoring requirements.
- Contamination control.
- Management of radioactive material.

The SOPs needed to support the requirements of the RWP (as determined by the RSO) will be cited in the RWP (these are provided in Appendix A of the RPP Manual). All RWP workers must receive training on the RWP, and personnel must sign the RWP Training Log (Form SOP-1A). The training will include demonstration of the use of instruments for surveys as necessary, along with instruction on documentation.

4.3. Documentation and Records Retention

The RSO and RST will record/document results of all instrument QC measurements and survey or monitoring results, and will maintain all RWP documentation for at least three years. This includes all radiological monitoring and survey forms that apply under the SOPs issued under the RWP.

5. REFERENCES

Rio Grande Resources (RGR). 2020. Radiation Protection Program Manual. Revision 4. May 22, 2020.

6. ATTACHMENTS

- Form SOP-1A: RWP Training Log

FORM SOP-1A: RWP Training Log

Signing this training log sheet indicates that you have attended RWP training prior to work under the RWP and fully understand all RWP requirements.

Date	Name (please print)	Signature

Training Performed by:

Signature _______________________________________ Date _______________________

SOP-2 *Instrument Testing and Calibration*

Version History	Date
2017 RML renewal	12-04-2017
Revision 1	05-20-2019
Revision 2	11-19-2019
Revision 3	04-01-2020
Revision 4	05-22-2020
Revision 5	03-18-2021

Distribution
Facility Manager Radiation Safety Officer Radiation Safety Technician Radiation Protection Program Manual

1. PURPOSE

This Standard Operating Procedure (SOP) describes the procedures for calibration, operational function checks and measurement efficiency determinations for radiation detectors/meters prior to collecting radiological survey or monitoring data at the Mount Taylor Mine (Site).

2. DISCUSSION

This SOP covers a range of potential instruments and equipment that may be used to perform radiological surveys or monitoring as may be required under the generalized Radiation Protection Program (RPP), or for non-routine activities, under a specific Radiation Work Permit (RWP). Radiological measurements for non-routine RWP activities will be determined by the Radiation Safety Officer (RSO). Rio Grande Resources (RGR) does not maintain calibrated radiation measurement instruments at the Site. Required instrumentation will be rented from a qualified vendor that properly maintains the instruments supplied in terms of calibration and repair. Advanced planning is required to ensure that the required instruments are available onsite to meet operational needs.

3. RESPONSIBILITY

- Facility Manager – responsible for reviewing and approving the RPP, SOPs, RWPs and providing the resources necessary to implement these radiation protection planning documents (e.g. instrumentation and related equipment).
- Radiation Safety Officer – responsible for selecting the types of radiological surveys or monitoring required for a RWP, and for specifying the instrumentation and equipment needed.
- Radiation Safety Technician – responsible for onsite management and implementation of daily instrument QC checks, radiological surveys, documentation, etc. The RST role may be filled by a temporary designee at the discretion of the RSO, provided that the individual is qualified by previous experience and sufficient on-the-job training is received.
- Site Workers – responsible for receiving hands-on instruction in the operation and use of radiological survey instruments and monitoring devices as required under the RPP, SOP or RWP.

4. PROCEDURE

4.1. Equipment and Materials

- Ratemeters and/or Scalars including Ludlum Models 12, 19, 2221, 2360, 2929, or equivalent.
- Detectors including Ludlum Models 43-5, 44-9, 44-10, 43-93, 43-10-1, or equivalent.

- Cable: C-C or other connectors, as applicable.
- Forms: Form SOP-2A (Instrument Function Check Form) (see Attachments).
- Radiological check sources, typically Th-230 (alpha), Tc-99 (beta), and/or Cs-137 (gamma).
- Calibration Jig.

4.2. Instrument Calibration

All electronic radiation detection and measurement instruments must be calibrated by a qualified vendor within 1 year prior to use at the Site. For gamma detectors with meters calibrated to measure gamma exposure rate (e.g. µR/hr), the calibration must include testing in known radiation fields (calibration range measurements). Calibration metrics are documented with the calibration certificate. Calibration certificates for all instruments used for a RWP will be kept with other RWP records. All hardcopy RWP records will be maintained onsite with electronically scanned copies retained by the RSO. RWP records will be retained for at least 3 years or until the radioactive materials license (RML) at the Site has been terminated.

4.3. Determination of Control Limits for Daily Function Checks

Prior to use in the field, the RSO and/or RST will establish quantitative quality control (QC) limits on the response of each instrument to an appropriate radiation source under a designated (fixed) measurement location and geometry. The QC limits will be used to evaluate daily instrument function check measurements to ensure acceptable instrument performance. The steps for initial determination of instrument QC limits are as follows:

4.3.1. Create a separate Instrument Function Check Form (Form SOP-2A; see Attachments) for each piece of equipment being used. Record serial numbers, calibration dates, and check source information in the appropriate fields. Under comments, record source to detector distance, site name, and location on site where function check is performed.

4.3.2. Replace the batteries in the meter if the meter battery level is low. *Note: For Model 2221 a battery voltage below 4.5 is considered low. For a Model 12, Model 19 or Model 2360 the meter needle should deflect to the BAT TEST or BAT OK range. If using an AC powered meter, no battery level test is necessary.*

4.3.3. With the meter in the ratemeter position and a meter scale selected so that the meter is not pegged (other than the log scale), move both ends of the detector cable to determine if the cable is functioning properly. A faulty cable will introduce spurious counts. To test a cable, move both ends of the cable watching the meter. If excessive counts occur the cable may be faulty. Replace with a new cable of identical size and repeat the test. Document faulty cable and dispose of cable.

4.3.4. Select a designated (fixed) location to perform the initial QC measurements and all subsequent daily function checks. Describe the location and measurement geometry where indicated on the Function Check Form. The daily function check location should be selected with the following conditions in mind:

- The location should represent reasonably low background conditions for the Site.
- The radiological conditions surrounding the location should be expected to remain consistent throughout the duration of the project.
- This will be the location that all instrument function checks will be performed at the beginning of the workday.

4.3.5. With the detector placed in the fixed geometry position with no radioactive check source present, perform 1-minute scaler count and record the background count rate on the Function Check Form (if using a ratemeter with analog or digital readout, record approximate average value). Unless directed otherwise by the RSO, repeat until ten background readings are recorded.

4.3.6. Repeat the 1-minute scaler counts with the radioactive check source in place (if using a ratemeter with analog or digital readout, record approximate average value). Record the results on the Function Check Form. Unless directed otherwise by the RSO, repeat until ten background readings are recorded.

4.3.7. Determine the net count rate (source CPM – background CPM) for each of the ten measurements and record results on the Function Check Form.

4.3.8. Acceptable QC limits for each instrument are represented by the upper and lower bounds on the average net (above background) count rate for the initial ten counts ± 20%.

4.4. Daily Instrument Function Checks

For each day of radiological instrument use, the RST will perform daily function checks to verify that each instrument is responding within the QC limits established as indicated in Section 4.3. The steps for daily instrument function checks are as follows:

4.4.1. The daily function check should be performed each morning before onsite use. If an instrument begins to respond oddly during the course of the day, a second function check should be performed, and if outside QC limits the instrument should be taken out of service for repair and recalibration.

4.4.2. Create a Daily Function Check form for each piece of equipment being used as described in the previous Section of this SOP. In the comments field note that the form is being used as a daily function check form.

4.4.3. Follow steps 4.3.1 – 4.3.4 above.

4.4.4. Measure the background count for one minute (unless otherwise directed by the RSO) at the designated function check location (see Section 4.3.5 above). Record the results on the Instrument Function Check form.

4.4.5. Repeat step 4.4.4 with the check source in place. If the detector is dual channel (alpha/beta) then repeat again with the second source in place.

4.4.6. Determine the net count rate (source CPM – background CPM) for the daily QC measurement and record result on the Function Check Form.

4.4.7. Calculate the instrument counting efficiency (ε_i = net CPM / 2π EPM = Counts/Decay) and record result on the Function Check Form (applicable to alpha and beta only).

4.4.8. If the daily function check result for net count rate does do not fall within the QC limits as defined above (step 4.3.8), check the source, geometry and immediate area to determine if anything may have caused the QC measurement to exceed the QC limits. If a reason is found attempt to fix the problem. Count again. If the daily function check results in a second exceedance of the QC limits remove the instrument from service and report the event to the RSO.

4.5. Measurement Efficiency Determination

For air particulate monitoring and alpha/beta contamination surveys, the radiological counting efficiency for corresponding instruments must be determined. In addition, the total detection efficiency of the monitoring or survey method (e.g. air filter samples, swipe samples for removable surface contamination, or fixed/static measurements of total activity on the surface of interest) shall be used in calculation of air concentrations or surface activity for comparison against the applicable limits given in Table 2 of the RPP Manual (RGR, 2020). The procedures for conducting surface contamination surveys are given in SOP-3 (Radiological Contamination Surveys). Procedures for conducting radiological air monitoring are given in SOP-4 (Radiological Monitoring for Occupational Exposure). The method for calculation of air concentrations or surface activity based on alpha or beta emissions is defined below.

4.5.1. Guidance from the International Organization for Standardization (ISO) in ISO 7503-1 (Evaluation of Surface Contamination) calls for use of 2π surface emission rate when determining instrument counting efficiency (ISO, 1988). Consistent with ISO guidance, NUREG-1575 (NRC, 2000) also defines instrument efficiency as "the ratio of the net count rate of the instrument and the surface emission rate of a source for a specified geometry". Based on this information, the formula for instrument efficiency calculations is as follows (Equation 2-1):

$$\varepsilon_i = \frac{R_{S+B} - R_B}{q_{2\pi}}$$ **Equation 2-1**

Where:

ε_i = instrument efficiency.

R_{S+B} = detector count rate of the source plus background (CPM).

R_B = detector background count rate (CPM).

$q_{2\pi}$ = certified 2π surface emission rate of the source (EPM).

4.5.2. The 2π surface emission rate for alpha and beta particles is listed on the source calibration certificates.[1] ISO 7503-1 gives generic source efficiency values (ε_s) for alpha and beta emissions (0.25 for alpha and low-energy betas, and 0.5 for beta energies > 400 keV). For UN2910 shipping, an additional swipe removal efficiency of 0.1 must be applied. Studies of self-absorption of alpha particles on air sample filters (Higby, 1984; Terry, 1995) suggest a 2π emission efficiency of 0.85 is appropriate for personal breathing zone (BZ) air filter samples, but to obtain a measure of the total 4π activity on the filter, this value must be multiplied by 0.5 (giving an ε_s value of 0.425). Calculate the total (effective) detection efficiency for alpha and beta emissions from equipment surfaces, swipe samples or air filter samples as follows (Equation 2-2):

$$\varepsilon_t = \varepsilon_i \times \varepsilon_s$$ **Equation 2-2**

Where,

ε_t = Total detection efficiency (counts/emission).

ε_i = 2π instrument counting efficiency, calculated as defined above.

ε_s = Source efficiency factor:

[1] The surface emission rate (EPM) is assumed equivalent to the measured count rate (CPM) specified for 2π source emission geometry based on verification of absolute counting as indicated in the Measurement Method section of the certificate of calibration.

- 0.25 for alpha and low-energy betas (static count or removable swipe samples).
- 0.5 for high-energy betas > 400 keV (static count or removable swipe samples).
- 0.425 for alpha radiation on BZ air sampling filters.
- For UN2910 excepted packages, multiply ε_t by an additional factor of 0.1 to account for swipe removal efficiency.

4.5.3. Once the total detection efficiency is determined, the surface activity (DPM/cm^2) or activity concentration in air (µCi/mL) are given by Equation 2-3:

$$C = \frac{R_S - R_B}{\varepsilon_t(CF)(A\ or\ V)}$$ **Equation 2-3**

Where:

C = surface activity (DPM/cm^2) or air concentration (µCi/mL).

R_S = detector count rate for the surface or sampling media (CPM).

R_B = background count rate for "clean" surface or unused sampling media (CPM).

ε_t = total detection efficiency (counts/emission).

CF = conversion factor (2.22E+06 DPM/µCi) (applicable to air filter samples only).

A = areal dimensions (cm^2) of active probe area (for static surface counts) or of the area swipe tested (for removable contamination). To calculate surface activity in conventional units of DPM/100 cm^2, replace the value of A in the above formula with the ratio A/100 (see Section 6.6.1 of MARSSIM; NRC, 2000).

V = volume of air sampled (mL) (applicable to air filter samples only).

4.6. Documentation and Records Retention

The RSO and RST will retain all instrument QC function check forms for at least three years from the date the record was created. Air monitoring data, dosimetry records and contamination survey results will be maintained along with all RWP documentation until license termination. This includes all radiological monitoring and survey forms that apply under applicable SOPs.

5. REFERENCES

Higby, D.P. 1984. Effects of Particle Size and Velocity on Burial Depth of Airborne Particles in Glass Fiber Filters. PNL-5278 UC-41. Pacific Northwest Laboratory.

Rio Grande Resources (RGR). 2020. Radiation Protection Program Manual. Revision 4. May 22, 2020.

International Organization for Standardization (ISO). 1988. Evaluation of Surface Contamination – Part 1: Beta-emitters (maximum beta energy greater than 0.15 MeV) and Alpha-emitters.

Terry, K.W. 1995. Alpha Self-absorption in Monazite Dusts. Health Physics, Volume 69, Number 4: pages 553-555. October 1995.

U.S. Nuclear Regulatory Commission (NRC). 2000. Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM), Revision 1. NUREG-1575 (amended in 2002). Washington, D.C.

6. ATTACHMENTS

- Form SOP-2A: Instrument Function Check Form

Form SOP-2A

Instrument Function Check Form

METER	
Manufacturer:	
Model:	
Serial No.:	
Cal. Due Date:	

DETECTOR	
Manufacturer:	
Model:	
Serial No.:	
Cal. Due Date:	

Location:
Geometry:
Comments:

Alpha Source: __________ SN: ____________________ 2π Emission Rate: ________ EPM* Calibration Date:_________________ Distance to Source (cm): __________

Beta Source: __________ SN: ____________________ 2π Emission Rate: ________ EPM* Calibration Date:_________________ Distance to Source (cm): __________

Gamma Source: __________ SN: ____________________ Source Activity: ________ µCi Calibration Date:_________________ Distance to Source (cm): __________

*Emissions per minute (EPM) = 2π Emission Rate stated on calibration certificate (in CPM).

Net (above background) Control Limits:

Low - High α (CPM) ______________________ Low - High β (CPM) ______________________ Low - High γ (µR/hr)______________________

Date	Battery OK?	Alpha (CPM)			Alpha Inst. Efficiency*	Beta (CPM)			Beta Inst. Efficiency*	Gamma (µR/hr)			Initials
		Source	BKG	Net		Source	BKG	Net		Source	BKG	Net	

*Instrument counting efficiency = net Count Rate (CPM) / 2π Emission Rate (EPM) = Counts/Decay

Reviewed by: ____________________________ **Review Date:** __________________________

SOP-3 *Radiological Contamination Surveys*

Version History	Date
2017 RML renewal	12-04-2017
Revision 1	05-20-2019
Revision 2	11-19-2019
Revision 3	04-01-2020
Revision 4	05-22-2020

Distribution
Facility Manager Radiation Safety Officer Radiation Safety Technician Radiation Protection Program Manual

1. PURPOSE

This Standard Operating Procedure (SOP) describes the procedures for conducting radiological contamination surveys for personnel and equipment at the Mount Taylor Mine (Site). Also provided are decontamination procedures in the event that regulatory and/or administrative limits given in Table 2 of the Radiation Protection Program (RPP) Manual (RGR, 2020) are not met.

2. DISCUSSION

This SOP covers several types of radiological contamination surveys that may be required including fixed or removable contamination consisting of alpha, beta and/or gamma radiation(s) on personnel or equipment (or some combination thereof). Before leaving the Site, radiological contamination surveys are required for all personnel and equipment that are significantly exposed to, and/or in direct contact with, radioactive materials within Controlled or Restricted Areas of the Site.

3. RESPONSIBILITY

- Facility Manager – responsible for reviewing and approving the RPP, SOPs, and RWPs, and providing the resources necessary to implement these radiological protection and monitoring documents (e.g. instrumentation and related equipment, training, etc.).
- Radiation Safety Officer – responsible for developing the RPP, SOPs, and RWPs, and selecting the appropriate types of radiological surveys or monitoring required along with the instrumentation or equipment needed.
- Radiation Safety Technician – responsible for onsite management and implementation of daily instrument QC checks, radiological surveys, documentation, etc. The RST role may be filled by a temporary designee at the discretion of the RSO, provided that the individual is qualified by previous experience and sufficient on-the-job training is received.
- Site Workers – responsible for receiving hands-on instruction in the operation and use of instruments for personnel contamination surveys and occupational exposure monitoring as required under the RPP and/or RWP.

4. CONTAMINATION SURVEY PROCEDURE

4.1. Equipment and Materials

- Radiation survey instruments as specified in the RPP, SOP or RWP.
- Materials and equipment as needed for instrument function checks and efficiency determinations (per SOP-2).

- Removable surface contamination swipe (smear) sampling pads (if applicable under RWP).
- Field logbook and/or Radiological Survey Form SOP-3A (attached) to document survey results.
- Camera (e.g. cell phone camera) to document equipment being released and identify the locations surveyed on a photo diagram as indicated on Form SOP-3A (attached).

4.2. Preliminary Measurements

Before a contamination survey is conducted, preliminary measurements are required to verify and document proper instrument response performance (function checks), and to determine instrument counting efficiency (number of counts detected per radioactive emission), where applicable. These measurements and calculations will be performed in accordance with applicable specifications of SOP-2 (Instrument Testing and Calibration).

4.3. Equipment Release Surveys

Equipment release surveys consist of scans, static measurements and removable swipe testing to identify and quantify radiological contamination from alpha, beta and gamma radiations.

4.3.1. Release Criteria

RGR administrative limits for surface contamination, regulatory release limits for unrestricted future use, and contamination limits for UN2910 excepted packages[1], are given in Table 3-1. Equipment that meets the release limits for total and removable alpha activity on surfaces from Table 3-1 will meet U.S. Nuclear Regulatory Commission (NRC) criteria for unrestricted release from a uranium recovery facility as indicated in U.S. NRC Regulatory Guide 8.30 (NRC, 2002).

Table 3-1: Regulatory and Administrative Contamination limits.

Category	Parameter	Regulatory Limit (1)	Administrative Limit (1)
Contamination Limits	Personnel	1,000 dpm/100 cm^2 (4)	Background
	Equipment Release	5,000 dpm/100 cm^2 (2) 15,000 dpm/100 cm^2 (3) 1,000 dpm/100 cm^2 (4)	200 dpm/100 cm^2, 20 μR/hr
	UN2910 Excepted Packages	24 dpm/cm^2 (5) 240 dpm/cm^2 (6) 500 μR/hr (7)	N/A

(1) Note that limits for personnel and equipment apply only to licensed radioactive materials, but broader application to all radioactive materials is an ALARA goal for Site operations. All limits are net (above background) values.

(2) Average total (fixed plus removable) alpha (or beta) activity across any 1-m^2 area (NRC Reg Guide 8.30).

(3) Maximum total alpha (or beta) activity across any 100-cm^2 area (NRC Reg Guide 8.30).

(4) Removable gross alpha (or beta) surface activity above background (NRC Reg Guide 8.30).

(5) Removable alpha activity on package surface (average across 300 cm^2 area).

(6) Removable beta/gamma activity on package surface (average across 300 cm^2 area).

(7) Gamma exposure rate on contact with package.

[1] For shipping small quantities of radioactive material (e.g. samples for laboratory analysis).

4.3.2. Calculation of Surface Activity for Alpha or Beta Radiation

Once measurements of the count rate (cpm) for total (fixed + removable) contamination or removable contamination (swipe samples) have been taken, the measured count rate must be converted to units of surface activity for comparison against the limits given in Table 3-1. The formula for calculation of surface activity is given by Equation 3-1.

$$C = \frac{R_S - R_B}{\varepsilon_t\left(\frac{A}{100}\right)}$$ **Equation 3-1**

Where:

C = surface activity concentration (dpm/100 cm^2).

R_S = detector count rate for the surface or sampling media (cpm).

R_B = background count rate for "clean" surface or unused sampling media (cpm).

ε_t = total detection efficiency (counts/decay) as determined in SOP-2 (Equation 2-2).

A = areal dimensions (cm^2) of active probe area (for static surface counts) or of the area swipe tested (for removable). Note that replacing the ratio A/100 in the above formula with the value of "A" alone will give the activity in units of dpm/cm^2.

4.3.3. Gamma Scans

Equipment that has the potential to contain residual radioactive materials in interior void spaces (sample packaging, piping, tanks, machinery, etc.) requires a gamma exposure rate scan. All accessible surfaces should be scanned with the detector on or in close contact with surfaces of any item to be released for unrestricted use, or for UN2910 shipping. Investigate any areas with clearly elevated readings, including subsequent alpha/beta measurements. Results must be documented on the Equipment Release Survey Form (Form SOP-3A [attached]).

If the net measured exposure rate across accessible surfaces is less than 20 µR/hr above background, the item is a candidate for unrestricted release provided that it also meets the alpha and/or beta surface contamination limits given in Table 3-1.

For samples of radioactive material that will be shipped to a commercial laboratory under UN2910 excepted package protocols, the net exposure rate must be less than 500 µR/hr at any point of contact.

4.3.4. Alpha/Beta Scans for Total Surface Activity

All equipment, vehicles or materials that could potentially become radiologically contaminated when working in Controlled or Restricted Areas shall be surveyed for radioactive surface contamination and results evaluated against applicable release criteria specified in Table 3-1. Consistent with specifications found in NRC Regulatory Guide 8.30 (NRC, 2002), surveys for alpha activity alone are normally sufficient to demonstrate compliance with release limits at uranium recovery facilities.

However, items with the potential for penetration of contamination below the surface, or if items to be surveyed are wet (e.g. due to decontamination, rain or snow), should also be surveyed for beta activity. Examples include items comprised of wood or other porous material, items that have been in contact with water in water treatment and runoff control ponds, and tanks or pipes that may contain scale or solid residues from mine water treatment. If in doubt, also perform a beta contamination survey. Note that instruments prescribed by the RSO may allow simultaneous alpha/beta surveys. Contact the RSO if questions regarding instrument selection and/or use arise when performing contamination surveys required under the RWP.

1. General Considerations for Equipment Release Surveys:

   a) If equipment to be released has been washed or is otherwise wet prior to surveying, allow the equipment to dry if feasible. Alpha particles will not penetrate a layer of water on the equipment. If drying is not feasible, a beta survey can be used in place of an alpha survey, though results may not be as reliable as minimum detectable concentration (MDC) limits for betas generally cannot be met with normal count times (e.g. 1 minute count measurements).

   b) Using Form SOP-3A (attached), document the location where the equipment was used, description of the equipment, name of the RST conducting the release survey, release survey date, and the specific components of the equipment and/or location(s) surveyed (a photo diagram on the second page of the form with annotated location ID numbers corresponding to the locations listed on page 1 is requested but not mandatory). In addition, document the information regarding each radiological survey instrument used including the serial number, calibration date, instrument background (at the survey location), and the total detection efficiency (ε_t) as determined under SOP-2 (Instrument Testing and Calibration).

2. Total (Fixed + Removable) Surface Contamination Survey:

   a) Scan for total alpha activity (and total beta activity if appropriate) on accessible surfaces of potentially contaminated items by placing the detector approximately 0.5 cm from the surface, moving the detector over the surface at about 2 cm per second or less.

   b) If elevated counts are detected while scanning (relative to background levels), take a static 1-minute scaler count where highest elevated counts were observed. If no elevated counts observed while scanning, then select location(s) based on potential likelihood for contamination and make a 1-minute scaler count at each location.

   c) The number of static measurement locations must be sufficient to adequately represent the entire item being surveyed. For each static measurement, record the location and resulting scaler count rate on Form SOP-3A (attached).

   d) For each static measurement location, convert the measured net survey count rate (in cpm) to units of total surface activity (dpm/100 cm^2) using Equation 3-1 (Section 4.3.2). Record the result on Form SOP-3A (attached) in the column labeled Total Alpha Activity (and Total Beta Activity if appropriate).

3. Removable Surface Contamination Survey:

   a) If the total (fixed + removable) surface activity for alpha radiation (as measured in Step 2 above) is less than the removable limit (1,000 dpm/100 cm^2) across all scanned surfaces, a swipe test for removable alpha contamination is technically unnecessary. Note that this consideration does not apply to removable swipe testing of packages used to ship samples containing radioactive materials under UN2910 excepted package protocols (i.e. swipe testing is always required for shipment of radioactive materials).

   b) If the total measured surface activity exceeds the removable limit anywhere on the equipment being surveyed, swipe testing shall be performed in areas with the highest scan readings, along with several other locations as needed to provide representative coverage of accessible surfaces. At each location, swipe test an area of 100 cm^2 (approximately 4 x 4 inches) and subsequently count the sample to determine the removable alpha activity. Note that for UN2910 shipping container surveys, the area to be swipe tested is 300 cm^2.

c) Ideally, swipe samples are counted with an instrument that has an attached or built-in sample counting tray (e.g. Ludlum Model 2929 scaler with Model 43-10-1 detector or a combined Model 3030 sample counting instrument), but a portable alpha/beta survey detector may also be used provided the meter includes appropriate dual channel scaler counting capability (e.g. Ludlum Model 2360 scaler with 43-93 alpha/beta detector). In the latter case, a simple makeshift counting jig can be used to provide a consistent measurement geometry for sample counting, instrument efficiency determinations, and daily function checks. Such a counting jig, where the plastic detector cover is used to maintain a consistent distance of about 0.5 cm between the detector and the sample or check source, is shown in Figure 3-1.

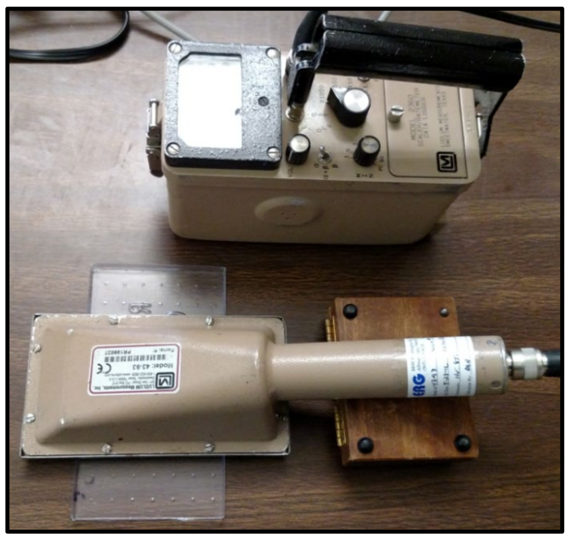


Figure 3-1: Example fixed-geometry measurement jig using a Ludlum 43-93 survey probe (to count swipe samples, determine instrument efficiency, and to perform daily QC function checks).

e) Once the swipe sample has been counted, convert the measured count rate (in cpm) to units of removable gross alpha surface activity (dpm/100 cm^2) using Equation 3-1 (Section 4.3.2).

f) Record the result in the column labeled Removable Alpha Activity on Form SOP-3A (attached).

4. <u>Swipe Testing for UN2910 Shipping Packages:</u>

The procedure for swipe testing UN2910 shipping packages is the same as indicated above for equipment release surveys except for the following: 1) the areal basis for swipe testing is 300 cm^2, 2) a swipe removal efficiency value of 0.1 must also be applied, in addition to the applicable total efficiency (ε_t) value given in SOP-2 (see Equation 2-2), 3) applicable limits differ, and 4) results of the surveys should be recorded on Form SOP-3B (UN2910 Shipping Package Survey Form) (attached).

4.4. Personnel Exit Surveys

Personnel working with potentially contaminated equipment and/or materials within Controlled or Restricted Areas are required to scan their clothing, exposed skin, and shoes prior to leaving the Site. All workers will be instructed in the use of the survey instruments, performing a proper personal exit survey, and documenting results on the Personnel Exit Survey Form (Form SOP-3C). Basic steps for personnel exit surveys are as follows:

- While holding an alpha detector approximately 0.5 cm from the surface to be scanned, survey at a rate of approximately 2 cm per second or less, paying attention to the audible output (clicks) and/or analog dial response or digital display readings.
- If audibly or visually elevated counts (relative to background) are observed while scanning, pause at that location to confirm whether the counts are at background levels or above.
- If count rate is at background levels, continue with the survey.
- If count rate exceeds the background level, carefully scan around the location to determine the extent of the elevated readings. Note the area for subsequent decontamination and continue scanning until the survey is completed.
- If above-background contamination is identified, the decontamination procedures in Section 5 of this SOP will be followed as applicable.
- If radioactivity above background persists after decontamination, and the applicable regulatory limits in Table 3-1 cannot be met with standard decontamination procedures (Section 5), contact the RST or RSO for further advising.

The administrative release limit for personnel exit surveys, commonly known as an “Action Level”, will be determined each day by the RST for each survey instrument to be used based on the maximum ambient “background” count rate observed at the personnel exit survey location, multiplied by a factor of 1.5 to account for natural diurnal fluctuations in background radon progeny levels. This target “Action Level” will be labeled at the top of the Personnel Exit Survey Form provided for the day (Form SOP-3C; attached). Personnel must acknowledge and document that they have performed a personnel exit survey by providing the date, name, company, any special notes regarding the survey, and to confirm that the release limit was met by initialing the Personnel Exit Survey Form in the indicated column.

4.5. Documentation and Records Retention

The RSO and RST will retain all completed Survey Forms (Forms SOP-3A, SOP-3B and SOP-3C) and associated QC data (from SOP-2), and will maintain these records for at least three years from the date the record was created.

5. DECONTAMINATION

5.1. Overview

While generally unlikely at the Mount Taylor Mine, the surfaces of equipment, vehicles, personnel protective equipment (PPE), clothing or skin could potentially become contaminated in excess of administrative action levels or regulatory release limits. In such cases, decontamination is required before releasing the person and/or equipment from the Site. This procedure describes the methods for decontamination.

5.2. Decontamination Facilities and Equipment

There is not currently a designated area for decontamination of equipment or personnel at the Site. In the unlikely event that contamination above release limits occurs, the quantity of liquid/solid residues generated from the decontamination process will be negligible relative to the large quantities of unlicensed radioactive materials stored in former waste rock dumps, the ore stockpile, new waste repository, and sediments in ponds used for mine water treatment and retention of stormwater runoff from the Site. By design, all stormwater runoff and entrained sediments from the Site are intercepted in diversion channels and will eventually drain into a runoff/sediment retention pond. Here, sediments that may include unlicensed TENORM will settle out and remain isolated from the active surface environment. This sediment capture and retention system minimizes potential human exposures and prevents offsite migration of TENORM-bearing sediments. For these reasons, any suitable location at the Site (e.g. a location with a water supply and drain/sump features) may be used to decontaminate equipment and personnel.

Once a decontamination area is selected, the same location should be used for this purpose until mine operations are terminated, the decontamination area is cleaned up and reclaimed, and radiation control procedures are no longer required. A source of clean water and common tools for washing or other means of removing contaminated residues from the surfaces of equipment or personnel will be provided as needed to attain compliance with applicable release limits. The following is a list of decontamination equipment and materials:

- Personal protective equipment, including Level D work clothing, Tyvek coveralls, rubber boots, nitrile gloves, etc. as required.
- Decontamination equipment and materials, as required (e.g. clean water supply, mild biodegradable detergent, pressure washer, brushes, double-sided sticky tape, etc.).
- Container(s) for radioactive residues and waste materials from decontamination activities as required.

5.3. Decontamination Methods:

- Use of scrapers or brushes can be effective for removing gross accumulations of dirt or mud on equipment, vehicles, and PPE. Stiff-bristled brushes or other abrasive removal methods should not be used for skin to avoid damaging the skin and creating a potential pathway for absorption of radiological contamination into the bloodstream.
- Decontamination with water (e.g. washing skin, pressure washing dirt/mud from equipment, etc.) is effective for most contamination likely to be present at the Site. Mild, biodegradable soap or detergent can increase the effectiveness of water as a decontamination agent.
- Disposable wet-wipes or double-sided sticky tape can be effective for removing small amounts of removable contamination or short-lived radon decay products from skin or clothing.

5.4. Personnel Decontamination

If radioactive surface contamination exceeding the administrative limit (above background) is identified on skin, clothing or PPE for personnel working under a RWP, decontamination of the affected area(s) must be attempted. Brushing off visible accumulations of dirt or mud may be sufficient for clothing or PPE, but skin should also be gently washed with mild soap and water. All workers will be instructed in the use of the exit survey instruments and performing a proper personal exit survey.

In cases where simple decontamination efforts to remove long-lived radiological contamination (as opposed to short-lived radon decay products) prove ineffective, the RSO or RST must be notified for further advising. The RST will assist the contaminated personnel until the decontamination process has been completed or otherwise terminated. The following are general considerations to be observed during personnel decontamination activities:

- Administration of first aid for immediate treatment of serious injuries or illness must take priority over personnel contamination surveys and decontamination considerations.
- Decontamination of serious wounds (other than minor cuts or abrasions) shall be performed by professional medical personnel.
- Minor wounds (cuts, abrasions, etc.) can be flushed with lukewarm water and mild soap.
- Use protective clothing (e.g. gloves) as necessary when decontaminating personnel to prevent inadvertent secondary spread of contamination.
- The mildest methods of decontamination should be attempted first, progressing to harsher methods when necessary. Cleansing methods, from the least to most harsh are listed below:
    - Flushing with water
    - Soap and warm water
    - Mildly abrasive soap, soft brush, and water

5.5. Decontamination of Personal Clothing or Articles

- Decontamination of clothing or personal articles may be performed by the individual under the direction of the RST and in accordance with this procedure.
- Personal clothing or items may be released when surveys indicate that surface activity meets the administrative limit provided at the top of the Personnel Exit Survey Form (Form SOP-3C). If decontamination does not result in compliance with the administrative limit, the worker and personal effects may be released provided that the regulatory limit (1,000 dpm/100 cm^2) is not exceeded.

  Special Note: Short-lived airborne decay products of radon gas (progeny) can readily adhere to clothing, particularly fleece and polyester materials. Radon progeny may produce false positive readings on personnel exit surveys. Radon progeny on surfaces are not considered contamination nor a health concern as within several hours, associated radioactivity will decay away. Washing skin and use of double-sided sticky tape rollers (lint removal devices) on clothing can help to remove radon progeny and reduce false positive survey readings for long-lived radionuclides, which are the primary concern. If these measures do not reduce survey readings to acceptable levels, the individual may place affected clothing or item in a sealed plastic bag then resurvey after 20-30 minutes. If readings have measurably decreased, this is a strong indication of radon progeny and the person may leave the Site without need for further decontamination. Alternatively, the article of clothing may be placed in a plastic bag, left onsite, and be resurveyed the following morning to verify that short-lived radon progeny has decayed, and readings have returned to background levels.

5.6. Decontamination of Equipment and Vehicles

- Gross accumulations of dirt or mud on equipment and vehicles shall be removed with a flat bladed scraper, brushes or by pressure washing within the decontamination station.
- Personnel performing decontamination shall wear appropriate PPE as needed (e.g. nitrile gloves, rubber boots, safety glasses, and Tyvek coveralls when using a pressure washer).
- Equipment such as excavators and haul trucks should be cleaned with a pressure washer if required to remove potentially contaminated accumulations of mud or dirt. Care should be taken to adequately clean hard to reach places on complicated pieces of machinery.
- After cleaning and sufficient drying of equipment has been completed, perform appropriate radiological surveys as indicated in this SOP to ensure that the equipment meets applicable criteria for release for unrestricted use as specified in Table 3-1.
- Perform additional decontamination as necessary until applicable limits are met.

6. REFERENCES

Rio Grande Resources (RGR). 2020. Radiation Protection Program Manual. Revision 4. May 22, 2020.

US Nuclear Regulatory Commission (NRC). 2002. Health Physics Surveys in Uranium Recovery Facilities. NRC Regulatory Guide 8.30 (Revision 1).

7. ATTACHMENTS

- Form SOP-3A: Equipment Release Survey Form.
- Form SOP-3B: UN2910 Shipping Package Survey Form.
- Form SOP-3C: Personnel Exit Survey Form.

Form SOP-3A Equipment Release Survey Form

Site: Mount Taylor Mine	**Equipment Use/Location:**	Page 1 of 2
Survey description:	**RWP #**	**DATE:**

Meter / Detector (radiation survey type):	**Detector Area (cm^2)**	**Serial Number:**		**Cal. Due Date:**		**Background** (CPM)		**Total Efficiency** (counts/decay)	
		Meter	**Detector**	**Meter**	**Detector**	**Alpha (α)**	**Beta (β)**	**Alpha (α)****	**Beta (β)****
Model 2360 / 43-93 (α/β)	100								
Model 12 / 44-9 (β/γ)	15.5								
Model 12 / 43-5 (α)	76								
Model 19 (γ)	NA		NA		NA	(µR/hr)		NA	NA
Model 3030 Swipe Counter (α/β)	100								

Contamination Limits: (dpm/100cm²) *		Removable α **1,000** (200)			Removable β **1,000** (200)			Total α **5,000**			Total β **5,000**			**20** µR/hr
Sample No.	Description/ Location	Gross CPM α Removable	Net CPM α Removable	dpm/100cm² α Removable	Gross CPM β Removable	Net CPM β Removable	dpm/100cm² β Removable	Gross CPM α Total	Net CPM α Total	dpm/100cm² α Total	Gross CPM β Total	Net CPM β Total	dpm/100cm² β Total	**Net Gamma** (µR/hr)
1														
2														
3														
4														
5														
6														
7														
8														
9														
10														

REMARKS:

TECHNICIAN SIGNATURE/DATE:

REVIEWER SIGNATURE/DATE:

***Administrative limit given in parentheses**

****Per Equation 2-2 in SOP-2**

Form SOP-3A **Equipment Release Survey Form (continued)**

Site: Mount Taylor Mine	**Survey Locations Diagram**	Page 2 of 2

Insert Photo Diagram or Sketch of Locations Here

Form SOP-3B UN2910 Shipping Package Survey Form

SITE: **Mount Taylor Mine**	PACKAGE DESCRIPTION:		Page 1 of 2
SAMPLE TYPE(S):		PACKAGE #	DATE:

Meter / Detector (radiation survey type):	**Detector Area (cm²)**	**Serial Number:**		**Cal. Due Date:**		**Background (CPM)**		**Total Efficiency (counts/decay)**	
		Meter	**Detector**	**Meter**	**Detector**	**Alpha (α)**	**Beta (β)**	**Alpha (α)***	**Beta (β)***
Model 2360 / 43-93 (α/β)	100								
Model 12 / 43-5 (α)	76								
Model 19 (γ)	NA		NA		NA	(µR/hr)		NA	NA
Model 3030 Swipe Counter (α/β)	100								

Contamination Limits:		**Removable α: 24 DPM/cm²**			**Removable β/γ and α_{LT}**: 240 DPM/cm²**			**Max Gamma: 500 µR/hr**	**Package Diagram with Annotated Survey Locations**
Sample No.	Description/ Location	Gross CPM α Removable	Net CPM α Removable	dpm/cm² α Removable	Gross CPM β Removable	Net CPM β Removable	dpm/cm² β Removable	Exposure Rate (µR/hr) on Contact	
1									
2									
3									
4									
5									
6									
7									
8									
9									
10									

REMARKS:
TECHNICIAN SIGNATURE/DATE:
REVIEWER SIGNATURE/DATE:

***Including addition of a swipe removal efficiency factor of 0.1 (i.e. $\varepsilon_t \times 0.1$; see SOP-2, Equation 2-2)**

****α_{LT} = Low toxicity alpha emitters**

Form SOP-3C Personnel Exit Survey Form

Date___________________________ Radiation Work Permit No. _______________________________________

Instrument Model Numbers: Detector___________________________ Meter_____________________________

Maximum background alpha surface activity prior to first daily entry into Controlled Area _________cpm[2]

ALARA Action Level = max background_________ (cpm) × 1.5 = __________cpm[3] (if Bkg. ≤ 2 cpm, use 4 cpm)

Regulatory Release Limit = (1,000 dpm/100 cm^2) × (total α efficiency __________cpm/dpm)[4] = ___________ (cpm)

Name (please print)	Company	Max Survey Reading (cpm)	Initials

[2] The RST will determine the maximum background alpha count rate on personal clothing/skin first thing in the morning each day, prior to entry of any personnel into the Controlled Area.

[3] To account for temporal variability in background levels of short-lived radon progeny on clothing/skin, the daily background alpha activity value is multiplied by a factor of 1.5 to determine the daily personal exit survey limit.

[4] Total α efficiency for Ludlum 43-93 is typically 0.1 cpm/dpm (10%)

SOP-4 *Radiological Monitoring for Occupational Exposure*

Version History	Date
2017 RML renewal	12-04-2017
Revision 1	05-20-2019
Revision 2	11-19-2019
Revision 3	04-01-2020
Revision 4	05-22-2020

Distribution
Facility Manager
Radiation Safety Officer
Radiation Safety Technician
Radiation Protection Program Manual

1. PURPOSE

This Standard Operating Procedure (SOP) describes the procedures for monitoring occupational exposure to radioactive materials under the Radiation Protection Program (RPP) at the Mount Taylor Mine (Site). Included are procedures for monitoring of airborne particulate radionuclides, radon gas, radon progeny, and external (direct) radiation in support of occupational radiation dose estimation (where applicable).

2. DISCUSSION

As indicated in the RPP Manual (RGR, 2020), occupational radiation exposure monitoring at the Site is limited to non-routine work conducted under a radiation work permit (RWP) issued by the Radiation Safety Officer (RSO). Routine decommissioning operations at the Site are not expected to involve significant potential for radiological exposures and thus, occupational radiation monitoring is not required for routine operations.

This SOP covers potential forms of radiological exposure monitoring as noted above. The RSO will determine whether one or more forms of monitoring are warranted for a given RWP, depending on the nature of the project work and potential for exposure to radioactive materials through various exposure pathways (external gamma radiation, inhalation or ingestion).

3. RESPONSIBILITY

- Facility Manager – responsible for reviewing and approving RWPs and providing the resources necessary to implement them (e.g. instrumentation and related equipment, training, etc.).
- Radiation Safety Officer – responsible for selecting the types of radiological exposure monitoring required for a RWP, and for specifying the instrumentation needed to perform this monitoring.
- Radiation Safety Technician – responsible for onsite management and implementation of RWPs, including radiological exposure monitoring under the direction of the RSO. The RST role may be filled by a temporary designee at the discretion of the RSO, provided that the individual is qualified by previous experience and sufficient on-the-job training is received.
- RWP Workers – responsible for receiving hands-on instruction in the operation and use of monitoring equipment (e.g. dosimeters and personal breathing zone air samplers) when required under the RWP.

4. RADIOLOGICAL MONITORING PROCEDURES

4.1. Equipment and Materials

Active Air Monitoring

- Properly calibrated battery-powered lapel-type breathing zone (BZ) air sampling pump(s) with intake tube and inlet cassette.
- Appropriate glass-fiber or membrane type air sampling filters.
- Tweezers for handling air sampling filters.
- Envelopes for containing and labeling individual filter samples to be counted.
- Air-tight resealable plastic bags to store and transport air filters and air sampling intake cassettes (to minimize potential for contamination of sample filters before or after the air sampling period).
- Suitable instrumentation and check source for measurement of alpha emissions from air filters as specified by the RSO (see SOP-2, Instrument Testing and Calibration).
- Electronic spreadsheet for entering air sampling and filter counting data with automated calculation of airborne uranium and radon progeny concentrations.
- Field logbook for documenting work activity/personnel to be monitored, along with date and pump start/stop times.

Passive Radon Monitoring

- Passive alpha track-etch radon detectors (high-sensitivity Rapidos® detectors from Radonova).

External Occupational Dose Monitoring

- Optically Stimulated Luminescence (OSL) dosimeters (e.g. Luxel® from Landauer) or self-reading pocket dosimeters for occupational dose rate monitoring.

4.2. Active Radiological Air Monitoring

There are two general types of radiological air monitoring that may be required by the RSO: active and passive. Active air monitoring utilizes lapel-type BZ air samplers with battery operated air pumps that are worn by representative workers (Figure 4-1). Personal BZ air monitoring is used for two objectives including: 1) sampling for radioactive air particulates (long-lived radionuclides), and 2) sampling for short-lived airborne radon decay products (progeny). This Section provides procedures for active monitoring for air particulates (Section 4.2.1) and radon progeny (Section 4.2.2). Passive radiological air monitoring for radon gas includes long-term monitoring with time-integrating alpha track-etch detectors to measure average radon gas levels (see Section 4.3).

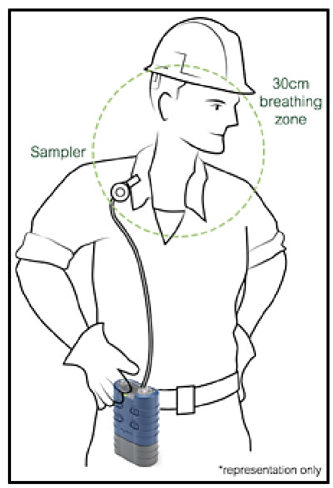


Figure 4-1: Portable BZ air sampler.

4.2.1. BZ Sampling for Airborne Particulate Radionuclides

The breathing zone of a worker is the air around the nose and mouth area. When properly worn, a BZ air sampler is designed to collect a representative sample of air inhaled by the worker for the duration of the monitoring period.

Steps for BZ air monitoring:

- When BZ air sampling is required by the RWP, not all workers need be monitored unless directed otherwise by the RSO. A single worker having the greatest potential for inhalation exposures is generally sufficient for BZ monitoring to conservatively represent all worker exposures for a given RWP activity.
- Prior to loading the filter in the filter mounting cassette for a BZ sampling event, mark a small dot with an ink pen on the influent (collection) side of the filter to avoid subsequently counting of the wrong side of the filter for gross alpha emissions. Note that filter holder cassettes are available with pre-loaded 37 mm filters (photo at right) to minimize the potential for contamination of the filter due to plate-out of ambient radon progeny or from multiple handlings of the filter itself.

Figure 4-2: Pre-loaded BZ air filter cassettes.

- To open the cassette, use a coin or a screwdriver to gently pry the lid upwards from the assembly, taking care not to damage the plastic cassette.
- Use tweezers to load the filter in the cassette (if not pre-loaded) and gently insert the lid back in place to secure the filter (do not apply excessive force). Remove the inlet/outlet plugs for monitoring, but save for re-plugging the cassette chamber at the end of the monitoring period (prior to transport to the onsite filter counting location).
- Position the filter cassette as close to the worker's breathing zone as possible without interfering with the work to be done. Attach the sampler head to the worker's collar or chest area with the filter head facing downwards.
- Start the pump just prior to the worker entering the work area and record in the field logbook the name of the monitored worker, date, pump start time and pump flow rate. When starting up the air sampling pump, be sure the indicated flow rate is set at the maximum value of 3 liters per minute (LPM) to maximize the volume of air sampled (helps to increase measurement sensitivity). Note the cassette inlet/outlet plugs must be removed to allow for air to flow through the cassette.
- At the end of the BZ sampling period, turn off the pump, remove the filter cassette from the flexible connector tube and re-plug the inlet/outlet openings to the cassette chamber at the end of the monitoring period (prior to transport and delivery to the RST for subsequent sample analysis at the designated filter counting location). Record the pump stop time/date.
- If a BZ-monitored individual temporarily leaves the work area (e.g. for lunch or breaks), leave the air sampler pump running and temporarily store the pump/cassette assembly on a clean, dry shelf at a designated indoor location.
- Prior to onsite analysis of a BZ filter sample, the RST shall ensure that all necessary information concerning the sampling event is documented in the field logbook, including:
  - ✓ Date of sampling event.
  - ✓ Name of the monitored individual and description of the location/task being evaluated.

- ✓ Pump start/stop times (in military time format).
- ✓ Beginning/ending flow rate.
- ✓ Name of the RST responsible for collecting/measuring the sample.

<u>Analysis of BZ Air Filter Samples</u>:

- To avoid potential interference of short-lived radon progeny when counting the filter sample for gross alpha activity, the RST must wait at least 5 hours before counting the sample (to allow sufficient decay of radon progeny). During this waiting period, the filter sample should remain in the cassette with the ends plugged (or the cassette placed in a plastic bag zipped shut to prevent exposure of the filter to outside air).
- After the radiological decay period as noted above, remove the sampling filter from the cassette with tweezers (avoid touching the filter with hands). Place the filter sample into the measurement counting planchet with the ink-dot-marked side of the filter facing upwards (towards the detector), then place the counting planchet into the counting tray or a makeshift counting jig as previously described.
- Referring to the field logbook notes, record the date, sample location/worker name, and start/stop time (in military time format) in the Air Particulate Calculation Spreadsheet developed and provided by the RSO (all cells highlighted in blue require user input data).

  CAUTION: Do not attempt to edit or manipulate the calculation formulas contained in white cells of the spreadsheet as these formulas are designed to automatically calculate the correct air concentration, percentage of the derived air concentration (DAC) and minimum detectable concentration (MDC) for each individual measurement.

- Perform the following sample measurement steps as indicated in the Air Particulate Monitoring spreadsheet:
  1. In the indicated columns, enter the certified Th-230 alpha source emission rate (as listed on the calibration certificate for the source), then count the alpha source for 1 minute and enter the count rate (CPM). See SOP-2 for more details on the use of and quality control for radiation counting instruments.
  2. Count a blank (clean) filter for 5 minutes and enter number of background counts in the indicated column.
  3. Count air sample filter for 5 minutes, then enter number of "gross" counts the indicated column.
  4. Enter any remaining air sampling input data (blue cells).
- Note that for BZ air sampling, NRC Regulatory Guide 8.25 (NRC, 1992) indicates that "lapel samplers may not be able to detect uranium concentrations of 10% of the DAC, but lapel samplers are still acceptable for measuring the uranium intake of workers". In this case, 10% of derived air concentration (DAC) for uranium ore dust is equivalent to 6E-12 µCi/mL.
- In the event a sampling result returns a percentage of the DAC value greater than 10%, recount the sample. If the elevated counting result persists, the original counting result will be considered the official result. If not, the recount will be considered the official result. If measured gross alpha activity in air filter samples exceeds 10% of the DAC over several consecutive days of sampling events (as indicated in the air monitoring spreadsheet), gather

all known information related to the subject sample collection events and contact the RSO for further instruction (could be indicative of a trend that requires investigation and/or follow-up sampling or analysis).

4.2.2. Sampling for Airborne Radon Progeny

Measurement of radon progeny involves grab sampling of air with a BZ sampler, followed by analysis of the air filter sample for alpha activity to calculate the concentration of radon decay products (in units of "working level" [WL]). The procedure for measurement of radon progeny as described below is based on the modified Kusnetz Method as described in the Canadian Nuclear Safety Commission guidance document: Measuring Airborne Radon Progeny at Uranium Mines and Mills, Regulatory Guide G-4 (CNSC, 2003) and in NRC Regulatory Guide 8.30 (NRC, 2002). The steps are described below, and the formulas contained in the Air Monitoring Spreadsheet for radon progeny measurements (to be provided by the RSO) are based on those indicated in the guidance cited above.

Use of Lapel-type Air Samplers for Radon Progeny Measurements:

- Prior to loading the filter in the filter mounting cassette for a radon progeny sampling event, mark a small dot with an ink pen on the influent (collection) side of the filter to avoid subsequently counting of the wrong side of the filter for gross alpha emissions. Note that filter holder cassettes are available with pre-loaded 37 mm filters (photo above) to minimize the potential for contamination of the filter due to plate-out of ambient radon progeny or from multiple handlings of the filter itself.
- To open the cassette, use a coin or a screwdriver to gently pry the lid upwards from the assembly, taking care not to damage the plastic cassette.
- Use tweezers to load the filter in the cassette (if not pre-loaded) and gently insert the lid back in place to secure the filter (do not apply excessive force). Remove the inlet/outlet plugs for monitoring, but save for re-plugging the cassette chamber at the end of the monitoring period (prior to transport to the onsite filter counting location).
- At the desired location and time of day, collect a 5-minute air sample at a pump flow rate of 3 liters per minute.
- At the end of the radon progeny air sampling period, turn off the sampling pump and note the following information in the field logbook:
    - ✓ Date of sampling event.
    - ✓ Location of sampling event (with location ID number, if applicable).
    - ✓ Pump start/stop times (in military time format).
    - ✓ Flow rate.
    - ✓ Name of the RST responsible for collecting/measuring the radon progeny sample.
- Upon completion of a radon progeny sampling event, plug the inlet/outlet openings of the cassette (or simply place in a sealed and labeled plastic baggie) and label the cassette with the sample ID number to match the field logbook information listed above. Transport the sealed filter sample back to the RST office for sample counting/analysis.

Analysis of Air Filter Samples for Radon Progeny Measurements:

- As with measurement of BZ filter samples for air particulates, the RSO will supply a Radon Progeny Air Monitoring Spreadsheet for calculation of radon progeny levels based on gross alpha counting of the radon progeny air sampling filters.
- After collecting the progeny sample on the BZ filter, and while waiting for the sample decay time to elapse as noted below, determine the gross alpha counting efficiency and background count rate from a clean (unused) filter paper[1]:
  1. Enter Th-230 plate source activity (DPM) in the indicated column of the Radon Progeny Air Monitoring spreadsheet, then count the Th-230 plate source for 1 minute and enter the measured count rate (CPM) in the indicated column in the Radon Progeny Air Monitoring Spreadsheet.
  2. Count a blank (clean) filter for 5 minutes, then enter the measured number of "background" counts the indicated column in the Radon Progeny Air Monitoring Spreadsheet.
- After the appropriate radiological decay period for radon progeny sample analysis (between 40-90 minutes after the midpoint of the 5-minute radon progeny sampling period), remove the filter sample from the sampling cassette with tweezers and place the filter in the counting planchet, then place the planchet in the counting tray or makeshift counting jig as previously described. Be sure to face the previously ink-marked-dot side of the filter sample (the sampling intake side of the filter) upwards in the counting planchette (facing the detector).

  CAUTION: Avoid touching the inside of the filter holder cassette or filter with anything other than tweezers to avoid potential contamination of the filter sample.
- At the beginning of the 5-minute counting interval for the air sample filter, record the counting start time in the spreadsheet. At the end of the counting interval, enter the measured number of "gross" alpha activity counts in the indicated column of Radon Progeny Air Monitoring Spreadsheet.
- Enter any remaining air sampling input data in the Radon Progeny Air Monitoring spreadsheet (blue cells).

  CAUTION: Do not attempt to edit or manipulate the calculation formulas contained in white cells of the spreadsheet as these formulas are designed to automatically calculate the correct radon progeny WL concentration and percentage of the DAC for each individual measurement.
- Once all blue cells in the spreadsheet have had the appropriate data entered, the spreadsheet automatically calculates the measured concentration of radon progeny [in units of working level (WL)], along with the percentage of the DAC for radon progeny in equilibrium with their radon-222 gas precursor.
- If measured radon progeny concentrations exceed 10% of the applicable DAC over several consecutive days of sampling events (as indicated in the Air Monitoring Spreadsheet), gather all known information related to the subject sample collection events and contact the RSO

[1] See SOP-2 for more details on the use of and quality control for radiation counting instruments.

for further instruction (could be indicative of a trend that requires investigation and/or additional follow-up sampling).

4.3. Passive Radon Monitoring

Rapidos® Alpha track-etch detectors from Radonova (or equivalent) are used for routine monitoring of long-term ambient radon gas (Rn-222) concentrations in air at representative terrestrial environmental radiation monitoring locations (see SOP-6 for details). Most of these locations (Figure 4-3) are situated within operationally Controlled Areas of the Site, and as such, resulting radon data can be used to evaluate potential occupational exposures and doses.

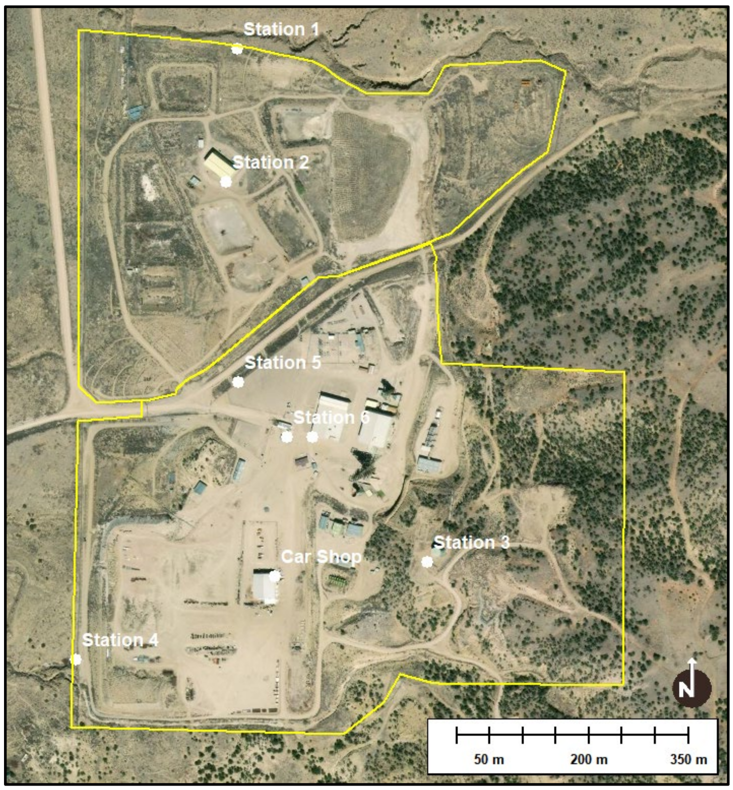


Figure 4-3: Terrestrial environmental radiation monitoring locations across operationally Controlled Areas at the Site.

While unlikely for relatively short-term work conducted under a RWP, additional radon monitoring may be required at the discretion of the RSO. At each radon monitoring location, a single high-sensitivity "Rapidos" track-etch detector from Radonova is deployed during the monitoring period. Each batch of Rapidos detectors comes equipped with three trip control detectors, to be opened and shipped back to Radonova with all field detectors at the end of a given monitoring period. At the beginning of a new radon monitoring period, mount the new Rapidos detector in the special housing designed to protect the detector from damage due to weather or other environmental factors (e.g. moisture intrusion can compromise detector performance). Record on the detector deployment logsheet (provided by vendor) the detector serial number, starting date, ending date, and the detector field location and field ID number for each detector.

After the monitoring period, collect and send the radon track-etch detectors, opened transit control detectors, and completed detector logsheet back to the vendor for analysis. Retain a copy of the logsheet on file for future reference. Results shall be reported to the RSO for evaluation. The RSO will discuss results any radiological concerns with the Site Manager and as appropriate, with individual workers (radiological dose information is considered private information, not to be shared with anyone other than Site management and if warranted, with applicable regulatory agencies).

4.4. External Dose Monitoring

If required under a RWP, workers will be issued optically stimulated luminescent (OSL) dosimeter badges or similar integrating dosimeters (e.g. “pocket” ionization chambers or digital solid-state dosimeters) as specified in the RWP. Alternatively, measurements of external gamma exposure rates in the Restricted Area (as defined by the RWP) may be taken and used by the RSO, along with estimates of worker occupancy time in the Restricted Area, to calculate estimates of the external dose received during the course of the RWP. The RSO is responsible for evaluation of dosimeter data (or calculation of external dose as noted above) and responding to any unusual results. The procedure for OSL dosimeter badge distribution is as follows:

1. Once an individual has completed the RWP training, an OSL dosimeter badge will be issued along with instruction on the use and care for their assigned dosimeter. Each badge has a unique ID number, and shall be worn only by the individual to whom it is issued.
2. When issuing a dosimeter badge, the RST/RSO will document the date, worker name, company name, and badge ID number on the dosimeter badge logsheet supplied by the dosimetry vendor. This logsheet shall accompany the badges when they are returned to the dosimetry services provider at the end of the quarter or upon termination of the RWP.
3. Dosimeter badges shall be worn between the head and waist (e.g. clipped to a shirt collar, shirt pocket, or on a waist belt). The badge shall be worn at all times while working in Restricted or Controlled Areas that are covered by the RWP.
4. A dosimeter badge storage location will be designated by the RST/RSO at the beginning of the RWP project. This storage location should be in an area with relatively low background level exposure rates, or in a lead box to minimize badge exposures when not being worn in the field. Workers must pick up and drop off their badge at the designated storage location daily.
5. It is the responsibility of workers to wear and properly care for their assigned dosimeter and to report any badge loss to the RST and/or RSO immediately. In the event of a lost dosimeter, a new one will be issued by the RST and any “missed dose” will be estimated by the RSO.

5. REFERENCES

Canadian Nuclear Safety Commission. 2003. Measuring Airborne Radon Progeny at Uranium Mines and Mills. Regulatory Guide G-4. June 2003.

Rio Grande Resources (RGR). 2020. Radiation Protection Program Manual. Revision 4. May 22, 2020.

US Nuclear Regulatory Commission (NRC). 1992. Air Sampling in the Workplace. NRC Regulatory Guide 8.25 (Revision 1).

US Nuclear Regulatory Commission (NRC). 2002. Health Physics Surveys in Uranium Recovery Facilities. NRC Regulatory Guide 8.30 (Revision 1).

6. ATTACHMENTS

- Electronic file containing the Air Monitoring Calculation Spreadsheets for radioactive particulates and/or radon progeny air sampling.

SOP-5 *Transport of Uranium Ore as LSA-1*

Version History	Date
2017 RML renewal	12-04-2017
Revision 1	04-30-2019
Revision 2	11-19-2019

Distribution
Site Manager Radiation Safety Officer Radiation Safety Technician Radiation Protection Program Manual

1. PURPOSE

This Standard Operating Procedure (SOP) describes the steps for conducting radiological dose rate and contamination surveys of haul trucks transporting uranium ore as LSA-1.

2. DISCUSSION

This SOP covers the steps necessary to ensure a haul truck carrying uranium ore meets the DOT requirements to transport material as LSA-1. Requirements include personnel training, radiological dose rate and removable contamination surveys, vehicle placarding and marking, and making sure all paperwork associated with the shipment is correct and complete.

3. RESPONSIBILITY

- Facility Manager – responsible for reviewing and approving SOPs.
- Radiation Safety Officer (RSO) – responsible for development and approval of SOPs and oversight of procedure implementation.
- Radiation Safety Technician – responsible for onsite management and implementation of this SOP, including daily instrument QC checks, radiological surveys, documentation, etc. The RST role may be filled by a temporary designee at the discretion of the RSO, provided that the individual is qualified by previous experience and sufficient on-the-job training is received.

4. TRAINING

Anyone associated with the loading/unloading, transport of, and radiological survey of the trailer must have all appropriate hazardous materials (HAZMAT) shipper training; including knowledge of emergency response information, self-protection measures, accident prevention methods and procedures, and modal-specific training requirements for the shipment of LSA-1 materials.

5. EQUIPMENT AND MATERIALS

- Ludlum Model 19 Micro-R Meter (Model 19), or similar.
- Ludlum Model 2929 with Ludlum Model 43-10-1 Dual-Channel Tray Counter (Model 2929), or similar.
- Radiological check source and materials as needed for instrument function checks and efficiency determinations.
- Removable surface contamination swipe (smear) sampling pads.
- SOP-5A LSA-1 Shipment Survey Form (attached) to document survey results.

6. CONTAMINATION SURVEY PROCEDURE

6.1. Preliminary Radiological Survey Measurements

Function check radiological survey instruments in accordance with applicable specifications of SOP-2 (Instrument Testing and Calibration).

6.2. Shipping Manifest Confirmation

Receive the shipping manifest, as prepared by the haul truck driver. Determine the total amount of radioactivity contained in the ore shipment [expressed as percent uranium oxide (% U_3O_8)] and provide this information along with the measured Transport Index (Section 6.4.1.3) to the driver to complete the shipping manifest. Both values will be determined by the Radiation Safety Technician (RST) and included on Form SOP-5A following radiological release surveys (Section 6.4). Confirm that the manifest is complete and correct.

6.2.1. Must include the Consignor's address. The address for Mt. Taylor Mine is 36 Rio Grande Resources Road, San Mateo, NM 87051.

6.2.2. Must include the Consignee's address. The address for Energy Fuel's White Mesa Mill is 6425 South Highway 191, P.O. Box 809 Blanding, UT 84511.

6.2.3. The words "Exclusive Use Shipment" must be included on the paperwork.

6.2.4. Must include the DOT proper shipping name and description, including:

- 6.2.4.1. Shipping Name: Radioactive material, low specific activity (LSA-I)
- 6.2.4.2. Hazard Class: Class 7
- 6.2.4.3. Identification Number: UN2912
- 6.2.4.4. Packaging: Bulk-Unpackaged
- 6.2.4.5. Quantity: Total amount of radioactivity being shipped in terabecquerels (TBq) and in curies (Ci). *Note: This value is calculated on Form SOP-5A based on the ore grade and measured net weight of ore in the shipment*.
- 6.2.4.6. Radionuclide(s): U-Nat, Pb-210, Po-210, Ra-226, Rn-222, Th-230.
- 6.2.4.7. Form: Solid (Unrefined Uranium Ore)
- 6.2.4.8. Transport Index: The Transport Index (T.I.) will be calculated in Section 6.4.1.3 below.

6.2.5. The emergency contact and phone number need to be included.

6.2.6. The Mine Facilities Manager must certify the shipment by signing and dating the manifest.

6.2.7. Keep a copy of the shipping manifest with the contamination survey log form for the shipment.

6.3. **Visual Vehicle Inspection**

Walk around the trailer and visually confirm and document of Form SOP-5A the following:

6.3.1. The tarp cover assembly and gates must be closed and secured.

6.3.2. There should be no loose or leaking material observed on the trailer. If loose material is identified, then it should be removed.

6.3.3. The words "**RADIOACTIVE – LSA**" and "**FOR RADIOACTIVE MATERIALS USE ONLY**" are stenciled or marked in a visible and conspicuous place on both sides of the trailer on the in 3-inch letters.

6.3.4. If the shipping manifest indicates a quantity greater than 0.053 Ci then the letters "**RQ**" must also be stenciled or marked in a visible and conspicuous place on both sides of the trailer in 3-inch letters.

6.3.5. Each side and end of the trailer shall have a "**RADIOACTIVE"** placard

6.4. **RADIOLOGICAL RELEASE SURVEY**

6.4.1. Dose Rate Measurements

NOTE: The Ludlum Model 19 instrument measures external gamma exposure rate [in units of micro-roentgen per hour (µR/hr)]. For the purposes of this procedure, the measured exposure rate value will be considered equivalent to the tissue-equivalent dose rate [in units of microrem per hour (µrem/hr)], and this dose rate will be divided by 1,000 to obtain the dose rate in units of millirem per hour (mrem/hr) as required by DOT regulations.

6.4.1.1. Walk around the trailer making periodic measurements with the Ludlum Model 19 on the side, top and underneath surfaces. **No point on the external surfaces should exceed 200,000 µR/hr**. Enter the measurement results and locations on the Form SOP-5A Calculator spreadsheet.

NOTE: The maximum reading a Ludlum Model 19 can display is 5,000 µR/hr. If this rate is exceeded, then contact the site Radiation Safety Officer (RSO) for further guidance.

6.4.1.2. Walk around the trailer making periodic measurements 2-meters from the trailer side. **No point on the external surfaces should exceed 10,000 µR/hr**. Confirm on Form SOP-5A Calculator spreadsheet that no readings exceed 10,000 µR/hr.

6.4.1.3. Transport Index – At the location exhibiting the highest gamma rates make a measurement 1-meter from the trailer side. *The Transport Index is equivalent to the millirem measurement. For example: 2 millirem (2,000 µR/hr) at 1-meter away results in a T.I. of 2.0.* Record on Form SOP-5A Calculator spreadsheet the calculated Transport Index. **Provide this value to the driver to compete the shipping manifest.**

6.4.1.4. Make a measurement in the haul truck driver's cab (occupied space) with the Ludlum Model 19. **No point in the cab exceed 2,000 µR/hr**. Confirm on Form SOP-5A Calculator spreadsheet that no readings exceed 2,000 µR/hr.

6.4.2. Removable Contamination Measurements

NOTE: Make enough removable contamination measurements to ensure the trailer has been adequately surveyed.

6.4.2.1. Select locations on the trailer to make removable contamination measurements. Swipes should be selected to identify areas of possible contamination; tires, visible dust, gates, etc.

6.4.2.2. Using a removable contamination swipe, pressing downward on the surface cover an area of 300-cm^2, approximately 2-inches wide by 24-inches long.

6.4.2.3. Count the swipes on the Ludlum Model 2929 with Ludlum Model 43-10-1 tray counter and enter the results on Form SOP-5A Calculator. **No removable contamination measurement may exceed 24 dpm/cm^2 for alpha or 240 dpm/cm^2 for beta-gamma.** The removable activity calculations must take into account the 0.10 removable efficiency. This factor is built into the Form SOP-5A Calculator spreadsheet already.

6.4.3. Survey Documentation

6.4.3.1. Print Form SOP-5A from the Form SOP-5A Calculator spreadsheet.

6.4.3.2. Review and confirm all criteria result in a “PASS” result, and there are no failures. If results are acceptable, sign and date the form. If results are not acceptable then identify what additional information is necessary and/or contact the site RSO for additional guidance.

6.4.3.3. Make a copy of final documentation and provide to the haul truck driver for their records.

6.4.3.4. Attach the shipping manifest copy provided by the haul truck driver to the completed Form SOP-5A and file.

7. TRANSPORTATION EMERGENCY REPONSE PLAN

A Transportation Emergency Response Plan (TERP) for the transport of LSA-1 materials from Rio Grande Resources’ Mt. Taylor Mine to the Energy Fuels’ White Mesa Mill. A well-constructed TERP could prevent a minor incident from becoming a disaster, save lives, prevent injuries, and minimize potential damage to property and the environment. The TERP is included in this procedure as Attachment A.

Form SOP-5A LSA-I Shipment Survey Form

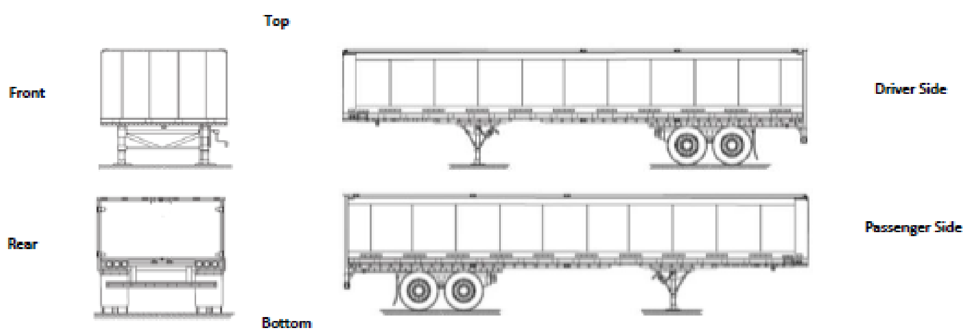
Facility: ____________________ Transport Vehicle ID: ____________________ Date/Time: ____________________

Shipping Container Contents Description: ____ U3O8 Grade: ________%

Has a complete and correct Shipping Manifest been provided?		Yes or No	
Is the tarp cover assembly and tailgate fully closed and secured?		Yes or No	
Is there loose or leaking material observed on vehicle?		Yes or No	
Is the vehicle properly marked and placarded?		Yes or No	
Maximum exposure rate 2-meters from vehicle outer lateral surfaces (µR/hr):		Consignment Limit: 10,000 µR/hr	
Maximum exposure rate vehicle cab-interior (µR/hr):		Limit: 2,000 µR/hr	
Transport Index (T.I.)		T.I. Limit: 10.0	

Instrument Make/Model:						
Instrument Serial No.:						
Calibration Due Date:						
Total Efficiency (cpm/dpm): (2)	Cs-137 Button Source	n/a	alpha:		beta:	
Background (counts):						
MDA (dpm/100-cm²): (4)		n/a				

#	Package/Description	Contact Exposure Rate Limit: 200,000 µR/hr		Remov. Alpha Activity (3) Limit: 24 dpm/cm²		Remov. Beta Activity (3) Limit: 240 dpm/cm²		Meets DOT Limits For Shipping
		Gross (µR/hr)	Net (µR/hr)	Gross Counts	Activity (dpm/100 cm²)	Gross Counts	Activity (dpm/100 cm²)	
1								
2								
3								
4								
5								
6								
7								
8								



Comments:

Technician Signature/Date:

Reviewer Signature/Date:

Notes:

(1) Radiological check sources used:

(2) If instrument function check is within acceptable range then total efficiency number used is based on intial instrument QC counts. The instrument total efficiency is calculated per NUREG 1579; Total Efficiency = Instrument Efficiency X Source Efficiency. Alpha source efficiency and beta source efficiency (for < 400 keV) = 0.25.

(3) Smear removal efficiency of 0.10 used in removable activity calculation.

(4) Calculations rely on user set count times:

ALPHA: Th-230 (s/n:)		2π dpm
BETA: Tc-99 (s/n:)		2π dpm
Remov. SOURCE Count Time:		minute(s)
Remov. BKG Count Time:		minute(s)
Remov. SAMPLE Count Time:		minute(s)

Page ______ of ______

ATTACHMENT A

Transportation Emergency Response Plan

Traffic Accident or Cargo Spill Response Procedure for shipments from Rio Grande Resources’ Mt Taylor Mine to the White Mesa Mill in Blanding, UT

February 2019

Transportation Emergency Response Plan

Table of Contents

1. **Introduction**
2. **Objectives of an Emergency Response Plan**
3. **Planning**
4. **Plan Elements**
    a. Plan Activation
        i. Internal Alerting Mechanism
        ii. Situation Appraisal
        iii. Authority and Resource Mobilization
        iv. Qualifications of Emergency Response Crews
    b. Response Tasks
        i. External Alerting Mechanism
        ii. Cargo Spill Recovery Procedures
        iii. Potential for Exposure
        iv. Required Personal Protection Equipment (PPE)
        v. Cleanup Procedures
    c. Recovered Cargo Disposal
        i. Procedure for Cargo Disposal
        ii. Site Inspection and Cargo Recovery Verification Procedure
        iii. Cleanup Verification
    d. Decontamination of Equipment and Tools
5. **Certification Statement**

<u>Transportation Emergency Response Plan</u>

1. Introduction

A Transportation Emergency Response Plan (TERP) is established to meet the requirements of the US Department of Transportation's (DOT) regulations found at US Code of Federal Regulations (CFR) Title 49, Part 172, Subpart G, transportation and in accordance with Rio Grande Resources' and Energy Fuels Resources' Transportation Policy for shipments of low-grade uranium ore to the White Mesa Mill (Attachment A). A well-constructed TERP could prevent a minor incident from becoming a disaster, save lives, prevent injuries, and minimize potential damage to property and the environment.

Below is a proposed haul route from the Mt Taylor Mine to the White Mesa Mill:

Route ID	Route Description	Approximate Distance (miles)
A	South on State Hwy 605 to Interstate 40	22.2
B	West on I-40 to US Hwy 491	58.7
C	North on US Hwy 491 to US Hwy 160	91.6
D	West on US Hwy 160 to US Hwy 191	55.2
E	North on US Hwy 191 to the White Mesa Mill	50.3

Ore will be transported in over the road 24-ton haul trucks and end dump trailers. Transportation will occur Monday thru Friday. Transportation is limited to 10 trucks.

2. Objectives of an Emergency Response Plan

The objectives of this TERP are:

- To minimize any adverse effects on people, damage to property, or harm to the environmental in a transport emergency;
- To facilitate a rapid and effective emergency response and recovery;
- To aid emergency and security services; and
- To communicate vital information to all relevant persons involved in the transport emergency (both internal personnel and external agencies) with a minimum of delay.

3. Planning

This TERP prepares for the unexpected by identifying response mechanisms to a variety of potential crises arising from the transport of uranium ore. It outlines the necessary resources, personnel and logistics which allow for prompt, coordinated, and rational approach to a transport incident.

4. Plan Elements

The following discusses the elements of the plan as they relate to plan activation, response tasks, recovered cargo disposal, and decontamination of equipment and tools.

a. Plan Activation

This section discusses internal alerting mechanisms, situation appraisal, authority and resource mobilization, and qualifications of emergency response crews.

i. **Internal Alerting Mechanism**

In the event of an accident, the truck driver should notify:

George Barlow, Dispatch
435-212-3290
Daunt Hammon
435-773-3622
George Hammon
435-467-8703

ii. **Situation Appraisal**

Prior to performing any action at an accident, the scene should be quickly evaluated for potential hazards including injuries, fires, fuel spills, downed power lines, traffic hazards, and proximity to streams or rivers. Identified hazards are to be avoided and, if possible, abated as soon as possible. It is recommended that the driver carry a copy of USDOT's current Emergency Response Guidebook and be trained in its use so that he/she can better identify potential hazards and the appropriate response procedures.

Initially, reflective triangles, flares, and volunteer flaggers can be used to control traffic until emergency responders arrive. Professional traffic control measures would be needed for any subsequent clean-up actions.

Contacting the local fire station and/or sheriff's department is often the fastest method for gaining assistance when responding to identified hazards.

A checklist for recording essential information about the incident is provided as Attachment D. This checklist includes the date, time, location, nature of the incident, likely or possible causes of the incident (such as collision with another vehicle or object, equipment failure, sabotage or attack), etc. The situation appraisal will define the critical issues at hand, allow the plan activators to set priorities regarding preventative and corrective strategies, and choose the response required.

iii. **Authority and Resource Mobilization**

The driver, if capable, is responsible for the accident site and related area on public roads or highways until the arrival of the fire department or law enforcement personnel. Once the site has been secured and preliminary investigation is complete, the assigned supervisor of the contracted Emergency Response Team shall be charge of traffic control and cleanup activities. In addition, Rio Grande Resources or Energy Fuels Resources radiation staff will respond and provide technical assistance during cleanup effort.

Hammon Trucking, Inc personnel (as established in the Internal Alerting Mechanism) will notify the following:

Re Grande Resources-Grants, NM

Bruce Norquist, Facilities Manager
505-287-7971
Energy Fuels Resources-White Mesa Mill
435-678-2221

iv. **Qualifications of Emergency Response Crews**
General constructions skills are needed plus experience in the use of radiological monitoring instruments. Emergency response crews should be in proximity to the ore haulage route. If a haulage route is relatively long, different crews may be needed to respond to different sections of the route. The operator should also be aware of preliminary first aid measures.

b. Response Tasks

This section discusses external alerting mechanisms, cargo spill recovery procedures, potential for exposure, required personal protection equipment (PPE), and cleanup procedures.

i. **External Alerting Mechanism**
Hammon Trucking, Inc. personnel in conjunction with Rio Grande Recourse's/Energy Fuels Resource's personnel will notify the police/highway patrol and the fire department depending on route location.

In the event of an emergency the best number to dial is 9-1-1

Useful Phone Numbers	
New Mexico Highway Patrol	505-287-4377
Utah Highway Patrol	435-587-2000
Arizona Highway Patrol	928-697-3325

Useful Phone Numbers	
McKinley County Sheriff's Office (NM)	505-722-7205
San Juan County Sheriff's Office (NM)	505-334-6107
San Juan County Sheriff's Office (UT)	435-587-2237
Apache County Sheriff's Office (AZ)	928-337-4321

Depending on the severity of the incident, on or more state and federal agencies may need to be notified. These notifications would be coordinated by Rio Grande Resources/Energy Fuels Resources personnel and may include both verbal and written requirements. Rio Grande Resources/Energy Fuels Resources will be responsible for contacting environmental protection authorities, federal agencies outside of emergency response personnel, and the media.

ii. **Cargo Spill recovery Procedures**

The procedure for spill recovery is as follows:

- Secure site for Public Safety. Identify potential hazards
  - Set up caution signs and flagmen
- Remove/secure damaged equipment
- Mobilize, within 24 hours, equipment and personnel for cargo spill recovery, to include Rio Grande Resources/Energy Fuels Resources radiation staff.
  - Deploy various equipment as may be required
    - Loaders, front end loader or backhoe, skid steer loader, truck and trailer
    - Hand equipment
  - Following cargo recovery, conduct 10 ft. grid survey of the site by trained personnel using geometrics GR-101A gamma ray Scintillometer or Ludlum Measurements, Inc. model 3 survey meter.

iii. **Potential for Exposure**

The uranium ore transported to the mill is low specific activity material in uranium grade typically less than one percent U_3O_8. Based on EPA and NRC health-based standards, a clean-up action of material having this low of uranium content would not result in a worker becoming overexposed to radiation, even if the action extends over several days.

iv. **Required Personal Protection Equipment (PPE)**

Due to the limited risks posed by the Low Specific Activity uranium ores being transported, worker protection can be limited to standard industrial clothing and safety protection consisting of work pants, sleeved work shirt, hard hats, safety glasses, and steel toed safety shoes/boots. In addition, reflective clothing to Department of Transportation Specifications should be provided and used in the event of an accident.

v. **Clean up Procedures**

Because of its potential to cause a fire or contaminate near by water sources, containment and cleanup of any fuel spills is normally the priority. Many of the fire departments carry absorbents and booms to contain and clean up these types of spills. Spilled ore materials, depending on the size of the spill, can be cleaned up initially with a loader and completed with hand tools. If the spill is large, the ore should be transferred directly to another truck approved for uranium ore haulage. Smaller spills can be placed in barrels or other suitable containers. If it is windy, dust can be controlled with light water sprays; however, large volumes of water should not be used because this could result in runoff of water containing uranium and other contaminants. If the spill occurs near or within a stream or river, efforts should be made to limit the quantity of ore released to the water source. Because of its relatively low uranium content, however, no long-term environmental impacts would be expected if some of the material cannot be safely removed.

c. Recovered Cargo Disposal

This Section discusses the procedure for cargo disposal, site inspection and cargo recovery procedure and cleanup verification.

i. **Procedure for Cargo Disposal**

The procedure for cargo disposal is as follows:

- Delivered to a specific location per Rio Grande Resources/Energy Fuels Resources
- Deliver to White Mesa Mill in Blanding, UT

Recovered materials that have been loaded for transport can be released by the assigned cleanup supervisor to be transported to the mill. Any materials contaminated with oil or fuel should be containerized and transported to a suitable holding are for later characterization and appropriate disposal.

ii. **Site inspection and Cargo Recovery Verification Procedure**

The procedure for site inspection and cargo recovery verification is as follows:

- Third Party Consultants
    - Site back to natural background radio metric survey.

- Rio Grande Resources/Energy Fuels Resources personnel to approve cleanup
- Incident report to various agencies

iii. **Cleanup Verification**

After visible spilled ore material has been removed, a Scintillometer or gamma meter should be used to identify any "hot spots" of residual radiation on ground surfaces. These areas are determined by comparison to local background gamma measurements from an unaffected area near the accident scene. The hot spots can be marked using spray paint, chalk, or utility flags. After these hotspots are further cleaned, they should be rechecked with the instrument to verify that the area is at or near background radiation levels. This is normally readily achievable on hard surfaces such as concrete or asphalt. Some over-excavation of underlying soils may be necessary in gravel or grassy areas. If there is a concern regarding the cleanup levels achieved, soil samples can be taken of the contaminated area and nearby uncontaminated are to establish background level.

d. Decontamination of Equipment and Tools

There will be specific procedures in place for decontaminating equipment and tools for "free release" of these items. These procedures generally include cleaning protocols, collecting swipe samples for analysis, and scanning for radiation levels.

5. Certification Statement

The statement below should be signed and provided to Rio Grande Resources/Energy Fuels Resources for file and should also be included with this plan in each shipping vehicle.

I certify that I have read and reviewed this plan and will abide by the requirements of it in the even of an emergency response.

Name: ________________________________ Date: _____________________________

Title: __________________________________ Company: _________________________

Transportation Emergency Response Plan

Date:	
Time:	
Names of Individuals Involved:	
Causes of Incident:	
Injuries:	
Type of Container Involved:	
Placard:	
Label:	
Pertinent Manifest Details:	
Weather Conditions:	
Terrain:	
Personnel Onsite:	
Amount of ore involved	
Other notes:	

SOP-6 *Environmental Radiation Monitoring*

Version History	Date
2017 RML renewal	12-04-2017
Revision 1	05-20-2019
Revision 2	11-19-2019
Revision 3	04-01-2020
Revision 4	05-22-2020

Distribution
Facility Manager
Radiation Safety Officer
Radiation Safety Technician
Radiation Protection Program Manual

1. PURPOSE

Environmental monitoring of ambient radon gas concentrations and terrestrial gamma radiation at the Mount Taylor Mine (Site) is conducted on a quarterly basis as specified in the Radiation Protection Program (RPP) Manual for the Site (RGR, 2020). Eight monitoring stations are located within operational Controlled Areas at the Site (Figure 1) while three locations are situated in adjacent offsite areas. The primary objective of this monitoring is to detect and quantify any differences in ambient radiation levels between areas surrounding the mine Site versus those measured across operational areas. To represent potential public exposures to effluent radiation from the Site, one offsite monitoring station is located at a local residence in the nearby town of San Mateo, New Mexico. This Standard Operating Procedure (SOP) provides the methods and procedures for implementation of the environmental monitoring program at the Mount Taylor Mine Site.

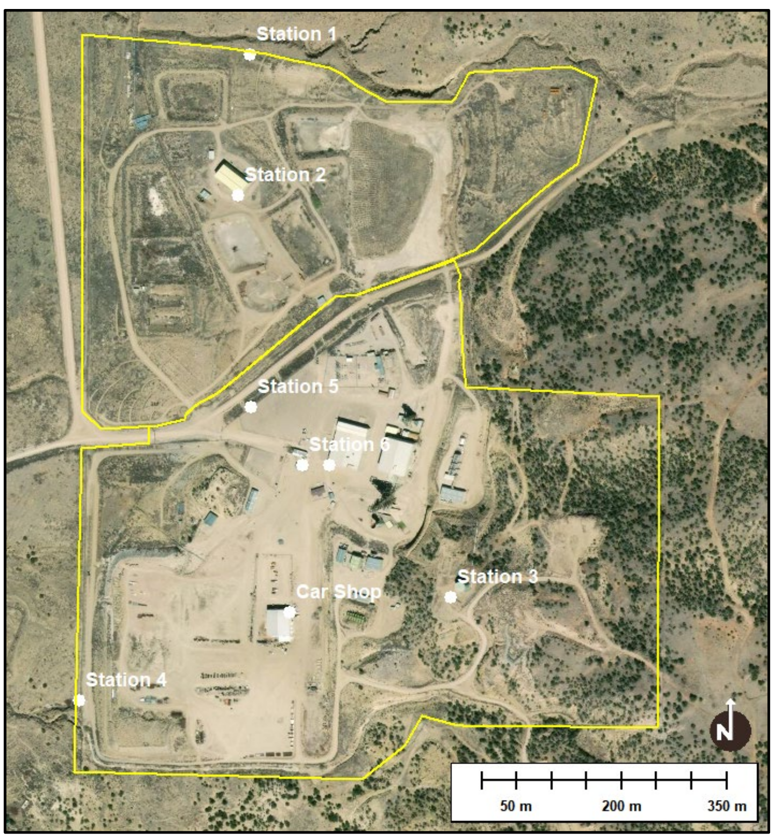


Figure 1: Environmental radiation monitoring station locations across operational areas at the Mt. Taylor Mine.

2. DISCUSSION

While not a regulatory requirement under the existing mine permit with the Mining and Minerals Division (MMD) of the New Mexico Energy, Minerals and Natural Resources Department (MMD permit C1002RE), nor a requirement under the existing Radioactive Materials License (RML) with the Radiation Control Bureau (RCB) of the New Mexico Environment Department (NMED) (RML SO043-11), the environmental radiation monitoring program described in this SOP is conducted by Rio Grande Resources (RGR) to ensure that any changes in effluent radiological emissions from the Site to the local *terrestrial environment* can be detected and quantified.

Environmental radiation monitoring parameters are limited to radon gas and ambient external dose rates from gamma radiation. While gamma radiation is not a form of potential terrestrial effluent releases from the Site, it can be an indirect indicator of changes in offsite radiological conditions associated with airborne effluents or hydrologically-driven migration mechanisms. Such releases could potentially involve offsite transport/deposition of airborne particulates containing long-lived radionuclides, or atmospheric transport of gaseous radon emissions and subsequent deposition of short-lived radon decay products (progeny). A secondary objective of this monitoring is to characterize terrestrial radiation levels across operational areas, information that can be used to assess onsite occupational radiation doses.

Long-term integrated average radon gas concentrations and ambient gamma radiation dose rates are monitored with passive measurement technologies, including alpha track-etch detectors from Radonova for radon gas (high-sensitivity Rapidos detectors) and optically stimulated luminescent (OSL) dosimeters from Landauer (InLight environmental OSL dosimeters). This SOP provides the methods and procedures for implementation of the environmental monitoring program at the Mount Taylor Mine.

3. RESPONSIBILITY

- Facility Manager – responsible for reviewing and approving the environmental monitoring program and providing the resources necessary to implement its requirements (e.g. operational staff and measurement equipment).
- Radiation Safety Officer – responsible for environmental monitoring program oversight, data review and analysis, radiological dose assessments based on the data generated (if applicable), and for making any program changes to address changing conditions or program objectives.
- Radiation Safety Technician – responsible for onsite management and implementation of environmental radiation monitoring procedures under the direction of the RSO. The RST role may be filled by a temporary designee at the discretion of the RSO, provided that the individual is qualified by previous experience and sufficient on-the-job training is received.

4. ENVIRONMENTAL RADIATION MONITORING PROCEDURES

4.1. Equipment and Materials

- Field logbook.
- Ziplock plastic bags to retrieve field detectors.

- Passive alpha track-etch radon detectors (high-sensitivity Rapidos® detectors from Radonova, or equivalent) and associated deployment/retrieval logsheet.
- Optically Stimulated Luminescence (OSL) dosimeters (e.g. InLight® environmental monitoring dosimeters from Landauer, or equivalent) and associated deployment/retrieval logsheet.

4.2. Radon Gas Monitoring

At each radon monitoring location, a single high-sensitivity Radonova "Rapidos" track-etch detector from Radonova is deployed during the quarterly monitoring period. At the beginning of a new radon monitoring period, remove the detectors from their sealed bags and mount in the special housing designed to protect the detector from damage due to weather or other environmental factors (e.g. moisture intrusion can compromise detector performance). Record on the detector deployment logsheet (provided by vendor) the detector serial number, starting date, ending date, and the detector field location and field ID number for each detector.

Each batch of Rapidos detectors comes equipped with three transit control detectors. During the monitoring period the transit control detectors are to remain in their sealed bags and kept in the Main Office filing cabinet with the Radonova deployment logsheet, and any other associated paperwork.

At the end of the monitoring period, exchange the recently received Rapidos detectors with the previous quarter's detectors. Remove the transit control detectors from their sealed bags and return them with the retrieved detectors and completed deployment logsheet(s) to Radonova for analysis.

4.3. Environmental OSL Dosimeter Monitoring

At each dose rate monitoring location, a single Landauer InLight environmental gamma OSL dosimeter is deployed during the quarterly monitoring period. Take care to note (and deploy at) the field location printed on the dosimeter. When deploying dosimeters record in a field logbook the dosimeter serial number, starting date, ending date, and the dosimeter field location and field ID for each dosimeter.

Each batch of InLight OSL dosimeters comes with two control dosimeters; one deploy control and one transit control. During the quarterly monitoring period the deploy control dosimeter is kept in the Main Office filing cabinet with the Landauer packing list, and any other associated paperwork. The transit control is to be returned with the previous quarter's dosimeters.

At the end of the quarterly monitoring period exchange the recently received dosimeters with the previous quarter's deployed dosimeters. Return the retrieved dosimeters, the deploy control dosimeter and the recently received transit control dosimeter back to Landauer for analysis.

5. REFERENCE

Rio Grande Resources (RGR). 2020. Radiation Protection Program Manual. Revision 4. May 22, 2020.

SOP-7 *GPS-Based Gamma Radiation Surveys*

Version History	Date
Revision 0	05-22-2020

Distribution
Facility Manager Radiation Safety Officer Radiation Safety Technician Radiation Protection Program Manual

1. PURPOSE

This Standard Operating Procedure (SOP) describes the procedures for performing gamma radiation surveys of land areas using a survey meter and gamma radiation detector coupled to a global positioning system (GPS) unit at the Mount Taylor Mine (Site).

2. DISCUSSION

Geographic information systems (GIS)-based gamma radiation surveys are used to identify, characterize, and delineate areas of radiological contamination in surface soils across potentially impacted land areas. By combining radiological survey instruments with a GPS-unit, the survey data and associated GPS coordinates can be logged in electronic format suitable for mapping the data with GIS software. Depending upon survey objectives, land area terrain and nature of soil contamination, a GPS-based gamma survey may be performed with scanning equipment carried by the surveyor (walkover scanning) or mounted on a motorized or manually propelled means of system transport (push cart, utility terrain vehicle, or truck) for increased scanning efficiency when surveying large land areas.

3. RESPONSIBILITY

- Facilities Manager – responsible for reviewing and approving the RPP, applicable SOPs and survey project Work Plans, and providing the resources necessary to implement these project planning documents (e.g. qualified staffing and the necessary instrumentation/equipment).
- Radiation Safety Officer – responsible for selecting the types of radiological surveys or monitoring required, and for specifying the instrumentation/equipment needed.
- Radiation Safety Technician – responsible for onsite management and implementation of written Work Plans and/or verbal instructions from the RSO concerning the conduct of GPS-based gamma surveys. This includes onsite oversight responsibility to ensure that survey Field Technicians are properly trained on the applicable Work Plan and this SOP, and that gamma surveys are conducted accordingly (e.g. daily instrument QC checks and documentation, scanning technique and coverage to be attained, and that the data are properly managed for transfer to the RSO).
- Field Technician – responsible for reviewing Work Plans and applicable SOPs and receiving hands-on instruction in the operation and use of gamma survey instruments and equipment as required under the RPP, applicable SOPs and Work Plan.

4. PROCEDURE

4.1. Equipment and Materials

The necessary components to perform a GPS-based radiological survey:

- GPS survey system of mapping grade or better (sub-meter accuracy) – Juniper Systems Mesa 2 and Geode, Trimble ProXRT, ProXH, or similar with data logger/controller.
- Gamma radiological survey instruments with RS-232 data output or Bluetooth output – Ludlum Model 2221 or 3000 ratemeter/scaler, or Ludlum Model 4612 counter paired with a Ludlum Model 44-10 (2-inch by 2-inch NaI), or functionally equivalent gamma survey instrumentation as need to suit survey objectives.
- All appropriate cables, including GPS antenna cable as necessary, RS-232 cable from meter to GPS data logger, C-cables from meter to detector, and others, as necessary.
- Detector rack to hold multiple detectors at set height above ground surface, as necessary when performing a push-cart, UTV, or truck survey.

4.2. Equipment Setup

Setup the survey system hardware by assembling the GPS backpack or detector rack (push-cart, UTV, and truck), as appropriate. Connect cabling and/or Bluetooth connection(s) between GPS units, antennas, ratemeter/scaler/counters, detectors, and data loggers or controller, as necessary. Use sufficient cabling such that it will be safe and secure from damage or unintended disconnection. If performing a vehicle survey, mount rack to vehicle and attach detectors to rack. The GPS data loggers or controllers are typically setup to record the external sensor (ratemeter/scaler/counter) output with associated position every one second.

4.3. Daily Function Checks

Perform function check of the radiological survey instrument(s) per SOP-2 Instrument Testing and Calibration before each day of use.

4.4. Survey

4.4.1. Survey File Management

Open a new survey file and give it a unique file name indicative of the survey. The file name could include the survey date and/or time, the surveyor initials, and/or the site name. The RadScout software on the Mesa 2 provides a default file name based on the date, time, and Mesa 2 ID number. The user should add their initials and a description of the file, where appropriate. With multiple dataloggers being used the surveyor should add their initials and/or a description (R/L; right/left, 1: first, etc.) to the end of the file.

4.4.2. Scanning Procedures

- Turn the ratemeter/scaler/counter on prior to beginning a survey file. NOTE: If the ratemeter/scalar/counter unit is not turned on (and properly connected) prior to opening a survey file the initial recorded gamma count rate records will be low.
- Begin and end a survey data file at a point/location where it is desirable to collect data. Do not start a survey file when in close proximity to the function check source.

- If stopping movement during the survey for a period of time (approximately 30 seconds), then pause the data collection. Avoid collecting data in a static location to the extent possible. If you are not actively moving and collecting data (e.g. if taking a breaking, taking a phone call or having a conversation, etc.), best practices dictate pausing the data collection. This helps to avoid skewing or biasing statistical metrics. Remember to resume data collection upon resuming the survey.
- Close the survey file upon completion of the survey. If the user wishes to continue the survey after closing the file, create a new survey file upon resuming the survey.

4.4.3. Survey Design

Perform the survey by either walking (backpack), pushing (push-cart), or driving (UTV or truck) the survey equipment following the survey design as specified by the Work Plan and/or RSO. The survey design is dependent upon the goal of the survey and the equipment being used to conduct the survey and should take into account the radiation detector type and model choice, survey scan speed, detector spacing, and height of detector above ground during the survey. Some of these design parameters may be dependent upon the survey area terrain.

- Detector

  Choose a detector that is appropriate to meet the goals and/or requirements of the survey. For middle to high-energy gamma emitting radiation it is common to use the Model 44-10, Model 44-20, or similar detector. For low-energy emitting radiation a FIDLER detector may be more suitable. If surveying in an area where gamma shine is an issue, then use of a detector shield may be appropriate. The project work plan will typically prescribe the detector type to be used.

- Survey Scan Speed

  Use the designed survey scan speed or choose a survey scan speed range that is appropriate to meet the goals and/or requirements of the survey. A survey scan speed that is too fast may not allow for a detector to physically be present over a localized area of elevated gamma count rates long enough to adequately represent the conditions. For an area believed to have homogenous gamma count rates a slower survey scan speed may be unnecessary and inefficient. The project work plan will typically prescribe the survey scan speed.

- Ground Coverage (Survey Density)

  Scan the specified survey area at the required transect spacing to meet the goals and/or requirements of the survey as specified by the Work Plan and/or RSO. When surveying over an area where radiological conditions are unknown or are highly variable, then a tighter/closer detector or transect spacing may be appropriate to better define the areal extent of any radiological impacts. If in doubt about increasing the survey density based on observed variability, or if the specified coverage cannot be achieved due to obstructions or unsafe terrain, contact the RSO for further instruction.

- Detector Height

The detector height above ground will be determined by the RSO to meet the objectives of the survey. Attempt to maintain the same detector height throughout the survey. The project Work Plan will typically prescribe the detector height.

4.5. Data Processing and Review

Upon completion of a GPS-based radiological survey download the data from the datalogger(s) or controller and convert into usable format, typically a GIS shapefile format. Visually inspect the processed data for possible errors and/or missing data. Resurvey areas where data is unexplainably missing, corrupt, or there is reason to believe the results are in error.

5. REFERENCES

None

6. ATTACHMENTS

None

SOP-7 *Soil Sampling for Radiometric Analysis*

Version History	Date
Revision 0	05-22-2020

Distribution
Facility Manager Radiation Safety Officer Radiation Safety Technician Radiation Protection Program Manual

1. PURPOSE

This Standard Operating Procedure (SOP) describes the procedures for collection of soil samples suitable for radionuclide and/or heavy metal analyses at the Mount Taylor Mine (Site).

2. DISCUSSION

Soil samples are used to characterize the levels and spatial distribution of radionuclides of interest and to verify that remediation criteria have been met. Soil samples may be collected at discrete individual locations or as composite samples representing average values across a larger area of interest. The laboratory methods for analytical testing of soil samples may vary depending on the desired level of accuracy and project time frames for obtaining results, but analytical methods and required detection limits should be specified in the Work Plan or Sampling and Analysis Plan (SAP), and this information should be communicated to the laboratory on the chain-of-custody (COC) form.

The definition of sampling depth increments should be specified in the SAP for surface soils (typically 0-15 cm) or subsurface soils (depth increments deeper than that defined for surface soils). Hand sampling methods are typically adequate to sample surface and shallow subsurface intervals. Samples taken below 1.5 m (~ 5 feet) below the surface typically require mechanized methods of soil core sample collection including mechanized direct-push technology, motorized augers, and drill rigs.

The largest source of error or uncertainty in analytical results is related to inconsistencies in sample collection and handling protocols and/or a lack of representativeness relative to sampling objectives. For this reason, it is important to ensure consistent sample collection and handling techniques as specified in the SAP, and to minimize deviation from the specified methods to the extent possible. It is also important to document conditions or unusual observations at individual sampling locations.

3. RESPONSIBILITY

- Facilities Manager – responsible for reviewing and approving the RPP, applicable SOPs and Sampling and Analysis Plan (SAP), and providing the resources necessary to implement these project planning documents (e.g. qualified staffing and the necessary instrumentation and equipment).
- Radiation Safety Officer – responsible for selecting the locations and number of soil samples, sampling depths, and the types of laboratory analysis to be performed on collected samples.
- Radiation Safety Technician – responsible for onsite management and implementation of the SAP or Work Plan with respect to sample collection, documentation, processing, and offsite shipping to a qualified contract laboratory. This includes onsite oversight responsibility to ensure that Field Technicians tasked with soil sampling are properly trained on the SAP and this SOP, and that

soil sampling is conducted accordingly (e.g. sample collection methods and locations, decontamination of sampling equipment between samples, sample handling and preparation, documentation in field logbooks and on COC forms, and offsite shipping).

- <u>Field Technician</u> – responsible for reviewing the SAP and applicable SOPs and receiving hands-on instruction on soil sampling methods and sample handling as required under the RPP, applicable SOPs and the SAP.

4. PROCEDURE

4.1. Equipment and Materials

The necessary equipment and supplies to collect soil sample(s) per this procedure:

- Field sampling equipment:
  - Surface: shovel, hand trowel, or soil core sampler
  - Shallow Subsurface: soil auger or direct-push with slide-hammer
  - Subsurface: mechanized direct-push, drill rig, or motorized auger
- Sample transport containers and means for sample labeling.
- Bucket or bowl and mixing trowel for field homogenization.
- Screwdriver, or other method of removing soil from sampler.
- Decontamination supplies (e.g. paper towels, brushes, and where applicable, Alconox or other suitable cleaning agent, and clean rinse water).
- Field logbook and/or sampling forms as required by the SAP.

4.2. Sampling Procedure

- Clear debris, loose brush, and any excess vegetation or rock from sample locations.
- If making a radiological measurement of the sample location, do so prior to collecting soil sample.
- Using a decontaminated sampler collect the soil sample to the prescribed depth for the sample. If sampler encounters refusal (i.e. cannot advance sampler to full sample depth) then modify the planned sample location to an adjacent location as near as practical to the original planned location.
- Make sure the sample provided is equally representative across the full thickness of the prescribed sample depth increment. If multiple soil samples are required at a given location for composite sampling and/or to attain sufficient sample mass for analysis, either submit all of the collected soil for analysis, or using a mixing bucket or bowl homogenize the collected soil into a single representative sample of sufficient mass for laboratory analysis.
- Place the sample into a properly labeled and decontaminated sample container. At a minimum, the label information should include the sample ID number, sample depth, and date and time that the samples was collected.
- Prior to collecting additional samples or leaving a sample location, decontaminate the sampling and mixing equipment to prevent cross-contamination between samples. If using

rinse water to decontaminate equipment, release rinse water to the ground unless the SAP or RSO specifies that it be retained.

- Repeat steps above as necessary to collect samples to the required depth at all prescribed samples and locations. NOTE: If collecting soil sample(s) at greater depths take care not to knock any surface or side-wall soils into hole.
- Prior to leaving the sample location record position using GPS and close off the sample opening(s) with excess sample material and/or surrounding materials.

5. REFERENCES

None

6. ATTACHMENTS

None